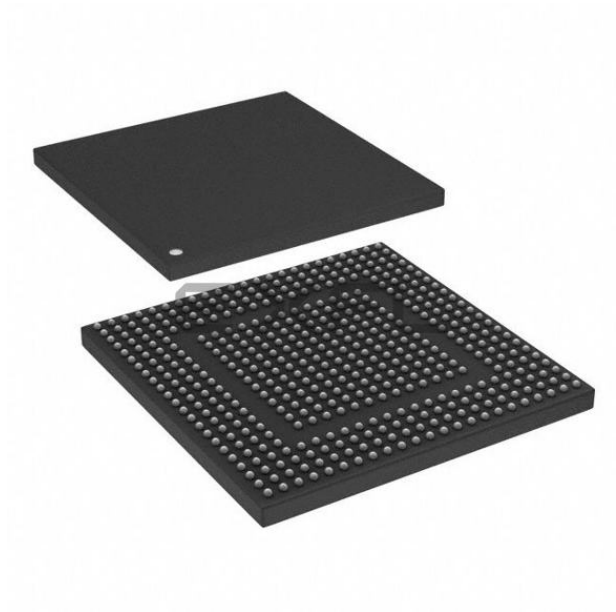

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Understanding Embedded - Microprocessors

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	Obsolete
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/pro/item?MUrl=&PartUrl=mpc8308czqafd

The I/O power supply ramp-up slew rate should be slower than 4V/100 μs, this requirement is for ESD circuit. Note that there is no specific power down sequence requirement for the device. I/O voltage supplies (GV_{DD}, LV_{DD}, and NV_{DD}) do not have any ordering requirements with respect to one another.

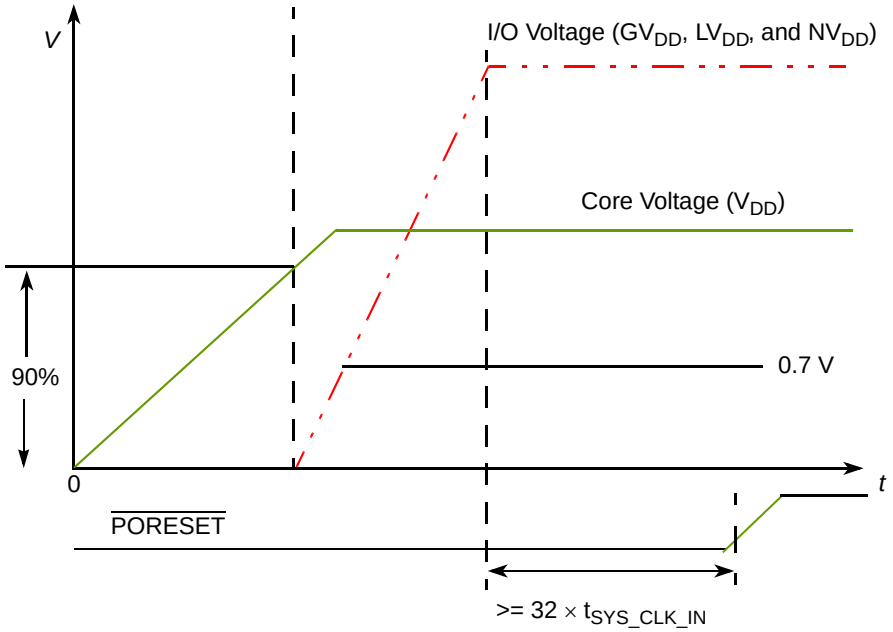


Figure 3. Power-Up Sequencing Example

3 Power Characteristics

The estimated typical power dissipation, not including I/O supply power for the device is shown in this table. Table 5 shows the estimated typical I/O power dissipation.

Table 4. MPC8308 Power Dissipation[1]

Core Frequency (MHz)	CSB Frequency (MHz)	Typical[2]	Maximum [3]	Unit
266	133	530	900	mW
333	133	565	950	mW
400	133	600	1000	mW

Note:

1 The values do not include I/O supply power but do include core (V_{DD}) and PLL (AV_{DD1}, AV_{DD2}, $XCOREV_{DD}$, $XPADV_{DD}$, and $SDAV_{DD}$)

2 Typical power is based on best process, a voltage of V_{DD} = 1.0 V and ambient temperature of T_A = 25° C and an artificial smoker test.

3 Maximum power is estimated based on best process, a voltage of V_{DD} = 1.05 V, a junction temperature of T_J = 105° C

Table 8. SYS_CLK_IN AC Timing Specifications

Parameter/	Symbol	Min	Typ	Max	Unit	Notes
SYS_CLK_IN frequency	$f_{SYS\_CLK\_IN}$	24	—	66.67	MHz	1, 6
SYS_CLK_IN period	$t_{SYS\_CLK\_IN}$	15	—	41.67	ns	—
SYS_CLK_IN rise and fall time	t_{KH}, t_{KL}	0.6		1.2	ns	2
SYS_CLK_IN duty cycle	$t_{KHK}/t_{SYS\_CLK\_IN}$	40	—	60	%	3
SYS_CLK_IN jitter	—	—	—	±150	ps	4, 5

Notes:
1. **Caution:** The system and core must not exceed their respective maximum or minimum operating frequencies.
2. Rise and fall times for SYS_CLK_IN are measured at 0.4 and 2.7 V.
3. Timing is guaranteed by design and characterization.
4. This represents the total input jitter—short term and long term—and is guaranteed by design.
5. The SYS_CLK_IN driver's closed loop jitter bandwidth should be <500 kHz at –20 dB. The bandwidth must be set low to allow cascade-connected PLL-based devices to track SYS_CLK_IN drivers with the specified jitter.
6. Spread spectrum is allowed up to 1% down-spread @ 33 kHz (max rate).

Table 9. RTC_PIT_CLOCK AC Timing Specifications

Parameter/	Symbol	Min	Typ	Max	Unit	Notes
RTC_PIT_CLOCK frequency	$f_{RTC\_PIT\_CLOCK}$	1	32768	—	Hz	—
RTC_PIT_CLOCK rise and fall time	t_{RTCH}, t_{RTCL}	1.5	—	3	μs	—
RTC_PIT_CLOCK duty cycle	$t_{RTCHK}/t_{RTC\_PIT\_CLOCK}$	45	—	55	%	—

5 RESET Initialization

This section describes the DC and AC electrical specifications for the reset initialization timing and electrical requirements of the device.

5.1 RESET DC Electrical Characteristics

This table provides the DC electrical characteristics for the RESET pins.

Table 10. RESET Pins DC Electrical Characteristics

Characteristic	Symbol	Condition	Min	Max	Unit
Input high voltage	V_{IH}	—	2.0	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
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

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	—

6 DDR2 SDRAM

This section describes the DC and AC electrical specifications for the DDR2 SDRAM interface. Note that DDR2 SDRAM is GV_{DD}(typ) = 1.8 V.

