SD2 USB and Mass Storage Peripheral Controller

Features

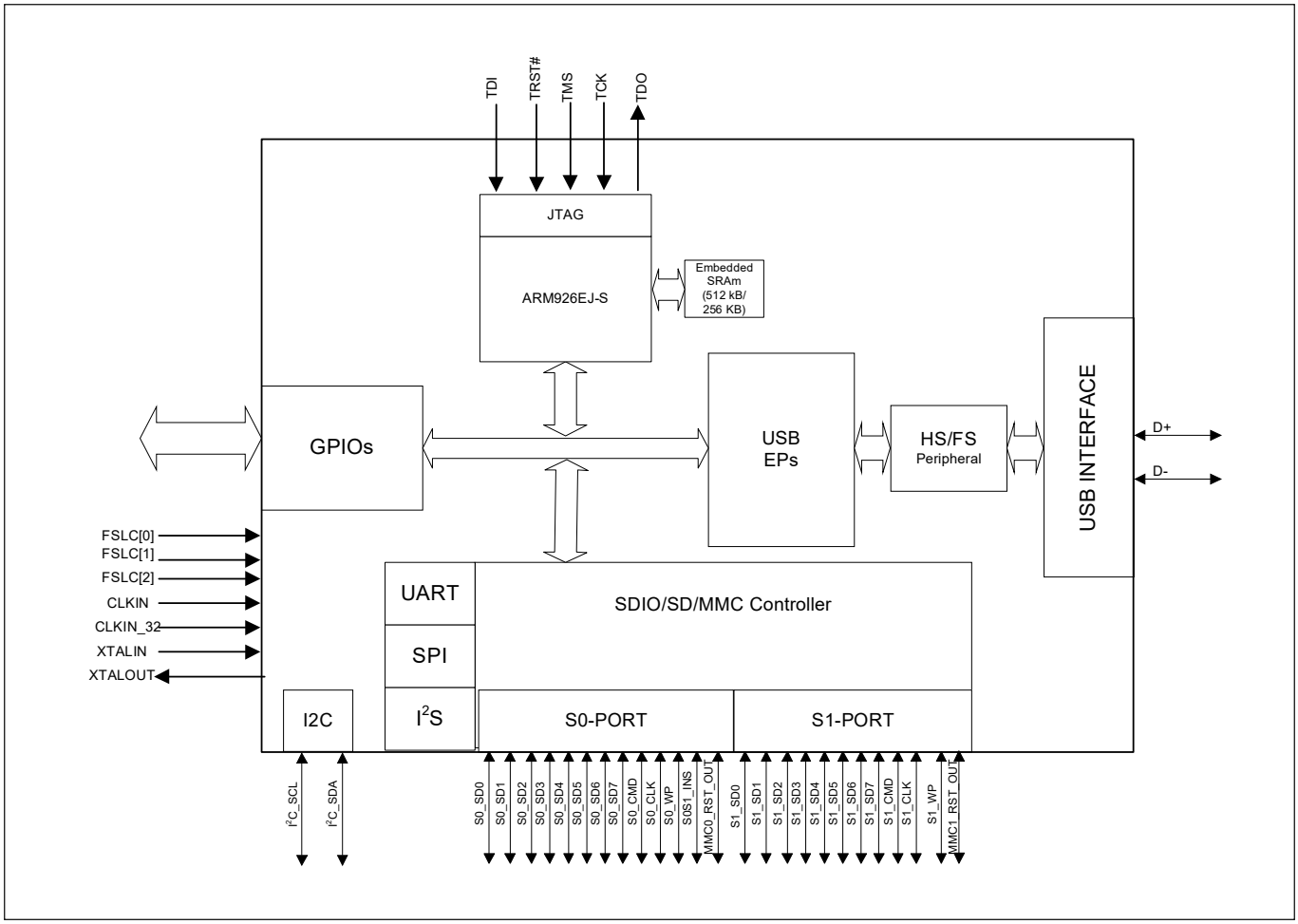
- Latest generation storage support
  - SD2.0/SDXC – UHS1 SDR50 / DDR50 Master
  - eMMC 4.4 Master
  - SDIO 3.0 Master
- USB integration
  - Certified USB 2.0 peripheral: Hi-Speed (HS) and Full-Speed (FS) only
  - 32 physical endpoints
  - Integrated transceiver
- Ultra low-power in core power-down mode
  - Less than 60 µA with VBATT on and 20 µA with VBATT off
- I^2C master controller at 1 MHz
- Selectable input clock frequencies
  - 19.2, 26, 38.4, and 52 MHz
  - 19.2 MHz crystal input support
- Independent power domains for core and I/O
- 10 × 10 mm, 0.8 mm pitch ball grid array (BGA) package

Applications

- USB thumb drives
- Card readers
- Laptop with SD slots
- SD slot in TV/STB
- WiFi Dongles
- USB SDIO Bridge

Applications

Block diagram



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1 Functional overview

SD2 is a USB 2.0 High Speed mass-storage controller providing the latest SD/MMC support. SD2 complies with the SD specification, Version 3.0, and the MMC specification, Version 4.41.

SD2 offers the following access paths among USB and mass storage ports:

- A USB-port (U-Port) supporting USB 2.0 peripheral
- Two mass-storage ports (S0-Port and S1-Port) supporting mass-storage devices. Following are the possible configurations for the two mass-storage ports:
  - SD and MMC
  - SD and SD
  - MMC and MMC
  - SD and SDIO
  - MMC and SDIO
  - SDIO and SDIO

Combinations of these accesses can happen independently or in an interleaved manner.

The SD2 complies with the USB 2.0 specification.

1.1 USB interface (U-port)

SD2 offers the following features:

- Supports USB peripheral functionality compliant with the USB 2.0 specification
- Supports up to 16 IN and 16 OUT endpoints.
- Supports the USB 2.0 Streams feature. It also supports USB Attached SCSI (UAS) device class to optimize mass-storage access performance.
- As a USB peripheral, SD2 supports UAS and mass storage class (MSC) peripheral classes.
- When the USB port is not in use, the PHY and transceiver may be disabled for power savings.

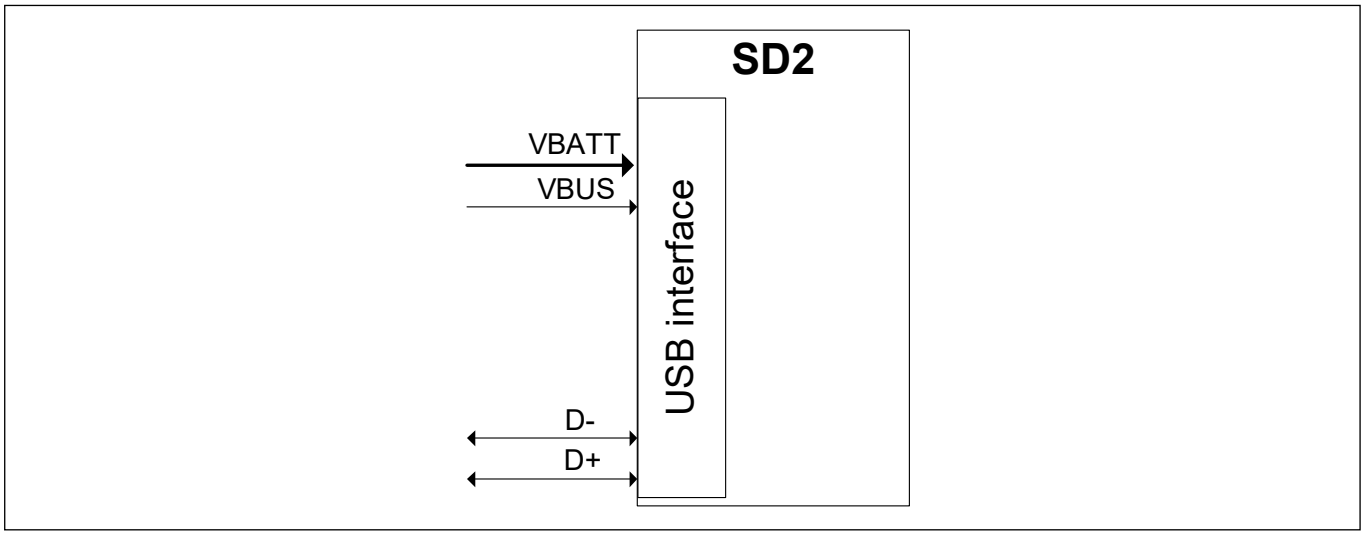


Figure 1 USB interface signals

1.2 Mass-storage support (S-port)

The SD2 storage interface port supports the following specifications:

- SD Specification, Version 3.0
- Multimedia card-system specification, MMCA technical committee, Version 4.4
- SDIO host controller compliant with SDIO specification Version 3.00

1.3 I²C interface

SD2 has an I²C interface compatible with the I²C bus specification Revision 3, as SD2's I²C interface is capable of operating only as an I²C master, it may be used to communicate with other I²C slave devices. For example, SD2 may boot from an EEPROM connected to the I²C interface, as a selectable boot option.

SD2's I²C master controller also supports multi-master mode functionality.

The power supply for the I²C interface is VIO5, which is a separate power domain from the other serial peripherals. This is to allow the I²C interface the flexibility to operate at a different voltage than the other serial interfaces.

The I²C controller supports bus frequencies of 100 kHz, 400 kHz, and 1 MHz. When VIO5 is 1.2 V, the maximum operating frequency supported is 100 kHz. When VIO5 is 1.8 V, 2.5 V, or 3.3 V, the operating frequencies supported are 400 kHz and 1 MHz. The I²C controller supports the clock stretching feature to enable slower devices to exercise flow control.

