



FEATURES

GENERAL FEATURES

- Six independent 3/1.5Gbps SATA ports.
- Connects 2 host ports to 4 device ports.
- Supports 3/1.5Gbps rate detection/speed negotiation.
- Supports power down modes - Active, partial, slumber and power down.
- Advanced features configurable through MDIO bus.

PORT MULTIPLIER/SELECTOR LOGIC FEATURES

- Low latency architecture.
- Supports OOB signaling for SATA applications. Internal OOB detectors for COMRESET/COMINIT and COMWAKE.

I/O FEATURES

- High speed outputs with programmable pre-emphasis to drive long interconnects.
- Selectable high speed input equalization for optimum reception.
- Compliant with SATA Gen-2i & Gen-2m specification.
- Enables reliable data transmission over 1 meter or more of FR-4 and 4 meters or more of unequalized copper cable.
- Selectable spread spectrum clocking (SSC) to reduce EMI.

PHYSICAL FEATURES

- CMOS 0.13 Micron Technology
- Single 1.2 V Power Supply
- -40°C to 85°C Industrial Temperature Range
- No heatsink or airflow required
- 100-Pin LQFP Package

1.0 INTRODUCTION

The XRS10L240 provides the combined advantages of the Serial ATA II Port Selector and Port Multiplier implementations for Serial ATA II systems at 3.0 Gbps and 1.5 Gbps. Combining the capability to address four Serial ATA devices from one external link with support for a failover path from two

independent hosts, the XRS10L240 offers a leading solution for propagation of high data rate Serial ATA products in a wide variety of applications. The integration of Serial ATA PHY links, a variety of digital logic capabilities, rate adjust FIFOs, integrated low-cost clock oscillator support, test and loopback features is achieved in a low cost and lower power implementation.

The port selector function is used when dual hosts, such as I/O controllers, must access single-port disk drives in high availability storage subsystems where redundancy and load sharing are important. The outputs from the I/O controllers are multiplexed to a Serial ATA drive through the port selector block of the XRS10L240. Active/passive port selector in XRS10L240 allows two different host ports to connect to the same target in order to create a redundant path to that target. In combination with RAID, the XRS10L240 allows system providers to build fully redundant solutions. This avoids the presence of a single point of failure, and enables a fail-over path in the case of host failure.

This port multiplier function is used when one active host has to communicate with multiple SATA drives. The XRS10L240 supports up to 4 SATA drives and utilizes the full bandwidth of the host connection.

The XRS10L240 includes enhanced features such as staggered HDD spin-up, power management control, hot plug capability and support for legacy software. The XRS10L240 acts as a retimer, maintaining independent signaling domains between the drives, hosts and the external interconnect.

The high-speed serial input feature: selectable equalization and the high-speed serial output feature: programmable pre-emphasis can be used to compensate for ISI (Inter-Symbol Interference) and increase maximum cabling distances.

XRS10L240 meets tight jitter budgets in SATA applications. Exar's serial I/O technology enables reliable data transmission over 1 meter or more of FR-4 and 4 meters or more of unequalized copper cable.

Host and drive port speeds can be mixed and matched, based upon inherent data rate negotiation present in the SATA II specifications.

The MDIO bus allows simple configuration of the XRS10L240 when needed. Receive equalization, transmit amplitude and pre-emphasis and SSC control are all configurable via the 2-wire MDIO interface.

To summarize, the port multiplier functionality in the XRS10L240 allows the system designer to increase the number of serial ATA connections in an enclosure that does not have a sufficient number of serial ATA connections for all of the drives in the enclosure. The port selector functionality in the XRS10L240 allows replacement for expensive Fibre Channel drives with cost effective and high capacity SATA drives in enterprise class applications without compromising on redundancy or performance.

STANDARDS COMPLIANCE

The XRS10L240 is compliant with the following industry specifications:

- Serial ATA, Revision 1.0a
- Serial ATA II: Extensions to Serial ATA 1.0a, Revision 1.2
- Serial ATA II PHY Electrical Specifications, Revision 1.0
- Serial ATA II: Port Selector, Revision 1.0
- Serial ATA II: Port Multiplier, Revision 1.2
- Serial ATA II: Revision 2.6

APPLICATIONS

- Serial ATA Enclosures
- Other Serial ATA link replicator applications
- Buffers for externally connected links
- High density storage boxes
- RAID Subsystems

APPLICATION EXAMPLE

The XRS10L240 is ideally suited for use within an external drive enclosure as a means of providing redundant host access to ensure system availability and reliability, while enabling access to up to four target devices per XRS10L240. This application is shown in **Figure 1**. Other applications for the XRS10L240 include use in fixed-content or network attached storage systems, storage arrays, desktop applications or entry-level servers, RAID storage or disk-to-disk backup.

FIGURE 1. SYSTEM BLOCK DIAGRAM FOR XRS10L240 IN A DRIVE ENCLOSURE APPLICATION

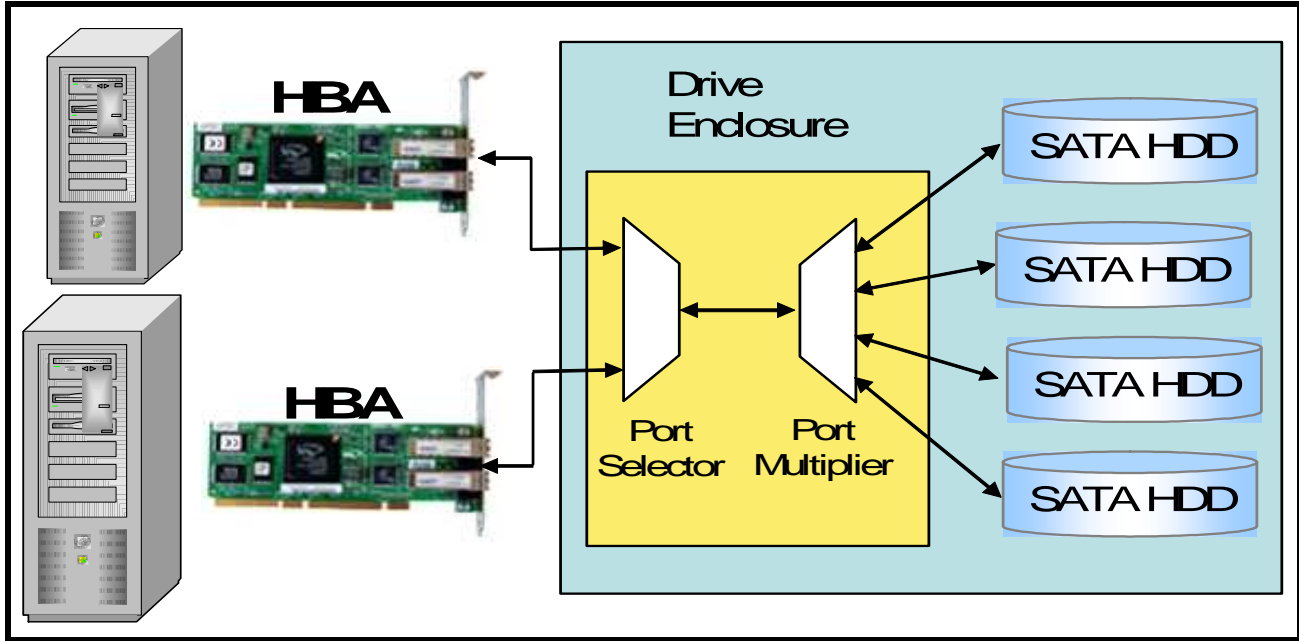
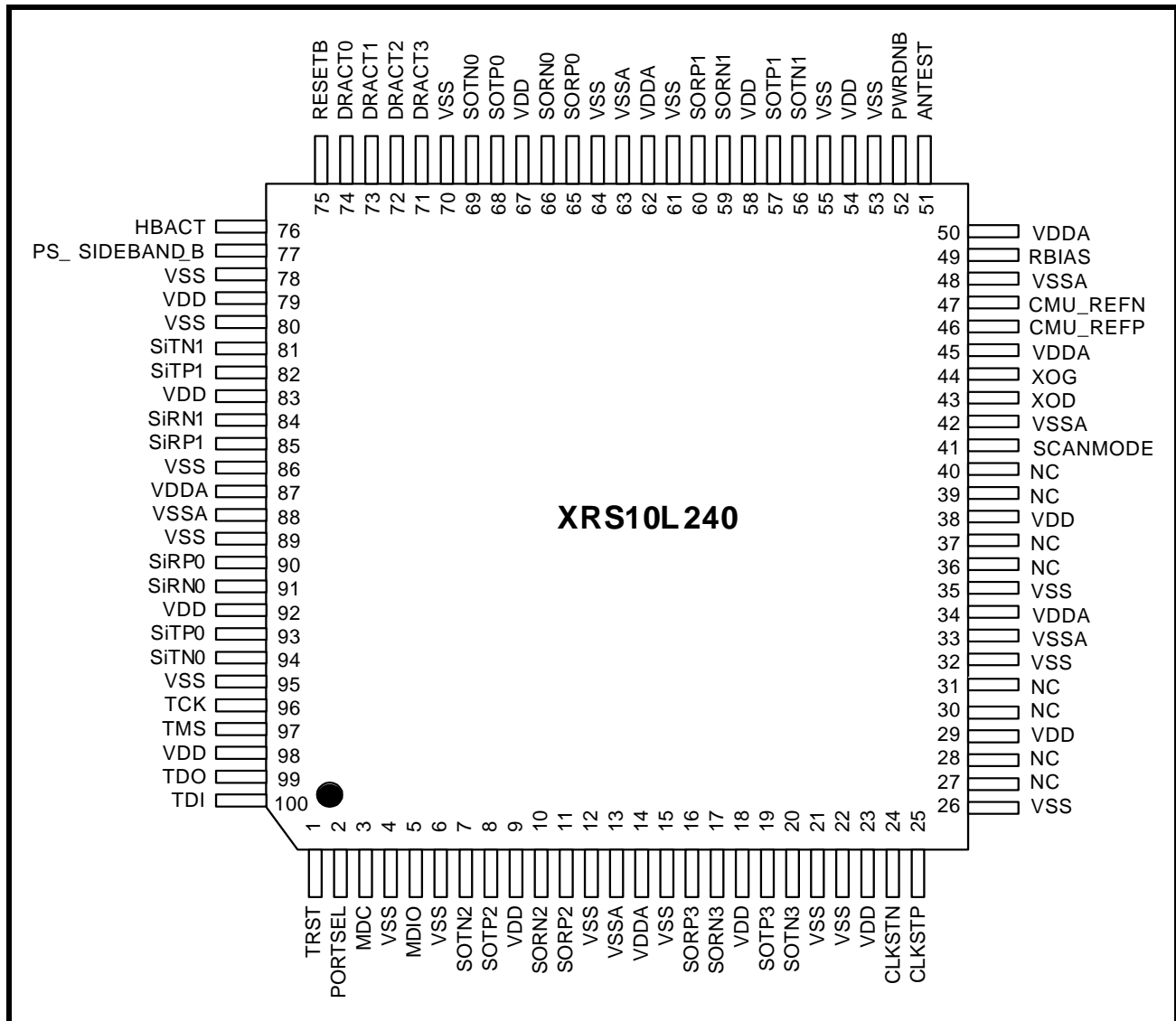


FIGURE 2. PINOUT OF THE XRS10L240





2.0 PIN DESCRIPTIONS

TABLE 1: XRS10L240 PIN DESCRIPTIONS

| Pin Name | Pin Number | I/O | | DESCRIPTION |
|---|------------|-----|----------------------|--|
| DATA INTERFACE | | | | |
| SOTP0/SOTN0 | 68, 69 | O | CML AC Coupled | Serial ATA Output Transmitters. These ports communicate from the XRS10L240 to downstream devices |
| SOTP1/SOTN1 | 57, 56 | | | |
| SOTP2/SOTN2 | 8, 7 | | | |
| SOTP3/SOTN3 | 19, 20 | | | |
| SORP0/SORN0 | 65, 66 | I | | Serial ATA Input Receivers. These ports receive signals from downstream devices |
| SORP1/SORN1 | 60, 59 | | | |
| SORP2/SORN2 | 11, 10 | | | |
| SORP3/SORN3 | 16, 17 | | | |
| SITP0/SITN0 | 93, 94 | O | | Serial ATA Output Transmitters. These ports communicate from the XRS10L240 to upstream hosts. |
| SITP1/SITN1 | 82, 81 | | | |
| SIRP0/SIRN0 | 90, 91 | I | | Serial ATA Input Receivers. These ports receive signals from upstream hosts. |
| SIRP1/SIRN1 | 85, 84 | | | |
| CLOCK INTERFACE | | | | |
| CMU_REFP/ CMU_REFN | 46, 47 | I | CML AC Coupled | Reference clock input |
| XOD | 43 | 0 | Analog | Crystal oscillator output |
| XOG | 44 | I | Analog | Crystal oscillator input, 1.26V max |
| MDIO INTERFACE SIGNALS | | | | |
| MDC | 3 | I | LVC MOS | MDIO clock input, +3.3V LVC MOS |
| MDIO | 5 | I/O | LVC MOS | MDIO data port, +3.3V LVC MOS. Open drain |
| JTAG Interface Signals | | | | |
| TCK | 96 | I | LVC MOS | JTAG test clock, +3.3V LVC MOS |
| TDI | 100 | I | | JTAG test data in, +3.3V LVC MOS |
| TDO | 99 | O | | JTAG test data out, +3.3V LVC MOS. Open drain. If used to daisy chain JTAG devices, pull up externally using 3.3KOhm resistor. |
| TMS | 97 | I | | JTAG mode select, +3.3V LVC MOS |
| TRST | 1 | I | | JTAG test reset, +3.3V LVC MOS. Pull low externally using 3.3KOhm resistor for normal operation of the device. |
| GENERAL CONTROL AND CONFIGURATION SIGNALS (CMOS) | | | | |
| RBIAS | 49 | I | Analog | Connection point for calibration termination resistor. |
| RESETB | 75 | I | LVC MOS | Active low reset pin, +3.3V LVC MOS. |