6.1 DDR2 SDRAM DC Electrical Characteristics

This table provides the recommended operating conditions for the DDR2 SDRAM component(s) when GV_{DD}(typ) = 1.8 V.

Table 13. DDR2 SDRAM DC Electrical Characteristics for GV_{DD}(typ) = 1.8 V

Parameter/Condition	Symbol	Min	Max	Unit	Note
I/O supply voltage	GV_{DD}	1.7	1.9	V	1
I/O reference voltage	MV_{REF}	0.49 × GV_{DD}	0.51 × GV_{DD}	V	2
I/O termination voltage	V_{TT}	MV_{REF} – 0.04	MV_{REF} + 0.04	V	3
Input high voltage	V_{IH}	MV_{REF} + 0.125	GV_{DD} + 0.3	V	—
Input low voltage	V_{IL}	–0.3	MV_{REF} – 0.125	V	—
Output leakage current	I_{OZ}	–9.9	9.9	μA	4
Output high current (V_{OUT} = 1.420 V)	I_{OH}	–13.4	—	mA	—
Output low current (V_{OUT} = 0.280 V)	I_{OL}	13.4	—	mA	—

Notes:
1. GV_{DD} is expected to be within 50 mV of the DRAM GV_{DD} at all times.
2. MV_{REF} is expected to be equal to 0.5 × GV_{DD}, and to track GV_{DD} DC variations as measured at the receiver. Peak-to-peak noise on MV_{REF} may not exceed ±2% of the DC value.
3. V_{TT} is not applied directly to the device. It is the supply to which far end signal termination is made and is expected to be equal to MV_{REF}. This rail should track variations in the DC level of MV_{REF}.
4. Output leakage is measured with all outputs disabled, 0 V ≤ V_{OUT} ≤ GV_{DD}.

This table provides the DDR2 capacitance when GV_{DD}(typ) = 1.8 V.

Table 14. DDR2 SDRAM Capacitance for GV_{DD}(typ)=1.8 V

Parameter/Condition	Symbol	Min	Max	Unit	Notes
Input/output capacitance: DQ, DQS, $\overline{DQS}$	C_{IO}	6	8	pF	1
Delta input/output capacitance: DQ, DQS, $\overline{DQS}$	C_{DIO}	—	0.5	pF	1

Note:
1. This parameter is sampled. GV_{DD} = 1.8 V ± 0.090 V, f = 1 MHz, T_A = 25°C, V_{OUT} = GV_{DD}/2, V_{OUT} (peak-to-peak) = 0.2 V.

This figure shows the MII receive AC timing diagram.

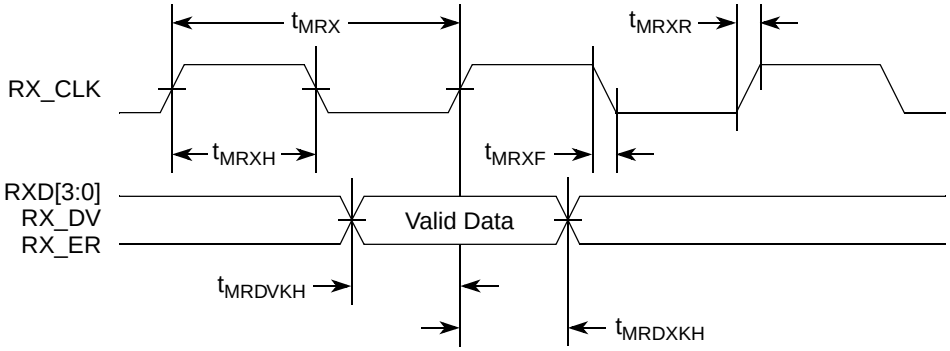


Figure 9. MII Receive AC Timing Diagram RMII AC Timing Specifications

This figure provides the AC test load.

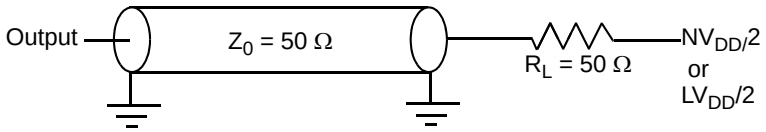


Figure 10. AC Test Load

8.2.2 RGMII AC Timing Specifications

This table presents the RGMII AC timing specifications.

Table 25. RGMII AC Timing Specifications

At recommended operating conditions with LV_{DD} of 2.5 V ± 5%.

Parameter/Condition	Symbol [1]	Min	Typ	Max	Unit
Data to clock output skew (at transmitter)	t_{SKRGT}	–0.6	—	0.6	ns
Data to clock input skew (at receiver) [2]	t_{SKRGT}	1.0	—	2.6	ns
Clock cycle duration [3]	t_{RGT}	7.2	8.0	8.8	ns
Duty cycle for 1000Base-T [4, 5]	t_{RGTH}/t_{RGT}	45	50	55	%
Duty cycle for 10BASE-T and 100BASE-TX [3, 5]	t_{RGTH}/t_{RGT}	40	50	60	%
Rise time (20%–80%)	t_{RGTR}	—	—	0.75	ns
Fall time (20%–80%)	t_{RGTF}	—	—	0.75	ns

Table 25. RGMII AC Timing Specifications (continued)

At recommended operating conditions with LV_{DD} of 2.5 V ± 5%.

GTX_CLK125 reference clock period	t_{G12} [6]	—	8.0	—	ns
GTX_CLK125 reference clock duty cycle	t_{G125H}/t_{G125}	47	—	53	%

Notes:

1. In general, the clock reference symbol representation for this section is based on the symbols RGT to represent RGMII timing. For example, the subscript of t_{RGT} represents the RGMII receive (RX) clock. Note also that the notation for rise (R) and fall (F) times follows the clock symbol that is being represented. For symbols representing skews, the subscript is skew (SK) followed by the clock that is being skewed (RGT).
2. This implies that PC board design requires clocks to be routed such that an additional trace delay of greater than 1.5 ns is added to the associated clock signal.
3. For 10 and 100 Mbps, t_{RGT} scales to 400 ns ± 40 ns and 40 ns ± 4 ns, respectively.
4. Duty cycle may be stretched/shrunk during speed changes or while transitioning to a received packet's clock domains as long as the minimum duty cycle is not violated and stretching occurs for no more than three t_{RGT} of the lowest speed transitioned between.
5. Duty cycle reference is $0.5*LV_{DD}$
6. This symbol is used to represent the external GTX_CLK125 and does not follow the original symbol naming convention.

This figure shows the RGMII AC timing and multiplexing diagrams.

