



# KSZ8462HLI/FHLI

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## IEEE 1588 Precision Time Protocol-Enabled, Two-Port, 10/100 Mbps Ethernet Switch with 8- or 16-Bit Host Interface

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### Features

#### Management Capabilities

- The KSZ8462 Includes All the Functions of a 10/100BASE-T/TX/FX Switch System that Combines a Switch Engine, Frame Buffer Management, Address Look-Up Table, Queue Management, MIB Counters, Media Access Controllers (MAC) and PHY Transceivers
- Non-Blocking Store-and-Forward Switch Fabric Ensures Fast Packet Delivery by Utilizing 1024 Entry Forwarding Table
- Port Mirroring/Monitoring/Sniffing: Ingress and/or Egress Traffic to any Port
- MIB Counters for Fully Compliant Statistics Gathering: 34 Counters per Port
- Loopback Modes for Remote Failure Diagnostics
- Rapid Spanning Tree Protocol Support (RSTP) for Topology Management and Ring/Linear Recovery

#### Robust PHY Ports

- Two Integrated IEEE 802.3/802.3u-Compliant Ethernet Transceivers Supporting 10BASE-T and 100BASE-TX
- Copper and 100BASE-FX Fiber Mode Support in the KSZ8462FHL
- Copper Mode Support in the KSZ8462HL
- On-Chip Termination Resistors and Internal Biasing for Differential Pairs to Reduce Power
- HP Auto MDI/MDI-X Crossover Support Eliminates the Need to Differentiate Between Straight or Crossover Cables in Applications

#### MAC Ports

- Three Internal Media Access Control (MAC) Units
- 2Kbyte Jumbo Packet Support
- Tail Tagging Mode (One byte Added before FCS) Support at Port 3 to Inform The Processor Which Ingress Port Receives the Packet and its Priority
- Programmable MAC Addresses for Port 1 and Port 2 and Source Address Filtering for Implementing Ring Topologies
- MAC Filtering Function to Filter or Forward Unknown Unicast Packets
- Port 1 and Port 2 MACs Programmable as Either E2E or P2P Transparent Clock (TC) Ports for 1588 Support

#### Advanced Switch Capabilities

- Non-Blocking Store-and-Forward Switch Fabric Ensures Fast Packet Delivery by Utilizing 1024 Entry Forwarding Table
- IEEE 802.1Q VLAN for Up to 16 Groups with Full Range of VLAN IDs
- IEEE 802.1p/Q Tag Insertion or Removal on a per Port Basis (Egress) and Support Double-Tagging
- VLAN ID Tag/Untag Options on per Port Basis
- Fully Compliant with IEEE 802.3/802.3u Standards
- IEEE 802.3x Full-Duplex with Force-Mode Option and Half-Duplex Backpressure Collision Flow Control
- IEEE 802.1w Rapid Spanning Tree Protocol Support
- IGMP v1/v2/v3 Snooping for Multicast Packet Filtering
- QoS/CoS Packets Prioritization Support: 802.1p, DiffServ-Based and Re-Mapping of 802.1p Priority Field per Port Basis on Four Priority Levels

#### IPv4/IPv6 QoS Support

- IPv6 Multicast Listener Discovery (MLD) Snooping Support
- Programmable Rate Limiting at the Ingress and Egress Ports
- Broadcast Storm Protection
- 1K Entry Forwarding Table with 32K Frame Buffer
- Four Priority Queues with Dynamic Packet Mapping for IEEE 802.1p, IPv4 TOS (DIFFSERV), IPv6 Traffic Class, etc.

#### Comprehensive Configuration Registers Access

- Complete Register Access via the Parallel Host Interface
- Facility to Load MAC Address from EEPROM at Power-Up and Reset Time
- I/O Pin Strapping Facility to Set Certain Register Bits from I/O Pins at Reset Time
- Control Registers Configurable On-the-Fly

#### IEEE 1588v2 PTP and Clock Synchronization

- Fully Compliant with the IEEE 1588v2 Precision Time Protocol
- One-Step or Two-Step Transparent Clock (TC) Timing Corrections
- E2E (End-to-End) or P2P (Peer-to-Peer) Transparent Clock (TC)

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- Grandmaster, Master, Slave, Ordinary Clock (OC) Support
- IEEE1588v2 PTP Multicast and Unicast Frame Support
- Transports of PTP Over IPv4/IPv6 UDP and IEEE 802.3 Ethernet
- Delay Request-Response and Peer Delay Mechanism
- Ingress/Egress Packet Time Stamp Capture/Recording and Checksum Update
- Correction Field Update with Residence Time and Link Delay
- IEEE1588v2 PTP Packet Filtering Unit to Reduce Host Processor Overhead
- A 64-bit Adjustable System Precision Clock
- Twelve Trigger Output Units and Twelve Time Stamp Input Units Available for Flexible IEEE1588v2 Control of Seven Programmable GPIO[6:0] Pins Synchronized to the Precision Time Clock
- GPIO Pin Usage for 1 PPS Generation, Frequency Generator, Control Bit Streams, Event Monitoring, Precision Pulse Generation, Complex Waveform Generation

## Host Interface

- Selectable 8- or 16-bit Wide Interface
- Supports Big- and Little-Endian Processors
- Indirect Data Bus for Data, Address and Byte Enable to Access any I/O Registers and RX/TX FIFO Buffers
- Large Internal Memory with 12Kbyte for RX FIFO and 6Kbytes for TX FIFO
- Programmable Low, High, and Overrun Watermark for Flow Control in RX FIFO
- Efficient Architecture Design with Configurable Host Interrupt Schemes to Minimize Host CPU Overhead and Utilization
- Queue Management Unit (QMU) Supervises Data Transfers Across This Interface

## Power and Power Management

- Single 3.3V Power Supply with Optional VDD I/O for 1.8V, 2.5V, or 3.3V
- Integrated Low Voltage (~1.3V) Low-Noise Regulator (LDO) Output for Digital and Analog Core Power
- Supports IEEE P802.3az™ Energy Efficient Ethernet (EEE) to Reduce Power Consumption in Transceivers in LPI State
- Full-Chip Hardware or Software Power-Down (All Registers Value are Not Saved and Strap-In Value will Re-Strap After Releasing the Power-Down)

- Energy Detect Power-Down (EDPD), which Disables the PHY Transceiver when Cables are Removed
- Wake-on-LAN Supported with Configurable Packet Control
- Dynamic Clock Tree Control to Reduce Clocking in Areas Not in Use
- Power Consumption Less than 0.5W

## Additional Features

- Single 25 MHz  $\pm 50$  ppm Reference Clock Requirement
- Comprehensive Programmable Two LED Indicators Support for Link, Activity, Full-/Half-Duplex and 10/100 Speed
- LED Pins Directly Controllable
- Industrial Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- 64-Pin (10 mm x 10 mm) Lead Free (RoHS) LQFP Package

## Applications

- Industrial Ethernet Applications that Employ IEEE 802.3-Compliant MACs. (Ethernet/IP, Profinet, MODBUS TCP, etc)
- Real-Time Ethernet Networks Requiring Sub-Microsecond Synchronization over Standard Ethernet
- IEC 61850 Networks Supporting Power Substation Automation
- Networked Measurement and Control Systems
- Industrial Automation and Motion Control Systems
- Test and Measurement Equipment

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## 1.0 INTRODUCTION

### 1.1 General Terms and Conditions

The following is list of the general terms used throughout this document:

|   |   |
|---|---|
| <b>BIU - Bus Interface Unit</b>                       | The host interface function that performs code conversion, buffering, and the like required for communications to and from a network.   |
| <b>BPDU - Bridge Protocol Data Unit</b>               | A packet containing ports, addresses, etc. to make sure data being passed through a bridged network arrives at its proper destination.  |
| <b>CMOS - Complementary Metal Oxide Semiconductor</b> | A common semiconductor manufacturing technique in which positive and negative types of transistors are combined to form a current gate that in turn forms an effective means of controlling electrical current through a chip.  |
| <b>CRC - Cyclic Redundancy Check</b>                  | A common technique for detecting data transmission errors. CRC for Ethernet is 32 bits long.  |
| <b>Cut-Through Switch</b>                             | A switch typically processes received packets by reading in the full packet (storing), then processing the packet to determine where it needs to go, then forwarding it. A cut-through switch simply reads in the first bit of an incoming packet and forwards the packet. Cut-through switches do not store the packet.  |
| <b>DA - Destination Address</b>                       | The address to send packets.  |
| <b>DMA - Direct Memory Access</b>                     | A design in which memory on a chip is controlled independently of the CPU.  |
| <b>EMI - Electromagnetic Interference</b>             | A naturally occurring phenomena when the electromagnetic field of one device disrupts, impedes or degrades the electromagnetic field of another device by coming into proximity with it. In computer technology, computer devices are susceptible to EMI because electromagnetic fields are a byproduct of passing electricity through a wire. Data lines that have not been properly shielded are susceptible to data corruption by EMI.   |
| <b>FCS - Frame Check Sequence</b>                     | See CRC.  |
| <b>FID - Frame or Filter ID</b>                       | Specifies the frame identifier. Alternately is the filter identifier.   |
| <b>GPIO - General Purpose Input/Output</b>            | General Purpose Input/Output pins are signal pins that can be controlled or monitored by hardware and software to perform specific tasks.   |
| <b>IGMP - Internet Group Management Protocol</b>      | The protocol defined by RFC 1112 for IP multicast transmissions.  |
| <b>IPG - Inter-Packet Gap</b>                         | A time delay between successive data packets mandated by the network standard for protocol reasons. In Ethernet, the medium has to be "silent" (i.e., no data transfer) for a short period of time before a node can consider the network idle and start to transmit. IPG is used to correct timing differences between a transmitter and receiver. During the IPG, no data is transferred, and information in the gap can be discarded or additions inserted without impact on data integrity. |
| <b>ISA - Industry Standard Architecture</b>           | A bus architecture used in the IBM PC/XT and PC/AT.   |
| <b>ISI - Inter-Symbol Interference</b>                | The disruption of transmitted code caused by adjacent pulses affecting or interfering with each other.  |
| <b>Jumbo Packet</b>                                   | A packet larger than the standard Ethernet packet (1500 bytes). Large packet sizes allow for more efficient use of bandwidth, lower overhead, less processing, etc.   |
| <b>MAC - Media Access Controller</b>                  | A functional block responsible for implementing the media access control layer which is a sub layer of the data link layer.   |

|   |  |
|---|--|
| <b>MDI - Medium Dependent Interface</b>             | An Ethernet port connection that allows network hubs or switches to connect to other hubs or switches without a null-modem, or crossover, cable. MDI provides the standard interface to a particular media (copper or fiber) and is therefore “media dependent”.   |
| <b>MDI-X - Medium Dependent Interface Crossover</b> | An Ethernet port connection that allows networked end stations (i.e., PCs or workstations) to connect to each other using a null-modem, or crossover, cable. For 10/100 full-duplex networks, an end point (such as a computer) and a switch are wired so that each transmitter connects to the far end receiver. When connecting two computers together, a cable that crosses the TX and RX is required to do this. With auto MDI-X, the PHY senses the correct TX and RX roles, eliminating any cable confusion. |
| <b>MIB - Management Information Base</b>            | The MIB comprises the management portion of network devices. This can include things like monitoring traffic levels and faults (statistical), and can also change operating parameters in network nodes (static forwarding addresses).   |
| <b>MII - Media Independent Interface</b>            | The MII accesses PHY registers as defined in the IEEE 802.3 specification.   |
| <b>NIC - Network Interface Card</b>                 | An expansion board inserted into a computer to allow it to be connected to a network. Most NICs are designed for a particular type of network, protocol, and media, although some can serve multiple networks.   |
| <b>NPVID - Non-Port VLAN ID</b>                     | The port VLAN ID value is used as a VLAN reference.  |
| <b>NRZ - Non-Return to Zero</b>                     | A type of signal data encoding whereby the signal does not return to a zero state in between bits.   |
| <b>PHY</b>  | A device or functional block which performs the physical layer interface function in a network.  |
| <b>PLL - Phase-Locked Loop</b>                      | An electronic circuit that controls an oscillator so that it maintains a constant phase angle (i.e., lock) on the frequency of an input, or reference, signal. A PLL ensures that a communication signal is locked on a specific frequency and can also be used to generate, modulate, and demodulate a signal and divide a frequency.   |
| <b>PTP - Precision Time Protocol</b>                | A protocol, IEEE 1588 as applied to this device, for synchronizing the clocks of devices attached to a specific network.   |
| <b>QMU - Queue Management Unit</b>                  | Manages packet traffic between the port 3 internal MAC and the system host (processor) interface. The QMU has built-in packet memories for receive and transmit functions called TXQ (Transmit Queue) and RXQ (Receive Queue). For the QMU, “transmit” means into port 3 of the switch from the external host, and “receive” is from the switch to the external host. This terminology is the opposite of the terminology used for other KSZ8462 switch blocks.  |
| <b>SA - Source Address</b>                          | The address from which information has been sent.  |
| <b>TDR - Time Domain Reflectometry</b>              | TDR is used to pinpoint flaws and problems in underground and aerial wire, cabling, and fiber optics. They send a signal down the conductor and measure the time it takes for the signal, or part of the signal, to return.  |
| <b>TSU - Time Stamp Input Unit</b>                  | The functional block which captures signals on the GPIO pins and assigns a time to the specific event.   |
| <b>UTP - Unshielded Twisted Pair</b>                | Commonly a cable containing four twisted pairs of wires. The wires are twisted in such a manner as to cancel electrical interference generated in each wire, therefore shielding is not required.  |
| <b>VLAN - Virtual Local Area Network</b>            | A configuration of computers that acts as if all computers are connected by the same physical network but which may be located virtually anywhere.   |

## 1.2 General Description

The KSZ8462 EtherSynch<sup>®</sup> product line consists of IEEE 1588v2 enabled Ethernet switches, providing integrated communications and synchronization for a range of Industrial Ethernet applications.

The KSZ8462 EtherSynch product line enables distributed, daisy-chained topologies preferred for Industrial Ethernet networks. Conventional centralized (i.e., star-wired) topologies are also supported for dual-homed, fault-tolerant arrangements.

A flexible 8- or 16-bit general bus interface is provided for interfacing to an external host processor.

The KSZ8462 devices incorporate the IEEE 1588v2 protocol. Sub-microsecond synchronization is available via the use of hardware-based time-stamping and transparent clocks making it the ideal solution for time synchronized Layer 2 communication in critical industrial applications.

Extensive general purpose I/O (GPIO) capabilities are available to use with the IEEE 1588v2 PTP to efficiently and accurately interface to locally connected devices.

Complementing the industry's most-integrated IEEE 1588v2 device is a precision timing protocol (PTP) v2 software stack that has been pre-qualified with the KSZ84xx product family. The PTP stack has been optimized around the KSZ84xx chip architecture, and is available in source code format along with Microchip's chip driver.

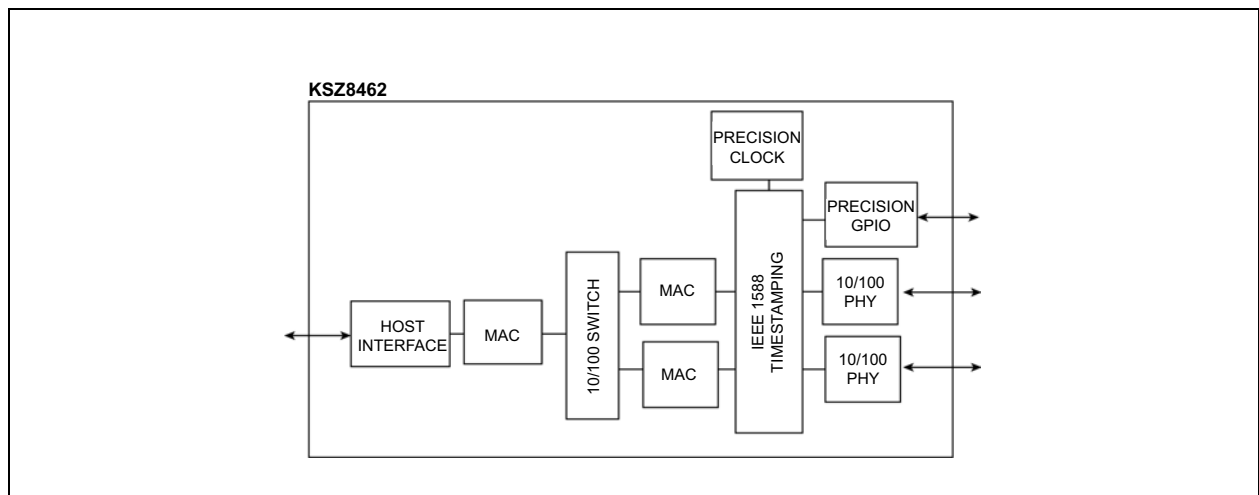
The wire-speed, store-and-forward switching fabric provides a full complement of quality-of-service (QoS) and congestion control features optimized for real-time Ethernet.

The KSZ8462 product line is built upon Microchip's industry-leading Ethernet technology, with features designed to off-load host processing and streamline your overall design.

- Wire-speed Ethernet switching fabric with extensive filtering
- Two integrated 10/100BASE-TX PHY transceivers, featuring the industry's lowest power consumption
- Full-featured quality-of-service (QoS) support
- Flexible management options that support common standard interfaces

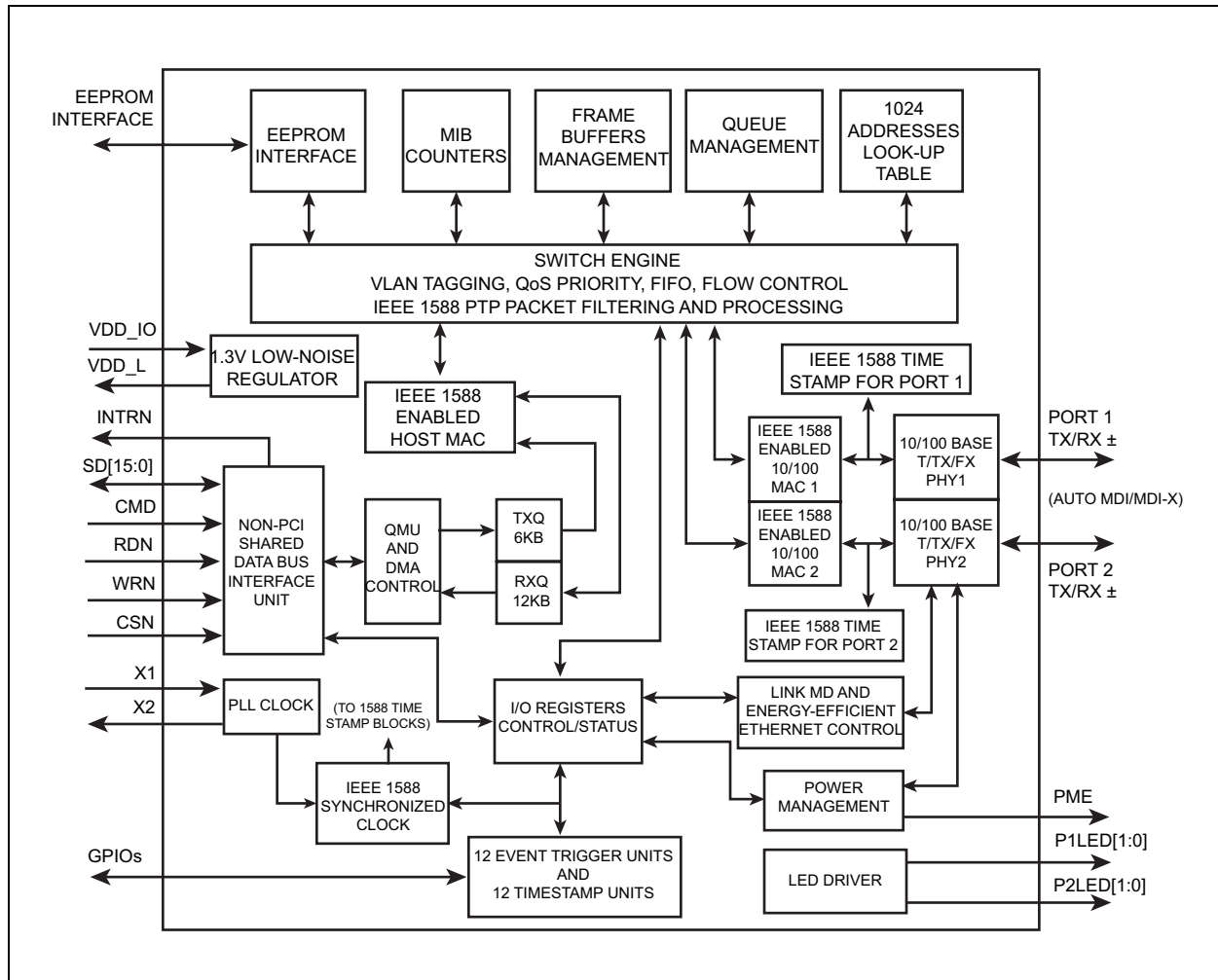
A robust assortment of power-management features including Energy Efficient Ethernet (EEE) have been designed in to satisfy energy efficient environments.

**FIGURE 1-1: KSZ8462 TOP LEVEL ARCHITECTURE**



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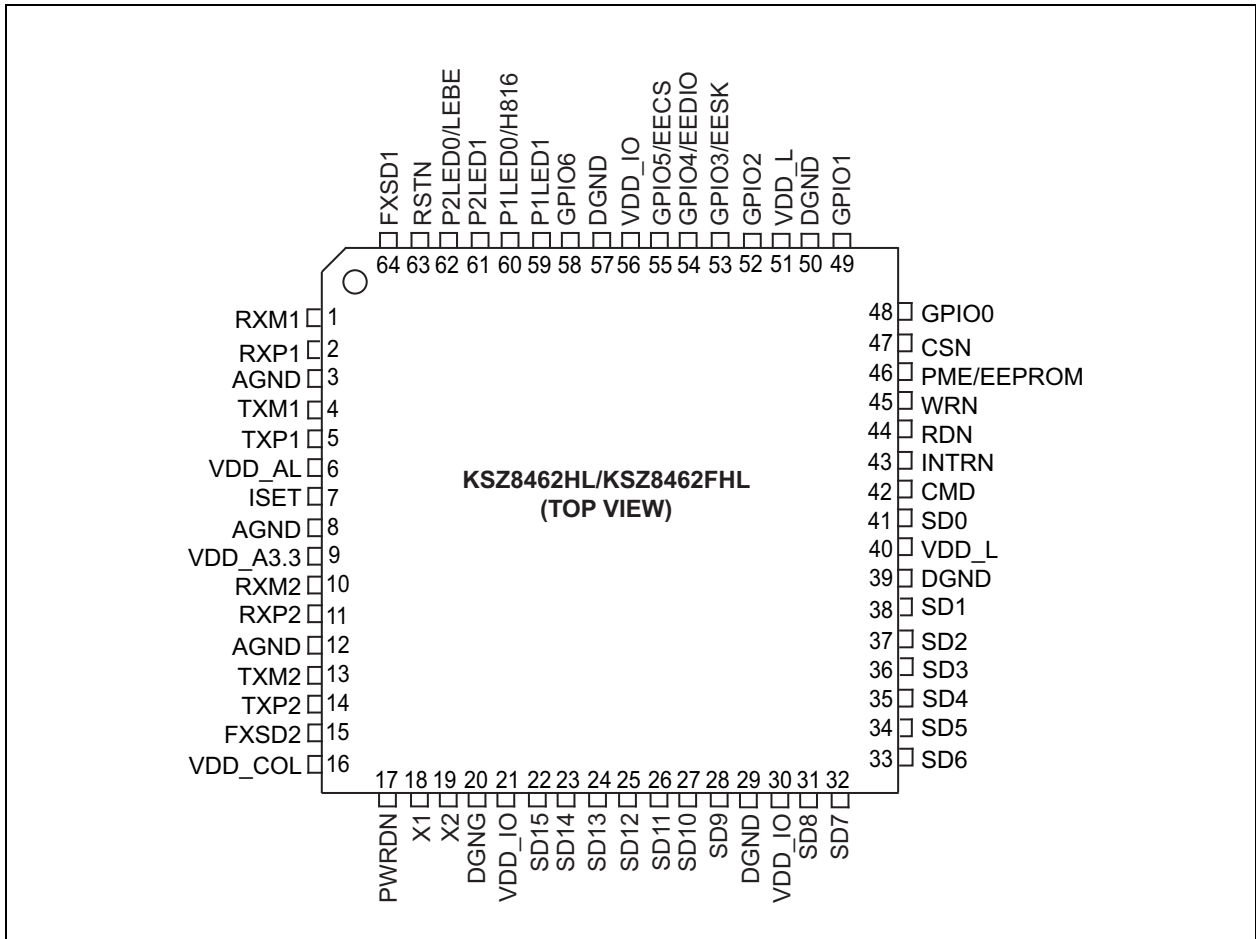
**FIGURE 1-2: SYSTEM BLOCK DIAGRAM, KSZ8462HLI/FHLI**





## 2.0 PIN DESCRIPTION AND CONFIGURATION

FIGURE 2-1: 64-PIN LQFP ASSIGNMENT, (TOP VIEW)



# KSZ8462HLI/FHLI

TABLE 2-1: SIGNALS FOR KSZ8462HLI/FHLI

| Pin Number | Pin Name | Type<br>(Note 2-1) | Description   |
|------------|----------|--------------------|---|
| 1          | RXM1     | I/O                | Port 1 physical receive (MDI) or transmit (MDIX) signal (– differential).   |
| 2          | RXP1     | I/O                | Port 1 physical receive (MDI) or transmit (MDIX) signal (+ differential).   |
| 3          | AGND     | GND                | Analog Ground.  |
| 4          | TXM1     | I/O                | Port 1 physical transmit (MDI) or receive (MDIX) signal (– differential).   |
| 5          | TXP1     | I/O                | Port 1 physical transmit (MDI) or receive (MDIX) signal (+ differential).   |
| 6          | VDD_AL   | P                  | This pin is used as an input for the low-voltage analog power. Its source should have appropriate filtering with a ferrite bead and capacitors.   |
| 7          | ISSET    | O                  | Set physical transmits output current.<br>Pull-down this pin with a 6.49 kΩ (1%) resistor to ground.  |
| 8          | AGND     | GND                | Analog Ground.  |
| 9          | VDD_A3.3 | P                  | 3.3V analog V <sub>DD</sub> input power supply (Must be well decoupled).  |
| 10         | RXM2     | I/O                | Port 2 physical receive (MDI) or transmit (MDIX) signal (– differential).   |
| 11         | RXP2     | I/O                | Port 2 physical receive (MDI) or transmit (MDIX) signal (+ differential).   |
| 12         | AGND     | GND                | Analog Ground.  |
| 13         | TXM2     | I/O                | Port 2 physical transmit (MDI) or receive (MDIX) signal (– differential).   |
| 14         | TXP2     | I/O                | Port 2 physical transmit (MDI) or receive (MDIX) signal (+ differential).   |
| 15         | FXSD2    | I                  | Fiber signal detect input for port 2 in 100BASE-FX fiber mode. When in copper mode, this input is unused and should be pulled to GND.<br>Note: This functionality is available only on the KSZ8462FHLI.   |
| 16         | VDD_COL  | P                  | This pin is used as a second input for the low-voltage analog power. Its source should have appropriate filtering with a ferrite bead and capacitors.   |
| 17         | PWRDN    | IPU                | <b>Full-Chip Power-Down</b><br>Active-Low (Low = Power-down; High or floating = Normal operation).<br>While this pin is asserted low, all I/O pins will be tri-stated. All registers will be set to their default state. While this pin is asserted, power consumption will be minimal. When the pin is de-asserted, power consumption will climb to nominal and the device will be in the same state as having been reset by the reset pin (RSTN, pin 63). |
| 18         | X1       | I                  | <b>25 MHz Crystal or Oscillator Clock Connection</b><br>Pins (X1, X2) connect to a crystal or frequency oscillator source. If an oscillator is used, X1 connects to a V <sub>DD_IO</sub> voltage tolerant oscillator and X2 is a no connect. This clock requirement is ±50 ppm.   |
| 19         | X2       | O                  |   |
| 20         | DGND     | GND                | Digital ground.   |
| 21         | VDD_IO   | P                  | 3.3V, 2.5V, or 1.8V digital V <sub>DD</sub> input power pin for IO logic and the internal low-voltage regulator.  |

**TABLE 2-1: SIGNALS FOR KSZ8462HLI/FHLI (CONTINUED)**

| Pin Number | Pin Name | Type<br>(Note 2-1) | Description  |
|------------|----------|--------------------|--|
| 22         | SD15/BE3 | I/O (PD)           | Shared Data Bus Bit[15] or BE3: This is data bit (D15) access when CMD = "0". This is Byte Enable 3 (BE3, 4th byte enable and active-high) at double-word boundary access in 16-bit bus mode when CMD = "1". This pin must be tied to GND in 8-bit bus mode. |
| 23         | SD14/BE2 | I/O (PD)           | Shared Data Bus Bit[14] or BE2: This is data bit (D14) access when CMD = "0". This is Byte Enable 2 (BE2, 3rd byte enable and active-high) at double-word boundary access in 16-bit bus mode when CMD = "1". This pin must be tied to GND in 8-bit bus mode. |
| 24         | SD13/BE1 | I/O (PD)           | Shared Data Bus Bit[13] or BE1: This is data bit (D13) access when CMD = "0". This is Byte Enable 1 (BE1, 2nd byte enable and active-high) at double-word boundary access in 16-bit bus mode when CMD = "1". This pin must be tied to GND in 8-bit bus mode. |
| 25         | SD12/BE0 | I/O (PD)           | Shared Data Bus Bit[12] or BE0: This is data bit (D12) access when CMD = "0". This is Byte Enable 0 (BE0, 1st byte enable and active-high) at double-word boundary access in 16-bit bus mode when CMD = "1". This pin must be tied to GND in 8-bit bus mode. |
| 26         | SD11     | I/O (PD)           | Shared Data Bus Bit[11]: This is data bit (D11) access when CMD = "0". Don't care when CMD = "1". This pin must be tied to GND in 8-bit bus mode.  |
| 27         | SD10/A10 | I/O (PD)           | Shared Data Bus bit[10]: This is data bit (D10) access when CMD = "0". In 8-bit bus mode, this pin must be tied to GND. In 16-bit bus mode, this is address A10 access when CMD = "1".   |
| 28         | SD9/A9   | I/O (PD)           | Shared Data Bus Bit[9] or A9: This is data bit (D9) access when CMD = "0". In 8-bit bus mode, this pin must be tied to GND. In 16-bit bus mode, this is address A9 access when CMD = "1".  |
| 29         | DGND     | GND                | Digital Ground.  |
| 30         | VDD_IO   | P                  | 3.3V, 2.5V, or 1.8V digital V <sub>DD</sub> input power pin for IO logic and the internal low-voltage regulator.   |
| 31         | SD8/A8   | IPU/O              | Shared Data Bus Bit[8] or A8: This is data bit (D8) access when CMD = "0". In 8-bit bus mode, this pin must be tied to GND. In 16-bit bus mode, this is address A8 access when CMD = "1".  |
| 32         | SD7/A7   | IPU/O              | Shared Data Bus Bit[7] or A7: This is data bit (D7) access when CMD = "0". In 8-bit bus mode, this is address A7 (1st write) or Don't care (2nd write) access when CMD = "1". In 16-bit bus mode, this is address A7 access when CMD = "1".                  |
| 33         | SD6/A6   | IPU/O              | Shared Data Bus Bit[6] or A6: This is data bit (D6) access when CMD = "0". In 8-bit bus mode, this is address A6 (1st write) or Don't care (2nd write) access when CMD = "1". In 16-bit bus mode, this is address A6 access when CMD = "1".                  |
| 34         | SD5/A5   | IPU/O              | Shared Data Bus Bit[5] or A5: This is data bit (D5) access when CMD = "0". In 8-bit bus mode, this is address A5 (1st write) or Don't care (2nd write) access when CMD = "1". In 16-bit bus mode, this is address A5 access when CMD = "1".                  |

# KSZ8462HLI/FHLI

TABLE 2-1: SIGNALS FOR KSZ8462HLI/FHLI (CONTINUED)

| Pin Number | Pin Name  | Type<br>(Note 2-1) | Description   |
|------------|-----------|--------------------|---|
| 35         | SD4/A4    | IPU/O              | Shared Data Bus Bit[4] or A4: This is data bit (D4) access when CMD = "0". In 8-bit bus mode, this is address A4 (1st write) or Don't care (2nd write) access when CMD = "1". In 16-bit bus mode, this is address A4 access when CMD = "1".   |
| 36         | SD3/A3    | I/O<br>(PD)        | Shared Data Bus Bit[3] or A3: This is data bit (D3) access when CMD = "0". In 8-bit bus mode, this is address A3 (1st write) or Don't care (2nd write) access when CMD = "1". In 16-bit bus mode, this is address A3 access when CMD = "1".   |
| 37         | SD2/A2    | I/O<br>(PD)        | Shared Data Bus Bit[2] or A2: This is data bit (D2) access when CMD = "0". In 8-bit bus mode, this is address A2 (1st write) or A10 (2nd write) access when CMD = "1". In 16-bit bus mode, this is address A2 access when CMD = "1".  |
| 38         | SD1/A1/A9 | I/O<br>(PD)        | Shared Data Bus Bit[1] or A1 or A9: This is data bit (D1) access when CMD = "0". In 8-bit bus mode, this is address A1 (1st write) or A9 (2nd write) access when CMD = "1". In 16-bit bus mode, this is "Don't care" when CMD = "1".  |
| 39         | DGND      | GND                | Digital Ground  |
| 40         | VDD_L     | P                  | This pin can be used in two ways: as the pin to input a low voltage to the device if the internal low-voltage regulator is not used, or as the low-voltage output if the internal low-voltage regulator is used.  |
| 41         | SD0/A0/A8 | IPU/O              | Shared Data Bus Bit[0] or A0 or A8: This is data bit (D0) access when CMD = "0". In 8-bit bus mode, this is address A0 (1st write) or A8 (2nd write) access when CMD = "1". In 16-bit bus mode, this is "Don't care" when CMD = "1".  |
| 42         | CMD       | IPD                | Command Type: This command input decides the SD[15:0] shared data bus access information. When command input is low, the access of shared data bus is for data access either SD[15:0] -> DATA[15:0] in 16-bit bus mode or SD[7:0] -> DATA[7:0] in 8-bit bus mode.<br>When command input is high, in 16-bit bus mode: The access of shared data bus is for address A[10:2] access at shared data bus SD[10:2] and SD[1:0] is "don't care." Byte enable BE[3:0] at SD[15:12] and the SD[11] is "don't care".<br>in 8-bit bus mode: It is for address A[7:0] during 1st write access at shared data bus SD[7:0] or A[10:8] during 2nd write access at shared data bus SD[2:0] (SD[7:3] is don't care). |
| 43         | INTRN     | OPU                | <b>Interrupt Output.</b><br>This is an active-low signal going to the host CPU to indicate an interrupt status bit is set. This pin needs an external 4.7 kΩ pull-up resistor.  |
| 44         | RDN       | IPU                | <b>Read Strobe</b><br>This signal is an active low signal used as the asynchronous read strobe during read access cycles by the Host processor. It is recommended that it be pulled up with a 4.7 kΩ resistor.  |
| 45         | WRN       | IPU                | <b>Write Strobe</b><br>This is an asynchronous write strobe signal used during write cycles from the external host processor. It is a low active signal.  |

**TABLE 2-1: SIGNALS FOR KSZ8462HLI/FHLI (CONTINUED)**

| Pin Number | Pin Name    | Type (Note 2-1) | Description   |
|------------|-------------|-----------------|---|
| 46         | PME/EEPROM  | IPD/O           | <b>Power Management Event:</b> This output signal indicates that a wake-on-LAN event has been detected. The KSZ8462 is requesting the system to wake up from low power mode. Its assertion polarity is programmable with the default polarity to be active-low.<br><b>Config Mode: (EEPROM):</b> At the end of the power-up/reset period, this pin is sampled and the pull-up/pull-down value is latched. The value latched will indicate if a serial EEPROM is present or not. See <a href="#">Table 2-2</a> for details.  |
| 47         | CSN         | IPU             | <b>Chip Select:</b> This signal is the chip-select signal that is used by the external Host processor for accesses to the device. It is an active-low signal.   |
| 48         | GPIO0       | I/O (PU)        | <b>General Purpose Input/Output [0]</b><br>This pin can be used as an input or output pin for use by the IEEE 1588 event trigger or time stamp capture units. It will be synchronized to the internal IEEE 1588 clock. The host processor can also directly drive or read this GPIO pin.  |
| 49         | GPIO1       | I/O (PU)        | This pin is GPIO1 (refer to GPIO0 pin 48 description).  |
| 50         | DGND        | GND             | Digital Ground.   |
| 51         | VDD_L       | P               | This pin can be used in two ways: as the pin to input a low voltage to the device if the internal low-voltage regulator is not used, or as the low-voltage output if the internal low-voltage regulator is used.  |
| 52         | GPIO2       | I/O (PU)        | This pin is GPIO2 (refer to GPIO0 pin 48 description).  |
| 53         | GPIO3/EESK  | I/O (PD)        | <b>Default function:</b><br>EEPROM Serial Clock Output: A serial output clock is used to load configuration data into the KSZ8462 from the external EEPROM when it is present.<br><b>Alternate function:</b><br>General Purpose Input/Output [3]: This pin can be used as an input or output pin for use by the IEEE 1588 event trigger or time stamp capture units. It will be synchronized to the internal IEEE 1588 clock. The host processor can also directly drive or read this GPIO pin.<br>Function of this pin is controlled by bit[5] in IOMUXSEL register. |
| 54         | GPIO4/EEDIO | I/O (PD)        | <b>Default function:</b><br>EEPROM Data Input/Output: Serial data input/output is from/to external EEPROM when it is present.<br><b>Alternate function:</b><br>General Purpose Input/Output [4]: This pin can be used as an input or output pin for use by the IEEE 1588 event trigger or time stamp capture units. It will be synchronized to the internal IEEE 1588 clock. The host processor can also directly drive or read this GPIO pin.<br>Function of this pin is controlled by bit[2] in IOMUXSEL register.  |

# KSZ8462HLI/FHLI

TABLE 2-1: SIGNALS FOR KSZ8462HLI/FHLI (CONTINUED)

| Pin Number    | Pin Name                                 | Type<br>( <a href="#">Note 2-1</a> ) | Description  |               |  |      |          |      |                 |    |    |    |               |       |     |        |        |
|---------------|--|--------------------------------------|--|---------------|--|------|----------|------|-----------------|----|----|----|---------------|-------|-----|--------|--------|
| 55            | GPIO5/EECS                               | I/O<br>(PD)                          | <b>Default function:</b><br>EEPROM Chip Select Output: This signal is used to select an external EEPROM device when it is present.<br><b>Alternate function:</b><br>General Purpose Input/Output [5]: This pin can be used as an input or output pin for use by the IEEE 1588 event trigger or time stamp capture units. It will be synchronized to the internal IEEE 1588 clock. The host processor can also directly drive or read this GPIO pin.<br>Function of this pin is controlled by bit[1] in IOMUXSEL register.  |               |  |      |          |      |                 |    |    |    |               |       |     |        |        |
| 56            | VDD_IO                                   | P                                    | 3.3V, 2.5V, or 1.8V digital V <sub>DD</sub> input power pin for IO logic and the internal low-voltage regulator.   |               |  |      |          |      |                 |    |    |    |               |       |     |        |        |
| 57            | DGND                                     | GND                                  | Digital ground.  |               |  |      |          |      |                 |    |    |    |               |       |     |        |        |
| 58            | GPIO6                                    | I/O<br>(PU)                          | This pin is GPIO6 (refer to GPIO0 pin 48 description).   |               |  |      |          |      |                 |    |    |    |               |       |     |        |        |
| 59            | P1LED1                                   | IPU/O                                | <b>Programmable LED Output to Indicate Port 1 and Port 2 Activity/Status.</b><br>The LED is ON (active) when output is LOW; the LED is OFF (inactive) when output is HIGH. The port 1 LED pins outputs are determined by the table below if Reg. 0x06C – 0x06D, bits[14:12] are set to '000'. Otherwise, the port 1 LED pins are controlled via the processor by setting Reg. 0x06C – 0x06D, bits[14:12] to a non-zero value.<br>The port 2 LED pins outputs are determined by the table below if Reg. 0x084 – 0x085, bits[14:12] are set to '000'. Otherwise, the port 2 LED pins are controlled via the processor by setting Reg. 0x084 – 0x085, bits[14:12] to a non-zero value.<br>Automatic port 1 and port 2 indicators are defined as follows:  |               |  |      |          |      |                 |    |    |    |               |       |     |        |        |
| 60            | P1LED0/<br>H816                          | IPU/O                                | <table><tr><td rowspan="2">—</td><td colspan="4">Two bits [9:8] in SPCR7 Control Register</td></tr><tr><td>00<br/>(default)</td><td>01</td><td>10</td><td>11</td></tr><tr><td>P1LED1/P2LED1</td><td>Speed</td><td>ACT</td><td>Duplex</td><td>Duplex</td></tr></table>  | —             | Two bits [9:8] in SPCR7 Control Register |      |          |      | 00<br>(default) | 01 | 10 | 11 | P1LED1/P2LED1 | Speed | ACT | Duplex | Duplex |
| —             | Two bits [9:8] in SPCR7 Control Register |                                      |  |               |  |      |          |      |                 |    |    |    |               |       |     |        |        |
|               | 00<br>(default)                          | 01                                   | 10   | 11            |  |      |          |      |                 |    |    |    |               |       |     |        |        |
| P1LED1/P2LED1 | Speed                                    | ACT                                  | Duplex   | Duplex        |  |      |          |      |                 |    |    |    |               |       |     |        |        |
| 61            | P2LED1                                   | O                                    | <table><tr><td>P1LED0/P2LED0</td><td>Link/ACT</td><td>Link</td><td>Link/ACT</td><td>Link</td></tr></table>   | P1LED0/P2LED0 | Link/ACT                                 | Link | Link/ACT | Link |                 |    |    |    |               |       |     |        |        |
| P1LED0/P2LED0 | Link/ACT                                 | Link                                 | Link/ACT   | Link          |  |      |          |      |                 |    |    |    |               |       |     |        |        |
| 62            | P2LED0/<br>LEBE                          | IPU/O                                | <p>Link = LED ON; ACT = LED Blink; Link/ACT = LED ON/Blink<br/>Speed = LED ON (100BASE-TX); LED OFF (10BASE-T)<br/>Duplex = LED ON (Full-Duplex); LED OFF (Half-Duplex)</p> <p>Config Mode: (P1LED1): At the end of the power-up/reset period, this pin is sampled and the pull-up/pull-down value is latched. It must be at a logic high level at this time. See <a href="#">Table 2-2</a> for details.</p> <p>Config Mode: (P1LED0/H816): At the end of the power-up/reset period, this pin is sampled and the pull-up/pull-down value is latched. The value latched will determine if 8-bit or 16-bit mode will be used for the Host Interface. See <a href="#">Table 2-2</a> for details.</p> <p>Config Mode: (P2LED0/LEBE): At the end of the power-up/reset period, this pin is sampled and the pull-up/pull-down value is latched. The value latched will determine if “Little Endian” or “Big Endian” mode will be used for the Host Interface. See <a href="#">Table 2-2</a> for details.</p> |               |  |      |          |      |                 |    |    |    |               |       |     |        |        |

**TABLE 2-1: SIGNALS FOR KSZ8462HLI/FHLI (CONTINUED)**

| Pin Number | Pin Name | Type<br>(Note 2-1) | Description  |
|------------|----------|--------------------|--|
| 63         | RSTN     | IPU                | Hardware reset input (active-low). This reset input is required to be low for a minimum of 10 ms after supply voltages VDD_IO and 3.3V are stable.   |
| 64         | FXSD1    | I                  | Fiber Signal Detect input for port 1 in 100BASE-FX fiber mode. When in copper mode, this input is unused and should be pulled to GND.<br>Note: This functionality is available only on the KSZ8462FHLI device. |

**Note 2-1** P = power supply; GND = ground  
I = input; O = output; I/O = bi-directional  
IPU/O = Input with internal pull-up (58 kΩ ±30%) during power-up/reset; output pin otherwise.  
IPD/O = Input with internal pull-down (58 kΩ ±30%) during power-up/reset; output pin otherwise.  
IPU = Input with internal pull-up. (58 kΩ ±30%)  
IPD = Input with internal pull-down. (58 kΩ ±30%)  
OPU = Output with internal pull-up. (58 kΩ ±30%)  
OPD = Output with internal pull-down. (58 kΩ ±30%)  
I/O (PD) = Bi-directional input/output with internal pull-down. (58 kΩ ±30%)  
I/O (PU) = Bi-directional input/output with internal pull-up. (58 kΩ ±30%)

**TABLE 2-2: STRAPPING OPTIONS**

| Pin Number | Pin Name        | Type<br>Note 2-1 | Description  |
|------------|-----------------|------------------|--|
| 46         | PME/<br>EEPROM  | IPD/O            | <b>EEPROM Select</b><br>Pull-Up = EEPROM present,<br>NC or Pull-Down (default) = EEPROM not present.<br>This pin value is latched into register CCR, bit [9] at the end of the power-on-reset time.                        |
| 59         | P1LED1          | IPU/O            | <b>Reserved</b><br>NC or Pull-Up (default) = Normal Operation,<br>Pull-Down = Reserved   |
| 60         | P1LED0/<br>H816 | IPU/O            | <b>8- or 16-Bit Bus Mode Select</b><br>NC or Pull-Up (default) = 16-bit bus mode, Pull-Down = 8-bit bus mode.<br>This pin value is also latched into register CCR, bit [7:6] at the end of the power-on-reset time.        |
| 62         | P2LED0/<br>LEBE | IPU/O            | <b>Endian Mode Select for 8-/16-bit Host Interface</b><br>NC or Pull-Up (default) = Little Endian, Pull-Down = Big Endian.<br>This pin value is latched into register CCR, bit [10] at the end of the power-on-reset time. |

**Note 2-1** IPU/O = Input with internal pull-up (58 kΩ ±30%) during power-up/reset; output pin otherwise.  
IPD/O = Input with internal pull-down (58 kΩ ±30%) during power-up/reset; output pin otherwise.

All strapping pins are latched at the end of the power-up or reset cycle. They are also latched when powering-up from a hardware or software power-down or hardware reset state.

# KSZ8462HLI/FHLI

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## 3.0 FUNCTIONAL DESCRIPTION

The KSZ8462HLI/FHLI is a highly integrated networking device that incorporates a Layer 2 switch, two 10BASE-T/100BASE-TX physical layer transceivers (PHYs) and associated MAC units, and a bus interface unit (BIU) with one general 8-/16-bit host interface, and key IEEE 1588 precision time protocol (PTP) features.

The KSZ8462HLI/FHLI operates in a managed mode. In managed mode, a host processor can access and control all PHY, Switch, MAC, and IEEE 1588 related registers within the device via the host interface.

Physical signal transmission and reception are enhanced through the use of analog circuits in the PHY that make the design more efficient and allow for low power consumption. Both power management and Energy Efficient Ethernet (EEE) are designed to save more power while device is in idle state. Wake-on-LAN is implemented to allow the KSZ8462 to monitor the network for packets intended to wake up the system which is upstream from the KSZ8462.

The KSZ8462HLI/FHLI is fully compliant to IEEE802.3u standards.

### 3.1 Direction Terminology

Readers should note that two different terminologies are used in this data sheet to describe the direction of data flow. In the standard terminology that is used for all Microchip switches, directions are described from the point of view of the switch core: “transmit” indicates data flow out of the KSZ8462 on any of the three ports, while “receive” indicates data flow into the KSZ8462. This terminology is used for the MIB counters.

When referencing the QMU block, which is located on port 3 between the internal MAC and the external 8-/16-bit host interface, directions are reversed – they are described from the point of view of the external host processor. Thus, “transmit” indicates data flow from the host into port 3 of the KSZ8462, while “receive” indicates data flow out of the KSZ8462 on port 3. Because both terminologies are used for port 3, it is important to note whether or not a particular section refers to the QMU.

### 3.2 Physical (PHY) Block

#### 3.2.1 100BASE-TX TRANSMIT

The 100BASE-TX transmit function performs parallel-to-serial conversion, 4B/5B coding, scrambling, NRZ-to-NRZI conversion, and MLT3 encoding and transmission.

The circuitry starts with a parallel-to-serial conversion, which converts the MII data from the MAC into a 125 MHz serial bit stream. The data and control stream is then converted into 4B/5B coding, followed by a scrambler. The serialized data is further converted from NRZ-to-NRZI format, and then transmitted in MLT3 current output. An external 6.49 k $\Omega$  (1%) resistor for the 1:1 transformer ratio sets the output current.

The output signal has a typical rise/fall time of 4 ns and complies with the ANSI TP-PMD standard regarding amplitude balance, overshoot, and timing jitter. The wave-shaped 10BASE-T output driver is also incorporated into the 100BASE-TX driver.

#### 3.2.2 100BASE-TX RECEIVE

The 100BASE-TX receiver function performs adaptive equalization, DC restoration, MLT3-to-NRZI conversion, data and clock recovery, NRZI-to-NRZ conversion, de-scrambling, 4B/5B decoding, and serial-to-parallel conversion.

The receiving side starts with the equalization filter to compensate for inter-symbol interference (ISI) over the twisted pair cable. Because the amplitude loss and phase distortion is a function of the cable length, the equalizer has to adjust its characteristics to optimize performance. In this design, the variable equalizer makes an initial estimation based on comparisons of incoming signal strength against some known cable characteristics, and then tunes itself for optimization. This is an ongoing process and self-adjusts against environmental changes such as temperature variations.

Next, the equalized signal goes through a DC restoration and data conversion block. The DC restoration circuit is used to compensate for the effect of baseline wander and to improve the dynamic range. The differential data conversion circuit converts the MLT3 format back to NRZI. The slicing threshold is also adaptive.

The clock recovery circuit extracts the 125 MHz clock from the edges of the NRZI signal. This recovered clock is then used to convert the NRZI signal into the NRZ format. This signal is sent through the de-scrambler followed by the 4B/5B decoder. Finally, the NRZ serial data is converted to an MII format and provided as the input data to the MAC.



## 3.2.3 SCRAMBLER/DE-SCRAMBLER (100BASE-TX ONLY)

The purpose of the scrambler is to spread the power spectrum of the signal to reduce electromagnetic interference (EMI) and baseline wander.

Transmitted data is scrambled through the use of an 11-bit wide linear feedback shift register (LFSR). The scrambler generates a 2047-bit non-repetitive sequence. Then the receiver de-scrambles the incoming data stream using the same sequence as at the transmitter.

## 3.2.4 PLL CLOCK SYNTHESIZER (RECOVERY)

The internal PLL clock synthesizer generates 125 MHz, 62.5 MHz and 31.25 MHz clocks for the KSZ8462 system timing. These internal clocks are generated from an external 25 MHz crystal or oscillator. Refer to the [Device Clocks](#) section for details of this area.

## 3.2.5 100BASE-FX OPERATION

Fiber Mode is available only on the KSZ8462FHL device.

100BASE-FX operation is similar to 100BASE-TX operation except that the scrambler/de-scrambler and MLT3 encoder/decoder are bypassed on transmission and reception. In this fiber mode, the auto-negotiation feature is bypassed and auto MDI/MDIX is disabled because there is no standard that supports fiber auto-negotiation and auto MDI/MDIX mode. The fiber port must be forced to either full-duplex or half-duplex mode.

All KSZ8462 devices are in copper mode (10BASE-T/100BASE-TX) when reset or powered on. Fiber mode is enabled by clearing bits[7:6] in the CFGR register (0x0D8-0x0D9). Each port is individually configurable. Bit [13] in the DSP\_CNTRL\_6 register (0x734-0x735) should also be cleared if either (or both) ports are set to fiber mode.

## 3.2.6 100BASE-FX SIGNAL DETECTION

In 100BASE-FX operation, the fiber signal detect inputs FXSD1 and FXSD2 are usually connected to the signal detect (SD) output pin of the fiber transceiver. When FXSD is low, no fiber signal is detected and a far-end fault (FEF) is generated. When FXSD is high, the fiber signal is detected. To ensure proper operation, a resistive voltage divider is recommended to adjust the fiber transceiver SD output voltage swing to match the FXSD pin's input voltage threshold.

Alternatively, the user may choose not to implement the FEF feature. In this case, the FXSD input pin is tied high to force 100BASE-FX mode.

In copper mode, and on the KSZ8462HLI, the FXSD pins are unused and should be pulled low.

## 3.2.7 100BASE-FX FAR-END FAULT

A Far-End Fault (FEF) occurs when the signal detection is logically false on the receive side of the fiber transceiver. The KSZ8462FHLI detects an FEF when its FXSD input is below the fiber signal detect threshold. When an FEF is detected, the KSZ8462FHLI signals its fiber link partner that a FEF has occurred by sending 84 1's followed by a zero in the idle period between frames. By default, FEF is enabled. FEF can be disabled through register setting in P1CR4[12] and P2CR4[12].

## 3.2.8 10BASE-T TRANSMIT

The 10BASE-T driver is incorporated with the 100BASE-TX driver to allow for transmission using the same magnetics. They are internally wave-shaped and pre-emphasized into outputs with typical 2.3V amplitude. The harmonic contents are at least 27 dB below the fundamental frequency when driven by an all-ones Manchester-encoded signal.

## 3.2.9 10BASE-T RECEIVE

On the receive side, input buffers and level detecting squelch circuits are employed. A differential input receiver circuit and a phase-locked loop (PLL) perform the decoding function.

The Manchester-encoded data stream is separated into clock signal and NRZ data. A squelch circuit rejects signals with levels less than 400 mV or with short pulse widths to prevent noise at the RXP1 or RXM1 input from falsely triggering the decoder. When the input exceeds the squelch limit, the PLL locks onto the incoming signal and the KSZ8462 decodes a data frame. The receiver clock is maintained active during idle periods in between data reception.

## 3.2.10 MDI/MDI-X AUTO CROSSOVER

To eliminate the need for crossover cables between similar devices, the KSZ8462 supports HP-Auto MDI/MDI-X and IEEE 802.3u standard MDI/MDI-X auto crossover. HP-Auto MDI/MDI-X is the default.

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The auto-sense function detects remote transmit and receive pairs and correctly assigns the transmit and receive pairs for the KSZ8462. This feature is extremely useful when end users are unaware of cable types in addition to saving on an additional uplink configuration connection. The auto-crossover feature can be disabled through the port control registers. The IEEE 802.3u standard MDI and MDI-X definitions are in [Table 3-1](#).

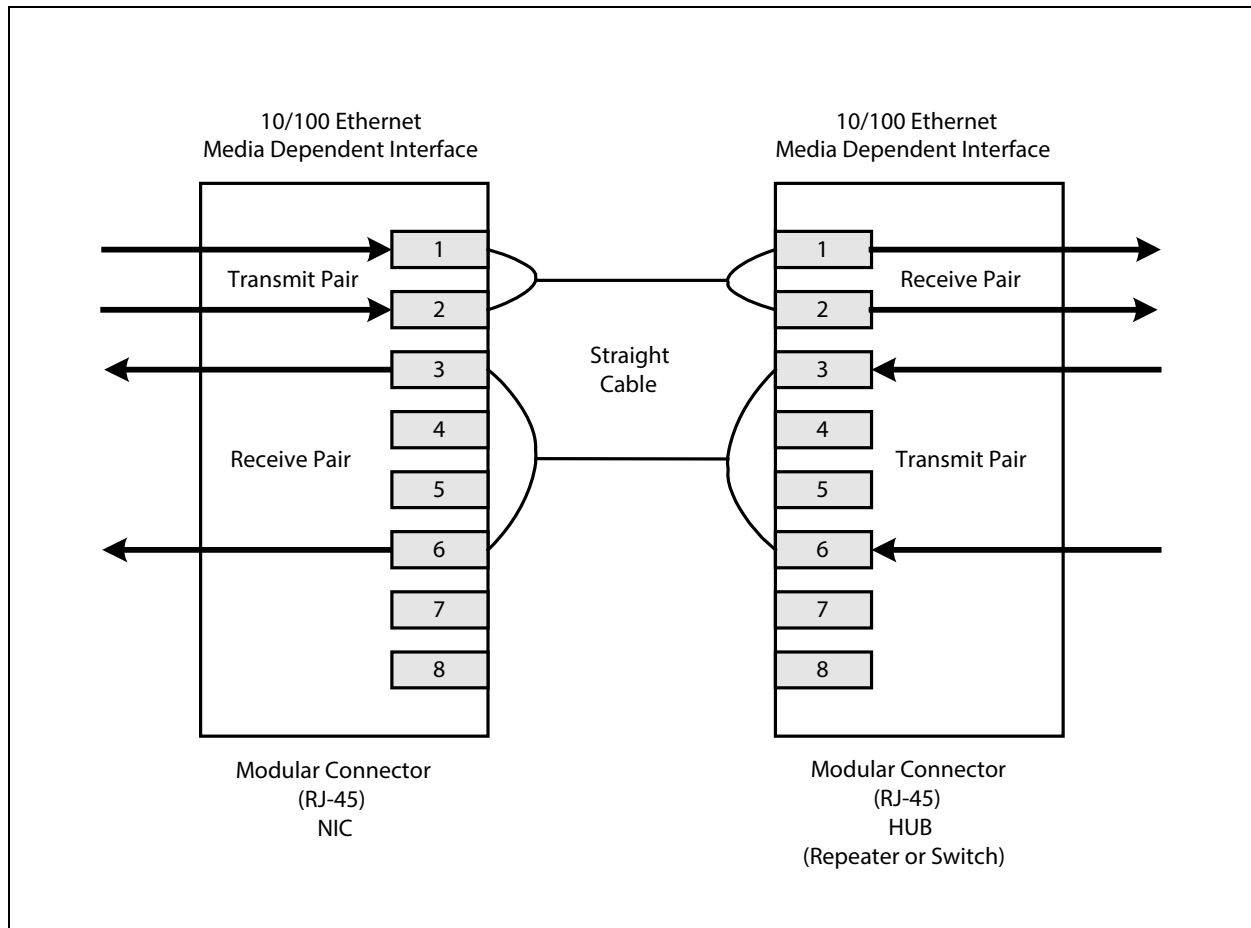
**TABLE 3-1: MDI/MDI-X PIN DEFINITION**

| MDI       |        | MDI-X     |        |
|-----------|--------|-----------|--------|
| RJ-45 Pin | Signal | RJ-45 Pin | Signal |
| 1         | TD+    | 1         | RD+    |
| 2         | TD–    | 2         | RD–    |
| 3         | RD+    | 3         | TD+    |
| 6         | RD–    | 6         | TD–    |

## 3.2.10.1 Straight Cable

A straight cable connects an MDI device to an MDI-X device, or an MDI-X device to an MDI device. [Figure 3-1](#) depicts a typical straight cable connection between a network interface card (NIC) and a switch, or hub (MDI-X).

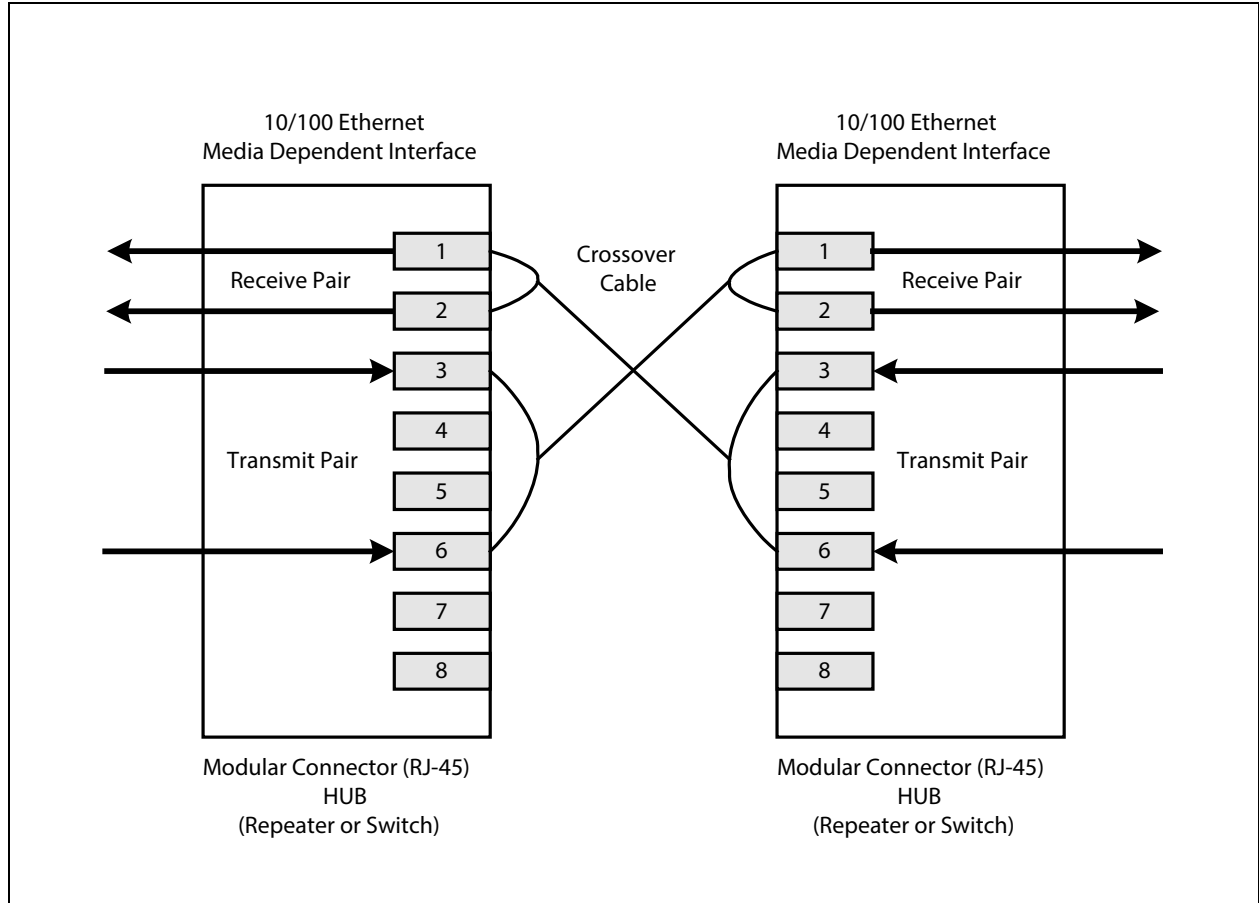
**FIGURE 3-1: TYPICAL STRAIGHT CABLE CONNECTION**



## 3.2.10.2 Crossover Cable

A crossover cable connects an MDI device to another MDI device, or an MDI-X device to another MDI-X device. [Figure 3-2](#) shows a typical crossover cable connection between two chips or hubs (two MDI-X devices).

**FIGURE 3-2: TYPICAL CROSSOVER CABLE CONNECTION**



## 3.2.11 AUTO-NEGOTIATION

The KSZ8462 conforms to the auto-negotiation protocol as described by IEEE 802.3. It allows each port to operate at either 10BASE-T or 100BASE-TX. Auto-negotiation allows unshielded twisted pair (UTP) link partners to select the best common mode of operation. In auto-negotiation, the link partners advertise capabilities across the link to each other and then compare their own capabilities with those they received from their link partners. The highest speed and duplex setting that is common to the two link partners is selected as the mode of operation. Auto-negotiation is also used to negotiate support for Energy Efficient Ethernet (EEE). Auto-negotiation is only supported on ports in copper mode, not fiber mode.

The following list shows the speed and duplex operation mode from highest to lowest.

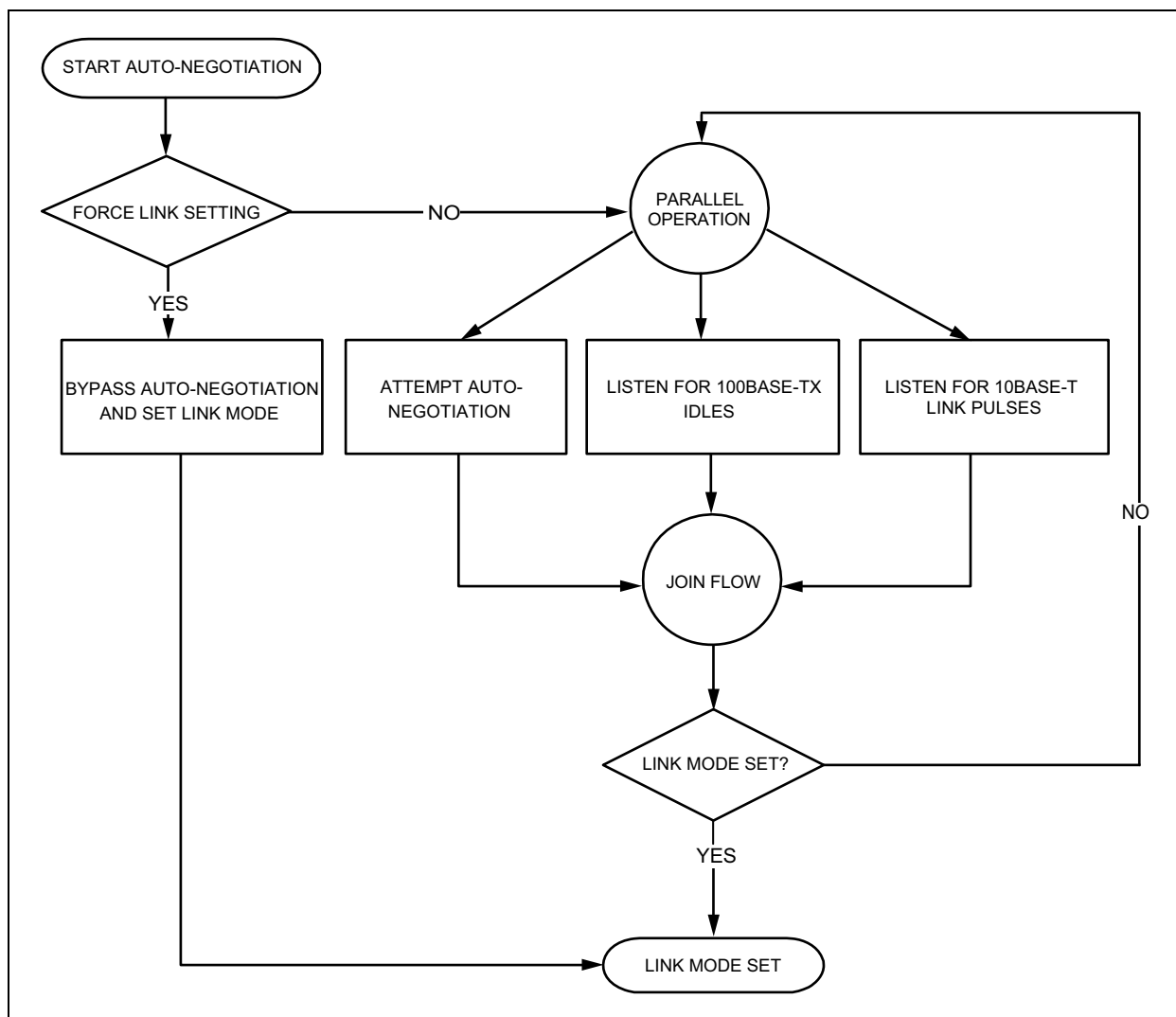
- Priority 1: 100BASE-TX, full-duplex
- Priority 2: 100BASE-TX, half-duplex
- Priority 3: 10BASE-T, full-duplex
- Priority 4: 10BASE-T, half-duplex

If auto-negotiation is not supported or the link partner to the KSZ8462 is forced to bypass auto-negotiation, the mode is automatically set by observing the signal at the receiver. This is known as parallel mode because while the transmitter is sending auto-negotiation advertisements, the receiver is listening for advertisements or a fixed signal protocol.

The auto-negotiation link up process is shown in the following flow chart.

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FIGURE 3-3: AUTO-NEGOTIATION FLOW CHART



## 3.2.12 LINKMD<sup>®</sup> CABLE DIAGNOSTICS

The KSZ8462 LinkMD uses time domain reflectometry (TDR) to analyze the cabling plant for common cabling problems such as open circuits, short circuits, and impedance mismatches.

LinkMD works by sending a pulse of known amplitude and duration down the MDI and MDI-X pairs and then analyzes the shape of the reflected signal. Timing the pulse duration gives an indication of the distance to the cabling fault with a maximum distance of 200m and an accuracy of  $\pm 2\text{m}$ . Internal circuitry displays the TDR information in a user-readable digital format in register P1SCSLMD[8:0] or P2SCSLMD[8:0].

Cable diagnostics are only valid for copper connections. Fiber-optic operation is not supported.

### 3.2.12.1 Access

LinkMD is initiated by accessing register P1SCSLMD (0x07C) or P2SCSLMD (0x094), the PHY special control/status and LinkMD register.

## 3.2.12.2 Usage

Before initiating LinkMD, the value 0x8008 must be written to the ANA\_CNTRL\_3 Register (0x74C – 0x74D). This needs to be done once (after power-on reset), but does not need to be repeated for each initiation of LinkMD. Auto-MDIX must also be disabled before using LinkMD. To disable Auto-MDIX, write a '1' to P1CR4[10] or P2CR4[10] to enable manual control over the pair used to transmit the LinkMD pulse. The self-clearing cable diagnostic test enable bit, P1SCSLMD[12] or P2SCSLMD[12], is set to '1' to start the test on this pair.

When bit P1SCSLMD[12] or P2SCSLMD[12] returns to '0', the test is completed. The test result is returned in bits P1SCSLMD[14:13] or P2SCSLMD[14:13] and the distance is returned in bits P1SCSLMD[8:0] or P2SCSLMD[8:0]. The cable diagnostic test results are as follows:

- 00 = Valid test, normal condition
- 01 = Valid test, open circuit in cable
- 10 = Valid test, short-circuit in cable
- 11 = Invalid test, LinkMD<sup>®</sup> failed

If P1SCSLMD[14:13] or P2SCSLMD[14:13] is "11", this indicates an invalid test. This occurs when the KSZ8462 is unable to shut down the link partner. In this instance, the test is not run, because it is not possible for the KSZ8462 to determine if the detected signal is a reflection of the signal generated or a signal from another source.

Cable distance can be approximated by utilizing the following formula:

- P1SCSLMD[8:0] x 0.4m for port 1 cable distance
- P2SCSLMD[8:0] x 0.4m for port 2 cable distance

This constant (0.4m) may be calibrated for different cabling conditions, including cables with a velocity of propagation that varies significantly from the norm.

## 3.2.13 ON-CHIP TERMINATION RESISTORS

Using the KSZ8462 reduces board cost and simplifies board layout by using on-chip termination resistors for the RX/TX differential pairs, eliminating the need for external termination resistors in copper mode. The internal chip termination and biasing provides significant power savings when compared with using external biasing and termination resistors.

## 3.2.14 LOOPBACK SUPPORT

The KSZ8462 provides two loopback modes. One is near-end (remote) loopback to support remote diagnosing of failures on line side, and the other is far-end loopback to support local diagnosing of failures through all blocks of the device. In loopback mode, the speed of the PHY port will be set to 100BASE-TX full-duplex mode.

### 3.2.14.1 Far-End Loopback

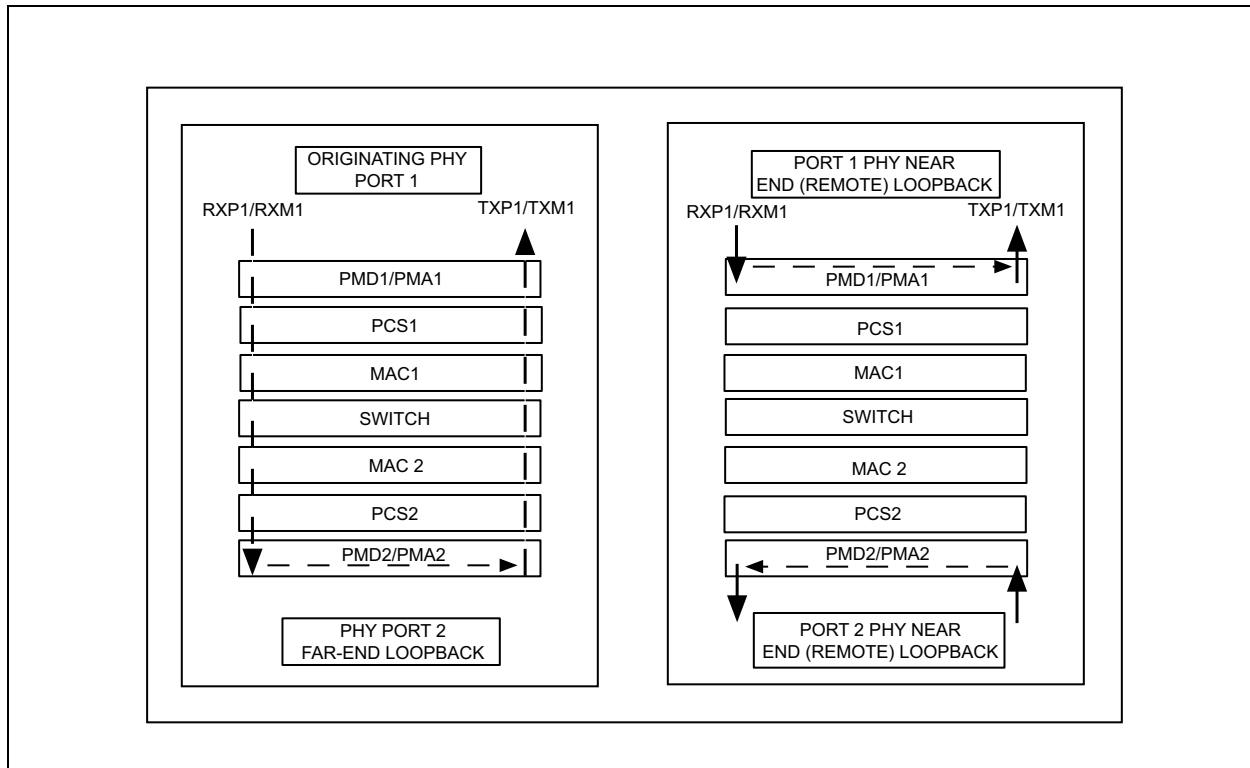
Far-end loopback is conducted between the KSZ8462's two PHY ports. The loopback path starts at the "originating" PHY port's receive inputs (RXP/RXM), wraps around at the "loopback" PHY port's PMD/PMA (Physical Media Dependent/Physical Media Attachment), and ends at the "originating" PHY port's transmit outputs (TXP/TXM).

Bit[8] of registers P1CR4 and P2CR4 is used to enable far-end loopback for ports 1 and 2, respectively. As an alternative, bit[14] of registers P1MBCR and P2MBCR can be used to enable far-end loopback. The far-end loopback path is illustrated in [Figure 3-4](#).

### 3.2.14.2 Near-End (Remote) Loopback

Near-end (remote) loopback is conducted at either PHY port 1 or PHY port 2 of the KSZ8462. The loopback path starts at the PHY port's receive inputs (RXPx/RXMx), wraps around at the same PHY port's PMD/PMA, and ends at the same PHY port's transmit outputs (TXPx/TXMx). Bit[1] of registers P1PHYCTRL and P2PHYCTRL is used to enable near-end loopback for ports 1 and 2, respectively. As an alternative, bit[9] of registers P1SCSLMD and P2SCSLMD can be used to enable near-end loopback. The near-end loopback paths for port 1 and port 2 are illustrated in [Figure 3-4](#).

**FIGURE 3-4: NEAR-END AND FAR-END LOOPBACK**



## 3.3 Media Access Controller (MAC) Block

### 3.3.1 MAC OPERATION

The KSZ8462 strictly abides by IEEE 802.3 standards to maximize compatibility. Additionally, there is an added MAC filtering function to filter unicast packets. The MAC filtering function is useful in applications such as VoIP where restricting certain packets reduces congestion and thus improves performance.

### 3.3.2 ADDRESS LOOKUP

The internal Dynamic MAC Address lookup table stores MAC addresses and their associated information. It contains a 1K entry unicast address learning table plus switching information.

The KSZ8462 is guaranteed to learn 1K addresses and distinguishes itself from hash-based lookup tables, which, depending on the operating environment and probabilities, may not guarantee the absolute number of addresses they can learn.

### 3.3.3 LEARNING

The internal lookup engine updates the Dynamic MAC Address table with a new entry if the following conditions are met:

- The received packet's source address (SA) does not exist in the lookup table.
- The received packet has no receiving errors, and the packet size is of legal length.

The lookup engine inserts the qualified SA into the table, along with the port number and time stamp. If the table is full, the oldest entry of the table is deleted to make room for the new entry.

### 3.3.4 MIGRATION

The internal lookup engine also monitors whether a station has moved. If a station has moved, it updates the table accordingly. Migration happens when the following conditions are met:

- The received packet's SA is in the table but the associated source port information is different.
- The received packet has no receiving errors, and the packet size is of legal length.

The lookup engine updates the existing record in the table with the new source port information.

### 3.3.5 AGING

The lookup engine updates the time stamp information of a record whenever the corresponding SA appears. The time stamp is used in the aging process. If a record is not updated for a period of time, the lookup engine removes the record from the table. The lookup engine constantly performs the aging process and continuously removes aging records. The aging period is about 300 seconds ( $\pm 75$  seconds). This feature can be enabled or disabled through global register SGCR1[10].

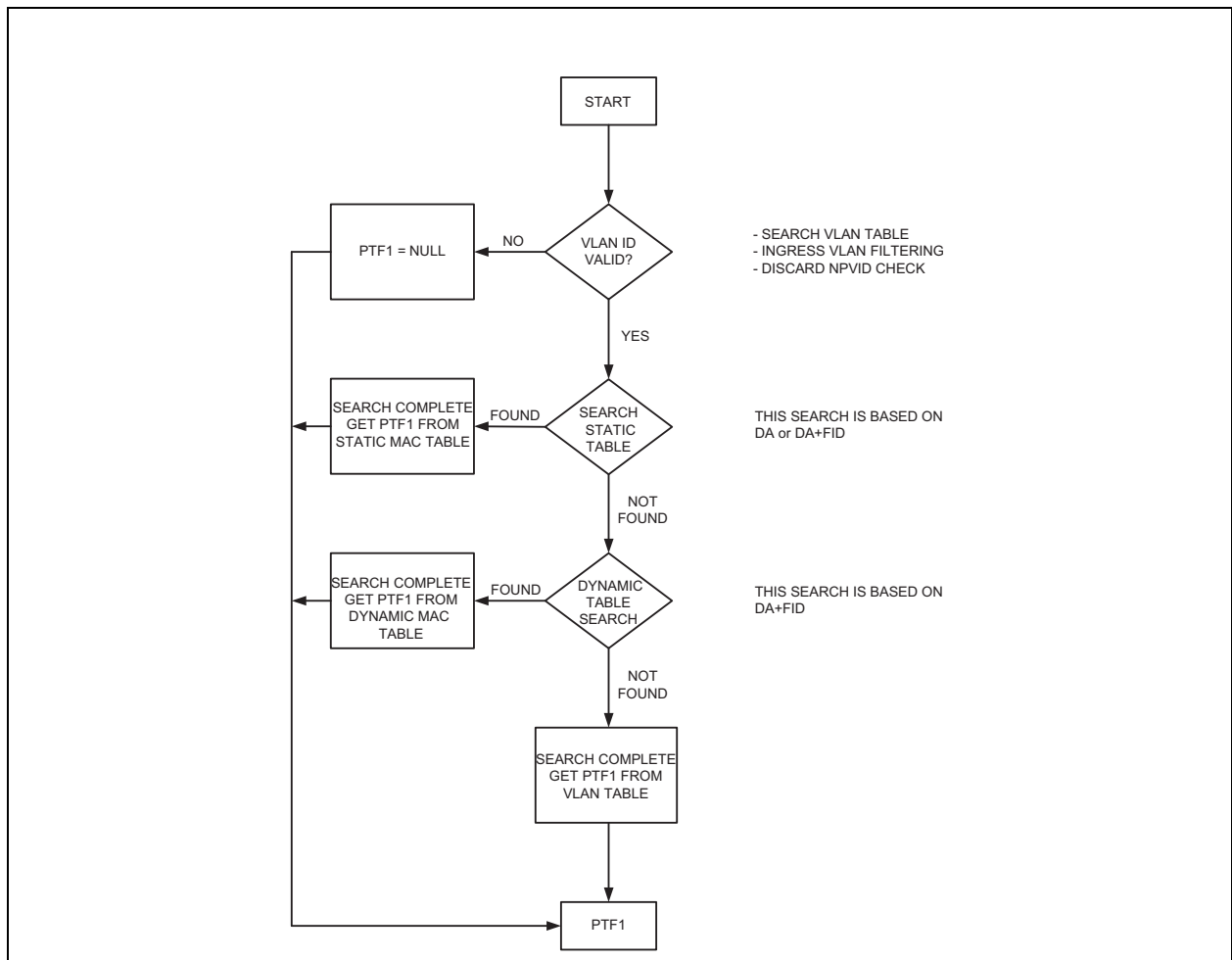
### 3.3.6 FORWARDING

The KSZ8462 forwards packets using the algorithm that is depicted in the following flowcharts. [Figure 3-5](#) shows stage one of the forwarding algorithm where the search engine looks up the VLAN ID, static table, and dynamic table for the destination address, and comes up with "port to forward 1" (PTF1). PTF1 is then further modified by spanning tree, IGMP snooping, port mirroring, and port VLAN processes to come up with "port-to-forward 2" (PTF2), as shown in [Figure 3-6](#). The packet is sent to PTF2.

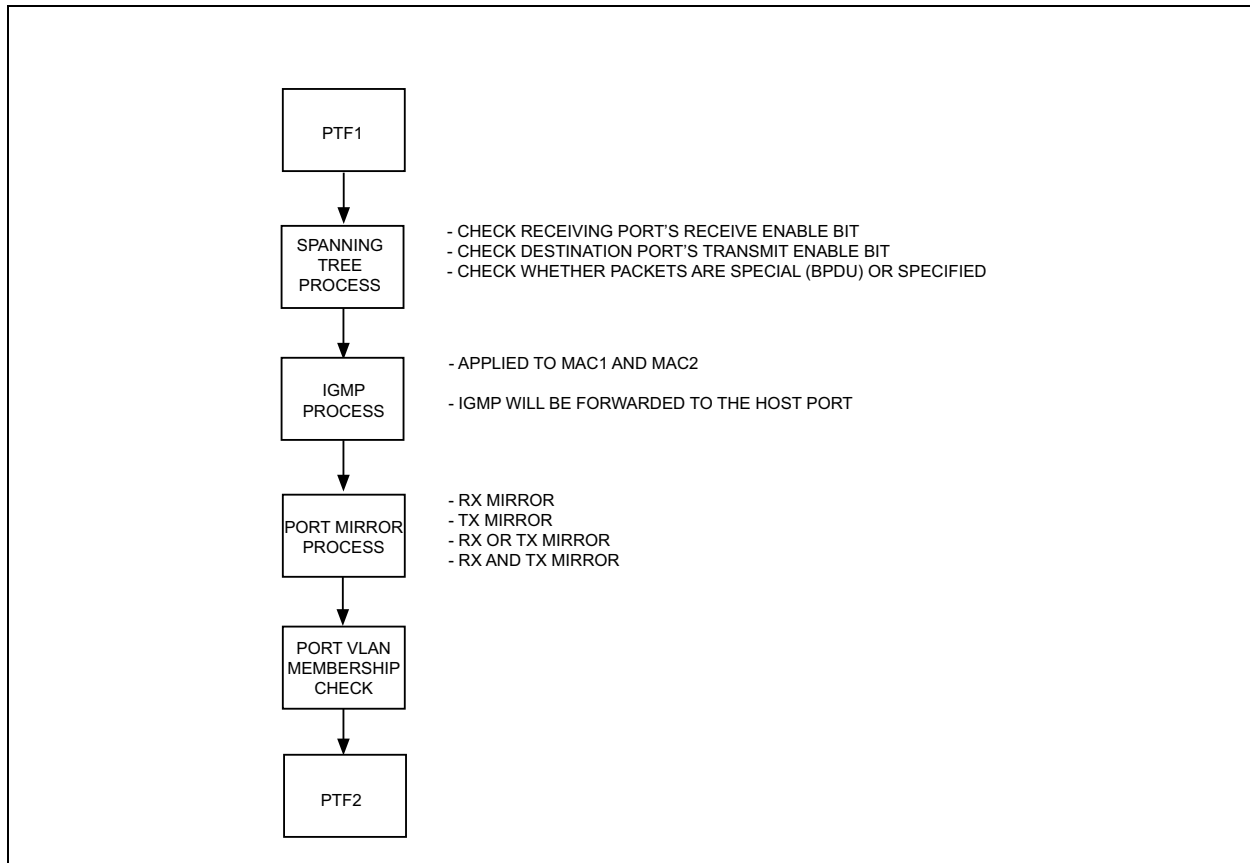
The KSZ8462 will not forward the following packets:

- Error packets: These include framing errors, frame check sequence (FCS) errors, alignment errors, and illegal size packet errors.
- IEEE802.3x PAUSE frames: KSZ8462 intercepts these packets and performs full duplex flow control accordingly.
- "Local" packets: Based on destination address (DA) lookup. If the destination port from the lookup table matches the port from which the packet originated, the packet is defined as "local."

**FIGURE 3-5: DESTINATION ADDRESS LOOKUP FLOW CHART IN STAGE ONE**



**FIGURE 3-6: DESTINATION ADDRESS RESOLUTION FLOW CHART IN STAGE TWO**



### 3.3.7 INTER-PACKET GAP (IPG)

If a frame is successfully transmitted, then the minimum 96-bit time for IPG is measured between two consecutive packets. If the current packet is experiencing collisions, the minimum 96-bit time for IPG is measured from carrier sense (CRS) to the next transmit packet.

### 3.3.8 BACK-OFF ALGORITHM

The KSZ8462 implements the IEEE standard 802.3 binary exponential back-off algorithm in half-duplex mode. After 16 collisions, the packet is dropped.

### 3.3.9 LATE COLLISION

If a transmit packet experiences collisions after 512 bit times of the transmission, the packet is dropped.

### 3.3.10 LEGAL PACKET SIZE

The KSZ8462 discards packets less than 64 bytes and can be programmed to accept packet sizes up to 1536 bytes in SGCR2[1]. The KSZ8462 can also be programmed for special applications to accept packet sizes up to 2000 bytes in SGCR1[4].

### 3.3.11 FLOW CONTROL

The KSZ8462 supports standard 802.3x flow control frames in both the transmit and receive directions.

In the receive direction, if a PAUSE control frame is received on any port, the KSZ8462 will not transmit the next normal frame on that port until the timer, specified in the PAUSE control frame, expires. If another PAUSE frame is received before the current timer expires, the timer will then update with the new value in the second PAUSE frame. During this period (while it is flow controlled), only flow control packets from the KSZ8462 are transmitted.



In the transmit direction, the KSZ8462 has intelligent and efficient ways to determine when to invoke flow control and send PAUSE frames. The flow control is based on availability of the system resources, including available buffers, available transmit queues and available receive queues.

The KSZ8462 issues a PAUSE frame containing the maximum pause time defined in IEEE standard 802.3x. Once the resource is freed up, the KSZ8462 sends out another flow control frame with zero pause time to turn off the flow control (turn on transmission to the port). A hysteresis feature is provided to prevent the flow control mechanism from being constantly activated and deactivated.

On port 3, a flow control handshake exists internally between the QMU and the port 3 MAC. In the QMU, there are three programmable threshold levels for flow control in the RXQ FIFO:

1. Low watermark register FCLWR (0x1B0)
2. High watermark register FCHWR (0x1B2)
3. Overrun watermark register FCOWR (0x1B4)

The QMU will send a PAUSE frame internally to the MAC when the RXQ buffer fills with egress packets above the high watermark level (default 3.072 Kbytes available), and a stop PAUSE frame when the RXQ buffer drops below the low watermark level (default 5.12 Kbytes available). The QMU will drop new packets from the switch when the RXQ buffer fills beyond the overrun watermark level (default 256 bytes available).

### 3.3.12 HALF-DUPLEX BACKPRESSURE

A half-duplex backpressure option (non-IEEE 802.3 standards) is also provided. The activation and deactivation conditions are the same as in full-duplex mode. If backpressure is required, the KSZ8462 sends preambles to defer the other stations' transmission (carrier sense deference).

To avoid jabber and excessive deference (as defined in the 802.3 standard), after a certain time, the KSZ8462 discontinues the carrier sense and then raises it again quickly. This short silent time (no carrier sense) prevents other stations from sending out packets thus keeping other stations in a carrier sense deferred state. If the port has packets to send during a backpressure situation, the carrier sense type backpressure is interrupted and those packets are transmitted instead. If there are no additional packets to send, carrier sense type backpressure is reactivated again until chip resources free up. If a collision occurs, the binary exponential back-off algorithm is skipped and carrier sense is generated immediately, thus reducing the chance of further collision and carrier sense is maintained to prevent packet reception.

To ensure no packet loss in 10BASE-T or 100BASE-TX half-duplex mode, the user must enable the following bits:

- Aggressive back-off (bit [8] in SGCR1)
- No excessive collision drop (bit [3] in SGCR2)
- Backpressure flow control enable (bit [11] in P1CR2/P2CR2)

Please note that these bits are not set in default because this is not the IEEE standard.

### 3.3.13 BROADCAST STORM PROTECTION

The KSZ8462 has an intelligent option to protect the switch system from receiving too many broadcast packets. As the broadcast packets are forwarded to all ports except the source port, an excessive number of switch resources (bandwidth and available space in transmit queues) may be utilized. The KSZ8462 has the option to include "multicast packets" for storm control. The broadcast storm rate parameters are programmed globally, and can be enabled or disabled on a per port basis in P1CR1[7] and P2CR1[7]. The rate is based on a 67 ms interval for 100BASE-TX and a 670 ms interval for 10BASE-T. At the beginning of each interval, the counter is cleared to zero and the rate limit mechanism starts to count the number of bytes during the interval. The rate definition is described in SGCR3[2:0][15:8]. The default setting is 0x63 (99 decimal). This is equal to a rate of 1%, calculated as follows:

#### EQUATION 3-1:

$$148,000 \text{ frames/sec} \times 67 \text{ ms/interval} \times 1\% = 99 \text{ frames/interval (appx.)} = 0x63$$

148,800 frames/sec is based on 64-byte block of packets in 100BASE-T with 12 bytes of IPG and 8 bytes of preamble between two packets.

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## 3.3.14 PORT INDIVIDUAL MAC ADDRESS AND SOURCE PORT FILTERING

The KSZ8462 can provide individual MAC addresses for port 1 and port 2. They can be set at registers 0x0B0h – 0x0B5h and 0x0B6 – 0x0BB. Received packets can be filtered (dropped) if their source address matches the MAC address of port 1 or port 2. This feature can be enabled by setting bits [11:10] in the P1CR1 or P2CR1 registers. One example of usage is that a packet will be dropped after it completes a full round trip within a ring network.

## 3.3.15 ADDRESS FILTERING FUNCTION

The KSZ8462 supports 11 different address filtering schemes as shown in [Table 3-2](#). The Ethernet destination address (DA) field inside the packet is the first 6-byte field which uses to compare with either the host MAC address registers (0x110 – 0x115) or the MAC address hash table registers (0x1A0 – 0x1A7) for address filtering operation. The first bit (bit[40]) of the destination address (DA) in the Ethernet packet decides whether this is a physical address if bit[40] is “0” or a multicast address if bit[40] is “1”.