TABLE 1: XRS10L240 PIN DESCRIPTIONS

| Pin Name | Pin Number | I/O | | DESCRIPTION |
|---------------------------------|--|-----|----------------------|--|
| PWRDNB | 52 | I | LVC MOS | Active low power down signal for chip, +3.3V LVC MOS. |
| DRACT[3:0] | 71, 72, 73, 74 | O | LVC MOS | Drive activity port for external LED. Active Low, 3.3V LVC MOS, open drain |
| HBACT | 76 | O | LVC MOS | 0 = Host 0 selected (status) 1 = No Host is selected (status) 0-1-0-1 Toggle (with 1 sec stay at each state) indicates Host 1 is selected. 3.3V LVC MOS |
| PS_SIDE BAND_B | 77 | I | LVC MOS | +3.3V LVC MOS Please refer to Table 2, "Host Port Selection," on page 7 |
| PORTSEL | 2 | I | LVC MOS | Port selector external input pin when this mode is set in the register. Low selects host port 0, otherwise port 1. +3.3V LVC MOS |
| TEST PIN | | | | |
| ANTEST | 51 | O | Analog | Analog test pin |
| CLKSTN/ CLKSTP | 24, 25 | O | CML AC Coupled | Output clock test pin |
| RESERVED PINS | | | | |
| NC | 27, 28, 30, 31, 36, 37, 39, 40 | | | No Connect |
| SCANMODE | 41 | I | LVC MOS | For factory use only. connect to ground. |
| POWER AND GROUND SIGNALS | | | | |
| VDD | 9, 18, 23, 29, 38, 54, 58, 67, 79, 83, 92, 98 | I | | 1.2V supply. |
| VDDA | 14, 34, 45, 50, 62, 87 | I | | 1.2V Analog supply. |
| VSS | 4, 6, 12, 15, 21, 22, 26, 32, 35, 53, 55, 61, 64, 70, 78, 80, 86, 89, 95 | I | | Ground. |
| VSSA | 13, 33, 42, 48, 63, 88 | I | | Analog Ground. |



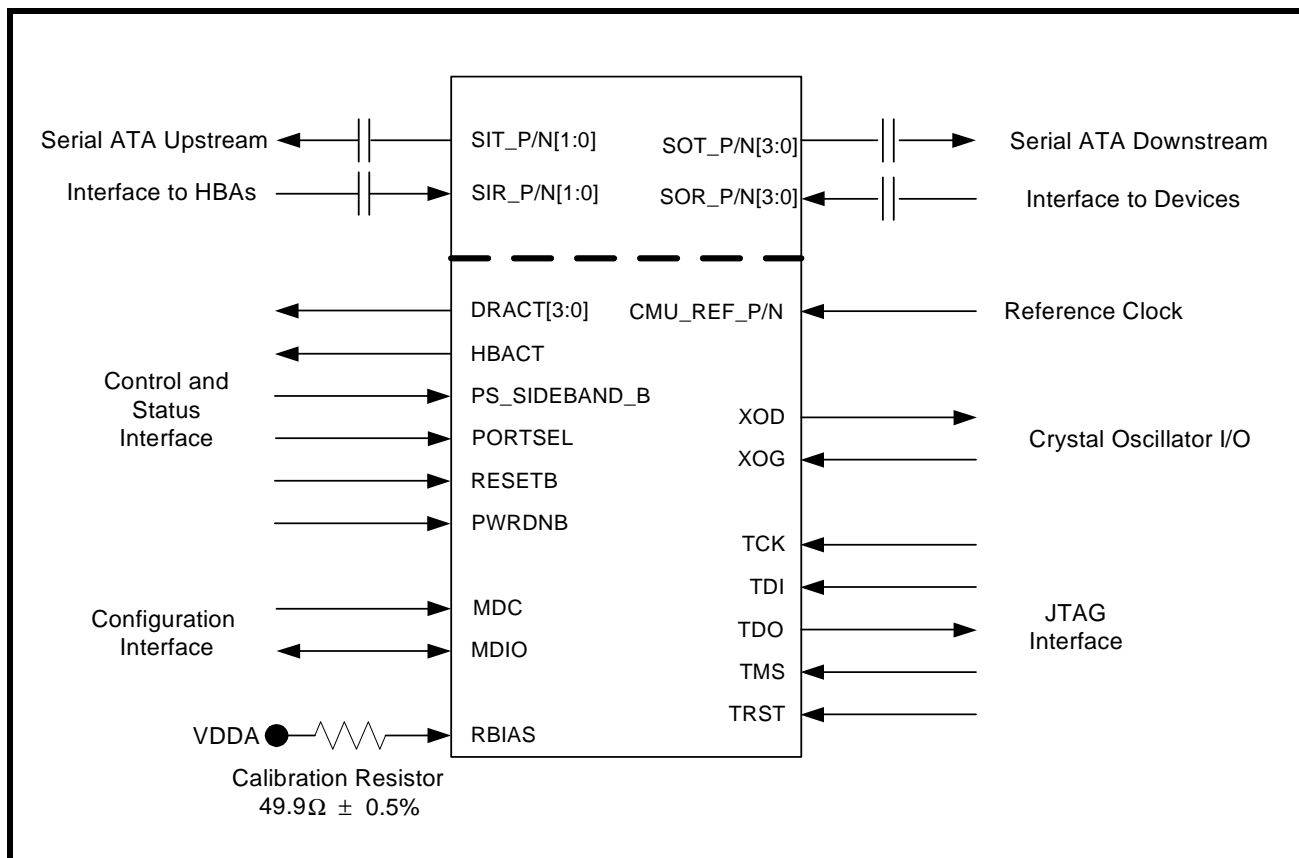
TABLE 2: HOST PORT SELECTION

| HARDWARE PINS | | REGISTER SETTINGS - REGISTER 0.009A | | | COMMENTS |
|-----------------------------|--|-------------------------------------|----------------------|--|---|
| PS_SIDE BAND B PIN 77 | PORTSEL PIN 2 | P_SEL_MTHD BIT 0 | P_SIDE_MTHD BIT 1 | P_HOST_SEL BIT 2 | 3.3V LVCMOS |
| 0 | "Selects host port 0 = Host port 0 1 = Host port 1 | x | 0 | x | Host port is selected by hardware PORTSEL pin |
| x | "Selects host port 0 = Host port 0 1 = Host port 1 | 1 | 0 | x | Host port is selected by hardware PORTSEL pin |
| 0 | x | x | 1 | "Selects host port 0 = Host port 0 1 = Host port 1 | "Host port is selected by register 0x0.009A bit 2 |
| x | x | 1 | 1 | "Selects host port 0 = Host port 0 1 = Host port 1 | "Host port is selected by register 0x0.009A bit 2 |
| 1 | x | 0 | x | x | Host port is selected by protocol based selection |

3.0 FUNCTIONAL DESCRIPTION

A top-level view of the XRS10L240 is shown in **Figure 3** outlining the interfaces to the device and the required support components. The data path can be seen at the top of the device. This includes the two output transmit and input receive paths at the top left, providing the upstream interface to the host, and the four output transmit and input receive paths at the top right, providing the downstream interface to the target devices. The clocking, control, and configuration interfaces are shown below the dotted line.

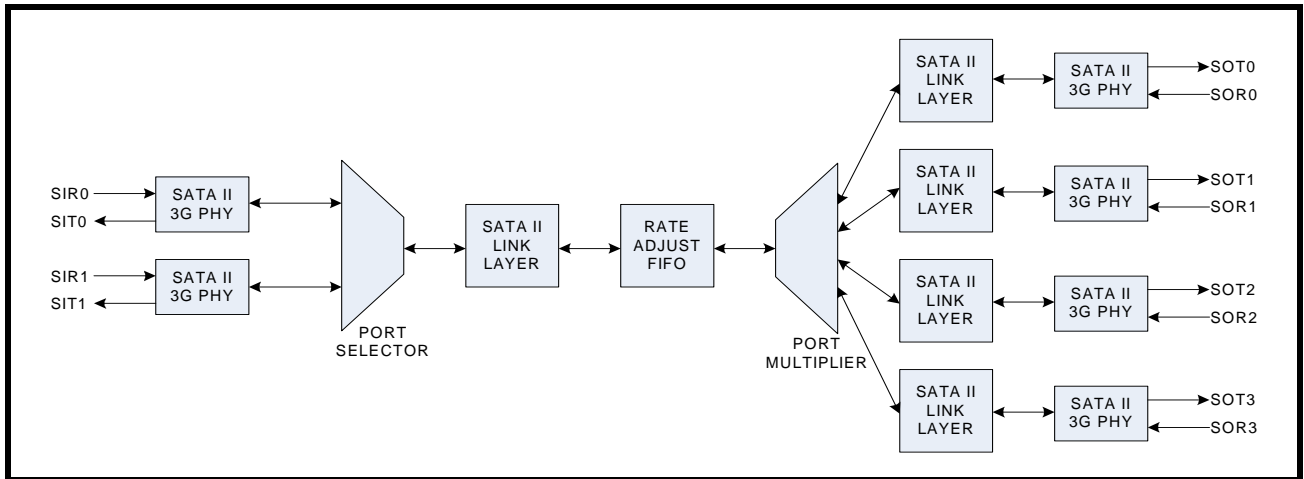
FIGURE 3. XRS10L240 INTERFACES



The XRS10L240 incorporates identical instantiations of a dual-channel Serial ATA II 3 Gbps PHY macro. This common building block provides a uniform implementation with common characteristics and a common register map, but provides a functional implementation of independent PHY blocks. Digital logic implementations of Serial ATA link layer blocks along with port selector and port multiplier logic provide the remainder of the data path within the XRS10L240. In addition, management and control interfaces including an

MDIO interface for register control, a JTAG interface for boundary scan purposes, and a resistor calibration circuit complete the device. A block diagram of the XRS10L240 is shown in **Figure 4**.

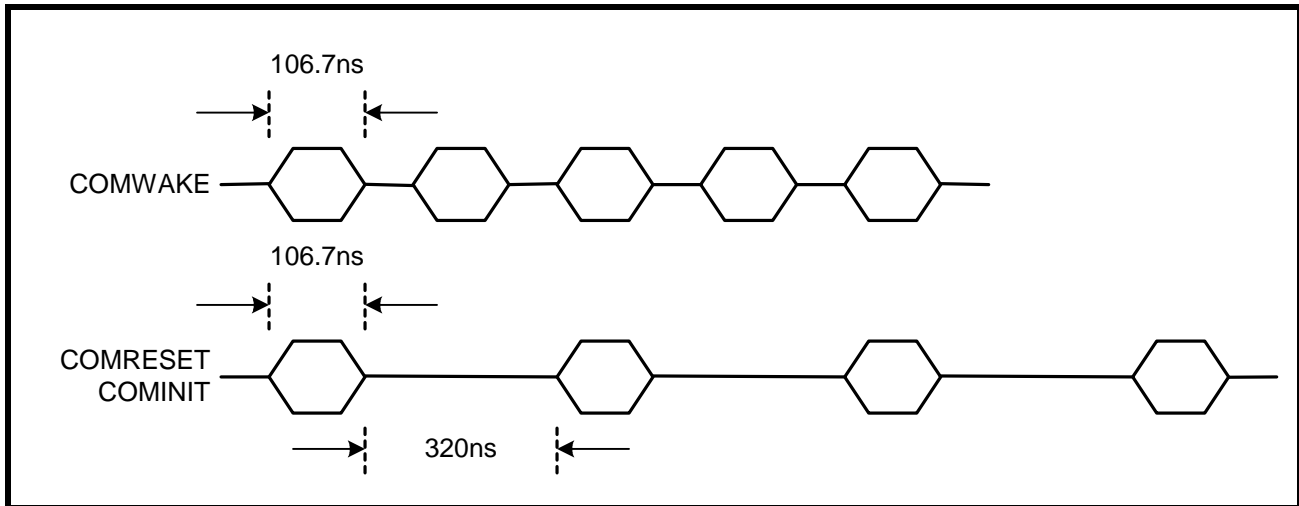
FIGURE 4. XRS10L240 BLOCK DIAGRAM



3.1 Out Of Band Feature

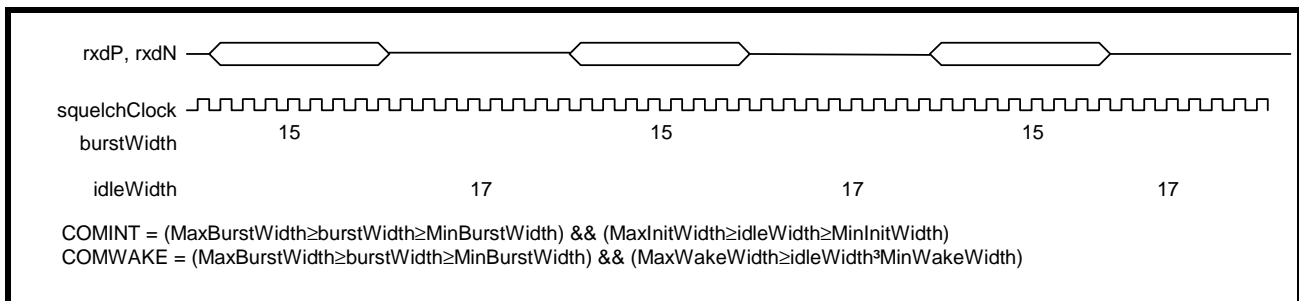
Each Serial ATA link provides full support for the three Out Of Band (OOB) signals supported by Serial ATA: COMRESET, COMINIT and COMWAKE. These sequences must be separated by idle periods as shown in **Figure 5**. The sequences are comprised of 106.7ns bursts of activity that are interleaved with varying length stretches of electrical idle. This alternating sequence must be repeated four times to be recognized.

