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32-bit Microcontroller Traveo™ Family

S6J32E, S6J32F, S6J32G, S6J32H Series Hardware Manual

Doc. No. 002-12500 Rev.*H

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Preface



Thank you for your continued use of Cypress semiconductor products.
Read this manual and "Data Sheet" thoroughly before using products in this family.

Purpose of This Manual and Intended Readers

This manual explains the functions and operations of this family and describes how it is used. The manual is intended for engineers engaged in the actual development of products using this family.

** This manual explains the configuration and operation of the peripheral functions, but does not cover the specifics of each device in the family.*

Users should refer to the respective data sheets of devices for device-specific details.

Microcontroller support information:

<http://www.cypress.com/mcu>

Table of Contents



CHAPTER 1:	Overview.....	19
1.	Overview.....	20
2.	Document Definition	21
3.	Register Attribute	22
3.1.	Read and Write	22
3.2.	Protection.....	22
3.3.	Register Information.....	23
4.	Abbreviation.....	24
CHAPTER 2:	Function List	26
1.	Function List	27
2.	Optional Function.....	29
2.1.	Basic Option	29
2.2.	ID	31
2.3.	Restriction.....	33
CHAPTER 3:	Product Description	34
1.	Overview.....	35
2.	Product Description	36
2.1.	Ethernet	41
2.2.	RAM Guarantee	42
3.	Note	43
3.1.	Status Flag Clear	43
3.2.	Error Response.....	43
3.3.	Register Initial Value	44
3.4.	Restriction.....	46
CHAPTER 4:	Block Diagram	47
1.	Block Diagram	48
2.	Note	49
CHAPTER 5:	Clock Configuration	50
1.	Overview.....	51
2.	Operation.....	52
2.1.	Spread Spectrum Clock Generator (SSCG)	55
3.	Remark.....	57
CHAPTER 6:	Operation Mode	58
1.	Overview.....	59
2.	Configuration	60
3.	Registers	61
CHAPTER 7:	Memory and Base Address Map.....	62
1.	Memory Map.....	63
2.	Base Address Map	65
3.	Note	72
CHAPTER 8:	IRQ and NMI Map.....	73
1.	IRQ Map	74
2.	NMI Map	82

CHAPTER 9:	DMA Channel Activation Factors	83
1.	Factors List	84
2.	Note	90
CHAPTER 10:	Port Description	91
1.	Port Description List	92
2.	Remark	108
CHAPTER 11:	Port Configuration	109
1.	Overview	110
2.	Configuration and Block Diagram	111
3.	Operation	112
3.1.	Resource Input Configuration Module	112
3.2.	Port Output Function Configuration	188
3.3.	Analog I/O Setting	202
3.4.	Input Level Setting	203
3.5.	Output Drive Capacity Setting	206
3.6.	Port Status	210
3.7.	Function Port Group	211
3.8.	Key Code Register	213
4.	Registers	214
5.	Configuration Procedure	215
5.1.	Resource I/O Port (Both Direction)	216
5.2.	Resource Input	217
5.3.	Resource Output	219
5.4.	Port Function Input	220
5.5.	Port Function Output	221
5.6.	Analog Function Input or Output	222
CHAPTER 12:	State Transition	223
1.	Overview	224
2.	Diagram of State Transition	225
3.	Fetching the Operation Mode	227
4.	Changes to PSS and RUN	232
CHAPTER 13:	Low-voltage Detection	236
1.	Overview	237
2.	Configuration and Block Diagram	238
3.	Operation	239
3.1.	LVD operation	239
3.2.	Configurations	240
4.	Registers	241
5.	Electric Characteristics	245
CHAPTER 14:	Serial Programming	246
1.	Overview	247
2.	Memory Map	248
3.	FLASH Sector Configuration	249
4.	Port Configuration	250
5.	Operation	251
5.1.	Timing Chart	251
5.2.	RAM Executing Communication Protocol	252
5.3.	Operation Flow	254
6.	Note	255
6.1.	PSC Port State	255
CHAPTER 15:	12-/10-/8-bit Analog to Digital Converter	256
1.	Overview	257
2.	Configuration and Block Diagram	259
3.	Operation of A/D Converter	260
3.1.	A/D Conversion Flow	260

3.2.	Logical Channel Mapping to Analog Input Signals	262
3.3.	Logical Channel Data Protection Function	263
3.4.	Logical Channel Triggering and Priority	264
3.5.	Group Processing	266
3.6.	Multiple Conversion Logical Channels	274
3.7.	Forced Stop	277
3.8.	A/D Converter Calibration	278
3.9.	DMA Transfer Function	280
3.10.	Range Comparator Function	280
3.11.	Pulse Detection Function	283
3.12.	Debug Mode	284
4.	Setup Procedure Examples	285
4.1.	Control of A/D Conversion	285
4.2.	Setting of Global A/D Conversion	286
4.3.	Setting of Logical Channel	287
4.4.	Setting of Range Comparator	288
4.5.	Setting of Pulse Detection	289
4.6.	A/D Conversion	290
4.7.	Range Comparator	292
4.8.	Pulse Detection	293
5.	Registers	294
5.1.	A/D Channel Control Registers (ADC12Bn_CHCTRL0 to 63)	295
5.2.	A/D Channel Status Registers (ADC12Bn_CHSTAT0 to 63)	298
5.3.	A/D Conversion Data Registers (ADC12Bn_CD0 to 63)	300
5.4.	Pulse Counter Control Registers (ADC12Bn_PCCTRL0 to 63)	302
5.5.	A/D Conversion Done Interrupt Flag Registers (ADC12Bn_CDONEIRQ0 to 1)	304
5.6.	A/D Conversion Done Interrupt Enable Registers (ADC12Bn_CDONEIRQE0 to 1)	306
5.7.	A/D Conversion Done Interrupt Clear Registers (ADC12Bn_CDONEIRQC0 to 1)	308
5.8.	Group Interrupted Interrupt Flag Registers (ADC12Bn_GRPIRQ0 to 1)	310
5.9.	Group Interrupted Interrupt Enable Registers (ADC12Bn_GRPIRQE0 to 1) ..	312
5.10.	Group Interrupted Interrupt Clear Registers (ADC12Bn_GRPIRQC0 to 1)	314
5.11.	Range Comparator Interrupt Flag Registers (ADC12Bn_RCIRQ0 to 1)	316
5.12.	Range Comparator Interrupt Enable Registers (ADC12Bn_RCIRQE0 to 1) ..	319
5.13.	Range Comparator Interrupt Clear Registers (ADC12Bn_RCIRQC0 to 1)	321
5.14.	Pulse Counter Interrupt Flag Registers (ADC12Bn_PCIRQ0 to 1)	323
5.15.	Pulse Counter Interrupt Enable Registers (ADC12Bn_PCIRQE0 to 1)	325
5.16.	Pulse Counter Interrupt Clear Registers (ADC12Bn_PCIRQC0 to 1)	327
5.17.	A/D Channel Trigger Status Flag Registers (ADC12Bn_TRGST0 to 1)	329
5.18.	A/D Channel Trigger Clear Registers (ADC12Bn_TRGCL0 to 1)	332
5.19.	A/D Channel Trigger Overrun Flag Registers (ADC12Bn_TRGOR0 to 1)	335
5.20.	A/D Channel Trigger Overrun Clear Registers (ADC12Bn_TRGORC0 to 1) ..	337
5.21.	Range Comparator Over Threshold Flag Registers (ADC12Bn_RCOTF0 to 1)	339
5.22.	Conversion Done DMA Select Registers (ADC12Bn_CDDS0 to 3)	341
5.23.	A/D Converter Comparison Time Setting Register (ADC12Bn_CT)	342
5.24.	A/D Converter Resumption Time Setting Register (ADC12Bn_RT)	343
5.25.	A/D Converter Sampling Time Setting Registers (ADC12Bn_ST0 to 3)	344
5.26.	A/D Converter Offset Compensation Setting Register (ADC12Bn_OCV)	345
5.27.	A/D Converter Gain Compensation Setting Register (ADC12Bn_GCV)	346
5.28.	A/D Converter Global Control Register (ADC12Bn_CTRL)	347
5.29.	A/D Converter Global Status Register (ADC12Bn_STAT)	350
5.30.	Range Comparator Upper Threshold Registers (ADC12Bn_RCOH0 to 7)	352
5.31.	Range Comparator Lower Threshold Registers (ADC12Bn_RCOL0 to 7)	353
5.32.	Full Range Comparator Upper Threshold Registers (ADC12Bn_FRCOH0 to 7)	354
5.33.	Full Range Comparator Lower Threshold Registers (ADC12Bn_FRCOL0 to 7)	355

5.34.	A/D Multiple Conversion Channel Control Registers (ADC12Bn_MCCTRL0 to 3).....	356
5.35.	A/D Multiple Conversion Channel Status Registers (ADC12Bn_MCSTAT0 to 3)	358
CHAPTER 16:	Stepper Motor Controller.....	359
1.	Overview.....	360
2.	Configuration and Block Diagram	361
3.	Operation of the Stepper Motor Controller	363
3.1.	Operation of PWM Pulse Generator	364
3.2.	Selection of Motor Drive Signals	367
3.3.	Synchronization System of Stepper Motor Controller	368
3.4.	Operation of the SMC Trigger Delay Function	369
4.	Registers	372
4.1.	PWM Control Register (PWC)	373
4.2.	PWM1 and PWM2 Compare Registers (PWC1, PWC2).....	375
4.3.	PWM Selection Register (PWS)	377
4.4.	PWM Selection Set Register (PWSS).....	380
4.5.	SMC Trigger Delay Register (PTRGDL)	381
CHAPTER 17:	Trigger Configuration of Stepper Motor Controller	382
1.	Overview.....	383
2.	Configuration and Block Diagram	384
3.	Operation	385
4.	Registers	386
4.1.	SMC Trigger Selection Register (SMCTGg_PTRGS)	387
4.2.	SMC Trigger Register (SMCTGg_PTRG)	390
CHAPTER 18:	Sound Generator	392
1.	Overview.....	393
2.	Configuration	395
3.	Operations	396
3.1.	Relation between the Amplitude Data Register (SGAR) and PWM Pulse.....	398
3.2.	Relation between the Frequency Data Register (SGFR) and Tone Pulse Signal	399
3.3.	Relation between the PWM Cycle Data Register (SGPCR) and PWM Cycle	400
3.4.	Relation between the DMA Transfer Update Enable Register (SGDER) and DMA Settings	401
3.5.	Sound Generator Operation.....	406
3.6.	Continuous Operation of Sound Generator by MCU.....	409
3.7.	Sound Generator Operation with DMA	411
3.8.	Interrupt of Sound Generator	427
4.	Registers	428
4.1.	DMA Transfer Update Enable Register (SGDER)	429
4.2.	Sound Control Register (SGCR).....	431
4.3.	Amplitude Data Register (SGAR)	435
4.4.	Frequency Data Register (SGFR).....	436
4.5.	Tone Output Number Register (SGNR).....	437
4.6.	Time Cycle Register (SGTCR).....	438
4.7.	Increase and Decrease Data Register (SGIDR)	439
4.8.	PWM Cycle Data Register (SGPCR)	440
4.9.	DMA Transfer Intermediate Register (SGDMAR).....	441
4.10.	Interrupt Clear Register (SGCCR)	442
CHAPTER 19:	Sound Waveform Generator	443
1.	Overview.....	444
2.	Configuration and Block Diagram	445
3.	Operation of the Sound Waveform Generator	446
3.1.	Sound Source Specifications	446
3.2.	Interrupt	448
3.3.	SWFG Sound Source Generation Start	449

3.4.	SWFG Sound Source Generation Stop	450
3.5.	Continuous SWFG Sound Source Generation.....	451
3.6.	Filter.....	452
4.	Registers	454
4.1.	Waveform Generator Channel Enable Register (WGCHEN)	454
4.2.	Waveform Generator Channel Start Register (WGCHSTART)	456
4.3.	Waveform Generator Channel Address1 Register (WGCHADD1).....	458
4.4.	Waveform Generator Channel Address2 Register (WGCHADD2).....	459
4.5.	Waveform Generator Channel Address3 Register (WGCHADD3).....	460
4.6.	Waveform Generator Channel Monaural Register (WGCHMONO)	461
4.7.	Waveform Generator Channel n Control Register1 (WGCHnCTRL1, n=0 to 4).....	462
4.8.	Waveform Generator Channel n Control Register2 (WGCHnCTRL2, n=0 to 4).....	466
4.9.	Waveform Generator Channel n Control Register3 (WGCHnCTRL3, n=0 to 4).....	468
4.10.	Waveform Generator Channel Clear Register (WGCHCLR).....	471
4.11.	Waveform Generator Interrupt Enable Register (WGINTREN).....	473
4.12.	Waveform Generator Interrupt State Register (WGINTRSTATE).....	475
4.13.	Waveform Generator Interrupt Clear Register (WGINTRCLR)	477
4.14.	Waveform Generator AHB Bus Error Register (WGAHBERR).....	479
CHAPTER 20:	Sound Mixer.....	481
1.	Overview.....	482
2.	Configuration and Block Diagram	483
3.	Operation of the Sound Mixer	484
3.1.	Basic Mixing Operation Procedure	484
3.2.	Volume Effects	486
3.3.	Sound Source Input and Internal Mixing Process Mode	487
3.4.	Interrupt	488
3.5.	Data Request Control	489
3.6.	Data Output Control.....	490
3.7.	AHB Slave Interface.....	491
3.8.	AHB Master Interface.....	492
3.9.	Input Buffer (FIFO).....	493
3.10.	Sound Source Sampling Rate.....	494
4.	Registers	495
4.1.	Mixer Channel Register (MXCH)	495
4.2.	Mixer Output Control Register (MXOCTRL).....	497
4.3.	Mixer Data Request Control Register (MXDRQCTRL)	498
4.4.	Mixer Input Control Register (MXICTRL)	500
4.5.	Mixer Channel Monaural Register (MXCHMONO)	502
4.6.	Mixer Channel Volume1 Register (MXCHVOL1)	504
4.7.	Mixer Channel Volume2 Register (MXCHVOL2)	505
4.8.	Mixer Channel Volume3 Register (MXCHVOL3)	506
4.9.	Mixer Channel Mute Register (MXCHMUTE)	507
4.10.	Mixer Channel Fade_In/Out1 Register (MXCHFADE1)	509
4.11.	Mixer Channel Fade_In/Out2 Register (MXCHFADE2)	511
4.12.	Mixer Channel Fade_In/Out3 Register (MXCHFADE3)	513
4.13.	Mixer Channel Fade_In/Out4 Register (MXCHFADE4)	515
4.14.	Mixer Channel Fade_in/out5 Register (MXCHFADE5)	517
4.15.	Mixer Mixed Fade_In/Out Register (MXMXDFADE)	519
4.16.	Mixer Channel Fade_In/Out Enable Register (MXCHFADEEN)	520
4.17.	Mixer Buffer Clear Register (MXBUFFCLR)	522
4.18.	Mixer FADE_In/Out Clear Register (MXFADECLR).....	524
4.19.	Mixer Interrupt Enable Register (MXINTREN)	526
4.20.	Mixer Interrupt Status Register (MXINTRSTATE)	528
4.21.	Mixer Interrupt Clear Register (MXINTRCLR).....	531
4.22.	Mixer Input Buffer Count1 Register (MXINBUFFCNT1).....	533
4.23.	Mixer Input Buffer Count2 Register (MXINBUFFCNT2).....	536
4.24.	Mixer Channel Buffer Count Register (MXCHBUFFCNT).....	538

4.25.	Mixer Output Buffer Count Register (MXOUTBUFFCNT)	540
4.26.	Mixer AHB Bus Error Register (MXAHBERR).....	542
4.27.	Mixer WFGn Data Address Register (MXWFGnDADR, n=0 to 4).....	545
4.28.	Mixer PCM/I2S n Data Address Register0-15 (MXPMISnDADR0-15, n=0 to 4)	546
5.	Appendix.....	547
5.1.	Gain for Volume Control.....	547
5.2.	Fade In/Fade Out Time	554
5.3.	Digital Filter.....	555
CHAPTER 21:	Ethernet MAC	558
1.	Overview.....	559
2.	Configuration and Block Diagram	560
3.	Operation of the Ethernet MAC	561
3.1.	Direct Memory Access Interface	561
3.2.	MAC Transmitter Block	574
3.3.	MAC Receiver Block	574
3.4.	Checksum Offload for IP, TCP, and UDP	575
3.5.	MAC Filtering Block	576
3.6.	IEEE Std 1588 and IEEE Std 802.1AS Support.....	579
3.7.	MAC IEEE Std 802.3 Pause Frame Support	584
3.8.	MAC PFC Based Pause Frame Support.....	586
3.9.	Energy Efficient Ethernet Support.....	588
3.10.	LPI Operation in Ethernet MAC	588
3.11.	IEEE Std 802.1Qav Support – Credit Based Shaping	589
3.12.	PHY Interface	589
3.13.	Jumbo Frames.....	589
4.	Registers	590
4.1.	Network Control Register (ETHERNETn_network_control)	596
4.2.	Network Configuration Register (ETHERNETn_network_configuration)	600
4.3.	Network Status Register (ETHERNETn_network_status).....	604
4.4.	User I/O Register (ETHERNETn_user_io).....	605
4.5.	DMA Configuration Register (ETHERNETn_dma_config)	606
4.6.	Transmit Status Register (ETHERNETn_transmit_status).....	610
4.7.	RX Buffer Queue Base Address Register (ETHERNETn_receive_q_ptr)	612
4.8.	TX Buffer Queue Base Address Register (ETHERNETn_transmit_q_ptr)	613
4.9.	Receive Status Register (ETHERNETn_receive_status).....	614
4.10.	Interrupt Status Register (ETHERNETn_int_status)	615
4.11.	Interrupt Enable Register (ETHERNETn_int_enable).....	619
4.12.	Interrupt Disable Register (ETHERNETn_int_disable)	622
4.13.	Interrupt Mask Register (ETHERNETn_int_mask).....	625
4.14.	PHY Maintenance Register (ETHERNETn_phy_management)	630
4.15.	Receive Pause Quantum Register (ETHERNETn_pause_time).....	632
4.16.	Transmit Pause Quantum Register (ETHERNETn_tx_pause_quantum).....	633
4.17.	TX Partial Store and Forward Register (ETHERNETn_pbuf_txcutthru).....	634
4.18.	RX Partial Store and Forward Register (ETHERNETn_pbuf_rxcutthru)	635
4.19.	Jumbo-Frame Maximum Length Register (ETHERNETn_jumbo_max_length).....	636
4.20.	AXI Maximum Pipeline Register (ETHERNETn_axi_max_pipeline)	637
4.21.	Interrupt Moderation Register (ETHERNETn_int_moderation)	639
4.22.	System Wake Time Register (ETHERNETn_sys_wake_time).....	640
4.23.	Hash Bottom Register (ETHERNETn_hash_bottom)	641
4.24.	Hash Top Register (ETHERNETn_hash_top)	642
4.25.	Specific Address Bottom i Register (ETHERNETn_spec_add_bottom_i) (i=1 to 4)	643
4.26.	Specific Address Top i Register (ETHERNETn_spec_add_top_i) (i=1 to 4) ...	644
4.27.	Type ID Match i Register (ETHERNETn_spec_type_i) (i=1 to 4).....	645
4.28.	Stacked VLAN Register (ETHERNETn_stacked_vlan).....	646
4.29.	Transmit PFC Pause Register (ETHERNETn_tx_pfc_pause).....	647
4.30.	Specific Address Mask 1 Bottom Register (ETHERNETn_mask_add1_bottom).....	648

4.31.	Specific Address Mask 1 Top Register (ETHERNETn_mask_add1_top).....	649
4.32.	RX PTP Unicast IP Destination Address Register (ETHERNETn_rx_ptp_unicast).....	650
4.33.	TX PTP Unicast IP Destination Address Register (ETHERNETn_tx_ptp_unicast).....	651
4.34.	Receive DMA Data Buffer Address Mask Register (ETHERNETn_dma_addr_or_mask).....	652
4.35.	IEEE 1588 Timer Comparison Value Nanoseconds Register (ETHERNETn_tsu_nsec_cmp).....	653
4.36.	IEEE 1588 Timer Comparison Value Seconds Bottom Register (ETHERNETn_tsu_sec_cmp).....	654
4.37.	IEEE 1588 Timer Comparison Value Seconds Top Register (ETHERNETn_tsu_msb_sec_cmp).....	655
4.38.	PTP Event Frame Transmitted Seconds [47:32] Register (ETHERNETn_tsu_ptp_tx_msb_sec).....	656
4.39.	PTP Event Frame Received Seconds [47:32] Register (ETHERNETn_tsu_ptp_rx_msb_sec).....	657
4.40.	PTP Peer Event Frame Transmitted Seconds [47:32] Register (ETHERNETn_tsu_peer_tx_msb_sec).....	658
4.41.	PTP Peer Event Frame Received Seconds [47:32] Register (ETHERNETn_tsu_peer_rx_msb_sec).....	659
4.42.	Identification and Revision Register (ETHERNETn_revision_reg).....	660
4.43.	Octets Transmitted Bottom Register (ETHERNETn_octets_txed_bottom).....	661
4.44.	Octets Transmitted Top Register (ETHERNETn_octets_txed_top).....	662
4.45.	Frames Transmitted Register (ETHERNETn_frames_txed_ok).....	663
4.46.	Broadcast Frames Transmitted Register (ETHERNETn_broadcast_txed).....	664
4.47.	Multicast Frames Transmitted Register (ETHERNETn_multicast_txed).....	665
4.48.	Pause Frames Transmitted Register (ETHERNETn_pause_frames_txed).....	666
4.49.	64 Byte Frames Transmitted Register (ETHERNETn_frames_txed_64).....	667
4.50.	65 To 127 Byte Frames Transmitted Register (ETHERNETn_frames_txed_65).....	668
4.51.	128 To 255 Byte Frames Transmitted Register (ETHERNETn_frames_txed_128).....	669
4.52.	256 To 511 Byte Frames Transmitted Register (ETHERNETn_frames_txed_256).....	670
4.53.	512 To 1023 Byte Frames Transmitted Register (ETHERNETn_frames_txed_512).....	671
4.54.	1024 To 1518 Byte Frames Transmitted Register (ETHERNETn_frames_txed_1024).....	672
4.55.	Greater Than 1518 Byte Frames Transmitted Register (ETHERNETn_frames_txed_1519).....	673
4.56.	Transmit Under Runs Register (ETHERNETn_tx_underruns).....	674
4.57.	Single Collision Frames Register (ETHERNETn_single_collisions).....	675
4.58.	Multiple Collision Frames Register (ETHERNETn_multiple_collisions).....	676
4.59.	Excessive Collisions Register (ETHERNETn_excessive_collisions).....	677
4.60.	Late Collisions Register (ETHERNETn_late_collisions).....	678
4.61.	Deferred Transmission Frames Register (ETHERNETn_deferred_frames)....	679
4.62.	Carrier Sense Errors Register (ETHERNETn_crs_errors).....	680
4.63.	Octets Receive Bottom Register (ETHERNETn_octets_rxed_bottom).....	681
4.64.	Octets Receive TOP Register (ETHERNETn_octets_rxed_top).....	682
4.65.	Frames Received Register (ETHERNETn_frames_rxed_ok).....	683
4.66.	Broadcast Frames Received Register (ETHERNETn_broadcast_rxed).....	684
4.67.	Multicast Frames Received Register (ETHERNETn_multicast_rxed).....	685
4.68.	Pause Frames Received Register (ETHERNETn_pause_frames_rxed).....	686
4.69.	64 Byte Frames Received Register (ETHERNETn_frames_rxed_64).....	687
4.70.	65 To 127 Byte Frames Received Register (ETHERNETn_frames_rxed_65).....	688
4.71.	128 To 255 Byte Frames Received Register (ETHERNETn_frames_rxed_128).....	689
4.72.	256 To 511 Byte Frames Received Register (ETHERNETn_frames_rxed_256).....	690

4.73.	512 To 1023 Byte Frames Received Register (ETHERNETn_frames_rxed_512)	691
4.74.	1024 To 1518 Byte Frames Received Register (ETHERNETn_frames_rxed_1024)	692
4.75.	Greater than 1518 Byte Frames Received Register (ETHERNETn_frames_rxed_1519)	693
4.76.	Undersized Frames Received Register (ETHERNETn_undersized_frames)	694
4.77.	Oversize Frames Received Register (ETHERNETn_excessive_rx_length) ...	695
4.78.	Jabbers Received Register (ETHERNETn_rx_jabbers)	696
4.79.	Frame Check Sequence Errors Register (ETHERNETn_fcs_errors)	697
4.80.	Length Field Frame Errors Register (ETHERNETn_rx_length_errors)	698
4.81.	Receive Symbol Errors Register (ETHERNETn_rx_symbol_errors)	699
4.82.	Alignment Errors Register (ETHERNETn_alignment_errors)	700
4.83.	Receive Resource Errors Register (ETHERNETn_rx_resource_errors)	701
4.84.	Receive Over Runs Register (ETHERNETn_rx_overruns)	702
4.85.	IP Header Checksum Errors Register (ETHERNETn_rx_ip_ck_errors)	703
4.86.	TCP Checksum Errors Register (ETHERNETn_rx_tcp_ck_errors)	704
4.87.	UDP Checksum Errors Register (ETHERNETn_rx_udp_ck_errors)	705
4.88.	Receive DMA Flushed Packets Register (ETHERNETn_auto_flushed_pkts)	706
4.89.	IEEE 1588 Timer Increment Sub Nanoseconds Register (ETHERNETn_tsu_timer_incr_sub_nsec)	707
4.90.	IEEE 1588 Timer Seconds [47:32] Register (ETHERNETn_tsu_timer_msb_sec)	708
4.91.	IEEE 1588 Timer Seconds [31:0] Register (ETHERNETn_tsu_timer_sec)	709
4.92.	IEEE 1588 Timer Nanoseconds Register (ETHERNETn_tsu_timer_nsec)	710
4.93.	IEEE 1588 Timer Adjust Register (ETHERNETn_tsu_timer_adjust)	711
4.94.	IEEE 1588 Timer Increment Register (ETHERNETn_tsu_timer_incr)	712
4.95.	PTP Event Frame Transmitted Seconds [31:0] Register (ETHERNETn_tsu_ptp_tx_sec)	713
4.96.	PTP Event Frame Transmitted Nanoseconds Register (ETHERNETn_tsu_ptp_tx_nsec)	714
4.97.	PTP Event Frame Received Seconds [31:0] Register (ETHERNETn_tsu_ptp_rx_sec)	715
4.98.	PTP Event Frame Received Nanoseconds Register (ETHERNETn_tsu_ptp_rx_nsec)	716
4.99.	PTP Peer Event Frame Transmitted Seconds [31:0] Register (ETHERNETn_tsu_peer_tx_sec)	717
4.100.	PTP Peer Event Frame Transmitted Nanoseconds Register (ETHERNETn_tsu_peer_tx_nsec)	718
4.101.	PTP Peer Event Frame Received Seconds [31:0] Register (ETHERNETn_tsu_peer_rx_sec)	719
4.102.	PTP Peer Event Frame Received Nanoseconds Register (ETHERNETn_tsu_peer_rx_nsec)	720
4.103.	Transmit Pause Quantum 1 Register (ETHERNETn_tx_pause_quantum1) ...	721
4.104.	Transmit Pause Quantum 2 Register (ETHERNETn_tx_pause_quantum2) ...	722
4.105.	Transmit Pause Quantum 3 Register (ETHERNETn_tx_pause_quantum3) ...	723
4.106.	Receive LPI Transitions Register (ETHERNETn_rx_lpi)	724
4.107.	Received LPI Time Register (ETHERNETn_rx_lpi_time)	725
4.108.	Transmit LPI Transitions Register (ETHERNETn_tx_lpi)	726
4.109.	Transmit LPI Time Register (ETHERNETn_tx_lpi_time)	727
4.110.	Design Configuration 3 Register (ETHERNETn_designcfg_debug3)	728
4.111.	Design Configuration 4 Register (ETHERNETn_designcfg_debug4)	729
4.112.	Design Configuration 5 Register (ETHERNETn_designcfg_debug5)	730
4.113.	Design Configuration 6 Register (ETHERNETn_designcfg_debug6)	732
4.114.	Design Configuration 7 Register (ETHERNETn_designcfg_debug7)	734
4.115.	Design Configuration 8 Register (ETHERNETn_designcfg_debug8)	735
4.116.	Design Configuration 9 Register (ETHERNETn_designcfg_debug9)	736
4.117.	Design Configuration 10 Register (ETHERNETn_designcfg_debug10)	737
4.118.	Interrupt Status Queue i Register (ETHERNETn_int_status_qi) (i=1 to 3)	738

4.119.	TX Buffer Queue 1 Base Address Register (ETHERNETn_transmit_q1_ptr)	740
4.120.	TX Buffer Queue 2 Base Address Register (ETHERNETn_transmit_q2_ptr)	741
4.121.	TX Buffer Queue 3 Base Address Register (ETHERNETn_transmit_q3_ptr)	742
4.122.	RX Buffer Queue 1 Base Address Register (ETHERNETn_receive_q1_ptr)	743
4.123.	RX Buffer Queue 2 Base Address Register (ETHERNETn_receive_q2_ptr)	744
4.124.	RX Buffer Queue 3 Base Address Register (ETHERNETn_receive_q3_ptr)	745
4.125.	RX Buffer Size Queue i Register (ETHERNETn_rxbuf_size_qi) (i=1 to 3).....	746
4.126.	CBS Control Register (ETHERNETn_cbs_control).....	748
4.127.	CBS IdleSlope Queue A Register (ETHERNETn_cbs_idleslope_q_a)	749
4.128.	CBS IdleSlope Queue B Register (ETHERNETn_cbs_idleslope_q_b)	750
4.129.	MSB Buffer Queue Base Address Register (ETHERNETn_msb_buff_q_base_addr_reg)	751
4.130.	TX BD Control Register (ETHERNETn_tx_bd_control)	752
4.131.	RX BD Control Register (ETHERNETn_rx_bd_control).....	753
4.132.	Screening Type 1 Register i (ETHERNETn_screening_type_1_register_i) (i=0 to 15)	754
4.133.	Screening Type 2 Register i (ETHERNETn_screening_type_2_register_i) (i=0 to 15)	756
4.134.	Interrupt Enable Queue i Register (ETHERNETn_int_enable_qi) (i=1 to 3) ...	758
4.135.	Interrupt Disable Queue i Register (ETHERNETn_int_disable_qi) (i=1 to 3)	760
4.136.	Interrupt Mask Queue i Register (ETHERNETn_int_mask_qi) (i=1 to 3)	762
4.137.	EtherType 2 Register i (ETHERNETn_screening_type_2_ethertype_reg_i) (i=0 to 7)	764
4.138.	Type2 Compare Word 0 i Register (ETHERNETn_type2_compare_i_word_0) (i=0 to 31)	765
4.139.	Type2 Compare Word 1 i Register (ETHERNETn_type2_compare_i_word_1) (i=0 to 31)	766
5.	Functional Limitations	767
5.1.	Priority Flow Control - pausing the transmitting the frames.....	767
5.2.	Priority Queuing - screening using DS/TC field in IP header	767
5.3.	Priority Queuing - screening using compare_offset = "10" or "11"	767
5.4.	Enable/Disable the partial store and forward mode	767
5.5.	PTP/gPTP - The ptp_sync_frame_transmitted interrupt	767
5.6.	PTP/gPTP - TSU timer comparison with 0	767
CHAPTER 22:	Media Local Bus Interface (MediaLB)	768
1.	Overview.....	769
2.	Configuration and Block Diagram	771
3.	Operation of the MediaLB	776
3.1.	Notes on Using MediaLB	776
3.2.	List of References	776
4.	Registers	777
4.1.	MediaLBn Device Control Configuration Register (MLBn_DCCR).....	782
4.2.	MediaLBn System Status Configuration Register (MLBn_SSCR)	785
4.3.	MediaLBn System Data Configuration Register (MLBn_SDCR)	788
4.4.	MediaLBn System Mask Configuration Register (MLBn_SMCR)	789
4.5.	MediaLBn Version Control Configuration Register (MLBn_VCCR).....	791
4.6.	MediaLBn Synchronous Base Address Configuration Register (MLBn_SBCR)	792
4.7.	MediaLBn Asynchronous Base Address Configuration Register (MLBn_ABCR)	793
4.8.	MediaLBn Control Base Address Configuration Register (MLBn_CBCR).....	794
4.9.	MediaLBn Isochronous Base Address Configuration Register (MLBn_IBCR)	795

4.10.	MediaLBn Channel Interrupt Configuration Register (MLBn_CICR)	796
4.11.	MediaLBn AHB Master Control Register (MLBn_AHBMCTL)	797
4.12.	MediaLBn Channel Entry Configuration Register (MLBn_CECR0 - MLBn_CECR15)	798
4.13.	MediaLBn Channel Status Configuration Register (MLBn_CSCR0 - MLBn_CSCR15)	802
4.14.	MediaLBn Channel Current Buffer Configuration Register (MLBn_CCBCR0 - MLBn_CCBCR15)	807
4.15.	MediaLBn Channel Next Buffer Configuration Register (MLBn_CNBCR0 - MLBn_CNBCR15)	809
4.16.	MediaLBn Local Channel Buffer Configuration Register (MLBn_LCBCR0 - MLBn_LCBCR15)	811
4.17.	MediaLBn Module Identification Register (MLBn_MID)	813
CHAPTER 23:	Stereo Audio DAC	814
1.	Overview	815
2.	Configuration and Block Diagram	816
3.	Operation	817
3.1.	Initialization	817
3.2.	Using DMA Transfers to Update DADR Register	818
3.3.	Output Data Values of the Analog DAC	819
3.4.	Switching Clock Frequencies of the Analog DAC	820
3.5.	Minimum Writing Interval between the DAOSR and DACR Registers	821
3.6.	Interrupt	822
3.7.	AHB Slave Interface	823
3.8.	FIFO	824
3.9.	Frequency of CLKPI and CLKDA	825
3.10.	Sampling Frequency and Oversampling Setting of D/A Converter	826
3.11.	Output Stop Control of Analog DAC	828
3.12.	Bridge-tied Load (BTL)	829
4.	Registers	830
4.1.	DAC Over Sampling Register(DAOSR)	830
4.2.	DAC Configuration (DACR)	832
4.3.	DAC BUSY Register(DABUSY)	833
4.4.	DAC Control Register(DACTRL)	834
4.5.	DAC FLUSH Register(DAFLUSH)	836
4.6.	Interrupt Enable Register(INTREN)	837
4.7.	Interrupt State Register (INTRSTAT)	839
4.8.	Interrupt Clear Register (INTCTR)	841
4.9.	DAC Polarity Configuration Register (DPCR)	843
4.10.	Data 0..15 Register (DADR)	844
CHAPTER 24:	Inter-IC Sound (I2S)	845
1.	Overview	846
2.	Configuration and Block Diagram	847
3.	Operations of the I2S	848
3.1.	I2S Frame Construction	848
3.2.	I2S Configuration and Operation Modes	850
3.3.	Bit Alignment	856
3.4.	FIFO Construction	858
3.5.	Caution Summary	861
4.	Registers	862
4.1.	Reception FIFO Data Register (I2Sn_RXFDAT0 to 15)	865
4.2.	Transmission FIFO Data Register (I2Sn_TXFDAT0 to 15)	866
4.3.	Control Register (I2Sn_CNTREG)	867
4.4.	Channel Control Register 0 (I2Sn_MCR0REG)	872
4.5.	Channel Control Register 1 (I2Sn_MCR1REG)	875
4.6.	Channel Control Register 2 (I2Sn_MCR2REG)	876
4.7.	Operation Control Register (I2Sn_OPRREG)	877
4.8.	Software Reset Register (I2Sn_SRST)	879
4.9.	Interrupt Control Register (I2Sn_INTCNT)	880

4.10.	Status Register (I2Sn_STATUS)	884
4.11.	DMA Activate Register (I2Sn_DMAACT)	888
4.12.	Debug Register (I2Sn_DEBUG)	890
4.13.	Module ID Register (I2Sn_MIDREG)	891
CHAPTER 25:	Programmable CRC	892
1.	Overview	893
2.	Configuration and Block Diagram	894
3.	Operation of the Programmable CRC	895
3.1.	CRC Operation Flowcharts	896
3.2.	CRC Input Data and Checksum Calculation Flow	900
3.3.	CRC Calculation Example	903
4.	Registers	904
4.1.	CRC Polynomial Register (CRCn_POLY)	905
4.2.	CRC Seed Register (CRCn_SEED)	906
4.3.	CRC Final XOR Register (CRCn_FXOR)	907
4.4.	CRC Configuration Register (CRCn_CFG)	908
4.5.	CRC Write Register (CRCn_WR)	912
4.6.	CRC Read Register (CRCn_RD)	913
CHAPTER 26:	PCMPWM	914
1.	Overview	915
2.	Configuration and Block Diagram	916
2.1.	Block Diagram	916
2.2.	Configuration of the PCMPWM Module	917
2.3.	Output Configuration	921
3.	Operation of the PCMPWM	922
3.1.	Description of the PCM to PWM Conversion Process	922
3.2.	PWM Cycle Time Configuration	927
3.3.	PCM Data Sample Input	928
3.4.	Interrupts	929
3.5.	Dead Timer Operation	930
4.	Registers	931
4.1.	PCMPWM Control Register (PCMPWmi_CONTROL)	932
4.2.	PCMPWM Output Control Register (PCMPWmi_OCTRL)	934
4.3.	PCMPWM Clock Select Register (PCMPWmi_CLKSEL)	936
4.4.	PCMPWM Count Period Register (PCMPWmi_COUNTP)	937
4.5.	PCM Offset Register (PCMPWmi_PCMOFFS)	938
4.6.	PCM Interrupt Enable Register (PCMPWmi_INTREN)	939
4.7.	PCM Interrupt Status Register (PCMPWmi_INTRSTAT)	941
4.8.	PCM Interrupt Clear Register (PCMPWmi_INTRCLR)	943
4.9.	PCM Data Register 0..15 (PCMPWmi_DATA)	945
CHAPTER 27:	HyperBus Interface	946
1.	Overview	947
2.	Block Diagram	948
3.	Operation of the HYPERBUSI	949
3.1.	HyperBus Core	949
3.2.	Tx/Rx Controller	951
3.3.	C/A Coder	952
3.4.	FIFO	953
3.5.	CS REG (Control Status Register)	954
3.6.	AXI Slave Interface	954
4.	Registers	955
4.1.	Controller Status Register (HYPERBUSIn_CSR)	956
4.2.	Interrupt Enable Register (HYPERBUSIn_IEN)	959
4.3.	Interrupt Status Register (HYPERBUSIn_ISR)	961
4.4.	Memory Base Address Register (HYPERBUSIn_MBR0 to 1)	962
4.5.	Memory Configuration Register (HYPERBUSIn_MCR0 to 1)	963
4.6.	Memory Timing Register (HYPERBUSIn_MTR0 to 1)	965
4.7.	General Purpose Output Register (HYPERBUSIn_GPOR)	968

4.8.	Write Protection Register (HYPERBUSIn_WPR).....	969
4.9.	Test Register (HYPERBUSIn_TEST).....	970
CHAPTER 28:	Indicator PWM	971
1.	Overview.....	972
2.	Configuration and Block Diagram	973
3.	Operation of Indicator PWM	974
3.1.	Indicator PWM Timer	974
3.2.	PWM Timer Count Operation Start	975
3.3.	Timer Count Operation Stop	976
3.4.	Counter Value Updating while PWM Counter Operation is in Progress	977
3.5.	Indicator PWM Interrupts	978
3.6.	Operation Flowchart.....	980
4.	Registers	982
4.1.	Timer Control Register (ITMCR)	983
4.2.	Count Control Register (ICNTCR)	985
4.3.	Status Control Register (ISTC)	987
4.4.	Status Control Clear Register (ISTCC)	989
4.5.	Status Control Set Register (ISTCS)	991
4.6.	PWM Cycle Setting Register (IPCSR)	993
4.7.	PWM Duty Setting Register (IPDUT)	994
5.	Precautions for Using This Device.....	995
5.1.	Notes to Observe When Accessing a Register	995
5.2.	Indicator PWM Operation Precautions.....	995
CHAPTER 29:	FPD-Link Converter	996
1.	Overview.....	997
2.	Configuration and Block Diagram	998
3.	Operation.....	1000
3.1.	Register IF	1000
3.2.	Output Signal Selection for FPD-Link	1001
3.3.	FPD-Link Control	1002
4.	Registers	1003
4.1.	Unlock Registers (UNLOCK)	1004
4.2.	Control0 Registers (CTRL0)	1005
4.3.	Control1 Registers (CTRL1)	1007
4.4.	Channel Select Registers (CH_SEL)	1010
4.5.	TXn Configuration Registers (TXn_CONF (n: 0 to 4))	1011
4.6.	GDC Control Register (GDCCR)	1013
CHAPTER 30:	Memory Protection Unit for AXI	1014
1.	Overview.....	1015
2.	Configuration and Block Diagram	1016
3.	Operation of the MPU AXI	1017
4.	Registers	1023
4.1.	MPU AXI Control Register (MPUXn_CTRL0)	1026
4.2.	MPU AXI NMI Enable Register (MPUXn_NMIEN)	1028
4.3.	MPU AXI Write Error Control Register (MPUXn_WERRC)	1029
4.4.	MPU AXI Write Error Address Register (MPUXn_WERRA)	1030
4.5.	MPU AXI Read Error Control Register (MPUXn_RERRC).....	1031
4.6.	MPU AXI Read Error Address Register (MPUXn_RERRA)	1032
4.7.	MPU AXI Region Control Registers (MPUXn_CTRL1 to 8)	1033
4.8.	MPU AXI Start Address Registers (MPUXn_SADDR1 to 8).....	1034
4.9.	MPU AXI End Address Registers (MPUXn_EADDR1 to 8).....	1035
4.10.	MPU AXI Unlock Register (MPUXn_UNLOCK)	1036
4.11.	MPU AXI Module ID Register (MPUXn_MID)	1037
5.	Notes on Using MPU AXI	1038
CHAPTER 31:	Memory Protection Unit for AHB	1040
1.	Overview.....	1041
2.	Configuration and Block Diagram	1042

3.	Operation of the MPU AHB.....	1043
4.	Registers	1047
4.1.	MPU AHB Control Register (MPUHN_CTRL0).....	1049
4.2.	MPU AHB NMI Enable Register (MPUHN_NMIEN)	1051
4.3.	MPU AHB Memory Error Control Register (MPUHN_MERRC).....	1052
4.4.	MPU AHB Memory Error Address Register (MPUHN_MERRA).....	1053
4.5.	MPU AHB Region Control Registers (MPUHN_CTRL1 to 8).....	1054
4.6.	MPU AHB Start Address Registers (MPUHN_SADDR1 to 8).....	1055
4.7.	MPU AHB End Address Registers (MPUHN_EADDR1 to 8).....	1056
4.8.	MPU AHB Unlock Register (MPUHN_UNLOCK).....	1057
4.9.	MPU AHB Module ID Register (MPUHN_MID).....	1058
5.	Notes on Using the MPU AHB	1059
CHAPTER 32:	Graphics Subsystem.....	1061
1.	Overview.....	1062
1.1.	Feature Summary	1062
2.	Configuration and Block Diagram	1063
2.1.	Block Diagrams.....	1063
2.2.	The 2D Graphics Core	1063
2.3.	High Performance Bus Matrix	1063
2.4.	Memory Protection Units (MPU)	1063
2.5.	Bus Monitor.....	1064
2.6.	Video RAM.....	1064
2.7.	DDR High-Speed SPI	1064
2.8.	HyperBus [™] Interface	1064
2.9.	Interrupts.....	1065
2.10.	Address Map.....	1067
2.11.	Key Codes	1068
3.	Operation of the Graphics Subsystem	1069
3.1.	Common Setup.....	1069
3.2.	The 2D Graphics Core Display Setup	1075
4.	Registers	1076
4.1.	General	1076
4.2.	SubSysCtrl.....	1080
4.3.	Memory Protection Unit	1135
4.4.	High Performance Bus Matrix	1136
4.5.	Bus Monitor.....	1137
4.6.	MonitorStatus.....	1142
5.	References	1144
CHAPTER 33:	Sound System Configuration	1145
1.	Overview.....	1146
1.1.	Input Module	1146
1.2.	Sound Mixer.....	1146
1.3.	Output Module	1146
2.	Configuration and Block Diagram	1147
3.	Operation.....	1148
3.1.	Start Operations.....	1148
3.2.	Addition of Sound Source Inputs	1150
3.3.	Stop Operations.....	1151
3.4.	Operation of a Sound Source	1152
4.	Configuration and limitation of each module.....	1153
4.1.	Interface between SMIX and DAC	1153
4.2.	Interface between SMIX and PCM-PWM.....	1153
4.3.	Interface between SMIX and I2S	1154
4.4.	Interface between SWFG and SMIX.....	1155
4.5.	Interface between DMAC and SMIX	1155
4.6.	Interface between CPU and SMIX	1155
5.	Note	1156

CHAPTER 34:	Base Timer Port Definition	1157
1.	Overview.....	1158
2.	Definition.....	1159
2.1.	Unit and Channel Number Definition	1159
2.2.	Port Name Definition and Supported Operation Mode.....	1159
3.	Supplementation.....	1161
3.1.	Input Port Configuration	1161
3.2.	Output Port Configuration	1161
4.	Operation and Registers.....	1162
CHAPTER 35:	Appendix.....	1163
1.	Pin Status in Each CPU State	1164
1.1.	TEQFP-216 Pin	1164
1.2.	TEQFP-208pin.....	1165
2.	Master Access Table	1166
CHAPTER 36:	Major Changes	1170
	Revision History	1171

CHAPTER 1: Overview



This chapter explains the product overview.

1. Overview
2. Document Definition
3. Register Attribute
4. Abbreviation

CODE: OVERVIEW-S6J3200-E1

1. Overview

S6J3200 is a microcontroller series which is to be applied to automotive systems representative of a graphical cluster control unit on a dashboard.

2. Document Definition

The related documents of S6J3200 are the followings.

Table 2-1

Document Type	Definition	Primary User	Document Code
Datasheet	The function and its characteristics are specified quantitatively.	Investigator and hardware engineer	DS708-00003-Revision
S6J3200 hardware manual	The function and its operation of S6J3200 series are described.	Software engineer	MN708-00005-Revision
Traveo™ Platform hardware manual	The function and its operation of CPU core platform are described.	Software engineer	MN708-00006-Revision
Supplementary Information for Datasheet	Supplementary information for document such as difference with previous revision.	Datasheet user.	DS708-00003-Revision-E-SI
Supplementary Information for Hardware manual	Supplementary information for document such as difference with previous revision.	Hardware manual user.	MN708-00005-Revision-E-SI
Application note	The reference software, sample application, the reference board design and so on are explained.	Software and hardware engineer	Under consideration

Notes:

- Refer all documents for the system development.
- "Primary user" is a most likely engineer for whom the document is the most useful.
- The description of the datasheet and the S6J3200 hardware manual should precede the duplicated description of Traveo platform hardware manual.
- Traveo platform hardware manual is expected to be used as dictionary of platform specification.
- Document code usually includes its revision.
- Revise information from the previous revision can be seen the supplementary information.

3. Register Attribute

3.1. Read and Write

Refer the table with the following definition.

Table 3-1 Register Attribute of Read and Write

Attribute	Definition
R	It can be read.
R0	"0" is to be read.
R1	"1" is to be read.
RX	The read value is undefined.
W	It can be written.
W0	"0" must be written.
W1	"1" must be written.
WX	Writing doesn't affect the operation.
WN	Never write
"/" (slash)	The read value is same as the written value.
"," (comma)	The read value is different from the written value.

■ Example

R/W : The written value is to be read.
 R, W0 : "0" must be written, and the read value is different from the written value.

Notes:

- The register attribute of a status register which has its clear register and set register is conveniently described to be R/W though the written value cannot be read directly. In this case R/W has a meaning that the controlled value is to be read.
- A register attribute does not necessarily describe a prohibited operation of the register. Any prohibited operations should be referred within the line of the register description as well. See every description of the register specification together with every note.

3.2. Protection

Refer the table with the following definition.

Table 3-2 Register Attribute of Protection

Attribute	Definition
RP	It can be read at the supervisor mode.
WP	It can be written at the supervisor mode.
WS	It can be written after cancelling the sequence protection.
WPS	It can be written after cancelling the sequence protection at the supervisor mode.

3.3. Register Information

You can also see register information in a table as bellow.

REGISTER_NAME	The register name and its abbreviation.
OFFSET	The offset address of the register
ACCESS_SIZE	B: The byte (8bit) access is possible. H: The half-word (16bit) access is possible when the lower bit of the address is "0". W: The word (32bit) access is possible when the lower bit of the address is "00".
MULTIPLE	No definition
NUMERIC_TYPE	No definition
OTHER	No definition

Register attribute for header file generation.

BIT_OFFSET	The bit offset (Ex. 31,30,29,...,0)
BIT_NAME	The bit name
ACCESS_TYPE	The allowed access defined 3.1
PROT_TYPE	The allowed access defined 3.2
INITIAL_VALUE	The initial value

4. Abbreviation

Abbreviation	Definition	Remark
A/D converter	Analog to Digital Converter	
ADC	Analog to Digital Converter	
AHB	Advanced High performance Bus	
AMBATM	Advanced Microcontroller Bus Architecture	
APB	Advanced Peripheral Bus	
ATCM	TCM-A port	
AXI	Advanced eXtensible Interface	
B0TCM	TCM B0 port	
B1TCM	TCM B1 port	
BBU	Bit Banding Unit	
BDR	Boot Description Record	
BT	Base Timer	
BTL	Bridge-Tied Load	
CAN	Control Area Network	
CD	Clock Domain	
CPU	Central Processing Unit	
CR	CR Oscillator	
CRC	Cyclic Redundancy Check	
CSV	Clock SuperVisor	
DAC	Digital Analog Converter	
DAP	Debug Access Port	
DED	Dual Error Detection	
DMA	Direct Memory Access	
DMAC	DMA Controller	
EAM	Exclusive Access Memory	
ECC	Error Correction Code	
ETM	Embedded Trace Macro	
EXT-IRC	External InteRrupt Controller	
FIQ	Fast Interrupt Request	
FPU	Floating Point Unit	
FRT	Free-Run Timer	
GPIO	General Purpose I/O	
HPM	High Performance Matrix	
HW-WDT	Hardware Watchdog Timer	
I/O	Input or Output	
I2S	Inter-IC Sound	
ICU	Input Capture Unit	
IPCU	Inter-Processor Communication Unit	
IRC	InteRrupt Controller	
IRQ	InteRrupt Request	
ISR	Interrupt Service Routine	
JTAG	Joint Test Action Group	
LLPP	Low Latency Peripheral Port	
LVD	Low Voltage Detector	
MCU	MicroController Unit	
MFS	Multi-Function Serial interface	
MLB	Media LB	

Abbreviation	Definition	Remark
NF	Noise Filter	
NMI	Non Maskable Interrupt	
OCU	Output Compare Unit	
OSC	OSCillator	
PCB	Printed Circuit Board	
PCBA	Printed Circuit Board Assembly	
PCM	Pulse Coded Module	
PD	Power Domain	
PLL	Phase Locked Loop	
PONR	Power ON Reset	
PPC	Port Pin Configuration	
PSC	Power Supply Control	
PSS	Power Saving State	
PWM	Pulse Width Modulation	
QPRC	Quad Position & Revolution Counter	
RAM	Random Access Memory	
RIC	Resource Input Configuration	
RLT	Reload Timer	
ROM	Read Only Memory	
RSDS	Reduced Swing Differential Signal	
RTC	Real Time Clock	
RVD	Low Voltage Detection and Reset for RAM Retention	
SCT	Source Clock Timer	
SEC	Single Error Correction	
SECEDED	Single Error Correction and Dual Error Detection	
SG	Sound Generator	
SHE	Secure Hardware Extension	
SMC	Stepper Motor Controller	
SMIX	Sound Mixer	
SPI	Serial Peripheral Interface	
SRAM	Static RAM	
SSCG	Spread Spectrum Clock Generation	
SWFG	Sound Waveform Generator	
SW-WDT	Software Watchdog Timer	
SYSC	System Controller	
TCFLASH	FLASH connected to TCM	
TCM	Tightly Coupled Memory	
TCRAM	RAM connected to TCM	
TPU	Timing Protection Unit	
TSU	Time Stamp Unit	
VIC	Vectored Interrupt Controller	
VRAM	Video RAM	
WDR	Watchdog Description Record	
WDT	Watchdog Timer	
WFG	Waveform Generator	
WorkFLASH	Work FLASH Memory	

CHAPTER 2: Function List



This chapter explains the functions.

1. Function List
2. Optional Function

CODE: FUNCTIONLIST-S6J3200-E1

1. Function List

The table shows the functions which are implemented in S6J32E, S6J32F, S6J32G, S6J32H series.

Table 1-1

Function	Description	Remark
CPU core	ARM Cortex R5F	
FPU	Available (Double precision and Single precision)	
PPU	Available	
MPU	Available	
TPU	Available	
Endian	Little endian	
Core clock frequency	Option	See 2.1 and AC specification on the datasheet.
HPM bus frequency	Option	See AC specification on the datasheet
Resource clock frequency	Option	See AC specification on the datasheet
Embedded CR oscillation	Slow clock:100kHz, Fast clock: 4MHz (Center frequency)	See AC specification on the datasheet
PLL	PLL0, 1, 2, 3	
SSCG PLL	SSCG0, 1, 2, 3	
Clock supervisor	Available	
DMA	16 ch	
Boot-ROM	16 Kbytes	
JTAG	Available	
Data cache	16 Kbytes	
Instruction cache	16 Kbytes	
Program FLASH	Option	See 2.1
Work FLASH	112 Kbytes	
TC-RAM	Option	See 2.1
System-RAM	384Kbytes	
Backup-RAM	16Kbytes	
Security (SHE)	Option	See 2.1
Low latency interrupt	Available	
Power domain	5 domains	
Power supply	5V +/- 0.5V, 3.3V +/- 0.3V, 1.2V +/- 0.1V	
Embedded LDO power supply for 5.0V	Available	
Low-voltage detection of external power supply	Available	
Low-voltage detection of internal LDO output	Available	
Hardware watchdog timer	Available	
Software watchdog timer	Available	
Package	Option	See 2.1
AUTOSAR	AUTOSAR 4.0.3	
General Purpose I/O	Option	See 2.3
Quad Position & Revolution Counter	2 ch	
I/O timer	3 unit x 8 ch	
32bit Reload timer	14 ch	
Real time clock	Available	Automatic calibration
Sound generator	4 ch	
Sound waveform generator	Option 1 unit x 5 outputs	See 2.1
Sound mixer	Option 1 unit x 10 inputs	See 2.1
Stereo audio DAC	Option 1 unit (L and R)	See 2.1
PCM-PWM	Option 1 unit (L and R)	See 2.1
Base timer	12 units (24ch)	
Free-run timer	12 ch	
Input Capture Unit	12 unit (24channels of capture)	

Function	Description	Remark
Output Compare Unit	12unit (24 channels of compare match)	
Stepping motor controller (SMC)	For 6 gauges	
12bit-A/D converter	Option 1 unit x 50 input ports (Max)	See 2.3
CRC	1 unit	
Programmable CRC	1 unit	
Source clock timer	4 ch	
NMI	Available	
External interrupt	16 ch	
Internal interrupt	512 vectors	
I2S	2 ch	One only supports an output as a function of the sound system.
DDR HSSPI	2 ch	A type of Quad SPI
HyperBus (RPC2)	Option	See 2.1 See AC specification on the datasheet.
Multi-function serial interface	12 ch	
CAN-FD	4 ch	
CAN-FD RAM (ECC supported)	16KB/ch It equivalents to 128 message buffer per channel of CCAN module	
Ethernet AVB	1ch	
Media-LB (MOST25)	1ch	
Indicator PWM	1 ch	
MPU for AHB	1 unit	
MPU for AXI	1 unit	
Internal VRAM	2 MByte	
Graphic engine clock	200 MHz	
Graphic AXI clock	200 MHz	
Display clock	64MHz (ch.0), 50MHz(ch.1)	
Display clock source	Graphic display controller clock or external clock	
Target frame rate	60 fps	
Number of display outputs	Option Maximum 2 outputs simultaneously	See 2.1
TTL output (RGB888)	2 ch	Display channel ch.0 Display channel ch.1
RSDS/TCON support	1 output	Display channel ch.0
FPD-Link (LVDS)	1 output, 350Mbps (Max)	Display channel ch.0 Display channel ch.1
Video capture unit	1 ch	
Video capture format	ITU656, YCbCr4:4:4, YCbCr4:2:2, RGB888, RGB666	
2D Graphic engine	1 unit	
2.5D support	Available	
Vector drawing on 2D engine	Available	
Warping	Available	
Scale/Rotate/Blend	Available	
2D Driver API	CYPRESS proprietary	

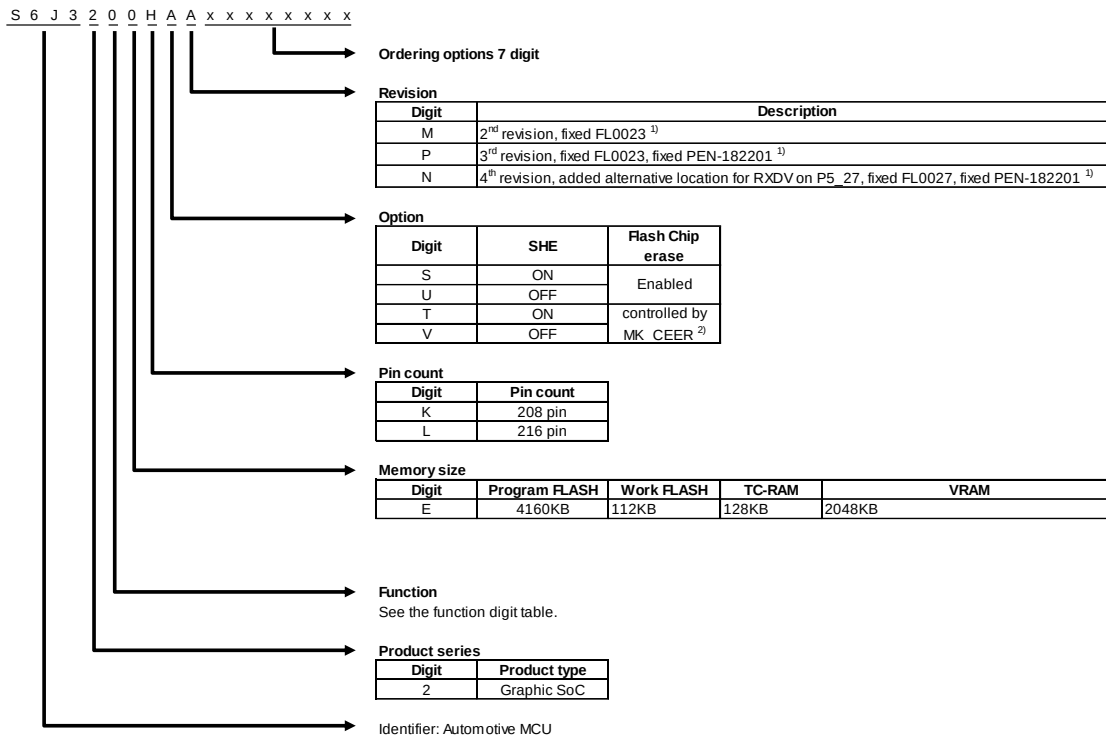
Notes:

- The options are described in 2.
- The described specifications in the table which are related the electric characteristics only show the typical values. They don't necessarily include the width of characteristics, errors, and so on. They should be seen in the datasheet in detailed.
- Target resolution of graphics is WVGA 800 x 480, WQVGA 480 x 272.
- Target capture resolution of graphics is WVGA 800 x 480.

2. Optional Function

2.1. Basic Option

The figure shows the optional function and the part number relations of the combined S6J3200 and S6J32E, S6J32F, S6J32G, S6J32H series.



1) Please contact your Cypress sales representative to receive the customer information CI708-00001 and Product Errata documents
 2) controlled by Chip erase enable marker MK_CEER

Function Digit Table for revision N

Part Number	S6J32X (X = function digit)			
	E	F	G	H
CPU Clock Maximum [MHz]	240	240	240	240
Graphics Clock Maximum [MHz]	200	200	200	200
Display Output Support [ch. no.]	0, 1	0, 1	0, 1	0, 1
Video Capture Support [units]	1	1	1	1
Graphic Engine Type	2D	2D	2D	2D
Hyper Bus Interface [ch. no.]	0, 1	0, 1	0, 1, 2	0, 1, 2
Sound System	OFF	ON	ON	ON
Ethernet RMII	ON	ON	ON	OFF

Function Digit Table for revision M and revision P

Part Number	S6J32X (X = function digit)		
	E	F	G
CPU Clock Maximum [MHz]	240	240	240
Graphics Clock Maximum [MHz]	200	200	200
Display Output Support [ch. no.]	0, 1	0, 1	0, 1
Video Capture Support [units]	1	1	1
Graphic Engine Type	2D	2D	2D
Hyper Bus Interface [ch. no.]	0, 1	0, 1	0, 1, 2
Sound System	OFF	ON	ON
Ethernet RMII	ON	ON	ON

Notes:

- This table only shows the relations between the optional function and the part numbers. That is, all products are not necessarily available for orders. See the order number on the datasheet and confirm actual availabilities of products.
- The sound system is composed of the sound waveform generator, the sound mixer, the audio DAC, PCM-PWM, and I2S0.
- The CLK_CPU is assigned to the CPU clock. The CLK_CD3A0 is assigned to the graphic clock. They are defined at the chapter of Clock Configuration.
- Display Output ch.0 is used for RSDS and FPD-LINK (LVDS) as well as DRGB (Digital RGB). The ch.0 of the product, which does not support FPD-LINK, is used for RSDS and DRGB.
- Display Output ch.1 is used for FPD-LINK (LVDS) and DRGB (Digital RGB). The ch.1 of the product, which does not support FPD-LINK, is used for DRGB only.

2.2. ID

Below table shows the Chip-ID and JTAG-ID for S6J32E, S6J32F, S6J32G, S6J32H variants.

Chip ID can be read from SYSC0_SYSIDR. For SYSC0_SYSIDR, see the Traveo™ Platform hardware manual.

Function Digit	Memory	Pin count	Option	Revision	Chip ID	JTAG ID
E	E	K	S	M / P	0x10150001	0x101035CF
			T			0x1010B5CF
			U			0x101135CF
			V			0x1011B5CF
		L	S			0x101015CF
			T			0x101095CF
			U			0x101115CF
			V			0x101195CF
F		K	S			0x101055CF
			T			0x1010D5CF
			U			0x101155CF
			V			0x1011D5CF
		L	S			0x101045CF
			T			0x1010C5CF
			U			0x101145CF
			V			0x1011C5CF
G		K	S			0x101025CF
			T			0x1010A5CF
			U			0x101125CF
			V			0x1011A5CF
		L	S			0x101005CF
			T			0x101085CF
			U			0x101105CF
			V			0x101185CF

Function Digit	Memory	Pin count	Option	Revision	Chip ID	JTAG ID
E	E	K	S	N	0x10150002	0x201035CF
			T			0x2010B5CF
			U			0x201135CF
			V			0x2011B5CF
		L	S			0x201015CF
			T			0x201095CF
			U			0x201115CF
			V			0x201195CF
F		K	S			0x201055CF
			T			0x2010D5CF
			U			0x201155CF
			V			0x2011D5CF
		L	S			0x201045CF
			T			0x2010C5CF
			U			0x201145CF
			V			0x2011C5CF
G		K	S			0x201025CF
			T			0x2010A5CF
			U			0x201125CF
			V			0x2011A5CF
		L	S			0x201005CF
			T			0x201085CF
			U			0x201105CF
			V			0x201185CF
H		K	S			0x201075CF
			T			0x2010F5CF
			U			0x201175CF
			V			0x2011F5CF
		L	S			0x201065CF
			T			0x2010E5CF
			U			0x201165CF
			V			0x2011E5CF

Note:

- The JTAG-ID is stored in a memory in the PD2. It can only be read after device startup (VCC12 must be supplied and RSTX must be released).

2.3. Restriction

Some functions have restrictions which depend on package pin counts.

Table 2-1

Function	TEQFP216	TEQFP208
Analog input port (12bit-ADC)	AN0 to AN49 (50 ports)	AN1 to AN3, AN5 to AN17, AN20 to AN49 (46 ports)
General Purpose I/O	P0_00, P0_01, P0_02, P0_03, P0_04, P0_05, P0_06, P0_07, P0_08, P0_09, P0_10, P0_11, P0_12, P0_13, P0_14, P0_15, P0_16, P0_17, P0_18, P0_19, P0_26, P0_27, P0_28, P0_30, P0_31, P1_00, P1_01, P1_02, P1_03, P1_04, P1_05, P1_06, P1_07, P1_08, P1_09, P2_16, P2_17, P2_19, P2_22, P2_24, P2_25, P2_26, P2_27, P2_28, P2_29, P2_30, P2_31, P3_00, P3_01, P3_02, P3_03, P3_04, P3_05, P3_06, P3_07, P3_08, P3_09, P3_10, P3_11, P3_12, P3_13, P3_14, P3_15, P3_16, P3_17, P3_18, P3_19, P3_20, P3_21, P3_22, P3_23, P3_24, P3_25, P3_26, P3_27, P3_28, P3_29, P3_30, P3_31, P4_00, P4_01, P4_02, P4_03, P4_04, P4_05, P4_06, P4_07, P4_08, P4_09, P4_10, P4_11, P4_12, P4_25, P4_26, P4_27, P4_28, P4_29, P4_30, P4_31, P5_00, P5_01, P5_02, P5_03, P5_04, P5_05, P5_06, P5_07, P5_08, P5_09, P5_10, P5_11, P5_12, P5_13, P5_14, P5_15, P5_16, P5_17, P5_18, P5_19, P5_20, P5_21, P5_22, P5_27, P5_28, P5_29, P5_30, P5_31, P6_00 (128 ports)	P0_00, P0_01, P0_04, P0_05, P0_06, P0_07, P0_08, P0_09, P0_10, P0_11, P0_12, P0_13, P0_14, P0_15, P0_16, P0_17, P0_18, P0_19, P0_26, P0_27, P0_28, P0_30, P0_31, P1_00, P1_01, P1_02, P1_03, P1_04, P1_05, P1_06, P1_07, P1_08, P1_09, P2_16, P2_17, P2_19, P2_22, P2_25, P2_26, P2_27, P2_29, P2_30, P2_31, P3_00, P3_01, P3_02, P3_03, P3_04, P3_05, P3_06, P3_07, P3_08, P3_09, P3_12, P3_13, P3_14, P3_15, P3_16, P3_17, P3_18, P3_21, P3_22, P3_23, P3_24, P3_25, P3_26, P3_27, P3_28, P3_29, P3_30, P3_31, P4_00, P4_01, P4_02, P4_03, P4_04, P4_05, P4_06, P4_07, P4_08, P4_09, P4_10, P4_11, P4_12, P4_25, P4_26, P4_27, P4_28, P4_29, P4_30, P4_31, P5_00, P5_01, P5_02, P5_03, P5_04, P5_05, P5_06, P5_07, P5_08, P5_09, P5_10, P5_11, P5_12, P5_13, P5_14, P5_15, P5_16, P5_17, P5_18, P5_19, P5_20, P5_21, P5_22, P5_27, P5_28, P5_29, P5_30, P5_31, P6_00 (120 ports)
PPG triggered input	PPG0/1/2/3/4/5_TIN1, PPG6/7/8/9/10/11_TIN	PPG6/7/8/9/10/11_TIN

Notes:

- See multiplexed functions on pin assignment sheet.
- The optional restrictions will be added without notification.

CHAPTER 3: Product Description



This chapter explains the function feature.

1. Overview
2. Product Description
3. Note

CODE: PRODUCT-S6J3200-E1

1. Overview

This chapter explains the product features of S6J3200 series. The description of this chapter should precede the duplicated description on platform manual.

2. Product Description

The table shows features.

Table 2-1

Feature	Description
Technology	55nm CMOS technology with embedded FLASH Fully automotive qualified according to ISO/TS 16949 and AEC-Q100
Functional Safety	The product series has some functional safety features suited for ASIL-B application.
Peripherals	See function list.
Power Domain (PD)	See the platform manual and chapter STATE TRANSITION in detail. The product series supports the power off control of PD1, PD2 and PD6. The power domain resets of PD3 and PD5 included in PD2 are not supported in the product series, and "0" is always read from the reset factor flags of them. This series doesn't support partial wakeup for PD6.
Debug and Trace	See the platform manual in detail. - Standard 5-pin JTAG interface 4k Word (16 Kbyte) Embedded Trace Buffer 4-bit trace support for TEQFP package. Full trace (dedicated 16-bit port) with special bond-out package is planned.
System Control	See the platform manual in detail. Main and sub oscillator is available. - A wide range of 3.6 - 16MHz is available for main oscillator 32KHz is available for sub oscillator Sub clock is enable/disable by register settings
Clock	See the platform manual in detail. CLK_CLKO (Clock Output Function) is not supported.
Embedded CR oscillation	100 KHz and 4 MHz Embedded CR oscillator See the platform manual in detail. Stabilization time is as followings. 5us for 4MHz (Fast clock) 20us for 100kHz (Slow clock)
Clock Supervisor	See the platform manual in detail. This product series doesn't support clock supervisor output port. (Related register and internal circuit is implemented.)
Reset	See the platform manual in detail. Following resets are not mounted on this device. - INITX - SRSTX (and nSRST pin)
Hardware Watchdog	See the platform manual in detail. Hardware watchdog function stops during PSS mode. In the related register of HWDG_CFG, the bit ALLOWSTOPCLK is always read as 1 (HWDG_CFG.ALLOWSTOPCLK=1). The product series doesn't support Watchdog Counter Monitor Output port. (Related register and internal circuit is implemented.)
Software Watchdog	See the platform manual in detail. The product series doesn't support Watchdog Counter Monitor Output port. (Related register and internal circuit is implemented.)
Standby Mode	See the platform manual in detail. Standby mode with 5V single power supply is available. Turning off the 3.3V supply and the external 1.2V supply in standby mode is available. The long term pulse of the indicator PWM can be outputted during RTC Standby mode.
PLL / SSCG PLL	See the platform manual in detail. Use case assumption is following. - PLL ➤ Sound system clock ➤ Sound frequency master clock ➤ Peripherals ➤ Display clock ➤ Trace clock - SSCG ➤ CPU core ➤ GDC core ➤ HyperBus ➤ DDR-HSPI SSCG supports center spread mode and down spread mode. But maximum frequency must not be exceeded in any mode.

Feature	Description
External Interrupts	See the platform manual in detail.
NMI	See the platform manual in detail. 1 NMI pin.
Memory Protection	MPU16 AHB: See the platform manual in detail. MPU for AXI: ch.0 (Supervise Ethernet) MPU for AHB: ch.1 (Supervise Media LB) Additional MPU for Graphic sub system, MediaLB and Ethernet AVB. They are described on the chapter of MPU for AHB and MPU for AXI. To configure Lock or Unlock for both MPUXn_UNLOCK and MPUHn_UNLOCK, - Lock: 0x112ABB56 - Unlock: 0xACCABB56
Peripheral Protection	See the platform manual in detail. Protected peripherals are described in the base address map.
Internal Memories System RAM	See the platform manual in detail. 1 wait cycle is necessary for RAM read at over 160MHz.No need to insert wait cycles for RAM write.
Internal Memories TCRAM	See the platform manual in detail.
Internal Memories Backup RAM	16KBytes (8kByte + 8 KByte) Backup RAM can only be operated in RUN mode (normal operation mode). In other mode the memory content is retained, but it cannot be operated. SLEEP control for Backup RAM is not supported and cannot be used.
Internal Memories VRAM	ECC region is shared with user region. Memory size available for user program become less when ECC is enabled. User can define ECC enabled area and ECC disabled area. Single error correction, double error detection (SECCDED) ECC support per 32-bit word.
Embedded Program/Work Flash Memory	Embedded Program Flash can be accessed with 0-wait-cycle if CPU frequency is 80MHz or less. 0-wait-cycle: 80MHz or less. 1-wait-cycle: 160MHz or less. 2-wait-cycle: more than 160MHz. The maximum frequency should be referred in datasheet. Erase suspend is supported. Reading and writing to the other sector are possible when Flash Erase is suspended. Serial Flash programing and Parallel Flash programing are supported. Margin mode is not supported.
Internal Power Domain	PD1: Always ON PD2: Cortex R5F platform/ GDC/ additional peripherals PD4: Backup RAM in Always On domain PD6: Peripherals in Always On domain * The chapter of the block diagram explains in detail.
Power Supply	External 5V, 3V, 1.2V is required. Built in LDO provides internal 1.2V for Always On region (PD1). External 1.2V power supply control pin is supported. External 3.3V power supply should be controlled by GPIO. There are constraints of power on/off sequence.
Low-voltage Detection	LVD for external voltage is supported. LVD for internal voltage is supported. See the specification of the detected level on the datasheet.
Low-voltage Detection for RAM Retention (RVD)	RVD for RAM retention is effective during the standby mode only. That is, it is only for the Backup RAM of 16KB that the function is available.
Resource inter-connect	The output signal of some resources can be input to the other resource.
I/O Ports	5V general purpose I/O 3V general purpose I/O Multi input level and multi output drivability Pull-up, pull-down function is available. Resource input and output is multiplexed. +B input is allowed many pins of 3.3V, 5V and 3.3V/5V I/O domain.

Feature	Description
A/D Converter	12bit resolution, 1 unit 50 channels of analog input for TEQPF216 46 channels of analog input for TEQFP208 24 channels of them are shared with the SMC for TEQFP216/208 External trigger and timer trigger are available. The description of the A/D converter function should be referred in the S6J3200 hardware manual. Though the chapter of I/O port in B/B hardware manual describes another A/D converter function, do not refer it.
CRC	See the platform manual in detail.
Programmable CRC	DMA support
Sound Generator	Produces sound/melody with varying frequency and amplitude for convenient duration Square wave sound output Automatic linear amplitude increment or decrement Interrupt request generated when specified sound length has ended
Sound Waveform Generator	Sine waveform, saw-tooth waveform and Square waveform are generated with easy configuration of the parameters which specified sound sources. Fade-in and Fade-out control for reverberation.
Sound Mixer	The input channels of 0 - 4 are reserved for waveform generator. Mixing different sampling frequency sounds. Mixing Internal sounds and External I2S input sounds. Saturating addition function for keeping sound quality. Cut a specific frequency data by digital filter. LPF is support by FIR filter. Fade-in and Fade-out control.
PCM-PWM	Conversion of PCM audio streaming to Pulse Width Modulated signals. Supports 2 output channels for stereo and mono data Up to 16-bit output sample resolution Support for half and full H-bridges
Audio DAC	The sound source of the fixed 48kHz sampling frequency can be outputted. 1unit, L/R channels support. Bridge-Tied Load (BTL) connection is available.
I2S	2channels. - I2S0 can output sound sources which are processed by Sound System. - I2S1 can input sound sources which are processed by Sound System. - I2S has its own PPU, but the function is fixed to disable. See the "Sound System Configuration" of S6J3200 hardware manual in detail.
Base Timer	One unit consists of a pair of 16bit base timers. 12 units, that is, 24 channels of base timers are available. 16-bit PWM Timer 16-bit PPG Timer 16/32-bit Reload Timer 16/32-bit PWC Timer See the platform manual in detail.
Reload Timer	See the platform manual in detail.
I/O Timer	Consists of 32-bit Free running timer 32-bit Input capture 32-bit Output compare See the platform manual in detail.
Quad Position & Revolution Counter (Up/Down Counter)	16-bit position counter with Position & Revolution Counter See the platform manual in detail.
Multi-functional Serial (MFS)	UART mode CSIO (SPI) mode LIN mode I2C mode CTS/RTS is not supported (hardware flow control is not supported for this series.) 2 ports of MFS only support I2C. 2 ports of MFS only support I2C. Not all pins support I2C. Only pins which have the I2C I/O characteristics support it. See the datasheet for details. WUCR function is not supported for this product.

Feature	Description
CAN-FD	ISO11898-1 (CAN specification Rev. 2.0 part A, B) CAN FD protocol specification 1.0 supported (Flexible data rate)16KB/channel of message RAM is available. The clock output from CAN pre-scaler is supplied to every CAN. ECC error generation function of the message RAM is not supported for this device. Therefore CAN FD ECC Error Insertion Control Register (FDSECR) is not writeable. See the platform manual in detail
Real Time Clock (RTC) with Auto-calibration	Provides real-time in hours, minutes, and second counter Possible source clocks are Main oscillator Sub oscillator, Slow RC oscillator See the platform manual in detail.
DDR High Speed SPI	Supports Legacy, Quad mode and Octal mode (Dual quad, Dual legacy) Allows the use of up to 8 Serial Flash Memories HSSPI channel 0: HSSPI as a MCU peripheral HSSPI channel 1: HSSPI on graphic subsystem See the platform manual in detail
HyperBus I/F	The Hyperbus I/Fs are located in the Graphic subsystem. Achieves maximum 333MB/s data throughput by 8 bits bus and few timing signals only - Supports double data rate interface - Supports two slave devices - Supports XiP operation by dynamic wrapped burst request ch.0: HyperBus as a MCU peripheral ch.1: HyperBus on graphic subsystem ch.2: HyperBus on graphic subsystem (not available on all devices) The following register is not supported and cannot be used. - Controller Status Register (HYPERBUSIn_CSR) - Interrupt Status Register (HYPERBUSIn_ISR) - Write Protection Register (HYPERBUSIn_WPR) - Test Register (HYPERBUSIn_TEST) GPO signal can only be used for "Internal Control example by GPO" in this product, that is, it can select using HyperBus of PF or using HyperBus of Graphic Sub System. See the "HyperBus Interface Port Configuration" of S6J3200 hardware manual in detail.
Stepper Motor Control (SMC)	Motor rotation is controlled by a combination of the PWM pulse generators and selector logic circuits. The synchronization mechanism enables synchronous operation of two PWM pulse generators. Each channel has 4 motor drivers with high output capability
External Interrupt Capture Unit (EICU)	Supports capture of events amongst 32 external interrupt pins. Sample frequency range of 500 Hz to 16 MHz provided by 6-bit linearly programmable prescaler. See the platform manual in detail.
Ethernet AVB	10/100 Mbps MII/RMII-Interface Supports Audio-Video Bridging (AVB)
MediaLB	MOST25 (512FS) 3 wires Supports 16 logical channels.
SHE	Provides AES-128 encryption and decryption operations Supports secure booting Secure key storage implemented in the WorkFLASH, using 16KB of its space. Unique read-only Identification item (UID) Supports generation of Cipher-based Message Authentication Code (CMAC) Random number generation function Data interface for direct access to microcontroller memory locations Implements FIFO-based data transfer Implements clock gating to reduce power consumption External debugger notification See the platform manual in detail.
Source Clock Timer	16-bit up-counter with 16 prescaler configurations 4-bit control to the 16 prescaler combination to divide the input clock by /20 or /21 or .../215 Supports 2 timer operation modes: single-shot and continuous Support for reconfigurable stabilization time by changing compare value during source stabilization time Debug support Support for interrupt generation during normal timer operation See the platform manual in detail.

Feature	Description
Graphics Subsystem	Variable setting about GDC clock. (Asynchronous with CPU clock) 2.5D drawing engine Order replacement of RGB pins.CPU can direct access to VRAM. Programmable panel timing controller with RGB888 and RSDS support.

Note:

- *The description of the preliminary documentation will be changed without any notification.*

2.1. Ethernet

The following functions are not supported.

Functions	Remark
External FIFO Interface	
Additional Low Latency TX FIFO Interface for DMA configurations	
MAC Transmit Block - half-duplex - collision - back_pressure	
MAC Filtering Block - external address match - Wakeup On Lan	
Energy Efficient Ethernet support	
LPI Operation in Cadence IP	
PHY Interface - GMII - SGMII - TBI - -RMII (on S6J32H series)	
10/100/1000 Operation - 1000 M	
SGMII Operation	
Jumbo Frames	
Physical Control Sub-Layer	

2.2. RAM Guarantee

For the following reset factors Ram Guarantee is not supported

Reset Category	Reset Factor	Operation after Reset is Released				
		Waiting for Stabilization	Mode Evaluation	Security Evaluation	Operation Clock	RAM Guarantee
Hardware Reset	Extended internal power supply low-voltage detection reset	FLASH 1.2V external power supply control	Yes	Yes	Fast CR	No
	RSTX pin input reset External power supply low-voltage detection reset	N/A	Yes	Yes	Fast CR	No

3. Note

3.1. Status Flag Clear

Note that the hardware operation of a write access to a register which has status flags may be later than program operations of software. The delay results from the fact that the write accesses and their signals are operated through multiple buses.

For example, when a software program intends to return from interrupt software routine (ISR) after clearing the interrupt flag, the return instruction may practically be executed before the completion of the write access as for hardware operation. That is, the CPU execution may immediately jump to the ISR again after returning from the ISR because the flag is not cleared.

To avoid such a phenomenon, the execution of Data Memory Barrier (DMB) instruction between the write access and the return instruction is recommended for the program. The return instruction is never executed before the completion of DMB execution.

It should be considered that the method takes a number of execution cycles and that it may cause some influence to application performance. For example, one time of the DMB execution is enough after a number of continuous flag clear operations.

3.2. Error Response

Error response is generated when access occurs to the following register and bit offset.

Function	Register	Bit Offset	Access	Error Type
12/10/8-BIT ANALOG TO DIGITAL CONVERTER	ADC12Bn_CHSTAT0 to 63	Whole register	Write(B,H,W)	Bus error
	ADC12Bn_CD0 to 63	Whole register	Write(B,H,W)	Bus error
	ADC12Bn_CDONEIRQ0 to 1	Whole register	Write(B,H,W)	Bus error
	ADC12Bn_GRPIRQ0 to 1	Whole register	Write(B,H,W)	Bus error
	ADC12Bn_RCIRQ0 to 1	Whole register	Write(B,H,W)	Bus error
	ADC12Bn_PCIRQ0 to 1	Whole register	Write(B,H,W)	Bus error
	ADC12Bn_TRGST0 to 1	Whole register	Write(B,H,W)	Bus error
	ADC12Bn_RCOTF0 to 1	Whole register	Write(B,H,W)	Bus error
	ADC12Bn_TRGOR0 to 1	Whole register	Write(B,H,W)	Bus error
	ADC12Bn_MCSTAT0 to 3	Whole register	Write(B,H,W)	Bus error
	(Other reserved area)	(Other reserved area)	Read / Write(B,H,W)	Bus error
Stepper Motor Controller	SMCi_PWSS	bit [7:0] Reserved	Write(B)	Bus error
	SMCi_PTRGDL	bit [15:8] Reserved	Write(B)	Bus error
Trigger configuration of Stepper motor controller	SMCTGg_PTRG	bit [15:8] Reserved	Write(B)	Bus error
INTER IC SOUND (I2S)	I2Sn_RXFDAT0 to 15	Whole register	Write(B,H,W)	Bus error
	I2Sn_OPRREG	bit [15:8] Reserved	Write(B)	Bus error
	I2Sn_SRST	bit [31:8] Reserved	Write(B,H)	Bus error
	I2Sn_STATUS	bit [15:0]	Write(B,H,W)	Bus error
	I2Sn_DMAACT	bit [31:24] Reserved bit [15:8] Reserved	Write(B)	Bus error
	I2Sn_DEBUG	bit [31:8] Reserved	Write(B,H)	Bus error
	I2Sn_MIDREG	Whole register	Write(B,H,W)	Bus error
MEDIA LOCAL BUS INTERFACE (Media LB)	MLBn_DCCR	bit [15:8] Reserved	Write(B)	Bus error
	MLBn_SSCR	bit [31:8] Reserved	Write(B,H)	Bus error
	MLBn_SDCR	Whole register	Write(B,H,W)	Bus error
	MLBn_SMCR	bit [31:8] Reserved	Write(B,H)	Bus error
	MLBn_VCCR	Whole register	Write(B,H,W)	Bus error
	MLBn_CICR	Whole register	Write(B,H,W)	Bus error

Function	Register	Bit Offset	Access	Error Type
	MLBn_CSCR0-15	bit [31:24]	Write(B)	Bus error
	MLBn_CCBCR0-15	Whole register	Write(B,H,W)	Bus error
	MLBn_MID	Whole register	Write(B,H,W)	Bus error

3.3. Register Initial Value

The table shows initial value of Register bit which is uniquely specified for the product series.

Register	Bit	Initial Value	Description
SYSC0_RUNREGCFGR	RVSEL	0	0 should be written. Prohibit setting 1.
SYSC0_STSREGCFGR	RVSEL	0	-
SYSC0_APPREGCFGR	RVSEL	0	-
SYSC0_APPLVDCFGR	LVDL1S	0	-
SYSC0_APPLVDCFGR	LVDL1V	10	-
SYSC0_APPLVDCFGR	LVDL1E	1	-
SYSC0_APPLVDCFGR	LVDL2S	0	-
SYSC0_APPLVDCFGR	LVDL2V	00	-
SYSC0_APPLVDCFGR	LVDL2E	1	-
SYSC0_APPLVDCFGR	LVDH1S	0	-
SYSC0_APPLVDCFGR	LVDH1V	0110	-
SYSC0_APPLVDCFGR	LVDH1E	1	-
SYSC0_APPLVDCFGR	LVDH2S	0	-
SYSC0_APPLVDCFGR	LVDH2V	0000	-
SYSC0_APPLVDCFGR	LVDH2E	0	-
SYSC0_STSLVDCFGR	LVDL1R	1	-
SYSC0_STSLVDCFGR	LVDL1S	0	-
SYSC0_STSLVDCFGR	LVDL1V	10	-
SYSC0_STSLVDCFGR	LVDL1E	1	-
SYSC0_STSLVDCFGR	LVDL2R	1	-
SYSC0_STSLVDCFGR	LVDL2S	0	-
SYSC0_STSLVDCFGR	LVDL2V	00	-
SYSC0_STSLVDCFGR	LVDL2E	1	-
SYSC0_STSLVDCFGR	LVDH1R	1	-
SYSC0_STSLVDCFGR	LVDH1S	0	-
SYSC0_STSLVDCFGR	LVDH1V	0110	-
SYSC0_STSLVDCFGR	LVDH1E	1	-
SYSC0_STSLVDCFGR	LVDH2R	0	-
SYSC0_STSLVDCFGR	LVDH2S	0	-
SYSC0_STSLVDCFGR	LVDH2V	0000	-
SYSC0_STSLVDCFGR	LVDH2E	0	-
SYSC0_PSSREGCFGR	RVSEL	0	0 should be written. Prohibit setting 1.
SYSC0_PSSLVDCFGR	LVDL1S	0	1 should be written only if LVDL1V is changed from initial value.
SYSC0_PSSLVDCFGR	LVDL1V	10	Greater than 0x0 should be written.
SYSC0_PSSLVDCFGR	LVDL1E	1	-
SYSC0_PSSLVDCFGR	LVDL2S	0	1 should be written only if LVDL2V is changed from initial value.
SYSC0_PSSLVDCFGR	LVDL2V	00	Greater than 0x0 should be written.
SYSC0_PSSLVDCFGR	LVDL2E	1	-
SYSC0_PSSLVDCFGR	LVDH1S	0	1 should be written only if LVDH1V is changed from initial value.

Register	Bit	Initial Value	Description
SYSC0_PSSLVDCFGR	LVDH1V	0110	-
SYSC0_PSSLVDCFGR	LVDH1E	1	-
SYSC0_PSSLVDCFGR	LVDH2S	0	1 should be written. Prohibit setting 0.
SYSC0_PSSLVDCFGR	LVDH2V	0000	Less than or equal to 0x2 should be written.
SYSC0_PSSLVDCFGR	LVDH2E	0	-
SYSC0_RUNLVDCFGR	LVDL1S	0	1 should be written only if LVDL1V is changed from initial value.
SYSC0_RUNLVDCFGR	LVDL1V	10	Greater than 0x0 should be written.
SYSC0_RUNLVDCFGR	LVDL1E	1	-
SYSC0_RUNLVDCFGR	LVDL2S	0	1 should be written only if LVDL2V is changed from initial value.
SYSC0_RUNLVDCFGR	LVDL2V	00	Greater than 0x0 should be written.
SYSC0_RUNLVDCFGR	LVDL2E	1	-
SYSC0_RUNLVDCFGR	LVDH1S	0	1 should be written only if LVDH1V is changed from initial value.
SYSC0_RUNLVDCFGR	LVDH1V	0110	-
SYSC0_RUNLVDCFGR	LVDH1E	1	-
SYSC0_RUNLVDCFGR	LVDH2S	0	1 should be written. Prohibit setting 0.
SYSC0_RUNLVDCFGR	LVDH2V	0000	Less than or equal to 0x2 should be written.
SYSC0_RUNLVDCFGR	LVDH2E	0	-
SYSC0_SPESPSWCFGR0	-	0x00070000	Writing doesn't affect anything.
SYSC0_SPESPSWCFGR1	-	0x77000000	Writing doesn't affect anything.
SYSC0_SPEWPSWCFGR0	-	0x00070000	Writing doesn't affect anything.
SYSC0_SPEWPSWCFGR1	-	0x77000000	Writing doesn't affect anything.

Notes:

- SYSC0_SPESPSWCFGR0 and 1, and SYSC0_SPEWPSWCFGR0 and 2 are not software configurable registers but hardware specific registers for the system.

3.4. Restriction

Function	Related Register and Configuration	Restriction	Remark
DDRHSSPI	DDRHSSPI Peripheral Communication Configuration Registers (DDRHSSPIIn_PCC0-3)	SS2CD[1:0] = 00 cannot be used. Configure delay as 01, 10, or 11.	
Power domain	SYSC0_RUNPDCFGR.PD5_xEN SYSC0_PLLPDCFGR.PD5_xEN SYSC0_APPPDCFGR.PD5_xEN SYSC0_STSPDCFGR.PD5_xEN	Configure them as same as PD2 registers because PD5 is a sub power domain of PD2.	As for PD3 related registers, they are specified as (R1, WX).

CHAPTER 4: Block Diagram



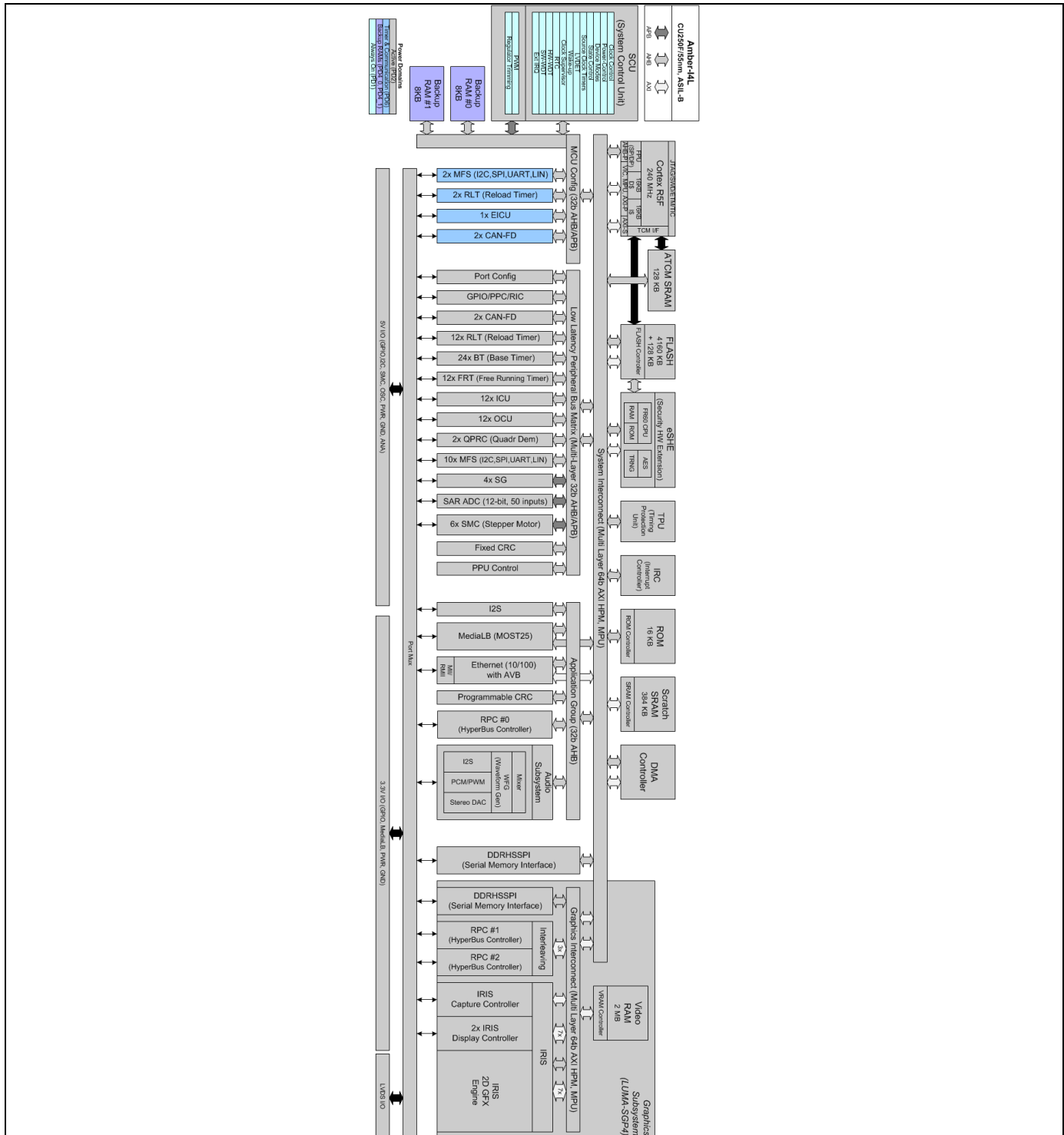
This chapter explains the block diagram.

1. Block Diagram
2. Note

CODE: BLOCK_DIAGRAM-S6J3200-E1

1. Block Diagram

Figure 1-1 Block diagram



2. Note

No description.

CHAPTER 5: Clock Configuration



This chapter explains the clock configuration.

1. Overview
2. Operation
3. Remark

CODE: CLOCK_SYSTEM-S6J3200-E1

1. Overview

This chapter describes clock selection and configuration of each function.

See the chapter of the clock system before referring this chapter.

2. Operation

The source clock of each function should be selected as following table.

Table 2-1

Function	Clock Name	Source Clock System	Configuration
CPU	CLK_CPU	SSCG0/PLL0	See Traveo Platform hardware manual
FLASH	CLK_FCLK	SSCG0/PLL0	See Traveo Platform hardware manual
HPM	CLK_HPM	SSCG0/PLL0	See Traveo Platform hardware manual
DMA	CLK_DMA	SSCG0/PLL0	See Traveo Platform hardware manual
LLPBM	CLK_LLPCM2	SSCG0/PLL0	See Traveo Platform hardware manual
MCU configuration	CLK_SYSC0H CLK_COMH CLK_RAM0H CLK_RAM1H	SSCG0/PLL0	See Traveo Platform hardware manual
DDR HSSPI MCU DDR HSSPI GDC	CLK_HSSPI	SSCG1	See Traveo Platform hardware manual
Graphics Core (Graphic)	CLK_CD3A0	SSCG2	See Traveo Platform hardware manual
Hyper FLASH	CLK_CD1	SSCG3	See Traveo Platform hardware manual
CAN	CLK_CAN	PLL0	See Traveo Platform hardware manual
Display clock FPD-Link	CLK_CD2A0	PLL1	See Traveo Platform hardware manual
CoreSight	CLK_TRC	PLL1	See Traveo Platform hardware manual
I2S0	CLK_CD4	PLL2	See Traveo Platform hardware manual
Audio DAC	CLK_CD4	PLL2	See Traveo Platform hardware manual. It is described as "CLKDACI" in the chapter or Audio DAC.
	CLK_CD5B0	PLL3	See Traveo Platform hardware manual. It is described as "CLKPI" in the chapter or Audio DAC.
PCM-PWM	CLK_CD4	PLL2	See Traveo Platform hardware manual
Sound waveform generator	CLK_CD5 CLK_CD5A0 CLK_CD5B0	PLL3	See Traveo Platform hardware manual
Sound mixer	CLK_CD5 CLK_CD5A0 CLK_CD5B0	PLL3	See Traveo Platform hardware manual
Ethernet Media-LB	CLK_HAPP1B0	SSCG0/PLL0	See Traveo Platform hardware manual
Registers of Indicator PWM	CLK_SYSC0P	SSCG0/PLL0	See Traveo Platform hardware manual
Hardware watchdog timer	CLK_HWWDT	Internal CR oscillator (High frequency)	See Traveo Platform hardware manual
Software watchdog timer	CLK_SWWDT	Internal CR oscillator (High frequency)	See Traveo Platform hardware manual
Hardware watchdog timer	CLK_HWWDT	Internal CR oscillator (Low frequency)	See Traveo Platform hardware manual
Software watchdog timer	CLK_SWWDT	Internal CR oscillator (Low frequency)	See Traveo Platform hardware manual
External interrupt capture unit	CLK_EICU	Main clock	See Traveo Platform hardware manual
Real time clock	CLK_RTC	Main clock	See Traveo Platform hardware manual
Real time clock	CLK_RTC	Sub clock	See Traveo Platform hardware manual

Note:

- The frequency of PLLout (output of PLL/SSCG PLL multiplier circuit) should be 800MHz or less.
- The frequency of CLK_CPU should be 232MHz or less if its source clock is SSCG.

The relation between source clock and local clock in product-specific functions is as follows.

Table 2-2: Source Clock - Local Clock List

Source Clock System	Clock Name	Function	Local clock name	Description
External input clock	External input clock	Ethernet MAC	TX_CLK	-
External input clock	External input clock	Ethernet MAC	RX_CLK	-
External input clock	External input clock	Inter IC Sound (I2S)	SCK	-
External input clock	External input clock	Inter IC Sound (I2S)	ECLK	-
External input clock	External input clock	Media Local Bus Interface (MediaLB)	MLBn_CLK	-
Main clock	Main clock	Indicator PWM	Main clock	-
PLL0 or SSCG0	CLK_LCP1A	12/10/8-BIT Analog to Digital Converter	No Define	-
PLL0 or SSCG0	CLK_LCP1A	Trigger Configuration of Stepper Motor Controller	No Define	-
PLL0 or SSCG0	CLK_LCP0A	Sound Generator	BCLK	-
PLL0 or SSCG0	CLK_LCP1A	Stepper Motor Controller	CLKP	-
PLL1	CLK_CD2A0	Graphics Subsystem	No Define	Display clock
PLL1	CLK_CD2A0	FPD-LINK Converter	dsp0_clock_output	-
PLL1	CLK_CD2A0	FPD-LINK Converter	dsp1_clock_output	-
PLL2	CLK_CD4	Inter IC Sound (I2S)	ECLK	-
PLL2	CLK_CD4	PCMPWM	PWM_CLK	-
PLL2	CLK_CD4	Stereo Audio DAC	CLKDACI	-
PLL3	CLK_CD5B0	Inter IC Sound (I2S)	No Define	-
PLL3	CLK_CD5B0	PCMPWM	No Define	-
PLL3	CLK_CD5	Sound Mixer	No Define	Waveform Generator and Sound Mixer bus interface clock
PLL3	CLK_CD5A0	Sound Mixer	No Define	Waveform Generator and Sound Mixer operation clock
PLL3	CLK_CD5	Sound Waveform Generator	No Define	Waveform Generator and Sound Mixer bus interface clock
PLL3	CLK_CD5A0	Sound Waveform Generator	No Define	Waveform Generator and Sound Mixer operation clock
PLL3	CLK_CD5B0	Stereo Audio DAC	CLKPI	-
SSCG0	CLK_HAPP1B0	Ethernet MAC	No Define	-
SSCG0	CLK_HAPP1B0	Hyperbus Interface (MCU)	No Define	Operation Clock for Control register
SSCG0	CLK_HPM	Hyperbus Interface (MCU)	No Define	Operation Clock for Main controller
SSCG0	CLK_SYSC0P	Indicator PWM	No Define	-
SSCG0	CLK_HAPP1B0	Media Local Bus Interface (MediaLB)	No Define	-
SSCG0	CLK_HAPP1B0	Memory Protection Unit for AHB	No Define	-
SSCG0	CLK_HAPP1B0	Memory Protection Unit for AHB	No Define	-
SSCG0	CLK_HAPP1B0	Memory Protection Unit for AXI	No Define	-
SSCG0	CLK_HAPP1B0	Memory Protection Unit for AXI	No Define	-
SSCG0	CLK_HAPP1B0	Programmable CRC	No Define	-
SSCG0	CLK_LCP0	FPD-LINK Converter	iPCLK	-
SSCG1	CLK_HSSPI	Graphics Subsystem	iHCLK	-
SSCG2	CLK_CD3A0	Graphics Subsystem	No Define	Graphics Core

Source Clock System	Clock Name	Function	Local clock name	Description
SSCG2	CLK_CD3A0	Hyperbus Interface (GDC)	No Define	Operation Clock for Control register
SSCG2	CLK_CD3A0	Hyperbus Interface (GDC)	No Define	Operation Clock for Main controller
SSCG3	CLK_CD1	Hyperbus Interface (MCU)	No Define	External Clock for HyperBus memory interface
SSCG3	CLK_CD1	Hyperbus Interface (GDC)	No Define	External Clock for HyperBus memory interface

Notes:

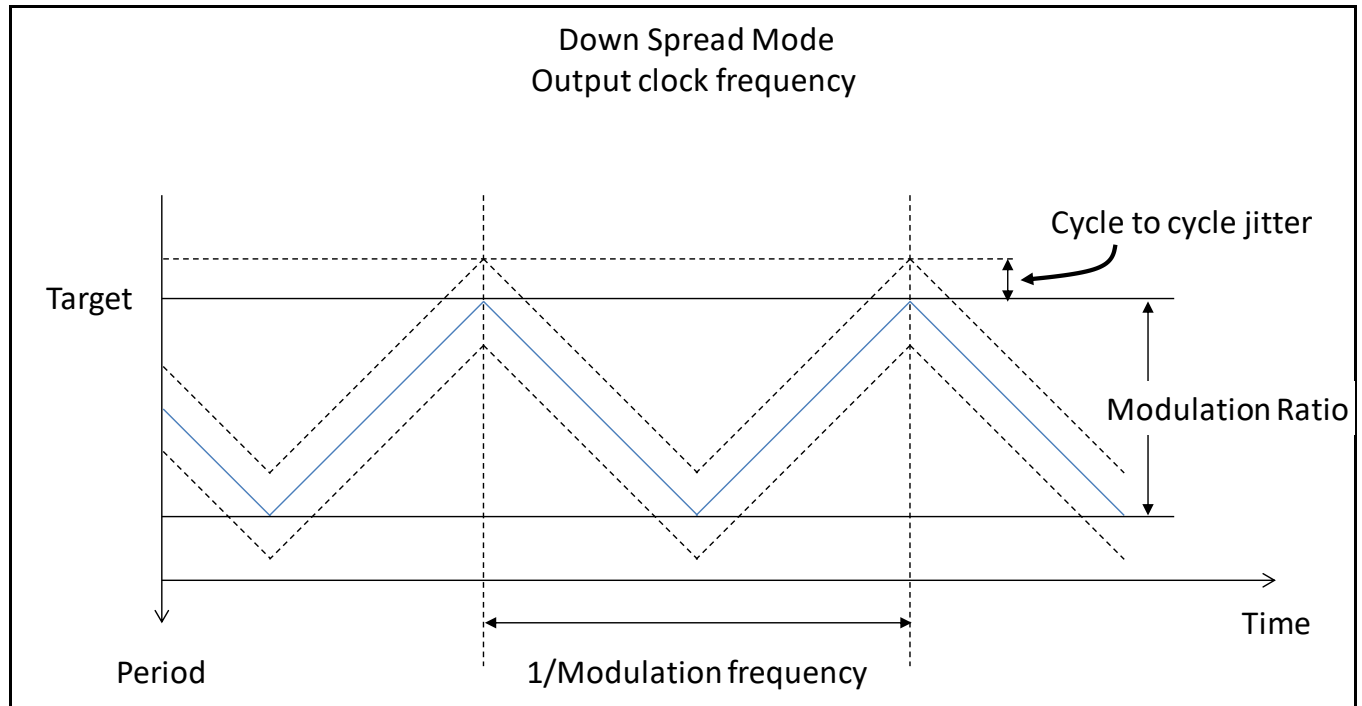
- The configuration of the maximum clock frequency above should satisfy the values specified in Datasheet.
- The frequency of CLK_CD5 and CLK_CD5A0 should satisfy the following conditions.
 - CLK_CD5 = 240MHz or 120MHz.
 - CLK_CD5A0 = 120MHz.
- Read/Write access from CPU or DMA may bring about dead-lock when the clock source is not supplied to the accessed clock domain because "handshake" for AXI transaction cannot be done. If you want to quit a clock generation for some clock domain, you also need to configure an access protection for the domain using MPU.

2.1. Spread Spectrum Clock Generator (SSCG)

Target frequency of SSCG should be referred in Datasheet.

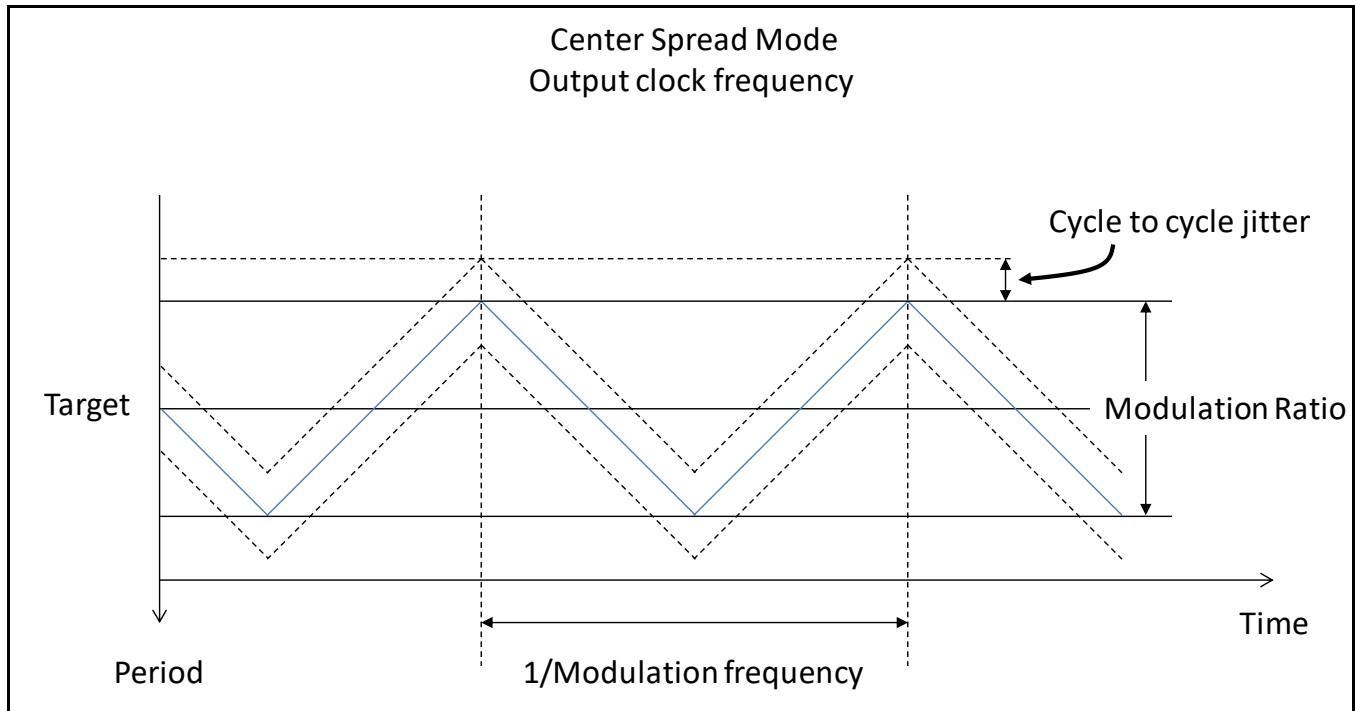
■ Down Spread Mode

Figure 2-1: Down Spread Mode



■ Center Spread Mode

Figure 2-2: Center Spread Mode



3. Remark

See the chapter of clock system before referring this chapter.

Note

- *If you want to know a combination of a peripheral function and its source clock, you need to see the group name from the table of base address map on this manual at first.*
- *The group name and its clock source are described in PLATFORM OVERVIEW Configuration. See Traveo Platform hardware manual.*
- *Clock frequency can be seen in datasheet of S6J3200 series.*

CHAPTER 6: Operation Mode



This chapter explains operation mode.

1. Overview
2. Configuration
3. Registers

CODE: MODE-S6J3200-E1

1. Overview

This section gives a description of operation mode.

The mode controller determines the operation mode of MCU. It supports,

- User mode
- Serial programming mode (with synchronous communication)
- Serial programming mode (with asynchronous communication)
- JTAG boundary scan mode

2. Configuration

Operation Mode	PORT		
	MODE	P225(SOT0)	P227(SIN0)
User Mode	1	-	-
Serial Programming Mode (Sync)	0	1	0
Serial Programming Mode (Async)	0	1	1
JTAG Boundary Scan Mode	0	0	0

Notes:

- User mode can be applied to Software debugging using JTAG interface with ICE.
- As for serial programming, see the chapter of SERIAL PROGRAMMING on this manual.

3. Registers

See Traveo Platform hardware manual.

CHAPTER 7: Memory and Base Address Map



This chapter explains the memory map and the base address map of registers.

1. Memory Map
2. Base Address Map
3. Note

CODE: MEMORYMAP-S6J3200-E1

1. Memory Map

Memory area of not-implemented function is not supported. See the chapter of function list.

Start Address	End Address	Group	Part
0000_0000		Internal area for CR5 Complex	TCRAM 8MB@Max
	007F_FFFF		Reserved
0080_0000			TCFLASH 8MB@Max
	00FF_FFFF		Reserved
0100_0000			AXI_FLASH 16MB@Max
	01FF_FFFF		
0200_0000		Shared Flash and memory area	System RAM 8MB@Max
	027F_FFFF		Reserved
0280_0000	0280_0FFF		Exclusive Access Memory
0280_1000	03FF_FFFF		Reserved
0400_0000	05FF_FFFF		AXI_SLAVE_CORE0
0600_0000	07FF_FFFF		Reserved
0800_0000	09FF_FFFF		Reserved
0A00_0000	0BFF_FFFF		Reserved
0C00_0000	0DFF_FFFF		Reserved
0E00_0000			Work_FLASH 3M@Max
	0E7F_FFFF		Reserved
0E80_0000	0E80_1FFF		BACKUP_RAM 8K (Backup RAM power supply domain:PD4_0)
0E80_2000	0E80_3FFF		BACKUP_RAM 8K (Backup RAM power supply domain:PD4_1)
0E80_4000	0EFF_FFFF		Reserved
0F00_0000	0FFF_FFFF		Reserved
1000_0000	1FFF_FFFF	Reserved	Reserved
2000_0000	2FFF_FFFF		
3000_0000	3FFF_FFFF		
4000_0000	4FFF_FFFF	Graphic subsystem (AppS #8)	Memory for DDRHSSPI/Hyper Bus ch.1/ch.2
5000_0000	501F_FFFF		2MB VRAM
5020_0000	5020_03FF		2D Graphics Core Subsystem control
5020_0400	5021_0BFF		2D Graphics core(Blit,Drawing,Capture,Display,CmdSeq)
5021_0C00	5021_0FFF		MPU_AXI(Capture Controller)
5021_1000	5021_13FF		MPU_AXI(Blit Engine)
5021_1400	5021_17FF		MPU_AXI(Drawing Engine)
5021_1800	5021_1FFF		Reserved
5021_2000	5021_23FF		DDRHSSPI configuration
5021_2400	5021_3FFF		Reserved
5021_4000	5021_43FF		Reserved
5021_4400	5021_47FF		AXI Interconnect(Error Monitor)

Start Address	End Address	Group	Part
5021_4800	5021_4FFF	Graphic subsystem (AppS #8)	Reserved
5021_5000	5021_53FF		Reserved
5021_5400	5021_57FF		Reserved
5021_5800	5021_5BFF		Reserved
5021_5C00	5027_FFFF		Reserved
5028_0000	5028_0FFF		Hyper Bus ch.1 Control Register
5028_1000	5028_1FFF		Hyper Bus ch.2 Control Register
5028_2000	502F_FFFF		Reserved
5030_0000	5030_FFFF		Reserved
5031_0000	503F_FFFF		Reserved
5040_0000	504F_FFFF		High Performance Bus Matrix
5050_0000	50FF_FFFF		Reserved
5100_0000	5FFF_FFFF		Hyper Bus external memory ch.1/ch.2 (alternative to 4000_0000~4FFF_FFFF)
6000_0000	7FFF_FFFF	Reserved	Reserved
8000_0000	8FFF_FFFF	HSSPI0_MEMORY	DDRHSSPI for CPU area
9000_0000	9FFF_FFFF	HSSPI1_MEMORY(Apps#11)	Memory for Hyper Bus ch.0
A000_0000	AFFF_FFFF	Reserved	Reserved
B000_0000	B7FF_FFFF	Peri area	Peri area
B800_0000	B802_87FF	Apps#3	Expansion area
B802_8800	BFFF_FFFF	Reserved	Reserved
C000_0000	FFFF_FFFF	Reserved	Reserved
F000_0000	FFFE_DFFF	BootROM/ERRCFG area	Reserved
FFFE_E000	FFFE_EFFF		ERRCFG
FFFE_F000	FFFE_FFFF		
FFFF_0000	FFFF_FFFF		BootROM

Notes:

- HSSPI1_MEMORY (Apps#11) is used for memory area for both DDR-HSSPI and Hyper Bus mounted on graphic subsystem.
- The sector configuration and end address of FLASH and RAM are described in the chapter of TCRAM, TCFLASH, and WorkFLASH of Traveo platform hardware manual.

2. Base Address Map

An address of a certain register can be specified as below.

- Base address
Look for the base address X of the function from the base address map below.
- Offset address
Look for the offset address Y of the register from the offset address list which is described in the chapter of the function. Each function chapter has offset address list or its information.
- Specify
The register address can be specified as X + Y.

Note:

- Address area of not-implemented function is not supported. See the chapter of function list.

Table 2-1: Base Address Map

Start Address	End Address	Group	Function	PPU_No
B000_0000	B00F_FFFF	Reserved	Reserved / AppS area for LLPP-AXI32 (1MB)	-
B010_0000	B010_03FF	Reserved	Reserved	-
B010_0400	B010_0FFF	Reserved	Reserved	-
B010_1000	B010_13FF	EMEM GROUP(reg)	DDR_HSSPI	1
B010_1400	B010_7FFF	Reserved	Reserved	-
B010_8000	B010_80FF	System SRAM	SystemSRAM registers	2
B010_8100	B01F_FFFF	Reserved	Reserved	-
B020_0000	B02F_FFFF	Reserved	Reserved	-
B030_0000	B030_7FFF	SYSC1	System Controller #1	4
B030_8000	B03F_FFFF	SYSC1	SWDT	5
B040_0000	B040_7FFF	MEM Config GROUP	IRC0	21
B040_8000	B040_FFFF	MEM Config GROUP	TPU0	19
B041_0000	B041_0FFF	MEM Config GROUP	TCRAM Control Status Register	16
B041_1000	B041_1FFF	MEM Config GROUP	TCFlash Control Status Register	17
B041_2000	B04F_20FF	MEM Config GROUP	Wflash Control Status Register	18
B041_2100	B04F_FFFF	Reserved	Reserved	-
B050_0000	B050_0FFF	DEBUG GROUP	DAP ROM table	-
B050_1000	B050_1FFF	DEBUG GROUP	ETB	-
B050_2000	B050_2FFF	DEBUG GROUP	CTI#4	-
B050_3000	B050_3FFF	DEBUG GROUP	TPIU	-
B050_4000	B057_FFFF	DEBUG GROUP	TRACE FUNNEL	-
B058_0000	B058_FFFF	DEBUG GROUP	CR5_RomTable	-
B059_0000	B059_1FFF	DEBUG GROUP	CORE0	-
B059_2000	B059_7FFF	Reserved	Reserved	-
B059_8000	B059_8FFF	DEBUG GROUP	CTI#0	-
B059_9000	B059_BFFF	Reserved	Reserved	-
B059_C000	B059_CFFF	DEBUG GROUP	ETM0	-
B059_D000	B05B_FFFF	Reserved	Reserved	-
B05C_0000		DEBUG GROUP	Security Checker	-
	B05F_FFFF	Reserved	Reserved	-
B060_0000	B060_007F	MCU_CONFIG_GROUP	Protection register area	51

Start Address	End Address	Group	Function	PPU_No
B060_0080	B060_00FF	MCU_CONFIG_GROUP	RUN profile register area	51
B060_0100	B060_017F	MCU_CONFIG_GROUP	PSS profile register area	51
B060_0180	B060_01FF	MCU_CONFIG_GROUP	APP profile register area	51
B060_0200	B060_027F	MCU_CONFIG_GROUP	STS profile register area	51
B060_0280	B060_02FF	MCU_CONFIG_GROUP	System register area	51
B060_0300	B060_037F	MCU_CONFIG_GROUP	CSV	51
B060_0380	B060_03FF	MCU_CONFIG_GROUP	RESET	51
B060_0400	B060_047F	MCU_CONFIG_GROUP	SCT(Fast CR)	34
B060_0480	B060_04FF	MCU_CONFIG_GROUP	SCT(Slow CR)	33
B060_0500	B060_057F	MCU_CONFIG_GROUP	SCT(Main clock)	35
B060_0600	B060_067F	MCU_CONFIG_GROUP	Clock System	51
B060_0680	B060_06FF	MCU_CONFIG_GROUP	Special register area	51
B060_0700	B060_07FF	MCU_CONFIG_GROUP	Debug register area	51
B060_0800	B060_BFFF	MCU_CONFIG_GROUP	MODEC	55
B060_C000	B060_FFFF	MCU_CONFIG_GROUP	HWDT	52
B061_0000	B061_7FFF	Reserved	Reserved	-
B061_8000	B061_FFFF	MCU_CONFIG_GROUP	RTC	32
B062_0000	B063_FFFF	MCU_CONFIG_GROUP	Ext-IRQ	53
B064_0000	B064_0FFF	MCU_CONFIG_GROUP	PWM	303
B064_1000	B064_1FFF	Reserved	Reserved	-
B064_2000	B064_2FFF	Reserved	Reserved	-
B064_3000	B065_FFFF	Reserved	Reserved	-
B066_0000	B067_FFFF	Reserved	Reserved	-
B068_0000	B068_7FFF	MCU_CONFIG_GROUP	BackupRam CSR	50
B068_8000	B068_83FF	MCU_CONFIG_GROUP	EICU	37
B068_8400	B068_87FF	MCU_CONFIG_GROUP	CR_CALIBRATION	38
B068_8800	B068_8BFF	MCU_CONFIG_GROUP	MCG_IRS	42
B068_8C00	B068_FFFF	MCU_CONFIG_GROUP	CAN_PRESCALER	43
B069_0000	B069_03FF	MCU_CONFIG_GROUP	ReloadTimer ch.48	39
B069_0400	B069_07FF	MCU_CONFIG_GROUP	ReloadTimer ch.49	40
B069_0800	B06A_7FFF	Reserved	Reserved	-
B06A_8000	B06A_83FF	MCU_CONFIG_GROUP	M.F.Serial ch.16	44
B06A_8400	B06A_87FF	MCU_CONFIG_GROUP	M.F.Serial ch.17	45
B06A_8800	B06B_FFFF	Reserved	reserved	-
B06C_0000	B06C_FFFF	MCU_CONFIG_GROUP	CAN_FD ch.5	47
B06D_0000	B06D_FFFF	MCU_CONFIG_GROUP	CAN_FD ch.6	48
B06E_0000	B06F_FFFF	Reserved	reserved	-
B070_0000	B07F_FFFF	Reserved	Reserved (1MB)	-
B080_0000	B0FF_FFFF	Bit RMW alias	Bit RMW alias for MCU Config (Covers B060_0000 -- B06F_FFFF)	-
B100_0000	B10F_FFFF	Bit RMW alias	Bit RMW alias for SYSC1 (Covers B030_0000 -- B031_FFFF)	-
B110_0000	B11F_FFFF	Bit RMW alias	Bit RMW alias for MEMC (Covers B040_0000 -- B041_FFFF)	-
B120_0000	B1FF_FFFF	Reserved	Reserved (14MB)	-
B200_0000	B20F_FFFF	SHE_CONFIG	SHE configuration registers (1MB)	63

Start Address	End Address	Group	Function	PPU_No
B210_0000	B3FF_FFFF	Reserved	Reserved / AppS area for LLPP-AXI32 (31MB)	-
B400_0000	B46F_FFFF	Reserved	Reserved (7MB)	-
B470_0000	B470_3FFF	Common PERI #2	DMAC #0 registers	64
B470_4000	B470_7FFF	Reserved	Reserved	-
B470_8000	B470_FFFF	Reserved	Reserved	-
B471_0000	B471_0FFF	Common PERI #2	MPU for DMAC#0	66
B471_1000	B471_1FFF	Reserved	Reserved	-
B471_2000	B471_3FFF	Reserved	Reserved	-
B471_4000	B471_4FFF	Common PERI #2	DMA Complex #0 registers (Additional registers, RLTs)	68
B471_5000	B471_5FFF	Reserved	Reserved	-
B471_6000	B471_7FFF	Reserved	Reserved	-
B471_8000	B471_83FF	Common PERI #2	CRC#0	70
B471_8400	B471_87FF	Common PERI #2	CRC#1	71
B471_8800	B471_8BFF	Common PERI #2	CRC#2	72
B471_8C00	B471_8FFF	Common PERI #2	CRC#3	73
B471_9000	B473_7FFF	Reserved	Reserved	-
B473_8000	B473_FFFF	Common PERI #2	GPIO	74
B474_0000	B474_7FFF	Common PERI #2	PPC	75
B474_8000	B474_FFFF	Common PERI #2	RIC	76
B475_0000	B475_7FFF	Common PERI #2	PPU	77
B475_8000	B478_7FFF	Reserved	Reserved	-
B478_8000	B478_83FF	Common PERI #2	Reload Timer ch.32	160
B478_8400	B478_87FF	Common PERI #2	Reload Timer ch.33	161
B478_8800	B478_8BFF	Common PERI #2	Reload Timer ch.34	162
B478_8C00	B478_8FFF	Common PERI #2	Reload Timer ch.35	163
B478_9000	B478_FBFF	Reserved	Reserved	-
B478_FC00	B478_FFFF	Common PERI #2	Reload Timer Simultaneous Soft Start for ch.32/33/34/35	82
B479_0000	B479_03FF	Reserved	Reserved	-
B479_0400	B47F_FFFF	Reserved	Reserved	-
B480_0000	B480_03FF	Common PERI #0	M.F.Serial ch.0	176
B480_0400	B480_07FF	Common PERI #0	M.F.Serial ch.1	177
B480_0800	B480_0BFF	Common PERI #0	M.F.Serial ch.2	178
B480_0C00	B480_0FFF	Common PERI #0	M.F.Serial ch.3	179
B480_1000	B480_13FF	Common PERI #0	M.F.Serial ch.4	180
B480_1400	B480_7FFF	Reserved	Reserved	-
B480_8000	B480_83FF	Common PERI #0	BaseTimer ch.0	88
B480_8400	B480_87FF	Common PERI #0	BaseTimer ch.1	89
B480_8800	B480_8BFF	Common PERI #0	BaseTimer ch.2	90
B480_8C00	B480_8FFF	Common PERI #0	BaseTimer ch.3	91
B480_9000	B480_93FF	Common PERI #0	BaseTimer ch.4	92
B480_9400	B480_97FF	Common PERI #0	BaseTimer ch.5	93
B480_9800	B480_9BFF	Common PERI #0	BaseTimer ch.6	94
B480_9C00	B480_9FFF	Common PERI #0	BaseTimer ch.7	95

Start Address	End Address	Group	Function	PPU_No
B480_A000	B480_A3FF	Common PERI #0	BaseTimer ch.8	96
B480_A400	B480_A7FF	Common PERI #0	BaseTimer ch.9	97
B480_A800	B480_ABFF	Common PERI #0	BaseTimer ch.10	98
B480_AC00	B480_AFFF	Common PERI #0	BaseTimer ch.11	99
B480_B000	B480_FFFF	Reserved	Reserved	-
B481_0000	B481_03FF	Common PERI #0	Reload Timer ch.0	128
B481_0400	B481_07FF	Common PERI #0	Reload Timer ch.1	129
B481_0800	B481_0BFF	Common PERI #0	Reload Timer ch.2	130
B481_0C00	B481_0FFF	Common PERI #0	Reload Timer ch.3	131
B481_1000	B481_7FFF	Reserved	Reserved	-
B481_8000	B481_FFFF	Reserved	Reserved	-
B482_0000	B482_03FF	Common PERI #0	FRT ch.0	208
B482_0400	B482_07FF	Common PERI #0	FRT ch.1	209
B482_0800	B482_0BFF	Common PERI #0	FRT ch.2	210
B482_0C00	B482_0FFF	Common PERI #0	FRT ch.3	211
B482_1000	B482_13FF	Common PERI #0	FRT ch.4	212
B482_1400	B482_17FF	Common PERI #0	FRT ch.5	213
B482_1800	B482_1BFF	Common PERI #0	FRT ch.6	214
B482_1C00	B482_1FFF	Common PERI #0	FRT ch.7	215
B482_2000	B482_7FFF	Reserved	Reserved	-
B482_8000	B482_83FF	Common PERI #0	Input Capture 0	224
B482_8400	B482_87FF	Common PERI #0	Input Capture 1	225
B482_8800	B482_8BFF	Common PERI #0	Input Capture 2	226
B482_8C00	B482_8FFF	Common PERI #0	Input Capture 3	227
B482_9000	B482_93FF	Common PERI #0	Input Capture 4	228
B482_9400	B482_97FF	Common PERI #0	Input Capture 5	229
B482_9800	B482_9BFF	Common PERI #0	Input Capture 6	230
B482_9C00	B482_9FFF	Common PERI #0	Input Capture 7	231
B482_A000	B482_FFFF	Reserved	Reserved	-
B483_0000	B483_03FF	Common PERI #0	Output Compare 0	240
B483_0400	B483_07FF	Common PERI #0	Output Compare 1	241
B483_0800	B483_0BFF	Common PERI #0	Output Compare 2	242
B483_0C00	B483_0FFF	Common PERI #0	Output Compare 3	243
B483_1000	B483_13FF	Common PERI #0	Output Compare 4	244
B483_1400	B483_17FF	Common PERI #0	Output Compare 5	245
B483_1800	B483_1BFF	Common PERI #0	Output Compare 6	246
B483_1C00	B483_1FFF	Common PERI #0	Output Compare 7	247
B483_2000	B483_FBFF	Reserved	Reserved	-
B483_FC00	B483_FFFF	Common PERI #0	Reload Timer Simultaneous Soft Start for ch.0/1/2/3	80
B484_0000	B484_03FF	Common PERI #0	SG ch.0	266
B484_0400	B484_07FF	Common PERI #0	SG ch.1	267
B484_0800	B484_0BFF	Common PERI #0	SG ch.2	268
B484_0C00	B484_0FFF	Common PERI #0	SG ch.3	269

Start Address	End Address	Group	Function	PPU_No
B484_1000	B484_FFFF	Reserved	Reserved APPS#5 area (PSEL x 64 ; 1KB per one PSEL)	-
B485_0000	B485_03FF	Common PERI #0	FPDLINK_CONV	264
B485_0400	B485_07FF	Reserved	Reserved	-
B486_0800	B487_FFFF	Reserved	Reserved	-
B488_0000	B488_03FF	Common PERI #1	M.F.Serial ch.8	184
B488_0400	B488_07FF	Common PERI #1	M.F.Serial ch.9	185
B488_0800	B488_0BFF	Common PERI #1	M.F.Serial ch.10	186
B488_0C00	B488_0FFF	Common PERI #1	M.F.Serial ch.11	187
B488_1000	B488_13FF	Common PERI #1	M.F.Serial ch.12	188
B488_1400	B488_7FFF	Reserved	Reserved	-
B488_8000	B488_83FF	Common PERI #1	BaseTimer ch.12	100
B488_8400	B488_87FF	Common PERI #1	BaseTimer ch.13	101
B488_8800	B488_8BFF	Common PERI #1	BaseTimer ch.14	102
B488_8C00	B488_8FFF	Common PERI #1	BaseTimer ch.15	103
B488_9000	B488_93FF	Common PERI #1	BaseTimer ch.16	104
B488_9400	B488_97FF	Common PERI #1	BaseTimer ch.17	105
B488_9800	B488_9BFF	Common PERI #1	BaseTimer ch.18	106
B488_9C00	B488_9FFF	Common PERI #1	BaseTimer ch.19	107
B488_A000	B488_A3FF	Common PERI #1	BaseTimer ch.20	108
B488_A400	B488_A7FF	Common PERI #1	BaseTimer ch.21	109
B488_A800	B488_ABFF	Common PERI #1	BaseTimer ch.22	110
B488_AC00	B488_AFFF	Common PERI #1	BaseTimer ch.23	111
B488_B000	B488_FFFF	Reserved	Reserved	-
B489_0000	B489_03FF	Common PERI #1	Reload Timer ch.16	144
B489_0400	B489_07FF	Common PERI #1	Reload Timer ch.17	145
B489_0800	B489_0BFF	Common PERI #1	Reload Timer ch.18	146
B489_0C00	B489_0FFF	Common PERI #1	Reload Timer ch.19	147
B489_1000	B489_7FFF	Reserved	Reserved	-
B489_8000	B489_83FF	Common PERI #1	QPRC ch.8	200
B489_8400	B489_87FF	Common PERI #1	QPRC ch.9	201
B489_8800	B489_FFFF	Reserved	Reserved	-
B48A_0000	B48A_03FF	Common PERI #1	FRT ch.8	216
B48A_0400	B48A_07FF	Common PERI #1	FRT ch.9	217
B48A_0800	B48A_0BFF	Common PERI #1	FRT ch.10	218
B48A_0C00	B48A_0FFF	Common PERI #1	FRT ch.11	219
B48A_1000	B48A_7FFF	Reserved	Reserved	-
B48A_8000	B48A_83FF	Common PERI #1	Input Capture 8	232
B48A_8400	B48A_87FF	Common PERI #1	Input Capture 9	233
B48A_8800	B48A_8BFF	Common PERI #1	Input Capture 10	234
B48A_8C00	B48A_8FFF	Common PERI #1	Input Capture 11	235
B48A_9000	B48A_FFFF	Reserved	Reserved	-
B48B_0000	B48B_03FF	Common PERI #1	Output Compare 8	248
B48B_0400	B48B_07FF	Common PERI #1	Output Compare 9	249

Start Address	End Address	Group	Function	PPU_No
B48B_0800	B48B_0BFF	Common PERI #1	Output Compare 10	250
B48B_0C00	B48B_0FFF	Common PERI #1	Output Compare 11	251
B48B_1000	B48B_FBFf	Reserved	Reserved	-
B48B_FC00	B48B_FFFF	Common PERI #1	Reload Timer Simultaneous Soft Start for ch.16/17/18/19	81
B48C_0000	B48C_03FF	Common PERI #1	ADC12B	270
B48C_0400	B48C_3FFF	Reserved	Reserved	-
B48C_4000	B48C_43FF	Common PERI #1	SMC ch.0	286
B48C_4400	B48C_47FF	Common PERI #1	SMC ch.1	287
B48C_4800	B48C_4BFF	Common PERI #1	SMC ch.2	288
B48C_4C00	B48C_4FFF	Common PERI #1	SMC ch.3	289
B48C_5000	B48C_53FF	Common PERI #1	SMC ch.4	290
B48C_5400	B48C_57FF	Common PERI #1	SMC ch.5	291
B48C_5800	B48C_5BFF	Common PERI #1	SMC_Trg_Reg	292
B48C_5C00	B48C_5FFF	Reserved	Reserved	-
B48C_6000	B48C_FFFF	Reserved	Reserved APPS#7 area (PSEL x 64 ; 1KB per one PSEL)	-
B48D_0000	B48D_FFFF	Reserved	Reserved APPS#6 area (PSEL x 64 ; 1KB per one PSEL)	-
B48E_0000	B48F_FFFF	Reserved	Reserved	-
B490_0000	B490_FFFF	Common Peri#0	CAN_FD ch.0	256
B491_0000	B491_FFFF	Common Peri#0	CAN_FD ch.1	257
B492_0000	B497_FFFF	Reserved	Reserved	-
B498_0000	B4BF_FFFF	Reserved	Reserved	-
B4C0_0000	B4FF_FFFF	Bit RMW alias	Bit RMW alias for CommonPERI#0 (Covers B490_0000 -- B497_FFFF)	-
B500_0000	B5FF_FFFF	AppS #0	AppS #0 (16MB)	-
B600_0000	B6FF_FFFF	AppS #1	AppS #1 (16MB)	-
B700_0000	B77F_FFFF	Bit RMW alias	Bit RMW alias for CommonPERI#2 (Covers B470_0000 -- B47F_FFFF)	-
B780_0000	B7BF_FFFF	Bit RMW alias	Bit RMW alias for CommonPERI#0 (Covers B480_0000 -- B487_FFFF)	-
B7C0_0000	B7FF_FFFF	Bit RMW alias	Bit RMW alias for CommonPERI#1 (Covers B488_0000 -- B48F_FFFF)	-
B800_0000	B800_07FF	Apps#3	ETHERNET	299
B800_0800	B800_0BFF	Apps#3	MPU_AXI	300
B800_0C00	B800_7FFF	Reserved	Reserved	-
B800_8000	B800_83FF	Apps#3	MLB	294
B800_8400	B800_87FF	Apps#3	MPU_AHB	295
B800_8800	B801_7FFF	Reserved	Reserved	-
B801_8000	B801_83FF	Apps#3	PRGCRC	296
B801_8400	B801_87FF	Reserved	Reserved	-
B801_8800	B801_FFFF	Reserved	Reserved	-
B802_0000	B802_03FF	Apps#3	SMIX (Sound System)	301
B802_0400	B802_07FF	Apps#3	Audio DAC (Sound System)	301
B802_0800	B802_0BFF	Apps#3	PCM-PWM (Sound System)	301
B802_0C00	B802_0FFF	Apps#3	I2S0 (Sound System)	301
B802_1000	B802_13FF	Apps#3	I2S1	298

Start Address	End Address	Group	Function	PPU_No
B802_1400	B802_7FFF	Reserved	Reserved	-
B802_8000	B802_83FF	Apps#3	Wave Form Generator (Sound System)	297
B802_8400	B802_87FF	Apps#3	Hyper Bus ch.0 Control Register	302
B802_8800	B802_FFFF	Reserved	Reserved	-
B803_0000	B803_03FF	Reserved	Reserved	-
B803_0400	BFFF_FFFF	Reserved	Reserved	-
C000_0000	FFFE_DFFF	Reserved	Reserved	-
FFFE_E000	FFFE_E3FF	ERRCFG	IRC0	-
FFFE_E400	FFFE_F7FF	Reserved	Reserved	-
FFFE_F800	FFFE_FBFF	ERRCFG	IRC Mirror	-
FFFE_FC00	FFFF_FFFF	BootROM	BootROM I/F	20

Notes:

- Note channel numbering rule that the channel number of function resource in MCU_CONFIG_GROUP should start from the maximum number + 1 assigned to the same name resource in Common PERI. For example, Traveo Platform has CAN0, 1, 2, 3, and 4 in Common PERI GROUP. On the other hand, this product series optionally has CAN 0 and 1 in Common PERI GROUP, and uniquely has enhanced CAN5 and 6 in MCU_CONFIG_GROUP.
- PPU number 301 is same for SMIX, Audio-DAC, PCM-PWM, and I2S0.

3. Note

When MPU attribute of Cortex-R5F is configured as "Normal", store buffer inside Cortex-R5F can operate and write data can be merged. To avoid influence of this data merger, MPU attribute "Device" or "Strongly Ordered" should be used.

MPU attribute "Device" or "Strongly Ordered" must be used for areas below, to avoid this influence.

- Backup RAM area (BACKUP_RAM) [0E80_0000 to 0E87_FFFF]
- Peripheral area (Peri area) [B000_0000 to B7FF_FFFF]
- Error Config area (ERRCFG) [FFFE_E000 to FFFE_FFFF]
- AppS area [B800_0000 to BFFF_FFFF]
- Register area in SUBSYSTEM [5020_0000 to 50FF_FFFF]

MPU attribute "Device" or "Strongly Ordered" is required for accesses to areas below, in particular situation.

- FLASH Memory (when writing commands)

CHAPTER 8: IRQ and NMI Map



This chapter explains IRQ and NMI map.

1. IRQ Map
2. NMI Map

CODE: IRQMAP-S6J3200-E1

1. IRQ Map

This section shows list of interrupt vector.

This list shows the assignment of interrupt vectors/interrupt control registers.

Vector of not-implemented function is not supported. See the chapter of function list.

IRQ No.	Detail	IRQ Priority Register	Vector Address Register
0	Reserved	-	-
1	System Control Status	IRC0_IRQPL0 : IRQPL1	IRC0_IRQVA1
2	HW-WDT Pre-warning	IRC0_IRQPL0 : IRQPL2	IRC0_IRQVA2
3	SW-WDT Pre-warning	IRC0_IRQPL0 : IRQPL3	IRC0_IRQVA3
4 to 7	Reserved	-	-
8	Single Bit Error	IRC0_IRQPL2 : IRQPL8	IRC0_IRQVA8
9	Reserved	-	-
10	Work FLASH Hang up	IRC0_IRQPL2 : IRQPL10	IRC0_IRQVA10
11 to 13	Reserved	-	-
14	System RAM Single Bit Error	IRC0_IRQPL3 : IRQPL14	IRC0_IRQVA14
15	Backup RAM / CAN FD RAM(ch.0,1,5,6) Single Bit Error	IRC0_IRQPL3 : IRQPL15	IRC0_IRQVA15
16	IRC Vector Address RAM Single Bit Error	IRC0_IRQPL4 : IRQPL16	IRC0_IRQVA16
17 to 19	Reserved	-	-
20	Work FLASH RDY, Write Enable Release, Single Bit Error	IRC0_IRQPL5 : IRQPL20	IRC0_IRQVA20
21 to 22	Reserved	-	-
23	EICU	IRC0_IRQPL5 : IRQPL23	IRC0_IRQVA23
24	External Interrupt Request ch.0	IRC0_IRQPL6 : IRQPL24	IRC0_IRQVA24
25	External Interrupt Request ch.1	IRC0_IRQPL6 : IRQPL25	IRC0_IRQVA25
26	External Interrupt Request ch.2	IRC0_IRQPL6 : IRQPL26	IRC0_IRQVA26
27	External Interrupt Request ch.3	IRC0_IRQPL6 : IRQPL27	IRC0_IRQVA27
28	External Interrupt Request ch.4	IRC0_IRQPL7 : IRQPL28	IRC0_IRQVA28
29	External Interrupt Request ch.5	IRC0_IRQPL7 : IRQPL29	IRC0_IRQVA29
30	External Interrupt Request ch.6	IRC0_IRQPL7 : IRQPL30	IRC0_IRQVA30
31	External Interrupt Request ch.7	IRC0_IRQPL7 : IRQPL31	IRC0_IRQVA31
32	External Interrupt Request ch.8	IRC0_IRQPL8 : IRQPL32	IRC0_IRQVA32
33	External Interrupt Request ch.9	IRC0_IRQPL8 : IRQPL33	IRC0_IRQVA33
34	External Interrupt Request ch.10	IRC0_IRQPL8 : IRQPL34	IRC0_IRQVA34
35	External Interrupt Request ch.11	IRC0_IRQPL8 : IRQPL35	IRC0_IRQVA35
36	External Interrupt Request ch.12	IRC0_IRQPL9 : IRQPL36	IRC0_IRQVA36
37	External Interrupt Request ch.13	IRC0_IRQPL9 : IRQPL37	IRC0_IRQVA37
38	External Interrupt Request ch.14	IRC0_IRQPL9 : IRQPL38	IRC0_IRQVA38
39	External Interrupt Request ch.15	IRC0_IRQPL9 : IRQPL39	IRC0_IRQVA39
40	MFS RX ch.16	IRC0_IRQPL10 : IRQPL40	IRC0_IRQVA40
41	MFS TX ch.16	IRC0_IRQPL10 : IRQPL41	IRC0_IRQVA41
42	MFS RX ch.17	IRC0_IRQPL10 : IRQPL42	IRC0_IRQVA42
43	MFS TX ch.17	IRC0_IRQPL10 : IRQPL43	IRC0_IRQVA43
44 to 45	Reserved	-	-
46	Reload Timer ch.48,49 OR-ed	IRC0_IRQPL11 : IRQPL46	IRC0_IRQVA46

IRQ No.	Detail	IRQ Priority Register	Vector Address Register
47	Reserved	-	-
48	CAN FD ch.5	IRC0_IRQPL12 : IRQPL48	IRC0_IRQVA48
49	CAN FD ch.6	IRC0_IRQPL12 : IRQPL49	IRC0_IRQVA49
50 to 55	Reserved	-	-
56	CAN FD ch.0	IRC0_IRQPL14 : IRQPL56	IRC0_IRQVA56
57	CAN FD ch.1	IRC0_IRQPL14 : IRQPL57	IRC0_IRQVA57
58 to 63	Reserved	-	-
64	MFS RX ch.0	IRC0_IRQPL16 : IRQPL64	IRC0_IRQVA64
65	MFS TX ch.0	IRC0_IRQPL16 : IRQPL65	IRC0_IRQVA65
66	MFS RX ch.1	IRC0_IRQPL16 : IRQPL66	IRC0_IRQVA66
67	MFS TX ch.1	IRC0_IRQPL16 : IRQPL67	IRC0_IRQVA67
68	MFS RX ch.2	IRC0_IRQPL17 : IRQPL68	IRC0_IRQVA68
69	MFS TX ch.2	IRC0_IRQPL17 : IRQPL69	IRC0_IRQVA69
70	MFS RX ch.3	IRC0_IRQPL17 : IRQPL70	IRC0_IRQVA70
71	MFS TX ch.3	IRC0_IRQPL17 : IRQPL71	IRC0_IRQVA71
72	MFS RX ch.4	IRC0_IRQPL18 : IRQPL72	IRC0_IRQVA72
73	MFS TX ch.4	IRC0_IRQPL18 : IRQPL73	IRC0_IRQVA73
74 to 79	Reserved	-	-
80	MFS RX ch.8	IRC0_IRQPL20 : IRQPL80	IRC0_IRQVA80
81	MFS TX ch.8	IRC0_IRQPL20 : IRQPL81	IRC0_IRQVA81
82	MFS RX ch.9	IRC0_IRQPL20 : IRQPL82	IRC0_IRQVA82
83	MFS TX ch.9	IRC0_IRQPL20 : IRQPL83	IRC0_IRQVA83
84	MFS RX ch.10	IRC0_IRQPL21 : IRQPL84	IRC0_IRQVA84
85	MFS TX ch.10	IRC0_IRQPL21 : IRQPL85	IRC0_IRQVA85
86	MFS RX ch.11	IRC0_IRQPL21 : IRQPL86	IRC0_IRQVA86
87	MFS TX ch.11	IRC0_IRQPL21 : IRQPL87	IRC0_IRQVA87
88	MFS RX ch.12	IRC0_IRQPL22 : IRQPL88	IRC0_IRQVA88
89	MFS TX ch.12	IRC0_IRQPL22 : IRQPL89	IRC0_IRQVA89
90 to 99	Reserved	-	-
100	SHE Error	IRC0_IRQPL25 : IRQPL100	IRC0_IRQVA100
101	SHE	IRC0_IRQPL25 : IRQPL101	IRC0_IRQVA101
102	DDR HSSPI RX	IRC0_IRQPL25 : IRQPL102	IRC0_IRQVA102
103	DDR HSSPI TX	IRC0_IRQPL25 : IRQPL103	IRC0_IRQVA103
104 to 109	Reserved	-	-
110	TCRAM	IRC0_IRQPL27 : IRQPL110	IRC0_IRQVA110
111	Reserved	-	-
112	BACKUP RAM	IRC0_IRQPL28 : IRQPL112	IRC0_IRQVA112
113 to 115	Reserved	-	-
116	RTC	IRC0_IRQPL29 : IRQPL116	IRC0_IRQVA116
117	CR CARIBRATION	IRC0_IRQPL29 : IRQPL117	IRC0_IRQVA117
118 to 127	Reserved	-	-
128	Base Timer ch.0/8/9/10/11	IRC0_IRQPL32 : IRQPL128	IRC0_IRQVA128
129	Base Timer ch.1	IRC0_IRQPL32 : IRQPL129	IRC0_IRQVA129

IRQ No.	Detail	IRQ Priority Register	Vector Address Register
130	Base Timer ch.2	IRC0_IRQPL32 : IRQPL130	IRC0_IRQVA130
131	Base Timer ch.3	IRC0_IRQPL32 : IRQPL131	IRC0_IRQVA131
132	Base Timer ch.4	IRC0_IRQPL33 : IRQPL132	IRC0_IRQVA132
133	Base Timer ch.5	IRC0_IRQPL33 : IRQPL133	IRC0_IRQVA133
134	Base Timer ch.6	IRC0_IRQPL33 : IRQPL134	IRC0_IRQVA134
135	Base Timer ch.7	IRC0_IRQPL33 : IRQPL135	IRC0_IRQVA135
136	Base Timer ch.12/20/21/22/23	IRC0_IRQPL34 : IRQPL136	IRC0_IRQVA136
137	Base Timer ch.13	IRC0_IRQPL34 : IRQPL137	IRC0_IRQVA137
138	Base Timer ch.14	IRC0_IRQPL34 : IRQPL138	IRC0_IRQVA138
139	Base Timer ch.15	IRC0_IRQPL34 : IRQPL139	IRC0_IRQVA139
140	Base Timer ch.16	IRC0_IRQPL35 : IRQPL140	IRC0_IRQVA140
141	Base Timer ch.17	IRC0_IRQPL35 : IRQPL141	IRC0_IRQVA141
142	Base Timer ch.18	IRC0_IRQPL35 : IRQPL142	IRC0_IRQVA142
143	Base Timer ch.19	IRC0_IRQPL35 : IRQPL143	IRC0_IRQVA143
144 to 151	Reserved	-	-
152	Reload Timer ch.0	IRC0_IRQPL38 : IRQPL152	IRC0_IRQVA152
153	Reload Timer ch.1	IRC0_IRQPL38 : IRQPL153	IRC0_IRQVA153
154	Reload Timer ch.2	IRC0_IRQPL38 : IRQPL154	IRC0_IRQVA154
155	Reload Timer ch.3	IRC0_IRQPL38 : IRQPL155	IRC0_IRQVA155
156 to 159	Reserved	-	-
160	Reload Timer ch.16	IRC0_IRQPL40 : IRQPL160	IRC0_IRQVA160
161	Reload Timer ch.17	IRC0_IRQPL40 : IRQPL161	IRC0_IRQVA161
162	Reload Timer ch.18	IRC0_IRQPL40 : IRQPL162	IRC0_IRQVA162
163	Reload Timer ch.19	IRC0_IRQPL40 : IRQPL163	IRC0_IRQVA163
164 to 167	Reserved	-	-
168	Reload Timer ch.32	IRC0_IRQPL42 : IRQPL168	IRC0_IRQVA168
169	Reload Timer ch.33	IRC0_IRQPL42 : IRQPL169	IRC0_IRQVA169
170	Reload Timer ch.34	IRC0_IRQPL42 : IRQPL170	IRC0_IRQVA170
171	Reload Timer ch.35	IRC0_IRQPL42 : IRQPL171	IRC0_IRQVA171
172 to 175	Reserved	-	-
176	FRT ch.0	IRC0_IRQPL44 : IRQPL176	IRC0_IRQVA176
177	FRT ch.1	IRC0_IRQPL44 : IRQPL177	IRC0_IRQVA177
178	FRT ch.2	IRC0_IRQPL44 : IRQPL178	IRC0_IRQVA178
179	FRT ch.3	IRC0_IRQPL44 : IRQPL179	IRC0_IRQVA179
180	FRT ch.4	IRC0_IRQPL45 : IRQPL180	IRC0_IRQVA180
181	FRT ch.5	IRC0_IRQPL45 : IRQPL181	IRC0_IRQVA181
182	FRT ch.6	IRC0_IRQPL45 : IRQPL182	IRC0_IRQVA182
183	FRT ch.7	IRC0_IRQPL45 : IRQPL183	IRC0_IRQVA183
184	FRT ch.8	IRC0_IRQPL46 : IRQPL184	IRC0_IRQVA184
185	FRT ch.9	IRC0_IRQPL46 : IRQPL185	IRC0_IRQVA185
186	FRT ch.10	IRC0_IRQPL46 : IRQPL186	IRC0_IRQVA186

IRQ No.	Detail	IRQ Priority Register	Vector Address Register
187	FRT ch.11	IRC0_IRQPL46 : IRQPL187	IRC0_IRQVA187
188 to 191	Reserved	-	-
192	IRQ0 of Input Capture 0	IRC0_IRQPL48 : IRQPL192	IRC0_IRQVA192
193	IRQ0 of Input Capture 1	IRC0_IRQPL48 : IRQPL193	IRC0_IRQVA193
194	IRQ0 of Input Capture 2	IRC0_IRQPL48 : IRQPL194	IRC0_IRQVA194
195	IRQ0 of Input Capture 3	IRC0_IRQPL48 : IRQPL195	IRC0_IRQVA195
196	IRQ0 of Input Capture 4	IRC0_IRQPL49 : IRQPL196	IRC0_IRQVA196
197	IRQ0 of Input Capture 5	IRC0_IRQPL49 : IRQPL197	IRC0_IRQVA197
198	IRQ0 of Input Capture 6	IRC0_IRQPL49 : IRQPL198	IRC0_IRQVA198
199	IRQ0 of Input Capture 7	IRC0_IRQPL49 : IRQPL199	IRC0_IRQVA199
200	IRQ0 of Input Capture 8	IRC0_IRQPL50 : IRQPL200	IRC0_IRQVA200
201	IRQ0 of Input Capture 9	IRC0_IRQPL50 : IRQPL201	IRC0_IRQVA201
202	IRQ0 of Input Capture 10	IRC0_IRQPL50 : IRQPL202	IRC0_IRQVA202
203	IRQ0 of Input Capture 11	IRC0_IRQPL50 : IRQPL203	IRC0_IRQVA203
204 to 207	Reserved	-	-
208	IRQ0 of Output Compare 0	IRC0_IRQPL52 : IRQPL208	IRC0_IRQVA208
209	IRQ0 of Output Compare 1	IRC0_IRQPL52 : IRQPL209	IRC0_IRQVA209
210	IRQ0 of Output Compare 2	IRC0_IRQPL52 : IRQPL210	IRC0_IRQVA210
211	IRQ0 of Output Compare 3	IRC0_IRQPL52 : IRQPL211	IRC0_IRQVA211
212	IRQ0 of Output Compare 4	IRC0_IRQPL53 : IRQPL212	IRC0_IRQVA212
213	IRQ0 of Output Compare 5	IRC0_IRQPL53 : IRQPL213	IRC0_IRQVA213
214	IRQ0 of Output Compare 6	IRC0_IRQPL53 : IRQPL214	IRC0_IRQVA214
215	IRQ0 of Output Compare 7	IRC0_IRQPL53 : IRQPL215	IRC0_IRQVA215
216	IRQ0 of Output Compare 8	IRC0_IRQPL54 : IRQPL216	IRC0_IRQVA216
217	IRQ0 of Output Compare 9	IRC0_IRQPL54 : IRQPL217	IRC0_IRQVA217
218	IRQ0 of Output Compare 10	IRC0_IRQPL54 : IRQPL218	IRC0_IRQVA218
219	IRQ0 of Output Compare 11	IRC0_IRQPL54 : IRQPL219	IRC0_IRQVA219
220 to 231	Reserved	-	-
232	QPRC ch.8	IRC0_IRQPL58 : IRQPL232	IRC0_IRQVA232
233	QPRC ch.9	IRC0_IRQPL58 : IRQPL233	IRC0_IRQVA233
234 to 239	Reserved	-	-
240	IRQ1 of Input Capture 0	IRC0_IRQPL60 : IRQPL240	IRC0_IRQVA240
241	IRQ1 of Input Capture 1	IRC0_IRQPL60 : IRQPL241	IRC0_IRQVA241
242	IRQ1 of Input Capture 2	IRC0_IRQPL60 : IRQPL242	IRC0_IRQVA242
243	IRQ1 of Input Capture 3	IRC0_IRQPL60 : IRQPL243	IRC0_IRQVA243
244	IRQ1 of Input Capture 4	IRC0_IRQPL61 : IRQPL244	IRC0_IRQVA244
245	IRQ1 of Input Capture 5	IRC0_IRQPL61 : IRQPL245	IRC0_IRQVA245
246	IRQ1 of Input Capture 6	IRC0_IRQPL61 : IRQPL246	IRC0_IRQVA246
247	IRQ1 of Input Capture 7	IRC0_IRQPL61 : IRQPL247	IRC0_IRQVA247
248	IRQ1 of Input Capture 8	IRC0_IRQPL62 : IRQPL248	IRC0_IRQVA248
249	IRQ1 of Input Capture 9	IRC0_IRQPL62 : IRQPL249	IRC0_IRQVA249

IRQ No.	Detail	IRQ Priority Register	Vector Address Register
250	IRQ1 of Input Capture 10	IRC0_IRQPL62 : IRQPL250	IRC0_IRQVA250
251	IRQ1 of Input Capture 11	IRC0_IRQPL62 : IRQPL251	IRC0_IRQVA251
252 to 255	Reserved	-	-
256	IRQ1 of Output Compare 0	IRC0_IRQPL64 : IRQPL256	IRC0_IRQVA256
257	IRQ1 of Output Compare 1	IRC0_IRQPL64 : IRQPL257	IRC0_IRQVA257
258	IRQ1 of Output Compare 2	IRC0_IRQPL64 : IRQPL258	IRC0_IRQVA258
259	IRQ1 of Output Compare 3	IRC0_IRQPL64 : IRQPL259	IRC0_IRQVA259
260	IRQ1 of Output Compare 4	IRC0_IRQPL65 : IRQPL260	IRC0_IRQVA260
261	IRQ1 of Output Compare 5	IRC0_IRQPL65 : IRQPL261	IRC0_IRQVA261
262	IRQ1 of Output Compare 6	IRC0_IRQPL65 : IRQPL262	IRC0_IRQVA262
263	IRQ1 of Output Compare 7	IRC0_IRQPL65 : IRQPL263	IRC0_IRQVA263
264	IRQ1 of Output Compare 8	IRC0_IRQPL66 : IRQPL264	IRC0_IRQVA264
265	IRQ1 of Output Compare 9	IRC0_IRQPL66 : IRQPL265	IRC0_IRQVA265
266	IRQ1 of Output Compare 10	IRC0_IRQPL66 : IRQPL266	IRC0_IRQVA266
267	IRQ1 of Output Compare 11	IRC0_IRQPL66 : IRQPL267	IRC0_IRQVA267
268 to 271	Reserved	-	-
272	DMA Error	IRC0_IRQPL68 : IRQPL272	IRC0_IRQVA272
273	DMAC Completion ch.0	IRC0_IRQPL68 : IRQPL273	IRC0_IRQVA273
274	DMAC Completion ch.1	IRC0_IRQPL68 : IRQPL274	IRC0_IRQVA274
275	DMAC Completion ch.2	IRC0_IRQPL68 : IRQPL275	IRC0_IRQVA275
276	DMAC Completion ch.3	IRC0_IRQPL69 : IRQPL276	IRC0_IRQVA276
277	DMAC Completion ch.4	IRC0_IRQPL69 : IRQPL277	IRC0_IRQVA277
278	DMAC Completion ch.5	IRC0_IRQPL69 : IRQPL278	IRC0_IRQVA278
279	DMAC Completion ch.6	IRC0_IRQPL69 : IRQPL279	IRC0_IRQVA279
280	DMAC Completion ch.7	IRC0_IRQPL70 : IRQPL280	IRC0_IRQVA280
281	Reserved	-	-
282	DMAC RLT(ch.0,1,2,3 OR-ed)	IRC0_IRQPL70 : IRQPL282	IRC0_IRQVA282
283 to 284	Reserved	-	-
285	DMAC Completion ch.8	IRC0_IRQPL71 : IRQPL285	IRC0_IRQVA285
286	DMAC Completion ch.9	IRC0_IRQPL71 : IRQPL286	IRC0_IRQVA286
287	DMAC Completion ch.10	IRC0_IRQPL71 : IRQPL287	IRC0_IRQVA287
288	DMAC Completion ch.11	IRC0_IRQPL72 : IRQPL288	IRC0_IRQVA288
289	DMAC Completion ch.12	IRC0_IRQPL72 : IRQPL289	IRC0_IRQVA289
290	DMAC Completion ch.13	IRC0_IRQPL72 : IRQPL290	IRC0_IRQVA290
291	DMAC Completion ch.14	IRC0_IRQPL72 : IRQPL291	IRC0_IRQVA291
292	DMAC Completion ch.15	IRC0_IRQPL73 : IRQPL292	IRC0_IRQVA292
293 to 307	Reserved	-	-
308	SCT CR IRQ	IRC0_IRQPL77 : IRQPL308	IRC0_IRQVA308
309	SCT SRC IRQ	IRC0_IRQPL77 : IRQPL309	IRC0_IRQVA309
310	SCT Main OSC IRQ	IRC0_IRQPL77 : IRQPL310	IRC0_IRQVA310
311	SCT Sub OSC IRQ	IRC0_IRQPL77 : IRQPL311	IRC0_IRQVA311

IRQ No.	Detail	IRQ Priority Register	Vector Address Register
312	CR5 Performance Monitor Unit IRQ	IRC0_IRQPL78 : IRQPL312	IRC0_IRQVA312
313 to 319	Reserved	-	-
320	MFS ch.0 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL80 : IRQPL320	IRC0_IRQVA320
321	MFS ch.1 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL80 : IRQPL321	IRC0_IRQVA321
322	MFS ch.2 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL80 : IRQPL322	IRC0_IRQVA322
323	MFS ch.3 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL80 : IRQPL323	IRC0_IRQVA323
324	MFS ch.4 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL81 : IRQPL324	IRC0_IRQVA324
325 to 327	Reserved	-	-
328	MFS ch.8 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL82 : IRQPL328	IRC0_IRQVA328
329	MFS ch.9 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL82 : IRQPL329	IRC0_IRQVA329
330	MFS ch.10 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL82 : IRQPL330	IRC0_IRQVA330
331	MFS ch.11 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL82 : IRQPL331	IRC0_IRQVA331
332	MFS ch.12 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL83 : IRQPL332	IRC0_IRQVA332
333 to 335	Reserved	-	-
336	MFS ch.16 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL84 : IRQPL336	IRC0_IRQVA336
337	MFS ch.17 Error (Tx/Rx error, Status OR-ed)	IRC0_IRQPL84 : IRQPL337	IRC0_IRQVA337
	Reserved	-	-
339	SMC ch.0	IRC0_IRQPL84 : IRQPL339	IRC0_IRQVA339
340	SMC ch.1	IRC0_IRQPL85 : IRQPL340	IRC0_IRQVA340
341	SMC ch.2	IRC0_IRQPL85 : IRQPL341	IRC0_IRQVA341
342	SMC ch.3	IRC0_IRQPL85 : IRQPL342	IRC0_IRQVA342
343	SMC ch.4	IRC0_IRQPL85 : IRQPL343	IRC0_IRQVA343
344	SMC ch.5	IRC0_IRQPL86 : IRQPL344	IRC0_IRQVA344
345 to 346	Reserved	-	-
347	SG ch.0	IRC0_IRQPL86 : IRQPL347	IRC0_IRQVA347
348	SG ch.1	IRC0_IRQPL87 : IRQPL348	IRC0_IRQVA348
349	SG ch.2	IRC0_IRQPL87 : IRQPL349	IRC0_IRQVA349
350	SG ch.3	IRC0_IRQPL87 : IRQPL350	IRC0_IRQVA350
351 to 352	Reserved	-	-
353	ADC12B Conversion Done	IRC0_IRQPL88 : IRQPL353	IRC0_IRQVA353
354	ADC12B Group interrupt	IRC0_IRQPL88 : IRQPL354	IRC0_IRQVA354
355	ADC12B pulse detection function	IRC0_IRQPL88 : IRQPL355	IRC0_IRQVA355
356	ADC12B RCO	IRC0_IRQPL89 : IRQPL356	IRC0_IRQVA356
357	RPGCRC	IRC0_IRQPL89 : IRQPL357	IRC0_IRQVA357
358	Reserved	-	-
359	MLB channel interrupt	IRC0_IRQPL89 : IRQPL359	IRC0_IRQVA359
360	MLB system interrupt	IRC0_IRQPL90 : IRQPL360	IRC0_IRQVA360
361	ETHERNET IRQ	IRC0_IRQPL90 : IRQPL361	IRC0_IRQVA361
362	ETHERNET Q1 IRQ	IRC0_IRQPL90 : IRQPL362	IRC0_IRQVA362
363	ETHERNET Q2 IRQ	IRC0_IRQPL90 : IRQPL363	IRC0_IRQVA363
364	ETHERNET Q3 IRQ	IRC0_IRQPL91 : IRQPL364	IRC0_IRQVA364

IRQ No.	Detail	IRQ Priority Register	Vector Address Register
365 to 367	Reserved	-	-
368	Indicator PWM	IRC0_IRQPL92 : IRQPL368	IRC0_IRQVA368
369	PCMPWM_DREQ	IRC0_IRQPL92 : IRQPL369	IRC0_IRQVA369
370	PCMPWM_OVFL	IRC0_IRQPL92 : IRQPL370	IRC0_IRQVA370
371	PCMPWM_UDRN	IRC0_IRQPL92 : IRQPL371	IRC0_IRQVA371
372	PCMPWM_DMAE	IRC0_IRQPL93 : IRQPL372	IRC0_IRQVA372
373	AUDIO_DAC_DREQ	IRC0_IRQPL93 : IRQPL373	IRC0_IRQVA373
374	AUDIO_DAC_OVFL_IRQ	IRC0_IRQPL93 : IRQPL374	IRC0_IRQVA374
375	AUDIO_DAC_UDRN_IRQ	IRC0_IRQPL93 : IRQPL375	IRC0_IRQVA375
376	AUDIO_DAC_DMAE_IRQ	IRC0_IRQPL94 : IRQPL376	IRC0_IRQVA376
377	I2S0_IRQ	IRC0_IRQPL94 : IRQPL377	IRC0_IRQVA377
378	I2S1_IRQ	IRC0_IRQPL94 : IRQPL378	IRC0_IRQVA378
379 to 400	Reserved	-	-
401	2D Graphics Core Command Sequencer	IRC0_IRQPL100 : IRQPL401	IRC0_IRQVA401
402	2D Graphics Core Blit Engine	IRC0_IRQPL100 : IRQPL402	IRC0_IRQVA402
403	2D Graphics Core Drawing Engine	IRC0_IRQPL100 : IRQPL403	IRC0_IRQVA403
404	2D Graphics Core Content Stream0	IRC0_IRQPL101 : IRQPL404	IRC0_IRQVA404
405	2D Graphics Core Safety Stream0	IRC0_IRQPL101 : IRQPL405	IRC0_IRQVA405
406	2D Graphics Core Display Stream0	IRC0_IRQPL101 : IRQPL406	IRC0_IRQVA406
407	2D Graphics Core Signature0	IRC0_IRQPL101 : IRQPL407	IRC0_IRQVA407
408	2D Graphics Core Display0 Sync0	IRC0_IRQPL102 : IRQPL408	IRC0_IRQVA408
409	2D Graphics Core Display0 Sync1	IRC0_IRQPL102 : IRQPL409	IRC0_IRQVA409
410	2D Graphics Core Content Stream1	IRC0_IRQPL102 : IRQPL410	IRC0_IRQVA410
411	2D Graphics Core Safety Stream1	IRC0_IRQPL102 : IRQPL411	IRC0_IRQVA411
412	2D Graphics Core Display Stream1	IRC0_IRQPL103 : IRQPL412	IRC0_IRQVA412
413	2D Graphics Core Signature1	IRC0_IRQPL103 : IRQPL413	IRC0_IRQVA413
414	2D Graphics Core Display1 Sync0	IRC0_IRQPL103 : IRQPL414	IRC0_IRQVA414
415	2D Graphics Core Display1 Sync1	IRC0_IRQPL103 : IRQPL415	IRC0_IRQVA415
416	2D Graphics Core Capture Plane0	IRC0_IRQPL104 : IRQPL416	IRC0_IRQVA416
417	2D Graphics Core Display Plane0	IRC0_IRQPL104 : IRQPL417	IRC0_IRQVA417
418	2D Graphics Core Storage Stream0	IRC0_IRQPL104 : IRQPL418	IRC0_IRQVA418
419	2D Graphics Core Histogram	IRC0_IRQPL104 : IRQPL419	IRC0_IRQVA419
420	2D Graphics Core DDRHSSPI	IRC0_IRQPL105 : IRQPL420	IRC0_IRQVA420
421 to 431	Reserved	-	-
432	WG_END_IRQ0	IRC0_IRQPL108 : IRQPL432	IRC0_IRQVA432

IRQ No.	Detail	IRQ Priority Register	Vector Address Register
433	WG_END_IRQ1	IRC0_IRQPL108 : IRQPL433	IRC0_IRQVA433
434	WG_END_IRQ2	IRC0_IRQPL108 : IRQPL434	IRC0_IRQVA434
435	WG_END_IRQ3	IRC0_IRQPL108 : IRQPL435	IRC0_IRQVA435
436	WG_END_IRQ4	IRC0_IRQPL109 : IRQPL436	IRC0_IRQVA436
437	WG_AHB_ERR_IRQ	IRC0_IRQPL109 : IRQPL437	IRC0_IRQVA437
438	MX_DATA_REQ_IRQ0	IRC0_IRQPL109 : IRQPL438	IRC0_IRQVA438
439	MX_DATA_REQ_IRQ1	IRC0_IRQPL109 : IRQPL439	IRC0_IRQVA439
440	MX_DATA_REQ_IRQ2	IRC0_IRQPL110 : IRQPL440	IRC0_IRQVA440
441	MX_DATA_REQ_IRQ3	IRC0_IRQPL110 : IRQPL441	IRC0_IRQVA441
442	MX_DATA_REQ_IRQ4	IRC0_IRQPL110 : IRQPL442	IRC0_IRQVA442
443	MX_OVFL_IRQ0	IRC0_IRQPL110 : IRQPL443	IRC0_IRQVA443
444	MX_OVFL_IRQ1	IRC0_IRQPL111 : IRQPL444	IRC0_IRQVA444
445	MX_OVFL_IRQ2	IRC0_IRQPL111 : IRQPL445	IRC0_IRQVA445
446	MX_OVFL_IRQ3	IRC0_IRQPL111 : IRQPL446	IRC0_IRQVA446
447	MX_OVFL_IRQ4	IRC0_IRQPL111 : IRQPL447	IRC0_IRQVA447
448 to 452	Reserved	-	-
453	MX_DMA_ERR_IRQ0	IRC0_IRQPL113 : IRQPL453	IRC0_IRQVA453
454	MX_DMA_ERR_IRQ1	IRC0_IRQPL113 : IRQPL454	IRC0_IRQVA454
455	MX_DMA_ERR_IRQ2	IRC0_IRQPL113 : IRQPL455	IRC0_IRQVA455
456	MX_DMA_ERR_IRQ3	IRC0_IRQPL114 : IRQPL456	IRC0_IRQVA456
457	MX_DMA_ERR_IRQ4	IRC0_IRQPL114 : IRQPL457	IRC0_IRQVA457
458	MX_AHB_ERR_IRQ	IRC0_IRQPL114 : IRQPL458	IRC0_IRQVA458
459 to 511	Reserved	-	-

2. NMI Map

This section shows NMI map.

NMI of not-implemented function is not supported. See the chapter of function list.

NMI No.	Detail	Priority Level	IRQ/NMI Vector Address
0	NMIX pin(Ext-IRC)	IRC0_NMIPL0 : NMIPL0	IRC0_NMIVA0
1 to 2	Reserved	-	-
3	Reserved	-	-
4	LVDs IRQ	IRC0_NMIPL1 : NMIPL4	IRC0_NMIVA4
5	CSV, Profile	IRC0_NMIPL1 : NMIPL5	IRC0_NMIVA5
6	HW-WDT	IRC0_NMIPL1 : NMIPL6	IRC0_NMIVA6
7	SW-WDT	IRC0_NMIPL1 : NMIPL7	IRC0_NMIVA7
8	IRC 2-bit ECC err detection	IRC0_NMIPL2 : NMIPL8	IRC0_NMIVA8
9 to 10	Reserved	-	-
11	Backup RAM 2-bit ECC error detection	IRC0_NMIPL2 : NMIPL11	IRC0_NMIVA11
12	M-CAN RAMs 2-bit ECC error detection	IRC0_NMIPL3 : NMIPL12	IRC0_NMIVA12
13	DMAC MPU #0 protection violation	IRC0_NMIPL3 : NMIPL13	IRC0_NMIVA13
14	Reserved	-	-
15	SHE MPU	IRC0_NMIPL3 : NMIPL15	IRC0_NMIVA15
16 to 17	Reserved	-	-
18	TPU protection violation	IRC0_NMIPL4 : NMIPL18	IRC0_NMIVA18
19	Reserved	-	-
20	Graphics subsystem Memory Protection	IRC0_NMIPL5 : NMIPL20	IRC0_NMIVA20
21	Graphics subsystem (VRAM) ECC Single Bit Error Detection	IRC0_NMIPL5 : NMIPL21	IRC0_NMIVA21
22	MLB_MPU_NMI	IRC0_NMIPL5 : NMIPL22	IRC0_NMIVA22
23	ETHERNET_MPU_NMI	IRC0_NMIPL5 : NMIPL23	IRC0_NMIVA23
24 to 31	Reserved	-	-

CHAPTER 9: DMA Channel Activation Factors



This chapter explains the DMA channel activation factors.

1. Factors List
2. Note

CODE: DMAFACT-S6J3200-E1

1. Factors List

Number of Channels	Peripheral Functions	Remark
0 to8	Reserved	-
9	Work FLASH	*1
10	Ext IRQ 0	*1
11	Ext IRQ 1	*1
12	Ext IRQ 2	*1
13	Ext IRQ 3	*1
14	Ext IRQ 4	*1
15	Ext IRQ 5	*1
16	Ext IRQ 6	*1
17	Ext IRQ 7	*1
18	Ext IRQ 8	*1
19	Ext IRQ 9	*1
20	Ext IRQ 10	*1
21	Ext IRQ 11	*1
22	Ext IRQ 12	*1
23	Ext IRQ 13	*1
24	Ext IRQ 14	*1
25	Ext IRQ 15	*1
26 to 41	Reserved	-
42	MFS ch.16 RX	*3
43	MFS ch.16 TX	*3
44	MFS Ch.17 RX	*3
45	MFS Ch.17 TX	*3
46 to 47	Reserved	-
48	CAN_FD ch.5	*1
49	CAN_FD ch.6	*1
50	Reserved	-
51	Reload Timer Ch.48	*1
52	Reload Timer Ch.49	*1
53 to 57	Reserved	-
58	DMAC #0 Reload Timer 0	*1
59	DMAC #0 Reload Timer 1	*1
60	DMAC #0 Reload Timer 2	*1
61	DMAC #0 Reload Timer 3	*1
62 to 65	Reserved	-
66	Reserved	-
67	DDRHSSPI RX	*1
68	DDRHSSPI TX	*1
69 to 72	Reserved	-
73	Base Timer ch.0-0	*2
74	Base Timer ch.1-0	*2
75	Base Timer ch.0-1	*2

Number of Channels	Peripheral Functions	Remark
76	Base Timer ch.1-1	*2
77	Base Timer ch.2-0	*2
78	Base Timer ch.3-0	*2
79	Base Timer ch.2-1	*2
80	Base Timer ch.3-1	*2
81	Base Timer ch.4-0	*2
82	Base Timer ch.5-0	*2
83	Base Timer ch.4-1	*2
84	Base Timer ch.5-1	*2
85	Base Timer ch.6-0	*2
86	Base Timer ch.7-0	*2
87	Base Timer ch.6-1	*2
88	Base Timer ch.7-1	*2
89	Base Timer ch.8-0	*2
90	Base Timer ch.9-0	*2
91	Base Timer ch.8-1	*2
92	Base Timer ch.9-1	*2
93	Base Timer ch.10-0	*2
94	Base Timer ch.11-0	*2
95	Base Timer ch.10-1	*2
96	Base Timer ch.11-1	*2
97	Base Timer ch.12-0	*2
98	Base Timer ch.13-0	*2
99	Base Timer ch.12-1	*2
100	Base Timer ch.13-1	*2
101	Base Timer ch.14-0	*2
102	Base Timer ch.15-0	*2
103	Base Timer ch.14-1	*2
104	Base Timer ch.15-1	*2
105	Base Timer ch.16-0	*2
106	Base Timer ch.17-0	*2
107	Base Timer ch.16-1	*2
108	Base Timer ch.17-1	*2
109	Base Timer ch.18-0	*2
110	Base Timer ch.19-0	*2
111	Base Timer ch.18-1	*2
112	Base Timer ch.19-1	*2
113	Base Timer ch.20-0	*2
114	Base Timer ch.21-0	*2
115	Base Timer ch.20-1	*2
116	Base Timer ch.21-1	*2
117	Base Timer ch.22-0	*2
118	Base Timer ch.23-0	*2
119	Base Timer ch.22-1	*2

Number of Channels	Peripheral Functions	Remark
120	Base Timer ch.23-1	*2
121 to 144	Reserved	-
145	Reload Timer ch.0	*1
146	Reload Timer ch.1	*1
147	Reload Timer ch.2	*1
148	Reload Timer ch.3	*1
149 to 160	Reserved	-
161	Reload Timer ch.16	*1
162	Reload Timer ch.17	*1
163	Reload Timer ch.18	*1
164	Reload Timer ch.19	*1
165 to 176	Reserved	-
177	Reload Timer ch.32	*1
178	Reload Timer ch.33	*1
179	Reload Timer ch.34	*1
180	Reload Timer ch.35	*1
181 to 192	Reserved	-
193	MFS ch.0 RX	*3
194	MFS ch.0 TX	*3
195	MFS ch.1 RX	*3
196	MFS ch.1 TX	*3
197	MFS ch.2 RX	*3
198	MFS ch.2 TX	*3
199	MFS ch.3 RX	*3
200	MFS ch.3 TX	*3
201	MFS ch.4 RX	*3
202	MFS ch.4 TX	*3
203 to 208	Reserved	-
209	MFS ch.8 RX	*3
210	MFS ch.8 TX	*3
211	MFS ch.9 RX	*3
212	MFS ch.9 TX	*3
213	MFS ch.10 RX	*3
214	MFS ch.10 TX	*3
215	MFS ch.11 RX	*3
216	MFS ch.11 TX	*3
217	MFS ch.12 RX	*3
218	MFS ch.12 TX	*3
219 to 224	Reserved	-
225	FRT ch.0 Match	*2
226	FRT ch.0 Zero	*2
227	FRT ch.1 Match	*2
228	FRT ch.1 Zero	*2
229	FRT ch.2 Match	*2

Number of Channels	Peripheral Functions	Remark
230	FRT ch.2 Zero	*2
231	FRT ch.3 Match	*2
232	FRT ch.3 Zero	*2
233	FRT ch.4 Match	*2
234	FRT ch.4 Zero	*2
235	FRT ch.5 Match	*2
236	FRT ch.5 Zero	*2
237	FRT ch.6 Match	*2
238	FRT ch.6 Zero	*2
239	FRT ch.7 Match	*2
240	FRT ch.7 Zero	*2
241	FRT ch.8 Match	*2
242	FRT ch.8 Zero	*2
243	FRT ch.9 Match	*2
244	FRT ch.9 Zero	*2
245	FRT ch.10 Match	*2
246	FRT ch.10 Zero	*2
247	FRT ch.11 Match	*2
248	FRT ch.11 Zero	*2
249 to 256	Reserved	-
257	ICU pair ch.0-0	*2
258	ICU pair ch.0-1	*2
259	ICU pair ch.1-0	*2
260	ICU pair ch.1-1	*2
261	ICU pair ch.2-0	*2
262	ICU pair ch.2-1	*2
263	ICU pair ch.3-0	*2
264	ICU pair ch.3-1	*2
265	ICU pair ch.4-0	*2
266	ICU pair ch.4-1	*2
267	ICU pair ch.5-0	*2
268	ICU pair ch.5-1	*2
269	ICU pair ch.6-0	*2
270	ICU pair ch.6-1	*2
271	ICU pair ch.7-0	*2
272	ICU pair ch.7-1	*2
273	ICU pair ch.8-0	*2
274	ICU pair ch.8-1	*2
275	ICU pair ch.9-0	*2
276	ICU pair ch.9-1	*2
277	ICU pair ch.10-0	*2
278	ICU pair ch.10-1	*2
279	ICU pair ch.11-0	*2
280	ICU pair ch.11-1	*2

Number of Channels	Peripheral Functions	Remark
281 to 288	Reserved	-
289	OCU pair ch.0-0	*2
290	OCU pair ch.0-1	*2
291	OCU pair ch.1-0	*2
292	OCU pair ch.1-1	*2
293	OCU pair ch.2-0	*2
294	OCU pair ch.2-1	*2
295	OCU pair ch.3-0	*2
296	OCU pair ch.3-1	*2
297	OCU pair ch.4-0	*2
298	OCU pair ch.4-1	*2
299	OCU pair ch.5-0	*2
300	OCU pair ch.5-1	*2
301	OCU pair ch.6-0	*2
302	OCU pair ch.6-1	*2
303	OCU pair ch.7-0	*2
304	OCU pair ch.7-1	*2
305	OCU pair ch.8-0	*2
306	OCU pair ch.8-1	*2
307	OCU pair ch.9-0	*2
308	OCU pair ch.9-1	*2
309	OCU pair ch.10-0	*2
310	OCU pair ch.10-1	*2
311	OCU pair ch.11-0	*2
312	OCU pair ch.11-1	*2
313 to 320	Reserved	-
321	CAN_FD ch.0	*1
322	CAN_FD ch.1	*1
323 to 337	Reserved	-
338	Sound Generator 0	*2
339	Sound Generator 1	*2
340	Sound Generator 2	*2
341	Sound Generator 3	*2
342 to 355	Reserved	-
356	ADC ch.0-0	*1
357	ADC ch.0-1	*1
358	ADC ch.0-2	*1
359	ADC ch.0-3	*1
360 to 377	Reserved	-
364	Mixer[0]	*1
365	Mixer[1]	*1
366	Mixer[2]	*1
367	Mixer[3]	*1
368	Mixer[4]	*1

Number of Channels	Peripheral Functions	Remark
369 to 375	Reserved	-
376	PRGCRC	*1
377 to 378	Reserved	-
379	I2S ch.1 RX	*1
380	I2S ch.1 TX	*1
381 to 511	Reserved	-

Note:

- DMA doesn't support the output modules of the sound system; Audio-DAC, PCM-PWM, and I2S0.

Remark	Interrupt Flag Clear	Necessity of Interrupt Enable
*1	Flag is not cleared.	Unnecessary
*2	Flag is automatically cleared after DMA transfer completed.	Necessary
*3	Flag is not cleared.	Necessary

2. **Note**

No description.

CHAPTER 10: Port Description



This chapter explains port functions.

1. Port Description List
2. Remark

CODE: PORT_DESCRIPTION-S6J3200-E1

1. Port Description List

The table shows the port function of description which is supported. The port function which is not described in the table is not supported for the product.

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
VCC12	+1.2V power supply pin	11, 28, 61, 85, 122, 123, 182, 183	11, 28, 63, 87, 128, 129, 190, 191	
VCC5	+5.0V power supply pin	87, 104, 115, 157, 171	89, 108, 119, 163, 179	
VCC3	+3.3V power supply pin	30, 43, 53, 65, 74, 81	30, 43, 55, 67, 76, 83	
VCC53	+3.3V/+5.0V selection power supply pin	173, 185, 194, 208	181, 193, 202, 216	
VCC3_LVDS_Tx	LVDS Tx power supply pin	14, 27	14, 27	
VSS	GND	1, 10, 29, 42, 52, 62, 64, 71, 73, 80, 86, 105, 116, 124, 158, 172, 184, 195	1, 10, 29, 42, 54, 64, 66, 73, 75, 82, 88, 109, 120, 130, 164, 180, 192, 203	
VSS_LVDS_Tx	LVDS Tx GND	15, 26	15, 26	
AVCC3_DAC	Audio DAC power supply pin	6	6	
AVCC3_LVDS_PLL	LVDS PLL power supply pin	13	13	
AVSS_LVDS_PLL	LVDS PLL GND	12	12	
AVCC5	A/D converter analog power supply pin	119	125	
AVRH5	A/D converter upper limit reference voltage pin	120	126	
AVSS	A/D converter GND	2, 5, 9, 121	2, 5, 9, 127	
DVCC	SMC large current port power supply pin	126, 136, 146, 156	132, 142, 152, 162	
DVSS	SMC large current port GND	125, 135, 145, 155	131, 141, 151, 161	
X1	Main clock oscillator output pin	106	110	
X0	Main clock oscillator input pin	107	111	
X1A	Sub-clock oscillator output	169	177	
X0A	Sub-clock oscillator input	170	178	
NMIX	Non-maskable interrupt input pin	103	107	
RSTX	External reset input pin	114	118	
PSC_1	External Power Supply Control pin	88	90	
MODE	Mode Pin	113	117	
C	External capacity connection output pin	117	121	
JTAG_NTRST	JTAG test reset input pin	108	112	
JTAG_TDO	JTAG test data output pin	109	113	
JTAG_TDI	JTAG test data input pin	110	114	
JTAG_TCK	JTAG test clock input pin	111	115	
JTAG_TMS	JTAG test mode state input pin	112	116	
TRACE0	Trace data 0 output pin	96	100	
TRACE1	Trace data 1 output pin	97	101	
TRACE2	Trace data 2 output pin	98	102	
TRACE3	Trace data 3 output pin	99	103	
TRACE_CLK	Trace clock	100	104	
TRACE_CTL	Trace control	101	105	
ADTRG	A/D converter external trigger input pin	118	122	
AN0	ADC Analog 0 input pin	-	92	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
AN1	ADC Analog 1 input pin	90	93	
AN2	ADC Analog 2 input pin	91	94	
AN3	ADC Analog 3 input pin	92	95	
AN4	ADC Analog 4 input pin	-	96	
AN5	ADC Analog 5 input pin	93	97	
AN6	ADC Analog 6 input pin	94	98	
AN7	ADC Analog 7 input pin	95	99	
AN8	ADC Analog 8 input pin	96	100	
AN9	ADC Analog 9 input pin	97	101	
AN10	ADC Analog 10 input pin	98	102	
AN11	ADC Analog 11 input pin	99	103	
AN12	ADC Analog 12 input pin	100	104	
AN13	ADC Analog 13 input pin	101	105	
AN14	ADC Analog 14 input pin	102	106	
AN15	ADC Analog 15 input pin	160	166	
AN16	ADC Analog 16 input pin	161	167	
AN17	ADC Analog 17 input pin	162	168	
AN18	ADC Analog 18 input pin	-	169	
AN19	ADC Analog 19 input pin	-	170	
AN20	ADC Analog 20 input pin	163	171	
AN21	ADC Analog 21 input pin	164	172	
AN22	ADC Analog 22 input pin	165	173	
AN23	ADC Analog 23 input pin	166	174	
AN24	ADC Analog 24 input pin	167	175	
AN25	ADC Analog 25 input pin	168	176	
AN26	ADC Analog 26 input pin	127	133	
AN27	ADC Analog 27 input pin	128	134	
AN28	ADC Analog 28 input pin	129	135	
AN29	ADC Analog 29 input pin	130	136	
AN30	ADC Analog 30 input pin	131	137	
AN31	ADC Analog 31 input pin	132	138	
AN32	ADC Analog 32 input pin	133	139	
AN33	ADC Analog 33 input pin	134	140	
AN34	ADC Analog 34 input pin	137	143	
AN35	ADC Analog 35 input pin	138	144	
AN36	ADC Analog 36 input pin	139	145	
AN37	ADC Analog 37 input pin	140	146	
AN38	ADC Analog 38 input pin	141	147	
AN39	ADC Analog 39 input pin	142	148	
AN40	ADC Analog 40 input pin	143	149	
AN41	ADC Analog 41 input pin	144	150	
AN42	ADC Analog 42 input pin	147	153	
AN43	ADC Analog 43 input pin	148	154	
AN44	ADC Analog 44 input pin	149	155	
AN45	ADC Analog 45 input pin	150	156	
AN46	ADC Analog 46 input pin	151	157	
AN47	ADC Analog 47 input pin	152	158	
AN48	ADC Analog 48 input pin	153	159	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
AN49	ADC Analog 49 input pin	154	160	
TX0	CAN transmission data 0 output pin	100	104	
TX1	CAN transmission data 1 output pin	102, 154	106, 160	
TX5	CAN transmission data 5 output pin	162, 166	168, 174	
TX6	CAN transmission data 6 output pin	168	170, 176	
RX0	CAN reception data 0 input pin	99	103	
RX1	CAN reception data 1 input pin	101, 153	105, 159	
RX5	CAN reception data 5 input pin	161, 165	167, 173	
RX6	CAN reception data 6 input pin	167	169, 175	
EINT0	External interrupt input pin	33, 39, 57, 63, 96, 140, 167, 170, 177, 199	33, 39, 59, 65, 100, 146, 175, 178, 185, 207	
EINT1	External interrupt input pin	40, 58, 82, 97, 141, 168, 169, 178, 200	40, 60, 84, 101, 147, 176, 177, 186, 208	
EINT2	External interrupt input pin	41, 59, 83, 98, 118, 142, 179, 201	41, 61, 85, 102, 122, 148, 187, 209	
EINT3	External interrupt input pin	31, 84, 99, 143, 159, 180, 202	31, 44, 86, 103, 123, 149, 165, 188, 210	
EINT4	External interrupt input pin	60, 100, 144, 181, 203	45, 62, 104, 124, 150, 189, 211	
EINT5	External interrupt input pin	44, 72, 101, 127, 147, 186	46, 74, 105, 133, 153, 194	
EINT6	External interrupt input pin	45, 75, 89, 102, 128, 148, 187	47, 77, 91, 106, 134, 154, 195	
EINT7	External interrupt input pin	46, 77, 129, 149, 160, 188	48, 79, 135, 155, 166, 196	
EINT8	External interrupt input pin	47, 76, 130, 150, 161, 189	49, 78, 92, 136, 156, 167, 197	
EINT9	External interrupt input pin	48, 79, 90, 131, 151, 162, 190, 204	50, 81, 93, 137, 157, 168, 198, 212	
EINT10	External interrupt input pin	49, 78, 91, 132, 152, 191, 205	51, 80, 94, 138, 158, 169, 199, 213	
EINT11	External interrupt input pin	34, 50, 69, 92, 133, 153, 192, 206	34, 52, 71, 95, 139, 159, 170, 200, 214	
EINT12	External interrupt input pin	35, 51, 66, 134, 154, 163, 193, 207	35, 53, 68, 96, 140, 160, 171, 201, 215	
EINT13	External interrupt input pin	36, 54, 68, 93, 137, 164, 174, 196	36, 56, 70, 97, 143, 172, 182, 204	
EINT14	External interrupt input pin	37, 55, 67, 94, 138, 165, 175, 197	37, 57, 69, 98, 144, 173, 183, 205	
EINT15	External interrupt input pin	32, 38, 56, 70, 95, 139, 166, 176, 198	32, 38, 58, 72, 99, 145, 174, 184, 206	
MFS0_CS0	Multi-function serial ch.0 chip select 0 pin	148	154	
MFS0_CS1	Multi-function serial ch.0 chip select 1 pin	153	159	
MFS0_CS2	Multi-function serial ch.0 chip select 2 pin	154	160	
MFS0_CS3	Multi-function serial ch.0 chip select 3 pin	152	158	
MFS2_CS0	Multi-function serial ch.2 chip select 0 pin	149	155	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
MFS2_CS1	Multi-function serial ch.2 chip select 1 pin	150	156	
MFS8_CS0	Multi-function serial ch.8 chip select 0 pin	163, 191	171, 199	
MFS8_CS1	Multi-function serial ch.8 chip select 1 pin	167, 198	175, 206	
MFS8_CS2	Multi-function serial ch.8 chip select 2 pin	168, 199	176, 207	
MFS8_CS3	Multi-function serial ch.8 chip select 3 pin	166, 197	174, 205	
MFS9_CS0	Multi-function serial ch.9 chip select 0 pin	164, 192	172, 200	
MFS9_CS1	Multi-function serial ch.9 chip select 1 pin	165, 193	173, 201	
SCK0	Multi-function serial ch.0 clock I/O pin	38, 91	38, 94	
SCK1	Multi-function serial ch.1 clock I/O pin	83, 94	85, 98	
SCK2	Multi-function serial ch.2 clock I/O pin	143	149	
SCK3	Multi-function serial ch.3 clock I/O pin	149	155	
SCK4	Multi-function serial ch.4 clock I/O pin	153	159	
SCK8	Multi-function serial ch.8 clock I/O pin	100, 180	104, 188	
SCK9	Multi-function serial ch.9 clock I/O pin	161, 188	167, 196	
SCK10	Multi-function serial ch.10 clock I/O pin	164, 192	172, 200	
SCK11	Multi-function serial ch.11 clock I/O pin	167, 198, 206	175, 206, 214	
SCK12	Multi-function serial ch.12 clock I/O pin	202	210	
SCK16	Multi-function serial ch.16 clock I/O pin	97	101	
SCK17	Multi-function serial ch.17 clock I/O pin	91	94	
SIN0	Multi-function serial ch.0 serial data input pin	45, 92	47, 95	
SIN1	Multi-function serial ch.1 serial data input pin	84, 95	86, 99	
SIN2	Multi-function serial ch.2 serial data input pin	144	150	
SIN3	Multi-function serial ch.3 serial data input pin	150	156	
SIN4	Multi-function serial ch.4 serial data input pin	154	160	
SIN8	Multi-function serial ch.8 serial data input pin	101, 181	105, 189	
SIN9	Multi-function serial ch.9 serial data input pin	162, 189	168, 197	
SIN10	Multi-function serial ch.10 serial data input pin	165, 193	173, 201	
SIN11	Multi-function serial ch.11 serial data input pin	168, 199, 207	176, 207, 215	
SIN12	Multi-function serial ch.12 serial data input pin	203	211	
SIN16	Multi-function serial ch.16 serial data input pin	98	102	
SIN17	Multi-function serial ch.17 serial data input pin	92	95	
SOT0	Multi-function serial ch.0 serial data output pin	37, 90	37, 93	
SOT1	Multi-function serial ch.1 serial data output pin	82, 93	84, 97	
SOT2	Multi-function serial ch.2 serial data output pin	142	148	
SOT3	Multi-function serial ch.3 serial data output pin	148	154	
SOT4	Multi-function serial ch.4 serial data output pin	152	158	
SOT8	Multi-function serial ch.8 serial data output pin	99, 179	103, 187	
SOT9	Multi-function serial ch.9 serial data output pin	160, 187	166, 195	
SOT10	Multi-function serial ch.10 serial data output pin	163, 191	171, 199	
SOT11	Multi-function serial ch.11 serial data output pin	166, 197, 205	174, 205, 213	
SOT12	Multi-function serial ch.12 serial data output pin	201	209	
SOT16	Multi-function serial ch.16 serial data output pin	96	100	
SOT17	Multi-function serial ch.17 serial data output pin	90	93	
SCL4	I ² C ch.4 clock I/O pin	153	159	
SCL10	I ² C ch.10 clock I/O pin	192	200	
SCL12	I ² C ch.12 clock I/O pin	202	210	
SCL16	I ² C ch.16 clock I/O pin	97	101	
SCL17	I ² C ch.17 clock I/O pin	91	94	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
SDA4	I ² C ch.4 serial data I/O pin	152	158	
SDA10	I ² C ch.10 serial data I/O pin	191	199	
SDA12	I ² C ch.12 serial data I/O pin	201	209	
SDA16	I ² C ch.16 serial data I/O pin	96	100	
SDA17	I ² C ch.17 serial data I/O pin	90	93	
PPG0_TOUT0	Base timer 0 output pin	39, 140, 161, 170, 199	39, 146, 167, 178, 207	
PPG0_TOUT2	Base timer 1 output pin	40, 141, 162, 169, 200, 204	40, 147, 168, 177, 208, 212	
PPG1_TOUT0	Base timer 2 output pin	41,142,201, 205	41,148,169, 209,213	
PPG1_TOUT2	Base timer 3 output pin	143, 202, 206	44, 149, 170, 210, 214	
PPG2_TOUT0	Base timer 4 output pin	144, 163, 203, 207	45, 150, 171, 211, 215	
PPG2_TOUT2	Base timer 5 output pin	44, 147, 164, 174	46, 153, 172, 182	
PPG3_TOUT0	Base timer 6 output pin	45, 89, 148, 165, 175	47, 91, 154, 173, 183	
PPG3_TOUT2	Base timer 7 output pin	32, 46, 149, 166, 176	32, 48, 155, 174, 184	
PPG4_TOUT0	Base timer 8 output pin	33, 47, 150, 167, 177	33, 49, 92, 156, 175, 185	
PPG4_TOUT2	Base timer 9 output pin	48, 84, 90, 151, 168, 178	50, 86, 93, 157, 176, 186	
PPG5_TOUT0	Base timer 10 output pin	49, 91, 118, 152, 179	51, 94, 122, 158, 187	
PPG5_TOUT2	Base timer 11 output pin	50, 72, 92, 153, 180	52, 74, 95, 123, 159, 188	
PPG6_TOUT0	Base timer 12 output pin	51, 75, 154, 181	53, 77, 96, 124, 160,189	
PPG6_TOUT2	Base timer 13 output pin	54, 77, 93, 127, 186	56, 79, 97, 133, 194	
PPG7_TOUT0	Base timer 14 output pin	55, 76, 94, 128, 187	57, 78, 98, 134, 195	
PPG7_TOUT2	Base timer 15 output pin	56, 79, 95, 129, 188	58, 81, 99, 135, 196	
PPG8_TOUT0	Base timer 16 output pin	57, 78, 96, 130, 189	59, 80, 100, 136, 197	
PPG8_TOUT2	Base timer 17 output pin	58, 69, 97, 131, 190	60, 71, 101, 137, 198	
PPG9_TOUT0	Base timer 18 output pin	59, 66, 98, 132, 191	61, 68, 102, 138, 199	
PPG9_TOUT2	Base timer 19 output pin	31, 34, 68, 99, 133, 192	31, 34, 70, 103, 139, 200	
PPG10_TOUT0	Base timer 20 output pin	35, 60, 67, 100, 134, 193	35, 62, 69, 104, 140, 201	
PPG10_TOUT2	Base timer 21 output pin	36, 70, 101, 137, 196	36, 72, 105, 143, 204	
PPG11_TOUT0	Base timer 22 output pin	37, 63, 102, 138, 197	37, 65, 106, 144, 205	
PPG11_TOUT2	Base timer 23 output pin	38, 139, 160, 198	38, 145, 166, 206	
PPG0/1/2/3/4/5_TIN1	Base timer 0/2/4/6/8/10 input pin	-	96	
PPG6/7/8/9/10/11_TIN1	Base timer 12/14/16/18/20/22 input pin	161	167	
WOT	RTC overflow output pin	161	167	
PWM1M0	SMC ch.0 output pin	128	134	
PWM1M1	SMC ch.1 output pin	132	138	
PWM1M2	SMC ch.2 output pin	138	144	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
PWM1M3	SMC ch.3 output pin	142	148	
PWM1M4	SMC ch.4 output pin	148	154	
PWM1M5	SMC ch.5 output pin	152	158	
PWM1P0	SMC ch.0 output pin	127	133	
PWM1P1	SMC ch.1 output pin	131	137	
PWM1P2	SMC ch.2 output pin	137	143	
PWM1P3	SMC ch.3 output pin	141	147	
PWM1P4	SMC ch.4 output pin	147	153	
PWM1P5	SMC ch.5 output pin	151	157	
PWM2M0	SMC ch.0 output pin	130	136	
PWM2M1	SMC ch.1 output pin	134	140	
PWM2M2	SMC ch.2 output pin	140	146	
PWM2M3	SMC ch.3 output pin	144	150	
PWM2M4	SMC ch.4 output pin	150	156	
PWM2M5	SMC ch.5 output pin	154	160	
PWM2P0	SMC ch.0 output pin	129	135	
PWM2P1	SMC ch.1 output pin	133	139	
PWM2P2	SMC ch.2 output pin	139	145	
PWM2P3	SMC ch.3 output pin	143	149	
PWM2P4	SMC ch.4 output pin	149	155	
PWM2P5	SMC ch.5 output pin	153	159	
OCU0_OTD0	Output compare 0 ch.0 output pin	39, 140, 161, 170, 199	39, 146, 167, 178, 207	
OCU0_OTD1	Output compare 0 ch.1 output pin	40, 141, 162, 169, 200, 204	40, 147, 168, 177, 208, 212	
OCU1_OTD0	Output compare 1 ch.0 output pin	41, 142, 201, 205	41, 148, 169, 209, 213	
OCU1_OTD1	Output compare 1 ch.1 output pin	143, 202, 206	44, 149, 170, 210, 214	
OCU2_OTD0	Output compare 2 ch.0 output pin	144, 163, 203, 207	45, 150, 171, 211, 215	
OCU2_OTD1	Output compare 2 ch.1 output pin	44, 147, 164, 174	46, 153, 172, 182	
OCU3_OTD0	Output compare 3 ch.0 output pin	45, 89, 148, 165, 175	47, 91, 154, 173, 183	
OCU3_OTD1	Output compare 3 ch.1 output pin	32, 46, 149, 166, 176	32, 48, 155, 174, 184	
OCU4_OTD0	Output compare 4 ch.0 output pin	33, 47, 150, 167, 177	33, 49, 92, 156, 175, 185	
OCU4_OTD1	Output compare 4 ch.1 output pin	48, 84, 90, 151, 168, 178	50, 86, 93, 157, 176, 186	
OCU5_OTD0	Output compare 5 ch.0 output pin	49, 91, 118, 152, 179	51, 94, 122, 158, 187	
OCU5_OTD1	Output compare 5 ch.1 output pin	50, 72, 92, 153, 180	52, 74, 95, 123, 159, 188	
OCU6_OTD0	Output compare 6 ch.0 output pin	51, 75, 154, 181	53, 77, 96, 124, 160, 189	
OCU6_OTD1	Output compare 6 ch.1 output pin	54, 77, 93, 127, 186	56, 79, 97, 133, 194	
OCU7_OTD0	Output compare 7 ch.0 output pin	55, 76, 94, 128, 187	57, 78, 98, 134, 195	
OCU7_OTD1	Output compare 7 ch.1 output pin	56, 79, 95, 129, 188	58, 81, 99, 135, 196	
OCU8_OTD0	Output compare 8 ch.0 output pin	57, 78, 96, 130, 189	59, 80, 100, 136, 197	
OCU8_OTD1	Output compare 8 ch.1 output pin	58, 69, 97, 131, 190	60, 71, 101, 137, 198	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
OCU9_OTD0	Output compare 9 ch.0 output pin	59, 66, 98, 132, 191	61, 68, 102, 138, 199	
OCU9_OTD1	Output compare 9 ch.1 output pin	31, 34, 68, 99, 133, 192	31, 34, 70, 103, 139, 200	
OCU10_OTD0	Output compare 10 ch.0 output pin	35, 60, 67, 100, 134, 193	35, 62, 69, 104, 140, 201	
OCU10_OTD1	Output compare 10 ch.1 output pin	36, 70, 101, 137, 196	36, 72, 105, 143, 204	
OCU11_OTD0	Output compare 11 ch.0 output pin	37, 63, 102, 138, 197	37, 65, 106, 144, 205	
OCU11_OTD1	Output compare 11 ch.1 output pin	38, 139, 160, 198	38, 145, 166, 206	
ICU0_IN0	Input Capture 0 ch.0 input pin	39, 140, 161, 170, 199	39, 146, 167, 178, 207	
ICU0_IN1	Input Capture 0 ch.1 input pin	40, 141, 162, 169, 200, 204	40, 147, 168, 177, 208, 212	
ICU1_IN0	Input Capture 1 ch.0 input pin	41, 142, 201, 205	41, 148, 169, 209, 213	
ICU1_IN1	Input Capture 1 ch.1 input pin	143, 159, 202, 206	44, 149, 165, 170, 210, 214	
ICU2_IN0	Input Capture 2 ch.0 input pin	144, 163, 203, 207	45, 150, 171, 211, 215	
ICU2_IN1	Input Capture 2 ch.1 input pin	44, 147, 164, 174	46, 153, 172, 182	
ICU3_IN0	Input Capture 3 ch.0 input pin	45, 89, 148, 165, 175	47, 91, 154, 173, 183	
ICU3_IN1	Input Capture 3 ch.1 input pin	32, 46, 149, 166, 176	32, 48, 155, 174, 184	
ICU4_IN0	Input Capture 4 ch.0 input pin	33, 47, 150, 167, 177	33, 49, 92, 156, 175, 185	
ICU4_IN1	Input Capture 4 ch.1 input pin	48, 84, 90, 151, 168, 178	50, 86, 93, 157, 176, 186	
ICU5_IN0	Input Capture 5 ch.0 input pin	49, 91, 118, 152, 179	51, 94, 122, 158, 187	
ICU5_IN1	Input Capture 5 ch.1 input pin	50, 72, 92, 153, 180	52, 74, 95, 123, 159, 188	
ICU6_IN0	Input Capture 6 ch.0 input pin	51, 75, 154, 181	53, 77, 96, 124, 160, 189	
ICU6_IN1	Input Capture 6 ch.1 input pin	54, 77, 93, 127, 186	56, 79, 97, 133, 194	
ICU7_IN0	Input Capture 7 ch.0 input pin	55, 76, 94, 128, 187	57, 78, 98, 134, 195	
ICU7_IN1	Input Capture 7 ch.1 input pin	56, 79, 95, 129, 188	58, 81, 99, 135, 196	
ICU8_IN0	Input Capture 8 ch.0 input pin	57, 78, 96, 130, 189	59, 80, 100, 136, 197	
ICU8_IN1	Input Capture 8 ch.1 input pin	58, 69, 97, 131, 190	60, 71, 101, 137, 198	
ICU9_IN0	Input Capture 9 ch.0 input pin	59, 66, 98, 132, 191	61, 68, 102, 138, 199	
ICU9_IN1	Input Capture 9 ch.1 input pin	31, 34, 68, 99, 133, 192	31, 34, 70, 103, 139, 200	
ICU10_IN0	Input Capture 10 ch.0 input pin	35, 60, 67, 100, 134, 193	35, 62, 69, 104, 140, 201	
ICU10_IN1	Input Capture 10 ch.1 input pin	36, 70, 101, 137, 196	36, 72, 105, 143, 204	
ICU11_IN0	Input Capture 11 ch.0 input pin	37, 63, 102, 138, 197	37, 65, 106, 144, 205	
ICU11_IN1	Input Capture 11 ch.1 input pin	38, 139, 160, 198	38, 145, 166, 206	
SGA0	Sound generator ch.0 SGA output pin	90, 97, 164	93, 101, 172	
SGA1	Sound generator ch.1 SGA output pin	91, 98, 165, 205	94, 102, 173, 213	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
SGA2	Sound generator ch.2 SGA output pin	100, 167	96, 104, 175	
SGA3	Sound generator ch.3 SGA output pin	94, 118, 175	98, 122, 183	
SGO0	Sound generator ch.0 SGO output pin	96, 163	92, 100, 171	
SGO1	Sound generator ch.1 SGO output pin	92,99,166,206	95,103,174,214	
SGO2	Sound generator ch.2 SGO output pin	93, 101, 168	97, 105, 176	
SGO3	Sound generator ch.3 SGO output pin	95, 176	99, 123, 184	
AN0(AL0)	PCM PWM ch.0 output pin	128, 175	134, 183	
AN1(AL1)	PCM PWM ch.1 output pin	132, 179	138, 187	
AP0(AH0)	PCM PWM ch.0 output pin	127, 174	133, 182	
AP1(AH1)	PCM PWM ch.1 output pin	131, 178	137, 186	
BN0(BL0)	PCM PWM ch.0 output pin	130, 177	136, 185	
BN1(BL1)	PCM PWM ch.1 output pin	134, 181	140, 189	
BP0(BH0)	PCM PWM ch.0 output pin	129, 176	135, 184	
BP1(BH1)	PCM PWM ch.1 output pin	133, 180	139, 188	
I2S0_ECLK	I2S external clock ch.0 input pin	50	52	
I2S1_ECLK	I2S external clock ch.1 input pin	56	58	
I2S0_SCK	I2S continuous serial clock ch.0 pin	55	57	
I2S1_SCK	I2S continuous serial clock ch.1 pin	59	61	
I2S0_SD	I2S serial data ch.0 pin	51	53	
I2S1_SD	I2S serial data ch.1 pin	57	59	
I2S0_WS	I2S word select ch.0 pin	54	56	
I2S1_WS	I2S word select ch.1 pin	58	60	
C_L	Audio DAC external capacity connection output pin (L)	8	8	
C_R	Audio DAC external capacity connection output pin (R)	4	4	
DAC_L	Audio DAC output pin (L)	7	7	
DAC_R	Audio DAC output pin (R)	3	3	
FRT0/1/2/3_TEXT	Free-run timer ch.0/1/2/3 clock input pin	160	166	
FRT4/5/6/7_TEXT	Free-run timer ch.4/5/6/7 clock input pin	166	174	
FRT8/9/10/11_TEXT	Free-run timer ch.4/5/6/7 clock input pin	95	99	
TIN0	Reload timer ch.0 event input pin	35	35, 96	
TIN1	Reload timer ch.1 event input pin	37, 93	37, 97	
TIN2	Reload timer ch.2 event input pin	39, 94	39, 98	
TIN3	Reload timer ch.3 event input pin	41, 95	41, 99	
TIN16	Reload timer ch.16 event input pin	100	45, 104	
TIN17	Reload timer ch.17 event input pin	45, 102	47, 106	
TIN18	Reload timer ch.18 event input pin	47, 162	49, 168	
TIN19	Reload timer ch.19 event input pin	49	51, 170	
TIN32	Reload timer ch.32 event input pin	51, 164	53, 172	
TIN33	Reload timer ch.33 event input pin	55, 166	57, 174	
TIN34	Reload timer ch.34 event input pin	57, 168	59, 176	
TIN35	Reload timer ch.35 event input pin	59	61, 123	
TIN48	Reload timer ch.48 event input pin	159	165	
TIN49	Reload timer ch.49 event input pin	89	91	
TOT0	Reload timer ch.0 output pin	34, 96	34, 100	
TOT1	Reload timer ch.1 output pin	36, 97	36, 101	
TOT2	Reload timer ch.2 output pin	38, 98	38, 102	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
TOT3	Reload timer ch.3 output pin	40, 99	40, 103	
TOT16	Reload timer ch.16 output pin	101	44, 105	
TOT17	Reload timer ch.17 output pin	44, 160	46, 166	
TOT18	Reload timer ch.18 output pin	46, 161	48, 167	
TOT19	Reload timer ch.19 output pin	48	50, 169	
TOT32	Reload timer ch.32 output pin	50, 163	52, 171	
TOT33	Reload timer ch.33 output pin	54, 165	56, 173	
TOT34	Reload timer ch.34 output pin	56, 167	58, 175	
TOT35	Reload timer ch.35 output pin	58, 118	60, 122	
AIN8	Up/Down counter AIN input pin ch.8	190	92, 198	
AIN9	Up/Down counter AIN input pin ch.9	93, 193	97, 201	
BIN8	Up/Down counter BIN input pin ch.8	90, 191	93, 199	
BIN9	Up/Down counter BIN input pin ch.9	94, 196	98, 204	
ZIN8	Up/Down counter ZIN input pin ch.8	91, 192	94, 200	
ZIN9	Up/Down counter ZIN input pin ch.9	95, 197	99, 205	
RMII_RXERR	Ethernet pin	35	35	
RMII_REFCLK	Ethernet pin	36	36	
RMII_RX0	Ethernet pin	37	37	
RMII_RX1	Ethernet pin	38	38	
RMII_TXD0	Ethernet pin	39	39	
RMII_TXD1	Ethernet pin	40	40	
RXD0	Ethernet pin	48	50	
RXD1	Ethernet pin	49	51	
RXD2	Ethernet pin	50	52	
RXD3	Ethernet pin	51	53	
TXD0	Ethernet pin	44	46	
TXD1	Ethernet pin	45	47	
TXD2	Ethernet pin	46	48	
TXD3	Ethernet pin	47	49	
RXER	Ethernet pin	56	58	
RXDV	Ethernet pin	34, 57	34, 59	Pin 34 not supported for revision M
RXCLK	Ethernet pin	55	57	
TXER	Ethernet pin	60	62	
TXEN	Ethernet pin	41	41	
TXCLK	Ethernet pin	54	56	
MDC	Ethernet pin	31	31	
MDIO	Ethernet pin	32	32	
MLBCLK	MediaLB pin	84	86	
MLBDAT	MediaLB pin	82	84	
MLBSIG	MediaLB pin	83	85	
TxCLK-	LVDS clock output pin	21	21	Described as TXOUT4M in FPD-Link Converter
TxCLK+	LVDS clock output pin	20	20	Described as TXOUT4P in FPD-Link Converter
TxDOUT0-	LVDS data output pin	25	25	Described as TXOUT0M in FPD-Link Converter
TxDOUT0+	LVDS data output pin	24	24	Described as TXOUT0P in FPD-Link Converter
TxDOUT1-	LVDS data output pin	23	23	Described as TXOUT1M in FPD-Link Converter

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
TxDOUT1+	LVDS data output pin	22	22	Described as TXOUT1P in FPD-Link Converter
TxDOUT2-	LVDS data output pin	19	19	Described as TXOUT2M in FPD-Link Converter
TxDOUT2+	LVDS data output pin	18	18	Described as TXOUT2P in FPD-Link Converter
TxDOUT3-	LVDS data output pin	17	17	Described as TXOUT3M in FPD-Link Converter
TxDOUT3+	LVDS data output pin	16	16	Described as TXOUT3P in FPD-Link Converter
G_SCLK0	Graphic HS-SPI clock output pin	72	74	
G_SDATA0_0	Graphic HS-SPI0 data 0 pin	75	77	
G_SDATA0_1	Graphic HS-SPI0 data 1 pin	77	79	
G_SDATA0_2	Graphic HS-SPI0 data 2 pin	76	78	
G_SDATA0_3	Graphic HS-SPI0 data 3 pin	79	81	
G_SDATA1_0	Graphic HS-SPI1 data 0 pin	66	68	
G_SDATA1_1	Graphic HS-SPI1 data 1 pin	68	70	
G_SDATA1_2	Graphic HS-SPI1 data 2 pin	67	69	
G_SDATA1_3	Graphic HS-SPI1 data 3 pin	70	72	
G_SSEL0	Graphic HS-SPI select 0 output pin	78	80	
G_SSEL1	Graphic HS-SPI select 1 output pin	69	71	
G_CK_1	Hyper Bus 1 clock output pin	63	65	
G_CS#1_1	Hyper Bus 1 select 1 output pin	70	72	
G_CS#2_1	Hyper Bus 1 select 2 output pin	75	77	
G_DQ0_1	Hyper Bus 1 Data 0 pin	69	71	
G_DQ1_1	Hyper Bus 1 Data 1 pin	68	70	
G_DQ2_1	Hyper Bus 1 Data 2 pin	67	69	
G_DQ3_1	Hyper Bus 1 Data 3 pin	66	68	
G_DQ4_1	Hyper Bus 1 Data 4 pin	76	78	
G_DQ5_1	Hyper Bus 1 Data 5 pin	77	79	
G_DQ6_1	Hyper Bus 1 Data 6 pin	78	80	
G_DQ7_1	Hyper Bus 1 Data 7 pin	79	81	
G_RWDS_1	Hyper Bus 1 RWDS pin #699	72	74	
G_CK_2	Hyper Bus 2 clock output pin	44	46	
G_CS#1_2	Hyper Bus 2 select 1 output pin	49	51	
G_CS#2_2	Hyper Bus 2 select 2 output pin	51	53	
G_DQ0_2	Hyper Bus 2 Data 0 pin	48	50	
G_DQ1_2	Hyper Bus 2 Data 1 pin	47	49	
G_DQ2_2	Hyper Bus 2 Data 2 pin	46	48	
G_DQ3_2	Hyper Bus 2 Data 3 pin	45	47	
G_DQ4_2	Hyper Bus 2 Data 4 pin	54	56	
G_DQ5_2	Hyper Bus 2 Data 5 pin	55	57	
G_DQ6_2	Hyper Bus 2 Data 6 pin	56	58	
G_DQ7_2	Hyper Bus 2 Data 7 pin	57	59	
G_RWDS_2	Hyper Bus 2 RWDS pin	50	52	
M_SCLK0	MCU HS-SPI clock output pin	63	65	
M_SDATA0_0	MCU HS-SPI0 data 0 pin	66	68	
M_SDATA0_1	MCU HS-SPI0 data 1 pin	68	70	
M_SDATA0_2	MCU HS-SPI0 data 2 pin	67	69	
M_SDATA0_3	MCU HS-SPI0 data 3 pin	70	72	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
M_SDATA1_0	MCU HS-SPI1 data 0 pin	75	77	
M_SDATA1_1	MCU HS-SPI1 data 1 pin	77	79	
M_SDATA1_2	MCU HS-SPI1 data 2 pin	76	78	
M_SDATA1_3	MCU HS-SPI1 data 3 pin	79	81	
M_SSEL0	MCU HS-SPI select 0 output pin	69	71	
M_SSEL1	MCU HS-SPI select 1 output pin	78	80	
M_CK_0	MCU Hyper Bus clock output pin	63	65	
M_CS#1_0	MCU Hyper Bus select 1 output pin	70	72	
M_CS#2_0	MCU Hyper Bus select 2 output pin	75	77	
M_DQ0_0	MCU Hyper Bus Data 0 pin	69	71	
M_DQ1_0	MCU Hyper Bus Data 1 pin	68	70	
M_DQ2_0	MCU Hyper Bus Data 2 pin	67	69	
M_DQ3_0	MCU Hyper Bus Data 3 pin	66	68	
M_DQ4_0	MCU Hyper Bus Data 4 pin	76	78	
M_DQ5_0	MCU Hyper Bus Data 5 pin	77	79	
M_DQ6_0	MCU Hyper Bus Data 6 pin	78	80	
M_DQ7_0	MCU Hyper Bus Data 7 pin	79	81	
M_RWDS_0	MCU Hyper Bus RWDS pin #699	72	74	
DSP0_CLK	Display 0 Clock output pin	32, 58	32, 60	
DSP0_CLK-	Display 0 RSDS Clock output pin	33	33	
DSP0_CLK+	Display 0 RSDS Clock output pin	32	32	
DSP0_CTRL0	Display 0 Control output pin	59, 60, 196	61, 62, 204	
DSP0_CTRL1	Display 0 Control output pin	31, 60, 197	31, 62, 205	
DSP0_CTRL2	Display 0 Control output pin	33, 57, 60, 82, 198	33, 59, 62, 84, 206	
DSP0_CTRL3	Display 0 Control output pin	83, 199	85, 207	
DSP0_CTRL4	Display 0 Control output pin	84, 200	86, 208	
DSP0_CTRL5	Display 0 Control output pin	201	209	
DSP0_CTRL6	Display 0 Control output pin	202	210	
DSP0_CTRL7	Display 0 Control output pin	203	211	
DSP0_CTRL8	Display 0 Control output pin	204	212	
DSP0_CTRL9	Display 0 Control output pin	205	213	
DSP0_CTRL10	Display 0 Control output pin	206	214	
DSP0_CTRL11	Display 0 Control output pin	207	215	
DSP0_DATA0_0	Display 0 Data output pin	34	34	
DSP0_DATA0_1	Display 0 Data output pin	36	36	
DSP0_DATA0_2	Display 0 Data output pin	38	38	
DSP0_DATA0_3	Display 0 Data output pin	40	40	
DSP0_DATA0_4	Display 0 Data output pin	31	31, 44	
DSP0_DATA0_5	Display 0 Data output pin	44	46	
DSP0_DATA0_6	Display 0 Data output pin	46	48	
DSP0_DATA0_7	Display 0 Data output pin	48	50	
DSP0_DATA0_8	Display 0 Data output pin	50	52	
DSP0_DATA0_9	Display 0 Data output pin	54	56	
DSP0_DATA0_10	Display 0 Data output pin	56	58	
DSP0_DATA0_11	Display 0 Data output pin	32, 58	32, 60	
DSP0_DATA1_0	Display 0 Data output pin	35	35	
DSP0_DATA1_1	Display 0 Data output pin	37	37	
DSP0_DATA1_2	Display 0 Data output pin	39	39	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
DSP0_DATA1_3	Display 0 Data output pin	41	41	
DSP0_DATA1_4	Display 0 Data output pin	33	33, 45	
DSP0_DATA1_5	Display 0 Data output pin	45	47	
DSP0_DATA1_6	Display 0 Data output pin	47	49	
DSP0_DATA1_7	Display 0 Data output pin	49	51	
DSP0_DATA1_8	Display 0 Data output pin	51	53	
DSP0_DATA1_9	Display 0 Data output pin	55	57	
DSP0_DATA1_10	Display 0 Data output pin	31, 57	31, 59	
DSP0_DATA1_11	Display 0 Data output pin	33, 59	33, 61	
DSP0_DATA_D0-	Display 0 RSDS Data output pin	35	35	
DSP0_DATA_D0+	Display 0 RSDS Data output pin	34	34	
DSP0_DATA_D1-	Display 0 RSDS Data output pin	37	37	
DSP0_DATA_D1+	Display 0 RSDS Data output pin	36	36	
DSP0_DATA_D2-	Display 0 RSDS Data output pin	39	39	
DSP0_DATA_D2+	Display 0 RSDS Data output pin	38	38	
DSP0_DATA_D3-	Display 0 RSDS Data output pin	41	41	
DSP0_DATA_D3+	Display 0 RSDS Data output pin	40	40	
DSP0_DATA_D4-	Display 0 RSDS Data output pin	-	45	
DSP0_DATA_D4+	Display 0 RSDS Data output pin	-	44	
DSP0_DATA_D5-	Display 0 RSDS Data output pin	45	47	
DSP0_DATA_D5+	Display 0 RSDS Data output pin	44	46	
DSP0_DATA_D6-	Display 0 RSDS Data output pin	47	49	
DSP0_DATA_D6+	Display 0 RSDS Data output pin	46	48	
DSP0_DATA_D7-	Display 0 RSDS Data output pin	49	51	
DSP0_DATA_D7+	Display 0 RSDS Data output pin	48	50	
DSP0_DATA_D8-	Display 0 RSDS Data output pin	51	53	
DSP0_DATA_D8+	Display 0 RSDS Data output pin	50	52	
DSP0_DATA_D9-	Display 0 RSDS Data output pin	55	57	
DSP0_DATA_D9+	Display 0 RSDS Data output pin	54	56	
DSP0_DATA_D10-	Display 0 RSDS Data output pin	57	59	
DSP0_DATA_D10+	Display 0 RSDS Data output pin	56	58	
DSP0_DATA_D11-	Display 0 RSDS Data output pin	59	61	
DSP0_DATA_D11+	Display 0 RSDS Data output pin	58	60	
DSP1_CLK	Display 1 Clock output pin	199, 204	207, 212	
DSP1_CTRL0	Display 1 Control output pin	200, 207	208, 215	
DSP1_CTRL1	Display 1 Control output pin	201, 206	209, 214	
DSP1_CTRL2	Display 1 Control output pin	198, 205	206, 213	
DSP1_DATA0_0	Display 1 Data output pin	203	211	
DSP1_DATA0_1	Display 1 Data output pin	201	209	
DSP1_DATA0_2	Display 1 Data output pin	199	207	
DSP1_DATA0_3	Display 1 Data output pin	197	205	
DSP1_DATA0_4	Display 1 Data output pin	193	201	
DSP1_DATA0_5	Display 1 Data output pin	191	199	
DSP1_DATA0_6	Display 1 Data output pin	189	197	
DSP1_DATA0_7	Display 1 Data output pin	187	195	
DSP1_DATA0_8	Display 1 Data output pin	181	189	
DSP1_DATA0_9	Display 1 Data output pin	179	187	
DSP1_DATA0_10	Display 1 Data output pin	177	185	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
DSP1_DATA0_11	Display 1 Data output pin	175	183	
DSP1_DATA1_0	Display 1 Data output pin	202	210	
DSP1_DATA1_1	Display 1 Data output pin	200	208	
DSP1_DATA1_2	Display 1 Data output pin	198	206	
DSP1_DATA1_3	Display 1 Data output pin	196	204	
DSP1_DATA1_4	Display 1 Data output pin	192	200	
DSP1_DATA1_5	Display 1 Data output pin	190	198	
DSP1_DATA1_6	Display 1 Data output pin	188	196	
DSP1_DATA1_7	Display 1 Data output pin	186	194	
DSP1_DATA1_8	Display 1 Data output pin	180	188	
DSP1_DATA1_9	Display 1 Data output pin	178	186	
DSP1_DATA1_10	Display 1 Data output pin	176	184	
DSP1_DATA1_11	Display 1 Data output pin	174	182	
CAP0_CLK	Video Capture 0 Clock input pin	59	61	
CAP0_DATA0	Video Capture 0 Data input pin	31	31	
CAP0_DATA1	Video Capture 0 Data input pin	32	32	
CAP0_DATA2	Video Capture 0 Data input pin	33	33	
CAP0_DATA3	Video Capture 0 Data input pin	34	34	
CAP0_DATA4	Video Capture 0 Data input pin	35	35	
CAP0_DATA5	Video Capture 0 Data input pin	36	36	
CAP0_DATA6	Video Capture 0 Data input pin	37	37	
CAP0_DATA7	Video Capture 0 Data input pin	38	38	
CAP0_DATA8	Video Capture 0 Data input pin	39	39	
CAP0_DATA9	Video Capture 0 Data input pin	40	40	
CAP0_DATA10	Video Capture 0 Data input pin	41	41	
CAP0_DATA11	Video Capture 0 Data input pin	44	44, 46	
CAP0_DATA12	Video Capture 0 Data input pin	45	45, 47	
CAP0_DATA13	Video Capture 0 Data input pin	44, 46	46, 48	
CAP0_DATA14	Video Capture 0 Data input pin	45, 47	47, 49	
CAP0_DATA15	Video Capture 0 Data input pin	46, 48	48, 50	
CAP0_DATA16	Video Capture 0 Data input pin	47	49	
CAP0_DATA17	Video Capture 0 Data input pin	48	50	
CAP0_DATA18	Video Capture 0 Data input pin	49	51	
CAP0_DATA19	Video Capture 0 Data input pin	50	52	
CAP0_DATA20	Video Capture 0 Data input pin	51	53	
CAP0_DATA21	Video Capture 0 Data input pin	54	56	
CAP0_DATA22	Video Capture 0 Data input pin	55	57	
CAP0_DATA23	Video Capture 0 Data input pin	56	58	
CAP0_DATA24	Video Capture 0 Data input pin	82	84	
CAP0_DATA25	Video Capture 0 Data input pin	83	85	
CAP0_DATA32	Video Capture 0 Data input pin	56, 57	58, 59	
CAP0_DATA33	Video Capture 0 Data input pin	58	60	
CAP0_DATA34	Video Capture 0 Data input pin	60	62	
CAP0_DATA35	Video Capture 0 Data input pin	57	59	
INDICATOR0_0	Indicator PWM output pin 0 (It can also obtained from INDICATOR0_1)	92	95	
INDICATOR0_1	Indicator PWM output pin (It can also obtained from INDICATOR0_0)	170	178	
P0_00	General-Purpose I/O port	40	40	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
P0_01	General-Purpose I/O port	41	41	
P0_02	General-Purpose I/O port	-	44	
P0_03	General-Purpose I/O port	-	45	
P0_04	General-Purpose I/O port	44	46	
P0_05	General-Purpose I/O port	45	47	
P0_06	General-Purpose I/O port	46	48	
P0_07	General-Purpose I/O port	47	49	
P0_08	General-Purpose I/O port	48	50	
P0_09	General-Purpose I/O port	49	51	
P0_10	General-Purpose I/O port	50	52	
P0_11	General-Purpose I/O port	51	53	
P0_12	General-Purpose I/O port	54	56	
P0_13	General-Purpose I/O port	55	57	
P0_14	General-Purpose I/O port	56	58	
P0_15	General-Purpose I/O port	57	59	
P0_16	General-Purpose I/O port	58	60	
P0_17	General-Purpose I/O port	59	61	
P0_18	General-Purpose I/O port	32	32	
P0_19	General-Purpose I/O port	33	33	
P0_26	General-Purpose I/O port	82	84	
P0_27	General-Purpose I/O port	83	85	
P0_28	General-Purpose I/O port	84	86	
P0_30	General-Purpose I/O port	72	74	
P0_31	General-Purpose I/O port	75	77	
P1_00	General-Purpose I/O port	77	79	
P1_01	General-Purpose I/O port	76	78	
P1_02	General-Purpose I/O port	79	81	
P1_03	General-Purpose I/O port	78	80	
P1_04	General-Purpose I/O port	69	71	
P1_05	General-Purpose I/O port	66	68	
P1_06	General-Purpose I/O port	68	70	
P1_07	General-Purpose I/O port	67	69	
P1_08	General-Purpose I/O port	70	72	
P1_09	General-Purpose I/O port	63	65	
P2_16	General-Purpose I/O port	170	178	
P2_17	General-Purpose I/O port	169	177	
P2_19	General-Purpose I/O port	159	165	
P2_22	General-Purpose I/O port	89	91	
P2_24	General-Purpose I/O port	-	92	
P2_25	General-Purpose I/O port	90	93	
P2_26	General-Purpose I/O port	91	94	
P2_27	General-Purpose I/O port	92	95	
P2_28	General-Purpose I/O port	-	96	
P2_29	General-Purpose I/O port	93	97	
P2_30	General-Purpose I/O port	94	98	
P2_31	General-Purpose I/O port	95	99	
P3_00	General-Purpose I/O port	96	100	
P3_01	General-Purpose I/O port	97	101	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
P3_02	General-Purpose I/O port	98	102	
P3_03	General-Purpose I/O port	99	103	
P3_04	General-Purpose I/O port	100	104	
P3_05	General-Purpose I/O port	101	105	
P3_06	General-Purpose I/O port	102	106	
P3_07	General-Purpose I/O port	160	166	
P3_08	General-Purpose I/O port	161	167	
P3_09	General-Purpose I/O port	162	168	
P3_10	General-Purpose I/O port	-	169	
P3_11	General-Purpose I/O port	-	170	
P3_12	General-Purpose I/O port	163	171	
P3_13	General-Purpose I/O port	164	172	
P3_14	General-Purpose I/O port	165	173	
P3_15	General-Purpose I/O port	166	174	
P3_16	General-Purpose I/O port	167	175	
P3_17	General-Purpose I/O port	168	176	
P3_18	General-Purpose I/O port	118	122	
P3_19	General-Purpose I/O port	-	123	
P3_20	General-Purpose I/O port	-	124	
P3_21	General-Purpose I/O port	127	133	
P3_22	General-Purpose I/O port	128	134	
P3_23	General-Purpose I/O port	129	135	
P3_24	General-Purpose I/O port	130	136	
P3_25	General-Purpose I/O port	131	137	
P3_26	General-Purpose I/O port	132	138	
P3_27	General-Purpose I/O port	133	139	
P3_28	General-Purpose I/O port	134	140	
P3_29	General-Purpose I/O port	137	143	
P3_30	General-Purpose I/O port	138	144	
P3_31	General-Purpose I/O port	139	145	
P4_00	General-Purpose I/O port	140	146	
P4_01	General-Purpose I/O port	141	147	
P4_02	General-Purpose I/O port	142	148	
P4_03	General-Purpose I/O port	143	149	
P4_04	General-Purpose I/O port	144	150	
P4_05	General-Purpose I/O port	147	153	
P4_06	General-Purpose I/O port	148	154	
P4_07	General-Purpose I/O port	149	155	
P4_08	General-Purpose I/O port	150	156	
P4_09	General-Purpose I/O port	151	157	
P4_10	General-Purpose I/O port	152	158	
P4_11	General-Purpose I/O port	153	159	
P4_12	General-Purpose I/O port	154	160	
P4_25	General-Purpose I/O port	204	212	
P4_26	General-Purpose I/O port	205	213	
P4_27	General-Purpose I/O port	206	214	
P4_28	General-Purpose I/O port	207	215	
P4_29	General-Purpose I/O port	174	182	

Port Name	Description	Package Pin Number		Remark
		TEQFP208	TEQFP216	
P4_30	General-Purpose I/O port	175	183	
P4_31	General-Purpose I/O port	176	184	
P5_00	General-Purpose I/O port	177	185	
P5_01	General-Purpose I/O port	178	186	
P5_02	General-Purpose I/O port	179	187	
P5_03	General-Purpose I/O port	180	188	
P5_04	General-Purpose I/O port	181	189	
P5_05	General-Purpose I/O port	186	194	
P5_06	General-Purpose I/O port	187	195	
P5_07	General-Purpose I/O port	188	196	
P5_08	General-Purpose I/O port	189	197	
P5_09	General-Purpose I/O port	190	198	
P5_10	General-Purpose I/O port	191	199	
P5_11	General-Purpose I/O port	192	200	
P5_12	General-Purpose I/O port	193	201	
P5_13	General-Purpose I/O port	196	204	
P5_14	General-Purpose I/O port	197	205	
P5_15	General-Purpose I/O port	198	206	
P5_16	General-Purpose I/O port	199	207	
P5_17	General-Purpose I/O port	200	208	
P5_18	General-Purpose I/O port	201	209	
P5_19	General-Purpose I/O port	202	210	
P5_20	General-Purpose I/O port	203	211	
P5_21	General-Purpose I/O port	31	31	
P5_22	General-Purpose I/O port	60	62	
P5_27	General-Purpose I/O port	34	34	
P5_28	General-Purpose I/O port	35	35	
P5_29	General-Purpose I/O port	36	36	
P5_30	General-Purpose I/O port	37	37	
P5_31	General-Purpose I/O port	38	38	
P6_00	General-Purpose I/O port	39	39	

2. Remark

Notes:

- *The port description list shows the port function of description which is mounted and supported on the product. The function which is not described in this table is not supported and assured.*
- *See the function list of the product as well.*

CHAPTER 11: Port Configuration



This chapter explains the port configuration.

