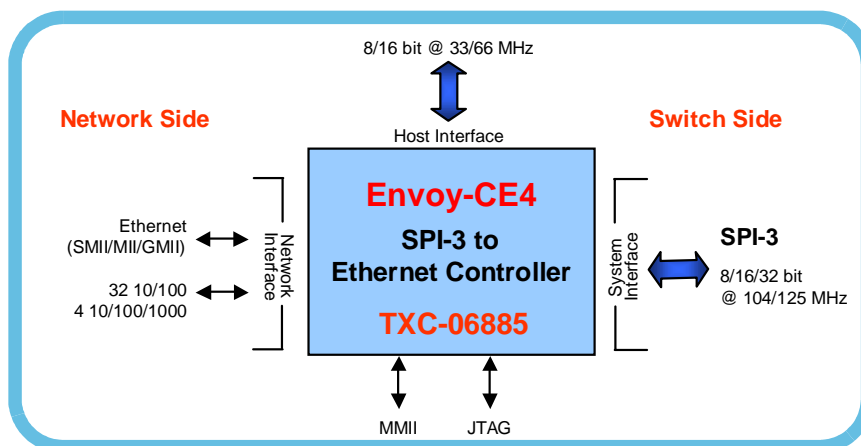


FEATURES

- 4 Configurable Media Access Controllers (MACs)
- Each MAC is configurable as 8 Fast Ethernet ports (10/100 Mbit/s), 2 Fast Ethernet ports with extended buffers or 1 Gigabit Ethernet port (10/100/1000 Mbit/s)
- SPI-3 interface configurable in Link or PHY layer mode, operating at 125 MHz
- Support for Jumbo frames (9600 Bytes) and Super Jumbo frames (12000 Bytes)
- Full and Half Duplex (CSMA/CD) operation (Half Duplex only supported for Fast Ethernet)
- Programmable SPI-3 burst size from 64 to 1024 bytes
- Frame integrity verification (FCS and Frame length checks) and generation
- Packet statistics and Performance monitoring support for RMON per port
- PAUSE frame flow control for Full Duplex mode
- "Raise Carrier" flow control for Half Duplex mode
- Programmable high and low FIFO watermarks for flow control trigger
- Automatic PAUSE frame generation and termination
- Filtering of PAUSE frames in Ethernet Ingress or Egress
- Port aggregation from Ethernet to SPI-3, using routing tag encapsulation
- 8/16 bit Microprocessor interface, selectable between Intel or Motorola
- JTAG Boundary Scan (IEEE 1149.1 Standard)
- 580-lead Plastic Ball Grid Array (PBGA) package, 27 mm x 27 mm

APPLICATIONS

- Metro Edge Routers and Switches
- Ethernet over SONET/SDH Multi-Service Provisioning Platforms (MSPPs)
- IP DSLAMs
- 3G Wireless Base Stations
- 3G Radio Network Controllers (RNCs)
- Multi-Service Access Platforms (MSAPs)



- IMPORTANT NOTICE -

TranSwitch Corporation reserves the right to make changes to its products, circuits or documentation described herein without notice.

EXCEPT AS SET FORTH IN A WRITTEN BINDING AGREEMENT BETWEEN TRANSWITCH CORPORATION AND A USER OF ITS PRODUCTS, TRANSWITCH CORPORATION ASSUMES NO LIABILITY FOR (A) CUSTOMER APPLICATIONS, INCLUDING CUSTOMER'S CIRCUITS, FIRMWARE AND SOFTWARE, (B) CUSTOMER PRODUCT DESIGN, (C) TRANSWITCH CORPORATION PRODUCT OR CUSTOMER PRODUCT SOFTWARE PERFORMANCE, (D) USE BY CUSTOMER OF ANY PRODUCT OR RELATED SAMPLE CIRCUIT OR APPLICATION PROVIDED HEREIN OR (E) INFRINGEMENT OF A THIRD PARTY'S PATENTS OR OTHER INTELLECTUAL PROPERTY RIGHTS ARISING OUT OF USE OF ANY AND ALL INFORMATION PROVIDED HEREIN. TRANSWITCH CORPORATION EXPRESSLY DISCLAIMS ALL REPRESENTATIONS AND WARRANTIES RELATED TO THE INFORMATION, PRODUCTS AND SAMPLE APPLICATIONS AND CIRCUITS CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF FITNESS FOR PURPOSE INTENDED, MERCHANTABILITY AND NON-INFRINGEMENT, AND WILL NOT BE LIABLE FOR DIRECT OR INDIRECT DAMAGES RESULTING FROM THEIR USE.

TRANSWITCH DOES NOT OFFER CUSTOMER EITHER AN EXPRESS OR AN IMPLIED LICENSE UNDER ANY PATENT RIGHT, COPYRIGHT, MASK WORK RIGHT, OR OTHER INTELLECTUAL PROPERTY RIGHT COVERING OR RELATED TO ANY DESIGN, COMBINATION, MACHINE OR PROCESS IN WHICH TRANSWITCH CORPORATION'S PRODUCTS OR SERVICES MIGHT BE OR ARE USED, INCLUDING BUT NOT LIMITED TO THE USES DESCRIBED HEREIN. THE CUSTOMER IS URGED TO CONSULT WITH LEGAL COUNSEL BEFORE DECIDING ON A PARTICULAR APPLICATION, CIRCUIT, FIRMWARE OR SOFTWARE WITH ANY OF TRANSWITCH'S PRODUCTS.

TRANSWITCH CORPORATION'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS (OR SIMILAR APPLICATIONS WHERE COMPONENT FAILURE COULD RESULT IN LOSS OF LIFE OR PHYSICAL HARM) WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF TRANSWITCH CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRELIMINARY information documents contain information on products in the sampling, pre-production or early production phases of the product life cycle. Characteristic data and other specifications are subject to change. Contact TranSwitch Applications Engineering for current information on this product.

U.S. Patents No. 4,967,405; 5,040,170; 5,142,529;
5,265,096; 5,331,641; 5,724,362; 6,577,651B1
U.S. and/or foreign patents issued or pending
Copyright © 2005 TranSwitch Corporation
Envoy is a trademark of TranSwitch Corporation
TranSwitch, TXC and PHAST are registered trademarks of TranSwitch Corporation

TABLE OF CONTENTS

Section	Page
List of Figures	5
List of Data Sheet Changes	6
1.0 Overview	7
1.1 Device Description	7
1.2 Application Example	8
2.0 Functional Description	9
2.1 Block Diagram	9
2.1.1 Media Access Controller (MAC)	10
2.1.2 Serial Media Independent Interface (SMII)	11
2.1.3 Gigabit Media Independent Interface (GMII) and Media Independent Interface (MII)	11
2.1.4 Ethernet Interface Description For Different Modes	12
2.1.5 Management Media Independent Interface (MMII) Port	15
2.1.6 Ingress and Egress Buffering Mechanism	16
2.1.7 System Packet Interface Level 3 (SPI-3)	16
2.1.7.1 PHY Mode	17
2.1.7.2 Link Mode	18
2.1.8 Microprocessor Interface	19
2.1.9 JTAG Boundary Scan	19
2.1.9.1 Boundary Scan Operation	20
2.1.9.2 Boundary Scan Reset	20
2.1.9.3 Boundary Scan Schematic	21
2.1.9.4 Boundary Scan Chain	21
3.0 Technical Characteristics	22
3.1 Lead Diagram	22
3.2 Lead Descriptions	23
4.0 Selected Parameter Values	46
4.1 Absolute Maximum Ratings and Environmental Limitations	46
4.2 Thermal Characteristics	47
4.3 Power Requirements	47
4.4 Input, Output and Input/Output Parameters	47
4.4.1 Input Parameters For LVTTL	47
4.4.2 Input Parameters For LVTTLpu (internal pull-up resistor)	47
4.4.3 Output Parameters For CMOS 8mA	48
4.4.4 Output Parameters For CMOS 12mA	48
4.4.5 Output Parameters For CMOS 16mA	48
4.4.6 Input/Output Parameters For LVTTL/CMOS 8mA	49
4.4.7 Input/Output Parameters For LVTTL/CMOS 16mA	49
5.0 Timing Characteristics	50
6.0 Operation	65
6.1 SMII/GMII to SPI-3 Flow control Operation	65
6.1.1 Receive MAC Data Flow	65
6.1.2 Receive MAC Checks	65
6.1.2.1 FCS Check:	65
6.1.2.2 Frame Length Check:	65
6.1.2.3 Maximum Frame Size Check:	66
6.1.2.4 Interframe Gap Check:	66
6.1.2.5 Destination Address Check:	66
6.1.3 Receive MAC Statistics	66
6.1.3.1 Counters:	66

6.1.4	Ingress FIFO Operations.....	67
6.1.4.1	Ingress FIFO Write:.....	67
6.1.4.2	Ingress FIFO Read:.....	67
6.1.4.3	Ingress FIFO Frame Availability for Transfer (Store and Forward/Streaming):.....	68
6.1.5	SPI-3 Output Operations.....	68
6.1.5.1	Data Flow Operations:	68
6.1.5.2	SPI-3 Output Interface Frame Format:.....	68
6.2	SPI-3 to SMII/GMII Flow control Operation	69
6.2.1	SPI-3 Input Operation	69
6.2.1.1	Input SPI-3 Data Flow:	69
6.2.1.2	Oversubscription Mode	70
6.2.1.3	Input SPI-3 Interface Frame Format:	71
6.2.2	Egress FIFO Operations	71
6.2.2.1	Egress FIFO Write:	71
6.2.2.2	Egress FIFO Frame Availability for Transfer (Store and Forward/Streaming):	72
6.2.2.3	Egress FIFO Read:	72
6.2.3	Transmit MAC Data Flow	72
6.2.4	Transmit MAC Configurable Options and Checks.....	72
6.2.4.1	Frame Check Sequence (FCS) Generation Option:	72
6.2.4.2	Pad Short Ethernet Frames Option:.....	73
6.2.4.3	Frame Length Check:.....	73
6.2.4.4	Maximum Frame Size Check:	73
6.2.4.5	Back to Back Interframe Gap Option:	73
6.2.4.6	Source Address Replace Option:.....	73
6.2.4.7	PAUSE Frame Filter Option:.....	73
6.2.4.8	Preamble Length Option:	73
6.2.5	Transmit MAC Statistics	73
6.2.5.1	Counters:.....	73
6.3	Port Aggregation.....	74
6.3.1	Normal vs. Aggregate Mode.....	75
6.4	Ethernet Half Duplex.....	75
6.4.1	Overview	75
6.4.2	Carrier Sense	75
6.4.3	Collision Detection.....	75
6.4.4	Alternate BEB Truncation.....	76
6.4.5	Excessive Collisions.....	76
6.4.6	Half-Duplex Flow Control	76
6.5	Ethernet Full Duplex	76
6.5.1	Overview	76
6.5.2	PAUSE Control Frame Reception	77
6.5.3	PAUSE Control Frame Generation	77
6.5.3.1	Automatic PAUSE Frame Generation.....	77
6.5.3.2	Host Initiated PAUSE Frame Generation.....	78
7.0	Memory Maps and Bit Descriptions	79
	Package Information.....	122
	Ordering Information.....	123
	Related Products.....	123
	Standards Documentation Sources.....	124

Please note that TranSwitch provides documentation for all of its products. Current editions of many documents are available from the Products page of the TranSwitch Web site at www.transwitch.com. Customers who are using a TranSwitch Product, or planning to do so, should register with the TranSwitch Marketing Department to receive relevant updated and supplemental documentation as it is issued. They should also contact the Applications Engineering Department to ensure that they are provided with the latest available information about the product, especially before undertaking development of new designs incorporating the product.

LIST OF FIGURES

Figure	Page
1. Flexible Architecture for Ethernet Over SONET/SDH and Router Application.....	8
2. Functional Block Diagram of the Envoy-CE4	9
3. GMII (1000 Mbit/s) Only Interface Connection	13
4. MII (10/100 Mbit/s) Only Interface Connection.....	14
5. GMII/MII (10/100/1000 Mbit/s) Interface Connection	14
6. SMII (10/100 Mbit/s) Interface Connection.....	15
7. Envoy-CE4 in PHY Layer Mode	17
8. Envoy-CE4 in Link Layer Mode.....	18
9. Boundary Scan Schematic.....	21
10. Envoy-CE4 Lead Diagram.....	22
11. SMII Sync In/Out Timing	50
12. SMII Transmit Interface Timing	51
13. SMII Receive Interface Timing	51
14. GMII Transmit Interface Timing Using <i>GmTXCLKI</i>	52
15. GMII/MII Receive Interface Timing Using <i>GmRXCLK</i>	53
16. MII Transmit Interface Timing Using <i>GmMTXCLK</i>	54
17. Management MII Interface Timing.....	55
18. SPI-3 Data Input Interface Timing	56
19. SPI-3 Data Output Interface Timing	57
20. Boundary Scan Timing Diagram	58
21. Motorola MPC860 Write Cycle Timing	59
22. Motorola MPC860 Read Cycle Timing	61
23. Asynchronous Microprocessor Interface: Intel Write Cycle Timing	63
24. Asynchronous Microprocessor Interface: Intel Read Cycle Timing	64
25. Envoy-CE4 Package Diagram.....	122

LIST OF DATA SHEET CHANGES

This change list identifies those areas within this updated Envoy-CE4 device Data Sheet that have significant differences relative to the previous and now superseded Envoy-CE4 Data Sheet:

Updated Envoy-CE4 device Data Sheet: *PRELIMINARY* Edition 6A, February 2005
Previous Envoy-CE4 device Data Sheet: *PRODUCT PREVIEW* Edition 6, January 2005

The page numbers indicated below of this updated Data Sheet include changes relative to the previous Data Sheet.

Page Number of <u>Updated</u> <u>Data Sheet</u>	<u>Summary of the Change</u>
All	Changed edition number and date.
All	Changed <i>Product Preview</i> to <i>Preliminary</i> .
90	Modified rows for register “2008”, “200C”, “2010” and “2014”.
92	Modified Description for Bit Range 7-0 of Address “2008” and “200C”.
93	Modified Description for Bit Range 7-0 of Address, “2010” and “2014”.

1.0 OVERVIEW

1.1 DEVICE DESCRIPTION

The Envoy[™]-CE4 is the next generation of powerful Ethernet to SPI-3 Controllers for carrier-class networks. The Envoy-CE4 incorporates four configurable Media Access Controllers (MACs). Each MAC can be configured as a single Gigabit Ethernet (10/100/1000 Mbit/s), dual Fast Ethernet with extended buffers or octal Fast Ethernet (10/100 Mbit/s) interface and is programmable for either full-duplex or half-duplex operation. The Envoy-CE4 supports Super Jumbo (12 KBytes) packets on both Fast Ethernet and Gigabit Ethernet interfaces.

The Envoy-CE4 is designed to interface directly with SPI-3 compliant devices, such as network processors. The support for master mode on the SPI-3 allows glueless interface with standard SPI-3 based GFP/VCAT framers and mappers. On the Ethernet side, the Envoy-CE4 interfaces directly with standard Fast Ethernet and Gigabit Ethernet PHY/SerDes devices via the SMII and GMII. The Envoy-CE4 incorporates on-chip buffering to promote high performance without congestion or loss of data and provides backpressure support on both the Ethernet and SPI-3 interfaces.

1.2 APPLICATION EXAMPLE

Ethernet is emerging as the Layer 2 Protocol of choice in Enterprise, Access and Metro Networks. This is due to its cost effectiveness, wide spread acceptance and ease of use. The Envoy-CE4 provides a means to connect a cost efficient, switching protocol interface in Ethernet to a Telecom based interface, the OIF SPI-3. Current network processing devices that traditionally have a packet based interface the OIF SPI-3 interface, can now interface to Ethernet based devices using the Envoy-CE4.

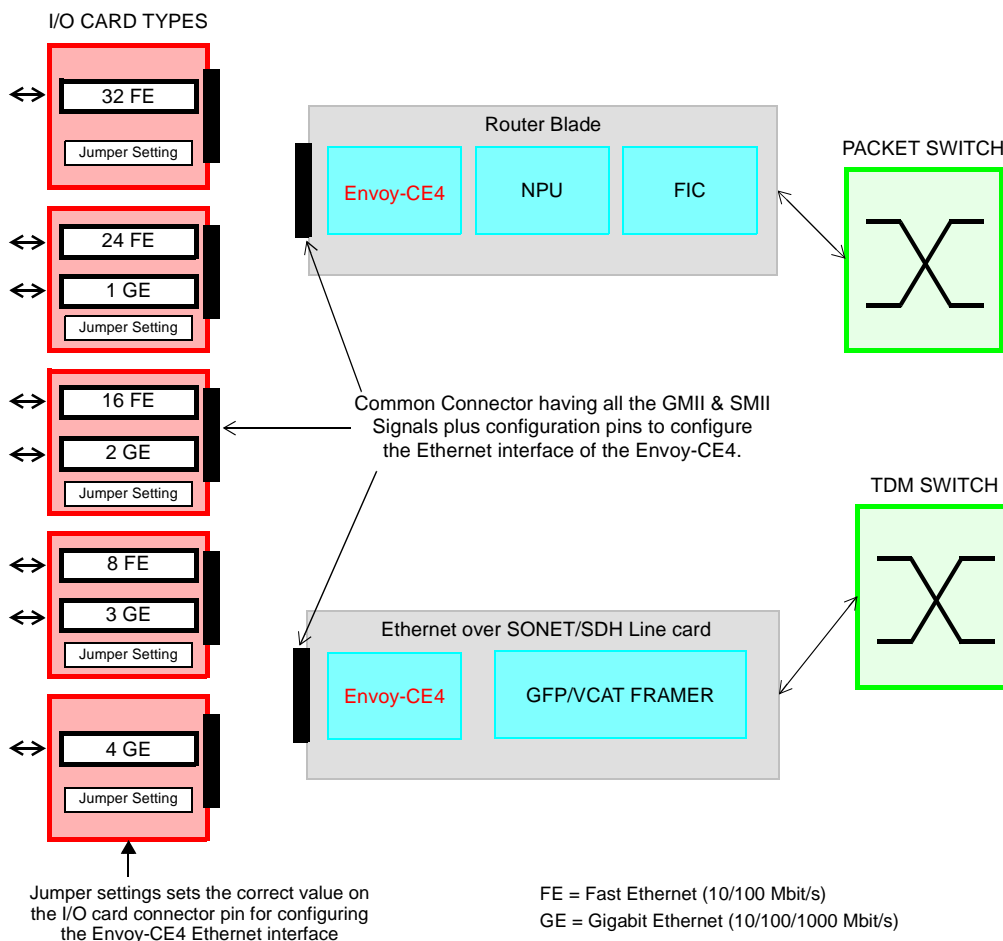
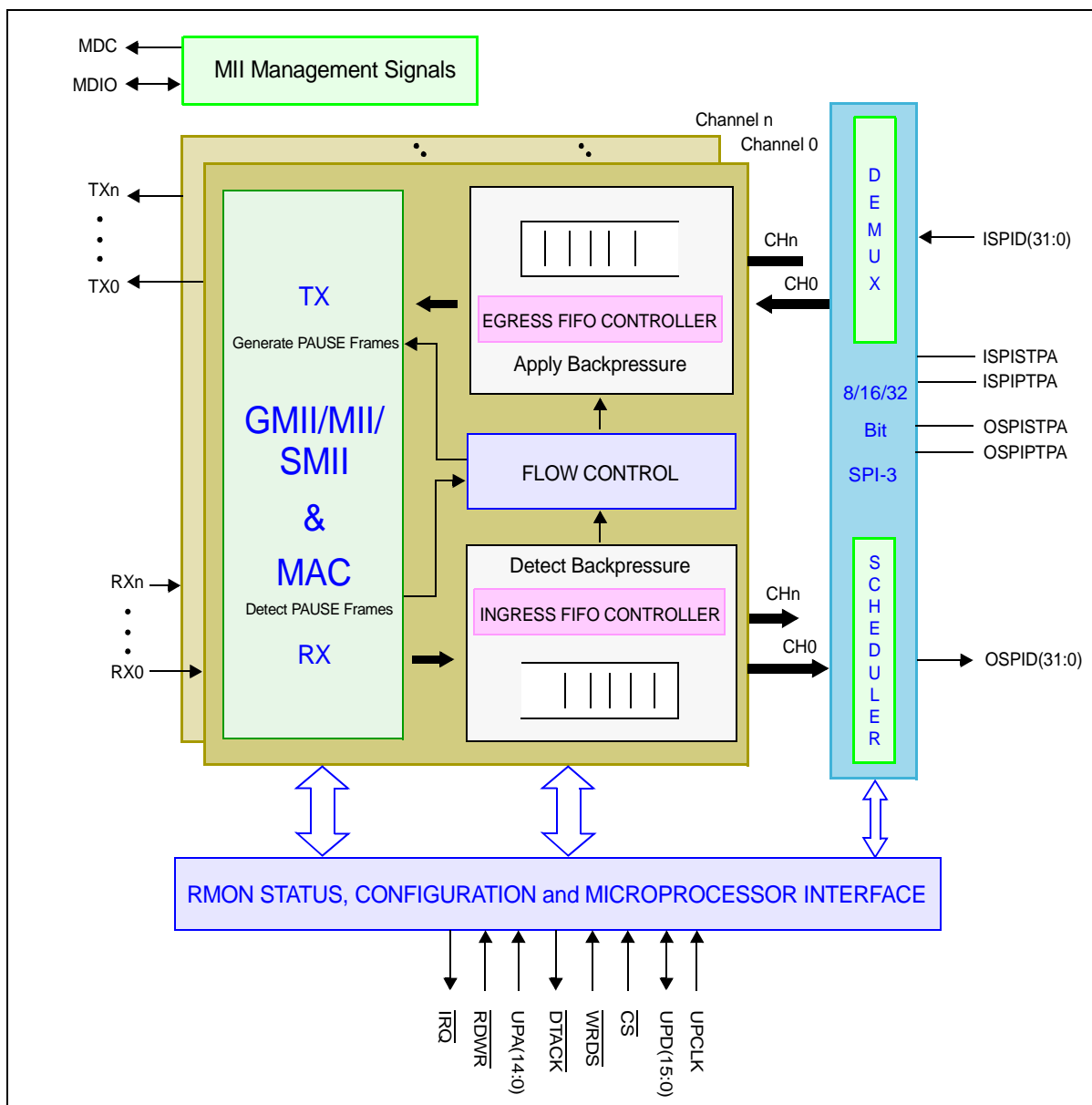


Figure 1. Flexible Architecture for Ethernet Over SONET/SDH and Router Application

2.0 FUNCTIONAL DESCRIPTION

2.1 BLOCK DIAGRAM



Note: Each MAC is configurable as 8 Fast Ethernet Ports (10/100 Mbit/s), 2 Fast Ethernet Ports with Extended Buffers, or 1 Gigabit Ethernet Port (10/100/1000 Mbit/s)

Figure 2. Functional Block Diagram of the Envoy-CE4

2.1.1 Media Access Controller (MAC)

The Envoy-CE4 has 4 Configurable Media Access Controllers (MACs):

- Configurable MAC A services ports 0 to 7
- Configurable MAC B services ports 8 to 15
- Configurable MAC C services ports 16 to 23
- Configurable MAC D services ports 24 to 31

Each MAC can be configured as:

- 8 Fast Ethernet ports with 7.75 KBytes of Ingress buffering and 4 KBytes of Egress buffering per port supporting 10/100 Mbit/s data rates via SMII.

OR

- 1 Gigabit Ethernet port with 62 KBytes of Ingress buffering and 32 KBytes of Egress buffering per port supporting 10/100/1000 Mbit/s data rates via GMII/MII.

OR

- 2 Fast Ethernet ports with 31 KBytes of Ingress buffering and 16 KBytes of Egress buffering per port supporting 10/100 Mbit/s data rates via SMII. (Extended SMII Mode)

Possible Envoy-CE4 Configurations:

- 32 Fast Ethernet Ports
- 4 Gigabit Ethernet Ports
- 24 Fast Ethernet Ports and 1 Gigabit Ethernet Port
- 16 Fast Ethernet Ports and 2 Gigabit Ethernet Ports
- 8 Fast Ethernet Ports and 3 Gigabit Ethernet Ports
- 8 Fast Ethernet Ports (Extended SMII Mode) with larger buffers (31 KBytes of Ingress Buffering and 16 KBytes of Egress Buffering per port).

The main features supported by each Configurable MAC are:

- Compliant to IEEE 802.3, 802.3i, 802.3u, 802.3x, 802.3z
- Full Duplex and Half Duplex (CSMA/CD) operation per configurable MAC
- Connection to standard 10/100 Mbit/s Fast Ethernet PHY devices via SMII interface
- Connection to Multi-rate 10/100/1000 Mbit/s Gigabit Ethernet PHY devices via GMII/MII interface
- Frame Integrity Verification (FCS and length checks)
- Errored Frames can be configured to be filtered
- Programmable Inter-Packet Gap (IPG) between Ethernet frames
- Programmable maximum frame length
 - Minimum frame size = 64 bytes
 - Maximum frame size = 12 KBytes
- Support for VLAN tagged frame transmission
- Programmable High and Low FIFO watermarks for space and frame/chunk availability generation

- MAC control sublayer provides support for control frames including PAUSE frames
- Automatic PAUSE Frame Generation and Termination
- 62 KByte ingress FIFO per Configurable MAC
- 32 KByte egress FIFO per Configurable MAC
- Far end switch side loopback for diagnostic capability
- Packet statistics and performance monitoring support for Remote Network Monitoring (RMON)

2.1.2 Serial Media Independent Interface (SMII)

The Serial Media Independent Interface (SMII) is capable of operating at 10/100 Mbit/s mixed mode. The SMII is configurable to operate in either Full Duplex or Half Duplex mode.

Control and Data are transported across the Tx and Rx signals in 10 bit segments. The segments are synchronized using the SYNC signal. From the 10 bits, 2 bits are control and the other 8 bits are data. In 100 Mbit/s mode, every 10 bit segment transfers a new byte of data. In 10 Mbit/s mode, each 10 bit segment is repeated ten times. Please refer to the SMII specification for further details.

Each SMII port is comprised of:

- Two serial data signals (Tx and Rx) per port
- 125 MHz reference clock signal (Clock) per Configurable MAC
- Synchronization signal (SYNC) per Configurable MAC

2.1.3 Gigabit Media Independent Interface (GMII) and Media Independent Interface (MII)

The GMII interface of the Envoy-CE4 is capable of operating at 1 Gbit/s. When configured in MII mode, the interface is capable of operating at 10/100 Mbit/s. The GMII/MII ports allow the Envoy-CE4 to connect to Multi-rate Gigabit Ethernet PHY devices.

When configured as GMII, each port is comprised of:

- Two data buses, Transmit and Receive, each 8 bits wide
- Two clock signals, 1 per direction
 - The transmit clock is an output and the receive clock is an input
 - An input pad is provided to source the transmit clock from an external oscillator
- Two network status signals (Rx Error and Tx Error)
- Two control signals (Rx Data Valid and Tx Enable)
- All signals are synchronous to the clock

Note: The GMII is a 3.3 V interface that will only work with a 3.3 V PHY device.

When configured as MII, each port is comprised of:

- Two data buses, Transmit and Receive, each 4 bits wide
 - Uses Least Significant Nibble of the GMII bus
- Two clock signals, 1 per direction
 - Both the transmit and receive clocks are inputs to the Envoy-CE4
- Four Status signals (Rx Data Valid, Tx Enable, Carrier sense, and Collision detect)

Note: The GMII signal pins are muxed with the SMII signal pins.

The following sequence needs to be performed when switching from GMII mode to MII mode and vice versa:

- Enable Soft Reset for the MAC (Register 0x4000 Bit 31 for Port 0)
- Reprogram Interface Mode Register (Register 0x4004 Bits 8-9)
- Remove Soft Reset

2.1.4 Ethernet Interface Description For Different Modes

The Envoy-CE4 has 32 Ethernet Ports: Ports 0 to 31. Ports 0 to 7 are assigned to Configurable MAC A (CMAC A), Ports 8 to 15 are assigned to Configurable MAC B (CMAC B), Ports 16 to 23 are assigned to Configurable MAC C (CMAC C), and Ports 24 to 31 are assigned to Configurable MAC D (CMAC D). Each CMAC can be configured as 8 SMII ports, 2 Extended SMII ports (larger buffers) or 1 triple speed GMII/II port. Device pins CFGCMACA(1-0), CFGCMACB(1-0), CFGCMACC(1-0), and CFGCMACD(1-0) are used to configure CMAC A, CMAC B, CMAC C, and CMAC D, respectively.

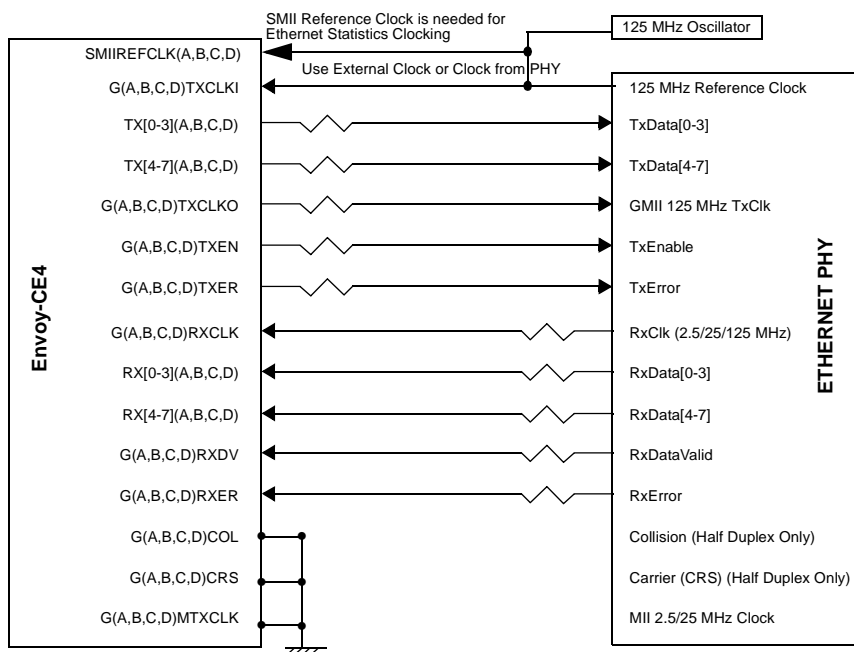
When CMAC A is configured in GMII/II mode (CFGCMACA = 01), port 0 will be in GMII or MII mode (II mode is based on programmable bits "Interface Mode": Register 4004 bits 8-9) and ports 1 to 7 are inactive. When CMAC A is configured in Extended SMII mode (CFGCMACA = 10), ports 0 and 4 will be in extended SMII mode and ports 1, 2, 3, 5, 6, and 7 are inactive. When CMAC A is configured in SMII mode (CFGCMACA = 11), ports 0 to 7 will be in SMII mode.

When CMAC B is configured in GMII/II mode (CFGCMACB = 01), port 8 will be in GMII or MII mode (II mode is based on programmable bits "Interface Mode": Register 4804 bits 8-9) and ports 9 to 15 are inactive. When CMAC B is configured in Extended SMII mode (CFGCMACB = 10), ports 8 and 12 will be in extended SMII mode and ports 9, 10, 11, 13, 14, and 15 are inactive. When CMAC B is configured in SMII mode (CFGCMACB = 11), ports 8 to 15 will be in SMII mode.

When CMAC C is configured in GMII/II mode (CFGCMACC = 01), port 16 will be in GMII or MII mode (II mode is based on programmable bits "Interface Mode": Register 5004 bits 8-9) and ports 17 to 23 are inactive. When CMAC C is configured in Extended SMII mode (CFGCMACC = 10), ports 16 and 20 will be in extended SMII mode and ports 17, 18, 19, 21, 22, and 23 are inactive. When CMAC C is configured in SMII mode (CFGCMACC = 11), ports 16 to 23 will be in SMII mode.

When CMAC D is configured in GMII/II mode (CFGCMACD = 01), port 24 will be in GMII or MII mode (II mode is based on programmable bits "Interface Mode": Register 5804 bits 8-9) and ports 25 to 31 are inactive. When CMAC D is configured in Extended SMII mode (CFGCMACD = 10), ports 24 and 28 will be in extended SMII mode and ports 25, 26, 27, 29, 30, and 31 are inactive. When CMAC D is configured in SMII mode (CFGCMACD = 11), ports 24 to 31 will be in SMII mode.

