

**IMPORTANT NOTICE**

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel. Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes Incorporated.

**LIFE SUPPORT**

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or
2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

Copyright © 2016, Diodes Incorporated

[www.diodes.com](http://www.diodes.com)

## REVISION HISTORY

| Date       | Revision Number | Description   |
|------------|-----------------|---|
| 10/31/07   | 0.1             | Preliminary Datasheet<br>Fixed the diagrams<br>Corrected Section 4.2 Pin Description (RREF, GPIO[7])<br>Updated Section 6 PCI Express Registers(6.2.42 [3], 6.2.36 UART Driver Setting, 6.2.41 GPIO Control Register )<br>Revised Section 7.1 Registers in I/O Mode<br>Updated Section 11 Ordering Info   |
| 12/20/2007 | 0.2             | Updated Section 4 Pin Assignment (description for shared pins added, MODE_SEL changed to DRIVER_SEL)<br>Updated Section 6 PCI Express Register Description<br>Updated Section 7 UART Register Description<br>Updated Section 8 EEPROM Interface   |
| 04/22/08   | 0.3             | Updated Section 1 Features (Clock prescaler, Data frame size, Power Dissipation)<br>Corrected Section 3 General Description<br>Updated Section 4 Pin Assignment (description for shared pins added, MODE_SEL changed to DRIVER_SEL, VAUX changed to VDDCAUX, WAKEUP_L, CLKINP, CLKINN)<br>Added 5.2.4 Mode Selection, 5.2.5 450/550 Mode, 5.2.6 Enhanced 550 Mode, 5.2.7 Enhanced 950 Mode<br>Corrected 5.2.8 Transmit and Receive FIFOs, 5.2.9 Automated Flow Control<br>Modified 5.2.12 Baud Rate Generation<br>Updated Section 6 PCI Express Register Description (6.2.36, 6.2.42)<br>Updated Format (6.2.20, 6.2.36, 6.2.54, 6.2.55, 6.2.57)<br>Updated Section 7 UART Register Description (7.1.6 LCR Bit[5:0], 7.1.7 MCR Bit[5] and Bit[7], 7.1.9 MSR Bit[3:0], 7.2.6 LCR Bit[5:0], 7.2.7 MCR Bit[5] and Bit[7], 7.2.9 MSR Bit[3:0], 7.2.11 DLL, 7.2.12 DLH, 7.2.13 EFR, 7.2.18 ACR Bit[7:2], 7.2.23 CPRM)<br>Updated Chapter 8.3 EEPROM Space Address Map And Description (00h, 0Ah, 40h)<br>Added Section 9 Electrical Specification<br>Corrected Section 9.2 DC Specification<br>Updated Section 9.3 AC Specification<br>Added Section 10 Clock Scheme |
| 08/13/08   | 0.4             | Updated Section 1 Features (added Industrial Temperature Range)<br>Updated 9.1 Absolute Maximum Ratings: Ambient Temperature with power applied   |
| 11/25/08   | 1.0             | Updated 7.1.13 Sample Clock Register and 7.2.27 Sample Clock Register<br>Updated Chapter 12 Ordering Information<br>Removed "Preliminary" and "Confidential" references   |
| 03/06/09   | 1.1             | Corrected Figure 3-1 PI7C9X7954 Block Diagram (SYN_UART_CLK removed)<br>Corrected Section 4.2.1 UART Interface (SYNCLK_IN_EN and SYN_UART_CLK removed)<br>Corrected Figure 5-2 Internal Loopback in PI7C7954<br>Corrected Figure 5-3 Crystal Oscillator as the Clock Source (14.7456 MHz)<br>Corrected Section 7.1.7 Modem Control Register (Bit[5]), 7.1.10 Special Function Register (Bit[4]), 7.2.7 Modem Control Register (Bit[5]), 7.2.10 Special Function Register (Bit[4]), 7.2.29 Receive FIFO Data Registers, 7.2.30 Transmit FIFO Data Register, 7.2.31   |
| 04/21/09   | 1.2             | Updated Section 4 Pin Description   |
| 09/24/09   | 1.3             | Updated Figure 5-3 Crystal Oscillator as the Clock Source<br>Updated Section 6.2.24 Message Signaled Interrupt (MSI) Next Item Pointer 8Ch<br>Added Section 6.2.25 Message Address Register – Offset 90h<br>Added Section 6.2.26 Message Upper Address Register – Offset 94h<br>Added Section 6.2.27 Message Data Register – Offset 98h   |
| 06/04/14   | 1.4             | Updated Section 4.1 Pin List (SR_DO and SR_DI)<br>Updated Section 4.2.5 EEPROM Interface (SR_DO and SR_DI)<br>Created for IC Revision B<br>Updated Section 12 Ordering Information<br>Added Section 6.2.25 Message Control Register – OFFSET 8Ch  |
| 01/09/15   | 1.5             | Updated Section 11 Package Information  |
| 05/11/15   | 1.6             | Updated Table 5-2 Baud Rate Generator Setting<br>Updated Section 7.2.23 Clock Prescale Register – Offset 14h  |
| 08/30/17   | 1.7             | Updated Section 4.1.PIN LIST OF 128-PIN LQFP<br>Updated Section 4.2.1 UART Interface<br>Updated Table 9.1 Absolute Maximum Ratings<br>Updated Table 9.2 DC Electrical Characteristics<br>Updated Section 12 Ordering Information  |
| 10/06/17   | 2               | Revision numbering system changed to whole number   |

# Table of Contents

|  |           |
|--|-----------|
| <b>1. FEATURES</b>                                 | <b>9</b>  |
| <b>2. APPLICATIONS</b>                             | <b>9</b>  |
| <b>3. GENERAL DESCRIPTION</b>                      | <b>10</b> |
| <b>4. PIN ASSIGNMENT</b>                           | <b>11</b> |
| 4.1. PIN LIST OF 128-PIN LQFP                      | 11        |
| 4.2. PIN DESCRIPTION                               | 12        |
| 4.2.1. UART INTERFACE                              | 12        |
| 4.2.2. PCI EXPRESS INTERFACE                       | 13        |
| 4.2.3. SYSTEM INTERFACE                            | 14        |
| 4.2.4. TEST SIGNALS                                | 14        |
| 4.2.5. EEPROM INTERFACE                            | 15        |
| 4.2.6. POWER PINS                                  | 15        |
| <b>5. FUNCTIONAL DESCRIPTION</b>                   | <b>16</b> |
| 5.1. CONFIGURATION SPACE                           | 16        |
| 5.1.1. PCI Express Configuration Space             | 16        |
| 5.1.2. UART Configuration Space                    | 16        |
| 5.2. DEVICE OPERATION                              | 17        |
| 5.2.1. Configuration Access                        | 17        |
| 5.2.2. I/O Reads/Writes                            | 17        |
| 5.2.3. Memory Reads/Writes                         | 17        |
| 5.2.4. Mode Selection                              | 18        |
| 5.2.5. 450/550 Mode                                | 18        |
| 5.2.6. Enhanced 550 Mode                           | 18        |
| 5.2.7. Enhanced 950 Mode                           | 18        |
| 5.2.8. Transmit and Receive FIFOs                  | 18        |
| 5.2.9. Automated Flow Control                      | 20        |
| 5.2.10. Internal Loopback                          | 21        |
| 5.2.11. Crystal Oscillator                         | 22        |
| 5.2.12. Baud Rate Generation                       | 23        |
| 5.2.13. Power Management                           | 23        |
| <b>6. PCI EXPRESS REGISTER DESCRIPTION</b>         | <b>24</b> |
| 6.1. REGISTER TYPES                                | 24        |
| 6.2. CONFIGURATION REGISTERS                       | 24        |
| 6.2.1. VENDOR ID REGISTER – OFFSET 00h             | 25        |
| 6.2.2. DEVICE ID REGISTER – OFFSET 00h             | 25        |
| 6.2.3. COMMAND REGISTER – OFFSET 04h               | 25        |
| 6.2.4. STATUS REGISTER – OFFSET 04h                | 26        |
| 6.2.5. REVISION ID REGISTER – OFFSET 08h           | 26        |
| 6.2.6. CLASS CODE REGISTER – OFFSET 08h            | 26        |
| 6.2.7. CACHE LINE REGISTER – OFFSET 0Ch            | 27        |
| 6.2.8. MASTER LATENCY TIMER REGISTER – OFFSET 0Ch  | 27        |
| 6.2.9. HEADER TYPE REGISTER – OFFSET 0Ch           | 27        |
| 6.2.10. BASE ADDRESS REGISTER 0 – OFFSET 10h       | 27        |
| 6.2.11. BASE ADDRESS REGISTER 1 – OFFSET 14h       | 27        |
| 6.2.12. SUBSYSTEM VENDOR REGISTER – OFFSET 2Ch     | 27        |
| 6.2.13. SUBSYSTEM ID REGISTER – OFFSET 2Ch         | 27        |
| 6.2.14. CAPABILITIES POINTER REGISTER – OFFSET 34h | 28        |

|         |  |    |
|---------|--|----|
| 6.2.15. | INTERRUPT LINE REGISTER – OFFSET 3Ch.....                                      | 28 |
| 6.2.16. | INTERRUPT PIN REGISTER – OFFSET 3Ch.....                                       | 28 |
| 6.2.17. | POWER MANAGEMENT CAPABILITY ID REGISTER – OFFSET 80h.....                      | 28 |
| 6.2.18. | NEXT ITEM POINTER REGISTER – OFFSET 80h.....                                   | 28 |
| 6.2.19. | POWER MANAGEMENT CAPABILITIES REGISTER – OFFSET 80h.....                       | 28 |
| 6.2.20. | POWER MANAGEMENT DATA REGISTER – OFFSET 84h.....                               | 29 |
| 6.2.21. | PPB SUPPORT EXTENSIONS – OFFSET 84h.....                                       | 29 |
| 6.2.22. | PM DATA REGISTER – OFFSET 84h.....   | 29 |
| 6.2.23. | MESSAGE SIGNED INTERRUPTS (MSI) Capability ID Register 8Ch.....                | 29 |
| 6.2.24. | MESSAGE SIGNED INTERRUPTS (MSI) NEXT ITEM POINTER 8Ch.....                     | 29 |
| 6.2.25. | MESSAGE CONTROL REGISTER – OFFSET 8Ch.....                                     | 30 |
| 6.2.26. | MESSAGE ADDRESS REGISTER – OFFSET 90h.....                                     | 30 |
| 6.2.27. | MESSAGE UPPER ADDRESS REGISTER – OFFSET 94h.....                               | 30 |
| 6.2.28. | MESSAGE DATA REGISTER – OFFSET 98h.....  | 30 |
| 6.2.29. | VPD CAPABILITY ID REGISTER – OFFSET 9Ch.....                                   | 30 |
| 6.2.30. | NEXT ITEM POINTER REGISTER – OFFSET 9Ch.....                                   | 30 |
| 6.2.31. | VPD REGISTER – OFFSET 9Ch.....   | 30 |
| 6.2.32. | VPD DATA REGISTER – OFFSET A0h.....  | 31 |
| 6.2.33. | VENDOR SPECIFIC CAPABILITY ID REGISTER – OFFSET A4h.....                       | 31 |
| 6.2.34. | NEXT ITEM POINTER REGISTER – OFFSET A4h.....                                   | 31 |
| 6.2.35. | LENGTH REGISTER – OFFSET A4h.....  | 31 |
| 6.2.36. | XPIP CSR0 – OFFSET A8h (Test Purpose Only).....                                | 31 |
| 6.2.37. | XPIP CSR1 – OFFSET ACh (Test Purpose Only).....                                | 31 |
| 6.2.38. | REPLAY TIME-OUT COUNTER – OFFSET B0h.....                                      | 32 |
| 6.2.39. | ACKNOWLEDGE LATENCY TIMER – OFFSET B0h.....                                    | 32 |
| 6.2.40. | UART DRIVER SETTING – OFFSET B4h.....  | 32 |
| 6.2.41. | POWER MANAGEMENT CONTROL PARAMETER – OFFSET B8h.....                           | 33 |
| 6.2.42. | DEBUG REGISTER 1 – OFFSET BCh (Test Purpose Only).....                         | 33 |
| 6.2.43. | DEBUG REGISTER 2 – OFFSET C0h (Test Purpose Only).....                         | 33 |
| 6.2.44. | DEBUG REGISTER 3 – OFFSET C4h (Test Purpose Only).....                         | 33 |
| 6.2.45. | DEBUG REGISTER 4 – OFFSET C8h (Test Purpose Only).....                         | 33 |
| 6.2.46. | GPIO CONTROL REGISTER – OFFSET D8h.....  | 33 |
| 6.2.47. | EEPROM CONTROL REGISTER – OFFSET DCh.....                                      | 34 |
| 6.2.48. | PCI EXPRESS CAPABILITY ID REGISTER – OFFSET E0h.....                           | 34 |
| 6.2.49. | NEXT ITEM POINTER REGISTER – OFFSET E0h.....                                   | 34 |
| 6.2.50. | PCI EXPRESS CAPABILITIES REGISTER – OFFSET E0h.....                            | 34 |
| 6.2.51. | DEVICE CAPABILITIES REGISTER – OFFSET E4h.....                                 | 35 |
| 6.2.52. | DEVICE CONTROL REGISTER – OFFSET E8h.....                                      | 35 |
| 6.2.53. | DEVICE STATUS REGISTER – OFFSET E8h.....                                       | 36 |
| 6.2.54. | LINK CAPABILITIES REGISTER – OFFSET ECh.....                                   | 36 |
| 6.2.55. | LINK CONTROL REGISTER – OFFSET F0h.....  | 37 |
| 6.2.56. | LINK STATUS REGISTER – OFFSET F0h.....   | 37 |
| 6.2.57. | PCI EXPRESS ADVANCED ERROR REPORTING CAPABILITY ID REGISTER – OFFSET 100h..... | 38 |
| 6.2.58. | CAPABILITY VERSION – OFFSET 100h.....  | 38 |
| 6.2.59. | NEXT ITEM POINTER REGISTER – OFFSET 100h.....                                  | 38 |
| 6.2.60. | UNCORRECTABLE ERROR STATUS REGISTER – OFFSET 104h.....                         | 38 |
| 6.2.61. | UNCORRECTABLE ERROR MASK REGISTER – OFFSET 108h.....                           | 39 |
| 6.2.62. | UNCORRECTABLE ERROR SEVERITY REGISTER – OFFSET 10Ch.....                       | 40 |
| 6.2.63. | CORRECTABLE ERROR STATUS REGISTER – OFFSET 110h.....                           | 41 |
| 6.2.64. | CORRECTABLE ERROR MASK REGISTER – OFFSET 114h.....                             | 41 |
| 6.2.65. | ADVANCE ERROR CAPABILITIES AND CONTROL REGISTER – OFFSET 118h.....             | 41 |
| 6.2.66. | HEADER LOG REGISTER – OFFSET From 11Ch to 128h.....                            | 42 |

## 7. UART REGISTER DESCRIPTION.....43

|         |   |    |
|---------|---|----|
| 7.1.    | REGISTERS IN I/O MODE .....                                 | 43 |
| 7.1.1.  | RECEIVE HOLDING REGISTER – OFFSET 00h .....                 | 44 |
| 7.1.2.  | TRANSMIT HOLDING REGISTER – OFFSET 00h .....                | 44 |
| 7.1.3.  | INTERRUPT ENABLE REGISTER – OFFSET 01h .....                | 44 |
| 7.1.4.  | INTERRUPT STATUS REGISTER – OFFSET 02h .....                | 45 |
| 7.1.5.  | FIFO CONTROL REGISTER – OFFSET 02h .....                    | 45 |
| 7.1.6.  | LINE CONTROL REGISTER – OFFSET 03h .....                    | 46 |
| 7.1.7.  | MODEM CONTROL REGISTER – OFFSET 04h .....                   | 46 |
| 7.1.8.  | LINE STATUS REGISTER – OFFSET 05h .....                     | 47 |
| 7.1.9.  | MODEM STATUS REGISTER – OFFSET 06h .....                    | 48 |
| 7.1.10. | SPECIAL FUNCTION REGISTER – OFFSET 07h .....                | 48 |
| 7.1.11. | DIVISOR LATCH LOW REGISTER – OFFSET 00h, LCR[7] = 1 .....   | 49 |
| 7.1.12. | DIVISOR LATCH HIGH REGISTER – OFFSET 01h, LCR[7] = 1 .....  | 49 |
| 7.1.13. | SAMPLE CLOCK REGISTER – OFFSET 02h, LCR[7] = 1 .....        | 49 |
| 7.2.    | REGISTERS IN MEMORY-MAPPING MODE .....                      | 50 |
| 7.2.1.  | RECEIVE HOLDING REGISTER – OFFSET 00h .....                 | 51 |
| 7.2.2.  | TRANSMIT HOLDING REGISTER – OFFSET 00h .....                | 52 |
| 7.2.3.  | INTERRUPT ENABLE REGISTER – OFFSET 01h .....                | 52 |
| 7.2.4.  | INTERRUPT STATUS REGISTER – OFFSET 02h .....                | 52 |
| 7.2.5.  | FIFO CONTROL REGISTER – OFFSET 02h .....                    | 53 |
| 7.2.6.  | LINE CONTROL REGISTER – OFFSET 03h .....                    | 53 |
| 7.2.7.  | MODEM CONTROL REGISTER – OFFSET 04h .....                   | 54 |
| 7.2.8.  | LINE STATUS REGISTER – OFFSET 05h .....                     | 54 |
| 7.2.9.  | MODEM STATUS REGISTER – OFFSET 06h .....                    | 55 |
| 7.2.10. | SPECIAL FUNCTION REGISTER – OFFSET 07h .....                | 56 |
| 7.2.11. | DIVISOR LATCH LOW REGISTER – OFFSET 08h .....               | 56 |
| 7.2.12. | DIVISOR LATCH HIGH REGISTER – OFFSET 09h .....              | 56 |
| 7.2.13. | ENHANCED FUNCTION REGISTER – OFFSET 0Ah .....               | 56 |
| 7.2.14. | XON SPECIAL CHARACTER 1 – OFFSET 0Bh .....                  | 57 |
| 7.2.15. | XON SPECIAL CHARACTER 2 – OFFSET 0Ch .....                  | 58 |
| 7.2.16. | XOFF SPECIAL CHARACTER 1 – OFFSET 0Dh .....                 | 58 |
| 7.2.17. | XOFF SPECIAL CHARACTER 2 – OFFSET 0Eh .....                 | 58 |
| 7.2.18. | ADVANCE CONTROL REGISTER – OFFSET 0Fh .....                 | 58 |
| 7.2.19. | TRANSMIT INTERRUPT TRIGGER LEVEL – OFFSET 10h .....         | 59 |
| 7.2.20. | RECEIVE INTERRUPT TRIGGER LEVEL – OFFSET 11h .....          | 59 |
| 7.2.21. | FLOW CONTROL LOW TRIGGER LEVEL – OFFSET 12h .....           | 59 |
| 7.2.22. | FLOW CONTROL HIGH TRIGGER LEVEL – OFFSET 13h .....          | 59 |
| 7.2.23. | CLOCK PRESCALE REGISTER – OFFSET 14h .....                  | 59 |
| 7.2.24. | RECEIVE FIFO DATA COUNTER – OFFSET 15h, SFR[6] = 0 .....    | 59 |
| 7.2.25. | LINE STATUS REGISTER COUNTER – OFFSET 15h, SFR[6] = 1 ..... | 60 |
| 7.2.26. | TRANSMIT FIFO DATA COUNTER – OFFSET 16h, SFR[7] = 1 .....   | 60 |
| 7.2.27. | SAMPLE CLOCK REGISTER – OFFSET 16h, SFR[7] = 0 .....        | 60 |
| 7.2.28. | GLOBAL LINE STATUS REGISTER – OFFSET 17h .....              | 60 |
| 7.2.29. | RECEIVE FIFO DATA REGISTERS – OFFSET 100h ~ 17Fh .....      | 61 |
| 7.2.30. | TRANSMIT FIFO DATA REGISTERS – OFFSET 100h ~ 17Fh .....     | 61 |
| 7.2.31. | LINE STATUS FIFO REGISTERS – OFFSET 180h ~ 1FFh .....       | 61 |
| 8.      | EEPROM INTERFACE .....                                      | 62 |
| 8.1.    | AUTO MODE EEPROM ACCESS .....                               | 62 |
| 8.2.    | EEPROM MODE AT RESET .....                                  | 62 |
| 8.3.    | EEPROM SPACE ADDRESS MAP AND DESCRIPTION .....              | 62 |
| 9.      | ELECTRICAL SPECIFICATION .....                              | 64 |
| 9.1.    | ABSOLUTE MAXIMUM RATINGS .....                              | 64 |

|            |                                  |           |
|------------|----------------------------------|-----------|
| 9.2.       | DC SPECIFICATIONS.....           | 64        |
| 9.3.       | AC SPECIFICATIONS.....           | 64        |
| <b>10.</b> | <b>CLOCK SCHEME .....</b>        | <b>67</b> |
| <b>11.</b> | <b>PACKAGE INFORMATION .....</b> | <b>68</b> |
| <b>12.</b> | <b>ORDER INFORMATION .....</b>   | <b>69</b> |



## Table of Tables

|  |    |
|--|----|
| TABLE 4-1 PIN-LIST OF 128-PIN LQFP .....         | 11 |
| TABLE 5-1 MODE SELECTION.....                    | 18 |
| TABLE 5-2 BAUD RATE GENERATOR SETTING .....      | 23 |
| TABLE 5-3 SAMPLE BAUD RATE SETTING.....          | 23 |
| TABLE 7-1 UART BASE ADDRESS IN I/O MODE.....     | 43 |
| TABLE 7-2 REGISTERS IN I/O MODE.....             | 44 |
| TABLE 7-3 UART BASE ADDRESS IN MEMORY MODE ..... | 50 |
| TABLE 7-4 MEMORY-MAP MODE .....                  | 51 |
| TABLE 9-1 ABSOLUTE MAXIMUM RATINGS .....         | 64 |
| TABLE 9-2 DC ELECTRICAL CHARACTERISTICS .....    | 64 |
| TABLE 9-3 TRANSMITTER CHARACTERISTICS.....       | 64 |
| TABLE 9-4 RECEIVER CHARACTERISTICS .....         | 65 |
| TABLE 10-1 INPUT CLOCK REQUIREMENTS .....        | 67 |

## List of Figures

|  |    |
|--|----|
| FIGURE 3-1 PI7C9X7954 BLOCK DIAGRAM .....                      | 10 |
| FIGURE 5-1 TRANSMIT AND RECEIVE FIFOs .....                    | 19 |
| FIGURE 5-2 INTERNAL LOOPBACK IN PI7C9X7954.....                | 21 |
| FIGURE 5-3 CRYSTAL OSCILLATOR AS THE CLOCK SOURCE .....        | 22 |
| FIGURE 5-4 EXTERNAL CLOCK SOURCE AS THE CLOCK SOURCE.....      | 22 |
| FIGURE 7-1 UART REGISTER BLOCK ARRANGEMENT IN I/O MODE .....   | 43 |
| FIGURE 7-2 UART REGISTER BLOCK ARRANGEMENT IN MEMORY MODE..... | 50 |
| FIGURE 11-1 PACKAGE OUTLINE DRAWING.....                       | 68 |

## 1. FEATURES

- x1 PCI Express link host interface
- Four high performance 950-class UARTs
- Compliant with PCI Express Base Specification 1.1
- Compliant with PCI Express CEM Specification 1.1
- Compliant with PCI Power Management 1.2
- Fully 16C550 software compatible UARTs
- 128-byte FIFO for each transmitter and receiver
- Baud rate up to 15 Mbps in asynchronous mode
- Flexible clock prescaler from 4 to 46
- Automated in-band flow control using programmable Xon/Xoff in both directions
- Automated out-of-band flow control using CTS#/RTS# and/or DSR#/DTR#
- Arbitrary trigger levels for receiver and transmitter FIFO interrupts and automatic in-band and out-of-band flow control
- Global Interrupt Status and readable FIFO levels to facilitate implementation of efficient device drivers
- Detection of bad data in the receiver FIFO
- Data framing size including 5, 6, 7, 8 and 9 bits
- Hardware reconfiguration through Microwire compatible EEPROM
- Operations via I/O or memory mapping
- Dual power operation (1.8V for PCIe I/O and core, 3.3V for UART I/O)
- Power dissipation: 0.8 W typical in normal mode
- Industrial Temperature Range -40° to 85°
- 128-pin LQFP, Pb-free and 100% Green

