



# **IDT<sup>®</sup> CPS-10Q**

## **Central Packet Switch**

# **User Manual**

**Revision 1.7**

July 10, 2012

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# About This Manual

## Introduction

This user's reference manual includes hardware and software information for the CPS-10Q (80KSW0005). This device is a member of the Central Packet Switch (CPS) family.

## Finding Additional Information

Information regarding the mechanical drawings, package pinouts, thermal characteristics, and electrical specifications can be found in the CPS-10Q datasheet. This datasheet is available on IDT's secure access site, mySites. To obtain a copy, contact your local IDT sales representative.

## Content Summary

**Chapter 1, "Device Overview,"** provides a complete introduction to the capabilities of the CPS-10Q. It includes the major differences from the PPS device.

**Chapter 2, "Serial RapidIO Ports,"** covers the CPS-10Q Serial RapidIO ports. These ports are RapidIO specification 1.3 compliant. It also covers IDT specific features such as tracing and filtering.

**Chapter 3, "Switch Description,"** covers the switch core behavior and flow control mechanism.

**Chapter 4, "I<sup>2</sup>C Bus Interface,"** describes the standard I<sup>2</sup>C bus interface implemented on the CPS-10Q.

**Chapter 5, "Error Management,"** explains the CPS-10Q Error Management block. This block is responsible for receiving, filtering, logging, counting, and responding to error reports from all functional blocks within the device.

**Chapter 6, "JTAG & Boundary Scan,"** describes the CPS-10Q JTAG interface and code.

**Chapter 7, "Reference Clock,"** describes the reference clock requirement, system clock and serdes clock generation.

**Chapter 8, "Programming the Device,"** provides the basic configure steps and rules.

**Chapter 9, "Reset & Initialization"** provides reset and initialization steps.

**Chapter 10, "Registers"** provides the full memory map and complete listing of the CPS-10Q registers, register type, register fields, and their respective addresses.

**Chapter 11, "References,"** provides a list of all associated specifications referred to in this manual.

## Documentation Conventions and Definitions

Throughout this manual the following conventions and terms are used:

- ◆ To define the active polarity of a signal, signal names with and without overbars will be used. Signal names with overbars are considered negative polarity or "active low" and are thus enabled when a low voltage is applied.
- ◆ To define buses, the most significant bit (MSB) will be on the left and least significant bit (LSB) will be on the right. No leading zeros will be included.
- ◆ To represent numerical values, either decimal, binary, or hexadecimal formats will be used. The binary format is as follows: 0bDDD, where "D" represents either 0 or 1; the hexadecimal format is as follows: 0xDD, where "D" represents the hexadecimal digit(s); otherwise, it is decimal.
- ◆ Unless otherwise denoted, a byte will refer to an 8-bit quantity. A word will refer to a 32-bit quantity, and a double word will refer to an 8 Byte (64-bit) quantity. This is in accordance with RapidIO convention.

- ◆ A bit is set when its value is 0b1. A bit is cleared when its value is 0b0.
- ◆ The compressed notation ABC[x|y|z]D refers to ABCxD, ABCyD, and ABCzD.
- ◆ The compressed notation ABC[x...y]D refers to ABCxD, ABC(x+1)D, ABC(x+2)D,... ABCyD.
- ◆ In double words, bit 63 is always the most significant bit and bit 0 is the least significant bit. In words, bit 31 is always the most significant bit and bit 0 is the least significant bit. In bytes, bit 7 is always the most significant bit and bit 0 is the least significant bit.
- ◆ This device follows the Big endian convention. The ordering of bytes within words is referred to as either “big endian” or “little endian.” Big endian systems label byte zero as the most significant (left-most) byte of a word. Little endian systems label byte zero as the least significant (rightmost) byte of a word.

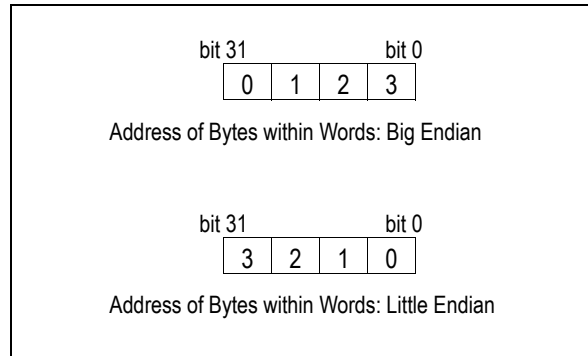


Figure 1 Example of Byte Ordering for “Big Endian” or “Little Endian” System Definition

- ◆ A read-only: register, bit, or field is one which can be read but not modified
- ◆ A sticky bit is a bit that remains set after being set by hardware until a zero is written to it. Writing a one to a sticky has no effect on its value.
- ◆ A zero field in a register, denoted as “0” in register figures, must be written with a value of zero and returns a value of zero when read.

## Revision History

- ◆ **July 10, 2012:** Revision 1.7. Removed the confidential statement from the document's footers.
- ◆ **January 19, 2011:** Revision 1.6. Fixed a number of minor errors.
- ◆ **December 14, 2010:** Revision 1.5. Fixed a number of minor errors, and added notes to [Packet Filtering](#) and [Multicast Packets](#).
- ◆ **June 4, 2009:** Revision 1.4. Updated [QUAD to QUAD Mesh PVC](#).
- ◆ **October 10, 2008:** Fourth release, Revision 1.3.
  1. Added more detail description on unicast, per-port reset and extended packet tracking.
  2. Corrected the output buffer able track 3 packet instead of 8.
  3. Quad0 and 5 PLL\_n\_Reset bit 10 and 11 are swap (In Register chapter).
  4. Added a correct way to use PLL\_n\_Reset bit. During the PLL reset, the port status bit will not get update (In Programming chapter - Quad control section).
  5. Changed the register address to bit 23 to bit 2 in the I2C EPROM configuration image address map.
  6. Changed the I2C Read/Write diagram register address to bit 23 to bit 2.
  7. Added more description on RT-mimi feature. (In Switch Chapter, RT-Mimi section)
- ◆ **July 11, 2008:** Third release, Revision 1.2. Corrected Error Source Code table. Corrected 40 multi-cast register to 40 multicast register per port.
- ◆ **April 8, 2008:** Second release. Revision 1.1. Corrected retransmit retry and multicast delay text in switch chapter. Corrected and made consistent in text that the interrupt in is active low.
- ◆ **September 10, 2007:** Initial release. Revision 1.0.



# Device Overview

## 1 DEVICE OVERVIEW

The objective of this chapter is to provide an overview of the capabilities of the CPS-10Q (80KSW0005).

### 1.1 DEVICE DESCRIPTION

The CPS-10Q functionality is optimized for line card and backplane switching. Its primary function is to switch data plane and control plane data packets via Serial Rapid IO (SRIO) between a set of devices that reside on the same line card. In addition, it supports the ability to bridge communications between multiple on-board (or local) devices and a set of external line cards by providing long run Rapid IO backplane interconnects. In this manner, for example, the device can serve as a switch between a set of RF cards and a set of Rapid IO based DSPs in a wireless basestation.

The CPS-10Q device supports packet switching from up to 16 ports which are comprised of 40 SRIO lanes. The encoded data rate for each of the lanes are configurable to either 1.25 Gbps, 2.5 Gbps, or 3.125 Gbps. The device supports lane grouping such that both 1x and 4x (standard quad) operation is provided, as defined in the applicable RIO specifications. In addition, there is an enhanced quad called "enhanced4," which is defined as a group of four lanes that can be configured as four individual non-redundant 1x ports.

The CPS-10Q supports the reception of SRIO maintenance packets (type 8) which are directed to it (i.e. hop count of 0) in support of requirements defined for a RIO switch in the applicable version 1.3 Rapid IO specifications. The CPS-10Q supports the ability to properly process and forward received maintenance packets with a hop count >0 as defined in the Rapid IO specifications. With the exception of maintenance packets, received packets are transmitted unmodified as defined in the 1.3 versions of the applicable Rapid IO specifications.

From a switching perspective the device functions statically. As such, all input to output port mappings are configurable through registers. Unless register configurations are changed, the input to output mappings remains static regardless of the received data (disregarding errors). The switching functionality does not dynamically "learn" which destinationIDs are tied to a given port by examining RIO header fields and dynamically updating internal routing tables.

The device supports priority levels 0 - 3 as defined in the revision 1.3 Rapid IO specifications.

The CPS-10Q is programmable by RIO ports, I<sup>2</sup>C or JTAG interface.

## 1.2 KEY FEATURES

- ◆ Interfaces - sRIO
  - Up to 40 Serial RapidIO (sRIO) v 1.3 full duplex lanes; 10 4x-ports and 16 1x-ports, or combinations thereof
  - Lane rates selectable; 3.125Gbps, 2.5Gbps, or 1.25Gbps
  - Short- or Long-haul reach for each Lane at all rates
  - Both preemphasis and equalization
  - Software assisted error recovery, support hot swap
- ◆ Interfaces - I<sup>2</sup>C
  - A single I<sup>2</sup>C interface either in master mode or slave mode
  - Hardware pin configurable address
  - Power up booting from external I<sup>2</sup>C memory device with error checking and reporting
- ◆ Switch
  - 100 Gbps peak throughput (decoded packets)
  - Support cut-through mode
  - Per priority buffering
  - Support 4 RIO priorities
  - Non head of line blocking
  - Support retransmissions use new payload with old ackIDs
  - Support multicast control symbol
  - Support multicast and broadcast
  - 40 per-port Multicast mask
  - Per port independent routing table
- ◆ Packet Trace
  - Each Port provides the ability to match the first 160 bits of any packet against up to 4 programmable values as comparison criteria to copy the packet to a programmable output trace port
- ◆ Clock and reset
  - Single input reference clock
  - Global hardware reset
  - Software reset
- ◆ Diagnostic packet counters per port
- ◆ Power Dissipation
  - CPS-10Q maximum power dissipation is 5.6W
- ◆ Full JTAG Boundary Scan Support (IEEE1149.1 and 1149.6)
- ◆ Package:
  - Pin-to-pin compatible package: FCBGA 676-ball grid array, 27 mm x 27mm, 1.0 mm ball pitch

## 1.3 ADDITIONAL RESOURCES

In addition to this User's Reference Manual, which explains the functionality of the CPS-10Q and how to use the device. There is a CPS-10Q datasheet which covers all electrical specifications, package pinouts, thermal characteristics, and electrical specifications available on IDT's secure access site,. Contact your local IDT sales representative to obtain your copy.

## 1.4 BLOCK DIAGRAM

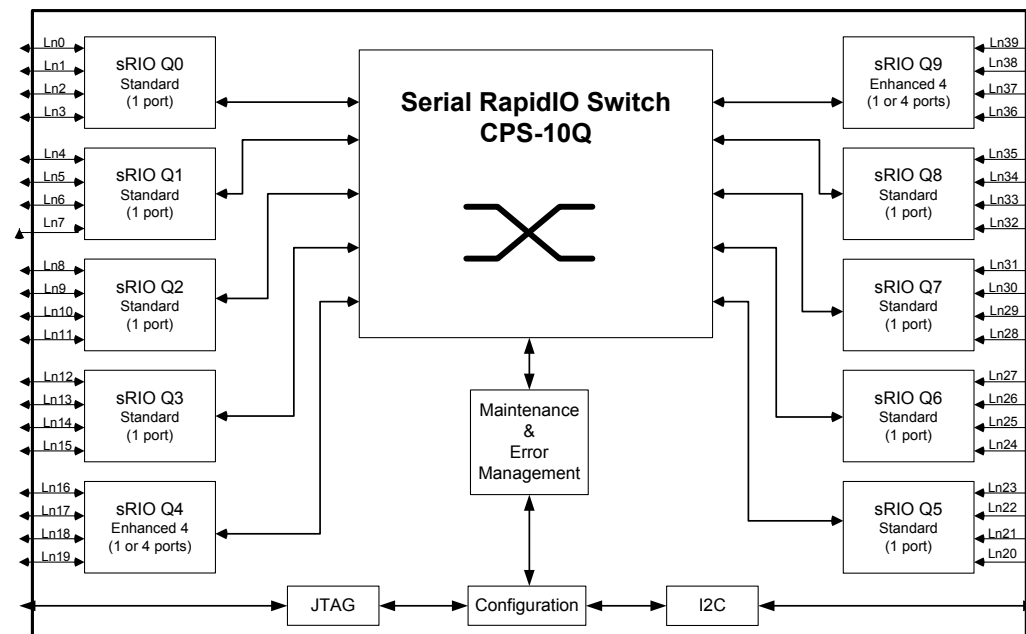


Figure 1.1 Block Diagram

## 1.5 APPLICATION EXAMPLE: THE WIRELESS BASESTATION

### Central switch based wireless processing

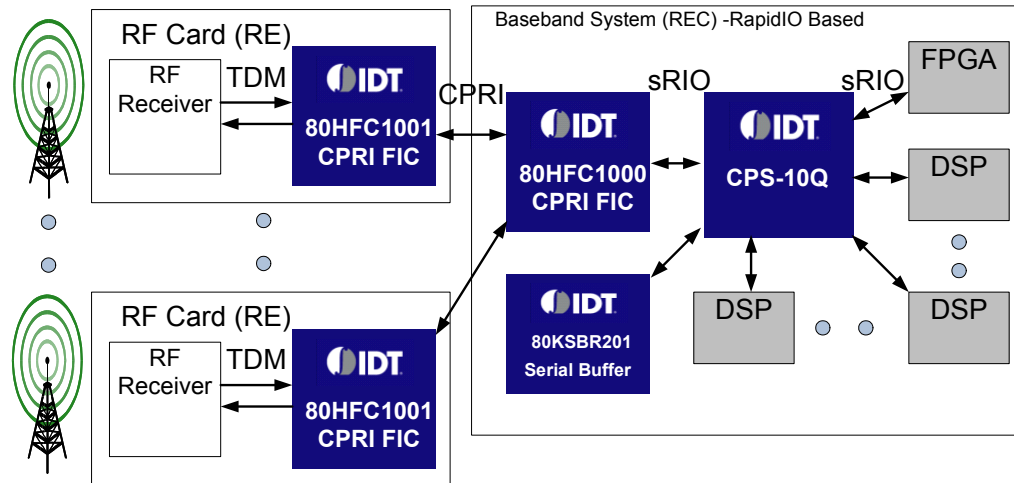


Figure 1.2 Application Overview



The CPS-10Q provides direct support for backplane connections using the serial RapidIO standard. The addition of an appropriate bridge (for example, CPRI to sRIO) allows for further backplane flexibility, accommodating designs based on a wide range of standards such as CPRI, OBSAI, GbE or PCIe.

In a macro wireless station, a switch-based raw data combination and distribution architecture is widely adopted. Switch based architecture provides high flexibility and high resource efficiency. The raw data from the Radio Unit is distributed to one or more processing cards by unicast or multicast. Aggregating raw data from processing cards to a buffer-less chain can be done by a fast non-blocking switch. It's also suitable in processing card since more and more processing is moved from RNC to Node B in the emerging applications.

### 1.6 FUNCTIONAL OVERVIEW

The user may program IDT's CPS-10Q to direct incoming packet data with a given destination ID to a packet processor. Input packets are switched as defined by the transport layer of RIO specification. The CPS-10Q receives packets from up to 16 unique ports, the received packets may be processed in three ways:

- Multicast:** If a Multicast ID is received, the CPS-10Q performs a multicast as defined by the device's configurable RIO multicast mask registers.
- Unicast:** All operations are performed as specified in RIO.
- Maintenance packets:** As specified in sRIO

### 1.7 FUNCTIONAL DIFFERENCES WITH PPS-Gen2 (80KSW00001)

#### 1.7.1 Non-blocking

When traffic is back-pressured to the receive buffer, the packet after the congested packet will still go through if it has same or higher priority and the destination port is not congested. The packet after with lower priority would not go through, even though the destination port is not congested.

#### 1.7.2 Port/Lane Count

The CPS-10Q device provides 40 sRIO lanes that can be configured up to 16 ports.

### **1.7.3 Bandwidth**

CPS-10Q provides a 100Gbps bandwidth.

### **1.7.4 PPSc Capability**

The CPS-10Q does not have PPSc

### **1.7.5 I<sup>2</sup>C Interface**

The CPS-10Q I<sup>2</sup>C interface may work either in Master mode or Slave mode.

### **1.7.6 Broadcast and Broadcast Packet Filtering**

The CPS-10Q support broadcast and broadcast filtering.

### **1.7.7 Multicast Register**

The CPS-10Q has 40 multicast register per each port.

### **1.7.8 Multicast Control Symbol**

The CPS-10Q can distribute multicast control symbol to all other ports when received a multicast control symbol. It enhances all output port synchronization.

### **1.7.9 Software Assisted Error Recovery**

The CPS-10Q can generate link request control symbol, reset control symbol and change the inbound and outbound AckID for hot swap applications.

### **1.7.10 Enhance Packet Tracking**

Ability to track up to 8 packets from a given input port.

### **1.7.11 Support for Two Separate Port Rates for Each Enhanced Quad**

In the same enhanced quad, a different lane may run at different speed.



# sRIO Ports

## 2 sRIO PORTS

### 2.1 sRIO PORT DEFINITION

The CPS-10Q provides a total of 40 Serial RapidIO lanes that are configurable into combinations of 4x and 1x ports. Each lane supports both long- or short-haul serial transmission (as defined by version 1.3 of the Serial RIO specification).

#### 2.1.1 Port Types

The CPS-10Q groups lanes in counts of four in a compatible implementation with that of the existing CPS and PPS device. A group of four lanes is defined as a "Quad". An enhanced quad called "enhanced4" can operate in enhanced or standard mode. This mode configuration is selectable through the use of Quad configuration registers (0xFF0000-0xFFF000). When Enhance4 Quad is configured in enhanced mode, it supports the ability for each of its four lanes to be used as individual 1x-ports (1 lane per port). When Enhance4 Quad is configured in standard mode, it is usable as a single 4x-port (4 sRIO lanes) or as a single 1x port. When an enhanced quad lanes are used as four individual 1x-ports, redundancy as defined by the sRIO specification is not provided.

The CPS-10Q provides 2 enhanced Quads (Enhanced4) that can be configured as four 1X ports, and 8 standard Quads that can be configured as one 4X/1X port.

An Enhanced4 Quad can be configured into either enhanced or standard mode using the mode select bit in the QUAD\_CTRL register. In standard mode, 4x or 1x operation is governed by the Port\_Width\_Override bit in the sRIO defined PORT\_CTRL\_CSR register.

A Standard Quad's operation in either 4x or 1x mode is fully governed by the sRIO defined Port\_CTRL\_CSR register (0x00015C - 0x00033C).

The complement of Standard and Enhanced Ports and Quads provided by the CPS-10Q is as shown in the following table. This table shows the maximum complement of 16 1x-ports.

Table 2.1 Port Numbering

Quad Number	Quad Mode	Lane	1X Mode	Port #	Lane	4X Mode	Port #
0	Standard	0/2	1X	0	3-0	4X	0
1	Standard	4/6	1X	1	7-4	4X	1
2	Standard	8/10	1X	2	11-8	4X	2
3	Standard	12/14	1X	3	15-12	4X	3
4	Enhanced	16	1X	4	16	4X	4
		17	1X	5	17		
		18	1X	6	18		
		19	1X	7	19		
5	Standard	20/22	1X	8	23-20	4X	5
6	Standard	24/26	1X	9	27-24	4X	6

**Table 2.1 Port Numbering**

Quad Number	Quad Mode	Lane	1X Mode	Port #	Lane	4X Mode	Port #
7	Standard	28/30	1X	10	31-28	4X	7
8	Standard	32/34	1X	11	35-32	4X	8
9	Enhanced	36	1X	12	36	4X	9
		37	1X	13	37		
		38	1X	14	38		
		39	1X	15	39		

The CPS-10Q supports lane to port assignments which are numbered from lane 0 to lane 39 in ordered fashion in groups of 10 Quad to port 0 through port 15.

An Enhanced port is capable of either being mapped into 4 device ports (if it is configured as 4 1x types) or a single device port (if it is configured as one 4x-port or one 1x-port).

The table below is informational and shows examples of configurations with various 1x and 4x device port complements versus link usage.

**Table 2.2 Port Configuration Examples**

4x Ports	1x Ports	Total Lanes Used	Quad Configurations
10	0	40	10 of 4X
9	4	40	9 of 4x 4 of 1x
8	8	40	8 of 4x 8 of 1x
0	16	16	16 of 1x

### 2.1.2 Data Rates

Each CPS-10Q sRIO Link is capable of full functionality at configurable rates of 1.25 Gbps, 2.5 Gbps, and 3.125 Gbps as defined in the Serial RapidIO Specifications revision 1.3.

### 2.1.3 Lane Configuration

sRIO lane characteristics is configurable via a set of QUAD\_n\_CTRL registers. These characteristics include the following:

- Data Rate
- Transmitter Pre-emphasis
- Drive Strength

For the Enhanced Quad, controls of each of these parameters are separately configurable such that the characteristics for lanes 0 and 1 can be different from those for land 2 and 3

In addition, these registers supports the ability to reset lanes in the quad and to force a reinitialization of lanes in the enhanced quad. The ability to control reset and initialization of lanes 0 and 1 versus lanes 2 and 3 through these registers are also provided.

## 2.1.4 Packet Forwarding

### 2.1.4.1 Store and Forward

The CPS-10Q supports a “Store and Forward” methodology for packet forwarding. This methodology consists of a validation of each received packet to the SRIO specifications (including a successful CRC verification) before the packet is forwarded via the output port referenced by the destination ID in the packet header.

### 2.1.4.2 Cut Through

The CPS-10Q supports “Cut Through” packet forwarding methodology. This methodology provides the ability to begin forwarding a packet via its referenced output port before it has been validated. Packets that have been found to be invalid after transmission has begun, is terminated with the SRIO STOMP control symbol which will be used in compliance with the rev 1.3 SRIO protocol standard. Assuming no starvation and no output port contention, the first byte in to first byte out latency for a maximum sized packet will be the same as that for a minimum sized packet.

Packet counters are implemented such that packets which are STOMPED are not included in the count. Note that Cut Through mode supports the use of the retransmit buffer for reliable transport as defined in the SRIO protocol specification.

If a Cut Through packet is being transmitted and the transmission becomes starved for data (part of the packet has been transmitted but the rest of the packet is not available for transmission) EOP control symbol will be transmitted within the packet (i.e within the boundary of the packet's SOP and EOP) until the rest (or more) of the packet becomes available for transmission.

Cut Through is disabled at reset of the device. This mode is enabled globally via a maintenance write command to the CUT\_THRU\_ENABLE bit of the CPS\_CONTROL register. If this bit is set, Cut Through forwarding methodology will be enabled for all ports.

When Cut Through is enabled the device's output packet scheduler will consider a packet as available for transmission/forwarding as soon as enough of the packet (i.e. the destination ID has been received and decoded) to determine which port to use for transmission. The device does not use full packet reception as a criteria to determine when a packet is available for transmission.

## 2.1.5 Port Statistics (Packet Counter)

The CPS-10Q provides the ability to generate statistics at each port. Each port provides a 32-bit packet counter for each of the following data for that given port:

- 1) Ack Counter: Number of Packet-accepted control symbol has been sent; number of packet has been successfully received.
- 2) Nack Counter: Number of Packet-not-accepted control symbol and packet-retry control symbol sent. Note, during the initialization and re-initialization, it may cause some Nack count. User should clear the Nack count after port initialization.
- 3) Switch Counter: Number of packet successfully sent out
- 4) Trace Counter: Packets which have met port's trace criteria (when enabled)
- 5) Filter Counter: Packets which have been filtered

All counters will reset to 0 when read, and will hold their maximum value (saturate) when it is reached.

## 2.2 TRACE FUNCTION

Each port supports the ability to compare a configurable set of parameters in a given received packet against a set of configurable predefined values and, if a match occurs, routes the packet to a configurable output port. This function is defined as the “Trace” function.

The device supports the ability to route a packet which matches the “Trace Criteria” to the port referenced by the packet's destination ID (including multicast references) as well as to the trace port.

Each port provides a unique trace circuit such that the user may enable trace on up to 16 simultaneous ports (4 for each of the 16 ports) as defined below.

### 2.2.1 Trace Criteria

The property of a given port matching a packet with a “Trace Criteria” refers to a successful comparison of the first 160 bits in a received packet to multiple pre-programmed values stored at that port. A successful match against a port’s Trace Criteria triggers a forwarding of the packet to the trace enabled output port.

Each port provides a set of four 160-bit comparison values which can be selectively applied to the first 160 bits of each packet that the port receives. Each port also provide a bit mask for each of the four programmable 160 bit comparison values which define which of the first 160 bits of packet data are relevant to the comparison. A logical value of 1 in the comparison value mask indicate that the corresponding bits in the programmed value and the corresponding bit in the packet data is compared. A logical value of zero in the comparison value mask is used as a “don’t care”. A don’t care value results in an automatic match of the corresponding bits in the programmable value with the corresponding packet data bits. When all bits of the packet data match with a given corresponding bit in a given programmable value (after the value’s mask has been applied) the Trace criteria has been met and the packet is forwarded to the trace enabled output port. The packet trace is triggered by a logical “OR” of the comparison match results (packet data with the four programmable values) such that if at least one match occurs, packet forwarding to the trace-enabled port is performed.

Note that the trace criteria is based on the “entire content” of the comparison value and its corresponding bit mask. This is true in the event that the bit count of the received packet is smaller than 160 bits. In this event, in order to match the trace criteria, the number of bits in the mask which are greater than the received packet data must be set to don’t cares as shown below.

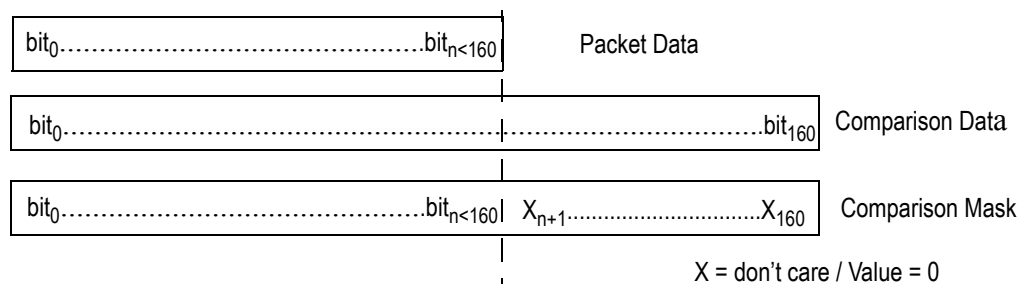


Figure 2.1 Trace Matching Criteria

For clarification, if the user wants to trace a packet which is smaller than 160 bits, the number of mask bits between the packet size and 160 must be set to don’t care.

A packet which matches any of the four values are forwarded to the trace enabled output port as well as any other ports referenced by the packet’s destination ID.

The Trace Criteria architecture is illustrated in the diagram below.

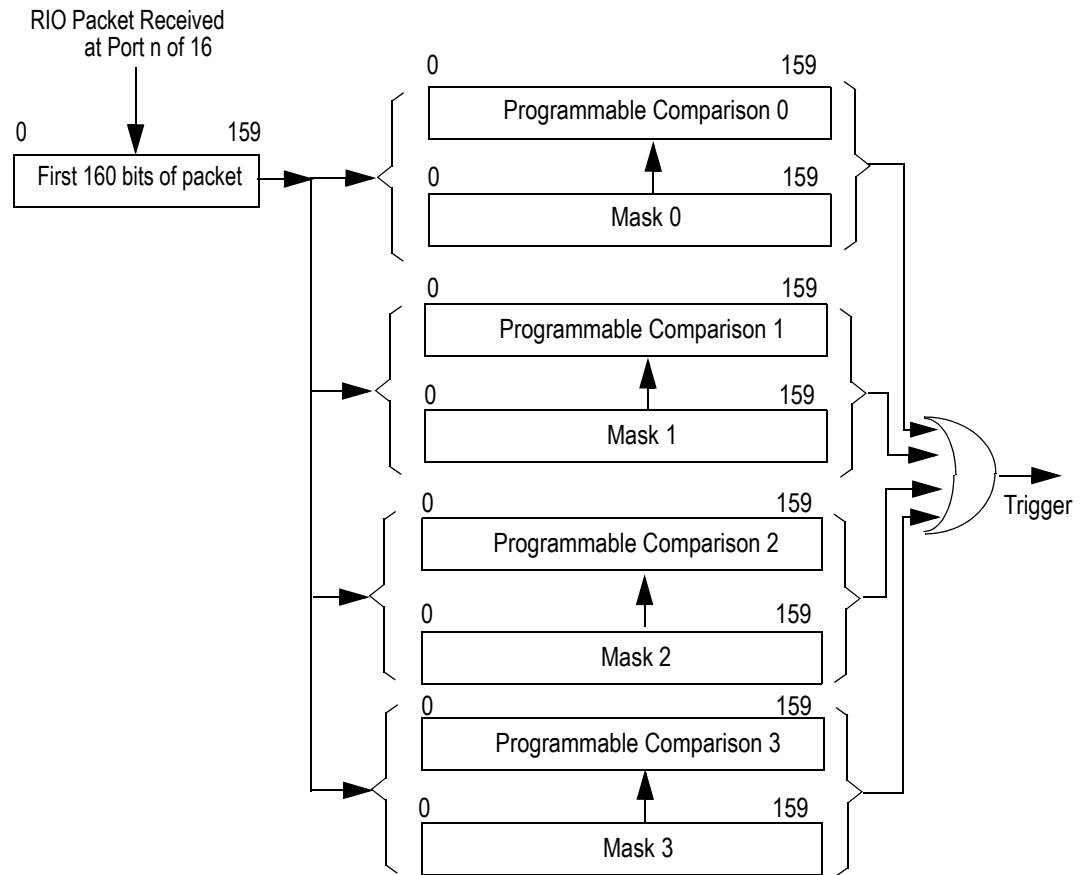


Figure 2.2 Illustration of the Trace Function within a Given Port

From an application perspective, the support for comparison over the first 160 bits of the packet is to ensure that the trace function can cover the worst case RapidIO header (including those using extended addressing) plus the first 32 bits of the payload. This implementation is totally flexible across the first 160 bits of the packet and ensures that the following parameters can be used as trace criteria: 1) the header's ftype field (4 bits), 2) the header's destination ID field (8 or 16 bits), 3) the header's mbox field (up to 8 bits), 4) the first 32 bits of the packet payload (32 bits). Note that if the input port detects an error in the received packet it will not be routed to the trace port.

### 2.2.2 Trace Output Port Features

At any given time the device supports a single Trace-enabled output port. It can be dynamically defined which output port is enabled for the Trace function. All packets which match the Trace Criteria from all trace enabled inputs is routed to the same configured trace output port.

The device supports the ability for the port defined as the output trace port to be also part of a multicast group. At the same time it is also possible for the user to configure the trace output port to match the intended destination port of a packet.



