

裕太微电子
MotorComm

Motorcomm YT8614

Datasheet

INTEGRATED QUAD 10/100/1000M ETHERNET
COMBO TRANSCEIVER

VERSION V1.06
DATE 2023-05-12

Copyright Statement

This document is copyright of Motorcomm Electronic Technology Co., Ltd. ("Motorcomm"). All rights reserved. No company or individual may copy, disseminate, disclose or otherwise distribute any part of this document to any third party without the written consent of Motorcomm. If any company or individual so does, Motorcomm reserves the right to hold it or him liable therefor.

Disclaimer

This document only provides periodic information, and its contents will/may be updated from time to time according to actual situation of Motorcomm' s products without further notice. Motorcomm will not take any responsibility for any direct or indirect losses caused due to improper use of this document.

Revision History

Revision	Release Date	Summary
v1.00	2021/02/01	Initial
v1.01	2021/06/23	1. Update RMS Jitter in section 7.4. 2. Add parameter L_{TX} in section 7.2.1. 3. Upadte R_{Y2} and $V_{RX-DIFFp-p}$ in section 7.2.4. 4. Add section 7.2.5 and 7.2.6.
v1.02	2021/07/05	1. Add seciton 7.2.8. Serial LED Timing. 2. Modify mechanical dimensions in section 10.2. 3. Remove parameter t_5 in section 8.3. 4. Remove peak to peak jitter in section 7.4.
v1.03	2022/04/12	Modify XTALI pin descriptions in section3.2.7
v1.04	2023/02/08	Modify parameter Ltx to parameter IL in section 7.2.1 and 7.2.3
V1.05	2023/02/24	Modify 6.2.11 bit10 and bit11 description
V1.06	2023/05/12	1.Modify the Cable diagnostic description to CSD 2.Modify the XTALI pin description 3.Modify 6.6.1 sds mii reg0x0[8] description 4.Modify 6.1.19 6.1.21 6.1.29 6.1.31 description 5.Updated fonts

Content

1. General Description.....	1
1.1. TARGET APPLICATIONS	1
1.2. System Application.....	2
2. Features.....	3
3. PIN Assignment	5
3.1. YT8614 LQFP-176	5
3.2. Pin Descriptions.....	6
3.2.1. ALL pins.....	7
3.2.2. Media Dependent Interface Pins	10
3.2.3. QSGMII Interface Pins	11
3.2.4. Serial LED Pins	11
3.2.5. SYNCE Interface	11
3.2.6. Configuration Pins.....	12
3.2.7. Miscellaneous Pins	13
3.2.8. Power and GND Pins	14
3.2.9. 1000BASE-X/100BASE-FX Interface Pins.....	15
4. Function Description.....	17
4.1. Mode selection.....	17
4.1.1. QSGMII x 1 + Combo x 4.....	17
4.1.2. QSGMII x 1 + Copper x 4	17
4.1.3. QSGMII x 1 + Fiber x 4	18
4.1.4. QSGMII x 1 + SGMII x 4	18
4.1.5. SGMII x 4 + Copper x 4.....	19
4.1.6. Copper x 4 + Fiber x 4.....	19
4.2. Transmit Functions.....	20
4.2.1. Transmit Encoder Modes.....	20
4.3. Receive Functions.....	20
4.3.1. Receive Decoder Modes.....	20
4.4. LRE100-4.....	20
4.5. Management Interface.....	21
4.6. Auto-Negotiation.....	21
4.7. LDS (Link discovery signaling)	22
4.8. Polarity detection and auto correction.....	22
4.9. Energy Efficient Ethernet (EEE).....	22
4.10. Synchronous Ethernet (Sync-E)	22
4.11. Link Down Power Saving (Sleep Mode)	23
4.12. Interrupt	23
5. Operational Description	24
5.1. Reset.....	24
5.2. PHY Address.....	24
5.3. Loopback Mode	24
5.3.1. Digital Loopback.....	25

5.3.2. External loopback.....	25
5.3.3. Remote PHY loopback.....	25
5.4. LED.....	26
5.5. Power Supplies.....	26
6. Register Overview	27
6.1. Common Register	27
6.1.1. SMI Mux (EXT 0xA000)	27
6.1.2. SLED cfg0 (EXT 0xA001)	27
6.1.3. SLED cfg (0xA004)	28
6.1.4. mode_chg_reset (0xA005)	29
6.1.5. chip_mode (0xA007).....	30
6.1.6. SYNCE0 cfg (0xA006).....	31
6.1.7. SYNCE1 cfg (0xA00E)	32
6.1.8. PHY Link Up/Down INTn Mask (0xA010).....	33
6.1.9. PHY Link Up/Down INTn Status (0xA011)	34
6.1.10. UTP Legacy Interrupt Mask (0xA012)	34
6.1.11. UTP Legacy Interrupt Status (0xA013).....	35
6.1.12. QSGMII Legacy Interrupt Mask (0xA014).....	36
6.1.13. QSGMII Legacy Interrupt Status (0xA015)	36
6.1.14. pkg_cfg0 (0xA0a0).....	37
6.1.15. pkg_cfg1 (0xA0a1).....	38
6.1.16. pkg_cfg2 (0xA0a2).....	38
6.1.17. pkg_rx_valid0 (0xA0a3)	39
6.1.18. pkg_rx_valid1 (0xA0a4)	39
6.1.19. pkg_rx_os0 (0xA0a5)	39
6.1.20. pkg_rx_os1 (0xA0a6)	40
6.1.21. pkg_rx_us0 (0xA0a7)	40
6.1.22. pkg_rx_us1 (0xA0a8)	40
6.1.23. pkg_rx_err (0xA0a9).....	40
6.1.24. pkg_rx_os_bad (0xA0aa).....	41
6.1.25. pkg_rx_fragment (0xA0ab).....	41
6.1.26. pkg_rx_nosfd (0xA0ac)	41
6.1.27. pkg_tx_valid0 (0xA0ad)	41
6.1.28. pkg_tx_valid1 (0xA0ae)	42
6.1.29. pkg_tx_os0 (0xA0af).....	42
6.1.30. pkg_tx_os1 (0xA0b0)	42
6.1.31. pkg_tx_us0 (0xA0b1)	42
6.1.32. pkg_tx_us1 (0xA0b2)	43
6.1.33. pkg_tx_err (0xA0b3).....	43
6.1.34. pkg_tx_os_bad (0xA0b4).....	43
6.1.35. pkg_tx_fragment (0xA0b5)	43
6.1.36. pkg_tx_nosfd (0xA0b6)	44
6.1.37. pkg_cfg3 (0xA0b7).....	44
6.1.38. pkg_az_cfg (0xA0b8)	45

6.1.39. pkg_da_sa_cfg (0xA0b9).....	45
6.1.40. manu_hw_reset (0xA0c0).....	46
6.2. UTP MII Register	46
6.2.1. Basic control register (0x00).....	46
6.2.2. Basic status register (0x01)	48
6.2.3. PHY identification register1 (0x02)	49
6.2.4. PHY identification register2 (0x03)	49
6.2.5. Auto-Negotiation advertisement (0x04)	49
6.2.6. Auto-Negotiation link partner ability (0x05)	52
6.2.7. Auto-Negotiation expansion register (0x06).....	54
6.2.8. Auto-Negotiation Next Page register (0x07)	54
6.2.9. Auto-Negotiation link partner Received Next Page register (0x08).....	55
6.2.10. MASTER-SLAVE control register (0x09).....	55
6.2.11. MASTER-SLAVE status register (0x0A)	57
6.2.12. MMD access control register (0x0D).....	58
6.2.13. MMD access data register (0x0E)	59
6.2.14. Extended status register (0x0F).....	59
6.2.15. PHY specific function control register (0x10).....	59
6.2.16. PHY specific status register (0x11).....	60
6.2.17. Interrupt Mask Register (0x12)	61
6.2.18. Interrupt Status Register (0x13).....	62
6.2.19. Speed Auto Downgrade Control Register (0x14).....	63
6.2.20. Rx Error Counter Register (0x15).....	63
6.2.21. Debug Register's Address Offset Register (0x1E).....	63
6.2.22. Debug Register's Data Register (0x1F).....	64
6.3. LDS MII Register	64
6.3.1. LRE control (0x00)	64
6.3.2. LRE status (0x01)	65
6.3.3. PHY ID (0x02).....	66
6.3.4. PHY ID (0x03).....	66
6.3.5. LDS auto-negotiation advertised ability (0x04).....	66
6.3.6. LDS auto-negotiation advertised control (0x05)	67
6.3.7. LDS ability Next Page transmit (0x06)	67
6.3.8. LDS link partner ability (0x07)	67
6.3.9. LDS link partner Next Page message (0x08)	68
6.3.10. LDS link partner Next Page message control (0x09)	68
6.3.11. LDS expansion (0x0A)	68
6.3.12. LDS Results (0x0B)	68
6.3.13. LDS Extended status (0x0F)	69
6.4. UTP MMD Register	69
6.4.1. PCS control 1 register (MMD3, 0x00)	69
6.4.2. PCS status 1 register (MMD3, 0x01)	69
6.4.3. EEE control and capability register (MMD3, 0x14)	70
6.4.4. EEE wake error counter (MMD3, 0x16).....	70

6.4.5. Local Device EEE Ability (MMD7, 0x3C).....	70
6.4.6. Link Partner EEE Ability (MMD7, 0x3D)	71
6.4.7. Autoneg Result of EEE (MMD7, 0x8000).....	71
6.5. UTP EXT Register.....	71
6.5.1. 10BT Debug, LPBKs Register (0x0A).....	71
6.5.2. Sleep Control1 (0x27).....	72
6.5.3. debug mon1 (0x5A)	72
6.5.4. debug mon2 (0x5B)	72
6.5.5. debug mon3 (0x5C)	73
6.5.6. debug mon4 (0x5D)	73
6.6. SDS(1.25G/5G) MII Register.....	73
6.6.1. Basic control register (0x00).....	73
6.6.2. Basic status register (0x01)	74
6.6.3. Sds identification register1 (0x02)	75
6.6.4. Sds identification register2 (0x03)	76
6.6.5. Auto-Negotiation advertisement (0x04)	76
6.6.6. Auto-Negotiation link partner ability (0x05)	77
6.6.7. Auto-Negotiation expansion register (0x06).....	77
6.6.8. Auto-Negotiation Next Page register (0x07)	78
6.6.9. Auto-Negotiation link partner Received Next Page register (0x08).....	78
6.6.10. Extended status register (0x0F).....	78
6.6.11. Sds specific status register (0x11)	78
6.6.12. 100fx cfg (0x14)	79
6.6.13. receive err counter mon (0x15).....	79
6.6.14. lint fail counter mon (0x16)	79
6.7. SDS(5G) EXT Register.....	80
6.7.1. bp_serdes_link_rst (0x00).....	80
6.7.2. sds analog digital interface cfg (0x02)	80
6.7.3. sds prbs cfg1 (0x05)	81
6.7.4. sds prbs cfg2 (0x06)	82
6.7.5. sds prbs cfg2 (0x07)	82
6.7.6. sds prbs mon1 (0x08).....	82
6.7.7. sds prbs mon2 (0x09).....	83
6.7.8. sds prbs mon3 (0x0A)	83
6.7.9. sds prbs mon4 (0x0B)	83
6.7.10. sds prbs mon5 (0x0C).....	83
6.7.11. analog cfg2 (0xA1).....	83
6.8. SDS(1.25G) EXT Register	84
6.8.1. sds prbs cfg1 (0x05)	84
6.8.2. sds prbs cfg2 (0x06)	85
6.8.3. sds prbs mon1 (0x08).....	85
6.8.4. sds prbs mon2 (0x09).....	85
6.8.5. sds prbs mon3 (0x0A)	86
6.8.6. sds prbs mon4 (0x0B)	86

6.8.7. sds prbs mon5 (0x0C)	86
6.8.8. analog cfg2 (0xA1)	86
7. Electrical Characteristics	87
7.1. DC Characteristics	87
7.2. AC Characteristics.....	88
7.2.1. QSGMII Differential Transmitter Characteristics	88
7.2.2. QSGMII Differential Receiver Characteristics.....	89
7.2.3. SGMII Differential Transmitter Characteristics	90
7.2.4. SGMII Differential Receiver Characteristics.....	91
7.2.5. 1000BASE-X Differential Transmitter Characteristics	92
7.2.6. 1000BASE-X Differential Receiver Characteristics.....	93
7.2.7. SMI (MDC/MDIO) Interface Characteristics	94
7.2.8. Serial LED Timing	94
7.3. Crystal Requirement	95
7.4. Oscillator/External Clock Requirement	95
8. Power Requirements.....	96
8.1. Absolute Maximum Ratings	96
8.2. Recommended Operating Conditions	96
8.3. Power and Reset Sequence.....	96
8.4. Power Ripple.....	97
8.5. Power Consumption.....	97
8.5.1. QSGMII x 1 + Combo x 4.....	97
8.5.2. QSGMII x 1 + Copper x 4	97
8.5.3. QSGMII x 1 + Fiber x 4	98
8.5.4. QSGMII x 1 + SGMII x 4	98
8.5.5. SGMII x 4 + Copper x 4.....	98
8.5.6. Copper x 4 + Fiber x 4.....	99
8.6. Maximum Power Consumption	99
9. Thermal Characteristics.....	100
9.1. Thermal Resistance	100
10. Package Information	101
10.1. LQFP-176 E-PAD.....	101
10.2. Mechanical Dimensions	102
11. Ordering Information	103

List of Table

Table 1. All Pins Assignment.....	7
Table 2. Media Dependent Interface Pins	10
Table 3. QSGMII Interface Pins	11
Table 4. Serial LED Pins	11
Table 5. SYNCE Interface	11
Table 6. Configuration Pins	12
Table 7. Miscellaneous Pins.....	13
Table 8. Power and GND Pins.....	14
Table 9. 1000BASE-X/100BASE-FX Interface Pins	15
Table 10. Reset Timing Characteristics.....	24
Table 11. SMI Mux (EXT 0xA000).....	27
Table 12. SLED cfg (0xA004).....	28
Table 13. mode_chg_reset (0xA005).....	29
Table 14. chip_mode (0xA007)	30
Table 15. SYNCE0 cfg (0xA006)	31
Table 16. SYNCE1 cfg (0xA00E).....	32
Table 17. PHY Link Up/Down INTn Mask (0xA010)	33
Table 18. PHY Link Up/Down INTn Status (0xA011)	34
Table 19. UTP Legacy Interrupt Mask (0xA012)	34
Table 20. UTP Legacy Interrupt Status (0xA013)	35
Table 21. QSGMII Legacy Interrupt Mask (0xA014).....	36
Table 22. QSGMII Legacy Interrupt Status (0xA015).....	36
Table 23. pkg_cfg0 (0xA0a0)	37
Table 24. pkg_cfg1 (0xA0a1)	38
Table 25. pkg_cfg2 (0xA0a2)	39
Table 26. pkg_rx_valid0 (0xA0a3).....	39
Table 27. pkg_rx_valid1 (0xA0a4).....	39
Table 28. pkg_rx_os0 (0xA0a5).....	39
Table 29. pkg_rx_os1 (0xA0a6).....	40
Table 30. pkg_rx_us0 (0xA0a7).....	40
Table 31. pkg_rx_us1 (0xA0a8).....	40
Table 32. pkg_rx_err (0xA0a9)	40
Table 33. pkg_rx_os_bad (0xA0aa)	41
Table 34. pkg_rx_fragment (0xA0ab)	41
Table 35. pkg_rx_nosfd (0xA0ac).....	41
Table 36. pkg_tx_valid0 (0xA0ad)	41
Table 37. pkg_tx_valid1 (0xA0ae)	42
Table 38. pkg_tx_os0 (0xA0af)	42
Table 39. pkg_tx_os1 (0xA0b0).....	42
Table 40. pkg_tx_us0 (0xA0b1).....	42
Table 41. pkg_tx_us1 (0xA0b2).....	43
Table 42. pkg_tx_err (0xA0b3).....	43

Table 43. pkg_tx_os_bad (0xA0b4)	43
Table 44. pkg_tx_fragment (0xA0b5).....	43
Table 45. pkg_tx_nosfd (0xA0b6).....	44
Table 46. pkg_cfg3 (0xA0b7)	44
Table 47. pkg_az_cfg (0xA0b8).....	45
Table 48. pkg_da_sa_cfg (0xA0b9)	46
Table 49. manu_hw_reset (0xA0c0)	46
Table 50. Basic control register (0x00)	46
Table 51. Basic status register (0x01)	48
Table 52. PHY identification register1 (0x02)	49
Table 53. PHY identification register2 (0x03)	49
Table 54. Auto-Negotiation advertisement (0x04).....	49
Table 55. Auto-Negotiation link partner ability (0x05).....	52
Table 56. Auto-Negotiation expansion register (0x06)	54
Table 57. Auto-Negotiation Next Page register (0x07).....	54
Table 58. Auto-Negotiation link partner Received Next Page register (0x08)	55
Table 59. MASTER-SLAVE control register (0x09)	55
Table 60. MASTER-SLAVE status register (0x0A)	57
Table 61. MMD access control register (0x0D)	58
Table 62. MMD access data register (0x0E).....	59
Table 63. Extended status register (0x0F)	59
Table 64. PHY specific function control register (0x10)	59
Table 65. PHY specific status register (0x11).....	60
Table 66. Interrupt Mask Register (0x12).....	61
Table 67. Interrupt Status Register (0x13).....	62
Table 68. Speed Auto Downgrade Control Register (0x14)	63
Table 69. Rx Error Counter Register (0x15)	63
Table 70. Debug Register's Address Offset Register (0x1E)	63
Table 71. Debug Register's Data Register (0x1F)	64
Table 72. LRE control (0x00)	64
Table 73. LRE status (0x01).....	65
Table 74. PHY ID (0x02).....	66
Table 75. PHY ID (0x03)	66
Table 76. LDS auto-negotiation advertised ability (0x04)	66
Table 77. LDS auto-negotiation advertised control (0x05)	67
Table 78. LDS ability Next Page transmit (0x06)	67
Table 79. LDS link partner ability (0x07)	67
Table 80. LDS link partner Next Page message (0x08).....	68
Table 81. LDS link partner Next Page message control (0x09).....	68
Table 82. LDS expansion (0x0A).....	68
Table 83. LDS Results (0x0B).....	68
Table 84. LDS Extended status (0x0F).....	69
Table 85. PCS control 1 register (MMD3, 0x00)	69
Table 86. PCS status 1 register (MMD3, 0x01).....	69

Table 87. EEE control and capability register (MMD3, 0x14).....	70
Table 88. EEE wake error counter (MMD3, 0x16)	70
Table 89. Local Device EEE Ability (MMD7, 0x3C)	70
Table 90. Link Partner EEE Ability (MMD7, 0x3D).....	71
Table 91. Autoneg Result of EEE (MMD7, 0x8000)	71
Table 92. 10BT Debug, LPBKs Register (0x0A)	71
Table 93. Sleep Control1 (0x27).....	72
Table 94. debug mon1 (0x5A).....	72
Table 95. debug mon2 (0x5B).....	72
Table 96. debug mon3 (0x5C)	73
Table 97. debug mon4 (0x5D)	73
Table 98. Basic control register (0x00)	73
Table 99. Basic status register (0x01)	74
Table 100. Sds identification register1 (0x02)	75
Table 101. Sds identification register2 (0x03)	76
Table 102. Auto-Negotiation advertisement (0x04)	76
Table 103. Auto-Negotiation link partner ability (0x05)	77
Table 104. Auto-Negotiation expansion register (0x06).....	77
Table 105. Auto-Negotiation Next Page register (0x07)	78
Table 106. Auto-Negotiation link partner Received Next Page register (0x08)	78
Table 107. Extended status register (0x0F).....	78
Table 108. Sds specific status register (0x11).....	78
Table 109. 100fx cfg (0x14).....	79
Table 110. receive err counter mon (0x15)	79
Table 111. lint fail counter mon (0x16).....	79
Table 112. bp_serdes_link_rst (0x00).....	80
Table 113. sds analog digital interface cfg (0x02).....	80
Table 114. sds prbs cfg1 (0x05)	81
Table 115. sds prbs cfg2 (0x06)	82
Table 116. sds prbs cfg2 (0x07)	82
Table 117. sds prbs mon1 (0x08).....	82
Table 118. sds prbs mon2 (0x09).....	83
Table 119. sds prbs mon3 (0x0A)	83
Table 120. sds prbs mon4 (0x0B)	83
Table 121. sds prbs mon5 (0x0C)	83
Table 122. analog cfg2 (0xA1).....	83
Table 123. sds prbs cfg1 (0x05)	84
Table 124. sds prbs cfg2 (0x06)	85
Table 125. sds prbs mon1 (0x08).....	85
Table 126. sds prbs mon2 (0x09).....	85
Table 127. sds prbs mon3 (0x0A)	86
Table 128. sds prbs mon4 (0x0B)	86
Table 129. sds prbs mon5 (0x0C)	86
Table 130. analog cfg2 (0xA1).....	86

Table 131. DC Characteristics	87
Table 132. QSGMII Differential Transmitter Characteristics	88
Table 133. QSGMII Differential Receiver Characteristics.....	89
Table 134. SGMII Differential Transmitter Characteristics	90
Table 135. SGMII Differential Receiver Characteristics.....	91
Table 136. 1000BASE-X Differential Transmitter Characteristics	92
Table 137. 1000BASE-X Differential Receiver Characteristics.....	93
Table 138. SMI (MDC/MDIO) Interface Characteristics	94
Table 139. MDC/MDIO Interface Characteristics.....	94
Table 140. Crystal Requirement	95
Table 141. Oscillator/External Clock Requirement	95
Table 142. Absolute Maximum Ratings.....	96
Table 143. Recommended Operating Conditions	96
Table 144. Power and Reset Sequence.....	96
Table 145. QSGMII x 1 + Combo x 4 Power Consumption	97
Table 146. QSGMII x 1 + Copper x 4 Power Consumption.....	97
Table 147. QSGMII x 1 + Fiber x 4 Power Consumption.....	98
Table 148. QSGMII x 1 + SGMII x 4 Power Consumption.....	98
Table 149. SGMII x 4 + Copper x 4 Power Consumption.....	98
Table 150. Copper x 4 + Fiber x 4 Power Consumption	99
Table 151. Maximum Power Consumption	99
Table 152. Thermal Resistance.....	100

List of Figures

Figure 1. System Application.....	2
Figure 2. System Application.....	5
Figure 3. QSGMII x 1 + Combo x 4.....	17
Figure 4. QSGMII x 1 + Copper x 4.....	17
Figure 5. QSGMII x 1 + Fiber x 4.....	18
Figure 6. QSGMII x 1 + SGMII x 4	18
Figure 7. SGMII x 4 + Copper x 4.....	19
Figure 8. Copper x 4 + Fiber x 4.....	19
Figure 9. Reset Timing Diagram	24
Figure 10. Digital Loopback.....	25
Figure 11. External Loopback	25
Figure 12. Remote PHY Loopback.....	25
Figure 13. QSGMII Differential Transmitter Eye Diagram.....	88
Figure 14. QSGMII Differential Receiver Eye Diagram	89
Figure 15. SGMII Differential Transmitter Eye Diagram.....	90
Figure 16. SGMII Differential Receiver Eye Diagram	91
Figure 17. 1000BASE-X Differential Transmitter Eye Diagram.....	92
Figure 18. 1000BASE-X Differential Receiver Eye Diagram.....	93

Figure 19. SMI (MDC/MDIO) Timing.....	94
Figure 20. MDC/MDIO Timing Parameters.....	94
Figure 21. Power and Reset Sequence.....	96

1. General Description

The YT8614 integrates quad independent 10/100/1000M Ethernet transceivers and four SerDes interface into a single IC, and performs all the physical layer (PHY) functions for 1000BASE-T, 100BASE-TX, and 10BASE-T_e Ethernet on category 5E UTP cable except 1000BASE-T half-duplex. 10BASE-T_e functionality can also be achieved on standard category 3 or 4 cable.

This device also supports four dual media ports and can support up to four 100BASE-FX, 1000BASE-X.

This device includes PCS, PMA, and PMD sub-layers. They perform encoding/decoding, clock/data recovery, digital adaptive equalization, echo cancellers, crosstalk elimination, and line driver, as well as other required supporting circuit functions. The YT8614 also integrates an internal hybrid that allows the use of inexpensive 1:1 transformer modules.

Each of the four independent transceivers features an comprehensive QSGMII for reduced PCB trace. All transceivers can communicate with the MAC simultaneously through the same QSGMII.