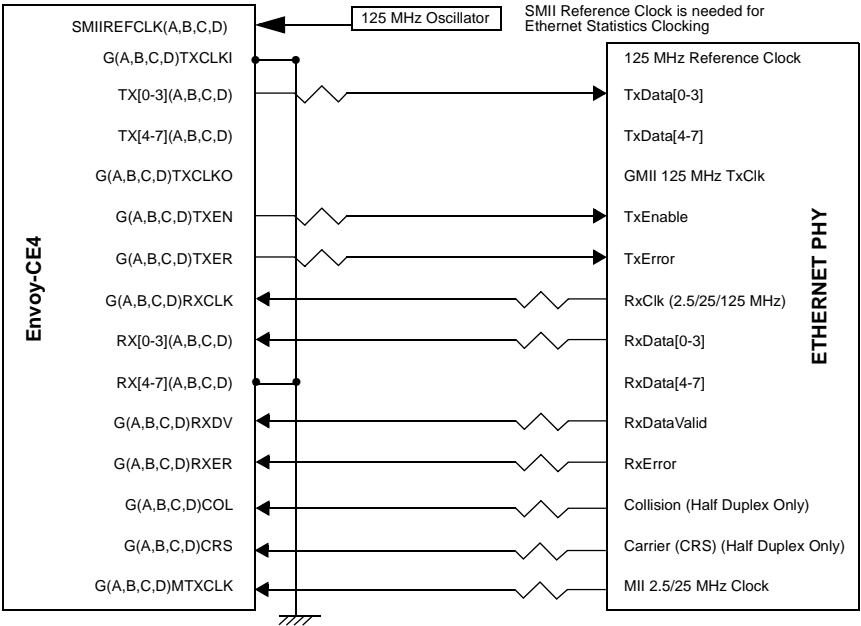
- Functional Description -



Note: Series termination resistor values are dependent on the selection of the Ethernet PHY. Please consult the specification of the Ethernet PHY for series termination resistor values

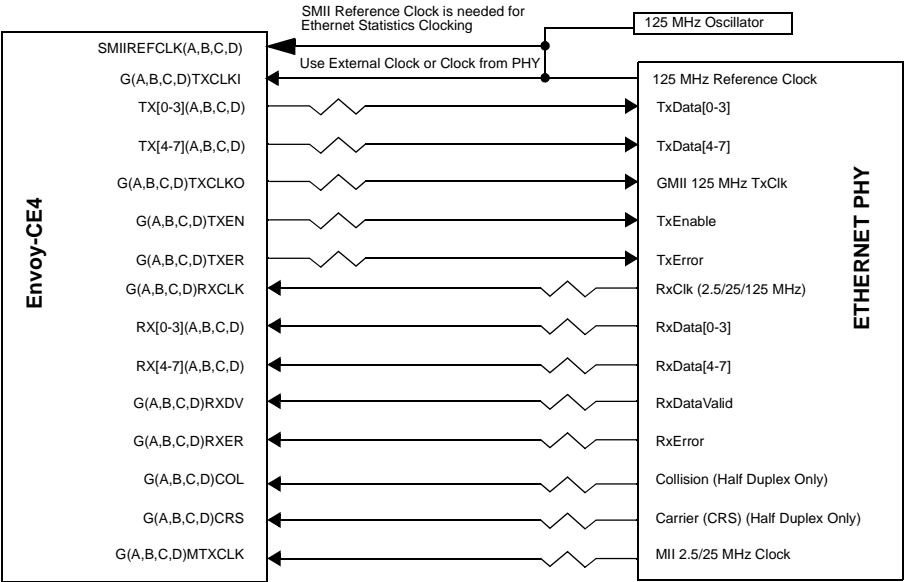
Figure 3. GMII (1000 Mbit/s) Only Interface Connection

- Functional Description -



Note: Series termination resistor values are dependent on the selection of the Ethernet PHY. Please consult the specification of the Ethernet PHY for series termination resistor values

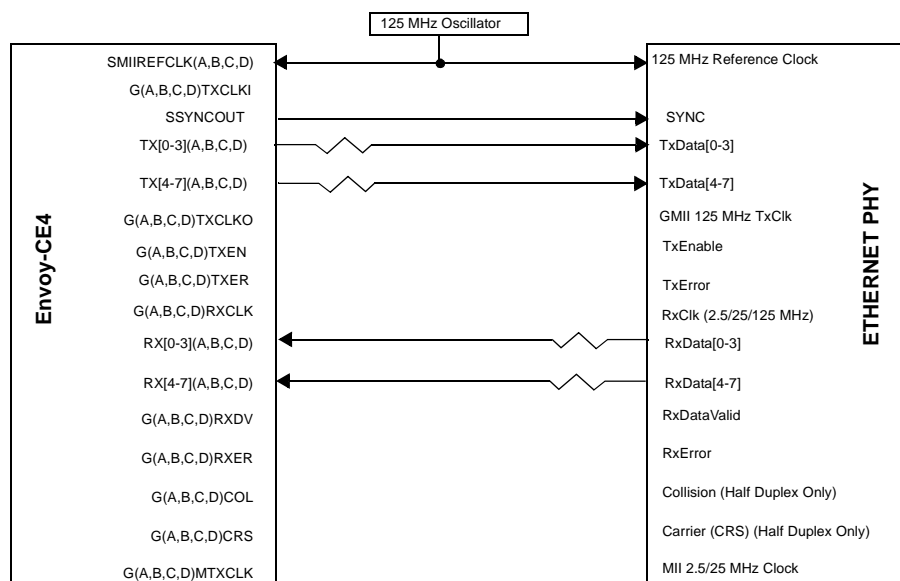
Figure 4. MII (10/100 Mbit/s) Only Interface Connection



Note: Series termination resistor values are dependent on the selection of the Ethernet PHY. Please consult the specification for the Ethernet PHY to determine the series termination resistor values

Figure 5. GMII/MII (10/100/1000 Mbit/s) Interface Connection

- Functional Description -



Note: Series termination resistor values are dependent on the selection of the Ethernet PHY.
Please consult the specification for the Ethernet PHY to determine the series termination resistor values

Figure 6. SMII (10/100 Mbit/s) Interface Connection

2.1.5 Management Media Independent Interface (MMII) Port

The MMII port on the Envoy-CE4 is used to configure and retrieve status from the Ethernet PHYs connected to the Envoy-CE4. Multiple PHY devices (up to 32) are programmable via this interface. The Envoy-CE4 MMII is compliant to the Management interface outlined in IEEE 802.3u. The device can be configured for preamble suppression at the MMII interface. The MMII port is comprised of an output Management Data clock signal and a bi-directional Management Data signal that allows serial data to be clocked in and out of the external PHY device. The frequency of the output clock of the MMII port (MDC) is programmable to UPCLK/ n ($n = 4, 6, 8, 10, 14, 20, \text{ or } 28$). All data transfers are synchronous to the clock signal and provide support for up to 32 PHYs.

Two additional functions performed by the interface are the Scan function and the Automatic PHY address Increment function. In Scan mode, multiple back-to-back reads can be performed from a particular PHY. When Scan mode and Auto PHY address increment are enabled, back-to-back reads can be performed with the PHY address being incremented after each read. Hence, the PHYs are scanned.

Notes:

1. When Scan mode and Auto PHY address increment are enabled, the range of addresses scanned will be between "PHY Address" (Register 0x0048 Bits 8-12) and PHY number 31.
2. Envoy's Management Media Independent Interface (MMII) is in Master mode.

2.1.6 Ingress and Egress Buffering Mechanism

Two buffering mechanisms are provided: **Store and Forward** and **Streaming**. In Store and Forward mode, a complete frame is stored in the Ingress and Egress buffers, before it is transmitted across the SPI-3 and Ethernet interfaces, respectively. In Streaming mode, a programmable number of bytes are stored in the Ingress and Egress buffers, before the frame is transmitted across the SPI-3 and Ethernet interfaces, respectively. Hence for low latency applications, streaming mode provides a solution to transport large frames with smaller buffer space. The Ingress and Egress buffers can be programmed separately.

2.1.7 System Packet Interface Level 3 (SPI-3)

The SPI-3 interface operates using an 8, 16, or 32 bit wide pin configurable data bus (TDAT(31-0) and RDAT(31-0)). The minimum clock (TFCLK and RFCLK) rate is 50 MHz and the maximum clock rate is 125 MHz. The device can be pin configured to operate as a Link (Master) or a PHY (Slave) layer device. Multi-PHY (MPHY) and Single-PHY (SPHY) modes of operation are supported (programmable). Packet level transfer mode is supported in Multi-PHY mode only and Byte level transfer mode is supported in both Single-PHY and Multi-PHY modes. On the output interface, chunking is supported where a configured number of bytes (chunk) are transferred by a port from the PHY device to the Link device. Programmable packet available thresholds are provided on the input interface. The SPI-3 interface is divided into the SPI-3 input and the SPI-3 output.

The SPI-3 interface assigns an 8 bit port address with an address range of 0 to 255. The Envoy-CE4 allows programming of an offset base address for the SPI-3 port address assignment. The base address is a 3-bit programmable value and is assigned to the most significant 3 bits of the 8 bit SPI-3 address. Individual SPI-3 port addresses are calculated by adding the (base address x 32) to the logical Ethernet port number. For example, the SPI-3 address of port 19 with a base address of 3 will give a SPI-3 port address of $(19 + (3 \times 32)) = 115$.

2.1.7.1 PHY Mode

In PHY layer mode, the following SPI-3 interface naming convention is used, per the OIF SPI-3 specification. Packets received at the Ethernet receive interface, are stored in the Ingress FIFO and **transmitted** on the **SPI-3 Rx** interface (SPI-3 output for Envoy-CE4). Packets **received** at the **SPI-3 Tx** interface (SPI-3 input for Envoy-CE4), are stored in the Egress FIFO and transmitted on the Ethernet transmit interface.

In PHY layer mode, space availability per channel for Transmit Interface (PTPA/STPA) is asserted when a programmable number of bytes or more, are available for storage in the Egress FIFO. The de-assertion of space availability is also programmable and is indicated when a programmed number of bytes are available for storage in the Egress FIFO (near-full condition). For PTPA, the programmable values for the assertion and de-assertion of the signal are 8 to 2040 bytes. For STPA, the programmable values for assertion and de-assertion are 2 to 255 bytes in 8-bit SPI-3 mode, 4 to 510 bytes in 16-bit SPI-3 mode, and 8 to 1020 bytes in 32-bit SPI-3 mode. In the Receive direction (SPI-3 output), one of the channels will be selected for frame transfer, based on a round robin algorithm. Packet data may be transferred across the Receive Interface in chunks, programmable from 8 to 2040 bytes, in 8 byte increments. In the Receive direction (SPI-3 output), the time between consecutive transfers (pause) is programmable to 0 or 2 cycles.

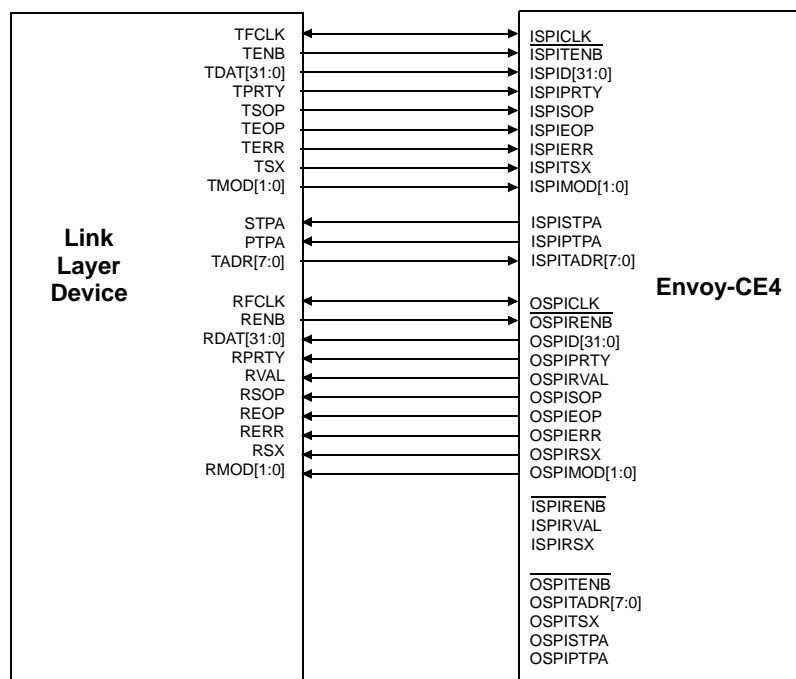


Figure 7. Envoy-CE4 in PHY Layer Mode

2.1.8 Microprocessor Interface

The Envoy-CE4 configuration, status, and device management is performed via its microprocessor interface. The interface has a 15 bit wide address bus UPA(14-0) and a pin configurable 8 or 16 bit wide data bus UPD(15-0). It is compatible with standard Intel/Motorola micro-controllers. The interface operates from a minimum clock (UPCLK) frequency of 33 MHz to a maximum clock frequency of 66 MHz.

The following table shows the Pin description for the Host interface in Intel and Motorola modes:

Envoy-CE4 Pin Name	Intel Mode Description	Motorola Mode Description
Microprocessor Clock (UPCLK)	Host Interface Clock	Host Interface Clock
Microprocessor Data Bus (UPD)	Host Data Bus	Host Data Bus
Microprocessor Address Bus (UPA)	Host Address Bus	Host Address Bus
Chip Select (CS)	Device Chip Select	Device Chip Select
Write/Transfer Start (WRDS)	Write Strobe (Active Low)	Active Low Transfer Start
Transfer Acknowledge (DTACK)	Ready	Active Low Transfer Acknowledge
Read/Write (RDWR)	Read Strobe (Active Low)	Read/Write Strobe
Interrupt (IRQ)	Interrupt Pin	Interrupt Pin

All internal registers (control and status) are 32 bits wide. In order to complete a write operation, all 32 bits must be written. All accesses require writing or reading the complete 32 bits. Hence, when performing a write when the Microprocessor Interface is configured as an 8 bit wide bus, it is required to do 4 writes to write to the internal register. Similarly, when doing a read when the bus is configured as an 8 bit wide bus, 4 reads need to be performed to access the register. The diagrams in [Figure 21](#), [Figure 22](#), [Figure 23](#), and [Figure 24](#) illustrate the bus accesses in Motorola and Intel modes for both read and write operations. The minimum CS to DTACK time is 6 UPCLK cycles and the maximum CS to DTACK time is 22 UPCLK cycles.

2.1.9 JTAG Boundary Scan

The IEEE 1149.1 standard defines the requirements of a boundary scan architecture that has been specified by the IEEE Joint Test Action Group (JTAG). Boundary scan is a specialized scan architecture that provides observability and controllability for the interface leads of the device. As shown in [Figure 9](#), one cell of a boundary scan register is assigned to each input or output lead to be observed or tested (bidirectional leads may have two cells). The boundary scan capability is based on a Test Access Port (TAP) controller, instruction and bypass registers, and a boundary scan register path bordering the input and output leads. The boundary scan test bus interface consists of four input signals and an output signal. The four input signals are Test Clock (TCK), Test Mode Select (TMS), Test Data Input (TDI) and Test Mode Reset (TRST). The output signal is Test Data Output (TDO). In addition to the TAP, a pin is provided (DEVHIZ) to place the output buffers in a high impedance state for systems that do not support the IEEE 1149.1 standard. Boundary scan signal timing is shown in [Figure 20](#).

The TAP controller receives external control information via a Test Clock (TCK) signal and a Test Mode Select (TMS) signal, and sends control signals to the internal scan paths. Detailed information on the operation of this state machine can be found in the IEEE 1149.1 standard. The serial scan path architecture consists of an instruction register, a boundary scan register and a bypass register. These three serial registers are connected in parallel between the Test Data Input (TDI) and Test Data Output (TDO) signals, as shown in [Figure 9](#).

The boundary scan function can be reset and disabled by holding lead $\overline{\text{TRST}}$ low. When boundary scan testing is not being performed the boundary scan register is transparent, allowing the input and output signals to pass to and from the Envoy-CE4 device's internal logic. During boundary scan testing, the boundary scan register may disable the normal flow of input and output signals to allow the device to be controlled and observed via scan operations.

2.1.9.1 Boundary Scan Operation

The Envoy-CE4 supports the following boundary scan test instructions:

The EXTEST test instruction provides the ability to test the connectivity of the Envoy-CE4 device to external circuitry.

The SAMPLE/PRELOAD test instruction provides the ability to examine the values of the Input and Output pins without interfering with device operation, and to initialize the Boundary Scan Register with new values for the next operation.

The BYPASS test instruction provides the ability to bypass the Envoy-CE4 boundary scan and instruction registers.

The IDCODE test instruction provides a unique device identification for the Envoy-CE4 device.

The HIGHZ test instruction provides the ability to drive all 3-state outputs and bidirectional pins to their high impedance state.

The CLAMP test instruction provides the ability to drive the component pins of the chip from the boundary scan register, while the bypass register is selected as the serial path between TDI and TDO. The component pins will not switch while the CLAMP instruction is selected.

2.1.9.2 Boundary Scan Reset

Specific control of the $\overline{\text{TRST}}$ lead is required in order to ensure that the boundary scan logic does not interfere with normal device operation. This lead must either be held low, asserted low, or asserted low then high (pulsed low), to asynchronously reset the Test Access Port (TAP) controller during power-up of the Envoy-CE4. If boundary scan testing is to be performed and the lead is held low, then a pull-down resistor value should be chosen which will allow the tester to drive this lead high, but still meet the V_{IL} requirements listed in the Input, Output and Input/Output Parameters section of this Data Sheet for worst case leakage currents of all devices sharing this pull-down resistor.

2.1.9.3 Boundary Scan Schematic

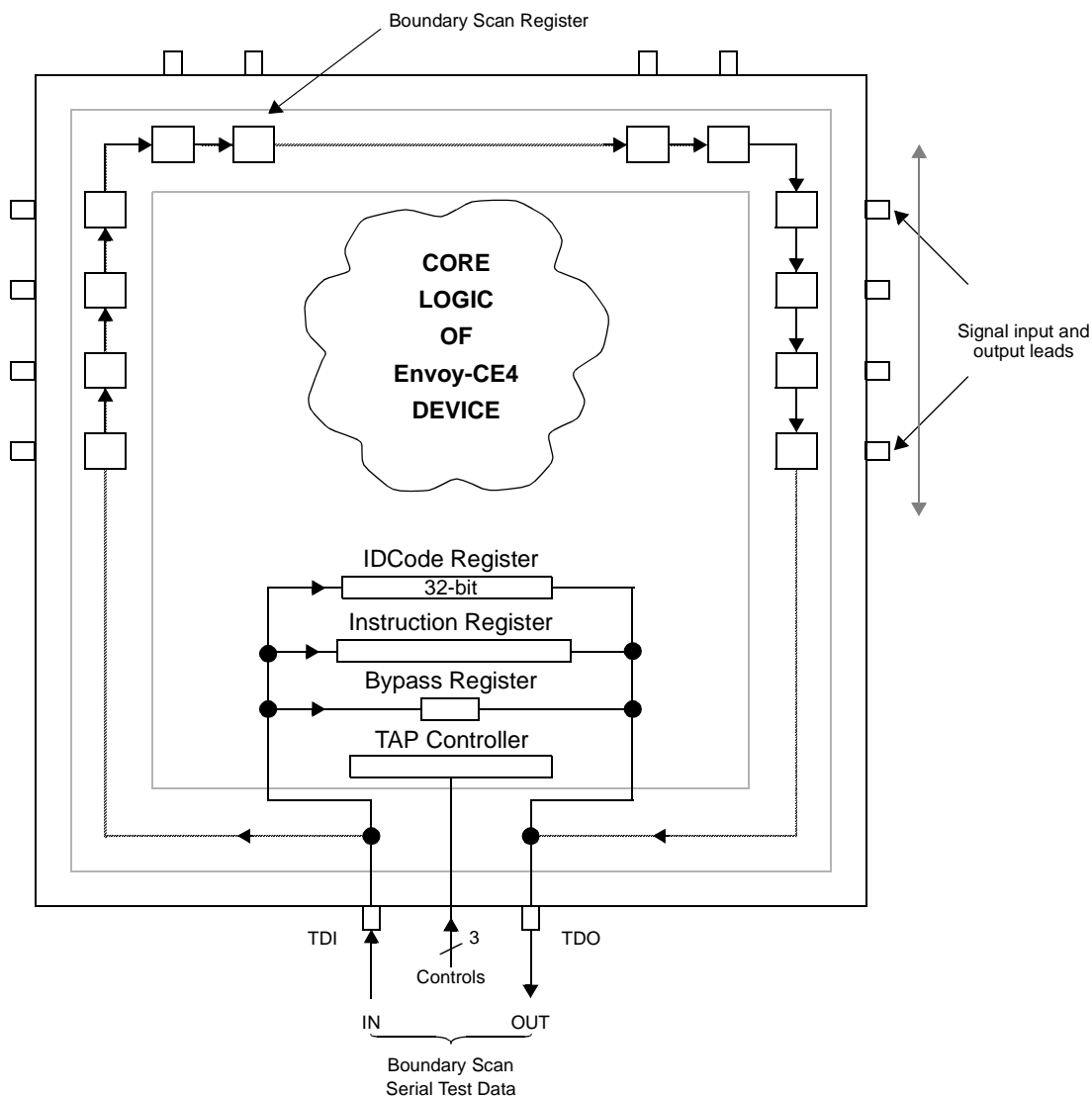


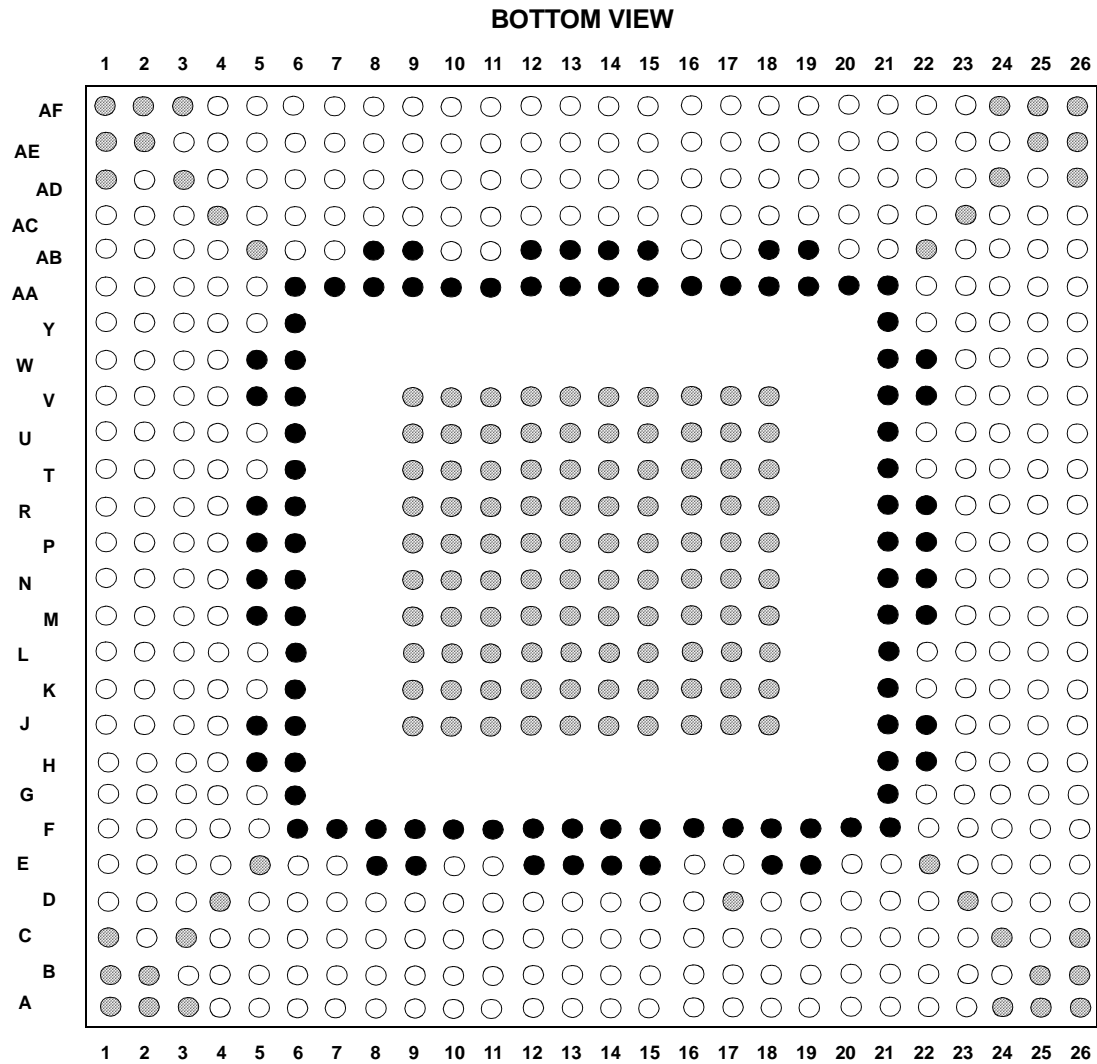
Figure 9. Boundary Scan Schematic

2.1.9.4 Boundary Scan Chain

A Boundary Scan Description Language (BSDL) source file for the Envoy-CE4 is available via the Products page of the TranSwitch Internet World Wide Web site at www.transwitch.com.

3.0 TECHNICAL CHARACTERISTICS

3.1 LEAD DIAGRAM



- Notes:
1. This is the bottom view and the leads are solder balls. See [Figure 25](#) for package information.
 2. Power supply leads are shown as solid black circles and ground leads are shown as cross-hatched circles.

Figure 10. Envoy-CE4 Lead Diagram

3.2 LEAD DESCRIPTIONS

POWER SUPPLY, GROUND, AND NO CONNECTS

Symbol	Lead No.	I/O/P *	Name/Function
VDD18	AA8, AA9, AA12, AA15, AA18, AA19, AB8, AB9, AB12, AB15, AB18, AB19, E8, E12, E15, E18, E19, F8, F9, E9, F12, F15, F18, F19, H5, H6, H21, H22, J5, J6, J21, J22, M5, M6, M21, M22, R5, R6, R21, R22, V5, V6, V21, V22, W5, W6, W21, W22	P	V _{DD18} : +1.8 volt $\pm 5\%$ CMOS core supply voltage.
VDD33	AA6, AA7, AA10, AA11, AA13, AA14, AA16, AA17, AA20, AA21, AB13, AB14, E13, E14, F6, F7, F10, F11, F13, F14, F16, F17, F20, F21, G21, G6, K6, K21, L6, L21, N5, N6, N21, N22, P5, P6, P21, P22, T6, T21, U6, U21, Y6, Y21	P	V _{DD33} : +3.3 volt $\pm 5\%$ CMOS input/output pad supply voltage.

Note: VDD18 and VDD33 Power Up Sequence. Because of the multi-power ESD structure used for CMOS I/O cells, there is a parasitic forward diode path from core power rail (V_{DD18}) to I/O power rail (V_{DD33}). So, if V_{DD18} is powered up earlier than V_{DD33}, there will be current flowing through the parasitic diode that may trigger latch-up. To avoid this problem, users can take either one of the approaches below:

(1) Power Up VDD33 First. Turning on V_{DD33} first, prevents the parasitic diode from turning on. For example, power up V_{DD33} first and then V_{DD18}. Note: TranSwitch does not recommend powering up V_{DD33} seconds earlier than V_{DD18} for reliability reasons. This is because the un-powered V_{DD18} may result in short circuit current (crowbar current) on the CMOS I/O cell's post-driver for unknown state. Bus conflict may also occur when only V_{DD33} is powered on. The maximum interval that V_{DD18} must be powered up after V_{DD33}, depends on the slew rate of power ramp-up in the customer's application.

(2) Place a Schottky Diode Between VDD18 and VDD33. If we can ensure that the parasitic diode does not turn on, we can even power up lower voltage first. This can be done by inserting an external diode between V_{DD18} and V_{DD33} on the board. By connecting the Schottky diode with anode to lower voltage rail (V_{DD18}) and cathode to higher voltage rail (V_{DD33}), we can force the latter to ramp up with the former with the voltage drop (Schottky diode V_t=150mV~200mV) less than the threshold voltage of the parasitic diode (parasitic diode V_t=500mV~600mV). This prevents from turning on the parasitic diode between power rails, avoiding latch up. The external diode will be turned off when V_{DD33} is powered up to its normal voltage.

*Note: I = Input; O = Output; P = Power; T = Tristate

Envoy-CE4 Device

DATA SHEET

TXC-06885

- Technical Characteristics -



Symbol	Lead No.	I/O/P *	Name/Function
VSS	A1, A2, A3, A24, A25, A26, AB5, AB22, AC4, AC23, AD1, AD3, AD24, AD26, AE1, AE2, AE25, AE26, AF1, AF2, AF3, AF24, AF25, AF26, B1, B2, B25, B26, C1, C3, C24, C26, D4, D17, D23, E5, E22, J9, J10, J11, J12, J13, J14, J15, J16, J17, J18, K9, K10, K11, K12, K13, K14, K15, K16, K17, K18, L9, L10, L11, L12, L13, L14, L15, L16, L17, L18, M9, M10, M11, M12, M13, M14, M15, M16, M17, M18, N9, N10, N11, N12, N13, N14, N15, N16, N17, N18, P9, P10, P11, P12, P13, P14, P15, P16, P17, P18, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, U9, U10, U11, U12, U13, U14, U15, U16, U17, U18, V9, V10, V11, V12, V13, V14, V15, V16, V17, V18	P	VSS: Ground 0 (zero) volts reference.
NC	A5, D7, A20, A23, AA25, AC8, AC17, AC22, AD2, AD4, AD10, AD13, AD23, AD25, AE3, AE8, AE19, AE20, AE24, AF8, AF17, B3, B4, B10, B22, B24, C2, C9, C12, C21, C23, C25, D1, D2, D3, D11, D13, D15, D16, D20, D24, E1, E4, E6, E7, E16, E20, E23, E25, F5, F22, F23, G2, J23, L2, M3, M24, N23, P25, R4, R23, U5, W2, W24, Y1, Y25		No Connect: NC leads are not to be connected, not even to another NC lead, but must be left floating. Connection of NC leads may impair performance or cause damage to the device. Some NC leads may be assigned functions in future upgrades of the device. Backwards compatibility of the upgraded device in existing applications may rely upon these leads having been left floating.

Proprietary TranSwitch Corporation Information for use Solely by its Customers

RESET AND TEST LEADS (INCLUDING TEST ACCESS PORT FOR BOUNDARY SCAN)

Symbol	Lead No.	I/O	Type	Name/Function
TDO	D21	O(T)	CMOS 4 mA	Test Data Output: Boundary scan output for data and test instructions from internal test registers.
$\overline{\text{TRST}}$	C22	I	LVTTLpu	Test Mode Reset: A 1 microsecond (minimum) low on this lead resets the boundary scan; recommended for use after power-up initialization as well. This lead should be held low whenever boundary scan operations are not being performed.
TMS	B23	I	LVTTLpu	Test Mode Select: Boundary scan test mode select. This signal must be pulled high. 4.7k Ω pull-up recommended.
TDI	E21	I	LVTTLpu	Test Data Input: Boundary scan input for data and test instructions. 4.7k Ω pull-up recommended.
TCK	D22	I	LVTTLpu	Test Clock: Boundary scan clock. Input signals are clocked in on its rising edge.
$\overline{\text{RESET}}$	B16	I	LVTLL	Hardware Reset: An active low pulse with minimum width of 1 ms which must be applied after power is applied to reset all registers, counters, and FIFOs. The reset is asynchronous going into the reset state, but requires all external clocks to be active and stable during the reset state.
$\overline{\text{TSTMODE}}$	A17	I	LVTTL	Test Mode: For TranSwitch testing purposes only. Tie to V_{DD33} . Active low to enable device test.
SCAN	C16	I	LVTTL	SCAN Test: For TranSwitch testing purposes only. Tie to V_{SS} . Active high to enable device internal scan test.
TEST1	B17	I	LVTTL	Test1: For TranSwitch testing purposes only. Tie to V_{SS} .
$\overline{\text{DEVHIZ}}$	C17	I	LVTTL	Device High Impedance: Active low to set all outputs (except TDO) to high impedance state. Tie to V_{DD33} .

INTEL/MOTOROLA HOST INTERFACE

Symbol	Lead No.	I/O/P*	Type	Name/Function
UPCLK	C15	I	LVTTL	Microprocessor Clock: This clock should come from the microprocessor being interfaced to this device. For Intel and Motorola modes, it is recommended that this lead be connected to the microprocessor bus clock. In Motorola mode, this clock must be synchronous to the microprocessor bus clock. Maximum frequency of 66 MHz, minimum frequency of 33 MHz.
$\overline{\text{CS}}$	A4	I	LVTTL	Chip Select: Chip select lead from Host. Active low assertion.
$\overline{\text{DTACK}}$	A16	O	CMOS 24 mA	Transfer Acknowledge: Active low signal indicating normal completion of the bus transfer. This output requires an external pull-up resistor. Note: Device asserts this high before tri-stating to improve acknowledge timing.
UPA14 UPA13 UPA12 UPA11 UPA10 UPA9 UPA8 UPA7 UPA6 UPA5 UPA4 UPA3 UPA2 UPA1 UPA0	A15 D14 C14 B14 A14 A13 B13 C13 A12 B12 A11 D12 B11 C11 A10	I	LVTTL	Microprocessor Address Bus: 15-bit address bus used by the Host Processor for accessing the Envoy-CE4 for a read/write cycle. UPA14 is the Most Significant Bit (MSB).

Symbol	Lead No.	I/O/P*	Type	Name/Function
UPD15 UPD14 UPD13 UPD12 UPD11 UPD10 UPD9 UPD8 UPD7 UPD6 UPD5 UPD4 UPD3 UPD2 UPD1 UPD0	C10 E11 A9 D10 B9 A8 E10 B8 D9 A7 C8 B7 A6 D8 C7 B6	I/O	LVTTTL/ CMOS 16 mA	Microprocessor Data Bus: Bi-directional 16-bit data bus used for transferring data between the Envoy-CE4 and the Host Processor. UPD15 is the Most Significant Bit (MSB).
WRDS	B5	I	LVTTTL	Write/Transfer Start: In Intel Mode, this pin is used for the Write signal and in Motorola mode, this pin is used for the active low Transfer start signal.
RDWR	C6	I	LVTTTL	Read/Write: In Intel Mode, this pin is used for the Read signal and in Motorola mode, this pin controls type of data transfer (Write = 0/Read = 1).
$\overline{\text{IRQ}}$	B15	O(T)	CMOS 16mA	Interrupt: Active low level-based interrupt to Host processor.