The trace port needs to be disable first before changing to a new trace port.

### 2.2.3 Trace Routing Features

CPS-10Q routing function in support of the trace function is provided in two modes.

#### 2.2.3.1 Default Trace Routing Mode

In the default mode, the trace-enabled port accepts normal RapidIO traffic (referenced by the received packet's destination ID field) as well as traffic which matches the trace criteria of all ports. Trace-triggered packets are treated by the trace-enabled output port in the same manner as it treats all other packets. Normal RapidIO priority and flow control rules apply.

#### 2.2.3.2 Optional Trace Routing Mode

In an optional mode, ONLY packets which have matched a port's trace criteria are routed to the trace port. For switch path, a received packet which does not match the Trace criteria, but whose destination ID field references the Trace-enabled port is not forwarded to the trace port. If this packet has a destination ID that references a multicast operation that includes the trace port, the packet is forwarded to all ports except for the Trace-enabled port. A packet which does not match a port's trace criteria and whose destination ID only references the Trace output port is treated as an error packet and is dropped. Trace-triggered packets are treated by the trace-enabled output port in the same manner as it treats all other packets. Normal RapidIO priority and flow control rules apply.

It is possible to configure the trace port into "trace only" mode and at the same time for the user to configure a port's route table to allow packets to be routed to the trace port (including packets which do not match the trace criteria). With this configuration, packets received by a given port which are to be routed to the trace port (as defined by that port's route table) will be dropped by the device if they do not match the trace criteria.

#### 2.2.3.3 No Route Conditions

Packets which meet the trace criteria are routed to the trace port even if the packet destination ID reference in the port's route table indicates "no route".

### 2.2.4 Trace Function Dynamic Programmability

By offering dynamic configurability, the CPS-10Q provides the user with the ability to modify trace function parameters without disabling the normal operation of the port's functionality.

The user is able to:

- 1) dynamically enable/disable the Trace function on a per-input port basis
- 2) dynamically assign the trace output port to any single output port
- 3) dynamically change the packet trace comparison values of any port
- 4) dynamically enable/disable any/all trace comparison values of any port
- 5) dynamically change the comparison value masks at any port
- 6) change a comparison value or mask (same value) for all ports with a write to a single address

### 2.2.5 Test feature for Trace Function

Each port provides a set of counters which increment each time the given port receives a packet that matches the Trace criteria. Each port provides a counter for each of the four comparison values. These counters are accessible in the same manner that all other device counters are made accessible. All trace counters are 32-bits.

### 2.2.6 Flow Control with Trace Enabled

The CPS-10Q supports sRIO defined receiver flow control when Trace is enabled as well. If buffer contention exists at the trace port such that a received packet which matches a port's trace criteria would have to be dropped (and therefore not be transmitted via the trace port) then the received packet is NACKed by the port. If this condition exists the packet is not transmitted by any port regardless of its buffer condition. For example, if the trace output port can't receive additional packets because of buffer congestion, but there is buffer space to support the normal (non-trace) path through the device, then the packet is NACKed and NOT transmitted via the normal route output port.

### 2.2.7 Errored Packets

The device does not trace packets with physical errors such as CRC errors and packets that are longer than 276 bytes. The device traces packets with logical errors (ex. invalid type) as long as they match the trace criteria.

### 2.2.8 Trace Configuration

The Trace Function is enabled globally for the device with a write to the CPS\_CONTROL register. When global trace is enabled the Trace Output Port defined in the CPS\_CONTROL register will be enabled. The CPS\_CONTROL register is used to control the mode of the Trace Output Port (Default or Trace only).

Each port supports an enable of each of its four trace criteria values in its respective PORT\_n\_OPS register. This will be independent such that a match on any given value does not depend on a match of any other value. The PORT\_n\_OPS register will also control whether or not a packet that matches a given port's trace criteria will cause the device to generate a Port Write packet.

### 2.2.9 Cut Through with Trace

The device supports Cut Through when Trace is enabled (see section 2.1.4.2).

## 2.3 PACKET FILTERING

Along with the ability to trace packets via comparisons against up to four comparison values, the CPS-10Q device supports the ability to filter packet based on comparisons against these same values. If this packet filtering is enabled, a successful comparison of the first 160 bits in a received packet to a port's pre-programmed values will result in the packet being dropped or "filtered" by the device. Note that a successful comparison will also prevent a maintenance packet from being "accepted/processed" by the CPS-10Q device (in the event that a maintenance packet that met the filter criteria had a hop count of 0).

The device supports the ability for the packet filtering to be enabled/disable at each port individually for each unique comparison value at that port.

The device provides the ability to enable/disable packet trace and packet filtering simultaneously for each port individually for each unique comparison value at that port. If both packet filtering and packet trace are enabled and a match occurs between a received packet and a comparison value, then the packet will be dropped but will also be traced to the specified trace output port. If packet filtering is enabled but trace is not, then the packet will be filtered and not traced to the specified output trace port.



In the case where packet does not match the filter and TRACE\_OUTPUT\_PORT\_MODE is set to a 1, the packet will not be routed to the destined port. IDT recommends to set the TRACE\_OUTPUT\_PORT\_MODE to 0 when only packet filtering is enabled.

The CPS-10Q provides a counter at each port for each comparison value. The counter provides a continuous count of the number of packets that have been filtered at each port as a result of a successful match against each comparison value.

## 2.4 SOFTWARE ASSISTED ERROR RECOVERY

Each port supports the software assisted error recovery registers defined in the rev 1.3 revision of the SRIO specification. Specifically these registers include the Port n Link Maintenance CSRs, the Port n Link Maintenance Response CSRs, and the Port n Local ACKID CSRs. A set of each of these three registers are provided per port.

### 2.4.1 Usage Definition for Port n Link Maintenance CSRs

A write to these registers will force CPS-10Q to transmit a Link Request Symbol on the associated link. The command field in the transmitted symbol will be the contents of the command field written into this register. A read of this register will return the value of the command field in the register.

Support is provided for two command field values: 1) Reset (0b011), and 2) Input Status (0b100)

#### 2.4.2 Link Maintenance CSR Reset Command field

A write to the Port n Maintenance CSR with the command field set to 0b011 (reset) the device will:

- 1) cease all current and pending transmissions (data and SRIO control symbols -- including multi-cast control symbols),
- 2) transmit 4 link request -- reset symbols in succession. After transmitting the link request -- reset symbols, the port will enter the output error state and wait for a corresponding link response.

#### 2.4.3 Usage Definition for Port n Link Maintenance Response CSRs

The Port n Link Maintenance Response CSRs will be read only registers which contain the information contained in the most recently received link response by the specific port. When read, they will return data.

#### 2.4.4 Usage Definition for Port n Local ACK ID CSRs

The CLR\_OUTSTANDING\_ACKIDs, INBOUND\_ACKID, OUTSTANDING\_ACKID, & OUTBOUND\_ACKID fields defined for this register are supported.

##### 2.4.4.1 CLR\_OUTSTANDING\_ACKIDs

This single bit field will be treated as write only. When this bit is written to a value of 1, CPS-10Q treats all previously transmitted packet for which acks have not been received as having been properly received by the link partner. Acknowledgment processing for these packets will no longer be required.

##### 2.4.4.2 INBOUND\_ACKID

The CPS-10Q supports both reads from and writes to the INBOUND\_ACKID parameter. If read, CPS-10Q will return the value of the expected ack ID of the next received packet.

A write of this parameter will set the expected ack ID for the next received packet to the value supplied with the write. If the port receiver state machine is in a stopped state it will return to the normal operational state after updating the expected ID value. If a packet is being received during this transition, it will be dropped without response.

##### 2.4.4.3 OUTBOUND\_ACKID

The CPS-10Q supports both reads from and writes to the OUTBOUND\_ACKID parameter. If read, CPS-10Q will refer to the value that the device will use for the next transmitted packet ack.

If written, the effect will be dependant upon whether or not there are outstanding ackIDs. If there are no outstanding ackIDs, the next transmitted packet will use the ackID written into this register. If there are outstanding ack IDs, the packets that have been previously transmitted (without the device having received an acknowledgement), will be retransmitted using ack IDs which start from the value written into this register.

##### 2.4.4.4 OUTSTANDING\_ACKID

The CPS-10Q supports both reads from and writes to the OUTSTANDING\_ACKID parameter. If read, this parameter will indicate the value of the next expected acknowledgement (control symbol ack ID field) from the port's link partner. The effect of writing this parameter will depend upon the current state of the port's outstanding ack ID status as follows:

- 1) If the port has no outstanding ack IDs the write will have no effect on the port. Because of the Outstanding AckID always reflects the ackID that the port expects to received next, so if the outbound ID change, then the outstanding ID will be changed.
- 2) If the port has outstanding ack IDs and the written value is one of them, the port will accept all existing ack IDs with lower values. Which means the port will accept the existing packets with this written value ackID and following values. The write in this case will have no effect on the ack ID of the next packet to be transmitted.
- 3) If the port has outstanding ack IDs and the written value is not one of them an error will be recorded and the port will take no action.



# Switch Description

## 3 SWITCH DESCRIPTION

### 3.1 CONCEPTUAL FUNCTIONALITY

The CPS-10Q pseudo mesh architecture is a combination of full mesh and TDM. The architecture is intended to avoid numerous parallel data paths within the switch, as opposed to a centralized arbitration scheme. Permanent Virtual Circuits (PVC) connections supports 10Gb/s of unidirectional data traffic. In systems where the QUAD\_ENH modules are operating as a single port with a maximum data bandwidth of 10Gb/s then the PVCs connected to each quad is dedicated to supporting that port. In systems where the QUAD\_ENH modules are operating as 4 independent ports each with a maximum 2.5Gb/s data bandwidth, the PVCs connected to that quad supports all 4 ports by granting bandwidth to each port in 32bit (word) portions. It is this time sharing concept that is the origin of many of the sub-modules that refer to time division multiplexing (TDM) in regard to PVC operation. This TDM method is strictly per PVC and is not functional as an overall switch-wide time division scheme. The packet ordering and sRIO protocol enforcement is handled in a distributed nature as well. The CPS-10Q switch core acts like a three stage switch composed of TDM, full mesh and TDM.

### 3.2 SWITCHING BLOCK AND ELEMENTS

The block diagram of the figure below shows the topology of the CPS-10Q Switch architecture. The PVC acronym refers to the interconnections illustrated in the figure which may be considered as permanent virtual channels. Inside each QUAD, TDM connects each port to the PVC.

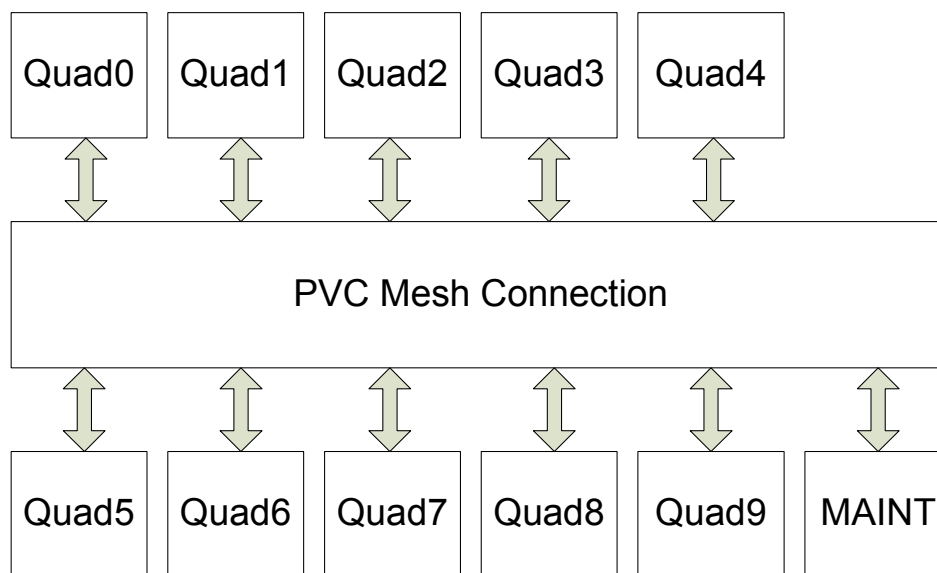


Figure 3.1 CPS-10Q Switch Core Block Diagram

### 3.3 SWITCH DESCRIPTION

The CPS-10Q device consists of three parts; the input buffers, the switching core, and the output buffers. Each of the three portions of the switch will be described in further details in the following sub-sections.

#### 3.3.1 Input Buffers

There is separate buffer resources for maintenance packets and data packets. This effectively allows a separate maintenance path through the switch. With judicious use of priorities, user can guarantee minimum latency through the system for maintenance packets even when data packets are congesting at these same ports.

For data packet, there is buffer space with room for 7 max size packets for each of the ports on the device. The port buffer space can be allocated through registers to the four priority levels, and can be configured on a per port basis. There will always be allocated room for at least one full size packet for each priority level. The buffer space is allocated in units of 35 word (140 Byte), so 2 units are required for storing one full maximum sized packet. The recommended default allocation of buffer space is 4 maximum size packet for priority 0, and 1 maximum sized packet for other priority, but this is subject to change by user.

For maintenance packet, the buffer size is 88Byte per priority per port. Separate maintenance packet input buffer will avoid being blocked due to resource sharing.

For each priority of a given port, the input buffers can keep track of up to 4 or 8 packets, giving that there is enough buffer space to hold them. The EXTENDED\_PKT\_RX\_ENABLE bit in Port Operation Register selects the number 4 or 8. See 3.3.2 Extended Packet Tracking.

When a packet arrives it will only be accepted into an input buffer if that buffer has room for at least one data word of 32 bits, for each additional data word of the packet if there is no more room in the buffer the packet will be aborted and a RETRY will be sent back out on the sRIO link. See Figure below.

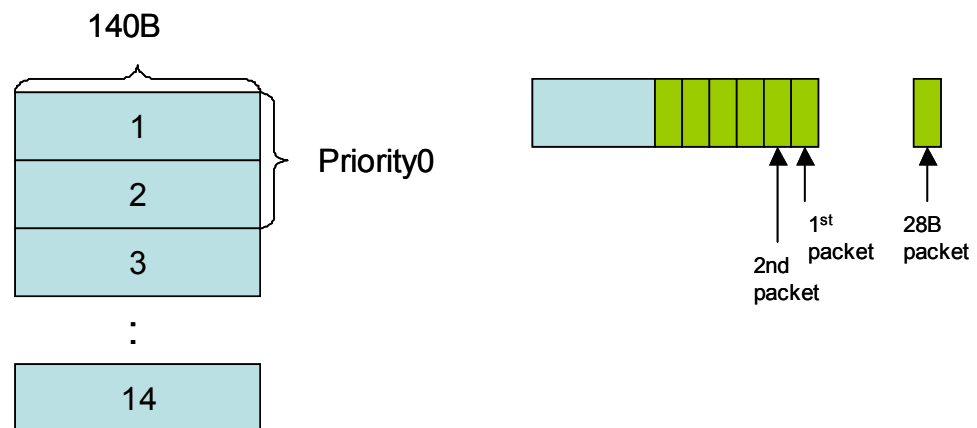


Figure 3.2 Input Buffer Diagram

#### 3.3.2 Extended Packet Tracking

The extended packet tracking function allows input buffer keep track up to 8 packet per priority. (See register 0xF40004 bit 18.) It is typically for small packet application. When the extended packet tracking function is enabled, the non-blocking within the priority function will be disabled automatically.

#### 3.3.3 Non-blocking Within the Priority

The Non-blocking function allows three late come in packets within the same priority by pass the blocking packet and send it to a free port. The Non-blocking function will automatically enabled when the extended packet tracking function is disabled.

### 3.3.4 Switch Core

The switch core acts like a three stage switch composed of TDM, Mesh and TDM. Mesh PVC connects QUAD to QUAD, TDM connect Port to Port inside the QUAD. The function of the switch core is moving data from input buffer to output buffer.

#### 3.3.4.1 QUAD to QUAD Mesh PVC

The PVC module is used to connect every quad to every other quad as well as all quads to the maintenance handler and the maintenance handler to all quads. It handles data transfer as well as control. The PVC module serves as a pipeline connection between nodes. It provides no other functionality beyond this and simply made up of registers for all incoming signals that then drive the outputs. There is total of 36 PVC for the data path in the CPS-10Q. Each PVC has 10G bandwidth.

#### CPS-10Q PVC Mapping

The CPS-10Q groups two standard quad to share 6 PVC. Those two standard quad called Quad group. See **Figure 3.3**. There is only one PVC connect one Quad group to another. Each Quad group has 6 PVC connect all other Quad group (total of 36 PVCs) and each PVC bandwidth is 10G. A given 10G PVC will share bandwidth by traffic flows from one Quad group to other Quad group.

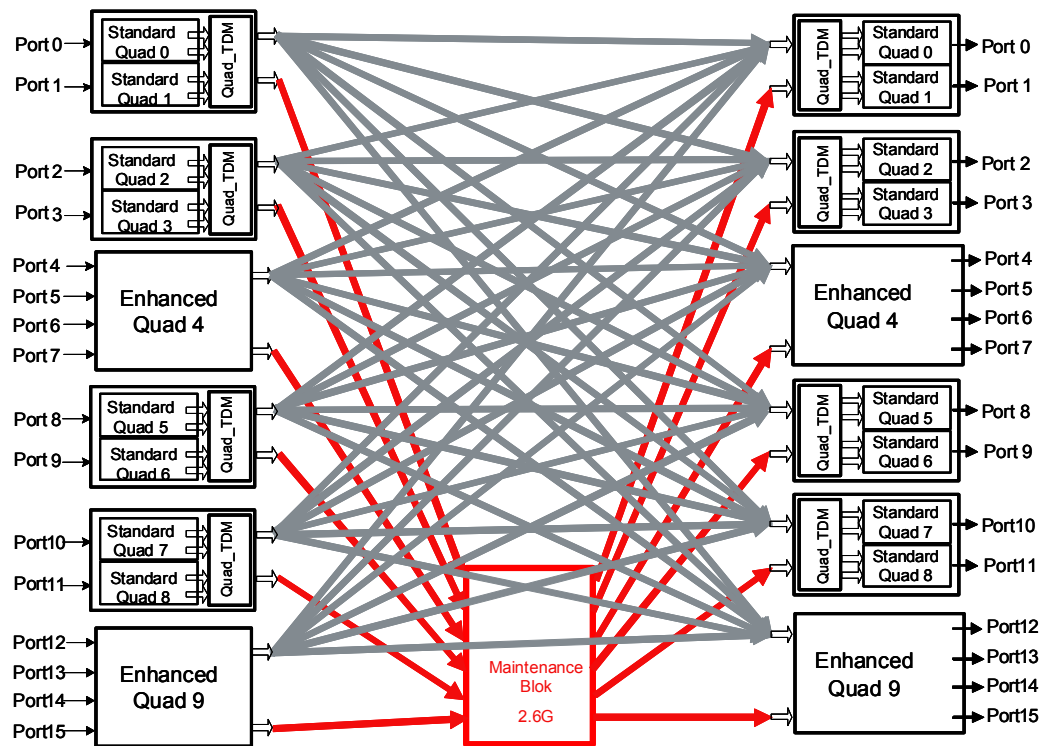


Figure 3.3 CPS-10Q PVC Mapping



The best traffic through for CPS-10Q is to avoid the two standard Quad in the same Quad group send traffic to other Quad group. For example, Quad0 and Quad1 send traffic to Quad2 and Quad3. Since there is only one PVC connect between the Quad group, the total bandwidth between the Quad group is 10G. If two ports in one Quad group send traffic to other two also in one Quad group, then it will have 10G bandwidth instead of 20G. See Figure 3.4 for worst data flow and Figure 3.5 for best data flow.

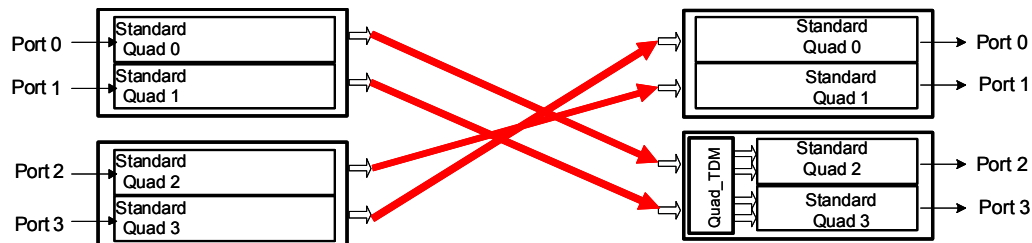


Figure 3.4 Worst data flow in CPS-10Q

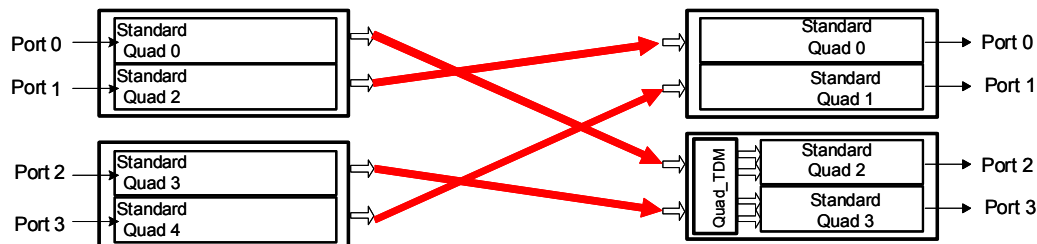


Figure 3.5 Best data flow in CPS-10Q

### 3.3.5 Output Buffers

There are separate output buffer resources for maintenance packet and data packet. The output buffer provides a temporary storage for outgoing packets, it decouples the switching and transmitting. It achieves wire speed while transmitting different priority packets per sRIO specification.

For data packet path, the output buffer size is 448 bytes per priority per port. Each output buffer can track up to 8 packets, given that there is enough buffer space for them. The output buffer will only allow new packet in if it has free tracking resources and buffer space available for a full maximum sized packet.

For maintenance packet path, the buffer size is 88 bytes per priority per port. The separate maintenance packet buffer builds a independent data path.

### 3.3.6 Retransmit Buffers

There is 4 maximum packet size retransmit buffer for each priority for a given port. There is total of 16 maximum packet size buffer for each port. Each priority can keep track of up to 32 packets. Both data packet and maintenance packet share the same buffer. The retransmit buffer is enough to deal with normal response delay.

## 3.4 SWITCHING SCHEDULER AND PRIORITIES

### 3.4.1 Input Buffer to Output Buffer

First arrive first served is the basic rule of moving data from input buffer to output buffer. For the same source port, strict-priority is applied. That means packets in the higher priority queue always is served first. For a given queue of given source port, it can bypass the destination-blocked packet to serve subsequent packets. Maintenance packets are always treated as higher priority than data packet.

For the same destination, same priority, different sources to this destination are done in a Round-Robin manner.

These rules apply to multicast and unicast. The difference is that the input buffer will not be released until the packet has been forwarded to all destinations in the multicast list. In another words, one blocked destination port of the multicast list will not block the forwarding to other destination ports (multicast splitting), but it does hold the input buffer resource.

### 3.4.2 Output Buffer to Transmit Buffer and Transmit Buffer to Line

#### 3.4.2.1 Unicast Packets

If a tx port fails in an attempt to transmit a priority N packet (call it PA) due to CRC error, and there is a priority >N Packet (call it PB) available at the port's retransmit buffer, then that higher priority packet PB must be the next one sent. Specifically, if tx port A transmits a packet of priority N (call it PA) but receives a "not accepted" response, then the next packet transmitted after receiving the response must be a packet of priority > N if one is available in the retransmit buffer. Since the "not accepted" result is due to CRC error, then the original packet PA will be retransmitted up to X times (See port operation register, bit 3-1, number of retransmissions). Before each of the X attempts, the retransmit buffer will be reviewed to verify that there are no priority > N packets available. If after X attempts the original packet PA is still not accepted, then PA will be discarded and transmission of the next packet in tx port A's retransmit buffer will be attempted. If the "not accepted" cause by the traffic flow control such as the endpoint is busy or endpoint input buffer is full, then PA will remain in retransmit buffer and keep retransmit until PA pass through. The following is standard behavior:

- 1) The retransmit buffer must have room for at least one maximum size packet of each of the four priorities. If the highest priority packet in the retransmit buffer is priority N, then the retransmit buffer must reserve space sufficient to store at least S maximum size packets, where  $S = 3 - N$ . The minimum size retransmit buffer that can meet this requirement is 4 times the maximum packet size.
- 2) If the highest priority packet in the retransmit buffer has priority N, and a packet of priority > N is being offered to the retransmit buffer by the switch's TXBUFs, then the retransmit buffer must accept the packet from the TXBUFs. This is true even if the tx port is blocked by a packet of priority N or less.
- 3) If TX/RX BUFs has lower priority packet A in buffer and continuously received higher priority packet which reach the port bandwidth, then the lower priority packet will continuously hold off until higher priority packet bandwidth drop below the port bandwidth. The same rule applies to all ports.

Also, the following behavior is standard:

- 1) **Not blocking with the same priority.** If rx port B receives a packet (call it PC) of priority M (where  $M \leq N$ ) targeted for tx port A, but port A cannot receive it due to the conflict resulting from PA described above, then PC will remain in the input buffer. All subsequent packets received at rx port B of priority M or higher targeted for other tx port will still switch over. For the subsequent packet with priority < M targeted for ANY tx port will delayed until packet PB can be forwarded to the switch.


#### 3.4.2.2 Multicast Packets

In general, multicast packets will be treated similarly to unicast packets. Specifically, if tx port A transmits a multicast packet of priority N (call it PA) but receives a "not accepted" response, then the next packet transmitted after receiving the response must be a packet (unicast OR multicast) of priority > N if one is available in the retransmit buffer. If the "not accepted" cause by the CRC error, then the original packet PA will be retransmitted up to X times (See port operation register, bit 3-1, number of retransmissions). Before each of the X attempts, the retransmitted buffer will be reviewed to verify that there are no priority > N packets available. If after X attempts the original packet PA is still not accepted, then PA will be discarded and transmission of the next packet in tx port A's retransmit buffer will be attempted. If the "not accepted" cause by the traffic flow control such as the endpoint is busy or input buffer is full, then PA will remain in retransmit buffer and keep retransmit until PA pass through. The following is standard behavior:

- 1) The retransmit buffer must have room for at least one maximum size packet of each of the four priorities. If the highest priority packet in the retransmit buffer is priority N, then the retransmit buffer must reserve space sufficient to store at least S maximum size packets, where  $S = 3 - N$ . The minimum size retransmit buffer that can meet this requirement is 4 times the maximum packet size. It is not necessary to distinguish between unicast and multicast packets in filling these buffers. They may be filled with 4 unicast packets, 4 multicast packets, or any combination of unicast and multicast packets.

2) If the highest priority packet in the retransmit buffer (unicast OR multicast) has priority N, and a unicast or multicast packet of priority > N is being offered to the retransmit buffer by the switch's txbuf, then the retransmit buffer must accept the packet from the TXBUFs.

Also, the following behavior is standard:

 **Multicast Split:** If rx port B receives a packet (call it PC) of priority M (where  $M \leq N$ ) targeted for tx port A, but port A cannot receive it due to the conflict resulting from PA described above, then PC will remain in the input buffer but it will continue multicast to other available tx port. All subsequent packets (multicast or unicast) received at rx port B with priority  $\geq M$  targeted for other tx port will still switch over. For the subsequent packet with priority < M targeted for ANY tx port will be delayed until packet PB can be forwarded to the switch. PC will not remove from the input buffer until port A is available to receive new packet.



For multicast, sRIO specification is limited to request transactions that do not require responses, such as SWRITE transactions. So it is user's responsibility to multicast non-response packet. The CPS-10Q will blindly forward packet based on the ID and routing table. If user multicast a transactions with responses, CPS-10Q will not drop any response. All responses will forward to the sender base on the DestID.

### 3.4.2.3 Re-Transmission MIMIC

The intent of RT-mimic was to allow for streaming data application where low-latency is preferred even at the cost of occasional packet loss. It is implemented by not storing packets in the retransmit buffer. In this way, if a retry was received because the link partner has a full input buffer or if a NAK was received because of a transmission error, then CPS-10Q would simply resent the next available packet instead of retransmitting the previous one. RT-mimic affects behavior on the output-port only and all packet traffic if it is enabled.

## 3.5 FLOW CONTROL AND CONGESTION MANAGEMENT

### 3.5.1 Flow Control Internal

Internally, self defined protocol coordinate each module. The flow control is always companioned with data in the anti-direction. Data is moving from input buffer to output buffer, flow control is send from output buffer to input buffer. Quick transportation and quick response minimize the buffer dimension.

### 3.5.2 Flow Control Outside

The CPS-10Q SRIO port supports receiver based flow control. (See sRIO spec for detail information about receiver based flow control).



# I<sup>2</sup>C Interface

## 4 I<sup>2</sup>C Interface

This chapter discusses the I<sup>2</sup>C capabilities of the CPS-10Q.

### 4.1 Overview

The I<sup>2</sup>C Interface is compliant with the *I<sup>2</sup>C Specification* as a slave device and as a temporary master. The I<sup>2</sup>C port can be thought of primarily as a control plane access point for the CPS-10Q. An external device such as a host processor can use it to access the CPS-10Q's registers. The port can also be used by the CPS-10Q to load registers.

The use of the I<sup>2</sup>C port is not targeted as a bridge to other external devices through the CPS-10Q's RapidIO ports. There is no special safeguard on the I<sup>2</sup>C address assignment inside the device. Users should assign the I<sup>2</sup>C address as per specification.

### 4.2 Master/Slave Configuration

The CPS-10Q provides an external signal, MM, to configure the device in Master mode or Slave mode out of reset. When this signal is tied to V<sub>DD</sub> (1.2V), it configures the device into temporary Master mode after reset. If left floating, it will configure the device into Slave mode after reset.

### 4.3 Temporary Master Mode

The CPS-10Q supports temporary Master mode to directly obtain its configuration from an external EEPROM using I<sup>2</sup>C. As such, in Master mode the device can read/download, and optionally verify, its registers from an external EEPROM. The CPS-10Q will operate one burst read to download all data from EEPROM. I<sup>2</sup>C burst read start address 0xh00 (16bit address bit).

The device supports configuration into temporary Master mode in two ways:

1. If an external Master mode signal is tied to V<sub>DD</sub> (1.2V), the device will come out of reset in Master mode.
2. If the Master mode signal is left floating the device will come out of reset in Slave mode, but can be configured to transition to Master mode. This is done by setting I2C frequency, slave address, and checksum disable in I2C Master Control Register and I2C Master Status and Control Register.

