

100Gb/s QSFP28 ZR4 Transceiver HX4X-CL381C

Features

- Compliant with 100GBASE-ZR4
- Support line rates from 103.125 Gb/s to 112 Gb/s OTU4
- Built-in 4-channel Clock and Data Recovery (CDR) in TX and RX
- LAN WDM EML laser and PIN receiver with SOA
- Up to 80km reach for G.652 SMF
- Hot pluggable 38 pin electrical interface
- QSFP28 MSA compliant
- Duplex LC optical receptacle
- RoHS-10 compliant and lead-free
- Excellent EMI performance
- Single +3.3V power supply
- Maximum power consumption 5.5W
- Case operating temperature
Commercial: 0 ~ 70°C



Applications

- 100GBASE-ZR4 Ethernet Links
- Infiniband QDR and DDR interconnects
- Telecom networking

Part Number Ordering Information

| Part Number | Data Rate (Gb/s) | Wavelength (nm) | Transmission Distance(km) | Temperature (°C) (Operating Case) |
|-------------|------------------|---------------------------------------|---------------------------|-----------------------------------|
| HX4X-CL381C | 103.1/112 | 1295.56, 1300.05, 1304.58, 1309.14 | 80 | 0~70 |

I. Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

| Parameter | Symbol | Min | Max | Unit | Notes |
|--------------------------------------|-----------------|------|-----|------|-------|
| Storage Temperature | T _s | -40 | 85 | °C | |
| Power Supply Voltage | V _{CC} | -0.3 | 4.0 | V | |
| Relative Humidity (non-condensation) | RH | 15 | 85 | % | |
| Damage Threshold | TH _d | 6.5 | | dBm | |

II. Recommended Operating Conditions

| Parameter | Symbol | Min | Typical | Max | Unit | Notes |
|----------------------------|-----------------|-------|----------|-----------------|------|------------|
| Operating Case Temperature | T _{OP} | 0 | | 70 | °C | commercial |
| Power Supply Voltage | V _{CC} | 3.135 | 3.3 | 3.465 | V | |
| Data Rate, each Lane | | | 25.78125 | 28.05 | Gb/s | |
| Control Input Voltage High | | 2 | | V _{cc} | V | |
| Control Input Voltage Low | | 0 | | 0.8 | V | |
| Link Distance (SMF) | D | | | 80 | km | 1 |

Notes:

1. Depending on actual fiber loss/km (link distance specified is for fiber insertion loss of 0.35dB/km)

III. General Description

Walsun'HX4X-CL381C is designed for 80km optical communication applications. This module contains 4-lane optical transmitter, 4-lane optical receiver and module management block including 2 wire serial inter-face. The optical signals are multiplexed to a single-mode fiber through an industry standard LC connector. A block diagram is shown in Figure 1.

ModSelL

The ModSelL is an input pin. When held low by the host, the module responds to 2-wire serial communication commands. The ModSelL allows the use of multiple modules on a single 2-wire interface bus. When the ModSelL is "High", the module shall not respond to or acknowledge any 2-wire interface communication from the host. ModSelL signal input node shall be biased to the "High" state in the module.

In order to avoid conflicts, the host system shall not attempt 2-wire interface communications within the ModSelL de-assert time after any modules are deselected. Similarly, the host shall wait at least for the period of the ModSelL assert time before communicating with the newly selected module. The assertion and de-asserting periods of different modules may overlap as long as the

above timing requirements are met.

