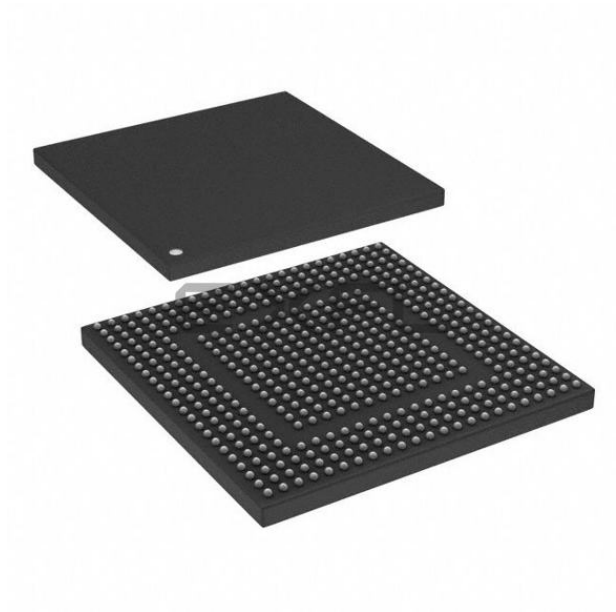

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Understanding Embedded - Microprocessors

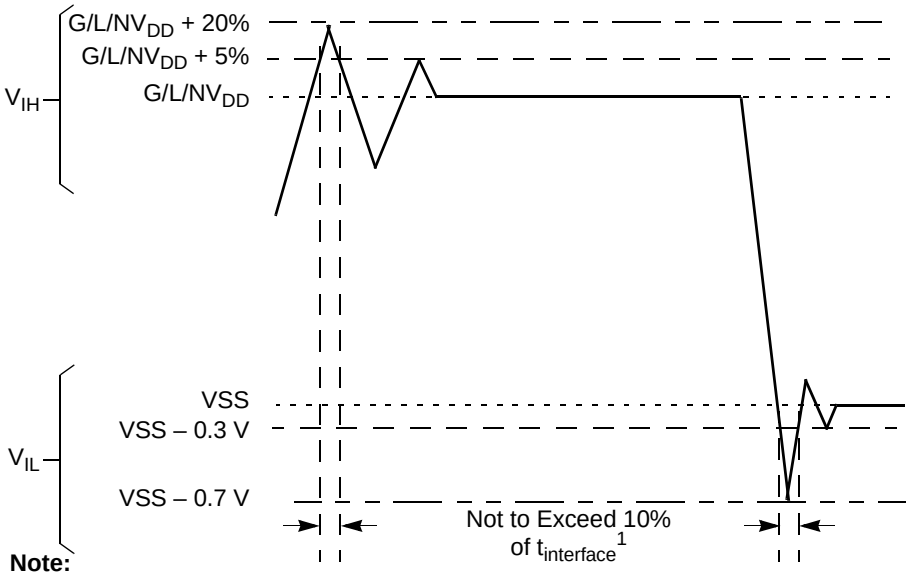
Embedded microprocessors are specialized computing chips designed to perform specific tasks within an embedded system. Unlike general-purpose microprocessors found in personal computers, embedded microprocessors are tailored for dedicated functions within larger systems, offering optimized performance, efficiency, and reliability. These microprocessors are integral to the operation of countless electronic devices, providing the computational power necessary for controlling processes, handling data, and managing communications.

Applications of Embedded - Microprocessors

Embedded microprocessors are utilized across a broad spectrum of applications, making them indispensable in

Details	
Product Status	Last Time Buy
Core Processor	PowerPC e300c3
Number of Cores/Bus Width	1 Core, 32-Bit
Speed	333MHz
Co-Processors/DSP	-
RAM Controllers	DDR2
Graphics Acceleration	No
Display & Interface Controllers	-
Ethernet	10/100/1000Mbps (3)
SATA	-
USB	USB 2.0 (1)
Voltage - I/O	1.8V, 2.5V, 3.3V
Operating Temperature	-40°C ~ 105°C (TA)
Security Features	-
Package / Case	473-LFBGA
Supplier Device Package	473-MAPBGA (19x19)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/mpc8308cvmafda

This figure shows the undershoot and overshoot voltages at the interfaces of the device.



Note:
1. $t_{interface}$ refers to the clock period associated with the bus clock interface.

Figure 2. Overshoot/Undershoot Voltage for GVDD/NVDD/LVDD

2.1.3 Output Driver Characteristics

This table provides information on the characteristics of the output driver strengths.

Table 3. Output Drive Capability

Driver Type	Output Impedance (Ω)	Supply Voltage
Local bus interface utilities signals	42	NV_{DD} = 3.3 V
DDR2 signals[1]	18	GV_{DD} = 1.8 V
DUART, system control, I^2C, JTAG, eSDHC, GPIO,SPI, USB	42	NV_{DD} = 3.3 V
eTSEC signals	42	LV_{DD} = 2.5/3.3 V

[1] Output Impedance can also be adjusted through configurable options in DDR Control Driver Register (DDRCDR). For more information, see the *MPC8308 PowerQUICC II Pro Processor Reference Manual*.

2.1.4 Power Sequencing

It is required to apply the core supply voltage (V_{DD}) before the I/O supply voltages (GV_{DD}, LV_{DD}, and NV_{DD}) and assert $\overline{\text{PORESET}}$ before the power supplies fully ramp up. The core voltage supply must rise to 90% of its nominal value before the I/O supplies reach 0.7 V; see Figure 3.

If this recommendation is not observed and I/O voltages are supplied before the core voltage, there might be a period of time that all input and output pins are actively driven and cause contention and excessive current. To overcome side effects of this condition, the application environment may require tuning of external pull-up or pull-down resistors on particular signals to lesser values.

5.2 RESET AC Electrical Characteristics

This table provides the reset initialization AC timing specifications.

Table 11. RESET Initialization Timing Specifications

Parameter/Condition	Min	Max	Unit	Notes
Required assertion time of $\overline{\text{HRESET}}$ (input) to activate reset flow	32	—	$t_{SYS\_CLK\_IN}$	1
Required assertion time of $\overline{\text{PORESET}}$ with stable power and clock applied to SYS_CLK_IN	32	—	$t_{SYS\_CLK\_IN}$	—
$\overline{\text{HRESET}}$ assertion (output)	512	—	$t_{SYS\_CLK\_IN}$	1
Input setup time for POR configuration signals (CFG_RESET_SOURCE[0:3]) with respect to negation of PORESET	4	—	$t_{SYS\_CLK\_IN}$	—
Input hold time for POR configuration signals with respect to negation of $\overline{\text{HRESET}}$	0	—	ns	—
Time for the device to turn off POR configuration signal drivers with respect to the assertion of $\overline{\text{HRESET}}$	—	4	ns	2
Time for the device to turn on POR configuration signal drivers with respect to the negation of $\overline{\text{HRESET}}$	1	—	ns	1, 2

Notes:
1. $t_{SYS\_CLK\_IN}$ is the clock period of the input clock applied to SYS_CLK_IN.
2. POR configuration signals consists of CFG_RESET_SOURCE[0:3].

This table provides the PLL lock times.

Table 12. PLL Lock Times

Parameter/Condition	Min	Max	Unit	Note
System PLL lock time	—	100	μs	—
e300 core PLL lock time	—	100	μs	—

This table provides the current draw characteristics for MV_{REF}.