1. Overview
2. Configuration and Block Diagram
3. Operation
4. Registers
5. Configuration Procedure

CODE: PORTCONFIG-S6J3200-E1

1. Overview

This chapter explains the particular port configuration of the product PKG pins.

The microcontroller has various functions such as general purpose I/O ports, input or output timers, analog input ports and son on. Some of these functions are multiplexed implemented in a pin, and the assignment to a pin is particular for the product.

A port configuration is to determine which function and which input/output direction is applied to a port.

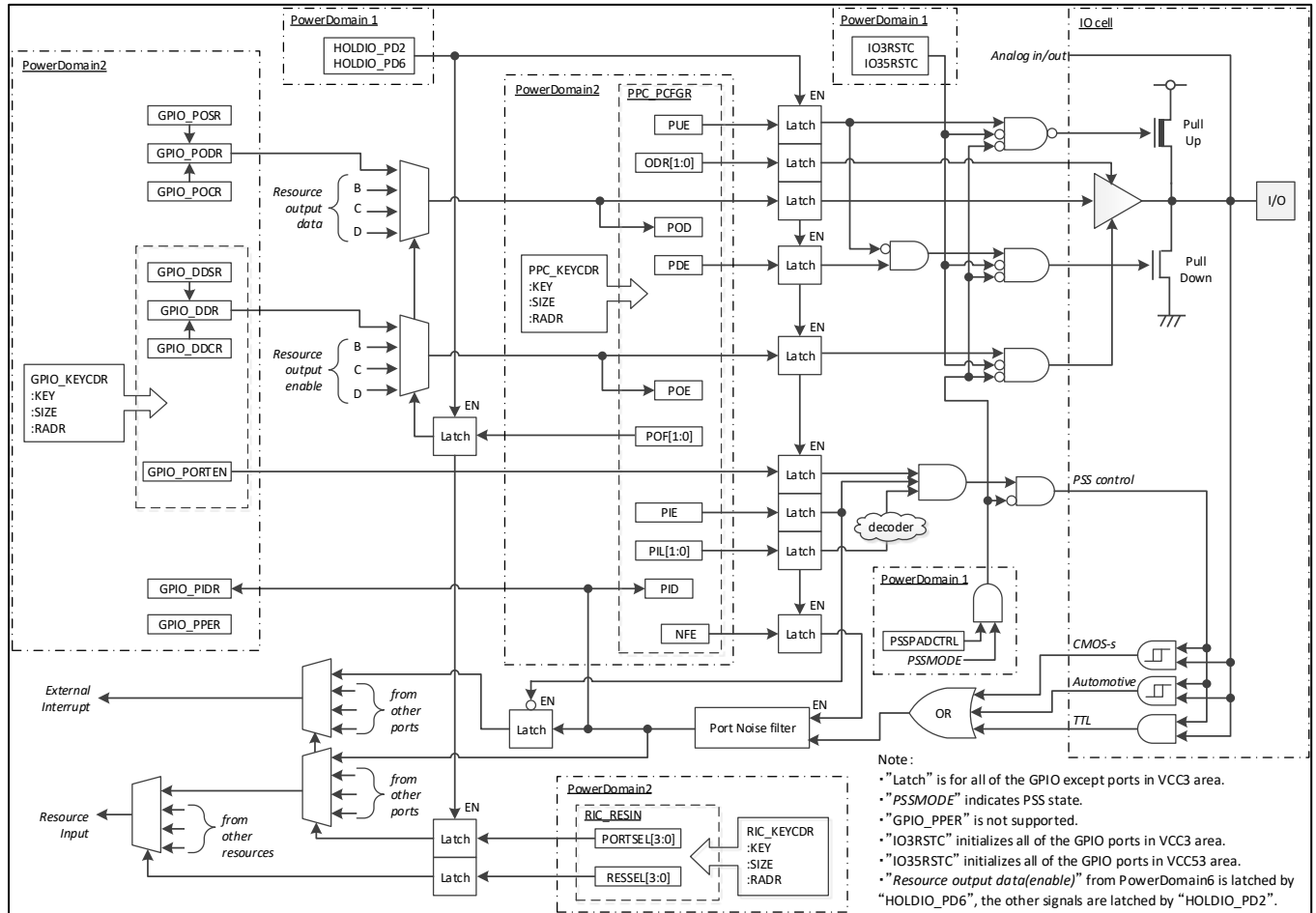
"3. Operation" of this chapter describes following.

- The particular port configurations of the resource input configuration register (RIC)
- The port output function configuration
- The analog I/O setting
- The input level setting
- The output drive capacity setting

See the common information of the registers on the hardware manual of Traveo Platform V3.

2. Configuration and Block Diagram

Figure 2-1



3. Operation

The relation between configuration and operation is described.

3.1. Resource Input Configuration Module

The resource input configuration module (RIC) is a function to select input from an external or output from another internal resource as resource input.

A resource which supports either a port input relocation or a resource inputs from the other resource has its RIC_RESIN register to configure resource input configuration.

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN051 (0x0066)	SCL4	RESSE L (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN052 (0x0068)	SDA4	RESSE L (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN093 (0x00BA)	SCL10	RESSE L (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN094 (0x00BC)	SDA10	RESSE L (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN107 (0x00D6)	SCL12	RESSEL (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN108 (0x00D8)	SDA12	RESSEL (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN002 (0x0004)	SCL16	RESSEL (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN003 (0x0006)	SDA16	RESSEL (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN004 (0x0008)	MFS16_TRIGGER	RESSEL (0-7)	TOT48	TOT49	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN009 (0x0012)	SCL17	RESSEL (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN010 (0x0014)	SDA17	RESSEL (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN011 (0x0016)	MFS17_TRIGGER	RESSEL (0-7)	TOT48	TOT49	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN021 (0x002A)	SIN0	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P2_27	-	-	P0_05	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN022 (0x002C)	SCK0	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P2_26	-	-	P5_31	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN023 (0x002E)	SCL0	RESSE L (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN024 (0x0030)	SDA0	RESSE L (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN025 (0x0032)	MFS0_TRIG GER	RESSE L (0-7)	TOT0	TOT1	TOT2	TOT3	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN028 (0x0038)	SIN1	RESSE L (0-7)	-	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	P2_31	P0_28	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN029 (0x003A)	SCK1	RESSE L (0-7)	-	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	P2_30	P0_27	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN030 (0x003C)	SCL1	RESSEL (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN031 (0x003E)	SDA1	RESSEL (0-7)	80ns noise filter disable	80ns noise filter enable	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN032 (0x0040)	MFS1_TRIG GER	RESSEL (0-7)	TOT0	TOT1	TOT2	TOT3	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN039 (0x004E)	MFS2_TRIG GER	RESSEL (0-7)	TOT0	TOT1	TOT2	TOT3	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN046 (0x005C)	MFS3_TRIG GER	RESSEL (0-7)	TOT0	TOT1	TOT2	TOT3	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN053 (0x006A)	MFS4_TRIG GER	RESSEL (0-7)	TOT0	TOT1	TOT2	TOT3	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN077 (0x009A)	SIN8	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	P5_04	-	P3_05	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN078 (0x009C)	SCK8	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	P5_03	-	P3_04	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN081 (0x00A2)	MFS8_TRIGGER	RESSEL (0-7)	TOT16	TOT17	TOT18	TOT19	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN084 (0x00A8)	SIN9	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	P5_08	P3_09	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN085 (0x00AA)	SCK9	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	P5_07	P3_08	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN088 (0x00B0)	MFS9_TRIGGER	RESSEL (0-7)	TOT16	TOT17	TOT18	TOT19	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN091 (0x00B6)	SIN10	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	P5_12	P3_14	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN092 (0x00B8)	SCK10	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	P5_11	P3_13	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN095 (0x00BE)	MFS10_TRIGGER	RESSEL (0-7)	TOT16	TOT17	TOT18	TOT19	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN098 (0x00C4)	SIN11	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	P5_16	P3_17	P4_28	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN099 (0x00C6)	SCK11	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	P5_15	P3_16	P4_27	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN102 (0x00CC)	MFS11_TRIGGER	RESSEL (0-7)	TOT16	TOT17	TOT18	TOT19	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN109 (0x00DA)	MFS12_TRIGGER	RESSEL (0-7)	TOT16	TOT17	TOT18	TOT19	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN133 (0x010A)	RX5	RESSEL (0-7)	PORT_P_IN	MCAN5_PIN_AND_TX	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	P3_08	-	-	-
		PORTSEL (8-15)	P3_14	-	-	-	-	-	-	-
RIC_RE SIN134 (0x010C)	RX6	RESSEL (0-7)	PORT_P_IN	MCAN6_PIN_AND_TX	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	P3_10	-
		PORTSEL (8-15)	-	-	P3_16	-	-	-	-	-
RIC_RE SIN136 (0x0110)	RX0	RESSEL (0-7)	PORT_P_IN	MCAN0_PIN_AND_TX	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN137 (0x0112)	RX1	RESSEL (0-7)	PORT_P_IN	MCAN1_PIN_AND_TX	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	P3_05	-	-	-	P4_11	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN141 (0x011A)	TIN48	RESSEL (0-7)	PORT_P_IN	TOT49	RLT49_UFSET	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN142 (0x011C)	TIN49	RESSEL (0-7)	PORT_P IN	TOT48	RLT48_U FSET	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN144 (0x0120)	TIN0	RESSEL (0-7)	PORT_P IN	TOT3	RLT3_U FSET	TOT1	PPG0_T OUT0	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P2_28	P5_28	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN145 (0x0122)	TIN1	RESSEL (0-7)	PORT_P IN	TOT0	RLT0_U FSET	TOT2	PPG1_T OUT0	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P2_29	P5_30	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN146 (0x0124)	TIN2	RESSEL (0-7)	PORT_P IN	TOT1	RLT1_U FSET	TOT3	PPG2_T OUT0	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P6_00	P2_30	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN147 (0x0126)	TIN3	RESSEL (0-7)	PORT_P IN	TOT2	RLT2_U FSET	TOT0	PPG3_T OUT0	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_01	P2_31	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN160 (0x0140)	TIN16	RESSEL (0-7)	PORT_P IN	TOT19	RLT19_U FSET	TOT17	PPG6_T OUT0	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_03	P3_04	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN161 (0x0142)	TIN17	RESSEL (0-7)	PORT_P IN	TOT16	RLT16_U FSET	TOT18	PPG7_T OUT0	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_05	P3_06	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN162 (0x0144)	TIN18	RESSEL (0-7)	PORT_P IN	TOT17	RLT17_U FSET	TOT19	PPG8_T OUT0	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_07	P3_09	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN163 (0x0146)	TIN19	RESSEL (0-7)	PORT_P IN	TOT18	RLT18_U FSET	TOT16	PPG9_T OUT0	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_09	P3_11	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN176 (0x0160)	TIN32	RESSEL (0-7)	PORT_P IN	TOT35	RLT35_U FSET	TOT33	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_11	P3_13	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN177 (0x0162)	TIN33	RESSEL (0-7)	PORT_P IN	TOT32	RLT32_U FSET	TOT34	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_13	P3_15	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN178 (0x0164)	TIN34	RESSEL (0-7)	PORT_P IN	TOT33	RLT33_U FSET	TOT35	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_15	P3_17	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN179 (0x0166)	TIN35	RESSEL (0-7)	PORT_P IN	TOT34	RLT34_U FSET	TOT32	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_17	P3_19	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN192 (0x0180)	EINT0	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P6_00	P0_15	P0_19	P1_09	P2_16	P3_00	P3_16	P4_00
		PORTSEL (8-15)	-	P5_00	P5_16	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN193 (0x0182)	EINT1	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_00	P0_16	P0_26	P2_17	P3_01	P3_17	P4_01	-
		PORTSEL (8-15)	P5_01	P5_17	-	-	-	-	-	-
RIC_RE SIN194 (0x0184)	EINT2	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_01	P0_17	P0_27	-	P3_02	P3_18	P4_02	-
		PORTSEL (8-15)	P5_02	P5_18	-	-	-	-	-	-
RIC_RE SIN195 (0x0186)	EINT3	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_02	P5_21	P0_28	P2_19	P3_03	P3_19	P4_03	-
		PORTSEL (8-15)	P5_03	P5_19	-	-	-	-	-	-
RIC_RE SIN196 (0x0188)	EINT4	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_03	P5_22	-	-	P3_04	P3_20	P4_04	-
		PORTSEL (8-15)	P5_04	P5_20	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN197 (0x018A)	EINT5	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_04	-	P0_30	-	P3_05	P3_21	P4_05	-
		PORTSEL (8-15)	P5_05	-	-	-	-	-	-	-
RIC_RE SIN198 (0x018C)	EINT6	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_05	-	P0_31	P2_22	P3_06	P3_22	P4_06	-
		PORTSEL (8-15)	P5_06	-	-	-	-	-	-	-
RIC_RE SIN199 (0x018E)	EINT7	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_06	-	P1_00	-	P3_07	P3_23	P4_07	-
		PORTSEL (8-15)	P5_07	-	-	-	-	-	-	-
RIC_RE SIN200 (0x0190)	EINT8	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_07	-	P1_01	P2_24	P3_08	P3_24	P4_08	-
		PORTSEL (8-15)	P5_08	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN201 (0x0192)	EINT9	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_08	-	P1_02	P2_25	P3_09	P3_25	P4_09	P4_25
		PORTSEL (8-15)	P5_09	-	-	-	-	-	-	-
RIC_RE SIN202 (0x0194)	EINT10	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_09	-	P1_03	P2_26	P3_10	P3_26	P4_10	P4_26
		PORTSEL (8-15)	P5_10	-	-	-	-	-	-	-
RIC_RE SIN203 (0x0196)	EINT11	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_10	-	P1_04	P2_27	P3_11	P3_27	P4_11	P4_27
		PORTSEL (8-15)	P5_11	-	-	P5_27	-	-	-	-
RIC_RE SIN204 (0x0198)	EINT12	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_11	-	P1_05	P2_28	P3_12	P3_28	P4_12	P4_28
		PORTSEL (8-15)	P5_12	-	-	P5_28	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN205 (0x019A)	EINT13	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_12	-	P1_06	P2_29	P3_13	P3_29	-	P4_29
		PORTSEL (8-15)	P5_13	-	-	P5_29	-	-	-	-
RIC_RE SIN206 (0x019C)	EINT14	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_13	-	P1_07	P2_30	P3_14	P3_30	-	P4_30
		PORTSEL (8-15)	P5_14	-	-	P5_30	-	-	-	-
RIC_RE SIN207 (0x019E)	EINT15	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P5_31	P0_14	P0_18	P1_08	P2_31	P3_15	P3_31	-
		PORTSEL (8-15)	P4_31	P5_15	-	-	-	-	-	-
RIC_RE SIN224 (0x01C0)	FRT0_TEXT	RESSEL (0-7)	PORT_P IN	TOT0	TOT1	PPG0_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN225 (0x01C2)	FRT1_TEXT	RESSEL (0-7)	PORT_P IN	TOT0	TOT2	PPG1_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN226 (0x01C4)	FRT2_TEXT	RESSEL (0-7)	PORT_P IN	TOT0	TOT3	PPG2_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN227 (0x01C6)	FRT3_TEXT	RESSEL (0-7)	PORT_P IN	TOT0	TOT1	PPG3_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN228 (0x01C8)	FRT4_TEXT	RESSEL (0-7)	PORT_P IN	TOT0	TOT2	PPG4_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN229 (0x01CA)	FRT5_TEXT	RESSEL (0-7)	PORT_P IN	TOT0	TOT3	PPG5_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN230 (0x01CC)	FRT6_TEXT	RESSEL (0-7)	PORT_P IN	TOT0	TOT1	PPG0_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN231 (0x01CE)	FRT7_TEXT	RESSEL (0-7)	PORT_P IN	TOT0	TOT2	PPG1_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN232 (0x01D0)	FRT8_TEXT	RESSEL (0-7)	PORT_P IN	RLT3_U FSET	RLT16_U FSET	PPG6_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN233 (0x01D2)	FRT9_TEXT	RESSEL (0-7)	PORT_P IN	RLT3_U FSET	RLT17_U FSET	PPG7_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN234 (0x01D4)	FRT10_TEXT	RESSEL (0-7)	PORT_P IN	RLT3_U FSET	RLT18_U FSET	PPG8_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN235 (0x01D6)	FRT11_TEXT	RESSEL (0-7)	PORT_P IN	RLT3_U FSET	RLT16_U FSET	PPG9_T OUT2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN240 (0x01E0)	OCU pair Ch.0-0	RESSE L (0-7)	FRT Ch0	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.0-1	RESSE L (0-7)	FRT Ch0	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN241 (0x01E2)	OCU0_MOD 0	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN242 (0x01E4)	OCU0_MOD 1	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN243 (0x01E6)	OCU pair Ch.1-0	RESSEL (0-7)	FRT Ch1	FRT Ch0	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.1-1	RESSEL (0-7)	FRT Ch1	FRT Ch0	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN244 (0x01E8)	OCU1_MOD 0	RESSEL (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN245 (0x01EA)	OCU1_MOD 1	RESSEL (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN246 (0x01EC)	OCU pair Ch.2-0	RESSE L (0-7)	FRT Ch2	FRT Ch0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.2-1	RESSE L (0-7)	FRT Ch2	FRT Ch0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN247 (0x01EE)	OCU2_MOD 0	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN248 (0x01F0)	OCU2_MOD 1	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN249 (0x01F2)	OCU pair Ch.3-0	RESSE L (0-7)	FRT Ch3	FRT Ch0	FRT Ch1	FRT Ch2	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.3-1	RESSE L (0-7)	FRT Ch3	FRT Ch0	FRT Ch1	FRT Ch2	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN250 (0x01F4)	OCU3_MOD 0	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN251 (0x01F6)	OCU3_MOD 1	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN252 (0x01F8)	OCU pair Ch.4-0	RESSEL (0-7)	FRT Ch4	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.4-1	RESSEL (0-7)	FRT Ch4	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN253 (0x01FA)	OCU4_MOD 0	RESSEL (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN254 (0x01FC)	OCU4_MOD 1	RESSEL (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN255 (0x01FE)	OCU pair Ch.5-0	RESSE L (0-7)	FRT Ch5	FRT Ch4	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.5-1	RESSE L (0-7)	FRT Ch5	FRT Ch4	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN256 (0x0200)	OCU5_MOD 0	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN257 (0x0202)	OCU5_MOD 1	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN258 (0x0204)	OCU pair Ch.6-0	RESSE L (0-7)	FRT Ch6	FRT Ch4	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.6-1	RESSE L (0-7)	FRT Ch6	FRT Ch4	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN259 (0x0206)	OCU6_MOD 0	RESSEL (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN260 (0x0208)	OCU6_MOD 1	RESSEL (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN261 (0x020A)	OCU pair Ch.7-0	RESSE L (0-7)	FRT Ch7	FRT Ch4	FRT Ch5	FRT Ch6	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.7-1	RESSE L (0-7)	FRT Ch7	FRT Ch4	FRT Ch5	FRT Ch6	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN262 (0x020C)	OCU7_MOD 0	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN263 (0x020E)	OCU7_MOD 1	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN264 (0x0210)	OCU pair Ch.8-0	RESSE L (0-7)	FRT Ch8	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.8-1	RESSE L (0-7)	FRT Ch8	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN265 (0x0212)	OCU8_MOD 0	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN266 (0x0214)	OCU8_MOD 1	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN267 (0x0216)	OCU pair Ch.9-0	RESSE L (0-7)	FRT Ch9	FRT Ch8	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.9-1	RESSE L (0-7)	FRT Ch9	FRT Ch8	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN268 (0x0218)	OCU9_MOD 0	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN269 (0x021A)	OCU9_MOD 1	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN270 (0x021C)	OCU pair Ch.10-0	RESSE L (0-7)	FRT Ch10	FRT Ch8	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.10-1	RESSE L (0-7)	FRT Ch10	FRT Ch8	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN271 (0x021E)	OCU10_MO D0	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN272 (0x0220)	OCU10_MO D1	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN273 (0x0222)	OCU pair Ch.11-0	RESSE L (0-7)	FRT Ch11	FRT Ch8	FRT Ch9	FRT Ch10	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	OCU pair Ch.11-1	RESSE L (0-7)	FRT Ch11	FRT Ch8	FRT Ch9	FRT Ch10	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN274 (0x0224)	OCU11_MO D0	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN275 (0x0226)	OCU11_MO D1	RESSE L (0-7)	set 1	set 0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN288 (0x0240)	ICU0_IN0	RESSE L (0-7)	PORT_P IN	MFS0_L SYN	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	P6_00	-	-	-	P2_16	-	P3_08	-
		PORTS EL (8-15)	P4_00	-	-	-	P5_16	-	-	-
RIC_RE SIN289 (0x0242)	ICU0_IN1	RESSE L (0-7)	PORT_P IN	MFS1_L SYN	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	set 1	P0_00	-	-	-	P2_17	-	P3_09
		PORTS EL (8-15)	-	P4_01	-	P4_25	-	P5_17	-	-
RIC_RE SIN290 (0x0244)	ICU pair ch.0-0	RESSE L (0-7)	FRT Ch0	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.0-1	RESSE L (0-7)	FRT Ch0	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN291 (0x0246)	ICU1_IN0	RESSE L (0-7)	PORT_P IN	MFS2_L SYN	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	P0_01	-	-	-	-	-	P3_10	-
		PORTS EL (8-15)	P4_02	-	P4_26	-	P5_18	-	-	-
RIC_RE SIN292 (0x0248)	ICU1_IN1	RESSE L (0-7)	PORT_P IN	MFS3_L SYN	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	set 1	P0_02	-	-	-	P2_19	-	P3_11
		PORTS EL (8-15)	-	P4_03	-	P4_27	-	P5_19	-	-
RIC_RE SIN293 (0x024A)	ICU pair ch.1-0	RESSE L (0-7)	FRT Ch1	FRT Ch0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.1-1	RESSE L (0-7)	FRT Ch1	FRT Ch0	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN294 (0x024C)	ICU2_IN0	RESSEL (0-7)	PORT_P IN	MFS4_L SYN	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_03	-	-	-	-	-	P3_12	-
		PORTSEL (8-15)	P4_04	-	P4_28	-	P5_20	-	-	-
RIC_RE SIN295 (0x024E)	ICU2_IN1	RESSEL (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	set 1	P0_04	-	-	-	-	-	P3_13
		PORTSEL (8-15)	-	P4_05	-	P4_29	-	-	-	-
RIC_RE SIN296 (0x0250)	ICU pair ch.2-0	RESSEL (0-7)	FRT Ch2	FRT Ch0	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.2-1	RESSEL (0-7)	FRT Ch2	FRT Ch0	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN297 (0x0252)	ICU3_IN0	RESSEL (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_05	-	-	-	P2_22	-	P3_14	-
		PORTSEL (8-15)	P4_06	-	P4_30	-	-	-	-	-
RIC_RE SIN298 (0x0254)	ICU3_IN1	RESSEL (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	P0_06	-	P0_18	-	-	-	P3_15
		PORTSEL (8-15)	-	P4_07	-	P4_31	-	-	-	-
RIC_RE SIN299 (0x0256)	ICU pair ch.3-0	RESSEL (0-7)	FRT Ch3	FRT Ch0	FRT Ch1	FRT Ch2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.3-1	RESSEL (0-7)	FRT Ch3	FRT Ch0	FRT Ch1	FRT Ch2	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN300 (0x0258)	ICU4_IN0	RESSEL (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_07	-	P0_19	-	P2_24	-	P3_16	-
		PORTSEL (8-15)	P4_08	-	P5_00	-	-	-	-	-
RIC_RE SIN301 (0x025A)	ICU4_IN1	RESSEL (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	P0_08	-	P0_28	-	P2_25	-	P3_17
		PORTSEL (8-15)	-	P4_09	-	P5_01	-	-	-	-
RIC_RE SIN302 (0x025C)	ICU pair ch.4-0	RESSEL (0-7)	FRT Ch4	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.4-1	RESSEL (0-7)	FRT Ch4	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN303 (0x025E)	ICU5_IN0	RESSE L (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	P0_09	-	-	-	P2_26	-	P3_18	-
		PORTS EL (8-15)	P4_10	-	P5_02	-	-	-	-	-
RIC_RE SIN304 (0x0260)	ICU5_IN1	RESSE L (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	P0_10	-	P0_30	-	P2_27	-	P3_19
		PORTS EL (8-15)	-	P4_11	-	P5_03	-	-	-	-
RIC_RE SIN305 (0x0262)	ICU pair ch.5-0	RESSE L (0-7)	FRT Ch5	FRT Ch4	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.5-1	RESSE L (0-7)	FRT Ch5	FRT Ch4	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN306 (0x0264)	ICU6_IN0	RESSE L (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	P0_11	-	P0_31	-	P2_28	-	P3_20	-
		PORTS EL (8-15)	P4_12	-	P5_04	-	-	-	-	-
RIC_RE SIN307 (0x0266)	ICU6_IN1	RESSE L (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	set 1	P0_12	-	P1_00	-	P2_29	-	P3_21
		PORTS EL (8-15)	-	-	-	P5_05	-	-	-	-
RIC_RE SIN308 (0x0268)	ICU pair ch.6-0	RESSE L (0-7)	FRT Ch6	FRT Ch4	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.6-1	RESSE L (0-7)	FRT Ch6	FRT Ch4	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN309 (0x026A)	ICU7_IN0	RESSE L (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	P0_13	-	P1_01	-	P2_30	-	P3_22	-
		PORTS EL (8-15)	-	-	P5_06	-	-	-	-	-
RIC_RE SIN310 (0x026C)	ICU7_IN1	RESSE L (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	P0_14	-	P1_02	-	P2_31	-	P3_23
		PORTS EL (8-15)	-	-	-	P5_07	-	-	-	-
RIC_RE SIN311 (0x026E)	ICU pair ch.7-0	RESSE L (0-7)	FRT Ch7	FRT Ch4	FRT Ch5	FRT Ch6	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.7-1	RESSE L (0-7)	FRT Ch7	FRT Ch4	FRT Ch5	FRT Ch6	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN312 (0x0270)	ICU8_IN0	RESSE L (0-7)	PORT_P IN	MFS8_L SYN	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	P0_15	-	P1_03	-	P3_00	-	P3_24	-
		PORTS EL (8-15)	-	-	P5_08	-	-	-	-	-
RIC_RE SIN313 (0x0272)	ICU8_IN1	RESSE L (0-7)	PORT_P IN	MFS9_L SYN	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	P0_16	-	P1_04	-	P3_01	-	P3_25
		PORTS EL (8-15)	-	-	-	P5_09	-	-	-	-
RIC_RE SIN314 (0x0274)	ICU pair ch.8-0	RESSE L (0-7)	FRT Ch8	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.8-1	RESSE L (0-7)	FRT Ch8	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN315 (0x0276)	ICU9_IN0	RESSE L (0-7)	PORT_P IN	MFS10_ LSYN	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	P0_17	-	P1_05	-	P3_02	-	P3_26	-
		PORTS EL (8-15)	-	-	P5_10	-	-	-	-	-
RIC_RE SIN316 (0x0278)	ICU9_IN1	RESSE L (0-7)	PORT_P IN	MFS11_ LSYN	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	P5_21	-	P1_06	-	P3_03	-	P3_27
		PORTS EL (8-15)	-	-	-	P5_11	-	-	-	P5_27
RIC_RE SIN317 (0x027A)	ICU pair ch.9-0	RESSE L (0-7)	FRT Ch9	FRT Ch8	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.9-1	RESSE L (0-7)	FRT Ch9	FRT Ch8	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN318 (0x027C)	ICU10_IN0	RESSE L (0-7)	PORT_P IN	MFS12_ LSYN	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	P5_22	-	P1_07	-	P3_04	-	P3_28	-
		PORTS EL (8-15)	-	-	P5_12	-	-	-	P5_28	-
RIC_RE SIN319 (0x027E)	ICU10_IN1	RESSE L (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	P1_08	-	P3_05	-	P3_29
		PORTS EL (8-15)	-	-	-	P5_13	-	-	-	P5_29
RIC_RE SIN320 (0x0280)	ICU pair ch.10-0	RESSE L (0-7)	FRT Ch10	FRT Ch8	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.10-1	RESSE L (0-7)	FRT Ch10	FRT Ch8	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN321 (0x0282)	ICU11_IN0	RESSEL (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	P1_09	P3_06	-	P3_30	-
		PORTSEL (8-15)	-	-	P5_14	-	-	-	P5_30	-
RIC_RE SIN322 (0x0284)	ICU11_IN1	RESSEL (0-7)	PORT_P IN	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P5_31	-	-	-	-	P3_07	-	P3_31
		PORTSEL (8-15)	-	-	-	P5_15	-	-	-	-
RIC_RE SIN323 (0x0286)	ICU pair ch.11-0	RESSEL (0-7)	FRT Ch11	FRT Ch8	FRT Ch9	FRT Ch10	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
	ICU pair ch.11-1	RESSEL (0-7)	FRT Ch11	FRT Ch8	FRT Ch9	FRT Ch10	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN360 (0x02D0)	AIN8	RESSEL (0-7)	PORT_P IN	TOT16	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P2_24	-	P5_09	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN361 (0x02D2)	BIN8	RESSEL (0-7)	PORT_P IN	TOT17	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P2_25	-	P5_10	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN362 (0x02D4)	ZIN8	RESSEL (0-7)	PORT_P IN	TOT18	PPG6_T OUT0	PPG6_T OUT2	PPG7_T OUT0	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P2_26	-	P5_11	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN363 (0x02D6)	AIN9	RESSEL (0-7)	PORT_P IN	TOT17	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P2_29	-	P5_12	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN364 (0x02D8)	BIN9	RESSEL (0-7)	PORT_P IN	TOT18	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P2_30	-	P5_13	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN365 (0x02DA)	ZIN9	RESSEL (0-7)	PORT_P IN	TOT19	PPG6_T OUT0	PPG6_T OUT2	PPG7_T OUT0	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P2_31	-	P5_14	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN384 (0x0300)	PPG0_TIN1	RESSEL (0-7)	PORT_P IN	TOT0	RLT0_U FSET	TOT1	RLT1_U FSET	FRT3_M TSF	OCU3_O TD0	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN385 (0x0302)	PPG0_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN386 (0x0304)	PPG0_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN387 (0x0306)	PPG1_TIN1	RESSEL (0-7)	PORT_P IN	TOT0	RLT0_U FSET	TOT2	RLT2_U FSET	FRT3_M TSF	OCU3_O TD0	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN388 (0x0308)	PPG1_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN389 (0x030A)	PPG1_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN390 (0x030C)	PPG2_TIN1	RESSEL (0-7)	PORT_P IN	TOT0	RLT0_U FSET	TOT3	RLT3_U FSET	FRT3_M TSF	OCU3_O TD0	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN391 (0x030E)	PPG2_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN392 (0x0310)	PPG2_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN393 (0x0312)	PPG3_TIN1	RESSEL (0-7)	PORT_P IN	TOT0	RLT0_U FSET	TOT1	RLT1_U FSET	FRT3_M TSF	OCU3_O TD0	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN394 (0x0314)	PPG3_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN395 (0x0316)	PPG3_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN396 (0x0318)	PPG4_TIN1	RESSEL (0-7)	PORT_P IN	TOT0	RLT0_U FSET	TOT2	RLT2_U FSET	FRT3_M TSF	OCU3_O TD0	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN397 (0x031A)	PPG4_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN398 (0x031C)	PPG4_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN399 (0x031E)	PPG5_TIN1	RESSEL (0-7)	PORT_P IN	TOT0	RLT0_U FSET	TOT3	RLT3_U FSET	FRT3_M TSF	OCU3_O TD0	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN400 (0x0320)	PPG5_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN401 (0x0322)	PPG5_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN402 (0x0324)	PPG6_TIN1	RESSE L (0-7)	PORT_P IN	TOT16	RLT16_U FSET	TOT17	RLT17_U FSET	FRT11_ MTSF	OCU11_ OTD0	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN403 (0x0326)	PPG6_TIN2	RESSE L (0-7)	set 0	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN404 (0x0328)	PPG6_TIN3	RESSE L (0-7)	set 0	-	-	-	-	-	-	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN405 (0x032A)	PPG7_TIN1	RESSE L (0-7)	PORT_P IN	TOT16	RLT16_U FSET	TOT18	RLT18_U FSET	FRT11_ MTSF	OCU11_ OTD0	-
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN406 (0x032C)	PPG7_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN407 (0x032E)	PPG7_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN408 (0x0330)	PPG8_TIN1	RESSEL (0-7)	PORT_P IN	TOT16	RLT16_U FSET	TOT19	RLT19_U FSET	FRT11_ MTSF	OCU11_ OTD0	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN409 (0x0332)	PPG8_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN410 (0x0334)	PPG8_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN411 (0x0336)	PPG9_TIN1	RESSEL (0-7)	PORT_P IN	TOT16	RLT16_U FSET	TOT17	RLT17_U FSET	FRT11_ MTSF	OCU11_ OTD0	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN412 (0x0338)	PPG9_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN413 (0x033A)	PPG9_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN414 (0x033C)	PPG10_TIN1	RESSEL (0-7)	PORT_P IN	TOT16	RLT16_U FSET	TOT18	RLT18_U FSET	FRT11_ MTSF	OCU11_ OTD0	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN415 (0x033E)	PPG10_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN416 (0x0340)	PPG10_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN417 (0x0342)	PPG11_TIN1	RESSEL (0-7)	PORT_P IN	TOT16	RLT16_U FSET	TOT19	RLT19_U FSET	FRT11_ MTSF	OCU11_ OTD0	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN418 (0x0344)	PPG11_TIN2	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN419 (0x0346)	PPG11_TIN3	RESSEL (0-7)	set 0	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN438 (0x036C)	ADC12B_HW TRG0	RESSEL (0-7)	PORT_P IN	RLT0_U FSET	RLT1_U FSET	OCU0_O TD0	OCU1_O TD0	BT0_AD TOUT0	BT1_AD TOUT2	BT3_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN439 (0x036E)	ADC12B_HW TRG1	RESSEL (0-7)	PORT_P IN	RLT1_U FSET	RLT2_U FSET	OCU1_O TD0	OCU2_O TD0	BT0_AD TOUT2	BT2_AD TOUT0	BT4_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN440 (0x0370)	ADC12B_HW TRG2	RESSEL (0-7)	PORT_P IN	RLT2_U FSET	RLT3_U FSET	OCU2_O TD0	OCU3_O TD0	BT1_AD TOUT0	BT2_AD TOUT2	BT4_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN441 (0x0372)	ADC12B_HW TRG3	RESSEL (0-7)	PORT_P IN	RLT3_U FSET	RLT16_U FSET	OCU3_O TD0	OCU4_O TD0	BT1_AD TOUT2	BT3_AD TOUT0	BT5_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN442 (0x0374)	ADC12B_HW TRG4	RESSEL (0-7)	PORT_P IN	RLT16_U FSET	RLT17_U FSET	OCU4_O TD0	OCU5_O TD0	BT2_AD TOUT0	BT3_AD TOUT2	BT5_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN443 (0x0376)	ADC12B_HW TRG5	RESSEL (0-7)	PORT_P IN	RLT17_U FSET	RLT18_U FSET	OCU5_O TD0	OCU6_O TD0	BT2_AD TOUT2	BT4_AD TOUT0	BT6_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN444 (0x0378)	ADC12B_HW TRG6	RESSEL (0-7)	PORT_P IN	RLT18_U FSET	RLT19_U FSET	OCU6_O TD0	OCU7_O TD0	BT3_AD TOUT0	BT4_AD TOUT2	BT6_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN445 (0x037A)	ADC12B_HW TRG7	RESSEL (0-7)	PORT_P IN	RLT19_U FSET	RLT32_U FSET	OCU7_O TD0	OCU8_O TD0	BT3_AD TOUT2	BT5_AD TOUT0	BT7_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN446 (0x037C)	ADC12B_HW TRG8	RESSEL (0-7)	PORT_P IN	RLT32_U FSET	RLT33_U FSET	OCU8_O TD0	OCU9_O TD0	BT4_AD TOUT0	BT5_AD TOUT2	BT7_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN447 (0x037E)	ADC12B_HW TRG9	RESSEL (0-7)	PORT_P IN	RLT33_U FSET	RLT34_U FSET	OCU9_O TD0	OCU10_O TD0	BT4_AD TOUT2	BT6_AD TOUT0	BT8_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN448 (0x0380)	ADC12B_HW TRG10	RESSEL (0-7)	PORT_P IN	RLT34_U FSET	RLT35_U FSET	OCU10_ OTD0	OCU11_ OTD0	BT5_AD TOUT0	BT6_AD TOUT2	BT8_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN449 (0x0382)	ADC12B_HW TRG11	RESSEL (0-7)	PORT_P IN	RLT35_U FSET	RLT0_U FSET	OCU11_ OTD0	OCU0_O TD0	BT5_AD TOUT2	BT7_AD TOUT0	BT9_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN450 (0x0384)	ADC12B_HW TRG12	RESSEL (0-7)	PORT_P IN	RLT0_U FSET	RLT2_U FSET	OCU0_O TD0	OCU2_O TD0	BT6_AD TOUT0	BT7_AD TOUT2	BT9_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN451 (0x0386)	ADC12B_HW TRG13	RESSEL (0-7)	PORT_P IN	RLT1_U FSET	RLT3_U FSET	OCU1_O TD0	OCU3_O TD0	BT6_AD TOUT2	BT8_AD TOUT0	BT10_A DTOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN452 (0x0388)	ADC12B_HW TRG14	RESSEL (0-7)	PORT_P IN	RLT2_U FSET	RLT16_U FSET	OCU2_O TD0	OCU4_O TD0	BT7_AD TOUT0	BT8_AD TOUT2	BT10_A DTOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN453 (0x038A)	ADC12B_HW TRG15	RESSEL (0-7)	PORT_P IN	RLT3_U FSET	RLT17_U FSET	OCU3_O TD0	OCU5_O TD0	BT7_AD TOUT2	BT9_AD TOUT0	BT11_A DTOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN454 (0x038C)	ADC12B_HW TRG16	RESSEL (0-7)	PORT_P IN	RLT16_U FSET	RLT18_U FSET	OCU4_O TD0	OCU6_O TD0	BT8_AD TOUT0	BT9_AD TOUT2	BT11_A DTOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN455 (0x038E)	ADC12B_HW TRG17	RESSEL (0-7)	PORT_P IN	RLT17_U FSET	RLT19_U FSET	OCU5_O TD0	OCU7_O TD0	BT8_AD TOUT2	BT10_A DTOUT0	BT0_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN456 (0x0390)	ADC12B_HW TRG18	RESSEL (0-7)	PORT_P IN	RLT18_U FSET	RLT32_U FSET	OCU6_O TD0	OCU8_O TD0	BT9_AD TOUT0	BT10_A DTOUT2	BT0_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN457 (0x0392)	ADC12B_HW TRG19	RESSEL (0-7)	PORT_P IN	RLT19_U FSET	RLT33_U FSET	OCU7_O TD0	OCU9_O TD0	BT9_AD TOUT2	BT11_A DTOUT0	BT1_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN458 (0x0394)	ADC12B_HW TRG20	RESSEL (0-7)	PORT_P IN	RLT32_U FSET	RLT34_U FSET	OCU8_O TD0	OCU10_ OTD0	BT10_A DTOUT0	BT11_A DTOUT2	BT1_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN459 (0x0396)	ADC12B_HW TRG21	RESSEL (0-7)	PORT_P IN	RLT33_U FSET	RLT35_U FSET	OCU9_O TD0	OCU11_ OTD0	BT10_A DTOUT2	BT0_AD TOUT0	BT2_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN460 (0x0398)	ADC12B_HW TRG22	RESSEL (0-7)	PORT_P IN	RLT34_U FSET	RLT0_U FSET	OCU10_ OTD0	OCU0_O TD0	BT11_A DTOUT0	BT0_AD TOUT2	BT2_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN461 (0x039A)	ADC12B_HW TRG23	RESSEL (0-7)	PORT_P IN	RLT35_U FSET	RLT1_U FSET	OCU11_ OTD0	OCU1_O TD0	BT11_A DTOUT2	BT1_AD TOUT0	BT3_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN462 (0x039C)	ADC12B_HW TRG24	RESSEL (0-7)	PORT_P IN	RLT0_U FSET	RLT3_U FSET	OCU0_O TD0	OCU3_O TD0	BT0_AD TOUT0	BT0_AD TOUT2	BT2_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN463 (0x039E)	ADC12B_HW TRG25	RESSEL (0-7)	PORT_P IN	RLT1_U FSET	RLT16_U FSET	OCU1_O TD0	OCU4_O TD0	BT0_AD TOUT2	BT1_AD TOUT0	BT3_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN464 (0x03A0)	ADC12B_HW TRG26	RESSEL (0-7)	PORT_P IN	RLT2_U FSET	RLT17_U FSET	OCU2_O TD0	OCU5_O TD0	BT1_AD TOUT0	BT1_AD TOUT2	BT3_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN465 (0x03A2)	ADC12B_HW TRG27	RESSEL (0-7)	PORT_P IN	RLT3_U FSET	RLT18_U FSET	OCU3_O TD0	OCU6_O TD0	BT1_AD TOUT2	BT2_AD TOUT0	BT4_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN466 (0x03A4)	ADC12B_HW TRG28	RESSEL (0-7)	PORT_P IN	RLT16_U FSET	RLT19_U FSET	OCU4_O TD0	OCU7_O TD0	BT2_AD TOUT0	BT2_AD TOUT2	BT4_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN467 (0x03A6)	ADC12B_HW TRG29	RESSEL (0-7)	PORT_P IN	RLT17_U FSET	RLT32_U FSET	OCU5_O TD0	OCU8_O TD0	BT2_AD TOUT2	BT3_AD TOUT0	BT5_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSE L[3:0] /PORTS EL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN468 (0x03A8)	ADC12B_HW TRG30	RESSE L (0-7)	PORT_P IN	RLT18_U FSET	RLT33_U FSET	OCU6_O TD0	OCU9_O TD0	BT3_AD TOUT0	BT3_AD TOUT2	BT5_AD TOUT2
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN469 (0x03AA)	ADC12B_HW TRG31	RESSE L (0-7)	PORT_P IN	RLT19_U FSET	RLT34_U FSET	OCU7_O TD0	OCU10_ OTD0	BT3_AD TOUT2	BT4_AD TOUT0	BT6_AD TOUT0
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN470 (0x03AC)	ADC12B_HW TRG32	RESSE L (0-7)	PORT_P IN	RLT32_U FSET	RLT35_U FSET	OCU8_O TD0	OCU11_ OTD0	BT4_AD TOUT0	BT4_AD TOUT2	BT6_AD TOUT2
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN471 (0x03AE)	ADC12B_HW TRG33	RESSE L (0-7)	PORT_P IN	RLT33_U FSET	RLT0_U FSET	OCU9_O TD0	OCU0_O TD0	BT4_AD TOUT2	BT5_AD TOUT0	BT7_AD TOUT0
		RESSE L (8-15)	-	-	-	-	-	-	-	-
		PORTS EL (0-7)	-	-	-	-	-	-	-	-
		PORTS EL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN472 (0x03B0)	ADC12B_HW TRG34	RESSEL (0-7)	PORT_P IN	RLT34_U FSET	RLT1_U FSET	OCU10_ OTD0	OCU1_O TD0	BT5_AD TOUT0	BT5_AD TOUT2	BT7_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN473 (0x03B2)	ADC12B_HW TRG35	RESSEL (0-7)	PORT_P IN	RLT35_U FSET	RLT2_U FSET	OCU11_ OTD0	OCU2_O TD0	BT5_AD TOUT2	BT6_AD TOUT0	BT8_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN474 (0x03B4)	ADC12B_HW TRG36	RESSEL (0-7)	PORT_P IN	RLT0_U FSET	RLT16_U FSET	OCU0_O TD0	OCU4_O TD0	BT6_AD TOUT0	BT6_AD TOUT2	BT8_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN475 (0x03B6)	ADC12B_HW TRG37	RESSEL (0-7)	PORT_P IN	RLT1_U FSET	RLT17_U FSET	OCU1_O TD0	OCU5_O TD0	BT6_AD TOUT2	BT7_AD TOUT0	BT9_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN476 (0x03B8)	ADC12B_HW TRG38	RESSEL (0-7)	PORT_P IN	RLT2_U FSET	RLT18_U FSET	OCU2_O TD0	OCU6_O TD0	BT7_AD TOUT0	BT7_AD TOUT2	BT9_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN477 (0x03BA)	ADC12B_HW TRG39	RESSEL (0-7)	PORT_P IN	RLT3_U FSET	RLT19_U FSET	OCU3_O TD0	OCU7_O TD0	BT7_AD TOUT2	BT8_AD TOUT0	BT10_A DTOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN478 (0x03BC)	ADC12B_HW TRG40	RESSEL (0-7)	PORT_P IN	RLT16_U FSET	RLT32_U FSET	OCU4_O TD0	OCU8_O TD0	BT8_AD TOUT0	BT8_AD TOUT2	BT10_A DTOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN479 (0x03BE)	ADC12B_HW TRG41	RESSEL (0-7)	PORT_P IN	RLT17_U FSET	RLT33_U FSET	OCU5_O TD0	OCU9_O TD0	BT8_AD TOUT2	BT9_AD TOUT0	BT11_A DTOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN480 (0x03C0)	ADC12B_HW TRG42	RESSEL (0-7)	PORT_P IN	RLT18_U FSET	RLT34_U FSET	OCU6_O TD0	OCU10_ OTD0	BT9_AD TOUT0	BT9_AD TOUT2	BT11_A DTOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN481 (0x03C2)	ADC12B_HW TRG43	RESSEL (0-7)	PORT_P IN	RLT19_U FSET	RLT35_U FSET	OCU7_O TD0	OCU11_ OTD0	BT9_AD TOUT2	BT10_A DTOUT0	BT0_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN482 (0x03C4)	ADC12B_HW TRG44	RESSEL (0-7)	PORT_P IN	RLT32_U FSET	RLT0_U FSET	OCU8_O TD0	OCU0_O TD0	BT10_A DTOUT0	BT10_A DTOUT2	BT0_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN483 (0x03C6)	ADC12B_HW TRG45	RESSEL (0-7)	PORT_P IN	RLT33_U FSET	RLT1_U FSET	OCU9_O TD0	OCU1_O TD0	BT10_A DTOUT2	BT11_A DTOUT0	BT1_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN484 (0x03C8)	ADC12B_HW TRG46	RESSEL (0-7)	PORT_P IN	RLT34_U FSET	RLT2_U FSET	OCU10_ OTD0	OCU2_O TD0	BT11_A DTOUT0	BT11_A DTOUT2	BT1_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN485 (0x03CA)	ADC12B_HW TRG47	RESSEL (0-7)	PORT_P IN	RLT35_U FSET	RLT3_U FSET	OCU11_ OTD0	OCU3_O TD0	BT11_A DTOUT2	BT0_AD TOUT0	BT2_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN486 (0x03CC)	ADC12B_HW TRG48	RESSEL (0-7)	PORT_P IN	RLT0_U FSET	RLT17_U FSET	OCU0_O TD0	OCU5_O TD0	BT0_AD TOUT0	BT4_AD TOUT0	BT5_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN487 (0x03CE)	ADC12B_HW TRG49	RESSEL (0-7)	PORT_P IN	RLT1_U FSET	RLT18_U FSET	OCU1_O TD0	OCU6_O TD0	BT0_AD TOUT2	BT4_AD TOUT2	BT5_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN488 (0x03D0)	ADC12B_HW TRG50	RESSEL (0-7)	PORT_P IN	RLT2_U FSET	RLT19_U FSET	OCU2_O TD0	OCU7_O TD0	BT1_AD TOUT0	BT5_AD TOUT0	BT6_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN489 (0x03D2)	ADC12B_HW TRG51	RESSEL (0-7)	PORT_P IN	RLT3_U FSET	RLT32_U FSET	OCU3_O TD0	OCU8_O TD0	BT1_AD TOUT2	BT5_AD TOUT2	BT6_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN490 (0x03D4)	ADC12B_HW TRG52	RESSEL (0-7)	PORT_P IN	RLT16_U FSET	RLT33_U FSET	OCU4_O TD0	OCU9_O TD0	BT2_AD TOUT0	BT6_AD TOUT0	BT7_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN491 (0x03D6)	ADC12B_HW TRG53	RESSEL (0-7)	PORT_P IN	RLT17_U FSET	RLT34_U FSET	OCU5_O TD0	OCU10_ OTD0	BT2_AD TOUT2	BT6_AD TOUT2	BT7_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN492 (0x03D8)	ADC12B_HW TRG54	RESSEL (0-7)	PORT_P IN	RLT18_U FSET	RLT35_U FSET	OCU6_O TD0	OCU11_ OTD0	BT3_AD TOUT0	BT7_AD TOUT0	BT8_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN493 (0x03DA)	ADC12B_HW TRG55	RESSEL (0-7)	PORT_P IN	RLT19_U FSET	RLT0_U FSET	OCU7_O TD0	OCU0_O TD0	BT3_AD TOUT2	BT7_AD TOUT2	BT8_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN494 (0x03DC)	ADC12B_HW TRG56	RESSEL (0-7)	PORT_P IN	RLT32_U FSET	RLT1_U FSET	OCU8_O TD0	OCU1_O TD0	BT4_AD TOUT0	BT8_AD TOUT0	BT9_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN495 (0x03DE)	ADC12B_HW TRG57	RESSEL (0-7)	PORT_P IN	RLT33_U FSET	RLT2_U FSET	OCU9_O TD0	OCU2_O TD0	BT4_AD TOUT2	BT8_AD TOUT2	BT9_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN496 (0x03E0)	ADC12B_HW TRG58	RESSEL (0-7)	PORT_P IN	RLT34_U FSET	RLT3_U FSET	OCU10_ OTD0	OCU3_O TD0	BT5_AD TOUT0	BT9_AD TOUT0	BT10_A DTOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN497 (0x03E2)	ADC12B_HW TRG59	RESSEL (0-7)	PORT_P IN	RLT35_U FSET	RLT16_U FSET	OCU11_ OTD0	OCU4_O TD0	BT5_AD TOUT2	BT9_AD TOUT2	BT10_A DTOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN498 (0x03E4)	ADC12B_HW TRG60	RESSEL (0-7)	PORT_P IN	RLT0_U FSET	RLT18_U FSET	OCU0_O TD0	OCU6_O TD0	BT6_AD TOUT0	BT10_A DTOUT0	BT11_A DTOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN499 (0x03E6)	ADC12B_HW TRG61	RESSEL (0-7)	PORT_P IN	RLT1_U FSET	RLT19_U FSET	OCU1_O TD0	OCU7_O TD0	BT6_AD TOUT2	BT10_A DTOUT2	BT11_A DTOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN500 (0x03E8)	ADC12B_HW TRG62	RESSEL (0-7)	PORT_P IN	RLT2_U FSET	RLT32_U FSET	OCU2_O TD0	OCU8_O TD0	BT7_AD TOUT0	BT11_A DTOUT0	BT0_AD TOUT0
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN501 (0x03EA)	ADC12B_HW TRG63	RESSEL (0-7)	PORT_P IN	RLT3_U FSET	RLT33_U FSET	OCU3_O TD0	OCU9_O TD0	BT7_AD TOUT2	BT11_A DTOUT2	BT0_AD TOUT2
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN510 (0x03FC)	M_DDRHSS PI_MSTART	RESSEL (0-7)	-	TOT0	TOT16	TOT32	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN520 (0x0410)	CAP0_RESET_N	RESSEL (0-7)	set 0	set 1	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN521 (0x0412)	CAP0_MOD E0	RESSEL (0-7)	set 0	set 1	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN522 (0x0414)	CAP0_MOD E1	RESSEL (0-7)	set 0	set 1	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN523 (0x0416)	CAP0_VLD	RESSEL (0-7)	-	set 1	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN526 (0x041C)	RXDV *1	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_15	P5_27	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN527 (0x041E)	RXD0 / RMII_RXD0	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	P0_08	P05_30	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN528 (0x0420)	RXD1 / RMII_RXD1	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	P0_09	P05_31	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN533 (0x042A)	RXER / RMII_RXER	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	P0_14	P5_28	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN542 (0x043C)	ECLK0	RESSEL (0-7)	PORT_P IN	SYSC1_ CLK_CD 4	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN546 (0x0444)	ECLK1	RESSEL (0-7)	PORT_P IN	SYSC1_ CLK_CD 4	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	-	-	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN558 (0x045C)	CAP0_DATA 11	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_02	P0_04	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN559 (0x045E)	CAP0_DATA 12	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_03	P0_05	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN560 (0x0460)	CAP0_DATA 13	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_04	P0_06	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN561 (0x0462)	CAP0_DATA 14	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_05	P0_07	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-
RIC_RE SIN562 (0x0464)	CAP0_DATA 15	RESSEL (0-7)	-	-	-	-	-	-	-	-
		RESSEL (8-15)	-	-	-	-	-	-	-	-
		PORTSEL (0-7)	P0_06	P0_08	-	-	-	-	-	-
		PORTSEL (8-15)	-	-	-	-	-	-	-	-

Register (Offset)	Resource	RESSEL[3:0] /PORTSEL[3:0]	Source for Resource Input							
			0	1	2	3	4	5	6	7
			8	9	10	11	12	13	14	15
RIC_RE SIN579 (0x0486)	CAP0_DATA 32	RESSEL L (0-7)	-	-	-	-	-	-	-	-
		RESSEL L (8-15)	-	-	-	-	-	-	-	-
		PORTSEL L (0-7)	P0_15	P0_14	-	-	-	-	-	-
		PORTSEL L (8-15)	-	-	-	-	-	-	-	-

Notes:

- Only the specified GPIOs are allowed to be used as inputs. Otherwise, undesired chip behavior could occur.
- When both GPIO_PORTEN.GPIOEN and PPC_PCFGR.PIE are configured as 0, the input signal is disconnected and external interrupt cannot be detected. During disconnecting, I/O internally outputs "low" to internal logic, and if ELVR is configured as low-level-detection, falling-edge-detection, or both-edge-detection it will be detected as external interrupt with EIRR=1.
- "Set 0" (Set 1) means that "0" ("1") is inputted.
- OCUX_MODn is described as MODn pin in Traveo Platform manual.
- Use external interrupt (EINTn: n = 0 to 15) port which is in VCC5 or VCC53 power supply area in order to wake up from PSS shutdown mode. I/O multiplexed functions of port in VCC3 area belong to PD2. The power doesn't supply to the I/O multiplexed functions during PSS shutdown mode, then internal signals of the interrupt factors which connect to EICn_EIRR are undefined. Thus, unexpected interrupt would occur during PSS shutdown mode if the interrupts are enabled. Disable EINTn in VCC3 by means of writing 0 in EICn_ENIR before transiting to PSS shutdown mode in order to avoid the unexpected waking up.
- *1) Selection of RXDV is not supported in S6J32E/F/GxxxM.
S6J32E/F/GxxxM supports RXDV only on pin P0_15 and selection of the input by SW is not required.

3.2. Port Output Function Configuration

The port output function configuration (POF) is a function to select a function to output to a port.

A resource which supports a port output relocation has its PPC_PCFGR.POF to configure resource output.

3.2.1. Standard Configuration

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR000 (0x0000)	P0_00	GPIO_POD R0:POD[0]	DSP0_DAT A0_3	DSP0_DA TA_D3+/-	RMII_TXD 1	TOT3	OCU0_OTD1	PPG0_TO UT2	-
PPC_PCF GR001 (0x0002)	P0_01	GPIO_POD R0:POD[1]	DSP0_DAT A1_3	GFXCOR E_RS_DS INACTIVE	TXEN	-	OCU1_OTD0	PPG1_TO UT0	-
PPC_PCF GR002 (0x0004)	P0_02	GPIO_POD R0:POD[2]	DSP0_DAT A0_4	DSP0_DA TA_D4+/-	-	TOT16	OCU1_OTD1	PPG1_TO UT2	
PPC_PCF GR003 (0x0006)	P0_03	GPIO_POD R0:POD[3]	DSP0_DAT A1_4	GFXCOR E_RS_DS INACTIVE	-	-	OCU2_OTD0	PPG2_TO UT0	-
PPC_PCF GR004 (0x0008)	P0_04	GPIO_POD R0:POD[4]	DSP0_DAT A0_5	DSP0_DA TA_D5+/-	TXD0	TOT17	OCU2_OTD1	PPG2_TO UT2	CK_2
PPC_PCF GR005 (0x000A)	P0_05	GPIO_POD R0:POD[5]	DSP0_DAT A1_5	GFXCOR E_RS_DS INACTIVE	TXD1	-	OCU3_OTD0	PPG3_TO UT0	DQ3_2
PPC_PCF GR006 (0x000C)	P0_06	GPIO_POD R0:POD[6]	DSP0_DAT A0_6	DSP0_DA TA_D6+/-	TXD2	TOT18	OCU3_OTD1	PPG3_TO UT2	DQ2_2
PPC_PCF GR007 (0x000E)	P0_07	GPIO_POD R0:POD[7]	DSP0_DAT A1_6	GFXCOR E_RS_DS INACTIVE	TXD3	-	OCU4_OTD0	PPG4_TO UT0	DQ1_2
PPC_PCF GR008 (0x0010)	P0_08	GPIO_POD R0:POD[8]	DSP0_DAT A0_7	DSP0_DA TA_D7+/-	-	TOT19	OCU4_OTD1	PPG4_TO UT2	DQ0_2
PPC_PCF GR009 (0x0012)	P0_09	GPIO_POD R0:POD[9]	DSP0_DAT A1_7	GFXCOR E_RS_DS INACTIVE	-	-	OCU5_OTD0	PPG5_TO UT0	CS#1_2
PPC_PCF GR010 (0x0014)	P0_10	GPIO_POD R0:POD[10]	DSP0_DAT A0_8	DSP0_DA TA_D8+/-	-	TOT32	OCU5_OTD1	PPG5_TO UT2	RWDS_2
PPC_PCF GR011 (0x0016)	P0_11	GPIO_POD R0:POD[11]	DSP0_DAT A1_8	GFXCOR E_RS_DS INACTIVE	I2S0_SD	-	OCU6_OTD0	PPG6_TO UT0	CS#2_2

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR012 (0x0018)	P0_12	GPIO_POD R0:POD[12]	DSP0_DAT A0_9	DSP0_DA TA_D9+/-	I2S0_WS	TOT33	OCU6_OTD1	PPG6_TO UT2	DQ4_2
PPC_PCF GR013 (0x001A)	P0_13	GPIO_POD R0:POD[13]	DSP0_DAT A1_9	GFXCOR E_RS_DS INACTIVE	I2S0_SCK	-	OCU7_OTD0	PPG7_TO UT0	DQ5_2
PPC_PCF GR014 (0x001C)	P0_14	GPIO_POD R0:POD[14]	DSP0_DAT A0_10	DSP0_DA TA_D10+/-	-	TOT34	OCU7_OTD1	PPG7_TO UT2	DQ6_2
PPC_PCF GR015 (0x001E)	P0_15	GPIO_POD R0:POD[15]	DSP0_DAT A1_10	GFXCOR E_RS_DS INACTIVE	I2S1_SD	DSP0_CT RL2	OCU8_OTD0	PPG8_TO UT0	DQ7_2
PPC_PCF GR016 (0x0020)	P0_16	GPIO_POD R0:POD[16]	DSP0_DAT A0_11	DSP0_DA TA_D11+/-	I2S1_WS	TOT35	OCU8_OTD1	PPG8_TO UT2	DSP0_CL K
PPC_PCF GR017 (0x0022)	P0_17	GPIO_POD R0:POD[17]	DSP0_DAT A1_11	GFXCOR E_RS_DS INACTIVE	I2S1_SCK	DSP0_CT RL0	OCU9_OTD0	PPG9_TO UT0	-
PPC_PCF GR018 (0x0024)	P0_18	GPIO_POD R0:POD[18]	DSP0_CLK	DSP0_CL K+/-	MDIO	DSP0_DA TA0_11	OCU3_OTD1	PPG3_TO UT2	-
PPC_PCF GR019 (0x0026)	P0_19	GPIO_POD R0:POD[19]	DSP0_CTR L2	GFXCOR E_RS_DS INACTIVE	DSP0_DA TA1_4	DSP0_DA TA1_11	OCU4_OTD0	PPG4_TO UT0	-
PPC_PCF GR026 (0x0034)	P0_26	GPIO_POD R0:POD[26]	MLBDAT	DSP0_CT RL2	SOT1	SDA1	-	-	-
PPC_PCF GR027 (0x0036)	P0_27	GPIO_POD R0:POD[27]	MLBSIG	DSP0_CT RL3	SCK1	SCL1	-	-	-
PPC_PCF GR028 (0x0038)	P0_28	GPIO_POD R0:POD[28]	-	DSP0_CT RL4	-	-	OCU4_OTD1	PPG4_TO UT2	-
PPC_PCF GR030 (0x003C)	P0_30	GPIO_POD R0:POD[30]	-	G_SCLK0	RWDS_0/ 1	-	OCU5_OTD1	PPG5_TO UT2	-
PPC_PCF GR031 (0x003E)	P0_31	GPIO_POD R0:POD[31]	M_SDATA1 _0	G_SDATA 0_0	CS#2_0/1	-	OCU6_OTD0	PPG6_TO UT0	-
PPC_PCF GR100 (0x0040)	P1_00	GPIO_POD R1:POD[0]	M_SDATA1 _1	G_SDATA 0_1	DQ5_0/1	-	OCU6_OTD1	PPG6_TO UT2	-

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR101 (0x0042)	P1_01	GPIO_POD R1:PÖD[1]	M_SDATA1 _2	G_SDATA 0_2	DQ4_0/1	-	OCU7_OTD0	PPG7_TO UT0	-
PPC_PCF GR102 (0x0044)	P1_02	GPIO_POD R1:PÖD[2]	M_SDATA1 _3	G_SDATA 0_3	DQ7_0/1	-	OCU7_OTD1	PPG7_TO UT2	-
PPC_PCF GR103 (0x0046)	P1_03	GPIO_POD R1:PÖD[3]	M_SSEL1	G_SSEL0	DQ6_0/1	-	OCU8_OTD0	PPG8_TO UT0	-
PPC_PCF GR104 (0x0048)	P1_04	GPIO_POD R1:PÖD[4]	M_SSEL0	G_SSEL1	DQ0_0/1	-	OCU8_OTD1	PPG8_TO UT2	-
PPC_PCF GR105 (0x004A)	P1_05	GPIO_POD R1:PÖD[5]	M_SDATA0 _0	G_SDATA 1_0	DQ3_0/1	-	OCU9_OTD0	PPG9_TO UT0	-
PPC_PCF GR106 (0x004C)	P1_06	GPIO_POD R1:PÖD[6]	M_SDATA0 _1	G_SDATA 1_1	DQ1_0/1	-	OCU9_OTD1	PPG9_TO UT2	-
PPC_PCF GR107 (0x004E)	P1_07	GPIO_POD R1:PÖD[7]	M_SDATA0 _2	G_SDATA 1_2	DQ2_0/1	-	OCU10_OTD 0	PPG10_TO UT0	-
PPC_PCF GR108 (0x0050)	P1_08	GPIO_POD R1:PÖD[8]	M_SDATA0 _3	G_SDATA 1_3	CS#1_0/1	-	OCU10_OTD 1	PPG10_TO UT2	-
PPC_PCF GR109 (0x0052)	P1_09	GPIO_POD R1:PÖD[9]	M_SCLK0	-	CK_0/1	-	OCU11_OTD 0	PPG11_TO UT0	-
PPC_PCF GR216 (0x00A0)	P2_16	GPIO_POD R2:PÖD[16]	-	INDICATO R0_1	-	-	OCU0_OTD0	PPG0_TO UT0	-
PPC_PCF GR217 (0x00A2)	P2_17	GPIO_POD R2:PÖD[17]	-	-	-	-	OCU0_OTD1	PPG0_TO UT2	-
PPC_PCF GR219 (0x00A6)	P2_19	GPIO_POD R2:PÖD[19]	-	-	-	-	-	-	-
PPC_PCF GR222 (0x00AC)	P2_22	GPIO_POD R2:PÖD[22]	-	-	-	-	OCU3_OTD0	PPG3_TO UT0	-
PPC_PCF GR224 (0x00B0)	P2_24	GPIO_POD R2:PÖD[24]	-	SGO0	-	-	OCU4_OTD0	PPG4_TO UT0	-

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR225 (0x00B2)	P2_25	GPIO_POD R2:POD[25]	-	SGA0	SOT0	SDA17	OCU4_OTD1	PPG4_TO UT2	SOT17
PPC_PCF GR226 (0x00B4)	P2_26	GPIO_POD R2:POD[26]	-	SGA1	SCK0	SCL17	OCU5_OTD0	PPG5_TO UT0	SCK17
PPC_PCF GR227 (0x00B6)	P2_27	GPIO_POD R2:POD[27]	-	SGO1	-	INDICATO R0_0	OCU5_OTD1	PPG5_TO UT2	-
PPC_PCF GR228 (0x00B8)	P2_28	GPIO_POD R2:POD[28]	-	SGA2	-	-	OCU6_OTD0	PPG6_TO UT0	-
PPC_PCF GR229 (0x00BA)	P2_29	GPIO_POD R2:POD[29]	-	SGO2	SOT1	-	OCU6_OTD1	PPG6_TO UT2	-
PPC_PCF GR230 (0x00BC)	P2_30	GPIO_POD R2:POD[30]	-	SGA3	SCK1	-	OCU7_OTD0	PPG7_TO UT0	-
PPC_PCF GR231 (0x00BE)	P2_31	GPIO_POD R2:POD[31]	-	SGO3	-	-	OCU7_OTD1	PPG7_TO UT2	-
PPC_PCF GR300 (0x00C0)	P3_00	GPIO_POD R3:POD[0]	SGO0	TOT0	SOT16	SDA16	OCU8_OTD0	PPG8_TO UT0	TRACE0
PPC_PCF GR301 (0x00C2)	P3_01	GPIO_POD R3:POD[1]	SGA0	TOT1	SCK16	SCL16	OCU8_OTD1	PPG8_TO UT2	TRACE1
PPC_PCF GR302 (0x00C4)	P3_02	GPIO_POD R3:POD[2]	SGA1	TOT2	-	-	OCU9_OTD0	PPG9_TO UT0	TRACE2
PPC_PCF GR303 (0x00C6)	P3_03	GPIO_POD R3:POD[3]	SGO1	TOT3	SOT8	-	OCU9_OTD1	PPG9_TO UT2	TRACE3
PPC_PCF GR304 (0x00C8)	P3_04	GPIO_POD R3:POD[4]	SGA2	TX0	SCK8	-	OCU10_OTD 0	PPG10_TO UT0	TRACE_C LK
PPC_PCF GR305 (0x00CA)	P3_05	GPIO_POD R3:POD[5]	SGO2	TOT16	-	-	OCU10_OTD 1	PPG10_TO UT2	TRACE_C TL
PPC_PCF GR306 (0x00CC)	P3_06	GPIO_POD R3:POD[6]	-	TX1	-	-	OCU11_OTD 0	PPG11_TO UT0	-

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR307 (0x00CE)	P3_07	GPIO_POD R3:POD[7]	-	TOT17	SOT9	-	OCU11_OTD 1	PPG11_TO UT2	-
PPC_PCF GR308 (0x00D0)	P3_08	GPIO_POD R3:POD[8]	WOT	TOT18	SCK9	-	OCU0_OTD0	PPG0_TO UT0	-
PPC_PCF GR309 (0x00D2)	P3_09	GPIO_POD R3:POD[9]	-	TX5	-	-	OCU0_OTD1	PPG0_TO UT2	-
PPC_PCF GR310 (0x00D4)	P3_10	GPIO_POD R3:POD[10]	-	TOT19	-	-	OCU1_OTD0	PPG1_TO UT0	-
PPC_PCF GR311 (0x00D6)	P3_11	GPIO_POD R3:POD[11]	-	TX6	-	-	OCU1_OTD1	PPG1_TO UT2	-
PPC_PCF GR312 (0x00D8)	P3_12	GPIO_POD R3:POD[12]	SGO0	TOT32	SOT10	MFS8_CS 0	OCU2_OTD0	PPG2_TO UT0	-
PPC_PCF GR313 (0x00DA)	P3_13	GPIO_POD R3:POD[13]	SGA0	-	SCK10	MFS9_CS 0	OCU2_OTD1	PPG2_TO UT2	-
PPC_PCF GR314 (0x00DC)	P3_14	GPIO_POD R3:POD[14]	SGA1	TOT33	-	MFS9_CS 1	OCU3_OTD0	PPG3_TO UT0	-
PPC_PCF GR315 (0x00DE)	P3_15	GPIO_POD R3:POD[15]	SGO1	TX5	SOT11	MFS8_CS 3	OCU3_OTD1	PPG3_TO UT2	-
PPC_PCF GR316 (0x00E0)	P3_16	GPIO_POD R3:POD[16]	SGA2	TOT34	SCK11	MFS8_CS 1	OCU4_OTD0	PPG4_TO UT0	-
PPC_PCF GR317 (0x00E2)	P3_17	GPIO_POD R3:POD[17]	SGO2	TX6	-	MFS8_CS 2	OCU4_OTD1	PPG4_TO UT2	-
PPC_PCF GR318 (0x00E4)	P3_18	GPIO_POD R3:POD[18]	SGA3	TOT35	-	-	OCU5_OTD0	PPG5_TO UT0	-
PPC_PCF GR319 (0x00E6)	P3_19	GPIO_POD R3:POD[19]	SGO3	-	-	-	OCU5_OTD1	PPG5_TO UT2	-
PPC_PCF GR320 (0x00E8)	P3_20	GPIO_POD R3:POD[20]	-	-	-	-	OCU6_OTD0	PPG6_TO UT0	-

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR321 (0x00EA)	P3_21	GPIO_POD R3:POD[21]	PWM1P0	AP0(AH0)	-	-	OCU6_OTD1	PPG6_TO UT2	-
PPC_PCF GR322 (0x00EC)	P3_22	GPIO_POD R3:POD[22]	PWM1M0	AN0(AL0)	-	-	OCU7_OTD0	PPG7_TO UT0	-
PPC_PCF GR323 (0x00EE)	P3_23	GPIO_POD R3:POD[23]	PWM2P0	BP0(BH0)	-	-	OCU7_OTD1	PPG7_TO UT2	-
PPC_PCF GR324 (0x00F0)	P3_24	GPIO_POD R3:POD[24]	PWM2M0	BN0(BL0)	-	-	OCU8_OTD0	PPG8_TO UT0	-
PPC_PCF GR325 (0x00F2)	P3_25	GPIO_POD R3:POD[25]	PWM1P1	AP1(AH1)	-	-	OCU8_OTD1	PPG8_TO UT2	-
PPC_PCF GR326 (0x00F4)	P3_26	GPIO_POD R3:POD[26]	PWM1M1	AN1(AL1)	-	-	OCU9_OTD0	PPG9_TO UT0	-
PPC_PCF GR327 (0x00F6)	P3_27	GPIO_POD R3:POD[27]	PWM2P1	BP1(BH1)	-	-	OCU9_OTD1	PPG9_TO UT2	-
PPC_PCF GR328 (0x00F8)	P3_28	GPIO_POD R3:POD[28]	PWM2M1	BN1(BL1)	-	-	OCU10_OTD 0	PPG10_TO UT0	-
PPC_PCF GR329 (0x00FA)	P3_29	GPIO_POD R3:POD[29]	PWM1P2	-	-	-	OCU10_OTD 1	PPG10_TO UT2	-
PPC_PCF GR330 (0x00FC)	P3_30	GPIO_POD R3:POD[30]	PWM1M2	-	-	-	OCU11_OTD 0	PPG11_TO UT0	-
PPC_PCF GR331 (0x00FE)	P3_31	GPIO_POD R3:POD[31]	PWM2P2	-	-	-	OCU11_OTD 1	PPG11_TO UT2	-
PPC_PCF GR400 (0x0100)	P4_00	GPIO_POD R4:POD[00]	PWM2M2	-	-	-	OCU0_OTD0	PPG0_TO UT0	-
PPC_PCF GR401 (0x0102)	P4_01	GPIO_POD R4:POD[01]	PWM1P3	-	-	-	OCU0_OTD1	PPG0_TO UT2	-
PPC_PCF GR402 (0x0104)	P4_02	GPIO_POD R4:POD[02]	PWM1M3	-	SOT2	-	OCU1_OTD0	PPG1_TO UT0	-

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR403 (0x0106)	P4_03	GPIO_POD R4:PÖD[3]	PWM2P3	-	SCK2	-	OCU1_OTD1	PPG1_TO UT2	-
PPC_PCF GR404 (0x0108)	P4_04	GPIO_POD R4:PÖD[4]	PWM2M3	-	-	-	OCU2_OTD0	PPG2_TO UT0	-
PPC_PCF GR405 (0x010A)	P4_05	GPIO_POD R4:PÖD[5]	PWM1P4	-	-	-	OCU2_OTD1	PPG2_TO UT2	-
PPC_PCF GR406 (0x010C)	P4_06	GPIO_POD R4:PÖD[6]	PWM1M4	-	SOT3	MFS0_CS 0	OCU3_OTD0	PPG3_TO UT0	-
PPC_PCF GR407 (0x010E)	P4_07	GPIO_POD R4:PÖD[7]	PWM2P4	-	SCK3	MFS2_CS 0	OCU3_OTD1	PPG3_TO UT2	-
PPC_PCF GR408 (0x0110)	P4_08	GPIO_POD R4:PÖD[8]	PWM2M4	-	-	MFS2_CS 1	OCU4_OTD0	PPG4_TO UT0	-
PPC_PCF GR409 (0x0112)	P4_09	GPIO_POD R4:PÖD[9]	PWM1P5	-	-	-	OCU4_OTD1	PPG4_TO UT2	-
PPC_PCF GR410 (0x0114)	P4_10	GPIO_POD R4:PÖD[10]	PWM1M5	-	SOT4	MFS0_CS 3	OCU5_OTD0	PPG5_TO UT0	SDA4
PPC_PCF GR411 (0x0116)	P4_11	GPIO_POD R4:PÖD[11]	PWM2P5	-	SCK4	MFS0_CS 1	OCU5_OTD1	PPG5_TO UT2	SCL4
PPC_PCF GR412 (0x0118)	P4_12	GPIO_POD R4:PÖD[12]	PWM2M5	TX1	-	MFS0_CS 2	OCU6_OTD0	PPG6_TO UT0	-
PPC_PCF GR425 (0x0132)	P4_25	GPIO_POD R4:PÖD[25]	DSP1_CLK	DSP0_CT RL8	-	-	OCU0_OTD1	PPG0_TO UT2	-
PPC_PCF GR426 (0x0134)	P4_26	GPIO_POD R4:PÖD[26]	SGA1	DSP1_CT RL2	SOT11	DSP0_CT RL9	OCU1_OTD0	PPG1_TO UT0	-
PPC_PCF GR427 (0x0136)	P4_27	GPIO_POD R4:PÖD[27]	SGO1	DSP1_CT RL1	SCK11	DSP0_CT RL10	OCU1_OTD1	PPG1_TO UT2	-
PPC_PCF GR428 (0x0138)	P4_28	GPIO_POD R4:PÖD[28]	DSP1_CTR L0	DSP0_CT RL11	-	-	OCU2_OTD0	PPG2_TO UT0	-

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR429 (0x013A)	P4_29	GPIO_POD R4:POD[29]	-	DSP1_DA TA1_11	AP0(AH0)	-	OCU2_OTD1	PPG2_TO UT2	-
PPC_PCF GR430 (0x013C)	P4_30	GPIO_POD R4:POD[30]	SGA3	DSP1_DA TA0_11	AN0(AL0)	-	OCU3_OTD0	PPG3_TO UT0	-
PPC_PCF GR431 (0x013E)	P4_31	GPIO_POD R4:POD[31]	SGO3	DSP1_DA TA1_10	BP0(BH0)	-	OCU3_OTD1	PPG3_TO UT2	-
PPC_PCF GR500 (0x0140)	P5_00	GPIO_POD R5:POD[0]	DSP1_DAT A0_10	BL0	-	-	OCU4_OTD0	PPG4_TO UT0	-
PPC_PCF GR501 (0x0142)	P5_01	GPIO_POD R5:POD[1]	DSP1_DAT A1_9	AH1	-	-	OCU4_OTD1	PPG4_TO UT2	-
PPC_PCF GR502 (0x0144)	P5_02	GPIO_POD R5:POD[2]	DSP1_DAT A0_9	SOT8	AN1(AL1)	-	OCU5_OTD0	PPG5_TO UT0	-
PPC_PCF GR503 (0x0146)	P5_03	GPIO_POD R5:POD[3]	DSP1_DAT A1_8	SCK8	BP1(BH1)	-	OCU5_OTD1	PPG5_TO UT2	-
PPC_PCF GR504 (0x0148)	P5_04	GPIO_POD R5:POD[4]	-	DSP1_DA TA0_8	BN1(BL1)	-	OCU6_OTD0	PPG6_TO UT0	-
PPC_PCF GR505 (0x014A)	P5_05	GPIO_POD R5:POD[5]	DSP1_DAT A1_7	-	-	-	OCU6_OTD1	PPG6_TO UT2	-
PPC_PCF GR506 (0x014C)	P5_06	GPIO_POD R5:POD[6]	DSP1_DAT A0_7	SOT9	-	-	OCU7_OTD0	PPG7_TO UT0	-
PPC_PCF GR507 (0x014E)	P5_07	GPIO_POD R5:POD[7]	DSP1_DAT A1_6	SCK9	-	-	OCU7_OTD1	PPG7_TO UT2	-
PPC_PCF GR508 (0x0150)	P5_08	GPIO_POD R5:POD[8]	DSP1_DAT A0_6	-	-	-	OCU8_OTD0	PPG8_TO UT0	-
PPC_PCF GR509 (0x0152)	P5_09	GPIO_POD R5:POD[9]	DSP1_DAT A1_5	-	-	-	OCU8_OTD1	PPG8_TO UT2	-
PPC_PCF GR510 (0x0154)	P5_10	GPIO_POD R5:POD[10]	DSP1_DAT A0_5	SOT10	SDA10	MFS8_CS 0	OCU9_OTD0	PPG9_TO UT0	-

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR511 (0x0156)	P5_11	GPIO_POD R5:POD[11]	DSP1_DAT A1_4	SCK10	SCL10	MFS9_CS 0	OCU9_OTD1	PPG9_TO UT2	-
PPC_PCF GR512 (0x0158)	P5_12	GPIO_POD R5:POD[12]	DSP1_DAT A0_4	-	-	MFS9_CS 1	OCU10_OTD 0	PPG10_TO UT0	-
PPC_PCF GR513 (0x015A)	P5_13	GPIO_POD R5:POD[13]	DSP1_DAT A1_3	DSP0_CT RL0	-	-	OCU10_OTD 1	PPG10_TO UT2	-
PPC_PCF GR514 (0x015C)	P5_14	GPIO_POD R5:POD[14]	DSP1_DAT A0_3	SOT11	DSP0_CT RL1	-	OCU11_OTD 0	PPG11_TO UT0	MFS8_CS 3
PPC_PCF GR515 (0x015E)	P5_15	GPIO_POD R5:POD[15]	DSP1_DAT A1_2	SCK11	DSP1_CT RL2	DSP0_CT RL2	OCU11_OTD 1	PPG11_TO UT2	MFS8_CS 1
PPC_PCF GR516 (0x0160)	P5_16	GPIO_POD R5:POD[16]	DSP1_DAT A0_2	DSP1_CL K	DSP0_CT RL3	-	OCU0_OTD0	PPG0_TO UT0	MFS8_CS 2
PPC_PCF GR517 (0x0162)	P5_17	GPIO_POD R5:POD[17]	DSP1_DAT A1_1	DSP1_CT RL0	DSP0_CT RL4	-	OCU0_OTD1	PPG0_TO UT2	-
PPC_PCF GR518 (0x0164)	P5_18	GPIO_POD R5:POD[18]	DSP1_DAT A0_1	SOT12	DSP1_CT RL1	DSP0_CT RL5	OCU1_OTD0	PPG1_TO UT0	SDA12
PPC_PCF GR519 (0x0166)	P5_19	GPIO_POD R5:POD[19]	DSP1_DAT A1_0	SCK12	DSP0_CT RL6	-	OCU1_OTD1	PPG1_TO UT2	SCL12
PPC_PCF GR520 (0x0168)	P5_20	GPIO_POD R5:POD[20]	DSP1_DAT A0_0	DSP0_CT RL7	-	-	OCU2_OTD0	PPG2_TO UT0	-
PPC_PCF GR521 (0x016A)	P5_21	GPIO_POD R5:POD[21]	DSP0_CTR L1	MDC	DSP0_DA TA0_4	DSP0_DA TA1_10	OCU9_OTD1	PPG9_TO UT2	-
PPC_PCF GR522 (0x016C)	P5_22	GPIO_POD R5:POD[22]	DSP0_CTR L0	DSP0_CT RL2	TXER	DSP0_CT RL1	OCU10_OTD 0	PPG10_TO UT0	-
PPC_PCF GR527 (0x0176)	P5_27	GPIO_POD R5:POD[27]	DSP0_DAT A0_0	DSP0_DA TA_D0+/-	-	TOT0	OCU9_OTD1	PPG9_TO UT2	-
PPC_PCF GR528 (0x0178)	P5_28	GPIO_POD R5:POD[28]	DSP0_DAT A1_0	GFXCOR E_RS DS_INACTIVE	-	-	OCU10_OTD 0	PPG10_TO UT0	-

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR529 (0x017A)	P5_29	GPIO_POD R5:POD[29]	DSP0_DAT A0_1	DSP0_DA TA_D1+/-	-	TOT1	OCU10_OTD 1	PPG10_TO UT2	-
PPC_PCF GR530 (0x017C)	P5_30	GPIO_POD R5:POD[30]	DSP0_DAT A1_1	GFXCOR E_RS_DS INACTIVE	SOT0	SDA0	OCU11_OTD 0	PPG11_TO UT0	-
PPC_PCF GR531 (0x017E)	P5_31	GPIO_POD R5:POD[31]	DSP0_DAT A0_2	DSP0_DA TA_D2+/-	SCK0	TOT2	OCU11_OTD 1	PPG11_TO UT2	SCL0
PPC_PCF GR600 (0x0180)	P6_00	GPIO_POD R6:POD[0]	DSP0_DAT A1_2	GFXCOR E_RS_DS INACTIVE	RMII_TXD 0	-	OCU0_OTD0	PPG0_TO UT0	-
PPC_PCF GR601 (0x0182)	P6_01	GPIO_POD R6:POD[1]	-	-	-	-	-	-	-
PPC_PCF GR602 (0x0184)	P6_02	GPIO_POD R6:POD[2]	-	-	-	-	-	-	-
PPC_PCF GR603 (0x0186)	P6_03	GPIO_POD R6:POD[3]	TRACE0	-	-	-	-	-	-
PPC_PCF GR604 (0x0188)	P6_04	GPIO_POD R6:POD[4]	TRACE1	-	-	-	-	-	-
PPC_PCF GR605 (0x018A)	P6_05	GPIO_POD R6:POD[5]	TRACE2	-	-	-	-	-	-
PPC_PCF GR606 (0x018C)	P6_06	GPIO_POD R6:POD[6]	TRACE3	-	-	-	-	-	-
PPC_PCF GR607 (0x018E)	P6_07	GPIO_POD R6:POD[7]	TRACE4	-	-	-	-	-	-
PPC_PCF GR608 (0x0190)	P6_08	GPIO_POD R6:POD[8]	TRACE5	-	-	-	-	-	-
PPC_PCF GR609 (0x0192)	P6_09	GPIO_POD R6:POD[9]	TRACE6	-	-	-	-	-	-
PPC_PCF GR610 (0x0194)	P6_10	GPIO_POD R6:POD[10]	TRACE7	-	-	-	-	-	-

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR611 (0x0196)	P6_11	GPIO_POD R6:POD[11]	TRACE8	-	-	-	-	-	-
PPC_PCF GR612 (0x0198)	P6_12	GPIO_POD R6:POD[12]	TRACE9	-	-	-	-	-	-
PPC_PCF GR613 (0x019A)	P6_13	GPIO_POD R6:POD[13]	TRACE10	-	-	-	-	-	-
PPC_PCF GR614 (0x019C)	P6_14	GPIO_POD R6:POD[14]	TRACE11	-	-	-	-	-	-
PPC_PCF GR615 (0x019E)	P6_15	GPIO_POD R6:POD[15]	TRACE12	-	-	-	-	-	-
PPC_PCF GR616 (0x01A0)	P6_16	GPIO_POD R6:POD[16]	TRACE13	-	-	-	-	-	-
PPC_PCF GR617 (0x01A2)	P6_17	GPIO_POD R6:POD[17]	TRACE14	-	-	-	-	-	-
PPC_PCF GR618 (0x01A4)	P6_18	GPIO_POD R6:POD[18]	TRACE15	-	-	-	-	-	-
PPC_PCF GR619 (0x01A6)	P6_19	GPIO_POD R6:POD[19]	TRACE_CLK	-	-	-	-	-	-
PPC_PCF GR620 (0x01A8)	P6_20	GPIO_POD R6:POD[20]	TRACE_CTL	-	-	-	-	-	-
PPC_PCF GR621 (0x01AA)	P6_21	GPIO_POD R6:POD[21]	-	-	-	-	-	-	-
PPC_PCF GR622 (0x01AC)	P6_22	GPIO_POD R6:POD[22]	-	-	-	-	-	-	-
PPC_PCF GR623 (0x01AE)	P6_23	GPIO_POD R6:POD[23]	-	-	-	-	-	-	-
PPC_PCF GR624 (0x01B0)	P6_24	GPIO_POD R6:POD[24]	-	-	-	-	-	-	-

Register (Offset)	Port	Resource Functional Outputs							
		POF=0	POF=1	POF=2	POF=3	POF=4	POF=5	POF=6	POF=7
PPC_PCF GR625 (0x01B2)	P6_25	GPIO_POD R6:POD[25]	-	-	-	-	-	-	-
PPC_PCF GR626 (0x01B4)	P6_26	GPIO_POD R6:POD[26]	-	-	-	-	-	-	-

Notes:

- The hyphen indicates that setting is prohibited. If setting the port will be operated as input independent on the register value of the GPIO_DDR.
- The register for P2_19 for POF exists though the port only supports input not supports output. The configuration of POF=0 for the port doesn't affect anything.

3.2.2. PIE (Port Input Enable) Configuration

- RSDS port
PPC_PCFGR.PIE (port input enable bit) should be configured using ports as RSDS ports. Set 0 to the appropriate PIE bit.
- I2SCLK port
PPC_PCFGR.PIE (port input enable bit) of P0_13 and P0_17 should be configured using ports as I2SCLK ports. Set 1 to the appropriate PIE bit.

3.2.3. RSDS Port Definition

The RSDS terminal is one pair of 2 ports, and a differential signal is output. The terminals have external terminal names and a POF definition names corresponding to each other.

The relations are shown and specified as followings.

Configure POF=2 in corresponding PPC_PCFGR to use RSDS, and the pair of RSDS ports will become effective without any configuration to GFXCORE_RSDS_INACTIVE.

On the other hand, if you only write POF=2 for GFXCORE_RSDS_INACTIVE, the pair of RSDS ports will not become effective, and to be an input status port.

Table 3-1: RSDS Port Name Definition Table

Differential Signal Positive (+)		Differential Signal Negative (-)	
External Port Name	POF Definition Name	External Port Name	POF Definition Name
DSP0_DATA_D*+, DSP0_CLK+	DSP0_DATA_D*+/-, DSP0_CLK+/-	DSP0_DATA_D*-, DSP0_CLK-	GFXCORE_RSDS_INACTIVE
P0_00		P0_01	
P0_02		P0_03	
P0_04		P0_05	
P0_06		P0_07	
P0_08		P0_09	
P0_10		P0_11	
P0_12		P0_13	
P0_14		P0_15	
P0_16		P0_17	
P0_18		P0_19	
P5_27		P5_28	
P5_29		P5_30	
P5_31		P6_00	

Notes:

- External port name is described in Port description list in this hardware manual.
- See 3.2.1 of POF (Port Output Function) configuration table.

3.3. Analog I/O Setting

If the analog function of a pin is used with ADC ensure following settings before using ADC.

- The PPC_PCFGR:PIE register of target port must be set to 0 to disable the digital input.
- It is possible to use port output function and Pull-up/down function at the same time as ADC conversion. Make sure that the maximum output current of the pin (see Datasheet) is not exceeded.

Note:

- *Regarding the analog switch setting, see 'CHAPTER of 12/10/8-BIT Analog to Digital Converter'.*

3.4. Input Level Setting

This section shows the I/O port input level settings.

Pin No. of Package		PORT No.	Value of PPC_PCFGR:PIL[1:0]				Remarks
TEQFP-216	TEQFP-208		2'b00	2'b01	2'b10	2'b11	
31	31	P5_21	CMOS-s	-	TTL	-	
32	32	P0_18	CMOS-s	-	TTL	-	
33	33	P0_19	CMOS-s	-	TTL	-	
34	34	P5_27	CMOS-s	-	TTL	-	
35	35	P5_28	CMOS-s	-	TTL	-	
36	36	P5_29	CMOS-s	-	TTL	-	
37	37	P5_30	CMOS-s	-	TTL	-	
38	38	P5_31	CMOS-s	-	TTL	-	
39	39	P6_00	CMOS-s	-	TTL	-	
40	40	P0_00	CMOS-s	-	TTL	-	
41	41	P0_01	CMOS-s	-	TTL	-	
44	-	P0_02	CMOS-s	-	TTL	-	
45	-	P0_03	CMOS-s	-	TTL	-	
46	44	P0_04	CMOS-s	-	TTL	-	
47	45	P0_05	CMOS-s	-	TTL	-	
48	46	P0_06	CMOS-s	-	TTL	-	
49	47	P0_07	CMOS-s	-	TTL	-	
50	48	P0_08	CMOS-s	-	TTL	-	
51	49	P0_09	CMOS-s	-	TTL	-	
52	50	P0_10	CMOS-s	-	TTL	-	
53	51	P0_11	CMOS-s	-	TTL	-	
56	54	P0_12	CMOS-s	-	TTL	-	
57	55	P0_13	CMOS-s	-	TTL	-	
58	56	P0_14	CMOS-s	-	TTL	-	
59	57	P0_15	CMOS-s	-	TTL	-	
60	58	P0_16	CMOS-s	-	TTL	-	
61	59	P0_17	CMOS-s	-	TTL	-	
62	60	P5_22	CMOS-s	-	TTL	-	
65	63	P1_09	CMOS-s	-	TTL	-	
68	66	P1_05	CMOS-s	-	TTL	-	
69	67	P1_07	CMOS-s	-	TTL	-	
70	68	P1_06	CMOS-s	-	TTL	-	
71	69	P1_04	CMOS-s	-	TTL	-	
72	70	P1_08	CMOS-s	-	TTL	-	
74	72	P0_30	CMOS-s	-	TTL	-	
77	75	P0_31	CMOS-s	-	TTL	-	
78	76	P1_01	CMOS-s	-	TTL	-	
79	77	P1_00	CMOS-s	-	TTL	-	
80	78	P1_03	CMOS-s	-	TTL	-	
81	79	P1_02	CMOS-s	-	TTL	-	
84	82	P0_26	CMOS-s	-	-	MediaLB	
85	83	P0_27	CMOS-s	-	-	MediaLB	
86	84	P0_28	CMOS-s	-	-	MediaLB	
91	89	P2_22	CMOS-s	Automotive	-	-	

Pin No. of Package		PORT No.	Value of PPC_PCFG:PIL[1:0]				Remarks
TEQFP-216	TEQFP-208		2'b00	2'b01	2'b10	2'b11	
92	-	P2_24	CMOS-s	Automotive	-	-	
93	90	P2_25	CMOS-s	Automotive	TTL	-	
94	91	P2_26	CMOS-s	Automotive	TTL	-	
95	92	P2_27	CMOS-s	Automotive	-	-	
96	-	P2_28	CMOS-s	Automotive	-	-	
97	93	P2_29	CMOS-s	Automotive	-	-	
98	94	P2_30	CMOS-s	Automotive	-	-	
99	95	P2_31	CMOS-s	Automotive	-	-	
100	96	P3_00	CMOS-s	Automotive	TTL	-	
101	97	P3_01	CMOS-s	Automotive	TTL	-	
102	98	P3_02	CMOS-s	Automotive	-	-	
103	99	P3_03	CMOS-s	Automotive	-	-	
104	100	P3_04	CMOS-s	Automotive	-	-	
105	101	P3_05	CMOS-s	Automotive	-	-	
106	102	P3_06	CMOS-s	Automotive	-	-	
122	118	P3_18	CMOS-s	Automotive	-	-	
123	-	P3_19	CMOS-s	Automotive	-	-	
124	-	P3_20	CMOS-s	Automotive	-	-	
133	127	P3_21	CMOS-s	Automotive	-	-	
134	128	P3_22	CMOS-s	Automotive	-	-	
135	129	P3_23	CMOS-s	Automotive	-	-	
136	130	P3_24	CMOS-s	Automotive	-	-	
137	131	P3_25	CMOS-s	Automotive	-	-	
138	132	P3_26	CMOS-s	Automotive	-	-	
139	133	P3_27	CMOS-s	Automotive	-	-	
140	134	P3_28	CMOS-s	Automotive	-	-	
143	137	P3_29	CMOS-s	Automotive	-	-	
144	138	P3_30	CMOS-s	Automotive	-	-	
145	139	P3_31	CMOS-s	Automotive	-	-	
146	140	P4_00	CMOS-s	Automotive	-	-	
147	141	P4_01	CMOS-s	Automotive	-	-	
148	142	P4_02	CMOS-s	Automotive	-	-	
149	143	P4_03	CMOS-s	Automotive	-	-	
150	144	P4_04	CMOS-s	Automotive	-	-	
153	147	P4_05	CMOS-s	Automotive	-	-	
154	148	P4_06	CMOS-s	Automotive	-	-	
155	149	P4_07	CMOS-s	Automotive	-	-	
156	150	P4_08	CMOS-s	Automotive	-	-	
157	151	P4_09	CMOS-s	Automotive	-	-	
158	152	P4_10	CMOS-s	Automotive	-	-	
159	153	P4_11	CMOS-s	Automotive	-	-	
160	154	P4_12	CMOS-s	Automotive	-	-	
165	159	P2_19	CMOS-s	Automotive	-	-	
166	160	P3_07	CMOS-s	Automotive	-	-	
167	161	P3_08	CMOS-s	Automotive	-	-	
168	162	P3_09	CMOS-s	Automotive	-	-	
169	-	P3_10	CMOS-s	Automotive	-	-	
170	-	P3_11	CMOS-s	Automotive	-	-	

Pin No. of Package		PORT No.	Value of PPC_PCFGR:PIL[1:0]				Remarks
TEQFP-216	TEQFP-208		2'b00	2'b01	2'b10	2'b11	
171	163	P3_12	CMOS-s	Automotive	-	-	
172	164	P3_13	CMOS-s	Automotive	-	-	
173	165	P3_14	CMOS-s	Automotive	-	-	
174	166	P3_15	CMOS-s	Automotive	-	-	
175	167	P3_16	CMOS-s	Automotive	-	-	
176	168	P3_17	CMOS-s	Automotive	-	-	
177	169	P2_17	CMOS-s	Automotive	-	-	
178	170	P2_16	CMOS-s	Automotive	-	-	
182	174	P4_29	CMOS-s	Automotive	TTL	-	
183	175	P4_30	CMOS-s	Automotive	TTL	-	
184	176	P4_31	CMOS-s	Automotive	TTL	-	
185	177	P5_00	CMOS-s	Automotive	TTL	-	
186	178	P5_01	CMOS-s	Automotive	TTL	-	
187	179	P5_02	CMOS-s	Automotive	TTL	-	
188	180	P5_03	CMOS-s	Automotive	TTL	-	
189	181	P5_04	CMOS-s	Automotive	TTL	-	
194	186	P5_05	CMOS-s	Automotive	TTL	-	
195	187	P5_06	CMOS-s	Automotive	TTL	-	
196	188	P5_07	CMOS-s	Automotive	TTL	-	
197	189	P5_08	CMOS-s	Automotive	TTL	-	
198	190	P5_09	CMOS-s	Automotive	TTL	-	
199	191	P5_10	CMOS-s	Automotive	TTL	-	
200	192	P5_11	CMOS-s	Automotive	TTL	-	
201	193	P5_12	CMOS-s	Automotive	TTL	-	
204	196	P5_13	CMOS-s	Automotive	TTL	-	
205	197	P5_14	CMOS-s	Automotive	TTL	-	
206	198	P5_15	CMOS-s	Automotive	TTL	-	
207	199	P5_16	CMOS-s	Automotive	TTL	-	
208	200	P5_17	CMOS-s	Automotive	TTL	-	
209	201	P5_18	CMOS-s	Automotive	TTL	-	
210	202	P5_19	CMOS-s	Automotive	TTL	-	
211	203	P5_20	CMOS-s	Automotive	TTL	-	
212	204	P4_25	CMOS-s	Automotive	TTL	-	
213	205	P4_26	CMOS-s	Automotive	TTL	-	
214	206	P4_27	CMOS-s	Automotive	TTL	-	
215	207	P4_28	CMOS-s	Automotive	TTL	-	

Notes:

- Only the specified GPIOs are allowed to be used as inputs. Otherwise, undesired chip behavior could occur.
- The hyphen of "Value of PPC_PCFGR:PIL[1:0]" indicates that setting is prohibited.
- "CMOS-s" is CMOS hysteresis input level.
- "Automotive" is Automotive input level.
- "TTL" is TTL input level.
- "MediaLB" is MediaLB input level.
- To get detailed information about the input level, see the DC characteristics of the Datasheet.

3.5. Output Drive Capacity Setting

This section shows the I/O port output drive capacity settings.

Pin No. of Package		PORT NO.	Value of PPC_PCFGR:ODR[1:0]				Remarks
TEQFP-216	TEQFP-208		2'b00	2'b01	2'b10	2'b11	
31	31	P5_21	2mA	5mA	10mA	20mA	
32	32	P0_18	2mA	5mA	10mA	20mA	*1
33	33	P0_19	2mA	5mA	10mA	20mA	*1
34	34	P5_27	2mA	5mA	10mA	20mA	*1
35	35	P5_28	2mA	5mA	10mA	20mA	*1
36	36	P5_29	2mA	5mA	10mA	20mA	*1
37	37	P5_30	2mA	5mA	10mA	20mA	*1
38	38	P5_31	2mA	5mA	10mA	20mA	*1
39	39	P6_00	2mA	5mA	10mA	20mA	*1
40	40	P0_00	2mA	5mA	10mA	20mA	*1
41	41	P0_01	2mA	5mA	10mA	20mA	*1
44	-	P0_02	2mA	5mA	10mA	20mA	*1
45	-	P0_03	2mA	5mA	10mA	20mA	*1
46	44	P0_04	2mA	5mA	10mA	20mA	*1
47	45	P0_05	2mA	5mA	10mA	20mA	*1
48	46	P0_06	2mA	5mA	10mA	20mA	*1
49	47	P0_07	2mA	5mA	10mA	20mA	*1
50	48	P0_08	2mA	5mA	10mA	20mA	*1
51	49	P0_09	2mA	5mA	10mA	20mA	*1
52	50	P0_10	2mA	5mA	10mA	20mA	*1
53	51	P0_11	2mA	5mA	10mA	20mA	*1
56	54	P0_12	2mA	5mA	10mA	20mA	*1
57	55	P0_13	2mA	5mA	10mA	20mA	*1
58	56	P0_14	2mA	5mA	10mA	20mA	*1
59	57	P0_15	2mA	5mA	10mA	20mA	*1
60	58	P0_16	2mA	5mA	10mA	20mA	*1
61	59	P0_17	2mA	5mA	10mA	20mA	*1
62	60	P5_22	2mA	5mA	10mA	20mA	
65	63	P1_09	2mA	5mA	-	10mA	
68	66	P1_05	2mA	5mA	-	10mA	
69	67	P1_07	2mA	5mA	-	10mA	
70	68	P1_06	2mA	5mA	-	10mA	
71	69	P1_04	2mA	5mA	-	10mA	
72	70	P1_08	2mA	5mA	-	10mA	
74	72	P0_30	2mA	5mA	-	10mA	
77	75	P0_31	2mA	5mA	-	10mA	
78	76	P1_01	2mA	5mA	-	10mA	
79	77	P1_00	2mA	5mA	-	10mA	
80	78	P1_03	2mA	5mA	-	10mA	
81	79	P1_02	2mA	5mA	-	10mA	
84	82	P0_26	2mA	5mA	6mA	10mA	*2-2
85	83	P0_27	2mA	5mA	6mA	10mA	*2-2
86	84	P0_28	2mA	5mA	6mA	10mA	
91	89	P2_22	1mA	2mA	-	5mA	

Pin No. of Package		PORT NO.	Value of PPC_PCFG:ODR[1:0]				Remarks
TEQFP-216	TEQFP-208		2'b00	2'b01	2'b10	2'b11	
92	-	P2_24	1mA	2mA	-	5mA	
93	90	P2_25	1mA	2mA	-	5mA	*2-1
94	91	P2_26	1mA	2mA	-	5mA	*2-1
95	92	P2_27	1mA	2mA	-	5mA	
96	-	P2_28	1mA	2mA	-	5mA	
97	93	P2_29	1mA	2mA	-	5mA	
98	94	P2_30	1mA	2mA	-	5mA	
99	95	P2_31	1mA	2mA	-	5mA	
100	96	P3_00	1mA	2mA	-	5mA	*2-1
101	97	P3_01	1mA	2mA	-	5mA	*2-1
102	98	P3_02	1mA	2mA	-	5mA	
103	99	P3_03	1mA	2mA	-	5mA	
104	100	P3_04	1mA	2mA	-	5mA	
105	101	P3_05	1mA	2mA	-	5mA	
106	102	P3_06	1mA	2mA	-	5mA	
122	118	P3_18	1mA	2mA	-	5mA	
123	-	P3_19	1mA	2mA	-	5mA	
124	-	P3_20	1mA	2mA	-	5mA	
133	127	P3_21	1mA	2mA	5mA	30mA	
134	128	P3_22	1mA	2mA	5mA	30mA	
135	129	P3_23	1mA	2mA	5mA	30mA	
136	130	P3_24	1mA	2mA	5mA	30mA	
137	131	P3_25	1mA	2mA	5mA	30mA	
138	132	P3_26	1mA	2mA	5mA	30mA	
139	133	P3_27	1mA	2mA	5mA	30mA	
140	134	P3_28	1mA	2mA	5mA	30mA	
143	137	P3_29	1mA	2mA	5mA	30mA	
144	138	P3_30	1mA	2mA	5mA	30mA	
145	139	P3_31	1mA	2mA	5mA	30mA	
146	140	P4_00	1mA	2mA	5mA	30mA	
147	141	P4_01	1mA	2mA	5mA	30mA	
148	142	P4_02	1mA	2mA	5mA	30mA	
149	143	P4_03	1mA	2mA	5mA	30mA	
150	144	P4_04	1mA	2mA	5mA	30mA	
153	147	P4_05	1mA	2mA	5mA	30mA	
154	148	P4_06	1mA	2mA	5mA	30mA	
155	149	P4_07	1mA	2mA	5mA	30mA	
156	150	P4_08	1mA	2mA	5mA	30mA	
157	151	P4_09	1mA	2mA	5mA	30mA	
158	152	P4_10	1mA	2mA	5mA	30mA	*2-2
159	153	P4_11	1mA	2mA	5mA	30mA	*2-2
160	154	P4_12	1mA	2mA	5mA	30mA	
165	159	P2_19	-	-	-	-	Input only
166	160	P3_07	1mA	2mA	-	5mA	
167	161	P3_08	1mA	2mA	-	5mA	
168	162	P3_09	1mA	2mA	-	5mA	
169	-	P3_10	1mA	2mA	-	5mA	
170	-	P3_11	1mA	2mA	-	5mA	

Pin No. of Package		PORT NO.	Value of PPC_PCFG:ODR[1:0]				Remarks
TEQFP-216	TEQFP-208		2'b00	2'b01	2'b10	2'b11	
171	163	P3_12	1mA	2mA	-	5mA	
172	164	P3_13	1mA	2mA	-	5mA	
173	165	P3_14	1mA	2mA	-	5mA	
174	166	P3_15	1mA	2mA	-	5mA	
175	167	P3_16	1mA	2mA	-	5mA	
176	168	P3_17	1mA	2mA	-	5mA	
177	169	P2_17	1mA	2mA	-	5mA	
178	170	P2_16	1mA	2mA	-	5mA	
182	174	P4_29	1mA	2mA	5mA	5mA	
183	175	P4_30	1mA	2mA	5mA	5mA	*2-2
184	176	P4_31	1mA	2mA	5mA	5mA	*2-2
185	177	P5_00	1mA	2mA	5mA	5mA	
186	178	P5_01	1mA	2mA	5mA	5mA	
187	179	P5_02	1mA	2mA	5mA	5mA	
188	180	P5_03	1mA	2mA	5mA	5mA	
189	181	P5_04	1mA	2mA	5mA	5mA	
194	186	P5_05	1mA	2mA	5mA	5mA	
195	187	P5_06	1mA	2mA	5mA	5mA	
196	188	P5_07	1mA	2mA	5mA	5mA	
197	189	P5_08	1mA	2mA	5mA	5mA	
198	190	P5_09	1mA	2mA	5mA	5mA	
199	191	P5_10	1mA	2mA	5mA	5mA	*2-2
200	192	P5_11	1mA	2mA	5mA	5mA	*2-2
201	193	P5_12	1mA	2mA	5mA	5mA	
204	196	P5_13	1mA	2mA	5mA	5mA	
205	197	P5_14	1mA	2mA	5mA	5mA	
206	198	P5_15	1mA	2mA	5mA	5mA	
207	199	P5_16	1mA	2mA	5mA	5mA	
208	200	P5_17	1mA	2mA	5mA	5mA	
209	201	P5_18	1mA	2mA	5mA	5mA	*2-2
210	202	P5_19	1mA	2mA	5mA	5mA	*2-2
211	203	P5_20	1mA	2mA	5mA	5mA	
212	204	P4_25	1mA	2mA	5mA	5mA	
213	205	P4_26	1mA	2mA	5mA	5mA	
214	206	P4_27	1mA	2mA	5mA	5mA	
215	207	P4_28	1mA	2mA	5mA	5mA	

See the note at the next page.

Notes:

- The hyphen of "Value of PPC_PCFGR:ODR[1:0]" indicates that setting is prohibited.
- *1 If PPC_PCFGR:POF[2:0] = "2"(the RSDS function setting) and PPC_PCFGR:ODR[0] = "0", the drive capacity will be 2mA.
If PPC_PCFGR:POF[2:0] = "2"(the RSDS function setting) and PPC_PCFGR:ODR[0] = "1", the drive capacity will be 4mA.
- *2-1 If the PPC_PCFGR:POF[2:0] is configured as SDA or SCL function, the pin is set to "Pseudo Open Drain" and IOL is set to 3mA ("I2C" function) - independent of the corresponding PPC_PCFGR:ODR[1:0] setting.
- *2-2 If the PPC_PCFGR:POF[2:0] is configured as SDA or SCL function, the pin is set to "Pseudo Open Drain". IOL is configured by the corresponding PPC_PCFGR:ODR[1:0] register.

To get detailed information about the drive capability, see the DC characteristics of the Datasheet.

3.6. Port Status

3.6.1. Hi-z Control

Traveo platform manual has description of System Special Setting Register (SYSC0_SPECFGFR).

The [bit23] PSSPADCTRL: PSS-time port configuring bit should be configured as below.

- 0: Do not perform Hi-z control.
- 1: Perform Hi-z control.

Notes:

- *At RUN mode, if configured as Hi-z control, it doesn't affect the port status immediately, but after executing WFI instruction to update the profile registers, then it turns out Hi-z status during PSS mode.*
- *As opposite control from PSS to RUN, the port status of Hi-z will automatically be released without reconfiguration of SYSC0_SPECFGFR.PSSPADCTRL = 0.*

3.6.2. Port Status Hold during PSS Mode

All of the GPIO except ports in VCC3 area can be kept the port status during PSS mode by System Special Setting Register (SYSC0_SPECFGFR).

The [bit31] to [bit24] HOLDIO_PD_x: HOLD data latch bit should be configured as below.

- 0: Do not retain control.
- 1: Retain control.

Notes:

- *During MCU RUN mode, I/O port status will be latched immediately after SYSC0_SPECFGFR.HOLDIO_PD_x = 1 (Retain control) configured.*
- *After SYSC0_SPECFGFR.HOLDIO_PD_x = 1, the status of followings will be latched. Please note that PID is not included, that is, input data cannot be latched.*
 - *PPC_PCFGRIj_{ij} POD, POE, PIL, PUE, PDE, ODR, NFE, and POF. (excluding PID: Input data cannot be latched)*
 - *RIC_RESIN_x.PORTSEL and RESSEL*
- *At turning from MCU PSS mode to RUN, the latched status will not be released automatically. Configuration SYSC0_SPECFGFR.HOLDIO_PD_x = 0 should be necessary for releasing the status.*

3.7. Function Port Group

A port group specifies an I/O port combination for a peripheral function. A peripheral function has some port groups and should be configured and used within a port group of them which is defined in the following table in order to satisfy AC specification.

Do not take a port combination which is not described in the following table as a port group.

Table 3-2: Function Port Group List

Function	Port Group
Multi-Function Serial Ch.0	Group1 - P5_31(SCK0) - P5_30(SOT0) - P0_05(SIN0) Group2 - P2_26(SCK0) - P2_25(SOT0) - P2_27(SIN0) - P4_06(MFS0_CS0) - P4_11(MFS0_CS1) - P4_12(MFS0_CS2) - P4_10(MFS0_CS3)
Multi-Function Serial Ch.1	Group1 - P0_27(SCK1) - P0_26(SOT1) - P0_28(SIN1) Group2 - P2_30(SCK1) - P2_29(SOT1) - P2_31(SIN1)
Multi-Function Serial Ch.8	Group1 - P3_04(SCK8) - P3_03(SOT8) - P3_05(SIN8) - P3_12(MFS8_CS0) - P3_16(MFS8_CS1) - P3_17(MFS8_CS2) - P3_15(MFS8_CS3) Group2 - P5_03(SCK8) - P5_02(SOT8) - P5_04(SIN8) - P5_10(MFS8_CS0) - P5_15(MFS8_CS1) - P5_16(MFS8_CS2) - P5_14(MFS8_CS3)
Multi-Function Serial Ch.9	Group1 - P3_08(SCK9) - P3_07(SOT9) - P3_09(SIN9) - P3_13(MFS9_CS0) - P3_14(MFS9_CS1) Group2 - P5_07(SCK9) - P5_06(SOT9) - P5_08(SIN9) - P5_11(MFS9_CS0) - P5_12(MFS9_CS1)

Function	Port Group
Multi-Function Serial Ch.10	Group1 - P3_13(SCK10) - P3_12(SOT10) - P3_14(SIN10) Group2 - P5_11(SCK10) - P5_10(SOT10) - P5_12(SIN10)
Multi-Function Serial Ch.11	Group1 - P3_16(SCK11) - P3_15(SOT11) - P3_17(SIN11) Group2 - P5_15(SCK11) - P5_14(SOT11) - P5_16(SIN11) Group3 - P4_27(SCK11) - P4_26(SOT11) - P4_28(SIN11)
CAN Ch.1	Group1 - P3_06(TX1) - P3_05(RX1) Group2 - P4_12(TX1) - P4_11(RX1)
CAN Ch.5	Group1 - P3_09(TX5) - P3_08(RX5) Group2 - P3_15(TX5) - P3_14(RX5)
CAN Ch.6	Group1 - P3_11(TX6) - P3_10(RX6) Group2 - P3_17(TX6) - P3_16(RX6)

3.8. Key Code Register

The write access to I/O Port register is protected by Key Code Register.

Table 3-3 Relationship between I/O Port register and Key Code Register

I/O Port Register	Key Code Register	Remark
Data Direction Register (GPIO_DDRI)	GPIO Key Code Register (GPIO_KEYCDR)	
Data Direction Set Register (GPIO_DDSDRI)	GPIO Key Code Register (GPIO_KEYCDR)	
Data Direction Clear Register (GPIO_DDCRI)	GPIO Key Code Register (GPIO_KEYCDR)	
Port Output Data Register (GPIO_PODRI)	-	
Port Output Set Register (GPIO_POSRI)	-	
Port Output Clear Register (GPIO_POCRI)	-	
Port Input Enable Register (GPIO_PORTEN)	GPIO Key Code Register (GPIO_KEYCDR)	
Port Input Data Register (GPIO_PIDRI)	-	
Port Enable Register (GPIO_PPERI)	-	
GPIO Key Code Register (GPIO_KEYCDR)	-	
Port Setting Register (PPC_PCFGRijj)	PPC Key Code Register (PPC_KEYCDR)	
PPC Key Code Register (PPC_KEYCDR)	-	
Resource Input Setting Register (RIC_RESINn)	RIC Key Code Register (RIC_KEYCDR)	
RIC Key Code Register (RIC_KEYCDR)	-	

4. Registers

See the common information of the registers on the hardware manual of Traveo Platform.

5. Configuration Procedure

The configuration procedure of resource I/O port is described.

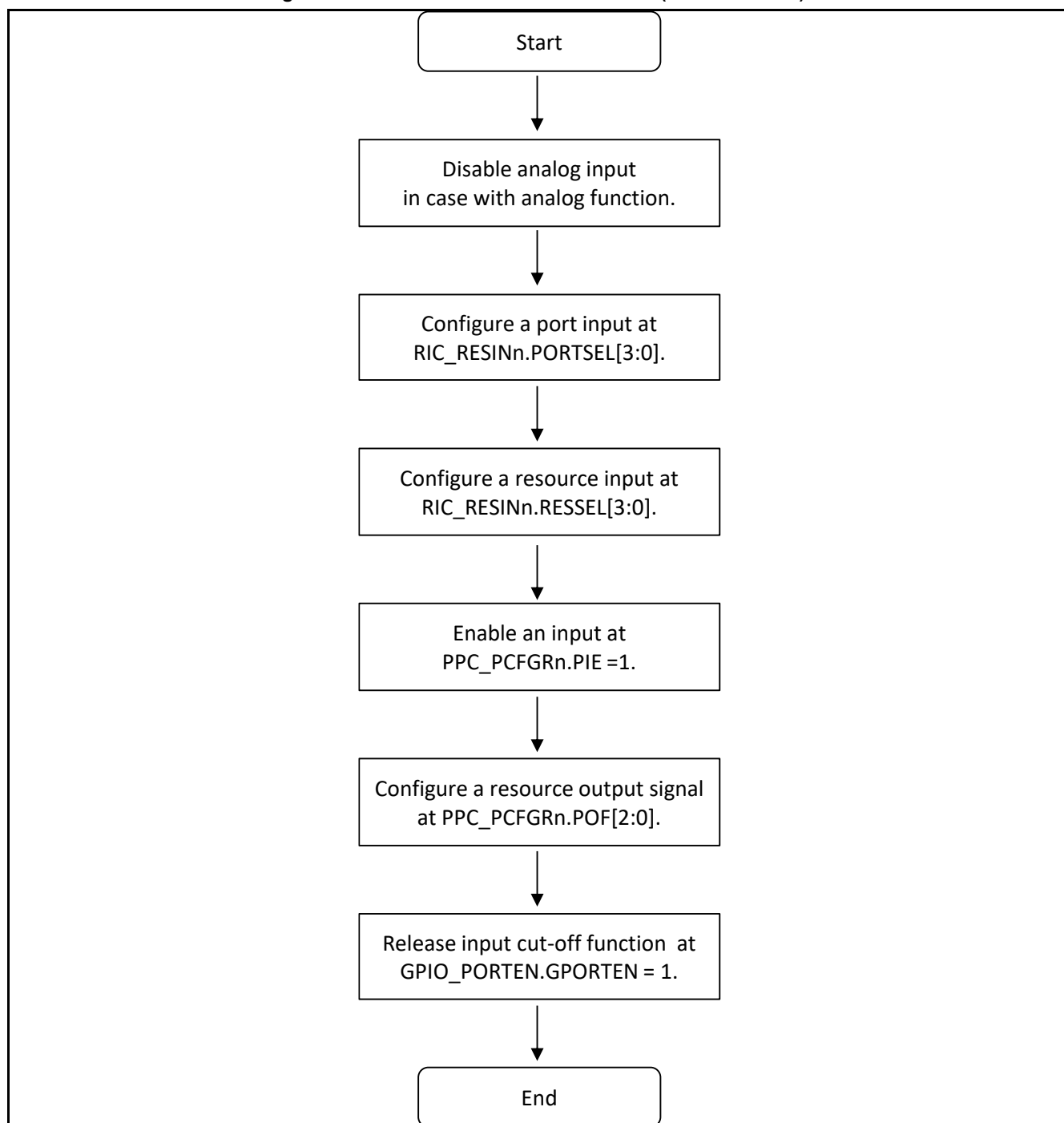
Category	I/O Direction	Referable Procedure	Remark
Resource I/O Port	Both Direction	See 5.1	
	Input	See 5.2	
	Output	See 5.3	
Port Function	Input	See 5.4	
	Output	See 5.5	
Analog Function	Input or Output	See 5.6	

Notes:

- *Glitch at output port may sometime be observed when the following case.*
 1. *from input to output*
 2. *from output to input*
 3. *from input to input*
 4. *from output to output*

5.1. Resource I/O Port (Both Direction)

Figure 5-1: Procedure of Resource I/O Port (Both Direction)

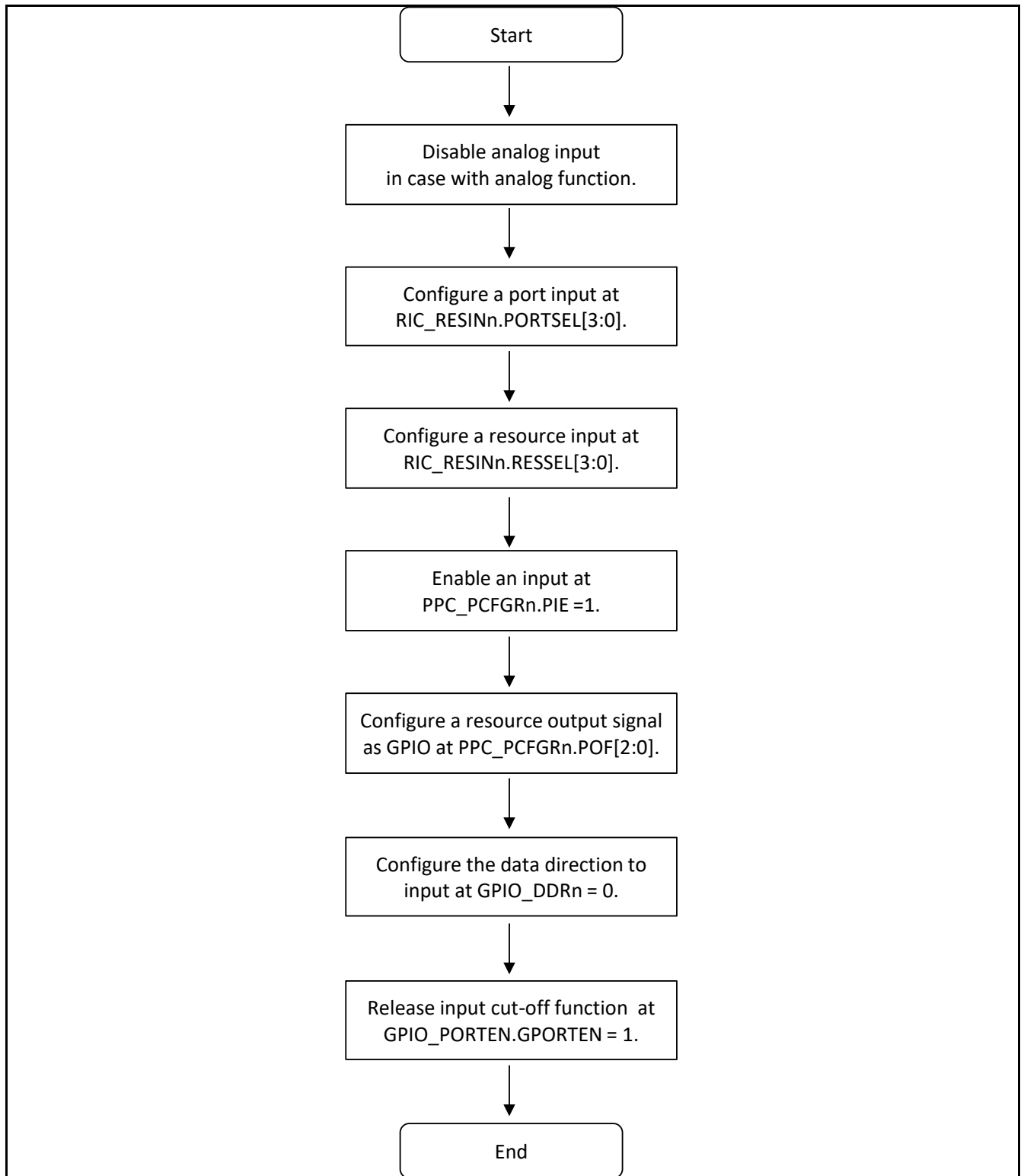


Notes:

- The dedicated input/output direction configuration should be necessary for SCK (MSF).

5.2. Resource Input

Figure 5-2: Procedure of Resource Input

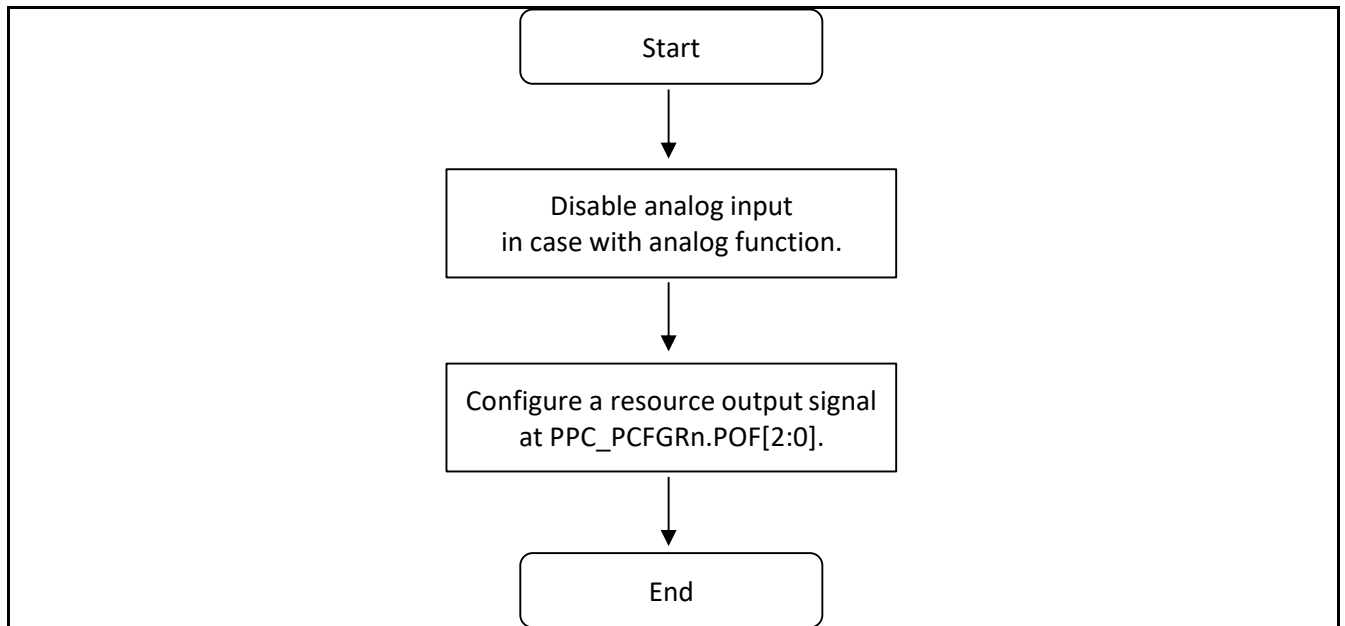


Notes:

- *RIC_RESINn register is only used for a resource which supports relocation function or resource input function from the other resource. The RIC_RESINn should be configured as above.*
- *A resource which supports neither relocation nor the other resource input doesn't have its RIC_RESINn register. Configurations can be skipped in above procedure.*

5.3. Resource Output

Figure 5-3: Procedure of Resource Output

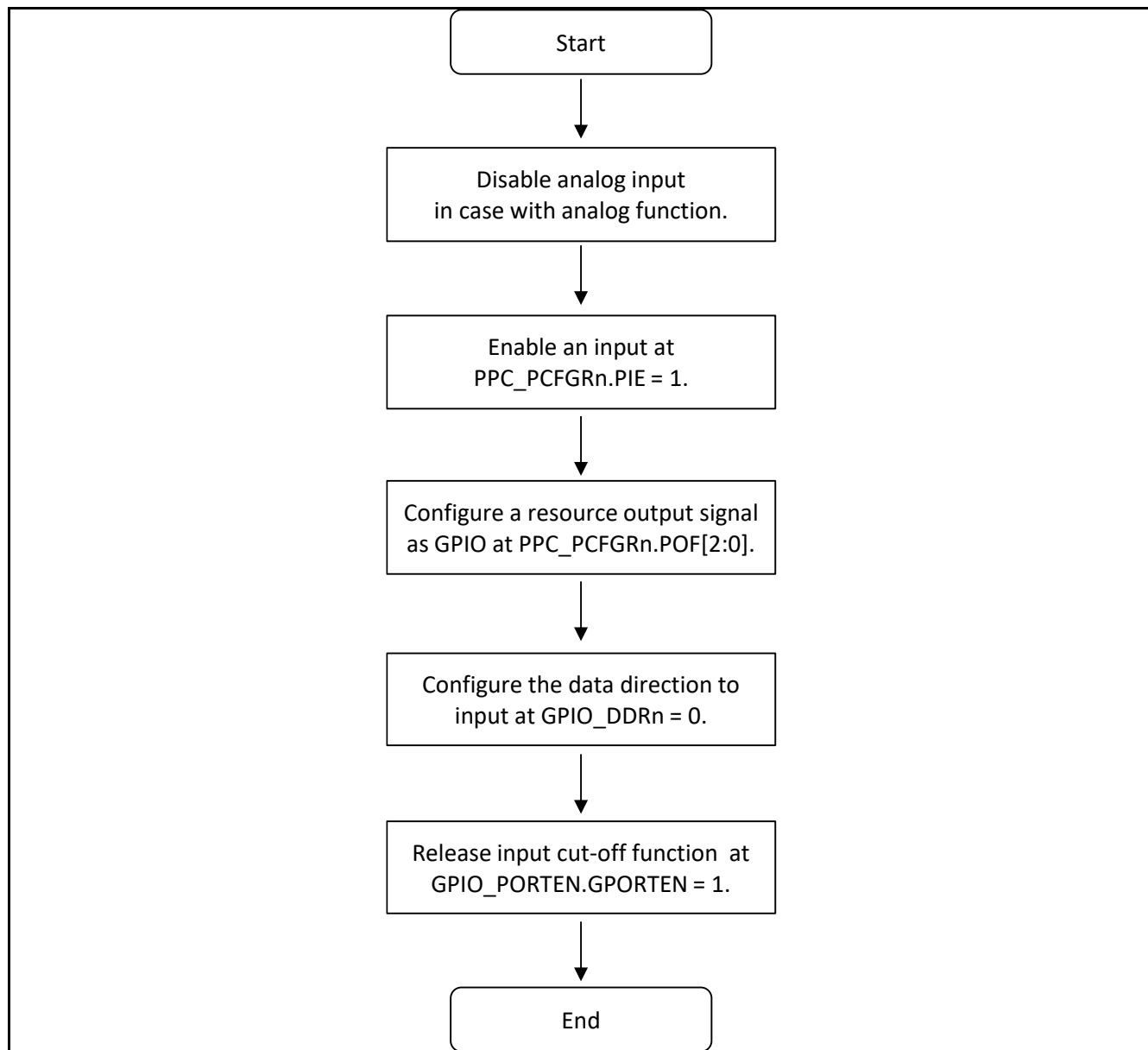


Notes:

- The dedicated output control configuration as well as POF should be necessary for bellows.
- SOUT(MFS),
- SGA,SGO(SG)
- WOT(RTC)
- MFS_CS (MFS)

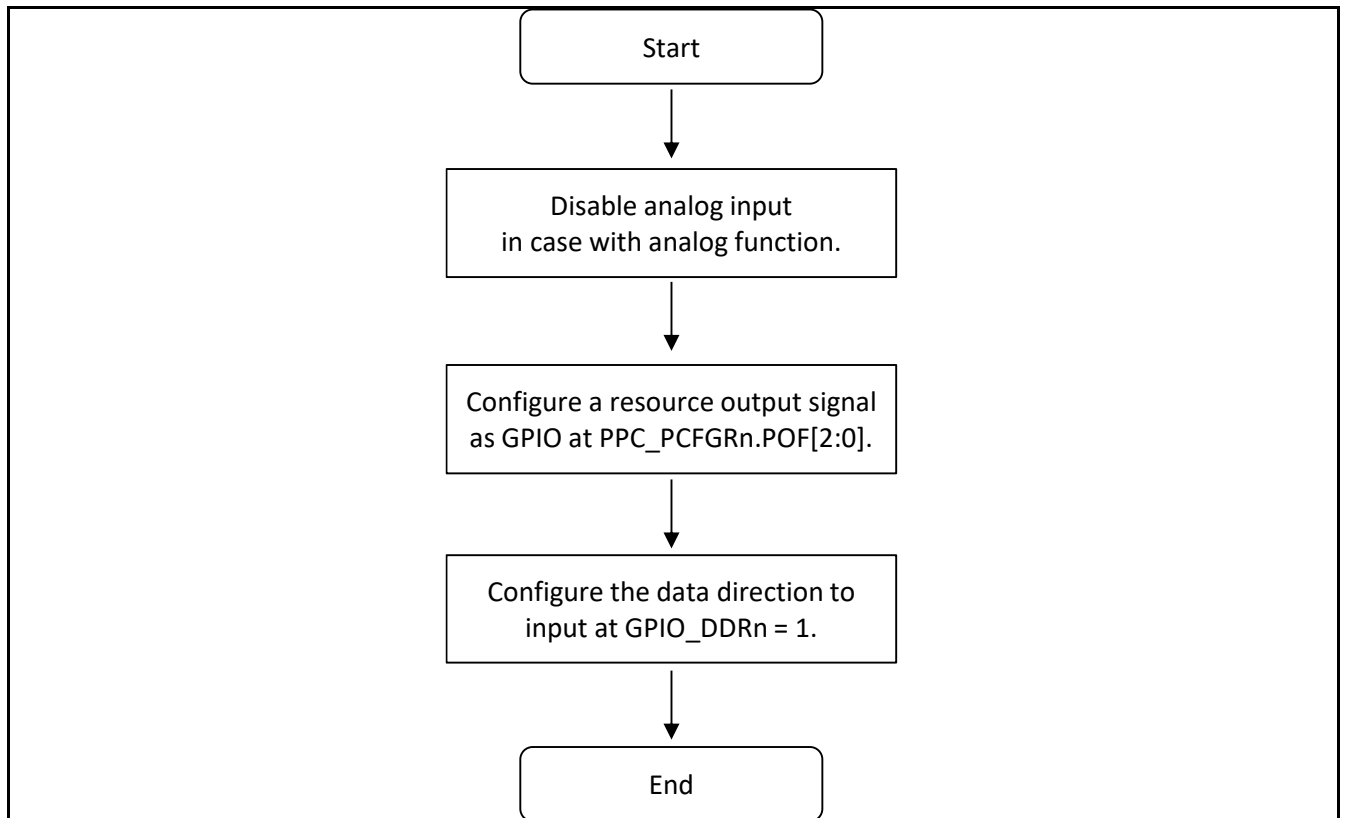
5.4. Port Function Input

Figure 5-4: Procedure of Port Input



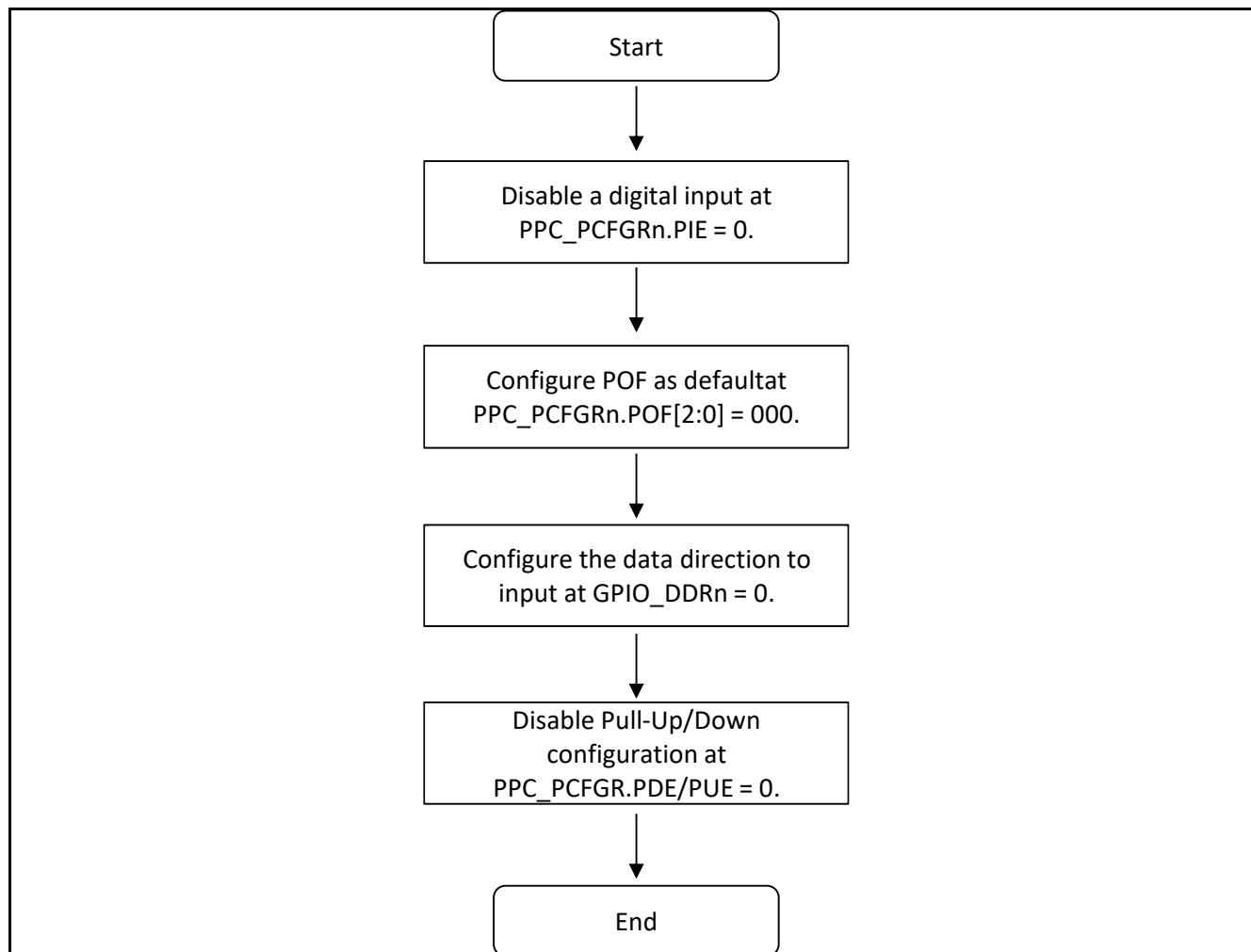
5.5. Port Function Output

Figure 5-5: Procedure of Port Output



5.6. Analog Function Input or Output

Figure 5-6: Procedure of Analog Function Input or Output



Notes:

- The procedure is for analog input or output function of A/D converter of which the ports have multiplexed usage.
- Regarding the analog switch setting, see 'CHAPTER of 12/10/8-BIT Analog to Digital Converter'.
- D/A Converter and FPD-Link has dedicated Output Ports. They don't have POF. The configuration is described in each chapter.

CHAPTER 12: State Transition



This chapter explains the state transition.

1. Overview
2. Diagram of State Transition
3. Fetching the Operation Mode
4. Changes to PSS and RUN

CODE: STATE_TRANSITION-S6J3200-E1

1. Overview

This section gives a brief overview of State transition

Refer to the low-power chapter for the detailed information for performing a change state.

2. Diagram of State Transition

This section shows diagram of state transitions.

The device state transitions for this series are shown below.

Figure 2-1 Diagram of Device State Transitions

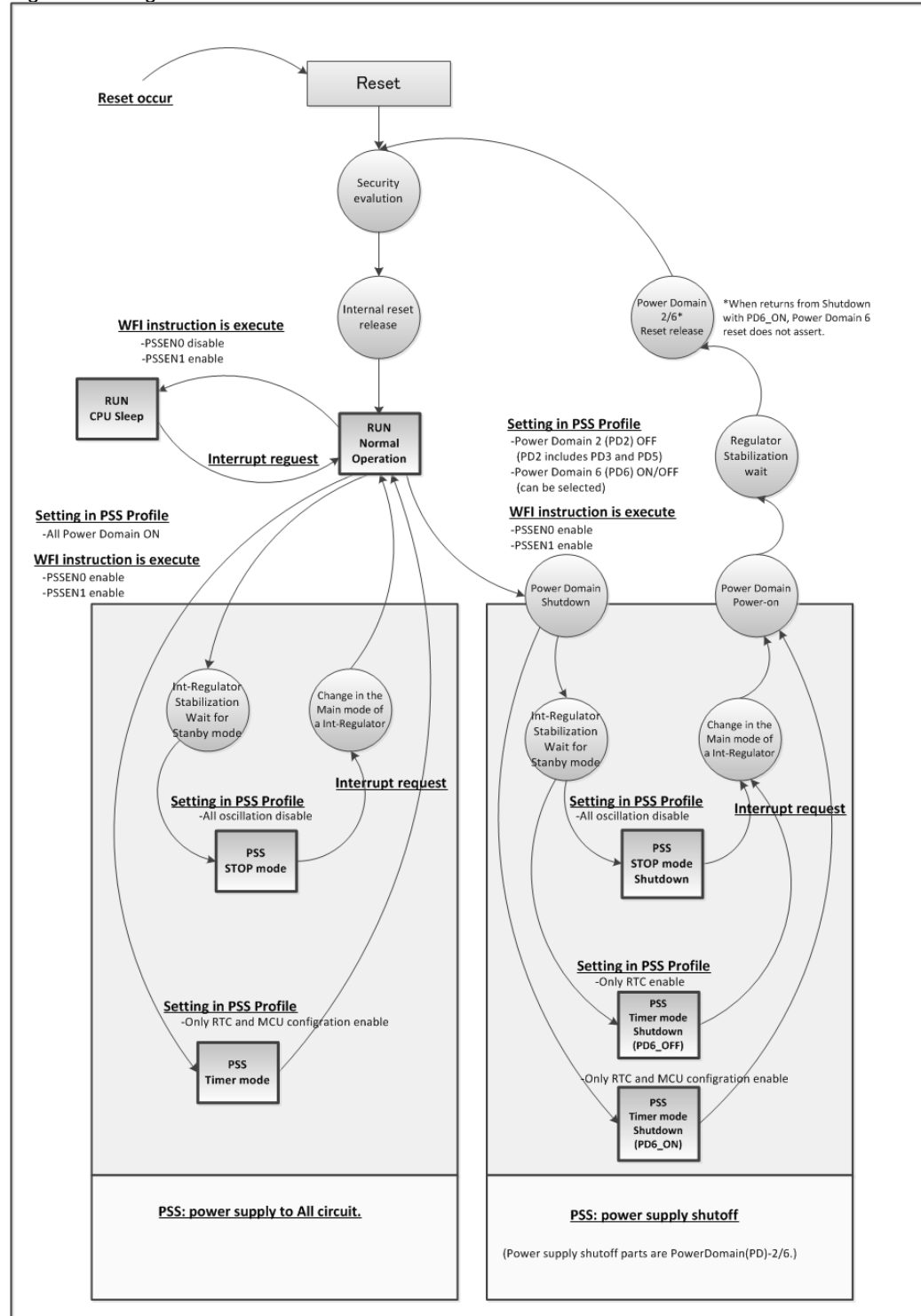


Figure 2-2 RUN/PSS State definitions

S6J3200 supports only the below defined operating state.

Internal state and a frequency definition

		RUN Normal Operation	RUN CPU Sleep	PSS Timer mode	PSS STOP mode	PSS Timer mode shutdown (PD6 ON)	PSS Timer mode shutdown (PD6 OFF)	PSS STOP mode Shutdown
Clocks	CLK_CPU	Customer any frequency	Customer any frequency	Prohibition of an oscillation	Prohibition of an oscillation	Prohibition of an oscillation	Prohibition of an oscillation	Prohibition of an oscillation
	CLK_FCLK							
	CLK_ATB							
	CLK_DBG							
	CLK_HPM							
	CLK_HPM2							
	CLK_DMA							
	CLK_MEMC							
	CLK_SYSC1							
	CLK_TRC							
	CLK_SYSC0H							
	CLK_COMH							
	CLK_RAM0H							
	CLK_RAM1H							
	CLK_SYSC0P							
	CLK_COMP	Prohibition of an oscillation	Prohibition of an oscillation					
	CLK_HAPP0A0							
	CLK_HAPP0A1							
	CLK_HAPP1B0							
	CLK_HAPP1B1							
	CLK_LLPM							
	CLK_LLPM2							
	CLK_LCP							
	CLK_LCP0							
	CLK_LCP0A							
	CLK_LCP1							
	CLK_LCP1A							
	CLK_LAPP0A0							
	CLK_LAPP0A1							
	CLK_LAPP1B0							
	CLK_LAPP1AB1							
oscillation state of a source clock	Slow-CR	100KHz	100KHz	100KHz / disable	Prohibition of an oscillation	100KHz / disable	100KHz / disable	Prohibition of an oscillation
	Fast-CR	4MHz	4MHz	4MHz / disable		4MHz / disable	Prohibition of an oscillation	
	Main oscillator	4MHz / disable	4MHz / disable	4MHz / disable		4MHz / disable	4MHz / disable	
	Sub oscillator	32KHz / disable	32KHz / disable	32KHz / disable		32KHz / disable	32KHz / disable	
	PLL	Customer any frequency	Customer any frequency	Prohibition of an oscillation		Prohibition of an oscillation	Prohibition of an oscillation	
	SSCG_PLL	Customer any frequency	Customer any frequency					

The macro operating state in each mode, and the state of the power domain.

		RUN Normal Operation	RUN CPU Sleep	PSS Timer mode	PSS STOP mode	PSS Timer mode shutdown (PD6 ON)	PSS Timer mode shutdown (PD6 OFF)	PSS STOP mode Shutdown
CPU(PD2)	-	enable	disable	disable	disable	Power down	Power down	Power down
FLASH(PD2)	-	Operation	NOP	Deep Sleep	Deep Sleep	Power down	Power down	Power down
Backup RAM(PD4)	-	Operation	NOP	NOP	NOP	NOP	NOP	NOP
Int-Regulator	-	Main mode	Main mode	Main mode	Standby mode	Main mode	Standby mode	Standby mode
Power Domain	PD2(PD3/PD5)	ON	ON	ON	ON	OFF	OFF	OFF
	PD4_0	ON	ON	ON	ON	ON or OFF	ON or OFF	ON or OFF
	PD4_1	ON	ON	ON	ON	ON or OFF	ON or OFF	ON or OFF
	PD6	ON	ON	ON	ON	ON	OFF	OFF

The conditions for changing in each state.

		RUN Normal Operation	RUN CPU Sleep	PSS Timer mode	PSS STOP mode	PSS Timer mode shutdown (PD6 ON)	PSS Timer mode shutdown (PD6 OFF)	PSS STOP mode Shutdown
Setup for changes	PSSEN0	-	disable	enable	enable	enable	enable	enable
	PSSEN1	-	enable	enable	enable	enable	enable	enable
Changes start command		-	Execution of a WFI command.					

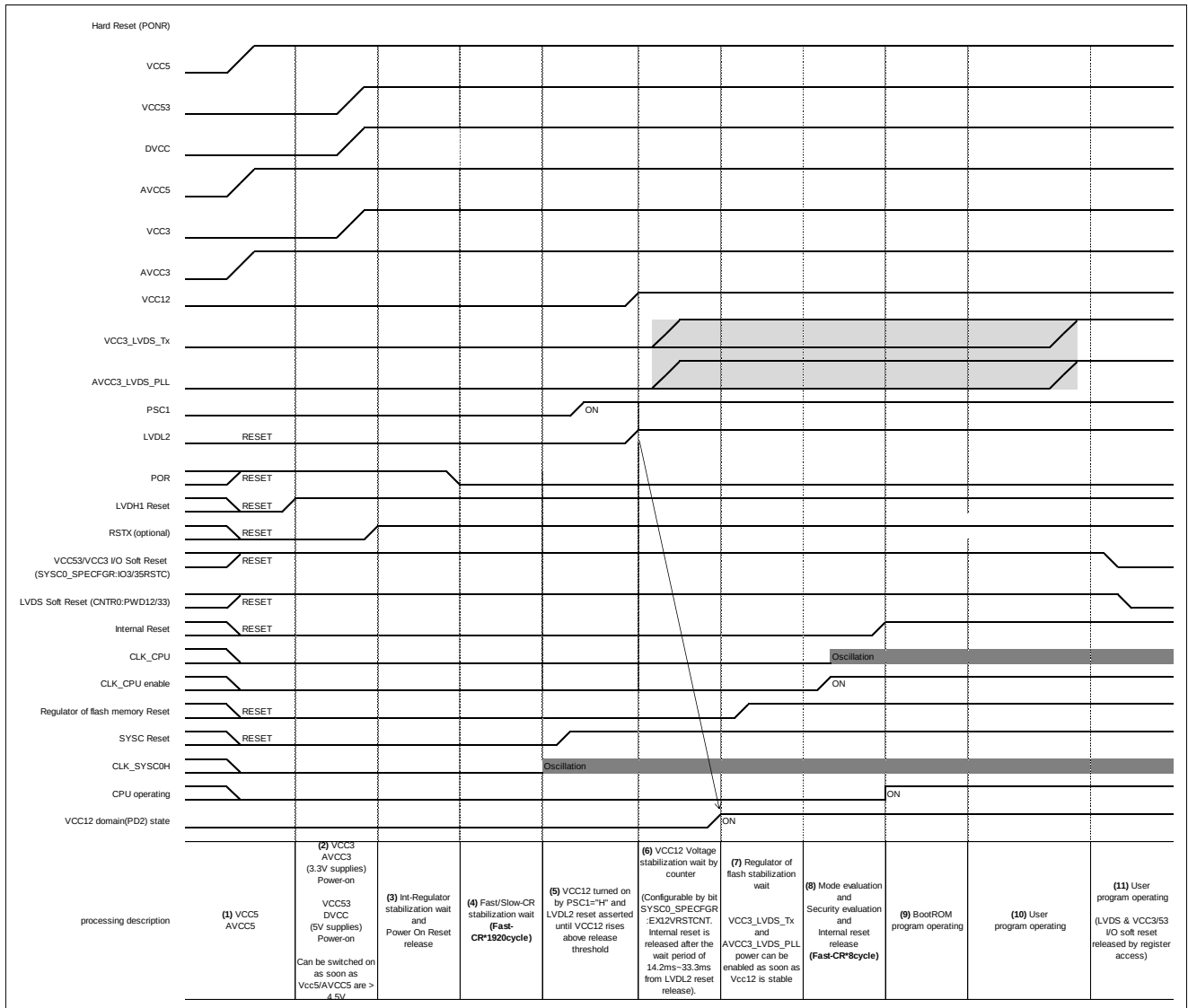
3. Fetching the Operation Mode

This section describes the Fetching the Operation Mode.

The operation mode is fetched by sampling the RST (Reset).

The following shows an operation sequence from an occurrence of reset cause to the determination of an operation mode.

Figure3-1 Operation Mode Fetch Timing Char - Hard reset



Below table describes reset asserted until stabilization of each supply.

Power supply	Reset	Who must monitor the supply?	Corresponding phase in POR release diagram (Figure3-1)	Explanation of Reset
VCC5	LVDH1 reset	CY MCU	(1)	VCC5 is monitored by LVDH1 which issues & releases reset above minimum operation voltage
VDD (internal 1.2V)	POR	CY MCU	(3)	VDD rises above minimum operation voltage during Int-Regulator stabilization wait shown in (3) in sheet POR Diagram
VCC53	LVDH1 reset or RSTX	CY MCU	(1) or (2)	LVDH1 can monitor VCC53 only if it's shorted with VCC5 on the board. Otherwise, this supply has to be monitored on the board and RSTX has to be issued to inactivate the domain until the supply is stable.
DVCC	LVDH1 reset or RSTX	CY MCU or User	(1)	LVDH1 can monitor DVCC only if it's shorted with VCC5 on the board. Otherwise, this supply has to be monitored on the board and RSTX has to be issued to inactivate the domain until the supply is stable.
AVCC5	LVDH1 reset or RSTX	CY MCU or User	(1)	LVDH1 can monitor AVCC5 only if it's shorted with VCC5 on the board. Otherwise, this supply has to be monitored on the board and RSTX has to be issued to inactivate the domain until the supply is stable.
VCC3	RSTX	User	(2)	This supply has to be monitored on the board and RSTX has to be issued to inactivate the domain until the supply is stable.
AVCC3	RSTX	User	(2)	This supply has to be monitored on the board and RSTX has to be issued to inactivate the domain until the supply is stable.
VCC12	Internal power controller reset	User	(6)	This reset is released after VCC12 stabilization counter expires (14.2ms~33.3ms). VCC12 has to rise above safe level within 14.2ms~33.3ms after LVDL2 reset release. Stabilization counter release time depends on Fast-CR-oscillation clock frequency.
AVCC3_LVDS_P LL	NA	User	(11)	Ensure use of LVDS after this supply is stable by software.
VCC3_LVDS_TX	NA	User	(11)	Ensure use of LVDS after this supply is stable by software.

Figure3-2 Operation Mode Fetch Timing Chart - Internal low voltage detector or INITX

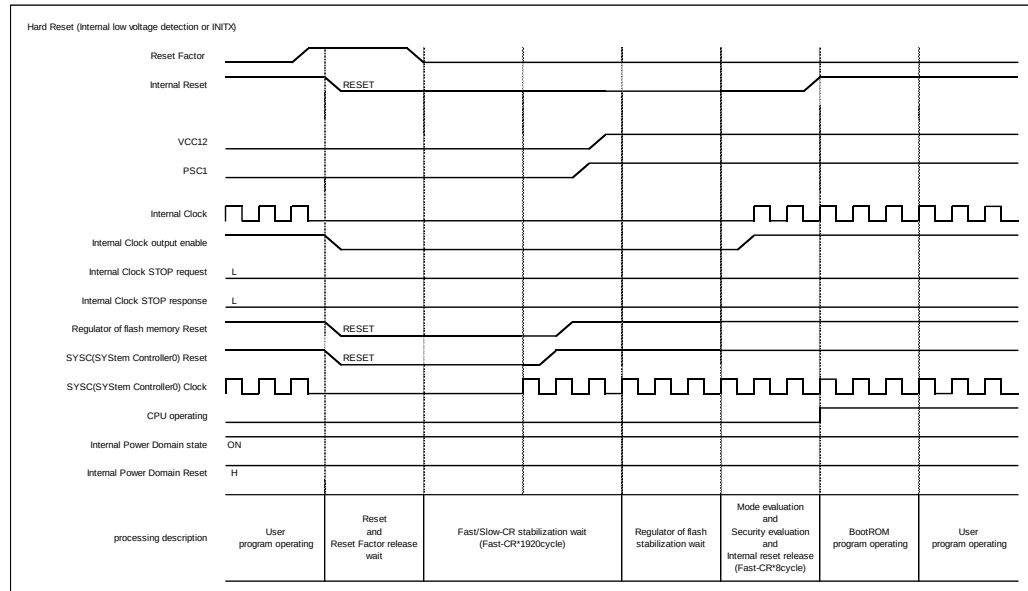


Figure3-3 Operation Mode Fetch Timing Chart

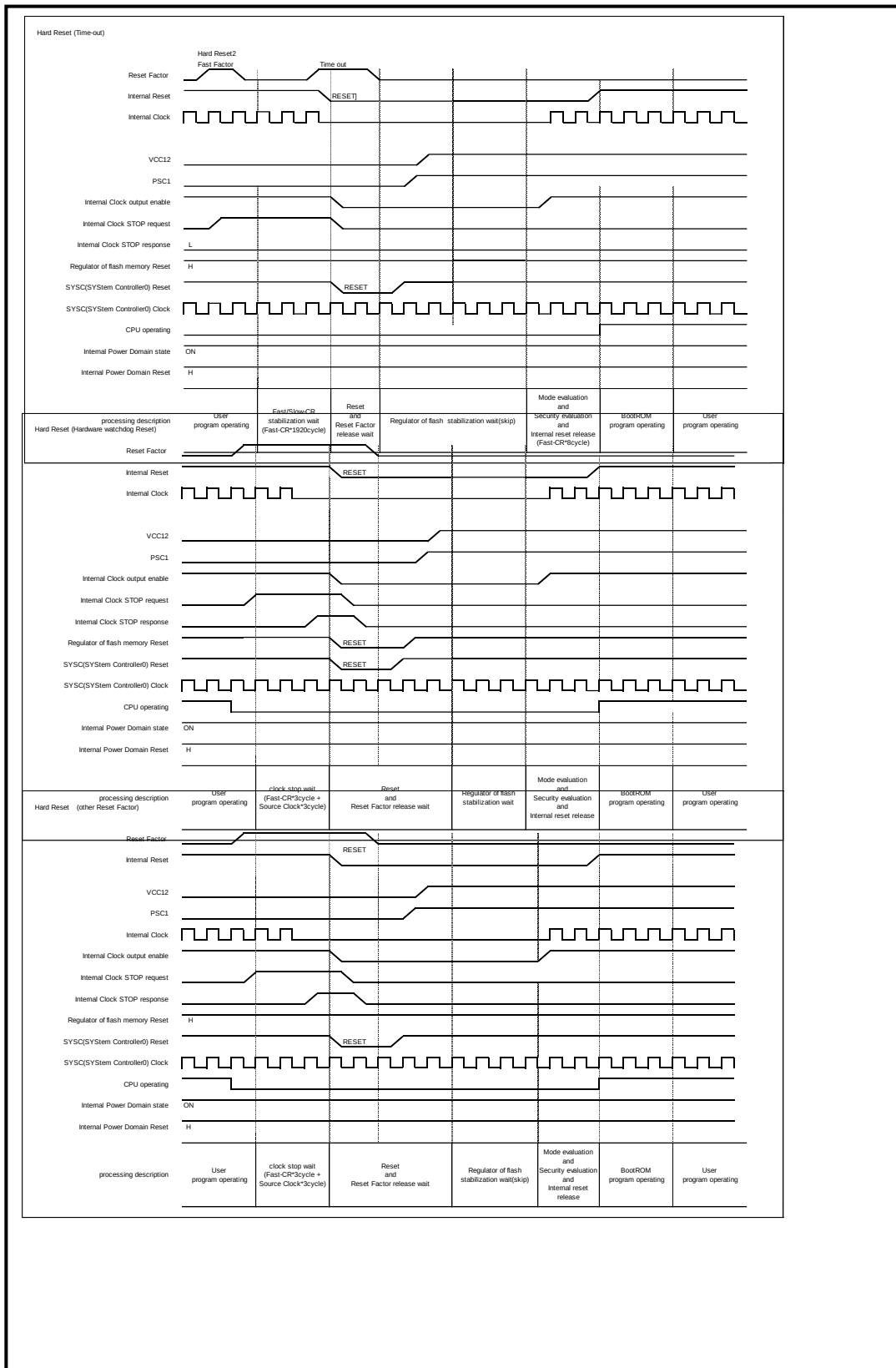
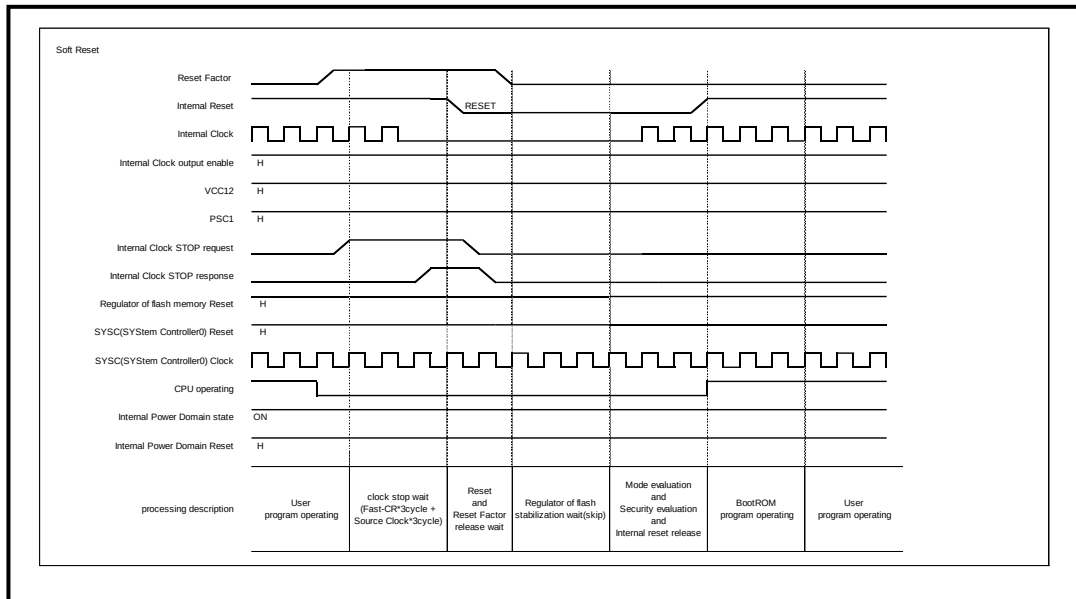


Figure3-4 Operation Mode Fetch Timing Chart



4. Changes to PSS and RUN

This section shows the sequence which changes to PSS and RUN.

Figure4-1 Changes to PSS Timing Chart

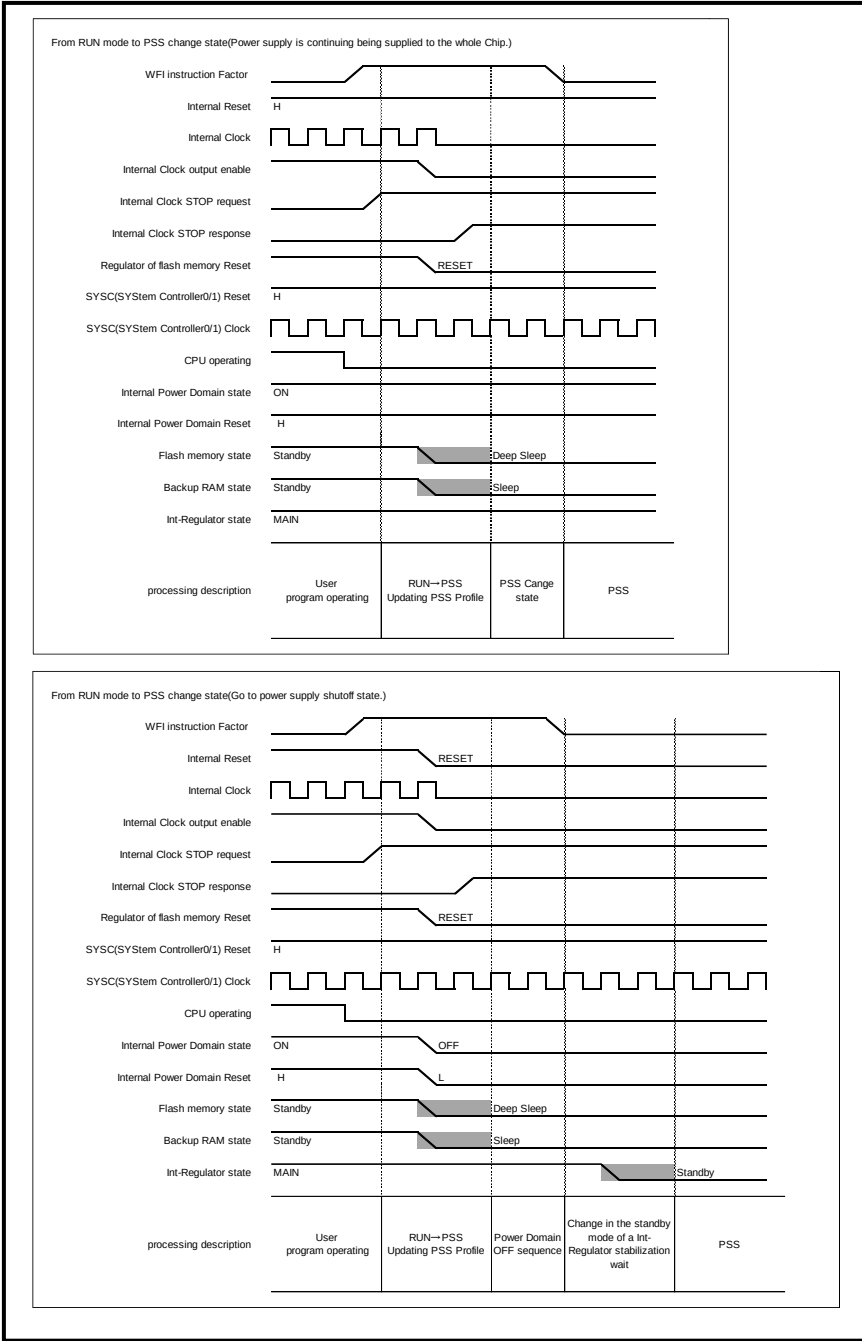


Figure4-2 Changes to PSS Timing Chart

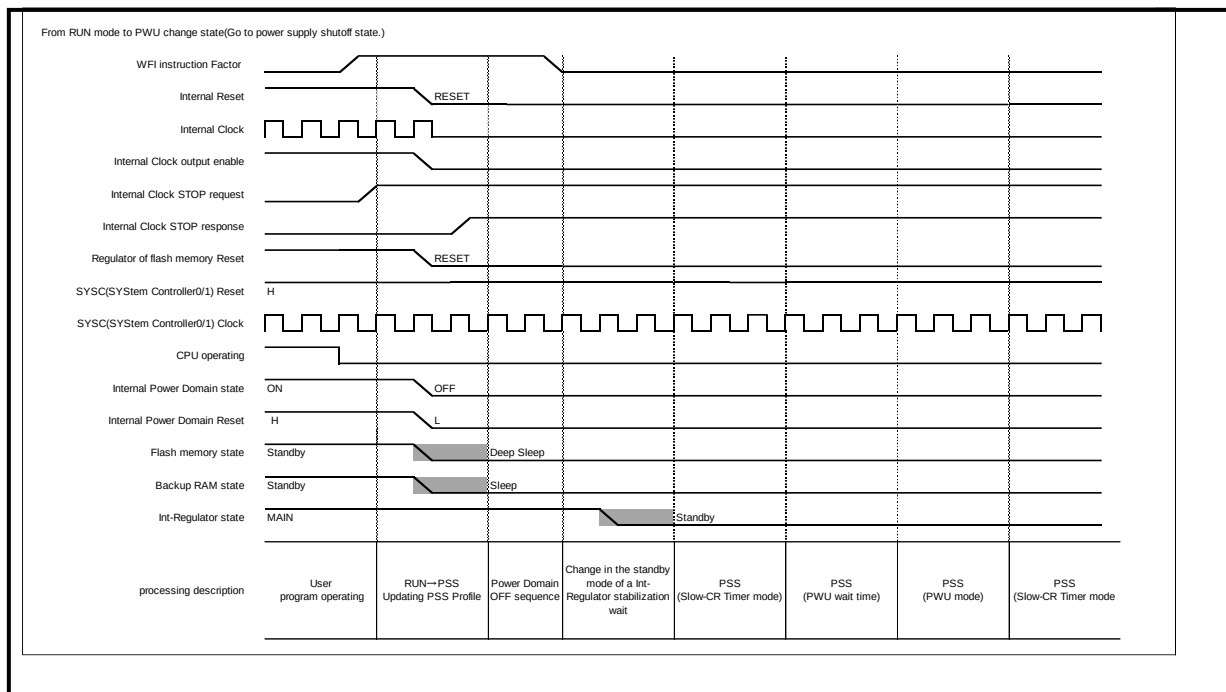


Figure4-3 Changes to RUN Timing Chart

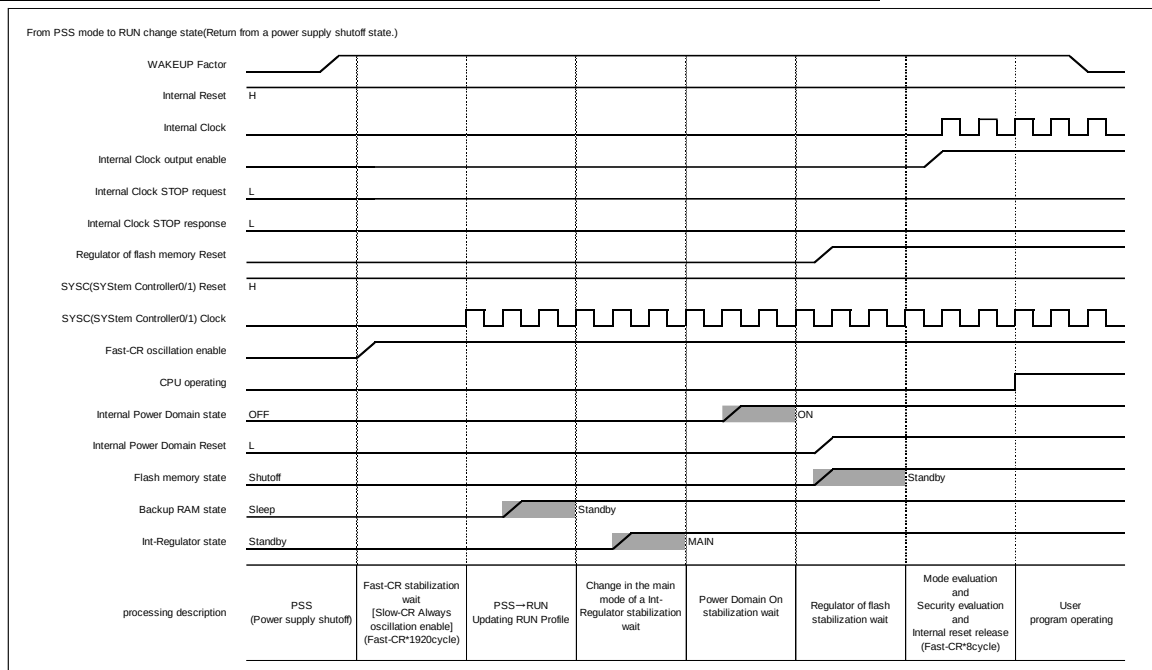
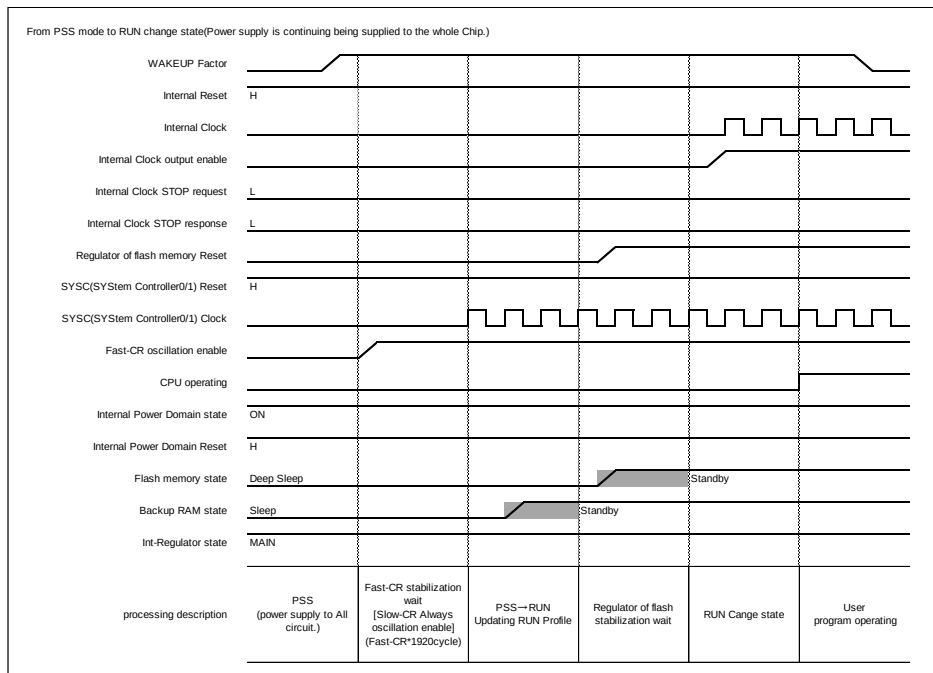
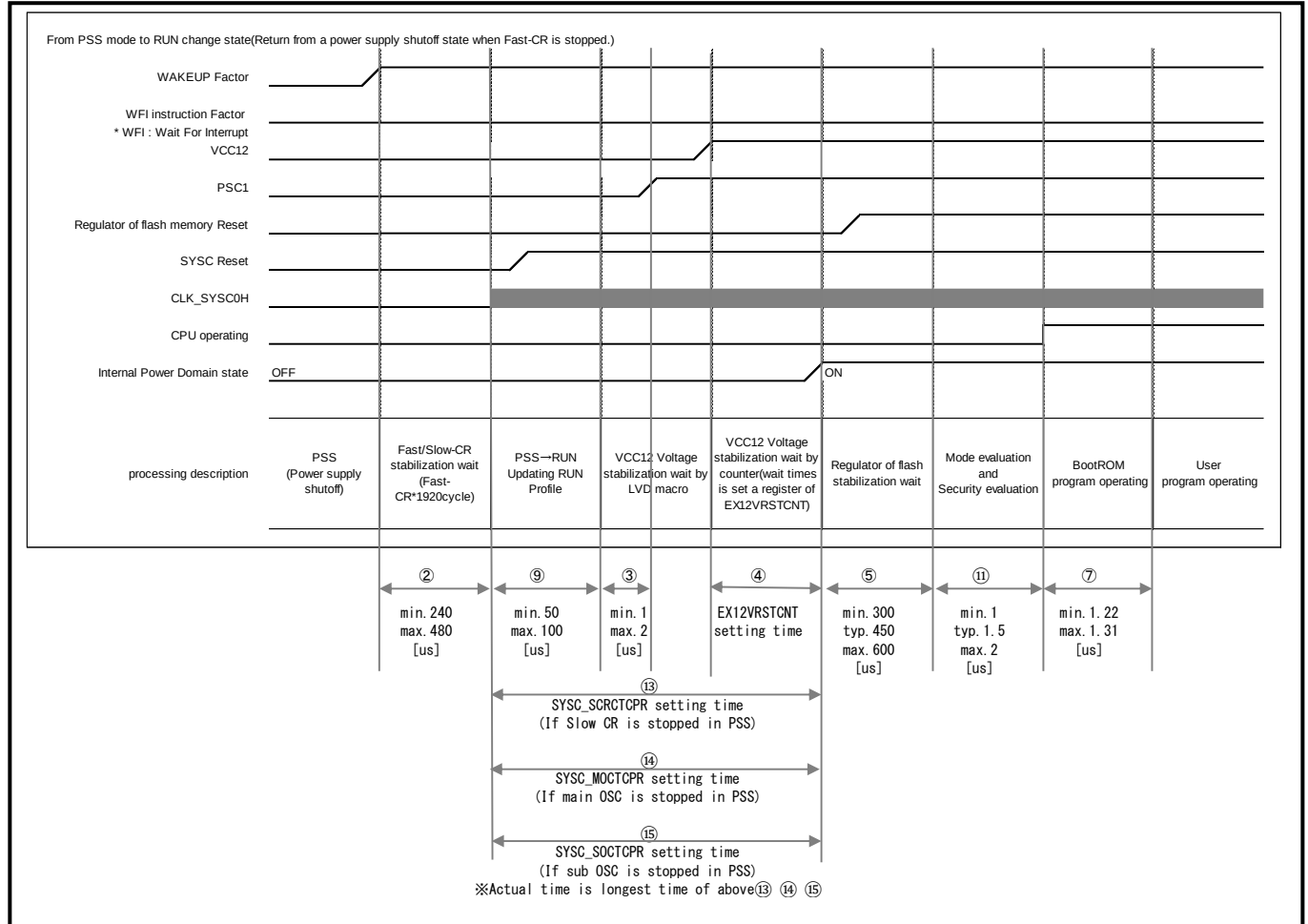


Figure4-4 PSS to RUN Timing Chart wit times in case Fast-CR is stopped



Note:

- ④ Power supply must ensure that VCC12 reaches recommended condition($1.2 \pm 0.1\text{v}$) during EX12VRSTCNT period.

CHAPTER 13: Low-voltage Detection



This chapter explains the function of low-voltage detection.

1. Overview
2. Configuration and Block Diagram
3. Operation
4. Registers
5. Electric Characteristics

CODE: LVD-S6J3200-E1

1. Overview

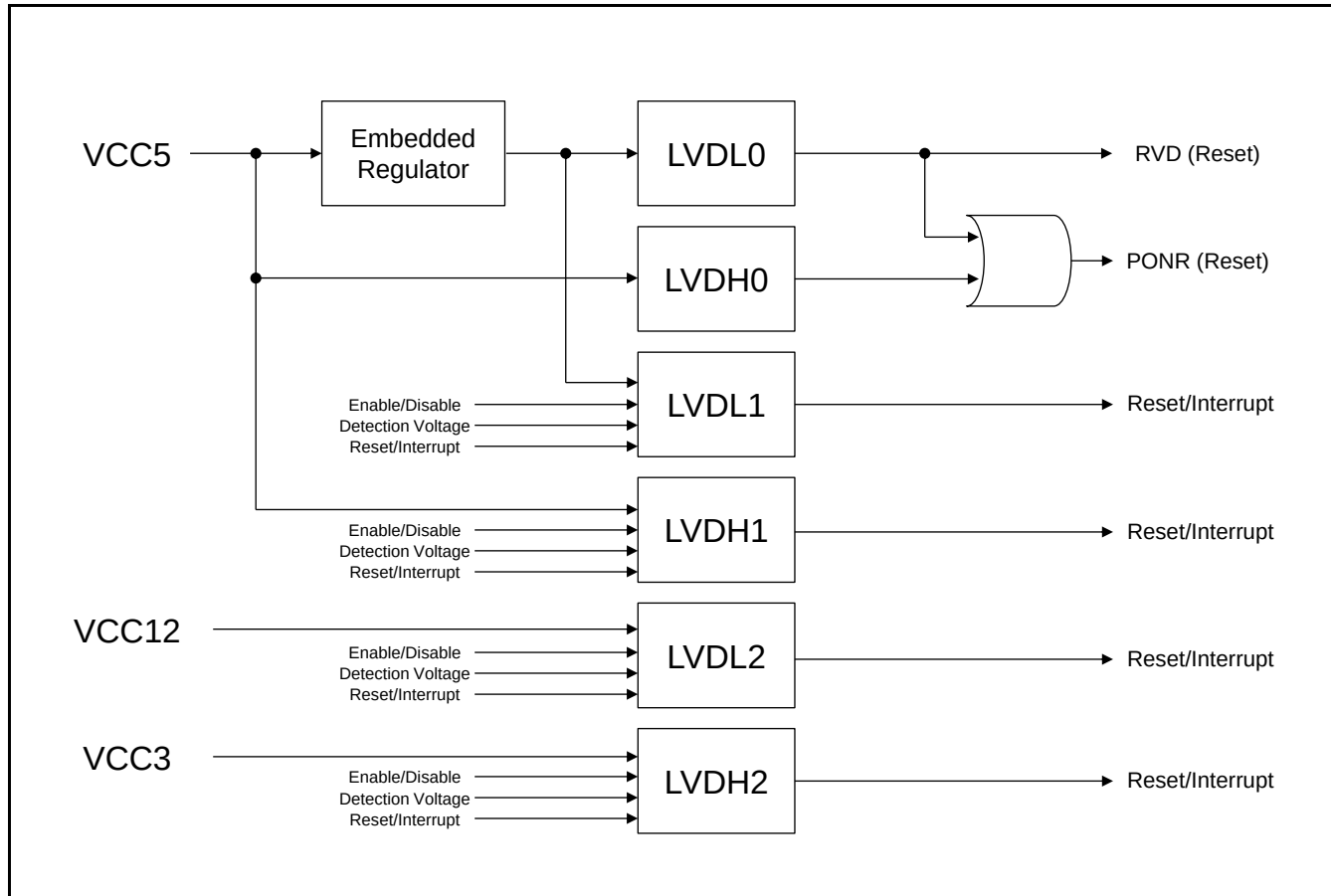
Low-Voltage Detection (LVD) gives the following functions.

- Power on reset (PONR) generation.
- RAM retention low-voltage detection reset (RVD) generation.
- Internal regulator output supervision.
- External power supply supervision.

2. Configuration and Block Diagram

The block diagram shows LVDs hardware and software configuration..

Figure 2-1: LVD Hardware and Software Configuration



3. Operation

3.1. LVD operation

Table 3-1: LVD Description

Channel	Monitor	Detected Voltage	Operation after detection	Enable/Disable	Description (Purpose)
LVDL0	Embedded regulator output	Specific	Reset only	Always enable	RAM retention voltage supervision. Power on condition supervision.
LVDH0	VCC5	Specific	Reset only	Always enable	Power on condition supervision.
LVDL1	Embedded regulator output	Configurable	Reset or interrupt	Configurable	PD1 power supply supervision.
LVDH1	VCC5	Configurable	Reset or interrupt	Configurable	Internal regulator input and 5V I/O power supply supervision.
LVDL2	VCC12	Configurable	Reset or interrupt	Configurable	PD2 power supply supervision.
LVDH2	VCC3	Configurable	Reset or interrupt	Configurable	3V I/O power supply supervision.

Notes:

- *PONR will be*
 - *generated by means of either LVDL0 or LVDH0 detected.*
 - *released by means of both LVDL0 and LVDH0 released.*
- *The voltage for both to detect and to release is specified in the datasheet.*

3.2. Configurations

Function enable/disable, detected voltage threshold, and operation option after low-voltage detection are selectable and configurable for LVDL1, LVDH1, LVDL2, and LVDH2 by software.

As for LVDL0 and LVDH0 anything cannot be configured by software. The functions are always enabled, detect specific voltage, and only generate reset.

The voltage range of detect and release for each is specified in datasheet.

Bit name	Description
LVDL1S, LVDH1S, LVDL2S, LVDH2S	0: Reset, 1: Interrupt
LVDL1V, LVDH1V, LVDL2V, LVDH2V	Threshold voltage can be configured to the bit range.
LVDL1E, LVDH1E, LVDL2E, LVDH2E	0: Disable, 1: Enable

4. Registers

See the RUN/PSS/APP/STS Low-voltage Detection setting Register on Traveo Platform hardware manual.

Here, configurable value and its operation are described.

[bit30] LVDL1S: LVDL1 operation selection bit

Bit	Description
0	Reset (Initial value)
1	Interrupt

[bit26:25] LVDL1V: LVDL1 voltage setting bits

Bits	Detection Voltage [V]	Guaranteed MCU operation range
00	Not supported	No
01	Not supported	
10	0.97 (Initial value)	
11	1.07	

Note:

- This LVD cannot be used to reliably generate a reset before voltage dips below minimum guaranteed MCU operation voltage.

[bit24] LVDL1E: LVDL1 operation enable bit

Bit	Description
0	STOP operation
1	Enable operation (Initial value)

[bit22] LVDL2S: LVDL2 operation selection bit

Bit	Description
0	Reset (Initial value)
1	Interrupt

[bit18:17] LVDL2V: LVDL2 voltage setting bits

Bits	Detection Voltage [V]	Guaranteed MCU operation range
00	0.77 (Initial value)	No
01	0.87	
10	0.97	
11	1.07	

Note:

- This LVD cannot be used to reliably generate a reset before voltage dips below minimum guaranteed MCU operation voltage.

[bit16] LVDL2E: LVDL2 operation enable bit

Bit	Description
0	STOP operation
1	Enable operation (Initial value)

[bit14] LVDH1S: LVDH1 operation selection bit

Bit	Description
0	Reset (Initial value)
1	Interrupt

Notes:

- EXVRSTCNT bit in SYSC0_SPECFGR register can be used to configure whether external power supply control pin PSC_1 is reset by LVDH1.
- If VCC12 needs to be switched off without entering PSS mode, set LVDH1S bit to "0".

[bit12:9] LVDH1V: LVDH1 voltage setting bits

Bits	Detection Voltage [V]	Guaranteed MCU operation range
0000	2.35	No *1
0001	2.75	
0010	2.85	
0011	3.60	
0100	3.80	Yes
0101	4.00	
0110	4.20 (Initial value)	
0111	4.40	
1000	4.65	
1001	4.65	
1010	4.65	
1011	4.65	
1100	4.65	
1101	4.65	
1110	4.65	
1111	4.65	

Notes:

- *1: These LVD settings cannot be used to reliably generate a reset before voltage dips below minimum guaranteed MCU operation voltage, as these detection levels are below the minimum guaranteed MCU operation voltage.
- When changing detection voltage level toward lower level, please change it step by step or set LVDH2E to "0" (Stop operation) to avoid activation by interference of LVDH1 switching activity.

[bit8] LVDH1E: LVDH1 operation enable bit

Bit	Description
0	STOP operation
1	Enable operation (Initial value)

[bit6] LVDH2S: LVDH2 operation selection bit

Bit	Description
0	Reset (Initial value)
1	Interrupt

[bit4:1] LVDH2V: LVDH2 voltage setting bits

Bits	Voltage [V]	Guaranteed MCU operation range
0000	2.35 (Initial value)	No *1
0001	2.75	
0010	2.85	Yes
0011	Not supported	
0100	Not supported	
0101	Not supported	
0110	Not supported	
0111	Not supported	
1000	Not supported	
1001	Not supported	
1010	Not supported	
1011	Not supported	
1100	Not supported	
1101	Not supported	
1110	Not supported	
1111	Not supported	

Note:

- *1: These LVD settings cannot be used to reliably generate a reset before voltage dips below minimum guaranteed MCU operation voltage, as these detection levels are below the minimum guaranteed MCU operation voltage.

[bit0] LVDH2E: LVDH2 operation enable bit

Bit	Description
0	STOP operation (Initial value)
1	Enable operation

5. Electric Characteristics

See the datasheet.

CHAPTER 14: Serial Programming



This chapter explains serial programming.

1. Overview
2. Memory Map
3. FLASH Sector Configuration
4. Port Configuration
5. Operation
6. Note.

CODE: SERIAL_PRG-S6J3200-E1

1. Overview

This chapter describes the FLASH serial programming. Please refer Traveo Platform hardware manual if necessary.

2. **Memory Map**

See the chapter of Memory AND BASE ADDRESS MAP on this hardware manual.

3. **FLASH Sector Configuration**

See the chapter of TCFLASH and WORKFLASH of Traveo Platform hardware manual.

4. Port Configuration

Table 4-1: Port Configuration and Usage

Port Name	Configuration	Remark
MODE	Pull-down	-
RSTX	Reset input	-
X0	Oscillation input	-
X1	Oscillation output	-
P2_27/SIN0	Pull-up: Clock asynchronous mode Pull-down: Clock synchronous mode Used for a serial input function after reset operation.	-
P2_25/SOT0	Pull-up: necessary until reset release. Used for a serial output function after reset operation.	-
P2_26/SCK0	Used for synchronous mode.	-

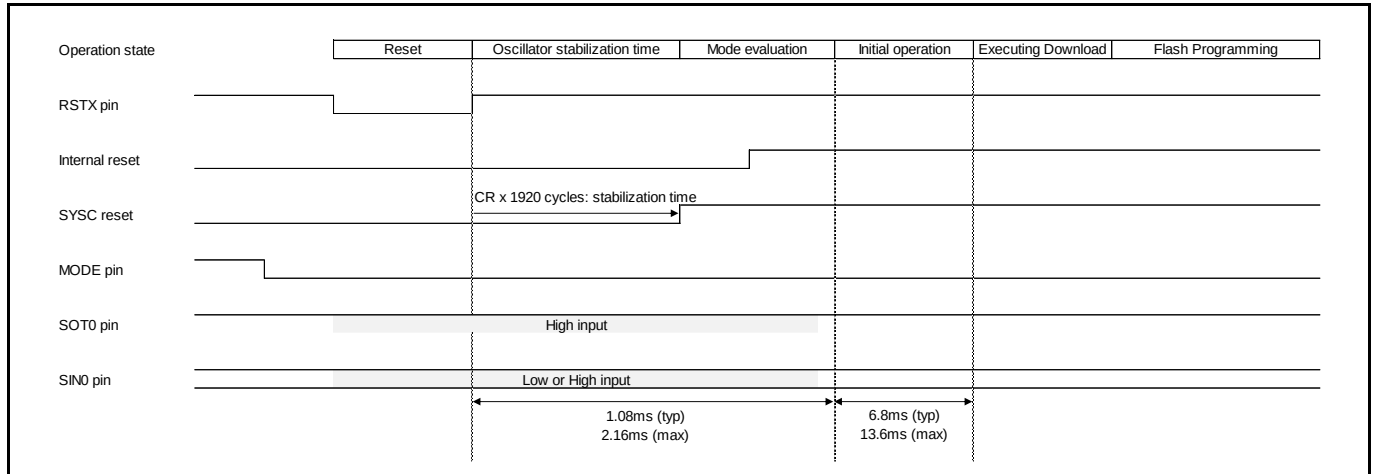
Notes:

- See the chapter of PORT DESCRIPTION for Port name.
- See the PIN ASSIGNMENT on Datasheet.

5. Operation

5.1. Timing Chart

Figure 5-1



5.2. RAM Executing Communication Protocol

5.2.1. Command Format

■ Download Command

Byte Position	Byte Value	Explanation
1	00H	Download command
2	XXH	Download start address (A7-A0)
3	XXH	Download start address (A15-A8)
4	XXH	Download start address (A23-A16)
5	XXH	Download start address (A31-A24)
6	XXH	Download count number (BC7-BC0)
7	XXH	Download count number (BC15-BC8)
8	XXH	Download count number (BC23-BC16)
9	XXH	Download count number (BC31-BC24)
10	XXH	Sum value of download command*1

*1: The SUM value is calculated in 8-bits, and the overflow of simple addition is ignored.

■ Executing Command

Byte Position	Byte Value	Explanation
1	C0H	Executing command
2	00H	Dummy data (For adjusting of command length)
3	00H	Dummy data (For adjusting of command length)
4	00H	Dummy data (For adjusting of command length)
5	00H	Dummy data (For adjusting of command length)
6	00H	Dummy data (For adjusting of command length)
7	00H	Dummy data (For adjusting of command length)
8	00H	Dummy data (For adjusting of command length)
9	00H	Dummy data (For adjusting of command length)
10	C0H	SUM value of executing command

■ Reset Command

Byte Position	Byte Value	Explanation
1	18H	Reset command

■ Full Chip Erase Command

Word Position	Word Value	Explanation
1	C0356EA5H	Key0
2	2E830596H	Key1
3	01A00000H	Key2
4	F3A033EDH	Key3
5	370E6A51H	Key4
6	B0412000H	Key5
7	00000002H	Key6
8	AA805510H	Key7

5.2.2. Command Sequence

■ Download Command Sequence

Byte Count	Host(Tool) => Micom	Micom => Host(Tool)
1 Byte	Receipt of down load command (00H)	
4 Byte	Receipt of download start address	
4 Byte	Receipt of download byte number	
1 Byte	SUM value of command	

Byte Count	Host(Tool) => Micom	Micom => Host(Tool)	
1 Byte		Command response Normal end SUM malfunction Command malfunction	: 01H : X2H : X4H
N Byte	Receipt of download data	Data input procedure(Little Endian) D7 to D0 D15 to D8 D23 to D16 D31 to D24	
1 Byte	SUM value of download data*1		
1 Byte		Download processing response Busy Normal end SUM malfunction	: 00H : 01H : 02H

*1: About downloaded N byte data, SUM value is calculated in 8-bits, and the overflow of simple addition is ignored.

■ Executing Command Sequence

Byte Count	Host(Tool) => Micom	Micom => Host(Tool)	
1 Byte	Receipt of executing command (C0H)		
8 Byte	Receipt of dummy data (00H)		
1 Byte	SUM value of the command (C0H)		
(1 Byte)		Command response (when SUM value is malfunction)*1 SUM malfunction	: C2H

*1: Only when the SUM malfunction occurs, command response is returned. Command response is not returned except the SUM malfunction occurs. After receiving executing command, it jumps to the download start address specified by the download command if the SUM is not malfunctioning.

■ Reset Command Sequence

Byte Count	Host(Tool) => Micom	Micom => Host(Tool)	
1 Byte	Download Command (18H)		
1 Byte		Command response *1 Normal end	: 11H

*1: Response of reset command is always normal end. (11H)

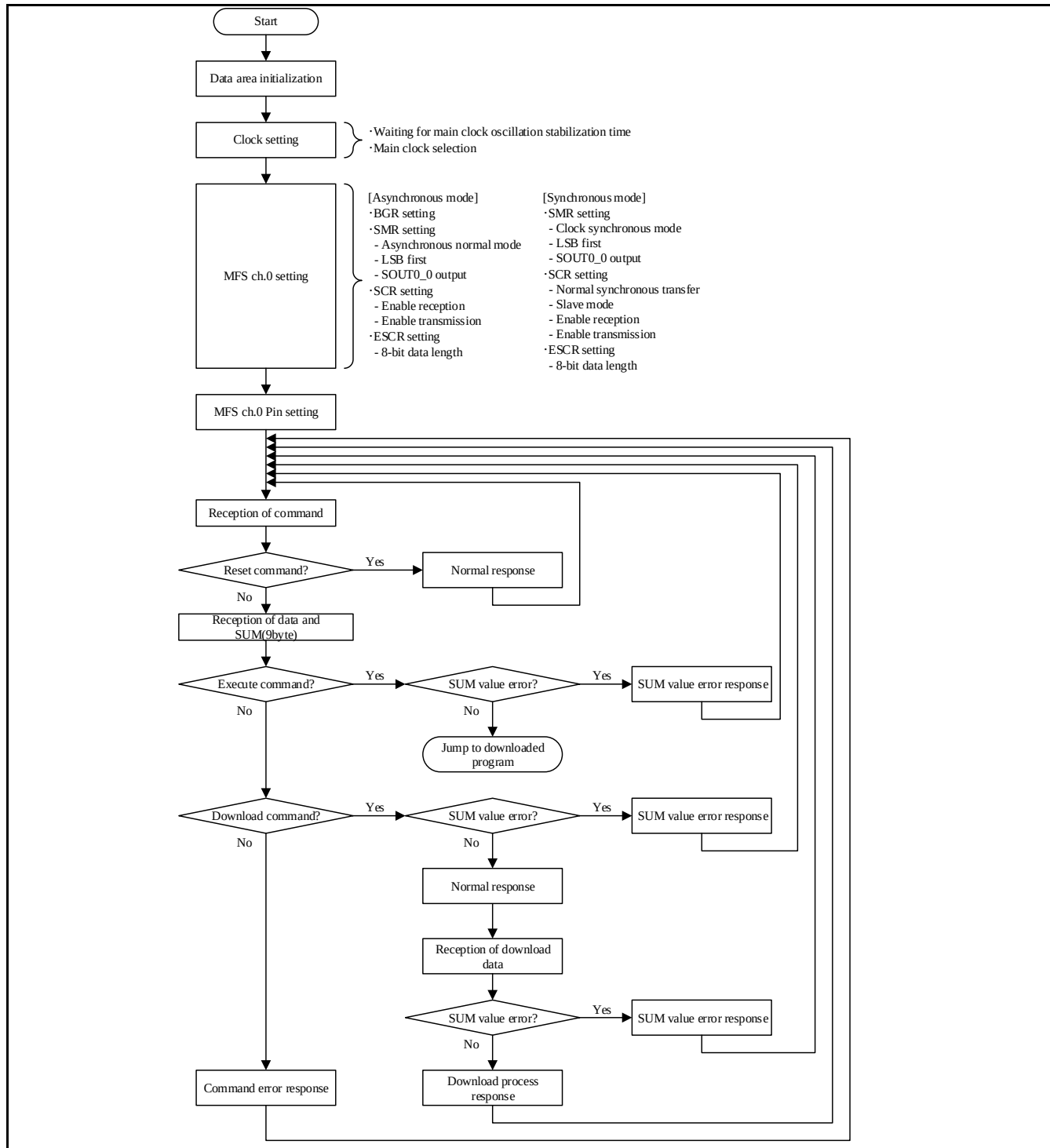
■ Full Chip Erase Command Sequence

Byte Count	Host(Tool) => Micom	Micom => Host(Tool)	
1-32 Byte	Key0-7Receive	-	
4 Byte	-	Command response *1 Normal end	: 12345678H
4 Byte	-	Command response *1 Normal end	: BABEFACEH

*1: Command response is returned only when it is normal end. In other cases, hard reset is operated and command response is not returned.

5.3. Operation Flow

Figure 5-2: Operation Flow Chart



6. Note.

See Traveo Platform hardware manual in detail.

6.1. PSC Port State

PSC port which is expected to control switching of external power supply devices will output "low" during external reset ("low" is inputted to RSTX) in SERIAL PROGRAMMING MODE. After reset ("high" is inputted to RSTX), PSC port will output "high".

If 1.2V power supply is supervised and RSTX is controlled with its low-voltage state, PSC cannot output "high", that is, external power supply devices would not start power supplying, and MCU cannot go to a power-on sequence before a serial programming operation.

CHAPTER 15: 12-/10-/8-bit Analog to Digital Converter



This chapter explains the functions and operations of the 12-/10-/8-bit A/D Converter.

1. Overview
2. Configuration and Block Diagram
3. Operation of A/D Converter
4. Setup Procedure Examples
5. Registers

CODE: FIP022-E02.3

1. Overview

The A/D Converter converts analog input voltages into digital values. The A/D Converter features eight range comparators, 64 pulse detection units, 64 separate conversion data registers and four multiple conversion channels.

Features of the A/D Converter

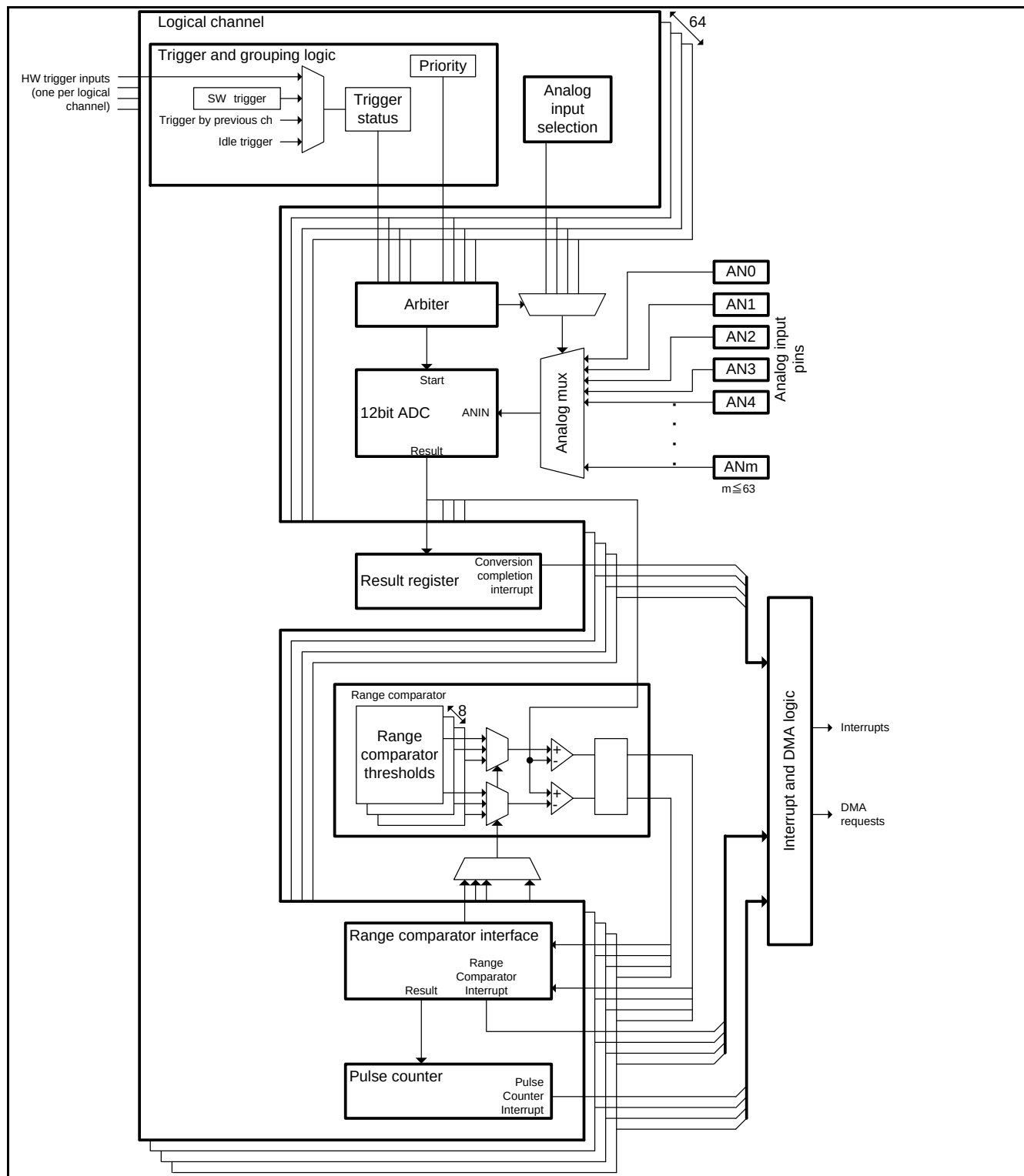
- Conversion time: Refer to the datasheet
- 12-/10-/8-bit resolution
- RC type successive approximation conversion with sample & hold circuit
- Programmable configuration of 64 logical channels by mapping them to up to 64 analog inputs
 - Each logical channel is mapped to exactly one analog input
 - Several logical channels can be mapped to the same analog input
- 64 dedicated logical channel conversion data registers
- Programmable selection of one of the four global sampling times for each logical channel
- Conversion request for each logical channel *i* is possible by software trigger only, hardware or software trigger, trigger by conversion completion of the preceding logical channel *i*-1 and idle trigger
- All active conversion requests are compared according to the corresponding logical channel priorities (selectable range is 0-15, 0 is the highest and 15 is the lowest priority) and A/D conversion is started for the logical channel with the highest priority
- When the higher priority conversion requests during an active A/D conversion, it is possible to select the following behavior
 - An active A/D conversion can be interrupted, and the higher priority conversion starts after interrupt operation
 - An active A/D conversion cannot be interrupted, hence the wait time between the higher priority conversion request and its conversion start can be up to the maximum A/D conversion period. In case of multiple conversion channel processing that are configured to be non-interruptible, the wait time can increase to the time needed to the maximum multiple channel conversion period
- The consecutive logical channels can be configured as a group, where the start channel conversion request is set to software trigger only, hardware or software trigger or idle trigger while all other channel conversion requests are set to the preceding logical channel conversion completion
- If a group conversion is interrupted by a higher priority conversion request, after the higher priority request is processed the following group configurations are possible:
 - Resume with the next logical channel in the group (before the conversion start of the channel the group is interrupted)
 - Restart with the group start channel or the last converted channel configured as "resume" channel within a group
 - Stop the group processing until next start channel conversion request is issued
- First four logical channels can be configured as:
 - Multiple conversion channels offering the possibility to perform 1 to 16 conversions of the same logical channel and accumulate the result
 - A/D Converter calibration channels providing the configuration for conversion of A/D Converter reference voltages in order to calculate the offset and gain corrections
- Eight range comparators are selectable for every logical channel, comparing the full range (12-bit)/upper 8-bit of the conversion result
- Programmable upper and lower thresholds for each range comparator
- The comparison results will set flags per logical channel, depending on the configuration. Possible configurations are:
 - "Outside range": The flags are set if the A/D result is below the lower OR above the upper threshold
 - "Inside range": The flags are set if the A/D result is above the lower AND below the upper threshold
- The results of the range comparator can be filtered to ignore short spikes
- During an active A/D conversion, it can be forced stop by software
- It is possible to select the operation after A/D conversion finished (and next conversion is not requested)
 - A/D converter goes to idle (power-down) state after A/D conversion finished
 - A/D converter does not go idle (power-down) state, it can start A/D sampling without the resumption time
- Interrupt request generation to CPU is provided for:
 - Conversion done interrupt (end of a logical channel conversion)

- Group interrupted interrupt (a group processing is interrupted just before the logical channel conversion is to be started or in case of multiple conversion channel before the last conversion is started)
- Range comparison interrupt
- Pulse detection interrupt
- Conversion done interrupts of up to four logical channels can trigger DMA requests to transfer the A/D conversion results to memory. The conversion done interrupts of the group last logical channels are good candidates for DMA burst setup, since the group result registers can be read linearly
- Debug mode provides the possibility to freeze further A/D conversion processing at the end of the current conversion

2. Configuration and Block Diagram

This section shows a block diagram of A/D converter.

Figure 2-1 Block Diagram of A/D Converter



3. Operation of A/D Converter

A/D Converter operates using the successive approximation method with 12-bit or 10-bit or 8-bit resolution. There is one A/D Conversion Data Register per logical channel which is updated each time the assigned logical channel is converted. First four logical channels can be configured as multiple conversion channels or used for A/D Converter calibration.

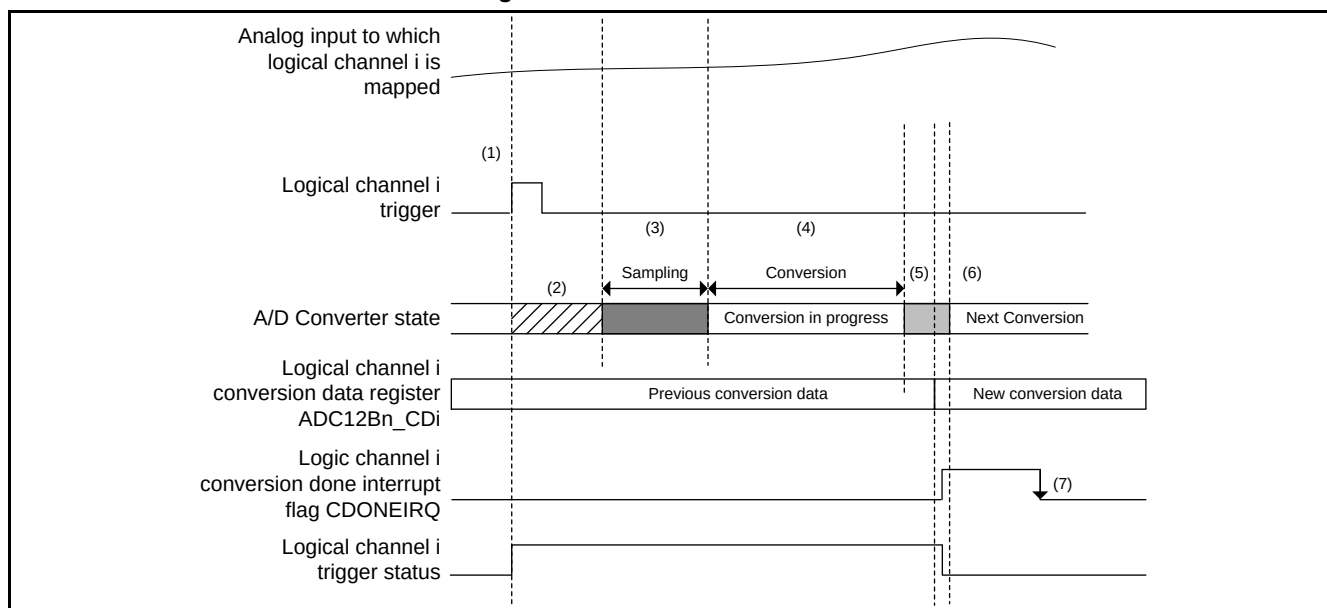
The range comparator compares the converted values with the configured values in the threshold registers and accordingly generates an interrupt for "inside range" or "outside range", depending on the configuration. Any of eight range comparators can be configured for any of 64 logical channels.

A/D Pulse Detection function detects events of desired length and also filters parasitic inverted events. Each logical channel has a dedicated pulse detection function.

3.1. A/D Conversion Flow

The basic A/D conversion flow is shown on Figure 3-1.

Figure 3-1 A/D Conversion Flow



The important steps marked on the figure are:

- (1) A/D conversion request (trigger) is issued for particular logical channel i and the corresponding trigger status is set.
- (2) Period between the trigger and actual conversion start depends on current A/D Converter state condition
 - If A/D Converter is in idle (power-down) state (power-down mode is enabled (ADC12Bn_CTRL.PDDMD = "0")) i.e. there are no trigger status set at the moment the trigger is issued, it is first waited until the resumption time (configured as A/D converter resumption time register (ADC12Bn_RT)) elapses. At the end of resumption time, the priority arbiter compares the priorities of all logical channels with set trigger status and inactive data protection feature. The conversion of the logical channel i start when this channel wins the arbitration, i.e. after all logical channels with higher priority are converted.
 - If A/D converter is active at the moment the trigger is issued, the operation is dependent on the setting of forced stop mode (ADC12Bn_CTRL.FSMD).
 - Forced stop is enabled (ADC12Bn_CTRL.FSMD = "1"): Even if the sampling phase is started, an active A/D conversion can be interrupted. So, the logical channel i starts after interrupt operations instead of currently performed conversion when this channel wins the priority arbitration.

- Forced stop is disabled (`ADC12Bn_CTRL.FSMD = "0"`): The conversion of the logical channel *i* starts when this channel wins the priority arbitration and currently preformed conversion is finished, since an A/D conversion cannot be interrupted once its sampling phase is started. Accordingly, even if the logical channel *i* has the highest priority, in worst case it can happen that its conversion is delayed by the maximum configured time needed to convert one logical channel (including the case of multiple conversion channel that cannot be interrupted).

(3) Sampling period. A/D converter internal input signal level goes to the level of the analog input to which the logical channel *i* is mapped.

(4) A/D conversion.

(5) A/D conversion finalization period. The conversion result is stored in the dedicated conversion data register `ADC12Bn_CDi`, the conversion done interrupt flag is set and the trigger status is cleared.

(6) Started next conversion of the logical channel with the highest priority at the moment. If there is no trigger for any logical channel, the operation is dependent on the setting of power-down disable mode (`ADC12Bn_CTRL.PDDMD`).

- Power down disable mode (`ADC12Bn_CTRL.PDDMD = "1"`): Even if the A/D conversion is finished (and next conversion is not requested), A/D converter does not go idle (power-down) state. It can start A/D sampling without A/D converter resumption time.
- Power down enable mode (`ADC12Bn_CTRL.PDDMD = "0"`): A/D converter goes to idle (power-down) state after A/D conversion finished (and next conversion is not requested).

If the trigger status of any logical channel is already set, next conversion is started without A/D converter resumption time.

(7) After the conversion data register (`ADC12Bn_CDi`) is read or by writing "1" to the corresponding conversion done interrupt clear bit (`ADC12Bn_CDONEIRQC0` to `1.CDONEIRQCi`), the conversion done interrupt flag is cleared.

In case A/D Converter reconfiguration takes place during operation (A/D Converter is not in power-down state), the following rules are to be obeyed:

- Do not reconfigure logical channels belonging to the group that is currently converted.
- Set the trigger types (`ADC12Bn_CHCTRL0` to `63.TRGTYP[1:0]`) of the logical channels affected by the reconfiguration to software trigger only ("00" setting).
- Clear all the trigger status flags (`ADC12Bn_TRGST0` to `1.TRGST` and `ADC12Bn_CHSTAT0` to `63.TRGST`) of the affected logical channels, by writing "1" to the corresponding bits of `ADC12Bn_TRGCL0` to `1` (or `ADC12Bn_CHCTRL0` to `63.TRGCL`) registers.
- Reconfigure the logical channels.

3.2. Logical Channel Mapping to Analog Input Signals

64 logical channels are mapped to up to 64 analog input signals that need to be converted into the digital values. The mapping is done over ADC12Bn_CHCTRL0 to 63.CHNUM configuration fields in the way that CHNUM value controls the number of the analog input signal AN, that is propagated to the A/D Converter input in case the logical channel is converted.

Figure 3-2 illustrates an example of possible logical channel mapping to analog inputs. Each logical channel is mapped to exactly one analog input and it is allowed to map several logical channels to the same analog input (logical channels 4, 5, 6 and 62 are mapped to the analog input AN8).

Figure 3-2 Example of Logical Channel Mapping to Analog Inputs

Logical channel number	0	1	2	3	4	5	6	7	...	58	59	60	61	62	63
CHNUM bit field setting	52	14	63	0	8	8	8	32	...	1	2	3	28	8	4
Analog input signal	AN52	AN14	AN63	AN0	AN8	AN8	AN8	AN32	...	AN1	AN2	AN3	AN28	AN8	AN4

The described way of logical channel organization provides following benefits:

- Configurable grouping and consecutive conversion of channels independent on physical pin order.
- Mapping of several logical channels to the same analog input allows repetitive conversion of the same analog input with only one interrupt at the end.

3.3. Logical Channel Data Protection Function

Every logical channel has its own conversion data register ADC12Bn_CD. They are written by hardware at the end of conversion of the dedicated channel. The CPU can read the data registers any time. If a conversion is finished and the data of the previous conversion of the same channel has not been read out, previous data could be overwritten and previous conversion result lost. To avoid this, the data protection function can be enabled so that the next conversion of this logical channel is not started until the previous data has been read out. The data protection function is controlled by the corresponding ADC12Bn_CHCTRL0 to 63.DP bits:

- If for some logical channel the dedicated ADC12Bn_CHCTRLi.DP bit is equal to "0", then conversion is continued and former conversion data are overwritten.
- In case of a regular logical channel, if the dedicated ADC12Bn_CHCTRLi.DP bit is equal to "1" and conversion done interrupt flag is set to "1", this logical channel cannot be selected for the conversion even though its trigger status may be set. The channel can be selected for conversion again after its conversion done interrupt flag has been cleared, e.g. by reading the conversion data register.
- In case of a multiple conversion logical channel
 - if the dedicated DP bit is equal to "1" and conversion done interrupt flag is set to "1" or
 - if the dedicated DP bit is equal to "1", group interrupted interrupt flag is set to "1", group interrupted interrupt is enabled and multiple conversions are already started, then the channel cannot be selected for conversion until its conversion done interrupt flag or group interrupted interrupt flag have been cleared.

Notes:

1. It should set DP to "1" only for the logical channels configured as a group (for details about group configuration please see section "Group processing" in chapter "3. Operation of A/D ") having all its logical channels set to "Resume" (ADC12Bn_CHCTRL0 to 63.RSMRST = "01"). In case of other group configurations:
 - "Restart" setting (ADC12Bn_CHCTRL0 to 63.RSMRST = "10") - the group may be restarted before the conversion done interrupt of the last channel in the group (meaning the interrupt that indicates that the conversion of the entire group has been completed) is asserted, so the CPU does not know that there is already a result available in this channel.
 - "Stop" setting (ADC12Bn_CHCTRL0 to 63.RSMRST = "00") - with the group interrupted interrupt enabled, it could be possible for the CPU to clear the conversion done interrupt flags of the affected channels, but the use case of both "Stop" and "Restart" is that the results of an interrupted group are not interesting, so they do not need to be protected.
2. For groups consisting of only one multiple conversion channel, it should use DP as follows:
 - "Resume" setting (ADC12Bn_CHCTRL0 to 63.RSMRST = "01") - when setting DP to "1", disable the group interrupted interrupt (set the corresponding ADC12Bn_GRP_IRQE0.GRPIRQE0 to 3 to "0"): The conversion result will be protected only after all conversions of the multiple conversion channel have been performed.
If the corresponding ADC12Bn_GRP_IRQE0.GRPIRQE0 to 3 is set to "1", then the conversion result will be protected at the time the channel is interrupted, and the conversions will not be resumed before the group interrupted interrupt flag has been cleared. When the conversion is resumed, the conversion counter is reset and first conversion is started. It means the multiple conversion cannot resume from the interrupted state.
 - "Restart" setting (ADC12Bn_CHCTRL0 to 63.RSMRST = "10") - when setting DP to "1", disable the group interrupted interrupt (set the corresponding ADC12Bn_GRP_IRQE0.GRPIRQE0 to 3 to "0"): The conversion result will be protected only after all conversions of the multiple conversion channel have been performed. Even if the corresponding ADC12Bn_GRP_IRQE0.GRPIRQE0 to 3 is set to "1", the conversion result will be protected only after all conversions of the multiple conversion channel have been performed.
 - "Stop" setting (ADC12Bn_CHCTRL0 to 63.RSMRST = "00") - when setting DP to "1", enable the group interrupted interrupt (set the corresponding ADC12Bn_GRP_IRQE0.GRPIRQE0 to 3 to "1"): The conversion result will be protected when the channel is interrupted or when all conversions have been completed.

3.4. Logical Channel Triggering and Priority

Each logical channel has the configuration bit field ADC12Bn_CHCTRL0 to 63.TRGTYPE[1:0], controlling the way a conversion request (trigger) can be issued. The following settings are possible:

- Software trigger only (TRGTYP = "00") - in order to set the dedicated trigger status flags (ADC12Bn_CHSTAT0 to 63.TRGST and ADC12Bn_TRGST0 to 1.TRGST) the corresponding software trigger bit (ADC12Bn_CHCTRL0 to 63.SWTRG) must be set to "1".
- Hardware or software trigger (TRGTYP = "01") - the corresponding trigger status flags can be set not only through software trigger bit, but also in case of the rising edge event on dedicated hardware trigger input.
- Trigger by completion of the preceding logical channel (TRGTYP = "10") - the trigger status flags are set only at the end of preceding logical channel conversion, i.e. updating of conversion data register ADC12Bn_CD of the preceding channel triggers this channel if the trigger status flags of the preceding channel are still set. This allows combining several consecutive logical channels into a group that will be sequentially converted after the start channel is triggered. To configure a group, the start channel trigger type is set to software trigger only, hardware or software trigger or idle trigger, while all other channel trigger types are set to the preceding logical channel conversion completion. It does not make sense to configure the first logical channel to trigger type 2, since the channels would never be triggered.
- Idle trigger (TRGTYP = "11") - the trigger status flags are set whenever there is no active conversion request, i.e. there is no logical channel having trigger status flag set and inactive data protection function. Accordingly, trigger status flags of all logical channels with idle trigger type are set at the same time. The further processing depends on their priority. The idle trigger type allows to form a regular group (the start channel is set to idle trigger and consecutive channels have preceding channel completion trigger type).

Once the logical channel trigger status is set to "1", the channel priority (bit fields ADC12Bn_CHCTRL0 to 63.CHPRI) configures the conversion order of logical channels with the inactive data protection function. In case of the same priority, active trigger status and inactive data protection function, the logical channel having lower number wins the priority arbitration. The priority can be set in the range 0 - 15. The setting 0 (CHPRI = "0000") is the highest priority, whereas the lowest possible priority setting is 15 (CHPRI = "1111").

Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1"):

When the higher priority conversion was requested during an active A/D conversion, the operation of interrupt is dependent on the setting of the channel priority (ADC12Bn_CHCTRL0 to 63.CHPRI) only.

- If the priority (CHPRI) of the requested channel is lower than active channel, it can be interrupted and the conversion of the channel with the higher priority is started.
- If the priority (CHPRI) is higher or same, it cannot be interrupted.

Figure 3-3 Example of Logical Channel Priority Configuration

Logical channel number	0	1	2	3	4	5	6	7	...	58	59	60	61	62	63
CHPRI bit field setting	0	12	13	5	1	6	3	10	...	1	2	3	14	15	15
Data protection function	1	0	0	0	0	0	0	0	...	0	1	0	0	0	0
Trigger status flag	1	1	1	0	1	0	0	1	...	1	0	1	1	1	1

The example on Figure 3-3 would result in following priority arbitration and corresponding logical channel conversion sequence:

(1) Logical channel 4.

Logical channel 0 has higher priority, but its data protection function is active.

(2) Logical channel 58.

This logical channel has the same priority as logical channel 4, but it is converted as second since its number is higher.

(3) Logical channel 60.

Although the channel 59 has higher priority, its trigger status is not set and even the data protection is active. Moreover, logical channel 6 has the same priority and even lower number, but its trigger status is not set.

(4) Logical channel 7.

Even though the logical channels 3 and 5 have higher priority, their trigger status is not set.

(5) Logical channel 1.

(6) Logical channel 2.

(7) Logical channel 61.

(8) Logical channel 62.

It has lower number then the channel 63.

(9) Logical channel 63.

3.5. Group Processing

A group is defined by the trigger type configuration of consecutive logical channels. The first channel of the group has the trigger type set to software trigger only, hardware or software trigger or idle trigger. If the following channel trigger type is not set to preceding logical channel conversion completion, the group consists of only one channel. Otherwise, the group continues until the last channel in a row having trigger type set to preceding logical channel conversion completion. After the first channel of the group is triggered and converted, automatically the second channel is triggered and so on until the whole group is converted.

Figure 3-4 Group Configuration Examples

a)							b)						
Group	1			2			Group	1			2		
Channel	0	1	2	3	4	5	Channel	0	1	2	3	4	5
Priority	7	8	9	1	2	3	Priority	4	3	3	6	5	5
Trigger type	1	2	2	1	2	2	Trigger type	1	2	2	0	2	2

c)							d)							
Group	1			2	3			Group	x					
Channel	0	1	2	3	4	5	6	Channel	0	1	2	3	4	5
Priority	0	2	2	0	15	14	14	Priority	0	2	2	0	14	15
Trigger type	1	2	2	0	3	2	2	Trigger type	2	2	2	0	2	2

Figure 3-4 shows some possible group configurations:

- a) In the example two groups are configured, the group 1 consists of logical channels 0, 1 and 2 and the group 2 includes logical channels 3, 4 and 5. If both groups are triggered (trigger status is set for the starting channels 0 and 3), the group 2 would be converted first due to higher priority setting. Since the first channel in the groups has the highest priority, the groups are "re-triggerable" (if the next starting channel trigger appears before the group conversion is finished, the conversion of the group would be restarted).
- b) Here the first channel of the groups has a lower priority than the remaining channels within the groups, hence it is not possible to re-trigger the group processing. The processing of the group 2 can be started only by the software trigger of the logical channel 3. The group 1 allows the triggering by the software or hardware trigger of the channel 0.
- c) This example contains three groups, where the group 2 consists of only one logical channel 3. The group 3 shows the configuration of the group starting with the idle trigger type, i.e. the trigger status of the logical channel 4 is set to "1" if there is no logical channel having trigger status flag set and inactive data protection function.
- d) In this case first three logical channels are set to trigger type 2 and since there will be no event of preceding channel conversion completion, the logical channels 0, 1 and 2 will never be converted.

Between the different groups (the group 1, the group 2): the priority of all the logical channels should be configured as [the group 1 > the group 2] or [the group 1 < the group 2].

(Example: When the priorities of all the channels included in the group 1 are set as 7-9, all the channels of the group 2 should be set lower (or higher) than 7-9.)

After a group processing is started (at least the conversion of the first channel of the group is started), it can be interrupted.

Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1"): If the triggered channel is higher priority than the current channel in the group, current conversion of group processing is interrupted after interrupt operation and the conversion of the channel with the higher priority is started.

Forced stop mode is disabled (ADC12Bn_CTRL.FSMD = "0"): If an A/D conversion is already started, it cannot be stopped. Hence if the triggered channel is higher priority than the next channel in the group, the group processing is interrupted before the conversion start of the next logical channel in the group.