Both SCL and SDA signals of the I²C interface require external pull-up resistors. These resistors must be connected to VIO5.

1.4 UART interface

The UART interface of SD2 supports full-duplex communication. It includes the signals noted in **Table 1**.

Table 1 UART interface signals

Signal	Description
TX	Output signal
RX	Input signal
CTS	Flow control
RTS	Flow control

The UART is capable of generating a range of baud rates, from 300 bps to 4608 Kbps, selectable by the firmware. If flow control is enabled, then SD2's UART only transmits data when the CTS input is asserted. In addition to this, SD2's UART asserts the RTS output signal, when it is ready to receive data.

1.5 I²S interface

SD2 has an I²S port to support external audio codec devices. SD2 functions as I²S Master as transmitter only. The I²S interface consists of four signals: clock line (I2S_CLK), serial data line (I2S_SD), word select line (I2S_WS), and master system clock (I2S_MCLK). SD2 can generate the system clock as an output on I2S_MCLK or accept an external system clock input on I2S_MCLK.

The sampling frequencies supported by the I²S interface are 8 kHz, 16 kHz, 32 kHz, 44.1 kHz, 48 kHz, 96 kHz and 192 kHz.

1.6 SPI interface

SD2 supports an SPI Master interface on the Serial Peripherals port. The maximum operation frequency is 33 MHz.

The SPI controller supports four modes of SPI communication (see **SPI timing specification** for details on the modes) with the Start-Stop clock. This controller is a single-master controller with a single automated SSN control. It supports transaction sizes ranging from 4 bits to 32 bits.

2 Boot options

SD2 can load boot images from various sources, selected by the configuration of the PMODE pins. The boot options for the SD2 are as follows:

- Boot from USB
- Boot from I^2C
- Boot from eMMC on S0-Port
- Boot from SPI
  - Infineon SPI Flash parts supported are S25FS064S (64 Mbit), S25FS128S (128 Mbit) and S25LFL064L (64 Mbit).
  - Winbond W25Q32FW (32 Mbit) is also supported.

Table 2 Booting options for SD2

PMODE[2:0][1]	Boot from
FF0	S0-Port: eMMC On failure, USB boot enabled
FF1	USB Boot
FFF	I^2C On Failure, USB Boot is enabled
0FF	I^2C only
0F1	SPI On Failure, USB Boot is enabled

Note
1. F indicates floating.

3 Reset

A reset is initiated by asserting the Reset# pin on SD2. The specific reset sequence and timing requirements are detailed in **Figure 3** and **Table 16**. All I/Os are tristated during a hard reset.

4 Clocking

SD2 allows either a crystal to be connected between the XTALIN and XTALOUT pins or an external clock to be connected at the CLKIN pin. The XTALIN, XTALOUT, CLKIN, and CLKIN_32 pins can be left unconnected if not used.

Crystal frequency supported is 19.2 MHz, while the external clock frequencies supported are 19.2, 26, 38.4, and 52 MHz.

SD2 has an on-chip oscillator circuit that uses an external 19.2 MHz (±100 ppm) crystal (when the crystal option is used). An appropriate load capacitance is required with a crystal. Refer to the specification of the crystal used to determine the appropriate load capacitance. The FSLC[2:0] pins must be configured appropriately to select the crystal option/clock frequency option. The configuration options are shown in **Table 3**.

Clock inputs to SD2 must meet the phase noise and jitter requirements specified in **Table 4**.

The input clock frequency is independent of the clock/data rate of SD2 core or any of the device interfaces. The internal PLL applies the appropriate clock multiply option depending on the input frequency.

Table 3 Crystal/Clock frequency selection

FSLC[2]	FSLC[1]	FSLC[0]	Crystal/Clock frequency
0	0	0	19.2 MHz crystal
1	0	0	19.2 MHz input CLK
1	0	1	26 MHz input CLK
1	1	0	38.4 MHz input CLK
1	1	1	52 MHz input CLK

Table 4 Input clock specifications for SD2

Parameter	Description	Specification		Units
		Min	Max	
Phase noise	100 Hz offset	–	–75	dB
	1 kHz offset	–	–104	dB
	10 kHz offset	–	–120	dB
	100 kHz offset	–	–128	dB
	1 MHz offset	–	–130	dB
Maximum frequency deviation	–	–	150	ppm
Duty cycle	–	30	70	%
Overshoot	–	–	3	%
Undershoot	–	–	–3	%
Rise time/fall time	–	–	3	ns

4.1 32 kHz watchdog timer clock input

SD2 includes a watchdog timer that can be used to interrupt the core, automatically wake up SD2 in Standby mode, and reset the core. The watchdog timer runs off a 32 kHz clock, which may optionally be supplied from an external source on a dedicated pin of SD2.

The watchdog timer can be disabled by firmware.

Requirements for the optional 32 kHZ clock input are listed in **Table 5**.

Table 5 32 kHz clock input requirements

Parameter	Min	Max	Units
Duty cycle	40	60	%
Frequency deviation	–	±200	ppm
Rise Time/fall Time	–	200	ns

5 Power

SD2 has the following main groups of power supply domains:

- **IO_VDDQ:** This refers to a group of independent supply domains for digital I/Os. The voltage level on these supplies are 1.8 V to 3.3 V. SD2 provides six independent supply domains for digital I/Os listed as follows:
  - VIO2: S0-Port (for SD/MMC) I/O Power supply domain
  - VIO3: S1-Port (for SD/MMC) I/O Power supply domain
  - VIO1: S2-Port (GPIO) Power supply domain
  - VIO4: S1-Port GPIO[53:57]/O Power supply domain (these pins support MMC's high nibble data line - D[7:4] on S1-Port)
  - VIO5: I2C Power supply domain (supports 1.2 V to 3.3 V)
  - CVDDQ: Clock power supply domain
- **VDD:** This is the supply voltage for the logic core. The nominal supply voltage level is 1.2 V. This supplies the core logic circuits. The same supply must also be used for the following:
  - **AVDD**: This is the 1.2 V supply for the PLL, crystal oscillator and other core analog circuits
- **VBATT/VBUS:** This is the 3.2 V to 6 V battery power supply for the USB I/O and analog circuits. This supply powers the USB transceiver through SD2's internal voltage regulator. VBATT is internally regulated to 3.3 V.

Note: No specific power-up sequence for SD2 power domains. Minimum power on reset time of 1 msec should be met and the power domains must be stable for SD2 operation.

5.1 Power modes

SD2 supports the following power modes:

- Normal mode: This is the full-functional operating mode. In this mode the internal CPU clock and the internal PLLs are enabled.

Normal operating power consumption does not exceed the sum of ICC_CORE max and ICC_USB max (see **Table 14** for current consumption specifications).

The I/O power supplies (VIO2, VIO3, VIO4, and VIO5) may be turned off when the corresponding interface is not in use. S2VDDQ cannot be turned off at any time if the S2-Port is used in the application.

- SD2 supports four low-power modes (see **Table 6**):
  - Suspend mode with USB 2.0 PHY enabled (L1 mode)
  - Suspend mode with USB 2.0 PHY disabled (L2 mode)
  - Standby mode (L3 mode)
  - Core power-down mode (L4 mode)

Table 6 Entry and exit methods for Low-power modes

Low-power mode	Characteristics	Methods of entry	Methods of exit
Suspend mode with USB 2.0 PHY Enabled (L1 mode)	The power consumption in this mode does not exceed ISB_1 USB 2.0 PHY is enabled and is in U3 mode (one of the suspend modes defined by the USB 3.0 specification). This one block alone operates with its internal clock while all other clocks are shut down All I/Os maintain their previous state Power supply for the wakeup source and core power must be retained. All other power domains can be turned on/off individually The states of the configuration registers, buffer memory and all internal RAM are maintained All transactions must be completed before SD2 enters Suspend mode (state of outstanding transactions are not preserved) The firmware resumes operation from where it was suspended (except when woken up by RESET# assertion) because the program counter does not reset	Firmware executing on the core can put SD2 into suspend mode. For example, on USB suspend condition, firmware may decide to put SD2 into suspend mode	D+ transitioning to low or high D– transitioning to low or high Detection of VBUS Assertion of GPIO[17] Assertion of RESET#

Table 6 Entry and exit methods for Low-power modes *(continued)*

Low-power mode	Characteristics	Methods of entry	Methods of exit
Suspend mode with USB 2.0 PHY disabled (L2 mode)	The power consumption in this mode does not exceed ISB_2 USB 2.0 PHY is disabled and the USB interface is in suspend mode The clocks are shut off. The PLLs are disabled All I/Os maintain their previous state USB interface maintains the previous state Power supply for the wakeup source and core power must be retained. All other power domains can be turned on/off individually The states of the configuration registers, buffer memory, and all internal RAM are maintained All transactions must be completed before SD2 enters Suspend mode (state of outstanding transactions are not preserved) The firmware resumes operation from where it was suspended (except when woken up by RESET# assertion) because the program counter does not reset	Firmware executing on the core can put SD2 into suspend mode. For example, on USB suspend condition, firmware may decide to put SD2 into suspend mode	D+ transitioning to low or high D– transitioning to low or high Detection of VBUS Assertion of GPIO[17] Assertion of RESET#

Table 6 Entry and exit methods for Low-power modes *(continued)*

Low-power mode	Characteristics	Methods of entry	Methods of exit
Standby Mode (L3 mode)	The power consumption in this mode does not exceed ISB3 All configuration register settings and program/data RAM contents are preserved. However, data in the buffers or other parts of the data path, if any, is not guaranteed. Therefore, the external processor should take care that needed data is read before putting SD2 into this Standby Mode The program counter is reset after waking up from Standby GPIO pins maintain their configuration Crystal oscillator is turned off Internal PLL is turned off USB transceiver is turned off Core is powered down. Upon wakeup, the core re-starts and runs the program stored in the program/data RAM Power supply for the wakeup source and core power must be retained. All other power domains can be turned on/off individually	Firmware executing on the core or external processor configures the appropriate register	Detection of VBUS Assertion of GPIO[17] Assertion of RESET#
Core Power Down Mode (L4 mode)	The power consumption in this mode does not exceed ISB_4 Core power is turned off All buffer memory, configu-ration registers and the program RAM do not maintain state. It is necessary to reload the firmware on exiting from this mode In this mode, all other power domains can be turned on/off individually	Turn off VDD	Reapply VDD Assertion of RESET#

6 Configuration fuse

Fuse options are available for specific usage models. Contact Infineon Applications/Marketing for details.