COMMON SMII INTERFACES PINS FOR ALL SMII PORTS (Ports 0 to 31) including extended SMII ports

Symbol	Lead No.	I/O/P*	Type	Name/Function
SSYNCIN	D25	I	LVTTTL	Synchronization Input Pulse: Global input signal that occurs every 10 SMIIREFCLK clock cycles and marks the start of data segments.
SSYNCDIR	E24	I	LVTTTL	Synchronization Pulse Direction: Determines the source of the synchronization pulse. 0 - The synchronization pulse will be taken from an internally generated source 1 - The synchronization pulse to the 8 SMII ports will be taken from SSYNCIN

SMII INTERFACE PINS FOR Configurable MAC A (Ports 0 to 7).**Extended SMII Ports are Ports 0 and 4**

Symbol	Lead No.	I/O/P*	Type	Name/Function
SIIREFCLKA	F1	I	LVTTL	SMII Reference Clock for Configurable MAC A: 125 MHz Clock. Must be active to support the Ethernet statistics registers of CMAC A - even when the CMAC is configured for GMII Mode.
SSYNCOUTA	H4	O	CMOS 12mA	Synchronization Output Pulse for Configurable MAC A: Global output signal that occurs every 10 SIIREFCLKA clock cycles and marks the start of data segments.
TX0A	H3	O	CMOS 12mA	Transmit Data Port 0: SMII port 0 data out signal.
RX0A	G1	I	LVTTL	Receive Data Port 0: SMII port 0 data in signal.
TX1A	J4	O	CMOS 12mA	Transmit Data Port 1: SMII port 1 data out signal.
RX1A	H2	I	LVTTL	Receive Data Port 1: SMII port 1 data in signal.
TX2A	K5	O	CMOS 12mA	Transmit Data Port 2: SMII port 2 data out signal.
RX2A	J3	I	LVTTL	Receive Data Port 2: SMII port 2 data in signal.
TX3A	H1	O	CMOS 12mA	Transmit Data Port 3: SMII port 3 data out signal.
RX3A	J2	I	LVTTL	Receive Data Port 3: SMII port 3 data in signal.
TX4A	K4	O	CMOS 12mA	Transmit Data Port 4: SMII port 4 data out signal.
RX4A	J1	I	LVTTL	Receive Data Port 4: SMII port 4 data in signal.
TX5A	L5	O	CMOS 12mA	Transmit Data Port 5: SMII port 5 data out signal.
RX5A	K3	I	LVTTL	Receive Data Port 5: SMII port 5 data in signal.
TX6A	K2	O	CMOS 12mA	Transmit Data Port 6: SMII port 6 data out signal.
RX6A	L4	I	LVTTL	Receive Data Port 6: SMII port 6 data in signal.
TX7A	K1	O	CMOS 12mA	Transmit Data Port 7: SMII port 7 data out signal.
RX7A	L3	I	LVTTL	Receive Data Port 7: SMII port 7 data in signal.

SMII INTERFACE PINS FOR Configurable MAC B (Ports 8 to 15).
Extended SMII Ports are Ports 8 and 12

Symbol	Lead No.	I/O/P*	Type	Name/Function
SIIREFCLKB	P4	I	LVTTL	SMII Reference Clock for Configurable MAC B: 125 MHz Clock. Must be active to support the Ethernet statistics registers of CMAC B - even when the CMAC is configured for GMII Mode.
SSYNCOUB	P3	O	CMOS 12mA	Synchronization Output Pulse for Configurable MAC B: Global output signal that occurs every 10 SIIREFCLKB clock cycles and marks the start of data segments.
TX0B	R1	O	CMOS 12mA	Transmit Data Port 8: SMII port 8 data out signal.
RX0B	R2	I	LVTTL	Receive Data Port 8: SMII port 8 data in signal.
TX1B	R3	O	CMOS 12mA	Transmit Data Port 9: SMII port 9 data out signal.
RX1B	T1	I	LVTTL	Receive Data Port 9: SMII port 9 data in signal.
TX2B	T2	O	CMOS 12mA	Transmit Data Port 10: SMII port 10 data out signal.
RX2B	T3	I	LVTTL	Receive Data Port 10: SMII port 10 data in signal.
TX3B	U1	O	CMOS 12mA	Transmit Data Port 11: SMII port 11 data out signal.
RX3B	T4	I	LVTTL	Receive Data Port 11: SMII port 11 data in signal.
TX4B	U2	O	CMOS 12mA	Transmit Data Port 12: SMII port 12 data out signal.
RX4B	U3	I	LVTTL	Receive Data Port 12: SMII port 12 data in signal.
TX5B	T5	O	CMOS 12mA	Transmit Data Port 13: SMII port 13 data out signal.
RX5B	V1	I	LVTTL	Receive Data Port 13: SMII port 13 data in signal.
TX6B	U4	O	CMOS 12mA	Transmit Data Port 14: SMII port 14 data out signal.
RX6B	V2	I	LVTTL	Receive Data Port 14: SMII port 14 data in signal.
TX7B	W1	O	CMOS 12mA	Transmit Data Port 15: SMII port 15 data out signal.
RX7B	V3	I	LVTTL	Receive Data Port 15: SMII port 15 data in signal.

SMII INTERFACE PINS FOR Configurable MAC C (Ports 16 to 23).**Extended SMII Ports are Ports 16 and 20**

Symbol	Lead No.	I/O/P*	Type	Name/Function
SIIREFCLKC	G26	I	LVTTL	SMII Reference Clock for Configurable MAC C: 125 MHz Clock. Must be active to support the Ethernet statistics registers of CMAC C - even when the CMAC is configured for GMII Mode.
SSYNOUTC	H24	O	CMOS 12mA	Synchronization Output Pulse for Configurable MAC C: Global output signal that occurs every 10 SIIREFCLKC clock cycles and marks the start of data segments.
TX0C	H25	O	CMOS 12mA	Transmit Data Port 16: SMII port 16 data out signal.
RX0C	K22	I	LVTTL	Receive Data Port 16: SMII port 16 data in signal.
TX1C	J24	O	CMOS 12mA	Transmit Data Port 17: SMII port 17 data out signal.
RX1C	H26	I	LVTTL	Receive Data Port 17: SMII port 17 data in signal.
TX2C	J25	O	CMOS 12mA	Transmit Data Port 18: SMII port 18 data out signal.
RX2C	K23	I	LVTTL	Receive Data Port 18: SMII port 18 data in signal.
TX3C	J26	O	CMOS 12mA	Transmit Data Port 19: SMII port 19 data out signal.
RX3C	L22	I	LVTTL	Receive Data Port 19: SMII port 19 data in signal.
TX4C	K24	O	CMOS 12mA	Transmit Data Port 20: SMII port 20 data out signal.
RX4C	K25	I	LVTTL	Receive Data Port 20: SMII port 20 data in signal.
TX5C	L23	O	CMOS 12mA	Transmit Data Port 21: SMII port 21 data out signal.
RX5C	K26	I	LVTTL	Receive Data Port 21: SMII port 21 data in signal.
TX6C	L24	O	CMOS 12mA	Transmit Data Port 22: SMII port 22 data out signal.
RX6C	L25	I	LVTTL	Receive Data Port 22: SMII port 22 data in signal.
TX7C	M23	O	CMOS 12mA	Transmit Data Port 23: SMII port 23 data out signal.
RX7C	L26	I	LVTTL	Receive Data Port 23: SMII port 23 data in signal.

SMII INTERFACE PINS FOR Configurable MAC D (Ports 24 to 31).
Extended SMII Ports are Ports 24 and 28

Symbol	Lead No.	I/O/P*	Type	Name/Function
SIIREFCLKD	T26	I	LVTTL	SMII Reference Clock for Configurable MAC D: 125 MHz Clock. Must be active to support the Ethernet statistics registers of CMAC D - even when the CMAC is configured for GMII Mode.
SSYNCOUD	R24	O	CMOS 8mA	Synchronization Output Pulse for Configurable MAC D: Global output signal that occurs every 10 SIIREFCLKD clock cycles and marks the start of data segments.
TX0D	T25	O	CMOS 12mA	Transmit Data Port 24: SMII port 24 data out signal.
RX0D	T24	I	LVTTL	Receive Data Port 24: SMII port 24 data in signal.
TX1D	U26	O	CMOS 12mA	Transmit Data Port 25: SMII port 25 data out signal.
RX1D	T23	I	LVTTL	Receive Data Port 25: SMII port 25 data in signal.
TX2D	U25	O	CMOS 12mA	Transmit Data Port 26: SMII port 26 data out signal.
RX2D	U24	I	LVTTL	Receive Data Port 26: SMII port 26 data in signal.
TX3D	T22	O	CMOS 12mA	Transmit Data Port 27: SMII port 27 data out signal.
RX3D	V26	I	LVTTL	Receive Data Port 27: SMII port 27 data in signal.
TX4D	U23	O	CMOS 12mA	Transmit Data Port 28: SMII port 28 data out signal.
RX4D	V25	I	LVTTL	Receive Data Port 28: SMII port 28 data in signal.
TX5D	W26	O	CMOS 12mA	Transmit Data Port 29: SMII port 29 data out signal.
RX5D	V24	I	LVTTL	Receive Data Port 29: SMII port 29 data in signal.
TX6D	U22	O	CMOS 12mA	Transmit Data Port 30: SMII port 30 data out signal.
RX6D	W25	I	LVTTL	Receive Data Port 30: SMII port 30 data in signal.
TX7D	V23	O	CMOS 12mA	Transmit Data Port 31: SMII port 31 data out signal.
RX7D	Y26	I	LVTTL	Receive Data Port 31: SMII port 31 data in signal.

GMII/MII INTERFACE PINS FOR GMII Port 0 (Configurable MAC A)
(SMIREFCLKA must be active)

Symbol	Lead No.	I/O/P*	Type	Name/Function
SMIREFCLKA	F1	I	LVTTL	SMII Reference Clock for Configurable MAC A: 125 MHz Clock. Must be active to support the Ethernet statistics registers of CMAC A - even when the CMAC is configured for GMII Mode.
GATXCLKO	G3	O	CMOS 16mA	GMII A Transmit Clock Output: 125 MHz output clock to which Data, Enable, and Error output signals are synchronized.
GATXCLKI	C4	I	LVTTL	GMII A Transmit Clock: 125 MHz input clock
GARXCLK	E3	I	LVTTL	GMII A Receive Clock: 125 MHz input clock
GATXEN	F4	O	CMOS 8mA	GMII A Transmit Enable: This active high output signal is asserted to indicate that valid data is present on the Data outputs.
GATXER	G5	O	CMOS 8mA	GMII A Transmit Error: This active high output signal is asserted to indicate that a coding violation exists in the output data stream.
GARXDV	G4	I	LVTTL	GMII A Receive Data Valid: This active high input signal is asserted to indicate that valid data is present on the input data leads.
GARXER	F2	I	LVTTL	GMII A Receive Error: This active high input signal is asserted to indicate that an error was detected in the incoming data stream.
TX0A	H3	O	CMOS 12mA	Transmit Data Port 0A: Bit 0 (LSB) of 8-bit GMII A Transmit Interface in GMII mode or Bit 0 of 4-bit MII A Transmit interface.
RX0A	G1	I	LVTTL	Receive Data Port 0A: Bit 0 (LSB) of 8-bit GMII A Receive Interface in GMII mode or Bit 0 of 4-bit MII A Receive interface.
TX1A	J4	O	CMOS 12mA	Transmit Data Port 1A: Bit 1 of 8-bit GMII A Transmit Interface in GMII mode or Bit 1 of 4-bit MII A Transmit interface.
RX1A	H2	I	LVTTL	Receive Data Port 1A: Bit 1 of 8-bit GMII A Receive Interface in GMII mode or Bit 1 of 4-bit MII A Receive interface.
TX2A	K5	O	CMOS 12mA	Transmit Data Port 2A: Bit 2 of 8-bit GMII A Transmit Interface in GMII mode or Bit 2 of 4-bit MII A Transmit interface.
RX2A	J3	I	LVTTL	Receive Data Port 2A: Bit 2 of 8-bit GMII A Receive Interface in GMII mode or Bit 2 of 4-bit MII A Receive interface.

Symbol	Lead No.	I/O/P*	Type	Name/Function
TX3A	H1	O	CMOS 12mA	Transmit Data Port 3A: Bit 3 of 8-bit GMII A Transmit Interface in GMII mode or Bit 3 of 4-bit MII A Transmit interface.
RX3A	J2	I	LVTTL	Receive Data Port 3A: Bit 3 of 8-bit GMII A Receive Interface in GMII mode or Bit 3 of 4-bit MII A Receive interface.
TX4A	K4	O	CMOS 12mA	Transmit Data Port 4A: Bit 4 of 8-bit GMII A Transmit Interface in GMII mode.
RX4A	J1	I	LVTTL	Receive Data Port 4A: Bit 4 of 8-bit GMII A Receive Interface in GMII mode.
TX5A	L5	O	CMOS 12mA	Transmit Data Port 5A: Bit 5 of 8-bit GMII A Transmit Interface in GMII mode.
RX5A	K3	I	LVTTL	Receive Data Port 5A: Bit 5 of 8-bit GMII A Receive Interface in GMII mode.
TX6A	K2	O	CMOS 12mA	Transmit Data Port 6A: Bit 6 of 8-bit GMII A Transmit Interface in GMII mode.
RX6A	L4	I	LVTTL	Receive Data Port 6A: Bit 6 of 8-bit GMII A Receive Interface in GMII mode.
TX7A	K1	O	CMOS 12mA	Transmit Data Port 7A: Bit 7 (MSB) of 8-bit GMII A Transmit Interface in GMII mode.
RX7A	L3	I	LVTTL	Receive Data Port 7A: Bit 7 (MSB) of 8-bit GMII A Receive Interface in GMII mode.
GACOL	F3	I	LVTTL	GMII A (MII Mode) Collision: This active high input signal is the collision lead used in MII mode for the GMII A interface.
GACRS	E2	I	LVTTL	GMII A (MII Mode) Carrier Sense: This active high input signal is the carrier sense lead used in MII mode for the GMII A interface.
GAMTXCLK	D5	I	LVTTL	GMII A (MII Mode) TXCLK: This is the TXCLK signal used in MII mode for the GMII A interface.

**GMII/MII INTERFACE PINS FOR GMII Port 8 (Configurable MAC B)
(SMIREFCLKB must be active)**

Symbol	Lead No.	I/O/P*	Type	Name/Function
SMIREFCLKB	P4	I	LVTTL	SMII Reference Clock for Configurable MAC B: 125 MHz Clock. Must be active to support the Ethernet statistics registers of CMAC B - even when the CMAC is configured for GMII Mode.
GBTXCLKO	P2	O	CMOS 16mA	GMII B Transmit Clock Output: 125 MHz output clock to which Data, Enable, and Error output signals are synchronized.
GBTXCLKI	L1	I	LVTTL	GMII B Transmit Clock: 125 MHz input clock
GBRXCLK	M2	I	LVTTL	GMII B Receive Clock: 125 MHz input clock
GBTXEN	M1	O	CMOS 8mA	GMII B Transmit Enable: This active high output signal is asserted to indicate that valid data is present on the Data outputs.
GBTXER	N4	O	CMOS 8mA	GMII B Transmit Error: This active high output signal is asserted to indicate that a coding violation exists in the output data stream.
GBRXDV	N1	I	LVTTL	GMII B Receive Data Valid: This active high input signal is asserted to indicate that valid data is present on the input data leads.
GBRXER	P1	I	LVTTL	GMII B Receive Error: This active high input signal is asserted to indicate that an error was detected in the incoming data stream.
TX0B	R1	O	CMOS 12mA	Transmit Data Port 0B: Bit 0 (LSB) of 8-bit GMII B Transmit Interface in GMII mode or Bit 0 of 4-bit MII B Transmit interface.
RX0B	R2	I	LVTTL	Receive Data Port 0B: Bit 0 (LSB) of 8-bit GMII B Receive Interface in GMII mode or Bit 0 of 4-bit MII B Receive interface.
TX1B	R3	O	CMOS 12mA	Transmit Data Port 1B: Bit 1 of 8-bit GMII B Transmit Interface in GMII mode or Bit 1 of 4-bit MII B Transmit interface.
RX1B	T1	I	LVTTL	Receive Data Port 1B: Bit 1 of 8-bit GMII B Receive Interface in GMII mode or Bit 1 of 4-bit MII B Receive interface.
TX2B	T2	O	CMOS 12mA	Transmit Data Port 2B: Bit 2 of 8-bit GMII B Transmit Interface in GMII mode or Bit 2 of 4-bit MII B Transmit interface.
RX2B	T3	I	LVTTL	Receive Data Port 2B: Bit 2 of 8-bit GMII B Receive Interface in GMII mode or Bit 2 of 4-bit MII B Receive interface.

Symbol	Lead No.	I/O/P*	Type	Name/Function
TX3B	U1	O	CMOS 12mA	Transmit Data Port 3B: Bit 3 of 8-bit GMII B Transmit Interface in GMII mode or Bit 3 of 4-bit MII B Transmit interface.
RX3B	T4	I	LVTTL	Receive Data Port 3B: Bit 3 of 8-bit GMII B Receive Interface in GMII mode or Bit 3 of 4-bit MII B Receive interface.
TX4B	U2	O	CMOS 12mA	Transmit Data Port 4B: Bit 4 of 8-bit GMII B Transmit Interface in GMII mode.
RX4B	U3	I	LVTTL	Receive Data Port 4B: Bit 4 of 8-bit GMII B Receive Interface in GMII mode.
TX5B	T5	O	CMOS 12mA	Transmit Data Port 5B: Bit 5 of 8-bit GMII B Transmit Interface in GMII mode.
RX5B	V1	I	LVTTL	Receive Data Port 5B: Bit 5 of 8-bit GMII B Receive Interface in GMII mode.
TX6B	U4	O	CMOS 12mA	Transmit Data Port 6B: Bit 6 of 8-bit GMII B Transmit Interface in GMII mode.
RX6B	V2	I	LVTTL	Receive Data Port 6B: Bit 6 of 8-bit GMII B Receive Interface in GMII mode.
TX7B	W1	O	CMOS 12mA	Transmit Data Port 7B: Bit 7 (MSB) of 8-bit GMII B Transmit Interface in GMII mode.
RX7B	V3	I	LVTTL	Receive Data Port 7B: Bit 7 (MSB) of 8-bit GMII B Receive Interface in GMII mode.
GBCOL	N2	I	LVTTL	GMII B (MII Mode) Collision: This active high input signal is the collision lead used in MII mode for the GMII B interface.
GBCRS	N3	I	LVTTL	GMII B (MII Mode) Carrier Sense: This active high input signal is the carrier sense lead used in MII mode for the GMII B interface.
GBMTXCLK	M4	I	LVTTL	GMII B (MII Mode) TXCLK: This is the TXCLK signal used in MII mode for the GMII B interface.

**GMII/MII INTERFACE PINS FOR GMII Port 16 (Configurable MAC C)
(SMIREFCLKC must be active)**

Symbol	Lead No.	I/O/P*	Type	Name/Function
SMIREFCLKC	G26	I	LVTTL	SMII Reference Clock for Configurable MAC C: 125 MHz Clock. Must be active to support the Ethernet statistics registers of CMAC C - even when the CMAC is configured for GMII Mode.
GCTXCLKO	G25	O	CMOS 16mA	GMII C Transmit Clock Output: 125 MHz output clock to which Data, Enable, and Error output signals are synchronized.
GCTXCLKI	D26	I	LVTTL	GMII C Transmit Clock: 125 MHz input clock
GCRXCLK	F24	I	LVTTL	GMII C Receive Clock: 125 MHz input clock
GCTXEN	G23	O	CMOS 8mA	GMII C Transmit Enable: This active high output signal is asserted to indicate that valid data is present on the Data outputs.
GCTXER	E26	O	CMOS 8mA	GMII C Transmit Error: This active high output signal is asserted to indicate that a coding violation exists in the output data stream.
GCRXDV	H23	I	LVTTL	GMII C Receive Data Valid: This active high input signal is asserted to indicate that valid data is present on the input data leads.
GCRXER	F26	I	LVTTL	GMII C Receive Error: This active high input signal is asserted to indicate that an error was detected in the incoming data stream.
TX0C	H25	O	CMOS 12mA	Transmit Data Port 0C: Bit 0 (LSB) of 8-bit GMII C Transmit Interface in GMII mode or Bit 0 of 4-bit MII C Transmit interface.
RX0C	K22	I	LVTTL	Receive Data Port 0C: Bit 0 (LSB) of 8-bit GMII C Receive Interface in GMII mode or Bit 0 of 4-bit MII C Receive interface.
TX1C	J24	O	CMOS 12mA	Transmit Data Port 1C: Bit 1 of 8-bit GMII C Transmit Interface in GMII mode or Bit 1 of 4-bit MII C Transmit interface.
RX1C	H26	I	LVTTL	Receive Data Port 1C: Bit 1 of 8-bit GMII C Receive Interface in GMII mode or Bit 1 of 4-bit MII C Receive interface.
TX2C	J25	O	CMOS 12mA	Transmit Data Port 2C: Bit 2 of 8-bit GMII C Transmit Interface in GMII mode or Bit 2 of 4-bit MII C Transmit interface.
RX2C	K23	I	LVTTL	Receive Data Port 2C: Bit 2 of 8-bit GMII C Receive Interface in GMII mode or Bit 2 of 4-bit MII C Receive interface.

Symbol	Lead No.	I/O/P*	Type	Name/Function
TX3C	J26	O	CMOS 12mA	Transmit Data Port 3C: Bit 3 of 8-bit GMII C Transmit Interface in GMII mode or Bit 3 of 4-bit MII C Transmit interface.
RX3C	L22	I	LVTTL	Receive Data Port 3C: Bit 3 of 8-bit GMII C Receive Interface in GMII mode or Bit 3 of 4-bit MII C Receive interface.
TX4C	K24	O	CMOS 12mA	Transmit Data Port 4C: Bit 4 of 8-bit GMII C Transmit Interface in GMII mode.
RX4C	K25	I	LVTTL	Receive Data Port 4C: Bit 4 of 8-bit GMII C Receive Interface in GMII mode.
TX5C	L23	O	CMOS 12mA	Transmit Data Port 5C: Bit 5 of 8-bit GMII C Transmit Interface in GMII mode.
RX5C	K26	I	LVTTL	Receive Data Port 5C: Bit 5 of 8-bit GMII C Receive Interface in GMII mode.
TX6C	L24	O	CMOS 12mA	Transmit Data Port 6C: Bit 6 of 8-bit GMII C Transmit Interface in GMII mode.
RX6C	L25	I	LVTTL	Receive Data Port 6C: Bit 6 of 8-bit GMII C Receive Interface in GMII mode.
TX7C	M23	O	CMOS 12mA	Transmit Data Port 7C: Bit 7 (MSB) of 8-bit GMII C Transmit Interface in GMII mode.
RX7C	L26	I	LVTTL	Receive Data Port 7C: Bit 7 (MSB) of 8-bit GMII C Receive Interface in GMII mode.
GCCOL	G24	I	LVTTL	GMII C (MII Mode) Collision: This active high input signal is the collision pin used in MII mode for the GMII C interface.
GCCRS	F25	I	LVTTL	GMII C (MII Mode) Carrier Sense: This active high input signal is the carrier sense pin used in MII mode for the GMII C interface.
GCMTXCLK	G22	I	LVTTL	GMII C (MII Mode) TXCLK: This is the TXCLK signal used in MII mode for the GMII C interface.

**GMII/MII INTERFACE PINS FOR GMII Port 24 (Configurable MAC D)
(SMIREFCLKD must be active)**

Symbol	Lead No.	I/O/P*	Type	Name/Function
SMIREFCLKD	T26	I	LVTTL	SMII Reference Clock for Configurable MAC D: 125 MHz Clock. Must be active to support the Ethernet statistics registers of CMAC D - even when the CMAC is configured for GMII Mode.
GDTXCLKO	R25	O	CMOS 16mA	GMII D Transmit Clock Output: 125 MHz output clock to which Data, Enable, and Error output signals are synchronized.
GDTXCLKI	M26	I	LVTTL	GMII D Transmit Clock: 125 MHz input clock
GDRXCLK	N24	I	LVTTL	GMII D Receive Clock: 125 MHz input clock
GDTXEN	N25	O	CMOS 8mA	GMII D Transmit Enable: This active high output signal is asserted to indicate valid data that is present on the Data outputs.
GDTXER	N26	O	CMOS 8mA	GMII D Transmit Error: This active high output signal is asserted to indicate that a coding violation exists in the output data stream.
GDRXDV	P23	I	LVTTL	GMII D Receive Data Valid: This active high input signal is asserted to indicate that valid data is present on the input data leads.
GDRXER	R26	I	LVTTL	GMII D Receive Error: This active high input signal is asserted to indicate that an error was detected in the incoming data stream.
TX0D	T25	O	CMOS 12mA	Transmit Data Port 0D: Bit 0 (LSB) of 8-bit GMII D Transmit Interface in GMII mode or Bit 0 of 4-bit MII D Transmit interface.
RX0D	T24	I	LVTTL	Receive Data Port 0D: Bit 0 (LSB) of 8-bit GMII D Receive Interface in GMII mode or Bit 0 of 4-bit MII D Receive interface.
TX1D	U26	O	CMOS 12mA	Transmit Data Port 1D: Bit 1 of 8-bit GMII D Transmit Interface in GMII mode or Bit 1 of 4-bit MII D Transmit interface.
RX1D	T23	I	LVTTL	Receive Data Port 1D: Bit 1 of 8-bit GMII D Receive Interface in GMII mode or Bit 1 of 4-bit MII D Receive interface.
TX2D	U25	O	CMOS 12mA	Transmit Data Port 2D: Bit 2 of 8-bit GMII D Transmit Interface in GMII mode or Bit 2 of 4-bit MII D Transmit interface.
RX2D	U24	I	LVTTL	Receive Data Port 2D: Bit 2 of 8-bit GMII D Receive Interface in GMII mode or Bit 2 of 4-bit MII D Receive interface.

Symbol	Lead No.	I/O/P*	Type	Name/Function
TX3D	T22	O	CMOS 12mA	Transmit Data Port 3D: Bit 3 of 8-bit GMII D Transmit Interface in GMII mode or Bit 3 of 4-bit MII D Transmit interface.
RX3D	V26	I	LVTTL	Receive Data Port 3D: Bit 3 of 8-bit GMII D Receive Interface in GMII mode or Bit 3 of 4-bit MII D Receive interface.
TX4D	U23	O	CMOS 12mA	Transmit Data Port 4D: Bit 4 of 8-bit GMII D Transmit Interface in GMII mode.
RX4D	V25	I	LVTTL	Receive Data Port 4D: Bit 4 of 8-bit GMII D Receive Interface in GMII mode.
TX5D	W26	O	CMOS 12mA	Transmit Data Port 5D: Bit 5 of 8-bit GMII D Transmit Interface in GMII mode.
RX5D	V24	I	LVTTL	Receive Data Port 5D: Bit 5 of 8-bit GMII D Receive Interface in GMII mode.
TX6D	U22	O	CMOS 12mA	Transmit Data Port 6D: Bit 6 of 8-bit GMII D Transmit Interface in GMII mode.
RX6D	W25	I	LVTTL	Receive Data Port 6D: Bit 6 of 8-bit GMII D Receive Interface in GMII mode.
TX7D	V23	O	CMOS 12mA	Transmit Data Port 7D: Bit 7 (MSB) of 8-bit GMII D Transmit Interface in GMII mode.
RX7D	Y26	I	LVTTL	Receive Data Port 7D: Bit 7 (MSB) of 8-bit GMII D Receive Interface in GMII mode.
GDCOL	P24	I	LVTTL	GMII D (MII Mode) Collision: This active high input signal is the collision pin used in MII mode for the GMII D interface.
GDCRS	P26	I	LVTTL	GMII D (MII Mode) Carrier Sense: This active high input signal is the carrier sense pin used in MII mode for the GMII D interface.
GDMTXCLK	M25	I	LVTTL	GMII D (MII Mode) TXCLK: This is the TXCLK signal used in MII mode for the GMII D interface.

Note: The GMII is a 3.3 V interface that will only work with a 3.3 V PHY device.

MII MANAGEMENT PINS

Symbol	Lead No.	I/O/P*	Type	Name/Function
MDC	C5	O	CMOS 16mA	Management Data Interface Clock: Management data (MDIO signal) is clocked into and out of the device on the rising edge of this clock.
MDIO	D6	I/O	LVTTL/ CMOS 16mA	Management Data I/O: I/O data lead for the IEEE 802.3u compliant management and status interface.

SPI-3 INTERFACE - Data Input

Symbol	Lead No.	I/O/P*	Type	Name/Function
ISPICLK	AC13	I	LVTTL	SPI-3 Input Clock: Maximum of 125 MHz.
ISPID31	AD7	I	LVTTL	SPI-3 Input Data Bus: 32-bit bus used to receive data from the Link or PHY Layer device. 8-bit SPI-3 Mode: ISPID(7-0); ISPID7 is MSB. 16-bit SPI-3 Mode: ISPID(15-0); ISPID15 is MSB. 32-bit SPI-3 Mode: ISPID(31-0); ISPID31 is MSB.
ISPID30	AE6			
ISPID29	AF5			
ISPID28	AC7			
ISPID27	AD6			
ISPID26	AE5			
ISPID25	AF4			
ISPID24	AB7			
ISPID23	AC6			
ISPID22	AD5			
ISPID21	AE4			
ISPID20	AB6			
ISPID19	AC5			
ISPID18	AC3			
ISPID17	AB4			
ISPID16	AA5			
ISPID15	AC2			
ISPID14	AB3			
ISPID13	AA4			
ISPID12	Y5			
ISPID11	AC1			
ISPID10	AB2			
ISPID9	AA3			
ISPID8	Y4			
ISPID7	AB1			
ISPID6	AA2			
ISPID5	Y3			
ISPID4	W4			
ISPID3	AA1			
ISPID2	Y2			
ISPID1	W3			
ISPID0	V4			
ISPIPTY	AF6	I	LVTTL	SPI-3 Input Bus Parity: This input signal indicates the parity calculated over the ISPID(31-0) bus, when start of transfer or read (Link layer mode)/write (PHY layer mode) enable signals are asserted.

Symbol	Lead No.	I/O/P*	Type	Name/Function
ISPIMOD1 ISPIMOD0	AD8 AE7	I	LVTTL	SPI-3 Input Data Word Modulo: These 2 inputs indicate the number of valid data bytes in ISPID(31-0). The ISPIMOD bus should always be all zero, except during the last double-word transfer of a frame on ISPID(31-0). 00 - ISPID(31-0) Valid 01 - ISPID(31-8) Valid 10 - ISPID(31-16) Valid 11 - ISPID(31-24) Valid
ISPISOP	AF7	I	LVTTL	SPI-3 Input Start of Frame: This active high input is used to delineate the frame boundaries on the ISPID(31-0) bus. When ISPISOP is high, the start of the frame is present on ISPID(31-0).
ISPIEOP	AC9	I	LVTTL	SPI-3 Input End of Frame: This input signal is used to delineate the frame boundaries on the ISPID(31-0) bus. When high, the end of the frame is present on ISPID(31-0).
ISPIERR	AB10	I	LVTTL	SPI-3 Input Error Indicator: This active high input signal is used to indicate that the current frame should be discarded.
ISPITSX	AE9	I	LVTTL	SPI-3 Input PHY Mode Transmit Start of Transfer: This active high input signal indicates when the inbound port address is present on ISPID(31-0).
ISPITENB	AD9	I	LVTTL	SPI-3 Input PHY Mode Transmit Write Enable: This active low input signal is used to control the flow of data to the transmit FIFOs.
ISPITADR7 ISPITADR6 ISPITADR5 ISPITADR4 ISPITADR3 ISPITADR2 ISPITADR1 ISPITADR0	AE11 AD11 AF10 AC11 AE10 AB11 AF9 AC10	I	LVTTL	SPI-3 Input PHY Mode Transmit Address: 8-bit bus containing the PHY address. ISPITADR7 is MSB.
ISPISTPA	AC12	O	CMOS 12mA	SPI-3 Input PHY Mode Selected Transmit Packet Available: Active high output used to indicate that space is available in the Egress FIFO specified on the inbound address on ISPID(31-0). This signal is used only for byte level flow control.
ISPIPTPA	AF11	O	CMOS 12mA	SPI-3 Input PHY Mode Polled Transmit Packet Available: Active high output used to indicate that space is available in the polled Egress FIFO. This signal is used only for packet level flow control.

Envoy-CE4 Device

DATA SHEET

TXC-06885



- Technical Characteristics -

Symbol	Lead No.	I/O/P*	Type	Name/Function
$\overline{\text{ISPIREN}}\text{B}$	AD12	O	CMOS 12mA	SPI-3 Input Link Mode Receive Read Enable: Active low signal used as read enable.
ISPIRVAL	AE12	I	LVTTL	SPI-3 Input Link Mode Receive Data Valid: Signal indicating valid data on the data bus ISPID(31-0)
ISPIRSX	AF12	I	LVTTL	SPI-3 Input Link Mode Receive Start of Transfer: Signal indicating start of data transfer in Link layer mode.

SPI-3 INTERFACE - Data Out

Symbol	Lead No.	I/O/P*	Type	Name/Function
OSPICK	AE22	I	LVTTL	SPI-3 Output Clock: Minimum of 50 MHz and maximum of 125 MHz for SPI-3 emulation.
OSPID31 OSPID30 OSPID29 OSPID28 OSPID27 OSPID26 OSPID25 OSPID24 OSPID23 OSPID22 OSPID21 OSPID20 OSPID19 OSPID18 OSPID17 OSPID16 OSPID15 OSPID14 OSPID13 OSPID12 OSPID11 OSPID10 OSPID9 OSPID8 OSPID7 OSPID6 OSPID5 OSPID4 OSPID3 OSPID2 OSPID1 OSPID0	AD21 AC20 AF22 AE21 AD20 AC19 AF21 AD19 AF20 AC18 AB17 AD18 AF19 AE18 AF18 AB16 AD17 AE17 AC16 AD16 AE16 AC15 AF16 AD15 AE15 AF15 AC14 AD14 AE14 AF14 AF13 AE13	O	CMOS 12mA	SPI-3 Output Data Bus: 32-bit bus used to transmit data to the Link Layer device. 8-bit SPI-3 Mode: OSPID(7-0); OSPID7 is MSB. 16-bit SPI-3 Mode: OSPID(15-0); OSPID15 is MSB. 32-bit SPI-3 Mode: OSPID(31-0); OSPID31 is MSB.

