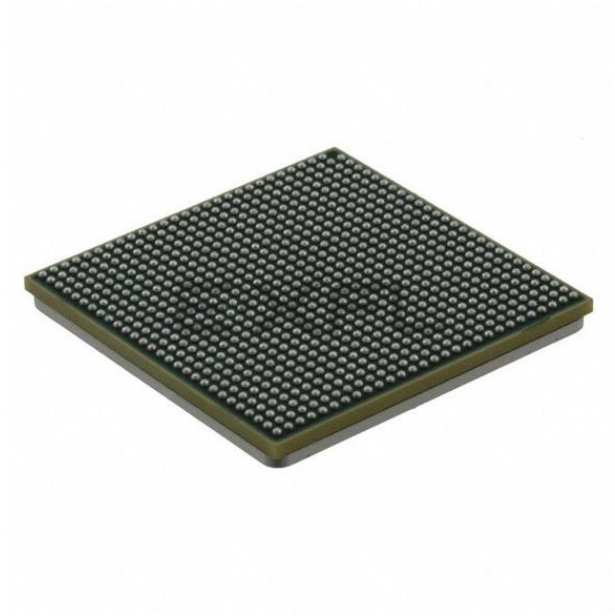

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Understanding Embedded - Microprocessors

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 e500
Number of Cores/Bus Width	1 Core, 32-Bit
Speed	1.333GHz
Co-Processors/DSP	Signal Processing; SPE
RAM Controllers	DDR, DDR2, SDRAM
Graphics Acceleration	No
Display & Interface Controllers	-
Ethernet	10/100/1000Mbps (4)
SATA	-
USB	-
Voltage - I/O	1.8V, 2.5V, 3.3V
Operating Temperature	0°C ~ 105°C (TA)
Security Features	-
Package / Case	783-BBGA, FCBGA
Supplier Device Package	783-FCPBGA (29x29)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/mpc8548pxaujd

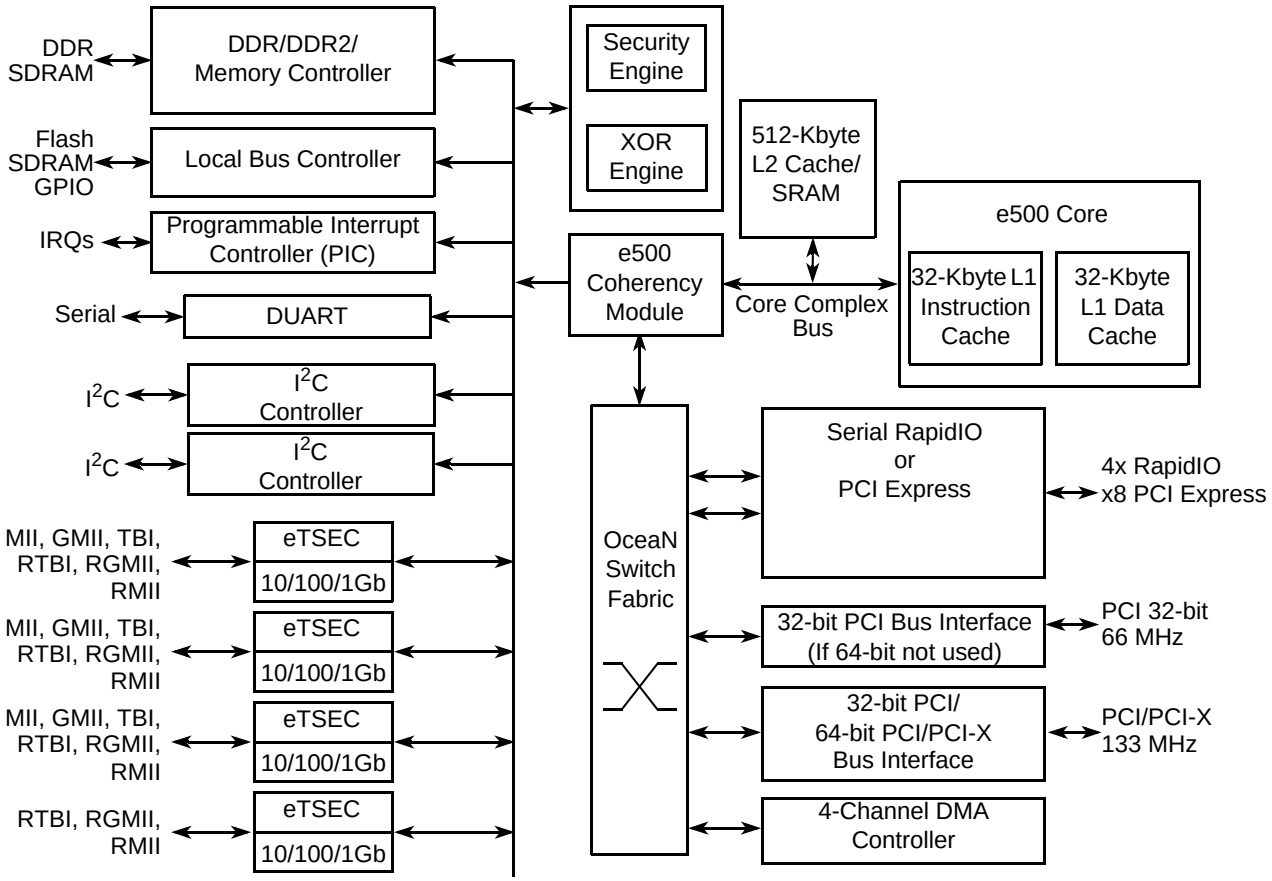


Figure 1. Device Block Diagram

1.1 Key Features

The following list provides an overview of the device feature set:

- High-performance 32-bit core built on Power Architecture® technology.
  - 32-Kbyte L1 instruction cache and 32-Kbyte L1 data cache with parity protection. Caches can be locked entirely or on a per-line basis, with separate locking for instructions and data.
  - Signal-processing engine (SPE) APU (auxiliary processing unit). Provides an extensive instruction set for vector (64-bit) integer and fractional operations. These instructions use both the upper and lower words of the 64-bit GPRs as they are defined by the SPE APU.
  - Double-precision floating-point APU. Provides an instruction set for double-precision (64-bit) floating-point instructions that use the 64-bit GPRs.
  - 36-bit real addressing
  - Embedded vector and scalar single-precision floating-point APUs. Provide an instruction set for single-precision (32-bit) floating-point instructions.
  - Memory management unit (MMU). Especially designed for embedded applications. Supports 4-Kbyte to 4-Gbyte page sizes.
  - Enhanced hardware and software debug support

  - Up to 32 simultaneous open pages for DDR2
- Contiguous or discontiguous memory mapping
- Read-modify-write support for RapidIO atomic increment, decrement, set, and clear transactions
- Sleep mode support for self-refresh SDRAM
- On-die termination support when using DDR2
- Supports auto refreshing
- On-the-fly power management using CKE signal
- Registered DIMM support
- Fast memory access via JTAG port
- 2.5-V SSTL_2 compatible I/O (1.8-V SSTL_1.8 for DDR2)
- Support for battery-backed main memory

- Programmable interrupt controller (PIC)
  - Programming model is compliant with the OpenPIC architecture.
  - Supports 16 programmable interrupt and processor task priority levels
  - Supports 12 discrete external interrupts
  - Supports 4 message interrupts with 32-bit messages
  - Supports connection of an external interrupt controller such as the 8259 programmable interrupt controller
  - Four global high-resolution timers/counters that can generate interrupts
  - Supports a variety of other internal interrupt sources
  - Supports fully nested interrupt delivery
  - Interrupts can be routed to external pin for external processing.
  - Interrupts can be routed to the e500 core's standard or critical interrupt inputs.
  - Interrupt summary registers allow fast identification of interrupt source.
- Integrated security engine (SEC) optimized to process all the algorithms associated with IPSec, IKE, WTLS/WAP, SSL/TLS, and 3GPP
  - Four crypto-channels, each supporting multi-command descriptor chains
    - Dynamic assignment of crypto-execution units via an integrated controller
    - Buffer size of 256 bytes for each execution unit, with flow control for large data sizes
  - PKEU—public key execution unit
    - RSA and Diffie-Hellman; programmable field size up to 2048 bits
    - Elliptic curve cryptography with F_2m and F(p) modes and programmable field size up to 511 bits
  - DEU—Data Encryption Standard execution unit
    - DES, 3DES
    - Two key (K1, K2) or three key (K1, K2, K3)
    - ECB and CBC modes for both DES and 3DES

2 Electrical Characteristics

This section provides the AC and DC electrical specifications and thermal characteristics for the device. This device is currently targeted to these specifications. Some of these specifications are independent of the I/O cell, but are included for a more complete reference. These are not purely I/O buffer design specifications.