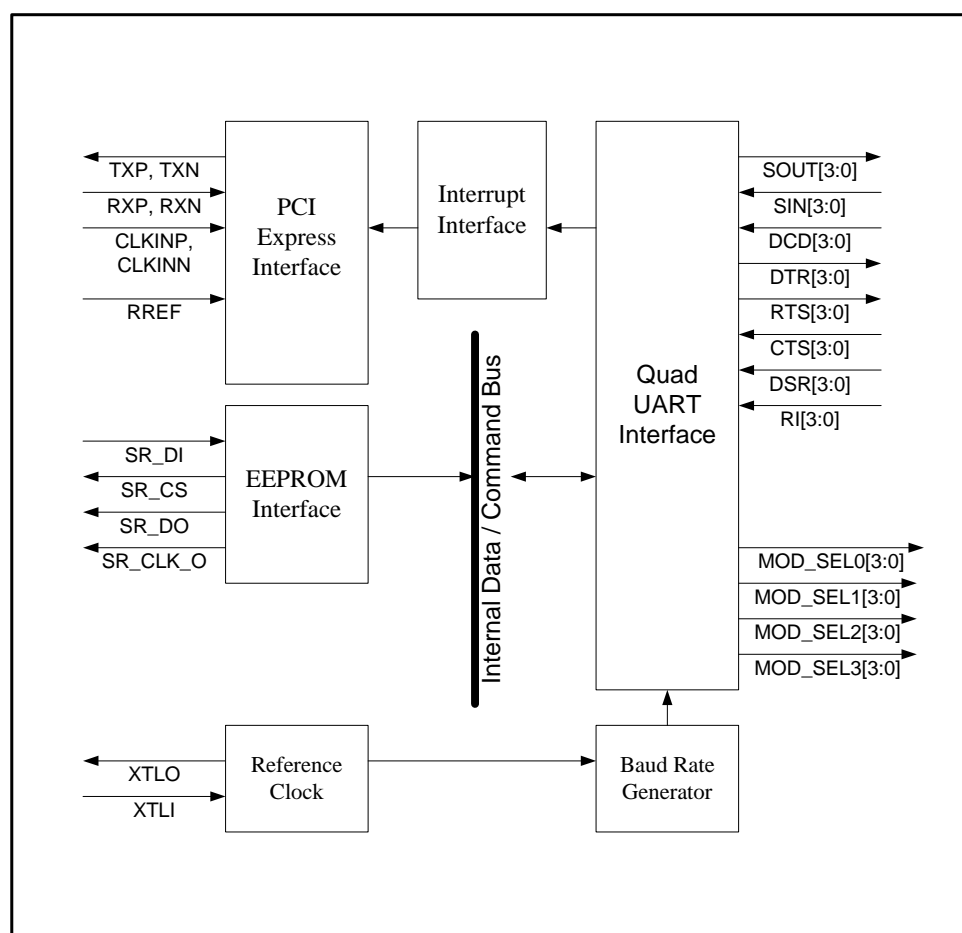
## 2. APPLICATIONS

- Remote Access Servers
- Network / Storage Management
- Factory Automation and Process Control
- Instrumentation
- Multi-port RS-232/ RS-422/ RS-485 Cards
- Point-of-Sale Systems (PoS)
- Industrial PC (IPC)
- Industrial Control
- Gaming Machines
- Building Automation
- Embedded Systems



### 3. GENERAL DESCRIPTION

The PI7C9X7954 is a PCI Express Quad UART (Universal Asynchronous Receiver-Transmitters) I/O Bridge. It is specifically designed to meet the latest system requirements of high performance and lead (Pb) -free. The bridge can be used in a wide range of applications such as Remote Access Servers, Automation, Process Control, Instrumentation, POS, ATM and Multi-port RS232/ RS422/ RS485 Cards. The PI7C9X7954 provides one x1 PCIe (dual simplex 2.5 Gbps) uplink port, and it is fully compliant with PCI express 1.1 and PCI power management 1.2 specifications. The bridge supports four high performance UARTs, each of which supports Baud rate up to 15 Mbps in asynchronous mode. The UARTs support in-band and out-band auto flow control, arbitrary trigger level, I/O mapping and memory mapping. The PI7C9X7954 is fully software compatible with 16C550 type device drivers and can be configured to fit the requirements of RS232, RS422 and RS485 applications. The EEPROM interface is provided for system implementation convenience. Some registers can be pre-programmed via hardware pin settings to facilitate system initialization. For programming flexibility, all of the default configuration registers can be overwritten by EEPROM data, such as sub-vendor and sub-system ID.



**Figure 3-1 PI7C9X7954 Block Diagram**

## 4. PIN ASSIGNMENT

### 4.1. PIN LIST OF 128-PIN LQFP

| PIN | NAME     | PIN | NAME                  | PIN | NAME                  | PIN | NAME        |
|-----|----------|-----|-----------------------|-----|-----------------------|-----|-------------|
| 1   | VDDR     | 33  | VDDC                  | 65  | DRIVER_SEL3[0]        | 97  | NC          |
| 2   | VDDR     | 34  | VDDCAUX               | 66  | DRIVER_SEL3[1]        | 98  | VDDC        |
| 3   | VSS      | 35  | VSS                   | 67  | DRIVER_SEL3[2]        | 99  | VDDC        |
| 4   | VSS      | 36  | PERST_L               | 68  | DRIVER_SEL3[3]        | 100 | VSS         |
| 5   | SCAN_EN  | 37  | TEST                  | 69  | VDDC                  | 101 | VSS         |
| 6   | XTLI     | 38  | GPIO[0]/DEQ[1]        | 70  | VSS                   | 102 | NC          |
| 7   | XTLO     | 39  | GPIO[1]/DEQ[2]        | 71  | SOUT[0]               | 103 | NC          |
| 8   | SR_CLK_O | 40  | VDDR                  | 72  | RTS[0]/EEPROM_BYPASS  | 104 | NC          |
| 9   | SR_DI    | 41  | VDDR                  | 73  | DTR[0]/TEST2          | 105 | NC          |
| 10  | SR_DO    | 42  | VSS                   | 74  | SIN[0]                | 106 | JTAG_TDI    |
| 11  | SR_CS    | 43  | GPIO[2]/DEQ[3]        | 75  | CTS[0]                | 107 | JTAG_TMS    |
| 12  | VDDC     | 44  | GPIO[3]/TXTERMADJ[0]  | 76  | DSR[0]                | 108 | JTAG_TCK    |
| 13  | VSS      | 45  | GPIO[4]/TXTERMADJ[1]  | 77  | RI[0]                 | 109 | JTAG_TDO    |
| 14  | WAKEUP_L | 46  | GPIO[5]/RXTERMADJ[0]  | 78  | DCD[0]                | 110 | JTAG_TRST_L |
| 15  | VSS      | 47  | GPIO[6]/RXTERMADJ[1]  | 79  | SOUT[1]/DEBUG_PIN     | 111 | NC          |
| 16  | CLKINP   | 48  | GPIO[7]/SR_ORG        | 80  | RTS[1]/UART_TEST_MODE | 112 | NC          |
| 17  | VDDA     | 49  | DRIVER_SEL0[0]/HI_DRV | 81  | DTR[1]                | 113 | NC          |
| 18  | CLKINN   | 50  | DRIVER_SEL0[1]/PHY_TM | 82  | SIN[1]                | 114 | NC          |
| 19  | VSS      | 51  | DRIVER_SEL0[2]/LO_DRV | 83  | CTS[1]                | 115 | VDDR        |
| 20  | VDDC     | 52  | DRIVER_SEL0[3]/DTX[0] | 84  | DSR[1]                | 116 | VDDR        |
| 21  | VTT      | 53  | VDDC                  | 85  | RI[1]                 | 117 | VSS         |
| 22  | TXN      | 54  | VSS                   | 86  | DCD[1]                | 118 | VSS         |
| 23  | TXP      | 55  | DRIVER_SEL1[0]/DTX[1] | 87  | SOUT[2]               | 119 | SOUT[3]     |
| 24  | VSS      | 56  | DRIVER_SEL1[1]/DTX[2] | 88  | RTS[2]                | 120 | RTS[3]      |
| 25  | VDDCAUX  | 57  | DRIVER_SEL1[2]/DTX[3] | 89  | DTR[2]                | 121 | DTR[3]      |
| 26  | RXP      | 58  | DRIVER_SEL1[3]/DEQ[0] | 90  | SIN[2]                | 122 | SIN[3]      |
| 27  | VSS      | 59  | DRIVER_SEL2[0]        | 91  | CTS[2]                | 123 | CTS[3]      |
| 28  | RXN      | 60  | DRIVER_SEL2[1]        | 92  | DSR[2]                | 124 | DSR[3]      |
| 29  | RREF     | 61  | DRIVER_SEL2[2]        | 93  | RI[2]                 | 125 | RI[3]       |
| 30  | VDDA     | 62  | DRIVER_SEL2[3]        | 94  | DCD[2]                | 126 | DCD[3]      |
| 31  | VSS      | 63  | VDDR                  | 95  | VDDR                  | 127 | VDDC        |
| 32  | VDDA     | 64  | VSS                   | 96  | VSS                   | 128 | VDDC        |

Table 4-1 Pin-List of 128-Pin LQFP

## 4.2. PIN DESCRIPTION

### 4.2.1. UART INTERFACE

| PIN NO.           | NAME       | TYPE | DESCRIPTION  |
|-------------------|------------|------|--|
| 119, 87, *79, 71  | SOUT [3:0] | O    | <p><b>UART Serial Data Outputs:</b> The output pins transmit serial data packets with start and end bits. SOUT[0] and SOUT[1] are output signals with weak internal pull-down resistors.</p> <p><b>DEBUG_PIN:</b> During system initialization, SOUT[1] acts as the DEBUG_IN pin, and it is used to internal debugging used only. In normal operation, it should be low. By default, it is set to '0' without pin strapped.</p>  |
| 122, 90, 82, 74   | SIN [3:0]  | I    | <b>UART Serial Data Inputs:</b> The input pins receive serial data packets with start and end bits. The pins are idle high.  |
| 126, 94, 86, 78   | DCD [3:0]  | I    | <b>Modem Data-Carrier-Detect Input and General Purpose Input (Active Low)</b>  |
| 121, 89, 81, *73  | DTR [3:0]  | O    | <p><b>Modem Data-Terminal-Ready Output (Active LOW):</b> If automated DTR# flow control is enabled, the DTR# pin is asserted and deasserted if the receiver FIFO reaches or falls below the programmed thresholds, respectively. DTR[0] and DTR[1] are output signals with weak internal pull-down resistors.</p> <p><b>TEST2:</b> During system initialization, DTR[0] acts as the TEST pin, and it is used for internal debugging used only. In normal operation, it should be low. By default, it is set to '0' without pin strapped.</p>   |
| 120, 88, *80, *72 | RTS [3:0]  | O    | <p><b>Modem Request-To-Send Output (Active LOW):</b> If automated RTS# flow control is enabled, the RTS# pin is deasserted and reasserted whenever the receiver FIFO reaches or falls below the programmed thresholds, respectively. RTS[0] and RTS[1] are output signals with weak internal pull-down resistors.</p> <p><b>UART_TEST_MODE:</b> During system initialization, RTS[1] acts as the UART_TEST_MODE pin, and it is used for internal debugging used only. In normal operation, it should be low. By default, it is set to '0' without pin strapped.</p> <p><b>EEPROM Bypass:</b> During system initialization, RTS[0] acts as the EEPROM Bypass pin, and it is used to bypass EEPROM pre-loading. The pin is active-high. When it is asserted at start-up, the EEPROM pre-loading is bypassed, and no configuration data is loaded from the EEPROM. Otherwise, configuration data is loaded from the EEPROM.</p> |
| 123, 91, 83, 75   | CTS [3:0]  | I    | <b>Modem Clear-To-Send Input (Active LOW):</b> If automated CTS# flow control is enabled, upon deassertion of the CTS# pin, the transmitter will complete the current character and enter the idle mode until the CTS# pin is reasserted. Note: flow control characters are transmitted regardless of the state of the CTS# pin.   |
| 124, 92, 84, 76   | DSR [3:0]  | I    | <b>Modem Data-Set-Ready Input (Active LOW):</b> If automated DSR# flow control is enabled, upon deassertion of the DSR# pin, the transmitter will complete the current character and enter the idle mode until the DSR# pin is reasserted. Note: flow control characters are transmitted regardless of the state of the DSR# pin.  |
| 125, 93, 85, 77   | RI [3:0]   | I    | <b>Modem Ring-Indicator Input (Active LOW)</b>   |
| 7                 | XTLO       | O    | <b>Crystal Oscillator Output</b>   |
| 6                 | XTLI       | I    | <b>Crystal Oscillator Input Or External Clock Pin:</b> The maximum frequency supported by this device is 60MHz.  |

| PIN NO.               | NAME                 | TYPE | DESCRIPTION   |
|-----------------------|----------------------|------|---|
| *52, *51,<br>*50, *49 | DRIVER_SEL0<br>[3:0] | O    | <p><b>DRIVER_SEL0:</b> Used to select RS-232/ RS-424/ 4-Wire RS-485/ 2-Wire RS-458 Serial Port Mode for UART 0. DRIVER_SEL0 [3:0] are output signals with weak internal pull-down resistors.</p> <p><b>Driver Current Level Control (DTX[0]):</b> During system initialization, DRIVER_SEL0[3] acts as the DTX[0] pin, and it is used to control the driver current level. By default, it is set to '0' without pin strapped.</p> <p><b>Low Driver Control (LO_DRV):</b> During system initialization, DRIVER_SEL0[2] acts as the LO_DRV pin, and it is used to decrease the nominal value of the PCI Express lane's driver current level. By default, it is set to '0' without pin strapped.</p> <p><b>PHY_TM:</b> During system initialization, DRIVER_SEL0[1] acts as the PHY_TM pin, and it is used for internal debugging used only. In normal operation, it should be low. By default, it is set to '0' without pin strapped.</p> <p><b>High Driver Control (HI_DRV):</b> During system initialization, DRIVER_SEL0[0] acts as the HI_DRV pin, and it is used to increase the nominal value of the PCI Express lane's driver current level. By default, it is set '0' without pin strapped.</p> |
| *58, *57,<br>*56, *55 | DRIVER_SEL1<br>[3:0] | O    | <p><b>DRIVER_SEL1:</b> Used to select RS-232/ RS-424/ 4-Wire RS-485/ 2-Wire RS-458 Serial Port Mode for UART 1. DRIVER_SEL1 [3:0] are output signals with weak internal pull-down resistors.</p> <p><b>Driver Equalization Level Control (DEQ[0]):</b> During system initialization, DRIVER_SEL1[3] acts as the DEQ[0] pin, and it is used to control the driver current level. By default, it is set to '0' without pin strapped.</p> <p><b>Driver Current Level Control (DTX[3:1]):</b> During system initialization, DRIVER_SEL1[2:0] acts as the DTX[3:1] pins, and they are used to control the driver current level. By default, they are set to '000' without pin strapped.</p>  |
| 62, 61, 60,<br>59     | DRIVER_SEL2<br>[3:0] | O    | <p><b>DRIVER_SEL2:</b> Used to select RS-232/ RS-424/ 4-Wire RS-485/ 2-Wire RS-458 Serial Port Mode for UART 2. DRIVER_SEL2[3] is an output signal with a weak internal pull-up resistor, and other DRIVER_SEL2 signals are output signals with internal pull-down resistors.</p>   |
| 68, 67, 66,<br>65     | DRIVER_SEL3<br>[3:0] | O    | <p><b>DRIVER_SEL3:</b> Used to select RS-232/ RS-424/ 4-Wire RS-485/ 2-Wire RS-458 Serial Port Mode for UART 3. DRIVER_SEL3 [3:0] are output signals with weak internal pull-up resistors.</p>  |

#### 4.2.2. PCI EXPRESS INTERFACE

| PIN NO. | NAME              | TYPE | DESCRIPTION   |
|---------|-------------------|------|---|
| 23, 22  | TXP, TXN          | O    | <b>PCI Express Serial Output Signal:</b> Differential PCI Express output signals.   |
| 26, 28  | RXP, RXN          | I    | <b>PCI Express Serial Input Signal:</b> Differential PCI Express input signals.   |
| 16, 18  | CLKINP,<br>CLKINN | I    | <p><b>Reference Input Clock:</b> Connects to external 100MHz differential clock</p> <p>The input clock signals must be delivered to the clock buffer cell through an AC-coupled interface so that only the AC information of the clock is received, converted, and buffered. It is recommended that a 0.1uF be used in the AC-coupling.</p> |
| 29      | RREF              | I    | <p><b>Reference Resistor:</b> To accurately set internal bias references, a precision resistor must be connected between <b>Rref</b> and <b>Vss</b>. The resistor should have a nominal value of 2.1 KΩ and accuracy of +/- 1%</p>  |

#### 4.2.3. SYSTEM INTERFACE

| PIN NO.   | NAME       | TYPE | DESCRIPTION  |
|---|------------|------|--|
| 36  | PEREST_L   | I    | <b>System Reset Input</b>  |
| *48, *47,<br>*46, *45,<br>*44, *43,<br>*39, *38 | GPIO [7:0] | I/O  | <p><b>General-Purpose Bi-Direction Signals / SR_ORG:</b> These eight general-purpose pins are programmed as either input-only or bi-directional pins by writing the GPIO output enable control register. GPIO[2] is a bi-directional signal with a weak internal pull-up resistor, and other GPIO pins are bi-directional signals with weak internal pull-down resistors.</p> <p><b>EEPROM Organization Pin (SR_ORG):</b> During system initialization, GPIO[7] acts as the SR_ORG pin, and it is used to select the organization structure of the EEPROM. The pin is active-high. When it is asserted at start-up, the EEPROM configuration data is organized in 16-bit structure. Otherwise, 8-bit structure is used.</p> <p><b>Receiver Termination Adjustment (RXTERMADJ[1:0]):</b> During system initialization, GPIO[6:5] acts as the RXTERMADJ[1:0] pins, and they are used to adjust the receive termination resistor value. By default, they are set to '00' without pin strapped.</p> <p><b>Transmit Termination Adjustment (TXTERMADJ[1:0]):</b> During system initialization, GPIO[4:3] acts as the TXTERMADJ[1:0] pins, and they are used to adjust the transmit termination resistor value. By default, they are set to "00" without pin strapped.</p> <p><b>Driver Equalization Level Control (DEQ[3:1]):</b> During system initialization, GPIO[2:0] acts as the DEQ[3:1] pins, and they are used to control the driver current level. By default, they are set to '100' without pin strapped.</p> |
| 14  | WAKEUP_L   | O    | <b>Wakeup Signal (Active LOW):</b> When the Ring Indicator is received on UART channel 0 in L2 state, the WAKEUP_L is asserted. WAKEUP_L is an output signal with a weak internal pull-down resistor.  |

#### 4.2.4. TEST SIGNALS

| PIN NO.   | NAME       | TYPE | DESCRIPTION   |
|---|------------|------|---|
| 106   | JTG_TDI    | I    | <b>Test Data Input:</b> When SCAN_EN is high, the pin is used (in conjunction with TCK) to shift data and instructions into the TAP in a serial bit stream. JTG_TDI is an input signal with a weak internal pull-up resistor. |
| 109   | JTG_TDO    | O    | <b>Test Data Output:</b> When SCAN_EN is high, it is used (in conjunction with TCK) to shift data out of the Test Access Port (TAP) in a serial bit stream.   |
| 107   | JTG_TMS    | I    | <b>Test Mode Select:</b> Used to control the state of the Test Access Port controller. JTG_TMS is an input signal with a weak internal pull-up resistor.  |
| 108   | JTG_TCK    | I    | <b>Test Clock:</b> Used to clock state information and data into and out of the chip during boundary scan.  |
| 110   | JTG_TRST_L | I    | <b>Test Reset:</b> Active LOW signal to reset the TAP controller into an initialized state. JTG_TRST_L is an input signal with a weak internal pull-up resistor.  |
| 5   | SCAN_EN    | I    | <b>Scan Test Enable Pin:</b> SCAN_EN is an input signal with a weak internal pull-up resistor.  |
| 37  | TEST       | I    | This input signal should be tied to ground during normal operation.   |
| 97, 102, 103,<br>104, 105,<br>111, 112,<br>113, 114 | NC         |      | These pins can be left floating.  |

#### 4.2.5. EEPROM INTERFACE

| PIN NO. | NAME     | TYPE | DESCRIPTION   |
|---------|----------|------|---|
| 11      | SR_CS    | O    | <b>EEPROM Chip Select:</b> SR_CS is an output signal with a weak internal pull-up resistor.   |
| 10      | SR_DO    | O    | <b>EEPROM Data Output:</b> Serial data output interface to the EEPROM. SR_DO is an output signal with a weak internal pull-up resistor. |
| 9       | SR_DI    | I    | <b>EEPROM Data Input:</b> Serial data input interface to the EEPROM. SR_DI is an input signal with a weak internal pull-up resistor.    |
| 8       | SR_CLK_O | O    | <b>EEPROM Clock Output.</b>   |

#### 4.2.6. POWER PINS

| PIN NO.   | NAME    | TYPE | DESCRIPTION   |
|---|---------|------|---|
| 12, 20, 33,<br>53, 69, 98,<br>99, 127, 128  | VDDC    | P    | <b>1.8 V Power Pin:</b> Used as digital core power pins.  |
| 17, 30, 32,   | VDDA    | P    | <b>1.8 V Power Pin:</b> Used as analog core power pins.   |
| 1, 2, 40, 41,<br>63, 95, 115,<br>116  | VDDR    | P    | <b>3.3 V Power Pin:</b> Used as digital I/O power pins.   |
| 25, 34  | VDDCAUX | P    | <b>1.8 V Power Pin:</b> Used as auxiliary power pins.   |
| 21  | VTT     | P    | <b>1.8V Termination Voltage:</b> Provides driver termination voltage at transmitter. Should be given the same consideration as VDDCAUX. |
| 3, 4, 13, 15,<br>19, 24, 27,<br>31, 35, 42,<br>54, 64, 70,<br>96, 100, 101,<br>117, 118 | VSS     | P    | <b>Ground Pin:</b> Used as ground pins.   |

## 5. FUNCTIONAL DESCRIPTION

The PI7C9X7954 is an integrated solution of four high-performance 16C550 UARTs with one x1 PCI Express host interface. The PCI Express host interface is compliant with the PCI Express Base Specification 1.1, PCI Express CEM Specification 1.1, and PCI Power Management 1.2. In addition, the chip is compliant with the Advanced Configuration Power Interface (ACPI) Specification and the PCI Standard Hot-Plug Controller (SHPC) and Subsystem Specification Revision 1.0. The x1 PCI Express host interface supports up to 2.5 Gbps bandwidth and complete PCI Express configuration register set. The PCI Express interface allows direct access to the configuration and status registers of the UART channels.

The UARTs in the PI7C9X7954 support the complete register set of the 16C550-type devices. The UARTs support Baud Rates up to 15 Mbps in asynchronous mode. Each UART channel has 128-byte deep transmit and receive FIFOs. The high-speed FIFOs reduce CPU utilization and improve data throughput. In addition, the UARTs support enhanced features including automated in-band flow control using programmable Xon/Xoff in both directions, automated out-band flow control using CTS#/ RTS# and/or DRS#/ DTR#, and arbitrary transmit and receive trigger levels.

### 5.1. CONFIGURATION SPACE

The PI7C9X7954 has two sets of registers to allow various configuration and status monitoring functions. The PCI Express Configuration Space Registers enable the plug-and-play and auto-configuration when the device is connected to the PCI Express system bus. The UART configuration and internal registers enable the general UART operation functions, status control and monitoring.

#### 5.1.1. PCI Express Configuration Space

The PI7C9X7954 is recognized as a PCI Express endpoint, which is mapped into the configuration space as a single logical device. Each endpoint in the system, including the PI7C9X7954, is part of a Hierarchy Domains originated by the Root Complex, which is a tree with a Root Port at its head in the configuration space. The device configuration registers are implemented for the user to access the functionalities provided by the PCI Express specification. The specification utilizes a flat memory-mapped configuration space to access device configuration registers.

All PCI Express endpoints facilitate a PCI-compatible configuration space to maintain compatibility with PCI software configuration mechanism. PCI Local Bus Specification, Revision 3.0 allocates 256 bytes per device function. PCI Express Base Specification 1.1 extends the configuration space to 4096 bytes to allow enhanced features. The first 256 bytes of the PCI Express Configuration Space are PCI 3.0 compatible region, and the rest of the 4096 bytes are PCI Express Configuration Space. The user can access the PCI 3.0 compatible region either by conventional PCI 3.0 configuration addresses or by the PCI Express memory-mapping addresses. These two types of accesses to the PCI 3.0 compatible region have identical results. The enhanced features in the PCI Express configuration space can only be accessed by PCI Express memory-mapping accesses.