Transceiver Block Diagrams

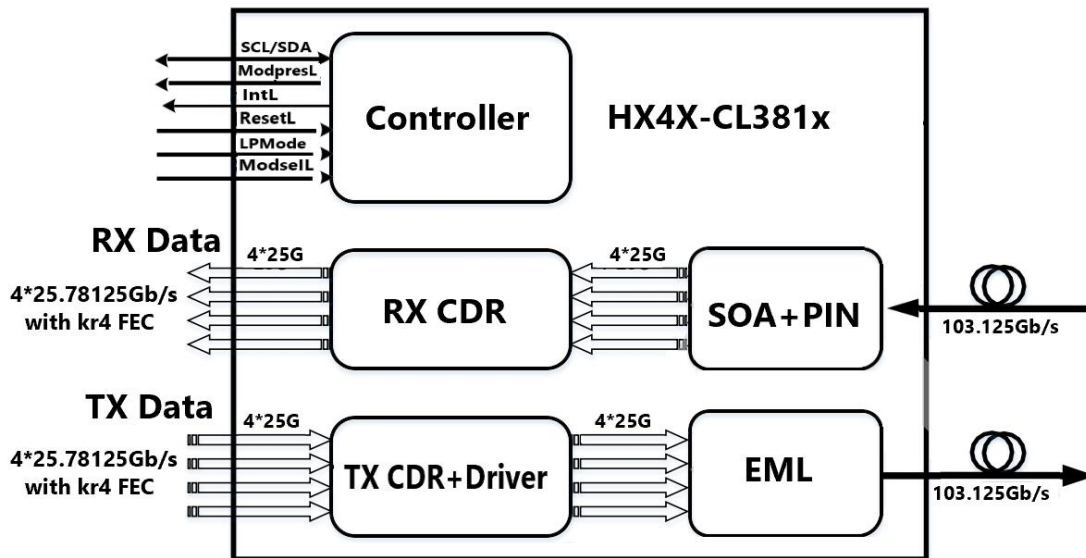


Figure1. Transceiver Block Diagram

ResetL:

The ResetL pin shall be pulled to Vcc in the module. A low level on the ResetL pin for longer than the minimum pulse length (t_{Reset_init}) initiates a complete module reset, returning all user module settings to their default state. Module Reset Assert Time (t_{init}) starts on the rising edge after the low level on the ResetL pin is released. During the execution of a reset (t_{init}) the host shall disregard all status bits until the module indicates a completion of the reset interrupt. The module indicates this by asserting "low" an IntL signal with the Data Not_Ready bit negated. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

LPMODE:

LPMODE: The LPMODE pin shall be pulled up to Vcc in the module. The pin is a hardware control used to put modules into a low power mode when high. By using the LPMODE pin and a combination of the Power override, Power_set and High_Power_Class_Enable software control bits (Address A0h, byte 93 bits 0,1,2).

ModPrsL:

ModPrsL is pulled up to Vcc_Host on the host board and grounded in the module. The ModPrsL is asserted "Low" when inserted and deasserted "High" when the module is physically absent from the host connector.

IntL:

IntL is an output pin. When IntL is "Low", it indicates a possible module operational fault or a

status critical to the host system. The host identifies the source of the interrupt using the 2-wire serial interface. The IntL pin is an open collector output and shall be pulled to host supply voltage on the host board. The INTL pin is deasserted "High" after completion of reset, when byte 2 bit 0 (Data Not Ready) is read with a value of '0' and the flag field is read .