**TABLE 3-2: MAC ADDRESS FILTERING SCHEME**

| Item | Address Filtering Mode                  | Receive Control Register (0x174 – 0x175): RXCR1 |                      |                                |                                | Description  |
|------|---|---|----------------------|--------------------------------|--------------------------------|--|
|      |   | RX ALL (Bit [4])                                | RX Inverse (Bit [1]) | RX Physical Address (Bit [11]) | RX Multicast Address (Bit [8]) |  |
| 1    | Perfect                                 | 0   | 0                    | 1                              | 1                              | All Rx frames are passed only if the DA exactly matches the MAC Address in MARL, MARM and MARH registers.  |
| 2    | Inverse Perfect                         | 0   | 1                    | 1                              | 1                              | All Rx frames are passed if the DA is not matching the MAC Address in MARL, MARM, and MARH registers.  |
| 3    | Hash Only                               | —   | 0                    | 0                              | 0                              | All Rx frames with either multicast or physical destination address are filtering against the MAC address hash table.  |
| 4    | Inverse Hash Only                       | 0   | 1                    | 0                              | 0                              | All Rx frames with either multicast or physical destination address are filtering not against the MAC address hash table.<br>All Rx frames which are filtering out at item 3 (Hash only) only are passed in this mode. |
| 5    | Hash Perfect (Default)                  | 0   | 0                    | 1                              | 0                              | All Rx frames are passed with physical address (DA) matching the MAC Address and to enable receive multicast frames that pass the hash table when Multicast address is matching the MAC address hash table.            |
| 6    | Inverse Hash Perfect                    | 0   | 1                    | 1                              | 0                              | All Rx frames which are filtering out at item 5 (hash perfect) only are passed in this mode.   |
| 7    | Promiscuous                             | 1   | 1                    | 0                              | 0                              | All Rx frames are passed without any conditions.   |
| 8    | Hash Only with Multicast Address Passed | 1   | 0                    | 0                              | 0                              | All Rx frames are passed with physical address (DA) matching the MAC Address hash table and with Multicast address without any conditions.   |

**TABLE 3-2: MAC ADDRESS FILTERING SCHEME (CONTINUED)**

| Item | Address Filtering Mode                 | Receive Control Register (0x174 – 0x175): RXCR1 |                      |                                |                                | Description   |
|------|--|---|----------------------|--------------------------------|--------------------------------|---|
|      |  | RX ALL (Bit [4])                                | RX Inverse (Bit [1]) | RX Physical Address (Bit [11]) | RX Multicast Address (Bit [8]) |   |
| 9    | Perfect with Multicast Address Passed  | 1   | 0                    | 1                              | 1                              | All Rx frames are passed with physical address (DA) matching the MAC Address and with Multicast address without any conditions.       |
| 10   | Hash Only with Physical Address Passed | 1   | 0                    | 1                              | 0                              | All Rx frames are passed with Multicast address matching the MAC Address hash table and with physical address without any conditions. |
| 11   | Perfect with Physical Address Passed   | 1   | 0                    | 0                              | 1                              | All Rx frames are passed with Multicast address matching the MAC Address and with physical address without any conditions.            |

Bit [0] (RX Enable), Bit [5] (RX Unicast Enable) and Bit [6] (RX Multicast Enable) must set to 1 in RXCR1 register. The KSZ8462 will discard frame with SA same as the MAC Address if bit[0] is set in RXCR2 register.

## 3.4 Switch Block

### 3.4.1 SWITCHING ENGINE

The KSZ8462 features a high-performance switching engine to move data to and from the MAC's packet buffers. It operates in store and forward mode, while the efficient switching mechanism reduces overall latency. The switching engine has a 32 KByte internal frame buffer. This resource is shared between all the ports. There are a total of 256 buffers available. Each buffer is sized at 128 Bytes.

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## 3.4.2 SPANNING TREE SUPPORT

To support spanning tree, the host port is the designated port for the processor. The other ports (port 1 and port 2) can be configured in one of the five spanning tree states via “transmit enable”, “receive enable”, and “learning disable” register settings in registers P1CR2 and P2CR2 for ports 1 and 2, respectively. [Table 3-3](#) shows the setting and software actions taken for each of the five spanning tree states.

**TABLE 3-3: SPANNING TREE STATES**

| Disable State   | Port Setting  | Software Action   |
|---|---|---|
| The port should not forward or receive any packets. Learning is disabled.   | transmit enable = “0”,<br>receive enable = “0”,<br>learning disable = “1” | The processor should not send any packets to the port. The switch may still send specific packets to the processor (packets that match some entries in the “Static MAC Table” with “overriding bit” set) and the processor should discard those packets. Address learning is disabled on the port in this state.  |
| Blocking State  | Port Setting  | Software Action   |
| Only packets to the processor are forwarded.                                | transmit enable = “0”,<br>receive enable = “0”,<br>learning disable = “1” | The processor should not send any packets to the port(s) in this state. The processor should program the “Static MAC Table” with the entries that it needs to receive (for example, BPDU packets). The “overriding” bit should also be set so that the switch will forward those specific packets to the processor. Address learning is disabled on the port in this state. |
| Listening State   | Port Setting  | Software Action   |
| Only packets to and from the processor are forwarded. Learning is disabled. | transmit enable = “0”,<br>receive enable = “0”,<br>learning disable = “1” | The processor should program the “Static MAC Table” with the entries that it needs to receive (for example, BPDU packets). The “overriding” bit should be set so that the switch will forward those specific packets to the processor. The processor may send packets to the port(s) in this state. Address learning is disabled on the port in this state.                 |
| Learning State  | Port Setting  | Software Action   |
| Only packets to and from the processor are forwarded. Learning is enabled.  | transmit enable = “0”,<br>receive enable = “0”,<br>learning disable = “0” | The processor should program the “Static MAC Table” with the entries that it needs to receive (for example, BPDU packets). The “overriding” bit should be set so that the switch will forward those specific packets to the processor. The processor may send packets to the port(s) in this state. Address learning is enabled on the port in this state.                  |
| Forwarding State  | Port Setting  | Software Action   |
| Packets are forwarded and received normally. Learning is enabled.           | transmit enable = “1”,<br>receive enable = “1”,<br>learning disable = “0” | The processor programs the “Static MAC Table” with the entries that it needs to receive (for example, BPDU packets). The “overriding” bit is set so that the switch forwards those specific packets to the processor. The processor can send packets to the port(s) in this state. Address learning is enabled on the port in this state.                                   |

## 3.4.3 RAPID SPANNING TREE SUPPORT

There are three operational states assigned to each port for RSTP (Discarding, Learning, and Forwarding):

- Discarding ports do not participate in the active topology and do not learn MAC addresses.
- Discarding state: the state includes three states of the disable, blocking and listening of STP.
- Port setting: transmit enable = "0", receive enable = "0", learning disable = "1".

### 3.4.3.1 Discarding State

Software action: The host processor should not send any packets to the port. The switch may still send specific packets to the processor (packets that match some entries in the static table with "overriding bit" set) and the processor should discard those packets. When the port's learning capability (learning disable = '1') is disabled, setting bits [10:9] in the SGCR8 register will rapidly flush the port related entries in the dynamic MAC table and static MAC table.

The processor is connected to port 3 via the host interface. Address learning is disabled on the port in this state.

### 3.4.3.2 Learning State

Ports in "learning states" learn MAC addresses, but do not forward user traffic.

Learning State: Only packets to and from the processor are forwarded. Learning is enabled.

Port setting for Learning State: transmit enable = "0", receive enable = "0", learning disable = "0".

Software action: The processor should program the static MAC table with the entries that it needs to receive (e.g., BPDU packets). The "overriding" bit should be set so that the switch will forward those specific packets to the processor. The processor may send packets to the port(s) in this state (see the [Tail Tagging Mode](#) sub-section for details). Address learning is enabled on the port in this state.

Ports in "forwarding states" fully participate in both data forwarding and MAC learning.

### 3.4.3.3 Forwarding State

Forwarding state: Packets are forwarded and received normally. Learning is enabled.

Port setting: transmit enable = "1", receive enable = "1", learning disable = "0".

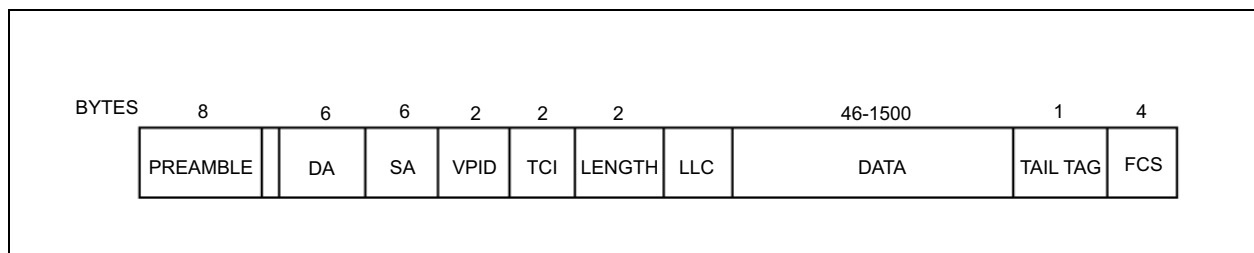
Software action: The processor should program the static MAC table with the entries that it needs to receive (e.g., BPDU packets). The "overriding" bit should be set so that the switch will forward those specific packets to the processor. The processor may send packets to the port(s) in this state (see the [Tail Tagging Mode](#) sub-section for details). Address learning is enabled on the port in this state.

RSTP uses only one type of BPDU called RSTP BPDUs. They are similar to STP configuration BPDUs with the exception of a type field set to "version 2" for RSTP and "version 0" for STP, and a flag field carrying additional information.

## 3.4.4 TAIL TAGGING MODE

The tail tag is only seen and used by the port 3 host interface, which should be connected to a processor. It is an effective way to retrieve the ingress port information for spanning tree protocol, IGMP snooping, and other applications. Bits [1:0] in the one byte tail tagging are used to indicate the source/destination port in port 3. Bits[3:2] are used for priority setting of the ingress frame in port 3. Other bits are not used. The tail tag feature is enabled by setting bit[8] in the SGCR8 register.

**FIGURE 3-7: TAIL TAG FRAME FORMAT**



# KSZ8462HLI/FHLI

**TABLE 3-4: TAIL TAG RULES**

| Ingress to Port 3 (Host to KSZ8462)  |                          |
|--------------------------------------|--------------------------|
| Bit[1:0]                             | Destination Port         |
| 00                                   | Normal (Address Look up) |
| 01                                   | Port 1                   |
| 10                                   | Port 2                   |
| 11                                   | Port 1 and Port 2        |
| Bit[3:2]                             | Frame Priority           |
| 00                                   | Priority 0               |
| 01                                   | Priority 1               |
| 10                                   | Priority 2               |
| 11                                   | Priority 3               |
| Egress from Port 3 (KSZ8462 to Host) |                          |
| Bit[0]                               | Source Port              |
| 0                                    | Port 1                   |
| 1                                    | Port 2                   |

## 3.4.5 IGMP SUPPORT

For Internet Group Management Protocol (IGMP) support in Layer 2, the KSZ8462 provides two components:

### 3.4.5.1 IGMP Snooping

The KSZ8462 traps IGMP packets and forwards them only to the processor (host port). The IGMP packets are identified as IP packets (either Ethernet IP packets, or IEEE 802.3 SNAP IP packets) with IP version = 0x4 and protocol version number = 0x2.

### 3.4.5.2 Multicast Address Insertion in the Static MAC Table

Once the multicast address is programmed in the Static MAC Address Table, the multicast session is trimmed to the subscribed ports, instead of broadcasting to all ports.

To enable IGMP support, set bit[14] to '1' in the SGCR2 register. Also, Tail Tagging Mode needs to be enabled, so that the processor knows which port the IGMP packet was received on. This is achieved by setting bit [8] to '1' in the SGCR8 register.

## 3.4.6 IPV6 MLD SNOOPING

The KSZ8462 traps IPv6 Multicast Listener Discovery (MLD) packets and forwards them only to the processor (host port). MLD snooping is controlled by SGCR2, bit[13] (MLD snooping enable) and SGCR2 bit[12] (MLD option).

Setting SGCR2 bit[13] causes the KSZ8462 to trap packets that meet all of the following conditions:

- IPv6 multicast packets
- Hop count limit = "1"
- IPv6 next header = "1" or "58" (or = "0" with hop-by-hop next header = "1" or "58")
- If SGCR2[12] = "1", IPv6 next header = "43", "44", "50", "51", or "60" (or = "0" with hop-by-hop next header = "43", "44", "50", "51", or "60")

## 3.4.7 PORT MIRRORING SUPPORT

KSZ8462 supports port mirroring comprehensively as illustrated in the following sub-sections:

### 3.4.7.1 "Receive Only" Mirror-on-a-Port

All the packets received on the port are mirrored on the sniffer port. For example, 1 is programmed to be "receive sniff" and the host port is programmed to be the "sniffer". A packet received on port 1 is destined to port 2 after the internal lookup. The KSZ8462 forwards the packet to both port 2 and the host port. The KSZ8462 can optionally even forward "bad" received packets to the "sniffer port".

## 3.4.7.2 “Transmit Only” Mirror-on-a-Port

All the packets transmitted on the port are mirrored on the sniffer port. For example, port 1 is programmed to be “transmit sniff” and the host port is programmed to be the “sniffer port”. A packet received on port 2 is destined to port 1 after the internal lookup. The KSZ8462 forwards the packet to both port 1 and the host port.

## 3.4.7.3 “Receive and Transmit” Mirror-on-Two-Ports

All the packets received on port A and transmitted on port B are mirrored on the sniffer port. To turn on the “AND” feature, set register SGCR2, bit 8 to “1”. For example, port 1 is programmed to be “receive sniff”, port 2 is programmed to be “transmit sniff”, and the host port is programmed to be the “sniffer port”. A packet received on port 1 is destined to port 2 after the internal lookup. The KSZ8462 forwards the packet to both port 2 and the host port.

Multiple ports can be selected as “receive sniff” or “transmit sniff”. In addition, any port can be selected as the “sniffer port”. All these per port features can be selected through registers P1CR2, P2CR2, and P3CR2 for ports 1, 2, and the host port, respectively.

## 3.4.7.4 IEEE 802.1Q VLAN Support

The KSZ8462 supports 16 active VLANs out of the 4096 possible VLANs specified in the IEEE 802.1Q specification. KSZ8462 provides a 16-entry VLAN table, which converts the 12-bits VLAN ID (VID) to the 4-bits Filter ID (FID) for address lookup. If a non-tagged or null-VID-tagged packet is received, the ingress port default VID is used for lookup. In VLAN mode, the lookup process starts with VLAN table lookup to determine whether the VID is valid. If the VID is not valid, the packet is dropped and its address is not learned. If the VID is valid, the FID is retrieved for further lookup. The FID + Destination Address (FID+DA) are used to determine the destination port. The FID + Source Address (FID+SA) are used for address learning (see [Table 3-5](#) and [Table 3-6](#)).

Advanced VLAN features are also supported in the KSZ8462, such as “VLAN ingress filtering” and “discard non PVID” defined in bits [14:13] of P1CR2, P2CR2, and P3CR2 registers. These features can be controlled on per port basis.

**TABLE 3-5: FID + DA LOOKUP IN VLAN MODE**

| DA found in Static MAC Table? | Use FID Flag? | FID Match? | DA+FID found in Dynamic MAC Table? | Action  |
|-------------------------------|---------------|------------|------------------------------------|---|
| No                            | Don't Care    | Don't Care | No                                 | Broadcast to the membership ports defined in the VLAN Table bits [18:16].             |
| No                            | Don't Care    | Don't Care | Yes                                | Send to the destination port defined in the Dynamic MAC Address Table bits [53:52].   |
| Yes                           | 0             | Don't Care | Don't Care                         | Send to the destination port(s) defined in the Static MAC Address Table bits [50:48]. |
| Yes                           | 1             | No         | No                                 | Broadcast to the membership ports defined in the VLAN Table bits [18:16].             |
| Yes                           | 1             | No         | Yes                                | Send to the destination port defined in the Dynamic MAC Address Table bits [53:52].   |
| Yes                           | 1             | Yes        | Don't Care                         | Send to the destination port(s) defined in the Static MAC Address Table bits [50:48]. |

**TABLE 3-6: FID + SA LOOKUP IN VLAN MODE**

| FID+SA found in Dynamic MAC Address Table? | Action   |
|--|--|
| No   | Learn and add FID+SA to the Dynamic MAC Address Table. |
| Yes  | Update time stamp.                                     |

## 3.4.8 QUALITY-OF-SERVICE (QOS) PRIORITY SUPPORT

The KSZ8462 provides quality-of-service (QoS) for applications such as VoIP and video conferencing. The KSZ8462 offer 1, 2, and 4 priority queues option per port. This is controlled by bit[0] and bit[8] in P1CR1, P2CR1, and P3CR1 registers as shown below:

- Bit[0], bit[8] = “00” egress port is a single output queue as default.

# KSZ8462HLI/FHLI

- Bit[0], bit[8] = “01” egress port can be split into two priority transmit queues. (Q0 and Q1)
- Bit[0], bit[8] = “10” egress port can be split into four priority transmit queues. (Q0, Q1, Q2 and Q3)

The four priority transmit queues is a new feature in the KSZ8462. Queue 3 is the highest priority queue and Queue 0 is the lowest priority queue. If a port's transmit queue is not split, high priority and low priority packets have equal priority in the transmit queue.

There is an additional option for every port via bits[15,7] in the P1TXQRCR1, P1TXQRCR2, P2TXQRCR1, P2TXQRCR2, P3TXQRCR1, and P3TXQRCR2 Registers to select either always to deliver high priority packets first or use weighted fair queuing for the four priority queues scale by 8:4:2:1.

## 3.4.9 PORT-BASED PRIORITY

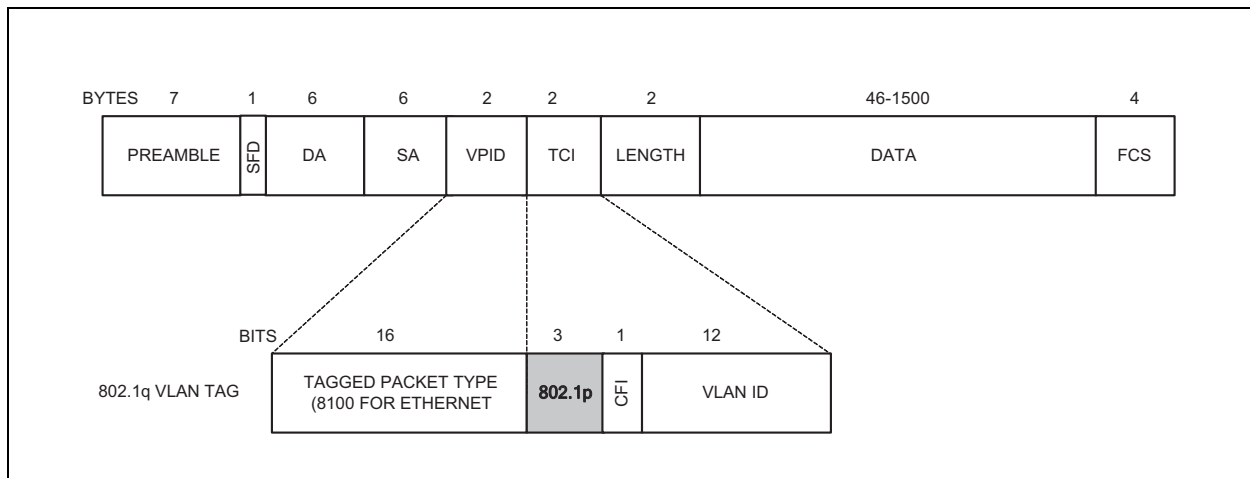
With port-based priority, each ingress port is individually classified as a specific priority level. All packets received at the high-priority receiving port are marked as high priority and are sent to the high-priority transmit queue if the corresponding transmit queue is split. Bits[4:3] of registers P1CR1, P2CR1, and P3CR1 are used to enable port-based priority for ports 1, 2, and the host port, respectively.

## 3.4.10 802.1P-BASED PRIORITY

For 802.1p-based priority, the KSZ8462 examines the ingress (incoming) packets to determine whether they are tagged. If tagged, the 3-bit priority field in the VLAN tag is retrieved and used to look up the “priority mapping” value, as specified by the register SGCR6. The “priority mapping” value is programmable.

Figure 3-8 illustrates how the 802.1p priority field is embedded in the 802.1Q VLAN tag.

**FIGURE 3-8: 802.1P PRIORITY FIELD FORMAT**



802.1p-based priority is enabled by bit[5] of registers P1CR1, P2CR1, and P3CR1 for ports 1, 2, and the host port, respectively.

The KSZ8462 provides the option to insert or remove the priority tagged frame's header at each individual egress port. This header, consisting of the 2 bytes VLAN protocol ID (VPID) and the 2 bytes tag control information field (TCI), is also referred to as the 802.1Q VLAN tag.

Tag insertion is enabled by bit[2] of registers P1CR1, P2CR1, and P3CR1 for ports 1, 2, and the host port, respectively. At the egress port, untagged packets are tagged with the ingress port's default tag. The default tags are programmed in register sets P1VIDCR, P2VIDCR, and P3VIDCR for ports 1, 2, and the host port, respectively. The KSZ8462 does not add tags to already tagged packets.

Tag removal is enabled by bit[1] of registers P1CR1, P2CR1, and P3CR1 for ports 1, 2, and the host port, respectively. At the egress port, tagged packets will have their 802.1Q VLAN tags removed. The KSZ8462 will not modify untagged packets.

The CRC is recalculated for both tag insertion and tag removal.



## 3.4.11 802.1P PRIORITY FIELD RE-MAPPING

This is a QoS feature that allows the KSZ8462 to set the “User Priority Ceiling” at any ingress port. If the ingress packet’s priority field has a higher priority value than the default tag’s priority field of the ingress port, the packet’s priority field is replaced with the default tag’s priority field. The “User Priority Ceiling” is enabled by bit[3] of registers P1CR2, P2CR2, and P3CR2 for ports 1, 2, and the host port, respectively.

## 3.4.12 DIFFSERV-BASED PRIORITY

DiffServ-based priority uses the ToS registers shown in the TOS Priority Control Registers. The ToS priority control registers implement a fully decoded, 128-bit differentiated services code point (DSCP) register to determine packet priority from the 6-bit ToS field in the IP header. When the most significant 6 bits of the ToS field are fully decoded, the resultant of the 64 possibilities is compared with the corresponding bits in the DSCP register to determine priority.

## 3.4.13 RATE LIMITING SUPPORT

The KSZ8462 supports hardware rate limiting from 64 Kbps to 99 Mbps (refer to Ingress or Egress Data Rate Limits), independently on the “receive side” and on the “transmit side” as per port basis. For 10BASE-T, a rate setting above 10 Mbps means the rate is not limited. On the receive side, the data receive rate for each priority at each port can be limited by setting up ingress rate control registers. On the transmit side, the data transmit rate for each priority queue at each port can be limited by setting up egress rate control registers. The size of each frame has options to include minimum interframe gap (IFG) or preamble byte, in addition to the data field (from packet DA to FCS).

For ingress rate limiting, KSZ8462 provides options to selectively choose frames from all types, multicast, broadcast, and flooded unicast frames. The KSZ8462 counts the data rate from those selected type of frames. Packets are dropped at the ingress port when the data rate exceeds the specified rate limit.

For egress rate limiting, the leaky bucket algorithm is applied to each output priority queue for shaping output traffic. Inter frame gap is stretched on a per frame base to generate smooth, non-burst egress traffic. The throughput of each output priority queue is limited by the egress rate specified.

If any egress queue receives more traffic than the specified egress rate throughput, packets may be accumulated in the output queue and packet memory. After the memory of the queue or the port is used up, packet dropping or flow control will be triggered. As a result of congestion, the actual egress rate may be dominated by flow control/dropping at the ingress end, and may be therefore slightly less than the specified egress rate.

To reduce congestion, it is a good practice to make sure the egress bandwidth exceeds the ingress bandwidth.

## 3.4.14 MAC ADDRESS FILTERING FUNCTION

When a packet is received, the destination MAC address is looked up in both the static and dynamic MAC address tables. If the address is not found in either of these tables, then the destination MAC address is “unknown”. By default, an unknown unicast packet is forwarded to all ports except the port at which it was received. An optional feature makes it possible to specify the port or ports to which to forward unknown unicast packets. It is also possible to specify no ports, meaning that unknown unicast packets will be discarded. This feature is enabled by setting bit[7] in SGCR7.

The unicast MAC address filtering function is useful in preventing the broadcast of unicast packets that could degrade the quality of this port in applications such as Voice over Internet Protocol (VoIP).

## 3.5 Queue Management Unit (QMU)

The Queue Management Unit (QMU) manages packet traffic on port 3 between the internal MAC and the external host processor interface. It has built-in packet memory for receive and transmit functions called transmit queue (TXQ) and receive queue (RXQ). The RXQ capacity is 12 Kbytes, and the TXQ capacity is 6 Kbytes. These FIFOs support back-to-back, non-blocking frame transfer performance. There are control registers for system control, frame status registers for current packet transmit/receive status, and interrupts to inform the host of the real time TX/RX status.

Please refer to the Direction Terminology section for a discussion of the different terminology used to describe the QMU.

### 3.5.1 TRANSMIT QUEUE (TXQ) FRAME FORMAT

The frame format for the transmit queue is shown in [Table 3-7](#). The first word contains the control information for the frame to transmit. The second word is used to specify the total number of bytes of the frame. The packet data follows. The packet data area holds the frame itself. It may or may not include the CRC checksum depending upon whether hardware CRC checksum generation is enabled in bit [1] in TXCR register.

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Multiple frames can be pipelined in both the transmit queue and receive queue as long as there is enough queue memory, thus avoiding overrun. For each transmitted frame, the transmit status information for the frame is located in the TXSR (0x172) register.

**TABLE 3-7: FRAME FORMAT FOR TRANSMIT QUEUE**

| Packet Memory Address<br>Offset (Bytes) | Bit 15<br>2nd Byte   | Bit 0<br>1st Byte |
|---|--|-------------------|
| 0                                       | Control Word<br>(High byte and low byte need to swap in Big-Endian mode) |                   |
| 2                                       | Byte Count<br>(High byte and low byte need to swap in Big-Endian mode)   |                   |
| 4 - Up                                  | Transmit Packet Data<br>(Maximum size is 2000)                           |                   |

Because multiple packets can be pipelined into the TX packet memory for transmit, the transmit status reflects the status of the packet that is currently being transferred on the MAC interface, which may or may not be the last queued packet in the TX queue.

The transmit control word is the first 16-bit word in the TX packet memory, followed by a 16-bit byte count. It must be word aligned. Each control word corresponds to one TX packet. [Table 3-8](#) gives the transmit control word bit fields.

**TABLE 3-8: TRANSMIT CONTROL WORD BIT FIELDS**

| Bit     | Description  |
|---------|--|
| 15      | TXIC Transmit Interrupt on Completion: When this bit is set, the KSZ8462 sets the transmit interrupt after the present frame has been transmitted.                   |
| 14 - 10 | Reserved   |
| 9 - 8   | Reserved   |
| 7 - 6   | Reserved   |
| 5 - 0   | TXFID Transmit Frame ID: This field specifies the frame ID that is used to identify the frame and its associated status information in the transmit status register. |

The transmit byte count specifies the total number of bytes to be transmitted from the TXQ. Its format is given in [Table 3-9](#).

**TABLE 3-9: TRANSMIT BYTE COUNT FORMAT**

| Bit     | Description   |
|---------|---|
| 15 - 11 | Reserved  |
| 10 - 0  | TXBC Transmit Byte Count: Transmit Byte Count. Hardware uses the byte count information to conserve the TX buffer memory for better utilization of the packet memory.<br><b>Note:</b> The hardware behavior is unknown if an incorrect byte count information is written to this field. Writing a "0" value to this field is not permitted. |

The data area contains six bytes of destination address (DA) followed by six bytes of source address (SA), followed by a variable-length number of bytes. On transmit, all bytes are provided by the CPU, including the source address. The KSZ8462 does not insert its own SA. The IEEE 802.3 frame length word (frame type in Ethernet) is not interpreted by the KSZ8462. It is treated transparently as data both for transmit operations.

## 3.5.2 FRAME TRANSMITTING PATH OPERATION IN TXQ

This section describes the typical register settings for transmitting packets from a host processor to the KSZ8462 using the generic bus interface. The user can use the default value for most of the transmit registers. [Table 3-10](#) describes all the registers which need to be set and used for transmitting single frames.

**TABLE 3-10: REGISTER SETTING FOR TRANSMIT FUNCTION BLOCK**

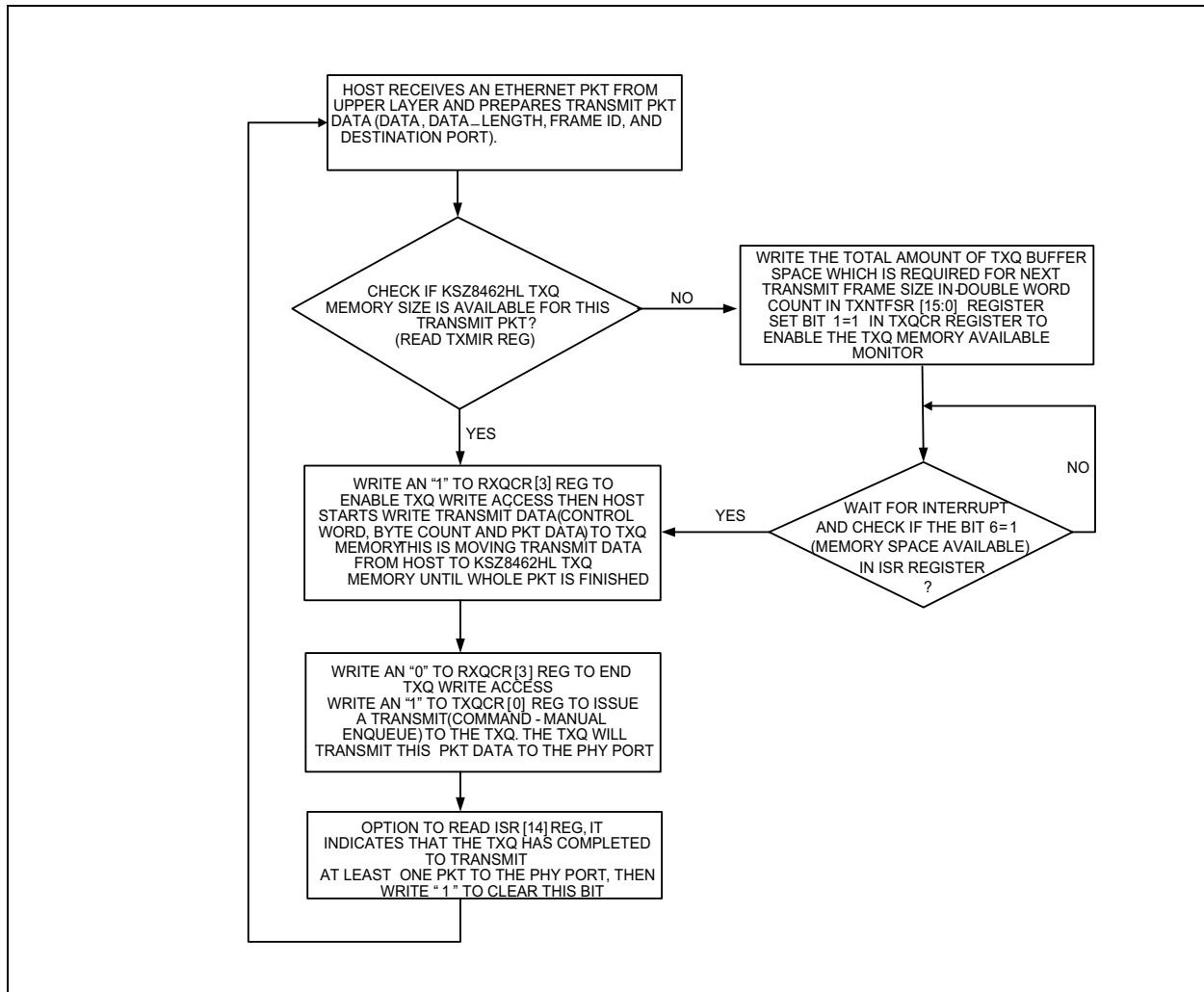
| Register Name<br>[bit](offset)       | Description  |
|--------------------------------------|--|
| TXCR[3:0](0x170)<br>TXCR[8:5](0x170) | Set transmit control function as below:<br>Set bit[3] to enable transmitting flow control. Set bit [2] to enable transmitting padding.<br>Set bit[1] to enable transmitting CRC. Set bit [0] to enable transmitting block operation.<br>Set transmit checksum generation for ICMP, UDP, TCP and IP packet.   |
| TXMIR[12:0](0x178)                   | The amount of free transmit memory available is represented in units of byte. The TXQ memory (6 KByte) is used for both frame payload and control word.  |
| TXQCR[0](0x180)                      | For single frame to transmit, set this bit[0] = “1” (manual enqueue). The KSZ8462 will enable current TX frame prepared in the TX buffer is queued for transmit; this is only transmit one frame at a time.<br><b>Note:</b> This bit is self-clearing after the frame is finished transmitting. The software should wait for the bit to be cleared before setting up another new TX frame.   |
| TXQCR[1](0x180)                      | When this bit is written as “1”, the KSZ8462 will generate interrupt (bit[6] in the ISR register) to CPU when TXQ memory is available based upon the total amount of TXQ space requested by CPU at TXNTFSR (0x19E) register.<br><b>Note:</b> This bit is self-clearing after the frame is finished transmitting. The software should wait for the bit to be cleared before set to “1” again. |
| RXQCR[3](0x182)                      | Set bit[3] to start DMA access from host CPU either read (receive frame data) or write (transmit data frame)   |
| TXFDPR[14](0x184)                    | Set bit[14] to enable TXQ transmit frame data pointer register increments automatically on accesses to the data register.  |
| IER[14][6](0x190)                    | Set bit[14] to enable transmit interrupt in interrupt enable register.<br>Set bit[6] to enable transmit space available interrupt in interrupt enable register.  |
| ISR[15:0](0x192)                     | Write all ones (0xFFFF) to clear all interrupt status bits after interrupt occurred in interrupt enable register.  |
| TXNTFSR[15:0](0x19E)                 | The host CPU is used to program the total amount of TXQ buffer space which is required for next total transmit frames size in double-word count.   |

### 3.5.3 DRIVER ROUTINE FOR TRANSMITTING PACKETS FROM HOST PROCESSOR TO KSZ8462

The transmit routine is called by the upper layer to transmit a contiguous block of data through the Ethernet controller. It is the user's choice to decide how the transmit routine is implemented. If the Ethernet controller encounters an error while transmitting the frame, it's the user's choice to decide whether the driver should attempt to retransmit the same frame or discard the data. [Figure 3-9](#) shows the step-by-step process for transmitting a single packet from host processor to the KSZ8462.

Each DMA write operation from the host CPU to the “write TXQ frame buffer” begins with writing a control word and a byte count of the frame header. At the end of the write, the host CPU must write each piece of frame data to align with a double word boundary at the end. For example, the host CPU has to write up to 68 bytes if the transmit frame is 65 bytes.

**FIGURE 3-9: HOST TX SINGLE FRAME IN MANUAL ENQUEUE FLOW DIAGRAM**



## 3.5.4 RECEIVE QUEUE (RXQ) FRAME FORMAT

The frame format for the receive queue is shown in [Table 3-11](#). The first word contains the status information for the frame received. The second word is the total number of bytes of the RX frame. Following that is the packet data area. The packet data area holds the frame itself. It includes the CRC checksum.

**TABLE 3-11: FRAME FORMAT FOR RECEIVE QUEUE**

| Packet Memory Address Offset (Bytes) | Bit 15<br>2nd Byte   | Bit 0<br>1st Byte |
|--------------------------------------|--|-------------------|
| 0                                    | Status Word<br>(High byte and low byte need to swap in Big-Endian mode. Also see description in RXFHSR register) |                   |
| 2                                    | Byte Count<br>(High byte and low byte need to swap in Big-Endian mode. Also see description in RXFHBCR register) |                   |
| 4 - Up                               | Receive Packet Data<br>(Maximum size is 2000)  |                   |

## 3.5.5 FRAME RECEIVING PATH OPERATION IN RXQ

This section describes the typical register settings for receiving packets from KSZ8462 to the host processor via the generic host bus interface. Users can use the default value for most of the receive registers. [Table 3-12](#) describes all registers which need to be set and used for receiving single or multiple frames.

**TABLE 3-12: REGISTER SETTINGS FOR RECEIVE FUNCTION BLOCK**

| Register Name<br>[bit](offset) | Description   |
|--------------------------------|---|
| RXCR1 (0x174)<br>RXCR2 (0x176) | Set receive control function as below:<br>Set RXCR1[10] to enable receiving flow control. Set RXCR1[0] to enable receiving block operation.<br>Set receive checksum check for ICMP, UDP, TCP, and IP packet.<br>Set receive address filtering scheme.   |
| RXFHSR[15:0] (0x17C)           | This register (read only) indicates the current received frame header status information.   |
| RXFHBCR[11:0] (0x17E)          | This register (read only) indicates the current received frame header byte count information.   |
| RXQCR[12:3] (0x182)            | Set RXQ control function as below:<br>Set bit[3] to start DMA access from host CPU either read (receive frame data) or write (transmit data frame).<br>Set bit[4] to automatically enable RXQ frame buffer de-queue.<br>Set bit[5] to enable RX frame count threshold and read bit[10] for status.<br>Set bit[6] to enable RX data byte count threshold and read bit[11] for status.<br>Set bit[7] to enable RX frame duration timer threshold and read bit[12] for status.<br>Set bit[9] to enable RX IP header two-byte offset. |
| RXFDPR[14] (0x186)             | Set bit[14] to enable RXQ address register increments automatically on accesses to the data register.   |
| RXDTTR[15:0] (0x18C)           | Used to program the received frame duration timer value. When Rx frame duration in RXQ exceeds this threshold in 1 $\mu$ s interval count and bit[7] of RXQCR register is set to "1", the KSZ8462 will generate RX interrupt in ISR[13] and indicate the status in RXQCR[12].   |
| RXDBCTR[15:0] (0x18E)          | Used to program the received data byte count value. When the number of received bytes in RXQ exceeds this threshold in byte count and bit [6] of RXQCR register is set to "1", the KSZ8462 will generate RX interrupt in ISR[13] and indicate the status in RXQCR[11].  |
| IER[13] (0x190)                | Set bit[13] to enable receive interrupt in interrupt enable register.   |
| ISR[15:0] (0x192)              | Write all ones (0xFFFF) to clear all interrupt status bits after interrupt occurred in interrupt status register.   |
| RXFC[15:8] (0x1B8)             | Rx Frame Count. This indicates the total number of frames received in the RXQ frame buffer when the receive interrupt (Reg. ISR, bit [13]) occurred.  |
| RXFCTR[7:0] (0x19C)            | Used to program the received frame count threshold value. When the number of received frames in RXQ exceeds this threshold value and bit[5] of RXQCR register is set to "1", the KSZ8462 will generate an RX interrupt in ISR[13] and indicate the status in RXQCR[10].   |

## 3.5.6 DRIVER ROUTINE FOR RECEIVING PACKETS FROM THE KSZ8462 TO THE HOST PROCESSOR

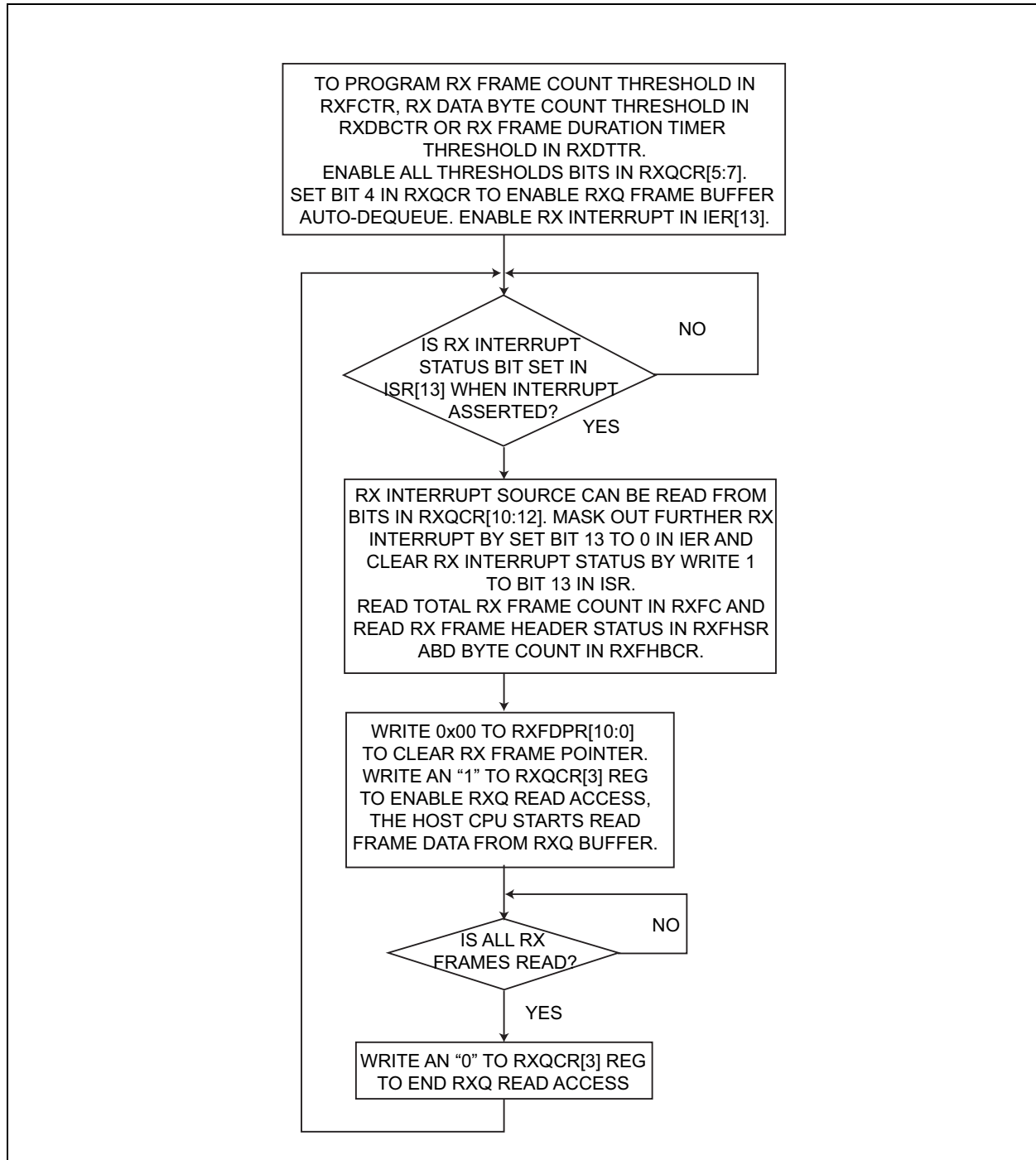
The software driver receives data packet frames from the KSZ8462 device either as a result of polling or an interrupt based service. When an interrupt is received, the operating system invokes the interrupt service routine that is in the interrupt vector table.

If your system has operating system support, to minimize interrupt lockout time, the interrupt service routine should handle at interrupt level only those tasks that require minimum execution time, such as error checking or device status change. The routine should queue all the time-consuming work to transfer the packet from the KSZ8462 RXQ into system memory at task level. [Figure 3-10](#) shows the step-by-step for receive packets from KSZ8462 to host processor.

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Note: For each DMA read operation from the host CPU to read the RXQ frame buffer, the first read data (byte in 8-bit bus mode, word in 16-bit bus mode) is dummy data and must be discarded by the host CPU. Afterward, the host CPU must read each data frame to align it with a double word boundary at the end. For example, the host CPU has to read up to 68 bytes if the number of received frames is 65 bytes.

**FIGURE 3-10: HOST RX SINGLE OR MULTIPLE FRAMES IN AUTO-DEQUEUE FLOW DIAGRAM**



In order to read received frames from RXQ without error, the software driver must follow these steps:

1. When a receive interrupt occurs and the software driver writes a “1” to clear the RX interrupt in the ISR register; the KSZ8462 will update the Rx frame counter (RXFC) register for this interrupt.
2. When the software driver reads back the Rx frame count (RXFC) register, the KSZ8462 will update both the receive frame header status and byte count registers (RXFHSR/RXFHBCR).
3. When the software driver reads back both the receive frame header status and byte count registers (RXFHSR/RXFHBCR), the KSZ8462 will update the next receive frame header status and byte count registers (RXFHSR/RXFHBCR).

## 3.6 IEEE 1588 Precision Time Protocol (PTP) Block

The IEEE 1588 precision time protocol (PTP) provides a method for establishing synchronized time across nodes in an Ethernet networking environment. The KSZ8462 implements V2 (2008) of the IEEE 1588 PTP specification.

The KSZ8462 3-port switch implements the IEEE 1588 PTP Version 2 protocol. Port 1 and port 2 can be programmed as either end-to-end (E2E) or peer-to-peer (P2P) transparent clock (TC) ports. In addition, port 3 can be programmed as either slave or master ordinary clock (OC) port. Ingress time stamp capture, egress time stamp recording, correction field update with residence time and link delay, delay turn-around time insertion, egress time stamp insertion, and checksum update are supported. PTP frame filtering is implemented to enhance overall system performance. Delay adjustments are implemented to fine tune the synchronization. Versatile event trigger outputs and time stamp capture inputs are implemented to meet various real time application requirements through GPIO pins.

The key features of the KSZ8462 implementation are as follows:

- Both one-step and two-step TC operations are supported
- Implementation of precision time clock per specification (Upper 16 bits of second clock not implemented due to practical values of time)
- Both E2E and P2P TC are supported on port 1 and port 2
- Both slave and master OC are supported on port 3
- PTP multicast and unicast frames are supported
- Transports of PTP over IPv4/IPv6 UDP and IEEE 802.3/Ethernet are supported
- Both path delay request-response and peer delay mechanism are supported
- Precision time stamping of input signals on the GPIO pins
- Creation and delivery of clocks, pulses, or other unique serial bit streams on the GPIO pins with respect to precise Precision time Clock time.

IEEE 1588 defines two essential functions: The measurement of link and residence (switching) delays by using the Delay\_Req/Resp or Pdelay\_Req/Resp messages, and the distribution of time information by using the Sync/Follow\_Up messages. The 1588 PTP event messages are periodically sent from the grandmaster(s) in the network to all slave clock devices. Link delays are measured by each slave node to all its link partners to compensate for the delay of PTP messages sent through the network.

The 1588 PTP Announce messages are periodically sent from the grandmaster(s) in the network to all slave clock devices. This information is then used by each node to select a master clock using the best master algorithm available.

1588 PTP (Version 2) defines two types of messages; event and general messages. These are summarized below and are supported by the KSZ8462:

Event Messages (an accurate time stamp is generated at egress and ingress):

- Sync (from Master to Slave)
- Delay\_Req (from Slave to Master)
- Pdelay\_Req (between link partners for peer delay measurement)
- Pdelay\_Resp (between link partners for peer delay measurement)

General Messages:

- Follow\_Up (from Master to Slave)
- Delay\_Resp (from Master to Slave)
- Pdelay\_Resp\_Follow\_Up (between link partners for peer delay measurement)
- Announce
- Management

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- Signaling

## 3.6.1 IEEE 1588 PTP CLOCK TYPES

The KSZ8462 supports the following clock types:

- Ordinary Clock (OC) is defined as a PTP clock with a single PTP port in a PTP domain. It may serve as a source of time such as a master clock, or it may be a slave clock which synchronizes to another master clock.
- End-to-End Transparent Clock (E2E TC) is defined as a transparent clock that supports the use of the end-to-end delay measurement mechanism between a slave clock and the master clock. In this method, the E2E TC intermediate devices do not need to be synchronized to the master clock and the end slave node is directly synchronized to the master clock. The E2E TC/SC slave intermediate devices can also be synchronized to the master clock. Note that the transparent clock is not a real clock that can be viewed on an oscilloscope but rather it is a mechanism by which delay are accounted for when transporting information across and through physical network nodes.
- Peer-to-Peer Transparent Clock (P2P TC for Version 2) is defined as a transparent clock, in addition to providing PTP event transit time information. P2P TC also provides corrections for the propagation delay between nodes (link partners) by using Pdelay\_Req (Peer Delay Request) and Pdelay\_Resp (Peer Delay Response). In this method, the P2P TC intermediate devices can be synchronized to the master clock. A transparent clock (TC) is not part of the master-slave hierarchy. Instead, it measures the resident time which is the time taken for a PTP message to traverse the node. The P2P TC then provides this information to the clock receiving the PTP message. In addition, the P2P TC measures and passes on the link delay of the receiving PTP message. Note that the transparent clock is not a real clock that can be viewed on an oscilloscope but rather it is a mechanism by which delay are accounted for when transporting information across and through physical network nodes.
- Master Clock is defined as a clock which is used as the reference clock for the entire system. The KSZ8462 can operate as a master clock if needed. However, the quality of the clock signal will be limited by the quality of the crystal or oscillator used to clock the device.

Note that P2P and E2E TCs cannot be mixed on the same communication path.

## 3.6.2 IEEE 1588 PTP ONE-STEP OR TWO-STEP CLOCK OPERATION

The KSZ8462 supports either 1-step or 2-step clock operation.

- One-Step Clock Operation: A PTP message (Sync) exchange that provides time information using a single event message which eliminates the need for a Follow\_Up message to be sent. This one-step operation will eliminate the need for software to read the timestamp and to send a Follow\_Up message.
- Two-Step Clock Operation: A PTP messages (Sync/Follow\_Up) that provides time information using the combination of an event message and a subsequent general message. The Follow\_Up message carries a precise estimate of the time the Sync message was placed on the PTP communication path by the sending node.

## 3.6.3 IEEE 1588 PTP BEST MASTER CLOCK SELECTION

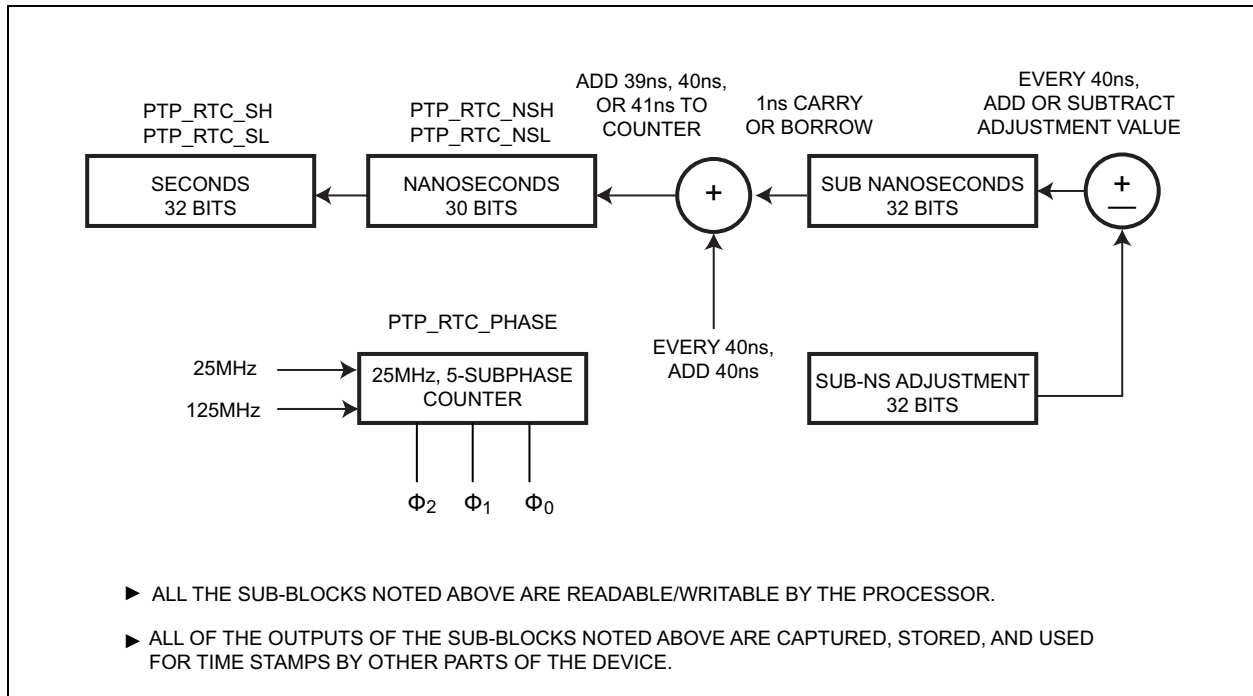
The IEEE 1588 PTP specification defines an algorithm based on the characteristics of the clocks and system topology called best master clock (BMC) algorithm. BMC uses announce messages to establish the synchronization hierarchy. The algorithm compares data from two clocks to determine the better clock. Each clock device continuously monitors the announce messages issued by the current master and compares the dataset to itself. The software controls this process.

## 3.6.4 IEEE 1588 PTP SYSTEM TIME CLOCK

The system time clock (STC) in KSZ8462 is a readable or writable time source for all IEEE 1588 PTP related functions and contains three counters: a 32-bit counter for seconds, a 30-bit counter for nanoseconds and a 32-bit counter for sub-nanoseconds (units of  $2^{-32}$  ns). Refer to [Figure 3-11](#) which shows the precision time protocol clock.



**FIGURE 3-11: PTP SYSTEM CLOCK OVERVIEW**



The STC is clocked (incremented by 40 ns or updated with sub ns carry info) every 40 ns by a derivative of the 125 MHz derived clock. The 30-bit nanosecond counter will be numerically incremented by 39 ns, 40 ns, or 41 ns every 40 ns. There is another 3-bit phase counter that is designed to indicate one of the five sub phases (0 ns, 8 ns, 16 ns, 24 ns, or 32 ns) within the 40 ns period. This provides finer resolution for the various messages and time stamps. The overflow for the 30-bit nanosecond counter is 0x3B9ACA00 (109) and the overflow for the 32-bit sub-nanosecond counter is 0xFFFFFFFF.

The system time clock does not support the upper 16-bits of the seconds field as defined by the IEEE 1588 PTP Version 2 which specifies a 48-bit seconds field. If the 32-bit seconds counter overflows, it will have to be handled by software. Note that an overflow of the seconds field only occurs every 136 years.

The seconds value is kept track of in the PTP\_RTC\_SH and PTP\_RTC\_SL registers (0x608 – 0x60B). The nanoseconds value is kept track of in the PTP\_RTC\_NSH and PTP\_RTC\_NSL registers (0x604 – 0x607).

The PTP\_RTC\_PHASE clock register (0x60C – 0x60D) is initialized to zero whenever the local processor writes to the PTP\_RTC\_NSL, PTP\_RTC\_NSH, PTP\_RTC\_SL, or PTP\_RTC\_SH registers.

During normal operation when the STC clock is keeping synchronized real time, and not while it is undergoing any initialization manipulation by the processor to get it close to the real time, the PTP\_RTC\_PHASE clock register will be reset to zero at the beginning of the current 40 ns STC clock update interval. It will start counting at zero at the beginning of the 40 ns period and every 8 ns it will be incremented. The information provided by the PTP\_RTC\_PHASE register will increase the accuracy of the various timestamps and STC clock readings.

### 3.6.5 UPDATING THE SYSTEM TIME CLOCK

The KSZ8462 provides four mechanisms for updating the system time clock:

- Directly Setting or Reading the Time
- Step-Time Adjustment
- Continuous Time Adjustment
- Temporary Time Adjustment

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## 3.6.5.1 Directly Setting or Reading the Time

Directly setting the system time clock to a value is accomplished by setting a new time in the real time clock registers (PTP\_RTC\_SH/L, PTP\_RTC\_NSH/L and PTP\_RTC\_PHASE) and then setting the load PTP 1588 clock bit (PTP\_LOAD\_CLK).

Directly reading the system time clock is accomplished by setting the read PTP 1588 clock bit (PTP\_READ\_CLK). To avoid lower bits overflowing during reading the system time clock, a snapshot register technique is used. The value in the system time clock will be saved into a snapshot register by setting the PTP\_READ\_CLK bit in PTP\_CLK\_CTL, and then subsequent reads from PTP\_RTC\_S, PTP\_RTC\_NS, and PTP\_RTC\_PHASE will return the system time clock value. The CPU will add the PTP\_RTC\_PHASE value to PTP\_RTC\_S and PTP\_RTC\_NS to get the exact real time.

## 3.6.5.2 Step-Time Adjustment

The system time clock can be incremented in steps if desired. The nanosecond value (PTP\_RTC\_NSH/L) can be added or subtracted when the PTP\_STEP\_ADJ\_CLK bit is set. The value will be added to the system time clock if this action occurs while the PTP\_STEP\_DIR bit = "1". The value will be subtracted from the system time clock if this action occurs while the PTP\_STEP\_DIR bit = "0". The PTP\_STEP\_ADJ\_CLK bit is self-clearing.

## 3.6.5.3 Continuous Time Adjustment

The system can be set up to perform continuous time adjustment to the 1588 PTP clock. This is the mode that is anticipated to be used the most. This mode is overseen by the local processor and provides a method of periodically adjusting the count of the PTP clock to match the time of the master clock as best as possible. The rate registers (PTP\_SNS\_RATE\_H and PTP\_SNS\_RATE\_L) (0x610 – 0x613) are used to provide a value by which the sub-nanosecond Portion of the clock is adjusted on a periodic basis. While continuous adjustment mode (PTP\_CONTINU\_ADJ\_CLK = "1") is selected every 40 ns the sub-nanosecond value of the clock will be adjusted in either a positive or negative direction as determined by the PTP\_RATE\_DIR bit. The value will be positively adjusted if PTP\_RATE\_DIR = "0" or negatively adjusted if PTP\_RATE\_DIR = "1". The rate adjustment allows for correction with resolution of  $2^{-32}$  ns for every 40 ns reference clock cycle, and it will be added to or subtracted from the system time clock on every reference clock cycle right after the write to PTP\_SNS\_RATE\_L is done. To stop the continuous time adjustment, one can either set the PTP\_CONTINU\_ADJ\_CLK = "0" or the PTP\_SNS\_RATE\_H/L value to zero.

## 3.6.5.4 Temporary Time Adjustment

This mode allows for the continuous time adjustment to take place over a specified period of time only. The period of time is specified in the PTP\_ADJ\_DURA\_H/L registers. This mode is enabled by setting the PTP\_TEMP\_ADJ\_CLK bit to one. Once the duration is reached, the increment or decrement will cease. When the temporary time adjustment is done, the internal duration counter register (PTP\_ADJ\_DURA\_H/L) will stay at zero, which will disable the time adjustment. The local processor needs to set the PTP\_TEMP\_ADJ\_CLK to one again to start another temporary time adjustment with the reloaded value into the internal rate and duration registers. The PTP\_ADJ\_DURA\_L register needs to be programmed before PTP\_ADJ\_DURA\_H register. The PTP\_ADJ\_DURA\_L, PTP\_ADJ\_DURA\_H and PTP\_SNS\_RATE\_L registers need to be programmed before the PTP\_SNS\_RATE\_H register. The temporary time adjustment will start after the PTP\_TEMP\_ADJ\_CLK bit is set to one. This bit is self-cleared when the adjustment is completed. Software can read this bit to check whether the adjustment is still in progress.

## 3.6.5.5 PTP Clock Initialization

During software initialization when the device is powering up, the PTP clock needs to be initialized in preparation for synchronizing to the master clock. The suggested order of tasks is to reset the PTP 1588 clock (RESET\_PTP\_CLK = "0"), load the PTP 1588 clock (PTP\_LOAD\_CLK = "1") with a value then enable the PTP 1588 clock (EN\_PTP\_CLK = "1"). During the initial synchronization attempt, the system time clock may be a little far apart from the PTP master clock, so it most likely will require a step-time adjustment to get it closer. After that, the continuous time adjustment method or temporary time adjustment method may be the best options when the system time clock is close to being synchronized with the master clock.

More details on the 1588 PTP system time clock controls and functions can be found in the register descriptions for registers 0x600 to 0x617.

## 3.6.6 IEEE 1588 PTP MESSAGE PROCESSING

The KSZ8462 supports IEEE 1588 PTP time synchronization when 1588 PTP mode and message detection are enabled in the PTP\_MSG\_CFG\_1 register (0x620 – 0x621). Different operations will be applied to PTP packet processing based on the setting of P2P or E2E in transparent clock mode for port 1 and port 2, master or slave in ordinary clock mode for port 3 (host port), one-step or two-step clock mode, and if the domain checking is enabled. For the IPv4/UDP

egress packet, the checksum can be updated by either re-calculating the two-bytes or by setting it to zero. For the IPv6/UDP egress packet, the checksum is always updated. All these 1588 PTP configuration bits are in the PTP\_MSG\_CFG\_G\_1/2 registers (0x620 – 0x623).

For a more detailed description of the 1588 PTP message processing control and function, please refer to the register descriptions in the register map at locations 0x620 to 0x68F.

### 3.6.6.1 IEEE 1588 PTP Ingress Packet Processing

The KSZ8462 can detect all IEEE 802.3 Ethernet 1588 PTP packets, IPv4/UDP 1588 PTP packets, and IPv6/UDP 1588 PTP packets by enabling these features in the PTP\_MSG\_CFG\_1 register (0x620 – 0x621). Upon detection of receiving a 1588 PTP packet, the device will capture the receive time stamp at the time when the start-of-frame delimiter (SFD) is detected. Adjusting the receive time stamp with the receive latency or asymmetric delay is the responsibility of the software. The hardware only takes these values into consideration when it updates the correction field in the PTP message header. Likewise, the software needs to adjust the transmit time stamp with the transmit latency. Both the ingress time stamp and the ingress port number will be embedded in the reserved fields of the 1588 PTP header. The embedded information will be used by the host to designate the destination port in the response egress packet, identify the direction of the master port, and to calculate the link delay and offset.

The 1588 PTP packet will be discarded if the 1588 PTP domain field does not match the domain number in the PTP\_DOMAIN\_VER register (0x624 – 0x625) or if the 1588 PTP version number does not match version number (either 1 or 2) in the PTP\_DOMAIN\_VER register (0x624 – 0x625). Packets with a version number of one will always be forwarded to port 1 or port 2, and not to port 3.

The 1588 PTP packets that are not associated with packet messages in pairs (Pdelay\_Req with Pdelay\_Resp, Sync with Follow\_Up, Delay\_Req with Delay\_Resp) can be filtered and not forwarded to port 3 if the corresponding enable bits are set in the PTP\_MSG\_CFG\_2 register (0x622 – 0x623). The 1588 PTP version-1 packet will be forwarded without being modified.

### 3.6.6.2 IEEE 1588 PTP Egress Packet Processing

The ingress time stamp, the transport type of the 1588 PTP packet, the packet type (tagged or untagged), and the type of correction field update on the egress side are in the frame header and are accessible for modification by the egress logic in local switch packet memory. The 1588 PTP packet will be put in the egress queue of highest priority. From the 1588 PTP frame header inside the switch packet memory, the egress logic will get the correction field update instruction. The residence time, link delay in the PTP\_P1/2\_LINK\_DLY registers (0x646 – 0x647 and 0x666 – 0x667) or turn-around time might be added to the correction field depending upon the type of 1588 PTP egress packet. The 1588 PTP packet received from port 3 (host port) has the destination port information to forward as well as the time stamp information that will be used for updating the correction field in one-step clock operation.

This embedded information (in the reserved fields of 1588 PTP frame header) will be zeroed out before the egress packet is sent out to conform to the 1588 PTP standard.

For one-step operation, the original time stamp will be inserted into the sync packet. The egress time stamp of the Sync packet will be latched in the P1/2\_SYNC\_TS registers (0x64C – 0x64F and 0x66C – 0x66F), the egress time stamps of Delay\_Req, Pdelay\_Req and Pdelay\_Resp will be latched in the P1/2\_XDLY\_REQ\_TS (0x648 – 0x64B and 0x668 – 0x66B) and P1/2\_PDLY\_RESP\_TS registers (0x650 – 0x653 and 0x670 – 0x673). These latched egress time stamps will generate an interrupt to the host CPU and set the interrupt status bits in the PTP\_TS\_IS register (0x68C – 0x68D) if the interrupt enable is set in the PTP\_TS\_IE register (0x68E – 0x68F). These captured egress time stamps will be used by the 1588 PTP software for link delay measurement, offset adjustment, and time calculation.

The transmit delay value from the port 1 or port 2 time stamp reference point to the network connection point in the PTP\_P1/2\_TX\_LATENCY registers (0x640 – 0x643) will be added to these value in the P1/2\_SYNC\_TS, P1/2\_XDLY\_REQ\_TS and P1/2\_PDLY\_RESP\_TS registers to get the egress time stamp with reference point to the network connection point. For transmit Delay\_Req or Pdelay\_Req packets, the value in the PTP\_P1/2\_ASYM\_COR registers (0x644 – 0x645 and 0x664 – 0x665) will be subtracted from the correction field.

### 3.6.7 IEEE 1588 PTP EVENT TRIGGERING AND TIME STAMPING

An event trigger output signal can be generated when the target and activation time matches the IEEE 1588 PTP system clock time. Likewise, an event time stamp input can be captured from an external event input signal and the corresponding time on the IEEE 1588 PTP system clock will be captured.

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Up to seven GPIO pins can be configured as either output signal when trigger target time is matching IEEE 1588 PTP system clock time or monitoring input signal for external event time stamp. All event trigger outputs are generated by comparing the system clock time with trigger target time continuously to make sure time synchronization is always ongoing.

## 3.6.7.1 IEEE 1588 PTP Trigger Output

The KSZ8462 supports up to 12 event trigger units which can output to any one of the seven GPIO pins by setting bits[3:0] in TRIG[1:12]\_CFG\_1 registers. Multiple trigger units can be assigned to a single GPIO pin at the same time as logical OR'ed function allowing generation of more complex waveforms. Also multiple trigger units can be cascaded (one Unit only at any time) to drive a single GPIO pin to generate a long and repeatable bit sequence. Each trigger unit that is cascaded can be any signal type (edge, pulse, periodic, register-bits, and clock output).

Each trigger unit can be programmed to generate one time rising or falling edge (toggle mode), a single positive or negative pulse of programmable width, a periodic signal of programmable width, cycle time, bit-patterns to shift out from TRIG[1:12]\_CFG\_1[1:8] registers, and each trigger Unit can be programmed to generate interrupt of trigger output Unit done and status in PTP\_TRIG\_IE/IS registers. For each trigger Unit, the host CPU programs the desired output waveform, GPIO pins, target time in TRIG[1:12]\_TGT\_NS and TRIG[1:12]\_TGT\_S registers that the activity is to occur, and enable the trigger output Unit in TRIG\_EN register, then the trigger output signal will be generated on the GPIO pin when the internal IEEE 1588 PTP system time matches the desired target time. The device can be programmed to generate a pulse-per-second (PPS) output signal. The maximum trigger output signal frequency is up to 12.5 MHz.

For a more detailed description of the 1588 PTP event trigger output control, configuration and function, please refer to the registers description in the register map from 0x200 to 0x397 locations.

## 3.6.7.2 IEEE 1588 PTP Event Time Stamp Input

External event inputs on the GPIO pins can be monitored and time stamped with the resolution of 8 ns. The external signal event can be monitored and detected as either rising edge, falling edge, positive pulse, or negative pulse by setting bits[7:6] in TS[1:12]\_CFG registers. Multiple time stamp units can be cascaded or chained together to associate with a single GPIO pin to detect a series of events. When event is detected, the time stamp will be captured in three fields: 32-bit second field in TS[1:12]\_SMPL1/2\_SH/L registers, 30-bit nanosecond field in TS[1:12]\_SMPL1/2\_NSH/L registers, and 3-bit phase field in TS[1:12]\_SMPL1/2\_SUB\_NS registers. Second and nanosecond fields are updated every 25 MHz clock cycle. The 3-bit phase field is updated every 125 MHz clock cycle and indicates one of the five 8 ns/125 MHz clock cycles. The bit [14] in TS[1:12]\_SMPL1/2\_NSH registers indicates the event time stamp input is either falling edge or rising edge.

The KSZ8462 supports up to twelve time stamp input units that can input from any one of the twelve GPIO pins by setting bits[11:8] in TS[1:12]\_CFG registers. The enable bits [11:0] in TS\_EN register are used to enable the time stamp units. The last time stamp unit (unit 12) can support up to eight time stamps for multiple event detection and up to four pulses can be detected. The rest of the units (units 1 through 11) have two time stamps to support single edge or pulse detection. Pulse width can be measured by the time difference between consecutive time stamps. When an input event is detected, one of the bits [11:0] in TS\_RDY register is asserted and will generate a time stamp interrupt if the PTP\_TS\_IE bit is set. The host CPU is also expected to read the time stamp status in the TS[1:12]\_STATUS registers to report the number of detected event (either rising or falling edge) counts and overflow. In single mode, it can detect up to fifteen events at any single Unit. In cascade mode, it can detect up to two events at units 1 through 11 or up to eight events at unit 12, and it can detect up to fifteen events for any unit as a tail unit. Pulses or edges can be detected up to 25 MHz.

For more details on 1588 PTP event time stamp input control, configuration and function, please refer to the register descriptions for locations 0x400 to 0x5FD in the register map.

## 3.6.7.3 IEEE 1588 PTP Event Interrupts

All IEEE 1588 PTP event trigger and time stamp interrupts are located in the PTP\_TRIG\_IE/PTP\_TS\_IE enable registers and the PTP\_TRIG\_IS/PTP\_TS\_IS status registers. These interrupts are fully maskable via their respective enable bits and shared with other interrupts that use the INTRN interrupt pin.

These twelve event trigger output status interrupts are logical OR'ed together and connected to bit[10] in the ISR register.

These twelve event trigger output enable interrupts are logical OR'ed together and connected to bit[10] in the IER register.

These twelve time stamp status interrupts are logical OR'ed together with the rest of bits in this register and the logical OR'ed output is connected to bit[12] in the ISR register.

These twelve time stamp enable interrupts are logical OR'ed together with the rest of bits in this register and the logical OR'ed output is connected to bit[12] in the IER register.

## 3.6.7.4 IEEE 1588 GPIO

The KSZ8462 supports twelve GPIO pins that can be used for general I/O or can be configured to utilize the timing of the IEEE 1588 protocol. These GPIO pins can be used for input event monitoring, outputting pulses, outputting clocks, or outputting unique serial bit streams. The GPIO output pins can be configured to initiate their output upon the occurrence of a specific time which is being kept by the onboard precision time clock. Likewise, the specific time of arrival of an input event can be captured and recorded with respect to the precision time clock. Refer to the General Purpose and IEEE 1588 Input/Output (GPIO) section for details on the operation of the GPIO pins.

## 3.7 General Purpose and IEEE 1588 Input/Output (GPIO)

### 3.7.1 OVERVIEW

The KSZ8462 devices incorporate a set of general purpose input/output (GPIO) pins that are configurable to meet the needs of many applications. The input and output signals on the GPIO pins can be directly controlled via a local processor or they can be set up to work closely with the IEEE 1588 protocol to create and/or monitor precisely timed signals which are synchronous to the precision time clock. Some GPIO pins are dedicated, while others are dual function pins. Dual function pins are managed by the IOMUXEL register. [Table 3-13](#) provides a convenient summary of available GPIO resources in the KSZ8462 devices.

**TABLE 3-13: GPIO PIN RESOURCES**

| GPIO   | Pin Number | Function              |
|--------|------------|-----------------------|
| GPIO_0 | 48         | GPIO0                 |
| GPIO_1 | 49         | GPIO1                 |
| GPIO_2 | 52         | GPIO2                 |
| GPIO_3 | 53         | EESK (default)/GPIO3  |
| GPIO_4 | 54         | EEDIO (default)/GPIO4 |
| GPIO_5 | 55         | EECS (default)/GPIO5  |
| GPIO_6 | 58         | GPIO6                 |

### 3.7.2 GPIO PIN FUNCTIONALITY CONTROL

The GPIO\_OEN register is used to configure each GPIO as an input or an output. Each GPIO pin has a set of registers associated with it that are configured to determine its functionality, and any relationship it has with other GPIO pins or registers. Each GPIO pin can be configured to output a binary signal state or a serial sequence of bits. Each GPIO pin can output a single serial bit pattern or it can be programmed to continuously loop and output the pattern until stopped. The duration of the high and low periods within the sequential bit patterns can be programmed to meet the requirements of the application. The output can be triggered to occur at any time by the local processor writing to the correct register or it can be triggered by the local IEEE precision timing protocol clock being equal to an exact time. The local processor can interrogate any GPIO pin at any time or the value of the IEEE precision time protocol clock can be captured and recorded when the specified event occurs on any of the GPIO pins. The control and output of the GPIO pins can be cascaded to create complex digital output sequences and waveforms. Lastly, the units can be programmed to generate an interrupt on specific conditions.

The control structure for the twelve GPIO pins are organized into two separate units called the trigger output units (TOU) and the time stamp input units (TSU). There are twelve TOUs and twelve TSUs that can be used with any of the GPIO pins. There are 32 control bytes for each of the two units to control the functionality. The depth of control is summarized in [Table 3-14](#).

**TABLE 3-14: TRIGGER OUTPUT UNITS AND TIME STAMP INPUT UNITS SUMMARY**

| Trigger Output Units   | Time Stamp Input Units  |
|--|---|
| 32 Bytes of Parameters   | 32 Bytes of Parameters  |
| Trigger Patterns:<br>Negative Edge, Positive Edge, Negative Pulse, Positive Pulse, Negative Period, Positive Period, Register Output Shift | Detection:<br>Negative or Positive Edges<br>Negative or Positive Pulses |

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**TABLE 3-14: TRIGGER OUTPUT UNITS AND TIME STAMP INPUT UNITS SUMMARY (CONTINUED)**

| Trigger Output Units   | Time Stamp Input Units   |
|--|--|
| Pulse Width:<br>16-Bit Counter @ 8 ns Each (524288 ns, maximum)    | Two Edge/One Pulse (Two Time Stamps) Detection<br>Capability (time stamp Units 10:0) |
| Cycle Width:<br>32-Bit Counter @ 1 ns Each (4.29 seconds, maximum) | Eight Edge/Four Pulse (Eight Time Stamps) Detection (time<br>stamp Unit 11)          |
| Cycle Count:<br>16-Bit Counter (0 = Infinite Loop)                 | Cascadable to Detect Multiple Edges  |
| Total Cascade Mode Cycle Time:<br>32-Bit Counter @ 1 ns Each       | —  |
| Shift Register:<br>16-Bits (only for register shift output mode)   | —  |
| Cascadable to Generate Complex Waveforms                           | —  |

## 3.7.3 GPIO PIN CONTROL REGISTER LAYOUT

Most of the registers used to control the time stamp units and the trigger output units are duplicated for each GPIO pin.

There are a few registers that are associated with all the overall functionality of all the GPIO pins or only specific GPIO pins. These are summarized in [Table 3-15](#).

**TABLE 3-15: GPIO REGISTERS AFFECTING EITHER ALL OR SPECIFIC UNITS**

| Register Name  | Register Location | Related to Which Trigger Output Units<br>or Time Stamping Units |
|--|-------------------|---|
| Trigger Error Register – TRIG_ERR  | 0x200 – 0x201     | All GPIO trigger output units.                                  |
| Trigger Active Register – TRIG_ACTIVE                                    | 0x202 – 0x203     | All GPIO trigger output units.                                  |
| Trigger Done Register – TRIG_DONE  | 0x204 – 0x205     | All GPIO trigger output units.                                  |
| Trigger Enable Register – TRIG_EN  | 0x206 – 0x207     | All GPIO trigger output units.                                  |
| Trigger SW Reset Register – TRIG_SW_RST                                  | 0x208 – 0x209     | All GPIO trigger output units.                                  |
| Trigger Unit 12 Output PPS<br>Pulse-Width Register –<br>TRIG12_PPS_WIDTH | 0x20A – 0x20B     | GPIO trigger output Unit 1, 12.                                 |
| Time Stamp Ready Register – TS_RDY                                       | 0x400 – 0x401     | All GPIO time stamp input units.                                |
| Time Stamp Enable Register – TS_EN                                       | 0x402 – 0x403     | All GPIO time stamp input units.                                |
| Time Stamp Software Reset Register –<br>TS_SW_RST                        | 0x404 – 0x405     | All GPIO time stamp input units.                                |

**FIGURE 3-12: TRIGGER OUTPUT UNIT ORGANIZATION AND ASSOCIATED REGISTERS**

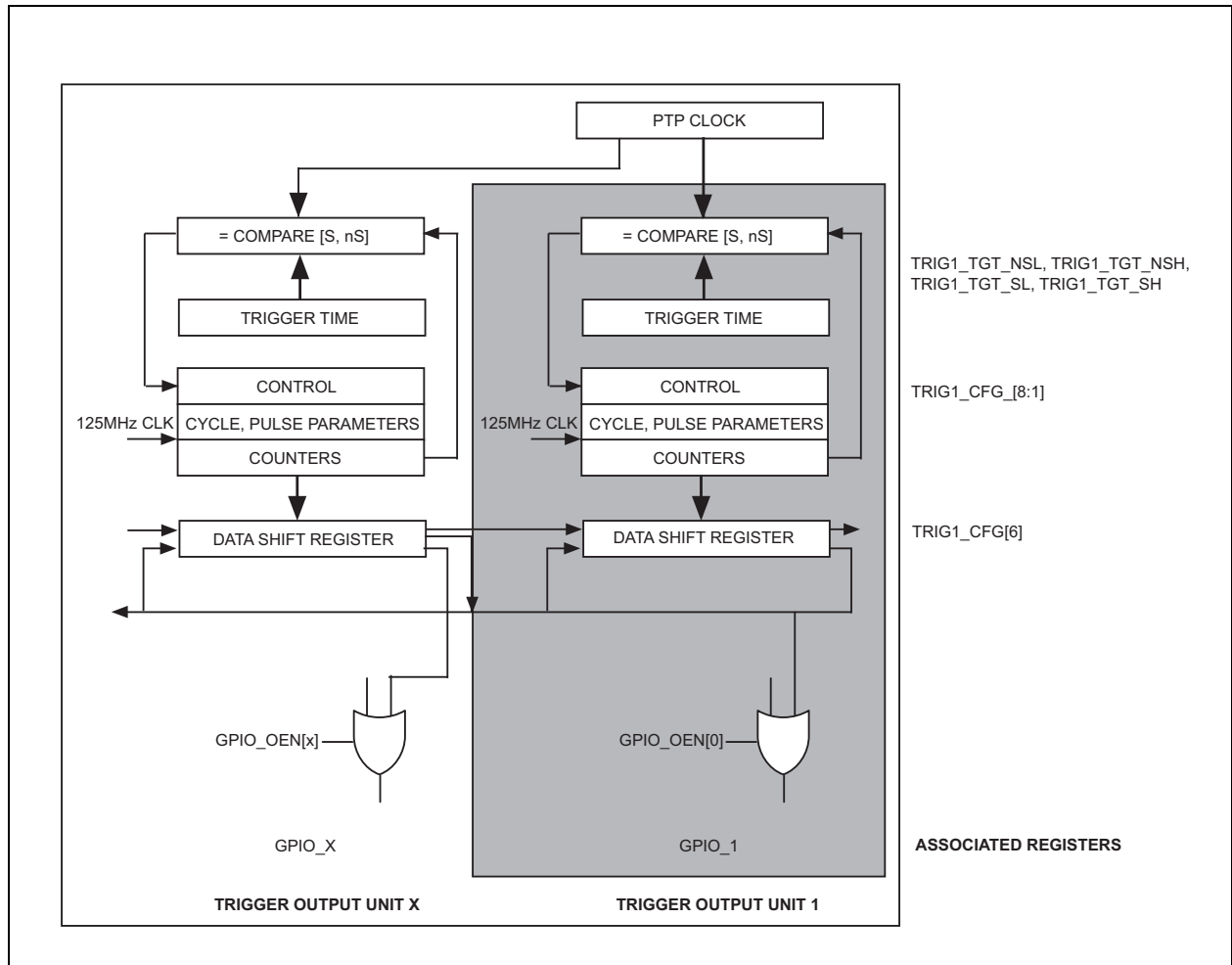
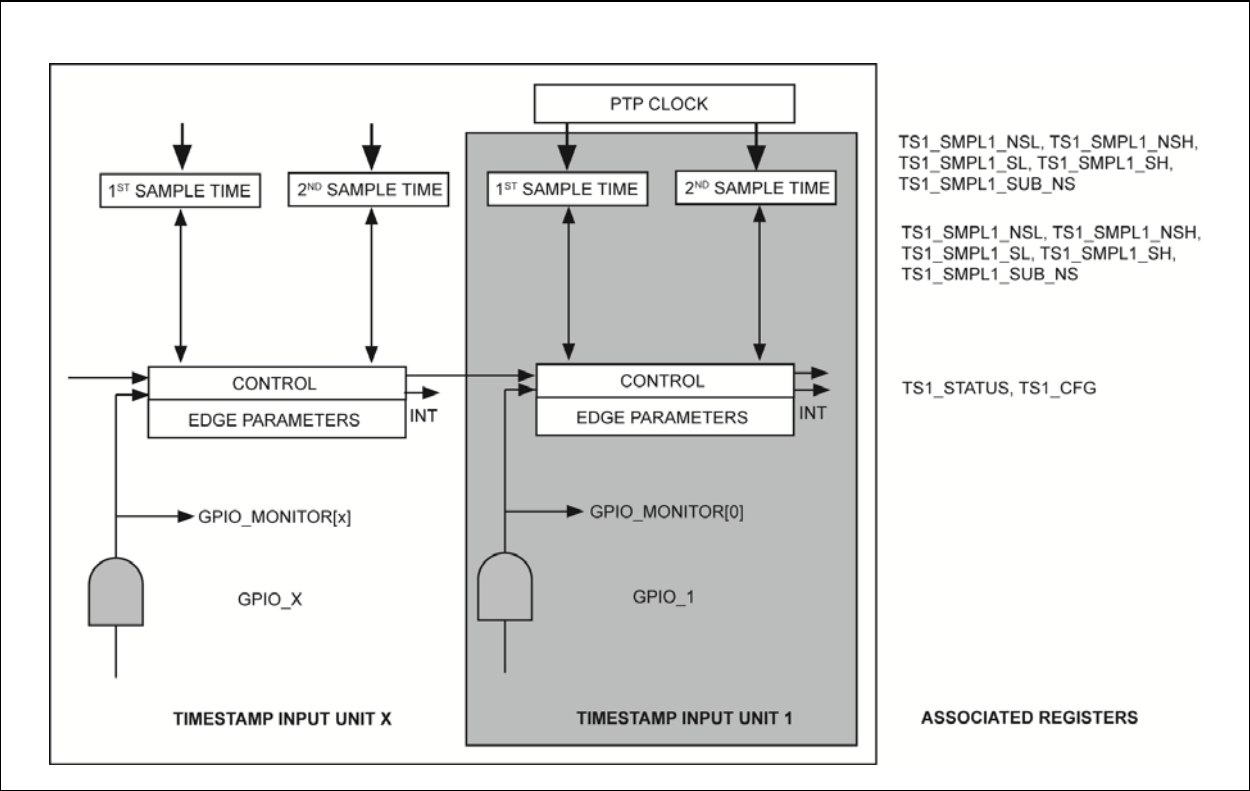


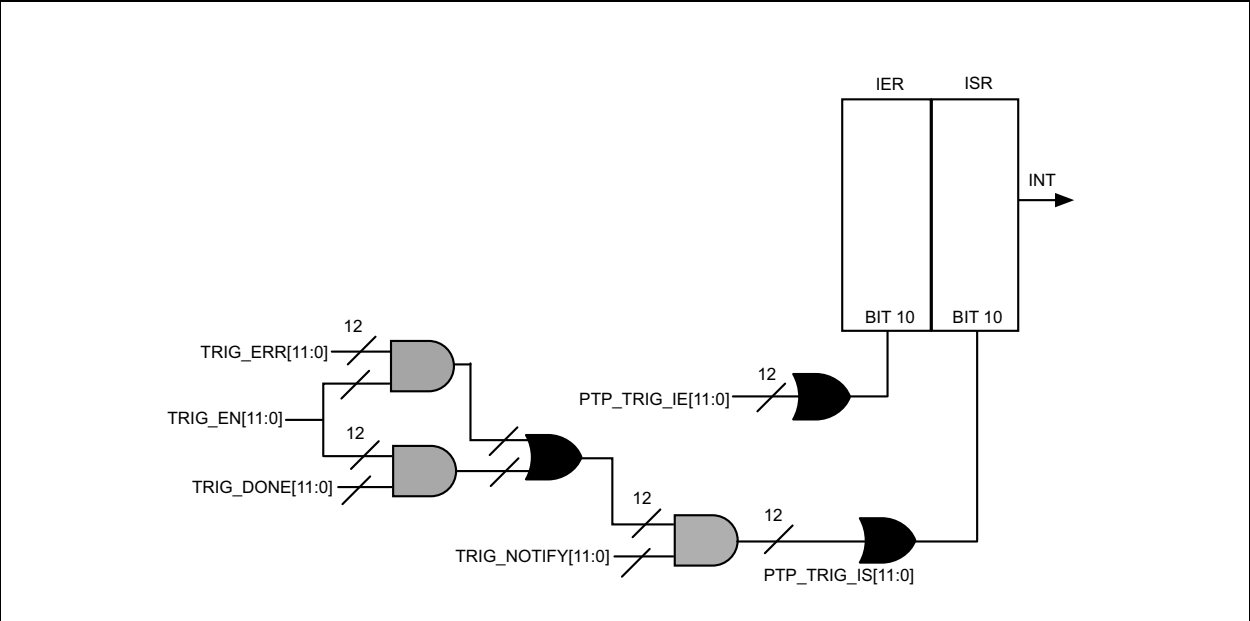
FIGURE 3-13: TIME STAMP INPUT UNIT ORGANIZATION AND ASSOCIATED REGISTERS



3.7.4 GPIO TRIGGER OUTPUT UNIT AND TIME STAMP INPUT UNIT INTERRUPTS

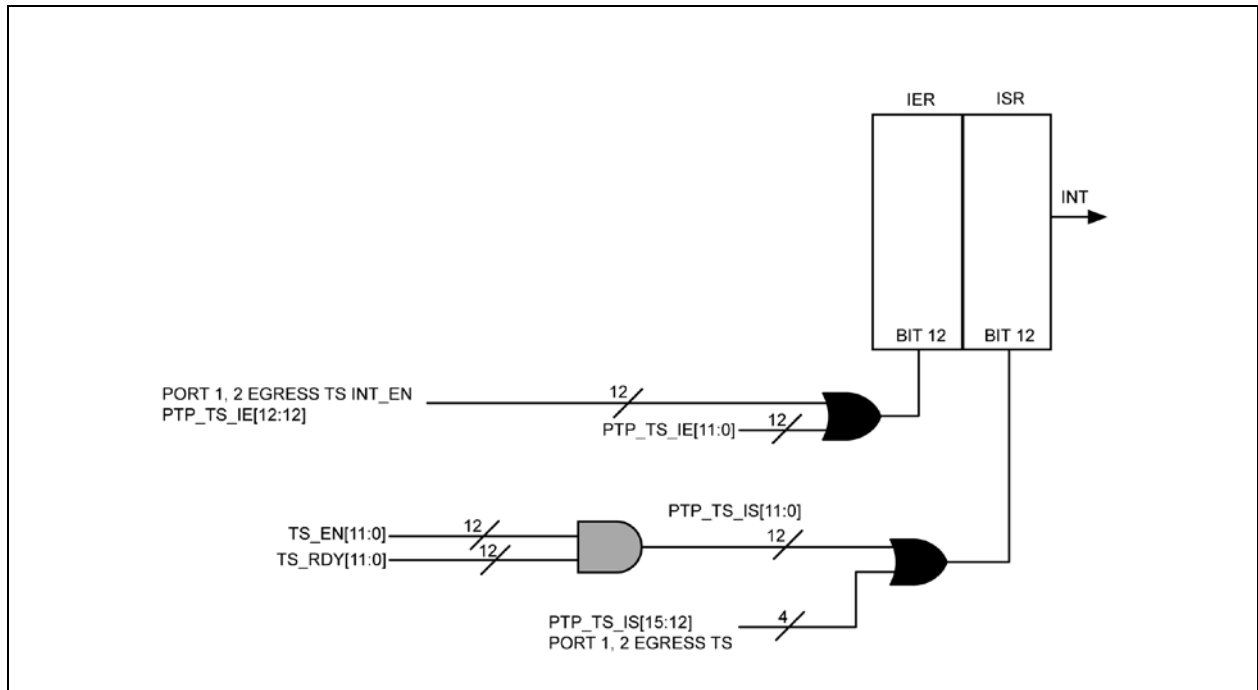
The trigger output units and the time stamp input units can be programmed to generate interrupts when specified events occur. The interrupt control structure is shown in Figure 3-14 and Figure 3-15.

FIGURE 3-14: TRIGGER UNIT INTERRUPTS





**FIGURE 3-15: TIME STAMP UNIT INTERRUPTS**



## 3.8 Using the GPIO Pins with the Trigger Output Units

The twelve trigger output units (TOU) can be used to generate a variety of pulses, clocks, waveforms, and data streams at user-selectable GPIO pins. The TOUs will generate the user-specified output starting at a specific time with respect to the IEEE 1588 precision time clock. This section provides some information on configuring the TOUs to generate specific types of output. In the information below, the value “x” represents one of the twelve TOUs. Because this area of the device is very flexible and powerful, please reference application note [ANLAN203, KSZ84xx GPIO Pin Output Functionality](#), for additional information on creating specific types of waveforms and utilizing this feature.

When using a single TOU to control multiple GPIO pins, there are several details of functionality that must be taken into account. When switching between GPIO pins, the output value on those pins can be affected. If a TOU changes the GPIO pin level to a high value, writing to this units configuration register to change the addressed GPIO pin to a different one will cause the hardware to drop the level in the previous GPIO pin and set the new GPIO pin to a high value. To prevent the second GPIO pin from going high immediately, the TOU must be reset prior to programming in a different GPIO pin value.

### 3.8.1 CREATING A LOW-GOING PULSE AT A SPECIFIC TIME

- Specifying the Time

The desired trigger time will be set in TRIGx\_TGT\_NSH, TRIGx\_TGT\_NSL, TRIGx\_TGT\_SH, and TRIGx\_TGT\_SL registers.

- Specifying the Pulse Parameters

TRIGx\_CFG\_1[6:4] = “010” for negative pulse generation.

TRIGx\_CFG\_2[15:0] = Pulse width where each Unit is 8 ns.

- Associate this Trigger Output Unit to a Specific GPIO Pin

TRIGx\_CFG\_1[3:0] = Selects GPIO pin to use.

- Set Up Interrupts, if Needed

If it is desired to get notification that the trigger output event occurred set up the following registers.

TRIGx\_CFG\_1, bit[8] (Trigger Notify) = “1” is one requirement for enabling interrupt on done or error.

Set the corresponding trigger Unit interrupt enable bit in the PTP\_TRIG\_IE register.

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- Enabling the Trigger Output Unit

Set the corresponding trigger Unit enable bit in the TRIG\_EN register.

Be aware that for a low-going pulse in non-cascaded mode (single mode), the output will be driven by the unit to a high level when the trigger unit is enabled. In cascade mode, the output will be driven by the unit to the high state 8 ns prior to the programmed trigger time.

## 3.8.2 CREATING A HIGH-GOING PULSE AT A SPECIFIC TIME

- Specifying the Time

The desired trigger time will be set in TRIGx\_TGT\_NSH, TRIGx\_TGT\_NSL, TRIGx\_TGT\_SH, and TRIGx\_TGT\_SL registers.

- Specifying the Pulse Parameters

TRIGx\_CFG\_1[6:4] = "011" for positive pulse generation.

TRIGx\_CFG\_2[15:0] = Pulse width where each Unit is 8 ns.

- Associate this Trigger Output Unit to a Specific GPIO Pin

TRIGx\_CFG\_1[3:0] = Selects GPIO pin to use.

- Set Up Interrupts if Needed

If it is desired to get notification that the trigger output event occurred set up the following registers.

TRIGx\_CFG\_1, bit[8] (Trigger Notify) = "1" is one requirement for enabling interrupt on done or error.

Set the corresponding trigger Unit interrupt enable bit in the PTP\_TRIG\_IE register.

- Enabling the Trigger Output Unit

Set the corresponding trigger Unit enable bit in the TRIG\_EN register.

Be aware that for a high-going pulse in non-cascaded mode (single mode), the output will be driven by the unit to a low level when the trigger unit is enabled. In cascade mode, the output will be driven by the unit to the low state 8 ns prior to the programmed trigger time.

## 3.8.3 CREATING A FREE RUNNING CLOCK SOURCE

- Specifying the Time

Typically there is no need to set up a desired trigger time with respect to a free running clock. There are two ways that the free running clock can be started.

Set up a desired trigger time in the TRIGx\_TGT\_NSH, TRIGx\_TGT\_NSL, TRIGx\_TGT\_SH, and TRIGx\_TGT\_SL registers.

After parameters have been set up, start the clock by setting the Trigger Now bit, bit[9], in the TRIGx\_CFG\_1 register.

- Specifying the Clock Parameters

TRIGx\_CFG\_1[6:4] = "101" for generating a positive periodic signal.

High part of cycle defined by bits[15:0] in the TRIGx\_CFG\_2 register. Each Unit is 8 ns.

Cycle width defined by bits[15:0] in TRIGx\_CFG\_3 and TRIGx\_CFG\_4 registers. Each Unit is 1 ns.

Continuous clock by setting TRIGx\_CFG\_5, bits[15:0] = "0".

- Associate this Trigger Output Unit to a Specific GPIO Pin

TRIGx\_CFG\_1[3:0] = Selects GPIO pin to use.

- Set Up Interrupts if Needed

If it is desired to get notification that the trigger output event occurred set up the following registers.

TRIGx\_CFG\_1, bit[8] (Trigger Notify) = "1" is one requirement for enabling interrupt on done or error.

Set the corresponding trigger Unit interrupt enable bit in the PTP\_TRIG\_IE register.

- Enabling the Trigger Output Unit

Set the corresponding trigger Unit enable bit in the TRIG\_EN register.

Because the frequencies to be generated are based on the period of the 125 MHz clock, there are some limitations that the user must be aware of. Certain frequencies can be created with unvarying duty cycles. However, other frequencies may incur some variation in duty cycle. There are methods of utilizing the trigger Unit 2 clock edge output select bit (bit[7] in of Reg. 0x248 – 0x249) and GPIO1 to control and minimize the variances.