#### 5.1.2. UART Configuration Space

Through the UART registers, the user can control and monitor various functionalities of the UARTs on the PI7C9X7954 including FIFOs, interrupt status, line status, modem status and sample clock. Each of the UART's transmit and receive data FIFOs can be conveniently accessed by reading and writing the registers in the UART configuration space. These registers allow flexible programming capability and versatile device operations of the PI7C9X7954. Each UART is accessed through an 8-byte I/O blocks. The addresses of the UART blocks are offset by the base address referred by the Base Address Register (BAR). The value of the base address is loaded from the I/O or Memory Base Address defined in the PCI Express configuration



space.

The PI7C9X7954 also supports enhanced features such as Xon/Xoff, automatic flow control, Baud Rate prescaling and various status monitoring. These enhanced features are available through the memory address offset by the BAR in the PCI Express configuration space.

The basic features available in the registers in I/O mode are also available in the registers in memory-mapping mode. Accesses to these registers are equivalent in these two modes.

The UARTs on the PI7C9X7954 supports operations in 16C450, 16C550 and 16C950 modes. These modes of operation are selected by writing the SFR, FCR and EFR registers. The PI7C9X7954 is backward compatible with these modes of operation.

## 5.2. DEVICE OPERATION

The PI7C9X7954 is configured by the Root Complex in the bootstrap process during system start-up. The Root Complex performs bus scans and recognizes the device by reading vendor and device IDs. Upon successful device identification, the system then loads device-specific driver software and allocates I/O, memory and interrupt resources. The driver software allows the user to access the functions of the device by reading and writing the UART registers. The PCI Express interface incorporates convenient device operation and high system performance.

### 5.2.1. Configuration Access

The PI7C9X7954 accepts type 0 configuration read and write accesses defined in the PCI Express Base1.1 Specification. The first 256 bytes of the PCI Express configuration are compatible with PCI 3.0.

### 5.2.2. I/O Reads/Writes

The PCI Express interface of the PI7C9X7954 decodes incoming transaction packets. If the address is within the region assigned by the I/O Base Address Registers, the transaction is recognized as an I/O Read or Write.

### 5.2.3. Memory Reads/Writes

Similar to the I/O Read/Write, if the address of the transaction packet is within the memory range, a Memory Read/Write occurs.

#### 5.2.4. Mode Selection

All of the internal UART channels in the I/O Bridge support the 16C450, 16C550, Enhanced 16C550, and Enhanced 950 UART Modes. The mode of the UART operation is selected by toggling the Special Function Register (SFR[5]) and Enhanced Function Register (EFR[4]). The FIFO depth of each mode and the mode selection is tabulated in the table below.

**Table 5-1 Mode Selection**

| UART Mode    | SFR[5] | EFR[4] | FIFO Size |
|--------------|--------|--------|-----------|
| 450/550      | X      | 0      | 1/16      |
| Enhanced 550 | 0      | 1      | 128       |
| Enhanced 950 | 1      | 1      | 128       |

#### 5.2.5. 450/550 Mode

The 450 Mode is inherently supported when 550 Mode is selected. When in the 450 Mode, the FIFOs are in the “Byte Mode”, which refers to the one-byte buffer in the Transmit Holding Register and the Receive Holding Register in each of the UART channels. When in the 550 Mode, the UARTs support an increased FIFO depth of 16.

When EFR[4] is set to “0”, the SFR[5] is ignored, and the 450/550 Mode is selected.

#### 5.2.6. Enhanced 550 Mode

Setting the SFR[5] to “0” and EFR[4] to “1” enables the Enhanced 550 Mode. The Enhanced 550 Mode further increases FIFO depth to 128.

#### 5.2.7. Enhanced 950 Mode

128-deep FIFOs are supported in the Enhanced 950 Mode. When the Enhanced 950 Mode is enabled, the UART channels support additional features:

- Sleep mode
- Special character detection
- Automatic in-band flow control
- Automatic flow control using selectable arbitrary thresholds
- Readable status for automatic in-band and out-of-band flow control
- Flexible clock prescaler
- Programmable sample clock
- DSR/DTR automatic flow control

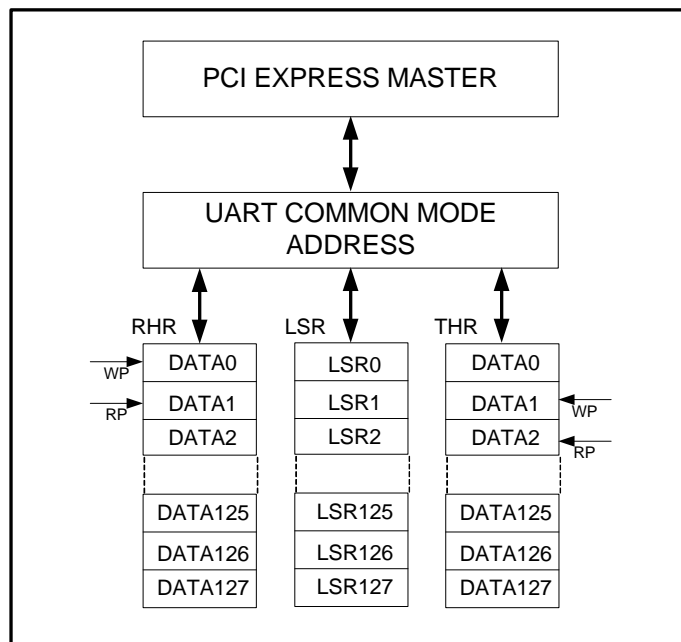
#### 5.2.8. Transmit and Receive FIFOs

Each channel of the UARTs consists of 128 bytes of transmit FIFOs and 128 bytes of receive FIFOs, namely the Transmit Holding Registers (THR) and the Receive Holding Registers (RHR). The FIFOs provide storage space for the data before they can be transmitted or processed. The THR and RHR operate simultaneously to transmit and read data.

The transmitter reads data from the THR into the Transmit Shift Register (TSR) and removes the data from top of the THR. It then converts the data into serial format with start and stop bits and parity bits if required. If the transmitter completes transmitting the data in the TSR and the THR is empty, the transmitter is in the idle state. The data that arrive most recently are written to the bottom of the THR. If the THR is full, and the user attempts to write data to the THR, a data overrun occurs and the data is lost.

The receiver writes data to the bottom of the RHR when it finishes receiving and decoding the data bits. If the RHR is full when the receiver attempts to write data to it, a data overrun occurs. Any read operation to an empty RHR is invalid.

The empty and full status of the THR and RHR can be determined by reading the empty and full flags in the Line Status Register (LSR). When the transmitter and receiver are ready to transfer data to and from the FIFOs, interrupts are raised to signal this condition. Additionally, the user can use the Receive FIFO Data Counter (RFDC) and Transmit FIFO Data Counter (TFDC) registers to determine the number of items in each FIFO.



**Figure 5-1 Transmit and Receive FIFOs**

### 5.2.9. Automated Flow Control

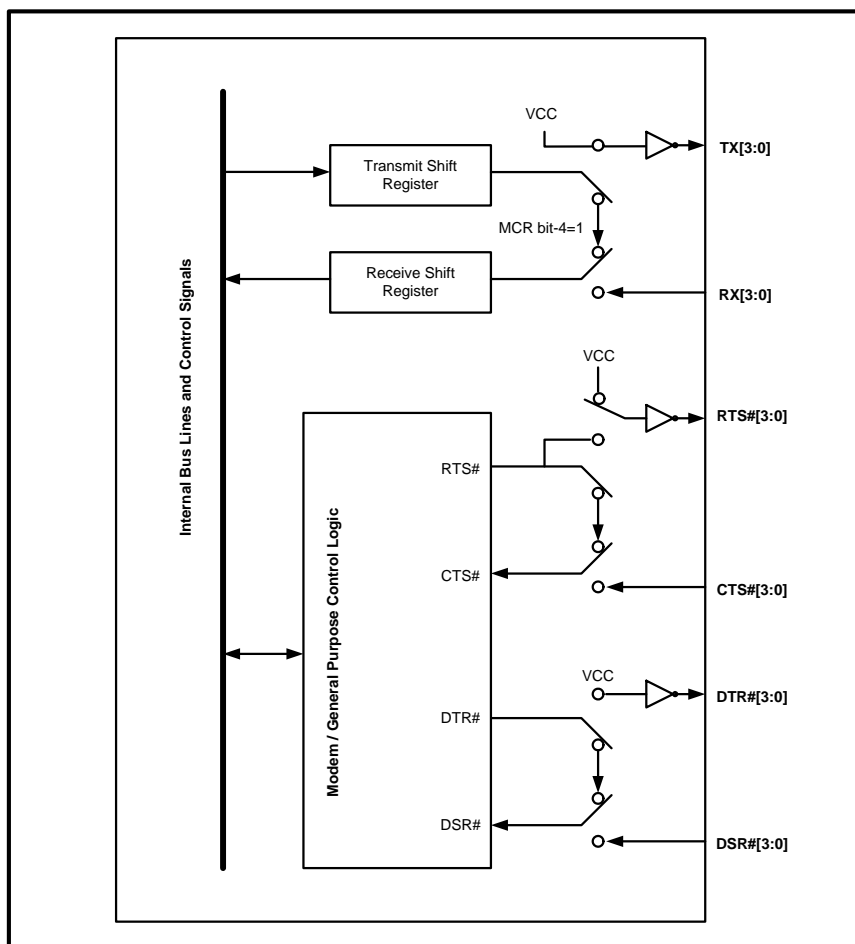
The device uses automatic in-band flow control to prevent data-overflow to the local receive FIFO and remote receive FIFO. This feature works in conjunction with the special character detection. When an XOFF condition is detected, the UART transmitter will suspend any further data transmission after the current character transmission is completed. The transmitter will resume data-transmission as soon as an XON condition is detected. The automatic in-band feature is enabled by the Enhanced Function Register (EFR). EFR[1:0] enables the in-band receive flow control, and EFR[3:2] enables the in-band transmit flow control.

The out-of-band flow control utilizes RTS# and CTS# pins to suspend and resume the data transmission and to prevent data-overflow. An asserted CTS# pin signals the UART to suspend transmission due to a full remote receive FIFO. Upon detecting an asserted CTS# pin, the UART will complete the current character transmission and enters idle mode until the CTS# pin is deasserted.

The UART deasserts RTS# to signal the remote transmitter that the local receive FIFO reaches the programmed upper trigger level. When the local receive FIFO falls below the programmed lower trigger level, the RTS# is reasserted. The automatic out-of-band flow control is enabled by EFR[7:6].

### 5.2.10. Internal Loopback

The internal loopback capability of the UARTs is enabled by setting Modem Control Register bit-4 (MCR[4]) to 1. When the feature is enabled, the data from the output of the transmit shift register are looped back to the input of the receive shift register. This feature provides the users a way to perform system diagnostics by allowing the UART to receive the same data it is sending.

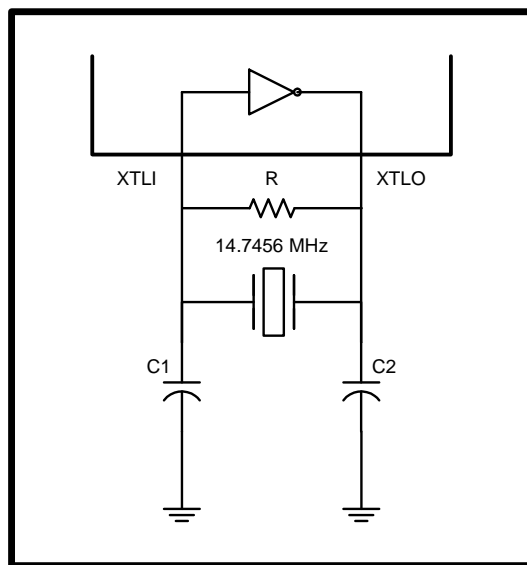


**Figure 5-2 Internal Loopback in PI7C9X7954**

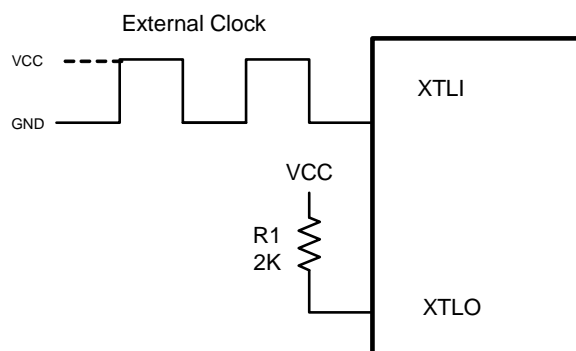
### 5.2.11. Crystal Oscillator

The PI7C9X7954 uses a crystal oscillator or an external clock source to provide system clock to the Baud Rate Generator. When a clock source is used, the clock signal should be connected to the XTLI pin, and a 2K pull-up resistor should be connected to the XTLO pin.

When a crystal oscillator is used, the XTLI is the input and XTLO is the output, and the crystal should be connected in parallel with two capacitors.



**Figure 5-3 Crystal Oscillator as the Clock Source**



**Figure 5-4 External Clock Source as the Clock Source**

### 5.2.12. Baud Rate Generation

The built-in Baud Rate Generator (BRG) allows a wide range of input frequency and flexible Baud Rate generation. To obtain the desired Baud Rate, the user can set the Sample Clock Register (SCR), Divisor Latch Low Register (DLL), Divisor Latch High Register (DLH) and Clock Prescale Registers (CPRM and CPRN). The Baud Rate is generated according to the following equation:

$$\text{BaudRate} = \frac{\text{InputFrequency}}{\text{Divisor} * \text{Prescaler}}$$

The parameters in the equation above can be programmed by setting the “SCR”, “DLL”, “DLH”, “CPRM” and “CPRN” registers according to the table below.

**Table 5-2 Baud Rate Generator Setting**

| Setting     | Description                      |
|-------------|----------------------------------|
| Divisor     | DLL + (256 * DLH)                |
| Prescaler   | $2^M * (\text{SampleClock} + N)$ |
| SampleClock | 16 – SCR, (SCR = ‘0h’ to ‘Ch’)   |
| M           | CPRM, (CPRM = ‘01h’ to ‘02h’)    |
| N           | CPRN, (CPRN = ‘0h’ to ‘7h’)      |

To ensure the proper operation of the Baud Rate Generator, users should avoid setting the value ‘0’ to Sample Clock, Divisor and Prescaler.

The following table lists some of the commonly used Baud Rates and the register settings that generate a specific Baud Rate. The examples assume an Input Clock frequency of 14.7456 Mhz. The SCR register is set to ‘0h’, and the CPRM and CPRN registers are set to ‘1h’ and ‘0h’ respectively. In these examples, the Baud Rates can be generated by different combination of the DLH and DLL register values.

**Table 5-3 Sample Baud Rate Setting**

| Baud Rate | DLH | DLL |
|-----------|-----|-----|
| 1,200     | 3h  | 00h |
| 2,400     | 1h  | 80h |
| 4,800     | 0h  | C0h |
| 9,600     | 0h  | 60h |
| 19,200    | 0h  | 30h |
| 28,800    | 0h  | 20h |
| 38,400    | 0h  | 18h |
| 57,600    | 0h  | 10h |
| 115,200   | 0h  | 08h |
| 921,600   | 0h  | 01h |

### 5.2.13. Power Management

The PI7C9X7954 supports the D0, D1, D2 and D3 power states. The device is compliant with PCI Power Management Specification Revision 1.2.



## 6. PCI EXPRESS REGISTER DESCRIPTION

### 6.1. REGISTER TYPES

| REGISTER TYPE | DEFINITION                            |
|---------------|---------------------------------------|
| HwInt         | Hardware Initialization               |
| RO            | Read Only                             |
| WO            | Write Only                            |
| RW            | Read / Write                          |
| RWC           | Read / Write 1 to Clear               |
| RWCS          | Sticky - Read Only / Write 1 to Clear |
| RWS           | Sticky - Read / Write                 |

### 6.2. CONFIGURATION REGISTERS

The following table details the allocation of the register fields of the PCI 2.3 compatible type 0 configuration space header.

| 31 – 24                            | 23 – 16     | 15 – 8                  | 7 – 0              | BYTE OFFSET |
|------------------------------------|-------------|-------------------------|--------------------|-------------|
| Device ID                          |             | Vendor ID               |                    | 00h         |
| Status                             |             | Command                 |                    | 04h         |
| Class Code                         |             |                         | Revision ID        | 08h         |
| Reserved                           | Header Type | Master Latency<br>Timer | Cache Line Size    | 0Ch         |
| Base Address Register 0            |             |                         |                    | 10h         |
| Base Address Register 1            |             |                         |                    | 14h         |
| Reserved                           |             |                         |                    | 18h~28h     |
| Subsystem ID                       |             | Subsystem Vendor ID     |                    | 2Ch         |
| Reserved                           |             |                         |                    | 30h         |
| Capability Pointer                 |             |                         |                    | 34h         |
| Reserved                           |             |                         |                    | 38h         |
| Reserved                           |             | Interrupt Pin           | Interrupt Line     | 3Ch         |
| Reserved                           |             |                         |                    | 40h – 7Fh   |
| Power Management Capabilities      |             | Next ID = 8C            | Capability ID = 01 | 80h         |
| PM Data                            | PPB Support | Power Management Data   |                    | 84h         |
| Message Control Register           |             | Next ID =9C             | Capability ID = 05 | 8Ch         |
| Message Address Register           |             |                         |                    | 90h         |
| Message Upper Address Register     |             |                         |                    | 94h         |
| Message Data Register              |             |                         |                    | 98h         |
| VPD Register                       |             | Next ID = A4            | Capability ID = 03 | 9Ch         |
| VPD Data Register                  |             |                         |                    | A0h         |
| Vendor Define Register(28h)        |             | Next ID = E0            | Capability ID = 09 | A4h         |
| XPIP CSR0                          |             |                         |                    | A8h         |
| XPIP CSR1                          |             |                         |                    | ACh         |
| ACK Latency Timer                  |             | Replay Time-out counter |                    | B0h         |
| UART Driver Selection              |             |                         |                    | B4h         |
| Power Management Control Parameter |             |                         |                    | B8h         |
| Debug Register                     |             |                         |                    | BCh – C4h   |
| PHY Parameter                      |             |                         |                    | C8h         |
| Reserved                           |             |                         |                    | CCh – D4h   |
| GPIO Data and Control              |             |                         |                    | D8h         |
| EEPROM Data                        |             | EEPROM Control          |                    | DCh         |
| PCI Express Capability Register    |             | Next ID = 00h           | Capability ID = 10 | E0h         |
| Device Capability                  |             |                         |                    | E4h         |
| Device Status                      |             | Device Control          |                    | E8h         |
| Link Capability                    |             |                         |                    | ECh         |
| Link Status                        |             | Link Control            |                    | F0h         |
| Reserved                           |             |                         |                    | F4h - FCh   |

Other than the PCI 2.3 compatible configuration space header, the I/O bridge also implements PCI express extended configuration space header, which includes advanced error reporting registers. The following table details the allocation of the register fields of PCI express extended capability space header. The first extended capability always begins at offset 100h with a PCI Express Enhanced Capability header and the rest of capabilities are located at an offset greater than 0FFh relative to the beginning of PCI compatible configuration space.

| 31 – 24  | 23 – 16            | 15 – 8                                    | 7 – 0 | BYTE OFFSET |
|--|--------------------|---|-------|-------------|
| Next Capability Offset = 000h                    | Capability Version | PCI Express Extended Capability ID = 001h |       | 100h        |
| Uncorrectable Error Status Register              |                    |   |       | 104h        |
| Uncorrectable Error Mask Register                |                    |   |       | 108h        |
| Uncorrectable Error Severity Register            |                    |   |       | 10Ch        |
| Correctable Error Status Register                |                    |   |       | 110h        |
| Correctable Error Mask Register                  |                    |   |       | 114h        |
| Advanced Error Capabilities and Control Register |                    |   |       | 118h        |
| Header Log Register                              |                    |   |       | 11Ch~128h   |

#### 6.2.1. VENDOR ID REGISTER – OFFSET 00h

| BIT  | FUNCTION  | TYPE | DESCRIPTION   |
|------|-----------|------|---|
| 15:0 | Vendor ID | RO   | Identifies Pericom as the vendor of this I/O bridge. The default value may be changed by auto-loading from EEPROM.<br><br>Reset to 12D8h. |

#### 6.2.2. DEVICE ID REGISTER – OFFSET 00h

| BIT   | FUNCTION  | TYPE | DESCRIPTION  |
|-------|-----------|------|--|
| 31:16 | Device ID | RO   | Identifies this I/O bridge as the PI7C9X7954. The default value may be changed by auto-loading from EEPROM.<br><br>Reset to 7954h. |

#### 6.2.3. COMMAND REGISTER – OFFSET 04h

| BIT | FUNCTION                           | TYPE | DESCRIPTION  |
|-----|------------------------------------|------|--|
| 0   | I/O Space Enable                   | RW   | Controls a device's response to I/O Space accesses. A value of 0 disables the device response. A value of 1 allows the device to respond to I/O Space accesses.<br><br>Reset to 0b.  |
| 1   | Memory Space Enable                | RW   | Controls a device's response to Memory Space accesses. A value of 0 disables the device response. A value of 1 allows the device to respond to memory Space accesses.<br><br>Reset to 0b.  |
| 2   | Bus Master Enable                  | RO   | It is not implemented. Hardwired to 0b.  |
| 3   | Special Cycle Enable               | RO   | Does not apply to PCI Express. Must be hardwired to 0b.  |
| 4   | Memory Write And Invalidate Enable | RO   | Does not apply to PCI Express. Must be hardwired to 0b.  |
| 5   | VGA Palette Snoop Enable           | RO   | Does not apply to PCI Express. Must be hardwired to 0b.  |
| 6   | Parity Error Response Enable       | RW   | Controls the device's response to parity errors. When the bit is set, the device must take its normal action when a parity error is detected. When the bit is 0, the device sets its Detected Parity Error Status bit when an error is detected.<br><br>Reset to 0b. |
| 7   | Wait Cycle Control                 | RO   | Does not apply to PCI Express. Must be hardwired to 0b.  |

| BIT   | FUNCTION                 | TYPE | DESCRIPTION   |
|-------|--------------------------|------|---|
| 8     | SERR# enable             | RW   | This bit, when set, enables reporting of Non-fatal and Fatal errors detected by the device to the Root Complex.<br>Reset to 0b. |
| 9     | Fast Back-to-Back Enable | RO   | Does not apply to PCI Express. Must be hardwired to 0b.   |
| 10    | Interrupt Disable        | RW   | Controls the ability of the I/O bridge to generate INTx interrupt Messages.<br>Reset to 0b.                                     |
| 15:11 | Reserved                 | RO   | Reset to 00000b.  |

#### 6.2.4. STATUS REGISTER – OFFSET 04h

| BIT   | FUNCTION                  | TYPE | DESCRIPTION  |
|-------|---------------------------|------|--|
| 18:16 | Reserved                  | RO   | Reset to 000b.   |
| 19    | Interrupt Status          | RO   | Indicates that an INTx interrupt Message is pending internally to the device.<br>Reset to 0b.  |
| 20    | Capabilities List         | RO   | Set to 1 to enable support for the capability list (offset 34h is the pointer to the data structure)<br>Reset to 1b.                           |
| 21    | 66MHz Capable             | RO   | Does not apply to PCI Express. Must be hardwired to 0b.  |
| 22    | Reserved                  | RO   | Reset to 0b.   |
| 23    | Fast Back-to-Back Capable | RO   | Does not apply to PCI Express. Must be hardwired to 0b.  |
| 24    | Master Data Parity Error  | RWC  | It is not implemented. Hardwired to 0b.  |
| 26:25 | DEVSEL# Timing            | RO   | Does not apply to PCI Express. Must be hardwired to 0b.  |
| 27    | Signaled Target Abort     | RWC  | Set to 1 (by a completer) whenever completing a request in the I/O bridge side using Completer Abort Completion Status.<br>Reset to 0b.        |
| 28    | Received Target Abort     | RWC  | It is not implemented. Hardwired to 0b.  |
| 29    | Received Master Abort     | RWC  | It is not implemented. Hardwired to 0b.  |
| 30    | Signaled System Error     | RWC  | Set to 1 when the I/O bridge sends an ERR_FATAL or ERR_NONFATAL Message, and the SERR Enable bit in the Command register is 1.<br>Reset to 0b. |
| 31    | Detected Parity Error     | RWC  | Set to 1 whenever the I/O bridge receives a Poisoned TLP.<br>Reset to 0b.  |