Table 15. Current Draw Characteristics for MV_{REF}

Parameter / Condition	Symbol	Min	Max	Unit	Note
Current draw for MV_{REF}	I_{MVREF}	—	500	μA	1

Note:
1. The voltage regulator for MV_{REF} must be able to supply up to 500 μA current.

6.2 DDR2 SDRAM AC Electrical Characteristics

This section provides the AC electrical characteristics for the DDR2 SDRAM interface.

6.2.1 DDR2 SDRAM Input AC Timing Specifications

This table provides input AC timing specifications for the DDR2 SDRAM when $GV_{DD}(typ)$=1.8 V.

Table 16. DDR2 SDRAM Input AC Timing Specifications for 1.8 V Interface

At recommended operating conditions with GV_{DD} of 1.8 ± 100 mV

Parameter	Symbol	Min	Max	Unit	Notes
AC input low voltage	V_{IL}	—	MV_{REF} – 0.45	V	—
AC input high voltage	V_{IH}	MV_{REF} + 0.45	—	V	—

This table provides input AC timing specifications for the DDR2 SDRAM interface.

Table 17. DDR2 SDRAM Input AC Timing Specifications

At recommended operating conditions. with GV_{DD} of 1.8± 100 mV

Parameter	Symbol	Min	Max	Unit	Notes
Controller skew for MDQS—MDQ/MECC 266 MHz	t_{CISKEW}	–875	875	ps	1, 2,3

Notes:
1. t_{CISKEW} represents the total amount of skew consumed by the controller between MDQS[n] and any corresponding bit that is captured with MDQS[n]. This should be subtracted from the total timing budget.
2. The amount of skew that can be tolerated from MDQS to a corresponding MDQ or MECC signal is called t_{DISKEW}. This can be determined by the following equation: t_{DISKEW} = +/–(T/4 – abs(t_{CISKEW})) where T is the clock period and abs(t_{CISKEW}) is the absolute value of t_{CISKEW}.
3. Memory controller ODT value of 150 Ω is recommended

This figure illustrates the DDR2 input timing diagram showing the t_{DISKEW} timing parameter.

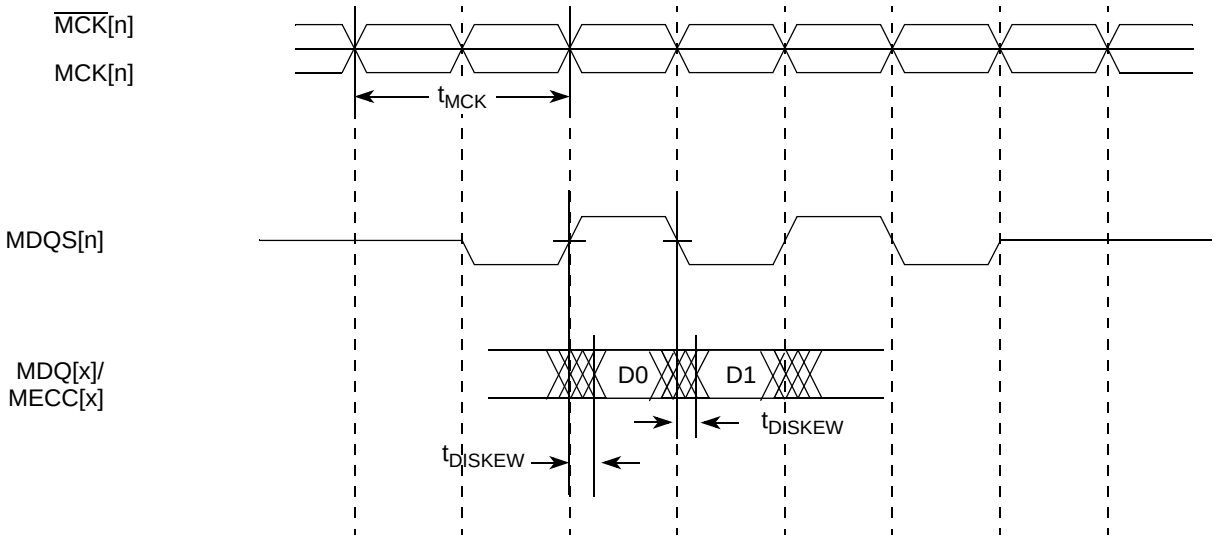


Figure 4. Timing Diagram for t_{DISKEW}

6.2.2 DDR2 SDRAM Output AC Timing Specifications

Table 18. DDR2 SDRAM Output AC Timing Specifications

Parameter	Symbol [1]	Min	Max	Unit	Notes
MCK[n] cycle time, MCK[n]/$\overline{\text{MCK}}$[n] crossing	t_{MCK}	7.5	10	ns	2
ADDR/CMD output setup with respect to MCK	t_{DDKHAS}		—	ns	3
266 MHz		2.9			
ADDR/CMD output hold with respect to MCK	t_{DDKHAX}		—	ns	3
266 MHz		2.33			
$\overline{\text{MCS}}$[n] output setup with respect to MCK	t_{DDKHCS}		—	ns	3
266 MHz		2.5			
$\overline{\text{MCS}}$[n] output hold with respect to MCK	t_{DDKHCX}		—	ns	3
266 MHz		3.15			
MCK to MDQS Skew	t_{DDKHMH}	–0.6	0.6	ns	4

This figure provides the AC test load for the DDR2 bus.

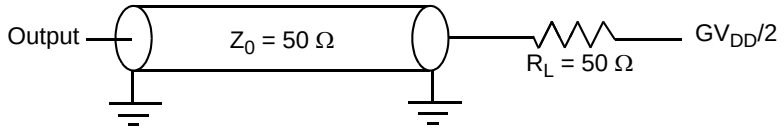


Figure 7. DDR2 AC Test Load

7 DUART

This section describes the DC and AC electrical specifications for the DUART interface.

7.1 DUART DC Electrical Characteristics

This table provides the DC electrical characteristics for the DUART interface.

Table 19. DUART DC Electrical Characteristics

Parameter	Symbol	Min	Max	Unit
High-level input voltage	V_{IH}	2.1	NV_{DD} + 0.3	V
Low-level input voltage NVDD	V_{IL}	–0.3	0.8	V
High-level output voltage, I_{OH} = –100 μA	V_{OH}	NV_{DD} – 0.2	—	V
Low-level output voltage, I_{OL} = 100 μA	V_{OL}	—	0.2	V
Input current (0 V ≤V_{IN} ≤ NV_{DD})	I_{IN}	—	± 5	μA

7.2 DUART AC Electrical Specifications

This table provides the AC timing parameters for the DUART interface.

Table 20. DUART AC Timing Specifications

Parameter	Value	Unit	Notes
Minimum baud rate	256	baud	—
Maximum baud rate	> 1,000,000	baud	1
Oversample rate	16	—	2

Notes:
1. Actual attainable baud rate is limited by the latency of interrupt processing.
2. The middle of a start bit is detected as the 8th sampled 0 after the 1-to-0 transition of the start bit. Subsequent bit values are sampled each 16th sample.

8 Ethernet: Three-Speed Ethernet, MII Management

This section provides the AC and DC electrical characteristics for three-speed, 10/100/1000, and MII management. MPC8308 supports dual Ethernet controllers.