2.1 Overall DC Electrical Characteristics

This section covers the ratings, conditions, and other characteristics.

2.1.1 Absolute Maximum Ratings

The following table provides the absolute maximum ratings.

Table 1. Absolute Maximum Ratings [1]

Characteristic		Symbol	Max Value	Unit	Notes
Core supply voltage		V_{DD}	–0.3 to 1.21	V	—
PLL supply voltage		AV_{DD}	–0.3 to 1.21	V	—
Core power supply for SerDes transceivers		SV_{DD}	–0.3 to 1.21	V	—
Pad power supply for SerDes transceivers		XV_{DD}	–0.3 to 1.21	V	—
DDR and DDR2 DRAM I/O voltage		GV_{DD}	–0.3 to 2.75 –0.3 to 1.98	V	2
Three-speed Ethernet I/O voltage		LV_{DD} (for eTSEC1 and eTSEC2) TV_{DD} (for eTSEC3 and eTSEC4)	–0.3 to 3.63 –0.3 to 2.75 –0.3 to 3.63 –0.3 to 2.75	V	3
PCI/PCI-X, DUART, system control and power management, I^2C, Ethernet MII management, and JTAG I/O voltage		OV_{DD}	–0.3 to 3.63	V	—
Local bus I/O voltage		BV_{DD}	–0.3 to 3.63 –0.3 to 2.75	V	—
Input voltage	DDR/DDR2 DRAM signals	MV_{IN}	–0.3 to (GV_{DD} + 0.3)	V	4
	DDR/DDR2 DRAM reference	MV_{REF}	–0.3 to (GV_{DD}/2 + 0.3)	V	—
	Three-speed Ethernet I/O signals	LV_{IN} TV_{IN}	–0.3 to (LV_{DD} + 0.3) –0.3 to (TV_{DD} + 0.3)	V	4
	Local bus signals	BV_{IN}	–0.3 to (BV_{DD} + 0.3)	—	—
	DUART, SYSCLK, system control and power management, I^2C, Ethernet MII management, and JTAG signals	OV_{IN}	–0.3 to (OV_{DD} + 0.3)	V	4
	PCI/PCI-X	OV_{IN}	–0.3 to (OV_{DD} + 0.3)	V	4

Figure 4 shows the DDR SDRAM output timing diagram.+

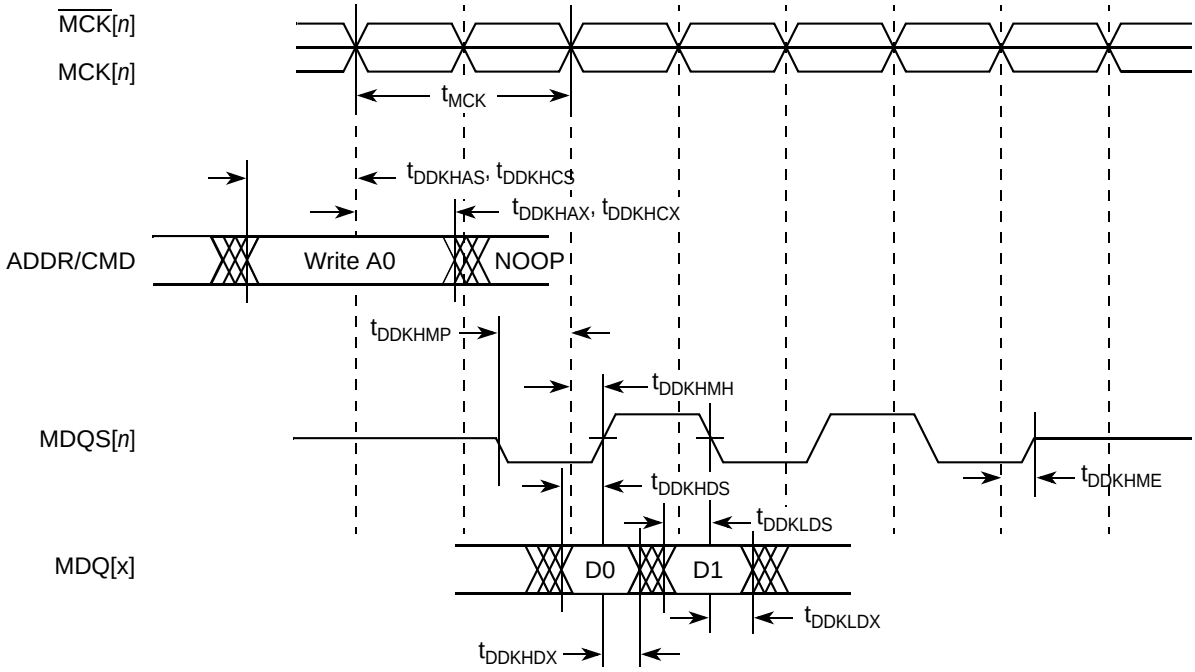


Figure 4. DDR SDRAM Output Timing Diagram

Figure 5 provides the AC test load for the DDR bus.

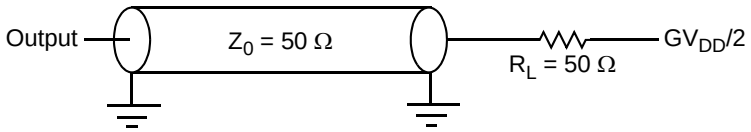


Figure 5. DDR AC Test Load

Figure 8 shows the GMII transmit AC timing diagram.

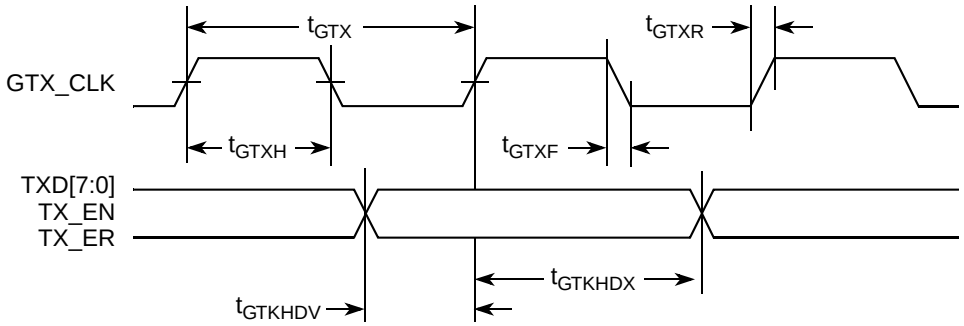


Figure 8. GMII Transmit AC Timing Diagram

8.2.2.2 GMII Receive AC Timing Specifications

This table provides the GMII receive AC timing specifications.

Table 27. GMII Receive AC Timing Specifications

Parameter/Condition	Symbol[1]	Min	Typ	Max	Unit
RX_CLK clock period	t_{GRX}	—	8.0	—	ns
RX_CLK duty cycle	t_{GRXH}/t_{GRX}	35	—	75	ns
RXD[7:0], RX_DV, RX_ER setup time to RX_CLK	t_{GRDVKH}	2.0	—	—	ns
RXD[7:0], RX_DV, RX_ER hold time to RX_CLK	t_{GRDXKH}	0	—	—	ns
RX_CLK clock rise (20%-80%)	t_{GRXR}[2]	—	—	1.0	ns
RX_CLK clock fall time (80%-20%)	t_{GRXF}[2]	—	—	1.0	ns

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_{GRDVKH} symbolizes GMII receive timing (GR) with respect to the time data input signals (D) reaching the valid state (V) relative to the t_{RX} clock reference (K) going to the high state (H) or setup time. Also, t_{GRDXKL} symbolizes GMII receive timing (GR) with respect to the time data input signals (D) went invalid (X) relative to the t_{GRX} 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_{GRX} represents the GMII (G) receive (RX) clock. For rise and fall times, the latter convention is used with the appropriate letter: R (rise) or F (fall).
2. Guaranteed by design.

Figure 9 provides the AC test load for eTSEC.

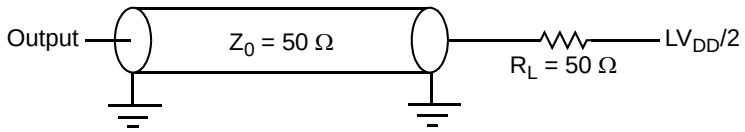


Figure 9. eTSEC AC Test Load

Figure 17 shows the RGMII and RTBI AC timing and multiplexing diagrams.