#### 6.2.5. REVISION ID REGISTER – OFFSET 08h

| BIT | FUNCTION | TYPE | DESCRIPTION   |
|-----|----------|------|---|
| 7:0 | Revision | RO   | Indicates revision number of the I/O bridge. The default value may be changed by auto-loading from EEPROM.<br>Reset to 00h. |

#### 6.2.6. CLASS CODE REGISTER – OFFSET 08h

| BIT   | FUNCTION              | TYPE | DESCRIPTION  |
|-------|-----------------------|------|--|
| 15:8  | Programming Interface | RO   | Read as 02h to indicate no programming interfaces have been defined for PCI-to-PCI bridges |
| 23:16 | Sub-Class Code        | RO   | Read as 00h to indicate device is PCI-to-PCI bridge  |
| 31:24 | Base Class Code       | RO   | Read as 07h to indicate device is a bridge device  |

**6.2.7. CACHE LINE REGISTER – OFFSET 0Ch**

| BIT | FUNCTION        | TYPE | DESCRIPTION   |
|-----|-----------------|------|---|
| 7:0 | Cache Line Size | RW   | The cache line size register is set by the system firmware and the operating system to system cache line size. This field is implemented by PCI Express devices as a RW field for legacy compatibility purposes but has no impact on any PCI Express device functionality.<br><br>Reset to 00h. |

**6.2.8. MASTER LATENCY TIMER REGISTER – OFFSET 0Ch**

| BIT  | FUNCTION      | TYPE | DESCRIPTION  |
|------|---------------|------|--|
| 15:8 | Latency timer | RO   | Does not apply to PCI Express. Must be hardwired to 00h. |

**6.2.9. HEADER TYPE REGISTER – OFFSET 0Ch**

| BIT   | FUNCTION    | TYPE | DESCRIPTION   |
|-------|-------------|------|---|
| 23:16 | Header Type | RO   | Read as 00h to indicate that the register layout conforms to the standard PCI-to-PCI bridge layout. |

**6.2.10. BASE ADDRESS REGISTER 0 – OFFSET 10h**

| BIT  | FUNCTION       | TYPE | DESCRIPTION  |
|------|----------------|------|--|
| 31:0 | Base Address 0 | RW   | Use this I/O base address to map the UART 16550 compatible registers.<br>The base address can be allocated to 64 Bytes.<br><br>Reset to 00000001h. |

**6.2.11. BASE ADDRESS REGISTER 1 – OFFSET 14h**

| BIT  | FUNCTION       | TYPE | DESCRIPTION   |
|------|----------------|------|---|
| 31:0 | Base Address 1 | RW   | Use this memory base address to map the UART 16550 compatible and enhanced registers.<br>The base address can be allocated to 4096 Bytes.<br><br>Reset to 00000000h |

**6.2.12. SUBSYSTEM VENDOR REGISTER – OFFSET 2Ch**

| BIT  | FUNCTION      | TYPE | DESCRIPTION  |
|------|---------------|------|--|
| 15:0 | Sub Vendor ID | RO   | Indicates the sub-system vendor id. The default value may be changed by auto-loading from EEPROM.<br><br>Reset to 0000h. |

**6.2.13. SUBSYSTEM ID REGISTER – OFFSET 2Ch**

| BIT   | FUNCTION      | TYPE | DESCRIPTION  |
|-------|---------------|------|--|
| 31:16 | Sub System ID | RO   | Indicates the sub-system device id. The default value may be changed by auto-loading from EEPROM.<br><br>Reset to 0000h. |

**6.2.14. CAPABILITIES POINTER REGISTER – OFFSET 34h**

| BIT | FUNCTION             | TYPE | DESCRIPTION   |
|-----|----------------------|------|---|
| 7:0 | Capabilities Pointer | RO   | This optional register points to a linked list of new capabilities implemented by the device. This default value may be changed by auto-loading from EEPROM.<br><br>The default value is 80h. |

**6.2.15. INTERRUPT LINE REGISTER – OFFSET 3Ch**

| BIT | FUNCTION       | TYPE | DESCRIPTION   |
|-----|----------------|------|---|
| 7:0 | Interrupt Line | RW   | Used to communicate interrupt line routing information. POST software will write the routing information into this register as it initializes and configures the system.<br><br>Reset to 00h. |

**6.2.16. INTERRUPT PIN REGISTER – OFFSET 3Ch**

| BIT  | FUNCTION      | TYPE | DESCRIPTION  |
|------|---------------|------|--|
| 15:8 | Interrupt Pin | RO   | Identifies the legacy interrupt Message(s) the device uses.<br><br>Reset to 01h. |

**6.2.17. POWER MANAGEMENT CAPABILITY ID REGISTER – OFFSET 80h**

| BIT | FUNCTION                 | TYPE | DESCRIPTION  |
|-----|--------------------------|------|--|
| 7:0 | Enhanced Capabilities ID | RO   | Read as 01h to indicate that these are power management enhanced capability registers. |

**6.2.18. NEXT ITEM POINTER REGISTER – OFFSET 80h**

| BIT  | FUNCTION          | TYPE | DESCRIPTION  |
|------|-------------------|------|--|
| 15:8 | Next Item Pointer | RO   | The pointer points to the Power Management capability register (8Ch).<br><br>Reset to 8Ch. |

**6.2.19. POWER MANAGEMENT CAPABILITIES REGISTER – OFFSET 80h**

| BIT   | FUNCTION                       | TYPE | DESCRIPTION  |
|-------|--------------------------------|------|--|
| 18:16 | Power Management Revision      | RO   | Read as 011b to indicate the I/O bridge is compliant to Revision 1.1 of <i>PCI Power Management Interface Specifications</i> .                                       |
| 19    | PME# Clock                     | RO   | Does not apply to PCI Express. Must be hardwired to 0b.  |
| 20    | Auxiliary Power                | RO   | Read as 1b to indicate the I/O bridge forwards the PME# message in D3cold and an auxiliary power source is required.   |
| 21    | Device Specific Initialization | RO   | Read as 0b to indicate the I/O bridge does not have device specific initialization requirements. The default value may be changed by auto-loading from EEPROM.       |
| 24:22 | AUX Current                    | RO   | Reset as 111b to indicate the I/O bridge need 375 mA in D3 state. The default value may be changed by auto-loading from EEPROM.                                      |
| 25    | D1 Power State Support         | RO   | Read as 1b to indicate the I/O bridge supports the D1 power management state. The default value may be changed by auto-loading from EEPROM.                          |
| 26    | D2 Power State Support         | RO   | Read as 1b to indicate the I/O bridge supports the D2 power management state. The default value may be changed by auto-loading from EEPROM.                          |
| 31:27 | PME# Support                   | RO   | Read as 01000b to indicate the I/O bridge supports the forwarding of PME# message in all power states. The default value may be changed by auto-loading from EEPROM. |

### 6.2.20. POWER MANAGEMENT DATA REGISTER – OFFSET 84h

| BIT   | FUNCTION      | TYPE | DESCRIPTION   |
|-------|---------------|------|---|
| 1:0   | Power State   | RW   | Indicates the current power state of the I/O bridge. Writing a value of D0 causes a hot reset without asserting PEREST_L when the previous state was D3.<br><br>00b: D0 state<br>01b: D1 state<br>10b: D2 state<br>11b: D3 hot state<br><br>Reset to 00b.                                   |
| 2     | Reserved      | RO   | Read as 0b.   |
| 3     | No_Soft_Reset | RO   | When set, this bit indicates that I/O bridge transitioning from D3hot to D0 does not perform an internal reset.<br>When clear, an internal reset is performed when power state transits from D3hot to D0. The default value may be changed by auto-loading from EEPROM.<br><br>Reset to 0b. |
| 7:4   | Reserved      | RO   | Read as 0h.   |
| 8     | PME# Enable   | RW   | When asserted, the I/O bridge will generate the PME# message.<br><br>Reset to 0b.   |
| 12:9  | Data Select   | RW   | Select data registers.<br><br>Reset to 0h.  |
| 14:13 | Data Scale    | RO   | Read as 00b.  |
| 15    | PME status    | RO   | Indicates that the PME# message is pending internally to the I/O bridge.<br><br>Reset to 0b.  |

### 6.2.21. PPB SUPPORT EXTENSIONS – OFFSET 84h

| BIT   | FUNCTION                            | TYPE | DESCRIPTION   |
|-------|-------------------------------------|------|---|
| 21:16 | Reserved                            | RO   | Reset to 000000b.                                       |
| 22    | B2_B3 Support for D3 <sub>HOT</sub> | RO   | Does not apply to PCI Express. Must be hardwired to 0b. |
| 23    | Bus Power / Clock Control Enable    | RO   | Does not apply to PCI Express. Must be hardwired to 0b. |

### 6.2.22. PM DATA REGISTER – OFFSET 84h

| BIT   | FUNCTION         | TYPE | DESCRIPTION                           |
|-------|------------------|------|---------------------------------------|
| 31:24 | PM Data Register | RO   | PM Data Register.<br><br>Reset to 00h |

### 6.2.23. MESSAGE SIALED INTERRUPTS (MSI) Capability ID Register 8Ch

| BIT | FUNCTION               | TYPE | DESCRIPTION  |
|-----|------------------------|------|--|
| 7:0 | Enhanced Capability ID | RO   | Read as 05h to indicate that this is Message Signaled Interrupt capability register. |

### 6.2.24. MESSAGE SIALED INTERRUPTS (MSI) NEXT ITEM POINTER 8Ch

| BIT  | FUNCTION          | TYPE | DESCRIPTION   |
|------|-------------------|------|---|
| 15:8 | Next Item Pointer | RO   | The pointer points to the Vendor Specific capability register (9Ch).<br><br>Reset to 9Ch. |

**6.2.25. MESSAGE CONTROL REGISTER – OFFSET 8Ch**

| BIT   | FUNCTION                 | TYPE | DESCRIPTION   |
|-------|--------------------------|------|---|
| 16    | MSI Enable               | RW   | 0b: The function is prohibited from using MSI to request service<br>1b: The function is permitted to use MSI to request service and is prohibited from using its INTx # pin<br><br>Reset to 1'b0. |
| 19:17 | Multiple Message Capable | RO   | Read as 3'b000.   |
| 22:20 | Multiple Message Enable  | RW   | Reset to 3'b000.  |
| 23    | 64-bit address capable   | RO   | 0b: The function is not capable of generating a 64-bit message address<br>1b: The function is capable of generating a 64-bit message address<br><br>Reset to 1'b1.                                |
| 31:24 | Reserved                 | RO   | Reset to 8'h00.   |

**6.2.26. MESSAGE ADDRESS REGISTER – OFFSET 90h**

| BIT  | FUNCTION        | TYPE | DESCRIPTION  |
|------|-----------------|------|--|
| 1:0  | Reserved        | RO   | Reset to 00b.  |
| 31:2 | Message Address | RW   | If the message enable bit is set, the contents of this register specify the DWORD aligned address for MSI memory write transaction.<br><br>Reset to 0. |

**6.2.27. MESSAGE UPPER ADDRESS REGISTER – OFFSET 94h**

| BIT  | FUNCTION              | TYPE | DESCRIPTION  |
|------|-----------------------|------|--|
| 31:0 | Message Upper Address | RW   | This register is only effective if the device supports a 64-bit message address is set.<br><br>Reset to 00000000h. |

**6.2.28. MESSAGE DATA REGISTER – OFFSET 98h**

| BIT  | FUNCTION     | TYPE | DESCRIPTION     |
|------|--------------|------|-----------------|
| 15:0 | Message Data | RW   | Reset to 0000h. |

**6.2.29. VPD CAPABILITY ID REGISTER – OFFSET 9Ch**

| BIT | FUNCTION                 | TYPE | DESCRIPTION   |
|-----|--------------------------|------|---|
| 7:0 | Enhanced Capabilities ID | RO   | Read as 03h to indicate that these are VPD enhanced capability registers. |

**6.2.30. NEXT ITEM POINTER REGISTER – OFFSET 9Ch**

| BIT  | FUNCTION          | TYPE | DESCRIPTION  |
|------|-------------------|------|--|
| 15:8 | Next Item Pointer | RO   | The pointer points to the VPD capability register (A4h).<br><br>Reset to A4h |

**6.2.31. VPD REGISTER – OFFSET 9Ch**

| BIT | FUNCTION  | TYPE | DESCRIPTION  |
|-----|-----------|------|--|
| 16  | VPD Start | RW   | Starts VPD read or write cycle. Assert by software and is de-asserted by hardware. |



| BIT   | FUNCTION      | TYPE | DESCRIPTION   |
|-------|---------------|------|---|
|       |               |      | Reset to 0b.  |
| 17    | VPD Operation | RW   | 0b: Performs VPD read command to VPD table at the location as specified in VPD address<br>1b: Performs VPD write command to VPD table at the location as specified in VPD address<br><br>Reset to 0b. |
| 22:18 | VPD Address   | RW   | Contains DWORD address that is used to generate read or write cycle to the VPD table stored in EEPROM.<br><br>Reset to 00000b.  |
| 31:23 | Reserved      | RO   | Read as 000h.   |

#### 6.2.32. VPD DATA REGISTER – OFFSET A0h

| BIT  | FUNCTION | TYPE | DESCRIPTION  |
|------|----------|------|--|
| 31:0 | VPD Data | RW   | When read, it returns the last data read from VPD table at the location as specified in VPD Address.<br><br>When writes, it places the current data into VPD table at the location as specified in VPD Address.<br><br>Reset to 00000000h. |

#### 6.2.33. VENDOR SPECIFIC CAPABILITY ID REGISTER – OFFSET A4h

| BIT | FUNCTION                 | TYPE | DESCRIPTION  |
|-----|--------------------------|------|--|
| 7:0 | Enhanced Capabilities ID | RO   | Read as 09h to indicate that these are Vendor Specific capability registers. |

#### 6.2.34. NEXT ITEM POINTER REGISTER – OFFSET A4h

| BIT  | FUNCTION          | TYPE | DESCRIPTION   |
|------|-------------------|------|---|
| 15:8 | Next Item Pointer | RO   | The pointer points to the PCI Express capability register (E0h).<br><br>Reset to E0h. |

#### 6.2.35. LENGTH REGISTER – OFFSET A4h

| BIT   | FUNCTION           | TYPE | DESCRIPTION   |
|-------|--------------------|------|---|
| 31:16 | Length Information | RO   | The length field provides the information for number of bytes in the capability structure (including the ID and Next pointer bytes).<br><br>Reset to 28h. |

#### 6.2.36. XPIP CSR0 – OFFSET A8h (Test Purpose Only)

| BIT  | FUNCTION | TYPE | DESCRIPTION         |
|------|----------|------|---------------------|
| 31:0 | Reserved | RW   | Reset to 04001060h. |

#### 6.2.37. XPIP CSR1 – OFFSET ACh (Test Purpose Only)

| BIT  | FUNCTION | TYPE | DESCRIPTION          |
|------|----------|------|----------------------|
| 31:0 | Reserved | RW   | Reset to 004000271h. |

**6.2.38. REPLAY TIME-OUT COUNTER – OFFSET B0h**

| BIT   | FUNCTION                 | TYPE | DESCRIPTION  |
|-------|--------------------------|------|--|
| 11:0  | User Replay Timer        | RW   | A 12-bit register contains a user-defined value. The default value may be changed by auto-loading from EEPROM.<br><br>Reset to 000h.                       |
| 12    | Enable User Replay Timer | RW   | When asserted, the user-defined replay time-out value would be employed. The default value may be changed by auto-loading from EEPROM.<br><br>Reset to 0b. |
| 15:13 | Reserved                 | RO   | Reset to 000b.   |

**6.2.39. ACKNOWLEDGE LATENCY TIMER – OFFSET B0h**

| BIT   | FUNCTION                | TYPE | DESCRIPTION  |
|-------|-------------------------|------|--|
| 29:16 | User ACK Latency Timer  | RW   | A 14-bit register contains a user-defined value. The default value may be changed by auto-loading from EEPROM.<br><br>Reset to 0000h..                 |
| 30    | Enable User ACK Latency | RW   | When asserted, the user-defined ACK latency value would be employed. The default value may be changed by auto-loading from EEPROM.<br><br>Reset to 0b. |
| 31    | Reserved                | RO   | Reset to 0b.   |

**6.2.40. UART DRIVER SETTING – OFFSET B4h**

| BIT   | FUNCTION                         | TYPE | DESCRIPTION   |
|-------|----------------------------------|------|---|
| 3:0   | UART 0 Transmitter Driver Enable | RW   | UART 0 DRIVER. The default value may be changed by auto-loading from EEPROM.<br><br>0000b: RS232<br>0001b: RS422<br>1011b: RS485-4W<br>1111b: RS485-2W<br><br>Reset to 0000b. |
| 7:4   | UART 1 Transmitter Driver Enable | RW   | UART 1 DRIVER. The default value may be changed by auto-loading from EEPROM.<br><br>0000b: RS232<br>0001b: RS422<br>1011b: RS485-4W<br>1111b: RS485-2W<br><br>Reset to 0000b. |
| 11:8  | UART 2 Transmitter Driver Enable | RW   | UART 2 DRIVER. The default value may be changed by auto-loading from EEPROM.<br><br>0000b: RS232<br>0001b: RS422<br>1011b: RS485-4W<br>1111b: RS485-2W<br><br>Reset to 0000b. |
| 27:12 | Reserved                         | RW   | Reserved  |
| 31:28 | UART 3 Transmitter Driver Enable | RW   | UART 3 DRIVER. The default value may be changed by auto-loading from EEPROM.<br><br>0000b: RS232<br>0001b: RS422  |

| BIT | FUNCTION | TYPE | DESCRIPTION   |
|-----|----------|------|---|
|     |          |      | 1011b: RS485-4W<br>1111b: RS485-2W<br><br>Reset to 0000b. |

#### 6.2.41. POWER MANAGEMENT CONTROL PARAMETER – OFFSET B8h

| BIT  | FUNCTION                           | TYPE | DESCRIPTION  |
|------|------------------------------------|------|--|
| 5:0  | Power Management Control Parameter | RW   | The default value may be changed by auto-loading from EEPROM.<br>Reset to 000001b. |
| 31:6 | Reserved                           | RO   | Reset to 0000000h.   |

#### 6.2.42. DEBUG REGISTER 1 – OFFSET BCh (Test Purpose Only)

| BIT  | FUNCTION         | TYPE | DESCRIPTION  |
|------|------------------|------|--|
| 31:0 | Debug Register 1 | RO   | Used for test purpose only.<br>Reset to 00000000h. |

#### 6.2.43. DEBUG REGISTER 2 – OFFSET C0h (Test Purpose Only)

| BIT  | FUNCTION         | TYPE | DESCRIPTION  |
|------|------------------|------|--|
| 31:0 | Debug Register 2 | RO   | Used for test purpose only.<br>Reset to 00000000h. |

#### 6.2.44. DEBUG REGISTER 3 – OFFSET C4h (Test Purpose Only)

| BIT  | FUNCTION         | TYPE | DESCRIPTION  |
|------|------------------|------|--|
| 31:0 | Debug Register 3 | RO   | Used for test purpose only.<br>Reset to 00000000h. |

#### 6.2.45. DEBUG REGISTER 4 – OFFSET C8h (Test Purpose Only)

| BIT   | FUNCTION                          | TYPE  | DESCRIPTION  |
|-------|-----------------------------------|-------|--|
| 0     | Low Driver Current                | HwInt | It indicates the status of the strapping pin LODRV. The default value may be changed by auto-loading from EEPROM.          |
| 1     | High Driver Current               | HwInt | It indicates the status of the strapping pin HIDRV. The default value may be changed by auto-loading from EEPROM.          |
| 5:2   | Driver Transmit Current           | HwInt | It indicates the status of the strapping pins DTX[3:0]. The default value may be changed by auto-loading from EEPROM.      |
| 9:6   | De-emphasis Transmit Equalization | HwInt | It indicates the status of the strapping pins DEQ[3:0]. The default value may be changed by auto-loading from EEPROM.      |
| 11:10 | Receive Termination Adjustment    | HwInt | It indicates the status of the strapping pins RXTRMADJ[1:0]. The default value may be changed by auto-loading from EEPROM. |
| 13:12 | Transmit Termination Adjustment   | HwInt | It indicates the status of the strapping pins TXTRMADJ[1:0]. The default value may be changed by auto-loading from EEPROM. |
| 31:14 | Reserved                          | RO    | Reset to 00000h.   |

#### 6.2.46. GPIO CONTROL REGISTER – OFFSET D8h

| BIT | FUNCTION   | TYPE | DESCRIPTION  |
|-----|------------|------|--|
| 7:0 | GPIO Input | RO   | The current state of the GPIO[x] pin can be read from bit[x] in this register, where x=7 to 0. The bits are effective only when the corresponding GPIO I/O Enable bits are set to “0”. |

| BIT   | FUNCTION        | TYPE | DESCRIPTION  |
|-------|-----------------|------|--|
| 15:8  | GPIO I/O Enable | RW   | These 8 bits determine whether the GPIO pins are input or output pins. Bit[x+8] corresponds to GPIO[x], where x=7 to 0. If the bit is set to "0", the corresponding GPIO pin is an input pin. If the bit is set to "1", the corresponding GPIO pin is an output pin. |
| 23:16 | GPIO Output     | RW   | The current state of the GPIO[x] pin can be written by bit[x+16] in this register, where x=7 to 0. The bits are effective only when the corresponding GPIO I/O Enable bits are set to "1".   |
| 31:24 | Reserved        | RO   | Reserved   |

#### 6.2.47. EEPROM CONTROL REGISTER – OFFSET DCh

| BIT   | FUNCTION                 | TYPE | DESCRIPTION   |
|-------|--------------------------|------|---|
| 0     | EEPROM Start             | RW   | Starts the EEPROM read or write cycle.<br>Reset to 0b.  |
| 1     | Reserved                 | RO   | Reset to 0b.  |
| 2     | EEPROM Preload Control   | RW   | Enable preload start.<br>Reset to 0b.   |
| 4:3   | EEPROM Operation Command | RW   | EEPROM Operation Command.<br>00b: Reserved<br>01b: Write operation command<br>10b: Read operation command<br>11b: Reserved<br>Reset to 00b. |
| 15:5  | EEPROM Address           | RW   | EEPROM RW address.<br>Reset to 000h.  |
| 31:16 | EEPROM Write DATA Buffer | RW   | EEPROM write data buffer register.<br>Reset to 0000h.   |

#### 6.2.48. PCI EXPRESS CAPABILITY ID REGISTER – OFFSET E0h

| BIT | FUNCTION                 | TYPE | DESCRIPTION   |
|-----|--------------------------|------|---|
| 7:0 | Enhanced Capabilities ID | RO   | Read as 10h to indicate that these are PCI express enhanced capability registers. |

#### 6.2.49. NEXT ITEM POINTER REGISTER – OFFSET E0h

| BIT  | FUNCTION          | TYPE | DESCRIPTION   |
|------|-------------------|------|---|
| 15:8 | Next Item Pointer | RO   | Read as 00h. No other ECP registers.<br>Reset to 00h. |

#### 6.2.50. PCI EXPRESS CAPABILITIES REGISTER – OFFSET E0h

| BIT   | FUNCTION                 | TYPE | DESCRIPTION  |
|-------|--------------------------|------|--|
| 19:16 | Capability Version       | RO   | Read as 0001b to indicate the I/O bridge is compliant to Revision 1.0a of <i>PCI Express Base Specifications</i> . |
| 23:20 | Device/Port Type         | RO   | Indicates the type of Legacy PCI Express Endpoint device.<br>Reset to 1h.  |
| 24    | Slot Implemented         | RO   | It is not implemented. Hardwired to 0b.  |
| 29:25 | Interrupt Message Number | RO   | It is not implemented. Hardwired to 00000b.  |
| 31:30 | Reserved                 | RO   | Reset to 00b.  |