1.1. TARGET APPLICATIONS

- High Port Density Switch
- QSGMII MAC
- Copper/Fiber Dual Media

1.2. System Application

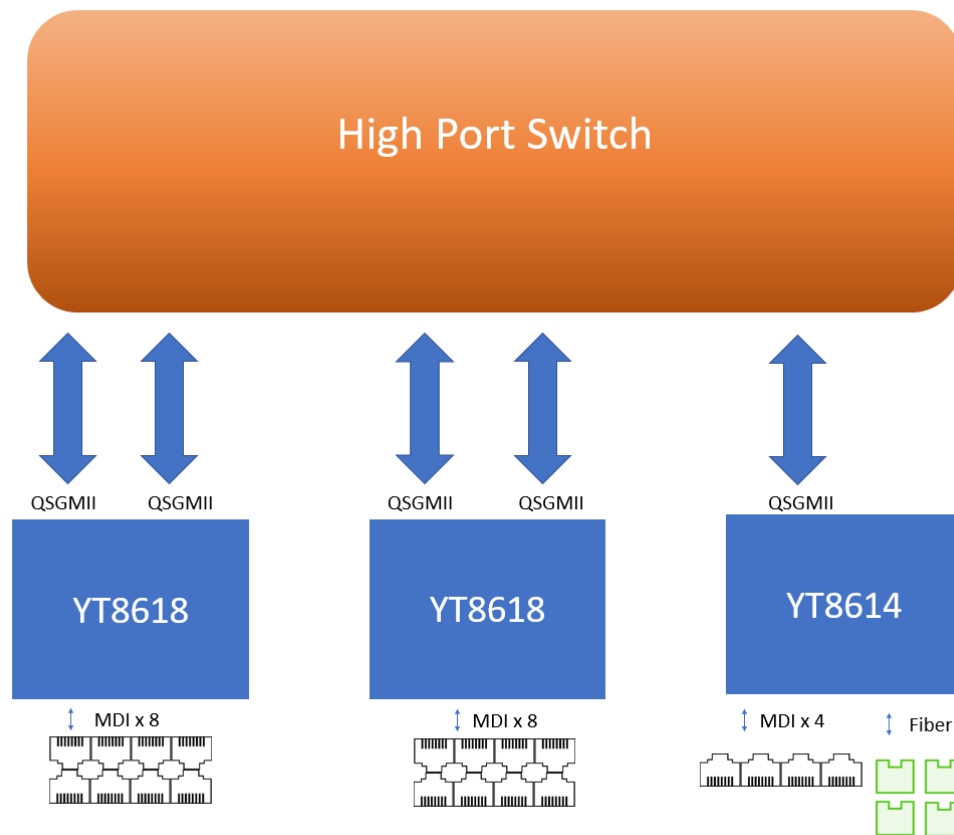


Figure 1. System Application

2. Features

- Integrated Quad 10/100/1000M Ethernet Transceiver with four SerDes interface
- Support QSGMII (Quad Serial Gigabit Media Independent Interface) in 10/100/1000M mode
- Support SGMII mode direct link to one designated Copper Giga PHY with speed adaption
- Physical interface supports 1000BASE-X
- Physical interface supports 100BASE-FX
- Support LRE100-4, disabled by default
 - Cable reach up to 400 meter @100Mbps
- Supports IEEE 802.3az-2010 (Energy Efficient Ethernet)
 - EEE Buffering
 - Incorporates EEE buffering for seamless support of legacy MACs
- Supports crossover detection and auto correction
- Supports auto-detection and auto-correction of wiring pair swaps, pair skew, and pair polarity
- Supports CSD(Cable status diagnostic)
- Supports Link Down Power Saving (Sleep Mode)
- Supports one interrupt output to external CPU for notification
- Supports fast link failure indication
- Supports unidirection in 1000BASE-X/100BASE-FX
- Supports 120m for CAT.5E cable in 1000BASE-T
- Supports Serial LED interface.
- Supports SyncE clock output Mux
 - Recover clock from either SerDes
 - Recover clock from either Copper PHY
 - From internal 25Mhz Clock
- SerDes Test pattern
 - PRBS-7/10/31
 - IDLE /K28.5 /D5.6
 - Customized define by user
 - SerDes BIST
- Packet Generator and Checker
- Low power consumption
- Easy layout, good EMI/EMS, and good thermal performance

Motorcomm YT8614 Datasheet

- Supports 25MHz crystal or 3.3V OSC input
- 3.3V and 1.2V power supply
- LQFP-176 E-PAD package

3.1. YT8614 LQFP-176



3.2. Pin Descriptions

- I: Input Pin
- AI: Analog Input Pin
- O: Output Pin
- AO: Analog Output Pin
- IO: Bidirectional Input/Output Pin
- AIO: Analog Bidirectional Input/Output Pin
- LI: Latched Input During Power UP or Hardware Reset
- P: Digital Power Pin
- AP: Analog Power Pin
- G: Digital Ground Pin
- AG: Analog Ground Pin
- PD: Internal Pull-Down
- PU: Internal Pull-UP
- SP: SerDes Power Pin
- SG: SerDes Ground Pin
- OD: Open Drain
- XT: Crystal Related

3.2.1. ALL pins

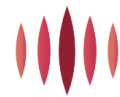
Table 1. All Pins Assignment

NO.	Name	TYPE
1	NC	–
2	P3MDICP	AIO
3	P3MDICN	AIO
4	P3MDIDP	AIO
5	P3MDIDN	AIO
6	AVDDH	AP
7	AVDDH	AP
8	AGND	AG
9	RBIAS	AO
10	AVDDL	AP
11	SYNCE0	IO/PD
12	SYNCE1	O/PD
13	NC	–
14	DVDDIO	P
15	DVDDL	P
16	NC	–
17	NC	–
18	EN_PHY	LI/PU
19	NC	–
20	INTERRUPT	O/OD
21	PHYADDR0/SYNC_ LOCK0	LI/O/PD
22	PHYADDR1/SYNC_ LOCK1	LI/O/PD
23	NC	–
24	DVDDL	P
25	FX3_TX_DIS	O/PU
26	FX2_TX_DIS	O/PU
27	FX1_TX_DIS	O/PU
28	FX0_TX_DIS	O/PU
29	NC	–
30	DIS_SLED	LI/PU
31	NC	–
32	NC	–
33	NC	–

NO.	Name	TYPE
35	NC	–
36	NC	–
37	NC	–
38	NC	–
39	AVDDH	AP
40	NC	–
41	NC	–
42	NC	–
43	NC	–
44	NC	–
45	AVDDL	AP
46	NC	–
47	NC	–
48	NC	–
49	NC	–
50	AVDDH	AP
51	NC	–
52	NC	–
53	NC	–
54	NC	–
55	AVDDL	AP
56	NC	–
57	NC	–
58	NC	–
59	NC	–
60	PLLVDL1	AP
61	NC	–
62	NC	–
63	NC	–
64	NC	–
65	NC	–
66	AVDDL	AP
67	NC	–

34	Reserved	PD
NO.	Name	TYPE
69	NC	–
70	NC	–
71	AVDDH	AP
72	NC	–
73	NC	–
74	NC	–
75	NC	–
76	AVDDL	AP
77	NC	–
78	NC	–
79	NC	–
80	NC	–
81	AVDDH	AP
82	MDIO	IO/PU
83	MDC	IO/PD
84	CHIP_MODE0	LI/PU
85	CHIP_MODE1	LI/PU
86	CHIP_MODE2	LI/PU
87	DVDDIO	P
88	DVDDL	P
89	DVDDL	P
90	FX0RXN	AI
91	FX0RXP	AI
92	SVDDL	SP
93	FX0TXN	AO
94	FX0TXP	AO
95	SGND	SG
96	FX1RXN	AI
97	FX1RXP	AI
98	SVDDL	SP
99	FX1TXN	AO
100	FX1TXP	AO
101	SGND	SG
102	FX2RXN	AI
103	FX2RXP	AI
104	SVDDL	SP
105	FX2TXN	AO

68	NC	–
NO.	Name	TYPE
107	SGND	SG
108	FX3RXN	AI
109	FX3RXP	AI
110	SVDDL	SP
111	FX3TXN	AO
112	FX3TXP	AO
113	SGND	SG
114	SVDDH	SP
115	NC	–
116	NC	–
117	SVDDL	SP
118	NC	–
119	NC	–
120	SGND	SP
121	NC	–
122	NC	–
123	SGND	SG
124	SVDDL	SP
125	S0RXN	AO
126	S0RXP	AO
127	SVDDL	SP
128	S0TXN	AI
129	S0TXP	AI
130	SGND	SG
131	XTALO	XT
132	XTALI	XT
133	DVDDIO	P
134	RESET_N	I/PU
135	PHYADDR4/LEDCK	LI/O/PD
136	PHYADDR3/LEDCA	LI/O/PD
137	PHYADDR2	LI/PD
138	En_PowerOn_Light	LI/PU
139	NC	–
140	AVDDH	AP
141	P0MDIAP	AIO
142	P0MDIAN	AIO
143	P0MDIBP	AIO



Motorcomm YT8614 Datasheet

106	FX2TXP	AO
NO.	Name	TYPE
145	AVDDL	AP
146	P0MDICP	AIO
147	P0MDICN	AIO
148	P0MDIDP	AIO
149	P0MDIDN	AIO
150	AVDDH	AP
151	P1MDIAP	AIO
152	P1MDIAN	AIO
153	P1MDIBP	AIO
154	P1MDIBN	AIO
155	AVDDL	AP
156	P1MDICP	AIO
157	P1MDICN	AIO
158	P1MDIDP	AIO
159	P1MDIDN	AIO
160	PLLVDDL0	AP
161	NC	-

144	P0MDIBN	AIO
NO.	Name	TYPE
162	P2MDIAP	AIO
163	P2MDIAN	AIO
164	P2MDIBP	AIO
165	P2MDIBN	AIO
166	AVDDL	AP
167	P2MDICP	AIO
168	P2MDICN	AIO
169	P2MDIDP	AIO
170	P2MDIDN	AIO
171	AVDDH	AP
172	P3MDIAP	AIO
173	P3MDIAN	AIO
174	P3MDIBP	AIO
175	P3MDIBN	AIO
176	AVDDL	AP
EPAD	GND EPAD	EPAD

3.2.2. Media Dependent Interface Pins

Table 2. Media Dependent Interface Pins

Pin Name	Pin No.	Type	Description
P0MDIAP	141	AIO	Port 0 Media Dependent Interface A~D. For 1000BASE-T operation, differential data from the media is transmitted and received on all four pairs. For 100BASE-TX and 10BASE-Te operation, only MDIAP/N and MDIBP/N are used. Auto MDIX can reverse the pairs MDIAP/N and MDIBP/N. Each of the differential pairs has an internal 100ohm termination resistor.
P0MDIAN	142	AIO	
P0MDIBP	143	AIO	
P0MDIBN	144	AIO	
P0MDICP	146	AIO	
P0MDICN	147	AIO	
P0MDIDP	148	AIO	
P0MDIDN	149	AIO	
P1MDIAP	151	AIO	Port 1 Media Dependent Interface A~D. For 1000BASE-T operation, differential data from the media is transmitted and received on all four pairs. For 100BASE-TX and 10BASE-Te operation, only MDIAP/N and MDIBP/N are used. Auto MDIX can reverse the pairs MDIAP/N and MDIBP/N. Each of the differential pairs has an internal 100ohm termination resistor.
P1MDIAN	152	AIO	
P1MDIBP	153	AIO	
P1MDIBN	154	AIO	
P1MDICP	156	AIO	
P1MDICN	157	AIO	
P1MDIDP	158	AIO	
P1MDIDN	159	AIO	
P2MDIAP	162	AIO	Port 2 Media Dependent Interface A~D. For 1000BASE-T operation, differential data from the media is transmitted and received on all four pairs. For 100BASE-TX and 10BASE-Te operation, only MDIAP/N and MDIBP/N are used. Auto MDIX can reverse the pairs MDIAP/N and MDIBP/N. Each of the differential pairs has an internal 100ohm termination resistor.
P2MDIAN	163	AIO	
P2MDIBP	164	AIO	
P2MDIBN	165	AIO	
P2MDICP	167	AIO	
P2MDICN	168	AIO	
P2MDIDP	169	AIO	
P2MDIDN	170	AIO	
P3MDIAP	172	AIO	Port 3 Media Dependent Interface A~D. For 1000BASE-T operation, differential data from the media is transmitted and received on all four pairs. For 100BASE-TX and 10BASE-Te operation, only MDIAP/N and MDIBP/N are used. Auto MDIX can reverse the pairs MDIAP/N and MDIBP/N. Each of the differential pairs has an internal 100ohm termination resistor.
P3MDIAN	173	AIO	
P3MDIBP	174	AIO	
P3MDIBN	175	AIO	
P3MDICP	2	AIO	
P3MDICN	3	AIO	
P3MDIDP	4	AIO	
P3MDIDN	5	AIO	

3.2.3. QSGMII Interface Pins

Table 3. QSGMII Interface Pins

Pin Name	Pin No.	Type	Description
S0RXP	126	AO	In the chip modes which QSGMII exits, these two pins are used for QSGMII Differential Output. 5GHz serial interfaces to transfer data to an External device that supports the QSGMII interface. Differential pairs have an internal 100ohm termination resistor. In other chip modes, these two pins are not used.
S0RXN	125	AO	
S0TXP	129	AI	In the chip modes which QSGMII exits, these two pins are used for QSGMII Differential Input. 5GHz serial interfaces to receive data from an External device that supports the QSGMII interface. Differential pairs have an internal 100ohm termination resistor. In other chip modes, these two pins are not used.
S0TXN	128	AI	

3.2.4. Serial LED Pins

Table 4. Serial LED Pins

Pin Name	Pin No.	Type	Description
DIS_SLED	30	LI/PU	Input upon Reset, 1: Disable Serial LED function. 0: Enable Serial LED function.
PHYADDR4/ LEDCK	135	LI/O/PD	Output after reset if Serial LED is enabled by DIS_SLED = 0. Used for Serial LED Clock.
PHYADDR3/ LEDDA	136	LI/O/PD	Output after reset if Serial LED is enabled by DIS_SLED = 0. Used for Serial LED Data.

3.2.5. SYNCE Interface

Table 5. SYNCE Interface

Pin Name	Pin No.	Type	Description
SYNCE0	11	IO/PD	SyncE0 clock output Suggest not to be pull-up.
SYNCE1	12	O/PD	SyncE1 clock output

PHYADDR0/ SYNC_LOCK 0	21	LI/O/PD	SyncE0 lock indicator
PHYADDR1/ SYNC_LOCK 1	22	LI/O/PD	SyncE1 lock indicator

3.2.6. Configuration Pins

Table 6. Configuration Pins

Pin Name	Pin No.	Type	Description
PHYADDR0/ SYNC_LOCK 0	21	LI/O/PD	PHYADDR0, PHY Address Select. These pins are the 5-bit IEEE-specified PHY address. The states of these five pins are latched during power-up or reset. <i>Note: This pin must be kept floating, or pulled high or low via an external 4.7k ohm resistor upon power on or reset.</i>
PHYADDR1/ SYNC_LOCK 1	22	LI/O/PD	PHYADDR1, PHY Address Select. These pins are the 5-bit IEEE-specified PHY address. The states of these five pins are latched during power-up or reset. <i>Note: This pin must be kept floating, or pulled high or low via an external 4.7k ohm resistor upon power on or reset.</i>
PHYADDR2	137	LI/PD	PHYADDR2, PHY Address Select. These pins are the 5-bit IEEE-specified PHY address. The states of these five pins are latched during power-up or reset. <i>Note: This pin must be kept floating, or pulled high or low via an external 4.7k ohm resistor upon power on or reset.</i>
PHYADDR3/ LEDDA	136	LI/O/PD	PHYADDR3, PHY Address Select. These pins are the 5-bit IEEE-specified PHY address. The states of these five pins are latched during power-up or reset. <i>Note: This pin must be kept floating, or pulled high or low via an external 4.7k ohm resistor upon power on or reset.</i>
PHYADDR4/ LEDCK	135	LI/O/PD	PHYADDR4, PHY Address Select. These pins are the 5-bit IEEE-specified PHY address. The states of these five pins are latched during power-up or reset. <i>Note: This pin must be kept floating, or pulled high or low via an external 4.7k ohm resistor upon power on or reset.</i>
EN_PHY	18	LI/PU	Enable PHY Power 1: Power up all ports. 0: Power down all ports and set the MII register 0.11 power down as 1. <i>Note: This pin must be kept floating, or pulled high or low via an external 4.7k ohm resistor upon power on or reset.</i>

CHIP_MODE2	86	LI/PU	CHIP MODE [2:0] refer to: 3'b000, 4x 1000BASE-X + Copper x4 3'b001, Reserved
CHIP_MODE1	85	LI/PU	3' b010, QSGMII x1 + Copper x4 mode, 3' b011, QSGMII x1 + Fiber x4 mode; 3' b100, QSGMII x1 + Combo x4 mode;
CHIP_MODE0	84	LI/PU	3' b101, QSGMII x1 + Combo x4 mode; 3' b110, QSGMII x1 + SGMII (MAC) x4 mode; 3' b111, SGMII(PHY) x4 + Copper x4 mode.
En_PowerOn_Light	138	LI/PU	En_PowerOn_Light. 1: Enable Serial LED Power On Light. 0: Disable Serial LED Power On Light. <i>Note: This pin must be kept floating, and pulled high or low via an external 4.7k ohm resistor upon power on or reset.</i>
DIS_SLED	30	LI/PU	Input upon Reset, 1: Disable Serial LED function. 0: Enable Serial LED function.

3.2.7. Miscellaneous Pins

Table 7. Miscellaneous Pins

Pin Name	Pin No.	Type	Description
MDC	83	IO/PD	MII Management Interface Clock Input. The clock reference for the MII management interface. The maximum frequency support is 12.5MHz.
MDIO	82	IO/PU	MII Management Interface Data Input/Output. MDIO transfer management data in and out of the device synchronous to the rising edge of MDC.
INTERRUPT	20	O/OD	Interrupt output when Interrupt even occurs, active low. Always open drain, must pull-up to DVDDIO via a 4.7K resistor.
RESET_N	134	I/PU	Hardware Reset (Active Low Reset Signal). To complete the reset function, this pin must be asserted for at least 10ms. It must be pulled high for normal operation.
RBIAS	9	AO	Bias Resistor. An external 2.49 k Ω $\pm$ 1% resistor must be connected between the RBIAS pin and GND

XTALI	132	XT	25MHz Crystal Clock Input. 25MHz $\pm$ 50ppm tolerance crystal reference or oscillator input. When using a crystal, connect a loading capacitor from each pad to ground. When either using an oscillator or driving an external 25MHz clock from another device, XTALO should be kept floating or with a low capacitance shunt capacitor to ground..
XTALO	131	XT	25Mhz Crystal Clock Output. 25MHz $\pm$ 50ppm tolerance crystal output. Refer to XTALI.
Reserved	34	PD	Internal pull down. Recommended to be floating or connected to GND directly.
NC	1, 13, 16, 17, 19, 23, 29, 31, 32, 33, 35, 36, 37, 38, 40, 41, 42, 43, 44, 46, 47, 48, 49, 51, 52, 53, 54, 56, 57, 58, 59, 61, 62, 63, 64, 65, 67, 68, 69, 70, 72, 73, 74, 75, 77, 78, 79, 80, 115, 116, 118, 119, 121, 122, 139, 161	–	NC pins and keep floating.

3.2.8. Power and GND Pins

Table 8. Power and GND Pins

Pin Name	Pin No.	Type	Description
AVDDH	6, 7, 39, 50, 71, 81, 140, 150,	AP	Analog High Voltage Power

	171		
AVDDL	10, 45, 55, 66, 76, 145, 155, 166, 176	AP	Analog Low Voltage Power
PLLVDDL0	160	AP	PLL Power This pin should be filtered with a low resistance series ferrite bead and 1000pF + 2.2μF shunt capacitors to ground
PLLVDDL1	60	AP	PLL Power This pin should be filtered with a low resistance series ferrite bead and 1000pF + 2.2μF shunt capacitors to ground
SVDDH	114	SP	QSGMII SerDes High Voltage Power
SVDDL	92, 98, 104, 110, 117, 124, 127	SP	QSGMII SerDes Low Voltage Power
DVDDIO	14, 87, 133	P	Digital I/O Power
DVDDL	15, 24, 88, 89	P	Digital Low Voltage Power
AGND	8	AG	Analog Ground
SGND	95, 101, 107, 113, 120, 123, 130	SG	SerDes Ground
GND	EPAD	G	Digital/Analog Ground

3.2.9. 1000BASE-X/100BASE-FX Interface Pins

Table 9. 1000BASE-X/100BASE-FX Interface Pins

Pin Name	Pin No.	Type	Description
FX0RXP	91	AI	Port 0 1000BASE-X Receiver Pair (1.25GHz Differential Signal Input).
FX0RXN	90		Port 0 100BASE-FX Receiver Pair (125MHz Differential Signal Input).
FX0TXP	94	AO	Port 0 1000BASE-X Transmit Pair (1.25GHz Differential

FX0TXN	93		Signal Output). Port 0 100BASE-FX Transmit Pair (125MHz Differential Signal Output).
FX1RXP	97	AI	Port 1 1000BASE-X Receiver Pair (1.25GHz Differential Signal Input).
FX1RXN	96		Port 1 100BASE-FX Receiver Pair (125MHz Differential Signal Input).
FX1TXP	100	AO	Port 1 1000BASE-X Transmit Pair (1.25GHz Differential Signal Output).
FX1TXN	99		Port 1 100BASE-FX Transmit Pair (125MHz Differential Signal Output).
FX2RXP	103	AI	Port 2 1000BASE-X Receiver Pair (1.25GHz Differential Signal Input).
FX2RXN	102		Port 2 100BASE-FX Receiver Pair (125MHz Differential Signal Input).
FX2TXP	106	AO	Port 2 1000BASE-X Transmit Pair (1.25GHz Differential Signal Output).
FX2TXN	105		Port 2 100BASE-FX Transmit Pair (125MHz Differential Signal Output).
FX3RXP	109	AI	Port 3 1000BASE-X Receiver Pair (1.25GHz Differential Signal Input).
FX3RXN	108		Port 3 100BASE-FX Receiver Pair (125MHz Differential Signal Input).
FX3TXP	112	AO	Port 3 1000BASE-X Transmit Pair (1.25GHz Differential Signal Output).
FX3TXN	111		Port 3 100BASE-FX Transmit Pair (125MHz Differential Signal Output).
FX0_TX_DIS	28	O/PU	Port 0 100BASE-FX/1000BASE-X Transmit Optical module Power Control
FX1_TX_DIS	27	O/PU	Port 1 100BASE-FX/1000BASE-X Transmit Optical module Power Control
FX2_TX_DIS	26	O/PU	Port 2 100BASE-FX/1000BASE-X Transmit Optical module Power Control
FX3_TX_DIS	25	O/PU	Port 3 100BASE-FX/1000BASE-X Transmit Optical module Power Control