FIGURE 5. COMWAKE AND COMRESET/COMINIT SEQUENCES



An example OOB sequence and the resulting burst and idle widths are shown in **Figure 6**. If the sequence of burstWidth and idleWidth counts falls within the range specified in the MDIO registers for four consecutive burst/idle sequences, then the link will assert COMINIT or COMWAKE. This OOB signal will remain asserted for as long as the corresponding sequence on the input pins continues.

FIGURE 6. EXAMPLE OOB SEQUENCE



3.2 Power Down Modes

The XRS10L240 features independent support for the 3 power modes, as follows:

- Active: All parts of the link are active. All power-down signals are de-asserted.
- Partial: In partial mode, the input and output pipelines are shut down, but the PLL and the OOB generation circuits are active.
- Slumber: In slumber mode, the PLL is also shut down, saving additional power but adding latency on exit.

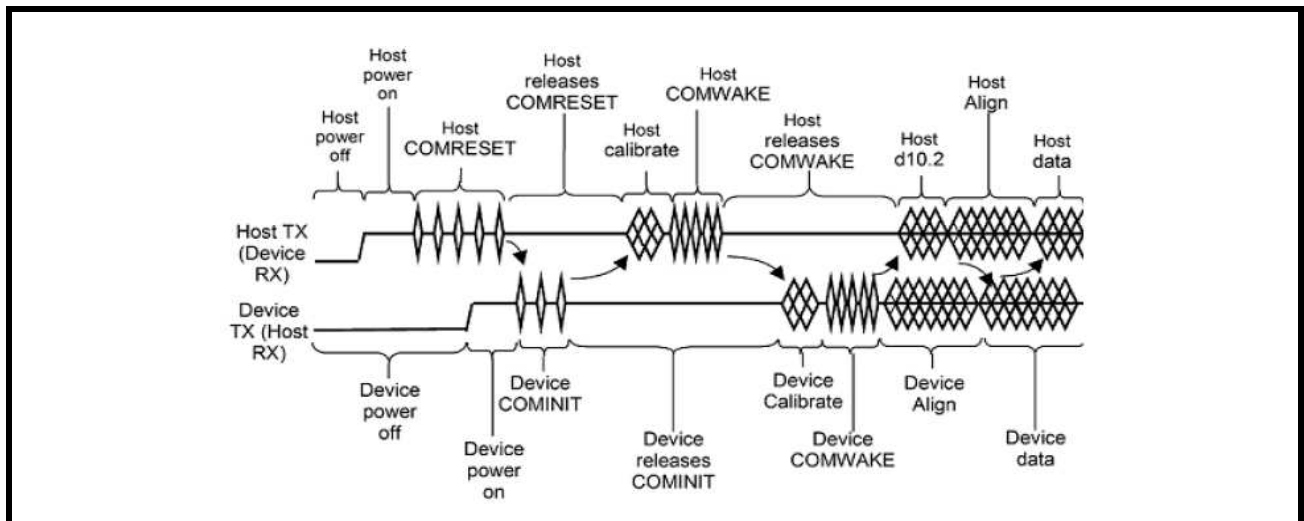
The XRS10L240 transceiver components (transmitter, receive CDR, PLL, etc.) can be powered down through MDIO register settings. **Please refer to Table 14, “Powerdown Registers (MDIO Devices 1, 2 & 3),” on page 29**

Please refer to “XRS10L240/140 Errata Sheet” for details regarding Link Power Management.

3.3 Speed Negotiation

The XRS10L240 will automatically perform speed negotiation with the host and devices in order to verify whether the second generation Serial ATA 3.0 Gbps data rate is available or whether the system will need to fall back upon the first generation Serial ATA 1.5 Gbps data rate. Speed negotiation is performed on an independent basis by each of the dual-channel macros. Speed negotiation is done independently on all host and device ports by default. MDIO configuration can request a common negotiated speed on the host and device ports if such a speed exists. To perform speed negotiation with a downstream device, the XRS10L240 will first perform a COMRESET/COMINIT handshake with the device and then performs a calibrate/COMWAKE handshake. Following receipt of the device COMWAKE signal, the XRS10L240 will continually send out a D10.2 signal while awaiting receipt of the device ALIGN primitive. Depending on the speed of the ALIGN primitive, the XRS10L240 will be able to determine the PHY generation of the device, and provide the appropriate 1.5 Gbps or 3.0 Gbps ALIGN primitive in return to the device, thus completing speed negotiation. This process is outlined in **Figure 7**.

FIGURE 7. SERIAL ATA SPEED NEGOTIATION



For speed negotiation with an upstream host, after the COMRESET/COMINIT and COMWAKE handshake is complete, the XRS10L240 will initially send out an ALIGN primitive at the 2nd generation 3.0 Gbps data rate. If no confirming 3.0 Gbps ALIGN primitive is received from the host, the XRS10L240 will then step down and attempt negotiation at the lower 1.5 Gbps data rate.

3.4 Port selector Implementation

The XRS10L240 provides full support for the Serial ATA II Port Selector specification. A Serial ATA Port Selector is a mechanism that allows two different host ports to connect to the same device in order to create a redundant path to that device. Only one host connection to the device is active at a time.

The two host ports are responsible for coordination of access to the XRS10L240 by one of two separate means: protocol-based port selection or sideband port selection. Each method is described in detail in the next two sections.

3.4.1 Protocol Based Port Selection

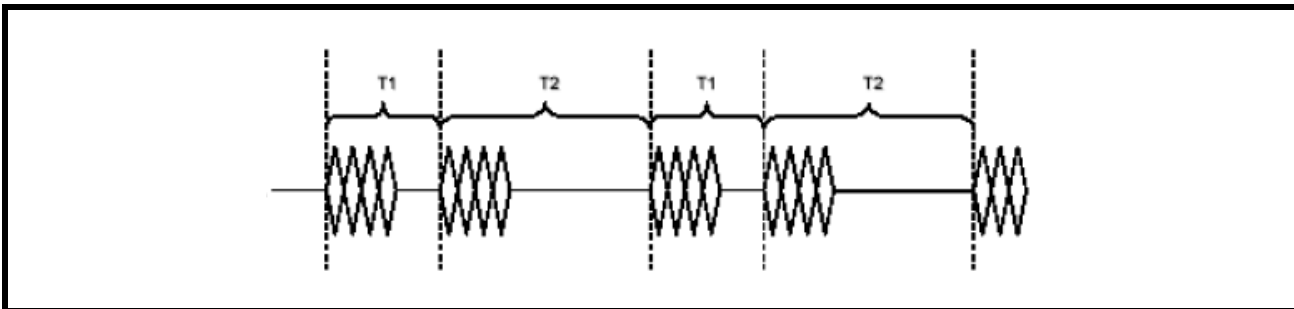
Protocol-based port selection makes use of a sequence of Serial ATA OOB signals to select the active host port. The port selection signal is based on a pattern of COMRESET OOB signals transmitted from the host to the XRS10L240. The port selection signal is composed of a series of COMRESET signals with the timing from one COMRESET signal to the next as shown in [Table 3](#) and [Figure 8](#). The XRS10L240 selects the port, if inactive, on the de-assertion of COMRESET after receiving two complete back-to-back sequences with this defined inter-burst spacing. This can also be identified as two sequences of two COMRESET intervals comprising a total of five COMRESET bursts with four inter-burst delays. Once a port is designated as active, reception of additional COMRESET signals is propagated directly to the device, even if the COMRESET signals constitute a port selection signal.

Note that when protocol based selection mode has been enabled, following the initial hardware reset, a single COMRESET burst will select the active host port. After this initial host port selection, only COMRESET OOB observing the protocol timing given below will change the active host.

TABLE 3: PORT SELECTOR SIGNAL INTER-RESET TIMING REQUIREMENTS

| | NOMINAL | MIN. | MAX | UNITS | COMMENTS |
|----|---------|------|-----|-------|--|
| T1 | 2.0 | 1.6 | 2.4 | ms | Inter-reset assertion delay for first event of the selection sequence |
| T2 | 8.0 | 7.6 | 8.4 | ms | Inter-reset assertion delay for second event of the selection sequence |

FIGURE 8. PORT SELECTION SIGNAL - TRANSMITTED COMRESET SIGNALS



3.4.2 Sideband Based Port Selection

The XRS10L240 also features support for a sideband port selection mechanism. This is implemented using a combination of the MDIO register settings and device pins including PS_SIDEHAND_B and PORTSEL. Refer to [Table 2](#) for a sideband port selection settings.

3.5 Port Multiplier Implementation

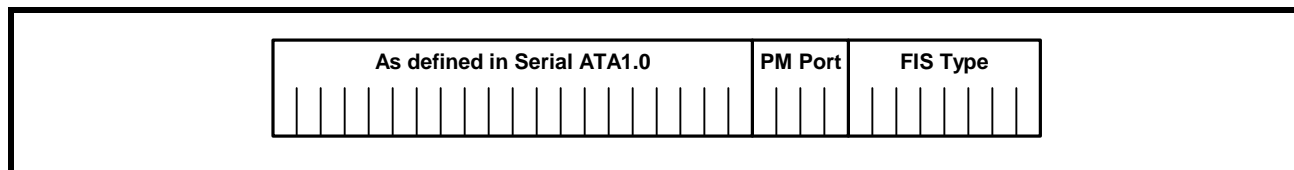
The XRS10L240 provides full support for the functionality outlined in the Serial ATA II Port Multiplier specification. This Port Multiplier functionality follows the Port Selector implementation, and only one link can be active at any time.

A Serial ATA II Port Multiplier is a mechanism for one active host connection to communicate with multiple devices. A Port Multiplier is conceptually a simple multiplexer in which one active host connection is multiplexed to multiple device connections.

The XRS10L240 uses four bits, known as the PM Port field in all Serial ATA frame types, to route frames between the selected host and the appropriate device. PM ports 0 through 3 are valid device ports within the 4-output XRS10L240, while PM port 15 is designated for communication between the host and the XRS10L240 itself. For host-to-device transactions, the PM Port field is designated by the host in order to specify which device the frame is intended for. For device-to-host transactions, the XRS10L240 fills in the PM Port field with the port address of the device that is transmitting the frame.

The PM Port field is defined in the Serial ATA port multiplier specification to be the first 32-bit Dword in the Frame Information Structure (FIS) for all FIS types, as shown in **Figure 9**.

FIGURE 9. PORT SELECTION SIGNAL - TRANSMITTED COMRESET SIGNALS



3.5.1 Transmission from a host to a device

A host indicates the target device for receipt of a transmitted frame by setting the PM Port field in the frame to the device's port address. When an XRS10L240 receives a frame as selected from one of the two available hosts by the port selector, it checks the PM Port field in the frame to determine which port address should be used. If the frame is set for transmission to the control port (15), the XRS10L240 receives the frame and performs the command or operation requested. If the frame is designated for a device port, the XRS10L240 obeys the following procedure:

1. The XRS10L240 first determines if the device port is valid. If the device port is not valid, the XRS10L240 will issue a SYNC primitive to the host and terminate reception of the frame.
2. The XRS10L240 determines if the X bit is set in the device port's PSCR[1] (SError) register. If the X bit is set, the XRS10L240 issues a SYNC primitive to the host and terminates reception of the frame.
3. The XRS10L240 determines if a collision has occurred. A collision occurs when a reception is already in progress from the device that the host wants to transmit to. If a collision has occurred, the XRS10L240 will finish receiving the frame from the host and will then issue an R_ERR primitive to the host as the ending status. The XRS10L240 will then discard the frame, but will not return an R_RDY primitive to the host until the frame from the affected device port has been transmitted to the host, thus indicating to the host when it can retry to send the frame. The transmission from the device will proceed as requested, as the device will always take collision precedence over the host.
4. The XRS10L240 initiates a transfer with the device by issuing an X_RDY primitive to the device. A collision may occur as the XRS10L240 is issuing the X_RDY to the device if the device has started transmitting an X_RDY primitive to the XRS10L240, indicating a decision to start a transmission to the host. In this case, the XRS10L240 will finish receiving the frame from the host and then issue an R_ERR primitive to the host to indicate an unsuccessful transmission. The transmission from the device will proceed as requested, as the device will always take collision precedence over the host.
5. After the device issues an R_RDY primitive to the XRS10L240, the XRS10L240 will transmit the frame from the host to the device. The XRS10L240 will not send an R_OK status primitive to the host until the device has issued an R_OK primitive to indicate successful frame reception. In this way, the R_OK status handshake is interlocked from the device to the host.