**6.2.51. DEVICE CAPABILITIES REGISTER – OFFSET E4h**

| BIT   | FUNCTION                        | TYPE | DESCRIPTION   |
|-------|---------------------------------|------|---|
| 2:0   | Max_Payload_Size Supported      | RO   | Indicates the maximum payload size that the I/O bridge can support for TLPs. The I/O bridge supports 128 bytes max payload size.<br><br>Reset to 000b.  |
| 4:3   | Phantom Functions Supported     | RO   | It is not implemented. Hardwired to 00b.  |
| 5     | Extended Tag Field Supported    | RO   | It is not implemented. Hardwired to 0b.   |
| 8:6   | Endpoint L0s Acceptable Latency | RO   | Acceptable total latency that an Endpoint can withstand due to the transition from L0s state to the L0 state.<br><br>Reset to 000b.   |
| 11:9  | Endpoint L1 Acceptable Latency  | RO   | Acceptable total latency that an Endpoint can withstand due to the transition from L1 state to the L0 state.<br><br>Reset to 000b.  |
| 12    | Attention Button Present        | RO   | It is not implemented. Hardwired to 0b.   |
| 13    | Attention Indicator Present     | RO   | It is not implemented. Hardwired to 0b.   |
| 14    | Power Indicator Present         | RO   | It is not implemented. Hardwired to 0b.   |
| 15    | Role_Base Error Reporting       | RO   | When set, indicated that the device implements the functionality originally defined in the Error Reporting ECN. The default value may be changed by auto-loading from EEPROM.<br><br>Reset to 1b.                   |
| 17:16 | Reserved                        | RO   | Reset to 00b.   |
| 25:18 | Captured Slot Power Limit Value | RO   | In combination with the Slot Power Limit Scale value, specifies the upper limit on power supplied by slot.<br><br>This value is set by the Set_Slot_Power_Limit message or hardwired to “00h”.<br><br>Reset to 00b. |
| 27:26 | Captured Slot Power Limit Scale | RO   | Specifies the scale used for the Slot Power Limit Value.<br><br>This value is set by the Set_Slot_Power_Limit message or hardwired to “00b”.<br><br>Reset to 00b.   |
| 31:28 | Reserved                        | RO   | Reset to 0h.  |

**6.2.52. DEVICE CONTROL REGISTER – OFFSET E8h**

| BIT | FUNCTION                             | TYPE | DESCRIPTION   |
|-----|--------------------------------------|------|---|
| 0   | Correctable Error Reporting Enable   | RW   | 0b: Disable Correctable Error Reporting.<br>1b: Enable Correctable Error Reporting.<br><br>Reset to 0b.     |
| 1   | Non-Fatal Error Reporting Enable     | RW   | 0b: Disable Non-Fatal Error Reporting.<br>1b: Enable Non-Fatal Error Reporting.<br><br>Reset to 0b.         |
| 2   | Fatal Error Reporting Enable         | RW   | 0b: Disable Fatal Error Reporting.<br>1b: Enable Fatal Error Reporting.<br><br>Reset to 0b.                 |
| 3   | Unsupported Request Reporting Enable | RW   | 0b: Disable Unsupported Request Reporting.<br>1b: Enable Unsupported Request Reporting.<br><br>Reset to 0b. |

| BIT   | FUNCTION                        | TYPE | DESCRIPTION  |
|-------|---------------------------------|------|--|
| 4     | Enable Relaxed Ordering         | RO   | It is not implemented.<br>Reset to 0b.   |
| 7:5   | Max_Payload_Size                | RW   | This field sets maximum TLP payload size for the device. Permissible values that can be programmed are indicated by the Max_Payload_Size Supported in the Device Capabilities register. Any value exceeding the Max_Payload_Size Supported written to this register results into clamping to the Max_Payload_Size Supported value.<br>Reset to 000b. |
| 8     | Extended Tag Field Enable       | RO   | It is not implemented. Hardwired to 0b.  |
| 9     | Phantom Function Enable         | RO   | It is not implemented. Hardwired to 0b.  |
| 10    | Auxiliary (AUX) Power PM Enable | RWS  | When set, indicates that the I/O bridge is enabled to draw AUX power independent of PME AUX power.<br>Reset to 0b.   |
| 11    | Enable No Snoop                 | RO   | It is not implemented. Hardwired to 0b.  |
| 14:12 | Max_Read_Request_Size           | RO   | It is not implemented. Hardwired to 000b.  |
| 15    | Reserved                        | RO   | Reset to 0b.   |

#### 6.2.53. DEVICE STATUS REGISTER – OFFSET E8h

| BIT   | FUNCTION                     | TYPE | DESCRIPTION   |
|-------|------------------------------|------|---|
| 16    | Correctable Error Detected   | RW1C | Asserted when correctable error is detected. Errors are logged in this register regardless of whether error reporting is enabled or not in the Device Control register.<br>Reset to 0b.   |
| 17    | Non-Fatal Error Detected     | RW1C | Asserted when non-fatal error is detected. Errors are logged in this register regardless of whether error reporting is enabled or not in the Device Control register.<br>Reset to 0b.     |
| 18    | Fatal Error Detected         | RW1C | Asserted when fatal error is detected. Errors are logged in this register regardless of whether error reporting is enabled or not in the Device Control register.<br>Reset to 0b.         |
| 19    | Unsupported Request Detected | RW1C | Asserted when unsupported request is detected. Errors are logged in this register regardless of whether error reporting is enabled or not in the Device Control register.<br>Reset to 0b. |
| 20    | AUX Power Detected           | RO   | Asserted when the AUX power is detected by the I/O bridge<br>Reset to 1b.   |
| 21    | Transactions Pending         | RO   | It is not implemented. Hardwired to 0b.   |
| 31:22 | Reserved                     | RO   | Reset to 000h.  |

#### 6.2.54. LINK CAPABILITIES REGISTER – OFFSET ECh

| BIT | FUNCTION           | TYPE | DESCRIPTION   |
|-----|--------------------|------|---|
| 3:0 | Maximum Link Speed | RO   | Indicates the Maximum Link Speed of the given PCIe Link.<br>Defined encodings are: 0001b, which indicates 2.5 Gb/s Link<br>Reset to 1h. |

| BIT   | FUNCTION                                     | TYPE | DESCRIPTION  |
|-------|--|------|--|
| 9:4   | Maximum Link Width                           | RO   | Indicates the maximum width of the given PCIe Link.<br>Reset to 000001b (x1).  |
| 11:10 | Active State Power Management (ASPM) Support | RO   | Indicates the level of ASPM supported on the given PCIe Link. The I/O bridge supports L0s and L1 entry. The default value may be changed by auto-loading from EEPROM.<br>Reset to 11b.   |
| 14:12 | L0s Exit Latency                             | RO   | Indicates the L0s exit latency for the given PCIe Link. The length of time this I/O bridge requires to complete transition from L0s to L0 is in the range of 256ns to less than 512ns. The default value may be changed by auto-loading from EEPROM.<br>Reset to 011b. |
| 17:15 | L1 Exit Latency                              | RO   | Indicates the L1 exit latency for the given PCIe Link. The length of time this I/O bridge requires to complete transition from L1 to L0 is in the range of 16us to less than 32us. The default value may be changed by auto-loading from EEPROM.<br>Reset to 000b.     |
| 23:18 | Reserved                                     | RO   | Reset to 00000b.   |
| 31:24 | Port Number                                  | RO   | It is not implemented. Hardwired to 00h.   |

#### 6.2.55. LINK CONTROL REGISTER – OFFSET F0h

| BIT  | FUNCTION                                     | TYPE | DESCRIPTION   |
|------|--|------|---|
| 1:0  | Active State Power Management (ASPM) Control | RW   | 00b: ASPM is Disabled.<br>01b: L0s Entry Enabled.<br>10b: L1 Entry Enabled.<br>11b: L0s and L1 Entry Enabled.<br><br>Note that the receiver must be capable of entering L0s even when the field is disabled.<br>Reset to 00b. |
| 2    | Reserved                                     | RO   | Reset to 0h.  |
| 3    | Read Completion Boundary (RCB)               | RO   | It is not implemented. Hardwired to 0b.   |
| 4    | Link Disable                                 | RO   | It is not implemented. Hardwired to 0b.   |
| 5    | Retrain Link                                 | RO   | It is not implemented. Hardwired to 0b.   |
| 6    | Common Clock Configuration                   | RW   | 0b: The components at both ends of a link are operating with asynchronous reference clock.<br>1b: The components at both ends of a link are operating with a distributed common reference clock.<br>Reset to 0b.              |
| 7    | Extended Synch                               | RW   | When set, it transmits 4096 FTS ordered sets in the L0s state for entering L0 state and transmits 1024 TS1 ordered sets in the L1 state for entering L0 state<br>Reset to 0b.   |
| 15:8 | RsvdP  | RO   | Reset to 00h.   |

#### 6.2.56. LINK STATUS REGISTER – OFFSET F0h

| BIT   | FUNCTION              | TYPE | DESCRIPTION  |
|-------|-----------------------|------|--|
| 19:16 | Link Speed            | RO   | Indicates the negotiated Link Speed of the given PCIe Link.<br>Defined encodings are: 0001b, which indicates 2.5 Gb/s Link<br>Reset to 1h. |
| 25:20 | Negotiated Link Width | RO   | Indicates the negotiated width of the given PCIe Link,<br>Reset to 000001b.  |



| BIT   | FUNCTION                 | TYPE | DESCRIPTION  |
|-------|--------------------------|------|--|
| 26    | Training Error           | RO   | When set, indicates a Link training error occurred. This bit is cleared by hardware upon successful training of the link to the L0 link state.<br><br>Reset to 0b. |
| 27    | Link Training            | RO   | When set, indicates the link training is in progress. Hardware clears this bit once link training is complete.<br><br>Reset to 0b.                                 |
| 28    | Slot Clock Configuration | RO   | It is not implemented. Hardwired to 0b.  |
| 31:29 | Reserved                 | RO   | Reset to 000b.   |

#### 6.2.57. PCI EXPRESS ADVANCED ERROR REPORTING CAPABILITY ID REGISTER – OFFSET 100h

| BIT  | FUNCTION                 | TYPE | DESCRIPTION   |
|------|--------------------------|------|---|
| 15:0 | Extended Capabilities ID | RO   | Read as 0001h to indicate that these are PCI express extended capability registers for advance error reporting. |

#### 6.2.58. CAPABILITY VERSION – OFFSET 100h

| BIT   | FUNCTION           | TYPE | DESCRIPTION  |
|-------|--------------------|------|--|
| 19:16 | Capability Version | RO   | Indicates PCI-SIG defined PCI Express capability structure version number.<br><br>Reset to 1h. |

#### 6.2.59. NEXT ITEM POINTER REGISTER – OFFSET 100h

| BIT   | FUNCTION               | TYPE | DESCRIPTION  |
|-------|------------------------|------|--|
| 31:20 | Next Capability Offset | RO   | Read as 00h. No other ECP registers.<br><br>Reset to 000h. |

#### 6.2.60. UNCORRECTABLE ERROR STATUS REGISTER – OFFSET 104h

| BIT  | FUNCTION                           | TYPE  | DESCRIPTION  |
|------|------------------------------------|-------|--|
| 0    | Training Error Status              | RW1CS | When set, indicates that the Training Error event has occurred.<br><br>Reset to 0b.              |
| 3:1  | Reserved                           | RO    | Reset to 000b.   |
| 4    | Data Link Protocol Error Status    | RW1CS | When set, indicates that the Data Link Protocol Error event has occurred.<br><br>Reset to 0b.    |
| 11:5 | Reserved                           | RO    | Reset to 0000000b.   |
| 12   | Poisoned TLP Status                | RW1CS | When set, indicates that a Poisoned TLP has been received or generated.<br><br>Reset to 0b.      |
| 13   | Flow Control Protocol Error Status | RW1CS | When set, indicates that the Flow Control Protocol Error event has occurred.<br><br>Reset to 0b. |
| 14   | Completion Timeout Status          | RW1CS | When set, indicates that the Completion Timeout event has occurred.<br><br>Reset to 0b.          |
| 15   | Completer Abort Status             | RW1CS | When set, indicates that the Completer Abort event has occurred.<br><br>Reset to 0b.             |

| BIT   | FUNCTION                         | TYPE  | DESCRIPTION  |
|-------|----------------------------------|-------|--|
| 16    | Unexpected Completion Status     | RW1CS | When set, indicates that the Unexpected Completion event has occurred.<br>Reset to 0b. |
| 17    | Receiver Overflow Status         | RW1CS | When set, indicates that the Receiver Overflow event has occurred.<br>Reset to 0b.     |
| 18    | Malformed TLP Status             | RW1CS | When set, indicates that a Malformed TLP has been received.<br>Reset to 0b.            |
| 19    | ECRC Error Status                | RW1CS | When set, indicates that an ECRC Error has been detected.<br>Reset to 0b.              |
| 20    | Unsupported Request Error Status | RW1CS | When set, indicates that an Unsupported Request event has occurred.<br>Reset to 0b.    |
| 31:21 | Reserved                         | RO    | Reset to 000h.   |

#### 6.2.61. UNCORRECTABLE ERROR MASK REGISTER – OFFSET 108h

| BIT  | FUNCTION                         | TYPE | DESCRIPTION   |
|------|----------------------------------|------|---|
| 0    | Training Error Mask              | RWS  | When set, the Training Error event is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.                                |
| 3:1  | Reserved                         | RO   | Reset to 000b.  |
| 4    | Data Link Protocol Error Mask    | RWS  | When set, the Data Link Protocol Error event is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.                      |
| 11:5 | Reserved                         | RO   | Reset to 0000000b.  |
| 12   | Poisoned TLP Mask                | RWS  | When set, an event of Poisoned TLP has been received or generated is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b. |
| 13   | Flow Control Protocol Error Mask | RWS  | When set, the Flow Control Protocol Error event is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.                   |
| 14   | Completion Timeout Mask          | RWS  | When set, the Completion Timeout event is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.                            |
| 15   | Completer Abort Mask             | RWS  | When set, the Completer Abort event is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.                               |
| 16   | Unexpected Completion Mask       | RWS  | When set, the Unexpected Completion event is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.                         |
| 17   | Receiver Overflow Mask           | RWS  | When set, the Receiver Overflow event is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.                             |
| 18   | Malformed TLP Mask               | RWS  | When set, an event of Malformed TLP has been received is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.             |

| BIT   | FUNCTION                       | TYPE | DESCRIPTION  |
|-------|--------------------------------|------|--|
| 19    | ECRC Error Mask                | RWS  | When set, an event of ECRC Error has been detected is not logged in the Header Log register and not issued as an Error Message to RC either.<br><br>Reset to 0b. |
| 20    | Unsupported Request Error Mask | RWS  | When set, the Unsupported Request event is not logged in the Header Log register and not issued as an Error Message to RC either.<br><br>Reset to 0b.            |
| 31:21 | Reserved                       | RO   | Reset to 000h.   |

#### 6.2.62. UNCORRECTABLE ERROR SEVERITY REGISTER – OFFSET 10Ch

| BIT   | FUNCTION                             | TYPE | DESCRIPTION                                      |
|-------|--------------------------------------|------|--|
| 0     | Training Error Severity              | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 1b. |
| 3:1   | Reserved                             | RO   | Reset to 000b.                                   |
| 4     | Data Link Protocol Error Severity    | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 1b. |
| 11:5  | Reserved                             | RO   | Reset to 0000000b.                               |
| 12    | Poisoned TLP Severity                | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 0b. |
| 13    | Flow Control Protocol Error Severity | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 1b. |
| 14    | Completion Timeout Error Severity    | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 0b. |
| 15    | Completer Abort Severity             | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 0b. |
| 16    | Unexpected Completion Severity       | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 0b. |
| 17    | Receiver Overflow Severity           | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 1b. |
| 18    | Malformed TLP Severity               | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 1b. |
| 19    | ECRC Error Severity                  | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 0b. |
| 20    | Unsupported Request Error Severity   | RWS  | 0b: Non-Fatal.<br>1b: Fatal.<br><br>Reset to 0b. |
| 31:21 | Reserved                             | RO   | Reset to 000h .                                  |

**6.2.63. CORRECTABLE ERROR STATUS REGISTER – OFFSET 110h**

| BIT   | FUNCTION                    | TYPE  | DESCRIPTION  |
|-------|-----------------------------|-------|--|
| 0     | Receiver Error Status       | RW1CS | When set, the Receiver Error event is detected.<br>Reset to 0b.                |
| 5:1   | Reserved                    | RO    | Reset to 0h.   |
| 6     | Bad TLP Status              | RW1CS | When set, the event of Bad TLP has been received is detected.<br>Reset to 0b.  |
| 7     | Bad DLLP Status             | RW1CS | When set, the event of Bad DLLP has been received is detected.<br>Reset to 0b. |
| 8     | REPLAY_NUM Rollover status  | RW1CS | When set, the REPLAY_NUM Rollover event is detected.<br>Reset to 0b.           |
| 11:9  | Reserved                    | RO    | Reset to 000b.   |
| 12    | Replay Timer Timeout status | RW1CS | When set, the Replay Timer Timeout event is detected.<br>Reset to 0b.          |
| 31:13 | Reserved                    | RO    | Reset to 00000h.   |

**6.2.64. CORRECTABLE ERROR MASK REGISTER – OFFSET 114h**

| BIT   | FUNCTION                  | TYPE | DESCRIPTION   |
|-------|---------------------------|------|---|
| 0     | Receiver Error Mask       | RWS  | When set, the Receiver Error event is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.                |
| 5:1   | Reserved                  | RO   | Reset to 0h.  |
| 6     | Bad TLP Mask              | RWS  | When set, the event of Bad TLP has been received is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.  |
| 7     | Bad DLLP Mask             | RWS  | When set, the event of Bad DLLP has been received is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b. |
| 8     | REPLAY_NUM Rollover Mask  | RWS  | When set, the REPLAY_NUM Rollover event is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.           |
| 11:9  | Reserved                  | RO   | Reset to 000b.  |
| 12    | Replay Timer Timeout Mask | RWS  | When set, the Replay Timer Timeout event is not logged in the Header Log register and not issued as an Error Message to RC either.<br>Reset to 0b.          |
| 31:13 | Reserved                  | RO   | Reset to 00000h .   |

**6.2.65. ADVANCE ERROR CAPABILITIES AND CONTROL REGISTER – OFFSET 118h**

| BIT | FUNCTION                | TYPE | DESCRIPTION   |
|-----|-------------------------|------|---|
| 4:0 | First Error Pointer     | ROS  | It indicates the bit position of the first error reported in the Uncorrectable Error Status register.<br>Reset to 00000b. |
| 5   | ECRC Generation Capable | RO   | When set, it indicates the I/O bridge has the capability to generate ECRC.<br>Reset to 1b.                                |
| 6   | ECRC Generation Enable  | RWS  | When set, it enables the generation of ECRC when needed.<br>Reset to 0b.  |

| BIT  | FUNCTION           | TYPE | DESCRIPTION   |
|------|--------------------|------|---|
| 7    | ECRC Check Capable | RO   | When set, it indicates the I/O bridge has the capability to check ECRC.<br>Reset to 1b. |
| 8    | ECRC Check Enable  | RWS  | When set, the function of checking ECRC is enabled.<br>Reset to 0b.                     |
| 31:9 | Reserved           | RO   | Reset to 000000h.   |

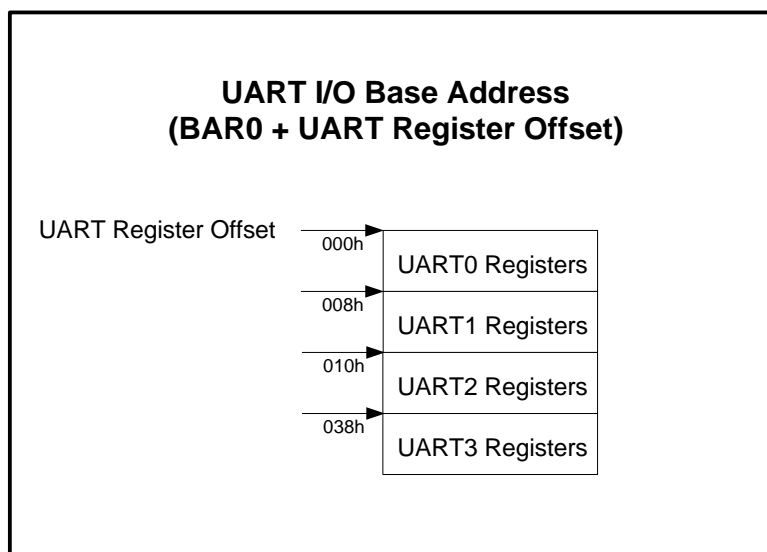
#### 6.2.66. HEADER LOG REGISTER – OFFSET From 11Ch to 128h

| BIT   | FUNCTION              | TYPE | DESCRIPTION   |
|-------|-----------------------|------|---|
| 3:0   | 1 <sup>st</sup> DWORD | RO   | Hold the 1st DWORD of TLP Header. The Head byte is in big endian. |
| 7:4   | 2 <sup>nd</sup> DWORD | RO   | Hold the 2nd DWORD of TLP Header. The Head byte is in big endian. |
| 11:8  | 3 <sup>rd</sup> DWORD | RO   | Hold the 3rd DWORD of TLP Header. The Head byte is in big endian. |
| 15:12 | 4 <sup>th</sup> DWORD | RO   | Hold the 4th DWORD of TLP Header. The Head byte is in big endian. |

## 7. UART REGISTER DESCRIPTION

### 7.1. REGISTERS IN I/O MODE

Each UART channel has a dedicated 8-byte register block in I/O mode. The register block can be accessed the UART I/O Base Address, which is obtained by adding the UART Register Offset to the content of the Base Address Register 0 (BAR0). The following diagram shows the arrangement of individual UART register blocks.



**Figure 7-1 UART Register Block Arrangement in I/O Mode**

**Table 7-1 UART Base Address in I/O Mode**

| UART  | UART I/O Base Address |
|-------|-----------------------|
| UART0 | BAR0 + 000h           |
| UART1 | BAR0 + 008h           |
| UART2 | BAR0 + 010h           |
| UART3 | BAR0 + 038h           |

Each register in the UART Register Block can be access by adding an offset to the UART I/O Base Address. The following table lists the arrangement of the registers in the UART Register Block in I/O mode.