IV. Pin Assignment and Pin Description

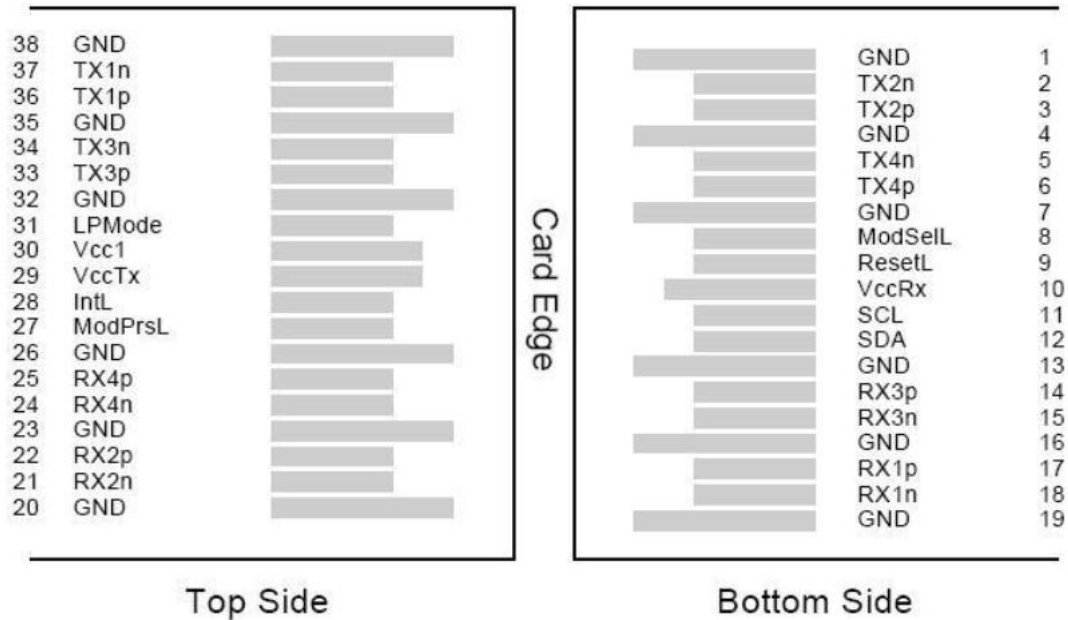


Figure2. Diagram of host board connector block pin numbers and names

| Pin | Symbol | Name/Description | Notes |
|-----|---------|--|-------|
| 1 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |
| 2 | Tx2n | Transmitter Inverted Data Input | |
| 3 | Tx2p | Transmitter Non-Inverted Data output | |
| 4 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |
| 5 | Tx4n | Transmitter Inverted Data Input | |
| 6 | Tx4p | Transmitter Non-Inverted Data output | |
| 7 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |
| 8 | ModSelL | Module Select | |
| 9 | ResetL | Module Reset | |

| | | | |
|----|---------|--|---|
| 10 | VccRx | 3.3V Power Supply Receiver | 2 |
| 11 | SCL | 2-Wire serial Interface Clock | |
| 12 | SDA | 2-Wire serial Interface Data | |
| 13 | GND | Transmitter Ground (Common with Receiver Ground) | |
| 14 | Rx3p | Receiver Non-Inverted Data Output | |
| 15 | Rx3n | Receiver Inverted Data Output | |
| 16 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |
| 17 | Rx1p | Receiver Non-Inverted Data Output | |
| 18 | Rx1n | Receiver Inverted Data Output | |
| 19 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |
| 20 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |
| 21 | Rx2n | Receiver Inverted Data Output | |
| 22 | Rx2p | Receiver Non-Inverted Data Output | |
| 23 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |
| 24 | Rx4n | Receiver Inverted Data Output | 1 |
| 25 | Rx4p | Receiver Non-Inverted Data Output | |
| 26 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |
| 27 | ModPrsl | Module Present | |
| 28 | IntL | Interrupt | |
| 29 | VccTx | 3.3V power supply transmitter | 2 |
| 30 | Vcc1 | 3.3V power supply | 2 |
| 31 | LPMODE | Low Power Mode | |
| 32 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |
| 33 | Tx3p | Transmitter Non-Inverted Data Input | |
| 34 | Tx3n | Transmitter Inverted Data Output | |

| | | | |
|----|------|--|---|
| 35 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |
| 36 | Tx1p | Transmitter Non-Inverted Data Input | |
| 37 | Tx1n | Transmitter Inverted Data Output | |
| 38 | GND | Transmitter Ground (Common with Receiver Ground) | 1 |

Notes:

1. GND is the symbol for signal and supply (power) common for QSFP28 modules. All are common within the QSFP28 module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground plane.
2. VccRx, VccI and VccTx are the receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. Vcc Rx, VccI and Vcc Tx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

V. Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

| Parameter | Symbol | Min. | Typ. | Max | Unit | Notes |
|---|--------|------|------|--|------|------------|
| Power Consumption | p | | | 5.5 | W | |
| Supply Current | Icc | | | 1585 | mA | |
| Transmitter (each Lane) | | | | | | |
| Overload Differential Voltage pk-pk | TP1a | | | 900 | mV | |
| Common Mode Voltage (Vcm) | TP1 | -350 | | 2850 | mV | 1 |
| Differential Termination Resistance Mismatch | TP1 | | | 10 | % | At 1MHz |
| Differential Return Loss (SDD11) | TP1 | | | See CEI-28G -VSR Equatio n 13-19 | dB | |
| Common Mode to Differential conversion and Differential to Common Mode conversion (SDC11, SCD11) | TP1 | | | See CEI-28G -VSR Equation | dB | |