4. Function Description

4.1. Mode selection

4.1.1. QSGMII x 1 + Combo x 4

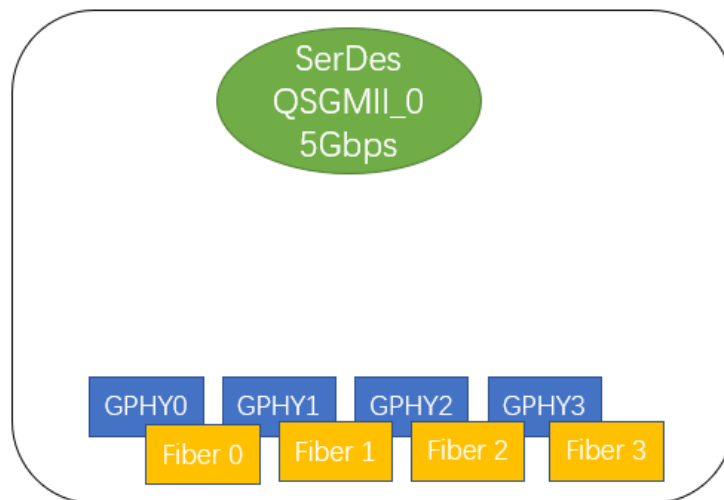


Figure 3. QSGMII x 1 + Combo x 4

4.1.2. QSGMII x 1 + Copper x 4

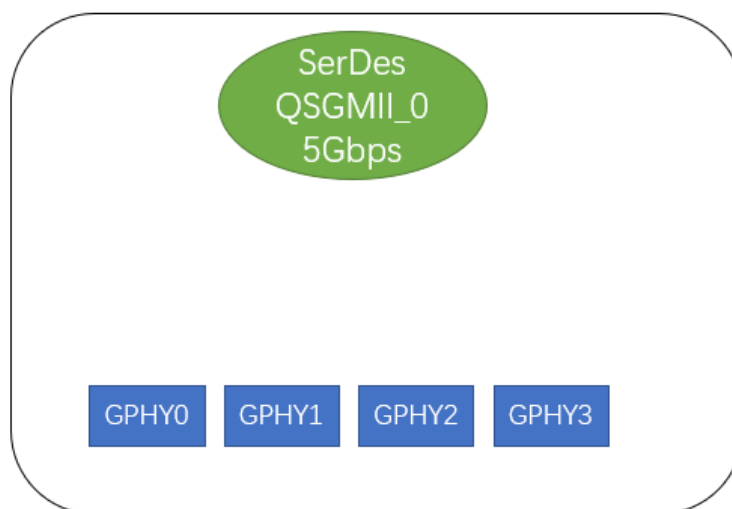


Figure 4. QSGMII x 1 + Copper x 4

4.1.3. QSGMII x 1 + Fiber x 4

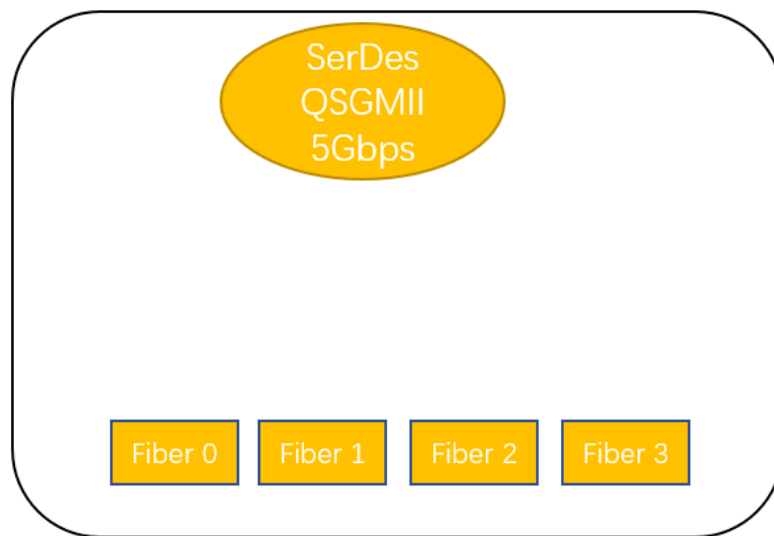


Figure 5. QSGMII x 1 + Fiber x 4

4.1.4. QSGMII x 1 + SGMII x 4

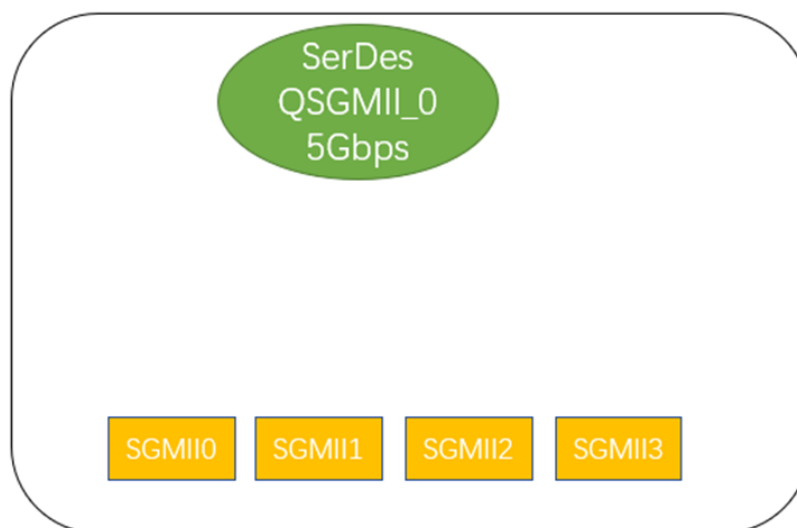


Figure 6. QSGMII x 1 + SGMII x 4

4.1.5. SGMII x 4 + Copper x 4

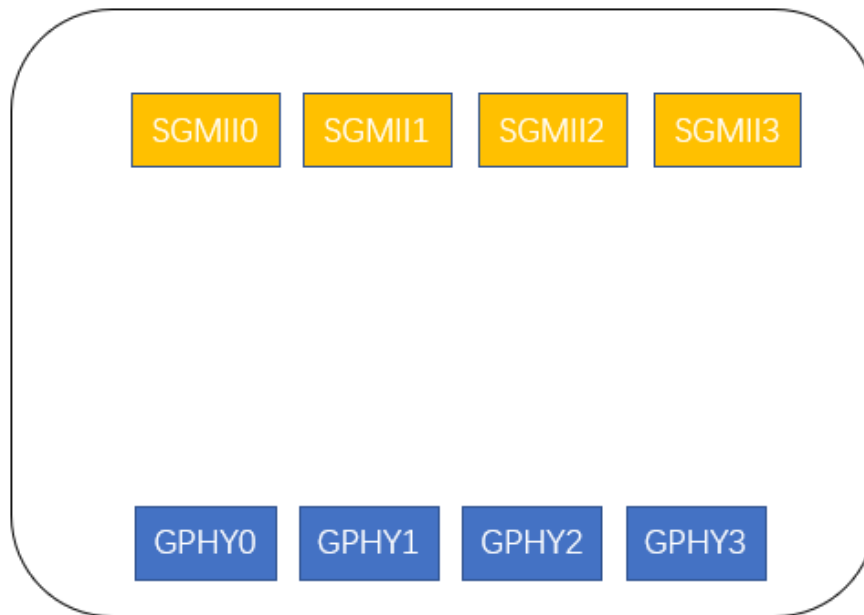


Figure 7. SGMII x 4 + Copper x 4

4.1.6. Copper x 4 + Fiber x 4

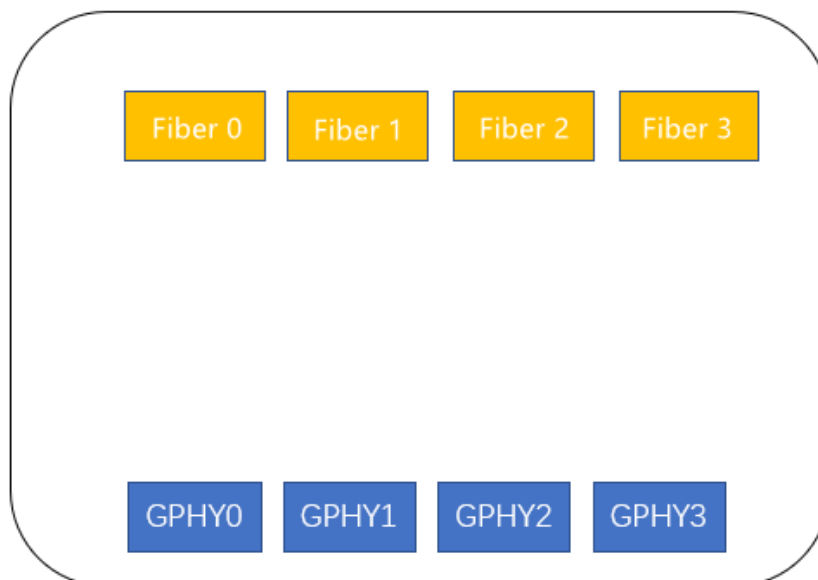


Figure 8. Copper x 4 + Fiber x 4

4.2. Transmit Functions

4.2.1. Transmit Encoder Modes

4.2.1.1. 1000BASE-T

In 1000BASE-T mode, the YT8614 scrambles transmit data bytes from the MAC interfaces to 9-bit symbols and encodes them into 4D five-level PAM signals over the four pairs of CAT.5E cable.

4.2.1.2. 100BASE-TX

In 100BASE-TX mode, 4-bit data from the MII is 4B/5B serialized, scrambled, and encoded to a three-level MLT3 sequence transmitted by the PMA.

4.2.1.3. 10BASE-Te

In 10BASE-Te mode, the YT8614 transmits and receives Manchester-encoded data.

4.3. Receive Functions

4.3.1. Receive Decoder Modes

4.3.1.1. 1000BASE-T

In 1000BASE-T mode, the PMA recovers the 4D PAM signals after accounting for the cabling conditions such as skew among the four pairs, the pair swap order, and the polarity of the pairs. The resulting code group is decoded into 8-bit data values. Data stream delimiters are translated appropriately and data is output to the MAC interfaces.

4.3.1.2. 100BASE-TX

In 100BASE-TX mode, the receive data stream is recovered and descrambled to align to the symbol boundaries. The aligned data is then parallelized and 5B/4B decoded to 4-bit data. This output runs to the MII receive data pins after data stream delimiters have been translated.

4.3.1.3. 10BASE-Te

In 10BASE-Te mode, the recovered 10 BASE-Te signal is decoded from Manchester then aligned.

4.4. LRE100-4

YT8614 supports a Motorcomm proprietary feature called LRE100-4, the Long Reach Ethernet (LRE) application up to 400m at 100Mbps data rate by 4-pairs in the CAT.5E UTP cable.

4.5. Management Interface

The Status and Control registers of the device are accessible through the MDIO and MDC serial interface. The functional and electrical properties of this management interface comply with IEEE 802.3, Section 22 and 45, and also support MDC clock rates up to 12.5 MHz.

4.6. Auto-Negotiation

The YT8614 negotiates its operation mode using the auto negotiation mechanism according to IEEE 802.3 clause 28 over the copper media. Auto negotiation supports choosing the mode of operation automatically by comparing its own abilities and received abilities from link partner. The advertised abilities include:

- a) Speed: 10/100/1000Mbps
- b) Duplex mode: full duplex and/or half duplex

Auto negotiation is initialized when the following scenarios happen:

- c) Power-up/Hardware/Software reset
- d) Auto negotiation restart
- e) Transition from power-down to power up
- f) Link down

Auto negotiation is enabled for YT8614 by default, and can be disabled by software control.

4.7. LDS (Link discovery signaling)

YT8614 supports Long Range Ethernet (LRE), which uses Link Discovery Signaling (LDS) instead of auto negotiation since the extended cable reach attenuates the auto negotiation link pulses. LDS is an extended reach signaling scheme and protocol, which is used to

- g) Master/Slave assignment
- h) Estimate cable length
- i) Confirm pair number and pair connectivity ordering
- j) Choose highest common operation mode

IEEE-compliant PHYs will ignore LDS signal since its frequency is less than 2MHz according to IEEE802.3 clause 14. If the link partner is an IEEE legacy ethernet PHY, YT8614 can detect the standard NLP, FLP, or MLT-3 IDLE signal, and then transits LDS mode into Clause 28 auto negotiation mode.

Forcing pair number and speed mode is also supported. The same forcing must be done at both ends of the link.

By default the LDS is disabled, and should be enabled before using this feature.

4.8. Polarity detection and auto correction

YT8614 can detect and correct two types of cable errors: swapping of pairs within the UTP cable (swapping between pair 0 and pair 1, and(or) swapping between pair 2 and pair 3) and swapping of wires within a pair.

4.9. Energy Efficient Ethernet (EEE)

EEE is IEEE 802.3az, an extension of the IEEE 802.3 standard. EEE defines support for the PHY to operate in Low Power Idle (LPI) mode which, when enabled, supports QUIET times during low link utilization allowing both link partners to disable portions of each PHY's circuitry and save power.

YT8614 also helps legacy MAC without EEE ability to work as a complete EEE power saving system.

4.10. Synchronous Ethernet (Sync-E)

YT8614 provides Synchronous Ethernet (Sync-E) support, and two Sync-E clock can output from SYNCE0 (pin 11) or SYNCE1 (pin 12). The Sync-E clock sources can be configured to recovery from UTP0~3, QSGMII0, or Fiber0~3 respectively. When SYNCE0 or SYNCE1 lock, the SYNC_LOCK0 (pin 21) or SYNC_LOCK1 (pin 22) will be high if its external pull down, and be low if its external pull up.

The recovery clock for Sync-E can be either a 125MHz, 31.25MHz or 25MHz clock.

When the PHY is in SLAVE mode, the CLKOUT will output the recovered clock from the MDI. If the device is in MASTER mode, the CLKOUT will output the clock based on the local free run PLL.

It's also configurable to output the 25MHz reference clock via SYNCE0 and(or) SYNCE1 pin.

4.11. Link Down Power Saving (Sleep Mode)

YT8614 supports link down power saving, also called sleep mode. When UTP port link down and no signals over UTP cable for 40 seconds, YT8614 will enter sleep mode.

For most of time in sleep mode, YT8614 will disable almost all the circuits except crystal clock and comparators for channel 0/1 of 10BASE-Te. Access by MDC/MDIO interface is available.

At a time interval in sleep mode, YT8614 will wake to transmit signals over TRXP1/TRXN1. The time interval is a random value around 2.7s.

Once detect signals over UTP cable, YT8614 will exit sleep mode.

4.12. Interrupt

YT8614 provides an active low interrupt output pin (INT_N) based on change of the PHY status. Every interrupt condition is represented by the read-only general interrupt status register (section 6.2.18. Interrupt Status Register (UTP MII register 0x13), EXT_0xA011, EXT_0xA013 and EXT_0xA015).

The interrupts can be individually enable or disable by setting or clearing bits in the interrupt enable register (section 6.2.17. Interrupt Mask Register (UTP MII register 0x12) , EXT_0xA010, EXT_0xA012 and EXT_0xA014).

Note 1: The interrupt of the YT8614 is a level-triggered mechanism.

Note 2: The interrupt output pin (INT_N) is open drain mode, and must pull-up to DVDDIO via a 4.7K resistor.

5. Operational Description

5.1. Reset

YT8614 have a hardware reset pin(RESET_N) which is low active. RESET_N should be active for at least 10ms to make sure all internal logic is reset to a known state. Hardware reset should be applied after power up.

RESET_N is also used for power on strapping. During RESET_N is active, YT8614 latches input value on strapping. Strapping is used as configuration information which provides flexibility in application without mdio access.

YT8614 also provides three kinds of software reset control registers. Two of them are in each UTP port and are used to reset this UTP port's internal logic except some mdio configuration registers, by setting bit 15 of UTP mii register (address 0x0) or LDS mii register (address 0x0). And the third is in each QSGMII channel or in each SGMII and is used to reset this QSGMII channel or SGMII' s internal logic except CDR and some mdio configuration registers, by setting bit15 of SerDes mii register(address 0x0) to 1. These three bits are self-clear after reset process is done. For detailed information about what register will be reset by software reset, please refer to register table.

Table 10. Reset Timing Characteristics

Symbol	Description	Min	Typ	Max	Units
T1	The duration from all powers steady to reset signal release to high	10	–	–	ms
T2	The duration of reset signal remain low timing	10	–	–	ms

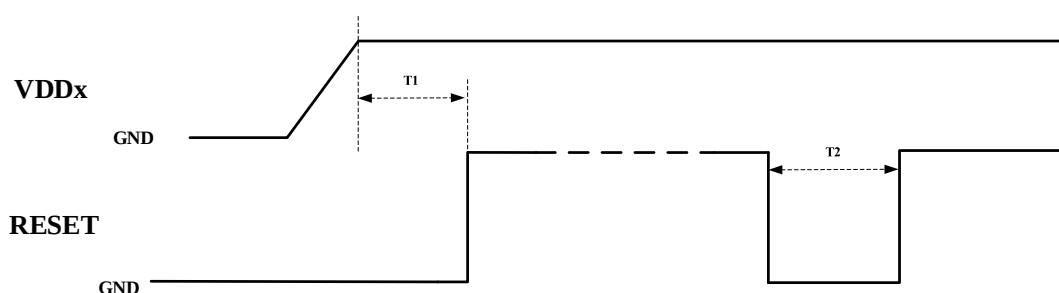


Figure 9. Reset Timing Diagram

5.2. PHY Address

For YT8614, Strapping PHYAD[4:0] is used to generate phy address port 0. The other port's phy address is the sum of the PHYAD[4:0] and port number. For example, if PHYAD[4:0] = 8, the phy address of port 3 is 11 (the sum of 8 and 3)

5.3. Loopback Mode

There are three loopback modes in YT8614.

5.3.1. Digital Loopback

Digital loopback provides the ability to loop transmitted data back to the receiver using digital circuitry in YT8614.

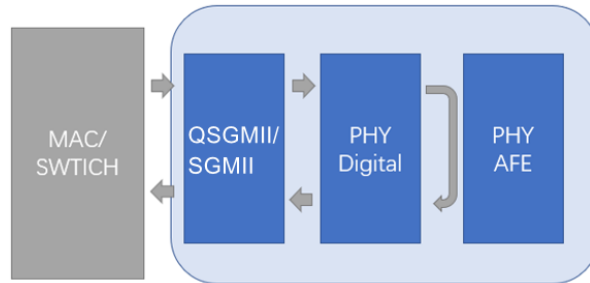


Figure 10. Digital Loopback

5.3.2. External loopback

External cable loopback loops Tx to Rx through a complete digital and analog path and an external cable, thus testing all the digital data paths and all the analog circuits. Figure shows a block diagram of external cable loopback.

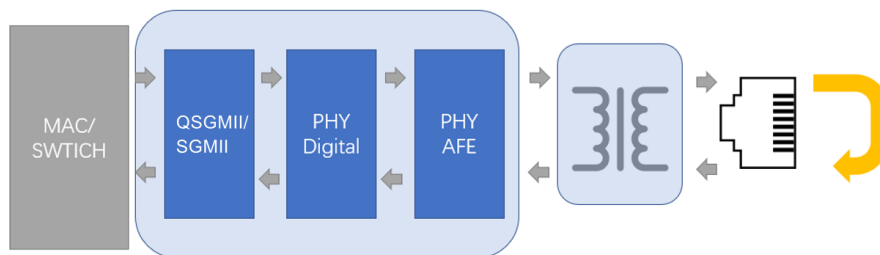


Figure 11. External Loopback

5.3.3. Remote PHY loopback

The Remote loopback connects the MDI receive path to the MDI transmit path, near the GMII interface, thus the remote link partner can detect the connectivity in the resulting loop. Figure below, shows the path of the remote loopback.

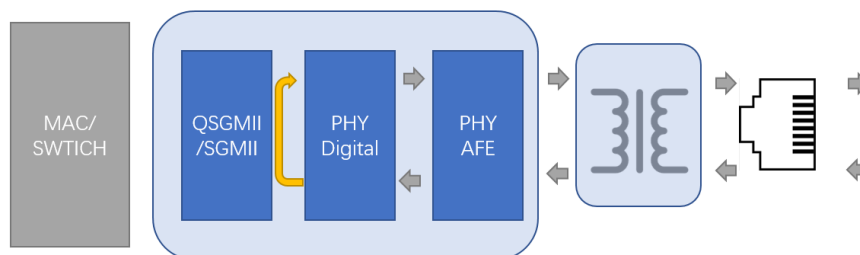


Figure 12. Remote PHY Loopback

5.4. LED

The YT8614 supports serial LED mode. In the serial LED mode, the data is clocked through a shift register and the shifted symbols are output to the 36 LED pins.

Each MDI port has three indicator symbols and each fiber port has three indicator symbols. Each symbol may have different indicator.

You can find more information from *YT8614 application note*.

5.5. Power Supplies

YT8614 requires external power supply 3.3 V and 1.2V. Please refer to *section 8. Power Requirements* for more information.

6. Register Overview

6.1. Common Register

6.1.1. SMI Mux (EXT 0xA000)

Table 11. SMI Mux (EXT 0xA000)

Bit	Symbol	Access	Default	Description
15:13	Reserved	RO	0x0	Reserved
12:8	MDIO_PHYAD	RO	0x0	the PHYAD field in current MDIO command
7:5	Reserved	RO	0x0	Reserved
4	en_brdest_phy	RW	0x0	When bit1 smi_sds_phy is 0, this bit controls to broadcast write to all PHYs. 0: disable. 1: enable broadcast write.
3	en_brdest_q	RW	0x0	When bit1 smi_sds_phy is 1 and bit0 smi_sf is 0, this bit controls to broadcast write to all QSGMII channels. 0: disable. 1: enable broadcast write;
2	en_brdest_sf	RW	0x0	When bit1 smi_sds_phy is 1 and bit0 smi_sf is 1, this bit controls to broadcast write to all SGMIIs. 0: disable. 1: enable broadcast write.
1	Smi_sds_phy	RW	0x0	To control access whether phy register or sds register. 0: to access phy. 1: to access sds.
0	smi_sf	RW	0x0	When smi_sds_phy is 1, this bit controls to access whether sds 2/3/4/5 (SGMII) register or sds 0/1 (QSGMII) register. 0: to access QSGMII register. 1: to access SGMII register;

6.1.2. SLED cfg0 (EXT 0xA001)

Table . SLED cfg0 (0xA001)

Bit	Symbol	Access	Default	Description
-----	--------	--------	---------	-------------

15	led_manu_en	RW	0x0	to control serial LEDs status manually. 1: enable; 0: disable, SLED are controlled by internal status then.
14:12	led_manu_st	RW	0x0	SLEDs' manu status, corresponding to each port's 3 SLEDs.
11	led_act_low	RW	0x1	control SLED's polarity. 1: active low; 0: active high.
10:8	led_bit_mask	RW	0x7	The thress mask bit for the three LED pins of each port: 1' b1: enable the pin output; 1' b0: disable pin output.
7:0	led_en_ctrl	RW	0xFF	Control to enable the eight ports' SLED: 1' b1: enable serial led output for this port; 1' b0: disable serial led output for this port. Note: Here eight ports are consisted of 4 UTP ports and 4 SGMII/Fiber ports.

6.1.3. SLED cfg (0xA004)

Table 12. SLED cfg (0xA004)

Bit	Symbol	Access	Default	Description
15:10	Reserved	RO	0x0	Always 0.
9	led_lsb	RW	0x1	control the SLED order; 1: LED00 first and LED35 last; 0: LED35 first and LED00 last.
8	led_seri_dis	RW	0x0	1: to disable the SLED function; 0: normal mode. See ext.A007.4 for detail.
7	led_clk_en	RW	0x1	1: enable SLED clock to output to SLED_CK pin; 0: disable SLED clock output and drive 0 on SLED_CK pin.
6	led_data_en	RW	0x1	1: enable SLED data to output to SLED_DA pin; 0: disable SLED data output and drive 0 on SLED_DA pin.
5:4	led_mode	RW	0x3	Control each port's LED indicator symbol number and the information it indicates. 2' b00, each port has one LED indicator symbols, {1st led}, to indicates: MDI: [link/act] FIBER: [link/act] 2' b01, each port has 2 LED indicator symbols, {1st led, 2nd led}, to indicate: MDI: [speed1000/act] [speed100(10)/act] FIBER: [speed1000/act] [speed100/act]

				2' b10, each port has 3 LED indicator symbols, {1st led, 2nd led, 3rd led}, to indicate: MDI: [speed1000/act] [speed100/act] [speed10/act] FIBER: [speed1000/act] [speed100/act] [Disable] 2' b11, each port has 3 LED indicator symbols, {1st led, 2nd led, 3rd led}, to indicate: MDI: [link/act] [speed1000] [speed100] FIBER: [link/act] [speed1000] [speed100]
3:2	led_burst_cycle	RW	0x2	Serial led burst cycle. SLED status will be updated when the timer is done. 2' b00: 8ms 2' b01: 16ms 2' b10: 32ms 2' b11: 64ms
1:0	led_clk_cycle	RW	0x1	Serial led clock cycle: 2' b00: 80ns 2' b01: 160ns 2' b10: 240ns 2' b11: 320ns

6.1.4. mode_chg_reset (0xA005)

Table 13. mode_chg_reset (0xA005)

Bit	Symbol	Access	Default	Description
15	mode_chg_reset	RW SC	0x0	This bit will asserts when ext.a007.12 en_phy or ext.a007.3:0 changes. When this bit asserts, whole chip will be reset except MDIO configuration registers. This bit is self-cleared.
14	en_manu_porten	RW	0x0	1: enable to control *_port_en in EXT 0xA00F manually; 0: *_port_en in EXT 0xA00F is controlled by chip_mode.
13	Reserved	RW	0x0	Reserved
12	iddq_mode_reg	RW	0x0	1: control to enter IDDQ mode.
11	Reserved	RW	0x0	Reserved
10	Bypass_mdio_watchdog	RW	0x0	1: bypass mdio watch dog
9:0	Reserved	RO	0x80	Reserved

6.1.5. chip_mode (0xA007)

Table 14. chip_mode (0xA007)

Bit	Symbol	Access	Default	Description
15:13	package_id	RO	0x5	The package_id for YT8614.
12	en_phy	RW POS	0x1	1: enable all the coppers port and serdes ports; 0: disable all the copper ports and serdes ports. The strapping of EN_PHY will power down all the copper ports and fiber ports; and the strapping value will be recorded in this register. But writing this register to 1 will not power down copper and fiber ports, but only generates a whole chip reset, (refer to EXT 0xA005 bit15).
11:6	reserved	RO	0x0	always 0.
5	en_pwron_light	RW POS	0x1	The strapping of En_PowerOn_Light will make SLEDs light for 200ms after hardware reset or power on reset. The strapping value will be recorded in this register.
4	dis_sled	RW POS	0x1	The strapping of Dis_Sled will disable SELD. 1: to disable SLED PINs SCL/SDA; 0: to enable SLED PINs SCL/SDA. The strapping value will be recorded in this register. If strapping of DIS_LED is 0 but then it's expected to disable SLED by MDIO, ext.A004.8 shall be set to 1 first, then set this register to 1. SLEDs may behave abnormally if set this register to 1 before set ext.A004.8 to 1.
3:0	chip_mode	RW POS	0xF	4'b1000, Fiber x4 + Copper x4 4'b1001, Reserved. 4'b1010, QSGMII x1 + Copper x4 mode, 4'b1011, QSGMII x1 + Fiber x4 mode; 4'b1100, QSGMII x1 + Combo x4 mode; 4'b1101, QSGMII x1 + Combo x4 mode; 4'b1110, QSGMII x1 + SGMII(MAC) x4 mode; 4'b1111, SGMII(PHY) x4 + Copper x4 mode.