**Table 7-2 Registers in I/O Mode**

| Offset   | Register Name             | Mnemonic | Register Type |
|--|---------------------------|----------|---------------|
| UART I/O Base Address + 00h                                | Receive Holding Register  | RHR      | RO            |
| UART I/O Base Address + 00h                                | Transmit Holding Register | THR      | WO            |
| UART I/O Base Address + 01h                                | Interrupt Enable Register | IER      | RW            |
| UART I/O Base Address + 02h                                | Interrupt Status Register | ISR      | RO            |
| UART I/O Base Address + 02h                                | FIFO Control Register     | FCR      | WO            |
| UART I/O Base Address + 03h                                | Line Control Register     | LCR      | RW            |
| UART I/O Base Address + 04h                                | Modem Control Register    | MCR      | RW            |
| UART I/O Base Address + 05h                                | Line Status Register      | LSR      | RO            |
| UART I/O Base Address + 06h                                | Modem Status Register     | MSR      | RO            |
| UART I/O Base Address + 07h                                | Special Function register | SFR      | RW            |
| <b>Additional Standard Registers (Required LCR[7] = 1)</b> |                           |          |               |
| UART I/O Base Address + 00h                                | Division Latch Low        | DLL      | RW            |
| UART I/O Base Address + 01h                                | Division Latch High       | DLH      | RW            |
| UART I/O Base Address + 02h                                | Sample Clock Register     | SCR      | RW            |

### 7.1.1. RECEIVE HOLDING REGISTER – OFFSET 00h

| BITS | FUNCTION   | TYPE | DESCRIPTION                        |
|------|------------|------|------------------------------------|
| 7:0  | Rx Holding | RO   | Data received<br><br>Reset to 00h. |

### 7.1.2. TRANSMIT HOLDING REGISTER – OFFSET 00h

| BITS | FUNCTION   | TYPE | DESCRIPTION                           |
|------|------------|------|---------------------------------------|
| 7:0  | Tx Holding | WO   | Data to transmit<br><br>Reset to 00h. |

### 7.1.3. INTERRUPT ENABLE REGISTER – OFFSET 01h

| BITS | FUNCTION                         | TYPE | DESCRIPTION   |
|------|----------------------------------|------|---|
| 0    | Rx Data Available Interrupt      | RW   | 0b: Disable the Receive Data Ready Interrupt<br>1b: Enable the Receive Data Ready Interrupt<br><br>Reset to 0b.                           |
| 1    | Tx Empty Interrupt               | RW   | 0b: Disable the Transmit Holding Register Empty Interrupt<br>1b: Enable the Transmit Holding Register Empty Interrupt<br><br>Reset to 0b. |
| 2    | Rx Status Interrupt              | RW   | 0b: Disable the Receive Line Status Interrupt<br>1b: Enable the Receive Line Status Interrupt<br><br>Reset to 0b.                         |
| 3    | Modem Status Interrupt           | RW   | 0b: Disable the Modem Status Register Interrupt<br>1b: Enable the Modem Status Register Interrupt<br><br>Reset to 0b.                     |
| 4    | Xoff/Special character interrupt | RW   | 0b: Disable the Software Flow Control Interrupt<br>1b: Enable the Software Flow Control Interrupt<br><br>Reset to 0b.                     |
| 5    | RTS Interrupt                    | RW   | 0b: Disable RTS/DTR Interrupt<br>1b: Enable RTS/DTR Interrupt<br><br>Reset to 0b.   |

| BIT | FUNCTION      | TYPE | DESCRIPTION   |
|-----|---------------|------|---|
| 6   | CTS Interrupt | RW   | 0b: Disable CTS/DSR interrupt<br>1b: Enable CTS/DSR interrupt<br><br>Reset to 0b. |
| 7   | Reserved      | RW   |   |

#### 7.1.4. INTERRUPT STATUS REGISTER – OFFSET 02h

| BIT | FUNCTION         | TYPE | DESCRIPTION  |
|-----|------------------|------|--|
| 7:0 | Interrupt Status | RO   | 0b: An interrupt is pending<br>1b: No interrupt pending<br><br>Reset to C1h. |

| Priority Level | Interrupt Status Bits |       |       |       |       |       |       |       | Interrupt Source                   |
|----------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|------------------------------------|
|                | BIT-7                 | BIT-6 | BIT-5 | BIT-4 | BIT-3 | BIT-2 | BIT-1 | BIT-0 |                                    |
| 1              | 1                     | 1     | 0     | 0     | 0     | 1     | 1     | 0     | Rx data error                      |
| 2              | 1                     | 1     | 0     | 0     | 0     | 1     | 0     | 0     | Rx data available                  |
| 3              | 1                     | 1     | 0     | 0     | 1     | 1     | 0     | 0     | Rx time-out                        |
| 4              | 1                     | 1     | 0     | 0     | 0     | 0     | 1     | 0     | Tx FIFO empty                      |
| 5              | 1                     | 1     | 0     | 0     | 0     | 0     | 0     | 0     | Modem status change                |
| 6              | 1                     | 1     | 0     | 1     | 0     | 0     | 0     | 0     | Xoff or special character detected |
| 7              | 1                     | 1     | 1     | 0     | 0     | 0     | 0     | 0     | CTS or RTS state changed           |
| X              | 1                     | 1     | 0     | 0     | 0     | 0     | 0     | 1     | No interrupt pending               |

#### 7.1.5. FIFO CONTROL REGISTER – OFFSET 02h

| BIT | FUNCTION         | TYPE | DESCRIPTION   |   |
|-----|------------------|------|---|---|
| 0   | FIFO Mode Enable | WO   | 0b: Disable the FIFO mode<br>1b: Enable the FIFO mode<br><br>Reset to 0b.                             |   |
| 1   | Rx FIFO Flush    | WO   | 0b: No action<br>1b: Reset the receive FIFO, self-clear after resetting the FIFO<br><br>Reset to 0b.  |   |
| 2   | Tx FIFO Flush    | WO   | 0b: No action<br>1b: Reset the transmit FIFO, self-clear after resetting the FIFO<br><br>Reset to 0b. |   |
| 3   | Reserved         | WO   | Reset to 0b.  |   |
| 5:4 | Tx Trigger Level | WO   | In the Enhanced Mode.<br><br>00b: 16<br>01b: 32<br>10b: 64<br>11b: 112<br><br>Reset to 00b.           |   |
| 7:6 | Rx Trigger Level | WO   | In the Non-Enhanced mode<br>00b: 1<br>01b: 4<br>10b: 8<br>11b: 14<br><br>Reset to 00b.                | In the Enhanced mode<br>00b: 15<br>01b: 31<br>10b: 63<br>11b: 111 |



**7.1.6. LINE CONTROL REGISTER – OFFSET 03h**

| BIT         | FUNCTION             | TYPE            | DESCRIPTION  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
|-------------|----------------------|-----------------|--|-------------|-------------|-----------------|------------------|---------|---|---|-----------|-----|---|-------|------------|---|---|---|-------------|---|---|---|------|---|---|---|-------|
| 1:0         | Data Length          | RW              | 00b: 5-bit data length<br>01b: 6-bit data length<br>10b: 7-bit data length<br>11b: 8-bit data length<br><br>Reset to 11b.  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 2           | Stop-Bit Length      | RW              | <table><tr><th>Bit 2 value</th><th>Data length</th><th>Stop bit length</th></tr><tr><td>0</td><td>5,6,7,8</td><td>1</td></tr><tr><td>1</td><td>5</td><td>1.5</td></tr><tr><td>1</td><td>6,7,8</td><td>2</td></tr></table><br>Reset to 0b.  | Bit 2 value | Data length | Stop bit length | 0                | 5,6,7,8 | 1 | 1 | 5         | 1.5 | 1 | 6,7,8 | 2          |   |   |   |             |   |   |   |      |   |   |   |       |
| Bit 2 value | Data length          | Stop bit length |  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 0           | 5,6,7,8              | 1               |  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 1           | 5                    | 1.5             |  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 1           | 6,7,8                | 2               |  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 5:3         | Parity Type          | RW              | <table><tr><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Parity selection</th></tr><tr><td>X</td><td>X</td><td>0</td><td>No parity</td></tr><tr><td>0</td><td>0</td><td>1</td><td>Odd parity</td></tr><tr><td>0</td><td>1</td><td>1</td><td>Even parity</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Mark</td></tr><tr><td>1</td><td>1</td><td>1</td><td>Space</td></tr></table><br>Reset to 000b. | Bit 5       | Bit 4       | Bit 3           | Parity selection | X       | X | 0 | No parity | 0   | 0 | 1     | Odd parity | 0 | 1 | 1 | Even parity | 1 | 0 | 1 | Mark | 1 | 1 | 1 | Space |
| Bit 5       | Bit 4                | Bit 3           | Parity selection   |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| X           | X                    | 0               | No parity  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 0           | 0                    | 1               | Odd parity   |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 0           | 1                    | 1               | Even parity  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 1           | 0                    | 1               | Mark   |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 1           | 1                    | 1               | Space  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 6           | Transmission Break   | RW              | 0b: No transmit break condition<br>1b: Force the transmitter output to a space for alerting the remote receiver of a line break condition.<br><br>Reset to 0b.   |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 7           | Divisor Latch Enable | RW              | 0b: Data registers are selected<br>1b: Divisor latch registers are selected<br><br>Reset to 0b.  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |

**7.1.7. MODEM CONTROL REGISTER – OFFSET 04h**

| BIT | FUNCTION               | TYPE | DESCRIPTION  |
|-----|------------------------|------|--|
| 0   | DTR Pin Control        | RW   | 0b: Forces DTR output high<br>1b: Forces DTR output low<br><br>Reset to 0b.  |
| 1   | RTS Pin Control        | RW   | 0b: Forces RTS output high<br>1b: Forces RTS output low<br><br>Reset to 0b.  |
| 2   | Output 1               | RW   | When the Internal Loopback Mode is enabled by setting Modem Control Register Bit[4], output of the Output1 is routed to RI.<br><br>Reset to 0b.  |
| 3   | Output 2               | RW   | When the Internal Loopback Mode is enabled by setting Modem Control Register Bit[4], output of the Output2 is routed to DCD.<br><br>Reset to 0b. |
| 4   | Internal Loopback Mode | RW   | 0b: Disables Internal Loopback Mode<br>1b: Enables Internal Loopback Mode<br><br>Reset to 0b.  |

| BIT             | FUNCTION              | TYPE  | DESCRIPTION   |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
|-----------------|-----------------------|---|---|-----------------|-----------------|---------------|---|---|---|---|---|---------------------------|---|---|-------------------------------------|
| 5               | AFE                   | RW  | <p>Autoflow Control Enable. When the AFE is enabled, autoflow control is enabled. When it is disabled, the diagnostic mode is enabled. In the diagnostic mode, transmitted data is immediately received.</p> <p>When AFE is set to “1”, MCR Bit 1 is used to enable and disable the auto-RTS.</p> <table><tr><th>MCR Bit 5 (AFE)</th><th>MCR Bit 1 (RTS)</th><th>Configuration</th></tr><tr><td>1</td><td>1</td><td>Auto-RTS and auto-CTS are enabled (autoflow control enabled).</td></tr><tr><td>1</td><td>0</td><td>Only auto-CTS is enabled.</td></tr><tr><td>0</td><td>x</td><td>Auto-RTS and auto-CTS are disabled.</td></tr></table> <p>Reset to 0b.</p> | MCR Bit 5 (AFE) | MCR Bit 1 (RTS) | Configuration | 1 | 1 | Auto-RTS and auto-CTS are enabled (autoflow control enabled). | 1 | 0 | Only auto-CTS is enabled. | 0 | x | Auto-RTS and auto-CTS are disabled. |
| MCR Bit 5 (AFE) | MCR Bit 1 (RTS)       | Configuration   |   |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 1               | 1                     | Auto-RTS and auto-CTS are enabled (autoflow control enabled). |   |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 1               | 0                     | Only auto-CTS is enabled.                                     |   |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 0               | x                     | Auto-RTS and auto-CTS are disabled.                           |   |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 6               | Reserved              |   | Reset to 0b.  |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 7               | Enhanced Transmission | RW  | <p>0b: Insert 1, 1.5 or 2 stop-bits between two transmitted characters.</p> <p>1b: Insert 0.5 stop-bits between two transmitted characters.</p> <p>Note: Enabling feature may result in certain compatibility issues. This feature is only recommended when using two Pericom UART devices.</p> <p>Reset to 0b.</p>   |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |

#### 7.1.8. LINE STATUS REGISTER – OFFSET 05h

| BIT | FUNCTION          | TYPE | DESCRIPTION   |
|-----|-------------------|------|---|
| 0   | Rx Data Available | RO   | <p>0b: No data in the receive FIFO<br/>           1b: Data in the receive FIFO</p> <p>Reset to 0b.</p>            |
| 1   | Rx FIFO Overrun   | RO   | <p>0b: No overrun error<br/>           1b: Overrun error</p> <p>Reset to 0b.</p>                                  |
| 2   | Rx Parity Error   | RO   | <p>0b: No parity error<br/>           1b: Parity error</p> <p>Reset to 0b.</p>                                    |
| 3   | Rx Frame Error    | RO   | <p>0b: No framing error<br/>           1b: Framing error</p> <p>Reset to 0b.</p>                                  |
| 4   | Rx Break Error    | RO   | <p>0b: No break condition<br/>           1b: Break condition</p> <p>Reset to 0b.</p>                              |
| 5   | Tx Empty          | RO   | <p>0b: Tx Holding Register is not empty.<br/>           1b: Tx Holding Register is empty.</p> <p>Reset to 0b.</p> |
| 6   | Tx Complete       | RO   | <p>0b: Tx Shift Register is not empty.<br/>           1b: Tx Shift Register is empty.</p> <p>Reset to 0b.</p>     |
| 7   | Rx Data Error     | RO   | <p>0b: No Rx FIFO error<br/>           1b: Rx FIFO error</p> <p>Reset to 0b.</p>                                  |

**7.1.9. MODEM STATUS REGISTER – OFFSET 06h**

| BIT | FUNCTION         | TYPE | DESCRIPTION   |
|-----|------------------|------|---|
| 0   | Delta CTS        | RO   | 0b: No change in CTS input.<br>1b: Indicates the CTS input has changed state.<br>This bit is read-clear.<br><br>Reset to 0b.                              |
| 1   | Delta DSR        | RO   | 0b: No change in DSR input.<br>1b: Indicates the DSR input has changed state.<br>This bit is read-clear.<br><br>Reset to 0b.                              |
| 2   | Trailing RI Edge | RO   | 0b: No change in RI input<br>1b: Indicates the RI input has changed state from the logic 0 to the logic 1.<br>This bit is read-clear.<br><br>Reset to 0b. |
| 3   | Delta DCD        | RO   | 0b: No change in DCD input<br>1b: Indicates the DCD input has changed state.<br>This bit is read-clear.<br><br>Reset to 0b.                               |
| 4   | CTS              | RO   | 0b: The CTS input state is the logic 0<br>1b: The CTS input state is the logic 1<br><br>Reset to 0b.  |
| 5   | DSR              | RO   | 0b: The DSR input state is the logic 0<br>1b: The DSR input state is the logic 1<br><br>Reset to 0b.  |
| 6   | RI               | RO   | The input state of RI pin<br><br>Reset to 0b.   |
| 7   | DCD              | RO   | The input state of DCD pin<br><br>Reset to 0b.  |

**7.1.10. SPECIAL FUNCTION REGISTER – OFFSET 07h**

| BIT | FUNCTION                      | TYPE | DESCRIPTION   |
|-----|-------------------------------|------|---|
| 0   | Force Transmission            | RW   | Forces transmitter to always to transmit data.<br><br>1b: Enabled<br>0b: Disabled<br><br>Reset to 0b.   |
| 1   | Auto DSR and DTR Flow Control | RW   | Auto DSR and DTR flow control enable<br><br>1b: Enables DSR and DTR auto flow control<br>0b: Disables DSR and DTR auto flow control<br><br>Reset to 0b. |
| 2   | Reserved                      | RO   | Reset to 0b.  |
| 3   | Reserved                      | RO   | Reset to 0b.  |
| 4   | Reserved                      | RW   | Reset to 0b.  |
| 5   | 950 Mode                      | RW   | 1b: Enables 950 mode<br>0b: Non-950 mode<br><br>Reset to 0b.  |
| 6   | RFD / LSR Counter Select      | RW   | 1b: OFFSET 15 bit[7:0] acts as the Line Status Register Counter<br>0b: OFFSET 15 bit[7:0] acts as the Receive FIFO Data Counter<br><br>Reset to 0b.     |

| BIT | FUNCTION         | TYPE | DESCRIPTION   |
|-----|------------------|------|---|
| 7   | TFD / SCR Select | RW   | 1b: OFFSET 16 bit[7:0] acts as the Transmit FIFO Data Counter<br>0b: OFFSET 16 bit[7:0] acts as the Sample Clock Register<br><br>Reset to 0b. |
| 7:6 | Reserved         | RW   | Reset to 00b.   |

#### 7.1.11. DIVISOR LATCH LOW REGISTER – OFFSET 00h, LCR[7] = 1

| BIT | FUNCTION    | TYPE | DESCRIPTION   |
|-----|-------------|------|---|
| 7:0 | Divisor Low | RW   | Lower-part of the divisor register<br><br>Reset to 00h. |

#### 7.1.12. DIVISOR LATCH HIGH REGISTER – OFFSET 01h, LCR[7] = 1

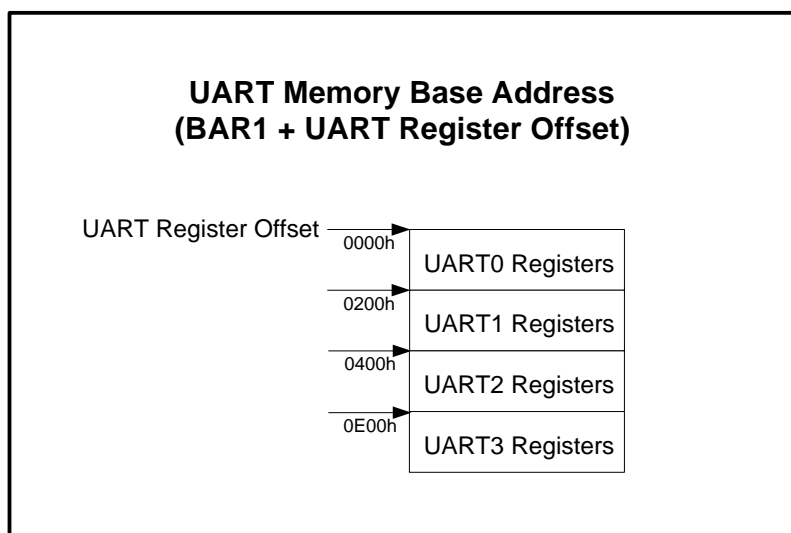
| BIT | FUNCTION     | TYPE | DESCRIPTION  |
|-----|--------------|------|--|
| 7:0 | Divisor High | RW   | Higher-part of the divisor register<br><br>Reset to 00h. |

#### 7.1.13. SAMPLE CLOCK REGISTER – OFFSET 02h, LCR[7] = 1

| BIT            | FUNCTION       | TYPE                         | DESCRIPTION   |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
|----------------|----------------|------------------------------|---|----------------|----------------|---------------|----------------|----------------|---------------|----------------|---------------|---------------|----------------|---------------|------------------------------|----------------|---------------|--|
| 3:0            | Sample Clock   | RW                           | This register determines the Sample Clock value (SC) used in the Baud Rate Generator. Please refer to 5.2.12 Baud Rate Generation for more detail   |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
|                |                |                              | <table><tr><td>0000b: SC = 16</td><td>0101b: SC = 11</td><td>1010b: SC = 6</td></tr><tr><td>0001b: SC = 15</td><td>0110b: SC = 10</td><td>1011b: SC = 5</td></tr><tr><td>0010b: SC = 14</td><td>0111b: SC = 9</td><td>1100b: SC = 4</td></tr><tr><td>0011b: SC = 13</td><td>1000b: SC = 8</td><td>Other settings are reserved.</td></tr><tr><td>0100b: SC = 12</td><td>1001b: SC = 7</td><td></td></tr></table> | 0000b: SC = 16 | 0101b: SC = 11 | 1010b: SC = 6 | 0001b: SC = 15 | 0110b: SC = 10 | 1011b: SC = 5 | 0010b: SC = 14 | 0111b: SC = 9 | 1100b: SC = 4 | 0011b: SC = 13 | 1000b: SC = 8 | Other settings are reserved. | 0100b: SC = 12 | 1001b: SC = 7 |  |
|                |                |                              | 0000b: SC = 16  | 0101b: SC = 11 | 1010b: SC = 6  |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| 0001b: SC = 15 | 0110b: SC = 10 | 1011b: SC = 5                |   |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| 0010b: SC = 14 | 0111b: SC = 9  | 1100b: SC = 4                |   |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| 0011b: SC = 13 | 1000b: SC = 8  | Other settings are reserved. |   |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| 0100b: SC = 12 | 1001b: SC = 7  |                              |   |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| Reset to 0h.   |                |                              |   |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| 7:4            | Reserve        | R                            | Reset to 0h.  |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |

## 7.2. REGISTERS IN MEMORY-MAPPING MODE

Each UART channel has a dedicated 512-byte register block in Memory mode. The register block can be accessed by the UART Memory Base Address, which is obtained by adding the UART Register Offset to the content of the Base Address Register 1 (BAR1). The following diagram shows the arrangement of individual UART register blocks.



**Figure 7-2 UART Register Block Arrangement in Memory Mode**

**Table 7-3 UART Base Address in Memory Mode**

| UART  | UART I/O Base Address |
|-------|-----------------------|
| UART0 | BAR1 + 0000h          |
| UART1 | BAR1 + 0200h          |
| UART2 | BAR1 + 0400h          |
| UART3 | BAR1 + 0E00h          |

Each register in the UART Register Block can be access by adding an offset to the UART Memory Base Address. The following table lists the arrangement of the registers in the UART Register Block in memory mode.

**Table 7-4 Memory-Map Mode**

| Offset                                | Register Name  | Mnemonic          | Register Type |
|---------------------------------------|--|-------------------|---------------|
| UART Memory Base Address + 00h        | Receive Holding Register   | RHR               | RO            |
| UART Memory Base Address + 00h        | Transmit Holding Register  | THR               | WO            |
| UART Memory Base Address + 01h        | Interrupt Enable Register  | IER               | RW            |
| UART Memory Base Address + 02h        | Interrupt Status Register  | ISR               | RO            |
| UART Memory Base Address + 02h        | FIFO Control Register  | FCR               | WO            |
| UART Memory Base Address + 04h        | Line Control Register  | LCR               | RW            |
| UART Memory Base Address + 04h        | Modem Control Register   | MCR               | RW            |
| UART Memory Base Address + 05h        | Line Status Register   | LSR               | RO            |
| UART Memory Base Address + 06h        | Modem Status Register  | MSR               | RO            |
| UART Memory Base Address + 07h        | Special Function Register  | SFR               | RW            |
| UART Memory Base Address + 08h        | Divisor Latch Low  | DLL               | WO            |
| UART Memory Base Address + 09h        | Divisor Latch High   | DLH               | WO            |
|                                       |  |                   |               |
| UART Memory Base Address + 0Ah        | Enhanced Function Register   | EFR               | RW            |
| UART Memory Base Address + 0Bh        | XON 1 Character/Special Character 1  | XON1              | RW            |
| UART Memory Base Address + 0Ch        | XON 2 Character/Special Character 2  | XON2              | RW            |
| UART Memory Base Address + 0Dh        | XOFF 1 Character/Special Character 3   | XOFF1             | RW            |
| UART Memory Base Address + 0Eh        | XOFF 2 Character/Special Character 3   | XOFF2             | RW            |
| UART Memory Base Address + 0Fh        | ACR Register   | ASR               | RW            |
| UART Memory Base Address + 10h        | Transmitter Interrupt Trigger Level  | TTL               | RW            |
| UART Memory Base Address + 11h        | Receiver Interrupt Trigger Level   | RTL               | RW            |
| UART Memory Base Address + 12h        | Automatic Flow control lower trigger level   | FCL               | RW            |
| UART Memory Base Address + 13h        | Automatic Flow control lower higher level  | FCH               | RW            |
| UART Memory Base Address + 14h        | Baud rate Prescale   | CPR               | RW            |
| UART Memory Base Address + 15h        | Receive FIFO Data Counter / Line Status Register Counter                               | RFD / LSR Counter | RO            |
| UART Memory Base Address + 16h        | Transmit FIFO Data Counter / Sample Clock Register                                     | TFD Counter / SCR | RW            |
| UART Memory Base Address + 17h        | Global Register of LSR   | GLSR              | RW            |
| UART Memory Base Address + 100h ~17Fh | UART0 FIFO DATA Register. Use this register to map FIFO data content.                  | FIFO_D            | RW            |
| UART Memory Base Address + 180h ~1FFh | UART0 FIFO DATA LSR Register. Use this register to map FIFO data relative LSR content. | FIFO_LSR          | RW            |

### 7.2.1. RECEIVE HOLDING REGISTER – OFFSET 00h

| BIT | FUNCTION   | TYPE | DESCRIPTION   |
|-----|------------|------|---|
| 7:0 | Rx Holding | RO   | <p>When data are read from the Receive Holding Register (RHR), they are removed from the top of the receiver's associated FIFOs, which holds a queue of data received by the receiver.</p> <p>Data read from the RHR when the FIFOs are empty are invalid. The Line Status Register (LSR) indicates the full or empty status of the FIFOs.</p> <p>Reset to 00h.</p> |

**7.2.2. TRANSMIT HOLDING REGISTER – OFFSET 00h**

| BIT | FUNCTION   | TYPE | DESCRIPTION   |
|-----|------------|------|---|
| 7:0 | Tx Holding | WO   | When data are written to the Transmit Holding Register (THR), they are written to the bottom of the transmitter's associated FIFOs, which holds a queue of data to be transmitted by the transmitter.<br><br>Data written to the THR when the FIFOs are full are lost. The Line Status Register (LSR) indicates the full or empty status of the FIFOs.<br><br>Reset to 00h. |

**7.2.3. INTERRUPT ENABLE REGISTER – OFFSET 01h**

| BIT | FUNCTION                         | TYPE | DESCRIPTION   |
|-----|----------------------------------|------|---|
| 0   | Rx Data Available Interrupt      | RW   | 0b: Disable the Receive Data Ready Interrupt<br>1b: Enable the Receive Data Ready Interrupt<br><br>Reset to 0b.                           |
| 1   | Tx Empty Interrupt               | RW   | 0b: Disable the Transmit Holding Register Empty Interrupt<br>1b: Enable the Transmit Holding Register Empty Interrupt<br><br>Reset to 0b. |
| 2   | Rx Error Status                  | RW   | 0b: Disable the Receive Line Status Interrupt<br>1b: Enable the Receive Line Status Interrupt<br><br>Reset to 0b.                         |
| 3   | Modem Status Interrupt           | RW   | 0b: Disable the Modem Status Register Interrupt<br>1b: Enable the Modem Status Register Interrupt<br><br>Reset to 0b.                     |
| 4   | Xoff/Special character interrupt | RW   | 0b: Disable the Software Flow Control Interrupt<br>1b: Enable the Software Flow Control Interrupt<br><br>Reset to 0b.                     |
| 5   | RTS Interrupt                    | RW   | 0b: Disable RTS/DTR Interrupt<br>1b: Enable RTS/DTR Interrupt<br><br>Reset to 0b.   |
| 6   | CTS Interrupt                    | RW   | 0b: Disable CTS/DSR interrupt<br>1b: Enable CTS/DSR interrupt<br><br>Reset to 0b.   |
| 7   | Reserved                         | RW   | Reset to 0b.  |