The configuration bit fields ADC12B_CHCTRL0 to 63.RSMRST define how the group processing is to be continued after the higher priority conversion requests are executed. Note that RSMRST setting of the first channel in the group does not matter, since the group cannot be interrupted before the conversion of its first channel started.

If stop group setting (RSMRST[1:0] = "00") is configured for a logical channel and the group is interrupted just before conversion start of that channel, the current processing of the group is stopped. Consequently, the trigger status flag of the logical channel (set by the conversion completion of the preceding channel in the group) is cleared.

Figure 3-5 shows an example of stopping a group processing.

- (1) Logic channel 0 trigger is issued and processing of the group 0 is initiated.
- (2) Processing of the group 0, conversion of logical channels 0 -> 1 -> 2 -> start of channel 3 conversion.
- (3) Logic channel 6 trigger is issued during the conversion of channel 3.
- (4) The operation is dependent on the setting of forced stop mode (ADC12Bn_CTRL.FSMD).

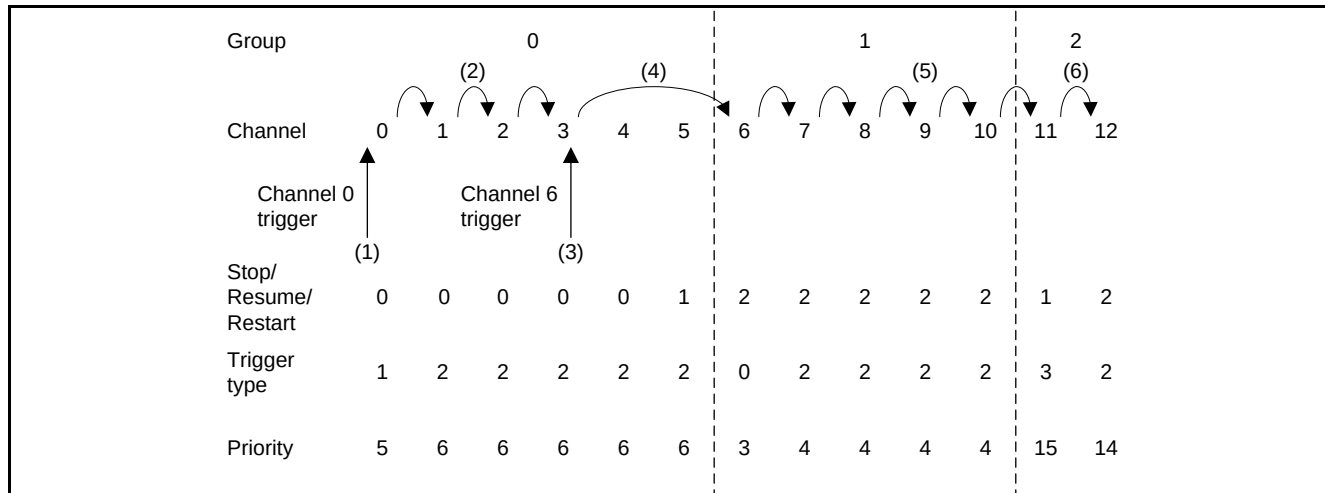
Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1"):

Since the priority of the channel 6 is higher than priority of the channel 3, the processing of the group 0 is interrupted during the conversion of channel 3. After interrupted operation, processing continues with the conversion of the channel 6.

Forced stop mode is disabled (ADC12Bn_CTRL.FSMD = "0"):

Since the priority of the channel 6 is higher than priority of the channel 4, the processing of the group 0 is interrupted after the conversion of channel 3 is finished. Moreover, the trigger status flag of the channel 4 is cleared and processing continues with the conversion of the channel 6.

- (5) Group 1 is converted.
- (6) Idle trigger group 2 is converted. Group 0 will not be processed until next channel 0 trigger appears.

Figure 3-5 Stopping of the Group Processing

Resume group setting (RSMRST[1:0] = "01") for a logical channel means that if the group is interrupted just before conversion start of that channel, the current processing of the group will be resumed with this channel after higher priority conversions are done.

When the channel which is configured as resume (ADC12Bn_CHCTRL0 to 63.RSMRST = "01") is in interrupted operation, group interrupted interrupt flag (corresponding bits of ADC12Bn_CHSTAT0 to 63.GRPIRQ and ADC12Bn_GRPIRQ0 to 1.GRPIRQ) is set to "1" whenever converting of other channel occurred.

Figure 3-6 shows an example of resuming a group processing (Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1")).

Figure 3-7 shows an example of resuming a group processing (Forced stop mode is disabled (ADC12Bn_CTRL.FSMD = "0")).

- (1) Logic channel 0 trigger is issued and processing of the group 0 is initiated.
- (2) Processing of the group 0, conversion of logical channels 0 -> 1 -> 2 -> start of channel 3 conversion.
- (3) Logic channel 6 trigger is issued during the conversion of channel 3.
- (4) The operation is dependent on the setting of forced stop mode (ADC12Bn_CTRL.FSMD).

Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1", Figure 3-6):

Since the priority of the channel 6 is higher than priority of the channel 3, the processing of the group 0 is interrupted during the conversion of channel 3.

Forced stop mode is disabled (ADC12Bn_CTRL.FSMD = "0", Figure 3-7):

Since the priority of the channel 6 is higher than priority of the channel 4, the processing of the group 0 is interrupted after the conversion of channel 3 is finished.
- (5) Group 1 is converted.
- (6) The operation is dependent on the setting of forced stop mode (ADC12Bn_CTRL.FSMD).

Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1", Figure 3-6):

After group 1 is finished, processing of group 0 is continued with conversion of channel 3 since its trigger status flag is still set.

Forced stop mode is disabled (ADC12Bn_CTRL.FSMD = "0", Figure 3-7):

After group 1 is finished, processing of group 0 is continued with conversion of channel 4 since its trigger status flag is still set.
- (7) At the end of group 0 processing, idle trigger group 2 is converted.

Figure 3-6 Resuming of the Group Processing
(Forced Stop Mode is Enabled (ADC12Bn_CTRL.FSMD = "1"))

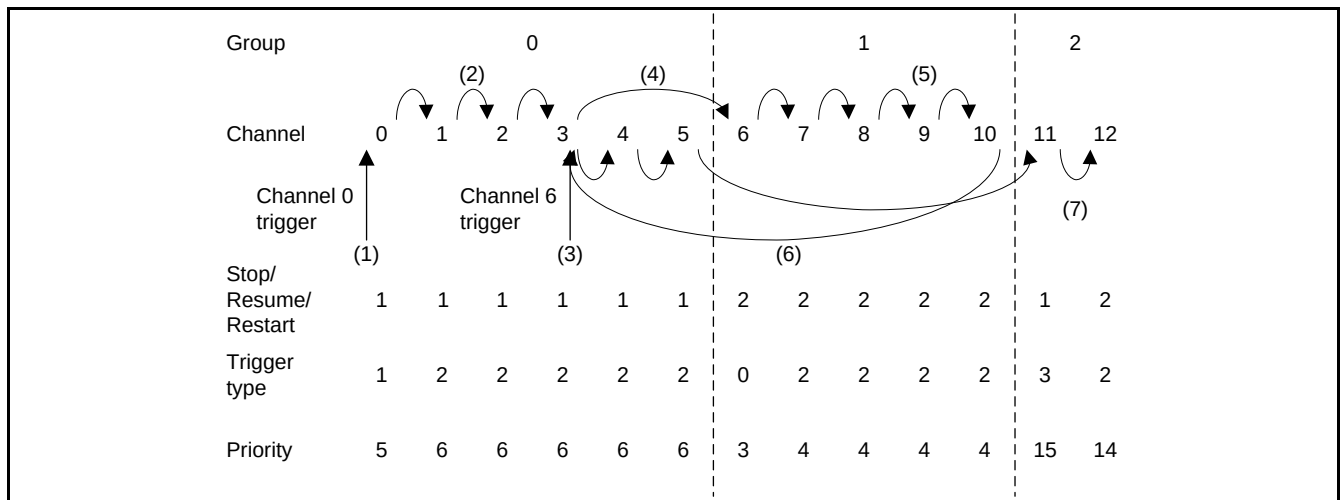
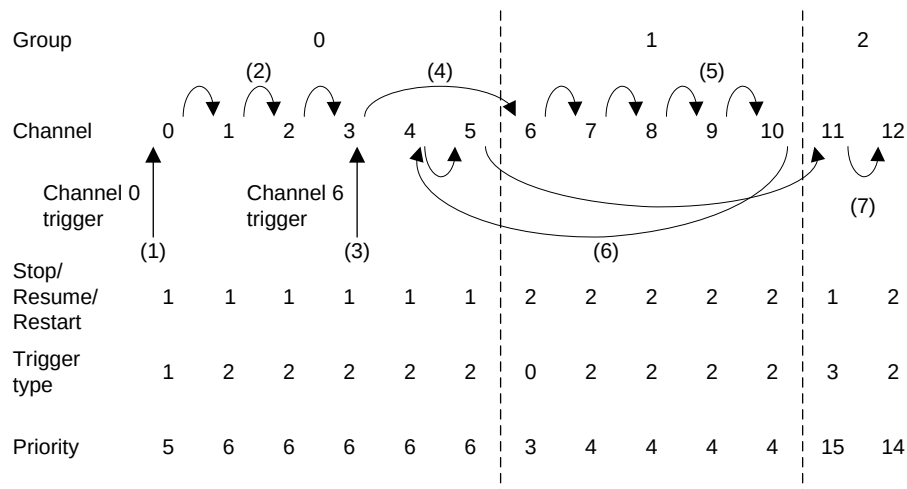


Figure 3-7 Resuming of the Group Processing
(Forced Stop Mode is Disabled (ADC12Bn_CTRL.FSMD = "0"))



Restart group setting (RSMRST[1:0] = "10") for a logical channel configures that if the group is interrupted just before conversion start of that channel, its trigger status is cleared and the processing of the group will be restarted after higher priority conversions are done:

- with the closest previous channel of the group set to resume (RSMRST = "1"), accordingly the trigger status flag of that channel is set
- with the first channel of the group (consequently, the trigger status flag of the first channel is set) if there are no previous channels set to resume.

Figure 3-8 shows an example of restarting a group processing with its first channel.

(1) Logic channel 0 trigger is issued and processing of the group 0 is initiated.

(2) Processing of the group 0, conversion of logical channels 0 -> 1 -> 2 -> start of channel 3 conversion.

(3) Logic channel 6 trigger is issued during the conversion of channel 3.

(4) The operation is dependent on the setting of forced stop mode (ADC12Bn_CTRL.FSMD).

Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1"):

Since the priority of the channel 6 is higher than priority of the channel 3, the processing of the group 0 is interrupted during the conversion of channel 3 and trigger status of channel 0 is set.

Forced stop mode is disabled (ADC12Bn_CTRL.FSMD = "0"):

Since the priority of the channel 6 is higher than priority of the channel 4, the processing of the group 0 is interrupted after the conversion of channel 3 is finished and trigger status of channel 0 is set.

(5) Group 1 is converted.

(6) After group 1 is finished, processing of group 0 is restarted with conversion of channel 0 since its trigger status flag is set to "1".

(7) Group 0 is converted.

(8) At the end of group 0 processing, idle trigger group 2 is converted.

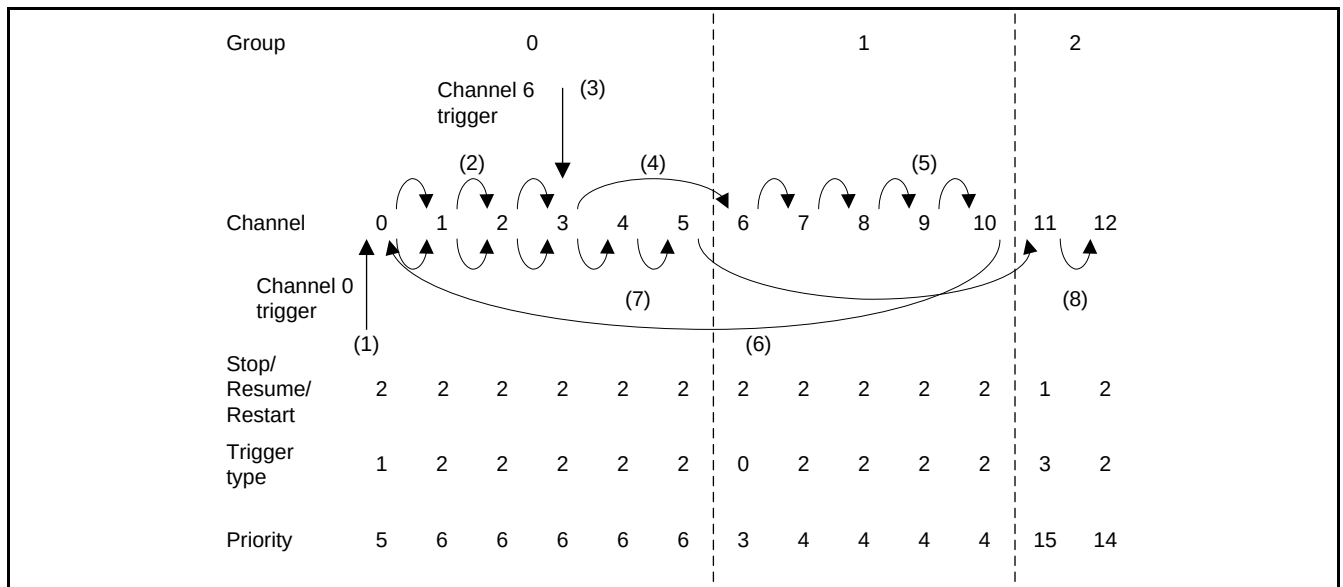
Figure 3-8 Restarting of the Whole Group Processing


Figure 3-9 shows an example of restarting a group processing with its first channel during the conversion of the last channel of the group processing (Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1")).

Figure 3-10 shows an example of restarting a group processing with its first channel during the conversion of the last channel of the group processing (Forced stop mode is disabled (ADC12Bn_CTRL.FSMD = "0")).

- (1) Logic channel 0 trigger is issued and processing of the group 0 is initiated.
- (2) Processing of the group 0, conversion of logical channels 0 -> 1 -> 2 -> 3 -> 4 -> start of channel 5 conversions (last channel of the group 0).
- (3) Logic channel 6 trigger is issued during the conversion of channel 5.

The operations after (3) are dependent on the setting of forced stop mode (ADC12Bn_CTRL.FSMD).
Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1", Figure 3-9):

- (4) Since the priority of the channel 6 is higher than priority of the channel 5, the processing of the group 0 is interrupted during the conversion of channel 5 and trigger status of channel 0 is set.
- (5) Group 1 is converted.
- (6) After group 1 is finished, processing of group 0 is restarted with conversion of channel 0 since its trigger status flag is set to "1".
- (7) Group 0 is converted.
- (8) At the end of group 0 processing, idle trigger group 2 is converted.

Forced stop mode is disabled (ADC12Bn_CTRL.FSMD = "0", Figure 3-10):

- (4) After the conversion of channel 5 is finished (group 0 is converted), processing continues with the conversion of the channel 6.
- (5) Group 1 is converted.
- (6) At the end of group 1 processing, idle trigger group 2 is converted (group 0 is not restarted).

Figure 3-9 Restarting a Group Processing with Its First Channel during the Conversion of the Last Channel of the Group Processing (Forced Stop Mode is Enabled (ADC12Bn_CTRL.FSMD = "1"))

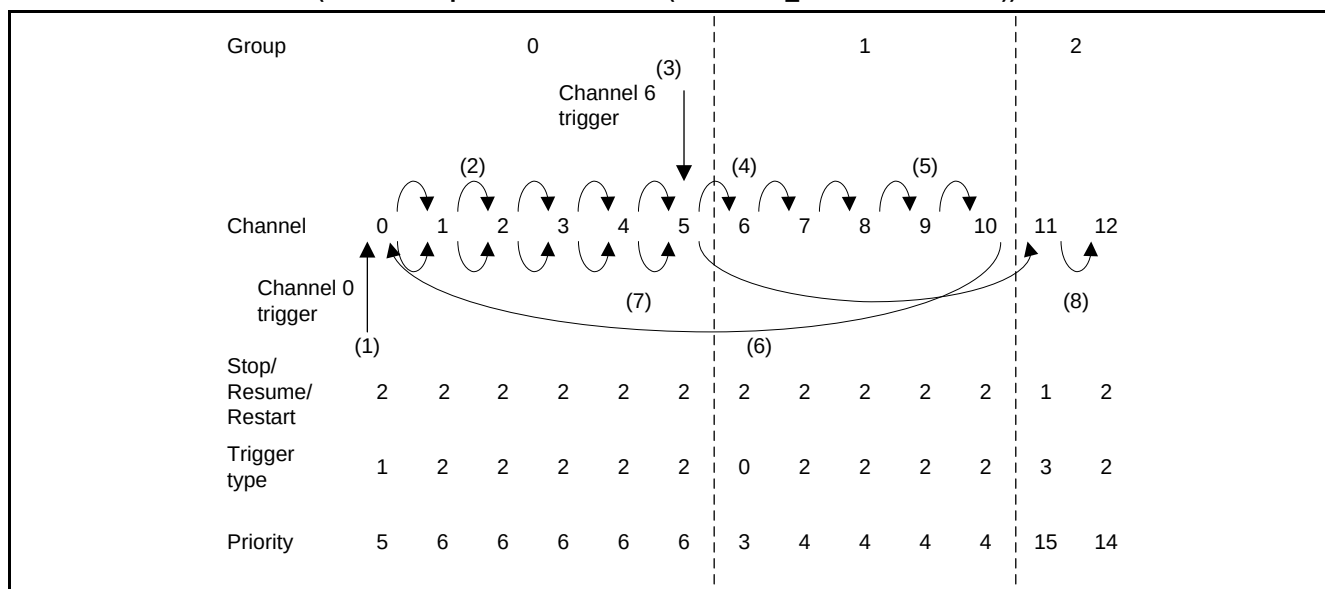


Figure 3-10 Restarting a Group Processing with Its First Channel during the Conversion of the Last Channel of the Group Processing (Forced Stop Mode is Disabled (ADC12Bn_CTRL.FSMD = "0"))

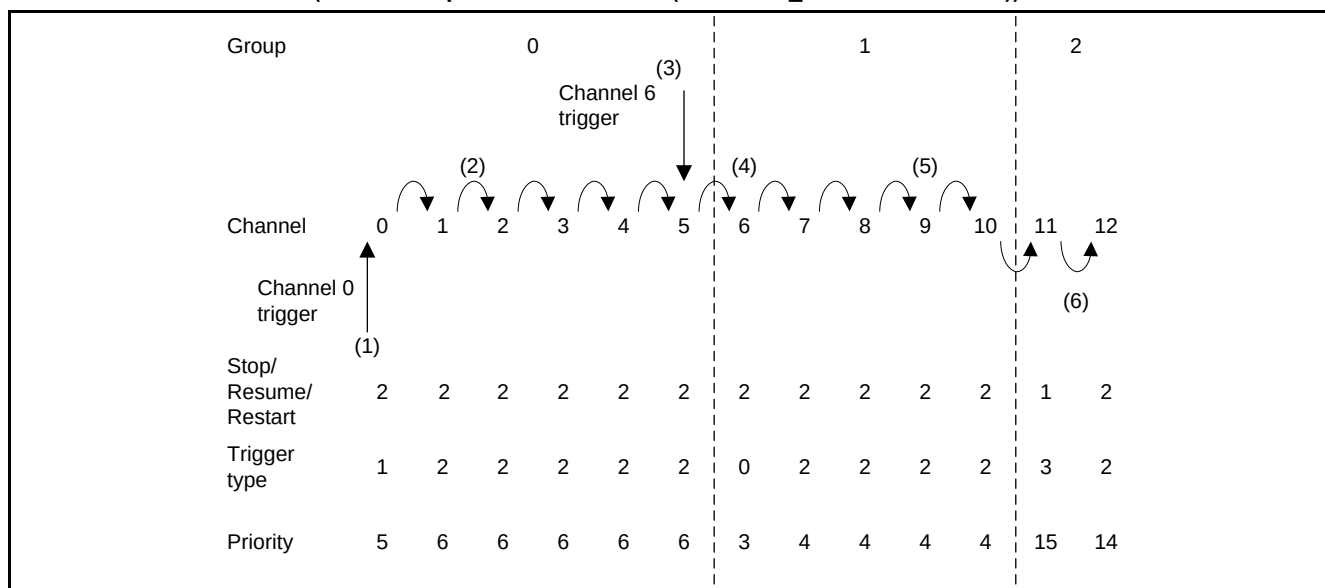


Figure 3-11 shows an example of restarting a group processing with its last converted channel set to resume. These way subgroups can be formed within a group.

- (1) Logic channel 0 trigger is issued and processing of the group 0 is initiated.
- (2) Processing of the group 0, conversion of logical channels 0 -> 1 -> 2 -> start of channel 3 conversion.
- (3) Logic channel 6 trigger is issued during the conversion of channel 3.
- (4) The operation is dependent on the setting of forced stop mode (ADC12Bn_CTRL.FSMD).

Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1"):

Since the priority of the channel 6 is higher than priority of the channel 3, the processing of the group 0 is interrupted during the conversion of channel 3 and trigger status of channel 0 is set.

Forced stop mode is disabled (ADC12Bn_CTRL.FSMD = "0"):

Since the priority of the channel 6 is higher than priority of the channel 4, the processing of the group 0 is interrupted after the conversion of channel 3 is finished and trigger status of channel 1 is set (channel 1 is the last converted channel set to resume).

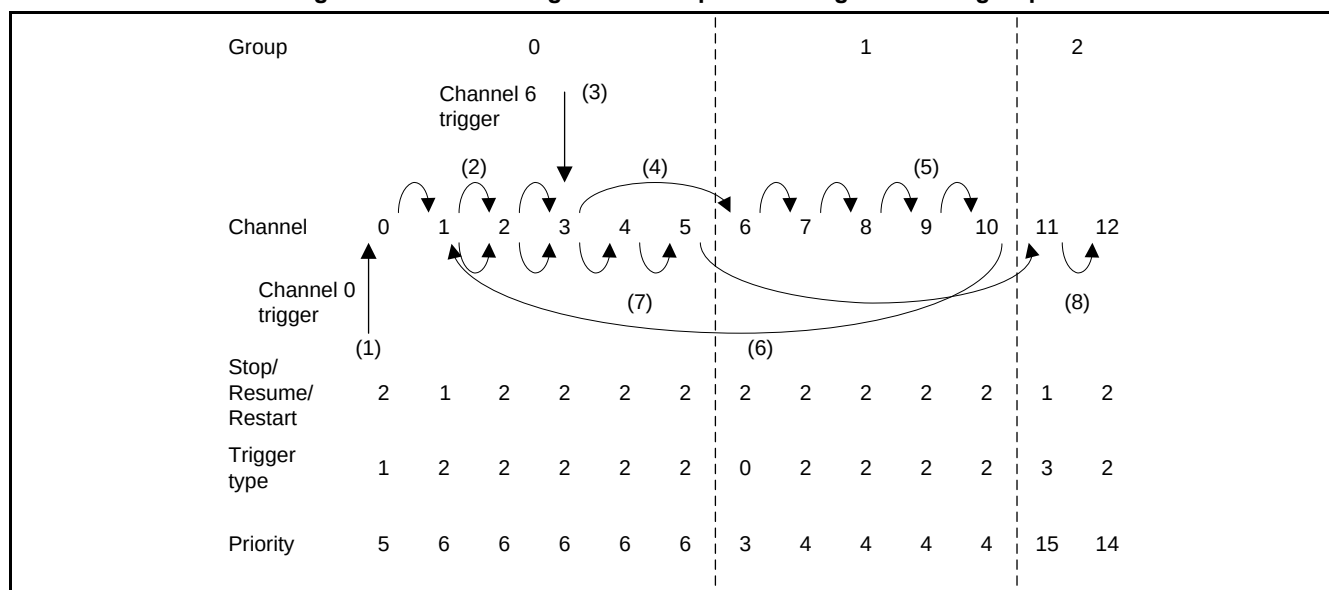
(5) Group 1 is converted.

(6) After group 1 is finished, processing of group 0 is restarted with conversion of channel 1 since its trigger status flag is set to "1".

(7) Subgroup (channels 1 till 5) of the group 0 is converted.

(8) At the end of group 0 processing, idle trigger group 2 is converted.

Figure 3-11 Restarting of the Group Processing with a Subgroup



3.6. Multiple Conversion Logical Channels

First four logical channels can be configured so that after the channel is triggered, several conversions (up to 16) are performed and conversion result is accumulated. These channels are referred to as multiple conversion channels. The following is valid for multiple conversion channels:

- All features and rules provided for regular logical channels (mapping to analog inputs, data protection, triggering rules, priority, channel grouping and behavior within a group) apply also to multiple conversion channels.
- The number of conversions to be performed when the channel is triggered is defined by ADC12Bn_MCCTRL0 to 3.CNVNUM bit field. If CNVNUM is set to "0", a multiple conversion channel behaves exactly like a regular channel.
- Dedicated A/D conversion data registers ADC12Bn_CD0 to 3 hold the sum of the single conversion results. Accordingly, ADC12Bn_CD0 to 3 registers are extended to 16 bits.
- Forced stop mode is enabled (ADC12Bn_CTRL.FSMD = "1"): In case the conversion request with higher priority is issued during multiple conversion, the multiple conversion channel is interrupted after interrupt operation, and the conversion of the channel with the higher priority is started. Forced stop mode is disabled (ADC12Bn_CTRL.FSMD = "0"): Once the first conversion of multiple conversion channel is started, the channel processing cannot be interrupted by higher priority requests until CNVNUM+1 conversions are finished, if the dedicated bit ADC12Bn_MCCTRL0 to 3.ICIRQY (intra-channel interrupt ability) is set to "1". The setting ADC12Bn_MCCTRL0 to 3.ICIRQY = "0" allows to interrupt multiple conversion channel processing between single conversions, if a higher priority request appears.
- In the case that a multiple conversion channel is interrupted between/during single conversions, the dedicated group interrupted interrupt flags (ADC12Bn_CHSTAT0 to 3.GRPIRQ and ADC12Bn_GRPIRQ0.GRPIRQ) are set. The corresponding Resume/Restart/Stop bit field (ADC12Bn_CHCTRL0 to 3.RSMRST) and intra-channel interrupt ability setting (ADC12Bn_MCCTRL0 to 3.ICIRQY) determine the further channel processing (after higher priority requests are converted).
 Table 3-1 shows the description about multiple conversion after interrupted (ADC12Bn_CTRL.FSMD = "0").
 Table 3-2 shows the description about multiple conversion after interrupted (ADC12Bn_CTRL.FSMD = "1").

Table 3-1 Description About Multiple Conversion after Interrupted (ADC12Bn_CTRL.FSMD = "0")

Settings		Description of Trigger Status and Conversion Counter after Interrupted
ADC12Bn_MCCTRL0 to 3. ICIRQY	ADC12Bn_CHCTRL0 to 63. RSMRST[1:0]	
"0" (can be interrupted between single conversion)	"00" (Stop)	Imposes the trigger status flag clearing. Keeps current value of the conversion counter. It is cleared by next conversion request.
	"01" (Resume)	Keeps the trigger status flag set and current value of the conversion counter.
	"10" (Restart)	The trigger status flag stays set only if the channel is first channel in the group, otherwise the trigger status of the channel is cleared and instead the trigger status flag of the first channel in the subgroup is set. The conversion counter is cleared immediately. It means that the accumulated conversion result before the interrupt is not really usable because it is not known how many conversions are done.
"1" (cannot be interrupted between single conversion)	Don't care	Don't care. Multiple conversion is not interrupted.

Table 3-2 Description About Multiple Conversion after Interrupted (ADC12Bn_CTRL.FSMD = "1")

Settings		Description of Trigger Status and Conversion Counter after Interrupted
ADC12Bn_MCCTRL0 to 3. ICIRQY	ADC12Bn_CHCTRL0 to 63. RSMRST[1:0]	
"0" (can be interrupted between single conversion)	"00" (Stop)	Imposes the trigger status flag clearing. Keeps current value of the conversion counter. It is cleared by next conversion request.
	"01" (Resume)	Keeps the trigger status flag set. The conversion counter is cleared immediately. It means that the accumulated conversion result before the interrupt is not really usable because it is not known how many conversions are done.
	"10" (Restart)	The trigger status flag stays set only if the channel is first channel in the group, otherwise the trigger status of the channel is cleared and instead the trigger status flag of the first channel in the subgroup is set. The conversion counter is cleared immediately. It means that the accumulated conversion result before the interrupt is not really usable because it is not known how many conversions are done.
"1" (cannot be interrupted between single conversion)	"00" (Stop)	Imposes the trigger status flag clearing. Keeps current value of the conversion counter. It is cleared by next conversion request.
	"01" (Resume)	Keeps the trigger status flag set and current value of the conversion counter.
	"10" (Restart)	The trigger status flag stays set only if the channel is first channel in the group, otherwise the trigger status of the channel is cleared and instead the trigger status flag of the first channel in the subgroup is set. The conversion counter is cleared immediately. It means that the accumulated conversion result before the interrupt is not really usable because it is not known how many conversions are done.

- In the case that range comparison is enabled for a multiple conversion channel, every conversion result is passed to the range comparator.
- For notes of data protection about multiple conversion, refer to section "Logical channel data protection function" in chapter "3. Operation of A/D".

3.7. Forced Stop

■ Forced stop mode (ADC12Bn_CTRL.FSMD = "1"):

During an active A/D conversion, it can be forced stop by the following ways.

- Writing ADC12Bn_CTRL.FSTP = "1":
All channel's trigger status flags are reset.
The current A/D conversion is stopped after interrupt operation.
- Writing "1" to the corresponding bits of ADC12Bn_TRGCL1 to 0.TRGCL or ADC12Bn_CHCTRLi.TRGCL:
The corresponding trigger status flag is reset immediately.
The current A/D conversion is stopped after interrupt operation,

■ Not forced stop mode (ADC12Bn_CTRL.FSMD = "0"):

The A/D conversion cannot stop.

- Writing ADC12Bn_CTRL.FSTP = "1": invalid.
- Writing "1" to the corresponding bits of ADC12Bn_TRGCL1 to 0.TRGCL or ADC12Bn_CHCTRLi.TRGCL:
The corresponding trigger status flag is reset immediately.
The current A/D conversion is not stopped, but A/D conversion result (the following) is not update.
 - A/D conversion done interrupt flag (the corresponding bits of ADC12Bn_CDONEIRQ1 to 0.CDONEIRQ or ADC12Bn_CHSTATi.CDONEIRQ)
 - A/D conversion data (the corresponding register of ADC12Bn_CD0 to 63)
 - Converted logical channel number (ADC12Bn_STAT.ACH[5:0] (ADC12Bn_CTRL.ACHMD is set as "1"))

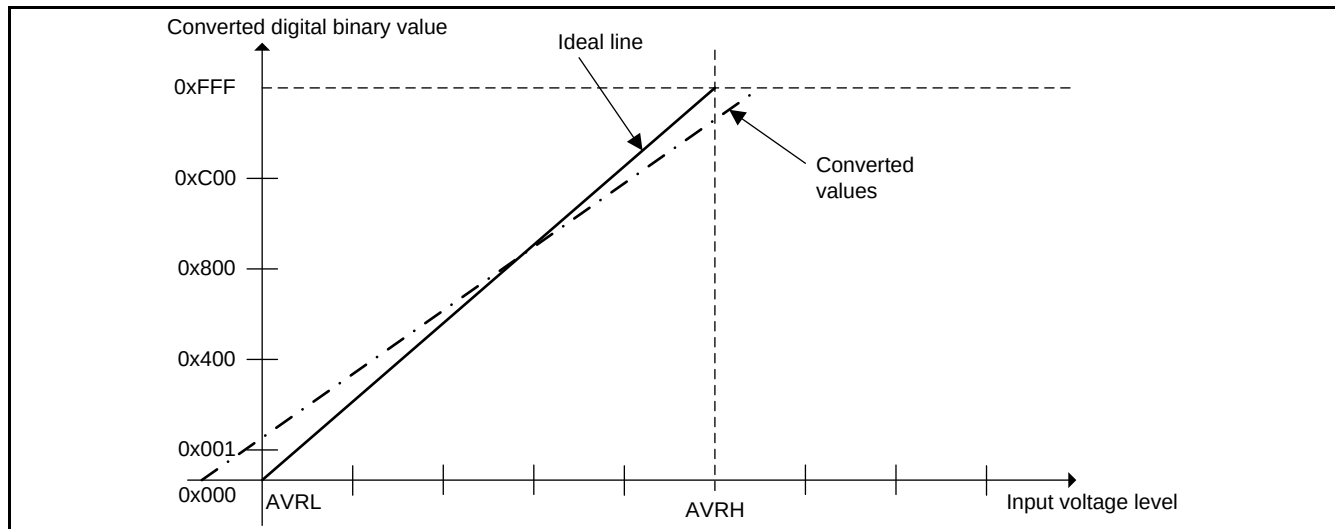
Even if the trigger status flag of the idle trigger channel i (ADC12Bn_CHCTRLi.TRGTYP[1:0] = "11") is cleared (by writing "1" to the corresponding bits of ADC12Bn_TRGCL1 to 0 or ADC12Bn_CHCTRLi.TRGCL), it is set "1" again immediately when the trigger status flag of all the channels is "0".

3.8. A/D Converter Calibration

Additional feature of multiple conversion logical channels is selection of A/D Converter reference voltages AVR_H or AVR_L for conversion instead of dedicated analog input signals. If AVR_L conversion is wanted it is enough to set one of ADC12Bn_MCCTRL0 to 3.AVRLSEL bits to "1" and trigger corresponding channel. For AVR_H conversion it is needed to set one of ADC12Bn_MCCTRL0 to 3.AVRHSEL bits to "1", set corresponding ADC12Bn_MCCTRL0 to 3.AVRLSEL bit to "0" and trigger the dedicated channel.

If AVRHSEL or ARVRLSEL bits is set to "1", during the conversion of the corresponding channel mapping of the logical channel to an analog inputs is disabled.

Figure 3-12 Example of Converted Digital Value Dependence on Input Voltage Level



This feature can be used to perform A/D Converter calibration. As it is shown on Figure 3-12 ideal characteristics of A/D Converter would have:

- transition between digital values 0x000 and 0x001 at AVR_L + 0.5LSB input voltage level and
- transition between digital values 0xFFEh and 0xFFFF at AVR_H - 1.5LSB input voltage level.

If this is not the case, A/D Converter can be calibrated by performing following steps:

- Set gain correction setting (ADC12Bn_GCV.GCV) to "0".
- Set a multiple conversion channel to highest priority and its AVRLSEL bit to "1".
- For different ADC12Bn_OCV.OCV settings trigger the multiple conversion channel, i.e. perform AVR_L voltage conversion. It is better to configure multiple conversions of AVR_L and calculate average result (accumulated result divided by the number of executed conversions).
- Find ADC12Bn_OCV.OCV setting x for which the transition between digital values 0x000 and 0x001 occurs.
- Set AVRLSEL bit back to "0".
- Set AVRHSEL bit to "1".
- For different ADC12Bn_OCV.OCV settings trigger the multiple conversion channel, i.e. perform AVR_H voltage conversion. It is better to configure multiple conversions of AVR_H and calculate average result.
- Find ADC12Bn_OCV.OCV setting y for which the transition between digital values 0xFFE and 0xFFFF occurs.
- Set A/D Converter offset compensation setting register ADC12Bn_OCV to the value calculated as $(x+y)/2 + 2$.
- Set AVRHSEL bit back to "0".
- Set AVRLSEL bit to "1".
- For different ADC12Bn_GCV.GCV settings trigger the multiple conversion channel, i.e. perform AVR_L voltage conversion. It is better to configure multiple conversions of AVR_L and calculate average result.

- Find ADC12Bn_GCV.GCV setting z for which the transition between digital values 0x000 and 0x001 occurs.
- Set A/D Converter gain compensation setting register ADC12Bn_GCV to the value calculated as " $z + 1$ ".
- Set AVRLSEL and AVRHSEL bits to "0".
- Trigger and perform further logical channel conversions (analog inputs AN to which are logical channels mapped are converted by calibrated A/D Converter).

3.9. DMA Transfer Function

There are four conversion done DMA triggers available. They can be configured through the corresponding ADC12Bn_CDDSO to 3 registers:

- The bit field CDCHNUM specifies the logical channel number whose conversion done interrupt flag issues a DMA request,
- CDCHEN bit controls enabling/disabling of the DMA request.

The feature provides an efficient way to transfer A/D conversion results to memory. Selecting of the group last logical channels through the four CDCHNUM bit fields can configure four different groups for DMA transfers. Since the group is always made of consecutive logical channels and the corresponding conversion data registers can be read linearly, the DMA transfer for the whole group is possible after the conversion of the last channel of the group is finished.

3.10. Range Comparator Function

The range comparator offers eight comparison groups with an upper and a lower threshold register each. The 64 logical channels can be enabled for range comparison and assigned to one of the eight comparators individually.

If range comparator is enabled for a logical channel, it provides two result flags:

- Interrupt flags ADC12Bn_RCIRQ0 to 1.RCIRQ and ADC12Bn_CHSTAT0 to 63.RCIRQ, signaling that the A/D conversion result is outside the range or inside the range ("inverted" operation, i.e. ADC12Bn_CHCTRL0 to 63.RCINVSEL = "1").
- Over threshold flags ADC12Bn_RCOTF0 to 1.RCOTF and ADC12Bn_CHSTAT0 to 63.RCOTF, showing that the A/D conversion value exceeded the upper threshold in the case of outside range detection.

Furthermore, each logical channel can be enabled to send an interrupt request to the CPU, if dedicated flags ADC12Bn_RCIRQ0 to 1.RCIRQ63 to 0 and ADC12Bn_CHSTAT0 to 63.RCIRQ are set.

The range comparator can choose 12/8-bit mode by the full range comparator mode (ADC12Bn_CTRL.FRCMD).

ADC12Bn_CTRL.FRCMD	Description
"1" : 12-bit range comparator	ADC12Bn_FRCOL0 to 11/FRCOH0 to 11 are used for range comparator upper/lower threshold value. Selection of one of eight available range comparator threshold values for the logical channel is configured by corresponding ADC12Bn_CHCTRL0 to 63.RCSEL[2:0] bit fields. The upper/lower comparator compares the 12 bits, 10 bits or 8 bits of the A/D conversion result. ADC12Bn_CTRL.RES[1:0] define this resolution. – If 12-bit resolution (ADC12Bn_CTRL.RES[1:0] = "x0"): Compares the 12 bits of A/D conversion result. – If 10-bit resolution (ADC12Bn_CTRL.RES[1:0] = "01"): Compares the 10 bits of A/D conversion result. – If 8-bit resolution (ADC12Bn_CTRL.RES[1:0] = "11"): Compares the 8 bits of A/D conversion result.
"0" : 8-bit range comparator	ADC12Bn_RCOL0 to 7/RCOH0 to 7 are used for range comparator upper/lower threshold value. Selection of one of eight available range comparator threshold values for the logical channel is configured by corresponding ADC12Bn_CHCTRL0 to 63.RCSEL[2:0] bit fields. The upper/lower comparator compares the upper 8 bits of the A/D conversion result.

Figure 3-13 shows the 8-bit range comparator structure.

Figure 3-14 shows the 12-bit range comparator structure.

Figure 3-13 8-bit Range Comparator Structure

8-bit range comparator (ADC12Bn_CHCTRL0~63.FRCMD="0")

Available range of threshold and A/D conversion result value by setting of resolution

Resolution of A/D conversion ADC12Bn_CTRL.RES[1:0]	Selected upper/lower threshold	A/D Conversion Result for comparator
"x0" : 12-bit	[7:0]	[11:4]
"01" : 10-bit	[7:0]	[9:2]
"11" : 8-bit	[7:0]	[7:0]

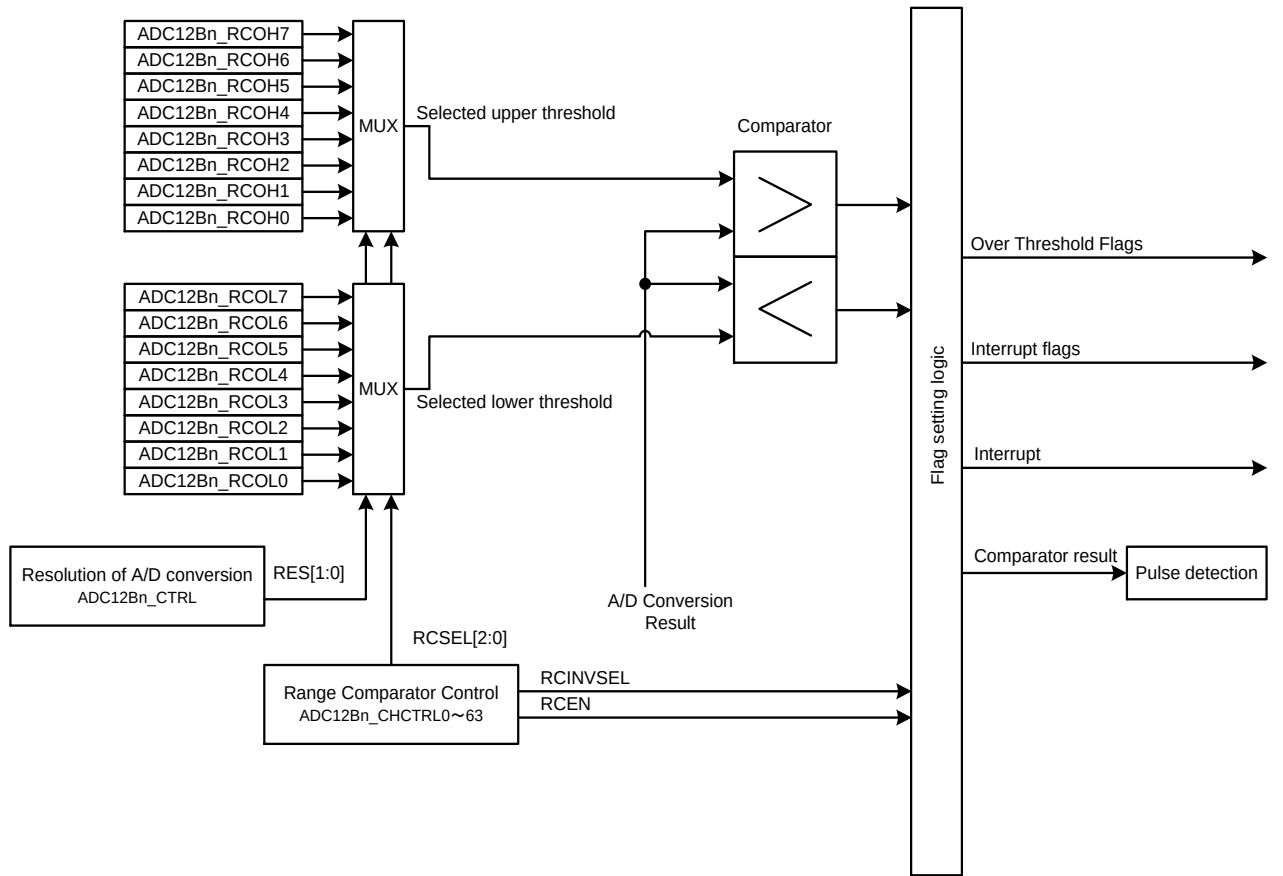
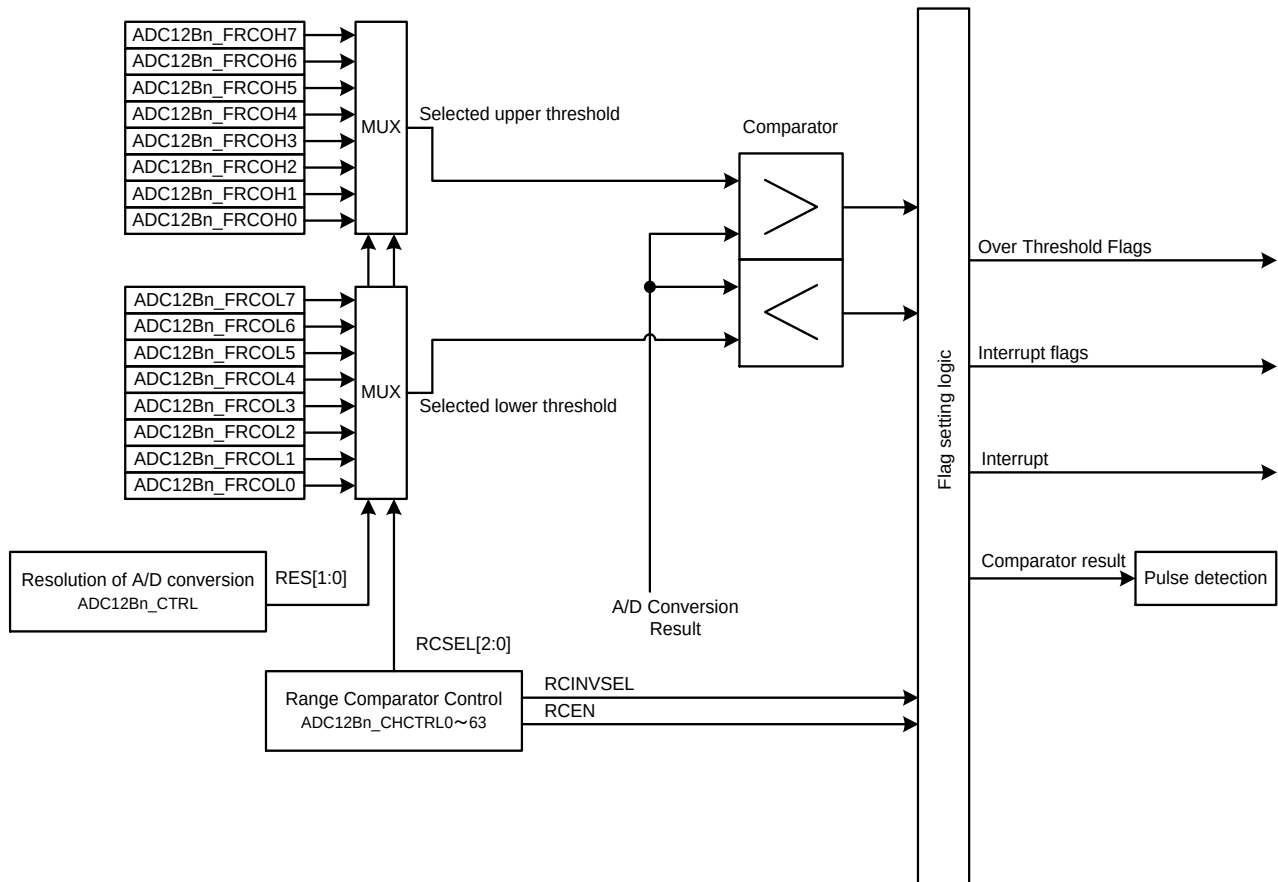


Figure 3-14 12-bit Range Comparator Structure
12-bit range comparator (ADC12Bn_CHCTRL0~63.FRCMD="1")

 Available range of threshold and A/D conversion result value
 by setting of resolution

Resolution of A/D conversion ADC12Bn_CTRL:RES[1:0]	Selected upper/lower threshold	A/D Conversion Result for comparator
"x0" : 12-bit	[11:0]	[11:0]
"01" : 10-bit	[9:0]	[9:0]
"11" : 8-bit	[7:0]	[7:0]



3.11. Pulse Detection Function

The result of the comparison from the range comparator can be filtered by the pulse detection function. For every logical channel, the pulse detection function has a pair of reload registers to store the initial value for the positive and negative down counters (ADC12Bn_PCCTRL0 to 63.PCTPRL[7:0] and ADC12Bn_PCCTRL0 to 63.PCTNRL[4:0]). The positive and the negative counters decrement on positive and negative events obtained from the result of the comparison done by the range comparator.

The features of the pulse detection function are:

- Detect events with desired length
- Filter parasitic inverted events
- Each logical channel has a pulse detection function module associated with it
- Interrupt can be generated on detection of a pulse.

The output of the range comparator for particular logical channel signifies either a positive event or a negative event depending on the configuration of ADC12Bn_CHCTRL0 to 63.RCINVSEL register in the dedicated channel control register and the converted digital value of the A/D Converter as explained in Table 3-3 "Generation of positive/negative events". Whenever a positive event occurs the corresponding positive counter ADC12B_PCCTRL0 to 63.PCTPCT is decremented. Similarly, the dedicated negative counter ADC12B_PCCTRL0 to 63.PCTNCT decrements with each negative event. The purpose of the positive counter is to detect consecutive range comparator events of desired length. The negative counter can be used to force a restart of the positive counter if a negative events of a certain length are detected due to spikes, noise etc.

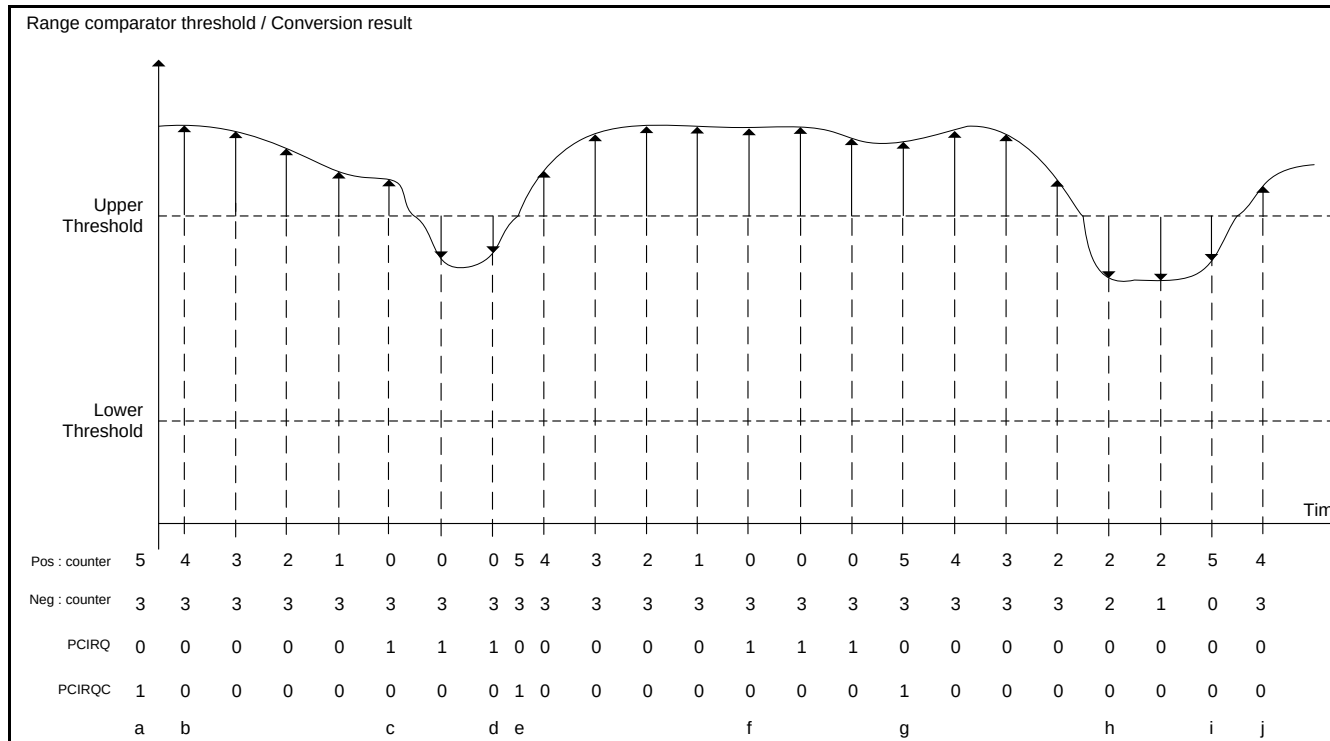
Table 3-3 Generation of Positive/Negative Events

Inverted Range Selection RCINVSEL Bit	Range Comparator Output	Events
0 (configured for "outside range")	inside range	Negative event
	outside range	Positive event
1 (configured for "inside range")	outside range	Negative event
	inside range	Positive event

The following steps describe the working principle.

- The positive counter is decremented with each positive event of the corresponding logical channel.
- The corresponding pulse counter interrupt flags (ADC12Bn_CHSTAT0 to 63.PCIRQ and ADC12Bn_PCIRQ0 to 1.PCIRQ63 to 0) are set as the positive counter reaches zero. This flag remains set until it is cleared through writing dedicated ADC12Bn_PCIRQC0 to 1.PCIRQC63 to 0 bit to "1". The positive counter and the negative counter are stopped as long as PCIRQ flag of the channel is "1".
- If PCIRQ is set and the corresponding enable bit ADC12B_PCIRQE0 to 1.PCIRQE63 to 0 is equal to "1", an interrupt is generated.
- The negative counter is decremented with each negative event of the corresponding logical channel except while the corresponding PCIRQ flag is set.
- Positive counter is reloaded with the value set in the reload register ADC12Bn_PCCTRL0 to 63.PCTPRL when:
 - Negative counter reaches zero,
 - "1" is written to dedicated ADC12Bn_PCIRQC0 to 1.PCIRQC63 to 0 bit.
- Negative counter is reloaded with the value set in the reload register ADC12Bn_PCCTRL0 to 63.PCTNRL when:
 - Any positive event occurs
 - "1" is written to dedicated ADC12Bn_PCIRQC0 to 1.PCIRQC63 to 0 bit
 - The positive counter reaches zero and PCIRQ flag is set. The negative counter will hold the reload value as long as PCIRQ flag is not cleared.

The Figure 3-15 shows the operation of the pulse detection function for channel 0 with ADC12Bn_CHCTRL0.RCINVSEL = "0" configured for outside range, reload register ADC12Bn_PCCTRL0.PCTPRL = "101" and reload register ADC12Bn_PCCTRL0.PCTNRL = "011".

Figure 3-15 Example of Pulse Detection Operation

- Reload counters with appropriate reload value by writing "1" to ADC12Bn_PCIRQC0.PCIRQC0.
- Positive counter decrements with positive events.
- Positive counter expires (becomes equal to "0"), the pulse counter interrupt flag PCIRQ is set.
- A series of negative events does not decrement the negative counter as the PCIRQ flag is set.
- The pulse counter interrupt flag PCIRQ is cleared and the positive as well as the negative counter are reloaded.
- Positive counter expires and PCIRQ flag is to "1".
- Software clears PCIRQ flag and reloads positive and negative counter.
- Negative event decrements negative counter.
- Negative counter expires and reloads positive counter.
- Positive counter decrements and negative counter reloads with positive event.

3.12. Debug Mode

When the ADC12Bn_CTRL.DBGE bit is set to "1" and the processor is in debug state, the A/D Converter completes the current conversion, but further conversion is stopped. When the processor leaves debug state or ADC12Bn_CTRL.DBGE is set to "0", conversion continues with the next channel from where it had stopped.

For the definition of debug state, refer to Section 12.8 of the ARM Cortex™-R5 Technical Reference Manual.

The ADC12Bn_STAT.BUSY flag is not affected even while ADC12Bn_CTRL.DBGE bit is set to "1" and the processor is in debug state: If all trigger status bits are cleared, ADC12Bn_STAT.BUSY flag is set to "0", and the A/D Converter goes to idle (power-down) state; if any trigger status bit is set again, the A/D Converter leaves idle state, and the ADC12Bn_STAT.BUSY flag is set to "1" after the resumption time elapses.

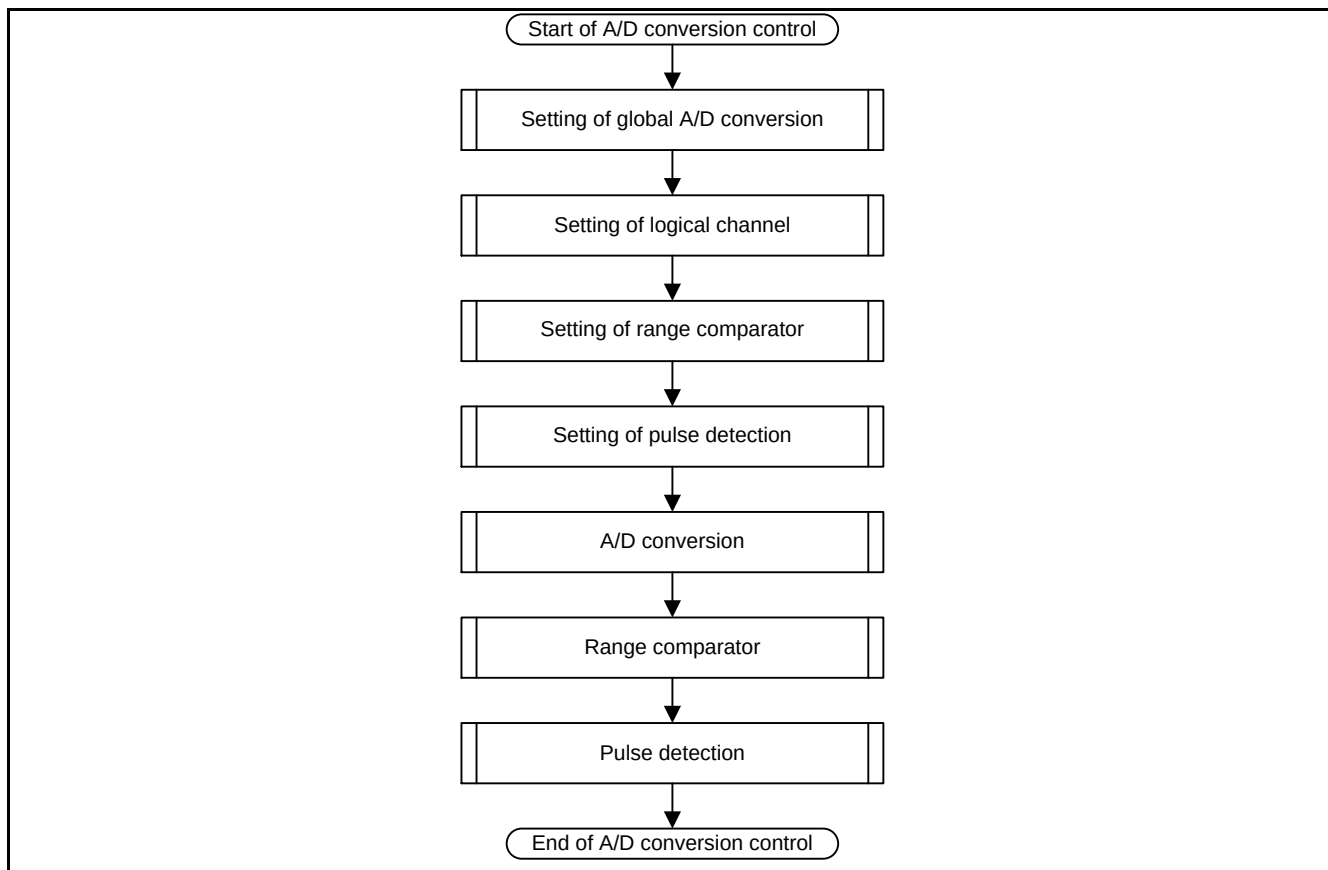
4. Setup Procedure Examples

This section shows examples of setup procedure of A/D converter.

4.1. Control of A/D Conversion

Figure 4-1 shows main flow of controlling A/D converter.

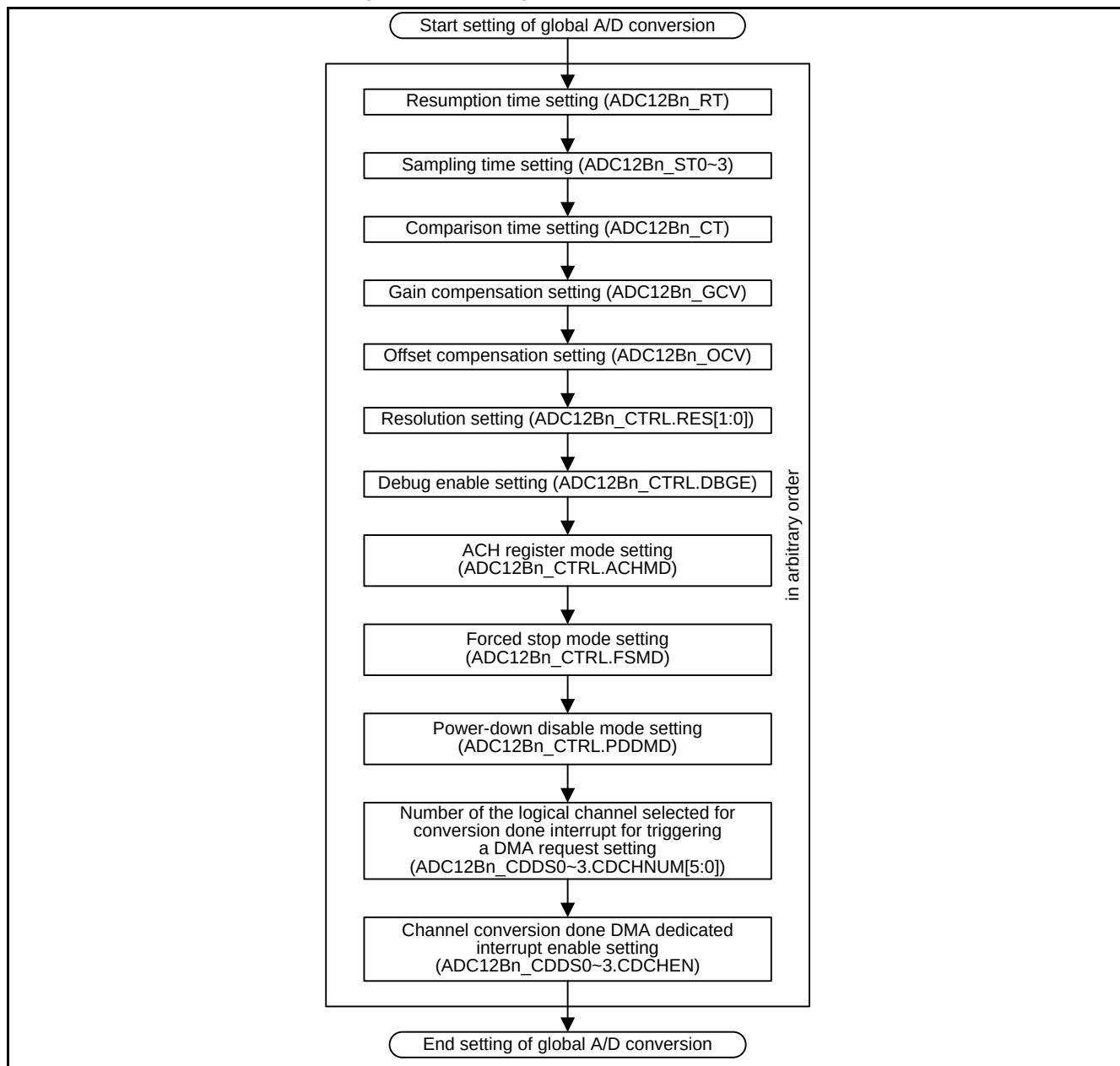
Figure 4-1 Main Flow of Controlling A/D Converter



4.2. Setting of Global A/D Conversion

Figure 4-2 shows the setting procedure of global A/D conversion.

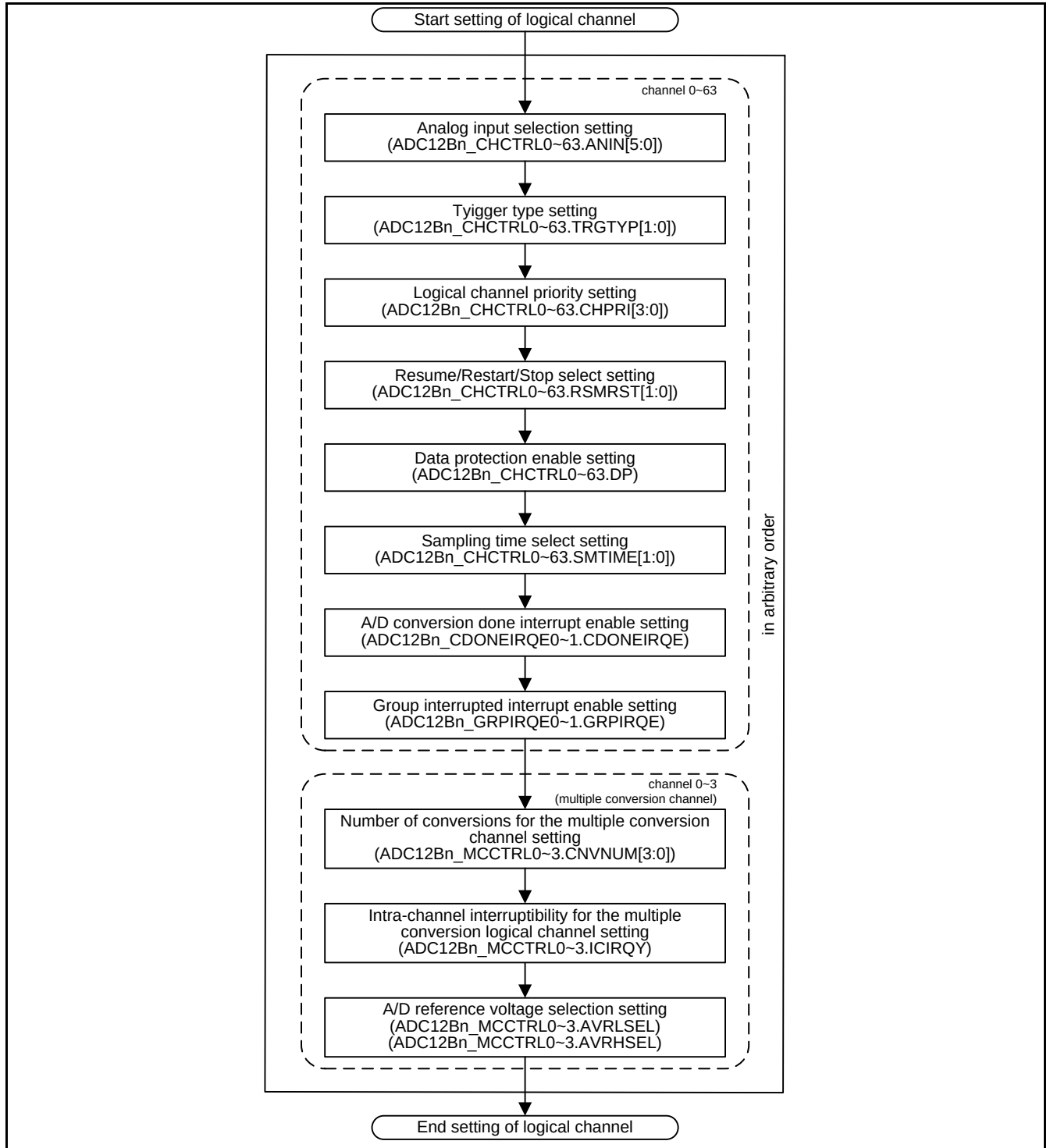
Figure 4-2 Setting of Global A/D Conversion



4.3. Setting of Logical Channel

Figure 4-3 shows the setting procedure of logical channel.

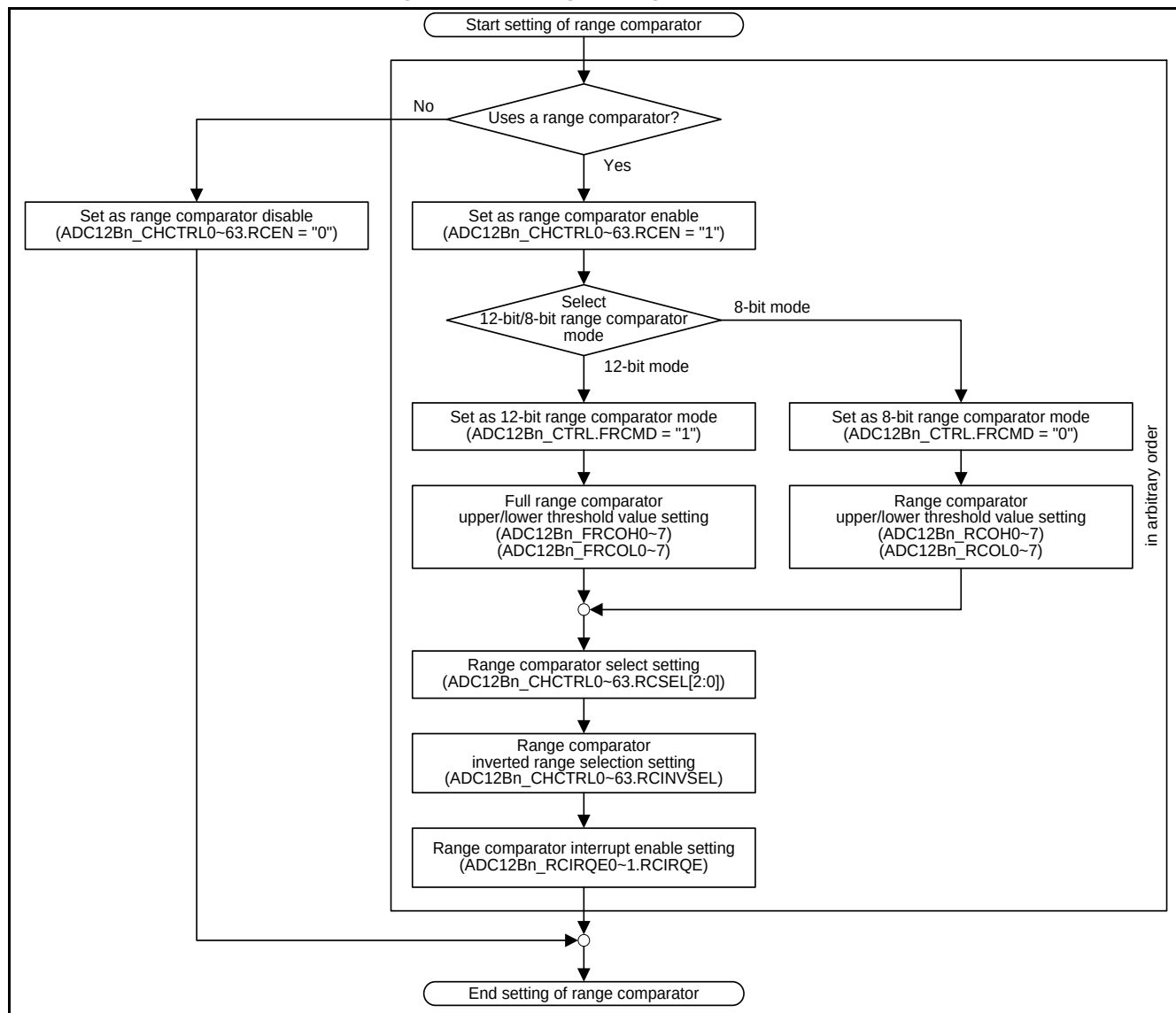
Figure 4-3 Setting of Logical Channel



4.4. Setting of Range Comparator

Figure 4-4 shows the setting procedure of range comparator.

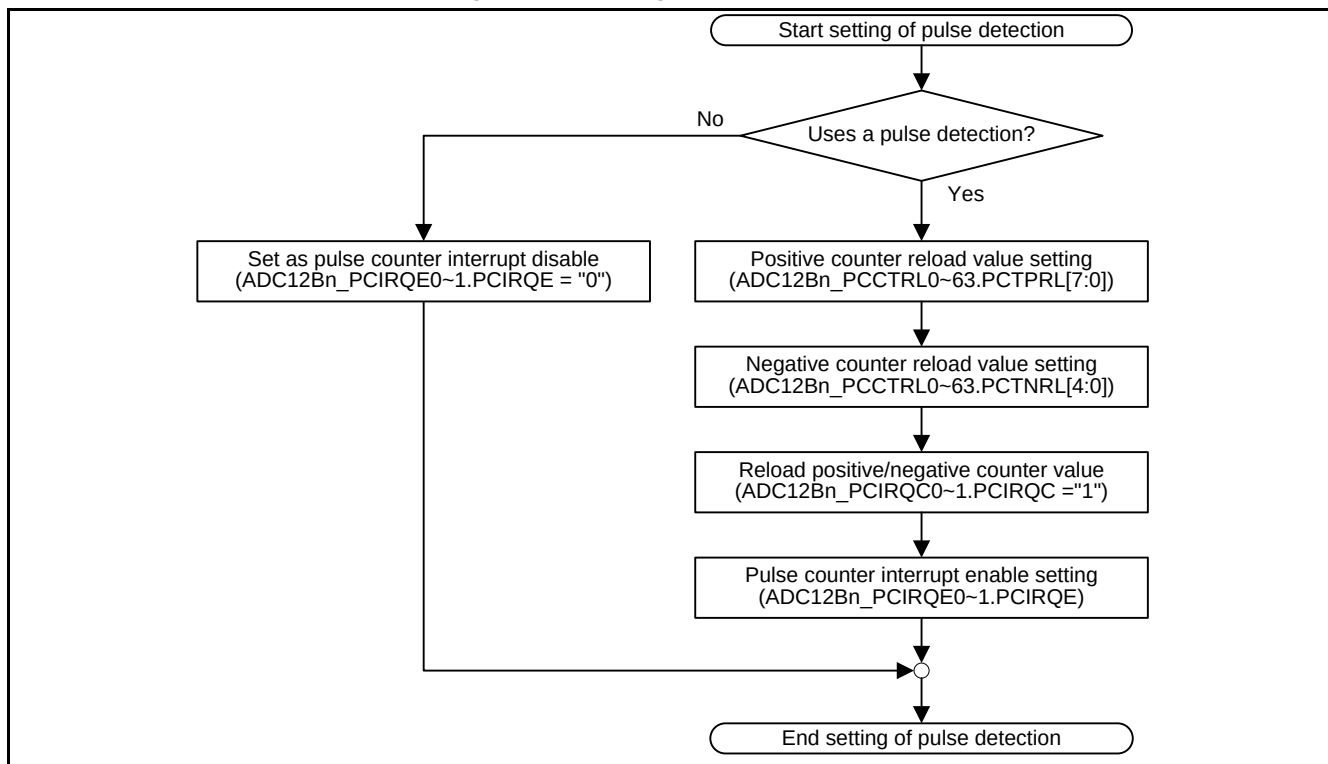
Figure 4-4 Setting of Range Comparator



4.5. Setting of Pulse Detection

Figure 4-5 shows setting procedure of pulse detection.

Figure 4-5 Setting of Pulse Detection

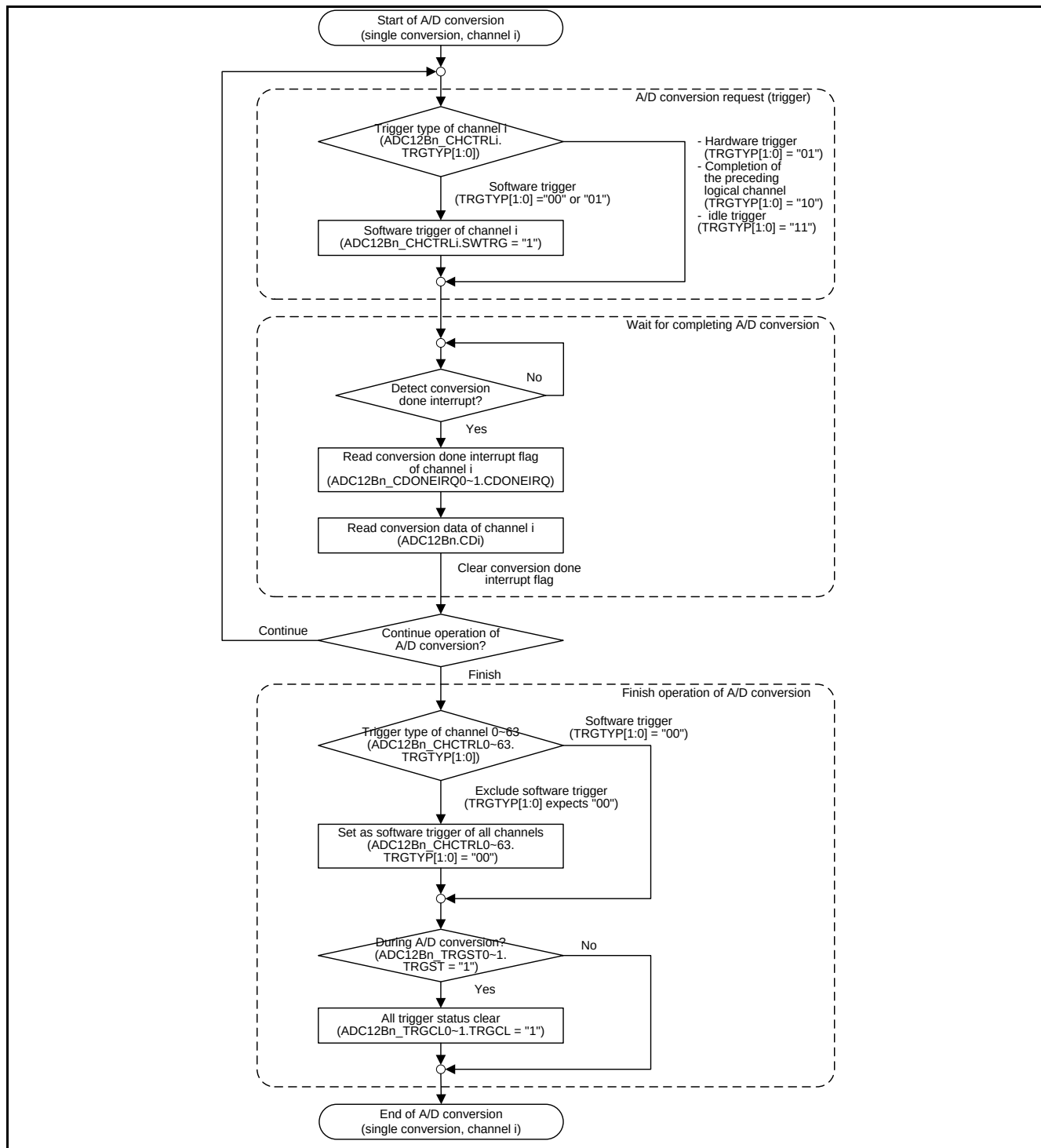


4.6. A/D Conversion

■ Single conversion

Figure 4-6 shows the example of A/D conversion (single conversion) operation.

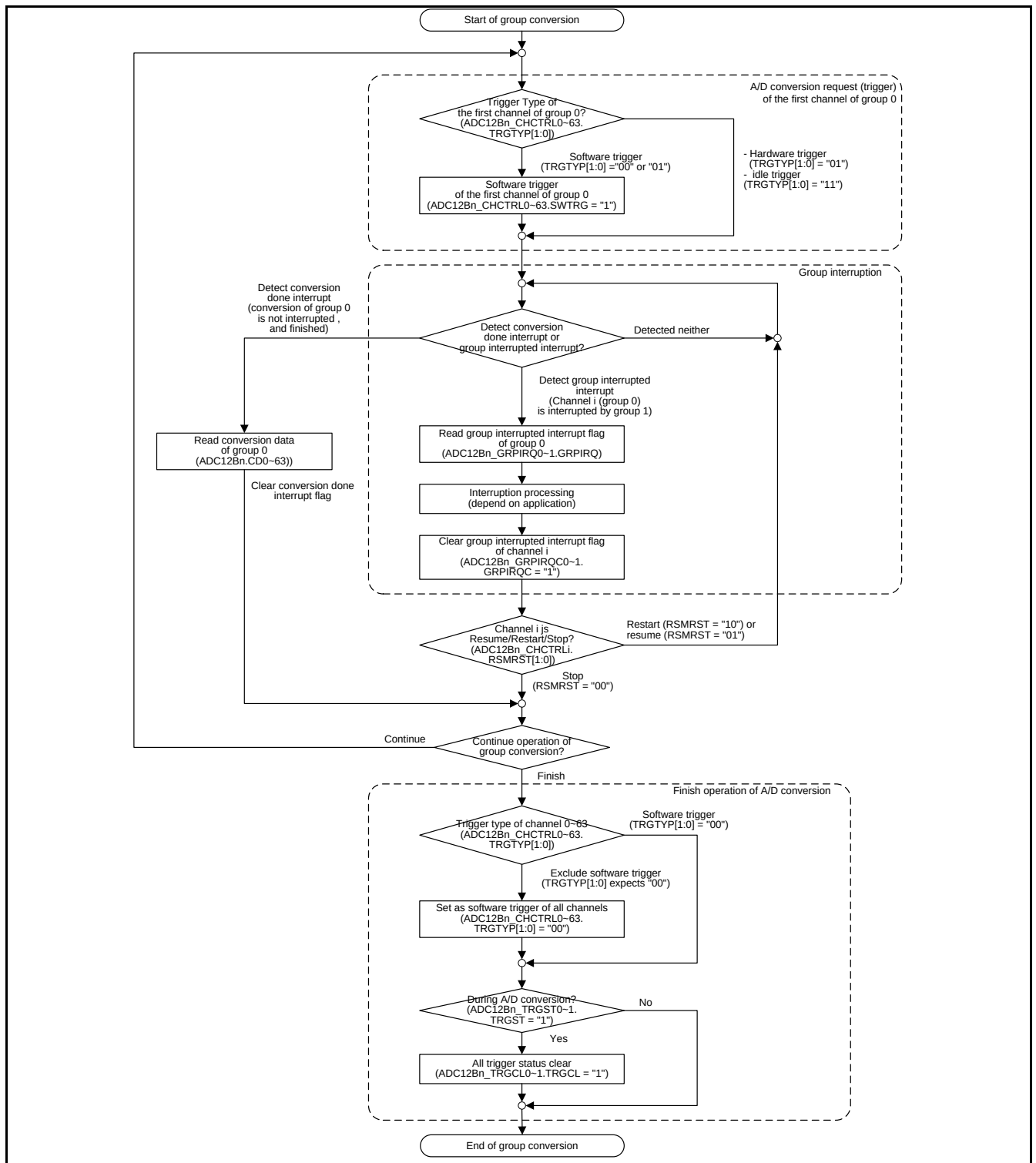
Figure 4-6 A/D Conversion (Single Conversion, Channel i)



■ Group conversion

Figure 4-7 shows the example of group conversion operation.

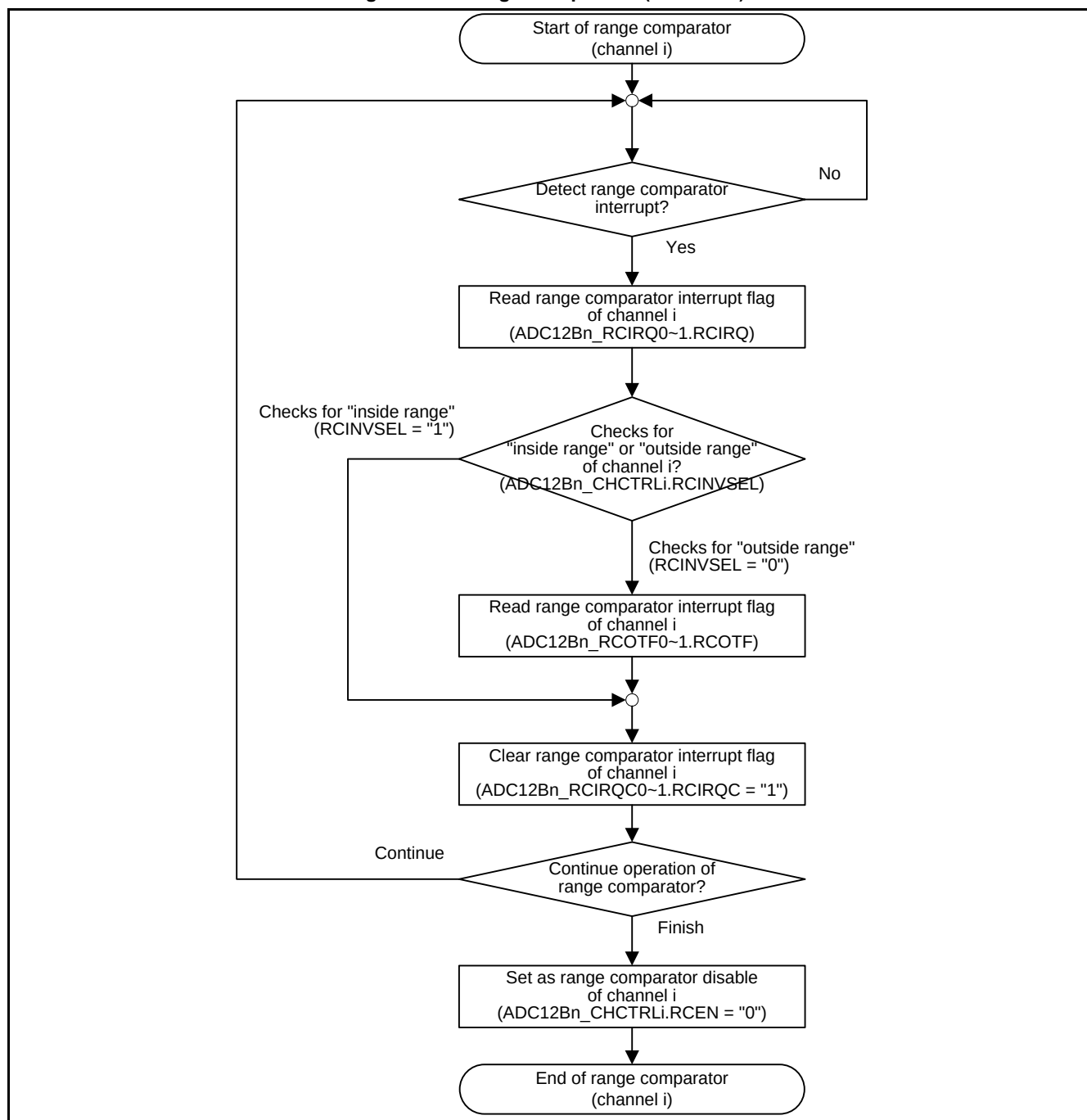
Figure 4-7 Group Conversion



4.7. Range Comparator

Figure 4-8 shows the example of range comparator operation.

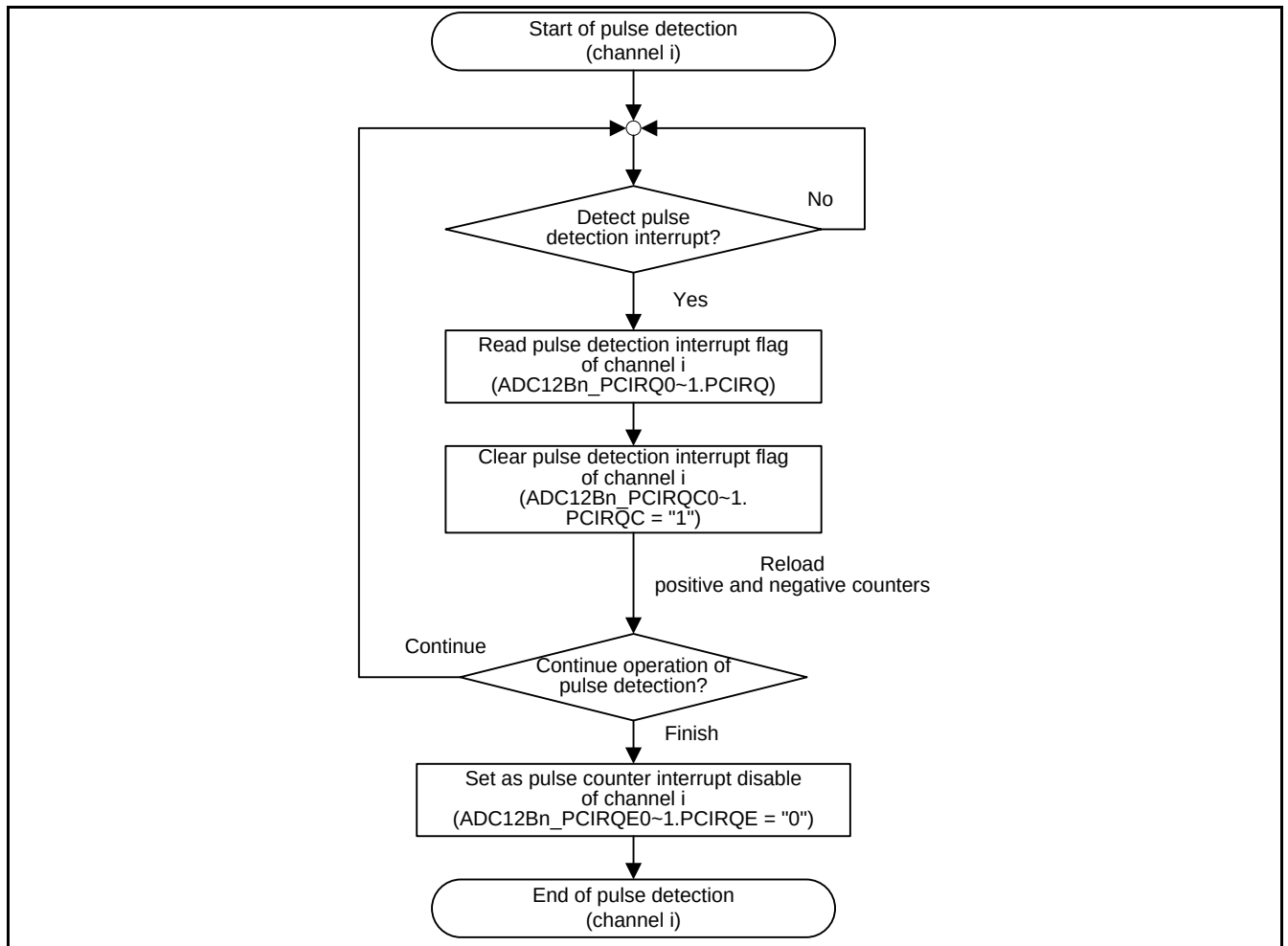
Figure 4-8 Range Comparator (Channel i)



4.8. Pulse Detection

Figure 4-9 shows the example of pulse detection operation.

Figure 4-9 Pulse Detection (Channel i)



5. Registers

The A/D converter contains registers to configure the operation of A/D conversion and to store the converted values. It also contains registers to configure the range comparators and registers to control and store the status of the pulse detection function. This section describes the registers of the A/D Converter in details.

The suffix "n" in the register name indicates that the register is an instance "n" of the module.

Registers of A/D Converter

Logical channel related registers are:

- A/D Channel Control Registers (ADC12Bn_CHCTRL0 to 63)
- A/D Channel Status Registers (ADC12Bn_CHSTAT0 to 63)
- A/D Conversion Data Registers (ADC12Bn_CD0 to 63)
- Pulse Counter Control Registers (ADC12Bn_PCCTRL0 to 63)
- A/D Conversion Done Interrupt Flags (ADC12Bn_CDONEIRQ0 to 1)
- A/D Conversion Done Interrupt Enable Registers (ADC12Bn_CDONEIRQE0 to 1)
- A/D Conversion Done Interrupt Clear Registers (ADC12Bn_CDONEIRQC0 to 1)
- Group Interrupted Interrupt Flags (ADC12Bn_GRPIRQ0 to 1)
- Group Interrupted Interrupt Enable Registers (ADC12Bn_GRPIRQE0 to 1)
- Group Interrupted Interrupt Clear Registers (ADC12Bn_GRPIRQC0 to 1)
- Range Comparator Interrupt Flags (ADC12Bn_RCIRQ0 to 1)
- Range Comparator Interrupt Enable Registers (ADC12Bn_RCIRQE0 to 1)
- Range Comparator Interrupt Clear Registers (ADC12Bn_RCIRQC0 to 1)
- Pulse Counter Interrupt Flags (ADC12Bn_PCIRQ0 to 1)
- Pulse Counter Interrupt Enable Registers (ADC12Bn_PCIRQE0 to 1)
- Pulse Counter Interrupt Clear Registers (ADC12Bn_PCIRQC0 to 1)
- A/D Channel Trigger Status Flags (ADC12Bn_TRGST0 to 1)
- A/D Channel Trigger Status Clear Registers (ADC12Bn_TRGCL0 to 1)
- A/D Channel Trigger Overrun Flags (ADC12Bn_TRGOR0 to 1)
- A/D Channel Trigger Overrun Clear Registers (ADC12Bn_TRGORC0 to 1)
- Range Comparator Over Threshold Flags (ADC12Bn_RCOTF0 to 1)

Global A/D Converter registers are:

- Conversion Done DMA Select Registers (ADC12Bn_CDDS0 to 3)
- A/D Converter Resumption Time Setting Register (ADC12Bn_RT)
- A/D Converter Comparison Time Setting Register (ADC12Bn_CT)
- A/D Converter Sampling Time Setting Registers (ADC12Bn_ST0 to 3)
- A/D Converter Offset Compensation Setting Register (ADC12Bn_OCV)
- A/D Converter Gain Compensation Setting Register (ADC12Bn_GCV)
- A/D Converter Global Control Register (ADC12Bn_CTRL)
- A/D Converter Global Status Register (ADC12Bn_STAT)
- Range Comparator Upper Threshold Registers (ADC12Bn_RCOH0 to 7)
- Range Comparator Lower Threshold Registers (ADC12Bn_RCOL0 to 7)
- Full Range Comparator Upper Threshold Registers (ADC12Bn_FRCOH0 to 7)
- Full Range Comparator Lower Threshold Registers (ADC12Bn_FRCOL0 to 7)

Multiple conversion logical channel related registers are:

- A/D Multiple Conversion Channel Control Registers (ADC12Bn_MCCTRL0 to 3)
- A/D Multiple Conversion Channel Status Registers (ADC12Bn_MCSTAT0 to 3)

5.1. A/D Channel Control Registers (ADC12Bn_CHCTRL0 to 63)

The A/D Channel Control Registers configure the logical channel specific settings. ADC12Bn_CHCTRL0 (described here) is dedicated to channel 0, ADC12Bn_CHCTRL63 is dedicated to channel 63. Other registers (ADC12Bn_CHCTRL1,.....ADC12Bn_CHCTRL62) have similar bit fields.

REGISTER NAME	ADC12Bn_CHCTRLi (i = 0 to 63)
OFFSET	0x0000 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:63
NUMERIC_TYPE	-
OTHER	-

A/D Channel Control Register (ADC12Bn_CHCTRL0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved						TRGCL	SWTRG
ACCESS_TYPE	R0,W0						R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0x00						0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RCEN	RCINVSEL	Reserved	RCSEL[2]	RCSEL[1]	RCSEL[0]	SMTIME[1]	SMTIME[0]
ACCESS_TYPE	R/W	R/W	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	DP	RSMRST[1]	RSMRST[0]	CHPRI[3]	CHPRI[2]	CHPRI[1]	CHPRI[0]
ACCESS_TYPE	R0,W0	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	TRGTYP[1]	TRGTYP[0]	ANIN[5]	ANIN[4]	ANIN[3]	ANIN[2]	ANIN[1]	ANIN[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:26] Reserved : Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit25] TRGCL : Trigger Status Clear bit

Bit	Description
0	No effect.
1	Clears corresponding trigger status bits ADC12Bn_CHSTAT0.TRGST and ADC12Bn_TRGST0.TRGST0.

Reading this bit always returns "0".

This bit is identical to the corresponding bit ADC12Bn_TRGCL0.TRGCL0.

[bit24] SWTRG : Software trigger bit

Bit	Description
0	No effect.
1	Sets corresponding trigger status bits ADC12Bn_CHSTAT0.TRGST and ADC12Bn_TRGST0.TRGST0. When trigger status bits are cleared and set at the same time, clearing has priority. When TRGTYP bits are set to "10" or "11", writing SWTRG bit to "1" has no effect.

Reading this bit always returns "0".

Note:

- Do not write "1" to this bit and reconfigure TRGTYP with the same access.

[bit23] RCEN : Range Comparator Enable bit

Bit	Description
0	Range comparator disabled.
1	Range comparator enabled.

[bit22] RCINVSEL : Range Comparator Inverted Range Selection bit

Bit	Description
0	The comparison checks for "outside range", i.e. the over threshold and interrupt flags (ADC12Bn_RCOTF0.RCOTF0, ADC12Bn_CHSTAT0.RCOTF, ADC12Bn_RCIRQ0.RCIRQ0 and ADC12Bn_CHSTAT0.RCIRQ) are set when the ADC result is above the upper threshold OR below the lower threshold. That is called "outside range".
1	The comparison checks for "inside range" i.e., the interrupt flags (ADC12Bn_CHSTAT0.RCIRQ and ADC12Bn_RCIRQ0.RCIRQ0) are set when the ADC result is below or equal the upper threshold AND above or equal the lower threshold. That is called "inside range" mode.

[bit21] Reserved : Reserved bit

When writing, always write "0".

When reading, "0" is always read.

[bit20:18] RCSEL[2:0] : Range Comparator Select bit

RCSEL[2:0]	Description
000	Select range comparator 0, defined by ADC12Bn_RCOH0 and ADC12Bn_RCOL0 registers.
...	...
111	Select range comparator 7, defined by ADC12Bn_RCOH7 and ADC12Bn_RCOL7 registers.

[bit17:16] SMTIME[1:0] : Sampling Time Select bits

SMTIME[1:0]	Description
00	ADC12Bn_ST0 register value is selected as channel sampling time.
01	ADC12Bn_ST1 register value is selected as channel sampling time.
10	ADC12Bn_ST2 register value is selected as channel sampling time.
11	ADC12Bn_ST3 register value is selected as channel sampling time.

[bit15] Reserved : Reserved bit

When writing, always write "0".

When reading, "0" is always read.

[bit14] DP : Data protection Enable bit

Bit	Description
0	Data protection function disabled.
1	Data protection function enabled.

[bit13:12] RSMRST[1:0] : Resume/Restart/Stop Select bits

RSMRST[1:0]	Description
00	Stop the group processing until next group start channel conversion request is issued.
01	Resume. If the group is interrupted just before the conversion of this channel is started, resume the group processing with this channel.
10	Restart. After the group is interrupted, restart with the start channel or the last converted channel configured as "resume" channel.
11	Reserved.

RSMRST[1:0] are not allowed to update during A/D conversion operation (ADC12Bn_TRGST0 to 1.TRGST and ADC12Bn_CHSTAT0 to 63.TRGST="1").

[bit11:8] CHPRI[3:0] : Logical channel priority

CHPRI[3:0]	Description
0000	Highest priority.
...	...
1111	Lowest priority.

CHPRI[3:0] are not allowed to update during A/D conversion operation (ADC12Bn_TRGST0 to 1.TRGST and ADC12Bn_CHSTAT0 to 63.TRGST="1").

[bit7:6] TRGTYP[1:0] : Trigger Type bits

TRGTYP[1:0]	Description
00	Software trigger only.
01	Software or hardware trigger.
10	Trigger by conversion completion and updating of conversion data register ADC12Bn_CD of the preceding channel.
11	Idle trigger, the channel trigger status is set if there is no channel having trigger status flag set and inactive data protection function.

TRGTYP[1:0] are not allowed to update during A/D conversion operation (ADC12Bn_TRGST0 to 1.TRGST and ADC12Bn_CHSTAT0 to 63.TRGST="1").

[bit5:0] ANIN[5:0] : Analog Input Selection bits

ANIN[5:0]	Description
000000	Analog input AN0 is selected.
...	...
111111	Analog input AN63 is selected.

5.2. A/D Channel Status Registers (ADC12Bn_CHSTAT0 to 63)

These registers store the status information of the corresponding logical channels related to interrupt flags and trigger status. ADC12Bn_CHSTAT0 (described here) is dedicated to channel 0, ADC12Bn_CHSTAT63 is dedicated to channel 63. Other registers (ADC12Bn_CHSTAT1,.....ADC12Bn_CHSTAT62) have similar bit fields.

REGISTER_NAME	ADC12Bn_CHSTATi (i = 0 to 63)
OFFSET	0x0100 + i*2
ACCESS_SIZE	B H W
MULTIPLE	0:63
NUMERIC_TYPE	-
OTHER	-

A/D Channel Status Register (ADC12Bn_CHSTAT0)

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE								
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved		RCOTF	PCIRQ	RCIRQ	GRPIRQ	CDONEIRQ	TRGST
ACCESS_TYPE	RX,WX		R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	00		0	0	0	0	0	0

[bit15:6] Reserved : Reserved bits

Reading this bit returns an undefined.

Writing data to these bits has no effect on the operation.

[bit5] RCOTF : Range Comparator Over Threshold flag

Bit	Description
0	The conversion result is less than or equal to the upper threshold.
1	The conversion result is above the upper threshold.

This bit is identical to the corresponding bit in the ADC12Bn_RCOTF0 register. For more details, see ADC12Bn_RCOTF0 to 1 register description.

[bit4] PCIRQ : Pulse Counter Interrupt flag

Bit	Description
0	Not detected.
1	Pulse counter interrupt detected.

This bit is identical to the corresponding bit in the ADC12Bn_PCIRQ0 register. For more details, see ADC12Bn_PCIRQ0 to 1 register description.

[bit3] RCIRQ : Range Comparator Interrupt flag

Bit	Description
0	Not detected.
1	Range comparator interrupt detected.

This bit is identical to the corresponding bit in the ADC12Bn_RCIRQ0 register. For more details, see ADC12Bn_RCIRQ0 to 1 register description.

[bit2] GRPIRQ : Group Interrupted Interrupt flag

Bit	Description
0	Not detected.
1	Group interrupted interrupt detected.

This bit is identical to the corresponding bit in the ADC12Bn_GRPIRQ0 register. For more details, see ADC12Bn_GRPIRQ0 to 1 register description.

[bit1] CDONEIRQ : Conversion done Interrupt flag

Bit	Description
0	Not detected
1	Conversion done Interrupt detected.

This bit is identical to the corresponding bit in the ADC12Bn_CDONEIRQ0 register. For more details, see ADC12Bn_CDONEIRQ0 to 1 register description.

[bit0] TRGST : Trigger Status flag

Bit	Description
0	Conversion request not detected.
1	Conversion request detected.

This bit is identical to the corresponding bit in the ADC12Bn_TRGST0 register. For more details, see ADC12Bn_TRGST0 to 1 register description.

5.3. A/D Conversion Data Registers (ADC12Bn_CD0 to 63)

There are 64 A/D conversion data registers, one per logical channel. The registers are written by hardware at the end of conversion if the trigger status is still set. Registers ADC12B_CD0 to 3 are dedicated to multiple conversion channels so their width is 16 bits. Width of registers ADC12B_CD4 to 63 is 12 bits.

REGISTER_NAME	ADC12Bn_CD <i>i</i> (i = 0 to 63)
OFFSET	0x0180 + i*2
ACCESS_SIZE	B H W
MULTIPLE	0:63
NUMERIC_TYPE	-
OTHER	-

5.3.1. A/D Conversion Data Result Registers (ADC12Bn_CD0 to 3)

Here is the register ADC12Bn_CD0 described, the registers ADC12Bn_CD1 to 3 have similar bit fields.

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	D[15]	D[14]	D[13]	D[12]	D[11]	D[10]	D[9]	D[8]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	D[7]	D[6]	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit15:0] D[15:0] : A/D Conversion Data bits

These bits store the conversion data.

The register is updated at the end of the A/D conversion only in the case the corresponding trigger status (ADC12Bn_TRGST0.TRGST0 and ADC12Bn_CHSTAT0.TRGST bits) is still "1".

The logical channel can be configured as multiple conversion channel, if ADC12Bn_MCCTRL0.CNVNUM is greater than 0. In that case the result of conversions is accumulated until the number of conversions reaches ADC12Bn_MCCTRL0.CNVNUM (the result of the first conversion is always directly stored and the following conversion results are added on current register value). Accordingly, if 12-bit conversion resolution is selected the conversion data can become 16-bit wide.

If ADC12Bn_MCCTRL0.CNVNUM is equal 0 (only one consecutive conversion is requested), the conversion data are provided in range of:

- bit[7:0] for 8-bit conversion resolution (bits 15 to 8 are "0"),
- bit[9:0] for 10-bit conversion resolution (bits 15 to 10 are "0"),
- bit[11:0] for 12-bit conversion resolution (bits 15 to 12 are "0").

5.3.2. A/D Conversion Data Registers (ADC12Bn_CD4 to 63)

Here is the register ADC12Bn_CD4 described, the registers ADC12Bn_CD5 to 63 have similar bit fields.

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved				D[11]	D[10]	D[9]	D[8]
ACCESS_TYPE	RX,WX				R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0000				X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	D[7]	D[6]	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit15:12] Reserved : Reserved bits

Reading this bit returns an undefined.

Writing data to these bits has no effect on the operation.

[bit11:0] D[11:0] : A/D Conversion Data bits

These bits store the conversion data, provided in range of:

- bit[7:0] for 8-bit conversion resolution (bits 11 to 8 are "0"),
- bit[9:0] for 10-bit conversion resolution (bits 11 to 10 are "0") and
- bit[11:0] for 12-bit conversion resolution.

The register is updated at the end of the A/D conversion only in the case the corresponding trigger status (ADC12Bn_TRGST0.TRGST4 and ADC12Bn_CHSTAT4.TRGST bits) is still "1".

5.4. Pulse Counter Control Registers (ADC12Bn_PCCTRL0 to 63)

These registers hold the reload and current values of positive and negative counters of the pulse detection function for the corresponding logical channel. The positive counters count down the positive events of the range comparator and negative counters count down the negative events of the range comparator. ADC12Bn_PCCTRL0 (described here) is dedicated to channel 0, ADC12Bn_PCCTRL63 is dedicated to channel 63. Other registers (ADC12Bn_PCCTRL1,.....ADC12Bn_PCCTRL62) have similar bit fields.

REGISTER_NAME	ADC12Bn_PCCTRLi (i = 0 to 63)
OFFSET	0x0200 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:63
NUMERIC_TYPE	-
OTHER	-

Pulse Counter Control Register (ADC12Bn_PCCTRL0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved			PCTNCT[4]	PCTNCT[3]	PCTNCT[2]	PCTNCT[1]	PCTNCT[0]
ACCESS_TYPE	RX,WX			R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	000			0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved			PCTNRL[4]	PCTNRL[3]	PCTNRL[2]	PCTNRL[1]	PCTNRL[0]
ACCESS_TYPE	R0,W0			R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	000			0	0	0	1	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PCTPCT[7]	PCTPCT[6]	PCTPCT[5]	PCTPCT[4]	PCTPCT[3]	PCTPCT[2]	PCTPCT[1]	PCTPCT[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PCTPRL[7]	PCTPRL[6]	PCTPRL[5]	PCTPRL[4]	PCTPRL[3]	PCTPRL[2]	PCTPRL[1]	PCTPRL[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	1	0

[bit31:29] Reserved : Reserved bits

Reading this bit returns an undefined.

Writing data to these bits has no effect on the operation.

[bit28:24] PCTNCT[4:0] : Pulse Negative Counter Register

This register reflects the current counter value of the pulse detection negative counter. Reload value is determined by PCTNRL.

The negative counter is reloaded under one of the following conditions:

- Writing "1" to the corresponding ADC12Bn_PCIRQC0.PCIRQC bit.
- Any positive event from the appropriate range comparator.

Therefore, in order to reload negative counter immediately after set to PCTNRL[4:0], the corresponding ADC12Bn_PCIRQC0 to 1.PCIRQC bit should be written "1".

[bit23:21] Reserved : Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit20:16] PCTNRL[4:0] : Pulse Negative Counter Reload Register

These register bits hold the reload value of the negative counter PCTNCT used for counting negative events of the range comparator. Do not set this bit field to "00000".

The negative counter is reloaded with the value from this register when "1" is written to the corresponding ADC12Bn_PCIRQC0.PCIRQC0 bit or on any positive event from the appropriate range comparator.

For further explanation of negative events and operation of pulse detection function refer to section "Pulse Detection Function" in chapter "3 Operation of A/D "

[bit15:8] PCTPCT[7:0] : Pulse Positive Counter Register

This register reflects the current counter value of the pulse detection positive counter. Reload value is determined by PCTPRL.

The positive counter is reloaded under one of the following conditions:

- Writing "1" to the corresponding ADC12Bn_PCIRQC0.PCIRQC0 bit.
- Expiration of the corresponding negative counter (PCTNCT).

Therefore, in order to reload negative counter immediately after set to PCTPRL[7:0], the corresponding ADC12Bn_PCIRQC0 to 1.PCIRQC0 bit should be written "1".

[bit7:0] PCTPRL[7:0] : Pulse Positive Counter Reload Register

These register bits hold the reload value of the positive counter PCTPCT used for counting positive events of the range comparator. Do not set this bit field to "00000000".

The positive counter is reloaded with the value from this register when "1" is written to the corresponding ADC12Bn_PCIRQC0.PCIRQC0 bit or on expiration of the corresponding negative counter (PCTNCT).

For further explanation of negative events and operation of pulse detection function refer to section "Pulse Detection Function" in chapter "3 Operation of A/D "

5.5. A/D Conversion Done Interrupt Flag Registers (ADC12Bn_CDONEIRQ0 to 1)

A/D Conversion Done Interrupt Flag Registers ADC12Bn_CDONEIRQ0 to 1 contain the status of conversion done interrupt flags for all 64 logical channels.

REGISTER_NAME	ADC12Bn_CDONEIRQi (i = 0 to 1)
OFFSET	0x300 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.5.1. A/D Conversion Done Interrupt Flag Register (ADC12Bn_CDONEIRQ0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	CDONEIRQ3 1	CDONEIRQ3 0	CDONEIRQ2 9	CDONEIRQ2 8	CDONEIRQ2 7	CDONEIRQ2 6	CDONEIRQ2 5	CDONEIRQ2 4
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	CDONEIRQ2 3	CDONEIRQ2 2	CDONEIRQ2 1	CDONEIRQ2 0	CDONEIRQ1 9	CDONEIRQ1 8	CDONEIRQ1 7	CDONEIRQ1 6
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	CDONEIRQ1 5	CDONEIRQ1 4	CDONEIRQ1 3	CDONEIRQ1 2	CDONEIRQ1 1	CDONEIRQ1 0	CDONEIRQ9	CDONEIRQ8
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CDONEIRQ7	CDONEIRQ6	CDONEIRQ5	CDONEIRQ4	CDONEIRQ3	CDONEIRQ2	CDONEIRQ1	CDONEIRQ0
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] CDONEIRQ31 to 0 : Conversion Done Interrupt flags

Bit	Description
0	Conversion done interrupt request not detected.
1	Conversion done interrupt request detected.

This bit is set when conversion data is stored in corresponding conversion data register ADC12Bn_CD0 to 31 and corresponding trigger status (ADC12Bn_TRGST0.TRGST and ADC12Bn_CHSTAT0 to 31.TRGST bits) is still "1".

In case of multiple conversion channels this bit is set when the last conversion is done, final conversion result is accumulated and corresponding trigger status (ADC12Bn_TRGST0.TRGST and ADC12Bn_CHSTAT0 to 31.TRGST bits) is still "1".

This bit is cleared by writing "1" to the corresponding ADC12Bn_CDONEIRQC0 bits or by reading the corresponding conversion data register ADC12Bn_CD0 to 31 (except by the debug master, DAP). All ADC12Bn_CD0 to 31 read access types (8/16/32-bit) clear the flag.

If this bit is set and cleared at the same time, clearing has higher priority.

This bit is identical to the CDONEIRQ bit in the corresponding ADC12Bn_CHSTAT0 to 31 registers.

5.5.2. A/D Conversion Done Interrupt Flag Register (ADC12Bn_CDONEIRQ1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	CDONEIRQ6 3	CDONEIRQ6 2	CDONEIRQ6 1	CDONEIRQ6 0	CDONEIRQ5 9	CDONEIRQ5 8	CDONEIRQ5 7	CDONEIRQ5 6
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	CDONEIRQ5 5	CDONEIRQ5 4	CDONEIRQ5 3	CDONEIRQ5 2	CDONEIRQ5 1	CDONEIRQ5 0	CDONEIRQ4 9	CDONEIRQ4 8
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	CDONEIRQ4 7	CDONEIRQ4 6	CDONEIRQ4 5	CDONEIRQ4 4	CDONEIRQ4 3	CDONEIRQ4 2	CDONEIRQ4 1	CDONEIRQ4 0
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CDONEIRQ3 9	CDONEIRQ3 8	CDONEIRQ3 7	CDONEIRQ3 6	CDONEIRQ3 5	CDONEIRQ3 4	CDONEIRQ3 3	CDONEIRQ3 2
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] CDONEIRQ63 to 32 : Conversion Done Interrupt flags

Bit	Description
0	Conversion done interrupt request not detected.
1	Conversion done interrupt request detected.

This bit is set when conversion data is stored in corresponding conversion data register ADC12Bn_CD32 to 63 and corresponding trigger status (ADC12Bn_TRGST1.TRGST and ADC12Bn_CHSTAT32 to 63.TRGST bits) is still "1".

This bit is cleared by writing "1" to the corresponding ADC12Bn_CDONEIRQC1 bits or by reading the corresponding conversion data register ADC12Bn_CD32 to 63 (except by the debug master, DAP). All ADC12Bn_CD32 to 63 read access types (8/16/32-bit) clear the flag.

If this bit is set and cleared at the same time, clearing has higher priority.

This bit is identical to the CDONEIRQ bit in the corresponding ADC12Bn_CHSTAT32 to 63 registers.

5.6. A/D Conversion Done Interrupt Enable Registers (ADC12Bn_CDONEIRQE0 to 1)

These registers contain enable bits for all 64 logical channels, dedicated to the generation of conversion done interrupt.

REGISTER_NAME	ADC12Bn_CDONEIRQEi (i = 0 to 1)
OFFSET	0x0308 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.6.1. A/D Conversion Done Interrupt Enable Register (ADC12Bn_CDONEIRQE0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	CDONEIRQ E31	CDONEIRQ E30	CDONEIRQ E29	CDONEIRQ E28	CDONEIRQ E27	CDONEIRQ E26	CDONEIRQ E25	CDONEIRQ E24
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	CDONEIRQ E23	CDONEIRQ E22	CDONEIRQ E21	CDONEIRQ E20	CDONEIRQ E19	CDONEIRQ E18	CDONEIRQ E17	CDONEIRQ E16
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	CDONEIRQ E15	CDONEIRQ E14	CDONEIRQ E13	CDONEIRQ E12	CDONEIRQ E11	CDONEIRQ E10	CDONEIRQ E9	CDONEIRQ E8
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CDONEIRQ E7	CDONEIRQ E6	CDONEIRQ E5	CDONEIRQ E4	CDONEIRQ E3	CDONEIRQ E2	CDONEIRQ E1	CDONEIRQ E0
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] CDONEIRQE31 to 0 : Conversion Done Interrupt Enable bits

Bit	Description
0	Conversion done interrupt disabled
1	Conversion done interrupt enabled.

Conversion done interrupt is issued when the bit is "1" and the corresponding interrupt flags ADC12Bn_CDONEIRQ0.CDONEIRQ31 to 0 and ADC12Bn_CHSTAT0 to 31.CDONEIRQ are set to "1".

5.6.2. A/D Conversion Done Interrupt Enable Register (ADC12Bn_CDONEIRQE1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	CDONEIRQ E63	CDONEIRQ E62	CDONEIRQ E61	CDONEIRQ E60	CDONEIRQ E59	CDONEIRQ E58	CDONEIRQ E57	CDONEIRQ E56
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	CDONEIRQ E55	CDONEIRQ E54	CDONEIRQ E53	CDONEIRQ E52	CDONEIRQ E51	CDONEIRQ E50	CDONEIRQ E49	CDONEIRQ E48
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	CDONEIRQ E47	CDONEIRQ E46	CDONEIRQ E45	CDONEIRQ E44	CDONEIRQ E43	CDONEIRQ E42	CDONEIRQ E41	CDONEIRQ E40
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CDONEIRQ E39	CDONEIRQ E38	CDONEIRQ E37	CDONEIRQ E36	CDONEIRQ E35	CDONEIRQ E34	CDONEIRQ E33	CDONEIRQ E32
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] CDONEIRQE63 to 32 : Conversion Done Interrupt Enable bits

Bit	Description
0	Conversion done interrupt disabled
1	Conversion done interrupt enabled.

Conversion done interrupt is issued when the bit is "1" and the corresponding interrupt flags ADC12Bn_CDONEIRQ1.CDONEIRQ63 to 32 and ADC12Bn_CHSTAT32 to 63.CDONEIRQ are set to "1".

5.7. A/D Conversion Done Interrupt Clear Registers (ADC12Bn_CDONEIRQ0 to 1)

These registers contain bits for clearing corresponding conversion done interrupt flags in the ADC12Bn_CDONEIRQ0 to 1 registers. The 64 bits are assigned to 64 logical channels.

REGISTER_NAME	ADC12Bn_CDONEIRQi (i = 0 to 1)
OFFSET	0x0310 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.7.1. A/D Conversion Done Interrupt Clear Register (ADC12Bn_CDONEIRQ0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	CDONEIRQ C31	CDONEIRQ C30	CDONEIRQ C29	CDONEIRQ C28	CDONEIRQ C27	CDONEIRQ C26	CDONEIRQ C25	CDONEIRQ C24
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	CDONEIRQ C23	CDONEIRQ C22	CDONEIRQ C21	CDONEIRQ C20	CDONEIRQ C19	CDONEIRQ C18	CDONEIRQ C17	CDONEIRQ C16
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	CDONEIRQ C15	CDONEIRQ C14	CDONEIRQ C13	CDONEIRQ C12	CDONEIRQ C11	CDONEIRQ C10	CDONEIRQ C9	CDONEIRQ C8
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CDONEIRQ C7	CDONEIRQ C6	CDONEIRQ C5	CDONEIRQ C4	CDONEIRQ C3	CDONEIRQ C2	CDONEIRQ C1	CDONEIRQ C0
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] CDONEIRQC31 to 0 : Conversion Done Interrupt Clear bits

Bit	Description
0	No effect.
1	Conversion Done Interrupt cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_CDONEIRQ0 register and CDONEIRQ bit in the corresponding ADC12Bn_CHSTAT0 to 31 register are cleared.

5.7.2. A/D Conversion Done Interrupt Clear Register (ADC12Bn_CDONEIRQC1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	CDONEIRQ C63	CDONEIRQ C62	CDONEIRQ C61	CDONEIRQ C60	CDONEIRQ C59	CDONEIRQ C58	CDONEIRQ C57	CDONEIRQ C56
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	CDONEIRQ C55	CDONEIRQ C54	CDONEIRQ C53	CDONEIRQ C52	CDONEIRQ C51	CDONEIRQ C50	CDONEIRQ C49	CDONEIRQ C48
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	CDONEIRQ C47	CDONEIRQ C46	CDONEIRQ C45	CDONEIRQ C44	CDONEIRQ C43	CDONEIRQ C42	CDONEIRQ C41	CDONEIRQ C40
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CDONEIRQ C39	CDONEIRQ C38	CDONEIRQ C37	CDONEIRQ C36	CDONEIRQ C35	CDONEIRQ C34	CDONEIRQ C33	CDONEIRQ C32
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] CDONEIRQC63 to 32 : Conversion Done Interrupt Clear bits

Bit	Description
0	No effect.
1	Conversion Done Interrupt cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_CDONEIRQ1 register and CDONEIRQ bit in the corresponding ADC12Bn_CHSTAT32 to 63 register are cleared.

5.8. Group Interrupted Interrupt Flag Registers (ADC12Bn_GRP_IRQ0 to 1)

These registers contain the status of group interrupted interrupt flags for all 64 logical channels.

REGISTER_NAME	ADC12Bn_GRP_IRQi (i = 0 to 1)
OFFSET	0x0318 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.8.1. Group Interrupted Interrupt Flag Register (ADC12Bn_GRP_IRQ0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	GRPIRQ31	GRPIRQ30	GRPIRQ29	GRPIRQ28	GRPIRQ27	GRPIRQ26	GRPIRQ25	GRPIRQ24
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	GRPIRQ23	GRPIRQ22	GRPIRQ21	GRPIRQ20	GRPIRQ19	GRPIRQ18	GRPIRQ17	GRPIRQ16
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	GRPIRQ15	GRPIRQ14	GRPIRQ13	GRPIRQ12	GRPIRQ11	GRPIRQ10	GRPIRQ9	GRPIRQ8
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	GRPIRQ7	GRPIRQ6	GRPIRQ5	GRPIRQ4	GRPIRQ3	GRPIRQ2	GRPIRQ1	GRPIRQ0
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] GRPIRQ31 to 0

Group Interrupted Interrupt flags for the case the group gets interrupted and stopped before finishing.

Bit	Description
0	Group interrupted interrupt not detected.
1	Group interrupted interrupt detected.

The bit is set to "1" if following conditions are fulfilled:

- The corresponding trigger status flags of the channel (ADC12Bn_CHSTAT0 to 31.TRGST and ADC12Bn_TRGST0.TRGST31 to 0) are set to "1"
- The channel is not first in the group i.e. the trigger type bits TRGTYP are set to "10" in the corresponding ADC12Bn_CHCTRL0 to 31 register
- The channel did not win arbitration for the next conversion, i.e. there was a channel with active trigger status and higher priority.

For multiple conversion logical channels, this bit is set to "1" also in the case the multiple conversions are started and they are interrupted before the last conversion is performed.

This bit is cleared by writing "1" to the corresponding ADC12Bn_GRP_IRQC0 bits.

This bit is identical to the GRPIRQ bit in the corresponding ADC12Bn_CHSTAT0 to 31 registers

5.8.2. Group Interrupted Interrupt Flag Register (ADC12Bn_GRP_IRQ1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	GRPIRQ63	GRPIRQ62	GRPIRQ61	GRPIRQ60	GRPIRQ59	GRPIRQ58	GRPIRQ57	GRPIRQ56
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	GRPIRQ55	GRPIRQ54	GRPIRQ53	GRPIRQ52	GRPIRQ51	GRPIRQ50	GRPIRQ49	GRPIRQ48
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	GRPIRQ47	GRPIRQ46	GRPIRQ45	GRPIRQ44	GRPIRQ43	GRPIRQ42	GRPIRQ41	GRPIRQ40
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	GRPIRQ39	GRPIRQ38	GRPIRQ37	GRPIRQ36	GRPIRQ35	GRPIRQ34	GRPIRQ33	GRPIRQ32
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] GRPIRQ63 to 32

Group Interrupted Interrupt flags for the case the group gets interrupted and stopped before finishing.

Bit	Description
0	Group interrupted interrupt not detected.
1	Group interrupted interrupt detected.

The bit is set to "1" if following conditions are fulfilled:

- The corresponding trigger status flags of the channel (ADC12Bn_CHSTAT32 to 63.TRGST and ADC12Bn_TRGST1.TRGST63 to 32) are set to "1"
- The channel is not first in the group i.e. the trigger type bits TRGTYP are set to "10" in the corresponding ADC12Bn_CHCTRL32 to 63 register
- The channel did not win arbitration for the next conversion, i.e. there was a channel with active trigger status and higher priority.

For multiple conversion logical channels, this bit is set to "1" also in the case the multiple conversions are started and they are interrupted before the last conversion is performed.

This bit is cleared by writing "1" to the corresponding ADC12Bn_GRP_IRQC1 bits.

This bit is identical to the GRPIRQ bit in the corresponding ADC12Bn_CHSTAT32 to 63 registers

5.9. Group Interrupted Interrupt Enable Registers (ADC12Bn_GRP_IRQE0 to 1)

These registers contain enable bits for all 64 logical channels, dedicated to the generation of group interrupted interrupt.

REGISTER_NAME	ADC12Bn_GRP_IRQEi (i = 0 to 1)
OFFSET	0x0320 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.9.1. Group Interrupted Interrupt Enable Register (ADC12Bn_GRP_IRQE0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	GRP_IRQE31	GRP_IRQE30	GRP_IRQE29	GRP_IRQE28	GRP_IRQE27	GRP_IRQE26	GRP_IRQE25	GRP_IRQE24
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	GRP_IRQE23	GRP_IRQE22	GRP_IRQE21	GRP_IRQE20	GRP_IRQE19	GRP_IRQE18	GRP_IRQE17	GRP_IRQE16
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	GRP_IRQE15	GRP_IRQE14	GRP_IRQE13	GRP_IRQE12	GRP_IRQE11	GRP_IRQE10	GRP_IRQE9	GRP_IRQE8
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	GRP_IRQE7	GRP_IRQE6	GRP_IRQE5	GRP_IRQE4	GRP_IRQE3	GRP_IRQE2	GRP_IRQE1	GRP_IRQE0
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] GRP_IRQE31 to 0 : Group Interrupted Interrupt Enable bits

Bit	Description
0	Group interrupted interrupt disabled.
1	Group interrupted interrupt enabled.

Group interrupted interrupt is issued when this bit is "1" and the corresponding interrupt flags (ADC12Bn_GRP_IRQ0.GRP_IRQ31 to 0 and ADC12Bn_CHSTAT0 to 31.GRP_IRQ) are set to "1".

5.9.2. Group Interrupted Interrupt Enable Register (ADC12Bn_GRPIRQE1)

BIT OFFSET	31	30	29	28	27	26	25	24
BIT NAME	GRPIRQE63	GRPIRQE62	GRPIRQE61	GRPIRQE60	GRPIRQE59	GRPIRQE58	GRPIRQE57	GRPIRQE56
ACCESS TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	23	22	21	20	19	18	17	16
BIT NAME	GRPIRQE55	GRPIRQE54	GRPIRQE53	GRPIRQE52	GRPIRQE51	GRPIRQE50	GRPIRQE49	GRPIRQE48
ACCESS TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	15	14	13	12	11	10	9	8
BIT NAME	GRPIRQE47	GRPIRQE46	GRPIRQE45	GRPIRQE44	GRPIRQE43	GRPIRQE42	GRPIRQE41	GRPIRQE40
ACCESS TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	7	6	5	4	3	2	1	0
BIT NAME	GRPIRQE39	GRPIRQE38	GRPIRQE37	GRPIRQE36	GRPIRQE35	GRPIRQE34	GRPIRQE33	GRPIRQE32
ACCESS TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] GRPIRQE63 to 32 : Group Interrupted Interrupt Enable bits

Bit	Description
0	Group interrupted interrupt disabled.
1	Group interrupted interrupt enabled.

Group interrupted interrupt is issued when this bit is "1" and the corresponding interrupt flags (ADC12Bn_GRPIRQ1.GRPIRQ63 to 32 and ADC12Bn_CHSTAT32 to 63.GRPIRQ) are set to "1".

5.10. Group Interrupted Interrupt Clear Registers (ADC12Bn_GRP_IRQC0 to 1)

These registers contain bits for clearing corresponding group interrupted interrupt flags in the ADC12Bn_GRP_IRQ0 to 1 registers. The 64 bits are assigned to 64 logical channels.

REGISTER_NAME	ADC12Bn_GRP_IRQCi (i = 0 to 1)
OFFSET	0x0328 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.10.1. Group Interrupted Interrupt Clear Register (ADC12Bn_GRP_IRQC0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	GRP_IRQC31	GRP_IRQC30	GRP_IRQC29	GRP_IRQC28	GRP_IRQC27	GRP_IRQC26	GRP_IRQC25	GRP_IRQC24
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	GRP_IRQC23	GRP_IRQC22	GRP_IRQC21	GRP_IRQC20	GRP_IRQC19	GRP_IRQC18	GRP_IRQC17	GRP_IRQC16
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	GRP_IRQC15	GRP_IRQC14	GRP_IRQC13	GRP_IRQC12	GRP_IRQC11	GRP_IRQC10	GRP_IRQC9	GRP_IRQC8
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	GRP_IRQC7	GRP_IRQC6	GRP_IRQC5	GRP_IRQC4	GRP_IRQC3	GRP_IRQC2	GRP_IRQC1	GRP_IRQC0
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] GRP_IRQC31 to 0 : Group Interrupted Clear bits

Bit	Description
0	No effect.
1	Group interrupted interrupt cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_GRP_IRQ0 register and GRP_IRQ bit in the corresponding ADC12Bn_CHSTAT0 to 31 register are cleared.

5.10.2. Group Interrupted Interrupt Clear Register (ADC12Bn_GRP_IRQC1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	GRPIRQC63	GRPIRQC62	GRPIRQC61	GRPIRQC60	GRPIRQC59	GRPIRQC58	GRPIRQC57	GRPIRQC56
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	GRPIRQC55	GRPIRQC54	GRPIRQC53	GRPIRQC52	GRPIRQC51	GRPIRQC50	GRPIRQC49	GRPIRQC48
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	GRPIRQC47	GRPIRQC46	GRPIRQC45	GRPIRQC44	GRPIRQC43	GRPIRQC42	GRPIRQC41	GRPIRQC40
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	GRPIRQC39	GRPIRQC38	GRPIRQC37	GRPIRQC36	GRPIRQC35	GRPIRQC34	GRPIRQC33	GRPIRQC32
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] GRPIRQC63 to 32 : Group Interrupted Clear bits

Bit	Description
0	No effect.
1	Group interrupted interrupt cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_GRP_IRQ1 register and GRPIRQ bit in the corresponding ADC12Bn_CHSTAT32 to 63 register are cleared.

5.11. Range Comparator Interrupt Flag Registers (ADC12Bn_RCIRQ0 to 1)

Range Comparator Interrupt Flag Registers ADC12Bn_RCIRQ0 to 1 contain the status of range comparator interrupt flags for all 64 logical channels.

REGISTER_NAME	ADC12Bn_RCIRQi (i = 0 to 1)
OFFSET	0x0330 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.11.1. Range Comparator Interrupt Flag Register (ADC12Bn_RCIRQ0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RCIRQ31	RCIRQ30	RCIRQ29	RCIRQ28	RCIRQ27	RCIRQ26	RCIRQ25	RCIRQ24
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RCIRQ23	RCIRQ22	RCIRQ21	RCIRQ20	RCIRQ19	RCIRQ18	RCIRQ17	RCIRQ16
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RCIRQ15	RCIRQ14	RCIRQ13	RCIRQ12	RCIRQ11	RCIRQ10	RCIRQ9	RCIRQ8
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RCIRQ7	RCIRQ6	RCIRQ5	RCIRQ4	RCIRQ3	RCIRQ2	RCIRQ1	RCIRQ0
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] RCIRQ31 to 0 : Range Comparator Interrupt flags

Bit	Description
0	Range comparator interrupt not detected.
1	Range comparator interrupt detected.

This flag shows that an outside range or inside range condition has been found on the corresponding logical channel.

This bit is set under the following conditions:

- The range comparison for this channel is enabled ADC12B_CHCTRL0 to 31.RCEN is set
- The conversion of the logical channel is just finished
- An interrupt condition is met (see Table 5-1)

This bit is cleared by writing "1" to the corresponding ADC12B_RCIRQC0.RCIRQC bit.

This bit is identical to the RCIRQ bit in the corresponding ADC12Bn_CHSTAT0 to 31 register.

5.11.2. Range Comparator Interrupt Flag Register (ADC12Bn_RCIRQ1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RCIRQ63	RCIRQ62	RCIRQ61	RCIRQ60	RCIRQ59	RCIRQ58	RCIRQ57	RCIRQ56
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RCIRQ55	RCIRQ54	RCIRQ53	RCIRQ52	RCIRQ51	RCIRQ50	RCIRQ49	RCIRQ48
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RCIRQ47	RCIRQ46	RCIRQ45	RCIRQ44	RCIRQ43	RCIRQ42	RCIRQ41	RCIRQ40
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RCIRQ39	RCIRQ38	RCIRQ37	RCIRQ36	RCIRQ35	RCIRQ34	RCIRQ33	RCIRQ32
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] RCIRQ63 to 32 : Range Comparator Interrupt flags

Bit	Description
0	Range comparator interrupt not detected.
1	Range comparator interrupt detected.

This flag shows that an outside range or inside range condition has been found on the corresponding logical channel.

This bit is set under the following conditions:

- The range comparison for this channel is enabled ADC12B_CHCTRL32 to 63.RCEN is set
- The conversion of the logical channel is just finished
- An interrupt condition is met (see Table 5-1)

This bit is cleared by writing "1" to the corresponding ADC12B_RCIRQC1.RCIRQC bit.

This bit is identical to the RCIRQ bit in the corresponding ADC12Bn_CHSTAT32 to 63 register.

Table 5-1 Range Comparator Interrupt Condition

Mode	Inverted Range Selection ADC12Bn_CHCTRL0 to 63.RCINVSEL	Conversion Result above Upper Threshold	Conversion Result below Lower Threshold	Interrupt Condition
outside range	0	1	x	INT condition: above range, ADC12Bn_RCOTF0 to 1.RCOTF and ADC12Bn_CHSTAT0 to 63.RCOTF are set.
		0	0	-
		0	1	INT condition: below range, ADC12Bn_RCOTF0 to 1.RCOTF and ADC12Bn_CHSTAT0 to 63.RCOTF are cleared.
inside range	1	1	x	-
		0	0	INT condition: inside range
		0	1	-

5.12. Range Comparator Interrupt Enable Registers (ADC12Bn_RCIRQE0 to 1)

These registers contain enable bits for all 64 logical channels, dedicated to the generation of range comparator interrupt.

REGISTER_NAME	ADC12Bn_RCIRQEi (i = 0 to 1)
OFFSET	0x0338 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.12.1. Range Comparator Interrupt Enable Register (ADC12Bn_RCIRQE0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RCIRQE31	RCIRQE30	RCIRQE29	RCIRQE28	RCIRQE27	RCIRQE26	RCIRQE25	RCIRQE24
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RCIRQE23	RCIRQE22	RCIRQE21	RCIRQE20	RCIRQE19	RCIRQE18	RCIRQE17	RCIRQE16
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RCIRQE15	RCIRQE14	RCIRQE13	RCIRQE12	RCIRQE11	RCIRQE10	RCIRQE9	RCIRQE8
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RCIRQE7	RCIRQE6	RCIRQE5	RCIRQE4	RCIRQE3	RCIRQE2	RCIRQE1	RCIRQE0
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] RCIRQE31 to 0 : Range Comparator Interrupt Enable bits

Bit	Description
0	Range comparator interrupt disabled.
1	Range comparator interrupt enabled

Range comparator interrupt is issued when this bit is "1" and the corresponding interrupt flags ADC12Bn_RCIRQ0.RCIRQ31 to 0 and ADC12Bn_CHSTAT0 to 31.RCIRQ are set to "1".

5.12.2. Range Comparator Interrupt Enable Register (ADC12Bn_RCIRQE1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RCIRQE63	RCIRQE62	RCIRQE61	RCIRQE60	RCIRQE59	RCIRQE58	RCIRQE57	RCIRQE56
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RCIRQE55	RCIRQE54	RCIRQE53	RCIRQE52	RCIRQE51	RCIRQE50	RCIRQE49	RCIRQE48
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RCIRQE47	RCIRQE46	RCIRQE45	RCIRQE44	RCIRQE43	RCIRQE42	RCIRQE41	RCIRQE40
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RCIRQE39	RCIRQE38	RCIRQE37	RCIRQE36	RCIRQE35	RCIRQE34	RCIRQE33	RCIRQE32
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] RCIRQE63 to 32 : Range Comparator Interrupt Enable bits

Bit	Description
0	Range comparator interrupt disabled.
1	Range comparator interrupt enabled

Range comparator interrupt is issued when this bit is "1" and the corresponding interrupt flags ADC12Bn_RCIRQ1.RCIRQ63 to 32 and ADC12Bn_CHSTAT32 to 63.RCIRQ are set to "1".

5.13. Range Comparator Interrupt Clear Registers (ADC12Bn_RCIRQC0 to 1)

These registers contain bits for clearing corresponding range comparator interrupt flags in the ADC12Bn_RCIRQ0 to 1 registers. The 64 bits are assigned to 64 logical channels.

REGISTER_NAME	ADC12Bn_RCIRQC <i>i</i> (<i>i</i> = 0 to 1)
OFFSET	0x0340 + <i>i</i> *4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.13.1. Range Comparator Interrupt Clear Register (ADC12Bn_RCIRQC0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RCIRQC31	RCIRQC30	RCIRQC29	RCIRQC28	RCIRQC27	RCIRQC26	RCIRQC25	RCIRQC24
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RCIRQC23	RCIRQC22	RCIRQC21	RCIRQC20	RCIRQC19	RCIRQC18	RCIRQC17	RCIRQC16
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RCIRQC15	RCIRQC14	RCIRQC13	RCIRQC12	RCIRQC11	RCIRQC10	RCIRQC9	RCIRQC8
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RCIRQC7	RCIRQC6	RCIRQC5	RCIRQC4	RCIRQC3	RCIRQC2	RCIRQC1	RCIRQC0
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] RCIRQC31 to 0 : Range Comparator Interrupt Clear bits

Bit	Description
0	No effect.
1	Range comparator interrupt cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_RCIRQ0 register and RCIRQ bit in the corresponding ADC12Bn_CHSTAT0 to 31 register are cleared.

5.13.2. Range Comparator Interrupt Clear Register (ADC12Bn_RCIRQC1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RCIRQC63	RCIRQC62	RCIRQC61	RCIRQC60	RCIRQC59	RCIRQC58	RCIRQC57	RCIRQC56
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RCIRQC55	RCIRQC54	RCIRQC53	RCIRQC52	RCIRQC51	RCIRQC50	RCIRQC49	RCIRQC48
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RCIRQC47	RCIRQC46	RCIRQC45	RCIRQC44	RCIRQC43	RCIRQC42	RCIRQC41	RCIRQC40
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RCIRQC39	RCIRQC38	RCIRQC37	RCIRQC36	RCIRQC35	RCIRQC34	RCIRQC33	RCIRQC32
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] RCIRQC63 to 32 : Range Comparator Interrupt Clear bits

Bit	Description
0	No effect.
1	Range comparator interrupt cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_RCIRQ1 register and RCIRQ bit in the corresponding ADC12Bn_CHSTAT32 to 63 register are cleared.

5.14. Pulse Counter Interrupt Flag Registers (ADC12Bn_PCIRQ0 to 1)

Pulse Comparator Interrupt Flag Registers ADC12Bn_PCIRQ0 to 1 contain the status of pulse counter interrupt flags for all 64 logical channels.

REGISTER_NAME	ADC12Bn_PCIRQi (i = 0 to 1)
OFFSET	0x0348 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.14.1. Pulse Counter Interrupt Flag Register (ADC12Bn_PCIRQ0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	PCIRQ31	PCIRQ30	PCIRQ29	PCIRQ28	PCIRQ27	PCIRQ26	PCIRQ25	PCIRQ24
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	PCIRQ23	PCIRQ22	PCIRQ21	PCIRQ20	PCIRQ19	PCIRQ18	PCIRQ17	PCIRQ16
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PCIRQ15	PCIRQ14	PCIRQ13	PCIRQ12	PCIRQ11	PCIRQ10	PCIRQ9	PCIRQ8
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PCIRQ7	PCIRQ6	PCIRQ5	PCIRQ4	PCIRQ3	PCIRQ2	PCIRQ1	PCIRQ0
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] PCIRQ31 to 0 : Pulse Counter Interrupt flags

Bit	Description
0	Pulse counter interrupt not detected.
1	Pulse counter interrupt detected.

This register returns the status of the pulse counter interrupt flag which is set when positive counter ADC12B_PCCTRL0 to 31.PCTPCT of the corresponding logical channel decrements to zero. The positive counter and negative counter are stopped as long as the pulse counter interrupt flag of the appropriate channel is set.

This bit is cleared by writing "1" to the corresponding bit in the ADC12Bn_PCIRQC0 register.

This bit is identical to the PCIRQ bit in the corresponding ADC12Bn_CHSTAT0 to 31 register.

5.14.2. Pulse Counter Interrupt Flag Register (ADC12Bn_PCIRQ1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	PCIRQ63	PCIRQ62	PCIRQ61	PCIRQ60	PCIRQ59	PCIRQ58	PCIRQ57	PCIRQ56
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	PCIRQ55	PCIRQ54	PCIRQ53	PCIRQ52	PCIRQ51	PCIRQ50	PCIRQ49	PCIRQ48
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PCIRQ47	PCIRQ46	PCIRQ45	PCIRQ44	PCIRQ43	PCIRQ42	PCIRQ41	PCIRQ40
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PCIRQ39	PCIRQ38	PCIRQ37	PCIRQ36	PCIRQ35	PCIRQ34	PCIRQ33	PCIRQ32
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] PCIRQ63 to 32 : Pulse Counter Interrupt flags

Bit	Description
0	Pulse counter interrupt not detected.
1	Pulse counter interrupt detected.

This register returns the status of the pulse counter interrupt flag which is set when positive counter ADC12B_PCCTRL32 to 63.PCTPCT of the corresponding logical channel decrements to zero. The positive counter and negative counter are stopped as long as the pulse counter interrupt flag of the appropriate channel is set.

This bit is cleared by writing "1" to the corresponding bit in the ADC12Bn_PCIRQC1 register.

This bit is identical to the PCIRQ bit in the corresponding ADC12Bn_CHSTAT32 to 63 register.

5.15. Pulse Counter Interrupt Enable Registers (ADC12Bn_PCIRQE0 to 1)

These registers contain enable bits for all 64 logical channels, dedicated to the generation of pulse counter interrupt.

REGISTER NAME	ADC12Bn_PCIRQEi (i = 0 to 1)
OFFSET	0x0350 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.15.1. Pulse Counter Interrupt Enable Register (ADC12Bn_PCIRQE0)

BIT OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	PCIRQE31	PCIRQE30	PCIRQE29	PCIRQE28	PCIRQE27	PCIRQE26	PCIRQE25	PCIRQE24
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	PCIRQE23	PCIRQE22	PCIRQE21	PCIRQE20	PCIRQE19	PCIRQE18	PCIRQE17	PCIRQE16
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PCIRQE15	PCIRQE14	PCIRQE13	PCIRQE12	PCIRQE11	PCIRQE10	PCIRQE9	PCIRQE8
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PCIRQE7	PCIRQE6	PCIRQE5	PCIRQE4	PCIRQE3	PCIRQE2	PCIRQE1	PCIRQE0
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] PCIRQE31 to 0 : Pulse Counter Interrupt Enable bits

Bit	Description
0	Pulse counter interrupt is disabled.
1	Pulse counter interrupt is enabled.

Pulse counter interrupt is issued when this bit is "1" and the corresponding interrupt flags ADC12Bn_PCIRQ0.PCIRQ31 to 0 and ADC12Bn_CHSTAT0 to 31.PCIRQ are set to "1".

5.15.2. Pulse Counter Interrupt Enable Register (ADC12Bn_PCIRQE1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	PCIRQE63	PCIRQE62	PCIRQE61	PCIRQE60	PCIRQE59	PCIRQE58	PCIRQE57	PCIRQE56
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	PCIRQE55	PCIRQE54	PCIRQE53	PCIRQE52	PCIRQE51	PCIRQE50	PCIRQE49	PCIRQE48
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PCIRQE47	PCIRQE46	PCIRQE45	PCIRQE44	PCIRQE43	PCIRQE42	PCIRQE41	PCIRQE40
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PCIRQE39	PCIRQE38	PCIRQE37	PCIRQE36	PCIRQE35	PCIRQE34	PCIRQE33	PCIRQE32
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] PCIRQE63 to 32 : Pulse Counter Interrupt Enable bits

Bit	Description
0	Pulse counter interrupt is disabled.
1	Pulse counter interrupt is enabled.

Pulse counter interrupt is issued when this bit is "1" and the corresponding interrupt flags ADC12Bn_PCIRQ1.PCIRQ63 to 32 and ADC12Bn_CHSTAT32 to 63.PCIRQ are set to "1".

5.16. Pulse Counter Interrupt Clear Registers (ADC12Bn_PCIRQC0 to 1)

These registers contain bits for clearing corresponding pulse counter interrupt flags in the ADC12Bn_PCIRQ0 to 1 registers. The 64 bits are assigned to 64 logical channels

REGISTER NAME	ADC12Bn_PCIRQCi (i = 0 to 1)
OFFSET	0x0358 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.16.1. Pulse Counter Interrupt Clear Register (ADC12Bn_PCIRQC0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	PCIRQC31	PCIRQC30	PCIRQC29	PCIRQC28	PCIRQC27	PCIRQC26	PCIRQC25	PCIRQC24
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	PCIRQC23	PCIRQC22	PCIRQC21	PCIRQC20	PCIRQC19	PCIRQC18	PCIRQC17	PCIRQC16
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PCIRQC15	PCIRQC14	PCIRQC13	PCIRQC12	PCIRQC11	PCIRQC10	PCIRQC9	PCIRQC8
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PCIRQC7	PCIRQC6	PCIRQC5	PCIRQC4	PCIRQC3	PCIRQC2	PCIRQC1	PCIRQC0
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] PCIRQC31 to 0 : ADC Pulse Counter Interrupt Clear bits

Bit	Description
0	No effect.
1	Pulse counter interrupt cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_PCIRQ0 register and PCIRQ bit in the corresponding ADC12Bn_CHSTAT0 to 31 register are cleared.

Additionally, the corresponding positive and negative counter (ADC12Bn_PCCTRL0 to 31.PCTPCT and ADC12Bn_PCCTRL0 to 31.PCTNCT) are reloaded with their reload values defined in the ADC12Bn_PCCTRL0 to 31.PCTPRL and ADC12Bn_PCCTRL0 to 31.PCTNRL.

5.16.2. Pulse Counter Interrupt Clear Register (ADC12Bn_PCIRQC1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	PCIRQC63	PCIRQC62	PCIRQC61	PCIRQC60	PCIRQC59	PCIRQC58	PCIRQC57	PCIRQC56
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	PCIRQC55	PCIRQC54	PCIRQC53	PCIRQC52	PCIRQC51	PCIRQC50	PCIRQC49	PCIRQC48
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PCIRQC47	PCIRQC46	PCIRQC45	PCIRQC44	PCIRQC43	PCIRQC42	PCIRQC41	PCIRQC40
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PCIRQC39	PCIRQC38	PCIRQC37	PCIRQC36	PCIRQC35	PCIRQC34	PCIRQC33	PCIRQC32
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] PCIRQC63 to 32 : ADC Pulse Counter Interrupt Clear bits

Bit	Description
0	No effect.
1	Pulse counter interrupt cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_PCIRQ1 register and PCIRQ bit in the corresponding ADC12Bn_CHSTAT32 to 63 register are cleared.

Additionally, the corresponding positive and negative counter (ADC12Bn_PCCTRL32 to 63.PCTPCT and ADC12Bn_PCCTRL32 to 63.PCTNCT) are reloaded with their reload values defined in the ADC12Bn_PCCTRL32 to 63.PCTPRL and ADC12Bn_PCCTRL32 to 63.PCTNRL.

5.17. A/D Channel Trigger Status Flag Registers (ADC12Bn_TRGST0 to 1)

A/D Channel Trigger Status Flag Registers ADC12Bn_TRGST0 to 1 contain the status of conversion requests for all 64 logical channels.

REGISTER_NAME	ADC12Bn_TRGSTi (i = 0 to 1)
OFFSET	0x0360 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.17.1. A/D Channel Trigger Status Flag Register (ADC12Bn_TRGST0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	TRGST31	TRGST30	TRGST29	TRGST28	TRGST27	TRGST26	TRGST25	TRGST24
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	TRGST23	TRGST22	TRGST21	TRGST20	TRGST19	TRGST18	TRGST17	TRGST16
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	TRGST15	TRGST14	TRGST13	TRGST12	TRGST11	TRGST10	TRGST9	TRGST8
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	TRGST7	TRGST6	TRGST5	TRGST4	TRGST3	TRGST2	TRGST1	TRGST0
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] TRGST31 to 0 : A/D Channel Trigger Status flags

Bit	Description
0	No conversion request.
1	Conversion request is issued.

This bit is set if any conversion request, dedicated to the corresponding logical channel, occurs (software, hardware, trigger by completion of preceding channel or idle trigger). Moreover, the bit is set if:

- The group of the corresponding logical channel is interrupted just before a channel configured as "restart" channel (ADC12Bn_CHCTRL32 to 63.RSMRST = "10")

The channel is the start channel of the group or the last already converted channel configured as "resume" channel (ADC12Bn_CHCTRL32 to 63.RSMRST = "01").

This bit is cleared under one of the following conditions:

- Completion of the logical channel conversion (the last conversion in the case of multiple conversion channels), at the same time the conversion done interrupt flag is set
- The corresponding group processing is interrupted just before the conversion of this channel is started and the channel is not configured as "resume" channel (ADC12Bn_CHCTRL0 to 31.RSMRST = "01"). Instead, the group interrupted interrupt flag is set

- Writing "1" to the corresponding bit in the ADC12Bn_TRGCL0 register or writing "1" to the corresponding ADC12Bn_CHCTRL0 to 31.TRGCL bit.

When setting and clearing of the bit takes place at the same time, clearing has priority.

This bit is identical to the TRGST bit in the corresponding ADC12Bn_CHSTAT0 to 31 register.

5.17.2. A/D Channel Trigger Status Flag Register (ADC12Bn_TRGST1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	TRGST63	TRGST62	TRGST61	TRGST60	TRGST59	TRGST58	TRGST57	TRGST56
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	TRGST55	TRGST54	TRGST53	TRGST52	TRGST51	TRGST50	TRGST49	TRGST48
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	TRGST47	TRGST46	TRGST45	TRGST44	TRGST43	TRGST42	TRGST41	TRGST40
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	TRGST39	TRGST38	TRGST37	TRGST36	TRGST35	TRGST34	TRGST33	TRGST32
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] TRGST63 to 32 : A/D Channel Trigger Status flags

Bit	Description
0	No conversion request.
1	Conversion request is issued.

This bit is set if any conversion request, dedicated to the corresponding logical channel, occurs (software, hardware, trigger by completion of preceding channel or idle trigger). Moreover, the bit is set if:

- The group of the corresponding logical channel is interrupted just before a channel configured as "restart" channel (ADC12Bn_CHCTRL32 to 63.RSMRST = "10")
- The channel is the start channel of the group or the last already converted channel configured as "resume" channel (ADC12Bn_CHCTRL32 to 63.RSMRST = "01").

This bit is cleared under one of the following conditions:

- Completion of the logical channel conversion, at the same time the conversion done interrupt flag is set
- The corresponding group processing is interrupted just before the conversion of this channel is started and the channel is not configured as "resume" channel (ADC12Bn_CHCTRL32 to 63.RSMRST = "01"). Instead, the group interrupted interrupt flag is set
- Writing "1" to the corresponding bit in the ADC12Bn_TRGCL1 register or writing "1" to the corresponding ADC12Bn_CHCTRL32 to 63.TRGCL bit.

When setting and clearing of the bit takes place at the same time, clearing has priority.

This bit is identical to the TRGST bit in the corresponding ADC12Bn_CHSTAT32 to 63 register.

5.18. A/D Channel Trigger Clear Registers (ADC12Bn_TRGCL0 to 1)

These registers contain bits for clearing corresponding A/D channel trigger status flags in the ADC12Bn_TRGST0 to 1 registers. The 64 bits are assigned to 64 logical channels.

REGISTER_NAME	ADC12Bn_TRGCLi (i = 0 to 1)
OFFSET	0x0368 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.18.1. A/D Channel Trigger Clear Register (ADC12Bn_TRGCL0)

BITS_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	TRGCL31	TRGCL30	TRGCL29	TRGCL28	TRGCL27	TRGCL26	TRGCL25	TRGCL24
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BITS_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	TRGCL23	TRGCL22	TRGCL21	TRGCL20	TRGCL19	TRGCL18	TRGCL17	TRGCL16
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BITS_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	TRGCL15	TRGCL14	TRGCL13	TRGCL12	TRGCL11	TRGCL10	TRGCL9	TRGCL8
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BITS_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	TRGCL7	TRGCL6	TRGCL5	TRGCL4	TRGCL3	TRGCL2	TRGCL1	TRGCL0
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] TRGCL31 to 0 : Trigger Status Clear bits

Bit	Description
0	No effect.
1	A/D channel trigger status is cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_TRGST0 register and TRGST bit in the corresponding ADC12Bn_CHSTAT0 to 31 register are cleared.

If the corresponding trigger status is cleared during A/D conversion, the operation is dependent on the setting of forced stop mode (ADC12Bn_CTRL.FSMD).

- Forced stop is enabled (ADC12Bn_CTRL.FSMD = "1"): A/D conversion is stopped after interrupt operation.
- Forced stop is disabled (ADC12Bn_CTRL.FSMD = "0"): A/D conversion is not stopped (but A/D conversion result is not updated). Hence, when the next conversion is already requested, the wait time from trigger status flag clear to the start of next conversion can be up to the maximum A/D conversion period.

This bit is identical to the TRGCL bit in the corresponding ADC12Bn_CHCTRL0 to 31 register.

Note:

- *If forced stop is disabled (`ADC12Bn_CTRL.FSMD = "0"`), do not set trigger status flag again during the same conversion after the trigger status is cleared. Please set again after the end timing of the cleared conversion.*

5.18.2. A/D Channel Trigger Clear Register (ADC12Bn_TRGCL1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	TRGCL63	TRGCL62	TRGCL61	TRGCL60	TRGCL59	TRGCL58	TRGCL57	TRGCL56
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	TRGCL55	TRGCL54	TRGCL53	TRGCL52	TRGCL51	TRGCL50	TRGCL49	TRGCL48
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	TRGCL47	TRGCL46	TRGCL45	TRGCL44	TRGCL43	TRGCL42	TRGCL41	TRGCL40
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	TRGCL39	TRGCL38	TRGCL37	TRGCL36	TRGCL35	TRGCL34	TRGCL33	TRGCL32
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] TRGCL63 to 32 : Trigger Status Clear bits

Bit	Description
0	No effect.
1	A/D channel trigger status is cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_TRGST1 register and TRGST bit in the corresponding ADC12Bn_CHSTAT32 to 63 register are cleared.

If the corresponding trigger status is cleared during A/D conversion, the operation is dependent on the setting of forced stop mode (ADC12Bn_CTRL.FSMD).

- Forced stop is enabled (ADC12Bn_CTRL.FSMD = "1"): A/D conversion is stopped after interrupt operation.
- Forced stop is disabled (ADC12Bn_CTRL.FSMD = "0"): A/D conversion is not stopped (but A/D conversion result is not updated). Hence, when the next conversion is already requested, the wait time from trigger status flag clear to the start of next conversion can be up to the maximum A/D conversion period.

This bit is identical to the TRGCL bit in the corresponding ADC12Bn_CHCTRL32 to 63 register.

Note:

- If forced stop is disabled (ADC12Bn_CTRL.FSMD = "0"), do not set trigger status flag again during the same conversion after the trigger status is cleared.
Please set again after the end timing of the cleared conversion.

5.19. A/D Channel Trigger Overrun Flag Registers (ADC12Bn_TRGOR0 to 1)

A/D Channel Trigger Overrun Flag Registers ADC12Bn_TRGOR0 to 1 register the possible trials to set already active (set to "1") trigger status for all 64 logical channels.

REGISTER_NAME	ADC12Bn_TRGORi (i = 0 to 1)
OFFSET	0x0378 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.19.1. A/D Channel Trigger Overrun Flag Register (ADC12Bn_TRGOR0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	TRGOR31	TRGOR30	TRGOR29	TRGOR28	TRGOR27	TRGOR26	TRGOR25	TRGOR24
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	TRGOR23	TRGOR22	TRGOR21	TRGOR20	TRGOR19	TRGOR18	TRGOR17	TRGOR16
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	TRGOR15	TRGOR14	TRGOR13	TRGOR12	TRGOR11	TRGOR10	TRGOR9	TRGOR8
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	TRGOR7	TRGOR6	TRGOR5	TRGOR4	TRGOR3	TRGOR2	TRGOR1	TRGOR0
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] TRGOR31 to 0 : A/D Channel Trigger Overrun flags

Bit	Description
0	No trigger overrun happened
1	Trigger overrun occurred

This bit is set to "1" under following conditions:

- Conversion request is issued although the corresponding trigger status bits ADC12Bn_TRGST0.TRGST and ADC12Bn_CHSTAT0 to 31.TRGST are already set to "1"
- Software and hardware trigger are issued at the same cycle and corresponding trigger type ADC12Bn_CHCTRL0 to 31.TRGTYP[1:0] is set to "01"

Writing "1" to the corresponding bit in the ADC12Bn_TRGORC0 register clears this bit.

5.19.2. A/D Channel Trigger Overrun Flag Register (ADC12Bn_TRGOR1)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	TRGOR63	TRGOR62	TRGOR61	TRGOR60	TRGOR59	TRGOR58	TRGOR57	TRGOR56
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	TRGOR55	TRGOR54	TRGOR53	TRGOR52	TRGOR51	TRGOR50	TRGOR49	TRGOR48
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	TRGOR47	TRGOR46	TRGOR45	TRGOR44	TRGOR43	TRGOR42	TRGOR41	TRGOR40
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	TRGOR39	TRGOR38	TRGOR37	TRGOR36	TRGOR35	TRGOR34	TRGOR33	TRGOR32
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] TRGOR63 to 32 : A/D Channel Trigger Overrun flags

Bit	Description
0	No trigger overrun happened
1	Trigger overrun occurred

This bit is set to "1" under following conditions:

- Conversion request is issued although the corresponding trigger status bits ADC12Bn_TRGST1.TRGST and ADC12Bn_CHSTAT32 to 63.TRGST are already set to "1"
- Software and hardware trigger are issued at the same cycle and corresponding trigger type ADC12Bn_CHCTRL32 to 63.TRGTYP[1:0] is set to "01"

Writing "1" to the corresponding bit in the ADC12Bn_TRGORC1 register clears this bit.

5.20. A/D Channel Trigger Overrun Clear Registers (ADC12Bn_TRGORC0 to 1)

These registers contain bits for clearing corresponding A/D channel trigger overrun flags in the ADC12Bn_TRGOR0 to 1 registers. The 64 bits are assigned to 64 logical channels.

REGISTER_NAME	ADC12Bn_TRGORCi (i = 0 to 1)
OFFSET	0x0380 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.20.1. A/D Channel Trigger Overrun Clear Register (ADC12Bn_TRGORC0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	TRGORC31	TRGORC30	TRGORC29	TRGORC28	TRGORC27	TRGORC26	TRGORC25	TRGORC24
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	TRGORC23	TRGORC22	TRGORC21	TRGORC20	TRGORC19	TRGORC18	TRGORC17	TRGORC16
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	TRGORC15	TRGORC14	TRGORC13	TRGORC12	TRGORC11	TRGORC10	TRGORC9	TRGORC8
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	TRGORC7	TRGORC6	TRGORC5	TRGORC4	TRGORC3	TRGORC2	TRGORC1	TRGORC0
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] TRGORC31 to 0 : Trigger Overrun Clear bits

Bit	Description
0	No effect.
1	Trigger overrun flag is cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_TRGOR0 register is cleared.

5.20.2. A/D Channel Trigger Overrun Clear Register (ADC12Bn_TRGORC1)

BIT OFFSET	31	30	29	28	27	26	25	24
BIT NAME	TRGORC63	TRGORC62	TRGORC61	TRGORC60	TRGORC59	TRGORC58	TRGORC57	TRGORC56
ACCESS TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT TYPE								
INITIAL VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	23	22	21	20	19	18	17	16
BIT NAME	TRGORC55	TRGORC54	TRGORC53	TRGORC52	TRGORC51	TRGORC50	TRGORC49	TRGORC48
ACCESS TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT TYPE								
INITIAL VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	15	14	13	12	11	10	9	8
BIT NAME	TRGORC47	TRGORC46	TRGORC45	TRGORC44	TRGORC43	TRGORC42	TRGORC41	TRGORC40
ACCESS TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT TYPE								
INITIAL VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	7	6	5	4	3	2	1	0
BIT NAME	TRGORC39	TRGORC38	TRGORC37	TRGORC36	TRGORC35	TRGORC34	TRGORC33	TRGORC32
ACCESS TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT TYPE								
INITIAL VALUE	0	0	0	0	0	0	0	0

[bit31:0] TRGORC63 to 32 : Trigger Overrun Clear bits

Bit	Description
0	No effect.
1	Trigger overrun flag is cleared.

When this bit is set to "1", the corresponding bit in the ADC12Bn_TRGOR1 register is cleared.

5.21. Range Comparator Over Threshold Flag Registers (ADC12Bn_RCOTF0 to 1)

The flag bits (ADC12Bn_RCOTF0 to 1) are set when the result of the range comparator is "outside range" and the converted value is above the value of the upper threshold register.

REGISTER_NAME	ADC12Bn_RCOTFi (i = 0 to 1)
OFFSET	0x0370 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	-
OTHER	-

5.21.1. Range Comparator Over Threshold Flag Register (ADC12Bn_RCOTF0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RCOTF31	RCOTF30	RCOTF29	RCOTF28	RCOTF27	RCOTF26	RCOTF25	RCOTF24
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RCOTF23	RCOTF22	RCOTF21	RCOTF20	RCOTF19	RCOTF18	RCOTF17	RCOTF16
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RCOTF15	RCOTF14	RCOTF13	RCOTF12	RCOTF11	RCOTF10	RCOTF9	RCOTF8
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RCOTF7	RCOTF6	RCOTF5	RCOTF4	RCOTF3	RCOTF2	RCOTF1	RCOTF0
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] RCOTF31 to 0 : Range Comparator Over Threshold flags

The flag is only applicable in "outside range" mode i.e. while the RCINVSEL bit in the corresponding ADC12Bn_CHCTRL0 to 31 register is "0". If a range comparator interrupt is signaled (corresponding bits ADC12Bn_RCIRQ0.RCIRQ31 to 0 = ADC12Bn_CHSTAT0 to 31.RCIRQ = "1"), this flag has the following meaning:

Bit	Description
0	The conversion result is less than or equal to the upper threshold.
1	The conversion result is above the upper threshold.

This bit is updated only in the case the corresponding interrupt flag (ADC12Bn_RCIRQ0.RCIRQ, ADC12Bn_CHSTAT0 to 31.RCIRQ) has a rising edge.

This bit is identical to the RCOTF bit in the corresponding ADC12Bn_CHSTAT0 to 31 register.

5.21.2. Range Comparator Over Threshold Flag Register (ADC12Bn_RCOTF1)

BIT OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RCOTF63	RCOTF62	RCOTF61	RCOTF60	RCOTF59	RCOTF58	RCOTF57	RCOTF56
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RCOTF55	RCOTF54	RCOTF53	RCOTF52	RCOTF51	RCOTF50	RCOTF49	RCOTF48
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RCOTF47	RCOTF46	RCOTF45	RCOTF44	RCOTF43	RCOTF42	RCOTF41	RCOTF40
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RCOTF39	RCOTF38	RCOTF37	RCOTF36	RCOTF35	RCOTF34	RCOTF33	RCOTF32
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] RCOTF63 to 32 : Range Comparator Over Threshold flags

The flag is only applicable in "outside range" mode i.e. while the RCINVSEL bit in the corresponding ADC12Bn_CHCTRL32 to 63 register is "0". If a range comparator interrupt is signaled (corresponding bits ADC12Bn_RCIRQ1.RCIRQ63 to 32 = ADC12Bn_CHSTAT32 to 63.RCIRQ = "1"), this flag has the following meaning:

Bit	Description
0	The conversion result is less than or equal to the upper threshold.
1	The conversion result is above the upper threshold.

This bit is updated only in the case the corresponding interrupt flag (ADC12Bn_RCIRQ1.RCIRQ, ADC12Bn_CHSTAT32 to 63.RCIRQ) has a rising edge.

This bit is identical to the RCOTF bit in the corresponding ADC12Bn_CHSTAT32 to 63 register.

5.22. Conversion Done DMA Select Registers (ADC12Bn_CDDS0 to 3)

These four registers specify four logical channels whose conversion done interrupt flags can initiate DMA requests to transfer A/D conversion results to memory. Only ADC12Bn_CDDS0 register is described here. Other registers (ADC12Bn_CDDS1, ADC12Bn_CDDS2 and ADC12Bn_CDDS3) have identical bit fields.

REGISTER_NAME	ADC12Bn_CDDSi (i = 0 to 3)
OFFSET	0x0388 + i*2
ACCESS_SIZE	B H W
MULTIPLE	0:3
NUMERIC_TYPE	-
OTHER	-

Conversion Done DMA Select Register (ADC12Bn_CDDS0)

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,W0							
PROT_TYPE								
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	CDCHEN	CDCHNUM[5]	CDCHNUM[4]	CDCHNUM[3]	CDCHNUM[2]	CDCHNUM[1]	CDCHNUM[0]
ACCESS_TYPE	R0,W0	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit15:7] Reserved : Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit6] CDCHEN : Channel conversion done DMA dedicated interrupt enable bit

Bit	Description
0	Interrupt for triggering DMA request on conversion done interrupt flag (ADC12Bn_CHSTAT0 to 63.CDONEIRQ = ADC12Bn_CDONEIRQ0 to 1.CDONEIRQ = "1") of the logical channel defined by CDCHNUM bits is disabled.
1	Interrupt for triggering DMA request on conversion done interrupt flag (ADC12Bn_CHSTAT0 to 63.CDONEIRQ = ADC12Bn_CDONEIRQ0 to 1.CDONEIRQ = "1") of the logical channel defined by CDCHNUM bits is enabled.

[bit5:0] CDCHNUM[5:0] : Number of the logical channel selected for conversion done interrupt for triggering a DMA request

CDCHNUM[5:0]	Description
000000	Logical channel 0 selected.
000001	Logical channel 1 selected.
...	...
111111	Logical channel 63 selected.

The conversion done interrupts of the group last logical channels are good candidates for DMA burst setup, since the group result registers can be read linearly.

5.23. A/D Converter Comparison Time Setting Register (ADC12Bn_CT)

ADC12Bn_CT register specifies the comparison time of the A/D converter. It is not allowed to update the value of this register during A/D conversion operation (ADC12Bn_TRGST0 to 1.TRGST and ADC12Bn_CHSTAT0 to 63.TRGST="1").

REGISTER_NAME	ADC12Bn_CT
OFFSET	0x0390
ACCESS_SIZE	B H W
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

A/D Converter Comparison Time Setting Register (ADC12Bn_CT)

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	CT[15]	CT[14]	CT[13]	CT[12]	CT[11]	CT[10]	CT[9]	CT[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CT[7]	CT[6]	CT[5]	CT[4]	CT[3]	CT[2]	CT[1]	CT[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	1	0	0

[bit15:0] CT[15:0] : A/D Converter Comparison Time Setting bits

These bits specify the comparison phase time.

If [CT value < 4]: Comparison time = (CT value x 12 + 4) x Peripheral clock period

If [CT value >= 4]: Comparison time = (CT value x 13) x Peripheral clock period

Do not set CT value to 0.

For specific values of minimum and maximum comparison time, please refer to the Device Data Sheet.

5.24. A/D Converter Resumption Time Setting Register (ADC12Bn_RT)

ADC12Bn_RT register specifies the resumption time of the A/D converter. It is not allowed to update the value of this register during A/D conversion operation (ADC12Bn_TRGST0 to 1.TRGST and ADC12Bn_CHSTAT0 to 63.TRGST="1").

REGISTER_NAME	ADC12Bn_RT
OFFSET	0x0392
ACCESS_SIZE	B H W
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

A/D Converter Resumption Time Setting Register (ADC12Bn_RT)

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,W0							
PROT_TYPE								
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RT[7]	RT[6]	RT[5]	RT[4]	RT[3]	RT[2]	RT[1]	RT[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	1	1	1	1	1	1

[bit15:8] Reserved : Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit7:0] RT[7:0] : A/D Converter Resumption Time Setting bits

These bits specify the resumption phase time (power-up wait time).

Please set RT value is longer than the specific values of maximum resumption time.

Do not set RT value to 0.

$RT \text{ value} \geq \text{Maximum resumption time} / \text{Peripheral clock period}$.

For specific values of maximum resumption time, please refer to the Device Data Sheet.

5.25. A/D Converter Sampling Time Setting Registers (ADC12Bn_ST0 to 3)

ADC12Bn_ST0 to 3 registers specify four different settings for the selection of the sampling time of the A/D converter. It is not allowed to update the value of these registers during A/D sampling operation (ADC12Bn_TRGST0 to 1.TRGST and ADC12Bn_CHSTAT0 to 63.TRGST="1"). Only ADC12Bn_ST0 register is described here. Other registers (ADC12Bn_ST1, ADC12Bn_ST2 and ADC12Bn_ST3) have similar bit fields.

REGISTER NAME	ADC12Bn_STi (i = 0 to 3)
OFFSET	0x0394 + i*2
ACCESS_SIZE	B H W
MULTIPLE	0:3
NUMERIC_TYPE	-
OTHER	-

A/D Converter Sampling Time Setting Register (ADC12Bn_ST0)

BIT OFFSET	15	14	13	12	11	10	9	8
BIT NAME	ST[15]	ST[14]	ST[13]	ST[12]	ST[11]	ST[10]	ST[9]	ST[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	7	6	5	4	3	2	1	0
BIT NAME	ST[7]	ST[6]	ST[5]	ST[4]	ST[3]	ST[2]	ST[1]	ST[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	1	0	1	1	0	0

[bit15:0] ST[15:0] : A/D Converter Sampling Time Setting bits

These bits specify one of the four available settings for A/D converter sampling phase time.

This time is selected for a logical channel conversion by configuring the corresponding logical channel register field ADC12Bn_CHCTRL0 to 63.SMTIME to "00".

Sampling time = ST value x Peripheral clock period

Do not set ST value below 6.

For specific values of minimum sampling time, please refer to the Device Data Sheet.

5.26. A/D Converter Offset Compensation Setting Register (ADC12Bn_OCV)

The global register ADC12Bn_OCV specifies the setting for offset compensation value.

REGISTER_NAME	ADC12Bn_OCV
OFFSET	0x039C
ACCESS_SIZE	B H W
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

A/D Converter Offset Compensation Setting Register (ADC12Bn_OCV)

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,W0							
PROT_TYPE								
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	OCV[7]	OCV[6]	OCV[5]	OCV[4]	OCV[3]	OCV[2]	OCV[1]	OCV[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	1	0

[bit15:8] Reserved : Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit7:0] OCV[7:0] : Offset Compensation Value

The A/D Converter can be configured to convert the values of its reference voltages AVRH and AVRL in order to calculate the offset compensation value.

After A/D Converter calibration, the calculated offset compensation value must be written to this register.

For further explanation of A/D Converter calibration refer to section "A/D Converter Calibration" in chapter "3 Operation of A/D".

5.27. A/D Converter Gain Compensation Setting Register (ADC12B_GCV)

This register ADC12Bn_GCV specifies the setting for gain compensation value.

REGISTER_NAME	ADC12Bn_GCV
OFFSET	0x039E
ACCESS_SIZE	B H W
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

A/D Converter Gain Compensation Setting Register (ADC12Bn_GCV)

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,W0							
PROT_TYPE								
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved			GCV[4]	GCV[3]	GCV[2]	GCV[1]	GCV[0]
ACCESS_TYPE	R0,W0			R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	000			0	0	0	0	0

[bit15:5] Reserved : Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit4:0] GCV[4:0] : Gain Compensation Value

The A/D Converter can be configured to convert the values of its reference voltages AVR_H and AVR_L in order to calculate the gain compensation value.

After A/D Converter calibration, the calculated gain compensation value must be written to this register.

For further explanation of A/D Converter calibration refer to section "A/D Converter Calibration" in chapter "3 Operation of A/D".

5.28. A/D Converter Global Control Register (ADC12Bn_CTRL)

The register configures the global control settings of the A/D Converter: A/D conversion resolution, enabling of the debug feature and the mode of ADC12Bn_STAT.ACH bits, forced stop mode and request, full range comparator mode, and power-down disable mode.

REGISTER NAME	ADC12Bn_CTRL
OFFSET	0x3A0
ACCESS_SIZE	B H W
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

A/D Converter Global Control Register (ADC12Bn_CTRL)

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,W0							
PROT_TYPE								
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PDDMD	FSTP	FRCMD	FSMD	ACHMD	DBGE	RES[1]	RES[0]
ACCESS_TYPE	R/W	R0,W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit15:8] Reserved : Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit7] PDDMD : Power-down disable mode

Bit	Description
0	A/D converter goes to idle (power-down) state after A/D conversion finished (and next conversion is not requested).
1	A/D converter does not go idle (power-down) state after A/D conversion finished (and next conversion is not requested). It can start A/D sampling without the resumption time.

Notes:

- At the following case, even if the power-down mode is disabled ($PDDMD = "1"$), A/D converter is waited until resumption time.
- A/D converter is in idle (power-down) state.
- PDDMD is change "0" to "1".

[bit6] FSTP : Forced stop

When the forced stop mode ($FSMD = "1"$):

Bit	Description	
	Read	Write
0	The value is always "0"	No effect.
1		Request forced stop of A/D conversion.

When the "not" forced stop mode ($FSMD = "0"$):

"0" is always read from this bit. Writing "0" or "1" to this bit has no effect.

[bit5] FRCMD : Full Range Comparator mode

Bit	Description
0	8-bit range comparator mode. ADC12Bn_RCOH and ADC12Bn_RCOL are used for 8-bit range comparator. ADC12Bn_FRCOH0 to 7 and ADC12Bn_FRCOL0 to 7 are not used.
1	12-bit range comparator mode. ADC12Bn_RCOH and ADC12Bn_RCOL are not used. ADC12Bn_FRCOH0 to 7 and ADC12Bn_FRCOL0 to 7 are used for 12-bit range comparator.

[bit4] FSMD : Forced stop mode

Bit	Description
0	The forced stop mode is disabled. – An active A/D conversion cannot be interrupted. – Request forced stop of A/D conversion is disabled.
1	The forced stop mode is enabled. – An active A/D conversion can be interrupted. – Request forced stop of A/D conversion is enabled.

[bit3] ACHMD : ACH register mode

Bit	Description
0	Direct ACH register mode. ADC12Bn_STAT.ACH shows the number of currently converted logical channel.
1	Latched ACH register mode. ADC12Bn_STAT.ACH shows the number of the logical channel whose conversion was finished last.

[bit2] DBGE : Debug Enable bit

Bit	Description
0	Debug mode disabled
1	Debug mode enabled.

When this bit is set to "1" and the processor is in debug state, the A/D Converter completes the current conversion, but further conversion is stopped. When the processor leaves debug state or DBGE is set to "0", conversion continues with the next channel from where it had stopped.

For the definition of debug state, refer to Section 12.8 of the ARM Cortex™-R5 Technical Reference Manual.

[bit1:0] RES[1:0] : Resolution of A/D conversion

RES[1:0]	Description
x0	12-bit resolution
01	10-bit resolution
11	8-bit resolution.

Conversion result is stored in lower 10 bits of ADC12Bn_CD0 to 63 registers in case of 10-bit resolution and in lower 8 bits of ADC12Bn_CD0 to 63 registers if the 8-bit resolution is configured.

In case of 10-bit or 8-bit resolution, the lower 2 or 4 bits of the 12-bit conversion result are truncated (not rounded).

5.29. A/D Converter Global Status Register (ADC12Bn_STAT)

The register ADC12Bn_STAT is responsible for storing global status information of A/D Converter, such as currently converted channel and activity indication bit.

REGISTER_NAME	ADC12Bn_STAT
OFFSET	0x03A2
ACCESS_SIZE	B H W
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

A/D Converter Global Status Register (ADC12Bn_STAT)

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE								
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	BUSY	ACH[5]	ACH[4]	ACH[3]	ACH[2]	ACH[1]	ACH[0]
ACCESS_TYPE	RX,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit15:7] Reserved : Reserved bits

Reading this bit returns an undefined.

Writing data to these bits has no effect on the operation.

[bit6] BUSY : A/D Converter Busy flag

Bit	Description
0	A/D Converter is not active, i. e. no A/D conversion is ongoing.
1	A/D Converter is active, i. e. A/D conversion is ongoing.

- Power-down disable mode (ADC12Bn_CTRL.PDDMD = "1"):
 - This bit set to "1" when first conversion request (trigger status set to "1") occurs (without A/D converter resumption time).
 - This bit clear to "0" when the all trigger status are cleared.
- Power-down enable mode (ADC12Bn_CTRL.PDDMD = "0"):
 - This bit is set to "1" when first conversion request (trigger status set to "1") occurs and A/D Converter resumption time (power-up wait time configured as A/D converter resumption time register (ADC12Bn_RT)) elapses.
 - This bit clear to "0" when the all trigger status are cleared.

If there is no idle trigger type set for any of logical channels, after all conversion requests are processed A/D Converter goes to idle (power-down) state and BUSY flag becomes "0" until next conversion request appears and resumption time elapses.

In case that idle trigger type is set (ADC12Bn_CHCTRL0 to 63.TRGTyp[1:0] = "11"), there will be always at least one conversion request active and after BUSY flag is set first time to "1", it will not change.

[bit5:0] ACH[5:0] : Converted logical channel number

This bit field depends on ADC12Bn_CTRL.ACHMD field setting.

- If ACHMD is equal to "0", ACH represents currently converted logical channel number.

- If ACHMD is equal to "1", ACH represents the last logical channel number whose conversion has finished. ACH is updated at the end of the A/D conversion only in the case the corresponding trigger status (ADC12Bn_TRGST0 to 1.TRGST and ADC12Bn_CHSTAT0 to 63.TRGST bits) is still "1".

5.30. Range Comparator Upper Threshold Registers (ADC12Bn_RCOH0 to 7)

When the 8-bit range comparator mode (ADC12Bn_CTRL.FRCMD = "0"), these registers are used for 8-bit range comparator.

If the 12-bit range comparator mode (ADC12Bn_CTRL.FRCMD = "1"), these registers are not used.

These registers specify the upper threshold values that can be selected for the 8-bit range comparator to which the output of the A/D Converter is compared. Only ADC12Bn_RCOH0 is described here. Other registers (ADC12Bn_RCOH1,..., ADC12Bn_RCOH6 and ADC12Bn_RCOH7) have similar bit fields.

REGISTER_NAME	ADC12Bn_RCOHi (i = 0 to 7)
OFFSET	0x03B1 + i*2
ACCESS_SIZE	B H W
MULTIPLE	0:7
NUMERIC_TYPE	-
OTHER	-

Range Comparator Upper Threshold Register 0 (ADC12Bn_RCOH0)

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RCOH[7]	RCOH[6]	RCOH[5]	RCOH[4]	RCOH[3]	RCOH[2]	RCOH[1]	RCOH[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	1	1	1	1	1	1	1	1

[bit7:0] RCOH[7:0] : Range Comparator Upper Threshold value

The RCOH bits define the upper comparison threshold of the range comparator 0.

The upper comparator compares the upper 8 bits of the A/D conversion result. If the value is higher than RCOH[7:0], then the conversion result is outside range.

Selection of one of eight available range comparator threshold values for the logical channel is configured by corresponding ADC12Bn_CHCTRL0 to 63.RCSEL[2:0] bit fields.

5.31. Range Comparator Lower Threshold Registers (ADC12Bn_RCOL0 to 7)

When the 8-bit range comparator mode (ADC12Bn_CTRL.FRCMD = "0"), these registers are used for 8-bit range comparator.

If the 12-bit range comparator mode (ADC12Bn_CTRL.FRCMD = "1"), these registers are not used.

These registers specify the lower threshold values that can be selected for the 8-bit range comparator to which the output of the A/D Converter is compared. Only ADC12Bn_RCOL0 is described here. Other registers (ADC12Bn_RCOL1,...,ADC12Bn_RCOL6, ADC12Bn_RCOL7) have similar bit fields.

REGISTER_NAME	ADC12Bn_RCOLi (i = 0 to 7)
OFFSET	0x03B0 + i*2
ACCESS_SIZE	B H W
MULTIPLE	0:7
NUMERIC_TYPE	-
OTHER	-

Range Comparator Lower Threshold Register 0 (ADC12Bn_RCOL0)

BIT OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RCOL[7]	RCOL[6]	RCOL[5]	RCOL[4]	RCOL[3]	RCOL[2]	RCOL[1]	RCOL[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit7:0] RCOL[7:0] : Range Comparator Lower Threshold value

The RCOL bits define the lower comparison threshold of the range comparator 0.

The lower comparator compares the upper 8 bits of the A/D conversion result. If the value is lower than RCOL[7:0], then the conversion result is outside range.

Selection of one of eight available range comparator threshold values for the logical channel is configured by corresponding ADC12Bn_CHCTRL0 to 63.RCSEL[2:0] bit fields.

5.32. Full Range Comparator Upper Threshold Registers (ADC12Bn_FRCOH0 to 7)

When the 12-bit range comparator mode (ADC12Bn_CTRL.FRCMD = "1"), these registers are used for 12-bit range comparator.

If the 8-bit range comparator mode (ADC12Bn_CTRL.FRCMD = "0"), these registers are not used.

These registers specify the upper threshold values that can be selected for the 12-bit range comparator to which the output of the A/D Converter is compared. Only ADC12Bn_FRCOH0 is described here. Other registers (ADC12Bn_FRCOH1,..., ADC12Bn_FRCOH6 and ADC12Bn_FRCOH7) have similar bit fields.

REGISTER_NAME	ADC12Bn_FRCOH _i (i = 0 to 7)
OFFSET	0x03F0 + i*2
ACCESS_SIZE	B H W
MULTIPLE	0:7
NUMERIC TYPE	-
OTHER	-

Full Range Comparator Upper Threshold Register 0 (ADC12Bn_FRCOH0)

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved				FRCOH[11]	FRCOH[10]	FRCOH[9]	FRCOH[8]
ACCESS_TYPE	R0,W0				R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0000				1	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	FRCOH[7]	FRCOH[6]	FRCOH[5]	FRCOH[4]	FRCOH[3]	FRCOH[2]	FRCOH[1]	FRCOH[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	1	1	1	1	1	1	1	1

[bit15:12] Reserved : Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit11:0] FRCOH[11:0] : Full Range Comparator Upper Threshold value

The FRCOH bits define the upper comparison threshold of the range comparator 0.

The upper comparator compares the 12 bits, 10 bits or 8 bits of the A/D conversion result.

ADC12Bn_CTRL.RES[1:0] define this resolution.

- If 12-bit resolution (ADC12Bn_CTRL.RES[1:0] = "x0"):

FRCOH[11:0]	Compares the 12 bits of A/D conversion result.
-------------	--

- If 10-bit resolution (ADC12Bn_CTRL.RES[1:0] = "01"):

FRCOH[11:10]	Not used for 10-bit range comparator.
FRCOH[9:0]	Compares the 10 bits of A/D conversion result.

- If 8-bit resolution (ADC12Bn_CTRL.RES[1:0] = "11"):

FRCOH[11:8]	Not used for 8-bit range comparator.
FRCOH[7:0]	Compares the 8 bits of A/D conversion result.

Selection of one of eight available range comparator threshold values for the logical channel is configured by corresponding ADC12Bn_CHCTRL0 to 63.RCSEL[2:0] bit fields.

5.33. Full Range Comparator Lower Threshold Registers (ADC12Bn_FRCOL0 to 7)

When the 12-bit range comparator mode (ADC12Bn_CTRL.FRCMD = "1"), these registers are used for 12-bit range comparator.

If the 8-bit range comparator mode (ADC12Bn_CTRL.FRCMD = "0"), these registers are not used.

These registers specify the lower threshold values that can be selected for the 12-bit range comparator to which the output of the A/D Converter is compared. Only ADC12Bn_FRCOL0 is described here. Other registers (ADC12Bn_FRCOL1,..., ADC12Bn_FRCOL6 and ADC12Bn_FRCOL7) have similar bit fields.

REGISTER_NAME	ADC12Bn_FRCOLi (i = 0 to 7)
OFFSET	0x03D0 + i*2
ACCESS_SIZE	B H W
MULTIPLE	0:7
NUMERIC TYPE	-
OTHER	-

Full Range Comparator Lower Threshold Register 0 (ADC12Bn_FRCOL0)

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved				FRCOL[11]	FRCOL[10]	FRCOL[9]	FRCOL[8]
ACCESS_TYPE	R0,W0				R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0000				0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	FRCOL[7]	FRCOL[6]	FRCOL[5]	FRCOL[4]	FRCOL[3]	FRCOL[2]	FRCOL[1]	FRCOL[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit15:12] Reserved : Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit11:0] FRCOL[11:0] : Full Range Comparator Lower Threshold value

The FRCOL bits define the lower comparison threshold of the range comparator 0.

The lower comparator compares the 12 bits, 10 bits or 8 bits of the A/D conversion result.

ADC12Bn_CTRL.RES[1:0] define this resolution.

- If 12-bit resolution (ADC12Bn_CTRL.RES[1:0] = "x0"):

FRCOL[11:0]	Compares the 12 bits of A/D conversion result.
-------------	--

- If 10-bit resolution (ADC12Bn_CTRL.RES[1:0] = "01"):

FRCOL[11:10]	Not used for 10-bit range comparator.
FRCOL[9:0]	Compares the 10 bits of A/D conversion result.

- If 8-bit resolution (ADC12Bn_CTRL.RES[1:0] = "11"):

FRCOL[11:8]	Not used for 8-bit range comparator.
FRCOL[7:0]	Compares the 8 bits of A/D conversion result.

Selection of one of eight available range comparator threshold values for the logical channel is configured by corresponding ADC12Bn_CHCTRL0 to 63.RCSEL[2:0] bit fields.

5.34. A/D Multiple Conversion Channel Control Registers (ADC12Bn_MCCTRL0 to 3)

These registers ADC12Bn_MCCTRL0 to 3 contain additional configuration bits for the first four logical channels (multiple conversion logical channels). They control number of conversions, multiple conversion interrupt and A/D Converter calibration setup. Only ADC12Bn_MCCTRL0 is described here. Other registers (ADC12Bn_MCCTRL1, ADC12Bn_MCCTRL2 and ADC12Bn_MCCTRL3) have identical bit fields.

REGISTER_NAME	ADC12Bn_MCCTRLi (i = 0 to 3)
OFFSET	0x03C0 + i
ACCESS_SIZE	B H W
MULTIPLE	0:3
NUMERIC_TYPE	-
OTHER	-

A/D Multiple Conversion Channel Control Register (ADC12Bn_MCCTRL0)

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	AVRHSEL	AVRLSEL	ICIRQY	CNVNUM[3]	CNVNUM[2]	CNVNUM[1]	CNVNUM[0]
ACCESS_TYPE	R0,W0	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit7] Reserved : Reserved bit

When writing, always write "0".

When reading, "0" is always read.

[bit6] AVRHSEL : A/D reference voltage AVRH selection bit

Bit	Description
0	AVRH voltage is not selected for A/D conversion
1	AVRH voltage is selected for A/D conversion.

In case that both bits AVRHSEL and AVRLSEL bits are set to "1", AVRLSEL has higher priority and AVRL voltage is converted.

If any of AVRHSEL/AVRLSEL bits is set to "1", conversion of a regular analog input AN is not possible.

For further explanation of A/D Converter calibration refer to section "A/D Converter Calibration" in chapter "3 Operation of A/D".

[bit5] AVRLSEL : A/D reference voltage AVRL selection bit

Bit	Description
0	AVRL voltage is not selected for A/D conversion
1	AVRL voltage is selected for A/D conversion

In case that both bits AVRHSEL and AVRLSEL bits are set to "1", AVRLSEL has higher priority and AVRL voltage is converted.

If any of AVRHSEL/AVRLSEL bits is set to "1", conversion of a regular analog input AN is not possible.

For further explanation of A/D Converter calibration refer to section "A/D Converter Calibration" in chapter "3 Operation of A/D".

[bit4] ICIRQY : Intra-channel interrupt ability for the multiple conversion logical channel

This bit determines if the multiple conversion logical channel can be interrupted between single conversions, in case the conversion request with higher priority is issued.

Bit	Description
0	Multiple conversion logical channel can be interrupted between single conversions.
1	Multiple conversion logical channel cannot be interrupted between single conversions.

This bit has no effect if CNVNUM[3:0] is configured to "0000".

[bit3:0] CNVNUM[3:0] : Number of conversions for the multiple conversion channel

This bit field specifies the number of A/D conversions to be performed if the conversion request for the multiple conversion logical channel is issued.

CNVNUM[3:0]	Description
0000	1 conversion. With this setting multiple conversion logical channel behaves like any other logical channel.
0001	2 conversions.
0010	3 conversions.
...	...
1111	16 conversions

CNVNUM[3:0] are not allowed to update during A/D conversion operation (ADC12Bn_TRGST0 to 1.TRGST and ADC12Bn_CHSTAT0 to 63.TRGST="1").

5.35. A/D Multiple Conversion Channel Status Registers (ADC12Bn_MCSTAT0 to 3)

These registers contain the current status of finished conversion number for first four multiple conversion logical channels. Only ADC12Bn_MCSTAT0 is described here. Other registers (ADC12Bn_MCSTAT1, ADC12Bn_MCSTAT2 and ADC12Bn_MCSTAT3) have identical bit fields.

REGISTER_NAME	ADC12Bn_MCSTATi (i = 0 to 3)
OFFSET	0x03E0 + i
ACCESS_SIZE	B H W
MULTIPLE	0:3
NUMERIC_TYPE	-
OTHER	-

A/D Multiple Conversion Channel Status Register (ADC12Bn_MCSTAT0)

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved			MCCNT[4]	MCCNT[3]	MCCNT[2]	MCCNT[1]	MCCNT[0]
ACCESS_TYPE	RX,WX			R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	000			0	0	0	0	0

[bit7:5] Reserved : Reserved bits

Reading this bit returns an undefined.

Writing data to these bits has no effect on the operation.

[bit4:0] MCCNT[4:0]

Conversion counter counting the number of already finished A/D conversions of the multiple conversion logical channel.

After the set event of the conversion done interrupt flag, the ADC12Bn_MCSTAT.MCCNT[4:0] are meaningless.

MCCNT[4:0]	Description
00000	No conversion is finished.
00001	1 conversion is finished.
...	...
10000	16 conversions are finished.
10001-11111	Reserved

CHAPTER 16: Stepper Motor Controller



This chapter explains the functions and operations of the Stepper Motor Controller (SMC).

1. Overview
2. Configuration and Block Diagram
3. Operation of the Stepper Motor Controller
4. Registers

CODE: FIP021-E1.1

1. Overview

This section lists the main features for Stepper Motor Controller.

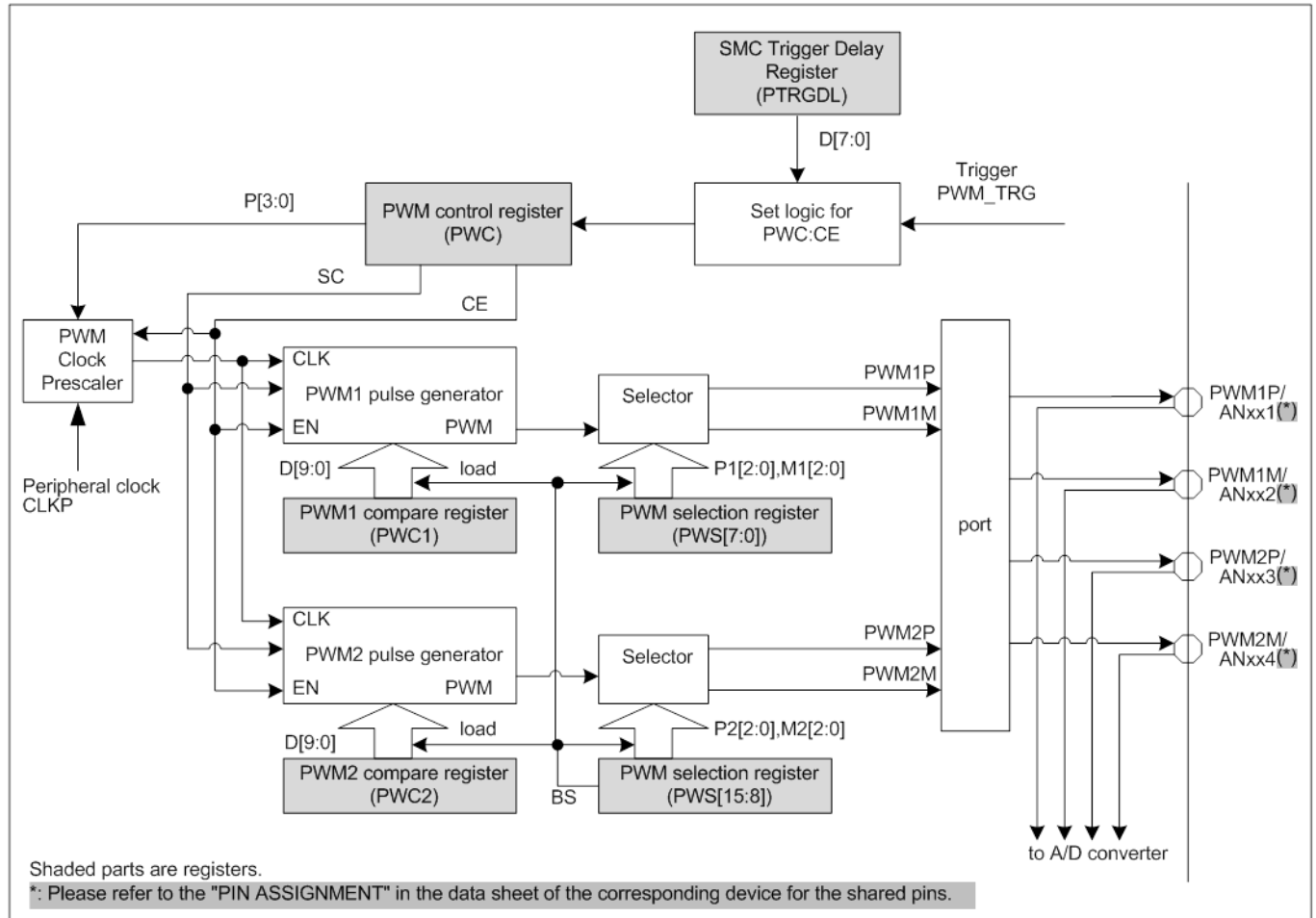
Features of the Stepper Motor Controller:

- Four high-current output drivers: Stepper Motor Controller provides four driver outputs with high current driving capability. Two motor coils can be connected directly to four stepper motor controller pins. The motor rotation is controlled by a combination of the PWM Pulse Generator and selector logic circuits.
- Two PWM Pulse Generators with 10-bit/8-bit operation mode (selected by software):
 - For the PWM pulse width in 8-bit operation mode, the duty can be specified within the range from 0% to 99.6%.
 - For the PWM pulse width in 10-bit operation mode, the duty can be specified within the range from 0% to 99.9%.
- A synchronization mechanism that enables synchronous operation of PWM Pulse Generators.
- A variable operating Clock Prescaler (the division ratio from a Peripheral clock can be selected by software).
- Output selector logic ("High", "Low", PWM pulse and "Hi-Z" signal levels can be selected).

2. Configuration and Block Diagram

This section shows block diagrams of the Stepper Motor Controller.

Figure 2-1 Block Diagram of the Stepper Motor Controller



PWM Clock Prescaler

The PWM Clock Prescaler divides the Peripheral clock (CLKP) and generates the PWM operating clock. The PWM operating clock is used by the PWM Pulse Generators.

PWM1 Pulse Generator / PWM2 Pulse Generator

The PWM Pulse Generators generate the pulse-width modulated signals according to the waveform configuration and the selected operation mode.

Selector

This sub-module, based on configuration, selects the level of the signal that will be sent to the Stepper Motor Controller output pins.

Port

The Port controls the I/O port for the Stepper Motor Controller pins.

PWM Control Register (PWC)

The PWM Control Register (PWC) starts/stops the Stepper Motor Controller, sets the PWM Prescaler and selects the operation mode for the PWM Pulse Generators.

PWM1 and PWM2 Compare Registers (PWC1, PWC2)

The PWM1 and PWM2 Compare Registers determine the PWM pulse width.

PWM Selection Register (PWS)

The PWM Selection Register selects the signal levels ("H" and "L", PWM pulse and "Hi-Z") to be output to the Stepper Motor Controller pins. It also sets the update instruction for the system to synchronize the PWM Pulse Generators.

SMC Trigger Delay Register (PTRGDL)

The SMC Trigger Delay Register (PTRGDL) is used to delay the start of the operation by 0 to 255 clock cycles.

Set Logic for PWC.CE

The Set logic for PWC.CE receives the trigger and waits for a configured delay time and sets automatically PWC.CE bit.

3. Operation of the Stepper Motor Controller

This section describes the operation of the Stepper Motor Controller.

- 3.1 Operation of PWM Pulse Generator
- 3.2 Selection of Motor Drive Signals
- 3.3 Synchronization System of Stepper Motor Controller
- 3.4 Operation of the SMC Trigger Delay Function

3.1. Operation of PWM Pulse Generator

The PWM period is determined by the selected division ratio from a Peripheral clock (CLKP) and the operation mode (8-bit/10-bit) of the PWM Pulse Generator:

- During configuration, software can select the PWM operating clock by specifying the division ratio for the Peripheral clock (CLKP). The division ratio for the Peripheral clock is defined by setting the PWM operating clock prescaler bits (PWC.P[3:0]).
- Software can also configure the operation mode for the counter that controls the PWM period. When the Operation Mode Switching bit (PWC.SC) is set to "0", 8-bit operation mode is selected (PWM period = 256 counts). If this bit is set to "1", 10-bit operation mode is selected (PWM period = 1024 counts).

Examples of operating clock values for different configurations are given in Table 3 1.

Table 3-1 Relation between PWM Operating Clock and PWM Period for Different Operation Modes

PWC P[3:0]	PWM Operating Clock (CLK)	PWM Period [μ s] (CLKP = 16 MHz)		PWM Period [μ s] (CLKP = 60 MHz)	
		PWC SC = "0"	PWC SC = "1"	PWC SC = "0"	PWC SC = "1"
0000	CLKP	16	64	4.267	17.067
0001	CLKP/4	64	256	17.067	68.267
0010	CLKP/5	80	320	21.333	85.333
0011	CLKP/6	96	384	25.6	102.4
0100	CLKP/8	128	512	34.133	136.533
0101	CLKP/10	160	640	42.667	170.667
0110	CLKP/12	192	768	51.2	204.8
0111	CLKP/16	256	1024	68.267	273.067
1000	CLKP/2	32	128	8.533	34.133
1001	CLKP/8	128	512	34.133	136.533
1010	CLKP/10	160	640	42.667	170.667
1011	CLKP/12	192	768	51.2	204.8
1100	CLKP/16	256	1024	68.267	273.067
1101	CLKP/20	320	1280	85.333	341.333
1110	CLKP/24	384	1536	102.4	409.6
1111	CLKP/32	512	2048	136.533	546.133

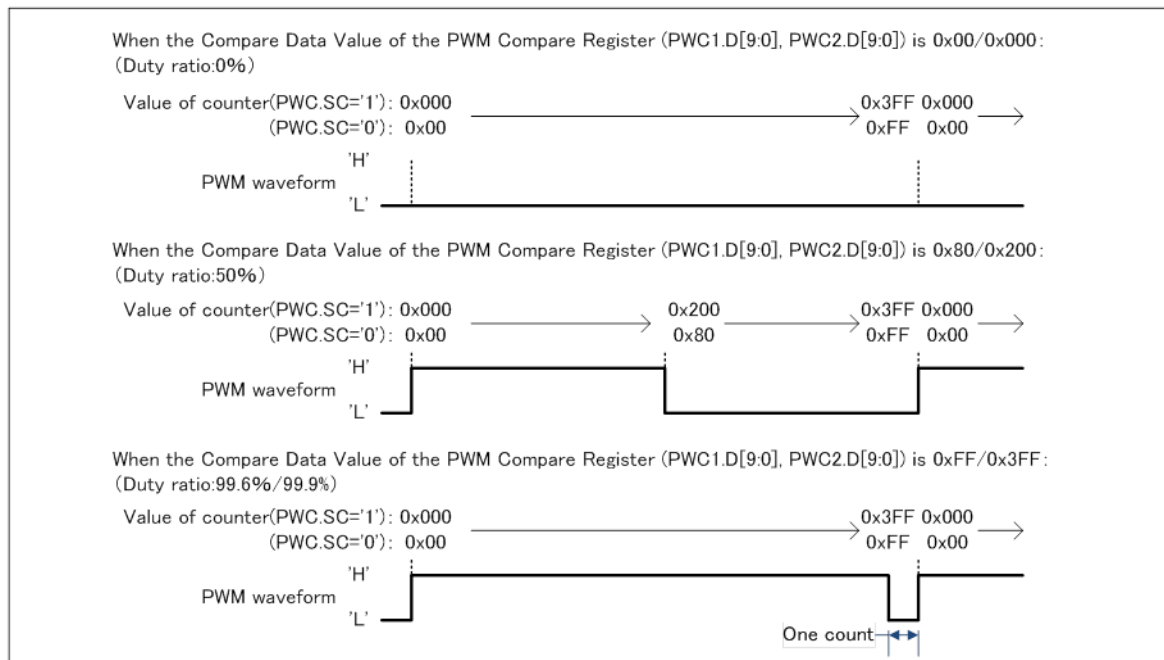
CLKP: Peripheral clock

The PWM pulse width (duty cycle) is determined by the PWM Compare Data Value (PWC1.D[9:0], PWC2.D[9:0]). In 8-bit operation mode (PWC.SC = "0"), the PWM Compare Data Value is taken from the PWC1.D[7:0], PWC2.D[7:0] bits and bits PWC1.D[9:8], PWC2.D[9:8] are "don't care". In 10-bit operation mode (PWC.SC = "1"), the PWM Compare Data Value is taken from the PWC1.D[9:0], PWC2.D[9:0] bits. Below are the ranges in which PWM Compare Data Values (PWC1.D[9:0], PWC2.D[9:0]) can be set:

- In 8-bit operation mode (PWC.SC = "0") 0% to 99.6% (0x00 to 0xFF)
- In 10-bit operation mode (PWC.SC = "1") 0% to 99.9% (0x000 to 0x3FF)

The PWM Pulse Generator is started/stopped using the Count Enable bit (PWC.CE). When this bit is set to "1", the PWM Pulse Generator starts the counter that controls the PWM period. The counter increments its value from 0x00 (0x000) at the rising edge of the PWM operating clock. The PWM Pulse Generator output remains at the "H" level until the counter value matches the PWM Compare Data Value. Once the PWM Compare Data Value is reached, the PWM Pulse Generator output changes to "L" and remains at the "L" level until the counter value overflows: 0xFF → 0x00 (0x3FF → 0x000).

Figure 3-1 shows the PWM waveforms generated by the PWM Pulse Generator.

Figure 3-1 Examples of PWM1 and PWM2 Output Waveforms


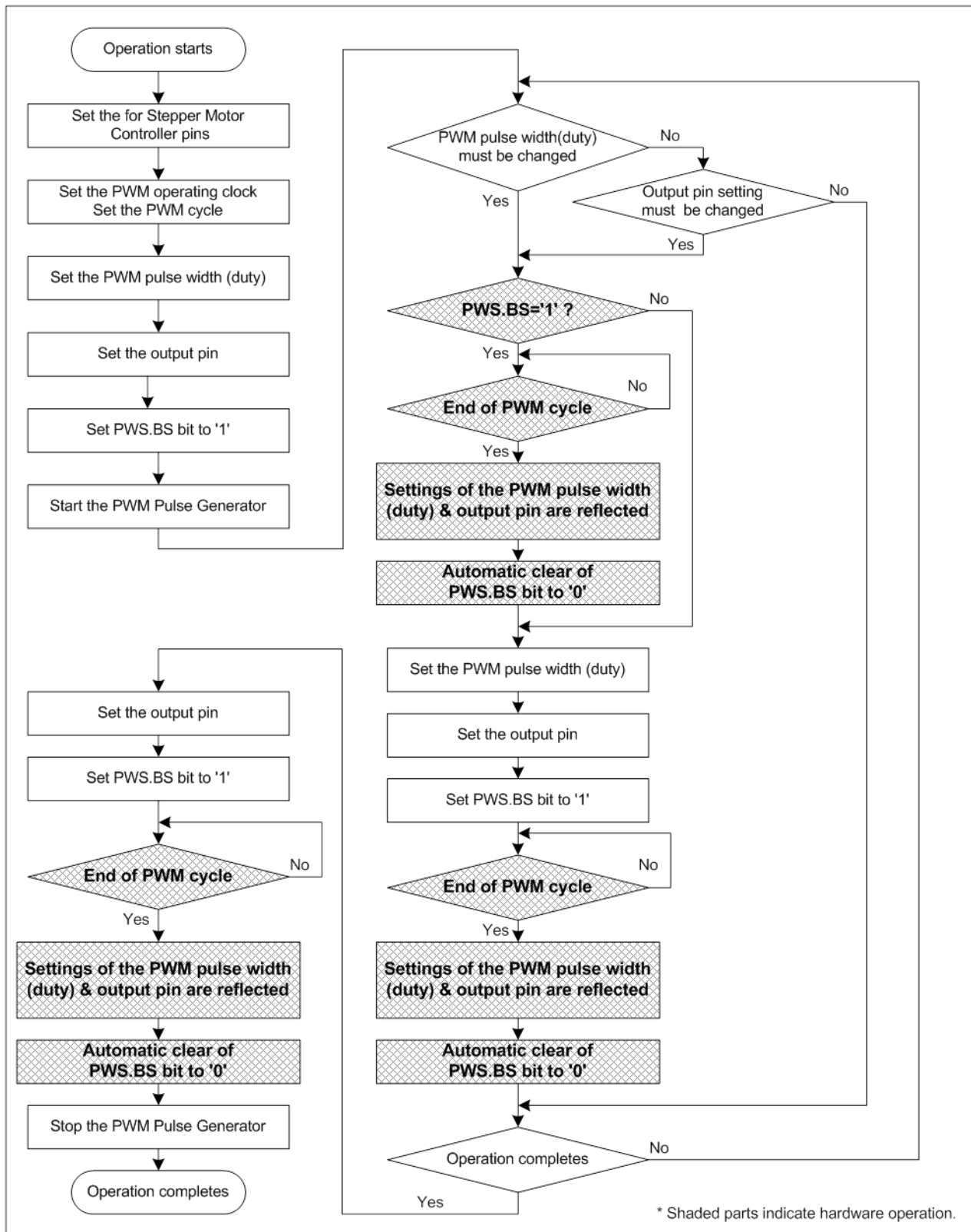
If the PWM Pulse Generator is stopped (PWC.CE = "0"), the setting of the PWM pulse width (duty cycle) and the output pin selection settings are not reflected on the Stepper Motor Controller outputs.

Notes:

- If the PWM Pulse Generator is started (PWC.CE="1"), operate following steps because the PWM Pulse Generator.Compare Data Value must be initialized.
 1. Set the PWM Compare Register.Compare Data Value(PWC1.D[9:0], PWC2.D[9:0])
 2. Set the PWM Selection Register.Output Selection bits(PWS.BS="1", PWS.P2[2:0], PWS.M2[2:0], PWS.P1[2:0], PWS.M1[2:0])
 3. Set the PWM Control Register.Count Enable bit(PWC.CE="1")
- If the PWM Pulse Generator is stopped when the Output Update bit (PWS.BS) is "1", the PWS.BS bit will retain the value "1" until the PWM Pulse Generator is started and the beginning of the new PWM cycle is detected. As a result, the setting of the PWM pulse width (duty cycle) and the output pin selection settings are reflected on the Stepper Motor Controller outputs. To avoid this scenario, clear PWC.CE only after PWS.BS is automatically cleared by the SMC.
- If the PWS.BS bit is "1", keep the following registers value because the setting of the PWM pulse width (duty cycle) and the output pin selection settings are not reflected at the same time.
 - PWM1 Compare Register.Compare Data Value(PWC1.D[9:0])
 - PWM2 Compare Register.Compare Data Value(PWC2.D[9:0])
 - PWM Selection Register.Output Selection bits(PWS.P2[2:0], PWS.M2[2:0], PWS.P1[2:0], PWS.M1[2:0])

An example for the Stepper Motor Controller setting procedure is given on the Figure 3 2 .

Figure 3-2 Example of the Setting Procedure for the Stepper Motor Controller



3.2. Selection of Motor Drive Signals

The user can select the signal at each output pin of the Stepper Motor Controller according to the Table 3 2 and Table 3 3. The selection of output pin is done by configuring the PWM Selection Register (PWS.P2[2:0], PWS.M2[2:0], PWS.P1[2:0], PWS.M1[2:0]).

Table 3-2 Selection of Motor Drive Signals and Setting of PWM1 Selection Bits

PWS.P1[2:0]	PWM1P
000	L
001	H
01X	PWM pulse
1XX	Hi-Z

PWS.M1[2:0]	PWM1M
000	L
001	H
01X	PWM pulse
1XX	Hi-Z

X: don't care

Table 3-3 Selection of Motor Drive Signals and Setting of PWM2 Selection Bits

PWS.P2[2:0]	PWM2P
000	L
001	H
01X	PWM pulse
1XX	Hi-Z

PWS.M2[2:0]	PWM2M
000	L
001	H
01X	PWM pulse
1XX	Hi-Z

X: don't care

3.3. Synchronization System of Stepper Motor Controller

The Stepper Motor Controller contains a dedicated system developed to enable synchronization of PWM1 and PWM2 Pulse Generators, as well as Stepper Motor Controller output pin selection. The synchronization system is controlled by the PWM Selection Register Output Update bit (PWS.BS). Until the Output Update bit (PWS.BS) is set to "1", changes made to the PWM Compare Registers (PWC1, PWC2) and the PWM Selection Register (PWS) are not reflected on the output. Configuring the Stepper Motor Controller output pin selection and setting the Output Update bit (PWS.BS) simultaneously (in the same software access) is allowed.

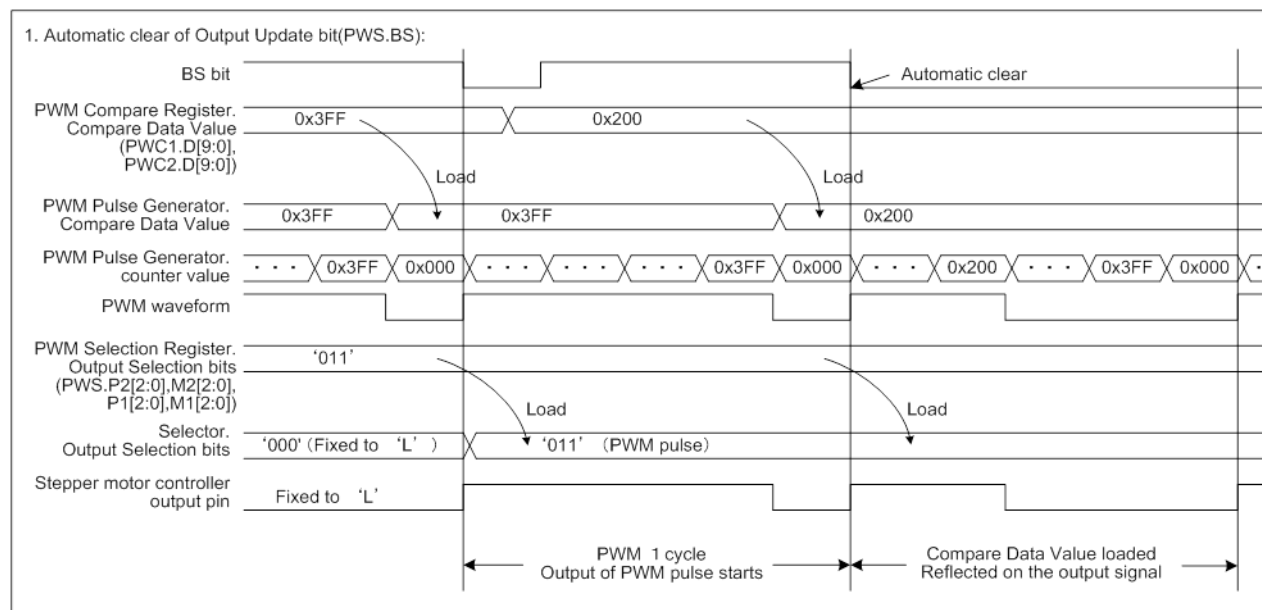
When the Output Update bit (PWS.BS) is set to "1" by software, and the end of current PWM cycle is detected, PWM Pulse Generator and motor drive selection logic will load values of the corresponding registers. The Output Update bit (PWS.BS) is automatically cleared to "0" at the beginning of the next PWM cycle.

If the Output Update bit (PWS.BS) is equal to "1" and the software access is initiated to set this bit to "1" at the beginning of the PWM cycle (at the same time when an automatic clear of Output Update bit (PWS.BS) is issued), the Output Update bit (PWS.BS) will retain the value "1" (i.e. no change is made to the PWS.BS bit) and the automatic clearing is canceled for this PWM cycle.

The following scenario is shown on Figure 3-3:

1. Automatic clear of the Output Update bit (PWS.BS): load operation is executed and reflected on the output.

Figure 3-3 Load Timing of PWM Compare Register and PWM Selection Register



3.4. Operation of the SMC Trigger Delay Function

After the Stepper Motor Controller receives a trigger input (PWM_TRG), it waits for a configured delay time to elapse before the Count Enable bit (PWC.CE) is automatically set and the Stepper Motor Controller starts operating. The delay time is configured in the SMC Trigger Delay Register (PTRGDL). The Stepper Motor Controller will continue to operate until the Count Enable bit (PWC.CE) is reset by software.

Figure 3-4 demonstrates the software flow for receiving a trigger input (PWM_TRG). An example, illustrating how the trigger starts Stepper Motor Controller, is shown on Figure 3-5.

Note:

- The trigger should only be received when the Stepper Motor Controller are not running (i.e. the Count Enable bit (PWC.CE) is cleared to "0").

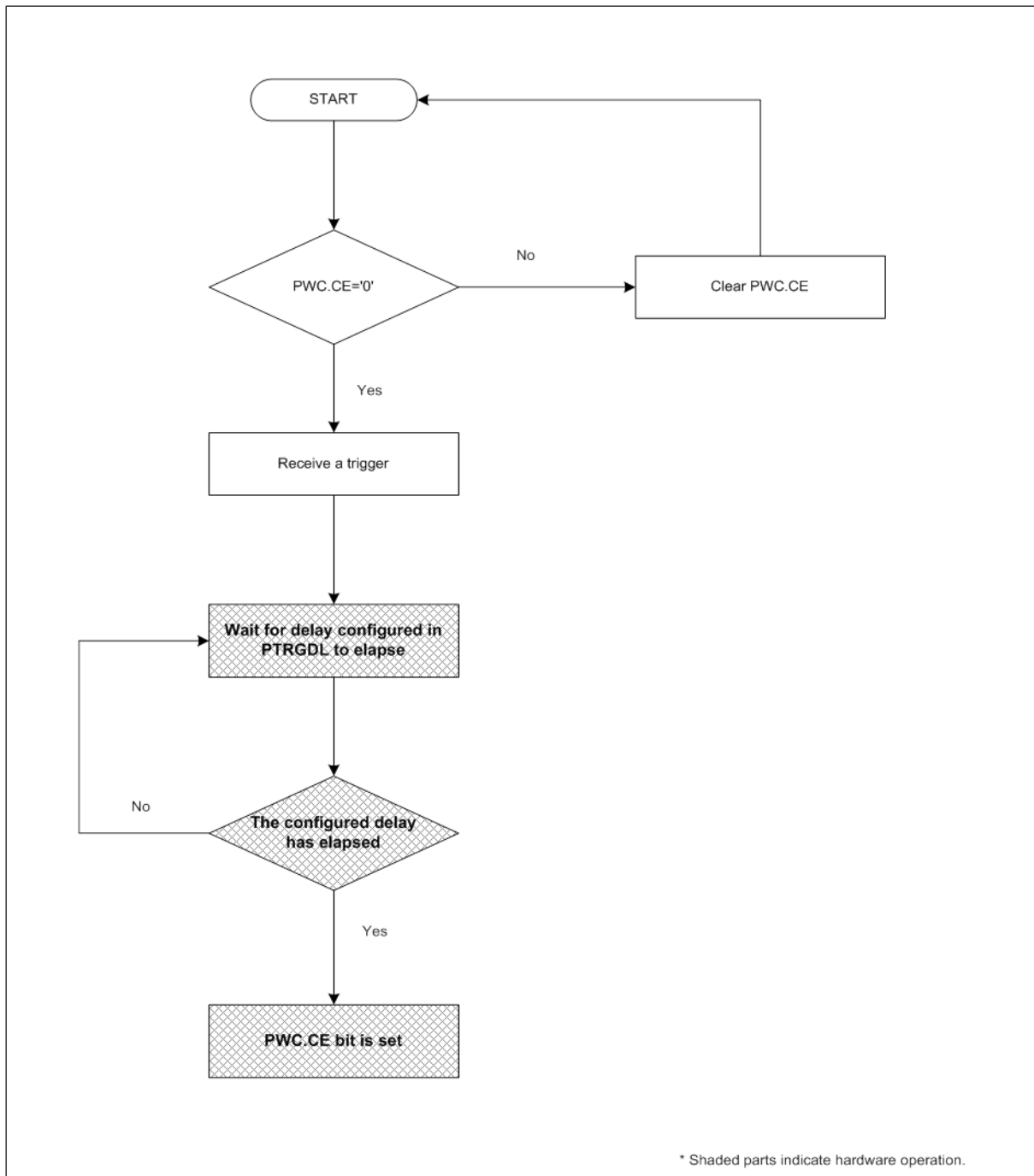
Figure 3-4 Flowchart for Triggering Stepper Motor Controller

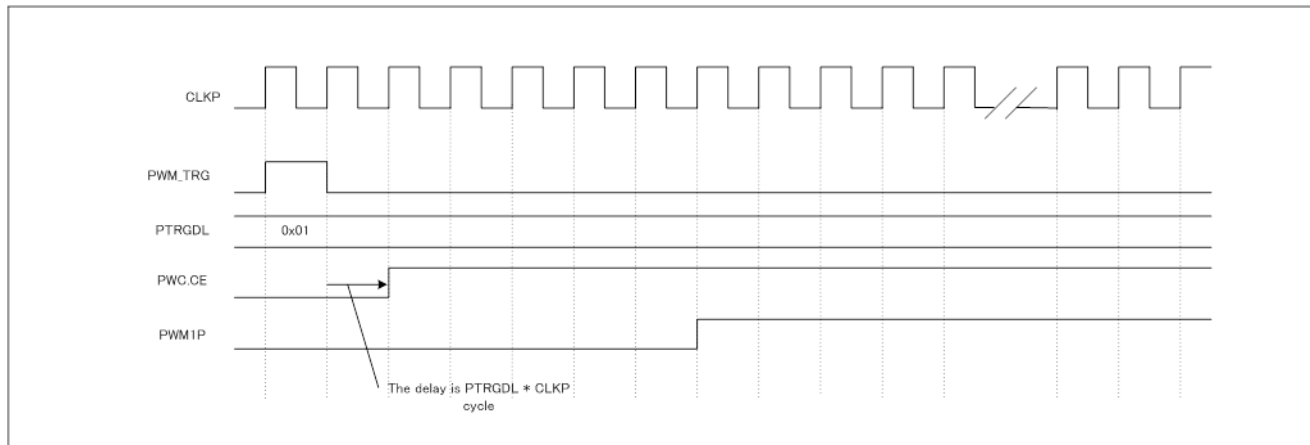
Figure 3-5 Timing Diagram for Triggering of Stepper Motor Controller


Figure 3-5 shows how the trigger starts Stepper Motor Controller (PTRGDL=0x01). If the SMC Trigger Delay Register (PTRGDL) setting is 0x00, PWC.CE is set immediately after receiving the trigger input (PWM_TRG). If the SMC Trigger Delay Register (PTRGDL) setting is 0x01, PWC.CE is set with a delay of one clock cycle after receiving the trigger input (PWM_TRG).

4. Registers

This section describes the registers of the Stepper Motor Controller.

■ The Following Registers are Available for One Stepper Motor Controller:

PWM Control Register (PWC)
 PWM1 and PWM2 Compare Registers (PWC1, PWC2)
 PWM Selection Register (PWS)
 PWM Selection Set Register (PWSS)
 SMC Trigger Delay Register (PTRGDL)

Table 4-1 List of Registers for the Stepper Motor Controller

Abbreviation	Register Name	Reference
PWC	PWM Control Register	4.1
PWC1	PWM1 Compare Register	4.2.1
PWC2	PWM2 Compare Register	4.2.2
PWS	PWM Selection Register	4.3
PWSS	PWM Selection Set Register	4.4
PTRGDL	SMC Trigger Delay Register	4.5

4.1. PWM Control Register (PWC)

The PWM Control Register starts/stops the Stepper Motor Controller, sets the PWM prescaler and selects the operation mode for the generation of the PWM pulse.

REGISTER_NAME	SMC _i PWC
OFFSET	0x00000000
ACCESS_SIZE	B, H
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						P[3]	Reserved
ACCESS_TYPE	R0,W0						R/W	R0/W0
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0						0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	P[2:0]			CE	SC	Reserved	Reserved
ACCESS_TYPE	R0/W0	R/W			R,W	R/W	R0,W0	R0/W0
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0			0	0	0	0

[bit15:10] Reserved: Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit9] P[3]: PWM Operating Clock Prescaler bit

P[3] bit, in combination with P[2:0] bits, specifies the clock input signal to the PWM Pulse Generators.

[bit8:7] Reserved: Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit6:4] P[2:0]: PWM Operating Clock Prescaler bits

P[2:0] bits, in combination with P[3] bit, specify the clock input signal to the PWM Pulse Generators.

P[3]	P[2:0]	Description
0	000	PWM Operating clock is equal to the Peripheral clock (CLKP)
0	001	PWM Operating clock is equal to CLKP/4
0	010	PWM Operating clock is equal to CLKP/5
0	011	PWM Operating clock is equal to CLKP/6
0	100	PWM Operating clock is equal to CLKP/8
0	101	PWM Operating clock is equal to CLKP/10
0	110	PWM Operating clock is equal to CLKP/12
0	111	PWM Operating clock is equal to CLKP/16
1	000	PWM Operating clock is equal to CLKP/2
1	001	PWM Operating clock is equal to CLKP/8
1	010	PWM Operating clock is equal to CLKP/10
1	011	PWM Operating clock is equal to CLKP/12
1	100	PWM Operating clock is equal to CLKP/16
1	101	PWM Operating clock is equal to CLKP/20
1	110	PWM Operating clock is equal to CLKP/24
1	111	PWM Operating clock is equal to CLKP/32

CLKP: Peripheral clock

Note:

- Configuration of the PWM Operating Clock Prescaler bits (P[3:0]) shall be done while counting operation is disabled (PWC.CE = "0").

[bit3] CE: Count Enable bit

The CE bit enables operation of the PWM Pulse Generators. When CE bit is set to "1", the PWM Pulse Generator starts its operating. The PWM2 Pulse Generator starts with the delay of one Peripheral clock cycle (CLKP) after the PWM1 Pulse Generator is started.

The CE bit can be set and cleared by the software. This bit also can be set to "1" by receiving trigger. To receive trigger, the CE bit must first be cleared to "0".

Bit	Description
0	Initializes and stops the operation of the PWM Pulse Generators
1	Starts the operation of the PWM Pulse Generators

Notes:

- If the PWM Pulse Generator is started (CE="1"), operate following steps because the PWM Pulse Generator.Compare Data Value must be initialized.
 1. Set the PWM Compare Register.Compare Data Value(PWC1.D[9:0], PWC2.D[9:0])
 2. Set the PWM Selection Register.Output Selection bits(PWS.BS="1", P2[2:0], M2[2:0], P1[2:0], M1[2:0])
 3. Set the PWM Control Register.Count Enable bit(CE="1")
- If the PWM Pulse Generator is stopped (CE="0") when the PWM pulse is selected by the Output Selection bits (PWS.P2[2:0], M2[2:0], P1[2:0], M1[2:0]), the pin for which the PWM pulse is selected is fixed to the "L" level.
- If the trigger input is used, write "0" to the CE bit only when the CE bit is "1". Because the CE bit can be cleared at the same time when the CE bit is set by the trigger.
- The CE bit shall be set to "1" after the setting of the PWM Operating Clock Prescaler bits (PWC.P[3:0]) and the Operation Mode Switching bit (PWC.SC) is completed.

[bit2] SC: Operation Mode Switching bit

This bit specifies the operation mode of the PWM Pulse Generators

Bit	Description
0	8-bit operation mode is selected
1	10-bit operation mode is selected

Note:

- The PWC.CE bit shall be set to "1" after the setting of the PWM Operating Clock Prescaler bits (PWC.P[3:0]) and the Operation Mode Switching bit (SC) is completed.

[bit1:0] Reserved: Reserved bits

When writing, always write "0".

When reading, "0" is always read.

4.2. PWM1 and PWM2 Compare Registers (PWC1, PWC2)

The value of the 8/10 bit PWM1 and PWM2 Compare Registers determines the width of the PWM pulse. A value of 0x00 (0x000) indicates that the PWM duty cycle is 0%, while a value of 0xFF (0x3FF) indicates that the PWM duty cycle is 99.6% (99.9%).

4.2.1. PWM1 Compare Register(PWC1)

REGISTER_NAME	SMCi_PWC1
OFFSET	0x00000002
ACCESS_SIZE	B, H
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						D[9:8]	
ACCESS_TYPE	R0,W0						R/W	
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0						X	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	D[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	X							

[bit15:10] Reserved: Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit9:0] D[9:0]: PWM1 Compare Data Value

The PWM1 Compare Data Value D[9:0] are used to set the PWM1 duty cycle. When the Operation Mode Switching bit is set to 8-bit operation mode (PWC.SC= "0"), the compare data value is taken from D[7:0] bits and D[9:8] bits are "don't care". When the Operation Mode Switching bit is set to 10-bit operation mode (PWC.SC= "1"), the compare data value is taken from D[9:0] bits.

D[9:0]	Description
0x(0)00	0%
...	Set the PWM pulse width
0x(3)FF	(99.9%) 99.6%

Notes:

- PWM Pulse Generator.Compare Data Value is updated at the end of PWM cycle, after PWS.BS bit is set to "1".
- When PWC.SC bit is set to "0" (PWM Pulse Generators are operating in 8-bit mode), D[9:8], PWC2.D[9:8] bits are "don't care".
- The software must always make a 16-bit write access to PWM1 and PWM2 Compare Registers (PWC1, PWC2) to ensure consistency of data. However, 8-bit write access to PWM1 or PWM2 Compare Register (PWC1, PWC2) is possible and will not result in error response.
- If the PWS.BS bit is "1", don't change the PWM Compare Register.Compare Data Value(D[9:0], PWC2.D[9:0]) and the PWM Selection Register.Output Selection bits (PWS.P2[2:0], PWS.M2[2:0], PWS.P1[2:0], PWS.M1[2:0]).