6.1.6. SYNCE0 cfg (0xA006)

Table 15. SYNCE0 cfg (0xA006)

Bit	Symbol	Access	Default	Description
15	sync_clk_en_0	RW	0x0	1=enable to output the sync_clk0 to the pin SYNCE0, and and sync_lock0 to the pin PHYADDR0/SYNC_LOCK0. It doesn't control whether to output the 25MHz referece clock to the SYNCE0 pin, which is only controlled by bit13 and bit10.
14	bp_sync_lock_gating_0	RW	0x0	When sync_clk0 is not locked, this bit controls whether to output the sync_clk0 to the pin SYNCE0 or not. 1: to output; 0: to not output.
13	sel_synce_125m_0	RW	0x0	bit13 and bit10 controls the sync_clk0's frequence and source: {sel_synce_125m_0, sel_clk_25m_xtl_0}, 2'b00: output 25MHz syncE clock; 2'b01: output 31.25MHz syncE clock; 2'b10: output 125MHz syncE clock; 2'b11: output 25MHz reference clock.
12:11	reserved	RO	0x0	always 0.
10	sel_clk_25m_xtl_0	RW	0x0	refer to bit13 sel_synce_125m_0 for detail.
9	reserved	RW	0x0	bit9:0, select the source of the sync_clk0 from the recovered RX clocks. The recovered RX clocks include that from 4 port copper PHY, 4 port Fiber/SGMII 1.25G serdes PHY and one 5G serdes PHY. MSB has the higher priority, for example, bit9:0=0x030 means to output the phy 5's RX recovered clock. sds0, means the 5G serdes QSGMII0. phy7, means the fiber/SGMII port 3. phy6, means the fiber/SGMII port 2. phy5, means the fiber/SGMII port 1. phy4, means the fiber/SGMII port 0. phy3, means the copper port 3. phy2, means the copper port 2. phy1, means the copper port 1. phy0, means the copper port 0.
8	sel_rclk_sds0_0	RW	0x0	
7	sel_rclk_phy7_0	RW	0x0	
6	sel_rclk_phy6_0	RW	0x0	
5	sel_rclk_phy5_0	RW	0x0	
4	sel_rclk_phy4_0	RW	0x0	
3	sel_rclk_phy3_0	RW	0x0	
2	sel_rclk_phy2_0	RW	0x0	
1	sel_rclk_phy1_0	RW	0x0	
0	sel_rclk_phy0_0	RW	0x0	

6.1.7. SYNCE1 cfg (0xA00E)

Table 16. SYNCE1 cfg (0xA00E)

Bit	Symbol	Access	Default	Description
15	sync_clk_en_1	RW	0x0	1=enable to output the sync_clk1 to the pin SYNCE1 and sync_lock1 to the pin PHYADDR1/SYNC_LOCK1. It doesn't control whether to output the 25MHz reference clock to the SYNCE1 pin, which is only controlled by bit13 and bit10.
14	bp_sync_lock_gating_1	RW	0x0	When sync_clk1 is not locked, this bit controls whether to output the sync_clk1 to the pin SYNCE1 or not. 1: to output; 0: to not output.
13	sel_synce_125m_1	RW	0x0	bit13 and bit10 controls the sync_clk1's frequency and source: {sel_synce_125m_1, sel_clk_25m_xtl_1}, 2'b00: output 25MHz syncE clock; 2'b01: output 31.25MHz syncE clock; 2'b10: output 125MHz syncE clock; 2'b11: output 25MHz reference clock.
12:11	reserved	RO	0x0	always 0.
10	sel_clk_25m_xtl_1	RW	0x0	refer to bit13 sel_synce_125m_1 for detail.
9	reserved	RW	0x0	bit9:0, select the source of the sync_clk0 from the recovered RX clocks. The recovered RX clocks include that from 4 port copper PHY, 4 port Fiber/SGMII 1.25G serdes PHY and one 5G serdes PHY. MSB has the higher priority, for example, bit9:0=0x030 means to output the phy 5's RX recovered clock. sds0, means the 5G serdes QSGMII0. phy7, means the fiber/SGMII port 3. phy6, means the fiber/SGMII port 2. phy5, means the fiber/SGMII port 1. phy4, means the fiber/SGMII port 0. phy3, means the copper port 3. phy2, means the copper port 2. phy1, means the copper port 1. phy0, means the copper port 0.
8	sel_rclk_sds0_1	RW	0x0	
7	sel_rclk_phy7_1	RW	0x0	
6	sel_rclk_phy6_1	RW	0x0	
5	sel_rclk_phy5_1	RW	0x0	
4	sel_rclk_phy4_1	RW	0x0	
3	sel_rclk_phy3_1	RW	0x0	
2	sel_rclk_phy2_1	RW	0x0	
1	sel_rclk_phy1_1	RW	0x0	
0	sel_rclk_phy0_1	RW	0x0	

6.1.8. PHY Link Up/Down INTn Mask (0xA010)

Table 17. PHY Link Up/Down INTn Mask (0xA010)

Bit	Symbol	Access	Default	Description
15	phy7_link_up_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy7_link_up_int. 1: to enable the interrupt.
14	phy6_link_up_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy6_link_up_int. 1: to enable the interrupt.
13	phy5_link_up_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy5_link_up_int. 1: to enable the interrupt.
12	phy4_link_up_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy4_link_up_int. 1: to enable the interrupt.
11	phy3_link_up_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy3_link_up_int. 1: to enable the interrupt.
10	phy2_link_up_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy2_link_up_int. 1: to enable the interrupt.
9	phy1_link_up_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy1_link_up_int. 1: to enable the interrupt.
8	phy0_link_up_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy0_link_up_int. 1: to enable the interrupt.
7	phy7_link_down_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy7_link_down_int. 1: to enable the interrupt.
6	phy6_link_down_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy6_link_down_int. 1: to enable the interrupt.
5	phy5_link_down_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy5_link_down_int. 1: to enable the interrupt.
4	phy4_link_down_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy4_link_down_int. 1: to enable the interrupt.
3	phy3_link_down_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy3_link_down_int. 1: to enable the interrupt.
2	phy2_link_down_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy2_link_down_int. 1: to enable the interrupt.
1	phy1_link_down_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy1_link_down_int. 1: to enable the interrupt.

0	phy0_link_down_int_mask	RW	0x0	the interrupt mask bit for EXT A011 phy0_link_down_int. 1: to enable the interrupt.
---	-------------------------	----	-----	--

6.1.9. PHY Link Up/Down INTn Status (0xA011)

Table 18. PHY Link Up/Down INTn Status (0xA011)

Bit	Symbol	Access	Default	Description
15	phy7_link_up_int	RO	0x0	It's the Fiber/SGMII port 3 link up interrupt status.
14	phy6_link_up_int	RO	0x0	It's the Fiber/SGMII port 2 link up interrupt status.
13	phy5_link_up_int	RO	0x0	It's the Fiber/SGMII port 1 link up interrupt status.
12	phy4_link_up_int	RO	0x0	It's the Fiber/SGMII port 0 link up interrupt status.
11	phy3_link_up_int	RO	0x0	It's the copper port 3 link up interrupt status.
10	phy2_link_up_int	RO	0x0	It's the copper port 2 link up interrupt status.
9	phy1_link_up_int	RO	0x0	It's the copper port 1 link up interrupt status.
8	phy0_link_up_int	RO	0x0	It's the copper port 0 link up interrupt status.
7	phy7_link_down_int	RO	0x0	It's the Fiber/SGMII port 3 link down interrupt status.
6	phy6_link_down_int	RO	0x0	It's the Fiber/SGMII port 2 link down interrupt status.
5	phy5_link_down_int	RO	0x0	It's the Fiber/SGMII port 1 link down interrupt status.
4	phy4_link_down_int	RO	0x0	It's the Fiber/SGMII port 0 link down interrupt status.
3	phy3_link_down_int	RO	0x0	It's the copper port 3 link down interrupt status.
2	phy2_link_down_int	RO	0x0	It's the copper port 2 link down interrupt status.
1	phy1_link_down_int	RO	0x0	It's the copper port 1 link down interrupt status.
0	phy0_link_down_int	RO	0x0	It's the copper port 0 link down interrupt status.

6.1.10. UTP Legacy Interrupt Mask (0xA012)

Table 19. UTP Legacy Interrupt Mask (0xA012)

Bit	Symbol	Access	Default	Description
-----	--------	--------	---------	-------------

15	en_clr_all_phys_intn	RW	0x0	1: reading EXT 0xA013 will clear itself and all UTP legacy interrupts' status in MII 0x13; 0: to clear EXT 0xA013, UTP legacy interrupts' status in MII 0x13 should be read clear first, then read clear 0xA013.
14:4	Reserved	RW	0x0	not used.
3	utp3_legacy_int_mask	RW	0x0	the interrupt mask bit for EXT 0xA013 utp3_legacy_int. 1: to enable the interrupt.
2	utp2_legacy_int_mask	RW	0x0	the interrupt mask bit for EXT 0xA013 utp2_legacy_int. 1: to enable the interrupt.
1	utp1_legacy_int_mask	RW	0x0	the interrupt mask bit for EXT 0xA013 utp1_legacy_int. 1: to enable the interrupt.
0	utp0_legacy_int_mask	RW	0x0	the interrupt mask bit for EXT 0xA013 utp0_legacy_int. 1: to enable the interrupt.

6.1.11. UTP Legacy Interrupt Status (0xA013)

Table 20. UTP Legacy Interrupt Status (0xA013)

Bit	Symbol	Access	Default	Description
15:4	Reserved	RO	0x0	always 0.
3	utp3_legacy_int	RO	0x0	the UTP legacy interrupt status bit for EXT 0xA013 utp3_legacy_int. It's asserted when copper port 3 MII 0x13 is not 0. When EXT 0xA012 bit15 is 1, it's read clear; else, copper port 3 MII 0x13 should be read clear first, then it will be cleared when read out.
2	utp2_legacy_int	RO	0x0	the UTP legacy interrupt status bit for EXT 0xA013 utp2_legacy_int. It's asserted when copper port 2 MII 0x13 is not 0. When EXT 0xA012 bit15 is 1, it's read clear; else, copper port 2 MII 0x13 should be read clear first, then it will be cleared when read out.
1	utp1_legacy_int	RO	0x0	the UTP legacy interrupt status bit for EXT 0xA013 utp1_legacy_int. It's asserted when copper port 1 MII 0x13 is not 0. When EXT 0xA012 bit15 is 1, it's read clear; else, copper port 1 MII 0x13 should be read clear first, then it will be cleared when read out.
0	utp0_legacy_int	RO	0x0	the UTP legacy interrupt status bit for EXT 0xA013 utp0_legacy_int. It's asserted when copper port 0 MII 0x13 is not 0. When EXT 0xA012 bit15 is 1, it's read clear; else,

				copper port 0 MII 0x13 should be read clear first, then it will be cleared when read out.
--	--	--	--	---

6.1.12. QSGMII Legacy Interrupt Mask (0xA014)

Table 21. QSGMII Legacy Interrupt Mask (0xA014)

Bit	Symbol	Access	Default	Description
15:12	Reserved	RO	0x0	Reserved
11	q0_ch3_link_up_int_mask	RO	0x0	the interrupt mask bit for EXT 0xA015 q0_ch3_link_up_int. 1: to enable the interrupt.
10	q0_ch2_link_up_int_mask	RO	0x0	the interrupt mask bit for EXT 0xA015 q0_ch2_link_up_int. 1: to enable the interrupt.
9	q0_ch1_link_up_int_mask	RO	0x0	the interrupt mask bit for EXT 0xA015 q0_ch1_link_up_int. 1: to enable the interrupt.
8	q0_ch0_link_up_int_mask	RO	0x0	the interrupt mask bit for EXT 0xA015 q0_ch0_link_up_int. 1: to enable the interrupt.
7:4	Reserved	RO	0x0	Reserved
3	q0_ch3_link_down_int_mask	RO	0x0	the interrupt mask bit for EXT 0xA015 q0_ch3_link_down_int. 1: to enable the interrupt.
2	q0_ch2_link_down_int_mask	RO	0x0	the interrupt mask bit for EXT 0xA015 q0_ch2_link_down_int. 1: to enable the interrupt.
1	q0_ch1_link_down_int_mask	RO	0x0	the interrupt mask bit for EXT 0xA015 q0_ch1_link_down_int. 1: to enable the interrupt.
0	q0_ch0_link_down_int_mask	RO	0x0	the interrupt mask bit for EXT 0xA015 q0_ch0_link_down_int. 1: to enable the interrupt.

6.1.13. QSGMII Legacy Interrupt Status (0xA015)

Table 22. QSGMII Legacy Interrupt Status (0xA015)

Bit	Symbol	Access	Default	Description
15:12	Reserved	RO	0x0	Reserved
11	q0_ch3_link_up_int	RO	0x0	It's the QSGMII channel 3 link up interrupt status.

10	q0_ch2_link_up_int	RO	0x0	It's the QSGMII channel 2 link up interrupt status.
9	q0_ch1_link_up_int	RO	0x0	It's the QSGMII channel 1 link up interrupt status.
8	q0_ch0_link_up_int	RO	0x0	It's the QSGMII channel 0 link up interrupt status.
7:4	Reserved	RO	0x0	Reserved
3	q0_ch3_link_down_int	RO	0x0	It's the QSGMII channel 3 link down interrupt status.
2	q0_ch2_link_down_int	RO	0x0	It's the QSGMII channel 2 link down interrupt status.
1	q0_ch1_link_down_int	RO	0x0	It's the QSGMII channel 1 link down interrupt status.
0	q0_ch0_link_down_int	RO	0x0	It's the QSGMII channel 0 link down interrupt status.

6.1.14. pkg_cfg0 (0xA0a0)

Port Index : 0 – 3

Port Offset : 0x100

Table 23. pkg_cfg0 (0xA0a0)

Bit	Symbol	Access	Default	Description
15	u0_pkg_chk_en	RW	0x0	1: to enable RX/TX package checker. For RX checker, if EXT 0xA0B7 bit15 is 0, RX checker checks the downstream media's GMII RX data or in Fiber x4 + Copper x4 mode, the UTP's GMII RX data, else it checks upstream media's GMII RX data or in Fiber x4 + Copperx4 mode, the Fiber's GMII RX data; For TX checker, if EXT 0xA0B7 bit15 is 1, TX checker checks the pkg_gen's TX data; else if EXT 0xA0B7 bit14 is 0, TX checker checks the downstream media's GMII TX data or in Fiber x4 + Copperx4 mode, the UTP's GMII TX data, else, it checks upstream media's GMII TX data or in Fiber x4 + Copperx4 mode, the Fiber's GMII TX data;
14	u0_pkg_en_gate	RW	0x1	1: to enable gate all the clocks to package self-test module when bit15 pkg_chk_en is

				0, bit13 bp_pkg_gen is 1 and bit12 pkg_gen_en is 0;
13	u0_bp_pkg_gen	RW	0x1	1: normal function; 0: test function, the TX data is sourced from pkg_gen;
12	u0_pkg_gen_en	RW SC	0x0	1: to enable pkg_gen generating GMII/MII packages. But, the data will only be sent to transceiver when bit13 bp_pkg_gen is 1'b0.
11:8	u0_pkg_prm_lth	RW	0x8	The preamble length of the generated packages, in Byte unit. Pkg_gen function only support >=2 Byte preamble length. Values smaller than 2 will be ignored by the pkg_gen module.
7:4	u0_pkg_ipg_lth	RW	0xc	The IPG of the generated packages, in Byte unit. Pkg_gen function only support >=2 Byte preamble length. Values smaller than 2 will be ignored by the pkg_gen module.
3	u0_Xmit_mac_force_gen	RW	0x0	1: To enable pkg_gen to send out the generated data even when the link is not established.
2	u0_pkg_corrupt_crc	RW	0x0	1: to make pkg_gen to send out CRC error packages.
1:0	u0_pkg_payload	RW	0x0	Control the payload of the generated packages, excluding the DA/SA field if EXT 0xA0B7 bit12 is 1. 00: the payload is increase byte; 01: the payload is random data; 10: the payload is periodic 0x5A/0xA5; 11: the payload is all 0x00.

6.1.15. pkg_cfg1 (0xA0a1)

Port Index : 0 - 3

Port Offset : 0x100

Table 24. pkg_cfg1 (0xA0a1)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_length	RW	0x40	To set the length of the generated packages.

6.1.16. pkg_cfg2 (0xA0a2)

Port Index : 0 - 3

Port Offset : 0x100

Table 25. pkg_cfg2 (0xA0a2)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_burst_size	RW	0x0	To set the number of packages in a burst of package generation. 0: to generate package continuously untill EXT 0xA0A0 bit15 is changed to 0.

6.1.17. pkg_rx_valid0 (0xA0a3)

Port Index : 0 - 3

Port Offset : 0x100

Table 26. pkg_rx_valid0 (0xA0a3)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ib_valid_high	RO RC	0x0	Pkg_ib_valid[31:16], pkg_ib_valid is the number of RX packages from wire whose CRC are good and length are >=64Byte and <=1518Byte.

6.1.18. pkg_rx_valid1 (0xA0a4)

Port Index : 0 - 3

Port Offset : 0x100

Table 27. pkg_rx_valid1 (0xA0a4)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ib_valid_low	RO RC	0x0	Pkg_ib_valid[15:0], pkg_ib_valid is the number of RX packages from wire whose CRC are good and length are >=64Byte and <=1518Byte.

6.1.19. pkg_rx_os0 (0xA0a5)

Port Index : 0 - 3

Port Offset : 0x100

Table 28. pkg_rx_os0 (0xA0a5)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ib_os_good_high	RO RC	0x0	Pkg_ib_os_good[31:16], pkg_ib_os_good is the number of RX packages from wire whose CRC are good and length are >1518Byte.

6.1.20. pkg_rx_os1 (0xA0a6)

Port Index : 0 - 3

Port Offset : 0x100

Table 29. pkg_rx_os1 (0xA0a6)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ib_os_good_low	RO RC	0x0	Pkg_ib_os_good[15:0], pkg_ib_os_good is the number of RX packages from wire whose CRC are good and length are >1518Byte.

6.1.21. pkg_rx_us0 (0xA0a7)

Port Index : 0 - 3

Port Offset : 0x100

Table 30. pkg_rx_us0 (0xA0a7)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ib_us_good_high	RO RC	0x0	Pkg_ib_us_good[31:16], pkg_ib_us_good is the number of RX packages from wire whose CRC are good and length are <64Byte.

6.1.22. pkg_rx_us1 (0xA0a8)

Port Index : 0 - 3

Port Offset : 0x100

Table 31. pkg_rx_us1 (0xA0a8)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ib_us_good_low	RO RC	0x0	Pkg_ib_us_good[15:0], pkg_ib_us_good is the number of RX packages from wire whose CRC are good and length are <64Byte.

6.1.23. pkg_rx_err (0xA0a9)

Port Index : 0 - 3

Port Offset : 0x100

Table 32. pkg_rx_err (0xA0a9)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ib_err	RO RC	0x0	pkg_ib_err is the number of RX packages from wire whose CRC are wrong and length are >=64Byte, <=1518Byte.

6.1.24. pkg_rx_os_bad (0xA0aa)

Port Index : 0 - 3

Port Offset : 0x100

Table 33. pkg_rx_os_bad (0xA0aa)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ib_os_bad	RO RC	0x0	pkg_ib_os_bad is the number of RX packages from wire whose CRC are wrong and length are >1518Byte.

6.1.25. pkg_rx_fragment (0xA0ab)

Port Index : 0 - 3

Port Offset : 0x100

Table 34. pkg_rx_fragment (0xA0ab)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ib_frag	RO RC	0x0	pkg_ib_frag is the number of RX packages from wire whose CRC are wrong and length are <64Byte.

6.1.26. pkg_rx_nosfd (0xA0ac)

Port Index : 0 - 3

Port Offset : 0x100

Table 35. pkg_rx_nosfd (0xA0ac)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ib_nosfd	RO RC	0x0	pkg_ib_nosfd is the number of RX packages from wire whose SFD are missed.

6.1.27. pkg_tx_valid0 (0xA0ad)

Port Index : 0 - 3

Port Offset : 0x100

Table 36. pkg_tx_valid0 (0xA0ad)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ob_valid_high	RO RC	0x0	Pkg_ob_valid[31:16], pkg_ob_valid is the number of TX packages from MII whose CRC are good and length are >=64Byte and <=1518Byte.

6.1.28. pkg_tx_valid1 (0xA0ae)

Port Index : 0 - 3

Port Offset : 0x100

Table 37. pkg_tx_valid1 (0xA0ae)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ob_valid_low	RO RC	0x0	Pkg_ob_valid[15:0], pkg_ob_valid is the number of TX packages from MII whose CRC are good and length are >=64Byte and <=1518Byte.

6.1.29. pkg_tx_os0 (0xA0af)

Port Index : 0 - 3

Port Offset : 0x100

Table 38. pkg_tx_os0 (0xA0af)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ob_os_good_high	RO RC	0x0	Pkg_ob_os_good[31:16], pkg_ob_os_good is the number of TX packages from MII whose CRC are good and length are >1518Byte.

6.1.30. pkg_tx_os1 (0xA0b0)

Port Index : 0 - 3

Port Offset : 0x100

Table 39. pkg_tx_os1 (0xA0b0)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ob_os_good_low	RO RC	0x0	Pkg_ob_os_good[15:0], pkg_ob_os_good is the number of TX packages from MII whose CRC are good and length are >1518Byte.

6.1.31. pkg_tx_us0 (0xA0b1)

Port Index : 0 - 3

Port Offset : 0x100

Table 40. pkg_tx_us0 (0xA0b1)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ob_us_good_high	RO RC	0x0	Pkg_ob_us_good[31:16], pkg_ob_us_good is the number of TX packages from MII

				whose CRC are good and length are <64Byte.
--	--	--	--	--

6.1.32. pkg_tx_us1 (0xA0b2)

Port Index : 0 - 3

Port Offset : 0x100

Table 41. pkg_tx_us1 (0xA0b2)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ob_us_good_low	RO RC	0x0	Pkg_ob_us_good[15:0], pkg_ob_us_good is the number of TX packages from MII whose CRC are good and length are <64Byte.

6.1.33. pkg_tx_err (0xA0b3)

Port Index : 0 - 3

Port Offset : 0x100

Table 42. pkg_tx_err (0xA0b3)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ob_err	RO RC	0x0	pkg_ob_err is the number of TX packages from MII whose CRC are wrong and length are >=64Byte, <=1518Byte.

6.1.34. pkg_tx_os_bad (0xA0b4)

Port Index : 0 - 3

Port Offset : 0x100

Table 43. pkg_tx_os_bad (0xA0b4)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ob_os_bad	RO RC	0x0	pkg_ob_os_bad is the number of TX packages from MII whose CRC are wrong and length are >1518Byte.

6.1.35. pkg_tx_fragment (0xA0b5)

Port Index : 0 - 3

Port Offset : 0x100

Table 44. pkg_tx_fragment (0xA0b5)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ob_frag	RO RC	0x0	pkg_ob_frag is the number of TX packages from MII whose length are <64Byte.

6.1.36. pkg_tx_nosfd (0xA0b6)

Port Index : 0 - 3

Port Offset : 0x100

Table 45. pkg_tx_nosfd (0xA0b6)

Bit	Symbol	Access	Default	Description
15:0	u0_pkg_ob_nosfd	RO RC	0x0	pkg_ob_nosfd is the number of TX packages from MII whose SFD is missed.

6.1.37. pkg_cfg3 (0xA0b7)

Port Index : 0 - 3

Port Offset : 0x100

Table 46. pkg_cfg3 (0xA0b7)

Bit	Symbol	Access	Default	Description
15	u0_pkgchk_rxsrc_sel	RW	0x0	control RX checker's data source. =0, RX checker checks the downstream media's GMII RX data or in Fiber x4 + Copper x4 mode, the UTP's GMII RX data, =1, it checks upstream media's GMII RX data or in Fiber x4 + Copper x4 mode, the Fiber's GMII RX data
14	u0_pkgchk_txsrc_sel	RW	0x0	When EXT 0xA0B7 bit10 is 0, it controls TX checker's data source. =0, TX checker checks the downstream media's GMII TX data or in Fiber x4 + Copper x4 mode, the UTP's GMII TX data; =1, it checks upstream media's GMII TX data or in Fiber x4 + Copper x4 mode, the Fiber's GMII TX data. It is not valid when EXT 0xA0B7 bit10 is 1.
13	u0_pkgen_txdire_sel	RW	0x0	Control the forward direction of the generated packages; 0=to downstream or to UTP in Fiber x4 + Copper x4 mode; 1=to upstream or to fiber in Fiber x4 + Copper x4 mode.
12	u0_en_pkgen_da_sa	RW	0x0	1: set the DA/SA of the packet generated by pkg_gen to a programmed value; For DA, if EXT 0xA0B7 bit11 is 1, the DA is set to broadcast address FF-FF-FF-FF-FF-FF; else, the highest 5 Bytes are 00-00-00-00-00, and the lowest 1 Byte is

				programmed by EXT 0xA0B9 bit[15:8]. For SA, the highest 5 Bytes are 00-00-00-00-00, and the lowest 1 Byte is programmed by EXT 0xA0B9 bit[7:0]. 0: the DA/SA is not programmed value
11	u0_pkg_brdcst	RW	0x0	Valid when EXT 0xA0B7 bit12 is 1. 1: set the DA to broadcast address FF-FF-FF-FF-FF-FF 0: set the DA to a fixed programmed value.
10	u0_pkgchk_txsrc_pkgen	RW	0x0	1: the package checker on TX side will check the tx data generated by pkg_gen; 0: the package checker on TX side will not check the tx data generated by pkg_gen. TX checker's data source is then controled by EXT 0xA0B7 bit14.
9	u0_pkg_en_az	RW	0x0	1: enable to generate and send out LPI pattern during IPG;
8:0	u0_pkg_in_az_t	RW	0x1ff	control the time dewll in LPI; When speed is 1000Mbps, the timer' s unit is 1024ns; when speed is 100Mbps, the timer' s unit is 1280ns.

6.1.38. pkg_az_cfg (0xA0b8)

Port Index : 0 - 3

Port Offset : 0x100

Table 47. pkg_az_cfg (0xA0b8)

Bit	Symbol	Access	Default	Description
15:8	u0_pkgen_pre_az_t	RW	0x20	control the time after last package done and before sending LPI pattern; When speed is 1000Mbps, the timer' s unit is 1024ns; when speed is 100Mbps, the timer' s unit is 1280ns.
7:0	u0_pkgen_aft_az_t	RW	0x19	control the time after sending LPI pattern and before the next burst package; When speed is 1000Mbps, the timer' s unit is 1024ns; when speed is 100Mbps, the timer' s unit is 1280ns.

6.1.39. pkg_da_sa_cfg (0xA0b9)

Port Index : 0 - 3

Port Offset : 0x100

Table 48. pkg_da_sa_cfg (0xA0b9)

Bit	Symbol	Access	Default	Description
15:8	u0_pkgen_da	RW	0x0	Lowest 8 bits of DA, others are zero. Refer to EXT 0xA0B7 bit12 for detail.
7:0	u0_pkgen_sa	RW	0x0	Lowest 8 bits of SA, others are zero. Refer to EXT 0xA0B7 bit12 for detail.

6.1.40. manu_hw_reset (0xA0c0)

Table 49. manu_hw_reset (0xA0c0)

Bit	Symbol	Access	Default	Description
15	manu_hw_reset	RW	0x0	1: to reset whole chip including all register space except itself. The power on strapping will not be triggerd but the last strapped value will be reloaded.
14:0	reserved	RO	0x0	Reserved.