7 Digital I/Os

SD2 provides firmware controlled pull-up or pull-down resistors internally on all digital I/O pins. The pins can be pulled high through an internal 50 kΩ resistor or can be pulled low through an internal 10 kΩ resistor to prevent the pins from floating. The I/O pins may have the following states:

- Tristated (High-Z)
- Weak pull-up (through internal 50 kΩ)
- Pull down (through internal 10 kΩ)
- Hold (I/O hold its value) when in low power modes

All unused I/Os should be pulled high by using the internal pull-up resistors. All unused outputs should be left floating. All I/Os can be driven at full-strength, three-quarter strength, half-strength, or quarter-strength. These drive strengths are configured based on each interface.

8 EMI

SD2 meets EMI requirements outlined by FCC 15B (USA) and EN55022 (Europe) for consumer electronics. SD2 can tolerate reasonable EMI, conducted by aggressor, outlined by these specifications and continue to function as expected.

9 System level ESD

SD2 has built-in ESD protection on the D+, D–, GND pins on the USB interface. The ESD protection levels provided on these ports are:

- ±2.2 KV human body model (HBM) based on JESD22-A114 specification
- ±6 KV contact discharge and ±8 KV air gap discharge based on IEC61000-4-2 level 3 A
- ±8 KV contact discharge and ±15 KV air gap discharge based on IEC61000-4-2 level 4 C.

This protection ensures the device continues to function after ESD events up to the levels stated.

The S0/S1_INS have up to ±2.2 KV HBM internal ESD protection.

10 Pinouts

	1	2	3	4	5	6	7	8	9	10	11
A	U3VSSQ	VDD	NC	NC	NC	NC	AVDD	VSS	DP	DM	NC
B	VIO4	FSLC[0]	NC	FSLC[1]	VDD	CVDDQ	AVSS	VSS	VSS	VDD	TRST#
C	GPIO[54]	GPIO[55]	VDD	GPIO[57]	RESET#	XTALIN	XTALOUT	R_USB2	OTG_ID	TDO	VIO5
D	GPIO[50]	GPIO[51]	GPIO[52]	GPIO[53]	GPIO[56]	CLKIN_32	CLKIN	VSS	I2C_GPIO[58]	I2C_GPIO[59]	NC
E	GPIO[47]	VSS	S1VDDQ	GPIO[49]	GPIO[48]	FSLC[2]	TDI	TMS	VDD	VBATT	VBUS
F	S0VDDQ	GPIO[45]	GPIO[44]	GPIO[41]	GPIO[46]	TCK	GPIO[2]	GPIO[5]	GPIO[1]	GPIO[0]	VDD
G	VSS	GPIO[42]	GPIO[43]	GPIO[30]	GPIO[25]	GPIO[22]	GPIO[21]	GPIO[15]	GPIO[4]	GPIO[3]	VSS
H	VDD	GPIO[39]	GPIO[40]	GPIO[31]	GPIO[29]	GPIO[26]	GPIO[20]	GPIO[24]	GPIO[7]	GPIO[6]	S2VDDQ
J	GPIO[38]	GPIO[36]	GPIO[37]	GPIO[34]	GPIO[28]	GPIO[16]	GPIO[19]	GPIO[14]	GPIO[9]	GPIO[8]	VDD
K	GPIO[35]	GPIO[33]	VSS	VSS	GPIO[27]	GPIO[23]	GPIO[18]	GPIO[17]	GPIO[13]	GPIO[12]	GPIO[10]
L	VSS	VSS	VSS	GPIO[32]	VDD	VSS	VDD	NC	S2VDDQ	GPIO[11]	VSS

Figure 2 SD2 BGA ball map (Top view)

11 Pin descriptions

Table 7 Pin list

Pin No.	Power domain	I/O	Name	Description		
S2-PORT (GPIO)						
F10	VI01	I/O	GPIO[0]	GPIO		
F9	VI01	I/O	GPIO[1]	GPIO		
F7	VI01	I/O	GPIO[2]	GPIO		
G10	VI01	I/O	GPIO[3]	GPIO		
G9	VI01	I/O	GPIO[4]	GPIO		
F8	VI01	I/O	GPIO[5]	GPIO		
H10	VI01	I/O	GPIO[6]	GPIO		
H9	VI01	I/O	GPIO[7]	GPIO		
J10	VI01	I/O	GPIO[8]	GPIO		
J9	VI01	I/O	GPIO[9]	GPIO		
K11	VI01	I/O	GPIO[10]	GPIO		
L10	VI01	I/O	GPIO[11]	GPIO		
K10	VI01	I/O	GPIO[12]	GPIO		
K9	VI01	I/O	GPIO[13]	GPIO		
J8	VI01	I/O	GPIO[14]	GPIO		
G8	VI01	I/O	GPIO[15]	GPIO		
J6	VI01	I/O	GPIO[16]	GPIO		
K8	VI01	I/O	GPIO[17]	GPIO		
K7	VI01	I/O	GPIO[18]	GPIO		
J7	VI01	I/O	GPIO[19]	GPIO		
H7	VI01	I/O	GPIO[20]	GPIO		
G7	VI01	I/O	GPIO[21]	GPIO		
G6	VI01	I/O	GPIO[22]	GPIO		
K6	VI01	I/O	GPIO[23]	GPIO		
H8	VI01	I/O	GPIO[24]	GPIO		
G5	VI01	I/O	GPIO[25]	GPIO		
H6	VI01	I/O	GPIO[26]	GPIO		
K5	VI01	I/O	GPIO[27]	GPIO		
J5	VI01	I/O	GPIO[28]	GPIO		
H5	VI01	I/O	GPIO[29]	GPIO		
G4	VI01	I/O	GPIO[30]	PMODE[0]		
H4	VI01	I/O	GPIO[31]	PMODE[1]		
L4	VI01	I/O	GPIO[32]	PMODE[2]		
L8	–	–	NC	No connect		
C5	CVDDQ	I	RESET#	Active Low. Hardware Reset.		
–				8b MMC Configuration	SD+GPIO Configuration	GPIO Configuration

Pin descriptions

Table 7 Pin list *(continued)*

Pin No.	Power domain	I/O	Name	Description							
K2	VI02	I/O	GPIO[33]	S0_SD0		S0_SD0			GPIO		
J4	VI02	I/O	GPIO[34]	S0_SD1		S0_SD1			GPIO		
K1	VI02	I/O	GPIO[35]	S0_SD2		S0_SD2			GPIO		
J2	VI02	I/O	GPIO[36]	S0_SD3		S0_SD3			GPIO		
J3	VI02	I/O	GPIO[37]	S0_SD4		GPIO			GPIO		
J1	VI02	I/O	GPIO[38]	S0_SD5		GPIO			GPIO		
H2	VI02	I/O	GPIO[39]	S0_SD6		GPIO			GPIO		
H3	VI02	I/O	GPIO[40]	S0_SD7		GPIO			GPIO		
F4	VI02	I/O	GPIO[41]	S0_CMD		S0_CMD			GPIO		
G2	VI02	I/O	GPIO[42]	S0_CLK		S0_CLK			GPIO		
G3	VI02	I/O	GPIO[43]	S0_WP		S0_WP			GPIO		
F3	VI02	I/O	GPIO[44]	S0S1_INS		S0S1_INS			GPIO		
F2	VI02	I/O	GPIO[45]	MMC0_RST_OUT		GPIO			GPIO		
–				8b MMC	SD+UART	SD+SPI	SD+GPIO	GPIO	GPIO+UART+I2S	SD+I2S	UART+SPI+I2S
F5	VI03	I/O	GPIO[46]	S1_SD0	S1_SD0	S1_SD0	S1_SD0	GPIO	GPIO	S1_SD0	UART_RTS
E1	VI03	I/O	GPIO[47]	S1_SD1	S1_SD1	S1_SD1	S1_SD1	GPIO	GPIO	S1_SD1	UART_CTS
E5	VI03	I/O	GPIO[48]	S1_SD2	S1_SD2	S1_SD2	S1_SD2	GPIO	GPIO	S1_SD2	UART_TX
E4	VI03	I/O	GPIO[49]	S1_SD3	S1_SD3	S1_SD3	S1_SD3	GPIO	GPIO	S1_SD3	UART_RX
D1	VI03	I/O	GPIO[50]	S1_CMD	S1_CMD	S1_CMD	S1_CMD	GPIO	I2S_CLK	S1_CMD	I2S_CLK
D2	VI03	I/O	GPIO[51]	S1_CLK	S1_CLK	S1_CLK	S1_CLK	GPIO	I2S_SD	S1_CLK	I2S_SD
D3	VI03	I/O	GPIO[52]	S1_WP	S1_WP	S1_WP	S1_WP	GPIO	I2S_WS	S1_WP	I2S_WS
D4	VIO4	I/O	GPIO[53]	S1_SD4	UART_RTS	SPI_SCK	GPIO	GPIO	UART_RTS	GPIO	SPI_SCK
C1	VIO4	I/O	GPIO[54]	S1_SD5	UART_CTS	SPI_SSN	GPIO	GPIO	UART_CTS	I2S_CLK	SPI_SSN
C2	VIO4	I/O	GPIO[55]	S1_SD6	UART_TX	SPI_MISO	GPIO	GPIO	UART_TX	I2S_SD	SPI_MISO
D5	VIO4	I/O	GPIO[56]	S1_SD7	UART_RX	SPI_MOSI	GPIO	GPIO	UART_RX	I2S_WS	SPI_MOSI
C4	VIO4	I/O	GPIO[57]	MMC1_RST_OUT	GPIO	GPIO	GPIO	GPIO	I2S_MCLK	I2S_MCLK	I2S_MCLK

