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MB90360E Series

F²MC-16LX 16-bit Microcontroller Datasheet

The MB90360E-series, loaded 1 channel FULL-CAN* interface and Flash ROM, is general-purpose Cypress 16-bit microcontroller designing for automotive and industrial applications. Its main feature is the on-board CAN Interfaces, which conform to Ver 2.0 Part A and Part B, while supporting a very flexible message buffer scheme and so offering more functions than a normal FULL-CAN approach. With the new 0.35 µm CMOS technology, Cypress now offers on-chip Flash ROM program memory up to 64 Kbytes.

The power supply (3 V) is supplied to the MCU core from an internal regulator circuit. This creates a major advantage in terms of EMI and power consumption.

The internal PLL clock frequency multiplier provides an internal 42 ns instruction execution time from an external 4 MHz clock. Also, main and sub clock can be monitored independently using the clock supervisor function.

The unit features a 4-channel input capture unit 1 channel 16-bit free running timer, 2-channel LIN-UART, and 16-channel 8/10-bit A/D converter as the peripheral resource.

*: Controller Area Network (CAN) - License of Robert Bosch GmbH

Features

Clock

- Built-in PLL clock frequency multiplication circuit
- Selection of machine clocks (PLL clocks) is allowed among frequency division by 2 on oscillation clock and multiplication of 1 to 6 times of oscillation clock (for 4 MHz oscillation clock, 4 MHz to 24 MHz)
- Operation by sub clock : internal operating clock frequency: up to 50 kHz (for operating with 100 kHz oscillation clock divided two and devices without S-suffix only) is available
- Minimum execution time of instruction: 42 ns (when operating with 4-MHz oscillation clock and 6-time multiplied PLL clock)

Clock supervisor (MB90x367x only)

- Main clock or sub clock is monitored independently

Instruction system best suited to controller

- 16 Mbytes CPU memory space
- 24-bit internal addressing
- Wide choice of data types (bit, byte, word, and long word)
- Wide choice of addressing modes (23 types)
- Enhanced multiply-divide instructions with sign and RETI instructions
- Enhanced high-precision computing with 32-bit accumulator

Instruction system compatible with high-level language (C language) and multitask

- Employing system stack pointer
- Enhanced various pointer indirect instructions
- Barrel shift instructions

Increased processing speed

4-byte instruction queue

Powerful interrupt function

- Powerful 8-level, 34-condition interrupt feature
- Up to 8 channels external interrupts are supported

Automatic data transfer function independent of CPU

Expanded intelligent I/O service function (EI²OS) : up to 16 channels

Low power consumption (standby) mode

- Sleep mode (a mode that halts CPU operating clock)
- Main timer mode (timebase timer mode that is transferred from main clock mode)
- PLL timer mode (timebase timer mode that is transferred from PLL clock mode)
- Watch mode (a mode that operates sub clock and watch timer only, devices without S-suffix)
- Stop mode (a mode that stops oscillation clock and sub clock)
- CPU blocking operation mode

Process

CMOS technology

I/O port

General purpose input/output port (CMOS output) :
- 34 ports (devices without S-suffix)
- 36 ports (devices with S-suffix)

Sub clock pin (X0A and X1A)

- Provided (used for external oscillation), devices without S-suffix
- Not provided, devices with S-suffix

Timer

- Timebase timer, watch timer (device without S-suffix) , watchdog timer: 1 channel

- 8/16-bit PPG timer: 8-bit × 4 channels or 16-bit × 2 channels
- 16-bit reload timer: 2 channels
- 16- bit input/output timer
  - 16-bit free-run timer: 1 channel (FRT0: ICU 0/1/2/3)
  - 16- bit input capture: (ICU) : 4 channels

FULL-CAN interface: 1 channel

- Compliant with CAN specifications Version 2.0 Part A and B
- 16 message buffers are built in
- CAN wake-up function

LIN-UART: 2 channels

- Equipped with full-duplex double buffer
- Clock-asynchronous or clock-synchronous serial transmission is available

DTP/External interrupt: up to 8 channels, CAN wakeup: up to 1 channel

Module for activation of expanded intelligent I/O service (EI^2OS) and generation of external interrupt by external input

Delay interrupt generator module

Generates interrupt request for task switching

8/10-bit A/D converter: 16 channels

- Resolution is selectable between 8-bit and 10-bit
- Activation by external trigger input is allowed
- Conversion time: 3 µs (at 24-MHz machine clock, including sampling time)

Address matching detection (program patch) function

Address matching detection for 6 address pointers

Low voltage/CPU operation detection reset (devices with T-suffix)

- Detects low voltage (4.0 V ± 0.3 V) and resets automatically
- Resets automatically when program is runaway and counter is not cleared within interval time
  (approx. 262 ms: external 4 MHz)

Capable of changing input voltage for port

Automotive/CMOS-Schmitt input level (initial level is Automotive in single-chip mode)

Flash memory security function

Protects the content of Flash memory (MB90F362x, MB90F367x only)

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1. Product Lineup

Features	MB90362E	MB90362TE	MB90362ES	MB90362TES	MB90V340E-101	MB90V340E-102
Type	MASK ROM product				Evaluation product	
CPU	F^2MC-16LX CPU					
System clock	PLL clock multiplier (× 1, × 2, × 3, × 4, × 6, 1/2 when PLL stops) Minimum instruction execution time: 42 ns (4 MHz oscillation clock, PLL × 6)					
Sub clock pin (X0A, X1A)	Yes		No		No	Yes
Clock supervisor	No					
ROM	MASK ROM, 64 Kbytes				External	
RAM capacitance	3 Kbytes				30 Kbytes	
CAN interface	1 channel				3 channels	
LIN-UART	2 channels					
Low voltage/CPU operation detection reset	No	Yes	No	Yes	No	
Package	LQFP-48P				PGA-299C	
Emulator-specific power supply *	—				Yes	
Corresponding evaluation product	MB90V340E-102		MB90V340E-101		—	

*: It is setting of Jumper switch (TOOL VCC) when emulator (MB2147-01) is used. Please refer to the Emulator hardware manual for the details.

Features	MB90F362E	MB90F362TE	MB90F362ES	MB90F362TES
Type	Flash memory product			
CPU	F^2MC-16LX CPU			
System clock	PLL clock multiplier (× 1, × 2, × 3, × 4, × 6, 1/2 when PLL stops) Minimum instruction execution time: 42 ns (4 MHz oscillation clock, PLL × 6)			
Sub clock pin (X0A, X1A)	Yes		No	
Clock supervisor	No			
ROM	Flash memory, 64 Kbytes			
RAM capacitance	3 Kbytes			
CAN interface	1 channel			
LIN-UART	2 channels			
Low voltage/CPU operation detection reset	No	Yes	No	Yes
Package	LQFP-48P			
Corresponding evaluation product	MB90V340E-102		MB90V340E-101	

Features	MB90367E	MB90367TE	MB90367ES	MB90367TES	MB90V340E-103	MB90V340E-104
Type	MASK ROM product				Evaluation product	
CPU	F^2MC-16LX CPU					
System clock	PLL clock multiplier (× 1, × 2, × 3, × 4, × 6, 1/2 when PLL stops) Minimum instruction execution time: 42 ns (4 MHz oscillation clock, PLL × 6)					
Sub clock pin (X0A, X1A)	Yes		No			Yes
Clock supervisor	Yes					
ROM	MASK ROM, 64 Kbytes				External	
RAM capacitance	3 Kbytes				30 Kbytes	
CAN interface	1 channel				3 channels	
LIN-UART	2 channels					
Low voltage/CPU operation detection reset	No	Yes	No	Yes	No	
Package	LQFP-48P				PGA-299C	
Emulator-specific power supply *	–				Yes	
Corresponding EVA product	MB90V340E-104		MB90V340E-103		–	

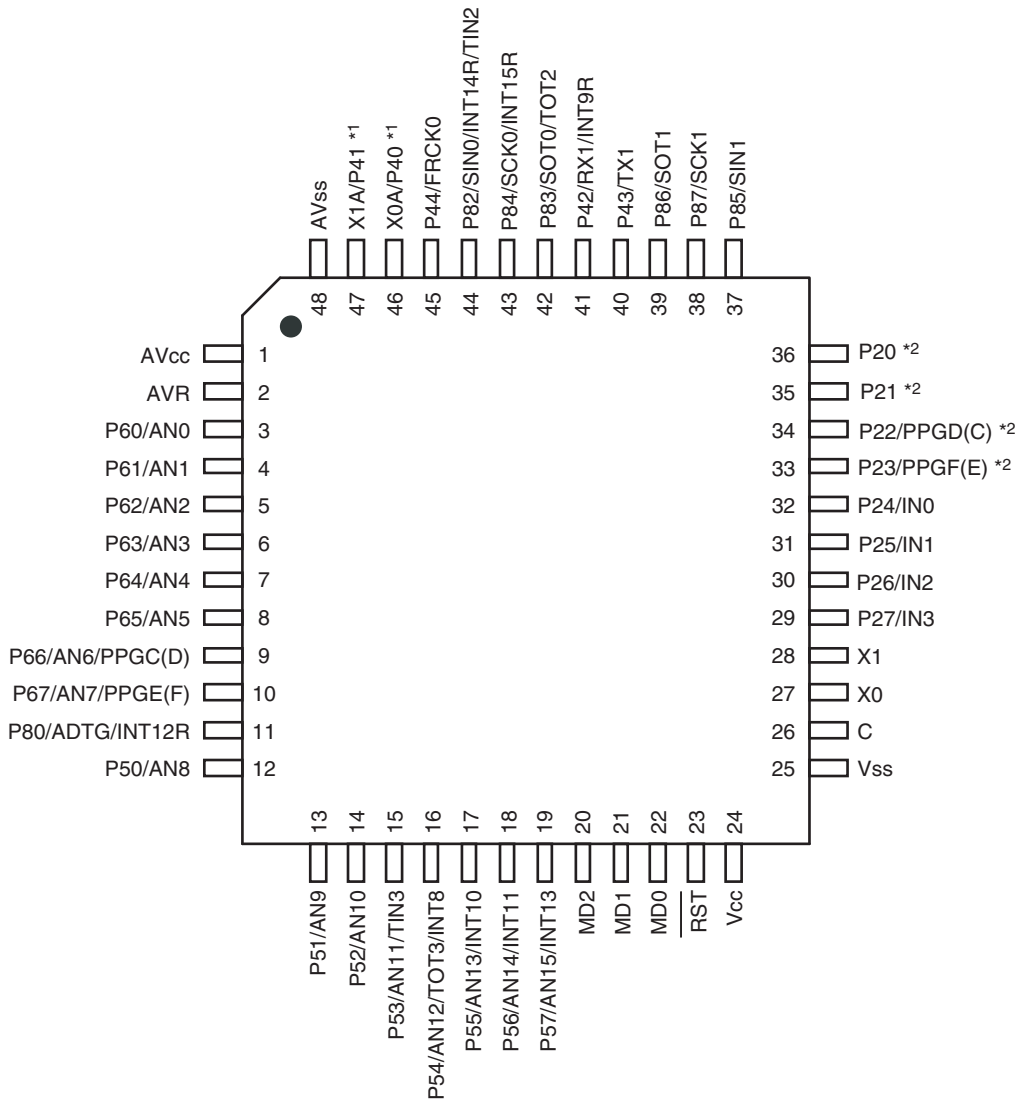
*: It is setting of Jumper switch (TOOL VCC) when emulator (MB2147-01) is used. Please refer to the Emulator hardware manual for the details.

Features	MB90F367E	MB90F367TE	MB90F367ES	MB90F367TES
Type	Flash memory product			
CPU	F^2MC-16LX CPU			
System clock	PLL clock multiplier (× 1, × 2, × 3, × 4, × 6, 1/2 when PLL stops) Minimum instruction execution time: 42 ns (4 MHz oscillation clock, PLL × 6)			
Sub clock pin (X0A, X1A)	Yes		No	
Clock supervisor	Yes			
ROM	Flash memory, 64 Kbytes			
RAM capacitance	3 Kbytes			
CAN interface	1 channel			
LIN-UART	2 channels			
Low voltage/CPU operation detection reset	No	Yes	No	Yes
Package	LQFP-48P			
Corresponding EVA product	MB90V340E-104		MB90V340E-103	

2. Pin Assignment

■ **MB90F362E/TE/ES/TES, MB90362E/TE/ES/TES, MB90F367E/TE/ES/TES, MB90367E/TE/ES/TES**

(TOP VIEW)



(FPT-48P-M26)

*1 : MB90F362E/TE, MB90362E/TE, MB90F367E/TE, MB90367E/TE : X0A, X1A
MB90F362ES/TES, MB90362ES/TES, MB90F367ES/TES, MB90367ES/TES : P40, P41

*2 : High current output port

3. Pin Description

Pin No.	Pin name	I/O circuit type*	Function
1	AV_{CC}	I	V_{CC} power input pin for analog circuit.
2	AVR	–	Power (Vref+) input pin for A/D converter. It should be below V_{CC}.
3 to 8	P60 to P65	H	General-purpose I/O port.
	AN0 to AN5		Analog input pins for A/D converter.
9, 10	P66, P67	H	General-purpose I/O port.
	AN6, AN7		Analog input pins for A/D converter.
	PPGC (D) , PPGE (F)		Output pins for PPG.
11	P80	F	General-purpose I/O port.
	ADTG		Trigger input pin for A/D converter.
	INT12R		External interrupt request input pin for INT12.
12 to 14	P50 to P52	H	General-purpose I/O port (P50 has different I/O circuit type from MB90V340E) .
	AN8 to AN10		Analog input pins for A/D converter.
15	P53	H	General-purpose I/O port.
	AN11		Analog input pin for A/D converter.
	TIN3		Event input pin for reload timer 3.
16	P54	H	General-purpose I/O port.
	AN12		Analog input pin for A/D converter.
	TOT3		Output pin for reload timer 3
	INT8		External interrupt request input pin for INT8.
17 to 19	P55 to P57	H	General-purpose I/O port.
	AN13 to AN15		Analog input pins for A/D converter.
	INT10, INT11, INT13		External interrupt request input pins for INT10, INT11, INT13.
20	MD2	D	Input pin for operation mode specification.
21, 22	MD1, MD0	C	Input pins for operation mode specification.
23	$\overline{RST}$	E	Reset input pin.
24	V_{CC}	–	Power input pin (3.5 V to 5.5 V) .
25	V_{SS}	–	Power input pin (0 V) .
26	C	I	Power supply stabilization capacitor pin. It should be connected to a higher than or equal to 0.1 µF ceramic condenser.

(Continued)

Pin No.	Pin name	I/O circuit type*	Function
27	X0	A	Oscillation input pin.
28	X1		Oscillation output pin.
29 to 32	P27 to P24	G	General-purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	IN3 to IN0		Event input pins for input capture 0 to 3.
33, 34	P23, P22	J	General-purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode. High current output port.
	PPGF (E) , PPGD (C)		Output pins for PPG.
35, 36	P21, P20	J	General-purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode. High current output port.
37	P85	K	General-purpose I/O port.
	SIN1		Serial data input pin for LIN-UART1.
38	P87	F	General-purpose I/O port.
	SCK1		Clock I/O pin for LIN-UART1.
39	P86	F	General-purpose I/O port.
	SOT1		Serial data output pin for LIN-UART1.
40	P43	F	General-purpose I/O port.
	TX1		TX output pin for CAN1 interface.
41	P42	F	General-purpose I/O port.
	RX1		RX input pin for CAN1 interface.
	INT9R		External interrupt request input pin for INT9 (Sub) .
42	P83	F	General-purpose I/O port.
	SOT0		Serial data output pin for LIN-UART0.
	TOT2		Output pin for reload timer 2.
43	P84	F	General-purpose I/O port.
	SCK0		Clock I/O pin for LIN-UART0.
	INT15R		External interrupt request input pin for INT15.

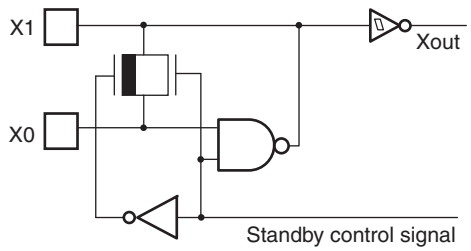
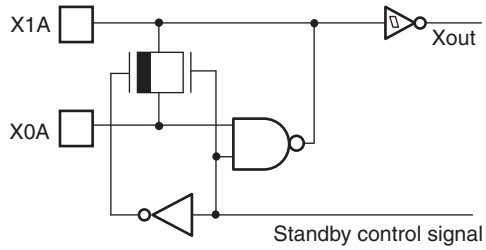
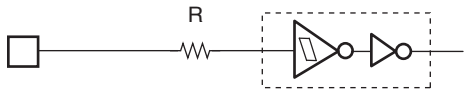
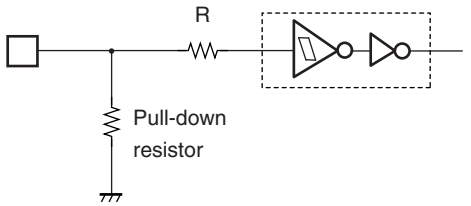
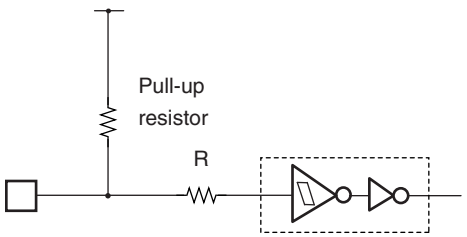
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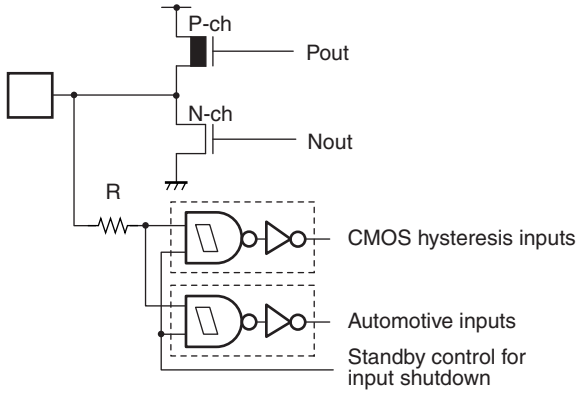
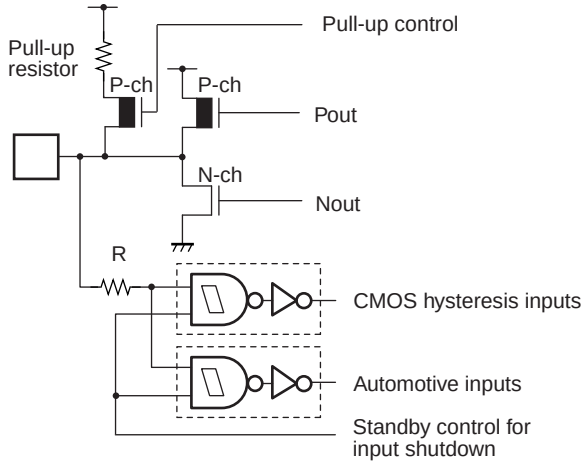
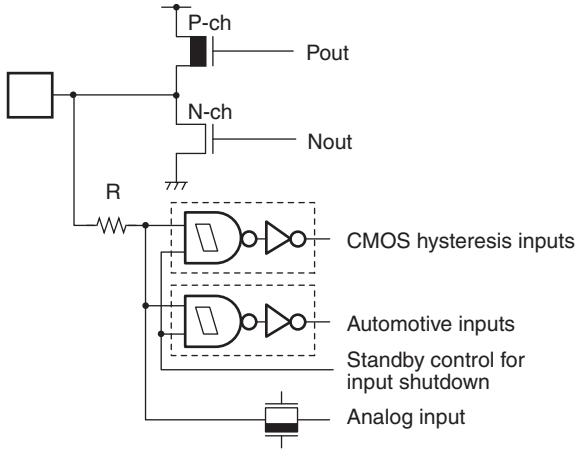
Pin No.	Pin name	I/O circuit type*	Function
44	P82	K	General-purpose I/O port.
	SIN0		Serial data input pin for LIN-UART0.
	INT14R		External interrupt request input pin for INT14.
	TIN2		Event input pin for reload timer 2.
45	P44	F	General-purpose I/O port (Different I/O circuit type from MB90V340E) .
	FRCK0		Free-run timer 0 clock pin.
46, 47	P40, P41	F	General-purpose I/O port (Devices with S-suffix and MB90V340E-101/103 only) .
	X0A, X1A	B	Oscillation pins for sub clock (Devices without S-suffix and MB90V340E-102/104 only) .
48	AV_{SS}	I	V_{SS} power input pin for analog circuit.