6.2. UTP MII Register

The YT8614 transceiver is designed to be fully compliant with the MII clause of the IEEE 802.3u Ethernet specification.

The MII management interface registers are written and read serially, using the MDIO and MDC pins. A clock of up to 12.5 MHz must drive the MDC pin of the YT8614. Data transferred to and from the MDIO pin is synchronized with the MDC clock. The following sections describe what each MII read or write instruction contains.

6.2.1. Basic control register (0x00)

Table 50. Basic control register (0x00)

Bit	Symbol	Access	Default	Description
15	Reset	RW SC	0x0	PHY Software Reset. Writing 1 to this bit causes immediate PHY reset. Once the operation is done, this bit is cleared automatically. 0: Normal operation 1: PHY reset
14	Loopback	RW SWC	0x0	Internal loopback control 1' b0: disable loopback 1' b1: enable loopback
13	Speed_Selection(LSB)	RW	0x0	LSB of speed_selection[1:0]. Link speed can be selected via either the Auto-Negotiation process, or manual speed

				selection speed_selection[1:0]. Speed_selection[1:0] is valid when Auto-Negotiation is disabled by clearing bit 0.12 to zero. Bit6 bit13 1 1 = Reserved 1 0 = 1000Mb/s 0 1 = 100Mb/s 0 0 = 10Mb/s
12	Autoneg_En	RW	0x1	1: to enable auto-negotiation; 0: auto-negotiation is disabled.
11	Power_down	RW SWC	0x0	1 = Power down 0 = Normal operation When the port is switched from power down to normal operation, software reset and Auto-Negotiation are performed even bit[15] Reset and bit[9] Re_Autoneg are not set by the user.
10	Isolate	RW SWC	0x0	Isolate phy from QSGMII/SGMII/FIBER. 1' b0: Normal mode 1' b1: Isolate mode
9	Re_Autoneg	RW SC SWS	0x0	Auto-Negotiation automatically restarts after hardware or software reset regardless of bit[9] Re_Autoneg. 1 = Restart Auto-Negotiation Process 0 = Normal operation
8	Duplex_Mode	RW	0x1	The duplex mode can be selected via either the Auto-Negotiation process or manual duplex selection. Manual duplex selection is allowed when Auto-Negotiation is disabled by setting bit[12] Autoneg_En to 0. 1 = Full Duplex 0 = Half Duplex
7	Collision_Test	RW SWC	0x0	Setting this bit to 1 makes the COL signal asserted whenever the TX_EN signal is asserted. 1 = Enable COL signal test 0 = Disable COL signal test
6	Speed_Selection(MSB)	RW	0x1	See bit13.
5:0	Reserved	RO	0x0	Reserved. Write as 0, ignore on read

6.2.2. Basic status register (0x01)

Table 51. Basic status register (0x01)

Bit	Symbol	Access	Default	Description
15	100BASE-T4	RO	0x0	PHY doesn't support 100BASE-T4
14	100BASE-X_Fd	RO	0x1	PHY supports 100BASE-X_FD
13	100BASE-X_Hd	RO	0x1	PHY supports 100BASE-X_HD
12	10Mbps_Fd	RO	0x1	PHY supports 10Mbps_Fd
11	10Mbps_Hd	RO	0x1	PHY supports 10Mbps_Hd
10	100BASE-T2_Fd	RO	0x0	PHY doesn't support 100BASE-T2_Fd
9	100BASE-T2_Hd	RO	0x0	PHY doesn't support 100BASE-T2_Hd
8	Extended_Status	RO	0x1	Whether support extended status register in 0Fh 0: Not supported 1: Supported
7	Unidirect_Ability	RO	0x0	1'b0: PHY able to transmit from MII only when the PHY has determined that a valid link has been established 1' b1: PHY able to transmit from MII regardless of whether the PHY has determined that a valid link has been established
6	Mf_Preamble_Suppression	RO	0x1	1'b0: PHY will not accept management frames with preamble suppressed 1' b1: PHY will accept management frames with preamble suppressed
5	Autoneg_Complete	RO SWC	0x0	1'b0: Auto-negotiation process not completed 1' b1: Auto-negotiation process completed
4	Remote_Fault	RO RC SWC LH	0x0	1'b0: no remote fault condition detected 1' b1: remote fault condition detected
3	Autoneg_Ability	RO	0x1	1'b0: PHY not able to perform Auto-negotiation 1' b1: PHY able to perform Auto-negotiation
2	Link_Status	RO SWC LL	0x0	Link status 1' b0: Link is down 1' b1: Link is up
1	Jabber_Detect	RO RC SWC LH	0x0	10BASE-Te jabber detected. It would assert if TX activity lasts longer than 42ms.

				1' b0: no jabber condition detected 1' b1: Jabber condition detected.
0	Extended_Capability	RO	0x1	To indicate whether support EXTended registers, to access from address register 0x1E and data register 0x1F. 1' b0: Not supported 1' b1: Supported

6.2.3. PHY identification register1 (0x02)

Table 52. PHY identification register1 (0x02)

Bit	Symbol	Access	Default	Description
15:0	Phy_Id	RO	0x4F51	Bits 3 to 18 of the Organizationally Unique Identifier

6.2.4. PHY identification register2 (0x03)

Table 53. PHY identification register2 (0x03)

Bit	Symbol	Access	Default	Description
15:10	Phy_Id	RO	0x3A	Bits 19 to 24 of the Organizationally Unique Identifier
9:4	Type_No	RO	0x9	6 bits manufacturer's type number.
3:0	Revision_No	RO	0x9	4 bits manufacturer's revision number.

6.2.5. Auto-Negotiation advertisement (0x04)

Table 54. Auto-Negotiation advertisement (0x04)

Bit	Symbol	Access	Default	Description
15	Next_Page	RW	0x0	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11]

				• Link goes down If 1000BASE-T is advertised, the required Next Pages are automatically transmitted. This bit must be set to 0 if no additional Next Page is needed. 1 = Advertise 0 = Not advertised
14	Ack	RO	0x0	Always 0.
13	Remote_Fault	RW	0x0	1 = Set Remote Fault bit 0 = Do not set Remote Fault bit
12	Extended_Next_Page	RW	0x1	Extended Next Page enable control bit 1 = Local device supports transmission of extended Next Pages 0 = Local device does not support transmission of extended Next Pages.
11	Asymmetric_Pause	RW	0x1	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11] • Link goes down 1 = Asymmetric Pause 0 = No asymmetric Pause
10	Pause	RW	0x1	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11]

				• Link goes down 1 = Symmetric Pause 0 = No symmetric Pause
9	100BASE-T4	RO	0x0	1 = Able to perform 100BASE-T4 0 = Not able to perform 100BASE-T4 Always 0
8	100BASE-TX_Full_Duplex	RW	0x1	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11] • Link goes down 1 = Advertise 0 = Not advertised
7	100BASE-TX_Half_Duplex	RW	0x1	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11] • Link goes down 1 = Advertise 0 = Not advertised
6	10BASE-T _e _Full_Duplex	RW	0x1	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15]

				- Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] - The port is switched from power down to normal operation by writing register 0x0 bit[11] - Link goes down 1 = Advertise 0 = Not advertised
5	10BASE-Te_Half_Duplex	RW	0x1	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: - Software reset is asserted by writing register 0x0 bit[15] - Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] - The port is switched from power down to normal operation by writing register 0x0 bit[11] - Link goes down 1 = Advertise 0 = Not advertised
4:0	Selector_Field	RW	0x1	Selector Field mode. 00001 = IEEE 802.3

6.2.6. Auto-Negotiation link partner ability (0x05)

Table 55. Auto-Negotiation link partner ability (0x05)

Bit	Symbol	Access	Default	Description
15	1000BASE-X_Fd	RO SWC	0x0	Received Code Word Bit 15 1 = Link partner is capable of Next Page 0 = Link partner is not capable of Next Page
14	ACK	RO SWC	0x0	Acknowledge. Received Code Word Bit 14 1 = Link partner has received link code word 0 = Link partner has not received link code word
13	REMOTE_FAULT	RO SWC	0x0	Remote Fault. Received Code Word Bit 13 1 = Link partner has detected remote fault 0 = Link partner has not detected remote fault
12	RESERVED	RO SWC	0x0	Technology Ability Field. Received Code Word Bit 12

11	ASYMMETRIC_PAUSE	RO SWC	0x0	Technology Ability Field. Received Code Word Bit 11 1 = Link partner requests asymmetric pause 0 = Link partner does not request asymmetric pause
10	PAUSE	RO SWC	0x0	Technology Ability Field. Received Code Word Bit 10 1 = Link partner supports pause operation 0 = Link partner does not support pause operation
9	100BASE-T4	RO SWC	0x0	Technology Ability Field. Received Code Word Bit 9 1 = Link partner supports 100BASE-T4 0 = Link partner does not support 100BASE-T4
8	100BASE-TX_FULL_DUPLEX	RO SWC	0x0	Technology Ability Field. Received Code Word Bit 8 1 = Link partner supports 100BASE-TX full-duplex 0 = Link partner does not support 100BASE-TX full-duplex
7	100BASE-TX_HALF_DUPLEX	RO SWC	0x0	Technology Ability Field. Received Code Word Bit 7 1 = Link partner supports 100BASE-TX half-duplex 0 = Link partner does not support 100BASE-TX half-duplex
6	10BASE-Te_FULL_DUPLEX	RO SWC	0x0	Technology Ability Field. Received Code Word Bit 6 1 = Link partner supports 10BASE-Te full-duplex 0 = Link partner does not support 10BASE-Te full-duplex
5	10BASE-Te_HALF_DUPLEX	RO SWC	0x0	Technology Ability Field. Received Code Word Bit 5 1 = Link partner supports 10BASE-Te half-duplex 0 = Link partner does not support 10BASE-Te half-duplex
4:0	SELECTOR_FIELD	RO SWC	0x0	Selector Field Received Code Word Bit 4:0

6.2.7. Auto-Negotiation expansion register (0x06)

Table 56. Auto-Negotiation expansion register (0x06)

Bit	Symbol	Access	Default	Description
15:5	Reserved	RO	0x0	Reserved
4	Parallel Detection fault	RO RC SWC LH	0x0	1 = Fault is detected 0 = No fault is detected
3	Link partner Next Page able	RO SWC LH	0x0	1 = Link partner supports Next Page 0 = Link partner does not support Next Page
2	Local Next Page able	RO	0x1	1 = Local Device supports Next Page 0 = Local Device does not Next Page
1	Page received	RO RC LH	0x0	1 = A new page is received 0 = No new page is received
0	Link Partner Auto negotiation able	RO	0x0	1 = Link partner supports auto-negotiation 0 = Link partner does not support auto-negotiation

6.2.8. Auto-Negotiation Next Page register (0x07)

Table 57. Auto-Negotiation Next Page register (0x07)

Bit	Symbol	Access	Default	Description
15	Next Page	RW	0x0	Transmit Code Word Bit 15 1 = The page is not the last page 0 = The page is the last page
14	Reserved	RO	0x0	Transmit Code Word Bit 14
13	Message page mode	RW	0x1	Transmit Code Word Bit 13 1 = Message Page 0 = Unformatted Page
12	Ack2	RW	0x0	Transmit Code Word Bit 12 1 = Comply with message 0 = Cannot comply with message
11	Toggle	RO	0x0	Transmit Code Word Bit 11 1 = This bit in the previously exchanged Code Word is logic 0 0 = The Toggle bit in the previously exchanged Code Word is logic 1
10:0	Message/Unformatte	RW	0x1	Transmit Code Word Bits [10:0]. These bits are encoded as Message Code Field when bit[13] is set to 1, or as Unformatted Code Field when bit[13] is set to 0.

6.2.9. Auto-Negotiation link partner Received Next Page register (0x08)

Table 58. Auto-Negotiation link partner Received Next Page register (0x08)

Bit	Symbol	Access	Default	Description
15	Next Page	RO	0x0	Received Code Word Bit 15 1 = This page is not the last page 0 = This page is the last page
14	Reserved	RO	0x0	Received Code Word Bit 14
13	Message page mode	RO	0x0	Received Code Word Bit 13 1 = Message Page 0 = Unformatted Page
12	Ack2	RO	0x0	Received Code Word Bit 12 1 = Comply with message 0 = Cannot comply with message
11	Toggle	RO	0x0	Received Code Word Bit 11 1 = This bit in the previously exchanged Code Word is logic 0 0 = The Toggle bit in the previously exchanged Code Word is logic 1
10:0	Message/Unformatte	RO	0x0	Received Code Word Bit 10:0 These bits are encoded as Message Code Field when bit[13] is set to 1, or as Unformatted Code Field when bit[13] is set to 0.

6.2.10. MASTER-SLAVE control register (0x09)

Table 59. MASTER-SLAVE control register (0x09)

Bit	Symbol	Access	Default	Description
15:13	Test mode	RW	0x0	The TX_TCLK signals from the RX_CLK pin is for jitter testing in test modes 2 and 3. When exiting the test mode, hardware reset or software reset through writing register 0x0 bit[15] must be performed to ensure normal operation. 000 = Normal Mode 001 = Test Mode 1 – Transmit Waveform Test 010 = Test Mode 2 – Transmit Jitter Test (MASTER mode) 011 = Test Mode 3 – Transmit Jitter Test (SLAVE mode) 100 = Test Mode 4 – Transmit Distortion

				Test 110, 111 = Reserved normal operation.
12	Master/Slave Manual configuration Enable	RW	0x0	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11] • Link goes down 1 = Manual MASTER/SLAVE configuration 0 = Automatic MASTER/SLAVE configuration.
11	Master/Slave configuration	RW	0x0	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11] • Link goes down This bit is ignored if bit[12] is 0. 1 = Manual configuration as MASTER 0 = Manual configuration as SLAVE.
10	Port Type	RW	0x1	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11]

				• Link goes down This bit is ignored if bit[12] is 1. 1 = Prefer multi-port device (MASTER) 0 = Prefer single port device (SLAVE)
9	1000BASE-T Full	RW	0x1	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11] • Link goes down 1 = Advertise 0 = Not advertised
8	1000BASE-T Half-	RW	0x0	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11] • Link goes down 1 = Advertise 0 = Not advertised (default)
7:0	Reserved	RW	0x0	Write as 0, ignore on read.

6.2.11. MASTER-SLAVE status register (0x0A)

Table 60. MASTER-SLAVE status register (0x0A)

Bit	Symbol	Access	Default	Description
15	Master/Slave_cfg_error	RO RC SWC LH	0x0	This register bit will clear on read, rising of MII 0.12 and rising of AN complete. 1 = Master/Slave configuration fault detected 0 = No fault detected

14	Master/Slave	RO	0x0	This bit is not valid unless register 0x1 bit5 is 1. 1 = Local PHY configuration resolved to Master 0 = Local PHY configuration resolved to Slave
13	Local Receiver Status	RO	0x0	1 = Local Receiver OK 0 = Local Receiver not OK
12	Remote Receiver	RO	0x0	1 = Remote Receiver OK 0 = Remote Receiver not OK
11	Link Partner 1000T FD	RO	0x0	This bit is not valid unless register 0x1 bit5 is 1. 1 = Link Partner supports 1000BASE-T full duplex 0 = Link Partner does not support 1000BASE-T full duplex
10	Link Partner 1000T HD	RO	0x0	This bit is not valid unless register 0x1 bit5 is 1. 1 = Link Partner supports 1000BASE-T half duplex 0 = Link Partner does not support 1000BASE-T half duplex
9:8	Reserved	RO	0x0	Reserved
7:0	Idle Error Count	RO RC	0x0	MSB of Idle Error Counter. The register indicates the idle error count since the last read operation performed to this register. The counter pegs at 11111111 and does not roll over.

6.2.12. MMD access control register (0x0D)

Table 61. MMD access control register (0x0D)

Bit	Symbol	Access	Default	Description
15:14	Function	RW	0x0	00 = Address 01 = Data, no post increment 10 = Data, post increment on reads and writes 11 = Data, post increment on writes only
13:5	Reserved	RO	0x0	Reserved
4:0	DEVAD	RW	0x0	MMD register device address. 00001 = MMD1 00011 = MMD3 00111 = MMD7

6.2.13. MMD access data register (0x0E)

Table 62. MMD access data register (0x0E)

Bit	Symbol	Access	Default	Description
15:0	Address data	RW	0x0	If register 0xD bits [15:14] are 00, this register is used as MMD DEVAD address register. Otherwise, this register is used as MMD DEVAD data register as indicated by its address register.

6.2.14. Extended status register (0x0F)

Table 63. Extended status register (0x0F)

Bit	Symbol	Access	Default	Description
15	1000BASE-X Full Duplex	RO	0x0	1 = PHY supports 1000BASE-X Full Duplex 0 = PHY does not supports 1000BASE-X Full Duplex Always 0.
14	1000BASE-X Half Duplex	RO	0x0	1 = PHY supports 1000BASE-X Half Duplex. 0 = PHY does not support 1000BASE-X Half Duplex. Always 0
13	1000BASE-T Full Duplex	RO	0x1	1 = PHY supports 1000BASE-T Full Duplex 0 = PHY does not supports 1000BASE-T Full Duplex Always 1
12	1000BASE-T Half Duplex	RO	0x0	1 = PHY supports 1000BASE-T Half Duplex 0 = PHY does not support 1000BASE-T Half Duplex Always 0.
11:0	Reserved	RO	0x0	Always 0

6.2.15. PHY specific function control register (0x10)

Table 64. PHY specific function control register (0x10)

Bit	Symbol	Access	Default	Description
15:7	Reserved	RO	0x0	Reserved
6:5	Cross_md	RW	0x3	Changes made to these bits disrupt normal operation, thus a software reset is

				mandatory after the change. And the configuration does not take effect until software reset. 00 = Manual MDI configuration 01 = Manual MDIX configuration 10 = Reserved 11 = Enable automatic crossover for all modes
4	Int_polar_sel	RW	0x0	Reserved
3	Crs_on_tx	RW	0x0	This bit is effective in 10BASE-T _e half-duplex mode and 100BASE-TX mode: 1 = Assert CRS on transmitting or receiving 0 = Never assert CRS on transmitting, only assert it on receiving.
2	En_sqe_test	RW	0x0	1 = SQE test enabled, 0 = SQE test disabled <i>Note: SQE Test is automatically disabled in full-duplex mode regardless the setting in this bit.</i>
1	En_pol_inv	RW	0x1	If polarity reversal is disabled, the polarity is forced to be normal in 10BASE-T _e . 1 = 10BASE-T _e Polarity Reversal Enabled 0 = 10BASE-T _e Polarity Reversal Disabled
0	Dis_jab	RW	0x0	Jabber takes effect only in 10BASE-T _e half-duplex mode. 1 = Disable jabber function 0 = Enable jabber function

6.2.16. PHY specific status register (0x11)

Table 65. PHY specific status register (0x11)

Bit	Symbol	Access	Default	Description
15:14	Speed_mode	RO	0x0	These status bits are valid only when bit11 is 1. Bit11 is set when Auto-Negotiation is completed or Auto-Negotiation is disabled. 11 = Reserved 10 = 1000 Mbps 01 = 100 Mbps 00 = 10 Mbps
13	Duplex	RO	0x0	This status bit is valid only when bit11 is 1. Bit11 is set when Auto-Negotiation is completed or Auto-Negotiation is disabled.

				1 = Full-duplex 0 = Half-duplex
12	Page Received real-time	RO	0x0	1 = Page received 0 = Page not received
11	Speed and Duplex Resolved	RO	0x0	When Auto-Negotiation is disabled, this bit is set to 1 for force speed mode. 1 = Resolved 0 = Not resolved
10	Link status real-time	RO	0x0	1 = Link up 0 = Link down
9:7	Reserved	RO	0x0	Reserved
6	MDI Crossover Status	RO	0x0	This status bit is valid only when bit11 is 1. Bit11 is set when Auto-Negotiation is completed or Auto-Negotiation is disabled. The bit value depends on register 0x10 "PHY specific function control register" bits6~bit5 configurations. Register 0x10 configurations take effect after software reset. 1 = MDIX 0 = MDI
5	Wirespeed downgrade	RO	0x0	1 = Downgrade 0 = No Downgrade
4:2	Reserved	RO	0x0	Reserved
1	Polarity Real Time	RO	0x0	1 = Reverted polarity 0 = Normal polarity
0	Jabber Real Time	RO	0x0	1 = Jabber 0 = No jabber

6.2.17. Interrupt Mask Register (0x12)

Table 66. Interrupt Mask Register (0x12)

Bit	Symbol	Access	Default	Description
15	Auto-Negotiation Error INT mask	RW	0x0	1 = Interrupt enable 0 = Interrupt disable
14	Speed Changed INT mask	RW	0x0	same as bit 15
13	Duplex changed INT mask	RW	0x0	same as bit 15
12	Page Received INT mask	RW	0x0	same as bit 15
11	Link Failed INT mask	RW	0x0	same as bit 15
10	Link Succeed INT mask	RW	0x0	same as bit 15

9:6	reserved	RW	0x0	No used.
5	Wirespeed downgraded INT mask	RW	0x0	same as bit 15
4:2	Reserved	RW	0x0	No used.
1	Polarity changed INT mask	RW	0x0	same as bit 15
0	Jabber Happened INT mask	RW	0x0	same as bit 15

6.2.18. Interrupt Status Register (0x13)

Table 67. Interrupt Status Register (0x13)

Bit	Symbol	Access	Default	Description
15	Auto-Negotiation Error INT	RO	0x0	Error can take place when any of the following happens: • MASTER/SLAVE does not resolve correctly • Parallel detect fault • No common HCD • Link does not come up after negotiation is complete • Selector Field is not equal • flp_receive_idle=true while Autoneg Arbitration FSM is in Next Page WAIT state 1 = Auto-Negotiation Error takes place 0 = No Auto-Negotiation Error takes place
14	Speed Changed INT	RO	0x0	1 = Speed changed 0 = Speed not changed
13	Duplex changed INT	RO	0x0	1 = duplex changed 0 = duplex not changed
12	Page Received INT	RO	0x0	1 = Page received 0 = Page not received
11	Link Failed INT	RO	0x0	1 = Phy link down takes place 0 = No link down takes place
10	Link Succeed INT	RO	0x0	1 = Phy link up takes place 0 = No link up takes place
9:6	Reserved	RO	0x0	reserved
5	Wirespeed downgraded INT	RO	0x0	1 = speed downgraded. 0 = Speed didn't downgrade.
4:2	Reserved	RO	0x0	reserved
1	Polarity changed INT	RO	0x0	1 = PHY reverved MDI polarity 0 = PHY didn't revert MDI polarity

0	Jabber Happened INT	RO	0x0	1 = 10BASE-Tx TX jabber happened 0 = 10BASE-Tx TX jabber didn't happen Please refer to mii.1.1 Jabber_Detect.
---	---------------------	----	-----	---

6.2.19. Speed Auto Downgrade Control Register (0x14)

Table 68. Speed Auto Downgrade Control Register (0x14)

Bit	Symbol	Access	Default	Description
15:6	Reserved	RO	0x0	Reserved
5	En_speed_downgrade	RW POS	0x1	When this bit is set to 1, the PHY enables smart-speed function. Writing this bit requires a software reset to update. This bit will be set to 1'b0 in Fiber x4 + Copper x4 mode automatically.
4:2	Autoneg retry limit pre-downgrade	RW	0x3	If these bits are set to 3, the PHY attempts five times (set value 3 + additional 2) before downgrading. The number of attempts can be changed by these bits. only take effect after software reset
1	Bp_autospd_timer	RW	0x0	1 = the wirespeed downgrade FSM will bypass the timer used for link stability check; only take effect after software reset 0 = not bypass the timer, then links that established but hold for less than 2.5s would still be taken as failure, autoneg retry counter will increase by 1.
0	Reserved	RO	0x0	Reserved

6.2.20. Rx Error Counter Register (0x15)

Table 69. Rx Error Counter Register (0x15)

Bit	Symbol	Access	Default	Description
15:0	Rx_err_counter	RO	0x0	Only valid for 1000M/s and 100M/s. This counter increase by 1 at the 1st rising of RX_ER when RX_DV is 1. The counter will hold at maximum 16'hFFFF and not roll over.

6.2.21. Debug Register's Address Offset Register (0x1E)

Table 70. Debug Register's Address Offset Register (0x1E)

Bit	Symbol	Access	Default	Description
-----	--------	--------	---------	-------------

15:8	Reserved	RO	0x0	Reserved
7:0	Debug Register Address Offset	RW	0x0	It's the address offset of the debug register that will be Write or Read

6.2.22. Debug Register's Data Register (0x1F)

Table 71. Debug Register's Data Register (0x1F)

Bit	Symbol	Access	Default	Description
15:0	Debug Register Datas	RW	0x0	It's the data to be written to the debug register indicated by the address offset in register 0x1E, or the data read out from that debug register.