8.1 Enhanced Three-Speed Ethernet Controller (eTSEC) (10/100/1000 Mbps)—MII/RGMII Electrical Characteristics

The electrical characteristics specified here apply to all the media independent interface (MII) and reduced gigabit media independent interface (RGMII), signals except management data input/output (MDIO) and management data clock (MDC). The RGMII interface is defined for 2.5 V, while the MII interface can be operated at 3.3 V. The RGMII interface follows the Hewlett-Packard reduced pin-count interface for Gigabit Ethernet Physical Layer Device Specification Version 1.2a (9/22/2000). The electrical characteristics for MDIO and MDC are specified in Section 8.3, "Ethernet Management Interface Electrical Characteristics."

8.1.1 eTSEC DC Electrical Characteristics

All MII and RGMII drivers and receivers comply with the DC parametric attributes specified in Table 21 and Table 22. The RGMII signals are based on a 2.5-V CMOS interface voltage as defined by JEDEC EIA/JESD8-5.

Table 21. MII DC Electrical Characteristics

Parameter	Symbol	Conditions		Min	Max	Unit
Supply voltage 3.3 V	LV_{DD}	—		3.0	3.6	V
Output high voltage	V_{OH}	I_{OH} = –4.0 mA	LV_{DD} = Min	2.40	LV_{DD} + 0.3	V
Output low voltage	V_{OL}	I_{OL} = 4.0 mA	LV_{DD}= Min	VSS	0.50	V
Input high voltage	V_{IH}	—	—	2.1	LV_{DD} + 0.3	V
Input low voltage	V_{IL}	—	—	–0.3	0.90	V
Input high current	I_{IH}	V_{IN} [1] = LV_{DD}		—	40	μA
Input low current	I_{IL}	V_{IN} [1] = VSS		–600	—	μA

Note:
1. The symbol V_{IN}, in this case, represents the LV_{IN} symbol referenced in Table 1 and Table 2.

This figure shows the MII transmit AC timing diagram.

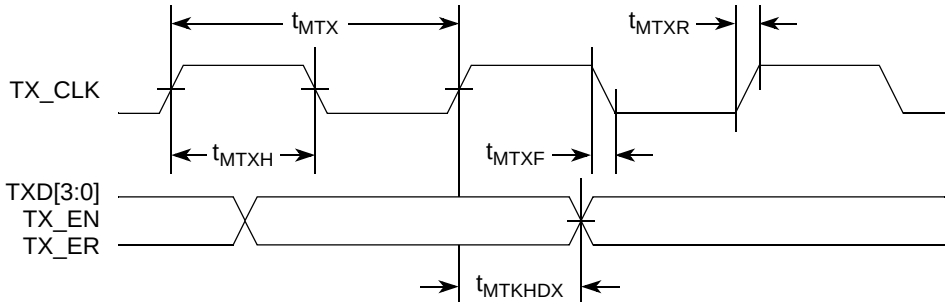


Figure 8. MII Transmit AC Timing Diagram

8.2.1.2 MII Receive AC Timing Specifications

This table provides the MII receive AC timing specifications.

Table 24. MII Receive AC Timing Specifications

At recommended operating conditions with LV_{DD} /NV_{DD} of 3.3 V ± 0.3V.

Parameter/Condition	Symbol [1]	Min	Typ	Max	Unit
RX_CLK clock period 10 Mbps	t_{MRX}	—	400	—	ns
RX_CLK clock period 100 Mbps	t_{MRX}	—	40	—	ns
RX_CLK duty cycle	t_{MRXH}/t_{MRX}	35	—	65	%
RXD[3:0], RX_DV, RX_ER setup time to RX_CLK	t_{MRDVKH}	10.0	—	—	ns
RXD[3:0], RX_DV, RX_ER hold time to RX_CLK	t_{MRDXKH}	10.0	—	—	ns
RX_CLK clock rise V_{IL}(min) to V_{IH}(max)	t_{MRXR}	1.0	—	4.0	ns
RX_CLK clock fall time V_{IH}(max) to V_{IL}(min)	t_{MRXF}	1.0	—	4.0	ns

Note:

1. The symbols used for timing specifications herein follow the pattern of $t_{\text{(first two letters of functional block)(signal)(state) (reference)(state)}}$ for inputs and $t_{\text{(first two letters of functional block)(reference)(state)(signal)(state)}}$ for outputs. For example, t_{MRDVKH} symbolizes MII receive timing (MR) with respect to the time data input signals (D) reach the valid state (V) relative to the t_{MRX} clock reference (K) going to the high (H) state or setup time. Also, t_{MRDXKL} symbolizes MII receive timing (GR) with respect to the time data input signals (D) went invalid (X) relative to the t_{MRX} clock reference (K) going to the low (L) state or hold time. Note that, in general, the clock reference symbol representation is based on three letters representing the clock of a particular functional. For example, the subscript of t_{MRX} represents the MII (M) receive (RX) clock. For rise and fall times, the latter convention is used with the appropriate letter: R (rise) or F (fall).

Table 28. GPIO DC Electrical Characteristics (continued)

Characteristic	Symbol	Condition	Min	Max	Unit
Input low voltage	V_{IL}	—	–0.3	0.8	V
Input current	I_{IN}	$0 V \le V_{IN} \le NVDD$	—	± 5	μA

8.4.2 IEEE 1588 Timer AC Specifications

This table provides the IEEE 1588 timer AC specifications.

Table 29. IEEE 1588 Timer AC Specifications

Parameter	Symbol	Min	Max	Unit	Notes
Timer clock cycle time	t_{TMRCK}	0	70	MHz	1
Input setup to timer clock	t_{TMRCKS}	—	—	—	2, 3
Input hold from timer clock	t_{TMRCKH}	—	—	—	2, 3
Output clock to output valid	t_{GCLKNV}	0	6	ns	—
Timer alarm to output valid	t_{TMRAL}	—	—	—	2

Note:
1. The timer can operate on rtc_clock or tmr_clock. These clocks get muxed and any one of them can be selected.
2. Asynchronous signals.
3. Inputs need to be stable at least one TMR clock.

9 USB

9.1 USB Dual-Role Controllers

This section provides the AC and DC electrical specifications for the USB-ULPI interface.

9.1.1 USB DC Electrical Characteristics

This table lists the DC electrical characteristics for the USB interface.

Table 30. USB DC Electrical Characteristics

Parameter	Symbol	Min	Max	Unit
High-level input voltage	V_{IH}	2	LVDD + 0.3	V
Low-level input voltage	V_{IL}	–0.3	0.8	V
Input current	I_{IN}	—	±5	μA
High-level output voltage, I_{OH} = –100 μA	V_{OH}	LVDD – 0.2	—	V
Low-level output voltage, I_{OL} = 100 μA	V_{OL}	—	0.2	V

Note:
1. The symbol V_{IN}, in this case, represents the NV_{IN} symbol referenced in Table 1 and Table 2.

This figure shows the SerDes reference clock connection reference circuits for a single-ended clock driver. It assumes the DC levels of the clock driver are compatible with the device's SerDes reference clock input's DC requirement.