*: For the I/O circuit type, refer to "I/O Circuit Type"

4. I/O Circuit Type

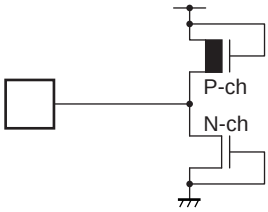
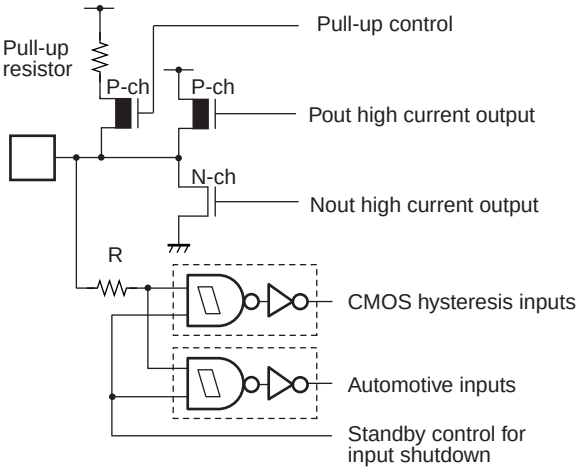
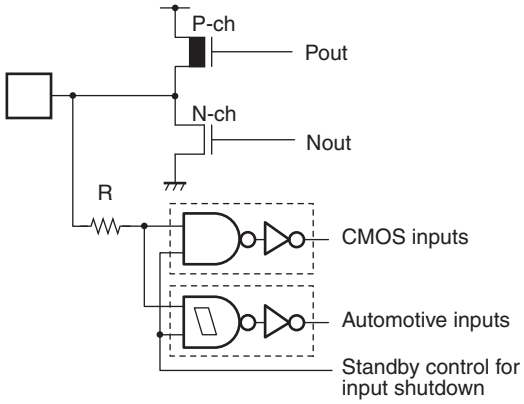
Type	Circuit	Remarks
A		Oscillation circuit: High-speed oscillation feedback resistor = approx. 1 MΩ
B		Oscillation circuit: Low-speed oscillation feedback resistor = approx. 10 MΩ
C		■ MASK ROM product: CMOS hysteresis input pin ■ Flash memory product: CMOS input pin
D		■ MASK ROM product: CMOS hysteresis input pin ■ Flash memory product: - CMOS input pin - No Pull-down
E		CMOS hysteresis input pin

(Continued)

Type	Circuit	Remarks
F		■ CMOS level output ■ CMOS hysteresis inputs (With the standby-time input shutdown function) ■ Automotive input (With the standby-time input shutdown function)
G		■ CMOS level output ■ CMOS hysteresis inputs (With the standby-time input shutdown function) ■ Automotive input (With the standby-time input shutdown function)
H		■ CMOS level output ■ CMOS hysteresis inputs (With the standby-time input shutdown function) ■ Automotive input (With the standby-time input shutdown function) ■ A/D analog input

(Continued)

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Type	Circuit	Remarks
I		Protection circuit for power supply input
J		■ CMOS level output ■ CMOS hysteresis inputs (With the standby-time input shutdown function) ■ Automotive input (With the standby-time input shutdown function)
K		■ CMOS level output ■ CMOS input (With standby-time input shutdown function) ■ Automotive input (With standby-time input shutdown function)

5. Handling Devices

1. Preventing latch-up

CMOS IC chips may suffer latch-up under the following conditions:

- A voltage higher than V_{CC} pin or lower than V_{SS} pin is applied to an input or output pin.
- A voltage higher than the rated voltage is applied between V_{CC} pin and V_{SS} pin.
- The AV_{CC} power supply is applied before the V_{CC} voltage.

Latch-up may increase the power supply current drastically, causing thermal damage to the device.

Use meticulous care not to exceed the rating.

For the same reason, also be careful not to let the analog power-supply voltage (AV_{CC}, AVR) exceed the digital power-supply voltage.

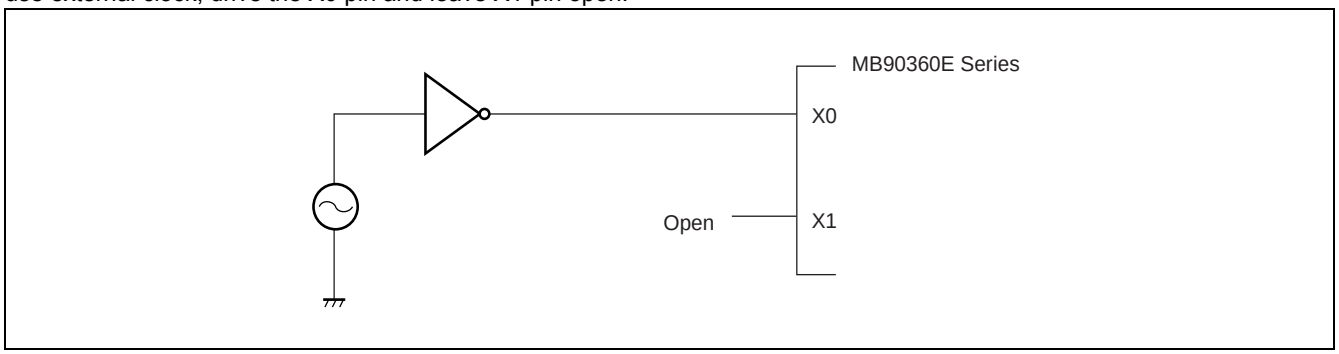
2. Treatment of unused pins

Leaving unused input pins open may result in permanent damage of the device due to misbehavior or latch-up. Therefore, they must be pulled up or pulled down through resistors. In this case, those resistors should be more than 2 kΩ .

Unused bidirectional pins should be set to the output state and can be left open, or the input state with the above described connection.

3. Using external clock

To use external clock, drive the X0 pin and leave X1 pin open.



4. Precautions for when not using a sub clock signal

If you do not connect pins X0A and X1A to an oscillator, use pull-down handling on the X0A pin and leave the X1A pin open.

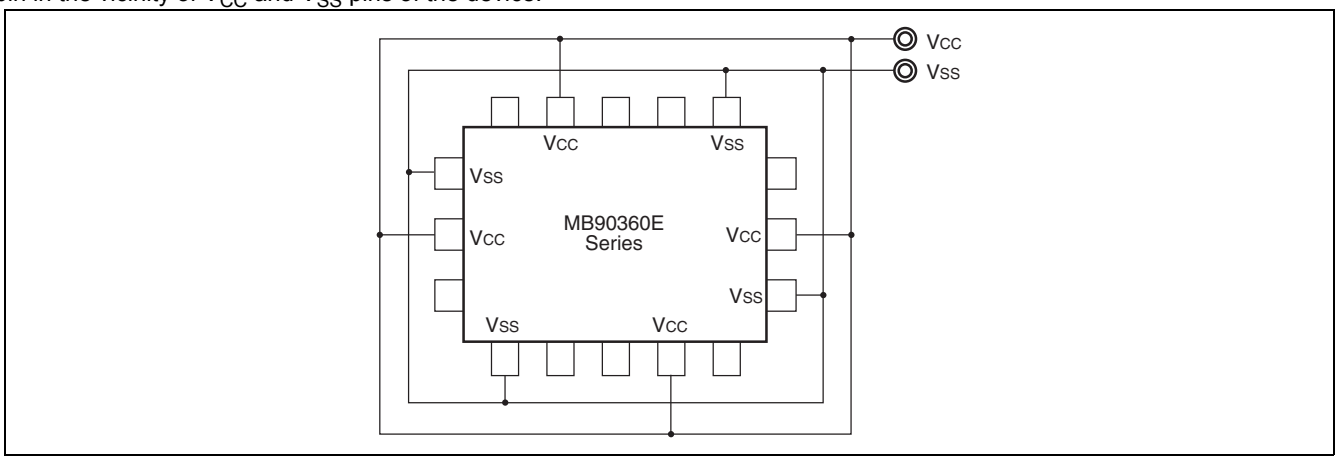
5. Notes on during operation of PLL clock mode

On this microcontroller, if in case the crystal oscillator breaks off or an external reference clock input stops while the PLL clock mode is selected, a self-oscillator circuit contained in the PLL may continue its operation at its self-running frequency. However, Fujitsu will not guarantee results of operations if such failure occurs.

6. Power supply pins (V_{CC}/V_{SS})

- If there are multiple V_{CC} and V_{SS} pins, from the point of view of device design, pins to be of the same potential are connected the inside of the device to prevent malfunction such as latch-up.
  To reduce unnecessary radiation, prevent malfunctioning of the strobe signal due to the rise of ground level, and observe the standard for total output current, be sure to connect the V_{CC} and V_{SS} pins to the power supply and ground externally.
- Connect V_{CC} and V_{SS} pins to the device from the current supply source at a low impedance.

■ As a measure against power supply noise, connect a capacitor of about 0.1 μF as a bypass capacitor between V_{CC} pin and V_{SS} pin in the vicinity of V_{CC} and V_{SS} pins of the device.



7. Pull-up/down resistors

The MB90360E Series does not support internal pull-up/down resistors (Port 2: built-in pull-up resistors) . Use external components where needed.

8. Crystal oscillator circuit

Noises around X0 or X1 pin may be possible causes of abnormal operations. Make sure to provide bypass capacitors via shortest distance from X0, X1 pins, crystal oscillator (or ceramic resonator) and ground lines, and make sure, to the utmost effort, that lines of oscillation circuit do not cross the lines of other circuits.

It is highly recommended to provide a printed circuit board artwork surrounding X0 and X1 pins with a ground area for stabilizing the operation. Please ask the crystal maker to evaluate the oscillational characteristics of the crystal and this device.

9. Turning-on sequence of power supply to A/D converter and analog inputs

Make sure to turn on the A/D converter power supply (AV_{CC} and AVR) and analog inputs (AN0 to AN15) after turning-on the digital power supply (V_{CC}) .

Turn-off the digital power after turning off the A/D converter power supply and analog inputs. In this case, make sure that the voltage does not exceed AVRH or AV_{CC} (turning on/off the analog and digital power supplies simultaneously is acceptable).

10. Connection of unused pins of A/D converter if A/D converter is not used

Connect unused pins of A/D converter to $AV_{CC} = V_{CC}$, $AV_{SS} = AVR = V_{SS}$.

11. Notes on energization

To prevent the internal regulator circuit from malfunctioning, set the voltage rise time during energization at 50 μs or more (0.2 V to 2.7 V) .

12. Stabilization of power supply voltage

A sudden change in the power supply voltage may cause the device to malfunction even within the specified V_{CC} power supply voltage operating guarantee range. Therefore, the V_{CC} power supply voltage should be stabilized.

For reference, the power supply voltage should be controlled so that V_{CC} ripple variations (peak-to-peak value) at commercial frequencies (50 Hz/60 Hz) fall below 10% of the standard V_{CC} power supply voltage and the coefficient of transient fluctuation does not exceed 0.1 V/ms at instantaneous power switching.

13. Initialization

In the device, there are internal registers which are initialized only by a power-on reset. To initialize these registers, turn on the power again.

14. Notes on using CAN function

To use CAN function, please set ’1’ to DIRECT bit of CAN direct mode register (CDMR) .
If DIRECT bit is set to ’0’ (initial value) , wait states will be performed when accessing CAN registers.

Note: Please refer to Hardware Manual of “MB90360E series for detail of CAN Direct Mode Register”.

15. Flash security function

The security bit is located in the area of the Flash memory.
If protection code 01_H is written in the security bit, the Flash memory is in the protected state by security.
Therefore, please do not write 01_H in this address if you do not use the security function.
Please refer to following table for the address of the security bit.

	Flash memory size	Address for security bit
MB90F362E MB90F362ES MB90F362TE MB90F362TES MB90F367E MB90F367ES MB90F367TE MB90F367TES	Embedded 512 Kbits Flash Memory	$FF0001_H$

16. Correspondence with T_A = +105 °C or more

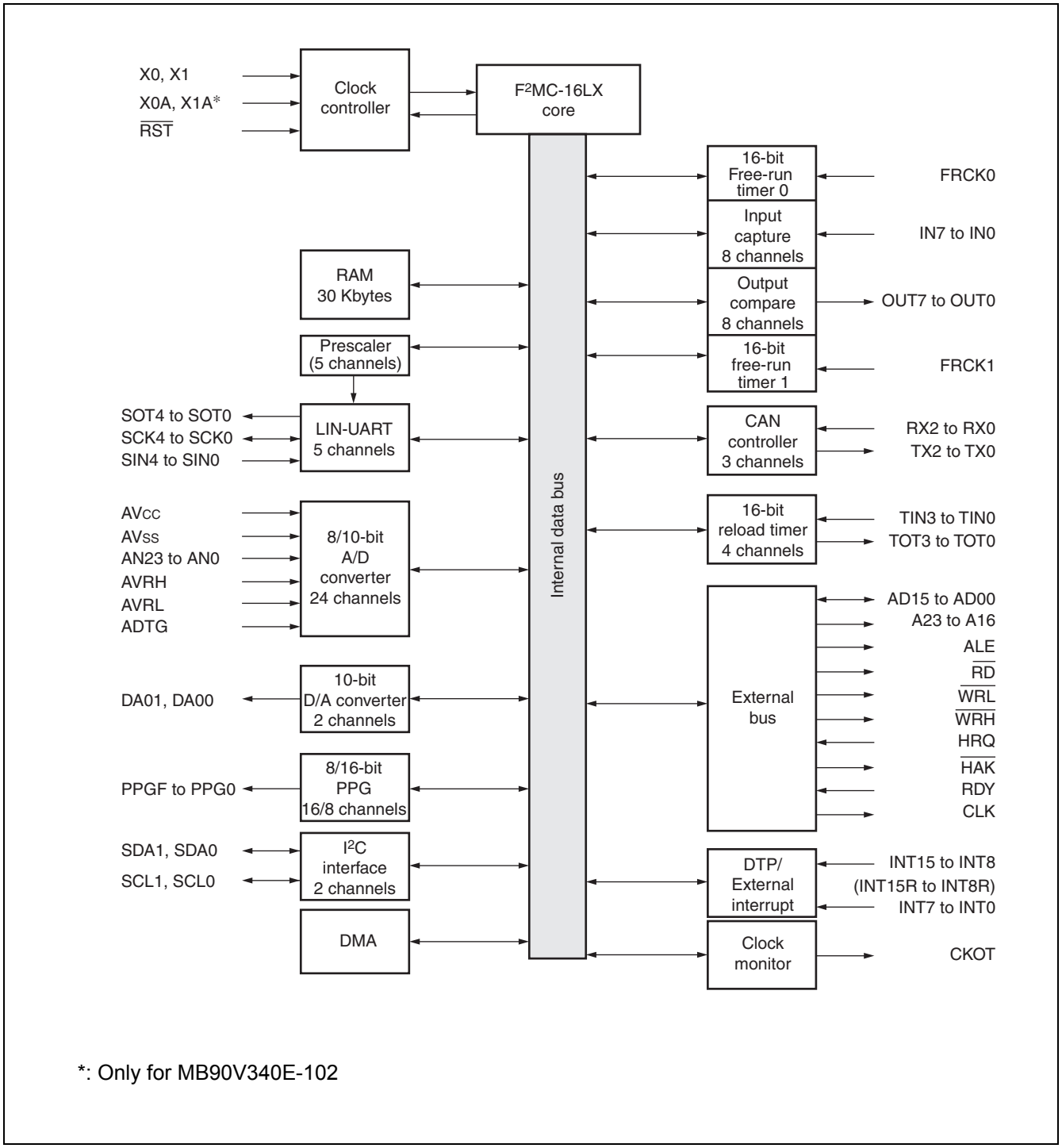
There is a restriction of reliability if the product is used exceeding $T_A = +105$ °C.
Contact the sales or support representative.
It is ensured to write/erase data to the Flash memory between $T_A = -40$ °C and +105 °C.

17. Serial communication

There is a possibility to receive wrong data due to the noise or other causes on the serial communication.
Therefore, design a printed circuit board so as to avoid noise.
Retransmit the data if an error occurs because of applying the checksum to the last data in consideration of receiving wrong data due to the noise.