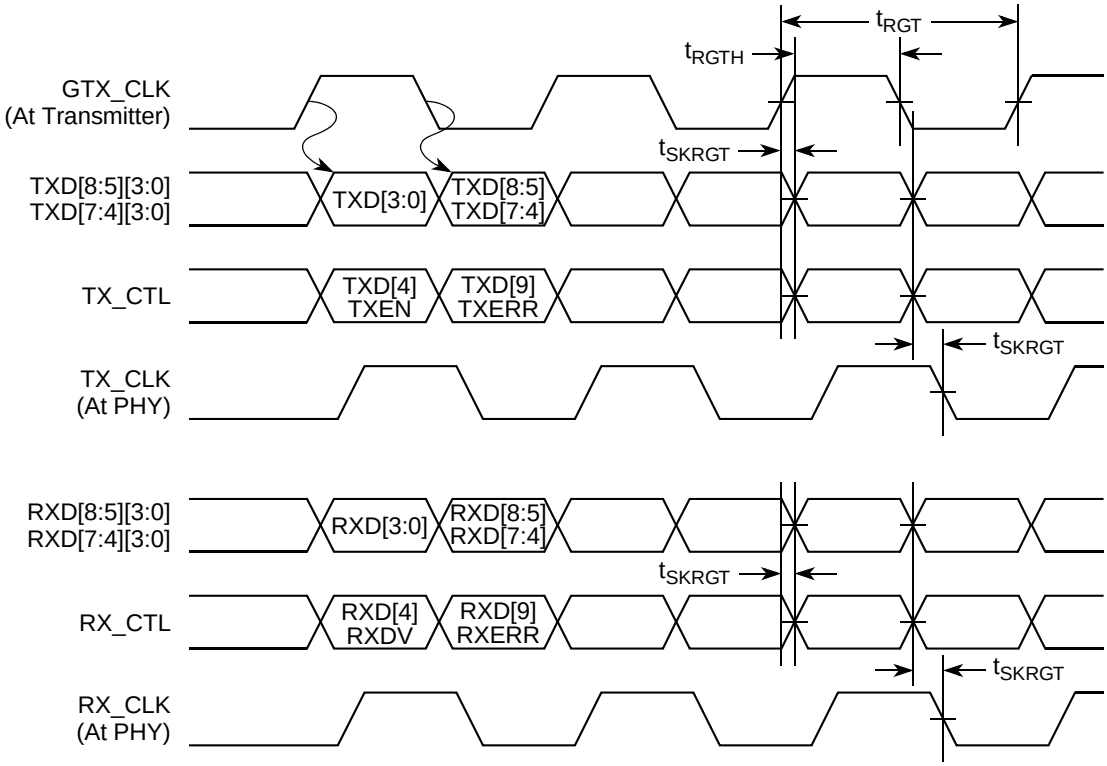


Figure 17. RGMII and RTBI AC Timing and Multiplexing Diagrams

8.2.7 RMII AC Timing Specifications

This section describes the RMII transmit and receive AC timing specifications.

8.2.7.1 RMII Transmit AC Timing Specifications

The RMII transmit AC timing specifications are in this table.

Table 34. RMII Transmit AC Timing Specifications

Parameter/Condition	Symbol[1]	Min	Typ	Max	Unit
TSEC*n*_TX_CLK clock period	t_{RMT}	15.0	20.0	25.0	ns
TSEC*n*_TX_CLK duty cycle	t_{RMTH}	35	50	65	%
TSEC*n*_TX_CLK peak-to-peak jitter	t_{RMTJ}	—	—	250	ps
Rise time TSEC*n*_TX_CLK (20%–80%)	t_{RMTR}	1.0	—	2.0	ns
Fall time TSEC*n*_TX_CLK (80%–20%)	t_{RMTF}	1.0	—	2.0	ns

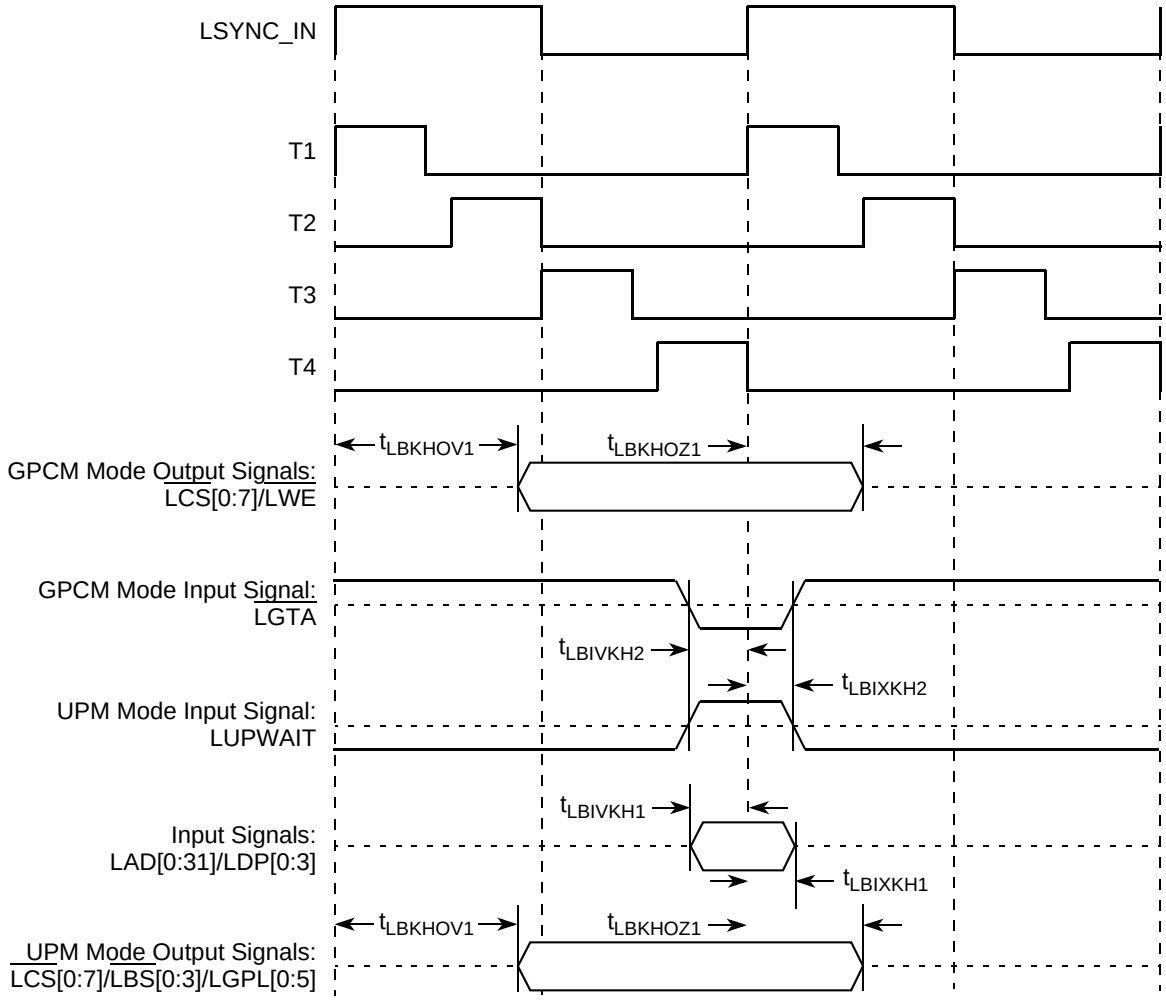


Figure 27. Local Bus Signals, GPCM/UPM Signals for LCCR[CLKDIV] = 8 or 16 (PLL Enabled)

16 High-Speed Serial Interfaces (HSSI)

The device features one Serializer/Deserializer (SerDes) interface to be used for high-speed serial interconnect applications. The SerDes interface can be used for PCI Express and/or serial RapidIO data transfers.

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.

16.1 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 38 shows how the signals are defined. For illustration purpose, only one SerDes lane is used for the description. The figure shows a waveform for either a transmitter output (SD_TX and $\overline{\text{SD\_TX}}$) or a receiver input (SD_RX and $\overline{\text{SD\_RX}}$). Each signal swings between A volts and B volts where A > B.

Using this waveform, the definitions are as follows. To simplify the 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 SD_TX, $\overline{\text{SD\_TX}}$, SD_RX and $\overline{\text{SD\_RX}}$ 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: $V_{SD\_TX} - V_{\overline{SD\_TX}}$. 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: $V_{SD\_RX} - V_{\overline{SD\_RX}}$. 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, $V_{DIFFp-p}$
  Because 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, $V_{DIFFp-p} = 2 \times V_{DIFFp} = 2 \times |(A - B)|$ volts, which is twice of differential swing in amplitude, or twice of the differential peak. For example, the output differential peak-to-peak voltage can also be calculated as $V_{TX-DIFFp-p} = 2 \times |V_{OD}|$.
- Common mode voltage, V_{cm}
  The common mode voltage is equal to one half of the sum of the voltages between each conductor

of a balanced interchange circuit and ground. In this example, for SerDes output, V_{cm_out} = V_{SD_TX} + $V_{\overline{SD\_TX}}$ = (A + B)/2, which is the arithmetic mean of the two complimentary output voltages within a differential pair. In a system, the common mode voltage may often differ from one component's output to the other's input. Sometimes, it may be even different between the receiver input and driver output circuits within the same component. It is also referred to as the DC offset.