4.2.2. PWM2 Compare Register(PWC2)

REGISTER_NAME	SMC _i PWC2
OFFSET	0x00000004
ACCESS_SIZE	B, H
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						D[9:8]	
ACCESS_TYPE	R0,W0						R/W	
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0						X	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	D[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	X							

[bit15:10] Reserved: Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit9:0] D[9:0]: PWM2 Compare Data Value

The PWM2 Compare Data Value D[9:0] bits are used to set the PWM2 duty cycle. When the Operation Mode Switching bit is set to 8-bit operation mode (PWC.SC= "0"), the compare data value is taken from D[7:0] bits and D[9:8] bits are "don't care". When the Operation Mode Switching bit is set to 10-bit operation mode (PWC.SC= "1"), the compare data value is taken from D[9:0] bits.

D[9:0]	Description
0x(0)00	0%
...	Set the PWM pulse width
0x(3)FF	(99.9%) 99.6%

Notes:

- PWM Pulse Generator.Compare Data Value is updated at the end of PWM cycle, after PWS.BS bit is set to "1".
- When PWC.SC bit is set to "0" (PWM Pulse Generators are operating in 8-bit mode), PWC1.D[9:8], D[9:8] bits are "don't care".
- The software must always make a 16-bit write access to PWM1 and PWM2 Compare Registers (PWC1, PWC2) to ensure consistency of data. However, 8-bit write access to PWM1 or PWM2 Compare Register (PWC1, PWC2) is possible and will not result in error response.
- If the PWS.BS bit is "1", don't change the PWM Compare Register.Compare Data Value(PWC1.D[9:0], D[9:0]) and the PWM Selection Register.Output Selection bits (PWS.P2[2:0], PWS.M2[2:0], PWS.P1[2:0], PWS.M1[2:0]).

4.3. PWM Selection Register (PWS)

The PWM Selection Register (PWS) sets the output state of the Stepper Motor Controller pins ("L", "H", PWM pulse or "Hi-Z") and allows the update of the PWM duty cycle or output pin states.

REGISTER NAME	SMC _i PWS
OFFSET	0x00000006
ACCESS_SIZE	B, H
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

BIT OFFSET	15	14	13	12	11	10	9	8
BIT NAME	Reserved	BS		P2[2:0]			M2[2:0]	
ACCESS_TYPE	R0,W0	R/+W		R/W			R/W	
PROT_TYPE				Rp/Wp				
INITIAL_VALUE	0	0		0			0	

BIT OFFSET	7	6	5	4	3	2	1	0
BIT NAME	Reserved			P1[2:0]			M1[2:0]	
ACCESS_TYPE	R0/W0			R/W			R/W	
PROT_TYPE				Rp/Wp				
INITIAL_VALUE	0			0			0	

[bit15] Reserved: Reserved bit

When writing, always write "0".

When reading, "0" is always read.

[bit14] BS: Output Update bit

The Output Update bit (BS) synchronously updates the Selector.Output Selection bits and PWM Pulse Generator.Compare Data Value (See Figure3-3). To change the settings for the PWM duty cycle or output pin states, the BS bit must be set to "1" after (or at the same time) a new configuration is written to the PWM1 and PWM2 Compare Registers (PWC1, PWC2) and PWM Selection Register (PWS). If the BS bit is set to "1" while PWM Pulse Generators are operating, the new settings are loaded at the end of the current PWM cycle. The BS bit is cleared automatically at the beginning of the following PWM cycle. As long as BS bit is "0", the PWM duty cycle and output pin states are not changed.

This bit can also be set by the PWSS.BSS bit.

Bit	Description
0	Disables the update of the setting for the PWM output
1	Enables the update of the setting for the PWM output

Notes:

- If the PWM Pulse Generator is started(PWC.CE="1"), operate following steps because the PWM Pulse Generator.Compare Data Value must be initialized.
 1. Set the PWM Compare Register.Compare Data Value(PWC1.D[9:0], PWC2.D[9:0])
 2. Set the PWM Selection Register.Output Selection bits(BS="1", PWS.P2[2:0], PWS.M2[2:0], PWS.P1[2:0], PWS.M1[2:0])
 3. Set the PWM Control Register.Count Enable bit(PWC.CE="1")
- If the BS bit is "1", don't change the PWM Compare Register.Compare Data Value(PWC1.D[9:0], PWC2.D[9:0]) and the PWM Selection Register.Output Selection bits (PWS.P2[2:0], PWS.M2[2:0], PWS.P1[2:0], PWS.M1[2:0]).

[bit13:11] P2[2:0]: Plus Output 2 Selection bits

The P2[2:0] bits select the output signal for PWM2P.

Bits	Description
000	"L": PWM2P output is fixed to low level
001	"H": PWM2P output is fixed to high level
01X	PWM pulse is driven on the PWM2P output
1XX	"Hi-Z": PWM2P output is set to high impedance

X: don't care

Note:

– If the PWS.BS bit is "1", don't change the PWM Compare Register.Compare Data Value(PWC1.D[9:0], PWC2.D[9:0]) and the PWM Selection Register.Output Selection bits (P2[2:0], PWS.M2[2:0], PWS.P1[2:0], PWS.M1[2:0]).

[bit10:8] M2[2:0]: Minus Output 2 Selection bits

The M2[2:0] bits selects the output signal for PWM2M.

Bits	Description
000	"L": PWM2M output is fixed to low level
001	"H": PWM2M output is fixed to high level
01X	PWM pulse is driven on the PWM2M output
1XX	"Hi-Z": PWM2M output is set to high impedance

X: don't care

Note:

- If the PWS.BS bit is "1", don't change the PWM Compare Register.Compare Data Value(PWC1.D[9:0], PWC2.D[9:0]) and the PWM Selection Register.Output Selection bits (PWS.P2[2:0], M2[2:0], PWS.P1[2:0], PWS.M1[2:0]).

[bit7:6] Reserved: Reserved bit

When writing, always write "0".

When reading, "0" is always read.

[bit5:3] P1[2:0]: Plus Output 1 Selection bits

The P1[2:0] bits select the output signal for PWM1P.

Bits	Description
000	"L": PWM1P output is fixed to low level
001	"H": PWM1P output is fixed to high level
01X	PWM pulse is driven on the PWM1P output
1XX	"Hi-Z": PWM1P output is set to high impedance

X: don't care

Note:

– If the PWS.BS bit is "1", don't change the PWM Compare Register.Compare Data Value(PWC1.D[9:0], PWC2.D[9:0]) and the PWM Selection Register.Output Selection bits (PWS.P2[2:0], PWS.M2[2:0], P1[2:0], PWS.M1[2:0]).

[bit2:0] M1[2:0]: Minus Output 1 Selection bits

The M1[2:0] bits selects the output signal for PWM1M.

Bits	Description
000	"L": PWM1M output is fixed to low level
001	"H": PWM1M output is fixed to high level
01X	PWM pulse is driven on the PWM1M output
1XX	"Hi-Z": PWM1M output is set to high impedance

X: don't care

Note:

- *If the PWS.BS bit is "1", don't change the PWM Compare Register.Compare Data Value(PWC1.D[9:0], PWC2.D[9:0]) and the PWM Selection Register.Output Selection bits (PWS.P2[2:0], PWS.M2[2:0], PWS.P1[2:0], M1[2:0]).*

4.4. PWM Selection Set Register (PWSS)

The PWM Selection Set Register is used to set the value of the PWS.BS bit.

REGISTER_NAME	SMC _i PWSS
OFFSET	0x00000008
ACCESS_SIZE	B,H
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	BSS	Reserved					
ACCESS_TYPE	R0,W0	R0,W	R0,W0					
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0					

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	R0,W0							
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0							

[bit15] Reserved: Reserved bit

When writing, always write "0".

When reading, "0" is always read.

[bit14] BSS: Set bit for the Output Update bit

This bit sets the value of PWS.BS bit.

Bit	Description
0	No effect
1	Sets the PWS.BS bit to "1". Reading of this bit returns "0".

Notes:

- If the PWM Pulse Generators is started(PWC.CE="1"), operate following steps because the PWM Pulse Generator.Compare Data Value must be initialized.
 1. Set the PWM Compare Register.Compare Data Value(PWC1.D[9:0], PWC2.D[9:0])
 2. Set the PWM Selection Register.Output Selection bits(PWS.BS="1", PWS.P2[2:0], PWS.M2[2:0], PWS.P1[2:0], PWS.M1[2:0])
 3. Set the PWM Control Register.Count Enable bit(PWC.CE="1")
- If the PWS.BS bit is "1", don't change the PWM Compare Register.Compare Data Value(PWC1.D[9:0], PWC2.D[9:0]) and the PWM Selection Register.Output Selection bits (PWS.P2[2:0], PWS.M2[2:0], PWS.P1[2:0], PWS.M1[2:0]).

[bit13:0] Reserved: Reserved bits

When writing, always write "0".

When reading, "0" is always read.

4.5. SMC Trigger Delay Register (PTRGDL)

The SMC Trigger Delay Register (PTRGDL) is used to delay the start of the operation by 0 to 255 clock cycles.

REGISTER_NAME	SMC _i PTRGDL
OFFSET	0x0000000A
ACCESS_SIZE	B, H
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,W0							
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	D[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0							

[bit15:8] Reserved: Reserved bits

When writing, always write "0".

When reading, "0" is always read.

[bit7:0] D[7:0]: Trigger Delay bits

The Trigger Delay bits (D[7:0]) configure a delay of the trigger input that starts the PWM operation from 0 to 255 clock cycles.

Bits	Description
0x00	No delay (delay disabled)
0x01	Delay of 1 clock cycle between the trigger and the clock cycle in which the PWM generation starts
...	...
0xFF	Delay of 255 clock cycles between the trigger and the clock cycle in which the PWM generation starts

CHAPTER 17: Trigger Configuration of Stepper Motor Controller



This chapter explains the trigger configuration of stepper motor controller.

1. Overview
2. Configuration and Block Diagram
3. Operation
4. Registers

CODE: SMCTRG-S6J3200-E1

1. Overview

The chapter describes the function and its operation of both SMC trigger selection register and SMC trigger register. See the chapter of Stepper motor controller with this chapter.

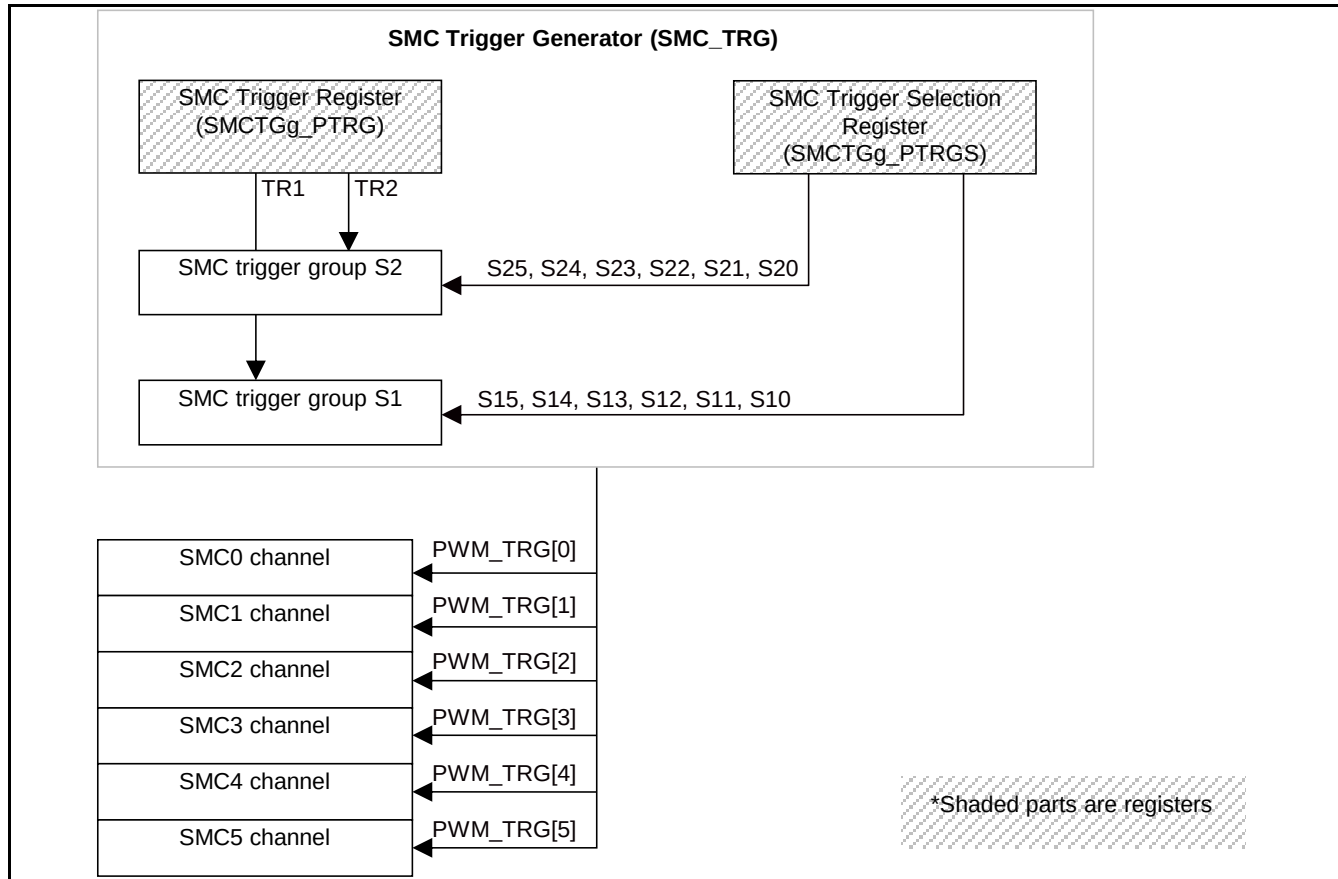
2. Configuration and Block Diagram

See the block diagram below.

Notes:

- The suffix 'g' in the register name indicates that the register is an instance 'g' of the SMC Trigger Generator.
- The suffix 'i' in the register name indicates that the register is an instance 'i' of the SMC channel.

Figure 2-1 Block Diagram of the SMC Module



3. Operation

The trigger configuration and its operation is described in 4.

4. Registers

Offset	Register Name
0x00000000	SMCTGg_PTRGS
0x00000002	SMCTGg_PTRG

4.1. SMC Trigger Selection Register (SMCTGg_PTRGS)

The SMC Trigger Selection Register (SMCTGg_PTRGS) selects multiple SMC channels that shall be triggered by the SMC Trigger Register to start operation synchronously or with a delay. The SMC channels can be combined into two trigger groups.

REGISTER NAME	SMCTGg_PTRGS
OFFSET	0x00000000
ACCESS_SIZE	B, H
MULTIPLE	0
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved		S25	S24	S23	S22	S21	S20
ACCESS_TYPE	R0,WX		R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0		0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved		S15	S14	S13	S12	S11	S10
ACCESS_TYPE	R0,WX		R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0		0	0	0	0	0	0

[bit13] S25 : Trigger Enable for Operation of SMC<6*g+5>

This bit selects SMC<6*g+5> for the SMC trigger group S2 (triggered by SMCTGg_PTRG:TR2).

Bit	Description
0	SMC<6*g+5> is not triggered by SMCTGg_PTRG:TR2
1	SMC<6*g+5> is triggered by SMCTGg_PTRG:TR2

[bit12] S24 : Trigger Enable for Operation of SMC<6*g+4>

This bit selects SMC<6*g+4> for the SMC trigger group S2 (triggered by SMCTGg_PTRG:TR2).

Bit	Description
0	SMC<6*g+4> is not triggered by SMCTGg_PTRG:TR2
1	SMC<6*g+4> is triggered by SMCTGg_PTRG:TR2

[bit11] S23 : Trigger Enable for Operation of SMC<6*g+3>

This bit selects SMC<6*g+3> for the SMC trigger group S2 (triggered by SMCTGg_PTRG:TR2).

Bit	Description
0	SMC<6*g+3> is not triggered by SMCTGg_PTRG:TR2
1	SMC<6*g+3> is triggered by SMCTGg_PTRG:TR2

[bit10] S22 : Trigger Enable for Operation of SMC<6*g+2>

This bit selects SMC<6*g+2> for the SMC trigger group S2 (triggered by SMCTGg_PTRG:TR2).

Bit	Description
0	SMC<6*g+2> is not triggered by SMCTGg_PTRG:TR2
1	SMC<6*g+2> is triggered by SMCTGg_PTRG:TR2

[bit9] S21 : Trigger Enable for Operation of SMC<6*g+1>

This bit selects SMC<6*g+1> for the SMC trigger group S2 (triggered by SMCTGg_PTRG:TR2).

Bit	Description
0	SMC<6*g+1> is not triggered by SMCTGg_PTRG:TR2
1	SMC<6*g+1> is triggered by SMCTGg_PTRG:TR2

[bit8] S20 : Trigger Enable for Operation of SMC<6*g+0>

This bit selects SMC<6*g+0> for the SMC trigger group S2 (triggered by SMCTGg_PTRG:TR2).

Bit	Description
0	SMC<6*g+0> is not triggered by SMCTGg_PTRG:TR2
1	SMC<6*g+0> is triggered by SMCTGg_PTRG:TR2

[bit5] S15 : Trigger Enable for Operation of SMC<6*g+5>

This bit selects SMC<6*g+5> for the SMC trigger group S1 (triggered by SMCTGg_PTRG:TR1).

Bit	Description
0	SMC<6*g+5> is not triggered by SMCTGg_PTRG:TR1
1	SMC<6*g+5> is triggered by SMCTGg_PTRG:TR1

[bit4] S14 : Trigger Enable for Operation of SMC<6*g+4>

This bit selects SMC<6*g+4> for the SMC trigger group S1 (triggered by SMCTGg_PTRG:TR1).

Bit	Description
0	SMC<6*g+4> is not triggered by SMCTGg_PTRG:TR1
1	SMC<6*g+4> is triggered by SMCTGg_PTRG:TR1

[bit3] S13 : Trigger Enable for Operation of SMC<6*g+3>

This bit selects SMC<6*g+3> for the SMC trigger group S1 (triggered by SMCTGg_PTRG:TR1).

Bit	Description
0	SMC<6*g+3> is not triggered by SMCTGg_PTRG:TR1
1	SMC<6*g+3> is triggered by SMCTGg_PTRG:TR1

[bit2] S12 : Trigger Enable for Operation of SMC<6*g+2>

This bit selects SMC<6*g+2> for the SMC trigger group S1 (triggered by SMCTGg_PTRG:TR1).

Bit	Description
0	SMC<6*g+2> is not triggered by SMCTGg_PTRG:TR1
1	SMC<6*g+2> is triggered by SMCTGg_PTRG:TR1

[bit1] S11 : Trigger Enable for Operation of SMC<6*g+1>

This bit selects SMC<6*g+1> for the SMC trigger group S1 (triggered by SMCTGg_PTRG:TR1).

Bit	Description
0	SMC<6*g+1> is not triggered by SMCTGg_PTRG:TR1
1	SMC<6*g+1> is triggered by SMCTGg_PTRG:TR1

[bit0] S10 : Trigger Enable for Operation of SMC<6*g+0>

This bit selects SMC<6*g+0> for the SMC trigger group S1 (triggered by SMCTGg_PTRG:TR1).

Bit	Description
0	SMC<6*g+0> is not triggered by SMCTGg_PTRG:TR1
1	SMC<6*g+0> is triggered by SMCTGg_PTRG:TR1

4.2. SMC Trigger Register (SMCTGg_PTRG)

The SMC Trigger Register is used to generate trigger signals for the two trigger groups configured in the SMC Trigger Selection Register (SMCTGg_PTRGS). The trigger group can be used to synchronously start several SMC channels. The operation (count enable) starts depending on the delay configured in the SMCi_PTRGDL register.

REGISTER_NAME	SMCTGg_PTRG
OFFSET	0x00000002
ACCESS_SIZE	B, H
MULTIPLE	0
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved						TR2	TR1
ACCESS_TYPE	R0,WX						R0,W	R0,W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0						0	0

[bit1] TR2 : SMC Trigger 2

This bit triggers the SMC trigger group S2 of SMCTGg. The configuration in SMCTGg_PTRGS:S2x determines which SMC channels are triggered. The trigger signal starts the delay counters (if enabled in SMCi_PTRGDL). If the delay has elapsed or the delay is disabled, the Count Enable (SMCi_PWC:CE) bits of the selected SMC channels will be set and the operation starts (PWM generation and output control).

Bit	Description
0	No effect
1	Triggers selected SMC channels via the Set logic for SMCi_PWC:CE

Notes:

- This bit is cleared automatically to "0" after one clock cycle.
- A second trigger should not be applied to a group which has already been triggered. If this happens, the running delay counter will reset its value.

[bit0] TR1 : SMC Trigger 1

This bit triggers the SMC trigger group S1 of SMCTGg. The configuration in SMCTGg_PTRGS:S1x determines which SMC channels are triggered. The trigger signal starts the delay counters (if enabled in SMCi_PTRGDL). If the delay has elapsed or the delay is disabled, the Count Enable (SMCi_PWC:CE) bits of the selected SMC channels will be set and the operation starts (PWM generation and output control).

Bit	Description
0	No effect
1	Triggers selected SMC channels via the Set logic for SMCi_PWC:CE

Notes:

- This bit is cleared automatically to "0" after one clock cycle.
- A second trigger should not be applied to a group which has already been triggered. If this happens, the running delay counter will reset its value.

CHAPTER 18: Sound Generator



This chapter explains the functions and operations of the Sound Generator(SG).

1. Overview
2. Configuration
3. Operations
4. Registers

CODE: FS12C-E01.21

1. Overview

The Sound Generator generates and outputs a tone pulse signal, a PWM pulse signal, or mixed one of both signals according to the setting by MCU. It is enabled to set the frequency of the tone pulse signal, sound volume (amplitude of PWM pulse), and length of sound. The Sound Generator consists of the following registers and counters.

- DMA Transfer Update Enable Register (SGDER)
- Sound Control Register (SGCR)
- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Time Cycle Register (SGTCR)
- Tone Output Number Register (SGNR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)
- DMA Transfer Intermediate Register (SGDMAR)
- Interrupt Clear Register (SGCCR)
- PWM pulse generation counter
- Frequency counter
- Decrement counter
- Tone pulse counter

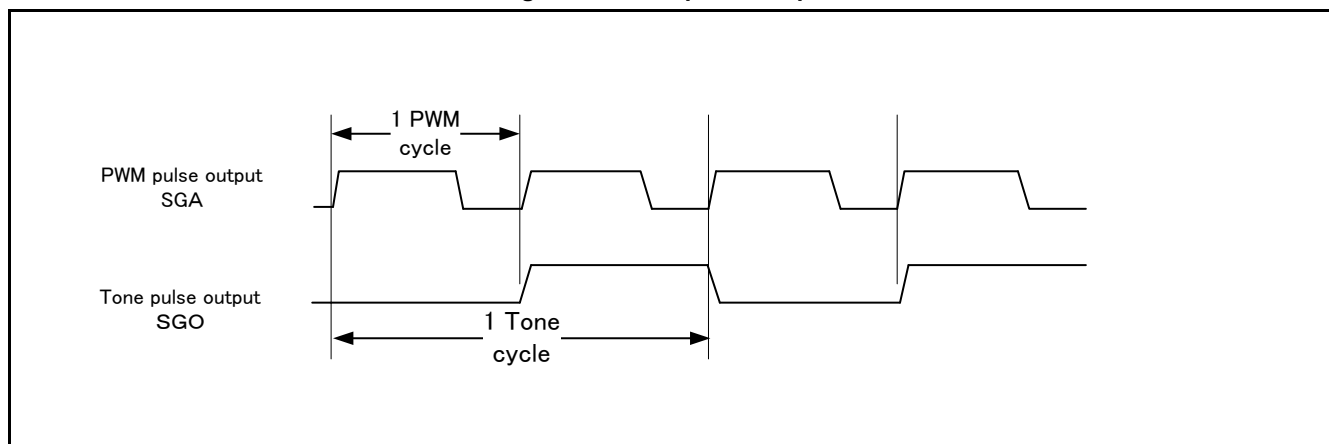
Functions of Sound Generator

Table 1-1 Functions of Sound Generator

No	Item	Function
1	Operation clock	Bus clock (BCLK)
2	Clock input	For clock input of the Sound Generator, divide the bus clock (BCLK) and use it. - 1 x BCLK - 1/2 x BCLK - 1/4 x BCLK - 1/8 x BCLK
3	Waveform	Rectangular wave for sound (tone pulse output, sound output from SGO pin)
4	Volume of sound	It is enabled to set their arbitrary level (PWM pulse output). (Amplitude output from SGA pin)
5	Frequency	It is enabled to set their arbitrary level for sound signal frequency. (Frequency setting and PWM cycle setting)
6	Length of sound	It is enabled to set their arbitrary level.
7	Interrupt	- It is enabled to generate interrupt requests at the end of outputting sound at programmed length (An overflow of Tone pulse counter). - It is enabled to generate interrupts by writing "1" to the Start bit (SGCR.ST) when in DMA mode (SGCR.DMA="1").

Output of Sound Generator

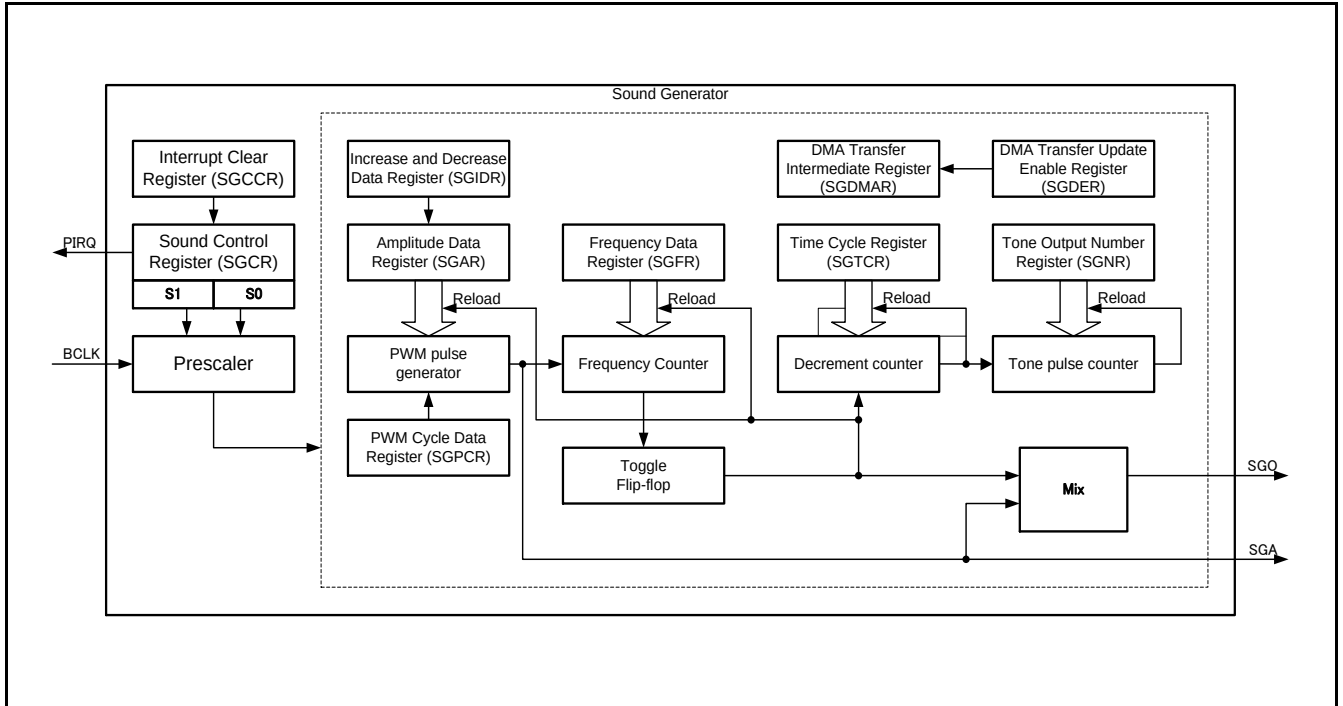
Figure 1-1 Example of Output



2. Configuration

This chapter shows the block diagram of Sound Generator.

Figure 2-1 Block Diagram

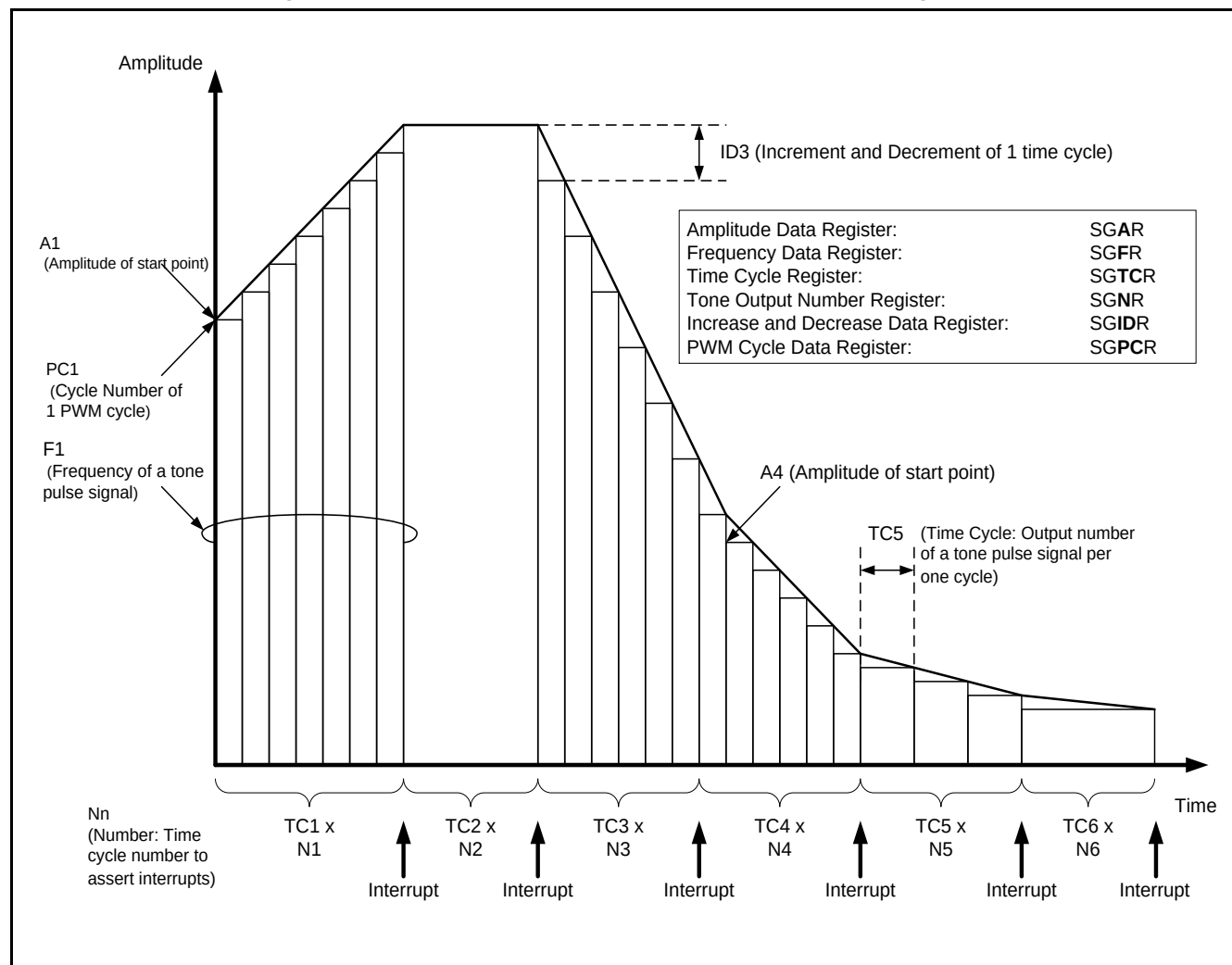


3. Operations

This chapter describes the Sound Generator operation.

The concept of Sound Generator operation is shown in the diagram as below.

Figure 3-1 The Operation of Sound Generator (Conceptual Diagram)



Set the various values in the register as follows:

Amplitude of start point (An) (SGAR)	- to the Amplitude Data Register
Frequency of a tone pulse signal (Fn) (SGFR)	- to the Frequency Data Register
Output number of a tone pulse signal per one cycle (TCn)	- to the Time Cycle Register (SGTCR)
Time cycle number to assert interrupts (Nn)	- to the Tone Output Number Register (SGNR)
Increment and Decrement of 1 time cycle (IDn)	- to the Increase and Decrease Data Register (SGIDR)

Cycle Number of 1 PWM cycle (PCn)	- to the PWM Cycle Data Register (SGPCR)
Other information about Sound Generator control (SGCR)	- to the Sound Control Register

The Sound Generator outputs the tone pulse signal and the amplitude data according to the setting above.

In the conceptual diagram shown above, it outputs 6 steps of signal.

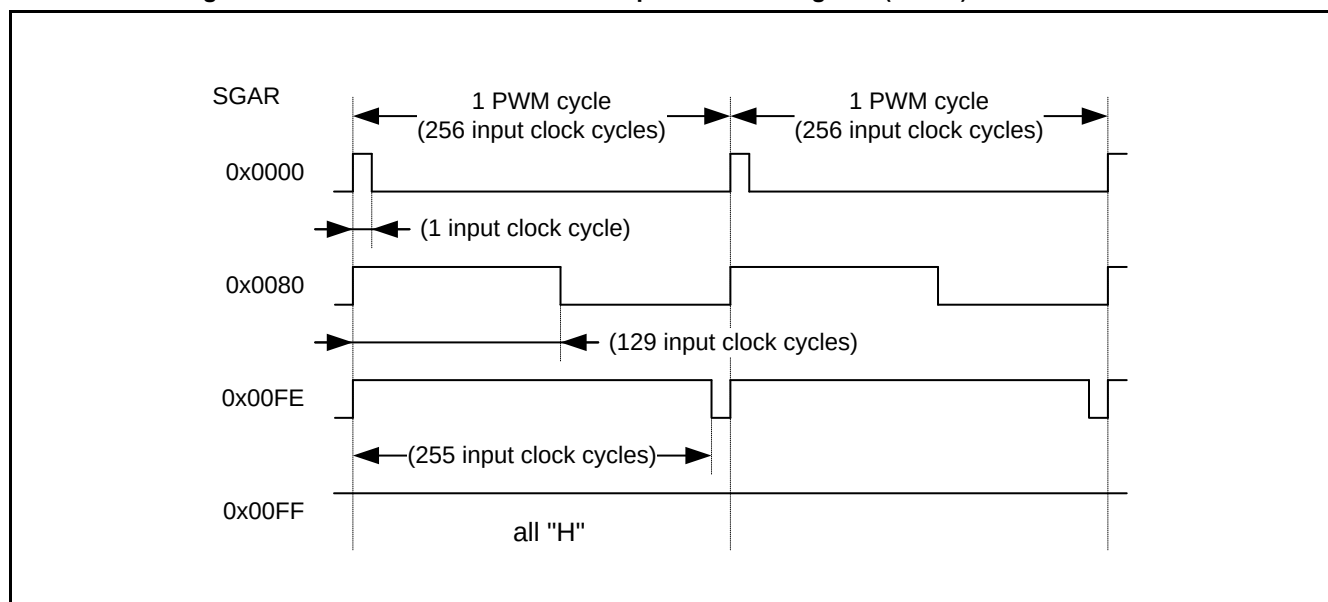
Each register, such as Amplitude Data Register, is supposed to be written at the following timing.

- Before starting signal output
- Each time after asserting an interrupt

3.1. Relation between the Amplitude Data Register (SGAR) and PWM Pulse

This section describes the relation between the Amplitude Data Register (SGAR) and a PWM pulse.

Figure 3-2 The Relation between the Amplitude Data Register (SGAR) and PWM Pulse



The amplitude data is output as a PWM (Pulse Width Modulation) waveform on the SGA pin.

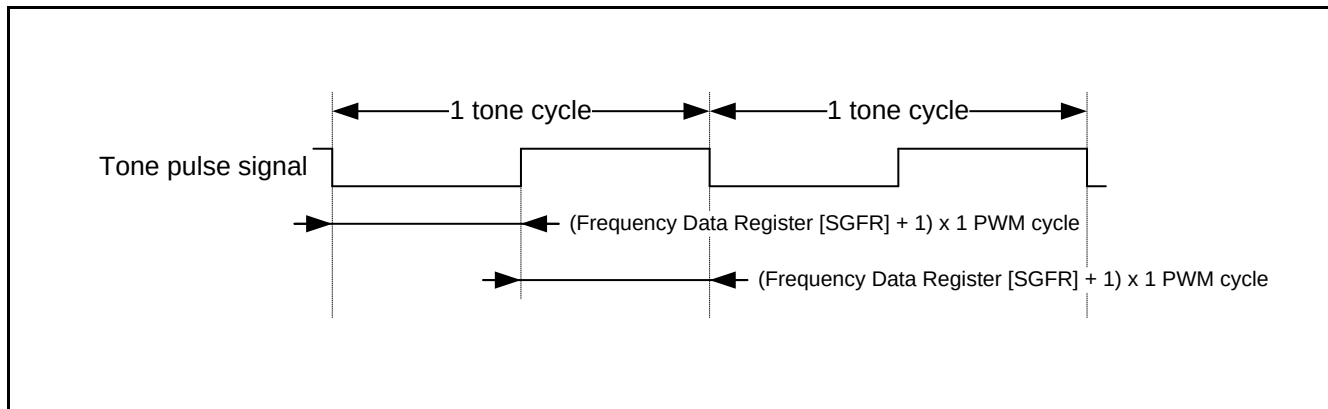
The length of a PWM cycle is programmable in the PWM Cycle Data Register (SGPCR). This length is based on the count of input clock. The initial value is 256 input clock cycle (SGPCR=0x00FF).

The value [Amplitude Data Register (SGAR) + 1] means the number of input clock cycles in which the SGA pin is "H" during 1 PWM cycle. Moreover, when the Amplitude Data Register (SGAR) is greater than or equal to the PWM Cycle Data Register (SGPCR), the SGA pin output is always "H".

3.2. Relation between the Frequency Data Register (SGFR) and Tone Pulse Signal

This section describes the relation between the Frequency Data Register (SGFR) and a tone pulse signal.

Figure 3-3 The Relation between the Frequency Data Register (SGFR) and Tone Pulse Signal



The tone pulse signal transits between "L" and "H" at every cycle of $(\text{Frequency Data Register [SGFR]} + 1) \times 1 \text{ PWM cycle}$. This signal is generated by an internal toggle flip-flop.

When the Tone output bit (TONE) of the Sound Control Register (SGCR) is "0", the tone pulse signal is mixed with a PWM pulse, and is output from the SGO pin. And when the Tone output bit (TONE) of the Sound Control Register (SGCR) is "1", the tone pulse signal is output without being mixed.

Note:

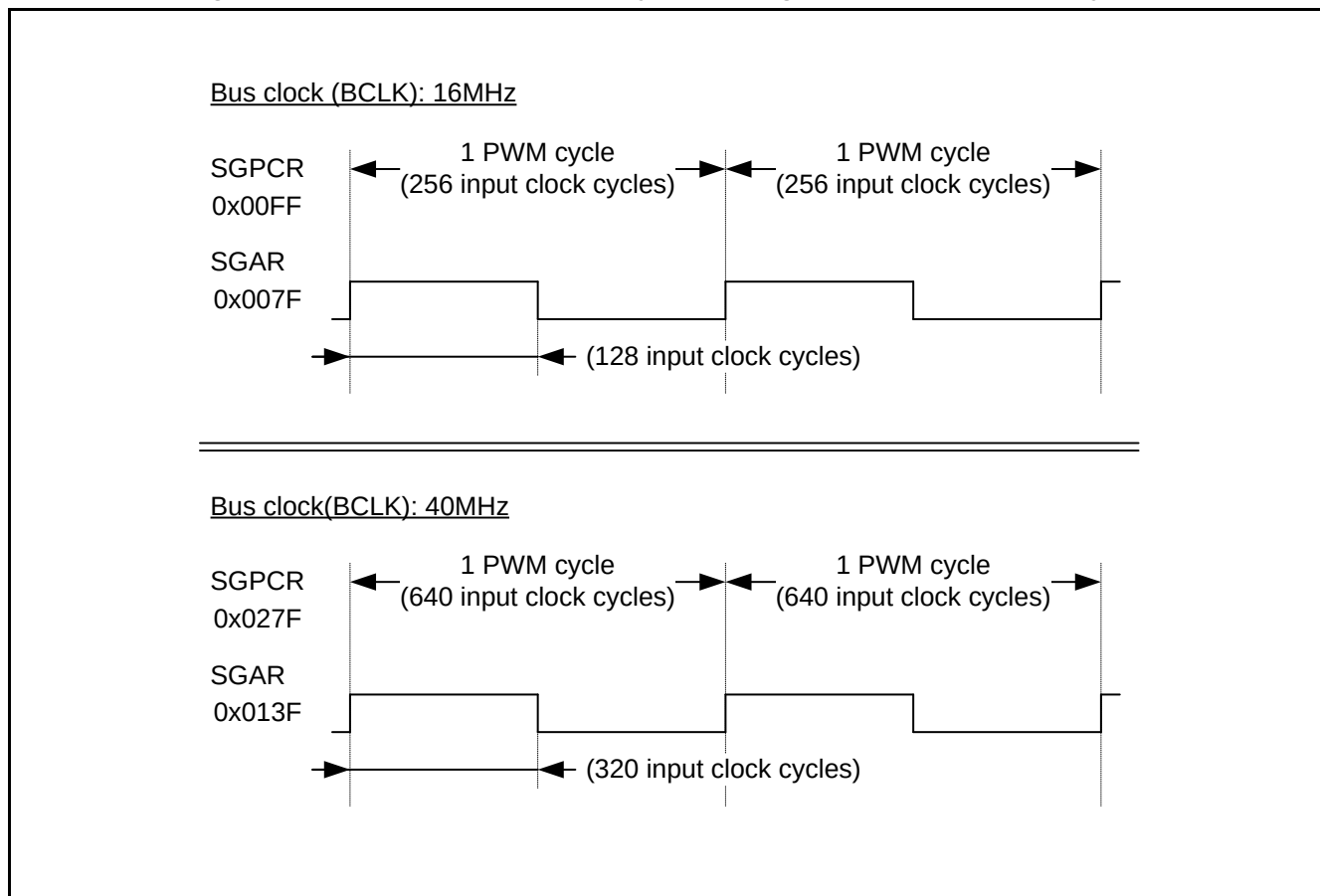
- During operation, in the case of changing a register value, meet the following either conditions.
 - (1) Sound generator is in the stop state ($\text{SGCR.BUSY} = "0"$).
 - (2) The changing comes between an interrupt occurrence and falling edge of the first tone pulse.
 (The limit time = $(\text{Frequency Data Register [SGFR]} + 1) \times 1 \text{ PWM cycle}$)

When it meets neither condition, the sound output cannot guarantee the expected duty ratio.

3.3. Relation between the PWM Cycle Data Register (SGPCR) and PWM Cycle

This section describes the relation between the PWM Cycle Data Register (SGPCR) and PWM cycle.

Figure 3-4 Relation between the PWM Cycle Data Register (SGPCR) and PWM Cycle



The length of a PWM cycle is programmable in the PWM Cycle Data Register (SGPCR). This length is based on the count of input clock, and defined as "PWM Cycle Data Register [SGPCR] + 1". The input clock is created by dividing the bus clock.

The PWM cycle is a reference clock for a tone pulse signal (or a mixed signal of the tone pulse signal and a PWM pulse signal), and a PWM pulse signal.

To generate the same sound output both by the bus clock at 16 MHz and 40 MHz, for example, it can be made by changing the values of the PWM Cycle Data Register (SGPCR) and the Amplitude Data Register (SGAR). Because the bus clock proportion of 16 MHz and 40 MHz is 1:2.5, the same sound can be made by setting the values of these two registers to 1:2.5.

3.4. Relation between the DMA Transfer Update Enable Register (SGDER) and DMA Settings

This section describes the relation between the DMA Transfer Update Enable Register (SGDER) and DMA settings.

3.4.1. The Number of DMA Transfers

DMA Transfer Update Enable Register (SGDER) determines the number of DMA transfer, once or twice.

If all of SGDER.ARE1, SGDER.ARE0, SGDER.FRE and SGDER.NRE are "0", or all of SGDER.TCRE, SGDER.IDRE, SGDER.PCRE1 and SGDER.PCRE0 are "0", the DMA transfer occurs only once. Otherwise, the DMA transfer occurs twice.

3.4.2. DMA Transfer Size

The DMA transfer size (1 byte, 2 bytes or 4 bytes) depends on the setting of the DMA Transfer Update Enable Register (SGDER).

The greater value of the following two becomes the DMA transfer size:

The value of SGDER.ARE1, SGDER.ARE0, SGDER.FRE, and SGDER.NRE,

The value of SGDER.TCRE, SGDER.IDRE, SGDER.PCRE1, and SGDER.PCRE0

The transfer size of 3 bytes is regarded as 4 bytes.

3.4.3. Transfer Byte Position in the DMA Transfer Intermediate Register (SGDMAR)

The DMA transfer byte position in the "DMA Transfer Intermediate Register (SGDMAR)" depends on the setting of the "DMA Transfer Update Enable Register (SGDER)" and the DMA transfer size.

If the size of a DMA transfer is less than 4 bytes, the byte position of DMA transfer is left-aligned.

The table below shows the relations between
"the setting of the DMA Transfer Update Enable Register (SGDER)"
and

"the byte position in the DMA Transfer Intermediate Register (SGDMAR)".

The byte position in the DMA Transfer Intermediate Register (SGDMAR) corresponds to the selection of the following registers.

- Amplitude Data Register (SGAR [15:0])
- Frequency Data Register (SGFR [7:0])
- Tone Output Number Register (SGNR [7:0])

The transfer size #1 is calculated by the setting of {SGDER.ARE1, SGDER.ARE0, SGDER.FRE, and SGDER.NRE} in the "DMA Transfer Update Enable Register (SGDER)". When this transfer size #1 is not 4 bytes, the transfer byte position is left-aligned.

Table 3-1 The Relations between the Setting of the DMA Transfer Update Enable Register (SGDER) and the Transfer Byte Position of SGDMAR #1

No.	Setting of SGDER				Transfer Size #1 *1	Transfer Byte Position of SGDMAR			
	ARE1	ARE0	FRE	NRE		SGAR [15:8]	SGAR [7:0]	SGFR [7:0]	SGNR [7:0]
1	0	0	0	0	0	-	-	-	-
2	1	0	0	0	1	SGDMAR [31:24]	-	-	-
3	0	1	0	0	1	-	SGDMAR [31:24]	-	-
4	1	1	0	0	2	SGDMAR [31:24]	SGDMAR [23:16]	-	-
5	0	0	1	0	1	-	-	SGDMAR [31:24]	-
6	1	0	1	0	2	SGDMAR [31:24]	-	SGDMAR [23:16]	-
7	0	1	1	0	2	-	SGDMAR [31:24]	SGDMAR [23:16]	-
8	1	1	1	0	4	SGDMAR [31:24]	SGDMAR [23:16]	SGDMAR [15:8]	-
9	0	0	0	1	1	-	-	-	SGDMAR [31:24]
10	1	0	0	1	2	SGDMAR [31:24]	-	-	SGDMAR [23:16]
11	0	1	0	1	2	-	SGDMAR [31:24]	-	SGDMAR [23:16]
12	1	1	0	1	4	SGDMAR [31:24]	SGDMAR [23:16]	-	SGDMAR [15:8]
13	0	0	1	1	2	-	-	SGDMAR [31:24]	SGDMAR [23:16]
14	1	0	1	1	4	SGDMAR [31:24]	-	SGDMAR [23:16]	SGDMAR [15:8]
15	0	1	1	1	4	-	SGDMAR [31:24]	SGDMAR [23:16]	SGDMAR [15:8]
16	1	1	1	1	4	SGDMAR [31:24]	SGDMAR [23:16]	SGDMAR [15:8]	SGDMAR [7:0]

*1: The transfer size which is calculated by the setting of SGDER.ARE1, SGDER.ARE0, SGDER.FRE, and SGDER.NRE.

- : Do not care.

The table below shows the relations between
 "the setting of the DMA Transfer Update Enable Register (SGDER)"
 and
 "the byte position in the DMA Transfer Intermediate Register (SGDMAR)".
 The byte position in the DMA Transfer Intermediate Register (SGDMAR) corresponds to the selection of the following registers.
 - Time Cycle Register (SGTCR[7:0])
 - Increase and Decrease Data Register (SGIDR[7:0])
 - PWM Cycle Data Register (SGPCR[15:0])

The transfer size #2 is calculated by the setting of {SGDER.TCRE, SGDER.IDRE, SGDER.PCRE1, and SGDER.PCRE0} in the DMA Transfer Update Enable Register (SGDER). When this transfer size #2 is not 4 bytes, the transfer byte position is left-aligned.

Table 3-2 The Relations between the Setting of the DMA Transfer Update Enable Register (SGDER) and Transfer Byte Position of SGDMAR #2

No.	Setting of SGDER				Transfer Size #2 *1	Transfer Byte Position of SGDMAR			
	TCRE	IDRE	PCRE1	PCRE0		SGTCR [7:0]	SGIDR [7:0]	SGPCR [15:8]	SGPCR [7:0]
1	0	0	0	0	0	-	-	-	-
2	1	0	0	0	1	SGDMAR [31:24]	-	-	-
3	0	1	0	0	1	-	SGDMAR [31:24]	-	-
4	1	1	0	0	2	SGDMAR [31:24]	SGDMAR [23:16]	-	-
5	0	0	1	0	1	-	-	SGDMAR [31:24]	-
6	1	0	1	0	2	SGDMAR [31:24]	-	SGDMAR [23:16]	-
7	0	1	1	0	2	-	SGDMAR [31:24]	SGDMAR [23:16]	-
8	1	1	1	0	4	SGDMAR [31:24]	SGDMAR [23:16]	SGDMAR [15:8]	-
9	0	0	0	1	1	-	-	-	SGDMAR [31:24]
10	1	0	0	1	2	SGDMAR [31:24]	-	-	SGDMAR [23:16]
11	0	1	0	1	2	-	SGDMAR [31:24]	-	SGDMAR [23:16]
12	1	1	0	1	4	SGDMAR [31:24]	SGDMAR [23:16]	-	SGDMAR [15:8]
13	0	0	1	1	2	-	-	SGDMAR [31:24]	SGDMAR [23:16]
14	1	0	1	1	4	SGDMAR [31:24]	-	SGDMAR [23:16]	SGDMAR [15:8]
15	0	1	1	1	4	-	SGDMAR [31:24]	SGDMAR [23:16]	SGDMAR [15:8]
16	1	1	1	1	4	SGDMAR [31:24]	SGDMAR [23:16]	SGDMAR [15:8]	SGDMAR [7:0]

*1: The transfer size which is calculated by the setting of SGDER.TCRE, SGDER.IDRE, SGDER.PCRE1, and SGDER.PCRE0.

- : Do not care.

3.4.4. DMA Transfer Image

This section shows an example of DMA transfer image, under the setting of DMA Transfer Update Enable Register (SGDER):

[SGDER.ARE1, SGDER.ARE0, SGDER.FRE, SGDER.NRE] ="1001"

[SGDER.TCRE, SGDER.IDRE, SGDER.PCRE1, SGDER.PCRE0] ="0100"

Condition:

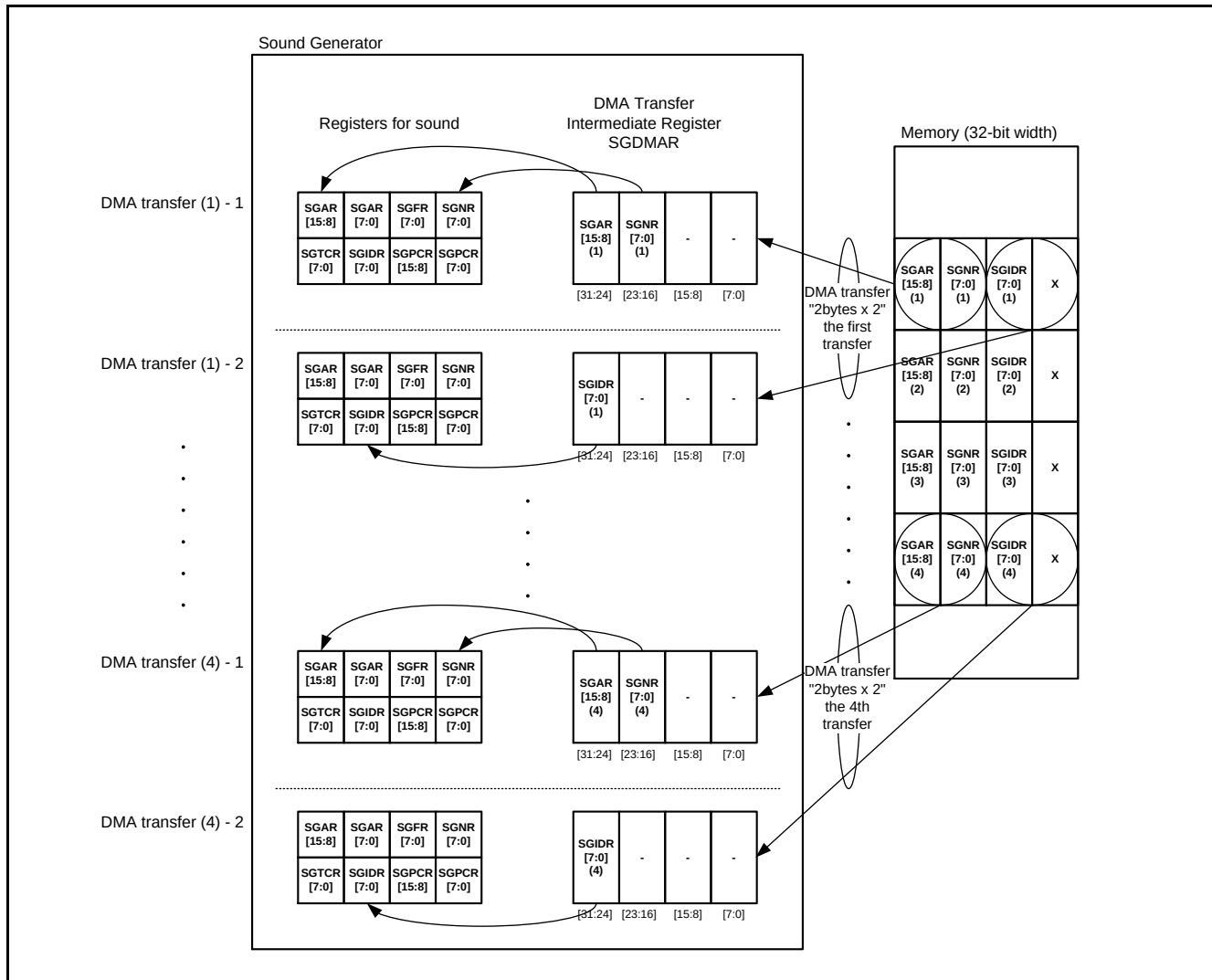
The number of times of DMA transfer : 2 times

DMA transfer size : 2 bytes

Transfer byte position of the DMA Transfer Intermediate Register (SGDMAR):

The first	SGDMAR[31:24]	← The amplitude data (upper byte) / SGAR[15:8]
	SGDMAR[23:16]	← The tone output number / SGNR[7:0]
	SGDMAR[15:0]	← Do not care
The second	SGDMAR[31:24]	← The increment and decrement data / SGIDR[7:0]
	SGDMAR[23:0]	← Do not care

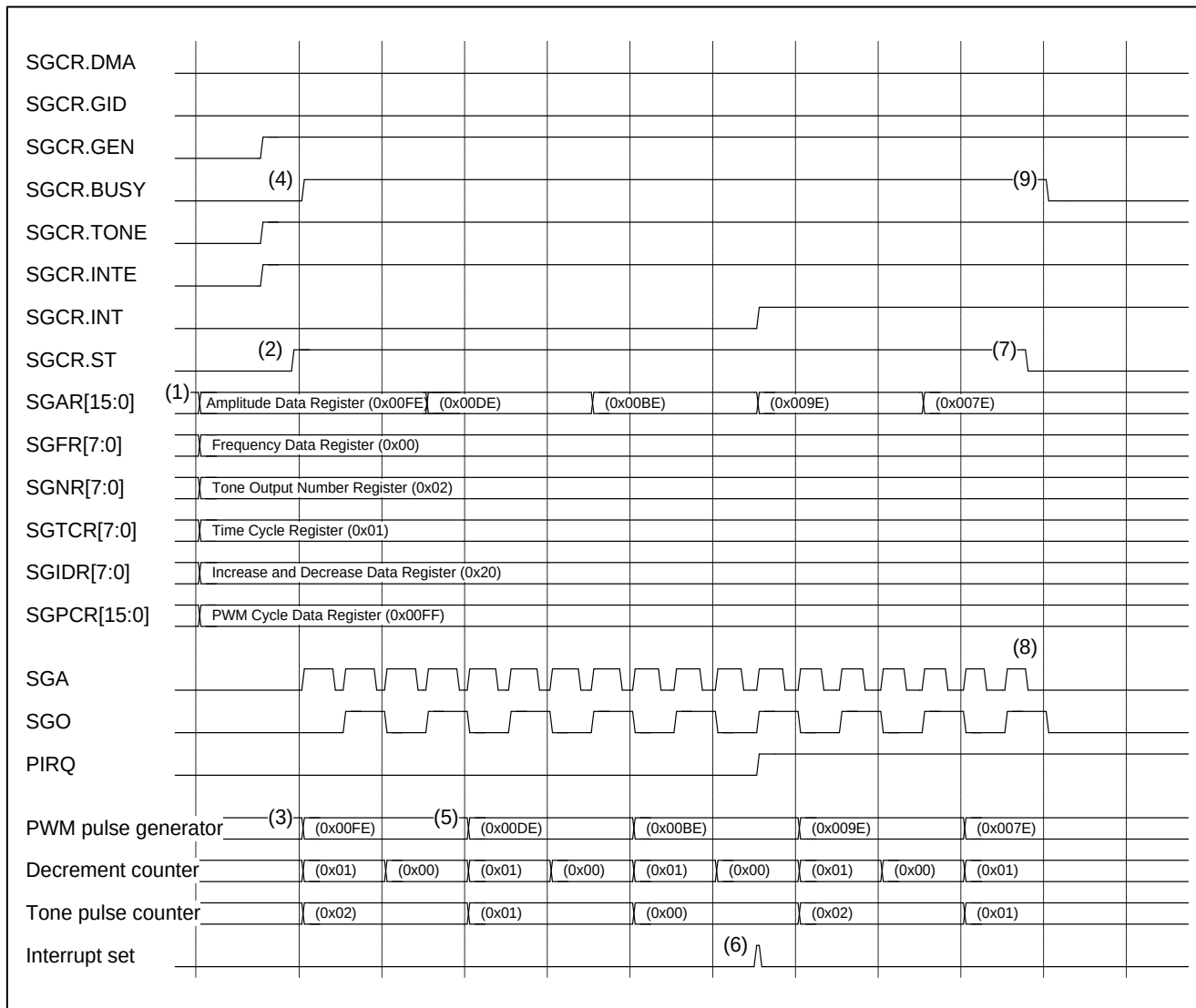
Figure 3-5 DMA Transfer Image



3.5. Sound Generator Operation

This section describes the Sound Generator operation as below

Figure 3-6 Sound Generator Operation



(1) The reload values are written to the Amplitude Data Register (SGAR), the Frequency Data Register (SGFR), the Tone Output Number Register (SGNR), and the Time Cycle Register (SGTCR) by software. Also the selection of increment and decrement of the amplitude is written to the Increase and Decrease Data Register (SGIDR) by software as well as the number of cycles in 1 PWM cycle to the PWM Cycle Data Register (SGPCR).

Moreover, set other information to the Sound Control Register (SGCR) to control the Sound Generator. Initialize the Interrupt status bit (SGCR.INT) and set the Interrupt enable bit (SGCR.INTE).

(2) Write "1" to the Start bit (SGCR.ST).

(3) By setting "1" to the Start bit (SGCR.ST), the Amplitude Data Register (SGAR) value is loaded into the PWM pulse generator, the Frequency Data Register (SGFR) value into the Frequency counter, the Tone Output Number Register (SGNR) value into the Tone pulse counter, the Time Cycle Register (SGTCR) value into the Decrement counter.

- (4) The operation flag (SGCR.BUSY) is automatically set.
- (5) Due to the operation that the Decrement counter counts the number of tone pulses until it reaches the reload value, the Amplitude Data Register (SGAR) value decreases according to the setting of the Automatic increase/decrease enable bit (SGCR.GEN) and the Increase/decrease setting bit (SGCR.GID).
- (6) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, it sets the Interrupt status bit (SGCR.INT) and asserts the Interrupt request (PIRQ).
 - Tone pulse counter is 0x00
 - Decrement counter is 0x00
 - At the rising edge of SGO
- (7) Write "0" to the Start bit (SGCR.ST). The Sound Generator keeps operating until the Busy status bit (SGCR.BUSY) turns "0".
- (8) The Sound Generator stops when the current tone cycle finishes.
- (9) The Busy status bit (SGCR.BUSY) turns "0".

DMA Transfer Start Interrupt Setting Enable Bit (SGCR.DMA)

To assert the first Interrupt request (PIRQ) after starting (SGCR.ST="1"), there are two modes for the request. And the selection depends on the setting of the "DMA transfer start interrupt setting enable bit (SGCR.DMA)".

- Normal mode :
When Sound Generator outputs the tone pulses, to the number programmed in the Time Cycle Register (SGTCR)
- DMA mode :
Immediately after the setting of Start bit (writing "1" to SGCR.ST)
(In this case, the Interrupt request (PIRQ) is regarded as the DMA transfer request.)

DMA Transfer

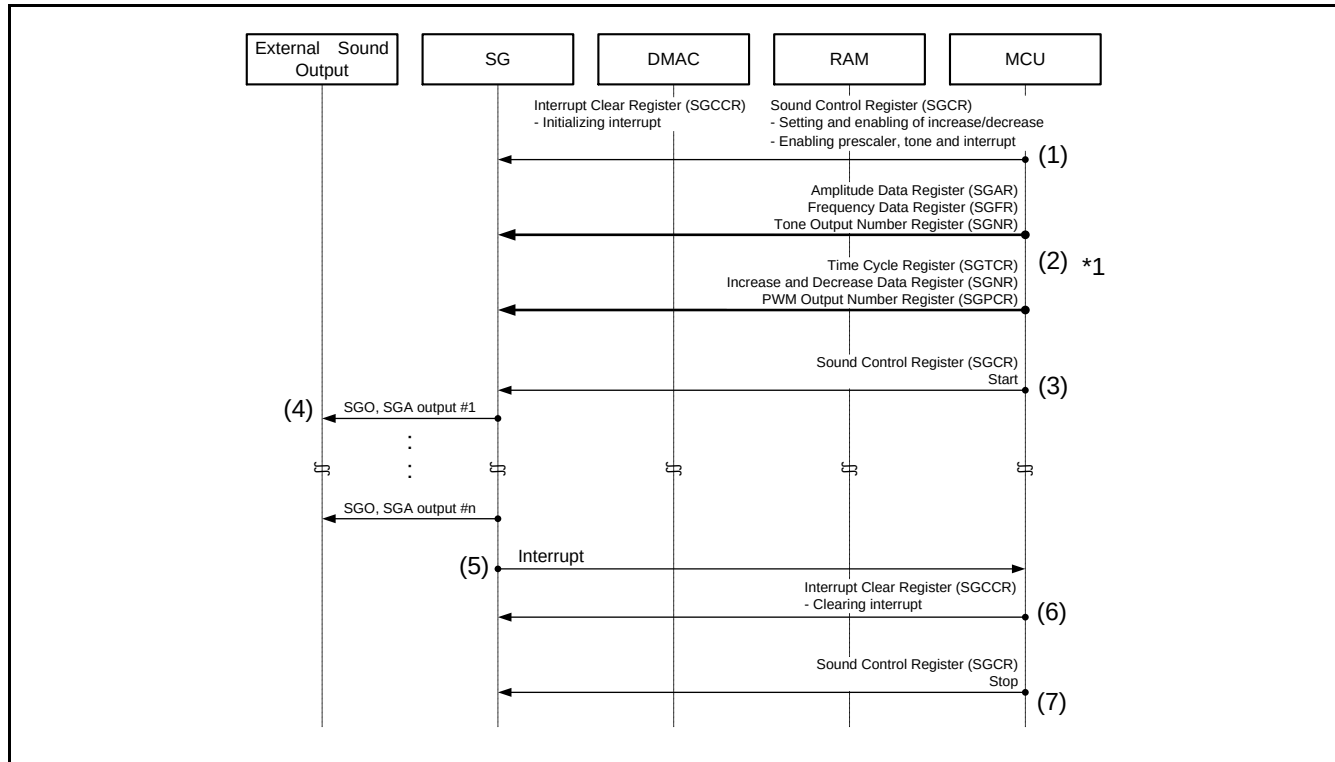
The following registers are set through the DMA Transfer Intermediate Register (SGDMAR).

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Time Cycle Register (SGTCR)
- Tone Output Number Register (SGNR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

3.5.1. Single Operation of Sound Generator by MCU

This section shows the single operation flow of the Sound Generator by MCU.

Figure 3-7 Single Operation of Sound Generator by MCU



(1) Set the information to control the Sound Generator to the Sound Control Register (SGCR) by software. Initialize the Interrupt status bit (SGCR.INT) and set the Interrupt enable bit (SGCR.INTE).

(2) Set registers "Amplitude Data Register (SGAR)", "Frequency Data Register (SGFR)", "Tone Output Number Register (SGNR)", "Time Cycle Register (SGTCR)", "Increase and Decrease Data Register (SGIDR)" and "PWM Cycle Data Register (SGPCR)" by software. (*1: Set only the necessary registers.)

(3) Write "1" to the Start bit (SGCR.ST).

(4) The outputs of SGO and SGA start.

(5) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

(6) MCU clears the interrupt.

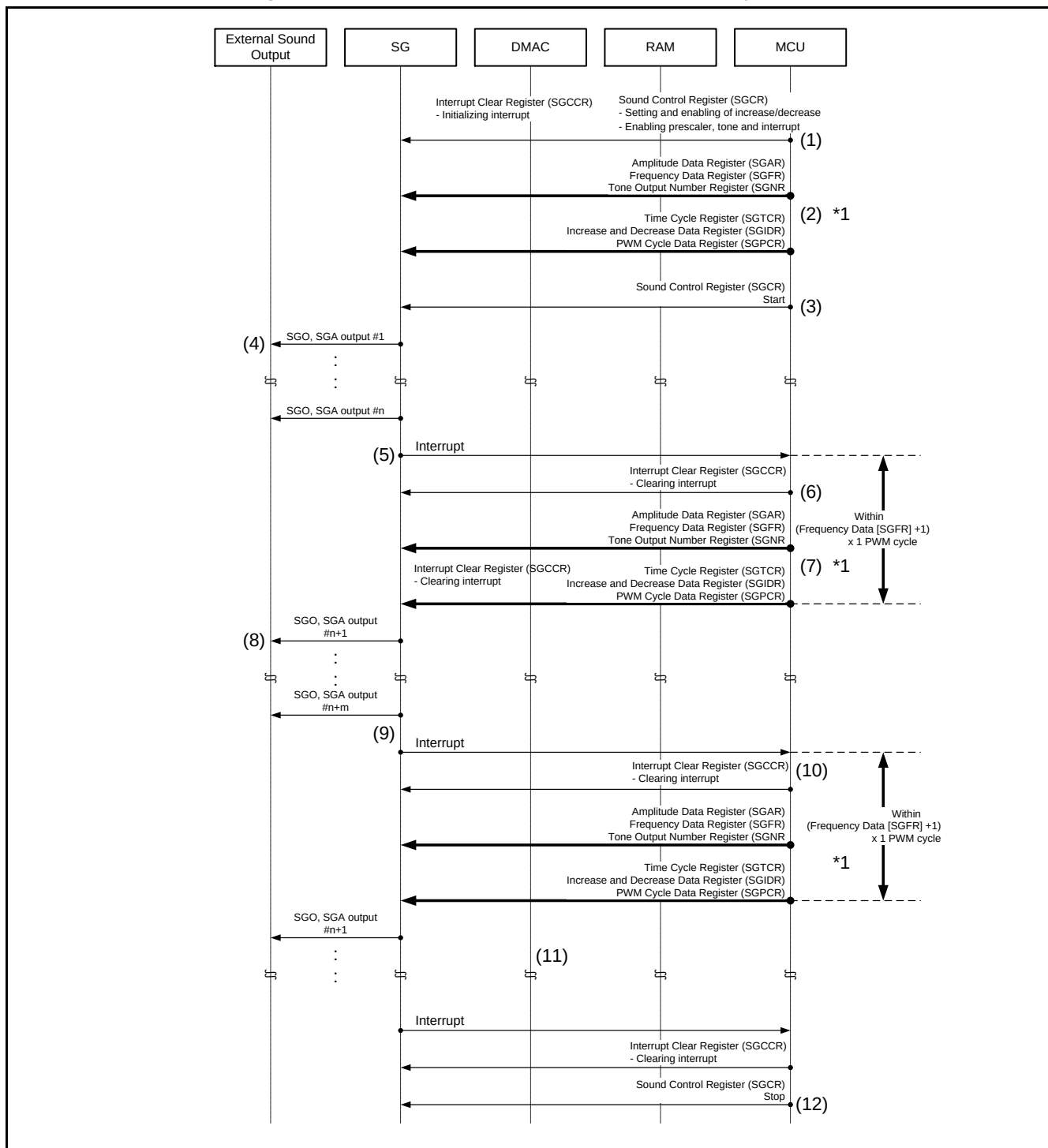
(7) Software writes "0" to the Stop bit (SGCR.ST) to stop outputting the sound.

3.6. Continuous Operation of Sound Generator by MCU

This section shows the continuous operation flow of the Sound Generator by MCU.

The flow from (7) is different from that of the single operation.

Figure 3-8 Continuous Operation of Sound Generator by MCU



- (1) Set the information to control the Sound Generator to the Sound Control Register (SGCR) by software. Initialize the Interrupt status bit (SGCR.INT) and set the Interrupt enable bit (SGCR.INTE).
- (2) Set registers "Amplitude Data Register (SGAR)", "Frequency Data Register (SGFR)", "Tone Output Number Register (SGNR)", "Time Cycle Register (SGTCR)", "Increase and Decrease Data Register (SGIDR)" and "PWM Cycle Data Register (SGPCR)" by software. (*1: Set only the necessary registers.)
- (3) Write "1" to the Start bit (SGCR.ST).
- (4) The outputs of SGO and SGA start.
- (5) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.
 - Tone pulse counter is 0x00
 - Decrement counter is 0x00
 - At the rising edge of SGO
- (6) MCU clears the interrupt.
- (7) Set registers "Amplitude Data Register (SGAR)", "Frequency Data Register (SGFR)", "Tone Output Number Register (SGNR)", "Time Cycle Register (SGTCR)", "Increase and Decrease Data Register (SGIDR)" and "PWM Cycle Data Register (SGPCR)" by software. (*1: Set only the necessary registers.)
- (8) The Sound Generator keeps outputting SGO and SGA, according to the register settings above.
- (9) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.
 - Tone pulse counter is 0x00
 - Decrement counter is 0x00
 - At the rising edge of SGO
- (10) MCU clears the interrupt.
- (11) Repeat the flow from 7 to 11 to continue outputting the sound.
- (12) Software writes "0" to the Start bit (SGCR.ST) to stop outputting the sound.

Notes:

- *The software must finish the procedure from step 5 to 7, within the following time.
The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle*
- *In case of switching the selection of increase/decrease, it is needed to write "Increase/decrease setting bit (SGCR.GID)" and the "Automatic increase/decrease enable bit (SGCR.GEN)" in the Sound Control Register (SGCR) within above-mentioned limit time.*

3.7. Sound Generator Operation with DMA

This section shows the flow of the Sound Generator operation with DMA.

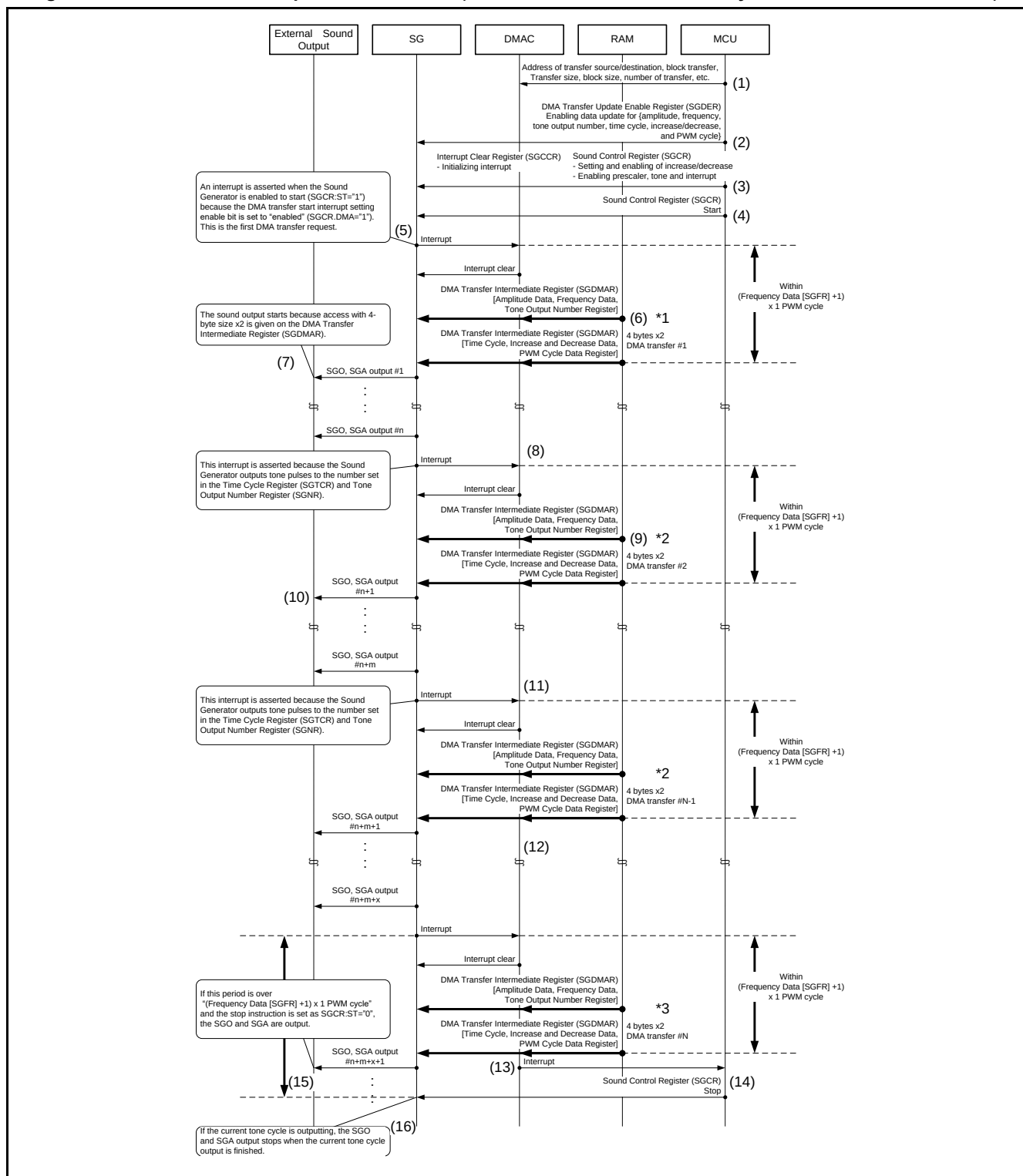
DMAC writes a register related to DMA in the Sound Generator. The timing of the first interrupt with DMA is different from the flow by MCU. The DMAC writes functional registers in the Sound Generator, through the DMA Transfer Intermediate Register (SGDMAR) which works as a window register.

Note:

- *Software needs to set the Interrupt enable bit (SGCR.INTE="1") in order to use the Interrupt request (PIRQ) as a DMA transfer request.*

3.7.1. In Case of DMA Transfer with 4-Byte Size x 2 Is Made N Times

Figure 3-9 Sound Generator Operation with DMA (When in DMA Transfer with 4-byte Size x 2 Is Made N Times)



(1) Software makes initial settings to those registers which are needed in DMA transfer. The DMA transfer is based on a block data of "4-byte size x 2", and this block can be repeated N times. DMAC sets following registers to prepare for a DMA transfer, through the "DMA Transfer Intermediate Register (SGDMAR)".

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)
- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

The destination address of the DMA transfer is a fixed one on the "DMA Transfer Intermediate Register (SGDMAR)".

(2) Software configures the "DMA Transfer Update Enable Register (SGDER)" to enable the automatic update of the following registers during DMA transfer.

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)
- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

(3) Software initialize Interrupt status bit (SGCR.INT) by writing "1" to Interrupt status clear bit (SGCCR.INTC). Then, the software configures the Sound Control Register (SGCR) in the needed mode, and this must include the following bit operations.

- DMA transfer start interrupt setting enable bit (SGCR.DMA) to "1"(enabled)
- Interrupt enable bit (SGCR.INTE) to "1"(enabled)

(4) Write "1" to the Start bit (SGCR.ST).

(5) The interrupt occurs immediately after setting Start bit (SGCR.ST), since the Sound Generator is enabled on DMA transfer (SGCR.DMA="1"). An Interrupt request (PIRQ) is asserted, and this interrupt is used as a DMA transfer request.

(6) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)". This operation configures the following registers by 2 steps.

[1st step]

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)

[2nd step]

- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

(*1: DMA block size must be "4-byte size x 2" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(7) The outputs of SGO and SGA start, according to the register settings above.

(8) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

(9) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)".

(*2: DMA block size must be "4-byte size x 2" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(10) The Sound Generator keeps outputting SGO and SGA, according to the register settings above.

(11) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

DMAC doesn't assert an interrupt to MCU until the DMAC completes all DMA transfer (with 4-byte size x2, N times).

(12) Repeat the flow from 9 to 11 to continue outputting the sound.

(13) When DMAC completes all DMA transfer (with 4-byte size x2, N times), it asserts an interrupt to MCU.

(14) Software writes "0" to the Start bit (SGCR.ST) to stop outputting the sound.

(15) When above operation (14) was made within the following time, the Nth DMA transfer doesn't come to the output of SGO and SGA. The Sound Generator stops driving SGO and SGA just before outputting the data of Nth DMA transfer.

The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle

(*3: The data of the Nth DMA transfer are written to the Sound Generator, however, they are not output. DMAC issues this Nth DMA transfer only to assert an interrupt toward the MCU.)

(16) If above (15) is not done within the limit time, the Sound Generator keeps driving SGO and SGA in order to output the data of the Nth DMA transfer. Then, the Sound Generator stops driving SGO and SGA after the end of all data.

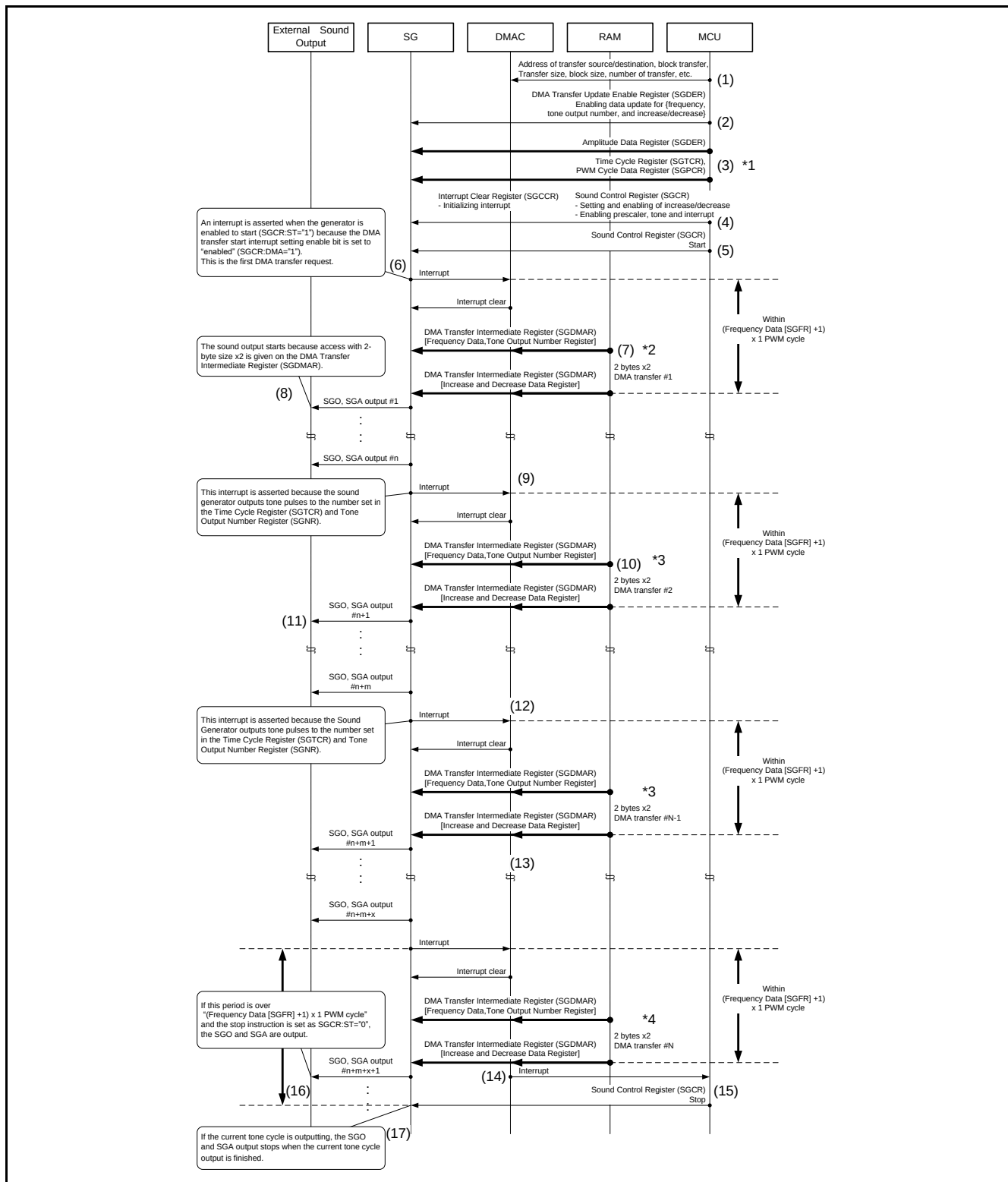
(*3: The data of the Nth DMA transfer are written to the Sound Generator, and they are output to the end.)

Notes:

- *The DMAC must finish the sequence from step 5 to 6, within the following time.
The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle*
- *The DMA transfer error means the occurrence of delay in the sound data setting. It causes unsteady sound output. In that case, please fix the priority of DMA transfer in the system to finish all data transfer within the limit time.*

3.7.2. In Case of DMA Transfer with 2-byte Size x 2 Is Made N Times

Figure 3-10 Sound Generator Operation with DMA (When DMA Transfer with 2-byte Size x 2 Is Made N Times)



(1) Software makes initial settings to those registers which are needed in DMA transfer. The DMA transfer is based on a block data of "2-byte size x 2", and this block can be repeated N times. DMAC sets following registers to prepare for a DMA transfer, through the "DMA Transfer Intermediate Register (SGDMAR)".

- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)
- Increase and Decrease Data Register (SGIDR)

The destination address of the DMA transfer is a fixed one on the "DMA Transfer Intermediate Register (SGDMAR)".

(2) Software configures the "DMA Transfer Update Enable Register (SGDER)" to enable the automatic update of the following registers during DMA transfer.

- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)
- Increase and Decrease Data Register (SGIDR)

(3) Software configures the "DMA Transfer Update Enable Register (SGDER)" to disable the automatic update of the following registers during DMA transfer.

- Amplitude Data Register (SGAR)
- Time Cycle Register (SGTCR)
- PWM Cycle Data Register (SGPCR)

(*1: Set values to these registers which are not automatically updated.)

(4) Software initialize Interrupt status bit (SGCR.INT) by writing "1" to Interrupt status clear bit (SGCCR.INTC). Then, the software configures the Sound Control Register (SGCR) in the needed mode, and this must include the following bit operations.

- DMA transfer start interrupt setting enable bit (SGCR.DMA) to "1"(enabled)
- Interrupt enable bit (SGCR.INTE) to "1"(enabled)

(5) Write "1" to the Start bit (SGCR.ST).

(6) The interrupt occurs immediately after setting Start bit (SGCR.ST), since the Sound Generator is enabled on DMA transfer (SGCR.DMA="1"). An Interrupt request (PIRQ) is asserted, and this interrupt is used as a DMA transfer request.

(7) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)". This operation configures the following registers by 2 steps.

[1st step]

- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)

[2nd step]

- Increase and Decrease Data Register (SGIDR)

(*2: DMA block size must be "2-byte size x 2" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(8) The outputs of SGO and SGA start, according to the register settings above.

(9) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

(10) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)".

(*3: DMA block size must be "2-byte size x 2" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(11) The Sound Generator keeps outputting SGO and SGA, according to the register settings above.

(12) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

DMAC doesn't assert an interrupt to MCU until the DMAC completes all DMA transfer (with 2-byte size x2, N times).

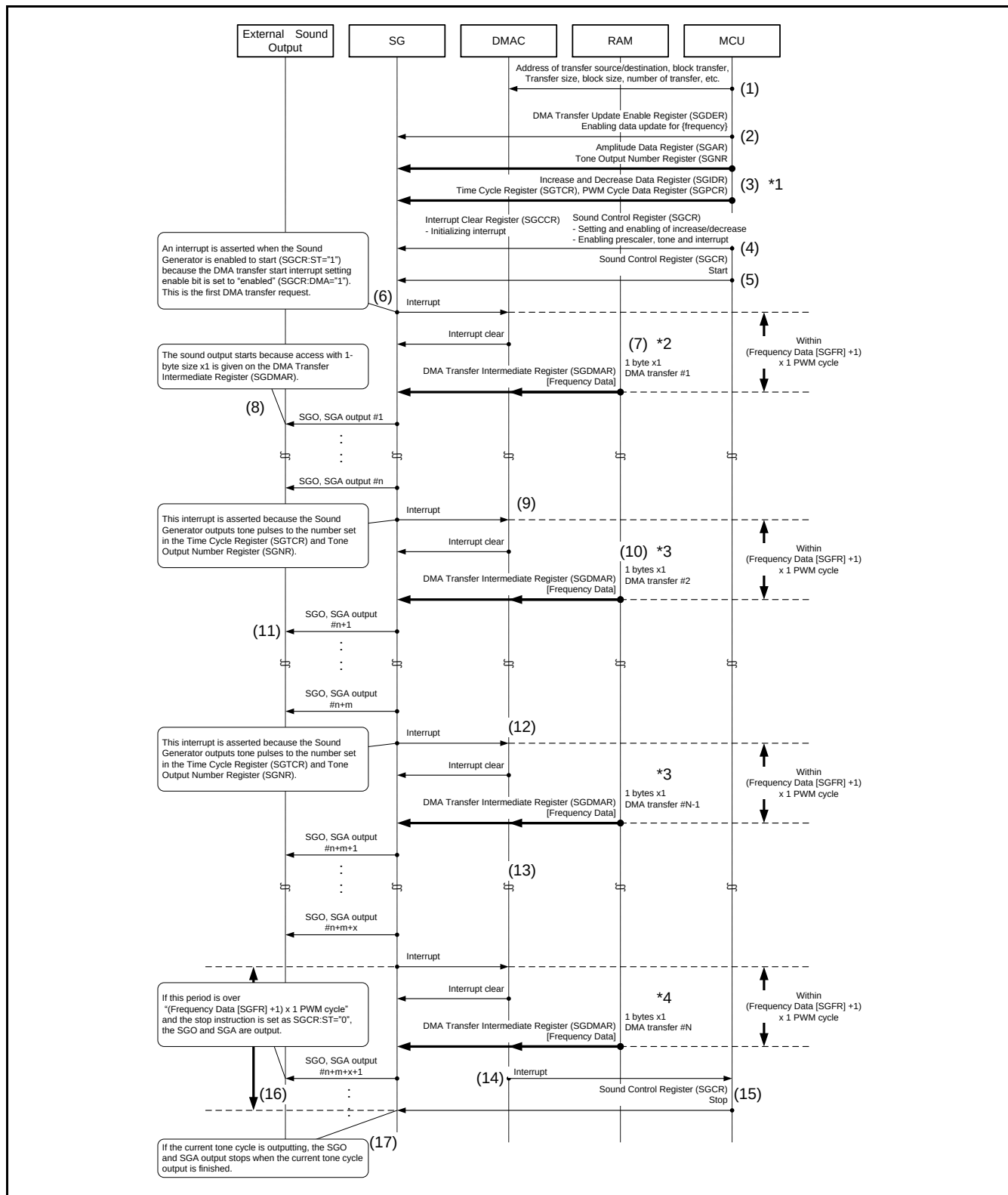
- (13) Repeat the flow from 10 to 12 to continue outputting the sound.
- (14) When DMAC completes all DMA transfer (with 2-byte size x2, N times), it asserts an interrupt to MCU.
- (15) Software writes "0" to the Start bit (SGCR.ST) to stop outputting the sound.
- (16) When above operation (15) was made within the following time, the Nth DMA transfer doesn't come to the output of SGO and SGA. The Sound Generator stops driving SGO and SGA just before outputting the data of Nth DMA transfer.
The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle
(*4: The data of the Nth DMA transfer are written to the Sound Generator, however, they are not output. DMAC issues this Nth DMA transfer only to assert an interrupt toward the MCU.)
- (17) If above (16) is not done within the limit time, the Sound Generator keeps driving SGO and SGA in order to output the data of the Nth DMA transfer. Then, the Sound Generator stops driving SGO and SGA after the end of all data.
(*4: The data of the Nth DMA transfer are written to the Sound Generator, and they are output to the end.)

Notes:

- *The DMAC must finish the sequence from step 6 to 7, within the following time.
The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle*
- *The DMA transfer error means the occurrence of delay in the sound data setting. It causes unsteady sound output. In that case, please fix the priority of DMA transfer in the system to finish all data transfer within the limit time.*

3.7.3. In Case of DMA Transfer with 1-byte Size x 1 Is Made N Times

Figure 3-11 Sound Generator Operation with DMA (When in DMA Transfer with 1-byte Size x 1 Is Made N Times)



(1) Software makes initial settings to those registers which are needed in DMA transfer. The DMA transfer is based on a block data of "1-byte size x 2", and this block can be repeated N times. DMAC sets following registers to prepare for a DMA transfer, through the "DMA Transfer Intermediate Register (SGDMAR)".

- Frequency Data Register (SGFR)

The destination address of the DMA transfer is a fixed one on the "DMA Transfer Intermediate Register (SGDMAR)".

(2) Software configures the "DMA Transfer Update Enable Register (SGDER)" to enable the automatic update of the following registers during DMA transfer.

- Frequency Data Register (SGFR)

(3) Software configures the "DMA Transfer Update Enable Register (SGDER)" to disable the automatic update of the following registers during DMA transfer.

- Amplitude Data Register (SGAR)
- Tone Output Number Register (SGNR)
- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

(*1: Set values to these registers which are not automatically updated.)

(4) Software initialize Interrupt status bit (SGCR.INT) by writing "1" to Interrupt status clear bit (SGCCR.INTC). Then, the software configures the Sound Control Register (SGCR) in the needed mode, and this must include the following bit operations.

- DMA transfer start interrupt setting enable bit (SGCR.DMA) to "1"(enabled)
- Interrupt enable bit (SGCR.INTE) to "1"(enabled)

(5) Write "1" to the Start bit (SGCR.ST).

(6) The interrupt occurs immediately after setting Start bit (SGCR.ST), since the Sound Generator is enabled on DMA transfer (SGCR.DMA="1"). An Interrupt request (PIRQ) is asserted, and this interrupt is used as a DMA transfer request.

(7) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)". This operation configures the following register.

- Frequency Data Register (SGFR)

(*2: DMA block size must be "1-byte size x 1" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(8) The outputs of SGO and SGA start, according to the register settings above.

(9) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

(10) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)".

(*3: DMA block size must be "1-byte size x 1" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(11) The Sound Generator keeps outputting SGO and SGA, according to the register settings above.

(12) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

DMAC doesn't assert an interrupt to MCU until the DMAC completes all DMA transfer (with 1-byte size x1, N times).

(13) Repeat the flow from 10 to 12 to continue outputting the sound.

(14) When DMAC completes all DMA transfer (with 1-byte size x1, N times), it asserts an interrupt to MCU.

(15) Software writes "0" to the Start bit (SGCR.ST) to stop outputting the sound.

(16) When above operation (15) was made within the following time, the Nth DMA transfer doesn't come to the output of SGO and SGA. The Sound Generator stops driving SGO and SGA just before outputting the data of Nth DMA transfer.

The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle

(*4: The data of the Nth DMA transfer are written to the Sound Generator, however, they are not output. DMAC issues this Nth DMA transfer only to assert an interrupt toward the MCU.)

(17) If above (16) is not done within the limit time, the Sound Generator keeps driving SGO and SGA in order to output the data of the Nth DMA transfer. Then, the Sound Generator stops driving SGO and SGA after the end of all data.

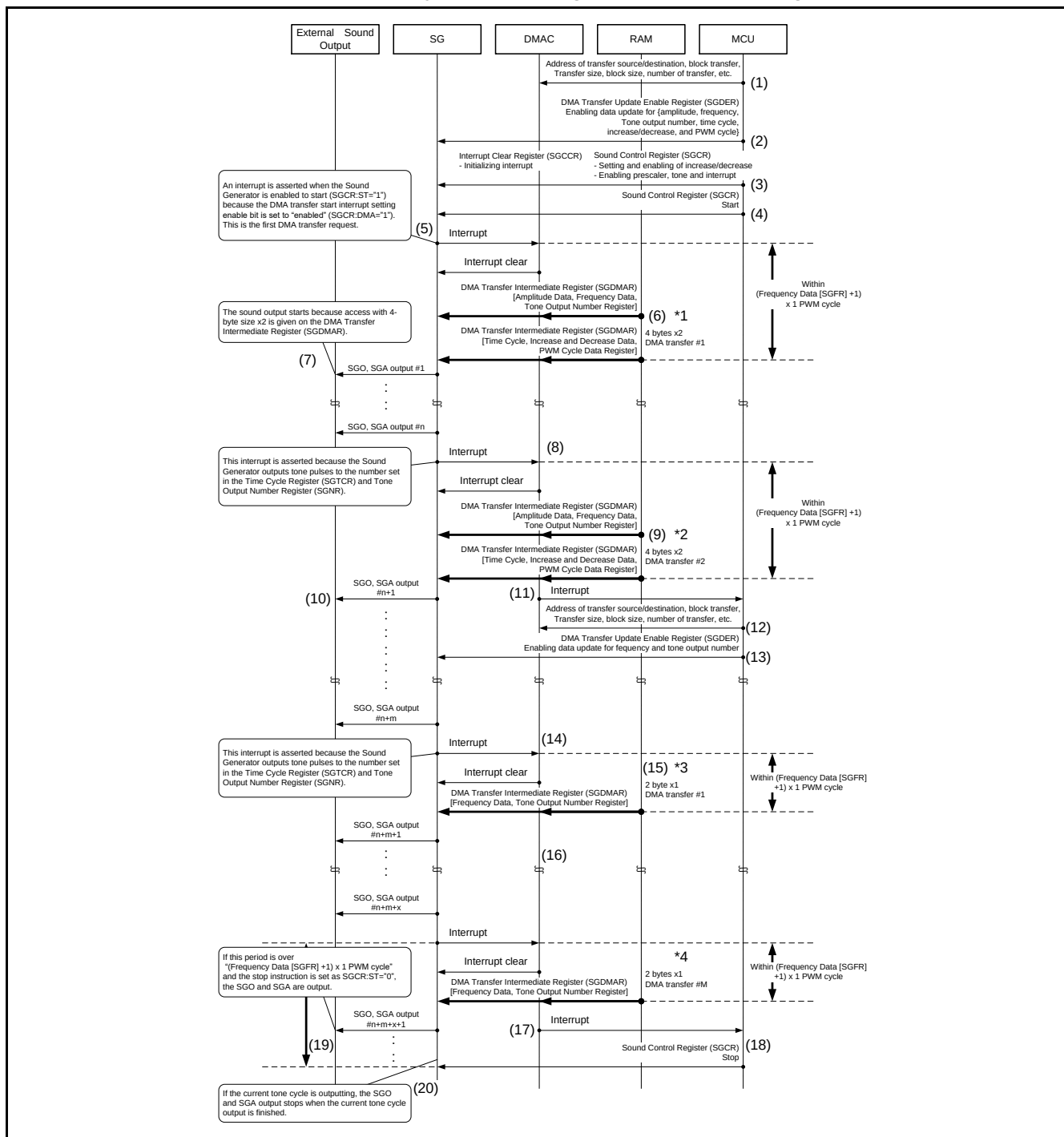
(*4: The data of the Nth DMA transfer are written to the Sound Generator, and they are output to the end.)

Notes:

- *The DMAC must finish the sequence from step 6 to 7, within the following time.
The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle*
- *The DMA transfer error means the occurrence of delay in the sound data setting. It causes unsteady sound output. In that case, please fix the priority of DMA transfer in the system to finish all data transfer within the limit time.*

3.7.4. In Case of DMA Transfer with 4-byte Size x 2 Is Made N Times and DMA Transfer with 2-byte Size x 1 Is Made M Times (The Case the Transfer Byte Size Is Changed while Sound Outputting)

Figure 3-12 Sound Generator Operation with DMA
 (The Case the Transfer Byte Size Is Changed while Sound Is Being Output)



(1) Software makes initial settings to those registers which are needed in DMA transfer. The DMA transfer is based on a block data of "4-byte size x 2", and this block can be repeated N times. DMAC sets following registers to prepare for a DMA transfer, through the "DMA Transfer Intermediate Register (SGDMAR)".

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)
- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

The destination address of the DMA transfer is a fixed one on the "DMA Transfer Intermediate Register (SGDMAR)".

(2) Software configures the "DMA Transfer Update Enable Register (SGDER)" to enable the automatic update of the following registers during DMA transfer.

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)
- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

(3) Software initialize Interrupt status bit (SGCR.INT) by writing "1" to Interrupt status clear bit (SGCCR.INTC). Then, the software configures the Sound Control Register (SGCR) in the needed mode, and this must include the following bit operations.

- DMA transfer start interrupt setting enable bit (SGCR.DMA) to "1"(enabled)
- Interrupt enable bit (SGCR.INTE) to "1"(enabled)

(4) Write "1" to the Start bit (SGCR.ST).

(5) The interrupt occurs immediately after setting Start bit (SGCR.ST), since the Sound Generator is enabled on DMA transfer (SGCR.DMA="1"). An Interrupt request (PIRQ) is asserted, and this interrupt is used as a DMA transfer request.

(6) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)". This operation configures the following registers by 2 steps.

[1st step]

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)

[2nd step]

- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

(*1: DMA block size must be "4-byte size x 2" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(7) The outputs of SGO and SGA start, according to the register settings above.

(8) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

(9) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)".

(*2: DMA block size must be "4-byte size x 2" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(10) The Sound Generator keeps outputting SGO and SGA, according to the register settings above.

(11) When DMAC completes all DMA transfer (with 4-byte size x2, N times), it asserts an interrupt to MCU.

(12) Software makes settings to those registers which are needed in DMA transfer. The DMA transfer is based on a block data of "2-byte size x 1", and this block can be repeated M times. DMAC sets following registers to prepare for a DMA transfer, through the "DMA Transfer Intermediate Register (SGDMAR)".

- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)

The destination address of the DMA transfer is a fixed one on the "DMA Transfer Intermediate Register (SGDMAR)".

(13) Software configures the "DMA Transfer Update Enable Register (SGDER)" to enable the automatic update of the following registers during DMA transfer.

- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)

(14) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

(15) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)".

(*3: DMA block size must be "2-byte size x 1" for the access to "DMA Transfer Intermediate Register (SGDMAR)".)

(16) Repeat the flow from 14 to 15 to continue outputting the sound.

(17) When DMAC completes all DMA transfer (with 2-byte size x1, M times), it asserts an interrupt to MCU.

(18) Software writes "0" to the Start bit (SGCR.ST) to stop outputting the sound.

(19) When above operation (18) was made within the following time, the Mth DMA transfer doesn't come to the output of SGO and SGA. The Sound Generator stops driving SGO and SGA just before outputting the data of Nth DMA transfer.

The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle

(*4: The data of the Mth DMA transfer are written to the Sound Generator, however, they are not output. DMAC issues this Mth DMA transfer only to assert an interrupt toward the MCU.)

(20) If above (19) is not done within the limit time, the Sound Generator keeps driving SGO and SGA in order to output the data of the Mth DMA transfer. Then, the Sound Generator stops driving SGO and SGA after the end of all data.

(*4: The data of the Mth DMA transfer are written to the Sound Generator, and they are output to the end.)

Notes:

- The DMAC must finish the sequence from step 5 to 6, within the following time.
The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle
- The DMA transfer error means the occurrence of delay in the sound data setting. It causes unsteady sound output. In that case, please fix the priority of DMA transfer in the system to finish all data transfer within the limit time.

Figure 3-13 Sound Generator Operation with DMA
(The Case the Transfer Byte Size and Increase/Decrease Setting Is Changed while Sound Is Being Output)



(1) Software makes initial settings to those registers which are needed in DMA transfer. The DMA transfer is based on a block data of "4-byte size x 2", and this block can be repeated N times. DMAC sets following registers to prepare for a DMA transfer, through the "DMA Transfer Intermediate Register (SGDMAR)".

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)
- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

The destination address of the DMA transfer is a fixed one on the "DMA Transfer Intermediate Register (SGDMAR)".

(2) Software configures the "DMA Transfer Update Enable Register (SGDER)" to enable the automatic update of the following registers during DMA transfer.

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)
- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

(3) Software initialize Interrupt status bit (SGCR.INT) by writing "1" to Interrupt status clear bit (SGCCR.INTC). Then, the software configures the Sound Control Register (SGCR) in the needed mode, and this must include the following bit operations.

- DMA transfer start interrupt setting enable bit (SGCR.DMA) to "1"(enabled)
- Interrupt enable bit (SGCR.INTE) to "1"(enabled)

(4) Write "1" to the Start bit (SGCR.ST).

(5) The interrupt occurs immediately after setting Start bit (SGCR.ST), since the Sound Generator is enabled on DMA transfer (SGCR.DMA="1"). An Interrupt request (PIRQ) is asserted, and this interrupt is used as a DMA transfer request.

(6) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)". This operation configures the following registers by 2 steps.

[1st step]

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)

[2nd step]

- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

(*1: DMA block size must be "4-byte size x 2" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(7) The outputs of SGO and SGA start, according to the register settings above.

(8) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

(9) DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)".

(*2: DMA block size must be "4-byte size x 2" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(10) The Sound Generator keeps outputting SGO and SGA, according to the register settings above.

(11) When DMAC completes all DMA transfer (with 4-byte size x2, N times), it asserts an interrupt to MCU.

(12) Change the increase/decrease setting of the Sound Control Register (SGCR) by software (SGCR.GID).

(13) Software makes settings to the DMAC. The DMA transfer is based on a block data of "4-byte size x 2 cycle", and this block can be repeated M times.

(14) The Sound Generator keeps outputting SGO and SGA.

(15) The Tone pulse counter counts the number of tone pulses. When the following conditions are satisfied, the interrupt is generated.

- Tone pulse counter is 0x00
- Decrement counter is 0x00
- At the rising edge of SGO

Then, DMAC clears the interrupt, and write registers in the Sound Generator through the "DMA Transfer Intermediate Register (SGDMAR)".

(*2: DMA block size must be "4-byte size x 2" for the access to "DMA Transfer Intermediate Register (SGDMAR)")

(16) Repeat the step 15 to continue outputting the sound.

(17) When DMAC completes all DMA transfer (with 4-byte size x2, M times), it asserts an interrupt to MCU.

(18) Software writes "0" to the Start bit (SGCR.ST) to stop outputting the sound.

(19) When above operation (18) was made within the following time, the Mth DMA transfer doesn't come to the output of SGO and SGA. The Sound Generator stops driving SGO and SGA just before outputting the data of Nth DMA transfer.

The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle

(*4: The data of the Mth DMA transfer are written to the Sound Generator, however, they are not output. DMAC issues this Mth DMA transfer only to assert an interrupt toward the MCU.)

(20) If above (19) is not done within the limit time, the Sound Generator keeps driving SGO and SGA in order to output the data of the Mth DMA transfer. Then, the Sound Generator stops driving SGO and SGA after the end of all data.

(*4: The data of the Mth DMA transfer are written to the Sound Generator, and they are output to the end.)

Notes:

- The DMAC must finish the sequence from step 5 to 6, within the following time.
The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle
- The DMA transfer error means the occurrence of delay in the sound data setting. It causes unsteady sound output. In that case, please fix the priority of DMA transfer in the system to finish all data transfer within the limit time.
- The DMAC must finish the sequence from step 8 to 12 (including the time for changing "the increase/decrease setting"), within the following time. The increase/decrease setting change comes into effect on the sound output from step 14, using the data of the Mth transfer with 4-byte size x 2.
The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle

3.8. Interrupt of Sound Generator

The interrupt from Sound Generator comes from the judgment of counting tone pulses.

Interrupt of Sound Generator

The interrupt control bit and its factor is shown in the following table.

Table 3-3 The Interrupt Bit of Sound Generator and Its Factor

	Interrupt bit of Sound Generator (singular)
Interrupt status bit	Register: Sound Control Register (SGCR) Bit: Interrupt status bit (INT: bit1)
Interrupt enable bit	Register: Sound Control Register (SGCR) Bit: Interrupt enable bit (INTE: bit2)
Interrupt factor	Tone pulse count is greater than or equal to (Time Cycle Register [SGTCR] + 1) x (Tone Output Number Register [SGNR] + 1)

During the tone pulses are counted, when the count reaches the multiple of "Time Cycle Register [SGTCR] + 1" and "Tone Output Number Register [SGNR] + 1", the Interrupt status bit (SGCR.INT) is set. When the interrupt is allowed by the setting of SGCR.INTE, an Interrupt request (PIRQ) is subsequently asserted (to be "H").

4. Registers

This chapter shows the list of registers in Sound Generator.

Registers of Sound Generator

Table 4-1 The List of Registers of Sound Generator

Contracted Name	Register Name	Reference
SGDER	DMA Transfer Update Enable Register	4.1
SGCR	Sound Control Register	4.2
SGAR	Amplitude Data Register	4.3
SGFR	Frequency Data Register	4.4
SGNR	Tone Output Number Register	4.5
SGTCR	Time Cycle Register	4.6
SGIDR	Increase and Decrease Data Register	4.7
SGPCR	PWM Cycle Data Register	4.8
SGDMAR	DMA Transfer Intermediate Register	4.9
SGCCR	Interrupt Clear Register	4.10

The Meaning of the Register Bit Property Code

Table 4-2 The Meaning of the Register Bit Property Code

R	Read-Only Register. Only Read access is available, and Write access is ignored.
W	Write-Only Register. Only Write access is available, and Read access makes nothing.
R/W	Read/Write Register. Both Read access and Write access are available.
-	Both Read access and Write access make nothing.

■ Register Offset Address Map

OFFSET_ADDRESS	REGISTER_NAME				ACCESS_SIZE
	+3	+2	+1	+0	
0x00000000	Reserved	SGDER	SGCR		B, H, W
0x00000004	SGAR		SGFR	SGNR	B, H, W
0x00000008	SGTCR	SGIDR	SGPCR		B, H, W
0x0000000C	SGDMAR				B, H, W
0x00000010	Reserved		SGCCR		H, W

4.1. DMA Transfer Update Enable Register (SGDER)

The DMA Transfer Update Enable Register (SGDER) is to enable the update of the registers (SGAR, SGFR, SGNR, SGTGR, SGIDR, SGPCR) which can be updated when in DMA transfer.

This setting is made for respective registers.

The Sound Generator identifies the register to be updated by DMA transfer according to the setting of this register.

It also recognizes the number of times of DMA transfer and the transfer byte size according to the setting of this register, as well as the valid byte position of the DMA Transfer Intermediate Register (SGDMAR).

bit	7	6	5	4	3	2	1	0
Field	ARE1	ARE0	FRE	NRE	TCRE	IDRE	PCRE1	PCRE0
Attribute	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Initial value	0	0	0	0	0	0	0	0

[bit7] ARE1 : Amplitude data (upper byte) update enable bit

This bit is to enable the update of the amplitude data (upper byte) of the Amplitude Data Register (SGAR) through the DMA Transfer Intermediate Register when in DMA transfer.

Bit	Description
0	The update of the amplitude data (upper byte) is disabled.
1	The update of the amplitude data (upper byte) is enabled.

[bit6] ARE0 : Amplitude data (lower byte) update enable bit

This bit is to enable the update of the amplitude data (lower byte) of the Amplitude Data Register (SGAR) through the DMA Transfer Intermediate Register when in DMA transfer.

Bit	Description
0	The update of the amplitude data (lower byte) is disabled.
1	The update of the amplitude data (lower byte) is enabled.

[bit5] FRE : Frequency data update enable bit

This bit is to enable the update of the frequency data of the Frequency Data Register (SGFR) through the DMA Transfer Intermediate Register when in DMA transfer.

Bit	Description
0	The update of the frequency data is disabled.
1	The update of the frequency data is enabled.

[bit4] NRE : Tone output number update enable bit

This bit is to enable the update of the tone output number of the Tone Output Number Register (SGNR) through the DMA Transfer Intermediate Register when in DMA transfer.

Bit	Description
0	The update of the tone output number is disabled.
1	The update of the tone output number is enabled.

[bit3] TCRE : Time cycle update enable bit

This bit is to enable the update of the time cycle of the Time Cycle Register (SGTCR) through the DMA Transfer Intermediate Register when in DMA transfer.

Bit	Description
0	The update of the time cycle is disabled.
1	The update of the time cycle is enabled.

[bit2] IDRE : Increase and decrease data update enable bit

This bit is to enable the update of the increase and decrease data of the Increase and Decrease Data Register (SGIDR) through the DMA Transfer Intermediate Register when in DMA transfer.

Bit	Description
0	The update of the increase and decrease data is disabled.
1	The update of the increase and decrease data is enabled.

[bit1] PCRE1 : PWM cycle data (upper byte) update enable bit

This bit is to enable the update of the PWM cycle data (upper byte) of the PWM Cycle Data Register (SGPCR) through the DMA Transfer Intermediate Register when in DMA transfer.

Bit	Description
0	The update of the PWM cycle data (upper byte) is disabled.
1	The update of the PWM cycle data (upper byte) is enabled.

[bit0] PCRE0 : PWM cycle data (lower byte) update enable bit

This bit is to enable the update of the PWM cycle data (lower byte) of the PWM Cycle Data Register (SGPCR) through the DMA Transfer Intermediate Register when in DMA transfer.

Bit	Description
0	The update of the PWM cycle data (lower byte) is disabled.
1	The update of the PWM cycle data (lower byte) is enabled.

4.2. Sound Control Register (SGCR)

The Sound Control Register (SGCR) is to control interrupts and operation status of the Sound Generator.

bit	15	14	13	12	11	10	9	8
Field	Reserved	SRST	DMA	GID	GEN	Reserved	BUSY	Reserved
Attribute	-	W	R/W	R/W	R/W	-	R	-
Initial value	0	0	0	0	0	0	0	0

bit	7	6	5	4	3	2	1	0
Field	S1	S0	TONE	SGOOE	SGAOE	INTE	INT	ST
Attribute	R/W	R/W	R/W	R/W	R/W	R/W	R	R/W
Initial value	0	0	0	0	0	0	0	0

[bit15] Reserved : Reserved bit

Always write "0" to this bit. The read value is "0".

[bit14] SRST : Software reset bit

This bit is used to issue a software reset in the Sound Generator.

When in the read access, the read value is always "0". Writing "0" to this bit has no effect.

Bit	Description
	Write
0	No effect.
1	Writing "1" issues a software reset.

[bit13] DMA : DMA transfer start interrupt setting enable bit

This bit is to enable DMA transfer start interrupt.

Bit	Description
0	Writing "1" to the Start bit (ST) does not make the Interrupt status bit (INT) set.
1	Writing "1" to the Start bit (ST) makes the Interrupt status bit (INT) set.

Note:

- Do not change this setting while operating (ST="1").

[bit12] GID : Increase/decrease setting bit

This bit is for automatic increase/decrease setting of the sound, working with the Time Cycle Register (SGTCR), the Increase and Decrease Data Register (SGIDR), and the automatic increase/decrease enable bit (GEN).

This bit determines whether the value of Amplitude Data Register (SGAR) increases or decreases.

Bit	Description
0	The value stored in the Amplitude Data Register (SGAR) decreases.
1	The value stored in the Amplitude Data Register (SGAR) increases.

Notes:

- This bit is valid only when the automatic increase/decrease enable bit is set to "enabled" (GEN="1").
- If this bit is changed during the operation, it is reflected at the time when the value of "Amplitude Data Register (SGAR)" is automatically updated.

[bit11] GEN : Automatic increase/decrease enable bit

This bit is for automatic increase/decrease setting of the sound, working with the Time Cycle Register (SGTCR), the Increase and Decrease Data Register (SGIDR), and the Increase/decrease setting bit (GID).

Bit	Description
0	The automatic increase or decrease is disabled.
1	The automatic increase or decrease is enabled.

Note:

- When this bit turns from "enabled" to "disabled", the Amplitude Data Register (SGAR) holds the value at that time.

[bit10] Reserved : Reserved bit

Always write "0" to this bit. The read value is "0".

[bit9] BUSY : Busy status bit

This bit is to indicate whether the Sound Generator is in operation or not.

This bit is only for read access, and the write access to this bit has no effect.

Bit	Description
	Read
0	Sound Generator is inactive. This bit is cleared under any of following conditions. - Software reset is set (SRST="1"). - ST bit is cleared by writing "0". And the operation is completed after 1 tone cycle (current tone cycle) has finished.
1	Sound Generator is active. This bit is set when ST bit is written "1".

[bit8] Reserved : Reserved bit

Always write "0" to this bit. The read value is "0".

[bit7:6] S1, S0 : Operation clock select bits

The combination of these bits controls the internal clock division, to determine the bit rate on the output sound.

S1	S0	Description
0	0	The division ratio at the Prescaler is 1.
0	1	The division ratio at the Prescaler is 2.
1	0	The division ratio at the Prescaler is 4.
1	1	The division ratio at the Prescaler is 8..

[bit5] TONE : Tone output bit

This bit controls the type of SGO output signal.

Bit	Description
0	SGO outputs the mixed signal of tone pulse and PWM pulse.
1	SGO outputs a simple square wave (tone pulse), that is generated by the internal toggle flip-flop.

[bit4] SGOOE : SGO signal output enable bit

This bit controls whether to enable the output of SGO.

Bit	Description
0	SGO output is disabled.
1	SGO output is enabled.

[bit3] SGAOE : SGA signal output enable bit

This bit controls whether to enable the output of SGA.

Bit	Description
0	SGA output is disabled.
1	SGA output is enabled.

[bit2] INTE : Interrupt enable bit

This bit enables the interrupt request of the Sound Generator.

Bit	Description
0	The interrupt by INT bit is masked, and the status of INT bit is not reflected to the output on PIRQ.

1	The interrupt by INT bit is not masked, and the status of INT bit is reflected to the output on PIRQ.
---	---

[bit1] INT : Interrupt status bit

This is an interrupt flag of the Sound Generator.

This bit is only for read access, and the write access to this bit has no effect.

Bit	Description	
	Read	Write
0	Sound Generator hasn't detected the end of tone pulses. This bit is cleared under any of following conditions. - Software reset is set (SRST="1"). - DMA transfer - Interrupt Clear bit is set (SGCCR.INTC="1")	No effect.
1	Sound Generator has detected the end of tone pulses. This bit is set under the following condition. - The number of tone pulse count is greater than or equal to (Time Cycle Register [SGTCR] + 1) x (Tone Output Number Register [SGNR] + 1)	No effect.

[bit0] ST : Start bit

This bit is a start trigger of the Sound Generator.

Bit	Description
0	Writing "0" to this bit stops Sound Generator.
1	Writing "1" to this bit starts Sound Generator.

Notes:

- Whether the Sound Generator is stopped or not can be seen on the status bit BUSY.
- This bit is cleared also when a software reset is issued (SRST = "1").

4.3. Amplitude Data Register (SGAR)

The Amplitude Data Register (SGAR) stores the reload value for a PWM pulse generator.

The register value represents sound amplitude and is reloaded into the PWM pulse generator at the end of every tone cycle.

bit	15	14	13	12	11	10	9	8
Field	SGAR[15:8]							
Attribute	R/W							
Initial value	0x00							

bit	7	6	5	4	3	2	1	0
Field	SGAR[7:0]							
Attribute	R/W							
Initial value	0x00							

[bit15:0] SGAR : Amplitude data bits

These bits store the reload value for the PWM pulse generator, and the value is written either in the following ways.

- (1) Software writes a value to this register.
- (2) DMAC writes a value through DMA Transfer Intermediate Register (SGDMAR).

When in decreasing the value of this register, 0x0000 is the lower limit and the value doesn't roll over to 0xFFFF from it.

When in increasing the value of this register, 0xFFFF is the upper limit and the value doesn't roll over to 0x0000 from it.

In any case, the Sound Generator keeps operating until the Start bit (SGCR.ST) is cleared.

Notes:

- The number of clock cycles in high width of 1 PWM is equal to "SGAR + 1".
- During operation, in the case of changing a register value, meet the following either conditions.
 - (1) Sound generator is in the stop state (SGCR.BUSY="0").
 - (2) The changing comes between an interrupt occurrence and falling edge of the first tone pulse.
 (The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle)
 When it meets neither condition, the sound output cannot guarantee the expected duty ratio.

4.4. Frequency Data Register (SGFR)

The Frequency Data Register (SGFR) stores the reload value for a Frequency counter.

bit	7	6	5	4	3	2	1	0
Field	SGFR[7:0]							
Attribute	R/W							
Initial value	0x00							

[bit7:0] SGFR : Frequency data bits

These bits store the reload value for the Frequency counter, and the value is written either in the following ways.

- (1) Software writes a value to this register.
- (2) DMAC writes a value through DMA Transfer Intermediate Register (SGDMAR).

Notes:

- The number of PWM pulses is equal to "SGFR + 1".
- During operation, in the case of changing a register value, meet the following either conditions.
 - (1) Sound generator is in the stop state (SGCR.BUSY="0").
 - (2) The changing comes between an interrupt occurrence and falling edge of the first tone pulse.
 (The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle)
 When it meets neither condition, the sound output cannot guarantee the expected duty ratio.

4.5. Tone Output Number Register (SGNR)

The Tone Output Number Register (SGNR) stores the reload value for a Tone pulse counter.

The Tone pulse counter accumulates the number of tone pulses (or the number of sound increment/decrement). When the accumulated value reaches the reload value, it sets the Interrupt status bit (SGCR.INT). This operation is to reduce the frequency of interrupts.

bit	7	6	5	4	3	2	1	0
Field	SGNR[7:0]							
Attribute	R/W							
Initial value	0x00							

[bit7:0] SGNR : Tone output number bits

These bits store the reload value for the Tone pulse counter, and the value is written either in the following ways.

- (1) Software writes a value to this register.
- (2) DMAC writes a value through DMA Transfer Intermediate Register (SGDMAR).

Notes:

- The number of pulses is equal to "SGNR + 1".
- During operation, in the case of changing a register value, meet the following either conditions.
 - (1) Sound generator is in the stop state (SGCR.BUSY="0").
 - (2) The changing comes between an interrupt occurrence and falling edge of the first tone pulse.
 (The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle)
 When it meets neither condition, the sound output cannot guarantee the expected duty ratio.

4.6. Time Cycle Register (SGTCR)

The Time Cycle Register (SGTCR) stores the reload value for a Decrement counter.

bit	7	6	5	4	3	2	1	0
Field	SGTCR[7:0]							
Attribute	R/W							
Initial value	0x00							

[bit7:0] SGTCR : Time cycle bits

These bits store the reload value for the Decrement counter, and the value is written either in the following ways.

- (1) Software writes a value to this register.
- (2) DMAC writes a value through DMA Transfer Intermediate Register (SGDMAR).

Notes:

- The number of pulses is equal to "SGTCR + 1".
- When SGTCR is 0x00, the automatic increase or decrease operation on the Amplitude Data Register (SGAR) occurs at each tone cycle.
- During operation, in the case of changing a register value, meet the following either conditions.
 - (1) Sound generator is in the stop state (SGCR.BUSY="0").
 - (2) The changing comes between an interrupt occurrence and falling edge of the first tone pulse.
 (The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle)
 When it meets neither condition, the sound output cannot guarantee the expected duty ratio.

4.7. Increase and Decrease Data Register (SGIDR)

The Increase and Decrease Data Register (SGIDR) stores the increment or decrement for the Amplitude Data Register (SGIDR).

bit	7	6	5	4	3	2	1	0
Field	SGIDR[7:0]							
Attribute	R/W							
Initial value	0x00							

[bit7:0] SGIDR : Increase and decrease data bits

These bits store the increment or decrement for the Amplitude Data Register (SGAR) , and the value is written either in the following ways.

- (1) Software writes a value to this register.
- (2) DMAC writes a value through DMA Transfer Intermediate Register (SGDMAR).

Note:

- During operation, in the case of changing a register value, meet the following either conditions.
 - (1) Sound generator is in the stop state (SGCR.BUSY="0").
 - (2) The changing comes between an interrupt occurrence and falling edge of the first tone pulse.
 (The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle)
 When it meets neither condition, the sound output cannot guarantee the expected duty ratio.

4.8. PWM Cycle Data Register (SGPCR)

The PWM Cycle Data Register (SGPCR) stores the number of cycles in 1 PWM cycle.

bit	15	14	13	12	11	10	9	8
Field	SGPCR[15:8]							
Attribute	R/W							
Initial value	0x00							

bit	7	6	5	4	3	2	1	0
Field	SGPCR[7:0]							
Attribute	R/W							
Initial value	0xFF							

[bit15:0] SGPCR : PWM cycle number data bits

These bits store the number of cycles in 1 PWM cycle, and the value is written either in the following ways.

- (1) Software writes a value to this register.
- (2) DMAC writes a value through DMA Transfer Intermediate Register (SGDMAR).

Notes:

- The number of cycles in 1 PWM is equal to "SGPCR + 1".
- During operation, in the case of changing a register value, meet the following either conditions.
 - (1) Sound generator is in the stop state (SGCR.BUSY="0").
 - (2) The changing comes between an interrupt occurrence and falling edge of the first tone pulse.
(The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle)
 When it meets neither condition, the sound output cannot guarantee the expected duty ratio.

4.9. DMA Transfer Intermediate Register (SGDMAR)

The DMA Transfer Intermediate Register (SGDMAR) is available in DMA transfer, and works as a window to access several registers. The details are described in "3.4 Relation between the DMA Transfer Update Enable Register (SGDER) and DMA ".

bit	31	30	29	28	27	26	25	24
Field	SGDMAR[31:24]							
Attribute	W							
Initial value	0x00							

bit	23	22	21	20	19	18	17	16
Field	SGDMAR[23:16]							
Attribute	W							
Initial value	0x00							

bit	15	14	13	12	11	10	9	8
Field	SGDMAR[15:8]							
Attribute	W							
Initial value	0x00							

bit	7	6	5	4	3	2	1	0
Field	SGDMAR[7:0]							
Attribute	W							
Initial value	0x00							

[bit31:0] SGDMAR : DMA Transfer data bits

This register is used to write the following registers:

- Amplitude Data Register (SGAR)
- Frequency Data Register (SGFR)
- Tone Output Number Register (SGNR)
- Time Cycle Register (SGTCR)
- Increase and Decrease Data Register (SGIDR)
- PWM Cycle Data Register (SGPCR)

The details are described in "3.4 Relation between the DMA Transfer Update Enable Register (SGDER) and DMA ".

The read value is always 0x00000000.

Notes:

- If the number of DMA transfer is greater than "the number determined by the DMA Transfer Update Enable Register (SGDER)", the value of this register is updated.
- When in reading corresponding registers (not through this register), please make sure the setting of "DMA Transfer Update Enable Register (SGDER)" is available for the target registers.
- As for the enabled setting register of the DMA Transfer Update Enable Register (SGDER), access is enabled to both the DMA Transfer Intermediate Register (SGDMAR) and individual registers (SGAR, SGFR, SGNR, SGTCR, SGIDR, SGPCR).
- During operation, in the case of changing a register value, meet the following either conditions.
 - (1) Sound generator is in the stop state (SGCR.BUSY="0").
 - (2) The changing comes between an interrupt occurrence and falling edge of the first tone pulse.
 (The limit time = (Frequency Data Register [SGFR] + 1) x 1 PWM cycle)
 When it meets neither condition, the sound output cannot guarantee the expected duty ratio.

4.10. Interrupt Clear Register (SGCCR)

The Interrupt Clear Register (SGCCR) clears the Interrupt status bit (SGCR.INT) in the Sound Control Register (SGCR).

bit	15	14	13	12	11	10	9	8
Field	Reserved							
Attribute	-							
Initial value	0x00							

bit	7	6	5	4	3	2	1	0
Field	Reserved						INTC	Reserved
Attribute	-						W	-
Initial value	0x00						0	0

Note:

- Use 16- or 32-bit data access for the SGCCR register.

[bit15:2] Reserved : Reserved bits

Always write "0" to these bits. The read value is "0".

[bit1] INTC : Interrupt status clear bit

When this bit is set, Interrupt status bit (SGCR.INT) is cleared.

The read value is "0".

Bit	Description
	Write
0	No effect.
1	Interrupt status bit (SGCR.INT) is cleared.

[bit0] Reserved : Reserved bit

Always write "0" to this bit. The read value is "0".

CHAPTER 19: Sound Waveform Generator



This chapter explains the sound waveform generator.

1. Overview
2. Configuration and Block Diagram
3. Operation of the Sound Waveform Generator
4. Registers

CODE: SOUNDWFG-E1.05-0

1. Overview

This section gives a brief overview of the sound waveform generator (SWFG).

Also refer to the chapter of "Sound System configuration" how to configure the SWFG..

The SWFG is a function that generates and outputs a Pulse Code Modulation (PCM) sound source using simple software settings.

Table 1-1

Feature	Description
Output frequency	64 types (scales) settable by software.
Output waveform	Sine wave, sawtooth wave, and square wave selectable by software.
Volume control (fade in and fade out functions)	Seamless fade in and fade out by software are supported immediately after generation starts and immediately before generation ends.
Sound time	A time from 1 ms to 4 seconds selectable by software.
Number of output channels	Simultaneous output of up to five different sound sources is supported.
Interrupt	Completion of sound source output generates an interrupt.
Consecutive setting	While a sound source is being generated, register settings for generating the next sound source can be configured.
Output data pattern	Generates a 16-bit PCM (Pulse Code Modulation) sound source XXXX internally by the SWFG, expands it to 32 bits, and outputs it (AHB master interface). The output data pattern can be selected by register settings. - XXXX_XXXX: Upper and lower 16 bits are the same data. - 0000_XXXX: Only lower 16 bits of data (Upper 16 bits are zero.) - XXXX_0000: Only upper 16 bits of data (Lower 16 bits are zero.)
Output sampling rate	48 kHz (fixed).
FIR filter	A Low Pass Filter is provided to eliminate sawtooth and square waveform overtones. The filtering cutoff frequency is selectable.

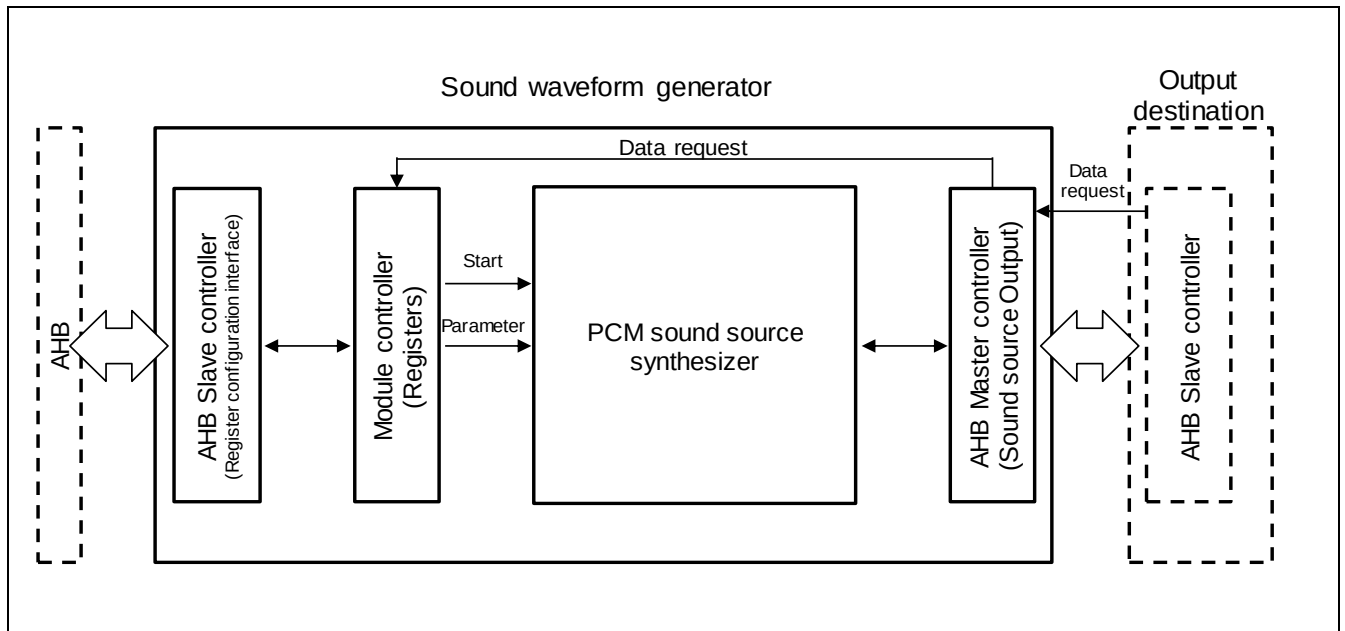
Notes:

- *Theoretically, system noise tends not to be a factor in the case of a sine wave that contains single frequency components. Use of a sine wave is particularly recommended when sound source mixing or other processes are performed by other functions.*
- *Interrupts due to factors other than sound source output completion are also supported. For details, see 3.2.*
- *Continuous sound (continuation of the same sound or different sound) can be generated by configuring the settings of the next sound's parameters while a sound source is being generated. However, when repeatedly generating the same sound the same parameters settings need to be configured.*
- *Use of the Low Pass Filter can be disabled. When using the Low Pass Filter, the optimum cutoff frequency should be decided upon sufficient evaluation of sound quality on the system.*

2. Configuration and Block Diagram

This section shows a block diagram of the sound waveform generator.

Figure 2-1



3. Operation of the Sound Waveform Generator

3.1. Sound Source Specifications

This section describes the specifications of a sound source generated by SWFG.

Figure 3-1

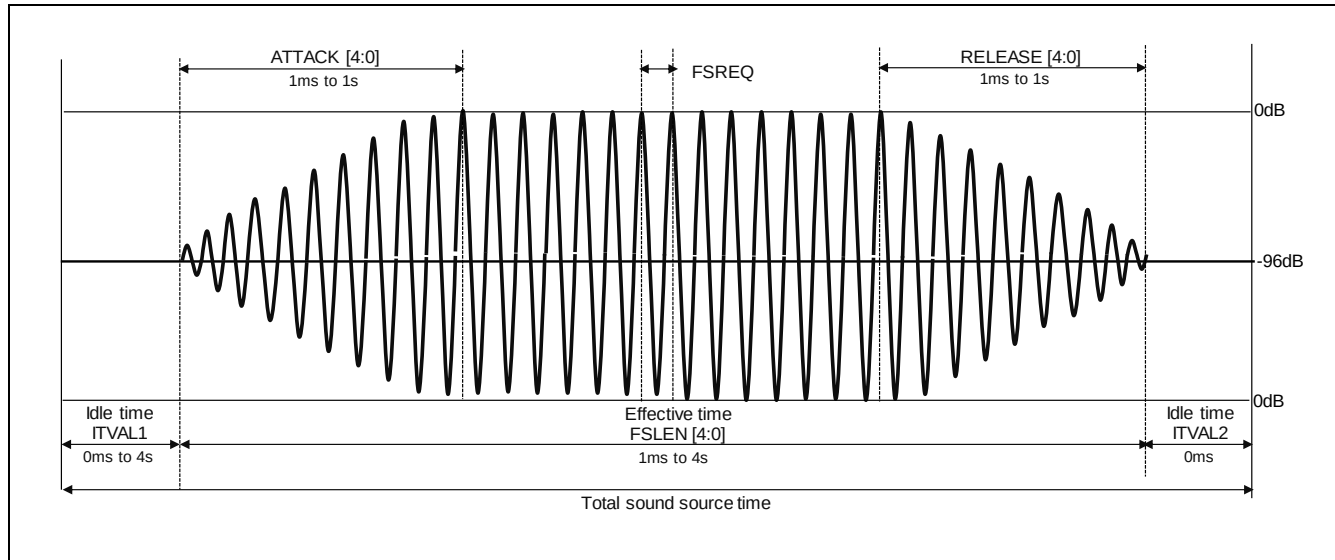


Table 3-1

Element	Description	Relation
Start idle time	Silence generation time (ALL 0 data generation) immediately following sound source generation start.	4.8
End idle time	This function is not supported.	4.8
Waveform	Sound source waveform	4.7
Frequency	Sound source frequency	4.7
Run time	Time to generate a sound source of a specified frequency	4.7
Fade in time (ATTACK)	Fade in time (included in run time) immediately following run time start	4.9
Fade out time (RELEASE)	Fade out time immediately before run time end (included in run time)	4.9
Overall sound source time	Overall time of the specified sound source, which is the total of idle time and effective time	Figure 3-1

3.1.1. Idle Time

There is start idle time and end idle time.

Start idle time is silence generation time immediately following sound source generation start. End idle time is not supported.

As for start idle time, one of 32 idle times from 0 ms to 4 seconds is selectable by software.

Notes:

- Control of WGCHEN under 4.1 causes ALL 0 to be output at the point that SWFG operation is enabled, but this is not included in idle time. It should be noted that start idle time indicates the period from the start of sound source generation in accordance with control by WGCHSTART under 4.2, up to generation of ALL 0.
- Refer also to 3.1.

3.1.2. Waveform

The waveform is the fundamental wave that makes up the sound source.

One of 3 waveforms (sine wave, sawtooth wave, square wave) is selectable by software. For details, see 4.7.

3.1.3. Frequency

Frequency is a sound source component that corresponds to the pitch of the sound.

One of 64 frequencies is selectable by software. For details, see 4.7.

3.1.4. Run Time

Run time is the time to generate a sound source of the specified frequency.

One of 31 run times from 1 ms to 4 seconds is selectable by software. For details, see 4.7.

Notes:

- Neither the start nor end idle times are included in the run time.
- Fade in time and fade out time are both included in the run time.

3.1.5. Fade In Time (ATTACK)

Fade in time is time required for volume change from -96 dB to 0 dB immediately following run time start. Fade in time is included in run time.

One of 24 fade in times from 1 ms to 1 seconds is selectable by software. For details, see 4.9.

3.1.6. Fade Out Time (RELEASE)

Fade out time is time required for volume change from 0 dB to -96 dB immediately following run time end. Fade out time is included in the run time.

One of 24 fade out times from 1 ms to 1 second is selectable by software. For details, see 4.9.

Notes:

- Fade in time and fade out time are both included in the run time. Configuration of settings that result in fade in time, fade out time, and the total of these times being shorter than the run time is prohibited.
- If the total of these times exceeds the run time, fade in will start from -96 dB and a switch will be made to fade out before 0 dB is reached.
- Each configuration should be under condition below.
 $Attack \leq FSLEN$, $Release \leq FSLEN$ and $Attack + Release \leq FSLEN$

3.2. Interrupt

SWFG supports the interrupts described below.

- Sound source generation complete interrupt
This interrupt is generated when sound source generation is complete. SWFG performs interrupt enable setting, interrupt clear control and status indication.
- SWFG AHB Master Interface bus error interrupt
This interrupt is generated when an error response is received during sound source output to an output destination on the AHB Master Interface of SWFG. SWFG performs interrupt enable setting, interrupt clear control and status indication.
- SWFG AHB Master Interface access error
This interrupt is generated when an error response is received for register access or another operation on the AHB Master Interface of SWFG. SWFG indicates the status of this error only. However, SWFG does not have functions enabling or clearing an interrupt generated by this error.

3.3. SWFG Sound Source Generation Start

The procedures for starting sound source generation is provided below. Each channel can be controlled independently.

1. Set the output destination address of the sound source. See WGCHADD1 through 3 under 4.3, 4.4, and 4.5.
2. Select the sound source output data pattern. See WGCHMONO under 4.6.
3. Configure interrupt enable/disable settings. See WGINTREN under 4.11.
4. Configure sound source specification settings. See WGCHxCTRL1 through 3(x=0 through 4) under 4.7, 4.8, and 4.9.
5. Performs startup control. For details, see WGCHEN under 4.1.
6. Start sound source generation. For details, see WGCHSTART under 4.2.

Notes:

- Steps 1 through 4 of the above procedure can be performed in any sequence.
- Enabling operation in step 5 of the above procedure causes SWFG to output ALL 0 data. After that, step 6 starts generation of the configured sound source. If SWFG is not running, the sound source is not generated when generation start is executed.
- Even if operation is enabled and sound source generation startup control is performed, it will not start without a data request from the SWFG output destination. The output destination needs to be set beforehand.

3.4. SWFG Sound Source Generation Stop

SWFG operation that started sound source generation can be stopped on a channel-by-channel basis. See WGCHEN under 4.1 and WGCHCLR under 4.10.

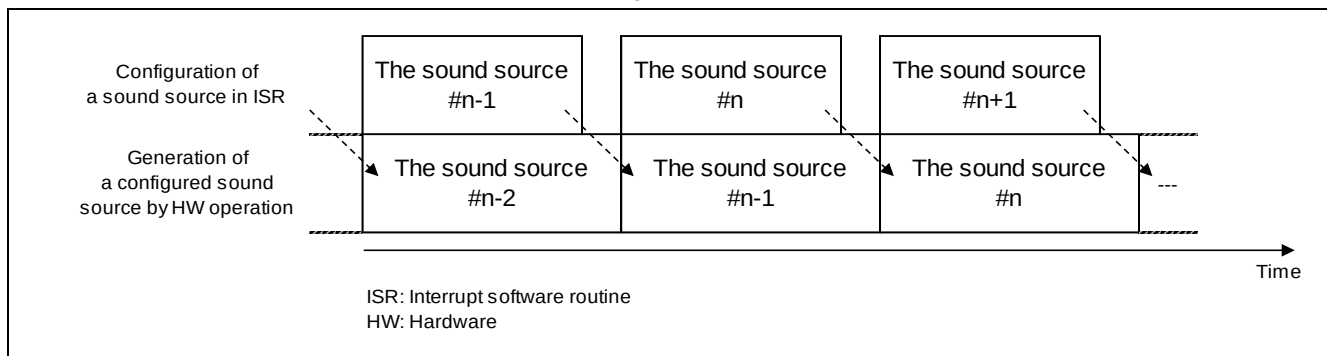
Notes:

- *Sound source generation stopped by WGCHEN under 4.1 can be resumed by performing startup control on the same bit, which will resume from the point where generation was stopped. There is no sound source output, including ALL 0, from channels that are stopped by this control. The effect on sound source output destinations should be kept firmly in mind when stopping sound source generation.*
- *Sound source generation can also be stopped by WGCHCLR under 4.10. However, there is no control to restart sound source generation from the point it was stopped by WGCHCLR. ALL 0 is output from channels that are stopped by WGCHCLR.*

3.5. Continuous SWFG Sound Source Generation

Setting of the next sound source specification can be performed by starting sound source generation using the procedure under 3.1, even if a previous sound source generation operation is in progress. After setting is complete, sound source generation starts and the corresponding WGCHSTART bit is set to 1, so generation of the next sound source starts as soon as generation of the current sound source is complete.

Figure 3-2



Notes:

- Setting the next sound's sound source specifications after the previous sound source generation is complete can cause an audible break in the sound. Consecutive sound generation that uses a sound source generation complete interrupt as shown in Figure 3-2 is recommended.
- Using fade in and fade out control between the previous generation and the current generation when consecutively generating sound sources can cause an audible break in the sound. When performing consecutive generation, application of fade in and fade out, control is recommended only when setting initial and final sound source specifications.
- The FLSLEN should be configured as longer than RELEASE. Only when the final sound source of consecutive sound generation is generated, RELEASE only performs and FSLEN is ignored in generation time.

3.6. Filter

3 type of digital filter can be selected and applied to the generated sound source to remove overtone affections of sawtooth and square wave-form. See 4.7 in detail.

Figure 3-3 Cutoff Frequency 8 kHz

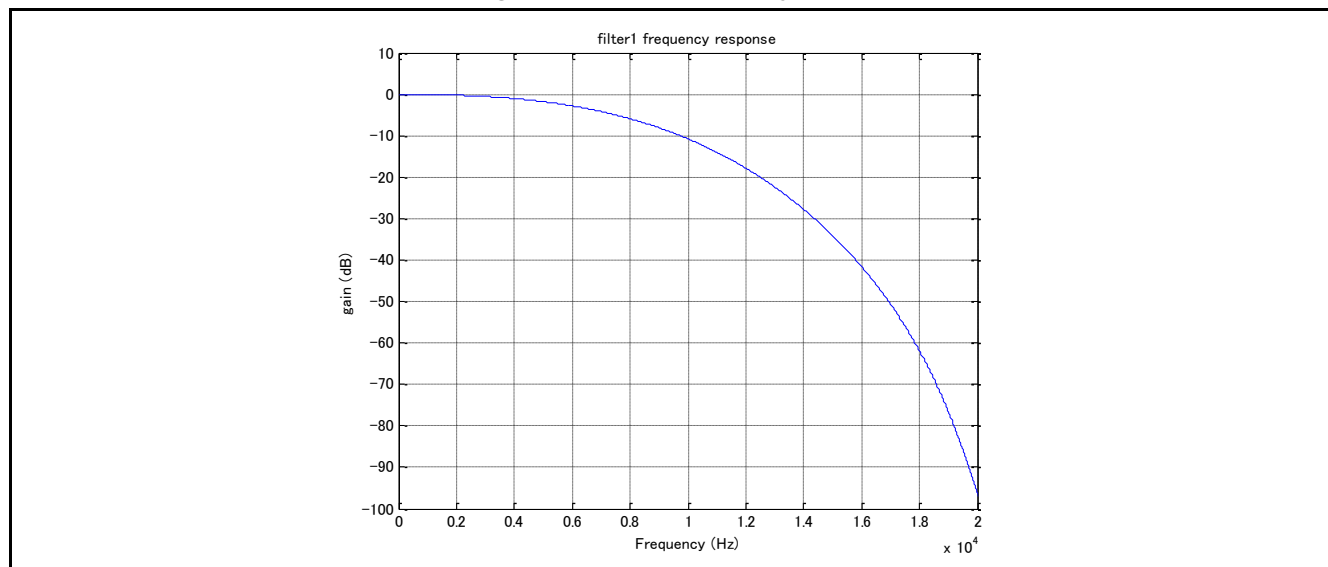


Figure 3-4 Cutoff Frequency 5 kHz

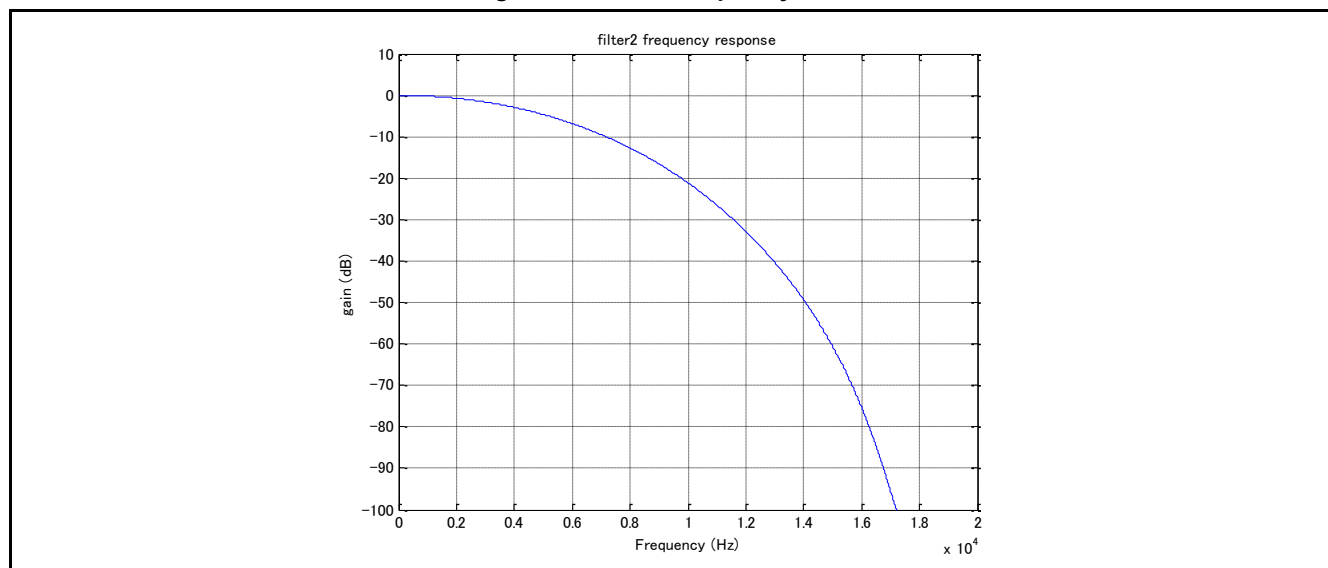
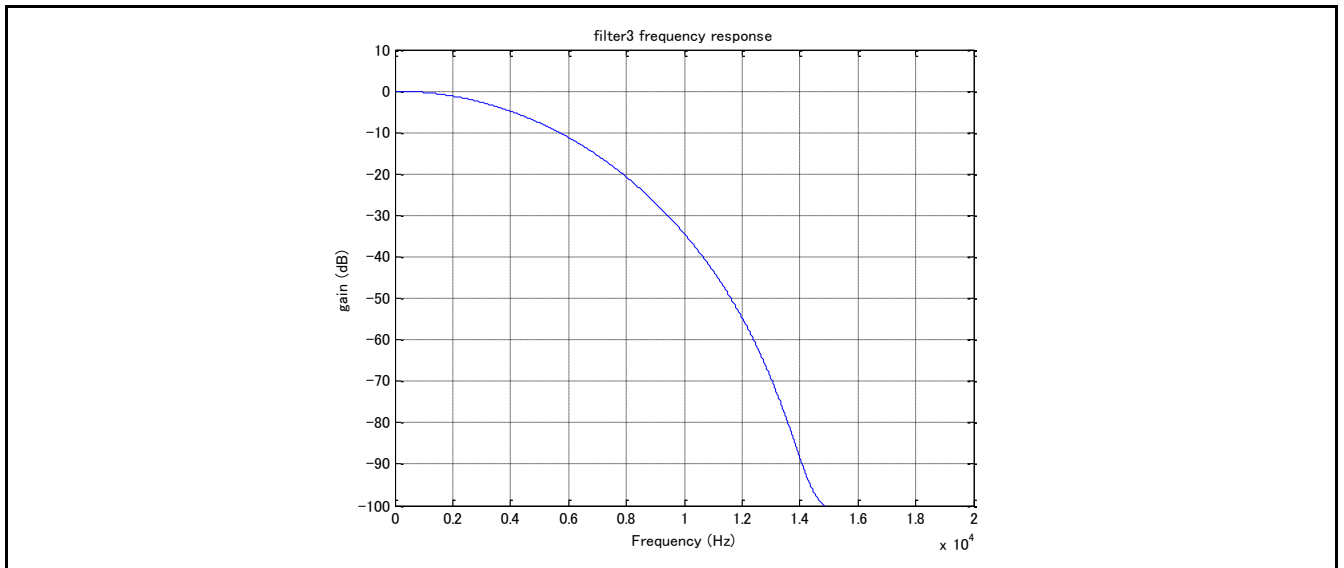


Figure 3-5 Cutoff Frequency 2 kHz



4. Registers

This section describes the registers of Sound Waveform Generator

4.1. Waveform Generator Channel Enable Register (WGCHEN)

REGISTER_NAME	Waveform Generator Channel Enable Register (WGCHEN)
OFFSET	0x000
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	CH4EN	CH3EN	CH2EN	CH1EN	CH0EN
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4] CH4EN: Channel 4 operation enable/disable

[bit3] CH3EN: Channel 3 operation enable/disable

[bit2] CH2EN: Channel 2 operation enable/disable

[bit1] CH1EN: Channel 1 operation enable/disable

[bit0] CH0EN: Channel 0 operation enable/disable

CHnEN (n=0 to 4)	Description
0	Stop operation.
1	Enable operation.

Notes:

- When operation is stopped, SWFG stops sound source generation and output.

- *There is no sound source output, including ALL 0, from channels that are stopped by this control. The effect on sound source output destinations should be kept firmly in mind when stopping sound source generation.*

4.2. Waveform Generator Channel Start Register (WGCHSTART)

REGISTER_NAME	Waveform Generator Channel Start Register (WGCHSTART)
OFFSET	0x004
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	CH4START	CH3START	CH2START	CH1START	CH0START
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4] CH4START: Channel 4 sound source generation start

[bit3] CH3START: Channel 3 sound source generation start

[bit2] CH2START: Channel 2 sound source generation start

[bit1] CH1START: Channel 1 sound source generation start

[bit0] CH0START: Channel 0 sound source generation start

CHnSTART (n=0 to 4)	Description	
	Read	Write
0	Enable sound source generation.	Does not have any effect on operation.
1	Sound source generation start wait.	Start sound source generation.

Notes:

- When "1" is written to this bit, SWFG starts sound source generation in accordance with sound source specification settings.

- *SWFG is when "1" is written to this bit while a previous sound source generation is in progress, consecutive sound source generation starts when generation of the previous sound source is complete.*
- *This bit is automatically cleared when the desired sound source generation starts.*
- *Writing "0" in this bit does not stop sound source generation. For information about stopping sound source generation, see 4.1.*
- *Sound source generation start wait cannot be canceled.*
- *Changing sound source specifications during sound source generation start standby can result in sound source generation starting while implementation of changes is in progress, resulting in unintended sound being produced. Set sound source specifications while sound source generation is enabled.*

4.3. Waveform Generator Channel Address1 Register (WGCHADD1)

REGISTER_NAME	Waveform Generator Channel Address1 Register (WGCHADD1)
OFFSET	0x010
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	CH1ADD[12:8]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	CH1ADD[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	CH0ADD[12:8]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CH0ADD[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit28:16] CH1ADD: Channel 1 output destination address

Sets the Channel 1 output destination address as 13 bits.

Notes:

These bits can be set at the initialization. After that, it should not be changed.

[bit15:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12:0] CH0ADD: Channel 0 output destination address

Sets the Channel 0 output destination address as 13 bits.

Notes:

These bits can be set at the initialization. After that, it should not be changed.

4.4. Waveform Generator Channel Address2 Register (WGCHADD2)

REGISTER_NAME	Waveform Generator Channel Address2 Register (WGCHADD2)
OFFSET	0x014
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	CH3ADD[12:8]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	CH3ADD[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	CH2ADD[12:8]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CH2ADD[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit28:16] CH3ADD: Channel 3 output destination address

Sets the Channel 3 output destination address as 13 bits.

Notes:

These bits can be set at the initialization. After that, it should not be changed.

[bit15:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12:0] CH2ADD: Channel 2 output destination address

Sets the Channel 2 output destination address as 13 bits.

Notes:

These bits can be set at the initialization. After that, it should not be changed.

4.5. Waveform Generator Channel Address3 Register (WGCHADD3)

REGISTER_NAME	Waveform Generator Channel Address3 Register (WGCHADD3)
OFFSET	0x018
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	CH4ADD[12:8]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CH4ADD[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12:0] CH4ADD: Channel 4 output destination address

Sets the Channel 4 output destination address as 13 bits.

Notes:

These bits can be set at the initialization. After that, it should not be changed.

4.6. Waveform Generator Channel Monaural Register (WGCHMONO)

REGISTER_NAME	Waveform Generator Channel Monaural Register (WGCHMONO)
OFFSET	0x01C
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	CH4MONO[1:0]	
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CH3MONO[1:0]		CH2MONO[1:0]		CH1MONO[1:0]		CH0MONO[1:0]	
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:10] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit9:8] CH4MONO Channel 4 output data pattern

[bit7:6] CH3MONO Channel 3 output data pattern

[bit5:4] CH2MONO Channel 2 output data pattern

[bit3:2] CH1MONO Channel 1 output data pattern

[bit1:0] CH0MONO Channel 0 output data pattern

CHnMONO [1:0] (n=0 to 4)	Description
00	Upper and lower 16 bits output the same data (XXXX_XXXX).
01	Only lower 16 bits of data are output (0000_XXXX).
10	Only upper 16 bits of data are output (XXXX_0000).
11	Setting prohibited

4.7. Waveform Generator Channel n Control Register1 (WGCHnCTRL1, n=0 to 4)

REGISTER_NAME	Waveform Generator Channel n Control Register (WGCHnCTRL1)
OFFSET	n=0:0x020, n=1:0x030, n=2:0x040, n=3:0x050, n=4:0x060,
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	FSLEN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	FSINF[1:0]	
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	FSFREQ[5:0]					
ACCESS_TYPE	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:21] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit20:16] FSLEN: Run time (Channel n = 0 to 4)

Specifies a setting of 1 ms to 4 seconds.

Bits	Description
00000	1ms
00001	1ms
00010	2ms
00011	3ms
00100	4ms
00101	5ms
00110	7.5ms
00111	10ms
01000	15ms
01001	20ms
01010	25ms
01011	30ms

Bits	Description
01100	40ms
01101	50ms
01110	75ms
01111	100ms
10000	125ms
10001	150ms
10010	200ms
10011	250ms
10100	300ms
10101	400ms
10110	500ms
10111	750ms
11000	1000ms
11001	1250ms
11010	1500ms
11011	2000ms
11100	2500ms
11101	3000ms
11110	3500ms
11111	4000ms

Note

When 00000 is written to these bits, the read value will be 00001 instead of 00000.

[bit15:10] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit9:8] FSINF: Waveform (Channel n = 0 to 4)

Bits	Description
00	Sine wave
01	Sawtooth wave
10	Square wave
11	Setting prohibited

[bit7:6] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit5:0] FSFREQ: Frequency (64 piano scales) (Channel n = 0 to 4)

FSFREQ[5:0]	Frequency (Hz)	Musical Scale
00	110.00	A2
01	116.54	A#2
02	123.47	B2
03	130.81	C3
04	138.59	C#3
05	146.83	D3
06	155.56	D#3
07	164.81	E3

FSFREQ[5:0]	Frequency (Hz)	Musical Scale
08	174.61	F3
09	185.00	F#3
0A	196.00	G3
0B	207.65	G#3
0C	220.00	A3
0D	233.08	A#3
0E	246.94	B3
0F	261.63	C4
10	277.18	C#4
11	293.66	D4
12	311.13	D#4
13	329.63	E4
14	349.23	F4
15	369.99	F#4
16	392.00	G4
17	415.30	G#4
18	440.00	A4
19	466.16	A#4
1A	493.88	B4
1B	523.25	C5
1C	554.37	C#5
1D	587.33	D5
1E	622.25	D#5
1F	659.26	E5
20	698.46	F5
21	739.99	F#5
22	783.99	G5
23	830.61	G#5
24	880.00	A5
25	932.33	A#5
26	987.77	B5
27	1046.50	C6
28	1108.73	C#6
29	1174.66	D6
2A	1244.51	D#6
2B	1318.51	E6
2C	1396.91	F6
2D	1479.98	F#6
2E	1567.98	G6
2F	1661.22	G#6
30	1760.00	A6
31	1864.66	A#6
32	1975.53	B6
33	2093.00	C7

FSFREQ[5:0]	Frequency (Hz)	Musical Scale
34	2217.46	C#7
35	2349.32	D7
36	2489.02	D#7
37	2637.02	E7
38	2793.83	F7
39	2959.96	F#7
3A	3135.96	G7
3B	3322.44	G#7
3C	3520.00	A7
3D	3729.31	A#7
3E	3951.07	B7
3F	4186.01	C8

4.8. Waveform Generator Channel n Control Register2 (WGCHnCTRL2, n=0 to 4)

REGISTER_NAME	Waveform Generator Channel n Control Register (WGCHnCTRL2)
OFFSET	n=0:0x024, n=1:0x034, n=2:0x044, n=3:0x054, n=4:0x064,
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	ITVAL2[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	ITVAL1[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:21] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit20:16] ITVAL2: End idle time (Channel n = 0 to 4)

This function is not supported.

[bit15:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4:0] ITVAL1: Start idle time (Channel n = 0 to 4)

Specifies a setting of 0 ms to 4 seconds.

ITVAL2 [4:0] ITVAL1 [4:0]	Description
00000	0ms
00001	1ms

ITVAL2 [4:0] ITVAL1 [4:0]	Description
00010	2ms
00011	3ms
00100	4ms
00101	5ms
00110	7.5ms
00111	10ms
01000	15ms
01001	20ms
01010	25ms
01011	30ms
01100	40ms
01101	50ms
01110	75ms
01111	100ms
10000	125ms
10001	150ms
10010	200ms
10011	250ms
10100	300ms
10101	400ms
10110	500ms
10111	750ms
11000	1000ms
11001	1250ms
11010	1500ms
11011	2000ms
11100	2500ms
11101	3000ms
11110	3500ms
11111	4000ms

4.9. Waveform Generator Channel n Control Register3 (WGCHnCTRL3, n=0 to 4)

REGISTER_NAME	Waveform Generator Channel n Control Register (WGCHnCTRL3)
OFFSET	n=0:0x028, n=1:0x038, n=2:0x048, n=3:0x058, n=4:0x068,
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	FILTER[1:0]	
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	RELEASE[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	ATTACK[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:18] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit17:16] FILTER : Low Pass Filter cutoff frequency (Channel n = 0 to 4)

Bits	Description
00	Disable filter.
01	8KHz
10	5KHz
11	2KHz

[bit15:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12:8] RELEASE: Fade out time (Channel n = 0 to 4)

Specifies a setting of 1 ms to 1 second. Set these bits to 00000 when fade in control is not used.

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4:0] ATTACK: Fade in time (Channel n = 0 to 4)

Specifies a setting of 1 ms to 1 second. Set these bits to 00000 when fade out control is not used.

ATTACK[4:0] RELEASE[4:0]	Description
00000	Fade in/fade out control not used.
00001	1ms
00010	2ms
00011	3ms
00100	4ms
00101	5ms
00110	7.5ms
00111	10ms
01000	15ms
01001	20ms
01010	25ms
01011	30ms
01100	40ms
01101	50ms
01110	75ms
01111	100ms
10000	125ms
10001	150ms
10010	200ms
10011	250ms

ATTACK[4:0] RELEASE[4:0]	Description
10100	300ms
10101	400ms
10110	500ms
10111	750ms
11000 to 11111	1000ms

Notes:

- Exercise caution concerning use when performing consecutive sound source generation. See 3.1.5, 3.1.6.
- When using fade in control, consecutive fade in control cannot be used without fade out control. Also, when using fade out control, consecutive fade out control cannot be used without fade in control.

4.10. Waveform Generator Channel Clear Register (WGCHCLR)

REGISTER NAME	Waveform Generator Channel Clear Register (WGCHCLR)
OFFSET	0x070
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	CH4CL	CH3CL	CH2CL	CH1CL	CH0CL
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4] CH4CL: Channel 4 sound source initialization

[bit3] CH3CL: Channel 3 sound source initialization

[bit2] CH2CL: Channel 2 sound source initialization

[bit1] CH1CL: Channel 1 sound source initialization

[bit0] CH0CL: Channel 0 sound source initialization

CHnCL (n=0 to 4)	Description	
	Read	Write
0	Not under initialization	Does not have any effect on operation.
1	Sound source specifications initialization wait	Sound source specifications initialization

Notes:

- When "1" is written to this bit, the set sound source specifications are initialized and sound source generation stops. However, this control does not initialize the source specification setting register but initialize WGCHSTART.

- *Initializing sound source specifications and stopping generation automatically clears this bit.*
- *If sound source specifications are initialized, generation cannot be resumed from the point where it was stopped. To generate a source, sound source specifications need to be set again and sound source generation start control is required. See 3.1.*

4.11. Waveform Generator Interrupt Enable Register (WGINTREN)

REGISTER_NAME	Waveform Generator Interrupt Enable Register (WGINTREN)
OFFSET	0x080
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	CH4END	CH3END	CH2END	CH1END	CH0END
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	AHBERR
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12] CH4END: Channel 4 sound source generation end interrupt enable

[bit11] CH3END: Channel 3 sound source generation end interrupt enable

[bit10] CH2END: Channel 2 sound source generation end interrupt enable

[bit9] CH1END: Channel 1 sound source generation end interrupt enable

[bit8] CH0END: Channel 0 sound source generation end interrupt enable

CHnEND (n=0 to 4)	Description
0	Disable interrupts.
1	Enable interrupts.

[bit7:1] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit0] AHBERR: AHB MASTER INTERFACE bus error interrupt enable

Bit	Description
0	Disable interrupts.
1	Enable interrupts.

4.12. Waveform Generator Interrupt State Register (WGINTRSTATE)

REGISTER_NAME	Waveform Generator Interrupt State Register (WGINTRSTATE)
OFFSET	0x084
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	CH4END	CH3END	CH2END	CH1END	CH0END
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	AHBERR
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates an SWFG AHB Slave interface access error.

[bit12] CH4END: Channel 4 sound source generation end interrupt status indication

[bit11] CH3END: Channel 3 sound source generation end interrupt status indication

[bit10] CH2END: Channel 2 sound source generation end interrupt status indication

[bit9] CH1END: Channel 1 sound source generation end interrupt status indication

[bit8] CH0END: Channel 0 sound source generation end interrupt status indication

CHnEND (n=0 to 4)	Description
0	No interrupt
1	Interrupt

[bit7:1] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates an SWFG AHB Slave interface access error.

Notes:

- *This bit is read-only, and writing is prohibited.*
- *Writing to this bit generates an SWFG AHB Slave Interface access error.*

[bit0] AHBERR: SWFG AHB MASTER INTERFACE bus error interrupt status indication

Bit	Description
0	No interrupt
1	Interrupt

Notes:

- *This bit is read-only, and writing is prohibited.*
- *Writing to this bit generates an SWFG AHB Slave Interface access error.*

4.13. Waveform Generator Interrupt Clear Register (WGINTRCLR)

REGISTER_NAME	Waveform Generator Interrupt Clear Register (WGINTRCLR)
OFFSET	0x088
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	CH4END	CH3END	CH2END	CH1END	CH0END
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	AHBERR
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12] CH4END: Channel 4 sound source generation end interrupt clear

[bit11] CH3END: Channel 3 sound source generation end interrupt clear

[bit10] CH2END: Channel 2 sound source generation end interrupt clear

[bit9] CH1END: Channel 1 sound source generation end interrupt clear

[bit8] CH0END: Channel 0 sound source generation end interrupt clear

CHnEND (n=0 to 4)	Description
0	Does not have any effect on operation.
1	Clear interrupts.

[bit7:1] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit0] AHBERR: SWFG AHB MASTER INTERFACE bus error interrupt clear

Explanation of AHBERR

Bit	Description
0	Does not have any effect on operation.
1	Clear interrupts.

Note:

- *If interrupt generation and interrupt clear occur simultaneously, interrupt generation is given priority.*

4.14. Waveform Generator AHB Bus Error Register (WGAHBERR)

REGISTER_NAME	Waveform Generator AHB Bus Error Register (WGAHBERR)
OFFSET	0x090
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	AHBSERR	
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:2] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates an SWFG AHB Slave interface access error.

[bit1:0] AHSERR: SWFG AHB Slave Interface access error information indication

Bits	Description
00	There is no error.
01	Address error
10	Write access to Read Only register
11	Access size error

Notes:

- *This bit is read-only, and writing is prohibited.*
- *Writing to this bit generates an SWFG AHB Slave Interface access error.*

CHAPTER 20: Sound Mixer



This chapter explains the sound mixer.

1. Overview
2. Configuration and Block Diagram
3. Operation of the Sound Mixer
4. Registers
5. Appendix

CODE: SOUNDMIX-E1.07-0

1. Overview

This section gives a brief overview of the sound mixer.

Also refer to the chapter of "Sound System configuration" how to configure the sound mixer.

The sound mixer provides functions for mixing multiple input PCM (pulse code modulation) sound sources.

Table 1-1

Feature	Description
Input sound source	16-bit or 32-bit PCM sound source
Output sound source	32-bit PCM sound source
Number of input channels	Up to 10 channels of sound source input are supported.
Number of output channels	1ch
Input sampling rate	Mixing of sound sources with different sampling rates is supported. – WFG0 to 4 (five channels total): Input channels for fixed sampling rates: 48kHz – PMIS0 to 4 (five channels total): Input channels for selectable sampling rates: 4, 8, 12, 24, 48, 96, and 44.1 kHz
Output sampling rate	48kHz
Mixing System	Saturation calculation operation
FIR filter	Prevention of sound quality change by sampling rate conversion
Volume effects	The volume and the mute, fade in, and fade out effects of the input sound source and output sound source are controllable.

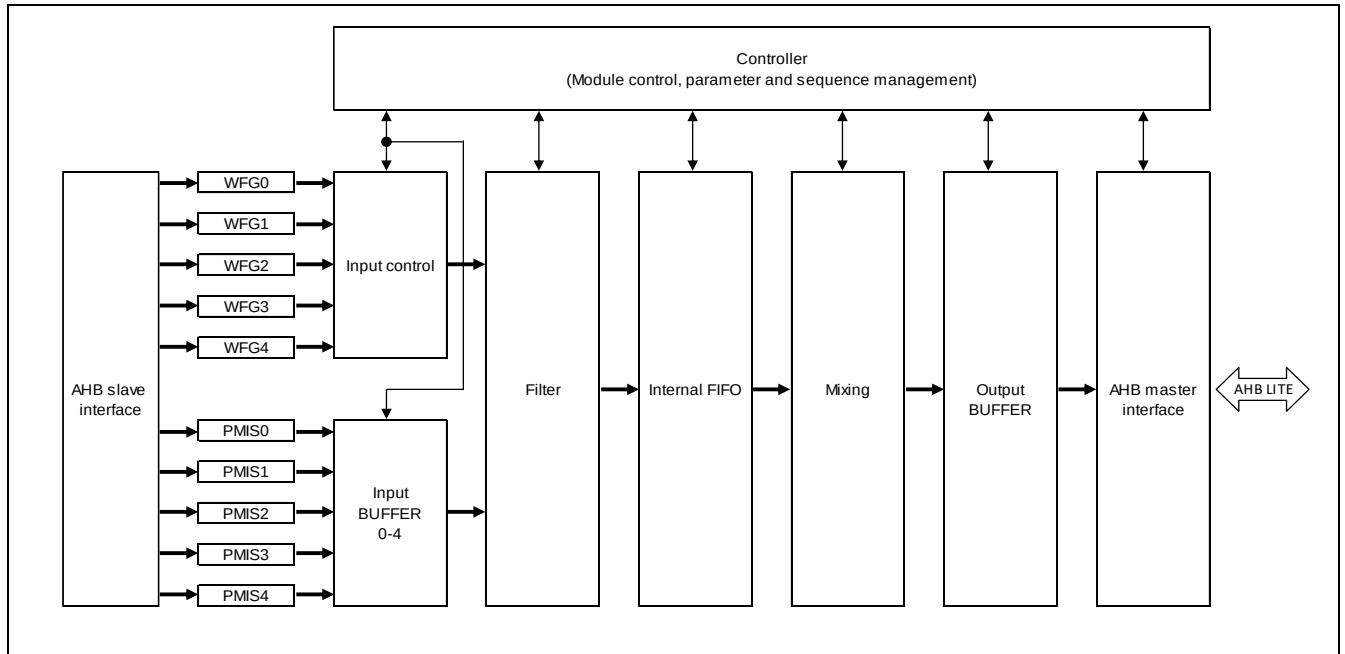
Notes:

- The input sound source is input in 32-bit units, regardless of the sound source format. A monaural sound source is input in 16-bit and 32-bit units.
- 16-bit monaural sound source output is not supported.
- Sound waveform generator output may have a fixed connection to WFG0 to 4. It should be noted that there may be specification limits on specific models.
- The 44.1 kHz input sampling rate can be applied to only one of the input channels PMIS0 to 4. Operation when 44.1 kHz is applied to multiple channels cannot be guaranteed from the viewpoint of the mixing process load imposed by the sound mixer. It should be noted that there may limits on specific models concerning the selection of other frequencies.
- In the case of a sound source with a sampling rate that is not 48 kHz or 96 kHz, the sampling rate is converted internally by the mixer to 48 kHz. Noise removal by an FIR noise filter is performed before mixing to reduce change in sound quality due to distortion generated by this conversion. However, noise removal by FIR filtering is not performed in the case of down sampling of a 96 kHz sound source to 48 kHz. Because of this, there is the risk of sound quality being affected by aliasing generated at that time. The sampling rate must be determined with sufficient sound quality evaluation being implemented by the system.
- Mixed sound sources are calculated by the sound mixer's signed saturation calculation. Saturation calculation uses a pre-defined minimum value or maximum value when a calculation operation generates overflow. Mixing multiple high volume (large amplitude) sound sources creates the risk of sound quality being affected by saturation calculation rounding error. Sound mixing supports individual volume control for each channel, so adjustments can be made while evaluating the result on the system.

2. Configuration and Block Diagram

This section shows a block diagram of the sound mixer.

Figure 2-1



Notes:

- The mixing section is equipped with functions for use by volume effects (volume control, mute, fade in/fade out effects). Volume of each input channel and volume effects of output are applied before and after saturation calculation operations within each mixing operation.
- The AHB master outputs the mixed sound source to the address specified as the output destination.
- Every channel of WFG0 to 4 has an input buffer for a word (32bit) in the part of "input control".

3. Operation of the Sound Mixer

3.1. Basic Mixing Operation Procedure

3.1.1. Mixing Start

The mixing procedure started by sound mixing is shown below.

1. Disable input of the sound source. See MXCH under 4.1.
2. Set the output destination address and number of transfers of the mix sound source. See MXOCTRL under 4.2.
3. Configure sound source input channel PMIS0 through 4 sampling rate settings. See MXICTRL under 4.4.
4. Configure sound source input channel PMIS0 through 4 sound source process mode settings. See MXCHMONO under 4.5.
5. Initialize the sound source input channel PMIS0 through 4 input buffers. Also, initialize the mixed sound source output buffer. See MXBUFFCLR under 4.17.
6. Enable sound source input. See MXCH under 4.1.
7. Configure DMA transfer request and data transfer request interrupt threshold value settings for sound input channels PMIS0 through 4. See MXDRQCTRL under 4.3.
8. Configure interrupt enable/disable settings. See MXINTREN under 4.19.
9. Start sound source input.

Notes:

- The settings in steps 3, 4 and 7 are not required for sound source input channels WFG0 through 4. Also, other settings equivalent to these settings are not configured.
- Configure the input channels with the above settings in sequence from 1 through 9 in order to add new sound source input to an ongoing sound mixer operation and perform consecutive mixing. However, the output destination setting in step 2 is not required.
- The number of transfers of mixed sound sources from the sound mixer must match the number of output destination transfer requests. When the number of transfers on the sound mixer side is greater, the output destination will generate a DMA transfer error. When the number of transfer requests on the output destination side is greater, the output destination will not issue a DMA transfer request.
- If a sound source is not input on the actual device a sound source input is enabled, mixing is stopped for all channels (not only on the applicable channel).

3.1.2. Mixing Stop

Stopping mixing stops input of all channels. Removing a specific channel from mixing stops input of that channel. See MXCH under 4.1.

3.1.3. Fade In

- This setting sets the initial fade in time. See MXCHFADE1 to 5 under 4.10 to 4.14.
- Next, initialize the fade state. See MXFADECLR under 4.18.
- After that, enable fade in. See MXCHFADEEN under 4.16.

Notes:

- The fade in effect assumes that settings are configured before mixing and applied simultaneously with the start of mixing. However, they can also be applied while the mixing operation is in progress. In that case, the fade in process starts immediately.
- Be sure to initialize the fade state before fade in. Fade in following initialization will perform fade in control of the fade gain from -96 dB to 0 dB. However, this initialization operation is not

necessarily required for fade in following fade out. This is because fade out causes gain to become -96 dB.

3.1.4. Fade Out

Fade out can be applied only after fade in.

First, set the fade out time. See MXCHFADE1 to 5 under 4.10 to 4.14. After that, enable fade out. See MXCHFADEEN under 4.16.

Notes:

- *The fade out effect assumes that settings are configured before the completion of mixing and applied simultaneously with the completion of mixing. However, they can also be applied while the mixing operation is in progress. In that case, the fade out process starts immediately.*
- *Be sure to initialize the fade state before fade out. Fade out following initialization will perform fade out control of the fade gain from 0 dB to -96 dB. However, this initialization operation is not necessarily required for fade out following fade in. This is because fade in causes gain to become 0 dB.*

3.2. Volume Effects

There are three volume effects: volume control, mute, and fade in/fade out.

These effects can be applied individually to sound sources being input/output.

In the case of an input sound source in particular, volume effect settings can be configured for each individual input channel (WFG0 to 4 and PMIS0 to 4).

Table 3-1

Volume Effects	Description
Volume control	Volume is controlled in accordance with the gain set by software.
Mute	Mute outputs ALL 0 or ALL 1, regardless of the input/output sound source set software.
Fade in/fade out effects	Phased fade in and fade out are automatically controlled over the time set by software.

3.2.1. Volume Control

Volume of the input/output sound source is controlled in accordance with the volume control gain set by software. This setting can be configured while operation is in progress, and settings are immediately reflected in operation.

For information about register settings, see 4.6, 4.7, and 4.8. For details about gain for volume control, see 5.1.

3.2.2. Mute

Outputs ALL 0 or ALL 1, regardless of the input/output sound source set software. This setting can be configured while operation is in progress, and settings are immediately reflected in operation.

For information about register settings, see 4.9.

3.2.3. Fade In/Fade Out Effects

Seamless fade in and fade out are controlled over the time set by software. The hardware internal fade in/out gain is changed automatically.

For information about the register setting procedure, see 3.1.3 and 3.1.4. For details about fade in and fade out time settings for volume control, see 5.2.

Notes:

- Volume control gain and fade in/gain are independent of each other. The product of both gains is applied as the overall volume effect.
- The fade in/out gain is 0 dB for both the fade in ending point and the fade out starting point. The gain of the overall volume effect is determined in accordance with the volume control gain set by software.

3.3. Sound Source Input and Internal Mixing Process Mode

Input the input sound source to PMIS0 to 4 in 32-bit units, regardless of the sound source format. Also input using 32-bit units in the case of 16-bit monaural sound source input.

The sound source will be mixed internally by the mixer as a 32-bit stereo sound source. In other words, the upper 16 of the 32 bits is considered to be the left sound source, with the lower 16 bits are considered to be the right sound source, and this is mixed with the upper 16 bits and lower 16 bits of sound sources that are input from other channels.

For input of 16-bit sound sources, the n-th sound source is input as the upper 16 bits and the n+1 sound source is input as the lower 16 bits for 32-bit unit input. Note that n is a positive integer.

A processing mode can be selected from among those shown in Table 3-2 for monaural sound source internal processing.

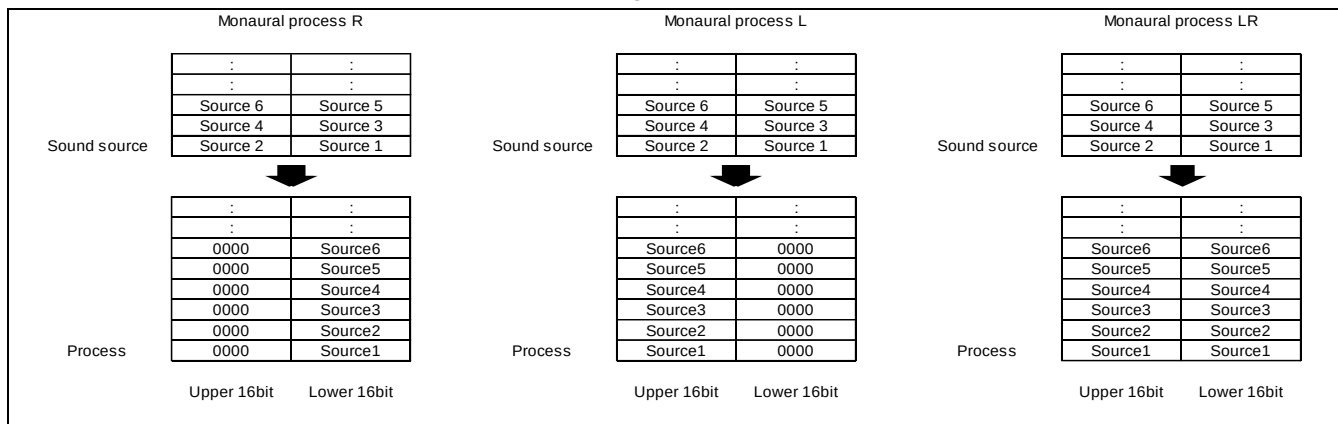
For information about configuring settings by software, see MXCHMONO under 4.5.

Table 3-2

Processing Mode	Application	Internal Process Overview
Stereo processing	Stereo processing	Mixes input 32-bit stereo sound source.
Monaural processing R	Right-side mixing	Mixes by converting to 32-bit data (Upper 16 bits = ALL 0, Lower 16 bits = Monaural sound source).
Monaural processing L	Left-side mixing	Mixes by converting to 32-bit data ("Upper 16 bits = Monaural sound source, Lower 16 bits = ALL 0).
Monaural processing LR	Both side mixing (Left=Right)	Mixes by converting to 32-bit data (Upper 16 bits = Lower 16 bits = Monaural sound source).

An example of monaural processing is shown in Figure 3-1.

Figure 3-1



Notes:

- A change in processing mode made while sound source is transferred to the sound source input channels PMIS0 through PMIS4 is prohibited.
- Monaural processing cannot be used on a 32-bit stereo sound source. Attempting to do so will result in improper sound.

3.4. Interrupt

The sound mixer supports the interrupts described below.

- Data transfer request interrupt
This interrupt is generated when a state is detected in which free space in the sound mixer PMIS0 to 4 input buffer 0 to 4 is greater than the FES0 value, set in the MXDRQCTRL register, + 1. The interrupt is generated when the value is equal to or greater than the threshold value set by software. The sound mixer interrupt enable setting, interrupt clear control and status indication.
- Input FIFO overflow interrupt
This interrupt is generated when an overflow is detected in the sound mixer PMIS0 to 4 input buffer 0 to 4. The sound mixer interrupt enable setting, interrupt clear control and status indication.
- DMA transfer error
This interrupt is generated when a state is detected in which data input to the PMIS0 to 4 input buffer 0 to 4 is greater than the FES0 value, set in the MXDRQCTRL register, + 1. The sound mixer interrupt enable setting, interrupt clear control and status indication.
- AHB Master Interface bus error interrupt
This interrupt is generated when an error response is received during sound source output to an output destination on the AHB Master Interface of the sound mixer. The sound mixer interrupt enable setting, interrupt clear control and status indication.

3.5. Data Request Control

Mixer macros generate two types of data requests for WFG (WFGDATAREQ[4:0]) and for DMAC (MX_DMA_REQ[4:0]).

Data request protocol specifications

- Request assert conditions are described below (1 and 2).
- When ACK is received in response to a request, the request is negated.
- Data transfer is performed following request transfer.
- The data transfer volume is counted internally, and the sequence of transfer protocols is ended after the requested volume of data is complete.

(The next sequential request cannot be asserted until the sequence of transfer protocols is complete.)

1. Data request for WFG

There is a WFGDATAREQ[4:0] (for WFG) for each channel. WFGDATAREQ[0] corresponds to WFG Channel 0 while WFGDATAREQ[4] corresponds to WFG Channel 4. WFG is notified by a level signal when data receive is possible. HIGH level indicates that receive is possible.

2. Data request for DMAC

Data request for DMAC (MX_DMA_REQ[4:0]) is a data request to DMAC that asserts the REQ signal of the applicable input channel when there is [threshold value + 1] of space in the input buffer. MX_DMA_REQ[0] is for PMIS Channel 0, while MX_DMA_REQ[4] is for PMIS Channel 4.

Notes:

If the DMAC is used for the sound source transmission, the corresponding DMAEN bit of MXDRQCTRL is set to 0 after the DMA-transmission is completed.

3.6. Data Output Control

Subordinate macro data transfer settings are regarded as DMAC INF.

A DMA request is received from a subordinate macro (DAC, PCMPWM, I2S), and [DATATN setting value + 1] data items are transferred to the macro specified by the MACRO field of the MXOCTRL register.

3.6.1. Function Details (Data Protocol Specifications)

1. Receive DMA request.
2. When [MXOCTRL register DATATN setting value + 1] or more of data is accumulated in the output buffer, send an ACK signal.
3. Following ACK transfer, send data. After data send is complete, end sequence of transfer protocols. (The next request cannot be accepted until the sequence of transfer protocols is complete.)

3.7. AHB Slave Interface

Mixer macros provide two AHB slave interface groups: for WFG interfacing and for CPU interfacing. AHB Slave interface specifications are shown in Table 3-3 and Table 3-4.

3.7.1. AHB Slave Interface (CPU/DMA)

Table 3-3 AHB Slave interface (CPU/DMA)

Item	Table_Header
Burst transfer	Mixer macros support burst transfer. However, all burst transfer is processed as a single transfer.
Protection control	not support
Response	OKAY and ERROR only
Access size	8,16,32bit only
Width of address	13bit

Notes:

- The following accesses cause the slave error response.
- 1) When the access destination is an address that does not exist in the memory map
- 2) The write access was done to the read only register.
- 3) When the access size is not supported.
- (For example it accessed MXWFGnDADR/MXPMISnDADR with 8bit or 16bit) $n=0$ to 4

3.7.2. WFG Dedicated AHB Slave Interface

Table 3-4 WFG AHB Slave interface

Item	Table_Header
Burst transfer	not support
Protection control	not support
Response	OKAY and ERROR only
Access size	8,16,32bit only
Width of address	10bit

Notes:

- The following accesses cause the slave error response.
- 1) When the access destination is an address that does not exist in the memory map
- 2) The write access was done to the read only register.
- 3) When the access size is not supported.
- (For example it accessed MXWFGnDADR/MXPMISnDADR with 8bit or 16bit) $n=0$ to 4

3.8. AHB Master Interface

Mixer macros provide an AHB master interface for interfacing with subordinate macros. AHB Master interface specifications are shown in Table 3-5.

Table 3-5 AHB Master interface

Item	Table Header
Burst transfer	not support
Protection control	not support
Response	OKAY and ERROR only
Access size	8,16,32bit only
Width of address	13bit

Notes:

- When an *ERROR* response is received by transfer control from the CPU interface, an error response is transferred to the CPU interface.
- Information about the operation when an error response is received during mixer macro self-operation is stored in the information register and interrupt occurs.

3.9. Input Buffer (FIFO)

Mixer macros provide a 5-channel input buffer for PCM/IS2 input. The input buffer is configured with one Dual Port RAM, and a one-channel 32-word area is configured by address segmentation.

The input buffer is accessed via the channel-use MXPMSnDADR0-15(n=0 to 4) register. Since access of the MXPMSnDADR0-15(n=0 to 4) register results in FIFO operation of the internal buffer, storage is in access sequence regardless of the access address. The configuration of the input buffer is shown in Table 3-6.

Table 3-6 Outline of input Buffer

Item	Description
Width of data	32bit
Width of address	7bit
Depth	160(32×5ch)
Composition	Dual Port RAM

3.10. Sound Source Sampling Rate

3.10.1. Input Sampling Rate

Sound source input/output sampling rates are shown in Table 3-7.

Table 3-7

Input or Output	Frequency						
	96	48	24	12	8	4	44.1
WFG0 to 4	-	Supported	-	-	-	-	-
PMIS0 to 4	Supported	Supported	Supported	Supported	Supported	Supported	Supported
Mixer output	-	Supported	-	-	-	-	-

3.10.2. Sampling Rate Conversion and FIR Filter

The sound mixer uses saturation calculation to output a mixed sound source with a sampling rate of 48 kHz. When a sound source with a sampling rate that is not 48 kHz is input to PMIS0 to 4, the sound mixer converts the sampling rate.

Conversion is by up-sampling, along with processing by an FIR filter to dampen high frequency noise and prevent changes in sound quality. However, down-sampling is performed in the case of a 96 kHz sampling rate, without filtering.

A list of filter processes for input sampling is shown below.

Table 3-8

Sampling Rate (kHz) (Input Sound Source)	Sampling Rate Change	FIR Filter Cut-Off Frequency (kHz)
96	Perform sound sampling.	-
48	Conversion not performed.	-
24	Perform up-sampling and FIR filter to prevent changes in sound quality.	11.0
12		5.0
8		3.0
4		1.2
44.1		17.0

Notes:

- However, down-sampling is performed in the case of 96 kHz → 48 kHz, without filtering sampling rate, without filtering, which creates the risk of aliasing. Sufficient evaluation with the actual device is recommended.
- Filter characteristics have been selected based on Spansion rules.
- See 5.3 in detail.

4. Registers

This section describes the registers of Sound Mixer

4.1. Mixer Channel Register (MXCH)

REGISTER NAME	Mixer Channel Register (MXCH)
OFFSET	0x000
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	PMIS4	PMIS3
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PMIS2	PMIS1	PMIS0	WFG4	WFG3	WFG2	WFG1	WFG0
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:10] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit9] PMIS4: PMIS4 input setting

[bit8] PMIS3: PMIS3 input setting

[bit7] PMIS2: PMIS2 input setting

[bit6] PMIS1: PMIS1 input setting

[bit5] PMIS0: PMIS0 input setting

PMISn (n=0 to 4)	Description
0	PMISn input invalid
1	PMISn input valid

Notes:

PMISn bit must not be changed from 0 to 1 when DMAENCHn bit of MXDRQCTRL register is 1.

[bit4] WFG4: WFG4 input setting

[bit3] WFG3: WFG3 input setting

[bit2] WFG2: WFG2 input setting

[bit1] WFG1: WFG1 input setting

[bit0] WFG0: WFG0 input setting

WFGn (n=0 to 4)	Description
0	WFGn input invalid
1	WFGn input valid

Note:

- *Configuring invalid, the channel will be out of mixing operation not depending on the left data on buffer.*

4.2. Mixer Output Control Register (MXOCTRL)

REGISTER_NAME	Mixer Output Control Register (MXOCTRL)
OFFSET	0x004
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	DATATN[3]	DATATN[2]	DATATN[1]	DATATN[0]
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	MACRO[2]	MACRO[1]	MACRO[0]
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:12] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit11:8] DATATN[3:0]: Number of transfers to output destination

Bit[3:0]	Description
0000 to 1111	Transfers the [value written here + 1] number of data items to the output destination.

Notes:

These bits can be set at the initialization. After that, it should not be changed.

[bit7:3] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit2:0] MACRO[2:0]: Output destination address

Bit[2:0]	Description
2:0	Specifies [12:10] of the AHB bus address.

Notes:

These bits can be set at the initialization. After that, it should not be changed.

4.3. Mixer Date Request Control Register (MXDRQCTRL)

REGISTER_NAME	Mixer Date Request Control Register (MXDRQCTRL)
OFFSET	0x008
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	DMAEN CH4	DMAEN CH3	DMAEN CH2	DMAEN CH1	DMAEN CH0
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	FESTCH4[3:0]			
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	FESTCH3[3:0]				FESTCH2[3:0]			
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	FESTCH1[3:0]				FESTCH0[3:0]			
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit28] DMAENCH4: DMA transfer to PMIS4 request setting

[bit27] DMAENCH3: DMA transfer to PMIS3 request setting

[bit26] DMAENCH2: DMA transfer to PMIS2 request setting

[bit25] DMAENCH1: DMA transfer to PMIS1 request setting

[bit24] DMAENCH0: DMA transfer to PMIS0 request setting

DMAENCHn (n=0 to 4)	Description
0	Disable
1	Enable

[bit23:20] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit19:16] FESTCH4: Data transfer to PMIS4 request assert threshold setting

[bit15:12] FESTCH3: Data transfer to PMIS3 request assert threshold setting

[bit11:8] FESTCH2: Data transfer to PMIS2 request assert threshold setting

[bit7:4] FESTCH1: Data transfer to PMIS1 request assert threshold setting

[bit3:0] FESTCH0: Data transfer to PMIS0 request assert threshold setting

FESTCHn[3:0] (n=0 to 4)	Description
0000 to 1111	A data transfer request is asserted when the input buffer free space becomes [value written here + 1] word.

Notes:

- See Figure 3-1.
- When a 16-bit monaural sound source is input in 32-bit units into PMIS0 to 4, the FESTCHn upper limit setting value is 7. This is because twice the buffer capacity is needed to perform the internal process shown in 3.3 on the monaural sound source.
- FESTCHn bits must not be changed when DMAENCHn bit is 1.

4.4. Mixer Input Control Register (MXICTRL)

REGISTER_NAME	Mixer Input Control Register (MXICTRL)
OFFSET	0x00C
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	PMIS4FREQ[2:0]		
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	PMIS3FREQ[2:0]			Reserved	PMIS2FREQ[2:0]		
ACCESS_TYPE	R0,W0	R/W	R/W	R/W	R0,W0	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	1	0	0	0	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	PMIS1FREQ[2:0]			Reserved	PMIS0FREQ[2:0]		
ACCESS_TYPE	R0,W0	R/W	R/W	R/W	R0,W0	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	1	0	0	0	1

[bit31:19] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit18:16] PMIS4FREQ: Input sampling frequency to PMIS4

[bit15] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit14:12] PMIS3FREQ: Input sampling frequency to PMIS3

[bit11] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit10:8] PMIS2FREQ: Input sampling frequency to PMIS2

[bit7] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit6:4] PMIS1FREQ: Input sampling frequency to PMIS1
[bit3] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit2:0] PMIS0FREQ: Input sampling frequency to PMIS0

PMISnFREQ[2:0] (n=0 to 4)	Description
000	96KHz
001	48KHz
010	24KHz
011	12KHz
100	8KHz
101	4KHz
110	44.1KHz
111	Reserved

Notes:

- Note that the initial value is 001 (48 kHz).
- The 44.1 kHz input sampling rate can be applied to only one of the input channels PMIS0 to 4. Operation when 44.1 kHz is applied to multiple channels cannot be guaranteed from the viewpoint of the mixing process load imposed by the sound mixer. It should be noted that there may limits on specific models concerning the selection of other frequencies.

4.5. Mixer Channel Monaural Register (MXCHMONO)

REGISTER_NAME	Mixer Channel Monaural Register (MXCHMONO)
OFFSET	0x010
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	PMIS4MONO[1:0]	
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PMIS3MONO[1:0]		PMIS2MONO[1:0]		PMIS1MONO[1:0]		PMIS0MONO[1:0]	
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:10] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit9:8] PMIS4MONO: PMIS4 sound source processing mode setting

[bit7:6] PMIS3MONO: PMIS3 sound source processing mode setting

[bit5:4] PMIS2MONO: PMIS2 sound source processing mode setting

[bit3:2] PMIS1MONO: PMIS1 sound source processing mode setting

[bit1:0] PMIS0MONO: PMIS0 sound source processing mode setting

PMISnMONO[1:0] (n=0 to 4)	Description
00	Stereo processing
01	Monaural process R (Upper 16 bits = ALL 0, Lower 16 bits = Monaural sound source).
10	Monaural process L (Upper 16 bits = Monaural sound source, Lower 16 bits = ALL 0).
11	Monaural process LR (Upper 16 bits = Lower 16 bits = Monaural sound source).

Notes:

- *These bits must not be changed during sound source transmission of the channel.*

4.6. Mixer Channel Volume1 Register (MXCHVOL1)

REGISTER_NAME	Mixer Channel Volume1 Register (MXCHVOL1)
OFFSET	0x020
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	WFG3VOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	WFG2VOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	WFG1VOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	WFG0VOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

[bit31:24] WFG3VOL: Gain setting for WFG3 volume control

[bit23:16] WFG2VOL: Gain setting for WFG2 volume control

[bit15:8] WFG1VOL: Gain setting for WFG1 volume control

[bit7:0] WFG0VOL: Gain setting for WFG0 volume control

For details about Gain settings for volume control, see 5.1.

4.7. Mixer Channel Volume2 Register (MXCHVOL2)

REGISTER_NAME	Mixer Channel Volume2 Register (MXCHVOL2)
OFFSET	0x024
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	PMIS2VOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	PMIS1VOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PMIS0VOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	WFG4VOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

[bit31:24] PMIS2VOL: Gain setting for PMIS2VOL volume control

[bit23:16] PMIS1VOL: Gain setting for PMIS1VOL volume control

[bit15:8] PMIS0VOL: Gain setting for PMIS0VOL volume control

[bit7:0] WFG4VOL: Gain setting for WFG4 volume control

For details about Gain settings for volume control, see 5.1.

4.8. Mixer Channel Volume3 Register (MXCHVOL3)

REGISTER_NAME	Mixer Channel Volume3 Register (MXCHVOL3)
OFFSET	0x028
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	MXDVOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PMIS4VOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PMIS3VOL[7:0]							
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0	0	1	1	1

[bit31:24] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit23:16] MXDVOL: Gain setting for mixed sound source volume control

[bit15:8] PMIS4VOL: Gain setting for PMIS4VOL volume control

[bit7:0] PMIS3VOL: Gain setting for PMIS3VOL volume control

For details about Gain settings for volume control, see 5.1.

4.9. Mixer Channel Mute Register (MXCHMUTE)

REGISTER_NAME	Mixer Channel Mute Register (MXCHMUTE)
OFFSET	0x02C
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	MXD MUTE	PMIS4 MUTE	PMIS3 MUTE
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PMIS2 MUTE	PMIS1 MUTE	PMIS0 MUTE	WFG4 MUTE	WFG3 MUTE	WFG2 MUTE	WFG1 MUTE	WFG0 MUTE
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:11] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit10] MXDMUTE: Mixed sound source MUTE setting

Bit	Description
0	Disable mute.
1	Enable mute.

[bit9] PMIS4MUTE: PMIS4 input sound source MUTE setting

[bit8] PMIS3MUTE: PMIS3 input sound source MUTE setting

[bit7] PMIS2MUTE: PMIS2 input sound source MUTE setting

[bit6] PMIS1MUTE: PMIS1 input sound source MUTE setting

[bit5] PMIS0MUTE: PMIS0 input sound source MUTE setting

PMISnMUTE (n=0 to 4)	Description
0	Disable mute.
1	Enable mute.

[bit4] WFG4MUTE: WFG4 input sound source MUTE setting

[bit3] WFG3MUTE: WFG3 input sound source MUTE setting

[bit2] WFG2MUTE: WFG2 input sound source MUTE setting

[bit1] WFG1MUTE: WFG1 input sound source MUTE setting

[bit0] WFG0MUTE: WFG0 input sound source MUTE setting

WFGnMUTE (n=0 to 4)	Description
0	Disable mute.
1	Enable mute.

4.10. Mixer Channel Fade_In/Out1 Register (MXCHFADE1)

REGISTER_NAME	Mixer Channel Fade_in/out1 Register (MXCHFADE1)
OFFSET	0x030
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	WFG1FADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	WFG1FADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	WFG0FADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	WFG0FADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit28:24] WFG1FADEOUT: WFG1 fade out time setting

[bit23:21] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit20:16] WFG1FADEIN: WFG1 fade in time setting

[bit15:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12:8] WFG0FADEOUT: WFG0 fade out time setting

[bit7:3] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4:0] WFG0FADEIN: WFG0 fade in time setting

For details about fade in and fade out time settings for volume control, see 5.2.

4.11. Mixer Channel Fade_In/Out2 Register (MXCHFADE2)

REGISTER_NAME	Mixer Channel Fade_in/out2 Register (MXCHFADE2)
OFFSET	0x034
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	WFG3FADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	WFG3FADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	WFG2FADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	WFG2FADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit28:24] WFG3FADEOUT: WFG3 fade out time setting

[bit23:21] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit20:16] WFG3FADEIN: WFG3 fade in time setting

[bit15:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12:8] WFG2FADEOUT: WFG2 fade out time setting

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4:0] WFG2FADEIN: WFG2 fade in time setting

For details about fade in and fade out time settings for volume control, see 5.2.

4.12. Mixer Channel Fade_In/Out3 Register (MXCHFADE3)

REGISTER_NAME	Mixer Channel Fade_in/out3 Register (MXCHFADE3)
OFFSET	0x038
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	PMIS0FADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	PMIS0FADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	WFG4FADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	WFG4FADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit28:24] PMIS0FADEOUT: PMIS0 fade out time setting

[bit23:21] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit20:16] PMIS0FADEIN: PMIS0 fade in time setting

[bit15:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12:8] WFG4FADEOUT: WFG4 fade out time setting

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4:0] WFG4FADEIN: WFG4 fade in time setting

For details about fade in and fade out time settings for volume control, see 5.2.

4.13. Mixer Channel Fade_In/Out4 Register (MXCHFADE4)

REGISTER_NAME	Mixer Channel Fade_in/out4 Register (MXCHFADE4)
OFFSET	0x03C
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	PMIS2FADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	PMIS2FADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	PMIS1FADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	PMIS1FADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit28:24] PMIS2FADEOUT: PMIS2 fade out time setting

[bit23:21] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit20:16] PMIS2FADEIN: PMIS2 fade in time setting

[bit15:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12:8] PMIS1FADEOUT: PMIS1 fade out time setting

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4:0] PMIS1FADEIN: PMIS1 fade in time setting

For details about fade in and fade out time settings for volume control, see 5.2.

4.14. Mixer Channel Fade_in/out5 Register (MXCHFADE5)

REGISTER_NAME	Mixer Channel Fade_in/out5 Register (MXCHFADE5)
OFFSET	0x040
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	PMIS4FADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	PMIS4FADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	PMIS3FADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	PMIS3FADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit28:24] PMIS4FADEOUT: PMIS4 fade out time setting

[bit23:21] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit20:16] PMIS4FADEIN: PMIS4 fade in time setting

[bit15:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12:8] PMIS3FADEOUT: PMIS3 fade out time setting

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4:0] PMIS3FADEIN: PMIS3 fade in time setting

For details about fade in and fade out time settings for volume control, see 5.2.

4.15. Mixer Mixed Fade_In/Out Register (MXMXDFADE)

REGISTER_NAME	Mixer Mixed Fade_in/out Register (MXMXDFADE)
OFFSET	0x044
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	MXDFADEOUT[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	MXDFADEIN[4:0]				
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12:8] MXDFADEOUT: Mixed sound source fade out time setting

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4:0] MXDFADEIN: Mixed sound source fade in time setting

For details about fade in and fade out time settings for volume control, see 5.2.

4.16. Mixer Channel Fade_In/Out Enable Register (MXCHFADEEN)

REGISTER_NAME	Mixer Channel Fade_in/out Enable Register(MXCHFADEEN)
OFFSET	0x048
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	MXDFADEEN[1:0]		PMIS4FADEEN[1:0]		PMIS3FADEEN[1:0]	
ACCESS_TYPE	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PMIS2FADEEN[1:0]		PMIS1FADEEN[1:0]		PMIS0FADEEN[1:0]		WFG4FADEEN[1:0]	
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	WFG3FADEEN[1:0]		WFG2FADEEN[1:0]		WFG1FADEEN[1:0]		WFG0FADEEN[1:0]	
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:22] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit21:20] MXDFADEEN: Mixed sound source fade in/out operation setting

Bit[1:0]	Description
00	No fade in/fade out
01	Setting prohibited
10	Enable fade in operation start.
11	Enable fade out operation start.

[bit19:18] PMIS4FADEEN: PMIS4 fade in/out operation setting
[bit17:16] PMIS3FADEEN: PMIS3 fade in/out operation setting
[bit15:14] PMIS2FADEEN: PMIS2 fade in/out operation setting
[bit13:12] PMIS1FADEEN: PMIS1 fade in/out operation setting
[bit11:10] PMIS0FADEEN: PMIS0 fade in/out operation setting

PMISnFADEEN[1:0] (n=0 to 4)	Description
00	No fade in/fade out
01	Setting prohibited
10	Enable fade in operation start.
11	Enable fade out operation start.

[bit9:8] WFG4FADEEN: WFG4 fade in/out operation setting
[bit7:6] WFG3FADEEN: WFG3 fade in/out operation setting
[bit5:4] WFG2FADEEN: WFG2 fade in/out operation setting
[bit3:2] WFG1FADEEN: WFG1 fade in/out operation setting
[bit1:0] WFG0FADEEN: WFG0 fade in/out operation setting

WFGnFADEEN[1:0] (n=0 to 4)	Description
00	No fade in/fade out
01	Setting prohibited
10	Enable fade in operation start.
11	Enable fade out operation start.

4.17. Mixer Buffer Clear Register (MXBUFFCLR)

REGISTER_NAME	Mixer Buffer Clear Register (MXBUFFCLR)
OFFSET	0x050
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	OUTBCLR	PMIS4 BCLR	PMIS3 BCLR
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PMIS2 BCLR	PMIS1 BCLR	PMIS0 BCLR	WFG4 BCLR	WFG3 BCLR	WFG2 BCLR	WFG1 BCLR	WFG0 BCLR
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:11] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit10] OUTBCLR: Output buffer initialization

Bit	Description	
	Read	Write
0	Not under initialization	Does not have any effect on operation.
1	Initialization wait	Initialize buffer (This bit automatically cleared to 0 following initialization.)

[bit9] PMIS4BCLR: PMIS4 input buffer initialization

[bit8] PMIS3BCLR: PMIS3 input buffer initialization

[bit7] PMIS2BCLR: PMIS2 input buffer initialization

[bit6] PMIS1BCLR: PMIS1 input buffer initialization

[bit5] PMIS0BCLR: PMIS0 input buffer initialization

PMISnBCLR (n=0 to 4)	Description	
	Read	Write
0	Not under initialization	Does not have any effect on operation.
1	Initialization wait	Initialize buffer (This bit automatically cleared to 0 following initialization.)

Note:

- PMISn input buffer initialization must not be executed when DMAENCHn bit of MXDRQCTRL register is 1.

[bit4] WFG4BCLR: WFG4 input buffer initialization

[bit3] WFG3BCLR: WFG3 input buffer initialization

[bit2] WFG2BCLR: WFG2 input buffer initialization

[bit1] WFG1BCLR: WFG1 input buffer initialization

[bit0] WFG0BCLR: WFG0 input buffer initialization

WFGnBCLR (n=0 to 4)	Description	
	Read	Write
0	Not under initialization	Does not have any effect on operation.
1	Initialization wait	Initialize buffer (This bit automatically cleared to 0 following initialization.)

Note:

- Every channel of WFG0 to 4 has an input buffer for a word (32bit) in the part of "input control".

4.18. Mixer FADE_In/Out Clear Register (MXFADECLR)

REGISTER_NAME	Mixer FADE_in/out Clear Register (MXFADECLR)
OFFSET	0x054
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	MIXCLR	PMIS4 CLR	PMIS3 CLR
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PMIS2 CLR	PMIS1 CLR	PMIS0 CLR	WFG4 CLR	WFG3 CLR	WFG2 CLR	WFG1 CLR	WFG0 CLR
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:11] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit10] MIXCLR: Mixed data FADE state initialization

Bit	Description	
	Read	Write
0	Not under initialization	Does not have any effect on operation.
1	Initialization wait	Initialize fade state (This bit automatically cleared to 0 following initialization.)

[bit9] PMIS4CLR: PMIS4 FADE state initialization
[bit8] PMIS3CLR: PMIS3 FADE state initialization
[bit7] PMIS2CLR: PMIS2 FADE state initialization
[bit6] PMIS1CLR: PMIS1 FADE state initialization
[bit5] PMIS0CLR: PMIS0 FADE state initialization

PMISnCLR (n=0 to 4)	Description	
	Read	Write
0	Not under initialization	Does not have any effect on operation.
1	Initialization wait	Initialize fade state (This bit automatically cleared to 0 following initialization.)

[bit4] WFG4CLR: WFG4 FADE state initialization
[bit3] WFG3CLR: WFG3 FADE state initialization
[bit2] WFG2CLR: WFG2 FADE state initialization
[bit1] WFG1CLR: WFG1 FADE state initialization
[bit0] WFG0CLR: WFG0 FADE state initialization

WFGnCLR (n=0 to 4)	Description	
	Read	Write
0	Not under initialization	Does not have any effect on operation.
1	Initialization wait	Initialize fade state (This bit automatically cleared to 0 following initialization.)

Note:

- "1" writing to initialize should be done after all the bits of MXFADECLR to be "0".

4.19. Mixer Interrupt Enable Register (MXINTREN)

REGISTER_NAME	Mixer Interrupt Enable Register (MXINTREN)
OFFSET	0x060
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	AHBERR	Reserved	Reserved	PMIS4 DMAERR	PMIS3 DMAERR	PMIS2 DMAERR	PMIS1 DMAERR	PMIS0 DMAERR
ACCESS_TYPE	R/W	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	PMIS4 BUFOVFL	PMIS3 BUFOVFL	PMIS2 BUFOVFL	PMIS1 BUFOVFL	PMIS0 BUFOVFL
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	PMIS4 BUFDREQ	PMIS3 BUFDREQ	PMIS2 BUFDREQ	PMIS1 BUFDREQ	PMIS0 BUFDREQ
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31] AHBERR: AHB Master interface bus error interrupt setting

Bit	Description
0	Disable interrupts.
1	Enable interrupts.

[bit30:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit28] PMIS4DMAERR: PMIS4DMA transfer error interrupt setting

[bit27] PMIS3DMAERR: PMIS3DMA transfer error interrupt setting

[bit26] PMIS2DMAERR: PMIS2DMA transfer error interrupt setting

[bit25] PMIS1DMAERR: PMIS1DMA transfer error interrupt setting

[bit24] PMIS0DMAERR: PMIS0DMA transfer error interrupt setting

PMISnDMAERR (n=0 to 4)	Description
0	Disable interrupts.
1	Enable interrupts.

[bit23:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12] PMIS4BUFOVFL: PMIS4 input buffer overflow interrupt setting
[bit11] PMIS3BUFOVFL: PMIS3 input buffer overflow interrupt setting
[bit10] PMIS2BUFOVFL: PMIS2 input buffer overflow interrupt setting
[bit9] PMIS1BUFOVFL: PMIS1 input buffer overflow interrupt setting
[bit8] PMIS0BUFOVFL: PMIS0 input buffer overflow interrupt setting

PMISnBUFOVFL (n=0 to 4)	Description
0	Disable interrupts.
1	Enable interrupts.

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4] PMIS4BUFDREQ: PMIS4 data transfer request interrupt setting
[bit3] PMIS3BUFDREQ: PMIS3 data transfer request interrupt setting
[bit2] PMIS2BUFDREQ: PMIS2 data transfer request interrupt setting
[bit1] PMIS1BUFDREQ: PMIS1 data transfer request interrupt setting
[bit0] PMIS0BUFDREQ: PMIS0 data transfer request interrupt setting

PMISnBUFDREQ (n=0 to 4)	Description
0	Disable interrupts.
1	Enable interrupts.

Note:

- When use of DMA request is disabled by the setting of MSDRQCTRL under 4.3, be sure to disable DMA transfer error interrupt. Failure to do so can result in generation of unexpected interrupts.

4.20. Mixer Interrupt Status Register (MXINTRSTATE)

REGISTER_NAME	Mixer Interrupt Status Register (MXINTRSTATE)
OFFSET	0x064
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	AHBERR	Reserved	Reserved	PMIS4 DMAERR	PMIS3 DMAERR	PMIS2 DMAERR	PMIS1 DMAERR	PMIS0 DMAERR
ACCESS_TYPE	R,WX	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	PMIS4 BUFOVFL	PMIS3 BUFOVFL	PMIS2 BUFOVFL	PMIS1 BUFOVFL	PMIS0 BUFOVFL
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	PMIS4 BUFDREQ	PMIS3 BUFDREQ	PMIS2 BUFDREQ	PMIS1 BUFDREQ	PMIS0 BUFDREQ
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	1	1	1	1	1

[bit31] AHBERR: AHB master interface bus error indication

Bit	Description
0	No error/no transfer request
1	Error/transfer request present

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

[bit30:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit28] PMIS4DMAERR: PMIS4 DMA transfer error indication

[bit27] PMIS3DMAERR: PMIS3 DAM transfer error indication

[bit26] PMIS2DMAERR: PMIS2DMA transfer error indication

[bit25] PMIS1DMAERR: PMIS1DMA transfer error indication

[bit24] PMIS0DMAERR: PMIS0DMA transfer error indication

PMISnDMAERR (n=0 to 4)	Description
0	No error/no transfer request
1	Error/transfer request present

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

[bit23:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit12] PMIS4BUFOVFL: PMIS4 input buffer overflow error indication

[bit11] PMIS3BUFOVFL: PMIS3 input buffer overflow error indication

[bit10] PMIS2BUFOVFL: PIS2 input buffer overflow error indication

[bit9] PMIS1BUFOVFL: PMIS1 input buffer overflow error indication

[bit8] PMIS0BUFOVFL: PMIS0 input buffer overflow error indication

PMISnBUFOVFL (n=0 to 4)	Description
0	No error/no transfer request
1	Error/transfer request present

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit4] PMIS4BUFDREQ: PMIS4 data transfer request indication

[bit3] PMIS3BUFDREQ: PMIS3 data transfer request indication

[bit2] PMIS2BUFDREQ: PMIS2 data transfer request indication

[bit1] PMIS1BUFDREQ: PMIS1 data transfer request indication

[bit0] PMIS0BUFDREQ: PMIS0 data transfer request indication

PMISnBUFDREQ (n=0 to 4)	Description
0	No error/no transfer request
1	Error/transfer request present

Notes:

- *This bit is read-only, and writing is prohibited.*
- *Writing to this bit generates a sound mixer AHB Slave Interface access error.*

4.21. Mixer Interrupt Clear Register (MXINTRCLR)

REGISTER_NAME	Mixer Interrupt Clear Register (MXINTRCLR)
OFFSET	0x068
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	AHBERR	Reserved	Reserved	PMIS4 DMAERR	PMIS3 DMAERR	PMIS2 DMAERR	PMIS1 DMAERR	PMIS0 DMAERR
ACCESS_TYPE	RX,W	RX,W0	RX,W0	RX,W	RX,W	RX,W	RX,W	RX,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	RX,W0	RX,W0	RX,W0	RX,W	RX,W	RX,W	RX,W	RX,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	PMIS4 BUFOVFL	PMIS3 BUFOVFL	PMIS2 BUFOVFL	PMIS1 BUFOVFL	PMIS0 BUFOVFL
ACCESS_TYPE	RX,W0	RX,W0	RX,W0	RX,W	RX,W	RX,W	RX,W	RX,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	PMIS4 BUFDREQ	PMIS3 BUFDREQ	PMIS2 BUFDREQ	PMIS1 BUFDREQ	PMIS0 BUFDREQ
ACCESS_TYPE	RX,W0	RX,W0	RX,W0	RX,W	RX,W	RX,W	RX,W	RX,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31] AHBERR: AHB master interface bus error interrupt clear

Bit	Description
0	Does not have any effect on operation.
1	Clear interrupts.

[bit30:29] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit28] PMIS4DMAERR: PMIS4 DMA transfer error interrupt clear

[bit27] PMIS3DMAERR: PMIS3 DMA transfer error interrupt clear

[bit26] PMIS2DMAERR: PMIS2DMA transfer error interrupt clear

[bit25] PMIS1DMAERR: PMIS1DMA transfer error interrupt clear

[bit24] PMIS0DMAERR: PMIS0DMA transfer error interrupt clear

PMISnDMAERR (n=0 to 4)	Description
0	Does not have any effect on operation.
1	Clear interrupts.

[bit23:13] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit12] PMIS4BUFOVFL: PMIS4 input buffer overflow interrupt clear**[bit11] PMIS3BUFOVFL: PMIS3 input buffer overflow interrupt clear****[bit10] PMIS2BUFOVFL: PMIS2 input buffer overflow interrupt clear****[bit9] PMIS1BUFOVFL: PMIS1 input buffer overflow interrupt clear****[bit8] PMIS0BUFOVFL: PMIS0 input buffer overflow interrupt clear**

PMISnBUFOVFL (n=0 to 4)	Description
0	Does not have any effect on operation.
1	Clear interrupts.

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit4] PMIS4BUFDREQ: PMIS4 data transfer request interrupt clear**[bit3] PMIS3BUFDREQ: PMIS3 data transfer request interrupt clear****[bit2] PMIS2BUFDREQ: PMIS2 data transfer request interrupt clear****[bit1] PMIS1BUFDREQ: PMIS1 data transfer request interrupt clear****[bit0] PMIS0BUFDREQ: PMIS0 data transfer request interrupt clear**

PMISnBUFDREQ (n=0 to 4)	Description
0	Does not have any effect on operation.
1	Clear interrupts.

Note:

- If interrupt generation and interrupt clear occur simultaneously, interrupt generation is given priority.

4.22. Mixer Input Buffer Count1 Register (MXINBUFFCNT1)

REGISTER_NAME	Mixer Input Buffer Count1 Register (MXINBUFFCNT1)
OFFSET	0x070
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	PMIS2CNT[5:0]					
ACCESS_TYPE	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	PMIS1CNT[5:0]					
ACCESS_TYPE	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	PMIS0CNT[5:0]					
ACCESS_TYPE	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	WFG4C	WFG3C	WFG2C	WFG1C	WFG0C
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:30] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit29:24] PMIS2CNT[5:0]: PMIS2 input buffer used volume indication

Bit[5:0]	Description
000000	Buffer is empty.
000001 to 111111	Used input buffer volume

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

[bit23:20] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit21:16] PMIS1CNT[5:0]: PMIS1 input buffer used volume indication

Bit[5:0]	Description
000000	Buffer is empty.
000001 to 111111	Used input buffer volume

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

[bit15:14] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit13:8] PMIS0CNT[5:0]: PMIS0 input buffer used volume indication

Bit[5:0]	Description
000000	Buffer is empty.
000001 to 111111	Used input buffer volume

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit4] WFG4C: WFG4 input data present/not present indication

[bit3] WFG3C: WFG3 input data present/not present indication

[bit2] WFG2C: WFG2 input data present/not present indication

[bit1] WFG1C: WFG1 input data present/not present indication

[bit0] WFG0C: WFG0 input data present/not present indication

WFGnC (n=0 to 4)	Description
0	Without data
1	With data

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

4.23. Mixer Input Buffer Count2 Register (MXINBUFFCNT2)

REGISTER_NAME	Mixer Input Buffer Count2 Register (MXINBUFFCNT2)
OFFSET	0x074
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	PMIS4CNT[5:0]					
ACCESS_TYPE	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	PMIS3CNT[5:0]					
ACCESS_TYPE	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:14] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit13:8] PMIS4CNT[5:0]: Input buffer used volume indication

Bit[5:0]	Description
000000	Buffer is empty.
000001 to 111111	Used input buffer volume

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

[bit7:6] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit5:0] PMIS3CNT[5:0]: Input buffer used volume indication

Bit[5:0]	Description
000000	Buffer is empty.
000001 to 111111	Used input buffer volume

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

4.24. Mixer Channel Buffer Count Register (MXCHBUFFCNT)

REGISTER_NAME	Mixer Input Buffer Count Register (MXCHBUFFCNT)
OFFSET	0x078
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	PMIS4CNT[3:0]			
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	PMIS3CNT[3:0]				PMIS2CNT[3:0]			
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PMIS1CNT[3:0]				PMIS0CNT[3:0]			
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	WFG4C	WFG3C	WFG2C	WFG1C	WFG0C
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:28] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit27:24] PMIS4CNT[3:0]: PMIS4 internal buffer used volume indication

[bit23:20] PMIS3CNT[3:0]: PMIS3 internal buffer used volume indication

[bit19:16] PMIS2CNT[3:0]: PMIS2 internal buffer used volume indication

[bit15:12] PMIS1CNT[3:0]: PMIS1 internal buffer used volume indication

[bit11:8] PMIS0CNT[3:0]: PMIS0 internal buffer used volume indication

PMISnCNT[3:0] (n=0 to 4)	Description
000000	Buffer is empty.
000001 to 111111	Internal buffer used volume display

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

[bit7:5] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit4] WFG4C: WFG4 internal buffer used volume indication
[bit3] WFG3C: WFG3 internal buffer used volume indication
[bit2] WFG2C: WFG2 internal buffer used volume indication
[bit1] WFG1C: WFG1 internal buffer used volume indication
[bit0] WFG0C: WFG0 internal buffer used volume indication

WFGnC (n=0 to 4)	Description
0	Buffer is empty.
1	Internal buffer used

Notes:

- This bit is read-only, and writing is prohibited.
- Writing to this bit generates a sound mixer AHB Slave Interface access error.

4.25. Mixer Output Buffer Count Register (MXOUTBUFFCNT)

REGISTER_NAME	Mixer Output Buffer Count Register (MXOUTBUFFCNT)
OFFSET	0x07C
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	OUTCNT[5:0]					
ACCESS_TYPE	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:6] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit5:0] OUTCNT[5:0]: Output buffer used volume indication

Bit[5:0]	Description
000000	Buffer is empty.
000001 to 111111	Output buffer used volume

Notes:

- *This bit is read-only, and writing is prohibited.*
- *Writing to this bit generates a sound mixer AHB Slave Interface access error.*

4.26. Mixer AHB Bus Error Register (MXAHBERR)

REGISTER_NAME	Mixer AHB Bus Error Register (MXAHBERR)
OFFSET	0x080
ACCESS_SIZE	B H W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	CNTREGERR[1:0]		PMIS4ERR[1:0]		PMIS3ERR[1:0]	
ACCESS_TYPE	R0,W0	R0,W0	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PMIS2ERR[1:0]		PMIS1ERR[1:0]		PMIS0ERR[1:0]		WFG4ERR[1:0]	
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	WFG3ERR[1:0]		WFG2ERR[1:0]		WFG1ERR[1:0]		WFG0ERR[1:0]	
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:22] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

This bit is read-only, and writing is prohibited.

Writing to this bit generates a sound mixer AHB Slave interface access error.

[bit21:20] CNTREGERR[1:0]: AHB Slave interface register access error information indication

Bit[1:0]	Description
00	There is no error.
01	Address error
10	Write access to Read Only register
11	Access size error

[bit19:18] PMIS4ERR[1:0]: AHB Slave interface PMIS4 transfer access error information indication

[bit17:16] PMIS3ERR[1:0]: AHB Slave interface PMIS3 transfer access error information indication

[bit15:14] PMIS2ERR[1:0]: AHB Slave interface PMIS2 transfer access error information indication

[bit13:12] PMIS1ERR[1:0]: AHB Slave interface PMIS1 transfer access error information indication

[bit11:10] PMIS0ERR[1:0]: AHB Slave interface PMIS0 transfer access error information indication

PMISnERR[1:0] (n=0 to 4)	Description
00	There is no error.
01	Address error
10	Write access to Read Only register
11	Access size error

[bit9:8] WFG4ERR[1:0]: AHB Slave interface WFG4 transfer access error information indication

[bit7:6] WFG3ERR[1:0]: AHB Slave interface WFG3 transfer access error information indication

[bit5:4] WFG2ERR[1:0]: AHB Slave interface WFG2 transfer access error information indication

[bit3:2] WFG1ERR[1:0]: AHB Slave interface WFG1 transfer access error information indication

[bit1:0] WFG0ERR[1:0]: AHB Slave interface WFG0 transfer access error information indication

WFGnERR[1:0] (n=0 to 4)	Description
00	There is no error.
01	Address error

10	Write access to Read Only register
11	Access size error

Notes:

- *This bit is read-only, and writing is prohibited.*
- *Writing to this bit generates a Mixer AHB Slave Interface access error.*
- *Every address error during transmission to WFG0 through 4 is informed to WFG0ERR[1:0]. It is also informed to CNTREGERR[1:0] during transmission to PMIS0 through 4.*
- *Every write access error of Read Only register is informed to CNTREERR[1:0].*

4.27. Mixer WFGn Data Address Register (MXWFGnDADR, n=0 to 4)

REGISTER_NAME	Mixer WFGn Data Address Register (MXWFGnDADR, n=0 to 4)
OFFSET	0x100(n=0), 0x104(n=1), 0x108(n=2), 0x10C(n=3), 0x110(n=4)
ACCESS_SIZE	W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	WFGnDADR[31:24]							
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	WFGnDADR[23:16]							
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	WFGnDADR[15:8]							
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	WFGnDADR[7:0]							
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] WFGnDADR [31:0]: WFGn input data register

Notes:

- Because Sound waveform generator output has a fixed connection to this register, this register cannot be written to from the CPU. Writing generates an error.