| | | | | | | |
|---|------|--|--|---|----|------------|
| | | | | 13-20 | | |
| Stressed Input Test | TP1a | See CEI-28G -VSR Section 13.3.11. 2.1 | | | | |
| Receiver | | | | | | |
| Differential Voltage, pk-pk | TP4 | | | 900 | mV | |
| Common Mode Voltage (Vcm) | TP4 | -350 | | 2850 | mV | 1 |
| Common Mode Noise, RMS | TP4 | | | 10 | % | At 1MHz |
| Differential Return Loss (SDD22) | TP4 | | | See CEI-28G -VSR Equation 13-19 | dB | |
| Common Mode to Differential conversion and Differential to Common Mode conversion (SDC22, SCD22) | TP4 | | | See CEI-28G -VSR Equation 13-21 | dB | |
| Common Mode Return Loss (SCC22) | TP4 | | | -2 | dB | 2 |
| Transition Time, 20 to 80% | TP4 | 9.5 | | | ps | |
| Vertical Eye Closure (VEC) | TP4 | | | 5.5 | dB | |
| Eye Width at 10-15 probability (EW15) | TP4 | 0.57 | | | UI | |
| Eye Height at 10-15 probability (EH15) | TP4 | 228 | | | mV | |

Notes:

1. Vcm is generated by the host. Specification includes effects of ground offset voltage.
2. From 250MHz to 30GHz.

VI. Optical Characteristics

The following optical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

| Parameter | Symbol | Min. | Typical | Max | Unit | Notes |
|--|----------------------|------------------------------------|----------|---------|-------|-------|
| Transmitter | | | | | | |
| Lane wavelength (range) | L0 | 1294.53 | 1295.56 | 1296.59 | nm | |
| | L1 | 1299.02 | 1300.05 | 1301.09 | nm | |
| | L2 | 1303.54 | 1304.58 | 1305.63 | nm | |
| | L3 | 1308.09 | 1309.14 | 1310.09 | nm | |
| Signaling rate, each lane | | | 25.78125 | 28.05 | GBd | |
| Side-mode suppression ratio | SMSR | 30 | | | | |
| Total launch power | P _T | 8.0 | | 12.5 | dBm | |
| Average launch power, each lane | P _{avg} | 2.0 | | 4.5 | dBm | |
| Extinction Ratio | ER | 6.0 | | | dB | |
| Difference in Launch Power between any Two Lanes (OMA) | P _{tx,diff} | | | 3.6 | dB | |
| Average launch power of OFF transmitter, each lane | P _{off} | | | -30 | dBm | |
| Transmitter reflectance | R _T | | | -12 | dB | |
| RIN _{20OMA} | RIN | | | -130 | dB/Hz | |
| Optical Return Loss Tolerance | TOL | | | 20 | dB | |
| Transmitter eye mask {X1, X2,X3, Y1, Y2, Y3} | | {0.25, 0.4, 0.45, 0.25, 0.28, 0.4} | | | | |
| Receiver | | | | | | |
| Signaling rate, each lane | | | 25.78125 | 28.05 | GBd | |
| Average Receive Power, each Lane | | -30 | | -7 | dBm | |
| Receive Power (OMA), each Lane | | | | -7 | dBm | |

| | | | | | | |
|--|------|-----|--|-----|-----|------------------------------|
| Receiver reflectance | | | | -26 | dB | |
| Receiver sensitivity Average, each lane | SEN1 | | | -23 | dBm | BER = 1x10 ⁻¹² |
| | SEN2 | | | -28 | dBm | BER = 5x10 ⁻⁵ |
| LOS Assert | LOSA | -40 | | | dBm | |
| LOS Deassert | LOSD | | | -29 | dBm | |
| LOS Hysteresis | LOSH | 0.5 | | | dB | |