Pin descriptions

Table 7 Pin list *(continued)*

Pin No.	Power domain	I/O	Name	Description
C9	–	–	NC	No connect
A3	–	–	NC	No connect
A4	–	–	NC	No connect
A6	–	–	NC	No connect
A5	–	–	NC	No connect
A9	VBATT/ VBUS	I/O	D+	USB (HS/FS) Data Plus
A10	VBATT/ VBUS	I/O	D-	USB (HS/FS) Data Minus
A11	–	–	NC	No connect
B2	CVDDQ	I	FSLC[0]	FSLC[0]
C6	AVDD	I/O	XTALIN	XTALIN
C7	AVDD	I/O	XTALOUT	XTALOUT
B4	CVDDQ	I	FSLC[1]	FSLC[1]
E6	CVDDQ	I	FSLC[2]	FSLC[2]
D7	CVDDQ	I	CLKIN	CLKIN
D6	CVDDQ	I	CLKIN_32	CLKIN_32
D9	VIO5	I/O	I^2C_GPIO[58]	SCL (Serial Clock) for I^2C Bus Interface
D10	VIO5	I/O	I^2C_GPIO[59]	SDA (Serial Data) for I^2C Bus Interface
E7	VIO5	I	TDI	TDI
C10	VIO5	O	TDO	TDO
B11	VIO5	I	TRST#	TRST#
E8	VIO5	I	TMS	TMS
F6	VIO5	I	TCK	TCK
D11	–	–	NC	No connect
E10	–	PWR	VBATT	–
B10	–	PWR	VDD	–
A1	–	PWR	VSS	–
E11	–	PWR	VBUS	–
D8	–	PWR	VSS	–
H11	–	PWR	VIO1	–
E2	–	PWR	VSS	–
L9	–	PWR	VIO1	–
G1	–	PWR	VSS	–
F1	–	PWR	VIO2	–
G11	–	PWR	VSS	–
E3	–	PWR	VIO3	–
L1	–	PWR	VSS	–

Pin descriptions

Table 7 Pin list *(continued)*

Pin No.	Power domain	I/O	Name	Description
B1	–	PWR	VIO4	–
L6	–	PWR	VSS	–
B6	–	PWR	CVDDQ	–
B5	–	–	NC	–
A2	–	–	NC	–
C11	–	PWR	VIO5	–
L11	–	PWR	VSS	–
A7	–	PWR	AVDD	–
B7	–	PWR	AVSS	–
C3	–	PWR	VDD	–
B8	–	PWR	VSS	–
E9	–	PWR	VDD	–
B9	–	PWR	VSS	–
F11	–	PWR	VDD	–
H1	–	PWR	VDD	–
L7	–	PWR	VDD	–
J11	–	PWR	VDD	–
L5	–	PWR	VDD	–
K4	–	PWR	VSS	–
L3	–	PWR	VSS	–
K3	–	PWR	VSS	–
L2	–	PWR	VSS	–
A8	–	PWR	VSS	–
–				Precision resistors
C8	VBUS/ VBATT	I/O	R_usb2	Precision resistor for USB 2.0 (Connect a 6.04 kΩ+/-1% resistor between this pin and GND)
B3	–	–	NC	No connect

12 AC timing parameters

12.1 Storage port timing

The S0-Port and S1-Port support the MMC Specification Version 4.4 and SD Specification Version 2.0. **Table 8** lists the timing parameters for S0-Port and S1-Port of SD2.

Table 8 S-port timing parameters[2]

Parameter	Description	Min	Max	Units
MMC-20				
tSDIS CMD	Host input setup time for CMD	4.8	–	ns
tSDIS DAT	Host input setup time for DAT	4.8	–	ns
tSDIH CMD	Host input hold time for CMD	4.4	–	ns
tSDIH DAT	Host input hold time for DAT	4.4	–	ns
tSDOS CMD	Host output setup time for CMD	5	–	ns
tSDOS DAT	Host output setup time for DAT	5	–	ns
tSDOH CMD	Host output hold time for CMD	5	–	ns
tSDOH DAT	Host output hold time for DAT	5	–	ns
tSCLKR	Clock rise time	–	2	ns
tSCLKF	Clock fall time	–	2	ns
tSDCK	Clock cycle time	50	–	ns
SDFREQ	Clock frequency	–	20	MHz
tSDCLKOD	Clock duty cycle	40	60	%
MMC-26				
tSDIS CMD	Host input setup time for CMD	10	–	ns
tSDIS DAT	Host input setup time for DAT	10	–	ns
tSDIH CMD	Host input hold time for CMD	9	–	ns
tSDIH DAT	Host input hold time for DAT	9	–	ns
tSDOS CMD	Host output setup time for CMD	3	–	ns
tSDOS DAT	Host output setup time for DAT	3	–	ns
tSDOH CMD	Host output hold time for CMD	3	–	ns
tSDOH DAT	Host output hold time for DAT	3	–	ns
tSCLKR	Clock rise time	–	2	ns
tSCLKF	Clock fall time	–	2	ns
tSDCK	Clock cycle time	38.5	–	ns
SDFREQ	Clock frequency	–	26	MHz
tSDCLKOD	Clock duty cycle	40	60	%

Note
2. All parameters guaranteed by design and validated through characterization.

AC timing parameters

Table 8 S-port timing parameters[2] *(continued)*

Parameter	Description	Min	Max	Units
MC-HS				
tSDIS CMD	Host input setup time for CMD	4	–	ns
tSDIS DAT	Host input setup time for DAT	4	–	ns
tSDIH CMD	Host input hold time for CMD	3	–	ns
tSDIH DAT	Host input hold time for DAT	3	–	ns
tSDOS CMD	Host output setup time for CMD	3	–	ns
tSDOS DAT	Host output setup time for DAT	3	–	ns
tSDOH CMD	Host output hold time for CMD	3	–	ns
tSDOH DAT	Host output hold time for DAT	3	–	ns
tSCLKR	Clock rise time	–	2	ns
tSCLKF	Clock fall time	–	2	ns
tSDCK	Clock cycle time	19.2	–	ns
SDFREQ	Clock frequency	–	52	MHz
tSDCLKOD	Clock duty cycle	40	60	%
MMC-DDR52				
tSDIS CMD	Host input setup time for CMD	4	–	ns
tSDIS DAT	Host input setup time for DAT	0.56	–	ns
tSDIH CMD	Host input hold time for CMD	3	–	ns
tSDIH DAT	Host input hold time for DAT	2.58	–	ns
tSDOS CMD	Host output setup time for CMD	3	–	ns
tSDOS DAT	Host output setup time for DAT	2.5	–	ns
tSDOH CMD	Host output hold time for CMD	3	–	ns
tSDOH DAT	Host output hold time for DAT	2.5	–	ns
tSCLKR	Clock rise time	–	2	ns
tSCLKF	Clock fall time	–	2	ns
tSDCK	Clock cycle time	19.2	–	ns
SDFREQ	Clock frequency		52	MHz
tSDCLKOD	Clock duty cycle	45	55	%
SD-Default Speed (SDR12)				
tSDIS CMD	Host input setup time for CMD	24	–	ns
tSDIS DAT	Host input setup time for DAT	24	–	ns
tSDIH CMD	Host input hold time for CMD	2.5	–	ns
tSDIH DAT	Host input hold time for DAT	2.5	–	ns
tSDOS CMD	Host output setup time for CMD	5	–	ns
tSDOS DAT	Host output setup time for DAT	5	–	ns
tSDOH CMD	Host output hold time for CMD	5	–	ns
tSDOH DAT	Host output hold time for DAT	5	–	ns
tSCLKR	Clock rise time	–	2	ns
tSCLKF	Clock fall time	–	2	ns
tSDCK	Clock cycle time	40	–	ns