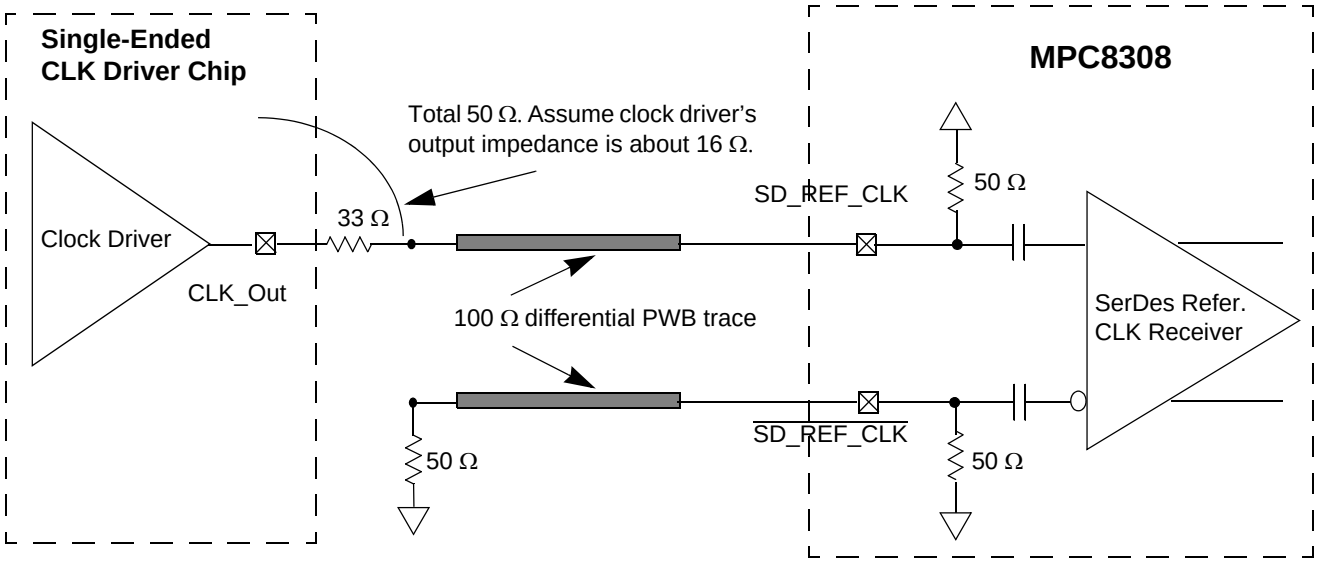


Figure 23. Single-Ended Connection (Reference Only)

10.2.4 AC Requirements for SerDes Reference Clocks

The clock driver selected should provide a high quality reference clock with low phase noise and cycle-to-cycle jitter. Phase noise less than 100 kHz can be tracked by the PLL and data recovery loops and is less of a problem. Phase noise above 15 MHz is filtered by the PLL. The most problematic phase noise occurs in the 1–15 MHz range. The source impedance of the clock driver should be 50 Ω to match the transmission line and reduce reflections which are a source of noise to the system.

This table describes some AC parameters for PCI Express protocol.

Table 32. SerDes Reference Clock AC Parameters

At recommended operating conditions with XCOREVDD= 1.0V ± 5%

Parameter	Symbol	Min	Max	Unit	Notes
Rising Edge Rate	Rise Edge Rate	1.0	4.0	V/ns	2, 3
Falling Edge Rate	Fall Edge Rate	1.0	4.0	V/ns	2, 3
Differential Input High Voltage	V_{IH}	+200	—	mV	2
Differential Input Low Voltage	V_{IL}	—	–200	mV	2

NOTE

The reference impedance for return loss measurements is 50 Ω to ground for both the D+ and D- line (that is, as measured by a Vector Network Analyzer with 50 Ω probes—see Figure 29). Note that the series capacitors, $C_{PEACCTX}$, are optional for the return loss measurement.

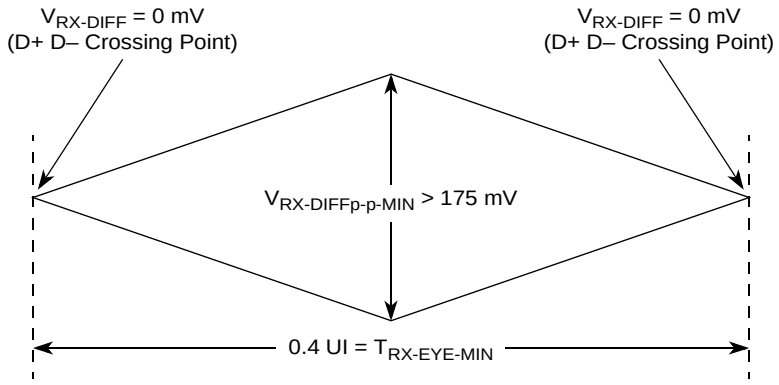


Figure 28. Minimum Receiver Eye Timing and Voltage Compliance Specification

11.5.1 Compliance Test and Measurement Load

The AC timing and voltage parameters must be verified at the measurement point, as specified within 0.2 inches of the package pins, into a test/measurement load shown in Figure 29.

NOTE

The allowance of the measurement point to be within 0.2 inches of the package pins is meant to acknowledge that package/board routing may benefit from D+ and D– not being exactly matched in length at the package pin boundary.

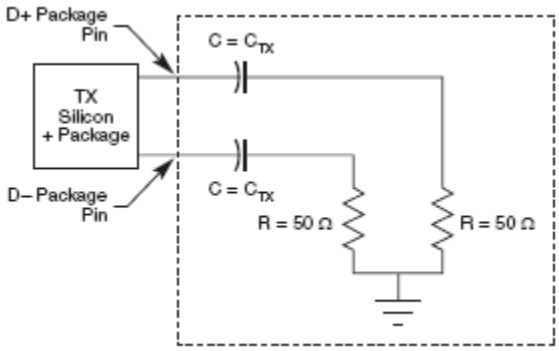


Figure 29. Compliance Test/Measurement Load

12 Enhanced Local Bus

This section describes the DC and AC electrical specifications for the enhanced local bus interface.

13.2.2 Full Speed Input Path (Read)

This figure provides the data and command input timing diagram.

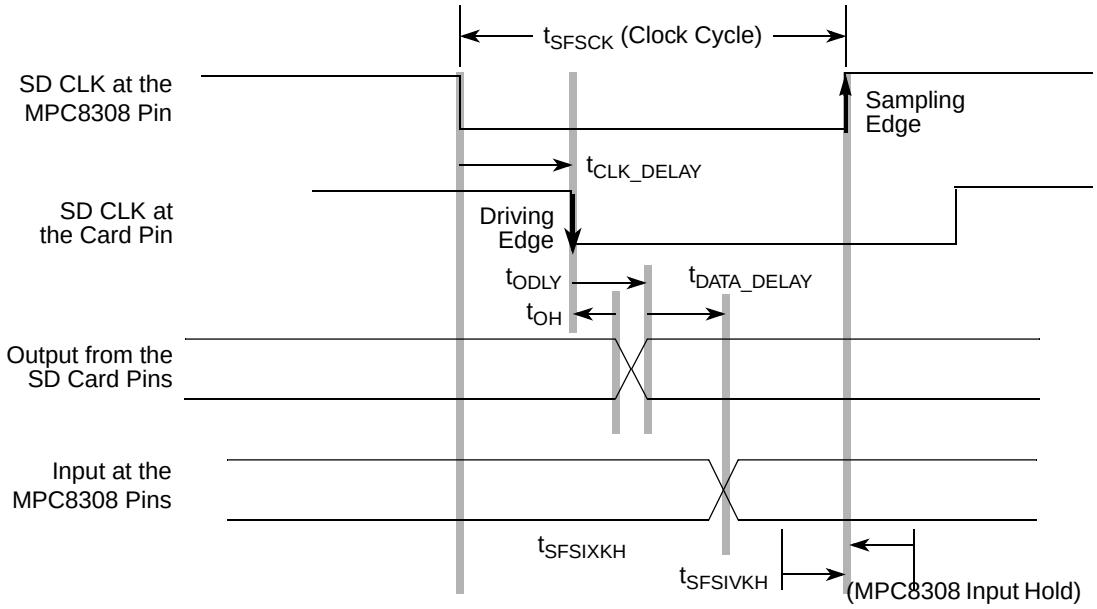


Figure 36. Full Speed Input Path

13.3 eSDHC AC Timing Specifications

This table provides the eSDHC AC timing specifications.