**7.2.4. INTERRUPT STATUS REGISTER – OFFSET 02h**

| BIT | FUNCTION         | TYPE | DESCRIPTION  |
|-----|------------------|------|--|
| 7:0 | Interrupt Status | RO   | 0b: An interrupt is pending<br>1b: No interrupt pending<br><br>Reset to C1h. |

| Priority Level | Interrupt Status Bits |       |       |       |       |       |       |       | Interrupt Source                   |
|----------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|------------------------------------|
|                | BIT-7                 | BIT-6 | BIT-5 | BIT-4 | BIT-3 | BIT-2 | BIT-1 | BIT-0 |                                    |
| 1              | 1                     | 1     | 0     | 0     | 0     | 1     | 1     | 0     | Rx data error                      |
| 2              | 1                     | 1     | 0     | 0     | 0     | 1     | 0     | 0     | Rx data available                  |
| 3              | 1                     | 1     | 0     | 0     | 1     | 1     | 0     | 0     | Rx time-out                        |
| 4              | 1                     | 1     | 0     | 0     | 0     | 0     | 1     | 0     | Tx FIFO empty                      |
| 5              | 1                     | 1     | 0     | 0     | 0     | 0     | 0     | 0     | Modem status change                |
| 6              | 1                     | 1     | 0     | 1     | 0     | 0     | 0     | 0     | Xoff or special character detected |

|   |   |   |   |   |   |   |   |   |                          |
|---|---|---|---|---|---|---|---|---|--------------------------|
| 7 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | CTS or RTS state changed |
| X | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | No interrupt pending     |

### 7.2.5. FIFO CONTROL REGISTER – OFFSET 02h

| BIT | FUNCTION         | TYPE | DESCRIPTION   |
|-----|------------------|------|---|
| 0   | FIFO Mode Enable | WO   | 0b: Disable the FIFO mode<br>1b: Enable the FIFO mode<br><br>Reset to 0b.   |
| 1   | Rx FIFO Flush    | WO   | 0b: No action<br>1b: Reset the receive FIFO, self-clear after resetting the FIFO<br><br>Reset to 0b.  |
| 2   | Tx FIFO Flush    | WO   | 0b: No action<br>1b: Reset the transmit FIFO, self-clear after resetting the FIFO<br><br>Reset to 0b.   |
| 3   | Reserved         | WO   | Reset to 0b   |
| 5:4 | Tx Trigger Level | WO   | In the Enhanced Mode:<br><br>00b: 16<br>01b: 32<br>10b: 64<br>11b: 112<br><br>Reset to 00b.   |
| 7:6 | Rx Trigger Level | WO   | In the Non-Enhanced mode<br>00b: 1<br>01b: 4<br>10b: 8<br>11b: 14<br><br>In the Enhanced mode<br>00b: 15<br>01b: 31<br>10b: 63<br>11b: 111<br><br>Reset to 00b. |

### 7.2.6. LINE CONTROL REGISTER – OFFSET 03h

| BIT         | FUNCTION           | TYPE            | DESCRIPTION  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
|-------------|--------------------|-----------------|--|-------------|-------------|-----------------|------------------|---------|---|---|-----------|-----|---|-------|------------|---|---|---|-------------|---|---|---|------|---|---|---|-------|
| 1:0         | Data Length        | RW              | 00b: 5-bit data length<br>01b: 6-bit data length<br>10b: 7-bit data length<br>11b: 8-bit data length<br><br>Reset to 00b.  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 2           | Stop-Bit Length    | RW              | <table><tr><th>Bit 2 value</th><th>Data length</th><th>Stop bit length</th></tr><tr><td>0</td><td>5,6,7,8</td><td>1</td></tr><tr><td>1</td><td>5</td><td>1.5</td></tr><tr><td>1</td><td>6,7,8</td><td>2</td></tr></table><br>Reset to 0b.  | Bit 2 value | Data length | Stop bit length | 0                | 5,6,7,8 | 1 | 1 | 5         | 1.5 | 1 | 6,7,8 | 2          |   |   |   |             |   |   |   |      |   |   |   |       |
| Bit 2 value | Data length        | Stop bit length |  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 0           | 5,6,7,8            | 1               |  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 1           | 5                  | 1.5             |  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 1           | 6,7,8              | 2               |  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 5:3         | Parity Type        | RW              | <table><tr><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Parity selection</th></tr><tr><td>X</td><td>X</td><td>0</td><td>No parity</td></tr><tr><td>0</td><td>0</td><td>1</td><td>Odd parity</td></tr><tr><td>0</td><td>1</td><td>1</td><td>Even parity</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Mark</td></tr><tr><td>1</td><td>1</td><td>1</td><td>Space</td></tr></table><br>Reset to 000b. | Bit 5       | Bit 4       | Bit 3           | Parity selection | X       | X | 0 | No parity | 0   | 0 | 1     | Odd parity | 0 | 1 | 1 | Even parity | 1 | 0 | 1 | Mark | 1 | 1 | 1 | Space |
| Bit 5       | Bit 4              | Bit 3           | Parity selection   |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| X           | X                  | 0               | No parity  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 0           | 0                  | 1               | Odd parity   |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 0           | 1                  | 1               | Even parity  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 1           | 0                  | 1               | Mark   |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 1           | 1                  | 1               | Space  |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |
| 6           | Transmission Break | RW              | 0b: No transmit break condition<br>1b: Force the transmitter output to a space for alerting the remote receiver of a line break condition.<br><br>Reset to 0b.   |             |             |                 |                  |         |   |   |           |     |   |       |            |   |   |   |             |   |   |   |      |   |   |   |       |



| BIT | FUNCTION             | TYPE | DESCRIPTION   |
|-----|----------------------|------|---|
| 7   | Divisor Latch Enable | RW   | 0b: Data registers are selected<br>1b: Divisor latch registers are selected<br><br>Reset to 0b. |

### 7.2.7. MODEM CONTROL REGISTER – OFFSET 04h

| BIT             | FUNCTION               | TYPE  | DESCRIPTION  |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
|-----------------|------------------------|---|--|-----------------|-----------------|---------------|---|---|---|---|---|---------------------------|---|---|-------------------------------------|
| 0               | DTR Pin Control        | RW  | 0b: Forces DTR output high<br>1b: Forces DTR output low<br><br>Reset to 0b.  |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 1               | RTS Pin Control        | RW  | 0b: Forces RTS output high<br>1b: Forces RTS output low<br><br>Reset to 0b.  |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 2               | Output 1               | RW  | When the Internal Loopback Mode is enabled by setting Modem Control Register Bit[4], output of the Output1 is routed to RI.<br><br>Reset to 0b.  |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 3               | Output 2               | RW  | When the Internal Loopback Mode is enabled by setting Modem Control Register Bit[4], output of the Output2 is routed to DCD.<br><br>Reset to 0b.   |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 4               | Internal Loopback Mode | RW  | 0b: Disables Internal Loopback Mode<br>1b: Enables Internal Loopback Mode<br><br>Reset to 0b.  |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 5               | AFE                    | RW  | Autoflow Control Enable. When the AFE is enabled, autoflow control is enabled. When it is disabled, the diagnostic mode is enabled. In the diagnostic mode, transmitted data is immediately received.<br><br>When AFE is set to “1”, MCR Bit 1 is used to enable and disable the auto-RTS.<br><table border="1"><thead><tr><th>MCR Bit 5 (AFE)</th><th>MCR Bit 1 (RTS)</th><th>Configuration</th></tr></thead><tbody><tr><td>1</td><td>1</td><td>Auto-RTS and auto-CTS are enabled (autoflow control enabled).</td></tr><tr><td>1</td><td>0</td><td>Only auto-CTS is enabled.</td></tr><tr><td>0</td><td>x</td><td>Auto-RTS and auto-CTS are disabled.</td></tr></tbody></table><br>Reset to 0b. | MCR Bit 5 (AFE) | MCR Bit 1 (RTS) | Configuration | 1 | 1 | Auto-RTS and auto-CTS are enabled (autoflow control enabled). | 1 | 0 | Only auto-CTS is enabled. | 0 | x | Auto-RTS and auto-CTS are disabled. |
| MCR Bit 5 (AFE) | MCR Bit 1 (RTS)        | Configuration   |  |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 1               | 1                      | Auto-RTS and auto-CTS are enabled (autoflow control enabled). |  |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 1               | 0                      | Only auto-CTS is enabled.                                     |  |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 0               | x                      | Auto-RTS and auto-CTS are disabled.                           |  |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 6               | Reserved               |   | Reset to 0b.   |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |
| 7               | Enhanced Transmission  | RW  | 0b: Insert 1, 1.5 or 2 stop-bits between two transmitted characters.<br>1b: Insert 0.5 stop-bits between two transmitted characters.<br><br>Note: Enabling feature may result in certain compatibility issues. This feature is only recommended when using two Pericom UART devices.<br><br>Reset to 0b.   |                 |                 |               |   |   |   |   |   |                           |   |   |                                     |

### 7.2.8. LINE STATUS REGISTER – OFFSET 05h

| BIT | FUNCTION          | TYPE | DESCRIPTION   |
|-----|-------------------|------|---|
| 0   | Rx Data Available | RO   | 0b: No data in the receive FIFO<br>1b: Data in the receive FIFO<br><br>Reset to 0b. |

| BIT | FUNCTION        | TYPE | DESCRIPTION  |
|-----|-----------------|------|--|
| 1   | Rx FIFO Overrun | RO   | 0b: No overrun error<br>1b: Overrun error<br><br>Reset to 0b.                                  |
| 2   | Rx Parity Error | RO   | 0b: No parity error<br>1b: Parity error<br><br>Reset to 0b.                                    |
| 3   | Rx Frame Error  | RO   | 0b: No framing error<br>1b: Framing error<br><br>Reset to 0b.                                  |
| 4   | Rx Break Error  | RO   | 0b: No break condition<br>1b: Break condition<br><br>Reset to 0b.                              |
| 5   | Tx Empty        | RO   | 0b: Tx Holding Register is not empty.<br>1b: Tx Holding Register is empty.<br><br>Reset to 0b. |
| 6   | Tx Complete     | RO   | 0b: Tx Shift Register is not empty.<br>1b: Tx Shift Register is empty.<br><br>Reset to 0b.     |
| 7   | Rx Data Error   | RO   | 0b: No Rx FIFO error<br>1b: Rx FIFO error<br><br>Reset to 0b.                                  |

#### 7.2.9. MODEM STATUS REGISTER – OFFSET 06h

| BIT | FUNCTION  | TYPE | DESCRIPTION   |
|-----|-----------|------|---|
| 0   | Delta CTS | RO   | 0b: No change in CTS input.<br>1b: Indicates the CTS input has changed state.<br>This bit is read-clear.<br><br>Reset to 0b.                              |
| 1   | Delta DSR | RO   | 0b: No change in DSR input.<br>1b: Indicates the DSR input has changed state.<br>This bit is read-clear.<br><br>Reset to 0b.                              |
| 2   | Delta RI  | RO   | 0b: No change in RI input<br>1b: Indicates the RI input has changed state from the logic 0 to the logic 1.<br>This bit is read-clear.<br><br>Reset to 0b. |
| 3   | Delta DCD | RO   | 0b: No change in DCD input<br>1b: Indicates the DCD input has changed state.<br>This bit is read-clear.<br><br>Reset to 0b.                               |
| 4   | CTS       | RO   | 0b: The CTS input state is the logic 0<br>1b: The CTS input state is the logic 1<br><br>Reset to 0b.  |
| 5   | DSR       | RO   | 0b: The DSR input state is the logic 0<br>1b: The DSR input state is the logic 1<br><br>Reset to 0b.  |
| 6   | RI        | RO   | The input state of RI pin<br><br>Reset to 0b.   |

| BIT | FUNCTION | TYPE | DESCRIPTION                                    |
|-----|----------|------|--|
| 7   | DCD      | RO   | The input state of DCD pin<br><br>Reset to 0b. |

### 7.2.10. SPECIAL FUNCTION REGISTER – OFFSET 07h

| BIT | FUNCTION                      | TYPE | DESCRIPTION   |
|-----|-------------------------------|------|---|
| 0   | Force Transmission            | RW   | Forces transmitter to always to transmit data.<br><br>1b: Enabled<br>0b: Disabled<br><br>Reset to 0b.   |
| 1   | Auto DSR and DTR Flow Control | RW   | Auto DSR and DTR flow control enable<br><br>1b: Enables DSR and DTR auto flow control<br>0b: Disables DSR and DTR auto flow control<br><br>Reset to 0b. |
| 2   | Reserved                      | RO   | Reset to 0b.  |
| 3   | Reserved                      | RO   | Reset to 0b.  |
| 4   | Reserved                      | RW   | Reset to 0b.  |
| 5   | 950 Mode                      | RW   | 1b: Enables 950 mode<br>0b: Non-950 mode<br><br>Reset to 0b.  |
| 6   | RFD / LSR Counter Select      | RW   | 1b: OFFSET 15 bit[7:0] acts as the Line Status Register Counter<br>0b: OFFSET 15 bit[7:0] acts as the Receive FIFO Data Counter<br><br>Reset to 0b.     |
| 7   | TFD / SCR Select              | RW   | 1b: OFFSET 16 bit[7:0] acts as the Transmit FIFO Data Counter<br>0b: OFFSET 16 bit[7:0] acts as the Sample Clock Register<br><br>Reset to 0b.           |

### 7.2.11. DIVISOR LATCH LOW REGISTER – OFFSET 08h

| BIT | FUNCTION    | TYPE | DESCRIPTION   |
|-----|-------------|------|---|
| 7:0 | Divisor Low | RW   | Lower-part of the divisor register<br><br>Reset to 00h. |

### 7.2.12. DIVISOR LATCH HIGH REGISTER – OFFSET 09h

| BIT | FUNCTION     | TYPE | DESCRIPTION  |
|-----|--------------|------|--|
| 7:0 | Divisor High | RW   | Higher-part of the divisor register<br><br>Reset to 00h. |

### 7.2.13. ENHANCED FUNCTION REGISTER – OFFSET 0Ah

| BIT | FUNCTION                          | TYPE | DESCRIPTION  |
|-----|-----------------------------------|------|--|
| 1:0 | In-Band Receive Flow Control Mode | RW   | When in-band receive flow control is enabled, the UART compares the received data with the programmed XOFF character(s). When this occurs, the UART will disable transmission as soon as any current character transmission is complete. The UART then compares the received data with the programmed XON character(s). When a match occurs, the UART will re-enable transmission (see section 7.11.6).<br><br>00b: In-band receive flow control is disabled.<br>01b: Single character in-band receive flow control enabled, |

| BIT | FUNCTION                           | TYPE | DESCRIPTION   |
|-----|------------------------------------|------|---|
|     |                                    |      | recognising XON2 as the XON character and XOFF2 as the XOFF character.<br>10b: Single character in-band receive flow control enabled, recognising XON1 as the XON character and XOFF1 and the XOFF character.<br>11b: The behavior of the receive flow control is dependent on the configuration of EFR[3:2]. Single character in-band receive flow control is enabled, accepting XON1 or XON2 as valid XON characters and XOFF1 or XOFF2 as valid XOFF characters when EFR[3:2] = "01" or "10". EFR[1:0] should not be set to "11" when EFR[3:2] is '00'.<br><br>Reset to 00b.   |
| 3:2 | In-Band Transmit Flow Control Mode | RW   | When in-band transmit flow control is enabled, XON/XOFF character are inserted into the data stream whenever the RFL passes the upper trigger level and falls below the lower trigger level respectively. For automatic in-band flow control, bit 4 of EFR must be set. The combinations of software transmit flow control can then be selected by programming EFR[3:2] as follows.<br><br>00b: In-band transmit flow control is disabled logic.<br>01b: Single character in-band transmit flow control enabled, using XON2 as the XON character and XOFF2 as the XOFF character.<br>10b: Single character in-band transmit flow control enabled, using XON1 as the XON character and XOFF1 as the XOFF character.<br>11b: The value EFR[3:2] = "11" is reserved for future use and should not be used<br><br>Reset to 00b. |
| 4   | Enhanced Mode                      | RW   | 0b: Non-Enhanced mode.<br>1b: Enhanced mode. Enables the Enhanced Mode functions. If use addition function except 16550 mode.<br><br>Reset to 0b.   |
| 5   | Special Character Detection Enable | RW   | 0b: Special character detection is disabled.<br>1b: While in Enhanced mode (EFR[4]=1), the UART compares the incoming receiver data with the XOFF1 or XOFF2 value and interrupt will be asserted.<br>If In-Band Flow Control is enabled, this bit must be set to '1'.<br><br>Reset to 0b.   |
| 6   | Automatic RTS Flow Control Enable  | RW   | 0b: RTS flow control is disabled.<br>1b: RTS flow control is enabled in Enhanced mode (i.e. EFR[4] = 1), where the RTS# pin will be forced inactive high if the RFL reaches the upper flow control threshold. This will be released when the RFL drops below the lower threshold. 650 and 950-mode drivers should use different threshold level.<br><br>Reset to 0b.  |
| 7   | Automatic CTS Flow Control Enable  | RW   | 0b: CTS flow control is disabled (default).<br>1b: CTS flow control is enabled in Enhanced mode (i.e. EFR[4] = 1), where the data transmission is prevented whenever the CTS# pin is held inactive high. 650 and 950-mode drivers should use different threshold level.<br><br>Reset to 0b.   |

#### 7.2.14. XON SPECIAL CHARACTER 1 – OFFSET 0Bh

| BIT | FUNCTION | TYPE | DESCRIPTION                           |
|-----|----------|------|---------------------------------------|
| 7:0 | XON1     | RW   | Xon character 1.<br><br>Reset to 00h. |

**7.2.15. XON SPECIAL CHARACTER 2 – OFFSET 0Ch**

| BIT | FUNCTION | TYPE | DESCRIPTION                           |
|-----|----------|------|---------------------------------------|
| 7:0 | XON2     | RW   | Xon character 2.<br><br>Reset to 00h. |

**7.2.16. XOFF SPECIAL CHARACTER 1 – OFFSET 0Dh**

| BIT | FUNCTION | TYPE | DESCRIPTION                            |
|-----|----------|------|--|
| 7:0 | XOFF1    | RW   | Xoff character 1.<br><br>Reset to 00h. |

**7.2.17. XOFF SPECIAL CHARACTER 2 – OFFSET 0Eh**

| BIT | FUNCTION | TYPE | DESCRIPTION                            |
|-----|----------|------|--|
| 7:0 | XOFF2    | RW   | Xoff character 2.<br><br>Reset to 00h. |

**7.2.18. ADVANCE CONTROL REGISTER – OFFSET 0Fh**

| BIT | FUNCTION                        | TYPE | DESCRIPTION  |
|-----|---------------------------------|------|--|
| 0   | Transmitter Terminate Condition | RO   | Indicates current transmitter terminate condition. If transmitter is disabled by remote terminate, the condition can be shown by this bit.<br><br>1b: Disabled by remote terminate.<br>0b: The transmitter can transmit data normally.<br><br>Reset to 0b.   |
| 1   | Remote TX Disable               | RO   | Remote TX Disable.<br><br>1b: If transmitter has sent XOFF message or RTS message, then DTR is inactive, and then it is enabled.<br>0b: otherwise<br><br>Reset to 0b.  |
| 2   | Xon/Xoff Detect                 | RO   | When receiving a XON/XOFF character from a remote transmitter, this bit is set to '1'. Otherwise, this bit is set to '0'. The bit is read-clear.<br>If the Xoff/Special Character Interrupt is enabled, the Xoff Detect status is also reflected in the Interrupt Status Register (Priority Level 6).<br><br>1b: Event true<br>0b: Event false<br><br>Reset to 0b. |
| 3   | Special Character Detect        | RO   | When detecting the special characters from a remote transmitter, this bit is set to '1'. Otherwise, this bit is set to '0'. The bit is read-clear.<br>If the Xoff/Special Character Interrupt is enabled, the status is also reflected in the Interrupt Status Register (Priority Level 6).<br><br>1b: Event true<br>0b: Event false<br><br>Reset to 0b.           |
| 7:4 | Reserved                        | RO   | Reset to 0000b.  |

**7.2.19. TRANSMIT INTERRUPT TRIGGER LEVEL – OFFSET 10h**

| BIT | FUNCTION | TYPE | DESCRIPTION   |
|-----|----------|------|---|
| 7:0 | TTL      | RW   | Transmitter Interrupt Trigger Level.<br><br>Reset to 00h. |

**7.2.20. RECEIVE INTERRUPT TRIGGER LEVEL – OFFSET 11h**

| BIT | FUNCTION | TYPE | DESCRIPTION  |
|-----|----------|------|--|
| 7:0 | RTL      | RW   | Receiver Interrupt Trigger Level.<br><br>Reset to 00h. |

**7.2.21. FLOW CONTROL LOW TRIGGER LEVEL – OFFSET 12h**

| BIT | FUNCTION | TYPE | DESCRIPTION  |
|-----|----------|------|--|
| 7:0 | FCL      | RW   | Automatic Flow Control Low Trigger Level.<br><br>Reset to 00h. |

**7.2.22. FLOW CONTROL HIGH TRIGGER LEVEL – OFFSET 13h**

| BIT | FUNCTION | TYPE | DESCRIPTION   |
|-----|----------|------|---|
| 7:0 | FCH      | RW   | Automatic Flow Control High Trigger Level.<br><br>Reset to 00h. |

**7.2.23. CLOCK PRESCALE REGISTER – OFFSET 14h**

| BIT | FUNCTION | TYPE | DESCRIPTION  |
|-----|----------|------|--|
| 3:0 | CPRN     | RW   | N number in calculating the Prescaler, which is used to generate the Baud Rate.<br><br>Reset to 0000b.   |
| 7:4 | CPRM     | RW   | M number in calculating the Prescaler, which is used to generate the Baud Rate.<br>It is recommended that the value of the CPRM be set to “0000”, “0001” or “0010”.<br><br>Reset to 0000b. |

**7.2.24. RECEIVE FIFO DATA COUNTER – OFFSET 15h, SFR[6] = 0**

The function of this register is selected by the Special Function Register (Offset 07h) bit 6. When SFR[6] is set to ‘1’, this register functions as the Receive FIFO Data Counter. Otherwise, it functions as the Line Status Register Counter.

| BIT | FUNCTION                  | TYPE | DESCRIPTION  |
|-----|---------------------------|------|--|
| 7:0 | Receive FIFO Data Counter | RO   | The Receive FIFO Data Counter indicates the amount of data in the Receive FIFO.<br><br>Reset to 00h. |

**7.2.25. LINE STATUS REGISTER COUNTER – OFFSET 15h, SFR[6] = 1**

| BIT | FUNCTION                     | TYPE | DESCRIPTION  |
|-----|------------------------------|------|--|
| 7:0 | Line Status Register Counter | RO   | The Line Status Register Counter indicates the amount of data in the LSR.<br><br>Reset to 00h. |

**7.2.26. TRANSMIT FIFO DATA COUNTER – OFFSET 16h, SFR[7] = 1**

The function of this register is selected by the Special Function Register (Offset 07h) bit 7. When SFR[7] is set to '1', this register functions as the Transmit FIFO Data Counter. Otherwise, it functions as the Sample Clock Register.

| BIT | FUNCTION                   | TYPE | DESCRIPTION  |
|-----|----------------------------|------|--|
| 7:0 | Transmit FIFO Data Counter | RO   | The Transmit FIFO Data Counter indicates the amount of data in the Transmit FIFO.<br><br>Reset to 00h. |