#### 4.3.1 Obtaining Configuration in Master Mode

If the Master mode signal, MM, is tied to V<sub>DD</sub> (1.2V), the CPS-10Q will attempt to load its configuration registers after the device reset sequence has completed. The CPS-10Q uses a 7-bit address of 1010[ID2][ID1][ID0] as the slave address of the device from which it will obtain its configuration. [ID2][ID1][ID0] are external signals to the device, and are the same three lower bits that would be used for the device's I<sup>2</sup>C address when configured as a slave. When configured to come out of reset as an I<sup>2</sup>C master, the device supports communication only with an external device that has a 7-bit address. 10-bit I<sup>2</sup>C addressing is not supported in this mode. The data includes a CRC value that the CPS-10Q uses to compare against its own calculated value to determine the validity of the registers load. The registers are loaded from the EEPROM regardless of the value of the checksum, but a flag is set (I2C Master Status and Control Register.I2C\_CHKSUM\_FAIL) if the CRC fails.

When in this mode, the state of the external ADS signal is ignored. Once the CPS-10Q completes its configuration sequence (successfully or unsuccessfully), it reverts to Slave mode (where the ADS signal becomes active).

### 4.3.2 Commanded Master Mode

The CPS-10Q can be commanded into temporary Master mode using a maintenance write to the I2C Master Control Register and I2C Master Status Control Register. In this scenario, the device has come out of reset in Slave mode with the Master mode external signal left floating, or optionally tied to GND. Writing to START\_I2C\_EEPROM\_READ in the I2C Master Status Control Register causes the device to transition from Slave to temporary Master mode and read the EEPROM from the address specified in the EEPROM\_START\_ADDR.

Commanded Master mode provides more configuration sequence flexibility. In this scenario the EEPROM slave address, and the EEPROM start address for the download, are both programmable. Whether or not a checksum comparison is performed to validate the download is also programmable. These configuration sequence options are established by writes to the I2C Master Control Register and I2C Master Status Control Register.

During (and after) the configuration sequence, the CPS-10Q provides status information about the operation. This status includes whether or not any I<sup>2</sup>C errors occurred, whether the operation is active or finished, and whether or not the operation was successful. The ability to abort the operation using a maintenance write to the I2C Master Status Control Register is also provided.

When the device is in temporary Master mode, the state of the external ADS signal is ignored. Once the device completes its configuration sequence (successfully or unsuccessfully), it reverts to slave mode (where the ADS signal will become active).

### 4.3.3 Master Clock Frequency

While in the Master mode, the CPS-10Q can be configured to supply a clock of either 100 kHz (Standard mode) or 400 kHz (Fast mode).

### 4.3.4 Register Map

The device's register map is based on the concept of configuration blocks whose definition and accompanying data is located at specific places in the EEPROM address map. The definition of the register map is as follows:

1. Byte addresses 0x0000 and 0x0001 contain the version number to be used as an initial verification of the registers (see [Table 4.1](#)). Each address must contain the value 0xAA, otherwise the EEPROM contents will not be loaded.
2. Byte addresses 0x0002 and 0x0003 define the number of configuration blocks that are in the register map. This value is one less than the number of configuration blocks in the device. For one image, the value should be 0x00 for each address.
3. Byte address 0x0004 is the start of the first block. All blocks have the same format.
4. The first byte in the block encodes the lower 8 bits [7:0] of a 10-bit word defining the number of registers represented in this block. A value of 0 = 1 register, 1 = 2 registers, and so on.
5. The first two bits in the second byte (bits 7 and 6) are the upper two bits of the number of registers loaded. The lower 6 bits are the upper bits of the address (bits [21:16]).
6. Bytes 3 and 4 of the block encode the address to load the data that follows. The 22-bit address is the 24-bit device register address with the lower 2 bits dropped and assumed to be zero.
7. The remainder of the bytes of the block contain the data to be loaded into consecutive register addresses.
8. Subsequent blocks use the same format, number of registers, address, and data.

9. Note, registers that are only 8 bits wide will only load 8 bits of data from the EEPROM. The data for subsequent registers will be every 8 bits.
10. The last two bytes of the register map represent the CRC for the image. For more information, see [CRC Calculation](#).

A tabular view of this definition is displayed below.

**Table 4.1 EEPROM Register Address Map**

EEPROM Address (byte level addresses)	Bits	EEPROM Contents	Comments
0x0000	0:7	First byte of Version Number [0:7]	This value must be = 0xAA. The two version bytes are used as an early validation of the format of the memory block. If the read value from the EEPROM does not equal 0xAA the read configuration sequence will be terminated.
0x0001	0:7	Second byte of Version Number [8:15]	This value must be = 0xAA.
0x0002	0:7	First byte of a 16-bit value that defines the total number of configuration blocks to read [0:7]	-
0x0003	0:7	Second byte of a 16-bit value that defines the total number of configuration blocks to read [8:15]	For n configuration blocks, the value entered here is n-1
0x0004	0:7	The lower 8 bits of a 10-bit value that defines the number of words in configuration Block 1.	Represents bits [0:7] of the 10-bit block count. For m words, the value entered here is m-1.
0x0005	0:1	Bits 8:9 of the 10-bit block count	-
0x0005	2:7	Bits 0:5 of the block address	-
0x0006	0:7	Bits 6:13 of the block address	-
0x0007	0:7	Bits 14:21 of the block address	Bits 22:23 are zero.
0x0008:0x000B	All	Bits 0:31 of the data to load into EEPROM address, 0x0005 to 0x0007	-
0x000C:0x000F	All	Bits 0:31 of the data to load into the above address + 1	-
...	...	Remainder of block 1	-
n	0:7	The lower 8 bits of a 10-bit value that defines the number of words in configuration Block 2.	Represents bits [0:7] of the 10-bit block count. For m words, the value entered here is m-1.
n + 1	7:6	Bits 8:9 of the 10-bit block count	-
n + 1	2:7	Bits 0:5 of the block address	-

**Table 4.1 EEPROM Register Address Map (Continued)**

EEPROM Address (byte level addresses)	Bits	EEPROM Contents	Comments
n + 2	0:7	Bits 6:13 of the block address	-
n + 3	0:7	Bits 14:21 of the block address	Bits 22:23 are zero
n + 4:n + 7	All	Bits 0:31 of the data to load into the above address, (n + 1) to (n + 3)	-
n + 8:n + 11	All	Bits 0:31 of the data to load into address + 1 above	-
...	...	Remainder of block 2	-
...	...	Remainder of blocks M	-
z	0:7	Bits 0:7 of CRC	-
z + 1	0:7	Bits 8:15 of CRC	-

### 4.3.5 CRC Calculation

The EEPROM's contents are protected by a 16-bit CRC at the end of the loaded image. The CRC does not prevent incorrect data from loading; however, the CPS-10Q will set the I2C\_CHKSUM\_FAIL status bit in the I2C Master Control Register to indicate that the CRC failed.

The CRC is calculated using a standard CRC-16 polynomial  $x^{16} + x^{15} + x^2 + 1$  with an initial value of zero. The algorithm used by the CPS-10Q to calculate the CRC differs from standard CRC algorithms in that the standard CRC algorithm normally pads the data by the width of the CRC as a final 16 bits of data to shift through the algorithm. The CPS-10Q does not do that, therefore, the standard CRC-16 algorithm will not generate a correct CRC. The following algorithm will generate the CRC-16 expected at the end of the EEPROM.

```

unsigned short icrc16(unsigned char* data, int numBytes) {
    unsigned short remainder = 0;
    unsigned char  crc[16];
    unsigned char  byte;
    unsigned char  bit_Pos;
    unsigned char  bit_Pos_Mask;
    unsigned char  carry;
    unsigned char  serial_data;
    unsigned int   word;
    int data_byte_size;
    int i, b;

    remainder = 0;
    memset(crc, 0, sizeof(crc));

    for (b=0; b < numBytes; b++) {
        byte = data[b];

        bit_Pos_Mask = 0x80;
    }

```

```

for (bit_Pos = 0; bit_Pos < 8; bit_Pos++) {
    carry = crc[15];
    if (bit_Pos_Mask & byte)
        serial_data = 1;
    else
        serial_data = 0;
    for (i=15; i>=0; i--) {
        if (i == 15) {
            crc[i] = carry ^ crc[i-1];
        } else if (i == 2) {
            crc[i] = carry ^ crc[i-1];
        } else if (i == 0) {
            crc[i] = carry ^ serial_data;
        } else {
            crc[i] = crc[i-1];
        }
    }
    bit_Pos_Mask >>= 1;
}

for (i=15; i>=0; i--) {
    remainder |= (crc[i] << i);
}

return (remainder);
}

```

### 4.3.6 Register Map Example

The following is a list of registers to be configured through an I2C EEPROM, and the I2C values required to set those registers.

**Table 4.2 Register Map Example**

Register	Value	Comment
0x00015C	0x00600000	Block 1
0xE00000	0x01	Block 2
0xE00004	0x02	-
0xE00008	0x03	-
0xE0000C	0x04	-
0xE00010	0x05	-
0xE00014	0x06	-
0xE00018	0x07	-
0xE0001C	0x08	-
0x6c	0x14	Block 3

### 4.3.7 EEPROM Format Example

Table 4.3 EEPROM Format Example

EEPROM Address	Data	Comment
0x0000	0xAA	Version Number
0x0001	0xAA	-
0x0002	0x00	-
0x0003	0x02	Number of Blocks = 3
0x0004	0x00	Start of Block 1 - Register count = 1
0x0005	0x00	-
0x0006	0x00	-
0x0007	0x57	Address = 0x158 >> 2 = 0x57
0x0008	0x00	Data for block 1 = 0x00600000
0x0009	0x06	-
0x000A	0x00	-
0x000B	0x00	-
0x000C	0x08	Start of Block 2 - Register count = 9
0x000D	0x38	Address = 0xE00000 >> 2 = 0x380000
0x000E	0x00	-
0x000F	0x00	-
0x0010	0x01	Data for address 0xE00000
0x0011	0x02	Data for address 0xE00004
0x0012	0x03	Data for address 0xE00008
0x0013	0x04	Data for address 0xE00010
0x0014	0x05	Data for address 0xE00014
0x0015	0x06	Data for address 0xE00018
0x0016	0x07	Data for address 0xE0001C

**Table 4.3 EEPROM Format Example (Continued)**

EEPROM Address	Data	Comment
0x0017	0x08	Data for address 0xE00020
0x0018	0x09	Data for address 0xE00024
0x0019	0x00	Start of Block 3 - Register count = 1
0x001A	0x00	Address = 0x6c >> 2 = 0x1B
0x001B	0x00	-
0x001C	0x1B	-
0x001D	0x00	Data for address 0x6c = 0x00000014
0x001E	0x00	-
0x001F	0x00	-
0x0020	0x14	-
0x0021	0xD7	CRC = 0xD746
0x0022	0x46	-

## 4.4 Slave Mode

When the CPS-10Q is configured as a slave, its physical device address is defined by 10 external pins, ID[9:0]. The device can operate as either a 10-bit or 7-bit addressable device, as defined by an additional external pin called ADS. If the ADS pin is tied to  $V_{DD}$  (1.2V), then the device operates as a 10-bit addressable device using ID[9:0]. If the ADS pin is tied to GND, then the device operates as a 7-bit addressable device as defined by ID[6:0].

**Table 4.4 I<sup>2</sup>C Address Pins**

Pin	Name
ID [9]	I2C address bit 9 (10-bit mode only)
ID [8]	I2C address bit 8 (10-bit mode only)
ID [7]	I2C address bit 7 (10-bit mode only)
ID [6]	I2C address bit 6
ID [5]	I2C address bit 5
ID [4]	I2C address bit 4
ID [3]	I2C address bit 3
ID [2]	I2C address bit 2
ID [1]	I2C address bit 1

Table 4.4 I<sup>2</sup>C Address Pins (Continued)

Pin	Name
ID [0]	I2C address bit 0

#### 4.4.1 Signaling in Slave Mode

Communication with the CPS-10Q in Slave mode on the I<sup>2</sup>C bus supports the following cases:

1. Master device to CPS-10Q:
  - a. Master device addresses the CPS-10Q as a slave
  - b. Master device (master-transmitter), sends data to the CPS-10Q (slave-receiver)
  - c. Master device terminates the transfer
2. CPS-10Q to Master device:
  - a. Master device addresses the CPS-10Q (slave)
  - b. Master device (master-receiver) receives data from the CPS-10Q (slave-transmitter)
  - c. Master device terminates the transfer.

Full signaling definition is defined in the *I<sup>2</sup>C Specification*. Standard waveforms are displayed in the following figures.

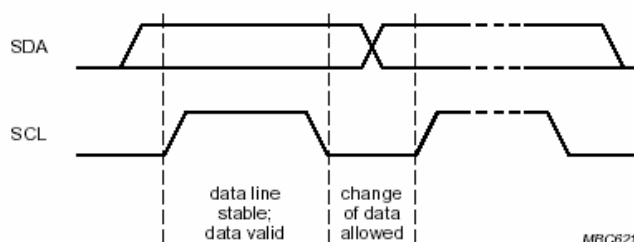


Figure 4.1 Bit Transfer on the I<sup>2</sup>C Bus

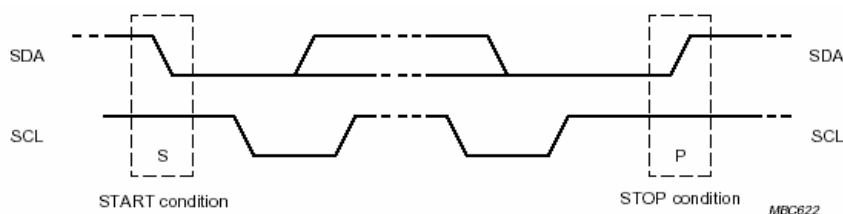


Figure 4.2 START and STOP Signaling

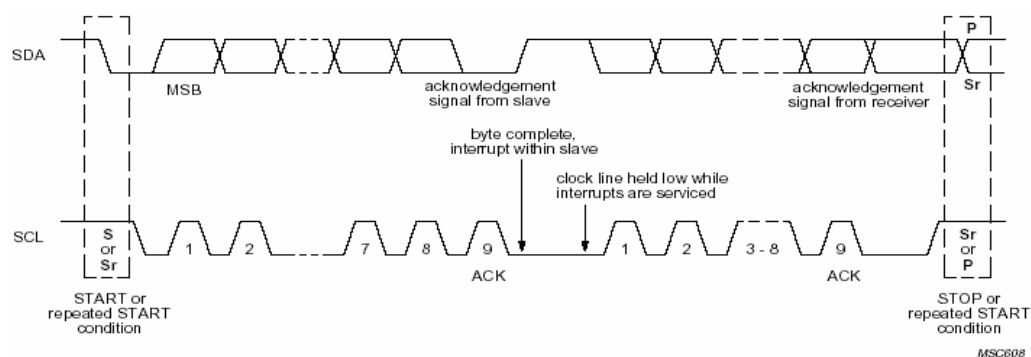


Figure 4.3 Data Transfer

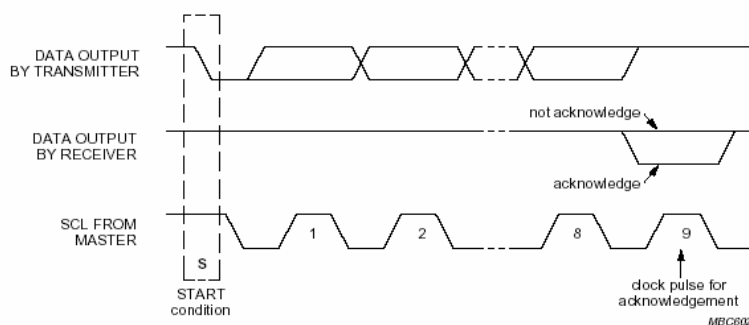


Figure 4.4 Acknowledgment

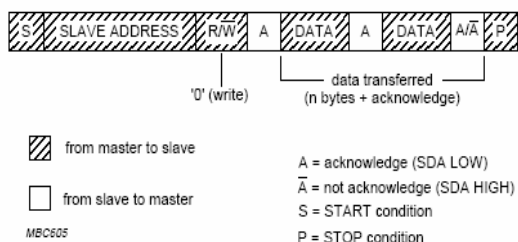


Figure 4.5 Master Addressing a Slave with a 7-bit Address (Transfer Direction is Not Changed)

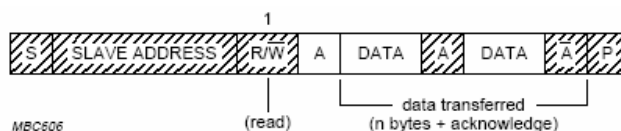


Figure 4.6 Master Reads a Slave Immediately After the First Byte

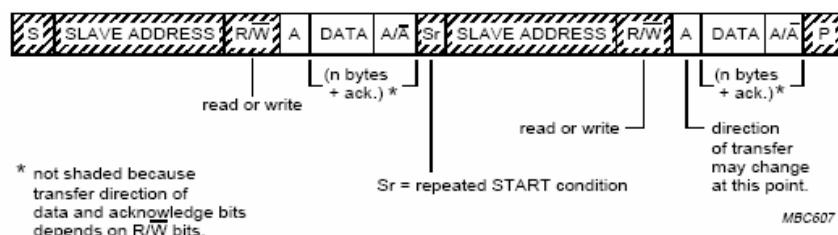


Figure 4.7 Combined Format



Figure 4.8 Master Addresses a Slave-Receiver with 10-bit Address

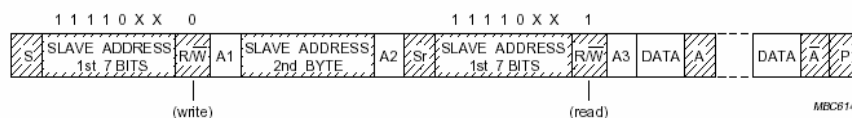


Figure 4.9 Master Addresses a Slave Transmitter with 10-bit Address

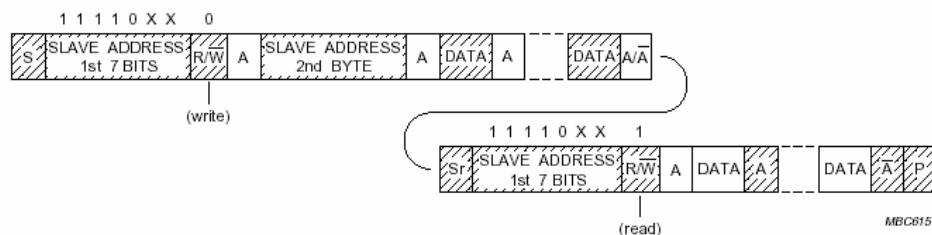


Figure 4.10 Combined Format: Master Addresses a Slave with 10-bit Address<sup>1</sup>

1. Then transmits data to slave and reads data from slave.

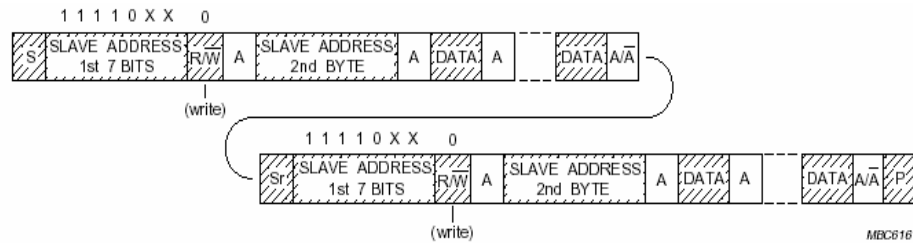


Figure 4.11 Combined Format: Master Transmits Data to Two Slaves, Both with 10-bit Address

#### 4.4.2 Connecting to Standard-, Fast-, and Hs-Mode Devices as a Slave

The CPS-10Q supports Fast / Standard (F/S) modes of operation. As per the *I<sup>2</sup>C specification*, in mixed speed communication the CPS-10Q supports HS and Fast-mode devices at 400 kbps, and Standard-mode devices at 100 kbps. The CPS-10Q supports speed negotiation on mixed speed buses as defined in the *I<sup>2</sup>C Specification*.

#### 4.4.3 CPS-10Q Memory Access through I<sup>2</sup>C as a Slave

The CPS-10Q supports direct memory access through its I<sup>2</sup>C Interface as defined in the *I<sup>2</sup>C Specification*. It requires the memory address to be specified during writes to its registers. This provides directed memory accesses through the I<sup>2</sup>C bus.

The CPS-10Q write procedure requires 22 bits of memory address to be provided following the device address. Thus, the following are required:

1. A device address (one or two bytes depending on 10-bit/7-bit addressing)
2. A memory address (3 bytes yielding 22-bits of memory address)
3. A 32-bit data payload (4 bytes)

Note that the device address can be configured to any arbitrary value using the external address select pins. A slave address should also be used that is unique to each device on the bus. IDT also recommends to avoid using reserved addresses as specified in the *I<sup>2</sup>C Specification*, such as CBUS addresses. Providing the I<sup>2</sup>C access is correct, the CPS-10Q will respond accordingly – even when the slave address is set to specification reserved address ranges.

As a slave, the CPS-10Q read procedure has the memory address section of the transfer removed. To perform a read, the proper access will be to perform a write operation (which provides a 22-bit address) and then to issue a repeated start after the acknowledge bit following the third byte of memory address. The master will issue a read command selecting the CPS-10Q through the standard device address procedure with the R/W bit high. Note that in 10-bit device address mode (ADS is 1), only the two MSBs need be provided during this read. Data from the previously loaded address will immediately follow the device address protocol. It will be possible to issue a stop or repeated start anytime during the write data payload procedure, but it must be before the final acknowledge; that is, canceling the write before the write operation is completed and performed. Also, the CPS-10Q I<sup>2</sup>C Interface will allow the master to access other devices attached to the I<sup>2</sup>C bus before returning to select the CPS-10Q for the subsequent read operation from the loaded address. Subsequent reads will begin at the address specified I<sup>2</sup>C during the last write.

As a slave, the CPS-10Q supports both indirect and direct memory mapping through the I<sup>2</sup>C Interface. The indirect memory mapping is implemented using the same standard device address/memory address/data write and read format as defined above, but the memory address specified is the address for the indirect memory mapping registers. For direct memory mapping, the same write and read procedures will be followed except that the memory address specified is the direct memory address.

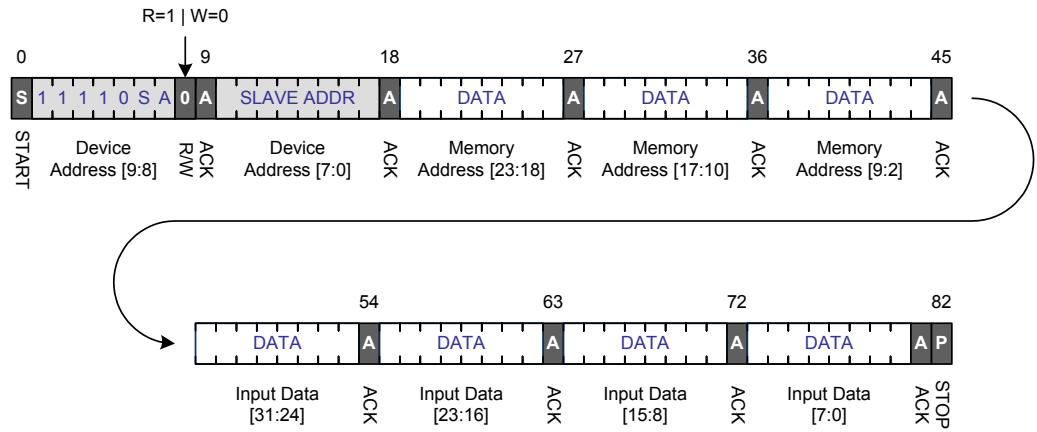


Figure 4.12 Write Protocol with 10-bit Slave Address (ADS is 1)

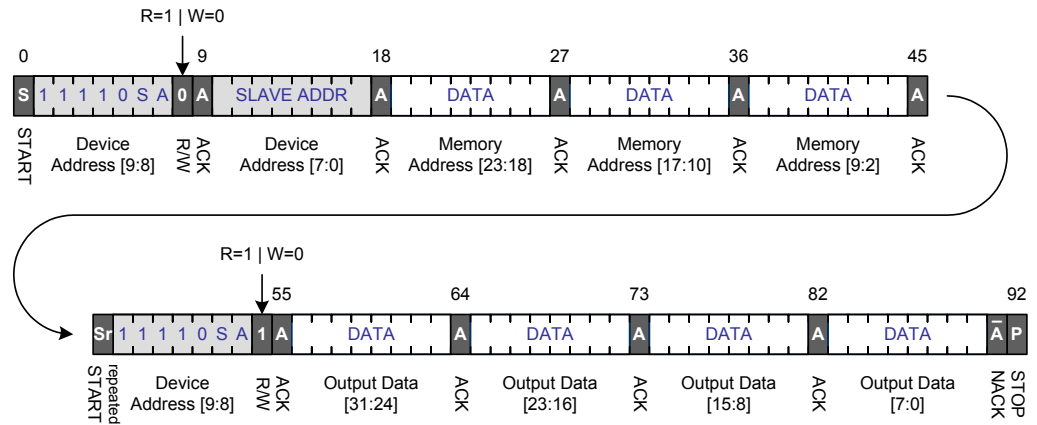


Figure 4.13 Read Protocol with 10-bit Slave Address (ADS is 1)

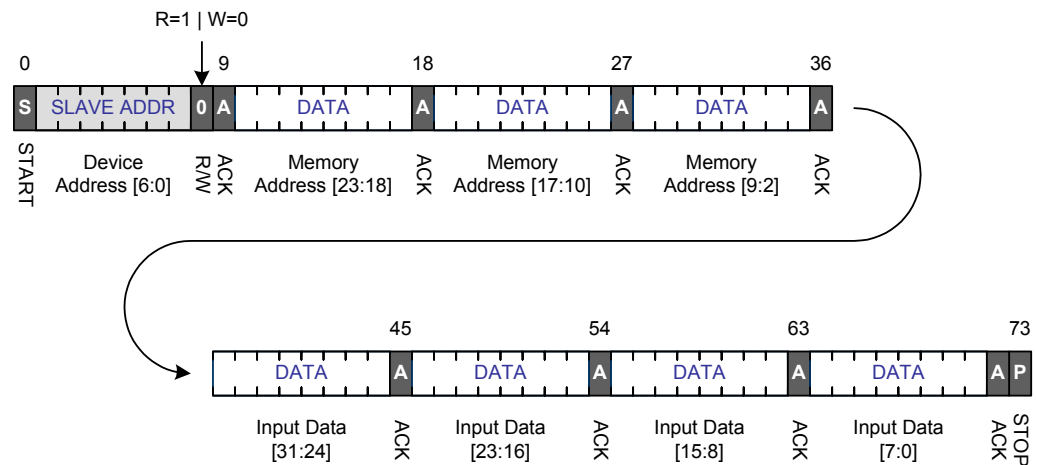


Figure 4.14 Write Protocol with 7-bit Slave Address (ADS is 0)

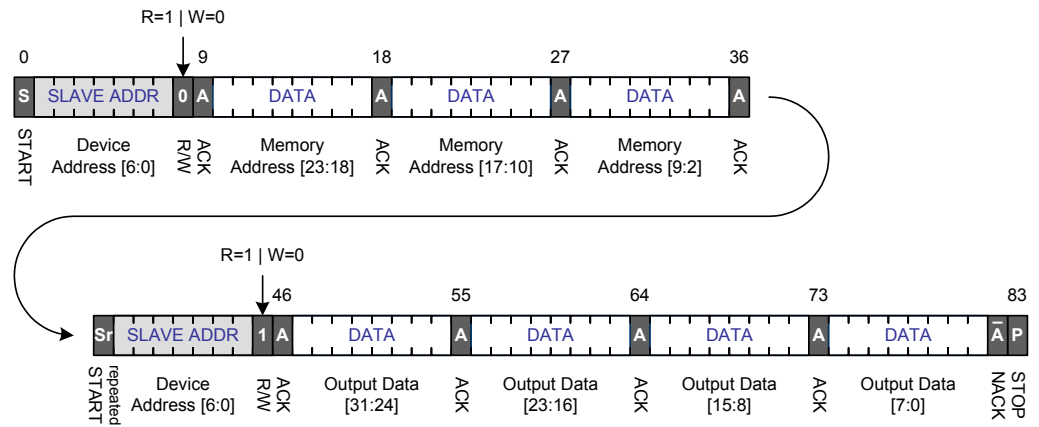


Figure 4.15 Read Protocol with 7-bit Slave Address (ADS is 0)



# Error Management

## 5 ERROR MANAGEMENT

The CPS-10Q provides the ability to record, manage, and report, errors and status information. The logic required to support this functionality is collectively known as “Error Management.”

### 5.1 ERROR MANAGEMENT FUNCTIONAL ARCHITECTURE

The device's error management functionality consists of a number of data structures as shown in the diagram below.

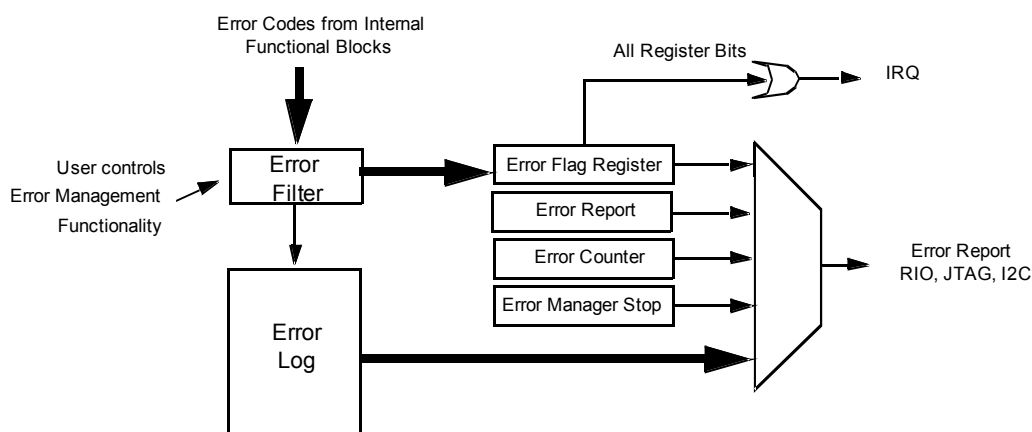


Figure 5.1 Functional View of Error Management Block

#### 5.1.1 Error Sources

Each functional block that supports error-reporting capability is defined as an “Error Source.” The device supports the ability for the user to enable and disable the error reporting functionality of each of these sources. Regardless of whether or not reporting is enabled, all errors that are received by the Error Management Block will be stored to the Error Log. The listing of Error Sources and their respective codes is provided below.