If an error is detected during any part of the frame transfer, the XRS10L240 will ensure that the error condition is propagated to the host and the device. If no error occurs during frame transfer, the XRS10L240 will not alter the contents of the frame, or modify the CRC in any way.

3.5.2 Transmission from a device to a host

A device indicates a transmit to a host in the same way as would be done if the host and device were attached directly. This transaction obeys the following procedure:

1. After receiving an X_RDY primitive from the device, the XRS10L240 will determine if the X bit is set in the device port's PSCR[1] (SError) register. The XRS10L240 will not issue an R_RDY primitive to the device until this bit is cleared to zero.
2. The XRS10L240 will then receive the frame from the device. The XRS10L240 will fill in the PM Port field with the port address of the transmitting device. The XRS10L240 will then check the CRC received from the device, and if valid, it will recalculate the CRC based upon the new PM Port field. If the CRC calculated from the device is incorrect, the XRS10L240 will corrupt the CRC sent to the host to ensure propagation of the error condition
3. The XRS10L240 will issue an X_RDY primitive to the host to start the transmission of the frame to the host. After the host issues an R_RDY primitive to the XRS10L240, the frame from the device, with the updated CRC, will then be transmitted to the host. The XRS10L240 will not send an R_OK status primitive to the device until the host has issued an R_OK primitive to indicate successful frame reception. In this way, the R_OK status handshake will be interlocked from the device to the host.

If an error is detected during any part of the frame transfer, the XRS10L240 will ensure that the error condition is propagated to the host and the device.

3.6 Clocking

The XRS10L240 allows the use of either an external reference clock or of a low cost crystal oscillator to act as a reference clock. Separate device inputs are available for each approach, with full rate reference clock inputs provided on pins CMU_REFP and CMU_REFN, and crystal oscillator inputs provided on pins XOD and XOG. Supported data rates and their appropriate PLL divide factors are outlined in [Table 4](#).

TABLE 4: PLL DIVIDE FACTORS

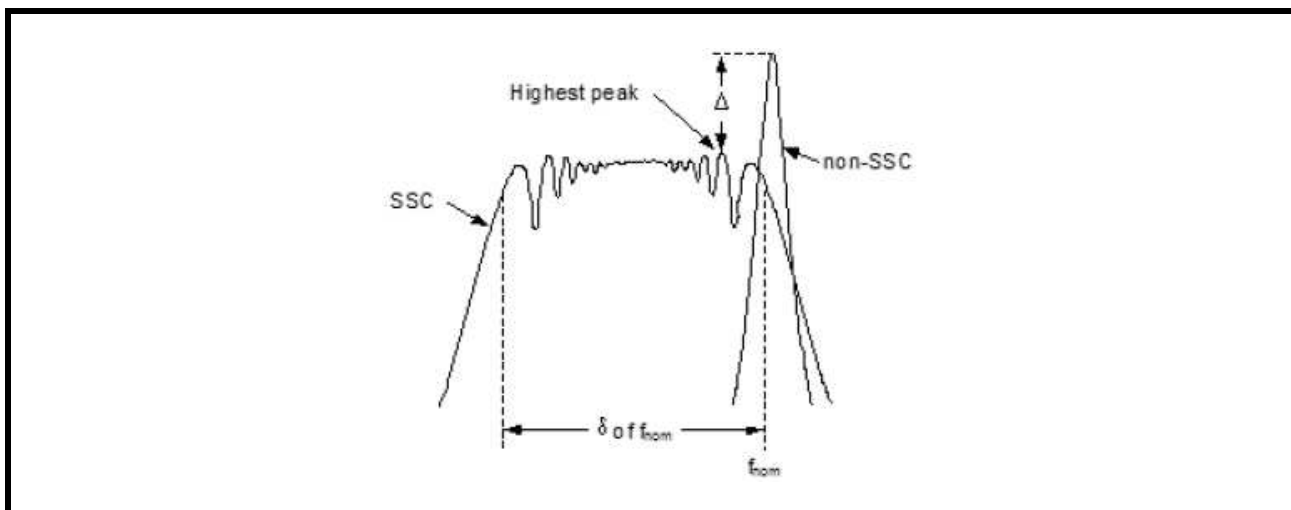
| MODE | SYSCLK | /REF | /FB | DINCLK RXCLK | SERIAL CLOCK | DATA RATE |
|-------------|--------|------|-----|-----------------|-----------------|--------------|
| SATA Gen. 2 | 25MHz | 1 | 60 | 300MHz | 1.5GHz | 3.0Gbps |
| SATA Gen. 2 | 50MHz | 1 | 30 | 300MHz | 1.5GHz | 3.0Gbps |
| SATA Gen. 2 | 75MHz | 1 | 20 | 300MHz | 1.5GHz | 3.0Gbps |
| SATA Gen. 2 | 100MHz | 2 | 30 | 300MHz | 1.5GHz | 3.0Gbps |
| SATA Gen. 2 | 150MHz | 1 | 10 | 300MHz | 1.5GHz | 3.0Gbps |

NOTE: * All link start with 3.0Gbps, then negotiate down to 1.5Gbps for SATA Generation 1 devices.

3.6.1 Spread Spectrum Clocking

The XRS10L240 provides full support for receipt and generation of signals that have been configured for Spread Spectrum Clocking (SSC) support. The spread technique is implemented by down-spreading the data rate by 0.5% as a means of reducing EMI. Generation of the down-spread clock is performed within the XRS10L240. An example of the resultant spectral fundamental frequency before and after SSC can be seen in [Figure 10](#).

FIGURE 10. SPREAD SPECTRUM CLOCKING



4.0 ELECTRICAL SPECIFICATIONS

This section contains the electrical specifications for the XRS10L240.

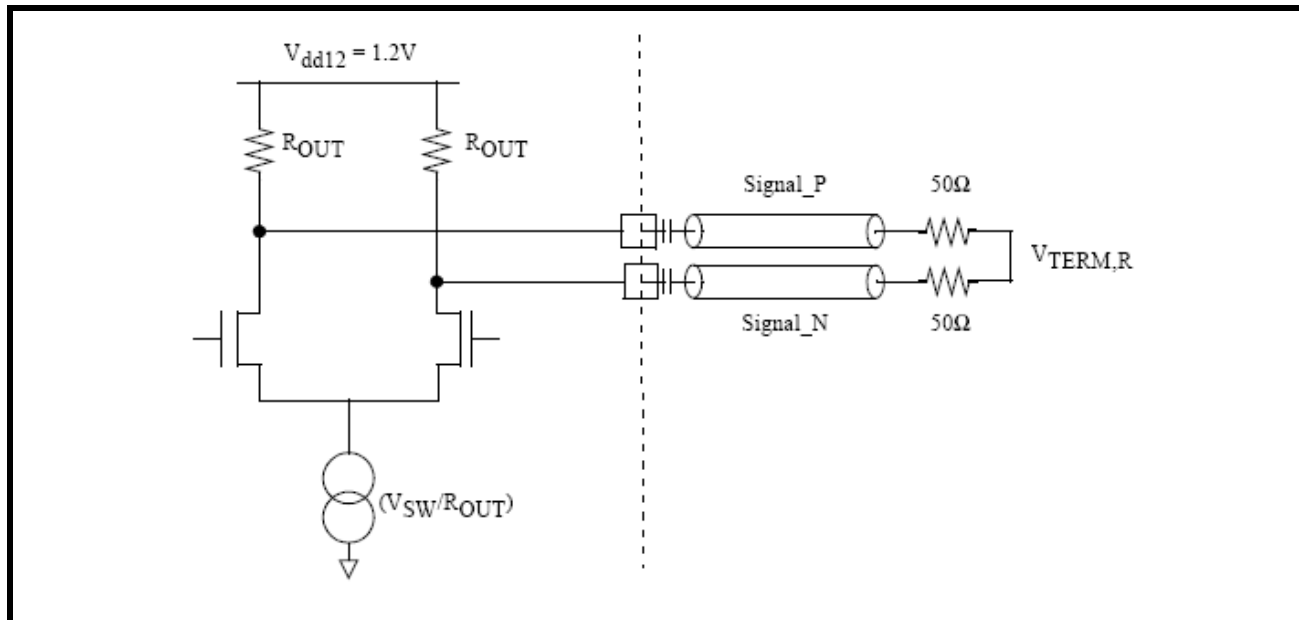
4.1 Serial ATA Specifications

The XRS10L240 electrical transmit and receive specifications are outlined in this section. The XRS10L240 is fully compliant to the Serial ATA II specification for Gen2i, Gen2x, Gen2m, Gen1i, Gen1x and Gen1m variations at 3.0 and 1.5 Gbps.

4.1.1 Serial ATA Transmitter

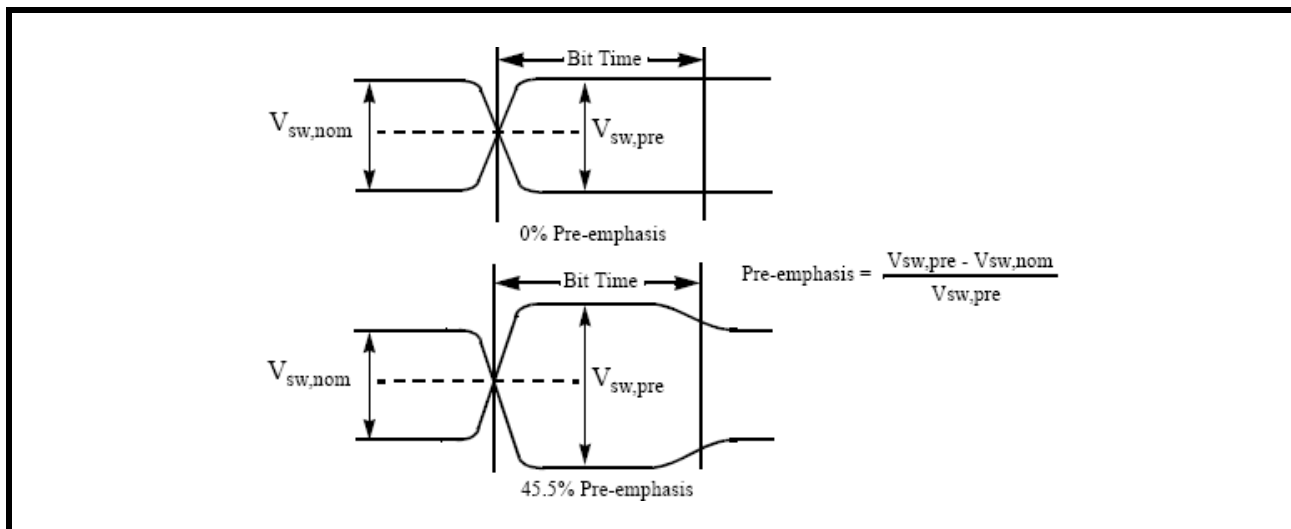
A simplified version of the output circuit and test fixture for each of the 6 Serial ATA transmit output pairs on the XRS10L240 is shown in [Figure 11](#). The output differential pair is terminated to the supply VDD. The circuit is designed to be AC coupled.

FIGURE 11. SERIAL ATA EQUIVALENT OUTPUT CIRCUIT



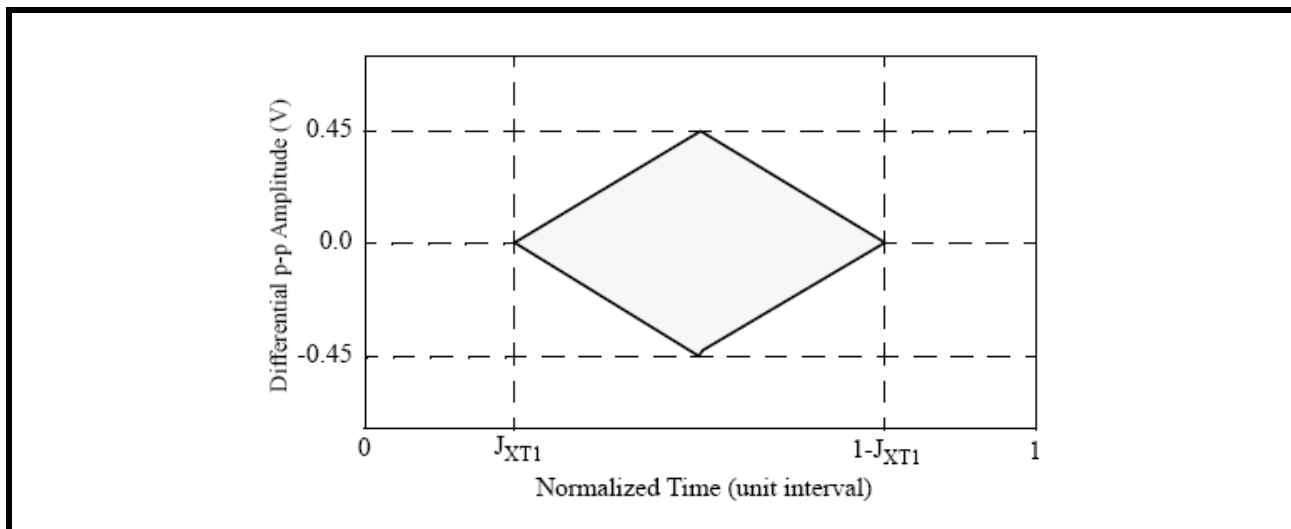
The XRS10L240 Serial ATA outputs include a simple one-tap equalizer, that is useful in driving longer printed circuit traces and is a required component in second generation Serial ATA PHYs. This equalizer pre-emphasizes the output signal whenever there is a data transition. The amount of pre-emphasis can vary between 0 and 45.5%, and is configured via MDIO register settings. Note that pre-emphasis doesn't increase the overall swing, but instead reduces the output amplitude when there is no transition.