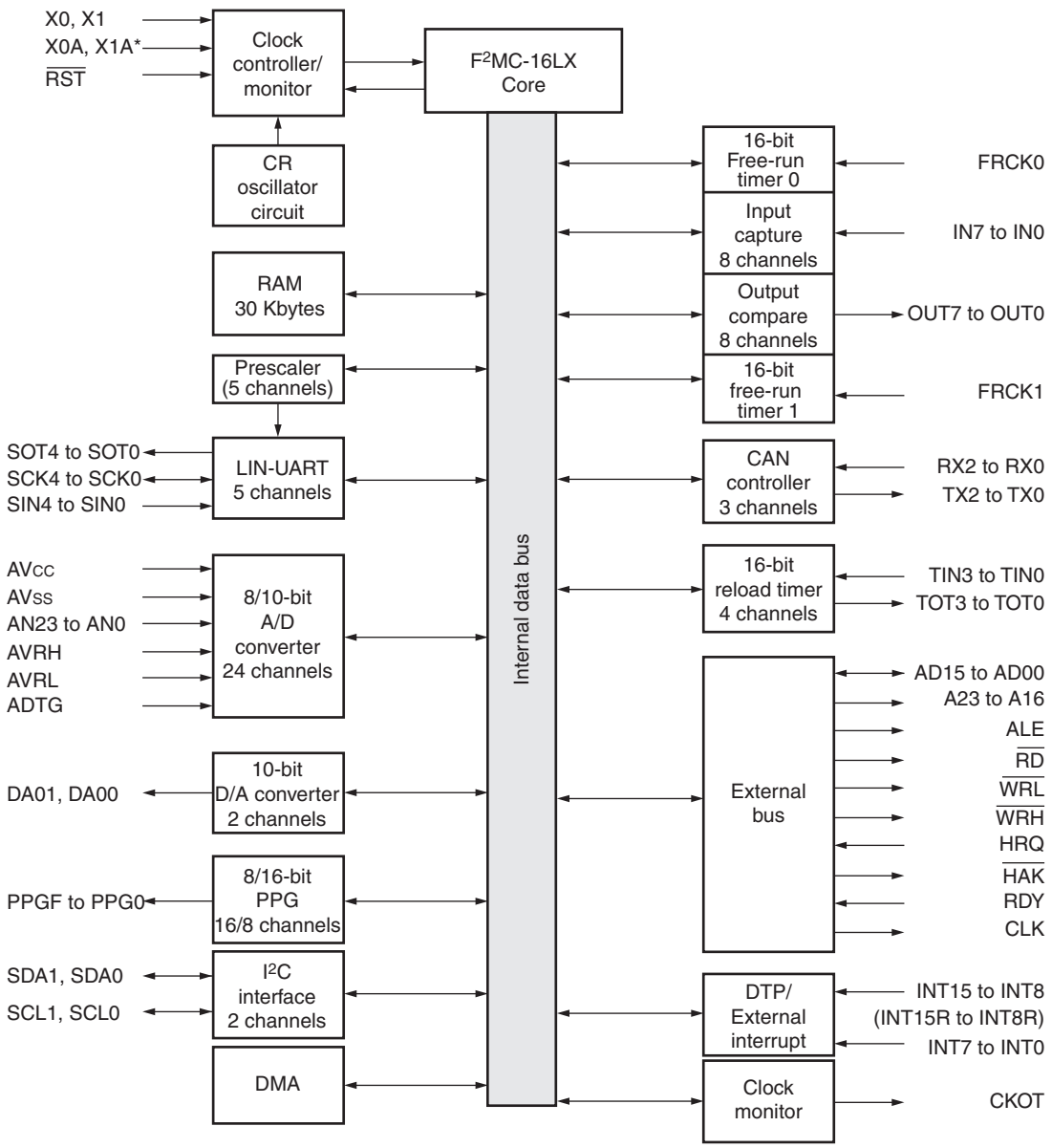
6. Block Diagrams

■ **MB90V340E-101/102**



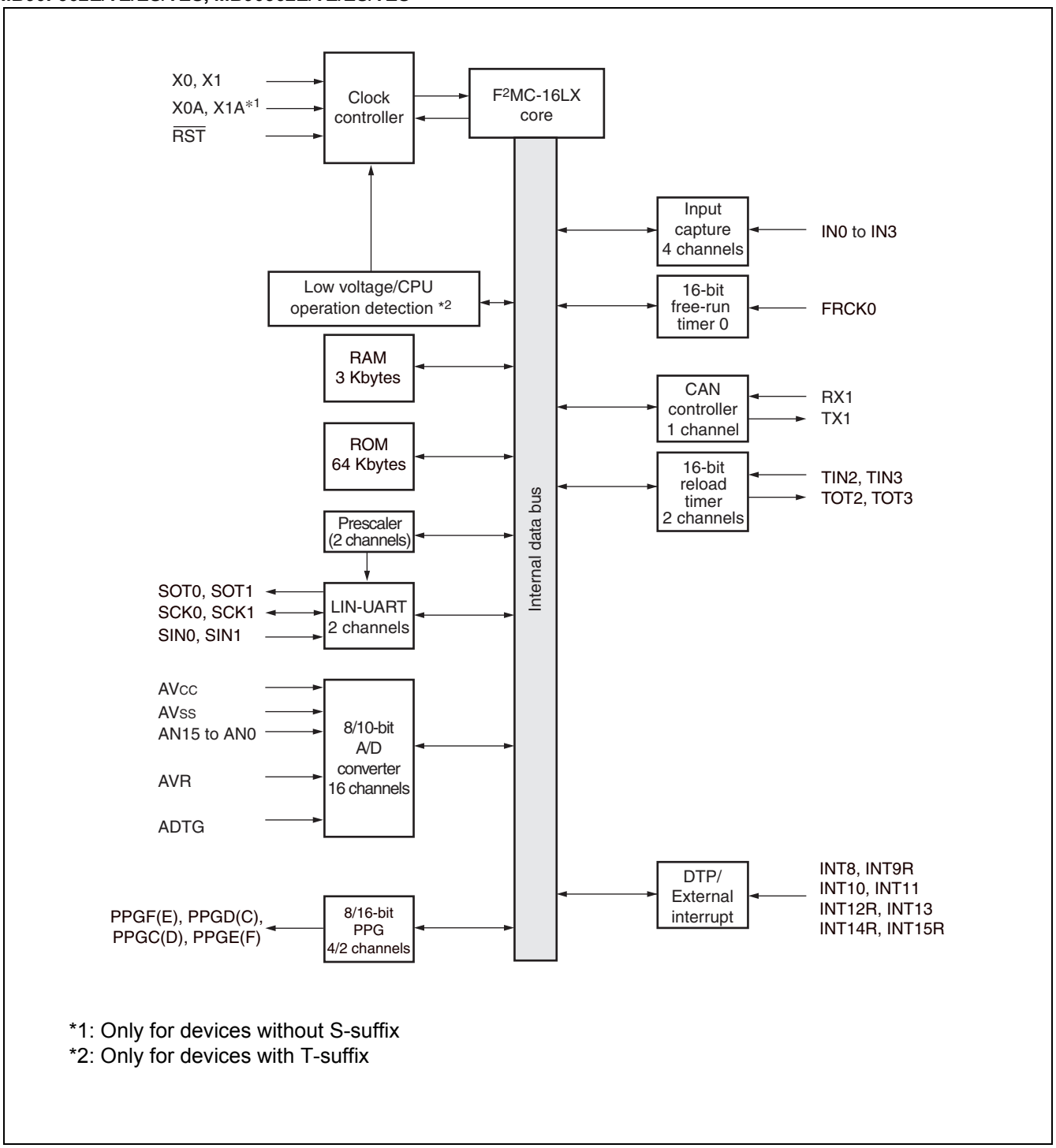
*: Only for MB90V340E-102

■ **MB90V340E-103/104**



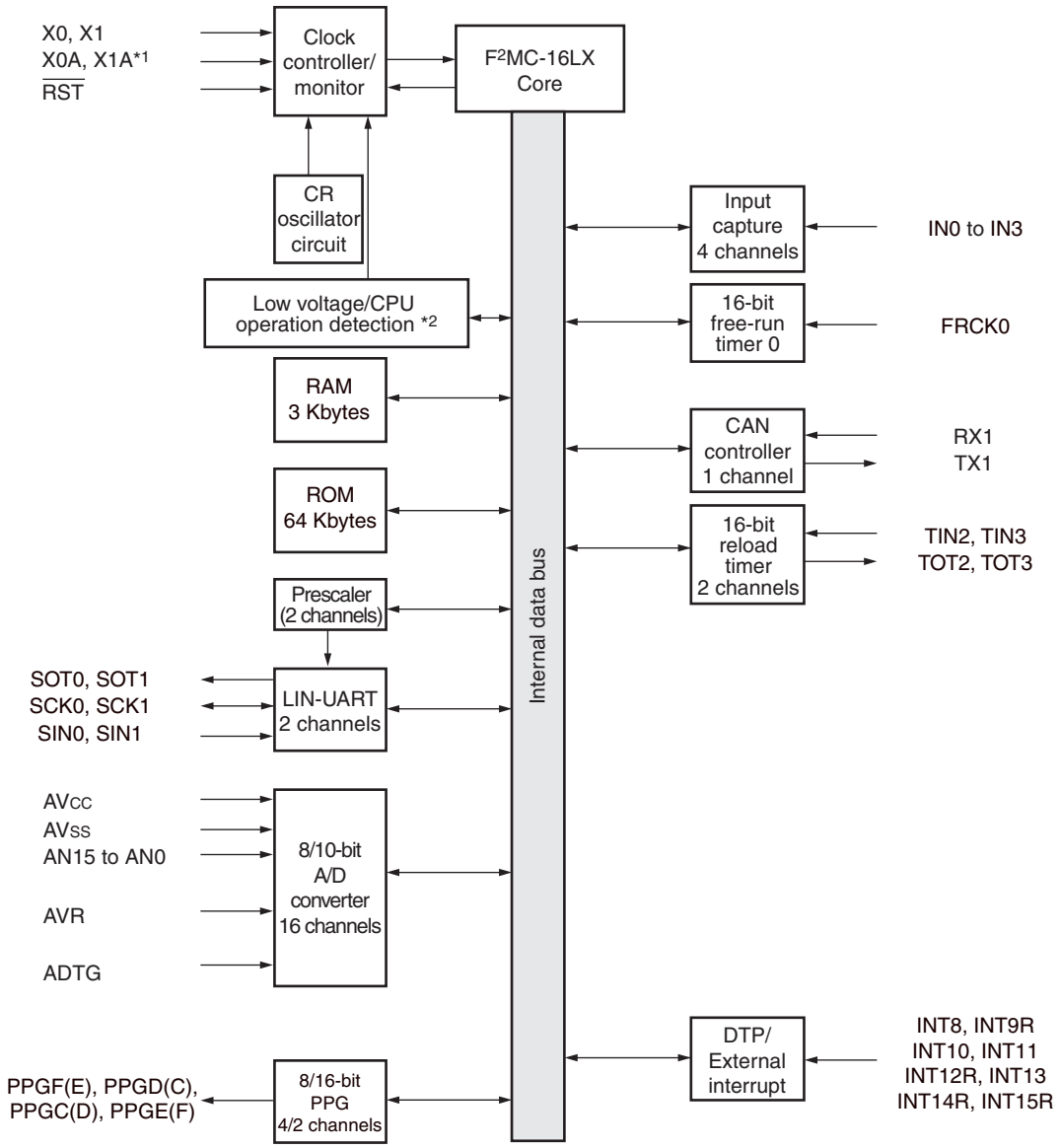
*: Only for MB90V340E-104

■ **MB90F362E/TE/ES/TES, MB90362E/TE/ES/TES**



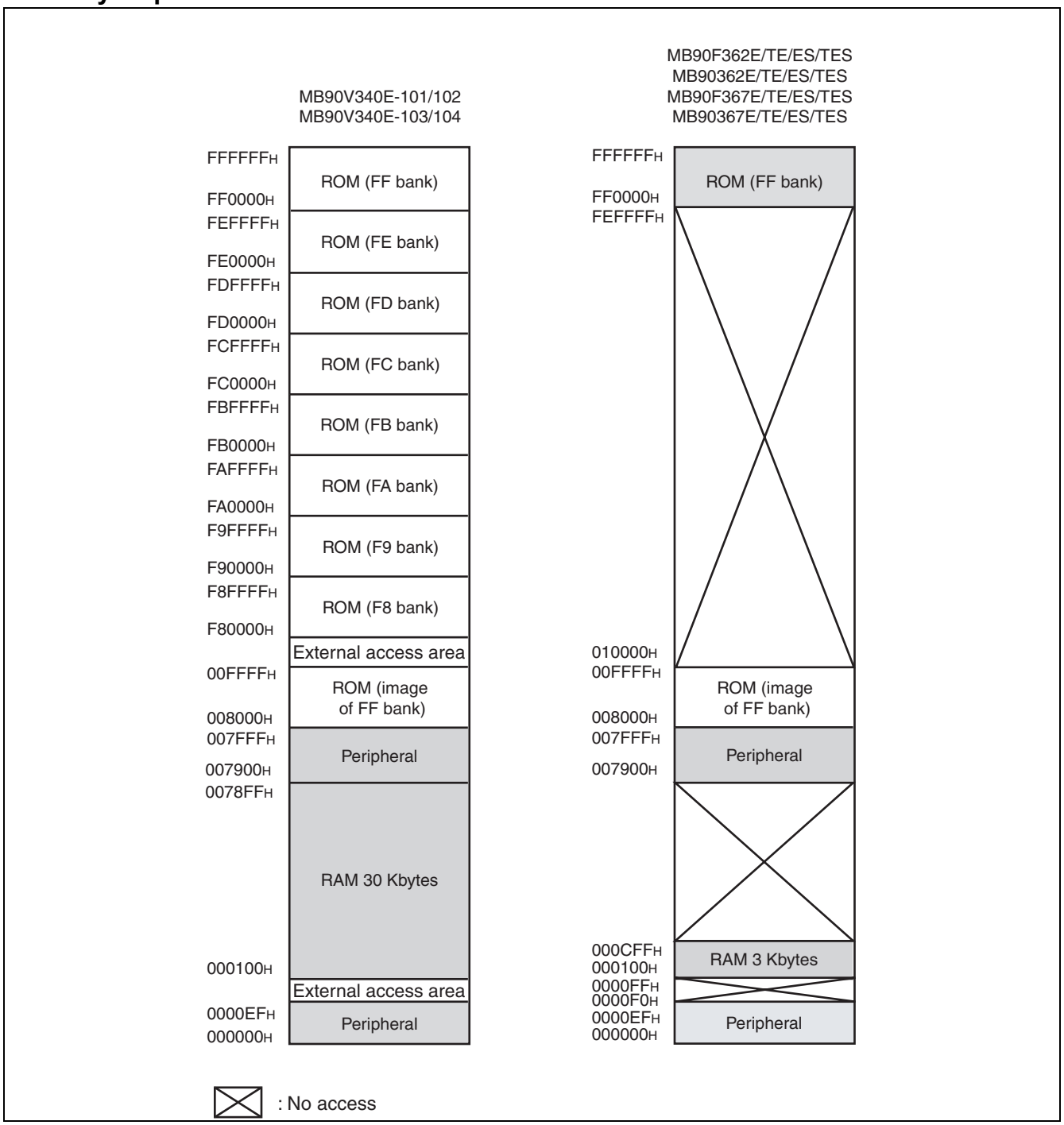
*1: Only for devices without S-suffix
*2: Only for devices with T-suffix

■ **MB90F367E/TE/ES/TES, MB90367E/TE/ES/TES**



*1: Only for devices without S-suffix
*2: Only for devices with T-suffix

7. Memory Map



Note: The high-order portion of bank 00 gives the image of the FF bank ROM to make the small model of the C compiler effective. Since the low-order 16 bits are the same, the table in ROM can be referred without using the far specification in the pointer declaration.
For example, an attempt to access $00C000_H$ practically accesses the value at $FFC000_H$ in ROM.
The ROM area in bank FF exceeds 32 Kbytes, and its entire image cannot be shown in bank 00.
The image between $FF8000_H$ and $FFFFFF_H$ is visible in bank 00, while the image between $FF0000_H$ and $FF7FFF_H$ is visible only in bank FF.