## 3.8.4 CREATING FINITE LENGTH PERIODIC BIT STREAMS AT A SPECIFIC TIME

This example implies that a uniform clock will be generated for a specific number of clock cycles:

- Specifying the Time

The desired trigger time will be set in TRIGx\_TGT\_NSH, TRIGx\_TGT\_NSL, TRIGx\_TGT\_SH, and TRIGx\_TGT\_SL registers.

- Specifying the Finite Length Periodic Bit Stream Parameters

TRIGx\_CFG\_1[6:4] = “101” for generating a positive periodic signal.

High part of cycle defined by bits[15:0] in the TRIGx\_CFG\_2 register. Each Unit is 8 ns.

Cycle width defined by bits[15:0] in TRIGx\_CFG\_3 and TRIGx\_CFG\_4 registers. Each Unit is 1 ns.

Finite length count established by setting TRIGx\_CFG\_5, bits[15:0] = “number of cycles”. Each Unit is one cycle.

- Associate this Trigger Output Unit to a Specific GPIO Pin

TRIGx\_CFG\_1[3:0] = Selects GPIO pin to use.

- Set Up Interrupts if Needed

If it is desired to get notification that the trigger output event occurred, set up the following registers.

TRIGx\_CFG\_1, bit[8] (Trigger Notify) = “1” is one requirement for enabling interrupt on done or error.

Set the corresponding trigger Unit interrupt enable bit in the PTP\_TRIG\_IE register.

- Enabling the Trigger Output Unit

Set the corresponding Trigger Unit Enable bit in the TRIG\_EN register.

## 3.8.5 CREATING FINITE LENGTH NON-UNIFORM BIT STREAMS AT A SPECIFIC TIME

Generation of a finite length non-uniform waveform which is a multiple of the bit pattern stored in the data storage register.

- Specifying the Time

The desired trigger time will be set in TRIGx\_TGT\_NSH, TRIGx\_TGT\_NSL, TRIGx\_TGT\_SH, and TRIGx\_TGT\_SL registers.

- Specifying the Finite Length Non-Uniform Bit Stream Parameters

TRIGx\_CFG\_1[6:4] = “110” for generating signal based on contents of data register.

16-bit pattern stored in TRIGx\_CFG\_6 register.

Bit width defined by bits[15:0] in TRIGx\_CFG\_3 and TRIGx\_CFG\_4 registers. Each Unit is 1 ns.

Bit length of finite pattern is established by shifting the data register “N” times. Set TRIGx\_CFG\_5, bits[15:0] = “N”.

- Associate this Trigger Output Unit to a Specific GPIO Pin

TRIGx\_CFG\_1[3:0] = Selects GPIO pin to use.

- Set up Interrupts if Needed

If it is desired to get notification that the trigger output event occurred, set up the following registers.

TRIGx\_CFG\_1, bit[8] (Trigger Notify) = “1” is one requirement for enabling interrupt on done or error.

Set the corresponding trigger unit interrupt enable bit in the PTP\_TRIG\_IE register.

- Enabling the Trigger Output Unit

Set the corresponding trigger unit enable bit in the TRIG\_EN register.

## 3.8.6 CREATING COMPLEX WAVEFORMS AT A SPECIFIC TIME

Complex waveforms can be created by combining the various functions available in the trigger output units using a method called “cascading.”

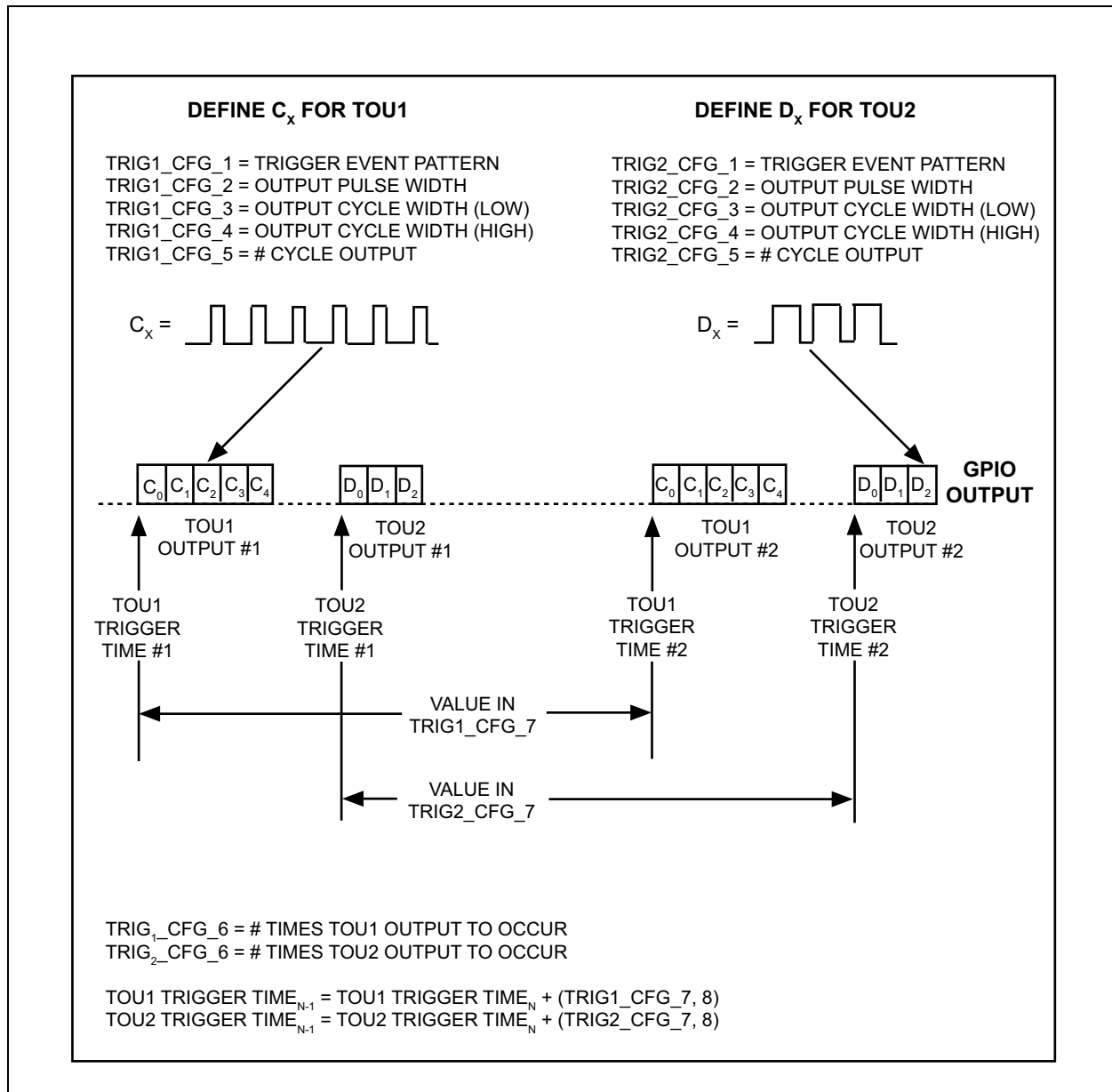
# KSZ8462HLI/FHLI

Figure 3-16 illustrates the generation of a complex waveform onto one GPIO pin. Trigger output Unit 1 (TOU1) and trigger output Unit 2 (TOU2) are cascaded to produce the complex waveform. Cascading allows multiple outputs to be sequentially output onto one GPIO pin. In Figure 3-16, the waveform created by TOU1 is output first on the selected GPIO pin when the indicated TOU1 trigger time is reached. The value in TRIG1\_CFG7 and TRIG1\_CFG8 will be added to the TOU1 trigger time and the next TOU1 output will occur at that time. Meanwhile, TOU2, will operate in the same manner; outputting its waveform at TOU2 trigger time and then outputting again at a time TRIG2\_CFG7 and TRIG2\_CFG8 later. The TRIGx\_CFG7 and 8 register values must be the same for all TOUs that are cascaded together. The number of times TOU1 and TOU2 will be output will depend on the cycle times programmed into the TRIG1\_CFG6 and TRIG2\_CFG6 registers. Care must be taken to select the correct values so as to avoid erroneous overlap.

Additional steps are required in setting up cascaded TOUs:

- Specifying which trigger output Unit in the cascade is the last Unit called the tail unit.
- The last trigger output Unit in a cascade setup should have its tail bit set to “1”.

**FIGURE 3-16: COMPLEX WAVEFORM GENERATION USING CASCADE MODE**



## 3.9 Using the GPIO Pins with the Time Stamp Input Units

The twelve time stamp input units (TSU) can be set up to capture a variety of inputs at user selectable GPIO pins. The current time of the precision time clock time will be captured and stored at the time in which the input event occurs. This section provides some information on configuring the time stamp input units. In the information below, the value “x” represents one of the twelve time stamp input units. Because this area of the device is very flexible and powerful, it is advised that you contact your Microchip representative for additional information on capturing specific types of waveforms and utilizing this feature.

### 3.9.1 TIME STAMP VALUE

Each time stamp input unit can capture two sampled values of time stamps. These first two values remain until read, even if more events occur. The time stamp value captured consists of three parts which are latched in three registers.

Sample #1, the seconds value; TSx\_SMPL1\_SH, TSx\_SMPL1\_SL

Sample #1, the nanoseconds value; TSx\_SMPL1\_NSH, TSx\_SMPL1\_NSL

Sample #1, the sub-nanoseconds value; TSx\_SMPL1\_SUB\_NS

Sample #2, the seconds value; TSx\_SMPL2\_SH, TSx\_SMPL2\_SL

Sample #2, the nanoseconds value; TSx\_SMPL2\_NSH, TSx\_SMPL2\_NSL

Sample #2, the sub-nanoseconds value; TSx\_SMPL2\_SUB\_NS

The actual value in TSx\_SMPL1/2\_SUB\_NS is a binary value of 0 through 4 which indicates 0 ns, 8 ns, 16 ns, 24 ns, or 32 ns. Note that the processor needs to add this value to the seconds and nanoseconds value to get the closest true value of the time stamp event.

- Number of Time Stamps Available

Each time stamp input unit can capture two events or two time stamps values. Note that the exception to this is TSU12. TSU12 can capture eight events and thus has eight sample time registers (SMPL1 thru SMPL8) allowing for more robust timing acquisition in one TSU. Note that the amount of samples for any given GPIO pin can be increased by cascading time stamp unit. When TSUs are cascaded, the incoming events are routed to a sequentially established order of TSUs for capture. For example, you can cascade TSU12, and TSU 1-4 to be able to capture twelve time stamps off of one GPIO pin. Cascading is set up in the TSx\_CFG registers.

- Events that can be Captured

The time stamp input units can capture rising edges and falling edges. In this case, the time stamp of the event will be captured in the Sample #1 time stamp registers. A pulse can be captured if rising edge detection is combined with falling edge detection. In this case, one edge will be captured in the Sample #1 time stamp registers and the other edge will be captured in the Sample #2 time stamp registers. This functionality is programmed in the TSx\_CFG register for each time stamp unit.

### 3.9.2 TIME STAMPING AN INCOMING LOW-GOING EDGE

- Specifying the Edge Parameters

TSx\_CFG bit[6] = “1”

- Associate this Time Stamp Unit to a Specific GPIO Pin

TSx\_CFG bits[11:8] = Selected GPIO Pin #

- Set Up Interrupts if Needed

Set the corresponding time stamp unit interrupt enable bit in the PTP\_TS\_IE register.

- Enabling the Time Stamp Unit

Set the corresponding time stamp unit enable bit in the TS\_EN register.

### 3.9.3 TIME STAMPING AN INCOMING HIGH-GOING EDGE

- Specifying the Edge Parameters

TSx\_CFG bit[7] = “1”

- Associate this Time Stamp Unit to a Specific GPIO Pin

TSx\_CFG bits[11:8] = Selected GPIO Pin #

- Set Up Interrupts if Needed

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Set the corresponding time stamp unit interrupt enable bit in the PTP\_TS\_IE register.

- Enabling the Time Stamp Unit

Set the corresponding time stamp unit enable bit in the TS\_EN register.

## 3.9.4 TIME STAMPING AN INCOMING LOW-GOING PULSE OR HIGH-GOING PULSE

- Specifying the Edge Parameters

TSx\_CFG bit[7] = “1”

TSx\_CFG bit[6] = “1”

- Associate this Time Stamp Unit to a Specific GPIO Pin

TSx\_CFG bits[11:8] = Selected GPIO Pin Number

- Set Up Interrupts if Needed

Set the corresponding time stamp unit interrupt enable bit in the PTP\_TS\_IE register.

- Enabling the Time Stamp Unit

Set the corresponding time stamp unit enable bit in the TS\_EN register.

## 3.10 Device Clocks

A 25 MHz crystal or oscillator clock is required to operate the device. This clock is used as input to a PLL clock synthesizer which generates 125 MHz, 62.5 MHz, and 31.25 MHz clocks for the KSZ8462 system timing. [Table 3-16](#) summarizes the clocking.

**TABLE 3-16: DEVICE CLOCKS AND RELATED PINS**

| Clock   | Usage   | Source  | Strapping Option |
|---------|---|---|------------------|
| 25 MHz  | Used for general system internal clocking.<br><br>Used to generate an internal 125 MHz clock for the IEEE 1588 block. | A 25 MHz crystal connected between pins X1 and X2.<br>or<br>A 25 MHz oscillator that is connected to only the X1 pin. The X2 pin is left unconnected.   | None             |
| SEEPROM | Used to clock data to or from the Serial EEPROM.  | 2.5 MHz, divided down from the 25 MHz input clock. Can also be software generated via Register 0x122 – 0x123 (EEPCR). After reset time, this is the only way to generate the clock to the Serial EEPROM for access. | —                |

Note that the clock tree power-down control register (0x038 – 0x039): CTPDC is used to power down the clocks in various areas of the device. There are no other internal register bits which control the clock generation or usage in the device.

### 3.10.1 GPIO AND IEEE 1588-RELATED CLOCKING

The GPIO and IEEE 1588-related circuits both utilize the 25 MHz clock and the derived 125 MHz clock. The tolerance and accuracy of the 25 MHz clock source will affect the IEEE 1588 jitter and offset in a system utilizing multiple slave devices. Therefore, the 25 MHz source should be chosen with care towards the performance of the application in mind. Using an oscillator will generally provide better results.

## 3.11 Power

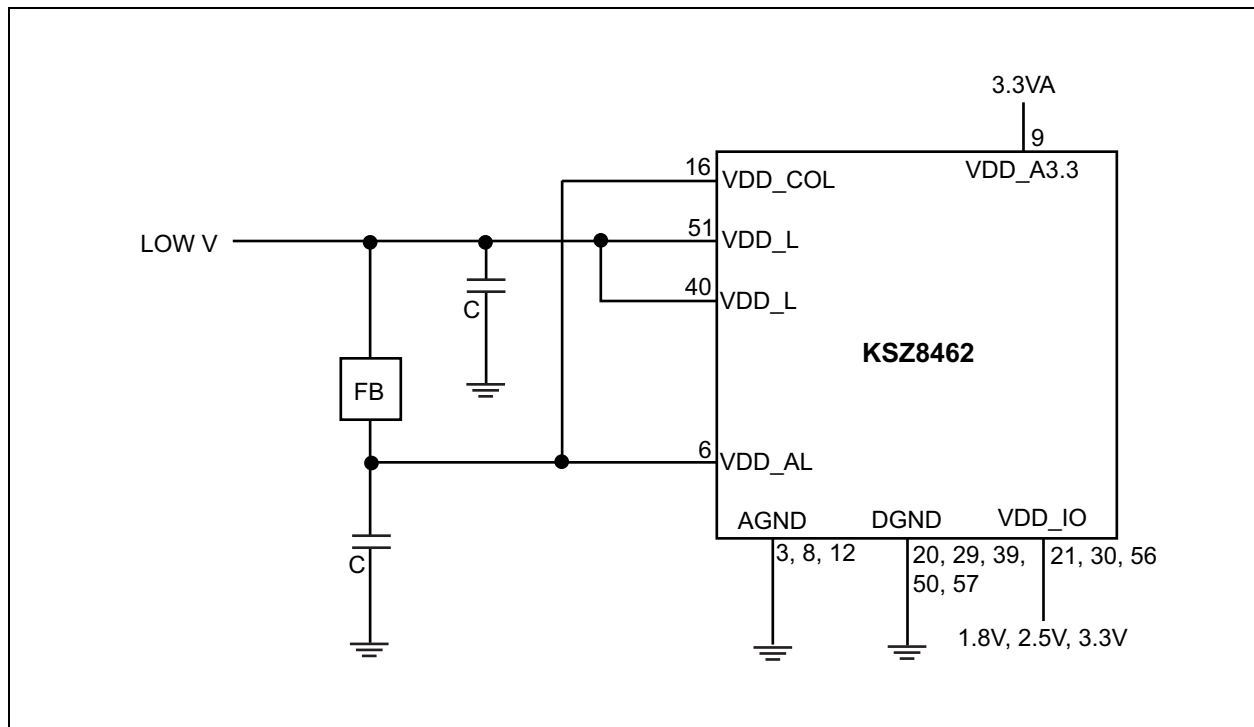
The KSZ8462 device requires a single 3.3V supply to operate. An internal low-voltage LDO provides the necessary low voltage (nominal ~1.3V) to power the analog and digital logic cores. The various I/Os can be operated at 1.8V, 2.5V, and 3.3V. [Table 3-17](#) illustrates the various voltage options and requirements of the device.

**TABLE 3-17: VOLTAGE OPTIONS AND REQUIREMENTS**

| Power Signal Name | Device Pin         | Requirement   |
|-------------------|--------------------|---|
| VDD_A3.3          | 9                  | 3.3V input power to the analog blocks in the device.  |
| VDD_IO            | 21, 30, 56         | Choice of 1.8V or 2.5V or 3.3V for the I/O circuits. These input power pins power the I/O circuitry of the device. This voltage is also used as the input to the internal low-voltage regulator.  |
| VDD_AL            | 6                  | Filtered low-voltage analog input voltage. This is where the filtered low voltage is fed back into the device to power the analog block.  |
| VDD_COL           | 16                 | Filtered low-voltage AD input voltage. This pin feeds the low voltage to the digital circuits within the analog block.  |
| VDD_L             | 40, 51             | Output of internal low-voltage LDO regulator. This voltage is available on these pins to allow connection to external capacitors and ferrite beads for filtering and power integrity. These pins must be externally connected to pins 6 and 16.<br><br>If the internal LDO regulator is turned off, these pins become power inputs. |
| AGND              | 3, 8, 12           | Analog Ground.  |
| DGND              | 20, 29, 39, 50, 57 | Digital Ground.   |

The preferred method of configuring the related low-voltage power pins when using an external low-voltage regulator is illustrated in [Figure 3-17](#). The number of capacitors, values of capacitors, and exact placement of components will depend upon the specific design.

**FIGURE 3-17: RECOMMENDED LOW-VOLTAGE POWER CONNECTION USING AN EXTERNAL LOW-VOLTAGE REGULATOR**



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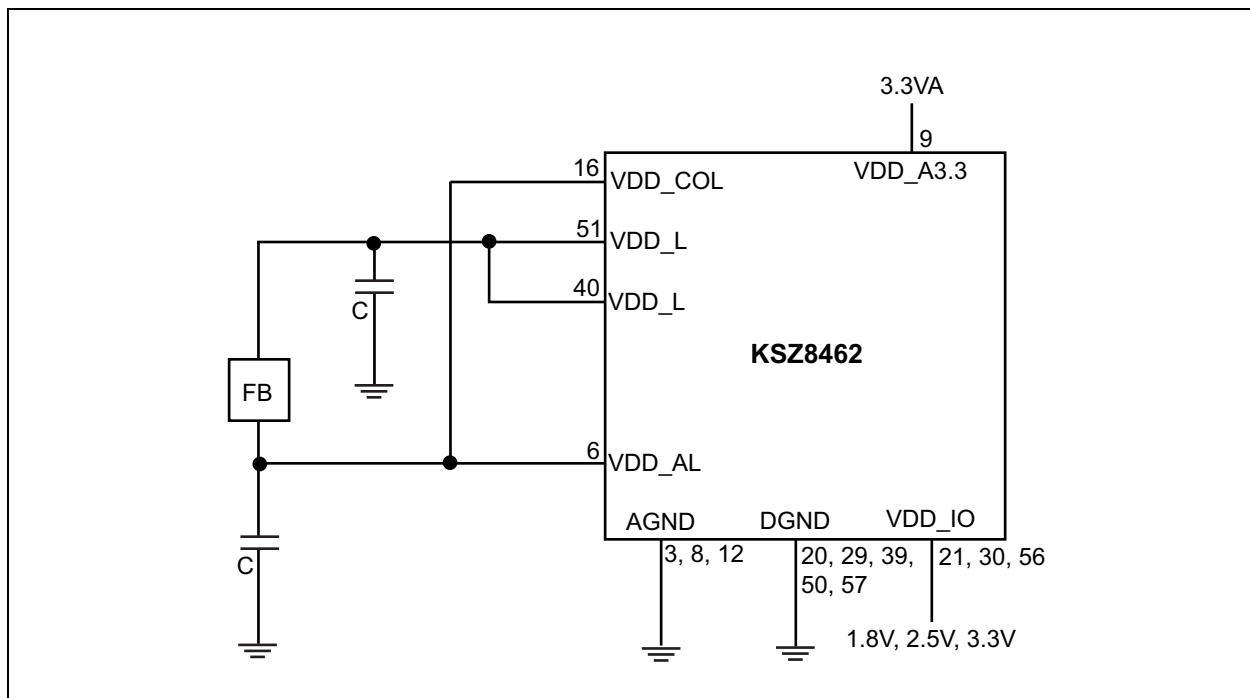
## 3.11.1 INTERNAL LOW VOLTAGE LDO REGULATOR

The KSZ8462 reduces board cost and simplifies board layout by integrating a low noise internal low-voltage LDO regulator to supply the nominal ~1.3V core power voltage for a single 3.3V power supply solution. If it is desired to take advantage of an external low-voltage supply that is available, the internal low-voltage regulator can be disabled to save power. The LDO\_Off bit, bit[7] in Register 0x748 is used to enable or disable the internal low-voltage regulator. The default state of the LDO\_Off bit is “0” which enables the internal low-voltage regulator. Turning off the internal low-voltage regulator will require software to write a “1” to that control bit. During the time from power up to setting this bit, both the external voltage supply and the internal regulator will be supplying power. Note that it is not necessary to turn off the internal low-voltage regulator. No damage will occur if it is left on. However, leaving it on will result in less than optimized power consumption.

The internal regulator takes its power from VDD\_IO, and functions best when VDD\_IO is 3.3V or 2.5V. If VDD\_IO is 1.8V, the output voltage will be somewhat decreased. For optimal performance, an external power supply, in place of the internal regulator, is recommended when VDD\_IO is 1.8V.

The preferred method of configuring the low-voltage related power pins for using the internal low-voltage regulator is illustrated in [Figure 3-18](#). The output of the internal regulator is available on pins 40 and 51 and is filtered using external capacitors and a ferrite bead to supply power to pins 6 and 16. The number of capacitors, values of capacitors, and exact placement of components will depend upon the specific design.

**FIGURE 3-18: RECOMMENDED LOW-VOLTAGE POWER CONNECTION USING THE INTERNAL LOW-VOLTAGE REGULATOR**



## 3.12 Power Management

The KSZ8462 supports enhanced power management features in low-power state with energy detection to ensure low-power dissipation during device idle periods. There are three operation modes under the power management function which is controlled by two bits in the power management control and wake-up event status register (PMCTRL, 0x032 – 0x033) as shown below:

- PMCTRL[1:0] = “00” Normal Operation Mode
- PMCTRL[1:0] = “01” Energy Detect Mode
- PMCTRL[1:0] = “10” Global Soft Power-Down Mode

The [Table 3-18](#) indicates all internal function blocks status under three different power-management operation modes.



**TABLE 3-18: POWER MANAGEMENT AND INTERNAL BLOCKS**

| KSZ8462 Function Blocks | Power Management Operation Modes |                     |                      |
|-------------------------|----------------------------------|---------------------|----------------------|
|                         | Normal Mode                      | Energy Detect Mode  | Soft Power-Down Mode |
| Internal PLL Clock      | Enabled                          | Disabled            | Disabled             |
| Tx/Rx PHYs              | Enabled                          | Energy Detect at Rx | Disabled             |
| MACs                    | Enabled                          | Disabled            | Disabled             |
| Host Interface          | Enabled                          | Disabled            | Disabled             |

### 3.12.1 NORMAL OPERATION MODE

Normal operation mode is the power management mode entered into after device power-up or after hardware reset pin 63. It is established via bits[1:0] = "00" in the PMCTRL register. When the KSZ8462 is in normal operation mode, all PLL clocks are running, PHYs and MACs are on, and the CPU is ready to read or write the KSZ8462 through host interface.

During the normal operation mode, the host CPU can change the power management mode bits[1:0] in the PMCTRL register to transition to another desired power management mode

### 3.12.2 ENERGY-DETECT MODE

Energy detect mode provides a mechanism to save more power than in normal operation mode when the KSZ8462 is not connected to an active link partner. For example, if the cable is not present or it is connected to a powered-down partner, the KSZ8462 can automatically enter the low power state in energy detect mode. Once activity resumes after attaching a cable or by a link partner attempting to establish a link, the KSZ8462 will automatically power up into the normal power state in energy detect normal power state. The energy detect mode function is not valid in fiber mode using the KSZ8462FHL.

Energy detect mode consists of two states, normal power state and low power state. While in low-power state, the KSZ8462 reduces power consumption by disabling all circuitry except the energy detect circuitry of the receiver. Energy detect mode is enabled by setting bits[1:0] = "01" in the PMCTRL register. When the KSZ8462 is in this mode, it will monitor the cable energy. If there is no energy on the cable for a time longer than a pre-configured value determined by bits[7:0] (go-sleep time) in the GST register, the device will go into the low power state. When the KSZ8462 is in low power state, it will keep monitoring the cable energy. Once energy is detected from the cable and is present for a time longer than 100 ns, the KSZ8462 will enter the normal power state.

The KSZ8462 will assert the PME output pin if the corresponding enable bit[0] is set in the PMEE register (0x034) or generate an interrupt to signal that an energy detect event has occurred if the corresponding enable bit[2] is set in the IER register (0x190). Once the local power management unit detects the PME output is asserted or that the interrupt is active, it will power up the host processor and issue a Wake-Up command which is a read cycle to read the globe reset register, GRR (0x126) to wake up the KSZ8462 from the low power state to the normal power state. When the KSZ8462 device is in the normal power state, it is able to transmit or receive packet from the cable.

### 3.12.3 GLOBAL SOFT POWER-DOWN MODE

Soft power-down mode is entered by setting bits[1:0] = "10" in PMCTRL register. When the device is in this mode, all PLL clocks are disabled, the PHYs and the MACs are off, all internal registers value will change to their default value (except the BIU, QMU registers), and the host interface is only used to wake-up this device from the current soft power-down mode to normal operation mode by setting bits[1:0] = "00" in the PMCTRL register.

Note that the registers within the QMU block will not be changed to their default values when a soft power-down is issued.

All strapping pins are sampled to latch any new values when soft power-down is disabled.

### 3.12.4 ENERGY EFFICIENT ETHERNET (EEE)

Energy Efficient Ethernet (EEE) is implemented in the KSZ8462 device as described in the IEEE 802.3AZ specification for MII operations on Port 1 and Port 2. The EEE function is not available for fiber mode ports using the KSZ8462FHL. EEE is not performed at Port 3 because that is a MAC to MAC interface and not a MAC to PHY interface. The internal connection between the MAC and PHY blocks are performed in MII mode. The details of the implementation are provided in the information that follows. The standards are defined around a MAC that supports special signaling associated with EEE. EEE saves power by keeping the voltage on the Ethernet cable at approximately 0V for as often as possible during periods of no traffic activity. This is called low-power idle (LPI) state. However, the link will respond automatically when traffic resumes and do so in such a way as to not cause blocking or dropping of any packets (the wake-

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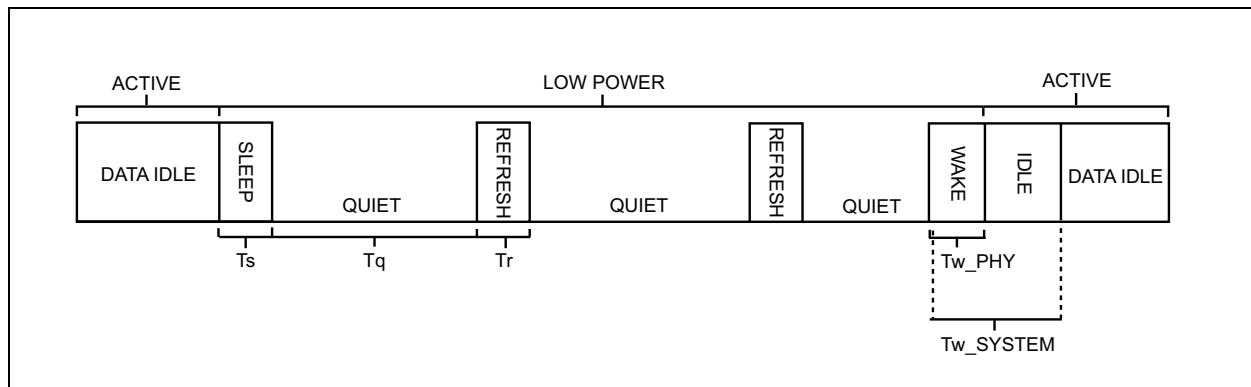
up time for 100BASE-TX is specified to be less than 30  $\mu$ s.). The transmit and receive directions are independently controlled. Note the EEE is not specified or implemented for 10BASE-T. In 10BASE-T, the transmitter is already OFF during idle periods.

The EEE feature is enabled by default. EEE is auto-negotiated independently for each direction on a link, and is enabled only if both nodes on a link support it. To disable EEE, clear the Next Page Enable bit(s) for the desired port(s) in the PCSEEEEC register (0x0F3) and restart auto-negotiation.

Based on the EEE specification, the energy savings from EEE occurs at the PHY level. However, the KSZ8462 device reduces the power consumption not only in the PHY block but also in the MAC and switch blocks by shutting down any unused clocks as much as possible when the device is at LPI state. A comprehensive LPI request on/off policy is also built-in at the switch level to determine when to issue LPI requests and when to stop the LPI request. Some software control options are provided in the device to terminate the LPI request in the early phase when certain events occur to reduce the latency impact during LPI recovery. A configurable LPI recovery time register is provided at each port to specify the recovery time (25  $\mu$ s at default) required for the KSZ8462 and its link partner before they are ready to transmit and receive a packet after going back to the normal state. For details, please refer to the KSZ8462 EEE registers (0x0E0 – 0x0F7) description.

The time during which LPI mode is active is during what is called quiet time. This is shown in [Figure 3-19](#).

**FIGURE 3-19: TRAFFIC ACTIVITY AND EEE**



## 3.12.5 TRANSMIT DIRECTION CONTROL FOR MII MODE

For ports 1 and 2, low-power idle (LPI) state for the transmit direction will be entered when the internal EEE MAC signals to its PHY to do so. The PHY will stay in the transmit LPI state as long as indicated by the MAC. The TX\_CLK is not stopped.

Even though the PHY is in LPI state, it will periodically leave the LPI state to transmit a refresh signal using specific transmit code bits. This allows the link partner to keep track of the long-term variation of channel characteristics and clock drift between the two partners. Approximately every 20 ms – 22 ms, the PHY will transmit a bit pattern to its link partner of duration 200  $\mu$ s – 220  $\mu$ s. The refresh times are listed in [Figure 3-19](#).

## 3.12.6 RECEIVE DIRECTION CONTROL FOR MII MODE

If enabled for LPI mode, upon receiving a P Code bit pattern (refresh), the PHY will enter the LPI state and signal to the internal MAC. If the PHY receives some non-P Code bit pattern, it will signal to the MAC to return to “normal frame” mode. The PHY can turn off the RX\_CLK after nine or more clocks have occurred in the LPI state.

In the EEE-compliant environment, the internal PHYs will be monitoring and expecting the P Code (refresh) bit pattern from its link partner that is generated approximately every 20 ms – 22 ms, with a duration of about 200  $\mu$ s – 220  $\mu$ s. This allows the link partner to keep track of the long term variation of channel characteristics and clock drift between the two partners.

## 3.12.7 REGISTERS ASSOCIATED WITH EEE

The following registers are used to configure or manage the EEE feature:

- Reg. DCh, DDh – P1ANPT – Port 1 Auto-Negotiation Next Page Transmit Register
- Reg. DEh, DFh – P1ALPRNP – Port 1 Auto-Negotiation Link Partner Received Next Page Register
- Reg. E0h, E1h – P1EEEE – Port 1 EEE and Link Partner Advertisement Register

- Reg. E2h, E3h – P1EEEWEC – Port 1 EEE Wake Error Count Register
- Reg. E4h, E5h – P1EEECES – Port 1 EEE Control/Status and Auto-Negotiation Expansion Register
- Reg. E6h – P1LPIRTC – Port 1 LPI Recovery Time Counter Register
- Reg. E7h – BL2LPIC1 – Buffer Load to LPI Control 1 Register
- Reg. E8h, E9h – P2ANPT – Port 2 Auto-Negotiation Next Page Transmit Register
- Reg. EAh, EBh – P2ALPRNP – Port 2 Auto-Negotiation Link Partner Received Next Page Register
- Reg. ECh, EDh – P2EEEA – Port 2 EEE and Link Partner Advertisement Register
- Reg. EEh, EFh – P2EEEWEC – Port 2 EEE Wake Error Count Register
- Reg. F0h, F1h – P2EEECES – Port 2 EEE Control/Status and Auto-Negotiation Expansion Register
- Reg. F2h – P2LPIRTC – Port 2 LPI Recovery Time Counter Register
- Reg. F3h – PCSEEEEC – PCS EEE Control Register
- Reg. F4h, F5h – ETLWTC – Empty TXQ to LPI Wait Time Control Register
- Reg. F6h, F7h – BL2LPIC2 – Buffer Load to LPI Control 2 Register

### 3.12.8 WAKE-ON-LAN

Wake-on-LAN is considered a power-management feature in that it can be used to communicate to a specific network device and tell it to “wake up” from sleep mode and be prepared to transfer data. The KSZ8462 can be programmed to notify the host of the Wake-Up detected condition. It does so by assertion of the interrupt signal pin (INTRN) or the power management event signal pin (PME). A wake-up event is a request for hardware and/or software external to the network device to put the system into a powered state (working). There are four events that will trigger the Wake-Up interrupt to occur. They are:

1. Detection of an energy signal over a pre-configured value (Indicated by bit[2] in the ISR register being set)
2. Detection of a linkup in the network link state (Indicated by bit[3] in the ISR register being set)
3. Receipt of a Magic Packet (Indicated by bit[4] in the ISR register being set)
4. Receipt of a network Wake-Up frame (Indicated by bit[5] in the ISR register being set)

There are also other types of wake-up events that are not listed here as manufacturers may choose to implement these in their own way.

#### 3.12.8.1 Direction of Energy

The energy is detected from the cable and is continuously presented for a time longer than pre-configured value, especially when this energy change may impact the level at which the system should re-enter to the normal power state.

#### 3.12.8.2 Detection of Linkup

Link status wake events are useful to indicate a linkup in the network's connectivity status.

#### 3.12.8.3 Wake-Up Packet

Wake-up packets are certain types of packets with specific CRC values that a system recognizes as a 'Wake-Up' frame. The KSZ8462 supports up to four user defined wake-up frames shown below:

- Wake-up frame 0 is defined in Wake-Up frame registers (0x130 – 0x13B) and is enabled by bit [0] in the Wake-Up frame register (0x12A).
- Wake-up frame 1 is defined in wake-up frame registers (0x140 – 0x14B) and is enabled by bit [1] in the Wake-Up frame register (0x12A).
- Wake-up frame 2 is defined in wake-up frame registers (0x150 – 0x15B) and is enabled by bit [2] in the Wake-Up frame register (0x12A).
- Wake-up frame 3 is defined in wake-up frame registers (0x160 – 0x16B) and is enabled by bit [3] in the Wake-Up frame register (0x12A).

#### 3.12.8.4 Magic Packet™

Magic Packet (MP) technology is used to remotely wake up a sleeping or powered-off PC on a LAN. This is accomplished by sending a specific packet of information, called an MP frame, to a node on the network. When a PC capable of receiving the specific frame goes to sleep, it enables the MP RX mode in the LAN controller, and when the LAN controller receives a MP frame, the LAN controller will alert the system to wake up.

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MP is a standard feature integrated into the KSZ8462. The controller implements multiple advanced power-down modes including MP to conserve power and operate more efficiently. Once the KSZ8462 has been put into MP enable mode (WFCR[7] = "1"), it scans all incoming frames addressed to the node for a specific data sequence, which indicates to the controller this is a MP frame.

The specific sequence consists of 16 duplications of the IEEE address of this node, with no breaks or interruptions. This sequence can be located anywhere within the packet, but must be preceded by a synchronization stream. The synchronization stream allows the scanning state machine to be much simpler. The synchronization stream is defined as 6 bytes of FFh. The device will also accept a broadcast frame, as long as the 16 duplications of the IEEE address match the address of the machine to be awakened.

Example:

If the IEEE address for a particular node on a network is 11h 22h, 33h, 44h, 55h, 66h, the LAN controller would be scanning for the data sequence (assuming an Ethernet frame):

DESTINATION SOURCE – MISC - FF FF FF FF FF FF - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - 11 22 33 44 55 66 - MISC - CRC.

There are no further restrictions on an MP frame. For example, the sequence could be in a TCP/IP packet or an IPX packet. The frame may be bridged or routed across the network without affecting its ability to wake-up a node at the frame's destination.

If the LAN controller scans a frame and does not find the specific sequence shown above, it discards the frame and takes no further action. If the KSZ8462 controller detects the data sequence, however, it then alerts the PC's power management circuitry (assert the PME pin) to wake up the system.

## 3.12.9 INTERRUPT GENERATION ON POWER MANAGEMENT-RELATED EVENTS

There are two ways an interrupt can be generated to the host whenever a power management related event takes place. The resulting interrupts are via the PME signal pin or via the INTRN signal pin. The usage is described in the following sub-sections:

### 3.12.9.1 To Generate an Interrupt on the PME Signal Pin

The PMEE register (0x034 – 0x035) contains the bits needed to control generating an interrupt on the PME signal pin whenever specific power management related events occur. The power management events controlled by this register includes detection of a Wake-Up frame, detection of a MP, detection that the link has changed state, and detection of energy on the Ethernet lines.

### 3.12.9.2 To Generate an Interrupt on the INTRN Signal Pin

The IER register (0x190 – 0x191) contains the bits needed to control generating an interrupt on the INTRN signal pin whenever specific power management related events occur. The power management events controlled by this register includes detection of a wake-up from a link state change and wake-up from detection of energy on the Ethernet lines.

## 3.13 Interfaces

The KSZ8462 device incorporates a number of interfaces to enable it to be designed into a standard network environment as well as a vendor unique environment. The available interfaces and details of each usage are provided in [Table 3-19](#).

**TABLE 3-19: AVAILABLE INTERFACES**

| Interface     | Type                              | Usage  | Registers Accessed |
|---------------|-----------------------------------|--|--------------------|
| Host Bus      | Configuration and Data Flow       | Provides a path for network data to be transferred to and from the host processor.<br>Provides in-band communication between a host processor and the KSZ8462 device for configuration, control, and monitoring. | All                |
| Serial EEPROM | Configuration and Register Access | Device can access the Serial EEPROM to load the MAC Address at power-up.<br>In addition, the remainder of EEPROM space can be written or read and used as needed by the host.                                    | 110h - 115h        |
| PHY           | Data Flow                         | Interface to the two internal PHY devices.   | N/A                |

## 3.13.1 BUS INTERFACE UNIT (BIU)/HOST INTERFACE

The BIU manages the host interface which is a generic indirect data bus interface, and is designed to communicate with embedded processors. Typically, no glue logic is required when interfacing to standard asynchronous buses and processors.

### 3.13.1.1 Supported Transfers

The BIU can support asynchronous transfers in SRAM-like slave mode. To support the data transfers, the BIU provides a group of signals as shown in Table 3-20. These signals are SD[15:0], CMD, CSN, RDN, WRN, and INTRN. Note that it is intended that the CSN signal be driven by logic within the host processor or by some external logic which decode the base address so the KSZ8462 device does not have to do address range decoding.

### 3.13.1.2 Physical Data Bus Size

The BIU supports an 8-bit or 16-bit host standard data bus. Depending on the size of the physical data bus, the KSZ8462 can support 8-bit or 16-bit data transfers.

For a 16-bit data bus mode, the KSZ8462 allows an 8-bit and 16-bit data transfer.

For an 8-bit data bus mode, the KSZ8462 only allows an 8-bit data transfer.

The KSZ8462 supports internal data byte-swapping. This means that the system/host data bus HD[7:0] connects to SD[7:0] for an 8-bit data bus interface. For a 16-bit data bus, the system/host data bus HD[15:8] and HD[7:0] connects to SD[15:8] and SD[7:0] respectively.

**TABLE 3-20: BUS INTERFACE UNIT SIGNAL GROUPING**

| Signal   | Type  | Function  |
|----------|-------|---|
| SD[15:0] | I/O   | <b>Shared Data Bus</b> <ul style="list-style-type: none"> <li>16-bit Mode &amp; CMD = "0" <ul style="list-style-type: none"> <li>SD[15:0] = D[15:0] data</li> </ul> </li> <li>16-bit Mode &amp; CMD = "1": <ul style="list-style-type: none"> <li>SD[10:2] = A[10:2] Address</li> <li>SD[15:12] = BE[3:0] Byte enable</li> <li>SD[1:0] and SD[11] are not used</li> </ul> </li> <li>8-bit Mode &amp; CMD = "0" <ul style="list-style-type: none"> <li>SD[7:0] = D[7:0] data</li> </ul> </li> <li>8-bit Mode &amp; CMD = "1" <ul style="list-style-type: none"> <li>SD[7:0] = A[7:0] = 1st address access</li> <li>SD[2:0] = A[10:8] = 2nd address access</li> <li>SD[7:3] = Not used during 2nd address access</li> </ul> </li> </ul> |
| CMD      | Input | <b>Command Type</b><br>This command input determines the SD[15:0] shared data bus access cycle information.<br>0: Data access<br>1: Command access for address and byte enable  |

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**TABLE 3-20: BUS INTERFACE UNIT SIGNAL GROUPING (CONTINUED)**

| Signal | Type   | Function  |
|--------|--------|---|
| CSN    | Input  | <b>Chip Select</b><br>Chip Select is an active low signal used to enable the shared data bus access.  |
| INTRN  | Output | <b>Interrupt</b><br>This low active signal is asserted low when an interrupt is being requested.  |
| RDN    | Input  | <b>Asynchronous Read</b><br>This low active signal is asserted low during a read cycle.<br>A 4.7 k $\Omega$ pull-up resistor is recommended on this signal. |
| WRN    | Input  | <b>Asynchronous Write</b><br>This low active signal is asserted low during a write cycle.   |

## 3.13.1.3 Little- and Big-Endian Support

The KSZ8462 supports either Little-Endian or Big-Endian processors. The external strap pin 62 (P2LED0) is used to select between the two modes. The KSZ8462 host interface operates in Little-Endian mode if this pin is pulled up during reset, or in Big-Endian mode if this pin is pulled down during reset. If there is no external load on pin 62 during reset, it will be pulled up by its internal pull-up resistor, placing the interface into Little-Endian mode.

Bit [11] (Endian mode selection) in RXFDPR register can be used to program either Little-Endian mode (bit [11] = “0”) or Big-Endian mode (bit [11] = “1”). Changes to this register bit will over-ride the pin 62 strap-in selection. Software in the host processor must take care to avoid unintentionally changing bit [11] when writing to register RXFDPR.

## 3.13.1.4 Asynchronous Interface

For asynchronous transfers, the asynchronous interface uses RDN (read) or WRN (write) signal strobe for data latching. The host utilizes the rising edge of RDN to latch read data and the KSZ8462 will use the falling edge of WRN to latch write data.

All asynchronous transfers are either single-data or burst-data transfers. Byte or word data bus access (transfers) is supported. The BIU, however, provides flexible asynchronous interfacing to communicate with various applications and architectures. No additional address latch is required. The BIU qualifies both chip select (CSN) pin and write enable (WRN) pin to write the Address A[10:2] and BE[3:0] value (in 16-bit mode) or Address A[10:0] value (in 8-bit mode with two write accesses) into KSZ8462 when CMD (Command type) pin is high. The BIU qualifies the CSN pin as well as the read enable (RDN) or write enable (WRN) pin to read or write the SD[15:0] (16-bit mode) or SD[7:0] (8-bit mode) data value from or to KSZ8462 when command type (CMD) pin is low.

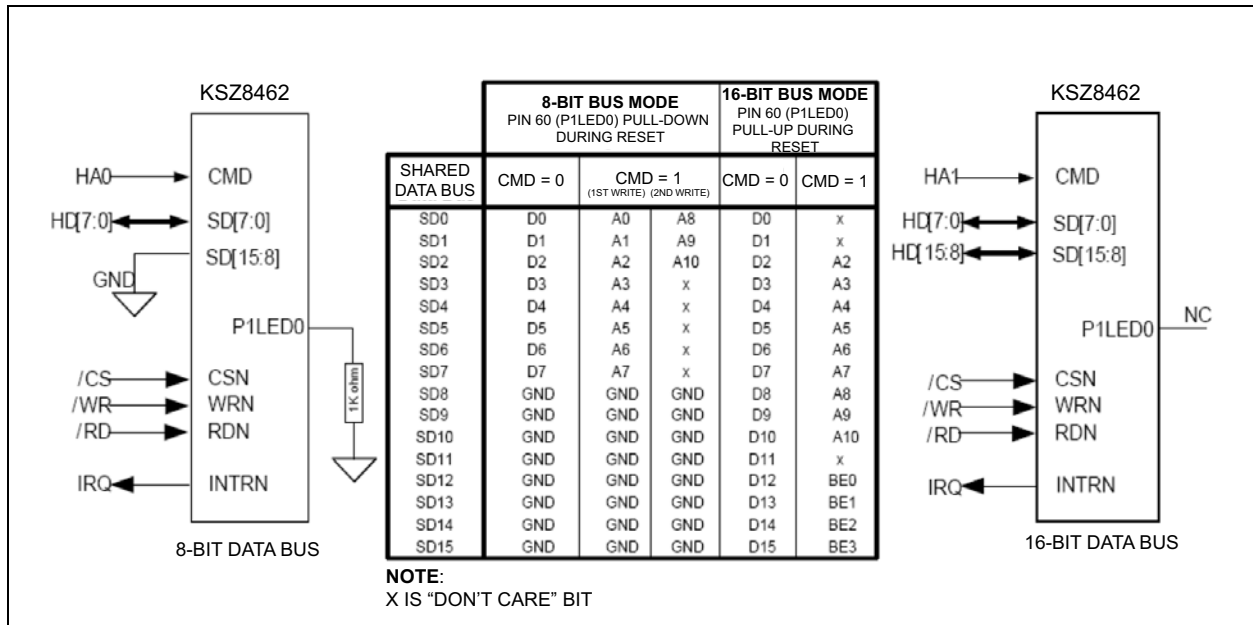
In order for software to read back the previous CMD register write value when CMD is “1”, the BIU qualifies both the CSN pin and the RDN pin to read the Address A[10:2] and BE[3:0] value (in 16-bit mode) back from the KSZ8462 when CMD pin is high. Reading back the addresses in 8-bit mode is not a valid operation.

## 3.13.1.5 BIU Summary

Figure 3-20 shows the connection for different data bus sizes.

All of control and status registers in the KSZ8462 are accessed indirectly depending on CMD pin. The command sequence to access the specified control or status register is to write the register’s address (when CMD = “1”) then read or write this register data (when CMD = “0”). If both RDN and WRN signals in the system are only used for KSZ8462, the CSN pin can be forced to active low to simplify the system design. The CMD pin can be connected to host address line HA[0] for 8-bit bus mode or HA[1] for 16-bit bus mode.

**FIGURE 3-20: KSZ8462 8-BIT AND 16-BIT DATA BUS CONNECTIONS**



Example:

Assume that the register space is located at an external I/O base address of 0x0300, a 16-bit data path is used, and it is desired to read two bytes of data from address 0xD0:

- External address decoding should decode the 0x0300 base address and create a signal for the CSN pin.
- The host address line 1 (HA[1]) is connected to the CMD input pin. For a host write to the device, the HA[1] being asserted will make CMD = "1" which will indicate that the data on the DS[15:0] bus are address and byte enable bits.
- The address bits A[10:2] are on SD[10:2].
- Write a value of 0x30D0 (register offset of 0xD0 with BE[1:0] (set on the SD[16:0] bus) to address 0x0302. (This sets up the address for the upcoming read operation by writing the desired destination address to be read.)
- Read the value from address 0x0300 with HA[1] = 0 (CMD = "0"). The CSN pin is driven again by the decode of the base address of 0x0300.

### 3.13.2 SERIAL EEPROM INTERFACE

A serial EEPROM interface has been incorporated into the device to enable loading the MAC address into the device at power-up time with a value from an external serial EEPROM. This feature is turned on using a strapping option on pin 46. At power-up time, the voltage on pin 46 is sampled. If the voltage is found to be high, the first seven words of the serial EEPROM will be read. Registers 0x110 – 0x115 will be loaded with words 01h – 03h.

A pull-up resistor is connected to pin 46 to create a high state at power-up time (see Strapping Options). After the de-assertion of RSTN, the KSZ8462 reads in the seven words of data. Note that a 3-wire 1Kbit serial EEPROM utilizing 7-bit addresses must be used. Other size options will not function correctly. A 93C46 or equivalent type device meets these requirements. The EEPROM must be organized in 16-bit mode.

The serial EEPROM interface signals are muxed with three of the GPIO signals on pins 53, 54, and 55. Register 0x0D6 – 0x0D7 bits[1, 2, 5] are used to select between the serial EEPROM function or the GPIO function. The default state of that register at power up is to configure the pins for serial EEPROM usage.

If the EEDIO pin (pin 54) is pulled high, then the KSZ8462 performs an automatic read of words 0h - 6h in the external EEPROM after the de-assertion of reset. The EEPROM values are placed in certain host-accessible registers. EEPROM read/write functions can also be performed by software read/writes to the EEPCR (0x122) registers.

A sample of the KSZ8462 EEPROM format is shown in [Table 3-21](#).

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**TABLE 3-21: SERIAL EEPROM FORMAT**

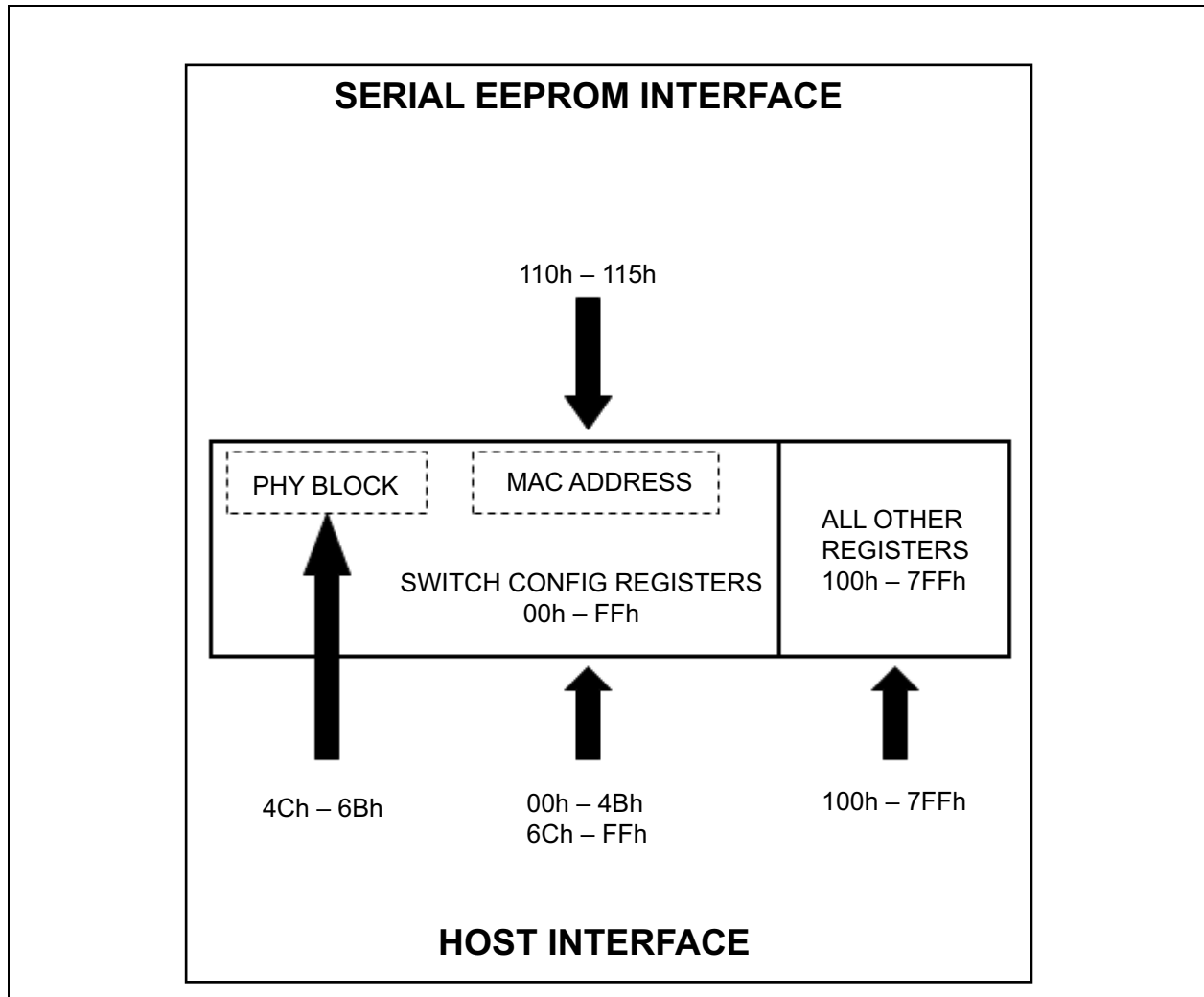
| Word     | 15:8   | 7:0                     |
|----------|--|-------------------------|
| 0h       | Reserved   |                         |
| 1h       | Host MAC Address Byte 2  | Host MAC Address Byte 1 |
| 2h       | Host MAC Address Byte 4  | Host MAC Address Byte 3 |
| 3h       | Host MAC Address Byte 6  | Host MAC Address Byte 5 |
| 4h - 6h  | Reserved   |                         |
| 7h - 3Fh | Not used for the KSZ8462 (Available for user-defined purposes) |                         |



## 4.0 REGISTER DESCRIPTIONS

The KSZ8462 device has a rich set of registers available to manage the functionality of the device. Access to these registers is via the host interface (BIU). The device can be programmed to automatically load register locations 0x110 – 0x115 with a MAC address stored in Word locations 01h – 03h in an external serial EEPROM. [Figure 4-1](#) provides a global picture of accessibility via the various interfaces and addressing ranges from the perspective of each interface.

**FIGURE 4-1: INTERFACE AND REGISTER MAPPING**



The registers within the linear 0x000 – 0x7FF address space are all accessible via the host interface bus by a microprocessor or CPU. The mapping of the various functions within that linear address space is summarized in [Table 4-1](#).

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**TABLE 4-1: MAPPING OF FUNCTIONAL AREAS WITHIN THE ADDRESS SPACE**

| Register Locations | Device Area  | Description   |
|--------------------|--|---|
| 0x000 – 0x0FF      | Switch Control and Configuration                         | Registers which control the overall functionality of the Switch, MAC, and PHYs  |
| 0x026 – 0x031      | Indirect Access Registers                                | Registers used to indirectly address and access four distinct areas within the device. <ul style="list-style-type: none"><li>• Management Information Base (MIB) Counters</li><li>• Static MAC Address Table</li><li>• Dynamic MAC Address Table</li><li>• VLAN Table</li></ul> |
| 0x044 – 0x06B      | PHY1 and PHY2 Registers                                  | The same PHY registers as specified in IEEE 802.3 specification   |
| 0x100 – 0x16F      | Interrupts, Global Reset, BIU                            | Registers and bits associated with interrupts, global reset, and the BIU  |
| 0x170 – 0x1FF      | QMU  | Registers and bits associated with the QMU  |
| 0x200 – 0x5FF      | IEEE 1588 PTP Event Trigger Control and Output Registers | Registers used to configure and use the IEEE 1588 trigger functions   |
| 0x600 – 0x7FF      | IEEE 1588 PTP Clock and Global Control                   | Registers that control the IEEE PTP Clock Control, Port Egress, Messaging, Port Ingress/Egress time stamp attributes  |

## 4.1 Register Map of CPU Accessible I/O Registers

The registers in the address range 00h through 7FFh can be read or written by a local CPU attached to the host interface. If enabled, registers 0x110 – 0x115 can be loaded at power on time by contents in the serial EEPROM. These registers are used for configuring the MAC address of the device.

### 4.1.1 I/O REGISTERS

- The following I/O register space mapping table applies to 8-bit or 16-bit locations. Depending upon the mode selected, each I/O access can be performed using 8-bit or 16-bit wide transfers.

**TABLE 4-2: INTERNAL I/O REGISTER SPACE MAPPING FOR SWITCH CONTROL AND CONFIGURATION (0X000 – 0X0FF)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description                             |
|------------------------------|----------------|-----------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                       |               |   |
| 0x000 – 0x001                | 0x000<br>0x001 | CIDER                 | 0x8433        | Chip ID and Enable Register [15:0]      |
| 0x002 – 0x003                | 0x002<br>0x003 | SGCR1                 | 0x3450        | Switch Global Control Register 1 [15:0] |
| 0x004 – 0x005                | 0x004<br>0x005 | SGCR2                 | 0x00F0        | Switch Global Control Register 2 [15:0] |
| 0x006 – 0x007                | 0x006<br>0x007 | SGCR3                 | 0x6320        | Switch Global Control Register 3 [15:0] |
| 0x008 – 0x00B                | 0x008<br>0x00B | Reserved<br>(4-Bytes) | Don't Care    | None                                    |
| 0x00C – 0x00D                | 0x00C<br>0x00D | SGCR6                 | 0xFA50        | Switch Global Control Register 6 [15:0] |
| 0x00E – 0x00F                | 0x00E<br>0x00F | SGCR7                 | 0x0827        | Switch Global Control Register 7 [15:0] |
| 0x010 – 0x011                | 0x010<br>0x011 | MACAR1                | 0x0010        | MAC Address Register 1 [15:0]           |

**TABLE 4-2: INTERNAL I/O REGISTER SPACE MAPPING FOR SWITCH CONTROL AND CONFIGURATION (0X000 – 0X0FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description   |
|------------------------------|----------------|------------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                        |               |   |
| 0x012 – 0x013                | 0x012<br>0x013 | MACAR2                 | 0xA1FF        | MAC Address Register 2 [15:0]                                     |
| 0x014 – 0x015                | 0x014<br>0x015 | MACAR3                 | 0xFFFF        | MAC Address Register 3 [15:0]                                     |
| 0x016 – 0x017                | 0x016<br>0x017 | TOSR1                  | 0x0000        | TOS Priority Control Register 1 [15:0]                            |
| 0x018 – 0x019                | 0x018<br>0x019 | TOSR2                  | 0x0000        | TOS Priority Control Register 2 [15:0]                            |
| 0x01A – 0x01B                | 0x01A<br>0x01B | TOSR3                  | 0x0000        | TOS Priority Control Register 3 [15:0]                            |
| 0x01C – 0x01D                | 0x01C<br>0x01D | TOSR4                  | 0x0000        | TOS Priority Control Register 4 [15:0]                            |
| 0x01E – 0x01F                | 0x01E<br>0x01F | TOSR5                  | 0x0000        | TOS Priority Control Register 5 [15:0]                            |
| 0x020 – 0x021                | 0x020<br>0x021 | TOSR6                  | 0x0000        | TOS Priority Control Register 6 [15:0]                            |
| 0x022 – 0x023                | 0x022<br>0x023 | TOSR7                  | 0x0000        | TOS Priority Control Register 7 [15:0]                            |
| 0x024 – 0x025                | 0x024<br>0x025 | TOSR8                  | 0x0000        | TOS Priority Control Register 8 [15:0]                            |
| 0x026 – 0x027                | 0x026<br>0x027 | IADR1                  | 0x0000        | Indirect Access Data Register 1 [15:0]                            |
| 0x028 – 0x029                | 0x028<br>0x029 | IADR2                  | 0x0000        | Indirect Access Data Register 2 [15:0]                            |
| 0x02A – 0x02B                | 0x02A<br>0x02B | IADR3                  | 0x0000        | Indirect Access Data Register 3 [15:0]                            |
| 0x02C – 0x02D                | 0x02C<br>0x02D | IADR4                  | 0x0000        | Indirect Access Data Register 4 [15:0]                            |
| 0x02E – 0x02F                | 0x02E<br>0x02F | IADR5                  | 0x0000        | Indirect Access Data Register 5 [15:0]                            |
| 0x030 – 0x031                | 0x030<br>0x031 | IACR                   | 0x0000        | Indirect Access Control Register [15:0]                           |
| 0x032 – 0x033                | 0x032<br>0x033 | PMCTRL                 | 0x0000        | Power Management Control and Wake-up Event Status Register [15:0] |
| 0x034 – 0x035                | 0x034<br>0x035 | PMEE                   | 0x0000        | Power Management Event Enable Register [15:0]                     |
| 0x036 – 0x037                | 0x036<br>0x037 | GST                    | 0x008E        | Go Sleep Time Register [15:0]                                     |
| 0x038 – 0x039                | 0x038<br>0x039 | CTPDC                  | 0x0000        | Clock Tree Power Down Control Register [15:0]                     |
| 0x03A – 0x04B                | 0x03A<br>0x04B | Reserved<br>(18-Bytes) | Don't Care    | None  |
| 0x04C – 0x04D                | 0x04C<br>0x04D | P1MBCR                 | 0x3120        | PHY 1 and MII Basic Control Register [15:0]                       |
| 0x04E – 0x04F                | 0x04E<br>0x04F | P1MBSR                 | 0x7808        | PHY 1 and MII Basic Status Register [15:0]                        |

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**TABLE 4-2: INTERNAL I/O REGISTER SPACE MAPPING FOR SWITCH CONTROL AND CONFIGURATION (0X000 – 0X0FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description   |
|------------------------------|----------------|-----------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                       |               |   |
| 0x050 – 0x051                | 0x050<br>0x051 | PHY1ILR               | 0x1430        | PHY 1 PHYID Low Register [15:0]                             |
| 0x052 – 0x053                | 0x052<br>0x053 | PHY1IHR               | 0x0022        | PHY 1 PHYID High Register [15:0]                            |
| 0x054 – 0x055                | 0x054<br>0x055 | P1ANAR                | 0x05E1        | PHY 1 Auto-Negotiation Advertisement Register [15:0]        |
| 0x056 – 0x057                | 0x056<br>0x057 | P1ANLPR               | 0x0001        | PHY 1 Auto-Negotiation Link Partner Ability Register [15:0] |
| 0x058 – 0x059                | 0x058<br>0x059 | P2MBCR                | 0x3120        | PHY 2 and MII Basic Control Register [15:0]                 |
| 0x05A – 0x05B                | 0x05A<br>0x05B | P2MBSR                | 0x7808        | PHY 2 and MII Basic Status Register [15:0]                  |
| 0x05C – 0x05D                | 0x05C<br>0x05D | PHY2ILR               | 0x1430        | PHY 2 PHYID Low Register [15:0]                             |
| 0x05E – 0x05F                | 0x05E<br>0x05F | PHY2IHR               | 0x0022        | PHY 2 PHYID High Register [15:0]                            |
| 0x060 – 0x061                | 0x060<br>0x061 | P2ANAR                | 0x05E1        | PHY 2 Auto-Negotiation Advertisement Register [15:0]        |
| 0x062 – 0x063                | 0x062<br>0x063 | P2ANLPR               | 0x0001        | PHY 2 Auto-Negotiation Link Partner Ability Register [15:0] |
| 0x064 – 0x065                | 0x064<br>0x065 | Reserved<br>(2-Bytes) | Don't Care    | None  |
| 0x066 – 0x067                | 0x066<br>0x067 | P1PHYCTRL             | 0x0004        | PHY 1 Special Control and Status Register [15:0]            |
| 0x068 – 0x069                | 0x068<br>0x069 | Reserved<br>(2-Bytes) | Don't Care    | None  |
| 0x06A – 0x06B                | 0x06A<br>0x06B | P2PHYCTRL             | 0x0004        | PHY2 Special Control and Status Register [15:0]             |
| 0x06C – 0x06D                | 0x06C<br>0x06D | P1CR1                 | 0x0000        | Port 1 Control Register 1 [15:0]                            |
| 0x06E – 0x06F                | 0x06E<br>0x06F | P1CR2                 | 0x0607        | Port 1 Control Register 2 [15:0]                            |
| 0x070 – 0x071                | 0x070<br>0x071 | P1VIDCR               | 0x0001        | Port 1 VID Control Register [15:0]                          |
| 0x072 – 0x073                | 0x072<br>0x073 | P1CR3                 | 0x0000        | Port 1 Control Register 3 [15:0]                            |
| 0x074 – 0x075                | 0x074<br>0x075 | P1IRCR0               | 0x0000        | Port 1 Ingress Rate Control Register 0 [15:0]               |
| 0x076 – 0x077                | 0x076<br>0x077 | P1IRCR1               | 0x0000        | Port 1 Ingress Rate Control Register 1 [15:0]               |
| 0x078 – 0x079                | 0x078<br>0x079 | P1ERCR0               | 0x0000        | Port 1 Egress Rate Control Register 0 [15:0]                |
| 0x07A – 0x07B                | 0x07A<br>0x07B | P1ERCR1               | 0x0000        | Port 1 Egress Rate Control Register 1 [15:0]                |
| 0x07C – 0x07D                | 0x07C<br>0x07D | P1SCSLMD              | 0x0400        | Port 1 PHY Special Control/Status, LinkMD Register [15:0]   |

**TABLE 4-2: INTERNAL I/O REGISTER SPACE MAPPING FOR SWITCH CONTROL AND CONFIGURATION (0X000 – 0X0FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description   |
|------------------------------|----------------|-----------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                       |               |   |
| 0x07E – 0x07F                | 0x07E<br>0x07F | P1CR4                 | 0x00FF        | Port 1 Control Register 4 [15:0]                          |
| 0x080 – 0x081                | 0x080<br>0x081 | P1SR                  | 0x8000        | Port 1 Status Register [15:0]                             |
| 0x082 – 0x083                | 0x082<br>0x083 | Reserved<br>(2-Bytes) | Don't Care    | None  |
| 0x084 – 0x085                | 0x084<br>0x085 | P2CR1                 | 0x0000        | Port 2 Control Register 1 [15:0]                          |
| 0x086 – 0x087                | 0x086<br>0x087 | P2CR2                 | 0x0607        | Port 2 Control Register 2 [15:0]                          |
| 0x088 – 0x089                | 0x088<br>0x089 | P2VIDCR               | 0x0001        | Port 2 VID Control Register [15:0]                        |
| 0x08A – 0x08B                | 0x08A<br>0x08B | P2CR3                 | 0x0000        | Port 2 Control Register 3 [15:0]                          |
| 0x08C – 0x08D                | 0x08C<br>0x08D | P2IRCR0               | 0x0000        | Port 2 Ingress Rate Control Register 0 [15:0]             |
| 0x08E – 0x08F                | 0x08E<br>0x08F | P2IRCR1               | 0x0000        | Port 2 Ingress Rate Control Register 1 [15:0]             |
| 0x090 – 0x091                | 0x090<br>0x091 | P2ERCR0               | 0x0000        | Port 2 Egress Rate Control Register 0 [15:0]              |
| 0x092 – 0x093                | 0x092<br>0x093 | P2ERCR1               | 0x0000        | Port 2 Egress Rate Control Register 1 [15:0]              |
| 0x094 – 0x095                | 0x094<br>0x095 | P2SCSLMD              | 0x0400        | Port 2 PHY Special Control/Status, LinkMD Register [15:0] |
| 0x096 – 0x097                | 0x096<br>0x097 | P2CR4                 | 0x00FF        | Port 2 Control Register 4 [15:0]                          |
| 0x098 – 0x099                | 0x098<br>0x099 | P2SR                  | 0x8000        | Port 2 Status Register [15:0]                             |
| 0x09A – 0x09B                | 0x09A<br>0x09B | Reserved<br>(2-Bytes) | Don't Care    | None  |
| 0x09C – 0x09D                | 0x09C<br>0x09D | P3CR1                 | 0x0000        | Port 3 Control Register 1 [15:0]                          |
| 0x09E – 0x09F                | 0x09E<br>0x09F | P3CR2                 | 0x0607        | Port 3 Control Register 2 [15:0]                          |
| 0x0A0 – 0x0A1                | 0x0A0<br>0x0A1 | P3VIDCR               | 0x0001        | Port 3 VID Control Register [15:0]                        |
| 0x0A2 – 0x0A3                | 0x0A2<br>0x0A3 | P3CR3                 | 0x0000        | Port 3 Control Register 3 [15:0]                          |
| 0x0A4 – 0x0A5                | 0x0A4<br>0x0A5 | P3IRCR0               | 0x0000        | Port 3 Ingress Rate Control Register 0 [15:0]             |
| 0x0A6 – 0x0A7                | 0x0A6<br>0x0A7 | P3IRCR1               | 0x0000        | Port 3 Ingress Rate Control Register 1 [15:0]             |
| 0x0A8 – 0x0A9                | 0x0A8<br>0x0A9 | P3ERCR0               | 0x0000        | Port 3 Egress Rate Control Register 0 [15:0]              |
| 0x0AA – 0x0AB                | 0x0AA<br>0x0AB | P3ERCR1               | 0x0000        | Port 3 Egress Rate Control Register 1 [15:0]              |

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**TABLE 4-2: INTERNAL I/O REGISTER SPACE MAPPING FOR SWITCH CONTROL AND CONFIGURATION (0X000 – 0X0FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description   |
|------------------------------|----------------|------------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                        |               |   |
| 0x0AC – 0x0AD                | 0x0AC<br>0x0AD | SGCR8                  | 0x8000        | Switch Global Control Register 8 [15:0]                                 |
| 0x0AE – 0x0AF                | 0x0AE<br>0x0AF | SGCR9                  | 0x0000        | Switch Global Control Register 9 [15:0]                                 |
| 0x0B0 – 0x0B1                | 0x0B0<br>0x0B1 | SAFMACA1L              | 0x0000        | Source Address Filtering MAC Address 1 Register Low [15:0]              |
| 0x0B2 – 0x0B3                | 0x0B2<br>0x0B3 | SAFMACA1M              | 0x0000        | Source Address Filtering MAC Address 1 Register Middle [15:0]           |
| 0x0B4 – 0x0B5                | 0x0B4<br>0x0B5 | SAFMACA1H              | 0x0000        | Source Address Filtering MAC Address 1 Register High [15:0]             |
| 0x0B6 – 0x0B7                | 0x0B6<br>0x0B7 | SAFMACA2L              | 0x0000        | Source Address Filtering MAC Address 2 Register Low [15:0]              |
| 0x0B8 – 0x0B9                | 0x0B8<br>0x0B9 | SAFMACA2M              | 0x0000        | Source Address Filtering MAC Address 2 Register Middle [15:0]           |
| 0x0BA – 0x0BB                | 0x0BA<br>0x0BB | SAFMACA2H              | 0x0000        | Source Address Filtering MAC Address 2 Register High [15:0]             |
| 0x0BC – 0x0C7                | 0x0BC<br>0x0C7 | Reserved<br>(12-Bytes) | Don't Care    | None  |
| 0x0C8 – 0x0C9                | 0x0C8<br>0x0C9 | P1TXQRCR1              | 0x8488        | Port 1 TXQ Rate Control Register 1 [15:0]                               |
| 0x0CA – 0x0CB                | 0x0CA<br>0x0CB | P1TXQRCR2              | 0x8182        | Port 1 TXQ Rate Control Register 2 [15:0]                               |
| 0x0CC – 0x0CD                | 0x0CC<br>0x0CD | P2TXQRCR1              | 0x8488        | Port 2 TXQ Rate Control Register 1 [15:0]                               |
| 0x0CE – 0x0CF                | 0x0CE<br>0x0CF | P2TXQRCR2              | 0x8182        | Port 2 TXQ Rate Control Register 2 [15:0]                               |
| 0x0D0 – 0x0D1                | 0x0D0<br>0x0D1 | P3TXQRCR1              | 0x8488        | Port 3 TXQ Rate Control Register 1 [15:0]                               |
| 0x0D2 – 0x0D3                | 0x0D2<br>0x0D3 | P3TXQRCR2              | 0x8182        | Port 3 TXQ Rate Control Register 2 [15:0]                               |
| 0x0D4 – 0x0D5                | 0x0D4<br>0x0D5 | Reserved<br>(2-Bytes)  | Don't Care    | None  |
| 0x0D6 – 0x0D7                | 0x0D6<br>0x0D7 | IOMXSEL                | 0x0FFF        | Input and Output Multiplex Selection Register [15:0]                    |
| 0x0D8 – 0x0D9                | 0x0D8<br>0x0D9 | CFGR                   | 0x00FE        | Configuration Status and Serial Bus Mode Register [15:0]                |
| 0x0DA – 0x0DB                | 0x0DA<br>0x0DB | Reserved<br>(2-Bytes)  | Don't Care    | None  |
| 0x0DC – 0x0DD                | 0x0DC<br>0x0DD | P1ANPT                 | 0x2001        | Port 1 Auto-Negotiation Next Page Transmit Register [15:0]              |
| 0x0DE – 0x0DF                | 0x0DE<br>0x0DF | P1ALPRNP               | 0x0000        | Port 1 Auto-Negotiation Link Partner Received Next Page Register [15:0] |
| 0x0E0 – 0x0E1                | 0x0E0<br>0x0E1 | P1EEEA                 | 0x0002        | Port 1 EEE and Link Partner Advertisement Register [15:0]               |
| 0x0E2 – 0x0E3                | 0x0E2<br>0x0E3 | P1EEEWEC               | 0x0000        | Port 1 EEE Wake Error Count Register [15:0]                             |

**TABLE 4-2: INTERNAL I/O REGISTER SPACE MAPPING FOR SWITCH CONTROL AND CONFIGURATION (0X000 – 0X0FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description  |
|------------------------------|----------------|-----------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                       |               |  |
| 0x0E4 – 0x0E5                | 0x0E4<br>0x0E5 | P1EEEC                | 0x8064        | Port 1 EEE Control/Status and Auto-Negotiation Expansion Register [15:0]                       |
| 0x0E6 – 0x0E7                | 0x0E6<br>0x0E7 | P1LPIRTC<br>BL2LPIC1  | 0x27<br>0x08  | Port 1 LPI Recovery Time Counter Register [7:0]<br>Buffer Load to LPI Control 1 Register [7:0] |
| 0x0E8 – 0x0E9                | 0x0E8<br>0x0E9 | P2ANPT                | 0x2001        | Port 2 Auto-Negotiation Next Page Transmit Register [15:0]                                     |
| 0x0EA – 0x0EB                | 0x0EA<br>0x0EB | P2ALPRNP              | 0x0000        | Port 2 Auto-Negotiation Link Partner Received Next Page Register [15:0]                        |
| 0x0EC – 0x0ED                | 0x0EC<br>0x0ED | P2EEEA                | 0x0002        | Port 2 EEE and Link Partner Advertisement Register [15:0]                                      |
| 0x0EE – 0x0EF                | 0x0EE<br>0x0EF | P2EEEWEC              | 0x0000        | Port 2 EEE Wake Error Count Register [15:0]  |
| 0x0F0 – 0x0F1                | 0x0F0<br>0x0F1 | P2EEEC                | 0x8064        | Port 2 EEE Control/Status and Auto-Negotiation Expansion Register [15:0]                       |
| 0x0F2 – 0x0F3                | 0x0F2<br>0x0F3 | P2LPIRTC<br>PCSEEEC   | 0x27<br>0x03  | Port 2 LPI Recovery Time Counter Register [7:0]<br>PCS EEE Control Register [7:0]              |
| 0x0F4 – 0x0F5                | 0x0F4<br>0x0F5 | ETLWTC                | 0x03E8        | Empty TXQ to LPI Wait Time Control Register [15:0]   |
| 0x0F6 – 0x0F7                | 0x0F6<br>0x0F7 | BL2LPIC2              | 0xC040        | Buffer Load to LPI Control 2 Register [15:0]   |
| 0x0F8 – 0x0FF                | 0x0F8<br>0x0FF | Reserved<br>(8-Bytes) | Don't Care    | None   |

**TABLE 4-3: INTERNAL I/O REGISTER SPACE MAPPING FOR INTERRUPTS AND GLOBAL RESET (0X100 – 0X16F)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description                        |
|------------------------------|----------------|------------------------|---------------|------------------------------------|
| 16-Bit                       | 8-Bit          |                        |               |                                    |
| 0x100 - 0x107                | 0x100<br>0x107 | Reserved<br>(8-Bytes)  | Don't Care    | None                               |
| 0x108 - 0x109                | 0x108<br>0x109 | CCR                    | Read Only     | Chip Configuration Register [15:0] |
| 0x10A - 0x10F                | 0x10A<br>0x10F | Reserved<br>(6-Bytes)  | Don't Care    | None                               |
| 0x110 - 0x111                | 0x110<br>0x111 | MARL                   | —             | MAC Address Register Low [15:0]    |
| 0x112 - 0x113                | 0x112<br>0x113 | MARM                   | —             | MAC Address Register Middle [15:0] |
| 0x114 - 0x115                | 0x114<br>0x115 | MARH                   | —             | MAC Address Register High [15:0]   |
| 0x116 - 0x121                | 0x116<br>0x121 | Reserved<br>(12-Bytes) | Don't Care    | None                               |
| 0x122 - 0x123                | 0x122<br>0x123 | EEPCR                  | 0x0000        | EEPROM Control Register [15:0]     |
| 0x124 - 0x125                | 0x124<br>0x125 | MBIR                   | 0x0000        | Memory BIST Info Register [15:0]   |

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**TABLE 4-3: INTERNAL I/O REGISTER SPACE MAPPING FOR INTERRUPTS AND GLOBAL RESET (0X100 – 0X16F) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description                                 |
|------------------------------|----------------|-----------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                       |               |   |
| 0x126 - 0x127                | 0x126<br>0x127 | GRR                   | 0x0000        | Global Reset Register [15:0]                |
| 0x128 - 0x129                | 0x128<br>0x129 | Reserved<br>(2-Bytes) | Don't Care    | None  |
| 0x12A - 0x12B                | 0x12A<br>0x12B | WFCR                  | 0x0000        | Wake-Up Frame Control Register [15:0]       |
| 0x12C - 0x12F                | 0x12C<br>0x12F | Reserved<br>(4-Bytes) | Don't Care    | None  |
| 0x130 - 0x131                | 0x130<br>0x131 | WF0CRC0               | 0x0000        | Wake-Up Frame 0 CRC0 Register [15:0]        |
| 0x132 - 0x133                | 0x132<br>0x133 | WF0CRC1               | 0x0000        | Wake-Up Frame 0 CRC1 Register [15:0]        |
| 0x134 - 0x135                | 0x134<br>0x135 | WF0BM0                | 0x0000        | Wake-Up Frame 0 Byte Mask 0 Register [15:0] |
| 0x136 - 0x137                | 0x136<br>0x137 | WF0BM1                | 0x0000        | Wake-Up Frame 0 Byte Mask 1 Register [15:0] |
| 0x138 - 0x139                | 0x138<br>0x139 | WF0BM2                | 0x0000        | Wake-Up Frame 0 Byte Mask 2 Register [15:0] |
| 0x13A - 0x13B                | 0x13A<br>0x13B | WF0BM3                | 0x0000        | Wake-Up Frame 0 Byte Mask 3 Register [15:0] |
| 0x13C - 0x13F                | 0x13C<br>0x13F | Reserved<br>(4-Bytes) | Don't Care    | None  |
| 0x140 - 0x141                | 0x140<br>0x141 | WF1CRC0               | 0x0000        | Wake-Up Frame 1 CRC0 Register [15:0]        |
| 0x142 - 0x143                | 0x142<br>0x143 | WF1CRC1               | 0x0000        | Wake-Up Frame 1 CRC1 Register [15:0]        |
| 0x144 - 0x145                | 0x144<br>0x145 | WF1BM0                | 0x0000        | Wake-Up Frame 1 Byte Mask 0 Register [15:0] |
| 0x146 - 0x147                | 0x146<br>0x147 | WF1BM1                | 0x0000        | Wake-Up Frame 1 Byte Mask 1 Register [15:0] |
| 0x148 - 0x149                | 0x148<br>0x149 | WF1BM2                | 0x0000        | Wake-Up Frame 1 Byte Mask 2 Register [15:0] |
| 0x14A - 0x14B                | 0x14A<br>0x14B | WF1BM3                | 0x0000        | Wake-Up Frame 1 Byte Mask 3 Register [15:0] |
| 0x14C - 0x14F                | 0x14C<br>0x14F | Reserved<br>(4-Bytes) | Don't Care    | None  |
| 0x150 - 0x151                | 0x150<br>0x151 | WF2CRC0               | 0x0000        | Wake-Up Frame 2 CRC0 Register [15:0]        |
| 0x152 - 0x153                | 0x152<br>0x153 | WF2CRC1               | 0x0000        | Wake-Up Frame 2 CRC1 Register [15:0]        |
| 0x154 - 0x155                | 0x154<br>0x155 | WF2BM0                | 0x0000        | Wake-Up Frame 2 Byte Mask 0 Register [15:0] |
| 0x156 - 0x157                | 0x156<br>0x157 | WF2BM1                | 0x0000        | Wake-Up Frame 2 Byte Mask 1 Register [15:0] |
| 0x158 - 0x159                | 0x158<br>0x159 | WF2BM2                | 0x0000        | Wake-Up Frame 2 Byte Mask 2 Register [15:0] |



**TABLE 4-3: INTERNAL I/O REGISTER SPACE MAPPING FOR INTERRUPTS AND GLOBAL RESET (0X100 – 0X16F) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description                                 |
|------------------------------|----------------|-----------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                       |               |   |
| 0x15A - 0x15B                | 0x15A<br>0x15B | WF2BM3                | 0x0000        | Wake-Up Frame 2 Byte Mask 3 Register [15:0] |
| 0x15C - 0x15F                | 0x15C<br>0x15F | Reserved<br>(4-Bytes) | Don't Care    | None  |
| 0x160 - 0x161                | 0x160<br>0x161 | WF3CRC0               | 0x0000        | Wake-Up Frame 3 CRC0 Register [15:0]        |
| 0x162 - 0x163                | 0x162<br>0x163 | WF3CRC1               | 0x0000        | Wake-Up Frame 3 CRC1 Register [15:0]        |
| 0x164 - 0x165                | 0x164<br>0x165 | WF3BM0                | 0x0000        | Wake-Up Frame 3 Byte Mask 0 Register [15:0] |
| 0x166 - 0x167                | 0x166<br>0x167 | WF3BM1                | 0x0000        | Wake-Up Frame 3 Byte Mask 1 Register [15:0] |
| 0x168 - 0x169                | 0x168<br>0x169 | WF3BM2                | 0x0000        | Wake-Up Frame 3 Byte Mask 2 Register [15:0] |
| 0x16A - 0x16B                | 0x16A<br>0x16B | WF3BM3                | 0x0000        | Wake-Up Frame 3 Byte Mask 3 Register [15:0] |
| 0x16C - 0x16F                | 0x16C<br>0x16F | Reserved<br>(4-Bytes) | Don't Care    | None  |

**TABLE 4-4: INTERNAL I/O REGISTER SPACE MAPPING FOR THE QMU (0X170 – 0X1FF)**

| I/O Register Offset Location |                | Register Name | Default Value | Description                                     |
|------------------------------|----------------|---------------|---------------|---|
| 16-Bit                       | 8-Bit          |               |               |   |
| 0x170 - 0x171                | 0x170<br>0x171 | TXCR          | 0x0000        | Transmit Control Register [15:0]                |
| 0x172 - 0x173                | 0x172<br>0x173 | TXSR          | 0x0000        | Transmit Status Register [15:0]                 |
| 0x174 - 0x175                | 0x174<br>0x175 | RXCR1         | 0x0800        | Receive Control Register 1 [15:0]               |
| 0x176 - 0x177                | 0x176<br>0x177 | RXCR2         | 0x0114        | Receive Control Register 2 [15:0]               |
| 0x178 - 0x179                | 0x178<br>0x179 | TXMIR         | 0x1800        | TXQ Memory Information Register [15:0]          |
| 0x17A - 0x17B                | 0x17A<br>0x17B | Reserved      | Don't Care    | None  |
| 0x17C - 0x17D                | 0x17C<br>0x17D | RXFHSR        | 0x0000        | Receive Frame Header Status Register [15:0]     |
| 0x17E - 0x17F                | 0x17E<br>0x17F | RXFHBCR       | 0x0000        | Receive Frame Header Byte Count Register [15:0] |
| 0x180 - 0x181                | 0x180<br>0x181 | TXQCR         | 0x0000        | TXQ Command Register [15:0]                     |
| 0x182 - 0x183                | 0x182<br>0x183 | RXQCR         | 0x0000        | RXQ Command Register [15:0]                     |
| 0x184 - 0x185                | 0x184<br>0x185 | TXFDPR        | 0x0000        | TX Frame Data Pointer Register [15:0]           |
| 0x186 - 0x187                | 0x186<br>0x187 | RXFDPR        | —             | RX Frame Data Pointer Register [15:0]           |

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**TABLE 4-4: INTERNAL I/O REGISTER SPACE MAPPING FOR THE QMU (0X170 – 0X1FF)  
(CONTINUED)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description  |
|------------------------------|----------------|------------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                        |               |  |
| 0x188 - 0x18B                | 0x188<br>0x18B | Reserved<br>(4-Bytes)  | Don't Care    | None   |
| 0x18C - 0x18D                | 0x18C<br>0x18D | RXDTR                  | 0x0000        | RX Duration Timer Threshold Register [15:0]                  |
| 0x18E - 0x18F                | 0x18E<br>0x18F | RXDBCTR                | 0x0000        | RX Data Byte Count Threshold Register [15:0]                 |
| 0x190 - 0x191                | 0x190<br>0x191 | IER                    | 0x0000        | Interrupt Enable Register [15:0]                             |
| 0x192 - 0x193                | 0x192<br>0x193 | ISR                    | 0x0000        | Interrupt Status Register [15:0]                             |
| 0x194 - 0x19B                | 0x194<br>0x19B | Reserved<br>(8-Bytes)  | Don't Care    | None   |
| 0x19C - 0x19D                | 0x19C<br>0x19D | RXFCTR                 | 0x0000        | RX Frame Count Threshold Register [7:0], [15:8] are Reserved |
| 0x19E - 0x19F                | 0x19E<br>0x19F | TXNTFSR                | 0x0000        | TX Next Total Frames Size Register [15:0]                    |
| 0x1A0 - 0x1A1                | 0x1A0<br>0x1A1 | MAHTR0                 | 0x0000        | MAC Address Hash Table Register 0 [15:0]                     |
| 0x1A2 - 0x1A3                | 0x1A2<br>0x1A3 | MAHTR1                 | 0x0000        | MAC Address Hash Table Register 1 [15:0]                     |
| 0x1A4 - 0x1A5                | 0x1A4<br>0x1A5 | MAHTR2                 | 0x0000        | MAC Address Hash Table Register 2 [15:0]                     |
| 0x1A6 - 0x1A7                | 0x1A6<br>0x1A7 | MAHTR3                 | 0x0000        | MAC Address Hash Table Register 3 [15:0]                     |
| 0x1A8 - 0x1AF                | 0x1A8<br>0x1AF | Reserved<br>(8-Bytes)  | Don't Care    | None   |
| 0x1B0 - 0x1B1                | 0x1B0<br>0x1B1 | FCLWR                  | 0x0600        | Flow Control Low Water Mark Register [15:0]                  |
| 0x1B2 - 0x1B3                | 0x1B2<br>0x1B3 | FCHWR                  | 0x0400        | Flow Control High Water Mark Register [15:0]                 |
| 0x1B4 - 0x1B5                | 0x1B4<br>0x1B5 | FCOWR                  | 0x0040        | Flow Control Overrun Water Mark Register [15:0]              |
| 0x1B6 - 0x1B7                | 0x1B6<br>0x1B7 | Reserved<br>(2-Bytes)  | Don't Care    | None   |
| 0x1B8 - 0x1B9                | 0x1B8<br>0x1B9 | RXFC                   | 0x00          | RX Frame Count[15:8], Reserved [7:0]                         |
| 0x1BA - 0x1FF                | 0x1BA<br>0x1FF | Reserved<br>(70-Bytes) | Don't Care    | None   |

**TABLE 4-5: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TRIGGER OUTPUT (12 UNITS, 0X200 – 0X3FF)**

| I/O Register Offset Location |                | Register Name | Default Value | Description                                |
|------------------------------|----------------|---------------|---------------|--|
| 16-Bit                       | 8-Bit          |               |               |  |
| 0x200 – 0x201                | 0x200<br>0x201 | TRIG_ERR      | 0x0000        | Trigger Output Unit Error Register [11:0]  |
| 0x202 – 0x203                | 0x202<br>0x203 | TRIG_ACTIVE   | 0x0000        | Trigger Output Unit Active Register [11:0] |

**TABLE 4-5: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TRIGGER OUTPUT (12 UNITS, 0X200 – 0X3FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description   |
|------------------------------|----------------|------------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                        |               |   |
| 0x204 – 0x205                | 0x204<br>0x205 | TRIG_DONE              | 0x0000        | Trigger Output Unit Done Register [11:0]                                    |
| 0x206 – 0x207                | 0x206<br>0x207 | TRIG_EN                | 0x0000        | Trigger Output Unit Enable Register [11:0]                                  |
| 0x208 – 0x209                | 0x208<br>0x209 | TRIG_SW_RST            | 0x0000        | Trigger Output Unit Software Reset Register [11:0]                          |
| 0x20A – 0x20B                | 0x20A<br>0x20B | TRIG12_PPS_WIDTH       | 0x0000        | Trigger Output Unit 12 PPS Pulse Width Register                             |
| 0x20C – 0x21F                | 0x20C<br>0x21F | Reserved<br>(20-Bytes) | Don't Care    | None  |
| 0x220 – 0x221                | 0x220<br>0x221 | TRIG1_TGT_NSL          | 0x0000        | Trigger Output Unit 1 Target Time in Nanoseconds Low-Word Register [15:0]   |
| 0x222 – 0x223                | 0x222<br>0x223 | TRIG1_TGT_NSH          | 0x0000        | Trigger Output Unit 1 Target Time in Nanoseconds High-Word Register [29:16] |
| 0x224 – 0x225                | 0x224<br>0x225 | TRIG1_TGT_SL           | 0x0000        | Trigger Output Unit 1 Target Time in Seconds Low-Word Register [15:0]       |
| 0x226 – 0x227                | 0x226<br>0x227 | TRIG1_TGT_SH           | 0x0000        | Trigger Output Unit 1 Target Time in Seconds High-Word Register [31:16]     |
| 0x228 – 0x229                | 0x228<br>0x229 | TRIG1_CFG_1            | 0x3C00        | Trigger Output Unit 1 Configuration/Control Register1                       |
| 0x22A – 0x22B                | 0x22A<br>0x22B | TRIG1_CFG_2            | 0x0000        | Trigger Output Unit 1 Configuration/Control Register2                       |
| 0x22C – 0x22D                | 0x22C<br>0x22D | TRIG1_CFG_3            | 0x0000        | Trigger Output Unit 1 Configuration/Control Register3                       |
| 0x22E – 0x22F                | 0x22E<br>0x22F | TRIG1_CFG_4            | 0x0000        | Trigger Output Unit 1 Configuration/Control Register4                       |
| 0x230 – 0x231                | 0x230<br>0x231 | TRIG1_CFG_5            | 0x0000        | Trigger Output Unit 1 Configuration/Control Register5                       |
| 0x232 – 0x233                | 0x232<br>0x233 | TRIG1_CFG_6            | 0x0000        | Trigger Output Unit 1 Configuration/Control Register6                       |
| 0x234 – 0x235                | 0x234<br>0x235 | TRIG1_CFG_7            | 0x0000        | Trigger Output Unit 1 Configuration/Control Register7                       |
| 0x236 – 0x237                | 0x236<br>0x237 | TRIG1_CFG_8            | 0x0000        | Trigger Output Unit 1 Configuration/Control Register8                       |
| 0x238 – 0x23F                | 0x238<br>0x23F | Reserved<br>(8-Bytes)  | Don't Care    | None  |
| 0x240 – 0x241                | 0x240<br>0x241 | TRIG2_TGT_NSL          | 0x0000        | Trigger Output Unit 2 Target Time in Nanoseconds Low-Word Register [15:0]   |
| 0x242 – 0x243                | 0x242<br>0x243 | TRIG2_TGT_NSH          | 0x0000        | Trigger Output Unit 2 Target Time in Nanoseconds High-Word Register [29:16] |
| 0x244 – 0x245                | 0x244<br>0x245 | TRIG2_TGT_SL           | 0x0000        | Trigger Output Unit 2 Target Time in Seconds Low-Word Register [15:0]       |
| 0x246 – 0x247                | 0x246<br>0x247 | TRIG2_TGT_SH           | 0x0000        | Trigger Output Unit 2 Target Time in Seconds High-Word Register [31:16]     |
| 0x248 – 0x249                | 0x248<br>0x249 | TRIG2_CFG_1            | 0x3C00        | Trigger Output Unit 2 Configuration/Control Register1                       |