AC timing parameters

Table 8 S-port timing parameters[2] *(continued)*

Parameter	Description	Min	Max	Units
SDFREQ	Clock frequency	–	25	MHz
tSDCLKOD	Clock duty cycle	40	60	%
SD-High-Speed(SDR25)				
tSDIS CMD	Host input setup time for CMD	4	–	ns
tSDIS DAT	Host input setup time for DAT	4	–	ns
tSDIH CMD	Host input hold time for CMD	2.5	–	ns
tSDIH DAT	Host input hold time for DAT	2.5	–	ns
tSDOS CMD	Host output setup time for CMD	6	–	ns
tSDOS DAT	Host output setup time for DAT	6	–	ns
tSDOH CMD	Host output hold time for CMD	2	–	ns
tSDOH DAT	Host output hold time for DAT	2	–	ns
tSCLKR	Clock rise time	–	2	ns
tSCLKF	Clock fall time	–	2	ns
tSDCK	Clock cycle time	20	–	ns
SDFREQ	Clock frequency	–	50	MHz
tSDCLKOD	Clock duty cycle	40	60	%
SD-SDR50				
tSDIS CMD	Host input setup time for CMD	1.5	–	ns
tSDIS DAT	Host input setup time for DAT	1.5	–	ns
tSDIH CMD	Host input hold time for CMD	2.5	–	ns
tSDIH DAT	Host input hold time for DAT	2.5	–	ns
tSDOS CMD	Host output setup time for CMD	3	–	ns
tSDOS DAT	Host output setup time for DAT	3	–	ns
tSDOH CMD	Host output hold time for CMD	0.8	–	ns
tSDOH DAT	Host output hold time for DAT	0.8	–	ns
tSCLKR	Clock rise time	–	2	ns
tSCLKF	Clock fall time	–	2	ns
tSDCK	Clock cycle time	10	–	ns
SDFREQ	Clock frequency	–	100	MHz
tSDCLKOD	Clock duty cycle	40	60	%
SD-DDR50				
tSDIS CMD	Host input setup time for CMD	4	–	ns
tSDIS DAT	Host input setup time for DAT	0.92	–	ns
tSDIH CMD	Host input hold time for CMD	2.5	–	ns
tSDIH DAT	Host input hold time for DAT	2.5	–	ns
tSDOS CMD	Host output setup time for CMD	6	–	ns
tSDOS DAT	Host output setup time for DAT	3	–	ns
tSDOH CMD	Host output hold time for CMD	0.8	–	ns
tSDOH DAT	Host output hold time for DAT	0.8	–	ns
tSCLKR	Clock rise time	–	2	ns

AC timing parameters

Table 8 S-port timing parameters[2] *(continued)*

Parameter	Description	Min	Max	Units
tSCLKF	Clock fall time	–	2	ns
tSDCK	Clock cycle time	20	–	ns
SDFREQ	Clock frequency	–	50	MHz
tSDCLKOD	Clock duty cycle	45	55	%

12.2 I²C interface timing

12.2.1 I²C timing

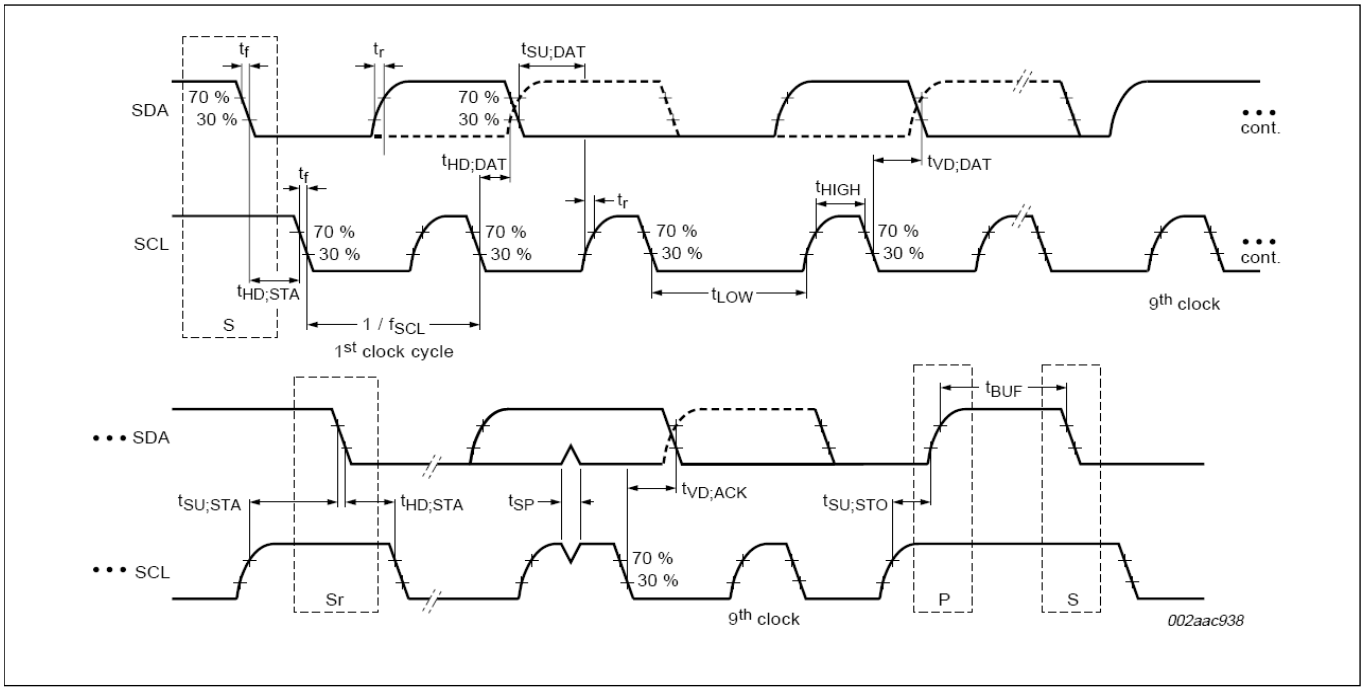


Figure 3 I²C timing definition

AC timing parameters

Table 9 I²C timing parameters[3]

Parameter	Description	Min	Max	Units
I²C Standard mode parameters				
fSCL	SCL clock frequency	0	100	kHz
tHD:STA	Hold time START condition	4	–	µs
tLOW	LOW period of the SCL	4.7	–	µs
tHIGH	HIGH period of the SCL	4	–	µs
tSU:STA	Setup time for a repeated START condition	4.7	–	µs
tHD:DAT	Data hold time	0	–	µs
tSU:DAT	Data setup time	250	–	ns
tr	Rise time of both SDA and SCL signals	–	1000	ns
tf	Fall time of both SDA and SCL signals	–	300	ns
tSU:STO	Setup time for STOP condition	4	–	µs
tBUF	Bus free time between a STOP and START condition	4.7	–	µs
tVD:DAT	Data valid time	–	3.45	µs
tVD:ACK	Data valid ACK	–	3.45	µs
tSP	Pulse width of spikes that must be suppressed by input filter	n/a	n/a	
I²C Fast mode parameters				
fSCL	SCL clock frequency	0	400	kHz
tHD:STA	Hold time START condition	0.6	–	µs
tLOW	LOW period of the SCL	1.3	–	µs
tHIGH	HIGH period of the SCL	0.6	–	µs
tSU:STA	Setup time for a repeated START condition	0.6	–	µs
tHD:DAT	Data hold time	0	–	µs
tSU:DAT	Data setup time	100	–	ns
tr	Rise time of both SDA and SCL signals	–	300	ns
tf	Fall time of both SDA and SCL signals	–	300	ns
tSU:STO	Setup time for STOP condition	0.6	–	µs
tBUF	Bus-free time between a STOP and START condition	1.3	–	µs
tVD:DAT	Data valid time	–	0.9	µs
tVD:ACK	Data valid ACK	–	0.9	µs
tSP	Pulse width of spikes that must be suppressed by input filter	0	50	ns
I²C Fast mode plus parameters (Not supported at I2C_VDDQ=1.2V)				
fSCL	SCL clock frequency	0	1000	kHz
tHD:STA	Hold time START condition	0.26	–	µs
tLOW	LOW period of the SCL	0.5	–	µs
tHIGH	HIGH period of the SCL	0.26	–	µs
tSU:STA	Setup time for a repeated START condition	0.26	–	µs
tHD:DAT	Data hold time	0	–	µs

Note
3. All parameters guaranteed by design and validated through characterization.

AC timing parameters

Table 9 I²C timing parameters[3] *(continued)*

Parameter	Description	Min	Max	Units
tSU:DAT	Data setup time	50	–	µs
tr	Rise time of both SDA and SCL signals	–	120	ns
tf	Fall time of both SDA and SCL signals	–	120	ns
tSU:STO	Setup time for STOP condition	0.26	–	µs
tBUF	Bus free time between a STOP and START condition	0.5	–	µs
tVD:DAT	Data valid time	–	0.45	µs
tVD:ACK	Data valid ACK	–	0.55	µs
tSP	Pulse width of spikes that must be suppressed by input filter	0	50	ns

Note
3. All parameters guaranteed by design and validated through characterization.