8. I/O Map

Address	Register	Abbreviation	Access	Resource name	Initial value
000000_H,000001_H	Reserved				
000002_H	Port 2 Data Register	PDR2	R/W	Port 2	$XXXXXXXX_B$
000003_H	Reserved				
000004_H	Port 4 Data Register	PDR4	R/W	Port 4	$XXXXXXXX_B$
000005_H	Port 5 Data Register	PDR5	R/W	Port 5	$XXXXXXXX_B$
000006_H	Port 6 Data Register	PDR6	R/W	Port 6	$XXXXXXXX_B$
000007_H	Reserved				
000008_H	Port 8 Data Register	PDR8	R/W	Port 8	$XXXXXXXX_B$
000009_H,$000A_H$	Reserved				
$00000B_H$	Port 5 Analog Input Enable Register	ADER5	R/W	Port 5, A/D	11111111_B
$00000C_H$	Port 6 Analog Input Enable Register	ADER6	R/W	Port 6, A/D	11111111_B
$00000D_H$	Reserved				
$00000E_H$	Input Level Select Register	ILSR0	R/W	Ports	$XXXX0XXX_B$
$00000F_H$	Input Level Select Register	ILSR1	R/W	Ports	$XXXXXXXX_B$
000010_H,0011_H	Reserved				
000012_H	Port 2 Direction Register	DDR2	R/W	Port 2	00000000_B
000013_H	Reserved				
000014_H	Port 4 Direction Register	DDR4	R/W	Port 4	$XXX00000_B$
000015_H	Port 5 Direction Register	DDR5	R/W	Port 5	00000000_B
000016_H	Port 6 Direction Register	DDR6	R/W	Port 6	00000000_B
000017_H	Reserved				
000018_H	Port 8 Direction Register	DDR8	R/W	Port 8	$000000X0_B$
000019_H	Reserved				
$00001A_H$	Port A Direction Register	DDRA	W	Port A	$XXX00XXX_B$
$00001B_H$ to $00001D_H$	Reserved				
$00001E_H$	Port 2 Pull-up Control Register	PUCR2	R/W	Port 2	00000000_B
$00001F_H$	Reserved				

Address	Register	Abbreviation	Access	Resource name	Initial value
000020_H	Serial Mode Register 0	SMR0	W, R/W	LIN-UART0	00000000_B
000021_H	Serial Control Register 0	SCR0	W, R/W		00000000_B
000022_H	Reception/Transmission Data Register 0	RDR0/TDR0	R/W		00000000_B
000023_H	Serial Status Register 0	SSR0	R, R/W		00001000_B
000024_H	Extended Communication Control Register 0	ECCR0	R, W, R/W		$000000XX_B$
000025_H	Extended Status/Control Register 0	ESCR0	R/W		00000100_B
000026_H	Baud Rate Generator Register 00	BGR00	R/W, R		00000000_B
000027_H	Baud Rate Generator Register 01	BGR01	R/W, R		00000000_B
000028_H	Serial Mode Register 1	SMR1	W, R/W	LIN-UART1	00000000_B
000029_H	Serial Control Register 1	SCR1	W, R/W		00000000_B
$00002A_H$	Reception/Transmission Data Register 1	RDR1/TDR1	R/W		00000000_B
$00002B_H$	Serial Status Register 1	SSR1	R, R/W		00001000_B
$00002C_H$	Extended Communication Control Register 1	ECCR1	R, W, R/W		$000000XX_B$
$00002D_H$	Extended Status/Control Register 1	ESCR1	R/W		00000100_B
$00002E_H$	Baud Rate Generator Register 10	BGR10	R/W, R		00000000_B
$00002F_H$	Baud Rate Generator Register 11	BGR11	R/W, R		00000000_B
000030_H to $00003A_H$	Reserved				
$00003B_H$	Address Detect Control Register 1	PACSR1	R/W	Address Match Detection 1	00000000_B
$00003C_H$ to 000047_H	Reserved				
000048_H	PPG C Operation Mode Control Register	PPGCC	W, R/W	16-bit PPG C/D	$0X000XX1_B$
000049_H	PPG D Operation Mode Control Register	PPGCD	W, R/W		$0X000001_B$
$00004A_H$	PPG C/PPG D Count Clock Select Register	PPGCD	R/W		$000000X0_B$
$00004B_H$	Reserved				
$00004C_H$	PPG E Operation Mode Control Register	PPGCE	W, R/W	16-bit PPG E/F	$0X000XX1_B$
$00004D_H$	PPG F Operation Mode Control Register	PPGCF	W, R/W		$0X000001_B$
$00004E_H$	PPG E/PPG F Count Clock Select Register	PPGEF	R/W		$000000X0_B$
$00004F_H$	Reserved				

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
000050_H	Input Capture Control Status 0/1	ICS01	R/W	Input Capture 0/1	00000000_B
000051_H	Input Capture Edge 0/1	ICE01	R/W, R		$XXX0X0XX_B$
000052_H	Input Capture Control Status 2/3	ICS23	R/W	Input Capture 2/3	00000000_B
000053_H	Input Capture Edge 2/3	ICE23	R		$XXXXXXXX_B$
000054_H to 000063_H	Reserved				
000064_H	Timer Control Status 2	TMCSR2	R/W	16-bit Reload Timer 2	00000000_B
000065_H	Timer Control Status 2	TMCSR2	R/W		$XXXX0000_B$
000066_H	Timer Control Status 3	TMCSR3	R/W	16-bit Reload Timer 3	00000000_B
000067_H	Timer Control Status 3	TMCSR3	R/W		$XXXX0000_B$
000068_H	A/D Control Status 0	ADCS0	R/W	A/D Converter	$000XXXX0_B$
000069_H	A/D Control Status 1	ADCS1	R/W, W		$0000000X_B$
$00006A_H$	A/D Data 0	ADCR0	R		00000000_B
$00006B_H$	A/D Data 1	ADCR1	R		$XXXXXX00_B$
$00006C_H$	ADC Setting 0	ADSR0	R/W		00000000_B
$00006D_H$	ADC Setting 1	ADSR1	R/W		00000000_B
$00006E_H$	Low Voltage/CPU Operation Detection Reset Control Register	LVRC	R/W, W	Low voltage/CPU operation detection reset	00111000_B
$00006F_H$	ROM Mirror Function Select	ROMM	W	ROM Mirror	$XXXXXXX1_B$
000070_H to $00007F_H$	Reserved				
000080_H to $00008F_H$	Reserved for CAN Interface 1. Refer to "CAN Controllers"				
000090_H to $00009D_H$	Reserved				
$00009E_H$	Address Detect Control Register 0	PACSR0	R/W	Address Match Detection 0	00000000_B
$00009F_H$	Delayed Interrupt/Release Register	DIRR	R/W	Delayed Interrupt generation module	$XXXXXXX0_B$
$0000A0_H$	Low-power Consumption Mode Control Register	LPMCR	W, R/W	Low-Power consumption Control Circuit	00011000_B
$0000A1_H$	Clock Selection Register	CKSCR	R, R/W	Low-Power consumption Control Circuit	11111100_B

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
$0000A2_H$ to $0000A7_H$	Reserved				
$0000A8_H$	Watchdog Control Register	WDTC	R, W	Watchdog Timer	$XXXXX111_B$
$0000A9_H$	Timebase Timer Control Register	TBTC	W, R/W	Timebase Timer	$1XX00100_B$
$0000AA_H$	Watch Timer Control register	WTC	R, R/W	Watch Timer	$1X001000_B$
$0000AB_H$ to $0000AD_H$	Reserved				
$0000AE_H$	Flash Control Status (Flash Devices only. Otherwise reserved)	FMCS	R, R/W	Flash Memory	$000X0000_B$
$0000AF_H$	Reserved				
$0000B0_H$	Interrupt Control Register 00	ICR00	W, R/W	Interrupt Control	00000111_B
$0000B1_H$	Interrupt Control Register 01	ICR01	W, R/W		00000111_B
$0000B2_H$	Interrupt Control Register 02	ICR02	W, R/W		00000111_B
$0000B3_H$	Interrupt Control Register 03	ICR03	W, R/W		00000111_B
$0000B4_H$	Interrupt Control Register 04	ICR04	W, R/W		00000111_B
$0000B5_H$	Interrupt Control Register 05	ICR05	W, R/W		00000111_B
$0000B6_H$	Interrupt Control Register 06	ICR06	W, R/W		00000111_B
$0000B7_H$	Interrupt Control Register 07	ICR07	W, R/W		00000111_B
$0000B8_H$	Interrupt Control Register 08	ICR08	W, R/W		00000111_B
$0000B9_H$	Interrupt Control Register 09	ICR09	W, R/W		00000111_B
$0000BA_H$	Interrupt Control Register 10	ICR10	W, R/W		00000111_B
$0000BB_H$	Interrupt Control Register 11	ICR11	W, R/W		00000111_B
$0000BC_H$	Interrupt Control Register 12	ICR12	W, R/W		00000111_B
$0000BD_H$	Interrupt Control Register 13	ICR13	W, R/W		00000111_B
$0000BE_H$	Interrupt Control Register 14	ICR14	W, R/W		00000111_B
$0000BF_H$	Interrupt Control Register 15	ICR15	W, R/W		00000111_B
$0000C0_H$ to $0000C9_H$	Reserved				
$0000CA_H$	External Interrupt Enable 1	ENIR1	R/W	External Interrupt 1	00000000_B
$0000CB_H$	External Interrupt Source 1	EIRR1	R/W		$XXXXXXXX_B$
$0000CC_H$	Detection Level Setting 1	ELVR1	R/W		00000000_B
$0000CD_H$					00000000_B
$0000CE_H$	External Interrupt Source Select	EISSR	R/W		00000000_B
$0000CF_H$	PLL/Sub clock Control Register	PSCCR	W	PLL	$XXXX0000_B$

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
$0000D0_H$ to $0000FF_H$	Reserved				
007900_H to 007917_H	Reserved				
007918_H	Reload Register LC	PRLLC	R/W	16-bit PPG C/D	$XXXXXXXX_B$
007919_H	Reload Register HC	PRLHC	R/W		$XXXXXXXX_B$
$00791A_H$	Reload Register LD	PRLLD	R/W		$XXXXXXXX_B$
$00791B_H$	Reload Register HD	PRLHD	R/W		$XXXXXXXX_B$
$00791C_H$	Reload Register LE	PRLLE	R/W	16-bit PPG E/F	$XXXXXXXX_B$
$00791D_H$	Reload Register HE	PRLHE	R/W		$XXXXXXXX_B$
$00791E_H$	Reload Register LF	PRLLF	R/W		$XXXXXXXX_B$
$00791F_H$	Reload Register HF	PRLHF	R/W		$XXXXXXXX_B$
007920_H	Input Capture 0	IPCP0	R	Input Capture 0/1	$XXXXXXXX_B$
007921_H	Input Capture 0	IPCP0	R		$XXXXXXXX_B$
007922_H	Input Capture 1	IPCP1	R		$XXXXXXXX_B$
007923_H	Input Capture 1	IPCP1	R		$XXXXXXXX_B$
007924_H	Input Capture 2	IPCP2	R	Input Capture 2/3	$XXXXXXXX_B$
007925_H	Input Capture 2	IPCP2	R		$XXXXXXXX_B$
007926_H	Input Capture 3	IPCP3	R		$XXXXXXXX_B$
007927_H	Input Capture 3	IPCP3	R		$XXXXXXXX_B$
007928_H to $00793F_H$	Reserved				
007940_H	Timer Data 0	TCDT0	R/W	Free-run Timer 0	00000000_B
007941_H	Timer Data 0	TCDT0	R/W		00000000_B
007942_H	Timer Control Status 0	TCCSL0	R/W		00000000_B
007943_H	Timer Control Status 0	TCCSH0	R/W		$0XXXXXXX_B$
007944_H to $00794B_H$	Reserved				
$00794C_H$	Timer 2/Reload 2	TMR2/TMRLR2	R/W	16-bit Reload Timer 2	$XXXXXXXX_B$
$00794D_H$			R/W		$XXXXXXXX_B$
$00794E_H$	Timer 3/Reload 3	TMR3/TMRLR3	R/W	16-bit Reload Timer 3	$XXXXXXXX_B$
$00794F_H$			R/W		$XXXXXXXX_B$
007950_H to $00795F_H$	Reserved				

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
007960_H	Clock Supervisor Control Register	CSVCR	R, R/W	Clock supervisor	00011100_B
007961_H to $00796D_H$	Reserved				
$00796E_H$	CAN Direct Mode Register (MB90V340E only)	CDMR	R/W	CAN clock sync	$XXXXXXX0_B$
$00796F_H$ to $0079DF_H$	Reserved				
$0079E0_H$	Detect Address Setting 0	PADR0	R/W	Address Match Detection 0	$XXXXXXXX_B$
$0079E1_H$	Detect Address Setting 0	PADR0	R/W		$XXXXXXXX_B$
$0079E2_H$	Detect Address Setting 0	PADR0	R/W		$XXXXXXXX_B$
$0079E3_H$	Detect Address Setting 1	PADR1	R/W		$XXXXXXXX_B$
$0079E4_H$	Detect Address Setting 1	PADR1	R/W		$XXXXXXXX_B$
$0079E5_H$	Detect Address Setting 1	PADR1	R/W		$XXXXXXXX_B$
$0079E6_H$	Detect Address Setting 2	PADR2	R/W		$XXXXXXXX_B$
$0079E7_H$	Detect Address Setting 2	PADR2	R/W		$XXXXXXXX_B$
$0079E8_H$	Detect Address Setting 2	PADR2	R/W		$XXXXXXXX_B$
$0079E9_H$ to $0079EF_H$	Reserved				
$0079F0_H$	Detect Address Setting 3	PADR3	R/W	Address Match Detection 1	$XXXXXXXX_B$
$0079F1_H$	Detect Address Setting 3	PADR3	R/W		$XXXXXXXX_B$
$0079F2_H$	Detect Address Setting 3	PADR3	R/W		$XXXXXXXX_B$
$0079F3_H$	Detect Address Setting 4	PADR4	R/W		$XXXXXXXX_B$
$0079F4_H$	Detect Address Setting 4	PADR4	R/W		$XXXXXXXX_B$
$0079F5_H$	Detect Address Setting 4	PADR4	R/W		$XXXXXXXX_B$
$0079F6_H$	Detect Address Setting 5	PADR5	R/W		$XXXXXXXX_B$
$0079F7_H$	Detect Address Setting 5	PADR5	R/W		$XXXXXXXX_B$
$0079F8_H$	Detect Address Setting 5	PADR5	R/W		$XXXXXXXX_B$
$0079F9_H$ to $007BFF_H$	Reserved				
$007C00_H$ to $007CFF_H$	Reserved for CAN Interface 1. Refer to “CAN Controllers”				
$007D00_H$ to $007DFF_H$	Reserved for CAN Interface 1. Refer to “CAN Controllers”				

(Continued)

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Address	Register	Abbrevia-tion	Access	Resource name	Initial value
$007E00_H$ to $007FFF_H$	Reserved				

Notes:
- Initial value of “X” represents unknown value.
- Any write access to reserved addresses in I/O map should not be performed. A read access to reserved addresses results in reading “X”.

9. CAN Controllers

- Conforms to CAN Specification Ver 2.0 Part A and Part B
  - Supports transmission/reception in standard frame and extended frame formats
- Supports transmitting of data frames by receiving remote frames
- 16 transmitting/receiving message buffers
  - 29-bit ID and 8-byte data
  - Multi-level message buffer configuration
- Provides full-bit comparison, full-bit mask, acceptance register 0/acceptance register 1 for each message buffer as ID acceptance mask
  - 2 acceptance mask registers in either standard frame format or extended frame formats
- Bit rate programmable from 10 kbps/s to 2 Mbps/s (when input clock is at 16 MHz)

List of Control Registers (1)

Address CAN1	Register	Abbreviation	Access	Initial Value
000080_H	Message buffer valid register	BVALR	R/W	$00000000\ 00000000_B$
000081_H				
000082_H	Transmit request register	TREQR	R/W	$00000000\ 00000000_B$
000083_H				
000084_H	Transmit cancel register	TCANR	W	$00000000\ 00000000_B$
000085_H				
000086_H	Transmission complete register	TCR	R/W	$00000000\ 00000000_B$
000087_H				
000088_H	Receive complete register	RCR	R/W	$00000000\ 00000000_B$
000089_H				
$00008A_H$	Remote request receiving register	RRTRR	R/W	$00000000\ 00000000_B$
$00008B_H$				
$00008C_H$	Receive overrun register	ROVRR	R/W	$00000000\ 00000000_B$
$00008D_H$				
$00008E_H$	Reception interrupt enable register	RIER	R/W	$00000000\ 00000000_B$
$00008F_H$				

List of Control Registers (2)

Address CAN1	Register	Abbreviation	Access	Initial Value
$007D00_H$	Control status register	CSR	R/W, W R/W, R	$0XXXX0X1\ 00XXX000_B$
$007D01_H$				
$007D02_H$	Last event indicator register	LEIR	R/W	$000X0000\ XXXXXXXX_B$
$007D03_H$				
$007D04_H$	Receive and transmit error counter	RTEC	R	$00000000\ 00000000_B$
$007D05_H$				
$007D06_H$	Bit timing register	BTR	R/W	$11111111\ X1111111_B$
$007D07_H$				
$007D08_H$	IDE register	IDER	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007D09_H$				
$007D0A_H$	Transmit RTR register	TRTRR	R/W	$00000000\ 00000000_B$
$007D0B_H$				
$007D0C_H$	Remote frame receive waiting register	RFWTR	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007D0D_H$				
$007D0E_H$	Transmit interrupt enable register	TIER	R/W	$00000000\ 00000000_B$
$007D0F_H$				
$007D10_H$	Acceptance mask select register	AMSR	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007D11_H$				
$007D12_H$				$XXXXXXXX\ XXXXXXXX_B$
$007D13_H$				
$007D14_H$	Acceptance mask register 0	AMR0	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007D15_H$				
$007D16_H$				$XXXXXXXX\ XXXXXXXX_B$
$007D17_H$				
$007D18_H$	Acceptance mask register 1	AMR1	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007D19_H$				
$007D1A_H$				$XXXXXXXX\ XXXXXXXX_B$
$007D1B_H$				

List of Message Buffers (ID Registers)

Address CAN1	Register	Abbreviation	Access	Initial Value
$007C00_H$ to $007C1F_H$	General-purpose RAM	–	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007C20_H$	ID register 0	IDR0	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007C21_H$				
$007C22_H$				$XXXXXXXX\ XXXXXXXX_B$
$007C23_H$				
$007C24_H$	ID register 1	IDR1	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007C25_H$				
$007C26_H$				$XXXXXXXX\ XXXXXXXX_B$
$007C27_H$				
$007C28_H$	ID register 2	IDR2	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007C29_H$				
$007C2A_H$				$XXXXXXXX\ XXXXXXXX_B$
$007C2B_H$				
$007C2C_H$	ID register 3	IDR3	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007C2D_H$				
$007C2E_H$				$XXXXXXXX\ XXXXXXXX_B$
$007C2F_H$				
$007C30_H$	ID register 4	IDR4	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007C31_H$				
$007C32_H$				$XXXXXXXX\ XXXXXXXX_B$
$007C33_H$				
$007C34_H$	ID register 5	IDR5	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007C35_H$				
$007C36_H$				$XXXXXXXX\ XXXXXXXX_B$
$007C37_H$				
$007C38_H$	ID register 6	IDR6	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007C39_H$				
$007C3A_H$				$XXXXXXXX\ XXXXXXXX_B$
$007C3B_H$				
$007C3C_H$	ID register 7	IDR7	R/W	$XXXXXXXX\ XXXXXXXX_B$
$007C3D_H$				
$007C3E_H$				$XXXXXXXX\ XXXXXXXX_B$
$007C3F_H$				

(Continued)

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Address CAN1	Register	Abbreviation	Access	Initial Value
$007C40_H$	ID register 8	IDR8	R/W	XXXXXXXX XXXXXXXX$_B$
$007C41_H$				
$007C42_H$				XXXXXXXX XXXXXXXX$_B$
$007C43_H$				
$007C44_H$	ID register 9	IDR9	R/W	XXXXXXXX XXXXXXXX$_B$
$007C45_H$				
$007C46_H$				XXXXXXXX XXXXXXXX$_B$
$007C47_H$				
$007C48_H$	ID register 10	IDR10	R/W	XXXXXXXX XXXXXXXX$_B$
$007C49_H$				
$007C4A_H$				XXXXXXXX XXXXXXXX$_B$
$007C4B_H$				
$007C4C_H$	ID register 11	IDR11	R/W	XXXXXXXX XXXXXXXX$_B$
$007C4D_H$				
$007C4E_H$				XXXXXXXX XXXXXXXX$_B$
$007C4F_H$				
$007C50_H$	ID register 12	IDR12	R/W	XXXXXXXX XXXXXXXX$_B$
$007C51_H$				
$007C52_H$				XXXXXXXX XXXXXXXX$_B$
$007C53_H$				
$007C54_H$	ID register 13	IDR13	R/W	XXXXXXXX XXXXXXXX$_B$
$007C55_H$				
$007C56_H$				XXXXXXXX XXXXXXXX$_B$
$007C57_H$				
$007C58_H$	ID register 14	IDR14	R/W	XXXXXXXX XXXXXXXX$_B$
$007C59_H$				
$007C5A_H$				XXXXXXXX XXXXXXXX$_B$
$007C5B_H$				
$007C5C_H$	ID register 15	IDR15	R/W	XXXXXXXX XXXXXXXX$_B$
$007C5D_H$				
$007C5E_H$				XXXXXXXX XXXXXXXX$_B$
$007C5F_H$				