Table 40. eSDHC AC Timing Specifications for High Speed Mode

At recommended operating conditions NV_{DD} = 3.3 V ± 300 mV.

Parameter	Symbol [1]	Min	Max	Unit	Notes
SD_CLK clock frequency—high speed mode	f_{SHSCK}	0	50	MHz	3
SD_CLK clock cycle	t_{SHSCK}	20	—	ns	—
SD_CLK clock frequency—identification mode	f_{SIDCK}	0	400	kHz	—
SD_CLK clock low time	t_{SHSCKL}	7	—	ns	2
SD_CLK clock high time	t_{SHSCKH}	7	—	ns	2
SD_CLK clock rise and fall times	t_{SHSCKR}/ t_{SHSCKF}	—	3	ns	2
Input setup times: SD_CMD, SD_DATx	$t_{SHSIVKH}$	3	—	ns	2
Input hold times: SD_CMD, SD_DATx	$t_{SHSIXKH}$	2	—	ns	2
Output delay time: SD_CLK to SD_CMD, SD_DATx valid	$t_{SHSKHOV}$	3	—	ns	2
Output Hold time: SD_CLK to SD_CMD, SD_DATx invalid	$t_{SHSKHOX}$	–3	—	ns	2
SD Card Input Setup	t_{ISU}	6	—	ns	3
SD Card Input Hold	t_{IH}	2	—	ns	3

Table 40. eSDHC AC Timing Specifications for High Speed Mode (continued)

At recommended operating conditions NV_{DD} = 3.3 V ± 300 mV.

Parameter	Symbol [1]	Min	Max	Unit	Notes
SD Card Output Valid	t_{ODLY}	—	14	ns	3
SD Card Output Hold	t_{OH}	2.5	—	ns	3

Notes:

1. The symbols used for timing specifications herein follow the pattern of $t_{\text{(first three letters of functional block)(signal)(state) (reference)(state)}}$ for inputs and $t_{\text{(first three letters of functional block)(reference)(state)(signal)(state)}}$ for outputs. For example, $t_{SFSIXKH}$ symbolizes eSDHC full mode speed device timing (SFS) input (I) to go invalid (X) with respect to the clock reference (K) going to high (H). Also $t_{SFSKHOV}$ symbolizes eSDHC full speed timing (SFS) for the clock reference (K) to go high (H), with respect to the output (O) going valid (V) or data output valid time. Note that, in general, the clock reference symbol representation is based on five letters representing the clock of a particular functional. For rise and fall times, the latter convention is used with the appropriate letter: R (rise) or F (fall).
2. Measured at capacitive load of 40 pF.
3. For reference only, according to the SD card specifications.

This figure provides the eSDHC clock input timing diagram.

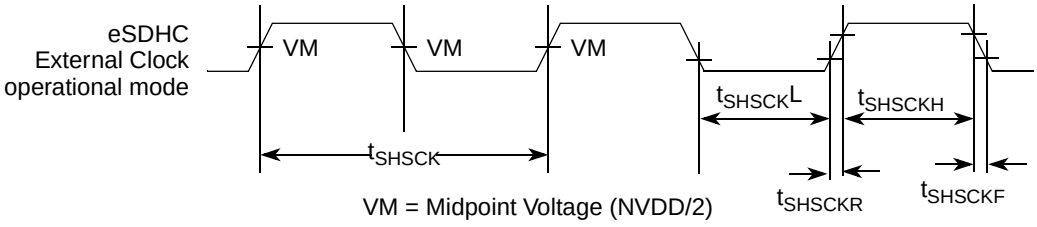


Figure 37. eSDHC Clock Input Timing Diagram

13.3.1 High Speed Output Path (Write)

This figure provides the data and command output timing diagram.

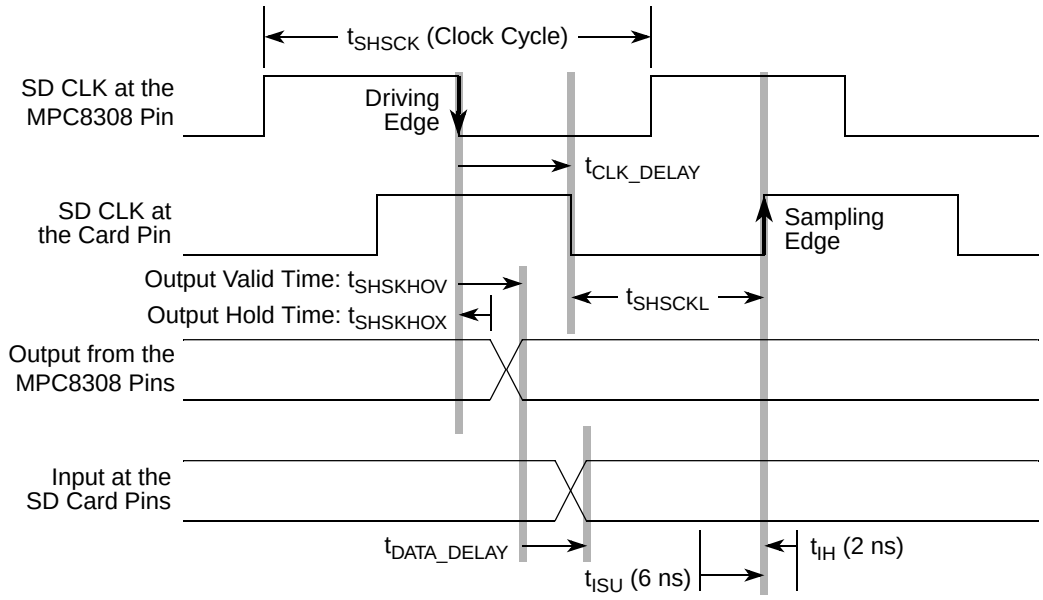


Figure 38. High Speed Output Path

13.3.2 High Speed Input Path (Read)

This figure provides the data and command input timing diagram.