4.28. Mixer PCM/I2S n Data Address Register0-15 (MXPMISnDADR0-15, n=0 to 4)

REGISTER_NAME	Mixer PCM/I2S n Data Address Register (MXPMISnDADR, n=0 to 4)
OFFSET	0x200 to 0x23C(n=0), 0x240 to 0x27C(n=1), 0x280 to 0x2BC(n=2) 0x2C0 to 0x2FC(n=3), 0x300 to 0x33C(n=4)
ACCESS_SIZE	W
MULTIPLE	31:0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	PMIS n DADR0 to 15[31:24]							
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	PMIS n DADR0 to 15[23:16]							
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PMIS n DADR0 to 15[15:8]							
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PMIS n DADR0 to 15[7:0]							
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] PMISnDADR0 to 15[31:0]: PMIS input data register

5. Appendix

5.1. Gain for Volume Control

Table 5-1

Bit[7:0]	Description	
	Gain (dB)	Magnification
00000000	-96.0	0.000016
00000001	-96.0	0.000016
00000010	-96.0	0.000016
00000011	-96.0	0.000016
00000100	-96.0	0.000016
00000101	-96.0	0.000016
00000110	-96.0	0.000016
00000111	-96.0	0.000016
00001000	-96.0	0.000016
00001001	-96.0	0.000016
00001010	-96.0	0.000016
00001011	-96.0	0.000016
00001100	-96.0	0.000016
00001101	-96.0	0.000016
00001110	-96.0	0.000016
00001111	-96.0	0.000016
00010000	-96.0	0.000016
00010001	-96.0	0.000016
00010010	-96.0	0.000016
00010011	-96.0	0.000016
00010100	-96.0	0.000016
00010101	-96.0	0.000016
00010110	-96.0	0.000016
00010111	-96.0	0.000016
00011000	-96.0	0.000016
00011001	-96.0	0.000016
00011010	-96.0	0.000016
00011011	-96.0	0.000016
00011100	-96.0	0.000016
00011101	-96.0	0.000016
00011110	-96.0	0.000016
00011111	-96.0	0.000016
00100000	-96.0	0.000016
00100001	-96.0	0.000016
00100010	-96.0	0.000016
00100011	-96.0	0.000016

Bit[7:0]	Description	
	Gain (dB)	Magnification
00100100	-96.0	0.000016
00100101	-96.0	0.000016
00100110	-96.0	0.000016
00100111	-96.0	0.000016
00101000	-95.5	0.000017
00101001	-95.0	0.000018
00101010	-94.5	0.000019
00101011	-94.0	0.000020
00101100	-93.5	0.000021
00101101	-93.0	0.000022
00101110	-92.5	0.000024
00101111	-92.0	0.000025
00110000	-91.5	0.000027
00110001	-91.0	0.000028
00110010	-90.5	0.000030
00110011	-90.0	0.000032
00110100	-89.5	0.000033
00110101	-89.0	0.000035
00110110	-88.5	0.000038
00110111	-88.0	0.000040
00111000	-87.5	0.000042
00111001	-87.0	0.000045
00111010	-86.5	0.000047
00111011	-86.0	0.000050
00111100	-85.5	0.000053
00111101	-85.0	0.000056
00111110	-84.5	0.000060
00111111	-84.0	0.000063
01000000	-83.5	0.000067
01000001	-83.0	0.000071
01000010	-82.5	0.000075
01000011	-82.0	0.000079
01000100	-81.5	0.000084
01000101	-81.0	0.000089
01000110	-80.5	0.000094
01000111	-80.0	0.000100
01001000	-79.5	0.000106
01001001	-79.0	0.000112
01001010	-78.5	0.000119
01001011	-78.0	0.000126

Bit[7:0]	Description	
	Gain (dB)	Magnification
01001100	-77.5	0.000133
01001101	-77.0	0.000141
01001110	-76.5	0.000150
01001111	-76.0	0.000158
01010000	-75.5	0.000168
01010001	-75.0	0.000178
01010010	-74.5	0.000188
01010011	-74.0	0.000200
01010100	-73.5	0.000211
01010101	-73.0	0.000224
01010110	-72.5	0.000237
01010111	-72.0	0.000251
01011000	-71.5	0.000266
01011001	-71.0	0.000282
01011010	-70.5	0.000299
01011011	-70.0	0.000316
01011100	-69.5	0.000335
01011101	-69.0	0.000355
01011110	-68.5	0.000376
01011111	-68.0	0.000398
01100000	-67.5	0.000422
01100001	-67.0	0.000447
01100010	-66.5	0.000473
01100011	-66.0	0.000501
01100100	-65.5	0.000531
01100101	-65.0	0.000562
01100110	-64.5	0.000596
01100111	-64.0	0.000631
01101000	-63.5	0.000668
01101001	-63.0	0.000708
01101010	-62.5	0.000750
01101011	-62.0	0.000794
01101100	-61.5	0.000841
01101101	-61.0	0.000891
01101110	-60.5	0.000944
01101111	-60.0	0.001000
01110000	-59.5	0.001059
01110001	-59.0	0.001122
01110010	-58.5	0.001189
01110011	-58.0	0.001259

Bit[7:0]	Description	
	Gain (dB)	Magnification
01110100	-57.5	0.001334
01110101	-57.0	0.001413
01110110	-56.5	0.001496
01110111	-56.0	0.001585
01111000	-55.5	0.001679
01111001	-55.0	0.001778
01111010	-54.5	0.001884
01111011	-54.0	0.001995
01111100	-53.5	0.002113
01111101	-53.0	0.002239
01111110	-52.5	0.002371
01111111	-52.0	0.002512
10000000	-51.5	0.002661
10000001	-51.0	0.002818
10000010	-50.5	0.002985
10000011	-50.0	0.003162
10000100	-49.5	0.003350
10000101	-49.0	0.003548
10000110	-48.5	0.003758
10000111	-48.0	0.003981
10001000	-47.5	0.004217
10001001	-47.0	0.004467
10001010	-46.5	0.004732
10001011	-46.0	0.005012
10001100	-45.5	0.005309
10001101	-45.0	0.005623
10001110	-44.5	0.005957
10001111	-44.0	0.006310
10010000	-43.5	0.006683
10010001	-43.0	0.007079
10010010	-42.5	0.007499
10010011	-42.0	0.007943
10010100	-41.5	0.008414
10010101	-41.0	0.008913
10010110	-40.5	0.009441
10010111	-40.0	0.010000
10011000	-39.5	0.010593
10011001	-39.0	0.011220
10011010	-38.5	0.011885
10011011	-38.0	0.012589

Bit[7:0]	Description	
	Gain (dB)	Magnification
10011100	-37.5	0.013335
10011101	-37.0	0.014125
10011110	-36.5	0.014962
10011111	-36.0	0.015849
10100000	-35.5	0.016788
10100001	-35.0	0.017783
10100010	-34.5	0.018836
10100011	-34.0	0.019953
10100100	-33.5	0.021135
10100101	-33.0	0.022387
10100110	-32.5	0.023714
10100111	-32.0	0.025119
10101000	-31.5	0.026607
10101001	-31.0	0.028184
10101010	-30.5	0.029854
10101011	-30.0	0.031623
10101100	-29.5	0.033497
10101101	-29.0	0.035481
10101110	-28.5	0.037584
10101111	-28.0	0.039811
10110000	-27.5	0.042170
10110001	-27.0	0.044668
10110010	-26.5	0.047315
10110011	-26.0	0.050119
10110100	-25.5	0.053088
10110101	-25.0	0.056234
10110110	-24.5	0.059566
10110111	-24.0	0.063096
10111000	-23.5	0.066834
10111001	-23.0	0.070795
10111010	-22.5	0.074989
10111011	-22.0	0.079433
10111100	-21.5	0.084140
10111101	-21.0	0.089125
10111110	-20.5	0.094406
10111111	-20.0	0.100000
11000000	-19.5	0.105925
11000001	-19.0	0.112202
11000010	-18.5	0.118850
11000011	-18.0	0.125893

Bit[7:0]	Description	
	Gain (dB)	Magnification
11000100	-17.5	0.133352
11000101	-17.0	0.141254
11000110	-16.5	0.149624
11000111	-16.0	0.158489
11001000	-15.5	0.167880
11001001	-15.0	0.177828
11001010	-14.5	0.188365
11001011	-14.0	0.199526
11001100	-13.5	0.211349
11001101	-13.0	0.223872
11001110	-12.5	0.237137
11001111	-12.0	0.251189
11010000	-11.5	0.266073
11010001	-11.0	0.281838
11010010	-10.5	0.298538
11010011	-10.0	0.316228
11010100	-9.5	0.334965
11010101	-9.0	0.354813
11010110	-8.5	0.375837
11010111	-8.0	0.398107
11011000	-7.5	0.421697
11011001	-7.0	0.446684
11011010	-6.5	0.473151
11011011	-6.0	0.501187
11011100	-5.5	0.530884
11011101	-5.0	0.562341
11011110	-4.5	0.595662
11011111	-4.0	0.630957
11100000	-3.5	0.668344
11100001	-3.0	0.707946
11100010	-2.5	0.749894
11100011	-2.0	0.794328
11100100	-1.5	0.841395
11100101	-1.0	0.891251
11100110	-0.5	0.944061
11100111	0.0	1.000000
11101000	0.5	1.059254
11101001	1.0	1.122018
11101010	1.5	1.188502
11101011	2.0	1.258925

Bit[7:0]	Description	
	Gain (dB)	Magnification
11101100	2.5	1.333521
11101101	3.0	1.412538
11101110	3.5	1.496236
11101111	4.0	1.584893
11110000	4.5	1.678804
11110001	5.0	1.778279
11110010	5.5	1.883649
11110011	6.0	1.995262
11110100	6.5	2.113489
11110101	7.0	2.238721
11110110	7.5	2.371374
11110111	8.0	2.511886
11111000	8.5	2.660725
11111001	9.0	2.818383
11111010	9.5	2.985383
11111011	10.0	3.162278
11111100	10.5	3.349654
11111101	11.0	3.548134
11111110	11.5	3.758374
11111111	12.0	3.981072

5.2. Fade In/Fade Out Time

Table 5-2

Bit[4:0]	Description
00000	Fade in/fade out effect not used.
00001	20ms (960 sample)
00010	40ms (1920 sample)
00011	60ms (2880 sample)
00100	80ms (3840 sample)
00101	100ms (4800 sample)
00110	200ms (9600 sample)
00111	300ms (14400 sample)
01000	400ms (19200 sample)
01001	500ms (24000 sample)
01010	600ms (28800 sample)
01011	700ms (33600 sample)
01100	800ms (38400 sample)
01101	900ms (43200 sample)
01110	1000ms (48000 sample)
01111	1100ms (52800 sample)
10000	1200ms (57600 sample)
10001	1300ms (62400 sample)
10010	1400ms (67200 sample)
10011	1500ms (72000 sample)
10100	1600ms (76800 sample)
10101	1700ms (81600 sample)
10110	1800ms (86400 sample)
10111	1900ms (91200 sample)
11000	2000ms (96000 sample)
11001	2000ms (96000 sample)
11010	2000ms (96000 sample)
11011	2000ms (96000 sample)
11100	2000ms (96000 sample)
11101	2000ms (96000 sample)
11110	2000ms (96000 sample)
11111	2000ms (96000 sample)

5.3. Digital Filter

5type of digital filters are prepared and automatically selected and applied to change sampling rate. See 3.10.2 of the description of FIR digital filter.

No	Sampling frequency	Cutoff frequency	remark
1	44kHz	17kHz	Figure 5-1
2	24kHz	11kHz	Figure 5-2
3	12kHz	5kHz	Figure 5-3
4	8kHz	3kHz	Figure 5-4
5	4kHz	1,2kHz	Figure 5-5

Figure 5-1 Filter No 1

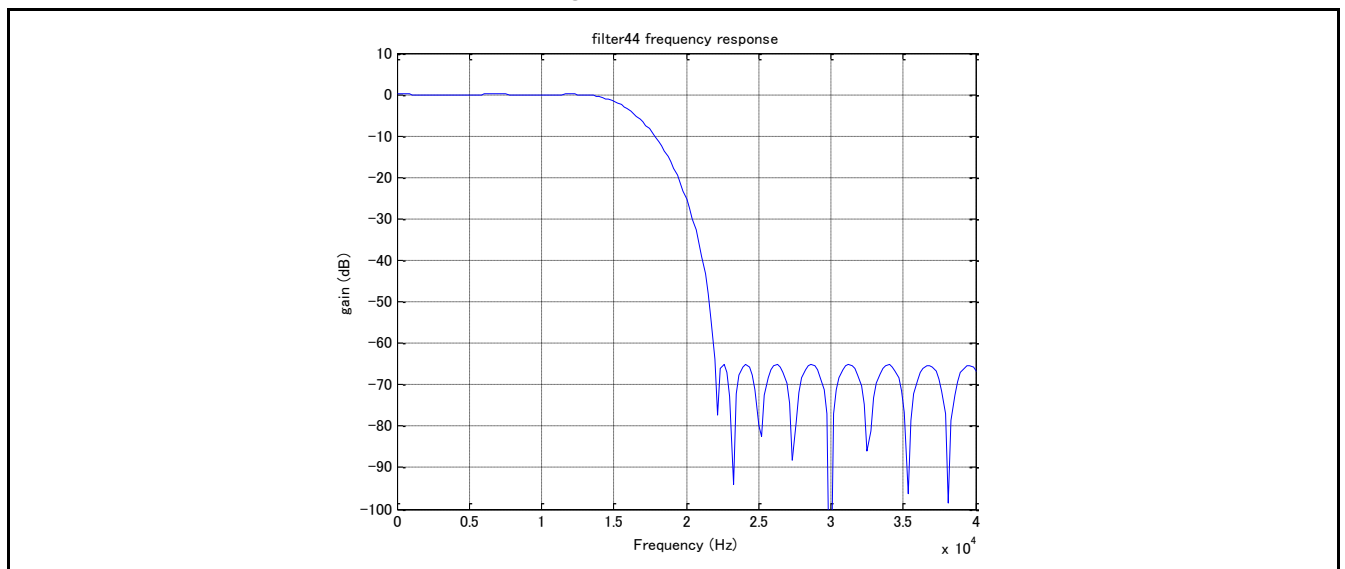


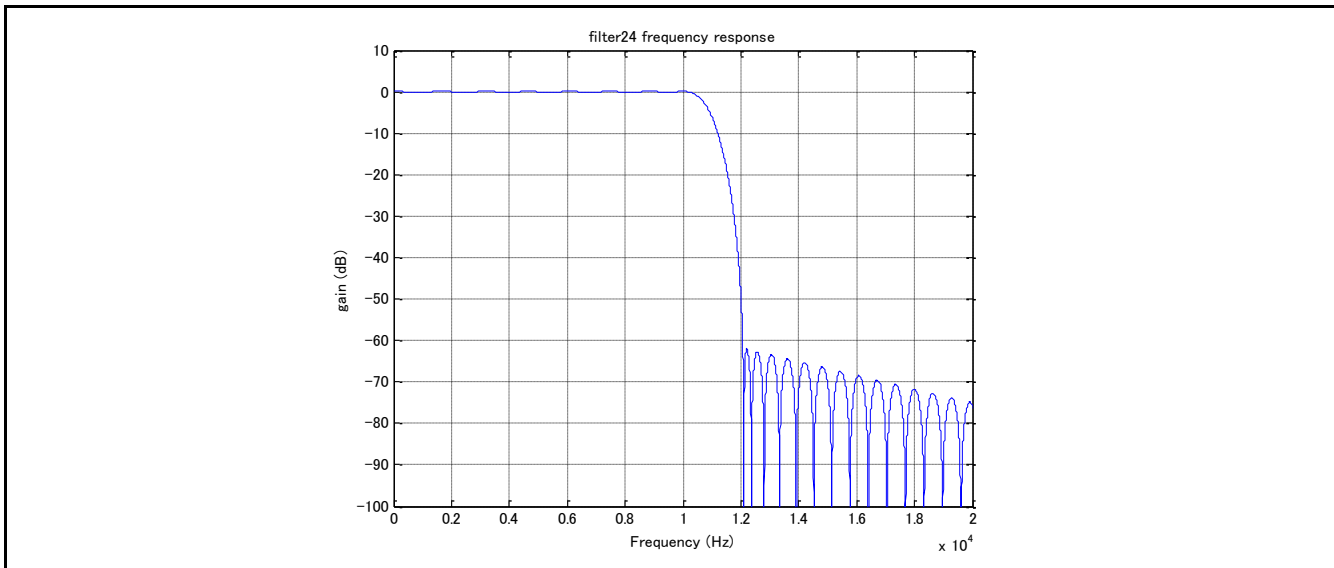
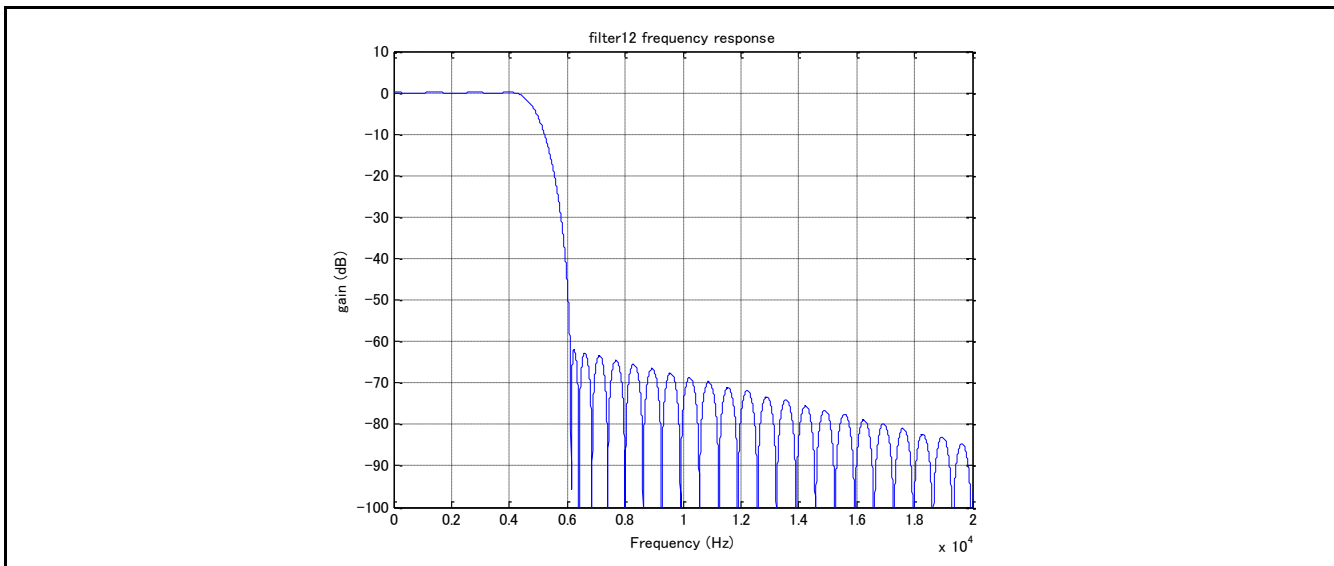
Figure 5-2 Filter No 2**Figure 5-3 Filter No 3**

Figure 5-4 Filter No 4

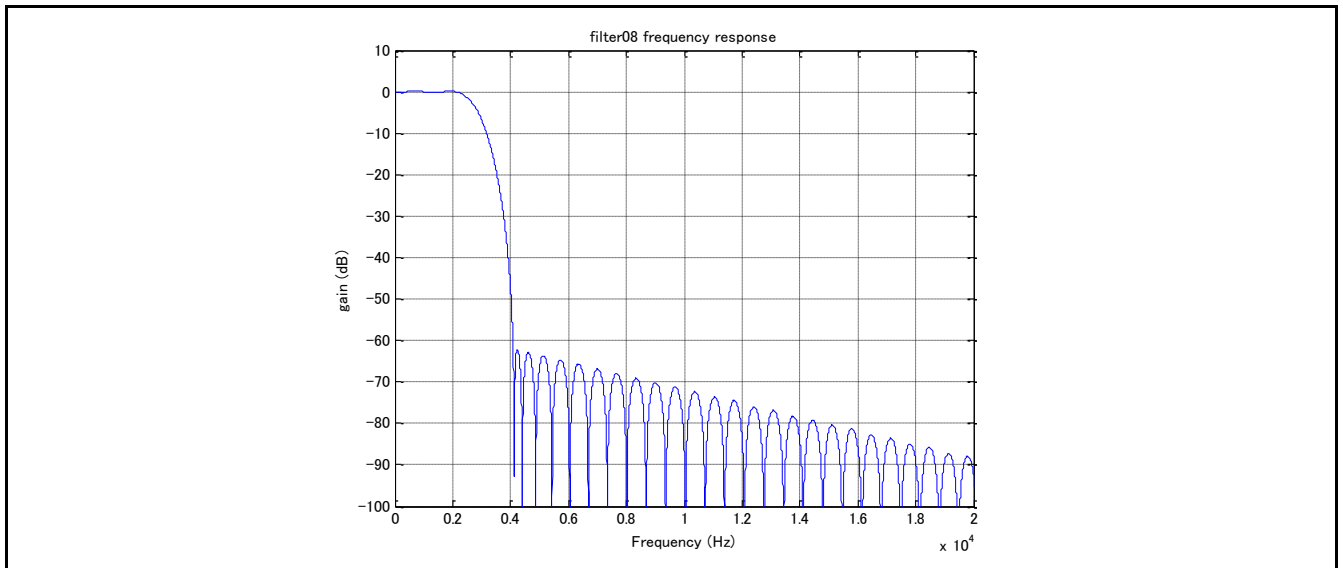
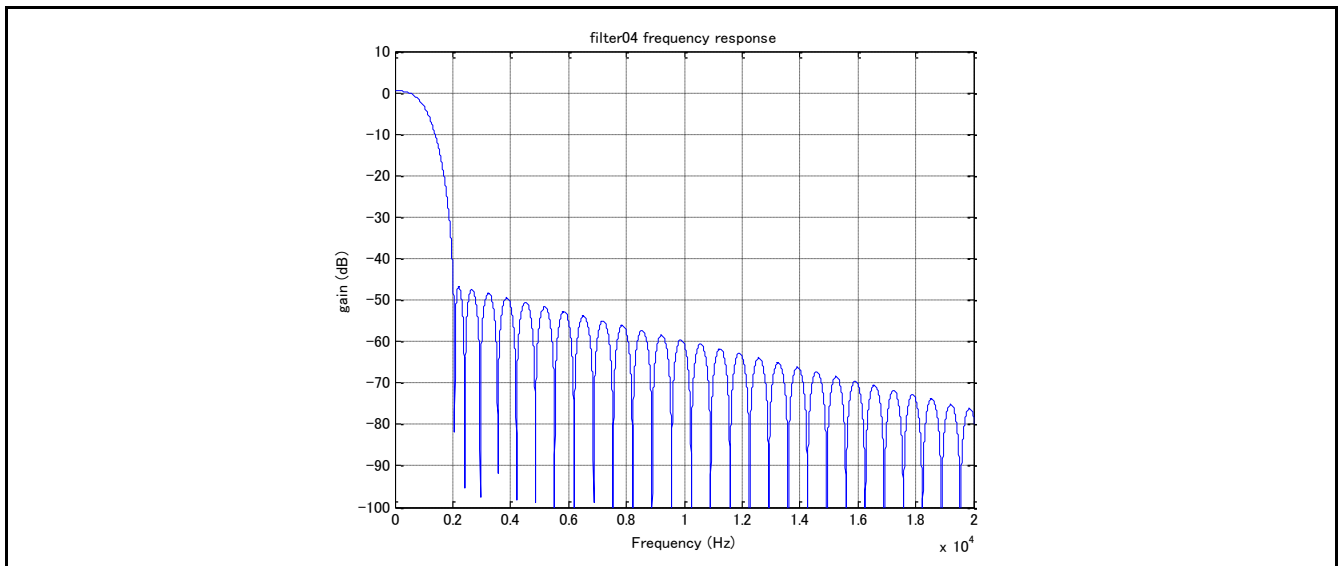


Figure 5-5 Filter No 5



CHAPTER 21: Ethernet MAC



This chapter explains the function and operation of the Ethernet MAC module.

1. Overview
2. Configuration and Block Diagram
3. Operation of the Ethernet MAC
4. Registers
5. Functional Limitations

CODE: ETHRNET-S6J3200-E1

1. Overview

This section gives a brief overview of Ethernet MAC.

Features of the Ethernet MAC

- Supports IEEE Std 802.1BA – Audio Video Bridging Systems
- Supports IEEE Std 802.1Qav – Forwarding and Queuing Enhancements for Time-Sensitive Streams
- Supports IEEE Std 802.1AS – Timing and Synchronization for Time-Sensitive Application in Bridged LAN's
- Supports IEEE Std 1588 – Precision Time Protocol
- 4 transmit and receive priority queues
- 16 screening type 1 registers to support up to 16 received priority queues
- 16 screening type 2 registers which combine matching of VLAN priority, EtherType, Compare A, Compare B, and Compare C comparisons
- full-duplex, 10Mbit/s or 100Mbit/s operation
- AMBA AXI Master Interface (32-bit address width, 64-bit data width)

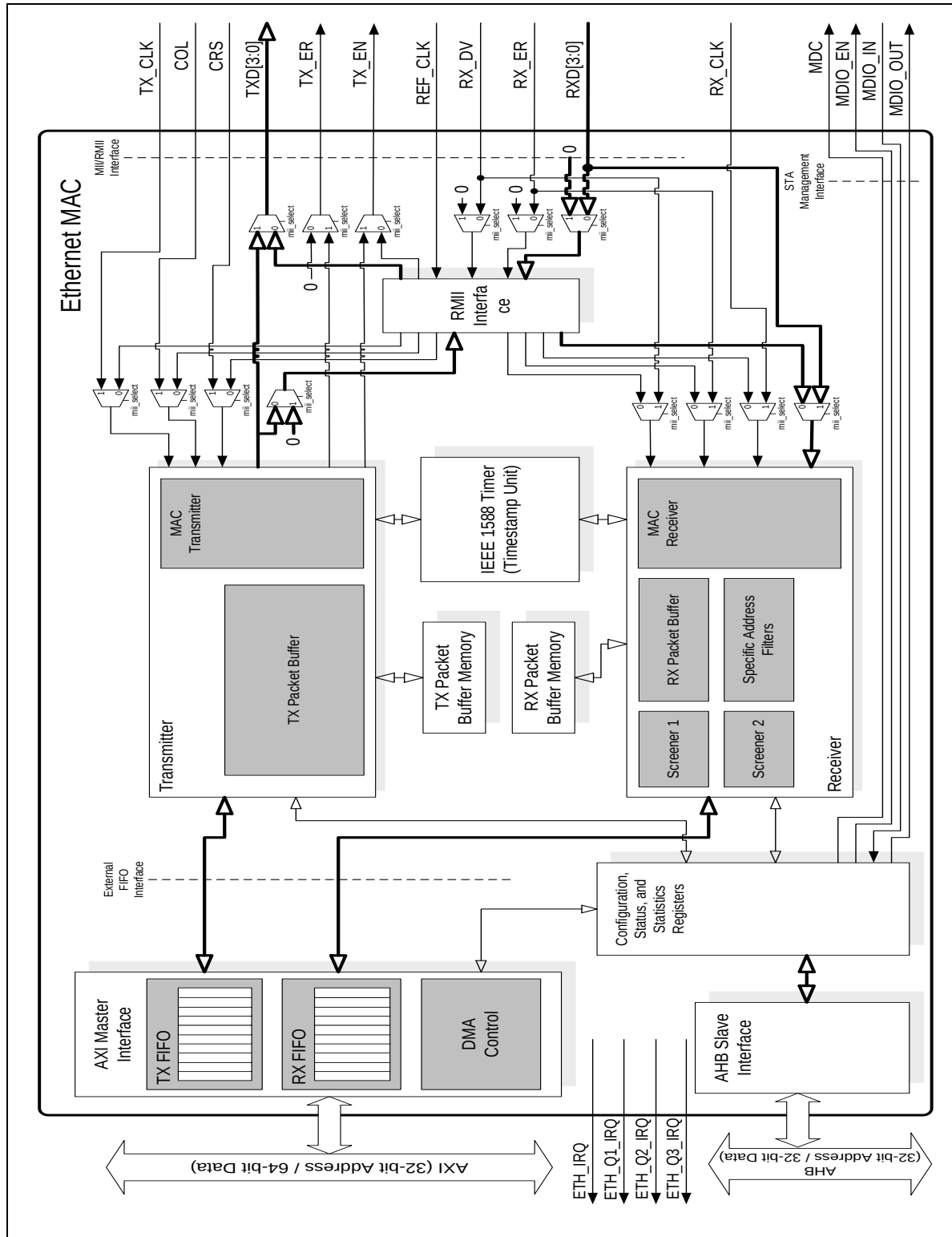
Acronyms and Abbreviations

Acronym	Description
BD	Buffer Descriptor
CBS	Credit Based Shaping
CFI	Canonical Format Indicator
EEE	Energy Efficient Ethernet (IEEE Std 802.3az)
EOF	End Of Frame
FCS	Frame Check Sequence
IP	Internet Protocol
IPG	Interpacket Gap
LAN	Local Area Network (IEEE Std 802)
LLDP	Link Layer Discovery Protocol (IEEE Std 802.1AB)
LPI	Low-Power Idle (IEEE Std 802.3az)
MAC	Media Access Control (IEEE Std 802)
MDC	Management Data Clock
MII	Media Independent Interface
NSP	Non-Standard Preamble
PCS	Physical Coding Sub-Layer
PFC	Priority based Flow Control (IEEE Std 802.1Qbb)
PHY	Physical sublayer
PPPoE	Point-to-Point Protocol over Ethernet
PTP	Precision Time Protocol (IEEE Std 1588)
RFC 791	DARPA Internet Program Protocol Specification
SerDes	Serialiser/Deserialiser
SFD	Start of Frame Delimiter
SGMII	Serial Gigabit Media Independent Interface
SNAP	Subnetwork Access Protocol
SOF	Start Of Frame
TCP	Transfer Control Protocol
TS	Timestamp
TSU	Timestamp Unit
UDP	User Datagram Protocol
VLAN	Virtual LAN (IEEE Std 802.1Q)
XFI	10-Gigabit/s Electrical Interface Specification

2. Configuration and Block Diagram

This section shows a block diagram of the Ethernet MAC.

Figure 2-1: Ethernet MAC Block Diagram



3. Operation of the Ethernet MAC

This section describes the operation of the Ethernet MAC.

3.1. Direct Memory Access Interface

The Ethernet MAC DMA is attached to the Ethernet MAC's External FIFO Interface to provide a scatter gather type capability for packet data storage.

The DMA is configured in packet buffering mode, where Dual-Port memories are used to buffer multiple frames. This allows using one of the programmable operation modes:

- Full Store and Forward
- Partial Store and Forward

In Full Store and Forward mode a packet will automatically be replayed directly from the packet buffer memory rather than having to re-fetch from system memory through AXI, when a collision occurs during transmission. In Full Store and Forward mode received erroneous packets are automatically dropped before they are sent to system memory, thus reducing AXI activity.

Further key features are:

- Transmit TCP/IP checksum offload.
- Priority queuing.
- Manual RX packet flushes.
- RX packet flush when there is lack of resource.
- Burst padding at end of packet and end of buffer to maximize AXI efficiency.
- 64-bit addressing for Data Buffer start address within Buffer Descriptor entry.
- TX/RX timestamp capture to Buffer Descriptor entry.

3.1.1. Using the AXI Interface

The Ethernet MAC's AXI master interface provides separate data and address connections for Reads and Writes, which allow simultaneous, bidirectional data transfers. The Ethernet MAC supports multiple outstanding transactions on both the AXI Read and Write address channels, up to the limit of 16. This means the issuing of Read and Write requests from the Ethernet MAC DMA (on AXI AR and AW channels) are decoupled from the AXI slave responses (on AXI R and B channels). The issuing of outstanding transactions is allowed to span multiple frames, maintaining high data transfer rates.

The Ethernet MAC will buffer the descriptor accesses locally to avoid the underlying DMA from pausing while descriptor transactions are completed by the High Performance Matrix.

- TX and RX descriptor reads are issued up-front and stored in a local buffer to feed the underlying DMA when required. This optimizes performance and avoids the need for the underlying DMA to pause while new descriptor fetches are sent to the system bus.
- TX and RX descriptor writes issued by the underlying DMA are buffered locally to avoid holding up the underlying DMA if and when the system delays the completion of descriptor writes. Note a descriptor write transaction is not considered complete until the write response (BRESP) associated with that transaction has arrived.

The maximum burst lengths the Ethernet MAC will use are programmable. Single accesses and bursts with up to 16 beats can be selected. With 64-bit data path and a burst length setting of 16, 128 Bytes transfers can be made with a single request. The burst length is controlled via the DMA Configuration register (ETHERNETn_dma_config[4:0]).

3.1.2. Partial Store and Forward Using Packet Buffer DMA

The Ethernet MAC can be programmed into a low latency mode, known as partial store and forward. This allows for a reduced latency as the full packet is not buffered before forwarding. This option is only available when not using multi buffer frames. This feature is enabled via the TX and RX Partial Store and Forward registers (ETHERNETn_pbuf_txcutthru, ETHERNETn_pbuf_rxcutthru). When transmit partial store and forward mode is activated, the transmitter will only begin to forward the packet to the MAC when there is enough packet data stored in the TX Packet Buffer Memory. Likewise, when receive partial store and forward mode is activated, the receiver will only begin to forward the packet to the system memory when enough packet data is stored in the RX Packet Buffer Memory. The amount of packet data required to activate the forwarding process is programmable via watermark registers which are located at the same address as the partial store and forward enable bits. Note that the minimum operational value for the TX partial store and forward watermark is 20. There is no operational limit for the RX partial store and forward watermark. Enabling partial store and forward is a useful means to reduce latency, but there are performance implications. In essence, the packet buffer DMA will start behaving in a similar way to the internal FIFO DMA mode when partial store and forward is enabled. Information regarding this behavior is described in section Receive DMA Buffers. When priority queuing is enabled, each TX Packet Buffer Memory region allocated to a queue must be greater than the size of the maximum frame length to be transmitted.

3.1.3. Ethernet MAC DMA Transactions

The Ethernet MAC DMA uses separate transmit and receive lists of buffer descriptors, with each descriptor describing a buffer area in system memory. This allows Ethernet packets to be broken up and scattered around the system memory.

The Ethernet MAC DMA controller performs six types of operation on the AMBA bus. In order of priority these are:

1. receive buffer manager write/read
2. transmit buffer manager write/read
3. receive data DMA write
4. transmit data DMA read

All read operations are routed to the AXI Master Interface read channel and all write operations to the AXI Master Interface write channel. Both read and write channel operate simultaneously. Arbitration logic is used when multiple requests are active on the same channel (e.g. when the TX DMA requests a transmit data read at the same time the RX DMA requests a receive descriptor read). In these cases, the RX DMA is granted the bus before the TX DMA. However the vast majority of requests are either receive data writes or transmit data reads both of which can operate in parallel.

Transfer size is set to 64-bit words by default in the Network Configuration register (ETHERNETn_network_configuration) and burst length can be programmed in the range from single access up to 16 accesses per burst using the DMA Configuration register (ETHERNETn_dma_config).

3.1.4. Receive DMA Buffers

Received frames, optionally including FCS, are written to receive buffers located in system memory. The receive buffer depth (rx_buf_size[7:0]) is programmable in the range of 64 bytes to 16 Kbytes in the DMA Configuration register, with the default being 15.360 bytes.

The start location for each receive buffer is stored in system memory in a list of receive buffer descriptors at an address location pointed to by the receive buffer queue pointer. The base address of the receive buffer queue pointer must be configured by software using the receive buffer queue base address registers (ETHERNETn_receive_q_ptr, ETHERNETn_receive_q1_ptr to ETHERNETn_receive_q3_ptr).

The number of words in each buffer descriptor (BD) is dependent on the operating mode. Each BD word is defined as 32 bits. The first two words (Word 0 and Word 1) are used for all BD modes.

In Extended Buffer Descriptor mode (ETHERNETn_dma_config[28]:rx_bd_extended_mode_en = 1), two BD words (Word 2 and Word 3) are added for timestamp capture if timestamp capture mode is enabled (ETHERNETn_rx_bd_control[5:4]:rx_bd_ts_mode > 0_h). There are therefore either two or four BD words in each BD entry depending on the operating mode, and every BD entry will have the same number of words. To summarize:

- Every descriptor will be 64 bits wide when descriptor time capture mode is disabled.
- Every descriptor will be 128 bits wide when descriptor time capture mode is enabled.

The following description details the functionality of Word 0 and Word 1. Each list entry consists of the same first two words. The first (i.e. Word 0) contains the start location of the receive buffer and the second (i.e. Word 1) the receive status. If the length of a receive frame exceeds the Ethernet MAC DMA buffer length, the status word for the used buffer is written with zeroes except for the "start of frame" bit, which is always set for the first buffer in a frame. Bit zero of the address field is written to "1" to show the buffer has been used. The receive buffer manager then reads the location of the next receive buffer and fills that with the next part of the received frame data. Receive buffers are filled until the frame is complete and the final buffer descriptor entry table for details of the receive buffer descriptor list.

When using receive descriptor timestamp capture, bit 2 of Word 0 is used to indicate a valid timestamp has been captured in the BD. The use of bit 2 for this purpose also necessitates the data buffer being located on a 64-bit address boundary.

Each receive buffer start location is a word address. The start of the first buffer in a frame can be offset by up to seven bytes depending on the value written to bits 15 and 14 of the Network Configuration register (receive_buffer_offset[1:0]) and bit 2 of Word 0.

Table 3-1: Receive Buffer Byte Offset Configuration

Receive Buffer Offset Configuration Bit 2 of Word 0	Receive_Buffer_Offset[1]	Receive_Buffer_Offset[0]	Number of Bytes Offset
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

If the start location of the buffer is offset the available length of the first buffer is reduced by the corresponding number of bytes.

Table 3-2: Receive Buffer Descriptor Entry

Bit	Function
Word 0	
31:3	Address [31:3] of beginning of buffer
2	Address [2] of beginning of buffer or In Extended Buffer Descriptor Mode, indicates a valid timestamp in the BD entry.

Bit	Function
1	Wrap - marks last descriptor in receive buffer descriptor list.
0	Ownership - needs to be "0" for the Ethernet MAC to write data to the receive buffer. The Ethernet MAC sets this to "1" once it has successfully written a frame to memory. Software has to clear this bit before the buffer can be used again.
Word 1	
31	Global all ones broadcast address detected.
30	Multicast hash match.
29	Unicast hash match.
28	External address match.
27	Unused.
26:25	Specific Address register match. Encoded as follows: 00 - Specific Address 1 register match (lowest priority) 01 - Specific Address 2 register match 10 - Specific Address 3 register match 11 - Specific Address 4 register match (highest priority) If more than one specific address is matched only one of them is indicated with priority 4 down to 1.
24	This bit has a different meaning depending on whether RX checksum offloading is enabled (ETHERNETn_network_configuration[24] = 1). With RX checksum offloading disabled: Type ID register match found, bit 22 and bit 23 indicate which Type ID register causes the match. With RX checksum offloading enabled: 0 - The frame was not SNAP encoded and/or had a VLAN tag with the CFI bit set. 1 - The frame was SNAP encoded and had either no VLAN tag or a VLAN tag with the CFI bit not set.
23:22	This bit has a different meaning depending on whether RX checksum offloading is enabled. With RX checksum offloading disabled: Type ID register match. Encoded as follows: 00 - Type ID Match 1 register 01 - Type ID Match 2 register 10 - Type ID Match 3 register 11 - Type ID Match 4 register If more than one Type ID is matched only one of them is indicated with priority 4 down to 1. With RX checksum offloading enabled: 00 - Neither the IP header checksum nor the TCP/UDP checksum was checked. 01 - The IP header checksum was checked and was correct. Neither the TCP nor UDP checksum was checked. 10 - Both the IP header and TCP checksum were checked and were correct. 11 - Both the IP header and UDP checksum were checked and were correct.
21	VLAN tag detected - Type ID of 8100 _h . For packets incorporating the stacked VLAN processing feature, this bit will be set if the second VLAN tag has a Type ID of 8100 _h .
20	Priority tag detected - Type ID of 8100 _h and null VLAN identifier. For packets incorporating the stacked VLAN processing feature, this bit will be set if the second VLAN tag has a Type ID of 8100 _h and a null VLAN identifier.
19:17	VLAN priority - only valid if bit 21 is set. 000 - Priority 0 (lowest) BK Background 001 - Priority 1 BE Best Effort 010 - Priority 2 EE Excellent Effort 011 - Priority 3 CA Critical Applications 100 - Priority 4 VI Video, <100ms latency and jitter 101 - Priority 5 VO Voice, <10ms latency and jitter 110 - Priority 6 IC Internetwork Control 111 - Priority 7 (highest) NC Network Control
16	Canonical Format Indicator (CFI) bit - only valid if bit 21 is set.
15	End of Frame - when set the buffer contains the end of a frame. If End of Frame is not set, then the only valid status bit is Start of Frame (bit 14).
14	Start of Frame - when set the buffer contains the start of a frame. If both bits 15 and 14 are set, the buffer contains a whole frame.

Bit	Function
13	This bit has a different meaning depending on whether jumbo frames and ignore FCS mode are enabled (ETHERNETn_network_configuration[3], ETHERNETn_network_configuration[26]). If neither mode is enabled this bit will be "0". With jumbo frame mode enabled: Additional bit for length of frame (bit 13), that is concatenated with bits [12:0] With ignore FCS mode enabled and jumbo frames disabled: This indicates per frame FCS status as follows: 0 - Frame had good FCS 1 - Frame had bad FCS, but was copied to memory as ignore FCS is enabled.
12:0	These bits represent the length of the received frame which may or may not include FCS depending on whether FCS discard mode is enabled (ETHERNETn_network_configuration[17] = 1). With FCS discard mode disabled: Least significant 12 bits for length of frame including FCS. If jumbo frames are enabled, these 12 bits are concatenated with bit 13 of the descriptor. With FCS discard mode enabled: Least significant 12 bits for length of frame excluding FCS. If jumbo frames are enabled, these 12 bits are concatenated with bit 13 of the descriptor.

When Descriptor Timestamp Capture mode is enabled, the following table identifies the added descriptor words.

Bit	Function
Word 2	
31:30	Timestamp seconds [1:0] (see Note1)
29:0	Timestamp nanoseconds [29:0] (see Note1)
Word 3	
31:10	Unused
9:0	Timestamp seconds [11:2] (see Note1)
	Note 1: The timestamp mode is controlled using the RX BD Control register (ETHERNETn_rx_bd_control). The timestamp bits are written back to the last buffer descriptor of a frame only.

To receive frames, the receive buffer descriptors must be initialized by writing an appropriate address to bits [31:2] (or [31:3] for timestamp capture mode) in the first word of each list entry. Bit 0 must be written with "0". Bit 1 is the wrap bit and indicates the last entry in the buffer descriptor list.

The start location of the receive buffer descriptor list must be written with the receive buffer queue base address before reception is enabled (ETHERNETn_network_control[2] = 1). Once reception is enabled, any writes to the RX Buffer Queue Base Address register are ignored. When read, it will return the current pointer position in the descriptor list, though this is only valid and stable when receive is disabled.

If the filter block indicates that a frame should be copied to memory, the receive data DMA operation starts writing data into the receive buffer. If an error occurs, the buffer is recovered.

A counter in the Ethernet MAC represents the receive buffer queue pointer and it is not visible through its register interface. The receive buffer queue pointer increments by two words after each buffer has been used. It re-initializes to the receive buffer queue base address if any descriptor has its wrap bit set.

As receive buffers are used, the receive buffer manager sets bit 0 of the first word of the descriptor to "1" indication the buffer has been used.

Software should search through the "Used" bits in the buffer descriptors to find out how many frames have been received, checking the Start of Frame and End of Frame bits.

When the Ethernet MAC DMA is configured in the partial store and forward mode, received frames are written out to the system memory as soon as enough frame data exists in the RX Packet Buffer Memory. This may mean several full buffers are used before some error conditions can be detected. If a receive error is detected the receive buffer currently being written will be recovered. Previous buffers will not be recovered. As an example, when receiving frames with CRC errors or excessive length, it is possible that a frame fragment might be stored in a sequence of receive buffers. Software can detect this by looking for Start of Frame bit set in a buffer following a buffer with no End of Frame bit set.

For a properly working 10/100 MBit/s Ethernet system there should be no excessive length frames or frames greater than 128 bytes with CRC errors. Collision fragments will be less than 128 bytes long,

therefore it will be a rare occurrence to find a frame fragment in a receive buffer, when using the value of 128 bytes for the receive buffers size (ETHERNETn_dma_config:rx_buf_size[7:0]).

When in full store and forward mode only good received frames are written out of the Ethernet MAC DMA, so no fragments will exist in the buffers due to MAC Receiver errors. There is still the possibility of fragments due to Ethernet MAC DMA errors, for example used bit read on the second buffer of a multi-buffer frame.

If bit 0 of the receive buffer descriptor is already set when the receive buffer manager reads the location of the receive buffer, then the buffer has been already used and cannot be used again until software has processed the frame and cleared bit 0. In this case, the "buffer not available" bit in the Receive Status register is set and an interrupt triggered. The Receive Resource Errors statistics register is also incremented.

When the Ethernet MAC DMA is configured in the full store and forward mode, it can be selected whether received frames should be automatically discarded when no AXI buffer resource is available. This feature is selected via bit 24 of the DMA Configuration register (by default, the received frames are not automatically discarded). If this feature is off, then received packets will remain to be stored in the RX Packet Buffer Memory until system memory resource next becomes available. This may lead to an eventual packet buffer overflow if packets continue to be received when bit 0 ("Used" bit) of the receive buffer descriptor remains set. Note that after a "Used" bit has been read, the receive buffer manager will re-read the location of the receive buffer descriptor every time a new packet is received. When the Ethernet MAC DMA is not configured in the full store and forward mode and a "Used" bit is read, the frame currently being received will be automatically discarded.

When the Ethernet MAC DMA is configured in the full store and forward mode, a receive over run condition occurs when the RX Packet Buffer Memory is full, or because an AXI error occurred. In all other modes, a receive over run condition occurs when either the AXI bus was not granted quickly enough, or because an AXI error occurred, or because a new frame has been detected by the receive block when the status update or write back for the previous frame has not yet finished. For a receive over run condition, the receive over run interrupt is asserted and the buffer currently being written is recovered. The next frame that is received whose address is recognized reuses the buffer.

When the Ethernet MAC DMA is configured for packet buffer mode, the upper bits of the data buffer address stored in bits [31:2] in the first word of each list entry can be dynamically altered in real-time without physically changing the system memory holding the list entry. This feature is useful if the destination has to be selected based on CPU usage or other flow control hardware. It is achieved using a MUX structure whereby it can be defined whether the upper 4 bits of the 32-bit data-buffer AXI address should come from the descriptor list entry or from a programmable register. Refer to the Receive DMA Data Buffer Address Mask register for further details. Note that any changes to this register will be ignored while the Ethernet MAC DMA is currently processing a receive packet. It will only affect the next full packet to be written to system memory.

3.1.5. Transmit DMA Buffers

Frames to transmit are stored in one or more transmit buffers. Transmit frames can be between 1 and 16.384 bytes long, so it is possible to transmit frames longer than the maximum length (1518 bytes) specified in the IEEE Std 802.3 standard. It should be noted that zero length buffers are allowed and that the maximum number of buffers permitted for each transmit frame is 128.

The start location for each transmit buffer is stored in system memory in a list of transmit buffer descriptors at a location pointed to by the transmit buffer queue pointer. The base address for this queue pointer must be configured by software using the TX Buffer Queue Base Address registers (ETHERNETn_transmit_q_ptr, ETHERNETn_transmit_q1_ptr to ETHERNETn_transmit_q3_ptr).

The number of words in each buffer descriptor (BD) is dependent on the operating mode. Each BD word is defined as 32 bits. The first two words (Word 0 and Word 1) are used for all BD modes.

In Extended Buffer Descriptor mode (ETHERNETn_dma_config[29]:tx_bd_extended_mode_en = 1), two BD words (Word 2 and Word 3) are added for timestamp capture mode if timestamp capture mode is enabled (ETHERNETn_tx_bd_control[5:4]:tx_bd_ts_mode > 0h). There are therefore either two or four BD words in each BD entry depending on the operating mode, and every BD entry will have the same number of words. To summarize:

- Every descriptor will be 64 bits wide when descriptor time capture mode is disabled.
- Every descriptor will be 128 bits wide when descriptor time capture mode is enabled.

The following description details the functionality of Word 0 and Word 1. Each list entry consists of the same first two words. The first (Word 0) is the byte address of the transmit buffer and the second (Word 1) contains the transmit control and status. For the packet buffer DMA, the start location for each AXI buffer is a byte address, the bottom bits of the address being used to offset the start of the data from the data-word boundary (i.e. bits 2, 1, and 0 are used to offset the address for 64-bit data paths).

Frames can be transmitted with or without automatic CRC generation. If CRC is automatically generated, pad will also be automatically generated to take frames to a minimum length of 64 bytes. When CRC is not automatically generated (as defined in Word 1 of the transmit buffer descriptor), the frame is assumed to be at least 64 bytes long and pad is not generated.

Table 3-3: Transmit Buffer Descriptor Entry

Bit	Function
Word 0	
31:0	Byte address of buffer
Word 1	
31	Used - must be "0" for the Ethernet MAC to read data to the transmit buffer. The Ethernet MAC sets this to "1" for the first buffer of a frame once it has been successfully transmitted. Software must clear this bit before the buffer can be used again.
30	Wrap - marks last descriptor in transmit buffer descriptor list. This can be set for any buffer within the frame.
29	Retry limit exceeded, transmit error detected
28	Unused
27	Transmit frame corruption due to AXI error - set if an error occurs whilst midway through reading through reading transmit frame from the AXI, including RRESP/BRESP errors and buffers exhausted mid frame (if the buffers run out during transmission of a frame then transmission stops, FCS shall be bad and TX_ER asserted). Also set if single frame is too large for the transmit packet buffer memory size.
26	Transmit error detected.
25:24	Reserved
23	For Extended Buffer Descriptor Mode this bit indicates a timestamp has been captured in the BD. Otherwise unused.

Bit	Function
22:20	Transmit IP/TCP/UDP checksum generation offload errors: 000 - No error 001 - The Packet was identified as a VLAN type, but the header was not fully complete, or had an error in it. 010 - The Packet was identified as a SNAP type, but the header was not fully complete, or had an error in it. 011 - The Packet was not of an IP type, or the IP packet was invalidly short, or the IP was not of type IPv4/IPv6 100 - The Packet was not identified as VLAN, SNAP or IP. 101 - Non supported packet fragmentation occurred. For IPv4 packets, the IP checksum was generated and inserted. 110 - Packet type detected was not TCP or UDP, TCP/UDP checksum was therefore not generated. For IPv4 packets, the IP checksum was generated and inserted. 111 - A premature end of packet was detected and the TCP/UDP checksum could not be generated.
19:17	Reserved
16	No CRC to be appended by MAC. When set this implies that the data in the buffers already contains a valid CRC and hence no CRC or padding is to be appended to the current frame by the MAC. This control bit must be set for the first buffer in a frame and will be ignored for the subsequent buffers of a frame. Note that this bit must be "0" when using the transmit IP/TCP/UDP checksum generation offload, otherwise checksum generation and substitution will not occur. Note this bit must also be "0" when TX Partial Store and Forward mode is active.
15	Last buffer, when "1" this bit will indicate the last buffer in the current frame has been reached.
14	Reserved
13:0	Length of buffer.

When Descriptor Timestamp Capture mode is enabled, the following table identifies the added descriptor words.

Bit	Function
Word 2	
31:30	Timestamp seconds [1:0] (see Note1)
29:0	Timestamp nanoseconds [29:0] (see Note1)
Word 3	
31:10	Unused
9:0	Timestamp seconds [11:2] (see Note1)
Note 1: The timestamp mode is controlled using the TX BD Control register (ETHERNETn_tx_bd_control). After transmission the timestamp bits are written back only to the first buffer descriptor.	

To transmit frames, the buffer descriptors must be initialized by writing an appropriate byte address to bits [31:0] in the first word (Word 0) of each ETHERNETn_tx_bd_control descriptor list entry.

The second word (Word 1) of the transmit buffer descriptor is initialized with control information that indicates the length of the frame, whether or not the MAC is to append CRC and whether the buffer is the last buffer in the frame.

After transmission the status bits are written back to the second word of the first buffer along with the "Used" bit. Bit 31 is the "Used" bit which must be "0" when the control word is read if transmission is to take place. It is written to "1" once the frame has been transmitted. Bits [29:20] indicate various transmit error conditions. Bit 23 indicates a valid timestamp has been captured in the BD. Bit 30 is the "Wrap" bit which can be set for any buffer within a frame. If no wrap bit is encountered the queue pointer continues to increment.

The TX Buffer Queue Base Address register can only be updated whilst transmission is disabled or halted; otherwise any attempted write will be ignored. When transmission is halted the transmit buffer queue pointer will maintain its value. Therefore when transmission is restarted the next descriptor read from the queue will be from immediately after the last successfully transmitted frame. Whilst transmit is disabled (ETHERNETn_network_control[3] = 0), the transmit buffer queue pointer resets to point to the address indicated by the TX Buffer Queue Base Address register. Note that disabling receive does not have the same effect on the receive buffer queue pointer.

Once the transmit queue is initialized, transmit is activated by writing to the transmit start bit (ETHERNETn_network_control[9]). Transmit is halted when a buffer descriptor with its “Used” bit set is read, a transmit error occurs, or by writing to the transmit halt bit of the Network Control register (ETHERNETn_network_control[10]). Transmission is suspended if a pause frame is received while the pause enable bit is set in the Network Configuration register (ETHERNETn_network_configuration[13]). Rewriting the start bit while transmission is active is allowed. This is implemented with a transmit_go variable which is readable in the Transmit Status register at bit location 3. The transmit_go variable is reset when:

1. Transmit is disabled
2. A buffer descriptor with its ownership bit set is read.
3. Bit 10, tx_halt_clk, of the Network Control register is written.
4. There is a transmit error such as too many retries or a transmit under run.

To set transmit_go write to bit 9, tx_start_clk, of the Network Control register. Transmit halt does not take effect until any ongoing transmit finishes.

If the Ethernet MAC DMA is configured for packet buffer partial store and forward mode and a collision occurs during transmission of a multi-buffer frame, transmission will automatically restart from the first buffer of the frame. For packet buffer mode, the entire contents of the frame are read into the TX Packet Buffer Memory, so the retry attempt will be replayed directly from the TX Packet Buffer Memory rather than having to re-fetch through AXI Master Interface.

If a “Used” bit is read mid way through transmission of a multi buffer frame this is treated as a transmit error. Transmission stops, TX_ER is asserted and the FCS will be bad.

If transmission stops due to a transmit error or a “Used” bit being read, transmission will restart from the first buffer descriptor of the frame being transmitted when the transmit start bit in the Network Control register (ETHERNETn_network_control[9]) is rewritten.

3.1.6. DMA Bursting

When performing data transfers, the burst length used can be programmed using bits [4:0] of the DMA Configuration register. Either single accesses (burst length = 1) or incrementing bursts of up to 16 can be used as appropriate.

When there is sufficient space and enough data to be transferred, the burst of programmed length will be used. If there is not enough data or space available, for example when at the end of a packet or buffer, burst lengths of less than the programmed burst length value will be issued. Single accesses will be used when a 4 Kbyte boundary will be crossed by the burst in order not to violate the AXI specification.

When the Ethernet MAC DMA is configured for packet buffer mode, an option to force the Ethernet MAC DMA to pad the remaining bursts at the end of a buffer or EOP to the programmed burst length value is available via bits 26 and 25 of the DMA Configuration register. Bit 26 will control the TX and bit 25 the RX. For RX, the data to burst is padded with "0"s up to the burst boundary defined by burst length. For TX, the extra data that is read is ignored by the Ethernet MAC DMA. This feature has been included for performance reasons when AHB/AXI slaves that are being accessed by the Ethernet MAC perform better when accessed using fixed length bursts. Note enabling this feature will not break the AHB 1Kbyte or the AXI 4Kbyte boundary rule.

The Ethernet MAC DMA will not terminate bursts premature if receive/transmit operation is disabled by writing to Network Control register bit 2/3.

3.1.7. DMA Packet Buffer

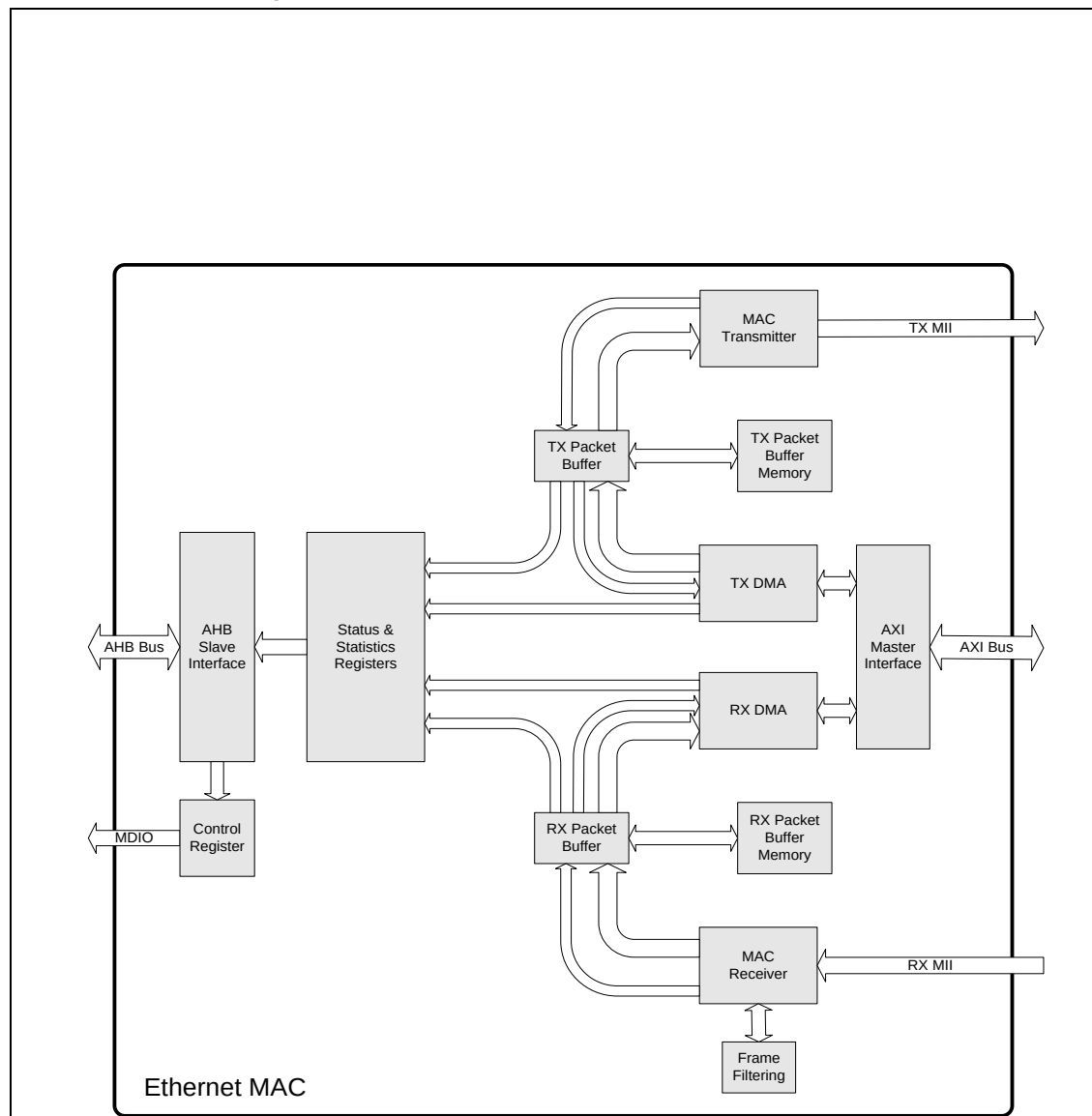
The packet buffer DMA mode allows multiple packets to be buffered in both transmit and receive directions and allows the Ethernet MAC DMA to withstand variable levels of access latencies on the AXI fabric. This mode offers the most efficient use of the AXI bandwidth.

As described earlier, the Ethernet MAC DMA can be programmed into a low latency mode known as partial store and forward. When the Ethernet MAC DMA is programmed in full store and forward mode full packets are buffered providing the opportunity to:

- Discard packets that are received with errors before they are partially written out of the Ethernet MAC DMA thus saving AXI bandwidth and driver processing overhead.
- Retry collided transmit frames from the buffer, thus saving AXI bus bandwidth.
- Implement transmit IP/TCP/UDP checksum generation offload.

The following figure illustrates the structure of the Ethernet MAC data paths.

Figure 3-1: Ethernet MAC Data Path Structure



In the transmit direction, the Ethernet MAC DMA will continue to fetch packet data up to a limit of 256 packets, or until the TX Packet Buffer Memory is full. The size of the TX Packet Buffer Memory is 16 Kbytes (4 Kbytes per queue). In the receive direction, if the RX Packet Buffer Memory becomes full, then an overflow will occur. An overflow will also occur if the limit of 256 packets is breached. The size of the RX Packet Buffer Memory is 4 Kbytes.

■ Transmit Packet Buffer

The Transmit Packet Buffer (TX Packet Buffer) will continue attempting to fetch frame data from the system memory until the TX Packet Buffer Memory is full, at which point it will attempt to maintain its full level.

To accommodate the status and statistics associated with each frame, 2 words per packet are reserved at the end of the packet data. If the packet was bad and requires to be dropped, the status and statistics are the only information held on that packet. Storing the status in the packet buffer is required in order to decouple the TX DMA interface of the buffer from the MAC Transmitter interface, to update the MAC status/statistics and to generate interrupts in the order in which the packets that they represent were fetched from the system memory.

If any errors occur on the AXI whilst reading the transmit frame then the fetching of packet data from memory is halted. The MAC Transmitter will continue to fetch packet data, thereby emptying the TX Packet Buffer Memory and allowing any good non-erroneous frames to be transmitted successfully. Once these have been fully transmitted, the status/statistics for the erroneous frame will be updated and software will be informed via an interrupt that an AXI error occurred. This way, the error is reported in the correct packet order.

The TX Packet Buffer will only attempt to read more frame data from the system memory when space is available in the TX Packet Buffer Memory. If space is not available it must wait until a packet fetched by the MAC Transmitter completes transmission and is subsequently removed from the TX Packet Buffer Memory. Note that if full store and forward mode is active and if a single frame is fetched that is too large for the TX Packet Buffer Memory, the frame is flushed and the TX DMA halted with an error status. This is because a complete frame must be written into the TX Packet Buffer Memory before transmission can begin.

In full store and forward mode, once the complete transmit frame is written into the TX Packet Buffer Memory, a trigger is sent across to the MAC Transmitter, which will then begin reading the frame from the TX Packet Buffer Memory. Since the whole frame is present and stable in the TX Packet Buffer Memory an underflow of the MAC Transmitter is not possible. The frame is kept in the TX Packet Buffer Memory until notification is received from the MAC Transmitter that the frame data has either been successfully transmitted or can no longer be re-transmitted. When this notification is received the frame is flushed from TX Packet Buffer Memory to make room for a new frame to be fetched from system memory.

In partial store and forward mode, a trigger is sent across to the MAC Transmitter as soon as sufficient packet data is available in the TX Packet Buffer Memory, which will then begin fetching the data from it. If, after this point, the MAC Transmitter is able to fetch data from the TX Packet Buffer Memory faster than the TX DMA can fill it, an underflow of the MAC Transmitter is possible. In this case, the transmission is terminated early, and the TX Packet Buffer Memory is flushed. Transmission can only be restarted by writing to the transmit start bit in the Network Control register (ETHERNETn_network_control[9]).

In full duplex mode, the frame is removed from the packet buffer on the fly.

■ Receive Packet Buffer

The Receive Packet Buffer (RX Packet Buffer) stores frames from the MAC Receiver along with their status and statistics. Frames with errors are flushed from the RX Packet Buffer Memory, whilst good frames are pushed onto the AXI Master Interface.

When programmed in full store and forward mode, if the frame has an error the frame data is immediately flushed from the RX Packet Buffer Memory allowing subsequent frames to utilize the freed up space. The status and statistics for bad frames are still used to update the Ethernet MAC registers.

To accommodate the status and statistics associated with each frame, up to 2 words (one being for descriptor timestamp capture when enabled) per packet are reserved at the end of the packet data. If the packet was bad and requires to be dropped, the status and statistics are the only information held on that packet.

The RX Packet Buffer will also detect a full condition such that an overflow condition can be detected. If this occurs subsequent packets will be dropped and an RX overflow interrupt is raised.

For full store and forward, the RX DMA will only begin packet fetches once the status and statistics for a frame are available. If the frame has a bad status due to a frame error, the status and statistics are passed onto the Ethernet MAC registers. If the frame has a good status, the information is used to read the frame from the RX Packet Buffer Memory and burst onto the AXI Master Interface using the DMA buffer management protocol.

If partial store and forward mode is active, the RX DMA will begin fetching the packet data before the status is available. As soon as the status becomes available, the RX DMA will fetch this information before continuing to fetch the remainder of the frame.

3.1.8. Priority Queuing in the Ethernet MAC DMA

The Ethernet MAC DMA uses 4 transmit and 4 receive queues. Each queue has an independent list of buffer descriptors pointing to separate data streams.

In the transmit direction, higher priority queues are serviced before lower priority queues.

This strict priority scheme requires the user to ensure that high priority traffic is constrained such that lower priority traffic will have the required bandwidth.

The Ethernet MAC DMA will determine the next queue to service by initiating a sequence of buffer descriptor reads interrogating the ownership bits of each. The buffer descriptor corresponding to the highest priority queue is read first. If the ownership bit of this descriptor is “1”, then the Ethernet MAC DMA will progress to reading the 2nd highest priority queue's descriptor. If that ownership bit read of this lower priority queue is “1”, then the Ethernet MAC DMA will read the 3rd highest priority queue's descriptor, and so on. If all the descriptors return an ownership bit set, then a resource error has occurred, an interrupt is generated and transmission is automatically halted.

Transmission can only be restarted by setting the start bit (tx_start_clk) in the Network Control register (ETHERNETn_network_control[9]). The Ethernet MAC DMA will need to identify the highest available queue for transmit from when the start bit in the Network Control register is written to and the TX is in a halted state, or when the last word of any packet has been fetched from system memory.

The Ethernet MAC TX DMA will maximize the effectiveness of priority queuing by ensuring that high priority traffic be transmitted as early as possible after being fetched from system memory. High priority traffic will be pushed to the MAC layer depending on traffic shaping being enabled and the associated credit value for that queue, before any lower priority traffic that may pre-exist in the TX Packet Buffer. This is achieved by separating the TX Packet Buffer Memory into regions, 4 regions per queue. The size of each region determines the amount of memory space allocated per queue and is 1Kbytes per region.

If a higher priority transmit queue contains relatively longer buffer, it can happen that a shorter frame from a lower priority queue is transferred before the higher priority queue. For each queue, there is an associated transmit buffer queue base address register. For the lowest priority queue (Queue 0), the TX Buffer Queue Base Address register is located at offset address 0x01C. For queues 1 to 3 the transmit buffer queue base address registers are located at sequential offset addresses starting at 0x440.

In the receive direction each data packet is written to system memory in the order that it is received. For each queue, there is an independent set of receive buffers for each queue. For each queue, there is an associated receive buffer queue base address register. For the lowest priority queue (Queue 0), the RX Buffer Queue Base Address register is located at offset address 0x018. For queues 1 to 3 the receive buffer queue base address registers are located at sequential offset addresses starting at 0x480. Every received packet will pass through a programmable screening algorithm which will allocate to that frame a particular queue to route it to. The interface to the screeners is via two banks of programmable registers, Screening Type 1 registers and Screening Type 2 registers.

Screening Type 1 registers allow routing received frames based on particular IP and UDP fields extracted from the received frames. Specifically these fields are DS (Differentiated Services field of IPv4 frames), TC (Traffic Class field of IPv6 frames) and/or the UDP destination port. These fields are compared against the values stored in each of the Screening Type 1 registers. If the result of this comparison is positive, then the received frame is routed to the priority queue specified in that Screening Type 1 register. Refer to Screening Type 1 register description for further programming details.

Screening Type 2 registers operate independently of Screening Type 1 registers and offer additional match capabilities, extending the capabilities into vendor specific protocols. The Type 2 screening allows a screen to be configured that is the combination of all or any of the following comparisons.

1. An enabled field VLAN Priority. A VLAN Priority match will be performed if the VLAN priority enable is set. The extracted priority field in the VLAN header is compared against 3 bits within the Screening Type 2 register itself.
2. An enabled field EtherType. The EtherType field inside the Screening Type 2 register maps to 1 of 8 EtherType Match registers. The extracted EtherType is compared against the EtherType 2 register designated by this EtherType field.
3. An enabled field Compare A.
4. An enabled field Compare B.
5. An enabled field Compare C.

Compare A, Compare B, and Compare C each have an Enable bit and Compare Register field. The Compare Register field is a pointer to a configured OFFSET, VALUE, and MASK. If enabled the compare is true if the data at the OFFSET into the frame, ANDed with the MASK value is equal to the COMPARE value. A 16-bit word comparison is done. The byte at the OFFSET number of bytes from the index start is compared through bits [15:8] of the configured VALUE and MASK. The OFFSET can be configured to be from 0 to 127 bytes from either the start of the frame, the byte following the EtherType field, the byte following the end of the IP header (IPv4 or IPv6) or the byte following the end of the TCP/UDP header. Note the logic to decode the IP header or the TCP/UDP header is reused from the TCP/UDP/IP checksum offload logic and therefore has the same restrictions on use (the main limitation is that IP fragmentation is not supported). Refer to Checksum Offload for IP, TCP, and UDP section for further details. The Compare Register field points to a single pool of 32 compare registers. Compare A, Compare B, and Compare C use a common set of compare registers.

Note Compare A, Compare B, and Compare C together allow matching against an arbitrary 48-bits of data and so can be used to match against a MAC address.

All enabled comparisons are ANDed together to form the overall Type 2 screener match. Refer to Screening Type 2 register descriptions for further programming details.

Each screener register is programmable via the AHB Slave Interface. Although this is not recommended, it is possible that more than one screener register will be programmed to match against a single frame. If this happens there are 2 cases to consider.

1. If a received frame matches against multiple screeners of the same type, then the frame will route to the queue mapped by the screener located at the lowest numeric offset address. E.g. if Screening Type 2 Register 0 and Screening Type 2 Register 1 both match, then the frame will be routed to the queue identified in queue_number[3:0] of Screening Type 2 Register 0.
2. If a received frame matches against a Screening Type 2 and a Screening Type 1, then the Screening Type 1 will take precedence.

When a screener is matched, the received frame will be routed to a queue defined inside bits [3:0] of the screener register (ETHERNETn_screening_type_1_register_i or ETHERNETn_screening_type_2_register_i). Unmatched frames are routed to Queue 0.

The interrupt outputs from the Ethernet MAC match the number of supported priority queues. Only Ethernet MAC DMA related events are reported using the individual interrupt outputs, as the Ethernet MAC can relate these events to specific queues. All other events generated within the Ethernet MAC are reported in the interrupt associated with the lowest priority queue (Queue 0). For the lowest priority queue the Interrupt Status register is located at offset address 0x024. For all other priority queues, the Interrupt Status register is located at sequential offset addresses starting at 0x400.

3.2. MAC Transmitter Block

The MAC Transmitter operates in full duplex and transmits frames in accordance with the Ethernet IEEE 802.3 standard.

A small input buffer receives data through the External FIFO Interface (from the Ethernet MAC DMA module) which, depending on the data_bus_width control bits in the Network Configuration register, will extract data in 64-bit form. All subsequent processing prior to the final output is performed in bytes.

Transmit data can be output using either the MII or RMII Interface.

Frame assembly starts by adding preamble and the start frame delimiter (SFD). Data is taken from the Transmit FIFO interface a word at a time. If necessary, padding is added to take the frame length to 60 bytes. CRC is calculated using an order 32 bit polynomial. This is inverted and appended to the end of the frame taking the frame length to a minimum of 64 bytes. If the "No CRC" bit (bit 16) is set in the second word (Word 1) of the last buffer descriptor of a transmit frame neither pad nor CRC are appended. The "No CRC" bit can also be set through the FIFO interface.

In full duplex mode, frames are transmitted immediately. Back to back frames are transmitted 96 bit times apart to guarantee the Interpacket Gap.

In all modes of operation, if the TX DMA under runs, a bad CRC is automatically appended using the same mechanism as jam insertion and the TX_ER signal is asserted. For a properly configured system this should never happen and also it is impossible if configured to use the DMA with packet buffers, as the complete frame is buffered in TX Packet Buffer Memory.

3.3. MAC Receiver Block

The MAC Receiver block checks for valid preamble, FCS, alignment and length, presents received frames to the External FIFO Interface and stores the frames destination address for use by the address checking block. If during frame reception, the frame is found to be too long, a bad frame indication is sent to the External FIFO Interface. The receiver logic ceases to send data to RX Packet Buffer Memory as soon as this condition occurs.

At End of Frame reception the MAC Receiver block indicates to the Ethernet MAC DMA whether the frame is good or bad. The Ethernet MAC DMA will recover the current receive buffer if the frame was bad.

Ethernet frames are normally stored in the receive buffer in the AXI memory complete with the FCS.

Setting the fcs_remove bit in the Network Configuration register

(ETHERNETn_network_configuration[17]) causes frames to be stored without their corresponding FCS.

The reported frame length field is reduced by four bytes to reflect this operation.

The MAC Receive block signals to the register block to increment the alignment, CRC (FCS), short frame, long frame, jabber or receive symbol errors when any of these exception conditions occur.

If bit 26 is set in the Network Configuration register, CRC errors will be ignored and CRC erroneous frames will not be discarded, though the Frame Check Sequence Errors statistics register will still be incremented. Additionally if configured to use the Ethernet MAC DMA and not enabled for jumbo frames mode, then bit 13 of the receive buffer descriptor Word 1 will be updated to indicate the FCS validity for the particular frame. This is useful for applications such as EtherCAT whereby individual frames with FCS errors must be identified.

Received frames can be checked for length field error by setting the length_field_error_frame_discard bit of the Network Configuration register (bit 16). When this bit is "1", the receiver compares a frame's measured length with the length field (bytes 13 and 14) extracted from the frame. The frame is discarded if the measured length is shorter. This checking procedure is for received frames between 64 bytes and 1518 bytes in length.

Each discarded frame is counted in the 10-bit length field Frame Check Sequence Errors statistics register. Frames where the length field value is greater than or equal to 0600_h (1536) will not be checked.

3.4. Checksum Offload for IP, TCP, and UDP

The Ethernet MAC can be programmed to perform IP, TCP, and UDP checksum offloading in both receive and transmit directions which is enabled by setting bit 24 in the Network Configuration register for receive and bit 11 in the DMA Configuration register for transmit.

IPv4 packets contain a 16-bit checksum field, which is the 16-bit 1's complement of the 1's complement sum of all 16-bit words in the header. TCP and UDP packets contain a 16-bit checksum field, which is the 16-bit 1's complement of the 1's complement sum of all 16-bit words in the header, the data and a conceptual IP pseudo header.

To calculate these checksums in software requires each byte of the packet to be processed. For TCP and UDP this can use a large amount of processing power. Offloading the checksum calculation to hardware can result in significant performance improvements.

For IP, TCP, and UDP checksum offload to be useful, the operating system containing the protocol stack must be aware that this offload is available so that it can make use of the fact that the hardware can either generate or verify the checksum.

3.4.1. Receiver Checksum Offload

When receive checksum offloading is enabled in the Ethernet MAC, the IPv4 header checksum is checked as per RFC 791, where the packet meets the following criteria:

- If present, the VLAN header must be four octets long and the CFI bit must not be "1". (Also for receive one stacked VLAN is supported.)
- Encapsulation must be RFC 894 Ethernet Type Encoding or RFC 1042 SNAP Encoding or PPPoE Encoding.
- IPv4 packet.
- IP header is of valid length.
- IP options are supported.

The Ethernet MAC also checks the TCP checksum as per RFC 793, or UDP checksum as per RFC 768, if the following criteria are met:

- IPv4 or IPv6 packet.
- IP options and all IPv6 extension headers (i.e. hop-by-hop, routing and destination) are supported (except for fragmentation headers).
- Good IP header checksum (if IPv4).
- IP fragmentation is not supported. (If a packet is fragmented, then the checksum will not be checked)
- TCP or UDP packet.

When an IP, TCP, or UDP frame is received, the receive buffer descriptor gives an indication if the Ethernet MAC was able to verify the checksums. There is also an indication if the frame had SNAP encapsulation. These indication bits will replace the Type ID match indication bits when the receive checksum offload is enabled. For details of these indication bits refer to table **Receive Buffer Descriptor Entry**.

If any of the checksums are verified incorrect by the Ethernet MAC, the packet is discarded and the appropriate statistics counter incremented.

3.4.2. Transmitter Checksum Offload

The transmitter checksum offload is only available if the Ethernet MAC is configured to use the DMA in packet buffer mode and full store and forward mode is enabled. This is because the complete frame to be transmitted must be read into the TX Packet Buffer Memory before the checksum can be calculated and written back into the headers at the beginning of the frame.

Transmitter checksum offload is enabled by setting bit 11 in the DMA Configuration register. When enabled, it will monitor the frame as it is written into the TX Packet Buffer Memory to automatically detect the protocol of the frame. Protocol support is identical to the receiver checksum offload.

For transmit checksum generation and substitution to occur, the protocol of the frame must be recognized and the frame must be provided without the FCS field, by making sure that bit 16 of the transmit descriptor Word 1 is clear (VLAN tagged frames will be recognized but stacked VLAN tagged frames will not be recognized). If the frame data already had the FCS field, this would be corrupted by the substitution of the new checksum fields.

If these conditions are met, the transmit checksum offload engine will calculate the IP, TCP, and UDP checksums as appropriate. Once the full packet is completely written into TX Packet Buffer Memory, the checksums will be valid and the relevant memory locations will be updated for the new checksum fields as per standard IP/TCP and UDP packet structures.

If the transmitter checksum engine is prevented from generating the relevant checksums, bits [22:20] of the **Transmit Buffer Descriptor Entry** will be updated to identify the reason for the error. Note that the frame will still be transmitted but without the checksum substitution, as typically the reason that the substitution did not occur was that the protocol was not recognized.

3.5. MAC Filtering Block

The filter block determines which frames should be written to the External FIFO Interface and on to the Ethernet MAC DMA.

Whether a frame is passed depends on what is enabled in the Network Configuration register, the contents of the Specific Address, Type ID Match and Hash registers and the frame's destination address and type field.

Ethernet frames are transmitted a byte at a time, least significant bit first. The first six bytes of an Ethernet frame make up the destination address. The first bit of the destination address, which is the LSB of the first byte of the frame, is the group or individual bit. This is "1" for multicast addresses and "0" for unicast ones. The "all ones" address is the broadcast address and a special case of multicast.

The Ethernet MAC supports recognition of specific source or destination addresses. The number of specific source or destination address filters is four. Each specific address filter consists of two registers, Specific Address Bottom *i* register and Specific Address Top *i* register. Specific Address Bottom *i* register stores the first four bytes of the compares source or destination address. Specific Address Top *i* register contains the last two bytes of this address, a control bit to select between source or destination address filtering and a 6-bit byte mask field to allow masking certain bytes during the comparison. The first filter (Filter 1) is slightly different to all other filters in that there is no byte mask. Instead address comparison against individual bits of Specific Address 1 register can be masked using the unique Specific Address Mask 1 register. The addresses stored in all filters can be specific (unicast), group (multicast), local or universal.

The destination or source address of received frames is compared against the data stored in the Specific Address registers once they have been activated. The addresses are deactivated at reset or when their corresponding Specific Address Bottom *i* register is written. They are activated when the corresponding Specific Address Top *i* register is written. If a receive frame address matches an active address, the frame is written to the External FIFO Interface and on to DMA memory if used.

Frames may be filtered using the Type ID field for matching. Four Type ID Match registers exist and each can be enabled for matching by writing a "1" to the MSB (bit 31) of the respective register. When a frame is received, the matching is implemented as an OR function of the various types of match.

The content of each Type ID register (when enabled) is compared against the length/Type ID of the frame being received (e.g. bytes 13 and 14 in non-VLAN and non-SNAP encapsulated frames) and copied to system memory if a match is found. The encoded Type ID match bits (Word 0, bit 22 and bit 23) in the

receive buffer descriptor status are set indication which Type ID Match register generated the match, if the receive checksum offload is disabled.

The reset state of the Type ID Match registers is “0”, hence each is initially disabled.

The following example illustrates the use of the address and Type ID Match registers for a MAC address of 21:43:65:87:A9:CB:

Preamble	55 _h
SFD	D5 _h
DA (Octet 0 – LSB)	21 _h
DA (Octet 1)	43 _h
DA (Octet 2)	65 _h
DA (Octet 3)	87 _h
DA (Octet 4)	A9 _h
DA (Octet 5 - MSB)	CB _h
SA (Octet 0 - LSB)	1.)
SA (Octet 1)	1.)
SA (Octet 2)	1.)
SA (Octet 3)	1.)
SA (Octet 4)	1.)
SA (Octet 5 - MSB)	1.)
Type ID (MSB)	43 _h
Type ID (LSB)	21 _h

1. *Contains the address of the transmitting device.*

The sequence above shows the beginning of an Ethernet frame. Byte order of transmission is from top to bottom as shown. For a successful match to Specific Address 1, the following address match registers must be set up:

Specific Address 1 Bottom (0x088)	87654321 _h
Specific Address 1 Top (0x08C)	0000CBA9 _h

And for a successful match to the Type ID, the Type ID Match 1 register must be set up:

Type ID Match 1 (0x0A8)	80004321 _h
-------------------------	-----------------------

3.5.1. Broadcast Address

Frames with the broadcast address of FFFFFFFF_h are stored to memory only if the no_broadcast bit in the Network Configuration register is set to “0”.

3.5.2. Hash Addressing

The 64-bit Hash register (Hash Top/Hash Bottom) takes up two locations in the memory map. The least significant bits are stored in Hash Bottom register and the most significant bits in Hash Top register.

The unicast hash enable and the multicast hash enable bits in the Network Configuration register enable the reception of hash matched frames. The destination address is reduced to a 6-bit index into the 64-bit Hash register using the following hash function. The hash function is an XOR of every sixth bit of the destination address.

```
hash_index[05] = da[05] ^ da[11] ^ da[17] ^ da[23] ^ da[29] ^ da[35] ^ da[41] ^ da[47]
hash_index[04] = da[04] ^ da[10] ^ da[16] ^ da[22] ^ da[28] ^ da[34] ^ da[40] ^ da[46]
hash_index[03] = da[03] ^ da[09] ^ da[15] ^ da[21] ^ da[27] ^ da[33] ^ da[39] ^ da[45]
hash_index[02] = da[02] ^ da[08] ^ da[14] ^ da[20] ^ da[26] ^ da[32] ^ da[38] ^ da[44]
hash_index[01] = da[01] ^ da[07] ^ da[13] ^ da[19] ^ da[25] ^ da[31] ^ da[37] ^ da[43]
hash_index[00] = da[00] ^ da[06] ^ da[12] ^ da[18] ^ da[24] ^ da[30] ^ da[36] ^ da[42]
```

da[00] represents the least significant bit of the first byte received, that is, the multicast/unicast indicator, and da[47] represents the most significant bit of the last byte received.

If the hash index points to a bit that is set in the Hash register then the frame will be matched according to whether the frame is multicast or unicast.

A multicast match will be signaled if the multicast hash enable bit is set, da[00] is “1” and the hash index points to a bit set in the Hash register.

A unicast match will be signaled if the unicast hash enable bit is set, da[00] is “1” and the hash index points to a bit set in the Hash register.

To receive all multicast frames, the Hash register must be set with all “1” and the multicast hash enable bit must be set to “1” in the Network Configuration register.

3.5.3. Copy All Frames (or Promiscuous Mode)

If the copy all frames bit is set in the Network Configuration register then all frames (except those that are too long, too short, have FCS errors or have RX_ER asserted during reception) will be copied to memory. Frames with FCS errors will be copied if bit 26 is set in the Network Configuration register.

3.5.4. Disable Copy of Pause Frames

Pause frames can be prevented from being written to memory by setting the disable copying of pause frames control bit 23 in the Network Configuration register. When set, pause frames are not copied to system memory regardless of the copy all frames bit, whether a hash match is found, a type ID match is identified or if a destination address match is found.

3.5.5. VLAN Support

An Ethernet encoded 802.1Q VLAN tag looks like this:

TPID (Tag Protocol Identifier) 16 bits	TCI (Tag Control Information) 16 bits
8100 _h	First 3 bits priority, then CFI bit, last 12 bits VID

The VLAN tag is inserted at the 13th byte of the frame adding an extra four bytes to the frame. To support these extra four bytes, the Ethernet MAC can accept frame lengths up to 1536 bytes by setting bit 8 in the Network Configuration register.

If the VID (VLAN identifier) is null (000_h) this indicates a priority-tagged frame.

The following bits in the receive buffer descriptor status word give information about VLAN tagged frames:

- Bit 21 set if receive frame is VLAN tagged (i.e. Type ID of 8100_h).
- Bit 20 set if receive frame is priority tagged (i.e. Type ID of 8100_h and null VID). (If bit 20 is set bit 21 will be set also.)
- Bit 19, 18, and 17 set to priority if bit 21 is set.
- Bit 16 set to CFI if bit 21 is set.

The Ethernet MAC can be configured to reject all frames except VLAN tagged frames by setting the discard non-VLAN frames bit in the Network Configuration register.

3.6. IEEE Std 1588 and IEEE Std 802.1AS Support

IEEE Std 1588 is a standard for precision time synchronization in local area networks. It works with the exchange of special Precision Time Protocol (PTP) frames. The PTP messages can be transported over IEEE Std 802.3/Ethernet, over Internet Protocol Version 4 (IPv4) or over Internet Protocol Version 6 (IPv6) as described in the annex of IEEE Std 1588-2008.

Most IEEE Std 1588 functionality can be implemented in software but for greatest accuracy hardware assist is required to detect when PTP event messages pass the MII interface (clock timestamp point).

Synchronization between master and slave clocks is a two stage process.

First the offset between the master and slave clocks is corrected by the master sending a Sync frame to the slave with a follow up frame containing the exact time the Sync frame was sent. Hardware assist modules at the master and slave side detect exactly when the Sync frame was sent by the master and received by the slave. The slave then corrects its clock to match the master clock.

Second the transmission delay between the master and slave is corrected. The slave sends a delay request frame to the master which sends a delay response frame in reply. Hardware assist modules at the master and slave side detect exactly when the delay request frame was sent by the slave and received by the master. The slave will now have enough information to adjust its clock to account for delay. For example if the slave was assuming zero delay the actual delay will be half the difference between transmit and receive time of the delay request frame (assuming equal transmit and receive times) because the slave clock will be lagging the master clock by the delay time already.

For hardware assist it is necessary to timestamp when Sync and Delay_Req messages are sent and received. The timestamp is taken when the message timestamp point passes the clock timestamp point. For Ethernet the message timestamp point is the SFD and the clock timestamp point is MII interface. (The IEEE Std 1588 spec refers to Sync and Delay_Req messages as event messages as these require time stamping. Follow up, delay response and management messages do not require time stamping and are referred to as general messages.)

IEEE Std 1588 version 2 (IEEE Std 1588-2008) defines two additional PTP event messages. These are the peer delay request (Pdelay_Req) and peer delay response (Pdelay_Resp) messages. These messages are used to calculate the delay on a link. Nodes at both ends of a link send both types of frames (regardless of whether they contain a master or slave clock). The Pdelay_Resp message contains the time at which a Pdelay_Req was received and is itself an event message. The time at which a Pdelay_Resp message is received is returned in a Pdelay_Resp_Follow_Up message.

IEEE Std 1588 version 2 introduces transparent clocks of which there are two kinds, peer-to-peer (P2P) and end-to-end (E2E). Transparent clocks measure the transit time of event messages through a bridge and amend a correction field within the message to allow for the transit time. P2P transparent clocks additionally correct for the delay in the receive path of the link using the information gathered from the peer delay frames. With P2P transparent clocks Delay_Req messages are not used to measure link delay. This simplifies the protocol and makes larger systems more stable.

The Ethernet MAC recognizes ten different encapsulations for PTP event messages:

1. IEEE Std 1588 version 1 (UDP/IPv4 multicast)
2. IEEE Std 1588 version 1 (UDP/IPv4 multicast with VLAN)
3. IEEE Std 1588 version 2 (UDP/IPv4 multicast)
4. IEEE Std 1588 version 2 (UDP/IPv4 multicast with VLAN)
5. IEEE Std 1588 version 2 (UDP/IPv4 unicast)
6. IEEE Std 1588 version 2 (UDP/IPv4 unicast with VLAN)
7. IEEE Std 1588 version 2 (UDP/IPv6 multicast)
8. IEEE Std 1588 version 2 (UDP/IPv6 multicast with VLAN)
9. IEEE Std 1588 version 2 (Ethernet multicast)
10. IEEE Std 1588 version 2 (Ethernet multicast with VLAN)

Note: IEEE Std 1588 version 1 (IEEE Std 1588-2002)

Unicast PTP frame recognition is enabled via bit 20 of the Network Control register. The unicast addresses themselves are programmable via the PTP Unicast IP Destination Address register for which there are two (ETHERNETn_rx_ptp_unicast and ETHERNETn_tx_ptp_unicast). The first holds the RX unicast IP destination address and the other the TX unicast destination address. The PTP Unicast IP Destination Address register should only be changed when the unicast PTP frame recognition is disabled.

Example of a Sync frame in the IEEE Std 1588 version 1 format:

```

Preamble/SFD                               55555555555555D5h
DA (Octets 0 – 5)
SA (Octets 6 – 11)
Type (Octets 12 – 13)                       0800h
IP stuff (Octets 14 – 22)
UDP (Octet 23)                             11h
IP stuff (Octets 24 – 29)
IP DA (Octets 30 – 32)                       E00001h
IP DA (Octet 33)                           81h or 82h or 83h or 84h
source IP port (Octets 34 – 35)
dest IP port (Octets 36 – 37)               013Fh
other stuff (Octets 38 – 42)
version PTP (Octet 43)                     01h
other stuff (Octets 44 – 73)
control (Octet 74)                         00h
other stuff (Octets 75 – 168)

```

Example of a Delay_Req frame in the IEEE Std 1588 version 1 format:

```

Preamble/SFD                               55555555555555D5h
DA (Octets 0 – 5)
SA (Octets 6 – 11)
Type (Octets 12 – 13)                       0800h
IP stuff (Octets 14 – 22)
UDP (Octet 23)                             11h
IP stuff (Octets 24 – 29)
IP DA (Octets 30 – 32)                       E00001h
IP DA (Octet 33)                           81h or 82h or 83h or 84h
source IP port (Octets 34 – 35)
dest IP port (Octets 36 – 37)               013Fh
other stuff (Octets 38 – 42)
version PTP (Octet 43)                     01h
other stuff (Octets 44 – 73)
control (Octet 74)                         01h

```

other stuff (Octets 75 – 168)

For IEEE Std 1588 version 1 messages Sync and Delay_Req frames are indicated by the Ethernet MAC if the frames type field indicates TCP/IP, UDP protocol is indicated, the destination IP address is 224.0.1.129/130/131/132, the destination UDP port is 319 and the control field is correct. The control field is 00_h for Sync frames and 01_h for Delay_Req frames.

For IEEE Std 1588 version 2 messages the type of frame is determined by looking at the message type field in the first byte of the PTP frame. Whether a frame is version 1 or version 2 can be determined by looking at the version PTP field in the second byte of version 1 and version 2 PTP frames.

In version 2 messages Sync frames have a message type value of 0_h, Delay_Req frames have 1_h, Pdelay_Req frames have 2_h and Pdelay_Resp frames have 3_h.

Example of a Sync frame in the IEEE Std 1588 version 2 (UDP/IPv4) format:

Preamble/SFD	55555555555555D5 _h
DA (Octets 0 – 5)	
SA (Octets 6 – 11)	
Type (Octets 12 – 13)	0800 _h
IP stuff (Octets 14 – 22)	
UDP (Octet 23)	11 _h
IP stuff (Octets 24 – 29)	
IP DA (Octets 30 - 33)	E0000181 _h
source IP port (Octets 34 – 35)	
dest IP port (Octets 36 – 37)	013F _h
other stuff (Octets 38 – 41)	
message type (Octet 42)	00 _h
version PTP (Octet 43)	02 _h

Example of a Pdelay_Req frame in the IEEE Std 1588 version 2 (UDP/IPv4) format:

Preamble/SFD	55555555555555D5 _h
DA (Octets 0 – 5)	
SA (Octets 6 – 11)	
Type (Octets 12 – 13)	0800 _h
IP stuff (Octets 14 – 22)	
UDP (Octet 23)	11 _h
IP stuff (Octets 24 – 29)	
IP DA (Octets 30 - 33)	E000006B _h
source IP port (Octets 34 – 35)	
dest IP port (Octets 36 – 37)	013F _h
other stuff (Octets 38 – 41)	
message type (Octet 42)	02 _h
version PTP (Octet 43)	02 _h

Example of a Sync frame in the IEEE Std 1588 version 2 (UDP/IPv6) format:

Preamble/SFD	55555555555555D5 _h
DA (Octets 0 – 5)	
SA (Octets 6 – 11)	
Type (Octets 12 – 13)	86DD _h
IP stuff (Octets 14 – 19)	
UDP (Octet 20)	11 _h
IP stuff (Octets 21 – 37)	
IP DA (Octets 38 - 53)	FF0X000000000181 _h
source IP port (Octets 54 – 55)	
dest IP port (Octets 56 – 57)	013F _h
other stuff (Octets 58 – 61)	
message type (Octet 62)	00 _h
other stuff (Octets 63 – 93)	
version PTP (Octet 94)	02 _h

Example of a Pdelay_Req frame in the IEEE Std 1588 version 2 (UDP/IPv6) format:

Preamble/SFD	55555555555555D5 _h
DA (Octets 0 – 5)	
SA (Octets 6 – 11)	
Type (Octets 12 – 13)	86DD _h
IP stuff (Octets 14 – 19)	
UDP (Octet 20)	11 _h
IP stuff (Octets 21 – 37)	
IP DA (Octets 38 – 53)	FF0200000000006B _h
source IP port (Octets 54 – 55)	
dest IP port (Octets 56 – 57)	013F _h
other stuff (Octets 58 – 61)	
message type (Octet 62)	03 _h
other stuff (Octets 63 – 93)	
version PTP (Octet 94)	02 _h

Example of a Sync frame in the IEEE Std 1588 version 2 (Ethernet multicast) format. For the multicast address 011B19000000_h Sync and Delay_Req frames are recognized depending on the message type field, 00_h for Sync and 01_h for Delay_Req:

Preamble/SFD	55555555555555D5 _h
DA (Octets 0 – 5)	011B19000000 _h
SA (Octets 6 – 11)	
Type (Octets 12 – 13)	88F7 _h
message type (Octet 14)	00 _h
version PTP (Octet 15)	02 _h

Example of a Pdelay_Req frame in the IEEE Std 1588 version 2 (Ethernet multicast) format, these need a special multicast address so they can get through ports blocked by the spanning tree protocol. For the multicast address 0180C200000E_h Sync, Pdelay_Req and Pdelay_Resp frames are recognized depending on the message type field, 00_h for Sync, 02_h for Pdelay_Req and 03_h for Pdelay_Resp:

Preamble/SFD	55555555555555D5 _h
DA (Octets 0 – 5)	0180C200000E _h
SA (Octets 6 – 11)	
Type (Octets 12 – 13)	88F7 _h
message type (Octet 14)	02 _h
version PTP (Octet 15)	02 _h

The Ethernet MAC contains a timestamp unit (TSU) which consists of a timer and registers to capture the time at which PTP event frames cross the message timestamp point. The registers are accessible through the Ethernet MAC's AHB slave interface. An interrupt is issued when a capture register is updated.

3.6.1. Support for Time Stamping and Timestamp Accuracy

The MAC has the responsibility of sampling the TSU timer value when the TX or RX SOF event of the frame passes the MII boundary. This event is an existing signal synchronous to MAC TX/RX clock domains. The MAC uses the sampled timestamp to insert the timestamp into transmitted PTP Sync frames (if one step sync feature is enabled), or to pass to the Ethernet MAC's register block to capture the timestamp (TS) in registers, or to pass to the Ethernet MAC DMA to insert into TX or RX buffer descriptors. For each of these, the SOF event, which is captured in the TX and RX clock domains respectively, is synchronized to the TSU clock domain and the resulting signal is used to sample the TSU count value. This value will be kept stable for an entire frame, or specifically at least 64 TX/RX clock cycles, since the minimum frame size in Ethernet is 64 bytes and worst case is a transfer rate of 1 byte per cycle. It is used as the source for all the components within the Ethernet MAC that require the timestamp value. Since the SOF event had to pass a clock boundary, there is a degree of inaccuracy in the captured timestamp. The level of inaccuracy depends on the frequency of the TSU clock (tsu_clk). There will be no more than 1 clock cycle of inaccuracy.

In the best case, the SOF event (which is in the TX/RX clock domain) just meets the setup time of the TSU clock domain at the input to the first synchronization FlipFlop. The captured TS is N+2, but it really should be N+1. In the worst case, the captured TS is also N+2, but it really should be N.

3.6.2. Single Step Time Stamping

Support of one step clock for TX Sync frames can be enabled by setting bit 24 in the Network Control register. In this mode the timestamp field, within the IEEE Std 1588 version 2 Sync frame, is replaced by the TSU timestamp value at the time the Sync frame SOF passes the MII Interface To use single step time stamping, the sampled timestamp must be stable before the point at which Ethernet MAC requires to insert the timestamp. This can be guaranteed by enforcing a rule that TSU clock (tsu_clk) is greater than 1/8th the frequency of TX clock (TX_CLK) or RX clock (RX_CLK).

3.6.3. Timestamp Capture in Registers

There are four 80-bit timestamp status registers that capture the time at which PTP event frames are transmitted and received.

- {ETHERNETn_tsu_ptp_rx_msb_sec, ETHERNETn_tsu_ptp_rx_sec, ETHERNETn_tsu_ptp_rx_nsec}
- {ETHERNETn_tsu_ptp_tx_msb_sec, ETHERNETn_tsu_ptp_tx_sec, ETHERNETn_tsu_ptp_tx_nsec}
- {ETHERNETn_tsu_peer_rx_msb_sec, ETHERNETn_tsu_peer_rx_sec, ETHERNETn_tsu_peer_rx_nsec}
- {ETHERNETn_tsu_peer_tx_msb_sec, ETHERNETn_tsu_peer_tx_sec, ETHERNETn_tsu_peer_tx_nsec}

An interrupt is issued when these registers are updated.

3.6.4. Timestamp Capture in DMA Descriptors

The TX and/or RX timestamp can optionally be captured in an extended buffer descriptor when configured using bits [29:28] in the DMA Configuration register. The timestamp can be captured for a number of frame types (PTP event or PTP general, or all frames, or none as defined in TX BD Control/RX BD Control registers) and a bit within Buffer Descriptor Word 0/1 is used to indicate that the timestamp is present.

3.6.5. Controlling the Timestamp Unit

The timer is implemented as a 94-bit register with the upper 48 bits counting seconds, the next 30 bits counting nanoseconds and the lowest 16 bits counting sub-nanoseconds. The lower 46 bits roll over when they have counted to one second. An interrupt is generated when the seconds increment. The timer value can be read, written and adjusted through the AHB Slave Interface. The timer is clocked with clock **CLK_HAPP1B0**.

There are two modes of operation to control the way the timer varies over time. These are:

Increment timer by a fixed value every clock (**CLK_HAPP1B0**). This is increment mode.

Increment timer by a fixed value for a fixed number of clocks, followed by an alternative increment value for a single clock. This is alternative increment mode.

■ Increment Mode

The amount by which the timer increments each clock cycle is controlled by the IEEE 1588 Timer Increment register. Bits [7:0] are the default increment value in nanoseconds and additional 16-bits of sub-nanoseconds resolution are available using the IEEE 1588 Timer Increment Sub Nanoseconds register. If the rest of the IEEE 1588 Timer Increment register is written with “0” the timer increments by the value in bits [7:0], plus the value in IEEE 1588 Timer Nanoseconds register, each clock cycle.

The IEEE 1588 Timer Nanoseconds register allows a resolution of approximately 15 femtoseconds (1ns/65536).

■ Alternative Increment Mode

Bits [15:8] of the IEEE 1588 Timer Increment register are the alternative increment value in nanoseconds and bits [23:16] are the number of increments after which the alternative increment value is used. If bits [23:16] are 00_h then the alternative increment value will never be used.

The timer count value can be compared to a programmable comparison value. For the comparison the 48 bits of the seconds value and the upper 22 bits of the nanoseconds value are used. An interrupt can be issued when the timer count value and the comparison value in the IEEE 1588 Timer Comparison Value registers (ETHERNETn_tsu_msb_sec_cmp, ETHERNETn_tsu_sec_cmp, ETHERNETn_tsu_nsec_cmp) is equal. The interrupt can be enabled with bit 29 in the Interrupt Enable register.

IEEE Std 802.1AS is mostly a subset of IEEE Std 1588. There is one difference in that IEEE Std 802.1AS uses the Ethernet multicast address 0180C200000E_h for Sync frame recognition whereas IEEE Std 1588 does not. Ethernet MAC is designed to recognize Sync frames with both IEEE Std 1588 and IEEE Std 802.1AS addresses and so can support their frame recognition simultaneously.

3.7. MAC IEEE Std 802.3 Pause Frame Support

The Ethernet MAC supports both hardware controlled pause of the transmitter upon reception of a pause frame and hardware generated pause frame transmission.

Note: See Clause 31, and Annex 31A and 31B of the IEEE Std 802.3 for a full description of pause operation.

The start of an IEEE Std 802.3 pause frame looks like this:

Destination Address	Source Address	Type (MAC Control Frame)	Pause Opcode	Pause Time
0180C2000001 _h	6 bytes	8808 _h	0001 _h	2 bytes

3.7.1. IEEE Std 802.3 Pause Frame Reception

Bit 13 of the Network Configuration register is the pause enable control for reception. If this bit is set transmission will pause if a non zero pause quantum frame is received.

If a valid pause frame is received then the Receive Pause Quantum register is updated with the new frame's pause time regardless of whether a previous pause frame is active or not. An interrupt (either bit 12 or 13 of the Interrupt Status register) is triggered when a pause frame is received, but only if the interrupt has been enabled. Pause frames received with non-zero quanta are indicated through the interrupt bit 12 of the Interrupt Status register. Pause frames received with zero quanta are indicated on bit 13 of the Interrupt Status register.

Once the Receive Pause Quantum register (ETHERNETn_pause_time) is loaded and the frame currently being transmitted has been sent, no new frames are transmitted until the pause time reaches zero. The loading of a new pause time, and hence pausing of transmission, occurs since the Ethernet MAC is operating in full duplex mode. A valid pause frame is defined as having a destination address that matches either the address stored in Specific Address 1 register or if it matches the reserved address of 0180C2000001_h. It must also have the MAC control frame Type ID of 8808_h and have the pause opcode of 0001_h.

Pause frames that have FCS or other errors will be treated as invalid and will be discarded. IEEE Std 802.3 pause frames that are received after Priority based Flow Control (PFC) has been negotiated will also be discarded. Valid pause frames received will increment the Pause Frames Received statistics register.

The Receive Pause Quantum register decrements every 512 bit times once transmission has stopped. For test purposes, the retry test bit can be set (bit 12 in the Network Configuration register) which causes the Receive Pause Quantum register to decrement every TX_CLK cycle once transmission has stopped.

The interrupt (bit 13 in the Interrupt Status register) is asserted whenever the Receive Pause Quantum register decrements to zero and it is enabled. This interrupt is also set when a zero quantum pause frame is received.

3.7.2. IEEE Std 802.3 Pause Frame Transmission

Automatic transmission of pause frames is supported through the transmit pause frame bits of the Network Control register. If either bit 11 or bit 12 of the Network Control register is written with "1", an IEEE Std 802.3 pause frame will be transmitted providing the MAC Transmitter is enabled (bit 3) in the Network Control register.

Pause frame transmission will happen immediately if transmit is inactive or if transmit is active between the current frame and the next frame due to be transmitted.

Transmitted pause frames comprise of the following:

- A destination address of 0180C2000001_h
- A source address taken from Specific Address 1 register
- A Type ID of 8808_h (MAC control frame)
- A pause opcode of 0001_h
- A pause quantum register
- Fill of 00_h to take the frame to minimum frame length
- Valid FCS

The pause quantum used in the generated frame will depend on the trigger source for the frame as follows:

- If bit 11 is written with "1", the pause quantum will be taken from the Transmit Pause Quantum register. The Transmit Pause Quantum register resets to a value of 0xFFFF giving maximum pause quantum as initial value.
- If bit 12 is written with "1", the pause quantum will be zero.

After transmission, a pause frame transmitted interrupt will be generated (bit 14 of the Interrupt Status register) and the only statistics register that will be incremented will be the Pause Frames Transmitted register.

Pause frames can also be transmitted by the MAC using normal frame transmission methods.

3.8. MAC PFC Based Pause Frame Support

The Ethernet MAC supports PFC Priority Based Pause transmission and reception. Before PFC pause frames can be received, bit 16 of the Network Control register must be set to “1”.

Note: Refer to IEEE Std 802.1Qbb for a full description of priority based pause operation.

The start of a PFC pause frame looks like this:

Destination Address	Source Address	Type (MAC Control Frame)	Pause Opcode	Priority Enable Vector	Pause Time
0180C2000001 _h	6 bytes	8808 _h	0101 _h	2 bytes	2 bytes

3.8.1. PFC Pause Frame Reception

The ability to receive and decode priority based pause frames is enabled by setting bit 16 of the Network Control register. When this bit is set, the Ethernet MAC will match either classic IEEE Std 802.3 pause frames or PFC priority based pause frames. Once a priority based pause frame has been received and matched, then from that moment on the Ethernet MAC will only match on priority based pause frames (this is IEEE Std 802.1Qbb requirement, known as PFC negotiation). Once priority based pause has been negotiated, any received IEEE Std 802.3x format pause frames will not be acted upon.

If a valid priority based pause frame is received then the Ethernet MAC will decode the frame and determine which, if any, of the 8 priorities require to be paused. Up to 8 pause time registers are then updated with the 8 pause times extracted from the frame regardless of whether a previous pause operation is active or not. An interrupt (bit 12 of the Interrupt Status register) is triggered when a non-zero PFC pause frame is received, but only if the interrupt has been enabled (bit 12 of the interrupt mask register). Pause frames received with non-zero quantum are indicated through the interrupt bit 12 of the interrupt status register. PFC pause frames received with zero quantum cannot trigger an interrupt; that is bit 13 is never set for PFC pause frames. The loading of a new pause time occurs since the Ethernet MAC is operating in full duplex mode. A valid pause frame is defined as having a destination address that matches either the address stored in Specific Address 1 register or if it matches the reserved address of 0180C2000001_h. It must also have the MAC control frame Type ID of 8808_h and have the pause opcode 0101_h.

Pause frames that have FCS or other errors will be treated as invalid and will be discarded. Valid pause frames received will increment the Pause Frames Received statistic register.

The Receive Pause Quantum register decrements every 512 bit times immediately, following the PFC frame reception. For test purposes, the retry test bit can be set (bit 12 in the Network Configuration register) which causes the Receive Pause Quantum register to decrement every RX_CLK cycle once transmission has stopped.

3.8.2. PFC Pause Frame Transmission

Automatic transmission of pause frames is supported through the transmit priority based pause frame bit of the Network Control register. If bit 17 of the Network Control register is written with “1”, a PFC pause frame will be transmitted providing the MAC Transmitter is enabled (bit 3) in the Network Control register. When bit 17 of the Network Control register is set to “1”, the fields of the priority base pause frame will be built using the values stored in the Transmit PFC Pause register.

Pause frame transmission will happen immediately if transmit is inactive or if transmit is active between the current frame and the next frame due to be transmitted.

Transmitted pause frames comprise of the following:

- A destination address of 0180C2000001_h
- A source address taken from Specific Address 1 register
- A Type ID of 8808_h (MAC control frame)
- A pause opcode of 0101_h
- A priority enable vector taken from the Transmit PFC Pause register
- 8 pause quanta in 4 registers (ETHERNET_n_tx_pause_quantum, ETHERNET_n_tx_pause_quantum1, ETHERNET_n_tx_pause_quantum2, ETHERNET_n_tx_pause_quantum3)
- Fill of 00_h to take the frame to minimum frame length
- Valid FCS

The pause quantum registers used in the generated frame will depend on the trigger source for the frame as follows:

- If bit 17 of the Network Control register is written with “1” then the priority enable vector of the priority based pause frame will be set equal to the value stored in the Transmit PFC Pause register bits [7:0]. For each entry equal to “0” in the Transmit PFC Pause register [15:8], the pause quantum field of the pause frame associated with that entry will be taken from the Transmit Pause Quantum register. For each entry equal to “1” in the Transmit PFC Pause register [15:8], the pause quantum associated with that entry will be “0”. The Transmit Pause Quantum register resets to a value of FFFF_h giving maximum pause quantum as initial value.
- The pause quantum registers are classed as static and these registers should be updated only when no PFC frame is transmitted.
- To use the eight priority pause quanta stored in the four Transmit Pause Quantum registers, set bit 24 to “1” in the Network Control register.

After transmission, a pause frame transmit interrupt will be issued (bit 14 of the Interrupt Status register) and the only statistics register that will be incremented will be the Pause Frames Transmitted register.

PFC Pause frames can also be transmitted by the MAC using normal frame transmission methods.

3.9. Energy Efficient Ethernet Support

IEEE Std 802.3az adds support for energy efficiency to Ethernet (EEE). These are the key features of IEEE Std 802.3az:

1. Allows a system's transmit path to enter a low power mode if there is nothing to transmit.
2. Allows a PHY to detect whether its link partner's transmit path is in low power mode, therefore allowing the system's receive path to enter low power mode.
3. Link remains up during lower power mode and no frames are dropped.
4. Asymmetric, one direction can be in low power mode while the other is transmitting normally.
5. LPI (Low Power idle) signaling is used to control entry and exit to and from low power modes.
6. LPI signaling can only take place if both sides have indicated support for it through auto-negotiation.

IEEE Std 802.3az operation:

1. Low-power control is done at MII/RMII (reconciliation sublayer).
2. As an architectural convenience in writing the 802.3az it is assumed that transmission is deferred by asserting carrier sense, in practice it will not be done this way. This system will know when it has nothing to transmit and only enter low power mode when it is not transmitting.
3. LPI should not be requested unless the link has been up for at least one second.
4. LPI is signaled on the MII transmit path by asserting 0x01 on TXD with TX_EN low and TX_ER high.
5. A PHY on seeing LPI requested on MII/RMII will send the sleep signal before going quiet. After going quiet it will periodically emit refresh signals.
6. The sleep, quiet and refresh periods are defined in Table 78-2 of IEEE Std 802.3az. E.g. for 100BASE-TX the sleep period (T_s) is 100 microseconds, the quiet periods (T_{qt}) / (T_{qr}) are 20/24 milliseconds, and the refresh period (T_r) is 100 microseconds. 10BASE-T is not supported.
7. 100BASE-TX is required to go quiet after sleep is signaled.
8. LPI mode ends by transmitting normal idle for the wake time. There is a default time for this but it can be adjusted in software using the Link Layer Discovery Protocol (LLDP) described in Clause 79 of IEEE Std 802.3az.
9. LPI is indicated at the receive side when sleep and refresh signaling has been detected.

3.10. LPI Operation in Ethernet MAC

Auto-negotiation:

1. Indicate EEE capability using auto-negotiation.

For the transmit path:

1. If the link has been up for 1 second and there is nothing being transmitted, write to the LPI bit (bit 19) in the Network Control register.
2. Wake up by clearing the LPI bit in the Network Control register.

For the receive path:

1. Wait for an interrupt to indicate that LPI has been received.
2. Wait for an interrupt to indicate that regular idle has been received and then re-enable the receive path.

3.11. IEEE Std 802.1Qav Support – Credit Based Shaping

A credit based shaping (CBS) algorithm is available on the two highest priority queues (Queue 3 (highest priority), Queue 2) and is defined in IEEE Std 802.1Qav: Forwarding and Queuing Enhancements for Time-Sensitive Streams (FQTSS). This allows traffic on these queues to be limited and to allow other queues to transmit.

Traffic shaping is enabled via the CBS Control register. This enables a counter which stores the amount of transmit 'credit', measured in bytes that a particular queue has. A queue may only transmit if it has non-negative credit. If a queue has data to send, but is held off from doing as another queue is transmitting, then credit will accumulate in the credit counter at the rate defined in the CBS IdleSlope register for that queue (ETHERNETn_cbs_idleslope_q_a, ETHERNETn_cbs_idleslope_q_b). idleSlope is the rate of change of credit when waiting to transmit and must be less than the value of the portTransmitRate. When this queue is transmitting the credit counter is decremented at the rate of sendSlope which is defined as the portTransmitRate – idleSlope. A queue can accumulate negative credit when transmitting which will hold off any other transfers from that queue until credit retruns to a non-negative value. No transfers are halted when a queue's credit becomes negative, it will accumulate negative credit until the transfer completes.

If both queues have positive credit, when the next queue to transfer is about to be selected, the queue with the most positive credit will be allowed to transfer first. The queue with the largest positive credit is the queue that had been prevented from transmitting for the longest time.

3.12. PHY Interface

The Ethernet MAC supports MII and RMII as PHY interface. The type of the Media Interface is selectable through the bit mii_select in the User I/O register (ETHERNETn_user_io).

3.13. Jumbo Frames

The jumbo frames enable bit in the Network Configuration register (bit 3) allows the Ethernet MAC in its initial state to receive jumbo frames up to a software configurable number of bytes in size. This operation is not part of IEEE Std 802.3 specification and is normally disabled. When jumbo frames are enabled, frames received with a frame size greater than the configured value are discarded.

The jumbo frames maximum length can be controlled using the Jumbo-Frame Maximum Length register. Its initial value is 2800_h which corresponds to 10240 bytes.

Note: The Jumbo-Frame Maximum Length register must be set to greater 1536 bytes (600_h) when control bit receive_1536_byte_frames in the Network Configuration register (bit 8) is set to "1".

4. Registers

This section describes the registers of the Ethernet MAC module.

- The following registers are available for the Ethernet MAC:
 - Operation and configuration registers:
 - Network Control Register (ETHERNETn_network_control)
 - Network Configuration Register (ETHERNETn_network_configuration)
 - Network Status Register (ETHERNETn_network_status)
 - User I/O Register (ETHERNETn_user_io)
 - DMA Configuration Register (ETHERNETn_dma_config)
 - Transmit Status Register (ETHERNETn_transmit_status)
 - RX Buffer Queue Base Address Register (ETHERNETn_receive_q_ptr)
 - TX Buffer Queue Base Address Register (ETHERNETn_transmit_q_ptr)
 - Receive Status Register (ETHERNETn_receive_status)
 - Interrupt Status Register (ETHERNETn_int_status)
 - Interrupt Enable Register (ETHERNETn_int_enable)
 - Interrupt Disable Register (ETHERNETn_int_disable)
 - Interrupt Mask Register (ETHERNETn_int_mask)
 - PHY Maintenance Register (ETHERNETn_phy_management)
 - Receive Pause Quantum Register (ETHERNETn_pause_time)
 - Transmit Pause Quantum Register (ETHERNETn_tx_pause_quantum)
 - Transmit Pause Quantum 1 Register (ETHERNETn_tx_pause_quantum1)
 - Transmit Pause Quantum 2 Register (ETHERNETn_tx_pause_quantum2)
 - Transmit Pause Quantum 3 Register (ETHERNETn_tx_pause_quantum3)
 - TX Partial Store and Forward Register (ETHERNETn_pbuf_txcutthru)
 - RX Partial Store and Forward Register (ETHERNETn_pbuf_rxcutthru)
 - Jumbo-Frame Maximum Length Register (ETHERNETn_jumbo_max_length)
 - AXI Maximum Pipeline Register (ETHERNETn_axi_max_pipeline)
 - Interrupt Moderation Register (ETHERNETn_int_moderation)
 - Hash Bottom Register (ETHERNETn_hash_bottom)
 - Hash Top Register (ETHERNETn_hash_top)
 - Specific Address Bottom 1 Register (ETHERNETn_spec_add_bottom_1)
 - Specific Address Top 1 Register (ETHERNETn_spec_add_top_1)
 - Specific Address Bottom 2 Register (ETHERNETn_spec_add_bottom_2)
 - Specific Address Top 2 Register (ETHERNETn_spec_add_top_2)
 - Specific Address Bottom 3 Register (ETHERNETn_spec_add_bottom_3)
 - Specific Address Top 3 Register (ETHERNETn_spec_add_top_3)
 - Specific Address Bottom 4 Register (ETHERNETn_spec_add_bottom_4)
 - Specific Address Top 4 Register (ETHERNETn_spec_add_top_4)
 - Type ID Match 1 Register (ETHERNETn_spec_type_1)
 - Type ID Match 2 Register (ETHERNETn_spec_type_2)
 - Type ID Match 3 Register (ETHERNETn_spec_type_3)
 - Type ID Match 4 Register (ETHERNETn_spec_type_4)
 - Stacked VLAN Register (ETHERNETn_stacked_vlan)

Transmit PFC Pause Register (ETHERNETn_tx_pfc_pause)
 Specific Address Mask 1 Bottom Register (ETHERNETn_mask_add1_bottom)
 Specific Address Mask 1 Top Register (ETHERNETn_mask_add1_top)
 Receive DMA Data Buffer Address Mask Register (ETHERNETn_dma_addr_or_mask)
 RX PTP Unicast IP Destination Address Register (ETHERNETn_rx_ptp_unicast)
 TX PTP Unicast IP Destination Address Register (ETHERNETn_tx_ptp_unicast)
 IEEE 1588 Timer Comparison Value Nanoseconds Register (ETHERNETn_tsu_nsec_cmp)
 IEEE 1588 Timer Comparison Value Seconds Bottom Register (ETHERNETn_tsu_sec_cmp)
 IEEE 1588 Timer Comparison Value Seconds Top Register (ETHERNETn_tsu_msb_sec_cmp)
 PTP Event Frame Transmitted Seconds [47:32] Register (ETHERNETn_tsu_ptp_tx_msb_sec)
 PTP Event Frame Received Seconds [47:32] Register (ETHERNETn_tsu_ptp_rx_msb_sec)
 PTP Peer Event Frame Transmitted Seconds [47:32] Register (ETHERNETn_tsu_peer_tx_msb_sec)
 PTP Peer Event Frame Received Seconds [47:32] Register (ETHERNETn_tsu_peer_rx_msb_sec)
 Identification and Revision Register (ETHERNETn_revision_reg)

Statistics registers. These registers reset to zero on a read and stick at all ones when they count to their maximum value. They should be read frequently enough to prevent loss of data. The receive statistics registers are only incremented when receive enable bit (ETHERNETn_network_control[2]) is set in the Network Control register. The statistics registers optionally have a snapshot capability which, when exercised, will simultaneously store and clear the current values of all the statistics registers into a snapshot register set in order to allow a consistent set of statistics to be read by the processor. The snapshot is controlled using bit 13 of the Network Control register. The read snapshot control indicated by bit 14 of the Network Control register determines whether the processor reads the snapshot registers (logic 1) or the incrementing registers (logic 0). The default Ethernet MAC configuration does not support the snapshot capability. All the statistics registers are read only. For test purposes they may be written by setting bit 7 (Write Enable) in the Network Control register. Setting bit 6 (increment statistics) in the Network Control register causes all the statistics registers to increment by one, again for test purposes. Once a statistics register has been read, it is automatically cleared. The statistics register block contains the following registers:

Octets Transmitted Bottom Register (ETHERNETn_octets_txed_bottom)
 Octets Transmitted Top Register (ETHERNETn_octets_txed_top)
 Frames Transmitted Register (ETHERNETn_frames_txed_ok)
 Broadcast Frames Transmitted Register (ETHERNETn_broadcast_txed)
 Multicast Frames Transmitted Register (ETHERNETn_multicast_txed)
 Pause Frames Transmitted Register (ETHERNETn_pause_frames_txed)
 64 Byte Frames Transmitted Register (ETHERNETn_frames_txed_64)
 65 To 127 Byte Frames Transmitted Register (ETHERNETn_frames_txed_65)
 128 To 255 Byte Frames Transmitted Register (ETHERNETn_frames_txed_128)
 256 To 511 Byte Frames Transmitted Register (ETHERNETn_frames_txed_256)
 512 To 1023 Byte Frames Transmitted Register (ETHERNETn_frames_txed_512)
 1024 To 1518 Byte Frames Transmitted Register (ETHERNETn_frames_txed_1024)
 Greater Than 1518 Byte Frames Transmitted Register (ETHERNETn_frames_txed_1519)
 Transmit Under Runs Register (ETHERNETn_tx_underruns)
 Single Collision Frames Register (ETHERNETn_single_collisions)
 Multiple Collision Frames Register (ETHERNETn_multiple_collisions)
 Excessive Collisions Register (ETHERNETn_excessive_collisions)
 Late Collisions Register (ETHERNETn_late_collisions)
 Deferred Transmission Frames Register (ETHERNETn_deferred_frames)
 Carrier Sense Errors Register (ETHERNETn_crs_errors)

Octets Receive Bottom Register (ETHERNETn_octets_rxed_bottom)
 Octets Receive TOP Register (ETHERNETn_octets_rxed_top)
 Frames Received Register (ETHERNETn_frames_rxed_ok)
 Broadcast Frames Received Register (ETHERNETn_broadcast_rxed)
 Multicast Frames Received Register (ETHERNETn_multicast_rxed)
 Pause Frames Received Register (ETHERNETn_pause_frames_rxed)
 64 Byte Frames Received Register (ETHERNETn_frames_rxed_64)
 65 To 127 Byte Frames Received Register (ETHERNETn_frames_rxed_65)
 128 To 255 Byte Frames Received Register (ETHERNETn_frames_rxed_128)
 256 To 511 Byte Frames Received Register (ETHERNETn_frames_rxed_256)
 512 To 1023 Byte Frames Received Register (ETHERNETn_frames_rxed_512)
 1024 To 1518 Byte Frames Received Register (ETHERNETn_frames_rxed_1024)
 Greater than 1518 Byte Frames Received Register (ETHERNETn_frames_rxed_1519)
 Undersized Frames Received Register (ETHERNETn_undersized_frames)
 Oversize Frames Received Register (ETHERNETn_excessive_rx_length)
 Jabbers Received Register (ETHERNETn_rx_jabbers)
 Frame Check Sequence Errors Register (ETHERNETn_fcs_errors)
 Length Field Frame Errors Register (ETHERNETn_rx_length_errors)
 Receive Symbol Errors Register (ETHERNETn_rx_symbol_errors)
 Alignment Errors Register (ETHERNETn_alignment_errors)
 Receive Resource Errors Register (ETHERNETn_rx_resource_errors)
 Receive Over Runs Register (ETHERNETn_rx_overruns)
 IP Header Checksum Errors Register (ETHERNETn_rx_ip_ck_errors)
 TCP Checksum Errors Register (ETHERNETn_rx_tcp_ck_errors)
 UDP Checksum Errors Register (ETHERNETn_rx_udp_ck_errors)
 Receive DMA Flushed Packets Register (ETHERNETn_auto_flushed_pkts)
 ----- end of statistics registers
 IEEE 1588 Timer Increment Sub Nanoseconds Register (ETHERNETn_tsu_timer_incr_sub_nsec)
 IEEE 1588 Timer Seconds [47:32] Register (ETHERNETn_tsu_timer_msb_sec)
 IEEE 1588 Timer Seconds [31:0] Register (ETHERNETn_tsu_timer_sec)
 IEEE 1588 Timer Nanoseconds Register (ETHERNETn_tsu_timer_nsec)
 IEEE 1588 Timer Adjust Register (ETHERNETn_tsu_timer_adjust)
 IEEE 1588 Timer Increment Register (ETHERNETn_tsu_timer_incr)
 PTP Event Frame Transmitted Seconds [31:0] Register (ETHERNETn_tsu_ptp_tx_sec)
 PTP Event Frame Transmitted Nanoseconds Register (ETHERNETn_tsu_ptp_tx_nsec)
 PTP Event Frame Received Seconds [31:0] Register (ETHERNETn_tsu_ptp_rx_sec)
 PTP Event Frame Received Nanoseconds Register (ETHERNETn_tsu_ptp_rx_nsec)
 PTP Peer Event Frame Transmitted Seconds [31:0] Register (ETHERNETn_tsu_peer_tx_sec)
 PTP Peer Event Frame Transmitted Nanoseconds Register (ETHERNETn_tsu_peer_tx_nsec)
 PTP Peer Event Frame Received Seconds [31:0] Register (ETHERNETn_tsu_peer_rx_sec)
 PTP Peer Event Frame Received Nanoseconds Register (ETHERNETn_tsu_peer_rx_nsec)
 Receive LPI Transitions Register (ETHERNETn_rx_lpi)
 Received LPI Time Register (ETHERNETn_rx_lpi_time)
 Transmit LPI Transitions Register (ETHERNETn_tx_lpi)

Transmit LPI Time Register (ETHERNETn_tx_lpi_time)
Interrupt Status Queue 1 Status Register (ETHERNETn_int_status_q1)
Interrupt Status Queue 2 Status Register (ETHERNETn_int_status_q2)
Interrupt Status Queue 3 Status Register (ETHERNETn_int_status_q3)
TX Buffer Queue 1 Base Address Register (ETHERNETn_transmit_q1_ptr)
TX Buffer Queue 2 Base Address Register (ETHERNETn_transmit_q2_ptr)
TX Buffer Queue 3 Base Address Register (ETHERNETn_transmit_q3_ptr)
RX Buffer Queue 1 Base Address Register (ETHERNETn_receive_q1_ptr)
RX Buffer Queue 2 Base Address Register (ETHERNETn_receive_q2_ptr)
RX Buffer Queue 3 Base Address Register (ETHERNETn_receive_q3_ptr)
RX Buffer Size Queue 1 Register (ETHERNETn_rxbuf_size_q1)
RX Buffer Size Queue 2 Register (ETHERNETn_rxbuf_size_q2)
RX Buffer Size Queue 3 Register (ETHERNETn_rxbuf_size_q3)
CBS Control Register (ETHERNETn_cbs_control)
CBS IdleSlope Queue A Register (ETHERNETn_cbs_idleslope_q_a)
CBS IdleSlope Queue B Register (ETHERNETn_cbs_idleslope_q_b)
MSB Buffer Queue Base Address Register (ETHERNETn_msb_buff_q_base_addr_reg)
TX BD Control Register (ETHERNETn_tx_bd_control)
RX BD Control Register (ETHERNETn_rx_bd_control)
Screening Type 1 Register 0 (ETHERNETn_screening_type_1_register_0)
Screening Type 1 Register 1 (ETHERNETn_screening_type_1_register_1)
Screening Type 1 Register 2 (ETHERNETn_screening_type_1_register_2)
Screening Type 1 Register 3 (ETHERNETn_screening_type_1_register_3)
Screening Type 1 Register 4 (ETHERNETn_screening_type_1_register_4)
Screening Type 1 Register 5 (ETHERNETn_screening_type_1_register_5)
Screening Type 1 Register 6 (ETHERNETn_screening_type_1_register_6)
Screening Type 1 Register 7 (ETHERNETn_screening_type_1_register_7)
Screening Type 1 Register 8 (ETHERNETn_screening_type_1_register_8)
Screening Type 1 Register 9 (ETHERNETn_screening_type_1_register_9)
Screening Type 1 Register 10 (ETHERNETn_screening_type_1_register_10)
Screening Type 1 Register 11 (ETHERNETn_screening_type_1_register_11)
Screening Type 1 Register 12 (ETHERNETn_screening_type_1_register_12)
Screening Type 1 Register 13 (ETHERNETn_screening_type_1_register_13)
Screening Type 1 Register 14 (ETHERNETn_screening_type_1_register_14)
Screening Type 1 Register 15 (ETHERNETn_screening_type_1_register_15)
Screening Type 2 Register 0 (ETHERNETn_screening_type_2_register_0)
Screening Type 2 Register 1 (ETHERNETn_screening_type_2_register_1)
Screening Type 2 Register 2 (ETHERNETn_screening_type_2_register_2)
Screening Type 2 Register 3 (ETHERNETn_screening_type_2_register_3)
Screening Type 2 Register 4 (ETHERNETn_screening_type_2_register_4)
Screening Type 2 Register 5 (ETHERNETn_screening_type_2_register_5)
Screening Type 2 Register 6 (ETHERNETn_screening_type_2_register_6)
Screening Type 2 Register 7 (ETHERNETn_screening_type_2_register_7)
Screening Type 2 Register 8 (ETHERNETn_screening_type_2_register_8)

Screening Type 2 Register 9 (ETHERNETn_screening_type_2_register_9)
Screening Type 2 Register 10 (ETHERNETn_screening_type_2_register_10)
Screening Type 2 Register 11 (ETHERNETn_screening_type_2_register_11)
Screening Type 2 Register 12 (ETHERNETn_screening_type_2_register_12)
Screening Type 2 Register 13 (ETHERNETn_screening_type_2_register_13)
Screening Type 2 Register 14 (ETHERNETn_screening_type_2_register_14)
Screening Type 2 Register 15 (ETHERNETn_screening_type_2_register_15)
Interrupt Enable Queue 1 Register (ETHERNETn_int_enable_q1)
Interrupt Enable Queue 2 Register (ETHERNETn_int_enable_q2)
Interrupt Enable Queue 3 Register (ETHERNETn_int_enable_q3)
Interrupt Disable Queue 1 Register (ETHERNETn_int_disable_q1)
Interrupt Disable Queue 2 Register (ETHERNETn_int_disable_q2)
Interrupt Disable Queue 3 Register (ETHERNETn_int_disable_q3)
Interrupt Mask Queue 1 Register (ETHERNETn_int_mask_q1)
Interrupt Mask Queue 2 Register (ETHERNETn_int_mask_q2)
Interrupt Mask Queue 3 Register (ETHERNETn_int_mask_q3)
EtherType 2 Register 0 (ETHERNETn_screening_type_2_ethertype_reg_0)
EtherType 2 Register 1 (ETHERNETn_screening_type_2_ethertype_reg_1)
EtherType 2 Register 2 (ETHERNETn_screening_type_2_ethertype_reg_2)
EtherType 2 Register 3 (ETHERNETn_screening_type_2_ethertype_reg_3)
EtherType 2 Register 4 (ETHERNETn_screening_type_2_ethertype_reg_4)
EtherType 2 Register 5 (ETHERNETn_screening_type_2_ethertype_reg_5)
EtherType 2 Register 6 (ETHERNETn_screening_type_2_ethertype_reg_6)
EtherType 2 Register 7 (ETHERNETn_screening_type_2_ethertype_reg_7)
Type2 Compare Word 0 0 Register (ETHERNETn_type2_compare_0_word_0)
Type2 Compare Word 1 0 Register (ETHERNETn_type2_compare_0_word_1)
Type2 Compare Word 0 1 Register (ETHERNETn_type2_compare_1_word_0)
Type2 Compare Word 1 1 Register (ETHERNETn_type2_compare_1_word_1)
Type2 Compare Word 0 2 Register (ETHERNETn_type2_compare_2_word_0)
Type2 Compare Word 1 2 Register (ETHERNETn_type2_compare_2_word_1)
Type2 Compare Word 0 3 Register (ETHERNETn_type2_compare_3_word_0)
Type2 Compare Word 1 3 Register (ETHERNETn_type2_compare_3_word_1)
Type2 Compare Word 0 4 Register (ETHERNETn_type2_compare_4_word_0)
Type2 Compare Word 1 4 Register (ETHERNETn_type2_compare_4_word_1)
Type2 Compare Word 0 5 Register (ETHERNETn_type2_compare_5_word_0)
Type2 Compare Word 1 5 Register (ETHERNETn_type2_compare_5_word_1)
Type2 Compare Word 0 6 Register (ETHERNETn_type2_compare_6_word_0)
Type2 Compare Word 1 6 Register (ETHERNETn_type2_compare_6_word_1)
Type2 Compare Word 0 7 Register (ETHERNETn_type2_compare_7_word_0)
Type2 Compare Word 1 7 Register (ETHERNETn_type2_compare_7_word_1)
Type2 Compare Word 0 8 Register (ETHERNETn_type2_compare_8_word_0)
Type2 Compare Word 1 8 Register (ETHERNETn_type2_compare_8_word_1)
Type2 Compare Word 0 9 Register (ETHERNETn_type2_compare_9_word_0)
Type2 Compare Word 1 9 Register (ETHERNETn_type2_compare_9_word_1)

Type2 Compare Word 0 10 Register (ETHERNETn_type2_compare_10_word_0)
Type2 Compare Word 1 10 Register (ETHERNETn_type2_compare_10_word_1)
Type2 Compare Word 0 11 Register (ETHERNETn_type2_compare_11_word_0)
Type2 Compare Word 1 11 Register (ETHERNETn_type2_compare_11_word_1)
Type2 Compare Word 0 12 Register (ETHERNETn_type2_compare_12_word_0)
Type2 Compare Word 1 12 Register (ETHERNETn_type2_compare_12_word_1)
Type2 Compare Word 0 13 Register (ETHERNETn_type2_compare_13_word_0)
Type2 Compare Word 1 13 Register (ETHERNETn_type2_compare_13_word_1)
Type2 Compare Word 0 14 Register (ETHERNETn_type2_compare_14_word_0)
Type2 Compare Word 1 14 Register (ETHERNETn_type2_compare_14_word_1)
Type2 Compare Word 0 15 Register (ETHERNETn_type2_compare_15_word_0)
Type2 Compare Word 1 15 Register (ETHERNETn_type2_compare_15_word_1)
Type2 Compare Word 0 16 Register (ETHERNETn_type2_compare_16_word_0)
Type2 Compare Word 1 16 Register (ETHERNETn_type2_compare_16_word_1)
Type2 Compare Word 0 17 Register (ETHERNETn_type2_compare_17_word_0)
Type2 Compare Word 1 17 Register (ETHERNETn_type2_compare_17_word_1)
Type2 Compare Word 0 18 Register (ETHERNETn_type2_compare_18_word_0)
Type2 Compare Word 1 18 Register (ETHERNETn_type2_compare_18_word_1)
Type2 Compare Word 0 19 Register (ETHERNETn_type2_compare_19_word_0)
Type2 Compare Word 1 19 Register (ETHERNETn_type2_compare_19_word_1)
Type2 Compare Word 0 20 Register (ETHERNETn_type2_compare_20_word_0)
Type2 Compare Word 1 20 Register (ETHERNETn_type2_compare_20_word_1)
Type2 Compare Word 0 21 Register (ETHERNETn_type2_compare_21_word_0)
Type2 Compare Word 1 21 Register (ETHERNETn_type2_compare_21_word_1)
Type2 Compare Word 0 22 Register (ETHERNETn_type2_compare_22_word_0)
Type2 Compare Word 1 22 Register (ETHERNETn_type2_compare_22_word_1)
Type2 Compare Word 0 23 Register (ETHERNETn_type2_compare_23_word_0)
Type2 Compare Word 1 23 Register (ETHERNETn_type2_compare_23_word_1)
Type2 Compare Word 0 24 Register (ETHERNETn_type2_compare_24_word_0)
Type2 Compare Word 1 24 Register (ETHERNETn_type2_compare_24_word_1)
Type2 Compare Word 0 25 Register (ETHERNETn_type2_compare_25_word_0)
Type2 Compare Word 1 25 Register (ETHERNETn_type2_compare_25_word_1)
Type2 Compare Word 0 26 Register (ETHERNETn_type2_compare_26_word_0)
Type2 Compare Word 1 26 Register (ETHERNETn_type2_compare_26_word_1)
Type2 Compare Word 0 27 Register (ETHERNETn_type2_compare_27_word_0)
Type2 Compare Word 1 27 Register (ETHERNETn_type2_compare_27_word_1)
Type2 Compare Word 0 28 Register (ETHERNETn_type2_compare_28_word_0)
Type2 Compare Word 1 28 Register (ETHERNETn_type2_compare_28_word_1)
Type2 Compare Word 0 29 Register (ETHERNETn_type2_compare_29_word_0)
Type2 Compare Word 1 29 Register (ETHERNETn_type2_compare_29_word_1)
Type2 Compare Word 0 30 Register (ETHERNETn_type2_compare_30_word_0)
Type2 Compare Word 1 30 Register (ETHERNETn_type2_compare_30_word_1)
Type2 Compare Word 0 31 Register (ETHERNETn_type2_compare_31_word_0)
Type2 Compare Word 1 31 Register (ETHERNETn_type2_compare_31_word_1)

4.1. Network Control Register (ETHERNETn_network_control)

Description of Network Control register is shown. The Network Control register contains general Ethernet MAC control functions for receiver and transmitter.

REGISTER_NAME	ETHERNETn_network_control
OFFSET	0x000
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved					Reserved	pfc_ctrl	one_step_sync_mode
ACCESS_TYPE	R0,WX					R/W0	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0x00					0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	store_udp_offset	Reserved	ptp_unicast_ena	tx_lpi_en	flush_rx_pkt_clk	transmit_pfc_priority_based_pause_frame	pfc_enable
ACCESS_TYPE	R0,WX	R/W	R/W0	R/W	R/W	R0,W	R0,W1S	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	store_rx_ts	stats_read_snap	stats_take_snap	tx_pause_frame_zero	tx_pause_frame_req	tx_halt_clk	tx_start_clk	Reserved
ACCESS_TYPE	R/W	R/W	R0,W	R0,W1S	R0,W1S	R0,W	R0,W	R/W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	stats_write_en	inc_all_stats_regs	clear_all_stats_regs	man_port_en	enable_transmit	enable_receive	Reserved	
ACCESS TYPE	R/W	R0,W	R0,W1S	R/W	R/W	R/W	R/W0	
PROT TYPE	Wp							
INITIAL VALUE	0	0	0	0	0	0	0x0	

[bit31:27] Reserved

Always read "0". Writing has no effect.

[bit26] Reserved

Always read written value. Always write 0.

[bit25] pfc_ctrl: PFC control

Enable multiple PFC pause quanta, one per pause priority

Bit	Description
0	Disable
1	Enable

[bit24] one_step_sync_mode: IEEE 1588 Timer One Step Sync Mode

Replace timestamp field in the IEEE 1588 header for TX Sync Frames with current IEEE 1588 Timer value.

Bit	Description
0	Disable

1	Enable
---	--------

[bit23] Reserved

Always read "0". Writing has no effect.

[bit22] store_udp_offset: Store UDP/TCP Offset

Store UDP/TCP offset to memory.

Bit	Description
0	Normal operation.
1	The upper 16-bits of the CRC of every received frame are replaced with the offset from start of frame to the beginning of the UDP or TCP header. The lower 16-bits of the CRC are replaced with zero and reserved for future use.

[bit21] Reserved

Always read write value. Always write "0".

[bit20] ptp_unicast_ena: PTP Unicast Frames Enable

Enable the detection of PTP unicast frames.

Bit	Description
0	Disable
1	Enable

[bit19] tx_lpi_en: LPI Transmission Enable

Enable immediate transmission of LPI (low power idle).

Bit	Description
0	Disable
1	Enable

[bit18] flush_rx_pkt_clk: Flush Next Packet From External RX DPRAM

Bit	Description
0	No effect
1	Writing this bit to "1" will only have an effect if the DMA is currently not reading a packet stored in RX DPRAM to memory.

[bit17] transmit_pfc_priority_based_pause_frame:

Bit	Description
0	No effect
1	Transmit PFC priority based pause frame. Takes the values stored in the Transmit PFC Pause register. Cleared by hardware.

[bit16] pfc_enable: Enable PFC Priority Based Pause Reception

Bit	Description
0	Disable
1	Enable PFC negotiation and recognition of priority based pause frames..

[bit15] store_rx_ts: Store receive time stamp

Bit	Description
0	Normal operation
1	Setting this bit to one will cause the CRC of every received frame to be replaced with the value of the nanoseconds field of the IEEE 1588 Timer that was captured as the receive frame passed the message time stamp point.

[bit14] stats_read_snap: Read snapshot

Bit	Description
0	The current value of the statistics register will be read back.
1	The snapshot value of the statistics register will be read back.

[bit13] stats_take_snap: Take snapshot

Bit	Description
0	No effect
1	Record the current value of all statistics registers in the snapshot registers and clear the statistics registers. Cleared by hardware.

[bit12] tx_pause_frame_zero: Transmit zero quantum pause frame

Bit	Description
0	No effect
1	Transmit pause frame with zero quantum. Cleared by hardware.

[bit11] tx_pause_frame_req: Transmit pause frame

Bit	Description
0	No effect
1	Transmit pause frame. Cleared by hardware.

[bit10] tx_halt_clk: Transmit halt

Bit	Description
0	No effect
1	Halts transmission as soon as any ongoing frame transmission ends. Cleared by hardware.

[bit9] tx_start_clk: Transmit start

Bit	Description
0	No effect
1	Starts transmission. Cleared by hardware.

[bit8] Reserved

Always read write value. Always write "0".

[bit7] stats_write_en: Write enable for statistics register

Bit	Description
0	Normal operation.
1	Statistics register can be written for functional test purposes.

[bit6] inc_all_stats_regs: Increment statistics register

Bit	Description
0	No effect
1	Increment all statistics registers by 1 for functional test purposes. Cleared by hardware.

[bit5] clear_all_stats_regs: Clear statistics register

Bit	Description
0	No effect

1	Clears all statistics registers. Cleared by hardware.
---	---

[bit4] man_port_en: Management port enable

Bit	Description
0	Disable management ports. MDIO is forced to High-Z and MDC to "0".
1	Enable management ports.

[bit3] enable_transmit: Transmit enable

Bit	Description
0	Transmission will stop immediately, the transmit pipeline and control registers will be cleared and the transmit queue pointer registers (TX Buffer Queue Base Address, TX Buffer Queue 1 Base Address, TX Buffer Queue 2 Base Address, and TX Buffer Queue 3 Base Address) will be reset to point to the start of the transmit descriptor list.
1	Enable the Ethernet MAC to send data.

[bit2] enable_receive: Receive enable

Bit	Description
0	Frame reception will stop immediately and the receive pipeline will be cleared. The receive queue pointer register (ETHERNETn_receive_q_ptr) is unaffected.
1	Enable the Ethernet MAC to receive data.

[bit1:0] Reserved

Always read write value. Always write "0".

4.2. Network Configuration Register (ETHERNETn_network_configuration)

Description of Network Configuration register is shown.

REGISTER_NAME	ETHERNETn_network_configuration
OFFSET	0x004
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	ignore_ipg_rx_er	nsp_change	Reserved	Reserved	ignore_rx_fcs	Reserved	receive_checksum_offload_enable
ACCESS_TYPE	R/W0	R/W	R/W	R/W0	R/W0	R/W	R/W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	disable_copy_of_pause_frames	data_bus_width[1:0]		mdc_clock_division[2:0]			fcs_remove	length_field_error_frame_discard
ACCESS_TYPE	R/W	R/W		R/W			R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0x1		0x2			0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	receive_buffer_offset[1:0]		pause_enable	retry_test	Reserved	Reserved	Reserved	receive_1536_byte_frames
ACCESS_TYPE	R/W		R/W	R/W	R/W0	R/W0	R/W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	unicast_has_h_enable	multicast_hash_enable	no_broadcast	copy_all_frames	jumbo_frames	discard_non_vlan_frames	full_duplex	Speed
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31] Reserved

Read always returns written value. Write always "0".

[bit30] ignore_ipg_rx_er: Ignore IPG RX_ER

Bit	Description
0	Ethernet MAC operation is affected by input signal RX_ER when RX_DV is low.
1	Ethernet MAC operation is not affected by input signal RX_ER when RX_DV is low.

[bit29] nsp_change: Receive bad preamble

Bit	Description
0	Frames with non-standard preamble are rejected.
1	Frames with non-standard preamble are not rejected.

[bit28:27] Reserved

Read always returns written value. Write always "0".

[bit26] ignore_rx_fcs: Ignore RX FCS

Bit	Description
0	Normal operation.
1	Frames with FCS/CRC errors will not be rejected. FCS error statistics will still be collected for frames with bad FCS and FCS status will be recorded in frame's DMA descriptor.

[bit25] Reserved

Read always returns written value. Write always "0".

[bit24] receive_checksum_offload_enable: Receive checksum offload enable

Bit	Description
0	Disable
1	The receive checksum engine is enabled. Frames with bad IP, TCP or UDP checksums are discarded.

[bit23] disable_copy_of_pause_frames: Disable copy of pause frames

Bit	Description
0	Disable
1	Set to "1" to prevent valid pause frames from being copied to memory. When set, pause frames are not copied to memory regardless of the state of the copy_all_frames bit; whether a hash match is found or whether a Type ID match is identified. If a destination address match is found the pause frame will be copied to memory. Note that valid pause frames received will still increment pause statistics and pause the transmission of frames as required.

[bit22:21] data_bus_width: Data bus width

Bit	Description
00	Reserved
01	64-bit AMBA AXI data bus width
10	Reserved
11	Reserved

[bit20:18] mdc_clock_division: MDC clock division

Set according to CLK_HAPP1B0 speed. These three bits determine the number, CLK_HAPP1B0 will be divided by to generate MDC. MDC must not exceed 2.5 MHz (MDC is only active during MDIO read and write operations)

Bit	Description
000	divide by 8
001	divide by 16
010	divide by 32
011	divide by 48
100	divide by 64
101	divide by 96
110	divide by 128
111	divide by 224

[bit17] fcs_remove: FCS remove

Setting this bit will cause received frames to be written to memory without their frame check sequence (last 4 bytes). The frame length indicated will be reduced by four bytes in this mode.

Bit	Description
0	Disable
1	Enable

[bit16] length_field_error_frame_discard: Length field error frame discard

Setting this bit causes frames with a measured length shorter than the extracted length field (as indicated by bytes 13 and 14 in a non-VLAN tagged frame) to be discarded. This only applies to frames with a length field less than 0600_h (1536_d).

Bit	Description
0	Disable
1	Enable

[bit15:14] receive_buffer_offset: Receive buffer offset

Indicates the number of bytes by which the received data is offset from the start of the receive buffer.

Bit	Description
00	no offset
01	one byte offset
10	two byte offset
11	three byte offset

[bit13] pause_enable: Pause enable

Bit	Description
0	Disable
1	Transmission will pause if a non zero 802.3 classic pause frame is received and PFC has not been negotiated.

[bit12] retry_test: Retry test

Bit	Description
0	Normal operation.
1	Backoff between collisions will always be one slot time. Setting this bit to "1" helps test the "too many retries" condition. Also used in the pause frame tests to reduce the pause counter's decrement time from 512 bit times, to every RX_CLK cycle.

[bit11:9] Reserved

Read always returns written value. Write always "0".

[bit8] receive_1536_byte_frames: Receive 1536 byte frames

Bit	Description
0	Ethernet MAC rejects frames above 1518 bytes in length.
1	Ethernet MAC accepts frames up to 1536 bytes in length.

[bit7] unicast_hash_enable: Unicast hash enable

Bit	Description
0	Unicast frames will not be accepted.
1	Unicast frames will be accepted when the 6-bit hash function of the destination address points to a bit that is set in the Hash register

[bit6] multicast_hash_enable: Multicast hash enable

Bit	Description
0	Multicast frames will not be accepted.
1	Multicast frames will be accepted when the 6-bit hash function of the destination address points to a bit that is set in the Hash register

[bit5] no_broadcast: No broadcast

Bit	Description
0	Frames addressed to the broadcast address of all ones will be accepted.
1	Frames addressed to the broadcast address of all ones will not be accepted.

[bit4] copy_all_frames: Copy all frames

Bit	Description
0	Only Unicast, Multicast, and Broadcast frames if enabled or frames which match Specific Address 1 to 4 are accepted.
1	All valid frames will be accepted.

[bit3] jumbo_frames: Jumbo frames

Bit	Description
0	Reject jumbo frames.
1	Accept jumbo frames up to 10240 bytes.

[bit2] discard_non_vlan_frames: Discard non-VLAN frames

Bit	Description
0	Non VLAN tagged frames will be discarded.
1	Only VLAN tagged frames will be passed to the address matching logic.

[bit1] full_duplex: Full duplex

Bit	Description
0	Setting not allowed.
1	Full duplex mode. The transmit block ignores the state of state of collision and carrier sense and allows receive while transmitting.

[bit0] Speed: Speed

Bit	Description
0	10Mbps operation.
1	100Mbps operation.

4.3. Network Status Register (ETHERNETn_network_status)

Description of Network Status register is shown. The register shows status information with respect to the PHY management interface.

REGISTER_NAME	ETHERNETn_network_status
OFFSET	0x008
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	lpi_indicate_clk	pfc_negotiate_clk	Reserved	Reserved	Reserved	man_done	mdio_in	Reserved
ACCESS_TYPE	R,WX	R,WX	R0,WX	R0,WX	R0,WX	R,WX	R,WX	R0,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	1	0	0

[bit31:8] Reserved

Always read "0". Writing has no effect

[bit7] lpi_indicate_clk: LPI indication

Low-power idle has been detected on receive. This bit is set when LPI is detected and reset when normal idle is detected. An interrupt is generated when the state of this bit is changed.

[bit6] pfc_negotiate_clk: PFC negotiated

This bit is set when PFC Priority Based Pause has been negotiated.

[bit5:3] Reserved

Always read "0". Writing has no effect

[bit2] man_done: Management done

When this bit is set it means PHY management logic is idle (i.e. has completed).

[bit1] mdio_in: MDIO_IN status

This bit returns the status of the mdio_in pin.

[bit0] Reserved

Always read "0". Writing has no effect

4.4. User I/O Register (ETHERNETn_user_io)

Description of User I/O register is shown.

REGISTER_NAME	ETHERNETn_user_io
OFFSET	0x00C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							mii_select
ACCESS_TYPE	R,WX							R/W
PROT_TYPE	Wp							Wp
INITIAL_VALUE	0x00							0

Bit[31:1] Reserved

Always read write value. Always write "0".

Bit[0] mii_select

This bit selects the type of the Media Interface the EthernetMAC is using.

Bit	Description
0	RMII (Reduced Media Independent Interface)
1	MII (Media Independent Interface)

4.5. DMA Configuration Register (ETHERNETn_dma_config)

Description of DMA Configuration register is shown.

REGISTER_NAME	ETHERNETn_dma_config
OFFSET	0x010
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	dma_addr_bus_width	tx_bd_extended_mode_en	rx_bd_extended_mode_en	Reserved	force_max_amba_burst_tx	force_max_amba_burst_rx	force_discard_on_err
ACCESS_TYPE	R0,WX	R/W	R/W	R/W	R0,WX	R/W	R/W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	rx_buf_size[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xF0							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved			infinite_last_dbuf_size_en	tx_pbuf_tcp_en	tx_pbuf_size	rx_pbuf_size[1:0]	
ACCESS_TYPE	R0,WX			R/W	R/W	R/W	R/W	
PROT_TYPE	Wp							
INITIAL_VALUE	0x0			0	0	1	0x3	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved		hdr_data_s plitting_en	amba_burst_length[4:0]				
ACCESS_TYPE	R0,W0		R/W	R/W				
PROT_TYPE	Wp							
INITIAL_VALUE	0		0	0x04				

[bit31] Reserved

Always read "0". Writing has no effect.

[bit30] dma_addr_bus_width: DMA address bus width

Bit	Description
0	32-bit DMA address bus width.
1	Setting not allowed.

[bit29] tx_bd_extended_mode_en: Enable TX extended BD mode

See TX BD Control register (ETHERNETn_tx_bd_control) for description of feature.

Bit	Description
0	Disable
1	Enable

[bit28] rx_bd_extended_mode_en: Enable RX extended BD mode

See RX BD Control register (ETHERNETn_rx_bd_control) for description of feature.

Bit	Description
0	Disable
1	Enable

[bit27] Reserved

Always read "0". Writing has no effect.

[bit26] force_max_amba_burst_tx: Force maximum length bursts on TX

Bit	Description
0	Maximum length bursts are not forced.
1	Force maximum length bursts on TX. Force the TX DMA to always issue maximum length bursts on EOP (end of packet) or EOB (end of buffer) transfers as defined by bits [4:0] of this register, even when there is less than maximum burst data bytes to read. Residual data read is ignored. Does not apply on bursts that crosses 1K boundary.

[bit25] force_max_amba_burst_rx: Force maximum length bursts on RX

Bit	Description
0	Maximum length bursts are not forced.
1	Force max length bursts on RX. Force the RX DMA to always issue maximum length bursts on EOP (end of packet) or EOB (end of buffer) transfers, even if there is less than maximum burst packet data required to be written. Any extra bytes of pad-data are set to 0x00. Does not apply on bursts that crosses 1K boundary.

[bit24] force_discard_on_err: Auto discard RX packets during lack of resource

A write to this bit is ignored if the DMA is not configured in the packet buffer full store and forward mode.

Bit	Description
0	Received packets will remain to be stored in the packet buffer until AXI buffer resource becomes available.
1	The Ethernet MAC DMA will automatically discard receive packets from the RX Packet Buffer Memory when no AXI resource is available.

[bit23:16] rx_buf_size: DMA receive buffer size in system memory

The value defined by these bits determines the size of the buffer to use in system memory when writing received data. The value is defined in multiples of 64 bytes.

Bit	Description
0x00	Setting not allowed
0x01	64 Byte
0x02	128 Byte (2 * 64 Byte)
.	.
.	.
.	.
0x18	1536 Byte (24 * 64 Byte) one maximum length frame/buffer
.	.
.	.
.	.
0xA0	10240 Byte (160 * 64 Byte) one jumbo frame/buffer
.	.
.	.
.	.
0xFF	16320 Byte (255 * 64 Byte)

[bit15:13] Reserved

Always read "0". Writing has no effect.

[bit12] infinite_last_dbuf_size_en

Forces the DMA to consider the data buffer pointed to by last descriptor in the descriptor list to be of infinite size.

Bit	Description
0	Disable
1	Enable

[bit11] tx_pbuf_tcp_en: Transmitter IP, TCP and UDP checksum generation offload enable

Note: Not supported if DMA is configured in TX Partial Store and Forward Mode (i.e. ETHERNETn_pbuf_txcutthru[31] = 0).

Bit	Description
0	Transmit frame data is unaffected.
1	Transmitter checksum generation engine is enabled, to calculate and substitute checksums for transmit frames.

[bit10] tx_pbuf_size: Transmitter packet buffer memory size select

This bit selects the amount of memory used for the transmit packet buffer. The reset value of "1" represents the maximum available TX Packet Buffer Memory size of 16 Kbytes.

Bit	Description
0	Do not use top address bit (8 Kbytes)
1	Use full configured addressable space (16 Kbytes)

[bit9:8] rx_pbuf_size: Receiver packet buffer memory size select

These bits select the amount of memory used for the receive packet buffer. The reset value of "0x3" represents the maximum available RX Packet Buffer Memory size of 4 Kbytes.

Bit	Description
00	Do not use top three address bits (512 bytes)
01	Do not use top two address bits (1 Kbytes)
10	Do not use top address bit (2 Kbytes)
11	Use full configure addressable space (4 Kbytes)

[bit7:6] Reserved

Always read "0". Always write "0".

[bit5] hdr_data_splitting_en

Enable header data splitting. When set, received frames will be forwarded to main memory using a minimum of two DMA data buffers. The first X data buffers will contain the frame header, consisting of the Ethernet, VLAN, (IPv4 or IPv6), (TCP or UDP). $X = (\text{frame header size} / \text{rx buf size})$ as defined in bits 23:16 of this register). The last Y data buffers will contain the frame payload. $Y = (\text{frame payload size} / \text{rx buf size})$. When this feature is disabled, the frame is forwarded to main memory in blocks of rx_buf_size.

Bit	Description
0	Disable
1	Enable

[bit4:0] amba_burst_length: AMBA burst length

Selects the attempted burst length used on the AMBA AXI when transferring frame data. Not used for DMA management operations and only used where space and data size allow and respecting AXI burst boundary rules.

Bit	Description
1xxxx	Attempt to use bursts with up to 16 data transfers
01xxx	Attempt to use bursts with up to 8 data transfers
001xx	Attempt to use bursts with up to 4 data transfers
0001x	Always use SINGLE data transfers
00001	Always use SINGLE data transfers
00000	The core will optimally decide the best AXI burst length with up to 16 data transfers if possible, whilst respecting the 4KB boundary restriction.

4.6. Transmit Status Register (ETHERNETn_transmit_status)

Description of Transmit Status register is shown.

REGISTER_NAME	ETHERNETn_transmit_status
OFFSET	0x014
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							resp_not_ok
ACCESS_TYPE	R0,WX							R,W1C
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	late_collision_occurred	transmit_under_run	transmit_complete	amba_error	transmit_go	retry_limit_exceeded	collision_occurred	used_bit_read
ACCESS_TYPE	R,W1C	R,W1C	R,W1C	R,W1C	R,WX	R,W1C	R,W1C	R,W1C
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:9] Reserved

Always read "0". Writing has no effect

[bit8] resp_not_ok: Response not OK

Set to "1" when the Ethernet MAC DMA sees BRESP not OK. Cleared by writing a "1" to this bit.

[bit7] late_collision_occurred: Late collision occurred

Only set if the condition occurs in gigabit mode, as retry is not attempted. Cleared by writing a one to this bit.

[bit6] transmit_under_run: Transmit under run

This bit is set if the transmitter was forced to terminate a frame that it had already began transmitting due to further data being unavailable. This bit is set if a transmitter status write back has not completed when another status write back is attempted. When using the DMA interface configured for internal FIFO mode, this bit is also set when the transmit DMA has written the SOP data into the FIFO and either the AHB bus was not granted in time for further data, or because an AHB not OK response was returned, or because a used bit was read. When using the DMA interface configured for packet buffer mode, this bit will never be set. When using the external FIFO interface, this bit is also set when the tx_r_underflow input is asserted during a frame transfer. Cleared by writing a 1.

[bit5] transmit_complete: Transmit complete

This bit is set when a frame has been transmitted. Cleared by writing "1" to this bit.

[bit4] amba_error: Transmit frame corruption due to AMBA (AXI) errors

Set if an error occurs whilst midway through reading transmit frame from system memory including RRESP or BRESP errors and buffers exhausted mid frame (if the buffers run out during transmission of a frame then transmission stops, FCS shall be bad and tx_er asserted). Also set in DMA packet buffer mode if single frame is too large for configured packet buffer memory size. Cleared by writing “1” to this bit.

[bit3] transmit_go: Transmit ongoing

While transmit is ongoing this bit reads as “1”. Writing has no effect.

[bit2] retry_limit_exceeded: Retry limit exceeded

Cleared by writing a one to this bit.

[bit1] collision_occurred: Collision occurred

Set by the assertion of collision. Cleared by writing a one to this bit. When operating in 10/100 mode, this status indicates either a collision or a late collision. In gigabit mode, this status is not set for a late collision..

[bit0] used_bit_read: Used bit read

Used bit read Set when a transmit buffer descriptor is read with its used bit set. Cleared by writing a one to this bit.

4.7. RX Buffer Queue Base Address Register (ETHERNETn_receive_q_ptr)

This register holds the start address of the receive buffer queue (receive buffers descriptor list). The RX Buffer Queue Base Address register must be initialized before receive is enabled through bit 2 of the Network Control register. Once reception is enabled, any write to the RX Buffer Queue Base Address register is ignored. Reading this register returns the location of the descriptor currently being accessed. This value increments as buffers are used. Software should not use this register for determining where to remove received frames from the queue as it constantly changes as new frames are received. Software should instead work its way through the buffer descriptor queue checking the used bits. In terms of AMBA AXI operation, the receive descriptors are read from memory using a single 32-bit AXI access. Since the datapath is 64-bit wide, the receive descriptors shall be aligned at 64-bit boundaries and each pair of 32-bit descriptors is written using a single 64-bit AXI access.

REGISTER_NAME	ETHERNETn_receive_q_ptr
OFFSET	0x018
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dma_rx_q_ptr[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dma_rx_q_ptr[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dma_rx_q_ptr[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_rx_q_ptr[7:2]						Reserved	
ACCESS_TYPE	R/W						R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0	

[bit31:2] dma_rx_q_ptr: Receive buffer queue base address

Start address of receive buffer queue in system memory.

[bit1:0] Reserved

Always read "0". Writing has no effect.

4.8. TX Buffer Queue Base Address Register (ETHERNETn_transmit_q_ptr)

This register holds the start address of the transmit buffer queue (transmit buffers descriptor list). The TX Buffer Queue Base Address register must be initialized before transmit is started through bit 9 of the Network Control register. Once transmission has started, any write to the TX Buffer Queue Base Address register is illegal and therefore ignored. Note that due to clock boundary synchronization, it takes a maximum of four clock cycles from the writing of the transmit start bit before the transmitter is active. Writing to the TX Buffer Queue Base Address register during this time may produce unpredictable results. Reading this register returns the location of the descriptor currently being accessed. Since the Ethernet MAC DMA handles two frames at once, this may not necessarily be pointing to the current frame being transmitted. In terms of AMBA AXI operation, the transmit descriptors are written to memory using a single 32-bit AXI access. Since the datapath is 64-bit wide, the transmit descriptors shall be aligned at 64-bit boundaries and each pair of 32-bit descriptors is read from memory using a single 64-bit AXI access.

REGISTER_NAME	ETHERNETn_transmit_q_ptr
OFFSET	0x01C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dma_tx_q_ptr[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dma_tx_q_ptr[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dma_tx_q_ptr[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_tx_q_ptr[7:2]						Reserved	
ACCESS_TYPE	R/W						R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

[bit31:2] dma_tx_q_ptr: Transmit buffer queue base address

Start address of transmit buffer queue in system memory.

[bit1:0] Reserved

Always read "0". Writing has no effect.

4.9. Receive Status Register (ETHERNETn_receive_status)

Description of Receive Status register is shown.

REGISTER_NAME	ETHERNETn_receive_status
OFFSET	0x020
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved				resp_not_ok	receive_overrun	frame_received	buffer_not_available
ACCESS_TYPE	R0,WX				R,W1C	R,W1C	R,W1C	R,W1C
PROT_TYPE	Wp							
INITIAL_VALUE	0x0				0	0	0	0

[bit31:4] Reserved

Always read "0". Writing has no effect.

[bit3] resp_not_ok: BRESP not OK

Set when the DMA block sees BRESP not OK. This bit is cleared by writing "1" to it.

[bit2] receive_overrun: Receive over run

This bit is set if the RX Packet Buffer Memory overflows. For DMA operation the buffer will be recovered if an over run occurs. This bit is cleared by writing "1" to it.

[bit1] frame_received: Frame received

One or more frames have been received and placed in memory. This bit is cleared by writing "1" to it.

[bit0] buffer_not_available: Buffer not available

An attempt was made to get a new buffer and the pointer indicated that it was owned by the processor. The RX DMA will reread the pointer each time an end of frame is received until a valid pointer is found. This bit is set following each descriptor read attempt that fails, even if consecutive pointers are unsuccessful and software has in the mean time cleared the status flag. This bit is cleared by writing "1" to it.

4.10. Interrupt Status Register (ETHERNETn_int_status)

Description of Interrupt Status register is shown. If not configured for priority queuing, the Ethernet MAC generates a single interrupt. This register indicates the source of this interrupt. The corresponding bit in the Interrupt Mask register must be clear for a bit to be set. If any bit is set in this register the interrupt signal will be asserted. For test purposes each bit can be set or reset by writing to the Interrupt Mask register. The default configuration is shown below whereby every bit is reset to "0" on writing a "1" to the appropriate bit. Reading has no effect on the status of the bit.

REGISTER_NAME	ETHERNETn_int_status
OFFSET	0x024
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		tsu_timer_comparison_interrupt	Reserved	receive_lpi_indication_status_bit_change	tsu_seconds_register_increment	ptp_pdelay_resp_frame_transmitted	ptp_pdelay_req_frame_transmitted
ACCESS_TYPE	R0,WX		R,W1C	R,WX	R,W1C	R,W1C	R,W1C	R,W1C
PROT_TYPE	Wp							
INITIAL_VALUE	0		0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ptp_pdelay_resp_frame_received	ptp_pdelay_req_frame_received	ptp_sync_frame_transmitted	ptp_delay_req_frame_transmitted	ptp_sync_frame_received	ptp_delay_req_frame_received	Reserved	
ACCESS_TYPE	R,W1C	R,W1C	R,W1C	R,W1C	R,W1C	R,W1C	R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0x0	

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	pause_frame_transmitted	pause_time_elapsed	pause_frame_with_non_zero_pause_quantum_received	resp_not_ok	receive_overflow	Reserved	
ACCESS_TYPE	R,WX	R,W1C	R,W1C	R,W1C	R,W1C	R,W1C	R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	transmit_complete	amba_error	retry_limit_exceeded	Reserved	tx_used_bit_read	rx_used_bit_read	receive_complete	management_frame_sent
ACCESS_TYPE	R,W1C	R,W1C	R,W1C	R,WX	R,W1C	R,W1C	R,W1C	R,W1C
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29] tsu_timer_comparison_interrupt: IEEE 1588 Timer comparison interrupt

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates when IEEE 1588 Timer count value is equal to programmed value.

[bit28] Reserved

Writing has no effect. This bit will read “1” if bit 28 of Interrupt Mask register is set otherwise it will read “0”.

[bit27] receive_lpi_indication_status_bit_change: Receive LPI Indication Status Bit change

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates that Receive LPI Indication Status bit has changed.

[bit26] tsu_seconds_register_increment: IEEE 1588 Timer Seconds register increment

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates that IEEE 1588 Timer Seconds register was incremented.

[bit25] ptp_pdelay_resp_frame_transmitted: PTP Pdelay_Resp frame transmitted

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates a PTP Pdelay_Resp frame has been transmitted.

[bit24] ptp_pdelay_req_frame_transmitted: PTP Pdelay_Req frame transmitted

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates a PTP Pdelay_Req frame has been transmitted.

[bit23] ptp_pdelay_resp_frame_received: PTP Pdelay_Resp frame received

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates a PTP Pdelay_Resp frame has been received.

[bit22] ptp_pdelay_req_frame_received: PTP Pdelay_Req frame received

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates a PTP Pdelay_Req frame has been received.

[bit21] ptp_sync_frame_transmitted: PTP Sync frame transmitted

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates a PTP Sync frame has been transmitted.

[bit20] ptp_delay_req_frame_transmitted: PTP Delay_Req frame transmitted

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates a PTP Delay_Req frame has been transmitted.

[bit19] ptp_sync_frame_received: PTP Sync frame received

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates a PTP Sync frame has been received.

[bit18] ptp_delay_req_frame_received: PTP Delay_Req frame received

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates a PTP Delay_Req frame has been received.

[bit17:15] Reserved

Writing has no effect. These bits will read “111” if bits [17:15] of Interrupt Mask register are set otherwise it will read “000”.

[bit14] pause_frame_transmitted: Pause frame transmitted

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates a pause frame has been successfully transmitted after being initiated from the Network Control register or from the tx_pause control pin.

[bit13] pause_time_elapsed: Pause Time elapsed

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when either the Receive Pause Quantum register decrements to zero, or when a valid pause frame is received with a zero pause quantum field.

[bit12] pause_frame_with_non_zero_pause_quantum_received: Pause frame with non-zero pause quantum received

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Indicates a valid pause has been received that has a non-zero pause quantum field.

[bit11] resp_not_ok: BRESP not OK

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when the DMA block sees BRESP not OK.

[bit10] receive_overrun: Receive over run

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when the receive over run status bit (ETHERNETn_receive_status[2]) gets set.

[bit9:8] Reserved

Writing has no effect. These bits will read “11” if bits [9:8] of Interrupt Mask register are set otherwise it will read “00”.

[bit7] transmit_complete: Transmit complete

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when a frame has been transmitted.

[bit6] amba_error: Transmit frame corruption due to AMBA AXI error

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set if an error occurs whilst midway through reading transmit frame from system memory, including BRESP errors and buffers exhausted mid frame (if the buffers run out during transmission of a frame then transmission stops, FCS shall be bad and TX_ER asserted). Also set in DMA packet buffer mode if single frame is too large for the transmit packet buffer memory size

[bit5] retry_limit_exceeded: Retry limit exceeded

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Transmit error.

[bit4] Reserved

Writing has no effect. This bit will read "1" if bit 4 of Interrupt Mask register is set otherwise it will read "0".

[bit3] tx_used_bit_read: TX used bit read

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when a transmit buffer descriptor is read with its used bit set.

[bit2] rx_used_bit_read: RX used bit read

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when a receive buffer descriptor is read with its used bit set.

[bit1] receive_complete: Receive complete

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when a frame has been stored in memory.

[bit0] management_frame_sent: Management frame sent

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when the PHY Maintenance register has completed its operation.

4.11. Interrupt Enable Register (ETHERNETn_int_enable)

At reset all interrupts are disabled. Writing a "1" to the relevant bit location enables that particular interrupt. This register is write only and when read will return "0".

REGISTER_NAME	ETHERNETn_int_enable
OFFSET	0x028
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		enable_tsu_timer_comparison_interrupt	Reserved	enable_rx_lpi_indication_interrupt	enable_tsu_seconds_register_increment	enable_ptp_pdelay_res_p_frame_transmitted	enable_ptp_pdelay_req_frame_transmitted
ACCESS_TYPE	R0,WX		R0,W1	R0,W0	R0,W1	R0,W1	R0,W1	R0,W1
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	enable_ptp_pdelay_res_p_frame_received	enable_ptp_pdelay_req_frame_received	enable_ptp_sync_frame_transmitted	enable_ptp_delay_req_frame_transmitted	enable_ptp_sync_frame_received	enable_ptp_delay_req_frame_received	Reserved	
ACCESS_TYPE	R0,W1	R0,W1	R0,W1	R0,W1	R0,W1	R0,W1	R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0x0	

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	enable_exte rnal_interru pt	enable_pau se_frame_tr ansmitted	enable_pau se_time_ela psed	enable_pau se_frame_w ith_non_zer o_pause_q uantum_rec eived	enable_res p_not_ok	enable_rec eive_overru n	Reserved	
ACCESS_TYPE	R0,W1	R0,W1	R0,W1	R0,W1	R0,W1	R0,W1	R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	enable_transmit_complete	enable_amba_error	enable_retry_limit_exceeded	Reserved	enable_tx_used_bit_read	enable_rx_used_bit_read	enable_receive_complete	enable_management_frame_sent
ACCESS_TYPE	R0,W1	R0,W1	R0,W1	R0,WX	R0,W1	R0,W1	R0,W1	R0,W1
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29] enable_tsu_timer_comparison_interrupt: Enable IEEE 1588 Timer comparison interrupt

Always read "0". Writing "1" enables IEEE 1588 Timer comparison interrupt.

[bit28] Reserved

Always read "0". Always write "0".

[bit27] enable_rx_lpi_indication_interrupt: Enable RX LPI indication interrupt

[bit26] enable_tsu_seconds_register_increment: Enable IEEE 1588 Timer Seconds register increment

Always read "0". Writing "1" enables IEEE 1588 Timer Seconds register increment interrupt.

[bit25] enable_ptp_pdelay_resp_frame_transmitted: Enable PTP Pdelay_Resp frame transmitted

Always read "0". Writing "1" enables PTP Pdelay_Resp frame transmitted interrupt.

[bit24] enable_ptp_pdelay_req_frame_transmitted: Enable PTP Pdelay_Req frame transmitted

Always read "0". Writing "1" enables PTP Pdelay_Req frame transmitted interrupt.

[bit23] enable_ptp_pdelay_resp_frame_received: Enable PTP Pdelay_Resp frame received

Always read "0". Writing "1" enables PTP Pdelay_Resp frame received interrupt.

[bit22] enable_ptp_pdelay_req_frame_received: Enable PTP Pdelay_Req frame received

Always read "0". Writing "1" enables PTP Pdelay_Req frame received interrupt.

[bit21] enable_ptp_sync_frame_transmitted: Enable PTP Sync frame transmitted

Always read "0". Writing "1" enables PTP Sync frame transmitted interrupt.

[bit20] enable_ptp_delay_req_frame_transmitted: Enable PTP Delay_Req frame transmitted

Always read "0". Writing "1" enables PTP Delay_Req frame transmitted interrupt.

[bit19] enable_ptp_sync_frame_received: Enable PTP Sync frame received

Always read "0". Writing "1" enables PTP Sync frame received interrupt.

[bit18] enable_ptp_delay_req_frame_received: Enable PTP Delay_Req frame received

Always read "0". Writing "1" enables PTP Delay_Req frame received interrupt.

[bit17:16] Reserved

Always read "0". Writing has no effect.

[bit15] enable_external_interrupt: Enable External interrupt

Always read "0". Writing "1" enables External interrupt

[bit14] enable_pause_frame_transmitted: Enable Pause frame transmitted

Always read "0". Writing "1" enables Pause frame transmitted interrupt.

[bit13] enable_pause_time_elapsed: Enable Pause Time elapsed

Always read "0". Writing "1" enables Pause Time elapsed interrupt.

[bit12] enable_pause_frame_with_non_zero_pause_quantum_received: Enable Pause frame with non-zero pause quantum received

Always read "0". Writing "1" enables Pause frame with non-zero pause quantum received interrupt.

[bit11] enable_resp_not_ok: Enable BRESP not OK

Always read "0". Writing "1" enables BRESP not OK interrupt.

[bit10] enable_receive_overrun: Enable Receive over run

Always read "0". Writing "1" enables Receive over run interrupt.

[bit9:8] Reserved

Always read "0". Writing has no effect.

[bit7] enable_transmit_complete: Enable Transmit complete

Always read "0". Writing "1" enables Transmit complete interrupt.

[bit6] enable_amba_error: Enable Transmit frame corruption due to AMBA AXI error

Always read "0". Writing "1" enables Transmit frame corruption due to AMBA AXI error interrupt.

[bit5] enable_retry_limit_exceeded: Enable Retry limit exceeded

Always read "0". Writing "1" enables Retry limit exceeded interrupt.

[bit4] Reserved

Always read "0". Writing has no effect.

[bit3] enable_tx_used_bit_read: Enable TX used bit read

Always read "0". Writing "1" enables TX used bit read interrupt.

[bit2] enable_rx_used_bit_read: Enable RX used bit read

Always read "0". Writing "1" enables RX used bit read interrupt.

[bit1] enable_receive_complete: Enable Receive complete

Always read "0". Writing "1" enables Receive complete interrupt.

[bit0] enable_management_frame_sent: Enable Management frame sent

Always read "0". Writing "1" enables Management frame sent interrupt.

4.12. Interrupt Disable Register (ETHERNETn_int_disable)

Writing a "1" to the relevant bit location disables that particular interrupt. This register is write only and when read will return "0".

REGISTER_NAME	ETHERNETn_int_disable
OFFSET	0x02C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		disable_tsu_timer_comparison_interrupt	Reserved	disable_rx_lpi_indication_interrupt	disable_tsu_seconds_register_increment	disable_ptp_delay_response_frame_transmitted	disable_ptp_delay_request_frame_transmitted
ACCESS_TYPE	R0,WX		R,W1	R0,W1	R,W1	R,W1	R,W1	R,W1
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	disable_ptp_pdelay_res p_frame_re ceived	disable_ptp_pdelay_re q_frame_re ceived	disable_ptp_sync_fram e_transmitt ed	disable_ptp_delay_req _frame_tran smitted	disable_ptp_sync_fram e_received	disable_ptp_delay_req _frame_rec eived	Reserved	
ACCESS_TYPE	R,W1	R,W1	R,W1	R,W1	R,W1	R,W1	R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0x0	

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	disable_external_interrupt	disable_pause_frame_transmitted	disable_pause_time_elapsed	disable_pause_with_non_zero_pause_quantum_received	disable_respond_not_ok	disable_receive_overflow	Reserved	
ACCESS_TYPE	R,W1	R,W1	R,W1	R,W1	R,W1	R,W1	R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	disable_transmit_complete	disable_amba_error	disable_retry_limit_exceeded	Reserved	disable_tx_used_bit_read	disable_rx_used_bit_read	disable_receive_complete	disable_management_frame_sent
ACCESS_TYPE	R,W1	R,W1	R,W1	R0,WX	R,W1	R,W1	R,W1	R,W1
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29] disable_tsu_timer_comparison_interrupt: Disable IEEE 1588 Timer comparison interrupt

Writing "1" disables IEEE 1588 Timer comparison interrupt.

[bit28] Reserved

Always read "0". Always write "1".

[bit27] disable_rx_lpi_indication_interrupt: Disable RX LPI indication interrupt

[bit26] disable_tsu_seconds_register_increment: Disable IEEE 1588 Timer Seconds register increment

Writing "1" disables IEEE 1588 Timer Seconds register increment interrupt.

[bit25] disable_ptp_pdelay_resp_frame_transmitted: Disable PTP Pdelay_Resp frame transmitted

Writing "1" disables PTP Pdelay_Resp frame transmitted interrupt.

[bit24] disable_ptp_pdelay_req_frame_transmitted: Disable PTP Pdelay_Req frame transmitted

Writing "1" disables PTP Pdelay_Req frame transmitted interrupt.

[bit23] disable_ptp_pdelay_resp_frame_received: Disable PTP Pdelay_Resp frame received

Writing "1" disables PTP Pdelay_Resp frame received interrupt.

[bit22] disable_ptp_pdelay_req_frame_received: Disable PTP Pdelay_Req frame received

Writing "1" disables PTP Pdelay_Req frame received interrupt.

[bit21] disable_ptp_sync_frame_transmitted: Disable PTP Sync frame transmitted

Writing "1" disables PTP Sync frame transmitted interrupt.

[bit20] disable_ptp_delay_req_frame_transmitted: Disable PTP Delay_Req frame transmitted

Writing "1" disables PTP Delay_Req frame transmitted interrupt.

[bit19] disable_ptp_sync_frame_received: Disable PTP Sync frame received

Writing "1" disables PTP Sync frame received interrupt.

[bit18] disable_ptp_delay_req_frame_received: Disable PTP Delay_Req frame received

Writing "1" disables PTP Delay_Req frame received interrupt.

[bit17:16] Reserved

Always read "0". Writing has no effect.

[bit15] disable_external_interrupt: Disable External interrupt

Writing "1" disables External interrupt

[bit14] disable_pause_frame_transmitted: Disable Pause frame transmitted

Writing "1" disables Pause frame transmitted interrupt.

[bit13] disable_pause_time_elapsed: Disable Pause Time elapsed

Writing "1" disables Pause Time elapsed interrupt.

[bit12] disable_pause_frame_with_non_zero_pause_quantum_received: Disable Pause frame with non-zero pause quantum received

Writing "1" disables Pause frame with non-zero pause quantum received interrupt.

[bit11] disable_resp_not_ok: Disable BRESP not OK

Writing "1" disables BRESP not OK interrupt.

[bit10] disable_receive_overrun: Disable Receive over run

Writing "1" disables Receive over run interrupt.

[bit9:8] Reserved

Always read "0". Writing has no effect.

[bit7] disable_transmit_complete: Disable Transmit complete

Writing "1" disables Transmit complete interrupt.

[bit6] disable_amba_error: Disable Transmit frame corruption due to AMBA AXI error

Writing "1" disables Transmit frame corruption due to AMBA AXI error interrupt.

[bit5] disable_retry_limit_exceeded: Disable Retry limit exceeded

Writing "1" disables Retry limit exceeded interrupt.

[bit4] Reserved

Always read "0". Writing has no effect.

[bit3] disable_tx_used_bit_read: Disable TX used bit read

Writing "1" disables TX used bit read interrupt.

[bit2] disable_rx_used_bit_read: Disable RX used bit read

Writing "1" disables RX used bit read interrupt.

[bit1] disable_receive_complete: Disable Receive complete

Writing "1" disables Receive complete interrupt.

[bit0] disable_management_frame_sent: Disable Management frame sent

Writing "1" disables Management frame sent interrupt.

4.13. Interrupt Mask Register (ETHERNETn_int_mask)

The Interrupt Mask register is a read only register indicating which interrupts are masked. All bits are set at reset and can be reset individually by writing to the Interrupt Enable register or set individually by writing to the Interrupt Disable register. Having separate address locations for enable and disable saves the need for performing a read modify write when updating the Interrupt Mask register. For test purposes there is a write-only function to this register that allows the bits in the Interrupt Status register to be set or cleared, regardless of the state of the Interrupt Mask register.

REGISTER_NAME	ETHERNETn_int_mask
OFFSET	0x030
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		tsu_timer_comparison_mask	wol_event_received_mask	rx_lpi_indication_mask	tsu_second_s_register_increment_mask	ptp_pdelay_resp_frame_transmitted_mask	ptp_pdelay_req_frame_transmitted_mask
ACCESS_TYPE	R0,WX		R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		1	1	1	1	1	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ptp_pdelay_resp_frame_received_mask	ptp_pdelay_req_frame_received_mask	ptp_sync_frame_transmitted_mask	ptp_delay_req_frame_transmitted_mask	ptp_sync_frame_received_mask	ptp_delay_req_frame_received_mask	pcs_link_partner_page_mask	pcs_auto_negotiation_complete_interrupt_mask
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	external_interrupt_mask	pause_frame_transmitted_interrupt_mask	pause_time_zero_interrupt_mask	pause_frame_with_non_zero_pause_quantum_interrupt_mask	resp_not_ok_interrupt_mask	receive_overflow_interrupt_mask	link_change_interrupt_mask	reserved
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R1, WX
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	transmit_complete_interrupt_mask	amba_error_interrupt_mask	retry_limit_exceeded_or_late_collision_mask	transmit_buffer_under_run_interrupt_mask	transmit_used_bit_read_interrupt_mask	receive_used_bit_read_interrupt_mask	receive_complete_interrupt_mask	management_done_interrupt_mask
ACCESS_TYPE	R,WX	R,WX	R,WX	R1,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29] tsu_timer_comparison_mask

Enable TSU timer comparison interrupt mask.

[bit28] wol_event_received_mask

A read of this register returns the value of the WOL event received mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit27] rx_lpi_indication_mask

A read of this register returns the value of the RX LPI indication mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit26] tsu_seconds_register_increment_mask: IEEE 1588 Timer Seconds register increment mask

A read of this register returns the value of the IEEE 1588 Timer Seconds register increment mask. A write to this register directly affects the state of the corresponding bit in the Interrupt Status register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit25] ptp_pdelay_resp_frame_transmitted_mask: PTP Pdelay_Resp frame transmitted mask

A read of this register returns the value of the PTP Pdelay_Resp frame transmitted mask. A write to this register directly affects the state of the corresponding bit in the Interrupt Status register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit24] ptp_pdelay_req_frame_transmitted_mask: PTP Pdelay_Req frame transmitted mask

A read of this register returns the value of the PTP Pdelay_Req frame transmitted mask. A write to this register directly affects the state of the corresponding bit in the Interrupt Status register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit23] ptp_pdelay_resp_frame_received_mask: PTP Pdelay_Resp frame received mask

A read of this register returns the value of the PTP Pdelay_Resp frame received mask. A write to this register directly affects the state of the corresponding bit in the Interrupt Status register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit22] ptp_pdelay_req_frame_received_mask: PTP Pdelay_Req frame received mask

A read of this register returns the value of the PTP Pdelay_Req frame received mask. A write to this register directly affects the state of the corresponding bit in the Interrupt Status register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit21] ptp_sync_frame_transmitted_mask: PTP Sync frame transmitted mask

A read of this register returns the value of the PTP Sync frame transmitted mask. A write to this register directly affects the state of the corresponding bit in the Interrupt Status register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit20] ptp_delay_req_frame_transmitted_mask: PTP Delay_Req frame transmitted mask

A read of this register returns the value of the PTP Delay_Req frame transmitted mask. A write to this register directly affects the state of the corresponding bit in the Interrupt Status register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit19] ptp_sync_frame_received_mask: PTP Sync frame received mask

A read of this register returns the value of the PTP Sync frame received mask. A write to this register directly affects the state of the corresponding bit in the Interrupt Status register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit18] ptp_delay_req_frame_received_mask: PTP Delay_Req frame received mask

A read of this register returns the value of the PTP Delay_Req frame received mask. A write to this register directly affects the state of the corresponding bit in the Interrupt Status register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit17] pcs_link_partner_page_mask

A read of this register returns the value of the PCS link partner page mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit16] pcs_auto_negotiation_complete_interrupt_mask

A read of this register returns the value of the PCS auto-negotiation complete interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit15] external_interrupt_mask: External interrupt mask

A read of this register returns the value of the external interrupt mask. A write to this register directly affects the state of the corresponding bit in the Interrupt Status register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit14] pause_frame_transmitted_interrupt_mask

pause frame transmitted interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit13] pause_time_zero_interrupt_mask

pause time zero interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit12] pause_frame_with_non_zero_pause_quantum_interrupt_mask

pause frame with non-zero pause quantum interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit11] resp_not_ok_interrupt_mask

brsp/hresp not OK interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit10] receive_overrun_interrupt_mask

receive overrun interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit9] link_change_interrupt_mask

A read of this register returns the value of the link change interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit8] reserved

This bit is not used.[bit7] transmit_complete_interrupt_mask

transmit complete interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit6] amba_error_interrupt_mask

transmit frame corruption due to AMBA (AHB/AXI) error interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit5] retry_limit_exceeded_or_late_collision_mask

A read of this register returns the value of the retry limit exceeded or late collision (gigabit mode only) interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit4] transmit_buffer_under_run_interrupt_mask

transmit buffer under run interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit3] transmit_used_bit_read_interrupt_mask

transmit used bit read interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit2] receive_used_bit_read_interrupt_mask

receive used bit read interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit1] receive_complete_interrupt_mask

receive complete interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

[bit0] management_done_interrupt_mask

management done interrupt mask. A write to this register directly affects the state of the corresponding bit in the interrupt status register, causing an interrupt to be generated if a 1 is written.

Bit	Description
0	Interrupt is enabled.
1	Interrupt is disabled.

4.14. PHY Maintenance Register (ETHERNETn_phy_management)

The PHY Maintenance register is implemented as a shift register. Writing to the register starts a shift operation which is signaled as complete when bit 2 is set in the Network Status register. It takes about 2000 clock cycles to complete, when MDC is set for clock divide by 32 in the Network Configuration register. An interrupt is generated upon completion. During this time, the MSB of the register is output on the MDIO pin and the LSB updated from the MDIO pin with each MDC cycle. This causes transmission of a PHY management frame on MDIO. See Section 22.2.4.5 of the IEEE Std 802.3 standard. Reading during the shift operation will return the current contents of the shift register. At the end of management operation, the bits will have shifted back to their original locations. For a read operation, the data bits will be updated with data read from the PHY. It is important to write the correct values to the register to ensure a valid PHY management frame is produced. The MDIO interface can read IEEE Std 802.3 clause 45 PHYs as well as clause 22 PHYs. To read clause 45 PHYs, bit 30 should be written with a "0" rather than a "1". For a description of MDC generation, see Network Configuration register.

REGISTER_NAME	ETHERNETn_phy_management
OFFSET	0x034
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	write0	write1	operation[1:0]		phy_address[4:1]			
ACCESS_TYPE	R/w0	R/W	R/W		R/W			
PROT_TYPE					Wp			
INITIAL_VALUE	0	0	0x0		0x0			

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	phy_addresses[0]	register_address[4:0]					write10[1:0]	
ACCESS_TYPE	R/W	R/W					R/W	
PROT_TYPE	Wp							
INITIAL_VALUE	0	0x00					0x0	

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	phy_write_read_data[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	phy_write_read_data[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31] write0: Write 0

Always read written value. Writing with "0".

[bit30] write1: Write 1

Must be written with "1" for a valid Clause 22 frame and with "0" for a valid Clause 45 frame.

[bit29:28] operation: Operation

Bit	Description
00	Reserved
01	Write operation.
10	Read operation.

11	Reserved
----	----------

[bit27:23] phy_address: PHY address

PHY address.

[bit22:18] register_address: Register address

Specifies the register in the PHY to access.

[bit17:16] write10: Write 10

Always read written value, Write with "0x2".

[bit15:0] phy_write_read_data: PHY write/read data

For a write operation the value in this register is written to the PHY as data. For a read operation this register contains the data read from the PHY.

4.15. Receive Pause Quantum Register (ETHERNETn_pause_time)

Description of Receive Pause Quantum register is shown.

REGISTER_NAME	ETHERNETn_pause_time
OFFSET	0x038
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	quantum[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	quantum[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] quantum: Received pause quantum

Stores the current value of the received pause quantum register which is decremented every 512 bit times.

4.16. Transmit Pause Quantum Register (ETHERNETn_tx_pause_quantum)

Description of Transmit Pause Quantum register is shown.

REGISTER_NAME	ETHERNETn_tx_pause_quantum
OFFSET	0x03C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	quantum_p1[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	quantum_p1[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	quantum[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	quantum[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

[bit31:16] quantum_p1: Transmit pause quantum - Priority 1

Write pause quantum value for pause frame transmission of priority 1.

[bit15:0] quantum: Transmit pause quantum

Write pause quantum value for pause frame transmission.

4.17. TX Partial Store and Forward Register (ETHERNETn_pbuf_txcutthru)

Description of TX Partial Store and Forward register is shown.

REGISTER_NAME	ETHERNETn_pbuf_txcutthru
OFFSET	0x040
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dma_tx_cutthru	Reserved						
ACCESS_TYPE	R/W	R0,WX						
PROT_TYPE		Wp						
INITIAL_VALUE	0	0x00						

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved					dma_tx_cutthru_threshold[10:8]		
ACCESS_TYPE	R0,WX					R/W		
PROT_TYPE	Wp							
INITIAL_VALUE	0x00					0x7		

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_tx_cutthru_threshold[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

[bit31] dma_tx_cutthru: TX Partial Store and Forward

Bit	Description
0	Enable TX Full Store and Forward operation mode.
1	Enable TX Partial Store and Forward operation mode.

[bit30:11] Reserved

Always read "0". Writing has no effect.

[bit10:0] dma_tx_cutthru_threshold: TX partial store and forward threshold

Watermark value. This value must be $\geq 0x14$

4.18. RX Partial Store and Forward Register (ETHERNETn_pbuf_rxcutthru)

Description of RX Partial Store and Forward register is shown.

REGISTER_NAME	ETHERNETn_pbuf_rxcutthru
OFFSET	0x044
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dma_rx_cutthru	Reserved						
ACCESS_TYPE	R/W	R0,WX						
PROT_TYPE		Wp						
INITIAL_VALUE	0	0x00						

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							dma_rx_cutthru_threshold[8]
ACCESS_TYPE	R0,WX							R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_rx_cutthru_threshold[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

[bit31] dma_rx_cutthru: RX Partial Store and Forward

Bit	Description
0	Enable RX Full Store and Forward operation mode.
1	Enable RX Partial Store and Forward operation mode.

[bit30:9] Reserved

Always read "0". Writing has no effect.

[bit8:0] dma_rx_cutthru_threshold: RX partial store and forward threshold

Watermark value.

4.19. Jumbo-Frame Maximum Length Register (ETHERNETn_jumbo_max_length)

Description of Jumbo-Frame Maximum Length register is shown.

REGISTER_NAME	ETHERNETn_jumbo_max_length
OFFSET	0x048
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved		jumbo_max_length[13:8]					
ACCESS_TYPE	R0,WX		R/W					
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0x28					

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	jumbo_max_length[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:14] Reserved

Always read "0". Writing has no effect.

[bit13:0] jumbo_max_length: Jumbo-Frame maximum length

Defines the maximum Jumbo-Frame size in Bytes. Reset value corresponds to 10240 Bytes.

4.20. AXI Maximum Pipeline Register (ETHERNETn_axi_max_pipeline)

Description of AXI Maximum Pipeline register is shown. Used to set the maximum amount of outstanding transactions on the AXI bus between AR/R channels and AW/W channels.

REGISTER NAME	ETHERNETn_axi_max_pipeline
OFFSET	0x054
ACCESS SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT OFFSET	31	30	29	28	27	26	25	24
BIT NAME	Reserved							
ACCESS TYPE	R0,WX							
PROT TYPE	Wp							
INITIAL_VALUE	0x00							

BIT OFFSET	23	22	21	20	19	18	17	16
BIT NAME	Reserved							
ACCESS TYPE	R0,WX							
PROT TYPE	Wp							
INITIAL_VALUE	0x00							

BIT OFFSET	15	14	13	12	11	10	9	8
BIT NAME	aw2w_max_pipeline[7:0]							
ACCESS TYPE	R/W							
PROT TYPE	Wp							
INITIAL_VALUE	0x01							

BIT OFFSET	7	6	5	4	3	2	1	0
BIT NAME	ar2r_max_pipeline[7:0]							
ACCESS TYPE	R/W							
PROT TYPE	Wp							
INITIAL_VALUE	0x01							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:8] aw2w_max_pipeline:

Defines the maximum number of outstanding AXI write requests that can be issued by the DMA via the AW channel.

Bit	Description
0x00	The maximum number of outstanding write requests is 1.
.	.
.	.
0x0F	The maximum number of outstanding write requests is 16.
0x10	Setting reserved.
–	
0xFF	

[bit7:0] ar2r_max_pipeline:

Defines the maximum number of outstanding AXI read requests that can be issued by the DMA via the AR channel.

Bit	Description
0x00	The maximum number of outstanding read requests is 1.

.	.
.	.
.	.
0x0F	The maximum number of outstanding read requests is 16.
0x10	
—	Setting reserved.
0xFF	

4.21. Interrupt Moderation Register (ETHERNETn_int_moderation)

Description of Interrupt Moderation register is shown. Used to moderate the number of transmit and receive interrupts issued. With interrupt moderation enabled, receive and transmit interrupts are not generated immediately a frame is transmitted or received. Instead when a receive or transmit event occurs a timer is started and the interrupt is asserted after it times out. This limits the frequency with which the CPU receives interrupts. When interrupt moderation is enabled, interrupt status bit 1 is always used for receive and bit 7 is always used for transmit even when priority queuing is enabled.

REGISTER_NAME	ETHERNETn_int_moderation
OFFSET	0x05C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	tx_int_moderation[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	rx_int_moderation[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:24] Reserved

Always read "0". Writing has no effect.

[bit23:16] tx_int_moderation: Transmit Interrupt Moderation

Count of 800nS periods before bit 7 is set in the interrupt status register after a frame is transmitted. A non-zero value indicates transmit interrupt moderation will be performed.

[bit15:8] Reserved

Always read "0". Writing has no effect.

[bit7:0] rx_int_moderation: Receive Interrupt Moderation

Count of 800nS periods before bit 1 is set in the interrupt status register after a frame is received. A non-zero value indicates receive interrupt moderation will be performed.

4.22. System Wake Time Register (ETHERNETn_sys_wake_time)

Description of System Wake Time Register is shown. Used to pause transmission after deassertion of tx_lpi_en. Each unit in this register corresponds to 320ns in 100Mbps operation and 3200ns in 10Mbps operation. After tx_lpi_en is deasserted, transmission will pause for the set time.

REGISTER_NAME	ETHERNETn_sys_wake_time
OFFSET	0x060
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	sys_wake_time[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	sys_wake_time[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] sys_wake_time: System Wakeup Time

Count of 320ns or 3200ns intervals before transmission starts after deassertion of tx_lpi_en (each intervals is equivalent to 8 tx_clk periods, and so varies with data rate).

4.23. Hash Bottom Register (ETHERNETn_hash_bottom)

Description of Hash Bottom register is shown.

REGISTER NAME	ETHERNETn_hash_bottom
OFFSET	0x080
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	address[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	address[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	address[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	address[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] address: Hash address [31:0]

The lower 32 bits of the hash address register.

4.24. Hash Top Register (ETHERNETn_hash_top)

Description of Hash Top register is shown.

REGISTER_NAME	ETHERNETn_hash_top
OFFSET	0x084
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	address[63:56]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	address[55:48]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	address[47:40]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	address[39:32]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] address: Hash address [63:32]

The upper 32 bits of the hash address register.

4.25. Specific Address Bottom i Register (ETHERNETn_spec_add_bottom_i) (i=1 to 4)

The address stored in the Specific Address i registers are deactivated at reset or when their corresponding Specific Address Bottom i register is written. They are activated when Specific Address Top i register is written.

REGISTER NAME	ETHERNETn_spec_add_bottom_i
OFFSET	(0x088 + ((i-1)*0x8))
ACCESS_SIZE	W
MULTIPLE	1:4
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	address[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	address[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	address[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	address[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] address: Specific address i [31:0]

Least significant 32 bits of the destination address, which is bits [31:0]. Bit 0 indicates whether the address is multicast or unicast and corresponds to the least significant bit of the first byte received.

4.26. Specific Address Top i Register (ETHERNETn_spec_add_top_i) (i=1 to 4)

The address stored in the Specific Address i registers are deactivated at reset or when their corresponding Specific Address Bottom i register is written. They are activated when Specific Address Top i register is written.

REGISTER NAME	ETHERNETn_spec_add_top_i
OFFSET	(0x08C + ((i-1)*0x8))
ACCESS_SIZE	W
MULTIPLE	1:4
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		filter_byte_mask[5:0]					
ACCESS_TYPE	R0,WX		R/W					
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0x00					

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							filter_type
ACCESS_TYPE	R0,WX							R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	address[47:40]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	address[39:32]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29:24] filter_byte_mask: Filter byte mask

When high, the associated byte of the specific address will not be compared. Bit 24 controls whether the first byte received should be compared. Bit 29 controls whether the last byte received should be compared.

[bit23:17] Reserved

Always read "0". Writing has no effect.

[bit16] filter_type: Filter type

This control bit selects whether this filter should be comparing the MAC source address or the MAC destination address of the received Ethernet frame. When set to "0", the filter is a destination address filter. When set to "1", the filter is a source address filter.

[bit15:0] address: Specific address i [47:32]

The most significant bits of the destination/source address that is to be compared, that is bits [47:32].

4.27. Type ID Match i Register (ETHERNETn_spec_type_i) (i= 1 to 4)

Description of Type ID Match i register is shown.

REGISTER NAME	ETHERNETn_spec_type_i
OFFSET	(0x0A8 + ((i-1)*0x4)
ACCESS_SIZE	W
MULTIPLE	1:4
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	enable_copy	Reserved						
ACCESS_TYPE	R/W	R0,WX						
PROT_TYPE	Wp							
INITIAL_VALUE	0	0x00						

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	match[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	match[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31] enable_copy: Enable copy

Enable copying of Type ID match, matched frames.

[bit30:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] match: Type ID match

Type ID match. For use in comparisons with received frames Type ID/length field.

4.28. Stacked VLAN Register (ETHERNETn_stacked_vlan)

Description of Stacked VLAN register is shown.

REGISTER_NAME	ETHERNETn_stacked_vlan
OFFSET	0x0C0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	enable_processing	Reserved						
ACCESS_TYPE	R/W	R0,WX						
PROT_TYPE	Wp							
INITIAL_VALUE	0	0x00						

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0, WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	match[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	match[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31] enable_processing: Enable processing

Enable stacked VLAN processing mode

[bit30:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] match: User defined VLAN_TYPE field

When Stacked VLAN is enabled, the first VLAN tag in a received frame will only be accepted if the VLAN type field is equal to this user defined VLAN_TYPE OR equal to the standard VLAN type (0x8100). Note that the second VLAN tag of a Stacked VLAN packet will only be matched correctly if its VLAN_TYPE field equals 0x8100.

4.29. Transmit PFC Pause Register (ETHERNETn_tx_pfc_pause)

Description of Transmit PFC Pause register is shown.

REGISTER NAME	ETHERNETn_tx_pfc_pause
OFFSET	0x0C4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vector[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vector_enable[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:8] vector: Priority vector pause size

If bit 17 of the Network Control register is written with a "1" then for each entry equal to "0" in the Transmit PFC Pause register [15:8], the PFC pause frame's pause quantum field associated with that entry will be taken from the Transmit Pause Quantum register. For each entry equal to "1" in the Transmit PFC Pause register [15:8], the pause quantum associated with that entry will be "0".

[bit7:0] vector_enable: Priority vector enable

If bit 17 of the Network Control register is written with a "1" then the priority enable vector of the PFC priority based pause frame will be set equal to the value stored in this register [7:0].

4.30. Specific Address Mask 1 Bottom Register (ETHERNETn_mask_add1_bottom)

Description of Specific Address Mask 1 Bottom register is shown.

REGISTER_NAME	ETHERNETn_mask_add1_bottom
OFFSET	0x0C8
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	address_mask[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	address_mask[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	address_mask[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	address_mask[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] address_mask: Specific Address Mask [31:0]

Setting a bit to "1" masks the corresponding bit in the Specific Address Bottom i register.

4.31. Specific Address Mask 1 Top Register (ETHERNETn_mask_add1_top)

Description of Specific Address Mask 1 Top register is shown.

REGISTER_NAME	ETHERNETn_mask_add1_top
OFFSET	0x0CC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	address_mask[47:40]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	address_mask[39:32]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] address_mask: Specific Address Mask [47:32]

Setting a bit to "1" masks the corresponding bit in the Specific Address Top i register.

4.32. RX PTP Unicast IP Destination Address Register (ETHERNETn_rx_ptp_unicast)

Description of RX PTP Unicast IP Destination Address register is shown.

REGISTER_NAME	ETHERNETn_rx_ptp_unicast
OFFSET	0x0D4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	address[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	address[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	address[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	address[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] address: Unicast IP destination address

Used for detection of PTP frames on receive path.

4.33. TX PTP Unicast IP Destination Address Register (ETHERNETn_tx_ptp_unicast)

Description of TX PTP Unicast IP Destination Address register is shown.

REGISTER_NAME	ETHERNETn_tx_ptp_unicast
OFFSET	0x0D8
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	address[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	address[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	address[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	address[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] address: Unicast IP destination address

Used for detection of PTP frames on transmit path.

4.34. Receive DMA Data Buffer Address Mask Register (ETHERNETn_dma_addr_or_mask)

Description of Receive DMA Data Buffer Address Mask register is shown.

REGISTER_NAME	ETHERNETn_dma_addr_or_mask
OFFSET	0x0D0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	mask_value[3:0]				Reserved			
ACCESS_TYPE	R/W				R0,WX			
PROT_TYPE	Wp							
INITIAL_VALUE	0x0				0x0			

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved				mask_enable[3:0]			
ACCESS_TYPE	R0,WX				R/W			
PROT_TYPE	Wp							
INITIAL_VALUE	0x0				0x0			

[bit31:28] mask_value: Data Buffer Address Mask Value

Values used to force bits [31:28] of the receive data buffer AXI address to a particular value when the associated enable bits stored in this register [3:0] are set. Any changes to this register will be ignored while the DMA is currently processing a receive packet. It will only affect the next full packet to be written to system memory.

[bit27:4] Reserved

Always read "0". Writing has no effect.

[bit3:0] mask_enable: Data Buffer Address Mask Enable

These bits are associated directly with bits [31:28]. When bit 0 is set, the AXI address bit 28 used for accessing the receive data buffers will be forced to the value stored in bit 28 of this register. When bit 1 is set, the AXI address bit 29 used for accessing the receive data buffers will be forced to the value stored in bit 29 of this register. When bit 2 is set, the AXI address bit 30 used for accessing the receive data buffers will be forced to the value stored in bit 30 of this register. When bit 3 is set, the AXI address bit 31 used for accessing the receive data buffers will be forced to the value stored in bit 31 of this register. When these bits are clear, the associated value stored in bits [31:28] have no effect on the AXI address used for receive data buffer accesses. Any changes to this register will be ignored while the DMA is currently processing a receive packet. It will only affect the next full packet to be written to system memory.

4.35. IEEE 1588 Timer Comparison Value Nanoseconds Register (ETHERNETn_tsu_nsec_cmp)

Description of IEEE 1588 Timer Comparison Value Nanoseconds register is shown.

REGISTER_NAME	ETHERNETn_tsu_nsec_cmp
OFFSET	0x0DC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved		comparison_value[21:16]					
ACCESS_TYPE	R0,WX		R/W					
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0x00					

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	comparison_value[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	comparison_value[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:22] Reserved

Always read "0". Writing has no effect.

[bit21:0] comparison_value: IEEE 1588 Timer comparison value nanoseconds [21:0]

The register value is compared to bits [45:24] of the IEEE 1588 Timer count value (upper 22 bits of nanosecond value).

4.36. IEEE 1588 Timer Comparison Value Seconds Bottom Register (ETHERNETn_tsu_sec_cmp)

Description of IEEE 1588 Timer Comparison Value Seconds Bottom register is shown.

REGISTER_NAME	ETHERNETn_tsu_sec_cmp
OFFSET	0x0E0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	comparison_value[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	comparison_value[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	comparison_value[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	comparison_value[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] comparison_value: IEEE 1588 Timer comparison value seconds [31:0]

The register value is compared to bits [31:0] of the IEEE 1588 Timer count value.

4.37. IEEE 1588 Timer Comparison Value Seconds Top Register (ETHERNETn_tsu_msb_sec_cmp)

Description of IEEE 1588 Timer Comparison Value Seconds Top register is shown.

REGISTER_NAME	ETHERNETn_tsu_msb_sec_cmp
OFFSET	0x0E4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	comparison_value[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	comparison_value[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] comparison_value: IEEE 1588 Timer comparison value seconds [47:32]

The register value is compared to bits [47:32] of the IEEE 1588 Timer count value.

4.38. PTP Event Frame Transmitted Seconds [47:32] Register (ETHERNETn_tsu_ptp_tx_msb_sec)

Description of PTP Event Frame Transmitted Seconds [47:32] register is shown.

REGISTER_NAME	ETHERNETn_tsu_ptp_tx_msb_sec
OFFSET	0x0E8
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer_seconds[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer_seconds[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] timer_seconds: PTP Event Frame Transmitted Seconds [47:32]

The register is updated with the value that the IEEE 1588 Timer Seconds register held when the SFD of a PTP transmit primary event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP sync or Delay_Req frame. An interrupt is issued when the register is updated.

4.39. PTP Event Frame Received Seconds [47:32] Register (ETHERNETn_tsu_ptp_rx_msb_sec)

Description of PTP Event Frame Received Seconds [47:32] register is shown.

REGISTER_NAME	ETHERNETn_tsu_ptp_rx_msb_sec
OFFSET	0x0EC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer_seconds[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer_seconds[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] timer_seconds: PTP Event Frame Received Seconds [47:32]

The register is updated with the value that the IEEE 1588 Timer Seconds register held when the SFD of a PTP receive primary event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Sync or Delay_Req frame. An interrupt is issued when the register is updated.

4.40. PTP Peer Event Frame Transmitted Seconds [47:32] Register (ETHERNETn_tsu_peer_tx_msb_sec)

Description of PTP Peer Event Frame Transmitted Seconds [47:32] register is shown.

REGISTER_NAME	ETHERNETn_tsu_peer_tx_msb_sec
OFFSET	0x0F0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer_seconds[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer_seconds[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] timer_seconds: PTP Peer Event Frame Transmitted Seconds [47:32]

The register is updated with the value that the IEEE 1588 Timer Seconds register held when the SFD of a PTP transmit peer event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Pdelay_Req or Pdelay_Resp frame. An interrupt is issued when the register is updated.

4.41. PTP Peer Event Frame Received Seconds [47:32] Register (ETHERNETn_tsu_peer_rx_msb_sec)

Description of PTP Peer Event Frame Received Seconds [47:32] register is shown.

REGISTER_NAME	ETHERNETn_tsu_peer_rx_msb_sec
OFFSET	0x0F4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer_seconds[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer_seconds[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] timer_seconds: PTP Peer Event Frame Received Seconds [47:32]

The register is updated with the value that the IEEE 1588 Timer Seconds register held when the SFD of a PTP transmit peer event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Pdelay_Req or Pdelay_Resp frame. An interrupt is issued when the register is updated.

4.42. Identification and Revision Register (ETHERNETn_revision_reg)

Description of Identification and Revision register is shown.

REGISTER_NAME	ETHERNETn_revision_reg
OFFSET	0x0FC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	module_identification_number[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x30							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	module_identification_number[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x07							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	module_revision[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x01							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	module_revision[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x08							

[bit31:16] module_identification_number[15:0]: Module identification number

Module identification number for the Ethernet MAC.

[bit15:0] module_revision[15:0]: Module revision number

Module revision number for the Ethernet MAC.

4.43. Octets Transmitted Bottom Register (ETHERNETn_octets_txed_bottom)

Description of Octets Transmitted [31:0] register is shown. When reading the Octets Transmitted registers, bits [31:0] (ETHERNETn_octets_txed_bottom) should be read prior to bits [47:32] (ETHERNETn_octets_txed_top) to ensure reliable operation.

REGISTER NAME	ETHERNETn_octets_txed_bottom
OFFSET	0x100
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: Transmitted octets in frame without errors [31:0]

The number of octets transmitted in valid frames of any type. This counter is 48-bits, and is read through two registers (ETHERNETn_octets_txed_top and ETHERNETn_octets_txed_bottom). This count does not include octets from automatically generated pause frames.

4.44. Octets Transmitted Top Register (ETHERNETn_octets_txed_top)

Description of Octets Transmitted [47:32] register is shown. When reading the Octets Transmitted registers, bits [31:0] (ETHERNETn_octets_txed_bottom) should be read prior to bits [47:32] (ETHERNETn_octets_txed_top) to ensure reliable operation.

REGISTER_NAME	ETHERNETn_octets_txed_top
OFFSET	0x104
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[47:40]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[39:32]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] count: Transmitted octets in frame without errors [47:32]

The number of octets transmitted in valid frames of any type. This counter is 48-bits, and is read through two registers (ETHERNETn_octets_txed_top and ETHERNETn_octets_txed_bottom). This count does not include octets from automatically generated pause frames.

4.45. Frames Transmitted Register (ETHERNETn_frames_txed_ok)

Description of Frames Transmitted register is shown.

REGISTER NAME	ETHERNETn_frames_txed_ok
OFFSET	0x108
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: Frames transmitted without error

A 32-bit register counting the number of frames successfully transmitted, i.e. no under run and not too many retries. Excludes pause frames.

4.46. Broadcast Frames Transmitted Register (ETHERNETn_broadcast_txed)

Description of Broadcast Frames Transmitted register is shown.

REGISTER_NAME	ETHERNETn_broadcast_txed
OFFSET	0x10C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: Broadcast frames transmitted without error

A 32-bit register counting the number of broadcast frames successfully transmitted without error, i.e. no under run and not too many retries. Excludes pause frames.

4.47. Multicast Frames Transmitted Register (ETHERNETn_multicast_txed)

Description of Multicast Frames Transmitted register is shown.

REGISTER_NAME	ETHERNETn_multicast_txed
OFFSET	0x110
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: Multicast frames transmitted without error

A 32-bit register counting the number of multicast frames successfully transmitted without error, i.e. no under run and not too many retries. Excludes pause frames.

4.48. Pause Frames Transmitted Register (ETHERNETn_pause_frames_txed)

Description of Pause Frames Transmitted register is shown.

REGISTER_NAME	ETHERNETn_pause_frames_txed
OFFSET	0x114
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] count: Transmitted pause frames

A 16-bit register counting the number of pause frames transmitted. Only pause frames triggered by the register interface or through the external pause pins are counted as pause frames. Pause frames received through the External FIFO Interface are counted in the frames transmitted counter.

4.49. 64 Byte Frames Transmitted Register (ETHERNETn_frames_txed_64)

Description of 64 Byte Frames Transmitted register is shown.

REGISTER_NAME	ETHERNETn_frames_txed_64
OFFSET	0x118
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 64 byte frames transmitted without error

A 32-bit register counting the number of 64 byte frames successfully transmitted without error, i.e. no under run and not too many retries.

4.50. 65 To 127 Byte Frames Transmitted Register (ETHERNETn_frames_txed_65)

Description of 65 To 127 Byte Frames Transmitted register is shown.

REGISTER_NAME	ETHERNETn_frames_txed_65
OFFSET	0x11C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 65 to 127 byte frames transmitted without error

A 32-bit register counting the number of 65 to 127 byte frames successfully transmitted without error, i.e. no under run and not too many retries.

4.51. 128 To 255 Byte Frames Transmitted Register (ETHERNETn_frames_txed_128)

Description of 128 To 255 Byte Frames Transmitted register is shown.

REGISTER_NAME	ETHERNETn_frames_txed_128
OFFSET	0x120
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 128 to 255 byte frames transmitted without error

A 32-bit register counting the number of 128 to 255 byte frames successfully transmitted without error, i.e. no under run and not too many retries.

4.52. 256 To 511 Byte Frames Transmitted Register (ETHERNETn_frames_txed_256)

Description of 256 To 511 Byte Frames Transmitted register is shown.

REGISTER_NAME	ETHERNETn_frames_txed_256
OFFSET	0x124
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 256 to 511 byte frames transmitted without error

A 32-bit register counting the number of 256 to 511 byte frames successfully transmitted without error, i.e. no under run and not too many retries.

4.53. 512 To 1023 Byte Frames Transmitted Register (ETHERNETn_frames_txed_512)

Description of 512 To 1023 Byte Frames Transmitted register is shown.

REGISTER_NAME	ETHERNETn_frames_txed_512
OFFSET	0x128
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 512 to 1023 byte frames transmitted without error

A 32-bit register counting the number of 512 to 1023 byte frames successfully transmitted without error, i.e. no under run and not too many retries.

4.54. 1024 To 1518 Byte Frames Transmitted Register (ETHERNETn_frames_txed_1024)

Description of 1024 To 1518 Byte Frames Transmitted register is shown.

REGISTER_NAME	ETHERNETn_frames_txed_1024
OFFSET	0x12C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 1024 to 1518 byte frames transmitted without error

A 32-bit register counting the number of 1024 to 1518 byte frames successfully transmitted without error, i.e. no under run and not too many retries.

4.55. Greater Than 1518 Byte Frames Transmitted Register (ETHERNETn_frames_txed_1519)

Description of Greater Than 1518 Byte Frames Transmitted register is shown.

REGISTER_NAME	ETHERNETn_frames_txed_1519
OFFSET	0x130
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: Greater than 1518 Byte frames transmitted without error

A 32-bit register counting the number of 1518 or above byte frames successfully transmitted without error, i.e. no under run and not too many retries.

4.56. Transmit Under Runs Register (ETHERNETn_tx_underruns)

Description of Transmit Under Runs register is shown.

REGISTER_NAME	ETHERNETn_tx_underruns
OFFSET	0x134
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Transmit under runs

A 10-bit register counting the number of frames not transmitted due to a transmit under run. If this register is incremented then no other statistics register is incremented.

4.57. Single Collision Frames Register (ETHERNETn_single_collisions)

Description of Single Collision Frames register is shown.

REGISTER NAME	ETHERNETn_single_collisions
OFFSET	0x138
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved						count[17:16]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:18] Reserved

Always read "0". Writing has no effect.

[bit17:0] count: Single collision frames

An 18-bit register counting the number of frames experiencing a single collision before being successfully transmitted, i.e. no under run.

4.58. Multiple Collision Frames Register (ETHERNETn_multiple_collisions)

Description of Multiple Collision Frames register is shown.

REGISTER_NAME	ETHERNETn_multiple_collisions
OFFSET	0x13C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved						count[17:16]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:18] Reserved

Always read "0". Writing has no effect.

[bit17:0] count: Multiple collision frames

An 18-bit register counting the number of frames experiencing between two and fifteen collisions prior to being successfully transmitted, i.e. no under run and not too many retries.

4.59. Excessive Collisions Register (ETHERNETn_excessive_collisions)

Description of Excessive Collisions register is shown.

REGISTER_NAME	ETHERNETn_excessive_collisions
OFFSET	0x140
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Excessive collision frames

A 10-bit register counting the number of frames that failed to be transmitted because they experienced 16 collisions.

4.60. Late Collisions Register (ETHERNETn_late_collisions)

Description of Late Collisions register is shown.

REGISTER_NAME	ETHERNETn_late_collisions
OFFSET	0x144
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Late collision frames

A 10-bit register counting the number of late collision occurring after the slot time (512 bits) has expired. In 10/100 MBit/s mode, late collisions are counted twice i.e. both as a collision and a late collision.

4.61. Deferred Transmission Frames Register (ETHERNETn_deferred_frames)

Description of Deferred Transmission Frames register is shown.

REGISTER_NAME	ETHERNETn_deferred_frames
OFFSET	0x148
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved						count[17:16]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:18] Reserved

Always read "0". Writing has no effect.

[bit17:0] count: Deferred transmission frames

An 18-bit register counting the number of frames experiencing deferral due to carrier sense being active on their first attempt at transmission. Frames involved in any collision are not counted nor are frames that experienced a transmit under run.

4.62. Carrier Sense Errors Register (ETHERNETn_crs_errors)

Description of Carrier Sense Errors register is shown.

REGISTER_NAME	ETHERNETn_crs_errors
OFFSET	0x14C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Carrier sense errors

A 10-bit register counting the number of frames transmitted where carrier sense was not seen during transmission or where carrier sense was de-asserted after being asserted in a transmit frame without collision (no under run). Only incremented in half duplex mode. The only effect of a carrier sense error is to increment this register. The behaviour of the other statistics registers is unaffected by the detection of a carrier sense error.

4.63. Octets Receive Bottom Register (ETHERNETn_octets_rxed_bottom)

Description of Octets Receive [31:0] register is shown. When reading the Octets Receive registers, bits [31:0] (ETHERNETn_octets_rxed_bottom) should be read prior to bits [47:32] (ETHERNETn_octets_rxed_top) to ensure reliable operation.

REGISTER NAME	ETHERNETn_octets_rxed_bottom
OFFSET	0x150
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: Received octets in frame without errors [31:0]

The number of octets received in valid frames of any type. This counter is 48-bits, and is read through two registers (ETHERNETn_octets_rxed_top and ETHERNETn_octets_rxed_bottom). This count does not include octets from pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.64. Octets Receive TOP Register (ETHERNETn_octets_rxed_top)

Description of Octets Receive [47:32] register is shown. When reading the Octets Receive registers, bits [31:0] (ETHERNETn_octets_rxed_bottom) should be read prior to bits [47:32] (ETHERNETn_octets_rxed_top) to ensure reliable operation.

REGISTER_NAME	ETHERNETn_octets_rxed_top
OFFSET	0x154
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[47:40]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[39:32]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] count: Transmitted octets in frame without errors [47:32]

The number of octets received in valid frames of any type. This counter is 48-bits, and is read through two registers (ETHERNETn_octets_rxed_top and ETHERNETn_octets_rxed_bottom). This count does not include octets from pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.65. Frames Received Register (ETHERNETn_frames_rxed_ok)

Description of Frames Received register is shown.

REGISTER NAME	ETHERNETn_frames_rxed_ok
OFFSET	0x158
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: Frames received without error

A 32-bit register counting the number of frames successfully received. Excludes pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.66. Broadcast Frames Received Register (ETHERNETn_broadcast_rxd)

Description of Broadcast Frames Received register is shown.

REGISTER_NAME	ETHERNETn_broadcast_rxd
OFFSET	0x15C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: Broadcast frames received without error

A 32-bit register counting the number of broadcast frames successfully received without error. Excludes pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.67. Multicast Frames Received Register (ETHERNETn_multicast_rxed)

Description of Multicast Frames Received register is shown.

REGISTER_NAME	ETHERNETn_multicast_rxed
OFFSET	0x160
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: Multicast frames received without error

A 32-bit register counting the number of multicast frames successfully received without error. Excludes pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.68. Pause Frames Received Register (ETHERNETn_pause_frames_rxd)

Description of Pause Frames Received register is shown.

REGISTER_NAME	ETHERNETn_pause_frames_rxd
OFFSET	0x164
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] count: Received pause frames

A 16-bit register counting the number of pause frames received without error.

4.69. 64 Byte Frames Received Register (ETHERNETn_frames_rxed_64)

Description of 64 Byte Frames Received register is shown.

REGISTER NAME	ETHERNETn_frames_rxed_64
OFFSET	0x168
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 64 Byte frames received without error

A 32-bit register counting the number of 64 byte frames successfully received without error. Excludes pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.70. 65 To 127 Byte Frames Received Register (ETHERNETn_frames_rxed_65)

Description of 65 To 127 Byte Frames Received register is shown.

REGISTER_NAME	ETHERNETn_frames_rxed_65
OFFSET	0x16C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 65 to 127 Byte frames received without error

A 32-bit register counting the number of 65 to 127 byte frames successfully received without error. Excludes pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.71. 128 To 255 Byte Frames Received Register (ETHERNETn_frames_rxed_128)

Description of 128 To 255 Byte Frames Received register is shown.

REGISTER_NAME	ETHERNETn_frames_rxed_128
OFFSET	0x170
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 128 to 255 Byte frames received without error

A 32-bit register counting the number of 128 to 255 byte frames successfully received without error. Excludes pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.72. 256 To 511 Byte Frames Received Register (ETHERNETn_frames_rxed_256)

Description of 256 To 511 Byte Frames Received register is shown.

REGISTER_NAME	ETHERNETn_frames_rxed_256
OFFSET	0x174
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 256 to 511 Byte frames received without error

A 32-bit register counting the number of 256 to 511 byte frames successfully received without error. Excludes pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.73. 512 To 1023 Byte Frames Received Register (ETHERNETn_frames_rxed_512)

Description of 512 To 1023 Byte Frames Received register is shown.

REGISTER_NAME	ETHERNETn_frames_rxed_512
OFFSET	0x178
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 512 to 1023 Byte frames received without error

A 32-bit register counting the number of 512 to 1023 byte frames successfully received without error. Excludes pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.74. 1024 To 1518 Byte Frames Received Register (ETHERNETn_frames_rxed_1024)

Description of 1024 To 1518 Byte Frames Received register is shown.

REGISTER_NAME	ETHERNETn_frames_rxed_1024
OFFSET	0x17C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 1024 to 1518 Byte frames received without error

A 32-bit register counting the number of 1024 to 1518 byte frames successfully received without error. Excludes pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.75. Greater than 1518 Byte Frames Received Register (ETHERNETn_frames_rxed_1519)

Description of Greater than 1518 Byte Frames Received register is shown.

REGISTER_NAME	ETHERNETn_frames_rxed_1519
OFFSET	0x180
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	count[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] count: 1519 to maximum byte frames received without error

A 32-bit register counting the number of 1519 byte or above frames successfully received without error. Maximum frame size is determined by the Network Configuration register bit 8 (1536 maximum frame size) or bit 3 (jumbo frame size). Excludes pause frames, and is only incremented if the frame is successfully filtered and copied to memory.

4.76. Undersized Frames Received Register (ETHERNETn_undersized_frames)

Description of Undersized Frames Received register is shown.

REGISTER_NAME	ETHERNETn_undersized_frames
OFFSET	0x184
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Undersized frames received

A 10-bit register counting the number of frames received less than 64 bytes in length (10/100 MBit/s mode) that do not have either a CRC error or an alignment error.

4.77. Oversize Frames Received Register (ETHERNETn_excessive_rx_length)

Description of Oversize Frames Received register is shown.

REGISTER_NAME	ETHERNETn_excessive_rx_length
OFFSET	0x188
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Oversize frames received

A 10-bit register counting the number of frames received exceeding 1518 bytes (1536 bytes if bit 8 is set in Network Configuration register, 10240 bytes if bit 3 is set in the Network Configuration register) in length but do not have either a CRC error, an alignment error nor a receive symbol error.

4.78. Jabbers Received Register (ETHERNETn_rx_jabbers)

Description of Jabbers Received register is shown.

REGISTER_NAME	ETHERNETn_rx_jabbers
OFFSET	0x18C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Jabbers received

A 10-bit register counting the number of frames received exceeding 1518 bytes (1536 if bit 8 set in Network Configuration register, 10240 bytes if bit 3 is set in the Network Configuration register) in length and have either a CRC error, an alignment error or a receive symbol error.

4.79. Frame Check Sequence Errors Register (ETHERNETn_fcs_errors)

Description of Frame Check Sequence Errors register is shown.

REGISTER NAME	ETHERNETn_fcs_errors
OFFSET	0x190
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Frame check sequence errors

A 10-bit register counting frames that are an integral number of bytes, have bad CRC and are between 64 and 1518 bytes in length (1536 if bit 8 set in Network Configuration register, 10240 bytes if bit 3 is set in the Network Configuration register). This register is also incremented if a symbol error is detected and the frame is of valid length and has an integral number of bytes. This register is incremented for a frame with bad FCS, regardless of whether it is copied to memory due to ignore FCS mode being enabled in bit 26 of the Network Configuration register.

4.80. Length Field Frame Errors Register (ETHERNETn_rx_length_errors)

Description of Length Field Frame Errors register is shown.

REGISTER_NAME	ETHERNETn_rx_length_errors
OFFSET	0x194
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Length field frame errors

A 10-bit register counting frames received that have a measured length shorter than that extracted from the length field (bytes 13 and 14). This condition is only counted if the value of the length field is less than 0x0600 (1536), the frame is not of excessive length and checking is enabled through bit 16 of the Network Configuration register.

4.81. Receive Symbol_Errors Register (ETHERNETn_rx_symbol_errors)

Description of Receive Symbol_Errors register is shown.

REGISTER NAME	ETHERNETn_rx_symbol_errors
OFFSET	0x198
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Receive symbol errors

A 10-bit register counting the number of frames that had RX_ER asserted during reception. For 10/100 MBit/s mode symbol errors are counted regardless of frame length checks. Receive symbol errors will also be counted as an FCS or alignment error if the frame is between 64 and 1518 bytes (1536 bytes if bit 8 is set in the Network Configuration register, 10240 bytes if bit 3 is set in the Network Configuration register). If the frame is larger it will be recorded as a jabber error.

4.82. Alignment Errors Register (ETHERNETn_alignment_errors)

Description of Alignment Errors register is shown.

REGISTER_NAME	ETHERNETn_alignment_errors
OFFSET	0x19C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Alignment errors

A 10-bit register counting the number of frames that are not an integral number of bytes long and have bad CRC when their length is truncated to an integral number of bytes and are between 64 and 1518 bytes in length (1536 if bit 8 set in Network Configuration register, 10240 bytes if bit 3 is set in the Network Configuration register). This register is also incremented if a symbol error is detected and the frame is of valid length and does not have an integral number of bytes.

4.83. Receive Resource Errors Register (ETHERNETn_rx_resource_errors)

Description of Receive Resource Errors register is shown.

REGISTER_NAME	ETHERNETn_rx_resource_errors
OFFSET	0x1A0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved						count[17:16]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:18] Reserved

Always read "0". Writing has no effect.

[bit17:0] count: Receive resource errors

An 18-bit register counting the number of frames that were successfully received by the Ethernet MAC (correct address matched frame and adequate slot time) but could not be copied to memory because no receive buffer was available. This occurs when the Ethernet MAC reads a buffer descriptor with its ownership (or used) bit set.

4.84. Receive Over Runs Register (ETHERNETn_rx_overruns)

Description Receive Over Runs register is shown.

REGISTER_NAME	ETHERNETn_rx_overruns
OFFSET	0x1A4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						count[9:8]	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9:0] count: Receive over runs

A 10-bit register counting the number of frames that are address recognized but were not copied to memory due to a receive over run.

4.85. IP Header Checksum Errors Register (ETHERNETn_rx_ip_ck_errors)

Description of IP Header Checksum Errors register is shown.

REGISTER_NAME	ETHERNETn_rx_ip_ck_errors
OFFSET	0x1A8
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:8] Reserved

Always read "0". Writing has no effect.

[bit7:0] count: IP header checksum errors

An 8-bit register counting the number of frames discarded due to an incorrect IP header checksum, but are between 64 and 1518 bytes (1536 bytes if bit 8 is set in the Network Configuration register or 10240 bytes if bit 3 is in the Network Configuration register) and do not have a CRC error, an alignment error, nor a symbol error.

4.86. TCP Checksum Errors Register (ETHERNETn_rx_tcp_ck_errors)

Description of TCP Checksum Errors register is shown.

REGISTER_NAME	ETHERNETn_rx_tcp_ck_errors
OFFSET	0x1AC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:8] Reserved

Always read "0". Writing has no effect.

[bit7:0] count: TCP checksum errors

An 8-bit register counting the number of frames discarded due to an incorrect TCP checksum, but are between 64 and 1518 bytes (1536 bytes if bit 8 is set in the Network Configuration register or 10240 bytes if bit 3 is in the Network Configuration register) and do not have a CRC error, an alignment error, nor a symbol error.

4.87. UDP Checksum Errors Register (ETHERNETn_rx_udp_ck_errors)

Description of UDP Checksum Errors register is shown.

REGISTER NAME	ETHERNETn_rx_udp_ck_errors
OFFSET	0x1B0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:8] Reserved

Always read "0". Writing has no effect.

[bit7:0] count: UDP checksum errors

An 8-bit register counting the number of frames discarded due to an incorrect UDP checksum, but are between 64 and 1518 bytes (1536 bytes if bit 8 is set in the Network Configuration register or 10240 bytes if bit 3 is in the Network Configuration register) and do not have a CRC error, an alignment error, nor a symbol error.