12.2.2 I²S timing diagram

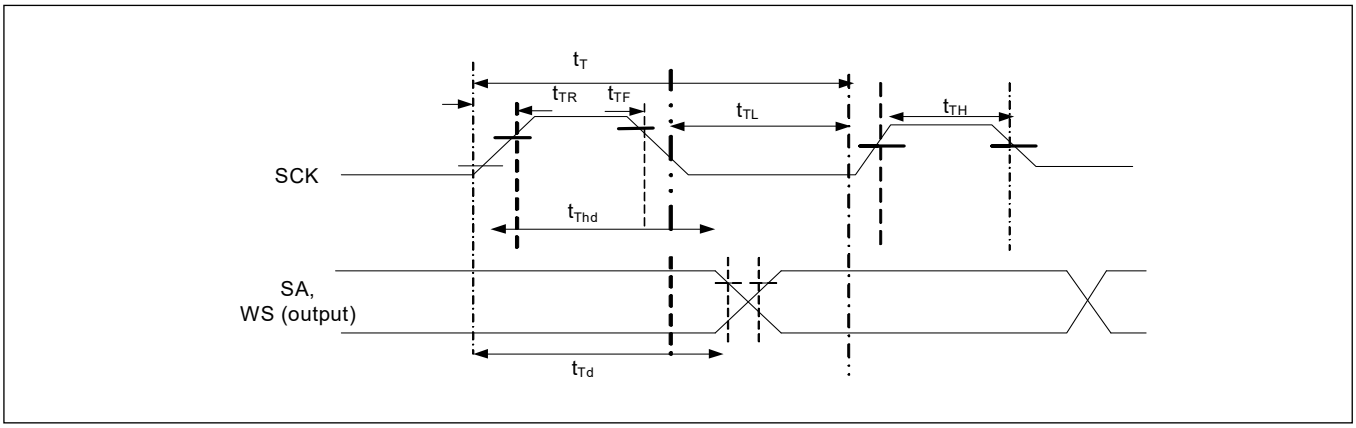


Figure 4 I²S transmit cycle

Table 10 I²S timing parameters[4]

Parameter	Description	Min	Max	Units
tT	I²S transmitter clock cycle	Ttr	–	ns
tTL	I²S transmitter cycle LOW period	0.35 Ttr	–	ns
tTH	I²S transmitter cycle HIGH period	0.35 Ttr	–	ns
tTR	I²S transmitter rise time	–	0.15 Ttr	ns
tTF	I²S transmitter fall time	–	0.15 Ttr	ns
tThd	I²S transmitter data hold time	0	–	ns
tTd	I²S transmitter delay time	–	0.8tT	ns

Note: T is selectable through clock gears. Max Ttr is designed for 96 kHz codec at 32 bits to be 326 ns (3.072 MHz).

12.2.3 SPI timing specification

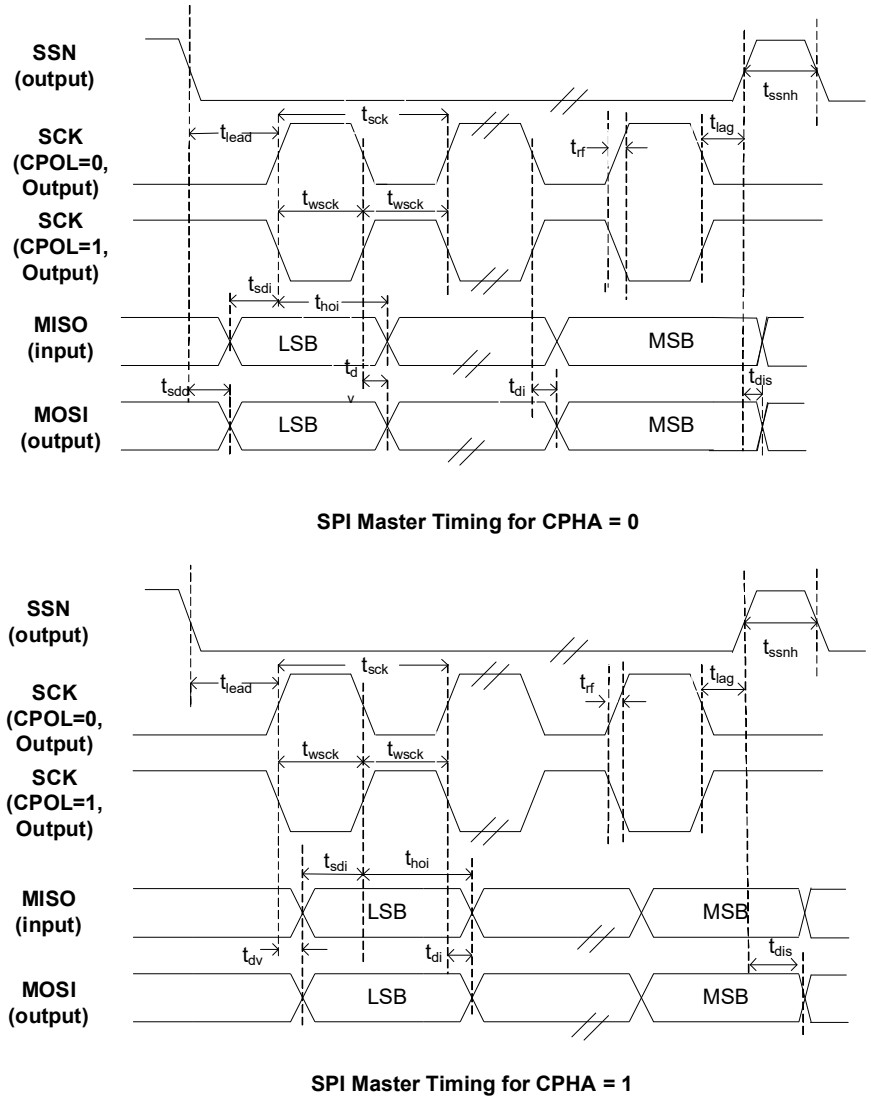


Figure 5 SPI timing

AC timing parameters

Table 11 SPI timing parameters[4]

Parameter	Description	Min	Max	Units
fop	Operating frequency	0	33	MHz
tsck	Cycle time	30	–	ns
twsck	Clock high/low time	13.5	–	ns
tlead	SSN-SCK lead time	1/2 tsck[5] - 5	1.5 tsck[5]+ 5	ns
tlag	Enable lag time	0.5	1.5 tsck[5]+5	ns
trf	Rise/fall time	–	8	ns
tsdd	Output SSN to valid data delay time	–	5	ns
tdv	Output data valid time	–	5	ns
tdi	Output data invalid	0	–	ns
tssnh	Minimum SSN high time	10	–	ns
tsdi	Data setup time input	8	–	ns
thoi	Data hold time input	0	–	ns
tdis	Disable data output on SSN high	0	–	ns

Notes
4. All parameters guaranteed by design and validated through characterization.
5. Depends on LAG and LEAD setting in the SPI_CONFIG register.

13 Absolute maximum ratings

Exceeding maximum ratings may shorten the useful life of the device.

Table 12 Absolute maximum ratings

Specifications	Range values
Storage temperature	–65 °C to +150 °C
Ambient temperature with power supplied (Industrial)	–40 °C to +85 °C
Supply voltage to ground potential V_{DD}, A_{VDDQ}	1.25 V
$S2_{VDDQ}$,$S1_{VDDQ}$, $S0_{VDDQ}$, V_{IO4}, V_{IO5}	3.6 V
$U3TX_{VDDQ}$, $U3RX_{VDDQ}$	1.25 V
DC input voltage to any input pin	VCC + 0.3
DC voltage applied to outputs in High Z State	VCC + 0.3
Note: VCC is the corresponding I/O voltage	
Latch-up current	> 200 mA
Maximum output short circuit current for all I/O configurations. (Vout = 0 V)	–100 mA

Static discharge voltage ESD protection levels:

- ±2.2 KV human body model (HBM) based on JESD22-A114
- Additional ESD Protection levels on D+, D–, VBUS, GND pins U-port and GPIO pins LPP-Port
- ±6 KV contact discharge, ±8 KV air gap discharge based on IEC61000-4-2 level 3 A, ±8 KV contact discharge, and ±15 KV air gap discharge based on IEC61000-4-2 level 4 C

14 Operating conditions

Table 13 Operating conditions

Conditions	Range values
TA (ambient temperature under bias) Commercial	0 °C to +70 °C
TA (ambient temperature under bias) Industrial	–40 °C to +85 °C
V_{DD}, A_{VDDQ}, $U3TX_{VDDQ}$, $U3RX_{VDDQ}$ supply voltage	1.15 V to 1.25 V
V_{BATT} supply voltage	3.2 V to 6 V
$S2_{VDDQ}$, $S1_{VDDQ}$, $S0_{VDDQ}$, V_{IO4}, C_{VDDQ} supply voltage	1.7 V to 3.6 V
V_{IO5} supply voltage	1.15 V to 3.6 V

15 DC specifications

Table 14 DC specifications

Parameter	Description	Min	Max	Units	Notes
V_{DD}	Core voltage supply	1.15	1.25	V	1.2 V typical
A_{VDD}	Analog voltage supply	1.15	1.25	V	1.2 V typical
V_{IO2}	SD/ MMC/ CF I/O power supply domain	1.7	3.6	V	1.8, 2.5, and 3.3 V typical
V_{IO3}	SD/MMC I/O power supply domain	1.7	3.6	V	1.8, 2.5, and 3.3 V typical
V_{IO1}	GPIO/ CF I/O power supply domain	1.7	3.6	V	1.8, 2.5, and 3.3 V typical
V_{IO4}	GPIO/ I/O power supply domain	1.7	3.6	V	1.8, 2.5, and 3.3 V typical
V_{BATT}	USB voltage supply	3.2	6	V	3.7 V typical
V_{BUS}	USB voltage supply	4.0	6	V	5 V typical
C_{VDDQ}	Clock voltage supply	1.7	3.6	V	1.8, 3.3 V typical
V_{IO5}	I^2C voltage supply	1.2	3.3	V	1.2, 1.8, 2.5, and 3.3 V typical
V_{IH1}	Input HIGH voltage 1	0.625 × VCC	VCC + 0.3	V	For 2.0 V ≤ V_{CC} ≤ 3.6 V (except USB port).VCC is the corresponding I/O voltage supply.
V_{IH2}	Input HIGH voltage 2	VCC - 0.4	VCC + 0.3	V	For 1.7 V ≤ V_{CC} ≤ 2.0 V (except USB port). VCC is the corresponding I/O voltage supply.
V_{IL}	Input LOW voltage	–0.3	0.25 × VCC	V	VCC is the corresponding I/O voltage supply.
V_{OH}	Output HIGH voltage	0.9 × VCC	–	V	I_{OH} (max) = –100 µA tested at quarter drive strength. VCC is the corresponding I/O voltage supply.
V_{OL}	Output LOW voltage	–	0.1 × VCC	V	I_{OL} (min) = +100 µA tested at quarter drive strength. VCC is the corresponding I/O voltage supply.
I_{IX}	Input leakage current for all pins	–1	1	µA	All I/O signals held at V_{DDQ} (For I/Os that have a pull-up/down resistor connected, the leakage current increases by V_{DDQ}/R_{pu} or V_{DDQ}/R_{PD}
I_{OZ}	Output High-Z leakage current for all pins	–1	1	µA	All I/O signals held at VDDQ
I_{CC} Core	Core and Analog Voltage Operating Current	–	150	mA	Total current through AVDD, VDD
I_{CC} USB	USB voltage supply operating current	–	20	mA	–
I_{SB1}	Total suspend current during Suspend Mode with USB 3.0 PHY enabled (L1 mode)	–	–	mA	Core current: 1.5 mA I/O current: 20 uA USB current: 2 mA For typical PVT (Typical silicon, all power supplies at their respective nominal levels at 25 °C.)