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**TABLE 4-5: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TRIGGER OUTPUT (12 UNITS, 0X200 – 0X3FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description  |
|------------------------------|----------------|-----------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                       |               |  |
| 0x24A – 0x24B                | 0x24A<br>0x24B | TRIG2_CFG_2           | 0x0000        | Trigger Output Unit 2 Configuration/Control Register2                        |
| 0x24C – 0x24D                | 0x24C<br>0x24D | TRIG2_CFG_3           | 0x0000        | Trigger Output Unit 2 Configuration/Control Register3                        |
| 0x24E – 0x24F                | 0x24E<br>0x24F | TRIG2_CFG_4           | 0x0000        | Trigger Output Unit 2 Configuration/Control Register4                        |
| 0x250 – 0x251                | 0x250<br>0x251 | TRIG2_CFG_5           | 0x0000        | Trigger Output Unit 2 Configuration/Control Register5                        |
| 0x252 – 0x253                | 0x252<br>0x253 | TRIG2_CFG_6           | 0x0000        | Trigger Output Unit 2 Configuration/Control Register6                        |
| 0x254 – 0x255                | 0x254<br>0x255 | TRIG2_CFG_7           | 0x0000        | Trigger Output Unit 2 Configuration/Control Register7                        |
| 0x256 – 0x257                | 0x256<br>0x257 | TRIG2_CFG_8           | 0x0000        | Trigger Output Unit 2 Configuration/Control Register8                        |
| 0x258 – 0x25F                | 0x258<br>0x25F | Reserved<br>(8-Bytes) | Don't Care    | None   |
| 0x260 – 0x261                | 0x260<br>0x261 | TRIG3_T-<br>GT_NSL    | 0x0000        | Trigger Output Unit 3 Target Time in Nano-seconds Low-Word Register [15:0]   |
| 0x262 – 0x263                | 0x262<br>0x263 | TRIG3_T-<br>GT_NSH    | 0x0000        | Trigger Output Unit 3 Target Time in Nano-seconds High-Word Register [29:16] |
| 0x264 – 0x265                | 0x264<br>0x265 | TRIG3_TGT_SL          | 0x0000        | Trigger Output Unit 3 Target Time in Seconds Low-Word Register [15:0]        |
| 0x266 – 0x267                | 0x266<br>0x267 | TRIG3_T-<br>GT_SH     | 0x0000        | Trigger Output Unit 3 Target Time in Seconds High-Word Register [31:16]      |
| 0x268 – 0x269                | 0x268<br>0x269 | TRIG3_CFG_1           | 0x3C00        | Trigger Output Unit 3 Configuration/Control Register1                        |
| 0x26A – 0x26B                | 0x26A<br>0x26B | TRIG3_CFG_2           | 0x0000        | Trigger Output Unit 3 Configuration/Control Register2                        |
| 0x26C – 0x26D                | 0x26C<br>0x26D | TRIG3_CFG_3           | 0x0000        | Trigger Output Unit 3 Configuration/Control Register3                        |
| 0x26E – 0x26F                | 0x26E<br>0x26F | TRIG3_CFG_4           | 0x0000        | Trigger Output Unit 3 Configuration/Control Register4                        |
| 0x270 – 0x271                | 0x270<br>0x271 | TRIG3_CFG_5           | 0x0000        | Trigger Output Unit 3 Configuration/Control Register5                        |
| 0x272 – 0x273                | 0x272<br>0x273 | TRIG3_CFG_6           | 0x0000        | Trigger Output Unit 3 Configuration/Control Register6                        |
| 0x274 – 0x275                | 0x274<br>0x275 | TRIG3_CFG_7           | 0x0000        | Trigger Output Unit 3 Configuration/Control Register7                        |
| 0x276 – 0x277                | 0x276<br>0x277 | TRIG3_CFG_8           | 0x0000        | Trigger Output Unit 3 Configuration/Control Register8                        |
| 0x278 – 0x27F                | 0x278<br>0x27F | Reserved<br>(8-Bytes) | Don't Care    | None   |
| 0x280 – 0x281                | 0x280<br>0x281 | TRIG4_T-<br>GT_NSL    | 0x0000        | Trigger Output Unit 4 Target Time in Nano-seconds Low-Word Register [15:0]   |
| 0x282 – 0x283                | 0x282<br>0x283 | TRIG4_T-<br>GT_NSH    | 0x0000        | Trigger Output Unit 4 Target Time in Nano-seconds High-Word Register [29:16] |

**TABLE 4-5: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TRIGGER OUTPUT (12 UNITS, 0X200 – 0X3FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description   |
|------------------------------|----------------|-----------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                       |               |   |
| 0x284 – 0x285                | 0x284<br>0x285 | TRIG4_TGT_SL          | 0x0000        | Trigger Output Unit 4 Target Time in Seconds Low-Word Register [15:0]       |
| 0x286 – 0x287                | 0x286<br>0x287 | TRIG4_TGT_SH          | 0x0000        | Trigger Output Unit 4 Target Time in Seconds High-Word Register [31:16]     |
| 0x288 – 0x289                | 0x288<br>0x289 | TRIG4_CFG_1           | 0x3C00        | Trigger Output Unit 4 Configuration/Control Register1                       |
| 0x28A – 0x28B                | 0x28A<br>0x28B | TRIG4_CFG_2           | 0x0000        | Trigger Output Unit 4 Configuration/Control Register2                       |
| 0x28C – 0x28D                | 0x28C<br>0x28D | TRIG4_CFG_3           | 0x0000        | Trigger Output Unit 4 Configuration/Control Register3                       |
| 0x28E – 0x28F                | 0x28E<br>0x28F | TRIG4_CFG_4           | 0x0000        | Trigger Output Unit 4 Configuration/Control Register4                       |
| 0x290 – 0x291                | 0x290<br>0x291 | TRIG4_CFG_5           | 0x0000        | Trigger Output Unit 4 Configuration/Control Register5                       |
| 0x292 – 0x293                | 0x292<br>0x293 | TRIG4_CFG_6           | 0x0000        | Trigger Output Unit 4 Configuration/Control Register6                       |
| 0x294 – 0x295                | 0x294<br>0x295 | TRIG4_CFG_7           | 0x0000        | Trigger Output Unit 4 Configuration/Control Register7                       |
| 0x296 – 0x297                | 0x296<br>0x297 | TRIG4_CFG_8           | 0x0000        | Trigger Output Unit 4 Configuration/Control Register8                       |
| 0x298 – 0x29F                | 0x298<br>0x29F | Reserved<br>(8-Bytes) | Don't Care    | None  |
| 0x2A0 – 0x2A1                | 0x2A0<br>0x2A1 | TRIG5_TGT_NSL         | 0x0000        | Trigger Output Unit 5 Target Time in Nanoseconds Low-Word Register [15:0]   |
| 0x2A2 – 0x2A3                | 0x2A2<br>0x2A3 | TRIG5_TGT_NSH         | 0x0000        | Trigger Output Unit 5 Target Time in Nanoseconds High-Word Register [29:16] |
| 0x2A4 – 0x2A5                | 0x2A4<br>0x2A5 | TRIG5_TGT_SL          | 0x0000        | Trigger Output Unit 5 Target Time in Seconds Low-Word Register [15:0]       |
| 0x2A6 – 0x2A7                | 0x2A6<br>0x2A7 | TRIG5_TGT_SH          | 0x0000        | Trigger Output Unit 5 Target Time in Seconds High-Word Register [31:16]     |
| 0x2A8 – 0x2A9                | 0x2A8<br>0x2A9 | TRIG5_CFG_1           | 0x3C00        | Trigger Output Unit 5 Configuration/Control Register1                       |
| 0x2AA – 0x2AB                | 0x2AA<br>0x2AB | TRIG5_CFG_2           | 0x0000        | Trigger Output Unit 5 Configuration/Control Register2                       |
| 0x2AC – 0x2AD                | 0x2AC<br>0x2AD | TRIG5_CFG_3           | 0x0000        | Trigger Output Unit 5 Configuration/Control Register3                       |
| 0x2AE – 0x2AF                | 0x2AE<br>0x2AF | TRIG5_CFG_4           | 0x0000        | Trigger Output Unit 5 Configuration/Control Register4                       |
| 0x2B0 – 0x2B1                | 0x2B0<br>0x2B1 | TRIG5_CFG_5           | 0x0000        | Trigger Output Unit 5 Configuration/Control Register5                       |
| 0x2B2 – 0x2B3                | 0x2B2<br>0x2B3 | TRIG5_CFG_6           | 0x0000        | Trigger Output Unit 5 Configuration/Control Register6                       |
| 0x2B4 – 0x2B5                | 0x2B4<br>0x2B5 | TRIG5_CFG_7           | 0x0000        | Trigger Output Unit 5 Configuration/Control Register7                       |
| 0x2B6 – 0x2B7                | 0x2B6<br>0x2B7 | TRIG5_CFG_8           | 0x0000        | Trigger Output Unit 5 Configuration/Control Register8                       |

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**TABLE 4-5: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TRIGGER OUTPUT (12 UNITS, 0X200 – 0X3FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description  |
|------------------------------|----------------|-----------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                       |               |  |
| 0x2B8 – 0x2BF                | 0x2B8<br>0x2BF | Reserved<br>(8-Bytes) | Don't Care    | None   |
| 0x2C0 – 0x2C1                | 0x2C0<br>0x2C1 | TRIG6_T-<br>GT_NSL    | 0x0000        | Trigger Output Unit 6 Target Time in Nano-seconds Low-Word Register [15:0]   |
| 0x2C2 – 0x2C3                | 0x2C2<br>0x2C3 | TRIG6_T-<br>GT_NSH    | 0x0000        | Trigger Output Unit 6 Target Time in Nano-seconds High-Word Register [29:16] |
| 0x2C4 – 0x2C5                | 0x2C4<br>0x2C5 | TRIG6_TGT_SL          | 0x0000        | Trigger Output Unit 6 Target Time in Seconds Low-Word Register [15:0]        |
| 0x2C6 – 0x2C7                | 0x2C6<br>0x2C7 | TRIG6_T-<br>GT_SH     | 0x0000        | Trigger Output Unit 6 Target Time in Seconds High-Word Register [31:16]      |
| 0x2C8 – 0x2C9                | 0x2C8<br>0x2C9 | TRIG6_CFG_1           | 0x3C00        | Trigger Output Unit 6 Configuration/Control Register1                        |
| 0x2CA – 0x2CB                | 0x2CA<br>0x2CB | TRIG6_CFG_2           | 0x0000        | Trigger Output Unit 6 Configuration/Control Register2                        |
| 0x2CC – 0x2CD                | 0x2CC<br>0x2CD | TRIG6_CFG_3           | 0x0000        | Trigger Output Unit 6 Configuration/Control Register3                        |
| 0x2CE – 0x2CF                | 0x2CE<br>0x2CF | TRIG6_CFG_4           | 0x0000        | Trigger Output Unit 6 Configuration/Control Register4                        |
| 0x2D0 – 0x2D1                | 0x2D0<br>0x2D1 | TRIG6_CFG_5           | 0x0000        | Trigger Output Unit 6 Configuration/Control Register5                        |
| 0x2D2 – 0x2D3                | 0x2D2<br>0x2D3 | TRIG6_CFG_6           | 0x0000        | Trigger Output Unit 6 Configuration/Control Register6                        |
| 0x2D4 – 0x2D5                | 0x2D4<br>0x2D5 | TRIG6_CFG_7           | 0x0000        | Trigger Output Unit 6 Configuration/Control Register7                        |
| 0x2D6 – 0x2D7                | 0x2D6<br>0x2D7 | TRIG6_CFG_8           | 0x0000        | Trigger Output Unit 6 Configuration/Control Register8                        |
| 0x2D8 – 0x2DF                | 0x2D8<br>0x2DF | Reserved<br>(8-Bytes) | Don't Care    | None   |
| 0x2E0 – 0x2E1                | 0x2E0<br>0x2E1 | TRIG7_T-<br>GT_NSL    | 0x0000        | Trigger Output Unit 7 Target Time in Nano-seconds Low-Word Register [15:0]   |
| 0x2E2 – 0x2E3                | 0x2E2<br>0x2E3 | TRIG7_T-<br>GT_NSH    | 0x0000        | Trigger Output Unit 7 Target Time in Nano-seconds High-Word Register [29:16] |
| 0x2E4 – 0x2E5                | 0x2E4<br>0x2E5 | TRIG7_TGT_SL          | 0x0000        | Trigger Output Unit 7 Target Time in Seconds Low-Word Register [15:0]        |
| 0x2E6 – 0x2E7                | 0x2E6<br>0x2E7 | TRIG7_T-<br>GT_SH     | 0x0000        | Trigger Output Unit 7 Target Time in Seconds High-Word Register [31:16]      |
| 0x2E8 – 0x2E9                | 0x2E8<br>0x2E9 | TRIG7_CFG_1           | 0x3C00        | Trigger Output Unit 7 Configuration/Control Register1                        |
| 0x2EA – 0x2EB                | 0x2EA<br>0x2EB | TRIG7_CFG_2           | 0x0000        | Trigger Output Unit 7 Configuration/Control Register2                        |
| 0x2EC – 0x2ED                | 0x2EC<br>0x2ED | TRIG7_CFG_3           | 0x0000        | Trigger Output Unit 7 Configuration/Control Register3                        |
| 0x2EE – 0x2EF                | 0x2EE<br>0x2EF | TRIG7_CFG_4           | 0x0000        | Trigger Output Unit 7 Configuration/Control Register4                        |
| 0x2F0 – 0x2F1                | 0x2F0<br>0x2F1 | TRIG7_CFG_5           | 0x0000        | Trigger Output Unit 7 Configuration/Control Register5                        |

**TABLE 4-5: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TRIGGER OUTPUT (12 UNITS, 0X200 – 0X3FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description  |
|------------------------------|----------------|-----------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                       |               |  |
| 0x2F2 – 0x2F3                | 0x2F2<br>0x2F3 | TRIG7_CFG_6           | 0x0000        | Trigger Output Unit 7 Configuration/Control Register6                        |
| 0x2F4 – 0x2F5                | 0x2F4<br>0x2F5 | TRIG7_CFG_7           | 0x0000        | Trigger Output Unit 7 Configuration/Control Register7                        |
| 0x2F6 – 0x2F7                | 0x2F6<br>0x2F7 | TRIG7_CFG_8           | 0x0000        | Trigger Output Unit 7 Configuration/Control Register8                        |
| 0x2F8 – 0x2FF                | 0x2F8<br>0x2FF | Reserved<br>(8-Bytes) | Don't Care    | None   |
| 0x300 – 0x301                | 0x300<br>0x301 | TRIG8_T-<br>GT_NSL    | 0x0000        | Trigger Output Unit 8 Target Time in Nano-seconds Low-Word Register [15:0]   |
| 0x302 – 0x303                | 0x302<br>0x303 | TRIG8_T-<br>GT_NSH    | 0x0000        | Trigger Output Unit 8 Target Time in Nano-seconds High-Word Register [29:16] |
| 0x304 – 0x305                | 0x304<br>0x305 | TRIG8_TGT_SL          | 0x0000        | Trigger Output Unit 8 Target Time in Seconds Low-Word Register [15:0]        |
| 0x306 – 0x307                | 0x306<br>0x307 | TRIG8_T-<br>GT_SH     | 0x0000        | Trigger Output Unit 8 Target Time in Seconds High-Word Register [31:16]      |
| 0x308 – 0x309                | 0x308<br>0x309 | TRIG8_CFG_1           | 0x3C00        | Trigger Output Unit 8 Configuration/Control Register1                        |
| 0x30A – 0x30B                | 0x30A<br>0x30B | TRIG8_CFG_2           | 0x0000        | Trigger Output Unit 8 Configuration/Control Register2                        |
| 0x30C – 0x30D                | 0x30C<br>0x30D | TRIG8_CFG_3           | 0x0000        | Trigger Output Unit 8 Configuration/Control Register3                        |
| 0x30E – 0x30F                | 0x30E<br>0x30F | TRIG8_CFG_4           | 0x0000        | Trigger Output Unit 8 Configuration/Control Register4                        |
| 0x310 – 0x311                | 0x310<br>0x311 | TRIG8_CFG_5           | 0x0000        | Trigger Output Unit 8 Configuration/Control Register5                        |
| 0x312 – 0x313                | 0x312<br>0x313 | TRIG8_CFG_6           | 0x0000        | Trigger Output Unit 8 Configuration/Control Register6                        |
| 0x314 – 0x315                | 0x314<br>0x315 | TRIG8_CFG_7           | 0x0000        | Trigger Output Unit 8 Configuration/Control Register7                        |
| 0x316 – 0x317                | 0x316<br>0x317 | TRIG8_CFG_8           | 0x0000        | Trigger Output Unit 8 Configuration/Control Register8                        |
| 0x318 – 0x31F                | 0x318<br>0x31F | Reserved<br>(8-Bytes) | Don't Care    | None   |
| 0x320 – 0x321                | 0x320<br>0x321 | TRIG9_T-<br>GT_NSL    | 0x0000        | Trigger Output Unit 9 Target Time in Nano-seconds Low-Word Register [15:0]   |
| 0x322 – 0x323                | 0x322<br>0x323 | TRIG9_T-<br>GT_NSH    | 0x0000        | Trigger Output Unit 9 Target Time in Nano-seconds High-Word Register [29:16] |
| 0x324 – 0x325                | 0x324<br>0x325 | TRIG9_TGT_SL          | 0x0000        | Trigger Output Unit 9 Target Time in Seconds Low-Word Register [15:0]        |
| 0x326 – 0x327                | 0x326<br>0x327 | TRIG9_T-<br>GT_SH     | 0x0000        | Trigger Output Unit 9 Target Time in Seconds High-Word Register [31:16]      |
| 0x328 – 0x329                | 0x328<br>0x329 | TRIG9_CFG_1           | 0x3C00        | Trigger Output Unit 9 Configuration/Control Register1                        |
| 0x32A – 0x32B                | 0x32A<br>0x32B | TRIG9_CFG_2           | 0x0000        | Trigger Output Unit 9 Configuration/Control Register2                        |

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**TABLE 4-5: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TRIGGER OUTPUT (12 UNITS, 0X200 – 0X3FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description   |
|------------------------------|----------------|-----------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                       |               |   |
| 0x32C – 0x32D                | 0x32C<br>0x32D | TRIG9_CFG_3           | 0x0000        | Trigger Output Unit 9 Configuration/Control Register3                         |
| 0x32E – 0x32F                | 0x32E<br>0x32F | TRIG9_CFG_4           | 0x0000        | Trigger Output Unit 9 Configuration/Control Register4                         |
| 0x330 – 0x331                | 0x330<br>0x331 | TRIG9_CFG_5           | 0x0000        | Trigger Output Unit 9 Configuration/Control Register5                         |
| 0x332 – 0x333                | 0x332<br>0x333 | TRIG9_CFG_6           | 0x0000        | Trigger Output Unit 9 Configuration/Control Register6                         |
| 0x334 – 0x335                | 0x334<br>0x335 | TRIG9_CFG_7           | 0x0000        | Trigger Output Unit 9 Configuration/Control Register7                         |
| 0x336 – 0x337                | 0x336<br>0x337 | TRIG9_CFG_8           | 0x0000        | Trigger Output Unit 9 Configuration/Control Register8                         |
| 0x338 – 0x33F                | 0x338<br>0x33F | Reserved<br>(8-Bytes) | Don't Care    | None  |
| 0x340 – 0x341                | 0x340<br>0x341 | TRIG10_T-<br>GT_NSL   | 0x0000        | Trigger Output Unit 10 Target Time in Nano-seconds Low-Word Register [15:0]   |
| 0x342 – 0x343                | 0x342<br>0x343 | TRIG10_T-<br>GT_NSH   | 0x0000        | Trigger Output Unit 10 Target Time in Nano-seconds High-Word Register [29:16] |
| 0x344 – 0x345                | 0x344<br>0x345 | TRIG10_T-<br>GT_SL    | 0x0000        | Trigger Output Unit 10 Target Time in Seconds Low-Word Register [15:0]        |
| 0x346 – 0x347                | 0x346<br>0x347 | TRIG10_T-<br>GT_SH    | 0x0000        | Trigger Output Unit 10 Target Time in Seconds High-Word Register [31:16]      |
| 0x348 – 0x349                | 0x348<br>0x349 | TRIG10_CFG_1          | 0x3C00        | Trigger Output Unit 10 Configuration/Control Register1                        |
| 0x34A – 0x34B                | 0x34A<br>0x34B | TRIG10_CFG_2          | 0x0000        | Trigger Output Unit 10 Configuration/Control Register2                        |
| 0x34C – 0x34D                | 0x34C<br>0x34D | TRIG10_CFG_3          | 0x0000        | Trigger Output Unit 10 Configuration/Control Register3                        |
| 0x34E – 0x34F                | 0x34E<br>0x34F | TRIG10_CFG_4          | 0x0000        | Trigger Output Unit 10 Configuration/Control Register4                        |
| 0x350 – 0x351                | 0x350<br>0x351 | TRIG10_CFG_5          | 0x0000        | Trigger Output Unit 10 Configuration/Control Register5                        |
| 0x352 – 0x353                | 0x352<br>0x353 | TRIG10_CFG_6          | 0x0000        | Trigger Output Unit 10 Configuration/Control Register6                        |
| 0x354 – 0x355                | 0x354<br>0x355 | TRIG10_CFG_7          | 0x0000        | Trigger Output Unit 10 Configuration/Control Register7                        |
| 0x356 – 0x357                | 0x356<br>0x357 | TRIG10_CFG_8          | 0x0000        | Trigger Output Unit 10 Configuration/Control Register8                        |
| 0x358 – 0x35F                | 0x358<br>0x35F | Reserved<br>(8-Bytes) | Don't Care    | None  |
| 0x360 – 0x361                | 0x360<br>0x361 | TRIG11_T-<br>GT_NSL   | 0x0000        | Trigger Output Unit 11 Target Time in Nano-seconds Low-Word Register [15:0]   |
| 0x362 – 0x363                | 0x362<br>0x363 | TRIG11_T-<br>GT_NSH   | 0x0000        | Trigger Output Unit 11 Target Time in Nano-seconds High-Word Register [29:16] |
| 0x364 – 0x365                | 0x364<br>0x365 | TRIG11_T-<br>GT_SL    | 0x0000        | Trigger Output Unit 11 Target Time in Seconds Low-Word Register [15:0]        |



**TABLE 4-5: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TRIGGER OUTPUT (12 UNITS, 0X200 – 0X3FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name           | Default Value | Description  |
|------------------------------|----------------|-------------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                         |               |  |
| 0x366 – 0x367                | 0x366<br>0x367 | TRIG11_T-<br>GT_SH      | 0x0000        | Trigger Output Unit 11 Target Time in Seconds High-Word Register [31:16]     |
| 0x368 – 0x369                | 0x368<br>0x369 | TRIG11_CFG_1            | 0x3C00        | Trigger Output Unit 11 Configuration/Control Register1                       |
| 0x36A – 0x36B                | 0x36A<br>0x36B | TRIG11_CFG_2            | 0x0000        | Trigger Output Unit 11 Configuration/Control Register2                       |
| 0x36C – 0x36D                | 0x36C<br>0x36D | TRIG11_CFG_3            | 0x0000        | Trigger Output Unit 11 Configuration/Control Register3                       |
| 0x36E – 0x36F                | 0x36E<br>0x36F | TRIG11_CFG_4            | 0x0000        | Trigger Output Unit 11 Configuration/Control Register4                       |
| 0x370 – 0x371                | 0x370<br>0x371 | TRIG11_CFG_5            | 0x0000        | Trigger Output Unit 11 Configuration/Control Register5                       |
| 0x372 – 0x373                | 0x372<br>0x373 | TRIG11_CFG_6            | 0x0000        | Trigger Output Unit 11 Configuration/Control Register6                       |
| 0x374 – 0x375                | 0x374<br>0x375 | TRIG11_CFG_7            | 0x0000        | Trigger Output Unit 11 Configuration/Control Register7                       |
| 0x376 – 0x377                | 0x376<br>0x377 | TRIG11_CFG_8            | 0x0000        | Trigger Output Unit 11 Configuration/Control Register8                       |
| 0x378 – 0x37F                | 0x378<br>0x37F | Reserved<br>(8-Bytes)   | Don't Care    | None   |
| 0x380 – 0x381                | 0x380<br>0x381 | TRIG12_T-<br>GT_NSL     | 0x0000        | Trigger Output Unit 12 Target Time in Nanoseconds Low-Word Register [15:0]   |
| 0x382 – 0x383                | 0x382<br>0x383 | TRIG12_T-<br>GT_NSH     | 0x0000        | Trigger Output Unit 12 Target Time in Nanoseconds High-Word Register [29:16] |
| 0x384 – 0x385                | 0x384<br>0x385 | TRIG12_T-<br>GT_SL      | 0x0000        | Trigger Output Unit 12 Target Time in Seconds Low-Word Register [15:0]       |
| 0x386 – 0x387                | 0x386<br>0x387 | TRIG12_T-<br>GT_SH      | 0x0000        | Trigger Output Unit 12 Target Time in Seconds High-Word Register [31:16]     |
| 0x388 – 0x389                | 0x388<br>0x389 | TRIG12_CFG_1            | 0x3C00        | Trigger Output Unit 12 Configuration/Control Register1                       |
| 0x38A – 0x38B                | 0x38A<br>0x38B | TRIG12_CFG_2            | 0x0000        | Trigger Output Unit 12 Configuration/Control Register2                       |
| 0x38C – 0x38D                | 0x38C<br>0x38D | TRIG12_CFG_3            | 0x0000        | Trigger Output Unit 12 Configuration/Control Register3                       |
| 0x38E – 0x38F                | 0x38E<br>0x38F | TRIG12_CFG_4            | 0x0000        | Trigger Output Unit 12 Configuration/Control Register4                       |
| 0x390 – 0x391                | 0x390<br>0x391 | TRIG12_CFG_5            | 0x0000        | Trigger Output Unit 12 Configuration/Control Register5                       |
| 0x392 – 0x393                | 0x392<br>0x393 | TRIG12_CFG_6            | 0x0000        | Trigger Output Unit 12 Configuration/Control Register6                       |
| 0x394 – 0x395                | 0x394<br>0x395 | TRIG12_CFG_7            | 0x0000        | Trigger Output Unit 12 Configuration/Control Register7                       |
| 0x396 – 0x397                | 0x396<br>0x397 | TRIG12_CFG_8            | 0x0000        | Trigger Output Unit 12 Configuration/Control Register8                       |
| 0x398 – 0x3FF                | 0x398<br>0x3FF | Reserved<br>(104-Bytes) | Don't Care    | None   |

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**TABLE 4-6: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description  |
|------------------------------|----------------|------------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                        |               |  |
| 0x400 – 0x401                | 0x400<br>0x401 | TS_RDY                 | 0x0000        | Input Unit Ready Register [11:0]   |
| 0x402 – 0x403                | 0x402<br>0x403 | TS_EN                  | 0x0000        | Time stamp Input Unit Enable Register [11:0]   |
| 0x404 – 0x405                | 0x404<br>0x405 | TS_SW_RST              | 0x0000        | Time stamp Input Unit Software Reset Register [11:0]   |
| 0x406 – 0x41F                | 0x406<br>0x41F | Reserved<br>(26-Bytes) | Don't Care    | None   |
| 0x420 – 0x421                | 0x420<br>0x421 | TS1_STATUS             | 0x0000        | Time stamp Input Unit 1 Status Register  |
| 0x422 – 0x423                | 0x422<br>0x423 | TS1_CFG                | 0x0000        | Time stamp Input Unit 1 Configuration/Control Register   |
| 0x424 – 0x425                | 0x424<br>0x425 | TS1_SM-<br>PL1_NSL     | 0x0000        | Time stamp Unit 1 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds Low-Word Register [15:0]   |
| 0x426 – 0x427                | 0x426<br>0x427 | TS1_SM-<br>PL1_NSH     | 0x0000        | Time stamp Unit 1 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |
| 0x428 – 0x429                | 0x428<br>0x429 | TS1_SM-<br>PL1_SL      | 0x0000        | Time stamp Unit 1 Input Sample Time (1 <sup>st</sup> ) in Seconds Low-Word Register [15:0]       |
| 0x42A – 0x42B                | 0x42A<br>0x42B | TS1_SM-<br>PL1_SH      | 0x0000        | Time stamp Unit 1 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |
| 0x42C – 0x42D                | 0x42C<br>0x42D | TS1_SMPL1_-<br>SUB_NS  | 0x0000        | Time stamp Unit 1 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x42E – 0x433                | 0x42E<br>0x433 | Reserved<br>(6-Bytes)  | Don't Care    | None   |
| 0x434 – 0x435                | 0x434<br>0x435 | TS1_SM-<br>PL2_NSL     | 0x0000        | Time stamp Unit 1 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |
| 0x436 – 0x437                | 0x436<br>0x437 | TS1_SM-<br>PL2_NSH     | 0x0000        | Time stamp Unit 1 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]              |
| 0x438 – 0x439                | 0x438<br>0x439 | TS1_SM-<br>PL2_SL      | 0x0000        | Time stamp Unit 1 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                    |
| 0x43A – 0x43B                | 0x43A<br>0x43B | TS1_SM-<br>PL2_SH      | 0x0000        | Time stamp Unit 1 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                  |
| 0x43C – 0x43D                | 0x43C<br>0x43D | TS1_SMPL2_-<br>SUB_NS  | 0x0000        | Time stamp Unit 1 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                      |
| 0x43E – 0x43F                | 0x43E<br>0x43F | Reserved<br>(2-Bytes)  | Don't Care    | None   |
| 0x440 – 0x441                | 0x440<br>0x441 | TS2_STATUS             | 0x0000        | Time stamp Input Unit 2 Status Register  |
| 0x442 – 0x443                | 0x442<br>0x443 | TS2_CFG                | 0x0000        | Time stamp Input Unit 2 Configuration/Control Register   |
| 0x444 – 0x445                | 0x444<br>0x445 | TS2_SM-<br>PL1_NSL     | 0x0000        | Time stamp Unit 2 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds Low-Word Register [15:0]   |
| 0x446 – 0x447                | 0x446<br>0x447 | TS2_SM-<br>PL1_NSH     | 0x0000        | Time stamp Unit 2 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |

**TABLE 4-6: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description  |
|------------------------------|----------------|-----------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                       |               |  |
| 0x448 – 0x449                | 0x448<br>0x449 | TS2_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 2 Input Sample Time (1 <sup>st</sup> ) in Seconds Low-Word Register [15:0]       |
| 0x44A – 0x44B                | 0x44A<br>0x44B | TS2_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 2 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |
| 0x44C – 0x44D                | 0x44C<br>0x44D | TS2_SMPL1_-<br>SUB_NS | 0x0000        | Time stamp Unit 2 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x44E – 0x453                | 0x44E<br>0x453 | Reserved<br>(6-Bytes) | Don't Care    | None   |
| 0x454 – 0x455                | 0x454<br>0x455 | TS2_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 2 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |
| 0x456 – 0x457                | 0x456<br>0x457 | TS2_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 2 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]              |
| 0x458 – 0x459                | 0x458<br>0x459 | TS2_SMP2_SL           | 0x0000        | Time stamp Unit 2 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                    |
| 0x45A – 0x45B                | 0x45A<br>0x45B | TS2_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 2 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                  |
| 0x45C – 0x45D                | 0x45C<br>0x45D | TS2_SMPL2_-<br>SUB_NS | 0x0000        | Time stamp Unit 2 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                      |
| 0x45E – 0x45F                | 0x45E<br>0x45F | Reserved<br>(2-Bytes) | Don't Care    | None   |
| 0x460 – 0x461                | 0x460<br>0x461 | TS3_STATUS            | 0x0000        | Time stamp Input Unit 3 Status Register  |
| 0x462 – 0x463                | 0x462<br>0x463 | TS3_CFG               | 0x0000        | Time stamp Input Unit 3 Configuration/Control Register   |
| 0x464 – 0x465                | 0x464<br>0x465 | TS3_SM-<br>PL1_NSL    | 0x0000        | Time stamp Unit 3 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds Low-Word Register [15:0]   |
| 0x466 – 0x467                | 0x466<br>0x467 | TS3_SM-<br>PL1_NSH    | 0x0000        | Time stamp Unit 3 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |
| 0x468 – 0x469                | 0x468<br>0x469 | TS3_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 3 Input Sample Time (1 <sup>st</sup> ) in Seconds Low-Word Register [15:0]       |
| 0x46A – 0x46B                | 0x46A<br>0x46B | TS3_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 3 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |
| 0x46C – 0x46D                | 0x46C<br>0x46D | TS3_SMPL1_-<br>SUB_NS | 0x0000        | Time stamp Unit 3 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x46E – 0x473                | 0x46E<br>0x473 | Reserved<br>(6-Bytes) | Don't Care    | None   |
| 0x474 – 0x475                | 0x474<br>0x475 | TS3_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 3 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |
| 0x476 – 0x477                | 0x476<br>0x477 | TS3_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 3 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]              |
| 0x478 – 0x479                | 0x478<br>0x479 | TS3_SMP2_SL           | 0x0000        | Time stamp Unit 3 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                    |
| 0x47A – 0x47B                | 0x47A<br>0x47B | TS3_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 3 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                  |

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**TABLE 4-6: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description  |
|------------------------------|----------------|-----------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                       |               |  |
| 0x47C – 0x47D                | 0x47C<br>0x47D | TS3_SMPL2_<br>SUB_NS  | 0x0000        | Time stamp Unit 3 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                      |
| 0x47E – 0x47F                | 0x47E<br>0x47F | Reserved<br>(2-Bytes) | Don't Care    | None   |
| 0x480 – 0x481                | 0x480<br>0x481 | TS4_STATUS            | 0x0000        | Time stamp Input Unit 4 Status Register  |
| 0x482 – 0x483                | 0x482<br>0x483 | TS4_CFG               | 0x0000        | Time stamp Input Unit 4 Configuration/Control Register   |
| 0x484 – 0x485                | 0x484<br>0x485 | TS4_SM-<br>PL1_NSL    | 0x0000        | Time stamp Unit 4 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds Low-Word Register [15:0]   |
| 0x486 – 0x487                | 0x486<br>0x487 | TS4_SM-<br>PL1_NSH    | 0x0000        | Time stamp Unit 4 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |
| 0x488 – 0x489                | 0x488<br>0x489 | TS4_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 4 Input Sample Time (1 <sup>st</sup> ) in Seconds Low-Word Register [15:0]       |
| 0x48A – 0x48B                | 0x48A<br>0x48B | TS4_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 4 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |
| 0x48C – 0x48D                | 0x48C<br>0x48D | TS4_SMPL1_<br>SUB_NS  | 0x0000        | Time stamp Unit 4 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x48E – 0x493                | 0x48E<br>0x493 | Reserved<br>(6-Bytes) | Don't Care    | None   |
| 0x494 – 0x495                | 0x494<br>0x495 | TS4_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 4 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |
| 0x496 – 0x497                | 0x496<br>0x497 | TS4_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 4 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]              |
| 0x498 – 0x499                | 0x498<br>0x499 | TS4_SMP2_SL           | 0x0000        | Time stamp Unit 4 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                    |
| 0x49A – 0x49B                | 0x49A<br>0x49B | TS4_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 4 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                  |
| 0x49C – 0x49D                | 0x49C<br>0x49D | TS4_SMPL2_<br>SUB_NS  | 0x0000        | Time stamp Unit 4 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                      |
| 0x49E – 0x49F                | 0x49E<br>0x49F | Reserved<br>(2-Bytes) | Don't Care    | None   |
| 0x4A0 – 0x4A1                | 0x4A0<br>0x4A1 | TS5_STATUS            | 0x0000        | Time stamp Input Unit 5 Status Register  |
| 0x4A2 – 0x4A3                | 0x4A2<br>0x4A3 | TS5_CFG               | 0x0000        | Time stamp Input Unit 5 Configuration/Control Register   |
| 0x4A4 – 0x4A5                | 0x4A4<br>0x4A5 | TS5_SMPL1_<br>NSL     | 0x0000        | Time stamp Unit 5 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds Low-Word Register [15:0]   |
| 0x4A6 – 0x4A7                | 0x4A6<br>0x4A7 | TS5_SMPL1_<br>NSH     | 0x0000        | Time stamp Unit 5 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |
| 0x4A8 – 0x4A9                | 0x4A8<br>0x4A9 | TS5_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 5 Input Sample Time (1 <sup>st</sup> ) in Seconds Low-Word Register [15:0]       |
| 0x4AA – 0x4AB                | 0x4AA<br>0x4AB | TS5_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 5 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |

**TABLE 4-6: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description  |
|------------------------------|----------------|-----------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                       |               |  |
| 0x4AC – 0x4AD                | 0x4AC<br>0x4AD | TS5_SMPL1_-<br>SUB_NS | 0x0000        | Time stamp Unit 5 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x4AE – 0x4B3                | 0x4AE<br>0x4B3 | Reserved<br>(6-Bytes) | Don't Care    | None   |
| 0x4B4 – 0x4B5                | 0x4B4<br>0x4B5 | TS5_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 5 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |
| 0x4B6 – 0x4B7                | 0x4B6<br>0x4B7 | TS5_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 5 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]              |
| 0x4B8 – 0x4B9                | 0x4B8<br>0x4B9 | TS5_SMP2_SL           | 0x0000        | Time stamp Unit 5 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                    |
| 0x4BA – 0x4BB                | 0x4BA<br>0x4BB | TS5_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 5 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                  |
| 0x4BC – 0x4BD                | 0x4BC<br>0x4BD | TS5_SMPL2_-<br>SUB_NS | 0x0000        | Time stamp Unit 5 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                      |
| 0x4BE – 0x4BF                | 0x4BE<br>0x4BF | Reserved<br>(2-Bytes) | Don't Care    | None   |
| 0x4C0 – 0x4C1                | 0x4C0<br>0x4C1 | TS6_STATUS            | 0x0000        | Time stamp Input Unit 6 Status Register  |
| 0x4C2 – 0x4C3                | 0x4C2<br>0x4C3 | TS6_CFG               | 0x0000        | Time stamp Input Unit 6 Configuration/Control Register   |
| 0x4C4 – 0x4C5                | 0x4C4<br>0x4C5 | TS6_SM-<br>PL1_NSL    | 0x0000        | Time stamp Unit 6 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds Low-Word Register [15:0]   |
| 0x4C6 – 0x4C7                | 0x4C6<br>0x4C7 | TS6_SM-<br>PL1_NSH    | 0x0000        | Time stamp Unit 6 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |
| 0x4C8 – 0x4C9                | 0x4C8<br>0x4C9 | TS6_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 6 Input Sample Time (1 <sup>st</sup> ) in Seconds Low-Word Register [15:0]       |
| 0x4CA – 0x4CB                | 0x4CA<br>0x4CB | TS6_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 6 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |
| 0x4CC – 0x4CD                | 0x4CC<br>0x4CD | TS6_SMPL1_-<br>SUB_NS | 0x0000        | Time stamp Unit 6 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x4CE – 0x4D3                | 0x4CE<br>0x4D3 | Reserved<br>(6-Bytes) | Don't Care    | None   |
| 0x4D4 – 0x4D5                | 0x4D4<br>0x4D5 | TS6_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 6 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |
| 0x4D6 – 0x4D7                | 0x4D6<br>0x4D7 | TS6_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 6 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]              |
| 0x4D8 – 0x4D9                | 0x4D8<br>0x4D9 | TS6_SMP2_SL           | 0x0000        | Time stamp Unit 6 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                    |
| 0x4DA – 0x4DB                | 0x4DA<br>0x4DB | TS6_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 6 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                  |
| 0x4DC – 0x4DD                | 0x4DC<br>0x4DD | TS6_SMPL2_-<br>SUB_NS | 0x0000        | Time stamp Unit 6 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                      |
| 0x4DE – 0x4DF                | 0x4DE<br>0x4DF | Reserved<br>(2-Bytes) | Don't Care    | None   |

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**TABLE 4-6: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description  |
|------------------------------|----------------|-----------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                       |               |  |
| 0x4E0 – 0x4E1                | 0x4E0<br>0x4E1 | TS7_STATUS            | 0x0000        | Time stamp Input Unit 7 Status Register  |
| 0x4E2 – 0x4E3                | 0x4E2<br>0x4E3 | TS7_CFG               | 0x0000        | Time stamp Input Unit 7 Configuration/Control Register   |
| 0x4E4 – 0x4E5                | 0x4E4<br>0x4E5 | TS7_SM-<br>PL1_NSL    | 0x0000        | Time stamp Unit 7 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds Low-Word Register [15:0]   |
| 0x4E6 – 0x4E7                | 0x4E6<br>0x4E7 | TS7_SM-<br>PL1_NSH    | 0x0000        | Time stamp Unit 7 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |
| 0x4E8 – 0x4E9                | 0x4E8<br>0x4E9 | TS7_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 7 Input Sample Time (1 <sup>st</sup> ) in Seconds Low-Word Register [15:0]       |
| 0x4EA – 0x4EB                | 0x4EA<br>0x4EB | TS7_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 7 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |
| 0x4EC – 0x4ED                | 0x4EC<br>0x4ED | TS7_SMPL1_-<br>SUB_NS | 0x0000        | Time stamp Unit 7 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x4EE – 0x4F3                | 0x4EE<br>0x4F3 | Reserved<br>(6-Bytes) | Don't Care    | None   |
| 0x4F4 – 0x4F5                | 0x4F4<br>0x4F5 | TS7_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 7 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |
| 0x4F6 – 0x4F7                | 0x4F6<br>0x4F7 | TS7_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 7 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]              |
| 0x4F8 – 0x4F9                | 0x4F8<br>0x4F9 | TS7_SMP2_SL           | 0x0000        | Time stamp Unit 7 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                    |
| 0x4FA – 0x4FB                | 0x4FA<br>0x4FB | TS7_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 7 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                  |
| 0x4FC – 0x4FD                | 0x4FC<br>0x4FD | TS7_SMPL2_-<br>SUB_NS | 0x0000        | Time stamp Unit 7 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                      |
| 0x4FE – 0x4FF                | 0x4FE<br>0x4FF | Reserved<br>(2-Bytes) | Don't Care    | None   |
| 0x500 – 0x501                | 0x500<br>0x501 | TS8_STATUS            | 0x0000        | Time stamp Input Unit 8 Status Register  |
| 0x502 – 0x503                | 0x502<br>0x503 | TS8_CFG               | 0x0000        | Time stamp Input Unit 8 Configuration/Control Register   |
| 0x504 – 0x505                | 0x504<br>0x505 | TS8_SM-<br>PL1_NSL    | 0x0000        | Time stamp Unit 8 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds Low-Word Register [15:0]   |
| 0x506 – 0x507                | 0x506<br>0x507 | TS8_SM-<br>PL1_NSH    | 0x0000        | Time stamp Unit 8 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |
| 0x508 – 0x509                | 0x508<br>0x509 | TS8_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 8 Input Sample Time (1 <sup>st</sup> ) in Seconds Low-Word Register [15:0]       |
| 0x50A – 0x50B                | 0x50A<br>0x50B | TS8_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 8 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |
| 0x50C – 0x50D                | 0x50C<br>0x50D | TS8_SMPL1_-<br>SUB_NS | 0x0000        | Time stamp Unit 8 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x50E – 0x513                | 0x50E<br>0x513 | Reserved<br>(6-Bytes) | Don't Care    | None   |

**TABLE 4-6: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name         | Default Value | Description  |
|------------------------------|----------------|-----------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                       |               |  |
| 0x514 – 0x515                | 0x514<br>0x515 | TS8_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 8 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |
| 0x516 – 0x517                | 0x516<br>0x517 | TS8_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 8 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]              |
| 0x518 – 0x519                | 0x518<br>0x519 | TS8_SMP2_SL           | 0x0000        | Time stamp Unit 8 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                    |
| 0x51A – 0x51B                | 0x51A<br>0x51B | TS8_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 8 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                  |
| 0x51C – 0x51D                | 0x51C<br>0x51D | TS8_SMPL2_-<br>SUB_NS | 0x0000        | Time stamp Unit 8 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                      |
| 0x51E – 0x51F                | 0x51E<br>0x51F | Reserved<br>(2-Bytes) | Don't Care    | None   |
| 0x520 – 0x521                | 0x520<br>0x521 | TS9_STATUS            | 0x0000        | Time stamp Input Unit 9 Status Register  |
| 0x522 – 0x523                | 0x522<br>0x523 | TS9_CFG               | 0x0000        | Time stamp Input Unit 9 Configuration/Control Register   |
| 0x524 – 0x525                | 0x524<br>0x525 | TS9_SM-<br>PL1_NSL    | 0x0000        | Time stamp Unit 9 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [15:0]  |
| 0x526 – 0x527                | 0x526<br>0x527 | TS9_SM-<br>PL1_NSH    | 0x0000        | Time stamp Unit 9 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |
| 0x528 – 0x529                | 0x528<br>0x529 | TS9_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 9 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [15:0]      |
| 0x52A – 0x52B                | 0x52A<br>0x52B | TS9_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 9 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |
| 0x52C – 0x52D                | 0x52C<br>0x52D | TS9_SMPL1_-<br>SUB_NS | 0x0000        | Time stamp Unit 9 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x52E – 0x533                | 0x52E<br>0x533 | Reserved<br>(6-Bytes) | Don't Care    | None   |
| 0x534 – 0x535                | 0x534<br>0x535 | TS9_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 9 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |
| 0x536 – 0x537                | 0x536<br>0x537 | TS9_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 9 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]              |
| 0x538 – 0x539                | 0x538<br>0x539 | TS9_SMP2_SL           | 0x0000        | Time stamp Unit 9 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                    |
| 0x53A – 0x53B                | 0x53A<br>0x53B | TS9_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 9 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                  |
| 0x53C – 0x53D                | 0x53C<br>0x53D | TS9_SMPL2_-<br>SUB_NS | 0x0000        | Time stamp Unit 9 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                      |
| 0x53E – 0x53F                | 0x53E<br>0x53F | Reserved<br>(2-Bytes) | Don't Care    | None   |
| 0x540 – 0x541                | 0x540<br>0x541 | TS10_STATUS           | 0x0000        | Time stamp Input Unit 10 Status Register   |
| 0x542 – 0x543                | 0x542<br>0x543 | TS10_CFG              | 0x0000        | Time stamp Input Unit 10 Configuration/Control Register  |

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**TABLE 4-6: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description   |
|------------------------------|----------------|------------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                        |               |   |
| 0x544 – 0x545                | 0x544<br>0x545 | TS10_SM-<br>PL1_NSL    | 0x0000        | Time stamp Unit 10 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds Low-Word Register [15:0]   |
| 0x546 – 0x547                | 0x546<br>0x547 | TS10_SM-<br>PL1_NSH    | 0x0000        | Time stamp Unit 10 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |
| 0x548 – 0x549                | 0x548<br>0x549 | TS10_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 10 Input Sample Time (1 <sup>st</sup> ) in Seconds Low-Word Register [15:0]       |
| 0x54A – 0x54B                | 0x54A<br>0x54B | TS10_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 10 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |
| 0x54C – 0x54D                | 0x54C<br>0x54D | TS10_SMPL1_-<br>SUB_NS | 0x0000        | Time stamp Unit 10 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x54E – 0x553                | 0x54E<br>0x553 | Reserved<br>(6-Bytes)  | Don't Care    | None  |
| 0x554 – 0x555                | 0x554<br>0x555 | TS10_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 10 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |
| 0x556 – 0x557                | 0x556<br>0x557 | TS10_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 10 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]              |
| 0x558 – 0x559                | 0x558<br>0x559 | TS10_SMP2_S<br>L       | 0x0000        | Time stamp Unit 10 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                    |
| 0x55A – 0x55B                | 0x55A<br>0x55B | TS10_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 10 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                  |
| 0x55C – 0x55D                | 0x55C<br>0x55D | TS10_SMPL2_-<br>SUB_NS | 0x0000        | Time stamp Unit 10 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                      |
| 0x55E – 0x55F                | 0x55E<br>0x55F | Reserved<br>(2-Bytes)  | Don't Care    | None  |
| 0x560 – 0x561                | 0x560<br>0x561 | TS11_STATUS            | 0x0000        | Time stamp Input Unit 11 Status Register  |
| 0x562 – 0x563                | 0x562<br>0x563 | TS11_CFG               | 0x0000        | Time stamp Input Unit 11 Configuration/Control Register   |
| 0x564 – 0x565                | 0x564<br>0x565 | TS11_SM-<br>PL1_NSL    | 0x0000        | Time stamp Unit 11 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds Low-Word Register [15:0]   |
| 0x566 – 0x567                | 0x566<br>0x567 | TS11_SM-<br>PL1_NSH    | 0x0000        | Time stamp Unit 11 Input Sample Time (1 <sup>st</sup> ) in Nanoseconds High-Word Register [29:16] |
| 0x568 – 0x569                | 0x568<br>0x569 | TS11_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 11 Input Sample Time (1 <sup>st</sup> ) in Seconds Low-Word Register [15:0]       |
| 0x56A – 0x56B                | 0x56A<br>0x56B | TS11_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 11 Input Sample Time (1 <sup>st</sup> ) in Seconds High-Word Register [31:16]     |
| 0x56C – 0x56D                | 0x56C<br>0x56D | TS11_SMPL1_-<br>SUB_NS | 0x0000        | Time stamp Unit 11 Input Sample Time (1 <sup>st</sup> ) in Sub-Nanoseconds Register [2:0]         |
| 0x56E – 0x573                | 0x56E<br>0x573 | Reserved<br>(6-Bytes)  | Don't Care    | None  |
| 0x574 – 0x575                | 0x574<br>0x575 | TS11_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 11 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                |



**TABLE 4-6: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description  |
|------------------------------|----------------|------------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                        |               |  |
| 0x576 – 0x577                | 0x576<br>0x577 | TS11_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 11 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]                 |
| 0x578 – 0x579                | 0x578<br>0x579 | TS11_SMP2_S<br>L       | 0x0000        | Time stamp Unit 11 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                       |
| 0x57A – 0x57B                | 0x57A<br>0x57B | TS11_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 11 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                     |
| 0x57C – 0x57D                | 0x57C<br>0x57D | TS11_SMPL2_-<br>SUB_NS | 0x0000        | Time stamp Unit 11 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                         |
| 0x57E – 0x57F                | 0x57E<br>0x57F | Reserved<br>(2-Bytes)  | Don't Care    | None   |
| 0x580 – 0x581                | 0x580<br>0x581 | TS12_STATUS            | 0x0000        | Time stamp Input Unit 12 Status Register   |
| 0x582 – 0x583                | 0x582<br>0x583 | TS12_CFG               | 0x0000        | Time stamp Input Unit 12 Configuration/<br>Control Register  |
| 0x584 – 0x585                | 0x584<br>0x585 | TS12_SM-<br>PL1_NSL    | 0x0000        | Time stamp Unit 12 Input Sample Time (1 <sup>st</sup> )<br>in Nanoseconds Low-Word Register [15:0]   |
| 0x586 – 0x587                | 0x586<br>0x587 | TS12_SM-<br>PL1_NSH    | 0x0000        | Time stamp Unit 12 Input Sample Time (1 <sup>st</sup> )<br>in Nanoseconds High-Word Register [29:16] |
| 0x588 – 0x589                | 0x588<br>0x589 | TS12_SM-<br>PL1_SL     | 0x0000        | Time stamp Unit 12 Input Sample Time (1 <sup>st</sup> )<br>in Seconds Low-Word Register [15:0]       |
| 0x58A – 0x58B                | 0x58A<br>0x58B | TS12_SM-<br>PL1_SH     | 0x0000        | Time stamp Unit 12 Input Sample Time (1 <sup>st</sup> )<br>in Seconds High-Word Register [31:16]     |
| 0x58C – 0x58D                | 0x58C<br>0x58D | TS12_SMPL1_-<br>SUB_NS | 0x0000        | Time stamp Unit 12 Input Sample Time (1 <sup>st</sup> )<br>in Sub-Nanoseconds Register [2:0]         |
| 0x58E – 0x593                | 0x58E<br>0x593 | Reserved<br>(6-Bytes)  | Don't Care    | None   |
| 0x594 – 0x595                | 0x594<br>0x595 | TS12_SM-<br>PL2_NSL    | 0x0000        | Time stamp Unit 12 Input Sample Time (2nd) in Nanoseconds Low-Word Register [15:0]                   |
| 0x596 – 0x597                | 0x596<br>0x597 | TS12_SM-<br>PL2_NSH    | 0x0000        | Time stamp Unit 12 Input Sample Time (2nd) in Nanoseconds High-Word Register [29:16]                 |
| 0x598 – 0x599                | 0x598<br>0x599 | TS12_SMP2_S<br>L       | 0x0000        | Time stamp Unit 12 Input Sample Time (2nd) in Seconds Low-Word Register [15:0]                       |
| 0x59A – 0x59B                | 0x59A<br>0x59B | TS12_SM-<br>PL2_SH     | 0x0000        | Time stamp Unit 12 Input Sample Time (2nd) in Seconds High-Word Register [31:16]                     |
| 0x59C – 0x59D                | 0x59C<br>0x59D | TS12_SMPL2_-<br>SUB_NS | 0x0000        | Time stamp Unit 12 Input Sample Time (2nd) in Sub-Nanoseconds Register [2:0]                         |
| 0x59E – 0x5A3                | 0x59E<br>0x5A3 | Reserved<br>(6-Bytes)  | Don't Care    | None   |
| 0x5A4 – 0x5A5                | 0x5A4<br>0x5A5 | TS12_SM-<br>PL3_NSL    | 0x0000        | Time stamp Unit 12 Input Sample Time (3rd) in Nanoseconds Low-Word Register [15:0]                   |

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**TABLE 4-6: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description  |
|------------------------------|----------------|------------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                        |               |  |
| 0x5A6 – 0x5A7                | 0x5A6<br>0x5A7 | TS12_SM-<br>PL3_NSH    | 0x0000        | Time stamp Unit 12 Input Sample Time (3rd) in Nanoseconds High-Word Register [29:16] |
| 0x5A8 – 0x5A9                | 0x5A8<br>0x5A9 | TS12_SM-<br>PL3_SL     | 0x0000        | Time stamp Unit 12 Input Sample Time (3rd) in Seconds Low-Word Register [15:0]       |
| 0x5AA – 0x5AB                | 0x5AA<br>0x5AB | TS12_SM-<br>PL3_SH     | 0x0000        | Time stamp Unit 12 Input Sample Time (3rd) in Seconds High-Word Register [31:16]     |
| 0x5AC – 0x5AD                | 0x5AC<br>0x5AD | TS12_SMPL3_-<br>SUB_NS | 0x0000        | Time stamp Unit 12 Input Sample Time (3rd) in Sub-Nanoseconds Register [2:0]         |
| 0x5AE – 0x5B3                | 0x5AE<br>0x5B3 | Reserved<br>(6-Bytes)  | Don't Care    | None   |
| 0x5B4 – 0x5B5                | 0x5B4<br>0x5B5 | TS12_SM-<br>PL4_NSL    | 0x0000        | Time stamp Unit 12 Input Sample Time (4th) in Nanoseconds Low-Word Register [15:0]   |
| 0x5B6 – 0x5B7                | 0x5B6<br>0x5B7 | TS12_SM-<br>PL4_NSH    | 0x0000        | Time stamp Unit 12 Input Sample Time (4th) in Nanoseconds High-Word Register [29:16] |
| 0x5B8 – 0x5B9                | 0x5B8<br>0x5B9 | TS12_SM-<br>PL4_SL     | 0x0000        | Time stamp Unit 12 Input Sample Time (4th) in Seconds Low-Word Register [15:0]       |
| 0x5BA – 0x5BB                | 0x5BA<br>0x5BB | TS12_SM-<br>PL4_SH     | 0x0000        | Time stamp Unit 12 Input Sample Time (4th) in Seconds High-Word Register [31:16]     |
| 0x5BC – 0x5BD                | 0x5BC<br>0x5BD | TS12_SMPL4_-<br>SUB_NS | 0x0000        | Time stamp Unit 12 Input Sample Time (4th) in Sub-Nanoseconds Register [2:0]         |
| 0x5BE – 0x5C3                | 0x5BE<br>0x5C3 | Reserved<br>(6-Bytes)  | Don't Care    | None   |
| 0x5C4 – 0x5C5                | 0x5C4<br>0x5C5 | TS12_SM-<br>PL5_NSL    | 0x0000        | Time stamp Unit 12 Input Sample Time (5th) in Nanoseconds Low-Word Register [15:0]   |
| 0x5C6 – 0x5C7                | 0x5C6<br>0x5C7 | TS12_SM-<br>PL5_NSH    | 0x0000        | Time stamp Unit 12 Input Sample Time (5th) in Nanoseconds High-Word Register [29:16] |
| 0x5C8 – 0x5C9                | 0x5C8<br>0x5C9 | TS12_SM-<br>PL5_SL     | 0x0000        | Time stamp Unit 12 Input Sample Time (5th) in Seconds Low-Word Register [15:0]       |
| 0x5CA – 0x5CB                | 0x5CA<br>0x5CB | TS12_SM-<br>PL5_SH     | 0x0000        | Time stamp Unit 12 Input Sample Time (5th) in Seconds High-Word Register [31:16]     |
| 0x5CC – 0x5CD                | 0x5CC<br>0x5CD | TS12_SMPL5_-<br>SUB_NS | 0x0000        | Time stamp Unit 12 Input Sample Time (5th) in Sub-Nanoseconds Register [2:0]         |
| 0x5CE – 0x5D3                | 0x5CE<br>0x5D3 | Reserved<br>(6-Bytes)  | Don't Care    | None   |
| 0x5D4 – 0x5D5                | 0x5D4<br>0x5D5 | TS12_SM-<br>PL6_NSL    | 0x0000        | Time stamp Unit 12 Input Sample Time (6th) in Nanoseconds Low-Word Register [15:0]   |
| 0x5D6 – 0x5D7                | 0x5D6<br>0x5D7 | TS12_SM-<br>PL6_NSH    | 0x0000        | Time stamp Unit 12 Input Sample Time (6th) in Nanoseconds High-Word Register [29:16] |

**TABLE 4-6: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description  |
|------------------------------|----------------|------------------------|---------------|--|
| 16-Bit                       | 8-Bit          |                        |               |  |
| 0x5D8 – 0x5D9                | 0x5D8<br>0x5D9 | TS12_SM-<br>PL6_SL     | 0x0000        | Time stamp Unit 12 Input Sample Time (6th) in Seconds Low-Word Register [15:0]       |
| 0x5DA – 0x5DB                | 0x5DA<br>0x5DB | TS12_SM-<br>PL6_SH     | 0x0000        | Time stamp Unit 12 Input Sample Time (6th) in Seconds High-Word Register [31:16]     |
| 0x5DC – 0x5DD                | 0x5DC<br>0x5DD | TS12_SMPL6_-<br>SUB_NS | 0x0000        | Time stamp Unit 12 Input Sample Time (6th) in Sub-Nanoseconds Register [2:0]         |
| 0x5DE – 0x5E3                | 0x5DE<br>0x5E3 | Reserved<br>(6-Bytes)  | Don't care    | None   |
| 0x5E4 – 0x5E5                | 0x5E4<br>0x5E5 | TS12_SM-<br>PL7_NSL    | 0x0000        | Time stamp Unit 12 Input Sample Time (7th) in Nanoseconds Low-Word Register [15:0]   |
| 0x5E6 – 0x5E7                | 0x5E6<br>0x5E7 | TS12_SM-<br>PL7_NSH    | 0x0000        | Time stamp Unit 12 Input Sample Time (7th) in Nanoseconds High-Word Register [29:16] |
| 0x5E8 – 0x5E9                | 0x5E8<br>0x5E9 | TS12_SM-<br>PL7_SL     | 0x0000        | Time stamp Unit 12 Input Sample Time (7th) in Seconds Low-Word Register [15:0]       |
| 0x5EA – 0x5EB                | 0x5EA<br>0x5EB | TS12_SM-<br>PL7_SH     | 0x0000        | Time stamp Unit 12 Input Sample Time (7th) in Seconds High-Word Register [31:16]     |
| 0x5EC – 0x5ED                | 0x5EC<br>0x5ED | TS12_SMPL7_-<br>SUB_NS | 0x0000        | Time stamp Unit 12 Input Sample Time (7th) in Sub-Nanoseconds Register [2:0]         |
| 0x5EE – 0x5F3                | 0x5EE<br>0x5F3 | Reserved<br>(6-Bytes)  | Don't Care    | None   |
| 0x5F4 – 0x5F5                | 0x5F4<br>0x5F5 | TS12_SM-<br>PL8_NSL    | 0x0000        | Time stamp Unit 12 Input Sample Time (8th) in Nanoseconds Low-Word Register [15:0]   |
| 0x5F6 – 0x5F7                | 0x5F6<br>0x5F7 | TS12_SM-<br>PL8_NSH    | 0x0000        | Time stamp Unit 12 Input Sample Time (8th) in Nanoseconds High-Word Register [29:16] |
| 0x5F8 – 0x5F9                | 0x5F8<br>0x5F9 | TS12_SM-<br>PL8_SL     | 0x0000        | Time stamp Unit 12 Input Sample Time (8th) in Seconds Low-Word Register [15:0]       |
| 0x5FA – 0x5FB                | 0x5FA<br>0x5FB | TS12_SM-<br>PL8_SH     | 0x0000        | Time stamp Unit 12 Input Sample Time (8th) in Seconds High-Word Register [31:16]     |
| 0x5FC – 0x5FD                | 0x5FC<br>0x5FD | TS12_SMPL8_-<br>SUB_NS | 0x0000        | Time stamp Unit 12 Input Sample Time (8th) in Sub-Nanoseconds Register [2:0]         |
| 0x5FE – 0x5FF                | 0x5FE<br>0x5FF | Reserved<br>(2-Bytes)  | Don't Care    | None   |

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**TABLE 4-7: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP 1588 CLOCK AND GLOBAL CONTROL (0X600 – 0X7FF)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description   |
|------------------------------|----------------|------------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                        |               |   |
| 0x600 – 0x601                | 0x600<br>0x601 | PTP_CLK_CTL            | 0x0002        | PTP Clock Control Register [6:0]  |
| 0x602 – 0x603                | 0x602<br>0x603 | Reserved<br>(2-Bytes)  | Don't care    | None  |
| 0x604 – 0x605                | 0x604<br>0x605 | PTP_RTC_NSL            | 0x0000        | PTP Real Time Clock in Nanoseconds Low-Word Register [15:0]                               |
| 0x606 – 0x607                | 0x606<br>0x607 | PTP_RTC_NSH            | 0x0000        | PTP Real Time Clock in Nanoseconds High-Word Register [31:16]                             |
| 0x608 – 0x609                | 0x608<br>0x609 | PTP_RTC_SL             | 0x0000        | PTP Real Time Clock in Seconds Low-Word Register [15:0]                                   |
| 0x60A – 0x60B                | 0x60A<br>0x60B | PTP_RTC_SH             | 0x0000        | PTP Real Time Clock in Seconds High-Word Register [31:16]                                 |
| 0x60C – 0x60D                | 0x60C<br>0x60D | PTP_RT-<br>C_PHASE     | 0x0000        | PTP Real Time Clock in Phase Register [2:0]   |
| 0x60E – 0x60F                | 0x60E<br>0x60F | Reserved<br>(2-Bytes)  | Don't Care    | None  |
| 0x610 – 0x611                | 0x610<br>0x611 | PTP_SNS_RATE_L         | 0x0000        | PTP Sub-nanosecond Rate Low-Word Register [15:0]  |
| 0x612 – 0x613                | 0x612<br>0x613 | PTP_SNS_RATE_H         | 0x0000        | PTP Sub-nanosecond Rate High-Word [29:16] and Configuration Register                      |
| 0x614 – 0x615                | 0x614<br>0x615 | PTP_TEMP_ADJ_DURA_L    | 0x0000        | PTP Temporary Adjustment Mode Duration Low-Word Register [15:0]                           |
| 0x616 – 0x617                | 0x616<br>0x617 | PTP_TEMP_ADJ_DURA_H    | 0x0000        | PTP Temporary Adjustment Mode Duration High-Word Register [31:16]                         |
| 0x618 – 0x61F                | 0x618<br>0x61F | Reserved<br>(8-Bytes)  | Don't Care    | None  |
| 0x620 – 0x621                | 0x620<br>0x621 | PTP_MSG_CFG_1          | 0x0059        | PTP Message Configuration 1 Register [7:0]  |
| 0x622 – 0x623                | 0x622<br>0x623 | PTP_MSG_CFG_2          | 0x0404        | PTP Message Configuration 2 Register [10:0]   |
| 0x624 – 0x625                | 0x624<br>0x625 | PTP_DOMAIN_VER         | 0x0200        | PTP Domain and Version Register [11:0]  |
| 0x626 – 0x63F                | 0x626<br>0x63F | Reserved<br>(26-Bytes) | Don't Care    | None  |
| 0x640 – 0x641                | 0x640<br>0x641 | PTP_P1_RX_LATENCY      | 0x019F        | PTP Port 1 Receive Latency Register [15:0]  |
| 0x642 – 0x643                | 0x642<br>0x643 | PTP_P1_TX_LATENCY      | 0x002D        | PTP Port 1 Transmit Latency Register [15:0]   |
| 0x644 – 0x645                | 0x644<br>0x645 | PTP_P1_ASYM_COR        | 0x0000        | PTP Port 1 Asymmetry Correction Register [15:0]   |
| 0x646 – 0x647                | 0x646<br>0x647 | PTP_P1_LINK_DLY        | 0x0000        | PTP Port 1 Link Delay Register [15:0]   |
| 0x648 – 0x649                | 0x648<br>0x649 | P1_XDLY_REQ_TSL        | 0x0000        | PTP Port 1 Egress Time stamp Low-Word for Pdelay_REQ and Delay_REQ Frames Register [15:0] |

**TABLE 4-7: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP 1588 CLOCK AND GLOBAL CONTROL (0X600 – 0X7FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name          | Default Value | Description   |
|------------------------------|----------------|------------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                        |               |   |
| 0x64A – 0x64B                | 0x64A<br>0x64B | P1_XD-<br>LY_REQ_TSH   | 0x0000        | PTP Port 1 Egress Time stamp High-Word for Pdelay_REQ and Delay_REQ Frames Register [31:16] |
| 0x64C – 0x64D                | 0x64C<br>0x64D | P1_SYNC_TSL            | 0x0000        | PTP Port 1 Egress Time stamp Low-Word for SYNC Frame Register [15:0]                        |
| 0x64E – 0x64F                | 0x64E<br>0x64F | P1_SYNC_TSH            | 0x0000        | PTP Port 1 Egress Time stamp High-Word for SYNC Frame Register [31:16]                      |
| 0x650 – 0x651                | 0x650<br>0x651 | P1_PDLY_RE-<br>SP_TSL  | 0x0000        | PTP Port 1 Egress Time stamp Low-Word for Pdelay_resp Frame Register [15:0]                 |
| 0x652 – 0x653                | 0x652<br>0x653 | P1_PDLY_RE-<br>SP_TSH  | 0x0000        | PTP Port 1 Egress Time stamp High-Word for Pdelay_resp Frame Register [31:16]               |
| 0x654 – 0x65F                | 0x654<br>0x65F | Reserved<br>(12-Bytes) | Don't Care    | None  |
| 0x660 – 0x661                | 0x660<br>0x661 | PTP_P2_RX-<br>_LATENCY | 0x019F        | PTP Port 2 Receive Latency Register [15:0]  |
| 0x662 – 0x663                | 0x662<br>0x663 | PTP_P2_TX-<br>_LATENCY | 0x002D        | PTP Port 2 Transmit Latency Register [15:0]   |
| 0x664 – 0x665                | 0x664<br>0x665 | PTP_P2_ASYM-<br>_COR   | 0x0000        | PTP Port 2 Asymmetry Correction Register [15:0]   |
| 0x666 – 0x667                | 0x666<br>0x667 | PTP_P2_LINK-<br>_DLY   | 0x0000        | PTP Port 2 Link Delay Register [15:0]   |
| 0x668 – 0x669                | 0x668<br>0x669 | P2_XD-<br>LY_REQ_TSL   | 0x0000        | PTP Port 2 Egress Time stamp Low-Word for Pdelay_REQ and Delay_REQ Frames Register [15:0]   |
| 0x66A – 0x66B                | 0x66A<br>0x66B | P2_XD-<br>LY_REQ_TSH   | 0x0000        | PTP Port 2 Egress Time stamp High-Word for Pdelay_REQ and Delay_REQ Frames Register [31:16] |
| 0x66C – 0x66D                | 0x66C<br>0x66D | P2_SYNC_TSL            | 0x0000        | PTP Port 2 Egress Time stamp Low-Word for SYNC Frame Register [15:0]                        |
| 0x66E – 0x66F                | 0x66E<br>0x66F | P2_SYNC_TSH            | 0x0000        | PTP Port 2 Egress Time stamp High-Word for SYNC Frame Register [31:16]                      |
| 0x670 – 0x671                | 0x670<br>0x671 | P2_PDLY_RE-<br>SP_TSL  | 0x0000        | PTP Port 2 Egress Time stamp Low-Word for Pdelay_resp Frame Register [15:0]                 |
| 0x672 – 0x673                | 0x672<br>0x673 | P2_PDLY_RE-<br>SP_TSH  | 0x0000        | PTP Port 2 Egress Time stamp High-Word for Pdelay_resp Frame Register [31:16]               |
| 0x674 – 0x67F                | 0x674<br>0x67F | Reserved<br>(12-Bytes) | Don't Care    | None  |
| 0x680 – 0x681                | 0x680<br>0x681 | GPIO_MONI-<br>TOR      | 0x0000        | PTP GPIO Monitor Register [11:0]  |
| 0x682 – 0x683                | 0x682<br>0x683 | GPIO_OEN               | 0x0000        | PTP GPIO Output Enable Register [11:0]  |
| 0x684 – 0x687                | 0x684<br>0x687 | Reserved<br>(4-Bytes)  | Don't Care    | None  |
| 0x688 – 0x689                | 0x688<br>0x689 | PTP_TRIG_IS            | 0x0000        | PTP Trigger Unit Interrupt Status Register  |
| 0x68A – 0x68B                | 0x68A<br>0x68B | PTP_TRIG_IE            | 0x0000        | PTP Trigger Unit Interrupt Enable Register  |

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**TABLE 4-7: INTERNAL I/O REGISTER SPACE MAPPING FOR PTP 1588 CLOCK AND GLOBAL CONTROL (0X600 – 0X7FF) (CONTINUED)**

| I/O Register Offset Location |                | Register Name           | Default Value | Description                                   |
|------------------------------|----------------|-------------------------|---------------|---|
| 16-Bit                       | 8-Bit          |                         |               |   |
| 0x68C – 0x68D                | 0x68C<br>0x68D | PTP_TS_IS               | 0x0000        | PTP Time stamp Unit Interrupt Status Register |
| 0x68E – 0x68F                | 0x68E<br>0x68F | PTP_TS_IE               | 0x0000        | PTP Time stamp Unit Interrupt Enable Register |
| 0x690 – 0x733                | 0x690<br>0x733 | Reserved<br>(164-Bytes) | Don't Care    | None  |
| 0x734 – 0x735                | 0x734<br>0x735 | DSP_CNTRL_6             | 0x3020        | DSP Control 1 Register                        |
| 0x736 – 0x747                | 0x736<br>0x747 | Reserved<br>(18-Bytes)  | Don't Care    | None  |
| 0x748 – 0x749                | 0x748<br>0x749 | ANA_CNTRL_1             | 0x0000        | Analog Control 1 Register                     |
| 0x74A – 0x74B                | 0x74A<br>0x74B | Reserved<br>(2-Bytes)   | Don't Care    | None  |
| 0x74C – 0x74D                | 0x74C<br>0x74D | ANA_CNTRL_3             | 0x0000        | Analog Control 3 Register                     |
| 0x74E – 0x7FF                | 0x74E<br>0x7FF | Reserved<br>(178-Bytes) | Don't Care    | None  |

## 4.2 Register Bit Definitions

The section provides details of the bit definitions for the registers summarized in the previous section. Writing to a bit or register defined as reserved could cause unpredictable results. If it is necessary to write to registers that contain both writable and reserved bits in the same register, the user should first read back the reserved bits (RO or RW), then “OR” the desired settable bits with the value read and write back the “ORed” value back to the register.

Bit Type Definition:

- RO = Read only.
- WO = Write only.
- RW = Read/Write.
- SC = Self-Clear.
- W1C = Write “1” to Clear (Write a “1” to clear this bit).

### 4.2.1 INTERNAL I/O REGISTER SPACE MAPPING FOR SWITCH CONTROL AND CONFIGURATION (0X000 – 0X0FF)

#### 4.2.1.1 Chip ID and Enable Register (0x000 – 0x001): CIDER

This register contains the chip ID and switch-enable control.

**TABLE 4-8: CHIP ID AND ENABLE REGISTER (0X000 – 0X001): CIDER**

| Bit    | Default | R/W | Description                                   |
|--------|---------|-----|---|
| 15 – 8 | 0x84    | RO  | <b>Family ID</b><br>Chip family ID.           |
| 7 – 4  | 0x3     | RO  | <b>Chip ID</b><br>0x3 is assigned to KSZ8462. |
| 3 – 1  | 001     | RO  | <b>Revision ID</b><br>Chip revision ID.       |

**TABLE 4-8: CHIP ID AND ENABLE REGISTER (0X000 – 0X001): CIDER (CONTINUED)**

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 0   | 1       | RW  | <b>Start Switch</b><br>1 = Start the chip.<br>0 = Switch is disabled. |

## 4.2.1.2 Switch Global Control Register 1 (0x002 – 0x003): SGCR1

This register contains global control bits for the switch function.

**TABLE 4-9: SWITCH GLOBAL CONTROL REGISTER 1 (0X002 – 0X003): SGCR1**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 15    | 0       | RW  | <b>Pass All Frames</b><br>1 = Switch all packets including bad ones. Used solely for debugging purposes. Works in conjunction with sniffer mode only.<br>0 = Do not pass bad frames.   |
| 14    | 0       | RW  | <b>Receive 2000 Byte Packet Length Enable</b><br>1 = Enables the receipt of packets up to and including 2000 bytes in length.<br>0 = Discards the received packets if their length is greater than 2000 bytes.   |
| 13    | 1       | RW  | <b>IEEE 802.3x Transmit Direction Flow Control Enable</b><br>1 = Enables transmit direction flow control feature.<br>0 = Disable transmit direction flow control feature. The switch will not generate any flow control packets.                               |
| 12    | 1       | RW  | <b>IEEE 802.3x Receive Direction Flow Control Enable</b><br>1 = Enables receive direction flow control feature.<br>0 = Disable receive direction flow control feature. The switch will not react to any received flow control packets.                         |
| 11    | 0       | RW  | <b>Frame Length Field Check</b><br>1 = Enable checking frame length field in the IEEE packets. If the actual length does not match, the packet will be dropped (for Length/Type field < 1500).<br>0 = Disable checking frame length field in the IEEE packets. |
| 10    | 1       | RW  | <b>Aging Enable</b><br>1 = Enable aging function in the chip.<br>0 = Disable aging function in the chip.   |
| 9     | 0       | RW  | <b>Fast Age Enable</b><br>1 = Turn on fast age (800 μs).   |
| 8     | 0       | RW  | <b>Aggressive Back-Off Enable</b><br>1 = Enable more aggressive back-off algorithm in half-duplex mode to enhance performance. This is not an IEEE standard.   |
| 7 – 6 | 01      | RW  | Reserved   |
| 5     | 0       | RW  | <b>Enable Flow Control when Exceeding Ingress Limit</b><br>1 = Flow control frame will be sent to link partner when exceeding the ingress rate limit.<br>0 = Frame will be dropped when exceeding the ingress rate limit.                                      |
| 4     | 1       | RW  | <b>Receive 2K Byte Packets Enable</b><br>1 = Enable packet length up to 2K bytes. While set, SGCR2 bits[2,1] will have no effect.<br>0 = Discard packet if packet length is greater than 2000 bytes.   |
| 3     | 0       | RW  | <b>Pass Flow Control Packet</b><br>1 = Switch will not filter 802.3x “flow control” packets.   |
| 2 – 1 | 00      | RW  | Reserved   |

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**TABLE 4-9: SWITCH GLOBAL CONTROL REGISTER 1 (0X002 – 0X003): SGCR1 (CONTINUED)**

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 0   | 0       | RW  | <b>Link Change Age</b><br>1 = Link change from “link” to “no link” will cause fast aging (<800 $\mu$ s) to age address table faster. After an age cycle is complete, the age logic will return to normal (300 $\pm$ 75 seconds). This affects ports not linked and not active linked ports.<br><b>Note:</b> If any port is unplugged, all addresses will be automatically aged out. |

## 4.2.1.3 Switch Global Control Register 2 (0x004 – 0x005): SGCR2

This register contains global control bits for the switch function.

**TABLE 4-10: SWITCH GLOBAL CONTROL REGISTER 2 (0X004 – 0X005): SGCR2**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15     | 0       | RW  | <b>802.1Q VLAN Enable</b><br>1 = 802.1Q VLAN mode is turned on. VLAN table must be set up before the operation.<br>0 = 802.1Q VLAN is disabled.   |
| 14     | 0       | RW  | <b>IGMP Snoop Enable</b><br>1 = IGMP snoop is enabled.<br>0 = IGMP snoop is disabled.   |
| 13     | 0       | RW  | <b>IPv6 MLD Snooping Enable</b><br>1 = Enable IPv6 MLD snooping.  |
| 12     | 0       | RW  | <b>IPv6 MLD Snooping Option Select</b><br>1 = Enable IPv6 MLD snooping option.  |
| 11 – 9 | 000     | RW  | Reserved  |
| 8      | 0       | RW  | <b>Sniff Mode Select</b><br>1 = Performs RX and TX sniff (both the source port and destination port need to match).<br>0 = Performs RX or TX sniff (either the source port or destination port needs to match). This is the mode used to implement RX only sniff.   |
| 7      | 1       | RW  | <b>Unicast Port-VLAN Mismatch Discard</b><br>1 = No packets can cross the VLAN boundary.<br>0 = Unicast packets (excluding unknown/multicast/broadcast) can cross the VLAN boundary.  |
| 6      | 1       | RW  | <b>Multicast Storm Protection Disable</b><br>1 = “Broadcast Storm Protection” does not include multicast packets. Only DA = FF-FF-FF-FF-FF-FF packets are regulated.<br>0 = “Broadcast Storm Protection” includes DA = FF-FF-FF-FF-FF-FF and DA[40] = “1” packets.  |
| 5      | 1       | RW  | <b>Back Pressure Mode</b><br>1 = Carrier sense-based back pressure is selected.<br>0 = Collision-based back pressure is selected.   |
| 4      | 1       | RW  | <b>Flow Control and Back Pressure Fair Mode</b><br>1 = Fair mode is selected. In this mode, if a flow control port and a non-flow control port talk to the same destination port, packets from the non-flow control port may be dropped. This prevents the flow control port from being flow controlled for an extended period of time.<br>0 = In this mode, if a flow control port and a non-flow control port talk to the same destination port, the flow control port is flow controlled. This may not be “fair” to the flow control port. |
| 3      | 0       | RW  | <b>No Excessive Collision Drop</b><br>1 = The switch does not drop packets when 16 or more collisions occur.<br>0 = The switch drops packets when 16 or more collisions occur.  |



**TABLE 4-10: SWITCH GLOBAL CONTROL REGISTER 2 (0X004 – 0X005): SGCR2 (CONTINUED)**

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 2   | 0       | RW  | <b>Huge Packet Support</b><br>1 = Accepts packet sizes up to 1916 bytes (inclusive). This bit setting overrides setting from bit [1] of the same register.<br>0 = The max packet size is determined by bit [1] of this register.  |
| 1   | 0       | RW  | <b>Legal Maximum Packet Size Check Enable</b><br>1 = 1522 bytes for tagged packets, 1518 bytes for untagged packets. Any packets larger than the specified value are dropped.<br>0 = Accepts packet sizes up to 1536 bytes (inclusive).   |
| 0   | 0       | RW  | <b>Priority Buffer Reserve</b><br>1 = Each port is pre-allocated 48 buffers, used exclusively for high priority (q3, q2, and q1) packets. Effective only when the multiple queue feature is turned on.<br>0 = Each port is pre-allocated 48 buffers used for all priority packets (q3, q2, q1, and q0). |

## 4.2.1.4 Switch Global Control Register 3 (0x006 – 0x007): SGCR3

This register contains global control bits for the switch function.

**TABLE 4-11: SWITCH GLOBAL CONTROL REGISTER 3 (0X006 – 0X007): SGCR3**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 – 8 | 0x63    | RW  | <b>Broadcast Storm Protection Rate Bits[7:0]</b><br>These bits, along with SGCR3[2:0], determine how many 64-byte blocks of packet data are allowed on an input port in a preset period. The period is 67 ms for 100BASE-TX or 670 ms for 10BASE-T. The default is 1%.   |
| 7      | 0       | RO  | Reserved   |
| 6      | 0       | RW  | <b>Switch Host Port in Half-Duplex Mode</b><br>1 = Enable host port interface half-duplex mode.<br>0 = Enable host port interface full-duplex mode.  |
| 5      | 1       | RW  | <b>Switch Host Port Flow Control Enable</b><br>1 = Enable full-duplex flow control on switch host port.<br>0 = Disable full-duplex flow control on switch host port  |
| 4      | 0       | RW  | <b>Switch MII 10BASE-T</b><br>1 = The switch is in 10 Mbps mode.<br>0 = The switch is in 100 Mbps mode.  |
| 3      | 0       | RW  | <b>Null VID Replacement</b><br>1 = Replaces NULL VID with port VID (12 bits).<br>0 = No replacement for NULL VID.  |
| 2 – 0  | 000     | RW  | <b>Broadcast Storm Protection Rate Bits[10:8]</b><br>These bits, along with SGCR3[15:8] determine how many 64-byte blocks of packet data are allowed on an input port in a preset period. The period is 67 ms for 100BASE-TX or 670 ms for 10BASE-T. The default is 1%.<br>Broadcast storm protection rate: 148,800 frames/sec * 67 ms/interval * 1% = 99 frames/interval (approx. 0x63) |

## 4.2.1.5 0x008 – 0x00B: Reserved

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## 4.2.1.6 Switch Global Control Register 6 (0x00C – 0x00D): SGCR6

This register contains global control bits for the switch function.

**TABLE 4-12: SWITCH GLOBAL CONTROL REGISTER 6 (0X00C – 0X00D): SGCR6**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 – 14 | 11      | RW  | <b>Tag_0x7</b><br>IEEE 802.1p mapping. The value in this field is used as the frame's priority when its VLAN Tag has a value of 0x7. |
| 13 – 12 | 11      | RW  | <b>Tag_0x6</b><br>IEEE 802.1p mapping. The value in this field is used as the frame's priority when its VLAN Tag has a value of 0x6. |
| 11 – 10 | 10      | RW  | <b>Tag_0x5</b><br>IEEE 802.1p mapping. The value in this field is used as the frame's priority when its VLAN Tag has a value of 0x5. |
| 9 – 8   | 10      | RW  | <b>Tag_0x4</b><br>IEEE 802.1p mapping. The value in this field is used as the frame's priority when its VLAN Tag has a value of 0x4. |
| 7 – 6   | 01      | RW  | <b>Tag_0x3</b><br>IEEE 802.1p mapping. The value in this field is used as the frame's priority when its VLAN Tag has a value of 0x3. |
| 5 – 4   | 01      | RW  | <b>Tag_0x2</b><br>IEEE 802.1p mapping. The value in this field is used as the frame's priority when its VLAN Tag has a value of 0x2. |
| 3 – 2   | 00      | RW  | <b>Tag_0x1</b><br>IEEE 802.1p mapping. The value in this field is used as the frame's priority when its VLAN Tag has a value of 0x1. |
| 1 – 0   | 00      | RW  | <b>Tag_0x0</b><br>IEEE 802.1p mapping. The value in this field is used as the frame's priority when its VLAN Tag has a value of 0x0. |

## 4.2.1.7 Switch Global Control Register 7 (0x00E – 0x00F): SGCR7

This register contains global control bits for the switch function.

**TABLE 4-13: SWITCH GLOBAL CONTROL REGISTER 7 (0X00E – 0X00F): SGCR7**

| Bit     | Default | R/W | Description  |                 |                   |
|---------|---------|-----|--|-----------------|-------------------|
| 15 – 10 | 0x02    | RW  | Reserved   |                 |                   |
| 9 – 8   | 00      | RW  | <b>Port LED Mode</b><br>When read, these two bits provide the current setting of the LED display mode for P1/2LED1 and P1/2LED0 as defined as below. Reg. 0x06C – 0x06D, bits [14:12] determine if this automatic functionality is utilized or if the port 1 LEDs are controlled by the local processor. Reg. 0x084 – 0x085, bits [14:12] determine if this automatic functionality is utilized or if the port 2 LEDs are controlled by the local processor. |                 |                   |
|         |         |     | <b>LED Mode</b>  | <b>P1/2LED1</b> | <b>P1/2LED0</b>   |
|         |         |     | 00   | Speed           | Link and Activity |
|         |         |     | 01   | Activity        | Link              |
|         |         |     | 10   | Full-Duplex     | Link and Activity |
|         |         |     | 11   | Full-Duplex     | Link              |
|         |         |     |  |                 |                   |
| 7       | 0       | RW  | <b>Unknown Default Port Enable</b><br>Send packets with unknown destination address to specified ports in bits [2:0].<br>1 = Enable to send unknown DA packet  |                 |                   |

**TABLE 4-13: SWITCH GLOBAL CONTROL REGISTER 7 (0X00E – 0X00F): SGR7 (CONTINUED)**

| Bit   | Default  | R/W | Description  |
|-------|----------|-----|--|
| 6 – 5 | 01 or 10 | RW  | <b>Driver Strength Selection</b><br>These two bits determine the drive strength of all I/O pins except for the following category of pins: LED pins, GPIO pins, INTRN, RSTN, and RXD3/REFCLK_0.<br>00 = 4 mA<br>01 = 8 mA. (Default when VDD_IO is 3.3V or 2.5V)<br>10 = 12 mA. (Default when VDD_IO is 1.8V)<br>11 = 16 mA. |
| 4 – 3 | 00       | RW  | Reserved   |
| 2 – 0 | 111      | RW  | <b>Unknown Packet Default Port(s)</b><br>Specifies which ports to send packets with unknown destination addresses. This applies to both unicast and multicast addresses that are unknown. Feature is enabled by bit[7].<br>Bit[2] = For Port 3 (MII/RMII Port)<br>Bit[1] = For Port 2<br>Bit[0] = For Port 1                 |

## 4.2.2 MAC ADDRESS REGISTERS

### 4.2.2.1 MAC Address Register 1 (0x010 – 0x011): MACAR1

This register contains the two MSBs of the MAC address for the switch function. This MAC address is used for sending PAUSE frames.

**TABLE 4-14: MAC ADDRESS REGISTER 1 (0X010 – 0X011): MACAR1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 – 0 | 0x0010  | RW  | <b>MACA[47:32]</b><br>Specifies MAC Address 1 for sending PAUSE frame. |

### 4.2.2.2 MAC Address Register 2 (0x012 – 0x013): MACAR2

This register contains the MAC address for the switch function. This MAC address is used for sending PAUSE frames.

**TABLE 4-15: MAC ADDRESS REGISTER 2 (0X012 – 0X013): MACAR2**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 – 0 | 0xA1FF  | RW  | <b>MACA[31:16]</b><br>Specifies MAC Address 2 for sending PAUSE frame. |

### 4.2.2.3 MAC Address Register 3 (0x014 – 0x015): MACAR3

This register contains the two LSBs of the MAC address for the switch function. This MAC address is used for sending PAUSE frames.

**TABLE 4-16: MAC ADDRESS REGISTER 3 (0X014 – 0X015): MACAR3**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 – 0 | 0xFFFF  | RW  | <b>MACA[15:0]</b><br>Specifies MAC Address 3 for sending PAUSE frame. |

## 4.2.3 TYPE-OF-SERVICE (TOS) PRIORITY CONTROL REGISTERS

### 4.2.3.1 TOS Priority Control Register 1 (0x016 – 0x017): TOSR1

The IPv4/IPv6 type-of-service (TOS) priority control registers are used to define a 2-bit priority to each of the 64 possible values in the 6-bit differentiated services code point (DSCP) field in the IP header of ingress frames.

This register contains the TOS priority control bits for the switch function.

**TABLE 4-17: TOS PRIORITY CONTROL REGISTER 1 (0X016 – 0X017): TOSR1**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 – 14 | 00      | RW  | <b>DSCP[15:14]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x1c. |
| 13 – 12 | 00      | RW  | <b>DSCP[13:12]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x18. |
| 11 – 10 | 00      | RW  | <b>DSCP[11:10]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x14. |
| 9 – 8   | 00      | RW  | <b>DSCP[9:8]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x10.   |
| 7 – 6   | 00      | RW  | <b>DSCP[7:6]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x0c.   |
| 5 – 4   | 00      | RW  | <b>DSCP[5:4]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x08.   |
| 3 – 2   | 00      | RW  | <b>DSCP[3:2]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x04.   |
| 1 – 0   | 00      | RW  | <b>DSCP[1:0]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x00.   |

## 4.2.3.2 TOS Priority Control Register 2 (0x018 – 0x019): TOSR2

This register contains the TOS priority control bits for the switch function.

**TABLE 4-18: TOS PRIORITY CONTROL REGISTER 2 (0X018 – 0X019): TOSR2**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 – 14 | 00      | RW  | <b>DSCP[31:30]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x3c. |
| 13 – 12 | 00      | RW  | <b>DSCP[29:28]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x38. |
| 11 – 10 | 00      | RW  | <b>DSCP[27:26]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x34. |
| 9 – 8   | 00      | RW  | <b>DSCP[25:24]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x30. |
| 7 – 6   | 00      | RW  | <b>DSCP[23:22]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x2c. |
| 5 – 4   | 00      | RW  | <b>DSCP[21:20]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x28. |
| 3 – 2   | 00      | RW  | <b>DSCP[19:18]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x24. |

**TABLE 4-18: TOS PRIORITY CONTROL REGISTER 2 (0X018 – 0X019): TOSR2 (CONTINUED)**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 1 – 0 | 00      | RW  | <b>DSCP[17:16]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x20. |

## 4.2.3.3 TOS Priority Control Register 3 (0x01A – 0x01B): TOSR3

This register contains the TOS priority control bits for the switch function.

**TABLE 4-19: TOS PRIORITY CONTROL REGISTER 3 (0X01A – 0X01B): TOSR3**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 – 14 | 00      | RW  | <b>DSCP[47:46]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x5c. |
| 13 – 12 | 00      | RW  | <b>DSCP[45:44]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x58. |
| 11 – 10 | 00      | RW  | <b>DSCP[43:42]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x54. |
| 9 – 8   | 00      | RW  | <b>DSCP[41:40]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x50. |
| 7 – 6   | 00      | RW  | <b>DSCP[39:38]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x4c. |
| 5 – 4   | 00      | RW  | <b>DSCP[37:36]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x48. |
| 3 – 2   | 00      | RW  | <b>DSCP[35:34]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x44. |
| 1 – 0   | 00      | RW  | <b>DSCP[33:32]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x40. |

## 4.2.3.4 TOS Priority Control Register 4 (0x01C – 0x01D): TOSR4

This register contains the TOS priority control bits for the switch function.

**TABLE 4-20: TOS PRIORITY CONTROL REGISTER 4 (0X01C – 0X01D): TOSR4**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 – 14 | 00      | RW  | <b>DSCP[63:62]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x7c. |
| 13 – 12 | 00      | RW  | <b>DSCP[61:60]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x78. |
| 11 – 10 | 00      | RW  | <b>DSCP[59:58]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x74. |
| 9 – 8   | 00      | RW  | <b>DSCP[57:56]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x70. |

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**TABLE 4-20: TOS PRIORITY CONTROL REGISTER 4 (0X01C – 0X1D): TOSR4 (CONTINUED)**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 7 – 6 | 00      | RW  | <b>DSCP[55:54]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x6c. |
| 5 – 4 | 00      | RW  | <b>DSCP[53:52]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x68. |
| 3 – 2 | 00      | RW  | <b>DSCP[51:50]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x64. |
| 1 – 0 | 00      | RW  | <b>DSCP[49:48]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x60. |

## 4.2.3.5 TOS Priority Control Register 5 (0x01E – 0x1F): TOSR5

This register contains the TOS priority control bits for the switch function.