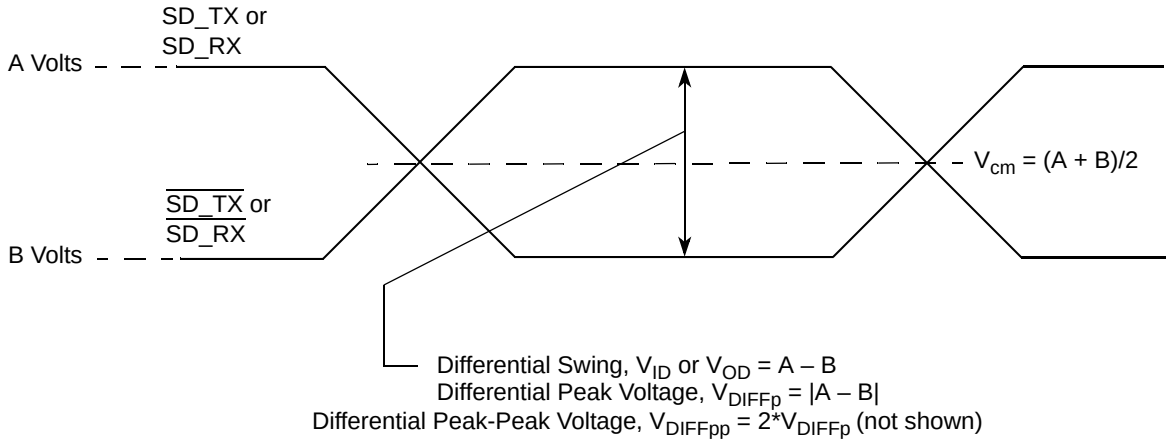


Figure 38. Differential Voltage Definitions for Transmitter or Receiver

To illustrate these definitions using real values, consider the case of a CML (current mode logic) transmitter that has a common mode voltage of 2.25 V and each of its outputs, TD and $\overline{TD}$, has a swing that goes between 2.5 and 2.0 V. Using these values, the peak-to-peak voltage swing of each signal (TD or $\overline{TD}$) is 500 mVp-p, which is referred as the single-ended swing for each signal. In this example, since the differential signaling environment is fully symmetrical, the transmitter output's differential swing (V_{OD}) has the same amplitude as each signal's single-ended swing. The differential output signal ranges between 500 and –500 mV, in other words, V_{OD} is 500 mV in one phase and –500 mV in the other phase. The peak differential voltage (V_{DIFFp}) is 500 mV. The peak-to-peak differential voltage ($V_{DIFFp-p}$) is 1000 mVp-p.

16.2 SerDes Reference Clocks

The SerDes reference clock inputs are applied to an internal PLL whose output creates the clock used by the corresponding SerDes lanes. The SerDes reference clocks inputs are SD_REF_CLK and $\overline{SD\_REF\_CLK}$ for PCI Express and serial RapidIO.

The following sections describe the SerDes reference clock requirements and some application information.

16.2.1 SerDes Reference Clock Receiver Characteristics

Figure 39 shows a receiver reference diagram of the SerDes reference clocks.

- The supply voltage requirements for XV_{DD_SRDS2} are specified in Table 1 and Table 2.
- SerDes Reference clock receiver reference circuit structure:

— The input amplitude of the differential clock must be between 400 and 1600 mV differential peak-peak (or between 200 and 800 mV differential peak). In other words, each signal wire of the differential pair must have a single-ended swing less than 800 mV and greater than 200 mV. This requirement is the same for both external DC- or AC-coupled connection.

— For external DC-coupled connection, as described in Section 16.2.1, "SerDes Reference Clock Receiver Characteristics," the maximum average current requirements sets the requirement for average voltage (common mode voltage) to be between 100 and 400 mV. Figure 40 shows the SerDes reference clock input requirement for DC-coupled connection scheme.

— For external AC-coupled connection, there is no common mode voltage requirement for the clock driver. Since the external AC-coupling capacitor blocks the DC level, the clock driver and the SerDes reference clock receiver operate in different command mode voltages. The SerDes reference clock receiver in this connection scheme has its common mode voltage set to SGND_SRDS*n*. Each signal wire of the differential inputs is allowed to swing below and above the command mode voltage (SGND_SRDS*n*). Figure 41 shows the SerDes reference clock input requirement for AC-coupled connection scheme.

- Single-ended mode
  — The reference clock can also be single-ended. The SD_REF_CLK input amplitude (single-ended swing) must be between 400 and 800 mV peak-to-peak (from V_{min} to V_{max}) with $\overline{\text{SD\_REF\_CLK}}$ either left unconnected or tied to ground.
  — The SD_REF_CLK input average voltage must be between 200 and 400 mV. Figure 42 shows the SerDes reference clock input requirement for single-ended signaling mode.
  — To meet the input amplitude requirement, the reference clock inputs might need to be DC- or AC-coupled externally. For the best noise performance, the reference of the clock could be DC- or AC-coupled into the unused phase ($\overline{\text{SD\_REF\_CLK}}$) through the same source impedance as the clock input (SD_REF_CLK) in use.

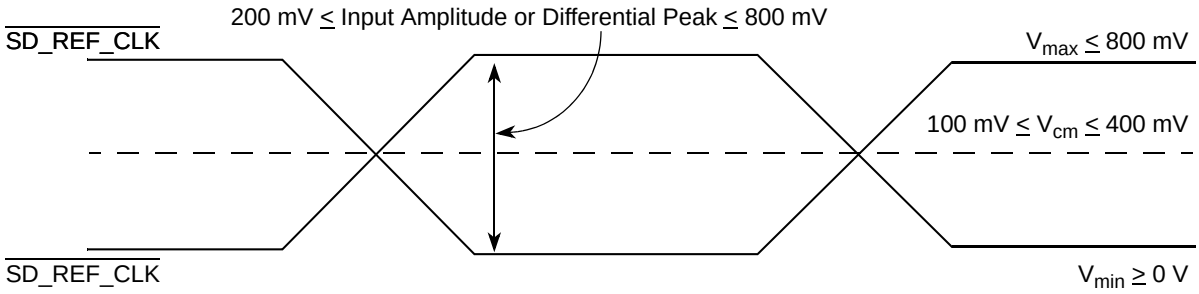


Figure 40. Differential Reference Clock Input DC Requirements (External DC-Coupled)

to AC-coupling. Its value could be ranged from 140 to 240 Ω depending on the 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 SerDes reference clock's differential input amplitude requirement (between 200 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. Consult a clock driver chip manufacturer to verify whether this connection scheme is compatible with a particular clock driver chip.

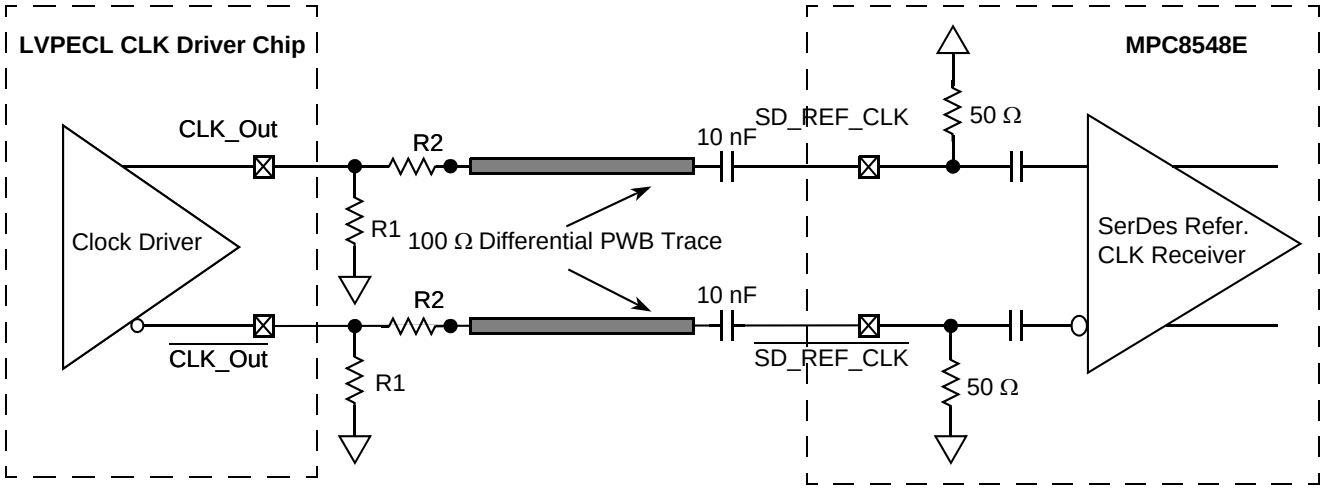


Figure 45. AC-Coupled Differential Connection with LVPECL Clock Driver (Reference Only)

Figure 46 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 SerDes reference clock input's DC requirement.