List of Message Buffers (DLC Registers and Data Registers)

Address CAN1	Register	Abbreviation	Access	Initial Value
$007C60_H$	DLC register 0	DLCR0	R/W	$XXXXXXXX_B$
$007C61_H$				
$007C62_H$	DLC register 1	DLCR1	R/W	$XXXXXXXX_B$
$007C63_H$				
$007C64_H$	DLC register 2	DLCR2	R/W	$XXXXXXXX_B$
$007C65_H$				
$007C66_H$	DLC register 3	DLCR3	R/W	$XXXXXXXX_B$
$007C67_H$				
$007C68_H$	DLC register 4	DLCR4	R/W	$XXXXXXXX_B$
$007C69_H$				
$007C6A_H$	DLC register 5	DLCR5	R/W	$XXXXXXXX_B$
$007C6B_H$				
$007C6C_H$	DLC register 6	DLCR6	R/W	$XXXXXXXX_B$
$007C6D_H$				
$007C6E_H$	DLC register 7	DLCR7	R/W	$XXXXXXXX_B$
$007C6F_H$				
$007C70_H$	DLC register 8	DLCR8	R/W	$XXXXXXXX_B$
$007C71_H$				
$007C72_H$	DLC register 9	DLCR9	R/W	$XXXXXXXX_B$
$007C73_H$				
$007C74_H$	DLC register 10	DLCR10	R/W	$XXXXXXXX_B$
$007C75_H$				
$007C76_H$	DLC register 11	DLCR11	R/W	$XXXXXXXX_B$
$007C77_H$				
$007C78_H$	DLC register 12	DLCR12	R/W	$XXXXXXXX_B$
$007C79_H$				
$007C7A_H$	DLC register 13	DLCR13	R/W	$XXXXXXXX_B$
$007C7B_H$				
$007C7C_H$	DLC register 14	DLCR14	R/W	$XXXXXXXX_B$
$007C7D_H$				
$007C7E_H$	DLC register 15	DLCR15	R/W	$XXXXXXXX_B$
$007C7F_H$				

(Continued)

Address CAN1	Register	Abbreviation	Access	Initial Value
$007C80_H$ to $007C87_H$	Data register 0 (8 bytes)	DTR0	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007C88_H$ to $007C8F_H$	Data register 1 (8 bytes)	DTR1	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007C90_H$ to $007C97_H$	Data register 2 (8 bytes)	DTR2	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007C98_H$ to $007C9F_H$	Data register 3 (8 bytes)	DTR3	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CA0_H$ to $007CA7_H$	Data register 4 (8 bytes)	DTR4	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CA8_H$ to $007CAF_H$	Data register 5 (8 bytes)	DTR5	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CB0_H$ to $007CB7_H$	Data register 6 (8 bytes)	DTR6	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CB8_H$ to $007CBF_H$	Data register 7 (8 bytes)	DTR7	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CC0_H$ to $007CC7_H$	Data register 8 (8 bytes)	DTR8	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CC8_H$ to $007CCF_H$	Data register 9 (8 bytes)	DTR9	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CD0_H$ to $007CD7_H$	Data register 10 (8 bytes)	DTR10	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CD8_H$ to $007CDF_H$	Data register 11 (8 bytes)	DTR11	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CE0_H$ to $007CE7_H$	Data register 12 (8 bytes)	DTR12	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CE8_H$ to $007CEF_H$	Data register 13 (8 bytes)	DTR13	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$

(Continued)

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Address	Register	Abbreviation	Access	Initial Value
CAN1				
$007CF0_H$ to $007CF7_H$	Data register 14 (8 bytes)	DTR14	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$
$007CF8_H$ to $007CFF_H$	Data register 15 (8 bytes)	DTR15	R/W	$XXXXXXXX_B$ to $XXXXXXXX_B$

10. Interrupt Factors, Interrupt Vectors, Interrupt Control Register

Interrupt cause	EI^{2}OS corresponding	Interrupt vector		Interrupt control register	
		Number	Address	Number	Address
Reset	N	#08	$FFFFDC_H$	–	–
INT9 instruction	N	#09	$FFFFD8_H$	–	–
Exception	N	#10	$FFFFD4_H$	–	–
Reserved	N	#11	$FFFFD0_H$	ICR00	$0000B0_H$
Reserved	N	#12	$FFFFCC_H$		
CAN 1 reception	N	#13	$FFFFC8_H$	ICR01	$0000B1_H$
CAN 1 transmission/node status	N	#14	$FFFFC4_H$		
Reserved	N	#15	$FFFFC0_H$	ICR02	$0000B2_H$
Reserved	N	#16	$FFFFBC_H$		
Reserved	N	#17	$FFFFB8_H$	ICR03	$0000B3_H$
Reserved	N	#18	$FFFFB4_H$		
16-bit reload timer 2	Y1	#19	$FFFFB0_H$	ICR04	$0000B4_H$
16-bit reload timer 3	Y1	#20	$FFFFAC_H$		
Reserved	N	#21	$FFFFA8_H$	ICR05	$0000B5_H$
Reserved	N	#22	$FFFFA4_H$		
PPG C/D	N	#23	$FFFFA0_H$	ICR06	$0000B6_H$
PPG E/F	N	#24	$FFFF9C_H$		
Timebase timer	N	#25	$FFFF98_H$	ICR07	$0000B7_H$
External interrupt 8 to 11	Y1	#26	$FFFF94_H$		
Watch timer	N	#27	$FFFF90_H$	ICR08	$0000B8_H$
External interrupt 12 to 15	Y1	#28	$FFFF8C_H$		
A/D converter	Y1	#29	$FFFF88_H$	ICR09	$0000B9_H$
16-bit free-run timer 0	N	#30	$FFFF84_H$		
Reserved	N	#31	$FFFF80_H$	ICR10	$0000BA_H$
Reserved	N	#32	$FFFF7C_H$		
Input capture 0 to 3	Y1	#33	$FFFF78_H$	ICR11	$0000BB_H$
Reserved	N	#34	$FFFF74_H$		
LIN-UART 0 reception	Y2	#35	$FFFF70_H$	ICR12	$0000BC_H$
LIN-UART 0 transmission	Y1	#36	$FFFF6C_H$		
LIN-UART 1 reception	Y2	#37	$FFFF68_H$	ICR13	$0000BD_H$
LIN-UART 1 transmission	Y1	#38	$FFFF64_H$		

(Continued)

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Interrupt cause	EI^{2}OS corresponding	Interrupt vector		Interrupt control register	
		Number	Address	Number	Address
Reserved	N	#39	$FFFF60_H$	ICR14	$0000BE_H$
Reserved	N	#40	$FFFF5C_H$		
Flash memory	N	#41	$FFFF58_H$	ICR15	$0000BF_H$
Delayed interrupt generation module	N	#42	$FFFF54_H$		

Y1 : Usable

Y2 : Usable, with EI^{2}OS stop function

N : Unusable

Notes:
- The peripheral resources sharing the ICR register have the same interrupt level.
- When the peripheral resources sharing the ICR register use extended intelligent I/O service, only one can use extended intelligent I/O service at a time.
- When either of the 2 peripheral resources sharing the ICR register specifies extended intelligent I/O service, the other one cannot use interrupts.

11. Electrical Characteristics

11.1 Absolute Maximum Ratings

Parameter	Symbol	Rating		Unit	Remarks
		Min	Max		
Power supply voltage*1	V_{CC}	V_{SS} − 0.3	V_{SS} + 6.0	V	
	AV_{CC}	V_{SS} − 0.3	V_{SS} + 6.0	V	$V_{CC} = AV_{CC}$*2
	AVR	V_{SS} − 0.3	V_{SS} + 6.0	V	$AV_{CC} \geq AVR$*2
Input voltage*1	V_I	V_{SS} − 0.3	V_{SS} + 6.0	V	*3
Output voltage*1	V_O	V_{SS} − 0.3	V_{SS} + 6.0	V	*3
Maximum clamp current	I_{CLAMP}	−2.0	+2.0	mA	*6
Total Maximum clamp current	$\Sigma\lvert I_{CLAMP}\rvert$	−	40	mA	*6
“L” level maximum output current	I_{OL1}	−	15	mA	*4
	I_{OL2}	−	40	mA	*5
“L” level average output current	I_{OLAV1}	−	4	mA	*4
	I_{OLAV2}	−	30	mA	*5
“L” level maximum overall output current	ΣI_{OL1}	−	125	mA	*4
	ΣI_{OL2}	−	160	mA	*5
“L” level average overall output current	ΣI_{OLAV1}	−	40	mA	*4 +105 °C < T_A ≤ +125 °C
	ΣI_{OLAV2}				*5 +105 °C < T_A ≤ +125 °C
	ΣI_{OLAV1}	−	40	mA	*4 −40 °C ≤ T_A ≤ +105 °C
	ΣI_{OLAV2}				*5 −40 °C ≤ T_A ≤ +105 °C
“H” level maximum output current	I_{OH1}	−	−15	mA	*4
	I_{OH2}	−	−40	mA	*5
“H” level average output current	I_{OHAV1}	−	−4	mA	*4
	I_{OHAV2}	−	−30	mA	*5
“H” level maximum overall output current	ΣI_{OH1}	−	−125	mA	*4
	ΣI_{OH2}	−	−160	mA	*5
“H” level average overall output current	ΣI_{OHAV1}	−	−40	mA	*4 +105 °C < T_A ≤ +125 °C
	ΣI_{OHAV2}				*5 +105 °C < T_A ≤ +125 °C
	ΣI_{OHAV1}	−	−40	mA	*4 −40 °C ≤ T_A ≤ +105 °C
	ΣI_{OHAV2}				*5 −40 °C ≤ T_A ≤ +105 °C
Power consumption	P_D	−	308	mW	Flash memory updata not performed
		−	390	mW	Flash memory updata performed
Operating temperature	T_A	−40	+105	°C	
		−40	+125	°C	*7
Storage temperature	T_{STG}	−55	+150	°C	

(Continued)

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*1: This parameter is based on $V_{SS} = AV_{SS} = 0$ V.

*2: Set AV_{CC} and V_{CC} to the same voltage. Make sure that AV_{CC} does not exceed V_{CC} and that the voltage at the analog inputs does not exceed AV_{CC} when the power is switched on.

*3: V_I and V_O should not exceed V_{CC} + 0.3 V. V_I should not exceed the specified ratings. However, if the maximun current to/from an input is limited by some means with external components, the I_{CLAMP} rating supersedes the V_I rating.

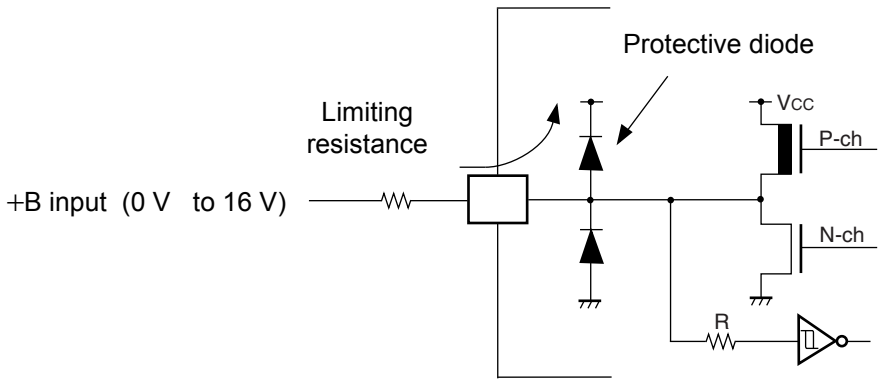
*4: Applicable to pins : P24 to P27, P40 to P44, P50 to P57, P60 to P67, P80, P82 to P87

*5: Applicable to pins : P20 to P23

*6: Applicable to pins: P20 to P27, P40 to P44, P50 to P57, P60 to P67, P80, P82 to P87

- Use within recommended operating conditions.
- Use at DC voltage (current) .
- The +B signal should always be applied a connecting limit resistance between the +B signal and the microcontroller.
- The value of the limiting resistance should be set so that when the +B signal is applied the input current to the microcontroller pin does not exceed rated values, either instantaneously or for prolonged periods.
- Note that when the microcontroller drive current is low, such as in the power saving modes, the +B input potential may pass through the protective diode and increase the potential at the V_{CC} pin, and this may affect other devices.
- Note that if a +B signal is inputted when the microcontroller power supply is off (not fixed at 0 V) , the power supply is provided from the pins, so that incomplete operation may result.
- Note that if the +B input is applied during power-on, the power supply is provided from the pins and the resulting power supply voltage may not be sufficient to operate the power-on reset.
- Care must be taken not to leave the +B input pin open.
- Recommended circuit sample:

• Input/output equivalent circuits



*7: There is a restriction of reliability if the product is used exceeding $T_A = +105$ °C.
Contact the sales or support representative.
It is ensured to write/erase data to the Flash memory between $T_A = -40$ °C and +105 °C.

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

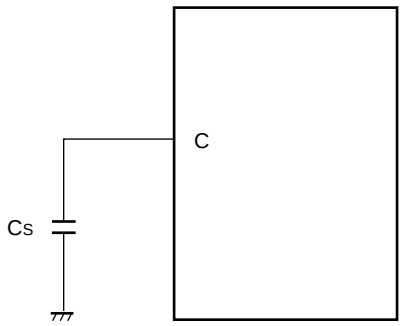
11.2 Recommended Conditions

(V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
Power supply voltage	V_{CC}, AV_{CC}	4.0	5.0	5.5	V	Under normal operation
		3.5	5.0	5.5	V	Under normal operation when not using the A/D converter and not Flash programming.
		3.0	–	5.5	V	Maintains RAM data in stop mode
Smoothing capacitor	C_S	0.1	–	1.0	µF	Use a ceramic capacitor or comparable capacitor of the AC characteristics. Bypass capacitor at the V_{CC} pin should be greater than this capacitor.
Operating temperature	T_A	–40	–	+105	°C	
		–40	–	+125	°C	*

*: There is a restriction of reliability if the product is used exceeding T_A = +105 °C.
Contact the sales or support representative.
It is ensured to write/erase data to the Flash memory between T_A = – 40 °C and +105 °C.

● **C Pin Connection Diagram**



WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges.

Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their representatives beforehand.

11.3 DC Characteristics

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value			Unit	Remarks
				Min	Typ	Max		
Input “H” voltage	V_{IHS}	–	–	0.8 V_{CC}	–	V_{CC} + 0.3	V	Pin inputs if CMOS hysteresis input levels are selected (except P82, P85)
	V_{IHA}	–	–	0.8 V_{CC}	–	V_{CC} + 0.3	V	Pin inputs if Automotive input levels are selected
	V_{IHS}	–	–	0.7 V_{CC}	–	V_{CC} + 0.3	V	P82, P85 inputs if CMOS input levels are selected
	V_{IHR}	–	–	0.8 V_{CC}	–	V_{CC} + 0.3	V	$\overline{RST}$ input pin (CMOS hysteresis)
	V_{IHM}	–	–	V_{CC} – 0.3	–	V_{CC} + 0.3	V	MD input pin
Input “L” voltage	V_{ILS}	–	–	V_{SS} – 0.3	–	0.2 V_{CC}	V	Pin inputs if CMOS hysteresis input levels are selected (except P82, P85)
	V_{ILA}	–	–	V_{SS} – 0.3	–	0.5 V_{CC}	V	Pin inputs if Automotive input levels are selected
	V_{ILS}	–	–	V_{SS} – 0.3	–	0.3 V_{CC}	V	P82, P85 inputs if CMOS input levels are selected
	V_{ILR}	–	–	V_{SS} – 0.3	–	0.2 V_{CC}	V	$\overline{RST}$ input pin (CMOS hysteresis)
	V_{ILM}	–	–	V_{SS} – 0.3	–	V_{SS} + 0.3	V	MD input pin
Output “H” voltage	V_{OH}	Other than P20 to P23	V_{CC} = 4.5 V, I_{OH} = –4.0 mA	V_{CC} – 0.5	–	–	V	
	V_{OHI}	P20 to P23	V_{CC} = 4.5 V, I_{OH} = –14.0 mA	V_{CC} – 0.5	–	–	V	
Output “L” voltage	V_{OL}	Other than P20 to P23	V_{CC} = 4.5 V, I_{OL} = 4.0 mA	–	–	0.4	V	
	V_{OLI}	P20 to P23	V_{CC} = 4.5 V, I_{OL} = 20.0 mA	–	–	0.4	V	
Input leak current	I_{IL}	–	V_{CC} = 5.5 V, V_{SS} < V_I < V_{CC}	–1	–	+ 1	µA	
Pull-up resistance	R_{UP}	P20 to P27, $\overline{RST}$	–	25	50	100	kΩ	

(Continued)

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Pin	Condition		Value			Unit	Remarks
					Min	Typ	Max		
Pull-down resistance	R_{DOWN}	MD2	–		25	50	100	kΩ	MB90362E, MB90362ES, MB90362TE, MB90362TES
Power supply current*	I_{CC}	V_{CC}	V_{CC} = 5.0 V, Internal frequency: 24 MHz, At normal operation.		–	35	45	mA	
			V_{CC} = 5.0 V, Internal frequency: 24 MHz, At writing Flash memory.		–	50	60	mA	Flash memory devices
			V_{CC} = 5.0 V, Internal frequency: 24 MHz, At erasing Flash memory.		–	50	60	mA	Flash memory devices
	I_{CCS}		V_{CC} = 5.0 V, Internal frequency: 24 MHz, At sleep mode.		–	12	20	mA	
	I_{CTS}		V_{CC} = 5.0 V, Internal frequency: 2 MHz, At main timer mode		–	0.3	0.8	mA	Devices without T-suffix
					–	0.4	1.0		Devices with T-suffix
	$I_{CTSPLL6}$		V_{CC} = 5.0 V, Internal frequency: 24 MHz, At PLL timer mode, External frequency = 4 MHz		–	4	7	mA	
	I_{CCL}		V_{CC} = 5.0 V Internal frequency: 8 kHz, At sub operation, T_A = +25°C	Stopping clock supervisor	–	40	100	µA	MB90F362E, MB90F367E, MB90362E, MB90367E
				Operating clock supervisor	–	60	150		MB90F367E, MB90367E
				Stopping clock supervisor	–	90	200		MB90F362TE, MB90F367TE, MB90362TE, MB90367TE
				Operating clock supervisor	–	110	250		MB90F367TE, MB90367TE
	I_{CCLS}		V_{CC} = 5.0 V Internal frequency: 8 kHz, At sub sleep, T_A = +25°C	Stopping clock supervisor	–	10	50	µA	MB90F362E, MB90F367E, MB90362E, MB90367E
				Operating clock supervisor	–	30	100		MB90F367E, MB90367E
				Stopping clock supervisor	–	60	150		MB90F362TE, MB90F367TE, MB90362TE, MB90367TE
				Operating clock supervisor	–	80	200		MB90F367TE, MB90367TE

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(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Sym-bol	Pin	Condition		Value			Unit	Remarks
					Min	Typ	Max		
Power supply current*	I_{CCT}	V_{CC}	V_{CC} = 5.0 V Internal frequency: 8 kHz, At watch mode, T_A = +25°C	Stopping clock supervisor	–	8	30	µA	MB90F362E, MB90F367E, MB90362E, MB90367E
				Operating clock supervisor	–	30	70		MB90F367E, MB90367E
				Stopping clock supervisor	–	60	130		MB90F362TE, MB90F367TE, MB90362TE, MB90367TE
				Operating clock supervisor	–	80	170		MB90F367TE, MB90367TE
	I_{CCH}		V_{CC} = 5.0 V, At stop mode, T_A = +25°C		–	5	25	µA	Devices without T-suffix
					–	50	130	µA	Devices with T-suffix
Input capacity	C_{IN}	Other than AV_{CC}, AV_{SS}, AVR, V_{CC}, V_{SS}, C	–		–	5	15	pF	

*: The power supply current is measured with an external clock.