**TABLE 4-21: TOS PRIORITY CONTROL REGISTER 5 (0X01E – 0X1F): TOSR5**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 – 14 | 00      | RW  | <b>DSCP[79:78]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x9c. |
| 13 – 12 | 00      | RW  | <b>DSCP[77:76]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x98. |
| 11 – 10 | 00      | RW  | <b>DSCP[75:74]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x94. |
| 9 – 8   | 00      | RW  | <b>DSCP[73:72]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x90. |
| 7 – 6   | 00      | RW  | <b>DSCP[71:70]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x8c. |
| 5 – 4   | 00      | RW  | <b>DSCP[69:68]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x88. |
| 3 – 2   | 00      | RW  | <b>DSCP[67:66]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x84. |
| 1 – 0   | 00      | RW  | <b>DSCP[65:64]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0x80. |

## 4.2.3.6 TOS Priority Control Register 6 (0x020 – 0x021): TOSR6

This register contains the TOS priority control bits for the switch function.

**TABLE 4-22: TOS PRIORITY CONTROL REGISTER 6 (0X020 – 0X021): TOSR6**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 – 14 | 00      | RW  | <b>DSCP[95:94]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xbc. |

**TABLE 4-22: TOS PRIORITY CONTROL REGISTER 6 (0X020 – 0X021): TOSR6 (CONTINUED)**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 13 – 12 | 00      | RW  | <b>DSCP[93:92]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xb8. |
| 11 – 10 | 00      | RW  | <b>DSCP[91:90]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xb4. |
| 9 – 8   | 00      | RW  | <b>DSCP[89:88]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xb0. |
| 7 – 6   | 00      | RW  | <b>DSCP[87:86]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xac. |
| 5 – 4   | 00      | RW  | <b>DSCP[85:84]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xa8. |
| 3 – 2   | 00      | RW  | <b>DSCP[83:82]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xa4. |
| 1 – 0   | 00      | RW  | <b>DSCP[81:80]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xa0. |

## 4.2.3.7 TOS Priority Control Register 7 (0x022 – 0x023): TOSR7

This register contains the TOS priority control bits for the switch function.

**TABLE 4-23: TOS PRIORITY CONTROL REGISTER 7 (0X022 – 0X023): TOSR7**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 – 14 | 00      | RW  | <b>DSCP[111:110]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xdc. |
| 13 – 12 | 00      | RW  | <b>DSCP[109:108]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xd8. |
| 11 – 10 | 00      | RW  | <b>DSCP[107:106]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xd4. |
| 9 – 8   | 00      | RW  | <b>DSCP[105:104]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xd0. |
| 7 – 6   | 00      | RW  | <b>DSCP[103:102]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xcc. |
| 5 – 4   | 00      | RW  | <b>DSCP[101:100]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xc8. |
| 3 – 2   | 00      | RW  | <b>DSCP[99:98]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xc4.   |
| 1 – 0   | 00      | RW  | <b>DSCP[97:96]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xc0.   |

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## 4.2.3.8 TOS Priority Control Register 8 (0x024 – 0x025): TOSR8

This register contains the TOS priority control bits for the switch function.

**TABLE 4-24: TOS PRIORITY CONTROL REGISTER 8 (0X024 – 0X025): TOSR8**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 – 14 | 00      | RW  | <b>DSCP[127:126]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xfc  |
| 13 – 12 | 00      | RW  | <b>DSCP[125:124]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xf8. |
| 11 – 10 | 00      | RW  | <b>DSCP[123:122]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xf4. |
| 9 – 8   | 00      | RW  | <b>DSCP[121:120]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xf0. |
| 7 – 6   | 00      | RW  | <b>DSCP[119:118]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xec. |
| 5 – 4   | 00      | RW  | <b>DSCP[117:116]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xe8. |
| 3 – 2   | 00      | RW  | <b>DSCP[115:114]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xe4. |
| 1 – 0   | 00      | RW  | <b>DSCP[113:112]</b><br>The value in this field is used as the frame's priority when bits [7:2] of the IP TOS/DiffServ/Traffic Class value are 0xe0. |

## 4.2.4 INDIRECT ACCESS DATA REGISTERS

### 4.2.4.1 Indirect Access Data Register 1 (0x026 – 0x027): IADR1

This register is used to indirectly read or write the data in the Management Information Base (MIB) Counters, Static MAC Address Table, Dynamic MAC Address Table, or the VLAN Table. Review those sections for detail bit information.

**TABLE 4-25: INDIRECT ACCESS DATA REGISTER 1 (0X026 – 0X027): IADR1**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 – 8 | 0x00    | RO  | Reserved  |
| 7      | 0       | RO  | <b>CPU Read Status</b><br>Only for dynamic and statistics counter reads.<br>1 = Read is still in progress.<br>0 = Read has completed. |
| 6 – 3  | 0x0     | RO  | Reserved  |
| 2 – 0  | 000     | RO  | <b>Indirect Data [66:64]</b><br>Bit[66:64] of indirect data.  |



## 4.2.4.2 Indirect Access Data Register 2 (0x028 – 0x029): IADR2

This register is used to indirectly read or write the data in the Management Information Base (MIB) Counters, Static MAC Address Table, Dynamic MAC Address Table, or the VLAN Table. Review those sections for detail bit information.

**TABLE 4-26: INDIRECT ACCESS DATA REGISTER 2 (0X028 – 0X029): IADR2**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 – 0 | 0x0000  | RW  | <b>Indirect Data [47:32]</b><br>Bit[47:32] of indirect data. |

## 4.2.4.3 Indirect Access Data Register 3 (0x02A – 0x02B): IADR3

This register is used to indirectly read or write the data in the Management Information Base (MIB) Counters, Static MAC Address Table, Dynamic MAC Address Table, or the VLAN Table. Review those sections for detail bit information.

**TABLE 4-27: INDIRECT ACCESS DATA REGISTER 3 (0X02A – 0X02B): IADR3**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 – 0 | 0x0000  | RW  | <b>Indirect Data [63:48]</b><br>Bit[63:48] of indirect data. |

## 4.2.4.4 Indirect Access Data Register 4 (0x02C – 0x02D): IADR4

This register is used to indirectly read or write the data in the Management Information Base (MIB) Counters, Static MAC Address Table, Dynamic MAC Address Table, or the VLAN Table. Review those sections for detail bit information.

**TABLE 4-28: INDIRECT ACCESS DATA REGISTER 4 (0X02C – 0X02D): IADR4**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 – 0 | 0x0000  | RW  | <b>Indirect Data [15:0]</b><br>Bit[15:0] of indirect data. |

## 4.2.4.5 Indirect Access Data Register 5 (0x02E – 0x02F): IADR5

This register is used to indirectly read or write the data in the Management Information Base (MIB) Counters, Static MAC Address Table, Dynamic MAC Address Table, or the VLAN Table. Review those sections for detail bit information.

**TABLE 4-29: INDIRECT ACCESS DATA REGISTER 5 (0X02E – 0X02F): IADR5**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 – 0 | 0x0000  | RW  | <b>Indirect Data [31:16]</b><br>Bit[31:16] of indirect data. |

## 4.2.4.6 Indirect Access Control Register (0x030 – 0x031): IACR

This register is used to indirectly read or write the data in the Management Information Base (MIB) Counters, Static MAC Address Table, Dynamic MAC Address Table, or the VLAN Table. Review those sections for detail bit information. Writing to IACR triggers a command. Read or write access is determined by Register bit 12.

**TABLE 4-30: INDIRECT ACCESS CONTROL REGISTER (0X030 – 0X031): IACR**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 – 13 | 000     | RW  | Reserved  |
| 12      | 0       | RW  | <b>Read or Write Access Selection</b><br>1 = Read cycle.<br>0 = Write cycle.  |
| 11 – 10 | 00      | RW  | <b>Table Select</b><br>00 = Static MAC address table selected.<br>01 = VLAN table selected.<br>10 = Dynamic MAC address table selected.<br>11 = MIB counter selected. |
| 9 – 0   | 0x000   | RW  | <b>Indirect Address [9:0]</b><br>Bit[9:0] of indirect address.  |

## 4.2.5 POWER MANAGEMENT CONTROL AND WAKE-UP EVENT STATUS

### 4.2.5.1 Power Management Control and Wake-Up Event Status (0x032 – 0x033): PMCTRL

This register controls the power management mode and provides wake-up event status.

**TABLE 4-31: POWER MANAGEMENT CONTROL AND WAKE-UP EVENT STATUS (0X032 – 0X033): PMCTRL**

| Bit    | Default | R/W         | Description  |
|--------|---------|-------------|--|
| 15 – 6 | 0x000   | RO          | Reserved.  |
| 5      | 0       | RW<br>(W1C) | <b>Wake-Up Frame Detect Status</b><br>1 = A wake-up frame has been detected at the host QMU (Write a “1” to clear).<br>0 = No Wake-Up frame has been detected.   |
| 4      | 0       | RW<br>(W1C) | <b>Magic Packet Detect Status</b><br>1 = A Magic Packet has been detected at either port 1 or port 2 (Write a “1” to clear).<br>0 = No Magic Packet has been detected.                                   |
| 3      | 0       | RW<br>(W1C) | <b>Link-Up Detect Status</b><br>1 = A Link Up condition has been detected at either port 1 or port 2 (Write a “1” to clear).<br>0 = No Link Up has been detected.  |
| 2      | 0       | RW<br>(W1C) | <b>Energy Detect Status</b><br>1 = Energy is detected at either port 1 or port 2 (Write a “1” to clear).<br>0 = No energy is detected.   |
| 1 – 0  | 00      | RW          | <b>Power Management Mode</b><br>These two bits are used to control device power management mode.<br>00 = Normal Mode.<br>01 = Energy Detect Mode.<br>10 = Global Soft Power-Down Mode.<br>11 = Reserved. |

### 4.2.5.2 Power Management Event Enable Register (0x034 – 0x035): PMEE

This register contains the power management event enable control bits.

**TABLE 4-32: POWER MANAGEMENT EVENT ENABLE REGISTER (0X034 – 0X035): PMEE**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 5 | 0x000   | RW  | Reserved   |
| 4      | 0       | RW  | <b>PME Polarity:</b><br>1 = The PME pin is active-high.<br>0 = The PME pin is active-low.  |
| 3      | 0       | RW  | <b>PME Woken Up By Wake-Up Frame Enable</b><br>1 = The PME pin will be asserted when a wake-up frame is detected.<br>0 = PME won't be asserted by the wake-up frame detection              |
| 2      | 0       | RW  | <b>PME Woken Up By Magic Packet Enable</b><br>1 = The PME pin will be asserted when a magic packet is detected.<br>0 = PME won't be asserted by the magic packet detection                 |
| 1      | 0       | RW  | <b>PME Woken Up By Link-Up Enable</b><br>1 = The PME pin will be asserted when a link-up is detected at port 1 or port 2.<br>0 = PME won't be asserted by the link-up detection            |
| 0      | 0       | RW  | <b>PME Woken Up By Energy Detect Enable</b><br>1 = The PME pin will be asserted when energy on line is detected at port 1 or port 2.<br>0 = PME won't be asserted by the energy detection. |

## 4.2.6 GO SLEEP TIME AND CLOCK TREE POWER-DOWN CONTROL REGISTERS

### 4.2.6.1 Go Sleep Time Register (0x036 – 0x037): GST

This register contains the value which is used to control the minimum Go-Sleep time period when the device transitions from normal power state to low power state in energy detect mode.

**TABLE 4-33: GO SLEEP TIME REGISTER (0X036 – 0X037): GST**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 – 8 | 0x00    | RO  | Reserved   |
| 7 – 0  | 0x8E    | RW  | <b>Go Sleep Time</b><br>This value is used to control the minimum period the no energy event has to be detected consecutively before the device enters the low power state during energy-detect mode.<br>The unit is 20 ms. The default go sleep time is around 3.0 seconds. |

### 4.2.6.2 Clock Tree Power-Down Control Register (0x038 – 0x039): CTPDC

This register contains the power-down control bits for all clocks.

**TABLE 4-34: CLOCK TREE POWER-DOWN CONTROL REGISTER (0X038 – 0X039): CTPDC**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 – 5 | 0x000   | RO  | Reserved  |
| 4      | 0       | RW  | Reserved  |
| 3      | 0       | RW  | <b>Switch Clock Auto Shut Down Enable</b><br>1 = When no packet transfer is detected on the MII interface of all ports (port 1, port 2, and port 3) longer than the time specified in bit[1:0] of current register, the device will shut down the switch clock automatically. The switch clock will be woken up automatically when the MII interface of any port becomes busy.<br>0 = Switch clock is always on.                                |
| 2      | 0       | RW  | <b>CPU Clock Auto Shutdown Enable</b><br>1 = When no packet transfer is detected both on host interface and on MII interface of all ports (port 1, port 2, and port 3) longer than the time specified in bit[1:0] of current register, the device will shut down CPU clock automatically. The CPU clock will be waked up automatically when host activity is detected or MII interface of any port becomes busy.<br>0 = CPU clock is always on. |
| 1 – 0  | 00      | RW  | <b>Shutdown Wait Period</b><br>These two bits specify the time for device to monitor host/MII activity continuously before it could shut down switch or CPU clock.<br>00 = 5.3s.<br>01 = 1.6s.<br>10 = 1 ms.<br>11 = 3.2 $\mu$ s.   |

### 4.2.6.3 0x03A – 0x04B: Reserved

## 4.2.7 PHY AND MII BASIC CONTROL REGISTERS

### 4.2.7.1 PHY 1 and MII Basic Control Register (0x04C – 0x04D): P1MBCR

This register contains media independent interface (MII) control bits for the switch port 1 function as defined in the IEEE 802.3 specification.

**TABLE 4-35: PHY 1 AND MII BASIC CONTROL REGISTER (0X04C – 0X04D): P1MBCR**

| Bit | Default | R/W | Description | Bit is Same As |
|-----|---------|-----|-------------|----------------|
| 15  | 0       | RO  | Reserved    | —              |

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**TABLE 4-35: PHY 1 AND MII BASIC CONTROL REGISTER (0X04C – 0X04D): P1MBCR  
(CONTINUED)**

| Bit | Default | R/W   | Description  | Bit is Same As   |
|-----|---------|-------|--|------------------|
| 14  | 0       | RW    | <b>Far-End Loopback</b><br>1 = Perform loopback as follows:<br>Start: RXP2/RXM2 (port 2)<br>Loopback: PMD/PMA of port 1's PHY<br>End: TXP2/TXM2 (port 2)<br>0 = Normal operation.                                    | Bit[8] in P1CR4  |
| 13  | 1       | RW    | <b>Force 100BASE-TX</b><br>1 = Force 100 Mbps if auto-negotiation is disabled (bit [12])<br>0 = Force 10 Mbps if auto-negotiation is disabled (bit [12])   | Bit[6] in P1CR4  |
| 12  | 1       | RW    | <b>Auto-Negotiation Enable</b><br>1 = Auto-negotiation enabled.<br>0 = Auto-negotiation disabled.  | Bit[7] in P1CR4  |
| 11  | 0       | RW    | <b>Power-Down</b><br>1 = Power-down.<br>0 = Normal operation.  | Bit[11] in P1CR4 |
| 10  | 0       | RO    | <b>Isolate</b><br>Not supported.   | —                |
| 9   | 0       | RW/SC | <b>Restart Auto-Negotiation</b><br>1 = Restart auto-negotiation.<br>0 = Normal operation.  | Bit[13] in P1CR4 |
| 8   | 1       | RW    | <b>Force Full-Duplex</b><br>1 = Force full-duplex.<br>0 = Force half-duplex.<br>Applies only when auto-negotiation is disabled (bit [12]).<br>It is always in half-duplex if auto-negotiation is enabled but failed. | Bit[5] in P1CR4  |
| 7   | 0       | RO    | <b>Collision test</b><br>Not supported.  | —                |
| 6   | 0       | RO    | Reserved.  | —                |
| 5   | 1       | RW    | <b>HP_MDIX</b><br>1 = HP Auto-MDI-X mode.<br>0 = Microchip Auto-MDI-X mode.  | Bit[15] in P1SR  |
| 4   | 0       | RW    | <b>Force MDI-X</b><br>1 = Force MDI-X.<br>0 = Normal operation.  | Bit[9] in P1CR4  |
| 3   | 0       | RW    | <b>Disable Auto-MDI-X</b><br>1 = Disable Auto-MDI-X.<br>0 = Normal operation.  | Bit[10] in P1CR4 |
| 2   | 0       | RW    | <b>Disable Far-End-Fault</b><br>1 = Disable far-end-fault detection.<br>0 = Normal operation.<br>For 100BASE-FX fiber mode operation.  | Bit[12] in P1CR4 |
| 1   | 0       | RW    | <b>Disable Transmit</b><br>1 = Disable transmit.<br>0 = Normal operation.  | Bit[14] in P1CR4 |
| 0   | 0       | RW    | Reserved   | —                |

## 4.2.7.2 PHY 1 and MII Basic Status Register (0x04E – 0x04F): P1MBSR

This register contains the media independent interface (MII) status bits for the switch port 1 function.

**TABLE 4-36: PHY 1 AND MII BASIC STATUS REGISTER (0X04E – 0X04F): P1MBSR**

| Bit    | Default | R/W | Description   | Bit is Same As |
|--------|---------|-----|---|----------------|
| 15     | 0       | RO  | <b>T4 Capable</b><br>1 = 100BASE-T4 capable.<br>0 = Not 100BASE-T4 capable.   | —              |
| 14     | 1       | RO  | <b>100BASE-TX Full Capable</b><br>1 = 100BASE-TX full-duplex capable.<br>0 = Not 100BASE-TX full-duplex capable.              | —              |
| 13     | 1       | RO  | <b>100BASE-TX Half Capable</b><br>1 = 100BASE-TX half-duplex capable.<br>0 = Not 100BASE-TX half-duplex capable.              | —              |
| 12     | 1       | RO  | <b>10BASE-T Full Capable</b><br>1 = 10BASE-T full-duplex capable.<br>0 = Not 10BASE-T full-duplex capable.                    | —              |
| 11     | 1       | RO  | <b>10BASE-T Half Capable</b><br>1 = 10BASE-T half-duplex capable.<br>0 = Not 10BASE-T half-duplex capable.                    | —              |
| 10 – 7 | 0x0     | RO  | Reserved  | —              |
| 6      | 0       | RO  | <b>Preamble Suppressed</b><br>Not supported.  | —              |
| 5      | 0       | RO  | <b>Auto-Negotiation Complete</b><br>1 = Auto-negotiation complete.<br>0 = Auto-negotiation not completed.                     | Bit[6] in P1SR |
| 4      | 0       | RO  | <b>Far-End-Fault</b><br>1 = Far-end-fault detected.<br>0 = No far-end-fault detected.<br>For 100BASE-FX fiber mode operation. | Bit[8] in P1SR |
| 3      | 1       | RO  | <b>Auto-Negotiation Capable</b><br>1 = Auto-negotiation capable.<br>0 = Not auto-negotiation capable.                         | —              |
| 2      | 0       | RO  | <b>Link Status</b><br>1 = Link is up.<br>0 = Link is down.  | Bit[5] in P1SR |
| 1      | 0       | RO  | <b>Jabber test</b><br>Not supported.  | —              |
| 0      | 0       | RO  | <b>Extended Capable</b><br>1 = Extended register capable.<br>0 = Not extended register capable.                               | —              |

## 4.2.7.3 PHY 1 PHYID Low Register (0x050 – 0x051): PHY1ILR

This register contains the PHY ID (low) for the switch port 1 function.

**TABLE 4-37: PHY 1 PHYID LOW REGISTER (0X050 – 0X051): PHY1ILR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 – 0 | 0x1430  | RO  | <b>PHY 1 ID Low Word</b><br>Low order PHY 1 ID bits. |

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## 4.2.7.4 PHY 1 PHYID High Register (0x052 – 0x053): PHY1IHR

This register contains the PHY ID (high) for the switch port 1 function.

**TABLE 4-38: PHY 1 PHYID HIGH REGISTER (0X052 – 0X053): PHY1IHR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 – 0 | 0x0022  | RO  | <b>PHY 1 ID High Word</b><br>High-order PHY 1 ID bits. |

## 4.2.7.5 PHY 1 Auto-Negotiation Advertisement Register (0x054 – 0x055): P1ANAR

This register contains the auto-negotiation advertisement bits for the switch port 1 function.

**TABLE 4-39: PHY 1 AUTO-NEGOTIATION ADVERTISEMENT REGISTER (0X054 – 0X055): P1ANAR**

| Bit     | Default | R/W | Description   | Bit is Same As  |
|---------|---------|-----|---|-----------------|
| 15      | 0       | RO  | <b>Next page</b><br>Not supported.  | —               |
| 14      | 0       | RO  | Reserved  | —               |
| 13      | 0       | RO  | <b>Remote fault</b><br>Not supported.   | —               |
| 12 – 11 | 00      | RO  | Reserved  | —               |
| 10      | 1       | RW  | <b>Pause (flow control capability)</b><br>1 = Advertise pause ability.<br>0 = Do not advertise pause capability.                                    | Bit[4] in P1CR4 |
| 9       | 0       | RW  | Reserved  | —               |
| 8       | 1       | RW  | <b>Advertise 100BASE-TX Full-Duplex</b><br>1 = Advertise 100BASE-TX full-duplex capable.<br>0 = Do not advertise 100BASE-TX full-duplex capability. | Bit[3] in P1CR4 |
| 7       | 1       | RW  | <b>Advertise 100BASE-TX Half-Duplex</b><br>1 = Advertise 100BASE-TX half-duplex capable.<br>0 = Do not advertise 100BASE-TX half-duplex capability. | Bit[2] in P1CR4 |
| 6       | 1       | RW  | <b>Advertise 10BASE-T Full-Duplex</b><br>1 = Advertise 10BASE-T full-duplex capable.<br>0 = Do not advertise 10BASE-T full-duplex capability.       | Bit[1] in P1CR4 |
| 5       | 1       | RW  | <b>Advertise 10BASE-T Half-Duplex</b><br>1 = Advertise 10BASE-T half-duplex capable.<br>0 = Do not advertise 10BASE-T half-duplex capability.       | Bit[0] in P1CR4 |
| 4 – 0   | 0x01    | RO  | <b>Selector Field</b><br>802.3  | —               |

## 4.2.7.6 PHY 1 Auto-Negotiation Link Partner Ability Register (0x056 – 0x057): P1ANLPR

This register contains the auto-negotiation link partner ability bits for the switch port 1 function.

**TABLE 4-40: PHY 1 AUTO-NEGOTIATION LINK PARTNER ABILITY REGISTER (0X056 – 0X057): P1ANLPR**

| Bit | Default | R/W | Description                           | Bit is Same As |
|-----|---------|-----|---------------------------------------|----------------|
| 15  | 0       | RO  | <b>Next page</b><br>Not supported.    | —              |
| 14  | 0       | RO  | <b>LP ACK</b><br>Not supported.       | —              |
| 13  | 0       | RO  | <b>Remote fault</b><br>Not supported. | —              |

**TABLE 4-40: PHY 1 AUTO-NEGOTIATION LINK PARTNER ABILITY REGISTER (0X056 – 0X057): P1ANLPR (CONTINUED)**

| Bit     | Default | R/W | Description  | Bit is Same As |
|---------|---------|-----|--|----------------|
| 12 - 11 | 00      | RO  | Reserved   | —              |
| 10      | 0       | RO  | <b>Pause</b><br>Link partner pause capability.   |                |
| 9       | 0       | RO  | Reserved   | —              |
| 8       | 0       | RO  | <b>Advertise 100BASE-TX Full-Duplex</b><br>Link partner 100BASE-TX full-duplex capability. |                |
| 7       | 0       | RO  | <b>Advertise 100BASE-TX Half-Duplex</b><br>Link partner 100 half-duplex capability.        |                |
| 6       | 0       | RO  | <b>Advertise 10BASE-T Full-Duplex</b><br>Link partner 10BASE-T full-duplex capability.     |                |
| 5       | 0       | RO  | <b>Advertise 10BASE-T Half-Duplex</b><br>Link partner 10BASE-T half-duplex capability.     |                |
| 4 - 0   | 0x01    | RO  | Reserved   | —              |

## 4.2.7.7 PHY 2 and MII Basic Control Register (0x058 – 0x059): P2MBCR

This register contains media independent interface (MII) control bits for the switch port 2 function as defined in the IEEE 802.3 specification.

**TABLE 4-41: PHY 2 AND MII BASIC CONTROL REGISTER (0X058 – 0X059): P2MBCR**

| Bit | Default | R/W   | Description  | Bit is Same As   |
|-----|---------|-------|--|------------------|
| 15  | 0       | RO    | Reserved   | —                |
| 14  | 0       | RW    | <b>Far-End Loopback</b><br>1 = Perform loopback, as follows:<br>Start: RXP1/RXM1 (port 1)<br>Loopback: PMD/PMA of port 2's PHY<br>End: TXP1/TXM1 (port 1)<br>0 = Normal operation. | Bit[8] in P2CR4  |
| 13  | 1       | RW    | <b>Force 100BASE-TX</b><br>1 = Force 100 Mbps if auto-negotiation is disabled (bit [12])<br>0 = Force 10 Mbps if auto-negotiation is disabled (bit [12])                           | Bit[6] in P2CR4  |
| 12  | 1       | RW    | <b>Auto-Negotiation Enable</b><br>1 = Auto-negotiation enabled.<br>0 = Auto-negotiation disabled.  | Bit[7] in P2CR4  |
| 11  | 0       | RW    | <b>Power Down</b><br>1 = Power down.<br>0 = Normal operation.  | Bit[11] in P2CR4 |
| 10  | 0       | RO    | <b>Isolate</b><br>Not supported.   | —                |
| 9   | 0       | RW/SC | <b>Restart Auto-Negotiation</b><br>1 = Restart auto-negotiation.<br>0 = Normal operation   | Bit[13] in P2CR4 |

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**TABLE 4-41: PHY 2 AND MII BASIC CONTROL REGISTER (0X058 – 0X059): P2MBCR (CONTINUED)**

| Bit | Default | R/W | Description  | Bit is Same As   |
|-----|---------|-----|--|------------------|
| 8   | 1       | RW  | <b>Force Full-Duplex</b><br>1 = Force full-duplex.<br>0 = Force half-duplex.<br>Applies only when auto-negotiation is disabled (bit [12]).<br>It is always in half-duplex if auto-negotiation is enabled but failed. | Bit[5] in P2CR4  |
| 7   | 0       | RO  | <b>Collision test</b><br>Not supported.  | —                |
| 6   | 0       | RO  | Reserved   | —                |
| 5   | 1       | RW  | <b>HP_MDIX</b><br>1 = HP Auto-MDI-X mode.<br>0 = Microchip Auto-MDI-X mode.  | Bit[15] in P2SR  |
| 4   | 0       | RW  | <b>Force MDI-X</b><br>1 = Force MDI-X.<br>0 = Normal operation.  | Bit[9] in P2CR4  |
| 3   | 0       | RW  | <b>Disable Auto- MDI-X</b><br>1 = Disable Auto-MDI-X.<br>0 = Normal operation.   | Bit[10] in P2CR4 |
| 2   | 0       | RW  | <b>Disable Far-End-Fault</b><br>1 = Disable far-end-fault detection.<br>0 = Normal operation.<br>For 100BASE-FX fiber mode operation.  | Bit[12] in P2CR4 |
| 1   | 0       | RW  | <b>Disable Transmit</b><br>1 = Disable transmit.<br>0 = Normal operation.  | Bit[14] in P2CR4 |
| 0   | 0       | RW  | Reserved   | —                |

## 4.2.7.8 PHY 2 and MII Basic Status Register (0x05A – 0x05B): P2MBSR

This register contains the media independent interface (MII) status bits for the switch port 2 function.

**TABLE 4-42: PHY 2 AND MII BASIC STATUS REGISTER (0X05A – 0X05B): P2MBSR**

| Bit    | Default | R/W | Description  | Bit is Same As |
|--------|---------|-----|--|----------------|
| 15     | 0       | RO  | <b>T4 Capable</b><br>1 = 100BASE-T4 capable.<br>0 = Not 100BASE-T4 capable.                                      | —              |
| 14     | 1       | RO  | <b>100BASE-TX Full Capable</b><br>1 = 100BASE-TX full-duplex capable.<br>0 = Not 100BASE-TX full-duplex capable. | —              |
| 13     | 1       | RO  | <b>100BASE-TX Half Capable</b><br>1 = 100BASE-TX half-duplex capable.<br>0 = Not 100BASE-TX half-duplex capable. | —              |
| 12     | 1       | RO  | <b>10BASE-T Full Capable</b><br>1 = 10BASE-T full-duplex capable.<br>0 = Not 10BASE-T full-duplex capable.       | —              |
| 11     | 1       | RO  | <b>10BASE-T Half Capable</b><br>1 = 10BASE-T half-duplex capable.<br>0 = Not 10BASE-T half-duplex capable.       | —              |
| 10 - 7 | 0x0     | RO  | Reserved   | —              |
| 6      | 0       | RO  | <b>Preamble Suppressed</b><br>Not supported.   | —              |



**TABLE 4-42: PHY 2 AND MII BASIC STATUS REGISTER (0X05A – 0X05B): P2MBSR (CONTINUED)**

| Bit | Default | R/W | Description   | Bit is Same As |
|-----|---------|-----|---|----------------|
| 5   | 0       | RO  | <b>Auto-Negotiation Complete</b><br>1 = Auto-negotiation complete.<br>0 = Auto-negotiation not completed.                     | Bit[6] in P2SR |
| 4   | 0       | RO  | <b>Far-End-Fault</b><br>1 = Far-end-fault detected.<br>0 = No far-end-fault detected.<br>For 100BASE-FX fiber mode operation. | Bit[8] in P2SR |
| 3   | 1       | RO  | <b>Auto-Negotiation Capable</b><br>1 = Auto-negotiation capable.<br>0 = Not auto-negotiation capable.                         | —              |
| 2   | 0       | RO  | <b>Link Status</b><br>1 = Link is up.<br>0 = Link is down.  | Bit[5] in P2SR |
| 1   | 0       | RO  | <b>Jabber Test</b><br>Not supported.  | —              |
| 0   | 0       | RO  | <b>Extended Capable</b><br>1 = Extended register capable.<br>0 = Not extended register capable.                               | —              |

#### 4.2.7.9 PHY 2 PHYID Low Register (0x05C – 0x05D): PHY2ILR

This register contains the PHY ID (low) for the switch port 2 function.

**TABLE 4-43: PHY 2 PHYID LOW REGISTER (0X05C – 0X05D): PHY2ILR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x1430  | RO  | <b>PHY 2 ID Low Word</b><br>Low order PHY 2 ID bits. |

#### 4.2.7.10 PHY 2 PHYID High Register (0x05E – 0x05F): PHY2IHR

This register contains the PHY ID (high) for the switch port 2 function.

**TABLE 4-44: PHY 2 PHYID HIGH REGISTER (0X05E – 0X05F): PHY2IHR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0022  | RO  | <b>PHY 2 ID High Word</b><br>High order PHY 2 ID bits. |

#### 4.2.7.11 PHY 2 Auto-Negotiation Advertisement Register (0x060 – 0x061): P2ANAR

This register contains the auto-negotiation advertisement bits for the switch port 2 function.

**TABLE 4-45: PHY 2 AUTO-NEGOTIATION ADVERTISEMENT REGISTER (0X060 – 0X061): P2ANAR**

| Bit     | Default | R/W | Description  | Bit is Same As  |
|---------|---------|-----|--|-----------------|
| 15      | 0       | RO  | <b>Next Page</b><br>Not supported.   | —               |
| 14      | 0       | RO  | Reserved   | —               |
| 13      | 0       | RO  | <b>Remote Fault</b><br>Not supported.  | —               |
| 12 - 11 | 00      | RO  | Reserved   | —               |
| 10      | 1       | RW  | <b>Pause (Flow Control Capability)</b><br>1 = Advertise pause ability.<br>0 = Do not advertise pause capability. | Bit[4] in P2CR4 |
| 9       | 0       | RW  | Reserved   | —               |

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**TABLE 4-45: PHY 2 AUTO-NEGOTIATION ADVERTISEMENT REGISTER (0X060 – 0X061): P2ANAR (CONTINUED)**

| Bit   | Default | R/W | Description   | Bit is Same As  |
|-------|---------|-----|---|-----------------|
| 8     | 1       | RW  | <b>Advertise 100BASE-TX Full-Duplex</b><br>1 = Advertise 100BASE-TX full-duplex capable.<br>0 = Do not advertise 100BASE-TX full-duplex capability. | Bit[3] in P2CR4 |
| 7     | 1       | RW  | <b>Advertise 100BASE-TX Half-Duplex</b><br>1 = Advertise 100BASE-TX half-duplex capable.<br>0 = Do not advertise 100BASE-TX half-duplex capability. | Bit[2] in P2CR4 |
| 6     | 1       | RW  | <b>Advertise 10BASE-T Full-Duplex</b><br>1 = Advertise 10BASE-T full-duplex capable.<br>0 = Do not advertise 10BASE-T full-duplex capability.       | Bit[1] in P2CR4 |
| 5     | 1       | RW  | <b>Advertise 10BASE-T Half-Duplex</b><br>1 = Advertise 10BASE-T half-duplex capable.<br>0 = Do not advertise 10BASE-T half-duplex capability.       | Bit[0] in P2CR4 |
| 4 - 0 | 0x01    | RO  | <b>Selector Field</b><br>802.3  | —               |

## 4.2.7.12 PHY 2 Auto-Negotiation Link Partner Ability Register (0x062 – 0x063): P2ANLPR

This register contains the auto-negotiation link partner ability bits for the switch port 2 function.

**TABLE 4-46: PHY 2 AUTO-NEGOTIATION LINK PARTNER ABILITY REGISTER (0X062 – 0X063): P2ANLPR**

| Bit     | Default | R/W | Description  | Bit is Same As |
|---------|---------|-----|--|----------------|
| 15      | 0       | RO  | <b>Next page</b><br>Not supported.   | —              |
| 14      | 0       | RO  | <b>LP ACK</b><br>Not supported.  | —              |
| 13      | 0       | RO  | <b>Remote fault</b><br>Not supported.  | —              |
| 12 - 11 | 00      | RO  | Reserved   | —              |
| 10      | 0       | RO  | <b>Pause</b><br>Link partner pause capability.   | Bit[4] in P2SR |
| 9       | 0       | RO  | Reserved   | —              |
| 8       | 0       | RO  | <b>Advertise 100BASE-TX Full-Duplex</b><br>Link partner 100BASE-TX full-duplex capability. | Bit[3] in P2SR |
| 7       | 0       | RO  | <b>Advertise 100BASE-TX Half-Duplex</b><br>Link partner 100 half-duplex capability.        | Bit[2] in P2SR |
| 6       | 0       | RO  | <b>Advertise 10BASE-T Full-Duplex</b><br>Link partner 10BASE-T full-duplex capability.     | Bit[1] in P2SR |
| 5       | 0       | RO  | <b>Advertise 10BASE-T Half-Duplex</b><br>Link partner 10BASE-T half-duplex capability.     | Bit[0] in P2SR |
| 4 - 0   | 0x01    | RO  | Reserved   | —              |

## 4.2.7.13 0x064 – 0x065: Reserved

## 4.2.7.14 PHY1 Special Control and Status Register (0x066 – 0x067): P1PHYCTRL

This register contains control and status information of PHY 1.

**TABLE 4-47: PHY1 SPECIAL CONTROL AND STATUS REGISTER (0X066 – 0X067): P1PHYCTRL**

| Bit    | Default | R/W | Description   | Bit is Same As      |
|--------|---------|-----|---|---------------------|
| 15 - 6 | 0x000   | RO  | Reserved  | —                   |
| 5      | 0       | RO  | <b>Polarity Reverse</b><br>1 = Polarity is reversed.<br>0 = Polarity is not reversed.   | Bit[13] in P1SR     |
| 4      | 0       | RO  | <b>MDI-X Status</b><br>0 = MDI<br>1 = MDI-X   | Bit[7] in P1SR      |
| 3      | 0       | RW  | <b>Force Link</b><br>1 = Force link pass.<br>0 = Normal operation.  | Bit[11] in P1SCSLMD |
| 2      | 1       | RW  | <b>Enable Energy Efficient Ethernet (EEE) on 10BASE-Te</b><br>1 = Disable 10BASE-Te.<br>0 = Enable 10BASE-Te.                     | —                   |
| 1      | 0       | RW  | <b>Remote (Near-End) Loopback</b><br>1 = Perform remote loopback at port 1's PHY (RXP1/RXM1 -> TXP1/TXM1)<br>0 = Normal operation | Bit[9] in P1SCSLMD  |
| 0      | 0       | RW  | Reserved  | —                   |

4.2.7.15 0x068 – 0x069: Reserved

4.2.7.16 PHY 2 Special Control and Status Register (0x06A – 0x06B): P2PHYCTRL

This register contains control and status information of PHY 2.

**TABLE 4-48: PHY 2 SPECIAL CONTROL AND STATUS REGISTER (0X06A – 0X06B): P2PHYCTRL**

| Bit    | Default | R/W | Description   | Bit is Same As      |
|--------|---------|-----|---|---------------------|
| 15 - 6 | 0x000   | RO  | Reserved  | —                   |
| 5      | 0       | RO  | <b>Polarity Reverse</b><br>1 = Polarity is reversed.<br>0 = Polarity is not reversed.   | Bit[13] in P2SR     |
| 4      | 0       | RO  | <b>MDI-X Status</b><br>0 = MDI<br>1 = MDI-X   | Bit[7] in P2SR      |
| 3      | 0       | RW  | <b>Force Link</b><br>1 = Force link pass.<br>0 = Normal operation.  | Bit[11] in P2SCSLMD |
| 2      | 1       | RW  | <b>Enable Energy Efficient Ethernet (EEE) on 10BASE-Te</b><br>1 = Disable 10BASE-Te.<br>0 = Enable 10BASE-Te.                     | —                   |
| 1      | 0       | RW  | <b>Remote (Near-End) Loopback</b><br>1 = Perform remote loopback at port 2's PHY (RXP2/RXM2 -> TXP2/TXM2)<br>0 = Normal operation | Bit[9] in P2SCSLMD  |
| 0      | 0       | RW  | Reserved  | —                   |

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## 4.2.8 PORT 1 CONTROL REGISTERS

### 4.2.8.1 Port 1 Control Register 1 (0x06C – 0x06D): P1CR1

This register contains control bits for the switch Port 1 function.

**TABLE 4-49: PORT 1 CONTROL REGISTER 1 (0X06C – 0X06D): P1CR1**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15      | 0       | RO  | Reserved  |
| 14 - 12 | 000     | RW  | <b>Port 1 LED Direct Control</b><br>These bits directly control the port 1 LED pins.<br>0xx = Normal LED function as set up via Reg. 0x00E – 0x00F, Bits[9:8].<br>100 = Both port 1 LEDs off.<br>101 = Port 1 LED1 off, LED0 on.<br>110 = Port 1 LED1 on, LED0 off.<br>111 = Both port 1 LEDs on.   |
| 11      | 0       | RW  | <b>Source Address Filtering Enable for MAC Address 2</b><br>1 = Enable the source address filtering function when the SA matches MAC Address 2 in SAFMACA2 (0x0B6 – 0x0BB).<br>0 = Disable source address filtering function.   |
| 10      | 0       | RW  | <b>Source Address Filtering Enable for MAC Address 1</b><br>1 = Enable the source address filtering function when the SA matches MAC Address 1 in SAFMACA1 (0x0B0 – 0x0B5).<br>0 = Disable source address filtering function.   |
| 9       | 0       | RW  | <b>Drop Tagged Packet Enable</b><br>1 = Enable dropping of tagged ingress packets.<br>0 = Disable dropping of tagged ingress packets.   |
| 8       | 0       | RW  | <b>TX Two Queues Select Enable</b><br>1 = The port 1 output queue is split into two priority queues (q0 and q1).<br>0 = Single output queue on port 1. There is no priority differentiation even though packets are classified into high or low priority.<br><br>Also see bit 0 in this register. Do not set both bits 0 and 8.   |
| 7       | 0       | RW  | <b>Broadcast Storm Protection Enable</b><br>1 = Enable broadcast storm protection for ingress packets on port 1.<br>0 = Disable broadcast storm protection.   |
| 6       | 0       | RW  | <b>Diffserv Priority Classification Enable</b><br>1 = Enable DiffServ priority classification for ingress packets on port 1.<br>0 = Disable DiffServ function.  |
| 5       | 0       | RW  | <b>802.1p Priority Classification Enable</b><br>1 = Enable 802.1p priority classification for ingress packets on port 1.<br>0 = Disable 802.1p.   |
| 4 - 3   | 00      | RW  | <b>Port-Based Priority Classification</b><br>00 = Ingress packets on port 1 are classified as priority 0 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br>01 = Ingress packets on port 1 are classified as priority 1 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br>10 = Ingress packets on port 1 are classified as priority 2 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br>11 = Ingress packets on port 1 are classified as priority 3 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br><b>Note:</b> “DiffServ”, “802.1p” and port priority can be enabled at the same time. The OR’ed result of 802.1p and DSCP overwrites the port priority. |

**TABLE 4-49: PORT 1 CONTROL REGISTER 1 (0X06C – 0X06D): P1CR1 (CONTINUED)**

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 2   | 0       | RW  | <b>Tag Insertion</b><br>1 = When packets are output on port 1, the switch adds 802.1p/q tags to packets without 802.1p/q tags when received. The switch will not add tags to packets already tagged. The tag inserted is the ingress port's "port VID".<br>0 = Disable tag insertion.   |
| 1   | 0       | RW  | <b>Tag Removal</b><br>1 = When packets are output on port 1, the switch removes 802.1p/q tags from packets with 802.1p/q tags when received. The switch will not modify packets received without tags.<br>0 = Disable tag removal.  |
| 0   | 0       | RW  | <b>TX Multiple Queues Select Enable</b><br>1 = The port 1 output queue is split into four priority queues (q0, q1, q2 and q3).<br>0 = Single output queue on the port 1. There is no priority differentiation even though packets are classified into high or low priority.<br><br>Also see bit 8 in this register. Do not set both bits 0 and 8. |

## 4.2.8.2 Port 1 Control Register 2 (0x06E – 0x06F): P1CR2

This register contains control bits for the switch port 1 function.

**TABLE 4-50: PORT 1 CONTROL REGISTER 2 (0X06E – 0X06F): P1CR2**

| Bit | Default | R/W | Description  |
|-----|---------|-----|--|
| 15  | 0       | RW  | Reserved   |
| 14  | 0       | RW  | <b>Ingress VLAN Filtering</b><br>1 = The switch discards packets whose VID port membership in VLAN table bits [18:16] does not include the ingress port VID.<br>0 = No ingress VLAN filtering. |
| 13  | 0       | RW  | <b>Discard Non PVID Packets</b><br>1 = The switch discards packets whose VID does not match the ingress port default VID.<br>0 = No packets are discarded.                                     |
| 12  | 0       | RW  | <b>Force Flow Control</b><br>1 = Always enable flow control on the port, regardless of auto-negotiation result.<br>0 = The flow control is enabled based on auto-negotiation result.           |
| 11  | 0       | RW  | <b>Back Pressure Enable</b><br>1 = Enable port's half-duplex back pressure.<br>0 = Disable port's half-duplex back pressure.   |
| 10  | 1       | RW  | <b>Transmit Enable</b><br>1 = Enable packet transmission on the port.<br>0 = Disable packet transmission on the port.  |
| 9   | 1       | RW  | <b>Receive Enable</b><br>1 = Enable packet reception on the port.<br>0 = Disable packet reception on the port.   |
| 8   | 0       | RW  | <b>Learning Disable</b><br>1 = Disable switch address learning capability.<br>0 = Enable switch address learning.  |
| 7   | 0       | RW  | <b>Sniffer Port</b><br>1 = Port is designated as a sniffer port and transmits packets that are monitored.<br>0 = Port is a normal port.  |

**TABLE 4-50: PORT 1 CONTROL REGISTER 2 (0X06E – 0X06F): P1CR2 (CONTINUED)**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 6     | 0       | RW  | <b>Receive Sniff</b><br>1 = All packets received on the port are marked as “monitored packets” and forwarded to the designated “sniffer port.”<br>0 = No receive monitoring.   |
| 5     | 0       | RW  | <b>Transmit Sniff</b><br>1 = All packets transmitted on the port are marked as “monitored packets” and forwarded to the designated “sniffer port.”<br>0 = No transmit monitoring.  |
| 4     | 0       | RW  | Reserved   |
| 3     | 0       | RW  | <b>User Priority Ceiling</b><br>1 = If the packet’s “priority field” is greater than the “user priority field” in the port VID control register bit[15:13], replace the packet’s “priority field” with the “user priority field” in the port VID control register bit[15:13].<br>0 = Do not compare and replace the packet’s “priority field.” |
| 2 - 0 | 111     | RW  | <b>Port VLAN Membership</b><br>Define the port’s port VLAN membership. Bit[2] stands for the host port, bit [1] for port 2, and bit [0] for port 1. The port can only communicate within the membership. A ‘1’ includes a port in the membership; a ‘0’ excludes a port from the membership.   |

#### 4.2.8.3 Port 1 VID Control Register (0x070 – 0x071): P1VIDCR

This register contains control bits for the switch port 1 function. This register has two main uses. It is associated with the ingress of untagged packets and used for egress tagging as well as being used for address lookup and providing a default VID for the ingress of untagged or null-VID-tagged packets.

**TABLE 4-51: PORT 1 VID CONTROL REGISTER (0X070 – 0X071): P1VIDCR**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 13 | 0x0     | RW  | <b>Default Tag[15:13]</b><br>Port’s default tag, containing “User Priority Field” bits. |
| 12      | 0       | RW  | <b>Default Tag[12]</b><br>Port’s default tag, containing the CFI bit.                   |
| 11 - 0  | 0x001   | RW  | <b>Default Tag[11:0]</b><br>Port’s default tag, containing the VID[11:0].               |

#### 4.2.8.4 Port 1 Control Register 3 (0x072 – 0x073): P1CR3

This register contains control bits for the switch port 1 function.

**TABLE 4-52: PORT 1 CONTROL REGISTER 3 (0X072 – 0X073): P1CR3**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 5 | 0x000   | RO  | Reserved   |
| 4      | 0       | RW  | Reserved   |
| 3 - 2  | 00      | RW  | <b>Ingress Limit Mode</b><br>These bits determine what kinds of frames are limited and counted against ingress rate limiting as follows:<br>00 = Limit and count all frames.<br>01 = Limit and count Broadcast, Multicast, and flooded Unicast frames.<br>10 = Limit and count Broadcast and Multicast frames only.<br>11 = Limit and count Broadcast frames only. |

**TABLE 4-52: PORT 1 CONTROL REGISTER 3 (0X072 – 0X073): P1CR3 (CONTINUED)**

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 1   | 0       | RW  | <b>Count Inter-Frame Gap</b><br>Count IFG Bytes.<br>1 = Each frame's minimum inter frame gap. IFG bytes (12 per frame) are included in Ingress and Egress rate limiting calculations.<br>0 = IFG bytes are not counted. |
| 0   | 0       | RW  | <b>Count Preamble</b><br>Count preamble Bytes.<br>1 = Each frame's preamble bytes (8 per frame) are included in Ingress and Egress rate limiting calculations.<br>0 = Preamble bytes are not counted.                   |

## 4.2.8.5 Port 1 Ingress Rate Control Register 0 (0x074 – 0x075): P1RCR0

This register contains the port 1 ingress rate limiting control for priority 1 and priority 0.

**TABLE 4-53: PORT 1 INGRESS RATE CONTROL REGISTER 0 (0X074 – 0X075): P1RCR0**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15     | 0       | RW  | Reserved  |
| 14 - 8 | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 1 Frames</b><br>Ingress priority 1 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | Reserved  |
| 6 - 0  | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 0 Frames</b><br>Ingress priority 0 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |

**TABLE 4-54: INGRESS OR EGRESS DATA RATE LIMITS**

| Data Rate Limit for Ingress or Egress | 100BASE-TX for Priority [3:0]<br>Register Bit[14:8] or Bit[6:0]      | 10BASE-T for Priority [3:0]<br>Register Bit[14:8] or Bit[6:0]       |
|---------------------------------------|--|---|
|                                       | 0x01 to 0x64 for the rate matches<br>1 Mbps to 100 Mbps respectively | 0x01 to 0x0A for the rate matches<br>1 Mbps to 10 Mbps respectively |
|                                       | 0x00 (default) for the rate is no limit<br>(full 100 Mbps)           | 0x00 (default) for the rate<br>is no limit (full 10 Mbps)           |
| 64 Kbps                               |  | 0x65  |
| 128 Kbps                              |  | 0x66  |
| 192 Kbps                              |  | 0x67  |
| 256 Kbps                              |  | 0x68  |
| 320 Kbps                              |  | 0x69  |
| 384 Kbps                              |  | 0x6A  |
| 448 Kbps                              |  | 0x6B  |
| 512 Kbps                              |  | 0x6C  |
| 576 Kbps                              |  | 0x6D  |
| 640 Kbps                              |  | 0x6E  |
| 704 Kbps                              |  | 0x6F  |
| 768 Kbps                              |  | 0x70  |
| 832 Kbps                              |  | 0x71  |

**TABLE 4-54: INGRESS OR EGRESS DATA RATE LIMITS (CONTINUED)**

| Data Rate Limit for Ingress or Egress | 100BASE-TX for Priority [3:0]<br>Register Bit[14:8] or Bit[6:0]      | 10BASE-T for Priority [3:0]<br>Register Bit[14:8] or Bit[6:0]       |
|---------------------------------------|--|---|
|                                       | 0x01 to 0x64 for the rate matches<br>1 Mbps to 100 Mbps respectively | 0x01 to 0x0A for the rate matches<br>1 Mbps to 10 Mbps respectively |
|                                       | 0x00 (default) for the rate is no limit<br>(full 100 Mbps)           | 0x00 (default) for the rate<br>is no limit (full 10 Mbps)           |
| 896 Kbps                              | 0x72   |   |
| 960 Kbps                              | 0x73   |   |

## 4.2.8.6 Port 1 Ingress Rate Control Register 1 (0x076 – 0x077): P1IRCR1

This register contains the port 1 ingress rate limiting control bits for priority 3 and priority 2.

**TABLE 4-55: PORT 1 INGRESS RATE CONTROL REGISTER 1 (0X076 – 0X077): P1IRCR1**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15     | 0       | RW  | Reserved  |
| 14 - 8 | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 3 Frames</b><br>Ingress priority 3 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | Reserved  |
| 6 - 0  | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 2 Frames</b><br>Ingress priority 2 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |

## 4.2.8.7 Port 1 Egress Rate Control Register 0 (0x078 – 0x079): P1ERCRO

This register contains the port 1 egress rate limiting control bits for priority 1 and priority 0. When this port is configured for 1 egress queue (which is the default), only the Priority 0 rate limit is applied. When it is configured for 2 queues, only the Priority 1 and Priority 0 settings are applied.

**TABLE 4-56: PORT 1 EGRESS RATE CONTROL REGISTER 0 (0X078 – 0X079): P1ERCRO**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 0       | RW  | Reserved   |
| 14 - 8 | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 1 Frames</b><br>Egress priority 1 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | <b>Egress Rate Limit Control Enable</b><br>1 = Enable egress rate limit control.<br>0 = Disable egress rate limit control.   |
| 6 - 0  | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 0 Frames</b><br>Egress priority 0 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |



## 4.2.8.8 Port 1 Egress Rate Control Register 1 (0x07A – 0x07B): P1ERCR1

This register contains the port 1 egress rate limiting control bits for priority 3 and priority 2. When this port is configured for 1 egress queue (which is the default), only the Priority 0 rate limit is applied. When it is configured for 2 queues, only the Priority 1 and Priority 0 settings are applied.

**TABLE 4-57: PORT 1 EGRESS RATE CONTROL REGISTER 1 (0X07A – 0X07B): P1ERCR1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 0       | RW  | Reserved   |
| 14 - 8 | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 3 Frames</b><br>Egress priority 3 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | Reserved   |
| 6 - 0  | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 2 Frames</b><br>Egress priority 2 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |

## 4.2.8.9 Port 1 PHY Special Control/Status, LinkMD (0x07C – 0x07D): P1SCSLMD

This register contains the LinkMD control and status information of PHY 1.

**TABLE 4-58: PORT 1 PHY SPECIAL CONTROL/STATUS, LINKMD (0X07C – 0X07D): P1SCSLMD**

| Bit     | Default | R/W   | Description  | Bit is Same As      |
|---------|---------|-------|--|---------------------|
| 15      | 0       | RO    | <b>CDT_10m_Short</b><br>1 = Less than 10 meter short.  | —                   |
| 14 - 13 | 00      | RO    | <b>Cable Diagnostic Test Results</b><br>[00] = Normal condition.<br>[01] = Open condition has been detected in cable.<br>[10] = Short condition has been detected in cable.<br>[11] = Cable diagnostic test has failed.                | —                   |
| 12      | 0       | RW/SC | <b>Cable Diagnostic Test Enable</b><br>1 = Cable diagnostic test is enabled. It is self-cleared after the test is done.<br>0 = Indicates that the cable diagnostic test has completed and the status information is valid for reading. | —                   |
| 11      | 0       | RW    | <b>Force_Link</b><br>1 = Force link pass.<br>0 = Normal operation.   | Bit[3] in P1PHYCTRL |
| 10      | 1       | RW    | Reserved   | —                   |
| 9       | 0       | RW    | <b>Remote (Near-End) Loopback</b><br>1 = Perform remote loopback at port 1's PHY (RXP1/RXM1 -> TXP1/TXM1)<br>0 = Normal operation  | Bit[1] in P1PHYCTRL |
| 8 - 0   | 0x000   | RO    | <b>CDT_Fault_Count</b><br>Distance to the fault. It's approximately 0.4m*CDT_Fault_Count.  | —                   |

## 4.2.8.10 Port 1 Control Register 4 (0x07E – 0x07F): P1CR4

This register contains control bits for the switch port 1 function.

**TABLE 4-59: PORT 1 CONTROL REGISTER 4 (0X07E – 0X07F): P1CR4**

| Bit | Default | R/W | Description | Bit is Same As |
|-----|---------|-----|-------------|----------------|
| 15  | 0       | RW  | Reserved    | —              |

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**TABLE 4-59: PORT 1 CONTROL REGISTER 4 (0X07E – 0X07F): P1CR4 (CONTINUED)**

| Bit | Default | R/W   | Description   | Bit is Same As    |
|-----|---------|-------|---|-------------------|
| 14  | 0       | RW    | <b>Disable Transmit</b><br>1 = Disable the port's transmitter.<br>0 = Normal operation.   | Bit[1] in P1MBCR  |
| 13  | 0       | RW/SC | <b>Restart Auto-Negotiation</b><br>1 = Restart auto-negotiation.<br>0 = Normal operation.   | Bit[9] in P1MBCR  |
| 12  | 0       | RW    | <b>Disable Far-End-Fault</b><br>1 = Disable far-end-fault detection.<br>0 = Normal operation.<br>For 100BASE-FX fiber mode operation.   | Bit[2] in P1MBCR  |
| 11  | 0       | RW    | <b>Power Down</b><br>1 = Power down.<br>0 = Normal operation.<br>No change to registers setting.  | Bit[11] in P1MBCR |
| 10  | 0       | RW    | <b>Disable Auto-MDI/MDI-X</b><br>1 = Disable Auto-MDI/MDI-X function.<br>0 = Enable Auto-MDI/MDI-X function.  | Bit[3] in P1MBCR  |
| 9   | 0       | RW    | <b>Force MDI-X</b><br>1 = If Auto-MDI/MDI-X is disabled, force PHY into MDI-X mode.<br>0 = Do not force PHY into MDI-X mode.  | Bit[4] in P1MBCR  |
| 8   | 0       | RW    | <b>Far-End Loopback</b><br>1 = Perform loopback, as indicated:<br>Start: RXP2/RXM2 (port 2).<br>Loopback: PMD/PMA of port 1's PHY.<br>End: TXP2/TXM2 (port 2).<br>0 = Normal operation.                           | Bit[14] in P1MBCR |
| 7   | 1       | RW    | <b>Auto-Negotiation Enable</b><br>1 = Auto-negotiation is enabled.<br>0 = Disable auto-negotiation, speed, and duplex are decided by bits[6:5] of the same register.  | Bit[12] in P1MBCR |
| 6   | 1       | RW    | <b>Force Speed</b><br>1 = Force 100BASE-TX if auto-negotiation is disabled (bit[7]).<br>0 = Force 10BASE-T if auto-negotiation is disabled (bit[7]).  | Bit[13] in P1MBCR |
| 5   | 1       | RW    | <b>Force Duplex</b><br>1 = Force full-duplex if auto-negotiation is disabled.<br>0 = Force half-duplex if auto-negotiation is disabled.<br>It is always in half-duplex if auto-negotiation is enabled but failed. | Bit[8] in P1MBCR  |
| 4   | 1       | RW    | <b>Advertised Flow Control Capability</b><br>1 = Advertise flow control (pause) capability.<br>0 = Suppress flow control (pause) capability from transmission to link partner.                                    | Bit[10] in P1ANAR |
| 3   | 1       | RW    | <b>Advertised 100BASE-TX Full-Duplex Capability</b><br>1 = Advertise 100BASE-TX full-duplex capability.<br>0 = Suppress 100BASE-TX full-duplex capability from transmission to link partner.                      | Bit [8] in P1ANAR |
| 2   | 1       | RW    | <b>Advertised 100BASE-TX Half-Duplex Capability</b><br>1 = Advertise 100BASE-TX half-duplex capability.<br>0 = Suppress 100BASE-TX half-duplex capability from transmission to link partner.                      | Bit[7] in P1ANAR  |

**TABLE 4-59: PORT 1 CONTROL REGISTER 4 (0X07E – 0X07F): P1CR4 (CONTINUED)**

| Bit | Default | R/W | Description  | Bit is Same As   |
|-----|---------|-----|--|------------------|
| 1   | 1       | RW  | <b>Advertised 10BASE-T Full-Duplex Capability</b><br>1 = Advertise 10BASE-T full-duplex capability.<br>0 = Suppress 10BASE-T full-duplex capability from transmission to link partner. | Bit[6] in P1ANAR |
| 0   | 1       | RW  | <b>Advertised 10BASE-T Half-Duplex Capability</b><br>1 = Advertise 10BASE-T half-duplex capability.<br>0 = Suppress 10BASE-T half-duplex capability from transmission to link partner. | Bit[5] in P1ANAR |

## 4.2.8.11 Port 1 Status Register (0x080 – 0x081): P1SR

This register contains status bits for the switch port 1 function.

**TABLE 4-60: PORT 1 STATUS REGISTER (0X080 – 0X081): P1SR**

| Bit | Default | R/W | Description  | Bit is Same As      |
|-----|---------|-----|--|---------------------|
| 15  | 1       | RW  | <b>HP_Mdix</b><br>1 = HP Auto-MDI-X mode.<br>0 = Microchip Auto-MDI-X mode.  | Bit[5] in P1MBCR    |
| 14  | 0       | RO  | Reserved   | —                   |
| 13  | 0       | RO  | <b>Polarity Reverse</b><br>1 = Polarity is reversed.<br>0 = Polarity is not reversed.  | Bit[5] in P1PHYCTRL |
| 12  | 0       | RO  | <b>Transmit Flow Control Enable</b><br>1 = Transmit flow control feature is active.<br>0 = Transmit flow control feature is inactive.                        | —                   |
| 11  | 0       | RO  | <b>Receive Flow Control Enable</b><br>1 = Receive flow control feature is active.<br>0 = Receive flow control feature is inactive.                           | —                   |
| 10  | 0       | RO  | <b>Operation Speed</b><br>1 = Link speed is 100 Mbps.<br>0 = Link speed is 10 Mbps.  | —                   |
| 9   | 0       | RO  | <b>Operation Duplex</b><br>1 = Link duplex is full.<br>0 = Link duplex is half.  | —                   |
| 8   | 0       | RO  | <b>Far-End-Fault</b><br>1 = Far-end-fault detected.<br>0 = No far-end-fault detected.<br>For 100BASE-FX fiber mode operation.                                | Bit[4] in P1MBSR    |
| 7   | 0       | RO  | <b>MDI-X Status</b><br>0 = MDI.<br>1 = MDI-X.  | Bit[4] in P1PHYCTRL |
| 6   | 0       | RO  | <b>Auto-Negotiation Done</b><br>1 = Auto-negotiation done.<br>0 = Auto-negotiation not done.   | Bit[5] in P1MBSR    |
| 5   | 0       | RO  | <b>Link Status</b><br>1 = Link good.<br>0 = Link not good.   | Bit[2] in P1MBSR    |
| 4   | 0       | RO  | <b>Partner Flow Control Capability</b><br>1 = Link partner flow control (pause) capable.<br>0 = Link partner not flow control (pause) capable.               | Bit[10] in P1ANLPR  |
| 3   | 0       | RO  | <b>Partner 100BASE-TX Full-Duplex Capability</b><br>1 = Link partner 100BASE-TX full-duplex capable.<br>0 = Link partner not 100BASE-TX full-duplex capable. | Bit[8] in P1ANLPR   |

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**TABLE 4-60: PORT 1 STATUS REGISTER (0X080 – 0X081): P1SR (CONTINUED)**

| Bit | Default | R/W | Description  | Bit is Same As    |
|-----|---------|-----|--|-------------------|
| 2   | 0       | RO  | <b>Partner 100BASE-TX Half-Duplex Capability</b><br>1 = Link partner 100BASE-TX half-duplex capable.<br>0 = Link partner not 100BASE-TX half-duplex capable. | Bit[7] in P1ANLPR |
| 1   | 0       | RO  | <b>Partner 10BASE-T Full-Duplex Capability</b><br>1 = Link partner 10BASE-T full-duplex capable.<br>0 = Link partner not 10BASE-T full-duplex capable.       | Bit[6] in P1ANLPR |
| 0   | 0       | RO  | <b>Partner 10BASE-T Half-Duplex Capability</b><br>1 = Link partner 10BASE-T half-duplex capable.<br>0 = Link partner not 10BASE-T half-duplex capable.       | Bit[5] in P1ANLPR |

4.2.8.12 0x082 – 0x083: Reserved

## 4.2.9 PORT 2 CONTROL REGISTERS

### 4.2.9.1 Port 2 Control Register 1 (0x084 – 0x085): P2CR1

This register contains control bits for the switch port 2 function.

**TABLE 4-61: PORT 2 CONTROL REGISTER 1 (0X084 – 0X085): P2CR1**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15      | 0       | RO  | Reserved   |
| 14 - 12 | 000     | RW  | <b>Port 2 LED Direct Control</b><br>These bits directly control the port 2 LED pins.<br>0xx = Normal LED function as set up via Reg. 0x00E – 0x00F, Bit[9:8].<br>100 = Both port 2 LEDs off.<br>101 = Port 2 LED1 off, LED0 on.<br>110 = Port 2 LED1 on, LED0 off.<br>111 = Both port 2 LEDs on. |
| 11      | 0       | RW  | <b>Source Address Filtering Enable for MAC Address 2</b><br>1 = Enable the source address filtering function when the SA matches MAC Address 2 in SAFMACA2 (0x0B6 – 0x0BB).<br>0 = Disable source address filtering function.  |
| 10      | 0       | RW  | <b>Source Address Filtering Enable for MAC Address 1</b><br>1 = Enable the source address filtering function when the SA matches MAC Address 1 in SAFMACA1 (0x0B0 – 0x0B5).<br>0 = Disable source address filtering function.  |
| 9       | 0       | RW  | <b>Drop Tagged Packet Enable</b><br>1 = Enable dropping of tagged ingress packets.<br>0 = Disable dropping of tagged ingress packets.  |
| 8       | 0       | RW  | <b>TX Two Queues Select Enable</b><br>1 = The port 2 output queue is split into two priority queues (q0 and q1)<br>0 = Single output queue on port 2. There is no priority differentiation even though packets are classified into high or low priority.   |
| 7       | 0       | RW  | <b>Broadcast Storm Protection Enable</b><br>1 = Enable broadcast storm protection for ingress packets on port 2.<br>0 = Disable broadcast storm protection.  |
| 6       | 0       | RW  | <b>Diffserv Priority Classification Enable</b><br>1 = Enable DiffServ priority classification for ingress packets on port 2.<br>0 = Disable DiffServ function.   |
| 5       | 0       | RW  | <b>802.1p Priority Classification Enable</b><br>1 = Enable 802.1p priority classification for ingress packets on port 2.<br>0 = Disable 802.1p.  |

**TABLE 4-61: PORT 2 CONTROL REGISTER 1 (0X084 – 0X085): P2CR1 (CONTINUED)**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 4 - 3 | 00      | RW  | <b>Port-Based Priority Classification</b><br>00 = Ingress packets on port 2 are classified as priority 0 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br>01 = Ingress packets on port 2 are classified as priority 1 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br>10 = Ingress packets on port 2 are classified as priority 2 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br>11 = Ingress packets on port 2 are classified as priority 3 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br><b>Note:</b> “DiffServ”, “802.1p” and port priority can be enabled at the same time. The OR’ed result of 802.1p and DSCP overwrites the port priority. |
| 2     | 0       | RW  | <b>Tag Insertion</b><br>1 = When packets are output on port 2, the switch adds 802.1p/q tags to packets without 802.1p/q tags when received. The switch will not add tags to packets already tagged. The tag inserted is the ingress port’s “port VID”.<br>0 = Disable tag insertion.   |
| 1     | 0       | RW  | <b>Tag Removal</b><br>1 = When packets are output on port 2, the switch removes 802.1p/q tags from packets with 802.1p/q tags when received. The switch will not modify packets received without tags.<br>0 = Disable tag removal.  |
| 0     | 0       | RW  | <b>TX Multiple Queues Select Enable</b><br>1 = The port 2 output queue is split into four priority queues (q0, q1, q2 and q3).<br>0 = Single output queue on port 2. There is no priority differentiation even though packets are classified into high or low priority.   |

## 4.2.9.2 Port 2 Control Register 2 (0x086 – 0x087): P2CR2

This register contains control bits for the switch port 2 function.

**TABLE 4-62: PORT 2 CONTROL REGISTER 2 (0X086 – 0X087): P2CR2**

| Bit | Default | R/W | Description  |
|-----|---------|-----|--|
| 15  | 0       | RW  | Reserved   |
| 14  | 0       | RW  | <b>Ingress VLAN Filtering</b><br>1 = The switch discards packets whose VID port membership in VLAN table bits [18:16] does not include the ingress port VID.<br>0 = No ingress VLAN filtering. |
| 13  | 0       | RW  | <b>Discard Non PVID Packets</b><br>1 = The switch discards packets whose VID does not match the ingress port default VID.<br>0 = No packets are discarded.                                     |
| 12  | 0       | RW  | <b>Force Flow Control</b><br>1 = Always enable flow control on the port, regardless of auto-negotiation result.<br>0 = The flow control is enabled based on auto-negotiation result.           |
| 11  | 0       | RW  | <b>Back Pressure Enable</b><br>1 = Enable port’s half-duplex back pressure.<br>0 = Disable port’s half-duplex back pressure.   |
| 10  | 1       | RW  | <b>Transmit Enable</b><br>1 = Enable packet transmission on the port.<br>0 = Disable packet transmission on the port.  |

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**TABLE 4-62: PORT 2 CONTROL REGISTER 2 (0X086 – 0X087): P2CR2 (CONTINUED)**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 9     | 1       | RW  | <b>Receive Enable</b><br>1 = Enable packet reception on the port.<br>0 = Disable packet reception on the port.   |
| 8     | 0       | RW  | <b>Learning Disable</b><br>1 = Disable switch address learning capability.<br>0 = Enable switch address learning.  |
| 7     | 0       | RW  | <b>Sniffer Port</b><br>1 = Port is designated as a sniffer port and transmits packets that are monitored.<br>0 = Port is a normal port.  |
| 6     | 0       | RW  | <b>Receive Sniff</b><br>1 = All packets received on the port are marked as “monitored packets” and forwarded to the designated “sniffer port.”<br>0 = No receive monitoring.   |
| 5     | 0       | RW  | <b>Transmit Sniff</b><br>1 = All packets transmitted on the port are marked as “monitored packets” and forwarded to the designated “sniffer port.”<br>0 = No transmit monitoring.  |
| 4     | 0       | RW  | Reserved   |
| 3     | 0       | RW  | <b>User Priority Ceiling</b><br>1 = If the packet’s “priority field” is greater than the “user priority field” in the port VID control register bit[15:13], replace the packet’s “priority field” with the “user priority field” in the port VID control register bit[15:13].<br>0 = Do not compare and replace the packet’s “priority field.” |
| 2 - 0 | 111     | RW  | <b>Port VLAN Membership</b><br>Define the port’s port VLAN membership. Bit[2] stands for the host port, bit[1] for port 2, and bit[0] for port 1. The port can only communicate within the membership. A ‘1’ includes a port in the membership; a ‘0’ excludes a port from the membership.   |

## 4.2.9.3 Port 2 VID Control Register (0x088 – 0x089): P2VIDCR

This register contains control bits for the switch port 2 function. This register has two main uses. It is associated with the ingress of untagged packets and used for egress tagging as well as being used for address lookup and providing a default VID for the ingress of untagged or null-VID-tagged packets.

**TABLE 4-63: PORT 2 VID CONTROL REGISTER (0X088 – 0X089): P2VIDCR**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 13 | 000     | RW  | <b>Default Tag[15:13]</b><br>Port’s default tag, containing “User Priority Field” bits. |
| 12      | 0       | RW  | <b>Default Tag[12]</b><br>Port’s default tag, containing CFI bit.                       |
| 11 - 0  | 0x001   | RW  | <b>Default Tag[11:0]</b><br>Port’s default tag, containing VID[11:0].                   |

## 4.2.9.4 Port 2 Control Register 3 (0x08A – 0x08B): P2CR3

This register contains the control bits for the switch port 2 function.

**TABLE 4-64: PORT 2 CONTROL REGISTER 3 (0X08A – 0X08B): P2CR3**

| Bit    | Default | R/W | Description |
|--------|---------|-----|-------------|
| 15 - 5 | 0x000   | RO  | Reserved    |
| 4      | 0       | RW  | Reserved    |

**TABLE 4-64: PORT 2 CONTROL REGISTER 3 (0X08A – 0X08B): P2CR3 (CONTINUED)**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 3 - 2 | 00      | RW  | <b>Ingress Limit Mode</b><br>These bits determine what kinds of frames are limited and counted against ingress rate limiting as follows:<br>00 = Limit and count all frames.<br>01 = Limit and count Broadcast, Multicast, and flooded Unicast frames.<br>10 = Limit and count Broadcast and Multicast frames only.<br>11 = Limit and count Broadcast frames only. |
| 1     | 0       | RW  | <b>Count Inter-Frame Gap</b><br>Count IFG Bytes.<br>1 = Each frame's minimum inter frame gap. IFG bytes (12 per frame) are included in Ingress and Egress rate limiting calculations.<br>0 = IFG bytes are not counted.  |
| 0     | 0       | RW  | <b>Count Preamble</b><br>Count preamble Bytes.<br>1 = Each frame's preamble bytes (8 per frame) are included in Ingress and Egress rate limiting calculations.<br>0 = Preamble bytes are not counted.  |

## 4.2.9.5 Port 2 Ingress Rate Control Register 0 (0x08C – 0x08D): P2IRCR0

This register contains the port 2 ingress rate limiting control bits for priority 1 and priority 0.

**TABLE 4-65: PORT 2 INGRESS RATE CONTROL REGISTER 0 (0X08C – 0X08D): P2IRCR0**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15     | 0       | RW  | Reserved  |
| 14 - 8 | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 1 Frames</b><br>Ingress priority 1 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | Reserved  |
| 6 - 0  | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 0 Frames</b><br>Ingress priority 0 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |

## 4.2.9.6 Port 2 Ingress Rate Control Register 1 (0x08E – 0x08F): P2IRCR1

This register contains the port 2 ingress rate limiting control bits for priority 3 and priority 2.

**TABLE 4-66: PORT 2 INGRESS RATE CONTROL REGISTER 1 (0X08E – 0X08F): P2IRCR1**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15     | 0       | RW  | Reserved  |
| 14 - 8 | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 3 Frames</b><br>Ingress priority 3 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | Reserved  |
| 6 - 0  | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 2 Frames</b><br>Ingress priority 2 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |

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## 4.2.9.7 Port 2 Egress Rate Control Register 0 (0x090 – 0x091): P2ERCR0

This register contains the port 2 egress rate limiting control bits for priority 1 and priority 0. When this port is configured for 1 egress queue (which is the default), only the Priority 0 rate limit is applied. When it is configured for 2 queues, only the Priority 1 and Priority 0 settings are applied.

**TABLE 4-67: PORT 2 EGRESS RATE CONTROL REGISTER 0 (0X090 – 0X091): P2ERCR0**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 0       | RW  | Reserved   |
| 14 - 8 | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 1 Frames</b><br>Egress priority 1 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | <b>Egress Rate Limit Control Enable</b><br>1 = Enable egress rate limit control.<br>0 = Disable egress rate limit control.   |
| 6 - 0  | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 0 Frames</b><br>Egress priority 0 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |

## 4.2.9.8 Port 2 Egress Rate Control Register 1 (0x092 – 0x093): P2ERCR1

This register contains the port 2 egress rate limiting control bits for priority 3 and priority 2. When this port is configured for 1 egress queue (which is the default), only the Priority 0 rate limit is applied. When it is configured for 2 queues, only the Priority 1 and Priority 0 settings are applied.

**TABLE 4-68: PORT 2 EGRESS RATE CONTROL REGISTER 1 (0X092 – 0X093): P2ERCR1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 0       | RW  | Reserved   |
| 14 - 8 | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 3 Frames</b><br>Egress priority 3 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | Reserved   |
| 6 - 0  | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 2 Frames</b><br>Egress priority 2 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |

## 4.2.9.9 Port 2 PHY Special Control/Status, LinkMD® (0x094 – 0x095): P2SCSLMD

This register contains the LinkMD control and status information of PHY 2.

**TABLE 4-69: PORT 2 PHY SPECIAL CONTROL/STATUS, LINKMD® (0X094 – 0X095): P2SCSLMD**

| Bit     | Default | R/W | Description  | Bit is Same As |
|---------|---------|-----|--|----------------|
| 15      | 0       | RO  | <b>CDT_10m_Short</b><br>1 = Less than 10 meter short.  | —              |
| 14 - 13 | 00      | RO  | <b>Cable Diagnostic Results</b><br>[00] = Normal condition.<br>[01] = Open condition has been detected in cable.<br>[10] = Short condition has been detected in cable.<br>[11] = Cable diagnostic test has failed. | —              |



**TABLE 4-69: PORT 2 PHY SPECIAL CONTROL/STATUS, LINKMD® (0X094 – 0X095): P2SCSLMD (CONTINUED)**

| Bit   | Default | R/W   | Description  | Bit is Same As      |
|-------|---------|-------|--|---------------------|
| 12    | 0       | RW/SC | <b>Cable Diagnostic Test Enable</b><br>1 = Cable diagnostic test is enabled. It is self-cleared after the test is done.<br>0 = Indicates that the cable diagnostic test has completed and the status information is valid for reading. | —                   |
| 11    | 0       | RW    | <b>Force_Link</b><br>Force link.<br>1 = Force link pass.<br>0 = Normal operation.  | Bit[3] in P2PHYCTRL |
| 10    | 1       | RW    | Reserved   | —                   |
| 9     | 0       | RW    | <b>Remote (Near-End) Loopback</b><br>1 = Perform remote loopback at port 2's PHY (RXP2/ RXM2 -> TXP2/TXM2)<br>0 = Normal operation   | Bit[1] in P2PHYCTRL |
| 8 - 0 | 0x000   | RO    | <b>CDT_Fault_Count</b><br>Distance to the fault. It's approximately 0.4m*CDT_- Fault_Count.  | —                   |

## 4.2.9.10 Port 2 Control Register 4 (0x096 – 0x097): P2CR4

This register contains the control bits for the switch port 2 function.

**TABLE 4-70: PORT 2 CONTROL REGISTER 4 (0X096 – 0X097): P2CR4**

| Bit | Default | R/W   | Description   | Bit is Same As    |
|-----|---------|-------|---|-------------------|
| 15  | 0       | RW    | Reserved  | —                 |
| 14  | 0       | RW    | <b>Disable Transmit</b><br>1 = Disable the port's transmitter.<br>0 = Normal operation.   | Bit[1] in P2MBCR  |
| 13  | 0       | RW/SC | <b>Restart Auto-Negotiation</b><br>1 = Restart auto-negotiation.<br>0 = Normal operation.   | Bit[9] in P2MBCR  |
| 12  | 0       | RW    | <b>Disable Far-End-Fault</b><br>1 = Disable far-end-fault detection.<br>0 = Normal operation.<br>For 100BASE-FX fiber-mode operation.   | Bit[2] in P2MBCR  |
| 11  | 0       | RW    | <b>Power Down</b><br>1 = Power down.<br>0 = Normal operation.<br>No change to registers setting   | Bit[11] in P2MBCR |
| 10  | 0       | RW    | <b>Disable Auto-MDI/MDI-X</b><br>1 = Disable Auto-MDI/MDI-X function.<br>0 = Enable Auto- MDI/MDI-X function.   | Bit[3] in P2MBCR  |
| 9   | 0       | RW    | <b>Force MDI-X</b><br>1 = If Auto-MDI/MDI-X is disabled, force PHY into MDI-X mode.<br>0 = Do not force PHY into MDI-X mode.  | Bit[4] in P2MBCR  |
| 8   | 0       | RW    | <b>Far-End Loopback</b><br>1 = Perform loopback, as indicated:<br>Start: RXP1/RXM1 (port 1).<br>Loopback: PMD/PMA of port 2's PHY.<br>End: TXP1/TXM1 (port 1).<br>0 = Normal operation. | Bit[14] in P2MBCR |

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**TABLE 4-70: PORT 2 CONTROL REGISTER 4 (0X096 – 0X097): P2CR4 (CONTINUED)**

| Bit | Default | R/W | Description  | Bit is Same As    |
|-----|---------|-----|--|-------------------|
| 7   | 1       | RW  | <b>Auto-Negotiation Enable</b><br>1 = Auto-negotiation is enabled.<br>0 = Disable auto-negotiation, speed, and duplex are decided by bits [6:5] of the same register.  | Bit[12] in P2MBCR |
| 6   | 1       | RW  | <b>Force Speed</b><br>1 = Force 100BASE-TX if auto-negotiation is disabled (bit[7]).<br>0 = Force 10BASE-T if auto-negotiation is disabled (bit[7]).   | Bit[13] in P2MBCR |
| 5   | 1       | RW  | <b>Force Duplex</b><br>1 = Force full-duplex if auto-negotiation is disabled.<br>0 = Force half-duplex if auto-negotiation is disabled. It is always in half-duplex if auto-negotiation is enabled but failed. | Bit[8] in P2MBCR  |
| 4   | 1       | RW  | <b>Advertised Flow Control Capability</b><br>1 = Advertise flow control (pause) capability.<br>0 = Suppress flow control (pause) capability from transmission to link partner.                                 | Bit[10] in P2ANAR |
| 3   | 1       | RW  | <b>Advertised 100BASE-TX Full-Duplex Capability</b><br>1 = Advertise 100BASE-TX full-duplex capability.<br>0 = Suppress 100BASE-TX full-duplex capability from transmission to link partner.                   | Bit[8] in P2ANAR  |
| 2   | 1       | RW  | <b>Advertised 100BASE-TX Half-Duplex Capability</b><br>1 = Advertise 100BASE-TX half-duplex capability.<br>0 = Suppress 100BASE-TX half-duplex capability from transmission to link partner.                   | Bit[7] in P2ANAR  |
| 1   | 1       | RW  | <b>Advertised 10BASE-T Full-Duplex Capability</b><br>1 = Advertise 10BASE-T full-duplex capability.<br>0 = Suppress 10BASE-T full-duplex capability from transmission to link partner.                         | Bit[6] in P2ANAR  |
| 0   | 1       | RW  | <b>Advertised 10BASE-T Half-Duplex Capability</b><br>1 = Advertise 10BASE-T half-duplex capability.<br>0 = Suppress 10BASE-T half-duplex capability from transmission to link partner.                         | Bit[5] in P2ANAR  |

## 4.2.9.11 Port 2 Status Register (0x098 – 0x099): P2SR

This register contains status bits for the switch port 2 function.

**TABLE 4-71: PORT 2 STATUS REGISTER (0X098 – 0X099): P2SR**

| Bit | Default | R/W | Description   | Bit is Same As      |
|-----|---------|-----|---|---------------------|
| 15  | 1       | RW  | <b>HP_MDIX</b><br>1 = HP Auto-MDI-X mode.<br>0 = Microchip Auto-MDI-X mode.   | Bit[5] in P2MBCR    |
| 14  | 0       | RO  | Reserved  | —                   |
| 13  | 0       | RO  | <b>Polarity Reverse</b><br>1 = Polarity is reversed.<br>0 = Polarity is not reversed.   | Bit[5] in P2PHYCTRL |
| 12  | 0       | RO  | <b>Transmit Flow Control Enable</b><br>1 = Transmit flow control feature is active.<br>0 = Transmit flow control feature is inactive. | —                   |

**TABLE 4-71: PORT 2 STATUS REGISTER (0X098 – 0X099): P2SR (CONTINUED)**

| Bit | Default | R/W | Description  | Bit is Same As      |
|-----|---------|-----|--|---------------------|
| 11  | 0       | RO  | <b>Receive Flow Control Enable</b><br>1 = Receive flow control feature is active.<br>0 = Receive flow control feature is inactive.                           | —                   |
| 10  | 0       | RO  | <b>Operation Speed</b><br>1 = Link speed is 100 Mbps.<br>0 = Link speed is 10 Mbps.  | —                   |
| 9   | 0       | RO  | <b>Operation Duplex</b><br>1 = Link duplex is full.<br>0 = Link duplex is half.  | —                   |
| 8   | 0       | RO  | <b>Far-End-Fault</b><br>1 = Far-end-fault detected.<br>0 = No far-end-fault detected.<br>For 100BASE-FX fiber mode operation.                                | Bit[4] in P2MBSR    |
| 7   | 0       | RO  | <b>MDI-X status</b><br>0 = MDI.<br>1 = MDI-X.  | Bit[4] in P2PHYCTRL |
| 6   | 0       | RO  | <b>Auto-Negotiation Done</b><br>1 = Auto-negotiation done.<br>0 = Auto-negotiation not done.   | Bit[5] in P2MBSR    |
| 5   | 0       | RO  | <b>Link Status</b><br>1 = Link good.<br>0 = Link not good.   | Bit[2] in P2MBSR    |
| 4   | 0       | RO  | <b>Partner Flow Control Capability</b><br>1 = Link partner flow control (pause) capable.<br>0 = Link partner not flow control (pause) capable.               | Bit[10] in P2ANLPR  |
| 3   | 0       | RO  | <b>Partner 100BASE-TX Full-Duplex Capability</b><br>1 = Link partner 100BASE-TX full-duplex capable.<br>0 = Link partner not 100BASE-TX full-duplex capable. | Bit[8] in P2ANLPR   |
| 2   | 0       | RO  | <b>Partner 100BASE-TX Half-Duplex Capability</b><br>1 = Link partner 100BASE-TX half-duplex capable.<br>0 = Link partner not 100BASE-TX half-duplex capable. | Bit[7] in P2ANLPR   |
| 1   | 0       | RO  | <b>Partner 10BASE-T Full-Duplex Capability</b><br>1 = Link partner 10BASE-T full-duplex capable.<br>0 = Link partner not 10BASE-T full-duplex capable.       | Bit[6] in P2ANLPR   |
| 0   | 0       | RO  | <b>Partner 10BASE-T Half-Duplex Capability</b><br>1 = Link partner 10BASE-T half-duplex capable.<br>0 = Link partner not 10BASE-T half-duplex capable.       | Bit[5] in P2ANLPR   |

4.2.9.12 0x09A – 0x09B: Reserved

## 4.2.10 PORT 3 CONTROL REGISTERS

### 4.2.10.1 Port 3 Control Register 1 (0x09C – 0x09D): P3CR1

This register contains control bits for the switch port 3 function.

**TABLE 4-72: PORT 3 CONTROL REGISTER 1 (0X09C – 0X09D): P3CR1**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 10 | 0x00    | RO  | Reserved  |
| 9       | 0       | RW  | <b>Drop Tagged Packet Enable</b><br>1 = Enable dropping of tagged ingress packets.<br>0 = Disable dropping of tagged ingress packets. |

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**TABLE 4-72: PORT 3 CONTROL REGISTER 1 (0X09C – 0X09D): P3CR1 (CONTINUED)**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 8     | 0       | RW  | <b>TX Two Queues Select Enable</b><br>1 = The port 3 output queue is split into two priority queues (q0 and q1).<br>0 = Single output queue on port 3. There is no priority differentiation even though packets are classified into high or low priority.   |
| 7     | 0       | RW  | <b>Broadcast Storm Protection Enable</b><br>1 = Enable broadcast storm protection for ingress packets on port 3.<br>0 = Disable broadcast storm protection.   |
| 6     | 0       | RW  | <b>Diffserv Priority Classification Enable</b><br>1 = Enable DiffServ priority classification for ingress packets on port 3.<br>0 = Disable DiffServ function.  |
| 5     | 0       | RW  | <b>802.1p Priority Classification Enable</b><br>1 = Enable 802.1p priority classification for ingress packets on port 3.<br>0 = Disable 802.1p.   |
| 4 - 3 | 00      | RW  | <b>Port-Based Priority Classification</b><br>00 = Ingress packets on port 3 are classified as priority 0 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br>01 = Ingress packets on port 3 are classified as priority 1 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br>10 = Ingress packets on port 3 are classified as priority 2 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br>11 = Ingress packets on port 3 are classified as priority 3 queue if “Diff-Serv” or “802.1p” classification is not enabled or fails to classify.<br><b>Note:</b> “DiffServ”, “802.1p” and port priority can be enabled at the same time. The OR’ed result of 802.1p and DSCP overwrites the port priority. |
| 2     | 0       | RW  | <b>Tag Insertion</b><br>1 = When packets are output on port 3, the switch adds 802.1p/q tags to packets without 802.1p/q tags when received. The switch will not add tags to packets already tagged. The tag inserted is the ingress port’s “port VID”.<br>0 = Disable tag insertion.   |
| 1     | 0       | RW  | <b>Tag Removal</b><br>1 = When packets are output on port 3, the switch removes 802.1p/q tags from packets with 802.1p/q tags when received. The switch will not modify packets received without tags.<br>0 = Disable tag removal.  |
| 0     | 0       | RW  | <b>TX Multiple Queues Select Enable</b><br>1 = The port 3 output queue is split into four priority queues (q0, q1, q2 and q3).<br>0 = Single output queue on port 3. There is no priority differentiation even though packets are classified into high or low priority.   |

## 4.2.10.2 Port 3 Control Register 2 (0x09E – 0x09F): P3CR2

This register contains control bits for the switch port 3 function.

**TABLE 4-73: PORT 3 CONTROL REGISTER 2 (0X09E – 0X09F): P3CR2**

| Bit | Default | R/W | Description  |
|-----|---------|-----|--|
| 15  | 0       | RW  | Reserved   |
| 14  | 0       | RW  | <b>Ingress VLAN Filtering</b><br>1 = The switch discards packets whose VID port membership in VLAN table bits [18:16] does not include the ingress port VID.<br>0 = No ingress VLAN filtering. |

**TABLE 4-73: PORT 3 CONTROL REGISTER 2 (0X09E – 0X09F): P3CR2 (CONTINUED)**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 13    | 0       | RW  | <b>Discard Non PVID Packets</b><br>1 = The switch discards packets whose VID does not match the ingress port default VID.<br>0 = No packets are discarded.   |
| 12    | 0       | RW  | Reserved   |
| 11    | 0       | RW  | <b>Back Pressure Enable</b><br>1 = Enable port's half-duplex back pressure.<br>0 = Disable port's half-duplex back pressure.   |
| 10    | 1       | RW  | <b>Transmit Enable</b><br>1 = Enable packet transmission on the port.<br>0 = Disable packet transmission on the port.  |
| 9     | 1       | RW  | <b>Receive Enable</b><br>1 = Enable packet reception on the port.<br>0 = Disable packet reception on the port.   |
| 8     | 0       | RW  | <b>Learning Disable</b><br>1 = Disable switch address learning capability.<br>0 = Enable switch address learning.  |
| 7     | 0       | RW  | <b>Sniffer Port</b><br>1 = Port is designated as a sniffer port and transmits packets that are monitored.<br>0 = Port is a normal port.  |
| 6     | 0       | RW  | <b>Receive Sniff</b><br>1 = All packets received on the port are marked as "monitored packets" and forwarded to the designated "sniffer port."<br>0 = No receive monitoring.   |
| 5     | 0       | RW  | <b>Transmit Sniff</b><br>1 = All packets transmitted on the port are marked as "monitored packets" and forwarded to the designated "sniffer port."<br>0 = No transmit monitoring.  |
| 4     | 0       | RW  | Reserved   |
| 3     | 0       | RW  | <b>User Priority Ceiling</b><br>1 = If the packet's "priority field" is greater than the "user priority field" in the port VID control register bit[15:13], replace the packet's "priority field" with the "user priority field" in the port VID control register bit[15:13].<br>0 = Do not compare and replace the packet's "priority field." |
| 2 - 0 | 111     | RW  | <b>Port VLAN Membership</b><br>Define the port's port VLAN membership. Bit[2] stands for the host port, bit [1] for port 2, and bit [0] for port 1. The port can only communicate within the membership. A '1' includes a port in the membership; a '0' excludes a port from the membership.   |

#### 4.2.10.3 Port 3 VID Control Register (0x0A0 – 0x0A1): P3VIDCR

This register contains the control bits for the switch port 3 function. This register has two main uses. It is associated with the ingress of untagged packets and used for egress tagging as well as being used for address lookup and providing a default VID for the ingress of untagged or null-VID-tagged packets.

**TABLE 4-74: PORT 3 VID CONTROL REGISTER (0X0A0 – 0X0A1): P3VIDCR**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 13 | 0x0     | RW  | <b>Default Tag[15:13]</b><br>Port's default tag, containing "User Priority Field" bits. |
| 12      | 0       | RW  | <b>Default Tag[12]</b><br>Port's default tag, containing CFI bit.                       |

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**TABLE 4-74: PORT 3 VID CONTROL REGISTER (0X0A0 – 0X0A1): P3VIDCR (CONTINUED)**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 11 - 0 | 0x001   | RW  | <b>Default Tag[11:0]</b><br>Port's default tag, containing VID[11:0]. |

## 4.2.10.4 Port 3 Control Register 3 (0x0A2 – 0x0A3): P3CR3

This register contains the control bits for the switch port 3 function.

**TABLE 4-75: PORT 3 CONTROL REGISTER 3 (0X0A2 – 0X0A3): P3CR3**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 8 | 0x00    | RO  | Reserved   |
| 7      | 0       | RW  | Reserved   |
| 6 - 4  | 000     | RW  | Reserved   |
| 3 - 2  | 00      | RW  | <b>Ingress Limit Mode</b><br>These bits determine what kinds of frames are limited and counted against ingress rate limiting as follows:<br>00 = Limit and count all frames.<br>01 = Limit and count Broadcast, Multicast, and flooded Unicast frames.<br>10 = Limit and count Broadcast and Multicast frames only.<br>11 = Limit and count Broadcast frames only. |
| 1      | 0       | RW  | <b>Count Inter-Frame Gap</b><br>Count IFG Bytes.<br>1 = Each frame's minimum inter frame gap. IFG bytes (12 per frame) are included in Ingress and Egress rate limiting calculations.<br>0 = IFG bytes are not counted.  |
| 0      | 0       | RW  | <b>Count Preamble</b><br>Count preamble Bytes.<br>1 = Each frame's preamble bytes (8 per frame) are included in Ingress and Egress rate limiting calculations.<br>0 = Preamble bytes are not counted.  |

## 4.2.10.5 Port 3 Ingress Rate Control Register 0 (0x0A4 – 0x0A5): P3IRCR0

This register contains the port 3 ingress rate limiting control bits for priority 1 and priority 0.

**TABLE 4-76: PORT 3 INGRESS RATE CONTROL REGISTER 0 (0X0A4 – 0X0A5): P3IRCR0**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15     | 0       | RW  | Reserved  |
| 14 - 8 | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 1 Frames</b><br>Ingress priority 1 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | Reserved  |
| 6 - 0  | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 0 Frames</b><br>Ingress priority 0 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |

## 4.2.10.6 Port 3 Ingress Rate Control Register 1 (0x0A6 – 0x0A7): P3IRCR1

This register contains the port 3 ingress rate limiting control bits for priority 3 and priority 2.