**7.2.27. SAMPLE CLOCK REGISTER – OFFSET 16h, SFR[7] = 0**

| BIT            | FUNCTION       | TYPE                         | DESCRIPTION  |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
|----------------|----------------|------------------------------|--|----------------|----------------|---------------|----------------|----------------|---------------|----------------|---------------|---------------|----------------|---------------|------------------------------|----------------|---------------|--|
| 3:0            | Sample Clock   | RW                           | <div><p>This register determines the Sample Clock value (SC) used in the Baud Rate Generator. Please refer to 5.2.12 Baud Rate Generation for more detail</p><table><tr><td>0000b: SC = 16</td><td>0101b: SC = 11</td><td>1010b: SC = 6</td></tr><tr><td>0001b: SC = 15</td><td>0110b: SC = 10</td><td>1011b: SC = 5</td></tr><tr><td>0010b: SC = 14</td><td>0111b: SC = 9</td><td>1100b: SC = 4</td></tr><tr><td>0011b: SC = 13</td><td>1000b: SC = 8</td><td>Other settings are reserved.</td></tr><tr><td>0100b: SC = 12</td><td>1001b: SC = 7</td><td></td></tr></table></div> <p>Reset to 0h.</p> | 0000b: SC = 16 | 0101b: SC = 11 | 1010b: SC = 6 | 0001b: SC = 15 | 0110b: SC = 10 | 1011b: SC = 5 | 0010b: SC = 14 | 0111b: SC = 9 | 1100b: SC = 4 | 0011b: SC = 13 | 1000b: SC = 8 | Other settings are reserved. | 0100b: SC = 12 | 1001b: SC = 7 |  |
| 0000b: SC = 16 | 0101b: SC = 11 | 1010b: SC = 6                |  |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| 0001b: SC = 15 | 0110b: SC = 10 | 1011b: SC = 5                |  |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| 0010b: SC = 14 | 0111b: SC = 9  | 1100b: SC = 4                |  |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| 0011b: SC = 13 | 1000b: SC = 8  | Other settings are reserved. |  |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| 0100b: SC = 12 | 1001b: SC = 7  |                              |  |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |
| 7:4            | Reserved       | RO                           | Reset to 0h.   |                |                |               |                |                |               |                |               |               |                |               |                              |                |               |  |

**7.2.28. GLOBAL LINE STATUS REGISTER – OFFSET 17h**

| BIT | FUNCTION          | TYPE | DESCRIPTION  |
|-----|-------------------|------|--|
| 0   | RX Data Available | RO   | 0b: No data in the receive FIFO<br>1b: Data in the receive FIFO<br><br>Reset to 0b.            |
| 1   | RX FIFO Overrun   | RO   | 0b: No overrun error<br>1b: Overrun error<br><br>Reset to 0b.                                  |
| 2   | RX Parity Error   | RO   | 0b: No parity error<br>1b: Parity error<br><br>Reset to 0b.                                    |
| 3   | RX Frame Error    | RO   | 0b: No framing error<br>1b: Framing error<br><br>Reset to 0b.                                  |
| 4   | RX Break Error    | RO   | 0b: No break condition<br>1b: Break condition<br><br>Reset to 0b.                              |
| 5   | TX Empty          | RO   | 0b: Tx Holding Register is not empty.<br>1b: Tx Holding Register is empty.<br><br>Reset to 0b. |

| BIT | FUNCTION      | TYPE | DESCRIPTION  |
|-----|---------------|------|--|
| 6   | TX Complete   | RO   | 0b: Tx Shift Register is not empty.<br>1b: Tx Shift Register is empty.<br><br>Reset to 0b. |
| 7   | RX Data Error | RO   | 0b: No Rx FIFO error<br>1b: Rx FIFO error<br><br>Reset to 0b.                              |

### 7.2.29. RECEIVE FIFO DATA REGISTERS – OFFSET 100h ~ 17Fh

| BIT | FUNCTION          | TYPE | DESCRIPTION   |
|-----|-------------------|------|---|
| 7:0 | Receive FIFO Data | RO   | This register is used to map RX FIFO data content.<br><br>Reset to 00h. |

### 7.2.30. TRANSMIT FIFO DATA REGISTERS – OFFSET 100h ~ 17Fh

| BIT | FUNCTION           | TYPE | DESCRIPTION  |
|-----|--------------------|------|--|
| 7:0 | Transmit FIFO Data | WO   | This register is used to map TX FIFO to memory space.<br><br>Reset to 00h. |

### 7.2.31. LINE STATUS FIFO REGISTERS – OFFSET 180h ~ 1FFh

| BIT | FUNCTION         | TYPE | DESCRIPTION   |
|-----|------------------|------|---|
| 7:0 | Line Status FIFO | RO   | This register is used to map FIFO data relative LSR content.<br><br>Reset to 00h. |



## 8. EEPROM INTERFACE

The EEPROM interface consists of five pins: SR\_DI (EEPROM data input), SR\_DO (EEPROM data output), SR\_CS (EEPROM chip select), SR\_CLK\_O (EEPROM clock output), and SR\_ORG (EEPROM organization). The device may control a 93C56 or compatible parts using 2K bits. The EEPROM is used to initialize a number of registers before enumeration. This is accomplished at start-up when RTS[0] is de-asserted, at which time the data from the EEPROM is loaded. The EEPROM interface is organized into a 16-bit base, and the device supplies a 7-bit EEPROM word address.

### 8.1. AUTO MODE EERPOM ACCESS

The device may access the EEPROM in a WORD or BYTE format, which is decided by the SR\_ORG# at start-up. If SR\_ORG# is asserted at start-up, EEPROM is accessed using the WORD format. Otherwise, Byte format is used.

### 8.2. EEPROM MODE AT RESET

During a reset, the device will automatically load the information/data from the EEPROM if the automatic load condition is met. The first offset in the EEPROM contains a signature. If the signature is recognized, and if RTS[0] is de-asserted, the autoload initiates right after the reset.

### 8.3. EEPROM SPACE ADDRESS MAP AND DESCRIPTION

| EEPROM ADDRESS | PCIE REGISTER OFFSET               | DEFAULT Value | DESCRIPTION  |
|----------------|------------------------------------|---------------|--|
| 00h            |                                    | A868h         | Check Code   |
| 02h            | Offset 00h bit[15:0]               | 12D8h         | Vendor ID  |
| 04h            | Offset 00h bit[31:16]              | 7954h         | Device ID  |
| 06h            | Offset 2Ch bit[15:0]               | 0000h         | Subsystem Vendor ID  |
| 08h            | Offset 2Ch bit[31:16]              | 0000h         | Subsystem ID   |
| 0Ah            | Bit[0] - Offset 80h bit[21]        | 0b            | <b>Device Specific Initialization:</b> When set, the DSI is required.  |
|                | Bit[3:1] - Offset 80h bit[24:22]   | 111b          | <b>Aux. Current:</b> When set, the I/O bridge needs 375 mA in D3 state.  |
|                | Bit[4] - Offset 80h bit[25]        | 1b            | <b>D1 Support:</b> When set, this bridge supports D1 Power Management state.   |
|                | Bit[5] - Offset 80h bit[26]        | 1b            | <b>D2 Support:</b> When set, this bridge supports D2 Power Management state.   |
|                | Bit[10:6] - Offset 80h bit[31:27]  | 01000b        | <b>PME Support:</b> When set, the PME supports D1 and D2 Power Management states.  |
|                | Bit[11] - Offset 84h bit[3]        | 1b            | <b>No Soft Reset:</b> When set, the device does not trigger the Internal Reset Command during the transition from D3hot to D0 power state. |
|                | Bit[13:12] - Offset A8h bit[14:13] | 00b           | <b>XPIP CSR0</b>   |
| 0Ch            | Offset B0h bit[15:0]               | 0000h         | <b>Replay Time-out Counter</b>   |
| 0Eh            | Offset B0h bit[31:16]              | 0000h         | <b>Acknowledge Latency Timer</b>   |
| 10h            | Bit[1:0] - Offset ECh bit[11:10]   | 11b           | <b>ASPM Capability Support:</b> When set, this bridge supports L0s and L1 entry  |
|                | Bit[4:2] - Offset ECh bit[14:12]   | 011b          | <b>Exit L0s Latency Timer</b>  |
|                | Bit[7:5] - Offset ECh bit[17:15]   | 000b          | <b>Exit L1 Latency Timer</b>   |
| 12h            | Offset B4h bit[15:0]               | 0000h         | <b>UART Transmitter Drive Enable:</b><br>RS232/422/485-2W/485-4W Selection for UART 0 to 3   |

| EEPROM ADDRESS | PCIE REGISTER OFFSET             | DEFAULT Value | DESCRIPTION  |
|----------------|----------------------------------|---------------|--|
| 14h            | Offset B4h bit[31:16]            | 0000h         | <b>UART Transmitter Drive Enable:</b> RS232/422/485-2W/485-4W Selection for UART 4 to 7                |
| 16h            | Bit[1:0] - Offset B8h bit[17:16] | 01b           | <b>PM Control Parameter:</b> Determines whether this bridge enters L1 or not when D3 condition occurs. |
|                | Bit[3:2] - Offset B8h bit[19:18] | 00b           | <b>PM Control Parameter:</b> Determines the delay counter value when entering L1                       |
|                | Bit[5:4] - Offset B8h bit[21:20] | 00b           | <b>PM Control Parameter:</b> Determines whether this bridge asserts L0s/L1 handshake protocol          |
| 18h            | Bit[13:0] - Offset C8h bit[13:0] | 0200h         | <b>PHY Parameter</b>   |
| 1Ah            | Bit[0] - Offset C4h bit[15]      | 1b            | <b>Role Based Error Report Enable:</b> Indicates implement the role-base error reporting               |
|                | Bit[15:8] - Offset 34h bit[7:0]  | 80h           | <b>Capability List Pointer:</b> Points to a linked list of new capabilities implemented by the device  |
| 1Ch            | [7:0] - Offset 08h bit[7:0]      | 00h           | <b>Revision ID:</b> Indicates revision number of device  |
| 40h            |                                  | 12D8h         | <b>Check Code</b>  |

## 9. ELECTRICAL SPECIFICATION

### 9.1. ABSOLUTE MAXIMUM RATINGS

**Table 9-1 Absolute Maximum Ratings**

(Above which the useful life may be impaired. For user guidelines, not tested.)

|  |                 |
|--|-----------------|
| Storage Temperature  | --65°C to 150°C |
| PCI Express supply voltage to ground potential (VDDA, VDDC, VTT and VDDCAUX) | -0.3v to 2.1v   |
| PCI supply voltage to ground potential (VDDR)                                | -0.3v to 3.8v   |
| DC input voltage for PCI Express signals                                     | -0.3v to 2.1v   |

Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

### 9.2. DC SPECIFICATIONS

**Table 9-2 DC Electrical Characteristics**

| Symbol  | Min. | Typ. | Max. |
|---------|------|------|------|
| VDDA    | 1.6v | 1.8v | 2.0v |
| VDDC    | 1.6v | 1.8v | 2.0v |
| VDDCAUX | 1.6v | 1.8v | 2.0v |
| VTT     | 1.6v | 1.8v | 2.0v |
| VDDR    | 3.0v | 3.3v | 3.6v |
| VIL     |      |      | 0.8v |
| VIH     | 2.0v |      |      |
| VOL     |      |      | 0.4v |
| VOH     | 2.6v |      |      |

VDDA: analog power supply for PCI Express Interface

VDDC: digital power supply for the core

VTT: termination power supply for PCI Express Interface

VDDCAUX: auxiliary power supply

VDDR: digital power supply for the I/O

VIH: I/O input high voltage

VIL: I/O input low voltage

VOL: I/O output low voltage

VOH: I/O output High voltage

The typical power consumption of PI7C9X7954 is about 0.8 watt.

### 9.3. AC SPECIFICATIONS

**Table 9-3 Transmitter Characteristics**

| Symbol                    | Description  | Min              | Typical                       | Max.              | Unit |
|---------------------------|--|------------------|-------------------------------|-------------------|------|
| <b>Voltage Parameters</b> |  |                  |                               |                   |      |
| $V_{TX-DIFF}^a$           | Output voltage compliance @ typical swing            |                  |                               |                   |      |
|                           | $V_{TX-DIFFp}$ (peak-to-peak, single ended)          | 400              | 500                           | 600               | mV   |
|                           | $V_{TX-DIFFpp}$ (peak-to-peak, differential)         | 800              | 1000                          | 1200              | mV   |
| $V_{SW}$                  | Supported TX output voltage range (pp, differential) | 700 <sup>b</sup> |                               | 1400 <sup>c</sup> | mV   |
| $V_{OL}$                  | Low-level output voltage                             |                  | $V_{TT} - 1.5 * V_{TX-DIFFp}$ |                   | V    |
| $V_{OH}$                  | High-level output voltage                            |                  | $V_{TT} - 0.5V_{TX-DIFFp}$    |                   | V    |
| $V_{TX-CM-AC}$            | Transmit common-mode voltage in L0                   | 0.50             | $V_{TT} - V_{TX-DIFFp}$       | 1.45              | V    |

| Symbol                                   | Description  | Min    | Typical               | Max.              | Unit |
|--|--|--------|-----------------------|-------------------|------|
| V <sub>TX-CM-HIZ</sub>                   | Transmit common-mode voltage in L0s (TX) & L1  |        | V <sub>TX-CM-AC</sub> |                   | V    |
| V <sub>TX-DE-RATIO</sub>                 | De-emphasized differential output voltage  | 0      |                       | -7.96             | dB   |
| V <sub>TX-IDLE-DIFFp</sub>               | Electric Idle differential peak voltage  |        |                       | 20                | mV   |
| V <sub>TX-RCV-DETECT</sub>               | Voltage change during Receive Detection  |        | V <sub>TX-DIFFp</sub> |                   | mV   |
| RL <sub>TX-DIFF</sub>                    | Transmitter Differential Return loss   | 10     |                       |                   | dB   |
| RL <sub>TX-CM</sub>                      | Transmitter Common Mode Return loss  | 6      |                       |                   | dB   |
| Z <sub>OSE</sub>                         | Single-ended output impedance  | 40     | 50                    | 60                | Ω    |
| Z <sub>TX-DIFF-DC</sub>                  | DC Differential TX Impedance   | 80     | 100                   | 120               | Ω    |
| T <sub>TX-RISE, TTX-FALL</sub>           | Rise / Fall time of TxP, TxN outputs   | 80     |                       | 110 <sup>d</sup>  | ps   |
| <b>Jitter Parameters</b>                 |  |        |                       |                   |      |
| UI                                       | Unit Interval  | 399.88 | 400                   | 400.12            | ps   |
| T <sub>TX-MAX-JITTER</sub>               | Transmitter total jitter (peak-to-peak)  |        |                       | 0.30 <sup>e</sup> | UI   |
| T <sub>TX-EYE</sub>                      | Minimum TX Eye Width (1 - T <sub>TX-MAX-JITTER</sub> )   | 0.70   |                       |                   | UI   |
| T <sub>TX-EYE-MEDIAN-to-MAX-JITTER</sub> | Maximum time between the jitter median and maximum deviation from the median                       |        |                       | 0.15              | UI   |
| <b>Timing Parameters</b>                 |  |        |                       |                   |      |
| L <sub>TLAT-10</sub>                     | Transmitter data latency (for n=10)  | 9      |                       | 11                | UI   |
| L <sub>TLAT-20</sub>                     | Transmitter data latency (for n=20)  | 9      |                       | 11                | UI   |
| L <sub>TX-SKEW</sub>                     | Transmitter data skew between any 2 lanes  | 0      |                       | 2 + 200ps         | UI   |
| T <sub>TX-IDLE-SET-TO-IDLE</sub>         | Maximum time to transition to a valid electrical idle after sending an Electrical Idle ordered set |        |                       | 8                 | ns   |
| T <sub>EIE<sub>exit</sub></sub>          | Time to exit Electrical Idle (L0s) state into L0   |        | 12                    | 16                | ns   |
| T <sub>BTE<sub>n</sub></sub>             | Time from asserting BeaconTxEn to beacon being transmitted on the lane                             |        | 30                    | 80                | ns   |

a. Measured with V<sub>tt</sub> = 1.2V, HiDrv='0', LowDrv='0' and Dtx='0000'.

b. Minimum swing assumes LoDrv = 1, HiDrv = 0 and Dtx = 1100

c. Max swing assumes LoDrv = 0, HiDrv = 1, Dtx = 0010, V<sub>TT</sub> = 1.8V

d. As measured between 20% and 80% points. Will depend on package characteristics.

e. Measured using PCI Express Compliance Pattern

**Table 9-4 Receiver Characteristics**

| Symbol                                   | Description   | Min  | Typical | Max.  | Unit |
|--|---|------|---------|-------|------|
| <b>Voltage Parameters</b>                |   |      |         |       |      |
| V <sub>RX-DIFFp-p</sub>                  | Differential input voltage (peak-to-peak)   | 170  |         | 1200  | mV   |
| V <sub>RX-IDLE-DET-DIFFp-p</sub>         | Differential input threshold voltage (peak-to-peak) to assert TxIdleDetect output | 65   |         | 175   | mV   |
| V <sub>RX-CM-AC</sub>                    | Receiver common-mode voltage for AC-coupling                                      |      | 0       | 150   | mV   |
| T <sub>RX-RISE, TRX-FALL</sub>           | Rise time / Fall time of RxP, RxN inputs  |      |         | 160   | Ps   |
| Z <sub>RX-DIFF-DC</sub>                  | Differential input impedance (DC)   | 80   | 100     | 120   | Ω    |
| Z <sub>RX-COM-DC</sub>                   | Single-ended input impedance  | 40   | 50      | 60    | Ω    |
| Z <sub>RX-COM-INITIAL-DC</sub>           | Initial input common mode impedance (DC)  | 5    | 50      | 60    | Ω    |
| Z <sub>RX-COM-HIGH-IMP-DC</sub>          | Powered down input common mode impedance (DC)                                     | 200k |         |       | Ω    |
| RL <sub>RX-DIFF</sub>                    | Receiver Differential Return Loss <sup>a</sup>                                    | 10   |         |       | dB   |
| RL <sub>RX-CM</sub>                      | Receiver Common Mode Return Loss <sup>b</sup>                                     | 6    |         |       | dB   |
| <b>Jitter Parameters</b>                 |   |      |         |       |      |
| T <sub>RX-MAX-JITTER</sub>               | Receiver total jitter tolerance   |      |         | 0.65  | UI   |
| T <sub>RX-EYE</sub>                      | Minimum Receiver Eye Width  | 0.35 |         |       | UI   |
| T <sub>RX-EYE-MEDIAN-to-MAX-JITTER</sub> | Maximum time between jitter median and max deviation from                         |      |         | 0.325 | UI   |

| Symbol                   | Description  | Min | Typical | Max.           | Unit |
|--------------------------|--|-----|---------|----------------|------|
|                          | median   |     |         |                |      |
| <b>Timing Parameters</b> |  |     |         |                |      |
| LRLAT-10                 | Receiver data latency for n=10   | 28  |         | 29             | bits |
| LRLAT-20                 | Receiver data latency for n=20   | 49  |         | 60             | bits |
| TRX-SKEW                 | Receiver data skew between any 2 lanes   | 0   |         | 1 <sup>c</sup> | bits |
| TBDDly                   | Beacon-Activity on channel to detection of Beacon <sup>d</sup>                                       |     |         | 200            | us   |
| TRX-IDLE_ENTER           | Delay from detection of Electrical Idle condition on the channel to assertion of TxIdleDetect output |     | 10      | 20             | ns   |
| TRX-IDLE_EXIT            | Delay from detection of L0s to L0 transition to deassertion of TxIdleDetect output                   |     | 5       | 10             | ns   |

- a. Over a frequency range of 50 MHz to 1.25 GHz.  
b. Over a frequency range of 50 MHz to 1.25 GHz.  
c. Assuming synchronized bit streams at the respective receiver inputs.  
d. This is a function of beacon frequency

## 10. CLOCK SCHEME

The PI7C9X7954 requires 100MHz differential clock inputs through CLKINP and CLKINN Pins as shown in the following table.

**Table 10-1 Input Clock Requirements**

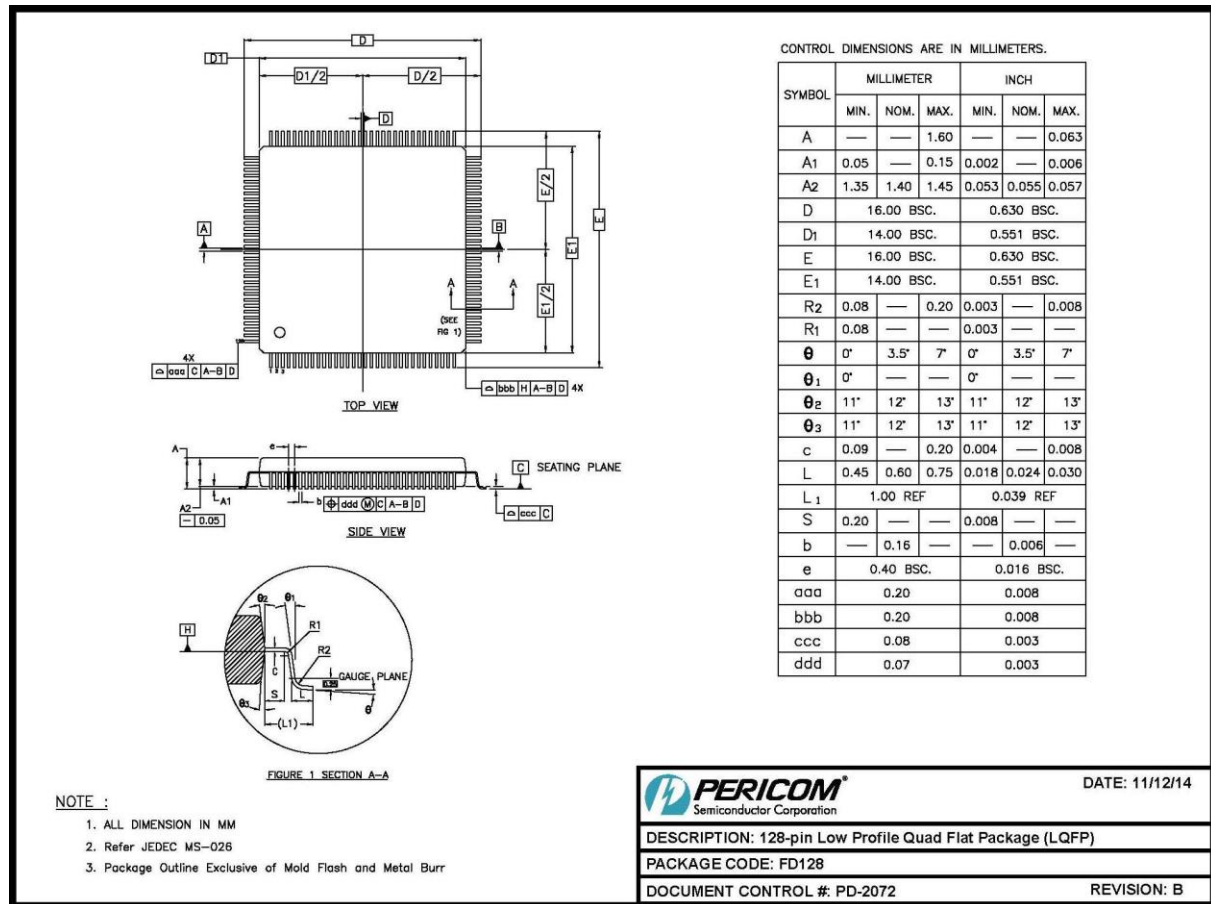
| Symbol                          | Description                                     | Min | Typical | Max. | Unit              |
|---------------------------------|---|-----|---------|------|-------------------|
| ClkIn <sub>FREQ</sub>           | Reference input clock range                     | -   | 100     | -    | MHz               |
| ClkIn <sub>DC</sub>             | Duty cycle of input clock                       | 40  | 50      | 60   | %                 |
| T <sub>R</sub> , T <sub>F</sub> | Rise/Fall time of input clock                   | -   | -       | 0.2  | RCUI <sup>a</sup> |
| V <sub>SW</sub>                 | Differential input voltage swing (zero-to-peak) | 0.4 |         | 0.8  | V                 |

a. RCUI (Reference Clock Unit Interval) refers to the reference clock period

## 11. PACKAGE INFORMATION

The package of PI7C9X7954 is a 14mm x 14mm LQFP (128 Pin) package. The following are the package information and mechanical dimension:

**Figure 11-1 Package Outline Drawing**



## 12. Order Information

| Part Number       | Temperature Range                         | Package                     | Pb-Free & Green |
|-------------------|---|-----------------------------|-----------------|
| PI7C9X7954 □ FDEX | -40°C to 85°C<br>(Industrial Temperature) | 128-pin LQFP<br>14mm x 14mm | Yes             |