11.4 AC Characteristics

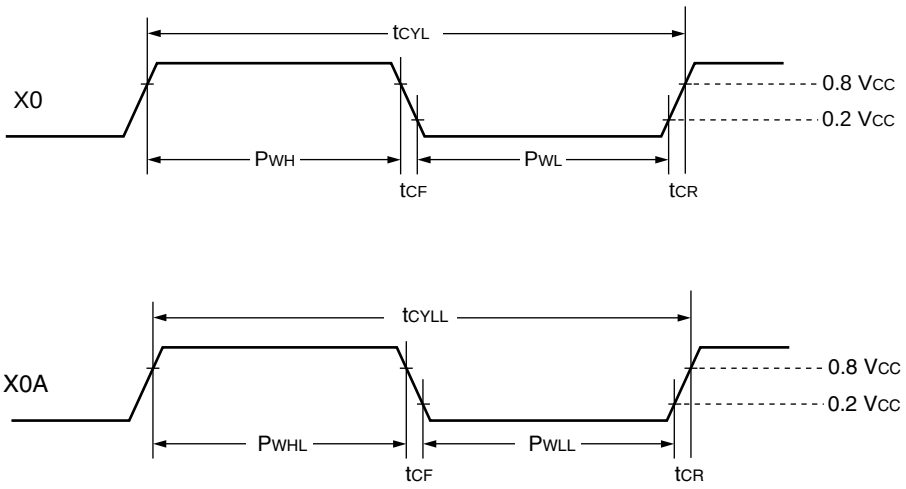
11.4.1 Clock Timing

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

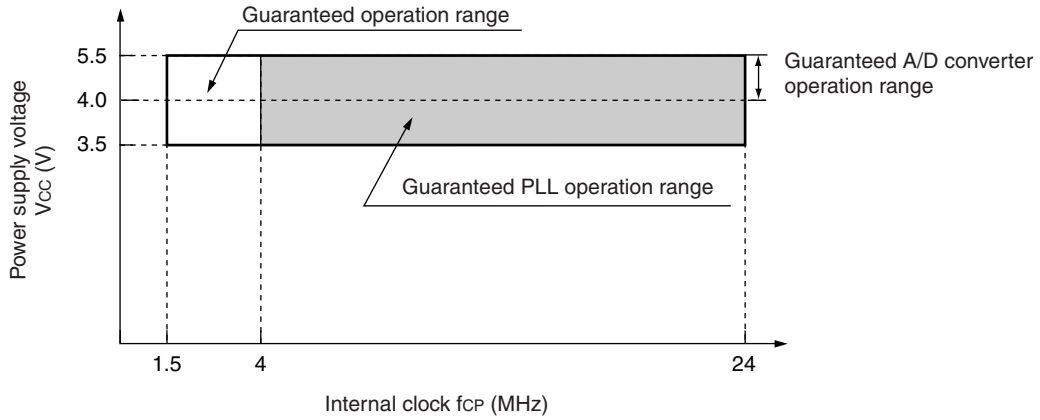
Parameter	Symbol	Pin	Value			Unit	Remarks
			Min	Typ	Max		
Clock frequency*	f_C	X0, X1	3	–	16	MHz	1/2 when PLL stops, When using an oscillation circuit
			4	–	16	MHz	PLL × 1, When using an oscillation circuit
			4	–	12	MHz	PLL × 2, When using an oscillation circuit
			4	–	8	MHz	PLL × 3, When using an oscillation circuit
			4	–	6	MHz	PLL × 4, When using an oscillation circuit
			4	–	4	MHz	PLL × 6, When using an oscillation circuit
		X0, X1	3	–	24	MHz	1/2 when PLL stops, When using an external clock
			4	–	24	MHz	PLL × 1, When using an external clock
			4	–	12	MHz	PLL × 2, When using an external clock
			4	–	8	MHz	PLL × 3, When using an external clock
			4	–	6	MHz	PLL × 4, When using an external clock
			4	–	4	MHz	PLL × 6, When using an external clock
	fCL	X0A, X1A	—	32.768	100	kHz	
Clock cycle time	t_{CYL}	X0, X1	62.5	–	333	ns	When using an oscillation circuit
		X0, X1	41.67	–	333	ns	When using an external clock
	tCYLL	X0A, X1A	10	30.5	—	µs	
Input clock pulse width	P_{WH}, P_{WL}	X0	10	–	–	ns	Duty ratio is about 30% to 70%.
	P_{WHL}, P_{WLL}	X0A	5	15.2	–	µs	
Input clock rise and fall time	t_{CR}, t_{CF}	X0	–	–	5	ns	When using external clock
Internal operating clock frequency (machine clock)	f_{CP}	–	1.5	–	24	MHz	When using main clock
	f_{CPL}	–	–	8.192	50	kHz	When using sub clock
Internal operating clock cycle time (machine clock)	t_{CP}	–	41.67	–	666	ns	When using main clock
	t_{CPL}	–	20	122.1	–	µs	When using sub clock

*: When selecting the PLL clock, the range of clock frequency is limited. Use this product within range as mentioned in “Relation among external clock frequency and internal clock frequency”.

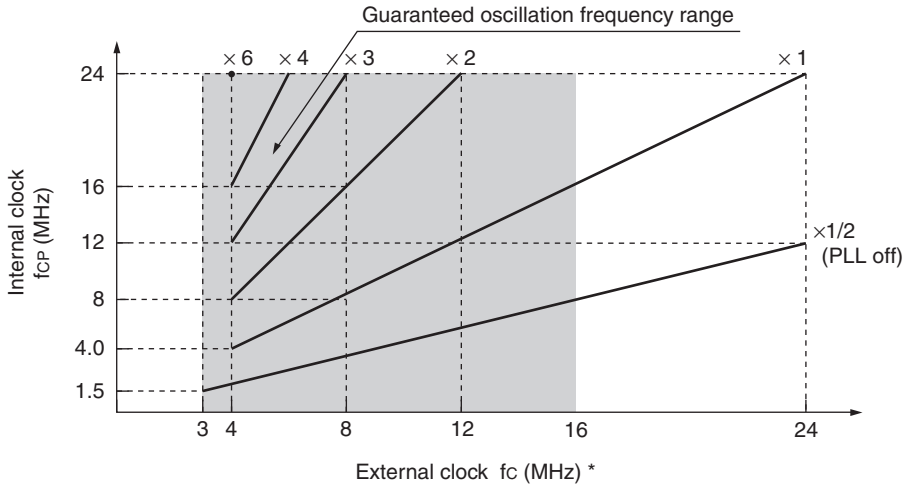
- **Clock Timing**



- Guaranteed PLL Operation Range



Guaranteed operation range of MB90360E series



*: When using the oscillation circuit, the maximum oscillation clock frequency is 16 MHz.

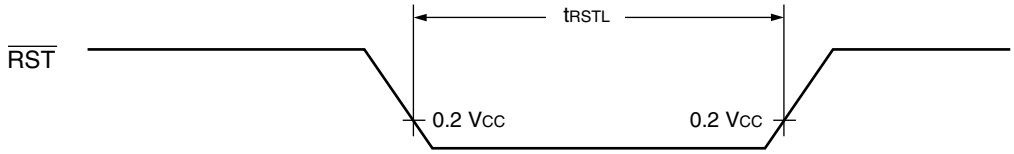
11.4.2 Reset Standby Input

(T_A = −40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

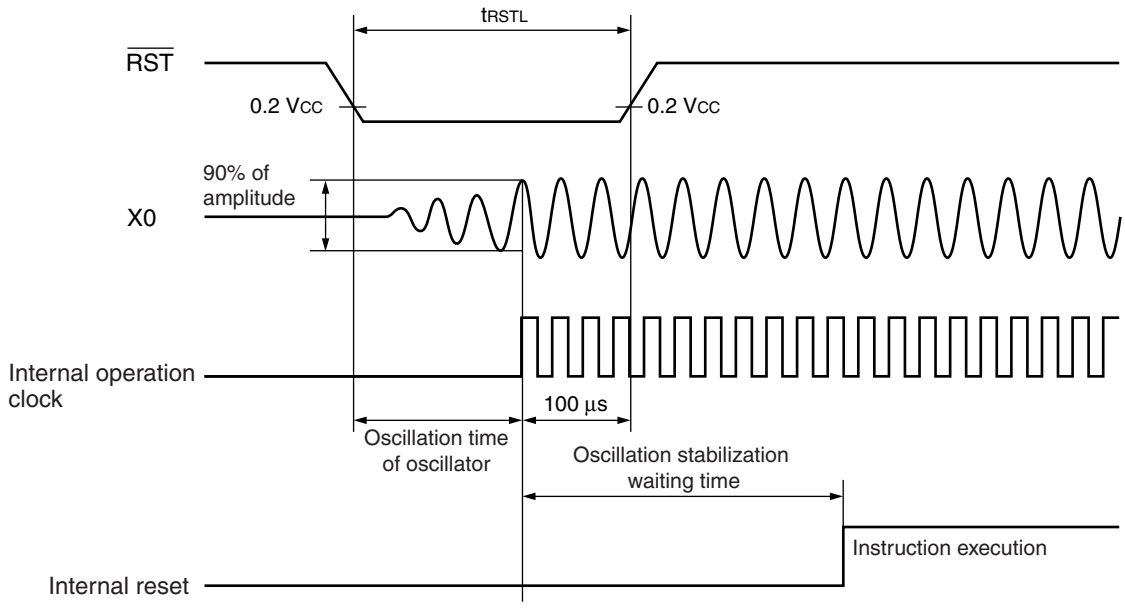
Parameter	Symbol	Pin	Value		Unit	Remarks
			Min	Max		
Reset input time	t_{RSTL}	$\overline{RST}$	500	–	ns	Under normal operation
			Oscillation time of oscillator* + 100 µs	–	µs	In stop mode, sub clock mode, sub sleep mode, and watch mode
			100	–	µs	In timebase timer mode

*: Oscillation time of oscillator is the time that the amplitude reaches 90%. In the crystal oscillator, the oscillation time is between several ms and tens of ms. In ceramic oscillators, the oscillation time is between hundreds of µs and several ms. With an external clock, the oscillation time is 0 ms.

- **Under normal operation:**



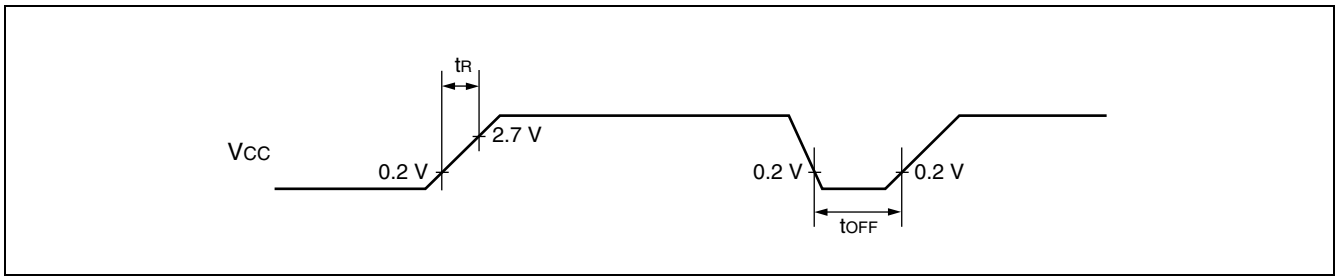
- **In stop mode, sub clock mode, sub sleep mode, and watch mode:**



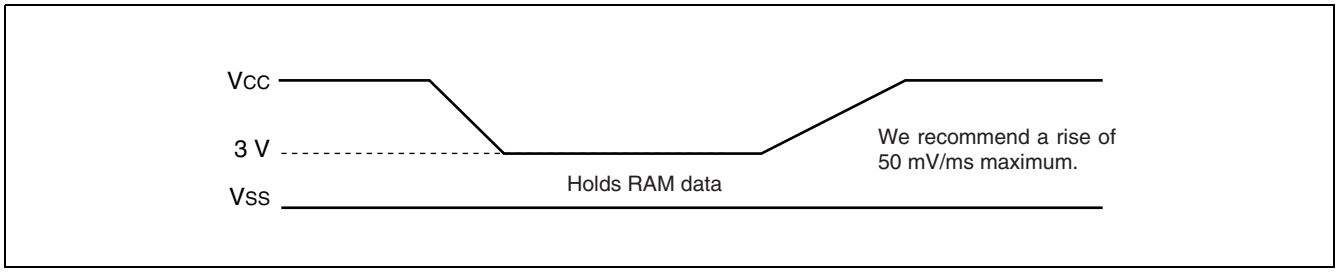
11.4.3 Power-on Reset

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Power on rise time	t_R	V_{CC}	–	0.05	30	ms	
Power off time	t_{OFF}	V_{CC}		1	–	ms	Due to repetitive operation



Note: If you change the power supply voltage too rapidly, a power-on reset may occur. We recommend that you start up smoothly by restraining voltages when changing the power supply voltage during operation, as shown in the figure below. Perform while not using the PLL clock. However, if voltage drops are within 1 V/s, you can operate while using the PLL clock.



11.4.4 LIN-UART0/1

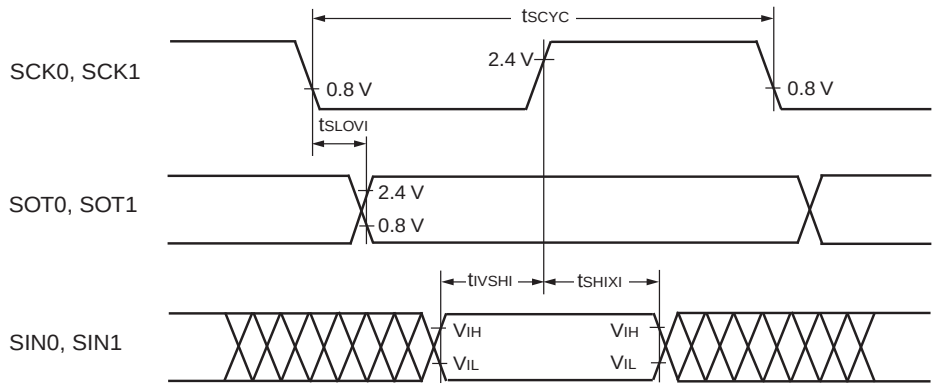
■ **Bit setting: ESCR:SCES = 0, ECCR:SCDE = 0**

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = 0 V)

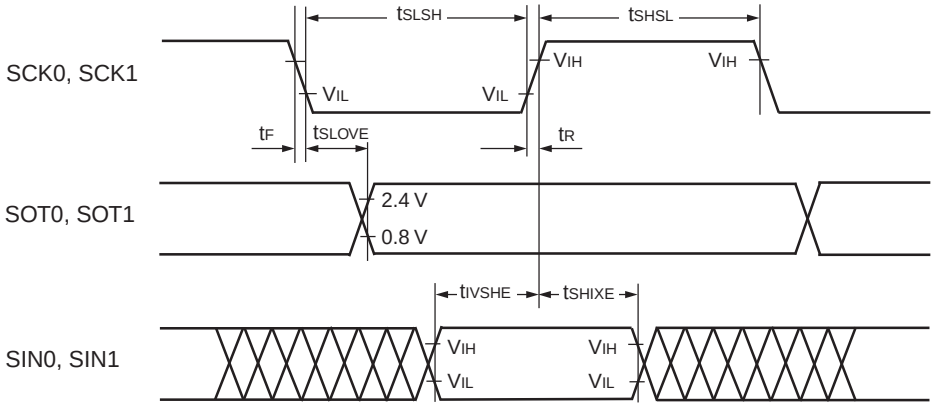
Parameter	Symbol	Pin	Condition	Value		Unit
				Min	Max	
Serial clock cycle time	t_{SCYC}	SCK0, SCK1	Internal shift clock mode output pins are CL = 80 pF + 1 TTL.	5 t_{CP}	–	ns
SCK ↓ → SOT delay time	t_{SLOVI}	SCK0, SCK1, SOT0, SOT1		–50	+50	ns
Valid SIN → SCK ↑	t_{IVSHI}	SCK0, SCK1, SIN0, SIN1		t_{CP} + 80	–	ns
SCK ↑ → Valid SIN hold time	t_{SHIXI}	SCK0, SCK1, SIN0, SIN1		0	–	ns
Serial clock “L” pulse width	t_{SHSL}	SCK0, SCK1	External shift clock mode output pins are CL = 80 pF + 1 TTL.	3 t_{CP} - t_R	–	ns
Serial clock “H” pulse width	t_{SLSH}	SCK0, SCK1		t_{CP} + 10	–	ns
SCK ↓ → SOT delay time	t_{SLOVE}	SCK0, SCK1, SOT0, SOT1		–	2 t_{CP} + 60	ns
Valid SIN → SCK ↑	t_{IVSHE}	SCK0, SCK1, SIN0, SIN1		30	–	ns
SCK ↑ → Valid SIN hold time	t_{SHIXE}	SCK0, SCK3, SIN0, SIN1		t_{CP} + 30	–	ns
SCK fall time	t_F	SCK0, SCK1		–	10	ns
SCK rise time	t_R	SCK0, SCK1		–	10	ns

Notes:
- AC characteristic in CLK synchronized mode.
- C_L is load capacity value of pins when testing.
- t_{CP} is internal operating clock cycle time (machine clock) . Refer to “Clock Timing”.