**TABLE 4-77: PORT 3 INGRESS RATE CONTROL REGISTER 1 (0X0A6 – 0X0A7): P3IRCR1**

| Bit | Default | R/W | Description |
|-----|---------|-----|-------------|
| 15  | 0       | RW  | Reserved    |

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**TABLE 4-77: PORT 3 INGRESS RATE CONTROL REGISTER 1 (0X0A6 – 0X0A7): P3IRCR1 (CONTINUED)**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 14 - 8 | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 3 Frames</b><br>Ingress priority 3 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | Reserved  |
| 6 - 0  | 0x00    | RW  | <b>Ingress Data Rate Limit for Priority 2 Frames</b><br>Ingress priority 2 frames will be limited or discarded as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |

## 4.2.10.7 Port 3 Egress Rate Control Register 0 (0x0A8 – 0x0A9): P3ERCR0

This register contains the port 3 egress rate limiting control bits for priority 1 and priority 0. When this port is configured for 1 egress queue (which is the default), only the Priority 0 rate limit is applied. When it is configured for 2 queues, only the Priority 1 and Priority 0 settings are applied.

**TABLE 4-78: PORT 3 EGRESS RATE CONTROL REGISTER 0 (0X0A8 – 0X0A9): P3ERCR0**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 0       | RW  | Reserved   |
| 14 - 8 | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 1 Frames</b><br>Egress priority 1 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | <b>Egress Rate Limit Control Enable</b><br>1 = Enable egress rate limit control.<br>0 = Disable egress rate limit control.   |
| 6 - 0  | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 0 Frames</b><br>Egress priority 0 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |

## 4.2.10.8 Port 3 Egress Rate Control Register 1 (0x0AA – 0x0AB): P3ERCR1

This register contains the port 3 egress rate limiting control bits for priority 3 and priority 2. When this port is configured for 1 egress queue (which is the default), only the Priority 0 rate limit is applied. When it is configured for 2 queues, only the Priority 1 and Priority 0 settings are applied.

**TABLE 4-79: PORT 3 EGRESS RATE CONTROL REGISTER 1 (0X0AA – 0X0AB): P3ERCR1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 0       | RW  | Reserved   |
| 14 - 8 | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 3 Frames</b><br>Egress priority 3 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |
| 7      | 0       | RW  | Reserved   |
| 6 - 0  | 0x00    | RW  | <b>Egress Data Rate Limit for Priority 2 Frames</b><br>Egress priority 2 frames will be limited as shown in <a href="#">Table 4-54</a> .<br><b>Note:</b> The default value 0x00 is full rate at 10 Mbps or 100 Mbps with no limit. |



## 4.2.11 SWITCH GLOBAL CONTROL REGISTERS

### 4.2.11.1 Switch Global Control Register 8 (0x0AC – 0x0AD): SGCR8

This register contains the global control bits for the switch function.

**TABLE 4-80: SWITCH GLOBAL CONTROL REGISTER 8 (0X0AC – 0X0AD): SGCR8**

| Bit     | Default | R/W   | Description  |
|---------|---------|-------|--|
| 15 - 14 | 10      | RW    | <b>Two Queue Priority Mapping</b><br>These bits determine the mapping between the priority of the incoming frames and the destination on-chip queue in a two queue configuration which uses egress queues 0 and 1.<br>'00' = Reserved<br>'01' = Egress Queue 1 receives priority 1, 2, 3 frames<br>Egress Queue 0 receives priority 0 frames<br>'10' = (default) Reserved<br>'11' = Egress Queue 1 receives priority 1, 2, 3 frames<br>Egress Queue 0 receives priority 0 frames |
| 13 - 11 | 000     | RO    | Reserved   |
| 10      | 0       | RW/SC | <b>Flush Dynamic MAC Table</b><br>Before flushing the dynamic MAC table, switch address learning must be disabled by setting bit[8] in the P1CR2, P2CR2, and P3CR2 registers.  |
| 9       | 0       | RW    | <b>Flush Static MAC Table</b><br>1 = Enable flush static MAC table for spanning tree application.<br>0 = Disable flush static MAC table for spanning tree application.   |
| 8       | 0       | RW    | <b>Port 3 Tail-Tag Mode Enable</b><br>1 = Enable tail tag mode.<br>0 = Disable tail tag mode.  |
| 7 - 0   | 0x00    | RW    | <b>Force PAUSE Off Iteration Limit Time Enable</b><br>0x01 – 0xFF = Enable to force PAUSE off iteration limit time (a unit number is 160 ms).<br>0x00 = Disable Force PAUSE Off Iteration Limit.   |

### 4.2.11.2 Switch Global Control Register 9 (0x0AE – 0x0AF): SGCR9

This register contains the global control bits for the switch function.

**TABLE 4-81: SWITCH GLOBAL CONTROL REGISTER 9 (0X0AE – 0X0AF): SGCR9**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 11 | 0x00    | RO  | Reserved  |
| 10 - 8  | 000     | RW  | <b>Forwarding Invalid Frame</b><br>Define the forwarding port for frame with invalid VID. Bit[10] stands for the host port, bit[9] for port 2, and bit[8] for port 1. |
| 7 - 6   | 00      | RW  | Reserved  |
| 5       | 0       | RW  | <b>Enable Insert Source Port PVID Tag when Untagged Frame from Port 3 to Port 2</b><br>1 = Enable.<br>0 = Disable.  |
| 4       | 0       | RW  | <b>Enable Insert Source Port PVID Tag when Untagged Frame from Port 3 to Port 1</b><br>1 = Enable.<br>0 = Disable.  |
| 3       | 0       | RW  | <b>Enable Insert Source Port PVID Tag when Untagged Frame from Port 2 to Port 3</b><br>1 = Enable.<br>0 = Disable.  |

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**TABLE 4-81: SWITCH GLOBAL CONTROL REGISTER 9 (0X0AE – 0X0AF): SGCR9 (CONTINUED)**

| Bit | Default | R/W | Description  |
|-----|---------|-----|--|
| 2   | 0       | RW  | <b>Enable Insert Source Port PVID Tag when Untagged Frame from Port 2 to Port 1</b><br>1 = Enable.<br>0 = Disable. |
| 1   | 0       | RW  | <b>Enable Insert Source Port PVID Tag when Untagged Frame from Port 1 to Port 3</b><br>1 = Enable.<br>0 = Disable. |
| 0   | 0       | RW  | <b>Enable Insert Source Port PVID Tag when Untagged Frame from Port 1 to Port 2</b><br>1 = Enable.<br>0 = Disable. |

## 4.2.12 SOURCE ADDRESS FILTERING REGISTERS

### 4.2.12.1 Source Address Filtering MAC Address 1 Register Low (0x0B0 – 0x0B1): SAFMACA1L

The following table shows the register bit fields for the low word of MAC Address 1.

**TABLE 4-82: SOURCE ADDRESS FILTERING MAC ADDRESS 1 REGISTER LOW (0X0B0 – 0X0B1): SAFMACA1L**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Source Filtering MAC Address 1 Low</b><br>The least significant word of MAC Address 1. |

### 4.2.12.2 Source Address Filtering MAC Address 1 Register Middle (0x0B2 – 0x0B3): SAFMACA1M

The following table shows the register bit fields for the middle word of MAC Address 1.

**TABLE 4-83: SOURCE ADDRESS FILTERING MAC ADDRESS 1 REGISTER MIDDLE (0X0B2 – 0X0B3): SAFMACA1M**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Source Filtering MAC Address Middle 1</b><br>The middle word of MAC Address 1. |

### 4.2.12.3 Source Address Filtering MAC Address 1 Register High (0x0B4 – 0x0B5): SAFMACA1H

The following table shows the register bit fields for the high word of MAC Address 1.

**TABLE 4-84: SOURCE ADDRESS FILTERING MAC ADDRESS 1 REGISTER HIGH (0X0B4 – 0X0B5): SAFMACA1H**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Source Filtering MAC Address 1 High</b><br>The most significant word of MAC Address 1. |

## 4.2.12.4 Source Address Filtering MAC Address 2 Register Low (0x0B6 – 0x0B7): SAFMACA2L

The following table shows the register bit fields for the low word of MAC Address 2.

**TABLE 4-85: SOURCE ADDRESS FILTERING MAC ADDRESS 2 REGISTER LOW (0X0B6 – 0X0B7): SAFMACA2L**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Source Filtering MAC Address Low 2</b><br>The least significant word of MAC Address 2. |

## 4.2.12.5 Source Address Filtering MAC Address 2 Register Middle (0x0B8 – 0x0B9): SAFMACA2M

The following table shows the register bit fields for the middle word of MAC Address 2.

**TABLE 4-86: SOURCE ADDRESS FILTERING MAC ADDRESS 2 REGISTER MIDDLE (0X0B8 – 0X0B9): SAFMACA2M**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Source Filtering MAC Address Middle 2</b><br>The middle word of MAC Address 2. |

## 4.2.12.6 Source Address Filtering MAC Address 2 Register High (0x0BA – 0x0BB): SAFMACA2H

The following table shows the register bit fields for the high word of MAC Address 2.

**TABLE 4-87: SOURCE ADDRESS FILTERING MAC ADDRESS 2 REGISTER HIGH (0X0BA – 0X0BB): SAFMACA2H**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Source Filtering MAC Address High 2</b><br>The most significant word of MAC Address 2. |

## 4.2.12.7 0x0BC – 0x0C7: Reserved

## 4.2.13 TXQ RATE CONTROL REGISTERS

### 4.2.13.1 Port 1 TXQ Rate Control Register 1 (0x0C8 – 0x0C9): P1TXQRCR1

This register contains the q2 and q3 rate control bits for port 1.

**TABLE 4-88: PORT 1 TXQ RATE CONTROL REGISTER 1 (0X0C8 – 0X0C9): P1TXQRCR1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 1       | RW  | <b>Port 1 Transmit Queue 2 (high) Ratio Control</b><br>0 = Strict priority. Port 1 will transmit all the packets from this priority q2 before transmit lower priority queue.<br>1 = Bit[14:8] reflect the number of packets allow to transmit from this priority q2 within a certain time.   |
| 14 - 8 | 0x04    | RW  | <b>Port 1 Transmit Queue 2 (high) Ratio</b><br>This ratio indicates the number of packet for high priority packet can transmit within a given period.  |
| 7      | 1       | RW  | <b>Port 1 Transmit Queue 3 (highest) Ratio Control</b><br>0 = Strict priority. Port 1 will transmit all the packets from this priority q3 before transmit lower priority queue.<br>1 = Bit[6:0] reflect the number of packets allow to transmit from this priority q3 within a certain time. |
| 6 - 0  | 0x08    | RW  | <b>Port 1 Transmit Queue 3 (highest) Ratio</b><br>This ratio indicates the number of packet for highest priority packet can transmit within a given period.  |

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## 4.2.13.2 Port 1 TXQ Rate Control Register 2 (0x0CA – 0x0CB): P1TXQRCR2

This register contains the q0 and q1 rate control bits for port 1.

**TABLE 4-89: PORT 1 TXQ RATE CONTROL REGISTER 2 (0X0CA – 0X0CB): P1TXQRCR2**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 1       | RW  | <b>Port 1 Transmit Queue 0 (lowest) Ratio Control</b><br>0 = Strict priority. Port 1 will transmit all the packets from this priority q0 after transmit higher priority queue.<br>1 = Bit[14:8] reflect the number of packets allow to transmit from this priority q0 within a certain time. |
| 14 - 8 | 0x01    | RW  | <b>Port 1 Transmit Queue 0 (lowest) Ratio</b><br>This ratio indicates the number of packet for lowest priority packet can transmit within a given period.  |
| 7      | 1       | RW  | <b>Port 1 Transmit Queue 1 (low) Ratio Control</b><br>0 = Strict priority. Port 1 will transmit all the packets from this priority q1 before transmit lower priority queue.<br>1 = Bit[6:0] reflect the number of packets allow to transmit from this priority q1 within a certain time.     |
| 6 - 0  | 0x02    | RW  | <b>Port 1 Transmit Queue 1 (low) Ratio</b><br>This ratio indicates the number of packet for low priority packet can transmit within a given period.  |

## 4.2.13.3 Port 2 TXQ Rate Control Register 1 (0x0CC – 0x0CD): P2TXQRCR1

This register contains the q2 and q3 rate control bits for port 2.

**TABLE 4-90: PORT 2 TXQ RATE CONTROL REGISTER 1 (0X0CC – 0X0CD): P2TXQRCR1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 1       | RW  | <b>Port 2 Transmit Queue 2 (high) Ratio Control</b><br>0 = Strict priority. Port 2 will transmit all the packets from this priority q2 before transmit lower priority queue.<br>1 = Bit[14:8] reflect the number of packets allow to transmit from this priority q2 within a certain time.   |
| 14 - 8 | 0x04    | RW  | <b>Port 2 Transmit Queue 2 (high) Ratio</b><br>This ratio indicates the number of packet for high priority packet can transmit within a given period.  |
| 7      | 1       | RW  | <b>Port 2 Transmit Queue 3 (highest) Ratio Control</b><br>0 = Strict priority. Port 2 will transmit all the packets from this priority q3 before transmit lower priority queue.<br>1 = Bit[6:0] reflect the number of packets allow to transmit from this priority q3 within a certain time. |
| 6 - 0  | 0x08    | RW  | <b>Port 2 Transmit Queue 3 (highest) Ratio</b><br>This ratio indicates the number of packet for highest priority packet can transmit within a given period.  |

## 4.2.13.4 Port 2 TXQ Rate Control Register 2 (0x0CE – 0x0CF): P2TXQRCR2

This register contains the q0 and q1 rate control bits for port 2.

**TABLE 4-91: PORT 2 TXQ RATE CONTROL REGISTER 2 (0X0CE – 0X0CF): P2TXQRCR2**

| Bit | Default | R/W | Description  |
|-----|---------|-----|--|
| 15  | 1       | RW  | <b>Port 2 Transmit Queue 0 (lowest) Ratio Control</b><br>0 = Strict priority. Port 2 will transmit all the packets from this priority q0 after transmit higher priority queue.<br>1 = Bit[14:8] reflect the number of packets allow to transmit from this priority q0 within a certain time. |

**TABLE 4-91: PORT 2 TXQ RATE CONTROL REGISTER 2 (0X0CE – 0X0CF): P2TXQRCR2 (CONTINUED)**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 14 - 8 | 0x01    | RW  | <b>Port 2 Transmit Queue 0 (lowest) Ratio</b><br>This ratio indicates the number of packet for lowest priority packet can transmit within a given period.  |
| 7      | 1       | RW  | <b>Port 2 Transmit Queue 1 (low) Ratio Control</b><br>0 = Strict priority. Port 2 will transmit all the packets from this priority q1 before transmit lower priority queue.<br>1 = Bit[6:0] reflect the number of packets allow to transmit from this priority q1 within a certain time. |
| 6 - 0  | 0x02    | RW  | <b>Port 2 Transmit Queue 1 (low) Ratio</b><br>This ratio indicates the number of packet for low priority packet can transmit within a given period.  |

## 4.2.13.5 Port 3 TXQ Rate Control Register 1 (0x0D0 – 0x0D1): P3TXQRCR1

This register contains the q2 and q3 rate control bits for port 3.

**TABLE 4-92: PORT 3 TXQ RATE CONTROL REGISTER 1 (0X0D0 – 0X0D1): P3TXQRCR1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 1       | RW  | <b>Port 3 Transmit Queue 2 (high) Ratio Control</b><br>0 = Strict priority. Port 3 will transmit all the packets from this priority q2 before transmit lower priority queue.<br>1 = Bit[14:8] reflect the number of packets allow to transmit from this priority q2 within a certain time.   |
| 14 - 8 | 0x04    | RW  | <b>Port 3 Transmit Queue 2 (high) Ratio</b><br>This ratio indicates the number of packet for high priority packet can transmit within a given period.  |
| 7      | 1       | RW  | <b>Port 3 Transmit Queue 3 (highest) Ratio Control</b><br>0 = Strict priority. Port 3 will transmit all the packets from this priority q3 before transmit lower priority queue.<br>1 = Bit[6:0] reflect the number of packets allow to transmit from this priority q3 within a certain time. |
| 6 - 0  | 0x08    | RW  | <b>Port 3 Transmit Queue 3 (highest) Ratio</b><br>This ratio indicates the number of packet for highest priority packet can transmit within a given period.  |

## 4.2.13.6 Port 3 TXQ Rate Control Register 2 (0x0D2 – 0x0D3): P3TXQRCR2

This register contains the q0 and q1 rate control bits for port 3.

**TABLE 4-93: PORT 3 TXQ RATE CONTROL REGISTER 2 (0X0D2 – 0X0D3): P3TXQRCR2**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 1       | RW  | <b>Port 3 Transmit Queue 0 (lowest) Ratio Control</b><br>0 = Strict priority. Port 3 will transmit all the packets from this priority q0 after transmit higher priority queue.<br>1 = Bit[14:8] reflect the number of packets allow to transmit from this priority q0 within a certain time. |
| 14 - 6 | 0x01    | RW  | <b>Port 3 Transmit Queue 0 (lowest) Ratio</b><br>This ratio indicates the number of packet for lowest priority packet can transmit within a given period.  |

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**TABLE 4-93: PORT 3 TXQ RATE CONTROL REGISTER 2 (0X0D2 – 0X0D3): P3TXQRCR2 (CONTINUED)**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 7     | 1       | RW  | <b>Port 3 Transmit Queue 1 (low) Ratio Control</b><br>0 = Strict priority. Port 3 will transmit all the packets from this priority q1 before transmit lower priority queue.<br>1 = Bit[6:0] reflect the number of packets allow to transmit from this priority q1 within a certain time. |
| 6 - 0 | 0x02    | RW  | <b>Port 3 Transmit Queue 1 (low) Ratio</b><br>This ratio indicates the number of packet for low priority packet can transmit within a given period.  |

4.2.13.7 0x0D4 – 0x0D5: Reserved

## 4.2.14 INPUT AND OUTPUT MULTIPLEX SELECTION REGISTER

4.2.14.1 Input and Output Multiplex Selection Register (0x0D6 – 0x0D7): IOMUXSEL

This register is used to select input/output pin functions of Pins 53, 54, and 55.

**TABLE 4-94: INPUT AND OUTPUT MULTIPLEX SELECTION REGISTER (0X0D6 – 0X0D7): IOMUXSEL**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 12 | 0x0     | RO  | Reserved  |
| 11      | 1       | RW  | Reserved  |
| 10      | 1       | RW  | Reserved  |
| 9       | 1       | RW  | Reserved  |
| 8       | 1       | RW  | Reserved  |
| 7       | 1       | RW  | Reserved  |
| 6       | 1       | RW  | Reserved  |
| 5       | 1       | RW  | <b>Selection of EESK or GPIO3 on Pin 53</b><br>1 = This pin is used for EESK (default), serial EEPROM clock.<br>0 = This pin is used for GPIO3.       |
| 4       | 1       | RW  | Reserved  |
| 3       | 1       | RW  | Reserved  |
| 2       | 1       | RW  | <b>Selection of EEDIO or GPIO4 on Pin 54</b><br>1 = This pin is used for EEDIO (default), serial EEPROM data.<br>0 = This pin is used for GPIO4.      |
| 1       | 1       | RW  | <b>Selection of EECS or GPIO5 on Pin 55</b><br>1 = This pin is used for EECS (default), serial EEPROM chip select.<br>0 = This pin is used for GPIO5. |
| 0       | 1       | RW  | Reserved  |

## 4.2.15 CONFIGURATION STATUS AND SERIAL BUS MODE REGISTER

4.2.15.1 Configuration Status and Serial Bus Mode Register (0x0D8 – 0x0D9): CFGR

This register is used to select fiber mode, if desired.

**TABLE 4-95: CONFIGURATION STATUS AND SERIAL BUS MODE REGISTER (0X0D8 – 0X0D9): CFGR**

| Bit    | Default | R/W | Description |
|--------|---------|-----|-------------|
| 15 - 8 | 0x00    | RO  | Reserved    |

**TABLE 4-95: CONFIGURATION STATUS AND SERIAL BUS MODE REGISTER (0X0D8 – 0X0D9): CFGR (CONTINUED)**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 7     | 1       | RW  | <b>Selection of Port 2 Mode of Operation</b><br>1 = Select copper mode<br>0 = Select fiber mode (bypass MLT3 encoder/decoder, scrambler and descrambler). Fiber mode is available only for the KSZ8462FHL.<br>When fiber mode is selected, bit [13] in DSP_CNTRL_6 (0x734 – 0x735) should be cleared. |
| 6     | 1       | RW  | <b>Selection of Port 1 Mode of Operation</b><br>1 = Select copper mode<br>0 = Select fiber mode (bypass MLT3 encoder/decoder, scrambler and descrambler). Fiber mode is available only for the KSZ8462FHL.<br>When fiber mode is selected, bit [13] in DSP_CNTRL_6 (0x734 – 0x735) should be cleared. |
| 5 - 4 | 11      | RO  | Reserved  |
| 3 - 0 | 0xE     | RW  | Reserved  |

4.2.15.2 0x0DA – 0x0DB: Reserved

## 4.2.16 AUTO-NEGOTIATION NEXT PAGE REGISTERS

### 4.2.16.1 Port 1 Auto-Negotiation Next Page Transmit Register (0x0DC – 0x0DD): P1ANPT

This register contains the port 1 auto-negotiation next page transmit related bits.

**TABLE 4-96: PORT 1 AUTO-NEGOTIATION NEXT PAGE TRANSMIT REGISTER (0X0DC – 0X0DD): P1ANPT**

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 15  | 0       | RO  | <b>Next Page</b><br>Next Page (NP) is used by the Next Page function to indicate whether or not this is the last Next Page to be transmitted. NP shall be set as follows:<br>1 = Additional Next Page(s) will follow.<br>0 = Last page.   |
| 14  | 0       | RO  | Reserved  |
| 13  | 1       | RO  | <b>Message Page</b><br>Message Page (MP) is used by the Next Page function to differentiate a Message Page from an Unformatted Page. MP shall be set as follows:<br>1 = Message Page.<br>0 = Unformatted Page.  |
| 12  | 0       | RO  | <b>Acknowledge 2</b><br>Acknowledge 2 (Ack2) is used by the Next Page function to indicate that a device has the ability to comply with the message. Ack2 shall be set as follows:<br>1 = Able to comply with message.<br>0 = Unable to comply with message.  |
| 11  | 0       | RO  | <b>Toggle</b><br>Toggle (T) is used by the arbitration function to ensure synchronization with the link partner during Next Page exchange. This bit shall always take the opposite value of the Toggle bit in the previously exchanged Link Codeword. The initial value of the Toggle bit in the first Next Page transmitted is the inverse of bit [11] in the base Link Codeword and, therefore, may assume a value of logic one or zero. The Toggle bit shall be set as follows:<br>1 = Previous value of the transmitted Link Codeword equal to logic zero.<br>0 = Previous value of the transmitted Link Codeword equal to logic one. |

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TABLE 4-96: PORT 1 AUTO-NEGOTIATION NEXT PAGE TRANSMIT REGISTER (0X0DC – 0X0DD): P1ANPT (CONTINUED)

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 10 - 0 | 0x001   | RO  | <b>Message and Unformatted Code Field</b><br>Message/Unformatted code field bit[10:0] |



## 4.2.16.2 Port 1 Auto-Negotiation Link Partner Received Next Page Register (0x0DE – 0x0DF): P1ALPRNP

This register contains the port 1 auto-negotiation link partner received next page related bits.

**TABLE 4-97: PORT 1 AUTO-NEGOTIATION LINK PARTNER RECEIVED NEXT PAGE REGISTER (0X0DE – 0X0DF): P1ALPRNP**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15     | 0       | RO  | <b>Next Page</b><br>Next Page (NP) is used by the Next Page function to indicate whether or not this is the last Next Page to be transmitted. NP shall be set as follows:<br>1 = Additional Next Page(s) will follow.<br>0 = Last page.   |
| 14     | 0       | RO  | <b>Acknowledge</b><br>Acknowledge (Ack) is used by the auto-negotiation function to indicate that a device has successfully received its Link Partner's Link Codeword. The Acknowledge bit is encoded in bit 14 regardless of the value of the Selector Field or Link Codeword encoding. If no Next Page information is to be sent, this bit shall be set to logic one in the Link Codeword after the reception of at least three consecutive and consistent FLP Bursts (ignoring the Acknowledge bit value).   |
| 13     | 0       | RO  | <b>Message Page</b><br>Message Page (MP) is used by the Next Page function to differentiate a Message Page from an Unformatted Page. MP shall be set as follows:<br>1 = Message Page.<br>0 = Unformatted Page.  |
| 12     | 0       | RO  | <b>Acknowledge 2</b><br>Acknowledge 2 (Ack2) is used by the Next Page function to indicate that a device has the ability to comply with the message. Ack2 shall be set as follows:<br>1 = Able to comply with message.<br>0 = Unable to comply with message.  |
| 11     | 0       | RO  | <b>Toggle</b><br>Toggle (T) is used by the arbitration function to ensure synchronization with the link partner during Next Page exchange. This bit shall always take the opposite value of the Toggle bit in the previously exchanged Link Codeword. The initial value of the Toggle bit in the first Next Page transmitted is the inverse of bit [11] in the base Link Codeword and, therefore, may assume a value of logic one or zero. The Toggle bit shall be set as follows:<br>1 = Previous value of the transmitted Link Codeword equal to logic zero.<br>0 = Previous value of the transmitted Link Codeword equal to logic one. |
| 10 - 0 | 0x000   | RO  | <b>Message and Unformatted Code Field</b><br>Message/Unformatted code field bit[10:0]   |

## 4.2.17 EEE AND LINK PARTNER ADVERTISEMENT REGISTERS

### 4.2.17.1 Port 1 EEE and Link Partner Advertisement Register (0x0E0 – 0x0E1): P1EEEE

This register contains the port 1 EEE advertisement and link partner advertisement information. Note that EEE is not supported in fiber mode.

**TABLE 4-98: PORT 1 EEE AND LINK PARTNER ADVERTISEMENT REGISTER (0X0E0 – 0X0E1): P1EEEE**

| Bit | Default | R/W | Description |
|-----|---------|-----|-------------|
| 15  | 0       | RO  | Reserved    |

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**TABLE 4-98: PORT 1 EEE AND LINK PARTNER ADVERTISEMENT REGISTER (0X0E0 – 0X0E1): P1EEEE (CONTINUED)**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 14    | 0       | RO  | <b>10GBASE-KR EEE</b><br>1 = Link Partner EEE is supported for 10GBASE-KR.<br>0 = Link Partner EEE is not supported for 10GBASE-KR.  |
| 13    | 0       | RO  | <b>10GBASE-KX4 EEE</b><br>1 = Link Partner EEE is supported for 10GBASE-KX4.<br>0 = Link Partner EEE is not supported for 10GBASE-KX4.   |
| 12    | 0       | RO  | <b>1000BASE-KX EEE</b><br>1 = Link Partner EEE is supported for 1000BASE-KX.<br>0 = Link Partner EEE is not supported for 1000BASE-KX.   |
| 11    | 0       | RO  | <b>10GBASE-T EEE</b><br>1 = Link Partner EEE is supported for 10GBASE-T.<br>0 = Link Partner EEE is not supported for 10GBASE-T.   |
| 10    | 0       | RO  | <b>1000BASE-T EEE</b><br>1 = Link Partner EEE is supported for 1000BASE-T.<br>0 = Link Partner EEE is not supported for 1000BASE-T.  |
| 9     | 0       | RO  | <b>100BASE-TX EEE</b><br>1 = Link Partner EEE is supported for 100BASE-TX.<br>0 = Link Partner EEE is not supported for 100BASE-TX.  |
| 8 - 7 | 00      | RO  | Reserved   |
| 6     | 0       | RO  | <b>10GBASE-KR EEE</b><br>1 = Port 1 EEE is supported for 10GBASE-KR.<br>0 = Port 1 EEE is not supported for 10GBASE-KR.  |
| 5     | 0       | RO  | <b>10GBASE-KX4 EEE</b><br>1 = Port 1 EEE is supported for 10GBASE-KX4.<br>0 = Port 1 EEE is not supported for 10GBASE-KX4.   |
| 4     | 0       | RO  | <b>1000BASE-KX EEE</b><br>1 = Port 1 EEE is supported for 1000BASE-KX.<br>0 = Port 1 EEE is not supported for 1000BASE-KX.   |
| 3     | 0       | RO  | <b>10GBASE-T EEE</b><br>1 = Port 1 EEE is supported for 10GBASE-T.<br>0 = Port 1 EEE is not supported for 10GBASE-T.   |
| 2     | 0       | RO  | <b>1000BASE-T EEE</b><br>1 = Port 1 EEE is supported for 1000BASE-T.<br>0 = Port 1 EEE is not supported for 1000BASE-T.  |
| 1     | 1       | RW  | <b>100BASE-TX EEE</b><br>1 = Port 1 EEE is supported for 100BASE-TX.<br>0 = Port 1 EEE is not supported for 100BASE-TX.<br>To disable EEE capability, clear the port 1 Next Page Enable bit in the PCSEEEC register (0x0F3). |
| 0     | 0       | RO  | Reserved   |

## 4.2.17.2 Port 1 EEE Wake Error Count Register (0x0E2 – 0x0E3): P1EEEWEC

This register contains the port 1 EEE wake error count information. Note that EEE is not supported in Fiber mode.

**TABLE 4-99: PORT 1 EEE WAKE ERROR COUNT REGISTER (0X0E2 – 0X0E3): P1EEEWEC**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Port 1 EEE Wake Error Count</b><br>This counter is incremented by each transition of lpi_wake_timer_done from FALSE to TRUE. It means the wakeup time is longer than 20.5 $\mu$ s. The value will be held at all ones in the case of overflow and will be cleared to zero after this register is read. |

## 4.2.17.3 Port 1 EEE Control/Status and Auto-Negotiation Expansion Register (0x0E4 – 0x0E5): P1EEEECS

This register contains the port 1 EEE control/status and auto-negotiation expansion information. Note that EEE is not supported in Fiber mode.

**TABLE 4-100: PORT 1 EEE CONTROL/STATUS AND AUTO-NEGOTIATION EXPANSION REGISTER (0X0E4 – 0X0E5): P1EEEECS**

| Bit   | Default | R/W                      | Description  |
|-------|---------|--------------------------|--|
| 15    | 1       | RW                       | Reserved   |
| 14    | 0       | RO                       | <b>Hardware 100BASE-TX EEE Enable Status</b><br>1 = 100BASE-TX EEE is enabled by hardware-based NP exchange.<br>0 = 100BASE-TX EEE is disabled.  |
| 13    | 0       | RO/LH<br>(Latching High) | <b>TX LPI Received</b><br>1 = Indicates that the transmit PCS has received low power idle (LPI) signaling one or more times since the register was last read.<br>0 = Indicates that the PCS has not received low power idle (LPI) signaling.<br>The status will be latched high and stay that way until cleared. To clear this status bit, a “1” needs to be written to this register bit. |
| 12    | 0       | RO                       | <b>TX LPI Indication</b><br>1 = Indicates that the transmit PCS is currently receiving low power idle (LPI) signals.<br>0 = Indicates that the PCS is not currently receiving low power idle (LPI) signals.<br>This bit will dynamically indicate the presence of the TX LPI signal.   |
| 11    | 0       | RO/LH<br>(Latching High) | <b>RX LPI Received</b><br>1 = Indicates that the receive PCS has received low power idle (LPI) signaling one or more times since the register was last read.<br>0 = Indicates that the PCS has not received low power idle (LPI) signaling.<br>The status will be latched high and stay that way until cleared. To clear this status bit, a “1” needs to be written to this register bit.  |
| 10    | 0       | RO                       | <b>RX LPI Indication</b><br>1 = Indicates that the receive PCS is currently receiving low power idle (LPI) signals.<br>0 = Indicates that the PCS is not currently receiving low power idle (LPI) signals.<br>This bit will dynamically indicate the presence of the RX LPI signal.  |
| 9 - 8 | 00      | RW                       | Reserved   |
| 7     | 0       | RO                       | Reserved   |
| 6     | 1       | RO                       | <b>Received Next Page Location Able</b><br>1 = Received Next Page storage location is specified by bit[6:5].<br>0 = Received Next Page storage location is not specified by bit[6:5].  |
| 5     | 1       | RO                       | <b>Received Next Page Storage Location</b><br>1 = Link partner Next Pages are stored in P1ALPRNP (Reg. 0x0DE – 0x0DF).<br>0 = Link partner Next Pages are stored in P1ANLPR (Reg. 0x056 – 0x057).  |
| 4     | 0       | RO/LH<br>(Latching High) | <b>Parallel Detection Fault</b><br>1 = A fault has been detected via the parallel detection function.<br>0 = A fault has not been detected via the parallel detection function.<br>This bit is cleared after read.   |
| 3     | 0       | RO                       | <b>Link Partner Next Page Able</b><br>1 = Link partner is Next Page abled.<br>0 = Link partner is not Next Page abled.   |

**TABLE 4-100: PORT 1 EEE CONTROL/STATUS AND AUTO-NEGOTIATION EXPANSION REGISTER (0X0E4 – 0X0E5): P1EEEECS (CONTINUED)**

| Bit | Default | R/W                      | Description   |
|-----|---------|--------------------------|---|
| 2   | 0       | RO                       | <b>Next Page Able</b><br>1 = Local device is Next Page abled.<br>0 = Local device is not Next Page abled.                                   |
| 1   | 0       | RO/LH<br>(Latching High) | <b>Page Received</b><br>1 = A New Page has been received.<br>0 = A New Page has not been received.  |
| 0   | 0       | RO                       | <b>Link Partner Auto-Negotiation Able</b><br>1 = Link partner is auto-negotiation abled.<br>0 = Link partner is not auto-negotiation abled. |

## 4.2.18 PORT 1 LPI RECOVERY TIME COUNTER REGISTER

### 4.2.18.1 Port 1 LPI Recovery Time Counter Register (0x0E6): P1LPIRTC

This register contains the port 1 LPI recovery time counter information.

**TABLE 4-101: PORT 1 LPI RECOVERY TIME COUNTER REGISTER (0X0E6): P1LPIRTC**

| Bit   | Default           | R/W | Description   |
|-------|-------------------|-----|---|
| 7 - 0 | 0x27 (25 $\mu$ s) | RW  | <b>Port 1 LPI Recovery Time Counter</b><br>This register specifies the time that the MAC device has to wait before it can start to send out packets. This value should be the maximum of the LPI recovery time between local device and remote device.<br>Each count is 640 ns. |

## 4.2.19 BUFFER LOAD-TO-LPI CONTROL 1 REGISTER

### 4.2.19.1 Buffer Load to LPI Control 1 Register (0x0E7): BL2LPIC1

This register contains the buffer load to LPI Control 1 information.

**TABLE 4-102: BUFFER LOAD TO LPI CONTROL 1 REGISTER (0X0E7): BL2LPIC1**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 7     | 0       | RW  | <b>LPI Terminated by Input Traffic Enable</b><br>1 = LPI request will be stopped if input traffic is detected.<br>0 = LPI request won't be stopped by input traffic.  |
| 6     | 0       | RO  | Reserved  |
| 5 - 0 | 0x08    | RW  | <b>Buffer Load Threshold for Source Port LPI Termination</b><br>This value defines the maximum buffer usage allowed for a single port before it starts to trigger the LPI termination for the specific source port.<br>(512 bytes per unit) |

## 4.2.20 PORT 2 AUTO-NEGOTIATION REGISTERS

### 4.2.20.1 Port 2 Auto-Negotiation Next Page Transmit Register (0x0E8 – 0x0E9): P2ANPT

This register contains the port 2 auto-negotiation next page transmit related bits.

**TABLE 4-103: PORT 2 AUTO-NEGOTIATION NEXT PAGE TRANSMIT REGISTER (0X0E8 – 0X0E9): P2ANPT**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 0       | RO  | <b>Next Page</b><br>Next Page (NP) is used by the Next Page function to indicate whether or not this is the last Next Page to be transmitted. NP shall be set as follows:<br>1 = Additional Next Page(s) will follow.<br>0 = Last page.  |
| 14     | 0       | RO  | Reserved   |
| 13     | 1       | RO  | <b>Message Page</b><br>Message Page (MP) is used by the Next Page function to differentiate a Message Page from an Unformatted Page. MP shall be set as follows:<br>1 = Message Page.<br>0 = Unformatted Page.   |
| 12     | 0       | RO  | <b>Acknowledge 2</b><br>Acknowledge 2 (Ack2) is used by the Next Page function to indicate that a device has the ability to comply with the message. Ack2 shall be set as follows:<br>1 = Able to comply with message.<br>0 = Unable to comply with message.   |
| 11     | 0       | RO  | <b>Toggle</b><br>Toggle (T) is used by the arbitration function to ensure synchronization with the link partner during Next Page exchange. This bit shall always take the opposite value of the Toggle bit in the previously exchanged Link Codeword. The initial value of the Toggle bit in the first Next Page transmitted is the inverse of bit[11] in the base Link Codeword and, therefore, may assume a value of logic one or zero. The Toggle bit shall be set as follows:<br>1 = Previous value of the transmitted Link Codeword equal to logic zero.<br>0 = Previous value of the transmitted Link Codeword equal to logic one. |
| 10 - 0 | 0x001   | RO  | <b>Message and Unformatted Code Field</b><br>Message/Unformatted code field bit[10:0]  |

### 4.2.20.2 Port 2 Auto-Negotiation Link Partner Received Next Page Register (0x0EA – 0x0EB): P2ALPRNP

This register contains the port 2 auto-negotiation link partner received next page related bits.

**TABLE 4-104: PORT 2 AUTO-NEGOTIATION LINK PARTNER RECEIVED NEXT PAGE REGISTER (0X0EA – 0X0EB): P2ALPRNP**

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 15  | 0       | RO  | <b>Next Page</b><br>Next Page (NP) is used by the Next Page function to indicate whether or not this is the last Next Page to be transmitted. NP shall be set as follows:<br>1 = Additional Next Page(s) will follow.<br>0 = Last page. |

**TABLE 4-104: PORT 2 AUTO-NEGOTIATION LINK PARTNER RECEIVED NEXT PAGE REGISTER (0X0EA – 0X0EB): P2ALPRNP (CONTINUED)**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 14     | 0       | RO  | <b>Acknowledge</b><br>Acknowledge (Ack) is used by the auto-negotiation function to indicate that a device has successfully received its Link Partner's Link Codeword. The Acknowledge bit is encoded in bit [14] regardless of the value of the Selector Field or Link Codeword encoding. If no Next Page information is to be sent, this bit shall be set to logic one in the Link Codeword after the reception of at least three consecutive and consistent FLP Bursts (ignoring the Acknowledge bit value).  |
| 13     | 0       | RO  | <b>Message Page</b><br>Message Page (MP) is used by the Next Page function to differentiate a Message Page from an Unformatted Page. MP shall be set as follows:<br>1 = Message Page.<br>0 = Unformatted Page.   |
| 12     | 0       | RO  | <b>Acknowledge 2</b><br>Acknowledge 2 (Ack2) is used by the Next Page function to indicate that a device has the ability to comply with the message. Ack2 shall be set as follows:<br>1 = Able to comply with message.<br>0 = Unable to comply with message.   |
| 11     | 0       | RO  | <b>Toggle</b><br>Toggle (T) is used by the arbitration function to ensure synchronization with the link partner during Next Page exchange. This bit shall always take the opposite value of the Toggle bit in the previously exchanged Link Codeword. The initial value of the Toggle bit in the first Next Page transmitted is the inverse of bit[11] in the base Link Codeword and, therefore, may assume a value of logic one or zero. The Toggle bit shall be set as follows:<br>1 = Previous value of the transmitted Link Codeword equal to logic zero.<br>0 = Previous value of the transmitted Link Codeword equal to logic one. |
| 10 - 0 | 0x000   | RO  | <b>Message and Unformatted Code Field</b><br>Message/Unformatted code field bit[10:0]  |

## 4.2.21 PORT 2 EEE REGISTERS

### 4.2.21.1 Port 2 EEE and Link Partner Advertisement Register (0x0EC – 0x0ED): P2EEEE

This register contains the port 2 EEE advertisement and link partner advertisement information. Note that EEE is not supported in Fiber mode. Note that EEE is not supported in Fiber mode.

**TABLE 4-105: PORT 2 EEE AND LINK PARTNER ADVERTISEMENT REGISTER (0X0EC – 0X0ED): P2EEEE**

| Bit | Default | R/W | Description  |
|-----|---------|-----|--|
| 15  | 0       | RO  | Reserved   |
| 14  | 0       | RO  | <b>10GBASE-KR EEE</b><br>1 = Link Partner EEE is supported for 10GBASE-KR.<br>0 = Link Partner EEE is not supported for 10GBASE-KR.    |
| 13  | 0       | RO  | <b>10GBASE-KX4 EEE</b><br>1 = Link Partner EEE is supported for 10GBASE-KX4.<br>0 = Link Partner EEE is not supported for 10GBASE-KX4. |
| 12  | 0       | RO  | <b>1000BASE-KX EEE</b><br>1 = Link Partner EEE is supported for 1000BASE-KX.<br>0 = Link Partner EEE is not supported for 1000BASE-KX. |

**TABLE 4-105: PORT 2 EEE AND LINK PARTNER ADVERTISEMENT REGISTER (0X0EC – 0X0ED): P2EEEA (CONTINUED)**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 11    | 0       | RO  | <b>10GBASE-T EEE</b><br>1 = Link Partner EEE is supported for 10GBASE-T.<br>0 = Link Partner EEE is not supported for 10GBASE-T.  |
| 10    | 0       | RO  | <b>1000BASE-T EEE</b><br>1 = Link Partner EEE is supported for 1000BASE-T.<br>0 = Link Partner EEE is not supported for 1000BASE-T.   |
| 9     | 0       | RO  | <b>100BASE-TX EEE</b><br>1 = Link Partner EEE is supported for 100BASE-TX.<br>0 = Link Partner EEE is not supported for 100BASE-TX.   |
| 8 - 7 | 00      | RO  | Reserved  |
| 6     | 0       | RO  | <b>10GBASE-KR EEE</b><br>1 = Port 2 EEE is supported for 10GBASE-KR.<br>0 = Port 2 EEE is not supported for 10GBASE-KR.   |
| 5     | 0       | RO  | <b>10GBASE-KX4 EEE</b><br>1 = Port 2 EEE is supported for 10GBASE-KX4.<br>0 = Port 2 EEE is not supported for 10GBASE-KX4.  |
| 4     | 0       | RO  | <b>1000BASE-KX EEE</b><br>1 = Port 2 EEE is supported for 1000BASE-KX.<br>0 = Port 2 EEE is not supported for 1000BASE-KX.  |
| 3     | 0       | RO  | <b>10GBASE-T EEE</b><br>1 = Port 2 EEE is supported for 10GBASE-T.<br>0 = Port 2 EEE is not supported for 10GBASE-T.  |
| 2     | 0       | RO  | <b>1000BASE-T EEE</b><br>1 = Port 2 EEE is supported for 1000BASE-T.<br>0 = Port 2 EEE is not supported for 1000BASE-T.   |
| 1     | 1       | RW  | <b>100BASE-TX EEE</b><br>1 = Port 2 EEE is supported for 100BASE-TX.<br>0 = Port 2 EEE is not supported for 100BASE-TX.<br>To disable EEE capability, clear the port 2 Next Page Enable bit in the PCSEEEEC register (0x0F3). |
| 0     | 0       | RO  | Reserved  |

## 4.2.21.2 Port 2 EEE Wake Error Count Register (0x0EE – 0x0EF): P2EEEWEC

This register contains the port 2 EEE wake error count information. Note that EEE is not supported in Fiber mode.

**TABLE 4-106: PORT 2 EEE WAKE ERROR COUNT REGISTER (0X0EE – 0X0EF): P2EEEWEC**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>Port 2 EEE Wake Error Count</b><br>This counter is incremented by each transition of lpi_wake_timer_done from FALSE to TRUE. It means the wake-up time is longer than 20.5 $\mu$ s. The value will be held at all ones in the case of overflow and will be cleared to zero after this register is read. |

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## 4.2.21.3 Port 2 EEE Control/Status and Auto-Negotiation Expansion Register (0x0F0 – 0x0F1): P2EEECs

This register contains the port 2 EEE control/status and auto-negotiation expansion information. Note that EEE is not supported in Fiber mode.

**TABLE 4-107: PORT 2 EEE CONTROL/STATUS AND AUTO-NEGOTIATION EXPANSION REGISTER (0X0F0 – 0X0F1): P2EEECs**

| Bit   | Default | R/W                      | Description  |
|-------|---------|--------------------------|--|
| 15    | 1       | RW                       | Reserved   |
| 14    | 0       | RO                       | <b>Hardware 100BASE-TX EEE Enable Status</b><br>1 = 100BASE-TX EEE is enabled by hardware based NP exchange.<br>0 = 100BASE-TX EEE is disabled.  |
| 13    | 0       | RO/LH<br>(Latching High) | <b>TX LPI Received</b><br>1 = Indicates that the transmit PCS has received low power idle (LPI) signaling one or more times since the register was last read.<br>0 = Indicates that the PCS has not received low power idle (LPI) signaling.<br>The status will be latched high and stay that way until cleared. To clear this status bit, a “1” needs to be written to this register bit. |
| 12    | 0       | RO                       | <b>TX LPI Indication</b><br>1 = Indicates that the transmit PCS is currently receiving low power idle (LPI) signals.<br>0 = Indicates that the PCS is not currently receiving low power idle (LPI) signals.<br>This bit will dynamically indicate the presence of the TX LPI signal.   |
| 11    | 0       | RO/LH<br>(Latching High) | <b>RX LPI Received</b><br>1 = Indicates that the receive PCS has received low power idle (LPI) signaling one or more times since the register was last read.<br>0 = Indicates that the PCS has not received low power idle (LPI) signaling.<br>The status will be latched high and stay that way until cleared. To clear this status bit, a “1” needs to be written to this register bit.  |
| 10    | 0       | RO                       | <b>RX LPI Indication</b><br>1 = Indicates that the receive PCS is currently receiving low power idle (LPI) signals.<br>0 = Indicates that the PCS is not currently receiving low power idle (LPI) signals.<br>This bit will dynamically indicate the presence of the RX LPI signal.  |
| 9 - 8 | 00      | RW                       | Reserved   |
| 7     | 0       | RO                       | Reserved   |
| 6     | 1       | RO                       | <b>Received Next Page Location Able</b><br>1 = Received Next Page storage location is specified by bit[6:5].<br>0 = Received Next Page storage location is not specified by bit[6:5].  |
| 5     | 1       | RO                       | <b>Received Next Page Storage Location</b><br>1 = Link partner Next Pages are stored in P2ALPRNP (Reg. 0x0EA – 0x0EB).<br>0 = Link partner Next Pages are stored in P2ANLPR (Reg. 0x062 – 0x063).  |
| 4     | 0       | RO/LH<br>(Latching High) | <b>Parallel Detection Fault</b><br>1 = A fault has been detected via the parallel detection function.<br>0 = A fault has not been detected via the parallel detection function.<br>This bit is cleared after read.   |
| 3     | 0       | RO                       | <b>Link Partner Next Page Able</b><br>1 = Link partner is Next Page abled.<br>0 = Link partner is not Next Page abled.   |



**TABLE 4-107: PORT 2 EEE CONTROL/STATUS AND AUTO-NEGOTIATION EXPANSION REGISTER (0X0F0 – 0X0F1): P2EEECs (CONTINUED)**

| Bit | Default | R/W                      | Description   |
|-----|---------|--------------------------|---|
| 2   | 1       | RO                       | <b>Next Page Able</b><br>1 = Local device is Next Page abled.<br>0 = Local device is not Next Page abled.                                   |
| 1   | 0       | RO/LH<br>(Latching High) | <b>Page Received</b><br>1 = A New Page has been received.<br>0 = A New Page has not been received.  |
| 0   | 0       | RO                       | <b>Link Partner Auto-Negotiation Able</b><br>1 = Link partner is auto-negotiation abled.<br>0 = Link partner is not auto-negotiation abled. |

## 4.2.22 PORT 2 LPI RECOVERY TIME COUNTER REGISTER

### 4.2.22.1 Port 2 LPI Recovery Time Counter Register (0x0F2): P2LPIRTC

This register contains the port 2 LPI recovery time counter information.

**TABLE 4-108: PORT 2 LPI RECOVERY TIME COUNTER REGISTER (0X0F2): P2LPIRTC**

| Bit   | Default           | R/W | Description  |
|-------|-------------------|-----|--|
| 7 - 0 | 0x27 (25 $\mu$ s) | RW  | <b>Port 2 LPI Recovery Time Counter</b><br>This register specifies the time that the MAC device has to wait before it can start to send out packets. This value should be the maximum of the LPI recovery time between local device and remote device. Each count is 640 ns. |

## 4.2.23 PCS EEE CONTROL REGISTER

### 4.2.23.1 PCS EEE Control Register (0x0F3): PCSEEEEC

This register contains the PCS EEE control information.

**TABLE 4-109: PCS EEE CONTROL REGISTER (0X0F3): PCSEEEEC**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 7 - 6 | 00      | RW  | Reserved   |
| 5 - 2 | 0x0     | RO  | Reserved   |
| 1     | 1       | RW  | <b>Port 2 Next Page Enable</b><br>1 = Enable next page exchange during auto-negotiation.<br>0 = Skip next page exchange during auto-negotiation.<br>Auto-negotiation uses next page to negotiate EEE. To disable EEE auto-negotiation on port 2, clear this bit to zero. Restarting auto-negotiation may then be required. |
| 0     | 1       | RW  | <b>Port 1 Next Page Enable</b><br>1 = Enable next page exchange during auto-negotiation.<br>0 = Skip next page exchange during auto-negotiation.<br>Auto-negotiation uses next page to negotiate EEE. To disable EEE auto-negotiation on port 1, clear this bit to zero. Restarting auto-negotiation may then be required. |

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## 4.2.24 EMPTY TXQ-TO-LPI WAIT TIME CONTROL REGISTER

### 4.2.24.1 Empty TXQ to LPI Wait Time Control Register (0x0F4 – 0x0F5): ETLWTC

This register contains the empty TXQ to LPI wait time control information.

**TABLE 4-110: EMPTY TXQ TO LPI WAIT TIME CONTROL REGISTER (0X0F4 – 0X0F5): ETLWTC**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x03E8  | RW  | <b>Empty TXQ to LPI Wait Time Control</b><br>This register specifies the time that the LPI request will be generated after a TXQ has been empty exceeds this configured time. This is only valid when EEE 100BASE-TX is enabled. This setting will apply to all the three ports. The unit is 1.3 ms. The default value is 1.3 seconds (range from 1.3 ms to 86 seconds) |

## 4.2.25 BUFFER LOAD-TO-LPI CONTROL 2 REGISTER

### 4.2.25.1 Buffer Load to LPI Control 2 Register (0x0F6 – 0x0F7): BL2LPIC2

This register contains the buffer load to LPI control 2 information.

**TABLE 4-111: BUFFER LOAD TO LPI CONTROL 2 REGISTER (0X0F6 – 0X0F7): BL2LPIC2**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 8 | 0x01    | RO  | Reserved   |
| 7 - 0  | 0x40    | RW  | <b>Buffer Load Threshold for All Ports LPI Termination</b><br>This value defines the maximum buffer usage allowed for a single port before it starts to trigger the LPI termination for every port. (128 bytes per unit) |

### 4.2.25.2 0x0F8 – 0x0FF: Reserved

## 4.2.26 INTERNAL I/O REGISTER SPACE MAPPING FOR INTERRUPTS, BIU, AND GLOBAL RESET (0X100 – 0X1FF)

### 4.2.26.1 0x100 – 0x107: Reserved

### 4.2.26.2 Chip Configuration Register (0x108 – 0x109): CCR

This register indicates the chip configuration mode based on strapping and bonding options.

**TABLE 4-112: CHIP CONFIGURATION REGISTER (0X108 – 0X109): CCR**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 11 | —       | RO  | Reserved   |
| 10      | —       | RO  | <b>Bus Endian Mode</b><br>The P2LED0/LEBE pin value is latched into this bit during power-up/reset.<br>0 = Bus in Big Endian mode<br>1 = Bus in Little Endian mode                         |
| 9       | —       | RO  | <b>EEPROM Presence</b><br>The PME/EEPROM pin value is latched into this bit during power-up/reset.<br>0 = No external EEPROM<br>1 = Use external EEPROM                                    |
| 8       | 0       | RO  | Reserved   |
| 7       | —       | RO  | <b>8-Bit Data Bus Width</b><br>This bit value is loaded from P1LED0/H816 (pin 60) to indicate the data bus mode.<br>0 = Not in 8-bit bus mode operation<br>1 = In 8-bit bus mode operation |

**TABLE 4-112: CHIP CONFIGURATION REGISTER (0X108 – 0X109): CCR (CONTINUED)**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 6     | —       | RO  | <b>16-Bit Data Bus Width</b><br>This bit value is loaded from P1LED0/H816 (pin 60) to indicate the data bus mode.<br>0 = Not in 16-bit bus mode operation<br>1 = In 16-bit bus mode operation |
| 5     | 0       | RO  | Reserved  |
| 4     | 1       | RO  | <b>Shared Data Bus Mode for Data and Address</b><br>0 = Not valid<br>1 = Data and address bus are shared.   |
| 3 - 0 | 0x2     | RO  | Reserved  |

4.2.26.3 0x10A – 0x10F: Reserved

4.2.26.4 Host MAC Address Registers: MARL, MARM and MARH

These host MAC address registers are loaded starting at word location 0x1 of the EEPROM upon hardware reset. The software driver can read or write these registers values, but it will not modify the original host MAC address values in the EEPROM. These six bytes of host MAC address in external EEPROM are loaded to these three registers as mapped below:

- MARL[15:0] = EEPROM 0x1 (MAC Byte 2 and 1)
- MARM[15:0] = EEPROM 0x2 (MAC Byte 4 and 3)
- MARH[15:0] = EEPROM 0x3 (MAC Byte 6 and 5)

The host MAC address is used to define the individual destination address that the KSZ8462 responds to when receiving frames. Network addresses are generally expressed in the form of 01:23:45:67:89:AB, where the bytes are received from left to right, and the bits within each byte are received from right to left (LSB to MSB). For example, the actual transmitted and received bits are on the order of 10000000 11000100 10100010 11100110 10010001 11010101. These three registers value for host MAC address 01:23:45:67:89:AB will be held as below:

- MARL[15:0] = 0x89AB
- MARM[15:0] = 0x4567
- MARH[15:0] = 0x0123

**TABLE 4-113: HOST MAC ADDRESS REGISTER LOW (0X110 – 0X111): MARL**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | —       | RW  | <b>MARL MAC Address Low</b><br>The least significant word of the MAC Address. |

**TABLE 4-114: HOST MAC ADDRESS REGISTER MIDDLE (0X112 – 0X113): MARM**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | —       | RW  | <b>MARM MAC Address Middle</b><br>The middle word of the MAC Address. |

**TABLE 4-115: HOST MAC ADDRESS REGISTER HIGH (0X114 – 0X115): MARH**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | —       | RW  | <b>MARH MAC Address High</b><br>The most significant word of the MAC Address. |

4.2.26.5 0x116 – 0x121: Reserved

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## 4.2.26.6 EEPROM Control Register (0x122 – 0x123): EEPCR

To support an external EEPROM, the PME/EEPROM pin should be pulled-up to high; otherwise, it should be pulled low. If an external EEPROM is not used, the software should program the host MAC address. If an EEPROM is used in the design, the chip host MAC address can be loaded from the EEPROM immediately after reset. The KSZ8462 allows the software to access (read or write) the EEPROM directly; that is, the EEPROM access timing can be fully controlled by the software if the EEPROM software access bit is set.

**TABLE 4-116: EEPROM CONTROL REGISTER (0X122 – 0X123): EEPCR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 6 | —       | RO  | Reserved   |
| 5      | 0       | WO  | <b>EESWA EEPROM Software Read or Write Access</b><br>0 = S/W read enable to access EEPROM when software access enabled (bit[4] = “1”)<br>1 = S/W write enable to access EEPROM when software access enabled (bit[4] = “1”) |
| 4      | 0       | RW  | <b>EESA EEPROM Software Access</b><br>1 = Enable software to access EEPROM through bits[3:0].<br>0 = Disable software to access EEPROM.  |
| 3      | —       | RO  | <b>EESB EEPROM Status Bit</b><br>Data Receive from EEPROM. This bit directly reads the EEDIO pin.  |
| 2      | 0       | RW  | <b>EECB EEPROM WR DATA</b><br>Write Data to EEPROM. This bit directly controls the device’s EEDIO pin.   |
| 1      | 0       | RW  | <b>EECB EEPROM Clock</b><br>Serial EEPROM Clock. This bit directly controls the device’s EESK pin.   |
| 0      | 0       | RW  | <b>EECB EEPROM CS</b><br>Chip Select for the EEPROM. This bit directly controls the device’s EECS pin.   |

## 4.2.26.7 Memory BIST Info Register (0x124 – 0x125): MBIR

This register indicates the built-in self-test results for both TX and RX memories after power-up/reset. The device should be reset after the BIST procedure to ensure proper subsequent operation.

**TABLE 4-117: MEMORY BIST INFO REGISTER (0X124 – 0X125): MBIR**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15      | 0       | RO  | <b>Memory BIST Done</b><br>0 = BIST In progress<br>1 = BIST Done   |
| 14 - 13 | 00      | RO  | Reserved   |
| 12      | —       | RO  | <b>TXMBF TX Memory BIST Completed</b><br>0 = TX Memory built-in self-test has not completed.<br>1 = TX Memory built-in self-test has completed.  |
| 11      | —       | RO  | <b>TXMBFA TX Memory BIST Failed</b><br>0 = TX Memory built-in self-test has completed without failure.<br>1 = TX Memory built-in self-test has completed with failure.                 |
| 10 - 8  | —       | RO  | <b>TXMBFC TX Memory BIST Fail Count</b><br>0 = TX Memory built-in self-test completed with no count failure.<br>1 = TX Memory built-in self-test encountered a failed count condition. |
| 7 - 5   | —       | RO  | Reserved   |
| 4       | —       | RO  | <b>RXMBF RX Memory BIST Completed</b><br>0 = Completion has not occurred for the RX Memory built-in self-test.<br>1 = Indicates completion of the RX Memory built-in self-test.        |
| 3       | —       | RO  | <b>RXMBFA RX Memory BIST Failed</b><br>0 = No failure with the RX Memory built-in self-test.<br>1 = Indicates the RX Memory built-in self-test has failed.                             |

**TABLE 4-117: MEMORY BIST INFO REGISTER (0X124 – 0X125): MBIR (CONTINUED)**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 2 - 0 | —       | RO  | <b>RXMBFC RX Memory BIST Test Fail Count</b><br>0 = No count failure for the RX Memory BIST.<br>1 = Indicates the RX Memory built-in self-test failed count. |

## 4.2.26.8 Global Reset Register (0x126 – 0x127): GRR

This register controls the global and PTP reset functions with information programmed by the CPU.

**TABLE 4-118: GLOBAL RESET REGISTER (0X126 – 0X127): GRR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 4 | 0x000   | RO  | Reserved   |
| 3      | 0       | RW  | <b>Memory BIST Start</b><br>1 = Setting this bit will start the Memory BIST.<br>0 = Setting this bit will stop the Memory BIST.  |
| 2      | 0       | RW  | <b>PTP Module Soft Reset</b><br>1 = Setting this bit resets the 1588/PTP blocks including the time stamp input units, the trigger output units and the PTP clock.<br>0 = Software reset is inactive.   |
| 1      | 0       | RW  | <b>QMU Module Soft Reset</b><br>1 = Software reset is active to clear both the TXQ and RXQ memories.<br>0 = QMU reset is inactive.<br>QMU software reset will flush out all TX/RX packet data inside the TXQ and RXQ memories and reset all the QMU registers to their default value.  |
| 0      | 0       | RW  | <b>Global Soft Reset</b><br>1 = Software reset is active.<br>0 = Software reset is inactive.<br>Global software reset will reset all registers to their default value. The strap-in values are not affected. This bit is not self-clearing. After writing a “1” to this bit, wait for 10 ms to elapse then write a “0” for normal operation. |

## 4.2.26.9 0x128 – 0x129: Reserved

## 4.2.26.10 Wake-Up Frame Control Register (0x12A – 0x12B): WFCR

This register holds control information programmed by the CPU to control the Wake-Up frame function.

**TABLE 4-119: WAKE-UP FRAME CONTROL REGISTER (0X12A – 0X12B): WFCR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 8 | 0x00    | RO  | Reserved   |
| 7      | 0       | RW  | <b>MPRXE</b><br>Magic Packet RX Enable<br>When set, it enables the Magic Packet pattern detection.<br>When reset, the Magic Packet pattern detection is disabled.      |
| 6 - 4  | 000     | RO  | Reserved   |
| 3      | 0       | RW  | <b>WF3E</b><br>Wake-Up Frame 3 Enable<br>When set, it enables the Wake-Up frame 3 pattern detection.<br>When reset, the Wake-Up frame 3 pattern detection is disabled. |
| 2      | 0       | RW  | <b>WF2E</b><br>Wake-Up Frame 2 Enable<br>When set, it enables the Wake-Up frame 2 pattern detection.<br>When reset, the Wake-Up frame 2 pattern detection is disabled. |

**TABLE 4-119: WAKE-UP FRAME CONTROL REGISTER (0X12A – 0X12B): WFCR (CONTINUED)**

| Bit | Default | R/W | Description  |
|-----|---------|-----|--|
| 1   | 0       | RW  | <b>WF1E</b><br>Wake-Up Frame 1 Enable<br>When set, it enables the Wake-Up frame 1 pattern detection.<br>When reset, the Wake-Up frame 1 pattern detection is disabled. |
| 0   | 0       | RW  | <b>WF0E</b><br>Wake-Up Frame 0 Enable<br>When set, it enables the Wake-Up frame 0 pattern detection.<br>When reset, the Wake-Up frame 0 pattern detection is disabled. |

4.2.26.11 0x12C – 0x12F: Reserved

4.2.26.12 Wake-Up Frame 0 CRC0 Register (0x130 – 0x131): WF0CRC0

This register contains the expected CRC values of the Wake-Up frame 0 pattern.

The value of the CRC calculated is based on the IEEE 802.3 Ethernet standard; it is taken over the bytes specified in the Wake-Up byte mask registers.

**TABLE 4-120: WAKE-UP FRAME 0 CRC0 REGISTER (0X130 – 0X131): WF0CRC0**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>WF0CRC0</b><br>Wake-Up Frame 0 CRC (lower 16 bits)<br>The expected CRC value of a Wake-Up frame 0 pattern. |

4.2.26.13 Wake-Up Frame 0 CRC1 Register (0x132 – 0x133): WF0CRC1

This register contains the expected CRC values of the Wake-Up frame 0 pattern.

The value of the CRC calculated is based on the IEEE 802.3 Ethernet standard; it is taken over the bytes specified in the Wake-Up byte mask registers.

**TABLE 4-121: WAKE-UP FRAME 0 CRC1 REGISTER (0X132 – 0X133): WF0CRC1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF0CRC1</b><br>Wake-Up Frame 0 CRC (upper 16 bits).<br>The expected CRC value of a Wake-Up frame 0 pattern. |

4.2.26.14 Wake-Up Frame 0 Byte Mask 0 Register (0x134 – 0x135): WF0BM0

This register contains the first 16 bytes mask values of the Wake-Up frame 0 pattern. Setting bit [0] selects the first byte of the Wake-Up frame 0. Setting bit [15] selects the 16th byte of the Wake-Up frame 0.

**TABLE 4-122: WAKE-UP FRAME 0 BYTE MASK 0 REGISTER (0X134 – 0X135): WF0BM0**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF0BM0</b><br>Wake-Up Frame 0 Byte Mask 0<br>The first 16 byte mask of a Wake-Up frame 0 pattern. |

## 4.2.26.15 Wake-Up Frame 0 Byte Mask 1 Register (0x136 – 0x137): WF0BM1

This register contains the next 16 bytes mask values of the Wake-Up frame 0 pattern. Setting bit [0] selects the 17th byte of the Wake-Up frame 0. Setting bit [15] selects the 32nd byte of the Wake-Up frame 0.

**TABLE 4-123: WAKE-UP FRAME 0 BYTE MASK 1 REGISTER (0X136 – 0X137): WF0BM1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF0BM1</b><br>Wake-Up Frame 0 Byte Mask 1.<br>The next 16 byte mask covering bytes 17 to 32 of a Wake-Up frame 0 pattern. |

## 4.2.26.16 Wake-Up Frame 0 Byte Mask 2 Register (0x138 – 0x139): WF0BM2

This register contains the next 16 bytes mask values of the Wake-Up frame 0 pattern. Setting bit [0] selects the 33rd byte of the Wake-Up frame 0. Setting bit [15] selects the 48th byte of the Wake-Up frame 0.

**TABLE 4-124: WAKE-UP FRAME 0 BYTE MASK 2 REGISTER (0X138 – 0X139): WF0BM2**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF0BM2</b><br>Wake-Up Frame 0 Byte Mask 2.<br>The next 16 byte mask covering bytes 33 to 48 of a wake-up frame 0 pattern. |

## 4.2.26.17 Wake-Up Frame 0 Byte Mask 3 Register (0x13A – 0x13B): WF0BM3

This register contains the last 16 bytes mask values of the Wake-Up frame 0 pattern. Setting bit [0] selects the 49th byte of the Wake-Up frame 0. Setting bit [15] selects the 64th byte of the Wake-Up frame 0.

**TABLE 4-125: WAKE-UP FRAME 0 BYTE MASK 3 REGISTER (0X13A – 0X13B): WF0BM3**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF0BM3</b><br>Wake-Up Frame 0 Byte Mask 3.<br>The last 16 byte mask covering bytes 49 to 64 of a wake-up frame 0 pattern. |

## 4.2.26.18 0x13C – 0x13F: Reserved

## 4.2.26.19 Wake-Up Frame 1 CRC0 Register (0x140 – 0x141): WF1CRC0

This register contains the expected CRC values of the Wake-Up frame 1 pattern.

The value of the CRC calculated is based on the IEEE 802.3 Ethernet standard; it is taken over the bytes specified in the Wake-Up byte mask registers.

**TABLE 4-126: WAKE-UP FRAME 1 CRC0 REGISTER (0X140 – 0X141): WF1CRC0**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>WF1CRC0</b><br>Wake-Up Frame 1 CRC (lower 16 bits)<br>The expected CRC value of a Wake-Up frame 1 pattern. |

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## 4.2.26.20 Wake-Up Frame 1 CRC1 Register (0x142 – 0x143): WF1CRC1

This register contains the expected CRC values of the Wake-Up frame 1 pattern.

The value of the CRC calculated is based on the IEEE 802.3 Ethernet standard; it is taken over the bytes specified in the Wake-Up byte mask registers.

**TABLE 4-127: WAKE-UP FRAME 0 CRC1 REGISTER (0X142 – 0X143): WF1CRC1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF1CRC1</b><br>Wake-Up Frame 1 CRC (upper 16 bits).<br>The expected CRC value of a Wake-Up frame 1 pattern. |

## 4.2.26.21 Wake-Up Frame 1 Byte Mask 0 Register (0x144 – 0x145): WF1BM0

This register contains the first 16 bytes mask values of the Wake-Up frame 1 pattern. Setting bit [0] selects the first byte of the Wake-Up frame 1. Setting bit [15] selects the 16th byte of the Wake-Up frame 1.

**TABLE 4-128: WAKE-UP FRAME 1 BYTE MASK 0 REGISTER (0X144 – 0X145): WF1BM0**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF1BM0</b><br>Wake-Up Frame 1 Byte Mask 0<br>The first 16 byte mask of a Wake-Up frame 1 pattern. |

## 4.2.26.22 Wake-Up Frame 1 Byte Mask 1 Register (0x146 – 0x147): WF1BM1

This register contains the next 16 bytes mask values of the Wake-Up frame 1 pattern. Setting bit [0] selects the 17th byte of the Wake-Up frame 1. Setting bit [15] selects the 32nd byte of the Wake-Up frame 1.

**TABLE 4-129: WAKE-UP FRAME 1 BYTE MASK 1 REGISTER (0X146 – 0X147): WF1BM1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF1BM1</b><br>Wake-Up Frame 1 Byte Mask 1.<br>The next 16 byte mask covering bytes 17 to 32 of a Wake-Up frame 1 pattern. |

## 4.2.26.23 Wake-Up Frame 1 Byte Mask 2 Register (0x148 – 0x149): WF1BM2

This register contains the next 16 bytes mask values of the Wake-Up frame 1 pattern. Setting bit [0] selects the 33rd byte of the Wake-Up frame 1. Setting bit [15] selects the 48th byte of the Wake-Up frame 1.

**TABLE 4-130: WAKE-UP FRAME 1 BYTE MASK 2 REGISTER (0X148 – 0X149): WF1BM2**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF1BM2</b><br>Wake-Up Frame 1 Byte Mask 2.<br>The next 16 byte mask covering bytes 33 to 48 of a wake-up frame 1 pattern. |

## 4.2.26.24 Wake-Up Frame 1 Byte Mask 3 Register (0x14A – 0x14B): WF1BM3

This register contains the last 16 bytes mask values of the Wake-Up frame 1 pattern. Setting bit [0] selects the 49th byte of the Wake-Up frame 1. Setting bit [15] selects the 64th byte of the Wake-Up frame 1.

**TABLE 4-131: WAKE-UP FRAME 1 BYTE MASK 3 REGISTER (0X14A – 0X14B): WF1BM3**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF1BM3</b><br>Wake-Up Frame 1 Byte Mask 3.<br>The last 16 byte mask covering bytes 49 to 64 of a wake-up frame 1 pattern. |



4.2.26.25 0x14C – 0x14F: Reserved

4.2.26.26 Wake-Up Frame 2 CRC0 Register (0x150 – 0x151): WF2CRC0

This register contains the expected CRC values of the Wake-Up frame 2 pattern.

The value of the CRC calculated is based on the IEEE 802.3 Ethernet standard; it is taken over the bytes specified in the Wake-Up byte mask registers.

**TABLE 4-132: WAKE-UP FRAME 2 CRC0 REGISTER (0X150 – 0X151): WF2CRC0**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>WF2CRC0</b><br>Wake-Up Frame 2 CRC (lower 16 bits)<br>The expected CRC value of a Wake-Up frame 2 pattern. |

4.2.26.27 Wake-Up Frame 2 CRC1 Register (0x152 – 0x153): WF2CRC1

This register contains the expected CRC values of the Wake-Up frame 2 pattern.

The value of the CRC calculated is based on the IEEE 802.3 Ethernet standard; it is taken over the bytes specified in the Wake-Up byte mask registers.

**TABLE 4-133: WAKE-UP FRAME 2 CRC1 REGISTER (0X152 – 0X153): WF2CRC1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF2CRC1</b><br>Wake-Up Frame 2 CRC (upper 16 bits).<br>The expected CRC value of a Wake-Up frame 2 pattern. |

4.2.26.28 Wake-Up Frame 2 Byte Mask 0 Register (0x154 – 0x155): WF2BM0

This register contains the first 16 bytes mask values of the Wake-Up frame 2 pattern. Setting bit [0] selects the first byte of the Wake-Up frame 2. Setting bit [15] selects the 16th byte of the Wake-Up frame 2.

**TABLE 4-134: WAKE-UP FRAME 2 BYTE MASK 0 REGISTER (0X154 – 0X155): WF2BM0**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF2BM0</b><br>Wake-Up Frame 2 Byte Mask 0<br>The first 16 byte mask of a Wake-Up frame 2 pattern. |

4.2.26.29 Wake-Up Frame 2 Byte Mask 1 Register (0x156 – 0x157): WF2BM1

This register contains the next 16 bytes mask values of the Wake-Up frame 2 pattern. Setting bit [0] selects the 17th byte of the Wake-Up frame 2. Setting bit [15] selects the 32nd byte of the Wake-Up frame 2.

**TABLE 4-135: WAKE-UP FRAME 2 BYTE MASK 1 REGISTER (0X156 – 0X157): WF2BM1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF2BM1</b><br>Wake-Up Frame 2 Byte Mask 1.<br>The next 16 byte mask covering bytes 17 to 32 of a Wake-Up frame 2 pattern. |

4.2.26.30 Wake-Up Frame 2 Byte Mask 2 Register (0x158 – 0x159): WF2BM2

This register contains the next 16 bytes mask values of the Wake-Up frame 2 pattern. Setting bit [0] selects the 33rd byte of the Wake-Up frame 2. Setting bit [15] selects the 48th byte of the Wake-Up frame 2.

**TABLE 4-136: WAKE-UP FRAME 2 BYTE MASK 2 REGISTER (0X158 – 0X159): WF2BM2**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF2BM2</b><br>Wake-Up Frame 2 Byte Mask 2.<br>The next 16 byte mask covering bytes 33 to 48 of a wake-up frame 2 pattern. |

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## 4.2.26.31 Wake-Up Frame 2 Byte Mask 3 Register (0x15A – 0x15B): WF2BM3

This register contains the last 16 bytes mask values of the Wake-Up frame 2 pattern. Setting bit [0] selects the 49th byte of the Wake-Up frame 2. Setting bit [15] selects the 64th byte of the Wake-Up frame 2.

**TABLE 4-137: WAKE-UP FRAME 2 BYTE MASK 3 REGISTER (0X15A – 0X15B): WF2BM3**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF2BM3</b><br>Wake-Up Frame 2 Byte Mask 3.<br>The last 16 byte mask covering bytes 49 to 64 of a wake-up frame 2 pattern. |

## 4.2.26.32 0x15C – 0x15F: Reserved

## 4.2.26.33 Wake-Up Frame 3 CRC0 Register (0x160 – 0x161): WF3CRC0

This register contains the expected CRC values of the Wake-Up frame 3 pattern.

The value of the CRC calculated is based on the IEEE 802.3 Ethernet standard; it is taken over the bytes specified in the Wake-Up byte mask registers.

**TABLE 4-138: WAKE-UP FRAME 3 CRC0 REGISTER (0X160 – 0X161): WF3CRC0**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>WF3CRC0</b><br>Wake-Up Frame 3 CRC (lower 16 bits)<br>The expected CRC value of a Wake-Up frame 3 pattern. |

## 4.2.26.34 Wake-Up Frame 3 CRC1 Register (0x162 – 0x163): WF3CRC1

This register contains the expected CRC values of the Wake-Up frame 3 pattern.

The value of the CRC calculated is based on the IEEE 802.3 Ethernet standard; it is taken over the bytes specified in the Wake-Up byte mask registers.

**TABLE 4-139: WAKE-UP FRAME 3 CRC1 REGISTER (0X162 – 0X163): WF3CRC1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF3CRC1</b><br>Wake-Up Frame 3 CRC (upper 16 bits).<br>The expected CRC value of a Wake-Up frame 3 pattern. |

## 4.2.26.35 Wake-Up Frame 3 Byte Mask 0 Register (0x164 – 0x165): WF3BM0

This register contains the first 16 bytes mask values of the Wake-Up frame 3 pattern. Setting bit [0] selects the first byte of the Wake-Up frame 3. Setting bit [15] selects the 16th byte of the Wake-Up frame 3.

**TABLE 4-140: WAKE-UP FRAME 3 BYTE MASK 0 REGISTER (0X164 – 0X165): WF3BM0**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF3BM0</b><br>Wake-Up Frame 3 Byte Mask 0<br>The first 16 byte mask of a Wake-Up frame 3 pattern. |

## 4.2.26.36 Wake-Up Frame 3 Byte Mask 1 Register (0x166 – 0x167): WF3BM1

This register contains the next 16 bytes mask values of the Wake-Up frame 3 pattern. Setting bit [0] selects the 17th byte of the Wake-Up frame 3. Setting bit [15] selects the 32nd byte of the Wake-Up frame 3.

**TABLE 4-141: WAKE-UP FRAME 3 BYTE MASK 1 REGISTER (0X166 – 0X167): WF3BM1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF3BM1</b><br>Wake-Up Frame 3 Byte Mask 1.<br>The next 16 byte mask covering bytes 17 to 32 of a Wake-Up frame 3 pattern. |

## 4.2.26.37 Wake-Up Frame 3 Byte Mask 2 Register (0x168 – 0x169): WF3BM2

This register contains the next 16 bytes mask values of the Wake-Up frame 3 pattern. Setting bit [0] selects the 33rd byte of the Wake-Up frame 3. Setting bit [15] selects the 48th byte of the Wake-Up frame 3.

**TABLE 4-142: WAKE-UP FRAME 3 BYTE MASK 2 REGISTER (0X168 – 0X169): WF3BM2**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF3BM2</b><br>Wake-Up Frame 3 Byte Mask 2.<br>The next 16 byte mask covering bytes 33 to 48 of a wake-up frame 3 pattern. |

## 4.2.26.38 Wake-Up Frame 3 Byte Mask 3 Register (0x16A – 0x16B): WF3BM3

This register contains the last 16 bytes mask values of the Wake-Up frame 3 pattern. Setting bit [0] selects the 49th byte of the Wake-Up frame 3. Setting bit [15] selects the 64th byte of the Wake-Up frame 3.

**TABLE 4-143: WAKE-UP FRAME 3 BYTE MASK 3 REGISTER (0X16A – 0X16B): WF3BM3**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>WF3BM3</b><br>Wake-Up Frame 3 Byte Mask 3.<br>The last 16 byte mask covering bytes 49 to 64 of a wake-up frame 3 pattern. |

## 4.2.26.39 0x16C – 0x16F: Reserved

## 4.2.27 INTERNAL I/O REGISTER SPACE MAPPING FOR THE QUEUE MANAGEMENT UNIT (0X170 – 0X1FF)

### 4.2.27.1 Transmit Control Register (0x170 – 0x171): TXCR

This register holds control information programmed by the CPU to control the QMU transmit module function.

**TABLE 4-144: TRANSMIT CONTROL REGISTER (0X170 – 0X171): TXCR**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 9 | —       | RO  | Reserved  |
| 8      | 0       | RW  | <b>TCGICMP Transmit Checksum Generation for ICMP</b><br>When this bit is set, the device hardware is enabled to generate an ICMP frame checksum in a non-fragmented ICMP frame.   |
| 7      | 0       | RW  | <b>TCGUDP Transmit Checksum Generation for UDP</b><br>When this bit is set, the device hardware is enabled to generate a UDP frame checksum in a non-fragmented UDP frame.  |
| 6      | 0       | RW  | <b>TCGTCP Transmit Checksum Generation for TCP</b><br>When this bit is set, the device hardware is enabled to generate a TCP frame checksum in a non-fragmented TCP frame.  |
| 5      | 0       | RW  | <b>TCGIP Transmit Checksum Generation for IP</b><br>When this bit is set, the device hardware is enabled to generate an IP header checksum in a non-fragmented IP frame.  |
| 4      | 0       | RW  | <b>FTXQ Flush Transmit Queue</b><br>When this bit is set, the transmit queue memory is cleared and TX frame pointer is reset.<br>Note: Disable the TXE transmit enable bit[0] first before setting this bit, then clear this bit to normal operation. |

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TABLE 4-144: TRANSMIT CONTROL REGISTER (0X170 – 0X171): TXCR (CONTINUED)

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 3   | 0       | RW  | <b>TXFCE Transmit Flow Control Enable</b><br>When this bit is set and the device is in full-duplex mode, flow control is enabled. The device transmits a PAUSE frame when the receive buffer capacity reaches a threshold level that will cause the buffer to overflow. When this bit is set and the device is in half-duplex mode, back-pressure flow control is enabled. When this bit is cleared, no transmit flow control is enabled. |
| 2   | 0       | RW  | <b>TXPE Transmit Padding Enable</b><br>When this bit is set, the device automatically adds a padding field to a packet shorter than 64 bytes.<br>Note: Setting this bit requires enabling the add CRC feature (bit[1] = “1”) to avoid CRC errors for the transmit packet.   |
| 1   | 0       | RW  | <b>TXCE Transmit CRC Enable</b><br>When this bit is set, the device automatically adds a 32-bit CRC checksum field to the end of a transmit frame.  |
| 0   | 0       | RW  | <b>TXE Transmit Enable</b><br>When this bit is set, the transmit module is enabled and placed in a running state. When reset, the transmit process is placed in the stopped state after the transmission of the current frame is completed.   |

## 4.2.27.2 Transmit Status Register (0x172 – 0x173): TXSR

This register keeps the status of the last transmitted frame in the QMU transmit module.

TABLE 4-145: TRANSMIT STATUS REGISTER (0X172 – 0X173): TXSR

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 14 | 00      | RO  | Reserved  |
| 13      | 0       | RO  | <b>TXLC Transmit Late Collision</b><br>This bit is set when a transmit late collision occurs.   |
| 12      | 0       | RO  | <b>TXMC Transmit Maximum Collision</b><br>This bit is set when a transmit maximum collision is reached.   |
| 11 - 6  | —       | RO  | Reserved  |
| 5 - 0   | —       | RO  | <b>TXFID Transmit Frame ID</b><br>This field identifies the transmitted frame. All of the transmit status information in this register belongs to the frame with this ID. |

## 4.2.27.3 Receive Control Register 1 (0x174 – 0x175): RXCR1

This register holds control information programmed by the host to control the receive function in the QMU module.

TABLE 4-146: RECEIVE CONTROL REGISTER 1 (0X174 – 0X175): RXCR1

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 15  | 0       | RW  | <b>FRXQ Flush Receive Queue</b><br>When this bit is set, The receive queue memory is cleared and RX frame pointer is reset.<br>Note: Disable the RXE receive enable bit[0] first before setting this bit, then clear this bit for normal operation. |
| 14  | 0       | RW  | <b>RXUDPFCC Receive UDP Frame Checksum Check Enable</b><br>While this bit is set, if any received UDP frame has an incorrect UDP checksum, the frame will be discarded.   |
| 13  | 0       | RW  | <b>RXTCPFCC Receive TCP Frame Checksum Check Enable</b><br>While this bit is set, if any received TCP frame has an incorrect TCP checksum, the frame will be discarded.   |

**TABLE 4-146: RECEIVE CONTROL REGISTER 1 (0X174 – 0X175): RXCR1 (CONTINUED)**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 12    | 0       | RW  | <b>RXIPFCC Receive IP Frame Checksum Check Enable</b><br>While this bit is set, if any received IP frame has an incorrect IP checksum, the frame will be discarded.   |
| 11    | 1       | RW  | <b>RXPAFMA Receive Physical Address Filtering with MAC Address Enable</b><br>This bit enables the RX function to receive the physical address that passes the MAC Address filtering mechanism.  |
| 10    | 0       | RW  | <b>RXFCE Receive Flow Control Enable</b><br>When this bit is set and the device is in full-duplex mode, flow control is enabled, and the device will acknowledge a PAUSE frame from the receive interface; i.e., the outgoing packets are pending in the transmit buffer until the PAUSE frame control timer expires. This field has no meaning in half-duplex mode and should be programmed to “0”. When this bit is cleared, flow control is not enabled. |
| 9     | 0       | RW  | <b>RXEFE Receive Error Frame Enable</b><br>When this bit is set, frames with CRC error are allowed to be received into the RX queue.<br>When this bit is cleared, all CRC error frames are discarded.   |
| 8     | 0       | RW  | <b>RXMAFMA Receive Multicast Address Filtering with MAC Address Enable</b><br>When this bit is set, this bit enables the RX function to receive multicast address that pass the MAC Address filtering mechanism.  |
| 7     | 0       | RW  | <b>RXBE Receive Broadcast Enable</b><br>When this bit is set, the RX module is enabled to receive all the broadcast frames.   |
| 6     | 0       | RW  | <b>RXME Receive Multicast Enable</b><br>When this bit is set, the RX module is enabled to receive all the multicast frames (including broadcast frames).  |
| 5     | 0       | RW  | <b>RXUE Receive Unicast Enable</b><br>When this bit is set, the RX module is enabled to receive unicast frames that match the 48-bit station MAC address of the module.   |
| 4     | 0       | RW  | <b>RXAE Receive All Enable</b><br>When this bit is set, the device is enabled to receive all incoming frames, regardless of the frame’s destination address.  |
| 3 - 2 | 00      | RW  | Reserved  |
| 1     | 0       | RW  | <b>RXINVF Receive Inverse Filtering</b><br>When this bit is set, the device receives function with address check operation in inverse filtering mode.   |
| 0     | 0       | RW  | <b>RXE Receive Enable</b><br>When this bit is set, the RX block is enabled and placed in a running state.<br>When this bit is cleared, the receive process is placed in the stopped state upon completing reception of the current frame.   |

## 4.2.27.4 Receive Control Register 2 (0x176 – 0x177): RXCR2

This register holds control information programmed by the host to control the receive function in the QMU module.

**TABLE 4-147: RECEIVE CONTROL REGISTER 2 (0X176 – 0X177): RXCR2**

| Bit    | Default | R/W | Description |
|--------|---------|-----|-------------|
| 15 - 9 | —       | RO  | Reserved    |

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**TABLE 4-147: RECEIVE CONTROL REGISTER 2 (0X176 – 0X177): RXCR2 (CONTINUED)**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 8     | 1       | RW  | <b>EQFCPT Enable QMU Flow Control Pause Timer</b><br>While this bit is set, another pause frame will be sent out if the pause timer is expired and RXQ (12 KB) is still above the low water mark. The pause timer will reset itself when it expires and RXQ is still above the low water mark and it will be disabled or stop counting when RXQ is below the low water mark. The pause frame is sent out before RXQ is above the high water mark. |
| 7 - 5 | 000     | RO  | Reserved  |
| 4     | 1       | RW  | <b>IUFFP IPv4/IPv6/UDP Fragment Frame Pass</b><br>While this bit is set, the device will pass the frame without checking the UDP checksum at the received side for IPv6 UDP frames with a fragmented extension header. Operating with this bit cleared is not a valid mode since the hardware cannot calculate a correct UDP checksum without all of the IP fragments.  |
| 3     | 0       | RW  | Reserved  |
| 2     | 1       | RW  | <b>UDPLFE UDP Lite Frame Enable</b><br>While this bit is set, the KSZ8462 will check the checksum at receive side and generate the checksum at transmit side for UDP lite frame. While this bit is cleared, the KSZ8462 will pass the checksum check at receive side and skip the checksum generation at transmit side for UDP lite frame.  |
| 1     | 0       | RW  | <b>RXICMPFCC Receive ICMP Frame Checksum Check Enable</b><br>While this bit is set, any received ICMP frame (only a non-fragmented frame) with an incorrect checksum will be discarded. If this bit is not set, the frame will not be discarded even though there is an ICMP checksum error.  |
| 0     | 0       | RW  | <b>RXSAF Receive Source Address Filtering</b><br>While this bit is set, the device will drop the frame if the source address is the same as the MAC Address in the MARL, MARM, MARH registers.  |

## 4.2.27.5 TXQ Memory Information Register (0x178 – 0x179): TXMIR

This register indicates the amount of free memory available in the TXQ of the QMU module.

**TABLE 4-148: TXQ MEMORY INFORMATION REGISTER (0X178 – 0X179): TXMIR**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 13 | —       | RO  | Reserved  |
| 12 - 0  | 0x1800  | RO  | <b>TXMA Transmit Memory Available</b><br>The amount of memory available is represented in units of byte. The TXQ memory is used for both frame payload, control word.<br>Note: Software must be written to ensure that there is enough memory for the next transmit frame including control information before transmit data is written to the TXQ. |

## 4.2.27.6 0x17A – 0x17B: Reserved

## 4.2.27.7 Receive Frame Header Status Register (0x17C – 0x17D): RXFHSR

This register indicates the received frame header status information. The received frames are reported in the RXFC register. This register contains the status information for the frame received, and the host processor can read as many times as the frame count value in the RXFC register.

**TABLE 4-149: RECEIVE FRAME HEADER STATUS REGISTER (0X17C – 0X17D): RXFHSR**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 15    | —       | RO  | <b>RXFV Receive Frame Valid</b><br>This bit is set if the present frame in the receive packet memory is valid. The status information currently in this location is also valid. When clear, it indicates that there is either no pending receive frame or that the current frame is still in the process of receiving. |
| 14    | —       | RO  | Reserved   |
| 13    | —       | RO  | <b>RXICMPFCS Receive ICMP Frame Checksum Status</b><br>When this bit is set, the KSZ8462 received ICMP frame checksum is incorrect.  |
| 12    | —       | RO  | <b>RXIPFCS Receive IP Frame Checksum Status</b><br>When this bit is set, the KSZ8462 received IP header checksum is incorrect.   |
| 11    | —       | RO  | <b>RXTCPFCS Receive TCP Frame Checksum Status</b><br>When this bit is set, the KSZ8462 received TCP frame checksum is incorrect.   |
| 10    | —       | RO  | <b>RXUDPFCS Receive UDP Frame Checksum Status</b><br>When this bit is set, the KSZ8462 received UDP frame checksum is incorrect.   |
| 9 - 8 | —       | RO  | Reserved   |
| 7     | —       | RO  | <b>RXBF Receive Broadcast Frame</b><br>When this bit is set, it indicates that this frame has a broadcast address.   |
| 6     | —       | RO  | <b>RXMF Receive Multicast Frame</b><br>When this bit is set, it indicates that this frame has a multicast address (including the broadcast address).   |
| 5     | —       | RO  | <b>RXUF Receive Unicast Frame</b><br>When this bit is set, it indicates that this frame has a unicast address.   |
| 4     | —       | RO  | Reserved   |
| 3     | —       | RO  | <b>RXFT Receive Frame Type</b><br>When this bit is set, it indicates that the frame is an Ethernet-type frame (frame length is greater than 1500 bytes). When clear, it indicates that the frame is an IEEE 802.3 frame. This bit is not valid for “runt” frames.  |
| 2     | —       | RO  | Reserved   |
| 1     | —       | RO  | <b>RXRF Receive Runt Frame</b><br>When this bit is set, it indicates that a frame was damaged by a collision or had a premature termination before the collision window passed. “Runt” frames are passed to the host only if the Pass Bad Frame bit is set.  |
| 0     | —       | RO  | <b>RXCE Receive CRC Error</b><br>When this bit is set, it indicates that a CRC error has occurred on the current received frame. CRC error frames are passed to the host only if the Pass Bad Frame bit is set.  |

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## 4.2.27.8 Receive Frame Header Byte Count Register (0x17E – 0x17F): RXFHBCR

This register indicates the received frame header byte count information. The received frames are reported in the RXFC register. This register contains the total number of bytes information for the frame received, and the host processor can read as many times as the frame count value in the RXFC register.

**TABLE 4-150: RECEIVE FRAME HEADER BYTE COUNT REGISTER (0X17E – 0X17F): RXFHBCR**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 12 | —       | RO  | Reserved   |
| 11 - 0  | —       | RO  | <b>RXBC Receive Byte Count</b><br>This field indicates the present received frame byte size.<br>Note: Always read low byte first for 8-bit mode operation. |

## 4.2.27.9 TXQ Command Register (0x180 – 0x181): TXQCR

This register is programmed by the host CPU to issue a transmit command to the TXQ. The present transmit frame in the TXQ memory is queued for transmit.

**TABLE 4-151: TXQ COMMAND REGISTER (0X180 – 0X181): TXQCR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 3 | —       | RW  | Reserved   |
| 2      | 0       | RW  | Reserved   |
| 1      | 0       | RW  | <b>TXQMAM TXQ Memory Available Monitor</b><br>When this bit is written as a “1”, the KSZ8462 will generate interrupt (bit [6] in the ISR register) to the CPU when TXQ memory is available based upon the total amount of TXQ space requested by CPU at TXNTFSR (0x19E) register.<br>Note: This bit is self-clearing after the frame is finished transmitting. The software should wait for the bit to be cleared before setting to “1” again. |
| 0      | 0       | RW  | <b>METFE Manual Enqueue TXQ Frame Enable</b><br>When this bit is written as “1”, the KSZ8462 will enable the current TX frame in the TX buffer to be queued for transmit one frame at a time.<br>Note: This bit is self-cleared after the frame transmission is complete. The software should wait for the bit to be cleared before setting up another new TX frame.   |

## 4.2.27.10 RXQ Command Register (0x182 – 0x183): RXQCR

This register is programmed by the host CPU to issue DMA read or write command to the RXQ and TXQ. This register also is used to control all RX thresholds enable and status.