4.88. Receive DMA Flushed Packets Register (ETHERNETn_auto_flushed_pkts)

Description of Receive DMA Flushed Packets register is shown.

REGISTER_NAME	ETHERNETn_auto_flushed_pkts
OFFSET	0x1B4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] count: Flushed RX packets counter

A 16-bit register counting the number of frames that have been flushed from the receive SRAM based RX Packet Buffer Memory due to one of the following reasons:

1. When partial store and forward mode is enabled or bit 24 of the DMA Configuration register is enabled, a packet is received while there is no AMBA AXI resource.
2. When partial store and forward mode is enabled and an AMBA AXI error is encountered while writing the packet data to system memory. When bit 18 of the Network Control register (software action to flush a packet from the head of the PBUF queue) is pulsed and the Ethernet MAC DMA is not currently busy.

4.89. IEEE 1588 Timer Increment Sub Nanoseconds Register (ETHERNETn_tsu_timer_incr_sub_nsec)

Description of IEEE 1588 Timer Increment Sub Nanoseconds register is shown. This register must be written before the IEEE 1588 Timer Increment register. And the value written will not take effect until the IEEE 1588 Timer Increment register is written to.

REGISTER NAME	ETHERNETn_tsu_timer_incr_sub_nsec
OFFSET	0x1BC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Count[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:24] Count[7:0]: IEEE 1588 Timer Increment [7:0]

These are the least significant bits of the sub-ns value by which the IEEE 1588 Timer will be incremented each clock cycle.

[bit23:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] count[23:8]: IEEE 1588 Timer Increment [15:0]

These are the most significant bits of the sub-ns value by which the IEEE 1588 Timer will be incremented each clock cycle. 24 bits of sub-nanosecond precision give a resolution of approximately 5.86E-17 seconds (16 bits give 15.2E-15 sec).

4.90. IEEE 1588 Timer Seconds [47:32] Register (ETHERNETn_tsu_timer_msb_sec)

Description of IEEE 1588 Timer Seconds [47:32] register is shown.

REGISTER_NAME	ETHERNETn_tsu_timer_msb_sec
OFFSET	0x1C0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] timer: IEEE 1588 Timer Seconds [47:32]

IEEE 1588 Timer value (s). Most significant 16 bits of seconds timer count. The register is writeable.

The 48-bit counter increments by one when the IEEE 1588 Timer nanoseconds counter counts to one second. It may also be incremented or decremented when the IEEE 1588 Timer Adjust register is written (if decremented from zero the 48-bit combined count would roll back to 0xFFFFFFFFFFFF).

Note: The value of this register is used only when the lower 32-bit register is written to. This is to ensure a single update of the 48-bit seconds value.

4.91. IEEE 1588 Timer Seconds [31:0] Register (ETHERNETn_tsu_timer_sec)

Description of IEEE 1588 Timer Seconds [31:0] register is shown.

REGISTER_NAME	ETHERNETn_tsu_timer_sec
OFFSET	0x1D0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	timer[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	timer[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] timer: IEEE 1588 Timer Seconds [31:0]

IEEE 1588 Timer value (s). Least significant 32 bits of seconds timer count. This register is writeable. The 48-bit counter increments by one when the IEEE 1588 Timer Nanoseconds counter counts to one second. It may also be incremented or decremented when the IEEE 1588 Timer Adjust register is written (if decremented from zero the 48-bit combined count would roll back to 0xFFFFFFFFFFFF).

4.92. IEEE 1588 Timer Nanoseconds Register (ETHERNETn_tsu_timer_nsec)

Description of IEEE 1588 Timer Nanoseconds register is shown.

REGISTER_NAME	ETHERNETn_tsu_timer_nsec
OFFSET	0x1D4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		timer[29:24]					
ACCESS_TYPE	R0,WX		R/W					
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0x00					

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	timer[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29:0] timer: IEEE 1588 Timer nanoseconds

This register is writeable. It can also be adjusted by writes to the IEEE 1588 Timer Adjust register. It increments by the value of the IEEE 1588 Timer Increment register each clock cycle (if this register is close to zero and a write to the IEEE 1588 Timer Adjust register causes a decrement the seconds register will be decremented if necessary and the nanoseconds register will roll back to 9999999xx(dec)).

4.93. IEEE 1588 Timer Adjust Register (ETHERNETn_tsu_timer_adjust)

Description of IEEE 1588 Timer Adjust register is shown.

REGISTER NAME	ETHERNETn_tsu_timer_adjust
OFFSET	0x1D8
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	add_subtract	Reserved	increment_value[29:24]					
ACCESS_TYPE	R0,W	R0,WX	R0,W					
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0x00					

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	increment_value[23:16]							
ACCESS_TYPE	R0,W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	increment_value[15:8]							
ACCESS_TYPE	R0,W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	increment_value[7:0]							
ACCESS_TYPE	R0,W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31] add_subtract:

Write as "1" to subtract from the IEEE 1588 Timer. Write as "0" to add to it.

[bit30] Reserved

Always read "0". Writing has no effect.

[bit29:0] increment_value: IEEE 1588 Timer increment value

The number of nanoseconds to increment or decrement the IEEE 1588 Timer Nanoseconds register. If necessary the IEEE 1588 Timer Seconds register will be incremented or decremented.

4.94. IEEE 1588 Timer Increment Register (ETHERNETn_tsu_timer_incr)

Description of IEEE 1588 Timer Increment register is shown.

REGISTER_NAME	ETHERNETn_tsu_timer_incr
OFFSET	0x1DC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	num_incs[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	alt_count[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:24] Reserved

Always read "0". Writing has no effect.

[bit23:16] num_incs: Number of incs before alt inc

The number of increments after which the alternative increment is used.

[bit15:8] alt_count: Alternative count of nanoseconds

Alternative count of nanoseconds by which the IEEE 1588 Timer Nanoseconds register will be incremented each clock cycle.

[bit7:0] count[31:24]: Count of nanoseconds

A count of nanoseconds by which the IEEE 1588 Timer Nanoseconds register will be incremented each clock cycle. These are the most significant 8 bits of the 32-bit Timer increment counter. The IEEE 1588 Timer Increment Sub Nanoseconds register hold the least significant 24 bits of the increment.

4.95. PTP Event Frame Transmitted Seconds [31:0] Register (ETHERNETn_tsu_ptp_tx_sec)

Description of PTP Event Frame Transmitted Seconds [31:0] register is shown.

REGISTER_NAME	ETHERNETn_tsu_ptp_tx_sec
OFFSET	0x1E0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	timer[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	timer[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] timer: PTP Event Frame Transmitted Seconds [31:0]

The register is updated with the value that the IEEE 1588 Timer Nanoseconds register held when the SFD of a PTP transmit primary event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Sync or Delay_Req frame. An interrupt is issued when the register is updated.

4.96. PTP Event Frame Transmitted Nanoseconds Register (ETHERNETn_tsu_ptp_tx_nsec)

Description of PTP Event Frame Transmitted Nanoseconds register is shown.

REGISTER_NAME	ETHERNETn_tsu_ptp_tx_nsec
OFFSET	0x1E4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		timer[29:24]					
ACCESS_TYPE	R0,WX		R,WX					
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0x00					

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	timer[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29:0] timer: PTP Event Frame Transmitted Nanoseconds

The register is updated with the value that the IEEE 1588 Timer Nanoseconds register held when the SFD of a PTP transmit primary event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Sync or Delay_Req frame. An interrupt is issued when the register is updated.

4.97. PTP Event Frame Received Seconds [31:0] Register (ETHERNETn_tsu_ptp_rx_sec)

Description of PTP Event Frame Received Seconds [31:0] register is shown.

REGISTER_NAME	ETHERNETn_tsu_ptp_rx_sec
OFFSET	0x1E8
ACCESS_SIZE	W
MULTIPLE	1
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	timer[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	timer[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] timer: PTP Event Frame Received Seconds [31:0]

The register is updated with the value that the IEEE 1588 Timer Nanoseconds register held when the SFD of a PTP receive primary event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Sync or Delay_Req frame. An interrupt is issued when the register is updated.

4.98. PTP Event Frame Received Nanoseconds Register (ETHERNETn_tsu_ptp_rx_nsec)

Description of PTP Event Frame Received Nanoseconds register is shown.

REGISTER_NAME	ETHERNETn_tsu_ptp_rx_nsec
OFFSET	0x1EC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		timer[29:24]					
ACCESS_TYPE	R0,WX		R,WX					
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0x00					

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	timer[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29:0] timer: PTP Event Frame Received Nanoseconds

The register is updated with the value that the IEEE 1588 Timer Nanoseconds register held when the SFD of a PTP receive primary event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Sync or Delay_Req frame. An interrupt is issued when the register is updated.

4.99. PTP Peer Event Frame Transmitted Seconds [31:0] Register (ETHERNETn_tsu_peer_tx_sec)

Description of PTP Peer Event Frame Transmitted Seconds [31:0] register is shown.

REGISTER_NAME	ETHERNETn_tsu_peer_tx_sec
OFFSET	0x1F0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	timer[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	timer[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] timer: PTP Peer Event Frame Transmitted Seconds [31:0]

The register is updated with the value that the IEEE 1588 Timer Nanoseconds register held when the SFD of a PTP transmit peer event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Pdelay_Req or Pdelay_Resp frame. An interrupt is issued when the register is updated.

4.100. PTP Peer Event Frame Transmitted Nanoseconds Register (ETHERNETn_tsu_peer_tx_nsec)

Description of PTP Peer Event Frame Transmitted Nanoseconds register is shown.

REGISTER_NAME	ETHERNETn_tsu_peer_tx_nsec
OFFSET	0x1F4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		timer[29:24]					
ACCESS_TYPE	R0,WX		R,WX					
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0x00					

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	timer[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29:0] timer: PTP Peer Event Frame Transmitted Nanoseconds

The register is updated with the value that the IEEE 1588 Timer Nanoseconds register held when the SFD of a PTP transmit peer event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Pdelay_Req or Pdelay_Resp frame. An interrupt is issued when the register is updated.

4.101. PTP Peer Event Frame Received Seconds [31:0] Register (ETHERNETn_tsu_peer_rx_sec)

Description of PTP Peer Event Frame Received Seconds [31:0] register is shown.

REGISTER_NAME	ETHERNETn_tsu_peer_rx_sec
OFFSET	0x1F8
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	timer[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	timer[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] timer: PTP Peer Event Frame Received Seconds [31:0]

The register is updated with the value that the IEEE 1588 Timer Seconds register held when the SFD of a PTP receive peer event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Pdelay_Req or Pdelay_Resp frame. An interrupt is issued when the register is updated.

4.102. PTP Peer Event Frame Received Nanoseconds Register (ETHERNETn_tsu_peer_rx_nsec)

Description of PTP Peer Event Frame Received Nanoseconds register is shown.

REGISTER_NAME	ETHERNETn_tsu_peer_rx_nsec
OFFSET	0x1FC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		timer[29:24]					
ACCESS_TYPE	R0,WX		R,WX					
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0x00					

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	timer[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	timer[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	timer[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29:0] timer: PTP Peer Event Frame Received Nanoseconds

The register is updated with the value that the IEEE 1588 Timer Nanoseconds register held when the SFD of a PTP receive peer event crosses the MII interface. The actual update occurs when the Ethernet MAC recognizes the frame as a PTP Pdelay_Req or Pdelay_Resp frame. An interrupt is issued when the register is updated.

4.103. Transmit Pause Quantum 1 Register (ETHERNETn_tx_pause_quantum1)

Description of Transmit Pause Quantum 1 register is shown.

REGISTER_NAME	ETHERNETn_tx_pause_quantum1
OFFSET	0x260
ACCESS_SIZE	W
MULTIPLE	1:3
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	quantum_p3[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	quantum_p3[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	quantum_p2[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	quantum_p2[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

[bit31:16] quantum_p3: Transmit pause quantum prio 3

Written with the pause quantum value for pause frame transmission of priority 3.

[bit15:0] quantum_p2: Transmit pause quantum prio 2

Written with the pause quantum value for pause frame transmission of priority 2.

4.104. Transmit Pause Quantum 2 Register (ETHERNETn_tx_pause_quantum2)

Description of Transmit Pause Quantum 2 register is shown.

REGISTER_NAME	ETHERNETn_tx_pause_quantum2
OFFSET	0x264
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	quantum_p5[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	quantum_p5[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	quantum_p4[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	quantum_p4[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

[bit31:16] quantum_p5: Transmit pause quantum prio 5

Written with the pause quantum value for pause frame transmission of priority 5.

[bit15:0] quantum_p4: Transmit pause quantum prio 4

Written with the pause quantum value for pause frame transmission of priority 4.

4.105. Transmit Pause Quantum 3 Register (ETHERNETn_tx_pause_quantum3)

Description of Transmit Pause Quantum 3 register is shown.

REGISTER_NAME	ETHERNETn_tx_pause_quantum3
OFFSET	0x268
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	quantum_p7[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	quantum_p7[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	quantum_p6[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	quantum_p6[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xFF							

[bit31:16] quantum_p7: Transmit pause quantum prio 7

Written with the pause quantum value for pause frame transmission of priority 7.

[bit15:0] quantum_p6: Transmit pause quantum prio 6

Written with the pause quantum value for pause frame transmission of priority 6.

4.106. Receive LPI Transitions Register (ETHERNETn_rx_lpi)

Description of Receive LPI Transitions register is shown.

REGISTER_NAME	ETHERNETn_rx_lpi
OFFSET	0x270
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] count: Count of RX LPI transitions

A count of the number of times there is a transition from receiving normal idle to receiving low power idle. Cleared on read.

4.107. Received LPI Time Register (ETHERNETn_rx_lpi_time)

Description of Received LPI Time register is shown.

REGISTER NAME	ETHERNETn_rx_lpi_time
OFFSET	0x274
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	lpi_time[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	lpi_time[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	lpi_time[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:24] Reserved

Always read "0". Writing has no effect.

[bit23:0] lpi_time: Time in LPI

This register increments once every 16 clock cycles when the LPI Indication bit 7 is set in the Network Status register. Cleared on read.

4.108. Transmit LPI Transitions Register (ETHERNETn_tx_lpi)

Description of Transmit LPI Transitions register is shown.

REGISTER_NAME	ETHERNETn_tx_lpi
OFFSET	0x278
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	count[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	count[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] count: Count of TX LPI transitions

A count of the number of times the Enable LPI transmission bit 19 goes from low to high in the Network Control register.

4.109. Transmit LPI Time Register (ETHERNETn_tx_lpi_time)

Description of Transmit LPI Time register is shown.

REGISTER NAME	ETHERNETn_tx_lpi_time
OFFSET	0x27C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	lpi_time[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	lpi_time[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	lpi_time[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:24] Reserved

Always read "0". Writing has no effect.

[bit23:0] lpi_time: Time in LPI

This register increments once every 16 clock cycles when the Enable LPI transmission bit 19 is set in the Network Control register. Cleared on read.

4.110. Design Configuration 3 Register (ETHERNETn_designcfg_debug3)

Description of Design Configuration 3 register is shown.

REGISTER_NAME	ETHERNETn_designcfg_debug3
OFFSET	0x288
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		num_spec_add_filters					
ACCESS_TYPE	R0,WX		R,WX					
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0x04					

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29:24] num_spec_add_filters:

Takes the value of `num\_spec\_add\_filters`. Writing has no effect.

[bit23:0] Reserved

Always read "0". Writing has no effect.

4.111. Design Configuration 4 Register (ETHERNETn_designcfg_debug4)

Description of Design Configuration 4 register is shown.

REGISTER_NAME	ETHERNETn_designcfg_debug4
OFFSET	0x28C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] Reserved

Always read "0". Writing has no effect.

4.112. Design Configuration 5 Register (ETHERNETn_designcfg_debug5)

Description of Design Configuration 5 register is shown.

REGISTER_NAME	ETHERNETn_designcfg_debug5
OFFSET	0x290
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	axi_prot_value			tsu_clk	rx_buffer_length_def[7:4]			
ACCESS_TYPE	R,WX			R,WX	R,WX			
PROT_TYPE	Wp							
INITIAL_VALUE	0x2			0	0xF			

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	rx_buffer_length_def[3:0]				tx_pbuf_size_def	rx_pbuf_size_def		endian_swap_def[1]
ACCESS_TYPE	R,WX				R,WX	R,WX		R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0x0				1	0x3		0

BIT OFFSET	15	14	13	12	11	10	9	8
BIT NAME	endian_swap_def[0]	mdc_clock_div			dma_bus_width_def		phy_ident	tsu
ACCESS TYPE	R,WX	R,WX			R,WX		R,WX	R,WX
PROT TYPE	Wp							
INITIAL VALUE	0	0x2			0x1		0	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	tx_fifo_cnt_width				rx_fifo_cnt_width			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE					Wp			
INITIAL_VALUE	0x4				0x4			

[bit31:29] axi_prot_value:

Takes the value of `gem\_axi\_prot\_value`. Writing has no effect.

[bit28] tsu_clk:

Takes the value of `gem\_tsu\_clk`. Writing has no effect.

[bit27:20] rx_buffer_length_def:

Takes the value of `gem\_rx\_buffer\_length\_def`. Writing has no effect.

[bit19] tx_pbuf_size_def:

Takes the value of `gem\_tx\_pbuf\_size\_def`. Writing has no effect.

[bit18:17] rx_pbuf_size_def:

Takes the value of `gem\_rx\_pbuf\_size\_def`. Writing has no effect.

[bit16:15] endian_swap_def:

Takes the value of `gem\_endian\_swap\_def`. Writing has no effect.

[bit14:12] mdc_clock_div:

Takes the value of `gem\_mdc\_clock\_div`. Writing has no effect.

[bit11:10] dma_bus_width_def:

Takes the value of ``gem_dma_bus_width_def`. Writing has no effect.

[bit9] phy_ident:

Takes the value of ``gem_phy_ident`. Writing has no effect.

[bit8] tsu:

Takes the value of ``gem_tsu`. Writing has no effect.

[bit7:4] tx_fifo_cnt_width:

Takes the value of ``gem_tx_fifo_cnt_width`. Writing has no effect.

[bit3:0] rx_fifo_cnt_width:

Takes the value of ``gem_rx_fifo_cnt_width`. Writing has no effect.

4.113. Design Configuration 6 Register (ETHERNETn_designcfg_debug6)

Description of Design Configuration 6 register is shown.

REGISTER_NAME	ETHERNETn_designcfg_debug6
OFFSET	0x294
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved				pbuf_iso	pbuf_rsc	pbuf_cutthru	pfc_multi_quantum
ACCESS_TYPE	R0,WX				R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	(product specification)				0	0	1	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dma_addr_width_is_64b	host_if_soft_select	tx_add_fifo_if	ext_tsu_timer	tx_pbuf_queue_segment_size			
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX			
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0x2			

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dma_priority_queue15	dma_priority_queue14	dma_priority_queue13	dma_priority_queue12	dma_priority_queue11	dma_priority_queue10	dma_priority_queue9	dma_priority_queue8
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_priority_queue7	dma_priority_queue6	dma_priority_queue5	dma_priority_queue4	dma_priority_queue3	dma_priority_queue2	dma_priority_queue1	Reserved
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R0,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	1	1	1	0

[bit31:28] Reserved:

Always read "0". Writing has no effect.

[bit27] pbuf_iso

Takes the value of `gem\_pbuf\_iso`

[bit26] pbuf_rsc

Takes the value of `gem\_pbuf\_rsc`

[bit25] pbuf_cutthru:

Takes the value of `gem\_pbuf\_cutthru`. Writing has no effect.

[bit24] pfc_multi_quantum:

Takes the value of `gem\_pfc\_multi\_quantum`. Writing has no effect.

[bit23] dma_addr_width_is_64b:

Takes the value of `gem\_dma\_addr\_width\_is\_64b`. Writing has no effect.

[bit22] host_if_soft_select:

Takes the value of `gem_host_if_soft_select. Writing has no effect.

[bit21] tx_add_fifo_if:

Takes the value of `gem_tx_add_fifo_if. Writing has no effect.

[bit20] ext_tsu_timer:

Takes the value of `gem_ext_tsu_timer. Writing has no effect.

[bit19:16] tx_pbuf_queue_segment_size:

Takes the value of `gem_tx_pbuf_queue_segment_size. Writing has no effect.

[bit15] dma_priority_queue15:

Takes the value of `gem_dma_priority_queue15. Writing has no effect.

[bit14] dma_priority_queue14:

Takes the value of `gem_dma_priority_queue14. Writing has no effect.

[bit13] dma_priority_queue13:

Takes the value of `gem_dma_priority_queue13. Writing has no effect.

[bit12] dma_priority_queue12:

Takes the value of `gem_dma_priority_queue12. Writing has no effect.

[bit11] dma_priority_queue11:

Takes the value of `gem_dma_priority_queue11. Writing has no effect.

[bit10] dma_priority_queue10:

Takes the value of `gem_dma_priority_queue10. Writing has no effect.

[bit9] dma_priority_queue9:

Takes the value of `gem_dma_priority_queue9. Writing has no effect.

[bit8] dma_priority_queue8:

Takes the value of `gem_dma_priority_queue8. Writing has no effect.

[bit7] dma_priority_queue7:

Takes the value of `gem_dma_priority_queue7. Writing has no effect.

[bit6] dma_priority_queue6:

Takes the value of `gem_dma_priority_queue6. Writing has no effect.

[bit5] dma_priority_queue5:

Takes the value of `gem_dma_priority_queue5. Writing has no effect.

[bit4] dma_priority_queue4:

Takes the value of `gem_dma_priority_queue4. Writing has no effect.

[bit3] dma_priority_queue3:

Takes the value of `gem_dma_priority_queue3. Writing has no effect.

[bit2] dma_priority_queue2:

Takes the value of `gem_dma_priority_queue2. Writing has no effect.

[bit1] dma_priority_queue1:

Takes the value of `gem_dma_priority_queue1. Writing has no effect.

[bit0] Reserved:

Always read "0". Writing has no effect.

4.114. Design Configuration 7 Register (ETHERNETn_designcfg_debug7)

Description of Design Configuration 7 register is shown.

REGISTER_NAME	ETHERNETn_designcfg_debug7
OFFSET	0x298
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	tx_pbuf_num_segments_q7				tx_pbuf_num_segments_q6			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE					Wp			
INITIAL_VALUE	0x0				0x0			

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	tx_pbuf_num_segments_q5				tx_pbuf_num_segments_q4			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE					Wp			
INITIAL_VALUE	0x0				0x0			

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	tx_pbuf_num_segments_q3				tx_pbuf_num_segments_q2			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE					Wp			
INITIAL_VALUE	0x0				0x0			

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	tx_pbuf_num_segments_q1				tx_pbuf_num_segments_q0			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE					Wp			
INITIAL_VALUE	0x0				0x0			

[bit31:28] tx_pbuf_num_segments_q7:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q7`. Writing has no effect.

[bit27:24] tx_pbuf_num_segments_q6:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q6`. Writing has no effect.

[bit23:20] tx_pbuf_num_segments_q5:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q5`. Writing has no effect.

[bit19:16] tx_pbuf_num_segments_q4:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q4`. Writing has no effect.

[bit15:12] tx_pbuf_num_segments_q3:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q3`. Writing has no effect.

[bit11:8] tx_pbuf_num_segments_q2:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q2`. Writing has no effect.

[bit7:4] tx_pbuf_num_segments_q1:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q1`. Writing has no effect.

[bit3:0] tx_pbuf_num_segments_q0:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q0`. Writing has no effect.

4.115. Design Configuration 8 Register (ETHERNETn_designcfg_debug8)

Description of Design Configuration 8 register is shown.

REGISTER_NAME	ETHERNETn_designcfg_debug8
OFFSET	0x29C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	num_type1_sscreeners							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x10							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	num_type2_sscreeners							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x10							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	num_scr2_ethtype_regs							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x08							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	num_scr2_compare_regs							
ACCESS_TYPE	R,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x20							

[bit31:24] num_type1_sscreeners:

Takes the value of `gem_num_type1_sscreeners. Writing has no effect.

[bit23:16] num_type2_sscreeners:

Takes the value of `gem_num_type2_sscreeners. Writing has no effect.

[bit15:8] num_scr2_ethtype_regs:

Takes the value of `gem_num_scr2_ethtype_regs. Writing has no effect.

[bit7:0] num_scr2_compare_regs:

Takes the value of `gem_num_scr2_compare_regs. Writing has no effect.

4.116. Design Configuration 9 Register (ETHERNETn_designcfg_debug9)

Description of Design Configuration 9 register is shown.

REGISTER_NAME	ETHERNETn_designcfg_debug9
OFFSET	0x2A0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	tx_pbuf_num_segments_q15				tx_pbuf_num_segments_q14			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE					Wp			
INITIAL_VALUE	0x0				0x0			

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	tx_pbuf_num_segments_q13				tx_pbuf_num_segments_q12			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE					Wp			
INITIAL_VALUE	0x0				0x0			

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	tx_pbuf_num_segments_q11				tx_pbuf_num_segments_q10			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE					Wp			
INITIAL_VALUE	0x0				0x0			

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	tx_pbuf_num_segments_q9				tx_pbuf_num_segments_q8			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE					Wp			
INITIAL_VALUE	0x0				0x0			

[bit31:28] tx_pbuf_num_segments_q15:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q15`. Writing has no effect.

[bit27:24] tx_pbuf_num_segments_q14:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q14`. Writing has no effect.

[bit23:20] tx_pbuf_num_segments_q13:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q13`. Writing has no effect.

[bit19:16] tx_pbuf_num_segments_q12:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q12`. Writing has no effect.

[bit15:12] tx_pbuf_num_segments_q11:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q11`. Writing has no effect.

[bit11:8] tx_pbuf_num_segments_q10:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q10`. Writing has no effect.

[bit7:4] tx_pbuf_num_segments_q9:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q9`. Writing has no effect.

[bit3:0] tx_pbuf_num_segments_q8:

Takes the value of `gem\_tx\_pbuf\_num\_segments\_q8`. Writing has no effect.

4.117. Design Configuration 10 Register (ETHERNETn_designcfg_debug10)

Description of Design Configuration 10 register is shown.

REGISTER_NAME	ETHERNETn_designcfg_debug10
OFFSET	0x2A4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	emac bus width				tx pbuf data			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE	Wp							
INITIAL_VALUE	0x2				0x2			

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	rx pbuf data				axi access pipeline bits			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE	Wp							
INITIAL_VALUE	0x2				0x4			

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	axi tx_desc_rd_buff_bits				axi_rx_desc_rd_buff_bits			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE	Wp							
INITIAL_VALUE	0x4				0x4			

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	axi tx_desc_wr_buff_bits				axi rx_desc_wr_buff_bits			
ACCESS_TYPE	R,WX				R,WX			
PROT_TYPE	Wp							
INITIAL_VALUE	0x4				0x4			

[bit31:28] emac_bus_width:

Takes the value of `gem\_emac\_bus\_width`. Writing has no effect.

[bit27:24] tx_pbuf_data:

Takes the value of `gem\_tx\_pbuf\_data`. Writing has no effect.

[bit23:20] rx_pbuf_data:

Takes the value of `gem\_rx\_pbuf\_data`. Writing has no effect.

[bit19:16] axi_access_pipeline_bits:

Takes the value of `gem\_axi\_access\_pipeline\_bits`. Writing has no effect.

[bit15:12] axi_tx_desc_rd_buff_bits:

Takes the value of `gem\_axi\_tx\_desc\_rd\_buff\_bits`. Writing has no effect.

[bit11:8] axi_rx_desc_rd_buff_bits:

Takes the value of `gem\_axi\_rx\_desc\_rd\_buff\_bits`. Writing has no effect.

[bit7:4] axi_tx_desc_wr_buff_bits:

Takes the value of `gem\_axi\_tx\_desc\_wr\_buff\_bits`. Writing has no effect.

[bit3:0] axi_rx_desc_wr_buff_bits:

Takes the value of `gem\_axi\_rx\_desc\_wr\_buff\_bits`. Writing has no effect.

4.118. Interrupt Status Queue i Register (ETHERNETn_int_status_qi) (i=1 to 3)

Description of Interrupt Status Queue i register is shown.

REGISTER_NAME	ETHERNETn_int_status_qi
OFFSET	(0x400 + ((i-1)*0x4))
ACCESS_SIZE	W
MULTIPLE	1:3
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved				resp_not_o k	receive_ove rrun	Reserved	
ACCESS_TYPE	R0,WX				R/W	R/W	R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x0				0	0	0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	transmit_complete	amba_error	retry_limit_exceeded_or_late_collision	Reserved		rx_used_bit_read	receive_complete	Reserved
ACCESS_TYPE	R/W	R/W	R/W	R0,WX		R/W	R/W	R0,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0x0		0	0	0

[bit31:12] Reserved

Always read "0". Writing has no effect.

[bit11] resp_not_ok: BRESP not OK

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when the DMA block sees BRESP not OK.

[bit10] receive_overrun: Receive over run

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when the receive over run status bit (ETHERNETn_receive_status[2]) gets set.

[bit9:8] Reserved

Always read "0". Writing has no effect.

[bit7] transmit_complete: Transmit complete

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when when a frame has been transmitted.

[bit6] amba_error: Transmit frame corruption due to AMBA AXI error

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set if an error occurs whilst midway through reading transmit frame from system memory, including BRESP errors and buffers exhausted mid frame.

[bit5] retry_limit_exceeded_or_late_collision: Retry limit exceeded

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Transmit error.

[bit4:3] Reserved

Always read "0". Writing has no effect.

[bit2] rx_used_bit_read: RX used bit read

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when a receive buffer descriptor is read with its used bit set.

[bit1] receive_complete: Receive complete

Bit	Description
0	Interrupt de-asserted.
1	Interrupt asserted. Set when a frame has been stored in memory.

[bit0] Reserved

Always read "0". Writing has no effect.

4.119. TX Buffer Queue 1 Base Address Register (ETHERNETn_transmit_q1_ptr)

This register holds the start address of the transmit buffer queue 1 (transmit buffers descriptor list). The transmit buffer queue base address register must be initialized before transmit is started through bit 9 of the Network Control register. Once transmission has started, any write to the TX Buffer Queue 1 Base Address register is illegal and therefore ignored. Note that due to clock boundary synchronization, it takes a maximum of four clock cycles from the writing of the transmit start bit before the transmitter is active. Writing to the TX Buffer Queue 1 Base Address register during this time may produce unpredictable results. Reading this register returns the location of the descriptor currently being accessed. Since the DMA handles two frames at once, this may not necessarily be pointing to the current frame being transmitted. In terms of AMBA AXI operation, the transmit descriptors are written to memory using a single 32-bit AXI access. Since the datapath is 64-bit wide, the transmit descriptors shall be aligned at 64-bit boundaries and each pair of 32-bit descriptors is read from memory using a single 64-bit AXI access.

REGISTER_NAME	ETHERNETn_transmit_q1_ptr
OFFSET	0x440
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dma_tx_q_ptr[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dma_tx_q_ptr[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dma_tx_q_ptr[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_tx_q_ptr[7:2]						Reserved	
ACCESS_TYPE	R/W						R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

[bit31:2] dma_tx_q_ptr: Transmit buffer queue base address

Start address of transmit buffer queue.

[bit1:0] Reserved

Always read "0". Writing has no effect.

4.120. TX Buffer Queue 2 Base Address Register (ETHERNETn_transmit_q2_ptr)

This register holds the start address of the transmit buffer queue 2 (transmit buffers descriptor list). The transmit buffer queue base address register must be initialized before transmit is started through bit 9 of the Network Control register. Once transmission has started, any write to the TX Buffer Queue 2 Base Address register is illegal and therefore ignored. Note that due to clock boundary synchronization, it takes a maximum of four clock cycles from the writing of the transmit start bit before the transmitter is active. Writing to the TX Buffer Queue 2 Base Address register during this time may produce unpredictable results. Reading this register returns the location of the descriptor currently being accessed. Since the DMA handles two frames at once, this may not necessarily be pointing to the current frame being transmitted. In terms of AMBA AXI operation, the transmit descriptors are written to memory using a single 32-bit AXI access. Since the datapath is 64-bit wide, the transmit descriptors shall be aligned at 64-bit boundaries and each pair of 32-bit descriptors is read from memory using a single 64-bit AXI access.

REGISTER_NAME	ETHERNETn_transmit_q2_ptr
OFFSET	0x444
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dma_tx_q_ptr[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dma_tx_q_ptr[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dma_tx_q_ptr[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_tx_q_ptr[7:2]						Reserved	
ACCESS_TYPE	R/W						R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

[bit31:2] dma_tx_q_ptr: Transmit buffer queue base address

Start address of transmit buffer queue.

[bit1:0] Reserved

Always read "0". Writing has no effect.

4.121. TX Buffer Queue 3 Base Address Register (ETHERNETn_transmit_q3_ptr)

This register holds the start address of the transmit buffer queue 3 (transmit buffers descriptor list). The transmit buffer queue base address register must be initialized before transmit is started through bit 9 of the Network Control register. Once transmission has started, any write to the TX Buffer Queue 3 Base Address register is illegal and therefore ignored. Note that due to clock boundary synchronization, it takes a maximum of four clock cycles from the writing of the transmit start bit before the transmitter is active. Writing to the TX Buffer Queue 3 Base Address register during this time may produce unpredictable results. Reading this register returns the location of the descriptor currently being accessed. Since the DMA handles two frames at once, this may not necessarily be pointing to the current frame being transmitted. In terms of AMBA AXI operation, the transmit descriptors are written to memory using a single 32-bit AXI access. Since the datapath is 64-bit wide, the transmit descriptors shall be aligned at 64-bit boundaries and each pair of 32-bit descriptors is read from memory using a single 64-bit AXI access.

REGISTER_NAME	ETHERNETn_transmit_q3_ptr
OFFSET	0x448
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dma_tx_q_ptr[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dma_tx_q_ptr[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dma_tx_q_ptr[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_tx_q_ptr[7:2]						Reserved	
ACCESS_TYPE	R/W						R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

[bit31:2] dma_tx_q_ptr: Transmit buffer queue base address

Start address of transmit buffer queue.

[bit1:0] Reserved

Always read "0". Writing has no effect.

4.122. RX Buffer Queue 1 Base Address Register (ETHERNETn_receive_q1_ptr)

This register holds the start address of the receive buffer queue 1 (receive buffers descriptor list). The RX Buffer Queue 1 Base Address register must be initialized before receive is enabled through bit 2 of the Network Control register. Once reception is enabled, any write to the RX Buffer Queue 1 Base Address register is ignored. Reading this register returns the location of the descriptor currently being accessed. This value increments as buffers are used. Software should not use this register for determining where to remove received frames from the queue as it constantly changes as new frames are received. Software should instead work its way through the buffer descriptor queue checking the used bits. In terms of AMBA AXI operation, the receive descriptors are read from memory using a single 32-bit AXI access. Since the datapath is 64-bit wide, the receive descriptors shall be aligned at 64-bit boundaries and each pair of 32-bit descriptors is written using a single 64-bit AXI access.

REGISTER_NAME	ETHERNETn_receive_q1_ptr
OFFSET	0x480
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dma_rx_q_ptr[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dma_rx_q_ptr[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dma_rx_q_ptr[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_rx_q_ptr[7:2]						Reserved	
ACCESS_TYPE	R/W						R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

[bit31:2] dma_rx_q_ptr: Receive buffer queue base address

Start address of receive buffer queue.

[bit1:0] Reserved

Always read "0". Writing has no effect.

4.123. RX Buffer Queue 2 Base Address Register (ETHERNETn_receive_q2_ptr)

This register holds the start address of the receive buffer queue 2 (receive buffers descriptor list). The RX Buffer Queue 2 Base Address register must be initialized before receive is enabled through bit 2 of the Network Control register. Once reception is enabled, any write to the RX Buffer Queue 2 Base Address register is ignored. Reading this register returns the location of the descriptor currently being accessed. This value increments as buffers are used. Software should not use this register for determining where to remove received frames from the queue as it constantly changes as new frames are received. Software should instead work its way through the buffer descriptor queue checking the used bits. In terms of AMBA AXI operation, the receive descriptors are read from memory using a single 32-bit AXI access. Since the datapath is 64-bit wide, the receive descriptors shall be aligned at 64-bit boundaries and each pair of 32-bit descriptors is written using a single 64-bit AXI access.

REGISTER_NAME	ETHERNETn_receive_q2_ptr
OFFSET	0x484
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dma_rx_q_ptr[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dma_rx_q_ptr[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dma_rx_q_ptr[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_rx_q_ptr[7:2]						Reserved	
ACCESS_TYPE	R/W						R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

[bit31:2] dma_rx_q_ptr: Receive buffer queue base address

Start address of receive buffer queue.

[bit1:0] Reserved

Always read "0". Writing has no effect.

4.124. RX Buffer Queue 3 Base Address Register (ETHERNETn_receive_q3_ptr)

This register holds the start address of the receive buffer queue 3 (receive buffers descriptor list). The RX Buffer Queue 3 Base Address register must be initialized before receive is enabled through bit 2 of the Network Control register. Once reception is enabled, any write to the RX Buffer Queue 3 Base Address register is ignored. Reading this register returns the location of the descriptor currently being accessed. This value increments as buffers are used. Software should not use this register for determining where to remove received frames from the queue as it constantly changes as new frames are received. Software should instead work its way through the buffer descriptor queue checking the used bits. In terms of AMBA AXI operation, the receive descriptors are read from memory using a single 32-bit AXI access. Since the datapath is 64-bit wide, the receive descriptors shall be aligned at 64-bit boundaries and each pair of 32-bit descriptors is written using a single 64-bit AXI access.

REGISTER_NAME	ETHERNETn_receive_q3_ptr
OFFSET	0x488
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dma_rx_q_ptr[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dma_rx_q_ptr[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dma_rx_q_ptr[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_rx_q_ptr[7:2]						Reserved	
ACCESS_TYPE	R/W						R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0x0	

[bit31:2] dma_rx_q_ptr: Receive buffer queue base address

Start address of receive buffer queue.

[bit1:0] Reserved

Always read "0". Writing has no effect.

4.125. RX Buffer Size Queue i Register (ETHERNETn_rxbuf_size_qi) (i=1 to 3)

Description of RX Buffer Size Queue i register is shown.

REGISTER_NAME	ETHERNETn_rxbuf_size_qi
OFFSET	(0x4A0 + ((i-1)*0x4))
ACCESS_SIZE	W
MULTIPLE	1:3
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dma_rx_q_buf_size[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0xF0							

[bit31:8] Reserved

Always read "0". Writing has no effect.

[bit7:0] dma_rx_q_buf_size: DMA receive buffer size in system memory

The value defined by these bits determines the size of the buffer to use in system memory when writing received data. The value is defined in multiples of 64 bytes.

Bit	Description
0x00	Setting not allowed
0x01	64 Byte
0x02	128 Byte (2 * 64 Byte)
.	.
.	.
0x18	1536 Byte (24 * 64 Byte) one maximum length frame/buffer
.	.
.	.
0xA0	10240 Byte (160 * 64 Byte) one jumbo frame/buffer
.	.
.	.
0xF0	15360 Byte (240 * 64 Byte)

· · ·	· · ·
0xFF	16320 Byte (255 * 64 Byte)

4.126. CBS Control Register (ETHERNETn_cbs_control)

Description of CBS Control register is shown. The idleSlope value is defined as the rate of change of credit when a packet is waiting to be sent. This must not exceed the portTransmitRate which is dependent on the speed of operation, e.g. 100Mb/s = 017D7840_h, 10Mb/s = 002625A0_h. If 50% of bandwidth was to be allocated to a particular queue in 1Mb/s mode then the idleSlope value for that queue would be calculated as 017D7840_h/2. Note: Credit Based Shaping shall be disabled prior to updating the idleSlope values.

REGISTER_NAME	ETHERNETn_cbs_control
OFFSET	0x4BC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved						cbs_enable_queue_b	cbs_enable_queue_a
ACCESS_TYPE	R0,WX						R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0	0

[bit31:2] Reserved

Always read "0". Writing has no effect.

[bit1] cbs_enable_queue_b: Enable Credit Based Shaping on 2nd Highest Priority Queue

Bit	Description
0	CBS on Queue B disabled.
1	CBS on Queue B enabled.

[bit0] cbs_enable_queue_a: Enable Credit Based Shaping on Highest Priority Queue

Bit	Description
0	CBS on Queue A disabled.
1	CBS on Queue A enabled.

4.127. CBS IdleSlope Queue A Register (ETHERNETn_cbs_idleslope_q_a)

Description of CBS IdleSlope Queue A register is shown.

REGISTER_NAME	ETHERNETn_cbs_idleslope_q_a
OFFSET	0x4C0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	idleslope_a[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	idleslope_a[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	idleslope_a[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	idleslope_a[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] idleslope_a: IdleSlope Value for Queue A

Contains the idleSlope value for queue A in bytes per second. Queue A is the queue with the highest priority, i.e. queue number 3.

4.128. CBS IdleSlope Queue B Register (ETHERNETn_cbs_idleslope_q_b)

Description of CBS IdleSlope Queue B register is shown.

REGISTER NAME	ETHERNETn_cbs_idleslope_q_b
OFFSET	0x4C4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	idleslope_b[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	idleslope_b[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	idleslope_b[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	idleslope_b[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] idleslope_b: IdleSlope Value for Queue B

Contains the idleSlope value for queue B in bytes per second. Queue B is the queue with the second highest priority, i.e. queue number 2.

4.129. MSB Buffer Queue Base Address Register (ETHERNETn_msb_buff_q_base_addr_reg)

Description of MSB Buffer Queue Base Address register is shown.

REGISTER_NAME	ETHERNETn_msb_buff_q_base_addr_reg
OFFSET	0x4C8
ACCESS_SIZE	W
MULTIPLE	
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	msb_buff_q_base_addr[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	msb_buff_q_base_addr[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	msb_buff_q_base_addr[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	msb_buff_q_base_addr[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:0] msb_buff_q_base_addr: Upper 32-bit Buffer Queue Base Address

4.130. TX BD Control Register (ETHERNETn_tx_bd_control)

Description of TX BD Control register is shown.

REGISTER_NAME	ETHERNETn_tx_bd_control
OFFSET	0x4CC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved		tx_bd_ts_mode[1:0]		Reserved			
ACCESS_TYPE	R0,WX		R/W		R0,WX			
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0x0		0x0			

[bit31:6] Reserved

Always read "0". Writing has no effect.

[bit5:4] tx_bd_ts_mode: TX Descriptor Timestamp Insertion mode

Bit	Description
00	TS insertion disable
01	TS inserted for PTP Event Frames only
10	TS inserted for All PTP Frames only
11	TS insertion for All Frames

[bit3:0] Reserved

Always read "0". Writing has no effect.

4.131. RX BD Control Register (ETHERNETn_rx_bd_control)

Description of RX BD Control register is shown.

REGISTER NAME	ETHERNETn_rx_bd_control
OFFSET	0x4D0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT OFFSET	7	6	5	4	3	2	1	0
BIT NAME	Reserved		rx_bd_ts_mode[1:0]		Reserved			
ACCESS TYPE	R0,WX		R/W		R0,WX			
PROT TYPE	Wp							
INITIAL VALUE	0x0		0x0		0x0			

[bit31:6] Reserved

Always read "0". Writing has no effect.

[bit5:4] rx_bd_ts_mode: RX Descriptor Timestamp Insertion mode

Bit	Description
00	TS insertion disabled
01	TS inserted for PTP Event Frames only
10	TS inserted for All PTP Frames only
11	TS insertion for All Frames

[bit3:0] Reserved

Always read "0". Writing has no effect.

4.132. Screening Type 1 Register i (ETHERNETn_screening_type_1_register_i) (i=0 to 15)

Description of Screening Type 1 register is shown.

Screening Type 1 registers are used to allocate up to 16 priority queues to received frames based on certain IP or UDP fields of incoming frames. Firstly, when DS/TC match enable is set (bit 28), the DS (Differentiated Services) field of the received IPv4 header or TC field (Traffic Class) of IPv6 headers are matched against bits [11:4]. Secondly, when UDP port match enable is set (bit 29), the UDP Destination Port of the received UDP frame is matched against bits [27:12]. Both UDP and DS/TC matching can be enabled simultaneously or individually. If a match is successful, then the queue value programmed in bits [3:0] is allocated to the frame

REGISTER_NAME	ETHERNETn_screening_type_1_register_i
OFFSET	(0x500 + (i*0x4))
ACCESS_SIZE	W
MULTIPLE	0:15
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved		udp_port_match_enable	dstc_enable	udp_port_match[15:12]			
ACCESS_TYPE	R0,WX		R/W	R/W	R/W			
PROT_TYPE	Wp							
INITIAL_VALUE	0x0		0	0	0x0			

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	udp_port_match[11:4]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	udp_port_match[3:0]				dstc_match[7:4]			
ACCESS_TYPE	R/W				R/W			
PROT_TYPE					Wp			
INITIAL_VALUE	0x0				0x0			

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dstc_match[3:0]				queue_number[3:0]			
ACCESS_TYPE	R/W				R/W			
PROT_TYPE					Wp			
INITIAL_VALUE	0x0				0x0			

[bit31:30] Reserved

Always read "0". Writing has no effect.

[bit29] udp_port_match_enable: UDP port match enable

Bit	Description
0	Disable
1	Enable

[bit28] dstc_enable: DS/TC enable

Bit	Description
0	Disable
1	Enable

[bit27:12] udp_port_match: UDP port match

UDP Destination Port of the received UDP frame is matched against this value.

[bit11:4] dstc_match: DS/TC match

DS (Differentiated Services) field of the received IPv4 header or TC field (traffic class) of IPv6 headers is matched against this value.

[bit3:0] queue_number: Queue number

Queue Number (0 - 15).

4.133. Screening Type 2 Register i (ETHERNETn_screening_type_2_register_i) (i=0 to 15)

Description of Screening Type 2 register is shown.

Screener Type 2 match registers allow a screen to be configured that is the combination of all or any of the following comparisons:

1. An enabled field VLAN Priority. A VLAN Priority match will be performed if the VLAN priority enable is set. The extracted priority field in the VLAN header is compared against 3 bits within the screener type 2 register itself.
2. An enabled field EtherType.
3. An enabled field Compare A.
4. An enabled field Compare B.
5. An enabled field Compare C.

REGISTER_NAME	ETHERNETn_screening_type_2_register_i
OFFSET	0x540 + (i*0x4)
ACCESS_SIZE	W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	compare_c_enable	compare_c[4:0]				compare_b_enable	
ACCESS_TYPE	R0,WX	R/W	R/W				R/W	
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0x00				0	

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	compare_b[4:0]					compare_a_enable	compare_a[4:3]	
ACCESS_TYPE	R/W					R/W	R/W	
PROT_TYPE	Wp							
INITIAL_VALUE	0x00					0	0x0	

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	compare_a[2:0]			ethertype_enable	index[2:0]			vlan_enable
ACCESS_TYPE	R/W			R/W	R/W			R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0x0			0	0x0			0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	vlan_priority[2:0]			queue_number[3:0]			
ACCESS_TYPE	R/W	R/W			R/W			
PROT_TYPE					Wp			
INITIAL_VALUE	0	0x0			0x0			

[bit31] Reserved

Always read "0". Writing has no effect.

[bit30] compare_c_enable: Compare C enable

Bit	Description
0	Disable
1	Enable

[bit29:25] compare_c: Compare C

Index to screener type 2 Compare register.

[bit24] compare_b_enable: Compare B enable

Bit	Description
0	Disable
1	Enable

[bit23:19] compare_b: Compare B

Index to screener type 2 Compare register.

[bit18] compare_a_enable: Compare A enable

Bit	Description
0	Disable
1	Enable

[bit17:13] compare_a: Compare A

Index to screener type 2 Compare register.

[bit12] ethertype_enable: EtherType enable

Bit	Description
0	Disable
1	Enable

[bit11:9] index: EtherType

Index to screener type 2 EtherType register.

[bit8] vlan_enable: VLAN enable

Bit	Description
0	Disable
1	Enable

[bit7] Reserved

Always read write value. Writing always "0".

[bit6:4] vlan_priority: VLAN Priority

VLAN priority.

[bit3:0] queue_number: Queue number

Queue Number (0 - 15).

4.134. Interrupt Enable Queue i Register (ETHERNETn_int_enable_qi) (i=1 to 3)

At reset all interrupts are disabled. Writing a "1" to the relevant bit location enables that particular interrupt. This register is write only and when read will return "0".

REGISTER_NAME	ETHERNETn_int_enable_qi
OFFSET	(0x600 + ((i-1)*0x4))
ACCESS_SIZE	W
MULTIPLE	1:3
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved				enable_res p_not_ok_in terrupt	Reserved	Reserved	
ACCESS_TYPE	R0,WX				R0,W1	R0,WX	R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x0				0	0	0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	enable_transmit_complete_interrupt	enable_transmit_frame_corruption_due_to_amba_error_interrupt	enable_retry_limit_exceeded_or_late_collision_interrupt	Reserved		enable_rx_used_bit_read_interrupt	enable_receive_complete_interrupt	Reserved
ACCESS_TYPE	R0,W1	R0,W1	R0,W1	R0,WX		R0,W1	R0,W1	R0,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0		0	0	0

[bit31:12] Reserved

Always read "0". Writing has no effect.

[bit11] enable_resp_not_ok_interrupt: Enable BRESP not OK interrupt

Writing "1" enables BRESP not OK interrupt.

[bit10:8] Reserved

Always read "0". Writing has no effect.

[bit7] enable_transmit_complete_interrupt: Enable Transmit complete interrupt

Writing "1" enables Transmit complete interrupt.

[bit6] enable_transmit_frame_corruption_due_to_amba_axi_error_interrupt: Enable Transmit frame corruption due to AMBA AXI error interrupt

Writing "1" enables Transmit frame corruption due to AMBA AXI error interrupt.

[bit5] enable_retry_limit_exceeded_or_late_collision_interrupt: Enable Retry limit exceeded or late collision interrupt

Writing "1" enables Retry limit exceeded or late collision interrupt.

[bit4:3] Reserved

Always read "0". Writing has no effect.

[bit2] enable_rx_used_bit_read_interrupt: Enable RX used bit read interrupt

Writing "1" enables RX used bit read interrupt.

[bit1] enable_receive_complete_interrupt: Enable Receive complete interrupt

Writing "1" enables Receive complete interrupt.

[bit0] Reserved

Always read "0". Writing has no effect.

4.135. Interrupt Disable Queue i Register (ETHERNETn_int_disable_qi) (i=1 to 3)

Writing a "1" to the relevant bit location disables that particular interrupt. This register is write only and when read will return "0".

REGISTER_NAME	ETHERNETn_int_disable_qi
OFFSET	(0x620 + ((i-1)*0x4))
ACCESS_SIZE	W
MULTIPLE	1:3
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved				disable_res p_not_ok_in terrupt	Reserved	Reserved	
ACCESS_TYPE	R0,WX				R0,W1	R0,WX	R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x0				0	0	0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	disable_transmit_complete_interrupt	disable_transmit_frame_corruption_due_to_amba_error_interrupt	disable_retry_limit_exceeded_or_late_collision_interrupt	Reserved		disable_rx_used_bit_read_interrupt	disable_receive_complete_interrupt	Reserved
ACCESS_TYPE	R0,W1	R0,W1	R0,W1	R0,WX		R0,W1	R0,W1	R0,WX
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0		0	0	0

[bit31:12] Reserved

Always read "0". Writing has no effect.

[bit11] disable_resp_not_ok_interrupt: Disable BRESP not OK interrupt

Writing "1" disables BRESP not OK interrupt.

[bit10:8] Reserved

Always read "0". Writing has no effect.

[bit7] disable_transmit_complete_interrupt: Disable Transmit complete interrupt

Writing "1" disables Transmit complete interrupt.

[bit6] disable_transmit_frame_corruption_due_to_amba_axi_error_interrupt: Disable Transmit frame corruption due to AMBA AXI error interrupt

Writing "1" disables Transmit frame corruption due to AMBA AXI error interrupt.

[bit5] disable_retry_limit_exceeded_or_late_collision_interrupt: Disable Retry limit exceeded or late collision interrupt

Writing "1" disables Retry limit exceeded or late collision interrupt.

[bit4:3] Reserved

Always read "0". Writing has no effect.

[bit2] disable_rx_used_bit_read_interrupt: Disable RX used bit read interrupt

Writing "1" disables RX used bit read interrupt.

[bit1] disable_receive_complete_interrupt: Disable Receive complete interrupt

Writing "1" disables Receive complete interrupt.

[bit0] Reserved

Always read "0". Writing has no effect.

4.136. Interrupt Mask Queue i Register (ETHERNETn_int_mask_qi) (i=1 to 3)

The Interrupt Mask Queue i register is a read only register indicating which interrupts are masked. All bits are set at reset and can be reset individually by writing to the Interrupt Enable Queue i register or set individually by writing to the Interrupt Disable Queue i register. Having separate address locations for enable and disable saves the need for performing a read modify write when updating the Interrupt Mask Queue i register. For test purposes there is a write-only function to this register that allows the bits in the Interrupt Status Queue i register to be set or cleared, regardless of the state of the mask register

REGISTER_NAME	ETHERNETn_int_mask_qi
OFFSET	(0x640 + ((i-1)*0x4))
ACCESS_SIZE	W
MULTIPLE	1:3
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved				resp_not_o k_interrupt_ mask	Reserved	Reserved	
ACCESS_TYPE	R0,WX				R,W	R0,WX	R0,WX	
PROT_TYPE	Wp							
INITIAL_VALUE	0x0				1	0	0x0	

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	transmit_complete_interrupt_mask	transmit_frame_corruption_due_to_amba_error_interrupt_mask	retry_limit_exceeded_or_late_collision_interrupt_mask	Reserved		rx_used_bit_read_interrupt_mask	receive_complete_interrupt_mask	Reserved
ACCESS_TYPE	R,W	R,W	R,W	R0,WX		R,W	R,W	R0,WX
PROT_TYPE	Wp							
INITIAL_VALUE	1	1	1	0		1	1	0

[bit31:12] Reserved

Always read "0". Writing has no effect.

[bit11] resp_not_ok_interrupt_mask: BRESP not OK interrupt mask

A write to this register directly affects the state of the corresponding bit in the Interrupt Status Queue i register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt disabled
1	Interrupt enabled

[bit10:8] Reserved

Always read "0". Writing has no effect.

[bit7] transmit_complete_interrupt_mask: Transmit complete interrupt mask

A write to this register directly affects the state of the corresponding bit in the Interrupt Status Queue i register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt disabled
1	Interrupt enabled

[bit6] transmit_frame_corruption_due_to_amba_error_interrupt_mask: Transmit frame corruption due to AMBA AXI error interrupt mask

A write to this register directly affects the state of the corresponding bit in the Interrupt Status Queue i register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt disabled
1	Interrupt enabled

[bit5] retry_limit_exceeded_or_late_collision_interrupt_mask: Retry limit exceeded or late collision interrupt mask

A write to this register directly affects the state of the corresponding bit in the Interrupt Status Queue i register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt disabled
1	Interrupt enabled

[bit4:3] Reserved

Always read "0". Writing has no effect.

[bit2] rx_used_bit_read_interrupt_mask: RX used bit read interrupt mask

A write to this register directly affects the state of the corresponding bit in the Interrupt Status Queue i register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt disabled
1	Interrupt enabled

[bit1] receive_complete_interrupt_mask: Receive complete interrupt mask

A write to this register directly affects the state of the corresponding bit in the Interrupt Status Queue i register, causing an interrupt to be generated if a "1" is written.

Bit	Description
0	Interrupt disabled
1	Interrupt enabled

[bit0] Reserved

Always read "0". Writing has no effect.

4.137. EtherType 2 Register i (ETHERNETn_screening_type_2_ethertype_reg_i) (i=0 to 7)

Description of EtherType 2 register "i" is shown.

REGISTER_NAME	ETHERNETn_screening_type_2_ethertype_reg_i
OFFSET	0x6E0 + (i*0x4)
ACCESS_SIZE	W
MULTIPLE	0:7
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	compare_value[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	compare_value[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] Reserved

Always read "0". Writing has no effect.

[bit15:0] compare_value: Compare value

EtherType 2 compare value.

4.138. Type2 Compare Word 0 i Register (ETHERNETn_type2_compare_i_word_0) (i=0 to 31)

Description of Type2 Compare Word 0 "i" is shown.

REGISTER_NAME	ETHERNETn_type2_compare_i_word_0
OFFSET	0x700 + (i*0x8)
ACCESS_SIZE	W
MULTIPLE	0:31
NUMERIC TYPE	
OTHER	

BIT OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	compare_value[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	compare_value[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	mask_value[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	mask_value[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

[bit31:16] compare_value: Compare Value

2 byte Compare Value. The byte stored in bits [23:16] is compared against the 1st byte of the 2 bytes extracted from the frame. The byte stored in bits [31:24] is compared against the 2nd byte of the 2 bytes extracted from the frame.

[bit15:0] mask_value: Mask value

2 byte Mask Value.

4.139. Type2 Compare Word 1 i Register (ETHERNETn_type2_compare_i_word_1) (i=0 to 31)

Description of Type2 Compare Word 1 "i" is shown.

REGISTER_NAME	ETHERNETn_type2_compare_i_word_1
OFFSET	0x704 + (i*0x8)
ACCESS_SIZE	W
MULTIPLE	0:31
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0x00							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved						disable_mask	compare_ofset[1]
ACCESS_TYPE	R0,WX						R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0x00						0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	compare_of fset[0]	offset_value[6:0]						
ACCESS_TYPE	R/W	R/W						
PROT_TYPE		Wp						
INITIAL_VALUE	0	0x00						

[bit31:10] Reserved

Always read "0". Writing has no effect.

[bit9] disable_mask: Disable Mask

This bit is used to control whether the compare register word_0 contains a 4-byte compare value, or a 2-byte compare value with a 2-byte mask value.

Bit	Description
0	2-byte compare, 2-byte mask
1	4-byte compare value

[bit8:7] compare_offset[1:0]: Compare offset

Compare byte offset.

Bit	Description
00	Offset from beginning of frame.
01	Offset from byte after EtherType.
10	Offset from byte following end of IP header.
11	Offset from byte following end of TCP/UDP header.

[bit6:0] offset_value[6:0]: Offset value

Offset value in bytes.

5. Functional Limitations

5.1. Priority Flow Control - pausing the transmitting the frames

Transmission of frames will not be paused by the PFC pause frame reception.

5.2. Priority Queuing - screening using DS/TC field in IP header

When the frames with 0x00 at the IPv4 TOS field or at the IPv6 TC field are forwarded to the specific queue, the queue has to be the default queue (i.e. queue 0). Therefore there is no need of screeners to do such a forwarding.

5.3. Priority Queuing - screening using compare_offset = "10" or "11"

When only the byte matching is designated, screener type2 potentially produces a match for non-IP/TCP frames, since it doesn't check the type of frames. To specify the type of frames to match, the ethertype matching is needed to be enabled.

5.4. Enable/Disable the partial store and forward mode

Partial store and forward mode is a static programming option, and it should not be changed unless the ethernet link is down.

5.5. PTP/gPTP - The ptp_sync_frame_transmitted interrupt

The interrupt bit21 (ptp_sync_frame_transmitted) won't be generated for the transmission of the multicast SYNC frames satisfying all of the following conditions:

- Compliant for the IEEE Std. 1588 version 2.
- VLAN tagged.
- The destination address is 01:80:C2:00:00:0E.

This limitation won't be a issue for any real use case for the following reasons:

- In the IEEE Std. 1588 compliant system, the destination address 01:80:C2:00:00:0E is used by only the Pdelay Request frames and Pdelay Response frames. And the SYNC frames use the destination address 01:1B:19:00:00:00.
- In the IEEE Std. 802.1AS compliant system, The frames may not be VLAN tagged.

5.6. PTP/gPTP - TSU timer comparison with 0

When all of 3 TSU timer comparison value registers (located at the offset of 0x0DC, 0x0E0, and 0x0E4) are set to 0x0, the TSU timer comparison won't be executed. And, as a result, the interrupt request won't be generated.

The condition will be avoidable in the normal use cases.

CHAPTER 22: Media Local Bus Interface (MediaLB)



This chapter explains the functions and operations of the MediaLB.

1. Overview
2. Configuration and Block Diagram
3. Operation of the MediaLB
4. Registers

CODE: MEDIA_LB-S6J3200-E1

1. Overview

The MediaLB comprises a MediaLB functional block, a AHB Master and Slave interface, and a 9Kbit RAM for the local channel buffer. The MediaLB is an interface that implements the required functionality of a Media Local Bus Device for connecting the device with a MOST (Media Oriented System Transport, which is a multimedia-type in-vehicle LAN standard) network as outlined in reference MediaLB Specification by SMSC (TB0400AN3V0, rev 3.0 issued on February 2006). The MediaLB transfers data between the MediaLB Bus and the system memory, using the AHB Master Interface. In order to operate, MediaLB configuration registers must be set via the AHB Slave Interface. The features of the MediaLB module are listed in this section.

Features of the MediaLB

- Implements the Physical and Link Layer requirements outlined in MediaLB Specification rev 3.0
- Transmits commands and data when functioning as the transmitting device
- Receives data and transmits status responses when functioning as the receiving device
- Detection of the device lock or unlock from the MediaLB Frame.
- Handling of System Channel commands
- Supports 16 logical channels
- Each logical channel can be programmed as synchronous, asynchronous, isochronous and control channel type and as transmit or receive
- Loop back mode between the logical channel 0 (reception) and logical channel 1(transmission)
- Can operate in DMA mode (ping-pong buffering and circular buffering) and in IO mode
- Built-in dual-port RAM as local channel buffer for compensating the bus latency
- Supports 8-bit, 16-bit and 32-bit bus accesses to registers in MediaLB
- Configurable protection for read and write accesses to registers in MediaLB
- Programmable for 256Fs, 512Fs and 1024Fs transfer rates of operation at either 44.0kHz, 48.0kHz, or 48.1kHz.
- 3-pin MediaLB Mode

Abbreviations

This section lists the terms and abbreviations used in this chapter.

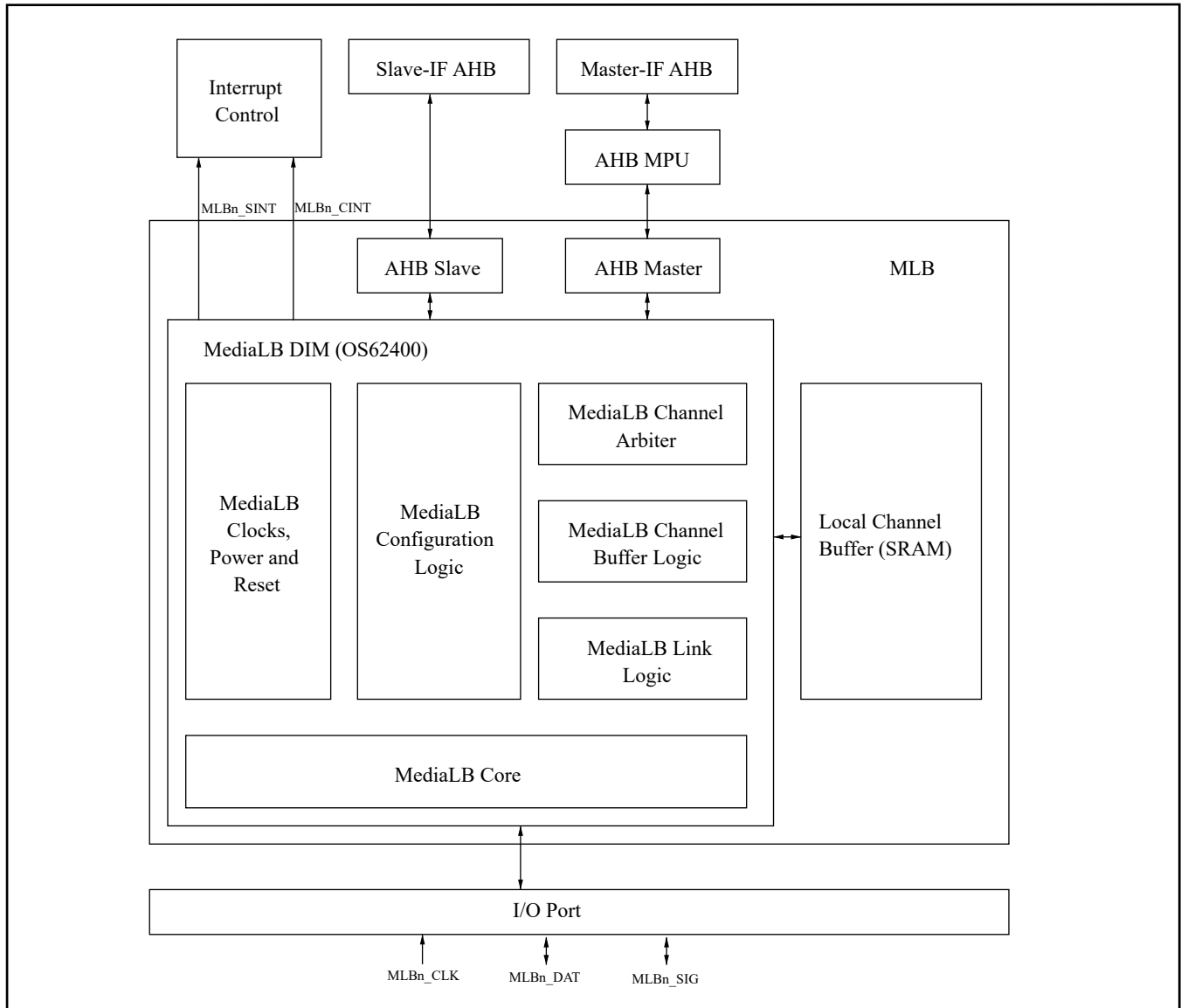
Table 1-1 Terms and Abbreviations

Term	Meaning
MediaLB	The function block that implements MediaLB (Media Local Bus), which is a local bus specification, for connecting IC devices with a MOST (Media Oriented System Transport), which is a multimedia-type in-vehicle LAN standard network.
Quadlet	Indicates a 4-byte unit.
Sync data	Data of stream signals, such as audio data.
Async data	Packet data.
Control data	Data of control signals.
Local channel buffer	The data storage area in the MediaLB
IO mode	The mode capable of exchanging transmission/reception data with the MediaLB from CPU.
DMA mode	The mode in which the MediaLB operates as the bus master of the AHB bus. Transmission/reception data is exchanged between the MediaLB and system memory via the AHB bus.
Current buffer	The data area on the AHB bus that is read/written in DMA mode.
Current buffer address	Indicates the address area that is output next on the AHB bus in DMA mode after processing the current buffer area. Set in the channel n next buffer configuration register (MLBn_CNBCRn).
Previous buffer	The data area processed before the current buffer in DMA mode.
Previous buffer address	The address area processed before the current buffer in DMA mode.
Ping-pong buffering	One of two data transfer methods in DMA mode. If the current buffer is filled, an interrupt occurs when moving to the next buffer and so the next address to be used next can be set again by software. Therefore, it is possible to transmit/receive data while changing the transfer destination data storage area one after another.
Circular buffering	One of two data transfer methods in DMA mode. Performs data transfers repeatedly for the data storage area indicated by the current buffer. No interrupt occurs at the completion of a transfer.
n	Indicates a logical channel number (n=0..15)

2. Configuration and Block Diagram

This section shows a block diagram of MediaLB.

Figure 2-1 MediaLB Block Diagram



MediaLB DIM

The function block of MediaLB is provided by SMSC IP OS62400 MediaLB Device Interface Macro. It implements the Physical and Link Layer requirements outlined in the MediaLB Specification by SMSC (TB0400AN3V0, rev 3.0 issued on February 2006).

Local Channel Buffer (SRAM)

A 9kbit SRAM is used for buffering of logical channel data for compensating the bus latency. It stores up to 256 quadlets plus tag information (256 words x 36 bits).

1. AHB Master Interface

The AHB Master Interface allows the MediaLB to access the system memory. It converts the MediaLB Host Bus Interface (HBI) protocol to AHB protocol.

2. AHB Slave Interface

The AHB Master Interface allows the bus masters to access the MediaLB configuration and status registers. It converts the AHB protocol to MediaLB Peripheral Bus Interface (PBI).

Notes:

- *In devices that use MediaLB, a minimum PERI4 clock value is specified. Please refer to the Internal Clock Timing table in the device-specific datasheet.*
- *In addition, the system must be able to handle 6 MByte/sec on the bus. This means that, depending on the bus traffic as well as access to system RAM by other masters, higher PERI4 clock frequencies are recommended.*

MediaLB IO Mode

The IO mode dictates a particular method used for transferring data between the local channel buffer and the system memory. For channels configured to receive data from the MediaLB interface, system software is responsible for periodically unloading RX data from the local channel buffer. For channels configured to transmit data to the MediaLB Interface, system software is responsible for periodically loading the local channel buffer with TX data. The MLBn_CCBCRn and MLBn_CNBCRn registers, accessed through the AHB Slave interface, are used as a data receive buffer and a data transmit buffer, respectively.

For details on the IO Mode operation, please contact SMSC.

MediaLB DMA Mode

The DMA mode is a mode in which MediaLB accesses the system memory via the AHB Master bus. The system memory contains transmitted and received data, which can be read by software and the MediaLB.

When MediaLB is used in the DMA mode, data is transmitted and received via the system memory. When used in the DMA mode, MediaLB functions as a master of the AHB bus, reading and writing data from and to the system memory. When MediaLB accesses the AHB bus, Buffer Current Address BCA[15:0] in Channel n Current Buffer Configuration Register (MLBn_CCBCRn) for MediaLB is output as the address of the AHB bus. In the DMA mode, two types of buffering is supported: Ping-Pong and circular buffering.

In the Ping-Pong buffering, if the current buffer is filled, an interrupt occurs when moving to the next buffer and so the next address to be used next can be set again by software. Therefore, it is possible to transmit/receive data while changing the transfer destination data storage area one after another.

In the circular buffering, a buffer from a start address to an end address is used in a loop indefinitely by setting the start and end addresses in Next Buffer Configuration Register (MLBn_CNBCRn) until the software sets to "0" the RDY bit in Channel n Status Configuration Register (MLBn_CSCRn). This type of buffering should be used only for synch channels.

For details on the DMA Mode operation, please contact SMSC.

Local Channel Buffer

The local channel buffer comprises RAM of 256 words x 36 bits, where each word contains 4 quadlets plus tag information. The local channel buffer is in MediaLB and used by each logical channel to store transmitted and received data temporarily. To assign a RAM area, Local Channel n Buffer Configuration Register (MLBn_LCBCRn) is used to set the start address (SA bit) and a length (BD bit) of the RAM area. Furthermore, in the IO mode, an interrupt can be triggered to each logical channel by setting a threshold value (TH bit) using Local Channel n Buffer Configuration Register (MLBn_LCBCRn).

For details on the Local channel buffer operation, please contact SMSC.

Interrupts by MediaLB

This section describes interrupts that MediaLB has. MediaLB has two types of interrupts* Channel interrupts indicating the state of each channel buffer (Cint) and System interrupts indicating the state of the MediaLB system (Sint).

A channel interrupt is triggered by the status or error information retained by Channel n Status Configuration Register (MLBn_CSCRn). Channel interrupts are maskable on a channel basis via the MLBn_CECRn register. To know in which channel an interrupt has been triggered, Channel Interrupt Configuration Register (MLBn_CICR) needs to be read. Each bit in Channel Interrupt Configuration Register (MLBn_CICR) is cleared to 0 by clearing the factor that has triggered an interrupt to each channel or masking the interrupt using the mask bit. The root cause of the interrupt can be determined by reading the current and previous status fields in the MLBn_CSCRn register. The following tables describe the interrupt flags for channel interrupts and corresponding interrupt cause factors. The interrupt flag is changed to "1" when an interrupt cause is detected. There are bits that change the meaning of the interrupt flag, depending on the operation mode (IO/DMA mode).

Note:

*Data interrupts (mlb_dint[30:0]) provided by SMSC IP OS62400 are not supported. Reason is that data interrupts are provided for customers who want to attach an external DMA Controller directly to OS62400 and load/unload the local channel buffers in IO Mode.

Table 2-1 Interrupt Flags and Causes Common Across IO and DMA Mode.

Interrupt Flag	Register	Interrupt Source	Valid Channel	Interrupt Mask	Interrupt Flag Clear
STS[0]	MLBn_CS CRn	Current Buffer Protocol Error	All channels with reception setting, and async and control channels with transmission setting.	MLBn_CECRn: MASK[0]	Writing "1" to STS[0]
STS[1]		Current Buffer Break	Async and control channels	MLBn_CECRn: MASK[1]	Writing "1" to STS[1]
STS[4]		Buffer Error	Sync (both transmission/reception) and isochronous channels with reception setting.	MLBn_CECRn: MASK[4]	Writing "1" to STS[4]
STS[6]		Frame Sync Lost	Sync channels (both transmission/reception)	MLBn_CECRn: MASK[6]	Writing "1" to STS[6]

Table 2-2 Interrupt Flags and Causes Valid Only in IO Mode.

Interrupt Flag	Register	Interrupt Source	Valid Channel	Interrupt Mask	Interrupt Flag Clear
STS[2]	MLBn_CS CRn	Receive service requests	All channels enabled for receiving.	MLBn_CECRn: MASK[2]	Writing "1" to STS[2]
STS[3]		Transmit service request	All channels enabled for transmitting.	MLBn_CECRn: MASK[3]	Writing "1" to STS[3]
STS[8]		Received packet aborted	Async and control channels enabled for receiving	MLBn_CECEn: MASK[2]	Writing "1" to STS[8]

Table 2-3 Interrupt Flags and Causes Valid in DMA Mode Only

Interrupt Flag	Register	Interrupt Source	Valid Channel	Interrupt Mask	Interrupt Flag Clear
STS[2]	MLBn_CS CRn	Current buffer ends	All channels (both transmission/reception)	MLBn_CECRn: MASK[2]	Writing "1" to STS[2]
STS[3]		Current buffer starts	All channels (both transmission/reception)	MLBn_CECRn: MASK[3]	Writing "1" to STS[3]
STS[5]		Host bus error (received AHB bus error response)	All channels (both transmission/reception).	*	Writing "1" to STS[5]
STS[8]		Previous buffer protocol error	All channels enabled for receiving or async and control channel enabled for transmitting	MLBn_CECEn: MASK[2]	Writing "1" to STS[8]
STS[9]		Previous buffer break	All channels (both transmission/reception).	MLBn_CECRn: MASK[1]	Writing "1" to STS[9]
STS[10]		Previous buffer end	All channels (both transmission/reception)	MLBn_CECRn: MASK[2]	Writing "1" to STS[10]
STS[11]		Previous buffer start	All channels (both transmission/reception)	MLBn_CECRn: MASK[3]	Writing "1" to STS[11]

*Cannot be masked. Setting the cause factor flag to "1" triggers an interrupt.

Note:

- A system interrupt is triggered when a system command, locking or unlocking is detected, as shown in Table 2-4. An interrupt flag is changed to "1" when an interrupt cause is detected. Each interrupt flag has a corresponding interrupt mask bit. Setting an interrupt mask to "1" enables masking.

Table 2-4 Interrupt Flags and Interrupt Cause Factors for System Interrupts

Interrupt Source	Register	Interrupt Flag	Interrupt Mask	Interrupt Flag Clear
Detecting a reset (MlbRset(FEH))	MLBn_SSCR	SDR	MLBn_SMCR:SMR	Writing "1" to SDR
Detecting a network lock (MOST_Lock(F0H))		SDNL	MLBn_SMCR:SMNL	Writing "1" to SDNL
Detecting a network unlock (MOST_Unlock(E2H))		SDNU	MLBn_SMCR:SMNU	Writing "1" to SDNU
Detecting a channel scan (MlbScan(E4H))		SDCS	MLBn_SMCR:SMCS	Writing "1" to SDCS
Detecting a sub-command (MlbSubCmd(E6H))		SDSC	MLBn_SMCR:SMSC	Writing "1" to SDSC
Detecting a MediaLB lock		SDML	MLBn_SMCR:SMMML	Writing "1" to SDML
Detecting a MediaLB unlock		SDMU	MLBn_SMCR:SMMU	Writing "1" to SDMU

Loop Back Mode

To facilitate debugging of transmission paths, MediaLB supports the loop back test mode.

Setting the LBM bit in Device Control Configuration Register (MLBn_DCCR) to "1" causes data to be received via Channel 0 and transmitted back via Channel 1. To use the loop back test mode, use the following steps to set the mode*:

1. Set the logical channel addresses for Channels 0 and 1. (Same address cannot be used for different channels.)
2. Set Channel 0 to any channel type. Enable "Receipt" and set "Enable channel".
3. Set Channel 1 to the same channel type as that of Channel 0, enable "Transmit" and set "Enable channel".
4. Set the loop back mode bit (MLBn_DCCR:LBM="1").

Note:

- **During the loop back mode, a protocol error or a break is prohibited for both Channels 0 and 1. During the loop back mode, the Next Buffer Ready bits for Channels 0 and 1 remains cleared (MLBn_CSCR0:RDY=MLBn_CSCR1:RDY="0"). During the loop back mode, little-endian mode must be disabled (MLBn_DCCR=MLE="0"). During the loop back mode, isochronous packet lengths must be quadlet multiples.*

3. Operation of the MediaLB

This section describes the operation of MediaLB.

3.1. Notes on Using MediaLB

This section is the "Programmer's Guide", which lists the usage notes for programming the MediaLB module. It is recommended to contact SMSC for further details.

General Usage Notes

- Reserved bits return undefined values. The software programs shall be independent of the values read from the reserved register bits.
- If the MediaLB should be accessible in user mode, PPU should be configured accordingly.

Steps in Programming the MediaLB Module

- After the system reset, the software shall detect the Module ID number of MediaLB, by reading the MLBn_MID register. This would help it in identifying the attributes and capabilities supported by the MediaLB module.
- Then Software should configure MediaLB by setting appropriate registers following recommended Software Flowcharts. For further details, please contact SMSC.

3.2. List of References

This chapter lists the various references to other documents, used in this specification.

- OS62400 MediaLB Device Interface Macro Advanced Product Data Sheet (DS62400AP5) by SMSC, issued on October 2006.
- MediaLB Specification by SMSC (TB0400AN3V0, rev 3.0 issued on February 2006)

4. Registers

The MediaLB module contains various registers to configure its operation, to monitor its status and, when configured in IO Mode, to access the receive and transmit data buffers.

The MediaLB module is allocated 1KB of MCU address space for mapping the Configuration and Status Registers (i.e. CSRs). The address area allocated to MediaLB and the Control and Status Registers in MediaLB are explained in this section.

The suffix 'n' in the register name indicates that the register is an instance 'n' of the module.

Registers of MediaLB

The following registers are available for each instance of MediaLB:

- MediaLBn Device Control Configuration Register (MLBn_DCCR)
- MediaLBn System Status Configuration Register (MLBn_SSCR)
- MediaLBn System Data Configuration Register (MLBn_SDCR)
- MediaLBn System Mask Configuration Register (MLBn_SMCR)
- MediaLBn Version Control Configuration Register (MLBn_VCCR)
- MediaLBn Synchronous Base Address Configuration Register (MLBn_SBCR)
- MediaLBn Asynchronous Base Address Configuration Register (MLBn_ABCR)
- MediaLBn Control Base Address Configuration Register (MLBn_CBCR)
- MediaLBn Isochronous Base Address Configuration Register (MLBn_IBCR)
- MediaLBn Channel Interrupt Configuration Register (MLBn_CICR)
- MediaLBn AHB Master Control Register (MLBn_AHBMCTL)
- MediaLBn Channel Entry Configuration Register (MLBn_CECR0 - MLBn_CECR15)
- MediaLBn Channel Status Configuration Register (MLBn_CSCR0 - MLBn_CSCR15)
- MediaLBn Channel Current Buffer Configuration Register (MLBn_CCBCR0 - MLBn_CCBCR15)
- MediaLBn Channel Next Buffer Configuration Register (MLBn_CNBCR0 - MLBn_CNBCR15)
- MediaLBn Local Channel Buffer Configuration Register (MLBn_LCBCR0 - MLBn_LCBCR15)
- MediaLBn Module Identification Register (MLBn_MID)

Arrangement of MediaLB Registers in Memory

Table 4-1 MediaLB Register Map

Offset	+3	+2	+1	+0
0x00000000	MLBn_DCCR 00000000 00000000 00000000 00000000			
0x00000004	MLBn_SSCR 00000000 00000000 00000000 00000000			
0x00000008	MLBn_SDCR 00000000 00000000 00000000 00000000			
0x0000000C	MLBn_SMCr 00000000 00000000 00000000 01100000			
0x00000010 - 0x00000018	reserved XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX			
0x0000001C	MLBn_VCCR 00000000 00000000 00000011 00000000			
0x00000020	MLBn_SBCR 00000000 00000000 00000000 00000000			
0x00000024	MLBn_ABCR 00000000 00000000 00000000 00000000			
0x00000028	MLBn_CBCR 00000000 00000000 00000000 00000000			
0x0000002C	MLBn_IBCR 00000000 00000000 00000000 00000000			
0x00000030	MLBn_CICR 00000000 00000000 00000000 00000000			
0x00000034 - 0x00000038	reserved XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX			
0x0000003C	MLBn_AHBMCTL 00000000 00000000 00000000 00000000			
0x00000040	MLBn_CECR0 00000000 00000000 00000000 00000000			
0x00000044	MLBn_CSCR0 10000000 00000000 00000000 00000000			
0x00000048	MLBn_CCBCR0 00000000 00000000 00000000 00000000			
0x0000004C	MLBn_CNBCR0 00000000 00000000 00000000 00000000			
0x00000050	MLBn_CECR1 00000000 00000000 00000000 00000000			
0x00000054	MLBn_CSCR1 10000000 00000000 00000000 00000000			
0x00000058	MLBn_CCBCR1 00000000 00000000 00000000 00000000			
0x0000005C	MLBn_CNBCR1 00000000 00000000 00000000 00000000			
0x00000060	MLBn_CECR2 00000000 00000000 00000000 00000000			
0x00000064	MLBn_CSCR2 10000000 00000000 00000000 00000000			
0x00000068	MLBn_CCBCR2 00000000 00000000 00000000 00000000			
0x0000006C	MLBn_CNBCR2 00000000 00000000 00000000 00000000			
0x00000070	MLBn_CECR3 00000000 00000000 00000000 00000000			
0x00000074	MLBn_CSCR3 10000000 00000000 00000000 00000000			
0x00000078	MLBn_CCBCR3 00000000 00000000 00000000 00000000			
0x0000007C	MLBn_CNBCR3 00000000 00000000 00000000 00000000			
0x00000080	MLBn_CECR4 00000000 00000000 00000000 00000000			

Offset	+3	+2	+1	+0
0x00000084	MLBn_CSCR4 10000000 00000000 00000000 00000000			
0x00000088	MLBn_CCBCR4 00000000 00000000 00000000 00000000			
0x0000008C	MLBn_CNBCR4 00000000 00000000 00000000 00000000			
0x00000090	MLBn_CECR5 00000000 00000000 00000000 00000000			
0x00000094	MLBn_CSCR5 10000000 00000000 00000000 00000000			
0x00000098	MLBn_CCBCR5 00000000 00000000 00000000 00000000			
0x0000009C	MLBn_CNBCR5 00000000 00000000 00000000 00000000			
0x000000A0	MLBn_CECR6 00000000 00000000 00000000 00000000			
0x000000A4	MLBn_CSCR6 10000000 00000000 00000000 00000000			
0x000000A8	MLBn_CCBCR6 00000000 00000000 00000000 00000000			
0x000000AC	MLBn_CNBCR6 00000000 00000000 00000000 00000000			
0x000000B0	MLBn_CECR7 00000000 00000000 00000000 00000000			
0x000000B4	MLBn_CSCR7 10000000 00000000 00000000 00000000			
0x000000B8	MLBn_CCBCR7 00000000 00000000 00000000 00000000			
0x000000BC	MLBn_CNBCR7 00000000 00000000 00000000 00000000			
0x000000C0	MLBn_CECR8 00000000 00000000 00000000 00000000			
0x000000C4	MLBn_CSCR8 10000000 00000000 00000000 00000000			
0x000000C8	MLBn_CCBCR8 00000000 00000000 00000000 00000000			
0x000000CC	MLBn_CNBCR8 00000000 00000000 00000000 00000000			
0x000000D0	MLBn_CECR9 00000000 00000000 00000000 00000000			
0x000000D4	MLBn_CSCR9 10000000 00000000 00000000 00000000			
0x000000D8	MLBn_CCBCR9 00000000 00000000 00000000 00000000			
0x000000DC	MLBn_CNBCR9 00000000 00000000 00000000 00000000			
0x000000E0	MLBn_CECR10 00000000 00000000 00000000 00000000			
0x000000E4	MLBn_CSCR10 10000000 00000000 00000000 00000000			
0x000000E8	MLBn_CCBCR10 00000000 00000000 00000000 00000000			
0x000000EC	MLBn_CNBCR10 00000000 00000000 00000000 00000000			
0x000000F0	MLBn_CECR11 00000000 00000000 00000000 00000000			
0x000000F4	MLBn_CSCR11 10000000 00000000 00000000 00000000			
0x000000F8	MLBn_CCBCR11 00000000 00000000 00000000 00000000			
0x000000FC	MLBn_CNBCR11 00000000 00000000 00000000 00000000			
0x00000100	MLBn_CECR12 00000000 00000000 00000000 00000000			

Offset	+3	+2	+1	+0
0x00000104		MLBn_CSCR12 10000000 00000000 00000000 00000000		
0x00000108		MLBn_CCBCR12 00000000 00000000 00000000 00000000		
0x0000010C		MLBn_CNBCR12 00000000 00000000 00000000 00000000		
0x00000110		MLBn_CECR13 00000000 00000000 00000000 00000000		
0x00000114		MLBn_CSCR13 10000000 00000000 00000000 00000000		
0x00000118		MLBn_CCBCR13 00000000 00000000 00000000 00000000		
0x0000011C		MLBn_CNBCR13 00000000 00000000 00000000 00000000		
0x00000120		MLBn_CECR14 00000000 00000000 00000000 00000000		
0x00000124		MLBn_CSCR14 10000000 00000000 00000000 00000000		
0x00000128		MLBn_CCBCR14 00000000 00000000 00000000 00000000		
0x0000012C		MLBn_CNBCR14 00000000 00000000 00000000 00000000		
0x00000130		MLBn_CECR15 00000000 00000000 00000000 00000000		
0x00000134		MLBn_CSCR15 10000000 00000000 00000000 00000000		
0x00000138		MLBn_CCBCR15 00000000 00000000 00000000 00000000		
0x0000013C		MLBn_CNBCR15 00000000 00000000 00000000 00000000		
0x00000140 - 0x0000027C		reserved XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX		
0x00000280		MLBn_LBCR0 00000000 01000000 00000000 00000000		
0x00000284		MLBn_LBCR1 00000000 01000000 00000000 00000000		
0x00000288		MLBn_LBCR2 00000000 01000000 00000000 00000000		
0x0000028C		MLBn_LBCR3 00000000 01000000 00000000 00000000		
0x00000290		MLBn_LBCR4 00000000 01000000 00000000 00000000		
0x00000294		MLBn_LBCR5 00000000 01000000 00000000 00000000		
0x00000298		MLBn_LBCR6 00000000 01000000 00000000 00000000		
0x0000029C		MLBn_LBCR7 00000000 01000000 00000000 00000000		
0x000002A0		MLBn_LBCR8 00000000 01000000 00000000 00000000		
0x000002A4		MLBn_LBCR9 00000000 01000000 00000000 00000000		
0x000002A8		MLBn_LBCR10 00000000 01000000 00000000 00000000		
0x000002AC		MLBn_LBCR11 00000000 01000000 00000000 00000000		
0x000002B0		MLBn_LBCR12 00000000 01000000 00000000 00000000		
0x000002B4		MLBn_LBCR13 00000000 01000000 00000000 00000000		
0x000002B8		MLBn_LBCR14 00000000 01000000 00000000 00000000		
0x000002BC		MLBn_LBCR15 00000000 01000000 00000000 00000000		

Offset	+3	+2	+1	+0
0x000002C0 - 0x000002F8	reserved XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX			
0x000002FC	MLBn_MID 00000000 00000000 00000000 00000000			

4.1. MediaLBn Device Control Configuration Register (MLBn_DCCR)

The MediaLBn Device Control Configuration Register (MLBn_DCCR) is used to control basic features of the MediaLB, such as clock rate, pinout, lock status, enable and device addressing.

REGISTER_NAME	YOURPERIn_CSRI
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLBn Device Control Configuration Register (MLBn_DCCR)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	MDE	LBM	MCS[1]	MCS[0]	M5PS	MLK	MLE	MHRE
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R,WX	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	MRS	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R/W	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	MDA[7]	MDA[6]	MDA[5]	MDA[4]	MDA[3]	MDA[2]	MDA[1]	MDA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31] MDE : MediaLB Device Enable

Enables the operation of MediaLB interface.

Bit	Description
0	Disables MediaLB Interface.
1	Enables MediaLB Interface based on the other bits in the register.

[bit30] LBM : Loop-Back Mode Enable

Sets whether the loopback test for the MediaLB bus between even logical channel N (reception setting) and odd logical channel N+1 (transmission setting) is enabled or disabled.

Bit	Description
0	Normal operation. Disables Loop-back test mode.
1	Enables Loop-back test mode.

Note:

- For more information on Loop-BackTest mode please contact SMSC support.

[bit29:28] MCS[1:0] : MediaLB Clock Select

Sets the MediaLB transfer rate.

This field must be programmed by the system software to reflect the MLB_n_MLBCLK speed.

Bits	Description
00	256Fs - supports 8 quadlets per frame
01	512Fs - supports 16 quadlets per frame
10	1024Fs - supports 32 quadlets per frame
11	Reserved

It is prohibited to set this bit field to "11"

[bit27] M5PS : MediaLB 5-Pin Select

Selects MediaLB 5-pin or 3-pin configuration.

Bit	Description
0	3-pin MediaLB mode
1	5-pin MediaLB mode

Note:

- This device does not support 5-pin MediaLB interface and therefore writing "1" to this bit is prohibited. Make sure the bit is set to "0".

[bit26] MLK : MediaLB Lock

Indicates whether MediaLB is in sync with the MediaLB frame (lock).

Bit	Description
0	Unlocked state
1	Locked state

When set, it indicates that the MediaLB Port is synchronized to the incoming MediaLB frame.

If MLK is clear (unlocked), MLK is set after FRAMESYNC is detected at the same position for three consecutive frames. If MLK is set (locked), MLK is cleared after not receiving FRAMESYNC at the expected time for two consecutive frames. While MLK is set, FRAMESYNC patterns occurring at locations other than the expected one are ignored.

Note:

- When MLB_n_DCCR:MRS is set to "1", this bit is cleared to "0". When MLB_n_DCCR:MDE is "0", the lock is not detected.

[bit25] MLE : MediaLB Little Endian mode

This field determines how MediaLB data (quadlet-based) is stored in system memory.

Bit	Description
0	Big Endian mode
1	Little Endian mode

[bit24] MHRE : MediaLB Hardware Reset Enable

This bit enables the hardware to automatically reset the MediaLB physical and link layer logic upon reception of the reset command.

Resetting is preformed by the reset request from the Intelligent Network Interface Controller (INIC).

Resetting is performed when either the global (MLB_n_SDCR:MSD = 0x00: all of MediaLB are targeted for reset) MlbReset (0xFE) or device-specific (MLB_n_SDCR:MSD = DA: MediaLB designated by Device Address is targeted for reset) MlbReset(0xFE) is received from INIC.

Bit	Description
0	Disables resetting upon reception of reset command
1	Enables resetting upon reception of reset command

[bit23] MRS : MediaLB Software Reset

When set, this bit resets the MediaLB physical and link layer. It is cleared automatically by hardware after the reset execution is complete.

Bit	Description
0	Normal operation
1	Reset

Note:

- Even when the *MLBn_DCCR:MHRE* bit is "1" and the reset operation by the receipt of the reset command is in progress, this bit is reset to "0" after the execution of the reset command.

[bit22:16] read0 : -

[bit15:8] read0 : -

[bit7:0] MDA[7:0] : MediaLB Device Address

The MediaLB Device Address (MDA[8:1]) sets a unique Device Address (DA) for the MediaLB Device.

The device address is a 16-bit address allocated to identify the MediaLB device.

The DA is used by the system channel MlbScan and MlbReset commands.

The received DA (DA[15:0]) operates as the command target when DA[15:9] and DA[0] are "0" and DA[8:1] matches this bit field.

4.2. MediaLBn System Status Configuration Register (MLBn_SSCR)

The MediaLBn System Status Configuration Register (MLBn_SSCR) is a register to indicate the status of the MediaLB network. MLBn_SSCR is updated for each MediaLB frame.

REGISTER_NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLBn System Status Configuration Register (MLBn_SSCR)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	SSRE	SDMU	SDML	SDSC	SDCS	SDNU	SDNL	SDR
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:8] read0 : -

[bit7] SSRE : System service request enable

Bit	Description
0	System service request response disabled
1	System service request response enable

System software can set this bit to indicate that the MediaLB Device is present and needs service. When this bit is set to "1", RxStatus (RxStatus (DeviceServiceRequest(0x82))) is transmitted as a response to the MlbScan (0xE4) system command. When RxStatus is transmitted, hardware clears this bit to "0".

[bit6] SDMU : System Detects MediaLB Unlock

Bit	Description
0	MediaLB unlock not detected
1	MediaLB unlock detected

This bit is set to indicate that the MediaLB Device has unlocked from the MediaLB frame. If not masked by the System Mask Configuration Register (MLBn_SMCR:SMMU), a system interrupt is generated when MediaLB unlock is detected. Write "1" to clear this bit. Writing "0" has no effect. Once set, this bit holds until it is cleared by software.

Note:

- During the locked state, this bit is set to "1" when the MLBn_DCCR:MRS bit is set to "1".

[bit5] SDML : System Detects MediaLB Lock

Bit	Description
0	MediaLB lock not detected
1	MediaLB lock detected

This bit is set to indicate that the MediaLB Device has locked to the MediaLB frame. If not masked by the System Mask Configuration Register (MLBn_SMCR:SMMU), a system interrupt is generated when the MediaLB lock is detected. Write "1" to clear this bit. Writing "0" has no effect. Once set, this bit holds until it is cleared by software.

[bit4] SDSC : System Detects Subcommand

Bit	Description
0	Subcommand not detected
1	Subcommand detected

This bit is set to indicate that the MediaLB Device has received the MlbSubCmd (0xE6) System Command. The user-defined software command is stored in the MLBn_SDCR register. The decoding of this command is left up to software. If not masked by the System Mask Configuration Register (MLBn_SMCR:SMSC), a system interrupt is generated on detecting MlbSubCmd. Write "1" to clear this bit. Writing "0" has no effect. Once set, this bit holds until it is cleared by software.

[bit3] SDCS : System Detects Channel Scan

Bit	Description
0	Channel scan is not detected
1	Channel scan is detected

This bit is set to indicate that the MediaLB Device has received the MlbScan (0xE4) System Command. The target DeviceAddress is stored in the MLBn_SDCR register. If not masked by the System Mask Configuration Register (MLBn_SMCR:SMCS), a system interrupt is generated on detection of the MlbScan command.

Write "1" to clear this bit. Writing "0" has no effect. Once set, this bit holds until it is cleared by software.

[bit2] SDNU : System Detects Network Unlock

Bit	Description
0	Network unlock not detected
1	Network unlock detected

This bit is set to indicate that the MediaLB Device has received the MOST_Unlock (0xE2) System Command.

If not masked by the System Mask Configuration Register (MLBn_SMCR:SMNU), a system interrupt is generated on detection of the MOST_Unlock command.

Write "1" to clear this bit. Writing "0" has no effect. Once set, this bit holds until it is cleared by software.

[bit1] SDNL : System Detects Network Lock

Bit	Description
0	Network lock not detected
1	Network lock detected

This bit is set to indicate that the MediaLB Device has received the MOST_Lock (0xE0) System Command.

If not masked by the System Mask Configuration Register (MLBn_SMCR:SMNL), a system interrupt is generated on detection of the MOST_Lock command.

Write "1" to clear this bit. Writing "0" has no effect. Once set, this bit holds until it is cleared by software

[bit0] SDR : System Detects Reset

Bit	Description
0	Reset not detected
1	Reset detected

This bit is set to indicate that the MediaLB Device has received the MlbReset (0xFE) System Command. The target DeviceAddress is stored in the MLBn_SDCR register.

If not masked by the System Mask Configuration Register (MLBn_SMCR:SMR), a system interrupt is generated on detection of the MlbReset command.

Write "1" to clear this bit. Writing "0" has no effect. Once set, this bit is sticky until cleared by software.

Note:

- The MediaLBn System Status Configuration register (MLBn_SSCR) allows system software to monitor and control the status of the MediaLB network. MLBn_SSCR is updated once per frame by hardware during the MediaLB System Channel. Except for the bits associated with MediaLB lock and unlock (MLBn_SSCR.SDMU and MLBn_SSCR.SDML), the bits of the MLBn_SSCR register are not valid until the device is locked to the MediaLB interface. System software must service status events before the start of the next MediaLB frame to prevent the current frame status from being lost.

4.3. MediaLBn System Data Configuration Register (MLBn_SDCR)

MediaLBn System Data Configuration Register (MLBn_SDCR) is a register to receive the system channel data for the MediaLB frame. SDCR is updated for each MediaLB frame. System software must read MLBn_SDCR before the start of the next MediaLB frame to prevent the current frame data from being lost.

REGISTER_NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLBn System Data Configuration Register (MLBn_SDCR)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	MSD[31]	MSD[30]	MSD[29]	MSD[28]	MSD[27]	MSD[26]	MSD[25]	MSD[24]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	MSD[23]	MSD[22]	MSD[21]	MSD[20]	MSD[19]	MSD[18]	MSD[17]	MSD[16]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	MSD[15]	MSD[14]	MSD[13]	MSD[12]	MSD[11]	MSD[10]	MSD[9]	MSD[8]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	MSD[7]	MSD[6]	MSD[5]	MSD[4]	MSD[3]	MSD[2]	MSD[1]	MSD[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] MSD[31:0] : MediaLB System Data

This register is loaded with the data from MLBn_MLBDAT during the System Channel quadlet.

The System Data Configuration register (MLBn_SDCR) allows system software to receive control information from the MediaLB Controller.

MLBn_SDCR is updated once per frame by hardware during the MediaLB System Channel. System software must read MLBn_SDCR before the start of the next MediaLB frame to prevent the current frame data from being lost.

4.4. MediaLBn System Mask Configuration Register (MLBn_SMCR)

MediaLBn System Mask Configuration Register (MLBn_SMCR) sets the system interrupt mask

REGISTER_NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB System Mask Configuration Register (MLBn_SMCR)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	read0	SMMU	SMML	SMSC	SMCS	SMNU	SMNL	SMR
ACCESS_TYPE	R0,WX	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	1	1	0	0	0	0	0

[bit31:8] read0 : -

[bit7] read0 : -

[bit6] SMMU : System Masks MediaLB Unlock

Sets whether system interrupt should be masked when unlock was detected from the MediaLB frame. Detection of unlock from the MediaLB frame is indicated by MLBn_SSCR:SDMU.

Bit	Description
0	Interrupt due to detection of unlock from the MediaLB frame is not masked.
1	Interrupt due to detection of unlock from the MediaLB frame is masked.

[bit5] SMML : System Masks MediaLB Lock

Sets whether the system interrupt should be masked when the lock was detected from the MediaLB frame. Detection of the lock from the MediaLB frame is indicated by MLBn_SSCR:SDML.

Bit	Description
0	Interrupt due to detection of lock with MediaLB frame is not masked.
1	Interrupt due to detection of lock with MediaLB frame is masked.

[bit4] SMSC : System Masks Subcommand

Sets whether system interrupt should be masked when the subcommand of the system command, MlbSubCmd(0xE6) is received. The receipt of a subcommand of the system command, MlbSubCmd(0xE6) is indicated by MLBn_SSCR:SDSC.

Bit	Description
0	Interrupt due to the receipt of the MlbSubCmd(0xE6) system command is not masked.
1	Interrupt due to the receipt of the MlbSubCmd(0xE6) system command is masked.

[bit3] SMCS : System Masks Channel Scan

Sets whether system interrupt should be masked when the system command, MlbScan(0xE4) is received. The receipt of system command, MlbScan(0xE4) is indicated by MLBn_SSCR:SDCS.

Bit	Description
0	Interrupt due to the receipt of the MlbScan(0xE4) system command is not masked.
1	Interrupt due to the receipt of the MlbScan(0xE4) system command is masked.

[bit2] SMNU : System Masks Network Unlock

Sets whether system interrupt should be masked when the system command, MOST_Unlock(0xE2) is received. The receipt of the system command, MOST_Unlock(0xE2) is indicated by MLBn_SSCR:SDNU.

Bit	Description
0	Interrupt due to the receipt of the MOST_Unlock(0xE2) system command is not masked.
1	Interrupt due to the receipt of the MOST_Unlock(0xE2) system command is masked.

[bit1] SMNL : System Masks Network Lock

Sets whether system interrupt should be masked when the system command, MOST_Lock(0xE0) is received. The receipt of system command, MOST_Lock(0xE0) is indicated by MLBn_SSCR:SDNL.

Bit	Description
0	Interrupt due to the receipt of the MOST_Lock(0xE0) system command is not masked.
1	Interrupt due to the receipt of the MOST_Lock(0xE0) system command is masked.

[bit0] SMR : System Masks Reset

Sets whether system interrupt should be masked when the system command, MlbReset(0xFE) is received. The receipt of system command, MlbReset(0xFE) is indicated by MLBn_SSCR:SDR.

Bit	Description
0	Interrupt due to the receipt of the MlbReset(0xFE) system command is not masked.
1	Interrupt due to the receipt of the MlbReset(0xFE) system command is masked.

4.5. MediaLBn Version Control Configuration Register (MLBn_VCCR)

MediaLBn Version Control Configuration Register (MLBn_VCCR) is a register to indicate the MediaLB device version.

REGISTER_NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Version Control Configuration Register (MLBn_VCCR)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	UMA[7]	UMA[6]	UMA[5]	UMA[4]	UMA[3]	UMA[2]	UMA[1]	UMA[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	UMI[7]	UMI[6]	UMI[5]	UMI[4]	UMI[3]	UMI[2]	UMI[1]	UMI[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	MMA[7]	MMA[6]	MMA[5]	MMA[4]	MMA[3]	MMA[2]	MMA[1]	MMA[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	MMI[7]	MMI[6]	MMI[5]	MMI[4]	MMI[3]	MMI[2]	MMI[1]	MMI[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:24] UMA[7:0] : User Major Revision Code

User Major Revision Code.

[bit23:16] UMI[7:0] : User Minor Revision Code

User Minor Revision Code.

[bit15:8] MMA[7:0] : MediaLB Major Revision Code

MediaLB Major Revision Code. This field identifies the major revision of the MediaLB module (OS62400) on this device. This value is hard-coded by the vendor.

Note:

- For OS62400 version code information, refer to the device datasheet.

[bit7:0] MMI[7:0] : MediaLB Minor Revision Code

MediaLB Minor Revision Code. This field identifies the minor revision of the MediaLB module (OS62400) implemented on this device. This value is hard-coded by the vendor.

Note:

- For OS62400 version code information, refer to the device datasheet.

4.6. MediaLBn Synchronous Base Address Configuration Register (MLBn_SBCR)

MediaLBn Synchronous Base Address Configuration Register (MLBn_SBCR) defines the base address for synchronous receive/transmit system memory buffers.

REGISTER_NAME	YOURPERIn_CSRI
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Synchronous Base Address Configuration Register (MLBn_SBCR)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	SRBA[15]	SRBA[14]	SRBA[13]	SRBA[12]	SRBA[11]	SRBA[10]	SRBA[9]	SRBA[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	SRBA[7]	SRBA[6]	SRBA[5]	SRBA[4]	SRBA[3]	SRBA[2]	SRBA[1]	SRBA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	STBA[15]	STBA[14]	STBA[13]	STBA[12]	STBA[11]	STBA[10]	STBA[9]	STBA[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	STBA[7]	STBA[6]	STBA[5]	STBA[4]	STBA[3]	STBA[2]	STBA[1]	STBA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:16] SRBA[15:0] : Upper Half of Synchronous Receive Base Address for DMA mode

These bits allow the system software to define the base address (SRBA[31:16]) for synchronous receive system memory buffers.

This base address is shared by all synchronous receive channels and defines the upper 16 bits of the 32-bit address for these channels.

This bit field is only used in DMA mode. In IO mode these bits are not used.

[bit15:0] STBA[15:0] : Upper Half of Synchronous Transmit Base Address for DMA mode

These bits allow the system software to define the base address (STBA[31:16]) for synchronous transmit system memory buffers in DMA mode.

This base address is shared by all synchronous transmit channels and defines the upper 16 bits of the 32-bit address for these channels.

This bit field is only used in DMA mode. In IO mode these bits are not used.

4.7. MediaLBn Asynchronous Base Address Configuration Register (MLBn_ABCR)

MediaLBn Asynchronous Base Address Configuration Register (MLBn_ABCR) defines the base address for asynchronous receive/transmit system memory buffers.

REGISTER_NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Asynchronous Base Address Configuration Register (MLBn_ABCR)

BIT OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	ARBA[15]	ARBA[14]	ARBA[13]	ARBA[12]	ARBA[11]	ARBA[10]	ARBA[9]	ARBA[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ARBA[7]	ARBA[6]	ARBA[5]	ARBA[4]	ARBA[3]	ARBA[2]	ARBA[1]	ARBA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	ATBA[15]	ATBA[14]	ATBA[13]	ATBA[12]	ATBA[11]	ATBA[10]	ATBA[9]	ATBA[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	ATBA[7]	ATBA[6]	ATBA[5]	ATBA[4]	ATBA[3]	ATBA[2]	ATBA[1]	ATBA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:16] ARBA[15:0] : Upper Half of Asynchronous Receive Base Address for DMA mode

These bits allow system software to define the base address (ARBA[31:16]) for asynchronous receive system memory buffers.

This base address is shared by all asynchronous receive channels and defines the upper 16 bits of the 32-bit system bus address for these channels.

This bit field is only used in DMA mode. In IO mode these bits are not used.

[bit15:0] ATBA[15:0] : Upper Half of Asynchronous Transmit Base Address for DMA mode

These bits allow the system software to define the base address (ATBA[31:16]) for asynchronous transmit system memory buffers in DMA mode.

This base address is shared by all asynchronous transmit channels and defines the upper 16 bits of the 32-bit system bus address for these channels.

This bit field is only used in DMA mode. In IO mode these bits are not used.

4.8. MediaLBn Control Base Address Configuration Register (MLBn_CBCR)

MediaLBn Control Base Address Configuration Register (MLBn_CBCR) defines the base address for control receive/transmit system memory buffers.

REGISTER_NAME	YOURPERIn_CSRI
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Control Base Address Configuration Register (MLBn_CBCR)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	CRBA[15]	CRBA[14]	CRBA[13]	CRBA[12]	CRBA[11]	CRBA[10]	CRBA[9]	CRBA[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	CRBA[7]	CRBA[6]	CRBA[5]	CRBA[4]	CRBA[3]	CRBA[2]	CRBA[1]	CRBA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	CTBA[15]	CTBA[14]	CTBA[13]	CTBA[12]	CTBA[11]	CTBA[10]	CTBA[9]	CTBA[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CTBA[7]	CTBA[6]	CTBA[5]	CTBA[4]	CTBA[3]	CTBA[2]	CTBA[1]	CTBA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:16] CRBA[15:0] : Upper Half of Control Receive Base Address for DMA mode

These bits allow the system software to define the base address (CRBA[31:16]) for control receive system memory buffers.

This base address is shared by all control receive channels and defines the upper 16 bits of the 32-bit system bus address for these channels.

This bit field is only used in DMA mode. In IO mode these bits are not used.

[bit15:0] CTBA[15:0] : Upper Half of Control Transmit Base Address for DMA mode

These bits allow the system software to define the base address (CTBA[31:16]) for control transmit system memory buffers in DMA mode.

This base address is shared by all control transmit channels and defines the upper 16 bits of the 32-bit system bus address for these channels.

This bit field is only used in DMA mode. In IO mode these bits are not used.

4.9. MediaLBn Isochronous Base Address Configuration Register (MLBn_IBCR)

MediaLBn Isochronous Base Address Configuration Register (MLBn_IBCR) defines the base address for control receive/transmit system memory buffers.

REGISTER_NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Isochronous Base Address Configuration Register (MLBn_IBCR)

BIT OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	IRBA[15]	IRBA[14]	IRBA[13]	IRBA[12]	IRBA[11]	IRBA[10]	IRBA[9]	IRBA[8]
ACCESS_TYPE	RpWp	RpWp	RpWp	RpWp	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	IRBA[7]	IRBA[6]	IRBA[5]	IRBA[4]	IRBA[3]	IRBA[2]	IRBA[1]	IRBA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	ITBA[15]	ITBA[14]	ITBA[13]	ITBA[12]	ITBA[11]	ITBA[10]	ITBA[9]	ITBA[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	ITBA[7]	ITBA[6]	ITBA[5]	ITBA[4]	ITBA[3]	ITBA[2]	ITBA[1]	ITBA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:16] IRBA[15:0] : Upper Half of Isochronous Receive Base Address for DMA mode

These bits allow the system software to define the base address (IRBA[31:16]) for isochronous receive system memory buffers.

This base address is shared by all isochronous receive channels and defines the upper 16 bits of the 32-bit system bus address for these channels.

This bit field is only used in DMA mode. In IO mode these bits are not used.

[bit15:0] ITBA[15:0] : Upper Half of Isochronous Transmit Base Address for DMA mode

These bits allow the system software to define the base address (ITBA[31:16]) for isochronous transmit system memory buffers in DMA mode.

This base address is shared by all isochronous transmit channels and defines the upper 16 bits of the 32-bit system bus address for these channels.

This bit field is only used in DMA mode. In IO mode these bits are not used.

4.10. MediaLBn Channel Interrupt Configuration Register (MLBn_CICR)

MediaLBn Channel Interrupt Configuration Register (MLBn_CICR) reflects the channel interrupt status. These bits are set by hardware when a channel interrupt is generated.

REGISTER_NAME	YOURPERIn_CSRI
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Channel Interrupt Configuration Register (MLBn_CICR)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	CNSU[15]	CNSU[14]	CNSU[13]	CNSU[12]	CNSU[11]	CNSU[10]	CNSU[9]	CNSU[8]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CNSU[7]	CNSU[6]	CNSU[5]	CNSU[4]	CNSU[3]	CNSU[2]	CNSU[1]	CNSU[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:16] read0 : -

[bit15:0] CNSU[15:0] : Channel Status Update (for Channel 15 through 0)

CNSU[n] indicates whether there is an interrupt for Channel n.

Bit	Description
0	If CNSU[n] is "0" there is no interrupt for Channel n.
1	If CNSU[n] is "1" Channel n has an interrupt.

Note:

- Writing to the MLBn_CICR register has no effect. To clear a particular bit in MLBn_CICR, software must clear all of the unmasked status bits in the corresponding MLBn_CSCRn register. For example, if MLBn_CNSU[4] is set, writing FFFFh to MLBn_CSCR4[15:0] releases the channel interrupt (MLBn_CINT) and clears MLBn_CICR[4].

4.11. MediaLBn AHB Master Control Register (MLBn_AHBMCTL)

MediaLBn AHB Master Control Register (MLBn_AHBMCTL) controls the AHB Bus Request from MediaLB Master.

REGISTER_NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB AHB Master Control Register (MLBn_AHBMCTL)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	MAXTRANS[15]	MAXTRANS[14]	MAXTRANS[13]	MAXTRANS[12]	MAXTRANS[11]	MAXTRANS[10]	MAXTRANS[9]	MAXTRANS[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	MAXTRANS[7]	MAXTRANS[6]	MAXTRANS[5]	MAXTRANS[4]	MAXTRANS[3]	MAXTRANS[2]	MAXTRANS[1]	MAXTRANS[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	MCYCNONR EQ[15]	MCYCNONR EQ[14]	MCYCNONR EQ[13]	MCYCNONR EQ[12]	MCYCNONR EQ[11]	MCYCNONR EQ[10]	MCYCNONR EQ[9]	MCYCNONR EQ[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	MCYCNONR EQ[7]	MCYCNONR EQ[6]	MCYCNONR EQ[5]	MCYCNONR EQ[4]	MCYCNONR EQ[3]	MCYCNONR EQ[2]	MCYCNONR EQ[1]	MCYCNONR EQ[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:16] MAXTRANS[15:0]

Always write "0" to this register. Read value is "X".

[bit15:0] MCYCNONREQ[15:0]

Always write "0" to this register. Read value is "X".

4.12. MediaLBn Channel Entry Configuration Register (MLBn_CECR0 - MLBn_CECR15)

MediaLBn Channel Entry Configuration Register (MLBn_CECRn) defines basic attributes for a given logical channel, such as the channel enable, channel type, channel direction, and channel address. There are 16 such registers corresponding to 16 logical MediaLB channels. The definition of the bit fields in the MLBn_CECRn register depends on the selected channel type.

REGISTER_NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Channel Entry Configuration Register (MLBn_CECR0 - MLBn_CECR15)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	CE	TR	CT[1]	CT[0]	FCE	MDS[1]	MDS[0]	read0
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	MASK[7]	MASK[6]	MASK[5]	MASK[4]	MASK[3]	MASK[2]	MASK[1]	MASK[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	IPL[7]	IPL[6]	IPL[5]	IPL[4]	IPL[3]	IPL[2]	IPL[1]	IPL[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CA[7]	CA[6]	CA[5]	CA[4]	CA[3]	CA[2]	CA[1]	CA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31] CE : Channel Enable

Enables channels

Bit	Description
0	Channel Disabled
1	Channel enabled

[bit30] TR : Channel Transmit Select

Sets whether the channel is for transmission or reception.

Bit	Description
0	Receive
1	Transmit

[bit29:28] CT[1:0] : Channel Type Select

Sets the channel type selection.

Bits	Description
00	Synchronous
01	Isochronous
10	Asynchronous
11	Control

[bit27] FCE : Flow Control Enable

For Isochronous channel, when set allows an isochronous receive channel to generate the ReceiverBusy(0x10) response.

Bit	Description
0	Generation of ReceiverBusy(0x10) response prohibited
1	Generation of ReceiverBusy(0x10) response allowed

For Asynchronous and control channel, this bit (PCE) sets whether the reception packet counter should be enabled. This bit is valid for asynchronous and control receive channels in IO Mode only.

Bit	Description
0	Reception packet counter disable
1	Reception packet counter enable

For Synchronous channel this bit (FSE) sets whether the frame synchronization for the streaming channel should be enabled.

Bit	Description
0	Frame synchronization disable
1	Frame synchronization enable

[bit26:25] MDS[1:0] : Channel Mode Select

Sets the channel mode.

Bits	Description
00	DMA mode enable (Ping-pong buffering)
01	DMA mode enable (Circular buffering)
10	IO mode enable
11	Reserved. It is prohibited to set MDS[1:0] = "11"

Set either DMA mode or IO mode for the channels to be used. All channels must be set to either DMA mode or IO mode. It is prohibited to set the IO mode and DMA mode in a mixed manner.

[bit24] read0 : -

[bit23:16] MASK[7:0] : Channel interrupt mask

MASK[7] - Reserved bit. Read value is "0". Write always "0" to this bit.

MASK[6] - Sets whether channel interrupt due to the frame sync lost should be masked. The status bit targeted for masking is CSCRn:STS[6].

Bit	Description
0	Lost frame synchronization interrupt is not masked
1	Lost frame synchronization interrupt is masked

MASK[5] - Reserved bit. Read value is "0". Write always "0" to this bit.

MASK[4] - Sets whether the channel interrupt due to a buffer error should be masked. The status bit targeted for masking is CSCRn:STS[4].

Bit	Description
0	Buffer error channel interrupt is not masked
1	Buffer error channel interrupt is masked

MASK[3] - This bit has different interpretation depending on DMA-mode or IO-mode and sets the mask for channel interrupts. The status bit targeted for masking is CSCRn:STS[3].

For DMA mode, it masks the buffer start interrupt.

For IO mode, it masks the transmission service request interrupt.

Bit	Description
0	Channel interrupt is not masked
1	Channel interrupt is masked

MASK[2] - This bit has different interpretation depending on DMA-mode or IO-mode and sets the mask for channel interrupts. The status bit targeted for masking is CSCRn:STS[2].

For DMA mode, it masks the buffer end interrupt.

For IO mode, it masks the reception service request interrupt or reception packet abort interrupt.

Bit	Description
0	Channel interrupt is not masked
1	Channel interrupt is masked

MASK[1] - Sets whether the channel interrupt due to the detection of break should be masked. The status bit targeted for masking is CSCRn:STS[1].

Bit	Description
0	Break detection channel interrupt is not masked
1	Break detection channel interrupt is masked

MASK[0] - Sets whether the channel interrupt due a protocol error should be masked. The status bit targeted for masking is CSCRn:STS[0].

Bit	Description
0	Protocol error channel interrupt is not masked
1	Protocol error channel interrupt is masked

[bit15:8] IPL[7:0] : Packet Length

■ For Isochronous channels:

For Isochronous transmit channels these bits define the number of packet bytes. The smallest isochronous packet size per frame is 5 bytes (IPL[7:0] >= 5).

For Isochronous receive channels, software must program IPL[7:2] to indicate the expected number of bytes per packet, where as IPL[1:0] always equals "00". A packet length of 8 is indicated by IPL=0x08, a

packet length of 12 is indicated by IPL=0x0C, a packet length of 252 is indicated by IPL=0xFC. However, a packet length of 256 bytes is represented as IPL[7:0]=0x00.

■ For Synchronous channel:

IPL[7]/FSCD sets frame synchronization disable.

Bit	Description
0	Frame synchronization channel is not disable
1	Frame synchronization channel disabled

IPL[6:5] - These bits are not used.

IPL[4:0]/FSPC[4:0] sets the number of frame synchronous physical channels. In other words, it defines the number of physical channels that match with the channel address (CECRn:CA[8:1]) among the synchronous channels contained in one frame.

■ For Asynchronous/Control channel:

IPL[7:5] - These bits are not used for Asynchronous/Control channel.

IPL[4:0]/PCTH[4:0] sets the packet count threshold. This bit field sets the number of packets to receive before generating a receive packet-count service request.

When the number of received packets has reached this setting, a reception service request is generated.

Also, when the local channel buffer has become full, a reception service request is generated.

When using this bit, it is recommended that the software sets LCBCRn:TH[6:0]=0x00. Set "000" for IPL[7:5]. PCTH[4:0] are valid only in the IO mode.

[bit7:0] CA[7:0] : Channel Address

Sets the channel address of the logical channel.

These bits determine the ChannelAddress (CA[8:1]) associated with this logical channel. This value is matched against the ChannelAddress of each received physical channel from the MediaLB Controller. There is a ChannelAddress match if and only if the ChannelAddress recovered from the MediaLB input, MLBn_MLBSIG, equals the ChannelAddress defined by:

$$CA[15:0] = \{7'h00, CA[8:1], 1'b0\}$$

4.13. MediaLBn Channel Status Configuration Register (MLBn_CSCR0 - MLBn_CSCR15)

MediaLBn Channel Status Configuration Register (MLBn_CSCRn) reflects the status of the current buffer and previous buffer for the logical channel n. There are 16 such registers corresponding to 16 logical MediaLB channels. The definitions of the bit fields in the MLBn_CSCRn register depends on the selected channel type.

REGISTER_NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Channel Status Configuration Register (MLBn_CSCR0 - MLBn_CSCR15)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	BM	BF	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R,WX	R,WX	R0,WX	R0,WX	R0,WX	R0,WX	p0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	1	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	read0	read0	read0	read0	IVB[1]	IVB[0]	GB	RDY
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R,WX	R,WX	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	STS[3]	STS[2]	STS[1]	STS[0]	STS	STS	STS	STS
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	STS	STS	STS	STS	STS	STS	STS	STS
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31] BM : Buffer Empty

This bit indicates that the local channel buffer is empty.

Bit	Description
0	Local channel buffer not empty
1	Local channel buffer empty

Note:

- This bit is set and cleared by hardware.

[bit30] BF : Buffer Full

This bit indicates that the local channel buffer is full.

Bit	Description
0	Local channel buffer not full
1	Local channel buffer full

Note:

- This bit is set and cleared by hardware.

[bit29:20] read0 : -

[bit19:18] IVB[1:0] : Isochronous Valid Bytes

These bits are loaded by hardware with the number of valid bytes in the last packet of a broken Isochronous receive channel. Used in conjunction with CCBCRn.BCA, IVB[1:0] can be used by software to determine the final valid byte of the local channel buffer.

Note:

- Valid for local channel buffers configured for isochronous RX data.

Bits	Description
00	Final valid byte = (CCBCRn.BCA - 5)
01	Final valid byte = (CCBCRn.BCA - 4).
10	Final valid byte = (CCBCRn.BCA - 3)
11	Final valid byte = (CCBCRn.BCA - 2)

[bit17] GB : Generate Break

This bit has different interpretation depending on the channel configuration.

For Synchronous channel, this bit is not used.

For Isochronous channel, the function of this bit is to Generate the Isochronous Receive Break (GIRB). When set, this bit causes the hardware to terminate the current packet, flush the local channel buffer, clear the RDY bit, and load CSCRn:IVB[1:0]. This bit is set by system software and cleared by hardware. It is valid for local channel buffers configured for isochronous RX data.

For Asynchronous and Control Channel, this bit (GB) enables break generation. When the local channel buffer is configured for transmitting data, the setting of this bit causes the hardware to send the AsyncBreak (0x26) or ControlBreak (0x36) command and stop the transfer. When the local channel buffer is configured for receiving data, the setting of this bit causes hardware to send the MediaLB RxStatus ReceiverBreak (0x70) and stop the transfer. This bit is set by system software and cleared by hardware.

[bit16] RDY : Next Buffer Ready

This bit has a different interpretation depending on DMA-mode or IO-mode.

In IO Mode this bit is not used.

In DMA Mode, system software should set this bit when all the registers, data and program memory variables are setup and ready to transmit or receive data in DMA Mode.

For transmitting data, the system memory buffer should also be filled. For DMA Mode using ping-pong buffering, hardware clears this bit after the buffer begins to be processed.

In DMA Mode using circular buffering, the software should clear this bit only when buffer processing needs to halted.

[bit15:12] STS : STS[15-12] Reserved

Read value is "0". Write always "0" to these bits.

[bit11] STS : STS[11]

This bit has a different interpretation depending on DMA-mode or IO-mode.

In DMA mode this is the Previous Buffer Start bit. When set, this bit indicates the first quadlet of the Previous Buffer has been successfully transmitted or received. The setting of this bit generates a maskable channel interrupt to system software. This bit is valid for all channel types.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

In IO Mode, this bit is not used.

[bit10] STS : STS[10]

This bit has a different interpretation depending on DMA-mode or IO-mode.

In DMA mode this is the Previous Buffer Done bit. When set, this bit indicates the last quadlet of the Previous Buffer has been successfully transmitted or received. The setting of this bit generates a maskable channel interrupt to system software. This bit is valid for all channel types.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

In IO Mode, this bit is not used.

[bit9] STS : STS[9]

This bit has different interpretation depending on DMA-mode or IO-mode.

In DMA mode this is the Previous Buffer Detect Break bit. When set, this bit indicates that either a transmit channel has detected a receiver break response, ReceiverBreak (0x70), or a receive channel has detected a transmitter break command, ControlBreak (0x36) or AsyncBreak (0x26), while processing the Previous Buffer.

The setting of this bit generates a maskable channel interrupt to system software. This bit is valid for all channel types.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

In IO Mode this is Receive Packet Start bit. When set, this bit indicates that an RX channel has detected a transmitter packet start command; ControlStart (0x30) or AsyncStart (0x20). This status bit can be used by system software to detect when it has reached the end of an aborted packet. This bit is valid for asynchronous and control RX channels only.

Note:

- In IO Mode, the STS[9] bit cannot be programmed to generate a channel interrupt. System software must poll this bit following a Receive Packet Abort (see MLBn_CSCR:STS[8]). As each quadlet of the broken packet is popped from the local channel buffer, software must check to see if the next quadlet is the start of a new packet. When software detects a Receive Packet Start, it can start processing valid data.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

[bit8] STS : STS[8]

This bit has different interpretation depending on DMA-mode or IO-mode.

In DMA mode this is Previous Buffer Protocol Error bit. When set, this bit indicates that either a transmit channel has detected an RxStatus of ReceiverProtocolError (0x72), a receive channel has detected an invalid command for this channel type, or an additional AsyncStart (0x20) or ControlStart (0x30) command has been received while in the middle of a packet.

The setting of this bit generates a maskable channel interrupt to system software. This bit is valid for all receive channels and valid for only asynchronous and control transmit channels.

In IO mode this is Receive Packet Abort bit. When set, this bit indicates that a receive channel has detected an aborted packet. Received packets are aborted if the receiver generates a break response, ReceiverBreak (0x70), or detects a transmitter packet break command; ControlBreak (0x36) or AsyncBreak (0x26).

This bit can also indicate the receive channel has detected a transmit command protocol error. The setting of this bit generates a maskable channel interrupt to system software. This interrupt can be used by system software to detect when it has encountered the beginning of an aborted packet. This bit is valid for asynchronous and control receive channels only.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software

[bit7] STS : STS[7] - Reserved

Read value is "0". Always write "0" to this bits.

[bit6] STS : STS[6] - Lost Frame Synchronization bit

When set, this bit indicates that the logical channel has lost synchronization with the MediaLB frame. The setting of this bit generates a maskable channel interrupt to system software. This bit is valid for synchronous channels only.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

[bit5] STS : STS[5]

This bit has a different interpretation depending on DMA-mode or IO-mode.

In DMA mode this is Host Bus Error bit. When set, this bit indicates that an HBI bus error has been detected. The setting of this bit generates a non-maskable channel interrupt to system software.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

In IO Mode, this bit is not used.

[bit4] STS : STS[4] : Buffer Error bit

When set, this bit indicates that either a transmit channel has detected a buffer underflow (e.g., attempted to pop data from an empty buffer), or a receive channel has detected a buffer overflow (e.g., attempted to push data onto a full buffer).

The setting of this bit generates a maskable channel interrupt to the system software. This bit is valid for synchronous receive/transmit and isochronous receive (MLBn_CECRn:FCE = 0) channels only.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

[bit3] STS : STS[3]

This bit has different interpretation depending on DMA-mode or IO-mode.

In DMA mode this is Current Buffer Start bit. When set, this bit indicates that the DMA controller has started processing the Current Buffer. This bit is set after the contents of MLBn_CNBCRn have been loaded into MLBn_CCBCRn, the MLBn_CSCRn:RDY bit has been cleared (for ping-pong buffering), and hardware is available to accept the next buffer.

The setting of this bit generates a maskable channel interrupt to system software. This bit is valid for all channel types.

In IO mode this is a Transmit Service Request bit. When set, it indicates that a transmit channel requests service from the system software. Transmit service requests are issued if the number of valid quadlets in the local channel buffer is less than or equal to MLBn_LCBCRn:TH[6:0].

The setting of this bit generates a maskable channel interrupt to the system software. This bit is valid for all channel types.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

[bit2] STS : STS[2]

This bit has different interpretation depending on DMA-mode or IO-mode.

In DMA mode this is Current Buffer Done bit. When set, this bit indicates that the last quadlet from the last packet (in the Current Buffer) has been successfully transmitted or received. The setting of this bit generates a maskable channel interrupt to system software. This bit is valid for all channel types.

In IO mode this bit is the Receive Service Request bit. When set, this bit indicates that a receive channel is requesting service from system software. Receive service requests are issued if the number of free quadlets in the local channel buffer is less than or equal to MLBn_LCBCRn:TH[6:0]. The setting of this bit generates a maskable channel interrupt to system software. This bit is valid for all channel types.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

[bit1] STS : STS[1] : Current Buffer Detect Break bit.

When set, this bit indicates that either a transmit channel has detected a receiver break response, ReceiverBreak (0x70), or a receive channel has detected a transmitter break command, ControlBreak (0x36) or AsyncBreak (0x26), while processing the Current Buffer. The setting of this bit generates a maskable channel interrupt to system software. This bit is valid for asynchronous and control channels only.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

[bit0] STS : STS[0] : Current Buffer Protocol Error bit

This bit indicates that either a transmit channel has detected an RxStatus of ReceiverProtocolError (0x72), a receive channel has detected an invalid command for a given channel type, or an additional ControlStart (0x30) or AsyncStart (0x20) command has been received while in the middle of a packet.

The setting of this bit generates a maskable channel interrupt to the system software. This bit is valid for all RX channel types and valid for only asynchronous and control TX channels.

Write "1" to clear this bit. Writing "0" has no effect.

Once set, this bit holds until it is cleared by software.

4.14. MediaLBn Channel Current Buffer Configuration Register (MLBn_CCBCR0 - MLBn_CCBCR15)

MediaLBn Channel n Current Buffer Configuration Register (MLBn_CCBCRn) indicates the address pointer and buffer length of the Current Buffer in system memory for the logical channel n when configured for DMA Mode. When configured for IO Mode it is receive data buffer. There are 16 such registers corresponding to 16 logical MediaLB channels. The definition of the bit fields in the MLBn_CCBCRn register depends on the selected channel type.

REGISTER NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Channel Current Buffer Configuration Register (MLBn_CCBCR0 -

BIT OFFSET	31	30	29	28	27	26	25	24
BIT NAME	BCA[15]	BCA[14]	BCA[13]	BCA[12]	BCA[11]	BCA[10]	BCA[9]	BCA[8]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	23	22	21	20	19	18	17	16
BIT NAME	BCA[7]	BCA[6]	BCA[5]	BCA[4]	BCA[3]	BCA[2]	BCA[1]	BCA[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	15	14	13	12	11	10	9	8
BIT NAME	BFA[15]	BFA[14]	BFA[13]	BFA[12]	BFA[11]	BFA[10]	BFA[9]	BFA[8]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	7	6	5	4	3	2	1	0
BIT NAME	BFA[7]	BFA[6]	BFA[5]	BFA[4]	BFA[3]	BFA[2]	BFA[1]	BFA[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:16] BCA[15:0] : Buffer Current Address

This bit field has different interpretations for DMA mode and IO mode.

In DMA mode, the BCA field defines a 16-bit address pointer, which identifies the lower half of the beginning address of the Current Buffer in system memory. The BCA[15:2] bits are loaded from MLBn_CNBCRn.BSA[15:2] when the Next Buffer is ready for processing. This Current Buffer address pointer, except when associated with isochronous channels, should always be quadlet aligned (i.e., set BCA[1:0] to "00" for Synchronous, Asynchronous and Control channels). During the processing of the Current Buffer, the BCA field marks which quadlet of the buffer is currently being processed. The upper half of the beginning address of the Current Buffer is system memory is defined by MLBn_SBCR.SRBA, MLBn_ABCR.ARBA, MLBn_CBCR.CRBA, or MLBn_IBCR.IRBA when MLBn_CECRn.TR is clear; MLBn_SBCR.STBA, MLBn_ABCR.ATBA, MLBn_CBCR.CTBA, or MLBn_IBCR.ITBA when MLBn_CECRn.TR is set, dependant on the value of MLBn_CECRn.CT[1:0].

In IO mode, this bit field defines the Receive Data Buffer bits - RDB[31:16].

This field contains the upper half of the next quadlet of receive data when the logical channel is configured as receive channel.

[bit15:0] BFA[15:0] : Buffer Final Address

This bit field has different interpretations for DMA mode and IO mode.

In DMA mode, the BFA field defines a 16-bit address pointer, which identifies the lower half of the ending address of the Current Buffer in system memory. The BFA[15:2] bits are loaded from MLBn_CNBCRn.BEA[15:2] when the Next Buffer is read for processing. This Current Buffer address pointer, except when associated with isochronous channels, should always be quadlet aligned (i.e., BFA[1:0] equals "00" for Synchronous, Asynchronous and Control channels). During the processing of the Current Buffer, the point at which the BCA field becomes equal to (or greater than) the BFA field indicates that the processing of the Current Buffer will end upon successful completion of the current quadlet (for isochronous and synchronous channels) or upon successful completion of the current packet (for asynchronous and control channels). It is the responsibility of system software to ensure the system memory buffers (for RX asynchronous and control channels) can accommodate overflow in the size of the largest packet supported. Additionally, single-packet buffering can be used by simply programming MLBn_CNBCRn.BSA[15:2] = MLBn_CNBCRn.BEA[15:2].

The upper half of the ending address of the Current Buffer in system memory is defined by MLBn_SBCR.SRBA, MLBn_ABCR.ARBA, MLBn_CBCR.CRBA, and MLBn_IBCR.IRBA when MLBn_CECRn.TR is clear; MLBn_SBCR.STBA, MLBn_ABCR.ATBA, MLBn_CBCR.CTBA, or MLBn_IBCR.ITBA when MLBn_CECRn.TR is set, dependant on the value of MLBn_CECRn.CT[1:0].

In IO mode, this bit field defines the Receive Data Buffer bits - RDB[15:0].

This field contains the lower half of the next quadlet of receive data when the logical channel is configured as receive channel.

4.15. MediaLBn Channel Next Buffer Configuration Register (MLBn_CNBCR0 - MLBn_CNBCR15)

The Channel n Next Buffer Configuration Register (MLBn_CNBCRn) configures the start and end addresses of the Next Buffer in system memory for the logical channel when configured for DMA Mode. When configured for IO Mode, the MLBn_CNBCRn registers is the Transmit Data Buffer. There are 16 such registers corresponding to 16 logical MediaLB channels. The definition of the bit fields in the MLBn_CNBCRn register depend on the selected channel type.

REGISTER NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLBn Channel Next Buffer Configuration Register (MLBn_CNBCR0 - MLBn_CNBCR15)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	BSA[15]	BSA[14]	BSA[13]	BSA[12]	BSA[11]	BSA[10]	BSA[9]	BSA[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	BSA[7]	BSA[6]	BSA[5]	BSA[4]	BSA[3]	BSA[2]	BSA[1]	BSA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	BEA[15]	BEA[14]	BEA[13]	BEA[12]	BEA[11]	BEA[10]	BEA[9]	BEA[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	BEA[7]	BEA[6]	BEA[5]	BEA[4]	BEA[3]	BEA[2]	BEA[1]	BEA[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:16] BSA[15:0] : Buffer Start Address bits

This bit field has different interpretations for DMA mode and IO mode.

In DMA mode, the BSA field defines a 16-bit address pointer, which identifies the lower half of the beginning address of the Next Buffer in system memory. Once system software detects MLBn_CSCRn.RDY has been cleared by hardware (for ping-pong buffering), the beginning address of the Next Buffer may be loaded into BSA[15:2]. System software should then set MLBn_CSCRn.RDY. Once processing of the Current Buffer for the logical channel is complete, the BSA[15:2] field is loaded into the MLBn_CCBCRn.BCA[15:2] field and processing of the next buffer can begin. This Next Buffer address pointer must always be quadlet aligned (e.g., BSA[1:0] must be written as "00"). The upper half of the beginning address of the Next Buffer in system memory is defined by MLBn_SBCR.SRBA, MLBn_ABCR.ARBA, MLBn_CBCR.CRBA, or MLBn_IBCR.IRBA when MLBn_CECRn.TR is clear; MLBn_SBCR.STBA, MLBn_ABCR.ATBA, MLBn_CBCR.CTBA, or MLBn_IBCR.ITBA when MLBn_CECRn.TR is set, dependant on the value of MLBn_CECRn.CT[1:0].

Note:

- For BSA[1:0] bits in DMA mode, read value is "X". Write always "0" to these bits. In IO mode, this bit field defines the Transmit Data Buffer bits - TDB[31:16].

This field contains the upper half of the next quadlet of transmit data when the logical channel is configured as transmit channel.

[bit15:0] BEA[15:0] : Buffer End Address bits

This bit field has different interpretations for DMA mode and IO mode.

In DMA mode, the BEA field defines a 16-bit address pointer, which identifies the lower half of the ending address of the Next Buffer in system memory. Once system software detects MLBn_CSCRn.RDY has been cleared by hardware (for ping-pong buffering), the ending address of the Next Buffer may be loaded into BEA[15:2]. System software should then set MLBn_CSCRn.RDY. Once processing of the Current Buffer for the logical channel is complete, the BEA[15:2] field is loaded into the MLBn_CCBCRn.BFA[15:2] field and processing of the next buffer can begin. The BEA[15:2] bits are loaded into MLBn_CCBCRn.BFA[15:2] when the Current Buffer is finished being processed. This Next Buffer address pointer, except when associated with isochronous channels, should always be quadlet aligned (i.e., set BEA[1:0] to "00" for Synchronous, Asynchronous and Control channels).

The upper half of the ending address of the Next Buffer in system memory is defined by MLBn_SBCR.SRBA, MLBn_ABCR.ARBA, MLBn_CBCR.CRBA, and MLBn_IBCR.IRBA when MLBn_CECRn.TR is clear; MLBn_SBCR.STBA, MLBn_ABCR.ATBA, MLBn_CBCR.CTBA, or MLBn_IBCR.ITBA when MLBn_CECRn.TR is set, dependant on the value of MLBn_CECRn.CT[1:0].

In IO mode, this bit field defines the Transmit Data Buffer bits - TDB[15:0].

This field contains the lower half of the next quadlet of transmit data when the logical channel is configured as transmit channel.

4.16. MediaLBn Local Channel Buffer Configuration Register (MLBn_LCBCR0 - MLBn_LCBCR15)

MediaLBn Local Channel n Buffer Configuration Register (MLBn_LCBCRn) configures the allocation of the local channel buffer area on the RAM for the local channel buffer. There are 16 such registers corresponding to 16 logical MediaLB channels. This register should only be written while the logical channel is disabled. Writing to this register while the corresponding logical channel is enabled may result in unexpected behavior.

REGISTER_NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Local Channel Buffer Configuration Register (MLBn_LCBCR0 - MLBn_LCBCR15)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	read0	read0	TH[6]	TH[5]	TH[4]	TH[3]	TH[2]
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	TH[1]	TH[0]	read0	read0	read0	BD[5]	BD[4]	BD[3]
ACCESS_TYPE	R/W	R/W	R0,WX	R0,WX	R0,WX	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	BD[2]	BD[1]	BD[0]	read0	read0	read0	read0	read0
ACCESS_TYPE	R/W	R/W	R/W	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	read0	read0	SA[5]	SA[4]	SA[3]	SA[2]	SA[1]	SA[0]
ACCESS_TYPE	R0,WX	R0,WX	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:29] read0 : -

[bit28:22] TH[6:0] : Buffer Threshold

TH[6:0] sets the threshold of the local channel buffer. The buffer threshold is set in units of 2 quadlets. This bit is used to determine whether a transmission/reception service request should be issued.

TH[6:0]	Description
0x00	When TH[6:0] is 0x00, an reception service request is generated if the buffer is full and a transmission service request is generated when the buffer is empty.
0x01	Threshold = 2 quadlets
0x02	Threshold = 4 quadlets
...	...
0x7F	Threshold = 254 quadlets

[bit21:19] read0 : -**[bit18:13] BD[5:0] : Buffer Depth**

BD[5:0] sets the depth of the local channel buffer. The depth is set in units of 4 quadlets.

BD[5:0]	Description
0x00	Depth= 4 quadlets
0x01	Depth= 8 quadlets
0x02	Depth= 12 quadlets
...	...
0x3F	Depth= 256 quadlets

[bit12:6] read0 : -**[bit5:0] SA[5:0] : Buffer Start Address**

SA[5:0] sets the start address of the local channel buffer.

SA[5:0]	Description
0x00	RAM Start Address offset of 0 quadlets
0x01	RAM Start Address offset of 4 quadlets
0x02	RAM Start Address offset of 8 quadlets
...	...
0x3F	RAM Start Address offset of 252 quadlets

Note:

- The initial value of SA[5:0] is $n*4$, where n is the channel number (0,1,2 ... 15). The initial value of SA[5:0] for Channel 0 is 0x0, for Channel 1 is 0x4, for Channel 2 is 0x8 and so on.

4.17. MediaLBn Module Identification Register (MLBn_MID)

This register identifies the particular version of the MediaLB hardware used in the device.

REGISTER NAME	YOURPERIn_CSRi
OFFSET	0 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

MediaLB Module Identification Register (MLBn_MID)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	MID[31]	MID[30]	MID[29]	MID[28]	MID[27]	MID[26]	MID[25]	MID[24]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	MID[23]	MID[22]	MID[21]	MID[20]	MID[19]	MID[18]	MID[17]	MID[16]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	MID[15]	MID[14]	MID[13]	MID[12]	MID[11]	MID[10]	MID[9]	MID[8]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	MID[7]	MID[6]	MID[5]	MID[4]	MID[3]	MID[2]	MID[1]	MID[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] MID[31:0] : Module ID

The MediaLB module implemented in the device may vary from device to device. This register identifies the particular version of the hardware used in the device. This register helps in developing software to the hardware version implemented in the device.

Note:

- Please refer to the device specific data sheet for the MID value.

CHAPTER 23: Stereo Audio DAC



This chapter presents the Stereo Audio Digital to Analog Converter(DAC).

1. Overview
2. Configuration and Block Diagram
3. Operation
4. Registers

CODE: ADAC-T01P01R02L01-E1

1. Overview

This section provides a general description of the Stereo Audio DAC

Also refer to the chapter of "Sound System configuration" how to configure the Stereo Audio DAC.

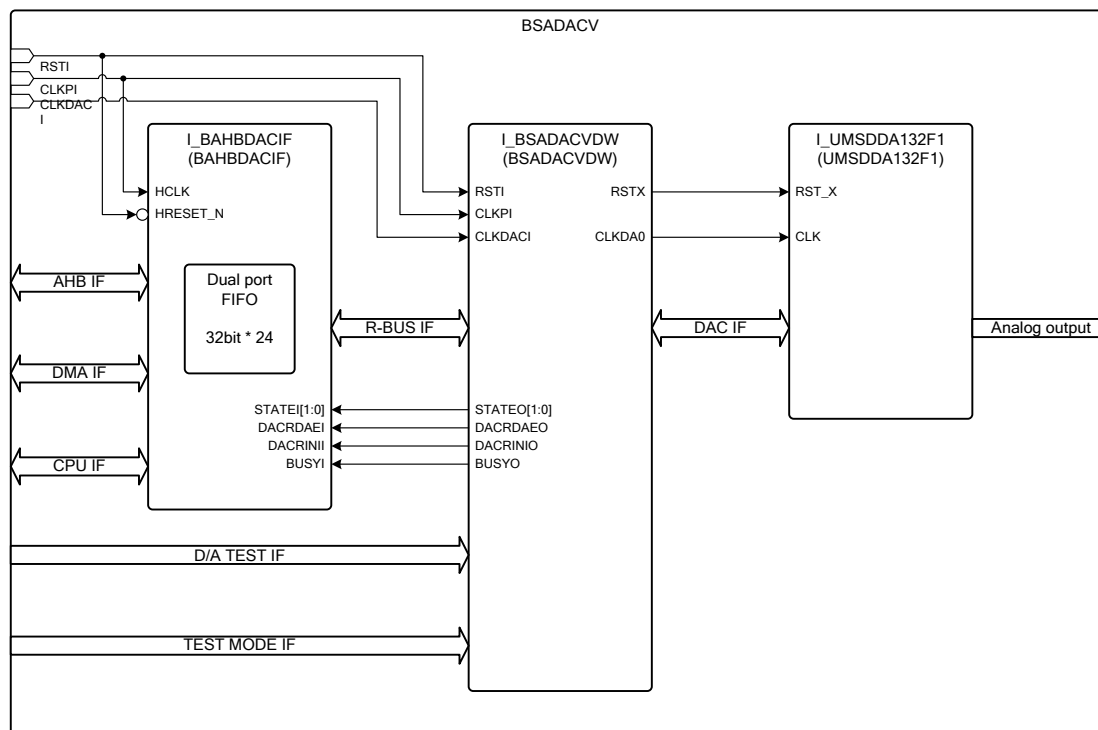
The Stereo Audio DAC is a dual-channel, audio digital-to-analog converter (DAC) that employs a delta-sigma modulator, with a sampling rate of 8-48 kHz, and an oversampling rate of 64-512. The Stereo Audio DAC consists of a digital input interface and an analog DAC, and features a software power-down function for lower power consumption.

The audio data format of the digital interface is a 32 bit word - the upper (lower) 16 bits are used as the data for the left (right) 24 bit channel of the DAC in a left justified manner.

2. Configuration and Block Diagram

This section contains the functional block diagram of the Stereo Audio DAC.

Figure 2-1 Block Diagram



3. Operation

This section describes how to use the Stereo Audio DAC

The Stereo Audio DAC is configured to be used at a sampling frequency of 8-48KHz, an oversampling rate of 64-512, and an operating frequency of 256fs or 512fs.

3.1. Initialization

Reset operation : reset the Stereo Audio DAC after powering up

DMA Interface Unused:

The sequence for powering up the analog DAC is as follows.

- 1) Configure the OSR and DACCLK bit of the DAOSR register.
- 2) Write a "1" into the INIT bit and DAE bit of the DACR register. This will release the power down state of the analog DAC and allow it to power up.
- 3) Wait for at least 300 sampling cycles (1/fs) before proceeding to the next step (step 4)
- 4) Write a "0" into the INIT bit of the DACR register. This will enable the output data pins of the digital interface thus providing data to the analog DAC.
- 5) Configure the PCL/PCR bit of the DPCR register.
- 6) Configure the FEST bit of the DACTRL register.
- 7) Writing the 0x7 into the INTREN register if you want to use DATA_REQ_IRQ, UDRN_IRQ, the OVFL_IRQ. As a result, DATA_REQ_IRQ is asserted.

DMA Interface Used:

The sequence for powering up the analog DAC is as follows.

- 1) Configure the OSR and DACCLK bit of the DAOSR register.
- 2) Write a "1" into the INIT bit and DAE bit of the DACR register. This will release the power down state of the analog DAC and allow it to power up.
- 3) Wait for at least 300 sampling cycles (1/fs) before proceeding to the next step (step 4)
- 4) Write a "0" into the INIT bit of the DACR register. This will enable the output data pins of the digital interface thus providing data to the analog DAC.
- 5) Configure the PCL/PCR bit of the DPCR register.
- 6) Configure the FEST bit of the DACTRL register. Write a "1" into the DMAEN bit of the DACTRL register. As a result, DAC_DMA_REQ is asserted.
- 7) Writing the 0xF into the INTREN register if you want to use DMA_ERR_IRQ, DATA_REQ_IRQ, UDRN_IRQ, OVFL_IRQ. As a result, DATA_REQ_IRQ is asserted.

Note;

- The write access to DAOSR/DACR register is effective at DABUSY_DABUSY=0. Write access to DAOSR / DACR register is discarded in the case of DABUSY_DABUSY=1.
- The data output pins of the analog DAC may take up to 715ms to stabilize after the DAE bit has been set
- The Stereo Audio DAC will generate a pop noise when a transition from high-to-low or low-to-high occurs on the DAE bit of the DACR register during power up or power down. Add external circuitry to suppress such pop noises if necessary.
- Do not change the DPCR register dynamically.

3.2. Using DMA Transfers to Update DADR Register

DMA mode must be enabled by setting the `DACTRL_DMAEN=1`.

The Stereo Audio DAC module will then assert the `DAC_DMA_REQ` output when the number of free entries in the FIFO buffer exceeds the value given by `FEST`. `DAC_DMA_REQ` stays active until the DMA acknowledges the request by asserting `DAC_DMA_ACK`.

There is an internal down counter for this purpose which is reloaded with the value of `FEST+1` when `DAC_DMA_REQ` is asserted. It is decremented with each word written to the FIFO buffer. When the counter reaches zero the transfer is complete and another DMA transfer may be requested. It is an error if the DMA writes data to the FIFO while the down counter is zero.

Note:

- *The block size configured in the DMA must match `DACTRL_FEST+1`*

3.3. Output Data Values of the Analog DAC

The data output pins of the analog DAC will be set to 0V when disabled.

When enabled, with a voltage reference at $0.5 \times AVCC(DAC)$, these pins will generate an output voltage with peak-to-peak values of $0.609 \times AVCC(DAC)$. The table below shows the theoretical output voltage values under typical conditions.

Table 2

DADR[31:16] or DADR[15:0] MSB LSB	DAC Left (or Right) data output pin voltage
0000H	$(0.5 + 0.3365 \times (0/32768)) \times AVCC(DAC)$
0001H	$(0.5 + 0.3365 \times (1/32768)) \times AVCC(DAC)$
0002H	$(0.5 + 0.3365 \times (2/32768)) \times AVCC(DAC)$
....	
7FFE H	$(0.5 + 0.3365 \times (32766/32768)) \times AVCC(DAC)$
7FFF H	$(0.5 + 0.3365 \times (32767/32768)) \times AVCC(DAC)$
8000H	$(0.5 + 0.3365 \times (-32768/32768)) \times AVCC(DAC)$
8001H	$(0.5 + 0.3365 \times (-32767/32768)) \times AVCC(DAC)$
....	
FFFDH	$(0.5 + 0.3365 \times (-3/32768)) \times AVCC(DAC)$
FFFEH	$(0.5 + 0.3365 \times (-2/32768)) \times AVCC(DAC)$
FFFFH	$(0.5 + 0.3365 \times (-1/32768)) \times AVCC(DAC)$

Note:

- The Stereo Audio DAC does not feature integrated output voltage buffers.

3.4. Switching Clock Frequencies of the Analog DAC

The sequence for changing the clock frequency of the analog DAC is as follows.

- 1) Write a "1" into the INIT bit of the DACR register. This will cause the data output pins of the digital interface to output a "00000000h" to the analog DAC.
- 2) Wait for at least 300 sampling cycles ($1/f_s$) before proceeding to the next step (step 3)
- 3) Configure the DACCLK and OSR bits of the DAOSR register. The value of the INIT bit must be "1" throughout this procedure.
- 4) Wait for at least 300 sampling cycles ($1/f_s$) before proceeding to the next step (step 5)
- 5) Write a "0" into the INIT bit of the DACR register. This will enable the output data pins of the digital interface thus providing data to the analog DAC.

3.5. Minimum Writing Interval between the DAOSR and DACR Registers

The write access to the DAOSR/DACR register mounts the asynchronous circuit from CLKPI to CLKDA. DABUSY field indicates that the write access to DAOSR/DACR register has not been completed. The write access to the DAOSR/DACR register is effective only at DABUSY=0. Write access to DAOSR/DACR register is discarded in the case of DABUSY=1.

This rule applies to the following cases:

- Write into the DOSR register → Write into the DAOSR register
- Write into the DOSR register → Write into the DACR register
- Write into the DCR register → Write into the DOSR register
- Write into the DCR register → Write into the DCR register

3.6. Interrupt

The Stereo Audio DAC module interrupts are controlled by three registers: the Interrupt Enable Register (INTREN), the Interrupt Status Register (INTRSTAT) and the Interrupt Clear Register (INTRCLR). After reset all interrupts are disabled. If an interrupt is to be used, it must be first enabled. The current status of an interrupt may be checked at any time in the Interrupt Status Register. The Interrupt Status Register contents are independent of the enable status of the interrupts. I.e. the Interrupt Status Bits are not masked by the Interrupt Enable Register.

If an interrupt has occurred, it can be reset by the Interrupt Clear Register. Writing a logic 1 to a bit in the Interrupt Clear Register clears the corresponding interrupt line as well as the interrupt status bit.

1. Data Request Interrupt

This interrupt indicates there is at least space for another $FEST + 1$ data samples in the FIFO buffer. I.e. the Stereo Audio DAC module asserts the interrupt request when a read from the FIFO buffer frees up another samples slot, so that there are $FEST + 1$ free entries in total.

2. FIFO Buffer Overflow Error Interrupt

This interrupt indicates the CPU has tried to write another data sample to the FIFO buffer when it was already completely filled.

3. FIFO Buffer Under-Run Error Interrupt

This interrupt indicates an under-run of the FIFO buffer for data samples. I.e. the analog DAC has tried to read a data sample from the FIFO buffer when it was empty.

4. DMA Block Error Interrupt

This interrupt indicates an error case when the DMA tries to transfer more data to the FIFO buffer than configured by $DACTRL:FEST + 1$.

3.7. AHB Slave Interface

AHB slave interface controls the read/write access to the FIFO and register access. Table 2 shows the access type of the corresponding AHB.

Table 3 AHB Slave Interface

Item	support
Burst transfer	Stereo Audio DAC supports the burst transfer. However, the burst transfer is processed as a single transfer.
Protection control	not support
response	OKAY and ERROR only
Access size	8,16,32bit only
Width of address	10bit

The following accesses cause the slave error response.

- 1) When the access destination is an address that does not exist in the memory map.
- 2) The write access was done to the read only register.
- 3) When the access size is a size not supported. (For example, it accessed DADR with 8bit or 16bit.)

3.8. FIFO

FIFO for data is built into the Stereo Audio DAC module. Table 3 shows the specifications of the FIFO. It accesses FIFO through the DADR0-15 register. It becomes possible to access FIFO by accessing either of register of DADR0-15. The access to FIFO is not related to the address of DADR. The access to FIFO is done in order of the access regardless of the address of DADR0-15.

Table 4 Outline of FIFO

Item	Content
Width of data	32bit
Width of address	5bit
Depth	24
Composition	Register

3.9. Frequency of CLKPI and CLKDA

Please set the clock that meets the following requirements to CLKPI (bus clock) and sampling clock CLKDA (CLKDAC1 is divides)

$$\text{CLKPI} \geq \text{CLKDA} / 17$$

FIFO operates with CLKPI, and the portion of analog circuit does with CLKDA. Then, CLKDA should be fast enough for data to be transferred from FIFO to analog circuit.

3.10. Sampling Frequency and Oversampling Setting of D/A Converter

The input of analogDAC is decided by setting DAOSR_OSR and DAOSR_DACCLK. Table 4 and Table 5 show the example of the set value to DAOSR_OSR and DAOSR_DACCLK.

Table 5 shows System Clock and over sampling ratio.

Table 6 shows Setting of dividing frequency.

Table 5 System Clock and over Sampling Ratio

Sampling frequency (fs)[kHz]	pin setting	OSR	system clock frequency
	OSR[1:0]		
8, 11.025, 12	11	512	512fs
16, 22.05, 24	10	256	256fs
32, 44.1, 48	01	128	256fs

Notes:

- 384fs is not supported.
- OSR[1:0]=00 is not supported.
- OSR[1:0] is OSR field of the DAOSR register.

Table 6 Setting of Dividing Frequency

Fs	256fs				512fs			
	CLKDAO	DACLK	CLKDACI		CLKDAO	DACLK	CLKDACI	
8kHz	2.048MHz	1/1	2.048	MHz	4.096MHz	1/1	4.096	MHz
		1/2	4.096	MHz		1/2	8.192	MHz
		1/8	16.384	MHz		1/8	32.768	MHz
		1/10	20.48	MHz		1/10	40.96	MHz
		1/16	32.768	MHz		1/16	65.536	MHz
11.025kHz	2.8224MHz	1/1	2.8224	MHz	5.6448MHz	1/1	5.6448	MHz
		1/2	5.6448	MHz		1/2	11.2896	MHz
		1/8	22.5792	MHz		1/8	45.1584	MHz
		1/10	28.224	MHz		1/10	56.448	MHz
		1/16	45.1584	MHz		1/16	90.3168	MHz
12kHz	3.072MHz	1/1	3.072	MHz	6.144MHz	1/1	6.144	MHz
		1/2	6.144	MHz		1/2	12.288	MHz
		1/8	24.576	MHz		1/8	49.152	MHz
		1/10	30.72	MHz		1/10	61.44	MHz
		1/16	49.152	MHz		1/16	98.304	MHz
12.8kHz	3.2768MHz	1/1	3.2768	MHz	6.5536MHz	1/1	6.5536	MHz
		1/2	6.5536	MHz		1/2	13.1072	MHz
		1/8	26.2144	MHz		1/8	52.4288	MHz
		1/10	32.768	MHz		1/10	65.536	MHz
		1/16	52.4288	MHz		1/16	104.8576	MHz

Fs	256fs				512fs			
	CLKDAO	DACC LK	CLKDACI		CLKDAO	DACCLK	CLKDACI	
16kHz	4.096MHz	1/1	4.096	MHz	8.192MHz	1/1	8.192	MHz
		1/2	8.192	MHz		1/2	16.384	MHz
		1/8	32.768	MHz		1/8	65.536	MHz
		1/10	40.96	MHz		1/10	81.92	MHz
		1/16	65.536	MHz		1/16	131.072	MHz
		1/1	5.6448	MHz	11.2896MHz	1/1	11.2896	MHz
22.05kHz	5.6448MHz	1/2	11.2896	MHz		1/2	22.5792	MHz
		1/8	45.1584	MHz		1/8	90.3168	MHz
		1/10	56.448	MHz		1/10	112.896	MHz
		1/16	90.3168	MHz		1/16	180.6336	MHz
		1/1	6.144	MHz	12.288MHz	1/1	12.288	MHz
		1/2	12.288	MHz		1/2	24.576	MHz
24kHz	6.144MHz	1/8	49.152	MHz		1/8	98.304	MHz
		1/10	61.44	MHz		1/10	122.88	MHz
		1/16	98.304	MHz		1/16	196.608	MHz
32kHz	8.192MHz	1/1	8.192	MHz	16.384MHz	1/1	16.384	MHz
		1/2	16.384	MHz		1/2	32.768	MHz
		1/8	65.536	MHz		1/8	131.072	MHz
		1/10	81.92	MHz		1/10	163.84	MHz
		1/16	131.072	MHz		1/16	262.144	MHz
		1/1	11.2896	MHz	22.5792MHz	1/1	22.5792	MHz
44.1kHz	11.2896MHz	1/2	22.5792	MHz		1/2	45.1584	MHz
		1/8	90.3168	MHz		1/8	180.6336	MHz
		1/10	112.896	MHz		1/10	225.792	MHz
		1/16	180.6336	MHz		1/16	361.2672	MHz
48kHz	12.288MHz	1/1	12.288	MHz	24.576MHz	1/1	24.576	MHz
		1/2	24.576	MHz		1/2	49.152	MHz
		1/8	98.304	MHz		1/8	196.608	MHz
		1/10	122.88	MHz		1/10	245.76	MHz
		1/16	196.608	MHz		1/16	393.216	MHz

Note:

- DACCLK is DACCLK field of the DAOSR register.

3.11. Output Stop Control of Analog DAC

The procedure for stopping the output data of analog DAC is below.

- 1) Write a "1" into the INIT bit of the DACR register.
- 2) FIFO is reset by writing "1" in FLUSH bit of the DAFLUSH register.
FIFO is reset by writing "1" in FLUSH bit, and the DAC_DATA_REQ_IRQ and DAC_DMA_REQ interrupt are issued.
- 3) Write a "0" into the INIT bit of the DACR register. As a result, the output of analog DAC is restarted.
When FIFO FLUSH is not used, it restarts by using the data stored in FIFO. However, the first data that was stored in the FIFO are discarded.

3.12. Bridge-tied Load (BTL)

The Stereo Audio DAC mounts the method of connection by Bridge-tied load(BTL). When BTL is used, output L and R of Audio DAC become the signal outputs with the phase difference of 180°.

It is necessary to reverse the polarity of the upper 16 bits (LDATA) by the DPCR register setting when BTL is applied or to reverse the polarity of the lower 16bits (RDATA). Concretely, the phase of the input signal is reversed by writing 01b or 10b in the DPCR register.

Table 7 AHB DATA (Input DATA)Format

31	16	15	0
The upper 16bits (LDATA)		The lower 16bits (RDATA)	
Left-Chanel		Right-Chanel	

Notes:

- BTL assumes the case when input data 32bit to Audio DAC is monaural (31:16 and 15:0 are equal). The effect that monaural BTL expects is not achieved though it operates even when 32bit stereo data of $L \neq R$ is input.
- Do not set the value of the DPCR register to 00b or 11b.
Because the amplitude is counterbalanced when connecting it with one speaker

4. Registers

The Stereo Audio DAC has the following set of registers, which are used to program the modes of operation

4.1. DAC Over Sampling Register(DAOSR)

This DAOSR Register is used to configure the oversampling clock frequency of the Analog DAC.

REGISTER_NAME	DAC Over Sampling Register(DAOSR)
OFFSET	0x000
ACCESS_SIZE	B H W
MULTIPLE	0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	DACCLK2	DACCLK1	DACCLK0	Reserved	Reserved	OSR1	OSR0
ACCESS_TYPE	R0,W0	R/W	R/W	R/W	R0,W0	R0,W0	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	1	0

[bit31:7] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit6:4] DACCLK[2:0]:Analog DAC clock setting

Explanation of DACCLK[2:0]

Bits	Description
000	Divide by 8: Conversion clock = CLKDACI/8
001	Divide by 10: Conversion clock = CLKDACI/10
010	Divide by 16: Conversion clock = CLKDACI/16
011	Divide by 2: Conversion clock = CLKDACI/2
100	Divide by 1: Conversion clock = CLKDACI
other	Not allowed. (Conversion clock = CLKDACI/10)

[bit3:2] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit1:0] OSR[1:0]:Over sampling

Explanation of OSR[1:0]

Bits	Description
00	Over sampling ratio : 64
01	Over sampling ratio : 128
10	Over sampling ratio : 256
11	Over sampling ratio : 512

4.2. DAC Configuration (DACR)

This DACR Register is used to configure the power down and send data of the Analog DAC.

REGISTER_NAME	DAC Configuration (DACR)
OFFSET	0x004
ACCESS_SIZE	B H W
MULTIPLE	0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	INIT
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	DAE
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:9] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit8] INIT: Initialize

Explanation of INIT

Bit	Description
0	The digital interface will output the DADR register value to the analog DAC (default)
1	The digital interface logic will be initialized and output a 00000000h value to the analog DAC

[bit7:1] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit0] DAE: DAC enable

Explanation of DAC enable

Bit	Description
0	Disable operation. The analog DAC output pins will output 0.0V. (default)
1	Normal operation. The analog DAC output pins will be enabled.

4.3. DAC BUSY Register(DABUSY)

It is displayed not to be able to do the write access in the DAOSR/DACR register.

REGISTER NAME	DAC BUSY Register(DABUSY)
OFFSET	0x008
ACCESS_SIZE	B H W
MULTIPLE	0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	DABUSY
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:1] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit0] DABUSY: DAOSR/DACR BUSY

Explanation of DAOSR/DACR

Bit	Description
0	The write access to the DAOSR/DACR register is possible.
1	The write access to the DAOSR/DACR register is impossible.

Note:

- The write access to the DAOSR/DACR register uses the asynchronous circuit from CLKPI to CLKDA. DABUSY field indicates that the write access to DAOSR / DACR register has not been completed. Write access to DAOSR / DACR register is discarded in the case of DABUSY=1.

4.4. DAC Control Register(DACTRL)

This DACTRL register performs a FIFO threshold setting and DMA setting.

REGISTER_NAME	DAC Control Register(DACTRL)
OFFSET	0x00C
ACCESS_SIZE	B H W
MULTIPLE	0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	FEST4	FEST3	FEST2	FEST1	FEST0
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	DMAEN
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:21] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit20:16] FEST[4:0]:FIFO Empty threshold

Explanation of FEST[4:0]

Bits	Description
00000 to 11111	This field defines the number of empty entries in the FIFO buffer, which triggers a DMA request and/or a data request interrupt when it is exceeded..

Note:

- FIFO buffer is 32bit * 24word. If this field is set to a value from 0 to 23, DAC_DMA_REQ and DAC_DATA_REQ_IRQ is generated when the number of empty FIFO buffer entries exceeds this value. If this field is set to a value greater than 23, DAC_DMA_REQ and DAC_DATA_REQ_IRQ are never generated.
- These bits must not be changed during the DMA transfers.

[bit15:9] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit8] DMAEN: DMA enable

Explanation of DMA enable

Bit	Description
0	The DMA interface is disabled (default)
1	The DMA interface is enabled

Notes:

- *This bit must not be changed during the DMA transfers*

[bit7:0] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

4.5. DAC FLUSH Register(DAFLUSH)

This DAFLUSH Register is the initialization of DATA FIFO.

REGISTER_NAME	DAC FLUSH Register(DAFLUSH)
OFFSET	0x010
ACCESS_SIZE	B H W
MULTIPLE	0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	FLUSH
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W1
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:1] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit0] FLUSH: FIFO FLUSH

Explanation of FIFO FLUSH

Bit	Description
0	No change
1	Enable FIFO FLUSH Mode

Note:

- The write access to this register is effective at DACR_INIT=1

4.6. Interrupt Enable Register(INTREN)

This INTREN Register is used to enable or disable individual interrupts of the Stereo Audio DAC module.

REGISTER NAME	Interrupt Enable Register(INTREN)
OFFSET	0x014
ACCESS_SIZE	B H W
MULTIPLE	0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	DMA_ERR	UDRN	OVFL	DREQ
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:4] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit3] DMA_ERR: DMA Block Error

Explanation of DMA_ERR

Bit	Description
0	The DMA block error interrupt is disabled. (default)
1	The DMA block error interrupt is enabled

[bit2] UDRN: FIFO Under-Run Error

Explanation of UDRN

Bit	Description
0	The FIFO under-run error interrupt is disabled (default)
1	The FIFO under-run error interrupt is enabled

[bit1] OVFL: FIFO Overflow Error

Explanation of OVFL

Bit	Description
0	The FIFO overflow error interrupt is disabled (default)
1	The FIFO overflow error interrupt is enabled

[bit0] DREQ: Data Request

Explanation of DREQ

Bit	Description
0	The FIFO data request interrupt is disabled (default)
1	The FIFO data request interrupt is enabled

4.7. Interrupt State Register (INTRSTAT)

This INTRSTAT Register reflects the status of the individual interrupt sources of the BSADACV module. The bits in this registers are "sticky", i.e. once they have been set from the hardware, they remain set until they are reset via a write access to the INTRCLR register.

REGISTER_NAME	Interrupt State Register(INTRSTAT)
OFFSET	0x018
ACCESS_SIZE	B H W
MULTIPLE	0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	DMA_ERR	UDRN	OVFL	DREQ
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R	R	R	R
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:4] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit3] DMA_ERR: DMA Block Error

Explanation of DMA_ERR

Bit	Description
0	No error
1	A DMA block error has occurred, i.e. there were more data transfers to the FIFO buffer than specified by CONTROL:FEST + 1

[bit2] UDRN:FIFO Under-Run Error

Explanation of UDRN

Bit	Description
0	No error
1	A FIFO buffer under-run has occurred, i.e. the digital DAC block tried to read another data sample, but the FIFO buffer is empty.

[bit1] OVFL: FIFO Overflow Error

Explanation of OVFL

Bit	Description
0	No error
1	A FIFO buffer overflow has occurred, i.e. there was a write access to the FIFO buffer when there was no more space available

[bit0] DREQ: Data Request

Explanation of DREQ

Bit	Description
0	No data request: There are less than CONTROL:FEST + 1 empty entries available in the FIFO buffer
1	Data request: there are CONTROL:FEST+1 or more empty entries available in the FIFO buffer

Note:

- *DREQ bit is set to "0" by a reset input. However, DREQ bit is set to "1" by releasing the reset. Because FIFO is empty after the reset is released*

4.8. Interrupt Clear Register (INTCTR)

This INTRCLR Register is used to clear individual interrupts of the BSADACV module.

REGISTER NAME	Interrupt Clear Register(INTCTR)
OFFSET	0x01C
ACCESS_SIZE	B H W
MULTIPLE	0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	DMA_ERR	UDRN	OVFL	DREQ
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W	R0,W	R0,W	R0,W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:4] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit3] DMA_ERR: DMA Block Error

Explanation of DMA_ERR

Bit	Description
0	Leave the DMA block error interrupt unchanged
1	Writing a "1" to this bit clears the DMA block error interrupt. This bit is always read as "0".

[bit2] UDRN: FIFO Under-Run Error

Explanation of UDRN

Bit	Description
0	Leave the FIFO under-run error interrupt unchanged
1	Writing a "1" to this bit clears the FIFO under-run error interrupt. This bit is always read as "0".

[bit1] OVFL: FIFO Overflow Error

Explanation of OVFL

Bit	Description
0	Leave the FIFO overflow error interrupt unchanged
1	Writing a "1" to this bit clears the FIFO overflow error interrupt. This bit is always read as "0".

[bit0] DREQ: Data Request

Explanation of DREQ

Bit	Description
0	Leave the data request interrupt unchanged
1	Writing a "1" to this bit clears the data request interrupt. This bit is always read as "0".

Note:

- *DREQ bit is set to "0" by a reset input. However, DREQ bit is set to "1" by releasing the reset. Because FIFO is empty after the reset is released*

4.9. DAC Polarity Configuration Register (DPCR)

This DPCR Register is used to configuration polarity conversion of LDATA and RDATA.

REGISTER NAME	DAC Polarity Configuration Register (DPCR)
OFFSET	0x020
ACCESS_SIZE	B H W
MULTIPLE	0
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	PCL	PCR
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:2] Reserved

This bit is reserved.

Always write "0" to this bit. The read value is "0".

[bit1] PCL: The upper 16bits (Left-DATA) Polarity conversion

Explanation of PCL

Bit	Description
0	No influence
1	LDATA Polarity conversion

[bit0] PCR: The lower 16bits (Right-DATA) polarity conversion

Explanation of PCR

Bit	Description
0	Leave the FIFO under-run error interrupt unchanged
1	RDATA Polarity conversion

4.10. Data 0..15 Register (DADR)

The DADR register (DAC Data Register) is the digital audio data interface to the analog DAC.

REGISTER_NAME	Data 0..15 Register (DADRI)
OFFSET	0x040+i*4
ACCESS_SIZE	W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	DADR31	DADR30	DADR29	DADR28	DADR27	DADR26	DADR25	DADR24
ACCESS_TYPE	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	DADR23	DADR22	DADR21	DADR20	DADR19	DADR18	DADR17	DADR16
ACCESS_TYPE	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	DADR15	DADR14	DADR13	DADR12	DADR11	DADR10	DADR9	DADR8
ACCESS_TYPE	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	DADR7	DADR6	DADR5	DADR4	DADR3	DADR2	DADR1	DADR0
ACCESS_TYPE	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W	RX/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] DADR: DAC Data Register

Explanation of DADR

Bits	Description
00000000 to 11111111	The DADR register is the digital audio data input to the analog DAC. The digital audio data format must be in 32 bit words. The upper 16 bits will be used as the input to the 24 bit left channel of the analog DAC, left justified. The lower 16 bits will be used as the input to the 24 bit right channel of the analog DAC, left justified. All data must be in binary twos complement format.

Notes:

- The DADR register accepts 32 bit word writes only.
- Please set the same value as DADR[31:16] and DADR[15:0] when outputting it by monaural.

CHAPTER 24: Inter-IC Sound (I2S)



This chapter explains the functions and operations of the serial audio interface that is the Inter IC Sound (I2S).

1. Overview
2. Configuration and Block Diagram
3. Operations of the I2S
4. Registers

CODE: I2S-S6J3200-E1

1. Overview

This section describes the features and the block diagram of the I2S module.

Also refer to the chapter of "Sound System Configuration" how to configure the I2S which is connected to the Sound Mixer.

I2S module is a full duplex, synchronous serial audio interface for multichannel specification. It can be configured to various frame formats by register setting.

This module can be set to operate as master and slave. In the master mode, clock (SCK) and frame synchronous signal (WS) are output to the external slave. In the slave mode, they are input from the external master.

During the master mode, SCK clock can be output by dividing external clock or internal clock (it is selectable by register). Frame synchronous signal can be generated by free-running or burst mode (generated only when there is transmission data).

This module has transmission/reception FIFOs, and their depths depend on the mode:

In transmission only mode, there is a 132-word 32-bit transmission FIFO. In reception only mode, there is a 132-word 32-bit reception FIFO. This module can also be configured in simultaneous mode. Simultaneous mode operates with a 66-word 32-bit transmission FIFO and a 66-word 32-bit reception FIFO.

Internal transfer between transmission and reception FIFO and internal system memory can be performed by DMA, interrupt, and polling.

Features of I2S

I2S interface has the following features:

- Programmable master/slave operations
- Support of transmission only, reception only and simultaneous transmission/reception modes
- Selecting 1 sub frame and 2 sub frame constructions
- Setting up to 32 channels to each sub frame
- Individually setting number of channel in each sub frame
- Individually setting channel length of each sub frame (number channel bit)
- Individually setting word length in channel of each sub frame
- Setting valid/invalid of each channel in each sub frame. Data is not sent or received to invalid channel
- Setting word length from 7 to 32 bits
- Programming frequency of frame synchronous signal
- Setting up to 3072 bits in 1 frame
- Programming width of frame synchronous signal (1 bit or 1 channel length)
- Programming phase of frame synchronous signal (0-bit or 1-bit delay)
- Setting polarity of frame synchronous signal
- Setting polarity of serial bit clock
- Programming sampling point of received data (center or at the end of received data)
- Selecting clock frequency source of serial bit clock in the master mode (internal and external clock)
- Setting clock frequency dividing ratio in the master mode
- Frequency of SCK = (frequency of internal clock or external clock) / (2 x I2Sn_CNTREG:CKRT[5:0])
- Frequency dividing ratio is settable within 0-126 in multiple of 2 (when the ratio is "0", frequency dividing source is bypassed)
- Data transfer to system memory by DMA, interrupt, and polling
- Debug support

3. Operations of the I2S

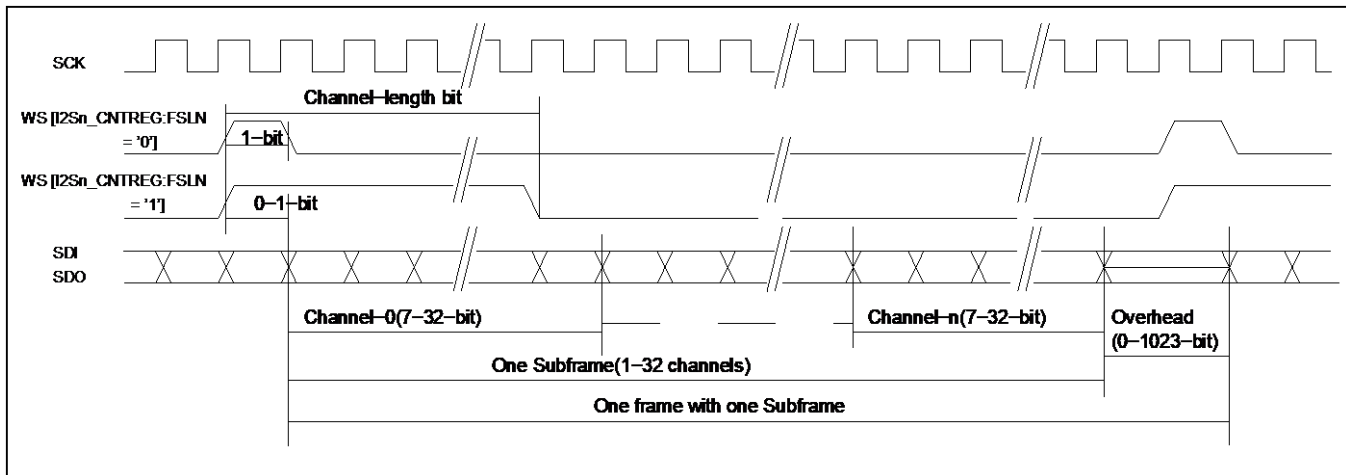
This section describes the operation of I2S.

3.1. I2S Frame Construction

I2S supports frame format of multiple channel construction. Frame can be configured to 1 or 2 sub frames. Number of each frame's channel and word length can be set individually.

1 Sub Frame Construction

Figure 3-1 1 Sub Frame Construction

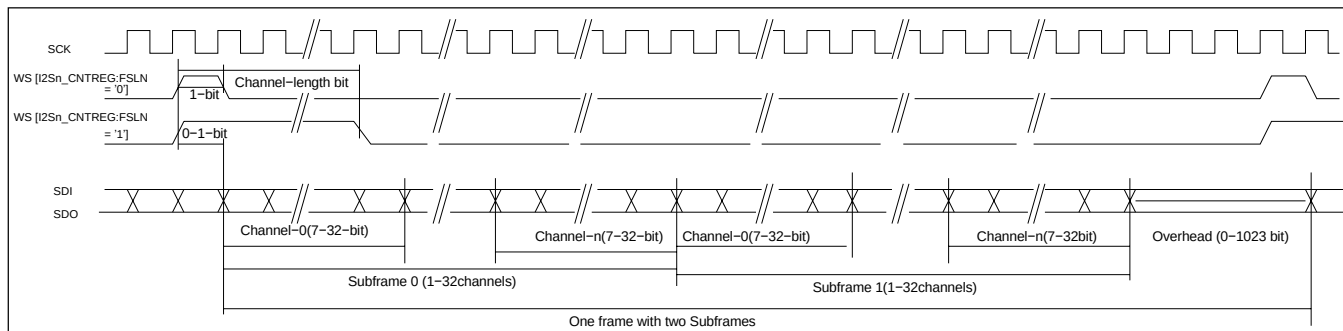


Description

- When I2Sn_CNTREG:SBFN bit is "0", frame becomes 1 sub frame composite
- Number of channels of 1-sub frame is determined by I2Sn_MCR0REG:S0CHN
- Up to 32 channels can be set
- Each channel bit length (word length) is determined by I2Sn_MCR0REG:S0WDL
- Sub frame channel starts from 0th. Each channel is set to valid/invalid with the corresponding bit of I2Sn_MCR1REG register. Transmission/reception of data is not performed to invalid channel
- Dummy bit can be inserted behind sub frame by setting I2Sn_CNTREG:OVHD. 0 to 1023 bits are insertable
- Polarity of WS is set with I2Sn_CNTREG:FSPL
- Pulse width of WS can be set to 1 bit or 1 channel length by setting I2Sn_CNTREG:FSLN
- Frame sync phase of WS can be set to "0" or "1" clock through I2Sn_CNTREG:FSPH
- In this construction, settings of I2Sn_MCR0REG:S1CHN and I2Sn_MCR2REG:S1WDL are ignored

2 Sub Frame Construction

Figure 3-2 2 Sub Frame Construction



Description

- When I2Sn_CNTREG:SBFN bit is "1", frame becomes 2 sub frame composition
- Set number of channel of sub frame 0 to I2Sn_MCR0REG:S0CHN, and set number of sub frame 1 channel to I2Sn_MCR0REG:S1CHN. Up to 32 channels can be set
- Channel bit length (word length) of sub frame 0 is determined by I2Sn_MCR0REG:S0WDL. For sub frame 1, they are determined by I2Sn_MCR0REG:S1WDL
- Sub frame channel starts from 0th. Each channel of sub frame 0 is set to valid/invalid with the corresponding bit of I2Sn_MCR1REG register, and corresponding bit of I2Sn_MCR2REG register for sub frame 1
- Transmission/reception of data is not performed to invalid channel
- Dummy bit can be inserted behind sub frame 1 by setting I2Sn_CNTREG:OVHD. 0 to 1023 bits are insertable
- Polarity of WS is set to I2Sn_CNTREG:FSPL bit
- Pulse width of WS can be set to 1 bit or 1 channel length by setting I2Sn_CNTREG:FSLN bit, channel length setting of 1 channel is determined by the channel length of sub frame "0"
- Frame sync phase of WS can be set to "0" or "1" clock through I2Sn_CNTREG:FSPH bit

3.2. I2S Configuration and Operation Modes

Transmission Only Mode

Table 3-1 Transmission Only Mode

Transfer Setting	Operation	Master Mode (I2Sn_CNTREG:MSMD = "1")	Slave Mode (I2Sn_CNTREG:MSMD = "0")
Transmission only I2Sn_CNTREG:TXDIS = "0" I2Sn_CNTREG:RXDIS = "1"	Start	Free-running mode (I2Sn_CNTREG:FRUN = "1"): After I2Sn_OPRREG:START bit becomes "1" and I2Sn_OPRREG:TXENB bit is "1", frame synchronous signal starts to output when transmission FIFO is not empty. From the second time, frame synchronous signal is output with the frame rate determined by the register setting. If transmission FIFO is empty, empty frame is output at the same time of frame synchronous signal output. Serial data of the empty frame can be set to "0" or "1" by the register setting. Burst mode (I2Sn_CNTREG:FRUN = "0"): If transmission FIFO is not empty, I2Sn_OPRREG:START bit is "1" and I2Sn_OPRREG:TXENB bit is "1", frame synchronous signal is output. After completion of one frame output, transmission FIFO status is always confirmed. If transmission FIFO is not empty, frame synchronous signal is output to perform frame transmission.	Free-running mode (I2Sn_CNTREG:FRUN = "1"): The frame synchronous signal is input at the frame rate determined by the register setting. If transmission FIFO is empty when the frame synchronous signal is input when I2Sn_OPRREG:START bit is "1" and I2Sn_OPRREG:TXENB bit is "1", empty frame is output. Serial data of the empty frame can be set to "0" or "1" by the register setting. Burst mode (I2Sn_CNTREG:FRUN = "0"): When I2Sn_OPRREG:START bit is "1" and I2Sn_OPRREG:TXENB bit is "1", one frame is output every time the frame synchronous signal is input. When transmission FIFO is empty at the time of frame synchronous signal input, empty frame is output.
Transmission only I2Sn_CNTREG:TXDIS = "0" I2Sn_CNTREG:RXDIS = "1"	Stop	At the time of stop, transmission FIFO becomes empty when there's no data transfer from internal memory to I2S transmission FIFO. To maintain I2Sn_OPRREG:START bit to "1": I2Sn_OPRREG:TXENB = "1": When "1" is written to I2Sn_OPRREG:TXENB, synchronous signal is output in the free-running mode. When transmission FIFO becomes empty, empty frame is output. In burst mode, frame synchronous signal is not output, and empty frame bits are output to serial data bus. I2Sn_OPRREG:TXENB = "0": When "0" is written to I2Sn_OPRREG:TXENB, transmission FIFO becomes empty. In the free-running mode, frame synchronous signal continues outputting and serial bus becomes high impedance state. In the burst mode, frame synchronous signal is not output and serial data bus becomes high impedance state. To make I2Sn_OPRREG:START bit "0": When "0" is written to I2Sn_OPRREG:START bit, then transmission FIFO becomes empty. Clock supply to the serial control part is stopped regardless of I2Sn_OPRREG:TXENB setting. Serial Output Clock and Frame synchronous signal output is stopped. Serial data bus becomes high impedance state.	To maintain I2Sn_OPRREG:START bit to "1": I2Sn_OPRREG:TXENB = "1": Empty frame data is output to serial bus. I2Sn_OPRREG:TXENB = "0": When "0" is written to I2Sn_OPRREG:TXENB, transmission FIFO becomes empty, and data present in the transmission FIFO at the time "0" was written to I2Sn_OPRREG:TXENB is not transmitted. Writing to transmission FIFO and detection of the frame synchronous signal are stopped. Serial data bus becomes high impedance state. To make I2Sn_OPRREG:START bit "0": When "0" is written to I2Sn_OPRREG:START bit, transmission FIFO becomes empty. Writing to transmission FIFO and detection of frame synchronous signal are stopped regardless of I2Sn_OPRREG:TXENB setting and serial bus becomes high impedance state.

Transfer Setting	Operation	Master Mode (I2Sn_CNTREG:MSMD = "1")	Slave Mode (I2Sn_CNTREG:MSMD = "0")
	Abnormality	When reading from transmission FIFO occurs while it is empty, empty frame is output. For the setting conditions of I2Sn_STATUS:TXUDR0 and I2Sn_STATUS:TXUDR1, refer to their bit descriptions. When writing to transmission FIFO occurs while it is full, set I2Sn_STATUS:TXOVR to "1".	When reading from transmission FIFO occurs while it is empty, empty frame is output. For the setting conditions of I2Sn_STATUS:TXUDR0 and I2Sn_STATUS:TXUDR1, refer to their bit descriptions. However I2Sn_STATUS:TXUDR0/1 are not set to "1" for the 1st output frame after the bits become I2Sn_OPRREG:START = "1" and I2Sn_OPRREG:TXENB = "1". When writing to transmission FIFO occurs while it is full, I2Sn_STATUS:TXOVR is set to "1". If the frame synchronous signal is not input with the defined frame rate in the free-running mode, I2Sn_STATUS:FERR is set to "1". If the next frame synchronous signal is input before completing 1 frame transmission in the burst mode, I2Sn_STATUS:FERR is set to "1".

Reception Only Mode

Table 3-2 Reception Only Mode

Transfer Setting	Operation	Master Mode (I2Sn_CNTREG:MSMD = "1")	Slave Mode (I2Sn_CNTREG:MSMD = "0")
Reception only I2Sn_CNTREG:TXDIS = "1" I2Sn_CNTREG:RXDIS = "0"	Start	Free-running mode (I2Sn_CNTREG:FRUN = "1"): Frame synchronous signal starts to output after I2Sn_OPRREG:START bit becomes "1" and I2Sn_OPRREG:RXENB bit is "1" when reception FIFO is not full. From the second time, frame synchronous signal with the frame rate determined by the register setting is output. Burst mode (I2Sn_CNTREG:FRUN = "0"): When I2Sn_OPRREG:START bit is "1" and I2Sn_OPRREG:RXENB bit is "1", frame synchronous signal is output to receive frame if reception FIFO is not full. If the FIFO is full, the signal is not output.	Free-running mode (I2Sn_CNTREG:FRUN = "1"): When I2Sn_OPRREG:START bit is "1" and I2Sn_OPRREG:RXENB bit is "1", input frame synchronous signal with the frame rate determined by the register setting. Frame should be received every time the signal is input. Burst mode (I2Sn_CNTREG:FRUN = "0"): When I2Sn_OPRREG:START bit is "1" and I2Sn_OPRREG:RXENB bit is "1", frame reception is performed every time frame synchronous signal is input. The signal is input with less speed than the frame rate in the free-running mode.
	Stop	At the time of stop, frame is not imported from serial bus even though reception FIFO is empty. To maintain I2Sn_OPRREG:START bit to "1": When "0" is written to I2Sn_OPRREG:RXENB, reception FIFO becomes empty. Although frame synchronous signal is kept outputting in the free-running mode, frame is not received. In the burst mode, frame is not received and the signal is not output. To make I2Sn_OPRREG:START bit "0": When "0" is written to I2Sn_OPRREG:START, reception FIFO becomes empty. Clock supply to the serial control part stops regardless of I2Sn_OPRREG:RXENB setting, and SCK supply to the external part is stopped as well.	To maintain I2Sn_OPRREG:START bit to "1": Reception FIFO becomes empty by writing "0" to I2Sn_OPRREG:RXENB. The input frame synchronous signal is ignored, and frames are not received. To make I2Sn_OPRREG:START bit "0": When "0" is written to the I2Sn_OPRREG:START bit, the reception FIFO becomes empty. The input frame synchronous signal is ignored regardless of I2Sn_OPRREG:RXENB setting, and frames are not received.
	Abnormality	When writing to reception FIFO occurs while it is full, I2Sn_STATUS:RXOVR is set to "1". I2Sn_STATUS:RXUDR bit is set to "1" when read access to reception FIFO occurs while it is empty.	When writing to reception FIFO occurs while it is full, I2Sn_STATUS:RXOVR is set to "1". When read access to reception FIFO occurs while it is empty, I2Sn_STATUS:RXUDR is set to "1". Free-running mode: If frame synchronous signal is not input with the frame rate defined by the register setting, I2Sn_STATUS:FERR bit is set to "1".

Simultaneous Transfer Mode

Table 3-3 Simultaneous Transfer Mode

Transfer Setting	Operation	Master Mode (I2Sn_CNTREG:MSMD = "1")	Slave Mode (I2Sn_CNTREG:MSMD = "0")
Simultaneous Transfer I2Sn_CNTREG:TXDIS = "0" I2Sn_CNTREG:RXDIS = "0"	Start	Free-running mode (I2Sn_CNTREG:FRUN = "1"): I2Sn_OPRREG:START = "1", I2Sn_OPRREG:TXENB = "1", and I2Sn_OPRREG:RXENB = "0": The same operation as transmission only mode. I2Sn_OPRREG:START = "1", I2Sn_OPRREG:TXENB = "0", and I2Sn_OPRREG:RXENB = "1": The same operation as reception only mode. I2Sn_OPRREG:START = "1", I2Sn_OPRREG:TXENB = "1", and I2Sn_OPRREG:RXENB = "1": Frame synchronous signal is output from the state that transmission FIFO is not empty and reception FIFO is not full. Then frame synchronous signal is output with the frame rate defined by the register setting. At the same time, empty frame is output if transmission FIFO is empty. Empty frame's serial data can be set to "0" or "1" by register setting. Every time frame synchronous signal is output, frame is received. Burst mode (I2Sn_CNTREG:FRUN = "0"): I2Sn_OPRREG:START = "1", I2Sn_OPRREG:TXENB = "1", and I2Sn_OPRREG:RXENB = "0": The same operation as transmission only mode. I2Sn_OPRREG:START = "1", I2Sn_OPRREG:TXENB = "0", and I2Sn_OPRREG:RXENB = "1": The same operation as reception only mode. I2Sn_OPRREG:START = "1", I2Sn_OPRREG:TXENB = "1", and I2Sn_OPRREG:RXENB = "1": Frame synchronous signal is output from the state that transmission FIFO is not empty and reception FIFO is not full. After completion of one frame output or at idle state, transmission/reception FIFO status is always confirmed. If transmission FIFO is not empty and reception FIFO is not full, frame synchronous signal is output to perform frame transmission/reception.	Free-running mode (I2Sn_CNTREG:FRUN = "1"): I2Sn_OPRREG:START = "1", I2Sn_OPRREG:TXENB = "1", and I2Sn_OPRREG:RXENB = "0": The same operation as transmission only mode. I2Sn_OPRREG:START = "1", I2Sn_OPRREG:TXENB = "0", and I2Sn_OPRREG:RXENB = "1": The same operation as reception only mode. I2Sn_OPRREG:START = "1", I2Sn_OPRREG:TXENB = "1", and I2Sn_OPRREG:RXENB = "1": Frame synchronous signal is input with the frame rate defined by the register setting. At the same time, empty frame is output if transmission FIFO is empty. The serial data can be set to "0" or "1" by the register setting I2Sn_CNTREG:MSKB. Every time frame synchronous signal is input, frame is received. Burst mode (I2Sn_CNTREG:FRUN = "0"): Every time frame synchronous signal is input when I2Sn_OPRREG:START bit is "1", transmission and reception for one frame is performed. When the frame synchronous signal is input, empty frame is output if transmission FIFO is empty.

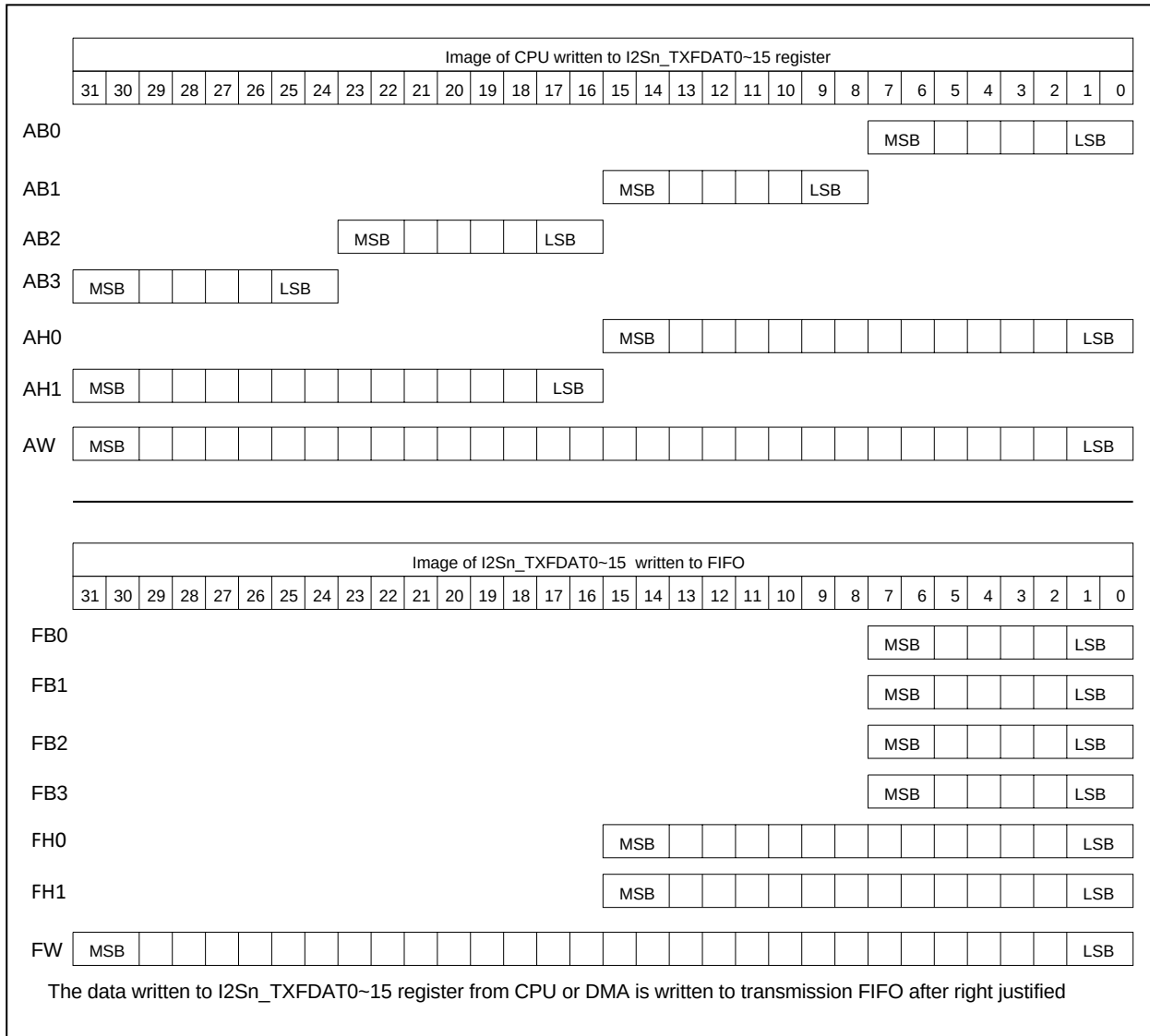
Transfer Setting	Operation	Master Mode (I2Sn_CNTREG:MSMD = "1")	Slave Mode (I2Sn_CNTREG:MSMD = "0")
Simultaneous Transfer I2Sn_CNTREG:TXDIS = "0" I2Sn_CNTREG:RXDIS = "0"	Stop	Stop operation has following states: Transmission stop: Transmission FIFO becomes empty when data is not transferred from internal memory to I2S transmission FIFO. Reception stop: Data does not need to be transferred from I2S reception FIFO to internal memory. To maintain I2Sn_OPRREG:START bit to "1": In free-running mode frame synchronous signal is output. In the burst mode, when transmission FIFO becomes empty, frame synchronous output is stopped. Transmission stop: I2Sn_OPRREG:TXENB = "1": Empty frame bit is output when transmission FIFO becomes empty. I2Sn_OPRREG:TXENB = "0": Transmission FIFO becomes empty and transmission serial data bus becomes high impedance. Writing to transmission FIFO stops. Reception stop: When "0" is written to I2Sn_OPRREG:RXENB, reception FIFO becomes empty and frame reception operation stops. To make I2Sn_OPRREG:START bit "0": When "0" is written to I2Sn_OPRREG:START, transmission/reception FIFO becomes empty. The clock supply to the internal serial control part stops regardless of I2Sn_OPRREG:TXENB and I2Sn_OPRREG:RXENB status. SCK output to the external part and frame synchronous signal output is also stopped.	To maintain I2Sn_OPRREG:START bit to "1": Transmission stop: When I2Sn_OPRREG:TXENB = "1", empty frame bits are output after transmission FIFO becomes empty. When "0" is written to I2Sn_OPRREG:TXENB, transmission FIFO becomes empty and transmission serial data bus becomes high impedance. Data present in the transmission FIFO at the time "0" was written to I2Sn_OPRREG:TXENB is not transmitted. While I2Sn_OPRREG:TXENB = "0", data is not written to transmission FIFO. Reception stop: When "0" is written to I2Sn_OPRREG:RXENB, reception FIFO becomes empty and frame reception operation stops. To make I2Sn_OPRREG:START bit "0": When "0" is written to I2Sn_OPRREG:START, transmission/reception FIFO becomes empty. Transmission/reception is stopped regardless of I2Sn_OPRREG:TXENB and I2Sn_OPRREG:RXENB status.

Transfer Setting	Operation	Master Mode (I2Sn_CNTREG:MSMD = "1")	Slave Mode (I2Sn_CNTREG:MSMD = "0")
	Abnormality	When reading from transmission FIFO occurs while it is empty, empty frame bit is output. For the setting conditions of I2Sn_STATUS:TXUDR0 and I2Sn_STATUS:TXUDR1, refer to their bit descriptions. When writing to transmission FIFO occurs while it is full, I2Sn_STATUS:TXOVR is set to "1". When read access occurs to reception FIFO while it is empty, I2Sn_STATUS:RXUDR is set to "1". When writing to reception FIFO occurs while it is full, I2Sn_STATUS:RXOVR is set to "1".	When reading from transmission FIFO occurs while it is empty, empty frame bit is output. For the setting conditions of I2Sn_STATUS:TXUDR0 and I2Sn_STATUS:TXUDR1, refer to their bit descriptions. When writing to transmission FIFO occurs while it is full, I2Sn_STATUS:TXOVR is set to "1". When read access occurs to reception FIFO while it is empty, I2Sn_STATUS:RXUDR is set to "1". When writing to reception FIFO occurs while it is full, I2Sn_STATUS:RXOVR is set to "1". If the frame synchronous signal is not input with the defined frame rate in the free-running mode, I2Sn_STATUS:FERR is set to "1". If the following frame synchronous signal is input before completing one frame transmission in the burst mode, I2Sn_STATUS:FERR is set to "1".

3.3. Bit Alignment

Transmission Word Alignment

Figure 3-3 Transmission Word Line Chart



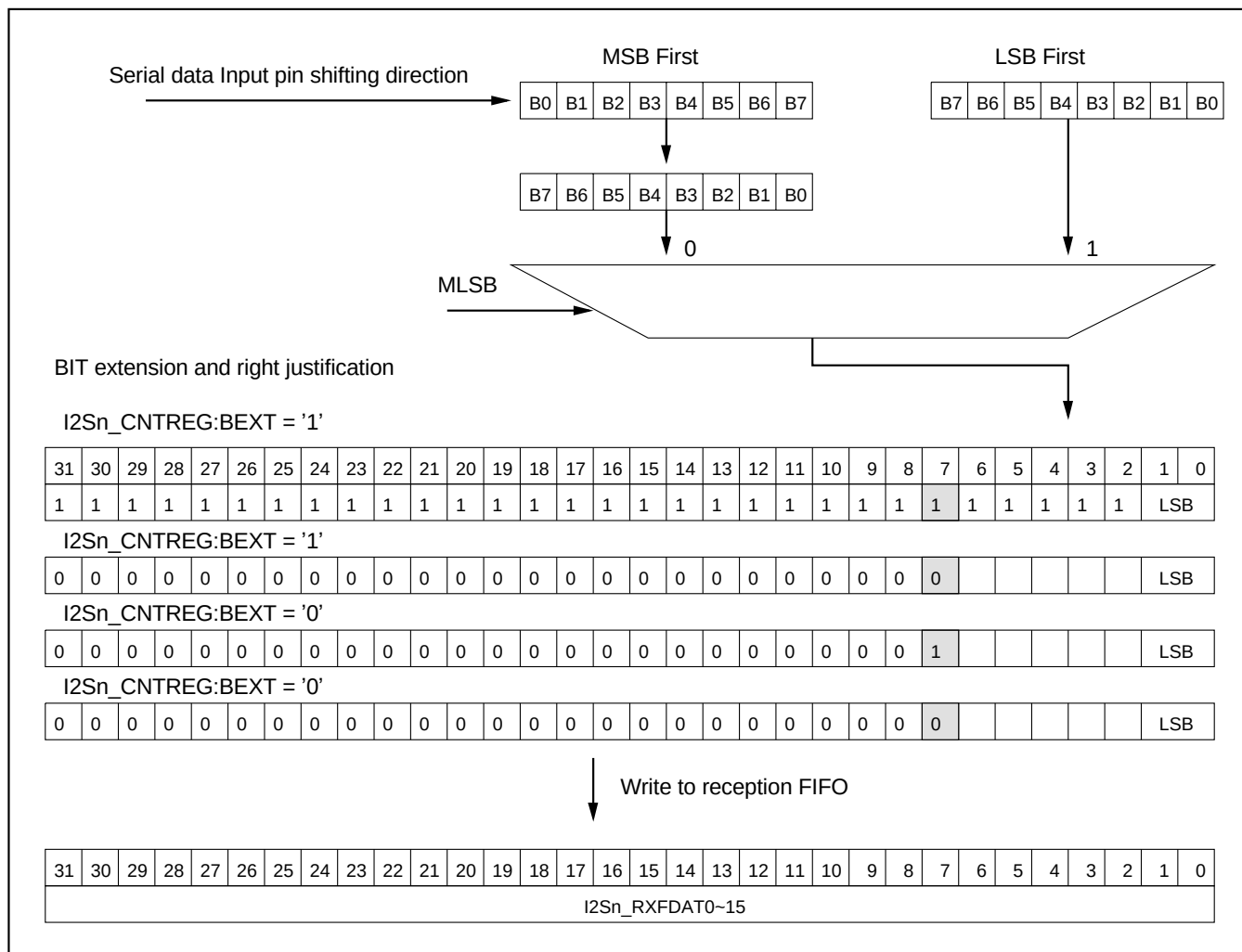
When transmission is performed with serial bus, word is sent MSB first when I2Sn_CNTREG:MSLB is "0" and LSB first when the value is "1". When channel length (set to I2Sn_MCR0REG:S0CHL and I2Sn_MCR0REG:S1CHL) is longer than the word length (set to I2Sn_MCR0REG:S0WDL and I2Sn_MCR0REG:S1WDL), remaining bits in the channel become I2Sn_CNTREG:MSKB. Setting the channel length to shorter than the word length is prohibited.

Notes:

- AB0, AB1, AB2, AB3, AH0, AH1, and AW on the above chart indicate byte 0, byte 1, byte 2, byte 3, half word 0, half word 1, and word at write accessing to I2Sn_TXFDAT0 to 15 on AHB bus
- Each FB0, FB1, FB2, FB3, FH0, FH1, and FW indicate AB0, AB1, AB2, AB3, AH0, AH1, and AW at writing to transmission FIFO after they are right justified

Reception Word Alignment

Figure 3-4 Reception Word Line Chart



This chart shows word line example of when word length is 8.

The word received from serial bus is always written to reception FIFO after being right justified.

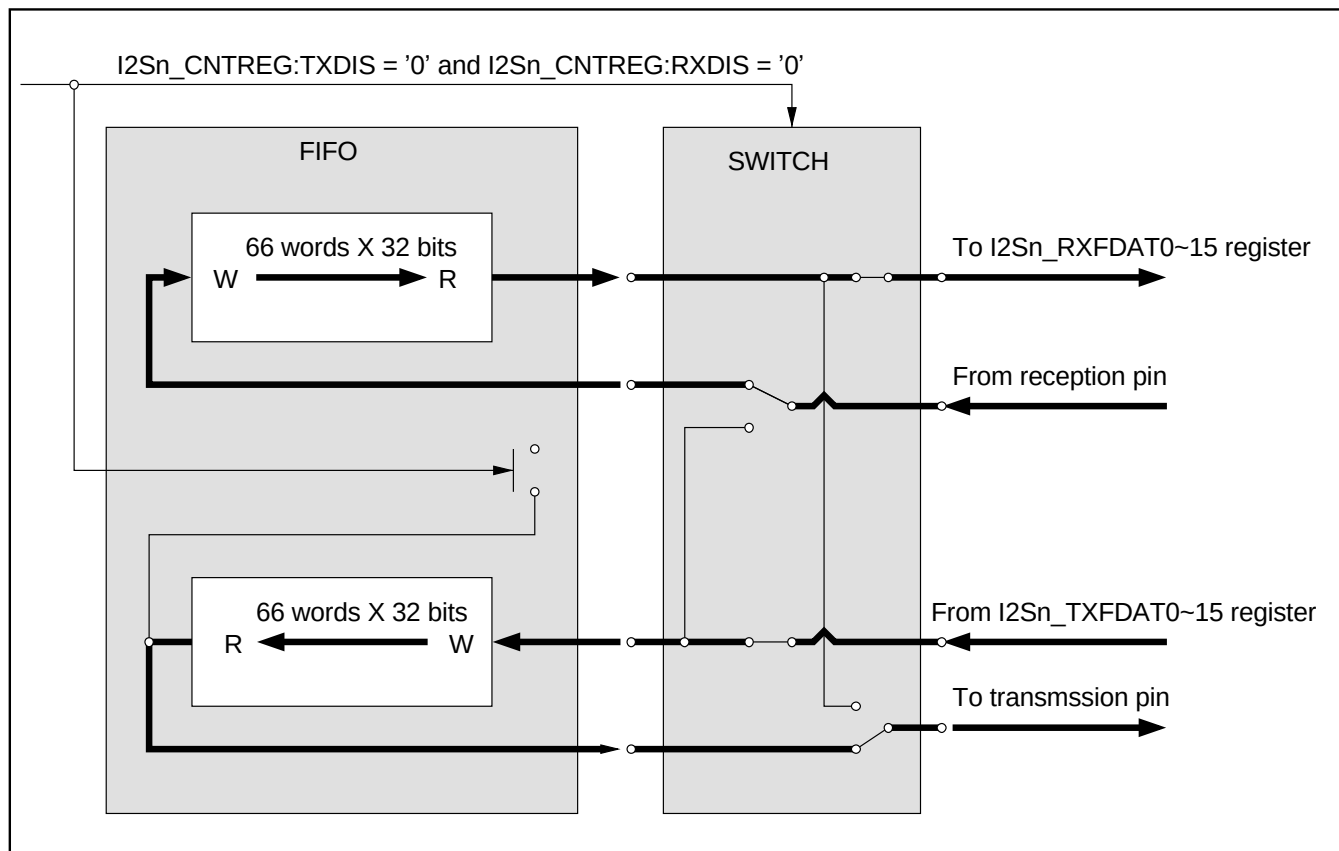
Therefore, read access should be performed from AHB bus to I2Sn_RXDAT0 to 15 in order to read as follows:

Word length:

- 8 or less: byte 0
- 9- 16: half word 0
- 17-32: all words

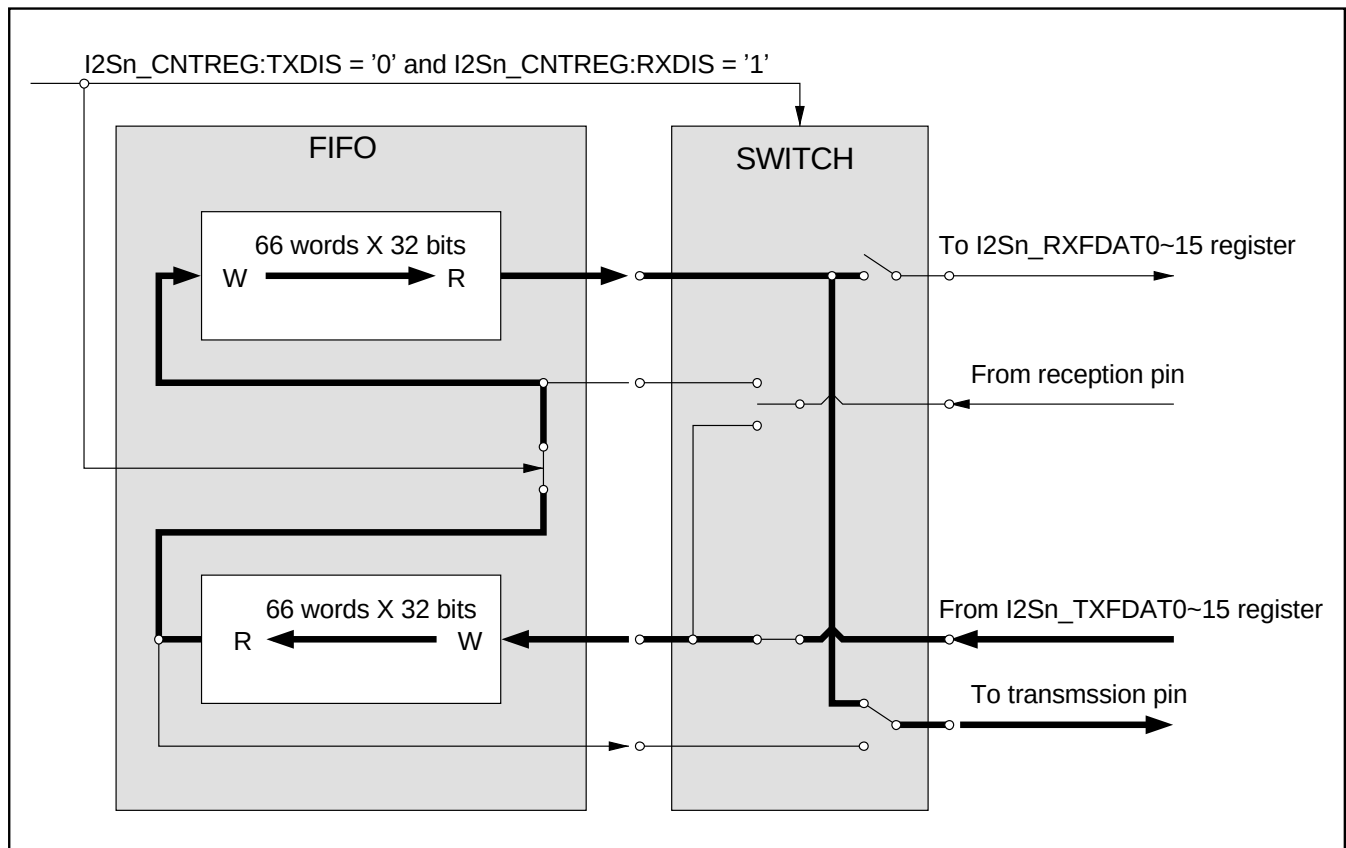
3.4. FIFO Construction

Figure 3-5 Simultaneous Transfer Mode Data Flow

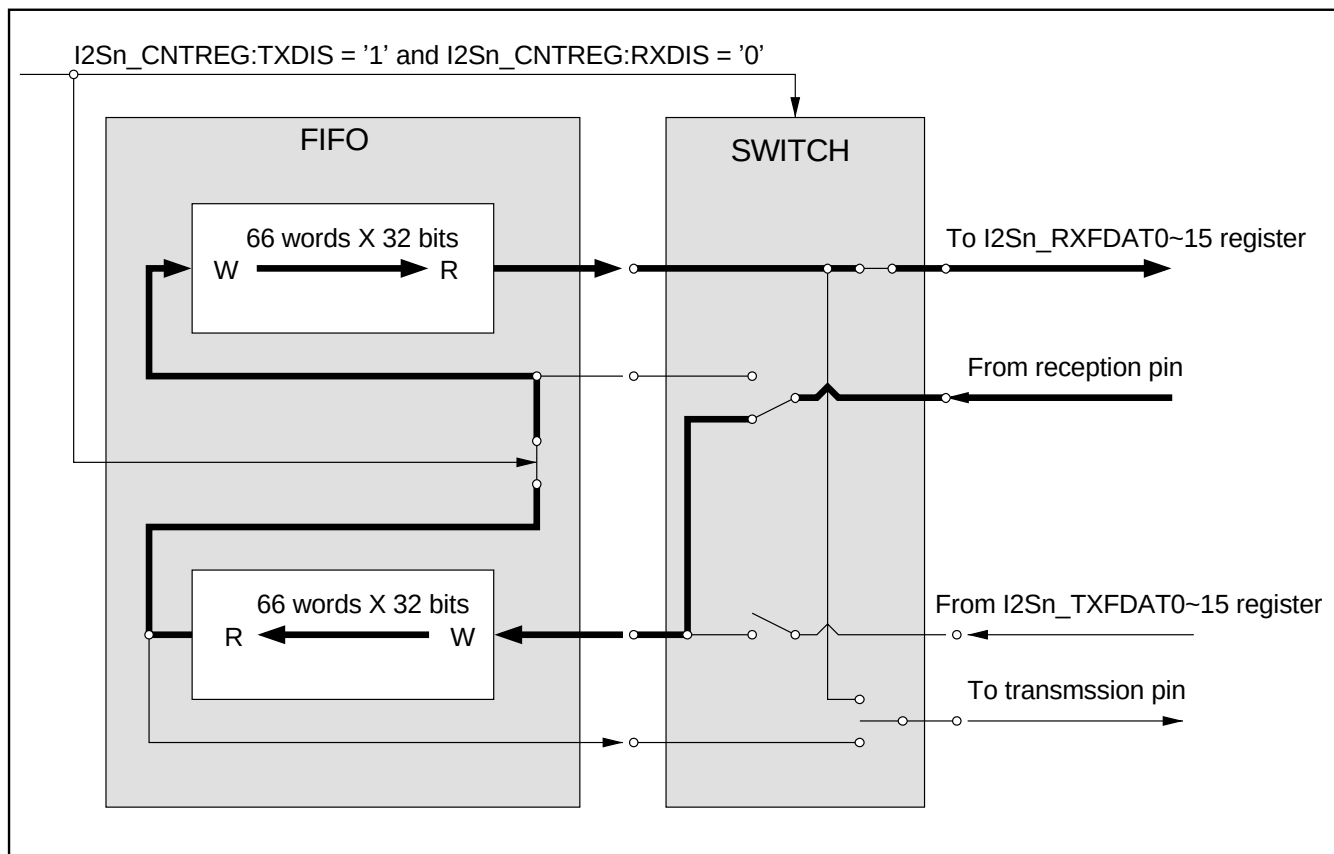


When I2Sn_CNTREG:TXDIS = "0" and I2Sn_CNTREG:RXDIS = "0", the mode is set to simultaneous transfer mode which operates with 66-word x 32-bit transmission and reception FIFOs.

Figure 3-6 Transmission Only Mode Data Flow



When `I2Sn_CNTREG:TXDIS = "0"` and `I2Sn_CNTREG:RXDIS = "1"`, the mode is set to transmission only mode which operates with a 132-word x 32-bit transmission FIFO, and reception is not performed.

Figure 3-7 Reception Only Mode Data Flow

When `I2Sn_CNTREG:TXDIS = "1"` and `I2Sn_CNTREG:RXDIS = "0"`, the mode is set to reception only mode which operates with a 132-word x 32-bit reception FIFO, and transmission is not performed.

3.5. Caution Summary

- I2Sn_MCR0REG:S0WDL, I2Sn_MCR0REG:S0CHL 1 to 6 bits are prohibited
- I2Sn_MCR0REG:S1WDL, I2Sn_MCR0REG:S1CHL 1 to 6 bits are prohibited
- When channel length (set to I2Sn_MCR0REG:S0CHL and I2Sn_MCR0REG:S1CHL) is longer than the word length (set to I2Sn_MCR0REG:S0WDL and I2Sn_MCR0REG:S1WDL), remaining bits in the channel become I2Sn_CNTREG:MSKB. Setting the channel length to shorter than the word length is prohibited
- Pulse width of one channel (I2Sn_CNTREG:FSLN = "1") is prohibited when frame length is set to one channel by I2Sn_MCR0REG:S0CHN = "0" and I2Sn_CNTREG:SBFN = "0"
- Rewrite to I2Sn_CNTREG, I2Sn_MCR0REG, I2Sn_MCR1REG, and I2Sn_MCR2REG is prohibited after I2Sn_OPRREG:START is set
- Rewrite to I2Sn_CNTREG, I2Sn_MCR0REG, I2Sn_MCR1REG, and I2Sn_MCR2REG is prohibited while DBGE is set to "1" and the processor is in debug state

4. Registers

This section describes the registers of the I2S in detail.

The suffix 'n' in the register name indicates that the register is in instance 'n' of the module.

Registers of I2S

The following registers are available for each instance of I2S:

- Reception FIFO Data Register (I2Sn_RXFDAT0 to 15)
- Transmission FIFO Data Register (I2Sn_TXFDAT0 to 15)
- Control Register (I2Sn_CNTREG)
- Channel Control Register 0 (I2Sn_MCR0REG)
- Channel Control Register 1 (I2Sn_MCR1REG)
- Channel Control Register 2 (I2Sn_MCR2REG)
- Operation Control Register (I2Sn_OPRREG)
- Software Reset Register (I2Sn_SRST)
- Interrupt Control Register (I2Sn_INTCNT)
- Status Register (I2Sn_STATUS)

DMA Activate Register (I2Sn_DMAACT)

- Debug Register (I2Sn_DEBUG)
- Module ID Register (I2Sn_MIDREG)

Memory Layout of I2S Registers

Offset	+3	+2	+1	+0
0x00000000	I2Sn_RXFDAT0 00000000 00000000 00000000 00000000			
0x00000004	I2Sn_RXFDAT1 00000000 00000000 00000000 00000000			
0x00000008	I2Sn_RXFDAT2 00000000 00000000 00000000 00000000			
0x0000000C	I2Sn_RXFDAT3 00000000 00000000 00000000 00000000			
0x00000010	I2Sn_RXFDAT4 00000000 00000000 00000000 00000000			
0x00000014	I2Sn_RXFDAT5 00000000 00000000 00000000 00000000			
0x00000018	I2Sn_RXFDAT6 00000000 00000000 00000000 00000000			
0x0000001C	I2Sn_RXFDAT7 00000000 00000000 00000000 00000000			
0x00000020	I2Sn_RXFDAT8 00000000 00000000 00000000 00000000			
0x00000024	I2Sn_RXFDAT9 00000000 00000000 00000000 00000000			
0x00000028	I2Sn_RXFDAT10 00000000 00000000 00000000 00000000			
0x0000002C	I2Sn_RXFDAT11 00000000 00000000 00000000 00000000			
0x00000030	I2Sn_RXFDAT12 00000000 00000000 00000000 00000000			
0x00000034	I2Sn_RXFDAT13 00000000 00000000 00000000 00000000			
0x00000038	I2Sn_RXFDAT14 00000000 00000000 00000000 00000000			
0x0000003C	I2Sn_RXFDAT15 00000000 00000000 00000000 00000000			
0x00000040	I2Sn_TXFDAT0 00000000 00000000 00000000 00000000			
0x00000044	I2Sn_TXFDAT1 00000000 00000000 00000000 00000000			
0x00000048	I2Sn_TXFDAT2 00000000 00000000 00000000 00000000			
0x0000004C	I2Sn_TXFDAT3 00000000 00000000 00000000 00000000			
0x00000050	I2Sn_TXFDAT4 00000000 00000000 00000000 00000000			
0x00000054	I2Sn_TXFDAT5 00000000 00000000 00000000 00000000			
0x00000058	I2Sn_TXFDAT6 00000000 00000000 00000000 00000000			
0x0000005C	I2Sn_TXFDAT7 00000000 00000000 00000000 00000000			
0x00000060	I2Sn_TXFDAT8 00000000 00000000 00000000 00000000			
0x00000064	I2Sn_TXFDAT9 00000000 00000000 00000000 00000000			
0x00000068	I2Sn_TXFDAT10 00000000 00000000 00000000 00000000			

Offset	+3	+2	+1	+0
0x0000006C	I2Sn_TXFDAT11 00000000 00000000 00000000 00000000			
0x00000070	I2Sn_TXFDAT12 00000000 00000000 00000000 00000000			
0x00000074	I2Sn_TXFDAT13 00000000 00000000 00000000 00000000			
0x00000078	I2Sn_TXFDAT14 00000000 00000000 00000000 00000000			
0x0000007C	I2Sn_TXFDAT15 00000000 00000000 00000000 00000000			
0x00000080	I2Sn_CNTREG 00000000 00000000 00000000 01100000			
0x00000084	I2Sn_MCR0REG 00000000 00000000 00000000 00000000			
0x00000088	I2Sn_MCR1REG 00000000 00000000 00000000 00000000			
0x0000008C	I2Sn_MCR2REG 00000000 00000000 00000000 00000000			
0x00000090	I2Sn_OPRREG 00000000 00000000 00000000 00000000			
0x00000094	I2Sn_SRST 00000000 00000000 00000000 00000000			
0x00000098	I2Sn_INTCNT 01111111 00111111 00000000 00000000			
0x0000009C	I2Sn_STATUS 00000000 00000000 00000000 00000000			
0x000000A0	I2Sn_DMAACT 00000000 00000000 00000000 00000000			
0x000000A4	I2Sn_DEBUG 00000000 00000000 00000000 00000000			
0x000000A8	I2Sn_MIDREG 00000000 00000000 00000000 00000000			
0x000000AC	reserved XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX			

4.1. Reception FIFO Data Register (I2Sn_RXFDAT0 to 15)

These registers are reception FIFO registers that can maintain up to 66 words (simultaneous transfer mode) or 132 words (reception only mode). There are 16 such registers, all consecutively placed in the register map. This is to support AHB burst transfers. Read access to any of the I2Sn_RXFDAT0 to 15 registers returns the word from reception FIFO. Each of these 16 registers are identical in function. Only one register (i.e. I2Sn_RXFDAT0) is explained here.

Reception FIFO Data Register 0 (I2Sn_RXFDAT0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RXDATA[31]	RXDATA[30]	RXDATA[29]	RXDATA[28]	RXDATA[27]	RXDATA[26]	RXDATA[25]	RXDATA[24]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RXDATA[23]	RXDATA[22]	RXDATA[21]	RXDATA[20]	RXDATA[19]	RXDATA[18]	RXDATA[17]	RXDATA[16]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RXDATA[15]	RXDATA[14]	RXDATA[13]	RXDATA[12]	RXDATA[11]	RXDATA[10]	RXDATA[9]	RXDATA[8]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RXDATA[7]	RXDATA[6]	RXDATA[5]	RXDATA[4]	RXDATA[3]	RXDATA[2]	RXDATA[1]	RXDATA[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] RXDATA : Receive Data

The word received from serial bus is written to reception FIFO.

When frame is 1 sub frame construction and word length set to I2Sn_MCR0REG:S0WDL is 32 bits or less (16 bits when I2Sn_CNTREG:RHLL register is "1"), it is written to reception FIFO after higher order bit is extended.

When frame is 2 sub frame construction and word length set to I2Sn_MCR0REG:S0WDL is 32 bits or less (16 bits when I2Sn_CNTREG:RHLL register is "1"), reception data of sub frame "0" is written to reception FIFO after higher order bit is extended.

For the case that word length set to I2Sn_MCR0REG:S1WDL is 32 bits or less, reception data of sub frame 1 is written to reception FIFO after higher order bit is extended.

When I2Sn_CNTREG:BEXT is "1", it is extended with MSB of reception word (sign extension). For the case that the value is "0", it is enhanced by "0".

Reading this register returns a word of data from the Rx FIFO location pointed by the Rx FIFO read pointer. After a read access to this register, the Rx FIFO read pointer is incremented, provided that the read cycle was initiated by the AHB master other than the Debug Access Port (DAP) controller. If the DAP controller reads this register, the Rx FIFO read pointer is not incremented.

When I2Sn_STATUS:RXNUM is 0x00000000, invalid data is read. An Rx FIFO underflow error (I2Sn_STATUS:RXUDR) flag is set, if the read cycle was initiated by the AHB master other than the DAP controller. If the DAP controller reads this register while the Rx FIFO is empty, the I2Sn_STATUS:RXUDR flag is not set.

4.2. Transmission FIFO Data Register (I2Sn_TXFDAT0 to 15)

These registers are transmission FIFO registers that can maintain up to 66 words (simultaneous transfer mode) or 132 words (transmission mode only). There are 16 such registers, all consecutively placed in the register map. This is to support AHB burst transfers. A write access to any of I2Sn_TXFDAT0 to 15 register writes a word of data in the transmission FIFO. Each of these 16 registers are identical in function. Only one register (i.e. I2Sn_TXFDAT0) is explained here.

Transmission FIFO Data Register 0 (I2Sn_TXFDAT0)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	TXDATA[31]	TXDATA[30]	TXDATA[29]	TXDATA[28]	TXDATA[27]	TXDATA[26]	TXDATA[25]	TXDATA[24]
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	TXDATA[23]	TXDATA[22]	TXDATA[21]	TXDATA[20]	TXDATA[19]	TXDATA[18]	TXDATA[17]	TXDATA[16]
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	TXDATA[15]	TXDATA[14]	TXDATA[13]	TXDATA[12]	TXDATA[11]	TXDATA[10]	TXDATA[9]	TXDATA[8]
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	TXDATA[7]	TXDATA[6]	TXDATA[5]	TXDATA[4]	TXDATA[3]	TXDATA[2]	TXDATA[1]	TXDATA[0]
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] TXDATA : Transmit Data

Word to be transmitted can be written as long as transmission FIFO is not full.

Write access can be performed regardless of shift register's operation status. Write access to full transmission FIFO is ignored and I2Sn_STATUS:TXOVR flag is set. Although writing data is accessed in word, half-word, and byte access, actual number of bits to be transmitted is determined by I2Sn_MCR0REG:S0WDL and I2Sn_MCR0REG:S1WDL (when frame is 2 sub frame).

The data read from I2Sn_TXFDAT0 returns "0".

4.3. Control Register (I2Sn_CNTREG)

The Control Register (I2Sn_CNTREG) sets the module configuration.