Proprietary TranSwitch Corporation Information for use Solely by its Customers

Symbol	Lead No.	I/O/P*	Type	Name/Function
OSPIPRTY	Y22	O	CMOS 12mA	SPI-3 Output Bus Parity: This output signal indicates the parity calculated over OSPID(31-0) bus.
OSPIMOD1 OSPIMOD0	AB25 AC26	O	CMOS 12mA	SPI-3 Output Data Word Modulo: These 2 inputs indicate the number of valid data bytes in OSPID(31-0). The OSPIMOD bus should always be all zero, except during the last double-word transfer of a frame on OSPID(31-0). 00 - OSPID(31-0) Valid 01 - OSPID(31-8) Valid 10 - OSPID(31-16) Valid 11 - OSPID(31-24) Valid
OSPISOP	AA24	O	CMOS 12mA	SPI-3 Output Start of Frame: This active high input is used to delineate the frame boundaries on the OSPID(31-0) bus. When OSPISOP is high, the start of the frame is present on OSPID(31-0).
OSPIEOP	Y23	O	CMOS 12mA	SPI-3 Output End of Frame: This output signal is used to delineate the frame boundaries on the OSPID(31-0) bus. When OSPIEOP is high, the end of the frame is present on OSPID(31-0).
OSPIERR	AB26	O	CMOS 12mA	SPI-3 Output Error Indicator: This active high output signal is used to indicate that the current frame is aborted and should be discarded.
OSPIRSX	AA26	O	CMOS 12mA	SPI-3 Output PHY Mode Receive Start of Transfer: This active high output signal indicates when the in-bound port address is present on OSPID(31-0).
$\overline{\text{OSPIREN B}}$	Y24	I	LVTTL	SPI-3 Output PHY Mode Receive Read Enable: This active low input signal is used to control the flow of data from the Ingress FIFOs.
OSPIRVAL	W23	O	CMOS 12mA	SPI-3 Output PHY Mode Receive Data Valid: Active high output signal that validates the OSPID(31-0), OSPIPRTY, OSPIMOD(1-0), OSPISOP, OSPIEOP, and OSPIERR signals. OSPIRVAL will transition low when the receive FIFO is empty or at the end of a frame.
$\overline{\text{OSPITEN B}}$	AA22	O	CMOS 12mA	SPI-3 Output Link Mode Transmit Write Enable: Active low write enable signal.
OSPITADR7 OSPITADR6 OSPITADR5 OSPITADR4 OSPITADR3 OSPITADR2 OSPITADR1 OSPITADR0	AB23 AC24 AB21 AE23 AD22 AC21 AB20 AF23	O	CMOS 12mA	SPI-3 Output Link Mode Transmit Address: Address in Link mode for addressing Multiple PHY devices. OSPITADR7 is MSB.

Envoy-CE4 Device

DATA SHEET

TXC-06885



- Technical Characteristics -

Symbol	Lead No.	I/O/P*	Type	Name/Function
OSPITSX	AA23	O	CMOS 12mA	SPI-3 Output Link Mode Transmit Start of Transfer: Signal indicating start of data transfer
OSPISTPA	AB24	I	LVTTL	SPI-3 Output Link Mode Selected Transmit Packet Available: Signal indicating packet available status from the selected PHY layer device. This signal is used only for byte level transfer mode.
OSPIPTPA	AC25	I	LVTTL	SPI-3 Output Link Mode Polled Transmit Packet Available: Signal indicating packet available status from the PHY layer device whose address is indicated on address bus OSPITADR(7-0). This signal is used only for packet level transfer mode.

CONFIGURATION PINS

Symbol	Lead No.	I/O/P*	Type	Name/Function
CFGUPBW	B18	I	LVTTL	Host Bus Width: Host I/F bus width select. 0 - 16 bits 1 - 8 bits
CFGOSPIMD	A19	I	LVTTL	SPI-3 Output Mode Select: Output SPI-3 mode select. 0 - SPI-3 in Slave mode 1 - SPI-3 in Master mode
CFGISPIMD	C18	I	LVTTL	SPI-3 Input Mode Select: Input SPI-3 mode select. 0 - SPI-3 in Slave mode 1 - SPI-3 in Master mode
CFGSPIBW1 CFGSPIBW0	B19 E17	I	LVTTL	SPI-3 Data Bus Width: SPI-3 Data Bus Width select. 00 - 32-bit mode 01 - 16-bit mode 10 - 8-bit mode 11 - Reserved
CFGCMACA1 CFGCMACA0	C19 D18	I	LVTTL	Configuration for CMACA (Configurable MAC A) Ports 0 to 7: Ethernet interface mode select 00 - OFF 01 - 1 GMII/MII 10 - 2 Extended SMII 11 - 8 SMII

Proprietary TranSwitch Corporation Information for use Solely by its Customers

Symbol	Lead No.	I/O/P*	Type	Name/Function
CFGCMACB1 CFGCMACB0	A21 B20	I	LVTTL	Configuration for CMACB (Configurable MAC B) Ports 8 to 15: Ethernet interface mode select 00 - OFF 01 - 1 GMII/MII 10 - 2 Extended SMII 11 - 8 SMII
CFGCMACC1 CFGCMACC0	C20 D19	I	LVTTL	Configuration for CMACC (Configurable MAC C) Ports 16 to 23: Ethernet interface mode select 00 - OFF 01 - 1 GMII/MII 10 - 2 Extended SMII 11 - 8 SMII
CFGCMACD1 CFGCMACD0	A22 B21	I	LVTTL	Configuration for CMACD (Configurable MAC D) Ports 24 to 31: Ethernet interface mode select 00 - OFF 01 - 1 GMII/MII 10 - 2 Extended SMII 11 - 8 SMII
CFGUPMD	A18	I	LVTTL	Configuration Pin for selecting Host processor interface mode: 0 - Host Interface in Intel Mode 1 - Host Interface in Motorola Mode

4.0 SELECTED PARAMETER VALUES

4.1 ABSOLUTE MAXIMUM RATINGS AND ENVIRONMENTAL LIMITATIONS

Parameter	Symbol	Min	Max	Unit	Conditions
Core Supply Voltage, +1.8V nominal	V _{DD1.8}	-0.3	2.1	V	Notes 1, 4
I/O Supply Voltage, +3.3V nominal	V _{DD3.3}	-0.3	3.9	V	Notes 1, 4
DC input voltage	V _{IN}	-0.5	5.5	V	Note 5
Storage temperature range	T _S	-55	150	°C	Note 1
Ambient operating temperature	T _A	-40	85	°C	0 ft/min. linear airflow
Moisture Exposure Level	ME	5		Level	Per IPC/JEDEC J-STD-020B
Relative humidity, during assembly	RH	30	60	%	Note 2
Relative humidity, in-circuit	RH	0	100	%	Non-condensing
ESD Classification	ESD	absolute value 2000		V	Note 3
Latch-Up	LU				Meets JEDEC STD-78

Notes:

- Conditions exceeding the Min or Max values may cause permanent failure. Exposure to conditions near the Min or Max values for extended periods may impair device reliability.
- Pre-assembly storage in non-drypack conditions is not recommended. Please refer to the instructions on the "CAUTION" label on the drypack bag in which devices are supplied.
- Test method for ESD per JEDEC JESD22-A114-B.
- Device core is 1.8V only.
- Envoy-CE4 is 5V compatible in the sense that the output logic 1 (VOH) and output logic 0 (VOL) levels of the Envoy-CE4 outputs have been specified at the same voltage levels that have been commonly recognized as logic 1 and logic 0 for the 5V environment. Envoy-CE4 can generally be expected to drive 5V TTL compatible components. However, while Envoy-CE4 outputs are able to meet the minimum input logic switching levels (VIH and VIL) of 5V TTL compatible components, the output logic 1 output voltage of some 5V components may exceed the maximum input voltage of Envoy-CE4. Depending on the technology and circuit implementation, the 5V TTL compatible components may drive their outputs anywhere from 3V to their VDD supply level.

CAUTION: Before connecting a 5V component to the Envoy-CE4, always check to be sure that the Maximum VOH of the 5V device does not exceed the specified Maximum VIN listed in the table above.

4.2 THERMAL CHARACTERISTICS

Parameter	Min	Typ	Max	Unit	Test Conditions
Thermal Resistance: junction to ambient	-	15.6	-	°C/W	Package mounted on 4-layer JEDEC board

4.3 POWER REQUIREMENTS

Parameter	Min	Typ	Max	Unit	Test Conditions
$V_{DD3.3}$	3.15	3.3	3.45	V	
$I_{DD3.3}$	150	155	160	mA	Temp = -40° to +85 °C
$P_{DD3.3}$	0.473	0.512	0.552	W	Temp = -40° to +85 °C
$V_{DD1.8}$	1.71	1.8	1.89	V	
$I_{DD1.8}$	1050	1100	1160	mA	Temp = -40° to +85 °C
$P_{DD1.8}$	1.796	1.980	2.192	W	Temp = -40° to +85 °C
Total Power	2.269	2.492	2.744	W	

4.4 INPUT, OUTPUT AND INPUT/OUTPUT PARAMETERS

4.4.1 Input Parameters For LVTTTL

Parameter	Min	Typ	Max	Unit	Test Conditions
V_{IH}	2.0			V	$3.14 \leq V_{DD33} \leq 3.46$
V_{IL}			0.8	V	$3.14 \leq V_{DD33} \leq 3.46$
Input leakage current	-10		10	μA	$V_{IN} = V_{DD33}$ or V_{SS}
Input capacitance		5		pF	

4.4.2 Input Parameters For LVTTTLpu (internal pull-up resistor)

Parameter	Min	Typ	Max	Unit	Test Conditions
V_{IH}	2.0			V	$3.14 \leq V_{DD33} \leq 3.46$
V_{IL}			0.8	V	$3.14 \leq V_{DD33} \leq 3.46$
Input current	-90		-25	μA	$V_{IN} = V_{SS}$
Input leakage current	-10		10	μA	$V_{IN} = V_{DD33}$
Input capacitance		5		pF	

4.4.3 Output Parameters For CMOS 8mA

Parameter	Min	Typ	Max	Unit	Test Conditions
V _{OH}	2.4			V	I _{OH} = -8 mA
V _{OL}			0.4	V	I _{OL} = 8 mA
I _{OL}			8.0	mA	
I _{OH}			-8.0	mA	
Leakage Tristate	-10		10	μA	

4.4.4 Output Parameters For CMOS 12mA

Parameter	Min	Typ	Max	Unit	Test Conditions
V _{OH}	2.4			V	I _{OH} = -12 mA
V _{OL}		0.2	0.4	V	I _{OL} = 12 mA
I _{OL}			12.0	mA	
I _{OH}			-12.0	mA	
Leakage Tristate	-10		10	μA	

4.4.5 Output Parameters For CMOS 16mA

Parameter	Min	Typ	Max	Unit	Test Conditions
V _{OH}	2.4			V	I _{OH} = -16 mA
V _{OL}		0.2	0.4	V	I _{OL} = 16 mA
I _{OL}			16.0	mA	
I _{OH}			-16.0	mA	
Leakage Tristate	-10		10	μA	

4.4.6 Input/Output Parameters For LVTTL/CMOS 8mA

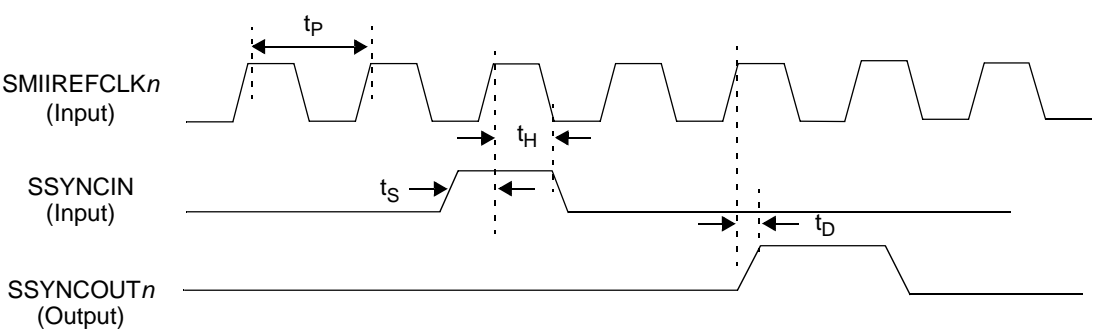
Parameter	Min	Typ	Max	Unit	Test Conditions
V_{IH}	2.0			V	$3.14 \leq V_{DD33} \leq 3.46$
V_{IL}			0.8	V	$3.14 \leq V_{DD33} \leq 3.46$
Input leakage current	-10		10	μA	$V_{DD33} = 3.46$
Input capacitance		5		pF	
V_{OH}	2.4			V	$V_{DD33} = 3.14$; $I_{OH} = -8$ mA
V_{OL}			0.4	V	$V_{DD33} = 3.14$; $I_{OL} = 8$ mA
I_{OL}			8.0	mA	
I_{OH}			-8.0	mA	

4.4.7 Input/Output Parameters For LVTTL/CMOS 16mA

Parameter	Min	Typ	Max	Unit	Test Conditions
V_{IH}	2.0			V	$3.14 \leq V_{DD33} \leq 3.46$
V_{IL}			0.8	V	$3.14 \leq V_{DD33} \leq 3.46$
Input leakage current	-10		10	μA	$V_{DD33} = 3.46$
Input capacitance		5		pF	
V_{OH}	2.4			V	$V_{DD33} = 3.14$; $I_{OH} = -16$ mA
V_{OL}			0.4	V	$V_{DD33} = 3.14$; $I_{OL} = -16$ mA
I_{OL}			16.0	mA	
I_{OH}			-16.0	mA	

5.0 TIMING CHARACTERISTICS

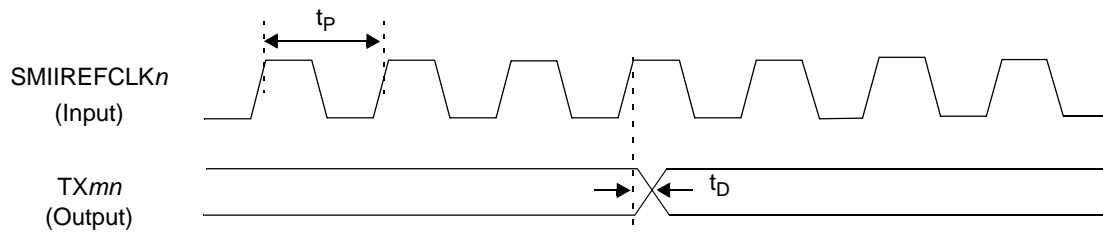
Figure 11. SMI Sync In/Out Timing



$n = A, B, C, D$

Parameter	Symbol	Min	Typ	Max	Unit
SMIREFCLK n period	t_p		8		ns
SMIREFCLK n duty cycle		45		55	%
SSYNCIN setup time to SMIREFCLK n \uparrow	t_s	1.5			ns
SSYNCIN hold time from SMIREFCLK n \uparrow	t_H	1			ns
SSYNCOUT n delay from SMIREFCLK n \uparrow	t_D	1.5		5	ns

Figure 12. SMII Transmit Interface Timing

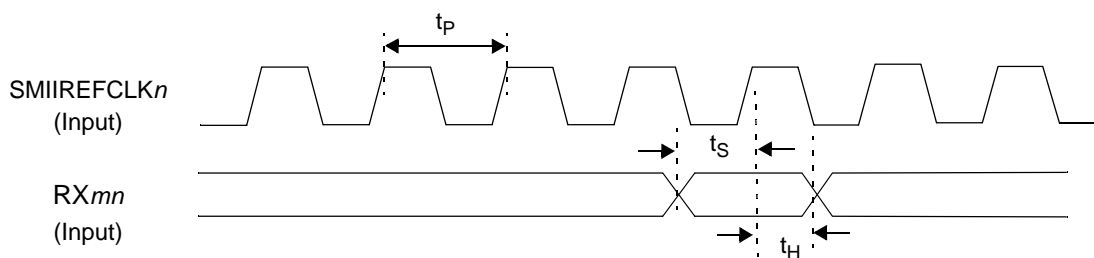


Note: 10 pF Load on All Outputs

$m = 0 \text{ to } 7, n = A, B, C, D$

Parameter	Symbol	Min	Typ	Max	Unit
TXmn delay from SMIREFCLKn \uparrow	t_D	1.5		5	ns

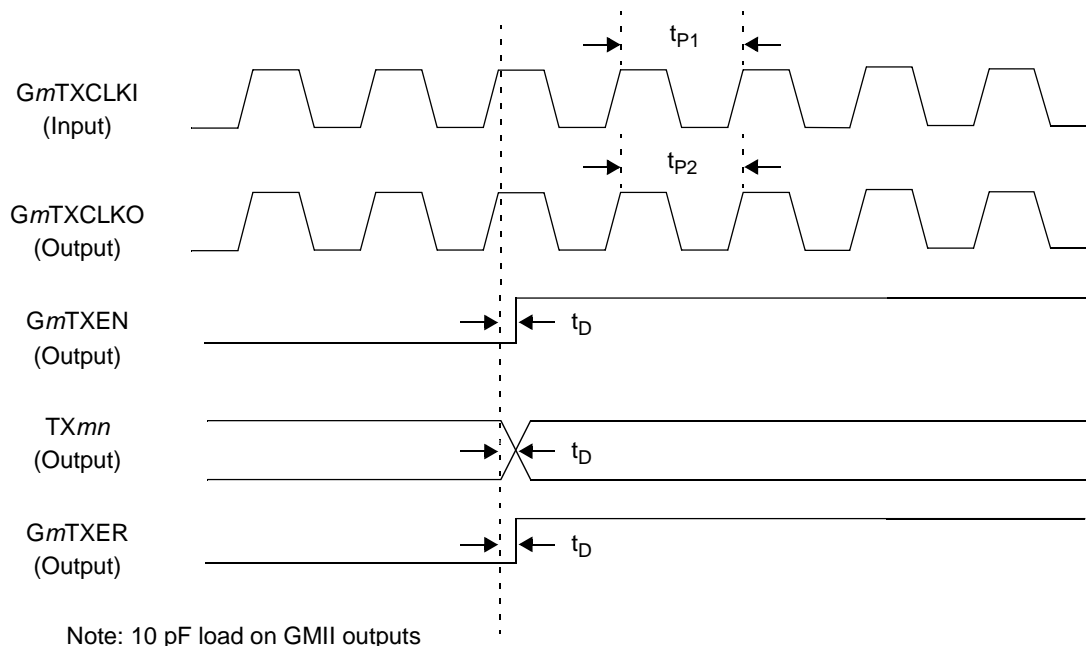
Figure 13. SMII Receive Interface Timing



Parameter	Symbol	Min	Typ	Max	Unit
RXmn setup to SMIREFCLKn \uparrow	t_s	1.5			ns
RXmn hold from SMIREFCLKn \uparrow	t_H	1			ns

$m = 0 \text{ to } 7, n = A, B, C, D$

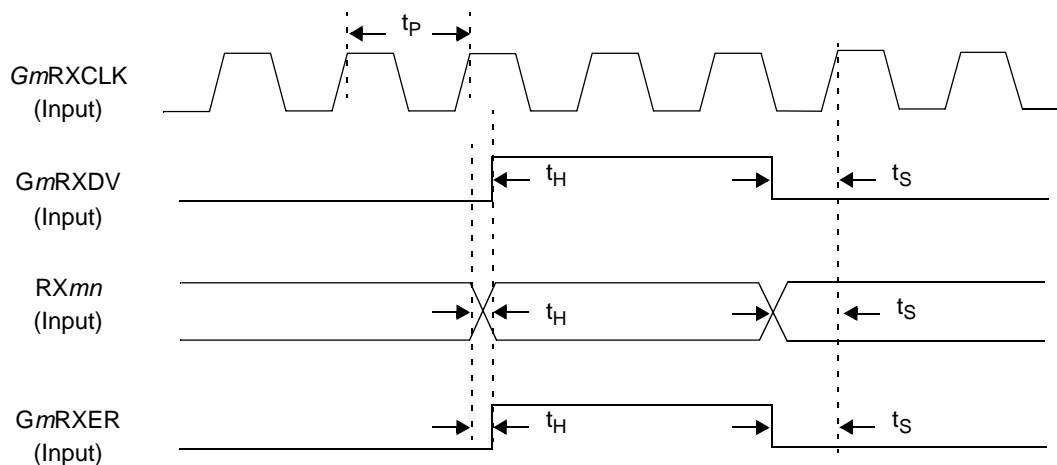
Figure 14. GMII Transmit Interface Timing Using GmTXCLKI



Parameter	Symbol	Min	Typ	Max	Unit
GmTXCLKI duty cycle		45		55	%
GmTXCLKI PERIOD	t_{P1}	7.5		8.5	ns
GmTXCLKO duty cycle		45		55	%
GmTXCLKO period	t_{P2}	7.5		8.5	ns
GmTXCLKO \uparrow (low to high transition time, 10% to 90%)				1	ns
GmTXEN, TXmn, GmTXER delay from GmTXCLKO \uparrow	t_D	0.5		4.5	ns

$m = 0$ to 7, $n = A, B, C, D$

Figure 15. GMII/MII Receive Interface Timing Using GmRXCLK

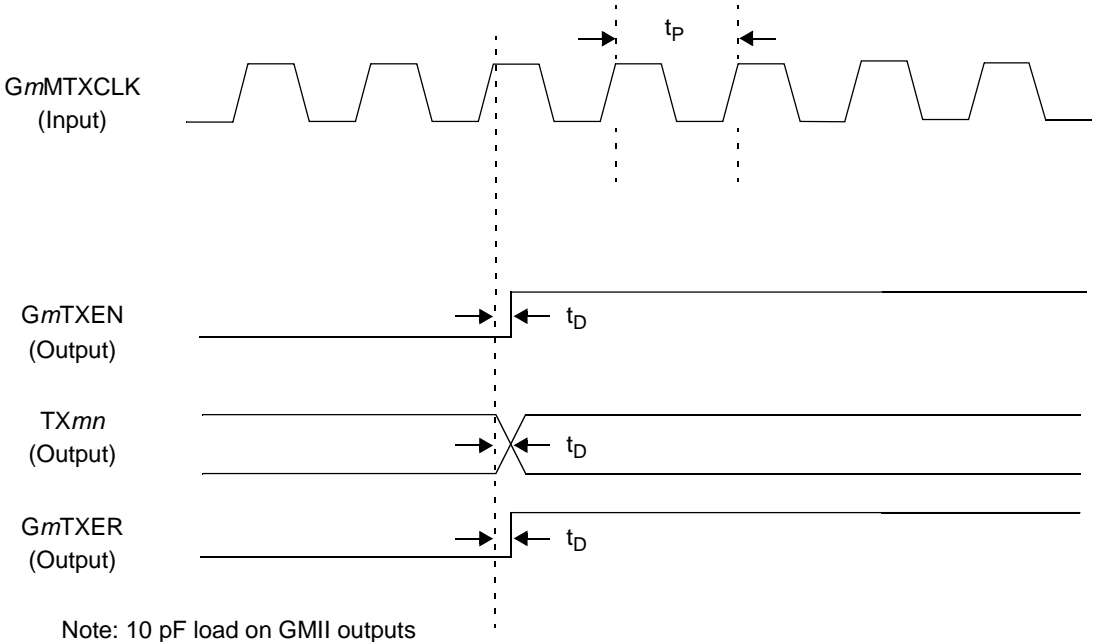


Parameter	Symbol	Min	Typ	Max	Unit
GmRXCLK duty cycle		45		55	%
GmRXCLK period	t_p	7.5		8.5	ns
GmRXDV, RXmn, GmRXER hold from GmRXCLK ↑	t_H	0.5			ns
GmRXDV, RXmn, GmRXER setup to GmRXCLK ↑	t_S	2.5			ns

$m = 0$ to 7, $n = A, B, C, D$

Note: The GMII and MII **Receive** Interface Timing diagrams are specified together in [Figure 15](#), since they are the same. The GMII and MII **Transmit** Interface Timing diagrams are specified separately in [Figure 14](#) and [Figure 16](#), since they are different.

Figure 16. MII Transmit Interface Timing Using GmMTXCLK

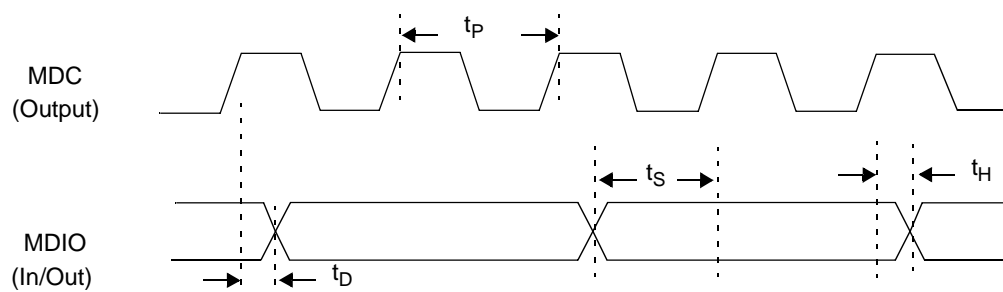


Parameter	Symbol	Min	Typ	Max	Unit
GmMTXCLK duty cycle		45		55	%
GmMTXCLK PERIOD	t_p	39	40	41	ns
GmMTXCLK \uparrow (low to high transition time, 10% to 90%)				1	ns
GmTXEN, TXmn, GmTXER delay from GmMTXCLK \uparrow	t_D	0.5		25	ns

$m = 0$ to 3, $n = A, B, C, D$

Note: The GMII and MII **Receive** Interface Timing diagrams are specified together in [Figure 15](#), since they are the same. The GMII and MII **Transmit** Interface Timing diagrams are specified separately in [Figure 14](#) and [Figure 16](#), since they are different.

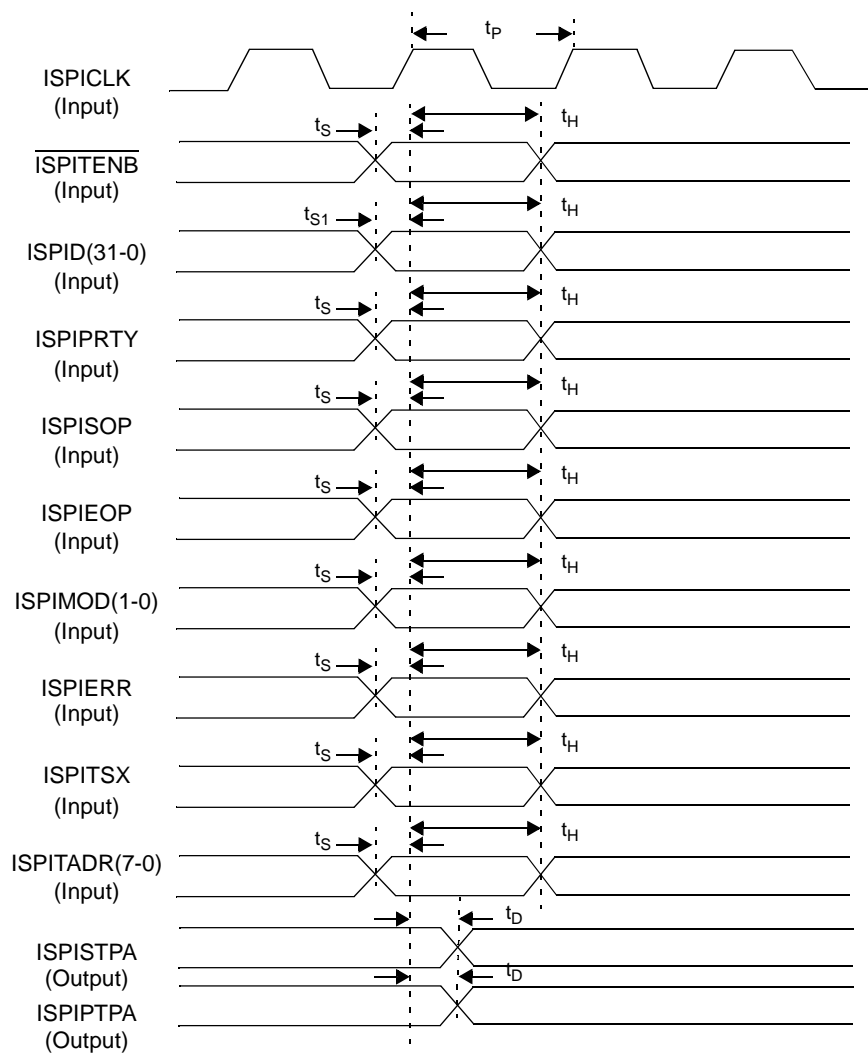
Figure 17. Management MII Interface Timing



Note: 10 pF load on all MII outputs

Parameter	Symbol	Min	Typ	Max	Unit
MDC frequency	$1/t_P$	1.2		15	MHz
MDC duty cycle		45		55	%
MDIO delay from MDC \uparrow	t_D	10		100	ns
MDIO setup to MDC \uparrow	t_S	20			ns
MDIO hold from MDC \uparrow	t_H	0			ns

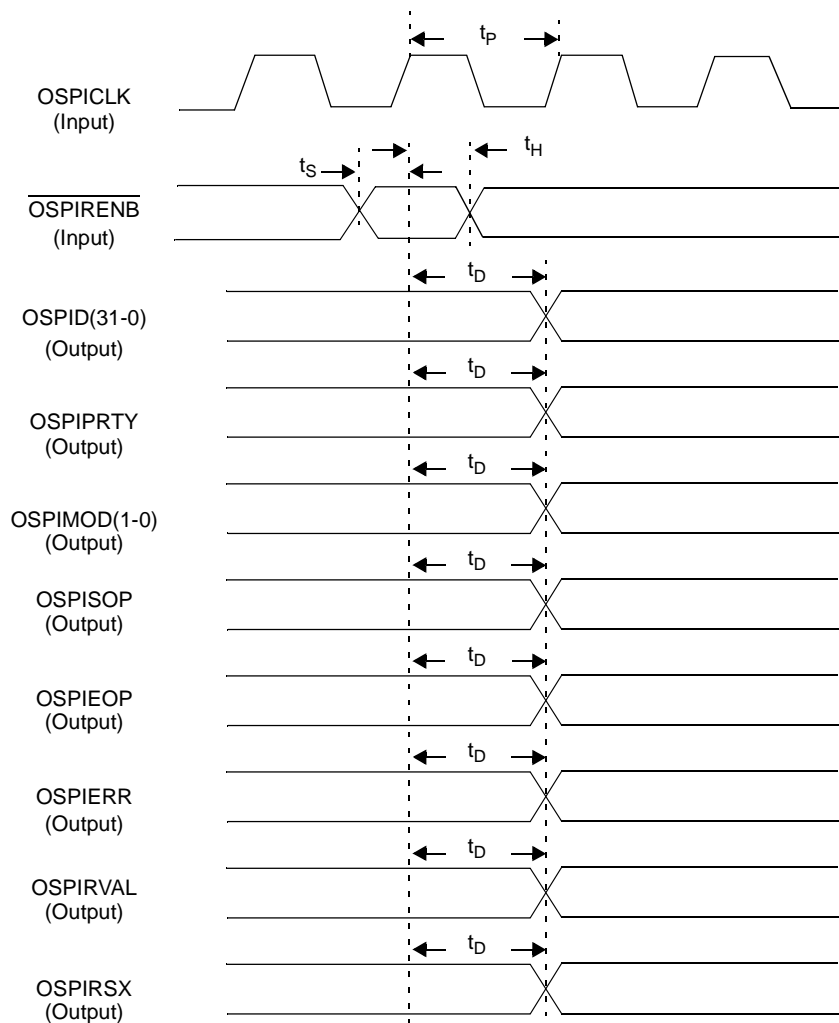
Figure 18. SPI-3 Data Input Interface Timing



Note: 10 pF load on SPI-3 interface outputs.
Please refer to OIF SPI-3 specification for protocol waveform.

Parameter	Symbol	Min	Typ	Max	Unit
ISPICLK frequency	$1/t_P$	25		125	MHz
ISPICLK duty cycle		45		55	%
$\overline{\text{TSPITENB}}$, PRTY, SOP, EOP, MOD(1-0), ERR, TSX, ADR(7-0) setup to ISPICLK \uparrow	t_S	2.0			ns
ISPID(31-0) setup to ISPICLK \uparrow	t_{S1}	2.0			ns
$\overline{\text{TSPITENB}}$, ISPID(31-0), PRTY, SOP, EOP, MOD(1-0), ERR, TSX, ADR(7-0) hold from ISPICLK \uparrow	t_H	0.5			ns
STPA, PTPA(7-0) delay from ISPICLK \uparrow	t_D	0.8		5	ns

Figure 19. SPI-3 Data Output Interface Timing

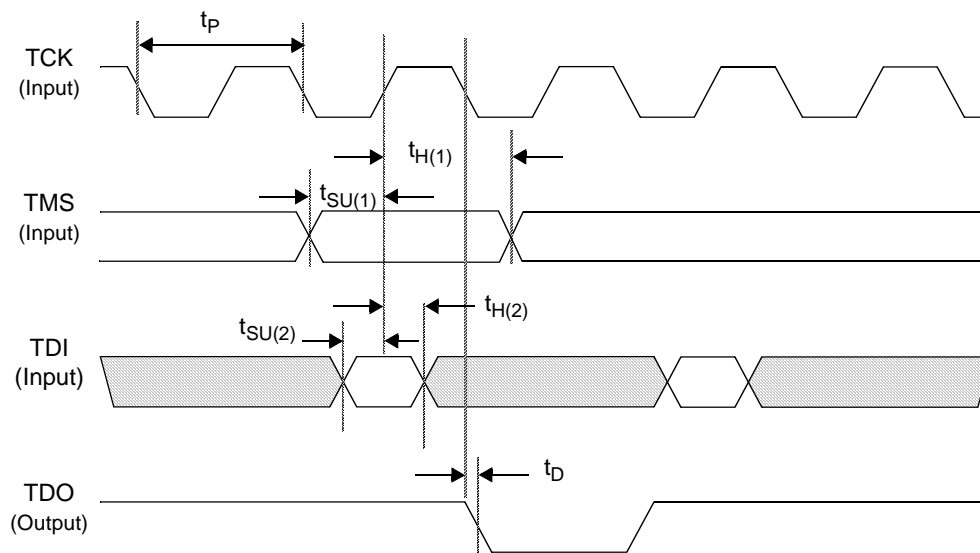


Note: 10 pF load on SPI-3 interface outputs.