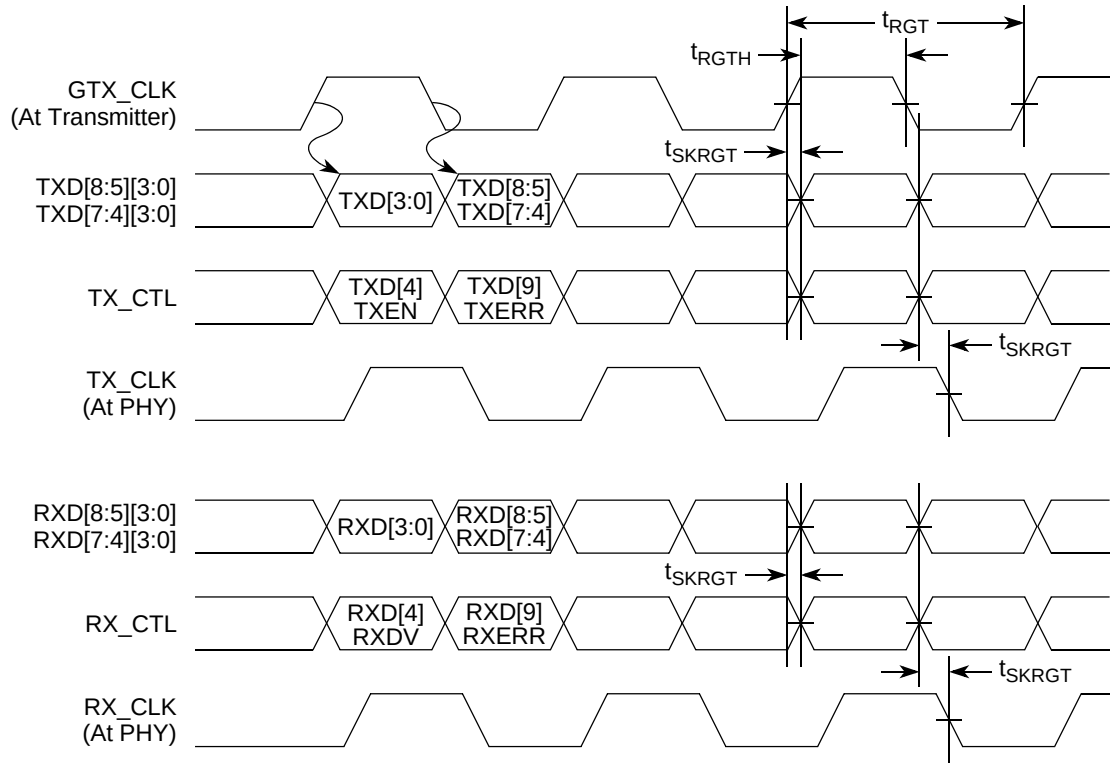


Figure 11. RGMII AC Timing and Multiplexing Diagrams

8.3 Ethernet Management Interface Electrical Characteristics

The electrical characteristics specified here apply to MII management interface signals MDIO (management data input/output) and MDC (management data clock). The electrical characteristics for MII

10 High-Speed Serial Interfaces (HSSI)

This section describes the common portion of SerDes DC electrical specifications, which is the DC requirement for SerDes reference clocks. The SerDes data lane's transmitter and receiver reference circuits are also shown.

10.1 Signal Terms Definition

The SerDes utilizes differential signaling to transfer data across the serial link. This section defines terms used in the description and specification of differential signals.

Figure 15 shows how the signals are defined. For illustration purpose, only one SerDes lane is used for description. The figure shows waveform for either a transmitter output (TX*n* and $\overline{\text{TX}n}$) or a receiver input (RX*n* and $\overline{\text{RX}n}$). Each signal swings between A Volts and B Volts where A > B.

Using this waveform, the definitions are as follows. To simplify illustration, the following definitions assume that the SerDes transmitter and receiver operate in a fully symmetrical differential signaling environment.

- **Single-Ended Swing**

  The transmitter output signals and the receiver input signals TX*n*, $\overline{\text{TX}n}$, RX*n*, and $\overline{\text{RX}n}$ each have a peak-to-peak swing of A – B Volts. This is also referred as each signal wire's single-ended swing.
- **Differential Output Voltage, V_{OD}** (or **Differential Output Swing**)

  The differential output voltage (or swing) of the transmitter, V_{OD}, is defined as the difference of the two complimentary output voltages: $V_{TXn} - V_{\overline{TXn}}$. The V_{OD} value can be either positive or negative.
- **Differential Input Voltage, V_{ID}** (or **Differential Input Swing**)

  The differential input voltage (or swing) of the receiver, V_{ID}, is defined as the difference of the two complimentary input voltages: $V_{RXn} - V_{\overline{RXn}}$. The V_{ID} value can be either positive or negative.
- **Differential Peak Voltage, V_{DIFFp}**

  The peak value of the differential transmitter output signal or the differential receiver input signal is defined as Differential Peak Voltage, V_{DIFFp} = |A – B| Volts.
- **Differential Peak-to-Peak, $V_{DIFFp-p}$**

  Since the differential output signal of the transmitter and the differential input signal of the receiver each range from A – B to –(A – B) Volts, the peak-to-peak value of the differential transmitter output signal or the differential receiver input signal is defined as differential peak-to-peak voltage, $V_{DIFFp-p} = 2*V_{DIFFp} = 2 * |(A - B)|$ Volts, which is twice of differential swing in amplitude, or twice of the differential peak. For example, the output differential peak-peak voltage can also be calculated as $V_{TX-DIFFp-p} = 2*|V_{OD}|$.
- **Differential Waveform**

  The differential waveform is constructed by subtracting the inverting signal (for example, $\overline{\text{TX}n}$) from the non-inverting signal (for example, TX*n*) within a differential pair. There is only one signal trace curve in a differential waveform. The voltage represented in the differential waveform is not referenced to ground. Refer to Figure 24 as an example for differential waveform.