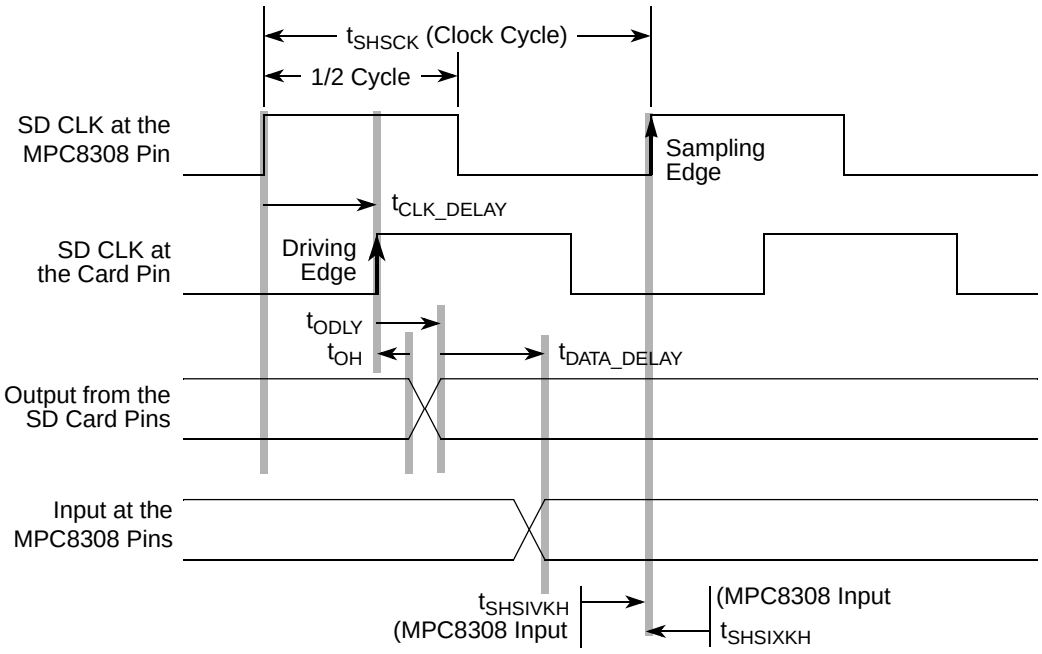


Figure 39. High Speed Input Path

Table 44. I²C AC Electrical Specifications (continued)

All values refer to V_{IH} (min) and V_{IL} (max) levels (see Table 43).

Parameter	Symbol[1]	Min	Max	Unit
Setup time for STOP condition	t_{I2PVKH}	0.6	—	μs
Bus free time between a STOP and START condition	t_{I2KHDX}	1.3	—	μs
Noise margin at the LOW level for each connected device (including hysteresis)	V_{NL}	$0.1 \times NV_{DD}$	—	V
Noise margin at the HIGH level for each connected device (including hysteresis)	V_{NH}	$0.2 \times NV_{DD}$	—	V

Notes:

1. The symbols used for timing specifications follow the pattern of $t_{\text{(first two letters of functional block)(signal)(state) (reference)(state)}}$ for inputs and $t_{\text{(first two letters of functional block)(reference)(state)(signal)(state)}}$ for outputs. For example, t_{I2DVKH} symbolizes I²C timing (I2) with respect to the time data input signals (D) reach the valid state (V) relative to the t_{I2C} clock reference (K) going to the high (H) state or setup time. Also, t_{I2SXKL} symbolizes I²C timing (I2) for the time that the data with respect to the start condition (S) went invalid (X) relative to the t_{I2C} clock reference (K) going to the low (L) state or hold time. Also, t_{I2PVKH} symbolizes I²C timing (I2) for the time that the data with respect to the stop condition (P) reaching the valid state (V) relative to the t_{I2C} clock reference (K) going to the high (H) state or setup time. For rise and fall times, the latter convention is used with the appropriate letter: R (rise) or F (fall).
2. The device provides a hold time of at least 300 ns for the SDA signal (referred to the V_{IHmin} of the SCL signal) to bridge the undefined region of the falling edge of SCL.
3. The maximum t_{I2DXKL} has only to be met if the device does not stretch the LOW period (t_{I2CL}) of the SCL signal.
4. C_B = capacitance of one bus line in pF.
5. The device does not follow the *I²C-BUS Specifications, Version 2.1,* regarding the t_{I2CF} AC parameter.

This figure provides the AC test load for the I²C.

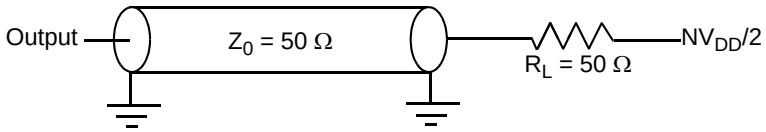


Figure 45. I²C AC Test Load

This figure shows the AC timing diagram for the I²C bus.

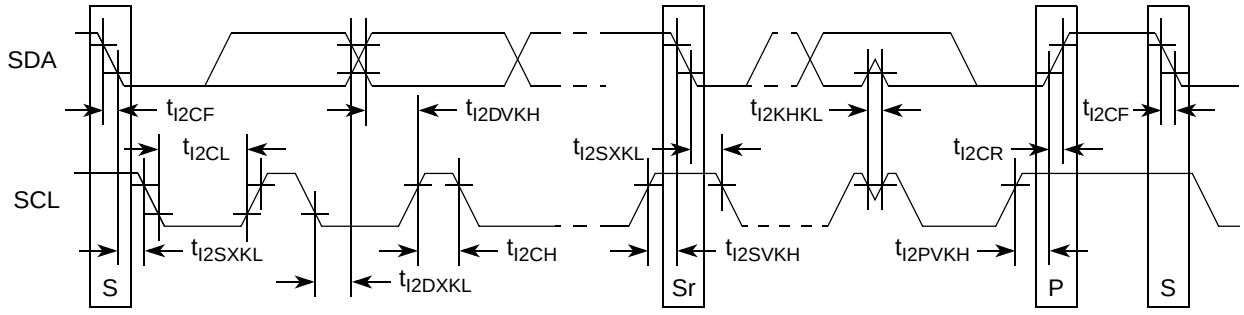


Figure 46. I²C Bus AC Timing Diagram

17 GPIO

This section describes the DC and AC electrical specifications for the GPIO of MPC8308

17.1 GPIO DC Electrical Characteristics

This table provides the DC electrical characteristics for the GPIO.

Table 47. GPIO DC Electrical Characteristic

Characteristic	Symbol	Condition	Min	Max	Unit
Output high voltage	V_{OH}	I_{OH} = –8.0 mA	2.4	—	V
Output low voltage	V_{OL}	I_{OL} = 8.0 mA	—	0.5	V
Output low voltage	V_{OL}	I_{OL} = 3.2 mA	—	0.4	V
Input high voltage	V_{IH}	—	2.1	NV_{DD} + 0.3	V
Input low voltage	V_{IL}	—	–0.3	0.8	V
Input current	I_{IN}	$0 V \le V_{IN} \le NV_{DD}$	—	± 5	μA

17.2 GPIO AC Timing Specifications

This table provides the GPIO input and output AC timing specifications.

Table 48. GPIO Input AC Timing Specifications

Characteristic	Symbol[1]	Min	Unit
GPIO inputs—minimum pulse width	t_{PIWID}	20	ns

Note:

1. GPIO inputs and outputs are asynchronous to any visible clock. GPIO outputs should be synchronized before use by any external synchronous logic. GPIO inputs are required to be valid for at least t_{PIWID} ns to ensure proper operation.

This figure provides the AC test load for the GPIO.