**TABLE 4-152: RXQ COMMAND REGISTER (0X182 – 0X183): RXQCR**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 13 | —       | RW  | Reserved   |
| 12      | —       | RO  | <b>RXDTTS RX Duration Timer Threshold Status</b><br>When this bit is set, it indicates that RX interrupt is due to the time starting at the first received frame in the RXQ buffer exceeding the threshold set in the RX Duration Timer Threshold Register (0x18C, RXDTTR).<br>This bit will be updated when a “1” is written to bit [13] in the ISR register. |
| 11      | —       | RO  | <b>RXDBCTS RX Data Byte Count Threshold Status</b><br>When this bit is set, it indicates that the RX interrupt is due to the number of received bytes in RXQ buffer exceeding the threshold set in the RX Data Byte Count Threshold register (0x18E, RXDBCTR).<br>This bit will be updated when a “1” is written to bit [13] in the ISR register.              |



**TABLE 4-152: RXQ COMMAND REGISTER (0X182 – 0X183): RXQCR (CONTINUED)**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 10    | —       | RO  | <b>RXFCTS RX Frame Count Threshold Status</b><br>When this bit is set, it indicates that the RX interrupt is due to the number of received frames in RXQ buffer exceeding the threshold set in the RX Frame Count Threshold register (0x19C, RXFCTR).<br>This bit will be updated when a “1” is written to bit [13] in the ISR register.  |
| 9     | 0       | RW  | <b>RXIPHTOE RX IP Header Two-Byte Offset Enable</b><br>When this bit is written as “1”, the device will enable the adding of two bytes before the frame header in order for the IP header inside the frame contents to be aligned with a double word boundary to speed up software operation.   |
| 8     | —       | RW  | Reserved  |
| 7     | 0       | RW  | <b>RXDTTE RX Duration Timer Threshold Enable</b><br>When this bit is written as “1”, the device will enable the RX interrupt (bit [13] in the ISR) when the time starts at the first received frame in the RXQ buffer if it exceeds the threshold set in the RX Duration Timer Threshold register (0x18C, RXDTTR).  |
| 6     | 0       | RW  | <b>RXDBCTE RX Data Byte Count Threshold Enable</b><br>When this bit is written as “1”, the device will enable the RX interrupt (bit [13] in ISR) when the number of received bytes in the RXQ buffer exceeds the threshold set in the RX Data Byte Count Threshold register (0x18E, RXDBCTR).   |
| 5     | 0       | RW  | <b>RXFCTE RX Frame Count Threshold Enable</b><br>When this bit is written as “1”, the device will enable the RX interrupt (bit [13] in ISR) when the number of received frames in the RXQ buffer exceeds the threshold set in the RX Frame Count Threshold register (0x19C, RXFCTR).  |
| 4     | 0       | RW  | <b>ADRFE Auto-Dequeue RXQ Frame Enable</b><br>When this bit is written as “1”, the device will automatically enable RXQ frame buffer dequeue. The read pointer in the RXQ frame buffer will be automatically adjusted to the next received frame location after the current frame is completely read by the host.   |
| 3     | 0       | RW  | <b>SDA Start DMA Access</b><br>When this bit is written as “1”, the device allows a DMA operation from the host CPU to access either the read RXQ frame buffer or the write TXQ frame buffer with CSN and RDN or WRN signals while the CMD pin is low. All register accesses are disabled except for access to this register during this DMA operation.<br>This bit must be set to “0” when the DMA operation is finished in order to access the rest of the registers. |
| 2 - 1 | —       | RW  | Reserved  |
| 0     | 0       | RW  | <b>RRXEF Release RX Error Frame</b><br>When this bit is written as “1”, the current RX error frame buffer is released.<br>Note: This bit is self-cleared after the frame memory is released. The software should wait for the bit to be cleared before processing a new RX frame.   |

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## 4.2.27.11 TX Frame Data Pointer Register (0x184 – 0x185): TXFDPR

The value of this register determines the address to be accessed within the TXQ frame buffer. When the auto increment is set, it will automatically increment the pointer value on write accesses to the data register.

The counter is incremented by one for every byte access, by two for every word access, and by four for every double word access.

**TABLE 4-153: TX FRAME DATA POINTER REGISTER (0X184 – 0X185): TXFDPR**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15      | —       | RO  | Reserved  |
| 14      | 0       | RW  | <b>TXFPAI TX Frame Data Pointer Auto Increment</b><br>1: When this bit is set, the TX Frame Data Pointer register increments automatically on accesses to the data register. The increment is by one for every byte access, by two for every word access, and by four for every double word access.<br>0: When this bit is reset, the TX Frame Data Pointer is manually controlled by the user to access the TX frame location. |
| 13 - 11 | —       | RO  | Reserved  |
| 10 - 0  | 0x000   | RO  | <b>TXFP TX Frame Data Pointer</b><br>TX frame pointer index to the Frame Data register for access. This field is reset to the next available TX frame location when the TX frame data has been enqueued through the TXQ command register.   |

## 4.2.27.12 RX Frame Data Pointer Register (0x186 – 0x187): RXFDPR

Bits [10:0] of this register determine the address to be accessed within the RXQ frame buffer. When the auto increment function is set, it will automatically increment the RXQ Pointer on read accesses to the data register. The counter is incremented by one for every byte access, by two for every word access, and by four for every double word access.

**TABLE 4-154: RX FRAME DATA POINTER REGISTER (0X186 – 0X187): RXFDPR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | —       | RO  | Reserved   |
| 14     | 0       | RW  | <b>RXFPAI RX Frame Pointer Auto Increment</b><br>1 = When this bit is set, the RXQ Address register increments automatically on accesses to the data register. The increment is by one for every byte access, by two for every word access, and by four for every double word access.<br>0 = When this bit is reset, the RX frame data pointer is manually controlled by user to access the RX frame location. |
| 13     | —       | RO  | Reserved   |
| 12     | 1       | RW  | <b>WST Write Sample Time</b><br>This bit is used to select the WRN active to write data valid time.<br>0 = WRN active to write data valid sample time is range of 8 ns (minimum) to 16 ns (maximum).<br>1 = WRN active to write data valid sample time is 4 ns (maximum).  |
| 11     | —       | RW  | <b>EMS Endian Mode Selection</b><br>This bit indicates the mode of the 8/16-bit host interface, either big endian or little endian. The mode is determined at reset or power up by the strap-in function on pin 62, and should not be changed when writing to this register.<br>0 = Set to little endian mode<br>1 = Set to big endian mode  |
| 10 - 0 | 0x000   | WO  | <b>RXFP RX Frame Pointer</b><br>RX Frame data pointer index to the data register for access. This pointer value must reset to 0x000 before each DMA operation from the host CPU to read RXQ frame buffer.  |

4.2.27.13 0x188 – 0x18B: Reserved

4.2.27.14 RX Duration Timer Threshold Register (0x18C – 0x18D): RXDTTR

This register is used to program the received frame duration timer threshold.

**TABLE 4-155: RX DURATION TIMER THRESHOLD REGISTER (0X18C – 0X18D): RXDTTR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>RXDTT Receive Duration Timer Threshold</b><br>These bits are used to program the “received frame duration timer threshold” value in 1μs increments. The maximum value is 0xCFFF. When bit [7] is set to “1” in RXQCR register, the KSZ8462 will set the RX interrupt (bit [13] in ISR) after the timer starts at the first received frame in the RXQ buffer and when it exceeds the threshold set in this register. |

4.2.27.15 RX Data Byte Count Threshold Register (0x18E – 0x18F): RXDBCTR

This register is used to program the received data byte count threshold.

**TABLE 4-156: RX DATA BYTE COUNT THRESHOLD REGISTER (0X18E – 0X18F): RXDBCTR**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>RXDBCT Receive Data Byte Count Threshold</b><br>These bits are used to program the “received data byte threshold” value in byte count. When bit [6] is set to “1” in RXQCR register, the KSZ8462 will set the RX interrupt (bit [13] in ISR) when the number of received bytes in the RXQ buffer exceeds the threshold set in this register. |

4.2.28 INTERNAL I/O REGISTER SPACE MAPPING FOR INTERRUPT REGISTERS (0X190 – 0X193)

4.2.28.1 Interrupt Enable Register (0x190 – 0x191): IER

This register enables the interrupts from the QMU, PTP and other sources.

**TABLE 4-157: INTERRUPT ENABLE REGISTER (0X190 – 0X191): IER**

| Bit | Default | R/W | Description  |
|-----|---------|-----|--|
| 15  | 0       | RW  | <b>LCIE Link Change Interrupt Enable</b><br>1 = When this bit is set, the link change interrupt is enabled.<br>0 = When this bit is reset, the link change interrupt is disabled.  |
| 14  | 0       | RW  | <b>TXIE Transmit Interrupt Enable</b><br>1 = When this bit is set, the transmit interrupt is enabled.<br>0 = When this bit is reset, the transmit interrupt is disabled.   |
| 13  | 0       | RW  | <b>RXIE Receive Interrupt Enable</b><br>1 = When this bit is set, the receive interrupt is enabled.<br>0 = When this bit is reset, the receive interrupt is disabled.  |
| 12  | 0       | RO  | <b>PTP Time Stamp Interrupt Enable</b><br>This status bit is an “OR” of the PTP_TS_IE[11:0] bits. Clearing the appropriate enable bit in the PTP_TS_IE register (0x68E – 0x68F) or clearing the appropriate status bit in the PTP_TS_IS register (0x68C – 0x68D) will clear this bit. When writing this register, always write this bit as a zero. |
| 11  | 0       | RW  | <b>RXOIE Receive Overrun Interrupt Enable</b><br>1 = When this bit is set, the receive overrun interrupt is enabled.<br>0 = When this bit is reset, the receive overrun interrupt is disabled.   |

**TABLE 4-157: INTERRUPT ENABLE REGISTER (0X190 – 0X191): IER (CONTINUED)**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 10    | 0       | RO  | <b>PTP Trigger Output Unit Interrupt Enable</b><br>This status bit is an “OR” of the PTP_TRIG_IE[11:0] bits. Clearing the appropriate enable bit in the PTP_TRIG_IE register (0x68A – 0x68B) or clearing the appropriate status bit in the PTP_TRIG_IS register (0x688 – 0x689) will clear this bit. When writing this register, always write this bit as a zero. |
| 9     | 0       | RW  | <b>TXPSIE Transmit Process Stopped Interrupt Enable</b><br>1 = When this bit is set, the transmit process stopped interrupt is enabled.<br>0 = When this bit is reset, the transmit process stopped interrupt is disabled.  |
| 8     | 0       | RW  | <b>RXPSIE Receive Process Stopped Interrupt Enable</b><br>1 = When this bit is set, the receive process stopped interrupt is enabled.<br>0 = When this bit is reset, the receive process stopped interrupt is disabled.   |
| 7     | 0       | RW  | Reserved  |
| 6     | 0       | RW  | <b>TXSAIE Transmit Space Available Interrupt Enable</b><br>1 = When this bit is set, the transmit memory space available interrupt is enabled.<br>0 = When this bit is reset, the transmit memory space available interrupt is disabled.  |
| 5     | 0       | RW  | <b>RXWFDIE Receive Wake-Up Frame Detect Interrupt Enable</b><br>1 = When this bit is set, the receive Wake-Up frame detect interrupt is enabled.<br>0 = When this bit is reset, the receive Wake-Up frame detect interrupt is disabled.   |
| 4     | 0       | RW  | <b>RXMPDIE Receive Magic Packet Detect Interrupt Enable</b><br>1 = When this bit is set, the receive Magic Packet detect interrupt is enabled.<br>0 = When this bit is reset, the receive Magic Packet detect interrupt is disabled.  |
| 3     | 0       | RW  | <b>LDIE Linkup Detect Interrupt Enable</b><br>1 = When this bit is set, the wake-up from a link up detect interrupt is enabled.<br>0 = When this bit is reset, the link up detect interrupt is disabled.  |
| 2     | 0       | RW  | <b>EDIE Energy Detect Interrupt Enable</b><br>1 = When this bit is set, the wake-up from energy detect interrupt is enabled.<br>0 = When this bit is reset, the energy detect interrupt is disabled.  |
| 1 - 0 | 00      | RO  | Reserved  |

## 4.2.28.2 Interrupt Status Register (0x192 – 0x193): ISR

This register contains the status bits for all interrupt sources.

When the corresponding enable bit is set, it causes the interrupt pin to be asserted.

This register is usually read by the host CPU and device drivers during an interrupt service routine or polling. The register bits are not cleared when read. The user has to write a “1” to clear.

**TABLE 4-158: INTERRUPT STATUS REGISTER (0X192 – 0X193): ISR**

| Bit | Default | R/W      | Description   |
|-----|---------|----------|---|
| 15  | 0       | RO (W1C) | <b>LCIS Link Change Interrupt Status</b><br>When this bit is set, it indicates that the link status has changed from link up to link down, or link down to link up.<br>This edge-triggered interrupt status is cleared by writing a “1” to this bit.  |
| 14  | 0       | RO (W1C) | <b>TXIS Transmit Interrupt Status</b><br>When this bit is set, it indicates that the TXQ MAC has transmitted at least a frame on the MAC interface and the QMU TXQ is ready for new frames from the host.<br>This edge-triggered interrupt status is cleared by writing a “1” to this bit.  |
| 13  | 0       | RO (W1C) | <b>RXIS Receive Interrupt Status</b><br>When this bit is set, it indicates that the QMU RXQ has received at least a frame from the MAC interface and the frame is ready for the host CPU to process.<br>This edge-triggered interrupt status is cleared by writing a “1” to this bit.   |
| 12  | 0       | RO (W1C) | <b>PTP Time Stamp Interrupt Status</b><br>When this bit is set, it indicates that one of 12 timestamp input units is ready (TS_RDY = “1”) or the egress timestamp is available from either port 1 or port 2.<br>This edge-triggered interrupt status is cleared by writing a “1” to this bit.   |
| 11  | 0       | RO (W1C) | <b>RXOIS Receive Overrun Interrupt Status</b><br>When this bit is set, it indicates that the receive overrun status has occurred.<br>This edge-triggered interrupt status is cleared by writing a “1” to this bit.  |
| 10  | 0       | RO (W1C) | <b>PTP Trigger Unit Interrupt Status</b><br>When this bit is set, it indicates that one of 12 trigger output units is done or has an error.<br>This edge-triggered interrupt status is cleared by writing a “1” to this bit.  |
| 9   | 0       | RO (W1C) | <b>TXPSIS Transmit Process Stopped Interrupt Status</b><br>When this bit is set, it indicates that the transmit process has stopped.<br>This edge-triggered interrupt status is cleared by writing a “1” to this bit.   |
| 8   | 0       | RO (W1C) | <b>RXPSIS Receive Process Stopped Interrupt Status</b><br>When this bit is set, it indicates that the receive process has stopped.<br>This edge-triggered interrupt status is cleared by writing a “1” to this bit.   |
| 7   | 0       | RO       | Reserved  |
| 6   | 0       | RO (W1C) | <b>TXSAIS Transmit Space Available Interrupt Status</b><br>When this bit is set, it indicates that transmit memory space available status has occurred.   |
| 5   | 0       | RO       | <b>RXWFDIS Receive Wake-Up Frame Detect Interrupt Status</b><br>When this bit is set, it indicates that a Wake-Up frame has been received. Write “1000” to PMCTRL[5:2] to clear this bit.   |
| 4   | 0       | RO       | <b>RXMPDIS Receive Magic Packet Detect Interrupt Status</b><br>When this bit is set, it indicates that a Magic Packet has been received. Write “0100” to PMCTRL[5:2] to clear this bit.   |
| 3   | 0       | RO       | <b>LDIS Linkup Detect Interrupt Status</b><br>When this bit is set, it indicates that wake-up from linkup detect status has occurred. Write 0010 to PMCTRL[5:2] to clear this bit.  |
| 2   | 0       | RO       | <b>EDIS Energy Detect Interrupt Status</b><br>When this bit is set and bit [2] = “1”, bit [0] = “0” in the IER register, it indicates that wake-up from energy detect status has occurred. When this bit is set and bit [2, 0] = “1” in the IER register, it indicates that wake-up from energy detect status has occurred.<br>Write 0001 to PMCTRL[5:2] to clear this bit. |

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**TABLE 4-158: INTERRUPT STATUS REGISTER (0X192 – 0X193): ISR (CONTINUED)**

| Bit   | Default | R/W | Description |
|-------|---------|-----|-------------|
| 1 - 0 | 00      | RO  | Reserved    |

4.2.28.3 0x194 – 0x19B: Reserved

## 4.2.29 INTERNAL I/O REGISTER SPACE MAPPING FOR THE QUEUE MANAGEMENT UNIT (0X19C – 0X1B9)

### 4.2.29.1 RX Frame Count and Threshold Register (0x19C – 0x19D): RXFCTR

This register is used to program the received frame count threshold.

**TABLE 4-159: RX FRAME COUNT AND THRESHOLD REGISTER (0X19C – 0X19D): RXFCTR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 8 | 0x00    | RW  | Reserved   |
| 7 - 0  | 0x00    | RW  | <b>RXFCT Receive Frame Count Threshold</b><br>This register is used to program the received frame count threshold value.<br>When bit [5] set to “1” in the RXQCR register, the device will set interrupt bit [13] in the ISR when the number of received frames in RXQ buffer exceeds the threshold set in this register. The count has to be at least equal to or greater than “1” to enable correct functioning of the hardware. A write of “1” to this register while the receive is enabled will result in erratic hardware operation. |

### 4.2.29.2 TX Next Total Frames Size Register (0x19E – 0x19F): TXNTFSR

This register is used by the Host CPU to program the total amount of TXQ buffer space requested for the next transmit.

**TABLE 4-160: TX NEXT TOTAL FRAMES SIZE REGISTER (0X19E – 0X19F): TXNTFSR**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>TXNTFSR TX Next TXQ Buffer Frame Space Required</b><br>The Host CPU programs the contents of this register to indicate the total amount of TXQ buffer space which is required for the next “one-frame” transmission. It contains the frame size in double-word count (multiples of four bytes).<br>When bit [1] (TXQ memory available monitor) is set to “1” in the TXQCR register, the device will generate interrupt (bit [6] in the ISR register) to the CPU when TXQ memory is available based upon the total amount of TXQ space requested by the CPU in this register. |

### 4.2.29.3 MAC Address Hash Table Register 0 (0x1A0 – 0x1A1): MAHTR0

The 64-bit MAC address table is used for group address filtering and it is enabled by selecting “Hash perfect” mode. This value is defined as the six most significant bits from CRC circuit calculation result that is based on 48-bit of DA input. The two most significant bits select one of the four registers to be used, while the others determine which bit within the register.

**TABLE 4-161: MULTICAST TABLE REGISTER 0**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>HT0 Hash Table 0</b><br>When the appropriate bit is set, if the packet received with DA matches the CRC, the hashing function is received without being filtered.<br>When the appropriate bit is cleared, the packet will be dropped.<br>Note: When “Receive All” (RXCR1, bit[4]) and the “Receive Multicast Addr. Filtering with the MAC Address” (RXCR1, bit[8]) bit is set, all multi-cast addresses are received regardless of the multicast table value. |

## 4.2.29.4 MAC Address Hash Table Register 1 (0x1A2 – 0x1A3): MAHTR1

**TABLE 4-162: MULTICAST TABLE REGISTER 1**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>HT1 Hash Table 1</b><br>When the appropriate bit is set, if the packet received with DA matches the CRC, the hashing function is received without being filtered.<br>When the appropriate bit is cleared, the packet will be dropped.<br>Note: When “Receive All” (RXCR1, bit[4]) and the “Receive Multicast Addr. Filtering with the MAC Address” (RXCR1, bit[8]) bit is set, all multi-cast addresses are received regardless of the multicast table value. |

## 4.2.29.5 MAC Address Hash Table Register 2 (0x1A4 – 0x1A5): MAHTR2

**TABLE 4-163: MULTICAST TABLE REGISTER 2**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>HT2 Hash Table 2</b><br>When the appropriate bit is set, if the packet received with DA matches the CRC, the hashing function is received without being filtered.<br>When the appropriate bit is cleared, the packet will be dropped.<br>Note: When “Receive All” (RXCR1, bit[4]) and the “Receive Multicast Addr. Filtering with the MAC Address” (RXCR1, bit[8]) bit is set, all multi-cast addresses are received regardless of the multicast table value. |

## 4.2.29.6 MAC Address Hash Table Register 3 (0x1A6 – 0x1A7): MAHTR3

**TABLE 4-164: MULTICAST TABLE REGISTER 3**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>HT3 Hash Table 3</b><br>When the appropriate bit is set, if the packet received with DA matches the CRC, the hashing function is received without being filtered.<br>When the appropriate bit is cleared, the packet will be dropped.<br>Note: When “Receive All” (RXCR1, bit[4]) and the “Receive Multicast Addr. Filtering with the MAC Address” (RXCR1, bit[8]) bit is set, all multi-cast addresses are received regardless of the multicast table value. |

## 4.2.29.7 0x1A8 – 0x1AF: Reserved

## 4.2.29.8 Flow Control Low Water Mark Register (0x1B0 – 0x1B1): FCLWR

This register is used to control the flow control for low water mark in QMU RX queue.

**TABLE 4-165: FLOW CONTROL LOW WATER MARK REGISTER (0x1B0 – 0x1B1): FCLWR**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 12 | —       | RW  | Reserved  |
| 11 - 0  | 0x600   | RW  | <b>FCLWC Flow Control Low Water Mark Configuration</b><br>These bits define the QMU RX queue low water mark configuration. It is in double words count and default is 6 KB available buffer space out of 12 KB. |

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## 4.2.29.9 Flow Control High Water Mark Register (0x1B2 – 0x1B3): FCHWR

This register is used to control the flow control for high water mark in QMU RX queue.

**TABLE 4-166: FLOW CONTROL HIGH WATER MARK REGISTER (0X1B2 – 0X1B3): FCHWR**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 12 | —       | RW  | Reserved  |
| 11 - 0  | 0x400   | RW  | <b>FCHWC Flow Control High Water Mark Configuration</b><br>These bits define the QMU RX queue high water mark configuration. It is in double words count and default is 4 KB available buffer space out of 12 KB. |

## 4.2.29.10 Flow Control Overrun Water Mark Register (0x1B4 – 0x1B5): FCOWR

This register is used to control the flow control for overrun water mark in QMU RX queue.

**TABLE 4-167: FLOW CONTROL OVERRUN WATER MARK REGISTER (0X1B4 – 0X1B5): FCOWR**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 12 | —       | RW  | Reserved   |
| 11 - 0  | 0x040   | RW  | <b>FCLWC Flow Control Overrun Water Mark Configuration</b><br>These bits define the QMU RX queue overrun water mark configuration. It is in double words count and default is 256 bytes available buffer space out of 12 KB. |

## 4.2.29.11 RX Frame Count Register (0x1B8 – 0x1B9): RXFC

This register indicates the current total amount of received frame count in RXQ frame buffer.

**TABLE 4-168: RX FRAME COUNT REGISTER (0X1B8 – 0X1B9): RXFC**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 8 | 0x00    | RO  | <b>RXFC RX Frame Count</b><br>Indicates the total received frames in RXQ frame buffer when the receive interrupt (bit [13] = “1” in the ISR) occurred and a '1' is written to clear this bit [13] in the ISR. The host CPU can start to read the updated receive frame header information in RXFHSR/RXFHBCR registers after reading the RX frame count register |
| 7 - 0  | 0x00    | RW  | Reserved  |

## 4.2.29.12 0x1BA – 0x1FF: Reserved

## 4.2.30 INTERNAL I/O REGISTER SPACE MAPPING FOR TRIGGER OUTPUT UNITS (12 UNITS, 0X200 – 0X3FF)

### 4.2.30.1 Trigger Error Register (0x200 – 0x201): TRIG\_ERR

This register contains the trigger output unit error status.

**TABLE 4-169: TRIGGER ERROR REGISTER (0X200 – 0X201): TRIG\_ERR**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 12 | 0x0     | RO  | Reserved   |
| 11 - 0  | 0x000   | RO  | <b>Trigger Output Unit Error</b><br>1 = The trigger time is set earlier than the system time clock when TRIG_NOTIFY bit is set to “1” in TRIG_CFG1 register and it will generate interrupt to host if interrupt enable bit is set in PTP_TRIG_IE register. This bit can be cleared by resetting the TRIG_EN bit to “0”.<br>0 = No trigger output unit error.<br>There are 12 trigger output units and therefore there is a corresponding Error bit for each of the trigger output units, bit[11:0] = unit[12:1]. |



## 4.2.30.2 Trigger Active Register (0x202 – 0x203): TRIG\_ACTIVE

This register contains the trigger output unit active status.

**TABLE 4-170: TRIGGER ACTIVE REGISTER (0X202 – 0X203): TRIG\_ACTIVE**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 12 | 0x0     | RO  | Reserved  |
| 11 - 0  | 0x000   | RO  | <b>Trigger Output Unit Active</b><br>1 = The trigger output unit is enabled and active without error.<br>0 = The trigger output unit is finished and inactive.<br>There are 12 trigger output units and therefore there is a corresponding active bit for each of the trigger output units, bit[11:0] = unit[12:1]. |

## 4.2.30.3 Trigger Done Register (0x204 – 0x205): TRIG\_DONE

This register contains the trigger output unit event done status.

**TABLE 4-171: TRIGGER DONE REGISTER (0X204 – 0X205): TRIG\_DONE**

| Bit     | Default | R/W      | Description   |
|---------|---------|----------|---|
| 15 - 12 | 0x0     | RO       | Reserved  |
| 11 - 0  | 0x000   | RO (W1C) | <b>Trigger Output Unit Event Done</b><br>1 = The trigger output unit event has been generated when TRIG_NOTIFY bit is set to “1” in TRIG_CFG1 register (write “1” to clear this bit) and it will generate interrupt to host if interrupt enable bit is set in PTP_TRIG_IE register.<br>0 = The trigger output unit event is not generated.<br>There are 12 trigger output units and therefore there is a corresponding Done bit for each of the trigger output units, bit[11:0] = unit[12:1]. |

## 4.2.30.4 Trigger Enable Register (0x206 – 0x207): TRIG\_EN

This register contains the trigger output unit enable control bits.

**TABLE 4-172: TRIGGER ENABLE REGISTER (0X206 – 0X207): TRIG\_EN**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 12 | 0x0     | RO  | Reserved  |
| 11 - 0  | 0x000   | RW  | <b>Trigger Output Unit Enable</b><br>1 = Enables the selected trigger output unit and will self-clear when the trigger output is generated. In cascade mode, only enable the head of trigger unit.<br>0 = The trigger output unit is disabled.<br>There are 12 trigger output units and therefore there is a corresponding enable bit for each of the trigger output units, bit[11:0] = unit[12:1]. |

## 4.2.30.5 Trigger Software Reset Register (0x208 – 0x209): TRIG\_SW\_RST

This register contains the software reset bits for the trigger output units.

**TABLE 4-173: TRIGGER SOFTWARE RESET REGISTER (0X208 – 0X209): TRIG\_SW\_RST**

| Bit     | Default | R/W | Description |
|---------|---------|-----|-------------|
| 15 - 12 | 0x0     | RO  | Reserved    |

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**TABLE 4-173: TRIGGER SOFTWARE RESET REGISTER (0X208 – 0X209): TRIG\_SW\_RST  
(CONTINUED)**

| Bit    | Default | R/W   | Description   |
|--------|---------|-------|---|
| 11 - 0 | 0x000   | RW/SC | <b>Trigger Output Unit Software Reset</b><br>1 = When set, the selected trigger output unit is put into the inactive state and default setting. This can be used to stop the cascade mode in continuous operation and prepare the selected trigger unit for the next operation.<br>0 = While zero, the selected trigger output unit is in normal operating mode.<br>There are 12 trigger output units and therefore there is a corresponding software reset bit for each of the trigger output units, bit[11:0] = unit[12:1]. |

**4.2.30.6 Trigger Output Unit 12 Output PPS Pulse-Width Register (0x20A – 0x20B):  
TRIG12\_PPS\_WIDTH**

This register contains the trigger output unit 12 PPS pulse width and trigger output unit 1 path delay compensation.

**TABLE 4-174: TRIGGER OUTPUT UNIT 12 OUTPUT PPS PULSE-WIDTH REGISTER (0X20A – 0X20B): TRIG12\_PPS\_WIDTH**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 12 | 0x0     | RO  | Reserved  |
| 11      | 0       | RW  | Reserved  |
| 10 - 8  | 000     | RW  | <b>Path Delay Compensation for Trigger Output Unit 1</b><br>These three bits are used to compensate the path delay of clock skew for event trigger output unit 1 in the range of 0 ns ~ 7 ns (bit[11] = "1") or 0 ns ~ 28 ns (bit[11] = "0").         |
| 7 - 0   | 0x00    | RW  | <b>PPS Pulse Width for Trigger Output Unit 12</b><br>This is upper third byte [23:16] in conjunction with the unit 12 trigger output pulse width in TRIG12_CFG_2[15:0] (0x38A) register to make this register value for PPS pulse width up to 134 ms. |

**4.2.30.7 0x20C – 0x21F: Reserved**

**4.2.30.8 Trigger Output Unit 1 Target Time in Nanoseconds Low-Word Register (0x220 – 0x221):  
TRIG1\_TGT\_NSL**

This register contains the trigger output unit 1 target time in nanoseconds low-word.

**TABLE 4-175: TRIGGER OUTPUT UNIT 1 TARGET TIME IN NANOSECONDS LOW-WORD  
REGISTER (0X220 – 0X221): TRIG1\_TGT\_NSL**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>Trigger Output Unit 1 Target Time in Nanoseconds Low-Word [15:0]</b><br>This is low-word of target time for trigger output unit 1 in nanoseconds. |

**4.2.30.9 Trigger Output Unit 1 Target Time in Nanoseconds High-Word Register (0x222 – 0x223):  
TRIG1\_TGT\_NSH**

This register contains the trigger output unit 1 target time in nanoseconds high-word.

**TABLE 4-176: TRIGGER OUTPUT UNIT 1 TARGET TIME IN NANOSECONDS HIGH-WORD  
REGISTER (0X222 – 0X223): TRIG1\_TGT\_NSH**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 14 | 00      | RO  | Reserved  |
| 13 - 0  | 0x0000  | RW  | <b>Trigger Output Unit 1 Target Time in Nanoseconds High-Word [29:16]</b><br>This is high-word of target time for trigger output unit 1 in nanoseconds. |

## 4.2.30.10 Trigger Output Unit 1 Target Time in Seconds Low-Word Register (0x224 – 0x225): TRIG1\_TGT\_SL

This register contains the trigger output unit 1 target time in seconds low-word.

**TABLE 4-177: TRIGGER OUTPUT UNIT 1 TARGET TIME IN SECONDS LOW-WORD REGISTER (0X224 – 0X225): TRIG1\_TGT\_SL**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>Trigger Output Unit 1 Target Time in Seconds Low-Word [15:0]</b><br>This is low-word of target time for trigger output unit 1 in seconds. |

## 4.2.30.11 Trigger Output Unit 1 Target Time in Seconds High-Word Register (0x226 – 0x227): TRIG1\_TGT\_SH

This register contains the trigger output unit 1 target time in seconds high-word.

**TABLE 4-178: TRIGGER OUTPUT UNIT 1 TARGET TIME IN SECONDS HIGH-WORD REGISTER (0X226 – 0X227): TRIG1\_TGT\_SH**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Trigger Output Unit 1 Target Time in Seconds High-Word [31:16]</b><br>This is high-word of target time for trigger output unit 1 in seconds. |

## 4.2.30.12 Trigger Output Unit 1 Configuration and Control Register 1 (0x228 – 0x229): TRIG1\_CFG\_1

This register (1 of 8) contains the trigger output unit 1 configuration and control bits.

**TABLE 4-179: TRIGGER OUTPUT UNIT 1 CONFIGURATION AND CONTROL REGISTER 1 (0X228 – 0X229): TRIG1\_CFG\_1**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15      | 0       | RW  | <b>Enable This Trigger Output Unit in Cascade Mode</b><br>1 = Enable this trigger output unit in cascade mode.<br>0 = disable this trigger output unit in cascade mode.  |
| 14      | 0       | RW  | <b>Indicate a Tail Unit for This Trigger Output Unit in Cascade Mode</b><br>1 = This trigger output unit is the last unit of the chain in cascade mode.<br>0 = This trigger output unit is not the last unit of a chain in cascade mode.<br><b>Note:</b> When this bit is set “0” in all CFG_1 trigger units, and all units are in cascade mode, the iteration count is ignored and it becomes infinite. To stop the infinite loop, set the respective bit[11:0] in TRIG_SW_RST register.                                |
| 13 - 10 | 0xF     | RW  | <b>Select Upstream Trigger Unit in Cascade Mode</b><br>These bits are used to select one of the 12 upstream trigger output units in Cascade mode.<br><b>Note:</b> 0x0 indicates TOU1, and 0xB indicates TOU12. (0xC to 0xF are not used.) For example, if units 1, 2 and 3 (tail unit) are set up in cascade mode, then these 4 bits are set as follows at the three trigger output units: unit 1 is set to 0x2 (indicates TOU3), at unit 2 is set to 0x0 (indicates TOU1) and at unit 3 is to set 0x1 (indicates TOU2). |
| 9       | 0       | RW  | <b>Trigger Now</b><br>1 = Immediately create the trigger output if the trigger target time is less than the system time clock.<br>0 = Wait for the trigger target time to occur to trigger the event output.   |
| 8       | 0       | RW  | <b>Trigger Notify</b><br>1 = Enable reporting both TRIG_DONE and TRIG_ERR status as well as interrupt to host if the interrupt enable bit is set in the TRIG_IE register.<br>0 = Disable reporting both TRIG_DONE and TRIG_ERR status.   |
| 7       | 0       | RO  | Reserved   |

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**TABLE 4-179: TRIGGER OUTPUT UNIT 1 CONFIGURATION AND CONTROL REGISTER 1 (0X228 – 0X229): TRIG1\_CFG\_1 (CONTINUED)**

| Bit   | Default | R/W | Description  |
|-------|---------|-----|--|
| 6 - 4 | 000     | RW  | <p><b>Trigger Output Signal Pattern</b></p> <p>This field is used to select the trigger output signal pattern when TRIG_EN = “1” and trigger target time has reached the system time:</p> <p>000: TRIG_NEG_EDGE - Generates negative edge (from default “H” -&gt; “L” and stays “L”).</p> <p>001: TRIG_POS_EDGE - Generates positive edge (from default “L” -&gt; “H” and stays “H”).</p> <p>010: TRIG_NEG_PULSE - Generates negative pulse (from default “H” -&gt; “L” pulse -&gt; “H” and stays “H”). The pulse width is defined in TRIG1_CFG_2 register.</p> <p>011: TRIG_POS_PULSE - Generates positive pulse (from default “L” -&gt; “H” pulse -&gt; “L” and stays “L”). The pulse width is defined in TRIG1_CFG_2 register.</p> <p>100: TRIG_NEG_CYCLE - Generates negative periodic signal. The “L” pulse width is defined in TRIG1_CFG_2 register, the cycle width is defined in TRIG1_CFG_3/4 registers and the number of cycles is defined in TRIG1_CFG_5 register (it is an infinite number if this register value is zero).</p> <p>101: TRIG_POS_CYCLE - Generates positive periodic signal. The “H” pulse width is defined in TRIG1_CFG_2 register, the cycle width is defined in TRIG1_CFG_3/4 registers and the number of cycles is defined in TRIG1_CFG_5 register (it is an infinite number if this register value is zero).</p> <p>110: TRIG_REG_OUTPUT - Generates an output signal from a 16-bit register. This 16-bit register bit-pattern in TRIG1_CFG_6 is shifted LSB bit first and looped, each bit width is defined in TRIG1_CFG_3/4 registers and total number of bits to shift out is defined in TRIG1_CFG_5 register (it is an infinite number if this register value is zero).</p> <p>111: Reserved</p> <p>Note: the maximum output clock frequency is up to 12.5 MHz.</p> |
| 3 - 0 | 0x0     | RW  | <p><b>Select GPIO[6:0] for This Trigger Output Unit</b></p> <p>Associate one of the 7 GPIO pins to this trigger output unit. The trigger output signals are OR’ed together to form a combined signal if multiple trigger output units have selected the same GPIO output pin. 0x0 indicates GPIO0, and 0x6 indicates GPIO6. (0x7 to 0xF are not used.)</p>   |

## 4.2.30.13 Trigger Output Unit 1 Configuration and Control Register 2 (0x22A – 0x22B): TRIG1\_CFG\_2

This register (2 of 8) contains the trigger output unit 1 configuration and control bits.

**TABLE 4-180: TRIGGER OUTPUT UNIT 1 CONFIGURATION AND CONTROL REGISTER 2 (0X22A – 0X22B): TRIG1\_CFG\_2**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <p><b>Trigger Output Pulse Width</b></p> <p>This number defines the width of the generated pulse or periodic signal from this trigger output unit. Its unit value is equal to 8 ns. For example, the pulse width is 80 ns if this register value is 10 (0xA).</p> <p><b>Iteration Count</b></p> <p>This number defines the iteration count for register trigger output pattern (TRIG1_CFG_6) in cascade mode when this trigger output unit is the tail unit. For example, 0x0000 = 1 count and 0x000F = 16 counts. It is an infinite number if there is no tail unit in Cascade mode.</p> |

## 4.2.30.14 Trigger Output Unit 1 Configuration and Control Register 3 (0x22C – 0x22D): TRIG1\_CFG\_3

This register (3 of 8) contains the trigger output Unit 1 configuration and control bits.

**TABLE 4-181: TRIGGER OUTPUT UNIT 1 CONFIGURATION AND CONTROL REGISTER 3 (0X22C – 0X22D): TRIG1\_CFG\_3**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>Trigger Output Cycle Width or Bit Width Low-Word [15:0]</b><br>To define cycle width for generating periodic signal or to define each bit width in TRIG1_CFG_8. A unit number of value equals to 1 ns. For example, the cycle or bit width is 80 ns if this register value is 80 (0x50) and next register value = 0x0000. |

## 4.2.30.15 Trigger Output Unit 1 Configuration and Control Register 4 (0x22E – 0x22F): TRIG1\_CFG\_4

This register (4 of 8) contains the trigger output unit 1 configuration and control bits.

**TABLE 4-182: TRIGGER OUTPUT UNIT 1 CONFIGURATION AND CONTROL REGISTER 4 (0X22E – 0X22F): TRIG1\_CFG\_4**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>Trigger Output Cycle Width or Bit Width High-Word [31:16]</b><br>This number defines the cycle width when generating periodic signals using this trigger output unit. Also, it is used to define each bit width in TRIG1_CFG_8. Each unit is equal to 1 ns. |

## 4.2.30.16 Trigger Output Unit 1 Configuration and Control Register 5 (0x230 – 0x231): TRIG1\_CFG\_5

This register (5 of 8) contains the trigger output unit 1 configuration and control bits.

**TABLE 4-183: TRIGGER OUTPUT UNIT 1 CONFIGURATION AND CONTROL REGISTER 5 (0X230 – 0X231): TRIG1\_CFG\_5**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Trigger Output Cycle Count</b><br>This number defines the quantity of cycles of the periodic signal output by the trigger output unit. Use a value of zero for infinite repetition. Valid for TRIG_NEG_CYCLE and TRIG_POS_CYCLE modes.<br><b>Bit Count</b><br>This number can define the number of bits that are output when generating output signals from the bit pattern register. It is an infinite number if this register value is zero. Valid for TRIG_REG_OUTPUT mode. |

## 4.2.30.17 Trigger Output Unit 1 Configuration and Control Register 6 (0x232 – 0x233): TRIG1\_CFG\_6

This register (6 of 8) contains the trigger output unit 1 configuration and control bits.

**TABLE 4-184: TRIGGER OUTPUT UNIT 1 CONFIGURATION AND CONTROL REGISTER 6 (0X232 – 0X233): TRIG1\_CFG\_6**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Trigger Output Unit Bit Pattern</b><br>This register is used to define the output bit pattern when the TRIG_REG_OUTPUT mode is selected.<br><b>Iteration Count</b><br>This register is used as the iteration count for the trigger output unit when the tail unit is in cascade mode but not using register mode. It is the number of cycles programmed in CFG_5 to be output by the trigger output unit. For example, 0x0000 = 1 count, 0x000F = 16 counts. An infinite number of cycles will occur if there is no tail unit in Cascade mode. |

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## 4.2.30.18 Trigger Output Unit 1 Configuration and Control Register 7 (0x234 – 0x235): TRIG1\_CFG\_7

This register (7 of 8) contains the trigger output unit 1 configuration and control bits.

**TABLE 4-185: TRIGGER OUTPUT UNIT 1 CONFIGURATION AND CONTROL REGISTER 7 (0X234 – 0X235): TRIG1\_CFG\_7**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Trigger Output Iteration Cycle Time in Cascade Mode Low-Word [15:0]</b><br>The value in this pair of registers defines the iteration cycle time for the trigger output unit in cascade mode. This value will be added to the current trigger target time for establishing the next trigger time for the trigger output unit. A unit number of value equals to 1 ns. For example, the cycle is 800 ns if this register value is 800 (0x320) and next register value = 0x0000. The iteration count (CFG_6) × trigger output cycle count (CFG_5) × waveform cycle time must be less than the iteration cycle time specified in CFG_7 and CFG_8. |

## 4.2.30.19 Trigger Output Unit 1 Configuration and Control Register 8 (0x236 – 0x237): TRIG1\_CFG\_8

This register (8 of 8) contains the trigger output unit 1 configuration and control bits.

**TABLE 4-186: TRIGGER OUTPUT UNIT 1 CONFIGURATION AND CONTROL REGISTER 8 (0X236 – 0X237): TRIG1\_CFG\_8**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>Trigger Output Iteration Cycle Time in Cascade Mode High-Word [31:16]</b><br>The value in this pair of registers defines the iteration cycle time for the trigger output unit in cascade mode. This value will be added to the current trigger target time for establishing the next trigger time for the trigger output unit. A unit number of value equals 1 ns. |

## 4.2.30.20 0x238 – 0x23F: Reserved

## 4.2.30.21 Trigger Output Unit 2 Target Time and Output Configuration/Control Registers (0x240 – 0x257)

These 12 registers contain the trigger output unit 2 target time and configuration/control bits, TRIG2\_CFG\_1[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#). Note that there is one bit that is different in this set of register bits. It is indicated in the following text.

## 4.2.30.22 Trigger Output Unit 2 Configuration and Control Register 1 (0x248 – 0x249): TRIG2\_CFG\_1

This register contains the trigger output unit 2 configuration and control bits.

**TABLE 4-187: TRIGGER OUTPUT UNIT 2 CONFIGURATION AND CONTROL REGISTER 1 (0X248 – 0X249): TRIG2\_CFG\_1**

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 7   | 0       | RW  | <b>Trigger Unit 2 Clock Edge Output Select</b><br>This bit is used to select either the positive edge or negative edge of the 125 MHz to clock out the trigger unit 2 output. This bit only pertains to usage with GPIO1 pin. This bit will not function with any other GPIO pin.<br>1 = Use negative edge of 125 MHz clock to clock out data<br>0 = Use positive edge of 125 MHz clock to clock out data |

4.2.30.23 0x258 – 0x25F: Reserved

4.2.30.24 Trigger Output Unit 3 Target Time and Output Configuration/Control Registers (0x260 – 0x277)

These 12 registers contain the trigger output unit 3 target time and configuration/control bits, TRIG3\_CFG\_[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#).

4.2.30.25 0x278 – 0x27F: Reserved

4.2.30.26 Trigger Output Unit 4 Target Time and Output Configuration/Control Registers (0x280 – 0x297)

These 12 registers contain the trigger output unit 4 target time and configuration/control bits, TRIG4\_CFG\_[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#).

4.2.30.27 0x298 – 0x29F: Reserved

4.2.30.28 Trigger Output Unit 5 Target Time and Output Configuration/Control Registers (0x2A0 – 0x2B7)

These 12 registers contain the trigger output unit 5 target time and configuration/control bits, TRIG5\_CFG\_[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#).

4.2.30.29 0x2B8 – 0x2BF: Reserved

4.2.30.30 Trigger Output Unit 6 Target Time and Output Configuration/Control Registers (0x2C0 – 0x2D7)

These 12 registers contain the trigger output unit 6 target time and configuration/control bits, TRIG6\_CFG\_[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#).

4.2.30.31 0x2D8 – 0x2DF: Reserved

4.2.30.32 Trigger Output Unit 7 Target Time and Output Configuration/Control Registers (0x2E0 – 0x2F7)

These 12 registers contain the trigger output unit 7 target time and configuration/control bits, TRIG7\_CFG\_[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#).

4.2.30.33 0x2F8 – 0x2FF: Reserved

4.2.30.34 Trigger Output Unit 8 Target Time and Output Configuration/Control Registers (0x300 – 0x317)

These 12 registers contain the trigger output unit 8 target time and configuration/control bits, TRIG8\_CFG\_[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#).

4.2.30.35 0x318 – 0x31F: Reserved

4.2.30.36 Trigger Output Unit 9 Target Time and Output Configuration/Control Registers (0x320 – 0x337)

These 12 registers contain the trigger output unit 9 target time and configuration/control bits, TRIG9\_CFG\_[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#).

4.2.30.37 0x338 – 0x33F: Reserved

4.2.30.38 Trigger Output Unit 10 Target Time and Output Configuration/Control Registers (0x340 – 0x357)

These 12 registers contain the trigger output unit 10 target time and configuration/control bits, TRIG10\_CFG\_[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#).

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4.2.30.39 0x358 – 0x35F: Reserved

4.2.30.40 Trigger Output Unit 11 Target Time and Output Configuration/Control Registers (0x360 – 0x377)

These 12 registers contain the trigger output unit 11 target time and configuration/control bits, TRIG11\_CFG\_[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#).

4.2.30.41 0x378 – 0x37F: Reserved

4.2.30.42 Trigger Output Unit 12 Target Time and Output Configuration/Control Registers (0x380 – 0x397)

These 12 registers contain the trigger output unit 12 target time and configuration/control bits, TRIG12\_CFG\_[1:8]. See descriptions in [Section 4.2.30.8](#) through [Section 4.2.30.19](#).

4.2.30.43 0x398 – 0x3FF: Reserved

4.2.31 INTERNAL I/O REGISTER SPACE MAPPING FOR PTP TIME STAMP INPUTS (12 UNITS, 0X400 – 0X5FF)

4.2.31.1 Time Stamp Ready Register (0x400 – 0x401): TS\_RDY

This register contains the PTP time stamp input unit ready-to-read status bits.

**TABLE 4-188: TIME STAMP READY REGISTER (0X400 – 0X401): TS\_RDY**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 12 | 0x0     | RO  | Reserved  |
| 11 - 0  | 0x000   | RO  | <b>Time Stamp Input Unit Ready</b><br>1 = This time stamp input unit is ready to read and will generate a time stamp interrupt if PTP_TS_IE = “1”. This bit will clear when TS_EN is disabled.<br>0 = This time stamp input unit is not ready to read or disabled.<br>There are 12 time stamp units and therefore there is a corresponding time stamp input ready bit for each of the time stamp units, bit[11:0] = unit[12:1]. |

4.2.31.2 Time Stamp Enable Register (0x402 – 0x403): TS\_EN

This register contains the PTP time stamp input unit enable control bits.

**TABLE 4-189: TIME STAMP ENABLE REGISTER (0X402 – 0X403): TS\_EN**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 12 | 0x0     | RO  | Reserved  |
| 11 - 0  | 0x000   | RO  | <b>Time Stamp Input Unit Enable</b><br>1 = Enable the selected time stamp input unit. Writing a “1” to this bit will clear the TS[12:1]_EVENT_DET_CNT.<br>0 = Disable the selected time stamp input unit. Writing a “0” to this bit will clear the TS_RDY and TS[12:1]_DET_CNT_OVFL.<br>There are 12 time stamp units and therefore there is a corresponding time stamp input unit enable bit for each of the time stamp units, bit[11:0] = unit[12:1]. |

4.2.31.3 Time Stamp Software Reset Register (0x404 – 0x405): TS\_SW\_RST

This register contains the PTP time stamp input unit software reset control bits.

**TABLE 4-190: TIME STAMP SOFTWARE RESET REGISTER (0X404 – 0X405): TS\_SW\_RST**

| Bit     | Default | R/W | Description |
|---------|---------|-----|-------------|
| 15 - 12 | 0x0     | RO  | Reserved    |



**TABLE 4-190: TIME STAMP SOFTWARE RESET REGISTER (0X404 – 0X405): TS\_SW\_RST (CONTINUED)**

| Bit    | Default | R/W   | Description   |
|--------|---------|-------|---|
| 11 - 0 | 0x000   | RW/SC | <b>Time Stamp Input Unit Software Reset</b><br>1 = Reset the selected time stamp input unit to inactive state and default setting.<br>0 = The selected time stamp input unit is in normal mode of operation.<br>There are 12 time stamp units and therefore there is a corresponding time stamp input unit software reset bit for each of the time stamp units, bit[11:0] = unit[12:1]. |

4.2.31.4 0x406 – 0x41F: Reserved

4.2.31.5 Time Stamp Unit 1 Status Register (0x420 – 0x421): TS1\_STATUS

This register contains PTP time stamp input unit 1 status.

**TABLE 4-191: TIME STAMP UNIT 1 STATUS REGISTER (0X420 – 0X421): TS1\_STATUS**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 4 | 0x000   | RO  | Reserved  |
| 4 - 1  | 0x0     | RO  | <b>Number of Detected Event Count for Time stamp Input Unit 1 (TS1_EVENT_DET_CNT)</b><br>This field is used to report the number of detected events (either rising or falling edge) count. in single mode, it can detect up to 15 events in any single time stamp input unit. In cascade mode, it can detect up to two events in time stamp input units 1-11 or up to 8 events at time stamp input unit 12 as a non-tail unit, and it can detect up to 15 events for any time stamp input unit as a tail unit. Pulses or edges can be detected up to 25 MHz. The pulse width can be measured by the difference between consecutive time stamps in the same time stamp input unit. |
| 0      | 0       | RO  | <b>Number of Detected Event Count Overflow for Time stamp Input Unit 1 (TS1_DET_CNT_OVFL)</b><br>1 = The number of detected event (either rising or falling edge) count has overflowed. In cascade mode, only tail unit will set this bit when overflow is occurred. The TS1_EVENT_DET_CNT will stay at 15 when overflow is occurred.<br>0 = The number of events (either rising or falling edge) detected count has not overflowed.  |

4.2.31.6 Time Stamp Unit 1 Configuration and Control Register (0x422 – 0x423): TS1\_CFG

This register contains PTP time stamp input unit 1 configuration and control bits.

**TABLE 4-192: TIME STAMP UNIT 1 CONFIGURATION AND CONTROL REGISTER (0X422 – 0X423): TS1\_CFG**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 12 | 0x0     | RO  | Reserved   |
| 11 - 8  | 0x0     | RW  | <b>Select GPIO[6:0] for Time Stamp Unit 1</b><br>This field is used to select one of the 7 GPIO pins to serve this timestamp unit. It is GPIO0 if these bits = "0000" and it is GPIO6 if these bits = "0110" (from "0111" to "1111" are not used). |
| 7       | 0       | RW  | <b>Enable Rising Edge Detection</b><br>1 = Enable rising edge detection.<br>0 = Disable rising edge detection.   |
| 6       | 0       | RW  | <b>Enable Falling Edge Detection</b><br>1 = Enable falling edge detection.<br>0 = Disable falling edge detection.  |

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**TABLE 4-192: TIME STAMP UNIT 1 CONFIGURATION AND CONTROL REGISTER (0X422 – 0X423): TS1\_CFG (CONTINUED)**

| Bit   | Default | R/W | Description   |
|-------|---------|-----|---|
| 5     | 0       | RW  | <b>Select Tail Unit for this Time Stamp Unit in Cascade Mode</b><br>1 = This time stamp unit is the last unit of the chain in cascade mode.<br>0 = This time stamp unit is not the last unit of the chain in cascade mode.  |
| 4 - 1 | 0x0     | RW  | <b>Select Upstream Time Stamp Done Unit in Cascade Mode</b><br>This is used to select one of the 12 upstream time stamps units for done input in cascade mode. For example, if units 1 (head unit), 2 and 3 (tail unit) are set up in cascade mode, then these 4-bits at unit 1 are set to 0x0, at unit 2 are set to 0x1, at unit 3 are set to 0x2. |
| 0     | 0       | RW  | <b>Enable This Time stamp Unit in Cascade Mode</b><br>1 = Enable the selected time stamp input unit in Cascade mode.<br>0 = Disable the time stamp input unit in Cascade mode.  |

## 4.2.31.7 Time Stamp Unit 1 Input 1st Sample Time in Nanoseconds Low-Word Register (0x424 – 0x425): TS1\_SMPL1\_NSL

This register contains the first sample time in nanoseconds low-word (the resolution of 40 ns) for PTP time stamp unit 1.

**TABLE 4-193: TIME STAMP UNIT 1 INPUT 1ST SAMPLE TIME IN NANOSECONDS LOW-WORD REGISTER (0X424 – 0X425): TS1\_SMPL1\_NSL**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RO  | <b>1st Sample Time in ns Low-Word [15:0] Time stamp Unit 1</b><br>This is the low-word of first sample time for time stamp unit 1 in nanoseconds. |

## 4.2.31.8 Time Stamp Unit 1 Input 1st Sample Time in Nanoseconds High-Word Register (0x426 – 0x427): TS1\_SMPL1\_NSH

This register contains the first sample time in nanoseconds high-word and edge detection status for PTP time stamp unit 1.

**TABLE 4-194: TIME STAMP UNIT 1 INPUT 1ST SAMPLE TIME IN NANOSECONDS HIGH-WORD REGISTER (0X426 – 0X427): TS1\_SMPL1\_NSH**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 0       | RO  | Reserved   |
| 14     | 0       | RO  | <b>1st Sample Edge Indication for Time stamp Unit 1</b><br>0 = Indicates the event is a falling edge signal.<br>1 = Indicates the event is a rising edge signal. |
| 13 - 0 | 0x0000  | RO  | <b>1st Sample Time in ns High-Word [29:16] for Time stamp Unit 1</b><br>This is the high-word of first sample time for time stamp unit 1 in nanoseconds.         |

## 4.2.31.9 Time Stamp Unit 1 Input 1st Sample Time in Seconds Low-Word Register (0x428 – 0x429): TS1\_SMPL1\_SL

This register contains the first sample time in seconds low-word for PTP time stamp unit 1.

**TABLE 4-195: TIME STAMP UNIT 1 INPUT 1ST SAMPLE TIME IN SECONDS LOW-WORD REGISTER (0X428 – 0X429): TS1\_SMPL1\_SL**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RO  | <b>1st Sample Time in Seconds Low-Word [15:0] for Time stamp Unit 1</b><br>This is the low-word of first sample time for time stamp unit 1 in seconds. |

## 4.2.31.10 Time Stamp Unit 1 Input 1st Sample Time in Seconds High-Word Register (0x42A – 0x42B): TS1\_SMPL1\_SH

This register contains the first sample time in seconds high-word for PTP time stamp unit 1.

**TABLE 4-196: TIME STAMP UNIT 1 INPUT 1ST SAMPLE TIME IN SECONDS HIGH-WORD REGISTER (0X42A – 0X42B): TS1\_SMPL1\_SH**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RO  | <b>1st Sample Time in Seconds High-Word [31:16] for Time Stamp Unit 1</b><br>This is the high-word of first sample time for time stamp unit 1 in seconds. |

## 4.2.31.11 Time Stamp Unit 1 Input 1st Sample Time in Sub-Nanoseconds Register (0x42C – 0x42D): TS1\_SMPL1\_SUB\_NS

This register contains the first sample time in sub-8 nanoseconds (the resolution of 8 ns) for PTP time stamp unit 1.

**TABLE 4-197: TIME STAMP UNIT 1 INPUT 1ST SAMPLE TIME IN SUB-NANOSECONDS REGISTER (0X42C – 0X42D): TS1\_SMPL1\_SUB\_NS**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 3 | 0x0000  | RO  | Reserved   |
| 2 - 0  | 000     | RO  | <b>1st Sample Time in Sub-8 Nanoseconds for Time stamp Unit 1</b><br>These bits indicate one of the 8 ns cycles for the first sample time for time stamp unit 1.<br>000: 0 ns (sample time at the first 8 ns cycle in 25 MHz/40 ns)<br>001: 8 ns (sample time at the second 8 ns cycle in 25 MHz/40 ns)<br>010: 16 ns (sample time at the third 8 ns cycle in 25 MHz/40 ns)<br>011: 24 ns (sample time at the fourth 8 ns cycle in 25 MHz/40 ns)<br>100: 32 ns (sample time at the fifth 8 ns cycle in 25 MHz/40 ns)<br>101-111: N/A |

## 4.2.31.12 0x42E – 0x433: Reserved

## 4.2.31.13 Time Stamp Unit 1 Input 2nd Sample Time in Nanoseconds Low-Word Register (0x434 – 0x435): TS1\_SMPL2\_NSL

This register contains the second sample time in nanoseconds low-word (the resolution of 40 ns) for PTP time stamp Unit 1.

**TABLE 4-198: TIME STAMP UNIT 1 INPUT 2ND SAMPLE TIME IN NANOSECONDS LOW-WORD REGISTER (0X434 – 0X435): TS1\_SMPL2\_NSL**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RO  | <b>2nd Sample Time in Nanoseconds for Low-Word [15:0] for Time stamp Unit 1</b><br>This is the low-word of the 2nd sample time for time stamp unit 1 in nano-seconds. |

## 4.2.31.14 Time stamp Unit 1 Input 2nd Sample Time in Nanoseconds High-Word Register (0x436 – 0x437): TS1\_SMPL2\_NSH

This register contains the 2nd sample time in nanoseconds high-word and edge detection status for the PTP time stamp unit 1.

**TABLE 4-199: TIME STAMP UNIT 1 INPUT 2ND SAMPLE TIME IN NANOSECONDS HIGH-WORD REGISTER (0X436 – 0X437): TS1\_SMPL2\_NSH**

| Bit | Default | R/W | Description |
|-----|---------|-----|-------------|
| 15  | 0       | RO  | Reserved    |

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**TABLE 4-199: TIME STAMP UNIT 1 INPUT 2ND SAMPLE TIME IN NANOSECONDS HIGH-WORD REGISTER (0X436 – 0X437): TS1\_SMPL2\_NSH (CONTINUED)**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 14     | 0       | RO  | <b>2nd Sample Edge Indication for Time stamp Unit 1</b><br>0 = Indicates the event is a falling edge signal.<br>1 = Indicates the event is a rising edge signal.    |
| 13 - 0 | 0x0000  | RO  | <b>2nd Sample Time in Nanoseconds High-Word [29:16] for Time stamp Unit 1</b><br>This is the high-word of the 2nd sample time for time stamp unit 1 in nanoseconds. |

4.2.31.15 Time Stamp Unit 1 Input 2nd Sample Time in Seconds Low-Word Register (0x438 – 0x439): TS1\_SMPL2\_SL

This register contains the 2nd sample time in seconds low-word for PTP time stamp unit 1.

**TABLE 4-200: TIME STAMP UNIT 1 INPUT 2ND SAMPLE TIME IN SECONDS LOW-WORD REGISTER (0X438 – 0X439): TS1\_SMPL2\_SL**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RO  | <b>2nd Sample Time in Seconds Low-Word [15:0] for Time stamp Unit 1</b><br>This is the low-word of the second sample time for time stamp unit 1 in seconds. |

4.2.31.16 Time Stamp Unit 1 Input 2nd Sample Time in Seconds High-Word Register (0x43A – 0x43B): TS1\_SMPL2\_SH

This register contains the 2nd sample time in seconds high-word for PTP time stamp unit 1.

**TABLE 4-201: TIME STAMP UNIT 1 INPUT 2ND SAMPLE TIME IN SECONDS HIGH-WORD REGISTER (0X43A – 0X43B): TS1\_SMPL2\_SH**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RO  | <b>2nd Sample Time in Seconds High-Word [31:16] for Time stamp Unit 1</b><br>This is the high-word of the second sample time for time stamp unit 1 in seconds. |

4.2.31.17 Time Stamp Unit 1 Input 2nd Sample Time in Sub-Nanoseconds Register (0x43C – 0x43D): TS1\_SMPL2\_SUB\_NS

This register contains the 2nd sample time in sub-8 nanoseconds (the resolution of 8 ns) for PTP time stamp unit 1.

**TABLE 4-202: TIME STAMP UNIT 1 INPUT 2ND SAMPLE TIME IN SUB-NANOSECONDS REGISTER (0X43C – 0X43D): TS1\_SMPL2\_SUB\_NS**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 3 | 0x0000  | RO  | Reserved   |
| 2 - 0  | 000     | RO  | <b>2nd Sample Time in Sub-8 Nanoseconds for Time stamp Unit 1</b><br>These bits indicate one of the 8 ns cycle for the second sample time for time stamp unit 1.<br>000: 0 ns (sample time at the first 8 ns cycle in 25 MHz/40 ns)<br>001: 8 ns (sample time at the second 8 ns cycle in 25 MHz/40 ns)<br>010: 16 ns (sample time at the third 8 ns cycle in 25 MHz/40 ns)<br>011: 24 ns (sample time at the fourth 8 ns cycle in 25 MHz/40 ns)<br>100: 32 ns (sample time at the fifth 8 ns cycle in 25 MHz/40 ns)<br>101-111: N/A |

4.2.31.18 0x43E – 0x43F: Reserved

4.2.31.19 Time Stamp Unit 2 Status/Configuration/Control and Input 1st Sample Time Registers (0x440 – 0x44D)

These seven registers contain the first sample time and status/configuration/control information for PTP time stamp unit 2. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.20 0x44E – 0x453: Reserved

4.2.31.21 Time Stamp Unit 2 Input 2nd Sample Time Registers (0x454 – 0x45D)

These five registers contain the second sample time for PTP time stamp unit 2. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.22 0x45E – 0x45F: Reserved

4.2.31.23 Time Stamp Unit 3 Status/Configuration/Control and Input 1st Sample Time Registers (0x460 – 0x46D)

These seven registers contain the first sample time and status/configuration/control information for PTP time stamp unit 3. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.24 0x46E – 0x473: Reserved

4.2.31.25 Time Stamp Unit 3 Input 2nd Sample Time Registers (0x474 – 0x47D)

These five registers contain the 2nd sample time for PTP time stamp unit 3. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.26 0x47E – 0x47F: Reserved

4.2.31.27 Time Stamp Unit 4 Status/Configuration/Control and Input 1st Sample Time Registers (0x480 – 0x48D)

These seven registers contain the 1st sample time and status/configuration/control information for PTP time stamp unit 4. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.28 0x48E – 0x493: Reserved

4.2.31.29 Time Stamp Unit 4 Input 2nd Sample Time Registers (0x494 – 0x49D)

These five registers contain the 2nd sample time for PTP time stamp unit 4 input. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.30 0x49E – 0x49F: Reserved

4.2.31.31 Time Stamp Unit 5 Status/Configuration/Control and Input 1st Sample Time Registers (0x4A0 – 0x4AD)

These seven registers contain the 1st sample time and status/configuration/control information for PTP time stamp unit 5. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.32 0x4AE – 0x4B3: Reserved

4.2.31.33 Time Stamp Unit 5 Input 2nd Sample Time Registers (0x4B4 – 0x4BD)

These five registers contain the 2nd sample time for PTP time stamp unit 5. See description in time stamp unit 1 (0x434 – 0x43D).

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4.2.31.34 0x4BE – 0x4BF: Reserved

4.2.31.35 Time Stamp Unit 6 Status/Configuration/Control and Input 1st Sample Time Registers (0x4C0 – 0x4CD)

These seven registers contain the 1st sample time and status/configuration/control information for PTP time stamp unit 6. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.36 0x4CE – 0x4D3: Reserved

4.2.31.37 Time Stamp Unit 6 Input 2nd Sample Time Registers (0x4D4 – 0x4DD)

These five registers contain the 2nd sample time for PTP time stamp unit 6. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.38 0x4DE – 0x4DF: Reserved

4.2.31.39 Time Stamp Unit 7 Status/Configuration/Control and Input 1st Sample Time Registers (0x4E0 – 0x4ED)

These seven registers contain the 1st sample time and status/configuration/control information for PTP time stamp unit 7. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.40 0x4EE – 0x4F3: Reserved

4.2.31.41 Time Stamp Unit 7 Input 2nd Sample Time Registers (0x4F4 – 0x4FD)

These five registers contain the 2nd sample time for PTP time stamp unit 7. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.42 0x4FE – 0x4FF: Reserved

4.2.31.43 Time Stamp Unit 8 Status/Configuration/Control and Input 1st Sample Time Registers (0x500 – 0x50D)

These seven registers contain the 1st sample time and status/configuration/control information for PTP time stamp unit 8. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.44 0x50E – 0x513: Reserved

4.2.31.45 Time Stamp Unit 8 Input 2nd Sample Time Registers (0x514 – 0x51D)

These five registers contain the 2nd sample time for PTP time stamp unit 8. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.46 0x51E – 0x51F: Reserved

4.2.31.47 Time Stamp Unit 9 Status/Configuration/Control and Input 1st Sample Time Registers (0x520 – 0x52D)

These seven registers contain the 1st sample time and status/configuration/control information for PTP time stamp unit 9. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.48 0x52E – 0x533: Reserved

4.2.31.49 Time Stamp Unit 9 Input 2nd Sample Time Registers (0x534 – 0x53D)

These five registers contain the 2nd sample time for PTP time stamp unit 9. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.50 0x53E – 0x53F: Reserved

4.2.31.51 Time Stamp Unit 10 Status/Configuration/Control and Input 1st Sample Time Registers (0x540 – 0x54D)

These seven registers contain the 1st sample time and status/configuration/control information for PTP time stamp unit 10. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.52 0x54E – 0x553: Reserved

4.2.31.53 Time Stamp Unit 10 Input 2nd Sample Time Registers (0x554 – 0x55D)

These five registers contain the 2nd sample time for PTP time stamp unit 10. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.54 0x55E – 0x55F: Reserved

4.2.31.55 Time Stamp Unit 11 Status/Configuration/Control and Input 1st Sample Time Registers (0x560 – 0x56D)

These seven registers contain the 1st sample time and status/configuration/control information for PTP time stamp unit 11. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.56 0x56E – 0x573: Reserved

4.2.31.57 Time Stamp Unit 11 Input 2nd Sample Time Registers (0x574 – 0x57D)

These five registers contain the 2nd sample time for PTP time stamp unit 11. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.58 0x57E – 0x57F: Reserved

4.2.31.59 Time Stamp Unit 12 Status/Configuration/Control and Input 1st Sample Time Registers (0x580 – 0x58D)

**(Note:** Time stamp unit 12 has eight sample time registers available)

These seven registers contain the 1st sample time and status/configuration/control information for PTP time stamp unit 12. See description in time stamp unit 1 (0x420 – 0x42D).

4.2.31.60 0x58E – 0x593: Reserved

4.2.31.61 Time Stamp Unit 12 Input 2nd Sample Time Registers (0x594 – 0x59D)

These 5 registers contain the 2nd sample time for PTP time stamp unit 12. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.62 0x59E – 0x5A3: Reserved

4.2.31.63 Time Stamp Unit 12 Input 3rd Sample Time Registers (0x5A4 – 0x5AD)

These 5 registers contain the 3rd sample time for PTP time stamp unit 12. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.64 0x5AE – 0x5B3: Reserved

4.2.31.65 Time Stamp Unit 12 Input 4th Sample Time Registers (0x5B4 – 0x5BD)

These five registers contain the 4th sample time for PTP time stamp unit 12. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.66 0x5BE – 0x5C3: Reserved

4.2.31.67 Time Stamp Unit 12 Input 5th Sample Time Registers (0x5C4 – 0x5CD)

These five registers contain the 5th sample time for PTP time stamp unit 12. See description in time stamp unit 1 (0x434 – 0x43D).

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4.2.31.68 0x5CE – 0x5D3: Reserved

4.2.31.69 Time Stamp Unit 12 Input 6th Sample Time Registers (0x5D4 – 0x5DD)

These five registers contain the 6th sample time for PTP time stamp unit 12. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.70 0x5DE – 0x5E3: Reserved

4.2.31.71 Time Stamp Unit 12 Input 7th Sample Time Registers (0x5E4 – 0x5ED)

These five registers contain the 7th sample time for PTP time stamp unit 12. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.72 0x5EE – 0x5F3: Reserved

4.2.31.73 Time stamp Unit 12 Input 8th Sample Time Registers (0x5F4 – 0x5FD)

These five registers contain the 8th sample time for PTP time stamp unit 12. See description in time stamp unit 1 (0x434 – 0x43D).

4.2.31.74 0x5FE – 0x5FF: Reserved

4.2.32 INTERNAL I/O REGISTERS SPACE MAPPING FOR PTP 1588 CLOCK AND GLOBAL CONTROL (0x600 – 0x7FF)

4.2.32.1 PTP Clock Control Register (0x600 – 0x601): PTP\_CLK\_CTL

This register contains control of PTP 1588 clock.

**TABLE 4-203: PTP CLOCK CONTROL REGISTER (0x600 – 0x601): PTP\_CLK\_CTL**

| Bit    | Default | R/W   | Description   |
|--------|---------|-------|---|
| 15 - 7 | 0x000   | RO    | Reserved  |
| 6      | 0       | RW/SC | <b>Enable Step Adjustment Mode to PTP 1588 Clock (PTP_STEP_ADJ_CLK)</b><br>Setting this bit will cause the time value in PTP_RTC_NSH/L registers to be added (PTP_STEP_DIR, bit [5]= “1” or subtracted (PTP_STEP_DIR, bit [5] = “0”) from the system time clock. This bit is self-clearing.   |
| 5      | 0       | RW    | <b>Direction Control for Step Adjustment Mode (PTP_STEP_DIR)</b><br>1 = To add the time value in PTP_RTC_NSH/L registers to system time clock.<br>0 = To subtract the time value in PTP_RTC_NSH/L registers from system time clock.   |
| 4      | 0       | RW/SC | <b>Enable Read PTP 1588 Clock (PTP_READ_CLK)</b><br>Setting this bit will cause the device to sample the PTP 1588 clock time value. This time value will be made available for reading through the PTP_RTC_SH/L, PTP_RTC_NSH/L and PTP_RTC_PHASE registers. This bit is self-clearing.  |
| 3      | 0       | RW/SC | <b>Enable Load PTP 1588 Clock for Direct Time Setting Mode (PTP_LOAD_CLK)</b><br>Setting this bit will cause the device to load the PTP 1588 clock time value from PTP_RTC_SH/L, PTP_RTC_NSH/L and PTP_RTC_PHASE registers. The writes to PTP_RTC_SH/L, PTP_RTC_NSH/L and PTP_RTC_PHASE are performed before setting this bit. This bit is self-clearing. |



**TABLE 4-203: PTP CLOCK CONTROL REGISTER (0X600 – 0X601): PTP\_CLK\_CTL (CONTINUED)**

| Bit | Default | R/W   | Description   |
|-----|---------|-------|---|
| 2   | 0       | RW    | <b>Enable Continuous Adjustment Mode for PTP 1588 Clock (PTP_CONTINU_ADJ_CLK)</b><br>1 = Enable continuous incrementing (PTP_RATE_DIR = “0”) or decrementing (PTP_RATE_DIR = “1”) frequency adjustment by the value in PTP_SNS_RATE_H [29:16] and PTP_SNS_RATE_L [15:0] on every 25 MHz clock cycle.<br>0 = Disable continuous adjustment mode to PTP 1588 clock. |
| 1   | 1       | RW    | <b>Enable PTP 1588 Clock (EN_PTP_CLK)</b><br>1 = To enable the PTP clock.<br>0 = To disable the PTP clock and the PTP clock will be frozen. For non-PTP mode, this bit is set to “0” for stopping clock toggling.   |
| 0   | 0       | RW/SC | <b>Reset PTP 1588 Clock (RESET_PTP_CLK)</b><br>Setting this bit will reset the PTP 1588 clock.  |

4.2.32.2 0x602 – 0x603: Reserved

4.2.32.3 PTP Real Time Clock in Nanoseconds Low-Word Register (0x604 – 0x605): PTP\_RTC\_NSL

This register contains the PTP real time clock in nanoseconds low-word.

**TABLE 4-204: PTP REAL TIME CLOCK IN NANOSECONDS LOW-WORD REGISTER (0X604 – 0X605): PTP\_RTC\_NSL**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>PTP Real Time Clock in Nanoseconds Low-Word [15:0]</b><br>This is low-word of the PTP real time clock in nanoseconds. |

4.2.32.4 PTP Real Time Clock in Nanoseconds High-Word Register (0x606 – 0x607): PTP\_RTC\_NSH

This register contains the PTP real time clock in nanoseconds high-word.

**TABLE 4-205: PTP REAL TIME CLOCK IN NANOSECONDS HIGH-WORD REGISTER (0X606 – 0X607): PTP\_RTC\_NSH**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 14 | 00      | RW  | Upper two bits in counter not used.   |
| 13 - 0  | 0x0000  | RW  | <b>PTP Real Time Clock in Nanoseconds High-Word [29:16]</b><br>This is high-word of the PTP real time clock in nanoseconds. |

4.2.32.5 PTP Real Time Clock in Seconds Low-Word Register (0x608 – 0x609): PTP\_RTC\_SL

This register contains the PTP real time clock in seconds low-word.

**TABLE 4-206: PTP REAL TIME CLOCK IN SECONDS LOW-WORD REGISTER (0X608 – 0X609): PTP\_RTC\_SL**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>PTP Real Time Clock in Seconds Low-Word [15:0]</b><br>This is low-word of the PTP real time clock in seconds. |

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## 4.2.32.6 PTP Real Time Clock in Seconds High-Word Register (0x60A – 0x60B): PTP\_RTC\_SH

This register contains the PTP real time clock in seconds high-word.

**TABLE 4-207: PTP REAL TIME CLOCK IN SECONDS HIGH-WORD REGISTER (0X60A – 0X60B): PTP\_RTC\_SH**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>PTP Real Time Clock in Seconds High-Word [31:16]</b><br>This is high-word of the PTP real time clock in seconds. |

## 4.2.32.7 PTP Real Time Clock in Phase Register (0x60C – 0x60D): PTP\_RTC\_PHASE

This register indicates which sub-phase of the PTP real time clock is current. The resolution is 8 ns. The PTP real time clock is updated every 40 ns.

**TABLE 4-208: PTP REAL TIME CLOCK IN PHASE REGISTER (0X60C – 0X60D): PTP\_RTC\_PHASE**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 3 | 0x0000  | RO  | Reserved  |
| 2 - 0  | 000     | RW  | <b>PTP Real Time Clock in Sub 8ns Phase</b><br>These bits indicate one of the 8ns sub-cycle times of the 40 ns period PTP real time clock.<br>000: 0 ns (real time clock at the first 8 ns cycle in 25 MHz/40 ns)<br>001: 8 ns (real time clock at the second 8 ns cycle in 25 MHz/40 ns)<br>010: 16 ns (real time clock at the third 8 ns cycle in 25 MHz/40 ns)<br>011: 24 ns (real time clock at the fourth 8 ns cycle in 25 MHz/40 ns)<br>100: 32 ns (real time clock at the fifth 8 ns cycle in 25 MHz/40 ns)<br>101-111: N/A<br>This register is set to zero whenever the PTP_RTC_NSL, PTP_RTC_NSH, PTP_RTC_SL, PTP_RTC_SH registers are written to by the CPU. |

## 4.2.32.8 0x60E – 0x60F: Reserved

## 4.2.32.9 PTP Rate in Sub-Nanoseconds Low-Word Register (0x610 – 0x611): PTP\_SNS\_RATE\_L

This register contains the PTP rate control in sub-nanoseconds low-word.

**TABLE 4-209: PTP RATE IN SUB-NANOSECONDS LOW-WORD REGISTER (0X610 – 0X611): PTP\_SNS\_RATE\_L**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>PTP Rate Control in Sub-Nanoseconds Low-Word [15:0]</b><br>This is low-word of PTP rate control value in units of $2^{-32}$ ns. The PTP rate control value is used for incrementing (PTP_RATE_DIR = "0") or decrementing (PTP_RATE_DIR = "1") the frequency adjustment by the value in PTP_SNS_RATE_H [29:16] and PTP_SNS_RATE_L [15:0] per reference clock cycle (40 ns). On each reference clock cycle, the PTP clock will be adjusted $REF\_CLK\_PERIOD \pm PTP\_SNS\_RATE\_H/L$ value. Setting both PTP_SNS_RATE_H/L registers value to "0x0" will disable both continuous and temporary adjustment modes. |

## 4.2.32.10 PTP Rate in Sub-Nanoseconds High-Word and Control Register (0x612 – 0x613): PTP\_SNS\_RATE\_H

This register contains the PTP rate control in sub-nanoseconds high-word and configuration.

**TABLE 4-210: PTP RATE IN SUB-NANOSECONDS HIGH-WORD AND CONTROL REGISTER (0X612 – 0X613): PTP\_SNS\_RATE\_H**

| Bit    | Default | R/W   | Description  |
|--------|---------|-------|--|
| 15     | 0       | RW    | <b>Rate Direction Control for Temporary or Continuous Adjustment Mode (PTP_RATE_DIR)</b><br>1 = Lower frequency. The PTP_SNS_RATE_H/L value will be added to system time clock on every 25 MHz clock cycle.<br>0 = Higher frequency. The PTP_SNS_RATE_H/L value will be subtracted from system time clock on every 25 MHz clock cycle.   |
| 14     | 0       | RW/SC | <b>Enable Temporary Adjustment Mode for PTP 1588 Clock (PTP_TEMP_ADJ_CLK)</b><br>1 = Enable the temporary incrementing (PTP_RATE_DIR = “0”) or decrementing (PTP_RATE_DIR = “1”) frequency adjustment by the value in the PTP_SNS_RATE_H/L registers over the duration of time set in the PTP_ADJ_DURA_H/L registers on every 25 MHz clock cycle. This bit is self-cleared when the adjustment is completed. Software can read this bit to check whether the adjustment is still in progress.<br>0 = Disable the temporary adjustment mode to the PTP clock.   |
| 13 - 0 | 0x0000  | RW    | <b>PTP Rate Control in Sub-Nanoseconds High-Word [29:16] (PTP_SNS_RATE_H[29:16])</b><br>This is high-word of PTP rate control value in units of $2^{-32}$ ns. The PTP rate control value is used for incrementing (PTP_RATE_DIR = “0”) or decrementing (PTP_RATE_DIR = “1”) the frequency adjustment by the value in PTP_SNS_RATE_H [29:16] and PTP_SNS_RATE_L [15:0] per reference clock cycle (40 ns). On each reference clock cycle, the PTP clock will be adjusted by a REF_CLK_PERIOD $\pm$ PTP_SNS_RATE_H/L value. Setting both PTP_SNS_RATE_H/L registers value to “0x0” will disable both continuous and temporary adjustment modes. |

## 4.2.32.11 PTP Temporary Adjustment Mode Duration in Low-Word Register (0x614 – 0x615): PTP\_TEMP\_ADJ\_DURA\_L

This register contains the PTP temporary rate adjustment duration in low-word.

**TABLE 4-211: PTP TEMPORARY ADJUSTMENT MODE DURATION IN LOW-WORD REGISTER (0X614 – 0X615): PTP\_TEMP\_ADJ\_DURA\_L**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>PTP Temporary Rate Adjustment Duration in Low-Word [15:0]</b><br>This register is used to set the duration for the temporary rate adjustment in number of 25 MHz clock cycles. |

## 4.2.32.12 PTP Temporary Adjustment Mode Duration in High-Word Register (0x616 – 0x617): PTP\_TEMP\_ADJ\_DURA\_H

This register contains the PTP temporary rate adjustment duration in high-word.

**TABLE 4-212: PTP TEMPORARY ADJUSTMENT MODE DURATION IN HIGH-WORD REGISTER (0X616 – 0X617): PTP\_TEMP\_ADJ\_DURA\_H**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>PTP Temporary Rate Adjustment Duration in High-Word [31:16]</b><br>This register is used to set the duration for the temporary rate adjustment in number of 25 MHz clock cycles. |

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4.2.32.13 0x618 – 0x61F: Reserved

4.2.32.14 PTP Message Configuration 1 Register (0x620 – 0x621): PTP\_MSG\_CFG\_1

This register contains the PTP message configuration 1.

**TABLE 4-213: PTP MESSAGE CONFIGURATION 1 REGISTER (0X620 – 0X621): PTP\_MSG\_CFG\_1**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 8 | 0x00    | RO  | Reserved  |
| 7      | 0       | RW  | <b>Enable IEEE 802.1AS Mode</b><br>Setting this bit will enable the IEEE 802.1AS mode and all PTP packets are forwarded to port 3.                              |
| 6      | 1       | RW  | <b>Enable IEEE 1588 PTP Mode</b><br>1 = To enable the IEEE 1588 PTP mode.<br>0 = To disable the IEEE 1588 PTP mode.   |
| 5      | 0       | RW  | <b>Enable Detection of IEEE 802.3 Ethernet PTP Message</b><br>1 = Enable to detect the Ethernet PTP message.<br>0 = Disable to detect the Ethernet PTP message. |
| 4      | 1       | RW  | <b>Enable Detection of IPv4/UDP PTP Message</b><br>1 = Enable to detect the IPv4/UDP PTP message.<br>0 = Disable to detect the IPv4/UDP PTP message.            |
| 3      | 1       | RW  | <b>Enable Detection of IPv6/UDP PTP Message</b><br>1 = Enable to detect the IPv6/UDP PTP message.<br>0 = Disable to detect the IPv6/UDP PTP message.            |
| 2      | 0       | RW  | <b>Selection of P2P or E2E</b><br>1 = Select Peer-to-Peer (P2P) transparent clock mode.<br>0 = Select End-to-End (E2E) transparent clock mode.                  |
| 1      | 0       | RW  | <b>Selection of Master or Slave</b><br>1 = Select port 3 as master in ordinary clock mode.<br>0 = Select port 3 as slave in ordinary clock mode.                |
| 0      | 1       | RW  | <b>Selection of One-step or Two-Step Operation</b><br>1 = Select one-step clock mode.<br>0 = Select two-step clock mode.  |

4.2.32.15 PTP Message Configuration 2 Register (0x622 – 0x623): PTP\_MSG\_CFG\_2

This register contains the PTP message configuration 2.

**TABLE 4-214: PTP MESSAGE CONFIGURATION 2 REGISTER (0X622 – 0X623): PTP\_MSG\_CFG\_2**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 13 | 000     | RO  | Reserved   |
| 12      | 0       | RW  | <b>Enable Unicast PTP</b><br>1 = The Unicast PTP packet can be recognized. If the packet UDP destination port is either 319 or 320 and the packet MAC/IP address is not the PTP reserved address, then the packet will be considered as Unicast PTP packet and the packet forwarding will be decided by regular table lookup.<br>0 = Only multicast PTP packet will be recognized. |

**TABLE 4-214: PTP MESSAGE CONFIGURATION 2 REGISTER (0X622 – 0X623): PTP\_MSG\_CFG\_2 (CONTINUED)**

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 11  | 0       | RW  | <b>Enable Alternate Master</b><br>1 = Alternate master clock is supported. The Sync, Follow_Up, Delay_Req, and Delay_Resp messages of the same domain received at port 1/port 2 by active master clock of same domain will be forwarded to port 2/port 1.<br>0 = Alternate master clock is not supported. The Sync message will not be forwarded to the other port when this bit = "0". The Delay_Req message of same domain received at port 1/port 2 by active master clock of same domain will be discarded on port 3 and be forwarded to port 2/port 1 if Delay_Req is for other domains. |
| 10  | 1       | RW  | <b>PTP Messages Priority TX Queue</b><br>1 = All PTP messages are assigned to highest priority TX queue.<br>0 = Only the PTP event messages are assigned to highest priority TX queue.  |
| 9   | 0       | RW  | <b>Enable Checking of Associated Sync and Follow_Up PTP Messages</b><br>Setting this bit will associate Follow_Up message with Sync message under certain situations. This bit only applies to PTP frames on port 3.  |
| 8   | 0       | RW  | <b>Enable Checking of Associated Delay_Req and Delay_Resp PTP Messages</b><br>While this bit is set, the Delay_Resp message will be forwarded to port 1/port 2 if the associations do not match and is forwarded to port 3 if the associations match. Setting this bit will associate Delay_Resp message with Delay_Req message when it has the same domain, sequenceID, and sourceportID. The PTP frame will be forwarded to port 3 if the ID matches.   |
| 7   | 0       | RW  | <b>Enable Checking of Associated Pdelay_Req and Pdelay_Resp PTP Messages</b><br>Setting this bit will associate Pdelay_Resp/Pdelay_Resp_Follow_Up messages with Pdelay_Req message when it has the same domain, sequenceID, and sourceportID. The PTP frame will be forwarded to port 3 if the ID matches. This bit only applies to PTP frames on port 3.   |
| 6   | 0       | RO  | Reserved  |
| 5   | 0       | RW  | Reserved  |
| 4   | 0       | RW  | <b>Enable Checking of Domain Field: DOMAIN_EN</b><br>Setting this DOMAIN_EN bit will enable the device to automatically check the domain field in PTP message with the PTP_DOMAIN_VER[7:0]. The PTP message will be forwarded to port 3 if the domain field is matched to PTP_DOMAIN_VER[7:0] otherwise the PTP message will be dropped. If set this bit to "0", regardless of domain field, PTP messages are always forwarded to port 3 according to hardware default rules.   |
| 3   | 0       | RO  | Reserved  |
| 2   | 1       | RW  | <b>Enable the IPv4/UDP Checksum Calculation for Egress Packets</b><br>1 = The device will re-calculate and generate a 2-byte checksum value due to a frame contents change.<br>0 = The checksum field is set to zero. If the IPv4/UDP checksum is zero, the checksum will remain zero regardless of this bit setting. For IPv6/UDP, the checksum is always updated.   |
| 1   | 0       | RW  | <b>Announce Message from Port 1</b><br>1 = The Announce message is received from port 1 direction.<br>0 = The Announce message is not received from port 1 direction.   |

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**TABLE 4-214: PTP MESSAGE CONFIGURATION 2 REGISTER (0X622 – 0X623): PTP\_MSG\_CFG\_2 (CONTINUED)**

| Bit | Default | R/W | Description   |
|-----|---------|-----|---|
| 0   | 0       | RW  | <b>Announce Message from Port 2</b><br>1 = The Announce message is received from port 2 direction.<br>0 = The Announce message is not received from port 2 direction. |

## 4.2.32.16 PTP Domain and Version Register (0x624 – 0x625): PTP\_DOMAIN\_VER

This register contains the PTP Domain and Version Information.

**TABLE 4-215: PTP DOMAIN AND VERSION REGISTER (0X624 – 0X625): PTP\_DOMAIN\_VER**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 12 | 0x0     | RO  | Reserved   |
| 11 - 8  | 0x2     | RW  | <b>PTP Version</b><br>This is the value of PTP message version number field. All PTP packets will be captured when the receive PTP message version matches the value in this field.<br>All PTP packets will be dropped if the receive PTP message version does not match the value in this field. Except for the value of version 1, the device is always forwarding PTP packets between port 1 and port 2, and not to port 3. |
| 7 - 0   | 0x00    | RW  | <b>PTP Domain</b><br>This is the value of the PTP message domain number field. If the DOMAIN_EN bit is set to “1”, the PTP messages will be filtered out and only forwarded to port 3 if the domain number matches.<br>If the DOMAIN_EN bit is set to “0”, the domain number field will be ignored under certain circumstances.  |

## 4.2.32.17 0x626 – 0x63F: Reserved

## 4.2.32.18 PTP Port 1 Receive Latency Register (0x640 – 0x641): PTP\_P1\_RX\_LATENCY

This register contains the PTP port 1 receive latency value in nanoseconds.

**TABLE 4-216: PTP PORT 1 RECEIVE LATENCY REGISTER (0X640 – 0X641): PTP\_P1\_RX\_LATENCY**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x019F  | RW  | <b>PTP Port 1 RX Latency in Nanoseconds [15:0]</b><br>This register is used to set the fixed receive delay value from port 1 wire to RX time stamp reference point. The default value is 415 ns. |

## 4.2.32.19 PTP Port 1 Transmit Latency Register (0x642 – 0x643): PTP\_P1\_TX\_LATENCY

This register contains the PTP port 1 transmit latency value in nanoseconds.

**TABLE 4-217: PTP PORT 1 TRANSMIT LATENCY REGISTER (0X642 – 0X643): PTP\_P1\_TX\_LATENCY**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x002D  | RW  | <b>PTP Port 1 TX Latency in Nanoseconds [15:0]</b><br>This register is used to set the fixed transmit delay value from port 1 TX time stamp reference point to wire. The default value is 45 ns. |

## 4.2.32.20 PTP Port 1 Asymmetry Correction Register (0x644 – 0x645): PTP\_P1\_ASYM\_COR

This register contains the PTP port 1 asymmetry correction value in nanoseconds.

**TABLE 4-218: PTP PORT 1 ASYMMETRY CORRECTION REGISTER (0X644 – 0X645): PTP\_P1\_ASYM\_COR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 0       | RW  | <b>PTP Port 1 Asymmetry Correction Sign Bit</b><br>1 = The magnitude in bit[14:0] is negative.<br>0 = The magnitude in bit[14:0] is positive.  |
| 14 - 0 | 0x0000  | RW  | <b>PTP Port 1 Asymmetry Correction in Nanoseconds [14:0]</b><br>This register is used to set the fixed asymmetry value to add in the correction field for ingress Sync and Pdelay_Resp or to subtract from correction field for egress Delay_Req and Pdelay_Req. |

## 4.2.32.21 PTP Port 1 Link Delay Register (0x646 – 0x647): PTP\_P1\_LINK\_DLY

This register contains the PTP port 1 link delay in nanoseconds.

**TABLE 4-219: PTP PORT 1 LINK DELAY REGISTER (0X646 – 0X647): PTP\_P1\_LINK\_DLY**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>PTP Port 1 Link Delay in Nanoseconds [15:0]</b><br>This register is used to set the link delay value between port 1 and link partner port. |

## 4.2.32.22 PTP Port 1 Egress Time stamp Low-Word Register for Pdelay\_Req and Delay\_Req (0x648 – 0x649): P1\_XDLY\_REQ\_TSL

This register contains the PTP port 1 egress time stamp low-word value for Pdelay\_Req and Delay\_Req frames in nanoseconds.

**TABLE 4-220: PTP PORT 1 EGRESS TIME STAMP LOW-WORD REGISTER FOR PDELAY\_REQ AND DELAY\_REQ (0X648 – 0X649): P1\_XDLY\_REQ\_TSL**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>PTP Port 1 Egress Time stamp for Pdelay_Req and Delay_Req in Nanoseconds [15:0]</b><br>This register contains port 1 egress time stamp low-word value for Pdelay_Req and Delay_Req frames in nanoseconds. |

## 4.2.32.23 PTP Port 1 Egress Time stamp High-Word Register for Pdelay\_Req and Delay\_Req (0x64A – 0x64B): P1\_XDLY\_REQ\_TSH

This register contains the PTP port 1 egress time stamp high-word value for Pdelay\_Req and Delay\_Req frames in nanoseconds.

**TABLE 4-221: PTP PORT 1 EGRESS TIME STAMP HIGH-WORD REGISTER FOR PDELAY\_REQ AND DELAY\_REQ (0X64A – 0X64B): P1\_XDLY\_REQ\_TSH**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 14 | 00      | RW  | <b>PTP Port 1 Egress Time stamp for Pdelay_Req and Delay_Req in Seconds [1:0]</b><br>These bits are bits [1:0] of the port 1 egress time stamp value for Pdelay_Req and Delay_Req frames in seconds.             |
| 13 - 0  | 0x0000  | RW  | <b>PTP Port 1 Egress Time stamp for Pdelay_Req and Delay_Req in Nanoseconds [29:16]</b><br>These bits are bits [29:16] of the port 1 egress time stamp value for Pdelay_Req and Delay_Req frames in nanoseconds. |

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## 4.2.32.24 PTP Port 1 Egress Time stamp Low-Word Register for Sync (0x64C – 0x64D): P1\_SYNC\_TSL

This register contains the PTP port 1 egress time stamp low-word value for Sync frame in nanoseconds.

**TABLE 4-222: PTP PORT 1 EGRESS TIME STAMP LOW-WORD REGISTER FOR SYNC (0X64C – 0X64D): P1\_SYNC\_TSL**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>PTP Port 1 Egress Time stamp for Sync in Nanoseconds [15:0]</b><br>This register contains port 1 egress time stamp low-word value for Sync frame in nanoseconds. |

## 4.2.32.25 PTP Port 1 Egress Time stamp High-Word Register for Sync (0x64E – 0x64F): P1\_SYNC\_TSH

This register contains the PTP port 1 egress time stamp high-word value for Sync frame in nanoseconds.

**TABLE 4-223: PTP PORT 1 EGRESS TIME STAMP HIGH-WORD REGISTER FOR SYNC (0X64E – 0X64F): P1\_SYNC\_TSH**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 14 | 00      | RW  | <b>PTP Port 1 Egress Time stamp for Sync in Seconds [1:0]</b><br>These bits are bits [1:0] of the port 1 egress time stamp value for Sync frame in seconds.             |
| 13 - 0  | 0x0000  | RW  | <b>PTP Port 1 Egress Time stamp for Sync in Nanoseconds [29:16]</b><br>These bits are bits [29:16] of the Port 1 egress time stamp value for Sync frame in nanoseconds. |

## 4.2.32.26 PTP Port 1 Egress Time stamp Low-Word Register for Pdelay\_Resp (0x650 – 0x651): P1\_PDLY\_RESP\_TSL

This register contains the PTP port 1 egress time stamp low-word value for Pdelay\_Resp frame in nanoseconds.