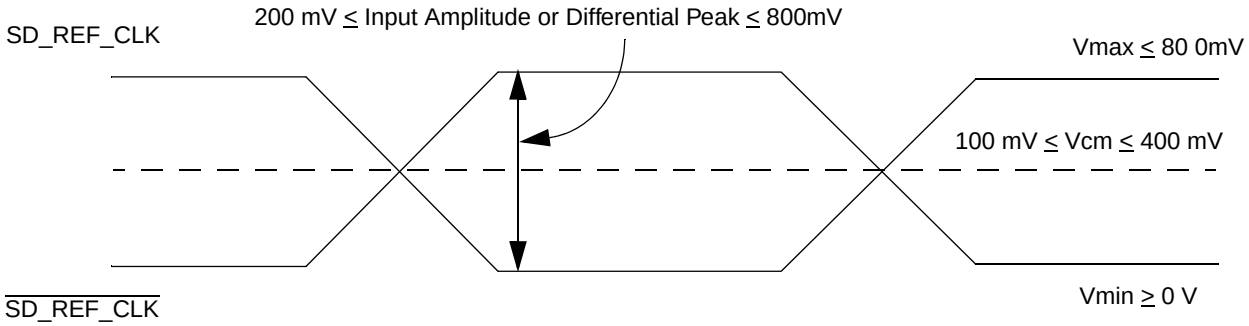


Figure 17. Differential Reference Clock Input DC Requirements (External DC-Coupled)

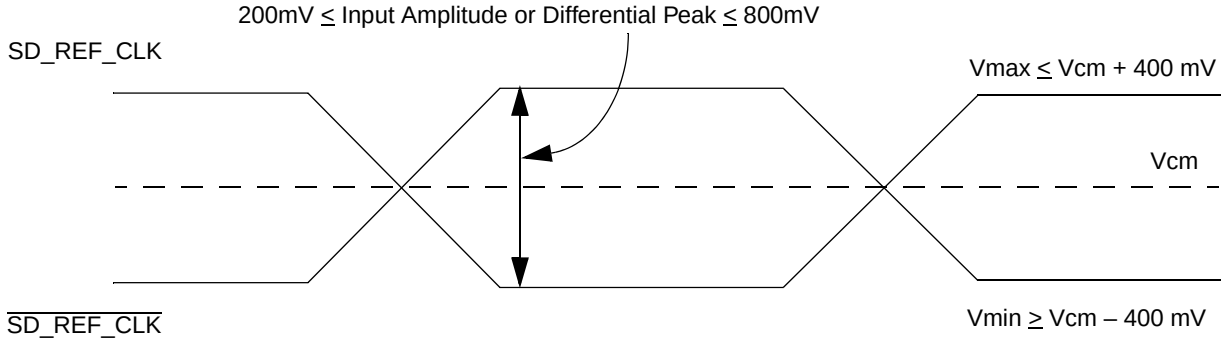


Figure 18. Differential Reference Clock Input DC Requirements (External AC-Coupled)

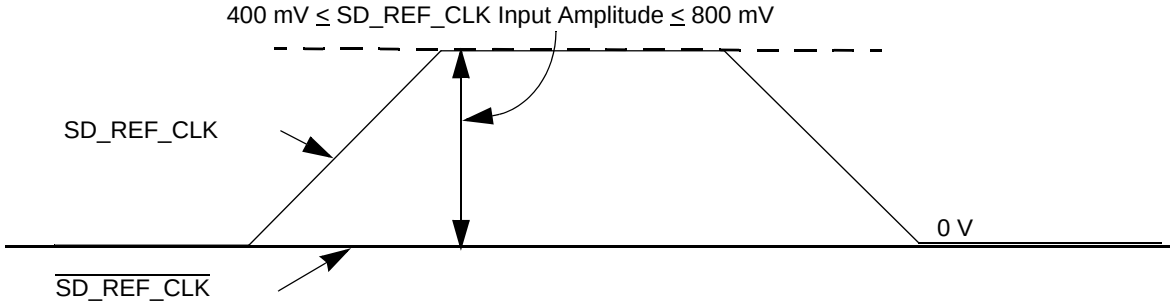


Figure 19. Single-Ended Reference Clock Input DC Requirements

10.2.3 Interfacing with Other Differential Signaling Levels

With on-chip termination to XCOREVSS, the differential reference clocks inputs are high-speed current steering logic (HCSL) compatible and DC coupled.

Many other low voltage differential type outputs like low-voltage differential signaling (LVDS) can be used but may need to be AC-coupled due to the limited common mode input range allowed (100–400 mV) for DC-coupled connection.

LVPECL outputs can produce signal with too large amplitude and may need to be DC-biased at clock driver output first, then followed with series attenuation resistor to reduce the amplitude, in addition to AC-coupling.

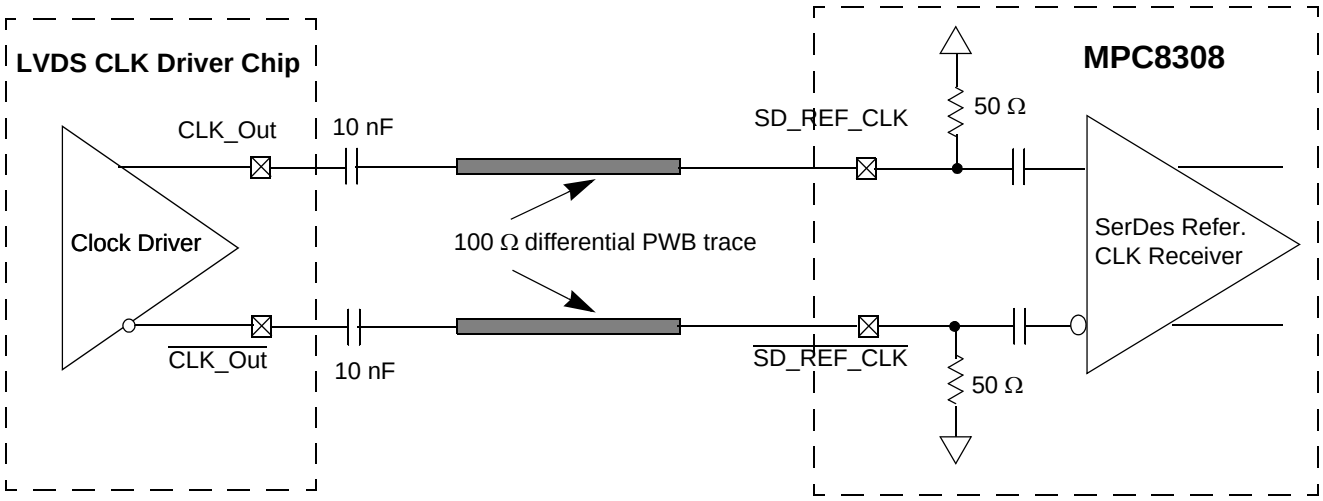


Figure 21. AC-Coupled Differential Connection with LVDS Clock Driver (Reference Only)

Figure 22 shows the SerDes reference clock connection reference circuits for LVPECL type clock driver. Since LVPECL driver's DC levels (both common mode voltages and output swing) are incompatible with MPC8308 SerDes reference clock input's DC requirement, AC-coupling has to be used.

This figure assumes that the LVPECL clock driver's output impedance is 50 Ω. R1 is used to DC-bias the LVPECL outputs prior to AC-coupling. Its value could be ranged from 140 Ω to 240 Ω depending on clock driver vendor's requirement. R2 is used together with the SerDes reference clock receiver's 50-Ω termination resistor to attenuate the LVPECL output's differential peak level such that it meets the MPC8308's SerDes reference clock's differential input amplitude requirement (between 200 mV and 800 mV differential peak). For example, if the LVPECL output's differential peak is 900 mV and the desired SerDes reference clock input amplitude is selected as 600 mV, the attenuation factor is 0.67, which requires R2 = 25 Ω. Please consult clock driver chip manufacturer to verify whether this connection scheme is compatible with a particular clock driver chip.