VII. EEPROM Serial ID Memory Contents

Upper Page 00h

| Add. | Size (Bytes) | Name of Field | Hex | Description |
|-----------|-----------------|------------------------------------|----------|-------------|
| 128 / 80h | 1 | Identifier | 11 | QSFP28 |
| 129 / 81h | 1 | Ext. Identifier | CD | |
| 130 / 82h | 1 | Connector Type | 07 | LC |
| 131 / 83h | 1 | Specification Compliance | 80 | |
| 132 / 84h | 1 | | 00 | |
| 133 / 85h | 1 | | 00 | |
| 134 / 86h | 1 | | 00 | |
| 135 / 87h | 1 | | 00 | |
| 136 / 88h | 1 | | 00 | |
| 137 / 89h | 1 | | 00 | |
| 138 / 8Ah | 1 | | 00 | |
| 139 / 8Bh | 1 | | Encoding | 03 |
| 140 / 8Ch | 1 | BR, nominal | FF | |
| 141 / 8Dh | 1 | Extended Rate Select Compliance | 00 | |
| 142 / 8Eh | 1 | Length (SMF) | 50 | 80km |
| 143 / 8Fh | 1 | Length (OM3 50 um) | 00 | |
| 144 / 90h | 1 | Length (OM2 50 um) | 00 | |

| | | | | |
|-----------|---|--|-----------------|-------------------------|
| 145 / 91h | 1 | Length (OM1 62.5 um) or Copper Cable Attenuation | 00 | |
| 146 / 92h | 1 | Length (passive copper or active cable or OM4 50 um) | 00 | |
| 147 / 93h | 1 | Device technology | 6E | 1310nm EML, Cooled, APD |
| 148 / 94h | 1 | Vendor name | -- | |
| 149 / 95h | 1 | | -- | |
| 150 / 96h | 1 | | -- | |
| 151 / 97h | 1 | | -- | |
| 152 / 98h | 1 | | -- | |
| 153 / 99h | 1 | | -- | |
| 154 / 9Ah | 1 | | -- | |
| 155 / 9Bh | 1 | | -- | |
| 156 / 9Ch | 1 | | -- | |
| 157 / 9Dh | 1 | | -- | |
| 158 / 9Eh | 1 | | -- | |
| 159 / 9Fh | 1 | | -- | |
| 160 / A0h | 1 | | -- | |
| 161 / A1h | 1 | | -- | |
| 162 / A2h | 1 | | -- | |
| 163 / A3h | 1 | | -- | |
| 164 / A4h | 1 | | Extended Module | 00 |
| 165 / A5h | 1 | Vendor OUI | 00 | |
| 166 / A6h | 1 | | 00 | |
| 167 / A7h | 1 | | 00 | |
| 168 / A8h | 1 | Vendor PN | -- | |
| 169 / A9h | 1 | | -- | |
| 170 / AAh | 1 | | -- | |

| | | | | |
|-----------|---|-----------------------------|----|--------------|
| 171 / ABh | 1 | | -- | |
| 172 / ACh | 1 | | -- | |
| 173 / ADh | 1 | | -- | |
| 174 / AEh | 1 | | -- | |
| 175 / AFh | 1 | | -- | |
| 176 / B0h | 1 | | -- | |
| 177 / B1h | 1 | | -- | |
| 178 / B2h | 1 | | -- | |
| 179 / B3h | 1 | | -- | |
| 180 / B4h | 1 | | -- | |
| 181 / B5h | 1 | | -- | |
| 182 / B6h | 1 | | -- | |
| 183 / B7h | 1 | | -- | |
| 184 / B8h | 1 | Vendor rev | 30 | 0 |
| 185 / B9h | 1 | | 31 | 1 |
| 186 / BAh | 1 | Wavelength or Copper | 66 | 1310nm |
| 187 / BBh | 1 | Cable Attenuation | 58 | |
| 188 / BCh | 1 | Wavelength tolerance or | 00 | 1.03nm |
| 189 / BDh | 1 | Copper Cable Attenuation | CE | |
| 190 / BEh | 1 | Max case temp. | 46 | 70C |
| 191 / BFh | 1 | CC_BASE | -- | |
| 192 / C0h | 1 | Link codes | 04 | 100GBASE-ER4 |
| 193 / C1h | 1 | Options | 0F | |
| 194 / C2h | 1 | | FF | |
| 195 / C3h | 1 | | DA | |
| 196 / C4h | 1 | Vendor SN | -- | |
| 197 / C5h | 1 | | -- | |
| 198 / C6h | 1 | | -- | |