6.3. LDS MII Register

6.3.1. LRE control (0x00)

Table 72. LRE control (0x00)

Bit	Symbol	Access	Default	Description
15	Reset	RW SC	0x0	PHY Software Reset. Writing 1 to this bit causes immediate PHY reset. Once the operation is done, this bit is cleared automatically.; 1'b0: Normal operation; 1'b1: PHY reset
14	Loopback	RW	0x0	Loopback control; 1'b0: disable loopback; 1'b1: enable loopback
13	Restart_LDS	RW SC	0x0	1'b1: restart LDS process
12	LDS_Enable	RW	0x0	1'b1: LDS enabled; 1'b0: LDS disabled
11	Power_down	RW	0x0	1 = Power down; 0 = Normal operation; When the port is switched from power down to; normal operation, software reset and Auto-; Negotiation are performed even bit[15] RESET and bit[9] RESTART_AUTO_NEGOTIATION are not set by the user.
10	Isolate	RW	0x0	Isolate phy from MII/GMII/RGMII: PHY will not respond to RGMII TXD/TX_CTL, and present high impedance on RXD/RX_CTL.; 1'b0: Normal mode; 1'b1: Isolate mode
9:6	Speed_selection	RW	0x0	4'b0000: 10Mbps; 4'b1000: 100Mbps; Others: reserved

5:4	Pair_selection	RW	0x0	2'b00: 1 pair connection; 2'b01: 2 pair connections; 2'b10: 4 pair connections; 2'b11: reserved
3	M/S_selection	RW	0x0	1'b1: manually force local device to master, when reg0.12 = 0; 1'b0: manually force local device to slave, when reg0.12 = 0
2	Force auto negotiation	RW	0x0	1'b1: manually force local device to auto negotiation state, when reg0.12 = 0
1:0	Reserved	RO	0x0	Reserved. Write as 0, ignore on read

6.3.2. LRE status (0x01)

Table 73. LRE status (0x01)

Bit	Symbol	Access	Default	Description
15:14	Reserved	RO	0x0	Ignore on read
13	100Mbps_1-pair capable	RO	0x0	1'b1: 100Mbps 1-pair capable; 1'b0: Not 100Mbps 1-pair capable
12	100Mbps_4-pair capable	RO	0x1	1'b1: 100Mbps 4-pair capable; 1'b0: Not 100Mbps 4-pair capable
11	100Mbps_2-pair capable	RO	0x0	1'b1: 100Mbps 2-pair capable; 1'b0: Not 100Mbps 2-pair capable
10	10Mbps_2-pair capable	RO	0x0	1'b1: 10Mbps 2-pair capable; 1'b0: Not 10Mbps 2-pair capable
9	10Mbps_1-pair capable	RO	0x0	1'b1: 10Mbps 1-pair capable; 1'b0: Not 10Mbps 1-pair capable
8	Extended_Status	RO	0x1	Whether support EXTended status register in 0Fh; 0: Not supported; 1: Supported
7	Reserved	RO	0x1	None
6	Mf_Preamble_Suppression	RO	0x1	1'b0: PHY will not accept management frames with preamble suppressed; 1'b1: PHY will accept management frames with preamble suppressed
5	LDS_Complete	RO	0x0	1'b1: LDS auto-negotiation complete; 1'b0: LDS auto-negotiation not complete
4	Support_IEEE_802.3_PHY	RO	0x1	1'b1: Support IEEE 802.3 PHY operation; 1'b0: Not Support IEEE 802.3 PHY operation
3	LDS_Ability	RO	0x1	1'b1: LDS auto-negotiation capable; 1'b0: Not LDS auto-negotiation capable
2	Link_Status	RO	0x0	Link status; 1'b0: Link is down; 1'b1: Link is up

1	Jabber_Detect	RO LH	0x0	10BASE-T jabber detected; 1'b0: no jabber condition detected; 1'b1: Jabber condition detected
0	Extended_Capability	RO LH	0x1	To indicate whether support EXTended registers, to access from address register 1Eh and data register 1Fh; 1'b0: Not supported; 1'b1: Supported

6.3.3. PHY ID (0x02)

Table 74. PHY ID (0x02)

Bit	Symbol	Access	Default	Description
15:0	PHY_ID	RO	0x4f51	None

6.3.4. PHY ID (0x03)

Table 75. PHY ID (0x03)

Bit	Symbol	Access	Default	Description
15:0	PHY_ID	RO	0xe899	None

6.3.5. LDS auto-negotiation advertised ability (0x04)

Table 76. LDS auto-negotiation advertised ability (0x04)

Bit	Symbol	Access	Default	Description
15	Asymmetric_pause	RW	0x0	1'b1: Advertise asymmetric pause; 1'b0: Advertise no asymmetric pause
14	Pause_capable	RW	0x0	1'b1: Advertise pause capable; 1'b0: Advertise no pause capable
13:6	Reserved	RO	0x0	reserved
5	100Mbps_1-pair capable	RW	0x0	1'b1: 100Mbps 1-pair capable; 1'b0: Not 100Mbps 1-pair capable
4	100Mbps_4-pair capable	RW	0x1	1'b1: 100Mbps 4-pair capable; 1'b0: Not 100Mbps 4-pair capable
3	100Mbps_2-pair capable	RW	0x0	1'b1: 100Mbps 2-pair capable; 1'b0: Not 100Mbps 2-pair capable
2	10Mbps_2-pair capable	RW	0x0	1'b1: 10Mbps 2-pair capable; 1'b0: Not 10Mbps 2-pair capable
1	10Mbps_1-pair capable	RW	0x0	1'b1: 10Mbps 1-pair capable; 1'b0: Not 10Mbps 1-pair capable
0	Auto negotiation capable	RW	0x1	1'b1: Auto negotiation capable; 1'b0: Auto negotiation capable

6.3.6. LDS auto-negotiation advertised control (0x05)

Table 77. LDS auto-negotiation advertised control (0x05)

Bit	Symbol	Access	Default	Description
15:13	Test_Mode	RW	0x0	Test Mode control
12:10	Reserved	RO	0x0	Reserved
9	Port_type_preference	RW	0x0	1'b1: multiport device (Mater); 1'b0: single-port device (Salve)
8	Ability_field_update	RW SC	0x0	1'b1: Contents of register 06h are updated; 1'b0: No updates
7:0	Local_field_number	RW	0x0	Local field number of Next Page message

6.3.7. LDS ability Next Page transmit (0x06)

Table 78. LDS ability Next Page transmit (0x06)

Bit	Symbol	Access	Default	Description
15:0	Next_Page_message	RW	0x0	LDS nEXT page message

6.3.8. LDS link partner ability (0x07)

Table 79. LDS link partner ability (0x07)

Bit	Symbol	Access	Default	Description
15	Asymmetric_pause	RO	0x0	1'b1: link partner supports asymmetric pause; 1'b0: link partner doesn't support asymmetric pause
14	Pause_capable	RO	0x0	1'b1: link partner supports pause capable; 1'b0: link partner doesn't support pause capable
13:6	Reserved	RO	0x0	None
5	100Mbps_1-pair_capable	RO	0x0	1'b1: link partner 100Mbps 1-pair capable; 1'b0: link partner not 100Mbps 1-pair capable
4	100Mbps_4-pair_capable	RO	0x0	1'b1: link partner 100Mbps 4-pair capable; 1'b0: link partner not 100Mbps 4-pair capable
3	100Mbps_2-pair_capable	RO	0x0	1'b1: link partner 100Mbps 2-pair capable; 1'b0: link partner not 100Mbps 2-pair capable
2	10Mbps_2-pair_capable	RO	0x0	1'b1: link partner 10Mbps 2-pair capable; 1'b0: link partner not 10Mbps 2-pair capable

1	10Mbps_1-pair_capable	RO	0x0	1'b1: link partner 10Mbps 1-pair capable; 1'b0: link partner not 10Mbps 1-pair capable
0	Reserved	RO	0x0	None

6.3.9. LDS link partner Next Page message (0x08)

Table 80. LDS link partner Next Page message (0x08)

Bit	Symbol	Access	Default	Description
15:0	Link_partner_Next_Page_message	RO	0x0	LDS link partner Next Page message

6.3.10. LDS link partner Next Page message control (0x09)

Table 81. LDS link partner Next Page message control (0x09)

Bit	Symbol	Access	Default	Description
15	Next_Page_read_flag	RW SC	0x0	1'b1: Next Page has been read
14:9	Reserved	RO	0x0	None
8	Remote_acknowledge	RO RC	0x0	1'b1: acknowledge from link partner;
7:0	Remote_field_number	RO	0xff	Remote field number of Next Page message

6.3.11. LDS expansion (0x0A)

Table 82. LDS expansion (0x0A)

Bit	Symbol	Access	Default	Description
15	Downgrade_ability	RO	0x0	1'b1: LDS speed downgrade
14	Master/Slave	RO	0x0	1 = Local PHY configuration resolved to Master; 0 = Local PHY configuration resolved to Slave
13:12	Connections_pairs	RO	0x0	Number of pairs; 2'b00: 1 pair; 2'b01: 2 pairs; 2'b10: 4 pairs; 2'b11: reserved
11:0	Estimated_cable_length	RO	0x0	None

6.3.12. LDS Results (0x0B)

Table 83. LDS Results (0x0B)

Bit	Symbol	Access	Default	Description
15:6	Reserved	RO	0x0	None
5	4-pair_100M	RO	0x0	1'b1: local PHY configuration resolved to 4-pair 100M

4	Auto_negotiation	RO	0x0	1'b1: local PHY configuration resolved to AN
3	1-pair_100M	RO	0x0	1'b1: local PHY configuration resolved to 1-pair 100M
2	1-pair_10M	RO	0x0	1'b1: local PHY configuration resolved to 1-pair 10M
1	2-pair_100M	RO	0x0	1'b1: local PHY configuration resolved to IEEE 100M
0	2-pair_10M	RO	0x0	1'b1: local PHY configuration resolved to IEEE 10M

6.3.13. LDS Extended status (0x0F)

Table 84. LDS Extended status (0x0F)

Bit	Symbol	Access	Default	Description
15:10	Reserved	RO	0x0	Reserved
9	Local_receiver status	RO	0x0	1'b1: local receiver ok; 1'b0: local receiver not ok
8	Remote_receiver status	RO	0x0	1'b1: remote receiver ok; 1'b0: remote receiver not ok
7:0	Idle_error_count	RO	0x0	Number of idle errors since last read

6.4. UTP MMD Register

6.4.1. PCS control 1 register (MMD3, 0x00)

Table 85. PCS control 1 register (MMD3, 0x00)

Bit	Symbol	Access	Default	Description
15	Pcs_rst	RW SC	0x0	Setting this bit will set all PCS registers to their default states. This action also initiate a reset in MII 0x0 bit15, MMD1 and MMD7.
14:11	Reserved	RO	0x0	Reserved
10	Clock_stoppable	RW SWC	0x0	Not used.
9:0	Reserved	RO	0x0	Reserved

6.4.2. PCS status 1 register (MMD3, 0x01)

Table 86. PCS status 1 register (MMD3, 0x01)

Bit	Symbol	Access	Default	Description
15:12	Reserved	RO	0x0	Reserved

11	Tx_lpi_rxed	RO LH	0x0	When read as 1, it indicates that the transmit PCS has received low power idle signaling one or more times since the register was last read. Latch High.
10	Rx_lpi_rxed	RO LH	0x0	When read as 1, it indicates that the receive PCS has received low power idle signaling one or more times since the register was last read. Latch High.
9	Tx_lpi_indic	RO	0x0	When read as 1, it indicates that the transmit PCS is currently receiving low power idle signals.
8	Rx_lpi_indic	RO	0x0	When read as 1, it indicates that the receive PCS is currently receiving low power idle signals.
7:3	Reserved	RO	0x0	Reserved
2	Pcsrx_Ink_status	RO LL	0x0	PCS status, latch low.
1:0	Reserved	RO	0x0	Reserved

6.4.3. EEE control and capability register (MMD3, 0x14)

Table 87. EEE control and capability register (MMD3, 0x14)

Bit	Symbol	Access	Default	Description
15:3	Reserved	RO	0x0	Reserved
2	1000BASE-T EEE	RO	0x1	Always 1. EEE is supported for 1000BASE-T
1	100BASE-TX EEE	RO	0x1	Always 1. EEE is supported for 100BASE-TX
0	Reserved	RO	0x0	Reserved

6.4.4. EEE wake error counter (MMD3, 0x16)

Table 88. EEE wake error counter (MMD3, 0x16)

Bit	Symbol	Access	Default	Description
15:0	Lpi_wake_err_cnt	RO RC SWC	0x0	Count wake time faults where the PHY fails to complete its normal wake sequence within the time required for the specific PHY type.

6.4.5. Local Device EEE Ability (MMD7, 0x3C)

Table 89. Local Device EEE Ability (MMD7, 0x3C)

Bit	Symbol	Access	Default	Description
-----	--------	--------	---------	-------------

15:3	Reserved	RO	0x0	Reserved
2	EEE_1000BT	RW	0x0	PHY's 1000BASE-T EEE ability.
1	EEE_100BT	RW	0x0	PHY's 100BASE-TX EEE ability.
0	Reserved	RO	0x0	Reserved

6.4.6. Link Partner EEE Ability (MMD7, 0x3D)

Table 90. Link Partner EEE Ability (MMD7, 0x3D)

Bit	Symbol	Access	Default	Description
15:3	Reserved	RO	0x0	Reserved
2	LP_ge_eee_ability	RO	0x0	Link partner's 1000BASE-T EEE ability.
1	LP_ge_eee_ability	RO	0x0	Link partner's 100BASE-TX EEE ability.
0	Reserved	RO	0x0	Reserved

6.4.7. Autoneg Result of EEE (MMD7, 0x8000)

Table 91. Autoneg Result of EEE (MMD7, 0x8000)

Bit	Symbol	Access	Default	Description
15:3	Reserved	RO	0x0	Reserved
2	En_ge_eee	RO	0x0	The autoneg result of whether 1000BASE-T EEE is supported by both sides.
1	En_fe_eee	RO	0x0	The autoneg result of whether 100BASE-TX EEE is supported by both sides.
0	Reserved	RW	0x0	Reserved

6.5. UTP EXT Register

6.5.1. 10BT Debug, LPBKs Register (0x0A)

Table 92. 10BT Debug, LPBKs Register (0x0A)

Bit	Symbol	Access	Default	Description
15:9	Reserved	RO	0x0	Reserved
8:6	phy_reg	RW	0x0	Reserved
5	rem_phy_lpbk	RW	0x0	control to set UTP to remote phy loopback mode or not.
4	Ext_lpbk	RW	0x0	control to set UTP to external loopback mode or not.
3	Reserved	RO	0x1	Reserved

2:0	Test_mode_10bt	RW SWC	0x0	Test_mode[2:0] is for 10BASE-T test mode select:
-----	----------------	-----------	-----	--

6.5.2. Sleep Control1 (0x27)

Table 93. Sleep Control1 (0x27)

Bit	Symbol	Access	Default	Description
15	En_sleep_sw	RW	0x1	1 = enable sleep mode: PHY will enter sleep mode and close AFE after unplug cable for a timer;
14	Pllon_in_slp	RW	0x0	1 = keep PLL on in sleep mode; 0 = PLL will be ON and OFF periodically.
13:6	Reserved	RO	0x0	Reserved
5	Sleeping	RO	0x0	1 = PHY is slept; 0 = PHY is waked.
4	Gate_25m	RO	0x0	Not used.
3:0	Reserved	RO	0x0	Reserved

6.5.3. debug mon1 (0x5A)

Table 94. debug mon1 (0x5A)

Bit	Symbol	Access	Default	Description
15	Hold_snap_shot	RO	0x0	Valid when EXT 0x58 bit14 en_snap_shot is set.
14:0	Mse0	RO	0x0	Valid when EXT 0x58 bit14 en_snap_shot is set, or EXT 0x59 bit15 prob_auto is set. Corresponding to these two setting, it is MDI channel 0's MSE at the time snap shot condition is met, or at the time this EXT register is being read.

6.5.4. debug mon2 (0x5B)

Table 95. debug mon2 (0x5B)

Bit	Symbol	Access	Default	Description
15	Hold_snap_shot_az	RO	0x0	Valid when EXT 0x58 bit15 en_snap_shot_az is set. 1 = the snap shot condition is met and triggered

14:0	Mse1	RO	0x0	Valid when EXT 0x58 bit14 en_snap_shot is set, or EXT 0x59 bit15 prob_auto is set. Corresponding to these two setting, it is MDI channel 1's MSE at the time snap shot condition is met, or at the time this EXT register is being read.
------	------	----	-----	--

6.5.5. debug mon3 (0x5C)

Table 96. debug mon3 (0x5C)

Bit	Symbol	Access	Default	Description
15	Reserved	RO	0x0	Reserved
14:0	Mse2	RO	0x0	Valid when EXT 0x58 bit14 en_snap_shot is set, or EXT 0x59 bit15 prob_auto is set. Corresponding to these two setting, it is MDI channel 2's MSE at the time snap shot condition is met, or at the time this EXT register is being read.

6.5.6. debug mon4 (0x5D)

Table 97. debug mon4 (0x5D)

Bit	Symbol	Access	Default	Description
15	Reserved	RO	0x0	Reserved
14:0	Mse3	RO	0x0	Valid when EXT 0x58 bit14 en_snap_shot is set, or EXT 0x59 bit15 prob_auto is set. Corresponding to these two setting, it is MDI channel 3's MSE at the time snap shot condition is met, or at the time this EXT register is being read.

6.6. SDS(1.25G/5G) MII Register

6.6.1. Basic control register (0x00)

Table 98. Basic control register (0x00)

Bit	Symbol	Access	Default	Description
15	Reset	RW SC	0x0	PHY Software Reset. Writing 1 to this bit causes immediate PHY reset. Once the operation is done, this bit is cleared automatically.

14	Loopback	RW	0x0	Internal loopback control, when it's set, SGMII/Fiber's TX data will be loopbacked to RX.
13	Speed_Selection(LSB)	RW	0x0	LSB of speed_selection[1:0]. Link speed can be selected via either the Auto-Negotiation process, or manual speed selection speed_selection[1:0]. Speed_selection[1:0] is valid when Auto-Negotiation is disabled by clearing bit 0.12 to zero.
12	Autoneg_En	RW	0x1	1: to enable auto-negotiation;
11	Power_down	RW	0x0	1: Power down
10	Isolate	RW	0x0	Isolate SerDes from UTP.
9	Re_Autoneg	RW SC	0x0	1: to restart auto-negotiation.
8	Duplex_Mode	RW	0x1	Valid only when the SerDes works as SGMII MAC The duplex mode can be selected via either the Auto-Negotiation process or manual duplex selection. Manual duplex selection is allowed when Auto-Negotiation is disabled by setting bit[12] Autoneg_En to 0. 1: Full Duplex 0: Half Duplex
7	Reserved	RW	0x0	Reserved
6	Speed_Selection(MSB)	RW	0x1	See bit13.
5	en_unidirection	RW	0x0	When bit 0.12 is zero and bit 0.8 is one: 1 = Enable transmit from media independent interface regardless of whether the PHY has determined that a valid link has been established 0 = Enable transmit from media independent interface only when the PHY has determined that a valid link has been established.
4:0	Reserved	RO	0x0	Reserved. Write as 0, ignore on read

6.6.2. Basic status register (0x01)

Table 99. Basic status register (0x01)

Bit	Symbol	Access	Default	Description
15	100BASE-T4	RO	0x0	PHY doesn't support 100BASE-T4

14	100BASE-X_Fd	RO	0x1	PHY supports 100BASE-X_FD
13	100BASE-X_Hd	RO	0x0	PHY supports 100BASE-X_HD
12	10Mbps_Fd	RO	0x0	PHY supports 10Mbps_Fd
11	10Mbps_Hd	RO	0x0	PHY supports 10Mbps_Hd
10	100BASE-T2_Fd	RO	0x0	PHY doesn't support 100BASE-T2_Fd
9	100BASE-T2_Hd	RO	0x0	PHY doesn't support 100BASE-T2_Hd
8	Extended_Status	RO	0x1	1 = Extended status information in Register 0xF 0 = No extended status information in Register 0xF
7	Unidirect_Ability	RO	0x1	1 = PHY able to transmit from media independent interface regardless of whether the PHY has determined that a valid link has been established; 0 = PHY able to transmit from media independent interface only when the PHY has determined that a valid link has been established
6	Mf_Preamble_Suppression	RO	0x1	1 = PHY will accept management frames with preamble suppressed; 0 = PHY will not accept management frames with preamble suppressed.
5	Autoneg_Complete	RO	0x0	1 = Auto-Negotiation process completed 0 = Auto-Negotiation process not completed
4	Remote_Fault	RO RC SWC LH	0x0	1 = remote fault condition detected 0 = no remote fault condition detected
3	Autoneg_Ability	RO	0x1	1 = PHY is able to perform Auto-Negotiation 0 = PHY is not able to perform Auto-Negotiation
2	Link_Status	RO SWC LL	0x0	1 = link is up 0 = link is down
1	Jabber_Detect	RO	0x0	always 0
0	Extended_Capability	RO	0x1	To indicate whether support EXTended registers, to access from address register 1Eh and data register 1Fh

6.6.3. Sds identification register1 (0x02)

Table 100. Sds identification register1 (0x02)

Bit	Symbol	Access	Default	Description
-----	--------	--------	---------	-------------

15:0	Phy_Id	RO	0x4f51	Bits 3 to 18 of the Organizationally Unique Identifier
------	--------	----	--------	--

6.6.4. Sds identification register2 (0x03)

Table 101. Sds identification register2 (0x03)

Bit	Symbol	Access	Default	Description
15:10	Phy_Id	RO	0x3a	Bits 19 to 24 of the Organizationally Unique Identifier
9:4	Type_No	RO	0x8	6 bits manufacturer's type number
3:0	Revision_No	RO	0x9	4 bits manufacturer's revision number

6.6.5. Auto-Negotiation advertisement (0x04)

Table 102. Auto-Negotiation advertisement (0x04)

Bit	Symbol	Access	Default	Description
15	Next_Page	RW	0x0	Reserved. Next Page exchange of SGMII/1000BASE-X Auto-negotiation is not supported in YT8614.
14	Ack	RO	0x0	Always 0
13:12	Remote_Fault	RO	0x0	Always 0
11:9	Reserved	RO	0x0	Reserved
8	Asymmetric_Pause	RW	0x1	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs: • Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11] • Link goes down 1 = Asymmetric Pause 0 = No asymmetric Pause
7	Pause	RW	0x1	This bit is updated immediately after the writing operation; however the configuration does not take effect until any of the following occurs:

				• Software reset is asserted by writing register 0x0 bit[15] • Restart Auto-Negotiation is triggered by writing register 0x0 bit[9] • The port is switched from power down to normal operation by writing register 0x0 bit[11] • Link goes down 1 = Symmetric Pause 0 = No symmetric Pause
6	Half_duplex	RW	0x0	Half duplex ability
5	Full_duplex	RW	0x1	Full duplex ability
4:0	Reserved	RO	0x0	Reserved

6.6.6. Auto-Negotiation link partner ability (0x05)

Table 103. Auto-Negotiation link partner ability (0x05)

Bit	Symbol	Access	Default	Description
15	Next_Page_or_Link	RO SWC	0x0	Received Code Word Bit 15. It's Next Page in 1000BASE-X auto-negotiation, and link status or 0 in SGMII auto-negotiation.
14	ACK	RO SWC	0x0	Acknowledge. Received Code Word Bit 14
13:12	REMOTE_FAULT	RO SWC	0x0	Remote Fault. Received Code Word Bit 13:12
11:9	RESERVED	RO	0x0	Reserved. Received Code Word Bit 11:9
8:7	PAUSE	RO SWC	0x0	Pause. Received Code Word Bit 8:7
6	HALF_DUPLEX	RO SWC	0x0	Half duplex. Received Code Word Bit 6
5	FULL_DUPLEX	RO SWC	0x0	Full duplex. Received Code Word Bit 5
4:0	RESERVED	RO	0x0	Reserved. Received Code Word Bit 4:0

6.6.7. Auto-Negotiation expansion register (0x06)

Table 104. Auto-Negotiation expansion register (0x06)

Bit	Symbol	Access	Default	Description
15:3	Reserved	RO	0x0	Reserved
2	Local Next Page able	RO	0x0	1 = Local Device supports Next Page

1	Page received	RO RC LH	0x0	1 = A new page is received
0	Reserved	RO	0x0	Reserved

6.6.8. Auto-Negotiation Next Page register (0x07)

Table 105. Auto-Negotiation Next Page register (0x07)

Bit	Symbol	Access	Default	Description
15:0	Next Page	RO	0x0	always be 0

6.6.9. Auto-Negotiation link partner Received Next Page register (0x08)

Table 106. Auto-Negotiation link partner Received Next Page register (0x08)

Bit	Symbol	Access	Default	Description
15:0	Link Partner Next Page	RO	0x0	always be 0

6.6.10. Extended status register (0x0F)

Table 107. Extended status register (0x0F)

Bit	Symbol	Access	Default	Description
15	1000BASE-X Full Duplex	RO	0x1	1 = PHY supports 1000BASE-X Full Duplex
14	1000BASE-X Half Duplex	RO	0x0	1 = PHY supports 1000BASE-X Half Duplex.
13	1000BASE-T Full Duplex	RO	0x0	1 = PHY supports 1000BASE-T Full Duplex
12	1000BASE-T Half Duplex	RO	0x0	1 = PHY supports 1000BASE-T Half Duplex
11:0	Reserved	RO	0x0	Always 0

6.6.11. Sds specific status register (0x11)

Table 108. Sds specific status register (0x11)

Bit	Symbol	Access	Default	Description
15:14	Speed_mode	RO	0x0	11 = Reserved 10 = 1000 Mbps 01 = 100 Mbps 00 = 10 Mbps
13	Duplex	RO	0x0	1 = Full-duplex 0 = Half-duplex
12:11	Pause	RO	0x0	Pause to mac
10	Link status real-time	RO	0x0	1 = Link up

				1 = Link down
9	Rx_lpi_active	RO	0x0	rx LPI is active
8	Duplex_error	RO	0x0	realtime duplex error
7	En_flowctrl_rx	RO	0x0	1 = Transmit pause enabled 0 = Transmit pause disabled
6	En_flowctrl_tx	RO	0x0	1 = Receive pause enabled 0 = Receive pause disabled
5:4	Ser_mode_cfg	RO	0x0	realtime serdes working mode. 00: SG_MAC; 01: SG_PHY; 10: FIB_1000; 11: FIB_100.
3:1	Xmit	RO	0x0	realtime transmit statemachine. 001: Xmit Idle; 010: Xmit Config; 100: Xmit Data.
0	Syncstatus	RO	0x0	realtime SerDes PCS sync_status

6.6.12. 100fx cfg (0x14)

Table 109. 100fx cfg (0x14)

Bit	Symbol	Access	Default	Description
15:14	Reserved	RW	0x1	Reserved
13:12	Pause_to_mac_100fx	RW	0x3	Pause setting to mac in 100fx mode
11:0	Reserved	RO	0x0	Reserved

6.6.13. receive err counter mon (0x15)

Table 110. receive err counter mon (0x15)

Bit	Symbol	Access	Default	Description
15:0	error_counter_rx	RO SWC	0x0	This counter increase by 1 at the 1st rising of RX_ER when RX_DV is 1. The counter will hold at maximum 16'hFFFF and not roll over.