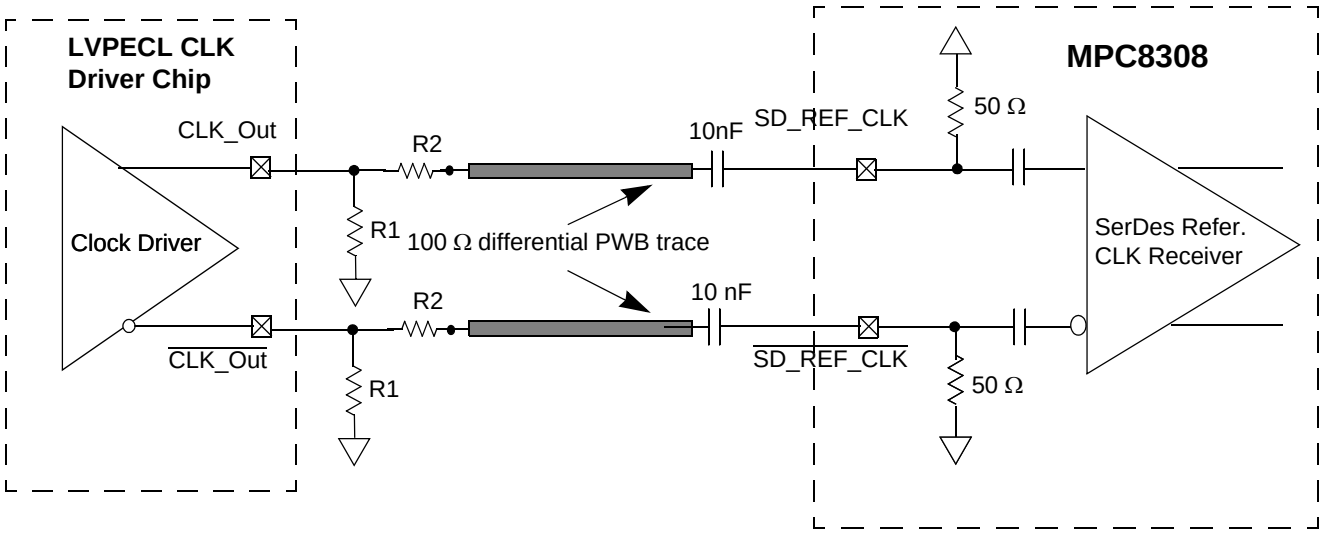


Figure 22. AC-Coupled Differential Connection with LVPECL Clock Driver (Reference Only)

10.2.4.1 Spread Spectrum Clock

SD_REF_CLK/$\overline{\text{SD\_REF\_CLK}}$ are not intended to be used with, and should not be clocked by, a spread spectrum clock source.

10.3 SerDes Transmitter and Receiver Reference Circuits

This figure shows the reference circuits for SerDes data lane's transmitter and receiver.

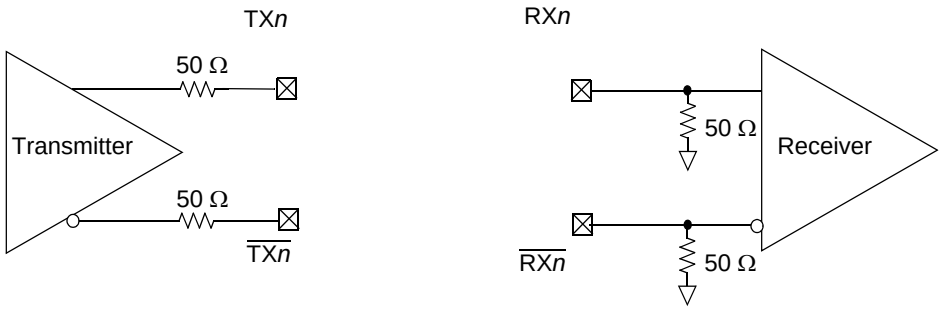


Figure 26. SerDes Transmitter and Receiver Reference Circuits

The DC and AC specification of SerDes data lanes are defined in Section 11, "PCI Express."

Note that external AC coupling capacitor is required for the PCI Express serial transmission protocol with the capacitor value defined in specification of PCI Express protocol section.

11 PCI Express

This section describes the DC and AC electrical specifications for the PCI Express bus.

11.1 DC Requirements for PCI Express SD_REF_CLK and $\overline{\text{SD\_REF\_CLK}}$

For more information, see Section 10.2, "SerDes Reference Clocks."

11.2 AC Requirements for PCI Express SerDes Clocks

This table lists the PCI Express SerDes clock AC requirements.

Table 33. SD_REF_CLK and $\overline{\text{SD\_REF\_CLK}}$ AC Requirements

Symbol	Parameter Description	Min	Typ	Max	Units	Notes
t_{REF}	REFCLK cycle time (for 125 MHz and 100 MHz)	8	10	—	ns	—
t_{REFCJ}	REFCLK cycle-to-cycle jitter. Difference in the period of any two adjacent REFCLK cycles.	—	—	100	ps	—
t_{REFPJ}	Phase jitter. Deviation in edge location with respect to mean edge location.	–50	—	50	ps	—

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.

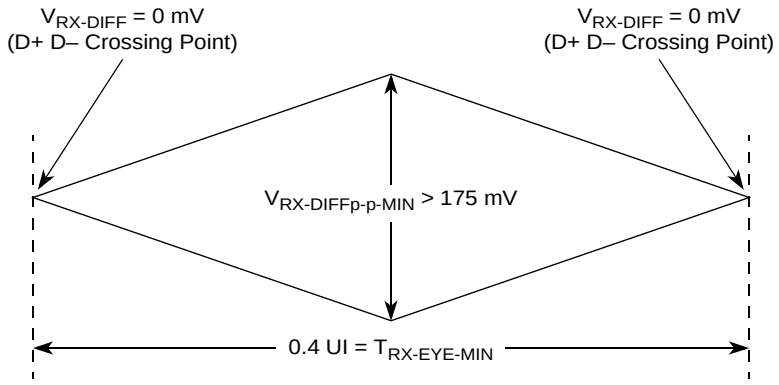


Figure 28. Minimum Receiver Eye Timing and Voltage Compliance Specification

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.