Table 5.1 Error Sources and Codes

Error Source	Code
Quad 0	0x2A
Quad 1	0x29
Quad 2	0x34
Quad 3	0x33
Quad 4 (Lane 0)	0x32
Quad 4 (Lane 1)	0x31

**Table 5.1 Error Sources and Codes**

Error Source	Code
Quad 4 (Lane 2)	0x3C
Quad 4 (Lane 3)	0x3B
Quad 5	0x3A
Quad 6	0x39
Quad 7	0x3D
Quad 8	0x3E
Quad 9 (Lane 0)	0x1C
Quad 9 (Lane 1)	0x1D
Quad 9 (Lane 2)	0x27
Quad 9 (Lane 3)	0x26
Maintenance Handler	0x1E
Configuration Block	0x00
JTAG	0x00
I <sup>2</sup> C	0x00

When an error is detected by one of the above sources, both the Error Source and Error Code number will be logged into the Error Log FIFO. The Error Source is a 6-bit field indicating the location of the error. The Error Code is an 8-bit field, and designates the type of error that occurred. The Error Management Block provides a single Error Log and arbitrates between error sources for access to the Error Log. The Error Management Block records the errors up to the speed of arbitration between all of the sources.

The device provides an Error Log Read Register which allows the user to read out the first error from the Error Log. This is a 32-bit register which lists the location and type of error (Error Source, Error Code: 14 bits) that occurred. When this register is read, the device returns the first entry in the Error Log.

The device provides the user with the ability to reset the contents of Error Log FIFO and the Error Log Read Register.

#### 5.1.1.1 I<sup>2</sup>C Errors

The I<sup>2</sup>C errors shown in the table below are detectable by the device. If I<sup>2</sup>C error reporting is enabled each of the errors defined below is sent to the Error Log when detected.

**Table 5.2 I<sup>2</sup>C Errors and Codes -- Group Number 0x1**

Error	Code	Description
Length Error	0x10	I2C Transmission has an invalid data payload length (read or write transaction)

**Table 5.2 I<sup>2</sup>C Errors and Codes -- Group Number 0x1**

Error	Code	Description
Ack Error	0x11	This error references an event when an acknowledgement is expected but is not received. This error can occur in Master or slave mode. If the error happens in Master mode, the data transfer will be terminated and the error will be captured. Note that although a NACK can be used by an external Master to terminate a CPS-10Q transmission, this event will not be captured as an error
22 bit Memory Address incomplete error	0x12	This error refers to the condition when an unexpected START/STOP is seen before all three bytes of a memory address are received. This occurs when the device is in slave mode and being addressed by the Master I2C device. The memory address will not be updated, and the write operation will be aborted.
Unexpected START/STOP	0x13	This error is captured when as a slave, the device encounters an unexpected START or STOP. When this happens during addressing or during a memory address transfer the operation is aborted. When this happens after memory address transfer is complete (but before data transfer is complete) the memory address counter will be updated, but the memory access will be aborted.
EPROM checksum error	0x14	This error occurs while the device is in Master mode if at the end of a configuration image update the checksum value in the image does not match the calculated value.

#### 5.1.1.2 JTAG Errors

The JTAG errors shown in the table below are detectable by the device. If JTAG error reporting is enabled each of the errors defined below is sent to the Error Log when detecting

**Table 5.3 JTAG Errors and Codes -- Group Number 0x2**

Error	Code	Description
Incomplete Write	0x20	Unexpected termination of write data to registers if serial data input is not 32 bit aligned

### 5.1.1.3 Maintenance Handler Errors

The Maintenance Handler errors shown in the table below are detectable by the device. If Maintenance Handler error reporting is enabled each of the errors defined below is sent to the Error Log when detected.

**Table 5.4 Maintenance Handler Errors and Codes -- Group Number 0x3**

Error	Code	Description
Maintenance Handler route error	0x30	Triggered when the destination of a received maintenance packet is not a port or a multicast mask
Maintenance Read Size invalid	0x31	Triggered when a read request maintenance packet has an invalid size (i.e. not 8, 16, 32, or 64 bytes). A response packet with an error status will be generated
Maintenance Write Size Invalid	0x32	Triggered when a write request maintenance packet has an invalid size (i.e. not 8, 16, 32, or 64 bytes). A response packet with an error status will be generated
Maintenance Transaction Field Error	0x33	An unexpected transaction field was decoded in an inbound maintenance packet with hop count = 0.
Maintenance read request with payload	0x34	Triggered if a Maintenance read request packet is received with a payload. A response packet with an error status will be generated
Maintenance Write request with no payload	0x35	Triggered if a Maintenance write packet is received without a payload. A response packet with an error status will be generate
Maintenance packet exceeds maximum payload	0x36	Triggered if a Maintenance packet is received which exceeds the RIO specified maximum payload size for maintenance packets

#### 5.1.1.4 Configuration Errors

The device supports the ability to detect the following configuration errors. If configuration error reporting is enabled each of the errors defined below is sent to the Error Log when detected.

**Table 5.5 Configuration Errors and Codes -- Group Number 0x5**

Error	Code	Description
Multicast mask config error	0x50	<p>Triggered whenever a direct write to a route table is attempted with an invalid mask number. A 'NO_ROUTE' will be written into the route table instead.</p> <p>Triggered if the user attempts to program the domain table with a multicast mask number.</p> <p>Triggered whenever the mcast_msk_port_csr is written to with an invalid mask.</p> <p>Triggered when the mcast_assoc_sel_csr is written to with an invalid mask number.</p> <p>Triggered if a write-to-verify command in the mcast_assoc_op_csr results in an access to the domain table. This is because the domain table can only store ports and no-routes (not multicast masks).</p> <p>Reads of invalid values also trigger this error.</p>
Port config error	0x53	<p>Triggered when a direct write to a route table is attempted with an invalid PORT number. A 'NO_ROUTE' will be written into the route table instead. This is also triggered whenever the mcast_msk_port_csr is written to that contains an invalid egress port number.</p> <p>This error is also triggered when an attempt is made to configure the part to use an invalid output trace port.</p>
Force Local config error	0x54	<p>Triggered whenever a 'FORCE_LOCAL' value is used in an attempt to be program the device route table. A 'NO_ROUTE' will be written into the device route table instead.</p>
Route Table conf error	0x55	<p>Triggered whenever a route table (or pointer table) is read and its value reference results in an illegal port value. A value of 8'ff will be returned to the user to indicate a failure occurred.</p>
Multicast translation config error	0x56	<p>Triggered if the user accesses a multicast register and a bit is high that does not correspond to a valid port on the device. The write will still occur, and any other valid ports will be changed.</p> <p>Triggered if the above scenario occurs during a write of the CPS_INPUT_PORTS and CPS_OUTPUT_PORTS registers as well.</p>

### 5.1.1.5 RIO SERDES Errors

The device supports the ability to detect the following RIO SERDES errors. If SERDES quad error reporting is enabled each of the errors defined below is sent to the Error Log when detected.

**Table 5.6 RIO SERDES Errors and Codes -- Group Number 0x6**

Error	Code	Description
Lane 0 Sync Lost	0x60	Triggered when Lane 0 of a given quad has lost sync. Reported only when quad_err_report is enabled.
Lane 1 Sync Lost	0x61	Triggered when Lane 1 of a given quad has lost sync. Reported only when quad_err_report is enabled.
Lane 2 Sync Lost	0x62	Triggered when Lane 2 of a given quad has lost sync. Reported only when quad_err_report is enabled.
Lane 3 Sync Lost	0x63	Triggered when Lane 3 of a given quad has lost sync. Reported only when quad_err_report is enabled.
Alignment Lost	0x64	Triggered when lane alignment has been lost when a port is in 4x mode. Reported only when quad_err_report is enabled.

### 5.1.1.6 RIO Link Layer Errors

The device supports the ability to detect the following RIO Link Layer errors. If Port level error reporting is enabled each of the errors defined below is sent to the Error Log when detected.

**Table 5.7 RIO Link Layer Errors and Codes -- Group Number 0x7**

Error	Code	Description
Bad or unexpected char received	0x70	Triggered when an invalid 8b10b char is received or when an invalid or unexpected control symbol is received. Reported only when Port_err_report is enabled.
Unaligned PD/SC char	0x71	Triggered when an unaligned packet delimiter (/PD) or unaligned control symbol delimiter (/SC) is received. If this error occurs when the quad is in 4x mode, then the error will be reported in port 0. If the quad is in 1x mode then an error detected in lane i will be reported in port i. Reported only when Port_err_report is enabled.
Invalid outstanding ackID Received	0x72	Triggered when an invalid outstanding ackID packet received.

**5.1.1.7 RIO Link Protocol Errors**

The device supports the ability to detect the following RIO Link Protocol errors. If Port level error reporting is enabled each of the errors defined below is sent to the Error Log when detected.

**Table 5.8 RIO Link Protocol Errors and Codes – Group Number 0x8**

Error	Code	Description
Received control symbol with bad CRC	0x80	Triggered when a control symbol with a bad CRC is received. Reported only when Port error reporting is enabled.
Received packet with bad CRC	0x81	Triggered when a packet with a bad CRC is received. Reported only when Port error reporting is enabled.
Received unexpected AckID	0x82	Triggered when a packet is received with an unexpected AckID (not the next in sequential order). Reported only when Port error reporting is enabled.
Unexpected STOMP received	0x83	Triggered when a STOMP control symbol is received unexpectedly (i.e. not received packet to STOMP). Reported only when Port error reporting is enabled.
Unexpected End of Packet received	0x84	Triggered when an unexpected EOP control symbol is received (i.e. when not having currently received a packet). Reported only when Port error reporting is enabled.
Port initialization reacquired	0x85	Triggered when a port which was properly initialized, lost initialization, and then properly reacquired initialization. This error will only be detected when the output side of the port transmitter reacquires the port init signal after having lost it. It will not be detected when initialization is first acquired after power-up or disabling and re-enabling the port of following a soft reset event. It will be detected only when initialization is lost during the normal exchange of packets and control symbols. Reported only when Port error reporting is enabled.
Received unexpected non-maintenance packet	0x86	Triggered when an unexpected non-maintenance packet is received while the port is in a state such that it can only respond to maintenance packets. Reported only when Port error reporting is enabled.
Received packet accept with an unexpected AckID	0x87	Triggered when a packet accept control symbol is received which is not expected (not in sequential order). Reported only when Port error reporting is enabled.
Received packet retry with an unexpected AckID	0x88	Triggered when a packet retry control symbol is received which is not expected (not in sequential order). Reported only when Port error reporting is enabled.
Received packet retry with a valid AckID	0x89	Triggered when a packet retry control symbol is received with a valid AckID. Reported only when Port error reporting is enabled.
Received packet not accepted	0x8A	Triggered when a packet not accepted control symbol is received. Reported only when Port error reporting is enabled.
Received link response with invalid AckID	0x8B	Triggered when a link response control symbol is received with an invalid AckID. Reported only when Port error reporting is enabled.

**Table 5.8 RIO Link Protocol Errors and Codes – Group Number 0x8**

Error	Code	Description
Fatal link response timeout encountered	0x8C	Triggered when 16 link timeouts occur while waiting for a link response. Reported only when Port error reporting is enabled.
Link Timeout encountered	0x8D	Triggered when a link timeout is encountered. Reported only when Port error reporting is enabled.
Received unsolicited restart retry	0x8E	Triggered when an unsolicited restart-from-retry control symbol is received. Reported only when Port error reporting is enabled.
Received unsolicited link response	0x8F	Triggered when an unsolicited link response control symbol is received. Reported only when Port error reporting is enabled.

#### 5.1.1.8 RIO Logical and Transport Layer Errors

The device supports the ability to detect the following RIO Logical and Transport Layer errors. If Port level error reporting is enabled each of the errors defined below is sent to the Error Log when detected.

**Table 5.9 RIO Logical and Transport Errors and Codes -- Group Number 0x9**

Error	Code	Description
Packet Length error	0x90	Triggered when a packet is received which exceeds the RIO length maximum (69 words). Reported only when Port error reporting is enabled.
Invalid transaction type	0x91	Triggered when a packet is received with an invalid tt field. Reported only when Port error reporting is enabled.
Pri - 0 Rx buffer over-flow	0x92	Triggered when the priority 0 packet buffer encounters an over-flow condition. Reported only when Port error reporting is enabled.
Pri - 1 Rx buffer over-flow	0x93	Triggered when the priority 1 packet buffer encounters an over-flow condition. Reported only when Port error reporting is enabled.
Pri - 2 Rx buffer over-flow	0x94	Triggered when the priority 2 packet buffer encounters an over-flow condition. Reported only when Port error reporting is enabled.
Pri - 3 Rx buffer over-flow	0x95	Triggered when the priority 3 packet buffer encounters an over-flow condition. Reported only when Port error reporting is enabled.
Rx buffer abort	0x96	Triggered when a packet of any priority overflows one of the pre-switched packet buffers. Reported only when Port error reporting is enabled. This error code is a logical or of the errors represented by codes 0x92 through 0x95 and of those represented by codes 0x 9A through 0x9D

Error	Code	Description
Dropped packet -- CRC retransmit limit	0x99	Triggered when a packet in the retransmit buffer has been retransmitted the configured maximum number of times due to the reception of a packet_not_accept control symbol with bad CRC status. Reported only when Port error reporting is enabled.
Pri - 0 Rx maintenance buffer overflow	0x9A	Triggered when the priority 0 maintenance buffer encounters an overflow condition. Reported only when Port error reporting is enabled.
Pri - 1 Rx maintenance buffer overflow	0x9B	Triggered when the priority 1 maintenance buffer encounters an overflow condition. Reported only when Port error reporting is enabled.
Pri - 2 Rx maintenance buffer overflow	0x9C	Triggered when the priority 2 maintenance buffer encounters an overflow condition. Reported only when Port error reporting is enabled.
Pri - 3 Rx maintenance buffer overflow	0x9D	Triggered when the priority 3 maintenance buffer encounters an overflow condition. Reported only when Port error reporting is enabled.
Trace Match Error	0x9E	Reserved for Internal Use
Filter Match Error	0x9F	Reserved for Internal Use

## 5.1.2 Special Error Structures and Functionality

### 5.1.2.1 Special Error Filter Register

The device provides Special Error Filter Registers which allow the user to configure special behavior when a specific error type is received by the Error Management logic. Each register supports the ability for the user to configure whether a detected specific error (defined by Number, Group, and Source) causes the device to count the error, flag the error, initiate the generation and transmission of a maintenance packet, or stop the Error Management function altogether. Each of the 8 registers also allow the user to mask the error's Source, Group, and Number values.

### 5.1.2.2 Error Flag Register

The device provides an Error Flag Register which indicates that one or more of the errors defined by the Special Error Filter Register has been detected. If the error flag bit in the Special Error Filter register is set for a specific error (as defined by Error Source, and Error Code), then a bit in the Error Flag Register is set to indicate which of the 8 specially configured errors has been detected. If additional errors are detected, which are enabled by their respective Special Error Filter Register configurations to be flagged, corresponding bits in the Error Flag Register are set as well. When the user reads out the flag register, all flag bits are de-asserted. The Error Flag Register will be reset when the Error Management module is reset, or the Error Flag bit in Error Reset Register is set.

### 5.1.2.3 Error Interrupt

The device provides a single interrupt pin. Its output state is driven by the logical OR of all Error Flag Register bits such that, if any one of the error flag bits are set, the Interrupt pin is driven to its low voltage state. Open-drain allows multiple such devices to be connected to a single bus, likely to an interrupt input of a host processor.

#### 5.1.2.4 Error Counter

The device provides an Error Counter. The user is capable, through use of the Special Error Filter Register, to define which of 8 specific errors, when detected, will increment this counter. The Error Counter is a 16-bit counter. If the counter reaches its maximum value (0xFFFF) it saturates and remains at its maximum value until it is reset. The Counter resets when the Error Manager is reset, or the Error Counter bit in the Error Reset Register is set.

#### 5.1.2.5 Error Management Stop

The device provides the capability to stop the Error Manager. Through the Special Error Filter Register the user is able to configure the Error Manager to stop if a specific error is detected.

The user is also able to stop the Error Manager by writing a logical 1 to the Stop\_EM bit in the Error Reset Register. The user must write a logical 0 to this same bit to enable the Error Management block to function again.

Stopping the Error Manager freezes its operation such that all subsequent errors are blocked, dropped, and not recorded.

#### 5.1.2.6 Error Capability Register

The device provides additional support for stopping the Error Manager through the use of a Error Capability Register.

Utilizing this register, the user is able to configure the device to set the STOP\_EM bit in the Error Reset Register if all 8 bits in the Error Flag Register are asserted (all 8) to subsequently stop the Error Management function. A maintenance packet is generated and transmitted if this sequence occurs under these configuration conditions.

Through the use of the Error Capability Register, the user is able to configure the device to set the STOP\_EM bit in the Error Reset Register when the Error Counter value reaches 0xFF, thus stopping the Error Manager. A maintenance packet is generated and transmitted if this sequence occurs under these configuration conditions.

#### 5.1.2.7 Error Reset

The device provides an Error Reset Register which allows the user to reset the Error Flag Register, the Error Counter, and or the Error Log. This register also provides the user the ability to configure the device to enable and disable the generation and transmission of a maintenance packet. In addition, it provides the user the capability to stop and restart the Error Manager.

#### 5.1.2.8 Maintenance Packet Generation

The device supports the ability to generate and transmit a maintenance packet under the conditions described in this chapter. Any of the errors defined in the 8 Special Error Filter Registers may cause the device to generate and transmit a maintenance packet. The maintenance packet is generated only when a filtered error causes the error handling module to take further actions, such as incrementing the error counter, setting an error flag, generating a maintenance packet, or stopping Error Management operation.

The destination ID used with each transmitted maintenance packet is the value programmed by the user into the RIO\_PORT\_WRITE\_INFO register. In this manner, the user can set the CPS-10Q to send any generated maintenance packets to a host processor elsewhere in the system. This host processor is thus notified of the error condition type, and can then invoke appropriate error recovery processes.

Each generated maintenance packet provides the following data: 1) the 6-bit Error Source, 2) the 8-bit error Code, 3) the Error Flag Register contents (8-bits), and 4) the Error Counter Register value (16-bit).

Each maintenance packet type is a "port-write" packet as defined in the applicable RIO specifications and will carry one 64-bit data word. It supports the following payload layout:

**Table 5.10 Port Write Payload Definition**

Reserved	Error Source	Error Code	Error Flags	Error Counter	Reserved
00	6 bit	8 bits	8 bits	16 bits	000000000000000000000000

The full maintenance packet generated appear as shown in the following table with the values described below

**Table 5.11 Maintenance Packet Format**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AckID					rsvd		CRF	Prio		tt		ftype = 0b1000			
destination ID								source ID							
ttype				rdsiz/wrsiz				Source Transaction ID							
Hop_Count								Config_Offset [20:13]							
Reserved													W	Reserved	
0b00		Error Source						Error Code							
Error Flags								Error Counter							
Error Counter								Data = 0x00							
Data = 0x0000															
CRC															

- i. CRF = 0
- ii. Prio as defined in the register RIO\_PORT\_WRITE\_INFO
- iii. tt to be set according to LARGE\_TRANS in the register RIO\_PORT\_WRITE\_INFO
- iv. destinationID as defined in the register RIO\_PORT\_WRITE\_INFO, the size is determined by the value of the LARGE\_TRANS register field
- v. sourceID as defined in the register RIO\_PORT\_WRITE\_SRCID, the size is determined by the value of the LARGE\_TRANS field in the RIO\_PORT\_WRITE\_INFO register
- vi. ttype (transaction) = 0b0100
- vii. rdsiz/wrsiz = 0b1011
- viii. Hop\_Count = 0xFF
- ix. W (wptr) = 0b0



# JTAG & Boundary Scan

## 6 JTAG & BOUNDARY SCAN

The CPS-10Q supports all the mandatory instructions defined in the IEEE 1149.1 specification. To support production testing, the device supports private instructions for Memory BIST and Scan Testing. The TAP controller allows access to the configuration registers. Boundary scan testing of the AC-coupled IOs are performed in accordance with IEEE 1149.6 (AC Extest).

This chapter covers the overall functionality of the JTAG TAP port interface and Configuration Registers Access (CRA) capability. For the full specification, please refer to the device's datasheet.



The CPS-10Q's JTAG functionality does not support register access when it is part of a chain, and must be the only device on the JTAG bus when its registers are accessed using JTAG interface.

### 6.1 JTAG AND AC EXTEST COMPLIANCE

All DC pins are in full compliance with IEEE 1149.1. All AC-coupled pins fully comply with IEEE 1149.6. All 1149.1 and 1149.6 boundary scan cells are on the same chain. No additional control cells are provided for independent selection of negative and / or positive terminals of the Tx or Rx pairs.

### 6.2 TEST INSTRUCTIONS

Table 6.1 Test Instructions

IR Code [3:0]	Instruction	Comments
0x0	Ex_Test	Implemented per IEEE 1149.1-2001
0x1	Sample/Preload	Implemented per IEEE 1149.1-2001
0x2	ID Code	Implemented per IEEE 1149.1-2001 Device ID = 0x35E (CPS-10Q)
0x3	High Z	Implemented per IEEE 1149.1-2001
0x4	Clamp	Implemented per IEEE 1149.1-2001
0x5	Ex_Test Pulse	Implemented per IEEE 1149.6
0x6	Ex_Test Train	Implemented per IEEE 1149.6
0x7	Reserved	
0x8	Reserved	
0x9	Reserved	
0xA	Configuration Register Access	Read and Write Access to Configuration Register space
0xB	ISCAN	Enables internal Scan for production test
0xC	Reserved	
0xD	Reserved	

**Table 6.1 Test Instructions**

IR Code [3:0]	Instruction	Comments
0xE	Die_Signature	Dumps fab information including die location, version, and wafer number
0xF	Bypass	Implemented per IEEE 1149.1-2001

### 6.3 DEVICE ID REGISTER

The JTAG Device ID register length is 32 bits wide. The Capture Data Register value is the Device ID.

The JTAG Device ID register is mapped to the DEV\_IDENT field in the DEV\_IDENT\_CAR as defined in the "Registers" section of this document. The device provides no correlation between the value in this register and the device's I<sup>2</sup>C address. There is no provision to read the I<sup>2</sup>C address from the TAP port.

The 11 bit JTAG Vendor ID is 0xB3 where the MSB = 1 (the code itself uses an ODD parity bit in the 8th bit. Per the JTAG specification, the first 7 bits of the Vendor ID will be the first 7 bits of the EIA/JEP106 code "discarding the parity bit." Thus, the JTAG IDCODE read from the TAP port will match 0x33, and NOT 0xB3.

### 6.4 INITIALIZATION AND RESET

At Power-Up,  $\overline{\text{TRST}}$  must be asserted LOW to bring the TAP controller up in a known, reset state. Per IEEE 1149.1 specification, the user can alternatively hold the TMS pin high while clocking TCK five times (minimum) to reset the controller. To deactivate JTAG,  $\overline{\text{TRST}}$  is tied low so that the TAP controller remains in a known state at all times. All of the other JTAG input pins are internally biased in such a way that by leaving them unconnected they are automatically disabled. Note that JTAG inputs are OK to float because they have leakers (as required by IEEE 1149.1 specification).

### 6.5 CONFIGURATION REGISTER ACCESS

The same JTAG instruction is used for both writes and reads of the Configuration Register space. Bit zero of the TDI data stream is used to define whether the command is a write or a read.

**Table 6.2 Configuration Registers**

Bits	Field Name	Size	Description
[0]	jtag_config_wr_n	1	1 - read configuration register 0 - write configuration register
[22:1]	jtag_config_addr	22	Starting address of the memory mapped configuration register
[54:23]	jtag_config_data	32	Reads: Data shifted out (one 32-bit word per read) is read from the configuration register at address jtag_config_addr.  Writes: Data shifted in (one 32-bit word per write) is written to the configuration register at address jtag_config_addr.

### 6.5.1 Configuration Register Access -- Writes

When bit 0 of the data stream is 0, data shifted in after the address is written to the address specified in `jtag_config_addr`. The TDO pin will transmit all 0s. Timing is shown below.

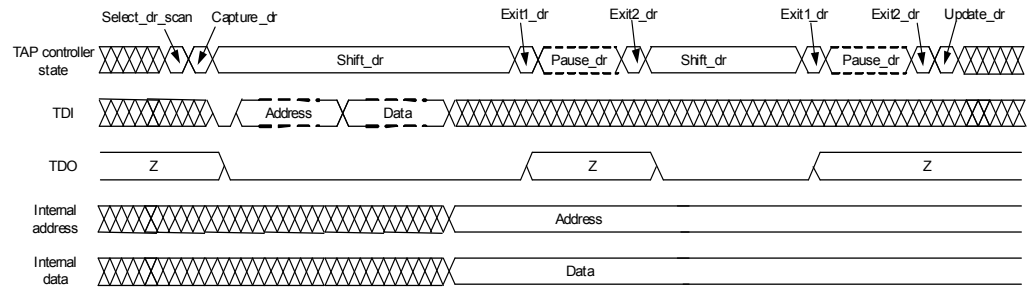


Figure 6.1 JTAG Write Cycle

The device is capable of reporting an unexpected termination of a register writes via JTAG and that JTAG sourced write data is not on a 32-bit boundary. This will apply to writes to Configuration Registers. The error code for this report is defined in the Error Management chapter of this document.

### 6.5.2 Configuration Register Access -- Reads

When bit 0 of the data stream is 1, data shifted out is read from the address specified in `jtag_config_addr`. TDI is not used after the address is shifted in. Timing is shown below.

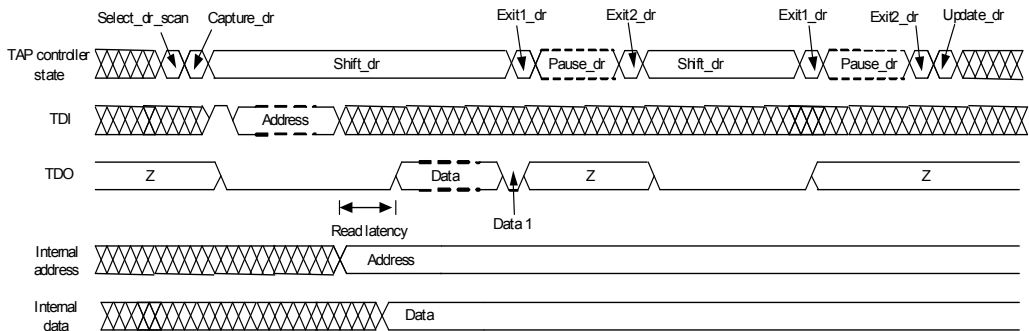


Figure 6.2 JTAG Read Cycle

## 6.6 BOUNDARY SCAN

JTAG instructions are provided for the purpose of making all the part inputs observable and all the outputs controllable.

All external I/Os are designed to support Boundary Scan testing as defined in IEEE 1149.1 and 1149.6 converting digital and AC-coupled I/Os respectively. All input / output possibilities are tested including support for leakage testing, and providing users easy debugging by isolating the CPS-10Q from other devices on a PCB board.



# Reference Clock

## 7 REFERENCE CLOCK

The CPS-10Q uses a reference clock (REF\_CLK) to generate its RIO PHY and internal clocks. This section outlines the definition of this clock and the auxiliary clocks used for testing.

### 7.1 REFERENCE CLOCK SPECIFICATION

The CPS-10Q internal timing is based on a AC coupled Reference Clock as specified below. CPS-10Q supports full functionality when supplied with 156.25 MHz.

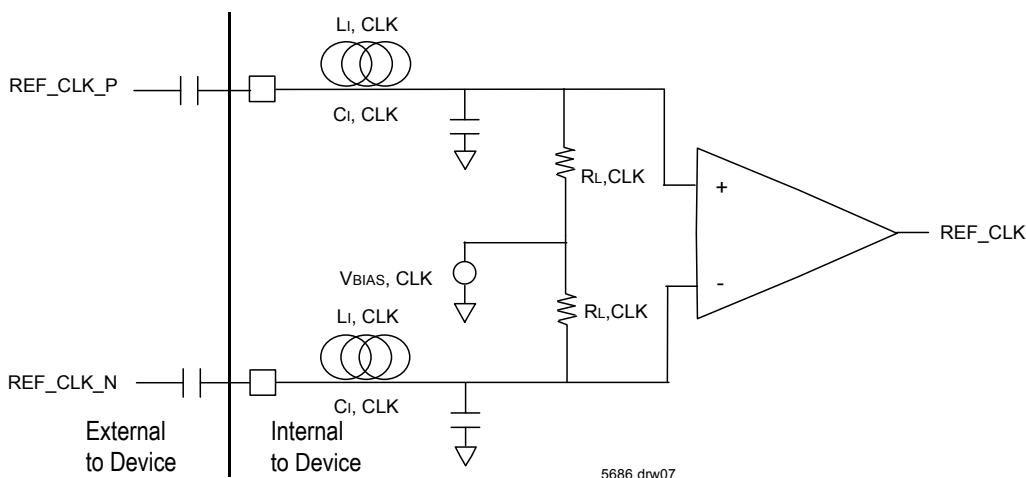
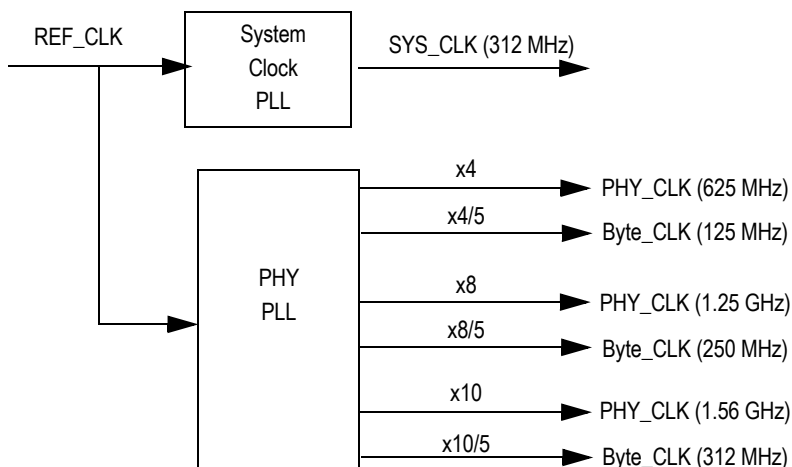


Figure 7.1 Reference Clock Representative Circuit

### 7.2 PLL

The device provides an internal PLL to create the 3.125MHz or half of that internal SYS\_CLK that is used to drive internal logic. The REF\_CLK is multiplied by 4, 8 and 10 to generate the bit clock needed for PHY clock. The resultant PHY\_CLK is also divided by 5 for the byte time of the internal parallel data. If half clock is applied to the reference clock, all the output clocks are changed to half frequency.





# Programming the Device

## 8 PROGRAMMING THE DEVICE

This chapter focuses on actual real-world usage of the device. This covers configuring and using the switch.

### 8.1 DEVICE ACCESS

The device can be programmed through three different interfaces: in-band through any of the RIO ports, or out of band through the I<sup>2</sup>C & JTAG interfaces. This section provides an overview of how each of those interfaces is used for programming. The subsequent sections provide the register and memory map which will be the target of all programming operations on these interfaces.