- Internal Shift Clock Mode



- External Shift Clock Mode



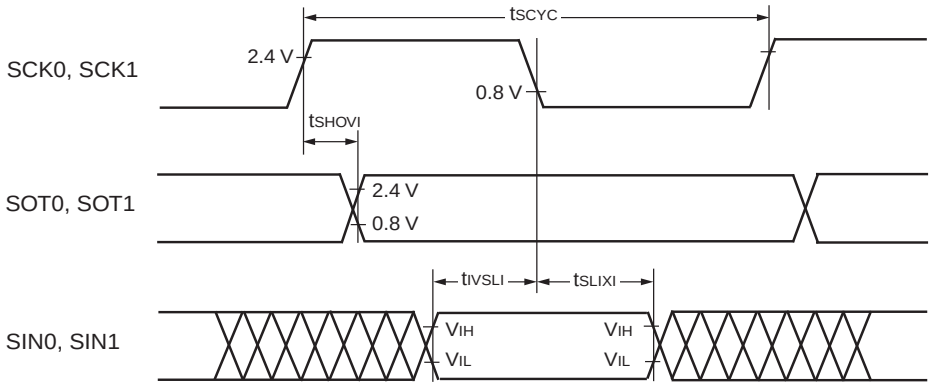
■ **Bit setting: ESCR:SCES = 1, ECCR:SCDE = 0**

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, V_{SS} = 0 V)

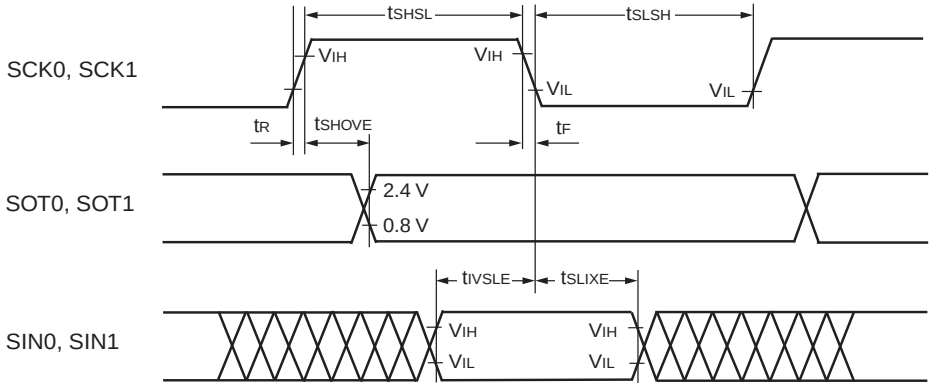
Parameter	Symbol	Pin	Condition	Value		Unit
				Min	Max	
Serial clock cycle time	t_{SCYC}	SCK0, SCK1	Internal shift clock mode output pins are CL = 80 pF + 1 TTL.	5 t_{CP}	–	ns
SCK ↑ → SOT delay time	t_{SHOVI}	SCK0, SCK1, SOT0, SOT1		–50	+50	ns
Valid SIN → SCK ↓	t_{IVSLI}	SCK0, SCK1, SIN0, SIN1		t_{CP} + 80	–	ns
SCK ↓ → Valid SIN hold time	t_{SLIXI}	SCK0, SCK1, SIN0, SIN1		0	–	ns
Serial clock “H” pulse width	t_{SHSL}	SCK0, SCK1	External shift clock mode output pins are CL = 80 pF + 1 TTL.	3 t_{CP} - t_R	–	ns
Serial clock “L” pulse width	t_{SLSH}	SCK0, SCK1		t_{CP} + 10	–	ns
SCK ↑ → SOT delay time	t_{SHOVE}	SCK0, SCK1, SOT0, SOT1		–	2 t_{CP} + 60	ns
Valid SIN → SCK ↓	t_{IVSLE}	SCK0, SCK1, SIN0, SIN1		30	–	ns
SCK ↓ → Valid SIN hold time	t_{SLIXE}	SCK0, SCK1, SIN0, SIN1		t_{CP} + 30	–	ns
SCK fall time	t_F	SCK0, SCK1		–	10	ns
SCK rise time	t_R	SCK0, SCK1		–	10	ns

Notes:
- C_L is load capacity value of pins when testing.
- t_{CP} is internal operating clock cycle time (machine clock) . Refer to “Clock Timing”.

- Internal Shift Clock Mode



- External Shift Clock Mode

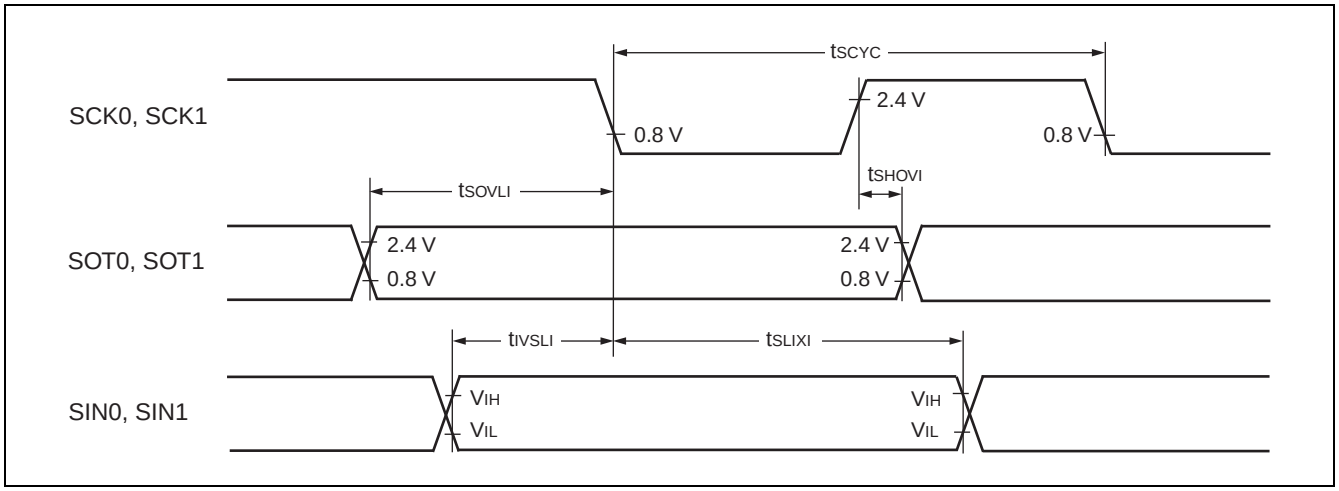


■ **Bit setting: ESCR:SCES = 0, ECCR:SCDE = 1**

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, V_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value		Unit
				Min	Max	
Serial clock cycle time	t_{SCYC}	SCK0, SCK1	Internal clock operation output pins are CL = 80 pF + 1 TTL.	5 t_{CP}	–	ns
SCK ↑ → SOT delay time	t_{SHOVI}	SCK0, SCK1, SOT0, SOT1		–50	+50	ns
Valid SIN → SCK ↓	t_{IVSLI}	SCK0, SCK1, SIN0, SIN1		t_{CP} + 80	–	ns
SCK ↓ → Valid SIN hold time	t_{SLIXI}	SCK0, SCK1, SIN0, SIN1		0	–	ns
SOT → SCK ↓ delay time	t_{SOVLI}	SCK0, SCK1, SOT0, SOT1		3 t_{CP} – 70	–	ns

Notes:
- C_L is load capacity value of pins when testing.
- t_{CP} is internal operating clock cycle time (machine clock) . Refer to “Clock Timing”.

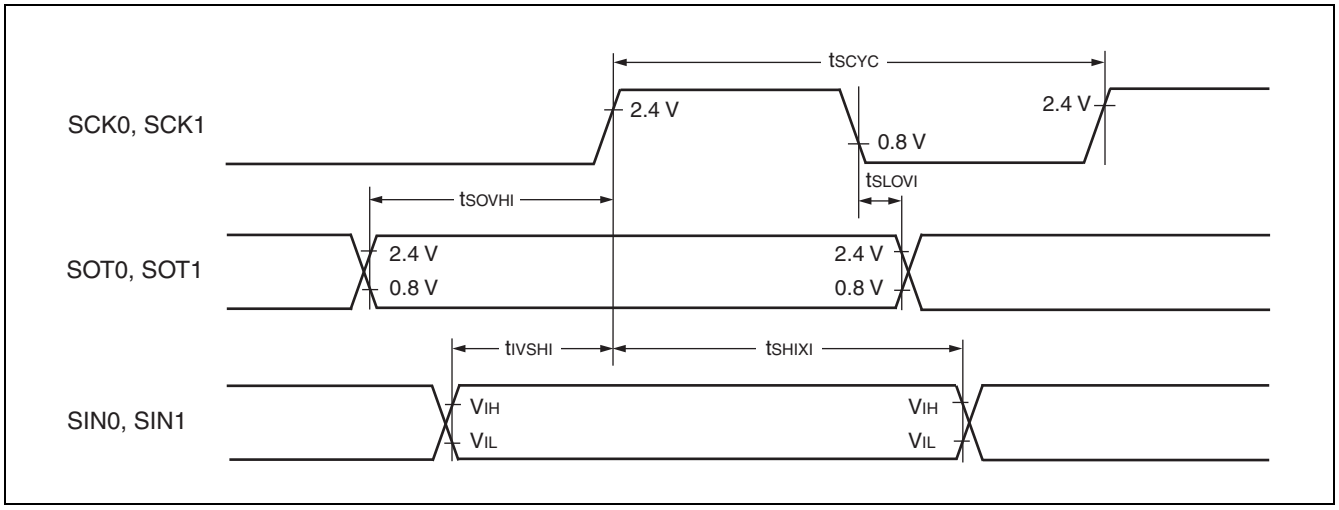

tSCYC
SCK0, SCK1
2.4 V
0.8 V
0.8 V
tSOVLI
tSHOVI
SOT0, SOT1
2.4 V
0.8 V
2.4 V
0.8 V
tIVSLI
tSLIXI
SIN0, SIN1
VIH
VIL
VIH
VIL

■ **Bit setting: ESCR:SCES = 1, ECCR:SCDE = 1**

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value		Unit
				Min	Max	
Serial clock cycle time	t_{SCYC}	SCK0, SCK1	Internal clock operation output pins are CL = 80 pF + 1 TTL.	5 t_{CP}	–	ns
SCK ↓ → SOT delay time	t_{SLOVI}	SCK0, SCK1, SOT0, SOT1		–50	+50	ns
Valid SIN → SCK ↑	t_{IVSHI}	SCK0, SCK1, SIN0, SIN1		t_{CP} + 80	–	ns
SCK ↑ → Valid SIN hold time	t_{SHIXI}	SCK0, SCK1, SIN0, SIN1		0	–	ns
SOT → SCK ↑ delay time	t_{SOVHI}	SCK0, SCK1, SOT0, SOT1		3 t_{CP} – 70	–	ns

Notes:
- C_L is load capacity value of pins when testing.
- t_{CP} is internal operating clock cycle time (machine clock) . Refer to "Clock Timing".

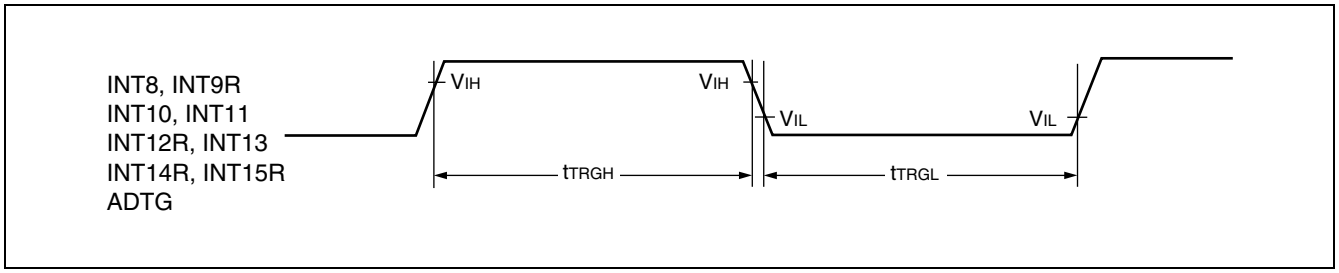


11.4.5 Trigger Input Timing

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value		Unit
				Min	Max	
Input pulse width	t_{TRGH} t_{TRGL}	INT8, INT9R INT10, INT11 INT12R, INT13 INT14R, INT15R ADTG	–	5 t_{CP}	–	ns

Note: t_{CP} is internal operating clock cycle time (machine clock) . Refer to "Clock Timing".

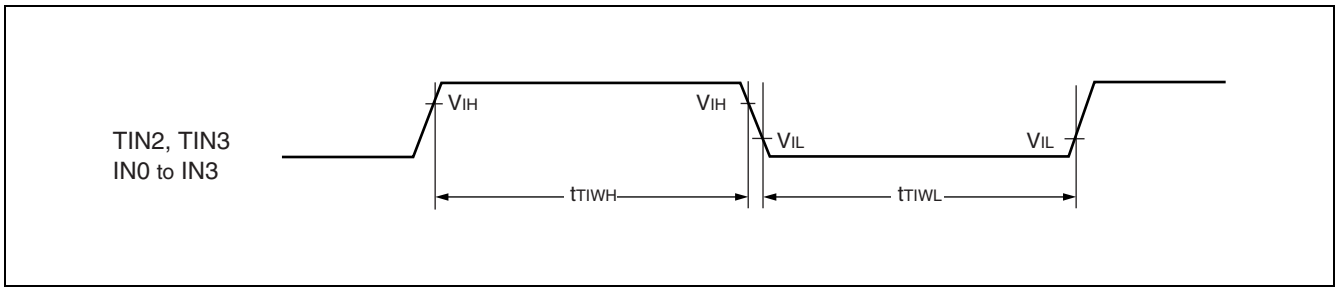


11.4.6 Timer Related Resource Input Timing

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value		Unit
				Min	Max	
Input pulse width	t_{TIWH} t_{TIWL}	TIN2, TIN3 IN0 to IN3	–	4 t_{CP}	–	ns

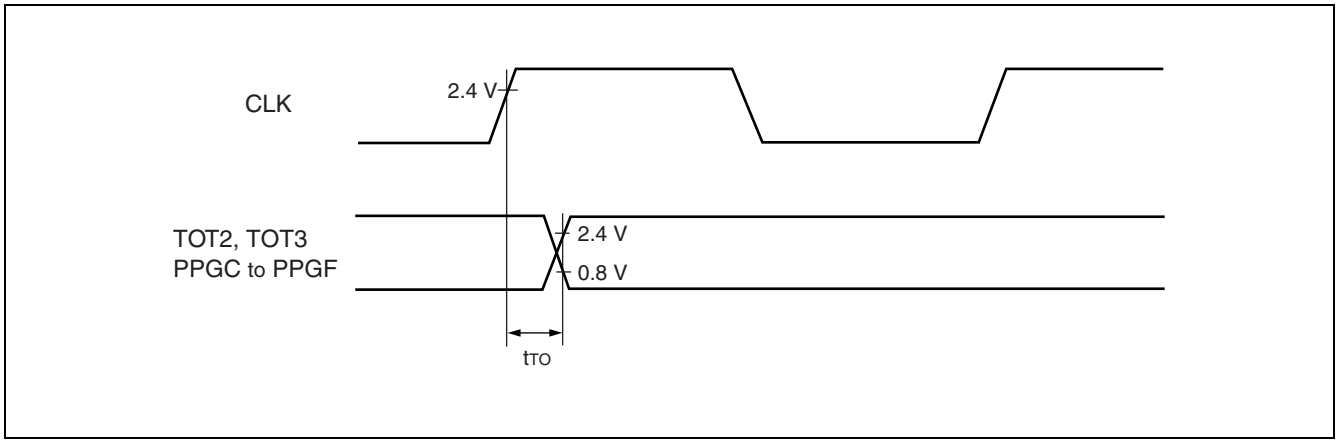
Note: t_{CP} is internal operating clock cycle time (machine clock) . Refer to “Clock Timing”.



11.4.7 Timer Related Resource Output Timing

(T_A = –40°C to +125°C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value		Unit
				Min	Max	
CLK ↑ → T_{OUT} change time	t_{TO}	TOT2, TOT3 PPGC to PPGF	–	30	–	ns



11.5 A/D Converter

(TA = –40 °C to +125 °C, 3.0 V ≤ AVR – AV_{SS}, V_{CC} = AV_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

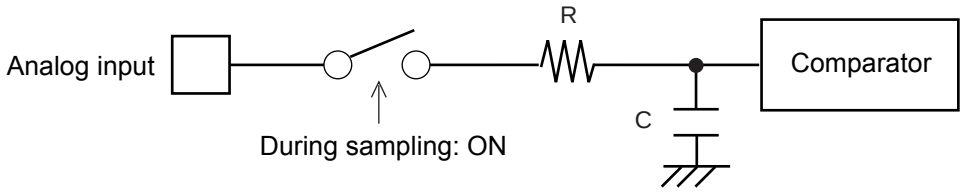
Parameter	Symbol	Pin	Value			Unit	Remarks
			Min	Typ	Max		
Resolution	–	–	–	–	10	bit	
Total error	–	–	–	–	±3.0	LSB	
Nonlinearity error	–	–	–	–	±2.5	LSB	
Differential nonlinearity error	–	–	–	–	±1.9	LSB	
Zero reading voltage	V_{OT}	AN0 to AN15	AV_{SS} – 1.5 × LSB	AV_{SS} + 0.5 × LSB	AV_{SS} + 2.5 × LSB	V	
Full scale reading voltage	V_{FST}	AN0 to AN15	AVR – 3.5 × LSB	AVR – 1.5 × LSB	AVR + 0.5 × LSB	V	
Compare time	–	–	1.0	–	16500	µs	4.5 V ≤ AV_{CC} ≤ 5.5 V
			2.0				4.0 V ≤ AV_{CC} < 4.5 V
Sampling time	–	–	0.5	–	∞	µs	4.5 V ≤ AV_{CC} ≤ 5.5 V
			1.2				4.0 V ≤ AV_{CC} < 4.5 V
Analog port input current	I_{AIN}	AN0 to AN15	–0.3	–	+0.3	µA	
Analog input voltage range	V_{AIN}	AN0 to AN15	AV_{SS}	–	AVR	V	
Reference voltage range	–	AVR	AV_{SS} + 2.7	–	AV_{CC}	V	
Power supply current	I_A	AV_{CC}	–	3.5	7.5	mA	
	I_{AH}	AV_{CC}	–	–	5	µA	*
Reference voltage supply current	I_R	AVR	–	600	900	µA	
	I_{RH}	AVR	–	–	5	µA	*
Offset between input channels	–	AN0 to AN15	–	–	4	LSB	

*: If A/D converter is not operating, a current when CPU is stopped is applicable (V_{CC} = AV_{CC} = AVR = 5.0 V) .