Please refer to OIF SPI-3 specification for protocol waveform.

Parameter	Symbol	Min	Typ	Max	Unit
OSPICLK frequency	$1/t_p$	25		125	MHz
OSPICLK duty cycle		45		55	%
OSPIRENB setup to OSPICLK \uparrow	t_s	2.0			ns
OSPIRENB hold from OSPICLK \uparrow	t_H	0.5			ns
OSPID(31-0), PRTY, MOD(1-0), ERR, SOP, EOP, VAL, RSX delay from OSPICLK \uparrow	t_D	0.8		5	ns

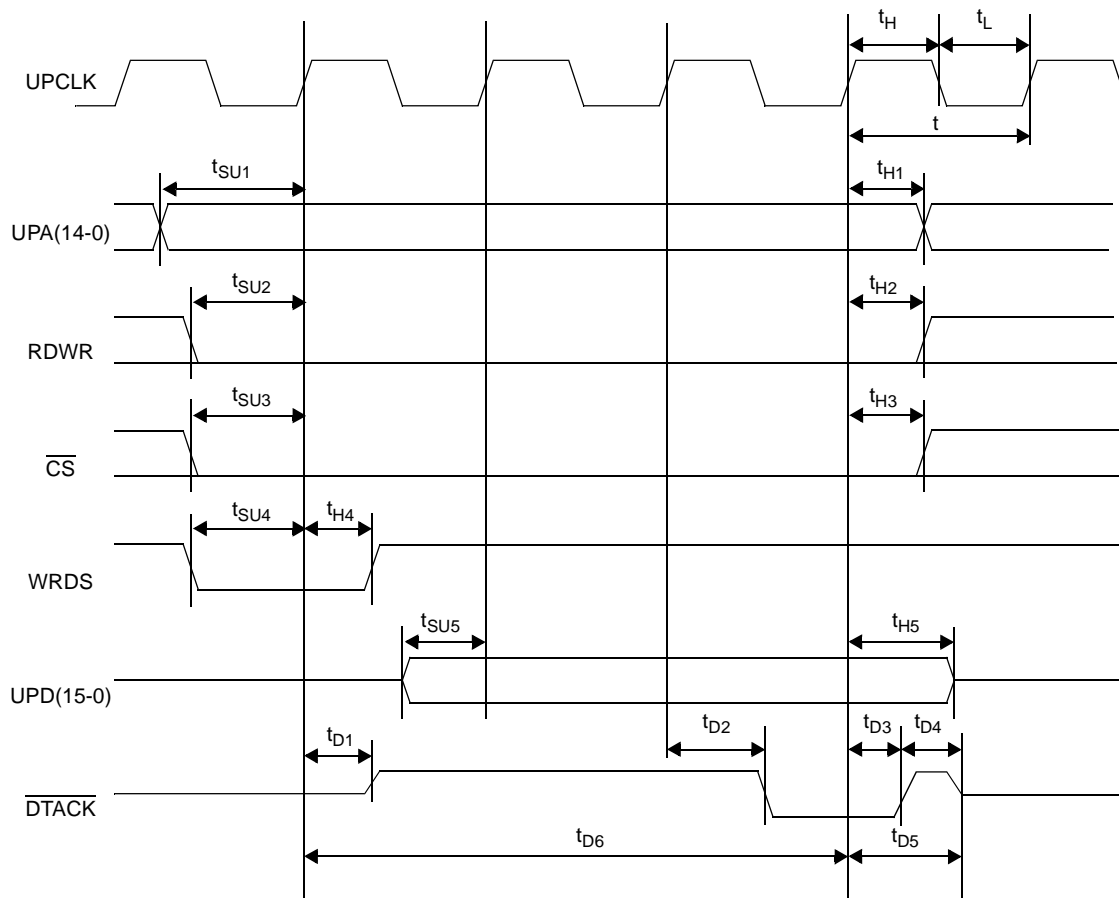
Figure 20. Boundary Scan Timing Diagram



Note: 25 pF Load on All Boundary Scan Interface Outputs

Parameter	Symbol	Min	Typ	Max	Unit
TCK period	t_p	50			ns
TCK clock duty cycle		40		60	%
TMS setup time before TCK \uparrow	$t_{SU(1)}$	2.0			ns
TMS hold time after TCK \uparrow	$t_{H(1)}$	3.0			ns
TDI setup time before TCK \uparrow	$t_{SU(2)}$	1.0			ns
TDI hold time after TCK \uparrow	$t_{H(2)}$	5.0			ns
TDO delay after TCK \downarrow	t_D			23.0	ns

Figure 21. Motorola MPC860 Write Cycle Timing

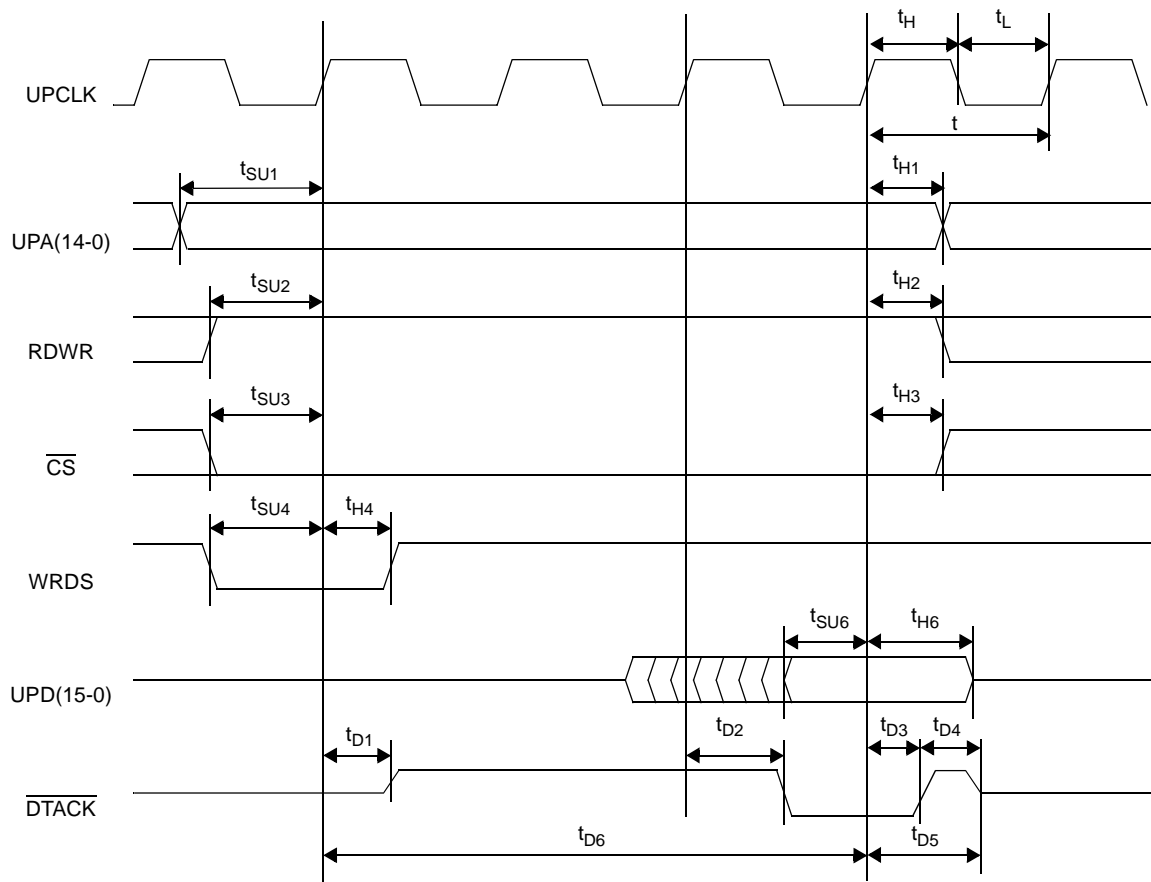


Parameter	Symbol	Min	Typ	Max	Unit
UPCLK clock period	t	15.0		-	ns
UPCLK clock low phase pulse width	t_L	0.4		-	t
UPCLK clock high phase pulse width	t_H	0.4		-	t
Setup time of UPA to rising edge UPCLK	t_{SU1}^a	4.0		-	ns
Setup time of RDWR to rising edge UPCLK	$t_{SU2}^{a, b}$	4.0		-	ns
Setup time of \overline{CS} to rising edge UPCLK	$t_{SU3}^{a, c}$	3.0		-	ns
Setup time of falling edge WRDS to rising edge UPCLK	t_{SU4}	2.0		-	ns
Setup time of UPD to rising edge UPCLK	t_{SU5}^d	4.0		-	ns
Hold time of UPA to rising edge UPCLK	t_{H1}^e	0.0		-	ns

Parameter	Symbol	Min	Typ	Max	Unit
Hold time of RDWR to rising edge UPCLK	$t_{H2}^{e, f}$	0.0		-	ns
Hold time of \overline{CS} to rising edge UPCLK	$t_{H3}^{e, c}$	1.0		-	ns
Hold time of WRDS to rising edge UPCLK	t_{H4}	2.0		-	ns
Hold time of UPD to rising edge UPCLK	t_{H5}^e	0.0		-	ns
Delay from rising edge UPCLK to \overline{DTACK} driving	t_{D1}^a	0.0		15.0	ns
Delay from rising edge UPCLK to active edge \overline{DTACK}	t_{D2}^g	3.0		7.0	ns
Delay from rising edge UPCLK to inactive edge \overline{DTACK}	t_{D3}^e	3.0		7.0	ns
Delay from \overline{DTACK} going inactive to \overline{DTACK} going in tristate	t_{D4}	4.0		-	ns
Delay from rising edge UPCLK to \overline{DTACK} going in tristate	t_{D5}^e	-		15.0	ns
Maximum response latency	t_{D6}	6		22	Cycles

- Timing is relative to the rising edge of UPCLK during which WRDS is asserted.
- Only applies if a write access is preceded by a read access. RDWR may stay low between 2 successive write accesses to the same peripheral.
- \overline{CS} may stay low between successive accesses to the same peripheral.
- Timing is relative to next rising edge after the one during which WRDS is asserted.
- Timing is relative to the rising edge of UPCLK during which \overline{DTACK} is asserted.
- Only applies if a write access is followed by a read access. RDWR may stay low between 2 successive write accesses to the same peripheral.
- Timing is relative to the rising edge before the one during which \overline{DTACK} is asserted.

Figure 22. Motorola MPC860 Read Cycle Timing

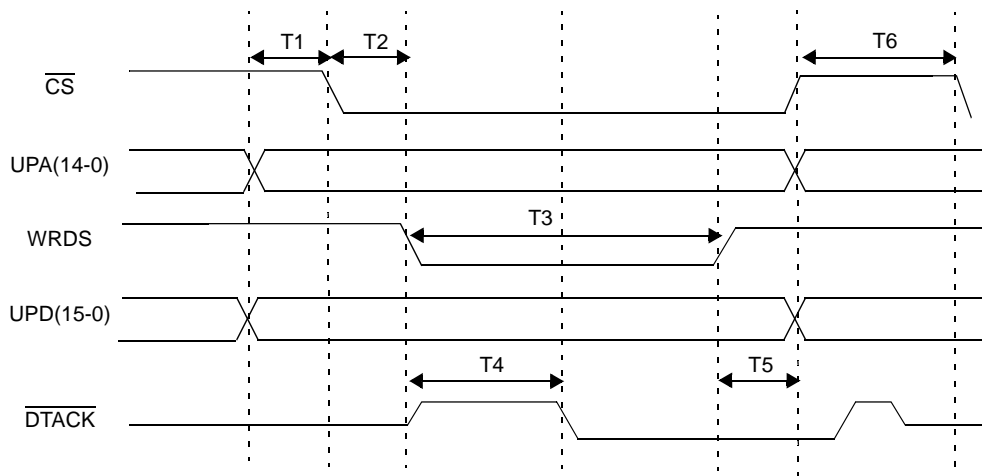


Parameter	Symbol	Min	Typ	Max	Unit
UPCLK clock period	t	15.0		-	ns
UPCLK clock low phase pulse width	t_L	0.4		-	t
UPCLK clock high phase pulse width	t_H	0.4		-	t
Setup time of UPA to rising edge UPCLK	t_{SU1}^a	4.0		-	ns
Setup time of RDWR to rising edge UPCLK	$t_{SU2}^{a, b}$	4.0		-	ns
Setup time of \overline{CS} to rising edge UPCLK	$t_{SU3}^{a, c}$	3.0		-	ns
Setup time of falling edge WRDS to rising edge UPCLK	t_{SU4}	2.0		-	ns
Hold time of UPA to rising edge UPCLK	t_{H1}^d	0.0		-	ns
Hold time of RDWR to rising edge UPCLK	$t_{H2}^{d, e}$	0.0		-	ns

Parameter	Symbol	Min	Typ	Max	Unit
Hold time of \overline{CS} to rising edge UPCLK	$t_{H3}^{c, d}$	1.0		-	ns
Hold time of WRDS to rising edge UPCLK	t_{H4}	2.0		-	ns
Delay from rising edge UPCLK to \overline{DTACK} driving	t_{D1}^a	0.0		20.0	ns
Delay from rising edge UPCLK to active edge DTACK	t_{D2}^f	3.0		7.0	ns
Delay from rising edge UPCLK to inactive edge DTACK	t_{D3}^d	3.0		7.0	ns
Delay from \overline{DTACK} going inactive to \overline{DTACK} going in tristate	t_{D4}	4.0		-	ns
Delay from rising edge UPCLK to \overline{DTACK} going in tristate	t_{D5}^d	-		15.0	ns
Maximum response latency	t_{D6}	6		22	Cycles
Setup time of UPD to rising edge UPCLK	t_{SU6}^d	15.0		-	ns
Hold time of UPD going in tristate to rising edge UPCLK	t_{H6}^d	3.0		12.0	ns

- Timing is relative to the rising edge of UPCLK during which WRDS is asserted.
- Only applies if a read access is preceded by a write access. RDWR may stay high between 2 successive read accesses to the same peripheral.
- CS may stay low between successive accesses to the same peripheral.
- Timing is relative to the rising edge of UPCLK during which DTACK is asserted.
- Only applies if a read access is followed by a write access. RDWR may stay high between 2 successive read accesses to the same peripheral.
- Timing is relative to the rising edge before the one during which \overline{DTACK} is asserted.

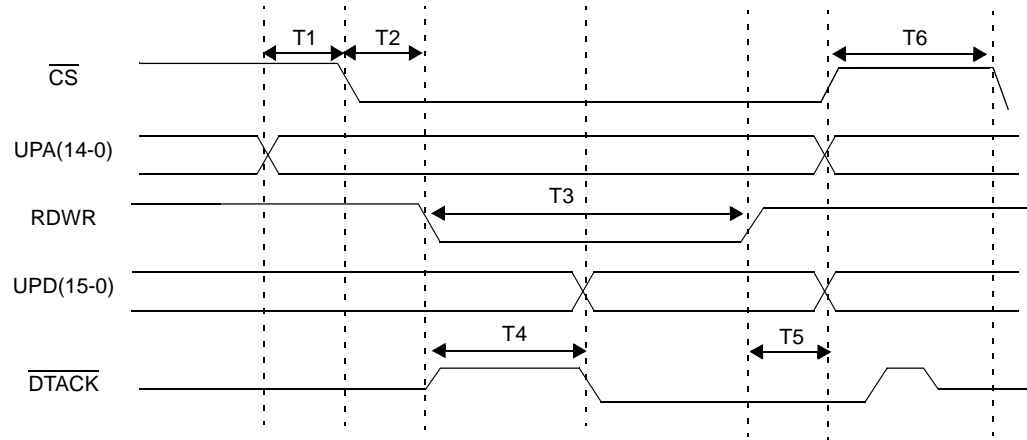
Figure 23. Asynchronous Microprocessor Interface: Intel Write Cycle Timing



Parameter	Symbol	Min in UPCLK Cycles	Max in UPCLK Cycles
Address setup to \overline{CS} driven low	T1	0	
\overline{CS} prior to WRDS (Write strobe) low	T2	0	1
Assertion time for WRDS (Write Strobe)	T3	6	
Write completion to \overline{DTACK} going low	T4	0	22
UPD, UPA, \overline{CS} hold time to \overline{DTACK} going low	T5	0	
\overline{CS} inactive hold time after write completion (for back to back writes or reads)	T6	2	

Note: The microprocessor clock must be present for correct operation.

Figure 24. Asynchronous Microprocessor Interface: Intel Read Cycle Timing



Parameter	Symbol	Min in UPCLK Cycles	Max in UPCLK Cycles
Address setup to \overline{CS} driven low	T1	0	
\overline{CS} prior to RDWR (Read strobe) low	T2	0	
Assertion time for RDWR (Read Strobe)	T3	6	
Read completion to \overline{DTACK} going low	T4	0	22
UPD, UPA, \overline{CS} hold time to \overline{DTACK} going low	T5	0	
\overline{CS} inactive hold time after read completion (for back to back reads or writes)	T6	2	

Note: The microprocessor clock must be present for correct operation.

6.0 OPERATION

6.1 SMII/GMII TO SPI-3 FLOW CONTROL OPERATION

6.1.1 Receive MAC Data Flow

Ethernet frames arriving at the SMII/GMII interface are qualified by an IEEE 802.3 compliant Media Access Controller (MAC) function. Each SMII/GMII interface or each channel is processed by the MAC. The MAC operates in Full-Duplex or Half-Duplex mode and processes both standard and VLAN tagged Ethernet frames. The MAC supports Control frames in addition to PAUSE control frames per the IEEE 802.3 standard (Generation and Termination). The SMII/GMII interface presents receive frames to the MAC receive block and the MAC removes the PREAMBLE and the SFD (Start of Frame Delimiter) and writes the frames into the appropriate Ingress FIFO.

6.1.2 Receive MAC Checks

Following are the checks performed by the MAC if enabled, for each port on the incoming Ethernet frame.

6.1.2.1 FCS Check:

The Frame Check Sequence (FCS) is checked for its correctness. The FCS of the received frame is checked against the FCS calculated by the MAC over the Data, address, and length/type fields. Frames failing the FCS check are optionally discarded or errored based on a programmable bit in the configuration register. This configuration bit is the FCS check failed discard bit.

When the IFIFO is configured for Store and Forward mode, the frame is discarded and will not show up on the SPI port. When the IFIFO is configured for Streaming mode, a bad FCS is appended to the frame.

6.1.2.2 Frame Length Check:

The length field of the received Ethernet frame is checked for correctness. The length of the Data field in the Ethernet frame is checked against the frame length field. The Frame length check enable bit is programmable (Register 0x4004 Bit 4). Frames failing the frame length check will be optionally discarded or errored if the frame length check discard configuration bit is set (Register 0x4084 Bit 25).

When the IFIFO is configured for Store and Forward mode, the frame is discarded and will not show up on the SPI port. When the IFIFO is configured for Streaming mode, a bad FCS is appended to the frame.

6.1.2.3 Maximum Frame Size Check:

The maximum size of the accepted Ethernet frame is programmable. The default value is 1536 (decimal) bytes. Frames exceeding the programmed maximum frame size are truncated. Truncated frames are optionally discarded or errored if the Discard Truncated Frame configuration bit is set (Register 0x4084 Bit 24). The maximum frame size check is disabled by setting the Huge Frame Enable configuration bit (Register 0x4004 Bit 5).

When the IFIFO is configured for Store and Forward mode, the frame is discarded and will not show up on the SPI port. When the IFIFO is configured for Streaming mode, a bad FCS is appended to the frame.

6.1.2.4 Interframe Gap Check:

The Interframe Gap (IFG) is programmable. A received Ethernet frame violating the programmed Interframe gap value is dropped or errored. The default value of the Minimum IFG is 80 (decimal) bits.

When the IFIFO is configured for Store and Forward mode, the frame is discarded and will not show up on the SPI port. When the IFIFO is configured for Streaming mode, a bad FCS is appended to the frame.

6.1.2.5 Destination Address Check:

The Destination address of the received Ethernet frame is compared to the programmed Source address of the device. If the destination address of the frame does not match the programmed source address, the frame will be optionally filtered out based on the Destination Address match discard configuration bit (Register 0x4084 Bit 29).

When the IFIFO is configured for Store and Forward mode, the frame is discarded and will not show up on the SPI port. When the IFIFO is configured for Streaming mode, a bad FCS is appended to the frame.

Note: When an incoming frame (from the Ethernet side) fails all the checks above (except for FCS) and the corresponding configuration bits to discard the frame are NOT SET, the frame will be output on the SPI-3 Receive Interface. The only requirement on the incoming frame for the above to occur, is that the incoming frame has a valid preamble, SFD, and FCS.

6.1.3 Receive MAC Statistics

The Receive MAC provides statistics and performance monitoring, to facilitate remote network monitoring (RMON) per Groups 1, 2, 3, and 9, in addition to supplementary statistics.

6.1.3.1 Counters:

The MAC records the following statistics using counters that are programmable as either clear on read saturating counters or rollover counters (Register 0x0030 Bit 0).

- Total number of bytes received. This counter can be programmed to exclude byte counts from errored frames (40 bit)
- Total number of frames received. This includes errored frames (32 bit)
- Count of Multicast frames received (32 bit)
- Count of Broadcast frames received (32 bit)
- Count of PAUSE Control frames received (32 bit)

- Count of Control frames received with unknown opcode (32 bit)
- Count of frames received with a valid FCS and length less than 64 bytes (32 bit)
- Count of frames received with a valid FCS and total byte count is between 1519 and maximum frame length (32 bit)
- Count of frames received with an invalid FCS and length less than 64 bytes (32 bit)
- Count of frames received with an invalid FCS and total byte count is between 64 and 1518 bytes (32 bit)
- Count of frames received with an invalid FCS and total byte count is between 1519 and maximum frame length (32 bit)
- Count of frames dropped by the receive MAC due to Ingress FIFO full (32 bit)
- Count of frames dropped by the receive MAC due to Unicast and Source address mismatch (32 bit)
- Count of VLAN tagged frames received (32 bit)
- Six sets of counts for frame sizes that fall in a certain range. The ranges are 64 bytes, 65 to 127 bytes, 128 to 255 bytes, 256 to 511 bytes, 512 to 1023 bytes, and 1024 to 1518 bytes.
- Count of frames received with the RX_ER asserted by the PHY during transmission (32 bit)
- Count of frames received with length error (32 bit)

6.1.4 Ingress FIFO Operations

6.1.4.1 Ingress FIFO Write:

Frames once qualified by the Receive MAC are written into the Ingress FIFO of the appropriate channel. The Ingress FIFO for each channel is 7.75 KBytes deep in SMII mode, 62 KBytes deep in GMII mode, and 31 KBytes deep in extended SMII mode. The ingress FIFO is an integral part of Envoy-CE4 IEEE 802.3 compliant Flow control mechanism, which is used to backpressure the Ethernet interface. When the Ingress FIFO starts becoming full, the flow control is activated (if enabled) and the device transmitting the Ethernet traffic is backpressured. A complete description of the procedure is outlined in section [“Ethernet Full Duplex” on page 76](#). If the Ethernet device transmitting frames, ignores the backpressure indication and attempts to overflow the Ingress FIFO, the Envoy-CE4 will truncate the frame being received during the overflow condition. Frames received when the Ingress FIFO is in an overflow condition are discarded and the number of discarded frames are counted. In Half Duplex mode, the backpressure mechanism used is the “Raise Carrier” method, which is described in section Ethernet [“Half-Duplex Flow Control” on page 76](#).

6.1.4.2 Ingress FIFO Read:

Frames are read out from the Ingress FIFO by the SPI-3 interface. Since the SPI-3 interface aggregates the traffic from the channels, a channel selection is required. The selection of the Ingress FIFO (or channel selection) for frame reads, is done by the SPI-3 interface. For SPI-3, the selection is done by the scheduler in the Envoy-CE4 SPI-3 interface block. The scheduler uses a round robin selection scheme.

6.1.4.3 Ingress FIFO Frame Availability for Transfer (Store and Forward/Streaming):

Frame data stored in the Ingress FIFO will be made available for transfer on the SPI-3 interface, depending on two selectable modes of operation:

- **Store and Forward Mode:** When a complete frame has been written into the Ingress FIFO, the frame is available for transfer. The SPI-3 interface may be configured for burst (chunk) or packet transfer mode, when the FIFO is configured for store and forward.
- **Streaming Mode:** When a selectable fixed number of bytes have been written into the Ingress FIFO, a chunk is available for transfer. The selection for streaming range from 1 to 255, in units of 8 byte words and is equal to the SPI-3 burst (chunk) size, defined for the SPI-3 output. Hence, in streaming mode, the SPI-3 interface needs to be in burst (chunk) transfer mode. When streaming is enabled and an end of frame is written into the Ingress FIFO, before the selected number of (streaming) bytes have been received, the frame data will be available for transfer across the SPI-3 interface based on the end of frame condition. When streaming is enabled, frame errors at the SMII/GMII interface are indicated on the SPI-3 interface during the transfer of the frame.

6.1.5 SPI-3 Output Operations

6.1.5.1 Data Flow Operations:

Frames from the Ingress FIFO are read out by the Output SPI-3 interface. The interface is programmable in either PHY or Link layer mode. The OIF System Packet Interface Level 3 (SPI-3) specification describes the interface in detail. When the SPI-3 output interface is configured in PHY layer mode, the Link layer device performs flow control by controlling the Read Enable. When the SPI-3 output interface is configured in Link layer mode, the PHY layer device provides backpressure information via the Transmit Packet Available pins and the device provides flow control using the Transmit Enable pins. The channel selection in both PHY and Link layer modes is done by the Envoy-CE4. Once a channel has data available for transfer based on store and forward or streaming mode, the scheduler in the SPI-3 interface block selects the channel for frame transfer. The Envoy-CE4 provides the burst mode option to restrict a channel from transmitting more than a fixed number of bytes once selected. Once a burst of data bytes has been transmitted by the selected channel, a new channel is selected for frame transfer. This prevents a channel from using up all the bandwidth on the SPI-3 interface, by giving the other channels access to the SPI-3 interface. The allowable burst sizes are 1 to 255 in units of 8 byte words. Alternatively, in packet transfer mode, a complete frame is transferred across the SPI-3 interface.

6.1.5.2 SPI-3 Output Interface Frame Format:

Data at the SPI-3 output interface is an Ethernet frame (VLAN frames also), excluding the preamble and start of frame delimiter. The FCS may be programmed to be excluded.

Note: The following figures show the inclusion of the FCS.

Standard Ethernet Frame at SMII/GMII interface

Preamble (7 bytes)	Start of Frame Delimiter (1 byte)	Destination Address (6 bytes)	Source Address (6 bytes)	Length/ Type (2 bytes)	Data (46 to 1500 bytes)	Frame Check Sequence (4 bytes)
-----------------------	---	-------------------------------------	--------------------------------	------------------------------	-------------------------------	--------------------------------------

Frame format at SPI-3 Output Interface

Destination Address (6 bytes)	Source Address (6 bytes)	Length/Type (2 bytes)	Data (46 to 1500 bytes)	Frame Check Sequence (4 bytes)
----------------------------------	-----------------------------	--------------------------	----------------------------	-----------------------------------

VLAN Tag Frame format at SPI-3 Output Interface

Destination Address (6 bytes)	Source Address (6 bytes)	VLAN Tag (4 bytes)	Length/Type (2 bytes)	Data (46 to 1500 bytes)	Frame Check Sequence (4 bytes)
----------------------------------	-----------------------------	-----------------------	--------------------------	----------------------------	-----------------------------------

Frame with Extension Field at SPI-3 Output Interface

Destination Address (6 bytes)	Source Address (6 bytes)	Length/Type (2 bytes)	Data (46 to 1500 bytes)	Frame Check Sequence (4 bytes)	Extension
----------------------------------	-----------------------------	--------------------------	----------------------------	-----------------------------------	-----------

6.2 SPI-3 TO SMII/GMII FLOW CONTROL OPERATION

6.2.1 SPI-3 Input Operation

6.2.1.1 Input SPI-3 Data Flow:

At the SPI-3 input interface, frames are transferred from the Link or PHY layer device to the Envoy-CE4. An Envoy-CE4 channel is selected for data transfer, by the Link or PHY layer device. In PHY layer mode, the Link layer device monitors the "Buffer Space Available" signals, STPA/PTPA and selects an Envoy-CE4 channel for data transfer, based on the Transmit packet available signals (STPA and PTPA). In Link layer mode, the PHY layer device transfers frame based on Envoy-CE4's read enable signal. Once a data transfer begins, the Link/PHY layer device qualifies the frame data being transferred into the channel's Egress FIFO, with the read enable/data valid signal. The "Buffer Space Available" signals reflect the full status of the channel's Egress FIFO and get de-asserted when the associated Egress FIFO becomes near full (near full level is programmable). When the Egress FIFO is configured for Store and Forward mode, frames received with the SPI-3 error pin asserted, will be either discarded or errored and a count of the discarded and errored frames is kept.

When the egress FIFO is configured for Store and Forward mode, frames received with the SPI-3 error pin asserted are discarded and will not show up on the Ethernet port. When the egress FIFO is configured for Streaming mode, frames received with the SPI-3 error pin asserted will show up on the Ethernet port with an additional four bytes of bad CRC appended to it.

6.2.1.2 Oversubscription Mode

The SPI-3 Input interface is designed to support an Oversubscription mode. In this mode, the far end SPI-3 Slave or Master device can ignore the backpressure exerted by the Envoy-CE4 SPI-3 Master or Slave. Since the backpressure is being ignored, it is possible that the per-PHY Egress FIFOs can be filled to overflow. When a PHY's Egress FIFO is filled, data from the Input SPI-3 data bus will still be clocked into the Envoy-CE4, but it will not be written into the PHY's Egress FIFO. This allows the SPI-3 bus to still run and service the PHYs whose buffers are not full.

Regardless of the Egress FIFO configuration for Store and Forward mode or Streaming mode, all complete packets received on the SPI-3 port for a full PHY will be discarded and counted. The only difference between Store and Forward mode and Streaming mode when Oversubscription is being used is in the treatment of the packet that overflows the Egress FIFO. In Store and Forward mode, the overflowing packet will be discarded and counted. In Streaming mode, the overflowing packet will be flagged as errored into the Egress FIFO and it will be errored on the way out of the Transmit MAC.

In PHY Layer mode, Oversubscription is always enabled. STPA/PTPA status is always presented accurately on the external SPI-3 port.

In Link Layer mode, Oversubscription can be enabled or disabled through the Oversubscription Enable bit (Register 0x002C Bit 4). If the Oversubscription enable bit is set to '1', the SPI-3 Master will never raise its ISPIRENB output. Setting this bit shuts off all Rx backpressure reporting from the Envoy-CE4. If the Oversubscription enable bit is set to '0', the SPI-3 Master uses the ISPIRENB output pin to exert standard SPI-3 backpressure.

6.2.1.3 Input SPI-3 Interface Frame Format:

The Data format accepted by Envoy-CE4, at the SPI-3 Input interface, is an Ethernet frame (VLAN frames also), excluding the preamble and the Start of frame delimiter. If the Transmit MAC is configured to generate the Frame Check Sequence (FCS), then the FCS is optional for the frame received by the Envoy-CE4 at the SPI-3 interface. If the Transmit MAC is not configured to generate the FCS, then the FCS needs to be included in the frame.

Standard Ethernet Frame at SMII/GMII Transmit interface

Preamble (7 bytes)	Start of Frame Delimiter (1 byte)	Destination Address (6 bytes)	Source Address (6 bytes)	Length/Type (2 bytes)	Data (46 to 1500 bytes)	Frame Check Sequence (4 bytes)
-----------------------	--	-------------------------------------	--------------------------------	--------------------------	-------------------------------	---

Frame format at the SPI-3 Input Interface with Frame Check Sequence

Destination Address (6 bytes)	Source Address (6 bytes)	Length/Type (2 bytes)	Data (46 to 1500 bytes)	Frame Check Sequence (4 bytes)
-------------------------------------	--------------------------------	--------------------------	----------------------------	--------------------------------------

Frame format at the SPI-3 Input Interface without Frame Check Sequence

Destination Address (6 bytes)	Source Address (6 bytes)	Length/Type (2 bytes)	Data (46 to 1500 bytes)
-------------------------------------	--------------------------------	--------------------------	----------------------------

VLAN Tagged and Extended frames may have the FCS included depending whether Envoy-CE4 is configured to generate FCS or not.

6.2.2 Egress FIFO Operations

6.2.2.1 Egress FIFO Write:

Each Egress FIFO is 3.2 KBytes deep in SMII mode, 32 KBytes deep in GMII mode, and 12.4 KBytes deep in extended SMII mode. The Link or PHY layer device (depending on the mode the Envoy-CE4 is in) is responsible for selecting the channel into which the frame data is written. The Egress FIFO backpressures the SPI-3 input interface when the FIFO becomes near full. The near full indication level is programmable as number of bytes from the FIFO full. If the Link or PHY layer device attempts to overflow the Egress FIFO when it is configured in Store and Forward mode, the complete frames being received are discarded and a count of the discarded frames are provided per channel. If the Link or PHY layer device attempts to overflow the Egress FIFO when it is configured in Streaming mode, the current frame being received is truncated and will be sent out the targeted Ethernet port as an errored frames. All subsequently arriving frames are discarded until some room is freed up in the Egress FIFO and a count of the discarded frames are provided per channel.

Note: The discard frame count is used to count frames discarded due to an Egress FIFO overflow condition and the SPI-3 Error pin assertion condition.

6.2.2.2 Egress FIFO Frame Availability for Transfer (Store and Forward/Streaming):

Frame data stored in the Egress FIFO will be made available for transfer on the Ethernet Transmit interface, depending on two selectable modes of operation:

- **Store and Forward Mode:** When a complete frame has been written into the Egress FIFO, the frame is available for transfer to the Ethernet transmit interface (SMII/GMII).
- **Streaming Mode:** When a selectable fixed number of bytes have been written into the Egress FIFO, a frame is available for transfer. The selections for streaming are 64, 128, 256, 512, 768, or 1544 bytes. When streaming is enabled and an end of frame is written into the Egress FIFO, before the selected number of (streaming) bytes have been received, the frame data will be available for transfer across the Ethernet transmit interface (SMII/GMII) based on the end of frame condition. When streaming is enabled, frame errors at the SPI-3 interface are indicated on the SMII/GMII interface during the transfer of the frame.