#### 8.1.1 RIO Access

The CPS-10Q provides in-band control plane access each sRIO ports through the maintenance packets. By sending RIO maintenance packets to the CPS-10Q, the user is capable of accessing the device's supported RIO registers and all other memory-mapped registers and internal memories.

In terms of Maintenance Packets, the CPS-10Q functions per the RapidIO specifications as a switch. It identifies a Maintenance Packet by decoding the ftype field to be 0b1000. The CPS-10Q decodes the RIO defined hop\_count field of the Maintenance Packet. If it has the value of 0, the CPS-10Q terminate and process the packet. If the hop\_count field is greater than 0, the CPS-10Q decrements the value by 1, recalculate the CRC and forward the packet to the destined port.

The CPS-10Q device supports both 8- and 16-bit destination IDs, where the size of the destination ID is defined by the tt field. The size of the destination ID in both cases are 8 bits. The format of the RIO Maintenance Request Packet with 8 bit addressing is as shown in the CPS-10Q destined Maintenance Packet figure shown below. If a Maintenance Packet is received with a transaction field (ttype) different from 0b0000 or 0b0001, then the CPS-10Q terminates the packet and logs an error.

Table 8.1 RIO Defined Maintenance Packet with CPS-10Q as Destination

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AckID					rsvd		CR F	Prio		tt		ftype = 0b1000			
destination ID								source ID							
ttype				rdsz/wrtsz				Source Transaction ID srcTID							
Hop_Count								Config_Offset [20:13]							
Config_Offset [12:0]													W	0b00	
Data															
Data.....Data															
Data															
CRC															

As the response to a Maintenance Request Packet, a Maintenance Response Packet is created using the format below with the hop\_count field set to 0xFF. Responses are sent via the port on which the Maintenance Packet was received.

**Table 8.2 RIO Defined Maintenance Response Packet generated by CPS-10Q**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AckID					rsvd		CR F	Prio		tt		ftype = 0b1000			
destination ID								source ID							
ttype				rdsz/wrtsz				Target Transaction ID (targetTID)							
Hop_Count = 0xFF								Config_Offset [20:13]							
Config_Offset [12:0]													W	0b00	
Data															
Data.....Data															
Data															
CRC															

In the response packet, the following fields are turned around from the request packet as defined below:

- 1) rsvd
- 2) CRF: The CPS-10Q copies this from the request maintenance packet, but otherwise will ignore the received value.
- 3) tt
- 4) ftype
- 5) targetTID(srcTID in the request packet)

Other fields are generated as follows:

- 1) AckID is generated as defined in sRIO at the PHY link level
- 2) the prio field is increased by one compared to the request packet. If the request priority was 3 then the response will be kept at priority 3
- 3) destinationID uses the value of the request packet's sourceID field
- 4) sourceID uses the value of the request packet's destinationID field
- 5) transaction is set to the correct response type as defined in the RIO specification
- 6) status is always set to 0b0000
- 7) hop\_count is set to 0xFF
- 8) read data as requested is provided in response packets

The device support the ability to process all self destined (i.e. with a hop count of 0) maintenance packets (without dropping them) as long as they are received with a spacing (time between packets -- SOP to SOP) of 32 ns.

### 8.1.2 I2C access

Please refer to I2C chapter.

### **8.1.3 JTAG access**

Please refer to JTAG chapter.

## **8.2 ROUTE TABLES**

### **8.2.1 Route Tables**

The CPS-10Q provides route tables which are used to determine the port(s) to which packets must be output. The CPS-10Q performs lookups into these route tables to associate the destination ID of each received packet with an output port configuration. Note that the device supports received destination ID associations to multiple output ports (in support of multicast). The CPS-10Q provides two route table types: 1) Device Route Tables and, 2) Domain Route Tables. Each table type is 256 entries in depth and 8 bits in width. The Domain Route Tables in conjunction with the Device Route Tables provide the user the capability of using both an 8-bit addressing scheme and a 16-bit addressing scheme simultaneously. Control Plane access to all of these tables (both read and write) is provided at the applicable addresses defined in the Memory Map (see Memory Map section).

### **8.2.2 Global Route Tables**

The CPS-10Q provides both a global domain route table and a global device route table. Along with the global tables, the CPS-10Q provides a set of route tables (domain and device) for each of its ports. Any write to the global route tables force a replication of the written data into all local route tables. The CPS-10Q supports the ability for the user to read the global route table by referencing the global route table's address.

### **8.2.3 Individual Local Route Tables Access**

In addition to the ability to globally access the routing tables, the CPS-10Q provides the user with the ability to write and read each individual port's local route tables (both device and domain). This provides the user with the ability to route packets with the same destination ID, (if received on different ports), to different output destination. A write to an individual port's local route table causes no change to any other route table in the device. Note that programming via global route table method will program ALL individual local route tables. The user can perform global and or local route table configuration. Neither has higher priority.

### **8.2.4 Route Table Usage**

Regardless of how the device is configured (i.e. with either writes to the global tables or to the individual local tables), each port always uses its local route tables to determine how to route a specific packet. The routing of received maintenance packets which have a hop count greater than zero is routed based on the local route table for the port at which it was received.

The figure below is an informative view of the functional flow details of a Route Table lookup.

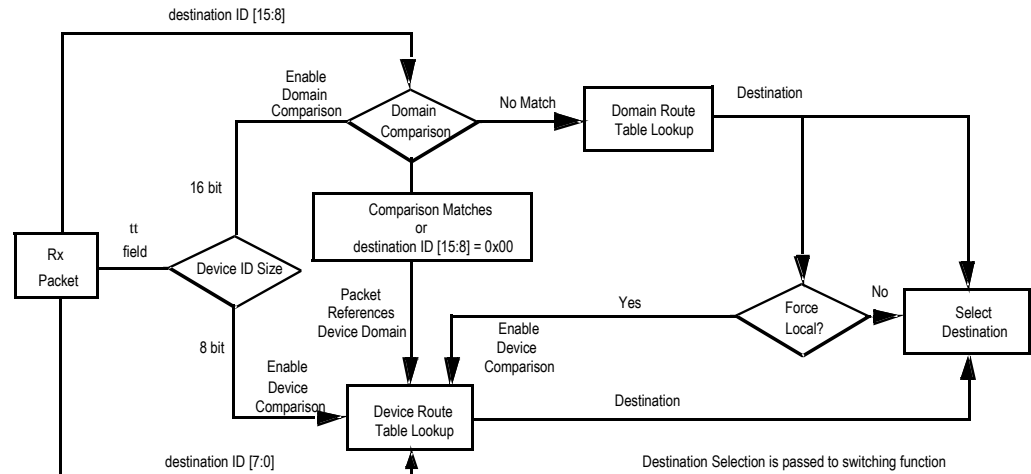


Figure 8.1 Route Table Lookup Diagram

When a packet is received, the CPS-10Q decodes the tt field to determine if the destination ID is 16 bits or 8 bits. If the tt field indicates that the destination ID is 16 bits:

- 1) The CPS-10Q divides the field into two 8-bit fields -- the domain ID and the device ID.
- 2) The upper 8 bits of the destination ID (the domain ID) is compared to the value programmed into the RIO\_Domain Register (0xF20020).
- 3) If these upper 8-bits are 0, or if upper 8-bits match the value in the domain register the CPS-10Q device treats the packet as being within the domain of the device.
- 4) If a match of the above criteria occurs, the CPS-10Q uses the lower 8-bits of the packet's destination ID field (device ID) as an address offset into the applicable Route Table to access the necessary data to use for its forwarding decision.
- 5) If the above upper 8-bit match criteria is not met, the CPS-10Q uses the upper 8-bits, i.e. the domain ID, as an address offset. The device uses the Domain Route Table content referenced by this address offset for its forwarding decision.
- 6) If the result of the domain route table lookup is "Force-Local", a lookup into the device route table with the lower 8 bits (config\_destID) is forced.

If the destination ID is only 8 bits, CPS-10Q uses these 8 bits as a direct address offset into the route table to obtain its forwarding information.

### 8.2.5 Route Table Programming

The CPS-10Q device allows the user access to each of the tables via RIO type 8 maintenance commands as defined in the RIO Part 1 rev 1.3 specification. The CPS-10Q provides the user with the ability to program the route tables by making associations between destination IDs and several device architectural constructs including:

- 1) Output ports,
- 2) Multicast Mask Registers

In addition to these constructs, the device supports destination ID associations with the "default route" action, and with the "no route" action. Note that after reset, route tables associate all destination IDs to the default route.

Destination ID associations in the route tables are dependent upon the port configurations of the device. The CPS-10Q supports the ability for the user to modify the QUAD\_CTRL registers and the PORT\_CTRL\_CSRS to configure the device's ports. Specifically, these register definitions determine the number of ports that are available at any time.

The device's port configuration is as shown in the table below after reset.

**Table 8.3 CPS-10Q Default Port Configuration**

Lane	Port Mode	Port Number (1x Capacity)
0-3	Standard 4x	0
4-7	Standard 4x	1
8-11	Standard 4x	2
12-15	Standard 4x	3
16	Enhanced 1x	4
17	Enhanced 1x	5
18	Enhanced 1x	6
19	Enhanced 1x	7
20-23	Standard 4x	8
24-27	Standard 4x	9
28-31	Standard 4x	10
32-35	Standard 4x	11
36	Enhanced 1x	12
37	Enhanced 1x	13
38	Enhanced 1x	14
39	Enhanced 1x	15

#### 8.2.5.1 Indirect Route Table Programming (sRIO CSRs Route Programming)

The CPS-10Q supports indirect updates to its route tables through the use of three registers (sRIO Standard Route Programming): 1) the Standard Route Configuration destination ID Select CSR (STD\_RTE\_CONF\_DESTID\_SEL\_CSR 0x000070), 2) the Standard Route Configuration Port Select CSR (STD\_RTE\_CONF\_PORT\_SEL\_CSR 0x000074), and 3) the Local Route Configuration destination ID Select Register (LOCAL\_RTE\_CONF\_DESTID\_SEL\_CSR 0x001070). The first two registers listed above are implemented as defined in the RIO Part 3 rev 1.3 Specification. The third listed register is an IDT specific RIO register which is used to determine which route tables are referenced for a given access request.

Through the use of these registers, the device supports the ability for the user to indirectly access a particular location in each of the CPS-10Q's routing tables (local and global).

The CPS-10Q supports the following statement in the RIO Interconnect Specification Part 3: Common Transport Specification: "The Standard Route Configuration destination ID Select CSR specifies the destination ID entry in the switch routing table to access when the Standard Route Configuration Port Select CSR is read or written".

Block writes (i.e. writing four consecutive entries into the route table) are also supported. In the case of a block write, if the 8 MSBs of a 16-bit destination ID do not match the value programmed in the RIO\_Domain register, only one entry is written into the Domain Route Table. If the 8 MSBs match the value in the RIO\_Domain register or are all 0s (8-bit destination ID), then 4 writes are performed into the Device Route Table.

Note that the upper 8 bits are always fixed for a block write into the Device Route Table. Addresses that increment into a new domain address (upper 8 bits) are ignored by the CPS-10Q. An example of this is given below:

A Block-write to 00000000 11111110 results in the following writes:

- 1) 00000000 11111110
- 2) 00000000 11111111
- 3) 00000001 00000000
- 4) 00000001 00000001

But the actual CPS-10Q write result will be:

- 1) 00000000 11111110
- 2) 00000000 11111111
- 3) 00000000 00000000
- 4) 00000000 00000001

#### 8.2.5.2 Direct Route Table Programming (IDT Standard Routing Table)

The CPS-10Q supports direct programming of the route tables without using the RIO CSRs described above. There is global route table (0xE00000 - 0xE00400) and per-port route table (Port 0: 0xE10000 - 0xE10400). A write to global route table will broadcast to all port route table register. A write to pre-port route table will update pre-port route table only. It will not update the global route table. Register address 0xE00000 is represent destination ID 0x00, 0xE00004 is represent destination ID 0x01, etc. The value in the register address 0xE00000 is represent output port number. For example register address 0xE00000 has value 0x0, which means destination ID 0x00 output to port 0. For more detail, see Destination Address to Route Table Mapping below.

The routing table can be accessed (read/write) through the use of RIO maintenance packets (or alternatively through I<sup>2</sup>C or JTAG) by providing the address (which is the destination ID) and the data (which is the destination address) to the routing table.

When a packet is received, the device performs a read of the per-port routing table at the address referred to by the packet's destination ID location and retrieves the destination reference to which it will forward the incoming packet.

#### 8.2.6 Programming Multicast Mask registers

The CPS-10Q supports the ability to access each of its 40 multicast mask registers per port indirectly through use of the Multicast Mask Port CSR, the Multicast Associate Select CSR, and the Multicast Associate Operation CSR as defined in "RapidIO Interconnect Specification, Part 9: Multicast Extensions Specification". The CPS-10Q supports the use of a Multicast Mask Port CSR as defined in RIO Part 9 in order to assign ports to multicast mask registers. It supports multicast mask querying via use of the Multicast Mask Port CSR as defined in RIO Part 9. The CPS-10Q supports the association of destination IDs to multicast mask registers by providing a Multicast Associate Select CSR and a Multicast Associate Operation CSR whose functionality is as defined in RIO Part 9.

The CPS-10Q device does not support the following multicast models as defined in the part 9 RIO specification:

- 1) the Simple Multicast Association Model
- 2) the Per Ingress Port Association Model

### 3) the Block Association Model



Part 9 of the *RIO Specification* states that only non-response transactions are allowed to use multicast. Further, Priority 3 packets should not be used since it's reserved for responses. Unexpected behavior can result in the event of priority 3 multicast transactions are used.

## 8.2.7 Multicast Mask Register

The CPS-10Q device provides 40 Multicast Mask Registers for each port. Each port has a unique Multicast Mask Register for multicast. There are also 40 global multicast mask registers, which will broadcast to all 16 port unique multicast mask registers when write operation occurs to these registers. The multicast mask registers determine when the output ports must be multicast. See Table 8.5.

There are two ways to update the Multicast Mask Register, the direct method or the indirect method:

- 1) Direct method is write to unique Multicast Mask register (address 0xF38000 - 0xF38F9C) or Global Multicast Mask Register (address 0xF30000 - 0xF3009C) directly.
- 2) Indirect method is write to sRIO protocol extension MCAST\_MASK\_PORT\_CSR (0x00080) register. It can add or remove ports in each multicast mask register. The LOCAL\_MCAST\_MASK\_PORT\_SEL (0x010080) register selects a different set of multicast register that MCAST\_MASK\_PORT\_CSR register will modify. For example, the LOCAL\_MCAST\_MASK\_PORT\_SEL register default value is 0 which is for global multicast register. So when write occurs to the MCAST\_MASK\_PORT\_CSR register all port's to the multicast register will be updated. If LOCAL\_MCAST\_MASK\_PORT\_SEL changes to 1 which is port 0, then reads/writes to (0x00080) the MCAST\_MASK\_PORT\_CSR register will apply to port 0's multicast masks only.

See Chapter 10 for detail register information.

## 8.2.8 Global Multicast Mask Register

The CPS-10Q provides a global multicast mask register which will broadcast to all the local multicast mask register. Any write to the global multicast mask register force a replication of the written data into all local multicast mask register. The CPS-10Q supports the ability for the user to read the global multicast mask register by referencing the global multicast mask register table's address.

The multicast mask values to be used in Multicast Mask Port CSR is as defined below:

**Table 8.4 Multicast Mask Register References for Multicast Mask Port CSR Usage**

A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0	Mask Register
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5
0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	6
0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	7
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	8
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	9
																.

**Table 8.4 Multicast Mask Register References for Multicast Mask Port CSR Usage**

A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0	Mask Register
0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	39

### 8.2.9 Destination Address to Route Table Mapping

CPS-10Q use Destination Addresses in the route tables in order to determine the proper output mapping of a given packet. The device use the destination ID provided in the packet header to reference its internal route tables for this mapping. Before the route tables are updated by the user, the device maps all packets to its default output port which is port zero (see the reset value of the STD\_RTE\_DEFAULT\_PORT\_CSR).

The device provide the ability to route packets to any of two separate constructs: 1) direct unicast to output ports 2) multicast output to multiple ports. In order to properly map packets to the proper device construct the user must use the route table values defined below. These regions are addressed uniquely with bit A[7:6] as shown below:

**Table 8.5 Region Select**

A7	A6	Region
0	0	Port Numbering
0	1	Multicast Mask Register

#### 8.2.9.1 Direct Output Port Mapping

Packets are routed directly to output ports in a unicast fashion. Port numbers (A7A6=00) are used for this type of configuration. An example of port number configuration is given below in the following table.

**Table 8.6 Port Number References**

A7	A6	A5	A4	A3	A2	A1	A0	Port Number
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	1	1	3
0	0	0	0	0	1	0	0	4
0	0	0	0	0	1	0	1	5
0	0	0	0	0	1	1	0	6
0	0	0	0	0	1	1	1	7
0	0	0	0	1	0	0	0	8
0	0	0	0	1	0	0	1	9
0	0	0	0	1	0	1	0	10
0	0	0	0	1	0	1	1	11
0	0	0	0	1	1	0	0	12

**Table 8.6 Port Number References**

A7	A6	A5	A4	A3	A2	A1	A0	Port Number
0	0	0	0	1	1	0	1	13
0	0	0	0	1	1	1	0	14
0	0	0	0	1	1	1	1	15

Port number references are supported in both the Domain Route Table and the Device Route table.

#### 8.2.9.2 Multicast Mask References

The device supports the ability to multicast packets to multiple output ports. In support of this, the Multicast Mask Registers must be referenced in the Device Route Table. Multicast Mask Registers are referenced in the Device Route Table as shown in the table below.

**Table 8.7 Multicast Mask References**

A7	A6	A5	A4	A3	A2	A1	A0	Mask Register Number
0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	1	1
0	1	0	0	0	0	1	0	2
0	1	0	0	0	0	1	1	3
0	1	0	0	0	1	0	0	4
0	1	0	0	0	1	0	1	5
0	1	0	0	0	1	1	0	6
0	1	0	0	0	1	1	1	7
0	1	0	0	1	0	0	0	8
0	1	0	0	1	0	0	1	9
								:
								:
0	1	1	0	0	1	1	1	39

If one of the above values is encountered in the route table at the route table reference defined by the destination ID in the packet header, the CPS-10Q moves the packet through its internal RIO switch, accesses the referenced multicast register, and multicasts the packet via the output ports specified by the per-port bitmapped value in the register.

The Multicast Mask Register addresses are supported in the Device Route Table, but not in the Domain Route Table.

#### 8.2.9.3 Default Route

The CPS-10Q supports references to its default port in both its Device Route Table and its Domain Route Table. The default value of routing table is 0xDE for all destination ID. 0xDE means route packet to the default port. The default port can be programmable through Standard Default Route Register (address 0x78).

#### 8.2.9.4 No Route

The CPS-10Q supports references to “no route” in both its Device Route Table and its Domain Route Table. To reference “no route” the user uses a value of 0xDF. If this value is encountered as a result of a lookup into either of its route tables, the device will drop the packet.

#### 8.2.9.5 Force Local

The CPS-10Q supports “force local” references in its Domain Route Table. A Force Local reference of 0xDD in the Domain Route Table forces a lookup with the 8 lower (lsb) bits of the destination ID in the Device Route Table.

### 8.3 DEVICE PROGRAMMING

This section provides an overview of device programming sequence and reference.

#### 8.3.1 Power Up and Reset

There are no power-up sequencing requirements with respect to the multiple supplies on the device. There is no power ramp up rate requirement.

With the device powered-up and the DC pins held static, it is time to issue a reset to the device. A reset is REQUIRED prior to performing any other operations on the device. Described here are the necessary steps. Please refer to the Reset & Initialization chapter for full detail.

There are three options to affect a hard reset of the CPS-10Q: driving the  $\overline{\text{RST}}$  pin, writing to the Soft Reset Register, or receipt of an sRIO link-request reset control symbol.

A hard reset MUST be performed after power-up. All three methods are equivalent. Each sets all internal registers to default values, and resets all PLLs. It also resets all port configurations to default, and sets the port speeds according to the speed pins previously mentioned.

A hard reset can also be performed any time after power-up by writing to the Soft Reset Register. Writing to the reset register can be accomplished via the I<sup>2</sup>C port, the JTAG port, or a host processor appropriately configured to communicate through the default sRIO port configuration of the CPS-10Q.

The third method is performed via sRIO control symbol. RapidIO defines a Link-Request Control Symbol that resets the receiving device. The CPS-10Q defines two options that define the behavior when this control symbol is received from one of the RIO ports. The user can program the ENABLE\_PORT\_RESET field in CPS\_CONTROL register. If this bit is set to 0, the whole device will be reset upon receipt of a reset symbol. Otherwise it will reset the port on which the symbol was received.

### 8.3.2 Per Port Reset

Per Port reset is reset to a single port only which is invoked when that port receives a sequence of four link-request or reset-device controls (also called a link-reset) as described by the sRIO spec in part-6. The reception of a local reset to the port in this way is referred to below as a local soft reset event and affects the port in the following way:

1. The input-retry state machine and input-error state machine are returned to their initial states, regardless of what the state was at the time the reset was received (including the stopped states).
2. The condition of actively receiving a packet is cleared on the input port, as if the packet had been cancelled. Packet word counters for measuring packet length are cleared to zero.
3. The local soft reset event causes any current packet being received to be discarded and not accepted by the switch.
4. Logic exists in the input port to detect when two link-requests are received before the port has transmitted a link-response for the first-link request. This logic is reset by local soft reset event.
5. The status control symbol counters are reset to zero. These are the counters which track the number of status control symbols that have been received and transmitted by the port following link up for the purpose of placing the port in the normal mode (i.e.- for asserting the port\_OK bit).
6. The local soft reset event causes the register to be reset which tracks the value of the ackid that is expected in the next packet that the port receives. Thus, following the local soft reset event, the port will be expecting the next packet that it receives to have ackid of zero.
7. The ackid queue in the input side of the port which buffers up the ackids of packets received is cleared. This queue buffers up the ackids for which the port must send packet-accept control symbols.
8. Detectable errors on control symbols or packets received by the port in the cycle in which the local soft reset event occurs are suppressed from being asserted.
9. Packets committed to the switch input buffer associated with the port being reset are not cleared by the local soft reset event.
10. Packets delivered by the switch to the switch output buffer associated with the port being reset are not cleared out by the local soft reset event. NOTE that for the CPS-10Q parts, the switch output buffer and the retransmit buffer are separate and distinct.
11. All packets in the retransmit buffered are cleared. In addition all state machine associated with the control of the retransmit buffer are returned to their initial states. This includes the state machines that control storing packets, reading packets out for transmission, clearing packets, tracking the number and order of packets to be cleared, retransmitting packets, and arbitrating for the next packet to transmit. All packet counters and packet trackers associated with packets in the retransmit buffer are reset. These actions effectively clear the retransmit buffer.
12. All counter registers associated with packet and control symbols statistics are reset by the local soft reset event. This includes number of packets transmit and received, particular control symbols transmitted and received, etc.
13. When a port's link maintenance response CSR is written such as to cause the port to transmit a sequence of link-request/reset-device control symbols, then a counter is used to establish a lockout window to prevent any other control symbols from being transmitted within the link-request/reset-device control symbol sequence (as required by sRIO spec for the link-reset sequence). This lockout counter is cleared by a local soft reset event.
14. There is a symbol counter in the output side of the port that counts the number of link-request/reset-device control symbols for the port to transmit when the port's link maintenance response CSR is written with a request to send a link-reset sequence. This symbol counter is cleared by a local soft reset event.
15. There is a symbol queue in the output port that buffers control symbols that need to be transmitted by the port. This queue is cleared by a local soft reset event.

16. There is an ackid scoreboard in the output side of the port which tracks the ackids that are in use (ie-outstanding on transmitted but unacknowledged packets). It also tracks the value of ackid to be transmitted in the next outbound packet as well as tracks the value of the ackid expected in the next acknowledge control symbol (accept, retry, or link-response) which the port receives. This ackid scoreboard is cleared by a local soft reset event. This means that the next packet to be transmitted following the port reset will start with ackid zero.
17. There is a counter in the output port which measures the elapsed time between when a packet is transmitted and when the packet accept control symbol is received. A second counter measures the time between when a link-request control symbol is transmitted and when the associated link-response control symbol is received. The values of these counters is used to enforce the timeouts required by sRIO. Both counters are cleared by a local soft reset event.
18. When the port\_disable bit of the port\_control1\_CSR is asserted the all link traffic is disabled and the port can enter a lower-power condition by not clocking most of the registers in the port. The CSRs in the port need to remain accessible to the user even when the port is in a low power state, so the registers referred to here which have their clocks gated off are non-CSR registers in the port logic (state machines, counters, pipeline stages, etc.). Before gating off the clocks to these registers, a local soft reset event is asserted, even though it was not caused by link-request/reset-device control symbols received by the port. The reason the local soft reset is asserted is to assign the registers to favorable values (typically zero) before the clocks are gated off. In this way, when the register clocks are restored, there will not be any stale values in the registers that could cause the port logic to behave in expected ways.
19. The output-retry state machine and output-error state machine are returned to their initial states, regardless of what the state was at the time the reset was received (including the stopped states and the fatal error state).
20. When the port does not receive a link-response control symbol following the transmission of a link-request/input-status control symbol, a link-response timeout event occurs. The port will then retransmit the link-request/input-status symbol which may again timeout. The CPS-10Q parts allow this process to iterate repeatedly up to 16 timeouts of the link-response before declaring a fatal-error condition. There is a counter associated with counting how many times the link-request/input-status symbol has been transmitted in this loop. That counter is cleared by a local soft reset event.
21. Most of the sRIO-defined port-level CSRs are not modified or cleared by a local soft reset event. The exceptions in the CPS-10Q design are in the PortN\_error\_and\_status CSR and include the port\_uninit bit which is set high and the following fields which are cleared to zero: port\_ok, port\_error, input\_error, input\_error\_encountered, input\_retry, output\_error, output\_error\_encountered, output\_retry, output\_retried, and output\_retry\_encountered.
22. The 1x/2x/Nx initialization state machine is returned to the initial state, regardless of what the state was at the time the reset was received. Since this involves returning to the SILENT state, the traffic on all lanes will be disabled which will force loss of link with the lane partner. This will cause link re-negotiation to occur in the same way as if the force\_reinit function had been invoked.

### 8.3.3 Reset Configuration

After resetting the CPS-10Q, the ports are set to their default configuration, with the port speed dictated by the speed pins (refer to the Reset & Initialization chapter). Since the serial RapidIO standard does not dictate a power-up speed setting, subsequent in-band sRIO programming requires the system designer ensure there is a path of connectivity from the host processor to the CPS-10Q via sRIO ports of compatible speed and configuration.

If the CPS-10Q boots from external EEPROM, the setting depends on the setting image. The booting status is reflected in the I2C master status register.

### 8.3.4 Port Configuration

The next step after resetting the CPS-10Q to its default state is to configure the physical ports. As usual, this can be accomplished by the I<sup>2</sup>C or JTAG ports, or by in-band sRIO maintenance packets.

### 8.3.5 Error Report Enables

To detect errors as early as possible (even those during the initial programming sequence), the error reporting features of the CPS-10Q is taken advantage of in this early stage of configuring the CPS-10Q. Errors are reported from any of several major architectural blocks aboard the CPS-10Q. Since the error reporting field defaults to OFF at reset, it is recommended that the user enable reporting for all architectural blocks.

For early debug, the Err\_Report\_Enable bit set for each of the following:

- ◆ Config\_mod\_err\_report\_enable
- ◆ I<sup>2</sup>C\_err\_report\_enable
- ◆ JTAG\_err\_report\_enable
- ◆ Quad\_err\_report\_enable

Errors will then be reported by all enabled blocks to the Error Management block. Refer to the “Error Management” chapter for full detail on the error handling features, and a full listing of error codes that is reported.

To better isolate a given type of fail, or as the system is fully debugged, the user might choose to throttle back the number of reporting blocks.

### 8.3.6 Quad Configuration (PHY Layer)

The physical layer ports on the CPS-10Q are next to be programmed. Doing so establishes the port configuration, and the CPS-10Q’s response to sRIO reset control symbols. This functionality is controlled through three main register sets:

- ◆ *CPS-10Q Control Registers*
  - This register dictates whether the CPS-10Q is completely reset, or just the port is reset upon receipt of an sRIO reset control symbol.
- ◆ *Quad Control Registers*
  - This register defines the behavior of a given quad (4 logically-grouped lanes). This includes enabling / disabling, setting the port speed, drive strength and pre-emphasis levels, and forcing a reset of the PLLs among others. This register dictates how the CPS-10Q’s ports are physically enabled, and logically enumerated.
  - In standard Quad configuration, the PLL\_reset bit 10 and 11 both must be the same value. Program to “00” for reset and “11” to deassert reset. In the enhance mode, bit 10 and 11 can operate independently. During the PLL\_reset, the port status in the port\_n\_err\_stat\_csr is not valid. If the PLLs are being reset, the port is always uninitialized, even if the Port\_OK is read from port\_n\_err\_stat\_csr.



To force an standard Quad to 1x mode, use RIO CSRs Port\_CTRL register (0x15C), bit 24-26 (PORT\_WIDTH\_OVERRIDE). Don’t use Quad Control Register, PLL\_Reset bit.

- ◆ *CPS-10Q Port Operation Registers*
  - These registers control how ports retransmit new packets and allows limits placed on the number of packets the are retransmitted upon CRC fail among others.

By programming the above three register sets, one can accomplish a full configuration of the physical layer of all CPS-10Q ports. This is key to configuring the device to interface properly to adjacent devices in the system prior to any sRIO bring-up and initialization routines take place.

Anytime a quad is configured or reconfigured, the user must also reinitialize the link by writing to the FORCE\_REINIT field in the QUAD\_CTRL register. See the “Registers” chapter for more detail.

### 8.3.7 sRIO Bring-Up & Initialization

The next task in configuring the CPS-10Q is going into the sRIO bring-up and initialization routines (refer to the RapidIO Software/System Bring Up specification).

## 8.4 EXAMPLE OF PROGRAMMING

There are only three steps to program the CPS-10Q switch route.

1. Program the QUAD\_CTRL\_Register (0xFF0000 - 0xFF9000).  
 Quad Mode (bit 5): Standard or Enhance  
 Quad Speed (bit 1-0): 3.125, 2.5 or 1.25 Gbps.  
 Transmitter Pre- emphasis (bit 4-2), Drive Strength (bit 9-7)
2. Program the Routing table (0xE00000 - 0xE00400 Global Device Route Table)  
 Register 0xE00000 is for Destination ID 0x00. The value in the register is the port number. For example, Destination ID 0x00 connected to Port 8, then write 0x8 into register 0xE00000. If destination ID 0x01 is multicast ID, then write 0x40 into register 0xE00004. It will call the multicast\_register\_0 when Dest\_ID is matched. For more information, see 8.2.9 Destination Address to Route Table Mapping.
3. Enable the input and output port. (0x15C - 0x33C)



All input and output port are disabled by default. It will only received maintenance packet only. Therefore, the input and output port need to be enabled before sending traffic.