• About the external impedance of analog input and its sampling time

A/D converter with sample and hold circuit. If the external impedance is too high to keep sufficient sampling time, the analog voltage changed to the internal sample and hold capacitor is insufficient, adversely affecting A/D conversion precision. Therefore, to satisfy the A/D conversion precision standard, consider the relationship between the external impedance and minimum sampling time and either adjust the resistor value and operating frequency or decrease the external impedance so that the sampling time is longer than the minimum value. And, if the sampling time cannot be sufficient, connect a capacitor of about 0.1 μF to the analog input pin.

• Analog input equivalent circuit model



MB90F362E/TE/ES/TES, MB90F367E/TE/ES/TES

	R	C
4.5 V ≤ AV_{CC} ≤ 5.5 V	2.0 kΩ (Max)	16.0 pF (Max)
4.0 V ≤ AV_{CC} < 4.5 V	8.2 kΩ (Max)	16.0 pF (Max)

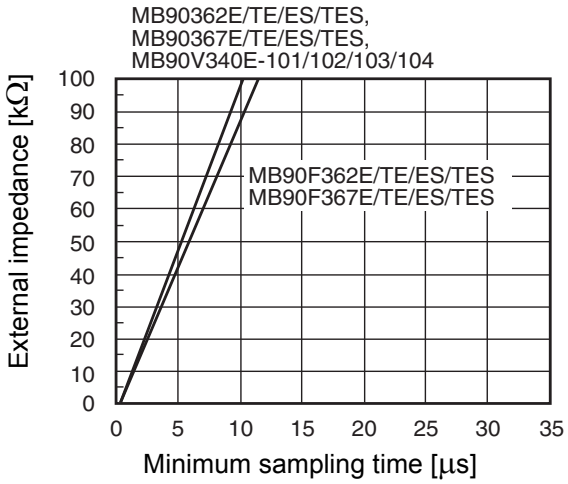
MB90362E/TE/ES/TES, MB90367E/TE/ES/TES,
MB90V340E-101/102/103/104

	R	C
4.5 V ≤ AV_{CC} ≤ 5.5 V	2.0 kΩ (Max)	14.4 pF (Max)
4.0 V ≤ AV_{CC} < 4.5 V	8.2 kΩ (Max)	14.4 pF (Max)

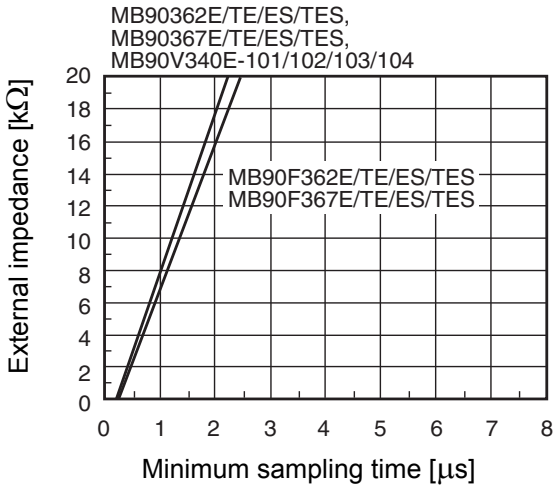
Note: The values are reference values.

- The relationship between external impedance and minimum sampling time
  - At 4.5 V ≤ AV_{CC} ≤ 5.5 V

(External impedance = 0 kΩ to 100 kΩ)

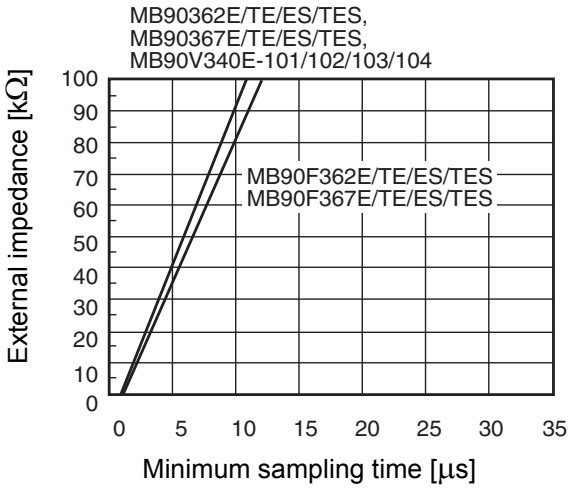


(External impedance = 0 kΩ to 20 kΩ)

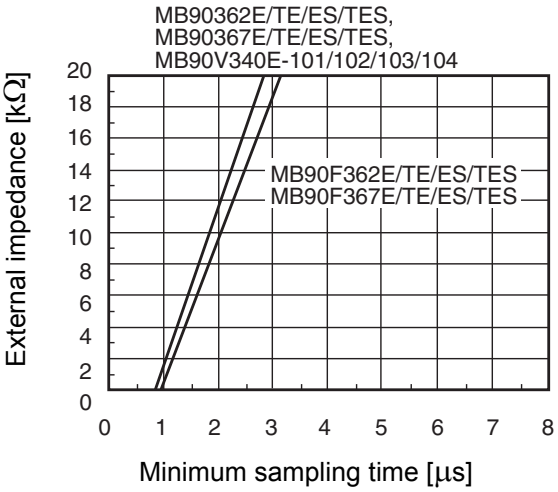


  - At 4.0 V ≤ AV_{CC} < 4.5 V

(External impedance = 0 kΩ to 100 kΩ)



(External impedance = 0 kΩ to 20 kΩ)

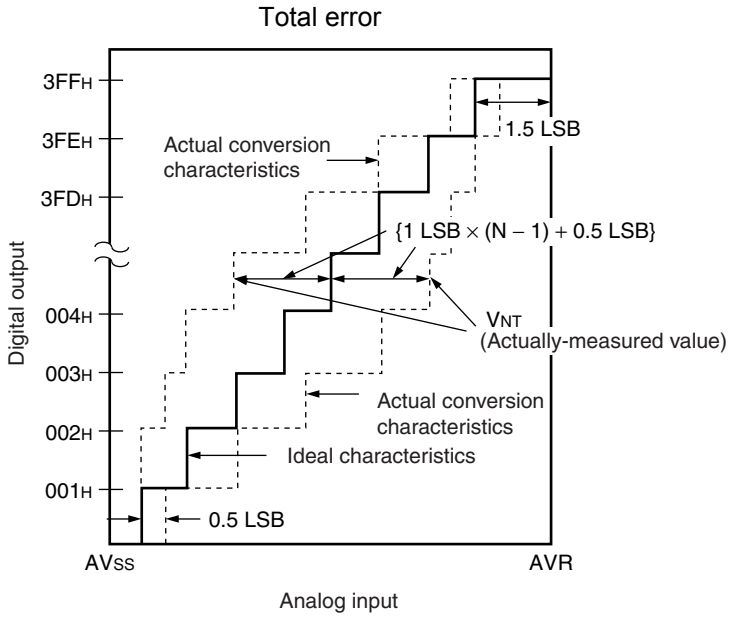


- **About errors**

As | AVR − AV_{SS} | becomes smaller, values of relative errors grow larger.

11.6 Definition of A/D Converter Terms

Resolution	:	Analog variation that is recognized by an A/D converter.
Non linearity error	:	Deviation between a line across zero-transition line (“00 0000 0000_B” ← → “00 0000 0001_B”) and full-scale transition line (“11 1111 1110_B” ← → “11 1111 1111_B”) and actual conversion characteristics.
Differential linearity error	:	Deviation of input voltage, which is required for changing output code by 1 LSB, from an ideal value.
Total error	:	Difference between an actual value and an theoretical value. A total error includes zero transition error, full-scale transition error, and linear error.



$$\text{Total error of digital output “N”} = \frac{V_{NT} - \{1\ \text{LSB} \times (N - 1) + 0.5\ \text{LSB}\}}{1\ \text{LSB}}\ [\text{LSB}]$$

$$1\ \text{LSB (Ideal value)} = \frac{AVR - AV_{SS}}{1024}\ [\text{V}]$$

N: A/D converter digital output value

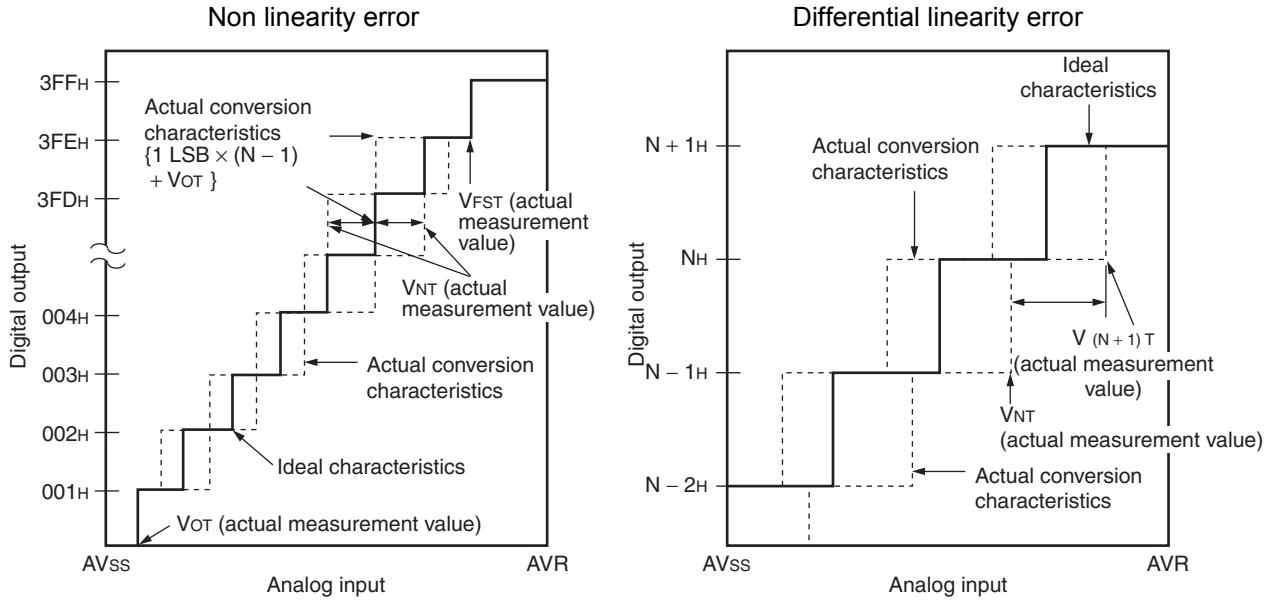
V_{OT} (Ideal value) $= AV_{SS} + 0.5$ LSB [V]

V_{FST} (Ideal value) $= AVR - 1.5$ LSB [V]

V_{NT}: A voltage at which digital output transits from (N − 1) to N.

(Continued)

(Continued)



$$\text{Non linearity error of digital output N} = \frac{V_{NT} - \{1\ \text{LSB} \times (N - 1) + V_{OT}\}}{1\ \text{LSB}}\ [\text{LSB}]$$

$$\text{Differential linearity error of digital output N} = \frac{V_{(N+1)T} - V_{NT}}{1\ \text{LSB}} - 1\ \text{LSB}\ [\text{LSB}]$$

$$1\ \text{LSB} = \frac{V_{FST} - V_{OT}}{1022}\ [\text{V}]$$

N : A/D converter digital output value
V_{OT} : Voltage at which digital output transits from "000_H" to "001_H."
V_{FST}: Voltage at which digital output transits from "$3FE_H$" to "$3FF_H$."

11.7 Flash Memory Program/Erase Characteristics

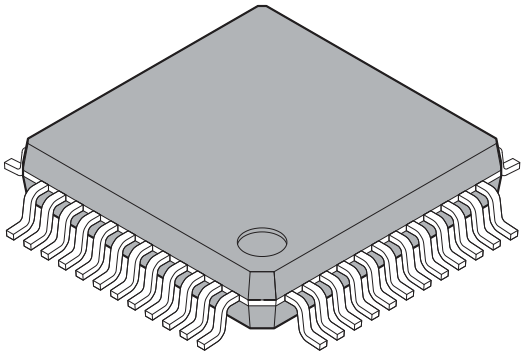
Parameter	Conditions	Value			Unit	Remarks
		Min	Typ	Max		
Chip erase time	T_A = –40 °C to +105 °C V_{CC} = 5.0 V	–	1	15	s	Excludes programming prior to erasure
Word (16-bit width) programming time		–	16	3600	µs	Except for the overhead time of the system level
Program/Erase cycle	–	10000	–	–	cycle	
Flash memory data retention time	Average T_A = +85 °C	20	–	–	year	*

*: Corresponding value comes from the technology reliability evaluation result (using Arrhenius equation to translate high temperature measurements into normalized value at +85 °C) .

12. Ordering Information

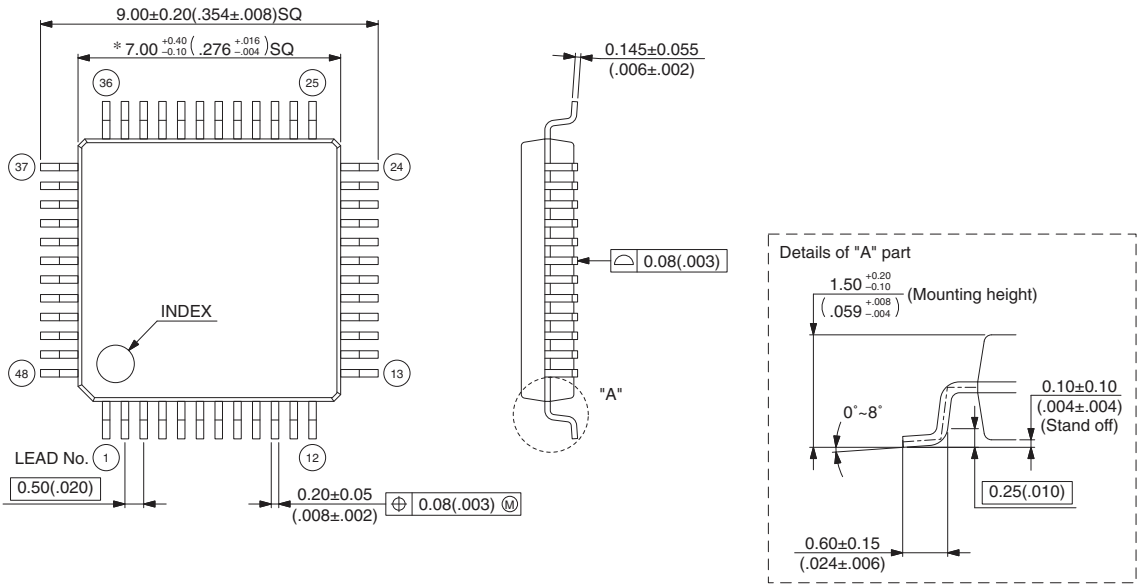
Part number	Package	Remarks
MB90F362EPMT	48-pin plastic LQFP (FPT-48P-M26)	
MB90F362TEPMT		
MB90F362ESPMT		
MB90F362TESPMT		
MB90F367EPMT		
MB90F367TEPMT		
MB90F367ESPMT		
MB90F367TESPMT		
MB90362EPMT		
MB90362TEPMT		
MB90362ESPMT		
MB90362TESPMT		
MB90367EPMT		
MB90367TEPMT		
MB90367ESPMT		
MB90367TESPMT		
MB90V340E-101CR	299-pin ceramic PGA (PGA-299C-A01)	For evaluation
MB90V340E-102CR		
MB90V340E-103CR		
MB90V340E-104CR		

13. Package Dimension

48-pin plastic LQFP		
 (FPT-48P-M26)	Lead pitch	0.50 mm
	Package width × package length	7 × 7 mm
	Lead shape	Gullwing
	Sealing method	Plastic mold
	Mounting height	1.70 mm MAX
	Weight	0.17 g
	Code (Reference)	P-LFQFP48-7×7-0.50

48-pin plastic LQFP
(FPT-48P-M26)

Note 1) * : These dimensions include resin protrusion.
Note 2) Pins width and pins thickness include plating thickness.
Note 3) Pins width do not include tie bar cutting remainder.



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Dimensions in mm (inches).
Note: The values in parentheses are reference values.

14. Major Changes

Spansion Publication Number: DS07-13746-3Et

Page	Section	Change Results
—	—	Changed are following names. UART → LIN-UART 16-bit I/O timer → 16-bit free-run timer
4, 5	Product Lineup	Added the row of LIN-UART.
15	Handling Devices	Added the item “17.Serial communication”.
37	Electrical Characteristics Absolute Maximum Ratings	Changed the maximum rating values and Remarks on Ratings of Power consumption. 300 → 308 Flash memory updata not performed 390 Flash memory updata performed
48 to 52	AC Characteristics	Changed the characteristics of (4)LIN-UART0/1. (4) UART0/UART1 → (4)LIN-UART0/1
55	A/D Converter	Changed the items of “Zero reading voltage” and “Full scale reading voltage”.
61	Ordering Information	Changed the part numbers; MB90V340E-101 → MB90V340E-101CR MB90V340E-102 → MB90V340E-102CR MB90V340E-103 → MB90V340E-103CR MB90V340E-104 → MB90V340E-104CR

NOTE: Please see “Document History” about later revised information.

Document History

Document Title: MB90360E Series F^{2}MC-16LX 16-bit Microcontroller Datasheet Document Number: 002-04496				
Revision	**ECN**	**Orig. of Change**	**Submission Date**	**Description of Change**
**	—	AKIH	11/16/2006	Migrated to Cypress and assigned document number 002-04496. No change to document contents or format.
*A	5223311	AKIH	04/19/2016	Updated to Cypress template

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