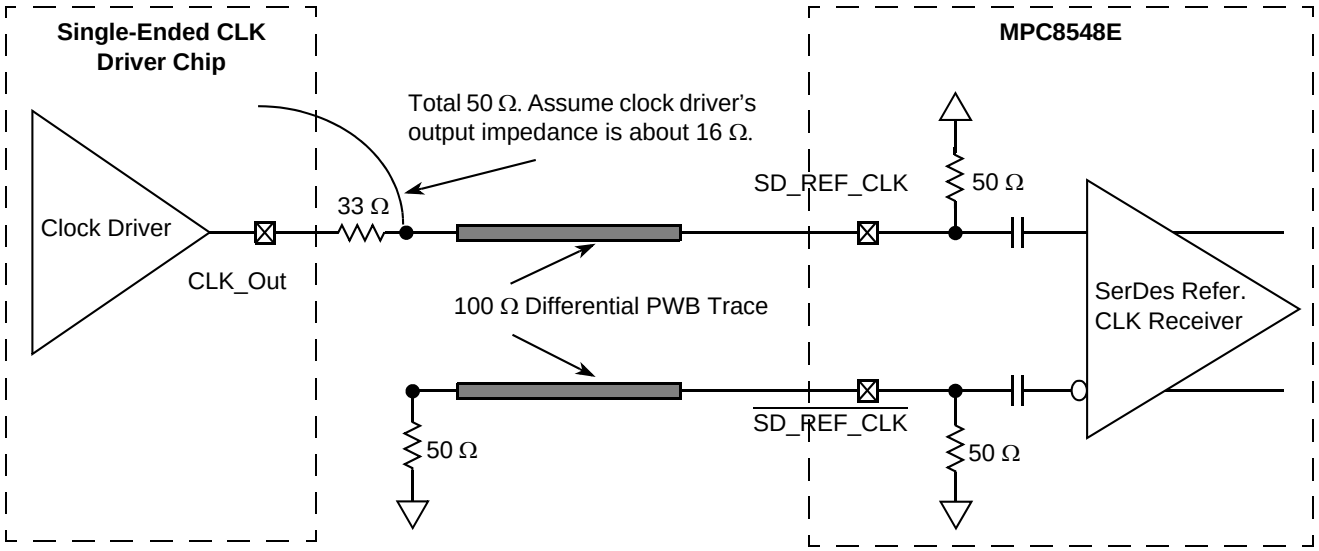


Figure 46. Single-Ended Connection (Reference Only)

Table 56. Differential Transmitter (TX) Output Specifications

Symbol	Parameter	Min	Nom	Max	Unit	Comments
UI	Unit interval	399.88	400	400.12	ps	Each UI is 400 ps ± 300 ppm. UI does not account for spread spectrum clock dictated variations. See Note 1.
$V_{TX-DIFFp-p}$	Differential peak-to-peak output voltage	0.8	—	1.2	V	$V_{TX-DIFFp-p} = 2 \times \lvert V_{TX-D+} - V_{TX-D-}\rvert$. See Note 2.
$V_{TX-DE-RATIO}$	De- emphasized differential output voltage (ratio)	–3.0	–3.5	–4.0	dB	Ratio of the $V_{TX-DIFFp-p}$ of the second and following bits after a transition divided by the $V_{TX-DIFFp-p}$ of the first bit after a transition. See Note 2.
T_{TX-EYE}	Minimum TX eye width	0.70	—	—	UI	The maximum transmitter jitter can be derived as $T_{TX-MAX-JITTER} = 1 - T_{TX-EYE} = 0.3$ UI. See Notes 2 and 3.
$T_{TX-EYE-MEDIAN-to-MAX-JITTER}$	Maximum time between the jitter median and maximum deviation from the median.	—	—	0.15	UI	Jitter is defined as the measurement variation of the crossing points ($V_{TX-DIFFp-p} = 0$ V) in relation to a recovered TX UI. A recovered TX UI is calculated over 3500 consecutive unit intervals of sample data. Jitter is measured using all edges of the 250 consecutive UI in the center of the 3500 UI used for calculating the TX UI. See Notes 2 and 3.
$T_{TX-RISE}$, $T_{TX-FALL}$	D+/D– TX output rise/fall time	0.125	—	—	UI	See Notes 2 and 5.
$V_{TX-CM-ACp}$	RMS AC peak common mode output voltage	—	—	20	mV	$V_{TX-CM-ACp} = RMS(\lvert V_{TXD+} + V_{TXD-}\rvert/2 - V_{TX-CM-DC})$ $V_{TX-CM-DC} = DC_{(avg)}$ of $\lvert V_{TX-D+} + V_{TX-D-}\rvert/2$. See Note 2.
$V_{TX-CM-DC-ACTIVE-IDLE-DELTA}$	Absolute delta of dc common mode voltage during L0 and electrical idle	0	—	100	mV	$\lvert V_{TX-CM-DC\ (during\ L0)} + V_{TX-CM-Idle-DC\ (during\ electrical\ idle)}\rvert \le 100$ mV $V_{TX-CM-DC} = DC_{(avg)}$ of $\lvert V_{TX-D+} + V_{TX-D-}\rvert/2$ [L0] $V_{TX-CM-Idle-DC} = DC_{(avg)}$ of $\lvert V_{TX-D+} + V_{TX-D-}\rvert/2$ [electrical idle] See Note 2.
$V_{TX-CM-DC-LINE-DELTA}$	Absolute delta of DC common mode between D+ and D–	0	—	25	mV	$\lvert V_{TX-CM-DC-D+} - V_{TX-CM-DC-D-}\rvert \le 25$ mV $V_{TX-CM-DC-D+} = DC_{(avg)}$ of $\lvert V_{TX-D+}\rvert$ $V_{TX-CM-DC-D-} = DC_{(avg)}$ of $\lvert V_{TX-D-}\rvert$. See Note 2.
$V_{TX-IDLE-DIFFp}$	Electrical idle differential peak output voltage	0	—	20	mV	$V_{TX-IDLE-DIFFp} = \lvert V_{TX-IDLE-D+} - V_{TX-IDLE-D-}\rvert \le 20$ mV. See Note 2.
$V_{TX-RCV-DETECT}$	The amount of voltage change allowed during receiver detection	—	—	600	mV	The total amount of voltage change that a transmitter can apply to sense whether a low impedance receiver is present. See Note 6.

18.8 Receiver Eye Diagrams

For each baud rate at which an LP-serial receiver is specified to operate, the receiver shall meet the corresponding bit error rate specification (Table 66, Table 67, and Table 68) when the eye pattern of the receiver test signal (exclusive of sinusoidal jitter) falls entirely within the unshaded portion of the receiver input compliance mask shown in Figure 54 with the parameters specified in Table 69. The eye pattern of the receiver test signal is measured at the input pins of the receiving device with the device replaced with a 100-Ω ± 5% differential resistive load.