## 8.5 OPTIONAL API CALLS

The IDT API fully supports all calls necessary to control the CPS-10Q's switch functionality as detailed above. These high level calls include the following:

- ◆ *Configure\_Quads*
  - This call passes the appropriate parameterized data structure per standard sRIO HAL requirements. The data structure is comprised of all required fields of the Quad Control register mentioned above.
- ◆ *Configure\_Ports*
  - This call passes the appropriate data structure to the appropriate port's control CSR per sRIO standard requirements for this CSR.
- ◆ *Read\_Quad\_Configuration*
  - This call retrieves as an output data structure the field information of the Quad Control register.
- ◆ *Add\_Delete\_Routes*
  - This function adds or deletes routes in the route table. Multiple number of routes can be entered which will be either deleted or inserted. If a route can not be added, the function is terminated, and index of unsuccessful route is returned.
- ◆ *Status\_destID*
  - This function checks if a destID is in the route table.
- ◆ *Write\_Domain\_Register*
  - This function can be used to directly write into the domain register instead of indirectly accessing it.
- ◆ *Read\_RT*
  - This function can be used to directly read from device or domain route tables instead of indirectly accessing them.
- ◆ *Read\_Domain\_Register*
  - This function can be used to directly read from domain register instead of indirectly accessing it.
- ◆ *Create\_MC\_List*
  - This function creates multicast (MC) lists based on user-specified member ports.
- ◆ *Get\_MC\_Occupancy\_List*
  - This function returns a list of those MC masks which are already in use.

- ◆ *MC\_Read*
  - This function reads the contents of a multicast (MC) list, identifying which ports are active.
- ◆ *MC\_Delete*
  - This function deletes user-specified individual member ports of a multicast (MC) list.



# Reset and Initialization

## 9 RESET AND INITIALIZATION

### 9.1 REGISTERS

The registers for the CPS-10Q supports the “Reset Values” defined in the “Registers” section of this document.

#### 9.1.1 RIO Ports

After Power Up and after device reset, the RIO Port configuration is as defined below:

Table 9.1 Port Configuration at Power Up

Lane	Port Mode	Port Number
3-0	Standard 4x	0
7-4	Standard 4x	1
11-8	Standard 4x	2
15-12	Standard 4x	3
16	Enhanced 1x	4
17	Enhanced 1x	5
18	Enhanced 1x	6
19	Enhanced 1x	7
23-20	Standard 4x	8
27-24	Standard 4x	9
31-28	Standard 4x	10
35-32	Standard 4x	11
36	Enhanced 1x	12
37	Enhanced 1x	13
38	Enhanced 1x	14
39	Enhanced 1x	15

The device provides two external pins, (SPD0 and SPD1) which determines the initial (default) port speed. These pins support the configurations defined below:

**Table 9.2 Default Speed Settings with SPD0 and SPD1**

SPD0/SPD1 States	Port Speed
00	1.25 Gbits/sec
01	2.5 Gbits/sec
10	3.125 Gigabits/sec
11	Reserved

## 9.2 INITIALIZATION STEPS

The CPS-10Q supports the following initialization steps.

The reset signal need not be held low for more than 5 REF-CLK cycles.

- 1) Initialize RIO PHY and ports.
  - a. The default setting for PHYs and links are set at this point.
  - b. PHYs start communicating with other neighbor devices.
- 2) Initialize the memory, and registers
  - a. This includes setting registers and memories to their default values

## 9.3 INITIALIZATION OF RIO PORTS

The CPS-10Q supports the initialization of RIO Ports as defined in Physical Layer Specification section rev 1.3.

The CPS-10Q provides registers which allow the user to define port configuration, speed, and AC Timing Specification (long run/short run). These registers are programmable through the I<sup>2</sup>C or JTAG interfaces during system initialization as well.

## 9.4 RIO SYSTEM BRING UP

The device supports the “system bring up” requirements defined in the RapidIO System Interconnect Specification Annex 1 -- Software and System Bringup Specification.

## 9.5 SERDES INITIALIZATION

SERDES Initialization for the CPS-10Q is defined in Chapter 6 of the RIO specification. Upon reset the TX drivers will drive a logic “0” out onto the serial port. After reset this logical “0” is held for a predetermined number of clock cycles. This number of clock cycles are register controlled. These register contents are compared to an 8-bit counter. Once they match, the TX drivers are released and transmission of the idle sequence begins. Once the lanes are synchronized, in 1X mode, or aligned in 4X mode, port\_initialized (as defined in RIO Chapter 6) will be driven to a logical “1”. This is the indicator to the PHY that the link is ready.



# Registers

## 10 REGISTERS

The register file addressable through I<sup>2</sup>C, JTAG and any RapidIO port and is built with 22-bit addresses and 32-bit words, as specified by the RIO spec. All unused address space is to be considered RESERVED. When write to any RESERVED address, no error is reported, and nothing happens. A read of any RESERVED address will result in a response of all 0s. Attempting to write to port registers for non-existent ports will also have no effect.

### 10.1 RAPIDIO COMPLIANCE

The CPS-10Q support applicable Rapid IO specifications to the maximum extent possible. In general the device supports the "Generic: All devices" requirements in the Rapid IO Interconnect Specification part 7: System and Device Interpretability Specification. This requirement suggests support for a number of Rapid IO specific registers. The CPS-10Q supports each of these registers except for the "Destination Operations CAR". Rapid IO Interconnect Specification part 1: Input/Output Logical Specification defines this register as only being applicable to end points.

#### 10.1.1 Interpretation of Reserved Register Bits

The CPS-10Q design is based on the RIO definition for the treatment of reserved register bits to support compatibility with the existing PPS and CPS family product. This treatment is defined in Table 3-2 of the RIO Common Transport Specification (Part 3). Under the "Target Behavior" column, the expected return of the reserved bits of a register read is "logic 0" for all RIO defined registers. The CPS-10Q has extended this to definition to its "Implementation Defined Space" as well. Although the CPS-10Q initializes with zeros in these bits positions, it does not prevent the user from writing into these bits. The CPS-10Q design is based on the expectation that the user will write zeros into reserved space when written to.

### 10.2 REGISTER TYPE FIELD DEFINITIONS

Table 10.1 Register Types

Type	Description
R/W	Both read and write from an external device are supported
RO	Read Only. These registers can not be written from an external device
WO	Write Only. These registers can only be written from an external device
RR	Reset on Read. These registers can only be read by external devices and are reset when read.

**Table 10.1 Register Types**

Type	Description
FR	Fixed Read. The values in these registers are fixed and can be only read from an external device.
W1R	Write Once Reset.

### 10.3 ADDRESS MAP

A mapping of registers to addresses exists as part of the overall memory address map of the device. This memory map is provided below.

For most of the registers, there is one instantiation for each port. The address on each individual register indicates the actual address for port 0. For all other ports, there is a offset to port 0.

**Table 10.2 CPS-10Q Memory Map**

Base Address	Description
<b>0x000000 - 0x000088</b>	<b>RIO Defined Registers</b>
0x000000	DEV_IDENT_CAR
0x000004	DEV_INF_CAR
0x000008	ASSY_IDENT_CAR
0x00000C	ASSY_INF_CAR
0x000010	PROC_ELEM_FEAT_CAR
0x000014	SWITCH_PORT_INF_CAR
0x000018	SRC_OP_CAR
0x000030	SW_MCAST_SUP_CAR
0x000034	SW_RTE_TBL_LIM_CAR
0x000038	SW_MCAST_INF_CAR
0x000068	HOST_BASE_DEV_ID_LOCK_CSR
0x00006C	COMP_TAG_CSR
0x000070	STD_RTE_CONF_DESTID_SEL_CSR
0x000074	STD_RTE_CONF_PORT_SEL_CSR
0x000078	STD_RTE_DEF_PORT_CSR
0x000080	MCAST_MSK_PORT_CSR
0x000084	MCAST_ASSOC_SEL_CSR
0x000088	MCAST_ASSOC_OP_CSR

**Table 10.2 CPS-10Q Memory Map**

Base Address	Description
<b>0x000100 - 0x0002BC</b>	<b>RIO Extended Feature Registers</b>
0x000100	PORT_MAINT_BLK_HEAD
0x000120	PORT_LINK_TIME_OUT_CTRL_CSR
0x00013C	PORT_GEN_CTRL_CSR
0x000140	PORT_0_LINK_MAINT_REQ_CSR
0x000144	PORT_0_LINK_MAINT_RESP_CSR
0x000148	PORT_0_LOCAL_ACKID_CSR
0x000158	PORT_0_ERR_N_STAT_CSR
0x00015C	PORT_0_CTRL_CSR
0x000140+ 0x20*PORT_NUM	Registers start for port PORT_NUM
...	...
0x000320	PORT_15_LINK_MAINT_REQ_CSR
0x000324	PORT_15_LINK_MAINT_RESP_CSR
0x000328	PORT_15_LOCAL_ACKID_CSR
0x000338	PORT_15_ERR_N_STAT_CSR
0x00033C	PORT_15_CTRL_CSR
0x010070	LOCAL_RTE_CONF_DESTID_SEL_CSR
0x010080	LOCAL_MCAST_MASK_PORT_SEL
<b>0xD00000-DFFFFC</b>	<b>Vendor access only</b>
<b>0xE00000-0xE1F400</b>	<b>Route Table</b>
0xE00000	Global Device Route Table
0xE00400	Global Domain Route Table
0xE10000	Port 0 Device Route Table
0xE10400	Port 0 Domain Route Table
...	...
0xE10000+0x1000*PORT_NUM	Registers start for port PORT_NUM
...	...
0xE1F000	Port 15 Device Route Table
0xE1F400	Port 15 Domain Route Table
<b>0xE40000 - E4B08C</b>	<b>Trace Comparison Values and Masks</b>

**Table 10.2 CPS-10Q Memory Map**

Base Address	Description
0xE40000	Port 0 Trace Comparison Value 1
0xE40014	Port 0 Trace Mask 1
0xE40028	Port 0 Trace Comparison Value 2
0xE4003C	Port 0 Trace Mask 2
0xE40050	Port 0 Trace Comparison Value 3
0xE40064	Port 0 Trace Mask 3
0xE40078	Port 0 Trace Comparison Value 4
0xE4008C	Port 0 Trace Mask 4
...	...
0xE40000+0x100*PORT_NUM	Registers start for port PORT_NUM
...	...
0xE40F00	Port 15 Trace Comparison Value 1
0xE40F14	Port 15 Trace Mask 1
0xE40F28	Port 15 Trace Comparison Value 2
0xE40F3C	Port 15 Trace Mask 2
0xE40F50	Port 15 Trace Comparison Value 3
0xE40F64	Port 15 Trace Mask 3
0xE40F78	Port 15 Trace Comparison Value 4
0xE40F8C	Port 15 Trace Mask 4
...	...
0xE4FF00	Broadcast Trace Comparison Value 1
0xE4FF14	Broadcast Trace Mask 1
0xE4FF28	Broadcast Trace Comparison Value 2
0xE4FF3C	Broadcast Trace Mask 2
0xE4FF50	Broadcast Trace Comparison Value 3
0xE4FF64	Broadcast Trace Mask 3
0xE4FF78	Broadcast Trace Comparison Value 4
0xE4FF8C	Broadcast Trace Mask 4
0xF00000 - 0xF1FFFF	Vendor access only

**Table 10.2 CPS-10Q Memory Map**

Base Address	Description
<b>0xF20000 - F20100</b>	<b>Global Configuration Registers</b>
0xF20000 - 0xF20008	Reserved
0xF2000C	CPS_CONTROL
0xF20010	Vendor access only
0xF20014	CONF_MOD_ERR_REPORT_ENABLE
0xF20018	AUXPORT_ERR_REPORT_ENABLE
0xF2001C	MAINT_ERR_REPORT_ENABLE
0xF20020	RIO_DOMAIN
0xF20024	RIO_PORT_WRITE_INFO
0xF20028	RIO_PORT_WTE_SRCID
0xF2002C	RIO_ASSY_IDENT_CAR
0xF20030	RIO_ASSY_INF_CAR
0xF20034	Reserved
0xF20038	Reserved
0xF20040	SOFT_RESET
0xF20050	I2C_MASTER_CONTROL
0xF20054	I2C_MASTER_STAT_CONTROL
<b>0xF30000 - 0xF3009C</b>	<b>Global Multicast Registers</b>
0xF30000	Global MULTICAST0
0xF30004	Global MULTICAST1
...	...
0xF3009C	Global MULTICAST39
0xF38000 - 0xF3809C	Port 0 Unique Multicast Masks
0xF38100 - 0xF3819C	Port 1 Unique Multicast Masks
0xF38200 - 0xF3829C	Port 2 Unique Multicast Masks
0xF38300 - 0xF3839C	Port 3 Unique Multicast Masks
0xF38400 - 0xF3849C	Port 4 Unique Multicast Masks
0xF38500 - 0xF3859C	Port 5 Unique Multicast Masks
0xF38600 - 0xF3869C	Port 6 Unique Multicast Masks
0xF38700 - 0xF3879C	Port 7 Unique Multicast Masks
0xF38800 - 0xF3889C	Port 8 Unique Multicast Masks

**Table 10.2 CPS-10Q Memory Map**

Base Address	Description
0xF38900 - 0xF3899C	Port 9 Unique Multicast Masks
0xF38A00 - 0xF38A9C	Port 10 Unique Multicast Masks
0xF38B00 - 0xF38B9C	Port 11 Unique Multicast Masks
0xF38C00 - 0xF38C9C	Port 12 Unique Multicast Masks
0xF38D00 - 0xF38D9C	Port 13 Unique Multicast Masks
0xF38E00 - 0xF38E9C	Port 14 Unique Multicast Masks
0xF38F00 - 0xF38F9C	Port 15 Unique Multicast Masks
<b>0xF40000 - 0xF40F1C</b>	<b>Switch Port Registers</b>
0xF40000	PORT_0_BUF_SIZE
0xF40004	PORT_0_OPS
0xF40008	PORT_0_ERR_REPORT_ENABLE
0xF4000C	PORT_0_SWITCH_BUF_STATUS
0xF40010	PORT_0_ACK_CNTR
0xF40014	PORT_0_NACK_CNTR
0xF40018	Reserved
0xF4001C	PORT_0_SW_PKT_CNTR
0xF40020	PORT_0_TRACE_MATCH_CNTR_1
0xF40024	PORT_0_TRACE_MATCH_CNTR_2
0xF40028	PORT_0_TRACE_MATCH_CNTR_3
0xF4002C	PORT_0_TRACE_MATCH_CNTR_4
0xF40030	PORT_0_FILTER_MATCH_CNTR_1
0xF40034	PORT_0_FILTER_MATCH_CNTR_2
0xF40038	PORT_0_FILTER_MATCH_CNTR_3
0xF4003C	PORT_0_FILTER_MATCH_CNTR_4
...	...
0xF40000+0x100*PORT_NUM	Registers start for port PORT_NUM
...	...
0xF40F00	PORT_15_BUF_SIZE
0xF40F04	PORT_15_OPS
0xF40F08	PORT_15_ERR_REPORT_ENABLE

**Table 10.2 CPS-10Q Memory Map**

Base Address	Description
0xF40F0C	PORT_15_SWITCH_BUF_STATUS
0xF40F10	PORT_15_ACK_CNTR
0xF40F14	PORT_15_NACK_CNTR
0xF40F18	Reserved
0xF40F1C	PORT_15_SW_PKT_CNTR
0xF40F20	PORT_15_TRACE_MATCH_CNTR_1
0xF40F24	PORT_15_TRACE_MATCH_CNTR_2
0xF40F28	PORT_15_TRACE_MATCH_CNTR_3
0xF40F2C	PORT_15_TRACE_MATCH_CNTR_4
0xF40F30	PORT_15_FILTER_MATCH_CNTR_1
0xF40F34	PORT_15_FILTER_MATCH_CNTR_2
0xF40F38	PORT_15_FILTER_MATCH_CNTR_3
0xF40F3C	PORT_15_FILTER_MATCH_CNTR_4
...	...
<b>0xF4FF00 - 0xF4FF08</b>	<b>Broadcast to Switchport Registers</b>
0xF4FF00	PORT_BUF_SIZE_BROADCAST
0xF4FF04	PORT_OPS_BROADCAST
0xF4FF08	PORT_ERR_REPORT_ENABLE_BROADCAST
<b>0xF50000</b>	<b>Vendor access only</b>
<b>0xFD0000 - 0xFD0030</b>	<b>Error Handling Registers</b>
0xFD0000	ERR_CAP_REG
0xFD0004	ERR_LOG
0xFD0008	SPECIAL_ERR_REG_0
0xFD000C	SPECIAL_ERR_REG_1
0xFD0010	SPECIAL_ERR_REG_2
0xFD0014	SPECIAL_ERR_REG_3
0xFD0018	SPECIAL_ERR_REG_4
0xFD001C	SPECIAL_ERR_REG_5
0xFD0020	SPECIAL_ERR_REG_6
0xFD0024	SPECIAL_ERR_REG_7
0xFD0028	ERR_FLAG

**Table 10.2 CPS-10Q Memory Map**

Base Address	Description
0xFD002C	ERR_COUNTER
0xFD0030	ERR_RESET
<b>0xFF0000 - 0xFFFF00</b>	<b>Quad Control Registers</b>
0xFF0000	QUAD_0_CTRL
0xFF0004	QUAD_0_ERR_REPORT_EN
0xFF1000	QUAD_1_CTRL
0xFF1004	QUAD_1_ERR_REPORT_EN
...	...
0xFF9000	QUAD_9_CTRL
0xFF9004	QUAD_9_ERR_REPORT_EN
0xFFFF00	QUAD_CTRL_BROADCAST

## 10.4 RAPID IO REGISTERS

Rapid IO specifications rev 1.3 specifies that certain registers be provided. These required registers is implemented as defined in this section.

### 10.4.1 Device Identity Capability Register (DEV\_IDENT\_CAR)

Table 10.3 DEV\_IDENT\_CAR 0x000000

Bit	Field Name	Type	Reset Value	Comment
15 - 0	DEV_VENDOR_IDENT	FR	0x0038	Device Vendor Identifier. Assigned by the RTA specifically for IDT
31 - 16	DEV_IDENT	FR	0x35E	Specific Device Identifier.

### 10.4.2 Device Information Capability Register (DEV\_INF\_CAR)

Table 10.4 DEV\_INF\_CAR 0x000004

Bit	Field Name	Type	Reset Value	Comment
3 - 0	DEV_REG_JTAG	FR	0b0000	Device Revision Level. Same as the Version Level in the JTAG device ID register
15 - 4				Reserved
20 - 16	DEV_REG_MINOR	FR	0b00000	MINOR_VER field from DIE SIG register
23 - 21	DEV_REG_MAJOR	FR	0b000	MAJOR_VER field from DIE SIG register
31 - 24				Reserved

### 10.4.3 Assembly Identity Capability Register (ASSY\_IDENT\_CAR)

Table 10.5 ASSY\_IDENT\_CAR 0x000008

Bit	Field Name	Type	Reset Value	Comment
15 - 0	ASSY_VENDOR_IDENT	FR	0x0000	Assembly Vendor Identifier. This field is used to uniquely identify the manufacturing vendor of the assembly containing this device.
31 - 16	ASSY_IDENT	FR	0x0000	This field uniquely identifies the type of assembly used. Assigned by the assembly supplier. The reader is referred to the definition of the RIO_ASSY_IDENT_CAR

#### 10.4.4 Assembly Information Capability Register (ASSY\_INF\_CAR)

Table 10.6 ASSY\_INF\_CAR 0x00000C

Bit	Field Name	Type	Reset Value	Comment
15 - 0	EXT_FEAT_PTR	FR	0x0100	Pointer to the first entry in the extended features list.
31 - 16	ASSY_REV	FR	0x0000	Assembly revision level. The reader is referred to the RIO_ASSY_INF_CAR

#### 10.4.5 Processing Element features Capability Register (PROC\_ELEM\_FEAT\_CAR)

Table 10.7 PROC\_ELEM\_FEAT\_CAR 0x000010

Bit	Field Name	Type	Reset Value	Comment
2 - 0	EXT_ADDR_SUPPORT	FR	0b001	Number of address bits supported 111 = 66, 50, and 34 bit addresses 101 = 66 and 34 bit addresses 010 = 50 and 34 bit addresses 001 = 34 bit addresses only all other values are reserved
3	EXT_FEATURES	FR	0b1	If enabled, the device has an extended features list and a valid pointer to it. 1 = enabled
4	COMMON_TRANSPORT_LARGE_SUPPORT	FR	0b1	If enabled, the device supports 16 bit source and destination IDs. 1 = enabled
5	CRITICAL_REQUEST_FLOW_SUPPORT	FR	0b0	0 = Critical Request Flow not supported 1 = Critical Request Flow is supported
6	CRC_ERROR_RECOVERY	FR	0b1	0 = Suppression of error recovery on CRC error is not supported 1 = Suppression of error recovery on CRC error is supported
7				Reserved

**Table 10.7 PROC\_ELEM\_FEAT\_CAR 0x000010**

Bit	Field Name	Type	Reset Value	Comment
8	STANDARD_ROUTE_CONFIGURATION_SUPPORT	FR	0b1	The device supports the standard route table configuration mechanism 1 = supported
9	EXTENDED_ROUTE_CONFIGURATION_SUPPORT	FR	0b1	The device supports extended route table configuration 1 = supported
10	MULTICAST_SUPPORT	FR	0b1	The device supports multicast extensions 1 = supported
27 - 11				Reserved
28	SWITCH_SUPPORT	FR	0b1	The device can bridge to another Rapid IO interface 1 = bridge support
29	PROCESSOR	FR	0b0	The device does not provide a processor that executes code 0 = processor not supported
30	MEMORY	FR	0b0	The device does not have physically addressable local address space and can not be accessed as an end point through non-maintenance operations 0 = no end point support
31	BRIDGE	FR	0b0	The device may or may not be able to bridge between sRIO and another non-sRIO interface 0 = No support for bridging to a non-sRIO interface

#### 10.4.6 Switch Port Information Capability Register (SWITCH\_PORT\_INF\_CAR)

**Table 10.8 SWITCH\_PORT\_INF\_CAR 0x000014**

Bit	Field Name	Type	Reset Value	Comment
7 - 0	PORT_NUMBER	RO	0x00	The port number from which the maintenance read operation accessed this register For I2C accessed, the value is 0xFE.
15 - 8	PORT_TOTAL	RO	0x10	The total number of ports configurable through the configuration registers

**Table 10.8 SWITCH\_PORT\_INF\_CAR 0x000014**

Bit	Field Name	Type	Reset Value	Comment
31 - 16				Reserved

#### 10.4.7 Source Operations Capabilities Register (SRC\_OPS\_CAR)

**Table 10.9 SRC\_OPS\_CAR 0x000018**

Bit	Field Name	Type	Reset Value	Comment
1 - 0				Reserved
2	PORT_WRITE	FR	0b1	Defines the ability of the device to source a port write operation 0 = no 1 = yes
3				Reserved
4	ATOMIC_CLEAR	FR	0b0	Defines the ability of the device to support an atomic clear operation 0 = no 1 = yes
5	ATOMIC_SET	FR	0b0	Defines the ability of the device to support an atomic set operation 0 = no 1 = yes
6	ATOMIC_DECREMENT	FR	0b0	Defines the ability of the device to support an atomic decrement operation 0 = no 1 = yes
7	ATOMIC_INCREMENT	FR	0b0	Defines the ability of the device to support an atomic increment operation 0 = no 1 = yes
8	ATOMIC_TEST_AND_SWAP	FR	0b0	Defines the ability of the device to support an atomic test and swap operation 0 = no 1 = yes
9				Reserved

**Table 10.9 SRC\_OPS\_CAR 0x000018**

Bit	Field Name	Type	Reset Value	Comment
10	DOORBELL	FR	0b0	Defines the ability of the device to support a doorbell operation 0 = no 1 = yes
11	DATA_MESSAGE	FR	0b0	Defines the ability of the device to support a data message operation 0 = no 1 = yes
12	WRITE_WITH_RESPONSE	FR	0b0	Defines the ability of the device to support a write with response operation 0 = no 1 = yes
13	STREAMING_WRITE	FR	0b0	Defines the ability of the device to support a streaming write operation 0 = no 1 = yes
14	WRITE	FR	0b0	Defines the ability of the device to source a write operation 0 = no 1 = yes
15	READ	FR	0b0	Defines the ability of the device to source a read operation 0 = no 1 = yes
31 - 16				Reserved

#### 10.4.8 Switch Multicast Support Capabilities Register (SW\_MCAST\_SUP\_CAR)

**Table 10.10 SW\_MCAST\_SUP\_CAR 0x000030**

Bit	Field Name	Type	Reset Value	Comment
30 - 0				Reserved
31	SIMPLE_ASSOC	FR	0b0	Defines the device's support of the simple multicast model 0 = no 1 = yes

### 10.4.9 Switch Route Table Entries Table Limit Capabilities Register (SW\_RTE\_TBL\_LIM\_CAR)

Table 10.11 SW\_RTE\_TBL\_LIM\_CAR 0x000034

Bit	Field Name	Type	Reset Value	Comment
15 - 0	MAXIMUM_DESTINATION_IDS_SUPPORTED	FR	0xFF	Maximum number of configurable destination IDs that are supported (0xFF = 256)
31 - 16				Reserved

### 10.4.10 Switch Multicast Information Capabilities Register (SW\_MULT\_INF\_CAR)

Table 10.12 SW\_MULT\_INF\_CAR 0x000038

Bit	Field Name	Type	Reset Value	Comment
15 - 0	MULTICAST_MASKS	FR	0x0028	Defines the number of multicast mask that are supported by the device
29 - 16	MAXIMIM_DESTINATION_IDS_PER_MULTICAST_MASK	FR	0x00FF	The max number of destination IDs that can be associated with a multicast mask
30	PER_PORT_ASSOCIATION	FR	0b0	Per Ingress port association support -- not supported by device
31	BLOCK_ASSOCIATION	FR	0b0	Block association support -- not supported by device

### 10.4.11 Host Base Device ID Lock Command and Status Register (HOST\_BASE\_DEV\_ID\_LOCK\_CSR)

Table 10.13 HOST\_BASE\_DEV\_ID\_LOCK\_CSR 0x000068

Bit	Field Name	Type	Reset Value	Comment
15 - 0	HOST_BASE_DEV_ID	R/W	0xFFFF	Base Device ID for the device that initializes this device
31 - 16				Reserved

#### 10.4.12 Component Tag Command and Status Register (COMPONENT\_TAG\_CSR)

Table 10.14 COMPONENT\_TAG\_CSR 0x00006C

Bit	Field Name	Type	Reset Value	Comment
31 - 0	COMPONENT_TAG	R/W	0x00	Component Tag for this device

#### 10.4.13 Standard Route Table Entries Configuration Destination ID Select Command and Status Register (STD\_RTE\_CONF\_DESTID\_SEL\_CSR)

The use of bits [19:16] are not sRIO compliant. sRIO does not provide the ability to differentiate between the route tables of specific ports.

Table 10.15 STD\_RTE\_CONF\_DESTID\_SEL\_CSR 0x000070

Bit	Field Name	Type	Reset Value	Comment
7 - 0	CONF_DESTID	R/W	0x00	Defines the destination ID used to select an entry in the switch routing table
15 - 8	LARGE_CONFIG_DESTINATION_ID_MSB	R/W	0x00	For a large common transport system, specifies the most significant byte of the destination ID used to select an entry in the switch route table when the Route Config Port CSR is used.
30 - 16				Reserved
31	EXTENDED_CONFIGURATION_ENABLE	R/W	0b0	Extended Configuration Enable. 0 = Disable 1 = Enabled

#### 10.4.14 Standard Route Table Entry Configuration Port Select Command and Status Register (STD\_RTE\_CONF\_PORT\_SEL\_CSR)

Table 10.16 STD\_RTE\_CONF\_PORT\_SEL\_CSR 0x000074

Bit	Field Name	Type	Reset Value	Comment
7 - 0	CONF_OUT_PORT	R/W	0x00	Destination value through which all messages intended for CON_DESTID are sent.
15 - 8	CONF_OUT_PORT_1	R/W	0x00	Destination value through which all messages intended for CON_DESTID + 1 are sent.

**Table 10.16 STD\_RTE\_CONF\_PORT\_SEL\_CSR 0x000074**

Bit	Field Name	Type	Reset Value	Comment
23 - 16	CONF_OUT_PORT_2	R/W	0x00	Destination value through which all messages intended for CON_DESTID + 2 are sent.
31 - 24	CONF_OUT_PORT_3	R/W	0x00	Destination value through which all messages intended for CON_DESTID + 3 are sent.