DC specifications

Table 14 DC specifications *(continued)*

Parameter	Description	Min	Max	Units	Notes
I_{SB2}	Total suspend current during Suspend Mode with USB 3.0 PHYdisabled (L2 mode)	–	–	mA	Core current: 250 uA I/O current: 20 uA USB current: 1.2 mA For typical PVT (Typical silicon, all power supplies at their respective nominal levels at 25 °C.)
I_{SB3}	Total Standby Current during Standby Mode (L3 mode)	–	–	µA	Core current: 60 uA I/O current: 20 uA USB current: 40 uA For typical PVT (Typical silicon, all power supplies at their respective nominal levels at 25 °C.)
I_{SB4}	Total Standby Current during Core Power Down Mode (L4 mode)	–	–	µA	Core current: 0 uA I/O current: 20 uA USB current: 40 uA For typical PVT (Typical silicon, all power supplies at their respective nominal levels at 25 °C.)
V_{RAMP}	Voltage Ramp Rate on Core and I/O Supplies	0.2	50	V/ms	Voltage ramp must be monotonic
V_N	Noise Level Permitted on VDD and I/O Supplies	–	100	mV	Max p-p noise level permitted on all supplies except A_{VDD}
V_{N_AVDD}	Noise Level Permitted on AVDD Supply	–	20	mV	Max p-p noise level permitted on A_{VDD}

16 Thermal characteristics

Table 15 Thermal characteristics

Parameter	Description	Value	Unit
$T_{J\ MAX}$	Maximum junction temperature	125	°C
Θ_{JA}	Thermal resistance (junction to ambient)	34.66	°C/W
Θ_{JB}	Thermal resistance (junction to board)	27.03	°C/W
Θ_{JC}	Thermal resistance (junction to case)	13.57	°C/W

17 Reset sequence

The hard reset sequence requirements for SD2 are specified in the following table.

Table 16 Reset and standby timing parameters

Parameter	Definition	Conditions	Min (ms)	Max (ms)
tRPW	Minimum RESET# pulse width	Clock Input	1	–
		Crystal Input	1	–
tRH	Minimum high on RESET#		5	–
tRR	Reset Recovery Time (after which Boot loader begins firmware download)	Clock Input	1	–
		Crystal Input	5	
tSBY	Time to enter Standby/Suspend (from the time MAIN_CLOCK_EN/ MAIN_POWER_EN bit is set)	–	–	1
tWU	Time to wakeup from standby	Clock Input	1	–
		Crystal Input	5	–
tWH	Minimum time before Standby/Suspend source may be reasserted	–	5	–

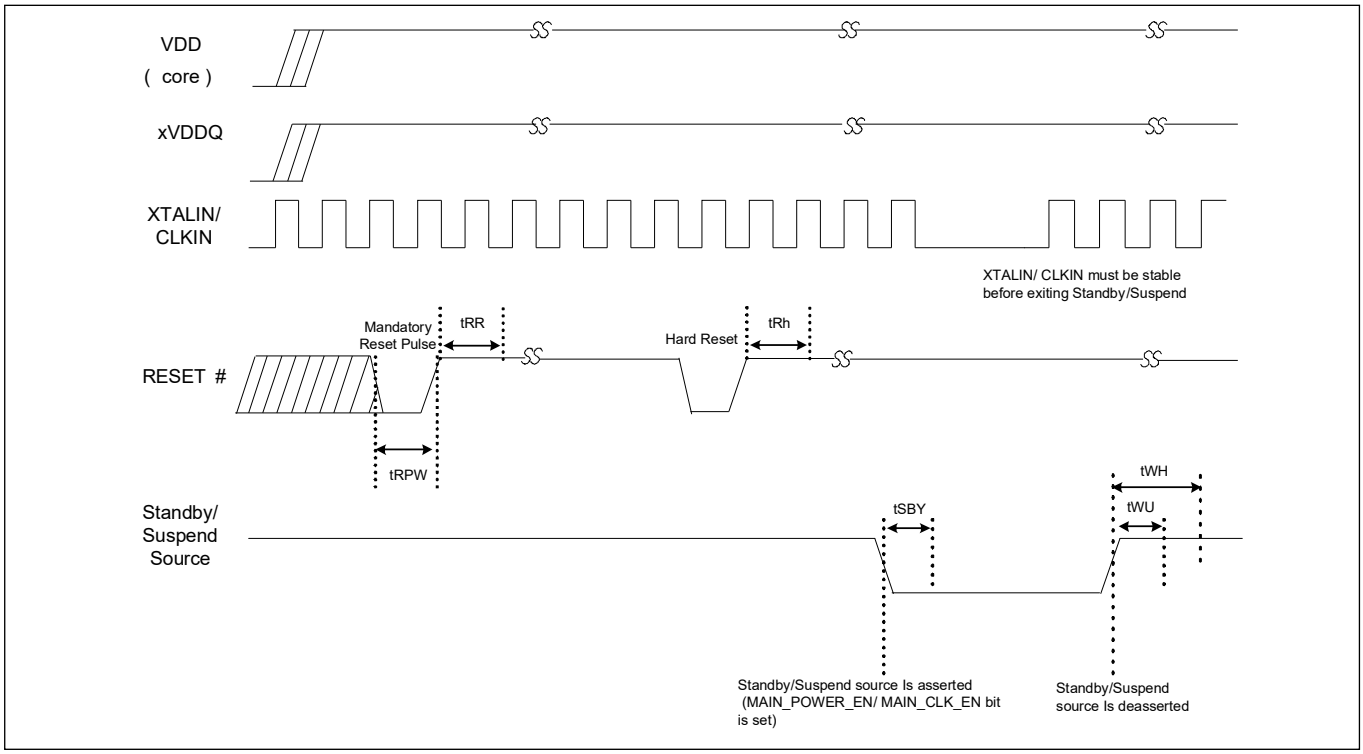
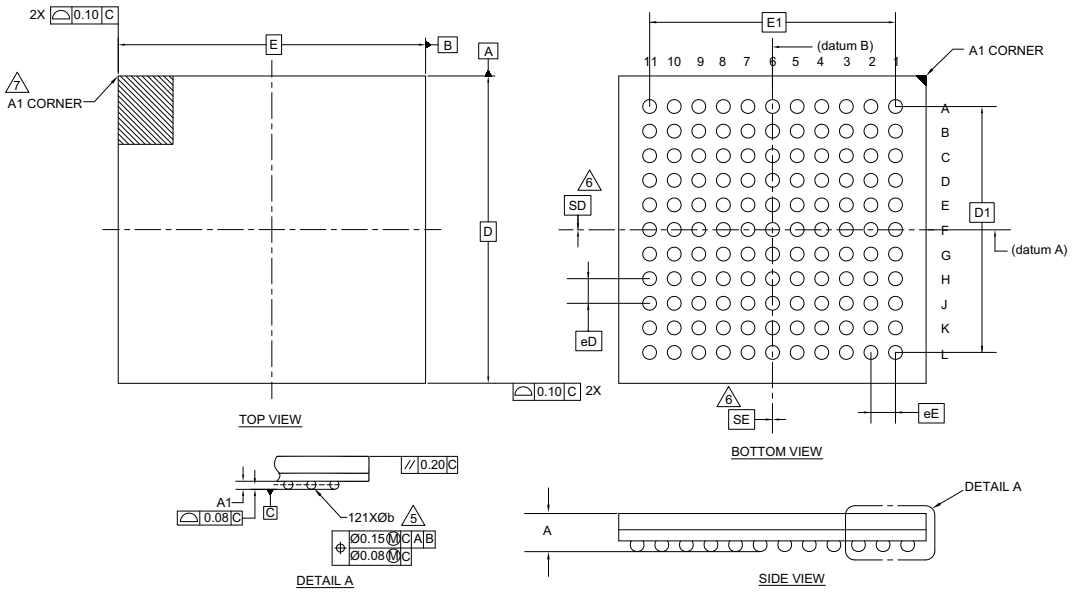


Figure 6 Reset sequence

18 Package diagram



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	-	-	1.20
A1	0.15	-	-
D	10.00 BSC		
E	10.00 BSC		
D1	8.00 BSC		
E1	8.00 BSC		
MD	11		
ME	11		
N	121		
∅ b	0.25	0.30	0.35
eD	0.80 BSC		
eE	0.80 BSC		
SD	0.00		
SE	0.00		

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. SOLDER BALL POSITION DESIGNATION PER JEP95, SECTION 3, SPP-020.
3. "e" REPRESENTS THE SOLDER BALL GRID PITCH.
4. SYMBOL "MD" IS THE BALL MATRIX SIZE IN THE "D" DIRECTION.
   SYMBOL "ME" IS THE BALL MATRIX SIZE IN THE "E" DIRECTION.
   N IS THE NUMBER OF POPULATED SOLDER BALL POSITIONS FOR MATRIX SIZE MD X ME.
5. DIMENSION "b" IS MEASURED AT THE MAXIMUM BALL DIAMETER IN A PLANE PARALLEL TO DATUM C.
6. "SD" AND "SE" ARE MEASURED WITH RESPECT TO DATUMS A AND B AND DEFINE THE POSITION OF THE CENTER SOLDER BALL IN THE OUTER ROW.
   WHEN THERE IS AN ODD NUMBER OF SOLDER BALLS IN THE OUTER ROW, "SD" OR "SE" = 0.
   WHEN THERE IS AN EVEN NUMBER OF SOLDER BALLS IN THE OUTER ROW, "SD" = eD/2 AND "SE" = eE/2.
7. A1 CORNER TO BE IDENTIFIED BY CHAMFER, LASER OR INK MARK METALIZED MARK, INDENTATION OR OTHER MEANS.
8. "+" INDICATES THE THEORETICAL CENTER OF DEPOPULATED SOLDER BALLS.