Control Register (I2Sn_CNTREG)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	CKRT[5]	CKRT[4]	CKRT[3]	CKRT[2]	CKRT[1]	CKRT[0]	OVHD[9]	OVHD[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	OVHD[7]	OVHD[6]	OVHD[5]	OVHD[4]	OVHD[3]	OVHD[2]	OVHD[1]	OVHD[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	MSKB	MSMD	SBFN	RHLL	ECKM	BEXT	FRUN
ACCESS_TYPE	R0,WX	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	MSLB	TXDIS	RXDIS	SMPL	CPOL	FSPH	FSLN	FSPL
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	1	1	0	0	0	0	0

[bit31:26] CKRT : Clock Divider

This sets output clock frequency dividing ratio at master operation.

Internal clock (CLK_HAPPS1B0) is divided at I2Sn_CNTREG:ECKM = "0", and external clock (ECLK) is divided at I2Sn_CNTREG:ECKM = "1". Only even number of the ratio is supported and output clock's duty becomes 50%.

Bit	Description
000000	Output clock is not divided
000001	Output clock is divided by 2
000010	Output clock is divided by 4
000011	Output clock is divided by 6
...	...
111110	Output clock is divided by 124
111111	Output clock is divided by 126

[bit25:16] OVHD : Frame Rate Control

Frame rate can be adjusted by inserting overhead (OVHD) bits following the valid data of the frame. The overhead section of the transmission frame enters the state of high impedance. Up to 1023 overhead bits can be inserted at the end of the frame.

The value set to OVHD becomes the number of insertion bits.

The following expressions are formed for OVHD and frame synchronous signal cycle.

1 sub frame construction:

- $OVHD = \text{Frame synchronous signal cycle/SCK cycle} - (I2Sn_MCR0REG:S0CHL + 1) * (I2Sn_MCR0REG:S0CHN + 1)$

2 sub frame construction:

- $OVHD = \text{Frame synchronous signal cycle/SCK cycle} - (I2Sn_MCR0REG:S0CHL + 1) * (I2Sn_MCR0REG:S0CHN + 1) - (I2Sn_MCR0REG:S1CHL + 1) * (I2Sn_MCR0REG:S1CHN + 1)$

[bit15] read0 : -**[bit14] MSKB : Serial Output Data in case of Invalid/Empty Frame Transmission**

For master operation (I2Sn_CNTREG:MSMD = "1"), free-running mode (I2Sn_CNTREG:FRUN = "0"), and I2Sn_OPRREG:TXENB = "1":

- When transmission FIFO is empty at frame synchronous signal output, MSKB is output to all valid channels of its transmission frame.

For slave operation (I2Sn_CNTREG:MSMD = "0") and I2Sn_OPRREG:TXENB = "1":

- When transmission FIFO is empty at frame synchronous signal reception, MSKB is output to all valid channels of its transmission frame.

For the case that transmission word length is shorter than the channel length, MSKB is driven to the rest of bit in transmission channel (channel length - word length).

[bit13] MSMD : Master and Slave Mode Select

Master and Slave modes are set.

Bit	Description
0	Slave operation
1	Master operation

[bit12] SBFN : Sub Frame Construction

Sub frame construction (number of sub frame) of the frame is specified.

Bit	Description
0	1 Sub frame construction (only sub frame 0)
1	2 Sub frame construction (sub frame 0 and sub frame 1). Frame starts from 0th sub frame

[bit11] RHLL : Word Construction

Word construction of FIFO – 1 word (32 bits) or 2 half words (16 bits) – is specified.

It is considered to be used at protocol, such as MSB-justified.

Bit	Description
0	32-bit FIFO word is handled as 1 word
1	32-bit FIFO word is handled as 2 half words at serial bus with dividing 16 bits each to low order and high order. They are transferred by serial bus in order of low order, high order, low order, and high order. At reception, 2 consecutive half words from serial bus are handled as low order and high order, and they are put in 1 word (32 bits) to write to reception FIFO

[bit10] ECKM : Clock Selector

Clock frequency dividing is selected in master mode.

Bit	Description
0	Internal clock (CLK_HAPPS1B0) is divided and output
1	External clock (ECLK) is divided and output

[bit9] BEXT : Bit Extension

When reception word length is shorter than the word length of FIFO (32 bits when RHLL is "0" and 16 bits when RHLL is "1"), extension mode of upper bit (word length of FIFO-reception word length) should be set.

Bit	Description
0	Extended by "0"
1	Extended by sign bit (if MSB of word/half word is "1", then it is extended by "1", if MSB is "0" then it is extended by "0")

[bit8] FRUN : Output Mode of Frame Synchronous Signal

Bit	Description
0	Burst mode When I2Sn_OPRREG:START bit is "1", frame synchronous signal is output according to I2Sn_OPRREG:TXENB, I2Sn_OPRREG:RXENB, and transmission/reception FIFO conditions. When I2Sn_OPRREG:START bit is "0", frame synchronous signal is not output.
1	Free-running mode When I2Sn_OPRREG:START register is "1", frame synchronous signal proceeds free-running with the set frame rate. When I2Sn_OPRREG:START bit is "0", frame synchronous signal is not output.

[bit7] MSLB : Shifting Order

Word bit's shift order is set.

Bit	Description
0	Shift starts from MSB of the word
1	Shift starts from LSB of the word

[bit6] TXDIS : Transmitter Disable

Transmitting function is enabled or disabled.

Bit	Description
0	Transmitting function is enabled
1	Transmitting function is disabled

[bit5] RXDIS : Receiver Disable

Receiving function is enabled or disabled.

Bit	Description
0	Receiving function is enabled
1	Receiving function is disabled

[bit4] SMPL : Sampling Point

Sampling point of the data is specified.

Bit	Description
0	Sampling at the center of reception data
1	Sampling at the end of reception data

[bit3] CPOL : Clock Polarity

SCK polarity which drives/samples serial data is specified.

Bit	Description
0	Data is driven at rising edge of SCK, and sampled at falling edge
1	Data is driven at falling edge of SCK, and sampled at rising edge

[bit2] FSPH : Frame Sync Phase

Phase is specified to WS frame data.

Bit	Description
0	WS becomes valid "1" clock before the first bit of frame data
1	WS becomes valid at the same time as the first bit of frame data

[bit1] FSLN : Frame Sync Pulse Width

Pulse width of WS is specified.

Bit	Description
0	Pulse width is 1 cycle/SCK long (1-bit)
1	Pulse width is 1 channel long (1 channel)

Pulse width of one channel FSLN = "1" is prohibited when frame length is set to one channel by I2Sn_MCR0REG:S0CHN = 0x0 and I2Sn_CNTREG:SBFN = "0".

[bit0] FSPL : Frame Sync Polarity

Polarity of WS is set.

Bit	Description
0	Frame synchronous signal becomes valid when WS is "1"
1	Frame synchronous signal becomes valid when WS is "0"

4.4. Channel Control Register 0 (I2Sn_MCR0REG)

The Channel Control Register 0 (I2Sn_MCR0REG) controls the frame construction.

Channel Control Register 0 (I2Sn_MCR0REG)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	S1CHN[4]	S1CHN[3]	S1CHN[2]	S1CHN[1]	S1CHN[0]	S1CHL[4]	S1CHL[3]
ACCESS_TYPE	R0,WX	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	S1CHL[2]	S1CHL[1]	S1CHL[0]	S1WDL[4]	S1WDL[3]	S1WDL[2]	S1WDL[1]	S1WDL[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	S0CHN[4]	S0CHN[3]	S0CHN[2]	S0CHN[1]	S0CHN[0]	S0CHL[4]	S0CHL[3]
ACCESS_TYPE	R0,WX	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	S0CHL[2]	S0CHL[1]	S0CHL[0]	S0WDL[4]	S0WDL[3]	S0WDL[2]	S0WDL[1]	S0WDL[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31] read0 : -

[bit30:26] S1CHN : Sub Frame 1 Channel Numbers

Number of channels of sub frame 1 is set.

This is valid only when the frame is 2 sub frame construction (I2Sn_CNTREG:SBFN is "1") and is invalid when the frame is 1 sub frame construction (I2Sn_CNTREG:SBFN is "0").

Up to 32 channels can be specified, and S1CHN needs to be set to "number of channel - 1".

Setting examples are shown below.

Bits	Description
00000	Sub frame 1 becomes 1 channel construction
00001	Sub frame 1 becomes 2 channel construction
00010	Sub frame 1 becomes 3 channel construction
...	...
11110	Sub frame 1 becomes 31 channel construction
11111	Sub frame 1 becomes 32 channel construction

[bit25:21] S1CHL : Sub Frame 1 Channel Length

Channel length of the channel constructing sub frame 1 (bit length of channel) is set.

7 to 32 bits of channel length are available but 1 to 6 bits are prohibited. S1CHL needs to be set to "channel length - 1"

Setting examples are shown below.

Bits	Description
00000-00101	Setting is prohibited
00110	Sub frame 1 channel length is 7 bits
00111	Sub frame 1 channel length is 8 bits
...	...
...	...
11110	Sub frame 1 channel length is 31 bits
11111	Sub frame 1 channel length is 32 bits

Channel length can be set to 32 bits or less regardless of I2Sn_CNTREG:RHLL.

[bit20:16] S1WDL : Sub Frame 1 Word Length

word length of the channel constructing sub frame 1 (bit length of word) is set.

7 to 32 bits of word length are available but 1 to 6 bits are prohibited. S1WDL needs to be set to "word length - 1"

S1WDL needs to be set less than or equal to the value set in I2Sn_MCR0REG:S1CHL.

Setting examples are shown below.

Bits	Description
00000-00101	Setting is prohibited
00110	Sub frame 1 word length is 7 bits
00111	Sub frame 1 word length is 8 bits
...	...
...	...
11110	Sub frame 1 word length is 31 bits
11111	Sub frame 1 word length is 32 bits

Notes:

- 1. If I2Sn_CNTREG:RHLL is "1", set word length to 16 bits or less.
- 2. If I2Sn_CNTREG:RHLL is "0", set word length to 32 bits or less.

S1WDL is valid only in 2 sub frame construction (I2Sn_CNTREG:SBN is "1") and is invalid in 1 sub frame construction (I2Sn_CNTREG:SBN is "0").

[bit15] read0 : -

[bit14:10] S0CHN : Sub Frame 0 Channel Numbers

Number of channels of sub frame 0 is set up to 32 channels.

S0CHN needs to be set to "number of channel - 1".

Setting examples are shown below.

Bits	Description
00000	Sub frame 0 becomes 1 channel construction
00001	Sub frame 0 becomes 2 channel construction
00010	Sub frame 0 becomes 3 channel construction
...	...
...	...
11110	Sub frame 0 becomes 31 channel construction
11111	Sub frame 0 becomes 32 channel construction

[bit9:5] S0CHL : Sub Frame 0 Channel Length

Channel length of the channel constructing sub frame 0 (bit length of channel) is set.

7 to 32 bits of channel length are available but 1 to 6 bits are prohibited. S0CHL needs to be set to "channel length - 1".

Setting examples are shown below.

Bits	Description
00000-00101	Setting is prohibited
00110	Sub frame 0 channel length is 7 bits
00111	Sub frame 0 channel length is 8 bits
...	...
...	...
11110	Sub frame 0 channel length is 31 bits
11111	Sub frame 0 channel length is 32 bits

Channel length can be set to 32 bits or less regardless of I2Sn_CNTREG:RHLL

[bit4:0] S0WDL: Sub Frame 1 Word Length

word length of the channel constructing sub frame 0 (bit length of channel) is set.

7 to 32 bits of word length are available but 1 to 6 bits are prohibited. S0WDL needs to be set to "word length - 1".

S0WDL needs to be set less than or equal to the value set in I2Sn_MCR0REG:S0CHL.

Setting examples are shown below.

Bits	Description
00000-00101	Setting is prohibited
00110	Sub frame 0 word length is 7 bits
00111	Sub frame 0 word length is 8 bits
...	...
...	...
11110	Sub frame 0 word length is 31 bits
11111	Sub frame 0 word length is 32 bits

Notes:

- 1. If I2Sn_CNTREG:RHLL is "1", set word length to 16 bits or less.
- 2. If I2Sn_CNTREG:RHLL is "0", set word length to 32 bits or less.

4.5. Channel Control Register 1 (I2Sn_MCR1REG)

The Channel Control Register 1 (I2Sn_MCR1REG) controls enable and disable functions to each channel of sub frame 0.

Channel Control Register 1 (I2Sn_MCR1REG)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	S0CH[31]	S0CH[30]	S0CH[29]	S0CH[28]	S0CH[27]	S0CH[26]	S0CH[25]	S0CH[24]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	S0CH[23]	S0CH[22]	S0CH[21]	S0CH[20]	S0CH[19]	S0CH[18]	S0CH[17]	S0CH[16]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	S0CH[15]	S0CH[14]	S0CH[13]	S0CH[12]	S0CH[11]	S0CH[10]	S0CH[9]	S0CH[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	S0CH[7]	S0CH[6]	S0CH[5]	S0CH[4]	S0CH[3]	S0CH[2]	S0CH[1]	S0CH[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] S0CH : Sub Frame 0 Channel Enable

Each bit enables/disables corresponding channel of sub frame 0 (e.g. S0CH[0] bit controls 0th channel of sub frame 0, S0CH[31] bit controls 31st channel of sub frame 0).

Bit	Description
0	The corresponding channel is disabled Transmission/reception is not performed to the disabled channel.
1	The corresponding channel is enabled Transmission/reception is performed to the enabled channel.

4.6. Channel Control Register 2 (I2Sn_MCR2REG)

The Channel Control Register 2 (I2Sn_MCR2REG) controls enable and disable functions to each channel of sub frame 1.

Channel Control Register 2 (I2Sn_MCR2REG)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	S1CH[31]	S1CH[30]	S1CH[29]	S1CH[28]	S1CH[27]	S1CH[26]	S1CH[25]	S1CH[24]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	S1CH[23]	S1CH[22]	S1CH[21]	S1CH[20]	S1CH[19]	S1CH[18]	S1CH[17]	S1CH[16]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	S1CH[15]	S1CH[14]	S1CH[13]	S1CH[12]	S1CH[11]	S1CH[10]	S1CH[9]	S1CH[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	S1CH[7]	S1CH[6]	S1CH[5]	S1CH[4]	S1CH[3]	S1CH[2]	S1CH[1]	S1CH[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] S1CH : Sub Frame 1 Channel Enable

Each bit enables/disables corresponding channel of sub frame 1 (e.g. S1CH[0] bit controls 0th channel of sub frame 1), S1CH[31] bit controls 31st channel of sub frame 1. When frame is 1 sub frame construction (I2Sn_CNTREG:SBFN is "0"), this is invalid.

Bit	Description
0	The corresponding channel is disabled Transmission/reception is not performed to the disabled channel.
1	The corresponding channel is enabled Transmission/reception is performed to the enabled channel.

4.7. Operation Control Register (I2Sn_OPRREG)

The Operation Control Register (I2Sn_OPRREG) controls receive and transmit operation.

Operation Control Register (I2Sn_OPRREG)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	RXENB
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	TXENB
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	START
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:25] read0 : -

[bit24] RXENB : Receive Enable

Enable/disable functions of receiving operation is set.

Bit	Description
0	Receiving operation is disabled Reception FIFO becomes empty with writing "0" to this bit. When RXENB is "0", the data received from serial reception bus is not written to reception FIFO. DMA reception channel stops during DMA transfer.
1	Receiving operation is enabled

[bit23:17] read0 : -

[bit16] TXENB : Transmit Enable

Enable/disable functions of transmitting operation is set.

Bit	Description
0	Transmit operation is disabled Transmit FIFO becomes empty with writing "0" to this bit. When TXENB is "0", the data written to Transmission FIFO Data Registers from CPU or DMA is not written to transmission FIFO. DMA transmit channel stops during DMA transfer.
1	Transmit operation is enabled

[bit15:8] read0 : -

[bit7:1] read0 : -

[bit0] START : I2S Enable

I2S is enabled/disabled.

Bit	Description
0	I2S is stopped and internal transmission/reception FIFO becomes empty by writing "0" to this bit
1	I2S is operable.

When START is "1", it is prohibited to rewrite I2Sn_CNTREG, I2Sn_MCR0REG, I2Sn_MCR1REG, and I2Sn_MCR2REG registers.

4.8. Software Reset Register (I2Sn_SRST)

This register is to control software reset.

Software Reset Register (I2Sn_SRST)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	SRST
ACCESS_TYPE	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R0,W	R,W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:8] read0 : -

[bit7:1] read0 : -

[bit0] SRST : Software Reset

Software reset is performed by writing "1".

I2Sn_STATUS register and each internal state machine enter initial state by software reset and transmission/reception FIFO becomes empty.

There is no influence to registers other than I2Sn_STATUS, I2Sn_INTCNT, and I2Sn_DMAACT registers.

When read value is "0" after writing "1", it indicates software reset is completed. "1" indicates software reset is in process.

4.9. Interrupt Control Register (I2Sn_INTCNT)

This register is to enable or disable interrupt function.

Interrupt Control Register (I2Sn_INTCNT)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	TXUD1M	TBERM	FERRM	TXUD0M	TXOVM	TXFDM	TXFIM
ACCESS_TYPE	R0,WX	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	1	1	1	1	1	1	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	read0	read0	RBERM	RXUDM	RXOVM	EOPM	RXFDM	RXFIM
ACCESS_TYPE	R0,WX	R0,WX	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	1	1	1	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	read0	read0	read0	TFTH[3]	TFTH[2]	TFTH[1]	TFTH[0]
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	read0	read0	RPTMR[1]	RPTMR[0]	RFTH[3]	RFTH[2]	RFTH[1]	RFTH[0]
ACCESS_TYPE	R0,WX	R0,WX	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31] read0 : -

[bit30] TXUD1M : Tx FIFO Underflow Interrupt Mask

This is transmission FIFO underflow interrupt mask bit.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn STATUS:TXUDR1 is not masked
1	Interrupt to CPU by I2Sn STATUS:TXUDR1 is masked

[bit29] TBERM : Tx Block Size Error Interrupt Mask

This is interrupt mask bit of block size error of transmission channel.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn STATUS:TBERR is not masked
1	Interrupt to CPU by I2Sn STATUS:TBERR is masked

[bit28] FERRM : Frame Error Interrupt Mask

This is frame error interrupt mask bit.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn STATUS:FERR is not masked
1	Interrupt to CPU by I2Sn STATUS:FERR is masked

[bit27] TXUD0M : Tx FIFO Underflow Interrupt Mask

This is transmission FIFO underflow interrupt mask bit.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn_STATUS:TXUDR0 is not masked
1	Interrupt to CPU by I2Sn_STATUS:TXUDR0 is masked

[bit26] TXOVM : Tx FIFO Overflow Interrupt Mask

This is transmission FIFO overflow interrupt mask bit.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn_STATUS:TXOVR is not masked
1	Interrupt to CPU by I2Sn_STATUS:TXOVR is masked

[bit25] TXFDM : Tx DMA Mask

This is transmission DMA request mask register bit.

It becomes "1" by software reset.

Bit	Description
0	DMA transfer is requested when empty space in transmission FIFO is more than threshold value
1	DMA transfer is not requested even when empty space in transmission FIFO is more than threshold value

[bit24] TXFIM : Tx FIFO Interrupt Mask

This is transmission FIFO interrupt mask bit.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn_STATUS:TXFI is not masked
1	Interrupt to CPU by I2Sn_STATUS:TXFI is masked

[bit23:22] read0 : -
[bit21] RBERM : Rx Block Size Error Interrupt Mask

This is interrupt mask bit of reception channel block size error.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn_STATUS:RBERR is not masked
1	Interrupt to CPU by I2Sn_STATUS:RBERR is masked

[bit20] RXUDM : Rx FIFO Underflow Interrupt Mask

This is reception FIFO underflow interrupt mask bit.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn_STATUS:RXUDR is not masked
1	Interrupt to CPU by I2Sn_STATUS:RXUDR is masked

[bit19] RXOVM : Rx FIFO Overflow Interrupt Mask

This is interrupt mask bit of reception FIFO overflow.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn_STATUS:RXOVR is not masked
1	Interrupt to CPU by I2Sn_STATUS:RXOVR is masked

[bit18] EOPM : EOPI Interrupt Mask

This is interrupt mask bit by EOPI of status register.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn_STATUS:EOPI is not masked
1	Interrupt to CPU by I2Sn_STATUS:EOPI is masked

[bit17] RXFDM : Rx FIFO DMA Mask

This is reception DMA request mask bit.

It becomes "1" by software reset.

Bit	Description
0	DMA transfer is requested when reception data written to reception FIFO is more than threshold value, previous Rx DMA block transfer has completed and there is no Rx block size error.
1	DMA transfer is not requested

[bit16] RXFIM : Rx FIFO Interrupt Mask

This is reception FIFO interrupt mask bit.

It becomes "1" by software reset.

Bit	Description
0	Interrupt to CPU by I2Sn_STATUS:RXFI is not masked
1	Interrupt to CPU by I2Sn_STATUS:RXFI is masked

[bit15:12] read0 : -**[bit11:8] TFTH : Tx FIFO Threshold**

Threshold value of transmission FIFO is set.

Empty space of transmission FIFO is more than threshold value and I2Sn_INTCNT: Interrupt to CPU occurs.

Empty space of transmission FIFO is more than threshold value, previous Tx DMA block transfer has completed, there is no Tx block size error I2Sn_INTCNT:TXFDM is "0": DMA is requested to DMAC.

Note:

- These bits must not be changed during DMA transfers

[bit7:6] read0 : -**[bit5:4] RPTMR : Rx Completion Timer**

This is packet reception completion timer setting bit which sets time-out value of the internal reception completion timer.

Reception FIFO is not empty and number of its data is smaller than or equal to threshold value: the timer always counts up.

Reception FIFO is empty or the data value is more than threshold value: the timer is cleared.

When the timer times out, I2Sn_STATUS:EOPI bit is set to "1".

The timer becomes "00" by software reset.

Bit	Description
00	0 (the timer is not in operation)
01	54000 CLK_HAPPS1B0 cycles
10	108000 CLK_HAPPS1B0 cycles
11	216000 CLK_HAPPS1B0 cycles

[bit3:0] RFTH : Rx FIFO Threshold

Threshold value of reception FIFO is set.

Number of receive words in reception FIFO is more than threshold value and I2Sn_INTCNT: Interrupt to CPU occurs.

Number of receive words in reception FIFO is more than threshold value, previous Rx DMA block transfer has completed, there is no Rx block size error and I2Sn_INTCNT:RXFDM is "0": DMA is requested to DMAC.

Note:

- *These bits must not be changed during DMA transfers*

4.10. Status Register (I2Sn_STATUS)

This register gives status information.

Status Register (I2Sn_STATUS)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	TBERR	RBERR	FERR	TXUDR1	TXUDR0	TXOVR	RXUDR	RXOVR
ACCESS_TYPE	R,WX	R,WX	R,W1	R,W1	R,W1	R,W1	R,W1	R,W1
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	read0	read0	read0	read0	EOP1	BSY	TXFI	RXFI
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R,W1	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	TXNUM[7]	TXNUM[6]	TXNUM[5]	TXNUM[4]	TXNUM[3]	TXNUM[2]	TXNUM[1]	TXNUM[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RXNUM[7]	RXNUM[6]	RXNUM[5]	RXNUM[4]	RXNUM[3]	RXNUM[2]	RXNUM[1]	RXNUM[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31] TBERR : Tx Block Size Error

When I2Sn_DMAACT:TDMACT is "1" and block transfer through DMA transmission channel is more than I2Sn_INTCNT:TFTH + 1, this bit is set to 1 and the DMA transmission channel is stopped.

When TBERR is "1" and I2Sn_INTCNT:TBERRM is "0", interrupt to CPU occurs.

This bit becomes "0" by software reset.

[30] RBERR : Rx Block Size Error

When I2Sn_DMAACT:RDMACT is "1" and block transfer through DMA reception channel is more than I2Sn_INTCNT:RFTH + 1, this bit is set to 1 and the DMA reception channel is stopped.

When RBERR is "1" and I2Sn_INTCNT:RBERM is "0", interrupt to CPU occurs.

This bit becomes "0" by software reset.

[bit29] FERR : Frame Error

Occurrence of frame error is indicated. This bit is set to "1" in the following cases:

- Frame synchronous signal cannot be received with the set frame rate in the free-running mode (I2Sn_CNTREG:FRUN = "0") and the slave mode (I2Sn_CNTREG:MSMD = "0").
- The next frame synchronous signal is received during frame transmission/reception in the slave mode (I2Sn_CNTREG:MSMD), not free-running mode (I2Sn_CNTREG:FRUN = "1").

When FERR is "1" and I2Sn_INTCNT:FERRM is "0", interrupt to CPU occurs.

Writing "1" from CPU clears the value to "0".

This bit becomes "0" by software reset.

[bit28] TXUDR1 : Tx FIFO Underflow Error

When transmission FIFO underflows at the start of frame, the value is set to "1".

When TXUDR1 is "1" and I2Sn_INTCNT:TXUD1M is "0", interrupt to the CPU occurs.

Writing "1" from CPU clears the value to "0".

This bit becomes "0" by software reset.

Note:

- When the transmission FIFO underflows at the start of frame, there will be no more attempts to read the transmission FIFO during the rest of the frame, so if the transmission FIFO is not written after it has underflowed, I2Sn_STATUS:TXUDR0 is not set to "1".

[bit27] TXUDR0 : Tx FIFO Underflow Error

When transmission FIFO underflows during frame transmission (from 2nd bit word to the last frame of the word), the value is set to "1".

When TXUDR0 is "1" and I2Sn_INTCNT:TXUD0M is "0", interrupt to the CPU occurs.

Writing "1" from CPU clears the value to "0".

This bit becomes "0" by software reset.

Note:

- When the transmission FIFO underflows during frame transmission and is still empty at the start of the next frame, I2Sn_STATUS:TXUDR1 is set to "1" too.

[bit26] TXOVR : Tx FIFO Overflow Error

When transmission FIFO overflows, the value is set to "1" indicating transmission data is written in the condition that transmission FIFO is full. The value "1" indicates 1 word or more of transmission data is ignored.

When TXOVR is "1" and I2Sn_INTCNT:TXOVM is "0", interrupt to CPU occurs.

Writing "1" from CPU clears the value to "0".

This bit becomes "0" by software reset.

[bit25] RXUDR : Rx FIFO Underflow Error

When reception FIFO underflows, the value is set to "1" indicating read access is carried out to reception FIFO in the condition that reception FIFO is empty.

When RXUDR is "1" and I2Sn_INTCNT:RXUDM is "0", interrupt to the CPU occurs. Writing "1" from CPU clears the value to "0".

This bit becomes "0" by software reset.

Note:

- This flag is not set when the DAP controller reads the Reception FIFO Data Registers while the reception FIFO is empty.

[bit24] RXOVR : Rx FIFO Overflow Error

When reception FIFO overflows, the value is set to "1" indicating reception is carried out in the condition that reception FIFO is full. The value "1" indicates 1 word or more of reception data is ignored.

When RXOVR is "1" and I2Sn_INTCNT:RXOVM is "0", interrupt to CPU occurs.

Writing "1" from CPU clears the value to "0".

This bit becomes "0" by software reset.

[bit23:20] read0 : -

[bit19] EOPI : Interrupt Flag for Rx Timer

This is an interrupt flag that is triggered when an internal reception timer times out. The reception timer is enabled when following conditions are met at the same time:

I2Sn_CNTREG:RXDIS is set to "0".

I2Sn_OPRREG:START bit is set to "1" and I2Sn_OPRREG:RXENB = "1".

After the reset, operation starts with the 1st word reception.

The count value is automatically cleared if reception FIFO data is more than threshold or it becomes empty. When the reception FIFO is not empty and the number of data is less than or equal to the threshold, the reception timer is incremented with each CLK_HAPPS1B0 cycle.

EOPI is set to "1" when reception FIFO is non-empty and reception timer count value reaches timeout set by I2Sn_INTCNT:RPTMR.

When EOPI is "1" and I2Sn_INTCNT:EOPM is "0", interrupt to CPU occurs.

Writing "1" from CPU clears the value to "0".

This bit becomes "0" by software reset.

[bit18] BSY : Serial Tx Busy

Serial transmission control part is in busy state. This bit is not affected by software reset.

Bit	Description
0	Serial transmission control part is in idle state
1	Serial transmission control part is in busy state

[bit17] TXFI : Tx FIFO Empty

When number of empty space of transmission FIFO is greater than the threshold set in I2Sn_INTCNT:TFTH, this bit is set to "1".

This bit is "1" and I2Sn_INTCNT: interrupt to CPU occurs.

When number of empty slot of transmission FIFO becomes smaller or equal to the threshold by writing to Transmission FIFO Data Registers from CPU or DMAC, this bit is cleared automatically to "0".

The value also become "0" when I2Sn_OPRREG:START bit is "0" or I2Sn_OPRREG:TXENB bit is "0".

If software reset is performed at I2Sn_OPRREG:START bit = "1" and I2Sn_OPRREG:TXENB bit = "1", the value becomes "0" during software reset then changes to "1" after the process.

[bit16] RXFI : Rx FIFO Full

When number of reception FIFO data becomes more than the threshold set in I2Sn_INTCNT:RFTH, this bit is set to "1".

This bit is "1" and I2Sn_INTCNT: interrupt to CPU occurs.

When number of data in reception FIFO becomes smaller or equal to the threshold by reading Reception FIFO DATA Registers from CPU or DMAC, this bit is automatically cleared to "0".

This bit becomes "0" by software reset.

[bit15:8] TXNUM : Number of Tx FIFO Data

The number of data in transmission FIFO is indicated.

This field is incremented by write access to Transmission FIFO Data Registers and decremented by serial word transmission.

Max. value of 66 can be displayed in the simultaneous transfer mode and value of 132 in the transmission only mode.

This field becomes "00000000" by software reset.

[bit7:0] RXNUM : Number of Data in Rx FIFO

The number of data in reception FIFO is indicated.

This field is incremented by word reception from serial bus and decremented by read access to Reception FIFO Data Registers.

Maximum value of 66 can be displayed in the simultaneous transfer mode and value of 132 in the reception mode.

This field becomes "00000000" by software reset.

4.11. DMA Activate Register (I2Sn_DMAACT)

This register is to enable or disable DMA control function.

DMA Activate Register (I2Sn_DMAACT)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	TDMACT
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	RDMACT
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:24] read0 : -

[bit23:17] read0 : -

[bit16] TDMACT : Tx DMA Control

The DMA transmission channel is activated.

After transmission channel starts, software should write "1" to TDMACT for transmit DMA channel to be active. When TDMACT is "0", transfer request of transmission channel block is not sent to DMAC.

Writing "0" from CPU clears the value to "0".

This bit becomes "0" by software reset.

Bit	Description
0	DMA transmission channel is disabled
1	DMA transmission channel is enabled

Clearing TDMACT also clears write transmission request.

[bit15:8] read0 : -

[bit7:1] read0 : -

[bit0] RDMACT : Rx DMA Control

The DMA reception channel is activated.

After reception channel starts, software should write "1" to RDMACT for receive DMA channel to be active. When RDMACT is "0", transfer request of reception channel block is not sent to DMAC.

Writing "0" from CPU clears the value to "0".

This bit becomes "0" by software reset.

Bit	Description
0	DMA reception channel is disabled
1	DMA reception channel is enabled

Clearing RDMACT also clears reception transfer request.

4.12. Debug Register (I2Sn_DEBUG)

This register is to enable or disable debug function.

Debug Register (I2Sn_DEBUG)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	read0
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	DBGE
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:8] read0 : -

[bit7:1] read0 : -

[bit0] DBGE : Debug Enable (DBGE)

This bit is used to enable/disable debug mode for I2S.

Bit	Description
0	Debug mode disabled
1	Debug mode enabled

This bit takes effect only in master mode (i.e. I2Sn_CNTREG:MSMD = "1").

When DBGE is set to "1" and the processor is in debug state and I2S is working as a master, then the serial interface is halted by stopping the activity on the SCK output. The activity on the serial clock resumes either when the processor leaves debug state or DBGE is set to "0".

4.13. Module ID Register (I2Sn_MIDREG)

This register implements unique module identification number. Refer to the device datasheet for the module identification number of I2S module in the device.

Module ID Register (I2Sn_MIDREG)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	MID[31]	MID[30]	MID[29]	MID[28]	MID[27]	MID[26]	MID[25]	MID[24]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	MID[23]	MID[22]	MID[21]	MID[20]	MID[19]	MID[18]	MID[17]	MID[16]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	MID[15]	MID[14]	MID[13]	MID[12]	MID[11]	MID[10]	MID[9]	MID[8]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	MID[7]	MID[6]	MID[5]	MID[4]	MID[3]	MID[2]	MID[1]	MID[0]
ACCESS_TYPE	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE								
INITIAL_VALUE	0	0	0	0	0	0	0	1

[bit31:0] MID : Module ID

This read-only register gives the unique module identification number of I2S module. The unique Module ID number identifies the version of the I2S module used in the MCU. Refer to the device specific datasheet for the module identification number of its I2S.

CHAPTER 25: Programmable CRC



This chapter explains the function and operation of the Programmable CRC.

1. Overview
2. Configuration and Block Diagram
3. Operation of the Programmable CRC
4. Registers

CODE: PRGCRC-S6J3200-E1

1. Overview

This section describes the features and the block diagram of the Programmable CRC.

Features of Programmable CRC

The Programmable CRC is a software configurable module with serial CRC calculation logic as hardware implementation. The serial CRC logic works on modulo-2 arithmetic for calculation of checksum. The CRC module can detect errors in data blocks by calculating a checksum.

- Programmable 8-, 16-, 24-, or 32-bit input data width
- Programmable polynomial value (polynomial degree from 2 to 32)
- Programmable initial seed value
- Programmable final checksum XOR value
- Interrupt and DMA trigger capability
- Configurable input/output bit reflection and byte swapping. This facilitates the different settings of common CRC standards and the handling of data organized in little or big endian format
- Supports block/multiple data transfers (more than 32-bit)

Areas of Application

- Data security/integrity
- Communication protocols

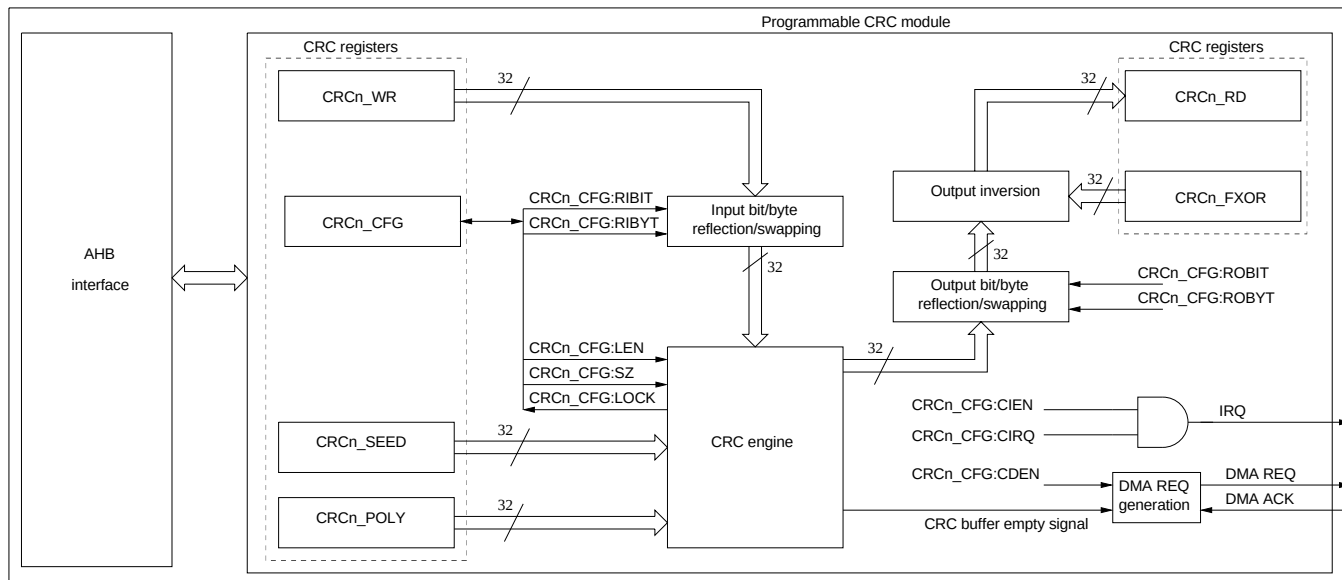
Programmable CRC module can be configured to widely used common CRC standards, some of them are listed below:

- CRC-32-IEEE 802.3
- CRC-16-CCITT
- CRC-8-CCITT
- CRC-5-USB
- CRC-XMODEM
- 12-bit CRC
- 10-bit CRC
- 8-bit CRC

2. Configuration and Block Diagram

This section shows a block diagram of Programmable CRC

Figure 2-1 Block Diagram of Programmable CRC



3. Operation of the Programmable CRC

This section describes operation of Programmable CRC in detail.

For more details on flowcharts for CRC operation see Section 3.1, on CRC calculation flow see Section 3.2, and on an example for CRC calculation see Section 3.3

3.1. CRC Operation Flowcharts

The flowcharts Figure 3-1,
Figure 3-2 , and
Figure 3-3 show the steps to configure CRC registers and to perform a CRC calculation.

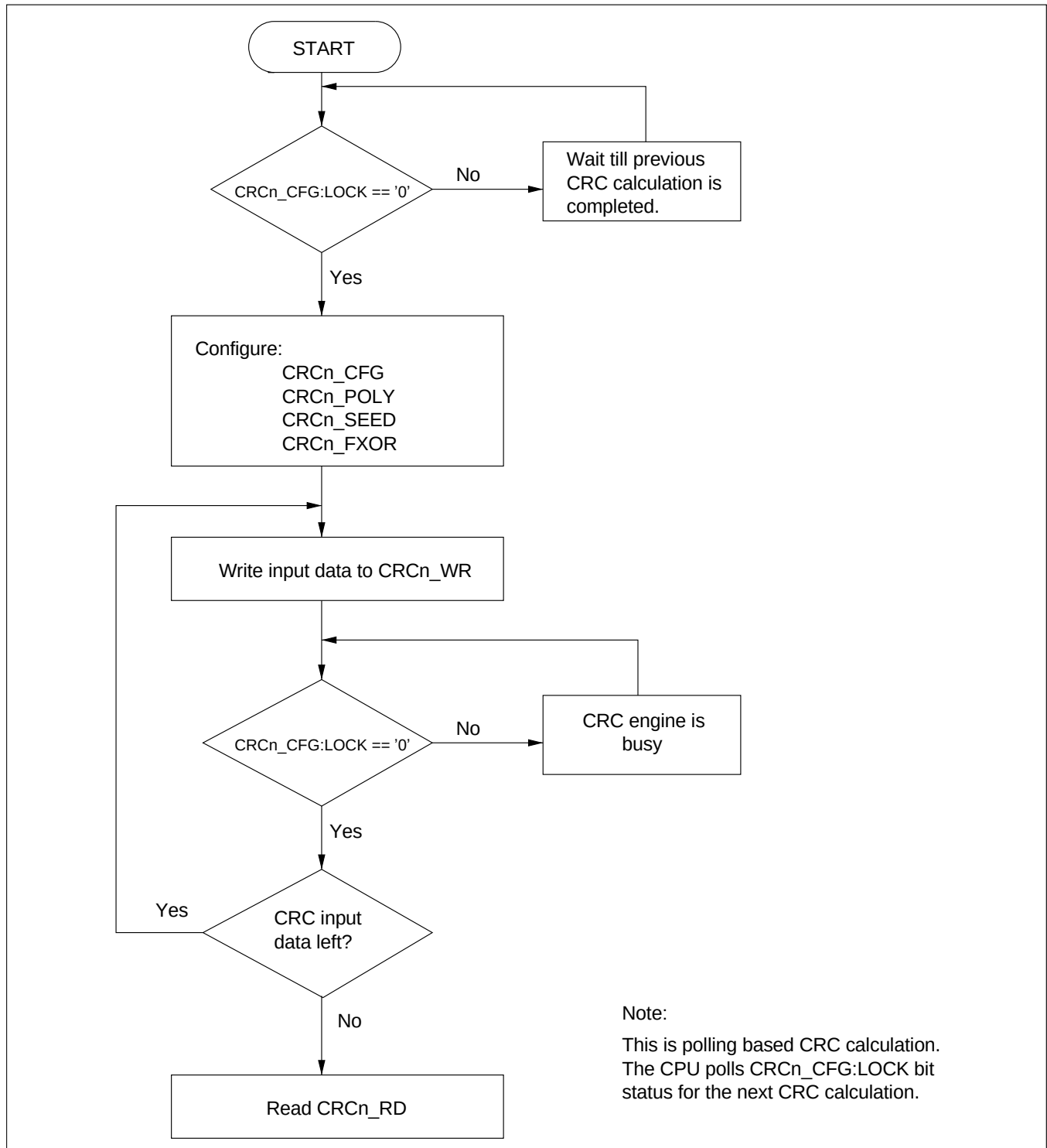
Figure 3-1 Polling Based CRC Operation


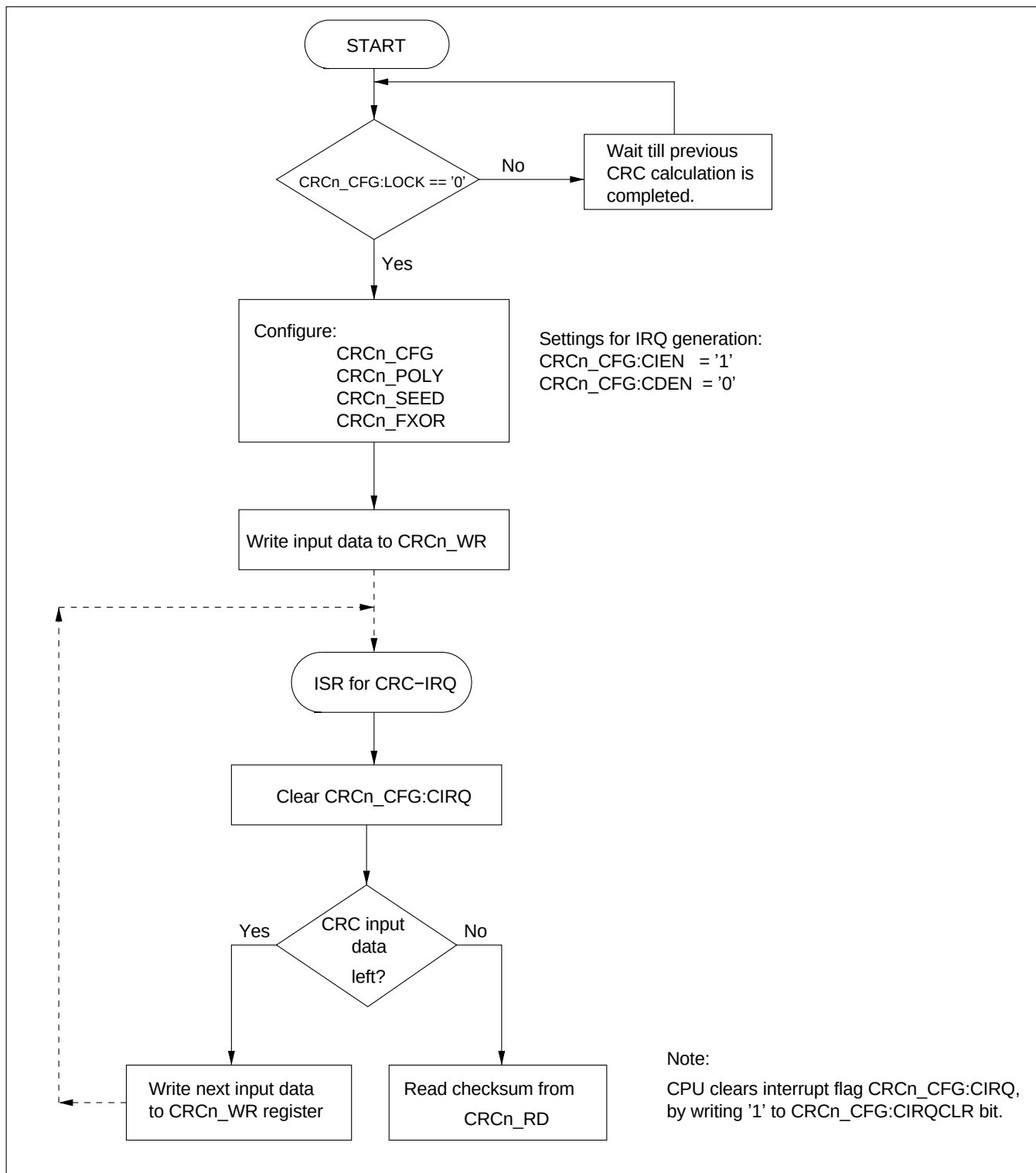
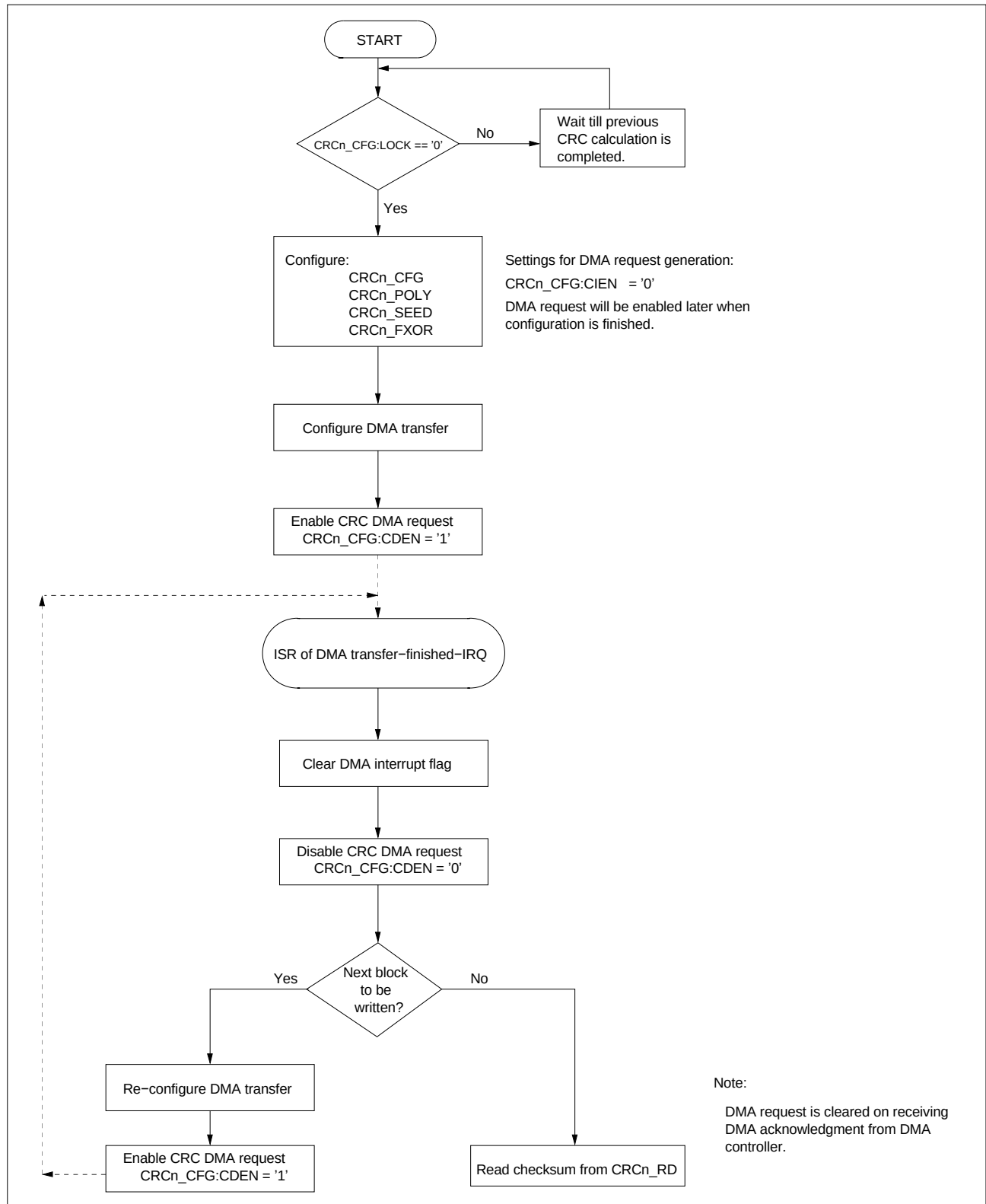
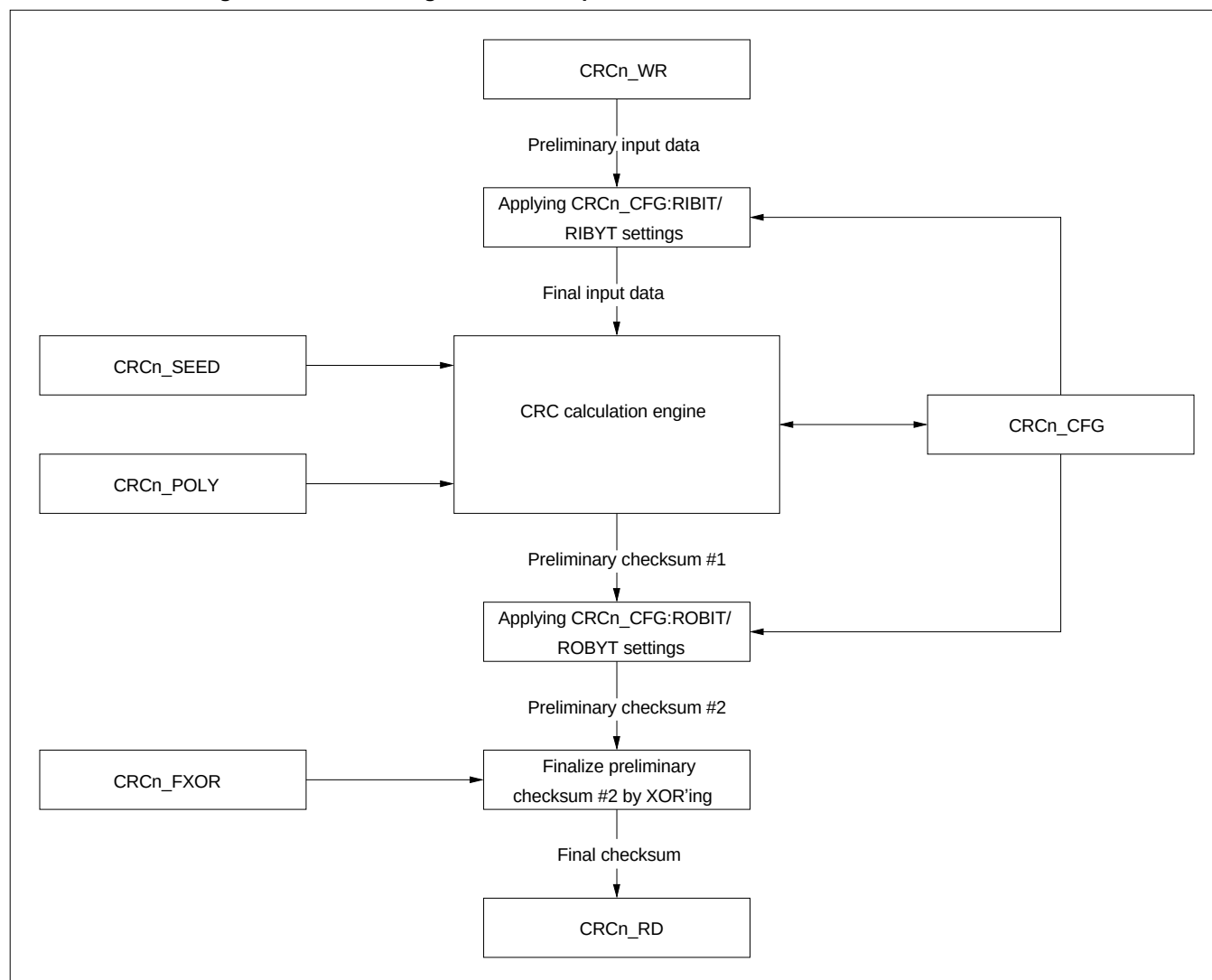
Figure 3-2 CRC Operation with IRQ

Figure 3-3 CRC Operation with DMA Request


3.2. CRC Input Data and Checksum Calculation Flow

Figure 3-4 Block Diagram of CRC Input Data and Checksum Calculation Flow



1. The input data for which CRC is to be calculated is written to **CRCn_WR** register. This is the "preliminary input data".
2. The "preliminary input data" bytes can be swapped/reflected bit-wise using **CRCn_CFG:RIBIT** and/or byte-wise using **CRCn_CFG:RIBYT** before they enter the CRC engine. The settings are shown below:
 "preliminary input data" in **CRCn_WR** register:
 A7----A0 B7----B0 C7----C0 D7----D0
 If the input data size is less than 32-bit ($SZ < "11"$), then the remaining bits (8-, 16-, or 24-bit) of the data are considered as don't care (X) as shown in below table.

Table 3-1 Preliminary Input Data Bit-wise and/or Byte-wise Reflection/Swapping

RIBYT	RIBIT	SZ	Final Input Data for CRC Engine			
			+3	+2	+1	+0
0	0	00	XXXX XXXX	XXXX XXXX	XXXX XXXX	D7-----D0
		01	XXXX XXXX	XXXX XXXX	C7-----C0	D7-----D0
		10	XXXX XXXX	B7-----B0	C7-----C0	D7-----D0
		11	A7-----A0	B7-----B0	C7-----C0	D7-----D0
	1	00	XXXX XXXX	XXXX XXXX	XXXX XXXX	D0-----D7
		01	XXXX XXXX	XXXX XXXX	C0-----C7	D0-----D7
		10	XXXX XXXX	B0-----B7	C0-----C7	D0-----D7
		11	A0-----A7	B0-----B7	C0-----C7	D0-----D7
1	0	00	XXXX XXXX	XXXX XXXX	XXXX XXXX	D7-----D0
		01	XXXX XXXX	XXXX XXXX	D7-----D0	C7-----C0
		10	XXXX XXXX	D7-----D0	C7-----C0	B7-----B0
		11	D7-----D0	C7-----C0	B7-----B0	A7-----A0
	1	00	XXXX XXXX	XXXX XXXX	XXXX XXXX	D0-----D7
		01	XXXX XXXX	XXXX XXXX	D0-----D7	C0-----C7
		10	XXXX XXXX	D0-----D7	C0-----C7	B0-----B7
		11	D0-----D7	C0-----C7	B0-----B7	A0-----A7

- The "preliminary input data" after applying the settings of CRCn_CFG:RIBIT/RIBYT results in the "final input data", which is sent to the CRC engine for checksum calculation.
- The CRCn_SEED register provides the initial value to the CRC engine. The required polynomial is provided by CRCn_POLY register. The CRC engine starts its operation once CRCn_WR register is written with the input data.
- CRC engine performance: The performance of CRC engine for CRC checksum calculation is based on the input data size and number of clock cycles (bus clock) required to complete a calculation. The shows number of clock cycles required to get final checksum at CRCn_RD register with respect to input data size.

Table 3-2 Clock Cycles Requirement for Checksum Calculation

Input Data Size	Number of Clock Cycles Required for Final Checksum at CRCn_RD
8-bit	Input data size (8-bit) + 2 = 10 clock cycles.
16-bit	Input data size (16-bit) + 2 = 18 clock cycles.
24-bit	Input data size (24-bit) + 2 = 26 clock cycles.
32-bit	Input data size (32-bit) + 2 = 34 clock cycles.

- The "preliminary checksum #1" bytes can be swapped/reflected bit-wise using CRCn_CFG:ROBIT and/or byte-wise using CRCn_CFG:ROBYT. shows at which positions the checksum bits of "preliminary checksum #1" S[(LEN-1):0] will be located in "preliminary checksum #2" after CRCn_CFG:ROBIT/ROBYT settings have been applied. Only some examples of different CRCn_CFG:LEN configurations are shown.

Note:

- Only some examples for CRCn_CFG:LEN are shown.

Table 3-3 Preliminary Checksum #1 Bit-wise and/or Byte-wise Reflection/Swapping

ROBYT	ROBIT	LEN	Preliminary Checksum #2				Action
			+3	+2	+1	+0	
0	0	32	S31---S24	S23---S16	S15---S8	S7---S0	No swapping/reflection. The checksum is aligned with the polynomial degree/length.
		21	0000 0000	000 S20---S16	S15---S8	S7---S0	No swapping/reflection. The checksum is aligned with the polynomial degree/length. The bits S21 to S31 are "0".
		16	0000 0000	0000 0000	S15---S8	S7---S0	No swapping/reflection. The checksum is aligned with the polynomial degree/length. The bits S16 to S31 are "0".
		3	0000 0000	0000 0000	0000 0000	00000 S2---S0	No swapping/reflection. The checksum is aligned with the polynomial degree/length. The bits S3 to S31 are "0".
	1	32	S24---S31	S16---S23	S8---S15	S0---S7	Byte aligned checksum reflection.
		21	0000 0000	S16---S20 000	S8---S15	S0---S7	Bit reflection. The checksum is byte aligned. Bit S21-S23 and S24-S31 are "0".
		16	0000 0000	0000 0000	S8---S15	S0---S7	Bit reflection. The checksum is byte aligned. Bit S16-S31 are "0".
		3	0000 0000	0000 0000	0000 0000	S0---S2 00000	Bit reflection. The checksum is byte aligned. Bit S3-S7 and S8-S31 are "0".
1	0	32	S7---S0	S15---S8	S23---S16	S31---S24	Byte aligned checksum swapping.
		21	0000 0000	S7---S0	S15---S8	000 S20---S16	Byte swapping. The checksum is byte aligned. Bit S21-S23 and S24-S31 are "0".
		16	0000 0000	0000 0000	S7---S0	S15---S8	Byte aligned checksum swapping. Bit S16-S31 are "0".
		3	0000 0000	0000 0000	0000 0000	00000 S2_S0	No byte swapping. Bit S3-S7 and S8-S31 are "0".
	1	32	S0---S7	S8---S15	S16---S23	S24---S31	Bit reflection and byte swapping aligned with polynomial degree/length.
		21	0000 0000	000 S0---S4	S5---S12	S13---S20	Bit reflection and byte swapping. The checksum is aligned with polynomial length/degree. Bit S21-S23 and S24-S31 are "0".
		16	0000 0000	0000 0000	S0---S7	S8---S15	Bit reflection and byte swapping. The checksum is aligned with polynomial length/degree. Bit S16-S31 are "0".
		3	0000 0000	0000 0000	0000 0000	00000 S0---S2	Bit reflection and byte swapping. The checksum is aligned with polynomial length/degree. Bit S3-S7 and S8-S31 are "0".

7. The checksum after applying settings of CRCn_CFG:ROBIT/ROBYT is "preliminary checksum #2".
8. The "preliminary checksum #2" is XOR'ed with the contents of CRCn_FXOR register to get the "final checksum".
9. The "final checksum" gets available at CRCn_RD register.

3.3. CRC Calculation Example

Consider the following values for calculating 8-bit CRC checksum value.

Input data = 0x0F (Hex)

Polynomial = $x^8 + x^2 + x + 1$

Seed = 0xFF (Hex)

Final XOR = 0x00 (Hex)

The coefficients of the polynomial are arranged in .

Table 3-4 Coefficients of the Polynomial

x8	x7	x6	x5	x4	x3	x2	x1	x0
1	0	0	0	0	0	1	1	1

The highest order coefficient x8 provides the degree of the CRC polynomial and the checksum length, respectively. It must not be set to "1" while configuring CRCn_POLY register, instead CRCn_CFG:LEN should be configured (here it is CRCn_CFG:LEN = 8). Therefore, the value of the polynomial that is written to CRCn_POLY register in accordance with above coefficients is 0x07 (Hex).

The input/output bit reflection is disabled in this example.

The Programmable CRC registers should be configured as follows for the given values:

The CRC configuration register is configured by considering 8-bit input data size and 8-bit polynomial/checksum length as follows.

CRCn_CFG = 0x00080000 (Hex)

CRCn_POLY = 0x00000007 (Hex)

CRCn_SEED = 0x000000FF (Hex)

CRCn_FXOR = 0x00000000 (Hex)

CRCn_WR = 0x0000000F (Hex)

The final result of CRC checksum calculation is 0xDE (Hex), which gets available after 10 clock cycles (once CRCn_WR is written) in the CRCn_RD register.

If another input data is given to the CRC module, then "preliminary checksum #1" (0xDE) is used as the initial seed value.

If the new CRC calculation should start from the seed value instead of from the last CRC result, then the CRCn_SEED register needs to be re-written (even if it is the same seed value as before).

4. Registers

All Programmable CRC registers are explained in this section.

The suffix 'n' in the register name indicates that the register is an instance 'n' of the module.

Registers of Programmable CRC

The following registers are available for each instance of Programmable CRC:

- CRC Polynomial Register (CRCn_POLY)
- CRC Seed Register (CRCn_SEED)
- CRC Final XOR Register (CRCn_FXOR)
- CRC Configuration Register (CRCn_CFG)
- CRC Write Register (CRCn_WR)
- CRC Read Register (CRCn_RD)

Memory Layout of Programmable CRC Registers

Figure 4-1 Memory Layout of Programmable CRC Registers

Offset	+3	+2	+1	+0
0x00000000	CRCn_POLY 00000100 11000001 00011101 10110111			
0x00000004	CRCn_SEED 11111111 11111111 11111111 11111111			
0x00000008	CRCn_FXOR 11111111 11111111 11111111 11111111			
0x0000000C	CRCn_CFG 00000000 11100000 00000000 00000000			
0x00000010	CRCn_WR 00000000 00000000 00000000 00000000			
0x00000014	CRCn_RD 00000000 00000000 00000000 00000000			

4.1. CRC Polynomial Register (CRCn_POLY)

The CRC Polynomial Register (CRCn_POLY) defines the polynomial value for the CRC checksum calculation.

CRC Polynomial Register (CRCn_POLY)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	POLY[31]	POLY[30]	POLY[29]	POLY[28]	POLY[27]	POLY[26]	POLY[25]	POLY[24]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	1	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	POLY[23]	POLY[22]	POLY[21]	POLY[20]	POLY[19]	POLY[18]	POLY[17]	POLY[16]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	1	0	0	0	0	0	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	POLY[15]	POLY[14]	POLY[13]	POLY[12]	POLY[11]	POLY[10]	POLY[9]	POLY[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	1	1	1	0	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	POLY[7]	POLY[6]	POLY[5]	POLY[4]	POLY[3]	POLY[2]	POLY[1]	POLY[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	0	1	1	0	1	1	1

[bit31:0] POLY[31:0] : CRC Polynomial

The CRCn_POLY contains the CRC polynomial. The degree of the polynomial must be between 2 to 32. Initial value is the common CRC-32 polynomial 0x04C11DB7 ($x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$). The highest degree of coefficient should be used to configure polynomial/checksum length (CRCn_CFG:LEN).

Note:

- If the polynomial length as defined by CRCn_CFG:LEN is less than 32-bit, then the upper bits [31:LEN] must be written to "0" by the programmer. The highest order degree must not be set to "1" while configuring CRCn_POLY register, as it is implicitly defined by CRCn_CFG:LEN.

4.2. CRC Seed Register (CRCn_SEED)

The CRC Seed Register (CRCn_SEED) defines the initial value for the CRC checksum calculation.

CRC Seed Register (CRCn_SEED)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	SEED[31]	SEED[30]	SEED[29]	SEED[28]	SEED[27]	SEED[26]	SEED[25]	SEED[24]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	SEED[23]	SEED[22]	SEED[21]	SEED[20]	SEED[19]	SEED[18]	SEED[17]	SEED[16]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	SEED[15]	SEED[14]	SEED[13]	SEED[12]	SEED[11]	SEED[10]	SEED[9]	SEED[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	SEED[7]	SEED[6]	SEED[5]	SEED[4]	SEED[3]	SEED[2]	SEED[1]	SEED[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

[bit31:0] SEED[31:0] : CRC SEED

CRCn_SEED contains the initial value for checksum calculation. If the seed value is not initialized for the next operation (even if the seed value is identical to the previous operation), then calculation is continued from the last state with the current checksum value as initial value. Initial value for seed register is 0xFFFFFFFF.

Note:

- The CRCn_SEED register should be configured with respect to the polynomial length (CRCn_CFG:LEN). If the polynomial length is less than 32-bit, then the upper bits [31:LEN] must be written to "0" by the programmer.

4.3. CRC Final XOR Register (CRCn_FXOR)

The CRC Final XOR register (CRCn_FXOR) contains the values to be XOR'ed with the preliminary checksum to finalize the CRC calculation

CRC Final XOR Register (CRCn_FXOR)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	FXOR[31]	FXOR[30]	FXOR[29]	FXOR[28]	FXOR[27]	FXOR[26]	FXOR[25]	FXOR[24]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	FXOR[23]	FXOR[22]	FXOR[21]	FXOR[20]	FXOR[19]	FXOR[18]	FXOR[17]	FXOR[16]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	FXOR[15]	FXOR[14]	FXOR[13]	FXOR[12]	FXOR[11]	FXOR[10]	FXOR[9]	FXOR[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	FXOR[7]	FXOR[6]	FXOR[5]	FXOR[4]	FXOR[3]	FXOR[2]	FXOR[1]	FXOR[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	1	1	1	1	1	1	1

[bit31:0] FXOR [31:0] : CRC XOR Data

The contents of CRCn_FXOR register are XOR'ed with the preliminary checksum data (after CRCn_CFG:ROBIT/ROBYT settings have been applied) and then the final checksum is moved to CRCn_RD register. Initial value for final XOR register is 0xFFFFFFFF.

Notes:

- The bits of this register affect the corresponding bits of the CRCn_RD register. Therefore, the bits not belonging to the checksum should be written to "0". For the position of the checksum bits depending on the used output bit/byte reflection refer to Table 3-3.

4.4. CRC Configuration Register (CRCn_CFG)

The CRC Configuration Register (CRCn_CFG) is used to set the operation mode of the CRC module. CRCn_CFG register describes the polynomial/checksum length, input data size, and input/output bit/byte reflection. It indicates the status of CRC operation. Interrupt and DMA requests are also configured using CRCn_CFG register.

CRC Configuration Register (CRCn_CFG)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	read0	read0	read0	LOCK	read0	CDEN	CIEN	CIRQ
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R,WX	R0,WX	R/W	R/W	R,WX
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	SZ[1]	SZ[0]	LEN[5]	LEN[4]	LEN[3]	LEN[2]	LEN[1]	LEN[0]
ACCESS_TYPE	R/W	R7W	R/W	R7W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	1	1	1	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	read0	read0	read0	read0	RIBIT	RIBYT	ROBIT	ROBYT
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	read0	read0	read0	read0	read0	read0	read0	CIRQCLR
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:29] read0 : -

[bit28] LOCK : CRC Engine Status bit

This bit indicates the status of the CRC engine.

Bit	Description
0	CRC engine is ready, new data can be written to CRC registers
1	CRC engine is busy and writing to CRC registers is not possible. If the data is written to the CRC registers when LOCK bit is "1", then an error response is generated

[bit27] read0 : -

[bit26] CDEN : DMA Request Enable bit

This bit enables/disables the DMA request

Bit	Description
0	Disable the DMA request
1	Enable the DMA request

DMA request is generated when CRC is in buffer empty state and CRCn_CFG:CDEN is set. DMA ISR should clear this bit after final transfer. Clearing this bit by CPU at any other time might lead to unwanted behavior.

[bit25] CIEN : CRC Interrupt Enable bit to CPU

This bit enables/disables the interrupt request.

Bit	Description
0	Disable the interrupt request
1	Enable the interrupt request

The IRQ is triggered when CRCn_CFG:CIEN bit is enabled and CRC interrupt flag (CRCn_CFG:CIRQ) is set.

[bit24] CIRQ : CRC Interrupt Flag

This bit indicates the interrupt status of CRC.

Bit	Description
0	No interrupt request Note: CPU clears interrupt flag by writing CRCn_CFG:CIRQCLR bit to "1":
1	Interrupt request

Checksum has been calculated by CRC engine and is available in CRCn_RD register.

[bit23:22] SZ[1:0] : CRC Input Data Size Configuration bits

These bits are used to configure the input data size as follows

Bits	Description
00	8-bit
01	16-bit
10	24-bit
11	32-bit

[bit21:16] LEN[5:0] : CRC Polynomial/Checksum Length Configuration bits

These bits are used to configure the length (degree) of CRC polynomial/checksum as follows:

Bits	Description
100000	32
011111	31
.....	
000010	2

Notes:

- The following settings are not supported:
- $CRCn_CFG:LEN > 32$
- $CRCn_CFG:LEN < 2$

[bit15:12] read0 : -**[bit11] RIBIT : Reflect Input Bits**

Bit	Description
0	Disable input bit reflection
1	Enable input bit reflection

When the input data in the $CRCn_WR$ register is passed to the CRC engine, the bit ordering of each byte within input data is reversed. For more details refer to Section "Operation of the Programmable CRC".

[bit10] RIBYT : Reflect Input Bytes

Bit	Description
0	Disable input byte reflection (swapping)
1	Enable input byte reflection (swapping)

When the input data in the $CRCn_WR$ register is passed to the CRC engine, the byte ordering of input data is reversed. Only the bytes of the configured input data size $CRCn_CFG:SZ$ are affected. For more details refer to Section "Operation of the Programmable CRC".

Note:

- For 8-bit input data, this setting has no effect.

[bit9] ROBIT : Reflect Output Bits

Bit	Description
0	Disable output bit reflection
1	Enable output bit reflection

The bit ordering of each byte within checksum is reversed, before passing the checksum to final XOR'ing stage. For more details refer to Section "Operation of the Programmable CRC".

[bit8] ROBYT : Reflect Output Bytes

Bit	Description
0	Disable output byte reflection (swapping)
1	Enable output byte reflection (swapping)

The byte ordering of checksum data is reversed, before passing the byte aligned polynomial length of checksum data to final XOR'ing stage. For more details refer to Section "Operation of the Programmable CRC".

Note:

- For the checksum data less than or equal to 8 bits, this setting has no effect.

[bit7:1] read0 : -
[bit0] CIRQCLR : Interrupt Clear

This bit clears the CRC interrupt flag.

Bit	Description
0	Write "0" is ignored, reading this bit always returns "0"
1	Clear CRC interrupt flag (CRCn_CFG:CIRQ)

4.5. CRC Write Register (CRCn_WR)

The input data for the CRC checksum calculation must be written to the CRC Write Register (CRCn_WR).

CRC Write Register (CRCn_WR)

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	CRCWR[31]	CRCWR[30]	CRCWR[29]	CRCWR[28]	CRCWR[27]	CRCWR[26]	CRCWR[25]	CRCWR[24]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	CRCWR[23]	CRCWR[22]	CRCWR[21]	CRCWR[20]	CRCWR[19]	CRCWR[18]	CRCWR[17]	CRCWR[16]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	CRCWR[15]	CRCWR[14]	CRCWR[13]	CRCWR[12]	CRCWR[11]	CRCWR[10]	CRCWR[9]	CRCWR[8]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	CRCWR[7]	CRCWR[6]	CRCWR[5]	CRCWR[4]	CRCWR[3]	CRCWR[2]	CRCWR[1]	CRCWR[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] CRCWR[31:0] : CRC Write Register

The CRCn_WR register contains the input data, for which the CRC checksum is to be calculated. Writing to this register starts the CRC calculation process. After pre-processing (bit/byte reflection/swapping) the contents of the CRCn_WR register are passed to the CRC engine (the contents of CRCn_SEED register are also provided). There it is divided by the content of CRCn_POLY register in modulo-2 arithmetic to get the final checksum after post-processing (bit/byte reflection/swapping and XOR'ing).

Note:

- The size of input data is configured by CRCn_CFG:SZ, where 8, 16, 24, and 32 bits are only supported as data size. If the input data size is less than 32-bit (i.e. 8, 16, or 24 bits), then the invalid/unused bits are considered as don't care (X).

4.6. CRC Read Register (CRCn_RD)

The CRC Read Register (CRCn_RD) contains the final checksum of the data written to the CRCn_WR register.

CRC Read Register (CRCn_RD)

BIT OFFSET	31	30	29	28	27	26	25	24
BIT NAME	CRCRD[31]	CRCRD[30]	CRCRD[29]	CRCRD[28]	CRCRD[27]	CRCRD[26]	CRCRD[25]	CRCRD[24]
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	23	22	21	20	19	18	17	16
BIT NAME	CRCRD[23]	CRCRD[22]	CRCRD[21]	CRCRD[20]	CRCRD[19]	CRCRD[18]	CRCRD[17]	CRCRD[16]
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	15	14	13	12	11	10	9	8
BIT NAME	CRCRD[15]	CRCRD[14]	CRCRD[13]	CRCRD[12]	CRCRD[11]	CRCRD[10]	CRCRD[9]	CRCRD[8]
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT OFFSET	7	6	5	4	3	2	1	0
BIT NAME	CRCRD[7]	CRCRD[6]	CRCRD[5]	CRCRD[4]	CRCRD[3]	CRCRD[2]	CRCRD[1]	CRCRD[0]
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	Rp/Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] CRCRD[31:0]: CRC Read Data

The CRC Read Register contains the result (final checksum) of the CRC calculation after post-processing (applying CRCn_CFG:ROBIT, CRCn_CFG:ROBYT, and CRCn_FXOR settings). Writing any value on CRCn_RD register changes its content and it does not affect CRC calculation.

Note:

- The polynomial length (CRCn_CFG:LEN) provides the length of the final checksum. If the polynomial length is less than 32-bit, then bits not belonging to the checksum are "0" (in case the invalid bits of the CRCn_FXOR register are not programmed to "0", then these bits in CRCn_RD register might also be "1"). The bit/byte reflection settings (CRCn_CFG:ROBIT/ROBYT) can influence the checksum in CRCn_RD register. For the position of the checksum bits refer to Table 3-3.

CHAPTER 26: PCMPWM



This chapter explains the function and operation of the PCMPWM module.

1. Overview
2. Configuration and Block Diagram
3. Operation of the PCMPWM
4. Registers

CODE: PCMPWM-S6J3200-E1.1

1. Overview

The PCMPWM module converts Pulse Code Modulated (PCM) data samples to Pulse Width Modulated (PWM) signals. The intended purpose of the module is to provide simple audio output capabilities.

Also refer to the chapter of "Sound System Configuration" how to configure the PCMPWM.

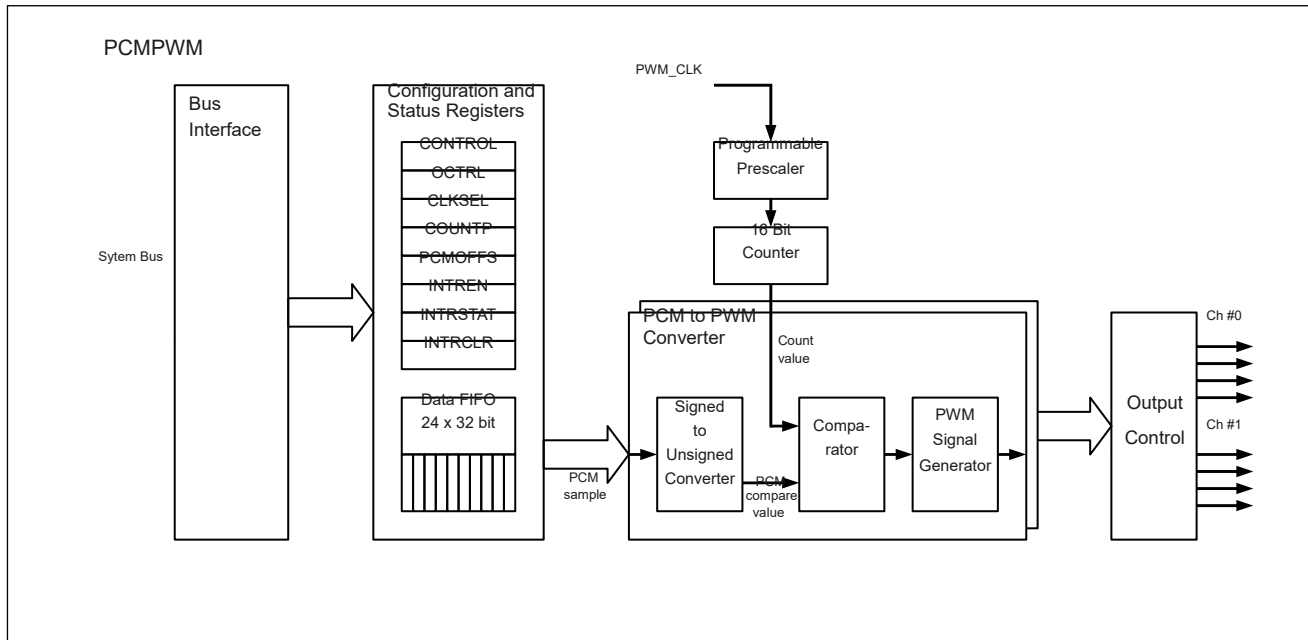
Features of the PCMPWM

- Two separate channels for stereo audio output
- Optional mono audio output mode
- A maximum output resolution of 16 bits
- An output resolution of 12 bits at a sampling frequency of 24.4 kHz (at 100 MHz PWM clock)
- An output resolution of 11 bits at a sampling frequency of 48.8 kHz (at 100 MHz PWM clock)
- Three modes of operation for different speaker interfacing:
 - Low-pass filter output mode
 - Simplified H-bridge output mode
 - Full H-bridge output mode
- Support for the DMA transfer of PCM data samples using DMA block transfer mode
- FIFO input buffer for PCM samples, with a depth 24
- Programmable clock divider for PWM cycle time
- Optional output of silence signals in debug mode and normal mode

2. Configuration and Block Diagram

2.1. Block Diagram

Figure 2-1 Block Diagram of the PCMPWM Module



Bus Interface

The Bus Interface connects the PCMPWM module's register file to the system bus.

Configuration and Status Registers

This block holds all the module's user accessible registers.

Data FIFO

This block represents a buffer for PCM samples and a boundary between the system bus clock and the PWM clock.

Clock Prescaler and 16-Bit Counter

These two blocks represent the free running counter and its prescaler used for the PCM to PWM conversion.

PCM to PWM Converters

These blocks represent the actual PCM to PWM conversion units. Each channel uses its own converter block.

Output Control

This block controls the PWM signal outputs. It e.g. defines the signals' output polarity and keeps unused outputs at their inactive levels.

2.2. Configuration of the PCMPWM Module

PCMPWM Enable

After reset the PCMPWM module is disabled. All PWM outputs are held at their inactive values. To start the PCM to PWM conversion and generate the PWM output signals, all configuration registers should be initialized and the global enable bit PCMPWMI_CONTROL:EN set. Once the module has been enabled, it must be ensured that the PCM data samples are provided to the FIFO buffer at the required rate. This may be done by either the CPU or the DMA unit.

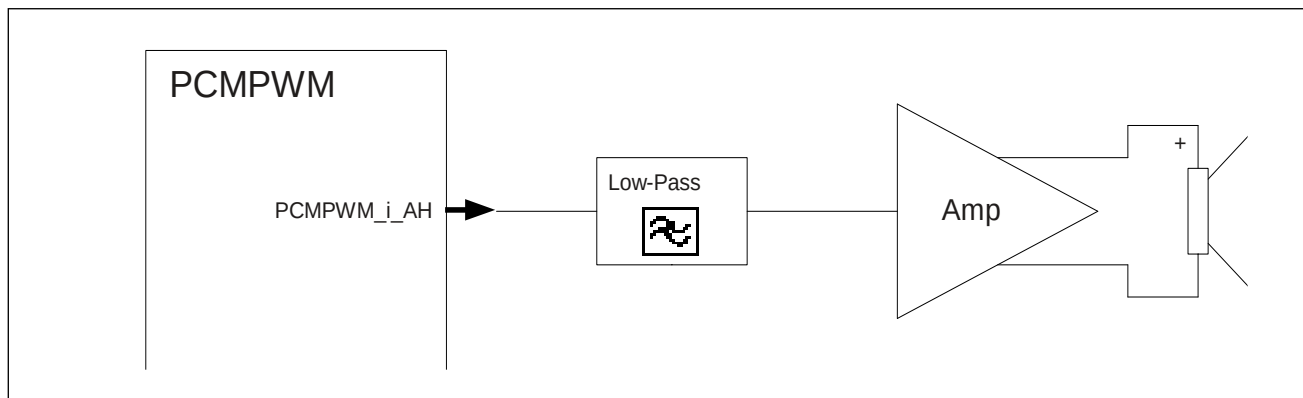
Operation Modes

The PCMPWM module supports three general modes of operation. Each mode is dedicated to a specific type of connection to the speaker. The operation mode is configured in the MODE bits of the CONTROL register (PCMPWMI_CONTROL:MODE). The following paragraphs describe these modes in detail.

1. Low-Pass Filter Mode

In the low-pass filter mode only a single output is used. The output drives an audio amplifier with a low-pass filter connected in-between. Figure 2-2 depicts the corresponding circuit.

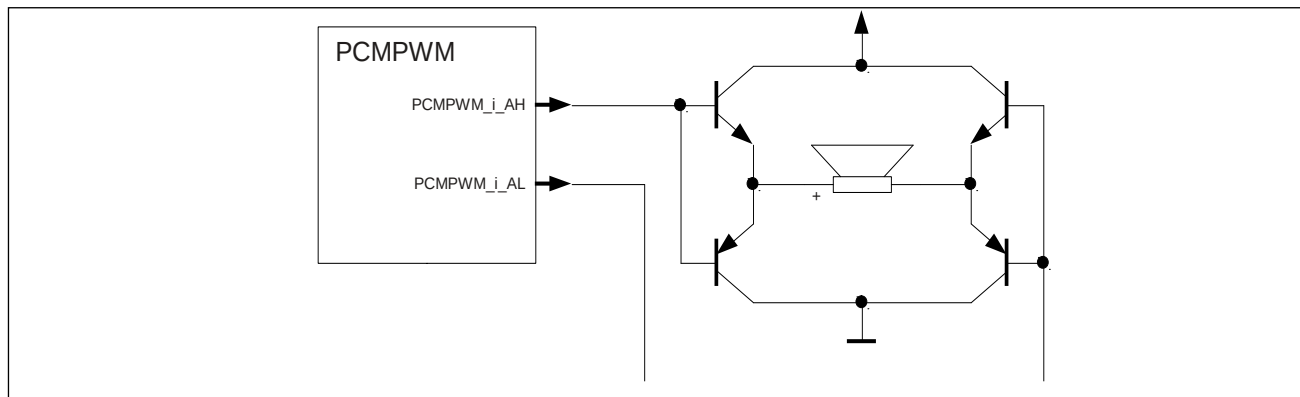
Figure 2-2 Simplified Schematic Illustration of Low Pass Filter Mode Output Circuit



For positive PCM data samples an output signal with a duty cycle of more than 50% is generated. For negative PCM data samples, the signal has a duty cycle of less than 50%. A PCM data sample of zero generates an exact 50% duty cycle output signal. A 0% and a 100% duty cycle may be reached as well if the PWM count period and the PCM conversion offset are configured appropriately (registers PCMPWMI_COUNTP and PCMPWMI_PCMOFFS).

2. Simplified H-Bridge Mode

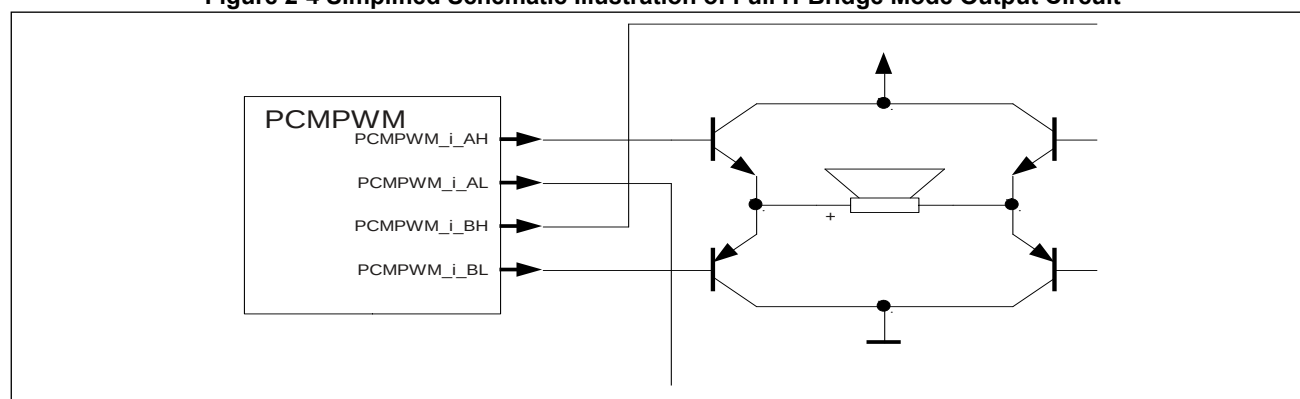
In the simplified H-bridge mode two outputs are used to drive a speaker. A pair of complementary emitter followers is connected to each output. Figure 2-3 depicts the circuit for simplified H-bridge mode.

Figure 2-3 Simplified Schematic Illustration of Simplified H-Bridge Mode Output Circuit

In simplified H-bridge mode, the signal at the PCMPWM_i_AL output is the inverted PCMPWM_i_AH signal.

3. Full H-Bridge Mode

In the full H-bridge mode four outputs per speaker are used. All transistors of the H-bridge have individual driver outputs. Figure 2-4 depicts the circuit for full H-bridge mode.

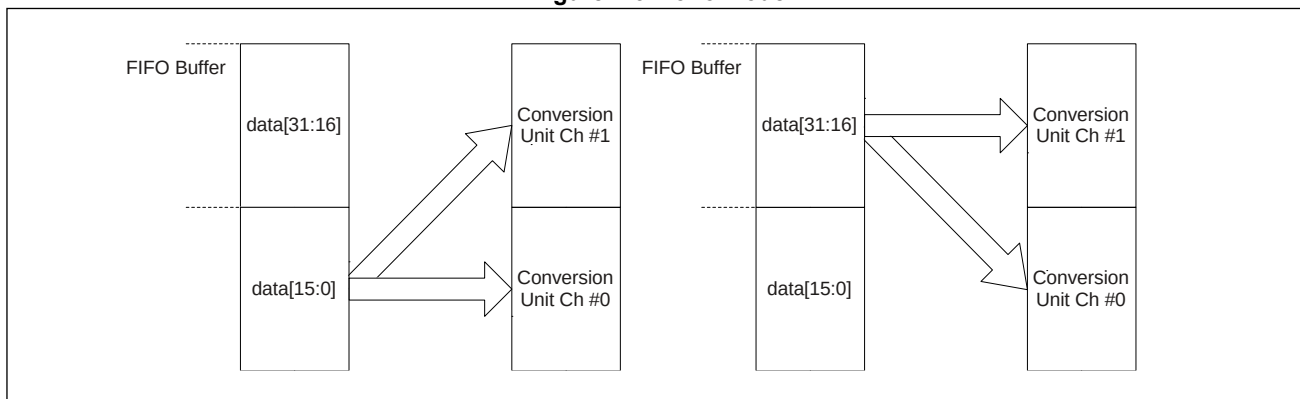
Figure 2-4 Simplified Schematic Illustration of Full H-Bridge Mode Output Circuit

In full H-bridge mode the PCMPWM_i_AL signal is again the inverted PCMPWM_i_AH signal whereas the signal at the PCMPWM_i_BL output is the inverted PCMPWM_i_BH signal. The PCMPWM_i_Ax output pair is activated for positive PCM data samples. The PCMPWM_i_Bx output pair is activated for negative PCM data samples. If the PCM data sample is zero, no branch of the H-bridge is activated. The PCMPWM_i_Ax and PCMPWM_i_Bx branches are never active at the same time.

Mono or Stereo Mode

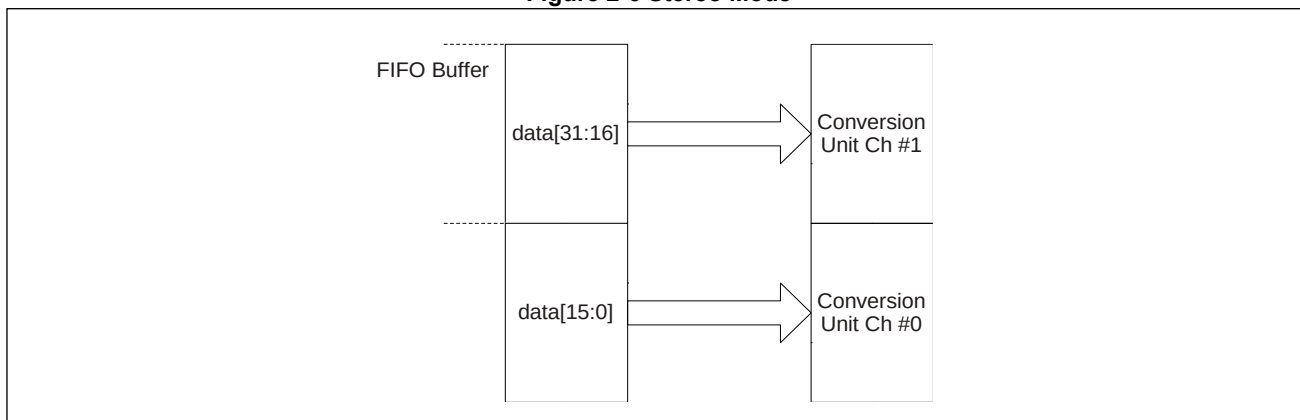
The PCMPWM module supports two modes of driving the two output channels – mono and stereo. In mono mode a single stream of PCM data samples is used to drive both output channels. I.e. both conversion units use the same PCM sample data values. Mono mode alternates between the lower (used first) and the upper 16 bits of the PCM data sample word. Thus the effective depth of the FIFO buffer increases to 48. Figure 2-5 depicts the data transfer from the FIFO buffer to the PCM to PWM conversion units in mono mode.

Figure 2-5 Mono Mode



In stereo mode each PCM sample consists of a pair of values for the two channels. They are written to the module at the same time but the values for both channels are independent of each other. The lower 16 bits of the sample word are used for channel #0 and the upper 16 bits are used for channel #1. Mono or stereo mode is configured with the PCMPWMI_CONTROL:STEREO bit. Figure 2-6 depicts the data transfer from the FIFO buffer to the PCM to PWM conversion units in stereo mode.

Figure 2-6 Stereo Mode



Single or Double Output Mode

The PCMPWM module supports two ways of processing the PCM data samples. In single output mode each PCM data sample is read from the FIFO buffer and then processed by the conversion unit. In double output mode each PCM data sample is processed twice. I.e. the same PCM data sample is used for two PWM cycles. The double output mode enables doubling of the PWM output frequency at the same PCM sample data rate.

The single/double output mode is independent of the mono/stereo mode setting.

Behavior in Debug Mode

The PCMPWM module supports debug mode. If enabled, the module stops converting PCM data samples after the one in progress and instead simply outputs a silent signal on both channels. The silent signal corresponds to a continuous stream of PCM data samples with the value of zero. In this mode no PCM samples are read from the FIFO buffer. However, new sample data may still be written to the FIFO buffer.

If the module's support for debug mode is not enabled, the PCMPWM module continues with regular PCM data sample conversion and PWM signal output.

DMA Mode

The PCM data samples may be transferred to the PCMPWM module via DMA. For this the DMA mode must be enabled by setting the PCMPWMI_CONTROL:DMAEN bit. The transfer works fully autonomously without any CPU intervention. The transfer takes place in chunks. The respective maximum number of 32-bit words per transfer is defined by PCMPWMI_CONTROL:FEST + 1. If the number of free entries in the FIFO buffer exceeds the number specified in PCMPWMI_CONTROL:FEST, a DMA transfer is requested by the PCMPWM module. The DMA then may fill up the full number of entries given by PCMPWMI_CONTROL:FEST + 1.

To set up the PCMPWM module for a DMA data transfer, the DMA unit must be configured for block transfer mode. The block size configured in the DMA must match PCMPWMI_CONTROL:FEST + 1. The PCMPWM module will then assert the PCMPWM_i_DMA_REQ output when the number of free entries in the FIFO buffer exceeds the value given by FEST. PCMPWM_i_DMA_REQ stays active until the DMA acknowledges the request by asserting PCMPWM_i_DMA_REQ_ACK. After the DMA has transferred FEST + 1 PCM data samples to the FIFO buffer, the PCMPWM will again assert the PCMPWM_i_DMA_REQ line again when the required number of free FIFO buffer entries is available. The PCMPWM module keeps track of the number of transferred data words by itself. There is an internal down counter for this purpose which is reloaded with the value of FEST + 1 when PCMPWM_i_DMA_REQ is asserted. It is decremented with each word written to the FIFO buffer. When the counter reaches zero the transfer is complete and another DMA transfer may be requested. It is an error if the DMA writes data to the FIFO while the down counter is zero. This condition is flagged as a DMA block error in the interrupt status register.

Silence Mode

By setting the PCMPWMI_CONTROL:SILENCE trigger, the module is set to silence mode. When this mode is triggered, the register holding the PCM sample to be converted is cleared to 0 and the reading from the FIFO is stopped. Also the FIFO is flushed. The FIFO can then be filled again via DMA or the CPU. As soon as the number of empty entries in the FIFO is equal or less than PCMPWMI_CONTROL:FEST, reading from the FIFO is resumed.

At begin of operation when the PCMPWM is enabled, the module is in silence mode until the required number of FIFO entries are written. This prevents possible FIFO under-runs directly after the start of operation.

2.3. Output Configuration

The two output channels of the PCMPWM module may be individually enabled and disabled. In addition, the output polarity of each channel may be selected. The enable bits are PCMPWMI_OCTRL:EN0 and PCMPWMI_OCTRL:EN1. The output polarity is programmed with PCMPWMI_OCTRL:LEVL0 and PCMPWMI_OCTRL:LEVL1.

If a channel's output is disabled, all the corresponding signals stay at their inactive values. The inactive value depends on the programmed output polarity. If a channel is programmed to an operation mode which does not use all outputs, the unused outputs also stay at their inactive values. Table 2-1 shows the inactive values of all outputs depending on the selected polarity.

Table 2-1 Inactive Output Values

PCMPWMI_OCTRL:LEVL0/LEVL1	PCMPWM_i_AH/BH	PCMPWM_i_AL/BL
0	1	0
1	0	1

3. Operation of the PCMPWM

This section describes the operation of the PCMPWM module.

3.1. Description of the PCM to PWM Conversion Process

The actual conversion of the PCM data samples to a PWM signal is done in the PCM to PWM converter as shown in Figure 2-1. The first step is a conversion of the signed PCM sample to an unsigned PCM compare value. How this is done depends on the operation mode. In low-pass filter mode and simplified H-bridge mode the step is a simple addition. The value to be added is configured in the PCMPWMI_PCMOFFS register. In full H-bridge mode the PCM compare value is the absolute value of the PCM data sample. Table 3-1 summarizes how the PCM compare value is computed in each operation mode.

Table 3-1 Inactive Output Values

Operation Mode	Computation
Low Pass Filter	PCM sample + PCMOFFS
Simplified H-Bridge	PCM sample + PCMOFFS
Full H-Bridge	PCM sample

The second step of the PCM to PWM conversion process comprises a free running counter and two comparators. The counter counts up from zero to a programmable maximum value. The maximum value is given by the PCMPWMI_COUNTP register. Whenever the counter has reached its maximum value, it wraps around to zero. The counter value is continuously compared against two values. The first value is zero and the second is the PCM compare value. The outputs of the two comparators are fed into the actual PWM signal generation. Depending on the operation mode this final block generates the actual PWM signals. Table 3-2 summarizes the logic for generating the PWM signals from the two comparator outputs. Please note the signal levels in the table are for the output polarity with PCMPWMI_OCTRL:LEVLx set to logic 1.

Table 3-2 Generation of PWM Output Signals

Event		Low-Pass Filter Mode	Simplified H-Bridge Mode		Full H-Bridge Mode			
		AH	AH	AL	AH	AL	BH	BL
Counter = 0	PCM sample positive	↑	↑	↓	↑	↓	0	1
	PCM sample = 0				0	1	0	1
	PCM sample negative				0	1	↑	↓
Counter = PCM compare value	PCM sample positive	↓	↓	↑	↓	↑	0	1
	PCM sample = 0				0	1	0	1
	PCM sample negative				0	1	↓	↑

Note:

- In case the PCM compare value is zero, the event given for equality with the PCM compare value takes precedence.

Figure 3-1 to Figure 3-4 depict some exemplary conversion cycles for all three operation modes. For low-pass filter mode and simplified H-bridge mode, PCMPWMI_COUNTP:COUNTP is set to 0xFFFF and PCMPWMI_PCMOFFS:PCMOFFS is set to 0x8000. For full H-bridge mode PCMPWMI_COUNTP:COUNTP is set to 0x7FFF. The diagrams show the value of the free running counter periodically ascending from 0 to its maximum value as well as the PCM samples and the corresponding PCM compare value.

Figure 3-1 PCM to PWM Conversion in Low-Pass Filter Mode

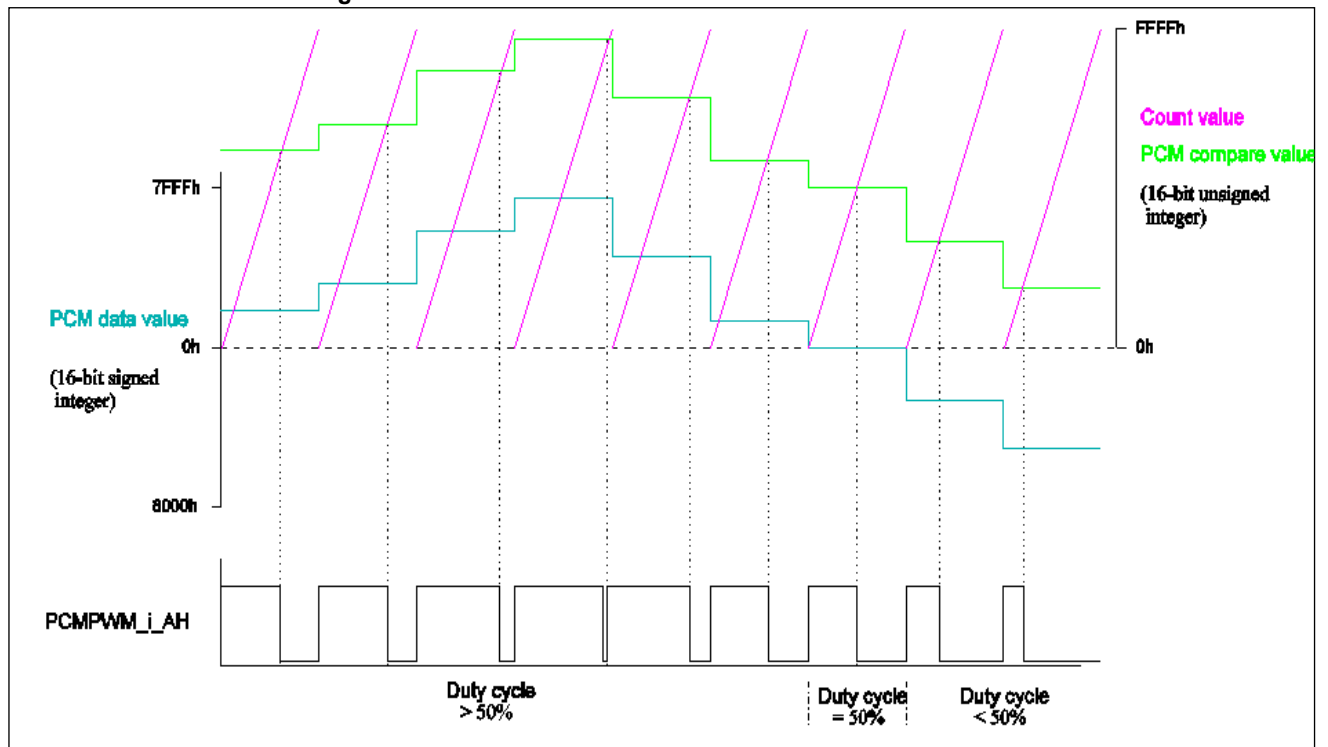


Figure 3-2 PCM to PWM Conversion in Simplified H-Bridge Mode

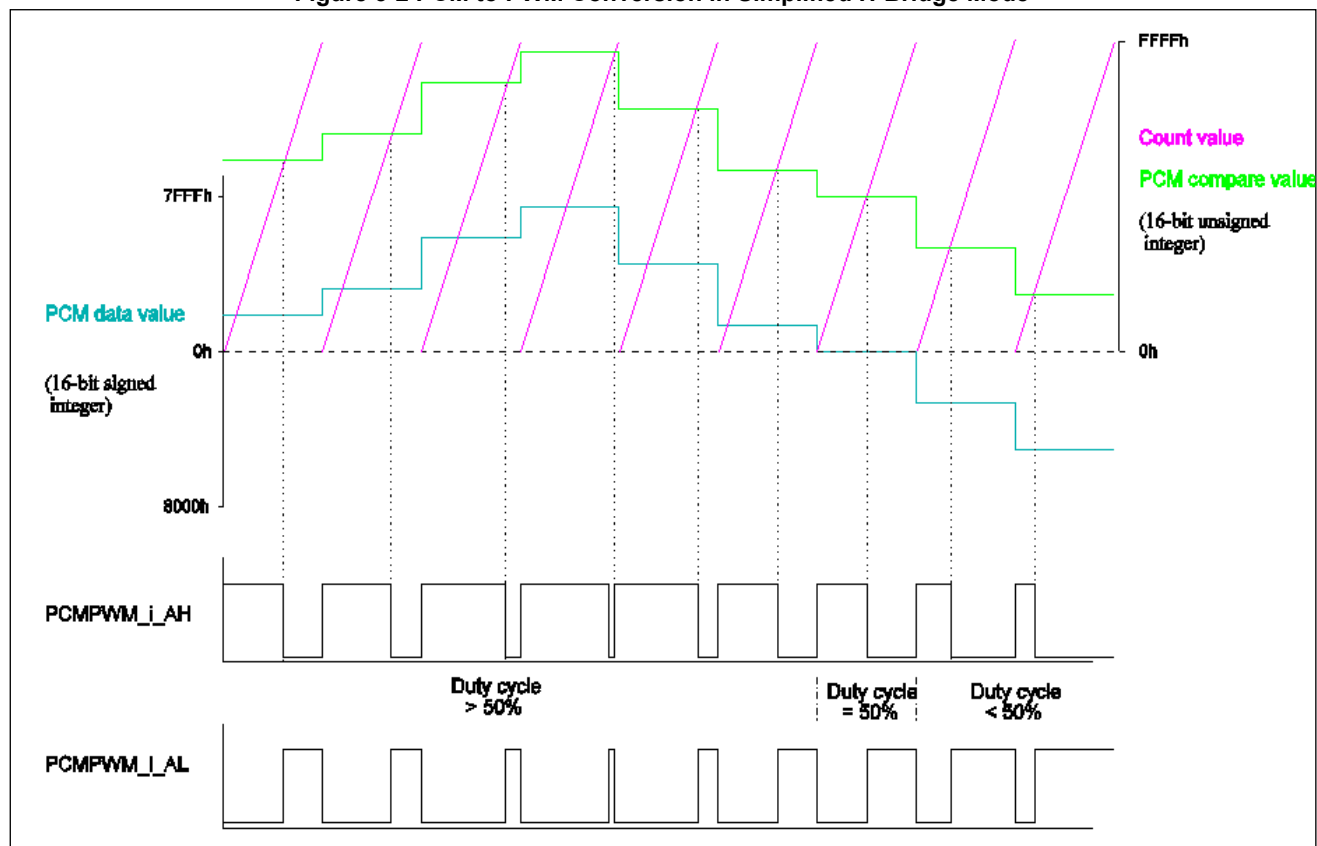


Figure 3-3 PCM to PWM Conversion in Full H-Bridge Mode

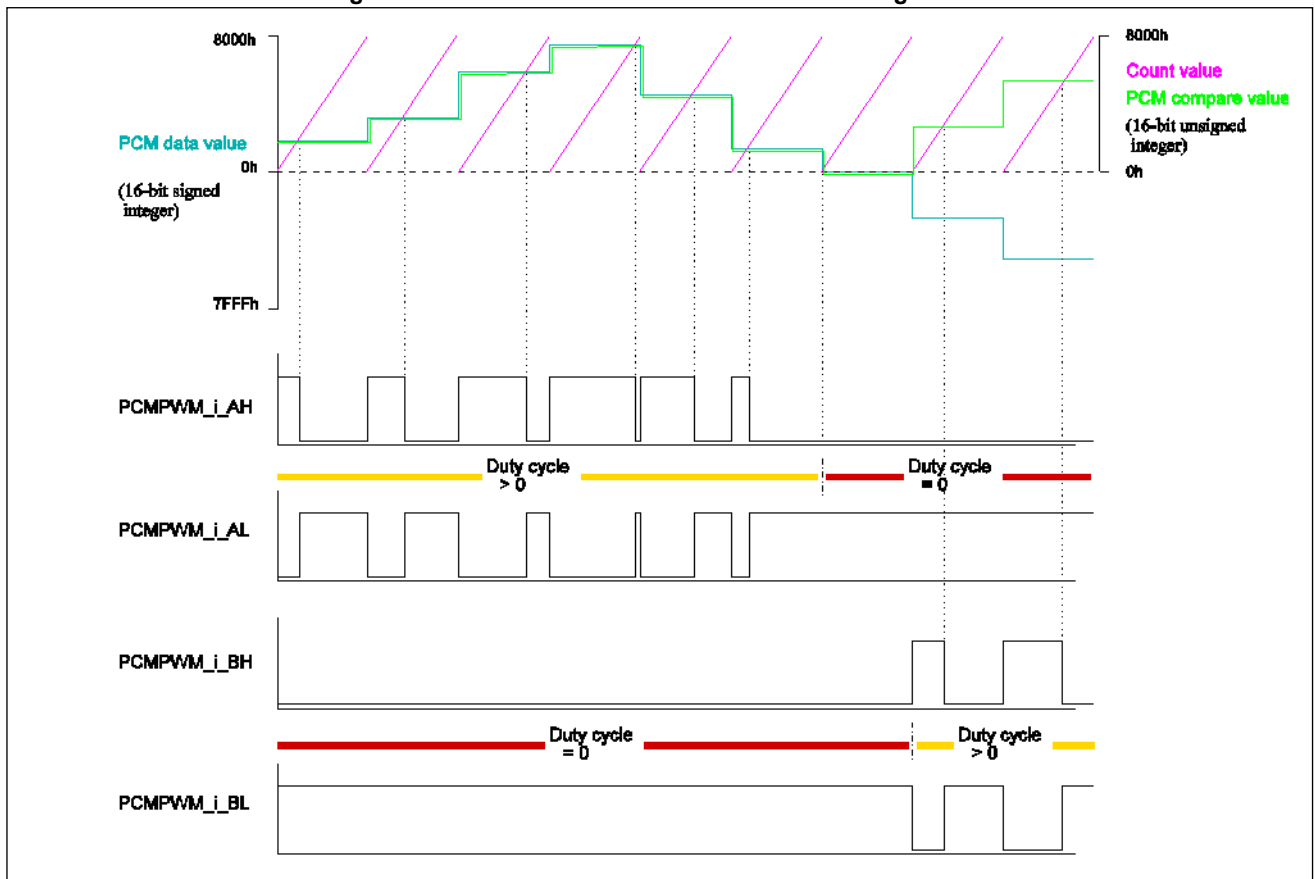
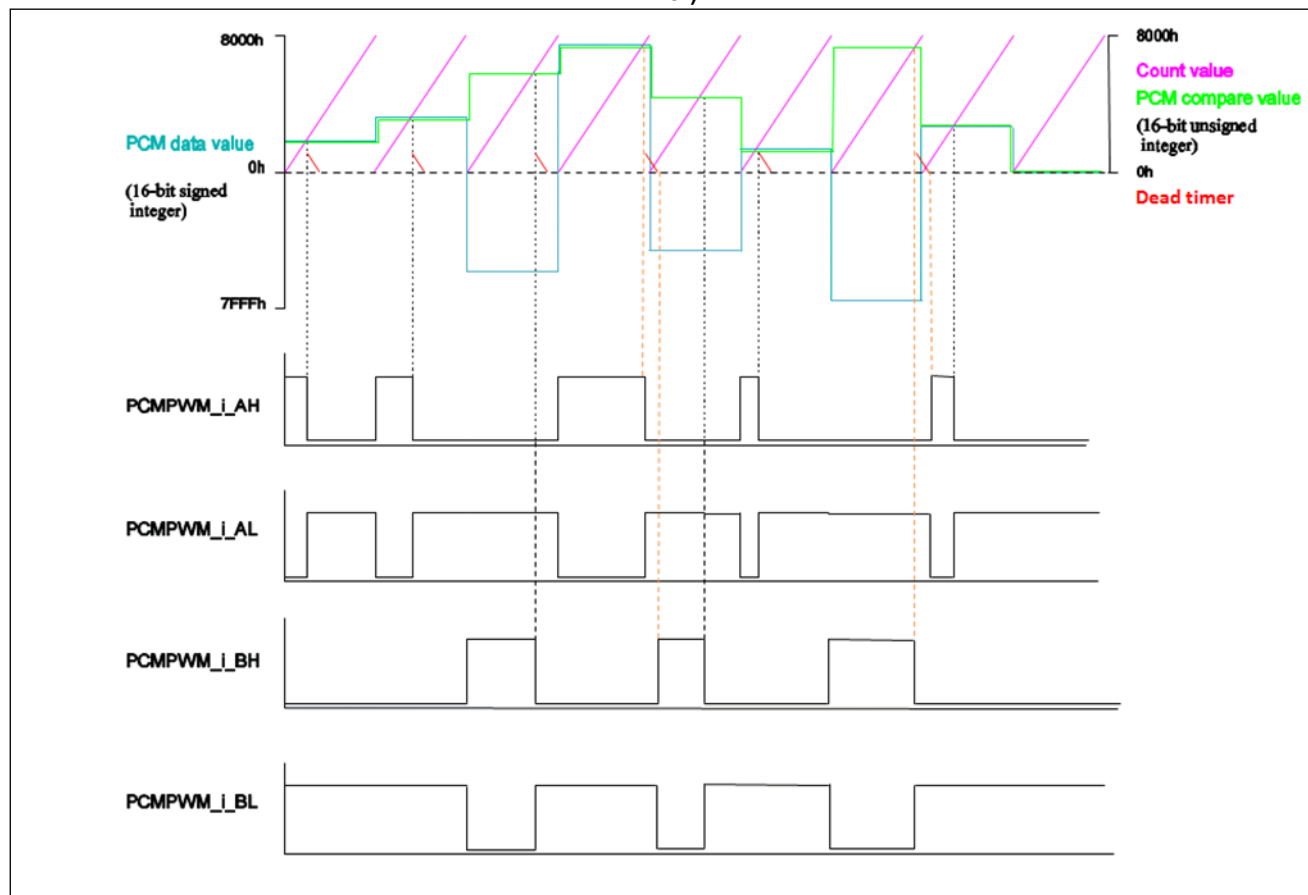


Figure 3-4 PCM to PWM Conversion in Full H-Bridge Mode (with Dead Timer)



3.2. PWM Cycle Time Configuration

The free running counter used in the PCM to PWM conversion process determines the cycle time of the generated PWM signal. The PWM cycle time is equal to the counter's full count period. So, the cycle time computes as follows:

$$T_{PWM} = \frac{COUNTP + 1}{f_{counter}}$$

The countp parameter is configured in the PCMPWMI_COUNTP register. The count frequency of the counter may be configured in the PCMPWMI_CLKSEL register. It determines the counter clock by dividing the PWM clock PWM_CLK by 1, 2, 4 or 8. So, the final formula for the PWM cycle time results to:

$$T_{PWM} = \frac{(COUNTP + 1) \times 2^{CLKSEL}}{f_{PWM_CLK}}$$

3.3. PCM Data Sample Input

The PCM to PWM conversion block reads the PCM data samples from a FIFO buffer. To ensure continuous operation of the PCM to PWM conversion, it is essential to provide the FIFO buffer with the same sustained rate of PCM data samples. The required frequency for the data samples corresponds to the reciprocal of the PWM cycle time:

$$f_{\text{sample}} = \frac{f_{\text{PWM_CLK}}}{(\text{COUNTP} + 1) \times 2^{\text{CLKSEL}}}$$

The data samples may be provided by the CPU or may be transferred via DMA. For a CPU based transfer there is support for requesting data by interrupt. Alternatively the CPU may poll the interrupt status register to determine, if there is free space in the FIFO buffer. Regardless of how the buffer FIFO is supplied with data samples, the PCMPWMI_CONTROL:FEST field specifies, at which number of free FIFO buffer entries the data transfer is requested. If the number of free entries exceeds that specified in the FEST field, the PCMPWMI_INTRSTAT:DREQ status bit is set and an interrupt request may be asserted or another DMA data transfer may be initiated.

If the PCM to PWM conversion tries to read a PCM data sample from the FIFO buffer and finds it empty, it uses the PCM value instead. I.e. the module outputs the last PWM pattern again, if no PCM data is supplied. To detect this error case of FIFO buffer under-run, an interrupt request is asserted.

Please note the above formula limits the resolution of the PCM to PWM conversion at a given $f_{\text{PWM_CLK}}$ and f_{sample} . E.g. at a clock frequency of 80 MHz, a sample frequency of 19.5 kHz, and CLKSEL set to zero, the counter may count to 4103 only. This corresponds to a resolution of about 12 bits. Table 3-3 shows some examples for the configuration of the PCMPWM module and the resulting sample frequencies and resolutions.

Table 3-3 Configuration Examples

$f_{\text{PWM_CLK}}$	CLKSEL	COUNTP	f_{sample}	Resolution
80 MHz	0	4,095	19.53 kHz	12 bit
80 MHz	0	65,535	1.22 kHz	16 bit
80 MHz	2	255	78.13 kHz	8 bit
100 MHz	1	1,023	48.83 kHz	10 bit

3.4. Interrupts

The PCMPWM module interrupts are controlled by three registers: the Interrupt Enable Register (PCMPWMI_INTREN), the Interrupt Status Register (PCMPWMI_INTRSTAT) and the Interrupt Clear Register (PCMPWMI_INTRCLR). After reset all interrupts are disabled. If an interrupt is to be used, it must be first enabled. The current status of an interrupt may be checked at any time in the Interrupt Status Register. The Interrupt Status Register contents are independent of the enable status of the interrupts. I.e. the Interrupt Status Bits are not masked by the Interrupt Enable Register.

If an interrupt has occurred, it can be reset by the Interrupt Clear Register. Writing a logic 1 to a bit in the Interrupt Clear Register clears the corresponding interrupt line as well as the interrupt status bit.

1. DMA Block Error Interrupt

This interrupt indicates an error case when the DMA tries to transfer more data to the FIFO buffer than configured by PCMPWMI_CONTROL:FEST + 1.

2. FIFO Buffer Under-Run Error Interrupt

This interrupt indicates an under-run of the FIFO buffer for PCM data samples. I.e. the PCM to PWM conversion has tried to read a PCM data sample from the FIFO buffer when it was empty. Instead of a new PCM data sample the PCM to PWM conversion uses the last PCM value instead.

3. FIFO Buffer Overflow Error Interrupt

This interrupt indicates the CPU has tried to write another PCM data sample to the FIFO buffer when it was already completely filled.

4. Data Request Interrupt

This interrupt indicates there is at least space for another FEST + 1 PCM data samples in the FIFO buffer. I.e. the PCMPWM module asserts the interrupt request when a read from the FIFO buffer frees up another PCM samples slot, so that there are FEST + 1 free entries in total.

3.5. Dead Timer Operation

In full H-Bridge mode, the 16-bit counter is compared in each count period CP with the value from the function minimum(duty, cycle) (this is the falling edge or the end of the PWM cycle). If the two values match, a down counter loaded with PCMPWMI_CONTROL:DTVAL starts to decrement with every clock cycle of the 16-bit counter. As long as the down counter is not zero, the opposite phase of the PWM outputs is masked with inactive values. Opposite phase in this case means:

- If the PCM data sample of count period CP is positive, then output signals PCMPWM_i_BL/BH are masked, although this doesn't happen in usual setup.
- If the PCM data sample of count period CP is negative, then output signals PCMPWM_i_AL/AH are masked, although this doesn't happen in usual setup.

4. Registers

This section describes the registers of the PCMPWM module.

Note:

- The suffix 'i' in the register name indicates that the register is in instance 'i' of the module.

The following registers are available for each instance of the PCMPWM:

- PCMPWM Control Register (PCMPWMi_CONTROL)
- PCMPWM Output Control Register (PCMPWMi_OCTRL)
- PCMPWM Clock Select Register (PCMPWMi_CLKSEL)
- PCMPWM Count Period Register (PCMPWMi_COUNTP)
- PCM Offset Register (PCMPWMi_PCMOFFS)
- PCM Interrupt Enable Register (PCMPWMi_INTREN)
- PCM Interrupt Status Register (PCMPWMi_INTRSTAT)
- PCM Interrupt Clear Register (PCMPWMi_INTRCLR)
- PCM Data Register 0..15 (PCMPWMi_DATA)

4.1. PCMPWM Control Register (PCMPWMI_CONTROL)

This Global Control Register is used to configure the PCMPWM module's basic mode of operation.

REGISTER_NAME	PCMPWMI_CONTROL
OFFSET	0x00000000
ACCESS_SIZE	B, H, W
MULTIPLE	0
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	DTVAL[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved			FEST[4:0]				
ACCESS_TYPE	R0,WX			R/W				
PROT_TYPE	Wp							
INITIAL_VALUE	0			0				

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved		DOUBLE	MODE[1:0]		STEREO	DBGEN	DMAEN
ACCESS_TYPE	R0,WX		R/W	R/W		R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0		0	0		0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved						SILENCE	EN
ACCESS_TYPE	R0,WX						R0,W1	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0						0	0

[bit31:24] DTVAL[7:0] : Dead Timer Value

This field defines the number of PWM_CLK cycles after the trailing edge for which the opposite phase of the PWM outputs in full H-Bridge Mode are masked with inactive value.

Setting of this field to a value greater than or equal to PCMPWMI_COUNTP:COUNTP is not allowed.

[bit20:16] FEST[4:0] : FIFO Empty Space Threshold

This field defines the number of empty entries in the FIFO buffer, which triggers a DMA request and/or a data request interrupt when it is exceeded. If this field is set to a value from 0 to 23 a data request is generated when the number of empty FIFO buffer entries exceeds this value. If this field is set to a value greater than 23, a data request is never generated.

Note:

- These bits must not be changed during DMA transfers.

[bit13] DOUBLE : Double Mode Enable

This bit enables operation in single or double mode.

Bit	Description
0	The module operates in single output mode, i.e. each PCM data sample is processed once by the conversion unit
1	The module operates in double output mode, i.e. each PCM data sample is processed twice by the conversion unit

[bit12:11] MODE[1:0] : Operation Mode

This field defines the module's mode of operation.

Bits	Description
00	The module is configured for low-pass filter mode
01	The module is configured for simplified H-bridge mode
10	The module is configured for full H-bridge mode
11	Not allowed

[bit10] STEREO : Stereo Mode Enable

This bit enables operation in mono or stereo mode.

Bit	Description
0	The module operates in mono mode, i.e. both channels output the same data
1	The module operates in stereo mode, i.e. each channel outputs its individual data

[bit9] DBGEN : Debug Mode Enable

This bit controls the module's operation when the CPU is in debug state.

Bit	Description
0	Disabled - The module continues regular operation when the CPU enters debug state
1	The module generates silence when the CPU is in debug state; no data is fetched from the FIFO buffer

[bit8] DMAEN : DMA Mode Enable

This bit controls the module's DMA interface.

Bit	Description
0	The DMA interface is disabled
1	The DMA interface is enabled

[bit1] SILENCE : Silence Module Trigger

This bit triggers the Silence Mode of the PCMPWM module. Reading of this bit returns always 0.

Writing 1 enables the Silence Mode, writing 0 has no effect. Since this bit is in the same byte as the EN bit and writing to SILENCE has only sense if the module is enabled, EN = 1 needs to be written at the same time as SILENCE is written.

Bit	Description
0	No change
1	Enable Silence Mode

[bit0] EN : PCMPWM Module Enable

This bit globally enables or disables the PCMPWM module. This bit must not be set before the module's configuration has been completed. After the module has been enabled via this bit and the PCM sample data FIFO buffer has been prefilled, the PCM to PWM conversion starts immediately. If the FIFO buffer is empty when the module gets enabled, silence is driven on the PWM outputs and the PCM to PWM conversion starts as soon as there are equal or less than PCMPWMI_CONTROL:FEST empty spaces in the FIFO. The conversion counter is always restarted from zero when the module gets enabled via this bit.

If the module's configuration is changed while this bit is set, i.e. the PCM to PWM conversion is ongoing; the changes take effect immediately and may lead to audible noise. Depending on the type of changes the reprogramming may also cause misbehavior on the module's other hardware interfaces. E.g. the DMA transfer protocol may be violated and thus a DMA error condition might be caused.

Bit	Description
0	PCMPWM is disabled; if the module is switched off via this bit, the PWM output stops immediately and the outputs are set to their inactive values; no interrupts and DMA transfers can be requested
1	PCMPWM is enabled

4.2. PCMPWM Output Control Register (PCMPWMI_OCTRL)

This Output Control Register is used to configure the individual output channels of the PCMPWM module.

REGISTER_NAME	PCMPWMI_OCTRL
OFFSET	0x00000004
ACCESS_SIZE	B, H, W
MULTIPLE	0
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved						LEVL1	LEVL0
ACCESS_TYPE	R0,WX						R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0						1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved						EN1	EN0
ACCESS_TYPE	R0,WX						R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0						0	0

[bit17] LEVL1 : Output Level Select Channel #1

This bit selects the output polarity of channel #1.

Bit	Description
0	PCMPWM_1_AH/BH are low-active and PCMPWM_1_AL/BL are high-active
1	PCMPWM_1_AH/BH are high-active and PCMPWM_1_AL/BL are low-active

[bit16] LEVL0 : Output Level Select Channel #0

This bit selects the output polarity of channel #0.

Bit	Description
0	PCMPWM_0_AH/BH are low-active and PCMPWM_0_AL/BL are high-active
1	PCMPWM_0_AH/BH are high-active and PCMPWM_0_AL/BL are low-active

[bit1] EN1 : Output Enable Channel #1

This bit enables or disables PWM signal generation on channel #1.

Bit	Description
0	PCMPWM_1_AH/BH/AL/BL are set to the inactive value
1	The PWM signal is enabled on channel #1

[bit0] EN0 : Output Enable Channel #0

This bit enables or disables PWM signal generation on channel #0.

Bit	Description
0	PCMPWM_0_AH/BH/AL/BL are set to the inactive value
1	The PWM signal is enabled on channel #0

4.3. PCMPWM Clock Select Register (PCMPWMI_CLKSEL)

This Clock Select Register is used to configure the PCMPWM conversion counter clock frequency.

REGISTER_NAME	PCMPWMI_CLKSEL
OFFSET	0x00000008
ACCESS_SIZE	B, H, W
MULTIPLE	0
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved						CLK_SEL[1:0]	
ACCESS_TYPE	R0,WX						R/W	
PROT_TYPE	Wp							
INITIAL_VALUE	0						0	

[bit1:0] CLK_SEL : Clock Select

This field selects the PCMPWM conversion counter clock.

Bits	Description
00	Divide by 1: Conversion counter clock = PWM_CLK
01	Divide by 2: Conversion counter clock = PWM_CLK/2
10	Divide by 4: Conversion counter clock = PWM_CLK/4
11	Divide by 8: Conversion counter clock = PWM_CLK/8

4.4. PCMPWM Count Period Register (PCMPWMI_COUNTP)

This Count Period Register is used to configure the PCMPWM conversion counter period.

REGISTER NAME	PCMPWMI_COUNTP
OFFSET	0x0000000C
ACCESS_SIZE	B, H, W
MULTIPLE	0
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	COUNTP[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	1							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	COUNTP[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	1							

[bit15:0] COUNTP : Count Period

This field defines the value of the PCMPWM conversion counter after which it continues to count from 0.

Setting of this field to 0 is not allowed.

4.5. PCM Offset Register (PCMPWMI_PCMOFFS)

This PCM Offset Register is used to configure the offset value used in the PCM signed to unsigned conversion.

REGISTER_NAME	PCMPWMI_PCMOFFS
OFFSET	0x00000010
ACCESS_SIZE	B, H, W
MULTIPLE	0
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	PCM_OFFS[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	PCM_OFFS[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

[bit15:0] PCM_OFFS : PCM Offset

This field defines the offset value used in the PCM signed to unsigned conversion in low-pass filter and simplified H-bridge mode.

4.6. PCM Interrupt Enable Register (PCMPWMI_INTREN)

This PCM Interrupt Enable Register is used to enable or disable individual interrupts of the PCMPWM module.

REGISTER_NAME	PCMPWMI_INTREN
OFFSET	0x00000014
ACCESS_SIZE	B, H, W
MULTIPLE	0
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved				DMA_ERR	UDRN	OVFL	DREQ
ACCESS_TYPE	R0,WX				R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0				0	0	0	0

[bit3] DMA_ERR : DMA Block Error

This bit enables or disables the DMA block error interrupt.

Bit	Description
0	The DMA block error interrupt is disabled
1	The DMA block error interrupt is enabled

[bit2] UDRN : FIFO Under-Run Error

This bit enables or disables the FIFO under-run error interrupt.

Bit	Description
0	The FIFO under-run error interrupt is disabled
1	The FIFO under-run error interrupt is enabled

[bit1] OVFL : FIFO Overflow Error

This bit enables or disables the FIFO overflow error interrupt.

Bit	Description
0	The FIFO overflow error interrupt is disabled
1	The FIFO overflow error interrupt is enabled

[bit0] DREQ : Data Request

This bit enables or disables the data request interrupt.

Bit	Description
0	The FIFO data request interrupt is disabled
1	The FIFO data request interrupt is enabled

4.7. PCM Interrupt Status Register (PCMPWMI_INTRSTAT)

This PCM Interrupt Status Register reflects the status of the individual interrupt sources of the PCMPWM module. The bits in this registers are "sticky", i.e. once they have been set from the hardware, they remain set until they are reset via a write access to the PCMPWMI_INTRCLR register.

REGISTER_NAME	PCMPWMI_INTRSTAT
OFFSET	0x00000018
ACCESS_SIZE	B, H, W
MULTIPLE	0
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WN							
PROT_TYPE	WN							
INITIAL_VALUE	0							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WN							
PROT_TYPE	WN							
INITIAL_VALUE	0							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WN							
PROT_TYPE	WN							
INITIAL_VALUE	0							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved				DMA_ERR	UDRN	OVFL	DREQ
ACCESS_TYPE	R0,WN				R,WN	R,WN	R,WN	R,WN
PROT_TYPE					WN			
INITIAL_VALUE	0				0	0	0	0

[bit3] DMA_ERR : DMA Block Error

This status bit reflects if a DMA block error has occurred.

Bit	Description
0	No error
1	A DMA block error has occurred, i.e. there were more data transfers to the FIFO buffer than specified by PCMPWMI_CONTROL:FEST + 1

[bit2] UDRN : FIFO Under-Run Error

This status bit reflects if a FIFO buffer under-run has occurred.

Bit	Description
0	No error
1	A FIFO buffer under-run has occurred, i.e. the PCM to PWM conversion block tried to read another PCM data sample, but the FIFO buffer is empty

[bit1] OVFL : FIFO Overflow Error

This status bit reflects if a FIFO buffer overflow has occurred.

Bit	Description
0	No error
1	A FIFO buffer overflow has occurred, i.e. there was a write access to the FIFO buffer when there was no more space available

[bit0] DREQ : Data Request

This status bit reflects if there is space for another n PCM data samples in the FIFO buffer. The number n is defined by PCMPWMI_CONTROL:FEST + 1.

Bit	Description
0	No data request: There are less than PCMPWMI_CONTROL:FEST + 1 empty entries available in the FIFO buffer
1	Data request: There are PCMPWMI_CONTROL:FEST + 1 or more empty entries available in the FIFO buffer

4.8. PCM Interrupt Clear Register (PCMPWMI_INTRCLR)

This PCM Interrupt Clear Register is used to clear individual interrupts of the PCMPWM module.

REGISTER NAME	PCMPWMI_INTRCLR
OFFSET	0x0000001C
ACCESS_SIZE	B, H, W
MULTIPLE	0
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	Wp							
INITIAL_VALUE	0							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved				DMA_ERR	UDRN	OVFL	DREQ
ACCESS_TYPE	R0,WX				R0/W	R0/W	R0/W	R0/W
PROT_TYPE	Wp							
INITIAL_VALUE	0				0	0	0	0

[bit3] DMA_ERR : DMA Block Error

When this bit is written as "1", the DMA block error interrupt is cleared.

Bit	Description
0	Leave the DMA block error interrupt unchanged
1	Writing a "1" to this bit clears the DMA block error interrupt. This bit is always read as "0".

[bit2] UDRN : FIFO Under-Run Error

When this bit is written as "1", the FIFO under-run error interrupt is cleared.

Bit	Description
0	Leave the FIFO under-run error interrupt unchanged
1	Writing a "1" to this bit clears the FIFO under-run error interrupt. This bit is always read as "0".

[bit1] OVFL : FIFO Overflow Error

When this bit is written as "1", the FIFO overflow error interrupt is cleared.

Bit	Description
0	Leave the FIFO overflow error interrupt unchanged
1	Writing a "1" to this bit clears the FIFO overflow error interrupt. This bit is always read as "0".

[bit0] DREQ : Data Request

When this bit is written as "1", the data request interrupt is cleared.

Bit	Description
0	Leave the data request interrupt unchanged
1	Writing a "1" to this bit clears the data request interrupt. This bit is always read as "0".

4.9. PCM Data Register 0..15 (PCMPWMI_DATA)

This PCM Data Register used to write PCM data samples to the PCMPWM module.

REGISTER NAME	PCMPWMI_DATA
OFFSET	0x00000040
ACCESS_SIZE	W
MULTIPLE	0:15
NUMERIC_TYPE	-
OTHER	-

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	DATA1[15:8]							
ACCESS_TYPE	RN,W							
PROT_TYPE	RN							
INITIAL_VALUE	-							

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	DATA1[7:0]							
ACCESS_TYPE	RN,W							
PROT_TYPE	RN							
INITIAL_VALUE	-							

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	DATA0[15:8]							
ACCESS_TYPE	RN,W							
PROT_TYPE	RN							
INITIAL_VALUE	-							

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	DATA0[7:0]							
ACCESS_TYPE	RN,W							
PROT_TYPE	RN							
INITIAL_VALUE	-							

[bit31:16] DATA1 : Data Input Channel #1

This field holds the PCM data for channel #1. In mono mode the data is used for channel #0 as well.

[bit15:0] DATA0 : Data Input Channel #0

This field holds the PCM data for channel #0. In mono mode the data is used for channel #1 as well.

CHAPTER 27: HyperBus Interface



This chapter explains the functionality and operation of the HyperBus interface (HYPERBUSI).

1. Overview
2. Block Diagram
3. Operation of the HYPERBUSI
4. Registers

CODE: HYPBUS-S6J3200-E1

1. Overview

The HYPERBUSI module provides function and operation for interfacing to the HyperBus memory devices. The HyperBus achieves both high speed read/write throughput by double data rate interface and low pin counts. The HYPERBUSI module's features are described in this section.

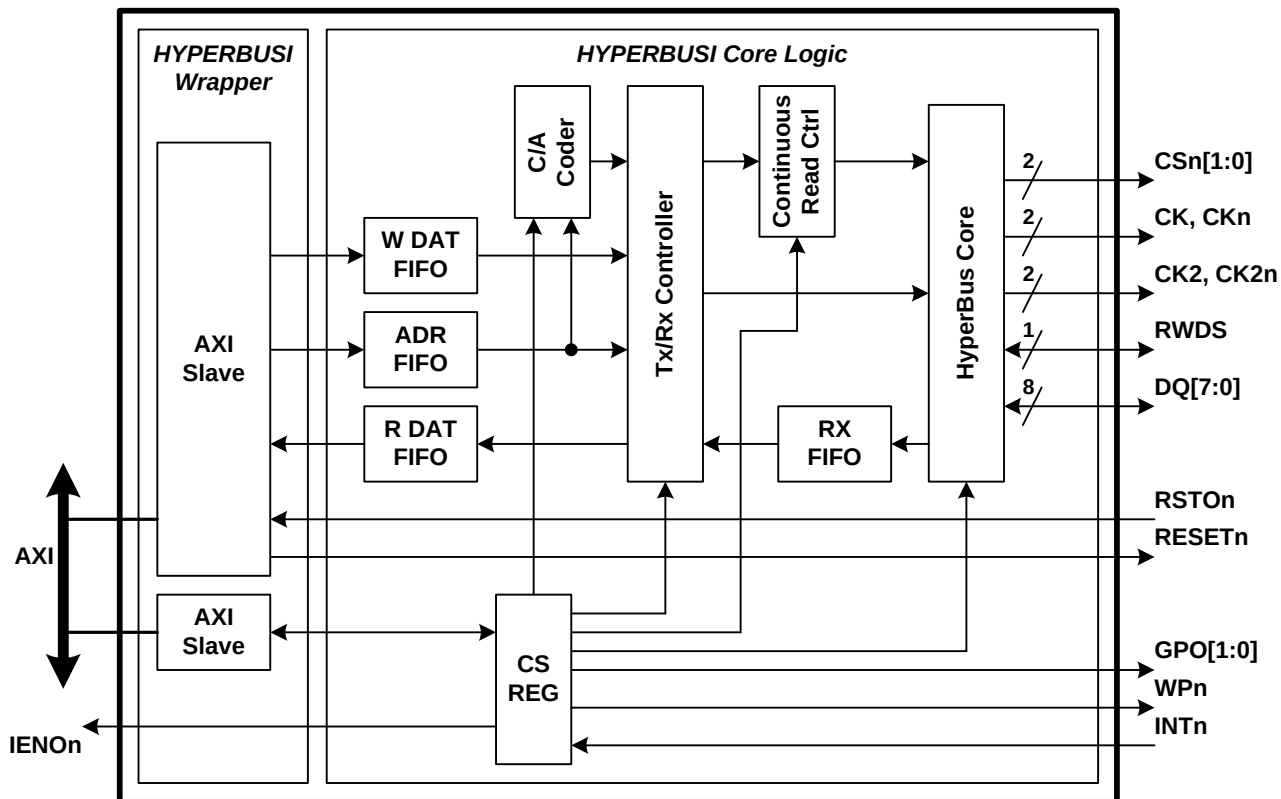
Features of the HyperBus Interface

- Supports operational frequency up to 166MHz
- Achieves maximum 333MB/s data throughput by 8 bits bus and few timing signals only
- Supports the double data rate interface
- Supports two slave devices
- Supports XiP operation by dynamic wrapped burst request

2. Block Diagram

This section shows a block diagram of HYPERBUSI module.

Figure 2-1 Block Diagram of HYPERBUSI



3. Operation of the HYPERBUSI

This section describes the operation of HYPERBUSI module.

3.1. HyperBus Core

This section describes physical interface of HYPERBUSI module. The HyperBus core generates HyperBus timing from control signals.

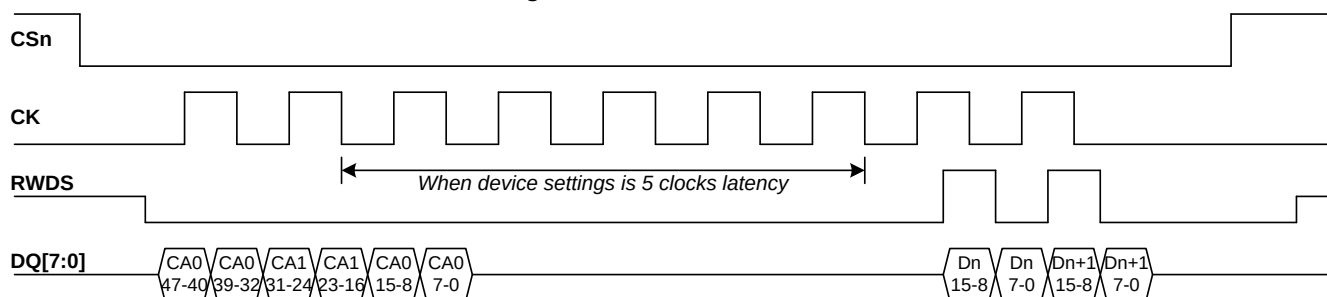
3.1.1. Read Operation

This section describes the read operation of HYPERBUSI. HYPERBUSI module asserts CS_n, CK, and DQ. Then, it outputs 3 words command/address, and reads 1 or more data by the timing of RWDS.

If both RX FIFO and R DAT FIFO become full, HyperBus Core ends the access. Then, when only RX FIFO becomes empty, HyperBus Core re-initiates the access. At this time, R DAT FIFO is transferring read data continuously to AXI bus.

The HYPERBUSI puts the transaction request from AXI bus, such as the burst type and the burst length, to the C/A cycle on HyperBus as is.

Figure 3-1 Read Waveform



3.1.2. Write Operation

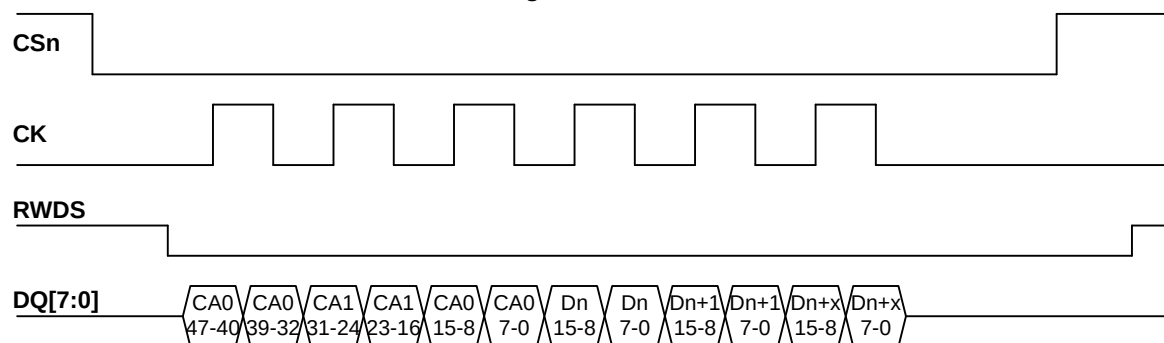
This section describes the write operation of HYPERBUSI for HyperFlash. HYPERBUSI asserts CS_n, CK, and DQ. Then, it outputs 3 words command/address, and writes 1 or more data. This write operation is used when the DEVTYPE of HYPERBUSI_MCR_n is chosen as HyperFlash.

The HYPERBUSI module puts the transaction request from AXI bus, such as the burst type and the burst length, to the C/A cycle on HyperBus as is.

Notes:

- Since HyperFlash supports only the write operation in every 2bytes, invalid data (0xFF) is written as insufficient one byte if only one byte is written.
- When using HyperFlash, the burst write of HyperFlash is supported only when CK frequency is 50MHz or less. Therefore, when the CK frequency of HyperFlash is 50MHz or more, the write data size in an AXI transaction should be only 2 bytes.

Figure 3-2 Write Waveform

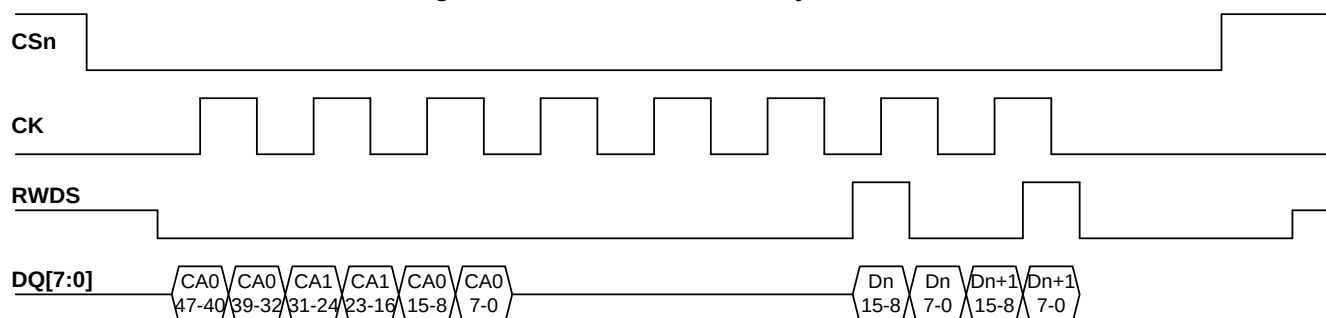


3.1.3. Write Operation with Byte Mask

This section describes the write operation of HYPERBUSI with byte mask for HyperRAM. HYPERBUSI asserts CSn, CK, and DQ. Then, it outputs 3 words command/address, and writes 1 or more data after latency cycles. This write operation is used when the DEVTYPE of HYPERBUSI_MCRn is chosen as HyperRAM. The HYPERBUSI module outputs RWDS signal as the byte mask during write operation. The invalid write data is masked by high of RWDS.

The HYPERBUSI module puts the transaction request from AXI bus, such as the burst type and the burst length, to the C/A cycle on HyperBus as is. Therefore, RWDS is determined by the access address, data size, and strobe signal on AXI bus.

Figure 3-3 Write Waveform with Byte Mask



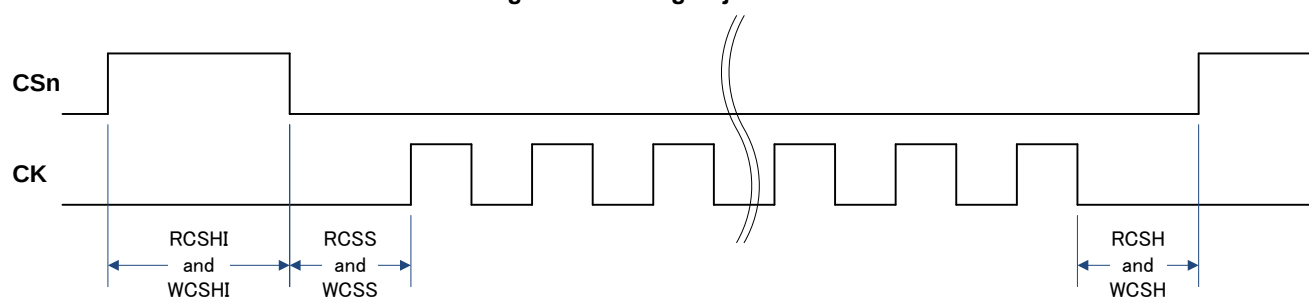
Note:

- In Figure 3-3, Dn 15-8 and Dn+1 7-0 are invalid data.

3.1.4. Timing Adjustment

This section describes the HyperBus timing adjustment. HyperBus core has timing adjustment circuit and timing adjustment is controlled by HYPERBUSI_MTRn. RCSHI, RCSS, and RCSH in HYPERBUSI_MTRn are used for the read timing adjustment, and WCSHI, WCSS, and WCSH in HYPERBUSI_MTRn are used for the write timing adjustment. Please refer to section 4.6 Memory Timing Register (HYPERBUSIn_MTR0 to 1).

Figure 3-4 Timing Adjustment



3.2. Tx/Rx Controller

This section describes the Tx/Rx Controller of HYPERBUSI module. The Tx/Rx Controller performs Tx/Rx operation control by state machine, and flow control of data between AXI bus and HyperBus. In addition, when next access address is accepted by multiple outstanding address on AXI bus, HYPERBUSI passes the transaction to the Continuous Read Ctrl if the address of subsequent access is continuous address to the present access.

3.2.1. Asymmetry Cache System Support

This section describes the asymmetry cache system support. The Tx/Rx Controller supports the system which has a different request size of the wrap burst from asymmetry cache system by having wrap size setting of HyperBus memory. This function is optional. Please refer to 4.5 Memory Configuration Register (HYPERBUSIn_MCR0 to 1) for more detailed information.

The operation of the Tx/Rx Controller for asymmetry cache system support is below.

- The Tx/Rx Controller accepts the wrap read transaction, and compares the required wrap size with the WRAPSIZE in HYPERBUSI_MCRn.
- When the wrap size is the same, the Tx/Rx Controller requires the wrap burst read to the HyperBus.
- When the wrap size differs, the Tx/Rx Controller emulates wrap burst read by requesting two continuous burst read to the HyperBus.

3.2.2. Continuous Read Ctrl

This section describes the Continuous Read Ctrl of HYPERBUSI module. When the address of subsequent access is continuous address to the present access, Continuous Read Ctrl merges the subsequent access to present access in order to improve the performance by removing the C/A cycle and initial latency cycle.

The Continuous Read Ctrl merges some read transactions by the following condition.

- Access to HyperFlash.
- Between the sequential read transactions which have INCR as the type of the burst and have the continuous address on AXI bus are merged.
- Between the read transaction with WRAP and the subsequent read transaction with INCR which have an address following the final address of wrap boundary are merged. This function is optional. Please refer to 4.5 Memory Configuration Register (HYPERBUSIn_MCR0 to 1) for more detailed information.

3.3. C/A Coder

The HYPERBUSI module outputs 6 bytes of command/address information to define the transaction. The C/A Coder builds a command/address information by the request from AXI bus and the register settings.

Table 3-1 C/A Format of HYPERBUSI

C/A Bit	Name	Assignment
47	R/W#	0: Write, 1: Read
46	Target	CRT in HYPERBUSI_MCRn
45	Burst Type	0: WRAP, 1: INCR
44	RFU	0
43 - 16	Page Address	Address [31:4]
15	RFU	0
14 - 13	RFU	3
12 - 3	RFU	0
2 - 0	Column Address	Address [3:1]

3.4. FIFO

This section describes the FIFO for processing transaction request.

3.4.1. ADR FIFO

ADR FIFO is composed of 46 bits width x 16 depth. This FIFO stores the control data of AXI bus transaction which includes address, length, burst type and r/w flag.

3.4.2. W DAT FIFO

The W DAT FIFO is composed of 40 bits width x 128 depth. This FIFO is used to store the write data, valid information, and strobe information written from the AXI bus, and in order to receive the burst write transaction without a wait on AXI bus.

3.4.3. R DAT FIFO and RX FIFO

The RX FIFO is composed of 20 bits width x 256 depth. This FIFO is used to store the data which reads from HyperBus, and stored data is outputted according to timing of CK on HyperBus to R DAT FIFO.

The R DAT FIFO is composed of 40 bits width x 128 depth. This FIFO is used to store the data read from RX FIFO and the error detection information, and data stored is outputted according to timing of ACLK on AXI bus. This error information is transferred to the master device by RRESP signals on AXI bus.

The FIFO for receiving data is divided into RX FIFO and R DAT FIFO in order to absorb the timing difference between AXI and HyperBus.

3.5. CS REG (Control Status Register)

The CS REG holds the configuration registers, which are used to control of the HYPERBUSI module. Please refer to section 4 Registers for more detailed information about the CS REG.

And, CS REG controls and outputs the WPn, IENOn, and GPO signals and inputs the INTn signal for controlling IENOn.

3.5.1. WPn Signal

WPn signal is allocated to external interface in order to connect WP# of HyperBus memory. WPn signal is controlled by HYPERBUSI_WPR. Please refer to section – Write Protection Register (HYPERBUSIn_WPR).

3.5.2. INTn / IENOn Signal

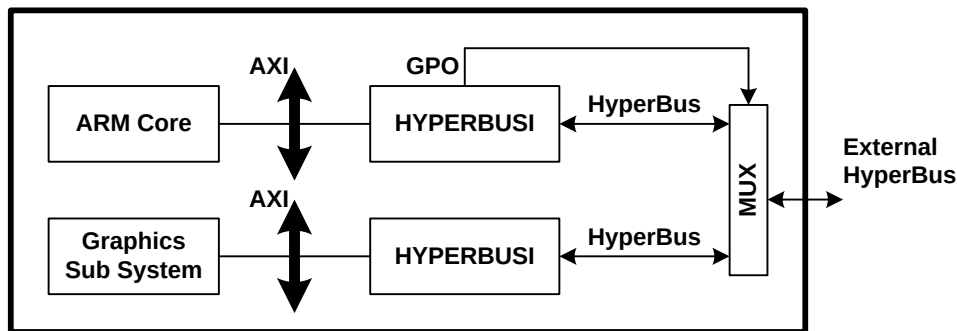
INTn signal is allocated to external interface in order to connect INT# of HyperBus memory. IENOn signal is connected internal interrupt controller and is controlled by HYPERBUSI_IEN and INTn signal. Please refer to section 4.2 Interrupt Enable Register (HYPERBUSIn_IEN) and – Interrupt Status Register (HYPERBUSIn_ISR).

3.5.3. GPO Signal

GPO signals are general purpose output signal and those signals are used for internal control or external control depending on the implemented system. GPO signals are controlled by HYPERBUSI_GPOR. Please refer to 4.7 General Purpose Output Register (HYPERBUSIn_GPOR).

The Figure 3-5 shows an example of internal control. In the example, GPO was used for choosing HYPERBUSI module.

Figure 3-5 Internal Control Example by GPO



3.6. AXI Slave Interface

HYPERBUSI module has two AXI slave interface for memory spaces access and CS REG access.

And, AXI slave interface outputs the RESETn signal and inputs the RSTOn signal for controlling memory access.

3.6.1. RSTOn

RSTOn signal is allocated to external interface in order to connect RSTO# of HyperBus memory. RSTOn signal is used in order to determine whether AXI transaction is acceptable. When RSTOn is low and AXI transaction comes, HYPERBUSI module replies the SLVERR response.

3.6.2. RESETn

RESETn signal is allocated to external interface in order to connect RESET# of HyperBus memory. When ARESETN signal on AXI interface is low, RESETn signal is low.

4. Registers

This section describes the registers of the HYPERBUSI in detail.

The suffix 'n' in the register name indicates that the register is an instance 'n' of the module.

■ Registers of the HYPERBUSI

The following registers are available for each instance of the HYPERBUSI.

- Controller Status Register (HYPERBUSIn_CSR)
- Interrupt Enable Register (HYPERBUSIn_IEN)
- Interrupt Status Register (HYPERBUSIn_ISR)
- Memory Base Address Register 0..1 (HYPERBUSIn_MBR)
- Memory Configuration Register 0..1 (HYPERBUSIn_MCR)
- Memory Timing Register 0..1 (HYPERBUSIn_MTR)
- General Purpose Output Register (HYPERBUSIn_GPOR)
- Write Protection Register (HYPERBUSIn_WPR)
- Test Register (HYPERBUSIn_TEST)

PERIPHERAL_NAME	HYPERBUSI
ADDRESS_WIDTH	32
ENDIANESS	Little
DOCPREFIX	HYPERBUSI
MODULE_ID	
PPU_NAME	PPU_HYPERBUSI
BASEADDRESS	
ADDR_BLOCK_SIZE	60
USAGE	Register

4.1. Controller Status Register (HYPERBUSIn_CSR)

HYPERBUSI_CSR indicates the internal status of HYPERBUSI module.

REGISTER_NAME	HYPERBUSIn_CSR
OFFSET	0x00
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Table 4-1 HYPERBUSI Controller Status Register Description

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RFU	RFU	RFU	RFU	RFU	WRSTOERR	WTRSEERR	WDECERR
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R,WX	R,WX	R,WX
PROT_TYPE	-	-	-	-	-	-	-	-
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	WACT
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R,WX
PROT_TYPE	-	-	-	-	-	-	-	-
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RFU	RFU	RFU	RFU	RDSSTALL	RRSTOERR	RTRSEERR	RDECERR
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R,WX	R,WX	R,WX	R,WX
PROT_TYPE	-	-	-	-	-	-	-	-
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RACT
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R,WX
PROT_TYPE	-	-	-	-	-	-	-	-
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:27], [bit23:17], [bit15:12], [bit7:1] RFU : Reserved for Future Use

When writing this register, this bit should be set to 0 for future compatibility. When reading this register, this bit is 0 for future compatibility.

[bit26] WRSTOERR : RSTO Error in Write Transaction

This bit indicates whether HyperBus memory is under reset state in the latest write transaction.

Bit	Description
0	Normal operation
1	HyperBus memory is under reset (AXI SLVERR occurs)

[bit25] WTRSERR : Transaction Error in Write Transaction

This bit indicates whether AXI protocol is acceptable by HYPERBUSI module in the latest write transaction.

Bit	Description
0	Normal operation
1	Protocol is not supported (AXI SLVERR occurs)

[bit24] WDECERR : Decode Error in Write Transaction

This bit indicates whether access address is acceptable in the latest write transaction.

Bit	Description
0	Normal operation
1	Access address is not reachable (AXI DECERR occurs)

[bit16] WACT : Write Transaction Active

This bit indicates whether write transaction is in progress.

Bit	Description
0	Write transaction is idle
1	Write transaction is active

[bit11] RDSSTALL : RDS Stall Error in Read Transaction

This bit indicates whether read data error occurs in the latest read transaction.

Bit	Description
0	Normal operation
1	Detect read data error (AXI SLVERR occurs)

[bit10] RRSTOERR : RSTO Error in Read Transaction

This bit indicates whether HyperBus memory is under reset state in the latest read transaction.

Bit	Description
0	Normal operation
1	HyperBus memory is under reset (AXI SLVERR occurs)

[bit9] RTRSERR : Transaction Error in Read Transaction

This bit indicates whether AXI protocol is acceptable by HYPERBUSI module in the latest read transaction.

Bit	Description
0	Normal operation
1	Protocol is not supported (AXI SLVERR occurs)

[bit8] RDECERR : Decode Error in Read Transaction

This bit indicates whether access address is acceptable in the latest read transaction.

Bit	Description
0	Normal operation
1	Access address is not reachable (AXI DECERR occurs)

[bit0] RACT : Read Transaction Active

This bit indicates whether read transaction is in progress.

Bit	Description
0	Read transaction is idle
1	Read transaction is active

4.2. Interrupt Enable Register (HYPERBUSIn_IEN)

. HYPERBUSIn_IEN sets up the condition of interrupt signal output (IENOn)

REGISTER NAME	HYPERBUSIn_IEN
OFFSET	0x04
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Table 4-2 HYPERBUSI Interrupt Enable Register Description

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	INTP	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R/W	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-	-	-	-	-	-	-	-
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-	-	-	-	-	-	-	-
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-	-	-	-	-	-	-	-
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RPCINTE
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W
PROT_TYPE	-	-	-	-	-	-	-	-
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31] INTP : Interrupt Polarity

This bit is used to choose the polarity of IENOn signal.

Bit	Description
0	IENOn signal is active low
1	IENOn signal is active high

[bit30:1] RFU : Reserved for Future Use

When writing this register, this bit should be set to 0 for future compatibility. When reading this register, this bit is 0 for future compatibility.

[bit0] RPCINTE : HyperBus Memory Interrupt Enable

This bit enables the interrupt from the HyperBus memory by INTn signal.

Bit	Description
0	Disable
1	Enable

4.3. Interrupt Status Register (HYPERBUSIn_ISR)

HYPERBUSI_ISR indicates the interrupt request source.

REGISTER NAME	HYPERBUSIn_ISR
OFFSET	0x08
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Table 4-3 HYPERBUSI Interrupt Status Register Description

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RPCINTS
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:1] RFU : Reserved for Future Use

When writing this register, this bit should be set to 0 for future compatibility. When reading this register, this bit is 0 for future compatibility.

[bit0] RPCINTS : HyperBus memory Interrupt Status

This bit indicates the interrupt from HyperBus memory by INTn signal.

While the INT# signal of the HyperBus memory is asserted, this bit is also asserted. In order to clear this bit, the interrupt of HyperBus memory must be cleared.

Bit	Description
0	No interrupt
1	Interrupt

4.4. Memory Base Address Register (HYPERBUSIn_MBR0 to 1)

The base address for each memory space is set up.

REGISTER_NAME	HYPERBUSIn_MBRi
OFFSET	0x10 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	
OTHER	

Table 4-4 HYPERBUSI Memory Base Address Register Description

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	A[31]	A[30]	A[29]	A[28]	A[27]	A[26]	A[25]	A[24]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	A[23]	A[22]	A[21]	A[20]	A[19]	A[18]	A[17]	A[16]
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	A[15]	A[14]	A[13]	A[12]	A[11]	A[10]	A[9]	A[8]
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	A[7]	A[6]	A[5]	A[4]	A[3]	A[2]	A[1]	A[0]
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] A[31:0] : Memory Base Address

The base address of addressable region to each memory is set up. Since register can be set in 16M bytes boundary, lower 24 bit is fixed to 0. MBR1 register base address must be larger than MBR0 register

4.5. Memory Configuration Register (HYPERBUSIn_MCR0 to 1)

The memory configuration for each memory space is set up.

REGISTER NAME	HYPERBUSIn_MCRi
OFFSET	0x20 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	
OTHER	

Table 4-5 HYPERBUSI Memory Configuration Register Description

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	CRMO	ACS
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RFU	RFU	CRT	DEVTYPE	RFU	RFU	WRAPSIZE[1]	WRAPSIZE[0]
ACCESS_TYPE	R0,WX	R0,WX	R/W	R/W	R0,WX	R0,WX	R/W	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	1	1

[bit31:18], [bit15:6], [bit3:2] RFU : Reserved for Future Use

When writing this register, this bit should be set to 0 for future compatibility. When reading this register, this bit is 0 for future compatibility.

[bit17] CRMO : Continuous Read Merging Option

This bit is set when the wrap transaction and subsequent continuous transaction can be merged. Please confirm whether it is corresponding HyperFlash memory before enabling this function.

Bit	Description
0	No merging WRAP and INCR transaction
1	Merging WRAP and INCR transaction

[bit16] ACS : Asymmetry Cache System Support

This bit is set when the different wrap size (cache size) is required by multi-core in system. This function should be disabled if the HyperBus memory itself supports the asymmetry cache system.

Bit	Description
0	No asymmetry cache system support
1	Asymmetry cache system support

[bit5] CRT : Configuration Register Target

This bit indicates whether access is to memory space or register space. This bit is mapped to CA[46] bit in command/address cycle to HyperBus memory.

Bit	Description
0	Memory space
1	Configuration register space

[bit4] DEVTYPE : Device Type

This bit is set as a device type of connected memory.

Bit	Description
0	HyperFlash memory
1	HyperRAM memory

[bit1:0] WRAPSIZE[1:0] : Wrapped Burst Size

This bit is set as wrap burst length which was set to HyperBus memory. This bit is ignored when the ACS bit ([bit16]) is 0. When the ACS bit is 1, this bit should be set the same as wrap size of configuration register in HyperBus memory.

Bits	Description
00	Reserved
01	64 Bytes
10	16 Bytes
11	32 Bytes

4.6. Memory Timing Register (HYPERBUSIn_MTR0 to 1)

The memory timing for each memory space is set up.

REGISTER NAME	HYPERBUSIn_MTRi
OFFSET	0x30 + i*4
ACCESS_SIZE	B H W
MULTIPLE	0:1
NUMERIC_TYPE	
OTHER	

Table 4-6 HYPERBUSI Memory Timing Register Description

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RCSHI[3]	RCSHI[2]	RCSHI[1]	RCSHI[0]	WCSHI[3]	WCSHI[2]	WCSHI[1]	WCSHI[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RCSS[3]	RCSS[2]	RCSS[1]	RCSS[0]	WCSS[3]	WCSS[2]	WCSS[1]	WCSS[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RCSH[3]	RCSH[2]	RCSH[1]	RCSH[0]	WCSH[3]	WCSH[2]	WCSH[1]	WCSH[0]
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RFU	RFU	RFU	RFU	LTCY[3]	LTCY[2]	LTCY[1]	LTCY[0]
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R/W	R/W	R/W	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	1

[bit31:28] RCSHI[3:0] : Read Chip Select High Between Operations

Before the read access, this bit inserts the CK cycles to the chip select high period.

Bits	Description
0000	1.5 CK
0001	2.5 CK
0010	3.5 CK
⋮	⋮
1111	16.5 CK

[bit27:24] WCSHI[3:0] : Write Chip Select High Between Operations

Before the write access, this bit inserts the CK cycles to the chip select high period.

Bits	Description
0000	1.5 CK
0001	2.5 CK
0010	3.5 CK
⋮	⋮
1111	16.5 CK

[bit23:20] RCSS[3:0] : Read Chip Select Setup to next CK Rising Edge

In the read access, this bit inserts the CK cycles, between the falling edge of chip select and the rising edge of first CK.

Bits	Description
0000	1 CK
0001	2 CK
0010	3 CK
⋮	⋮
1111	16 CK

[bit19:16] WCSS[3:0] : Write Chip Select Setup To Next CK Rising Edge

In the write access, this bit inserts the CK cycles, between the falling edge of chip select and the rising edge of first CK.

Bits	Description
0000	1 CK
0001	2 CK
0010	3 CK
⋮	⋮
1111	16 CK

[bit15:12] RCSH[3:0] : Read Chip Select Hold After CK falling Edge

In the read access, this bit inserts the CK cycles, between the falling edge of last CK and the rising edge of chip select.

Bits	Description
0000	1 CK
0001	2 CK
0010	3 CK
⋮	⋮
1111	16 CK

[bit11:8] WCSH[3:0] : Write Chip Select Hold After CK falling Edge

In the write access, this bit inserts the CK cycles, between the falling edge of last CK and the rising edge of chip select.

Bits	Description
0000	1 CK
0001	2 CK
0010	3 CK
:	:
:	:
1111	16 CK

[bit7:4] RFU : Reserved for Future Use

When writing this register, this bit should be set to 0 for future compatibility. When reading this register, this bit is 0 for future compatibility.

[bit3:0] LTCY[3:0] : Latency Cycle for HyperRAM mode

When DEVTYPE of HYPERBUSI_MCRn is set to HyperRAM mode, this bit should be set to the same value as the read latency in configuration register of HyperBus memory. This bit is ignored when the DEVTYPE of HYPERBUSI_MCRn is chosen to HyperFlash mode.

Bits	Description
0000	5 CK Latency
0001	6 CK Latency
0010	Reserved
:	:
:	:
1110	3CK Latency
1111	4 CK Latency

4.7. General Purpose Output Register (HYPERBUSIn_GPOR)

HYPERBUSI_GPOR is used in order to control the GPIO signals polarity.

REGISTER_NAME	HYPERBUSIn_GPOR
OFFSET	0x40
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Table 4-7 HYPERBUSI General Purpose Output Register Description

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	GPO[1]	GPO[0]
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:2] RFU : Reserved for Future Use

When writing this register, this bit should be set to 0 for future compatibility. When reading this register, this bit is 0 for future compatibility.

[bit1:0] GPO[1:0] : General Purpose Output Interface

HyperBus Interface ch.0 and ch.1 are assigned to the same GPIO pin. In addition to the configuration of the POF register, the channel ch.0 or ch.1 must be selected using the General Purpose Output Register (HYPERBUSIn_GPOR).

For HyperBus Interface ch.0, HYPERBUSI0_GPOR bit GPO[0] has following function.

Bit	Description
0	Select HyperBus Interface ch.0
1	Select HyperBus Interface ch.1

Note:

- GPO[1] in HYPERBUSI0_GPOR of HyperBus Interface ch.0 is not used.
- GPO[1:0] in HYPERBUSIn_GPOR of HyperBus Interface ch.1, ch.2 are not used.
- If HyperBus Interface ch.2 is used, the configuration of GPO bit is unnecessary.

4.8. Write Protection Register (HYPERBUSIn_WPR)

HYPERBUSI_WPR is used in order to control the WPn signal polarity.

REGISTER_NAME	HYPERBUSIn_WPR
OFFSET	0x44
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Table 4-8 HYPERBUSI Write Protection Register Description

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	WP
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:1] RFU : Reserved for Future Use

When writing this register, this bit should be set to 0 for future compatibility. When reading this register, this bit is 0 for future compatibility.

[bit0] WP : Write Protection

This bit is used to control WPn signal.

Bit	Description
0	Not protection (WPn signal is HIGH)
1	Protection (WPn signal is LOW)

4.9. Test Register (HYPERBUSIn_TEST)

This register is internal device test purpose. When writing this register, it should be set to 0.

REGISTER_NAME	HYPERBUSIn_TEST
OFFSET	0x48
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Table 4-9 HYPERBUSI Test Register Description

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RVD
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:1] RFU : Reserved for Future Use

When writing this register, this bit should be set to 0 for future compatibility. When reading this register, this bit is 0 for future compatibility.

[bit0] RVD : Reserved bit

This bit is reserved. It should be set to 0.

CHAPTER 28: Indicator PWM



This chapter explains the indicator PWM.

1. Overview
2. Configuration and Block Diagram
3. Operation of Indicator PWM
4. Registers
5. Precautions for Using This Device

CODE: INDICATOR_PWM-S6J3200-E1

1. Overview

The indicator PWM (Pulse Width Modulation) is an output timer that consists of a 16-bit down counter, a 16-bit data register for cycle setting, a 16-bit compare register for duty setting, and a pin controller.

Compared to other output timers, it is capable of output of waveforms with relatively long cycles. Output operation is also supported while in standby mode.

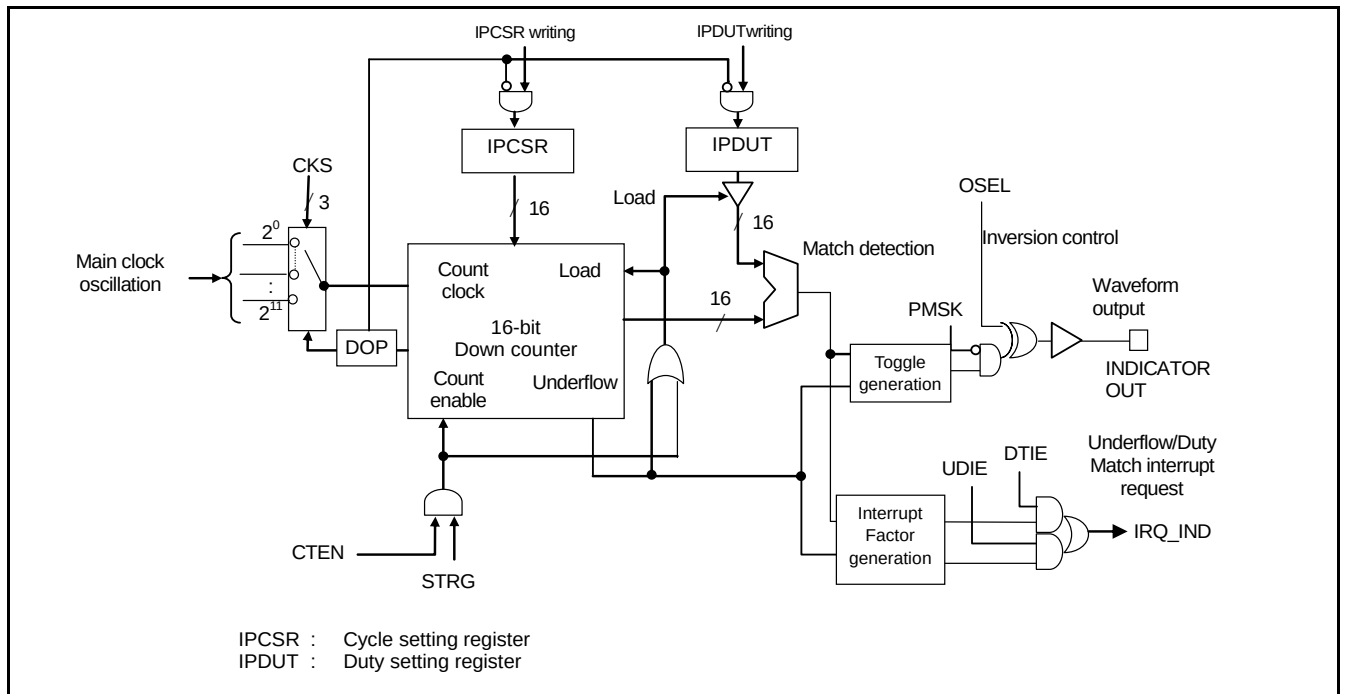
The 16-bit down counter clock can be selected from among six types of clocks (divided by 1, 16, 64, 256, 1024, 2048).

For the count operation, an underload reloads from the PWM cycle register and the count is repeated.

Indicator PWM timer activation is by software trigger only.

2. Configuration and Block Diagram

Figure 2 -1 Block Diagram of the Indicator PWM Timer



3. Operation of Indicator PWM

This section explains the operations of the indicator PWM timer.

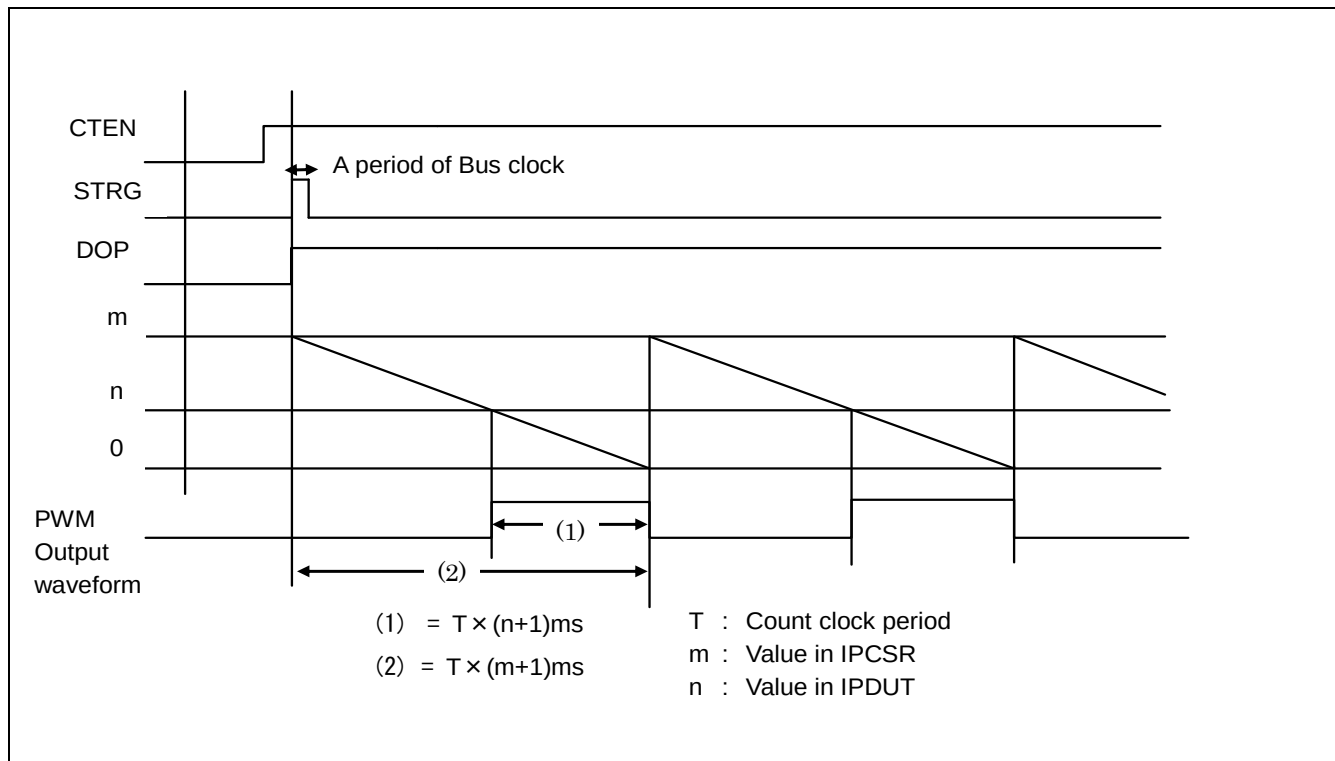
Notes:

- The explanations in this section assume that PWM output is normal polarity. When inverse polarity is set, invert the PWM output polarity shown in this explanation.
- For details on how to set inverse polarity, see the OSEL bit in 4.1 Timer Control Register (ITMCR).

3.1. Indicator PWM Timer

The indicator PWM timer starts counting down from the set cycle value upon software trigger activation. The first output at that time is the L level. If the 16-bit down counter matches the set value in the duty setting register, the output is inverted to the H level. Then, the output is inverted to the L level again when the counter underflows. Thus, this timer can generate a waveform with an arbitrary cycle and duty. The cycle of the output pulse can be controlled by configuring IPCSR register settings. The duty ratio can be controlled by configuring IPDUT register settings.

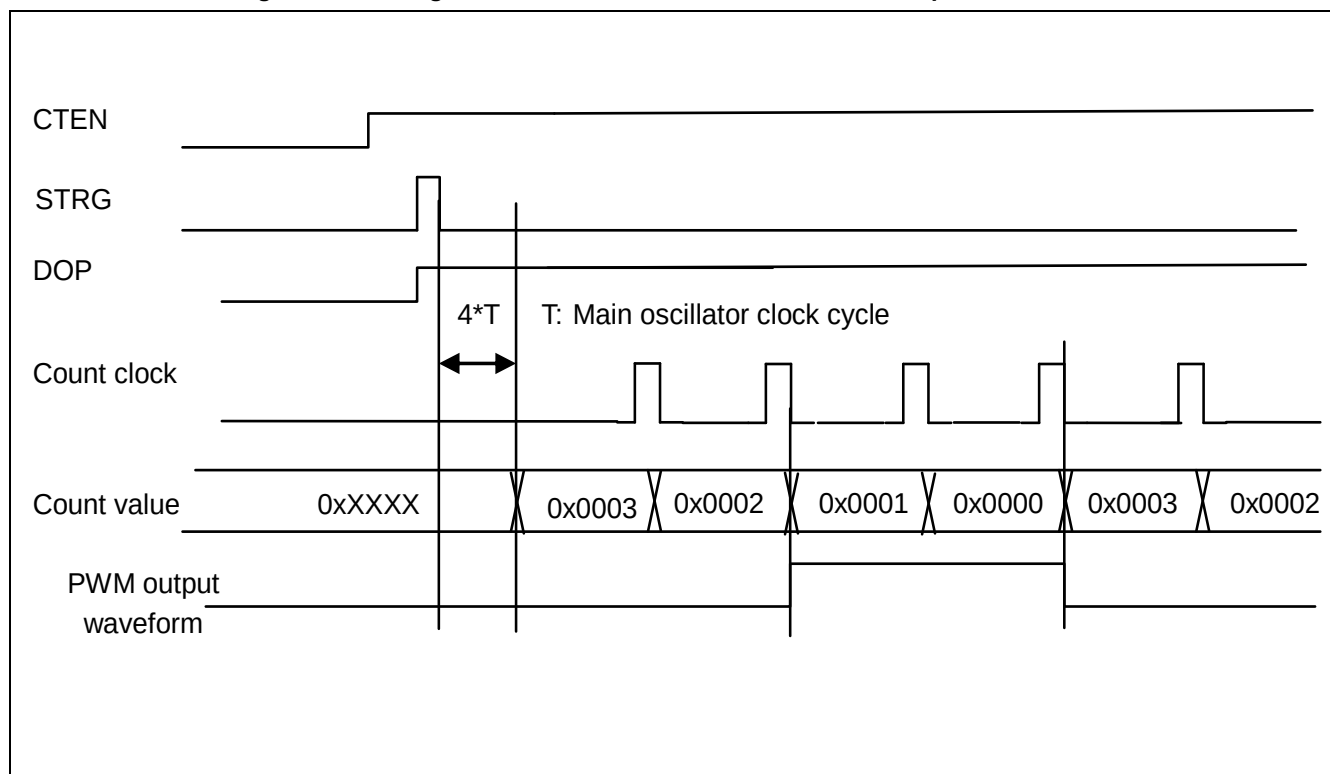
Figure 3-1: Indicator PWM Operation Timing Chart



3.2. PWM Timer Count Operation Start

Configure the PWM timer count lock select setting (ITMCR:CKS2=0), PWM cycle setting (IPCSR), and PWM duty setting (IPDUT) while the timer countdown is stopped (ICNTCR:DOP=0). After configuring settings, enable the count (ICNTCR:CTEN=1) and restart the counter operation by setting the software trigger (ICNTCR:STRG=1). As soon as the software setting is configured, the timer status becomes timer count operation in progress (ICNTCR:DOP=1).

Figure 3-2: Timing Chart When Indicator PWM Timer Count Operation Starts

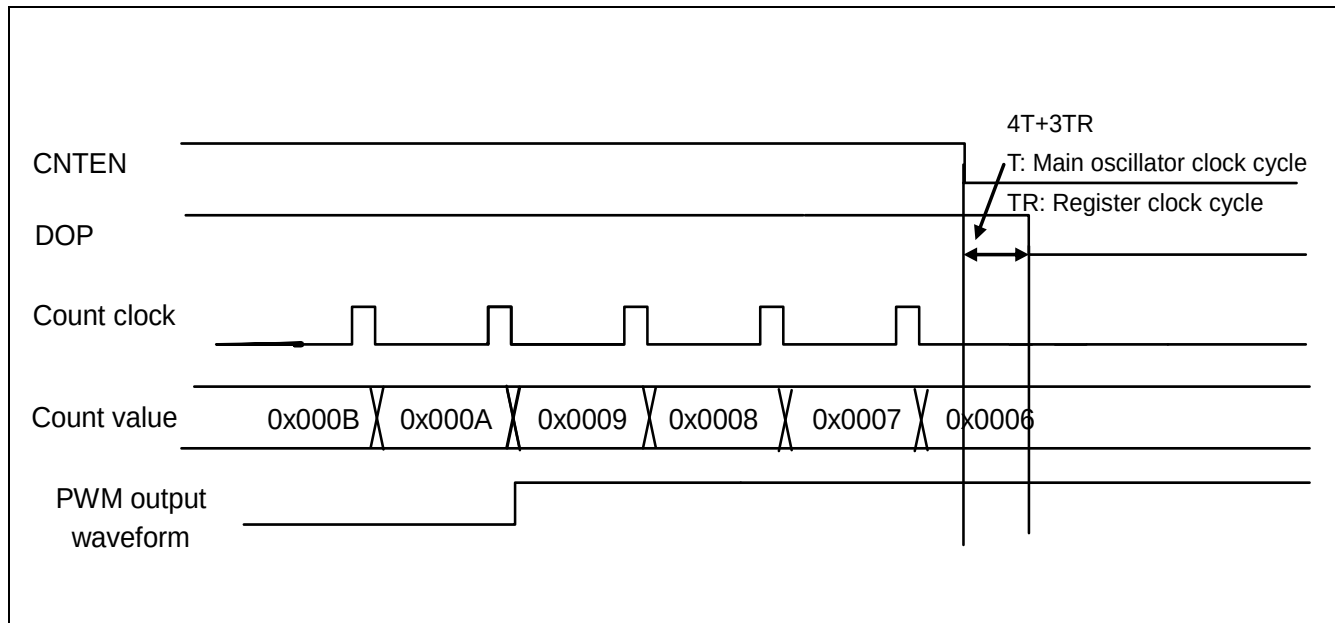


A time of $4T$ (T : main oscillator clock cycle) is required until the counter value is loaded after the STRG bit becomes 1. Figure 3-1 shows the timing chart for when the cycle setting value is $0x3$ and the duty value is $0x1$.

3.3. Timer Count Operation Stop

A timer count stop is requested by setting the timer count enable bit (ICNTCR:CTEN) to 0 while a timer count operation is in progress (ICNTCR:DOP=1). When the PWM timer stops the count, timer count operation stop (ICNTCR:DOP=0) is indicated as the timer status. PWM output maintains the output status as during timer count stop.

Figure 3-3: Timing Chart while Timer Count Operation is Stopped



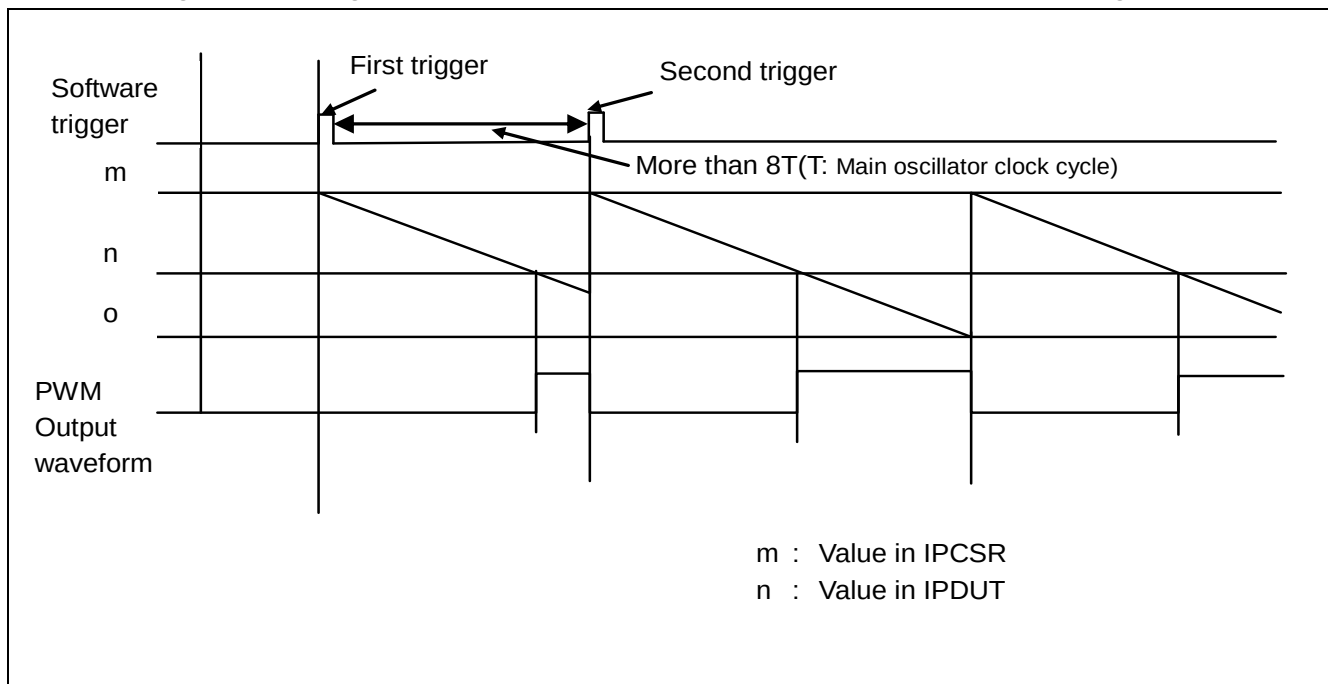
A time of $4T + 3TR$ (T : main oscillator clock cycle, TR : register clock) is required until the counter is stopped (ICNTCR:DOP=0) after the CTEN bit becomes 0.

Figure 3-3 shows the interrupt factors and a timing chart for when the cycle setting value is 0xB and the duty value is 0x9.

3.4. Counter Value Updating while PWM Counter Operation is in Progress

Setting a software trigger (ICNTCR:STRG=1) while a PWM counter operation is in progress loads the values of the PWM cycle setting register (IPCSR) and PWM duty setting register (IPDUT) and updates the count value and duty setting. However, allow a time of at least $8T$ (T : main oscillator clock cycle) before setting a second software trigger. Failure to do so may result in the software trigger not being reflected.

Figure 3-4: Timing Chart for Counter Update while a Timer Count Operation is in Progress



3.5. Indicator PWM Interrupts

This section provides information about indicator PWM interrupt request flags, interrupt enable bits, and interrupt factors.

Notes:

- The explanations in this section assume that PWM output is normal polarity. When inverse polarity is set, invert the PWM output polarity shown in this explanation.
- For details on how to set inverse polarity, see the OSEL bit in 4.1 Timer Control Register (ITMCR).

3.5.1. Interrupt Control Bits and Interrupt Factors

Table 3-1 lists interrupt control bits and interrupt factors. Underflow detection and detection of duty match share the same interrupt factory output signals (IRQ_IND).

Table 3-1: Interrupt Control Bits and Interrupt Factors

	Status Control Register (ISTC)			
	Interrupt Request Flag Bit	Interrupt Request Enable Bit	Interrupt Factor	Interrupt Factor Output Signal
Indicator PWM	UDIR : bit0	UDIE : bit4	Detection of underflow	IRQ_IND
	DTIR : bit1	DTIE : bit5	Detection of duty match	

An underflow in the PWM counter value causes the underflow interrupt request bit (ISTC:UDIR) of the status control register (ISTC) to be set to "1". Enabling underflow interrupt request enable (ISTC:UDIE=1) while this status exists will cause interrupt request output signal IRQ_IND to become "H". In the same way, "1" is set to the duty match interrupt request bit (ISTC:DTIR) of the status control register (ISTC) when the PWM counter count value matches the duty setting register (IPDUT) value. Enabling duty interrupt request enable (ISTC:DTIE=1) while this status exists will cause interrupt request output signal IRQ_IND to become "H".

3.5.2. Interrupt Factors and Timing Chart (PWM Output: Normal Polarity)

Figure 3-5: PWM Timer Interrupt Factors and Timing Chart

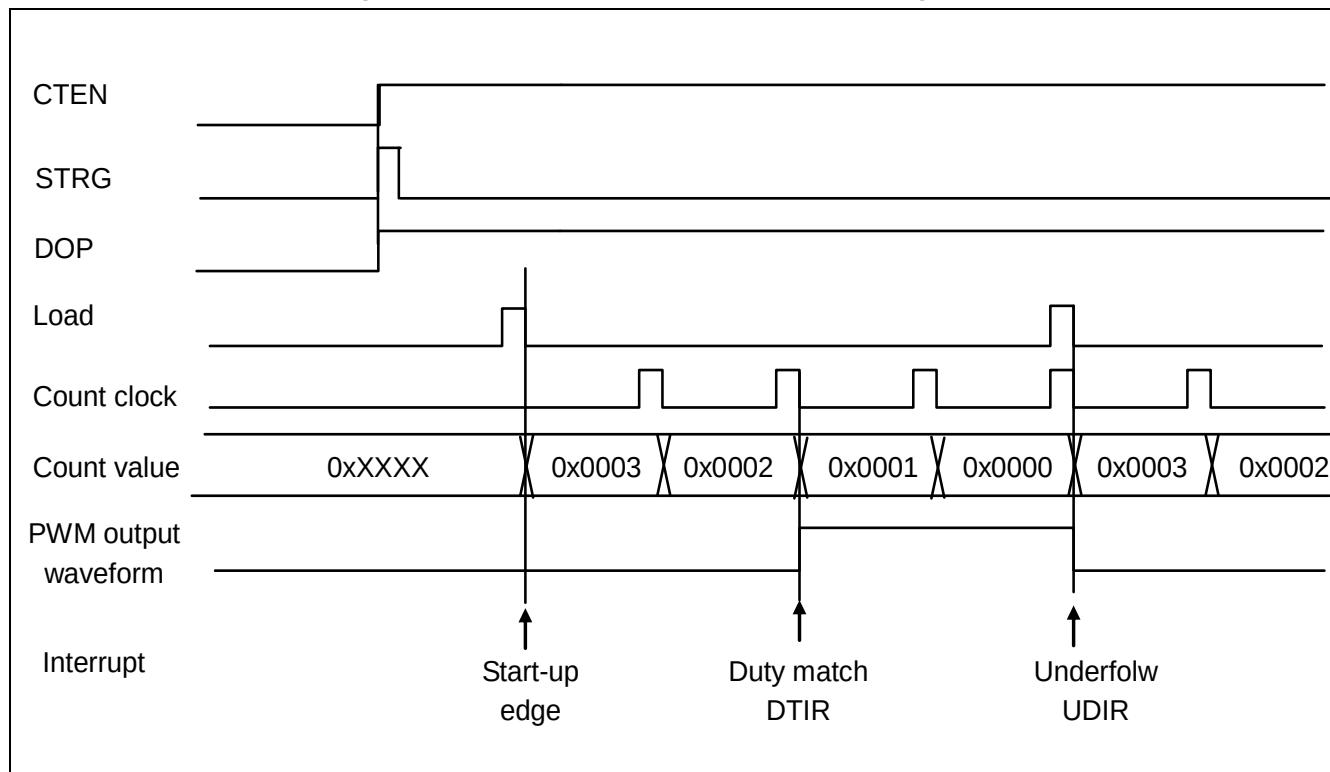


Figure 1-1 shows the interrupt factors and a timing chart for when the setting value is 0x3 and the duty value is 0x1.

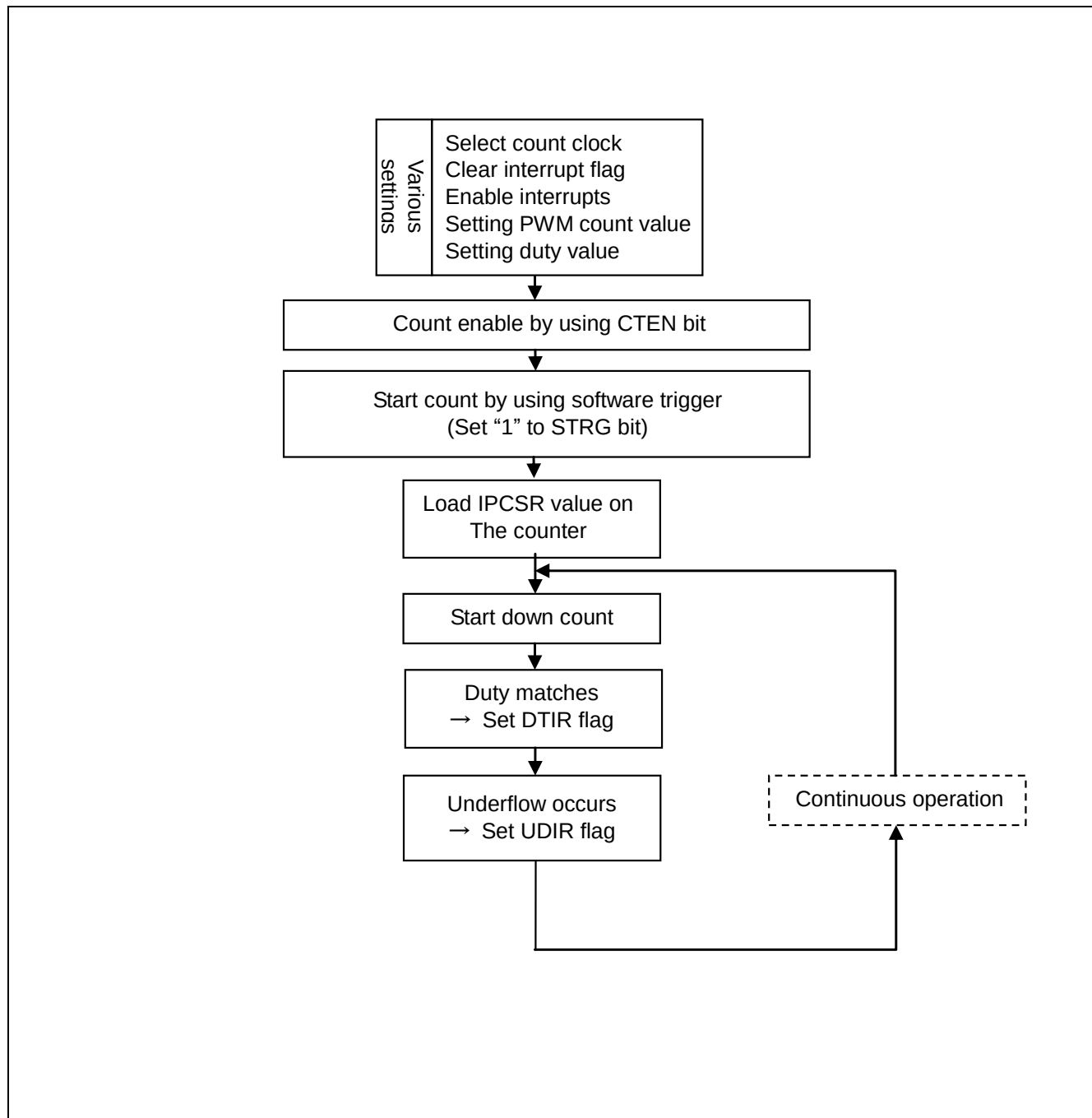
3.5.3. Return from PSS Mode

An interrupt of indicator PWM can be applied to a trigger of returning from PSS mode. Then the bus clock CLK_SYSC0P should be supplied during the PSS mode.

3.6. Operation Flowchart

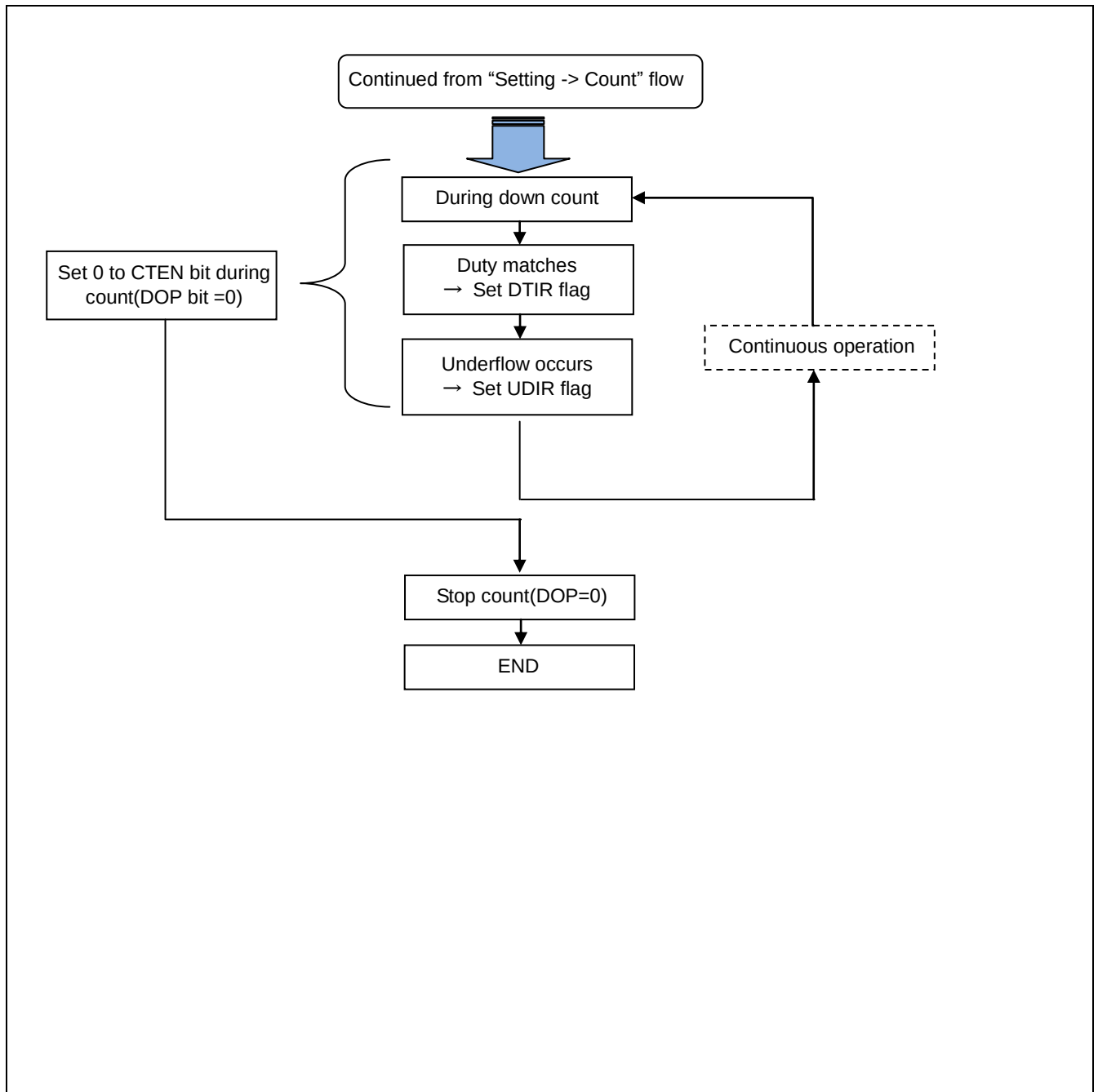
3.6.1. Operation Flowchart (Setting -> Count)

Figure 3-6



3.6.2. Operation Flowchart (Count -> Stop)

Figure 3-7



4. Registers

Table 4-1: Register List

Abbreviated Register Name	Register Name	Reference
ITMCR	Timer control register	4.1
ICNTCR	Count control register	4.2
ISTC	Status control register	4.3
ISTCC	Status control clear register	4.4
ISTCS	Status control set register	4.5
IPCSR	PWM cycle setting register	4.6
IPDUT	PWM duty setting register	4.7

4.1. Timer Control Register (ITMCR)

The timer control register (ITMCR) controls the indicator PWM timer. Note that there are bits that cannot be rewritten during timer operation (ICNTCR:DOP[bit]=1).

REGISTER_NAME	ITMCR
OFFSET	0x0C
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	CKS2	CKS1	CKS0	Reserved	PMSK	Reserved	Reserved
ACCESS_TYPE	R0,WX	R,W	R,W	R,W	R0,WX	R/W	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	OSEL	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R/W	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:15] Reserved

This is a reserved bit.

Writing data to these bits has no effect on operation.

[bit14:12] CKS2 to CKS0: Count clock selection bits

These bits select a count clock for the 16-bit down counter.

Stop the timer (ICNTCR:DOP[bit]=0) before changing the count clock.

CKS2	CKS1	CKS0	Description
0	0	0	Main oscillator clock
0	0	1	Main oscillator clock divided by 16
0	1	0	Main oscillator clock divided by 64
0	1	1	Main oscillator clock divided by 256
1	0	0	Main oscillator clock divided by 1024
1	0	1	Main oscillator clock divided by 2048
1	1	0	Main oscillator clock
1	1	1	Main oscillator clock

[bit11] Reserved

This is a reserved bit.

Writing data to these bits has no effect on operation.

[bit10] PMSK: Pulse output mask bit

This bit controls the output waveform level of the PWM output waveform.

When the bit is "0", the PWM waveform is output as is.

When the bit is "1", PWM output is masked to L output regardless of the cycle or duty setting value.

Note:

- If the output polarity specification bit (OSEL) in the timer control register (lower byte of ITMCR) is set for inverted output, setting the PMSK bit to "1" results in masking to H output.

Bit	Description
0	Normal output
1	Fixed at L output

[bit9:4] Reserved

These are reserved bits. Writing data to these bits has no effect on operation.

[bit3] OSEL: Output polarity specification bit

This bit sets the PWM output polarity.

Polarity	After Reset	Duty Match	Underflow
Normal	"L" output		
Inverse	"H" output		

Bit	Description
0	Normal polarity
1	Inverse polarity

[bit2:0] Reserved

These are reserved bits. Writing data to these bits has no effect on operation.

4.2. Count Control Register (ICNTCR)

The count control register(ICNTCR) is PWM timer count control register.

REGISTER_NAME	ICNTCR
OFFSET	0x10
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	DOP	Reserved	Reserved	Reserved	Reserved	Reserved	CTEN	STRG
ACCESS_TYPE	R,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R/W	R0,W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:8] Reserved

These are reserved bits. Writing data to these bits has no effect on operation.

[bit7] DOP: Count status bit

Setting the STRG bit to "1" while the CTEN bit is "1" will immediately make this bit "1".

The read value for this bit is "1" while a PWM timer count is in progress.

The read value for this bit is "0" while the PWM timer is stopped.

The read value for this bit is "0" while the PWM timer count is stopped after the CTEN bit is set to "0".

Set this bit to "0" before selecting a timer clock (ITMCR:CKS2-0), or configuring PWM cycle (IPCSR) or PWM duty (IPDUT) settings. These settings are ignored if they are configured while this bit is "1".

Bit	Description
0	Timer count stopped
1	Timer count operation in progress

[bit6:2] Reserved

These are reserved bits. Writing data to these bits has no effect on operation.

[bit1] CTEN: Count operation enable bit

This bit enables operation of the down counter.

If "0" is written to this bit while a counter operation is in progress (DOP bit is "1"), a stop request will be output for the counter.

Counter stop can be checked by confirming that the counter status bit (DOP bit) is "0".

After CTEN bit is set to 0, if you re-set CTEN bit to "1", you must check DOP bit is "0".

Bit	Description
0	Request stop
1	Enable operation.

[bit0] STRG: Software trigger bit

If "1" is written to the STRG bit when the CTEN bit is "1", a software trigger is applied.

The read value of the STRG bit is always "0".

Notes:

- Even if "1" is written to the CTEN and STRG bits at the same time, a software trigger is applied.
- When consecutively setting STRG bits, allow a time of at least $8T$ (T : main oscillator clock cycle) between settings. Failure to do so may result in a setting not being reflected.

Bit	Description
0	Disabled
1	Startup by software

4.3. Status Control Register (ISTC)

For details on writing to the status control register (ISTC), see "5.1 Notes to observe when accessing a register".

REGISTER_NAME	ISTC
OFFSET	0x14
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	DTIE	UDIE	Reserved	Reserved	DTIR	UDIR
ACCESS_TYPE	R0,WX	R0,WX	R,W	R,W	R0,WX	R0,WX	R,WX	R,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:6] Reserved

These are reserved bits. Writing data to these bits has no effect on operation.

[bit5] DTIE: Duty match interrupt request enable bit

This bit controls interrupt requests of the duty match interrupt request bit (bit1 DTIR).

If the DTIE bit is enabled and the DTIR bit is set to "1", an interrupt request is issued to the CPU.

Writing "1" to the ISTCC:DTIEC bit clears this bit.

Writing "1" to the ISTCS:DTIES bit sets this bit.

Bit	Description
0	Disable interrupt requests.
1	Enable interrupt requests.

[bit4] UDIE: Underflow interrupt request enable bit

This bit controls interrupt requests of the underflow interrupt request bit (bit0 UDIR).

If the UDIE bit is enabled and the UDIR bit is set to "1", an interrupt request is issued to the CPU.

Writing "1" to the ISTCC:UDIEC bit clears this bit.

Writing "1" to the ISTCS:UDIES bit sets this bit.

Bit	Description
0	Disable interrupt requests.
1	Enable interrupt requests.

[bit3:2] Reserved

These are reserved bits. Writing data to these bits has no effect on operation.

[bit1] DTIR: Duty match interrupt request bit

The DTIR bit is set to "1" when the count value matches the duty setting value.

Writing "1" to the ISTCC:DTIRC bit clears this bit.

This bit is read-only. Writing data to this bit has no effect on operation.

Bit	Description
0	The interrupt factor is cleared.
1	Detect the interrupt factor.

[bit0] UDIR: Underflow interrupt request bit

The UDIR bit is set to "1" when the count value underflows.

Writing "1" to the ISTCC:UDIRC bit clears this bit.

This bit is read-only. Writing data to this bit has no effect on operation.

Bit	Description
0	The interrupt factor is cleared.
1	Detect the interrupt factor.

4.4. Status Control Clear Register (ISTCC)

The status control clear register (ISTCC) is a register that is used to clear bits of the status control register (ISTCC).

REGISTER_NAME	ISTCC
OFFSET	0x18
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	DTIEC	UDIEC	Reserved	Reserved	DTIRC	UDIRC
ACCESS_TYPE	R0,WX	R0,WX	R0,W	R0,W	R0,WX	R0,WX	R0,W	R0,W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:6] Reserved

These are reserved bits. Writing data to these bits has no effect on operation.

[bit5] DTIEC: Duty match interrupt request enable clear bit

If "1" is written to this bit, the ISTC:DTIE bit is cleared to "0".

"0" is always read from this bit.

Bit	Description
0	Disabled
1	Clear the DTIE bit.

[bit4] UDIEC: Underflow interrupt request enable clear bit

If "1" is written to this bit, the ISTC:UDIE bit is cleared to "0".

"0" is always read from this bit.

Bit	Description
0	Disabled
1	Clear the UDIE bit.

[bit3:2] Reserved

These are reserved bits. Writing data to these bits has no effect on operation.

[bit1] DTIRC: Duty match interrupt request clear bit

If "1" is written to this bit, the ISTC:DTIR bit is cleared to "0".

"0" is always read from this bit.

Bit	Description
0	Disabled
1	Clear the DTIR bit.

[bit0] UDIRC: Underflow interrupt request clear bit

If "1" is written to this bit, the ISTC:UDIR bit is cleared to "0".

"0" is always read from this bit.

Bit	Description
0	Disabled
1	Clear the UDIR bit.

4.5. Status Control Set Register (ISTCS)

The status control set register (ISTCS) is a register that is used to set bits of the status control register (ISTC).

REGISTER_NAME	ISTCS
OFFSET	0x1C
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	DTIES	UDIES	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,W	R0,W	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:6] Reserved

This is a reserved bit.

Writing data to these bits has no effect on operation.

[bit5] DTIES: Duty match interrupt request enable set bit

If "1" is written to this bit, the ISTC:DTIE bit is set to "1".

"0" is always read from this bit.

Bit	Description
0	Disabled
1	Set the DTIE bit.

[bit4] UDIES: Underflow interrupt request enable set bit

If "1" is written to this bit, the ISTC:UDIE bit is set to "1".

"0" is always read from this bit.

Bit	Description
0	Disabled
1	Set the UDIE bit.

[bit3:0] Reserved

These are reserved bits. Writing data to these bits has no effect on operation.

4.6. PWM Cycle Setting Register (IPCSR)

The PWM cycle setting register (IPCSR) is a register with a buffer for setting a cycle. Transfer to the timer is performed upon software trigger activation. Note that rewriting is not supported while a timer count operation is in progress (ICNTCR:DOP[bit]=1).

REGISTER_NAME	IPCSR
OFFSET	0x00
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	IPCSR[15]	IPCSR[14]	IPCSR[13]	IPCSR[12]	IPCSR[11]	IPCSR[10]	IPCSR[9]	IPCSR[8]
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	IPCSR[7]	IPCSR[6]	IPCSR[5]	IPCSR[4]	IPCSR[3]	IPCSR[2]	IPCSR[1]	IPCSR[0]
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:16] Reserved

These are reserved bits. Writing data to these bits has no effect on operation.

[bit15:0] IPCSR: PWM cycle setting register

This register is for setting the PWM timer cycle. Transfer to the timer is performed upon software trigger activation.

Stop the timer (ICNTCR:DOP[bit]=0) before configuring the PWM cycle setting register (IPCSR) setting. Settings are ignored if they are configured while timer operation is in progress (ICNTCR:DOP[bit]=1).

4.7. PWM Duty Setting Register (IPDUT)

The PWM duty setting register (IPDUT) is a register for setting a duty. Transfer is performed upon software trigger activation. Note that rewriting is not supported while a timer count operation is in progress (ICNTCR:DOP[bit]=1).

REGISTER_NAME	IPDUT
OFFSET	0x04
ACCESS_SIZE	B H W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX	R0,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	IPDUT[15]	IPDUT[14]	IPDUT[13]	IPDUT[12]	IPDUT[11]	IPDUT[10]	IPDUT[9]	IPDUT[8]
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	IPDUT[7]	IPDUT[6]	IPDUT[5]	IPDUT[4]	IPDUT[3]	IPDUT[2]	IPDUT[1]	IPDUT[0]
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:16] Reserved

This is a reserved bit.

Writing data to these bits has no effect on operation.

[bit15:0] IPDUT: PWM Duty Setting Register

This is the register for setting the duty. Transfer is performed upon software trigger activation.

If the set values of the cycle setting register and duty setting register are the same value, the output for normal polarity is all "H", and the output for inverse polarity is all "L".

If IPCSR < IPDUT in the set values, the output for normal polarity is all "L", and the output for inverse polarity is all "H".

Stop the timer (ICNTCR:DOP[bit]=0) before configuring PWM duty setting register (IPDUT) settings. Settings are ignored if they are configured while timer operation is in progress (ICNTCR:DOP[bit]=1).

5. Precautions for Using This Device

This section explains precautions during use.

5.1. Notes to Observe When Accessing a Register

■ Status control register (ISTC) access

To clear a specific bit in this register, write "1" to the corresponding bit in the status control clear register (ISTCC).

To set a specific bit in this register, write "1" to the corresponding bit in the status control set register (ISTCS).

Data can be written directly to this register only when writing to all bits.

5.2. Indicator PWM Operation Precautions

■ Precautions when configuring settings using a program

Timer control register (ITMCR) CKS2-0 bits, PWM cycle setting register (IPCSR), and PWM duty setting register (IPDUT) settings are not reflected if they are configured while a count operation is in progress (ICNTCR:DOP=1). Be sure to stop the count (ICNTCR:DOP=0) before configuring these settings.

If the interrupt request flag set timing and clear timing overlap, the flag set has priority, and the clear operation is disabled.

If the load timing and count timing overlap, the load operation has priority for the down counter.

When consecutively setting STRG bits, allow a time of at least 8T (T: main clock cycle) between settings. Failure to do so may result in a setting not being reflected.

■ Note that re-setting STRG bit during timer operation.

During PWM timer operation, the re-setting of the software trigger (ICNTCR:STRG="1") allows to update the counter value. However, as a result of different between register clock speed and counter clock(Main clock) speed, the count value of the counter at last time would reach the register value of IPDUT or IPCSR before the re-setting of the software trigger is reflected in the counter. In this case, Note that there is a possibility that the Duty match interrupt and Underflow interrupt is generated.

CHAPTER 29: FPD-Link Converter



This chapter explains FPD-Link Converter.

1. Overview
2. Configuration and Block Diagram
3. Operation
4. Registers

CODE: FPDLINK-S6J3200-E1

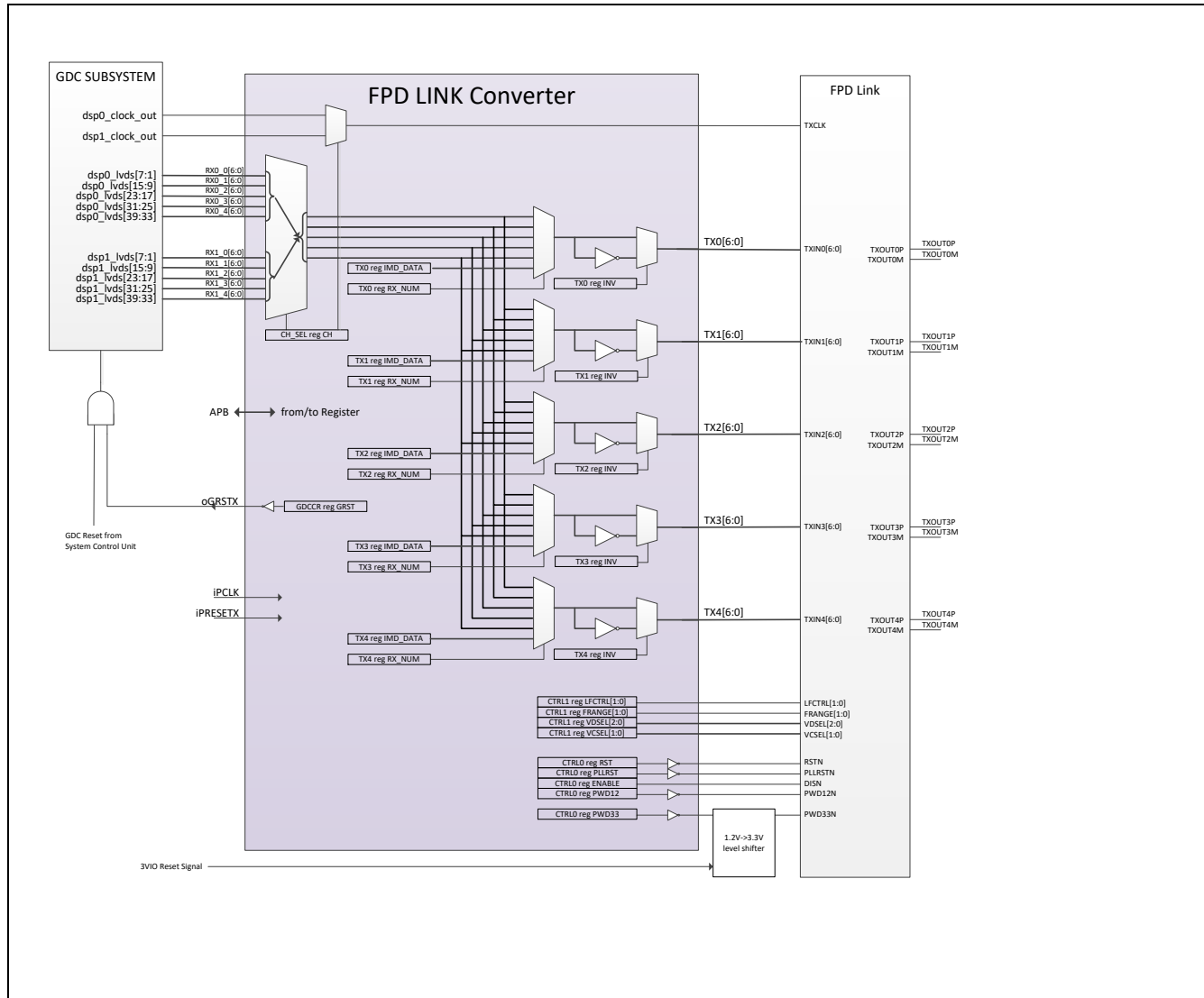
1. Overview

FPD-Link Converter is positioned between GDC SUBSYSTEM and FPD-Link. It has functions to accept the output signal for the LVDS mode of GDC SUBSYSTEM and pass them over to FPD-Link. It also controls external output from FPD-Link.

2. Configuration and Block Diagram

This section shows a block diagram of FPD-Link converter and FPD-Link

Figure 2-1 Block diagram of FPD-Link and FPD-Link converter



Notes:

- FPD-Link Converter is positioned between the graphic subsystem and FPD-Link.
- The FPD-Link converter receives the display output signal of the graphic subsystem. Because of this, names are changed (for example, `disp0_lvds[7:1]` = `RX0_0[6:0]`) in the FPD-Link Converter explanation for the sake of convenience.

Table 2-1: FPD-Link Port Definition

FPD-Link Converter	PHY		FPD-Link	Package External Port Name
	IN	OUT		Port Description
TX0[6:0]	TXIN0[6:0]	TXOUT0P	TXOUT0P	TxDOUT0+
		TXOUT0M	TXOUT0M	TxDOUT0-
TX1[6:0]	TXIN1[6:0]	TXOUT1P	TXOUT1P	TxDOUT1+
		TXOUT1M	TXOUT1M	TxDOUT1-
TX2[6:0]	TXIN2[6:0]	TXOUT2P	TXOUT2P	TxDOUT2+
		TXOUT2M	TXOUT2M	TxDOUT2-
TX3[6:0]	TXIN3[6:0]	TXOUT3P	TXOUT3P	TxDOUT3+
		TXOUT3M	TXOUT3M	TxDOUT3-
TX4[6:0]	TXCLK[6:0]	TXCLKP	TXOUT4P	TxCLK+
		TXCLKM	TXOUT4M	TxCLK-

3. Operation

3.1. Register IF

The register interface complies with the AMBA3 APB protocol specification. PSIZE[1:0] is expanded to support byte/half-word access as well. If the connected APB bus is not PSIZE expanded, PSIZE[1:0] is fixed to word access ("b10").

The table below describes PSIZE/PADDR processing when reading and writing.

PWRITE	PSIZE[1:0]	PADDR[1:0]	Description
READ	**	00	When reading, the lower two bits of PADDR are masked to "00", processing is word read. Select valid bytes on the master side.
WRITE	00(Byte)	**	Write processes only byte that corresponds to PADDR[1:0].
	01(Hword)	*0	"0" masks PADDR[0] and write processes Hword lane that corresponds to PADDR[1:0].
	10(Word)	00	"00" masks PADDR[1:0] performs Word Write process. Example: When word writing is performed at address 0x5, address 0x4 is processed as word write.
	11	**	Disabled (PSLVERR)

The conditions below are when this module will return a slave error.

1. Reserved (address without a register) area access
2. Byte/Hword access of an area of register reserved bits only
3. In the LOCK state, writing anywhere other than the UNLOCK Register
4. Access with PSIZE="11" (Double Word)

3.2. Output Signal Selection for FPD-Link

1 Channel is selected in accordance with the CH_SEL register setting and output is from display output signal Channel 2 of the Graphic Subsystem to the FPD-Link.

The signal output to TXn[6:0] is specified by the TXn Configuration register CH_NUM bit. Supported settings are the RXn of the channel selected above, or a fixed value. The fixed value is 7-bit data set in the TXn Configuration register IMD_DAT.

The signal output to TXn can be inverted in accordance with the setting of the Configuration register INV bit. This function makes it possible +/- swap the FPD-Link external output signal.

To configure TXn Configuration register settings, UNLOCK needs to be written to the Unlock Register in order to release LOCK. Attempting to write in the LOCK state returns an error (PSLVERR).

3.3. FPD-Link Control

Output to FPD-Link is controlled in accordance with the Control0/1 register setting. For details, see the description of registers.

4. Registers

This section describes the registers of FPD-Link CONVERTER Module

offset	Register Name	Memo
0x0000	UNLOCK	UNLOCK register Writing any value other than UNLOCK code results in LOCK.
0x0004	CTRL0	Control0 register Performs FPD-Link macro reset, clock inversion, power down control, etc.
0x0008	CTRL1	Control1 Register Adjusts FPD-Link external output.
0x000C	Reserved	PSLVERR
0x0010	CH_SEL	Input Channel select register
0x0014	TX0 CONF	TX0 Configuration register +2, +3 address access generates PSLVERR.
0x0018	TX1 CONF	TX1 Configuration register +2, +3 address access generates PSLVERR.
0x001C	TX2 CONF	TX2 Configuration register +2, +3 address access generates PSLVERR.
0x0020	TX3 CONF	TX3 Configuration register +2, +3 address access generates PSLVERR.
0x0024	TX4 CONF	TX4 Configuration register +2, +3 address access generates PSLVERR.
:	Reserved	PSLVERR
0x0040	GDCCR	GDC Control Register
:	Reserved	PSLVERR

4.1. Unlock Registers (UNLOCK)

Configures the setting that enables/disables writing to the FPD-Link Converter register. However, there is no enable/disable setting for this register.

To release LOCK, write the UNLOCK value (0xB3B0BCB4) as a word (32 bits) to this register. The UNLOCK value is read from this register in the UNLOCK state.

The LOCK state can be entered by writing a word other than the UNLOCK value, or by writing a byte or hword (data irrelevant). Reading this register in the LOCK state returns 0x00000000.

REGISTER_NAME	UNLOCK
OFFSET	0x0
ACCESS_SIZE	W
MULTIPLE	0:31
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	UNLOCK 31	UNLOCK 30	UNLOCK 29	UNLOCK 28	UNLOCK 27	UNLOCK 26	UNLOCK 25	UNLOCK 24
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	UNLOCK 23	UNLOCK 22	UNLOCK 21	UNLOCK 20	UNLOCK 19	UNLOCK 18	UNLOCK 17	UNLOCK 16
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	UNLOCK 15	UNLOCK 14	UNLOCK 13	UNLOCK 12	UNLOCK 11	UNLOCK 10	UNLOCK 9	UNLOCK 8
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	UNLOCK7	UNLOCK6	UNLOCK5	UNLOCK4	UNLOCK3	UNLOCK2	UNLOCK1	UNLOCK0
ACCESS_TYPE	R,W	R,W	R,W	R,W	R,W	R,W	R,W	R,W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] UNLOCK : Unlock

Controls LOCK/UNLOCK.

Bit[31:0]	Description
0xB3B0BCB4	UNLOCK
Other	LOCK Reading this bit in the LOCK state returns 0x00000000.

4.2. Control0 Registers (CTRL0)

Performs FPD-Link reset, power down, and output control.

REGISTER NAME	CTRL0
OFFSET	0x4
ACCESS_SIZE	W
MULTIPLE	0:31
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	PWD33
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	PWD12
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	ENABLE
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	PLL_RST	Reserved	Reserved	Reserved	RST
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R0,W0	R0,W0	R0,W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	1	0	0	0	1

[bit31:25] Reserved

Always write "0" to this bit. The read value is "0".

[bit24] PWD33 : Power Down 3.3V for FPD-Link

Controls the FPD-Link driver, serializer, 3.3 V line power down for the level converter section.

Bit	Description
0	Operation
1	Power Down(default) Differential Hi-Z output

[bit23:17] Reserved

Always write "0" to this bit. The read value is "0".

[bit16] PWD12 : Power Down 1.2V for FPD-Link

Controls the FPD-Link 1.2 V line power down for the level converter section.

Bit	Description
0	Operation
1	Power Down(default) Differential Hi-Z output

[bit15:9] Reserved

Always write "0" to this bit. The read value is "0".

[bit8] ENABLE : Output Enable

Controls FPD-Link external output enable/disable.

Bit	Description
0	Disable(default) Differential Hi-Z output
1	Enable

[bit7:5] Reserved

Always write "0" to this bit. The read value is "0".

[bit4] PLLRST

Controls PLL reset of the FPD-Link external output section.

Bit	Description
0	Release operation
1	Reset(default)

[bit3:1] Reserved

Always write "0" to this bit. The read value is "0".

[bit0] RST

Controls FPD-Link reset.

Bit	Description
0	Release operation
1	Reset(default) Differential 0 output

4.3. Control1 Registers (CTRL1)

Controls FPD-Link output timing, voltage, etc.

REGISTER NAME	CTRL1
OFFSET	0x8
ACCESS_SIZE	W
MULTIPLE	0:31
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	LFCTRL [1]	LFCTRL [0]	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	VCSEL1	VCSEL0	Reserved	VDSEL2	VDSEL1	VDSEL0
ACCESS_TYPE	R0,W0	R0,W0	R/W	R/W	R0,W0	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	1	0	1	0	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	FRANGE [1]	FRANGE [0]	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:30] Reserved

Always write "0" to this bit. The read value is "0".

[bit29:28] LFCTRL

These bits control cycle to cycle jitter of the output clock.

Bit	Loop filter Control Frequency
00	102 kHz (default)
01	229 kHz
10	376 kHz
11	1022 kHz (*1)

Note:

- (*1) LFCTRL must not be set to 11 if FRANGE is set to 01, 10 or 11.
- If FRANGE is set to 00, setting LFCTRL to 11 should be suitable for most applications.
- If FRANGE is set to 00, 01 or 10, setting LFCTRL to 10 should be suitable for most applications.
- The 00 setting of LFCTRL is recommended for designs that have low noise (< 7 mV pp) and good regulation on the AVCC3_LVDS_PLL supply. This setting provides the lowest possible output jitter transfer from the FPD-Link TXCLK.

- For designs with significant power supply noise spectral content near or above the selected loop-filter corner frequency, it is possible to select an alternate corner frequency. This allows the PLL to filter more of the power supply noise. Note that these higher loop-filter corner frequencies may allow more jitter from the FPD-Link TXCLK to propagate to the output. Therefore it should only be used when necessary.
- To limit power supply noise into the AVCC3_LVDS_PLL supply it is recommended that designs implement one of the external power filters documented in Cypress application note "AN213250 – Power Filter Options for FPD-Link Interfaces".

[bit27:24] Reserved

Always write "0" to this bit. The read value is "0".

[bit23:22] Reserved

Always write "0" to this bit. The read value is "0".

[bit21:20] VCSEL

The bits adjust the FPD-Link output common voltage.

Bits	Description	
	Typ	
00	1.250V	
01	1.200V	default
10	1.150V	Not supported
11	1.100V	Not supported

Note:

- See the S6J32E, S6J32F, S6J32G, S6J32H Series datasheet for detailed specification.

[bit19] Reserved

Always write "0" to this bit. The read value is "0".

[bit18:16] VDSEL

The bits adjust the FPD-Link output differential voltage.

Bits	Description	
	Typ	
000	100mv	Not supported
001	150mv	Not supported
010	200mv	Not supported
011	250mv	Not supported
100	300mv	
101	350mv	default
110	400mv	
111	450mv	Not supported

Note:

- See the S6J32E, S6J32F, S6J32G, S6J32H Series datasheet for detailed specification.

[bit15:8] Reserved

Always write "0" to this bit. The read value is "0".

[bit7:6] FRANGE

These bits select by the TXCLK frequency.

Bit	Reference Clock Frequency Range
00	$24\text{MHz} < \text{Frequency}$
01	$12\text{MHz} < \text{Frequency} \leq 24\text{MHz}$
10	$6\text{MHz} < \text{Frequency} \leq 12\text{MHz}$
11	$\text{Frequency} \leq 6\text{MHz}$

Note:

- Don't change the TXCLK frequency during operation (CTRL0[4]:PLL_RST bit is "0").
- If want to change the TXCLK frequency, set CTRL0[4]:PLL_RST bit to "1" and change FRANGE setting.

[bit5:0] Reserved

Always write "0" to this bit. The read value is "0".

4.4. Channel Select Registers (CH_SEL)

Selects one of the two input lines (RX0, RX1).

REGISTER NAME	CH_SEL
OFFSET	0x10
ACCESS_SIZE	B H W
MULTIPLE	0:31
NUMERIC TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	CH
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:1] Reserved

Always write "0" to this bit. The read value is "0".

[bit0] CH :Channel

Uses the selected input.

Bit	Description
0	Channel 0(RX0)
1	Channel 1(RX1)

4.5. TXn Configuration Registers (TXn_CONF (n: 0 to 4))

Specifies data to be output to TXn.

REGISTER NAME	TXn_CONF
OFFSET	0x14 + n*4
ACCESS_SIZE	B H W
MULTIPLE	0:15
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	IMD_DAT6	IMD_DAT5	IMD_DAT4	IMD_DAT3	IMD_DAT2	IMD_DAT1	IMD_DAT0
ACCESS_TYPE	R0,W0	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	INV	Reserved	RX_NUM2	RX_NUM1	RX_NUM0
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R/W	R0,W0	R/W	R/W	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	1	1	1

[bit31:15] Reserved

Always write "0" to this bit. The read value is "0".

[bit14:8] IMD_DAT[6:0] : Immediate Data

When 0b111 (0b110, 0b101) is set to RX_NUM bit, the immediate data output to TXn is set.