FIGURE 12. EFFECTS OF TRANSMIT PRE-EMPHASIS



The overall swing level can also be modified via MDIO register settings. The XRS10L240 transmit mask is shown in [Figure 13](#).

FIGURE 13. TRANSMIT EYE MASK FOR SERIAL ATA OUTPUT



4.1.2 Serial ATA Receiver

An equivalent circuit for the XRS10L240 Serial ATA inputs is shown in **Figure 14**. The device receiver mask is shown in **Figure 15**. This circuit is designed to be AC coupled. The termination resistors are not connected during power-up

FIGURE 14. SERIAL ATA EQUIVALENT INPUT CIRCUIT

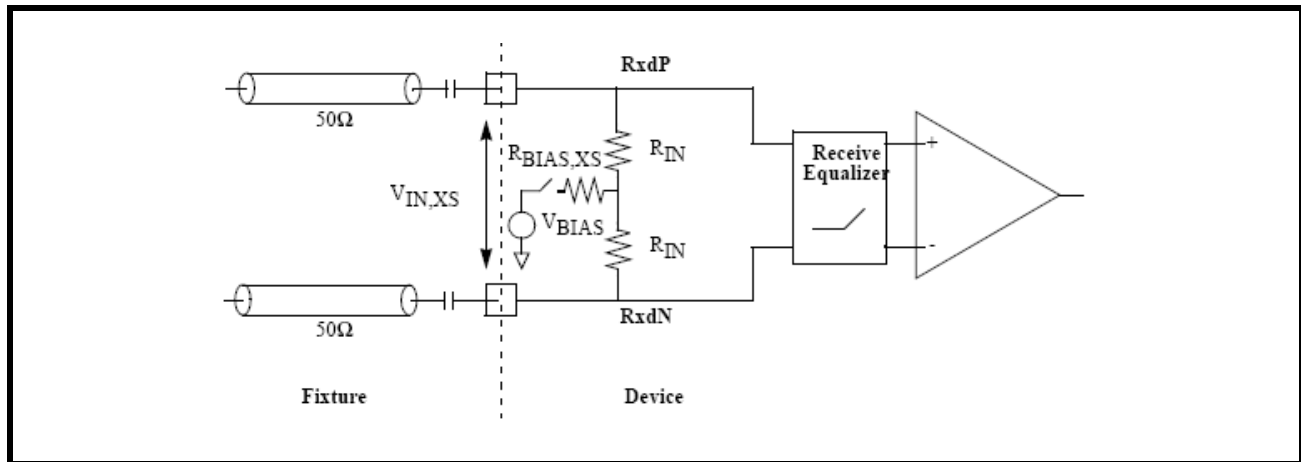


FIGURE 15. RECEIVE EYE MASK FOR SERIAL ATA INPUT

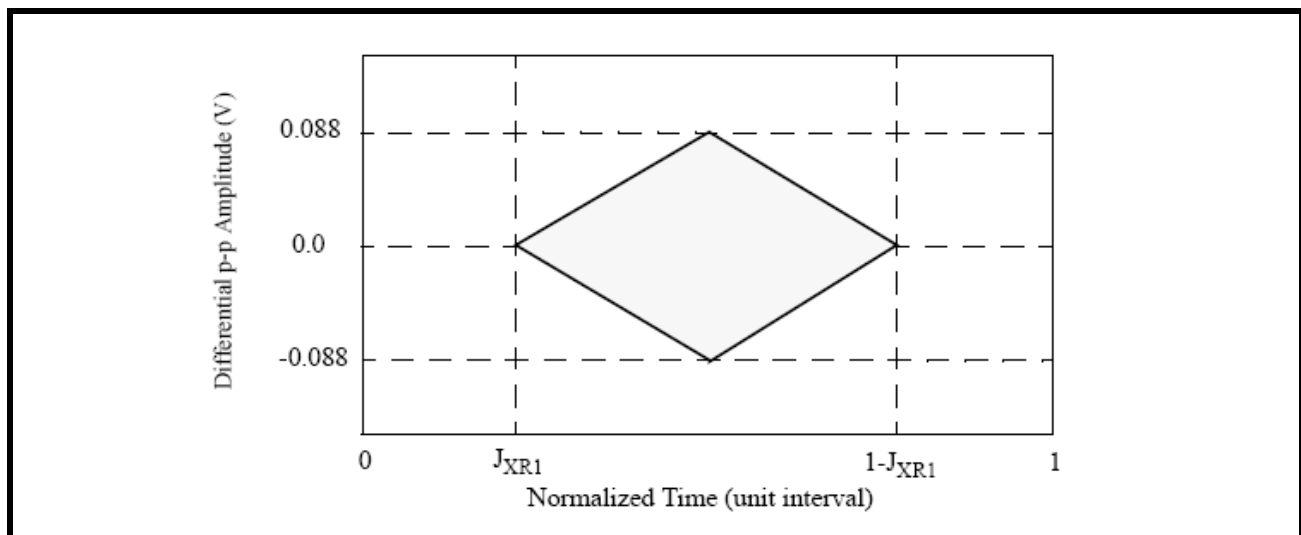


TABLE 5: SERIAL ATA LINK SPECIFICATIONS

| NAME | DESCRIPTION | MIN. | NOM | MAX | UNITS |
|-------------------|--|-------|-----|------|------------|
| $t_{BIT,XS}$ | Bit Time | 670 | - | 333 | ps |
| J_{XR1} | Input Jitter Tolerance Mask at signal crossover | 0.32 | - | - | UI |
| $J_{XR1,DJ}$ | Deterministic jitter tolerance at signal crossover | 0.18 | - | - | UI |
| J_{XT1} | Output jitter mask at signal crossover | - | - | 0.15 | UI |
| $J_{XT1,DJ}$ | Deterministic output jitter at signal crossover | - | - | 0.07 | UI |
| t_R/t_F | Input signal rise/fall times (20% - 80%) | 0.2 | - | 0.46 | UI |
| t_{QR}/t_{QF} | Output signal rise/fall times (20% - 80%) | 0.2 | - | 0.41 | UI |
| $t_{TOL,RX}^1$ | RX to sysclock frequency offset tolerance | -5350 | 0 | 350 | ppm |
| V_{IN} | Input swing, differential peak-peak | 175 | - | 1600 | mV |
| V_{SW}^2 | Output swing, differential peak-peak | 800 | - | 1200 | mV |
| $V_{IN,IDLE}$ | No swing detection threshold | 65 | 120 | 155 | mV |
| $R_{IN,DIFF}$ | Differential mode input resistance | 85 | 100 | 115 | Ω |
| $R_{IN,CM}^3$ | Common mode input resistance | 40 | 50 | 60 | Ω |
| $R_{IN,OFF}$ | Common mode input resistance, no power | 200 | - | - | k Ω |
| $R_{IN,XS}$ | Output termination resistance | 40 | 50 | 60 | Ω |
| $S_{11,IN,DIFF}$ | Differential input return loss, 50MHz - 1.5GHz | 12 | - | - | dB |
| $S_{11,IN,CM}$ | Common mode input return loss 50MHz-1.5GHz | 6 | - | - | dB |
| $S_{22,OUT,DIFF}$ | Differential output return loss 50MHz-1.5GHz | 12 | - | - | dB |
| $S_{22,OUT,CM}$ | Common mode output return loss 50MHz-1.5GHz | 6 | - | - | dB |
| $t_{S,REG}$ | Setup time for register port | 1.5 | - | - | ns |
| $t_{H,REG}$ | Hold time for register port | 1.5 | - | - | ns |
| $t_{Q,REG}$ | Clock to Q time for register port | 0 | - | 2 | ns |
| $t_{CYC,REG}$ | Register port clock cycle time | 10 | - | - | ns |
| $t_{HI,REG}$ | R register port clock high time | 4 | - | - | ns |
| $t_{LO,REG}$ | Register port clock low time | 4 | - | - | ns |
| $t_{RF,REG}$ | Register port input rise/fall time | - | - | 0.5 | ns |

NOTES:

1. This value includes 0.5% downspread Spread Spectrum clocking, plus 350ppm tolerance around the center frequency.
2. This is measured at the package ball and does not include any board or connector loss.
3. This value can be as low as 5 Ω during power on.

4.2 CMOS Interface

AC and DC specifications for the CMOS inputs and outputs are listed in [Table 6](#). Since all these signals are asynchronous, there are no setup or hold times defined. The CMOS pins are defined in the General Control and Configuration portion of [Table 1](#) in Section 3, "Pin Descriptions".

TABLE 6: CMOS I/O SPECIFICATIONS

| NAME | DESCRIPTION | MIN | NOM | MAX | UNITS |
|------------------------|--|------|-----|-----|-------|
| $t_{DR}/t_{DF,CMOS}$ | CMOS input signal rise/fall times (20% - 80%) | 0.2 | - | 5 | ns |
| $t_{QR}/t_{QF,CMOS}^1$ | CMOS output signal rise/fall times (20% - 80%) | 0.2 | - | 5 | ns |
| $V_{IL,CMOS}$ | CMOS input low voltage | -0.3 | 0 | 0.8 | V |
| $V_{IH,CMOS}$ | CMOS input high voltage | 1.7 | 3.3 | 3.6 | V |
| $V_{OL,CMOS}$ | CMOS output low voltage | -0.3 | 0 | 0.4 | V |
| V_{PULLUP} | Open Drain Pull-up Voltage | 2.3 | - | 3.6 | V |
| $I_{OL,CMOS}$ | Output current for $V_{OL} = 0.4V$ | 10 | - | 20 | mA |
| $dl_{OL}/dt_{,CMOS}$ | Output current rate of change | -10 | - | 10 | mA/ns |
| $L_{I,CMOS}$ | CMOS I/O inductance | - | - | 8 | nH |
| $C_{I,CMOS}$ | CMOS I/O capacitance | - | - | 5 | pF |
| $I_{LEAKAGE}^2$ | CMOS I/O Leakage Current | | | 150 | uA |

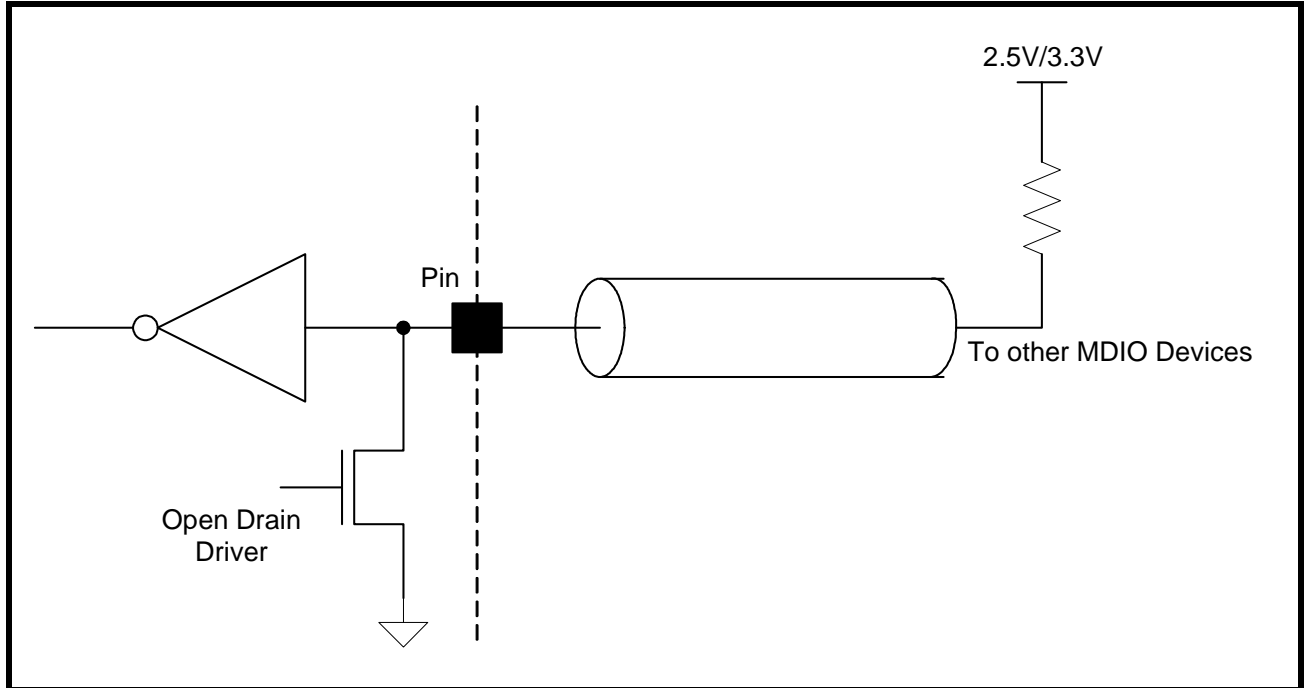
NOTE: .1. This value is measured driving a load of 20pF.