| | | | | |
|-----------|---|----------------------------|----|--------|
| 199 / C7h | 1 | | -- | |
| 200 / C8h | 1 | | -- | |
| 201 / C9h | 1 | | -- | |
| 202 / CAh | 1 | | -- | |
| 203 / CBh | 1 | | -- | |
| 204 / CCh | 1 | | -- | |
| 205 / CDh | 1 | | -- | |
| 206 / CEh | 1 | | -- | |
| 207 / CFh | 1 | | -- | |
| 208 / D0h | 1 | | -- | |
| 209 / D1h | 1 | | -- | |
| 210 / D2h | 1 | | -- | |
| 211 / D3h | 1 | | -- | |
| 212 / D4h | 1 | Date Code | -- | |
| 213 / D5h | 1 | | -- | |
| 214 / D6h | 1 | | -- | |
| 215 / D7h | 1 | | -- | |
| 216 / D8h | 1 | | -- | |
| 217 / D9h | 1 | | -- | |
| 218 / DAh | 1 | | -- | |
| 219 / DBh | 1 | | -- | |
| 220 / DCh | 1 | Diagnostic Monitoring Type | 0C | |
| 221 / DDh | 1 | Enhanced Options | 10 | |
| 222 / DEh | 1 | BR, nominal | 68 | 26Gbps |
| 223 / DFh | 1 | CC_EXT | -- | |
| 224 / E0h | 1 | Vendor Specific | 00 | |
| 225 / E1h | 1 | | 00 | |
| 226 / E2h | 1 | | 00 | |

| | | | | |
|-----------|---|--|----|--|
| 227 / E3h | 1 | | 00 | |
| 228 / E4h | 1 | | 00 | |
| 229 / E5h | 1 | | 00 | |
| 230 / E6h | 1 | | 00 | |
| 231 / E7h | 1 | | 00 | |
| 232 / E8h | 1 | | 00 | |
| 233 / E9h | 1 | | 00 | |
| 234 / EAh | 1 | | 00 | |
| 235 / EBh | 1 | | 00 | |
| 236 / ECh | 1 | | 00 | |
| 237 / EDh | 1 | | 00 | |
| 238 / EEh | 1 | | 00 | |
| 239 / EFh | 1 | | 00 | |
| 240 / F0h | 1 | | 00 | |
| 241 / F1h | 1 | | 00 | |
| 242 / F2h | 1 | | 00 | |
| 243 / F3h | 1 | | 00 | |
| 244 / F4h | 1 | | 00 | |
| 245 / F5h | 1 | | 00 | |
| 246 / F6h | 1 | | 00 | |
| 247 / F7h | 1 | | 00 | |
| 248 / F8h | 1 | | 00 | |
| 249 / F9h | 1 | | 00 | |
| 250 / FAh | 1 | | 00 | |
| 251 / FBh | 1 | | 00 | |
| 252 / FCh | 1 | | 00 | |
| 253 / FDh | 1 | | 00 | |
| 254 / FEh | 1 | | 00 | |
| 255 / FFh | 1 | | 00 | |

VIII. TX input equalization / RX output emphasis / RX output amplitude control

PAGE 03H BYTES

| Byte | bit | Name | Description |
|------|-----|--------------------------------|--|
| 234 | 7-4 | TX1 input equalization control | Input equalization control |
| | 3-0 | TX2 input equalization control | Input equalization control |
| 235 | 7-4 | TX3 input equalization control | Input equalization control |
| | 3-0 | TX4 input equalization control | Input equalization control |
| 236 | 7-4 | RX1 output emphasis control | Input emphasis control |
| | 3-0 | RX2 output emphasis control | Input emphasis control |
| 237 | 7-4 | RX3 output emphasis control | Input emphasis control |
| | 3-0 | RX4 output emphasis control | Input emphasis control |
| 238 | 7-4 | RX1 output amplitude control | Differential output amplitude without pre-emphasis |
| | 3-0 | RX2 output amplitude control | Differential output amplitude without pre-emphasis |
| 239 | 7-4 | RX3 output amplitude control | Differential output amplitude without pre-emphasis |
| | 3-0 | RX4 output amplitude control | Differential output amplitude without pre-emphasis |

INPUT EQUALIZATION (PAGE 03H BYTES 234-235)

| Value | Transmitter Input Equalization | |
|-------|--------------------------------|-------|
| | Nominal | Units |
| 11xxb | Reserved | |
| 1011b | Reserved | |
| 1010b | 10 | dB |
| 1001b | 9 | dB |
| 1000b | 8 | dB |
| 0111b | 7 | dB |
| 0110b | 6 | dB |
| 0101b | 5 | dB |
| 0100b | 4 | dB |
| 0011b | 3 | dB |
| 0010b | 2 | dB |
| 0001b | 1 | dB |
| 0000b | 0 | No EQ |