6.2.2.3 Egress FIFO Read:

Frame data from the Egress FIFO is read out by the Transmit MAC block. Each channel has an SMII/GMII Transmit block and interfaces to the appropriate Egress FIFO. When a complete frame or a programmed number of bytes have been written into the Egress FIFO, then it is available for transmission on the Ethernet Network via the SMII/GMII Transmit interface.

The Egress FIFO forms an integral part in the implementation of the IEEE 802.3 compliant Ethernet flow control mechanism in the Envoy-CE4, using PAUSE Control frames. When a PAUSE Control frame destined for the Envoy-CE4 reaches the SMII/GMII receive interface, the action taken by the Full-Duplex flow control block is to stop Egress FIFO reads. This may result in the Egress FIFO becoming full. As mentioned above, the SPI-3 interface is backpressured when the Egress FIFO becomes full. A complete explanation of the Full-Duplex Ethernet flow control mechanism is outlined in section [“Ethernet Full Duplex” on page 76](#).

6.2.3 Transmit MAC Data Flow

The MAC can be configured to operate in either Full-Duplex mode or Half Duplex mode (Fast Ethernet only). The MAC transmits both standard Ethernet frames and VLAN tagged Ethernet frames. The MAC supports Control frames in addition to PAUSE control frames per the IEEE 802.3 standard (Generation and Termination). The Egress FIFO indicates availability of a Frame to the Transmit MAC when a complete frame is stored in the Egress FIFO. The Transmit MAC reads the Egress FIFO and transmits the frame over the SMII/GMII transmit interface.

6.2.4 Transmit MAC Configurable Options and Checks

Following are the configurable options and checks for the MAC for the outgoing Ethernet frame.

6.2.4.1 Frame Check Sequence (FCS) Generation Option:

The MAC provides the option to append the correct FCS when Ethernet frames presented to the Envoy-CE4 at the SPI-3 Input interface, do not contain a valid FCS. Please note that this option also works in conjunction with the pad option.

6.2.4.2 Pad Short Ethernet Frames Option:

The MAC can be configured to pad short frames to 64 bytes and append the correct FCS. If this option is set, the FCS generation option is ignored. The pad option is for Ethernet frames presented at the SPI-3 Input interface with lengths less than 64 bytes.

6.2.4.3 Frame Length Check:

The length field of the received Ethernet frame is checked against the actual data length for correctness. The Frame length check enable bit is programmable (Register 0x4004 Bit 4).

6.2.4.4 Maximum Frame Size Check:

The maximum size of the accepted Ethernet frame is programmable. The default value is 1536 (decimal) bytes. Frames exceeding the programmed maximum frame size are truncated. Truncated frames are tagged with RX_ER. The maximum frame size check is disabled by setting the Huge Frame Enable configuration bit (Register 0x4004 Bit 5).

6.2.4.5 Back to Back Interframe Gap Option:

The Interframe Gap (IFG) between two back to back transmitted Ethernet frames is programmable. The default value of the Minimum IFG is 96 bits (decimal).

6.2.4.6 Source Address Replace Option:

The MAC provides the option to replace the source address (SA field) of the Ethernet frame received at the SPI-3 Input interface with the programmed source address (Register 0x4084 Bit 21). The Envoy-CE4 has programmable per port source address registers.

6.2.4.7 PAUSE Frame Filter Option:

The MAC provides the option to filter PAUSE frames received at the SPI-3 Input Interface. The option is provided to filter PAUSE frames with the specified Multicast address (01-80-C2-00-00-01) or to filter all PAUSE frames from the SPI-3 interface destined for the Ethernet Transmit interface (Register 0x4084 Bit 28). These frames will be errored by forcing the MAC to append an incorrect CRC

6.2.4.8 Preamble Length Option:

The Preamble length of the transmitted Ethernet frame is programmable by the MAC. The default value is 7 bytes (Register 0x4004 Bits 12-15).

6.2.5 Transmit MAC Statistics

The Transmit MAC provides statistics and performance monitoring, to facilitate remote network monitoring (RMON) per Groups 1, 2, 3, and 9, in addition to supplementary statistics.

6.2.5.1 Counters:

The MAC records the following statistics using counters that are programmable as either clear on read saturating counters or rollover counters (Register 0x0030 Bit 0).

- Total number of bytes transmitted. This counter can be programmed to exclude byte counts from errored frames (40 bit)

- Total number of frames transmitted. This includes all frames, broadcast and multicast (32 bit)
- Count of Multicast frames transmitted (32 bit)
- Count of Broadcast frames transmitted (32 bit)
- Count of PAUSE Control frames transmitted (32 bit)
- Count of VLAN tagged frames transmitted (32 bit)
- Count of frames transmitted with a valid FCS and total byte count is between 1519 and maximum frame length (32 bit)
- Count of frames transmitted with a valid FCS and length less than 64 bytes (32 bit)
- Count of deferred frames transmitted (32 bit)
- Count of excessive deferred frames transmitted (32 bit)
- Count of single collision frames (32 bit)
- Count of multiple collision frames (32 bit)
- Count of late collision frames (32 bit)
- Count of excessive collision frames (32 bit)
- Count of frames transmitted with an invalid FCS and length less than 64 bytes (32 bit)
- Count of frames transmitted with an invalid FCS and total byte count is between 1519 and maximum frame length (32 bit)
- Count of frames transmitted with an invalid FCS and total byte count is between 64 and 1518 bytes (32 bit)
- Count of dropped frames due to lack of system resources (32 bit)
- Count of aborted frames under command of the Egress FIFO logic (32 bit)
- Six sets of counts for frame sizes that fall in a certain range. The ranges are 64 bytes, 65 to 127 bytes, 128 to 255 bytes, 256 to 511 bytes, 512 to 1023 bytes, and 1024 to 1518 bytes.
- Count of PAUSE frames originated via SPI-3 interface that are discarded (32 bit)

6.3 PORT AGGREGATION

In Port Aggregation mode, the Envoy-CE4 aggregates all the Ethernet ports' receive data onto a single SPI-3 port. Port Aggregation mode may be programmed in SPI-3 Multi-PHY mode or SPI-3 Single-PHY mode. In Multi-PHY mode, all the Ethernet ports aggregate traffic onto SPI-3 port 0. A round robin mechanism schedules traffic from multiple Ingress FIFOs (per Port Ingress FIFOs) onto a single SPI-3 Port. Port Aggregation in Single-PHY mode is similar to the above except that there is no concept of a SPI-3 port and hence no SPI-3 port address. The Envoy-CE4 emulates a single PHY/Link layer device in Single-PHY operation.

A programmable port number is appended to the packet or chunk (depending on whether the device is in burst mode or not). The programmable port number may be used by the downstream device to identify the source of the packet from the Envoy-CE4 Ethernet interface.

In the SPI-3 receive to Ethernet Transmit direction, a prepended port number is required to de-multiplex the incoming packet stream on SPI-3 port 0 onto multiple Ethernet ports. The port number is assigned from 0 to 31 and a byte of packet data is used to convey this information. The appended port number will be removed before transmission onto the appropriate Ethernet interface.

6.3.1 Normal vs. Aggregate Mode

OPERATIONAL MODE	Default	Per Ethernet Port SPI-3 Tx Backpressure	Packet/Chunk Tagging	PAUSE Frame support per Ethernet Port	SPI-3 Chunking	Number of SPI-3 Ports supported
NORMAL	Yes	Yes	No	Yes	Yes	Multiple
AGGREGATE	No	No	Yes	Yes	Yes	Single*

* **Note:** The single port is either in Multi-PHY or Single-PHY mode.

6.4 ETHERNET HALF DUPLEX

6.4.1 Overview

In Half-Duplex mode, two or more Ethernet devices are connected to a common transmission medium and when one Ethernet device transmits, the others listen. In the case where two Ethernet devices transmit at once, a “Collision” is said to have occurred. A “Jam Sequence” is transmitted by the transmitting Ethernet device indicating the occurrence of a collision. The contention is resolved by each of the Ethernet devices responsible for the collision, backing off, and attempting to re-transmit after a time period. This method is called Carrier Sense Multiple Access/Collision Detection (CSMA/CD). The Envoy-CE4 Configurable Media Access Controller implements the IEEE 802.3 compliant CSMA/CD algorithm. For a complete definition of this algorithm, please refer to the IEEE 802.3 specification.

Note: Carrier Sense and Collision detection status is indicated by the Ethernet PHY device to the Envoy-CE4 via the SMII and MII interface only. Please refer to the Serial Media Independent Interface (SMII) specification for further details.

Following is an outline based on the Envoy-CE4 Configurable MAC.

6.4.2 Carrier Sense

Following the transmission of an Ethernet frame from the Envoy-CE4, the MAC times the Inter Packet Gap (IPG) count as programmed in the Back-to-Back IPG configuration register for the specific port. The MAC monitors the Carrier Sense status for the duration of IPG time before transmitting a new frame for the port. Envoy-CE4 provides an optional IPG mechanism where the IPG time is divided into a two-thirds/one-third ratio. During the first two-thirds of the IPG, the IPG timer is reset and Carrier Sense status is monitored or sensed. During the final one-third of the IPG, the Carrier sense status is ignored and the port begins transmission once the IPG timer has expired. This optional mechanism enhances system robustness. The configuration bits defining the two-thirds/one-third values are IPG1 and IPG2.

6.4.3 Collision Detection

In the event the Envoy-CE4 MAC detects a collision for a port when the device is transmitting an Ethernet frame, the MAC outputs the 32-bit jam sequence for the port. The jam sequence is made up of several bits of the CRC, inverted to guarantee an invalid CRC upon reception of the frame. The port then backs off transmission of the frame (retry) based on the “Truncated Binary Exponential Backoff” (BEB) algorithm. Following this backoff time, the frame is retried. When enabled, the “No Backoff” configuration bit (Register 0x400C Bit 17) retransmits the frame without a backoff, following a collision. This option needs to be enabled with caution.

6.4.4 Alternate BEB Truncation

The backoff time following a collision is a controlled randomization process called “truncated binary exponential backoff”. It is defined as an integer multiple of the slot times. The number of slot times to delay before the n^{th} retransmission attempt is chosen as a uniformly distributed random integer r in the range: $0 \leq r \leq 2^k$ where $k = \min(n, 10)$. So, after the first collision, the port will backoff either 0 or 1 slot times. After the fifth collision, the port will backoff between 0 and 32 slot times. After the tenth collision, the maximum number of slot times to backoff is 1024. By setting the Alternate BEB Enable bit (Register 0x400C Bit 19), the truncation point can be changed from $\min(n, 10)$ to $\min(n, m)$ where m is set in the Alternate BEB Truncation register (Register 0x400C Bits 20-23).

6.4.5 Excessive Collisions

Upon collision, the port attempts re-transmission of the frame. Per the IEEE 802.3 specification, a frame has excessive collisions if 15 re-transmission attempts have occurred. The number of retransmission attempts for excessive collisions is configurable. In the event a frame has been excessively deferred, the frame is discarded and will not be transmitted. It is possible to configure the Envoy-CE4 not to discard an excessively deferred frame.

6.4.6 Half-Duplex Flow Control

There is no IEEE 802.3 compliant backpressure mechanism for Half Duplex. The common industry implementation is the “Raise Carrier” method. The Envoy-CE4 MAC uses the configurable “Raise Carrier” method for flow control in Half-Duplex mode. In the event the Envoy-CE4 port needs to backpressure the transmission medium, it raises carrier by transmitting the preamble. Other devices on the transmission medium defer to the carrier. If a collision occurs due to the raised carrier, the congestion is resolved using the standardized collision-detect, backoff method. The Host can not initiate flow control in half-duplex mode.

6.5 ETHERNET FULL DUPLEX

6.5.1 Overview

The Envoy-CE4 implements the IEEE 802.3 compliant full-duplex flow control mechanism. This mechanism is used to prevent frame loss, resulting from frame discard due to a buffer becoming full. It is intended for a Full-Duplex link between two devices; for example, a link between a switch and an end device (e.g., host). The mechanism involves the generation and operation of specific Ethernet Control frames called “PAUSE Control frames”. A PAUSE control frame has certain values for the Destination Address field, Type field, Opcode field, MAC control parameter field and must have a valid FCS. Following are the required PAUSE control frame field values.

The Destination address must either be the multicast address (01-80-C2-00-00-01) or the unicast address of the device the frame is being sent to. The Type field should have a reserved value of 0x8808 (MAC Control frame type) and the Control Opcode should be equal to 0x0001. A MAC control parameter called `pause_time`, specifies the time period, in 512-bit times, for which the device receiving the PAUSE control frame is paused.

The Flow control operation in the Envoy-CE4 is divided into two operations:

- 1) The action taken when a PAUSE control frame is received from a remote device

2) The action taken when Envoy-CE4 generates a PAUSE control frame and transmits it to a remote device.

The remote device is connected to the Envoy-CE4 via a full duplex link. Envoy-CE4 PAUSE frame processing needs to be enabled for the PAUSE frame flow control mechanism to take effect. An option is provided in the device to filter out the received PAUSE control frame.

6.5.2 PAUSE Control Frame Reception

Remote devices receiving Ethernet frames from Envoy-CE4 can backpressure Envoy-CE4, by sending a PAUSE control frame to Envoy-CE4. The backpressure may be needed if the buffer of the remote device on the link is becoming full. Upon reception of the PAUSE control frame, Envoy-CE4 will stop transmitting frames to the remote device. If Envoy-CE4 is in the middle of transmission of a frame, when it receives a PAUSE control frame, it will complete transmission of the frame and then pause transmission of any further Data frames. When Envoy-CE4 is in the pause state, it allows transmission of PAUSE control frames from the Envoy-CE4. The period for which Envoy-CE4 stays in a PAUSE state is defined by the `pause_time` parameter in the PAUSE control frame. The `pause_time` parameter is used as the initial value of an internal count down timer. This timer is started as soon as the `pause_time` parameter is loaded into the count down timer. Envoy-CE4 will stay in this PAUSE state until the internal timer counts down to zero, in which case Envoy-CE4 will resume transmission of data frames to the remote device. If a PAUSE control frame with a new non zero `pause_time` parameter is received, the new `pause_time` is loaded into the internal down counter and the Envoy-CE4 stays in the PAUSE state for the time specified by the new `pause_time`. When a PAUSE frame with a timer parameter value of zero is received, the Envoy-CE4 will resume sending data frames to the remote device.

6.5.3 PAUSE Control Frame Generation

There are two modes for PAUSE Control Frame generation: Automatic PAUSE frame generation and Host initiated PAUSE frame generation.

6.5.3.1 Automatic PAUSE Frame Generation

In this mode, when the remote device sends Data frames to the Envoy-CE4 and the Ingress FIFO fills to a programmable High Watermark, Envoy-CE4's flow control mechanism is triggered and automatically generates a PAUSE control frame, which is sent after the current transfer is over. Envoy-CE4 transmits the frame to the remote device and backpressures the remote device. The `pause_time` value for the generated PAUSE control is programmable. Once the PAUSE control frame is transmitted, Envoy-CE4 will re-transmit another PAUSE control frame, every `pause_retransmit_time`, if a programmable Low Watermark is not reached in the Ingress FIFO. The effect of the re-transmitted PAUSE control frame on the remote device is that, it (remote device) is held in the PAUSE state and does not transmit data frames to Envoy-CE4. The value of `pause_retransmit_time` is programmable and is kept by the `pause_retransmit` counter (down counter). In the event the Low Watermark is reached before the `pause_retransmit` counter counts down to zero, Envoy-CE4 will transmit a PAUSE control frame with a `pause_time` value of zero to the remote device held in the pause state. The PAUSE control frame with `pause_time` value of zero will initiate resumption of transmission of data frames from the remote device to the Envoy-CE4.

6.5.3.2 Host Initiated PAUSE Frame Generation

The Host device can query Envoy-CE4 for the status of each Ingress FIFO (per channel). The values for the indication of near full status and near empty status, are programmable. They are the Ingress FIFO Control High and Low Watermarks associated with the Ingress FIFOs. The Envoy-CE4 provides the host with the ability to generate a PAUSE control frame from the Envoy-CE4. This is done by the Host enabling the PAUSE generate configuration bit. The Host can generate a PAUSE control frame with a non-zero value for pause_time, to the remote device across the link with Envoy-CE4, when the Ingress FIFOs reach the High Watermark and also generate a PAUSE control frame with a null value for pause_time, when the Ingress FIFO reaches the Low Watermark. This allows the Host to regulate the flow control mechanism.

7.0 MEMORY MAPS AND BIT DESCRIPTIONS

Envoy-CE4 Register Memory Map

Base Address (Hex)	Description	Size in bytes
0x0000	Host I/F Status and Configuration	8K
0x2000	Egress FIFO Status and Configuration Ingress FIFO Status and Configuration Output SPI-3 Status and Configuration Input SPI-3 Status and Configuration	8K
0x4000	Ethernet Status and Configuration for Port 0	256
0x4100	Ethernet Status and Configuration for Port 1	256
<div> <div>.</div> <div>.</div> <div>.</div> <div>Ethernet Status and Configuration for Port 2 ... Port 30</div> <div>.</div> <div>.</div> <div>.</div> </div>		
0x5F00	Ethernet Port Status and Configuration for Port 31	256
0x6000	Ethernet Statistics for Port 0	256
0x6100	Ethernet Statistics for Port 1	256
<div> <div>.</div> <div>.</div> <div>.</div> <div>Ethernet Statistics for Port 2 Port 30</div> <div>.</div> <div>.</div> <div>.</div> </div>		
0x7F00	Ethernet Statistics for Port 31	256

Note: Please refer to the above table for register addresses for Ethernet Status and Configuration for Port 1 to Port 31 and for register addresses for Ethernet statistics for Port 1 to Port 31. The SMIREFCLK for each of the four CMACs must be active for these registers to operate correctly - even when the CMAC is configured in GMII mode.

Mode	Description
RO	Read Only Register
RW	Read/Write Register
RC	Clear On Read Register/Counter that saturated. Note: RMON counters are clear on read saturating counters or rollover counters. This option is programmable.

Address	31								24	23																		8	7									0					
0x0000	DeviceID																																										
0x0004	Reserved																																										
0x0008	ScratchReg																																										
0x000C	Reserved																																										
0x0010	ResetControl																																										
0x0014	Reserved																										ResetControl																
0x0018	IrqMask																																										
0x001C	Reserved																										IrqMask																
0x0020	IrqStatus																																										
0x0024	Reserved																										IrqStatus																
0x0028	CfgPins																																										
0x002C	Reserved																										*	Reserved															
0x0030	Reserved																																							GlobalCon trol			
0x0034	StatIrqStatus																																										
0x0038	StatIrqMask																																										
0X003C	Reserved																																										
0x0040	MII MGMT Configuration																																										
0x0044	MII MGMT Command																																										
0x0048	MII MGMT Address																																										
0x004C	MII MGMT Control																																										
0x0050	MII MGMT Status																																										
0x0054	MII MGMT Indicators																																										

Host Interface Status and Configuration Register Definitions

Addr (hex)	Mode	Bit range	Default value after reset	Description
0000	RO	0	1	Reserved
		11-1	06B	TxC Manufacturing ID: This field contains the manufacturer identification number for TranSwitch Corporation, which is 0x06B.
		27-12	1AE5	ENVOY ID: This field contains the Envoy-CE4 part number, TxC-06885.
		31-28	1	Device Version Level. This field is 1.
0004	RO	31-0	0	Reserved
0008	RW	31-0	12345678	Scratchpad Memory. 32-bits of memory storage available to the host processor.
000C	RO	31-0	0	Reserved
0010	RW	0	0	Reset Ethernet Port 0: Writing a 1 to this bit will reset the Ethernet Port 0. The host may access this register when the Ethernet Port 0 is in reset state. A read will always return a 0.
		1	0	Reset Ethernet Port 1: Writing a 1 to this bit will reset the Ethernet Port 1. The host may access this register when the Ethernet Port 1 is in reset state. A read will always return a 0.
	RW	31	0	Reset Ethernet Port 31: Writing a 1 to this bit will reset the Ethernet Port 31. The host may access this register when the Ethernet Port 31 is in reset state. A read will always return a 0.

Envoy-CE4 Device

DATA SHEET

TXC-06885



- Memory Maps and Bit Descriptions -

Addr (hex)	Mode	Bit range	Default value after reset	Description
0014	RW	0	0	Reset Ingress FIFO: Writing a 1 to this bit will reset the Ingress FIFO for all ports. The host may access this register when the Ingress FIFO is in reset state. Note: This Reset will reset the block specific configuration registers.
		1	0	Reset SPI-3 Output: Writing a 1 to this bit will reset the SPI-3 output interface. The host may access this register when the SPI-3 output is in reset state. Note: This Reset will reset the block specific configuration registers.
		2	0	Reset Egress FIFO: Writing a 1 to this bit will reset the Egress FIFO for all ports. The host may access this register when the Egress FIFO is in reset state. Note: This Reset will reset the block specific configuration registers.
		3	0	Reset SPI-3 Input: Writing a 1 to this bit will reset the SPI-3 input interface. The host may access this register when the SPI-3 input is in reset state. Note: This Reset will reset the block specific configuration registers.
		4	0	Reset MII Management Port: Writing a 1 to this bit will reset the MII management port. The host may access this register when the MII management port is in reset state. Note: This Reset will reset the block specific configuration registers.
		5	0	Reset Ethernet Statistics Module: Writing a 1 to this bit will reset the Ethernet statistics module. The host may access this register when the Ethernet statistics module is in reset state. Note: This Reset will reset the block specific configuration registers.
	RO	31-6	0	Reserved
0018	RW	0	1	Interrupt Mask for Ethernet Port 0: Writing a 1 to this bit will mask the interrupt from Ethernet Port 0. Writing a 0 to this bit will enable interrupts from Ethernet Port 0.
		1	1	Interrupt Mask for Ethernet Port 1: Writing a 1 to this bit will mask the interrupt from Ethernet Port 1. Writing a 0 to this bit will enable interrupts from Ethernet Port 1.
	RO	31	1	Interrupt Mask for Ethernet Port 31: Writing a 1 to this bit will mask the interrupt from Ethernet Port 31. Writing a 0 to this bit will enable interrupts from Ethernet Port 31.

Addr (hex)	Mode	Bit range	Default value after reset	Description
001C	RW	0	1	Interrupt Mask for Ingress FIFO: Writing a 1 to this bit will mask the interrupt from the Ingress FIFO. Writing a 0 to this bit will enable interrupts from the Ingress FIFO.
		1	1	Interrupt Mask for SPI-3 Output Interface: Writing a 1 to this bit will mask the interrupt from the SPI-3 output interface. Writing a 0 to this bit will enable interrupts from the SPI-3 output interface.
		2	1	Interrupt Mask for Egress FIFO: Writing a 1 to this bit will mask the interrupt from the Egress FIFO. Writing a 0 to this bit will enable interrupts from the Egress FIFO.
		3	1	Interrupt Mask for SPI-3 Input Interface: Writing a 1 to this bit will mask the interrupt from the SPI-3 input interface. Writing a 0 to this bit will enable interrupts from the SPI-3 input interface.
		4	1	Interrupt Mask for Ethernet Statistics Module: Writing a 1 to this bit will mask the interrupt from the Ethernet Statistics module. Writing a 0 to this bit will enable interrupts from the Ethernet Statistics module.
		5	1	Interrupt Mask for MII Management Module: Writing a 1 to this bit will mask the interrupt from the MII management module. Writing a 0 to this bit will enable interrupts from the MII management module.
	RO	31-6	0	Reserved
0020	RO	0	0	Interrupt Status for Ethernet Port 0: A 1 indicates the occurrence of an interrupt in this module. Clearing of the interrupts must be done at the source. Refer to the section for each module.
		1	0	Interrupt Status for Ethernet Port 1: A 1 indicates the occurrence of an interrupt in this module. Clearing of the interrupts must be done at the source. Refer to the section for each module.
	RO	31	0	Interrupt Status for Ethernet Port 31: A 1 indicates the occurrence of an interrupt in this module. Clearing of the interrupts must be done at the source. Refer to the section for each module.

Addr (hex)	Mode	Bit range	Default value after reset	Description
0024	RO	0	0	Interrupt Status for Ingress FIFO: A 1 indicates the occurrence of an interrupt in this module. Clearing of the interrupts must be done at the source. Refer to the section for each module.
		1	0	Interrupt Status for SPI-3 Output Interface: A 1 indicates the occurrence of an interrupt in this module. Clearing of the interrupts must be done at the source. Refer to the section for each module.
		2	0	Interrupt Status for Egress FIFO: A 1 indicates the occurrence of an interrupt in this module. Clearing of the interrupts must be done at the source. Refer to the section for each module.
		3	0	Interrupt Status for SPI-3 Input Interface: A 1 indicates the occurrence of an interrupt in this module. Clearing of the interrupts must be done at the source. Refer to the section for each module.
		4	0	Interrupt Status for Ethernet Statistics Module: A 1 indicates the occurrence of an interrupt in this module. Clearing of the interrupts must be done at the source. Refer to the section for each module.
		5	0	Interrupt Status for MII Management Module: A 1 indicates the occurrence of an interrupt in this module. Clearing of the interrupts must be done at the source. Refer to the section for each module.
		31-6	0	Reserved
0028	RO	1-0		CMAC A Pin Configuration: Reflection of the Configuration Pin for configuring MAC A (Pin - CFGCMACA[1-0]) 00 - OFF 01 - 1 GMII/MII 10 - 2 Extended SMII 11 - 8 SMII
		3-2		CMAC B Pin Configuration: Reflection of the Configuration Pin for configuring MAC B (Pin - CFGCMACB[1-0]) 00 - OFF 01 - 1 GMII/MII 10 - 2 Extended SMII 11 - 8 SMII
		5-4		CMAC C Pin Configuration: Reflection of the Configuration Pin for configuring MAC C (Pin - CFGCMACC[1-0]) 00 - OFF 01 - 1 GMII/MII 10 - 2 Extended SMII 11 - 8 SMII

Addr (hex)	Mode	Bit range	Default value after reset	Description
0028 (cont.)	RO	7-6		CMAC D Pin Configuration: Reflection of the Configuration Pin for configuring MAC D (Pin - CFGCMACD[1-0]) 00 - OFF 01 - 1 GMII/MII 10 - 2 Extended SMII 11 - 8 SMII
		15-8	0	Reserved
		16		SPI-3 INPUT MODE Pin Configuration: Reflection of the Configuration Pin for configuring the SPI-3 Input Mode (CFGISPIMD) 0 - SPI-3 in PHY (Slave) mode 1 - SPI-3 in Link (Master) mode
		17		SPI-3 OUTPUT MODE Pin Configuration: Reflection of the Configuration Pin for configuring the SPI-3 Output Mode (CFGOSPIMD) 0 - SPI-3 in Slave mode 1 - SPI-3 in Master mode
		19-18		SPI-3 Bus Width Pin Configuration: Reflection of the Configuration Pin for configuring the SPI-3 Bus width (CFGOSPIBW[1-0]) 00 - 32-bit mode 01 - 16-bit mode 10 - 8-bit mode 11 - Reserved
		25-20	0	Reserved
		26		Host Interface Bus Width Pin Configuration: Reflection of the Configuration Pin for configuring the Host Interface Bus Width (CFGUPBW) 0 - 16 bits 1 - 8 bits
		27		Host Interface Selection Pin Configuration: Reflection of the Configuration Pin for configuring the Host Interface type, Intel or Motorola (CFGUPMD) 0 - Host Interface in Intel Mode 1 - Host Interface in Motorola Mode
		28		SMII SYNC Direction Selection Pin: Reflection of the Configuration Pin for configuring the SMII Sync Signal direction (SSYNCDIR) 0 - The synchronization pulse will be taken from an internally generated source 1 - The synchronization pulse to the 8 SMII ports will be taken from SSYNCDIN
		31-29	0	Reserved

Addr (hex)	Mode	Bit range	Default value after reset	Description
002C	RO	3-0	0	Reserved
	RW	4	0	Oversubscription Enable: Valid in SPI-3 Linke (master) mode only. 0 - The $\overline{\text{ISPIREN B}}$ output pin is used to apply SPI-3 standard backpressure 1 - Allows an external SPI-3 PHY (slave) device to push data into the SPI-3 input without ever being backpressured
	RW	31-5	0	Reserved
0030	RW	0	1	RMON Statistics Counter Auto Clear On Read: 0 - Statistics counter is not cleared on read and counter rolls over to 0 when it reaches maximum value 1 - Statistics counter is automatically cleared after it is read and counter will saturate at maximum value
		1	0	Received Byte Counter Config: 0 - The receive byte counter includes bytes from errored packets 1 - The receive byte counter only counts bytes from good packets
	RO	31-2	0	Reserved
0034	RO	0	0	Interrupt Status for Ethernet Port 0 Ethernet Statistics: A 1 indicates the occurrence of an interrupt from the Ethernet Statistics block for Ethernet Port 0.
		31-1	0	Interrupt Status for Ethernet Ports 1 to 31 Ethernet Statistics
0038	RW	0	0	Interrupt Mask for Ethernet Port 0 Ethernet Statistics: A 1 masks the interrupt from the Ethernet Statistics block for Ethernet Port 0.
		31-1	0	Interrupt Mask for Ethernet Ports 1 to 31 Ethernet Statistics
003C	RO	31-0	0	Reserved

Addr (hex)	Mode	Bit range	Default value after reset	Description																															
0040	RW	MII MGMT: CONFIGURATION REGISTER																																	
		2-0	0	MGMT Clock Select: This field determines the clock frequency of the MGMT Clock (MDC). Consult Table below - MGMT Clock Select Encoding on how to program this field. MGMT Clock Select Encoding <table><tr><th>MGMT Clock Select Bits</th><th>2</th><th>1</th><th>0</th></tr><tr><td>UPCLK divided by 4</td><td>0</td><td>0</td><td>X</td></tr><tr><td>UPCLK divided by 6</td><td>0</td><td>1</td><td>0</td></tr><tr><td>UPCLK divided by 8</td><td>0</td><td>1</td><td>1</td></tr><tr><td>UPCLK divided by 10</td><td>1</td><td>0</td><td>0</td></tr><tr><td>UPCLK divided by 14</td><td>1</td><td>0</td><td>1</td></tr><tr><td>UPCLK divided by 20</td><td>1</td><td>1</td><td>0</td></tr><tr><td>UPCLK divided by 28</td><td>1</td><td>1</td><td>1</td></tr></table>	MGMT Clock Select Bits	2	1	0	UPCLK divided by 4	0	0	X	UPCLK divided by 6	0	1	0	UPCLK divided by 8	0	1	1	UPCLK divided by 10	1	0	0	UPCLK divided by 14	1	0	1	UPCLK divided by 20	1	1	0	UPCLK divided by 28	1	1
	MGMT Clock Select Bits	2	1	0																															
	UPCLK divided by 4	0	0	X																															
	UPCLK divided by 6	0	1	0																															
	UPCLK divided by 8	0	1	1																															
	UPCLK divided by 10	1	0	0																															
	UPCLK divided by 14	1	0	1																															
	UPCLK divided by 20	1	1	0																															
	UPCLK divided by 28	1	1	1																															
RO	3		Reserved																																
RW	4	0	Preamble Suppression: 0 - MII MGMT will perform MGMT read/write cycles with the 32 clocks of preamble 1 - MII MGMT will suppress preamble generation and reduce the MGMT cycle from 64 clocks to 32 clocks per IEEE 802.3/22.2.4.4.2																																
	5	0	PHY/Register Scan Enable: When Scan Mode Enable is enabled, this bit determines whether or not to increment the PHY or register address for the next read cycle. 1 - Increment address																																
	6	0	Scan Register Increment Select: - When Scan Mode Enable is enabled, this bit determines whether to increment the Register address or the PHY address. 0 - Increment PHY address, allows read scan of the same register in all PHYs 1 - Increment register address, allows read scan of all registers in a specific PHY																																
RO	31-7		Reserved																																

Addr (hex)	Mode	Bit range	Default value after reset	Description
0044	RW	MII MGMT: COMMAND REGISTER		
		0	0	READ Operation Enable: Low to High transition initiates a Read cycle. The read data is returned in the MII MGMT Read Data register. In scan mode, after each read of the Read Data register, another Read cycle is performed.
		1	0	SCAN Mode Enable: When 1 and Read operation is enabled, causes the MII Management to perform Read cycles automatically.
	RO	31-2	0	Reserved
0048	RW	MII MGMT: ADDRESS REGISTER		
		4-0	0	Register Address: This field represents the 5-bit Register Address field of MGMT cycles. Up to 32 registers can be accessed. If scanning across multiple registers in a PHY is enabled, then load the address of the last PHY to be scanned here.
	RO	7-5		Reserved
	RW	12-8	0	PHY Address: This field represents the 5-bit PHY Address field of MGMT cycles. Up to 32 PHYs can be addressed. If scanning across multiple PHYs (Scan PHY Mode), then load the address of the last PHY to be scanned here.
	RO	31-13		Reserved
004C	RW	MII MGMT: Data Write		
		15-0	0	MII MGMT Write: When written, an MII MGMT write cycle is performed using the 16-bit data and the pre-configured PHY and Register addresses from the MII MGMT Address Register (0x0048).
	RO	31-16		Reserved