**TABLE 4-224: PTP PORT 1 EGRESS TIME STAMP LOW-WORD REGISTER FOR PDELAY\_RESP (0X650 – 0X651): P1\_PDLY\_RESP\_TSL**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>PTP Port 1 Egress Time stamp for Pdelay_Resp in Nanoseconds [15:0]</b><br>This register contains port 1 egress time stamp low-word value for Pdelay_Resp frame in nanoseconds. |

## 4.2.32.27 PTP Port 1 Egress Time stamp High-Word Register for Pdelay\_Resp (0x652 – 0x653): P1\_PDLY\_RESP\_TSH

This register contains the PTP port 1 egress time stamp high-word value for Pdelay\_Resp frame in nanoseconds.

**TABLE 4-225: PTP PORT 1 EGRESS TIME STAMP HIGH-WORD REGISTER FOR PDELAY\_RESP (0X652 – 0X653): P1\_PDLY\_RESP\_TSH**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 14 | 00      | RW  | <b>PTP Port 1 Egress Time stamp for Pdelay_Resp in Seconds [1:0]</b><br>These bits are bits [1:0] of the port 1 egress time stamp value for Pdelay_Resp frame in seconds.                       |
| 13 - 0  | 0x0000  | RW  | <b>PTP Port 1 Egress Time stamp for Pdelay_Resp in Nanoseconds [29:16]</b><br>These bits are bits [29:16] of the port 1 egress time stamp high-word value for Pdelay_Resp frame in nanoseconds. |



4.2.32.28 0x654 – 0x65F: Reserved

4.2.32.29 PTP Port 2 Receive Latency Register (0x660 – 0x661): PTP\_P2\_RX\_LATENCY

This register contains the PTP port 2 receive latency value in nanoseconds.

**TABLE 4-226: PTP PORT 2 RECEIVE LATENCY REGISTER (0X660 – 0X661): PTP\_P2\_RX\_LATENCY**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x019F  | RW  | <b>PTP Port 2 RX Latency in Nanoseconds [15:0]</b><br>This register is used to set the fixed receive delay value from port 2 wire to the RX time stamp reference point. The default value is 415 ns. |

4.2.32.30 PTP Port 2 Transmit Latency Register (0x662 – 0x663): PTP\_P2\_TX\_LATENCY

This register contains the PTP port 2 transmit latency value in nanoseconds.

**TABLE 4-227: PTP PORT 2 TRANSMIT LATENCY REGISTER (0X662 – 0X663): PTP\_P2\_TX\_LATENCY**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x002D  | RW  | <b>PTP Port 2 TX Latency in Nanoseconds [15:0]</b><br>This register is used to set the fixed transmit delay value from port 2 TX time stamp reference point to the wire. The default value is 45 ns. |

4.2.32.31 PTP Port 2 Asymmetry Correction Register (0x664 – 0x665): PTP\_P2\_ASYM\_COR

This register contains the PTP port 2 asymmetry correction value in nanoseconds.

**TABLE 4-228: PTP PORT 2 ASYMMETRY CORRECTION REGISTER (0X664 – 0X665): PTP\_P2\_ASYM\_COR**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15     | 0       | RW  | <b>PTP Port 2 Asymmetry Correction Sign Bit</b><br>1 = The magnitude in bit[14:0] is negative.<br>0 = The magnitude in bit[14:0] is positive.  |
| 14 - 0 | 0x0000  | RW  | <b>PTP Port 2 Asymmetry Correction in Nanoseconds [14:0]</b><br>This register is used to set the fixed asymmetry value to add in the correction field for ingress Sync and Pdelay_Resp or to subtract from correction field for egress Delay_Req and Pdelay_Req. |

4.2.32.32 PTP Port 2 Link Delay Register (0x666 – 0x667): PTP\_P2\_LINK\_DLY

This register contains the PTP port 2 link delay in nanoseconds.

**TABLE 4-229: PTP PORT 2 LINK DELAY REGISTER (0X666 – 0X667): PTP\_P2\_LINK\_DLY**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>PTP Port 2 Link Delay in Nanoseconds [15:0]</b><br>This register is used to set the link delay value between port 2 and link partner port. |

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## 4.2.32.33 PTP Port 2 Egress Time stamp Low-Word Register for Pdelay\_Req and Delay\_Req (0x668 – 0x669): P2\_XDLY\_REQ\_TSL

This register contains the PTP port 2 egress time stamp low-word value for Pdelay\_Req and Delay\_Req frames in nanoseconds.

**TABLE 4-230: PTP PORT 2 EGRESS TIME STAMP LOW-WORD REGISTER FOR PDELAY\_REQ AND DELAY\_REQ (0X668 – 0X669): P2\_XDLY\_REQ\_TSL**

| Bit    | Default | R/W | Description  |
|--------|---------|-----|--|
| 15 - 0 | 0x0000  | RW  | <b>PTP Port 2 Egress Time stamp for Pdelay_Req and Delay_Req in Nanoseconds [15:0]</b><br>This register contains port 2 egress time stamp low-word value for Pdelay_Req and Delay_Req frames in nanoseconds. |

## 4.2.32.34 PTP Port 2 Egress Time stamp High-Word Register for Pdelay\_Req and Delay\_Req (0x66A – 0x66B): P2\_XDLY\_REQ\_TSH

This register contains the PTP port 2 egress time stamp high-word value for Pdelay\_Req and Delay\_Req frames in nanoseconds.

**TABLE 4-231: PTP PORT 2 EGRESS TIME STAMP HIGH-WORD REGISTER FOR PDELAY\_REQ AND DELAY\_REQ (0X66A – 0X66B): P2\_XDLY\_REQ\_TSH**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 14 | 00      | RW  | <b>PTP Port 2 Egress Time stamp for Pdelay_Req and Delay_Req in Seconds [1:0]</b><br>These are bits [1:0] of the port 2 egress time stamp value for Pdelay_Req and Delay_Req frames in seconds.             |
| 13 - 0  | 0x0000  | RW  | <b>PTP Port 2 Egress Time stamp for Pdelay_Req and Delay_Req in Nanoseconds [29:16]</b><br>These are bits [29:16] of the port 2 egress time stamp value for Pdelay_Req and Delay_Req frames in nanoseconds. |

## 4.2.32.35 PTP Port 2 Egress Time stamp Low-Word Register for Sync (0x66C – 0x66D): P2\_SYNC\_TSL

This register contains the PTP port 2 egress time stamp low-word value for Sync frame in nanoseconds.

**TABLE 4-232: PTP PORT 2 EGRESS TIME STAMP LOW-WORD REGISTER FOR SYNC (0X66C – 0X66D): P2\_SYNC\_TSL**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>PTP Port 2 Egress Time stamp for Sync in Nanoseconds [15:0]</b><br>This register contains port 2 egress time stamp low-word value for Sync frame in nanoseconds. |

## 4.2.32.36 PTP Port 2 Egress Time stamp High-Word Register for Sync (0x66E – 0x66F): P2\_SYNC\_TSH

This register contains the PTP port 2 egress time stamp high-word value for Sync frame in nanoseconds.

**TABLE 4-233: PTP PORT 2 EGRESS TIME STAMP HIGH-WORD REGISTER FOR SYNC (0X66E – 0X66F): P2\_SYNC\_TSH**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 14 | 00      | RW  | <b>PTP Port 2 Egress Time stamp for Sync in Seconds [1:0]</b><br>These are bits [1:0] of the port 2 egress time stamp value for Sync frame in seconds.          |
| 13 - 0  | 0x0000  | RW  | <b>PTP Port 2 Egress Time stamp for Sync Nanoseconds [29:16]</b><br>These are bits [29:16] of the port 2 egress time stamp value for Sync frame in nanoseconds. |

## 4.2.32.37 PTP Port 2 Egress Time stamp Low-Word Register for Pdelay\_Resp (0x670 – 0x671): P2\_PDLY\_RESP\_TSL

This register contains the PTP port 2 egress time stamp low-word value for Pdelay\_Resp frame in nanoseconds.

**TABLE 4-234: PTP PORT 2 EGRESS TIME STAMP LOW-WORD REGISTER FOR PDELAY\_RESP (0X670 – 0X671): P2\_PDLY\_RESP\_TSL**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 0 | 0x0000  | RW  | <b>PTP Port 2 Egress Time stamp for Pdelay_Resp in Nanoseconds [15:0]</b><br>This register contains port 2 egress time stamp low-word value for Pdelay_Resp frame in nanoseconds. |

## 4.2.32.38 PTP Port 2 Egress Time stamp High-Word Register for Pdelay\_Resp (0x672 – 0x673): P2\_PDLY\_RESP\_TSH

This register contains the PTP port 2 egress time stamp high-word value for Pdelay\_Resp frame in nanoseconds.

**TABLE 4-235: PTP PORT 2 EGRESS TIME STAMP HIGH-WORD REGISTER FOR PDELAY\_RESP (0X672 – 0X673): P2\_PDLY\_RESP\_TSH**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 15 - 14 | 00      | RW  | <b>PTP Port 2 Egress Time Stamp for Pdelay_Resp in Seconds [1:0]</b><br>These are bits[1:0] of the port 2 egress time stamp value for Pdelay_Resp frame in seconds.   |
| 13 - 0  | 0x0000  | RW  | <b>PTP Port 2 Egress Time Stamp for Sync Nanoseconds [29:16]</b><br>These are bits[29:16] of the port 2 egress time stamp value for Pdelay_Resp frame in nanoseconds. |

## 4.2.32.39 0x674 – 0x67F: Reserved

## 4.2.32.40 GPIO Monitor Register (0x680 – 0x681): GPIO\_MONITOR

This register contains read-only access for the current values on GPIO inputs.

**TABLE 4-236: GPIO MONITOR REGISTER (0X680 – 0X681): GPIO\_MONITOR**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 7 | 0x000   | RO  | Reserved  |
| 6 - 0  | 0x00    | RO  | <b>GPIO Inputs Monitor</b><br>This field reflects the current values seen on the GPIO inputs. GPIOs 6 through 0 are mapped to bits [11:0] in order. |

## 4.2.32.41 GPIO Output Enable Register (0x682 – 0x683): GPIO\_OEN

This register contains the control bits for GPIO output enable.

**TABLE 4-237: GPIO OUTPUT ENABLE REGISTER (0X682 – 0X683): GPIO\_OEN**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 7 | 0x000   | RO  | Reserved  |
| 6 - 0  | 0x00    | RW  | <b>GPIO Output Enable</b><br>0 = Enables the GPIO pin as trigger output.<br>1 = Enables the GPIO pin as time stamp input.<br>GPIOs 6 through 0 are mapped to bits [6:0] in order. |

## 4.2.32.42 0x684 – 0x687: Reserved

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## 4.2.32.43 PTP Trigger Unit Interrupt Status Register (0x688 – 0x689): PTP\_TRIG\_IS

This register contains the interrupt status of PTP event trigger units.

**TABLE 4-238: PTP TRIGGER UNIT INTERRUPT STATUS REGISTER (0X688 – 0X689): PTP\_TRIG\_IS**

| Bit     | Default | R/W      | Description  |
|---------|---------|----------|--|
| 15 - 12 | 0x0     | RO       | Reserved   |
| 11 - 0  | 0x000   | RO (W1C) | <b>Trigger Output Unit Interrupt Status</b><br>When this bit is set to 1, it indicates that the trigger output unit is done or has an error. The trigger output units from 12 to 1 are mapped to bit [11:0].<br>These 12 trigger output unit interrupt status bits are logical OR'ed together and connected to ISR bit [10].<br>Any of the interrupt status bits are cleared by writing a "1" to the particular bit. |

## 4.2.32.44 PTP Trigger Unit Interrupt Enable Register (0x68A – 0x68B): PTP\_TRIG\_IE

This register contains the interrupt enable of PTP trigger output units.

**TABLE 4-239: PTP TRIGGER UNIT INTERRUPT ENABLE REGISTER (0X68A – 0X68B): PTP\_TRIG\_IE**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 12 | 0x0     | RO  | Reserved   |
| 11 - 0  | 0x000   | RW  | <b>Trigger Output Unit Interrupt Enable</b><br>When this bit is set to "1", it indicates that the trigger output unit interrupt is enabled.<br>The trigger output units from 12 to 1 are mapped to bit [11:0].<br>These 12 trigger output unit interrupt enables are logical OR'ed together and connected to IER bit [10]. |

## 4.2.32.45 PTP Time stamp Unit Interrupt Status Register (0x68C – 0x68D): PTP\_TS\_IS

This register contains the interrupt status of PTP time stamp units. Each bit in this register is cleared by writing a "1" to it.

**TABLE 4-240: PTP TIME STAMP UNIT INTERRUPT STATUS REGISTER (0X68C – 0X68D): PTP\_TS\_IS**

| Bit | Default | R/W      | Description  |
|-----|---------|----------|--|
| 15  | 0       | RO (W1C) | <b>Port 2 Egress Time stamp for Pdelay_Req/Resp and Delay_Req Frames Interrupt Status</b><br>When this bit is set to "1", it indicates that the egress time stamp is available from port 2 for Pdelay_Req/Resp and Delay_Req frames.<br>This bit will be logical OR'ed together with the rest of bits in this register and the logical OR'ed output is connected to ISR bit[12]. |
| 14  | 0       | RO (W1C) | <b>Port 2 Egress Time stamp for Sync Frame Interrupt Status</b><br>When this bit is set to "1", it indicates that the egress time stamp is available from port 2 for Sync frame.<br>This bit will be logical OR'ed together with the rest of bits in this register and the logical OR'ed output is connected to ISR bit[12].   |
| 13  | 0       | RO (W1C) | <b>Port 1 Egress Time stamp for Pdelay_Req/Resp and Delay_Req Frames Interrupt Status</b><br>When this bit is set to "1", it indicates that the egress time stamp is available from port 1 for Pdelay_Req/Resp and Delay_Req frames.<br>This bit will be logical OR'ed together with the rest of bits in this register and the logical OR'ed output is connected to ISR bit[12]. |

**TABLE 4-240: PTP TIME STAMP UNIT INTERRUPT STATUS REGISTER (0X68C – 0X68D): PTP\_TS\_IS (CONTINUED)**

| Bit    | Default | R/W      | Description  |
|--------|---------|----------|--|
| 12     | 0       | RO (W1C) | <b>Port 1 Egress Time stamp for Sync Frame Interrupt Status</b><br>When this bit is set to “1”, it indicates that the egress time stamp is available from port 1 for Sync frame.<br>This bit will be logical OR’ed together with the rest of bits in this register and the logical OR’ed output is connected to ISR bit[12].   |
| 11 - 0 | 0x000   | RO (W1C) | <b>Time stamp Unit Interrupt Status</b><br>When this bit is set to “1”, it indicates that the time stamp unit is ready (TS_RDY = “1”).<br>The time stamp units from 12 to 1 are mapped to bit [11:0].<br>These 12 time stamp interrupts status are logical OR’ed together with the rest of bits in this register and the logical OR’ed output is connected to ISR bit[12]. |

## 4.2.32.46 PTP Time stamp Unit Interrupt Enable Register (0x68E – 0x68F): PTP\_TS\_IE

This register contains the interrupt enable of PTP time stamp units.

**TABLE 4-241: PTP TIME STAMP UNIT INTERRUPT ENABLE REGISTER (0X68E – 0X68F): PTP\_TS\_IE**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15     | 0       | RW  | <b>Port 2 Egress Time stamp for Pdelay_Req/Resp and Delay_Req Frames Interrupt Enable</b><br>When this bit is set to “1”, it is enabled the interrupt when the egress time stamp is available from port 2 for Pdelay_Req/Resp and Delay_Req frames.<br>This bit will be logical OR’ed together with the rest of bits in this register and the logical OR’ed output is connected to IER bit[12]. |
| 14     | 0       | RW  | <b>Port 2 Egress Time stamp for Sync Frame Interrupt Enable</b><br>When this bit is set to “1”, it is enabled the interrupt when the egress time stamp is available from port 2 for Sync frame.<br>This bit will be logical OR’ed together with the rest of bits in this register and the logical OR’ed output is connected to IER bit[12].   |
| 13     | 0       | RW  | <b>Port 1 Egress Time stamp for Pdelay_Req/Resp and Delay_Req Frames Interrupt Enable</b><br>When this bit is set to “1”, it is enabled the interrupt when the egress time stamp is available from port 1 for Pdelay_Req/Resp and Delay_Req frames.<br>This bit will be logical OR’ed together with the rest of bits in this register and the logical OR’ed output is connected to IER bit[12]. |
| 12     | 0       | RW  | <b>Port 1 Egress Time stamp for Sync Frame Interrupt Enable</b><br>When this bit is set to “1”, it is enabled the interrupt when the egress time stamp is available from port 1 for Sync frame.<br>This bit will be logical OR’ed together with the rest of bits in this register and the logical OR’ed output is connected to IER bit[12].   |
| 11 - 0 | 0x000   | RW  | <b>Time stamp Unit Interrupt Enable</b><br>When this bit is set to “1”, it indicates that the time stamp unit interrupt is enabled.<br>The time stamp units from 12 to 1 are mapped to bit[11:0].<br>These 12 time stamp interrupts enable are logical OR’ed together with the rest of bits in this register and the logical OR’ed output is connected to IER bit[12].                          |

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4.2.32.47 0x690 – 0x733: Reserved

4.2.32.48 DSP Control 1 Register (0x734 – 0x735): DSP\_CNTRL\_6

This register contains control bits for the DSP block.

**TABLE 4-242: DSP CONTROL 1 REGISTER (0X734 – 0X735): DSP\_CNTRL\_6**

| Bit     | Default | R/W | Description  |
|---------|---------|-----|--|
| 15 - 14 | 00      | RW  | Reserved   |
| 13      | 1       | RW  | <b>Receiver Adjustment</b><br>Set this bit to “1” when both ports 1 and 2 are in copper mode. When port 1 and/or port 2 is in fiber mode, this bit should be cleared to “0”.<br>Note that the fiber or copper mode is selected in the CFGR register (0x0D8 – 0x0D9). |
| 12 - 0  | 0x1020  | RW  | Reserved   |

4.2.32.49 0x736 – 0x747: Reserved

4.2.32.50 Analog Control 1 Register (0x748 – 0x749): ANA\_CNTRL\_1

This register contains control bits for the analog block.

**TABLE 4-243: ANALOG CONTROL 1 REGISTER (0X748 – 0X749): ANA\_CNTRL\_1**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15 - 8 | 0x00    | RW  | Reserved  |
| 7      | 0       | RW  | <b>LDO Off</b><br>This bit is used to control the on/off state of the internal low-voltage regulator.<br>0 = LDO On (Default)<br>1 = Turn LDO Off |
| 6 - 0  | 0x00    | RW  | Reserved  |

4.2.32.51 0x74A – 0x74B: Reserved

4.2.32.52 Analog Control 3 Register (0x74C – 0x74D): ANA\_CNTRL\_3

This register contains control bits for the analog block.

**TABLE 4-244: ANALOG CONTROL 3 REGISTER (0X74C – 0X74D): ANA\_CNTRL\_3**

| Bit    | Default | R/W | Description   |
|--------|---------|-----|---|
| 15     | 0       | RW  | <b>HIPLS3 Mask</b><br>This bit must be set prior to initiating the LinkMD function. |
| 14 - 4 | 0x000   | RW  | Reserved  |
| 3      | 0       | RW  | <b>BTRX Reduce</b><br>This bit must be set prior to initiating the LinkMD function. |
| 2 - 0  | 000     | RW  | Reserved  |

4.2.32.53 0x74E – 0x7FF: Reserved

## 4.3 Management Information Base (MIB) Counters

The KSZ8462 provides 34 MIB counters for each port. These counters are used to monitor the port activity for network management. The MIB counters are formatted “per port” and “all ports dropped packet” as shown in [Table 4-245](#).

**TABLE 4-245: FORMAT OF PER-PORT MIB COUNTERS**

| Bit    | Name           | R/W | Description  | Default    |
|--------|----------------|-----|--|------------|
| 31     | Overflow       | RO  | 1 = Counter overflow.<br>0 = No counter overflow.              | 0          |
| 30     | Count Valid    | RO  | 1 = Counter value is valid.<br>0 = Counter value is not valid. | 0          |
| 29 - 0 | Counter Values | RO  | Counter value (read clear)                                     | 0x00000000 |

“Per Port” MIB counters are read using indirect memory access. The base address offsets and address ranges for all three ports are:

Port 1, base address is 0x00 and range is from 0x00 to 0x1F.

Port 2, base address is 0x20 and range is from 0x20 to 0x3F.

Port 3, base address is 0x40 and range is from 0x40 to 0x5F.

Per-port MIB counters are read using indirect access control in the IACR register and the indirect access data registers in IADR4[15:0], IADR5[31:16] (0x02C – 0x02F). The port 1 MIB counters address memory offset as in [Table 4-246](#).

**TABLE 4-246: PORT 1 MIB COUNTERS – INDIRECT MEMORY OFFSET**

| Offset | Counter Name      | Description  |
|--------|-------------------|--|
| 0x0    | RxLoPriorityByte  | Rx lo-priority (default) octet count including bad packets.  |
| 0x1    | RxHiPriorityByte  | Rx hi-priority octet count including bad packets.  |
| 0x2    | RxUndersizePkt    | Rx undersize packets with good CRC.  |
| 0x3    | RxFragments       | Rx fragment packets with bad CRC, symbol errors or alignment errors.   |
| 0x4    | RxOversize        | Rx oversize packets with good CRC (maximum: 2000 bytes).   |
| 0x5    | RxJabbers         | Rx packets longer than 1522 bytes with either CRC errors, alignment errors, or symbol errors (depends on max packet size setting).                                   |
| 0x6    | RxSymbolError     | Rx packets w/ invalid data symbol and legal packet size.   |
| 0x7    | RxCRCError        | Rx packets within (64,1522) bytes w/ an integral number of bytes and a bad CRC (upper limit depends on maximum packet size setting).                                 |
| 0x8    | RxAlignmentError  | Rx packets within (64,1522) bytes w/ a non-integral number of bytes and a bad CRC (upper limit depends on maximum packet size setting).                              |
| 0x9    | RxControl8808Pkts | Number of MAC control frames received by a port with 88-08h in Ether-Type field.   |
| 0xA    | RxPausePkts       | Number of PAUSE frames received by a port. PAUSE frame is qualified with EtherType (88-08h), DA, control opcode (00-01), data length (64B minimum), and a valid CRC. |
| 0xB    | RxBroadcast       | Rx good broadcast packets (not including error broadcast packets or valid multicast packets).  |
| 0xC    | RxMulticast       | Rx good multicast packets (not including MAC control frames, error multicast packets or valid broadcast packets).  |
| 0xD    | RxUnicast         | Rx good unicast packets.   |
| 0xE    | Rx64Octets        | Total Rx packets (bad packets included) that were 64 octets in length.   |
| 0xF    | Rx65to127Octets   | Total Rx packets (bad packets included) that are between 65 and 127 octets in length.  |
| 0x10   | Rx128to255Octets  | Total Rx packets (bad packets included) that are between 128 and 255 octets in length.   |
| 0x11   | Rx256to511Octets  | Total Rx packets (bad packets included) that are between 256 and 511 octets in length.   |

**TABLE 4-246: PORT 1 MIB COUNTERS – INDIRECT MEMORY OFFSET (CONTINUED)**

| Offset | Counter Name         | Description   |
|--------|----------------------|---|
| 0x12   | Rx512to1023Octets    | Total Rx packets (bad packets included) that are between 512 and 1023 octets in length.   |
| 0x13   | Rx1024to2000Octets   | Total Rx packets (bad packets included) that are between 1024 and 2000 octets in length (upper limit depends on max packet size setting). |
| 0x14   | TxLoPriorityByte     | Tx lo-priority good octet count, including PAUSE packets.   |
| 0x15   | TxHiPriorityByte     | Tx hi-priority good octet count, including PAUSE packets.   |
| 0x16   | TxLateCollision      | The number of times a collision is detected later than 512 bit-times into the Tx of a packet.   |
| 0x17   | TxPausePkts          | Number of PAUSE frames transmitted by a port.   |
| 0x18   | TxBroadcastPkts      | Tx good broadcast packets (not including error broadcast or valid multi-cast packets).  |
| 0x19   | TxMulticastPkts      | Tx good multicast packets (not including error multicast packets or valid broadcast packets).   |
| 0x1A   | TxUnicastPkts        | Tx good unicast packets.  |
| 0x1B   | TxDeferred           | Tx packets by a port for which the 1st Tx attempt is delayed due to the busy medium.  |
| 0x1C   | TxTotalCollision     | Tx total collision, half duplex only.   |
| 0x1D   | TxExcessiveCollision | A count of frames for which Tx fails due to excessive collisions.   |
| 0x1E   | TxSingleCollision    | Successfully Tx frames on a port for which Tx is inhibited by exactly one collision.  |
| 0x1F   | TxMultipleCollision  | Successfully Tx frames on a port for which Tx is inhibited by more than one collision.  |

**TABLE 4-247: "ALL PORTS DROPPED PACKET" MIB COUNTER FORMAT**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---------------|
| 30 - 16 | —       | N/A | Reserved      |
| 15 - 0  | 0x0000  | RO  | Counter Value |

**Note:** "All Ports Dropped Packet" MIB Counters do not indicate overflow or validity; therefore, the application must keep track of overflow and valid conditions.

"All Ports Dropped Packet" MIB counters are read using indirect memory access. The address offsets for these counters are in [Table 4-248](#).

**TABLE 4-248: "ALL PORTS DROPPED PACKET" MIB COUNTERS – INDIRECT MEMORY OFFSETS**

| Offset | Counter Name           | Description                                 |
|--------|------------------------|---|
| 0x100  | Port 1 TX Drop Packets | TX packets dropped due to lack of resources |
| 0x101  | Port 2 TX Drop Packets | TX packets dropped due to lack of resources |
| 0x102  | Port 3 TX Drop Packets | TX packets dropped due to lack of resources |
| 0x103  | Port 1 RX Drop Packets | RX packets dropped due to lack of resources |
| 0x104  | Port 2 RX Drop Packets | RX packets dropped due to lack of resources |
| 0x105  | Port 3 RX Drop Packets | RX packets dropped due to lack of resources |

## Examples:

1. MIB Counter Read (read port 1 "Rx64Octets" counter at indirect address offset 0x0E)

Write to Reg. IACR with 0x1C0E (set indirect address and trigger a read MIB counters operation)

Then:



Read Reg. IADR5 (MIB counter value [31:16]) // If bit [31] = "1", there was a counter overflow // If bit [30] = "0", restart (re-read) from this register

Read Reg. IADR4 (MIB counter value [15:0])

2. MIB Counter Read (read port 2 "Rx64Octets" counter at indirect address offset 0x2E)

Write to reg. IACR with 0x1C2E (set indirect address and trigger a read MIB counters operation)

Then:

Read Reg. IADR5 (MIB counter value [31:16]) // If bit [31] = "1", there was a counter overflow // If bit [30] = "0", restart (re-read) from this register

Read Reg. IADR4 (MIB counter value [15:0])

3. MIB Counter Read (read "port 1 TX Drop Packets" counter at indirect address offset 0x100)

Write to Reg. IACR with 0x1D00 (set indirect address and trigger a read MIB counters operation)

Then:

Read Reg. IADR4 (MIB counter value [15:0])

## 4.3.1 ADDITIONAL MIB INFORMATION

"Per Port" MIB counters are designed as "read clear". That is, these counters will be cleared after they are read.

"All Ports Dropped Packet" MIB counters are not cleared after they are accessed. The application needs to keep track of overflow and valid conditions on these counters.

## 4.4 Static MAC Address Table

The KSZ8462 supports both a static and a dynamic MAC address table. In response to a destination address (DA) look up, The KSZ8462 searches both tables to make a packet forwarding decision. In response to a source address (SA) look up, only the dynamic table is searched for aging, migration and learning purposes.

The static DA look up result takes precedence over the dynamic DA look up result. If there is a DA match in both tables, the result from the static table is used. These entries in the static table will not be aged out by the KSZ8462.

**TABLE 4-249: STATIC MAC TABLE FORMAT (8 ENTRIES)**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 57 - 54 | 0000    | RW  | <b>FID</b><br>Filter VLAN ID - identifies one of the 16 active VLANs.   |
| 53      | 0       | RW  | <b>Use FID</b><br>1 = Specifies the use of FID+MAC for static table look up.<br>0 = Specifies only the use of MAC for static table look up.   |
| 52      | 0       | RW  | <b>Override</b><br>1 = Overrides the port setting transmit enable = "0" or receive enable = "0" setting.<br>0 = Specifies no override.<br>Note: The override bit also allows usage (turns on the entry) even if the Valid bit = "0".  |
| 51      | 0       | RW  | <b>Valid</b><br>1 = Specifies that this entry is valid, and the look up result will be used.<br>0 = Specifies that this entry is not valid.   |
| 50 - 48 | 000     | RW  | <b>Forwarding Ports</b><br>These 3 bits control the forwarding port(s):<br>000 = No forward.<br>001 = Forward to port 1.<br>010 = Forward to port 2.<br>100 = Forward to port 3.<br>011 = Forward to port 1 and port 2.<br>110 = Forward to port 2 and port 3.<br>101 = Forward to port 1 and port 3.<br>111 = Broadcasting (excluding the ingress port). |

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**TABLE 4-249: STATIC MAC TABLE FORMAT (8 ENTRIES) (CONTINUED)**

| Bit    | Default | R/W | Description                              |
|--------|---------|-----|--|
| 47 - 0 | 0       | RW  | <b>MAC Address</b><br>48-bit MAC Address |

Static MAC Table Lookup Examples:

- Static Address Table Read (read the second entry at indirect address offset 0x01)
  - Write to Reg. IACR with 0x1001 (set indirect address and trigger a read static MAC table operation)
  - Then:
    - Read Reg. IADR3 (static MAC table bits [57:48])
    - Read Reg. IADR2 (static MAC table bits [47:32])
    - Read Reg. IADR5 (static MAC table bits [31:16])
    - Read Reg. IADR4 (static MAC table bits [15:0])
- Static Address Table Write (write the eighth entry at indirect address offset 0x07)
  - Write to Reg. IADR3 (static MAC table bits [57:48])
  - Write to Reg. IADR2 (static MAC table bits [47:32])
  - Write to Reg. IADR5 (static MAC table bits [31:16])
  - Write to Reg. IADR4 (static MAC table bits [15:0])
  - Write to Reg. IACR with 0x0007 (set indirect address and trigger a write static MAC table operation)

## 4.5 Dynamic MAC Address Table

The Dynamic MAC Address is a read-only table.

**TABLE 4-250: DYNAMIC MAC ADDRESS TABLE FORMAT (1024 ENTRIES)**

| Bit     | Default          | R/W | Description   |
|---------|------------------|-----|---|
| 71      | —                | RO  | <b>Data Not Ready</b><br>1 = Specifies that the entry is not ready, continue retrying until bit is set to "0".<br>0 = Specifies that the entry is ready.  |
| 70 - 67 | —                | RO  | Reserved  |
| 66      | 1                | RO  | <b>MAC Empty</b><br>1 = Specifies that there is no valid entry in the table<br>0 = Specifies that there are valid entries in the table  |
| 65 - 56 | 0x000            | RO  | <b>Number of Valid Entries</b><br>Indicates how many valid entries in the table.<br>0x3FF means 1K entries.<br>0x001 means 2 entries.<br>0x000 and bit [66] = "0" means 1 entry.<br>0x000 and bit [66] = "1" means 0 entry. |
| 55 - 54 | —                | RO  | <b>Time stamp</b><br>Specifies the 2-bit counter for internal aging.  |
| 53 - 52 | 00               | RO  | <b>Source Port</b><br>Identifies the source port where FID+MAC is learned:<br>00 = Port 1<br>01 = Port 2<br>10 = Port 3 (host port)   |
| 51 - 48 | 0x0              | RO  | <b>FID</b><br>Specifies the filter ID.  |
| 47 - 0  | 0x0000_0000_0000 | RO  | <b>MAC Address</b><br>Specifies the 48-bit MAC Address.   |

## Dynamic MAC Address Lookup Example

- Dynamic MAC Address Table Read (read the first entry at indirect address offset 0 and retrieve the MAC table size)
  - Write to Reg. IACR with 0x1800 (set indirect address and trigger a read dynamic MAC Address table operation)
  - Then:
    - Read Reg. IADR1 (dynamic MAC table bits [71:64]) // If bit [71] = "1", restart (reread) from this register
    - Read Reg. IADR3 (dynamic MAC table bits [63:48])
    - Read Reg. IADR2 (dynamic MAC table bits [47:32])
    - Read Reg. IADR5 (dynamic MAC table bits [31:16])
    - Read Reg. IADR4 (dynamic MAC table bits [15:0])

## 4.6 VLAN Table

The KSZ8462 uses the VLAN table to perform look-ups. If 802.1Q VLAN mode is enabled (SGCR2[15]), this table will be used to retrieve the VLAN information that is associated with the ingress packet. This information includes FID (Filter ID), VID (VLAN ID), and VLAN membership as described in [Table 4-251](#).

**TABLE 4-251: VLAN TABLE FORMAT (16 ENTRIES)**

| Bit     | Default | R/W | Description   |
|---------|---------|-----|---|
| 19      | 1       | RW  | <b>Valid</b><br>1 = Specifies that this entry is valid, the look up result will be used.<br>0 = Specifies that this entry is not valid.   |
| 18 - 16 | 111     | RW  | <b>Membership</b><br>Specifies which ports are members of the VLAN. If a DA look up fails (no match in both static and dynamic tables), the packet associated with this VLAN will be forwarded to ports specified in this field. For example: "101" means port 3 and port 1 are in this VLAN. |
| 15 - 12 | 0x0     | RW  | <b>FID</b><br>Specifies the Filter ID. The KSZ8462 supports 16 active VLANs represented by these four bit fields. The FID is the mapped ID. If 802.1Q VLAN is enabled, the look up will be based on FID+DA and FID+SA.  |
| 11 - 0  | 0x001   | RW  | <b>VID</b><br>Specifies the IEEE 802.1Q 12 bits VLAN ID.  |

If 802.1Q VLAN mode is enabled, then KSZ8462 will assign a VID to every ingress packet. If the packet is untagged or tagged with a null VID, then the packet is assigned with the default port VID of the ingress port. If the packet is tagged with non-null VID, then VID in the tag will be used. The look up process will start from the VLAN table look up. If the VID is not found in any of the VLAN table entries, or if the VID is found but is not valid, then packet will be dropped and no address learning will take place. If the VID is valid, then FID is retrieved. The FID+DA and FID+SA lookups are performed. The FID+DA look up determines the forwarding ports. If FID+DA fails, then the packet will be broadcast to all the members (excluding the ingress port) of the VLAN. If FID+SA fails, then the FID+SA will be learned.

### VLAN Table Lookup Examples

1. VLAN Table Read (read the third entry, at the indirect address offset 0x02)

Write to Reg. IACR with 0x1402 (set indirect address and trigger a read VLAN table operation)

Then:

Read Reg. IADR5 (VLAN table bits [19:16])

Read Reg. IADR4 (VLAN table bits [15:0])

2. VLAN Table Write (write the seventh entry, at the indirect address offset 0x06)

Write to Reg. IADR5 (VLAN table bits [19:16])

Write to Reg. IADR4 (VLAN table bits [15:0])

Write to Reg. IACR with 0x1406 (set indirect address and trigger a read VLAN table operation)

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## 5.0 OPERATIONAL CHARACTERISTICS

### 5.1 Absolute Maximum Ratings\*

|  |                 |
|--|-----------------|
| Supply Voltage ( $V_{DD\_A3.3}$ , $V_{DD\_IO}$ ) | –0.5V to +5.0V  |
| Supply Voltage ( $V_{DD\_AL}$ , $V_{DD\_L}$ )    | –0.5V to +1.8V  |
| Input Voltage (All Inputs)                       | –0.5V to +5.0V  |
| Output Voltage (All Outputs)                     | –0.5V to +5.0V  |
| Lead Temperature (soldering, 10s)                | +260°C          |
| Storage Temperature ( $T_S$ )                    | –65°C to +150°C |
| Maximum Junction Temperature ( $T_J$ )           | +125°C          |
| HBM ESD Rating                                   | 2 kV            |

\*Exceeding the absolute maximum rating may damage the device. Stresses greater than the absolute maximum rating may cause permanent damage to the device. Operation of the device at these or any other conditions above those specified in the operating sections of this specification is not implied. Maximum conditions for extended periods may affect reliability.

### 5.2 Operating Ratings\*\*

|  |                    |
|--|--------------------|
| Supply Voltage                             |                    |
| $V_{DDA\_3.3}$                             | +3.135V to +3.465V |
| $V_{DD\_L}$ , $V_{DD\_AL}$ , $V_{DD\_COL}$ | +1.25V to +1.4V    |
| $V_{DD\_IO}$ (3.3V)                        | +3.135V to +3.465V |
| $V_{DD\_IO}$ (2.5V)                        | +2.375 to +2.625V  |
| $V_{DD\_IO}$ (1.8V)                        | +1.71V to +1.89V   |
| Ambient Operating Temperature ( $T_A$ )    |                    |
| Industrial                                 | –40°C to +85°C     |
| Thermal Resistance (Note 5-1)              |                    |
| Junction-to-Ambient ( $\Theta_{JA}$ )      | +49°C/W            |
| Junction-to-Case ( $\Theta_{JC}$ )         | +19°C/W            |

\*\*The device is not guaranteed to function outside its operating ratings. Unused inputs must always be tied to an appropriate logic voltage level (GROUND to  $V_{DD\_IO}$ ).

|   |
|---|
| <b>Note:</b> Do not drive input signals without power supplied to the device. |
|---|

**Note 5-1** No heat spreader (HS) in this package. The  $\Theta_{JC}/\Theta_{JA}$  is under air velocity 0m/s.

## 6.0 ELECTRICAL CHARACTERISTICS

TABLE 6-1: ELECTRICAL CHARACTERISTICS (Note 6-1)

| Parameters  | Symbol                      | Min. | Typ. | Max. | Units | Note   |
|---|-----------------------------|------|------|------|-------|--|
| Supply Current for 100BASE-TX Operation<br>(Internal Low-Voltage Regulator On, $V_{DD\_A3.3} = 3.3V$ , $V_{DD\_IO} = 3.3V$ ) (Note 6-1)   |                             |      |      |      |       |  |
| —   | $I_{VDD\_A3.3}$             | —    | 42   | —    | mA    | 100% traffic on both ports   |
|   | $I_{VDD\_IO}$               | —    | 87   | —    | mA    |  |
|   | $PDISS_{DEVICE}$            | —    | 428  | —    | mW    |  |
| —   | $I_{VDD\_A3.3}$             | —    | 41   | —    | mA    | Link, no Traffic on Both Ports, EEE Feature is off                           |
|   | $I_{VDD\_IO}$               | —    | 86   | —    | mA    |  |
|   | $PDISS_{DEVICE}$            | —    | 421  | —    | mW    |  |
| —   | $I_{VDD\_A3.3}$             | —    | 4.6  | —    | mA    | Ports 1 and 2 Powered Down<br>(P1CR4, P2CR4 bit[11] = “1”)                   |
|   | $I_{VDD\_IO}$               | —    | 70   | —    | mA    |  |
|   | $PDISS_{DEVICE}$            | —    | 246  | —    | mW    |  |
| —   | $I_{VDD\_A3.3}$             | —    | 5.4  | —    | mA    | Ports 1 and 2 Not Connected, using EDPD Feature<br>(PMCTRL bits[1:0] = “01”) |
|   | $I_{VDD\_IO}$               | —    | 70   | —    | mA    |  |
|   | $PDISS_{DEVICE}$            | —    | 249  | —    | mW    |  |
| —   | $I_{VDD\_A3.3}$             | —    | 5.3  | —    | mA    | Ports 1 and 2 Connected, No Traffic, using EEE Feature                       |
|   | $I_{VDD\_IO}$               | —    | 71   | —    | mA    |  |
|   | $PDISS_{DEVICE}$            | —    | 251  | —    | mW    |  |
| —   | $I_{VDD\_A3.3}$             | —    | 0.98 | —    | mA    | Soft Power-Down Mode<br>(PMCTRL bits[1:0] = “10”)                            |
|   | $I_{VDD\_IO}$               | —    | 2.0  | —    | mA    |  |
|   | $PDISS_{DEVICE}$            | —    | 10   | —    | mW    |  |
| —   | $I_{VDD\_A3.3}$             | —    | 0.18 | —    | mA    | Hardware Power-Down Mode<br>While the PWDRN pin (pin 17) is Held Low.        |
|   | $I_{VDD\_IO}$               | —    | 0    | —    | mA    |  |
|   | $PDISS_{DEVICE}$            | —    | 0.6  | —    | mW    |  |
| Supply Current for 100BASE-TX Operation<br>(Internal Low-Voltage Regulator Off, $V_{DD\_A3.3}$ and $V_{DD\_IO} = 3.3V$ ; $V_{DD\_L}$ , $V_{DD\_AL}$ , and $V_{DD\_COL} = 1.4V$ ) (Note 6-1) |                             |      |      |      |       |  |
| —   | $I_{VDD\_A3.3}$             | —    | 40   | —    | mA    | 100% Traffic on Both Ports   |
|   | $I_{VDD\_IO}$               | —    | 0.6  | —    | mA    |  |
|   | $I_{VDD\_AL} + I_{VDD\_DL}$ | —    | 88   | —    | mA    |  |
|   | $PDISS_{DEVICE}$            | —    | 258  | —    | mW    |  |
| —   | $I_{VDD\_A3.3}$             | —    | 40   | —    | mA    | Link, no Traffic on both ports, EEE Feature is off.                          |
|   | $I_{VDD\_IO}$               | —    | 0.7  | —    | mA    |  |
|   | $I_{VDD\_AL} + I_{VDD\_DL}$ | —    | 87   | —    | mA    |  |
|   | $PDISS_{DEVICE}$            | —    | 256  | —    | mW    |  |
| —   | $I_{VDD\_A3.3}$             | —    | 3.8  | —    | mA    | Ports 1 and 2 Powered Down<br>(P1CR4, P2CR4 bit[11] = “1”)                   |
|   | $I_{VDD\_IO}$               | —    | 0.5  | —    | mA    |  |
|   | $I_{VDD\_AL} + I_{VDD\_DL}$ | —    | 71   | —    | mA    |  |
|   | $PDISS_{DEVICE}$            | —    | 114  | —    | mW    |  |

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**TABLE 6-1: ELECTRICAL CHARACTERISTICS (Note 6-1) (CONTINUED)**

| Parameters  | Symbol                                    | Min. | Typ. | Max. | Units | Note  |
|---|---|------|------|------|-------|---|
| —   | I <sub>VDD_A3.3</sub>                     | —    | 4.5  | —    | mA    | Ports 1 and 2 Not Connected, using EDPD Feature (PMCTRL bits[1:0] = “01”)                 |
|   | I <sub>VDD_IO</sub>                       | —    | 0.6  | —    | mA    |   |
|   | I <sub>VDD_AL</sub> + I <sub>VDD_DL</sub> | —    | 72   | —    | mA    |   |
|   | PDISS <sub>DEVICE</sub>                   | —    | 117  | —    | mW    |   |
| —   | I <sub>VDD_A3.3</sub>                     | —    | 5.2  | —    | mA    | Ports 1 and 2 Connected, No Traffic, using EEE Feature                                    |
|   | I <sub>VDD_IO</sub>                       | —    | 0.7  | —    | mA    |   |
|   | I <sub>VDD_AL</sub> + I <sub>VDD_DL</sub> | —    | 74   | —    | mA    |   |
|   | PDISS <sub>DEVICE</sub>                   | —    | 123  | —    | mW    |   |
| —   | I <sub>VDD_A3.3</sub>                     | —    | 0.2  | —    | mA    | Soft Power-Down Mode (PMCTRL bits[1:0] = “10”)  |
|   | I <sub>VDD_IO</sub>                       | —    | 0.7  | —    | mA    |   |
|   | I <sub>VDD_AL</sub> + I <sub>VDD_DL</sub> | —    | 1.1  | —    | mA    |   |
|   | PDISS <sub>DEVICE</sub>                   | —    | 4.3  | —    | mW    |   |
| —   | I <sub>VDD_A3.3</sub>                     | —    | 0.2  | —    | mA    | Hardware Power-Down Mode While the PWDRN pin (pin 17) is Held Low.                        |
|   | I <sub>VDD_IO</sub>                       | —    | 0.7  | —    | mA    |   |
|   | I <sub>VDD_AL</sub> + I <sub>VDD_DL</sub> | —    | 0.1  | —    | mA    |   |
|   | PDISS <sub>DEVICE</sub>                   | —    | 4.1  | —    | mW    |   |
| Supply Current for 10BASE-T Operation<br>(Internal Low-Voltage Regulator On, V <sub>DD_A3.3</sub> = 3.3V, V <sub>DD_IO</sub> = 3.3V) (Note 6-1)   |   |      |      |      |       |   |
| —   | I <sub>VDD_A3.3</sub>                     | —    | 53   | —    | mA    | 100% Traffic on Both Ports  |
|   | I <sub>VDD_IO</sub>                       | —    | 74   | —    | mA    |   |
|   | PDISS <sub>DEVICE</sub>                   | —    | 417  | —    | mW    |   |
| —   | I <sub>VDD_A3.3</sub>                     | —    | 17   | —    | mA    | Link, No Traffic on Both Ports  |
|   | I <sub>VDD_IO</sub>                       | —    | 71   | —    | mA    |   |
|   | PDISS <sub>DEVICE</sub>                   | —    | 290  | —    | mW    |   |
| Supply Current for 10BASE-T Operation<br>(Internal Low-Voltage Regulator Off, V <sub>DD_A3.3</sub> and V <sub>DD_IO</sub> = 3.3V; V <sub>DD_L</sub> , V <sub>DD_AL</sub> , and V <sub>DD_COL</sub> = 1.4V) (Note 6-1) |   |      |      |      |       |   |
| —   | I <sub>VDD_A3.3</sub>                     | —    | 51   | —    | mA    | 100% Traffic on Both Ports  |
|   | I <sub>VDD_IO</sub>                       | —    | 0.5  | —    | mA    |   |
|   | I <sub>VDD_AL</sub> + I <sub>VDD_DL</sub> | —    | 76   | —    | mA    |   |
|   | PDISS <sub>DEVICE</sub>                   | —    | 277  | —    | mW    |   |
| —   | I <sub>VDD_A3.3</sub>                     | —    | 16   | —    | mA    | Link, No Traffic on Both Ports  |
|   | I <sub>VDD_IO</sub>                       | —    | 0.6  | —    | mA    |   |
|   | I <sub>VDD_AL</sub> + I <sub>VDD_DL</sub> | —    | 74   | —    | mA    |   |
|   | PDISS <sub>DEVICE</sub>                   | —    | 158  | —    | mW    |   |
| Internal Voltage Regulator Output Voltage   |   |      |      |      |       |   |
| Output Voltage at V <sub>DD_L</sub>   | V <sub>LDO</sub>                          | —    | 1.32 | —    | V     | V <sub>DD_IO</sub> = 2.5V or 3.3V; internal regulator enabled; measured at pins 40 and 51 |

**TABLE 6-1: ELECTRICAL CHARACTERISTICS (Note 6-1) (CONTINUED)**

| Parameters   | Symbol     | Min.            | Typ. | Max.            | Units | Note   |
|--|------------|-----------------|------|-----------------|-------|--|
| <b>CMOS Inputs (<math>V_{DD\_IO} = 3.3V/2.5V/1.8V</math>)</b>              |            |                 |      |                 |       |  |
| Input High Voltage   | $V_{IH}$   | 2.1/1.7/<br>1.3 | —    | —               | V     | —  |
| Input Low Voltage  | $V_{IL}$   | —               | —    | 0.9/0.9/<br>0.6 | V     | —  |
| Input Current  | $I_{IN}$   | −10             | —    | 10              | μA    | $V_{IN} = GND \sim V_{DD\_IO}$                             |
| <b>X1 Crystal/Osc Input Pin</b>  |            |                 |      |                 |       |  |
| Input High Voltage   | $V_{IH}$   | 2.1             | —    | —               | V     | $V_{DD\_A3.3} = 3.3V, V_{DD\_IO} = \text{any}$             |
| Input Low Voltage  | $V_{IL}$   | —               | —    | 0.9             | V     | $V_{DD\_A3.3} = 3.3V, V_{DD\_IO} = \text{any}$             |
| Input Current  | $I_{IN}$   | —               | —    | 10              | μA    | —  |
| <b>PWRDN Input</b>   |            |                 |      |                 |       |  |
| Input High Voltage   | $V_{IH}$   | 1.1             | —    | —               | V     | $V_{DD\_A3.3} = 3.3V, V_{DD\_IO} = \text{any}$             |
| Input Low Voltage  | $V_{IL}$   | —               | —    | 0.3             | V     | $V_{DD\_A3.3} = 3.3V, V_{DD\_IO} = \text{any}$             |
| <b>FXSD Input</b>  |            |                 |      |                 |       |  |
| Input High Voltage   | $V_{IH}$   | 2.1             | —    | —               | V     | $V_{DD\_A3.3} = 3.3V, V_{DD\_IO} = \text{any}$             |
| Input Low Voltage  | $V_{IL}$   | —               | —    | 1.2             | V     | $V_{DD\_A3.3} = 3.3V, V_{DD\_IO} = \text{any}$             |
| <b>CMOS Outputs (<math>V_{DD\_IO} = 3.3V/2.5V/1.8V</math>)</b>             |            |                 |      |                 |       |  |
| Output High Voltage  | $V_{OH}$   | 2.4/1.9/<br>1.5 | —    | —               | V     | $I_{OH} = -8 \text{ mA}$                                   |
| Output Low Voltage   | $V_{OL}$   | —               | —    | 0.4/0.4/<br>0.2 | V     | $I_{OL} = 8 \text{ mA}$                                    |
| Output Tri-State Leakage   | $ I_{OZ} $ | —               | —    | 10              | μA    | —  |
| <b>100BASE-TX Transmit (Measured Differentially After 1:1 Transformer)</b> |            |                 |      |                 |       |  |
| Peak Differential Output Voltage   | $V_O$      | ±0.95           | —    | ±1.05           | V     | 100Ω termination on the diff. output                       |
| Output Voltage Imbalance   | $V_{IMB}$  | —               | —    | 2               | %     | 100Ω termination on the diff. output                       |
| Rise/Fall Time   | $t_r/t_f$  | 3               | —    | 5               | ns    | —  |
| Rise/Fall Time Imbalance   | —          | 0               | —    | 0.5             | ns    | —  |
| Duty Cycle Distortion  | —          | —               | —    | ±0.25           | ns    | —  |
| Overshoot  | —          | —               | —    | 5               | %     | —  |
| Reference Voltage of ISET  | $V_{SET}$  | —               | 0.65 | —               | V     | Using 6.49 kΩ – 1% resistor                                |
| Output Jitter  | —          | —               | 0.7  | 1.4             | ns    | Peak-to-peak   |
| <b>10BASE-T Receive</b>  |            |                 |      |                 |       |  |
| Squelch Threshold  | $V_{SQ}$   | —               | 400  | —               | mV    | 5 MHz square wave  |
| <b>10BASE-T Transmit (Measured Differentially After 1:1 Transformer)</b>   |            |                 |      |                 |       |  |
| Peak Differential Output Voltage   | $V_P$      | 2.2             | 2.5  | 2.8             | V     | 100Ω termination on the differential output                |
| Jitter Added   | —          | —               | 1.8  | 3.5             | ns    | 100Ω termination on the differential output (peak-to-peak) |
| Rise/Fall Time   | $t_r/t_f$  | —               | 25   | —               | ns    | —  |
| <b>LED Outputs</b>   |            |                 |      |                 |       |  |
| Output Drive Current   | $I_{LED}$  | —               | 8    | —               | mA    | Each LED pin (P1/2LED0, P1/2LED1)                          |
| <b>I/O Pin Internal Pull-Up and Pull-Down Effective Resistance</b>         |            |                 |      |                 |       |  |
| 1.8V Pull-Up Resistance  | R1.8PU     | 57              | 100  | 187             | kΩ    | $V_{DD\_IO} = 1.8V$  |
| 1.8V Pull-Down Resistance  | R1.8PD     | 55              | 100  | 190             | kΩ    |  |

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TABLE 6-1: ELECTRICAL CHARACTERISTICS (Note 6-1) (CONTINUED)

| Parameters                | Symbol | Min. | Typ. | Max. | Units      | Note                |
|---------------------------|--------|------|------|------|------------|---------------------|
| 2.5V Pull-Up Resistance   | R2.5PU | 37   | 59   | 102  | k $\Omega$ | $V_{DD\_IO} = 2.5V$ |
| 2.5V Pull-Down Resistance | R2.5PD | 35   | 60   | 110  | k $\Omega$ |                     |
| 3.3V Pull-Up Resistance   | R3.3PU | 29   | 43   | 70   | k $\Omega$ | $V_{DD\_IO} = 3.3V$ |
| 3.3V Pull-Down Resistance | R3.3PD | 27   | 43   | 76   | k $\Omega$ |                     |

**Note 6-1**  $I_{VDD\_A3.3}$  measured at pin 9.  $I_{VDD\_IO}$  measured at pins 21, 30, and 56.  $I_{VDD\_AL}$  measured at pins 6 and 16.  $I_{VDD\_DL}$  measured at pins 40 and 51.

**Note 6-2**  $T_A = 25^{\circ}C$ . Specification is for packaged product only.



## 7.0 TIMING SPECIFICATIONS

### 7.1 Host Interface Read/Write Timing

FIGURE 7-1: HOST INTERFACE READ/WRITE TIMING

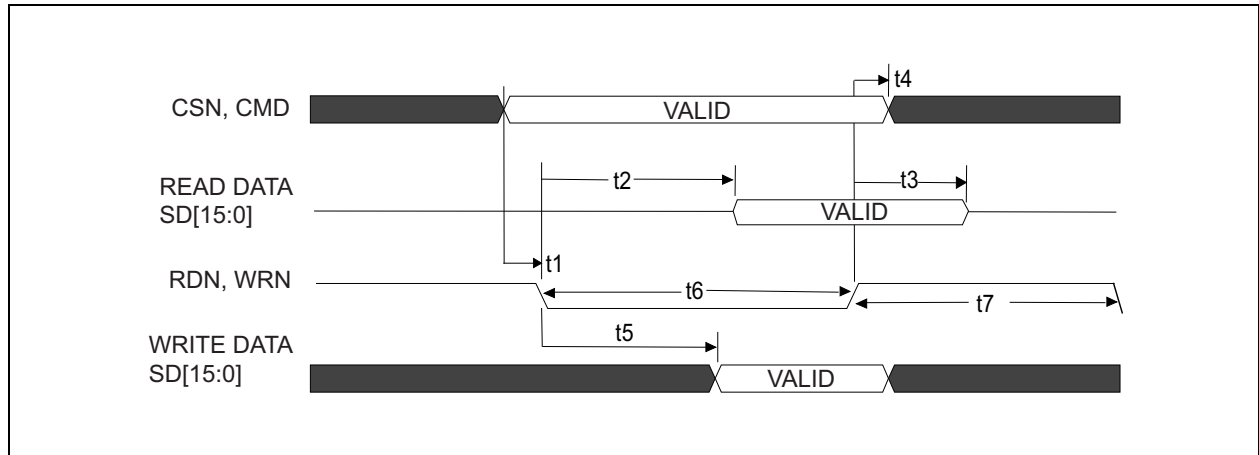


TABLE 7-1: HOST INTERFACE READ/WRITE TIMING PARAMETERS

| Symbol | Parameter   | Min. | Typ. | Max. | Units |
|--------|---|------|------|------|-------|
| t1     | CSN, CMD valid to RDN, WRN active   | 0    | —    | —    | ns    |
| t2     | RDN active to Read Data SD[15:0] valid<br>Note: This is the SD output delay after RDN becomes active until valid read data is available.  | 24   | —    | 32   | ns    |
| t3     | RDN inactive to Read data invalid<br>Note: The processor latches valid read data at the rising edge of RDN  | 1    | —    | 2    | ns    |
| t4     | CSN, CMD hold time after RDN, WRN inactive  | 0    | —    | —    | ns    |
| t5     | WRN active to write data valid (bit [12] = 0 in RXFDPR)   | 8    | —    | 16   | ns    |
|        | WRN active to write data valid (bit [12] = 1 in RXFDPR)<br>Note: It is better if the processor can provide data in less than 4 ns after WRN is active. If the processor provides data more than 4 ns after WRN is active, make sure that RXFDPR bit [12] = 0. | —    | —    | 4    | ns    |
| t6     | RDN Read active time (low)  | 40   | —    | —    | ns    |
|        | WRN Write active time (low)   | 40   | —    | —    | ns    |
| t7     | RDN Read Inactive time (high)   | 10   | —    | —    | ns    |
|        | WRN Write inactive time (high)  | 10   | —    | —    | ns    |

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## 7.2 Auto-Negotiation Timing

FIGURE 7-2: AUTO-NEGOTIATION TIMING

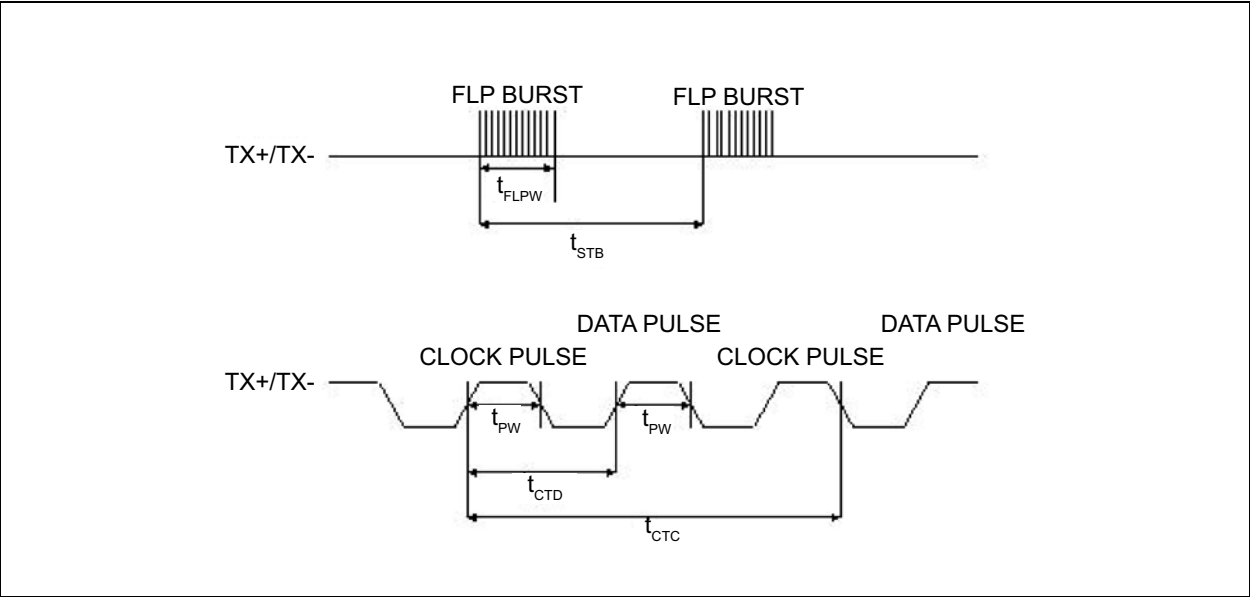


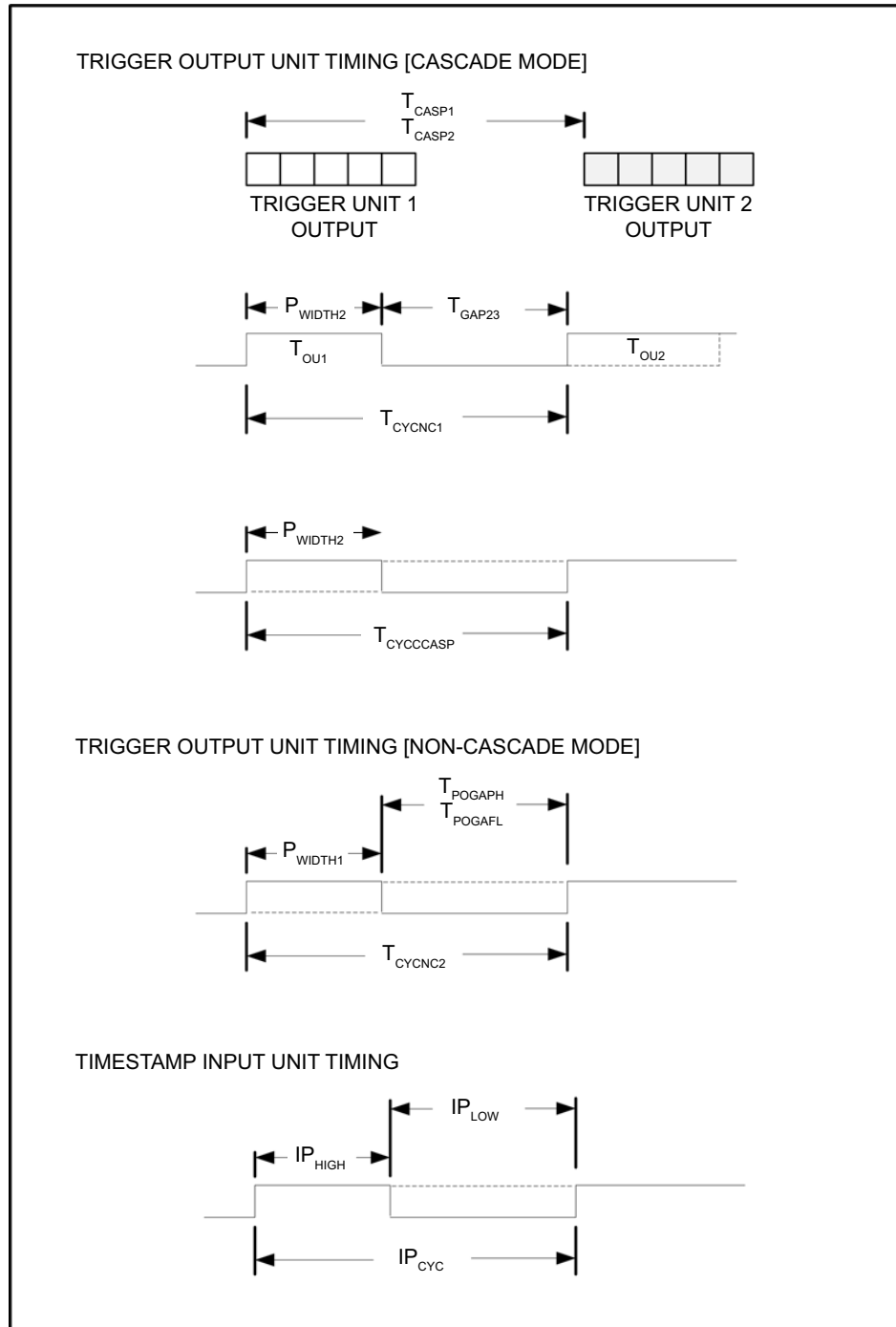
TABLE 7-2: AUTO-NEGOTIATION TIMING PARAMETERS

| Parameter  | Description                               | Min. | Typ. | Max. | Units   |
|------------|---|------|------|------|---------|
| $t_{BTB}$  | FLP Burst to FLP Burst                    | 8    | 16   | 24   | ms      |
| $t_{FLPW}$ | FLP Burst Width                           | —    | 2    | —    | ms      |
| $t_{PW}$   | Clock/Data Pulse Width                    | —    | 100  | —    | ns      |
| $t_{CTD}$  | Clock Pulse to Data Pulse                 | 55.5 | 64   | 69.5 | $\mu$ s |
| $t_{CTC}$  | Clock Pulse to Clock Pulse                | 111  | 128  | 139  | $\mu$ s |
| —          | Number of Clock/Data Pulses per FLP Burst | 17   | —    | 33   | —       |

## 7.3 Trigger Output Unit and Time Stamp Input Unit Timing

The timing information in the following figure provides details and constraints on various timing relationships within the twelve trigger output units and the time stamp input units.

**FIGURE 7-3: TRIGGER OUTPUT UNIT AND TIME STAMP INPUT UNIT TIMING**



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**TABLE 7-3: TRIGGER OUTPUT UNIT AND TIME STAMP INPUT UNIT TIMING PARAMETERS**

| Parameter  | Description   | Min. | Typ.                   | Max. | Units |
|--|---|------|------------------------|------|-------|
| <b>Trigger Output Unit Timing [Cascade Mode]</b>     |   |      |                        |      |       |
| $T_{CASP1}$  | In cascade mode for TRIGX_CFG_1[6:4] = 100, or 101, or 110 (Neg. Edge, Pos. Edge, and Shift Reg. Output signals). Minimum time between start of one TOU and the start of another TOU cascaded on the same GPIO pin.                       | 80   | —                      | —    | ns    |
| $T_{CASP2}$  | In cascade mode for TRIGX_CFG_1[6:4] = 010, 011, 100, or 101 (Neg. Pulse, Pos. Pulse, Neg. Periodic, and Pos. Periodic Output signals). Minimum time between start of one TOU and the start of another TOU cascaded on the same GPIO pin. | 120  | —                      | —    | ns    |
| $T_{CYCCASP}$  | In cascade mode for TRIGX_CFG_1[6:4] = 010, and 011 (Neg. Pulse, Pos. Pulse Output signals). In cascade mode, the cycle time of the trigger output unit operating in the indicated modes.   | 80   | $\geq 32 + P_{WIDTH2}$ |      | ns    |
| $T_{CYCNC1}$   | In cascade mode for TRIGX_CFG_1[6:4] = 100 or 101 (Neg. Periodic, Pos. periodic Output signals). Minimum cycle time for any trigger output unit operating in the indicated modes.   | 80   | $\geq 32 + P_{WIDTH2}$ |      | ns    |
| $T_{GAP23}$  | In cascade mode for TRIGX_CFG_1[6:4] = 010, and 011 (Neg. Pulse, Pos. Pulse Output signals): Minimum gap time required between end of period of first trigger output unit to beginning of output of 2nd trigger output unit.              | 80   | —                      | —    | ns    |
| $P_{WIDTH2}$   | In cascade mode, the minimum low or high pulse width of the trigger output unit.  | 8    | —                      | —    | ns    |
| <b>Trigger Output Unit Timing [Non-Cascade Mode]</b> |   |      |                        |      |       |
| $T_{CYCNC2}$   | In non-cascade mode, the minimum cycle time for any trigger output unit.  | 80   | $\geq 32 + P_{WIDTH2}$ |      | ns    |
| $T_{POGAP}$  | In non-cascade mode, the minimum time between the end of the generated pulse to the start of the next pulse.  | 32   | —                      | —    | ns    |
| $P_{WIDTH1}$   | In non-cascade mode, the minimum low or high pulse width of the trigger output unit.  | 8    | —                      | —    | ns    |
| <b>Time Stamp Input Unit Timing</b>                  |   |      |                        |      |       |
| $IP_{HIGH}$  | Allowable high time of an incoming digital waveform on any GPIO pin   | 24   | —                      | —    | ns    |
| $IP_{LOW}$   | In non-cascade mode, the minimum time between the end of the generated pulse to the start of the next pulse.  | 24   | —                      | —    | ns    |
| $IP_{CYC}$   | In non-cascade mode, the minimum time between the end of the generated pulse to the start of the next pulse.  | 48   | —                      | —    | ns    |

## 7.4 Serial EEPROM Interface Timing

FIGURE 7-4: SERIAL EEPROM TIMING

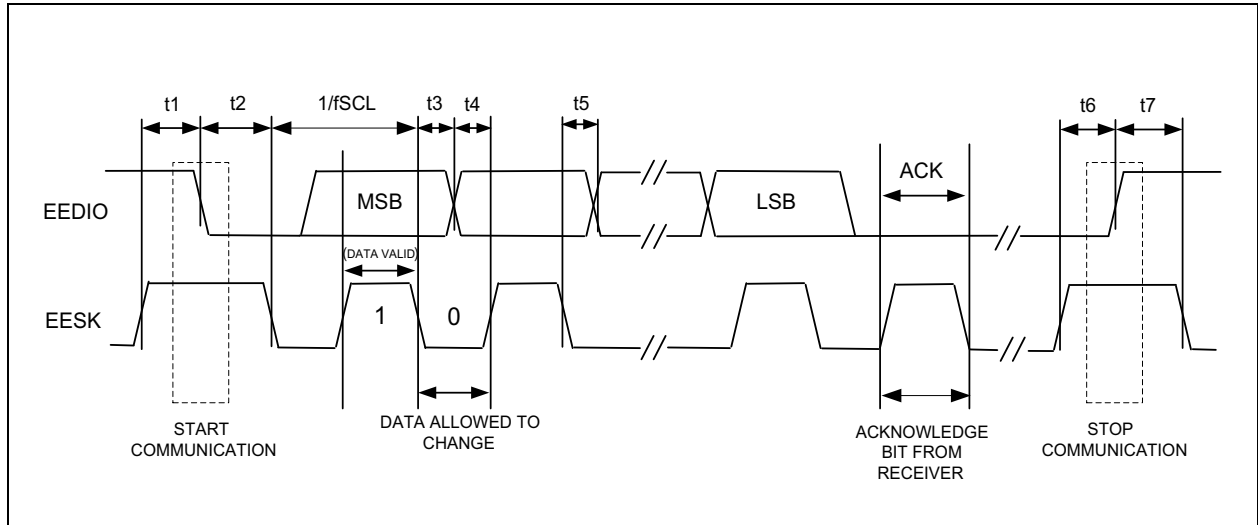


TABLE 7-4: SERIAL EEPROM TIMING PARAMETERS

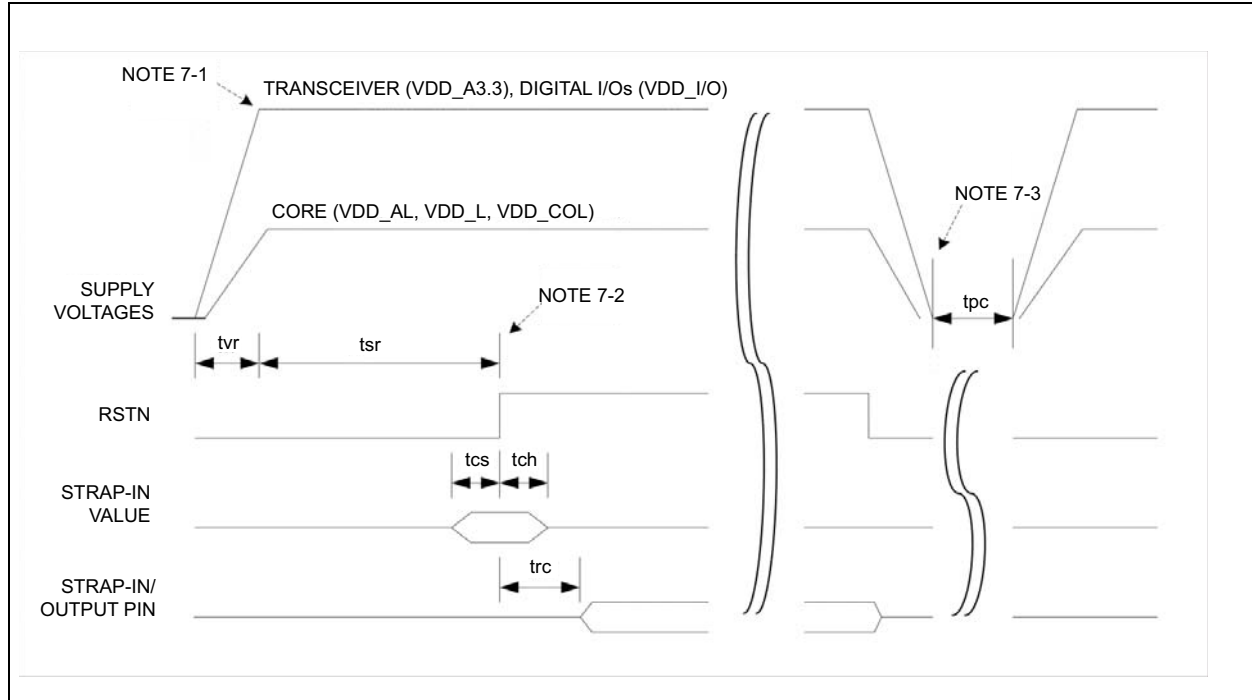
| Parameter | Description                | Min. | Typ. | Max. | Units |
|-----------|----------------------------|------|------|------|-------|
| fSCL      | EESK Clock Frequency       | —    | —    | 2.5  | MHz   |
| t1        | Setup Time for Start Bit   | 33   | —    | —    | ns    |
| t2        | Hold Time for Start Bit    | 33   | —    | —    | ns    |
| t3        | Hold Time for Data         | 20   | —    | —    | ns    |
| t4        | Setup Time for Data        | 33   | —    | —    | ns    |
| t5        | Output Valid Time for Data | 60   | —    | —    | ns    |
| t6        | Setup Time for Stop Bit    | 33   | —    | —    | ns    |
| t7        | Hold Time for Stop Bit     | 33   | —    | —    | ns    |

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## 7.5 Reset and Power Sequence Timing

The KSZ8462 reset timing and power sequence requirements are summarized in the following figure and table.

**FIGURE 7-5: RESET AND POWER SEQUENCE TIMING**



**TABLE 7-5: RESET AND POWER SEQUENCE TIMING PARAMETERS**  
(Note 7-1, Note 7-2, Note 7-3)

| Parameter | Description                                     | Min. | Typ. | Max. | Units   |
|-----------|---|------|------|------|---------|
| $t_{VR}$  | Supply voltages rise time (must be monotonic)   | 0    | —    | —    | $\mu s$ |
| $t_{SR}$  | Stable supply voltages to de-assertion of reset | 10   | —    | —    | ms      |
| $t_{CS}$  | Strap-in pin configuration setup time           | 5    | —    | —    | ns      |
| $t_{CH}$  | Strap-in pin configuration hold time            | 5    | —    | —    | ns      |
| $t_{RC}$  | De-assertion of reset to strap-in pin output    | 6    | —    | —    | ns      |

**Note 7-1** The recommended powering sequence is to bring up all voltages at the same time. However, if that cannot be attained, then a recommended power-up sequence is to have the transceiver ( $V_{DD\_A3.3}$ ) and digital I/Os ( $V_{DD\_IO}$ ) voltages power up before the low voltage core ( $V_{DD\_AL}$ ,  $V_{DD\_L}$ , and  $V_{DD\_COL}$ ) voltage, if an external low voltage core supply is used. There is no power sequence requirement between transceiver ( $V_{DD\_A3.3}$ ) and digital I/Os ( $V_{DD\_IO}$ ) power rails. The power-up waveforms should be monotonic for all supply voltages to the KSZ8462.

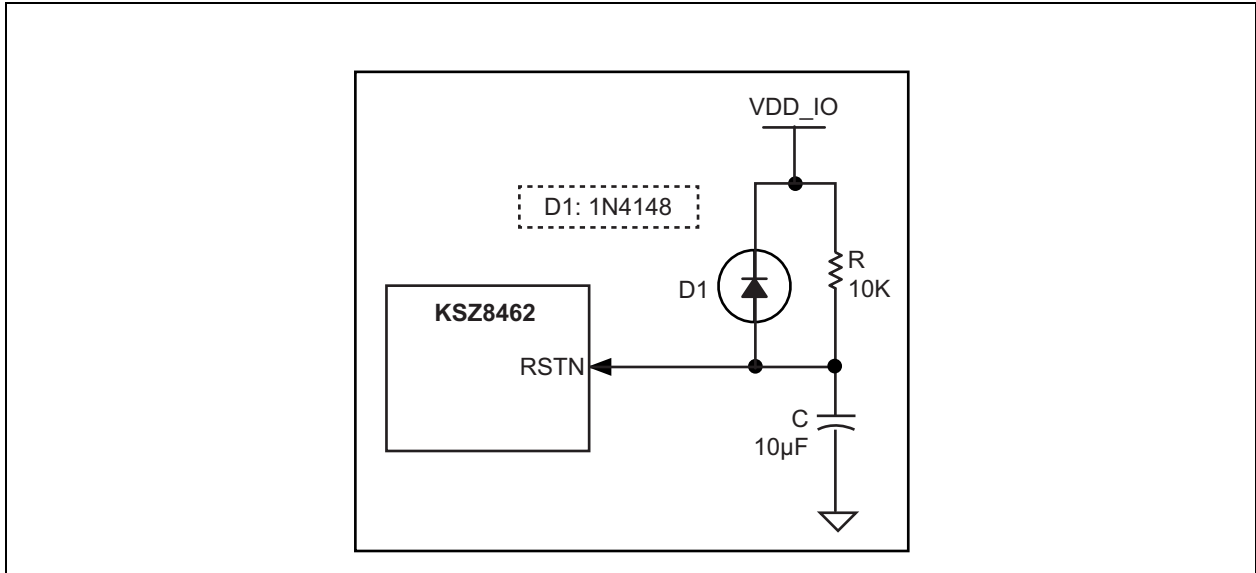
**Note 7-2** After the de-assertion of reset, it is recommended to wait a minimum of 100  $\mu s$  before starting programming of the device through any interface.

**Note 7-3** The recommended power-down sequence is to have the low voltage core voltage power down first before powering down the transceiver and digital I/O voltages.

## 7.6 Reset Circuit Guidelines

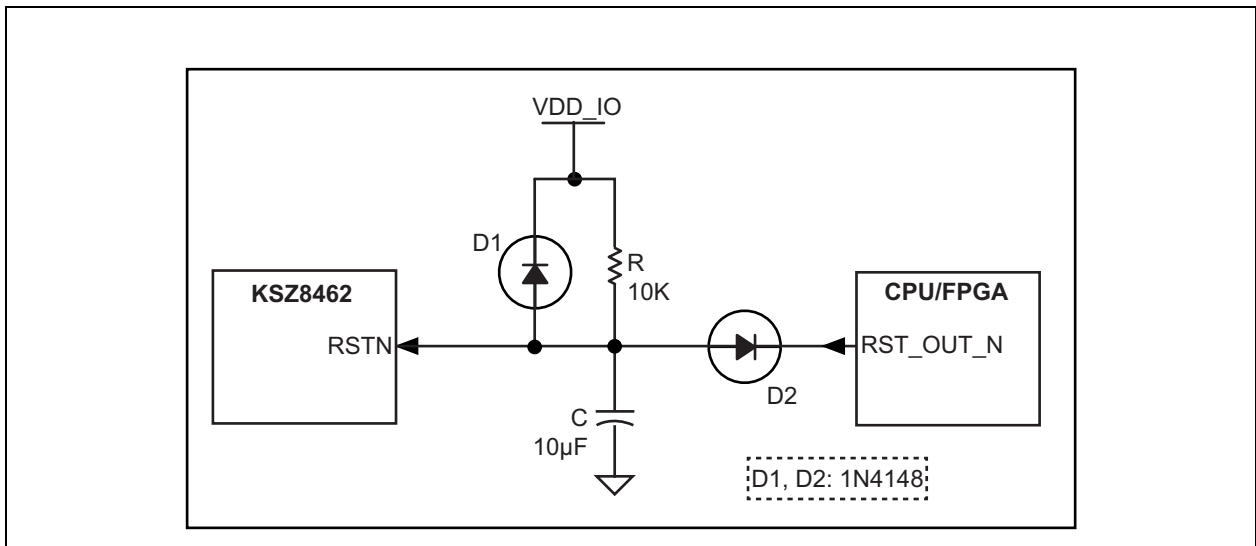
The following reset circuit is recommended for powering up the KSZ8462 device if reset is triggered by the power supply.

**FIGURE 7-6: SIMPLE RESET CIRCUIT**



The following reset circuit is recommended for applications where reset is driven by another device (e.g., CPU or FPGA). At POR, R, C, and D1 provide the necessary ramp rise time to reset the KSZ8462 device. The RST\_OUT\_N from CPU/FPGA provides the warm reset after power-up.

**FIGURE 7-7: RECOMMENDED RESET CIRCUIT FOR INTERFACING WITH CPU/FPGA RESET OUTPUT**



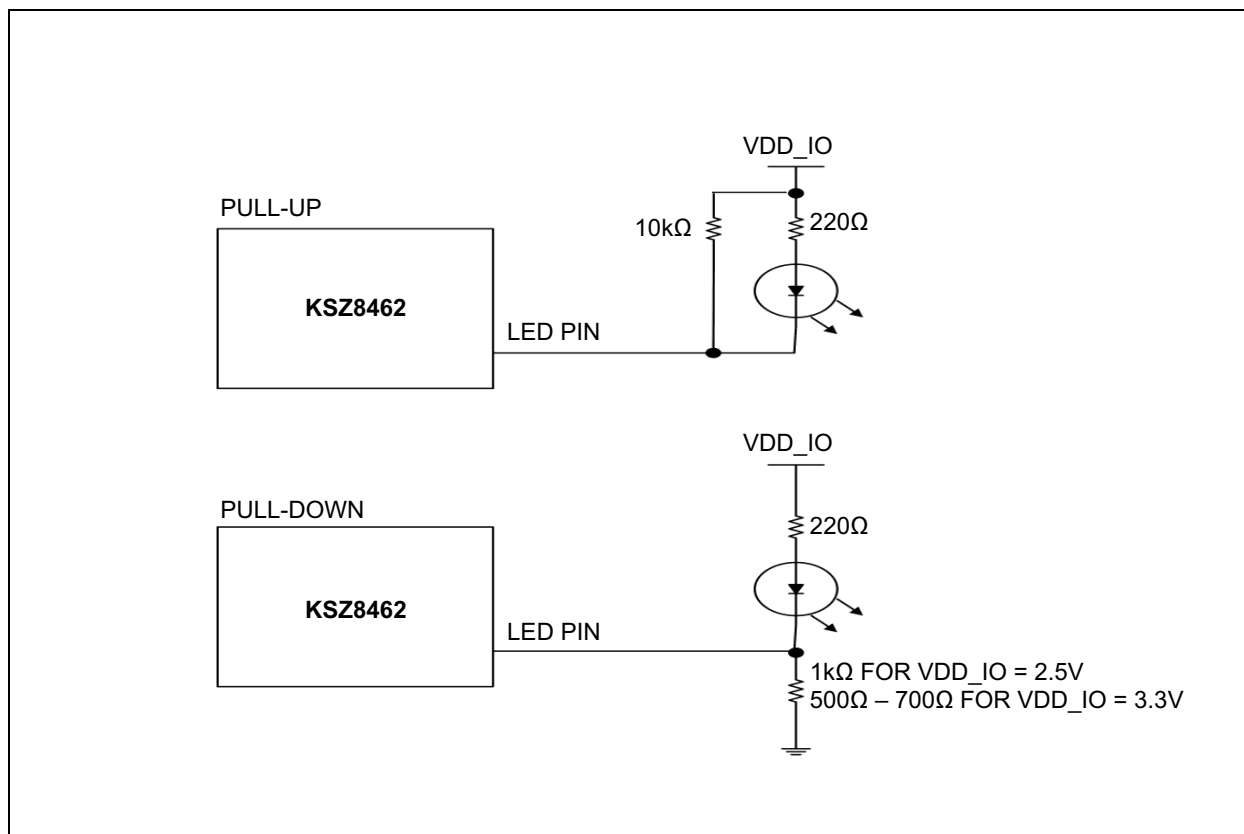
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## 8.0 REFERENCE CIRCUIT: LED STRAP-IN PINS

The pull-up and pull-down reference circuits for the P1LED0/H816 and P2LED0/LEBE strapping pins are shown in Figure 8-1.

The supply voltage for the LEDs must be at least ~2.2V, depending on the particular LED and the load resistor. If VDD\_IO is 1.8V, then a different (higher voltage) supply must be used for the LEDs.

FIGURE 8-1: TYPICAL LED STRAP-IN CIRCUIT



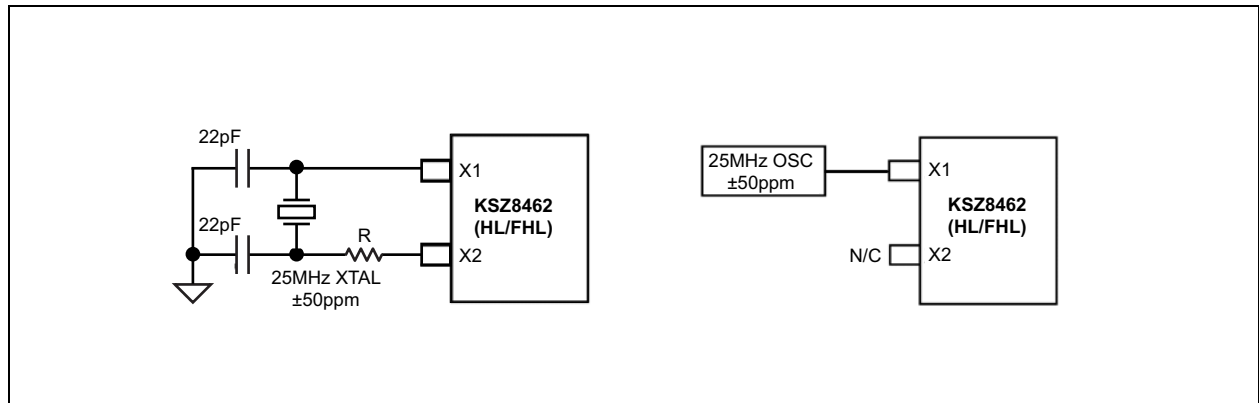


## 9.0 REFERENCE CLOCK: CONNECTION AND SELECTION

Figure 9-1 shows a crystal or external clock source, such as an oscillator, as the reference clock for the KSZ8462. The reference clock is 25 MHz for all operating modes of the KSZ8462. If an oscillator is used, connect it to X1, and leave X2 unconnected.

The resistor shown on X2 is optional and can be used to reduce the current to the crystal if needed, depending on the specific crystal that is used. The maximum recommended resistor value is 30Ω.

**FIGURE 9-1: 25MHZ CRYSTAL AND OSCILLATOR CLOCK CONNECTION OPTIONS**



**TABLE 9-1: TYPICAL REFERENCE CRYSTAL CHARACTERISTICS**

| Characteristics                       | Value   |
|---------------------------------------|---------|
| Frequency                             | 25 MHz  |
| Frequency tolerance (maximum)         | ±50 ppm |
| Effective Series resistance (maximum) | 50Ω     |

## 10.0 SELECTION OF ISOLATION TRANSFORMERS

A 1:1 isolation transformer is required at the line interface. An isolation transformer with integrated common-mode choke is recommended for exceeding FCC requirements.

Table 10-1 lists recommended transformer characteristics.

**TABLE 10-1: TRANSFORMER SELECTION CRITERIA**

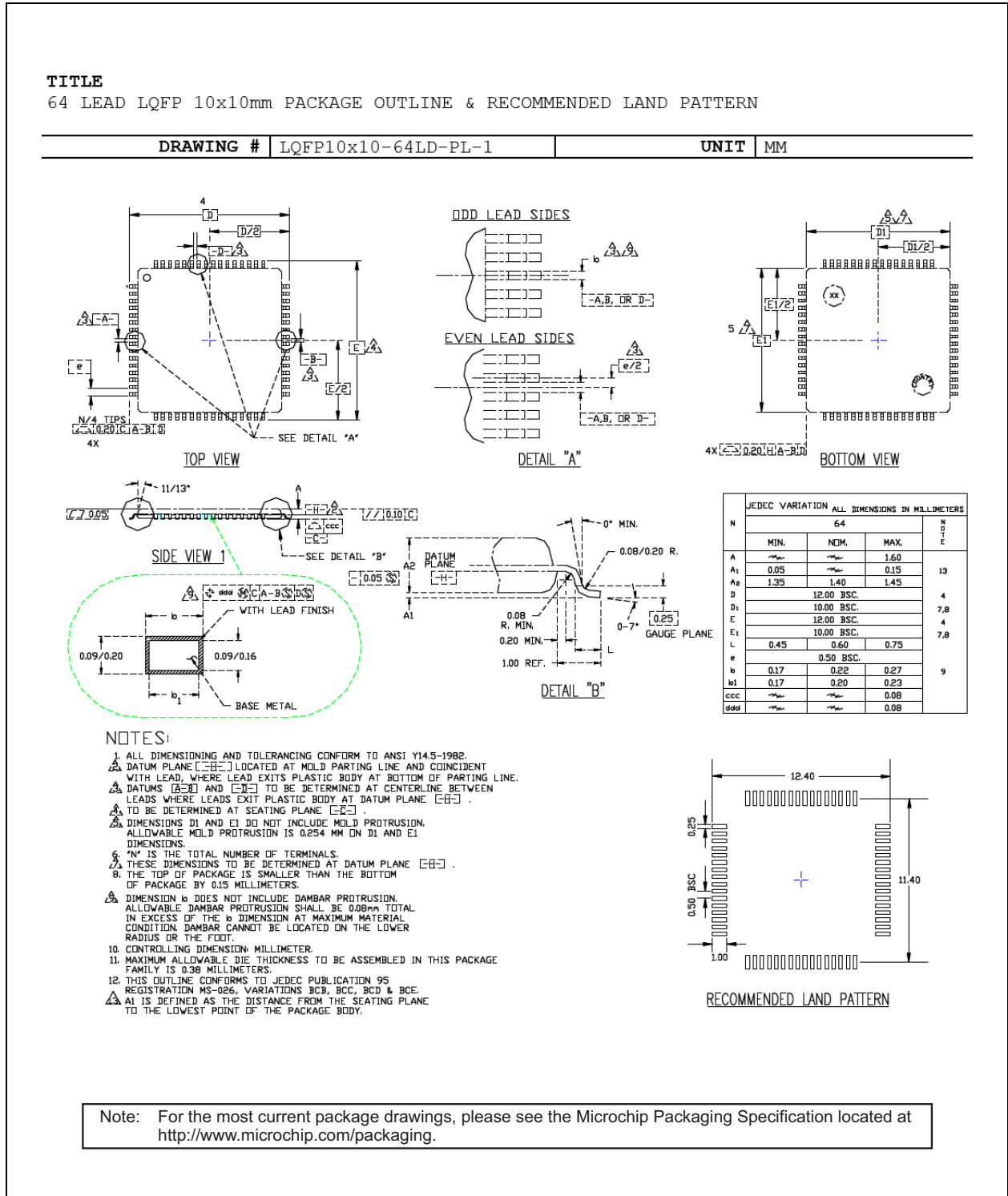
| Parameter                       | Value                 | Test Conditions       |
|---------------------------------|-----------------------|-----------------------|
| Turns Ratio                     | 1 CT:1 CT             | —                     |
| Open-Circuit Inductance (min.)  | 350 $\mu$ H           | 100 mV, 100 kHz, 8 mA |
| Leakage Inductance (max.)       | 0.4 $\mu$ H           | 1 MHz (min.)          |
| Interwinding Capacitance (max.) | 12 pF                 | —                     |
| D.C. Resistance (max.)          | 0.9 $\Omega$          | —                     |
| Insertion Loss (max.)           | –1.0 dB               | 100 kHz to 100 MHz    |
| HIPOT (min.)                    | 1500 V <sub>RMS</sub> | —                     |

**TABLE 10-2: QUALIFIED SINGLE-PORT MAGNETICS**

| Manufacturer     | Part Number  | Auto MDI-X |
|------------------|--------------|------------|
| Pulse            | H1102NL      | Yes        |
| Pulse (low cost) | H1260        | Yes        |
| Transpower       | HB726        | Yes        |
| Bel Fuse         | S558-5999-U7 | Yes        |
| Delta            | LF8505       | Yes        |
| LanKom           | LF-H41S      | Yes        |
| TDK (Mag Jack)   | TLA-6T718    | Yes        |

## 11.0 PACKAGE OUTLINE

**FIGURE 11-1: 64-LEAD LQFP 10 MM X 10 MM PACKAGE OUTLINE & RECOMMENDED LAND PATTERN**



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## APPENDIX A: DATA SHEET REVISION HISTORY

TABLE A-1: REVISION HISTORY

| Revision              | Section/Figure/Entry | Correction   |
|-----------------------|----------------------|--|
| DS00002641A (2-22-18) | —                    | Converted Micrel data sheet KSZ8462HLI/FHLI to Microchip DS00002641A. Minor text changes throughout. |

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# KSZ8462HLI/FHLI

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

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|--|--|--|
| <div><div><div>PART NO.</div><div>Device</div></div><div><div>X</div><div>Interface</div></div><div><div>X</div><div>Package</div></div><div><div>X</div><div>Temperature</div></div><div><div>—</div><div>Media Type</div></div><div><div>XX</div></div></div>  |  | <div>Examples:</div> <div>a) KSZ8462HLI: Generic Host Bus Interface, 64-Lead LQFP, Industrial Temperature, 160/Tray</div> <div>b) KSZ8462FHLI: Generic Host Bus Interface with Fiber Support, 64-Lead LQFP, Industrial Temperature, 160/Tray</div> |
| <div><div>Device:</div><div>KSZ8462</div></div> <div><div>Interface:</div><div>H = Generic Host Bus Interface</div><div>FH = Generic Host Bus Interface with Fiber support</div></div> <div><div>Package:</div><div>L = 64-Lead LQFP</div></div> <div><div>Temperature:</div><div>I = -40°C to +85°C (Industrial)</div></div> <div><div>Media Type:</div><div>&lt;blank&gt; = 160/Tray</div></div> |  |  |

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ISBN: 978-1-5224-2707-0

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