NOTE: .2. This values is measured at 2.5 VDC.

4.3 MDIO Interface

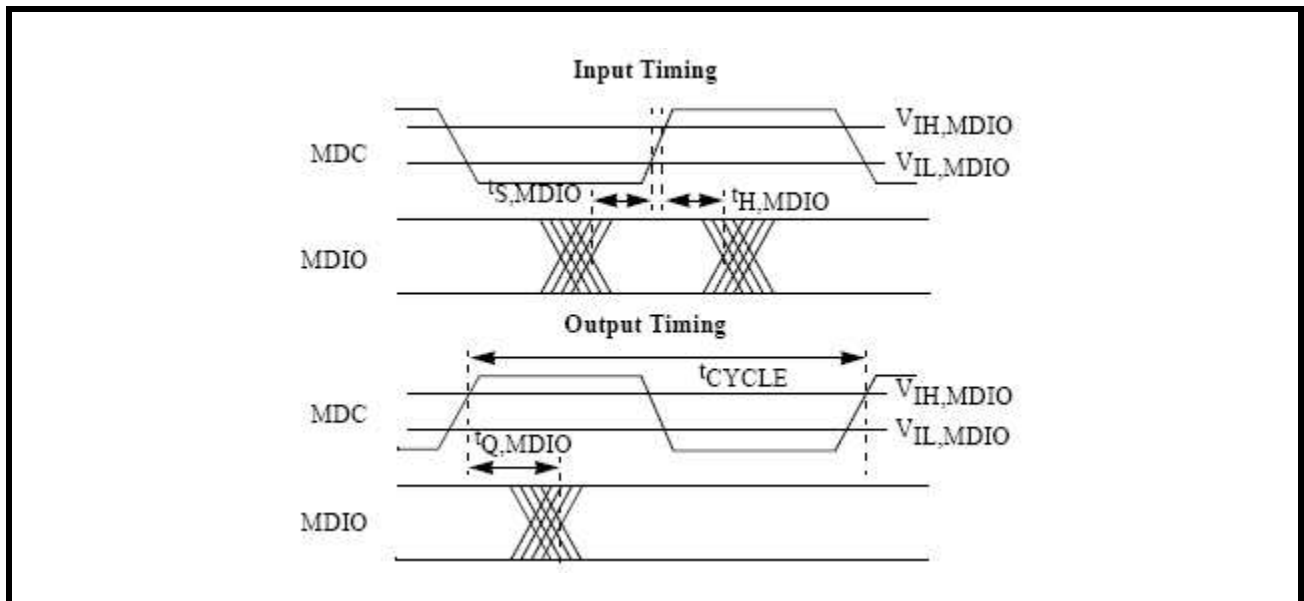
The Management Data Input/Output (MDIO) port complies with Clause 45 of the IEEE 802.3ae specification. A representative MDIO driver/receiver is shown in [Figure 16](#). MDIO uses an open drain driver with a pull-up resistor.

FIGURE 16. REPRESENTATIVE MDIO CIRCUIT



Representative MDIO Read and Write waveforms are shown in [Figure 17](#). The XRS10L240 samples MDIO on the rising edge of MDC for input and drives MDIO after the rising edge of MDC for output. Note that setup, hold, and output timings are defined from the maximum V_{IL} and minimum V_{IH} levels.

FIGURE 17. MDIO INPUT AND OUTPUT WAVEFORMS



Values for MDIO parameters are shown in [Table 7](#)

TABLE 7: MDIO DC AND AC CHARACTERISTICS

| NAME | DESCRIPTION | MIN | NOM | MAX | UNITS |
|--------------------------------------|---|------|-----|-----|-------|
| $t_{\text{CYCLE,MDIO}}$ | MDC cycle time | 400 | - | - | ns |
| $t_{\text{LOW,MDC}}$ | MDC low time | 160 | - | - | ns |
| $t_{\text{HIGH,MDC}}$ | MDC high time | 160 | - | - | ns |
| $t_{\text{S,MDIO}}^1$ | MDIO input to MDC setup time | 10 | - | - | ns |
| $t_{\text{H,MDIO}}^2$ | MDC to MDIO input hold time | 10 | - | - | ns |
| $t_{\text{Q,MDIO}}^3$ | MDC to MDIO output time | 0 | - | 150 | ns |
| $t_{\text{DR}}/t_{\text{DF,MDIO}}$ | MDIO input signal rise/fall times (20% - 80%) | 0.2 | - | 100 | ns |
| $t_{\text{QR}}/t_{\text{QF,MDIO}}^4$ | MDIO output signal rise/fall times (20% - 80%) | 0.2 | - | 80 | ns |
| $V_{\text{IL,MDIO}}$ | MDIO input low voltage | -0.3 | 0 | 0.8 | V |
| $V_{\text{IH,MDIO}}$ | MDIO input high voltage | 1.7 | 3.3 | 3.6 | V |
| $V_{\text{OL,MDIO}}^4$ | MDIO output low voltage | -0.3 | 0 | 0.4 | V |
| V_{PULLUP} | Open Drain Pull-up Voltage | 2.3 | - | 3.6 | V |
| $I_{\text{OL,MDIO}}$ | MDIO Output current for $V_{\text{OL}} = 0.4\text{V}$ | 10 | - | 20 | mA |
| $di_{\text{OL}}/dt_{\text{,MDIO}}$ | MDIO Output current rate of change | -10 | - | 10 | mA/ns |
| $L_{\text{I,MDIO}}$ | MDIO input inductance | - | - | 8 | nH |
| $C_{\text{I,MDIO}}$ | MDIO input capacitance | - | - | 5 | pF |

NOTES:

1. Measured from minimum MDIO V_{IH} to maximum MDC V_{IL} for MDIO rising edge.
Measured from maximum MDIO V_{IL} to maximum MDC V_{IL} for MDIO falling edge.
2. Measured from minimum MDC V_{IH} to maximum MDIO V_{IL} for MDIO rising edge.
Measured from minimum MDC V_{IH} to minimum MDIO V_{IH} for MDIO falling edge.
3. Measured from minimum MDC V_{IH} to maximum MDIO V_{IL} for MDIO rising edge and MDC rising edge.
Measured from minimum MDC V_{IH} to minimum MDIO V_{IH} for MDIO falling edge and MDC rising edge.
Measured from maximum MDC V_{IL} to maximum MDIO V_{IL} for MDIO rising edge and MDC falling edge.
Measured from maximum MDC V_{IL} to minimum MDIO V_{IH} for MDIO falling edge and MDC falling edge.
4. Measured driving a load of 470pF.

TABLE 8: OPERATING CONDITIONS

| Name | Description | Min | Nom | Max | Units |
|-----------------|--------------------------------|------|-----|------|-------|
| T_{A} | Ambient temperature under bias | -40 | 25 | 85 | °C |
| V_{DD} | Core power supply voltage | 1.14 | 1.2 | 1.26 | V |
| I_{DD} | Core power supply current | - | 460 | 600 | mA |



TABLE 8: OPERATING CONDITIONS

| Name | Description | Min | Nom | Max | Units |
|-------------------|--|-------|------|------|-------|
| V _{ESD1} | Electrostatic discharge tolerance, Human Body Model - Any pin with respect to any other pin except VDDA pins (pins 14, 34, 45, 50, 62, and 87) | -2000 | | 2000 | V |
| V _{ESD2} | Electrostatic discharge tolerance, Human Body Model - Any pin with respect to VDDA pins (pins 14, 34, 45, 50, 62, and 87) | -500 | | 500 | V |
| θ _{JA} | Junction-to-ambient thermal resistance | | 38.5 | | °C/W |

5.0 REGISTERS DESCRIPTION

The XRS10L240 provides a variety of registers for the purpose of device configuration, testing and monitoring. These registers are accessed through the MDIO interface, outlined in [“Section 4.3, MDIO Interface” on page 20](#). Operational registers available to the customer are given below. Note that all other address space should be left unmodified in order to ensure proper behavior of the device.

5.1 Register Overview

The XRS10L240 port address is hardwired to 0; this field should be set to 0 in all packets. The XRS10L240 contains three identical instantiations of a dual Serial ATA PHY macro. A common set of registers exists within each of these macros, and are outlined in [“Section 5.2, Macro Registers” on page 25](#). MDIO device designations 1-3 are used for each of these three macros as shown in [Table 9](#). Registers relating to the XRS10L240 as a whole are outlined in [“Section 5.3, XRS10L240 Device Generic Registers” on page 30](#) and make use of MDIO device 0.

TABLE 9: MDIO DEVICE DESIGNATIONS

| MDIO DEVICE DESIGNATION | MACRO | RELEVANT PINS |
|-------------------------|------------------------------------|---------------|
| 0 | XRS10L240 Device Generic Registers | N/A |
| 1 | Serial ATA Input Macro | SI0, SI1 |
| 2 | Serial ATA Output Macro 0 | SO0, SO1 |
| 3 | Serial ATA Output Macro 1 | SO2, SO3 |

The XRS10L240 registers are arranged as 8-bit fields with 8-bit addresses. These are mapped into the 16-bit MDIO address and data fields by setting the most significant byte of each to 0x00. An example mapping from a macro address/data combination to an MDIO address & data combination is shown in [Table 10](#).

TABLE 10: MDIO ADDRESSING

| MACRO ADDRESS | MACRO DATA | MDIO ADDRESS | MDIO DATA |
|---------------|------------|--------------|------------------|
| 0x40 | abcde | 0x0040 | 00000000000abcde |

NOTE: The unused upper 3 bits in FBDIV are also set to 0 during MDIO writes and are undefined during MDIO reads.

In the description of each register field, there is an entry describing its read/write status. This may fall into one of the following categories:

- RW- register field is read/write
- RO - register field is read only
- LL - Latching Low - Used with bits that monitor some state internal to the XRS10L240. When the condition for the bit to go low is reached, the bit stays low until the next time it is read. Once it is read, its value reverts to the current state of the condition it monitors.
- LH - Latching High - When the condition for the bit to go high is reached, the bit stays high until the next time it is read. Once it is read, its value reverts to the current state of the condition it monitors.
- SC - When an SC bit is set, some action is initiated; once the action is complete, the bit is cleared.

5.2 Macro Registers

The registers outlined in this section are common to each of the three Serial ATA dual PHY macros as described in the previous section. As such, each listed register is present in each of the 1, 2, and 3 MDIO register spaces, and will perform the stated function on the specified Serial ATA lane.

The registers within each dual PHY macro are split into the following sections:

| | |
|------------------------------------|------------------------|
| Transmit/Receive lane 0 registers: | Address range 000***** |
| Transmit/Receive lane 1 registers: | Address range 001***** |
| PLL registers: | Address range 010***** |
| Bias generator registers: | Address range 011***** |

TABLE 11: TRANSMIT/RECEIVE LANE REGISTERS (MDIO DEVICE 1, 2, 3)

| ADDRESS HEX | BIT(S) | NAME | RW | DEFAULT | DESCRIPTION |
|------------------|--------|--|----|---------|--|
| N.0000 N.0020 | 7 | Reserved | RW | 0 | DO NOT MODIFY |
| | 6 | SATAPCIEXB_G1 | RW | 0 | Tx output swing booster bit (Gen 1) 0 = boost swing by 15% 1 = nominal swing |
| | 5:1 | Reserved | RW | 0001 | DO NOT MODIFY |
| | 0 | SATAPCIEXB_G2 | RW | 0 | Tx output swing booster bit (Gen 2) 0 = boost swing by 15% 1 = nominal swing |
| N.0001 N.0021 | 7:3 | Reserved | RW | 00000 | DO NOT MODIFY |
| | 2:0 | Transmit_Eq0[2:0] Transmit_Eq1[2:0] | RW | 011 | Transmit preemphasis control 000 = 0% transmit preemphasis 001 = 6.5% transmit preemphasis 010 = 13% transmit preemphasis 011 = 19.5% transmit preemphasis 100 = 26% transmit preemphasis 101 = 32.5% transmit preemphasis 110 = 39% transmit preemphasis 111 = 45.5% transmit preemphasis |