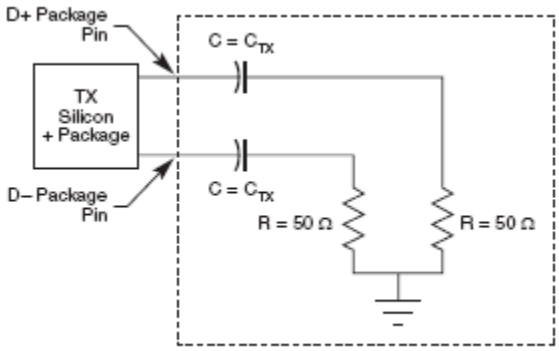


Figure 29. Compliance Test/Measurement Load

12 Enhanced Local Bus

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

Table 38. eSDHC interface DC Electrical Characteristics (continued)

Characteristic	Symbol	Condition	Min	Max	Unit
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

13.2 eSDHC AC Timing Specifications (Full Speed Mode)

This section describes the AC electrical specifications for the eSDHC (SD/MMC) interface of the device. This table provides the eSDHC AC timing specifications for full speed mode as defined in Figure 35 and Figure 36.

Table 39. eSDHC AC Timing Specifications for Full Speed Mode

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

Parameter	Symbol [1]	Min	Max	Unit	Notes
SD_CLK clock frequency—full speed mode	f_{SFSCK}	0	25	MHz	—
SD_CLK clock cycle	t_{SFSCK}	40	—	ns	—
SD_CLK clock frequency—identification mode	f_{SIDCK}	0	400	kHz	—
SD_CLK clock low time	t_{SFSCKL}	15	—	ns	2
SD_CLK clock high time	t_{SFSCKH}	15	—	ns	2
SD_CLK clock rise and fall times	t_{SFSCKR}/ t_{SFSCKF}	—	5	ns	2
Input setup times: SD_CMD, SD_DATx to SD_CLK	$t_{SFSIVKH}$	3	—	ns	2
Input hold times: SD_CMD, SD_DATx to SD_CLK	$t_{SFSIXKH}$	2	—	ns	2
Output valid: SD_CLK to SD_CMD, SD_DAT*x* valid	$t_{SFSKHOV}$	—	3	ns	2
Output hold: SD_CLK to SD_CMD, SD_DAT*x* valid	$t_{SFSKHOX}$	–3	—	—	—
SD card input setup	t_{ISU}	5	—	ns	3
SD card input hold	t_{IH}	5	—	ns	3
SD card output valid	t_{ODLY}	—	14	ns	3
SD card output hold	t_{OH}	0	—	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.
4. Average, for reference only.

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.

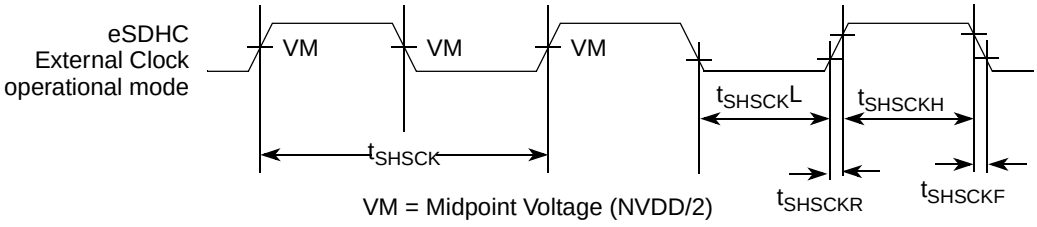


Figure 37. eSDHC Clock Input Timing Diagram

14 JTAG

This section describes the DC and AC electrical specifications for the IEEE Std 1149.1™ (JTAG) interface.

14.1 JTAG DC Electrical Characteristics

This table provides the DC electrical characteristics for the IEEE 1149.1 (JTAG) interface.

Table 41. JTAG Interface DC Electrical Characteristics

Characteristic	Symbol	Condition	Min	Max	Unit
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}	—		±5	μA
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

14.2 JTAG AC Timing Specifications

This section describes the AC electrical specifications for the IEEE 1149.1 (JTAG) interface.

This table provides the JTAG AC timing specifications as defined in Figure 41 through Figure 44.

Table 42. JTAG AC Timing Specifications (Independent of SYS_CLK_IN) [1]

At recommended operating conditions (see Table 2).

Parameter	Symbol[2]	Min	Max	Unit	Note
JTAG external clock frequency of operation	f_{JTG}	0	33.3	MHz	—
JTAG external clock cycle time	t_{JTG}	30	—	ns	—
JTAG external clock pulse width measured at 1.4 V	t_{JTKHKL}	15	—	ns	—
JTAG external clock rise and fall times	t_{JTGR} & t_{JTGF}	0	2	ns	—
$\overline{\text{TRST}}$ assert time	t_{TRST}	25	—	ns	3
Input setup times: Boundary-scan data TMS, TDI	 t_{JTDVKH} t_{JTIVKH}	 4 4	 — —	ns	4
Input hold times: Boundary-scan data TMS, TDI	 t_{JTDXKH} t_{JTIXKH}	 10 10	 — —	ns	4
Valid times: Boundary-scan data TDO	 t_{JTKLDV} t_{JTKLOV}	 2 2	 11 11	ns	5

20.2 Mechanical Dimensions of the MPC8308 MAPBGA

This figure shows the mechanical dimensions and bottom surface nomenclature of the MAPBGA package.