6.6.14. lint fail counter mon (0x16)

Table 111. lint fail counter mon (0x16)

Bit	Symbol	Access	Default	Description
15:8	Reserved	RO	0x0	Reserved

7:0	Link_fail_cnt	RO SWC RC	0x0	Link fail counter. This counter increases by 1 each time the SerDes link goes down.
-----	---------------	--------------	-----	---

6.7. SDS(5G) EXT Register

6.7.1. bp_serdes_link_rst (0x00)

Table 112. bp_serdes_link_rst (0x00)

Bit	Symbol	Access	Default	Description
15	bp_serdes_link_rst	RW	0x0	1: to not reset the bridge between PHY and serdes when serdes is link down; 0: to reset the bridge.
14	sgtx_fifo_en	RW	0x0	1: to enable the SGMII TX FIFO so preamble will not be dropped to align tx_even; 0: to bypass the SGMII TX FIFO.
13	en_swrst_selfclr	RW	0x0	1: serdes SW reset in EXT 0x2 bit15 is selfcleared; 0: it's not selfcleared, should be write as 0 to clear.
12	en_pcsrst_selfclr	RW	0x0	1: serdes PCS SW reset in EXT 0x2 bit8 is selfcleared; 0: it's not selfcleared, should be write as 0 to clear.
11	en_sw_reset_ana	RW	0x0	1: to enable serdes SW reset to reset analog TX/RX divider, TX/RX data path and PI code; 0: to disable serdes SW reset to reset analog TX/RX divider, TX/RX data path and PI code.
10	en_an_on_align_done	RW	0x1	1: to enable SGMII/1000BASE-X restart autoneg when RX alignment is done; 0: to disable.
9:0	Reserved	RO	0x0	Reserved

6.7.2. sds analog digital interface cfg (0x02)

Table 113. sds analog digital interface cfg (0x02)

Bit	Symbol	Access	Default	Description
15	Sw_reset	RW	0x0	SerDes software reset, high active; ext.0.13

				control it to be self clear or not, by default it's not self clear.
14	Tx_clk_sel	RW	0x0	select tx clock phase from analog. 1: inverted; 0: non-inverted.
13	Rx_clk_sel	RW	0x1	select rx clock phase from analog, 1: inverted; 0: non-inverted.
12	Rx_clk_cdr_sel	RW	0x1	select CDR's rx clock phase from analog, 1: inverted; 0: non-inverted.
11	Rot_clk_sel	RW	0x0	select rx clock phase used to latch rotator setting, 1: inverted; 0: non-inverted.
10	Loopback	RW	0x0	sds internal loopback, for QSGMII, all 4 channels' TX are loopbacked to RX.
9	Reserved	RO	0x0	always 0.
8	pcs_sw_reset	RW	0x0	SerDes PCS software reset, high active; ; ext.0.12 control it to be self clear or not, by default it's not self clear.
7	Tx_data_mlsb_sel	RW	0x0	1: swap msb and lsb for tx data to analog
6	Rx_data_mlsb_sel	RW	0x1	1: swap msb and lsb of rx data from analog.
5	Tx_data_pol_sel	RW	0x0	1: 1 map to 0 and 0 map to 1 for tx data to analog
4	Rx_data_pol_sel	RW	0x0	1: 1 map to 0 and 0 map to 1 for rx data from analog
3	Cdr_data_mlsb_sel	RW	0x0	1: swap msb and lsb of rx data for cdr from analog
2:1	Reserved	RW	0x0	Reserved
0	Reserved	RO	0x0	Reserved

6.7.3. sds prbs cfg1 (0x05)

Table 114. sds prbs cfg1 (0x05)

Bit	Symbol	Access	Default	Description
15	En_prbs	RW	0x0	enable TX PRBS or self-defined pattern, the pattern type is determined by bit8 Test_mode_prbs31 and bit7:5 test_mode.
14	En_bert	RW	0x0	enable Bit Error Rate Test;
13	Prbs_invert	RW	0x0	TX error injection function, it has highest polarity than prbs_err_once and prbs_err_cont. 1: to send polarity inverted PRBS or self-defined pattern;
12	Prbs_err_cont	RW	0x0	TX error injection function, it has the lowest polarity.1: to inject error on TX pattern continuously and periodic, the period is

				controlled by prbs_err_rate.
11:10	Prbs_err_rate	RW	0x0	It' s valid only when prbs_err_cont is 1. 2'b00: inject one error every 1024 cycles; 2'b01: inject one error every 2048 cycles; 2'b10: inject one error every 4096 cycles; 2'b11: inject one error every 8192 cycles;
9	Prbs_err_once	RW	0x0	TX error injection function.At the rising of this bit, to send polarity inverted PRBS or self-defined pattern for one cycle;
8	Test_mode_prbs31	RW	0x0	1: PRBS31, bit7:5 test_mode[2:0] has no effect.0: not PRBS31, bit7:5 test_mode[2:0] take effect then.
7:5	Test_mode	RW	0x0	Control the TX pattern in test mode: 3'h0, PRBS7; 3'h1, PRBS10; 3'h2, Fix pattern, the fix pattern is controlled by Ext.6;3'h3, 010101...; 3'h4, 00110011...; 3'h5, 00000_11111_00000_11111...; 3'h6, 0000_0000_00_1111_1111_11...; 3'h7, Increase pattern, 0->1023->0->1023...
4:0	Reserved	RO	0x0	Reserved

6.7.4. sds prbs cfg2 (0x06)

Table 115. sds prbs cfg2 (0x06)

Bit	Symbol	Access	Default	Description
15:0	Fix_pattern_15_0	RW	0x0	fix pattern transmited in test_mode 2

6.7.5. sds prbs cfg2 (0x07)

Table 116. sds prbs cfg2 (0x07)

Bit	Symbol	Access	Default	Description
15:4	Reserved	RO	0x0	Reserved
3:0	Fix_pattern_19_16	RW	0x0	fix pattern transmited in test_mode 2

6.7.6. sds prbs mon1 (0x08)

Table 117. sds prbs mon1 (0x08)

Bit	Symbol	Access	Default	Description
15:9	Reserved	RO	0x0	Reserved
8	Err	RO	0x0	Err flag after PRBS has synchronized
7:2	Reserved	RO	0x0	Reserved

1	bisync_latch_low	RO LL	0x0	PRBS test synchronization status, once the sync is lost, this bit will latch low, until it's been read out.
0	Bitsync	RO	0x0	real time PRBS test synchronization status

6.7.7. sds prbs mon2 (0x09)

Table 118. sds prbs mon2 (0x09)

Bit	Symbol	Access	Default	Description
15:0	Err_cnt_15_0	RO	0x0	real time lowest 16 bits received error bit counter

6.7.8. sds prbs mon3 (0x0A)

Table 119. sds prbs mon3 (0x0A)

Bit	Symbol	Access	Default	Description
15:0	Err_cnt_31_16	RO	0x0	real time highest 16 bits received error bit counter

6.7.9. sds prbs mon4 (0x0B)

Table 120. sds prbs mon4 (0x0B)

Bit	Symbol	Access	Default	Description
15:0	Good_cnt_15_0	RO	0x0	real time lowest 16 bits received good bit counter

6.7.10. sds prbs mon5 (0x0C)

Table 121. sds prbs mon5 (0x0C)

Bit	Symbol	Access	Default	Description
15:0	Good_cnt_31_16	RO	0x0	real time highest 16 bits received good bit counter

6.7.11. analog cfg2 (0xA1)

Table 122. analog cfg2 (0xA1)

Bit	Symbol	Access	Default	Description
15:12	Tx_driver_stg2	RW	0xA	TX driver stage2 amplitude control bit<3:2>: 00 +0mA 01: +2.5mA 10:+2.5mA 11+5mA bit<1:0>: 00 +0mA 01: +0.625mA 10: +1.25mA 11:+2.5mA

11	Tx_driver_stg1	RW	0x1	TX driver stage1 amplitude control
10:8	Reserved	RO	0x0	Reserved
7:6	vb_tx_term	RW	0x2	tx output common mode voltage when tx power down 00: 0.7V 01:0.8V 10:0.9V 11:1V
5	tx_vamp_post	RW	0x0	TX driver post stage1 amplitude control.
4	Reserved	RO	0x0	always 0.
3:1	tx_driver_post	RW	0x7	TX driver stage2 de-emphasize control bit<2>: 0 +0mA, 1: +2.5mA bit<1:0>: 00: +0mA 01: +0.625mA 10: +1.25mA 11:+2.5mA
0	Tx_pd	RW	0x0	power down analog tx

6.8. SDS(1.25G) EXT Register

6.8.1. sds prbs cfg1 (0x05)

Table 123. sds prbs cfg1 (0x05)

Bit	Symbol	Access	Default	Description
15	En_prbs	RW	0x0	enable TX PRBS or self-defined pattern, the pattern type is determined by bit8 Test_mode_prbs31 and bit7:5 test_mode.
14	En_bert	RW	0x0	enable Bit Error Rate Test;
13	Prbs_invert	RW	0x0	TX error injection function, it has highest polarity than prbs_err_once and prbs_err_cont. 1: to send polarity inverted PRBS or self-defined pattern;
12	Prbs_err_cont	RW	0x0	TX error injection function, it has the lowest polarity.1: to inject error on TX pattern continuously and periodic, the period is controlled by prbs_err_rate.
11:10	Prbs_err_rate	RW	0x0	It' s valid only when prbs_err_cont is 1. 2'b00: inject one error every 1024 cycles; 2'b01: inject one error every 2048 cycles; 2'b10: inject one error every 4096 cycles; 2'b11: inject one error every 8192 cycles;

9	Prbs_err_once	RW	0x0	TX error injection function. At the rising of this bit, to send polarity inverted PRBS or self-defined pattern for one cycle;
8	Test_mode_prbs31	RW	0x0	1: PRBS31, bit7:5 test_mode[2:0] has no effect. 0: not PRBS31, bit7:5 test_mode[2:0] take effect then.
7:5	Test_mode	RW	0x0	Control the TX pattern in test mode: 0x0, PRBS7; 0x1, PRBS10; 0x2, Fix pattern, the fix pattern is controlled by Ext.6; 0x3, 010101...; 0x4, 00110011...; 0x5, 00000_11111_00000_11111...; 0x6, 0000_0000_00_1111_1111_11...; 0x7, Increase pattern, 0→1023→0→1023...
4	Duration_check_en	RW	0x0	enable fixed number of bits check define in sds EXT BA/BB
3:0	Reserved	RO	0x0	Reserved

6.8.2. sds prbs cfg2 (0x06)

Table 124. sds prbs cfg2 (0x06)

Bit	Symbol	Access	Default	Description
15:10	Reserved	RO	0x0	Reserved
9:0	Fix_pattern_9_0	RW	0x0	fix pattern transmited in test_mode 2

6.8.3. sds prbs mon1 (0x08)

Table 125. sds prbs mon1 (0x08)

Bit	Symbol	Access	Default	Description
15:9	Reserved	RO	0x0	Reserved
8	Err	RO	0x0	Err flag after PRBS has synchronized
7:2	Reserved	RO	0x0	Reserved
1	Bitsync_latch_low	RO LL	0x0	PRBS test synchronization status, once the sync is lost, this bit will latch low, until it's been read out.
0	Bitsync	RO	0x0	real time synchronization status

6.8.4. sds prbs mon2 (0x09)

Table 126. sds prbs mon2 (0x09)

Bit	Symbol	Access	Default	Description
-----	--------	--------	---------	-------------

15:0	Err_cnt_15_0	RO	0x0	real time lowest 16 bits received error bit counter
------	--------------	----	-----	---

6.8.5. sds prbs mon3 (0x0A)

Table 127. sds prbs mon3 (0x0A)

Bit	Symbol	Access	Default	Description
15:0	Err_cnt_31_16	RO	0x0	real time highest 16 bits received error bit counter

6.8.6. sds prbs mon4 (0x0B)

Table 128. sds prbs mon4 (0x0B)

Bit	Symbol	Access	Default	Description
15:0	Good_cnt_15_0	RO	0x0	real time lowest 16 bits received good bit counter

6.8.7. sds prbs mon5 (0x0C)

Table 129. sds prbs mon5 (0x0C)

Bit	Symbol	Access	Default	Description
15:0	Good_cnt_31_16	RO	0x0	real time highest 16 bits received good bit counter

6.8.8. analog cfg2 (0xA1)

Table 130. analog cfg2 (0xA1)

Bit	Symbol	Access	Default	Description
15:12	Tx_driver_stg2	RW	0xA	Amplitude control of TX driver, 4'b0000: min; 4'b1111: max
11	Tx_driver_stg1	RW	0x1	TX driver stage1 amplitude control
10:8	Tx_ckdiv10_con	RW	0x0	tx divide by 10 clock delay control
7:5	Reserved	RW	0x0	Reserved
4	tx_post_en	RW	0x0	Enable or disable TX de-emphasis. 1'b0: disable; 1'b1: enable
3:1	tx_driver_post	RW	0x7	Amplitude control of TX de-emphasis. 3'b000: min; 3'b111: max
0	Tx_pd	RW	0x0	power down analog tx

7. Electrical Characteristics

7.1. DC Characteristics

Table 131. DC Characteristics

Symbol	Parameter	Min	Typ	Max	Units
DVDDIO, AVDDH, SVDDH	3.3V Supply Voltage	3.135	3.30	3.465	V
DVDDL, AVDDL, SVDDL, PLLVDDL	1.2V Supply Voltage	1.14	1.20	1.26	V
Voh	High Level Output Voltage	2.4	–	–	V
Vol	Low Level Output Voltage	–	–	0.4	V
Vih	High Level Input Voltage	DVDDIO– 0.7	–	–	V
Vil	Low Level Input Voltage	–	–	GND+0.7	V

7.2. AC Characteristics

7.2.1. QSGMII Differential Transmitter Characteristics

Table 132. QSGMII Differential Transmitter Characteristics

Symbol	Parameter	Min	Typ	Max	Units
UI	Unit Interval	–	200	–	ps
T _{X1}	Eye Mask	–	–	0.15	UI
T _{X2}	Eye Mask	–	–	0.4	UI
T _{Y1}	Eye Mask	200	–	–	mV
T _{Y2}	Eye Mask	–	–	450	mV
T _{TX-JITTER}	Output Jitter	–	–	0.30	UI
T _{TX-RISE}	Output Rise Time	30	–	–	ps
T _{TX-FALL}	Output Fall Time	30	–	–	ps
R _{TX}	Differential Resistance	80	100	120	ohm
C _{TX}	AC Coupling Capacitor	75	100	200	nF
IL	Insertion Loss @5GHz	–	–	14	dB

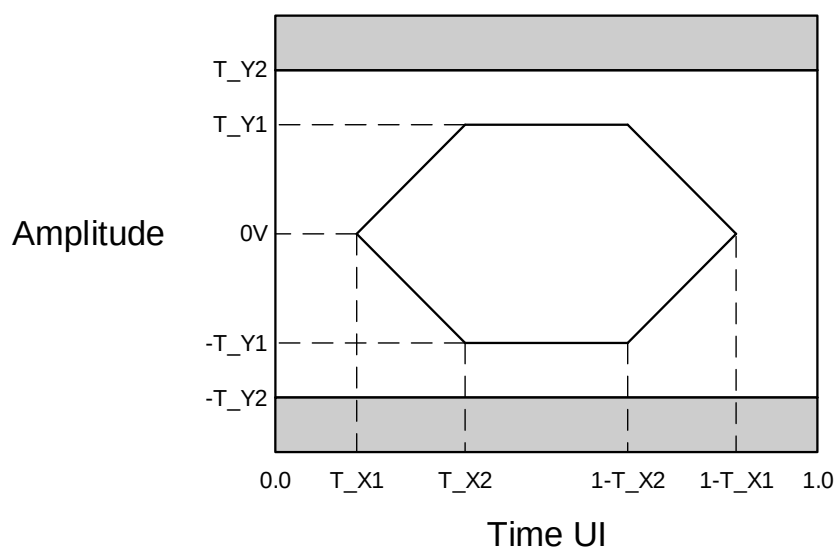


Figure 13. QSGMII Differential Transmitter Eye Diagram

7.2.2. QSGMII Differential Receiver Characteristics

Table 133. QSGMII Differential Receiver Characteristics

Symbol	Parameter	Min	Typ	Max	Units
UI	Unit Interval	–	200	–	ps
R_X1	Eye Mask	–	–	0.3	UI
R_Y1	Eye Mask	50	–	–	mV
R_Y2	Eye Mask	–	–	600	mV
T _{RX-JITTER}	Input Jitter Tolerance	–	–	0.60	UI
R _{RX}	Differential Resistance	80	100	120	ohm

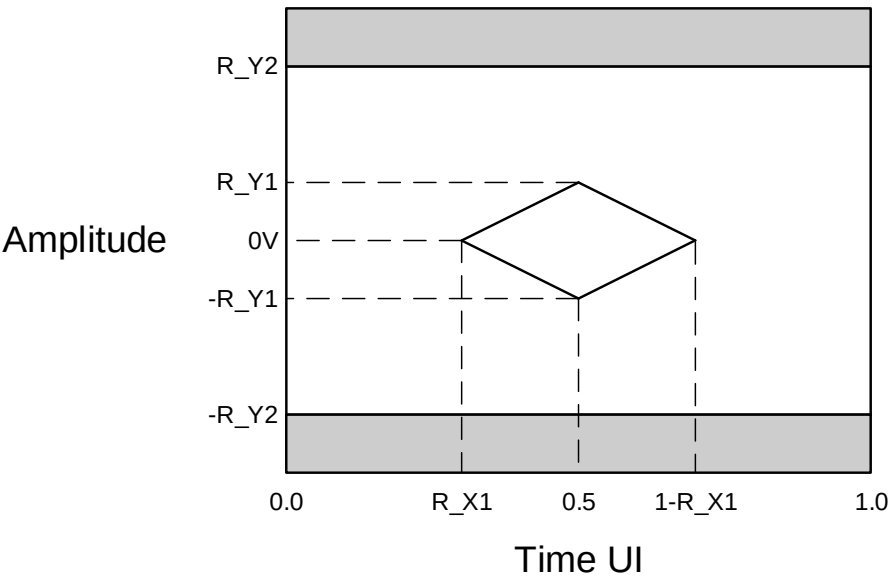


Figure 14. QSGMII Differential Receiver Eye Diagram

7.2.3. SGMII Differential Transmitter Characteristics

Table 134. SGMII Differential Transmitter Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Notes
UI	Unit Interval	799.94	800	800.06	ps	800ps $\pm$ 75ppm
T_X1	Eye Mask	–	–	0.1875	UI	–
T_X2	Eye Mask	–	–	0.4	UI	–
T_Y1	Eye Mask	200	–	–	mV	–
T_Y2	Eye Mask	–	–	450	mV	–
V _{TX-DIFFp-p}	Output Differential Voltage	400	700	900	mV	–
T _{TX-EYE}	Minimum TX Eye Width	0.625	–	–	UI	–
T _{TX-JITTER}	Output Jitter	–	–	0.375	UI	T _{TX-JITTER-MAX} = 1 – T _{TX-EYE-MIN} = 0.375UI
R _{TX}	Differential Resistance	80	100	120	ohm	–
C _{TX}	AC Coupling Capacitor	75	100	200	nF	–
IL	Insertion Loss @1.25GHz	–	–	10	dB	–

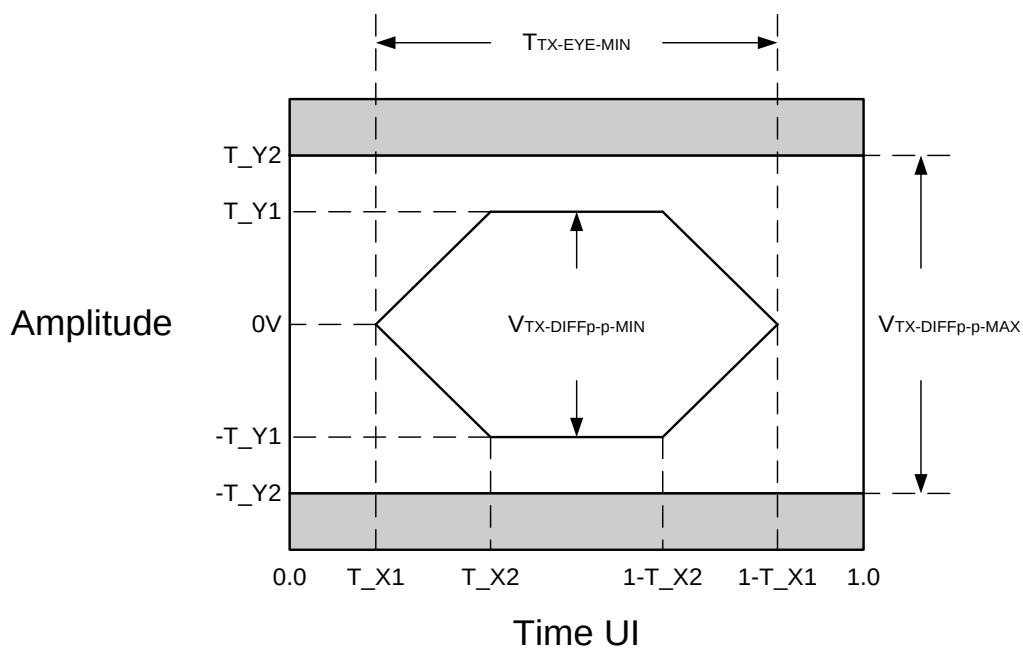


Figure 15. SGMII Differential Transmitter Eye Diagram

7.2.4. SGMII Differential Receiver Characteristics

Table 135. SGMII Differential Receiver Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Notes
UI	Unit Interval	799.94	800	800.06	ps	800ps $\pm$ 75ppm
R_X1	Eye Mask	–	–	0.3125	UI	–
R_Y1	Eye Mask	50	–	–	mV	–
R_Y2	Eye Mask	–	–	1000	mV	–
V _{RX-DIFFp-p}	Input Differential Voltage	100	–	2000	mV	–
T _{RX-EYE}	Minimum RX Eye Width	0.375	–	–	UI	–
T _{RX-JITTER}	Input Jitter Tolerance	–	–	0.625	UI	T _{RX-JITTER-MAX} = 1 – T _{RX-EYE-MIN} = 0.625UI
R _{RX}	Differential Resistance	80	100	120	ohm	–

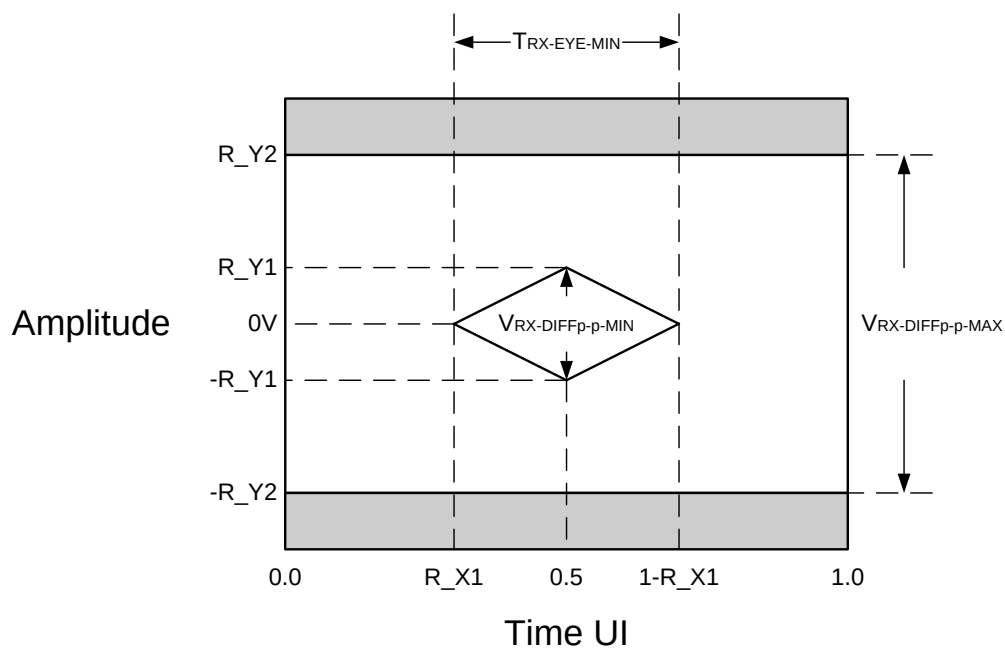


Figure 16. SGMII Differential Receiver Eye Diagram

7.2.5. 1000BASE-X Differential Transmitter Characteristics

Table 136. 1000BASE-X Differential Transmitter Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Notes
UI	Unit Interval	799.94	800	800.06	ps	800ps $\pm$ 75ppm
T_X1	Eye Mask	–	–	0.1875	UI	–
T_X2	Eye Mask	–	–	0.4	UI	–
T_Y1	Eye Mask	200	–	–	mV	–
T_Y2	Eye Mask	–	–	450	mV	–
V _{TX-DIFFp-p}	Output Differential Voltage	400	700	900	mV	–
T _{TX-EYE}	Minimum TX Eye Width	0.625	–	–	UI	–
T _{TX-JITTER}	Output Jitter	–	–	0.375	UI	T _{TX-JITTER-MAX} = 1 – T _{TX-EYE-MIN} = 0.375UI
R _{TX}	Differential Resistance	80	100	120	ohm	–
C _{TX}	AC Coupling Capacitor	75	100	200	nF	–
L _{TX}	Transmit Length in PCB(FR4)	–	–	10	inch	–