Addr (hex)	Mode	Bit range	Default value after reset	Description
0050	RO	MII MGMT: Data Read		
		15-0	0	MII MGMT Read Data: Following an MII MGMT Read Cycle, the 16-bit data can be read from this location.
		20-16	0	MII MGMT Read Register Address: Following an MII MGMT Read Cycle, the 5-bit register address of the register that was accessed can be read from this location. This eases reading registers in scan mode.
		23-21		Reserved
		28-24	0	MII MGMT Read PHY Address: Following an MII MGMT Read Cycle, the 5-bit PHY number of the register that was accessed can be read from this location. This eases reading registers in scan mode.
		30-29		Reserved
		31	0	Read Busy: 1 - Indicates MII MGMT block is currently performing an MII MGMT Read cycle
0054	RO	MII MGMT: INDICATORS		
		0	0	Busy: 1 - Indicates MII MGMT block is currently performing an MII MGMT Read or Write cycle
		31-1		Reserved

[illegible]

TXC-06885

Proprietary TranSwitch Corporation Information for use Solely by its Customers

Egress/Ingress FIFO and SPI-3 Input/Output, Status, and Control Register Map

Addr (hex)	Mode	Bit range	Default value after reset	Description
2000	RO			SPI-3 Input Configuration
		15-0		Reserved
	RW	16	0	SPI-3 Input Single-PHY Enable: The SPI-3 Single-PHY mode enable bit. 0 - Multi-PHY 1 - Single-PHY
		17	0	SPI-3 Input Aggregation Mode Enable: The Aggregation Mode Enable bit for SPI-3 Input. 0 - Normal mode 1 - Aggregate mode
		19-18	00	Aggregate Mode TAG Position: The Ethernet Aggregate Mode Tag Position. This indicates the byte position in the Aggregate Tag word (4 bytes long), which indicates the PHY number of the packet.
		20	1	SPI-3 Input Parity Mode: SPI-3 Input interface parity mode. 0 - Even parity 1 - Odd parity
		21	1	SPI-3 Input Parity Enable: SPI-3 Input interface parity checking enable bit. 0 - Parity checking not enabled 1 - Parity checking enabled
	RO	31-22		Reserved
2004	RW	31-0	00000000	SPI-3 Input PHY/Port Enable Per Port: SPI-3 Input PHY/Port Enable bits for the 32 SPI-3 Input ports (one per port). Bit 0 = Port 0, Bit 1 = Port 1..... Bit 31 = Port 31.
2008	RW	7-0	00000000	SPI-3 Input STPA Low Threshold: Input SPI-3 near full low threshold for assertion of STPA. Once STPA is de-asserted because the Egress FIFO reached the SPI-3 high threshold (SISHT), STPA will be asserted when the Egress FIFO reaches the STPA low threshold. This allows for a hysteresis in the STPA signal. For a bus width of 8 bits, the value is based on bytes. For a bus width of 16 bits, 2 bytes and a bus width of 32 bits, 4 bytes. Minimum value is 2.
	RO	31-8		Reserved
200C	RW	7-0	00000000	SPI-3 Input STPA High Threshold: Input SPI-3 near full high threshold for de-assertion of STPA. The high threshold is the fullness level and when reached by the Egress FIFO will de-assert STPA. The value is specified in terms of the SPI-3 bus width. For a bus width of 8 bits, the value is based on bytes. For a bus width of 16 bits, 2 bytes and a bus width of 32 bits, 4 bytes. Minimum value is 2.
	RO	31-8		Reserved

Addr (hex)	Mode	Bit range	Default value after reset	Description
2010	RW	7-0	00000000	SPI-3 Input PTPA Low Threshold: Input SPI-3 near full low threshold for assertion of PTPA. Once the PTPA is de-asserted because the Egress FIFO reached the SPI-3 high threshold (SIPHT), PTPA will be asserted when the Egress FIFO reaches the PTPA low threshold. This allows for a hysteresis in the PTPA signal. The threshold is in words (8 bytes). Programmable values are 1 to 255 which corresponds to threshold values of 8 to 2040, in 8 byte increments.
	RO	31-8		Reserved
2014	RW	7-0	00000000	SPI-3 Input PTPA High Threshold: Input SPI-3 near full high threshold for de-assertion of PTPA. The high threshold is the fullness level in words (8 bytes), when reached by the Egress FIFO will de-assert PTPA. Programmable values are 1 to 255 which corresponds to threshold values of 8 to 2040, in 8 byte increments. The PTPA High Threshold should be set to at least 3 times the chunk size being used in the attached device (associated with ISPI flow).
	RO	31-8		Reserved
2018	RW	0	1	Reserved Must be set to 0 for normal operation.
	RO	31-1	0	Reserved
201C	RO	31-0	0	Reserved
2040	RC	0	0	SPI-3 Input STPA Violation Status: Status bit indicating that the Link Layer Device has violated the agreed upon STPA protocol. An indication that the Link Layer device has sent more data than agreed upon between the PHY and Link layer devices after the de-assertion of STPA. This bit is only valid in PHY mode.
		1	0	SPI-3 Input Parity Error Status: Status bit indicating occurrence of Parity error across the SPI-3 Input Interface bus. Clear on Read.
		2	0	SPI-3 Input Packet Error Status: Status bit indicating occurrence of Packet error across the SPI-3 Input Interface indicated by the Error signal. Clear on Read.
		3	0	SPI-3 Input Start of Packet Error Status: Status bit indicating occurrence of Start of Packet error across the SPI-3 Input Interface. Clear on Read.
	RO	31-4		Reserved

Addr (hex)	Mode	Bit range	Default value after reset	Description
2050	RW	0	1	SPI-3 Input Overflow Discard Interrupt Mask: Interrupt Mask for SPI-3 Input Overflow Discard Status based interrupt. 0 = Disables Mask, 1 = Enables Mask.
		1	1	SPI-3 Input Parity Error Interrupt Mask: Interrupt Mask for SPI-3 Input Parity Error Status based interrupt. 0 = Disables Mask, 1 = Enables Mask.
		2	1	SPI-3 Input Packet Error Interrupt Mask: Interrupt Mask for SPI-3 Input Packet Error Status based interrupt. 0 = Disables Mask, 1 = Enables Mask.
		3	1	SPI-3 Input Start of Packet Error Interrupt Mask: Interrupt Mask for SPI-3 Input Start of Packet Error Status based interrupt. 0 = Disables Mask, 1 = Enables Mask.
	RO	31-4		Reserved
2060	RC	31-0	00000000	SPI-3 Input Parity Error Counter: Counter indicating the number of Parity Errors across the SPI-3 Input interface. Clear on Read.
2064	RC	31-0	00000000	SPI-3 Input Start of Packet Error Counter: Counter indicating the number of Start of Packet Errors across the SPI-3 Input interface. Clear on Read.
2068	RO	31-0	00000000	Reserved
2080	RC	31-0	00000000	SPI-3 Input Packet Error Counter Port 0: Counter indicating the number of SPI-3 Ingress Packet Errors indicated over the SPI-3 Error pin for Port 0. Clear on Read.
2084	RC	31-0	00000000	SPI-3 Input Packet Error Counter Port 1: Counter indicating the number of SPI-3 Ingress Packet Errors indicated over the SPI-3 Error pin for Port 1. Clear on Read.
<p style="text-align: center;">•</p> <p style="text-align: center;">SPI-3 Input Packet Error Counter for Port 2 to Port 30</p> <p style="text-align: center;">•</p>				
20FC	RC	31-0	00000000	SPI-3 Input Packet Error Counter Port 31: Counter indicating the number of SPI-3 Ingress Packet Errors indicated over the SPI-3 Error pin for Port 31. Clear on Read.

Addr (hex)	Mode	Bit range	Default value after reset	Description
2200	RW	2-0	0	SPI-3 Base Address: The 3 bit base address used to create the 8 bit SPI-3 port address for both SPI-3 Input and SPI-3 output. The base address is a 3 bit programmable value and is assigned to the most significant 3 bits of the 8 bit SPI-3 address. Individual SPI-3 port address are calculated by adding the (base address x 32) to the logical Ethernet port number.
	RO	3	0	Reserved
	RW	4	1	SPI-3 Output Pause Cycle Time: The minimum Pause time between transfers in SPI-3 clock cycles. Only used in PHY mode. 0 - 0 cycles 1 - 2 cycles
		5	0	SPI-3 Output Single-PHY Enable: The SPI-3 Single-PHY mode enable bit. 0 - Multi-PHY 1 - Single-PHY
		6	0	SPI-3 Output Aggregation Mode Enable: The Aggregation Mode Enable bit for SPI-3 Output. 0 - Normal mode 1 - Aggregate mode
		7	1	SPI-3 Output Parity Mode: SPI-3 Output interface parity mode. 0 - Even parity 1 - Odd parity
		8	1	SPI-3 Output Parity Enable: SPI-3 Output interface parity generation enable bit. 0 - Parity generation not enabled 1 - Parity generation enabled
		9	0	SPI-3 Output Mode: Bit to enable SPI-3 output mode. 0 - Burst (Chunk) Mode. In Burst mode, a configured number of bytes (SPI-3 Output Burst Size) is sent across the SPI-3 interface before a re-selection. 1 - Packet Mode. In Packet mode, a complete packet is sent across the SPI-3 interface by a port before a port re-selection.
	RO	31-10		Reserved
2204	RW	31-0	00000000	SPI-3 Output PHY/Port Enable Per Port: SPI-3 Output PHY/Port Enable bits for the 32 SPI-3 Output ports (one per port).
2208	RW	7-0	00000000	SPI-3 Output STPA Near Full Threshold: Output SPI-3 near full threshold for de-assertion of STPA.
	RO	31-8		Reserved

Addr (hex)	Mode	Bit range	Default value after reset	Description
220C	RW	7-0	00000000	SPI-3 Output Burst Size: Output SPI-3 Burst Size when the SPI-3 output is in Burst Mode (SPI-3 Output Mode = 0). The unit is in 8 byte words. Programmable values are 1 to 255 which corresponds to threshold values of 8 to 2040, in 8 byte increments.
	RO	31-8		Reserved
2210	RW	0	1	SPI-3 Output STPA Enable: Bit to enable usage of STPA when the SPI-3 Output interface is in Link (Master) mode.
	RO	31-1		Reserved
2214	RW	0	1	SPI-3 Output PTPA Enable: Bit to enable usage of PTPA when the SPI-3 Output interface is in Link (Master) mode.
	RO	31-1		Reserved
2280	RW	31-0	00000000	SPI-3 Output Aggregation Mode Tag Port 0: The Aggregation Tag for Port 0 that is prepended to each packet/chunk, when in Aggregation mode (SPI-3 Output Aggregation Mode Enable = 1).
2284	RW	31-0	00000000	SPI-3 Output Aggregation Mode Tag Port 1: The Aggregation Tag for Port 1 that is prepended to each packet/chunk, when in Aggregation mode (SPI-3 Output Aggregation Mode Enable = 1).
<p style="text-align: center;">•</p> <p style="text-align: center;">SPI-3 Output Aggregation Mode Tags for Port 2 to Port 30</p> <p style="text-align: center;">•</p>				
22FC	RW	31-0	00000000	SPI-3 Output Aggregation Mode Tag Port 31: The Aggregation Tag for Port 31 that is prepended to each packet/chunk, when in Aggregation mode (SPI-3 Output Aggregation Mode Enable = 1).
2400	RC	31-0	00000000	Egress FIFO Packet Drop Counter Port 0: The Egress FIFO Packet Drop Counter counts dropped packets for either of the following conditions: (a) Start of Packet and End of Packet in the same word (b) Assertion of the SPI-3 Error pin after a start of packet has been received. (c) An overflow occurred in the Egress FIFO. Packets are dropped in store and forward mode only (Egress FIFO Mode = 0). Clear on Read.
2404	RC	31-0	00000000	Egress FIFO Packet Drop Counter Port 1: The Egress FIFO Packet Drop Counter counts dropped packets for either of the following conditions: (a) Start of Packet and End of Packet in the same word (b) Assertion of the SPI-3 Error pin after a start of packet has been received. (c) An overflow occurred in the Egress FIFO. Packets are dropped in store and forward mode only (Egress FIFO Mode = 0). Clear on Read.

Addr (hex)	Mode	Bit range	Default value after reset	Description
Egress FIFO Packet Drop Counter for Port 2 to Port 30				
247C	RC	31-0	00000000	Egress FIFO Packet Drop Counter Port 31: The Egress FIFO Packet Drop Counter counts dropped packets for either of the following conditions: (a) Start of Packet and End of Packet in the same word (b) Assertion of the SPI-3 Error pin after a start of packet has been received. (c) An overflow occurred in the Egress FIFO. Packets are dropped in store and forward mode only (Egress FIFO Mode = 0). Clear on Read.
2500	RC	31-0	00000000	Egress FIFO Full Status Per Port: Indication of Egress FIFO for all 32 ports. When 1, indicates the FIFO Full state. Clear on Read.
2504	RC	31-0	00000000	Egress FIFO Disabled Error Status Per Port: Indication of Egress FIFO Error when a disabled port (done through configuration register Egress FIFO PHY/Port Enable) receives packet data from the SPI-3 interface. The packet data is discarded. When 1, indicates the occurrence of the error. Clear on Read.
2508	RC	31-0	00000000	Egress FIFO Start of Packet Error Status Per Port: Indication of Egress FIFO Start of Packet Error. The error status is indicated on the reception of packet data without the reception of a Start of Packet, after an End of Packet. When 1, indicates the occurrence of the error. Clear on Read.
2540	RW	0	0	Egress FIFO Mode: This bit sets the FIFO mode for all Egress FIFOs. 0 - Store and Forward Mode 1 - Streaming Mode
	RO	31-1	0	Reserved
2544	RW	31-0	FFFFFFFF	Egress FIFO Full Interrupt Mask Per Port: FIFO full interrupt mask for the 32 Egress FIFOs (one per port). A 0 disables the mask and an interrupt will be generated when the appropriate FIFO becomes full. The interrupt is cleared by reading the status register Egress FIFO Full Status Per Port . If this bit is 1, no interrupt will be generated.
2548	RW	31-0	FFFFFFFF	Egress FIFO Disabled Error Interrupt Mask Per Port: Disabled Egress FIFO Error interrupt mask for the 32 Egress FIFOs (one per port). A 0 disables the mask and an interrupt will be generated when the appropriate FIFO/Port is disabled and receives data for a write. The interrupt is cleared by reading the status register Egress FIFO Disabled Error Status . If this bit is 1, no interrupt will be generated.
254C	RW	31-0	FFFFFFFF	Egress FIFO Start of Packet Error Interrupt Mask Per Port: Egress FIFO Start of Packet Error interrupt mask for the 32 Egress FIFOs (one per port). A 0 disables the mask. An interrupt will be generated when the appropriate FIFO/Port receives consecutive End of Packets. The interrupt is cleared by reading the status register Egress FIFO Start of Packet Error Status . If this bit is 1, no interrupt will be generated.

Addr (hex)	Mode	Bit range	Default value after reset	Description
2550	RW	31-0	FFFFFFFF	Egress FIFO PHY/Port Enable Per Port: Egress FIFO/Port Enable bits for the 32 Egress FIFOs (one per port).
2580	RW	2-0	0	Egress FIFO Streaming Threshold Port 0: Egress FIFO Streaming threshold in bytes for Port 0. The values are: 000 - 64 Bytes 001 - 128 Bytes 010 - 256 Bytes 011 - 512 Bytes 100 - 768 Bytes 101 - 1544 Bytes 110 & 111 - Reserved When the Port is in Streaming mode and the Egress FIFO reaches the programmed threshold, an indication is sent to the associated Configurable MAC block to transfer the Port's Packet Data across the Ethernet interface.
	RO	31-3		Reserved
2584	RW	2-0	0	Egress FIFO Streaming Threshold Port 1: Egress FIFO Streaming threshold in bytes for Port 1. The values are: 000 - 64 Bytes 001 - 128 Bytes 010 - 256 Bytes 011 - 512 Bytes 100 - 768 Bytes 101 - 1544 Bytes 110 & 111 - Reserved When the Port is in Streaming mode and the Egress FIFO reaches the programmed threshold, an indication is sent to the associated Configurable MAC block to transfer the Port's Packet Data across the Ethernet interface.
	RO	31-3		Reserved

Addr (hex)	Mode	Bit range	Default value after reset	Description
Egress FIFO Streaming Threshold for Port 2 to Port 30				
25FC	RW	2-0	0	Egress FIFO Streaming Threshold Port 31: Egress FIFO Streaming threshold in bytes for Port 31. The values are: 000 - 64 Bytes 001 - 128 Bytes 010 - 256 Bytes 011 - 512 Bytes 100 - 768 Bytes 101 - 1544 Bytes 110 & 111 - Reserved When the Port is in Streaming mode and the Egress FIFO reaches the programmed threshold, an indication is sent to the associated Configurable MAC block to transfer the Port's Packet Data across the Ethernet interface.
	RO	31-3		Reserved
2600	RC	31-0	00000000	Ingress FIFO Packet Drop Counter Port 0: The Ingress FIFO Packet Drop Counter counts dropped packets due to the MAC detecting an error. Packets are dropped in store and forward mode only (Ingress FIFO Mode = 0). Clear on Read.
2604	RC	31-0	00000000	Ingress FIFO Packet Drop Counter Port 1: The Ingress FIFO Packet Drop Counter counts dropped packets due to the MAC detecting an error. Packets are dropped in store and forward mode only (Ingress FIFO Mode = 0). Clear on Read.
Ingress FIFO Packet Drop Counter for Port 2 to Port 30				
267C	RC	31-0	00000000	Ingress FIFO Packet Drop Counter Port 31: The Ingress FIFO Packet Drop Counter counts dropped packets due to the MAC detecting an error. Packets are dropped in store and forward mode only (Ingress FIFO Mode = 0). Clear on Read.
2700	RC	31-0	00000000	Ingress FIFO Full Interrupt Status Per Port: FIFO full Status for the 32 Ingress FIFOs (one per port).
2704	RC	31-0	00000000	Ingress FIFO Near Full Interrupt Status: FIFO Near full Status for the 32 Ingress FIFOs (one per port). A Port will go into a near full condition when its Ingress FIFO level goes beyond the Pause Frame High Threshold value associated with that port.

Addr (hex)	Mode	Bit range	Default value after reset	Description
2780	RW	0	0	Ingress FIFO Mode: This bit sets the FIFO mode for all Ingress FIFOs. 0 - Store and Forward Mode 1 - Streaming Mode
	RO	31-1	0	Reserved
2784	RW	0	0	Ingress FIFO LoopBack Enable: This bit sets the FIFO mode in loopback mode. Packets from the Ingress FIFO will be loop backed onto the Egress FIFO. This loopback can support a maximum of 800 Mbit/s. Note: The output SPI-3 must be in slave mode.
	RO	31-1	0	Reserved
2788	RW	0	0	Ingress FIFO LoopBack Block SPI-3: If this bit is set to 1 with the Ingress FIFO LoopBack enabled (Ingress FIFO LoopBack Enable = 1), packet data looped back will not appear at the SPI-3 output interface. When set to 0 and Ingress FIFO Loopback enabled, packet data will loopback to the Egress FIFO and appear at the SPI-3 output interface. Note: For this mode to work, the Output SPI-3 Enable pin needs to be asserted.
	RO	31-1	0	Reserved
278C	RW	12-0	1FFF	Flow Control High Threshold CMAC A: This register sets the high threshold in multiples of 8 bytes, for Ports 0 to 7 (served by Configurable MAC A), for generation of PAUSE frames or asserting raise carrier. In the event one of the Ethernet port's ingress FIFO (served by Configurable MAC A) reaches this threshold, a Pause frame will be sent or raise carrier will be asserted from that port. Note: Automatic pause frame generation needs to be enabled.
	RO	31-13	0	Reserved
2790	RW	12-0	1FFF	Flow Control Low Threshold CMAC A: This register sets the low threshold in multiples of 8 bytes, for Ports 0 to 7 (served by Configurable MAC A), to stop generation of PAUSE frames or de-asserting raise carrier. In the event one of the Ethernet port's ingress FIFO (served by Configurable MAC A) reaches this threshold, when in the pause frame generation state, further generation of Pause frames will halt or raise carrier will be de-asserted from that port. Note: Automatic pause frame generation needs to be enabled. Pause frame generation state is reached once the Pause high threshold is crossed.
	RO	31-13	0	Reserved

Addr (hex)	Mode	Bit range	Default value after reset	Description
2794	RW	12-0	1FFF	Flow Control High Threshold CMAC B: This register sets the high threshold in multiples of 8 bytes, for Ports 8 to 15 (serviced by Configurable MAC B), for generation of PAUSE frames or asserting raise carrier. In the event one of the Ethernet port's ingress FIFO (serviced by Configurable MAC B) reaches this threshold, a Pause frame will be sent or raise carrier will be asserted from that port. Note: Automatic pause frame generation needs to be enabled.
	RO	31-13	0	Reserved
2798	RW	12-0	1FFF	Flow Control Low Threshold CMAC B: This register sets the low threshold in multiples of 8 bytes, for Ports 8 to 15 (serviced by Configurable MAC B), to stop generation of PAUSE frames or de-asserting raise carrier. In the event one of the Ethernet port's ingress FIFO (serviced by Configurable MAC B) reaches this threshold, when in the pause frame generation state, further generation of Pause frames will halt or raise carrier will be de-asserted from that port. Note: Automatic pause frame generation needs to be enabled. Pause frame generation state is reached once the Pause high threshold is crossed.
	RO	31-13	0	Reserved
279C	RW	12-0	1FFF	Flow Control High Threshold CMAC C: This register sets the high threshold in multiples of 8 bytes, for Ports 16 to 23 (serviced by Configurable MAC C), for generation of PAUSE frames or asserting raise carrier. In the event one of the Ethernet port's ingress FIFO (serviced by Configurable MAC C) reaches this threshold, a Pause frame will be sent or raise carrier will be asserted from that port. Note: Automatic pause frame generation needs to be enabled.
	RO	31-13	0	Reserved
27A0	RW	12-0	1FFF	Flow Control Low Threshold CMAC C: This register sets the low threshold in multiples of 8 bytes, for Ports 16 to 23 (serviced by Configurable MAC C), to stop generation of PAUSE frames or de-asserting raise carrier. In the event one of the Ethernet port's ingress FIFO (serviced by Configurable MAC C) reaches this threshold, when in the pause frame generation state, further generation of Pause frames will halt or raise carrier will be de-asserted from that port. Note: Automatic pause frame generation needs to be enabled. Pause frame generation state is reached once the Pause high threshold is crossed.
	RO	31-13	0	Reserved

Addr (hex)	Mode	Bit range	Default value after reset	Description
27A4	RW	12-0	1FFF	Flow Control High Threshold CMAC D: This register sets the high threshold in multiples of 8 bytes, for Ports 24 to 31 (serviced by Configurable MAC D), for generation of PAUSE frames or asserting raise carrier. In the event one of the Ethernet port's ingress FIFO (serviced by Configurable MAC D) reaches this threshold, a Pause frame will be sent or raise carrier will be asserted from that port. Note: Automatic pause frame generation needs to be enabled.
	RO	31-13	0	Reserved
27A8	RW	12-0	1FFF	Flow Control Low Threshold CMAC D: This register sets the low threshold in multiples of 8 bytes, for Ports 24 to 31 (serviced by Configurable MAC D), to stop generation of PAUSE frames or de-asserting raise carrier. In the event one of the Ethernet port's ingress FIFO (serviced by Configurable MAC D) reaches this threshold, when in the pause frame generation state, further generation of Pause frames will halt or raise carrier will be de-asserted from that port. Note: Automatic pause frame generation needs to be enabled. Pause frame generation state is reached once the Pause high threshold is crossed.
	RO	31-13	0	Reserved
27AC	RW	15-0	FFFF	Pause Frame Regeneration Timer CMAC A: This register sets the Pause frame regeneration time in Pause Quanta (1 Pause Quanta = 512 bit times) for ports 0 to 7, (serviced by Configurable MAC A). The Pause Frame Regeneration time sets the time between consecutive Pause frames from an ethernet port, while the port is in the Pause Generation state. Note: Pause frame generation state is reached once the Pause high threshold is crossed and the Pause low threshold is not reached.
	RO	31-16	0	Reserved
27B0	RW	15-0	FFFF	Pause Frame Regeneration Timer CMAC B: This register sets the Pause frame regeneration time in Pause Quanta (1 Pause Quanta = 512 bit times) for ports 8 to 15, (serviced by Configurable MAC B). The Pause Frame Regeneration time sets the time between consecutive Pause frames from an ethernet port, while the port is in the Pause Generation state. Note: Pause frame generation state is reached once the Pause high threshold is crossed and the Pause low threshold is not reached.
	RO	31-16	0	Reserved

Addr (hex)	Mode	Bit range	Default value after reset	Description
27B4	RW	15-0	FFFF	<p>Pause Frame Regeneration Timer C MAC C: This register sets the Pause frame regeneration time in Pause Quanta (1 Pause Quanta = 512 bit times) for ports 16 to 23, (serviced by Configurable MAC C). The Pause Frame Regeneration time sets the time between consecutive Pause frames from an ethernet port, while the port is in the Pause Generation state.</p> <p>Note: Pause frame generation state is reached once the Pause high threshold is crossed and the Pause low threshold is not reached.</p>
	RO	31-16	0	Reserved
27B8	RW	15-0	FFFF	<p>Pause Frame Regeneration Timer C MAC D: This register sets the Pause frame regeneration time in Pause Quanta (1 Pause Quanta = 512 bit times) for ports 24 to 31, (serviced by Configurable MAC D). The Pause Frame Regeneration time sets the time between consecutive Pause frames from an ethernet port, while the port is in the Pause Generation state.</p> <p>Note: Pause frame generation state is reached once the Pause high threshold is crossed and the Pause low threshold is not reached.</p>
	RO	31-16	0	Reserved
27BC	RW	31-0	FFFFFFFF	<p>Ingress FIFO Full Interrupt Mask Per Port: FIFO full interrupt mask for the 32 Ingress FIFOs (one per port). When 0, disables the mask and an interrupt will be generated when the appropriate FIFO becomes full. The interrupt is cleared by reading the status register Ingress FIFO Full Status. If this bit is 1, no interrupt will be generated.</p>
27C0	RW	31-0	FFFFFFFF	<p>Ingress FIFO Near Full Interrupt Mask Per Port: FIFO Near full interrupt mask for the 32 Ingress FIFOs (one per port). When 0, disables the mask and an interrupt will be generated when the appropriate FIFO becomes Near full. The interrupt is cleared by reading the status register Ingress FIFO Near Full Status. If this bit is 1, no interrupt will be generated. A Port will go into a near full condition when its Ingress FIFO level goes beyond the Pause Frame High Threshold value associated with the port.</p>
27C4	RW	31-0	FFFFFFFF	<p>Ingress FIFO PHY/Port Enable Per Port: Ingress FIFO/Port Enable bits for the 32 Ingress FIFOs (one per port).</p>

Address Offset	31								24	23																8	7							0
0x00	MAC Configuration #1																																	
0x04	MAC Configuration #2																																	
0x08	IPG / IFG																																	
0x0C	Reserved									Half-Duplex																								
0x10	Reserved																Maximum Frame Length																	
0x14	Reserved																																	
0x18	Reserved																																	
0x1C	Reserved																												Test Register					
0x20	Reserved																																	
0x24	Reserved																																	
0x28	Reserved																																	
0x2C	Reserved																																	
0x30	Reserved																																	
0x34	Reserved																																	
0x38	SMII Control									Reserved																								
0x3C	Reserved																				SMII Status							Reserved						
0x40	Source Address 1-4																																	
0x44	Source Address 5-6																Reserved																	
....	Reserved																																	
0x80	CFEP																CFPT																	
0x84	LocCtrl1																LocCtrl2																	
0x88	Reserved									IrqMask						Reserved								IrqStatus					Reserved					
0x8C	Reserved																														GMII/ SMII			

The following table is the Ethernet Configuration and Status Register description for Port 0 (as identified by the register address). The Ethernet Configuration and Status Register description for Ports 1 to 31 are identical to Port 0. Port 1 registers start at 0x4100, Port 2 registers start at 0x4200, and so on. Port 31 registers start at 0x5F00 per the ["Envoy-CE4 Register Memory Map" on page 79](#).

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
Port 0 MAC Configuration and Status Registers.				
4000	RW	Port 0 Configuration Register #1		
		0	0	Transmit Enable: 0 - Transmission of frames is prevented 1 - The port is allowed to transmit frames to the system
	RO	1		Synchronized Transmit Enable: 1 - Transmit Enable is synchronized to the transmit stream
	RW	2	0	Receive Enable: 0 - Reception of frames is prevented 1 - The port is allowed to receive frames from the PHY
	RO	3		Synchronized Receive Enable: 1 - Receive Enable is synchronized to the receive stream.
	RW	4	0	Transmit Pause Frame Generation Enable: 0 - Prevents the transmit port MAC Control from sending Flow Control frames 1 - Allows the transmit port MAC Control to send PAUSE Control frames when requested by the system
		5	0	Receive Pause Frame Processing Enable: Setting this bit will cause the Receive port MAC Control to detect and act on PAUSE Control frames. Clearing this bit causes the Receive port MAC Control to ignore PAUSE Flow Control frames.
	RO	7-6	0	Reserved
	RW	8	0	Loopback Mode: 0 - Results in normal operation 1 - The port will "Loopback" all data received from the Egress FIFO controller to the Ingress FIFO controller, i.e. Data from the SPI-3 is looped back at the Ethernet interface
	RO	15-9		Reserved
	RW	16	0	Reset Tx Function: 1 - The Transmit Function block is placed in reset. This block performs the frame transmission protocol.