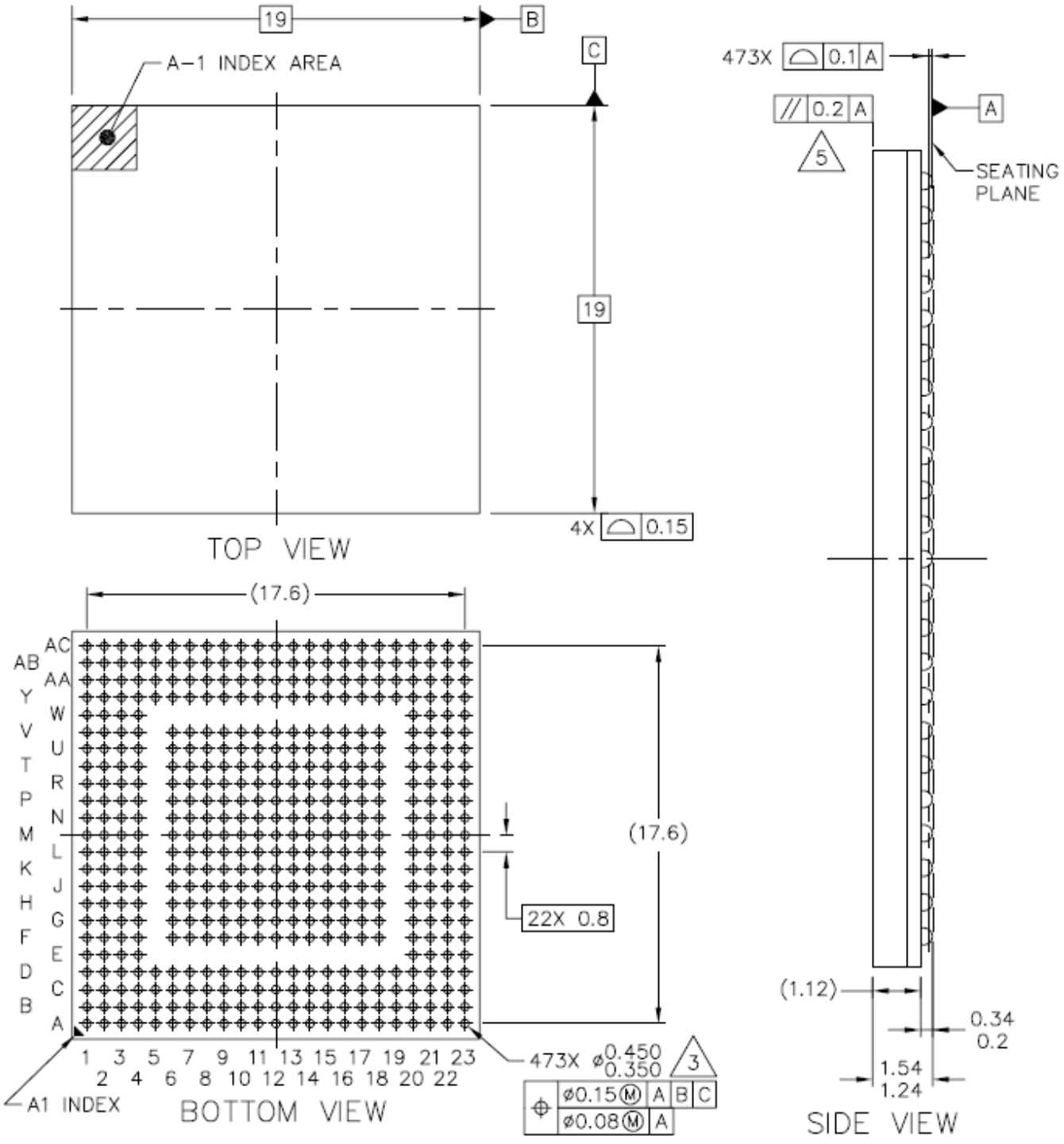


Figure 52. Mechanical Dimension and Bottom Surface Nomenclature of the MPC8308 MAPBG

Notes:
1. All dimensions are in millimeters.

Table 53. MPC8308 Pinout Listing (continued)

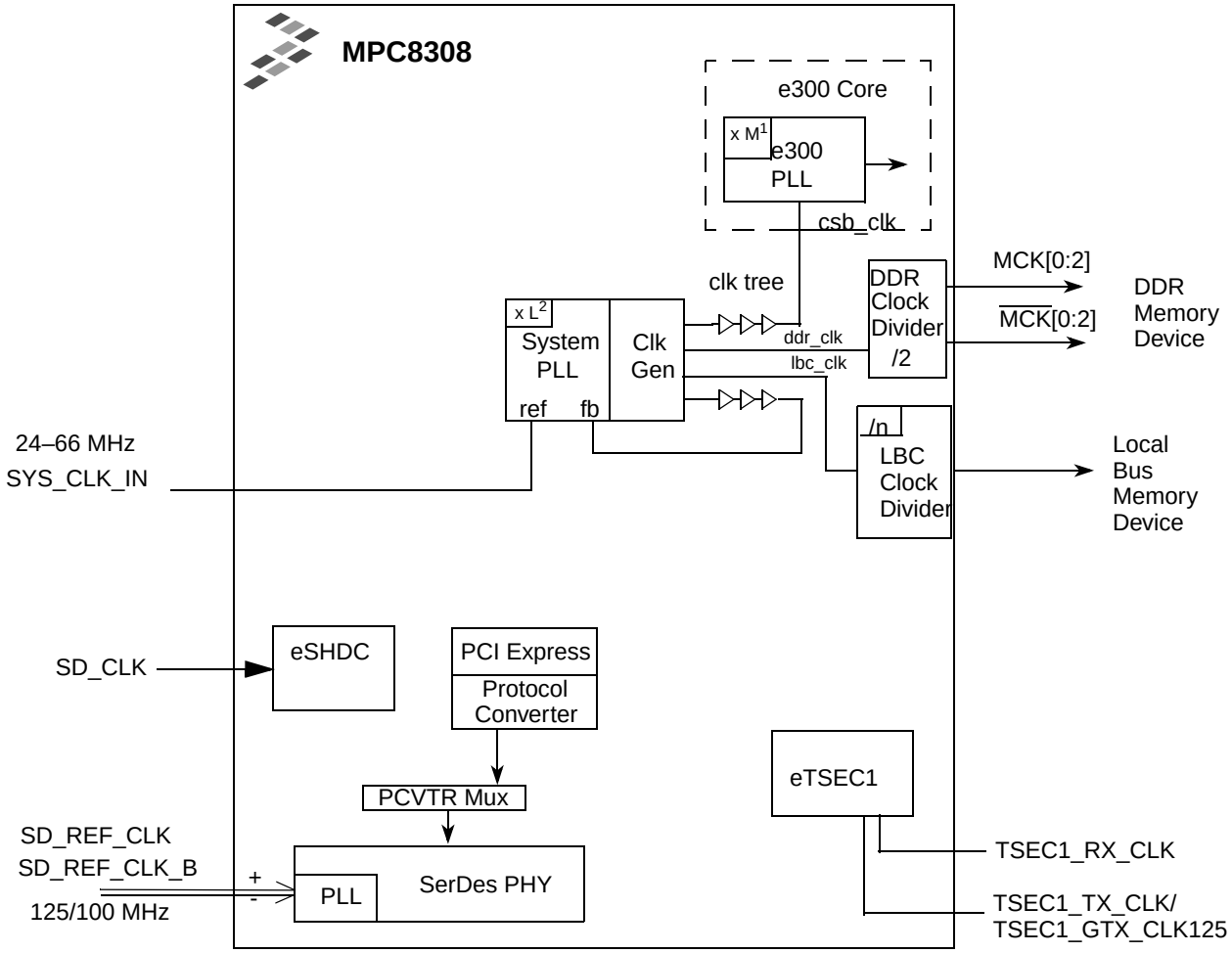
Signal	Package Pin Number	Pin Type	Power Supply	Note
SPICLK	AA5	I/O	NV_{DDP_K}	—
SPISEL	AB4	I	NV_{DDP_K}	—
GPIO/ETSEC2				
GPIO[0]/TSEC2_COL	G21	I/O	NV_{DDF}	—
GPIO[1]/TSEC2_TX_ER	K23	I/O	NV_{DDF}	—
GPIO[2]/TSEC2_GTX_CLK	H18	I/O	NV_{DDF}	—
GPIO[3]/TSEC2_RX_CLK	G23	I/O	NV_{DDF}	—
GPIO[4]/TSEC2_RX_DV	J18	I/O	NV_{DDF}	—
GPIO[5]/TSEC2_RXD3	J20	I/O	NV_{DDF}	—
GPIO[6]/TSEC2_RXD2	H22	I/O	NV_{DDF}	—
GPIO[7]/TSEC2_RXD1	H21	I/O	NV_{DDF}	—
GPIO[8]/TSEC2_RXD0	H20	I/O	NV_{DDF}	—
GPIO[9]/TSEC2_RX_ER	J21	I/O	NV_{DDF}	—
GPIO[10]/TSEC2_TX_CLK/ TSEC2_GTX_CLK125	J23	I/O	NV_{DDF}	—
GPIO[11]/TSEC2_TXD3	K22	I/O	NV_{DDF}	—
GPIO[12]/TSEC2_TXD2	K20	I/O	NV_{DDF}	—
GPIO[13]/TSEC2_TXD1	K18	I/O	NV_{DDF}	—
GPIO[14]/TSEC2_TXD0	J17	I/O	NV_{DDF}	—
GPIO[15]/TSEC2_TX_EN	K21	I/O	NV_{DDF}	—
USB/IEEE1588/GTM				
USBDR_PWR_FAULT	P20	I	NV_{DDH}	—
USBDR_CLK	R23	I	NV_{DDH}	—
USBDR_DIR	R21	I	NV_{DDH}	—
USBDR_NXT	P18	I	NV_{DDH}	—
USBDR_TXDRXD0	T22	I/O	NV_{DDH}	—
USBDR_TXDRXD1	T21	I/O	NV_{DDH}	—
USBDR_TXDRXD2	U23	I/O	NV_{DDH}	—
USBDR_TXDRXD3	U22	I/O	NV_{DDH}	—
USBDR_TXDRXD4	T20	I/O	NV_{DDH}	—
USBDR_TXDRXD5	R18	I/O	NV_{DDH}	—
USBDR_TXDRXD6	V23	I/O	NV_{DDH}	—
USBDR_TXDRXD7	V22	I/O	NV_{DDH}	—
USBDR_PCTL0	R17	O	NV_{DDH}	—