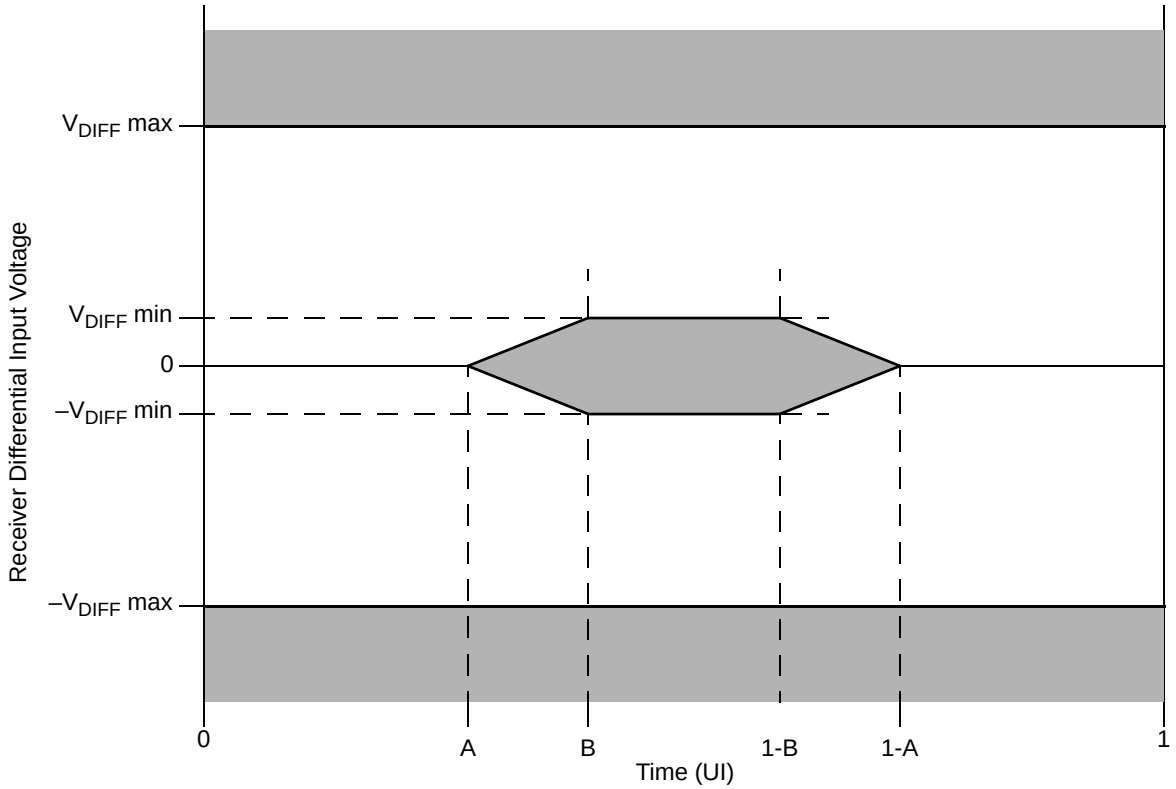


Figure 54. Receiver Input Compliance Mask

Table 69. Receiver Input Compliance Mask Parameters Exclusive of Sinusoidal Jitter

Receiver Type	V_{DIFF}min (mV)	V_{DIFF}max (mV)	A (UI)	B (UI)
1.25 GBaud	100	800	0.275	0.400
2.5 GBaud	100	800	0.275	0.400
3.125 GBaud	100	800	0.275	0.400

18.9 Measurement and Test Requirements

Since the LP-serial electrical specification are guided by the XAUI electrical interface specified in Clause 47 of IEEE Std. 802.3ae-2002, the measurement and test requirements defined here are similarly guided by Clause 47. Additionally, the CJPAT test pattern defined in Annex 48A of IEEE Std.

Table 71. MPC8548E Pinout Listing (continued)

Signal	Package Pin Number	Pin Type	Power Supply	Notes

25.These are test signals for factory use only and must be pulled up (100 Ω–1 kΩ) to OV_{DD} for normal machine operation.

26.Independent supplies derived from board V_{DD}.

27.Recommend a pull-up resistor (~1 kΩ) be placed on this pin to OV_{DD}.

29. The following pins must NOT be pulled down during power-on reset: TSEC3_TXD[3], TSEC4_TXD3/TSEC3_TXD7, HRESET_REQ, TRIG_OUT/READY/QUIESCE, MSRCID[2:4], ASLEEP.

30.This pin requires an external 4.7-kΩ pull-down resistor to prevent PHY from seeing a valid transmit enable before it is actively driven.

31.This pin is only an output in eTSEC3 FIFO mode when used as Rx flow control.

32.These pins must be connected to XV_{DD}.

33.TSEC2_TXD1, TSEC2_TX_ER are multiplexed as cfg_dram_type[0:1]. They must be valid at power-up, even before HRESET assertion.

34.These pins must be pulled to ground through a 300-Ω (±10%) resistor.

35.When a PCI block is disabled, either the POR config pin that selects between internal and external arbiter must be pulled down to select external arbiter if there is any other PCI device connected on the PCI bus, or leave the PCI*n*_AD pins as 'no connect' or terminated through 2–10 kΩ pull-up resistors with the default of internal arbiter if the PCI*n*_AD pins are not connected to any other PCI device. The PCI block drives the PCI*n*_AD pins if it is configured to be the PCI arbiter—through POR config pins—irrespective of whether it is disabled via the DEVDISR register or not. It may cause contention if there is any other PCI device connected on the bus.

36.MDIC0 is grounded through an 18.2-Ω precision 1% resistor and MDIC1 is connected to GV_{DD} through an 18.2-Ω precision 1% resistor. These pins are used for automatic calibration of the DDR IOs.

38.These pins must be left floating.

39. If PCI1 or PCI2 is configured as PCI asynchronous mode, a valid clock must be provided on pin PCI1_CLK or PCI2_CLK. Otherwise the processor will not boot up.

40.These pins must be connected to GND.

101.This pin requires an external 4.7-kΩ resistor to GND.

102.For Rev. 2.x silicon, DMA_DACK[0:1] must be 0b11 during POR configuration; for rev. 1.x silicon, the pin values during POR configuration are don't care.

103.If these pins are not used as GPIN*n* (general-purpose input), they must be pulled low (to GND) or high (to LV_{DD}) through 2–10 kΩ resistors.

104.These must be pulled low to GND through 2–10 kΩ resistors if they are not used.

105.These must be pulled low or high to LV_{DD} through 2–10 kΩ resistors if they are not used.

106.For rev. 2.x silicon, DMA_DACK[0:1] must be 0b10 during POR configuration; for rev. 1.x silicon, the pin values during POR configuration are don't care.

107.For rev. 2.x silicon, DMA_DACK[0:1] must be 0b01 during POR configuration; for rev. 1.x silicon, the pin values during POR configuration are don't care.

108.For rev. 2.x silicon, DMA_DACK[0:1] must be 0b11 during POR configuration; for rev. 1.x silicon, the pin values during POR configuration are don't care.

109.This is a test signal for factory use only and must be pulled down (100 Ω – 1 kΩ) to GND for normal machine operation.

110.These pins must be pulled high to OV_{DD} through 2–10 kΩ resistors.

111.If these pins are not used as GPIN*n* (general-purpose input), they must be pulled low (to GND) or high (to OV_{DD}) through 2–10 kΩ resistors.

112.This pin must not be pulled down during POR configuration.

113.These should be pulled low or high to OV_{DD} through 2–10 kΩ resistors.

Table 72. MPC8547E Pinout Listing (continued)

Signal	Package Pin Number	Pin Type	Power Supply	Notes
Local Bus Controller Interface				
LAD[0:31]	E27, B20, H19, F25, A20, C19, E28, J23, A25, K22, B28, D27, D19, J22, K20, D28, D25, B25, E22, F22, F21, C25, C22, B23, F20, A23, A22, E19, A21, D21, F19, B21	I/O	BV_{DD}	—
LDP[0:3]	K21, C28, B26, B22	I/O	BV_{DD}	—
LA[27]	H21	O	BV_{DD}	5, 9
LA[28:31]	H20, A27, D26, A28	O	BV_{DD}	5, 7, 9
$\overline{\text{LCS}}$[0:4]	J25, C20, J24, G26, A26	O	BV_{DD}	—
$\overline{\text{LCS5}}$/$\overline{\text{DMA\_DREQ2}}$	D23	I/O	BV_{DD}	1
$\overline{\text{LCS6}}$/$\overline{\text{DMA\_DACK2}}$	G20	O	BV_{DD}	1
$\overline{\text{LCS7}}$/$\overline{\text{DMA\_DDONE2}}$	E21	O	BV_{DD}	1
$\overline{\text{LWE0}}$/$\overline{\text{LBS0}}$/LSDDQM[0]	G25	O	BV_{DD}	5, 9
$\overline{\text{LWE1}}$/$\overline{\text{LBS1}}$/LSDDQM[1]	C23	O	BV_{DD}	5, 9
$\overline{\text{LWE2}}$/$\overline{\text{LBS2}}$/LSDDQM[2]	J21	O	BV_{DD}	5, 9
$\overline{\text{LWE3}}$/$\overline{\text{LBS3}}$/LSDDQM[3]	A24	O	BV_{DD}	5, 9
LALE	H24	O	BV_{DD}	5, 8, 9
LBCTL	G27	O	BV_{DD}	5, 8, 9
LGPL0/LSDA10	F23	O	BV_{DD}	5, 9
LGPL1/$\overline{\text{LSDWE}}$	G22	O	BV_{DD}	5, 9
LGPL2/$\overline{\text{LOE}}$/$\overline{\text{LSDRAS}}$	B27	O	BV_{DD}	5, 8, 9
LGPL3/$\overline{\text{LSDCAS}}$	F24	O	BV_{DD}	5, 9
LGPL4/$\overline{\text{LGTA}}$/LUPWAIT/LPBSE	H23	I/O	BV_{DD}	—
LGPL5	E26	O	BV_{DD}	5, 9
LCKE	E24	O	BV_{DD}	—
LCLK[0:2]	E23, D24, H22	O	BV_{DD}	—
LSYNC_IN	F27	I	BV_{DD}	—
LSYNC_OUT	F28	O	BV_{DD}	—
DMA				
$\overline{\text{DMA\_DACK}}$[0:1]	AD3, AE1	O	OV_{DD}	5, 9, 107
$\overline{\text{DMA\_DREQ}}$[0:1]	AD4, AE2	I	OV_{DD}	—
$\overline{\text{DMA\_DDONE}}$[0:1]	AD2, AD1	O	OV_{DD}	—
Programmable Interrupt Controller				
$\overline{\text{UDE}}$	AH16	I	OV_{DD}	—
$\overline{\text{MCP}}$	AG19	I	OV_{DD}	—