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
4000 (cont.)	RW	17	0	Reset Rx Function: 1 - The Receive Function block is placed in reset. This block performs the receive frame protocol.
		18	0	Reset Tx MAC Control: 1 - The Transmit port MAC Control block is placed in reset. This block multiplexes data and Control frame transfers. It also responds to XOFF PAUSE Control frames.
		19	0	Reset Rx MAC Control: 1 - The Receive port MAC Control block is placed in reset. This block detects Control frames and contains the pause timers.
	RO	29-20	0	Reserved
	RW	30	0	Simulation Reset: 1 - This bit will reset those registers, such as the random back-off timer, which are not controlled by normal resets (for simulation only).
		31	1	Soft Reset: Setting this bit will put all modules within the MAC in reset, except the Host Interface. The Host Interface is reset via Lead Hardware reset (RESET). Soft Reset should be performed in the absence of traffic.
4004	RW	Port 0 Configuration Register #2		
		0	0	Full-duplex: 0 - The port will operate in Half-Duplex mode 1 - The port will operate in Full-Duplex mode
		1	0	CRC Enable: 0 - Frames presented to the port MAC must have a valid length and contain a valid CRC 1 - The port will append a CRC on all frames If the configuration bit PAD/CRC Enable is set, CRC Enable is ignored. Note: Used for frames transmitted from the Ethernet (Egress) ports only
		2	0	PAD / CRC Enable: 0 - Frames presented to the port's MAC must have a valid length and contain a CRC 1 - The port will pad all short frames and append a CRC to every frame whether or not padding was required Note: Used for frames transmitted from the Ethernet (Egress) ports only
	RO	3		Reserved
	RW	4	0	Length Field Checking: 0 - No length field checking is performed 1 - The port will check if the frame length field matches the actual data field length

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
4004 (cont.)	RW	5	0	Huge Frame Enable: 0 - The port will limit the length of frames to the Maximum Frame Length value 1 - Allows frames longer than the Maximum Frame Length to be transmitted and received
	RO	7-6		Reserved
	RW	9-8	0	Interface Mode: This field determines the type of interface the port is connected to. These 2-bits must be set to "01" for SMII, "10" for GMII and "01" for MII interface. Note: This is in addition to the Port Configuration Pins (CFGCMACA[1-0] , CFGCMACB[1-0] , CFGCMACC[1-0] and CFGCMACD[1-0]). Ports 0, 8, 16, and 24 are the only ports that can be configured as GMII or MII ports.
	RO	11-10		Reserved
	RW	15-12	0x7	Preamble Length: This field determines the length of the preamble field of the frame, in bytes.
	RO	31-16		Reserved
4008	RW	IPG/IFG SETTINGS		
		6-0	0x60	Back-to-Back Inter-Packet-Gap: This is a programmable field representing the IPG between Back-to-Back Frames. This is the IPG parameter used exclusively in Full-Duplex and Half-Duplex modes when two transmit frames are sent back-to-back. Set this field to the number of bits of IPG desired. The default value is 0x60 (96d).
	RO	7		Reserved

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
4008 (cont.)	RW	15-8	0x50	<p>Minimum IFG Enforcement: This is a programmable field representing the minimum number of bits of IFG to enforce between frames. A frame whose IFG is less than that programmed is dropped or errored. The default value of 0x50 (80d) represents half of the nominal minimum IFG which is 160-bits. $IFG = IPG + \text{Preamble} + \text{SFD}$</p> <p>If the IFIFO is configured for Store and Forward mode, the frame will be dropped and will not appear on the SPI port. If the IFIFO is configured for Streaming mode, the frame will appear on the SPI port with 4 additional bad CRC bytes appended to it.</p> <p>When a port is configured in SMII mode, the allowed range of this register is a minimum of 0x4 (four) up to a maximum of 0xFF. In addition, the lower 2 bits should be masked out since the granularity of this interface is nibble based. (e.g., programming a value of 0x83 (or 0x81, 0x82) is functionally equivalent to 0x80. A packet with an IFG of 0x80 will pass through the device even though its value is less than 0x83 due to the nibble granularity in SMII mode).</p> <p>When a port is configured in GMII mode, the allowed range of this register is a minimum of 0x8 (eight) up to a maximum of 0xFF. In addition, the lower 3 bits should be masked out since the granularity of this interface is byte based. (e.g., programming a value of 0x87 (or 0x81, 0x82...0x86) is functionally equivalent to 0x80. A packet with an IFG of 0x80 will pass through the device even though its value is less than 0x87 due to the byte granularity in GMII mode).</p>
		22-16	0x60	<p>Non-Back-to-Back Inter-Packet-Gap Part 2 (IPG2): This is a programmable field representing the Non-Back-to-Back Inter-Packet-Gap in bits. Default value is 0x60 (96d).</p> <p>Note: For an IPG length of 96 and a 2/3 ratio, the values 0x20 and 0x7C are required in the IPG1 and IPG2 locations, respectively.</p>
	RO	23		Reserved
	RW	30-24	0x40	<p>Non-Back-to-Back Inter-Packet-Gap Part 1 (IPG1): This is a programmable field representing the optional Carrier Sense window referenced in IEEE 802.3/4.2.3.2.1 'Carrier Deference'. If carrier is detected during the timing of IPG1, the MAC defers to carrier. However, if carrier becomes active after IPG1, the MAC continues timing IPG2 and transmits, knowingly causing a collision, thus ensuring fair access to the medium. Its range of values is 0x0 to IPG2. Default value is 0x40 (64d) which follows the two-thirds/one-third guideline.</p> <p>Note: For an IPG length of 96 and a 2/3 ratio, the values 0x20 and 0x7C are required in the IPG1 and IPG2 locations, respectively.</p>
	RO	31		Reserved

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
400C	RW	HALF-DUPLEX REGISTER		
		9-0	0x37	Collision Window: This is a programmable field representing the slot time or collision window during which collisions occur in properly configured networks. Since the collision window starts at the beginning of transmission, the preamble and SFD are included. Its default value of 0x37 (55d) corresponds to the count of frame bytes at the end of the window.
	RO	11-10		Reserved
	RW	15-12	0xF	Retransmission Maximum: This is a programmable field specifying the number of retransmission attempts following a collision before aborting the frame due to excessive collisions. The Standard specifies the attempt limit to be 0xF (15d).
		16	1	Excessive Defer: 0 - Causes the Tx MAC to allow transmission of a packet that has been excessively deferred 1 - Configures the Tx MAC to abort transmission of a packet that has been excessively deferred
		17	0	No Backoff: 0 - Causes the Tx MAC to follow the binary exponential backoff rule 1 - Configures the Tx MAC to immediately re-transmit following a collision
		18	0	Backpressure No Backoff: 0 - Causes the Tx MAC to follow the binary exponential backoff rule 1 - Configures the Tx MAC to immediately re-transmit, following a collision, during backpressure
	RW	19	0	Alternate Binary Exponential Backoff Enable: 0 - Causes the Tx MAC to follow the standard binary exponential backoff rule 1 - Configures the Tx MAC to use the Alternate Binary Exponential Backoff Truncation setting instead of the IEEE 802.3 standard tenth collision. The Standard specifies that any collision after the tenth uses "210 - 1" as the maximum backoff time
		23-20	0xA	Alternate Binary Exponential Backoff Truncation: This field is used when Alternate Binary Exponential Backoff Enable is set. The value programmed is substituted for the Ethernet standard value of ten.
	RO	31-24		Reserved

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
4010	RW	MAXIMUM FRAME LENGTH REGISTER		
		15-0	0x0600	Maximum Frame Length: This field resets to 0x0600 (1536d), which represents the maximum frame size in both the transmit and receive directions.
	RO	31-16		Reserved
4014 to 4018	RO	31-0	0	Reserved
401C	RW	TEST REGISTER		
		0	0	Shortcut Slot Time: This bit allows the slot time counter to expire regardless of the current count. This bit is for testing purposes only.
		1	0	Test Pause: For testing purposes only. 1 - Allows the MAC to be paused via the host interface
		2	0	Registered Transmit Flow Enable: Register Transmit Half-Duplex Flow Enable, active high assertion.
		3	0	Maximum Backoff: 1 - The MAC is configured to backoff for the maximum possible length of time. This test bit is used to predict backoff times in Half-Duplex mode.
	RO	31-4		Reserved
4020 to 4034	RO	31-0	0	Reserved
4038	RO	SMII CONTROL REGISTER		
		23-0	0	Reserved
	RW	24	1	SMII PHY Mode: 0 - Allows MAC-to-MAC connections 1 - Allows MAC-to-PHY connections where Envoy-CE4 connects to a PHY
	RO	30-25	0	Reserved
	RW	31	0	Reset SMII Port: This resets the port if it is configured as an SMII port.
403C	RO	SMII STATUS REGISTER		
		3-0	0	Reserved
		4	0	Speed: 0 - The Serial MII PHY is operating at 10 Mbit/s mode 1 - The Serial MII PHY is operating at 100 Mbit/s mode

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
403C (cont.)	RO	5	0	Full Duplex: 0 - The Serial MII PHY is operating in Half-Duplex mode 1 - The Serial MII PHY is operating in Full-Duplex mode
		6	0	Link OK: 0 - The Serial MII PHY has not detected a valid link 1 - The Serial MII PHY has detected a valid link
		7	0	Jabber: 1 - The Serial MII PHY has detected a Jabber condition 0 - The Serial MII PHY has not detected a Jabber condition. This bit latches high.
		8	0	Clash: 0 - The Serial MII module is either in PHY mode or in MAC-to-MAC mode. 1 - The Serial MII module is in MAC-to-MAC mode with the partner in 10 Mbit/s and/or Half-Duplex mode indicative of a configuration error.
	RC	9	0	Excess Defer: This bit sets when the MAC excessively defers a transmission. It clears when read. This bit latches high.
	RO	31-10	0	Reserved
4040	RW	SOURCE ADDRESS REGISTER, PART 1		
		7-0	0	SOURCE ADDRESS, 4th Octet: This field holds the fourth octet of the source address. The fourth octet is stored in Bits 7-0 and defaults to 0.
		15-8	0	SOURCE ADDRESS, 3rd Octet: This field holds the third octet of the source address. The third octet is stored in Bits 15-8 and defaults to 0.
		23-16	0	SOURCE ADDRESS, 2nd Octet: This field holds the second octet of the source address. The second octet is stored in Bits 23-16 and defaults to 0.
		31-24	0	SOURCE ADDRESS, 1st Octet: This field holds the first octet of the source address. The first octet is stored in Bits 31-24 and defaults to 0.
4044	RO	SOURCE ADDRESS REGISTER, PART 2		
		15-0		Reserved
	RW	23-16	0	SOURCE ADDRESS, 6th octet: This field holds the sixth octet of the source address. The sixth octet is stored in Bits 23-16 and defaults to 0. This Byte is the first Address byte transmitted.
		31-24	0	SOURCE ADDRESS, 5th octet: This field holds the fifth octet of the source address. The fifth octet is stored in Bits 31-24 and defaults to 0.
4048 to 407C	RO	31-0		Reserved

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
4080	RW	15-0	0	CFPT: Control Frame parameter to set the Pause Time parameter. 16-bit field containing the Pause Time value.
		31-16	0	CFEP: Control Frame Extended Parameter. This extended parameter may contain additional information such as VLAN and/or priority information per IEEE 802.1p.
4084	RW	0	0	Rx Prepend Packet: Prepend receive packets with 2 dummy bytes (0X00000000) prior to sending to the SPI-3 output interface.
		1	0	Tx Prepend Strip: Strip out Prepend bytes received from the SPI-3 input interface.
		2	0	Tx Pause Frame Filter: When set, will enable filtering of Egress Pause Frames from the SPI interface. Pause frames whose EtherType = 8808h and OpCode = 0001h will be errored by forcing the MAC to append an incorrect CRC. Note: The RMON statistics counters will count the number of filtered pause frames. The statistics counters will also count each filtered pause frame as a Tx Fragment.
	RO	15-3		Reserved
	RW	16	0	Host Initiated Flow Control Enable: Once enabled, a Pause Control Frame is transmitted, when the Pause Regeneration Timer reaches '0'. The timer will reactivate after it reaches '0'. When exiting this mode, a null Pause Frame is sent. 0 - Disable 1 - Enable Note: Raise carrier flow mechanism can not be host initiated.
		17	0	Automatic Flow Control Enable: In this mode, when the ingress FIFO associated with this port reaches flow control high threshold, the flow control mechanism is activated. For full duplex, Pause Control Frames are used and for half duplex mode, raise carrier method is used. 0 - Disable 1 - Enable Note: Set Flow Control Mode (Bit 30) to Raise Carrier or PAUSE frame depending whether the Port is in half duplex or full duplex.
		18	0	STEN: Statistics Enable. 0 - Disables internal statistics counters update 1 - Enables internal statistics counters to update
	RO	20-19	0	Reserved

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
4084 (cont.)	RW	21	0	Tx Source Address Substitute Enable: Transmitter Source Address Substitution Enable. 1 - Substitute the outgoing source address field in the Ethernet header with the programmed source address in the MAC (Addresses 0x4040 and 0x4044).
		22	0	Rx CRC Remove: Configures the removal of the CRC (FCS) bytes from the Ethernet frame received at the Rx interface destined for the SPI-3 output interface. 1 - Remove CRC
		23	0	GTx Clock Select: The Rx clock is used when connecting the Envoy-CE4 to another MAC in a MAC-to-MAC configuration. 0 - Tx clock 1 - Rx clock For normal operation, this bit should set to 0.
		24	0	Discard Rx Truncated frames: 0 - Do not discard the frame if it is truncated 1 - Discard the frame if it is truncated If the IFIFO is configured for Store and Forward mode, the frame will be dropped and will not appear on the SPI port. If the IFIFO is configured for Streaming mode, the frame will appear on the SPI port with 4 additional bad CRC bytes appended to it.
		25	0	DISC Rx Length Field Mismatch: Discard unmatched length field. 0 - Do not discard the frame if the frame length field does not match the actual data length field 1 - Discard the frame if the frame length field does not match the actual data length field If the IFIFO is configured for Store and Forward mode, the frame will be dropped and will not appear on the SPI port. If the IFIFO is configured for Streaming mode, the frame will appear on the SPI port with 4 additional bad CRC bytes appended to it.
		26	0	DISC Rx CRC Field Mismatch: Discard frames with CRC error. 0 - Do not discard the frame if it has a CRC error 1 - Discard the frame if it has a CRC error If the IFIFO is configured for Store and Forward mode, the frame will be dropped and will not appear on the SPI port. If the IFIFO is configured for Streaming mode, the frame will appear on the SPI port with 4 additional bad CRC bytes appended to it.

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
4084 (cont.)	RW	27	0	DISC Rx ERR: Discard received frame with Rx error. 0 - Do not discard the frame if it has an Rx error 1 - Discard the frame if it has an Rx error If the IFIFO is configured for Store and Forward mode, the frame will be dropped and will not appear on the SPI port. If the IFIFO is configured for Streaming mode, the frame will appear on the SPI port with 4 additional bad CRC bytes appended to it.
		28	0	Rx PAUSE Frame Filter: Active high signal to filter out PAUSE frames if the Destination Address (DA) field matches the Source Address (SA) field in addresses 0x4040 and 0x4044 or if the DA is a Multicast address.
		29	0	Rx SA Filter ENB: Receive Source Address Filter enable. 0 - No filtering is performed 1 - Frames will be filtered out if the Destination Address (DA) field does not match the programmed Source Address (SA) field in addresses 0x4040 and 0x4044
		30	0	Flow Control Mode: Configures the flow control mode. 0 - Raise Carrier Mode 1 - Pause Frames
		31	0	Half-Duplex Flow Control Duration: Configures the Half Duplex flow control duration. 0 - Raise Carrier stopped after 128K byte times 1 - Continuous Raise Carrier flow control till congestion is relieved

Port 0 Ethernet Status and Configuration Register Description

Addr (hex)	Mode	Bit Range	Default value after reset	Description
4088	RO	2-0		Reserved
		3	0	PAUSE Frame Received: Status indication that an error free, unicast, or multicast PAUSE frame has been received.
		4	0	Rx Frame Discarded: Status indication of a frame discard due to lack of FIFO memory resource (overflow). Note: A counter for this register is described in the statistics section.
		5	0	Tx Frame Discarded: Status indication that an Under-run occurred in the Ethernet transmit direction. Note: In Streaming mode, when the port's Egress FIFO goes empty during frame transmission, an under-run occurs.
		6	0	Tx Abort Frame: Status indication that a frame has been transmitted with the error pin asserted.
		7	0	Tx Tag Error Status: Transmit Byte Buffer detected tag error in data from the Egress FIFO. For example, two start of packet tags without an end of packet tag between them would be an error. Tag errors are counted in the Tx Abort Counter.
		15-8	0	Reserved
		18-16	1	Reserved
	RW	19	1	PAUSE Frame Received Interrupt Mask: Interrupt Mask for PAUSE Frame Received Status based interrupt. 0 = Mask Disabled, 1 = Mask Enabled.
		20	1	Rx Frame Discarded Interrupt Mask: Interrupt Mask for Rx Frame Discarded Status based interrupt. 0 = Mask Disabled, 1 = Mask Enabled.
		21	1	Tx Frame Discarded Interrupt Mask: Interrupt Mask for Tx Frame Discarded Status based interrupt. 0 = Mask Disabled, 1 = Mask Enabled.
		22	1	Tx Abort Frame Interrupt Mask: Interrupt Mask for Tx Abort Frame Status based interrupt. 0 = Mask Disabled, 1 = Mask Enabled.
		23	1	Tx Tag Error Mask: Interrupt Mask for Tx Tag Error Status based interrupt. 0 = Mask Disabled, 1 = Mask Enabled.
	RO	31-24	0	Reserved
408C	RO	0	0	Reserved
		1	Depends on CMAC Configuration pins	GMII/SMII Mode Status: 0 - SMII Mode 1 - GMII Mode Only Ports 0, 8, 16, and 24 can be configured for GMII operation via external configuration pins. The other ports will always be in SMII mode.
		31-2	0	Reserved

The following table is the Ethernet Statistics Register description for Port 0 (as identified by the register address). The Ethernet Statistics Register description for the other ports are identical to that of Port 0. Port 1 registers start at 0x6100, Port 2 registers start at 0x6200 and so on. Port 31 registers start at 0x7F00 per the ["Envoy-CE4 Register Memory Map" on page 79](#). Upon reset, the following counters are clear on read saturating counters. To change to rollover counters, set **RMON STATISTIC COUNTER AUTO CLEAR ON READ** to 0.

Ethernet Statistics Register Description for Port 0

Addr (hex)	Mode	Bit Range	Default value after reset	Description
6000	RC	31-0	0	Rx Bytes Lo (Octets): The total number of octets of data (including those in bad packets) received on the network (excluding framing bits but including FCS octets). Note: The upper 8 bits of this 40-bit counter are accessed via Rx Byte Hi (Register 0x60C0). Note: If Received Byte Counter Config bit = 0 (Register 0x0030 Bit 1), then Rx Byte Counter will only count bytes from good packets.
6004	RC	31-0	0	Rx Packets: The total number of packets (including bad packets, broadcast packets, and multicast packets) received.
6008	RC	31-0	0	Rx Undersize Packets: The total number of packets received that were less than 64 octets in length (excluding framing bits, but including FCS octets), had a good FCS, and were otherwise well formed. Note: Packets less than 64 octets but with a bad FCS are counted in the Rx Fragment Packets counter.
600C	RC	31-0	0	Rx 64 Octets Packets: The total number of packets (including bad packets) received that were 64 octets in length (excluding framing bits but including FCS octets).
6010	RC	31-0	0	Rx 65 to 127 Octet Packets: The total number of packets (including bad packets) received that were between 65 and 127 octets in length inclusive (excluding framing bits but including FCS octets).
6014	RC	31-0	0	Rx 128 to 255 Octet Packets: The total number of packets (including bad packets) received that were between 128 and 255 octets in length inclusive (excluding framing bits but including FCS octets).
6018	RC	31-0	0	Rx 256 to 511 Octet Packets: The total number of packets (including bad packets) received that were between 256 and 511 octets in length inclusive (excluding framing bits but including FCS octets).
601C	RC	31-0	0	Rx 512 to 1023 Octet Packets: The total number of packets (including bad packets) received that were between 512 and 1023 octets in length inclusive (excluding framing bits but including FCS octets).

Addr (hex)	Mode	Bit Range	Default value after reset	Description
6020	RC	31-0	0	Rx 1024 to 1518 Octet Packets: The total number of packets (including bad packets) received that were between 1024 and 1518 octets (1522 for VLAN tagged packets) in length inclusive (excluding framing bits but including FCS octets).
6024	RC	31-0	0	Rx Frame Length Errored Packets: The total number of good packets received in which the IEEE 802.3 length field did not match the number of data bytes actually received (46-1500 bytes). The counter is not incremented if the length field is not a valid IEEE 802.3 length, e.g., an EtherType value.
6028	RC	31-0	0	Rx Oversize Packets: The total number of packets received that were longer than 1518 octets (1522 for VLAN tagged packets), had a good FCS, and were otherwise well formed. Note: Packets longer than MAX octets are truncated by the MAC and will therefore have an incorrect FCS; These packets will be counted in the Rx Jabber Packets counter. MAX octets value is the "Maximum Frame Length" value programmed in the MAC.
602C	RC	31-0	0	Rx Broadcast Packets: The total number of good packets received that were directed to the broadcast address. Note: This does not include multicast packets.
6030	RC	31-0	0	Rx Multicast Packets: The total number of good packets received that were directed to a multicast address. Note: This does not include packets directed to the broadcast address or packets with the Control Frame multicast address.
6034	RC	31-0	0	Rx Pause Control Frame Packets: The total number of good packets received that are Pause Control Frames.
6038	RC	31-0	0	Rx Unknown Opcode Control Frame Packets: The total number of good packets received that are Control Frame packets but whose opcode is other than the Pause opcode.
603C	RC	31-0	0	Rx VLAN Tagged Packets: The total number of good packets received that are VLAN tagged (Type/Len Field = 0x8100).
6040	RC	31-0	0	Rx Fragment Packets: The total number of packets received that were less than 64 octets in length (excluding framing bits but including FCS octets) and had either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS with a non-integral number of octets (Alignment Error).

Addr (hex)	Mode	Bit Range	Default value after reset	Description
6044	RC	31-0	0	Rx FCS Errored Packets: The total number of packets received that had a length (excluding framing bits, but including FCS octets) between 64 and 1518 octets (1522 for VLAN tagged packets), inclusive, but had either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS with a non-integral number of octets (Alignment Error).
6048	RC	31-0	0	Rx Jabber Packets: The total number of packets received that were longer than 1518 octets (1522 for VLAN tagged packets) (excluding framing bits, but including FCS octets), and had either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS with a non-integral number of octets (Alignment Error).
604C	RC	31-0	0	Rx Code Error Counter: The total number of packets received that the PHY asserted RX_ER during reception.
6050	RC	31-0	0	Rx Ingress FIFO Full Drop Counter: The total number of good or bad packets received which were dropped due to Ingress FIFO full condition, i.e., lack of system resources.
6054	RC	31-0	0	Rx Unicast SA Mismatch Drop Counter: The total number of good packets received which were dropped because they had a unicast address which did not match the source address and which are not Pause or Control Frames. Note: This counter will not be incremented if the packet is also dropped due to FIFO Full condition.
6058	RC	31-0	0	Tx Bytes Lo (Octets): The total number of octets of data transmitted on the network (excluding framing bits/SFD or jam octets but including FCS octets). This count does NOT include collided octets from collided transmission attempts. Note: The upper 8 bits of this 40-bit counter are accessed via Tx Bytes Hi (Register 0x60C4).
605C	RC	31-0	0	Tx Packets: The total number of packets transmitted successfully.
6060	RC	31-0	0	Tx Undersize Packets: The total number of packets transmitted successfully that were less than 64 octets in length (excluding framing bits, but including FCS octets), had a good FCS, and were otherwise well formed. Note: Packets less than 64 octets but with a bad FCS are counted in the Tx Fragment Packets counter.
6064	RC	31-0	0	Tx 64 Octet Packets: The total number of packets (including bad packets) transmitted successfully that were 64 octets in length (excluding framing bits but including FCS octets).

Addr (hex)	Mode	Bit Range	Default value after reset	Description
6068	RC	31-0	0	Tx 65 to 127 Octet Packets: The total number of packets (including bad packets) transmitted successfully that were between 65 and 127 octets in length inclusive (excluding framing bits but including FCS octets).
606C	RC	31-0	0	Tx 128 to 255 Octet Packets: The total number of packets (including bad packets) transmitted successfully that were between 128 and 255 octets in length inclusive (excluding framing bits but including FCS octets).
6070	RC	31-0	0	Tx 256 to 511 Octet Packets: The total number of packets (including bad packets) transmitted successfully that were between 256 and 511 octets in length inclusive (excluding framing bits but including FCS octets).
6074	RC	31-0	0	Tx 512 to 1023 Octet Packets: The total number of packets (including bad packets) transmitted successfully that were between 512 and 1023 octets in length inclusive (excluding framing bits but including FCS octets).
6078	RC	31-0	0	Tx 1024 to 1518 Octet Packets: The total number of packets (including bad packets) transmitted successfully that were between 1024 and 1518 octets (1522 for VLAN tagged packets) in length inclusive (excluding framing bits but including FCS octets).
607C	RC	31-0	0	Tx Pause Frames Discarded: Count of transmit Pause Frames originated via the SPI-3 interface which are discarded (incorrect CRC appended).
6080	RC	31-0	0	Tx Oversize Packets: The total number of packets transmitted successfully that were longer than 1518 (1522 for VLAN tagged packets) octets (excluding framing bits, but including FCS octets), had a good FCS, and were otherwise well formed. Note: Packets longer than MAX octets are truncated by the MAC and will have an incorrect FCS appended; These packets will be counted in the Tx Jabber Packets counter. MAX octets value is the "Maximum Frame Length" value programmed in the MAC.
6084	RC	31-0	0	Tx Broadcast Packets: The total number of good packets transmitted that were directed to the broadcast address. Note: This does not include multicast packets.
6088	RC	31-0	0	Tx Multicast Packets: The total number of good packets transmitted that were directed to a multicast address. Note: This does not include packets directed to the broadcast address or packets with the Control Frame multicast address.

Envoy-CE4 Device

DATA SHEET

TXC-06885



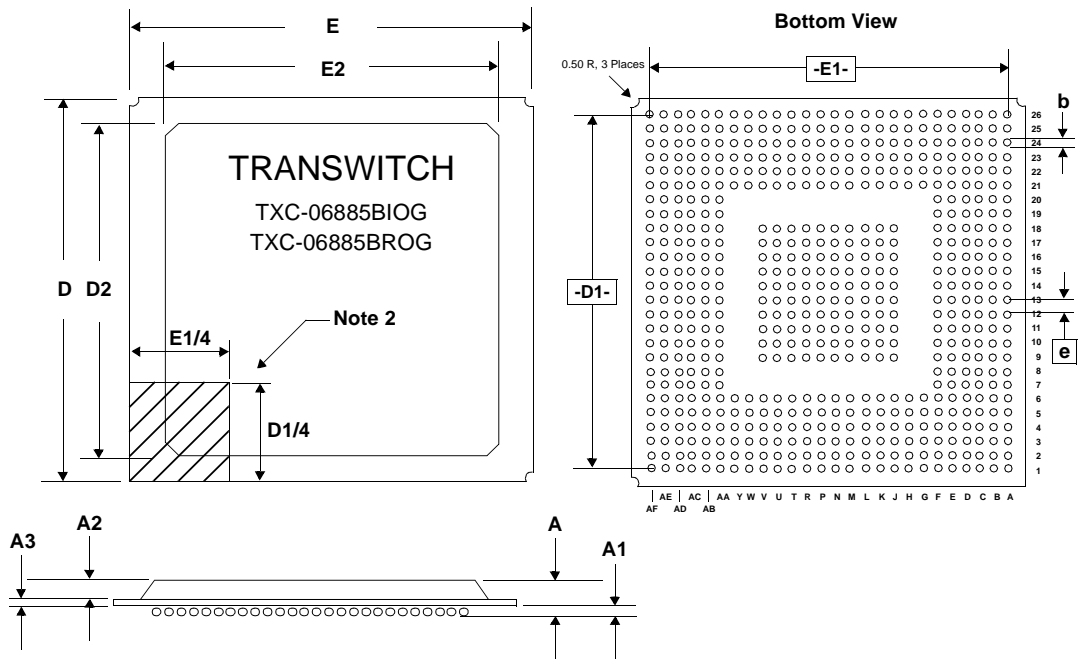
- Memory Maps and Bit Descriptions -

Addr (hex)	Mode	Bit Range	Default value after reset	Description
608C	RC	31-0	0	Tx PAUSE Frame Packets: The total number of good packets transmitted that are Pause Control Frames. Only Pause Control Frames which originated within the MAC are counted. Those that originated via the SPI-3 interface are not counted.
6090	RC	31-0	0	Tx VLAN Tagged Packets: The total number of good packets transmitted that are VLAN tagged (Type/Len Field = 0x8100)
6094	RC	31-0	0	Tx Deferral: A count of successfully transmitted packets for which the first transmission attempt was deferred because the medium was busy. The count does not include packets involved in collisions.
6098	RC	31-0	0	Tx Excess Deferral: A count of packets not transmitted because they were deferred for an excessive period of time (3036 byte times).
609C	RC	31-0	0	Tx Single Collision: A count of successfully transmitted packets for which transmission is inhibited by exactly one collision.
60A0	RC	31-0	0	Tx Multiple Collision: A count of successfully transmitted packets for which transmission is inhibited by more than one collision.
60A4	RC	31-0	0	Tx Late Collision: A count of packets transmitted which experience a late collision. A "late collision" is a collision detected more than 512 bit-times into the transmission of a packet. Note: Packet transmission can be continued or aborted by configuring the Excessive Defer bit in the MAC's Half-Duplex control register (Register 0x400C Bit 16).
60A8	RC	31-0	0	Tx Excessive Collision: A count of packets not transmitted due to excessive collisions.
60AC	RC	31-0	0	Tx Fragment Packets: The total number of packets transmitted that were less than 64 octets in length (excluding framing bits but including FCS octets) and had a bad Frame Check Sequence (FCS).
60B0	RC	31-0	0	Tx FCS Errored Packets: The total number of packets transmitted that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets (1522 for VLAN tagged packets), inclusive, but had a bad Frame Check Sequence (FCS).
60B4	RC	31-0	0	Tx Jabber Packets: The total number of packets transmitted that were longer than 1518 (1522 for VLAN tagged packets) octets (excluding framing bits, but including FCS octets), and had a bad Frame Check Sequence (FCS). This count will include packets truncated by the MAC because they were longer than MAX octets. MAX octets value is the "Maximum Frame Length" value programmed in the MAC.

Addr (hex)	Mode	Bit Range	Default value after reset	Description
60B8	RC	31-0	0	Tx Drop Frame: The total number of transmitted packets which were aborted due to an under-run of the Egress FIFO, i.e., lack of system resources. When this is detected, the MAC transmitter will jam the packet and insert an incorrect FCS.
60BC	RC	31-0	0	Tx Abort: The total number of transmitted packets which were aborted under command of the Egress FIFO logic (packet TAG = ERROR). When this is detected, the MAC transmitter will jam the packet and insert an incorrect FCS. This counter is also incremented if an unexpected tag is encountered after transmission of a packet has started, i.e., another SOP is detected before we get the EOP for the current packet.
60C0	RC	7-0	0	Rx Bytes Hi (MSByte of the Rx Byte): 8 MSBs of the 40-bit Rx Byte Counter. When doing a 32-bit read of this counter, the counter values are in Bits 0-7.
	RO	31-8	0	Reserved
60C4	RC	7-0	0	Tx Bytes Hi (MSByte of the Tx Byte): 8 MSBs of the 40-bit Tx Byte Counter. When doing a 32-bit read of this counter, the counter values are in Bits 0-7.
	RO	31-8	0	Reserved

PACKAGE INFORMATION

The Envoy-CE4 device is packaged in a 27 mm x 27 mm, 580-Lead Plastic Ball Grid Array (PBGA) package with a 1.0 mm pitch, as illustrated in Figure 25.



Notes:

1. All dimensions are in millimeters. Values shown are for reference only.
2. Identification of the solder ball A1 corner is contained within this shaded zone. This package corner may be a 90° angle, or chamfered for A1 identification.
3. Size of array: 26 x 26, JEDEC code MO-151.

Dimension (Note 1)	Nominal	
A (Nom)	2.23	
A1	0.4	0.6
A2	1.12	1.22
A3 (Nom)	0.56	
b (Ref.)	0.63	
D	27.0	
D1 (Nom)	25.0	
D2	23.95	24.35
E	27.0	
E1 (Nom)	25.0	
E2	23.95	24.35
e (Ref.)	1.0	

Figure 25. Envoy-CE4 Package Diagram

ORDERING INFORMATION

Part Number: TXC-06885BIOG 580-lead plastic ball grid array (PBGA) package,
Non-Green (Non-ROHS and non-lead free) compliant
TXC-06885BROG 580-lead plastic ball grid array (PBGA) package,
Green (ROHS and lead free) compliant

RELATED PRODUCTS

PHAST[®]-12P Device (STM-4/OC-12 SDH/SONET Overhead Terminator with CDB/PPP UTOPIA/POS-PHY Interface). The PHAST-12P is a highly integrated SDH/SONET overhead terminator device designed for ATM cell and PPP packet payload mappings. A single PHAST-12P can terminate four individual STM-1/OC-3 lines or a single STM-4/OC-12 line.

Envoy-8FE Device (Octal Fast Ethernet Controller). The Envoy-8FE Device is a Serial Media Independent Interface (SMII) to POS-PHY Level 2/3 interface converter transporting Ethernet packets. Envoy-8FE has 8 SMII ports. Packet data from the 8 ports are aggregated onto the POS-PHY interface.

Envoy-2GE Device (Dual Gigabit Ethernet Controller). The Envoy-2GE Device is a Gigabit Media Independent Interface (GMII) to POS-PHY Level 2/3 interface converter transporting Ethernet packets. Envoy-2GE has 2 GMII ports. Packet data from the 2 ports are aggregated onto the POS-PHY interface.

STANDARDS DOCUMENTATION SOURCES

Telecommunication technical standards and reference documentation may be obtained from the following organizations.

ANSI (U.S.A.):

American National Standards Institute

25 West 43rd Street
New York, New York 10036

Tel: (212) 642-4900
Fax: (212) 398-0023
Web: www.ansi.org

The ATM Forum (U.S.A., Europe, Asia):

404 Balboa Street
San Francisco, CA 94118

Tel: (415) 561-6275
Fax: (415) 561-6120
Web: www.atmforum.com

ATM Forum Europe Office

Kingsland House - 5th Floor
361-373 City Road
London EC1 1PQ, England

Tel: 20 7837 7882
Fax: 20 7417 7500

ATM Forum Asia-Pacific Office

Hamamatsucho Suzuki Building 3F
1-2-11, Hamamatsucho, Minato-ku
Tokyo 105-0013, Japan

Tel: 3 3438 3694
Fax: 3 3438 3698

Belcore (See Telcordia)

CCITT (See ITU-T)

EIA (U.S.A.):

Electronic Industries Association

Global Engineering Documents

15 Inverness Way East
Englewood, CO 80112

Tel: (800) 854-7179 (within U.S.A.)
Tel: (303) 397-7956 (outside U.S.A.)
Fax: (303) 397-2740
Web: www.global.ihs.com

ETSI (Europe):

**European Telecommunications
Standards Institute**

650 route des Lucioles
06921 Sophia-Antipolis Cedex, France

Tel: 4 92 94 42 00
Fax: 4 93 65 47 16
Web: www.etsi.org

GO-MVIP (U.S.A.):

**The Global Organization for Multi-Vendor
Integration Protocol (GO-MVIP)**

3220 N Street NW, Suite 360
Washington, DC 20007

Tel: (800) 669-6857 (within U.S.A.)
Tel: (903) 769-3717 (outside U.S.A.)
Fax: (903) 769-3818
Web: www.mvip.org

IEEE (Corporate Office):

American Institute of Electrical Engineers

3 Park Avenue, 17th Floor
New York, New York 10016-5997 U.S.A.

Tel: (212) 419-7900 (within U.S.A.)
Tel: (800) 678-4333 (Members only)
Fax: (212) 752-4929
Web: www.ieee.org

ITU-T (International):

**Publication Services of International
Telecommunication Union
Telecommunication Standardization Sector**

Place des Nations, CH 1211
Geneve 20, Switzerland

Tel: 22 730 5852
Fax: 22 730 5853
Web: www.itu.int

JEDEC (International):

Joint Electron Device Engineering Council

2500 Wilson Boulevard
Arlington, VA 22201-3834

Tel: (703) 907-7559
Fax: (703) 907-7583
Web: www.jedec.org

MIL-STD (U.S.A.):

**DODSSP Standardization Documents
Ordering Desk**

Building 4 / Section D
700 Robbins Avenue
Philadelphia, PA 19111-5094

Tel: (215) 697-2179
Fax: (215) 697-1462
Web: www.dodssp.daps.mil

PCI SIG (U.S.A.):

PCI Special Interest Group

5440 SW Westgate Dr., #217
Portland, OR 97221

Tel: (800) 433-5177 (within U.S.A.)
Tel: (503) 291-2569 (outside U.S.A.)
Fax: (503) 297-1090
Web: www.pcisig.com

Telcordia (U.S.A.):

**Telcordia Technologies, Inc.
Attention - Customer Service**

8 Corporate Place Rm 3A184
Piscataway, NJ 08854-4157

Tel: (800) 521-2673 (within U.S.A.)
Tel: (732) 699-2000 (outside U.S.A.)
Fax: (732) 336-2559
Web: www.telcordia.com

TTC (Japan):

**TTC Standard Publishing Group of the
Telecommunication Technology Committee**

Hamamatsu-cho Suzuki Building
1-2-11, Hamamatsu-cho, Minato-ku
Tokyo 105-0013, Japan

Tel: 3 3432 1551
Fax: 3 3432 1553
Web: www.ttc.or.jp

- NOTES -

- NOTES -

TranSwitch reserves the right to make changes to the product(s) or circuit(s) described herein without notice. No liability is assumed as a result of their use or application. TranSwitch assumes no liability for TranSwitch applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TranSwitch warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TranSwitch covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.



A leading developer and global supplier of innovative high-speed VLSI semiconductor solutions to communications network equipment manufacturers.



**Serving three fast-growing end-markets;
Public Network Infrastructure, Internet
Infrastructure and
Wide Area Networks (WANs).**



**Specializing in the design, development,
marketing and support of these networking
semiconductor solutions, which we call
“Connectivity Engines.”**