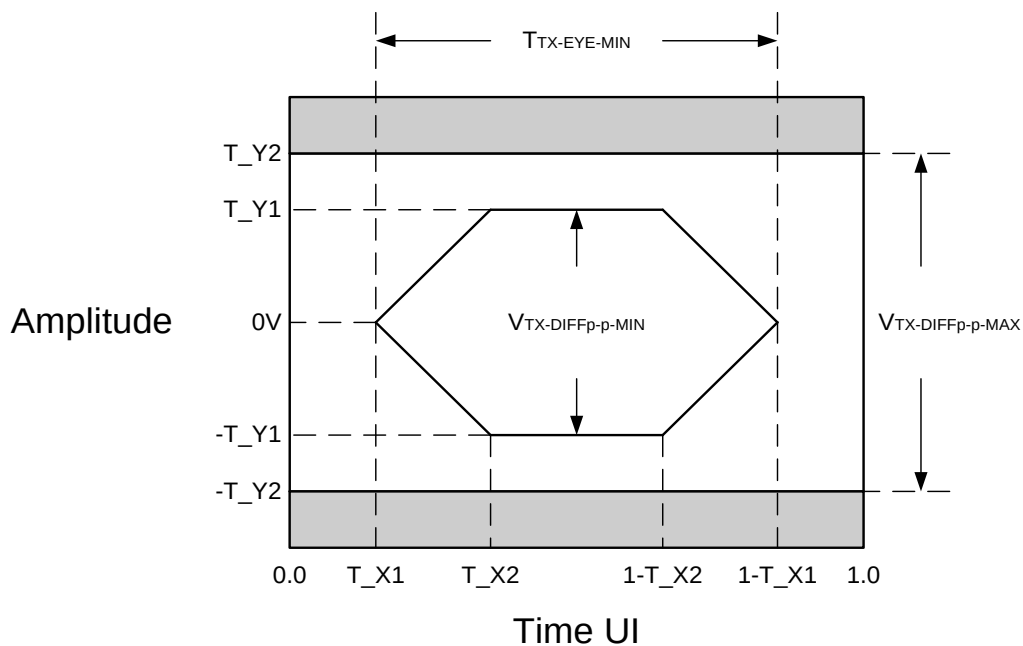


Figure 17. 1000BASE-X Differential Transmitter Eye Diagram

7.2.6. 1000BASE-X Differential Receiver Characteristics

Table 137. 1000BASE-X Differential Receiver Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Notes
UI	Unit Interval	799.94	800	800.06	ps	800ps $\pm$ 75ppm
R_X1	Eye Mask	–	–	0.3125	UI	–
R_Y1	Eye Mask	50	–	–	mV	–
R_Y2	Eye Mask	–	–	1000	mV	–
V _{RX-DIFFp-p}	Input Differential Voltage	100	–	2000	mV	–
T _{RX-EYE}	Minimum RX Eye Width	0.375	–	–	UI	–
T _{RX-JITTER}	Input Jitter Tolerance	–	–	0.625	UI	T _{RX-JITTER-MAX} = 1 – T _{RX-EYE-MIN} = 0.625UI
R _{RX}	Differential Resistance	80	100	120	ohm	–

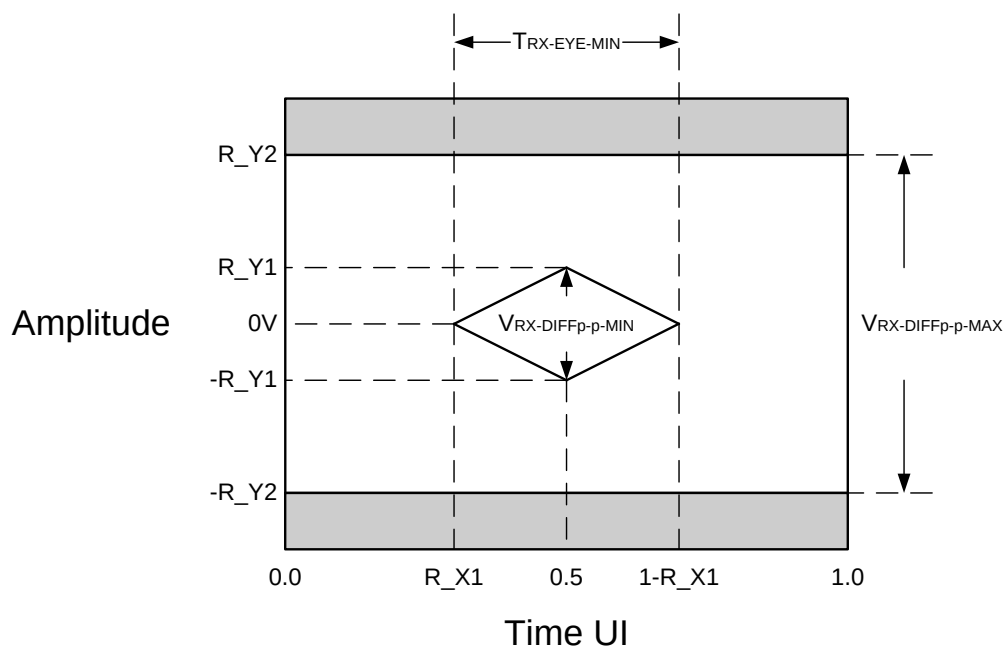


Figure 18. 1000BASE-X Differential Receiver Eye Diagram

7.2.7. SMI (MDC/MDIO) Interface Characteristics

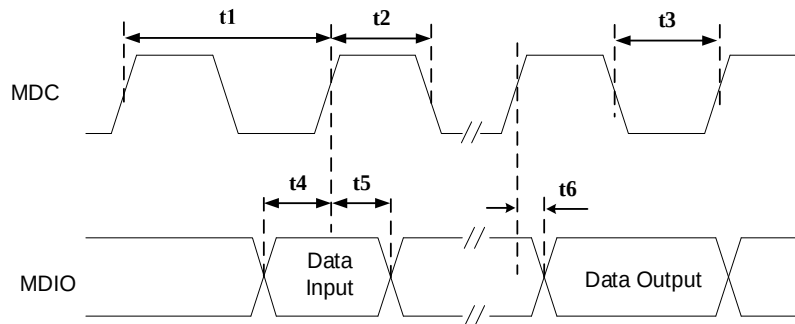


Figure 19. SMI (MDC/MDIO) Timing

Table 138. SMI (MDC/MDIO) Interface Characteristics

Symbol	Description	Min	Typ	Max	Units
t1	MDC Clock Period	80	–	–	ns
t2	MDC High Time	32	–	–	ns
t3	MDC Low Time	32	–	–	ns
t4	MDIO to MDC Rising Setup Time (Data Input)	10	–	–	ns
t5	MDIO to MDC Rising Hold Time (Data Input)	10	–	–	ns
t6	MDIO Valid from MDC rising edge (Data Output)	0	–	20	ns

7.2.8. Serial LED Timing

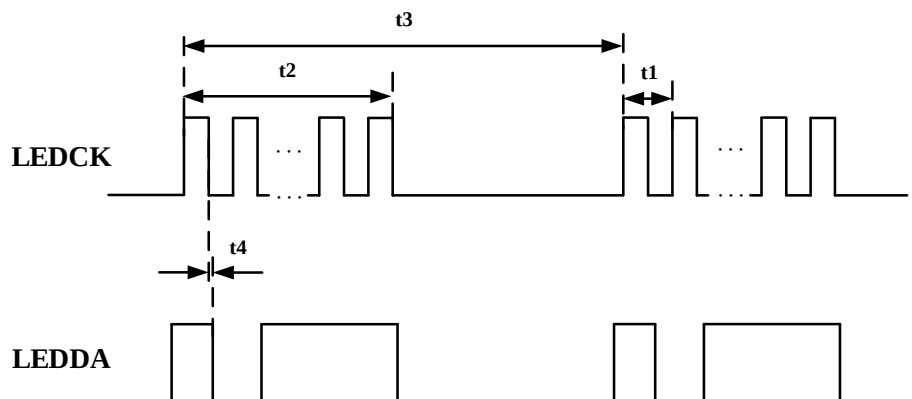


Figure 20. MDC/MDIO Timing Parameters

Table 139. MDC/MDIO Interface Characteristics

Symbol	Description	Min	Typ	Max	Units
t1	Serial LED Clock Cycle Time	–	160	–	ns
t2	Serial LED Clock On/Off Duration	–	5.68	–	us
t3	Serial LED Burst Cycle Time	–	32	–	ms

t4	LEDDA Valid from LEDCK falling edge	0	–	–	ns
----	-------------------------------------	---	---	---	----

7.3. Crystal Requirement

Table 140. Crystal Requirement

Symbol	Description	Min	Typ	Max	Unit
Fref	Parallel Resonant Crystal Reference Frequency	–	25	–	MHz
Fref Tolerance	Parallel Resonant Crystal Reference Frequency Tolerance	–50	–	50	ppm
Fref Duty Cycle	Reference Clock Input Duty Cycle	40	–	60	%
ESR	Equivalent Series Resistance	–	–	50	ohm
DL	Drive Level	–	–	0.5	mW
Vih	Crystal output high level	1.5	–	–	V
Vil	Crystal output low level	–	–	0.4	V

7.4. Oscillator/External Clock Requirement

Table 141. Oscillator/External Clock Requirement

Parameter	Min	Typ	Max	Unit
Frequency	–	25	–	MHz
Frequency tolerance	–50	–	50	PPM
Duty Cycle	40	–	60	%
Vih	1.5	–	–	V
Vil	–	–	0.4	V
Rise Time (10%~90%)	–	–	10	ns
Fall Time (10%~90%)	–	–	10	ns
RMS Jitter (12kHz~20MHz)	–	–	1	ps

8. Power Requirements

8.1. Absolute Maximum Ratings

Table 142. Absolute Maximum Ratings

Description	Symbol	Mini	Max	Unit
3.3 V power supply	DVDDIO, AVDDH, SVDDH	-0.3	3.63	V
1.2 V power supply	DVDDL, AVDDL, SVDDL, PLLVDDL	-0.2	1.32	V
Junction Temperature		-	125	° C
Storage Temperature		-45	125	° C

8.2. Recommended Operating Conditions

Table 143. Recommended Operating Conditions

Description	Pins	Min	Typ	Max	Unit
3.3 V power supply	DVDDIO, AVDDH, SVDDH	3.135	3.30	3.465	V
1.2 V power supply	DVDDL, AVDDL, SVDDL, PLLVDDL	1.14	1.20	1.26	V
Ambient Operation Temperature Ta Commercial		0	-	70	° C
Ambient Operation Temperature Ta Industry		-40	-	85	° C

8.3. Power and Reset Sequence

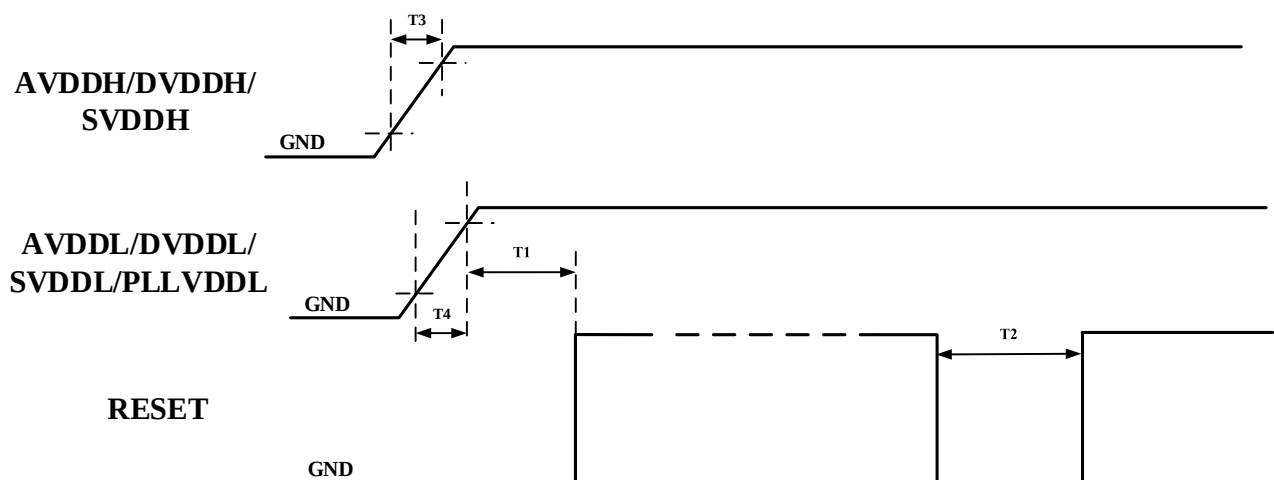


Figure 21. Power and Reset Sequence

Table 144. Power and Reset Sequence

Symbol	Description	Min	Typ	Max	Units
T1	The duration from all powers steady to reset signal release to high.	10	-	-	ms

T2	The duration of reset signal remain low timing.	10	–	–	ms
T3	AVDDH/DVDDH/SVDDH power rising time.	0.5	–	–	ms
T4	AVDDL/DVDDL/SVDDL/PLLVDL power rising time.	0.5	–	–	ms

8.4. Power Ripple

The ripple of AVDDH/DVDDH/SVDDH should be less than 50mV.

The ripple of AVDDL/DVDDL/SVDDL/PLLVDL should be less than 30mV.

8.5. Power Consumption

8.5.1. QSGMII x 1 + Combo x 4

Table 145. QSGMII x 1 + Combo x 4 Power Consumption

Condition	AVDDH (mA)	DVDDH (mA)	SVDDH (mA)	AVDDL (mA)	DVDDL (mA)	SVDDL (mA)	Power Consumption (mW)
Reset	45.3	0.2	2.1	2.1	7.3	9.6	179.88
Power Down	46.4	0.2	2.1	2.8	7	11.5	186.27
Copper Link Up @1000Mbps	296.6	39	29.7	178.2	390.2	60.2	1959.81
Copper Traffic @1000Mbps	296.2	39	29.7	178.2	421.3	60.5	1996.17
Fiber Link Up @1000Mbps	47.8	0.3	35.7	3.5	47.5	154	522.54
Fiber Traffic @1000Mbps	47.8	0.3	35.7	3.5	46.5	154	521.34

Note: Test by TT IC with VDDH = 3.3V and VDDL = 1.2V at room temperature.

8.5.2. QSGMII x 1 + Copper x 4

Table 146. QSGMII x 1 + Copper x 4 Power Consumption

Condition	AVDDH (mA)	DVDDH (mA)	SVDDH (mA)	AVDDL (mA)	DVDDL (mA)	SVDDL (mA)	Power Consumption (mW)
Reset	45.3	0.1	2.1	2.1	7.3	9.6	179.55

Power Down	46.4	0.1	2.1	2.8	7.1	11.5	186.06
Link Up @1000Mbps	296.5	39.1	29.7	178.1	391.5	60.4	1961.49
Traffic @1000Mbps	296.2	39	29.8	178.2	423	60.5	1998.54

Note: Test by TT IC with VDDH = 3.3V and VDDL = 1.2V.

8.5.3. QSGMII x 1 + Fiber x 4

Table 147. QSGMII x 1 + Fiber x 4 Power Consumption

Condition	AVDDH (mA)	DVDDH (mA)	SVDDH (mA)	AVDDL (mA)	DVDDL (mA)	SVDDL (mA)	Power Consumption (mW)
Power Down	46.4	0.3	2.1	2.8	7.1	11.5	186.72
Link Up @1000Mbps	46.5	0.3	35.7	2.8	49.4	153.9	519.57
Traffic @1000Mbps	46.4	0.3	35.7	2.8	48.3	154	518.04

Note: Test by TT IC with VDDH = 3.3V and VDDL = 1.2V at room temperature.

8.5.4. QSGMII x 1 + SGMII x 4

Table 148. QSGMII x 1 + SGMII x 4 Power Consumption

Condition	AVDDH (mA)	DVDDH (mA)	SVDDH (mA)	AVDDL (mA)	DVDDL (mA)	SVDDL (mA)	Power Consumption (mW)
Power Down	46.4	0.3	2.1	2.8	7.1	11.5	186.72
Link Up @1000Mbps	46.5	0.3	35.7	2.8	51.7	154	522.45
Traffic @1000Mbps	46.4	0.3	35.7	2.8	49.7	154	519.72

Note: Test by TT IC with VDDH = 3.3V and VDDL = 1.2V at room temperature.

8.5.5. SGMII x 4 + Copper x 4

Table 149. SGMII x 4 + Copper x 4 Power Consumption

Condition	AVDDH (mA)	DVDDH (mA)	SVDDH (mA)	AVDDL (mA)	DVDDL (mA)	SVDDL (mA)	Power Consumption (mW)

Reset	45.4	0.2	2.1	2.1	7.4	9.6	180.33
Power Down	46.4	0.2	2.1	2.8	7.1	12.6	187.71
Link Up @1000Mbps	296.8	6.1	8.5	178.2	397.3	108.1	1847.94
Traffic @1000Mbps	295.8	6.1	8.5	178.4	455.1	108	1914.12

Note: Test by TT IC with VDDH = 3.3V and VDDL = 1.2V at room temperature.

8.5.6. Copper x 4 + Fiber x 4

Table 150. Copper x 4 + Fiber x 4 Power Consumption

Condition	AVDDH (mA)	DVDDH (mA)	SVDDH (mA)	AVDDL (mA)	DVDDL (mA)	SVDDL (mA)	Power Consumption (mW)
Reset	45.4	0.2	2.1	2.1	7.4	9.6	180.33
Power Down	46.4	0.2	2.1	2.8	7.1	12.6	187.71
Link Up @1000Mbps	296.6	6.1	8.5	178.2	397.7	108.1	1847.76
Traffic @1000Mbps	295.8	6.1	8.5	178.4	455.2	108	1914.24

Note: Test by TT IC with VDDH = 3.3V and VDDL = 1.2V at room temperature.

8.6. Maximum Power Consumption

Table 151. Maximum Power Consumption

Condition	AVDDH (mA)	DVDDH (mA)	SVDDH (mA)	AVDDL (mA)	DVDDL (mA)	SVDDL (mA)	Power Consumption (mW)
Reset	48	0.1	2.2	2.2	7.7	10.2	190.11
Power Down	49.2	35.9	2.2	3	7.5	12.2	315.33
Link Up @1000Mbps	314.3	41.4	31.5	188.8	415	64	2079.12
Traffic @1000Mbps	314	41.3	31.6	188.9	448.4	64.1	2118.45

Note: Test by FF corner IC in QSGMII x 1 + Copper x 4 mode with VDDH = 3.3V and VDDL = 1.2V at high temperature 85°C.

9. Thermal Characteristics

9.1. Thermal Resistance

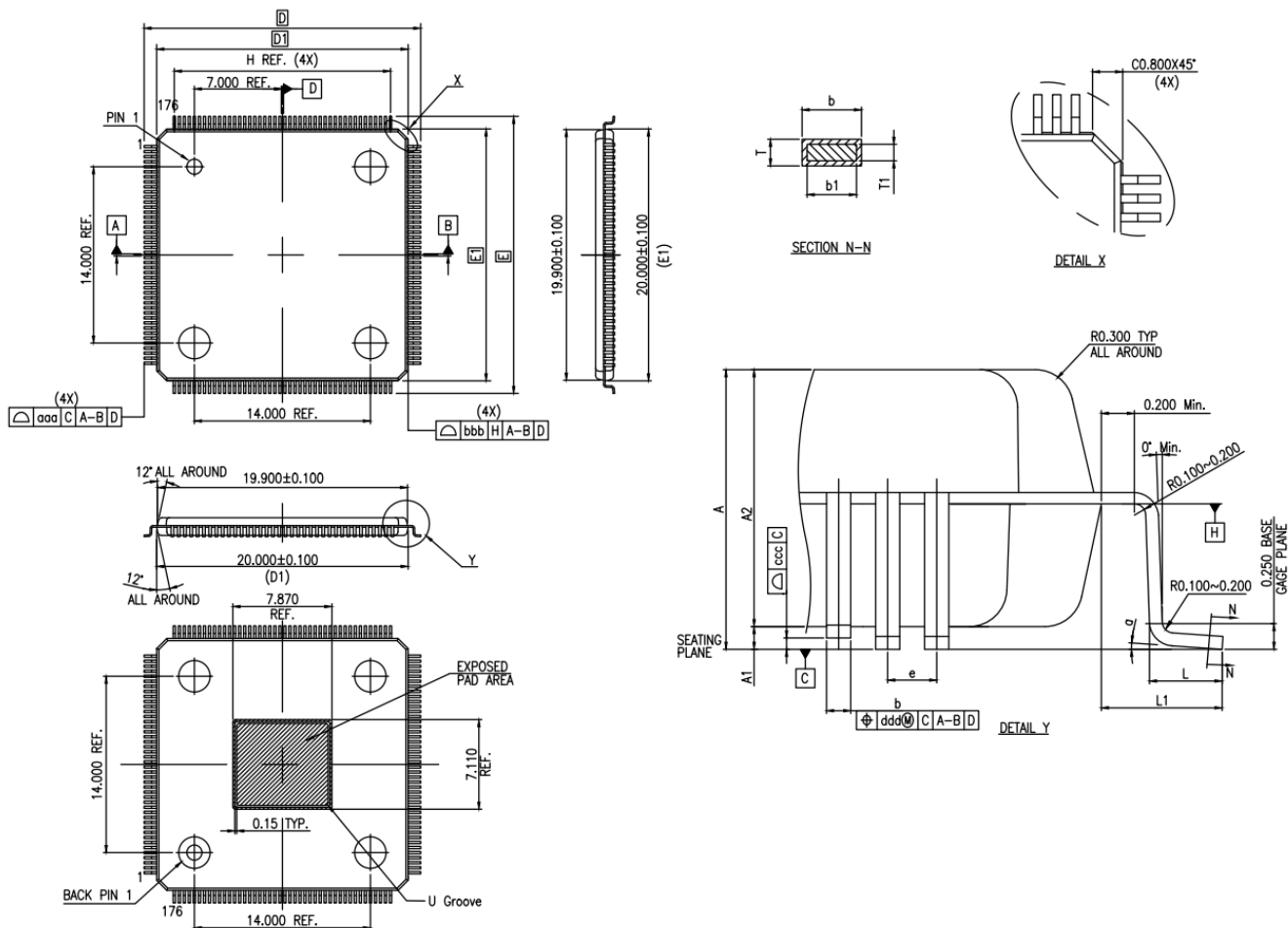
Table 152. Thermal Resistance

Symbol	Parameter	Condition	Typ	Units
θ_{JA}	Thermal resistance – junction to ambient $\theta_{JA} = (T_J - T_A) / P$ P = Total power dissipation	JEDEC 3.0 in. x 4.5 in. 4-layer PCB with no air flow $T_A = 25^\circ \text{C}$	21.2	$^\circ \text{C/W}$
		JEDEC 3.0 in. x 4.5 in. 4-layer PCB with no air flow $T_A = 85^\circ \text{C}$	19.22	$^\circ \text{C/W}$
θ_{JC}	Thermal resistance – junction to case $\theta_{JC} = (T_J - T_C) / P_{top}$ P_{top} = Power dissipation from the top of the package	JEDEC with no air flow	13.49	$^\circ \text{C/W}$
θ_{JB}	Thermal resistance – junction to board $\theta_{JB} = (T_J - T_B) / P_{bottom}$ P_{bottom} = Power dissipation from the bottom of the package to the PCB surface.	JEDEC with no air flow	10.63	$^\circ \text{C/W}$



10. Package Information

10.1. LQFP-176 E-PAD



10.2. Mechanical Dimensions

DIMENSION LIST (FOOTPRINT: 2.00)

S/N	SYM	DIMENSIONS	REMARKS
1	A	MAX. 1.600	OVERALL HEIGHT
2	A1	$0.100^{+0.027}_{-0.050}$	STANDOFF
3	A2	1.400 ± 0.050	PKG THICKNESS
4	D	22.000 ± 0.200	LEAD TIP TO TIP
5	D1	20.000 ± 0.100	PKG LENGTH
6	E	22.000 ± 0.200	LEAD TIP TO TIP
7	E1	20.000 ± 0.100	PKG WIDTH
8	L	0.600 ± 0.150	FOOT LENGTH
9	L1	1.000 REF.	LEAD LENGTH
10	T	$0.150^{+0.050}_{-0.060}$	LEAD THICKNESS
11	T1	0.127 ± 0.030	LEAD BASE METAL THICKNESS
12	a	0°~7°	FOOT ANGLE
13	b	0.180 ± 0.050	LEAD WIDTH
14	b1	0.160 ± 0.030	LEAD BASE METAL WIDTH
15	e	0.400 BASE	LEAD PITCH

11. Ordering Information

Motorcomm offers an RoHS package that is compliant with RoHS.

Part Number	Grade	Package	Pack	Status	Operation Temp
YT8614C	Consumer	LQFP-176 E-PAD	Tray 600ea	Mass Production	0 ~ 70° C
YT8614H	Industrial	LQFP-176 E-PAD	Tray 600ea	Mass Production	-40 ~ 85° C