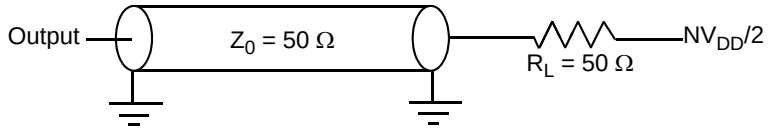
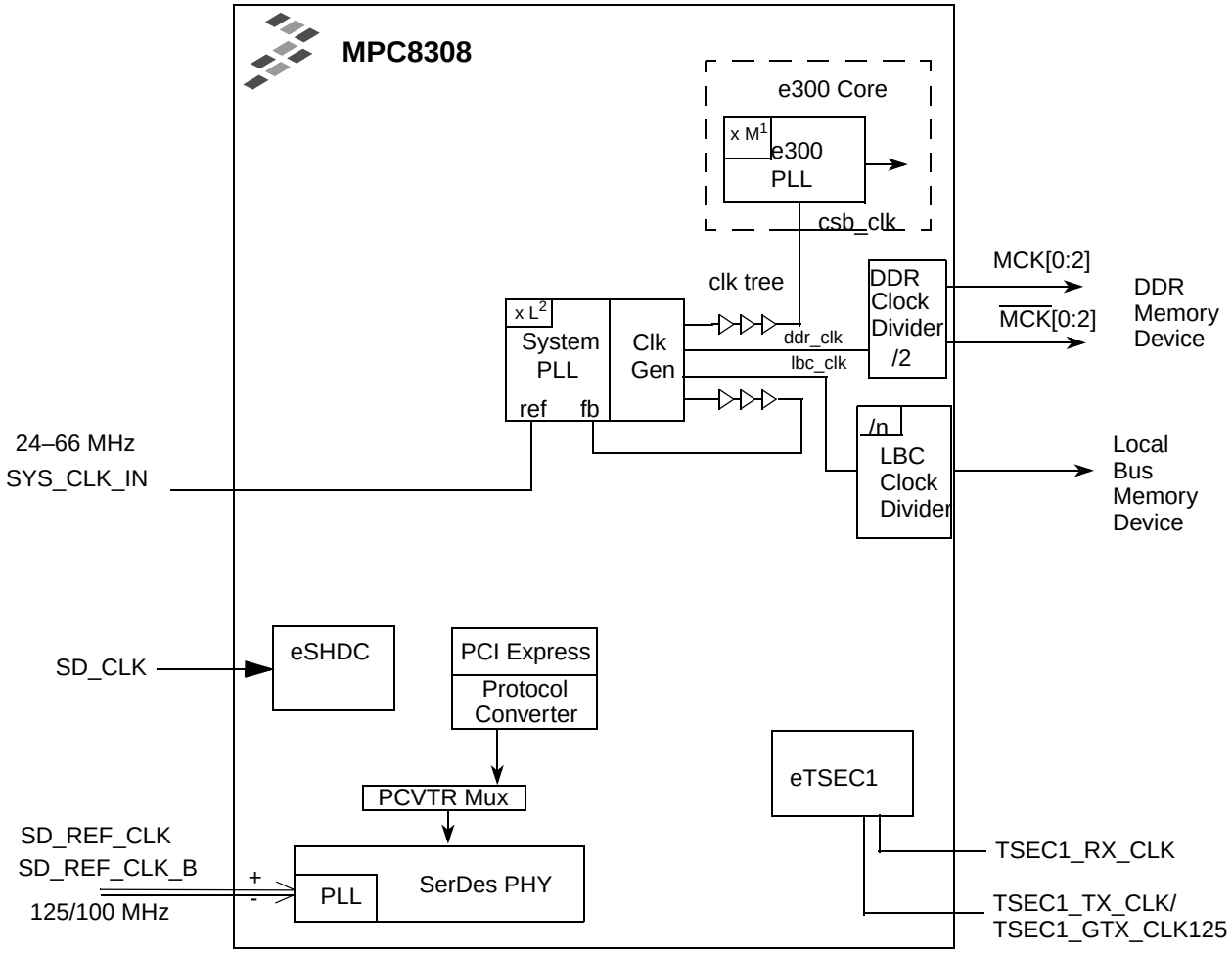


Figure 48. GPIO AC Test Load

21 Clocking

This figure shows the internal distribution of clocks within the device.



1 Multiplication factor M = 1, 1.5, 2, 2.5, and 3. Value is decided by RCWLR[COREPLL].

2 Multiplication factor L = 2, 3, 4, 5 and 6. Value is decided by RCWLR[SPMF].

Figure 53. MPC8308 Clock Subsystem

The following external clock sources are utilized on the MPC8308:

- System clock (SYS_CLK_IN)
- Ethernet Clock (TSEC1_RX_CLK/TSEC1_TX_CLK/TSEC1_GTX_CLK125 for eTSEC)
- SerDes PHY clock
- eSHDC clock (SD_CLK)

  For more information, see the SerDes chapter in the *MPC8308 PowerQUICC II Pro Processor Reference Manual*.

All clock inputs can be supplied using an external canned oscillator, a clock generation chip, or some other source that provides a standard CMOS square wave input.

21.3 Core PLL Configuration

RCWL[COREPLL] selects the ratio between the internal coherent system bus clock (*csb_clk*) and the e300 core clock (*core_clk*). This table shows the encodings for RCWL[COREPLL]. COREPLL values that are not listed in this table should be considered as reserved.

NOTE

Core VCO frequency = core frequency × VCO divider. The VCO divider, which is determined by RCWLR[COREPLL], must be set properly so that the core VCO frequency is in the range of 400–800 MHz.

Table 58. e300 Core PLL Configuration

RCWL[COREPLL]			*core_clk: csb_clk* Ratio[1]	VCO Divider (VCOD)[2]
0–1	**2–5**	**6**		
nn	**0000**	0	PLL bypassed (PLL off, *csb_clk* clocks core directly)	PLL bypassed (PLL off, *csb_clk* clocks core directly)
11	***nnnn***	n	n/a	n/a
00	**0001**	0	1:1	2
01	**0001**	0	1:1	4
10	**0001**	0	1:1	8
00	**0001**	1	1.5:1	2
01	**0001**	1	1.5:1	4
10	**0001**	1	1.5:1	8
00	**0010**	0	2:1	2
01	**0010**	0	2:1	4
10	**0010**	0	2:1	8
00	**0010**	1	2.5:1	2
01	**0010**	1	2.5:1	4
10	**0010**	1	2.5:1	8
00	**0011**	0	3:1	2
01	**0011**	0	3:1	4
10	**0011**	0	3:1	8

Note:

1 For any *core_clk:csb_clk* ratios, the *core_clk* must not exceed its maximum operating frequency of 400 MHz.

2 Core VCO frequency = core frequency × VCO divider. Note that VCO divider has to be set properly so that the core VCO frequency is in the range of 400–800 MHz.

22 Thermal

This section describes the thermal specifications of the device.

22.1 Thermal Characteristics

This table provides the package thermal characteristics for the 473, 19 × 19 mm MAPBGA.