Table 74. MPC8543E Pinout Listing (continued)

Signal	Package Pin Number	Pin Type	Power Supply	Notes
LSYNC_IN	F27	I	BV_{DD}	—
LSYNC_OUT	F28	O	BV_{DD}	—
DMA				
$\overline{\text{DMA\_DACK}}$[0:1]	AD3, AE1	O	OV_{DD}	5, 9, 108
$\overline{\text{DMA\_DREQ}}$[0:1]	AD4, AE2	I	OV_{DD}	—
$\overline{\text{DMA\_DDONE}}$[0:1]	AD2, AD1	O	OV_{DD}	—
Programmable Interrupt Controller				
$\overline{\text{UDE}}$	AH16	I	OV_{DD}	—
$\overline{\text{MCP}}$	AG19	I	OV_{DD}	—
IRQ[0:7]	AG23, AF18, AE18, AF20, AG18, AF17, AH24, AE20	I	OV_{DD}	—
IRQ[8]	AF19	I	OV_{DD}	—
IRQ[9]/$\overline{\text{DMA\_DREQ3}}$	AF21	I	OV_{DD}	1
IRQ[10]/$\overline{\text{DMA\_DACK3}}$	AE19	I/O	OV_{DD}	1
IRQ[11]/$\overline{\text{DMA\_DDONE3}}$	AD20	I/O	OV_{DD}	1
$\overline{\text{IRQ\_OUT}}$	AD18	O	OV_{DD}	2, 4
Ethernet Management Interface				
EC_MDC	AB9	O	OV_{DD}	5, 9
EC_MDIO	AC8	I/O	OV_{DD}	—
Gigabit Reference Clock				
EC_GTX_CLK125	V11	I	LV_{DD}	—
Three-Speed Ethernet Controller (Gigabit Ethernet 1)				
TSEC1_RXD[7:0]	R5, U1, R3, U2, V3, V1, T3, T2	I	LV_{DD}	—
TSEC1_TXD[7:0]	T10, V7, U10, U5, U4, V6, T5, T8	O	LV_{DD}	5, 9
TSEC1_COL	R4	I	LV_{DD}	—
TSEC1_CRS	V5	I/O	LV_{DD}	20
TSEC1_GTX_CLK	U7	O	LV_{DD}	—
TSEC1_RX_CLK	U3	I	LV_{DD}	—
TSEC1_RX_DV	V2	I	LV_{DD}	—
TSEC1_RX_ER	T1	I	LV_{DD}	—
TSEC1_TX_CLK	T6	I	LV_{DD}	—
TSEC1_TX_EN	U9	O	LV_{DD}	30
TSEC1_TX_ER	T7	O	LV_{DD}	—
GPIN[0:7]	P2, R2, N1, N2, P3, M2, M1, N3	I	LV_{DD}	103

Table 74. MPC8543E Pinout Listing (continued)

Signal	Package Pin Number	Pin Type	Power Supply	Notes
GPOUT[0:5]	N9, N10, P8, N7, R9, N5	O	LV_{DD}	—
cfg_dram_type0/GPOUT6	R8	O	LV_{DD}	5, 9
GPOUT7	N6	O	LV_{DD}	—
Reserved	P1	—	—	104
Reserved	R6	—	—	104
Reserved	P6	—	—	15
Reserved	N4	—	—	105
FIFO1_RXC2	P5	I	LV_{DD}	104
Reserved	R1	—	—	104
Reserved	P10	—	—	105
FIFO1_TXC2	P7	O	LV_{DD}	15
cfg_dram_type1	R10	O	LV_{DD}	5, 9
Three-Speed Ethernet Controller (Gigabit Ethernet 3)				
TSEC3_TXD[3:0]	V8, W10, Y10, W7	O	TV_{DD}	5, 9, 29
TSEC3_RXD[3:0]	Y1, W3, W5, W4	I	TV_{DD}	—
TSEC3_GTX_CLK	W8	O	TV_{DD}	—
TSEC3_RX_CLK	W2	I	TV_{DD}	—
TSEC3_RX_DV	W1	I	TV_{DD}	—
TSEC3_RX_ER	Y2	I	TV_{DD}	—
TSEC3_TX_CLK	V10	I	TV_{DD}	—
TSEC3_TX_EN	V9	O	TV_{DD}	30
TSEC3_TXD[7:4]	AB8, Y7, AA7, Y8	O	TV_{DD}	5, 9, 29
TSEC3_RXD[7:4]	AA1, Y3, AA2, AA4	I	TV_{DD}	—
Reserved	AA5	—	—	15
TSEC3_COL	Y5	I	TV_{DD}	—
TSEC3_CRS	AA3	I/O	TV_{DD}	31
TSEC3_TX_ER	AB6	O	TV_{DD}	—
DUART				
$\overline{\text{UART\_CTS}}$[0:1]	AB3, AC5	I	OV_{DD}	—
$\overline{\text{UART\_RTS}}$[0:1]	AC6, AD7	O	OV_{DD}	—
UART_SIN[0:1]	AB5, AC7	I	OV_{DD}	—
UART_SOUT[0:1]	AB7, AD8	O	OV_{DD}	—
I^2C interface				
IIC1_SCL	AG22	I/O	OV_{DD}	4, 27

21 Thermal

This section describes the thermal specifications of the device.

21.1 Thermal for Version 2.0 Silicon HiCTE FC-CBGA with Full Lid

This section describes the thermal specifications for the HiCTE FC-CBGA package for revision 2.0 silicon.

This table shows the package thermal characteristics.

Table 84. Package Thermal Characteristics for HiCTE FC-CBGA

Characteristic	JEDEC Board	Symbol	Value	Unit	Notes
Die junction-to-ambient (natural convection)	Single-layer board (1s)	$R_{\theta JA}$	17	°C/W	1, 2
Die junction-to-ambient (natural convection)	Four-layer board (2s2p)	$R_{\theta JA}$	12	°C/W	1, 2
Die junction-to-ambient (200 ft/min)	Single-layer board (1s)	$R_{\theta JA}$	11	°C/W	1, 2
Die junction-to-ambient (200 ft/min)	Four-layer board (2s2p)	$R_{\theta JA}$	8	°C/W	1, 2
Die junction-to-board	N/A	$R_{\theta JB}$	3	°C/W	3
Die junction-to-case	N/A	$R_{\theta JC}$	0.8	°C/W	4

Notes:

1. Junction temperature is a function of die size, on-chip power dissipation, package thermal resistance, mounting site (board) temperature, ambient temperature, airflow, power dissipation of other components on the board, and board thermal resistance.
2. Per JEDEC JESD51-6 with the board (JESD51-7) horizontal.
3. 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.
4. Thermal resistance between the die and the case top surface as measured by the cold plate method (MIL SPEC-883 Method 1012.1). The cold plate temperature is used for the case temperature, measured value includes the thermal resistance of the interface layer.