TABLE 11: TRANSMIT/RECEIVE LANE REGISTERS (MDIO DEVICE 1, 2, 3)

| ADDRESS HEX | BIT(S) | NAME | RW | DEFAULT | DESCRIPTION |
|------------------|------------|--|----|---------|--|
| N.0002 N.0022 | 7:6 7:6 | mscProg0[1:0] mscProg1[1:0] | RW | 10 | Receive equalization control – boost at 1.5GHz *(Note mscProg = '10' default for device Revision E, mscProg = '01' default for device Revision D) |
| | 5:3 5:3 | Beacon_Swing0[2:0] Beacon_Swing1[2:0] | RW | 100 | Transmit swing size for OOB Signals 000 = 800mV 001 = 700mV 010 = 600mV 011 = 500mV 100 = 400mV 101 = 300mV 110 = 200mV 111 = 0mV |
| | 2:0 2:0 | Output_Swing0[2:0] Output_Swing1[2:0] | RW | 100 | Transmit swing size in normal operation 000 = 800mV 001 = 700mV 010 = 600mV 011 = 500mV 100 = 400mV 101 = 300mV 110 = 200mV 111 = 0mV |
| N.0003 N.0023 | 7 | enEqB | RW | 0 | Enable receive equalization 0 = enable equalization 1 = disable equalization |
| | 6:0 | Reserved:0] | RW | 0010000 | DO NOT MODIFY |
| N.0015 N.0035 | 7 | Reserved | RO | - | Reserved |
| | 6:4 | sysclk25divsel0[2:0] sysclk25divsel1[2:0] | RW | 000 | Divider selection for sysclk-> sysclk25 000 = divide by 1 (sysclk is 25MHz) 001 = divide by 2 (sysclk is 50MHz) 010 = divide by 3 (sysclk is 75MHz) 011 = divide by 4 (sysclk is 100MHz) 100 = divide by 5 (sysclk is 125MHz) 101 = divide by 6 (sysclk is 150MHz) 110 = divide by 10 (sysclk is 250MHz) 111 = divide by 12 (sysclk is 300MHz) |
| | 3:0 | Reserved | RW | 0101 | DO NOT MODIFY |



TABLE 11: TRANSMIT/RECEIVE LANE REGISTERS (MDIO DEVICE 1, 2, 3)

| ADDRESS HEX | BIT(S) | NAME | RW | DEFAULT | DESCRIPTION |
|-------------|--------|--|----|---------|--|
| N.0018 | 7:3 | Reserved | RW | 00100 | DO NOT MODIFY |
| N.0038 | 2:0 | txbiasbuffsela0[2:0] txbiasbuffsela1[2:0] | RW | 100 | Tx Predriver swing size in normal operation 000 = 800mV 001 = 700mV 010 = 600mV 011 = 500mV 100 = 400mV (sata default) 101 = 300mV |

TABLE 12: PLL CONFIGURATION (MDIO DEVICE 1, 2, 3)

| ADDRESS HEX | BIT(S) | NAME | TYPE | DEFAULT | DESCRIPTION |
|------------------|--------|-------------|------|---------|---|
| N.0040 | 7:6 | Reserved | RO | - | Reserved |
| | 5:0 | FBDIV[5:0] | RW | 101101 | Divide value for feedback clock 110000 = divide by 5 100000 = divide by 10 100001 = divide by 15 100010 = divide by 20 100011 = divide by 25 100101 = divide by 30 100111 = divide by 50 101101 = divide by 60 (default for 25MHz Ref) Other - reserved |
| N.0041 | 7:6 | Reserved | RO | - | Reserved |
| | 5:0 | REFDIV[5:0] | RW | 010000 | Divide values for system clock 010000 = divide by 1 (default for 25MHz Ref) 000000 = divide by 2 000001 = divide by 3 000010 = divide by 4 000011 = divide by 5 000101 = divide by 6 000110 = divide by 8 000111 = divide by 10 001101 = divide by 12 001110 = divide by 16 001111 = divide by 20 Others - reserved |
| N.0044 | 7:6 | Reserved | RO | - | Reserved |
| | 5:0 | SSCMax | RW | 00000 | Maximum value for spread (set to 45, [0x2D] when SSCBypass is set to "0") |
| N.0045 NOTE 1 | 7:5 | Reserved | RO | - | Reserved |
| | 4 | SSCmode | RW | 0 | Selects position of spreading interpolator 0 = Interpolator in feedback path 1 = Interpolator in feedforward path Set to '1' when SSCBypass = '0' |
| | 3 | Reserved | RW | 0 | DO NOT MODIFY |
| | 2 | SSCInvert | RW | 0 | Spread up instead of down |
| | 1 | Reserved | RW | 0 | DO NOT MODIFY |
| | 0 | SSCBypass | RW | 1 | Bypass the saw generator and pulse density modulator and get increment from SSCMax (set SSCMax to 45, 0x2D when SSCBypass is set to 0) |

NOTE: 1) In order to enable SSC generation, set register N.0044 to 0x2D, N.0045 to 0x14 and then reset the PLL by writing register 0.0004 to 0x0 then 0xF.

TABLE 13: BIAS GENERATOR CONFIGURATION (MDIO DEVICE 1, 2, 3)

| ADDRESS HEX | BIT(S) | NAME | TYPE | RESET VALUE | DESCRIPTION |
|-------------|--------|-----------------|------|-------------|--|
| N.0064 | 7:4 | pr100Tx[3:0] | RW | 0x0 | Transmit pre-driver current bias 1010=50uA 0010=75uA 0000=100uA 0001=125uA 1100=150uA 0111=175uA 1111=200uA |
| | 3:0 | Reserved[3:0] | RW | 0x0 | DO NOT MODIFY |
| N.0065 | 7:4 | Reserved | RW | 0x0 | DO NOT MODIFY |
| | 3:0 | prcal100Tx[3:0] | RW | 0x0 | Transmit driver current bias 1010=50uA 0010=75uA 0000=100uA 0001=125uA 1100=150uA 0111=175uA 1111=200uA |

TABLE 14: POWERDOWN REGISTERS (MDIO DEVICES 1, 2 & 3)

| ADDRESS HEX | BIT(S) | NAME | TYPE | RESET VALUE | DESCRIPTION |
|----------------------------|--------|---|------|-------------|--|
| 1.0080 2.0080 3.0080 | 7:6 | SlpwrnDetB[1:0] SO01pwrnDetB[1:0] SO23pwrnDetB[1:0] | RW | 11 | Powers down the signal detector and COM* circuits 1 = normal operation 0 = power down |
| | 5:4 | SlpwrnRxB[1:0] SO01pwrnRxB[1:0] SO23pwrnRxB[1:0] | RW | 11 | Powers down the receivers and CDR 1 = normal operation 0 = power down |
| | 3:2 | SlpwrnTxDrvB[1:0] SO01pwrnTxDrvB[1:0] SO23pwrnTxDrvB[1:0] | RW | 11 | Powers down the transmitter 1 = normal operation 0 = power down |
| | 1:0 | SlpwrnTxB[1:0] SO01pwrnTxB[1:0] SO23pwrnTxB[1:0] | RW | 11 | Powers down the transmit pipes and clock 1 = normal operation 0 = power down |

TABLE 14: POWERDOWN REGISTERS (MDIO DEVICES 1, 2 & 3)

| ADDRESS HEX | BIT(S) | NAME | TYPE | RESET VALUE | DESCRIPTION |
|------------------|--------|---|------|-------------|--|
| 1.0081 | 7:2 | Reserved | RO | - | Reserved |
| 2.0081 3.0081 | 1 | SlpwrnBiasGen SO01pwrnBiasGen SO23pwrnBiasGen | RW | 0 | Powers down the bandgap. 1 = power down 0 = normal operation |
| | 0 | SlpwrnPLLB SO01pwrnPLLB SO23pwrnPLLB | RW | 1 | Powers down the PLL 1 = normal operation 0 = power down |

5.3 XRS10L240 Device Generic Registers

This section outlines generic registers relating to the XRS10L240 as a whole. These registers are accessed through MDIO device 0.

TABLE 15: RESET CONTROL SIGNALS

| ADDRESS HEX | BIT(S) | NAME | TYPE | RESET VALUE | DESCRIPTION |
|-------------|--------|------------------|------|-------------|------------------------------|
| 0.0030 | 7:0 | revision_id[7:0] | R/O | 05H | *(Note 1) Device Revision ID |
| 0.0031 | 7:0 | device_id [15:8] | R/O | 83H | Device ID MSB |
| 0.0032 | 7:0 | device_id [7:0] | R/O | 06H | Device ID LSB |

NOTE: 1) Revision ID 05H is for device Revision E. Revision ID 03H is for device Revision D.

TABLE 16: SATA PORT SELECTOR REGISTERS

| ADDRESS HEX | BIT(S) | NAME | TYPE | RESET VALUE | DESCRIPTION |
|-------------|--------|-------------|------|-------------|--|
| 0.009A | 7:3 | Reserved | RW | 00100 | DO NOT MODIFY |
| | 2 | p_host_sel | RW | 0 | Side band port selection 1 = Select Host port 1 0 = Select Host port 0 |
| | 1 | p_side_mthd | RW | 0 | 1 = p_host_sel based sideband selection 0 = external pin based sideband selection |
| | 0 | p_sel_mthd | RW | 0 | Please refer to Table 2, "Host Port Selection," on page 7 |

TABLE 17: CLOCK CONFIGURATION REGISTER

| ADDRESS HEX | BIT(s) | NAME | TYPE | RESET VALUE | DESCRIPTION |
|-------------|--------|-------------|------|-------------|---|
| 0.0001 | 7:3 | Reserved | RO | - | Reserved |
| | 2 | refClkSel | RW | 0 | 1 = select CMU_REF 0 = select on chip crystal oscillator |
| | 1 | pwrDnRefClk | RW | 0 | Powers down reference clock |
| | 0 | Reserved | RO | - | Reserved |

TABLE 18: PORT MULTIPLIER SATA STANDARD REGISTERS

| REGISTER | BIT(s) | NAME | TYPE | DEFAULT VALUE | DESCRIPTION |
|---------------------------------|---------|-------------------|------|---------------|---|
| GSCR(0) Product Identifier | 31 - 16 | Device ID | R/O | 0x8306 | Device ID allocated by the vendor. |
| | 15 - 0 | Vendor ID | R/O | 0x13A8 | Vendor ID allocated by the PCI-SIG of the vendor that produced the Port Multiplier. |
| GSCR(1) Revision Information | 31 - 16 | Reserved | R/O | 0x0000 | 31-16 Reserved |
| | 15 - 8 | REV_LEV | R/O | 0x03 | 15-8 Revision level of the Port Multiplier. |
| | 7:4 | Reserved | R/O | 0x0 | 7-4 Reserved |
| | 3 | PM_1,2 | R/O | 1 | 1=Supports Port Multiplier specification 1.2. |
| | 2 | PM_1.1 | R/O | 1 | 1=Supports Port Multiplier specification 1.1. |
| | 1 | PM_1.0 | R/O | 1 | 1=Supports Port Multiplier specification 1.0. |
| | 0 | Reserved | R/O | 0 | Reserved |
| GSCR(2) Port Information | 7:4 | Reserved | R/O | 0x0 | Reserved |
| | 3 - 0 | DEV_FAN_OUT_PORTS | R/O | 0x4 | Number of exposed device fan-out ports. |

TABLE 18: PORT MULTIPLIER SATA STANDARD REGISTERS

| REGISTER | BIT(S) | NAME | TYPE | DEFAULT VALUE | DESCRIPTION |
|---|-----------|------------------------|------|--|---|
| GSCR(32) Error Information | 31 - 15 | Reserved | R/O | 0x0 | |
| | 14 | Reserved | R/O | 0 | Unused |
| | 13 | Reserved | R/O | 0 | Unused |
| | 12 | Reserved | R/O | 0 | Unused |
| | 11 | Reserved | R/O | 0 | Unused |
| | 10 | Reserved | R/O | 0 | Unused |
| | 9 | Reserved | R/O | 0 | Unused |
| | 8 | Reserved | R/O | 0 | Unused |
| | 7 | Reserved | R/O | 0 | Unused |
| | 6 | Reserved | R/O | 0 | Unused |
| | 5 | Reserved | R/O | 0 | Unused |
| | 4 | Reserved | R/O | 0 | Unused |
| | 3 | OR_PORT-3 | R/O | 0 | OR of selectable bits in Port 3 PSCR[1] (SError) |
| | 2 | OR_PORT-2 | R/O | 0 | OR of selectable bits in Port 2 PSCR[1] (SError) |
| | 1 | OR_PORT-1 | R/O | 0 | OR of selectable bits in Port 1 PSCR[1] (SError) |
| 0 | OR_PORT-0 | R/O | 0 | OR of selectable bits in Port 0 PSCR[1] (SError) | |
| GSCR(33) Error Information Bit Enable | 31 - 0 | ERR_INFO_EN | R/O | 0x400FFFF | If set, bit is enabled for use in GSCR[32] |
| GSCR(64) Port Multiplier Revision 1.X Features Support | 31 - 5 | Reserved | R/O | 0x0 | Reserved |
| | 4 | PHY_EVENT | R/O | 0 | 1 = Supports Phy event counters |
| | 3 | ASYNC | R/O | 1 | 1 = Supports asynchronous notification |
| | 2 | SSC | R/O | 0 | 1 = Supports dynamic SSC transmit enable |
| | 1 | PMREQ _P | R/O | 1 | 1 = Supports issuing PMREQ _P to host |
| | 0 | BIST | R/O | 0 | 1 = Supports BIST |
| GSCR(96) Port Multiplier Revision 1.X Features Enable | 31 - 4 | Reserved | R/O | 0x0 | Reserved |
| | 3 | ASYNC_EN | RW | 0 | 1 = Asynchronous notification enabled |
| | 2 | SSC_EN | RW | 0 | 1 = Dynamic SSC transmit is enabled |
| | 1 | PMREQ _P _EN | RW | 0 | 1 = Issuing PMREQ _P to host is enabled |
| | 0 | BIST_EN | RW | 0 | 1 = BIST support is enabled |