001-54471 *F

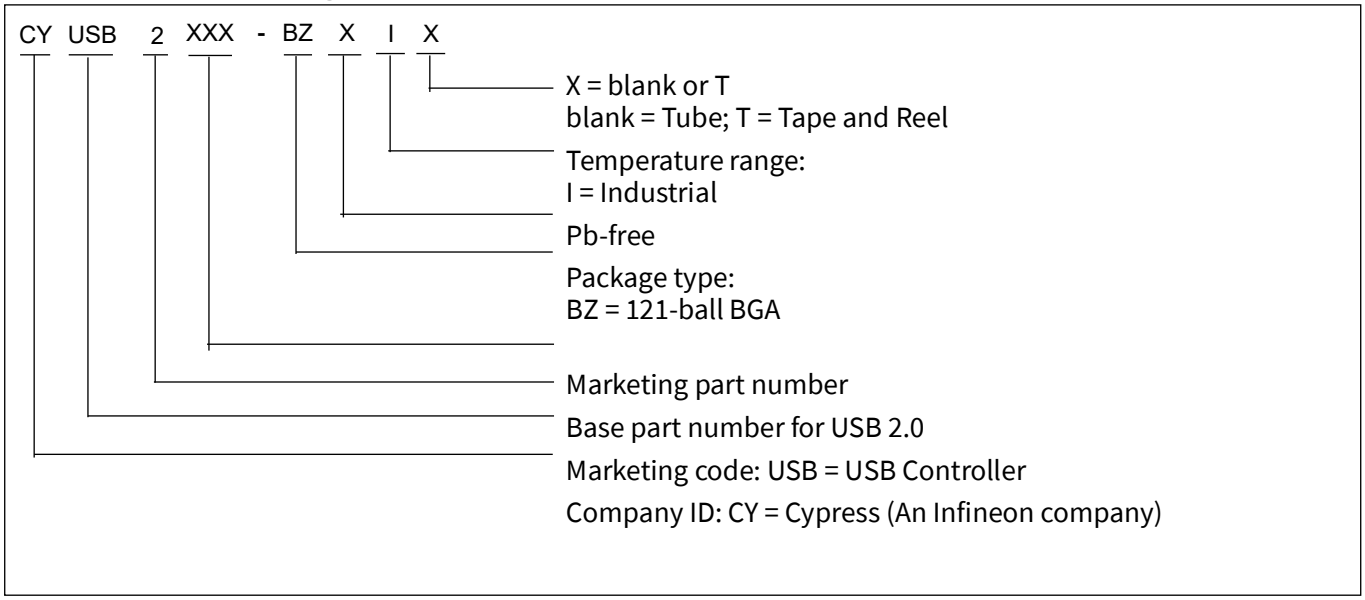
Figure 7 121-ball FBGA (10 × 10 × 1.20 mm), BK0AA/FBI121/T4A121 (PG-TFBGA-121)

19 Ordering information

Table 17 Ordering information

Ordering code	SD/eMMC SDIO ports	RAID support	SRAM (KB)	Package type
CYUSB2024-BZXI	2	No	512	121-ball BGA
CYUSB2025-BZXI	2	Yes	512	121-ball BGA

19.1 Ordering code definitions



20 Acronyms

Table 18 List of acronyms used in this document

Acronym	Description
BGA	ball grid array
MMC	multimedia card
PLL	phase locked loop
RAID	Redundant Array of Independent Disks
SD	secure digital
SDIO	secure digital input / output
SLC	single-level cell
USB	universal serial bus

21 Document conventions

21.1 Units of measure

Table 19 Units of measure

Symbol	Unit of measure
°C	degree celsius
µA	microamperes
µs	microseconds
mA	milliamperes
MBps	Megabytes per second
MHz	mega hertz
ms	milliseconds
ns	nanoseconds
Ω	ohms
pF	pico farad
V	volts

22 Errata

This section describes the errata for SD2 USB and mass storage peripheral controller. Details include errata trigger conditions, scope of impact, available workaround, and silicon revision applicability. Contact your local Cypress Sales Representative if you have questions.

Table 20 Part numbers affected

Products	Device characteristics
CYUSB2024-BZXI	All variants
CYUSB2025-BZXI	All variants

22.1 Qualification status

Product status: Production

22.2 Errata summary

The following table defines the errata applicability to available SD2 USB and mass storage peripheral controller family devices.

Items	Products	Silicon revision	Fix status
1. **Turning off VIO1 during Normal, Suspend and Standby modes causes the SD2 to stop working.**	CYUSB2024-BZXI CYUSB2025-BZXI	Rev. D	Workaround provided
2. **USB enumeration failure in USB boot mode when SD2 is self-powered.**	CYUSB2024-BZXI CYUSB2025-BZXI	Rev. D	Workaround provided
3. **Bus collision is seen when the I2C block is used as a master in the I2C Multi-master configuration.**	CYUSB2024-BZXI CYUSB2025-BZXI	Rev. D	Use SD2 in single I2C master environment only

1. **Turning off VIO1 during Normal, Suspend and Standby modes causes the SD2 to stop working.**

- **Problem Definition**
  Turning off the VIO1 during Normal, Suspend and Standby modes will cause the SD2 to stop working.
- **Parameters Affected**
  N/A
- **Trigger Conditions**
  This condition is triggered when the VIO1 is turned off during Normal, Suspend, and Standby modes.
- **Scope Of Impact**
  SD2 stops working.
- **Workaround**
  VIO1 must stay on during Normal, Suspend, and Standby modes.
- **Fix Status**
  No fix. Workaround is required.

2. USB enumeration failure in USB boot mode when SD2 is self-powered.

- **Problem Definition**
  When SD2 is self-powered and not connected to the USB host, it enters low-power mode and does not wake up when connected to USB host afterwards. This is because the bootloader does not check the VBUS pin on the connector to detect USB connection. It expects that the USB bus is connected to the host when it is powered on.
- **Parameters Affected**
  N/A
- **Trigger Conditions**
  This condition is triggered when SD2 is self-powered in USB boot mode.
- **Scope Of Impact**
  Device does not enumerate
- **Workaround**
  Reset the SD2 device after connecting to USB host using the RESET pin.
- **Fix Status**
  No fix. Workaround is required.

3. Bus collision is seen when the I^2C block is used as a master in the I^2C Multi-master configuration.

- **Problem Definition**
  When SD2 is used as a master in the I^2C multi-master configuration, there can be occasional bus collisions.
- **Parameters Affected**
  NA
- **Trigger Conditions**
  This condition is triggered only when the SD2 I^2C block operates in Multi-master configuration.
- **Scope Of Impact**
  The SD2 I^2C block can transmit data when the I^2C bus is not idle leading to bus collisions.
- **Workaround**
  Use SD2 in a single I2C master environment only.
- **Fix Status**
  No fix. Workaround is required.

Revision history

Document revision	Date	Description of change
**	31/05/2013	New data sheet.
*A	05/09/2013	Changed status from “Company Confidential” to “Final”. Updated to new template.
*B	29/06/2016	Updated **Package diagram**: spec 001-54471 – Changed revision from *D to *E. Updated to new template.
*C	24/04/2017	Updated Cypress Logo and Copyright.
*D	21/08/2018	Updated **SD2 USB and Mass Storage Peripheral Controller**: Updated description. Updated **Functional overview**: Updated **USB interface (U-port)**: Updated **Figure 1**. Updated **I2S interface**: Updated description. Updated **Boot options**: Updated description. Updated **Power**: Updated description. Updated **Power modes**: Updated description. Updated **Table 6**. Updated **Pinouts**: Updated **Figure 2**. Updated **Pin descriptions**: Updated **Table 7**. Updated **Operating conditions**: Added Commercial Temperature Range related information. Updated **DC specifications**: Updated **Table 14**. Added **Thermal characteristics**. Updated **Package diagram**: spec 001-54471 – Changed revision from *E to *F. Updated **Ordering information**: No change in part numbers. Added a column “RAID Support” and added details in that column. Added **Errata**. Updated to new template.
*E	18/12/2025	Migrated to Infineon template. Formatted **Absolute maximum ratings** and **Operating conditions** chapters. Formatted **Pinouts** diagram. Moved **Block diagram** before table of contents. Updated SD2™ to SD2. Formatted all the tables in this doc.

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