[bit7:5] Reserved

Always write "0" to this bit. The read value is "0".

[bit4] INV :Invert

Configures the setting of the Inversion function of the data selected by RX_NUM.

Bit	Description
0	Disable(default)
1	Enable

[bit3] Reserved

Always write "0" to this bit. The read value is "0".

[bit2:0] RX_NUM[2:0] :RX number

Selects data to be output to TXn (n= 0 to 4).

Bits	Description
000	RX0
001	RX1
010	RX2
011	RX3
100	RX4
101	IMD_DAT
110	IMD_DAT
111	IMD_DAT (default)

4.6. GDC Control Register (GDCCR)

Controls GDC SUBSYSTEM reset.

Depending on the GDC SUBSYSTEM status when the reset is executed, a system backup may be performed. Control reset based on GDC SUBSYSTEM specifications.

REGISTER_NAME	GDCCR
OFFSET	0x40
ACCESS_SIZE	B H W
MULTIPLE	0:31
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	GRST
ACCESS_TYPE	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R0,W0	R/W
PROT_TYPE	Wp							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:1] Reserved

Always write "0" to this bit. The read value is "0".

[bit0] GRST :GDC Reset

This bit controls reset signal of GDC.

Use software control to cancel a reset following the reset setting. The reset time should be in accordance with the requirements of GDC.

Bit	Description
0	Release reset (default)
1	Set reset

CHAPTER 30: Memory Protection Unit for AXI



This chapter explains the functions and operations of the Memory Protection Unit for AMBA AXI protocol bus (MPU AXI).

1. Overview
2. Configuration and Block Diagram
3. Operation of the MPU AXI
4. Registers
5. Notes on Using MPU AXI

CODE: MPUAXI-S6J3200-E1

1. Overview

This section describes the features of the MPU AXI.

■ Features of the MPU AXI

The MPU AXI module monitors the accesses from AXI masters and checks each access against an authorized set of access permissions. Access permissions ("permission attributes" here onwards) are defined by "access permissions" bits. These bits are explained in Section "MPU access permissions". MPU AXI provides eight regions and one background region. Each region has corresponding access permission bits that defines the permission attributes for that particular region. Any unauthorized access to memory space is flagged using Non-Maskable Interrupt. MPU AXI also collects information about the unauthorized bus access and stores it in its internal registers.

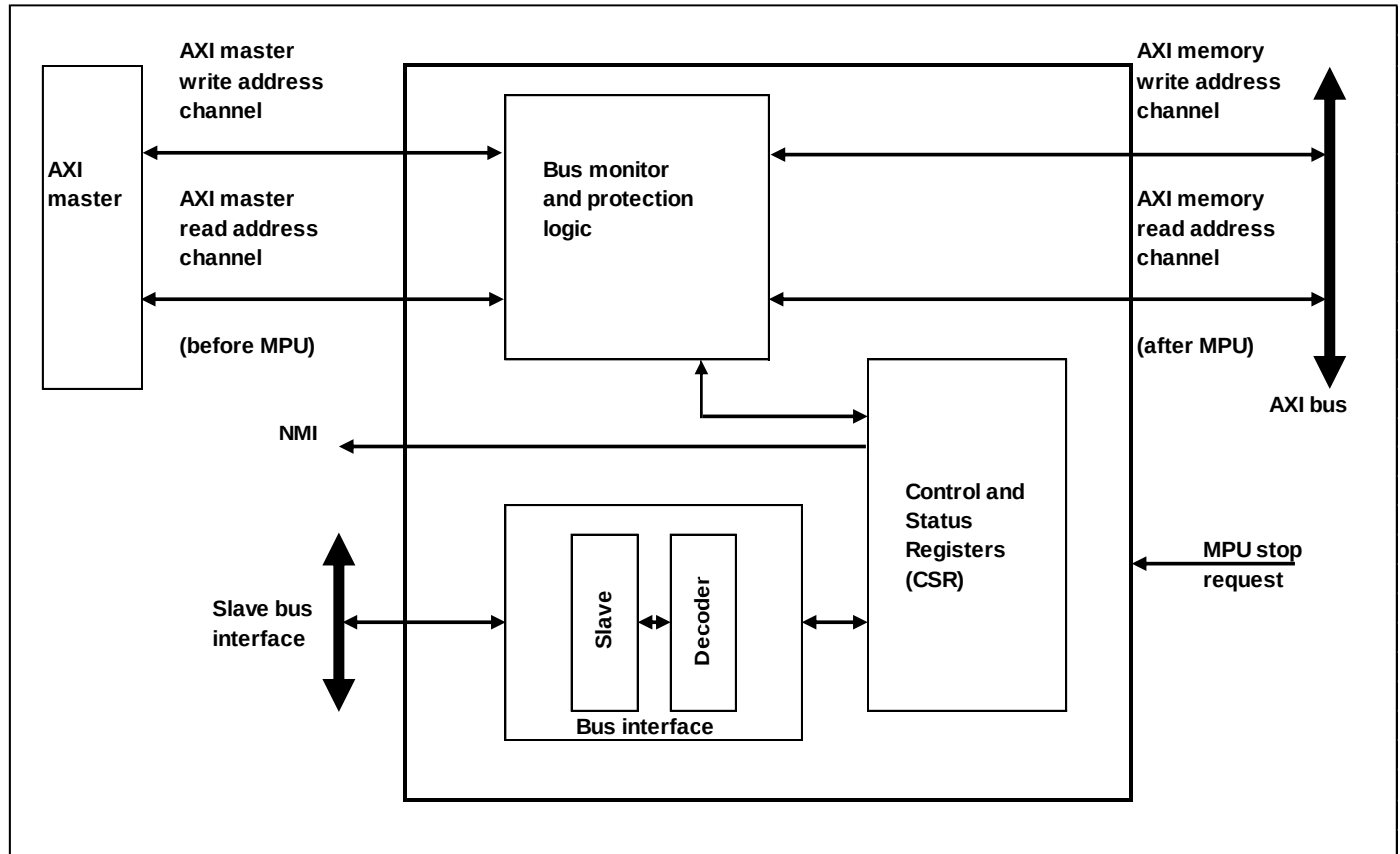
- Each of the eight regions in MPU AXI is specified using corresponding start address and end address
- Background region covers entire 4 GB address space
- On unauthorized access MPU AXI generates an NMI to the CPU
- MPU AXI collects information about the AXI master bus access that caused unauthorized access
- Supports 8-bit, 16-bit, and 32-bit bus accesses for configuration of registers in MPU AXI
- Supports lock, unlock feature for protection of registers from illegal write accesses
- Modification of registers in MPU AXI is only allowed in privileged mode
- Supports MPU stop feature that allows blocking of all the accesses to memory space
- Optionally supports privileged mode overwrite feature that allows overwrite of privilege attribute of memory side AXI interface

2. Configuration and Block Diagram

This section shows a block diagram of MPU AXI

■ Block Diagram of MPU AXI

Figure 2-1 Block Diagram of MPU AXI



■ Bus Interface

The bus masters can access the MPU AXI module through its slave bus interface.

■ Bus Monitor and Protection Logic

This logic monitors the transaction on AXI master interfaces. It finds out the region/s where the current transfer belongs to and then applies permissions based on the region match. It signals any permission violation to CSR logic that in turn generates NMI interrupt. All transactions on AXI master interfaces (including the transfer that caused permission violation) are blocked until NMI is cleared.

■ Control and Status Registers

The operation of MPU AXI can be controlled and monitored through its Control and Status Registers (CSR)

3. Operation of the MPU AXI

This section describes the operation of MPU AXI

MPU AXI provides start address and end address for each of the eight regions. MPU AXI regions are defined with granularity of 128 bytes.

Start address specifies the first address of the region and is specified by registers MPUXn_SADDR1 to MPUXn_SADDR8 for region 1 to region 8 respectively. Since the region granularity is 128 bytes least significant 7 bits of start addresses will read 0.

End addresses are specified by registers MPUXn_EADDR1 to MPUXn_EADDR8 for region 1 to region 8 respectively. Least significant 7 bits of End Address Registers are read-only bits and will always read "1". This ensures the granularity of 128 bytes.

■ AXI Burst Monitoring

Bus monitor and protection logic monitors AXI master "write address channel" signals and "read address channel" signals ("AXI master interfaces" here onwards). The transactions on AXI master interfaces are manipulated (if required) before they are passed on to AXI memory "write address channel" signals and "read address channel" signals ("AXI memory interfaces" here onwards).

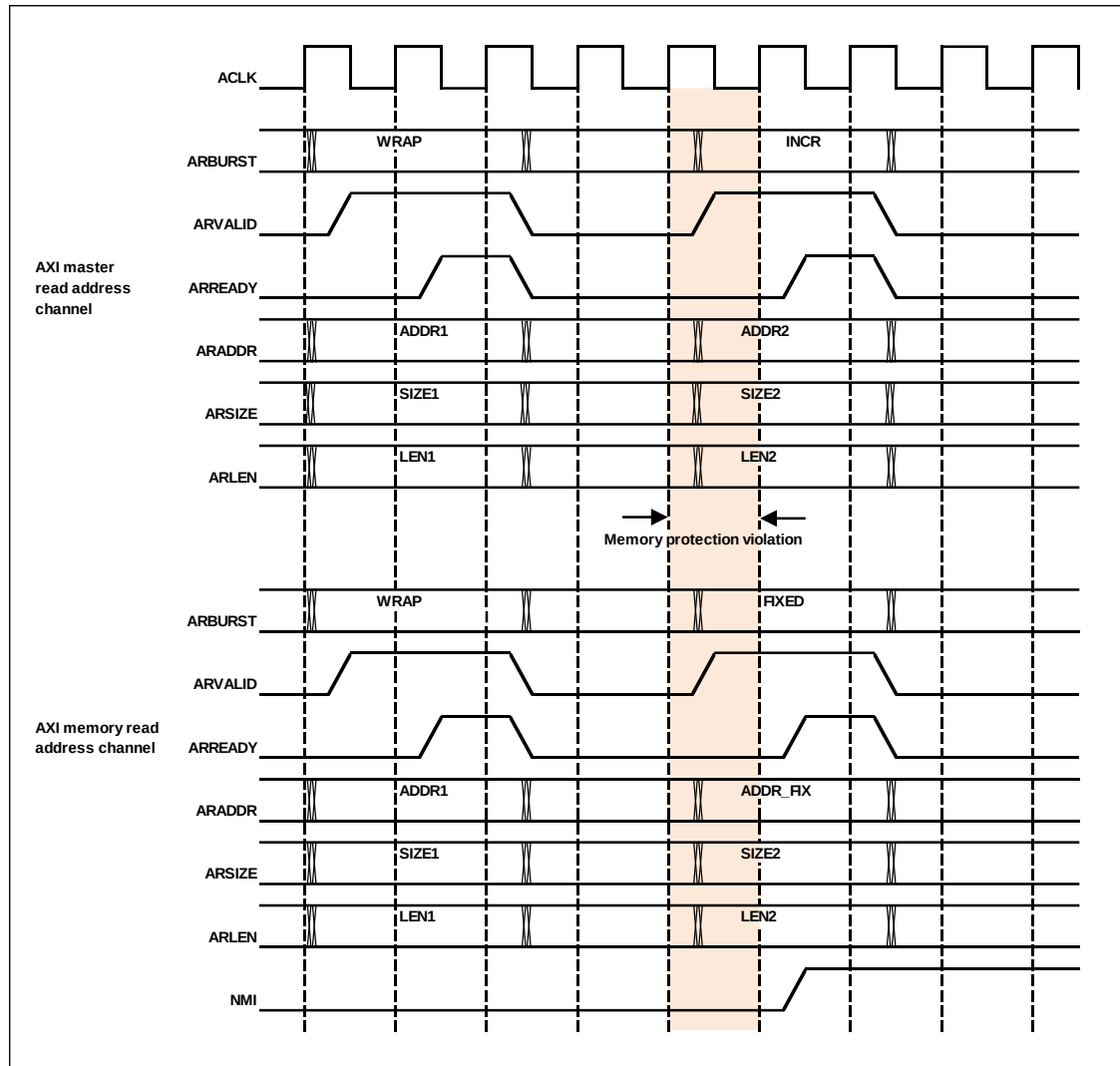
AXI protocol supports following features

- Separate address or control and data phases
- Burst based transaction where only start address is issued
- Separate write and read address/control channels
- Separate write and read data channels

AXI master begins each burst by driving transaction control information and address of the first byte in the transaction. As the burst transaction progresses, AXI slave calculates the addresses of subsequent transfers in the burst. The AWLEN (write address channel signal), ARLen (read address channel signal) specifies the number of data transfers for a burst transaction. Each burst can be of 1 to 16 transfers long. The AWSIZE, ARSIZE signals specifies the maximum number of data transfers in terms of bytes in each data transfer within a burst. The AXI protocol defines FIXED, incrementing and wrapping burst types.

As the addresses are defined in separate channels than data channels MPU AXI monitors and controls only address channels of AXI. If memory protection violation is detected entire burst transaction is manipulated to FIXED address burst with address of predefined value.

Figure Figure 3-1 shows timings for read address channel signals. First burst is of WRAP type for which no memory protection violation was detected. Second burst is of INCR type for which memory protection violation was detected and hence MPU AXI manipulates the ARBURST to FIXED type and ARADDR to predefined value (shown as ADDR_FIX).

Figure 3-1 MPU AXI Example Timings

MPU AXI uses burst start address (AWADDR, ARADDR signals), burst type (AWBURST, ARBURST signals), burst length (AWLEN, ARLEN signals), and burst size (AWSIZE, ARSIZE signals) from AXI burst transaction to calculate the lowest address and the highest address of the burst and then both the addresses are used to find the region match.

For FIXED type of burst:

Lowest address = Highest address = Burst start address

For INCR type of burst:

Lowest address = Burst start address

Highest address = Burst start address + (num_bytes x num_transfers) – 1

where, num_bytes is number of bytes in each transfer of burst and

num_transfers is number of transfers in the burst

For WRAP type of burst:

Lowest address = Wrap boundary

Highest address = Wrap boundary + (num_bytes x num_transfers) – 1

■ MPU Access Permissions

Region control registers in MPU AXI, MPUXn_CTRL1 to MPUXn_CTRL8 are used to control the access permission for region 1 to region 8 respectively. Also MPUXn_CTRL0 is used to control the access permission for background region.

Table 3-1 Access Permissions

AP Bits	Access in Privileged Mode	Access in Non- Privileged Mode	Comment
000 (default)	No access	No access	All bus accesses are blocked and hence would generate memory protection violation.
001	read, write	No access	Reads and writes are permitted in privileged mode only. Any access in non- privileged mode would generate memory protection violation.
010	read, write	read only	Reads and writes are permitted in privileged mode. Only reads are permitted in non-privileged mode. Writes in non- privileged mode would generate memory protection violation.
011	read, write	read, write	All bus transfers are permitted. No memory protection violation is generated in this mode.
100	No access	No access	All bus accesses are blocked and hence generate memory protection violation.
101	read only	No access	Reads are permitted in privileged mode only. Writes in privileged mode and any access in non-privileged mode would generate memory protection violation.
110	read only	read only	Reads are permitted in privileged as well as non-privileged mode. Any write access would generate memory protection violation.
111	read, write	read, write	All bus transfers are permitted. No memory protection violation is generated in this mode.

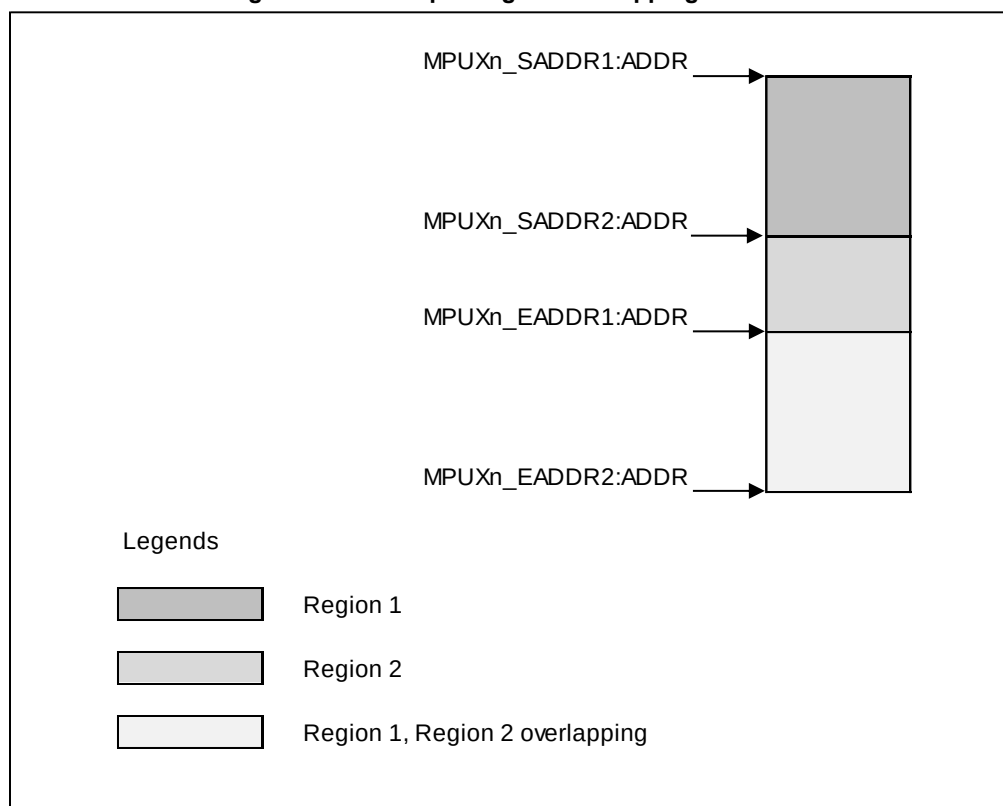
■ MPU Priority Decision

MPU AXI provides start address and end address for each region. Start address specifies the first address of the region and end address specifies the last address of the region. It is allowed in MPU AXI that the region may overlap each other. Hence it is also possible that an AXI transaction address may match with multiple regions.

For AXI protocol transaction following scenarios are possible.

2. Lowest address and highest address might fall in the same region.
3. Lowest address might match in one region, but highest address might match in some other region.
4. Scenario mentioned in point 1 here, happens for multiple regions due to region overlapping.
5. Scenario mentioned in point 2 here, happens for multiple regions due to region overlapping.

Figure 3-2 Example Region Overlapping



MPU AXI finds region match signals based on lowest address of AXI burst transaction and also separate region match signals based on highest address. Due to overlapping of regions it is possible lowest address and/or highest address may match with multiple regions.

MPU AXI supports upto eight regions. Each region is identified as region 1, region 2, region 3, and so on upto region 8. Region 8 is given highest priority, region 7 has second highest priority, and so on with region 1 as the second lowest priority region. Background region is the lowest priority region.

Whenever the AXI transaction lowest address matches with multiple regions the permissions corresponding to the highest priority (among all matching region) region is applied. Similarly, if AXI transaction highest address matches with multiple regions the permissions corresponding to highest priority (among all matching region) region is applied.

It is possible that lowest address and highest address may match with different highest priority regions. In this case the more restrictive permission is applied. Table 6.3-1 shows access permissions with corresponding restriction index for privileged mode access. Restriction index 1 has the most restrictive

access and access permissions with restriction index 3 has the least restrictive access. This table is applied when privileged mode attribute of current transaction is of type privileged mode.

Similarly, Table Table 3-1 shows access permissions with corresponding restriction index for non-privileged mode access. This table is applied when privileged mode attribute of current transaction is of type non-privileged mode.

Table 3-2 Restrictive Access Permission Matrix for Privileged Mode Access

AP Bits	Access in Privileged Mode	Restriction Index
"000", "100"	No access	1
"101", "110"	read only	2
"001", "010", "011", "111"	read, write	3

Table 3-3 Restrictive Access Permission Matrix for Non-privileged Mode Access

AP Bits	Access in Non-privileged Mode	Restriction Index
"000", "001", "100", "101"	No access	1
"010", "110"	read only	2
"011", "111"	read, write	3

■ Bus Monitor and Protection Logic

All transactions on the AXI master interfaces are monitored and checked for permitted access.

- Bus monitor and protection logic within MPU AXI compares the lowest address and highest address of current transaction with start addresses and end addresses of each region to find region match where the current transaction matches to among the eight defined regions
- As explained in Section MPU priority decision the AXI transaction address may match with multiple regions. The permission attributes of highest priority region are checked against the attributes of currently applied transaction from AXI master
- If the attributes of currently applied transaction are within permitted attributes, current transaction is passed on to the AXI memory interfaces
- If the attributes are not within permitted attributes current transaction is blocked. The Non Maskable Interrupt (MPUXn_CTRL0:NMI) flag is set. If the memory protection violation is detected on write address channel, the address and control information is stored in MPUXn_WERRA and MPUXn_WERRC registers respectively. If the memory protection violation is detected on read address channel, the address and control information is stored in MPUXn_RERRA and MPUXn_RERRC registers respectively. It is possible that memory protection violation is detected simultaneously on both the channels
- All further transaction are blocked until the MPUXn_CTRL0:NMI flag is cleared by software. Further monitoring of AXI master interfaces is also stalled until the MPUXn_CTRL0:NMI flag is cleared

When a transfer is blocked, MPU AXI does the following actions:

- Current transaction on AXI master is manipulated to FIXED address burst
- The transaction address is changed to predefined address. Check device specific datasheet for details of predefined address

■ MPU Stop Feature

Optionally MPU AXI supports MPU stop feature.

When this mode is enabled all accesses to memory space are blocked and MPU AXI does the following actions:

- Burst type signal is driven to FIXED type burst
- Burst address is driven to predefined FIXED address

■ Privileged Mode Overwrite Feature

Optionally MPU AXI supports privileged mode overwrite feature.

When this mode is enabled privileged mode attribute on the AXI memory interfaces are set by register bit setting MPUXn_CTRL0:PROT.

Note:

- *Bus monitor and protection logic for detecting memory protection violation uses privilege mode attribute on AXI master interfaces and not MPUXn_CTRL0:PROT bit setting even when privileged mode overwrite feature is enabled.*

4. Registers

This section describes the registers of MPU AXI

The MPU AXI module contains various registers to configure its operation, to monitor its status and to read the information it has collected from the AXI master interfaces at the time of the memory protection violation.

The MPU AXI module is allocated 1 KB of MCU address space for mapping the Configuration and Status Registers (i.e. CSRs). The address area allocated to MPU AXI and the Control and Status Registers in MPU AXI are explained in this section.

The suffix 'n' in the register name indicates that the register is an instance 'n' of the module.

■ Registers of MPU AXI

The following registers are available for MPU AXI:

- MPU AXI Control Register (MPUXn_CTRL0)
- MPU AXI NMI Enable Register (MPUXn_NMIEN)
- MPU AXI Write Error Control Register (MPUXn_WERRC)
- MPU AXI Write Error Address Register (MPUXn_WERRA)
- MPU AXI Read Error Control Register (MPUXn_RERRC)
- MPU AXI Read Error Address Register (MPUXn_RERRA)
- MPU AXI Region Control Registers (MPUXn_CTRL1 to 8)
- MPU AXI Start Address Registers (MPUXn_SADDR1 to 8)
- MPU AXI End Address Registers (MPUXn_EADDR1 to 8)
- MPU AXI Unlock Register (MPUXn_UNLOCK)
- MPU AXI Module ID Register (MPUXn_MID)

■ Memory Layout of MPU AXI Registers

Offset	+3	+2	+1	+0
0x00000000	MPUXn_CTRL0 00000000 00000000 00000001 00000000			
0x00000004	MPUXn_NMIEN 00000000 00000000 00000000 00000001			
0x00000008	MPUXn_WERRC 00000000 00000000 0000XXXX XXXXXXXX0			
0x0000000C	MPUXn_WERRA XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX			
0x00000010	MPUXn_RERRC 00000000 00000000 0000XXXX XXXXXXXX0			
0x00000014	MPUXn_RERRA XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX			
0x00000018	MPUXn_CTRL1 00000000 00000000 00000000 00000000			
0x0000001C	MPUXn_SADDR1 00000000 00000000 00000000 00000000			
0x00000020	MPUXn_EADDR1 00000000 00000000 00000000 01111111			

Offset	+3	+2	+1	+0
0x00000024	MPUXn_CTRL2 00000000 00000000 00000000 00000000			
0x00000028	MPUXn_SADDR2 00000000 00000000 00000000 00000000			
0x0000002C	MPUXn_EADDR2 00000000 00000000 00000000 01111111			
0x00000030	MPUXn_CTRL3 00000000 00000000 00000000 00000000			
0x00000034	MPUXn_SADDR3 00000000 00000000 00000000 00000000			
0x00000038	MPUXn_EADDR3 00000000 00000000 00000000 01111111			
0x0000003C	MPUXn_CTRL4 00000000 00000000 00000000 00000000			
0x00000040	MPUXn_SADDR4 00000000 00000000 00000000 00000000			
0x00000044	MPUXn_EADDR4 00000000 00000000 00000000 01111111			
0x00000048	MPUXn_CTRL5 00000000 00000000 00000000 00000000			
0x0000004C	MPUXn_SADDR5 00000000 00000000 00000000 00000000			
0x00000050	MPUXn_EADDR5 00000000 00000000 00000000 01111111			
0x00000054	MPUXn_CTRL6 00000000 00000000 00000000 00000000			
0x00000058	MPUXn_SADDR6 00000000 00000000 00000000 00000000			
0x0000005C	MPUXn_EADDR6 00000000 00000000 00000000 01111111			
0x00000060	MPUXn_CTRL7 00000000 00000000 00000000 00000000			
0x00000064	MPUXn_SADDR7 00000000 00000000 00000000 00000000			
0x00000068	MPUXn_EADDR7 00000000 00000000 00000000 01111111			
0x0000006C	MPUXn_CTRL8 00000000 00000000 00000000 00000000			
0x00000070	MPUXn_SADDR8 00000000 00000000 00000000 00000000			
0x00000074	MPUXn_EADDR8 00000000 00000000 00000000 01111111			

Offset	+3	+2	+1	+0
0x00000078	MPUXn_UNLOCK 00000000 00000000 00000000 00000000			
0x0000007C	MPUXn_MID 00000000 00000000 00000000 00000000			

4.1. MPU AXI Control Register (MPUXn_CTRL0)

MPU AXI Control Register can be used by the software to configure the MPU AXI. This register provides a bit to enable the MPU AXI monitoring and protection function. It also provides permission attributes for background region. It also provides controls for enabling or disabling of privileged mode overwrite feature and MPU stop feature. Lastly it provides MPU AXI lock status and controls the status for Non-Maskable Interrupt.

■ MPUXn_CTRL0

MPUXn_CTRL0																															
0	R0	read0	31																												
0	R0	read0	30																												
0	R0	read0	29																												
0	R0	read0	28																												
0	R0	read0	27																												
0	RWP	AP[2]	26																												
0	RWP	AP[1]	25																												
0	RWP	AP[0]	24																												
0	R0	read0	23																												
0	R0	read0	22																												
0	R0	read0	21																												
0	R0	read0	20																												
0	R0	read0	19																												
0	R0	read0	18																												
0	RWP	MPUENC	17																												
0	R	MPUEN	16																												
0	R0	read0	15																												
0	R0	read0	14																												
0	R0	read0	13																												
0	RWP	PROT	12																												
0	RWP	POEN	11																												
0	RWP	MPUSTOPEN	10																												
0	R	MPUSTOP	09																												
1	R	LST	08																												
0	R0	read0	07																												
0	R0	read0	06																												
0	R0	read0	05																												
0	R0	read0	04																												
0	R0	read0	03																												
0	R0	read0	02																												
0	R0WP	NMICL	01																												
0	R	NMI	00																												

Bit Position	Bit Field Name	Bit Description
[31:27]	read0	-
[26:24]	AP	Access Permissions for Background Region These bits are used to control access permissions for background region. For detailed description of these bits refer to Table "Access Permissions".
[23:18]	read0	-
[17]	MPUENC	MPU AXI Enable Control "0": MPU AXI monitoring and protection function is disabled "1": MPU AXI monitoring and protection function is enabled Read returns status of MPUENC bit. The region enable status to be effective takes some delay with reference to write on MPUENC bit. The actual enable status can be read through MPUXn_CTRL0:MPUEN bit.
[16]	MPUEN	MPU AXI Enable Status "0": MPU AXI monitoring and protection function is disabled. All accesses on AXI master write or read address channel inter- faces are passed on to AXI memory write or read address chan- nel interfaces without any protection "1": MPU AXI monitoring and protection function is enabled
[15:13]	read0	-
[12]	PROT	Privilege Attribute When privileged mode overwrite feature is available and also MPUXn_CTRL0:POEN = "1", privilege mode attribute on AXI memory interfaces are controlled by this bit. "0": Non-privilege mode "1": Privilege mode

Bit Position	Bit Field Name	Bit Description
[11]	POEN	Privileged Mode Overwrite Feature Enable "0": Privileged mode overwrite feature is disabled "1": Privileged mode overwrite feature is enabled Note: For availability of privileged mode overwrite feature, refer to device specific datasheet.
[10]	MPUSTOPEN	Enable for MPU STOP Feature "0": MPU stop feature is disabled "1": MPU stop feature is enabled This bit along with MPU stop input controls the STOP status of MPU AXI.
[9]	MPUSTOP	MPU Stop Status "0": MPU AXI is not stopped "1": MPU AXI is stopped (i.e.MPUXn_CTRL0:MPUSTOPEN = "1" and MPU stop input is asserted). All accesses on AXI master memory write or read address channel are converted to FIXED type burst with predefined address Note: For availability of MPU stop feature, refer to device specific datasheet.
[8]	LST	MPU Lock Status "0": MPU AXI is unlocked, registers in MPU AXI can be written "1": MPU AXI is locked, no registers (other than MPUXn_UNLOCK register) in MPU AXI can be written
[7:2]	read0	-
[1]	NMICL	NMI Interrupt Clear "0": No effect "1": Clears the NMI interrupt flag Read returns "0".
[0]	NMI	NMI Interrupt Flag This bit indicates that the memory protection violation is detected for an AXI transaction.

Note:

- The register bits MPUXn_CTRL0:AP, MPUXn_CTRL0:MPUSTOPEN, MPUXn_CTRL0:POEN and MPUXn_CTRL0:PRÖT in MPUXn_CTRL0 register can only be written when MPU is disabled (MPUXn_CTRL0:MPUEN = "0"). This also implies that when MPUXn_CTRL0:MPUEN = "1":
 - 32-bit or 16-bit access to this register is not allowed
 - 8-bit access is required to disable the MPU
 - 8-bit access is required to clear the NMI interrupt flag

4.2. MPU AXI NMI Enable Register (MPUXn_NMIEN)

MPU AXI NMI Enable Register can be used by software to reset NMI enable bit. Default value of NMI enable bit is "1". This bit can be reset by software only once after reset operation.

■ MPUXn_NMIEN

MPUXn_NMIEN																															
0	R0	read0	31																												
0	R0	read0	30																												
0	R0	read0	29																												
0	R0	read0	28																												
0	R0	read0	27																												
0	R0	read0	26																												
0	R0	read0	25																												
0	R0	read0	24																												
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0	R0	read0	14																												
0	R0	read0	13																												
0	R0	read0	12																												
0	R0	read0	11																												
0	R0	read0	10																												
0	R0	read0	09																												
0	R0	read0	08																												
0	R0	read0	07																												
0	R0	read0	06																												
0	R0	read0	05																												
0	R0	read0	04																												
0	R0	read0	03																												
0	R0	read0	02																												
0	R0	read0	01																												
1	RWP	NMIEN	00																												

Bit Position	Bit Field Name	Bit Description
[31:8]	read0	-
[7:1]	read0	-
[0]	NMIEN	NMI Interrupt Enable This bit decides whether the NMI interrupt flag is routed to NMI interrupt signal or not. "0": NMI interrupt flag does not trigger NMI interrupt signal "1": NMI interrupt flag triggers NMI interrupt signal The value of this bit can be changed only once after reset.

4.3. MPU AXI Write Error Control Register (MPUXn_WERRC)

This is a read-only register that provides the software the control information of AXI transaction on AXI master write address channel interface for which memory protection violation was detected. Software can read this register to get privileged mode, burst length, burst size, and burst type information of AXI transaction.

■ MPUXn_WERRC

MPUXn_WERRC																
0	R0	read0	31													
0	R0	read0	30													
0	R0	read0	29													
0	R0	read0	28													
0	R0	read0	27													
0	R0	read0	26													
0	R0	read0	25													
0	R0	read0	24													
0	R0	read0	23													
0	R0	read0	22													
0	R0	read0	21													
0	R0	read0	20													
0	R0	read0	19													
0	R0	read0	18													
0	R0	read0	17													
0	R0	read0	16													
0	R0	read0	15													
0	R0	read0	14													
0	R0	read0	13													
0	R0	read0	12													
0	R0	read0	11													
X	R	AWSIZE[2]	10													
X	R	AWSIZE[1]	09													
X	R	AWSIZE[0]	08													
X	R	AWBURST[1]	07													
X	R	AWBURST[0]	06													
X	R	AWLEN[3]	05													
X	R	AWLEN[2]	04													
X	R	AWLEN[1]	03													
X	R	AWLEN[0]	02													
X	R	AWPROTPRIV	01													
0	R	AWMPV	00													

Bit Position	Bit Field Name	Bit Description
[31:16]	read0	-
[15:11]	read0	-
[10:8]	AWSIZE	AXI Transaction Burst Size This bit provides the status of AWSIZE[2:0] signals of AXI transaction for which memory protection violation is detected.
[7:6]	AWBURST	AXI Transaction Burst Type This bit provides the status of AWBURST[1:0] signals of AXI transaction for which memory protection violation is detected.
[5:2]	AWLEN	AXI Transaction Burst Length This bit provides the status of AWLEN[3:0] signals of AXI transaction for which memory protection violation is detected.
[1]	AWPROTPRIV	AXI Transaction Privileged Mode This bit provides the status of AWPROT[0] signal of AXI transaction for which memory protection violation is detected.
[0]	AWMPV	AXI Write Memory Protection Violation This bit indicates that memory protection violation is detected on AXI write address channel. Writing "1" to MPUXn_CTRL0:NMICL bit clears AWMPV bit.

4.4. MPU AXI Write Error Address Register (MPUXn_WERRA)

This is a read-only register that provides the software the write address of AXI transaction on AXI master write address channel interface for which memory protection violation was detected.

■ MPUXn_WERRA

MPUXn_WERRA																															
X	R	AWADDR[31]	31																												
X	R	AWADDR[30]	30																												
X	R	AWADDR[29]	29																												
X	R	AWADDR[28]	28																												
X	R	AWADDR[27]	27																												
X	R	AWADDR[26]	26																												
X	R	AWADDR[25]	25																												
X	R	AWADDR[24]	24																												
X	R	AWADDR[23]	23																												
X	R	AWADDR[22]	22																												
X	R	AWADDR[21]	21																												
X	R	AWADDR[20]	20																												
X	R	AWADDR[19]	19																												
X	R	AWADDR[18]	18																												
X	R	AWADDR[17]	17																												
X	R	AWADDR[16]	16																												
X	R	AWADDR[15]	15																												
X	R	AWADDR[14]	14																												
X	R	AWADDR[13]	13																												
X	R	AWADDR[12]	12																												
X	R	AWADDR[11]	11																												
X	R	AWADDR[10]	10																												
X	R	AWADDR[9]	09																												
X	R	AWADDR[8]	08																												
X	R	AWADDR[7]	07																												
X	R	AWADDR[6]	06																												
X	R	AWADDR[5]	05																												
X	R	AWADDR[4]	04																												
X	R	AWADDR[3]	03																												
X	R	AWADDR[2]	02																												
X	R	AWADDR[1]	01																												
X	R	AWADDR[0]	00																												

Bit Position	Bit Field Name	Bit Description
[31:0]	AWADDR	AXI Write Address Write address of AXI transaction for which memory protection violation is detected.

4.5. MPU AXI Read Error Control Register (MPUXn_RERRC)

This is a read-only register that provides the software the control information of AXI transaction on AXI master read address channel interface for which memory protection violation was detected. Software can read this register to get privileged mode, burst length, burst size, and burst type information of AXI transaction.

■ MPUXn_RERRC

MPUXn_RERRC																
0	R0	read0	31													
0	R0	read0	30													
0	R0	read0	29													
0	R0	read0	28													
0	R0	read0	27													
0	R0	read0	26													
0	R0	read0	25													
0	R0	read0	24													
0	R0	read0	23													
0	R0	read0	22													
0	R0	read0	21													
0	R0	read0	20													
0	R0	read0	19													
0	R0	read0	18													
0	R0	read0	17													
0	R0	read0	16													
0	R0	read0	15													
0	R0	read0	14													
0	R0	read0	13													
0	R0	read0	12													
0	R0	read0	11													
X	R	ARSIZE[2]	10													
X	R	ARSIZE[1]	09													
X	R	ARSIZE[0]	08													
X	R	ARBURST[1]	07													
X	R	ARBURST[0]	06													
X	R	ARLEN[3]	05													
X	R	ARLEN[2]	04													
X	R	ARLEN[1]	03													
X	R	ARLEN[0]	02													
X	R	ARPROTPRIV	01													
0	R	ARMPV	00													

Bit Position	Bit Field Name	Bit Description
[31:16]	read0	-
[15:11]	read0	-
[10:8]	ARSIZE	AXI Transaction Burst Size This bit provides the status of ARSIZE[2:0] signals of AXI transaction for which memory protection violation is detected.
[7:6]	ARBURST	AXI Transaction Burst Type This bit provides the status of ARBURST[1:0] signals of AXI transaction for which memory protection violation is detected.
[5:2]	ARLEN	AXI Transaction Burst Length This bit provides the status of ARLEN[3:0] signals of AXI transaction for which memory protection violation is detected.
[1]	ARPROTPRIV	AXI Transaction Privileged Mode This bit provides the status of ARPROT[0] signal of AXI transaction for which memory protection violation is detected.
[0]	ARMPV	AXI Read Memory Protection Violation This bit indicates that memory protection violation is detected on AXI read address channel. Writing "1" to MPUXn_CTRL0:NMICL bit clears ARMPV bit.

4.6. MPU AXI Read Error Address Register (MPUXn_RERRA)

This is a read-only register that provides the software the read address of AXI transaction on AXI master read address channel interface for which memory protection violation was detected.

■ MPUXn_RERRA

MPUXn_RERRA																															
	X	R	ARADDR[31]	31																											
	X	R	ARADDR[30]	30																											
	X	R	ARADDR[29]	29																											
	X	R	ARADDR[28]	28																											
	X	R	ARADDR[27]	27																											
	X	R	ARADDR[26]	26																											
	X	R	ARADDR[25]	25																											
	X	R	ARADDR[24]	24																											
	X	R	ARADDR[23]	23																											
	X	R	ARADDR[22]	22																											
	X	R	ARADDR[21]	21																											
	X	R	ARADDR[20]	20																											
	X	R	ARADDR[19]	19																											
	X	R	ARADDR[18]	18																											
	X	R	ARADDR[17]	17																											
	X	R	ARADDR[16]	16																											
	X	R	ARADDR[15]	15																											
	X	R	ARADDR[14]	14																											
	X	R	ARADDR[13]	13																											
	X	R	ARADDR[12]	12																											
	X	R	ARADDR[11]	11																											
	X	R	ARADDR[10]	10																											
	X	R	ARADDR[9]	09																											
	X	R	ARADDR[8]	08																											
	X	R	ARADDR[7]	07																											
	X	R	ARADDR[6]	06																											
	X	R	ARADDR[5]	05																											
	X	R	ARADDR[4]	04																											
	X	R	ARADDR[3]	03																											
	X	R	ARADDR[2]	02																											
	X	R	ARADDR[1]	01																											
	X	R	ARADDR[0]	00																											

Bit Position	Bit Field Name	Bit Description
[31:0]	ARADDR	AXI Read Address Read address of AXI transaction for which memory protection violation is detected.

4.7. MPU AXI Region Control Registers (MPUXn_CTRL1 to 8)

MPU AXI Region Control Register is used to specify access permission for a particular region. Software can also use this register for enabling or disabling the particular region. MPUXn_CTRL1 Control Register for Region 1 is explained below.

■ MPUXn_CTRL1

MPUXn_CTRL1																															
0	R0	read0	31																												
0	R0	read0	30																												
0	R0	read0	29																												
0	R0	read0	28																												
0	R0	read0	27																												
0	R0	read0	26																												
0	R0	read0	25																												
0	R0	read0	24																												
0	R0	read0	23																												
0	R0	read0	22																												
0	R0	read0	21																												
0	R0	read0	20																												
0	R0	read0	19																												
0	R0	read0	18																												
0	R0	read0	17																												
0	R0	read0	16																												
0	R0	read0	15																												
0	R0	read0	14																												
0	R0	read0	13																												
0	R0	read0	12																												
0	R0	read0	11																												
0	RWP	AP[2]	10																												
0	RWP	AP[1]	09																												
0	RWP	AP[0]	08																												
0	R0	read0	07																												
0	R0	read0	06																												
0	R0	read0	05																												
0	R0	read0	04																												
0	R0	read0	03																												
0	R0	read0	02																												
0	RWP	MPUENC	01																												
0	R	MPUEN	00																												

Bit Position	Bit Field Name	Bit Description
[31:16]	read0	-
[15:11]	read0	-
[10:8]	AP	Access Permissions These bits are used to control access permissions for region 1.
[7:2]	read0	-
[1]	MPUENC	Enable Control bit "0": Memory protection for region 1 is disabled "1": Memory protection for region 1 is enabled Read returns status of MPUENC bit. The region enable status to be effective takes some delay with reference to write on MPUENC bit. The actual enable status can be read through MPUXn_CTRL1:MPUEN bit.
[0]	MPUEN	Enable Status "0": Memory protection for region 1 is disabled "1": Memory protection for region 1 is enabled This is a read-only bit, writing to this bit does not have any effect.

Notes:

- Access permission bits (i.e. MPUXn_CTRL1 to 8:AP) can only be written when corresponding region is disabled (MPUXn_CTRL1 to 8:MPUEN = "0") or MPU is disabled (MPUXn_CTRL0:MPUEN = "0").
- This also implies that when MPUXn_CTRL0:MPUEN = "1" and MPUXn_CTRL1 to 8:MPUEN = "1":
 - 32-bit or 16-bit access to this register is not allowed
 - 8-bit access is required to disable the MPU region

4.8. MPU AXI Start Address Registers (MPUXn_SADDR1 to 8)

Each region in MPU AXI can be set by specifying start address and end address for that particular region. MPUXn_SADDR1 to 8 registers are used to specify start address for eight regions. Start address indicates the first address for that region. MPUXn_SADDR1 Start Address Register for Region 1 is explained below.

■ MPUXn_SADDR1

MPUXn_SADDR1																															
0	RWP	SADDR[31]	31																												
0	RWP	SADDR[30]	30																												
0	RWP	SADDR[29]	29																												
0	RWP	SADDR[28]	28																												
0	RWP	SADDR[27]	27																												
0	RWP	SADDR[26]	26																												
0	RWP	SADDR[25]	25																												
0	RWP	SADDR[24]	24																												
0	RWP	SADDR[23]	23																												
0	RWP	SADDR[22]	22																												
0	RWP	SADDR[21]	21																												
0	RWP	SADDR[20]	20																												
0	RWP	SADDR[19]	19																												
0	RWP	SADDR[18]	18																												
0	RWP	SADDR[17]	17																												
0	RWP	SADDR[16]	16																												
0	RWP	SADDR[15]	15																												
0	RWP	SADDR[14]	14																												
0	RWP	SADDR[13]	13																												
0	RWP	SADDR[12]	12																												
0	RWP	SADDR[11]	11																												
0	RWP	SADDR[10]	10																												
0	RWP	SADDR[9]	09																												
0	RWP	SADDR[8]	08																												
0	RWP	SADDR[7]	07																												
0	RWP	SADDR[6]	06																												
0	RWP	SADDR[5]	05																												
0	RWP	SADDR[4]	04																												
0	RWP	SADDR[3]	03																												
0	RWP	SADDR[2]	02																												
0	RWP	SADDR[1]	01																												
0	RWP	SADDR[0]	00																												

Bit Position	Bit Field Name	Bit Description
[31:0]	SADDR	Start Address Start address for region 1

Note:

- MPUXn_SADDR1 to 8 registers can only be written when corresponding region is disabled (MPUXn_CTRL1 to 8:MPUEN = "0") or MPU is disabled (MPUXn_CTRL0:MPUEN = "0").

4.9. MPU AXI End Address Registers (MPUXn_EADDR1 to 8)

Each region in MPU AXI can be set by specifying start address and end address for that particular region. MPUXn_EADDR1 to 8 registers are used to specify end addresses for eight regions. End Address indicates the last address for that region. MPUXn_EADDR1 End Address Register for Region 1 is explained below.

■ MPUXn_EADDR1

MPUXn_EADDR1																															
0	RWP	EADDR[31]	31																												
0	RWP	EADDR[30]	30																												
0	RWP	EADDR[29]	29																												
0	RWP	EADDR[28]	28																												
0	RWP	EADDR[27]	27																												
0	RWP	EADDR[26]	26																												
0	RWP	EADDR[25]	25																												
0	RWP	EADDR[24]	24																												
0	RWP	EADDR[23]	23																												
0	RWP	EADDR[22]	22																												
0	RWP	EADDR[21]	21																												
0	RWP	EADDR[20]	20																												
0	RWP	EADDR[19]	19																												
0	RWP	EADDR[18]	18																												
0	RWP	EADDR[17]	17																												
0	RWP	EADDR[16]	16																												
0	RWP	EADDR[15]	15																												
0	RWP	EADDR[14]	14																												
0	RWP	EADDR[13]	13																												
0	RWP	EADDR[12]	12																												
0	RWP	EADDR[11]	11																												
0	RWP	EADDR[10]	10																												
0	RWP	EADDR[9]	09																												
0	RWP	EADDR[8]	08																												
0	RWP	EADDR[7]	07																												
1	RWP	EADDR[6]	06																												
1	RWP	EADDR[5]	05																												
1	RWP	EADDR[4]	04																												
1	RWP	EADDR[3]	03																												
1	RWP	EADDR[2]	02																												
1	RWP	EADDR[1]	01																												
1	RWP	EADDR[0]	00																												

Bit Position	Bit Field Name	Bit Description
[31:0]	EADDR	End Address End address for region 1

Note:

- MPUXn_EADDR1 to 8 registers can only be written when corresponding region is disabled (MPUXn_CTRL1 to 8:MPUEN = "0") or MPU is disabled (MPUXn_CTRL0:MPUEN = "0").

4.10. MPU AXI Unlock Register (MPUXn_UNLOCK)

The software can use this register to lock or unlock the MPU AXI registers for write access.

■ MPUXn_UNLOCK

MPUXn_UNLOCK			
0	R0WP	UNLOCK[31]	31
0	R0WP	UNLOCK[30]	30
0	R0WP	UNLOCK[29]	29
0	R0WP	UNLOCK[28]	28
0	R0WP	UNLOCK[27]	27
0	R0WP	UNLOCK[26]	26
0	R0WP	UNLOCK[25]	25
0	R0WP	UNLOCK[24]	24
0	R0WP	UNLOCK[23]	23
0	R0WP	UNLOCK[22]	22
0	R0WP	UNLOCK[21]	21
0	R0WP	UNLOCK[20]	20
0	R0WP	UNLOCK[19]	19
0	R0WP	UNLOCK[18]	18
0	R0WP	UNLOCK[17]	17
0	R0WP	UNLOCK[16]	16
0	R0WP	UNLOCK[15]	15
0	R0WP	UNLOCK[14]	14
0	R0WP	UNLOCK[13]	13
0	R0WP	UNLOCK[12]	12
0	R0WP	UNLOCK[11]	11
0	R0WP	UNLOCK[10]	10
0	R0WP	UNLOCK[9]	09
0	R0WP	UNLOCK[8]	08
0	R0WP	UNLOCK[7]	07
0	R0WP	UNLOCK[6]	06
0	R0WP	UNLOCK[5]	05
0	R0WP	UNLOCK[4]	04
0	R0WP	UNLOCK[3]	03
0	R0WP	UNLOCK[2]	02
0	R0WP	UNLOCK[1]	01
0	R0WP	UNLOCK[0]	00

Bit Position	Bit Field Name	Bit Description
[31:0]	UNLOCK	MPU AXI Unlock The MPU AXI Unlock Register protects the MPU AXI module from being modified accidentally by software. The MPU AXI registers cannot be written until this register has been written with a specific unlock value. The correct value for unlocking can be written only in privileged mode. Reading this register always returns a zero. To lock the MPU AXI again software must write another value specific to lock. Write access to MPU AXI registers without unlocking or writing a value other than the lock or unlock values to this register causes a protection error. Notes: This register can not be written by 8-bit or 16-bit write access; any such access causes protection error. For more details on lock and unlock values, refer to the device specific datasheet.

4.11. MPU AXI Module ID Register (MPUXn_MID)

This is a read-only register with a unique module identification number which identifies the version of the MPU AXI module used in the MCU.

■ MPUXn_MID

MPUXn_MID																																		
0	R	MID[31]	31																															
0	R	MID[30]	30																															
0	R	MID[29]	29																															
0	R	MID[28]	28																															
0	R	MID[27]	27																															
0	R	MID[26]	26																															
0	R	MID[25]	25																															
0	R	MID[24]	24																															
0	R	MID[23]	23																															
0	R	MID[22]	22																															
0	R	MID[21]	21																															
0	R	MID[20]	20																															
0	R	MID[19]	19																															
0	R	MID[18]	18																															
0	R	MID[17]	17																															
0	R	MID[16]	16																															
0	R	MID[15]	15																															
0	R	MID[14]	14																															
0	R	MID[13]	13																															
0	R	MID[12]	12																															
0	R	MID[11]	11																															
0	R	MID[10]	10																															
0	R	MID[9]	09																															
0	R	MID[8]	08																															
0	R	MID[7]	07																															
0	R	MID[6]	06																															
0	R	MID[5]	05																															
0	R	MID[4]	04																															
0	R	MID[3]	03																															
0	R	MID[2]	02																															
0	R	MID[1]	01																															
0	R	MID[0]	00																															

Bit Position	Bit Field Name	Bit Description
[31:0]	MID	Module ID The MPU AXI module implemented in the device may vary from device to device. This register identifies the particular version of the hardware used in the device. This register helps in developing software to hardware version implemented in the device

5. Notes on Using MPU AXI

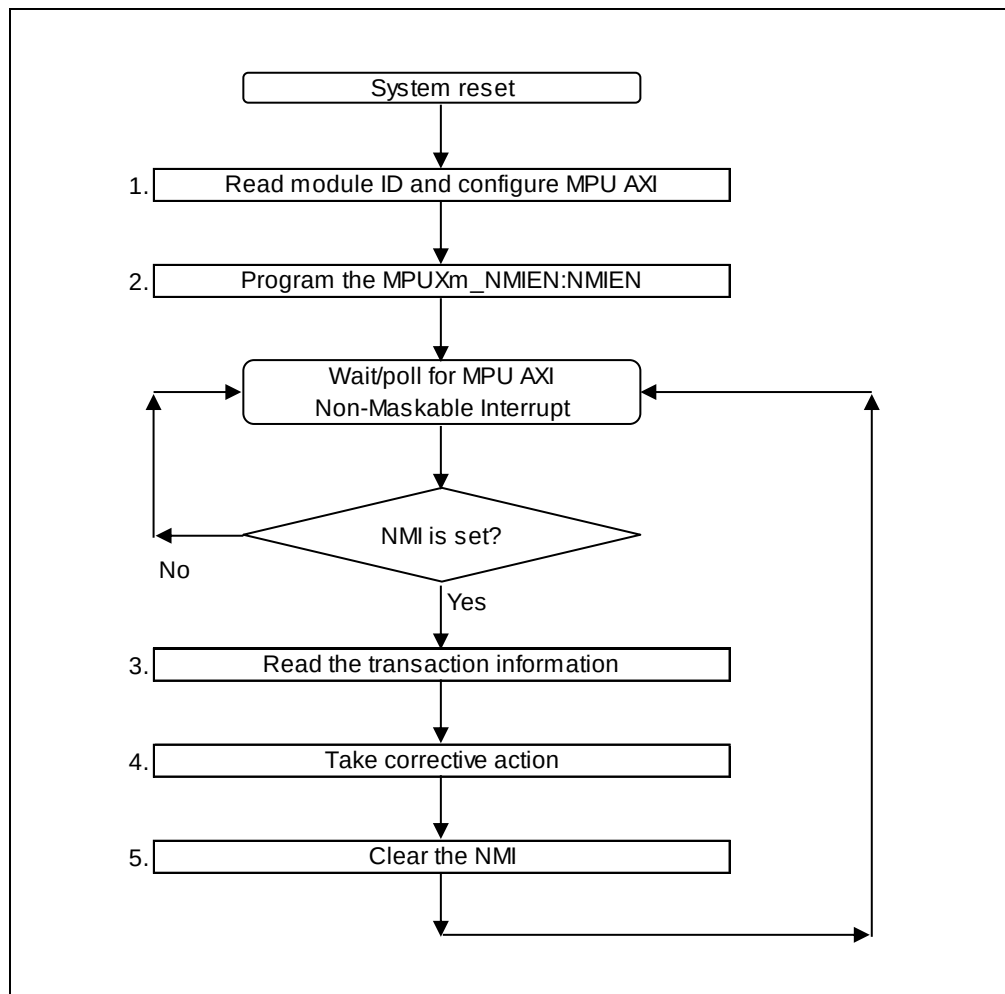
This section is the "programmer's guide", which lists the usage notes for programming the MPU AXI module. It is recommended to read these guidelines before programming the MPU AXI module.

■ General Usage Notes

- Reserved bits return undefined values. The software programs shall be independent of the values read from the reserved register bits
- The MPU AXI supports storage of information of first memory protection violation on the bus. Therefore, once an NMI interrupt flag is set, the further monitoring of AXI master interface is stalled until MPUXn_CTRL0:NMI bit is cleared. This implies that any protection violation occurring on the bus while the MPUXn_CTRL0:NMI is set are simply ignored by MPU AXI. Software developers must therefore try to keep the ISR size small, so that the NMI interrupt of MPU AXI does not remain unattended for long

■ Steps in Programming the MPU AXI Module

Figure 5-1 Programmer's Flowchart



1. After the system reset, the software detects the module ID number of MPU AXI, by reading the MPUXn_MID register. This helps it in identifying the attributes and capabilities supported by the MPU AXI module. Then the software configures MPU AXI by setting appropriate registers.

2. By default, MPU AXI propagates the MPUXn_CTRL0:NMI flag to the CPU through the Interrupt Controller. If polling mode is desired, the software can reset the MPUXn_NMIEN:NMIEN bit to "0".

Note:

- *The MPUXn_NMIEN:NMIEN can be written only once after reset. Subsequent write accesses to this bit have no visible impact on the state of this bit.*

3. When the NMI is triggered or is in polling mode, if the software detects during its polling cycle that the MPUXn_CTRL0:NMI status flag is set, the CPU is invoked. This would read the status information collected and stored by MPU AXI in its CSR.

4. The software diagnoses the information about the transaction for which memory protection violation was detected and initiates a corrective action (if any).

5. Once the software has processed the information from the status registers, it shall clear the MPUXn_CTRL0:NMI flag by writing a "1" to the MPUXn_CTRL0:NMICL bit. Clearing MPUXn_CTRL0:NMI flag ensures that the MPU AXI starts monitoring the AXI master interfaces again for checking memory protection violation.

Note:

- *Software may clear the NMI flag before taking corrective action, hence steps 4 and 5 can be interchanged.*

CHAPTER 31: Memory Protection Unit for AHB



This chapter explains the function and operation of the Memory Protection Unit for the AMBA Advanced High Speed Bus (MPU AHB) in the Next Generation Microcontrollers.

1. Overview
2. Configuration and Block Diagram
3. Operation of the MPU AHB
4. Registers
5. Notes on Using the MPU AHB

CODE: MPUAHB-S6J3200-E1

1. Overview

This section describes the features of the MPU AHB.

■ Features of MPU AHB

The MPU AHB module monitors the accesses from AHB Masters and checks each access against an authorized set of Access Permissions. Access Permissions (known as "permission attributes" from here onwards) are defined by Access Permissions (AP) bits. These AP bits are explained in Section MPU access permissions.

The MPU AHB provides eight regions and one background region. Each region has corresponding Access Permission bits that define the permission attributes for that particular region. Any unauthorized access to that memory space is flagged using a non-maskable interrupt. MPU AHB also collects information about unauthorized bus access and stores it in its internal registers.

The features of the MPU AHB module are listed in this section:

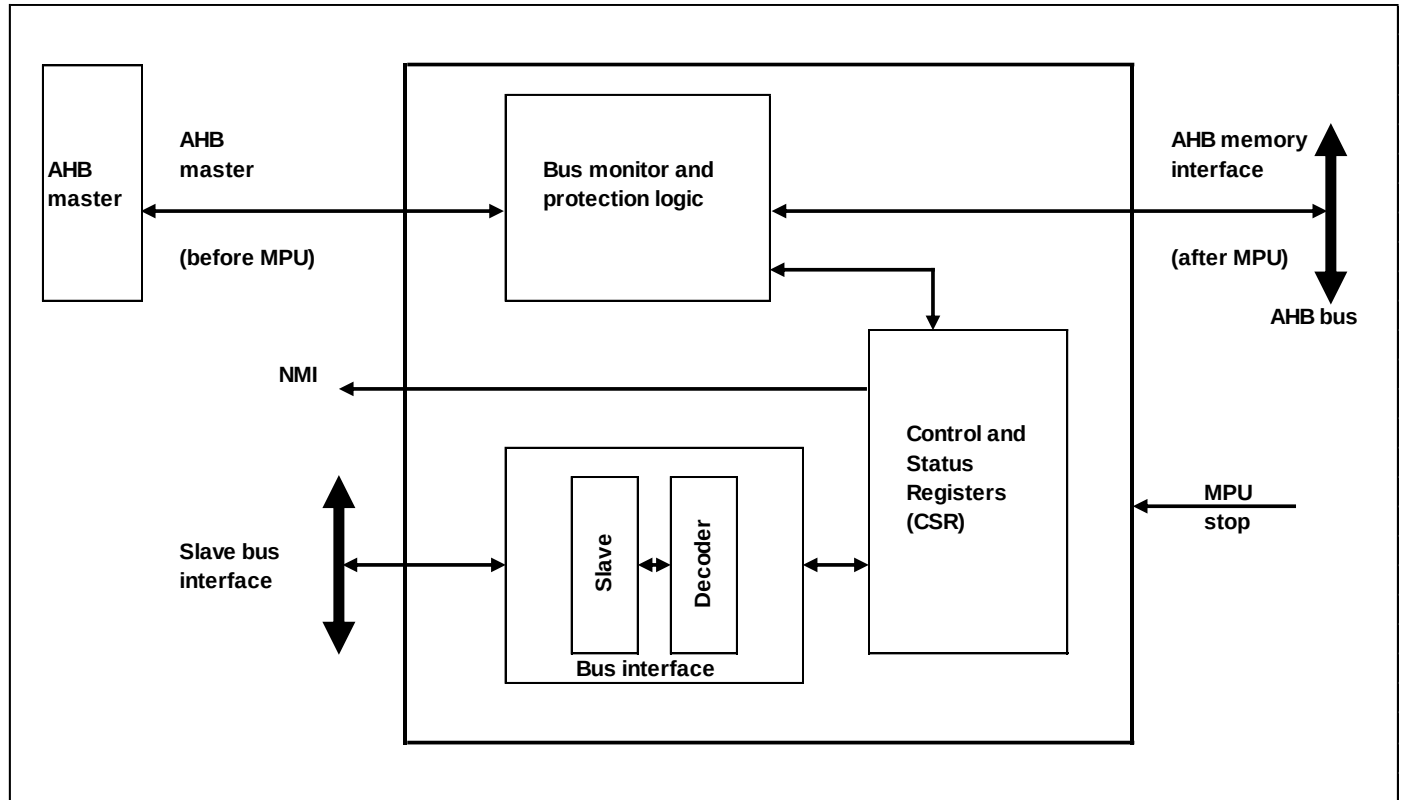
- Each of the eight regions in MPU AHB is specified using corresponding start address and end address
- The background region covers the entire 4GB address space
- With an unauthorized access, the MPU AHB generates an NMI to the CPU
- The MPU AHB collects information about the AHB Master bus access that caused the unauthorized access
- It supports 8-, 16- and 32-bit bus accesses for the configuration of the MPU AHB registers
- It supports lock and unlock feature to protect registers from illegal write accesses
- The modification of registers in the MPU AHB is only allowed in privileged mode
- MPU AHB registers can be written only after execution of the unlock sequence
- It supports an MPU STOP feature that allows blocking of all the accesses to memory space
- It optionally supports a privileged mode overwrite feature that allows the privilege attribute of the memory side AHB interface to be overwritten

2. Configuration and Block Diagram

This section shows a block diagram of the MPU AHB

■ Block Diagram of the MPU AHB

Figure 2-1 Block Diagram of MPU AHB



■ Bus Interface

The bus masters can access the MPU AHB module through its slave bus interface.

■ Bus Monitor and Protection Logic

This logic monitors the transfers on AHB master interface bus. It finds out the region/s where the current transfer belongs to and then applies permissions based on the region match. It signals any permission violation using an NMI interrupt. All transfers on the AHB Master Interface (including the one that caused permission violation) are blocked until the NMI is cleared.

■ Control and Status Registers

The operation of the MPU AHB can be controlled and monitored through its Control and Status Registers (CSR).

3. Operation of the MPU AHB

This section describes the operation of the MPU AHB

■ MPU AHB Region Granularity and Priority Decision

The MPU AHB supports up to 8 regions and provides the start and end addresses for each of these eight regions. MPU AHB regions are defined with a granularity of 32 bytes.

Each region is identified as Region 1, Region 2, Region 3 and so on up to Region 8, which is given highest priority. Region 7 has second highest priority and so on down to Region 1, which has the second lowest priority. The Background Region is designated the lowest priority region.

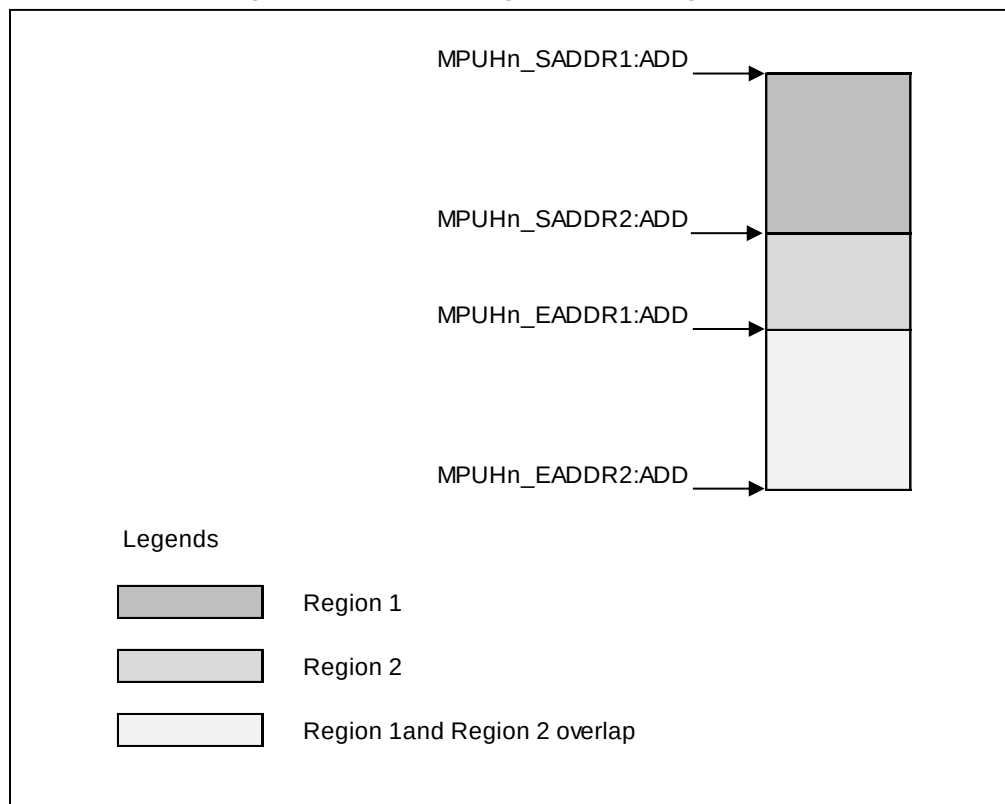
The Start Address specifies the first address of the region and is specified by registers MPUHn_SADDR1 to MPUHn_SADDR8 for region 1 to region 8 respectively. Since the region granularity is 32 bytes, the least significant 5 bits of the start addresses will read 0.

End Addresses are specified by registers MPUHn_EADDR1 to MPUHn_EADDR8n for region 1 to region 8 respectively. The least significant 5 bits of the End Address registers are read only bits and will always read 1. This ensures the granularity of 32 bytes.

In the MPU AHB, regions may overlap each other, as shown in Figure 3-1. Hence it is also possible that an AHB address for any transfer may match with multiple regions. Whenever the AHB Transfer Address matches with multiple regions, the permissions corresponding to the highest priority region (among all matching regions) is applied.

■ AHB Burst Monitoring

The MPU AHB only supports Single Transfer Monitoring and not AHB Burst Monitoring. Therefore, it can only be used together with AHB Masters that do not request Burst transfers.

Figure 3-1 Example Region Overlapping

■ MPU Access Permissions

Region Control registers in the MPU AHB (i.e. MPUHn_CTRL1 to MPUHn_CTRL8) are used to control the access permission to Regions 1 to 8. Also MPUHn_CTRL0 is used to control the access permission for the Background Region.

Table 3-1 Access Permissions

AP Bits	Access in Privileged Mode	Access in Non- Privileged Mode	Comment
000 (default)	No access	No access	All bus accesses are blocked and hence would generate a memory protection violation.
001	Read, write	No access	Reads and writes are permitted in privileged mode only. Any access in non- privileged mode would generate a memory protection violation.
010	Read, write	Read only	Reads and writes are permitted in privileged mode. Only reads are permitted in non-privileged mode. Writes in non- privileged mode would generate a memory protection violation.
011	Read, write	Read, write	All bus transfers are permitted. No memory protection violation is generated in this mode.
100	No access	No access	All bus accesses are blocked and hence generate a memory protection violation.
101	Read only	No access	Reads are permitted in privileged mode only. Writes in privileged mode and any access in non-privileged mode would generate a memory protection violation.
110	Read only	Read only	Reads are permitted in privileged as well as non-privileged mode. Any write access would generate a memory protection violation.
111	Read, write	Read, write	All bus transfers are permitted. No memory protection violation is generated in this mode.

■ Bus Monitor and Protection Logic

All transfers on the AHB Master Interface are monitored and checked for permitted access.

- Bus monitor and protection logic within the MPU AHB compares the address of the current transfer with the start and end addresses of each region to find a region match, i.e. where the current transfer matches one of the eight defined regions
- As explained in Section "MPU AHB region granularity and priority decision", the AHB transfer address may match multiple regions where the permission attributes of the region with highest priority are checked against the attributes of the currently applied transfer from the AHB master
- If the attributes of the currently applied transfer are within the permitted attributes, the current transaction is passed on to the AHB memory interface
- If the attributes are not within permitted attributes, the current transfer is blocked. The Non-Maskable Interrupt flag (MPUHN_CTRL0:NMI) is set. The address and control information of the current transfer is stored in MPUHN_MERRA and MPUHN_MERRC respectively
- All further transfers are blocked until the MPUHN_CTRL0:NMI flag is cleared by software. Further monitoring of the AHB transfer addresses is also stalled until the MPUHN_CTRL0:NMI flag is cleared.

When a transfer is blocked, the MPU AHB performs the following actions:

- It drives idle transfers on the AHB memory interface
- It generates an error response on the AHB master interface

■ MPU STOP Feature

Optionally the MPU AHB supports an MPU STOP feature.

When this mode is enabled, all accesses to memory space are blocked and the MPU AHB performs the following actions:

- It drives idle transfers on the AHB memory interface
- It generates an error response on the AHB master interface

■ Privileged Mode Overwrite Feature

Optionally the MPU AHB supports privileged mode overwrite feature.

When this mode is enabled, the privileged mode attribute on the AHB memory interface is set by setting the MPUHN_CTRL0:PROT bit

Note:

Bus monitor and protection logic for detecting memory protection violation uses the privileged mode attribute on the AHB master interface and not the MPUHN_CTRL0:PROT bit, even when the privileged mode overwrite feature is enabled.

4. Registers

This section describes the registers of the MPU AHB

The MPU AHB module contains various registers to configure its operation, to monitor its status and to read the information it has collected from the AHB master interface at the time of a memory protection violation.

The MPU AHB module is allocated 1 KB of MCU address space for mapping the Configuration and Status Registers (CSRs). The address area allocated to the MPU AHB and the CSRs in the MPU AHB are explained in this section.

The suffix 'n' in the register name indicates that the register is an instance 'n' of the module.

■ Registers of MPU AHB

The following registers are available for the MPU AHB:

- MPU AHB Control Register (MPUHn_CTRL0)
- MPU AHB NMI Enable Register (MPUHn_NMIEN)
- MPU AHB Memory Error Control Register (MPUHn_MERRC)
- MPU AHB Memory Error Address Register (MPUHn_MERRA)
- MPU AHB Region Control Registers (MPUHn_CTRL1 to 8)
- MPU AHB Start Address Registers (MPUHn_SADDR1 to 8)
- MPU AHB End Address Registers (MPUHn_EADDR1 to 8)
- MPU AHB Unlock Register (MPUHn_UNLOCK)
- MPU AHB Module ID Register (MPUHn_MID)

■ Memory Layout of MPU AHB Registers

Offset	+3	+2	+1	+0
0x00000000	MPUHn_CTRL0 00000000 00000000 00000001 00000000			
0x00000004	MPUHn_NMIEN 00000000 00000000 00000000 00000001			
0x00000008	MPUHn_MERRC 00000000 00000000 00000000 00000000			
0x0000000C	MPUHn_MERRA 00000000 00000000 00000000 00000000			
0x00000010	MPUHn_CTRL1 00000000 00000000 00000000 00000000			
0x00000014	MPUHn_SADDR1 00000000 00000000 00000000 00000000			
0x00000018	MPUHn_EADDR1 00000000 00000000 00000000 00011111			
0x0000001C	MPUHn_CTRL2 00000000 00000000 00000000 00000000			
0x00000020	MPUHn_SADDR2 00000000 00000000 00000000 00000000			
0x00000024	MPUHn_EADDR2 00000000 00000000 00000000 00011111			

Offset	+3	+2	+1	+0
0x00000028	MPUHn_CTRL3 00000000 00000000 00000000 00000000			
0x0000002C	MPUHn_SADDR3 00000000 00000000 00000000 00000000			
0x00000030	MPUHn_EADDR3 00000000 00000000 00000000 00011111			
0x00000034	MPUHn_CTRL4 00000000 00000000 00000000 00000000			
0x00000038	MPUHn_SADDR4 00000000 00000000 00000000 00000000			
0x0000003C	MPUHn_EADDR4 00000000 00000000 00000000 00011111			
0x00000040	MPUHn_CTRL5 00000000 00000000 00000000 00000000			
0x00000044	MPUHn_SADDR5 00000000 00000000 00000000 00000000			
0x00000048	MPUHn_EADDR5 00000000 00000000 00000000 00011111			
0x0000004C	MPUHn_CTRL6 00000000 00000000 00000000 00000000			
0x00000050	MPUHn_SADDR6 00000000 00000000 00000000 00000000			
0x00000054	MPUHn_EADDR6 00000000 00000000 00000000 00011111			
0x00000058	MPUHn_CTRL7 00000000 00000000 00000000 00000000			
0x0000005C	MPUHn_SADDR7 00000000 00000000 00000000 00000000			
0x00000060	MPUHn_EADDR7 00000000 00000000 00000000 00011111			
0x00000064	MPUHn_CTRL8 00000000 00000000 00000000 00000000			
0x00000068	MPUHn_SADDR8 00000000 00000000 00000000 00000000			
0x0000006C	MPUHn_EADDR8 00000000 00000000 00000000 00011111			
0x00000070	MPUHn_UNLOCK 00000000 00000000 00000000 00000000			
0x00000074	MPUHn_MID 00000000 00000000 00000000 00000000			

4.1. MPU AHB Control Register (MPUHN_CTRL0)

MPU AHB Control Register can be used by the software to configure the MPU AHB. This register provides enable bit to enable the MPU AHB monitoring and protection function. It also provides permission attributes for background region. It also provides controls for enabling or disabling of privileged mode overwrite feature and MPU STOP feature. Lastly it provides status of MPU AHB lock bit and Non-Maskable Interrupt flag.

MPUHN_CTRL0																															
0	R0	read0	31																												
0	R0	read0	30																												
0	R0	read0	29																												
0	R0	read0	28																												
0	R0	read0	27																												
0	RWP	AP[2]	26																												
0	RWP	AP[1]	25																												
0	RWP	AP[0]	24																												
0	R0	read0	23																												
0	R0	read0	22																												
0	R0	read0	21																												
0	R0	read0	20																												
0	R0	read0	19																												
0	R0	read0	18																												
0	RWHP	MPUENC	17																												
0	R	MPUEN	16																												
0	R0	read0	15																												
0	R0	read0	14																												
0	R0	read0	13																												
0	RWP	PROT	12																												
0	RWP	POEN	11																												
0	RWP	MPUSTOPEN	10																												
0	R	MPUSTOP	09																												
1	R	LST	08																												
0	R0	read0	07																												
0	R0	read0	06																												
0	R0	read0	05																												
0	R0	read0	04																												
0	R0	read0	03																												
0	R0	read0	02																												
0	R0WP1	NMICL	01																												
0	R	NMI	00																												

Bit Position	Bit Field Name	Bit Description
[31:27]	read0	-
[26:24]	AP	Access Permissions for Background Region These bits are used to control access permissions for a background region. For more details about these bits, refer to Table 7.3-1. Note: AP[2:0] bits for background region can only be written when the MPU is disabled (MPUHN_CTRL0:MPUEN = "0").
[23:18]	read0	-
[17]	MPUENC	MPU AHB Enable Control "0": MPU AHB Monitoring and Protection Function is disabled "1": MPU AHB Monitoring and Protection Function is enabled Read returns "0".
[16]	MPUEN	MPU AHB Enable Status "0": MPU AHB Monitoring and Protection Function is disabled. All accesses from the AHB Master Interface are passed on to the AHB memory interface without any protection "1": MPU AHB Monitoring and Protection Function is enabled
[15:13]	read0	-
[12]	PROT	Privileged Mode Attribute When the privileged mode overwrite feature is available and POEN = "1", the privilege attribute on AHB memory interface is controlled by this bit. "0": Non-privileged mode "1": Privileged mode

Bit Position	Bit Field Name	Bit Description
[11]	POEN	Privileged Mode Overwrite Feature Enable "0": Privileged mode overwrite feature is disabled "1": Privileged mode overwrite feature is enabled Note: For availability of the privileged mode overwrite feature, refer to the device-specific datasheet.
[10]	MPUSTOPEN	Enable for MPU STOP Feature "0": MPU STOP feature is disabled "1": MPU STOP feature is enabled This bit together with MPU STOP input controls the STOP status of MPU AHB.
[9]	MPUSTOP	MPU STOP Status "0": MPU AHB is not in STOP mode "1": MPU AHB is in STOP mode (i.e. MPUSTOPEN = "1" and MPU STOP input is asserted). All accesses are blocked in this mode Note: For availability of the MPU STOP feature, refer to the device specific datasheet.
[8]	LST	MPU Lock Status "0": MPU AHB is unlocked; registers in MPU AHB can be written "1": MPU AHB is locked; no registers (other than MPUHn_UNLOCK register) in MPU AHB can be written
[7:2]	read0	-
[1]	NMICL	NMI Interrupt Clear "0": No effect "1": Clears the NMI interrupt flag Read returns "0".
[0]	NMI	NMI Interrupt Flag This interrupt flag indicates that the memory protection violation was detected for an AHB transfer.

Note:

- The register bits MPUHn_CTRL0:AP[2:0], MPUHn_CTRL0:MPUSTOPEN, MPUHm_CTRL0:POEN and MPUHn_CTRL0:PROT can only be written when the MPU is disabled (MPUHn_CTRL0:MPUEN = "0").

4.2. MPU AHB NMI Enable Register (MPUHN_NMIEN)

MPU AHB NMI Enable Register can be used by software to reset the NMI enable bit. The default value of the NMI enable bit is 1. This bit can be reset by software only once after a reset operation.

MPUHN_NMIEN																															
0	R0	read0	31																												
0	R0	read0	30																												
0	R0	read0	29																												
0	R0	read0	28																												
0	R0	read0	27																												
0	R0	read0	26																												
0	R0	read0	25																												
0	R0	read0	24																												
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0	R0	read0	09																												
0	R0	read0	08																												
0	R0	read0	07																												
0	R0	read0	06																												
0	R0	read0	05																												
0	R0	read0	04																												
0	R0	read0	03																												
0	R0	read0	02																												
0	R0	read0	01																												
1	RWP	NMIEN	00																												

Bit Position	Bit Field Name	Bit Description
[31:8]	read0	-
[7:1]	read0	-
[0]	NMIEN	NMI Interrupt Enable This bit decides whether the NMI interrupt flag is routed to an NMI interrupt signal or not. "0": NMI interrupt flag does not trigger an NMI interrupt signal "1": NMI interrupt flag triggers an NMI interrupt signal The value of this bit can be changed only once after reset.

4.3. MPU AHB Memory Error Control Register (MPUHN_MERRC)

This is a read-only register that provides the control information of AHB transfer for which memory protection violation was detected. This register can be read to get the privileged mode and transfer mode (write/read) information of the AHB transfer.

MPUHn_MERRC																																		
	0	R0	read0	31																														
	0	R0	read0	30																														
	0	R0	read0	29																														
	0	R0	read0	28																														
	0	R0	read0	27																														
	0	R0	read0	26																														
	0	R0	read0	25																														
	0	R0	read0	24																														
	0	R0	read0	23																														
	0	R0	read0	22																														
	0	R0	read0	21																														
	0	R0	read0	20																														
	0	R0	read0	19																														
	0	R0	read0	18																														
	0	R0	read0	17																														
	0	R0	read0	16																														
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	0	R0	read0	12																														
	0	R0	read0	11																														
	0	R0	read0	10																														
	0	R0	read0	09																														
	0	R0	read0	08																														
	0	R0	read0	07																														
	0	R0	read0	06																														
	0	R0	read0	05																														
	0	R0	read0	04																														
	0	R0	read0	03																														
	0	R0	read0	02																														
	0	R	HPROT	01																														
	0	R	HWRITE	00																														

Bit Position	Bit Field Name	Bit Description
[31:8]	read0	-
[7:2]	read0	-
[1]	HPROT	AHB Transfer Privileged Mode. This bit provides the status of the HPROT signal of the AHB transfer for which memory protection violation is detected.
[0]	HWRITE	AHB Transfer Mode. This bit provides the status of the HWRITE signal of the AHB transfer for which memory protection violation is detected.

4.4. MPU AHB Memory Error Address Register (MPU_{Hn}_MERRA)

This is a read-only register that provides the address of AHB transfer for which memory protection violation was detected.

MPUHn_MERRA																																		
	0	R	HADDR[31]	31																														
	0	R	HADDR[30]	30																														
	0	R	HADDR[29]	29																														
	0	R	HADDR[28]	28																														
	0	R	HADDR[27]	27																														
	0	R	HADDR[26]	26																														
	0	R	HADDR[25]	25																														
	0	R	HADDR[24]	24																														
	0	R	HADDR[23]	23																														
	0	R	HADDR[22]	22																														
	0	R	HADDR[21]	21																														
	0	R	HADDR[20]	20																														
	0	R	HADDR[19]	19																														
	0	R	HADDR[18]	18																														
	0	R	HADDR[17]	17																														
	0	R	HADDR[16]	16																														
	0	R	HADDR[15]	15																														
	0	R	HADDR[14]	14																														
	0	R	HADDR[13]	13																														
	0	R	HADDR[12]	12																														
	0	R	HADDR[11]	11																														
	0	R	HADDR[10]	10																														
	0	R	HADDR[9]	09																														
	0	R	HADDR[8]	08																														
	0	R	HADDR[7]	07																														
	0	R	HADDR[6]	06																														
	0	R	HADDR[5]	05																														
	0	R	HADDR[4]	04																														
	0	R	HADDR[3]	03																														
	0	R	HADDR[2]	02																														
	0	R	HADDR[1]	01																														
	0	R	HADDR[0]	00																														

Bit Position	Bit Field Name	Bit Description
[31:0]	HADDR	AHB Address. The address of an AHB transfer for which memory protection violation was detected.

4.5. MPU AHB Region Control Registers (MPUHN_CTRL1 to 8)

MPU AHB Region Control Register is used to specify access permission for a particular region. Software can also use this register for enabling or disabling the particular region. MPUHN_CTRL1 Control Register for Region 1 is explained below.

Refer to the device-specific datasheet for the number of regions available.

MPUHN_CTRL1																															
0	R0	read0	31																												
0	R0	read0	30																												
0	R0	read0	29																												
0	R0	read0	28																												
0	R0	read0	27																												
0	R0	read0	26																												
0	R0	read0	25																												
0	R0	read0	24																												
0	R0	read0	23																												
0	R0	read0	22																												
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0	R0	read0	18																												
0	R0	read0	17																												
0	R0	read0	16																												
0	R0	read0	15																												
0	R0	read0	14																												
0	R0	read0	13																												
0	R0	read0	12																												
0	R0	read0	11																												
0	RWP	API[2]	10																												
0	RWP	API[1]	09																												
0	RWP	API[0]	08																												
0	R0	read0	07																												
0	R0	read0	06																												
0	R0	read0	05																												
0	R0	read0	04																												
0	R0	read0	03																												
0	R0	read0	02																												
0	R0WP	MPUENC	01																												
0	R	MPUEN	00																												

Bit Position	Bit Field Name	Bit Description
[31:16]	read0	-
[15:11]	read0	-
[10:8]	AP	Access Permissions These bits are used to control access permissions for region 1. For a detailed description of these bits refer to Table 7.3-1.
[7:2]	read0	-
[1]	MPUENC	Enable Control "0": Memory Protection for region 1 is disabled "1": Memory Protection for region 1 is enabled Read returns "0". The enable status of the region can be read through the MPUHN_CTRL1:MPUEN bit.
[0]	MPUEN	Enable Status "0": Memory Protection for region 1 is disabled "1": Memory Protection for region 1 is enabled This is a read-only bit; writing to this bit has no effect.

Note:

For all eight MPU AHB Region Control registers, the Access Permission bits (i.e. MPUHN_CTRL1 to 8:AP) can only be written when the corresponding region is disabled (i.e. MPUHN_CTRL1 to 8:MPUEN = "0") or the MPU is disabled (MPUHN_CTRL0:MPUEN = "0"). This also implies that when MPUHN_CTRL0:MPUEN = "1" and MPUHN_CTRL1 to 8:MPUEN = "1":

- 32- or 16-bit access to this register is not allowed
- 8-bit access is required to disable the MPU

4.6. MPU AHB Start Address Registers (MPUHN_SADDR1 to 8)

Each region in MPU AHB can be defined by specifying the start address and end address for that particular region. The MPUHN_SADDR1 to 8 registers are used to specify the start address for the eight regions. The start address indicates the first address for that region. MPUHN_SADDR1 is the Start Address Register for Region 1 and is explained below. Refer to the device-specific datasheet for the number of regions available .

MPUHN_SADDR1				
0	RWP	SADDR[31]	31	
0	RWP	SADDR[30]	30	
0	RWP	SADDR[29]	29	
0	RWP	SADDR[28]	28	
0	RWP	SADDR[27]	27	
0	RWP	SADDR[26]	26	
0	RWP	SADDR[25]	25	
0	RWP	SADDR[24]	24	
0	RWP	SADDR[23]	23	
0	RWP	SADDR[22]	22	
0	RWP	SADDR[21]	21	
0	RWP	SADDR[20]	20	
0	RWP	SADDR[19]	19	
0	RWP	SADDR[18]	18	
0	RWP	SADDR[17]	17	
0	RWP	SADDR[16]	16	
0	RWP	SADDR[15]	15	
0	RWP	SADDR[14]	14	
0	RWP	SADDR[13]	13	
0	RWP	SADDR[12]	12	
0	RWP	SADDR[11]	11	
0	RWP	SADDR[10]	10	
0	RWP	SADDR[9]	09	
0	RWP	SADDR[8]	08	
0	RWP	SADDR[7]	07	
0	RWP	SADDR[6]	06	
0	RWP	SADDR[5]	05	
0	R0	SADDR[4]	04	
0	R0	SADDR[3]	03	
0	R0	SADDR[2]	02	
0	R0	SADDR[1]	01	
0	R0	SADDR[0]	00	

Bit Position	Bit Field Name	Bit Description
[31:0]	SADDR	Start Address Start address for region 1

Note:

The MPUHN_SADDR1 to 8 registers can only be written when the corresponding region is disabled (MPUHN_CTRL1 to 8:MPUEN = "0") or the MPU is disabled (MPUHN_CTRL0:MPUEN = "0").

4.7. MPU AHB End Address Registers (MPUHN_EADDR1 to 8)

Each region in MPU AHB can be defined by specifying a start address and end address for that particular region. MPUHN_EADDR1 to 8 registers are used to specify the end addresses for the eight regions. The end address indicates the last address for that region. The MPUHN_EADDR1 End Address Register for Region 1 is explained below. Refer to the device-specific datasheet for the number of regions available.

MPUHN_EADDR1			
0	RWP	EADDR[31]	31
0	RWP	EADDR[30]	30
0	RWP	EADDR[29]	29
0	RWP	EADDR[28]	28
0	RWP	EADDR[27]	27
0	RWP	EADDR[26]	26
0	RWP	EADDR[25]	25
0	RWP	EADDR[24]	24
0	RWP	EADDR[23]	23
0	RWP	EADDR[22]	22
0	RWP	EADDR[21]	21
0	RWP	EADDR[20]	20
0	RWP	EADDR[19]	19
0	RWP	EADDR[18]	18
0	RWP	EADDR[17]	17
0	RWP	EADDR[16]	16
0	RWP	EADDR[15]	15
0	RWP	EADDR[14]	14
0	RWP	EADDR[13]	13
0	RWP	EADDR[12]	12
0	RWP	EADDR[11]	11
0	RWP	EADDR[10]	10
0	RWP	EADDR[9]	09
0	RWP	EADDR[8]	08
0	RWP	EADDR[7]	07
0	RWP	EADDR[6]	06
0	RWP	EADDR[5]	05
1	R1	EADDR[4]	04
1	R1	EADDR[3]	03
1	R1	EADDR[2]	02
1	R1	EADDR[1]	01
1	R1	EADDR[0]	00

Bit Position	Bit Field Name	Bit Description
[31:0]	EADDR	End Address End address for region 1

Note:

MPUHN_EADDR1 to 8 registers can only be written when the corresponding region is disabled (MPUHN_CTRL1 to 8:MPUEN = "0") or the MPU is disabled (MPUHN_CTRL0:MPUEN = "0").

4.8. MPU AHB Unlock Register (MPUHN_UNLOCK)

The software can use this register to lock or unlock the MPU AHB registers for write access.

MPUHN_UNLOCK																																		
0	R0WP	UNLOCK[31]	31																															
0	R0WP	UNLOCK[30]	30																															
0	R0WP	UNLOCK[29]	29																															
0	R0WP	UNLOCK[28]	28																															
0	R0WP	UNLOCK[27]	27																															
0	R0WP	UNLOCK[26]	26																															
0	R0WP	UNLOCK[25]	25																															
0	R0WP	UNLOCK[24]	24																															
0	R0WP	UNLOCK[23]	23																															
0	R0WP	UNLOCK[22]	22																															
0	R0WP	UNLOCK[21]	21																															
0	R0WP	UNLOCK[20]	20																															
0	R0WP	UNLOCK[19]	19																															
0	R0WP	UNLOCK[18]	18																															
0	R0WP	UNLOCK[17]	17																															
0	R0WP	UNLOCK[16]	16																															
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0	R0WP	UNLOCK[12]	12																															
0	R0WP	UNLOCK[11]	11																															
0	R0WP	UNLOCK[10]	10																															
0	R0WP	UNLOCK[9]	09																															
0	R0WP	UNLOCK[8]	08																															
0	R0WP	UNLOCK[7]	07																															
0	R0WP	UNLOCK[6]	06																															
0	R0WP	UNLOCK[5]	05																															
0	R0WP	UNLOCK[4]	04																															
0	R0WP	UNLOCK[3]	03																															
0	R0WP	UNLOCK[2]	02																															
0	R0WP	UNLOCK[1]	01																															
0	R0WP	UNLOCK[0]	00																															

Bit Position	Bit Field Name	Bit Description
[31:0]	UNLOCK	MPU AHB Unlock The MPU AHB Unlock Register protects the MPU AHB module from being modified accidentally by software. The MPU AHB registers cannot be written until this register has been written with a specific unlock value. The correct value for unlocking can be written only in privileged mode. Reading this register always returns "0". To lock the MPU AHB again software must write another value specific to lock. A write access to the MPU AHB registers without unlocking or writing value other than the lock or unlock value to this register causes a protection error. Notes: This register cannot be written by an 8- or 16-bit write access; any such access causes a protection error. For more details on the lock and unlock values, refer to the device- specific datasheet.

4.9. MPU AHB Module ID Register (MPU_{Hn}_MID)

This is a read-only register with a unique module identification number which identifies the version of the MPU AHB module used in the MCU. Refer to the device-specific datasheet for the module identification number of the MPU AHB module.

■ MPU AHB Module ID Register (MPU_{Hn}_MID)

MPUH _n _MID																																		
0	R	MID[31]	31																															
0	R	MID[30]	30																															
0	R	MID[29]	29																															
0	R	MID[28]	28																															
0	R	MID[27]	27																															
0	R	MID[26]	26																															
0	R	MID[25]	25																															
0	R	MID[24]	24																															
0	R	MID[23]	23																															
0	R	MID[22]	22																															
0	R	MID[21]	21																															
0	R	MID[20]	20																															
0	R	MID[19]	19																															
0	R	MID[18]	18																															
0	R	MID[17]	17																															
0	R	MID[16]	16																															
0	R	MID[15]	15																															
0	R	MID[14]	14																															
0	R	MID[13]	13																															
0	R	MID[12]	12																															
0	R	MID[11]	11																															
0	R	MID[10]	10																															
0	R	MID[9]	09																															
0	R	MID[8]	08																															
0	R	MID[7]	07																															
0	R	MID[6]	06																															
0	R	MID[5]	05																															
0	R	MID[4]	04																															
0	R	MID[3]	03																															
0	R	MID[2]	02																															
0	R	MID[1]	01																															
0	R	MID[0]	00																															

Bit Position	Bit Field Name	Bit Description
[31:0]	MID	Module ID The MPU AHB module implemented in the device may vary from device to device. This register identifies the particular version of the hardware used in the device. This register helps in developing the software to hardware version implemented in the device Note: For more details refer to the device-specific datasheet for the Module ID number.

5. Notes on Using the MPU AHB

This section is the "Programmer's Guide", which lists the usage notes for programming the MPU AHB module. Please read these guidelines before programming the module.

■ General Usage Notes

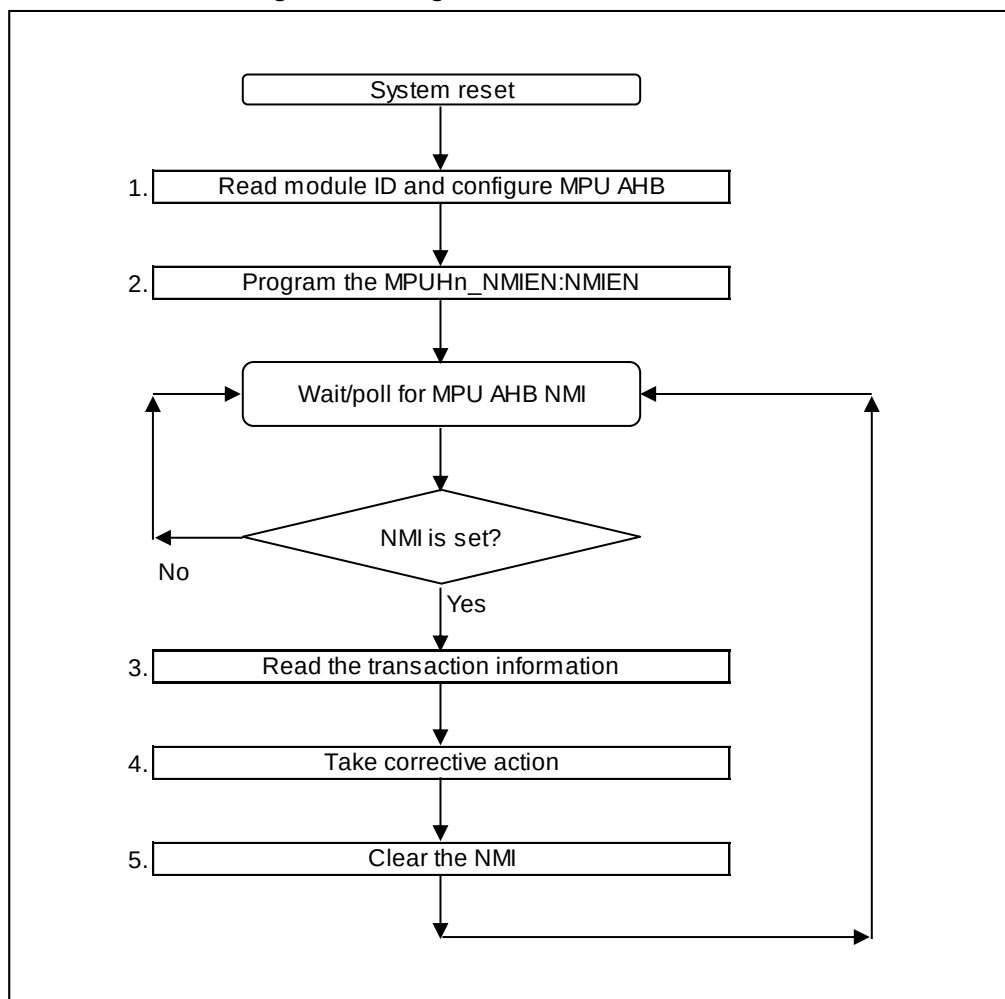
- Reserved bits return undefined values. The software programs shall be independent of the values read from the reserved register bits
- The MPU AHB supports storage of information of the first memory protection violation only on the bus. Therefore, once an NMI interrupt flag is set, further monitoring of the AHB master interface is stalled until the MPUHn_CTRL0:NMI bit is cleared. This implies that any memory protection violation occurring on the bus while the MPUHn_CTRL0:NMI is set is simply ignored by the MPU AHB

Note:

- Software developers must therefore try to keep the ISR size small so that the NMI interrupt of the MPU AHB does not remain unattended for long.

■ Steps in Programming the MPU AHB Module

Figure 5-1 Programmer's Flowchart



1. After the system reset, the software detects the module ID number of the MPU AHB by reading the MPUHn_MID register. This helps it in identifying the attributes and capabilities supported by the MPU AHB module. The software then configures the MPU AHB by setting the appropriate registers.
2. By default, the MPU AHB propagates the MPUHn_CTRL0:NMI flag to the CPU through the Interrupt Controller. If polling mode is desired, the software can reset the MPUHn_NMIEN:NMIEN bit to "0".

Note:

The MPUHn_NMIEN:NMIEN can be written only once after reset. Subsequent write accesses to this bit have no visible impact on the state of this bit.

3. When the NMI is triggered (or in polling mode if the software detects during its polling cycle that the MPUHn_CTRL0:NMI status flag is set), the CPU is invoked and reads the status information collected and stored by the MPU AHB in its CSR.
4. The software diagnoses the information about the protection violation transaction and initiates a corrective action (if any).
5. Once the software has processed the information from the status registers, it shall clear the MPUHn_CTRL0:NMI flag by writing "1" to the MPUHn_CTRL0:NMICL bit. Clearing the MPUHn_CTRL0:NMI flag ensures that the MPU AHB starts monitoring the AHB Master Interface again to check for memory protection violation.

Note:

- *Software may clear the NMI flag before taking corrective action; therefore steps 4 and 5 could be interchanged.*

CHAPTER 32: Graphics Subsystem



This chapter explains Graphics Subsystem.

1. Overview
2. Configuration and Block Diagram
3. Operation of the Graphics Subsystem
4. Registers
5. References

CODE: GDCSUB-S6J3200-E4

1. Overview

This section gives a brief overview of the Graphics Subsystem.

This section describes the graphics subsystem, which is built around the the 2D Graphics Core and essentially adds a bus matrix, memory interfaces and embedded video RAM to the core components for 2D rendering, display and capture control

1.1. Feature Summary

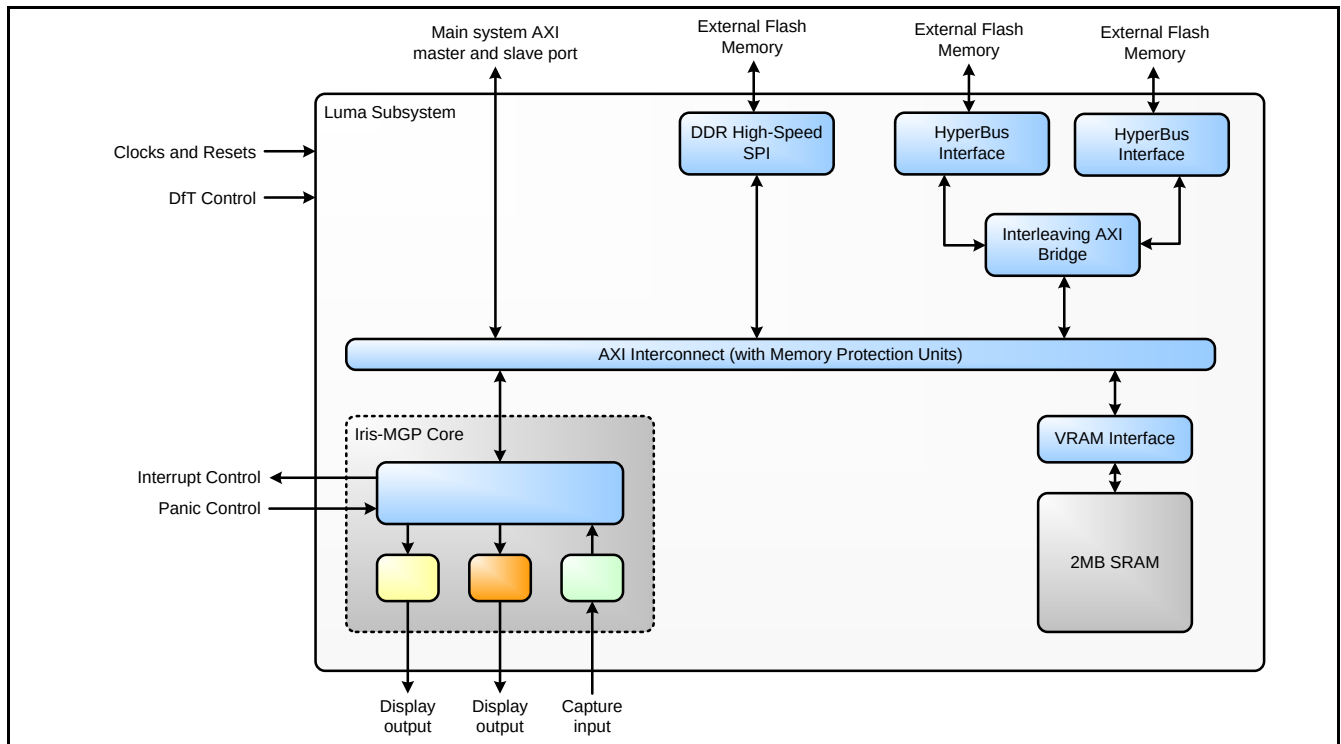
1. The 2D Graphics Core (for details see [1])
 - 2 Display Controllers for 24-bit TTL or RSDS or LVDS panels
 - 1 Capture Controller for ITU 656 or parallel RGB/YUV input
 - 1 BLIT Engine for raster graphics (2D and 2.5D)
 - 1 Drawing Engine for vector graphics (quadratic Bezier)
 - 1 Command Sequencer
 - Resolutions up to 64 MHz pixel clock (e.g. XGA @ 60 Hz)
 - Up to 200 MHz operation frequency
2. 2MB embedded video memory, optionally with error protection (ECC)
3. Memory Protection Units for all write internal bus masters
4. DDR High-Speed SPI for external flash memories (address mapped)
6. HyperBus[™] interface

2. Configuration and Block Diagram

This section shows a block diagram of Graphics Subsystem. And it gives the short descriptions about the major component of the Graphics Subsystem.

2.1. Block Diagrams

Figure 2-1 Block Diagram of the Graphics Subsystem



2.2. The 2D Graphics Core

For the detailed information of the 2D Graphics Core, refer to [1].

2.3. High Performance Bus Matrix

The modules inside the subsystem are connected each other, via local bus line. It has 64 bits data and 32 bits address width.

2.4. Memory Protection Units (MPU)

For safety reasons, access by write bus masters is protected by Memory Protection Units. For functional details of the Memory Protection Unit, refer to [3].

Affected write masters are

- Blit Engine
- Drawing Engine
- Capture Controller

The following write masters do not have an Memory Protection Units:

- Main system port;
Use the Memory Protection Unit in the main system to prevent the illegal access into the Graphics Subsystem..
- Command Sequencer –
The unit uses the port for write access to its command buffer only. The position and size of this buffer is a static configuration and protected by a lock mechanism, so there is no need for additional protection by a Memory Protection Unit.

2.5. Bus Monitor

A bus monitor observes all bus transactions in order to detect error responses. It can store the ID of the first master that received an error response and can trigger an interrupt.

This feature is particularly useful in the context of this subsystem, because the masters of the 2D Graphics Core do not implement a bus error detection, but simply ignore them.

2.6. Video RAM

The Video RAM block has the features listed below.

- 2MB embedded SRAM. And it consists of memory 8 banks.
- 64-bit data width => 1.600 MB/s peak bandwidth per port @ 200 MHz bus speed
- It has four access ports that all share the same address range; fixed mapping of all masters to one of these ports:
 - write port: All write masters
 - 1st read port: All non Display Controller read masters of the 2D Graphics Core and Main System (bandwidth sensitive)
 - 2nd read port: All Display Controller read masters of the 2D Graphics Core (bandwidth critical)
- Configurable priority for each port or Round-Robin arbitration.
- Arbitration not on burst, but single memory access level => can guarantee max possible bandwidth to certain VRAM ports
- Memory is separated into 8 banks with interleaved address access. This allows
 - Full bandwidth on all ports in parallel for ordered access patterns, i.e. 6,400 MB/s peak bandwidth in total (drops for random access patterns)
 - Operation of individual banks at half the bus clock speed only.
- Optionally ECC (Error Checking and Correction) for sub sections of the VRAM.

2.7. DDR High-Speed SPI

For the detailed information for the DDR High-Speed SPI interface, refer to [2]

2.8. HyperBus[™] Interface

For the detailed information for the HyperBus[™] interface, refer to [4].

2.9. Interrupts

As for the ID of each interrupt, please consult the specification of the interrupt controller module of embodied main system.

Table 32-1 Interrupts Generated by the Graphics Subsystem

Type	Requester	Name of the Interrupt Requested	Event (Cause)
IRQ	2D Graphics Core	CommandSequencer_2DGC	CmdSeq_Error, ComCtrl_SW0, ComCtrl_SW1
IRQ	2D Graphics Core	BlitEngine_2DGC	Store9_ShdlLoad, Store9_FrameComplete, Store9_SeqComplete
IRQ	2D Graphics Core	DrawingEngine_2DGC	DrawEng_DrawComplete, ComCtrl_SW2, ComCtrl_SW3
IRQ	2D Graphics Core	ContentStream0_2DGC	ExtDst0_ShdlLoad, ExtDst0_FrameComplete, ExtDst0_SeqComplete, FrameGen0_SecSync_On, FrameGen0_SecSync_Off, FrameGen0_Int1
IRQ	2D Graphics Core	SafetyStream0_2DGC	ExtDst4_ShdlLoad, ExtDst4_FrameComplete, ExtDst4_SeqComplete, FrameGen0_PrimSync_On, FrameGen0_PrimSync_Off, FrameGen0_Int0
IRQ	2D Graphics Core	DisplayStream0_2DGC	DisEngCfg_ShdlLoad0, DisEngCfg_FrameComplete0, DisEngCfg_SeqComplete0
IRQ	2D Graphics Core	Signature0_2DGC	Sig0_ShdlLoad, Sig0_Valid, Sig0_Error
IRQ	2D Graphics Core	Display0_Sync0_2DGC	FrameGen0_Int2
IRQ	2D Graphics Core	Display0_Sync1_2DGC	FrameGen0_Int3
IRQ	2D Graphics Core	ContentStream1_2DGC	ExtDst1_ShdlLoad, ExtDst1_FrameComplete, ExtDst1_SeqComplete, FrameGen1_SecSync_On, FrameGen1_SecSync_Off, FrameGen1_Int1
IRQ	2D Graphics Core	SafetyStream1_2DGC	ExtDst5_ShdlLoad, ExtDst5_FrameComplete, ExtDst5_SeqComplete, FrameGen1_PrimSync_On, FrameGen1_PrimSync_Off, FrameGen1_Int0
IRQ	2D Graphics Core	DisplayStream1_2DGC	DisEngCfg_ShdlLoad1, DisEngCfg_FrameComplete1, DisEngCfg_SeqComplete1
IRQ	2D Graphics Core	Signature1_2DGC	Sig1_ShdlLoad, Sig1_Valid, Sig1_Error
IRQ	2D Graphics Core	Display1_Sync0_2DGC	FrameGen1_Int2
IRQ	2D Graphics Core	Display1_Sync1_2DGC	FrameGen1_Int3
IRQ	2D Graphics Core	CapturePlane0_2DGC	Itulfc4_Error, FrameCap4_Sync_On, FrameCap4_Sync_Off
IRQ	2D Graphics Core	DisplayPlane0_2DGC	FrameDump8_Error
IRQ	2D Graphics Core	StorageStream0_2DGC	Store4_ShdlLoad, Store4_FrameComplete, Store4_SeqComplete
IRQ	2D Graphics Core	Histogram_2DGC	Histogram4_ShdlLoad, Histogram4_Valid

Type	Requester	Name of the Interrupt Requested	Event (Cause)
IRQ	DDRHSSPI interface	DDRHSSPI	DDRHSSPI_Tx, DDRHSSPI_Rx
NMI	Memory Protection Units/Bus Monitor	MemoryProtection	MPU for BlitEngine detected a violation, MPU for DrawingEngine detected a violation, MPU for StorageStream0 detected a violation, Bus Monitor detected error responses
NMI	VRAM	ECC_Single_Bit_Error_Detection	ECC single bit error detected at 1st read port, ECC single bit error detected at 2nd read port

2.10. Address Map

Offset values in the following table are relative to address space of the embodying main system.

Table 32-2 Address Map

Table Offset [Hex in Bytes]	Size [Hex in Bytes]	Description	Register Map
0000_0000	4000_0000	Main system	
4000_0000	1000_0000	External flash memory (read only; address mapped by HS-SPI or HyperBus [™] -interface module).	
5000_0000	0020_0000	2 MB internal video RAM	
5020_0000	0000_0400	SubsysCtrl	SubSysCtrl"
5020_0400	0001_0800	2D Graphics Core	See [1]
5021_0C00	0000_0400	Memory Protection Unit – Capture Controller	See [3]
5021_1000	0000_0400	Memory Protection Unit – Blit Engine	See [3]
5021_1400	0000_0400	Memory Protection Unit – Drawing Engine	See [3]
5021_1800	0000_0800	Reserved; do not use	
5021_2000	0000_0400	High-Speed HS-SPI configuration	See [2]
5021_2400	0000_0C00	Reserved; do not use	
5021_3000	0000_1000	Reserved; do not use	
5021_4000	0000_0400	Reserved; do not use.	
5021_4400	0000_0400	Bus Monitor	See "Bus Monitor"
5021_4800	0000_0800	Reserved; do not use	
5021_5000	0000_B000	Reserved; do not use.	
5022_0000	0006_0000	Reserved; do not use.	
5028_0000	0000_1000	HyperBus [™] interface Control Register	See [4]
5028_1000	0000_1000	HyperBus [™] interface Control Register	See [4]
5028_2000	0008_E000	Reserved; do not use	
5031_0000	000F_0000	Reserved; do not use.	
5040_0000	0010_0000	High Performance Bus Matrix	See "High Performance Bus Matrix"
5050_0000	00B0_0000	Reserved; do not use.	
5100_0000	0F00_0000	Hyperbus external memory	
6000_0000	A000_0000	Main system	

2.11. Key Codes

Several types of protection are available for the address blocks in the graphics subsystem.

Table 32-3 Key Codes

Name	Value	Function
lock key	0x112ABB56 (for MPUs) 0x5651F763 (for others)	Enable all access protection
unlock key	0xACCABB56 (for MPUs) 0x691DB936 (for others)	Disable all access protection
privilege key	0xAEE95CDC	Enable non-privileged access protection. Not available for MPUs.
unprivileged ley	0xB5E2466E	Disable non-privileged access protection. Not available for MPUs.
freeze key	0xFBE8B1E6	Freeze current protection status (cannot be changed any longer). Not available for MPUs.

3. Operation of the Graphics Subsystem

This section describes the operation of the Graphics Subsystem.

3.1. Common Setup

3.1.1. Configuration Register Clock Setup

The clock frequency for the configuration registers in the graphics subsystem can be setup using register field `ConfigClockSelect` in the `SubsysCtrl`. It specifies the divider used to generate the configuration clock from the High Performance Bus Matrix clock. The minimum allowed divider setting is 2 (maximum allowed configuration clock frequency is half the High Performance Bus Matrix clock frequency).

The configuration clock can be changed at any time (e.g. also when transfers are in progress), but note that configuration access bandwidth and latency are greatly influenced by this setting.

3.1.2. Display Clock Setup

There are two display clock management units available in the Subsystem Control module of the graphics subsystem. They are both identical. They contain clock measurement utility to determine the best possible clock divider for direct capture to display use cases to match the generated display clock as close as possible to the input capture clock. They also contain clock generation utility to generate the display clock from the input reference clock by using a fixed point divider. In addition the generated display clock can be shifted against the output display data to allow creation of sufficient margin for setup and hold times at the connected external device.

■ Capture Clock Measurement

In case the generated display clock should match as close as possible with the input capture clock a clock measurement utility can be used.

The capture clock must be running before the clock measurement is started for the measurement to work. Follow these steps to determine the best possible divider:

1. Write 1 to the dsp0/1_MeasurementStart register field to start the measurement.
2. Poll dsp0/1_MeasurementReady until it is 1 again.
3. Check that both dsp0/1_MeasurementNoCapClkError and dsp0/1_MeasurementSlowCapClkError are 0.
4. Read the measurement result from dsp0/1_MeasurementResult.
5. In case the 2D Graphics Core DisEngCfg ClockCtrl setting is set to DIV2 add 1/256 to the read 9.8 fixed point value and divide it by two (halved with rounding).
6. Use the obtained value to setup the display clock generation.

In case the two error fields are not both 0 check that the capture clock is running and that it has a frequency at which display clock generation is possible.

A restriction applies when using a spread spectrum reference clock. The error_constant can be taken from the following table:

Table 32-4 Error Constants Values

	Center Spread	Down Spread
Sinus modulation	4096	2048
Saw tooth modulation	8192	4096

The amplitude is the amplitude of spread spectrum modulation given in percent of clock frequency.

The sscg_frequency is the frequency of the spread spectrum modulation. The following formula must hold so that the capture clock measurement unit can be used with small enough error: $(\text{amplitude} * \text{capture_clock_frequency}) / (\text{error_constant} * \text{ssc_frequency}) \leq 0.01$.

If the capture clock itself is modulated, the capture clock measurement must not be used.

■ Display Clock Generation and Reset Control

The display clock generation can create the display clock from the input reference clock by application of a fixed point divider. To determine the best possible display clock frequency either use the clock measurement unit or divide the reference clock frequency by a multiple of 2 of the desired display clock frequency (if the 2D Graphics Core DisEngCfg ClockCtrl setting is set to DIV2) or directly by the desired display clock frequency (in case the 2D Graphics Core DisEngCfg ClockCtrl setting is set to DIV1), round this value to a fixed point with 8 decimal places and program the result to register field dsp?_ClockDivider. Then set register field dsp0/1_ClockEnable to 1 to start generation of the display clock.

The field dsp0/1_ClockDivider can be updated at any point in time (e.g. also when dsp0/1_ClockEnable is set to 1 and display clock is output). The display clock generation will then update the generated clocks frequency in such a manner that continuity of the generated display clock is guaranteed (e.g. no glitches are produced).

In addition to enabling the dsp0/1_ClockEnable setting the dsp0/1_SoftwareReset should be set to 0 to release the reset of the display logic and make it functional. Write dsp0/1_SoftwareReset to 1 only when the display engine has been completely shut down. Other use of the dsp0/1_SoftwareReset is applicable to debug purposes only.

Note that use of the generated display clock for display clock output is only allowed if the 2D Graphics Core DisEngCfg ClockCtrl setting is set to DIV2.

■ Display Clock Shift

To allow creating sufficient margin for setup and holding times at the external device the output display clock can be shifted. The `dsp0/1_ClockOffset` setting can shift the display clock up to (not including) 180 degrees in reference clock period steps. To achieve shifts larger or equal to 180 degrees the `dsp0/1_ClockInvert` setting can be used in addition to add 180 degrees to the shift achieved with `dsp0/1_ClockOffset`.

It is recommended to verify the achieved margins in setup and hold times by using e.g. an oscilloscope. Note that the generated display clock periods can jitter from cycle to cycle by the reference clock period due to the way the fixed point clock division works.

The `dsp0/1_ClockOffset` and `dsp0/1_ClockInvert` settings must not be changed when `dsp0/1_ClockEnable` is set to 1, otherwise corruption of displayed content is possible.

3.1.3. Configuration

■ IP Identifier

To get information about the Graphics Subsystem derivative and design revision: Read out IPIdentifier register from Sub System Control unit.

Note:

- *The content of this register can be changed by program.*

■ Register Protection

For the 2D Graphics Core configuration register, refer to [1].

The SubsysCtrl and High Performance Bus Matrix registers implements the same protection features as the 2D Graphics Core.

The Memory Protection Units implement a lock protection only.

Other modules don't have built in protection. So the corresponding address space must be protected globally by Memory Protection Units.

3.1.4. Handling Interrupts

■ Interrupts from the 2D Graphics Core

Interrupt control functionality (enable, status, clear) is implemented at the common control unit of the 2D Graphics Core (refer to [1]).

■ Interrupts from DDRHSSPI Module

Interrupt control functionality (enable, status, clear) is implemented at the DDRHSSPI module (refer to [2]).

■ Interrupts from VRAM Interface

Interrupt control functionality (enable, status, clear) is implemented at the SubSysCtrl registers: VRamInterruptEnable/Preset/Clear/Status.

■ Interrupts from Bus Monitor Module

Interrupt control functionality (enable, status, clear) is implemented at the Bus Monitor registers: MonitorInterruptEnable/Clear and ErrorType (= status).

■ Interrupts from Memory Protection Units

Interrupt control functionality (enable, status, clear) is implemented at the memory protection units (refer to [3]).

3.1.5. Memory Protection Units (MPU)

Refer to [3].

3.1.6. Bus Monitor

The bus monitor can observe the transfers on the high-performance matrix and remember the first error response it detects.

To deactivate monitoring for certain masters set their corresponding bit in register MonitorDisable to "1".

To check whether an error occurred read ErrorType and check whether it is set to NONE (no error occurred) or SLVERR or DECERR (error occurred). Alternatively the non-maskable interrupt event can be used.

To get the master which received the error read ErrorID. For masters that use an ID you can read the ID used from ErrorSubID.

To clear the remembered error, so that the monitor may detect another error, write "1" to MonitorClear.

3.1.7. Video RAM

- All configuration parameters of the Video RAM Interface are available via SubSysCtrl registers.

3.1.8. HyperBus™ access via interleaving AXI bridge

To use the second HyperBus™ interface or to use both HyperBus™ interfaces with interleaved access the AxiBridge needs to be set up. The AxiBridge configuration registers are a part of the SubSysCtrl module.

■ Use both HyperBus™ interfaces parallel

Before starting any AXI transfers to the external memory range, do the following:

- Setup registers StartMaster0Region so that there is some space available for HyperBus™ interface 1
- Setup registers StartMaster1Region to use some that available space for HyperBus™ interface 1
- Setup register field remap to 1 to select HyperBus for the external memory range

Do not change any of the above settings when the external memory range might be accessed.

■ Use both HyperBus™ interfaces interleaved

Before starting any AXI transfers to the external memory range, do the following:

- Setup registers StartMaster0Region and StartMaster1Region so that some of the regions are the same
- Setup registers InterleavingStepSize according to the interleaving step size you would like to use
- Setup register field remap to 1 to select HyperBus for the external memory range

Do not change any of the above settings when the external memory range might be accessed.

For optimal performance, set the InterleavingStepSize to 64 Byte.

3.2. The 2D Graphics Core Display Setup

Refer also to [1].

3.2.1. The restriction for the accesses by the 2D Graphics Cores

There are some restrictions for the accesses that are executed by 2D Graphics Core, as shown in Table 32-5.

Table 32-5 Restriction for the accesses by the 2D Graphics Core

Area	Address range	2D Graphics Core
External Flash Memory	0x40000000 - 0x4FFFFFFF	Read Only ^{*1}
Internal video RAM	0x50000000 - 0x501FFFFF	Read / Write
The rest of graphics subsystem	0x50200000 - 0x50FFFFFF	No
Hyperbus external memory	0x51000000 - 0x5FFFFFFF	Read / Write
The main system	0x00000000 - 0x3FFFFFFF, 0x60000000 - 0xFFFFFFFF	Read / Write ^{*2}

Note:

- **1: For DDRHSSPI or HYPERFLASH: Read Only (because of Flash Programming is necessary for writing). For HYPERRAM: There are no restrictions. Read / Write are possible.*
- **2: The accesses to the main system by the 2D Graphics Core are not restricted at the graphics subsystem side. But some restriction may be imposed by the target module of the access at the main system side.*

4. Registers

There are explanations about the registers in the Graphics Subsystem, except for the registers those are in (1) 2D Graphics Core, (2) DDRHSSPI interface, (3) HyperBus interface, (4) Memory Protection Unit.

4.1. General

4.1.1. Error Responses

The following conditions result in an error response when accessing the register:

- Read or write access to an address with no register / no field.
- Read or write access with transfer size other than 32-bit.
- Write access to a register that has read-only fields only..
- Read access to a register that has write-only fields only.
- Write access to a register with lock property "yes" when lock status is active.
- Non-privileged read or write access to a register when privileged status is active (except read access to status register, which is always allowed).
- Read access to lock/unlock register.
- Write access to the lock/unlock register with ...
 - ... an invalid key value.
 - ... a valid key value when the freeze status is active.
 - ... the lock key value when internal unlock counter is 15.
 - ... the privilege key value when the privilege status is active.
 - ... the un-privilege key value when the privilege status is not active.

4.1.2. Hardware Test Register Area

The hardware test register is a register whose function is not disclosed and not expected to be used by software developer. Do not read out or write to the register area by software operation.

The area is specified in the following table.

Any hardware or software operations would not be guaranteed if an unexpected accessing to the area was caused in error, especially; the access changed the specified values in the table to the non-specified values.

Table 32-6 Values for experimental register area

Offset Address	Value	Remark
0x1020_0000 + 0x0310	0x00000000	Write only
0x1020_0000 + 0x0314	-	Read only
0x1021_4000 + 0x0000	0x00000000	
0x1021_4000 + 0x0004	0x0FFFFFFF	
0x1021_4000 + 0x0008	0x00000000	
0x1021_4000 + 0x000C	0x00000000	
0x1021_4000 + 0x0010	0x00000000	
0x1021_4000 + 0x0014	0x00000000	
0x1021_4000 + 0x0018	-	Read only
0x1021_4000 + 0x001C	-	Read only
0x1021_4000 + 0x0020	0x00000000	
0x1021_4000 + 0x0024	-	Read only
0x1021_4000 + 0x0028	-	Read only
0x1021_4000 + 0x002C	-	Read only

Offset Address	Value	Remark
0x1021_4000 + 0x0030	-	Read only
0x1021_4000 + 0x0034	-	Read only
0x1021_4000 + 0x0038	0x00000000	
0x1021_4000 + 0x003C	-	Read only
0x1021_4000 + 0x0040	-	Read only
0x1021_4000 + 0x0044	-	Read only
0x1021_4000 + 0x0048	-	Read only
0x1021_4000 + 0x004C	-	Read only
0x1021_4000 + 0x0050	0x00000000	
0x1021_4000 + 0x0054	-	Read only
0x1021_4000 + 0x0058	-	Read only
0x1021_4000 + 0x005C	-	Read only
0x1021_4000 + 0x0060	-	Read only
0x1021_4000 + 0x0064	-	Read only
0x1021_4000 + 0x0068	0x00000000	
0x1021_4000 + 0x006C	-	Read only
0x1021_4000 + 0x0070	-	Read only
0x1021_4000 + 0x0074	-	Read only
0x1021_4000 + 0x0078	-	Read only
0x1021_4000 + 0x007C	-	Read only
0x1040_0000 + 0x1FD0	-	Read only
0x1040_0000 + 0x1FD4	-	Read only
0x1040_0000 + 0x1FD8	-	Read only
0x1040_0000 + 0x1FDC	-	Read only
0x1040_0000 + 0x1FE0	-	Read only
0x1040_0000 + 0x1FE4	-	Read only
0x1040_0000 + 0x1FE8	-	Read only
0x1040_0000 + 0x1FEC	-	Read only
0x1040_0000 + 0x1FF0	-	Read only
0x1040_0000 + 0x1FF4	-	Read only
0x1040_0000 + 0x1FF8	-	Read only
0x1040_0000 + 0x1FFC	-	Read only
0x1040_0000 + 0x5008	0x00000000	
0x1040_0000 + 0x5024	0x00000000	
0x1040_0000 + 0x5044	0x00000000	
0x1040_0000 + 0x6008	0x00000000	
0x1040_0000 + 0x6024	0x00000000	
0x1040_0000 + 0x6040	0x00000004	
0x1040_0000 + 0x6044	0x00000000	
0x1040_0000 + 0x8008	0x00000000	
0x1040_0000 + 0x8024	0x00000000	
0x1040_0000 + 0x8108	0x00000000	
0x1040_0000 + 0xB008	0x00000000	
0x1040_0000 + 0xB024	0x00000000	

Offset Address	Value	Remark
0x1040_0000 + 0xB108	0x00000000	
0x1040_0000 + 0x42100	0x00000001	
0x1040_0000 + 0x42104	0x00000001	
0x1040_0000 + 0x42108	0x00000000	
0x1040_0000 + 0x43024	0x00000000	
0x1040_0000 + 0x43100	0x00000000	
0x1040_0000 + 0x43104	0x00000000	
0x1040_0000 + 0x43108	0x00000000	
0x1040_0000 + 0x44024	0x00000000	
0x1040_0000 + 0x44100	0x00000000	
0x1040_0000 + 0x44104	0x00000000	
0x1040_0000 + 0x44108	0x00000000	
0x1040_0000 + 0x45100	0x00000000	
0x1040_0000 + 0x45104	0x00000000	
0x1040_0000 + 0x45108	0x00000000	
0x1040_0000 + 0x46100	0x00000000	
0x1040_0000 + 0x46104	0x00000000	
0x1040_0000 + 0x46108	0x00000000	
0x1040_0000 + 0x47100	0x00000000	
0x1040_0000 + 0x47104	0x00000000	
0x1040_0000 + 0x47108	0x00000000	
0x1040_0000 + 0x48100	0x00000000	
0x1040_0000 + 0x48104	0x00000000	
0x1040_0000 + 0x48108	0x00000000	
0x1040_0000 + 0x49100	0x00000001	
0x1040_0000 + 0x49104	0x00000001	
0x1040_0000 + 0x49108	0x00000000	
0x1040_0000 + 0x4A100	0x00000001	
0x1040_0000 + 0x4A104	0x00000001	
0x1040_0000 + 0x4A108	0x00000000	
0x1040_0000 + 0x4B100	0x00000001	
0x1040_0000 + 0x4B104	0x00000001	
0x1040_0000 + 0x4B108	0x00000000	
0x1040_0000 + 0x4C100	0x00000001	
0x1040_0000 + 0x4C104	0x00000001	
0x1040_0000 + 0x4C108	0x00000000	
0x1040_0000 + 0x4D100	0x00000001	
0x1040_0000 + 0x4D104	0x00000001	
0x1040_0000 + 0x4D108	0x00000000	
0x1040_0000 + 0x4E100	0x00000001	
0x1040_0000 + 0x4E104	0x00000001	
0x1040_0000 + 0x4E108	0x00000000	
0x1040_0000 + 0x4F100	0x00000001	
0x1040_0000 + 0x4F104	0x00000001	

Offset Address	Value	Remark
0x1040_0000 + 0x4F108	0x00000000	
0x1040_0000 + 0x50100	0x00000001	
0x1040_0000 + 0x50104	0x00000001	
0x1040_0000 + 0x50108	0x00000000	
0x1040_0000 + 0x51024	0x00000000	
0x1040_0000 + 0x51100	0x00000000	
0x1040_0000 + 0x51104	0x00000000	
0x1040_0000 + 0x51108	0x00000000	
0x1040_0000 + 0x52100	0x00000000	
0x1040_0000 + 0x52104	0x00000000	
0x1040_0000 + 0x52108	0x00000000	
0x1040_0000 + 0x53100	0x00000001	
0x1040_0000 + 0x53104	0x00000001	
0x1040_0000 + 0x53108	0x00000000	
0x1040_0000 + 0x54100	0x00000001	
0x1040_0000 + 0x54104	0x00000001	
0x1040_0000 + 0x54108	0x00000000	
0x1040_0000 + 0x55100	0x00000001	
0x1040_0000 + 0x55104	0x00000001	
0x1040_0000 + 0x55108	0x00000000	
0x1040_0000 + 0x56100	0x00000001	
0x1040_0000 + 0x56104	0x00000001	
0x1040_0000 + 0x56108	0x00000000	
0x1040_0000 + 0x57100	0x00000001	
0x1040_0000 + 0x57104	0x00000001	
0x1040_0000 + 0x57108	0x00000000	
0x1040_0000 + 0x58100	0x00000001	
0x1040_0000 + 0x58104	0x00000001	
0x1040_0000 + 0x58108	0x00000000	
0x1040_0000 + 0x59100	0x00000001	
0x1040_0000 + 0x59104	0x00000001	
0x1040_0000 + 0x59108	0x00000000	
0x1040_0000 + 0x5A100	0x00000001	
0x1040_0000 + 0x5A104	0x00000001	
0x1040_0000 + 0x5A108	0x00000000	

4.2. SubSysCtrl

In this section, the SubSysCtrl registers are described.

4.2.1. Address Block 0

■ LockUnlock

REGISTER_NAME	LockUnlock
OFFSET	0x10200000+0x0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Register to change the protection status of the address block 0.

When lock protection is active, no write but only read access is possible to all registers of this address block. When privilege protection is active, only privileged read and write access is possible. Both protections can be active at the same time.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	LockUnlock[31:24]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	LockUnlock[23:16]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	LockUnlock[15:8]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	LockUnlock[7:0]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

[bit31:0] LockUnlock : Lock/Unlock key

The protection status is changed by writing one of the following key values to this field:

Key	Key Value	Meaning
lock_key	0x5651F763	Decrements the unlock counter. When the counter value is null, lock protection is active. Reset counter value is 1.
unlock_key	0x691DB936	Increments the unlock counter. Max allowed value is 15.
privilege_key	0xAEE95CDC	Enables privilege protection. Disabled after reset.
unprivilege_key	0xB5E2466E	Disables privilege protection.
freeze_key	0xFBE8B1E6	Freezes current protection status. Writing keys to this register has no more effect until reset.

LockStatus

REGISTER_NAME	LockStatus
OFFSET	0x10200000+0x4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Lock status for write access to registers of this address block with lock property.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							FreezeStatus
ACCESS_TYPE	R0,WX							R,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved			PrivilegeStatus	Reserved			LockStatus
ACCESS_TYPE	R0,WX			R,WX	R0,WX			R,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit8] FreezeStatus : Freeze Status

Current status of lock protection.

Bit	Description
0	inactive (unlock counter > 0)
1	active (unlock counter == 0)

[bit4] PrivilegeStatus : Privilege Status

Current status of privilege protection.

Bit	Description
0	inactive
1	active

[bit0] LockStatus : Lock Status

Current freeze status.

Bit	Description
0	protection status can be changed
1	protection status cannot be changed

■ IPIdentifier

REGISTER_NAME	IPIdentifier
OFFSET	0x10200000+0x8
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

IP Identifier for this Graphics Subsystem. Needs to be unlocked.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	IPFamily				IPConfiguration			
ACCESS_TYPE	R/W				R/W			
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	1	0	0	0	1	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	IPApplication				IPFeatureSet			
ACCESS_TYPE	R/W				R/W			
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	1	0	0	0	1	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	IPEvolution				DesignMaturityLevel			
ACCESS_TYPE	R/W				R/W			
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	1	1	0	1	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	DesignDeliveryID				Reserved			
ACCESS_TYPE	R/W				R/W			
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	1	0	0	0	0

[bit31:28] IPFamily : IP Family

Bit	Description
0	Generation2010: 2D Graphics Core building block generation 2010
1	Generation2012: 2D Graphics Core building block generation 2012
2	Generation2013: 2D Graphics Core building block generation 2013

[bit27:24] IPConfiguration : IP Configuration

Bit	Description
1	Module: 2D Graphics Core only
2	System: 2D Graphics Core and sub-system
3	Graphics Subsystem with Graphics Core and the 3D Graphics Core

[bit23:20] IPApplication : IP Application

Bit	Description
1	Blit: Blit Engine
2	BlitDisplay: Blit Engine, Display Controller
3	DisplayCapture: Display Controller and Capture Link
4	BlitDisplayCaptureDrawing: Blit and Drawing Engine, Display and Capture Controller

[bit19:16] IPFeatureSet : IP Feature Set

Bit	Description
1	ECO
2	LIGHT
3	STANDARD
4	PLUS
5	EXTENSIVE

[bit15:12] IPEvolution : IP Evolution

IP evolution (increased for functional spec changes only when feature set keeps the same)

[bit11:8] DesignMaturityLevel : Design Maturity Level

Bit	Description
1	PreFS: Pre feasibility study
2	FS: Feasibility study
3	R0: Functionality complete
4	R1: Verification complete

[bit7:4] DesignDeliveryID : Design Delivery ID

Design delivery ID (increased with each official delivery when maturity keeps the same)

■ ConfigClockControl

REGISTER_NAME	ConfigClockControl
OFFSET	0x10200000+0xC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Controls config clock generation

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved					ConfigClockSelect[2:0]		
ACCESS_TYPE	R0,WX					R/W		
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	1

[bit2:0] ConfigClockSelect : Configuration register Clock Select

Divider of bus clock to generate the configuration register clock, given minus one.

Note:

- The value "0" is not allowed.

■ VRamInterruptEnable

REGISTER_NAME	VRamInterruptEnable
OFFSET	0x10200000+0x10
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

VRAM non-maskable interrupt enable register

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved						VRam Interrupt ECC Disp Enable	VRam Interrupt ECC 2DGC Sys Enable
ACCESS_TYPE	R0,WX						R/W	R/W
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	1	1

[bit1] VRamInterruptECCDispEnable : VRAM ECC Display non-maskable Interrupt Enable

This field can only be programmed once after reset. A second attempt at programming this will cause an error response and no change to the enable.

Bit	Description
0	The non-maskable interrupt is disabled and only the InterruptStatus register can be used to see the status.
1	The non-maskable interrupt is enabled.

[bit0] VRamInterruptECC2DGCSEnable : VRAM ECC 2D Graphics Core (non Display) and System non-maskable Interrupt Enable

This field can only be programmed once after reset. A second attempt at programming this will cause an error response and no change to the enable.

Bit	Description
0	The non-maskable interrupt is disabled and only the InterruptStatus register can be used to see the status.
1	The non-maskable interrupt is enabled.

■ VRamInterruptPreset

REGISTER_NAME	VRamInterruptPreset
OFFSET	0x10200000+0x14
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

VRAM non-maskable interrupt preset register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved						VRam Interrupt ECC Disp Preset	VRam Interrupt ECCBlit Draw Cmd Sys Preset
ACCESS_TYPE	RX,WX						RX,W	RX,W
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

[bit1] VRamInterruptECCDispPreset : VRAM ECC Display non-maskable Interrupt Preset

Bit Written	Description
0	Ignored.
1	Non-maskable interrupt request will be raised.

[bit0] VRamInterruptECCBlitDrawCmdSysPreset : VRAM ECC 2D Graphics Core (non Display) and System non-maskable Interrupt Preset

Bit Written	Description
0	Ignored.
1	Non-maskable interrupt request will be raised.

■ VRamInterruptClear

REGISTER_NAME	VRamInterruptClear
OFFSET	0x10200000+0x18
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

VRAM non-maskable interrupt clear register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved						VRam Interrupt ECC Disp Clear	VRam Interrupt ECCBlit Draw Cmd Sys Clear
ACCESS_TYPE	RX,WX						RX,W	RX,W
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

[bit1] VRamInterruptECCDispClear : VRAM ECC Display non-maskable Interrupt Clear

Bit Written	Description
0	Ignored.
1	Non-maskable interrupt request will be cleared.

[bit0] VRamInterruptECCBlitDrawCmdSysClear : VRAM ECC 2D Graphics Core (non Display) and System non-maskable Interrupt Clear

Bit Written	Description
0	Ignored.
1	Non-maskable interrupt request is cleared.

■ VRamInterruptStatus

REGISTER_NAME	VRamInterruptStatus
OFFSET	0x10200000+0x1C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

VRAM non-maskable interrupt status register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved						VRam Interrupt ECC Disp Status	VRam Interrupt ECCBlit Draw Cmd Sys Status
ACCESS_TYPE	R0,WX						R,WX	R,WX
PROT_TYPE	RpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit1] VRamInterruptECCDispStatus : VRAM ECC Display non-maskable Interrupt Status

Bit	Description
0	ECC single bit error condition is not reported.
1	ECC single bit error condition is reported.

[bit0] VRamInterruptECCBlitDrawCmdSysStatus : VRAM ECC 2D Graphics Core (non Display) and System non-maskable Interrupt Status

Bit	Description
0	ECC single bit error condition is not reported.
1	ECC single bit error condition is reported.

4.2.2. Address Block 1

■ dsp_LockUnlock

REGISTER_NAME	dsp_LockUnlock
OFFSET	0x10200000+0x40
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Register to change the protection status of the address block 1.

When lock protection is active, no write but only read access is possible to all registers of this address block. When privilege protection is active, only privileged read and write access is possible. Both protections can be active at the same time.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	dsp_LockUnlock[31:24]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dsp_LockUnlock[23:16]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dsp_LockUnlock[15:8]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	dsp_LockUnlock[7:0]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

[bit31:0] dsp_LockUnlock : display Lock/Unlock key

The protection status is changed by writing one of the following key values to this field:

Key	Key Value	Meaning
lock_key	0x5651F763	Decrements the unlock counter. When the counter value is null, lock protection is active. Reset counter value is 1.
unlock_key	0x691DB936	Increments the unlock counter. Max allowed value is 15.
privilege_key	0xAEE95CDC	Enables privilege protection. Disabled after reset.
unprivilege_key	0xB5E2466E	Disables privilege protection.
freeze_key	0xFBE8B1E6	Freezes current protection status. Writing keys to this register has no more effect until reset.

■ dsp_LockStatus

REGISTER_NAME	dsp_LockStatus
OFFSET	0x10200000+0x44
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Protection status of the address block 1.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							dsp_Freeze Status
ACCESS_TYPE	R0,WX							R,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved			dsp_Privilege Status	Reserved			dsp_Lock Status
ACCESS_TYPE	R0,WX			R,WX	R0,WX			R,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit8] dsp_FreezeStatus : display Freeze Status

Current status of lock protection.

Bit	Description
0	inactive (unlock counter > 0)
1	active (unlock counter == 0)

[bit4] dsp_PrivilegeStatus : display Privilege Status

Current status of privilege protection.

Bit	Description
0	inactive
1	active

[bit0] dsp_LockStatus : display Lock Status

Current freeze status.

Bit	Description
0	protection status can be changed
1	protection status cannot be changed

■ dsp0_ClockDivider

REGISTER_NAME	dsp0_ClockDivider
OFFSET	0x10200000+0x48
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Clock divider register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dsp0_ClockDivider[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	1	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dsp0_ClockDivider[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	1	1	1	1	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit23:8] dsp0_ClockDivider : display0 Clock Divider

Fixed point clock divider setting with 8 decimal places. Must be at least 2.0. Do not program in a way that a display clock in excess of the maximum frequency that the design can handle is generated, otherwise behavior of the silicon can be undefined. Can be written while clock is already enabled, generated clock will adapt to the new setting then.

In case of TTL:

The fix point clock divider means unless the clock divider is an integer, there will be a mix of lower and higher clock frequencies. Maximal peak frequency is calculated as follows.

If floating part of the DIVIDER is ≥ 0.5 : $f_{DSP_CLK_max} = f_{REF_CLK} / (2 \times \text{int}(\text{dsp0/1_ClockDivider}) + 1)$

If floating part of the DIVIDER is < 0.5 : $f_{DSP_CLK_max} = f_{REF_CLK} / (2 \times \text{int}(\text{dsp0/1_ClockDivider}))$
 (With $DIVIDER = f_{REF_CLK} / f_{DSP_CLK}$)

In case of RSDS:

Also unless the clock divider implemented is an integer, the duty cycle of the display clock is not 50%. The display clock consists of higher frequencies of $f_{DSP_CLK_max} = f_{REF} / \text{int}(DIVIDER)$ and lower frequencies of $f_{DSP_CLK_max} = f_{REF} / \text{int}(DIVIDER+1)$

This needs to be considered for the RSDS case where both edges of the display clock are used.

■ dsp0_DomainControl

REGISTER_NAME	dsp0_DomainControl
OFFSET	0x10200000+0x4C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Domain control register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							dsp0_ Software Reset
ACCESS_TYPE	R0,WX							R/W
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							dsp0_ Clock Enable
ACCESS_TYPE	R0,WX							R/W
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit16] dsp0_SoftwareReset : display0 Software Reset

Bit	Description
0	Making the display clock domain operational.
1	Keeping the display clock domain in reset state.

Note:

- This field will only have an effect when field ClockEnable is set to "1".

[bit0] dsp0_ClockEnable : display0 Clock Enable

Bit	Description
0	Disabling the display clock generation.
1	Enabling the display clock generation.

Note:

- Make sure that ClockDivider is set to a valid value before enabling this.

■ dsp0_ClockShift

REGISTER_NAME	dsp0_ClockShift
OFFSET	0x10200000+0x50
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Clock shift register.

With the settings in this register the display clock can be shifted relative to the display data. With the ClockOffset and the 2D Graphics Core display clock setting of DIV2 a maximum shift of only 180 degrees is possible, so to achieve shifts larger than 180 degrees the ClockInvert bit can be set. This basically adds 180 degrees to the shift set by ClockOffset. If the 2D Graphics Core display clock settings is set to DIV1 the display output must not be used (only the display bypass output can be used then). These settings will not affect the display bypass output of the 2D Graphics Core. These settings must not be changed when ClockEnable is set to "1".

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dsp0_ClockOffset[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							dsp0_ClockInvert
ACCESS_TYPE	R0,WX							R/W
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	1

[bit23:16] dsp0_ClockOffset : display0 Clock Offset

Sets the offset in reference clock cycles for the display clock output with reference to the data output. This has to be smaller than the integer part of ClockDivider.

[bit0] dsp0_ClockInvert : display0 Clock Invert

Bit	Description
0	Display clock output is not delayed.
1	Delays the display clock output for one generated display clock cycle.

■ dsp0_ClockMeasurementControl

REGISTER_NAME	dsp0_ClockMeasurementControl
OFFSET	0x10200000+0x54
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Clock measurement control register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							dsp0_MeasurementStart
ACCESS_TYPE	RX,WX							RX,W
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

[bit0] dsp0_MeasurementStart : display0 Measurement Start

Bit Written	Description
0	Ignored
1	Starting a clock period measurement of the capture clock.

Note:

- Make sure that MeasurementReady is 1 before starting it again.

■ dsp0_ClockMeasurementStatus

REGISTER_NAME	dsp0_ClockMeasurementStatus
OFFSET	0x10200000+0x58
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Clock measurement status register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved		dsp0_ Measurement Slow CapClk Error	dsp0_ Measurement No CapClk Error	Reserved			dsp0_ Measurement Ready
ACCESS_TYPE	R0,WX		R,W	R,W	R0,WX			R,WX
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	1

[bit5] dsp0_MeasurementSlowCapClkError : display0 Measurement Slow Capture Clock Error

The value of this field is valid when dsp0_MeasurementReady becomes "1" after a measurement is completed.

Bit	Description
0	The capture clock is running and not too slow..
1	The capture clock is too slow to be measured and the measurement result is unreliable.

Bit Written	Description
0	Ignored
1	This field will be cleared.

[bit4] dsp0_MeasurementNoCapClkError : display0 No Capture Clock Error

The value of this field is valid when dsp0_MeasurementReady becomes "1" after a measurement is completed.

Bit	Description
0	The capture clock is running and not extremely slow.
1	The capture clock is not running or extremely slow and the measurement result is unreliable.

Bit Written	Description
0	Ignored
1	This field will be cleared..

[bit0] dsp0_MeasurementReady : display0 Measurement Ready

Bit	Description
0	During a measurement.
1	New measurement can be started..

■ dsp0_ClockMeasurementResult

REGISTER_NAME	dsp0_ClockMeasurementResult
OFFSET	0x10200000+0x5C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Clock measurement result register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							dsp0_MeasurementResult[16]
ACCESS_TYPE	R0,WX							R,WX
PROT_TYPE	RpL							
INITIAL_VALUE	0	0	0	0	0	1	0	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dsp0_MeasurementResult[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dsp0_MeasurementResult[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit24:8] dsp0_MeasurementResult : display0 Measurement Result

The result of the measurement, this register is valid after MeasurementReady is "1" after a measurement and if no errors are shown in register MeasurementStatus. This is a fixed point value with 8 decimal places. If DIV2 is used in the 2D Graphics Core's display controller this value has to be incremented by 1/256 and then halved to get the desired ClockDivider setting (halved with rounding). If DIV1 is used this value can directly be used. Always check that this value is within expected and valid regions before using it as ClockDivider

■ dsp1_ClockDivider

REGISTER_NAME	dsp1_ClockDivider
OFFSET	0x10200000+0x60
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Clock divider register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dsp1_ClockDivider[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	1	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dsp1_ClockDivider[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	1	1	1	1	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit23:8] dsp1_ClockDivider : display1 Clock Divider

Fixed point clock divider setting with 8 decimal places. Must be at least 2.0. Do not program in a way that a display clock in excess of the maximum frequency that the design can handle is generated, otherwise behavior of the silicon can be undefined. Can be written while clock is already enabled, generated clock will adapt to the new setting then.

Unless the clock divider is an integer, there will be a mix of lower and higher clock frequencies. Maximal peak frequency is calculated as follows.

If floating part of the DIVIDER is ≥ 0.5 : $f_{DSP_CLK_max} = f_{REF_CLK} / (2 \times \text{int}(\text{dsp0/1_ClockDivider}) + 1)$

If floating part of the DIVIDER is < 0.5 : $f_{DSP_CLK_max} = f_{REF_CLK} / (2 \times \text{int}(\text{dsp0/1_ClockDivider}))$
 (With $DIVIDER = f_{REF_CLK} / f_{DSP_CLK}$)

■ dsp1_DomainControl

REGISTER_NAME	dsp1_DomainControl
OFFSET	0x10200000+0x64
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Domain control register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							dsp1_ Software Reset
ACCESS_TYPE	R0,WX							R/W
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							dsp1_ Clock Enable
ACCESS_TYPE	R0,WX							R/W
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit16] dsp1_SoftwareReset : display1 Software Reset

Bit	Description
0	Making the display clock domain operational.
1	Keeping the display clock domain in reset state.

Note:

- This field will only have an effect when field ClockEnable is set to "1".

[bit0] dsp1_ClockEnable : display1 Clock Enable

Bit	Description
0	Disabling the display clock generation.
1	Enabling the display clock generation.

Note:

- Make sure that ClockDivider is set to a valid value before enabling this.

■ dsp1_ClockShift

REGISTER_NAME	dsp1_ClockShift
OFFSET	0x10200000+0x68
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Clock shift register.

With the settings in this register the display clock can be shifted relative to the display data. With the ClockOffset and the 2D Graphics Core display clock setting of DIV2 a maximum shift of only 180 degrees is possible, so to achieve shifts larger than 180 degrees the ClockInvert bit can be set. This basically adds 180 degrees to the shift set by ClockOffset. If the 2D Graphics Core display clock settings is set to DIV1 the display output must not be used (only the display bypass output can be used then). These settings will not affect the display bypass output of the 2D Graphics Core. These settings must not be changed when ClockEnable is set to "1".

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dsp1_ClockOffset[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							dsp1_ClockInvert
ACCESS_TYPE	R0,WX							R/W
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	1

[bit23:16] dsp1_ClockOffset : display1 Clock Offset

Sets the offset in reference clock cycles for the display clock output with reference to the data output. This has to be smaller than the integer part of ClockDivider.

[bit0] dsp1_ClockInvert : display1 Clock Invert

Bit	Description
0	Display clock output is not delayed.
1	Delays the display clock output for one generated display clock cycle.

■ dsp1_ClockMeasurementControl

REGISTER_NAME	dsp1_ClockMeasurementControl
OFFSET	0x10200000+0x6C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Clock measurement control register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							dsp1_MeasurementStart
ACCESS_TYPE	RX,WX							RX,W
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

[bit0] dsp1_MeasurementStart : display1 Measurement Start

Bit Written	Description
0	Ignored
1	Starting a clock period measurement of the capture clock.

Note:

- Make sure that MeasurementReady is 1 before starting it again.

■ dsp1_ClockMeasurementStatus

REGISTER_NAME	ClockMeasurementStatus
OFFSET	0x10200000+0x70
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Clock measurement status register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved		dsp1_ Measurement Slow CapClk Error	dsp1_ Measurement No CapClk Error	Reserved			dsp1_ Measurement Ready
ACCESS_TYPE	R0,WX		R,W	R,W	R0,WX			R,WX
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	1

[bit5] dsp1_MeasurementSlowCapClkError : display1 Measurement Slow Capture Clock Error

The value of this field is valid when dsp1_MeasurementReady becomes "1" after a measurement is completed.

Bit	Description
0	The capture clock is running and not too slow..
1	The capture clock is too slow to be measured and the measurement result is unreliable.

Bit Written	Description
0	Ignored
1	This field will be cleared.

[bit4] dsp1_MeasurementNoCapClkError : display1 No Capture Clock Error

The value of this field is valid when dsp1_MeasurementReady becomes "1" after a measurement is completed.

Bit	Description
0	The capture clock is running and not extremely slow.
1	The capture clock is not running or extremely slow and the measurement result is unreliable.

Bit Written	Description
0	Ignored
1	This field will be cleared..

[bit0] dsp1_MeasurementReady : display1 Measurement Ready

Bit	Description
0	During a measurement.
1	New measurement can be started..

■ dsp1_ClockMeasurementResult

REGISTER_NAME	dsp1_ClockMeasurementResult
OFFSET	0x10200000+0x74
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Clock measurement result register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							dsp1_MeasurementResult[16]
ACCESS_TYPE	R0,WX							R,WX
PROT_TYPE	RpL							
INITIAL_VALUE	0	0	0	0	0	1	0	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	dsp1_MeasurementResult[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	dsp1_MeasurementResult[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit24:8] dsp1_MeasurementResult : display1 Measurement Result

The result of the measurement, this register is valid after MeasurementReady is "1" after a measurement and if no errors are shown in register MeasurementStatus. This is a fixed point value with 8 decimal places. If DIV2 is used in the 2D Graphics Core's display controller this value has to be incremented by 1/256 and then halved to get the desired ClockDivider setting (halved with rounding). If DIV1 is used this value can directly be used. Always check that this value is within expected and valid regions before using it as ClockDivider

4.2.3. Address Block 2

■ vram_LockUnlock

REGISTER_NAME	vram_LockUnlock
OFFSET	0x10200000+0x100
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Register to change the protection status of the address block 2.

When lock protection is active, no write but only read access is possible to all registers of this address block. When privilege protection is active, only privileged read and write access is possible. Both protections can be active at the same time.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	vram_LockUnlock[31:24]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	vram_LockUnlock[23:16]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_LockUnlock[15:8]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_LockUnlock[7:0]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

[bit31:0] vram_LockUnlock : VRAM Lock/Unlock key

The protection status is changed by writing one of the following key values to this field:

Key	Key Value	Meaning
lock_key	0x5651F763	Decrements the unlock counter. When the counter value is null, lock protection is active. Reset counter value is 1.
unlock_key	0x691DB936	Increments the unlock counter. Max allowed value is 15.
privilege_key	0xAEE95CDC	Enables privilege protection. Disabled after reset.
unprivilege_key	0xB5E2466E	Disables privilege protection.
freeze_key	0xFBE8B1E6	Freezes current protection status. Writing keys to this register has no more effect until reset.

■ vram_LockStatus

REGISTER_NAME	vram_LockStatus
OFFSET	0x10200000+0x104
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Protection status of the address block 2.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							vram_Freeze Status
ACCESS_TYPE	R0,WX							R,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved			vram_ Privilege Status	Reserved			vram_ Lock Status
ACCESS_TYPE	R0,WX			R,WX	R0,WX			R,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit8] vram_FreezeStatus : VRAM Freeze Status

Current status of lock protection.

Bit	Description
0	inactive (unlock counter > 0)
1	active (unlock counter == 0)

[bit4] vram_PrivilegeStatus : VRAM Privilege Status

Current status of privilege protection.

Bit	Description
0	inactive
1	active

[bit0] vram_LockStatus : VRAM Lock Status

Current freeze status.

Bit	Description
0	protection status can be changed
1	protection status cannot be changed

■ vram_sram_select

REGISTER_NAME	vram_sram_select
OFFSET	0x10200000+0x108
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Selects the size of the ECC-protected memory region.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved				vram_sram_select[11:8]			
ACCESS_TYPE	R0,WX				R/W			
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_sram_select[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit11:0] vram_sram_select : VRAM/SRAM Select

Select the ECC-protected region in units of 4KByte. A value of 0 means there is no protected region. This field accepts the value greater than 511. Such a value means that whole of 2MByte are protected region.

■ vram_errinj_data_s0_hi

REGISTER_NAME	vram_errinj_data_s0_hi
OFFSET	0x10200000+0x10C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

ECC error injection for S0 interface (upper 32bit).

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	vram_errinj_data_s0_hi[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	vram_errinj_data_s0_hi[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_errinj_data_s0_hi[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_errinj_data_s0_hi[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] vram_errinj_data_s0_hi : VRAM Error Injection for Data of S0 interface higher part

Each bit set in this register emulates a bit-flip in the corresponding read data (upper 32 bit) of the S0 interface.

■ vram_errinj_data_s0_lo

REGISTER_NAME	vram_errinj_data_s0_lo
OFFSET	0x10200000+0x110
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

ECC error injection for S0 interface (lower 32bit).

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	vram_errinj_data_s0_lo[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	vram_errinj_data_s0_lo[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_errinj_data_s0_lo[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_errinj_data_s0_lo[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] vram_errinj_data_s0_lo : VRAM Error Injection for Data of S0 interface lower part

Each bit set in this register emulates a bit-flip in the corresponding read data (lower 32 bit) of the S0 interface.

■ vram_errinj_ecc_s0_hi

REGISTER_NAME	vram_errinj_ecc_s0_hi
OFFSET	0x10200000+0x114
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

ECC error injection for S0 interface (check bits for upper 32bits).

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved				vram_errinj_ecc_s0_hi[19:16]			
ACCESS_TYPE	R0,WX				R/W			
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_errinj_ecc_s0_hi[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_errinj_ecc_s0_hi[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit19:0] vram_errinj_ecc_s0_hi : VRAM Error Injection for ECC check bits of S0 interface higher part

Each bit set in this register emulates a bit-flip in the corresponding ECC check bit for the read data (upper 32 bit) of the S0 interface

■ vram_errinj_ecc_s0_lo

REGISTER_NAME	vram_errinj_ecc_s0_lo
OFFSET	0x10200000+0x118
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

ECC error injection for S0 interface (check bits for lower 32bits).

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved				vram_errinj_ecc_s0_lo[19:16]			
ACCESS_TYPE	R0,WX				R/W			
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_errinj_ecc_s0_lo[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_errinj_ecc_s0_lo[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit19:0] vram_errinj_ecc_s0_lo : VRAM Error Injection for ECC check bits of S0 interface lower part

Each bit set in this register emulates a bit-flip in the corresponding ECC check bit for the read data (lower 32 bit) of the S0 interface

■ vram_errinj_data_s1_hi

REGISTER_NAME	vram_errinj_data_s1_hi
OFFSET	0x10200000+0x11C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

ECC error injection for S1 interface (upper 32bit).

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	vram_errinj_data_s1_hi[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	vram_errinj_data_s1_hi[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_errinj_data_s1_hi[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_errinj_data_s1_hi[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] vram_errinj_data_s1_hi : VRAM Error Injection for Data of S1 interface higher part

Each bit set in this register emulates a bit-flip in the corresponding read data (upper 32 bit) of the S1 interface.

■ vram_errinj_data_s1_lo

REGISTER_NAME	vram_errinj_data_s1_lo
OFFSET	0x10200000+0x120
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

ECC error injection for S1 interface (lower 32bit).

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	vram_errinj_data_s1_lo[31:24]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	vram_errinj_data_s1_lo[23:16]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_errinj_data_s1_lo[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_errinj_data_s1_lo[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit31:0] vram_errinj_data_s1_lo : VRAM Error Injection for Data of S1 interface lower part

Each bit set in this register emulates a bit-flip in the corresponding read data (lower 32 bit) of the S1 interface.

■ vram_errinj_ecc_s1_hi

REGISTER_NAME	vram_errinj_ecc_s1_hi
OFFSET	0x10200000+0x124
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

ECC error injection for S1 interface (check bits for upper 32bits).

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved				vram_errinj_ecc_s1_hi[19:16]			
ACCESS_TYPE	R0,WX				R/W			
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_errinj_ecc_s1_hi[16:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_errinj_ecc_s1_hi[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit19:0] vram_errinj_ecc_s1_hi : VRAM Error Injection for ECC check bits of S1 interface higher part

Each bit set in this register emulates a bit-flip in the corresponding ECC check bit for the read data (upper 32 bit) of the S1 interface

■ vram_errinj_ecc_s1_lo

REGISTER_NAME	vram_errinj_ecc_s1_lo
OFFSET	0x10200000+0x128
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

ECC error injection for S1 interface (check bits for lower 32bits).

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved				vram_errinj_ecc_s1_lo[19:16]			
ACCESS_TYPE	R0,WX				R/W			
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_errinj_ecc_s1_lo[15:8]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_errinj_ecc_s1_lo[7:0]							
ACCESS_TYPE	R/W							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit19:0] vram_errinj_ecc_s1_lo : VRAM Error Injection for ECC check bits of S1 interface lower part

Each bit set in this register emulates a bit-flip in the corresponding ECC check bit for the read data (lower 32 bit) of the S1 interface

■ vram_sberraddr_s0

REGISTER_NAME	vram_sberraddr_s0
OFFSET	0x10200000+0x13C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Address of the read access at S0 interface which had a single-bit error.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	vram_sberraddr_s0[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	vram_sberraddr_s0[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_sberraddr_s0[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_sberraddr_s0[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

[bit31:0] vram_sberraddr_s0 : VRAM Single Bit Error Address of S0 interface

When a single-bit error interrupt occurs, this register gives the address of the erroneous read access.

■ vram_sberraddr_s1

REGISTER_NAME	vram_sberraddr_s1
OFFSET	0x10200000+0x140
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Address of the read access at S1 interface which had a single-bit error.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	vram_sberraddr_s1[31:24]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	vram_sberraddr_s1[23:16]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	vram_sberraddr_s1[15:8]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	vram_sberraddr_s1[7:0]							
ACCESS_TYPE	R,WX							
PROT_TYPE	RpL							
INITIAL_VALUE	1	1	1	1	1	1	1	1

[bit31:0] vram_sberraddr_s1 : VRAM Single Bit Error Address of S1 interface

When a single-bit error interrupt occurs, this register gives the address of the erroneous read access.

■ vram_arbitor_priority

REGISTER_NAME	vram_arbitor_priority
OFFSET	0x10200000+0x148
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Assigns fixed arbitration priorities to each slave interface. An interface with a higher priority will always win over an interface with a lower one. Interfaces with equal priorities will be round-robin arbitrated.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	reserved		vram_priority_s1_read		vram_priority_s0_read		vram_priority_s0_write	
ACCESS_TYPE	RX/W0		R/W		R/W		R/W	
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit5:4] vram_priority_s1_read : VRAM Priority S1 Read

Fixed priority for S1 interface (read transactions).

[bit3:2] vram_priority_s0_read : VRAM Priority S0 Read

Fixed priority for S0 interface (read transactions).

[bit1:0] vram_priority_s0_write : VRAM Priority S0 Write

Fixed priority for S0 interface (write transactions).

4.2.4. Address Block 3

■ hpm_LockUnlock

REGISTER_NAME	hpm_LockUnlock
OFFSET	0x10200000+0x300
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Register to change the protection status of the registers inside address block 3 and High Performance Bus Matrix registers.

When lock protection is active, no write but only read access is possible to all registers of this address block. When privilege protection is active, only privileged read and write access is possible. Both protections can be active at the same time.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	hpm_LockUnlock[31:24]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	hpm_LockUnlock[23:16]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	hpm_LockUnlock[15:8]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	hpm_LockUnlock[7:0]							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	-	-	-	-	-	-	-	-

[bit31:0] hpm_LockUnlock : High Performance Bus Matrix registers Lock/Unlock key

The protection status is changed by writing one of the following key values to this field:

Key	Key Value	Meaning
lock_key	0x5651F763	Decrements the unlock counter. When the counter value is null, lock protection is active. Reset counter value is 1.
unlock_key	0x691DB936	Increments the unlock counter. Max allowed value is 15.
privilege_key	0xAEE95CDC	Enables privilege protection. Disabled after reset.
unprivilege_key	0xB5E2466E	Disables privilege protection.
freeze_key	0xFBE8B1E6	Freezes current protection status. Writing keys to this register has no more effect until reset.

■ hpm_LockStatus

REGISTER_NAME	hpm_LockStatus
OFFSET	0x10200000+0x304
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Lock status for write access to registers inside address block 3 and High Performance Bus Matrix registers with lock property.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							hpm_Freeze Status
ACCESS_TYPE	R0,WX							R,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved			hpm_Privilege Status	Reserved			hpm_Lock Status
ACCESS_TYPE	R0,WX			R,WX	R0,WX			R,WX
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit8] hpm_FreezeStatus : High performance Bus Matrix registers Freeze Status

Current status of lock protection.

Bit	Description
0	inactive (unlock counter > 0)
1	active (unlock counter == 0)

[bit4] hpm_PrivilegeStatus : High Performance Bus Matrix registers Privilege Status

Current status of privilege protection.

Bit	Description
0	inactive
1	active

[bit0] hpm_LockStatus : High Performance Bus Matrix registers Lock Status

Current freeze status.

Bit	Description
0	protection status can be changed
1	protection status cannot be changed

4.2.5. Address Block 4

■ ilaxibridge_LockUnlock

REGISTER_NAME	ilaxibridge_LockUnlock
OFFSET	0x10200000+0x380
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Register to change the protection status of this address block.

When lock protection is active, no write but only read access is possible to all registers of this address block. When privilege protection is active, only privileged read and write access is possible. Both protections can be active at the same time.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	ilaxibridge_LockUnlock							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ilaxibridge_LockUnlock							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	ilaxibridge_LockUnlock							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	ilaxibridge_LockUnlock							
ACCESS_TYPE	RX,W							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit31:0] ilaxibridge_LockUnlock

The protection status is changed by writing one of the following key values to this field:

- 0x5651F763 = lock_key: Decrements the unlock counter. When the counter value is null, lock protection is active. Reset counter value is 1.
- 0x691DB936 = unlock_key: Increments the unlock counter. Max allowed value is 15.
- 0xAEE95CDC = privilege_key: Enables privilege protection. Disabled after reset.
- 0xB5E2466E = unprivilege_key: Disables privilege protection.
- 0xFBE8B1E6 = freeze_key: Freezes current protection status. Writing keys to this register has no more effect until reset.

■ ilaxibridge_LockStatus

REGISTER_NAME	ilaxibridge_LockStatus
OFFSET	0x10200000+0x384
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Protection status of this address block.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							ilaxibridge_FreezeStatus
ACCESS_TYPE	RX,WX							R,WX
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved			ilaxibridge_Privilege Status	Reserved			ilaxibridge_Lock Status
ACCESS_TYPE	RX,WX			R,WX	RX,WX			R,WX
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	0	X	X	X	0

[bit8] ilaxibridge_FreezeStatus

Current freeze status: 0 = protection status can be changed, 1 = cannot be changed.

[bit4] ilaxibridge_PrivilegeStatus

Current status of privilege protection: 0 = inactive , 1 = active.

[bit0] ilaxibridge_LockStatus

Current status of lock protection: 0 = inactive (unlock counter > 0), 1 = active (unlock counter == 0).

■ ilaxibridge_StartMaster0Region0

REGISTER_NAME	ilaxibridge_StartMaster0Region0
OFFSET	0x10200000+0x388
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Start address register of memory region 0 of master interface 0.

The region defined by StartMaster0Region0 and EndMaster0Region0 must not overlap the region defined by StartMaster0Region1 and EndMaster0Region1. Any region defined by StartMaster0* must either be exactly the same as a region defined by StartMaster1* or not overlap it at all.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	ilaxibridge_StartMaster0Region0							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	1	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ilaxibridge_StartMaster0Region0							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit31:16] ilaxibridge_StartMaster0Region0

Base address of memory region 0 of master interface 0.

■ ilaxibridge_EndMaster0Region0

REGISTER_NAME	ilaxibridge_EndMaster0Region0
OFFSET	0x10200000+0x38C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

End address register of memory region 0 of master interface 0.

If Master0Region0 is not used, set EndMaster0Region0 the same as StartMaster0Region0.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	ilaxibridge_EndMaster0Region0							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	1	0	1	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ilaxibridge_EndMaster0Region0							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit31:16] ilaxibridge_EndMaster0Region0

End address of memory region 0 of master interface 0. This is the first address outside of the range.

■ ilaxibridge_StartMaster0Region1

REGISTER_NAME	ilaxibridge_StartMaster0Region1
OFFSET	0x10200000+0x390
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Start address register of memory region 1 of master interface 0.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	ilaxibridge_StartMaster0Region1							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	1	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ilaxibridge_StartMaster0Region1							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit31:16] ilaxibridge_StartMaster0Region1

Base address of memory region 1 of master interface 0.

■ ilaxibridge_EndMaster0Region1

REGISTER_NAME	ilaxibridge_EndMaster0Region1
OFFSET	0x10200000+0x394
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

End address register of memory region 1 of master interface 0.

If Master0Region1 is not used, set EndMaster0Region1 the same as StartMaster0Region1.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	ilaxibridge_EndMaster0Region1							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	1	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ilaxibridge_EndMaster0Region1							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit31:16] ilaxibridge_EndMaster0Region1

End address of memory region 1 of master interface 0. This is the first address outside of the range.

■ ilaxibridge_StartMaster1Region0

REGISTER_NAME	ilaxibridge_StartMaster1Region0
OFFSET	0x10200000+0x398
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Start address register of memory region 0 of master interface 1.

The region defined by StartMaster1Region0 and EndMaster1Region0 must not overlap the region defined by StartMaster1Region1 and EndMaster1Region1. Any region defined by StartMaster1* must either be exactly the same as a region defined by StartMaster0* or not overlap it at all.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	ilaxibridge_StartMaster1Region0							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	1	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ilaxibridge_StartMaster1Region0							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit31:16] ilaxibridge_StartMaster1Region0

Base address of memory region 0 of master interface 1.

■ ilaxibridge_EndMaster1Region0

REGISTER_NAME	ilaxibridge_EndMaster1Region0
OFFSET	0x10200000+0x39C
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

End address register of memory region 0 of master interface 1.

If Master1Region0 is not used, set EndMaster1Region0 the same as StartMaster1Region0.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	ilaxibridge_EndMaster1Region0							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	1	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ilaxibridge_EndMaster1Region0							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit31:16] ilaxibridge_EndMaster1Region0

End address of memory region 0 of master interface 1. This is the first address outside of the range.

■ ilaxibridge_StartMaster1Region1

REGISTER_NAME	ilaxibridge_StartMaster1Region1
OFFSET	0x10200000+0x3A0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Start address register of memory region 1 of master interface 1.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	ilaxibridge_StartMaster1Region1							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	1	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ilaxibridge_StartMaster1Region1							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit31:16] ilaxibridge_StartMaster1Region1

Base address of memory region 1 of master interface 1.

■ ilaxibridge_EndMaster1Region1

REGISTER_NAME	ilaxibridge_EndMaster1Region1
OFFSET	0x10200000+0x3A4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

End address register of memory region 1 of master interface 1.

If Master1Region1 is not used, set EndMaster1Region1 the same as StartMaster1Region1.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	ilaxibridge_EndMaster1Region1							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	1	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ilaxibridge_EndMaster1Region1							
ACCESS_TYPE	R/W							
PROT_TYPE	WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

[bit31:16] ilaxibridge_EndMaster1Region1

End address of memory region 1 of master interface 1. This is the first address outside of the range.

■ ilaxibridge_InterleavingStepSize

REGISTER_NAME	ilaxibridge_InterleavingStepSize
OFFSET	0x10200000+0x3A8
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Interleaving step size register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	X	X	X	X	X	X

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved		ilaxibridge_ InterleavingStepSize1		Reserved		ilaxibridge_ InterleavingStepSize0	
ACCESS_TYPE	RX,WX		R/W		RX,WX		R/W	
PROT_TYPE	WpL							
INITIAL_VALUE	X	X	1	1	X	X	1	1

[bit5:4] ilaxibridge_InterleavingStepSize1

Sets the interleaving step size used when interleaving if address region 1 of master 0 overlaps a region of master 1.

[bit1:0] ilaxibridge_InterleavingStepSize0

Sets the interleaving step size used when interleaving if address region 0 of master 0 overlaps a region of master 1.

- 0 = STEPSIZE8BYTE: Interleaving step size of 8 byte
- 1 = STEPSIZE16BYTE: Interleaving step size of 16 byte
- 2 = STEPSIZE32BYTE: Interleaving step size of 32 byte
- 3 = STEPSIZE64BYTE: Interleaving step size of 64 byte

4.3. Memory Protection Unit

There are 6 Memory Protection Units in the graphics sub-system, as shown in the Table 32-1.
For the details of each register, please refer[3].

4.4. High Performance Bus Matrix

The access with the transfer size of 32bits is allowed to read or write those registers.

The access with the other size can cause unpredictable result.

4.4.1. Remap

REGISTER_NAME	Remap
OFFSET	0x10400000+0x0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							remap
ACCESS_TYPE	R0,WX							R0,W
PROT_TYPE	RpL/WpL							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit0] remap : Remap control

Select the target module for the address range of 0x40000000 to 0x4FFFFFFF.

Bit	Description
0	DDRHSPI is selected.
1	HyperBus interface is selected.

4.5. Bus Monitor

4.5.1. MonitorDisable

REGISTER NAME	MonitorDisable
OFFSET	0x10214400+0x0
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Error monitor disable register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							draweng write
ACCESS_TYPE	R0,WX							R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	draweng read	store4	fetch eco4	fetch decode4	fetch layer1	fetch eco1	fetch warp1	fetch layer0
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	fetch decode0	store9	fetch eco9	fetch persp9	fetch decode9	cmdseq read	cmdseq write	msm
ACCESS_TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit16] drawengwrite

Bit	Description
0	The error monitor is enabled for the access by the drawengwrite of the 2D Graphics Core.
1	The error monitor is disabled for the access by the drawengwrite of the 2D Graphics Core.

[bit15] drawengread

Bit	Description
0	The error monitor is enabled for the access by the drawengread of the 2D Graphics Core.
1	The error monitor is disabled for the access by the drawengread of the 2D Graphics Core.

[bit14] store4

Bit	Description
0	The error monitor is enabled for the access by the store4 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the store4 of the 2D Graphics Core.

[bit13] fetcheco4

Bit	Description
0	The error monitor is enabled for the access by the fetcheco4 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the fetcheco4 of the 2D Graphics Core.

[bit12] fetchdecode4

Bit	Description
0	The error monitor is enabled for the access by the fetchdecode4 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the fetchdecode4 of the 2D Graphics Core.

[bit11] fetchlayer1

Bit	Description
0	The error monitor is enabled for the access by the fetchlayer1 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the fetchlayer1 of the 2D Graphics Core.

[bit10] fetcheco1

Bit	Description
0	The error monitor is enabled for the access by the fetcheco1 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the fetcheco1 of the 2D Graphics Core.

[bit9] fetchwarp1

Bit	Description
0	The error monitor is enabled for the access by the fetchwarp1 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the fetchwarp1 of the 2D Graphics Core.

[bit8] fetchlayer0

Bit	Description
0	The error monitor is enabled for the access by the fetchlayer0 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the fetchlayer0 of the 2D Graphics Core.

[bit7] fetchdecode0

Bit	Description
0	The error monitor is enabled for the access by the fetchdecode0 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the fetchdecode0 of the 2D Graphics Core.

[bit6] store9

Bit	Description
0	The error monitor is enabled for the access by the store9 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the store9 of the 2D Graphics Core.

[bit5] fetcheco9

Bit	Description
0	The error monitor is enabled for the access by the fetcheco9 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the fetcheco9 of the 2D Graphics Core.

[bit4] fetchpersp9

Bit	Description
0	The error monitor is enabled for the access by the fetchpersp9 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the fetchpersp9 of the 2D Graphics Core.

[bit3] fetchdecode9

Bit	Description
0	The error monitor is enabled for the access by the fetchdecode9 of the 2D Graphics Core.
1	The error monitor is disabled for the access by the fetchdecode9 of the 2D Graphics Core.

[bit2] cmdseqread

Bit	Description
0	The error monitor is enabled for the access by the cmdseqread of the 2D Graphics Core.
1	The error monitor is disabled for the access by the cmdseqread of the 2D Graphics Core.

[bit1] cmdseqwrite

Bit	Description
0	The error monitor is enabled for the access by the cmdseqwrite of the 2D Graphics Core.
1	The error monitor is disabled for the access by the cmdseqwrite of the 2D Graphics Core.

[bit0] msm

Bit	Description
0	The error monitor is enabled for the access from the main system.
1	The error monitor is disabled for the access from the main system.

4.5.2. MonitorInterruptEnable

REGISTER_NAME	MonitorInterruptEnable
OFFSET	0x10214400+0x4
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Error monitor non-maskable interrupt enable register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							Monitor Interrupt Enable
ACCESS_TYPE	R0,WX							R/W
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	1

[bit0] MonitorInterruptEnable : Monitor Interrupt Enable

This field can only be programmed once after reset. A second attempt at programming this will cause an error response and no change to the enable. If set to "1" the non-maskable interrupt is enabled, if set to "0" the non-maskable interrupt is disabled and only the MonitorStatus field can be used to detect errors.

4.5.3. MonitorInterruptClear

REGISTER_NAME	MonitorInterruptClear
OFFSET	0x10214400+0x8
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Error monitor non-maskable interrupt clear register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	-							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	-							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved							
ACCESS_TYPE	RX,WX							
PROT_TYPE	-							
INITIAL_VALUE	-	-	-	-	-	-	-	-

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved							Monitor Interrupt Clear
ACCESS_TYPE	RX,WX							RX,W
PROT_TYPE	-							
INITIAL_VALUE	-	-	-	-	-	-	-	-

[bit0] MonitorInterruptClear : Monitor Interrupt Clear

Writing a "1" clears the non-maskable interrupt and status and starts checking for next error.

4.6. MonitorStatus

REGISTER_NAME	MonitorStatus
OFFSET	0x10214400+0xC
ACCESS_SIZE	W
MULTIPLE	
NUMERIC_TYPE	
OTHER	

Error monitor status register.

BIT_OFFSET	31	30	29	28	27	26	25	24
BIT_NAME	Reserved							
ACCESS_TYPE	R0,WX							
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

BIT_OFFSET	23	22	21	20	19	18	17	16
BIT_NAME	ErrorSubID							
ACCESS_TYPE	R,WX							
PROT_TYPE	-							
INITIAL_VALUE	1	1	1	1	1	1	1	1

BIT_OFFSET	15	14	13	12	11	10	9	8
BIT_NAME	Reserved		ErrorID					
ACCESS_TYPE	R0,WX		R,WX					
PROT_TYPE	-							
INITIAL_VALUE	0	0	1	1	1	1	1	1

BIT_OFFSET	7	6	5	4	3	2	1	0
BIT_NAME	Reserved						ErrorType	
ACCESS_TYPE	R0,WX						R,WX	
PROT_TYPE	-							
INITIAL_VALUE	0	0	0	0	0	0	0	0

[bit23:16] ErrorSubID : Error Sub-ID

ID provided by the master itself that caused the erroneous request.

[bit13:8] ErrorID : Error ID

ID of master that did erroneous request.

Value	Source Selected	Description
0	MSM	Main system
1	CMDSEQWRITE	cmdseqwrite of the 2D Graphics Core
2	CMDSEQREAD	cmdseqread of the 2D Graphics Core
3	FETCHDECODE9	fetchdecode9 of the 2D Graphics Core
4	FETCHPERSP9	fetchpersp9 of the 2D Graphics Core
5	FETCHECO9	fetcheco9 of the 2D Graphics Core
6	STORE9	store9 of the 2D Graphics Core
7	FETCHDECODE0	fetchdecode0 of the 2D Graphics Core
8	FETCHLAYER0	fetchlayer0 of the 2D Graphics Core
9	FETCHWARP1	fetchwarp1 of the 2D Graphics Core
10	FETHECO1	fetcheco1 of the 2D Graphics Core
11	FETCHLAYER1	fetchlayer1 of the 2D Graphics Core
12	FETCHDECODE4	fetchdecode4 of the 2D Graphics Core
13	FETHECO4	fetcheco4 of the 2D Graphics Core
14	STORE4	store4 of the 2D Graphics Core
15	DRAWENGREAD	drawengread of the 2D Graphics Core

Value	Source Selected	Description
16	DRAWENGWRITE	drawengwrite of the 2D Graphics Core
63	NONE	No error detected

[bit1:0] : ErrorType : Error Type

Value	Name	Description
0	NONE	No error detected
1	-	Reserved
2	SLVERR	Slave signaled error
3	DECERR	Decoder signaled error

5. References

- [1] 2D GRAPHICS CORE PROGRAMMERS REFERENCE MANUAL
- [2] CHAPTER OF DDR HIGH SPEED SPI CONTROLLER
- [3] CHAPTER OF MEMORY PROTECTION UNIT FOR AXI
- [4] CHAPTER OF HYPER BUS INTERFACE

CHAPTER 33: Sound System Configuration



This chapter explains the definition of sound system and configuration.

1. Overview
2. Configuration and Block Diagram
3. Operation
4. Configuration and limitation of each module
5. Note

CODE: SOUNDSYSTEM_E1.02-0

1. Overview

The sound system is defined as the function group of following modules.

Function Group	Function Module
Input module	DMAC
	Sound waveform generator (SWFG)
Sound mixer	Sound mixer (SMIX)
Output module	Audio DAC (DAC)
	PCM-PWM
	I2S

Here the configuration procedure and notes are described in this chapter for each applied scope when the modules are used as the sound system.

See the dedicated chapter that describes in detailed each module composing the sound system before referring this chapter.

1.1. Input Module

There are 2 types of sound sources.

One is a sound source that is generated by the sound waveform generator (SWFG). SWFG with easy configurations by software can generate 16bit sound sources of PCM format, and output it as 32bit monaural source.

The other is a sound source that is in internal or external storage. DMAC or CPU can transfer sound source in the embedded Flash memory or data RAM, or comes from external memory via communication interface such as I2S.

1.2. Sound Mixer

The sound mixer (SMIX) synthesizes inputted sound sources by saturation calculation, and performs various effects of sound volume (configured volume, mute effect, fade-in, or fade out) automatically by hardware operation.

1.3. Output Module

The mixed sound source is outputted out of microcontroller.

Audio DAC converts PCM sound source to level of analog voltage. It enables to mount analog amplifier directly at analog output port of MCU.

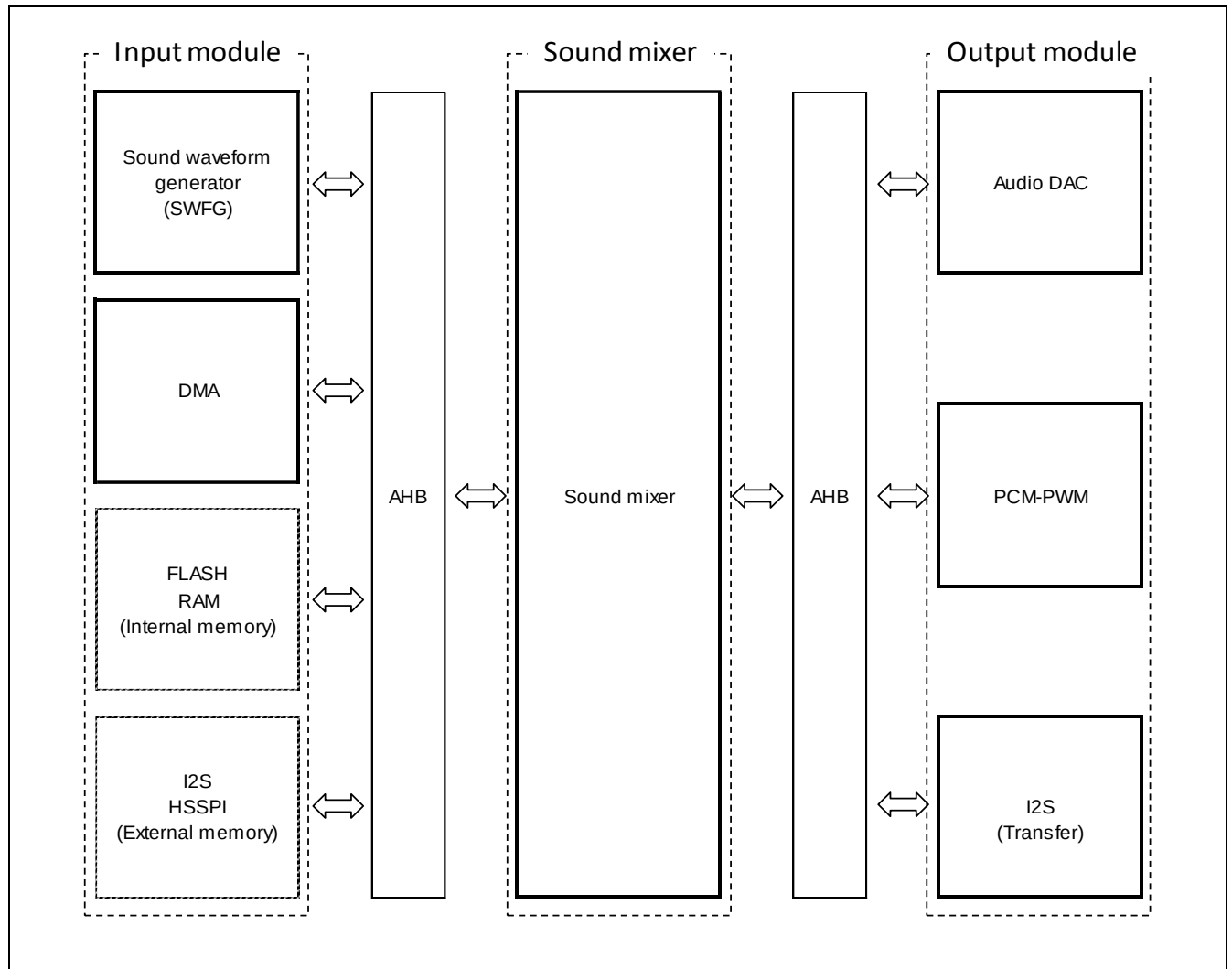
PCM-PWM converts PCM sound source to PWM (Pulse Width Modulation) waveform and outputs it. Through a kind of Integral circuit it can be converted to level of analog voltage.

I2S (Inter IC Sound) is a serial interface protocol. The sound system has its transfer facility as sound system function.

These 3 functions are exclusively used for the output module of the sound system.

2. Configuration and Block Diagram

Figure 2-1



Notes:

- I2S connected to the Sound Mixer supports only Transfer mode.

3. Operation

The operation of the sound system is a co-operation of the modules which are defined as 1. The followings are descriptions of the procedures for each case.

The detailed explanation of the module operation and its note is described in each chapter. Before referring this chapter, see the chapter of each module in advance.

3.1. Start Operations

Take the following procedure of 3.1.1 to 3.1.3 to start up the operation of the sound system.

3.1.1. Configuration of Input Modules

SWFG Configuration

Start sound source generations configuring SWFG.

The generations will practically begin by means of each transfer request from the sound mixer.

DMAC Configuration

Start sound source transmissions configuring DMAC.

The transmissions will practically begin by means of each transfer request from SMIX.

3.1.2. Configuration of Sound Mixer Operations

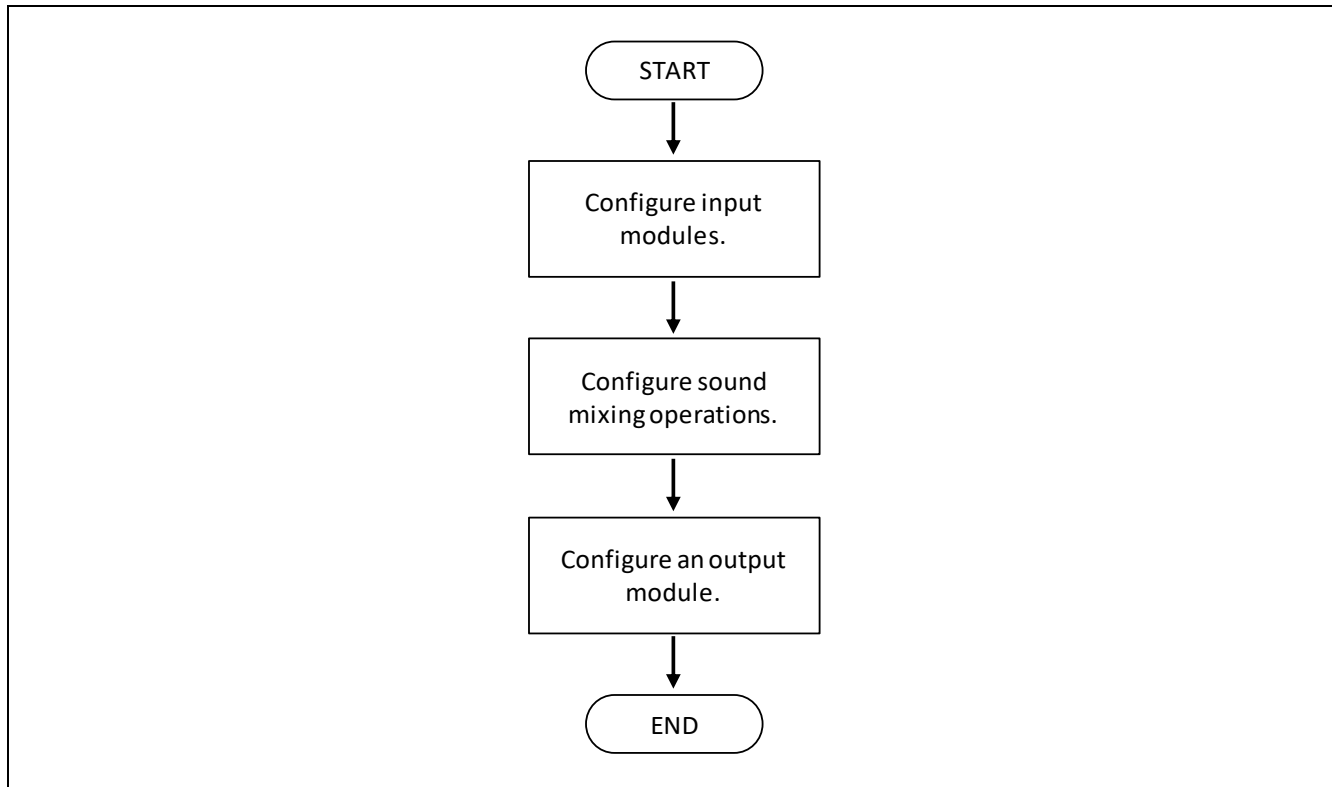
Start a mixing operation configuring SMIX.

The mixing will practically begin by means of a transfer request from the output module.

3.1.3. Configuration of an Output Module

Start an output operation configuring one of the modules out of the audio DAC, PCM-PWM, or I2S.

The co-operation of the modules as a sound system will begins by means of a start operation of the output module.

Figure 3-1: Start Operations

Notes:

- CPU can transfer sound sources to the input channel PMIS0 to 4 of SMIX with data transfer requests of SMIX.
- Note some sound source which is transferred from SWFG is deleted by buffer initialization (clear control) during SMIX configuration. In order to avoid the phenomenon, WGSTART control to start sound source generation of SWFG can only be done after SMIX configuration.

3.2. Addition of Sound Source Inputs

Take the following procedure to add additional sound sources to the operating sound system.

The existing mixed sound source can be continuously reproduced after the addition of new sound sources.

3.2.1. Configuration of Additional Input Sound Source

SWFG Configuration

Start additional sound source generations configuring channels of SWFG.

The generations will practically begin by means of each transfer request from SMIX.

DMA Configuration

Start additional sound source transmissions configuring a channel of DMA.

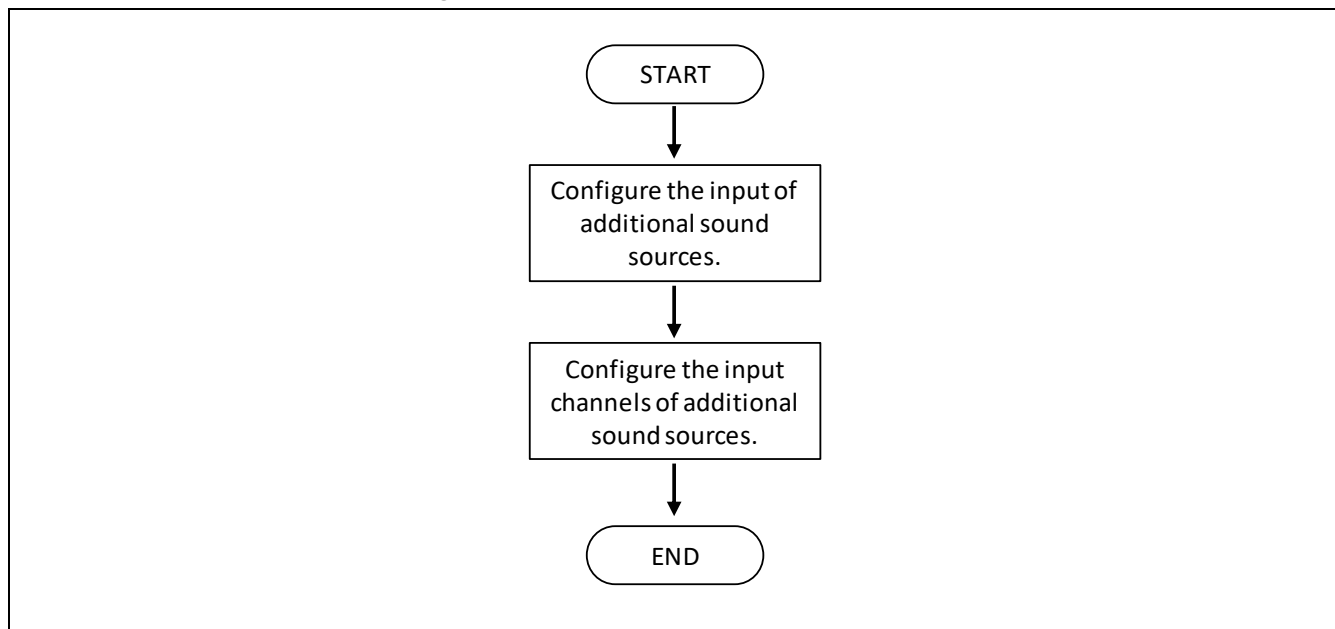
The transmissions will practically begin by means of each transfer request from SMIX.

3.2.2. Configuration of Additional Input Channel

Start an additional mixing operation configuring an input channel of SMIX.

The mixing will practically begin by means of a transfer request from the output module.

Figure 3-2: Addition of Sound Source Inputs



3.3. Stop Operations

Take the following procedure of 3.3.1 to 3.3.3 to stop the operation of the sound system.

3.3.1. Disabling the Output Module

Disable the output module. The procedure is described in the chapter of the audio-DAC, PCM-PWM and I2S in detailed.

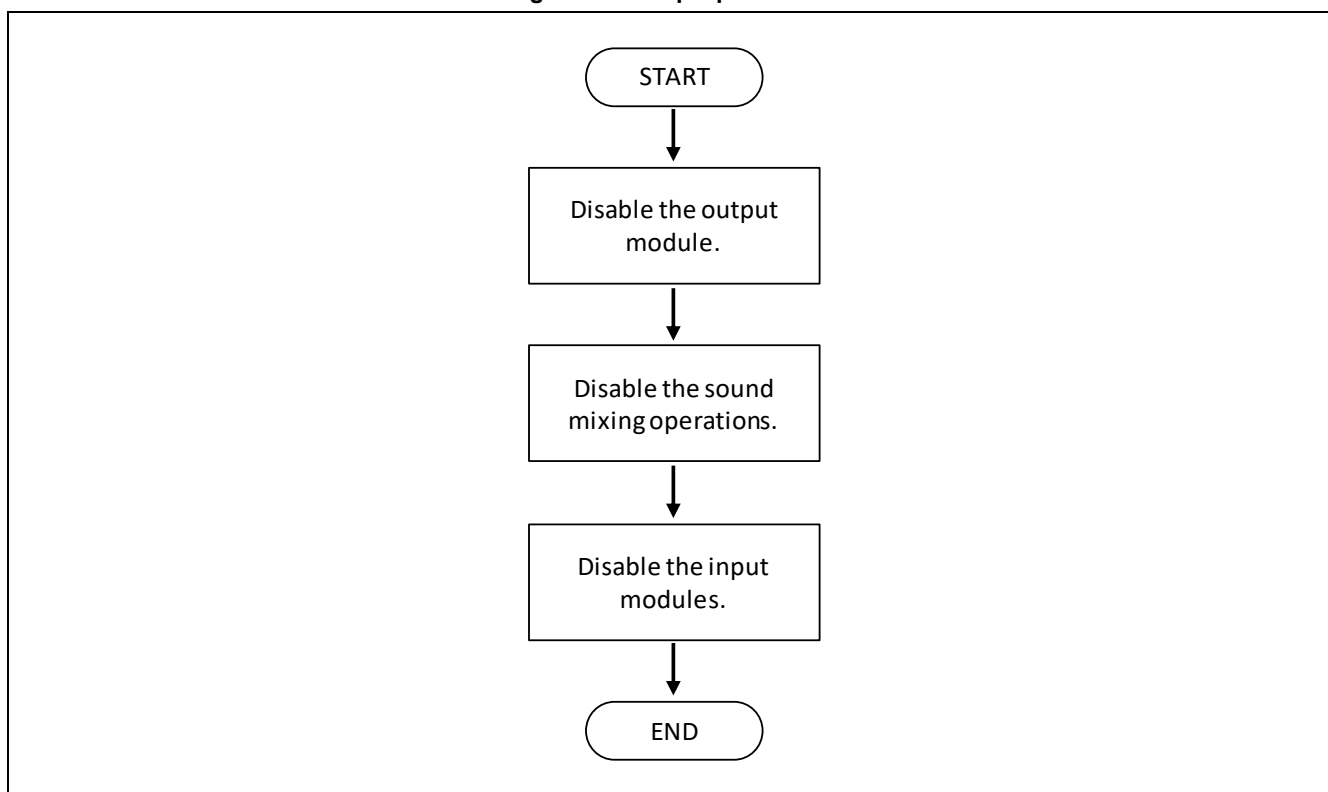
3.3.2. Disabling the Mixing

Disable the mixing operations of SMIX. The procedure is described in the chapter of SMIX in detailed.

3.3.3. Disabling the Input Modules

Disable the sound source generations and transmissions. The procedure is described in the chapter of DMA, interrupt and I2S in detailed.

Figure 3-3: Stop Operations



Notes:

- While the sound system operates continuously, a stop of a sound source generation of SWFG keeps all mixing operations of SMIX being hung up. Suspend a particular channel of SWFG only after disabling a corresponding input channel SMIX.
- DMA transfer needs a same operation as the case of SWFG. Before suspending DMA transfer, disable a corresponding input channel of SMIX.

3.4. Operation of a Sound Source

An application doesn't need the mixing operation but only needs an operation of an output module.

In the case the sound source should be transferred to SMIX as same as the case of a mixing of multi sound sources.

The sound system cannot directly transfer the sound source from an input module to an output module. Because every output module doesn't support any transfer requests for CPU and DMA.

On the other hand, every output module supports a transfer request for SMIX, that is, it is only SMIX that can transfer the sound source to an output module.

Notes:

- *SMIX only outputs the mixed sound source of 48 kHz sampling rate. Therefore the sound system cannot obtain the sound source with an original sampling rate even if the application doesn't need mixing function.*
- *SMIX has the volume effect control of the mute, fade-in, and fade-out. They are quite effective for a sound source even if the mixing operation is not necessary.*

4. Configuration and limitation of each module

This section shows configurations and limitations about each module interface in the sound system.

4.1. Interface between SMIX and DAC

Output modules including DAC are connected to SMIX by a dedicated bus interface. On this interface, the sound source transfer between SMIX and DAC is triggered by a data request from DMA interface of DAC.

DAC has two initialization procedures (refer to the chapter of the DAC for the details). One is "DMA Interface Unused", and the other is "DMA Interface Used". DAC must be initialized by the procedure of "DMA Interface used", because the sound source is transferred from SMIX to DAC by using DMA interface.

Because it is impossible to transfer the sound source from DMAC to DAC directly, the sound source needs to be transferred to DAC via SMIX. Therefore, the initialization of the SMIX is necessary even if it is not necessary to do the mixing of the sound source. If the sound source is not mixing, only 1 PMIS input channel (any number of channels can be used) of SMIX should be enabled.

4.1.1. Configuration

The address of DAC must be set to Output destination address of SMIX (MACRO of MXOCTRL register). The actual setting value is the following.

- *MACRO of MXOCTRL register* : 0x1

Number of transfers to output destination of SMIX (DATAN of MXOCTRL register) must be same as FIFO empty threshold of DAC (FEST of DACTRL register).

4.1.2. Limitation

Because the sound sources are transferred surely from SMIX to DAC, the following registers must not be changed during the sound source translation.

Even if SMIX is disabled by MXCH register, the data transfer from SMIX to DAC is not stopped immediately. Therefore, the following register must not be changed after setting it at the initialization.

- *DACTRL*
- *MXOCTRL*

4.2. Interface between SMIX and PCM-PWM

Output modules including PCM-PWM are connected to SMIX by a dedicated bus interface. On this interface, the sound source transfer between SMIX and PCM-PWM is triggered by a data request from DMA interface of PCM-PWM.

PCM-PWM supports two type data transfers. One is "DMA mode", and the other is "CPU mode". PCM-PWM must be set to "DMA mode", because the sound source is transferred from SMIX to PCM-PWM by using DMA interface.

Because it is impossible to transfer the sound source from DMAC to PCM-PWM directly, the sound source needs to be transferred to PCM-PWM via SMIX. Therefore, the initialization of the SMIX is necessary even if it is not necessary to do the mixing of the sound source. If the sound source is not mixing, only 1 PMIS input channel (any number of channels can be used) of SMIX should be enabled.

4.2.1. Configuration

The address of PCM-PWM must be set to Output destination address of SMIX (MACRO of MXOCTRL register). The actual setting value is the following.

- *MACRO of MXOCTRL register* : 0x2

Number of transfers to output destination of SMIX (DATAN of MXOCTRL register) must be same as FIFO empty threshold of PCM-PWM (FEST of PCMPWMI_CONTROL register).

4.2.2. Limitation

Because the sound sources are transferred surely from SMIX to PCM-PWM, the following registers must not be changed during the sound source translation.

Even if SMIX is disabled by MXCH register, the data transfer from SMIX to PCM-PWM is not stopped immediately. Therefore, the following register must not be changed after setting it at the initialization.

- *MXOCTRL*

And, FST of PCMPWMI_CONTROL must not be changed under the following condition.

- *EN of PCMPWMI_CONTROL is set to 1, and*
- *DMAEN of PCMPWMI_CONTROL is set to 1*

4.3. Interface between SMIX and I2S

Output modules including I2S are connected to SMIX by a dedicated bus interface. On this interface, the sound source transfer between SMIX and I2S is triggered by a data request from DMA interface of I2S.

I2S supports three type data transfers. These are "DMA", "Interrupt" and "Poling". I2S must be set to "DMA", because the sound source is transferred from SMIX to I2S by using DMA interface.

Because it is impossible to transfer the sound source from DMAC to I2S directly, the sound source needs to be transferred to I2S via SMIX. Therefore, the initialization of the SMIX is necessary even if it is not necessary to do the mixing of the sound source. If the sound source is not mixing, only 1 PMIS input channel (any number of channels can be used) of SMIX should be enabled.

4.3.1. Configuration

The address of I2S must be set to Output destination address of SMIX (MACRO of MXOCTRL register). The actual setting value is the following.

- *MACRO of MXOCTRL register : 0x3*

Number of transfers to output destination of SMIX (DATAN of MXOCTRL register) must be same as Tx FIFO Threshold of I2S (TFTH of I2Sn_INTCNT register).

4.3.2. Limitation

Because the sound sources are transferred surely from SMIX to I2S, the following registers must not be changed during the sound source translation.

Even if SMIX is disabled by MXCH register, the data transfer from SMIX to I2S is not stopped immediately. Therefore, the following register must not be changed after setting it at the initialization.

- *MXOCTRL*

And, TFTH of I2Sn_INTCNT must not be changed under the following condition.

- *START of I2Sn_OPRREG is set to 1, and*
- *TXENB of I2Sn_OPRREG is set to 1, and*
- *TXDMACT of I2Sn_DMAACT is set to 1*

4.4. Interface between SWFG and SMIX

SWFG is connected to SMIX by a dedicated bus interface. On this interface, the sound source transfer between SWFG and SMIX is triggered by a data request from SMIX.

4.4.1. Configuration

Sound sources from SWFG need to be input to MXWFGnDADR register of SMIX. Therefore, the address of MXWFGnDADR register should be set to WGCHADD1, WGCHADD2 and WGCHADD3. The actual setting values are the followings.

- WGCHADD1 : 0x01040100
- WGCHADD2 : 0x010C0108
- WGCHADD3 : 0x00000110

4.4.2. Limitation

Because the sound sources are transferred surely from SWFG to SMIX, the following registers must not be changed during the sound source translation.

Even if SWFG is disabled by WGCHEN register, the data transfer from SWFG to SMIX is not stopped immediately. Therefore, the following register must not be changed after setting it at the initialization.

- WGCHADD1
- WGCHADD2
- WGCHADD3

4.5. Interface between DMAC and SMIX

DMAC can be used to transfer the sound source to PMIS interface of SMIX.

4.5.1. Configuration

PMISn Request assert threshold setting of SMIX (FESTCHn of MXDRQCTRL register) must be same as the number of block count of DMAC.

4.5.2. Limitation

Because the sound sources are transferred surely from DMAC to SMIX, the following registers must not be changed during the sound source translation (from data request by SMIX to data transfer completion of DMAC).

- PMISnMONO of MXCHMONO

And, DMAENCHn of MXDREQCTRL must be 0 during the following procedures.

- Clear PMIS Input Buffer of the channel (Write 1 to PMOSnBCLR of MXBUFFCLR)
- Enable the channel by MXCH register (change from 0 to 1)
- Change FESTCHn of MXDREQCTRL of the channel

4.6. Interface between CPU and SMIX

CPU can be used to transfer the sound source to PMIS interface of SMIX. Data transfer request interrupt of SMIX can be used as trigger for the data transfer.

No special configuration or limitation to be considered.

5. Note

- *Every output module doesn't support any transfer requests for CPU and DMA. The transfer request only supports for the sound source transmission of SMIX. That is, CPU and DMA cannot directly transfer sound sources to the output modules without going through SMIX.*

CHAPTER 34: Base Timer Port Definition



This chapter explains Base Timer Port Definition.

1. Overview
2. Definition
3. Supplementation
4. Operation and Registers

CODE: BASETIMER_PORTDEF-S6J3200-E1

1. Overview

This product series has maximum 12 units, and total 24 channels of base timer.

A unit of 2 channels of base timer can be controlled and applied as well as individual operation of each timer channel, and all the modes of base timer operation are described and defined in the chapter of BASE TIMER in Traveo™ platform manual.

This series particularly has package external port names and function port names of base timer function input or output instead of the function port names which are defined in Traveo™ platform manual, and it sometime brings about confusion for software design to understand the relations.

Here, this chapter aims to describe and clarify the followings.

- Unit and channel number definition
- Port name definition and supported operation mode

Again, the description of base timer function, block diagram, operation, and register should be referred in Traveo™ platform manual in detail.

2. Definition

2.1. Unit and Channel Number Definition

Algebra	Definition	Relation	Remark
u	Unit number	$u = 0, 1, \dots, 11$	0 to 11
m	Channel number	$m = 2u$	0 to 22
n	Channel number	$n = 2u+1=m+1$	1 to 23

In this document Base timer is named as Base timer "u" with its unit number.

2.2. Port Name Definition and Supported Operation Mode

The function port name is described in Traveo™ platform manual.

■ I/O mode 0: 16-bit timer standard mode

Function Port Name in Traveo™ Platform Manual	Series Particular Port Name	Remark
TIOBn	PPGu_TIN3	See RIC table.
TIOAn	PPGu_TOUT2	See port description or POF table
TIOBm	PPGu_TIN1	See RIC table.
TIOAm	PPGu_TOUT0	See port description or POF table

■ I/O mode 1: 32-bit timer full-function mode

Function Port Name in Traveo™ Platform Manual	Series Particular Port Name	Remark
TIOBn	PPGu_TIN3	See RIC table.
TIOAn	PPGu_TIN2	See RIC table.
TIOBm	PPGu_TIN1	See RIC table.
TIOAm	PPGu_TOUT0	See port description or POF table

■ I/O mode 2: PPG trigger 2-channel sharing mode

Function Port Name in Traveo™ Platform Manual	Series Particular Port Name	Remark
TIOBn	Not used	-
TIOAn	PPGu_TOUT2	See port description or POF table
TIOBm	PPGu_TIN1	See RIC table.
TIOAm	PPGu_TOUT0	See port description list

■ I/O mode 4: Timer start/stop mode

Function Port Name in Traveo™ Platform Manual	Series Particular Port Name	Remark
TIOBn	Not used	-
TIOAn	PPGu_TOUT2	See port description or POF table
TIOBm	PPGu_TIN1	See RIC table.
TIOAm	PPGu_TOUT0	See port description or POF table

■ I/O mode 5: Simultaneous soft start mode

Function Port Name in Traveo™ Platform Manual	Series Particular Port Name	Remark
TIOBn	Not used	-
TIOAn	PPGu_TOUT2	See port description or POF table
TIOBm	Not used	-
TIOAm	PPGu_TOUT0	See port description or POF table

■ I/O mode 6: Timer start/stop and simultaneous soft start mode

Function Port Name in Traveo™ Platform Manual	Series Particular Port Name	Remark
TIOBn	Not used	-
TIOAn	PPGu_TOUT2	See port description or POF table
TIOBm	Not used	-
TIOAm	PPGu_TOUT0	See port description or POF table

■ I/O mode 7: Timer start mode

Function Port Name in Traveo™ Platform Manual	Series Particular Port Name	Remark
TIOBn	Not used	-
TIOAn	PPGu_TOUT2	See port description or POF table
TIOBm	PPGu_TIN1	See RIC table.
TIOAm	PPGu_TOUT0	See port description or POF table

Note:

- See RIC (Resource Input Configuration), POF (port output function configuration), and Port description list in this hardware manual.

3. Supplementation

3.1. Input Port Configuration

PPGu_TIN1, PPGu_TIN2, and PPGu_TIN3 are selected as input port of base timer by configuring RIC register. See the chapter of "PORT CONFIGURATION".

3.2. Output Port Configuration

PPGu_TOUT0 and PPGu_TOUT2 are selected as output port of base timer by configuring POF register. See the chapter of "PORT CONFIGURATION".

4. Operation and Registers

See the chapter of BASE TIMER in Traveo™ Platform hardware manual.

CHAPTER 35: Appendix



1. Pin Status in Each CPU State
2. Master Access Table

CODE: APPENDIX-S6J3200-E1

This section shows the pin status in each cpu state.

[illegible]

[illegible]

2. Master Access Table

This section shows the access policies for the bus masters.

Slave		Master							
		CPU	DMAC#0	TIC	DAP	SHE	MLB	Ethernet	Graphic Subsystem
Core Internal	TCRAM (Mem)	Y	N						
	TCFLASH_TCM (Mem)	Y	N						
	TCFLASH_AXI (Mem)	Y	N						
Core Slave	TCRAM (Mem)	Y							
	TCFLASH_TCM (Mem)	Y							
	TCFLASH_AXI (Mem)	Y							
Scratch Pad RAM	Memory	Y							
	Register	p	Y			N			
EAM	EAM	Y							
AppS #3 APPLGRP_MASTER	Ethernet	p	Y			N			
	MPU_AXI	p	Y			N			
	MLB	p	Y			N			
	MPU_AHB	p	Y			N			
	PRGCRC	p	Y			N			
	SMIX (Sound System)	p	Y			N			
	Audio DAC (Sound System)	p	Y			N			
	PCM-PWM (Sound System)	p	Y			N			
	I2S0 (Sound System)	p	Y			N			
	I2S1 (Sound System)	p	Y			N			
	Wave Form Generator (Sound System)	p	Y			N			
	Hyper Bus ch.0 Control Register	p	Y			N			

Slave		Master							
		CPU	DMAC#0	TIC	DAP	SHE	MLB	Ethernet	Graphic Subsystem
AppS #8 Graphic subsystem(*2)	External Memory for DDRHSSPI/Hyper Bus ch.1/ch.2	Y							N
	VRAM	Y							N
	2D Graphics Core Subsystem control	Y							N
	2D Graphics core (Blit, Drawing, Capture, Display, CmdSeq)	Y							N
	MPU_AXI(Capture Controller)	Y							N
	MPU_AXI(Blit Engine)	Y							N
	MPU_AXI(Drawing Engine)	Y							N
	DDRHSSPI configuration	Y							N
	AXI Interconnect(Performance Measurement Unit)	Y							N
	AXI Interconnect(Error Monitor)	Y							N
	Hyper Bus ch.1 Control Register	Y							N
	Hyper Bus ch.2 Control Register	Y							N
	High Performance Bus Matrix	Y							N
	Hyperbus external memory	Y							N
	AppS #11 HSSPI1_MEMORY	Memory for Hyper Bus ch.0	Y						
DDR-HSSPI Group	Memory	Y							
	Register	p	Y			N			
SHE Group	SHE	p	N			N			
Debug Group	CoreSight, etc	Y	N						

Slave		Master							
		CPU	DMAC#0	TIC	DAP	SHE	MLB	Ethernet	Graphic Subsystem
MCU Config Group	SYSC0 (excl. SCT)	p	N	Y				N	
	SCT	p	N	Y				N	
	MODEC	p	N	Y				N	
	HW-WDG	p	N	Y				N	
	WAKE	p	Y					N	
	RTC	p	Y					N	
	Ext-INT	p	Y					N	
	PD1 App Extend	p	Y					N	
	Backup RAM (Memory)		Y					N	
	Backup RAM (IO)	p	Y					N	
	EICU	p	Y					N	
	CR calibration	p	Y					N	
	ALL IRQ READ	p	Y					N	
	RLT	p	Y					N	
	CAN Prescaler	p	Y					N	
	MFS	p	Y					N	
	CAN FD	p	Y					N	
	PWM	p	Y					N	
	LCDE	p	Y					N	
SYSC1	SYSC1	p	N	Y				N	
	SW-WDG	p	N	Y				N	
Memory Config Group	WorkFLASH (Memory)		Y					N	
	WorkFLASH (IO)	p	Y					N	
	TCSRAM (IO)	p	Y					N	
	TCFLASH (IO)	p	Y					N	
	TPU	p	Y					N	
	IRC	p	Y					N	
	IRC (IRC0_NMIVASBR)		Y					N	
	IRC (IRC_NMIVASBR)	Y					N		
	BootROM IF (IO)	p(*1)	Y					N	
	BootROM IF (BootROM)		Y					N	

Slave		Master							
		CPU	DMAC#0	TIC	DAP	SHE	MLB	Ethernet	Graphic Subsystem
Common Peri Group #0	CAN FD	p	Y			N			
	RLT	p	Y			N			
	BT	p	Y			N			
	FRT	p	Y			N			
	ICU	p	Y			N			
	OCU	p	Y			N			
	QPRC	p	Y			N			
	MFS	p	Y			N			
	Misc Registers	p	Y			N			
	FPDLINK_CONV	p	Y			N			
Common Peri Group #1	SG	p	Y			N			
	RLT	p	Y			N			
	BT	p	Y			N			
	FRT	p	Y			N			
	ICU	p	Y			N			
	OCU	p	Y			N			
	QPRC	p	Y			N			
	MFS	p	Y			N			
	Misc Registers	p	Y			N			
	ADC12B	p	Y			N			
Common Peri Group #2	SMC	p	Y			N			
	SMC_Trg_Reg	p	Y			N			
	RLT	p	Y			N			
	BT	p	Y			N			
	CRC	p	Y			N			
	GPIO	p	Y			N			
	PPC	p	Y			N			
	RIC	p	Y			N			
Misc Registers	p	Y			N				
Bus Config Group	PPU_Master	Y					N		
	BPC	p	Y				N		
DMAC Complex#0	DMAC	p	N	Y			N		
	MPU_AHB	p	N	Y			N		
	DMAC Complex Additional (RLT, DMAAi_ASRn)	p	N	Y			N		

Y : access possible
N : access not possible
p : PPU protected

*1 : Privilege read access is always enabled whatever its PPU configuration is.
This is NOT to abort in reading exception vector register which located in BootROM interface, when CPU execute BootROM to branch to these exception handler.

*2 : Graphic subsystem masters can internally reach the own slaves

CHAPTER 36: Major Changes



Page	Section	Change Results
Revision 1.0		
-	-	Initial release
Revision 2.0		
-	-	See Supplementary Information as described in "CHAPTER 1:Overview 2. Document Definition"
Revision 3.0		
-	-	See Supplementary Information as described in "CHAPTER 1:Overview 2. Document Definition"
Revision 4.0		
-	-	See Supplementary Information as described in "CHAPTER 1:Overview 2. Document Definition"

Revision History



Document Revision History

Document Title: 32-bit Microcontroller Traveo™ Family S6J32E, S6J32F, S6J32G, S6J32H Series Hardware Manual Document Number: 002-12500			
Revision	ECN No.	Origin of Change	Description of Change
**	5240412	ANMA	New Specification
*A	5303329	ANMA	Media-LB: Figure 2-1: Corrected names of busses (CDT# 228789) PERI_4_S_AHB -> Slave-IF AHB PERI_4_M_AHB -> Master-IF AHB Function list: updated JTAG-ID table to latest specification and device plan Block diagram: changed from preliminary block diagram to same as NPP FPD-Link: 2. Configuration and Block Diagram Delete GEARS of setting 'LFCTRL_Release' from NOTE. FPD-Link: 4.3. Control1 Registers (CTRL1): Delete GEARS of setting 'LFCTRL_Release' from register lane of the CTRL1[31:24]. Change the [29:28]LFCTRL from 'Revised' to description of attachment picture. GDC-Subsystem: DesignDeliveryID: corrected bits from [7:3] to [7:4] (no functional change) Function list: changed picture and table for basic options contain only S6J32E, F G now; removed unnecessary notes below table
*B	5398012	ANMA	Chapter 32 Graphic sub system: VRamInterruptEnable: corrected bit#2 initial value from 1 to 0 for unused interrupt (BRONTES) Chapter 12 State transition: - updated Power on reset sequence picture (figure 3-1) Chapter 12 State transition: separated Hard-Reset (Figure 3-1) and Soft-reset because new Hard-Reset picture is bigger; adjusted Figure numbering Chapter 12: updated Figure 2-2 'RUN/PSS State definitions' allowing PD4_0/1 to be ON or OFF in PSS mode Chapter 21 Ethernet: Chapter 21.4.10 Typos in figure (bit14 and bit25) were corrected Chapter 21.4.11 Typos in figure (bit14, bit25, and bit27) were corrected. Chapter 21.4.12 Typos in figure (bit14 and bit27) were corrected. Chapter 21.4.43 Typo in figure (bit31-bit16) was corrected.

			Chapter 21.4.142 The bit number of the "disable_mask" bit was corrected to "9". Chapter 21.4.1 The range of reserved field in the description was aligned to the figure. Chapter 21.4.43 The reset value of revision_reg register was changed to 0x20070108 Chapter 21.3.1.4 In the Table 3-2, the width of Timestamp seconds field in the word3 of the descriptor was corrected to 10bits. Chapter 21.3.1.5 In the Table 3-3, the width of Timestamp seconds field in the word3 of the descriptor was corrected to 10bits. Chapter 21.3.9.1, 5.1 The explanation was corrected to explain that the bit13 of interrupt status register is never set for PFC pause frames. Chapter 21.5.1 was deleted, since the 3.9.1 was updated. Chapter 21.3.14 the maximum size of Jumbo frame was changed to "up to a software configurable number of bytes". The 10240 is expressed as "default". Chapter 21.4.90 The statement " this register must be written before the tsu_timer_incr register and the value written will not take effect until the tsu_timer_incr register is written to." was added to the description Chapter 21.5.5 Was deleted since corresponding bug was fixed Chapter21.3.1 At the end of Table 3-2, the statement was added to the note. Chapter21.3.2 At the end of Table 3-3, the statement was added to the note Chapter21.3.4 Replaced the words "DMA memory" with "the receive buffer in the AXI memory".(Following the GEM_GXL User's Guide "Receive DMA Buffers" section) Chapter21.4.1 Bit 26 of Network Control Register was changed to the reserved bit. Chapter21.4.90 Corrected the register description and figure. Chapter21.4.95 Corrected the description and figures about the count field. Chapter21.3.11 The 2nd step of "For receiver path" was deleted. Chapter21.4.43 The initial value of Revision register was changed to 0x30070108 Figure 3-2 Made new .emf file. And inserted to the correct position. All Replaced all occurrences of the word "Spansion" with the word "Cypress" All Replace the word "Bits" in the table header with the word "Bit". Chapter 29: FPD-Link Converter Chapter29.4.3 Updated note in LFCTRL detail description to write always 00 to LFCTRL
*C	5436383	ANMA	Updated Logo to new Cypress logo Chapter 2 Function list Section 2.1 Basic options: added option 'M' Section 2.2 ID: added Chip-ID and JTAG-ID for Revision 'M' Section 1 Function list: Graphic-TTL output/RSDS/FPD-link - added description which channel can be used on which output type Section 1 Function list: Display clock – corrected from 80 MHz to 64 MHz (same as AC –timing) Section 3.3 Register initial value: removed 'See note below' for LVDL2E, LVDL2R, LVDL2E because no note available and required

			Chapter 29 FPD-Link Figure 2-1: added name for the block diagram Figure 2-1: removed DLYD4, FRSEL, VRM because configuration is not allowed and removed the notes about the signals because they are removed now. Section 4.3 CTRL1: added more detailed note for LFCTRL-bits (also pointing to application note AN213250) Chapter 8 IRQ and NMI Map: removed RDY and HANG-IRQ for TCFlash as described in FL0026 (Interrupts are not allowed to use) Chapter 24 I2S: Add note about limitation of setting I2Sn_INTCNT:RFTH[3:0] and I2Sn_INTCNT:TFTH[3:0] Added reference to Sound system chapter for I2S connected to Sound system Chapter 26 PCMPWM: added reference to chapter "Sound System Configuration" for using DMA Add note that PCMPWmi_CONTROL:FTEST[4:0] must not be changed during DMA transfer Chapter 33 Soundsystem Configuration: Section 2. Configuration and Block Diagram/Figure 2-1: Add note about I2S limitation Section 4. Configuration and limitation of each module: - Add this section to explain the configuration and limitation of each module in the sound system Section 4.27: Change descriptions in "note" for MXFGnDADR register to explain that this register cannot be accessed from CPU. Section 4.4:Change the ACCESS_TYPE of reserved bits (bit 3 and bit 11) in MXICTRL register from R/W to R0,W0 Section 4.2, 4.3, 4.4. 4.10, 4.11, 4.12, 4.13, 4.14, 4.15, 4.19, 4.20, 4.21, 4.22, 4.23 and 4.24:Correct the order of bit field description for reserved bit. Section 4.24:Correct bit width and description for WFGnC in MXCHBUFFCNT Section 4.1, 4.9, 4.16, 4.17, 4.18, 4.19, 4.20, 4.21, 4.22, 4.24 and 4.26:Add bit field name to the table for bit field description. Section 3.1.1:Correct the interrupt name from DMAI error to DMA transfer error. Section 3.5:Correct channel number description. Section 3.5:Add description about FESTCHn value. Section 1. :Add comment to refer to the chapter of sound system configuration Section 3.5. :Add note about DMAEN bit operation when the mixing is stopped Section 4.1. :Add note about the bit operation of PMISn in MXCH register Section 4.2. :Add note about the bit operation of DATAN in MXOCTRL register Section 4.2. :Add note about the bit operation of MACRO in MXOCTRL register Section 4.3. :Add note about the bit operation of FESTCHn in MXDRQCTRL register Section 4.5. :Add note about the bit operation of PMISnMONO in MXMONO register Section 4.17. :Add note about the bit operation of PMISnBCLR in MXBUFFCLR register Section 4.1, .4.5 to 4.14 and 4.16. :Correct typos of "Chanel" to "Channel"
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			Section 4.4. :Correct typo of PMIS1REQ to PMIS1FREQ Section 4.24 :Correct typo of PMI2CNT to PMIS2CNT Section 4.24. :Correct typo of PMI0CNT to PMIS0CNT Chapter 19 Sound WFG Section 4.7 Add "note" for FSLEN bits to explain the read value when 00000 is written to the bits. Section 4.3, 4.4, 4.8, 4.9, 4.11 and 4.12: Correct the order of bit field description for reserved bit. Section 3.2 Change the interrupt name from "AHB Slave Error" to "AHB master Error" Section 3.1.6 Correct a typo about relation between FSLEN, Attack and Release Section 1. Add comment to refer to the chapter of sound system configuration Section 4.3. Add notes for CH0ADD and CH1ADD Section 4.4. Add notes for CH2ADD and CH3ADD Section 4.5. Add notes for CH4ADD Chapter 23 Stereo Audio DAC Section 1. :Add comment to refer to the chapter of sound system configuration Section 4.4. :Add note about the bit operation of FEST DACTRL register Section 4.4. :Add note about the bit operation of DMAEN DACTRL register Chapter 21 Ethernet Section 4.2: The descriptions (figure and table) for the Speed bit at the bit0 of network configuration register were added. Section 4.13. Interrupt Mask Register (ETHERNETn_int_mask) [bit8] changed "not_used" to "reserved" Chapter 11 Port configuration Section 3.1 RIC_RESIN527,528, 533 (RXD0/RMII_RXD0, RXD1/RMII_RXD1, RXER/RMII_RXER): changed bit 0 from '-' to 'set 1' Chapter 25 Programmable CRC Section 4.3: added bit name for bit[30] (FXOR) Chapter 32 Graphic Subsystem Section 4.2.3.4 register vram_errinj_data_s0_hi: Corrected bit names for bit[7:0] of from 'vram_errinj_s0_hi' to 'vram_errinj_data_s0_hi' Section 4.2.1 Address Block 0 - VRamInterruptPreset": - corrected bot[0] from VRamInterruptECC2DGCSysPreset to VRamInterruptECCBlitDrawCmdSysPreset Section 4.2.1 Address Block 0 - VRamInterruptClear: - corrected bit[0] from VRamInterruptECC2DGCSysClear to VRamInterruptECCBlitDrawCmdSysClear Section 4.2.1. Address Block 0 - VRamInterruptStatus: - corrected bit[0] from VRamInterruptECC2DGCSysStatus to VRamInterruptECCBlitDrawCmdSysStatus Section .2.5. Address Block 4 - ilaxibridge_LockStatus: - corrected bit[0] from ilaxibridge_FreezeStatus to ilaxibridge_LockStatus Chapter 2 Function List Section 1: Ethernet and Media-LB marked as 1ch instead of 'option' and removed 'see 2.1' for Ethernet and MediaLB because no difference between devices for these
*D	5515040	ANMA / ANZI / CASC /	Chapter 3 Product description Section 3.3 updated description of SYSC0_RUNLVDCFGR:LVDH2V Section 2.2 added limitation of RAM Guarantee feature

		GERH	Chapter 5 Clock configuration Table 2.1/2.2 removed LCD because not on the device Chapter 11 Port configuration Section 3.1, 3.4 added note for use of GPIO as input Section 3.3 Analog I/O Setting: Permitted to use Output function, Pull-up, Pull-down together with ADC Updated resource input configuration Section 3.2.4 Hyperbus_GPO: removed and added explanation in Hyperbus chapter 27 Chapter 13 Low-voltage Detection Section4 LVDL1V register bit description: changed description of setting "01" to "Not supported". 0.87V setting should not be used (already removed from datasheet) Added information about guaranteed MCU operation voltage range Chapter 27 Hyper bus Section 4.7: Added details about HYPERBUSIn_GPOR :GPO[1:0] configuration Chapter 29 FPD-Link CTRL1 register: Table for bits VCSEL and VDSEL: removed MIN/MAX value because it's redundant with DS. Only DS has min/max values. Typical value are kept in TRM Corrected DS-name in the note below the table Improved formatting of bit names in register pictures for better readability Chapter 32: Graphics Subsystem Section 3.1.2.1 "Capture Clock Measurement" corrected section location Section 4.2.2.3 Added description for maximum frequency calculation Section 4.2.2.9 Added description for maximum frequency calculation Appendix Chapter 1 Pin state: Removed comments related to LCD because not on this device Typos corrected, added legend Chapter 2 added Master Access Table
*E	5545128	ANZI	Chapter 13: Low-voltage Detection Section 4: Removed limitation that only interrupt function can be used when the LVD detection level is changed and added instruction for LVDH1 detection level change
*F	5917647	ANMA	Chapter 12: State transition Section 3/Figure 3-1: Corrected time (6) from 16.6ms to 14.2ms~33.3ms (16.6ms assumed trimmed oscillator) and added describing table below the chart Chapter 13: Low voltage detection Section 5.4: LVDH1S: added note about PSC_1 control and that bit needs to be set to '0' if VCC12 is switched off Chapter 10 Port Description Ethernet-CRS: removed completely because Half-duplex mode is not supported Ethernet-COL: removed completely because Half-duplex mode and collision detection

			is not supported Ethernet-RXDV: added pin 34 for QFP-216 and QFP-208 for S6J32E/F/GxxxN Chapter 11 Port Configuration Section 3.1 Resource Input Configuration Module: RIC_RESIN526: Changed function from CRS to RXDV and assigned RXDV pins P0_15 and P5_27 to bit 0 and bit 1 RIC_RESIN531 (COL): Removed because collision detection is not supported Added note that muxing of RXDV is not supported for revision M Chapter 2 Function list: Section 2.1 Basic Option: Added revision N for RXDV pinning extension Section 2.2 ID: Added IDs revision N Chapter 2 Function list: Section 2.1 Basic options: removed revision H because not offered Section 2.2 ID: removed ID-table for revision H Chapter 12 State transition: Added figure 4-4 " PSS to RUN Timing Chart wit times in case Fast-CR is stopped" Chapter 3.5 Output drive capacity settings: Removed 'revision D' from remarks of some pins (this revision has no meaning for this device)
*G	6195766	ANMA	Chapter 2 Function list: Section 2.1 Basic options: Added footnote where to find the FLxxx Section 2.1: Added revision P; added option H for revision N Section 2.2: Added revision P for the IDs Added IDs for revision N and option H removed 256-pin package Chapter 3 Product description: Section 2: removed 256-pin package Chapter 10 Port Description List: Section 1: changed description of M_SSEL0/1 and G_SSEL0/1
*H	6319895	MFEU	Added S6J32H