OUTPUT EMPHASIS CONTROL (PAGE 03H BYTES 236-237)

| Value | Receiver Output Emphasis At nominal Output Amplitude | |
|---------------|---|-------------|
| | Nominal | Units |
| 1xxx b | Reserved | |
| 0111 b | 7 | dB |
| 0110 b | 6 | dB |
| 0101 b | 5 | dB |
| 0100 b | 4 | dB |
| 0011 b | 3 | dB |
| 0010 b | 2 | dB |
| 0001 b | 1 | dB |
| 0000 b | 0 | No Emphasis |

OUTPUT DIFFERENTIAL AMPLITUDE CONTROL (PAGE 03H BYTES 238-239)

| Value | Receiver Output Amplitude No Output Equalization | |
|---------------|---|---------|
| | Nominal | Units |
| 1xxx b | Reserved | |
| 0111 b | Reserved | mV(P-P) |
| 0110 b | Reserved | mV(P-P) |
| 0101 b | Reserved | mV(P-P) |
| 0100 b | Reserved | mV(P-P) |
| 0011 b | 600-1200 | mV(P-P) |
| 0010 b | 400-800 | mV(P-P) |
| 0001 b | 300-600 | mV(P-P) |
| 0000 b | 100-400 | mV(P-P) |

IX. Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

| Parameter | Symbol | Min. | Max | Unit | Notes |
|---------------------------------------|----------|------|-----|------|----------------------|
| Temperature monitor absolute error | DMI_Temp | -3 | 3 | °C | Over operating temp |
| Supply voltage monitor absolute error | DMI_VCC | -3 | 3 | % | Full operating range |
| RX power monitor absolute error | DMI_RX | -3 | 3 | dB | |
| Bias current monitor error | DMI_bias | -10 | 10 | % | |
| TX power monitor absolute error | DMI_TX | -3 | 3 | dB | |

X. Mechanical Dimensions

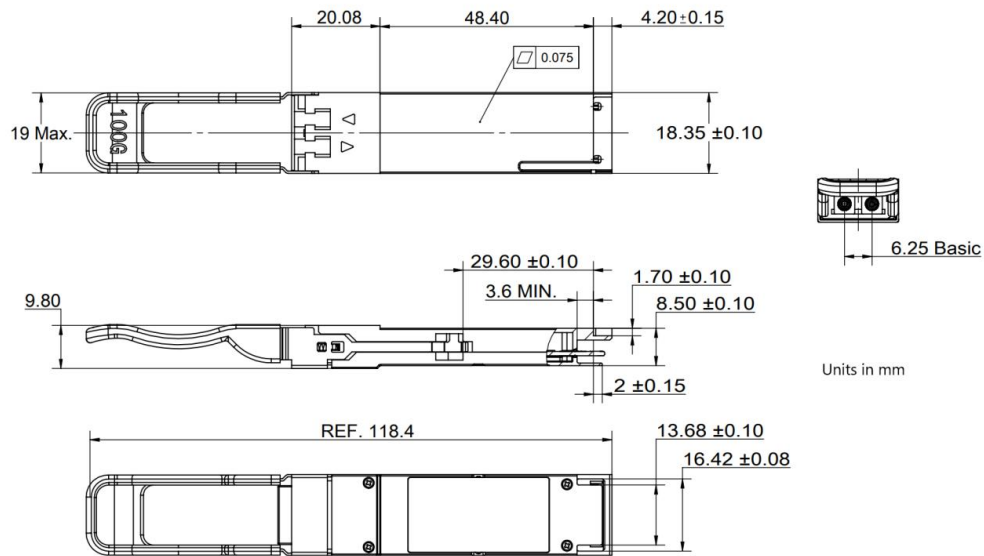


Figure2. Mechanical Outline

XI. Revision History

| Version No. | Initiated | Revised contents | Release Date |
|-------------|------------|-----------------------|--------------|
| V1.0 | Andy Zhang | Preliminary datasheet | 2021-10-20 |
| | | | |

XII. Contact us

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