TABLE 19: SATA STANDARD REGISTERS - DEVICE PORT (0 TO 3) - STATUS AND CONTROL

NOTE: Registers designated as WC are write clear. In order to clear a particular bit or bit field within a WC designated register, write a '1' to that bit or bit field.

| REGISTER | BIT(S) | NAME | TYPE | DEFAULT VALUE | DESCRIPTION |
|-----------------------|---------|----------|------|---------------|--|
| PSCR(0) (SStatus) | 31 - 12 | Reserved | R/O | 0x0 | Reserved |
| | 11 - 8 | IPM | R/O | 0x0 | The IPM value indicates the current interface power management state 0000b = Device not present or communication not established 0001b = Interface in active state 0010b = Interface in Partial power management state 0110b = Interface in Slumber power management state All other values reserved |
| | 7 - 4 | SPD | R/O | 0x0 | The SPD value indicates the negotiated interface communication speed established 0000b = No negotiated speed (device not present or communication not established) 0001b = Generation 1 communication rate negotiated 0010b = Generation 2 communication rate negotiated All other values reserved |
| | 3 - 0 | DET | R/O | 0x0 | The DET value indicates the interface device detection and Phy state. 0000b = No device detected and Phy communication not established 0001b = Device presence detected but Phy communication not established 0011b = Device presence detected and Phy communication established 0100b = Phy in offline mode as a result of the interface being disabled or running in a BIST loopback mode All other values reserved |
| PSCR(1) (SError) | 31 - 16 | DIAG | RWC | 0x40 | See description below |
| | 15 - 0 | ERR | RWC | 0x0 | See description below |
| PSCR(2) (SControl) | 31 - 19 | Reserved | R/O | 0x0 | Reserved All reserved fields shall be cleared to zero. |
| | 20 - 16 | Reserved | RW | 0x0 | Reserved All reserved fields shall be cleared to zero |
| | 15 - 12 | SPM | RW | 0x0 | See description below |
| | 11 - 8 | IPM | RW | 0x0 | See description below |
| | 7 - 4 | SPD | RW | 0x0 | See description below |
| | 3 - 0 | DET | RW | 0x4 | See description below |

SError register SCR(1) -

The Serial ATA interface Error register - SError - is a 32-bit register that conveys supplemental Interface error information to complement the error information available in the Shadow Register Block Error register. The register represents all the detected errors accumulated since the last time the SError register was cleared (whether recovered by the interface or not). Set bits in the error register are explicitly cleared by a write operation to the SError register, or a reset operation. The value written to clear set error bits shall have 1's encoded in the bit positions corresponding to the bits that are to be cleared. Host software should clear the Interface SError register at appropriate checkpoints in order to best isolate error conditions and the commands they impact.

Bits [31:16] DIAG

The DIAG field contains diagnostic error information for use by diagnostic software in validating correct operation or isolating failure modes. The field is bit significant as defined in the following figure.

| | | | | | | | | | | | | | | | | |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| DIAG | R | R | R | R | A | X | F | T | S | H | C | D | B | W | I | N |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|

A Port Selector presence detected: This bit is set to one when COMWAKE is received while the host is in state HP2: HR_AwaitCOMINIT. On power-up reset this bit is cleared to zero. The bit is cleared to zero when the host writes a one to this bit location.

B 10b to 8b Decode error: When set to a one, this bit indicates that one or more 10b to 8b decoding errors occurred since the bit was last cleared to zero.

C CRC Error: When set to one, this bit indicates that one or more CRC errors occurred with the Link layer since the bit was last cleared to zero.

D Disparity Error: When set to one, this bit indicates that incorrect disparity was detected one or more times since the last time the bit was cleared to zero.

F Unrecognized FIS type: When set to one, this bit indicates that since the bit was last cleared one or more FISes were received by the Transport layer with good CRC, but had atype field that was not recognized.

I Phy Internal Error: When set to one, this bit indicates that the Phy detected some internal error since the last time this bit was cleared to zero.

N PHYRDY change: When set to one, this bit indicates that the PHYRDY signal changed state since the last time this bit was cleared to zero.

H Handshake error: When set to one, this bit indicates that one or more R_ERRHandshake response was received in response to frame transmission. Such errors may be the result of a CRC error detected by the recipient, a disparity or 10b/8b decoding error, or other error condition leading to a negative handshake on a transmitted frame.

R Reserved bit for future use: Shall be cleared to zero.

S Link Sequence Error: When set to one, this bit indicates that one or more Link state machine error conditions was encountered since the last time this bit was cleared to zero. The Link layer state machine defines the conditions under which the link layer detects an erroneous transition.

T Transport state transition error: When set to one, this bit indicates that an error has occurred in the transition from one state to another within the Transport layer since the last time this bit was cleared to zero.

W COMWAKE Detected: When set to one this bit indicates that a COMWAKE signal was detected by the Phy since the last time this bit was cleared to zero.

X Exchanged: When set to one this bit indicates that device presence has changed since the last time this bit was cleared to zero. The means by which the implementation determines that the device presence has changed is vendor specific. This bit may be set to one anytime a Phy reset initialization sequence occurs as determined by reception of the COMINIT signal whether in response to a new device being inserted, in response to a COMRESET having been issued, or in response to power-up.

Bits [15:0] ERR

The ERR field contains error information for use by host software in determining the appropriate response to the error condition. The field is bit significant as defined in the following figure.

| | | | | | | | | | | | | | | | |
|-----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ERR | R | R | R | R | E | P | C | T | R | R | R | R | R | M | I |
|-----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

C Non-recovered persistent communication or data integrity error: A communication error that was not recovered occurred that is expected to be persistent. Since the error condition is expected to be persistent the operation need not be retried by host software. Persistent communications errors may arise from faulty interconnect with the device, from a device that has been removed or has failed, or a number of other causes.

E Internal error: The host bus adapter experienced an internal error that caused the operation to fail and may have put the host bus adapter into an error state. Host software should reset the interface before re-trying the operation. If the condition persists, the host bus adapter may suffer from a design issue rendering it incompatible with the attached device.

I Recovered data integrity error: A data integrity error occurred that was recovered by the interface through a retry operation or other recovery action. This may arise from a noise burst in the transmission, a voltage supply variation, or from other causes. No action is required by host software since the operation ultimately succeeded, however, host software may elect to track such recovered errors in order to gauge overall communications integrity and potentially step down the negotiated communication speed.

M Recovered communications error: Communications between the device and host was temporarily lost but was re-established. This may arise from a device temporarily being removed, from a temporary loss of Phy synchronization, or from other causes and may be derived from the PHYRDYn signal between the Phy and Link layers. No action is required by the host software since the operation ultimately succeeded, however, host software may elect to track such recovered errors in order to gauge overall communications integrity and potentially step down the negotiated communication speed.

P Protocol error: A violation of the Serial ATA protocol was detected. This may arise from invalid or poorly formed FISes being received, from invalid state transitions, or from other causes. Host software should reset the interface and retry the corresponding operation. If such an error persists, the attached device may have a design issue rendering it incompatible with the host bus adapter.

R Reserved bit for future use: Shall be cleared to zero.

T Non-recovered transient data integrity error: A data integrity error occurred that was not recovered by the interface. Since the error condition is not expected to be persistent the operation should be retried by host software.

SControl register SCR(2)

The Serial ATA interface Control register - SControl - is a 32-bit read-write register that provides the interface by which software controls Serial ATA interface capabilities. Writes to the SControl register result in an action being taken by the host adapter or interface. Reads from the register return the last value written to it.

Bits [19:16] PMP

The Port Multiplier Port (PMP) field represents the 4-bit value to be placed in the PM Port field of all transmitted FISes. This field is '0000' upon power-up. This field is optional and an HBA implementation may choose to ignore this field if the FIS to be transmitted is constructed via an alternative method.

Bits [15:12] SPM

The Select Power Management (SPM) field is used to select a power management state. A non-zero value written to this field shall cause the power management state specified to be initiated. A value written to this field is treated as a one-shot. This field shall be read as 0000b.

- 0000b = No power management state transition requested

- 0001b = Transition to the Partial power management state initiated
- 0010b = Transition to the Slumber power management state initiated
- 0100b = Transition to the active power management state initiated
- All other values reserved

Bits [11:8] IPM

The IPM field represents the enabled interface power management states that may be invoked via the Serial ATA interface power management capabilities

- 0000b = No interface power management state restrictions
- 0001b = Transitions to the Partial power management state disabled
- 0010b = Transitions to the Slumber power management state disabled
- 0011b = Transitions to both the Partial and Slumber power management states disabled
- All other values reserved

Bits [7:4]SPD

The SPD field represents the highest allowed communication speed the interface is allowed to negotiate when interface communication speed is established

- 0000b = No speed negotiation restrictions
- 0001b = Limit speed negotiation to a rate not greater than Gen 1 communication rate
- 0010b = Limit speed negotiation to a rate not greater than Gen 2 communication rate
- All other values reserved

Bits [3:0] DET

The DET field controls the host adapter device detection and interface initialization.

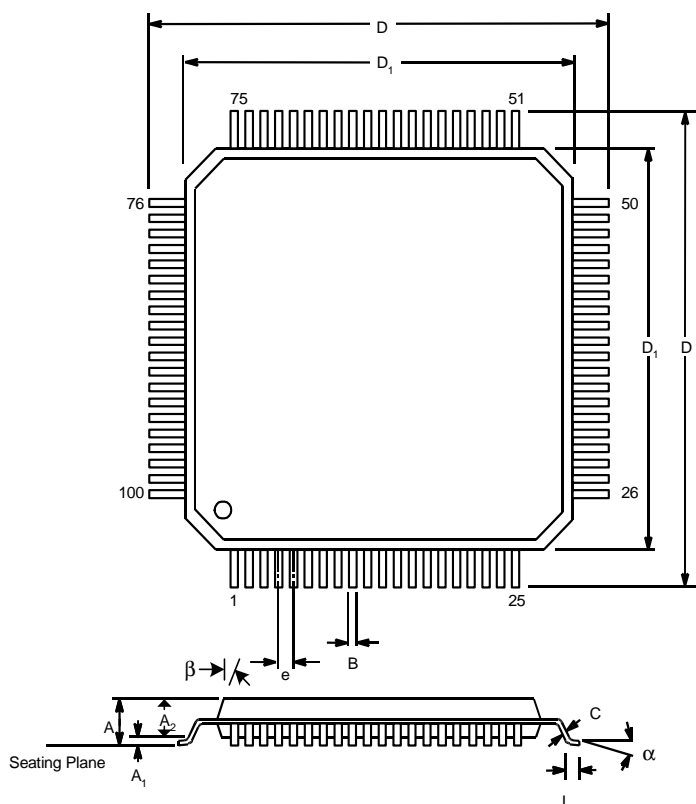
- 0000b = No device detection or initialization action requested
- 0001b = Perform interface communication initialization sequence to establish communication. This is functionally equivalent to a hard reset and results in the interface being reset and communications reinitialized. Upon a write to the SControl register that sets the DET field to 0001b, the host interface shall transition to the HP1: HR_Reset state and shall remain in that state until the DET field is set to a value other than 0001b, by a subsequent write to the SControl register.
- 0100b = Disable the Serial ATA interface and put Phy in offline mode.
- All other values reserved

PRODUCT ORDERING INFORMATION

| PRODUCT NUMBER | PACKAGE TYPE | OPERATING TEMPERATURE RANGE |
|----------------|--------------------------|-----------------------------|
| XRS10L240IV-F | 100 Pin LQFP (Lead Free) | -40°C to +85°C |
| XRS10L240IV | 100 Pin LQFP | -40°C to +85°C |

100 LEAD LOW-PROFILE QUAD FLAT PACK

(14 x 14 x 1.4 mm LQFP, 1.0 mm FORM)



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NOTE: The control dimension is in millimeters

| SYMBOL | INCHES | | MILLIMETERS | |
|----------------|------------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.055 | 0.063 | 1.40 | 1.60 |
| A ₁ | 0.002 | 0.006 | 0.05 | 0.15 |
| A ₂ | 0.053 | 0.057 | 1.35 | 1.45 |
| B | 0.010 | 0.014 | 0.17 | 0.27 |
| C | 0.004 | 0.008 | 0.09 | 0.20 |
| D | 0.622 | 0.638 | 15.80 | 16.20 |
| D ₁ | 0.390 | 0.555 | 13.90 | 14.10 |
| e | 0.0197 BSC | | 0.50 BSC | |
| L | 0.018 | 0.030 | 0.45 | 0.75 |
| α | 0° | 7° | 0° | 7° |
| β | 7°typ | | 7°typ | |

REVISIONS

| REV # | DATE | DESCRIPTION OF CHANGES |
|-------|---------------|--|
| 1.00 | November 2008 | Released. |
| 1.01 | January 2008 | Corrected JTAG TRST, TDO pin desc., part ordering info. |
| 1.02 | March 2008 | Revised to operational registers. |
| 1.03 | June 2008 | Corrected ESD tolerance to 2000V/500V (Table 8) Added more description for " Section 3.2, Power Down Modes " on page 11 - added reference to "XRS10L240/140 errata |
| 1.04 | August 2008 | Removed references to link power management |
| 1.05 | January 2009 | Chaged register default for Rx Equalization, corrected HBACT pin definition. |