#### 10.4.15 Standard Route Table Entry Default Port Command and Status Register (STD\_RTE\_DEFAULT\_PORT)

**Table 10.17 STD\_RTE\_DEFAULT\_PORT 0x000078**

Bit	Field Name	Type	Reset Value	Comment
7 - 0	DEFAULT_OUTPUT_PORT	R/W	0x00	Defines the device's default output port.
31 - 8				Reserved

#### 10.4.16 Multicast Mask Port Command and Status Register (MCAST\_MASK\_PORT)

Table 10.18 MCAST\_MASK\_PORT 0x000080

Bit	Field Name	Type	Reset Value	Comment
0	PORT_PRESENT	RO	0b0	Indication of the existence of the egress port and multicast mask pair as a result of the last Write_to_Verify command. 0 = Port not enabled in the multicast mask 1 = Port is enabled in the multicast mask
3 - 1				Reserved
6 - 4	MASK_CMD	R/W	0b000	000 = Write to verify 001 = Add Port 010 = Delete Port 100 = Delete All Ports 101 = Add all Ports
7				Reserved
15 - 8	EGRESS_PORT_NUMBER	R/W	0x00	Defines the port number which is modified/queried by the MASK_CMD
31 - 16	MCAST_MASK	R/W	0x0000	Defines the multicast mask to be modified/queried as determined by the MASK_CMD

#### 10.4.17 Multicast Association Selection Command and Status Register (MCAST\_ASSOC\_SEL\_CSR)

Table 10.19 MCAST\_ASSOC\_SEL\_CSR 0x000084

Bit	Field Name	Type	Reset Value	Comment
15 - 0	MULTICAST_MASK_NUMBER	R/W	0x0000	Selects the multicast mask number for an association
23 - 16	DESTINATION_ID	R/W	0x00	Selects a destination ID for an association operation
31 - 24	LARGE_DESTINATION_ID	R/W	0x00	Selects the most significant byte of a large transport destination ID for an association operation

#### 10.4.18 Multicast Association Operations Command and Status Register (MCAST\_ASSOC\_OP\_CSR)

Table 10.20 MCAST\_ASSOC\_OP\_CSR 0x000088

Bit	Field Name	Type	Reset Value	Comment
0	ASSOCIATION_PRESENT	RO	0b0	Contains the result of the last write to verify command. 0 = no association 1 = association present
4 - 1				Reserved
6 - 5	ASSOCIATION_COMMAND	R/W	0b00	Command when register is written 00 = Write to Verify 01 = Delete Association 11 = Add association
7	TRANSPORT_ASSOCIATION	R/W	0b0	0 = small transport association 1 = large transport association
31 - 8				Reserved

#### 10.4.19 Port Maintenance Block Head (PORT\_MAINT\_BLOCK\_HEAD)

Table 10.21 PORT\_MAINT\_BLOCK\_HEAD 0x000100

Bit	Field Name	Type	Reset Value	Comment
15 - 0	EF_ID	RO	0x0009	Hard Wired Extended Features ID
31 - 16	EF_PTR	RO	0x0000	Hard Wired pointer to the next block in the data structure

#### 10.4.20 Port Link Time Out Control Command and Status Register (PORT\_LINK\_TO\_CTRL\_CSR)

Table 10.22 PORT\_LINK\_TO\_CTRL\_CSR 0x000120

Bit	Field Name	Type	Reset Value	Comment
7 - 0				Reserved
31 - 8	TIME_OUT_VALUE	R/W	0xFFFFFFFF	Time out internal value

### 10.4.21 Port General Control Command and Status Register (PORT\_GEN\_CTRL\_CSR)

Table 10.23 PORT\_GEN\_CTRL\_CSR 0x00013C

Bit	Field Name	Type	Reset Value	Comment
28 - 0				Reserved
29	DISCOVERED	R/W	0b0	0 = device not discovered 1 = device discovered
31 - 30				Reserved

## 10.5 RAPIDIO EXTENDED FEATURE REGISTERS

Table 10.24 RapidIO Extended Register Map

Base Address (hex)	Associated Registers
0x000140, 0x000144, 0x000148, 0x000158, 0x00015C	PORT_0_LINK_MAINT_REQ_CSR, PORT_0_LINK_MAINT_RESP_CSR, PORT_0_LOCAL_ACKID_CSR, PORT_0_ERR_STAT_CSR, PORT_0_CTRL_CSR
0x000160- 0x00017C	For Port 1
0x000180- 0x00019C	For Port 2
0x0001A0- 0x0001BC	For Port 3
0x0001C0- 0x0001DC	For Port 4
0x0001E0- 0x0001FC	For Port 5
0x000200- 0x00021C	For Port 6
0x000220- 0x00023C	For Port 7
0x000240- 0x00025C	For Port 8
0x000260- 0x00027C	For Port 9
0x000280- 0x00029C	For Port 10
0x0002A0- 0x0002BC	For Port 11
0x0002C0- 0x0002DC	For Port 12
0x0002E0- 0x0002FC	For Port 13
0x000300- 0x00031C	For Port 14
0x000320- 0x00033C	For Port 15

### 10.5.1 Port 0 Link Maintenance Request Command and Status Register (PORT\_0\_LINK\_MAINT\_REQ\_CSR)

Table 10.25 PORT\_0\_LINK\_MAINT\_REQ\_CSR 0x000140

Bit	Field Name	Type	Reset Value	Comment
2 - 0	Command	R/W	0b000	0b011 = Reset device 0b100 = Input status 0b000 - 0b010 = Reserved 0b101 - 0b111 = Reserved See RIO part 6 table 3-6 (rev 1.3)
31 - 3				Reserved

### 10.5.2 Port 0 Link Maintenance Response Command and Status Register (PORT\_0\_LINK\_MAINT\_RESP\_CSR)

Table 10.26 PORT\_0\_LINK\_MAINT\_RESP\_CSR 0x000144

Bit	Field Name	Type	Reset Value	Comment
4 - 0	LINK_STATUS	RO	0b00000	Link status field from the link response control symbol
9 - 5	ACKID_STATUS	RO	0b00000	ackID status field from the link response control symbol
30 - 10				Reserved
31	RESPONSE_VALID	RO	0b0	If the previous link request causes a link response, then this bit indicates that the link response has been received and the status fields are valid. If the link request did not cause a link response, this bit indicates that the link request has been transmitted. This bit clears on read.

### 10.5.3 Port 0 Local ACKID Command and Status Register (PORT\_0\_LOCAL\_ACKID\_CSR)

Table 10.27 PORT\_0\_LOCAL\_ACKID\_CSR 0x000148

Bit	Field Name	Type	Reset Value	Comment
4 - 0	OUTBOUND_ACKID	R/W	0b00000	The next transmitted ackID value for the port. Writing this value can force retransmission of outstanding unacknowledged packets in order to manually implement error recovery
7 - 5				Reserved
12 - 8	OUTSTANDING_ACKID	R/W	0b00000	The output port unacknowledged ackID status. The next acknowledge control symbol ackID field that indicates the ackID value expected in the next received acknowledge control symbol
23 - 13				Reserved
28 - 24	INBOUND_ACKID	R/W	0b00000	Input port next expected ackID
30 - 29				Reserved
31	CLR_OUTSTANDING_ACKIDS	R/W	0b0	Writing a value of 1 to this bit causes all outstanding unacknowledged packets to be discarded. This bit is written when trying to recover a failed link. This bit will always return a value of zero when read.

### 10.5.4 Port 0 Error Status Command and Status Register (PORT\_0\_ERR\_STAT\_CSR)

This register will remain the same value during the PLL\_reset. During the PLL\_reset, the port error status register is not valid. So, if the PLLs are being reset, the port status is always uninitialized, even if the Port\_OK is high read from port\_n\_err\_stat\_csr register.

Table 10.28 PORT\_0\_ERR\_STAT\_CSR 0x000158

Bit	Field Name	Type	Reset Value	Comment
0	PORT_UNINIT	RO	0b1	Init status. 1=Uninitialized
1	PORT_OK	RO	0b0	Port status 1=Port OK
2	PORT_ERROR	W1R	0b0	Port Error Status

**Table 10.28 PORT\_0\_ERR\_STAT\_CSR 0x000158**

Bit	Field Name	Type	Reset Value	Comment
3				Reserved
4	PORT_WRITE_PENDING	FR	0b0	Pending Port Write
7 - 5				Reserved
8	INPUT_ERROR	RO	0b0	Input Error - Port is stopped
9	INPUT_ERROR_ENCOUNTERED	W1R	0b0	Input Error was encountered
10	INPUT_RETRY	RO	0b0	Input Retry - Port is stopped
15 - 11				Reserved
16	OUTPUT_ERROR	RO	0b0	Output Error - Port is stopped
17	OUTPUT_ERROR_ENCOUNTERED	W1R	0b0	Output Error was encountered
18	OUTPUT_RETRY	RO	0b0	Output Retry - Port is stopped
19	OUTPUT_RETRIED	RO	0b0	Output retried
20	OUTPUT_RETRY_ENCOUNTERED	W1R	0b0	Output Retry Encountered
31 - 21				Reserved

### 10.5.5 Port 0 Control Command and Status Register (PORT\_0\_CTRL\_CSR)

**Table 10.29 PORT\_0\_CTRL\_CSR 0x00015C**

Bit	Field Name	Type	Reset Value	Comment
0	PORT_TYPE	FR	0b1	0 = Parallel 1 = Serial
3 - 1				Reserved
11 - 4	RETRANSMIT_SUPPRESSION_MASK	R/W	0b0	Mask for retransmission suppression
16 - 12				Reserved
17	ENUMERATION_BOUNDARY	R/W	0b0	The enumeration boundary
18				Reserved
19	MULTICAST_EVENT_PARTICIPATION	R/W	0b0	Multicast event participation
20	ERROR_CHK_DISABLE	R/W	0b0	Disable error checking
21	INPUT_PORT_ENABLE	R/W	0b0	Enable the Input port
22	OUTPUT_PORT_ENABLE	R/W	0b0	Enable the Output port

**Table 10.29 PORT\_0\_CTRL\_CSR 0x00015C**

Bit	Field Name	Type	Reset Value	Comment
23	PORT_DISABLE	R/W	0b0	Port Disable
26 - 24	PORT_WIDTH_OVERRIDE	R/W	0b000	000 = no override 010 = single lane port lane 0 011 = single lane port lane 2 Others reserved
29 - 27	INIT_PORT_WIDTH	RO	0b000	Initialized Port Width 000 = single lane port lane 0 001 = single lane port lane 2 010 = 4 Lane Port Others reserved
31 - 30	PORT_WIDTH	RO	0b00	00 = Single Lane Port 01 = 4 Lane Port Others Reserved

## 10.6 IDT SPECIFIC RAPIDIO EXTENDED FEATURE REGISTERS

### 10.6.1 Local Route Configuration Destination ID Select Command and Status Register (LOCAL\_RTE\_CONF\_DESTID\_SEL\_CSR)

Table 10.30 LOCAL\_RTE\_CONF\_DESTID\_SEL\_CSR 0x010070

Bit	Field Name	Type	Reset Value	Comment
4 - 0	PORT_ROUTE_TABLE_SELECTION	R/W	0b00000	<p>Defines the port whose route table is affected when a write to or a read from the Standard Route Configuration Port Select CSR is made.</p> <p>0b00000 = Access is for Global Route Table  0b00001 = Access is for Port 0 Route Table  0b00010 = Access is for Port 1 Route Table  0b00011 = Access is for Port 2 Route Table  0b00100 = Access is for Port 3 Route Table  0b00101 = Access is for Port 4 Route Table  0b00110 = Access is for Port 5 Route Table  0b00111 = Access is for Port 6 Route Table  0b01000 = Access is for Port 7 Route Table  0b01001 = Access is for Port 8 Route Table  0b01010 = Access is for Port 9 Route Table  0b01011 = Access is for Port 10 Route Table  0x01100 = Access is for Port 11 Route Table  0x01101 = Access is for Port 12 Route Table  0x01110 = Access is for Port 13 Route Table  0x01111 = Access is for Port 14 Route Table  0x10000 = Access is for Port 15 Route Table</p> <p>All other values are undefined</p>
31 - 5				Reserved

## 10.6.2 Local Multicast Mask Port Select

Table 10.31 LOCAL\_MCAST\_MASK\_PORT\_SEL 0x010080

Bit	Field Name	Type	Reset Value	Comment
4 - 0	PORT_MCAST_SELECTION	R/W	0b00000	<p>Defines the port whose mcast masks are affected when a write to or a read from the Standard Mcast mask Port CSR (0x00080) is made.</p> <p>0b00000 = Access is for Global Mcast Masks  0b00001 = Access is for Port 0 Mcast Masks  0b00010 = Access is for Port 1 Mcast Masks  0b00011 = Access is for Port 2 Mcast Masks  0b00100 = Access is for Port 3 Mcast Masks  0b00101 = Access is for Port 4 Mcast Masks  0b00110 = Access is for Port 5 Mcast Masks  0b00111 = Access is for Port 6 Mcast Masks  0b01000 = Access is for Port 7 Mcast Masks  0b01001 = Access is for Port 8 Mcast Masks  0b01010 = Access is for Port 9 Mcast Masks  0b01011 = Access is for Port 10 Mcast Masks  0x01100 = Access is for Port 11 Mcast Masks  0x01101 = Access is for Port 12 Mcast Masks  0x01110 = Access is for Port 13 Mcast Masks  0x01111 = Access is for Port 14 Mcast Masks  0x10000 = Access is for Port 15 Mcast Masks</p> <p>All other values are undefined</p>
31 - 5				Reserved

## 10.7 ROUTING TABLE REGISTERS

Table 10.32 Routing Table Register

Base Addresses (Hex)	Associated Registers
0xE00000	Global Device Route Table for Device ID 0x00
0xE00004	Global Device Route Table for Device ID 0x01
...	...
0xE003FC	Global Device Route Table for Device ID 0xFF
0xE00400	Global Domain Route Table for Device ID 0x00
0xE00404	Global Domain Route Table for Device ID 0x01
...	...
0xE007FC	Global Domain Route Table for Device ID 0xFF
0xE10000	Port0 Device Route Table for Device ID 0x00
0xE10004	Port0 Device Route Table for Device ID 0x01
...	...
0xE103FC	Port0 Device Route Table for Device ID 0xFF
0xE10400	Port0 Domain Route Table for Device ID 0x00
0xE10404	Port0 Domain Route Table for Device ID 0x01
...	...
0xE107FC	Port0 Domain Route Table for Device ID 0xFF
0xE10000+0x1000*Port#	Register start for port PORT_NUM
...	...
0xE1F000	Port15 Device Route Table for Device ID 0x00
0xE1F004	Port15 Device Route Table for Device ID 0x01
...	...
0xE1F3FC	Port15 Device Route Table for Device ID 0xFF
0xE1F400	Port15 Domain Route Table for Device ID 0x00
0xE1F404	Port15 Domain Route Table for Device ID 0x01
...	...
0xE1F7FC	Port15 Domain Route Table for Device ID 0xFF

**Table 10.33 Route Table Register 0xE00000-0xE1F7FC**

Bit	Field Name	Type	Reset Value	Comment
7-0	Port_Number	R/W	0xDE	0x00 - x0F for unicast port number 0-15. 0x40 - x67 for multicast register 0 - 39

## 10.8 TRACE REGISTERS

**Table 10.34 Trace Register Map**

Base Addresses (Hex)	Associated Registers
0xE40000-0xE40024	Port 0 Trace Comparison Value 1 and Mask 1 Register
0xE40028-0xE4004C	Port 0 Trace Comparison Value 2 and Mask 2 Register
0xE40050-0xE40074	Port 0 Trace Comparison Value 3 and Mask 3 Register
0xE40078-0xE40098	Port 0 Trace Comparison Value 4 and Mask 4 Register
0xE40100-0xE40198	Port 1 Trace Comparison Values and Masks Register
0xE40200-0xE40298	Port 2 Trace Comparison Values and Masks Register
0xE40300-0xE40398	Port 3 Trace Comparison Values and Masks Register
0xE40400-0xE40498	Port 4 Trace Comparison Values and Masks Register
0xE40500-0xE40598	Port 5 Trace Comparison Values and Masks Register
0xE40600-0xE40698	Port 6 Trace Comparison Values and Masks Register
0xE40700-0xE40798	Port 7 Trace Comparison Values and Masks Register
0xE40800-0xE40898	Port 8 Trace Comparison Values and Masks Register
0xE40900-0xE40998	Port 9 Trace Comparison Values and Masks Register
0xE40A00-0xE40A98	Port 10 Trace Comparison Values and Masks Register
0xE40B00-0xE40B98	Port 11 Trace Comparison Values and Masks Register
0xE40C00-0xE40C98	Port 12 Trace Comparison Values and Masks Register
0xE40D00-0xE40D98	Port 13 Trace Comparison Values and Masks Register
0xE40E00-0xE40E98	Port 14 Trace Comparison Values and Masks Register
0xE40F00-0xE40F98	Port 15 Trace Comparison Values and Masks Register
0xE4FF00-0xE4FF98	Broadcast Trace Comparison Values and Masks Register

### 10.8.1 Port 0 Trace Comparison Value 1 Registers

Table 10.35 Port\_0\_Trace\_Value\_1\_Block\_0 0xE40000

Bit	Field Name	Type	Reset Value	Comment
31 - 0	COMPARISON_VALUE_1_BLOCK_0	R/W	0x00000000	This value will be used for a bit by bit comparison against the first 32 bits received in the packet. Bit 31 will be compared to the first packet bit Bit 30 will be compared to the second packet bit . . . Bit 0 will be compared to the 32nd packet bit

Table 10.36 Port\_0\_Trace\_Value\_1\_Block\_1 0xE40004

Bit	Field Name	Type	Reset Value	Comment
31 - 0	COMPARISON_VALUE_1_BLOCK_1	R/W	0x00000000	This value will be used for a bit by bit comparison against the first 32 bits received in the packet. Bit 31 will be compared to the 33rd packet bit Bit 30 will be compared to the 34th packet bit . . . Bit 0 will be compared to the 64th packet bit

**Table 10.37 Port\_0\_Trace\_Value\_1\_Block\_2 0xE40008**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	COMPARISON_VALUE_1_BLOCK_2	R/W	0x00000000	This value will be used for a bit by bit comparison against the first 32 bits received in the packet. Bit 31 will be compared to the 65th packet bit Bit 30 will be compared to the 66th packet bit . . . Bit 0 will be compared to the 96th packet bit

**Table 10.38 Port\_0\_Trace\_Value\_1\_Block\_3 0xE4000C**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	COMPARISON_VALUE_1_BLOCK_3	R/W	0x00000000	This value will be used for a bit by bit comparison against the first 32 bits received in the packet. Bit 31 will be compared to the 97th packet bit Bit 30 will be compared to the 98th packet bit . . . Bit 0 will be compared to the 128th packet bit

**Table 10.39 Port\_0\_Trace\_Value\_1\_Block\_4 0xE40010**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	COMPARISON_VALUE_1_BLOCK_4	R/W	0x00000000	This value will be used for a bit by bit comparison against the first 32 bits received in the packet. Bit 31 will be compared to the 129th packet bit Bit 30 will be compared to the 130th packet bit . . . Bit 0 will be compared to the 160th packet bit

### 10.8.2 Port 0 Mask Value 1 Registers

**Table 10.40 Port\_0\_Mask\_Value\_1\_Block\_0 0xE40014**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	MASK_VALUE_1_BLOCK_0	R/W	0x00000000	This value will be used for a bit by bit mask against the corresponding comparison value Bit 31 will be a mask for the first comparison value bit Bit 30 will be a mask for the second comparison bit . . . Bit 0 will be a mask for the 32nd comparison bit

**Table 10.41 Port\_0\_MASK\_Value\_1\_Block\_1 0xE40018**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	MASK_VALUE_1_BLOCK_1	R/W	0x00000000	<p>This value will be used for a bit by bit comparison against the first 32 bits received in the packet.</p> <p>Bit 31 will be a mask for the 33rd pack comparison bit</p> <p>Bit 30 will be a mask for the 34th comparison bit</p> <p>.</p> <p>.</p> <p>.</p> <p>Bit 0 will be a mask for the 64th comparison bit</p>

**Table 10.42 Port\_0\_MASK\_Value\_1\_Block\_2 0xE4001C**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	MASK_VALUE_1_BLOCK_2	R/W	0x00000000	<p>This value will be used for a bit by bit comparison against the first 32 bits received in the packet.</p> <p>Bit 31 will be a mask for the 65th comparison bit</p> <p>Bit 30 will be a mask for the 66th comparison bit</p> <p>.</p> <p>.</p> <p>.</p> <p>Bit 0 will be a mask for the 96th comparison bit</p>

**Table 10.43 Port\_0\_Mask\_Value\_1\_Block\_3 0xE40020**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	MASK_VALUE_1_BLOCK_3	R/W	0x00000000	This value will be used for a bit by bit comparison against the first 32 bits received in the packet. Bit 31 will be a mask for the 97th comparison bit Bit 30 will be a mask for the 98th comparison bit . . . Bit 0 will be a maks for the 128th comparison bit

**Table 10.44 Port\_0\_Mask\_Value\_1\_Block\_4 0xE40024**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	MASK_VALUE_1_BLOCK_4	R/W	0x00000000	This value will be used for a bit by bit comparison against the first 32 bits received in the packet. Bit 31 will be a maks for the 129th comparison bit Bit 30 will be a mask for the 130th comparison bit . . . Bit 0 will be a mask for the 160th comparison bit

## 10.9 GLOBAL CONFIGURATION REGISTERS

### 10.9.1 Control Register (CPS\_CONTROL)

Table 10.45 CPS\_CONTROL 0xF2000C

Bit	Field Name	Type	Reset Value	Comment
0	PORT_RESET_BEHAVIOR	R/W	0b0	Defines action upon reception of an sRIO reset control symbol (0 = reset chip, 1 = reset port via which the symbol was received)
4 - 1	TRACE_OUTPUT_PORT_ENABLE	R/W	0x0	Defines the output port via which traced packets are transmitted (only one valid port at a time).  0x0 Defines Port 0 as the Trace Port 0x1 Defines Port 1 as the Trace Port . . 0xF Defines Port 15 as the Trace Port
10 - 5				Reserved
11	CUT_THRU_ENABLE	R/W	0b0	0b0: Store and Forward Mode 0b1: Cut Through Mode
12	SYSPLL_HALF_CLK_RATE	R/W	0b0	0 = PLL/1 1 = PLL/2
13				Reserved
14	TRACE_ENABLE	R/W	0b0	Enables the Trace Function at the device level
15	TRACE_OUTPUT_PORT_MODE	R/W	0b0	0: Trace port is used for normal referenced traffic and for trace match data 1: Trace Port will only be used for trace match data.
19 - 16				Reserved
20	QUAD_OFF_0	R/W	0b0	0: On; 1: Off Quad 0 and Quad 1; sleep mode for power reduction
21	QUAD_OFF_1	R/W	0b0	0: On; 1: Off Quad 2 and Quad 3; sleep mode for power reduction
22	QUAD_OFF_2	R/W	0b0	0: On; 1: Off Quad 4; sleep mode for power reduction

**Table 10.45 CPS\_CONTROL 0xF2000C**

Bit	Field Name	Type	Reset Value	Comment
23	QUAD_OFF_3	R/W	0b0	0: On; 1: Off Quad 5 and Quad 6; sleep mode for power reduction
24	QUAD_OFF_4	R/W	0b0	0: On; 1: Off Quad 7 and Quad 8; sleep mode for power reduction
25	QUAD_OFF_5	R/W	0b0	0: On; 1: Off Quad 9; sleep mode for power reduction
31 - 26				Reserved

### 10.9.2 Configuration Error Report Enable Register (CONF\_MOD\_ERR\_REPORT\_ENABLE)

This register is used to enable/disable error reporting to the Error Manager from the device's configuration logic.

**Table 10.46 CONF\_MOD\_ERR\_REPORT\_ENABLE 0xF20014**

Bit	Field Name	Type	Reset Value	Comment
0	CONF_MOD_ERR_REPORT_ENABLE	R/W	0b0	0 = Disable Error Reporting 1 = Enable Error Reporting
31 - 1				Reserved

### 10.9.3 Auxiliary Port Error Report Enable Register (AUXPORT\_ERR\_REPORT\_ENABLE)

This register is used to enable/disable error reporting to the Error Manager from the device's JTAG and/or I<sup>2</sup>C logic.

Table 10.47 AUXPORT\_ERR\_REPORT\_ENABLE 0xF20018

Bit	Field Name	Type	Reset Value	Comment
0	JTAG_ERR_REPORT_ENABLE	R/W	0b0	0 = Disable JTAG Error Reporting 1 = Enable JTAG Error Reporting
1	I <sup>2</sup> C_ERR_REPORT_ENABLE	R/W	0b0	0 = Disable I <sup>2</sup> C Error Reporting 1 = Enable I <sup>2</sup> C Error Reporting
31 - 2				Reserved

### 10.9.4 Maintenance Error Reporting Enable Register (MAINT\_ERR\_REPORT\_ENABLE)

This register is used to enable/disable error reporting to the Error Manager from the device's Maintenance Packet Module.

Table 10.48 MAINT\_ERR\_REPORT\_ENABLE 0xF2001C

Bit	Field Name	Type	Reset Value	Comment
0	MAINT_ERR_REPORT_ENABLE	R/W	0b0	0 = Disable Error Reporting from the Maintenance Module 1 = Enable Error Reporting from the Maintenance Module
31 - 1				Reserved

### 10.9.5 RIO Domain Register (RIO\_DOMAIN)

This register is used for the user to define the domain this device belongs to.

Table 10.49 RIO\_DOMAIN 0xF20020

Bit	Field Name	Type	Reset Value	Comment
7 - 0	Domain	R/W	0x00	Device Domain Configuration
31 - 8				Reserved

### 10.9.6 Rapid IO Port Write Information (RIO\_PORT\_WRITE\_INFO)

This register will be used to define the priority and the destination\_ID that the device will use for Port-Write Packets.

Table 10.50 RIO\_PORT\_WRITE\_INFO 0xF20024

Bit	Field Name	Type	Reset Value	Comment
12 - 0				Reserved
14 - 13	PRIO	R/W	0b00	SRIO Priority to be used for port-writes
15	LARGE_TRANS	R/W	0b0	0 = use small device ID for port-writes 1 = use large device ID for port-writes
23 - 16	PORT_WRITE_TARGET_DEVICE_ID	R/W	0x00	Defines the Port-Write target device ID
31 - 24	DEVID_MSB	R/W	0x00	MSB of the port-write target device ID (Large transport definition only)

### 10.9.7 Rapid IO Port Write Source ID (RIO\_PORT\_WRITE\_SRCID)

This register will be used to define the Source\_ID that the device will use for Port Write Packets. The transaction model defined in the RIO\_PORT\_WRITE\_INFO register will apply to the Source\_ID as well.

Table 10.51 RIO\_PORT\_WRITE\_SRCID 0xF20028

Bit	Field Name	Type	Reset Value	Comment
15 - 0				Reserved
23 - 16	SRCID	R/W	0x00	Port-Write source device ID
31 - 24	SRCID_MSB	R/W	0x00	MSB of the port-write device ID (Large only)

### 10.9.8 Rapid IO Assembly Identification Capability Register (RIO\_ASSY\_IDENT\_CAR)

This register is used to provide the user control over the values that are used in the RIO defined ASSY\_IDENT\_CAR.

Table 10.52 RIO\_ASSY\_IDENT\_CAR 0xF2002C

Bit	Field Name	Type	Reset Value	Comment
15 - 0	RIO_ASSY_VENDOR_IDENT	R/W	0x0000	This value will be assigned to the ASSY_VENDOR_IDENT field in the sRIO ASSY_IDENT_CAR
31 - 16	RIO_ASSY_IDENT	R/W	0x0000	This value will be assigned to the ASSY_IDENT field in the sRIO ASSY_IDENT_CAR

### 10.9.9 Rapid IO Assembly Information Capability Register (RIO\_ASSY\_INF\_CAR)

Table 10.53 RIO\_ASSY\_INF\_CAR 0xF20030

Bit	Field Name	Type	Reset Value	Comment
15 - 0	RIO_ASSY_REV	R/W	0x0000	This value will be assigned to the ASSY_REV field of the sRIO ASSY_INF_CAR
31 - 16				Reserved

### 10.9.10 Soft Reset Register (SOFT\_RESET)

Table 10.54 PPS\_SOFT\_RESET 0xF20040

Bit	Field Name	Type	Reset Value	Comment
31 - 0	SOFT_RESET	Write Only	0x00000000	0x00030097 Resets the part

**10.9.11 I2C Master Control (I2C\_MASTER\_CTRL)**

Table 10.55 I2C\_MASTER\_CTRL 0xF20050

Bit	Field Name	Type	Reset Value	Comment
9 - 0	EPROM_SLAVE_ADDR	R/W	0b0001010[ID2][ID1][ID0]	I2C address to use for the EPROM for commanded master mode
10				Reserved
11	CHKSUM_DISABLE	R/W	0b0	0 = Verify checksum with EPROM read 1 = Do not verify checksum with EPROM read
15 - 12				Reserved
22 - 16	CLK_DIVISOR	R/W	0x62	Value used to convert internal Sys_Clk to I2C clocks and derive internal timing parameters. This value must be set such that the equation $SYS\_CLK / CLK\_DIVISOR = 32\text{ MHz}$ . The maximum value understood by the device is 0x62 such that if this value is programmed to >0x62 the value of 0x62 will be used. The minimum value for this parameter understood by the device is 0x31. Note that SYS_CLK can vary between 75 MHz and 156 MHz.
24 - 23				Reserved
25	MASTER_FREQ_SEL	R/W	0b0	0 = 400 kHz 1 = 100 kHz
31 - 26				Reserved

**10.9.12 I2C Master Status Control (I2C\_MASTER\_STAT\_CTRL)**

Table 10.56 I2C\_MASTER\_STAT\_CTRL 0xF20054

Bit	Field Name	Type	Reset Value	Comment
15 - 0	EPROM_START_ADDR	R/W	0x0000	EPROM address offset where I2C Master read operation take place
16	START_I2C_EPROM_READ	WO	0b0	Setting this bit to logical one will initiate the start of an I2C EPROM read
19 - 17				Reserved
20	I2C_ABORT	WO	0b0	Setting this bit to logical one will abort any pending I2C master operation
21	I2C_SUCCESSFUL	RO	0b0	A value of 1 indicates that a previous Master I2C read operation is complete and was successful  If successful this bit will stay high until the next sequence is initiated.
22	I2C_READ_IN_PROGRESS	RO	0b0	0 = I2C read operation is not in progress 1 = I2C read operation is in progress This bit will stay high as long as the sequence is in progress and then will go low upon its completion.
23	I2C_CHKSUM_FAIL	RO	0b0	A value of 1 indicates that the checksum verification of a I2C read operation failed Reset on read
24	I2C_32_BIT_WORD_ERR	RO	0b0	A value of 1 indicates that 32 bits of read data was expected but the operation was terminated prematurely Reset on read
25	I2C_22_BIT_WORD_ERR	RO	0b0	A value of 1 indicates that 22 bits of read data was expected but the operation was terminated prematurely Reset on read

**Table 10.56 I2C\_MASTER\_STAT\_CTRL 0xF20054**

Bit	Field Name	Type	Reset Value	Comment
26	I2C_NACK	RO	0b0	A value of 1 indicates that an expected ack was not received Reset on read
27	I2C_UNEXP_START_STOP	RO	0b0	A value of 1 indicates that an unexpected I2C start or stop was detected Reset on read
28	I2C_BAD_IMG_VERSION	RO	0b0	A value of 1 indicates that an bad image version was detected Reset on read
31 - 29				Reserved

## 10.10 MULTICAST REGISTERS

Table 10.57 MULTICAST Register Map

Base Address (Hex)	Associated Registers
0xF30000	Global MULTICAST0
0xF30004	Global MULTICAST1
...	...
0xF3009C	Global MULTICAST39
0xF38000	Port 0 MULTICAST0
0xF38004	Port 0 MULTICAST1
...	...
0xF3809C	Port 0 MULTICAST39
0xF38100	Port 1 MULTICAST0
0xF38104	Port 1 MULTICAST1
...	...
0xF3819C	Port 1 MULTICAST39
0xF38x00	Port x MULTICAST0 (x = ports 2 - 13)
0xF38x04	Port x MULTICAST1
...	...
0xF38x9C	Port x MULTICAST39
0xF38E00	Port 14 MULTICAST0
0xF38E04	Port 14 MULTICAST1
...	...
0xF38E9C	Port 14 MULTICAST39
0xF38F00	Port 15 MULTICAST0
0xF38F04	Port 15 MULTICAST1
...	...
0xF38F9C	Port 15 MULTICAST39