Table 53. MPC8308 Pinout Listing (continued)

Signal	Package Pin Number	Pin Type	Power Supply	Note
USBDR_PCTL1	U20	O	NV_{DDH}	—
USBDR_STP	V21	O	NV_{DDH}	—
TSEC_TMR_CLK/ GPIO[8]	W23	I	NV_{DDH}	—
GTM1_TOUT3/ GPIO[9]	T18	O	NV_{DDH}	—
GTM1_TOUT4/ GPIO[10]	V20	O	NV_{DDH}	—
TSEC_TMR_TRIG1/ GPIO[11]	W21	I	NV_{DDH}	—
TSEC_TMR_TRIG2/ GPIO[12]	Y21	I	NV_{DDH}	—
TSEC_TMR_GCLK	L17	O	NV_{DDG}	—
TSEC_TMR_PP1	L18	O	NV_{DDG}	—
TSEC_TMR_PP2	L21	O	NV_{DDG}	—
TSEC_TMR_PP3/ GPIO[13]	L22	O	NV_{DDG}	—
TSEC_TMR_ALARM1	L23	O	NV_{DDG}	—
TSEC_TMR_ALARM2/ GPIO[14]	M23	O	NV_{DDG}	—
GPIO[7]	M22	IO	—	—
TSEC2_CRS/ GPIO[0]	M21	IO	NV_{DDG}	—
TSEC2_TMR_RX_ESFD/ GPIO[1]	M18	O	NV_{DDG}	—
TSEC2_TMR_TX_ESFD/ GPIO[2]	M20	O	NV_{DDG}	—
TSEC1_TMR_RX_ESFD/ GPIO[3]	N23	O	NV_{DDG}	—
TSEC1_TMR_TX_ESFD/ GPIO[4]	N21	O	NV_{DDG}	—
GTM1_TGATE3	N20	I	NV_{DDG}	—
GTM1_TIN4	N18	I	NV_{DDG}	—
GTM1_TGATE4/ GPIO[15]	P23	I	NV_{DDG}	—
GTM1_TIN3	P22	I	NV_{DDG}	—
GPIO[5]	N17	IO	NV_{DDH}	—
GPIO[6]	P21	IO	NV_{DDH}	—
Power and Ground Supplies				
AV_{DD1}	R6	I	—	—
AV_{DD2}	V10	I	—	—
NC, No Connection	B11, B16, D16	—	—	—

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.

This table provides the operating frequencies for the device under recommended operating conditions (Table 2).

Table 55. Operating Frequencies for MPC8308

Characteristic[1]	Maximum Operating Frequency	Unit
e300 core frequency (*core_clk*)	400	MHz
Coherent system bus frequency (*csb_clk*)	133	MHz
DDR2 memory bus frequency (MCK)[2]	133	MHz
Local bus frequency (LCLK*0*)[3]	66	MHz

Notes:
1. The SYS_CLK_IN frequency, RCWL[SPMF], and RCWL[COREPLL] settings must be chosen such that the resulting *csb_clk*, MCK, LCLK0, and *core_clk* frequencies do not exceed their respective maximum or minimum operating frequencies.
2. The DDR data rate is 2x the DDR memory bus frequency.
3. The local bus frequency is 1/2, 1/4, or 1/8 of the *lbc_clk* frequency (depending on LCCR[CLKDIV]) which is in turn, 1x or 2x the *csb_clk* frequency (depending on RCWL[LBCM]).

21.2 System PLL Configuration

The system PLL is controlled by the RCWL[SPMF] parameter. This table shows the multiplication factor encodings for the system PLL.

Table 56. System PLL Ratio

RCWL[SPMF]	csb_clk: SYS_CLK_IN
0000	Reserved
0001	Reserved
0010	2 : 1
0011	3 : 1
0100	4 : 1
0101	5 : 1
0110–1111	Reserved

As described in Section 21, “Clocking,” the LBCM, DDRCM, and SPMF parameters in the reset configuration word low select the ratio between the primary clock input (SYS_CLK_IN) and the internal coherent system bus clock (*csb_clk*). This table shows the expected frequency values for the CSB frequency for select *csb_clk* to SYS_CLK_IN ratios.

Table 57. CSB Frequency Options

SPMF *csb_clk* :Input Clock Ratio		Input Clock Frequency (MHz)		
		25	33.33	66.67
0010	2:1			133
0100	4:1		133	
0101	5:1	125	167	

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.