Table 59. Package Thermal Characteristics for MAPBGA

Characteristic	Board Type	Symbol	Value	Unit	Note
Junction to Ambient Natural Convection	Single layer board (1s)	$R_{\theta JA}$	42	°C/W	1, 2
Junction to Ambient Natural Convection	Four layer board (2s2p)	$R_{\theta JA}$	27	°C/W	1, 2, 3
Junction to Ambient (@200 ft/min)	Single layer board (1s)	$R_{\theta JMA}$	35	°C/W	1, 3
Junction to Ambient (@200 ft/min)	Four layer board (2s2p)	$R_{\theta JMA}$	24	°C/W	1, 3
Junction to Board	—	$R_{\theta JB}$	17	°C/W	4
Junction to Case	—	$R_{\theta JC}$	9	°C/W	5
Junction to Package Top	Natural Convection	Ψ_{JT}	2	°C/W	6

Notes:
1. Junction temperature is a function of die size, on-chip power dissipation, package thermal resistance, mounting site (board) temperature, ambient temperature, air flow, power dissipation of other components on the board, and board thermal resistance.
2. Per JEDEC JESD51-2 with the single layer board horizontal. Board meets JESD51-9 specification.
3. Per JEDEC JESD51-6 with the board horizontal.
4. Thermal resistance between the die and the printed circuit board per JEDEC JESD51-8. Board temperature is measured on the top surface of the board near the package.
5. Thermal resistance between the die and the case top surface as measured by the cold plate method (MIL SPEC-883 Method 1012.1).
6. Thermal characterization parameter indicating the temperature difference between package top and the junction temperature per JEDEC JESD51-2. When Greek letters are not available, the thermal characterization parameter is written as Psi-JT.

22.2 Thermal Management Information

For the following sections, $P_D = (V_{DD} \times I_{DD}) + P_{I/O}$, where $P_{I/O}$ is the power dissipation of the I/O drivers.

22.2.1 Estimation of Junction Temperature with Junction-to-Ambient Thermal Resistance

An estimation of the chip junction temperature, T_J, can be obtained from the equation:

$$T_J = T_A + (R_{\theta JA} \times P_D)$$

where:

T_J = junction temperature (°C)

T_A = ambient temperature for the package (°C)

$R_{\theta JA}$ = junction-to-ambient thermal resistance (°C/W)

P_D = power dissipation in the package (W)

The junction-t-ambient thermal resistance is an industry standard value that provides a quick and easy estimation of thermal performance. As a general statement, the value obtained on a single layer board is

23 System Design Information

This section provides electrical and thermal design recommendations for successful application of the device

23.1 System Clocking

The device includes two PLLs.

1. The platform PLL generates the platform clock from the externally supplied SYS_CLK_IN input. The frequency ratio between the platform and SYS_CLK_IN is selected using the platform PLL ratio configuration bits as described in Section 21.2, “System PLL Configuration.”
2. The e300 core PLL generates the core clock as a slave to the platform clock. The frequency ratio between the e300 core clock and the platform clock is selected using the e300 PLL ratio configuration bits as described in Section 21.3, “Core PLL Configuration.”

23.2 PLL Power Supply Filtering

Each of the PLLs listed above is provided with power through independent power supply pins (AV_{DD1} for core PLL and AV_{DD2} for the platform PLL). The AV_{DD} level should always be equivalent to V_{DD}, and preferably these voltages are derived directly from V_{DD} through a low pass filter scheme such as the following.

There are a number of ways to reliably provide power to the PLLs, but the recommended solution is to provide independent filter circuits as illustrated in Figure 54, one to each of the two AV_{DD} pins. By providing independent filters to each PLL the opportunity to cause noise injection from one PLL to the other is reduced.

This circuit is intended to filter noise in the PLLs’ resonant frequency range from a 500 kHz to 10 MHz range. It should be built with surface mount capacitors with minimum effective series inductance (ESL). Consistent with the recommendations of Dr. Howard Johnson in *High Speed Digital Design: A Handbook of Black Magic* (Prentice Hall, 1993), multiple small capacitors of equal value are recommended over a single large value capacitor.

Each circuit should be placed as close as possible to the specific AV_{DD} pin being supplied to minimize noise coupled from nearby circuits. It should be possible to route directly from the capacitors to the AV_{DD} pin, which is on the periphery of package, without the inductance of vias.

This figure shows the PLL power supply filter circuits.

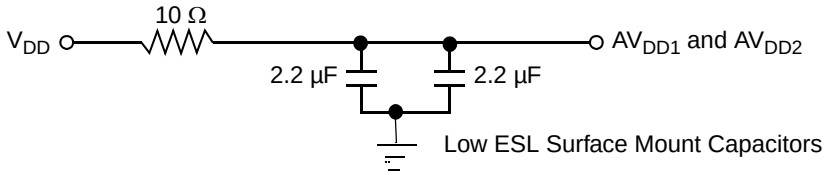


Figure 54. PLL Power Supply Filter Circuit

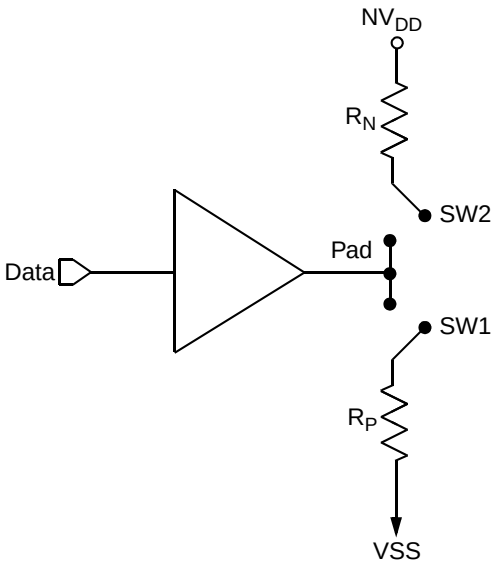


Figure 55. Driver Impedance Measurement

The value of this resistance and the strength of the driver's current source can be found by making two measurements. First, the output voltage is measured while driving logic 1 without an external differential termination resistor. The measured voltage is $V_1 = R_{source} \times I_{source}$. Second, the output voltage is measured while driving logic 1 with an external precision differential termination resistor of value R_{term}. The measured voltage is $V_2 = (1/(1/R_1 + 1/R_2)) \times I_{source}$. Solving for the output impedance gives $R_{source} = R_{term} \times (V_1/V_2 - 1)$. The drive current is then $I_{source} = V_1/R_{source}$.

This table summarizes the signal impedance targets. The driver impedance are targeted at minimum V_{DD}, nominal NV_{DD}, 105°C.

Table 60. Impedance Characteristics

Impedance	Local Bus, Ethernet, DUART, Control, Configuration, Power Management	DDR DRAM	Symbol	Unit
R_N	42 Target	20 Target	Z_0	Ω
R_P	42 Target	20 Target	Z_0	Ω

Note: Nominal supply voltages. See Table 2, T_j = 105°C.

23.6 Configuration Pin Muxing

The device provides the user with power-on configuration options which can be set through the use of external pull-up or pull-down resistors of 4.7 KΩ on certain output pins (see customer visible configuration pins). These pins are generally used as output only pins in normal operation.

While $\overline{\text{PORESET}}$ is asserted however, these pins are treated as inputs. The value presented on these pins while $\overline{\text{PORESET}}$ is asserted, is latched when $\overline{\text{PORESET}}$ deasserts, at which time the input receiver is disabled and the I/O circuit takes on its normal function. Careful board layout with stubless connections to these pull-up/pull-down resistors coupled with the large value of the pull-up/pull-down resistor should minimize the disruption of signal quality or speed for output pins thus configured.