**10.10.1 Multicast Mask 0 (MULTICAST0)**
**Table 10.58 Multicast Mask Register (0xF30000–0xF38F9C)**

Bit	Field Name	Type	Reset Value	Comment
0	MCAST_PORT_0	R/W	0b0	0 = Port 0 is not included in Multicast group 0 1 = Port 0 is included in Multicast group 0
1	MCAST_PORT_1	R/W	0b0	0 = Port 1 is not included in Multicast group 0 1 = Port 1 is included in Multicast group 0
2	MCAST_PORT_2	R/W	0b0	0 = Port 2 is not included in Multicast group 0 1 = Port 2 is included in Multicast group 0
3	MCAST_PORT_3	R/W	0b0	0 = Port 3 is not included in Multicast group 0 1 = Port 3 is included in Multicast group 0
4	MCAST_PORT_4	R/W	0b0	0 = Port 4 is not included in Multicast group 0 1 = Port 4 is included in Multicast group 0
5	MCAST_PORT_5	R/W	0b0	0 = Port 5 is not included in Multicast group 0 1 = Port 5 is included in Multicast group 0
6	MCAST_PORT_6	R/W	0b0	0 = Port 6 is not included in Multicast group 0 1 = Port 6 is included in Multicast group 0
7	MCAST_PORT_7	R/W	0b0	0 = Port 7 is not included in Multicast group 0 1 = Port 7 is included in Multicast group 0
8	MCAST_PORT_8	R/W	0b0	0 = Port 8 is not included in Multicast group 0 1 = Port 8 is included in Multicast group 0
9	MCAST_PORT_9	R/W	0b0	0 = Port 9 is not included in Multicast group 0 1 = Port 9 is included in Multicast group 0
10	MCAST_PORT_10	R/W	0b0	0 = Port 10 is not included in Multicast group 0 1 = Port 10 is included in Multicast group 0
11	MCAST_PORT_11	R/W	0b0	0 = Port 11 is not included in Multicast group 0 1 = Port 11 is included in Multicast group 0
12	MCAST_PORT_12	R/W	0b0	0 = Port 12 is not included in Multicast group 0 1 = Port 12 is included in Multicast group 0
13	MCAST_PORT_13	R/W	0b0	0 = Port 13 is not included in Multicast group 0 1 = Port 13 is included in Multicast group 0
14	MCAST_PORT_14	R/W	0b0	0 = Port 14 is not included in Multicast group 0 1 = Port 14 is included in Multicast group 0
15	MCAST_PORT_15	R/W	0b0	0 = Port 15 is not included in Multicast group 0 1 = Port 15 is included in Multicast group 0
31 - 16				Reserved

## 10.11 SWITCHING PORT REGISTERS

Table 10.59 Switching Port Register Map

Base Address (hex)	Associated Registers
0xF40000-0xF4003C	Switching Port 0 Registers
0xF40100-0xF4013C	Switching Port 1 Registers
0xF40200-0xF4023C	Switching Port 2 Registers
0xF40300-0xF4033C	Switching Port 3 Registers
0xF40400-0xF4043C	Switching Port 4 Registers
0xF40500-0xF4053C	Switching Port 5 Registers
0xF40600-0xF4063C	Switching Port 6 Registers
0xF40700-0xF4073C	Switching Port 7 Registers
0xF40800-0xF4083C	Switching Port 8 Registers
0xF40900-0xF4093C	Switching Port 9 Registers
0xF40A00-0xF40A3C	Switching Port 10 Registers
0xF40B00-0xF40B3C	Switching Port 11 Registers
0xF40C00-0xF40C3C	Switching Port 12 Registers
0xF40D00-0xF40D3C	Switching Port 13 Registers
0xF40E00-0xF40E3C	Switching Port 14 Registers
0xF40F00-0xF40F3C	Switching Port 15 Registers
0xF4FF00-0xF4FF08	Switching Port Broadcast Register, only first three register valid

### 10.11.1 Port 0 Input Buffer Size Register (PORT\_0\_BUF\_SIZE)

Table 10.60 PORT\_0\_BUF\_SIZE 0xF40000

Bit	Field Name	Type	Reset Value	Comment
3 - 0	PRI_0_BUF_SIZE	R/W	0b1000	RIO Priority Level 0 Input Buffer Size
7 - 4				Reserved
11 - 8	PRI_1_BUF_SIZE	R/W	0b0010	RIO Priority Level 1 Input Buffer Size
15 - 12				Reserved
19 - 16	PRI_2_BUF_SIZE	R/W	0b0010	RIO Priority Level 2 Input Buffer Size

**Table 10.60 PORT\_0\_BUF\_SIZE 0xF40000**

Bit	Field Name	Type	Reset Value	Comment
23 - 20				Reserved
27 - 24	PRI_3_BUF_SIZE	R/W	0b0010	RIO Priority Level 3 Input Buffer Size
31 - 25				Reserved

### 10.11.2 Port 0 Operations (PORT\_0\_OPS)

**Table 10.61 PORT\_0\_OPS 0xF40004**

Bit	Field Name	Type	Reset Value	Comment
0	RETRANSMISSION_MIMIC	R/W	0b0	0 = Normal RIO defined retransmissions 1 = retransmissions use new payload with old ackIDs
3 - 1	CRC_RETRANSMISSION_LIMIT	R/W	0b000	000 = no retransmission limit 001 - 111 = the number of retransmissions allowed before packet is dropped
4				Reserved
5				Reserved
6				Reserved
7	PORT_WRITE_ON_TRACE_MATCH	R/W	0b0	0 = Port Write will not be generated on a trace match 1 = Port Write will be generated on a trace match
8	RX2TX_LPBACK	R/W	0b0	0 = Port Loopback is disabled 1 = Port Loopback is enabled  This bit enables a visible external loopback. This loopback is through the SERDES IF RX into the PHY RX to the PHY TX and back through the SERDES TX. This lookback is at the quad level and affects all four lanes tied to the quad.

**Table 10.61 PORT\_0\_OPS 0xF40004**

Bit	Field Name	Type	Reset Value	Comment
9	ENABLE_TRACE_COMPARISON_1	R/W	0b0	0 = Trace Comparison Value 1 is disabled 1 = Trace Comparison Value 1 is enabled
10	ENABLE_TRACE_COMPARISON_2	R/W	0b0	0 = Trace Comparison Value 2 is disabled 1 = Trace Comparison Value 2 is enabled
11	ENABLE_TRACE_COMPARISON_3	R/W	0b0	0 = Trace Comparison Value 3 is disabled 1 = Trace Comparison Value 3 is enabled
12	ENABLE_TRACE_COMPARISON_4	R/W	0b0	0 = Trace Comparison Value 4 is disabled 1 = Trace Comparison Value 4 is enabled
13	ENABLE_FILTER_COMPARISON_1	R/W	0b0	0b0: Filter not enabled 0b1: Filter enabled
14	ENABLE_FILTER_COMPARISON_2	R/W	0b0	0b0: Filter not enabled 0b1: Filter enabled
15	ENABLE_FILTER_COMPARISON_3	R/W	0b0	0b0: Filter not enabled 0b1: Filter enabled
16	ENABLE_FILTER_COMPARISON_4	R/W	0b0	0b0: Filter not enabled 0b1: Filter enabled
17	ENABLE_SELF_MULTICAST	R/W	0b0	0 = disable 1 = enable
18	EXTENDED_PKT_RX_ENABLE	R/W	0b0	0 = Disable extended packet receive for this port 1 = Enable extended packet receive for this port
31 - 18				Reserved

### 10.11.3 Port 0 Error Report Enable (PORT\_0\_ERR\_REPORT\_ENABLE)

Table 10.62 PORT\_0\_ERR\_REPORT\_ENABLE 0xF40008

Bit	Field Name	Type	Reset Value	Comment
0	ERROR_REPORT_ENABLE	R/W	0b0	0 = Disable Error Reporting from this port 1 = Enable Error Reporting from this port
1	SWITCH_PORT_ERROR_REPORT_ENABLE	R/W	0b0	0 = Disable error reporting from switch buffers 1 = Enable error reporting from switch buffers
2	RETRY_ERROR_REPORT_ENABLE	R/W	0b0	0 = Disable Retry Symbol Received Reporting from Port 1 = Enable Retry Symbol Received Reporting from Port
31-3				Reserved

### 10.11.4 Port 0 Switch Buffer Status (PORT\_0\_SWITCH\_BUF\_STATUS)

Table 10.63 PORT\_0\_SWITCH\_BUF\_STATUS 0xF4000C

Bit	Field Name	Type	Reset Value	Comment
0	PRI_0_INPUT_BUF_STATUS	RO	0b0	0 = Not Empty 1 = Empty
1	PRI_1_INPUT_BUF_STATUS	RO	0b0	0 = Not Empty 1 = Empty
2	PRI_2_INPUT_BUF_STATUS	RO	0b0	0 = Not Empty 1 = Empty
3	PRI_3_INPUT_BUF_STATUS	RO	0b0	0 = Not Empty 1 = Empty
4	PRI_0_OUTPUT_BUF_STATUS	RO	0b0	0 = Not Empty 1 = Empty
5	PRI_1_OUTPUT_BUF_STATUS	RO	0b0	0 = Not Empty 1 = Empty
6	PRI_2_OUTPUT_BUF_STATUS	RO	0b0	0 = Not Empty 1 = Empty
7	PRI_3_OUTPUT_BUF_STATUS	RO	0b0	0 = Not Empty 1 = Empty

**Table 10.63 PORT\_0\_SWITCH\_BUF\_STATUS 0xF4000C**

Bit	Field Name	Type	Reset Value	Comment
8	PRI_0_OUTPUT_BUF_ALMOST_FULL_STATUS	RO	0b0	0 = Not Almost Full 1 = Almost Full
9	PRI_1_OUTPUT_BUF_ALMOST_FULL_STATUS	RO	0b0	0 = Not Almost Full 1 = Almost Full
10	PRI_2_OUTPUT_BUF_ALMOST_FULL_STATUS	RO	0b0	0 = Not Almost Full 1 = Almost Full
11	PRI_3_OUTPUT_BUF_ALMOST_FULL_STATUS	RO	0b0	0 = Not Almost Full 1 = Almost Full
31 - 12				Reserved

**10.11.5 Port 0 Port Acknowledgement Counter (PORT\_0\_ACK\_CNTR)**
**Table 10.64 PORT\_0\_ACK\_CNTR 0xF40010**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	ACK_COUNT	RR	0x00000000	A saturating count of packet acknowledgements issued by port 0

**10.11.6 Port 0 Port Not Acknowledgement Counter (PORT\_0\_NACK\_CNTR)**
**Table 10.65 PORT\_0\_NACK\_CNTR 0xF40014**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	NACK_COUNT	RR	0x00000000	A saturating count of packet not acknowledgements issued by port 0

**10.11.7 Port 0 Switch Packet Counter (PORT\_0\_SW\_PKT\_CNTR)**
**Table 10.66 PORT\_0\_SW\_PKT\_CNTR 0xF4001C**

Bit	Field Name	Type	Reset Value	Comment
31 - 0	SWITCH_PKT_COUNT	RR	0x00000000	A saturating count of packets sent for transmission through the internal switch that originated from port 0

### 10.11.8 Port 0 Trace Match Counter Value 1 (PORT\_0\_TRACE\_MATCH\_CNTR\_1)

Table 10.67 PORT\_0\_TRACE\_MATCH\_CNTR\_1 0xF40020

Bit	Field Name	Type	Reset Value	Comment
31 - 0	TRACE_COUNT_1	RR	0x00000000	A saturating count of packets at port 0 that have met the defined trace criteria with comparison Value 1

### 10.11.9 Port 0 Trace Match Counter Value 2 (PORT\_0\_TRACE\_MATCH\_CNTR\_2)

Table 10.68 PORT\_0\_TRACE\_MATCH\_CNTR\_2 0xF40024

Bit	Field Name	Type	Reset Value	Comment
31 - 0	TRACE_COUNT_2	RR	0x00000000	A saturating count of packets at port 0 that have met the defined trace criteria with comparison Value 2

### 10.11.10 Port 0 Trace Match Counter Value 3 (PORT\_0\_TRACE\_MATCH\_CNTR\_3)

Table 10.69 PORT\_0\_TRACE\_MATCH\_CNTR\_3 0xF40028

Bit	Field Name	Type	Reset Value	Comment
31 - 0	TRACE_COUNT_3	RR	0x00000000	A saturating count of packets at port 0 that have met the defined trace criteria with comparison Value 3

### 10.11.11 Port 0 Trace Match Counter Value 4 (PORT\_0\_TRACE\_MATCH\_CNTR\_4)

Table 10.70 PORT\_0\_TRACE\_MATCH\_CNTR\_4 0xF4002C

Bit	Field Name	Type	Reset Value	Comment
31 - 0	TRACE_COUNT_4	RR	0x00000000	A saturating count of packets at port 0 that have met the defined trace criteria with comparison Value 4

**10.11.12 Port 0 Filter Match Counter Value 1 (PORT\_0\_FILTER\_MATCH\_CNTR\_1)**

Table 10.71 PORT\_0\_FILTER\_MATCH\_CNTR\_1 0xF40030

Bit	Field Name	Type	Reset Value	Comment
31 - 0	FILTER_COUNT_1	RR	0x00000000	A saturating count of packets that have met the defined filter criteria with comparison Value 1

**10.11.13 Port 0 Filter Match Counter Value 2 (PORT\_0\_FILTER\_MATCH\_CNTR\_2)**

Table 10.72 PORT\_0\_FILTER\_MATCH\_CNTR\_2 0xF40034

Bit	Field Name	Type	Reset Value	Comment
31 - 0	FILTER_COUNT_2	RR	0x00000000	A saturating count of packets that have met the defined filter criteria with comparison Value 2

**10.11.14 Port 0 Filter Match Counter Value 3 (PORT\_0\_FILTER\_MATCH\_CNTR\_3)**

Table 10.73 PORT\_0\_FILTER\_MATCH\_CNTR\_3 0xF40038

Bit	Field Name	Type	Reset Value	Comment
31 - 0	FILTER_COUNT_3	RR	0x00000000	A saturating count of packets that have met the defined filter criteria with comparison Value 3

**10.11.15 Port 0 Filter Match Counter Value 4 (PORT\_0\_FILTER\_MATCH\_CNTR\_4)**

Table 10.74 PORT\_0\_FILTER\_MATCH\_CNTR\_4 0xF4003C

Bit	Field Name	Type	Reset Value	Comment
31 - 0	FILTER_COUNT_4	RR	0x00000000	A saturating count of packets that have met the defined filter criteria with comparison Value 4

**Table 10.75 Trace Register Map**

Base Addresses (Hex)	Associated Registers
0xE40000-0xE40024	Port 0 Trace Comparison Value 1 and Mask 1 Register
0xE40028-0xE4004C	Port 0 Trace Comparison Value 2 and Mask 2 Register
0xE40050-0xE40074	Port 0 Trace Comparison Value 3 and Mask 3 Register
0xE40078-0xE40098	Port 0 Trace Comparison Value 4 and Mask 4 Register
0xE40100-0xE40198	Port 1 Trace Comparison Values and Masks Register
0xE40200-0xE40298	Port 2 Trace Comparison Values and Masks Register
0xE40300-0xE40398	Port 3 Trace Comparison Values and Masks Register
0xE40400-0xE40498	Port 4 Trace Comparison Values and Masks Register
0xE40500-0xE40598	Port 5 Trace Comparison Values and Masks Register
0xE40600-0xE40698	Port 6 Trace Comparison Values and Masks Register
0xE40700-0xE40798	Port 7 Trace Comparison Values and Masks Register
0xE40800-0xE40898	Port 8 Trace Comparison Values and Masks Register
0xE40900-0xE40998	Port 9 Trace Comparison Values and Masks Register
0xE40A00-0xE40A98	Port 10 Trace Comparison Values and Masks Register
0xE40B00-0xE40B98	Port 11 Trace Comparison Values and Masks Register
0xE40C00-0xE40C98	Port 12 Trace Comparison Values and Masks Register
0xE40D00-0xE40D98	Port 13 Trace Comparison Values and Masks Register
0xE40E00-0xE40E98	Port 14 Trace Comparison Values and Masks Register
0xE40F00-0xE40F98	Port 15 Trace Comparison Values and Masks Register
0xE4FF00-0xE4FF98	Broadcast Trace Comparison Values and Masks Register

## 10.12 ERROR REGISTERS

### 10.12.1 Error Capability Register (ERR\_CAP\_REG)

Table 10.76 ERR\_CAP\_REG 0xFD0000

Bit	Field Name	Type	Reset Value	Comment
0	ALL_FLAG_STOP	R/W	0b0	0 = When all error flags are asserted stop the Error Management block and NOP 1 = When all error flags are asserted stop the Error Management function and generate a Maintenance Packet.
1	COUNTER_MAX_STOP	R/W	0b0	0 = When the error counter reaches the maximum value 0xFFFF, stop the error management function and NOP 1 = When the error counter reaches the maximum value 0xFFFF, stop the error management function and generate a maintenance packet
2	LOG_TABLE_OVERWRITE	R/W	0b0	0 = discard further errors when the error log is full 1 = overwrite the error log with new errors when it is full
31 - 3				Reserved

### 10.12.2 Error Log Read Register (ERR\_LOG)

Table 10.77 ERR\_LOG\_RD 0xFD0004

Bit	Field Name	Type	Reset Value	Comment
3 - 0	ERROR_NUMBER	RO	0b0000	Error Number
7 - 4	ERROR_GROUP	RO	0b0000	Error Group
13 - 8	ERROR_SOURCE	RO	0x00	Error Source (6 bits)
31 - 14				Reserved

### 10.12.3 Special Error Register

Table 10.78 SPECIAL\_ERR Register Map

Base Address (Hex)	Associated Registers
0xFD0008	SPECIAL_ERR_REG_0
0xFD000C	SPECIAL_ERR_REG_1
0xFD0010	SPECIAL_ERR_REG_2
0xFD0014	SPECIAL_ERR_REG_3
0xFD0018	SPECIAL_ERR_REG_4
0xFD0020	SPECIAL_ERR_REG_5
0xFD0024	SPECIAL_ERR_REG_6
0xFD0028	SPECIAL_ERR_REG_7

Table 10.79 SPECIAL\_ERR\_0 0xFD0008

Bit	Field Name	Type	Reset Value	Comment
3 - 0	ERROR_NUMBER	R/W	0b0000	Error code
7 - 4	ERROR_GROUP	R/W	0b0000	Error group number
13 - 8	ERROR_SOURCE	R/W	0x00	Error Source (6 bits)
15 - 14				Reserved
16	STOP_ENABLE	R/W	0b0	Enable Stopping the error management function and generation of a maintenance packet
17	MAINTENANCE_PACKET_ENABLE	R/W	0b0	Enable the generation of a maintenance packet in event of an error
18	FLAG_ENABLE	R/W	0b0	Enable flagging the error
19	COUNT_ENABLE	R/W	0b0	Enable counting the error
20	ERROR_NUMBER_MASK	R/W	0b0	0 = compare the error number 1 = do not compare the error number

**Table 10.79 SPECIAL\_ERR\_0 0xFD0008**

Bit	Field Name	Type	Reset Value	Comment
21	ERROR_GROUP_MASK	R/W	0b0	0 = compare the error group 1 = do not compare the error group
22	ERROR_SOURCE_MASK	R/W	0b0	0 = compare the error source 1 = do not compare the error source
31 - 23				Reserved

#### 10.12.4 Error flags (ERR\_FLAG)

**Table 10.80 ERR\_FLAG 0xFD0028**

Bit	Field Name	Type	Reset Value	Comment
0	FLAG_ERROR_0	RR	0b0	Assert this field to indicate and error applies to Special error register 0
1	FLAG_ERROR_1	RR	0b0	Assert this field to indicate and error applies to Special error register 1
2	FLAG_ERROR_2	RR	0b0	Assert this field to indicate and error applies to Special error register 2
3	FLAG_ERROR_3	RR	0b0	Assert this field to indicate and error applies to Special error register 3
4	FLAG_ERROR_4	RR	0b0	Assert this field to indicate and error applies to Special error register 4
5	FLAG_ERROR_5	RR	0b0	Assert this field to indicate and error applies to Special error register 5
6	FLAG_ERROR_6	RR	0b0	Assert this field to indicate and error applies to Special error register 6
7	FLAG_ERROR_7	RR	0b0	Assert this field to indicate and error applies to Special error register 7
31 - 8				Reserved

### 10.12.5 Error Counter (ERR\_COUNTER)

Table 10.81 ERR\_COUNTER 0xFD002C

Bit	Field Name	Type	Reset Value	Comment
15 - 0	COUNT	RO	0x00	The error count
31 - 16				Reserved

### 10.12.6 Error Reset (ERR\_RESET)

Table 10.82 ERR\_RESET 0xFD0030

Bit	Field Name	Type	Reset Value	Comment
0				Reserved
1	FLAG_RESET	R/W	0b0	Resets the flag register
2	COUNT_RESET	R/W	0b0	Resets the error count register
3	ERROR_FIFO_RESET	R/W	0b0	Reset the error FIFO
4	MAINTENANCE_PACKET_DISABLE	R/W	0b0	0 = generation of the maintenance packet is enabled 1 = generation of the maintenance packet is disabled
5	STOP_EM	R/W	0b0	Stops the error management function. Setting this bit to 1 will disable all port writes including those that result from trace matches.
31 - 6				Reserved

## 10.13 QUAD CONTROL REGISTERS

Table 10.83 QUAD\_CTRL Control Registers

Base Address (hex)	Associated Registers
0xFF0000-0xFF0004	QUAD_0_CTRL, QUAD_0_ERROR_REPORT_EN
0xFF1000-0xFF1004	QUAD_1_CTRL, QUAD_1_ERROR_REPORT_EN
0xFF2000-0xFF2004	QUAD_2_CTRL, QUAD_2_ERROR_REPORT_EN
0xFF3000-0xFF3004	QUAD_3_CTRL, QUAD_3_ERROR_REPORT_EN
0xFF4000-0xFF4004	QUAD_4_CTRL, QUAD_4_ERROR_REPORT_EN
0xFF5000-0xFF5004	QUAD_5_CTRL, QUAD_5_ERROR_REPORT_EN
0xFF6000-0xFF6004	QUAD_6_CTRL, QUAD_6_ERROR_REPORT_EN
0xFF7000-0xFF7004	QUAD_7_CTRL, QUAD_7_ERROR_REPORT_EN
0xFF8000-0xFF8004	QUAD_8_CTRL, QUAD_8_ERROR_REPORT_EN
0xFF9000-0xFF9004	QUAD_9_CTRL, QUAD_9_ERROR_REPORT_EN
0xFFFF000	Broadcast To All Quads Register

### 10.13.1 Quad 0 Control Register (QUAD\_0\_CTRL)

In standard Quad configuration, the PLL\_reset bit 10 and 11 both must be the same value. Program to “00” for reset and “11” to deassert reset. In the enhance mode, bit 10 and 11 can operate independently. In Quad0 and Quad5, Bit10 and Bit11 are swap, Bit10 is reset PLL\_lane\_2\_3, Bit11 is reset PLL\_lane\_0\_1.

During the PLL\_reset, the port status in the port\_n\_err\_stat\_csr is not valid. If the PLLs are being reset, the port is always uninitialized, even if the Port\_OK is read from port\_n\_err\_stat\_csr.

Table 10.84 QUAD\_0\_CTRL 0xFF0000

Bit	Field Name	Type	Reset Value	Comment
1 - 0	SPEEDSEL	R/W	0b00	Port Speed Selection. Default is set by external pins 00 = 1.25 Gbps 01 = 2.5 Gbps 10 = 3.125 Gbps
4 - 2	TCOEFF	R/W	0b000	Transmitter Pre-emphasis 000 = 0% 001 = 6.5% 010 = 13% 011 = 19.5% 100 = 26% 101 = 32.5% 110 = 39% 111 = 45.5%

**Table 10.84 QUAD\_0\_CTRL 0xFF0000**

Bit	Field Name	Type	Reset Value	Comment
5	STD_ENH_SEL	R/W	0b1	0 = standard 1 = enhanced
6	FORCE_REINIT	R/W	0b0	1 = Force Reinit 0 = don't initialize
9 - 7	TXDRVSEL	R/W	0b010	Transmitter Drive Strength 000 = Maximum 010 = Long Haul 100 = Short Haul 111 = Minimum
10	PLL_LANE_0_1_RESET	R/W	0b1	Forces reset of Lanes 0 and 1 (For Quad 0 and 5, it is reset Lane 2 and 3) 0 = Reset 1 = Deassert reset
11	PLL_LANE_2_3_RESET	R/W	0b1	Forces reset of Lanes 2 and 3 (For Quad 0 and 5, it is reset Lane 0 and 1) 0 = Reset 1 = Deassert reset
15 - 12				Reserved
16	LANE23_CTRL_EN	R/W	0b0	Enable separate configuration for Lanes 2 and 3 0 = Lanes 2 and 3 follow the same configuration as for Lanes 0 and 1 1 = Lanes 2 and 3 have a independent configuration from Lanes 0 and 1
18:17	LAN23_SPEEDSEL	R/W	0b00	Separate Port Speed Selection for Lanes 2 and 3. Only active if [16] = 1 00 = 1.25 Gbps 01 = 2.5 Gbps 10 = 3.125 Gbps Default is set by external pins (same as configuration for Lanes 1 and 2)
21:19	LANE23_TCOEFF	R/W	0b000	Separate Transmitter Pre-emphasis for Lanes 2 and 3. Only active if [16] = 1 000 = 0% 001 = 6.5% 010 = 13% 011 = 19.5% 100 = 26% 101 = 32.5% 110 = 39% 111 = 45.5%
22	LANE23_FORCE_REINIT	R/W	0b0	Force init on Lanes 2 and 3. Only active if [16] = 1

**Table 10.84 QUAD\_0\_CTRL 0xFF0000**

Bit	Field Name	Type	Reset Value	Comment
25:23	LANE23_TXDRVSEL	R/W	0b010	Transmitter Drive Strength for Lanes 2 and 3. Only active if [16] = 1 000 = Maximum 010 = Long Haul 100 = Short Haul 111 = Minimum
31 - 26				Reserved

### 10.13.2 QUAD 0 Error Report Enable (QUAD\_0\_ERR\_REPORT\_EN)

This register allows the user to enable and disable error reporting from Quad 0.

**Table 10.85 QUAD\_0\_ERR\_REPORT\_EN 0xFF0004**

Bit	Field Name	Type	Reset Value	Comment
0	ERR_REPORT_EN	R/W	0b0	Enables error reporting on a per-quad basis 0 = disable 1 = enable
31 - 1				Reserved

### 10.13.3 Broadcast To All Quads Register (QUAD\_CTRL\_BROADCAST)

A write to this address will reference all Quads.

**Table 10.86 QUAD\_CTRL\_BROADCAST 0xFFFF000**

Bit	Field Name	Type	Reset Value	Comment
1 - 0	SPEEDSEL	W	0b00	Port Speed Selection. default is set by external pins 00 = 1.25 Gbps 01 = 2.5 Gbps 10 = 3.125 Gbps
4 - 2	TCOEFF	W	0b000	Transmitter Pre-emphasis 000 = 0% 001 = 6.5% 010 = 13% 011 = 19.5% 100 = 26% 101 = 32.5% 110 = 39% 111 = 45.5%

**Table 10.86 QUAD\_CTRL\_BROADCAST 0xFFFF000**

Bit	Field Name	Type	Reset Value	Comment
5	STD_ENH_SEL	W	0b1	0 = standard 1 = enhanced
6	FORCE_REINIT	W	0b0	1 = Force Reinit 0 = don't initialize
9 - 7	TXDRVSEL	W	0b010	Transmitter Drive Strength 000 = Maximum 010 = Long Haul 100 = Short Haul 111 = Minimum
10	PLL_LANE_0_1_RESET	R/W	0b1	Forces reset of Lanes 0 and 1 0 = Reset 1 = Deassert reset
11	PLL_LANE_2_3_RESET	R/W	0b1	Forces reset of Lanes 0 and 1 0 = Reset 1 = Deassert reset
15 - 12				Reserved
16	LANE23_CTRL_EN	R/W	0b0	Enable separate configuration for Lanes 2 and 3 0 = Lanes 2 and 3 follow the same configuration as for Lanes 0 and 1 1 = Lanes 2 and 3 have a independent configuration from Lanes 0 and 1
18:17	LAN23_SPEEDSEL	R/W	0b00	Separate Port Speed Selection for Lanes 2 and 3. Only active if [16] = 1 00 = 1.25 Gbps 01 = 2.5 Gbps 10 = 3.125 Gbps Default is set by external pins (same as configuration for Lanes 1 and 2)
21:19	LANE23_TCOEFF	R/W	0b000	Separate Transmitter Pre-emphasis for Lanes 2 and 3. Only active if [16] = 1 000 = 0% 001 = 6.5% 010 = 13% 011 = 19.5% 100 = 26% 101 = 32.5% 110 = 39% 111 = 45.5%
22	LANE23_FORCE_REINIT	R/W	0b0	Force init on Lanes 2 and 3. Only active if [16] = 1

**Table 10.86 QUAD\_CTRL\_BROADCAST 0xFFFF000**

Bit	Field Name	Type	Reset Value	Comment
25:23	LANE23_TXDRVSEL	R/W	0b010	Transmitter Drive Strength for Lanes 2 and 3. Only active if [16] = 1 000 = Maximum 010 = Long Haul 100 = Short Haul 111 = Minimum
31 - 12				Reserved



# References

## 11 REFERENCES

For additional detail, the reader is encouraged to consult the following documents:

- 1) RapidIO Interconnect Specification, Part 1: Input/Output Logical Specification, Rev. 1.3
- 2) RapidIO Interconnect Specification, Part 2: Message Passing Logical Specification, Rev. 1.3
- 3) RapidIO Interconnect Specification, Part 3: Common Transport Specification, Rev. 1.3
- 4) RapidIO Interconnect Specification, Part 6: Physical Layer 1x/4x LP-Serial Specification, Rev. 1.3
- 5) RapidIO Interconnect Specification, Part 7: System and Device Inter-operability Specification, Rev. 1.3
- 6) RapidIO Interconnect Specification, Part 9: Flow Control Logic Layer Extensions Specification, Rev. 1.3
- 7) RapidIO Interconnect Specification, Part 11: Multicast Extensions Specification, Rev. 1.3
- 8) RapidIO Interconnect Specification, Annex I: Software/System Bring Up Specification, Rev. 1.3
- 9) IEEE Std 1149.1-2001 IEEE Standard Test Access Port and Boundary-Scan Architecture
- 10) IEEE Std 1149.6-2003 IEEE Standard for Boundary-Scan Testing of Advanced Digital Networks
- 11) IDT80KSW0005 Datasheet
- 12) The I<sup>2</sup>C-BUS Specification", version 2.1, January 2000, Philips



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