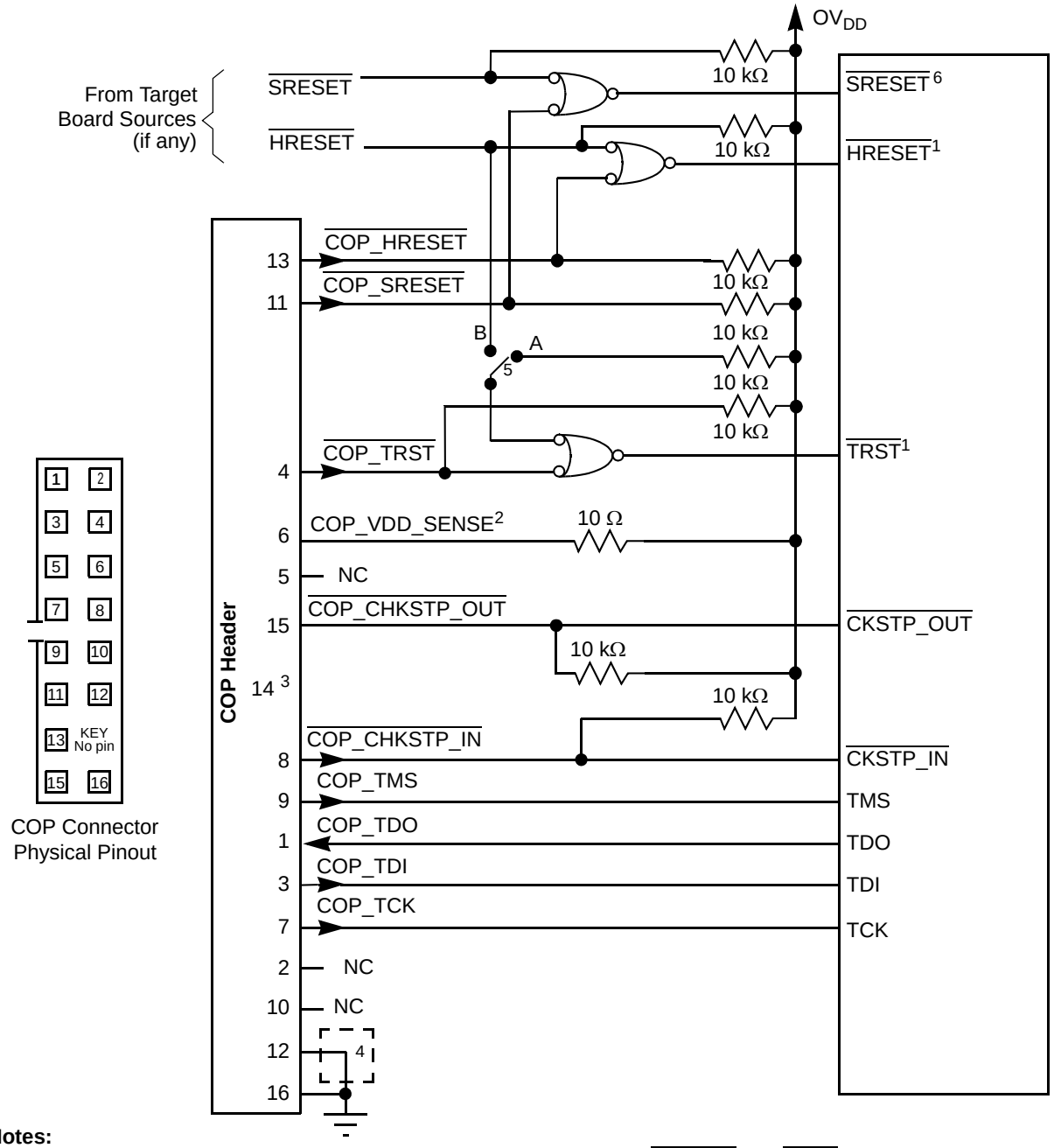
21.2 Thermal for Version 2.1.1, 2.1.2, and 2.1.3 Silicon FC-PBGA with Full Lid and Version 3.1.x Silicon with Stamped Lid

This section describes the thermal specifications for the FC-PBGA package for revision 2.1.1, 2.1.2, and 3.0 silicon.

This table shows the package thermal characteristics.

Table 85. Package Thermal Characteristics for FC-PBGA

Characteristic	JEDEC Board	Symbol	Value	Unit	Notes
Die junction-to-ambient (natural convection)	Single-layer board (1s)	$R_{\theta JA}$	18	°C/W	1, 2
Die junction-to-ambient (natural convection)	Four-layer board (2s2p)	$R_{\theta JA}$	13	°C/W	1, 2
Die junction-to-ambient (200 ft/min)	Single-layer board (1s)	$R_{\theta JA}$	13	°C/W	1, 2
Die junction-to-ambient (200 ft/min)	Four-layer board (2s2p)	$R_{\theta JA}$	9	°C/W	1, 2



Notes:

1. The COP port and target board must be able to independently assert $\overline{\text{HRESET}}$ and $\overline{\text{TRST}}$ to the processor in order to fully control the processor as shown here.
2. Populate this with a 10–Ω resistor for short-circuit/current-limiting protection.
3. The KEY location (pin 14) is not physically present on the COP header.
4. Although pin 12 is defined as a No-Connect, some debug tools may use pin 12 as an additional GND pin for improved signal integrity.
5. This switch is included as a precaution for BSDL testing. The switch must be closed to position A during BSDL testing to avoid accidentally asserting the $\overline{\text{TRST}}$ line. If BSDL testing is not being performed, this switch must be closed to position B.
6. Asserting $\overline{\text{SRESET}}$ causes a machine check interrupt to the e500 core.

Figure 63. JTAG Interface Connection

Table 88. Document Revision History (continued)

Rev. Number	Date	Substantive Change(s)
4	04/2009	• In Table 1, "Absolute Maximum Ratings [1]," and in Table 2, "Recommended Operating Conditions," moved text, "MII management voltage" from LV_{DD}/TV_{DD} to OV_{DD}, added "Ethernet management" to OVDD row of input voltage section. • In Table 5, "SYSCLK AC Timing Specifications," added notes 7 and 8 to SYSCLK frequency and cycle time. • In Table 36, "MII Management DC Electrical Characteristics," changed all instances of LV_{DD}/OV_{DD} to OV_{DD}. • Modified Section 16, "High-Speed Serial Interfaces (HSSI)," to reflect that there is only one SerDes. • Modified DDR clk rate min from 133 to 166 MHz. • Modified note in Table 75, "Processor Core Clocking Specifications (MPC8548E and MPC8547E), "." • In Table 56, "Differential Transmitter (TX) Output Specifications," modified equations in Comments column, and changed all instances of "LO" to "L0." Also added note 8. • In Table 57, "Differential Receiver (RX) Input Specifications," modified equations in Comments column, and in note 3, changed "TRX-EYE-MEDIAN-to-MAX-JITTER," to "$T_{RX\text{-}EYE\text{-}MEDIAN\text{-}to\text{-}MAX\text{-}JITTER}$." • Modified Table 83, "Frequency Options of SYSCLK with Respect to Memory Bus Speeds." • Added a note on Section 4.1, "System Clock Timing," to limit the SYSCLK to 100 MHz if the core frequency is less than 1200 MHz • In Table 71, "MPC8548E Pinout ListingTable 72, "MPC8547E Pinout ListingTable 73, "MPC8545E Pinout ListingTable 74, "MPC8543E Pinout Listing," added note 5 to LA[28:31]. • Added note to Table 83, "Frequency Options of SYSCLK with Respect to Memory Bus Speeds."
3	01/2009	• [Section 4.6, "Platform Frequency Requirements for PCI-Express and Serial RapidIO." Changed minimum frequency equation to be 527 MHz for PCI x8. • In Table 5, added note 7. • Section 4.5, "Platform to FIFO Restrictions." Changed platform clock frequency to 4.2. • Section 8.1, "Enhanced Three-Speed Ethernet Controller (eTSEC) (10/100/1Gb Mbps)—GMII/MII/TBI/RGMII/RTBI/RMII Electrical Characteristics." Added MII after GMII and add 'or 2.5 V' after 3.3 V. • In Table 23, modified table title to include GMII, MII, RMII, and TBI. • In Table 24 and Table 25, changed clock period minimum to 5.3. • In Table 25, added a note. • In Table 26, Table 27, Table 28, Table 29, and Table 30, removed subtitle from table title. • In Table 30 and Figure 15, changed all instances of PMA to TSEC*n*. • In Section 8.2.5, "TBI Single-Clock Mode AC Specifications." Replaced first paragraph. • In Table 34, Table 35, Figure 18, and Figure 20, changed all instances of REF_CLK to TSEC*n*_TX_CLK. • In Table 36, changed all instances of OV_{DD} to LV_{DD}/TV_{DD}. • In Table 37, "MII Management AC Timing Specifications," changed MDC minimum clock pulse width high from 32 to 48 ns. • Added new section, Section 16, "High-Speed Serial Interfaces (HSSI)." • Section 16.1, "DC Requirements for PCI Express SD_REF_CLK and SD_REF_CLK." Added new paragraph. • Section 17.1, "DC Requirements for Serial RapidIO SD_REF_CLK and SD_REF_CLK." Added new paragraph. • Added information to Figure 63, both in figure and in note. • Section 22.3, "Decoupling Recommendations." Modified the recommendation. • Table 87, "Part Numbering Nomenclature." In Silicon Version column added Ver. 2.1.2.