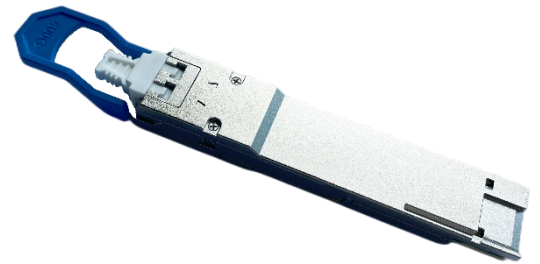


## RQ-400G-LR4

### 400G QSFP-DD LR4 CWDM4 10KM Optical Transceiver

#### Features

- ◆ Compliant with QSFP-DD MSA
- ◆ Compliant with 100G Lambda MSA 400G-LR4 Specification compliant
- ◆ Compliant with CMIS5.0
- ◆ Compliant with IEEE Std 802.3bs
- ◆ 8x53.125Gb/s electrical interface (400GAUI-8)
- ◆ Cooled EML laser with CWDM wavelength
- ◆ Up to 10km transmission on single mode fiber (SMF) with FEC
- ◆ Single +3.3V power supply
- ◆ Case temperature range: 0 ~ +70°C
- ◆ Maximum power consumption 12W
- ◆ Duplex LC connector
- ◆ RoHS complaint



#### Applications

- ◆ 400G BASE-LR4 Ethernet
- ◆ Data Center Interconnect
- ◆ Enterprise Networking

FIBERWDM's 400Gb/s QSFP-DD optical module designed for 10km optical communication applications. The module converts 8 channels of 50Gb/s (PAM4) electrical input data to 4 channels of CWDM optical signals and multiplexes them into a single channel for 400Gb/s optical transmission.

On the receiver side, the module optically de-multiplexes a 400Gb/s optical input into 4 channels of CWDM optical signals and converts them to 8 channels of 50Gb/s (PAM4) electrical output data.

The central wavelengths of the 4 CWDM channels are 1271, 1291, 1311 and 1331 nm as members of the CWDM wavelength grid defined in ITU-T G.694.2.

Host FEC is required to support up to 10km fiber transmission.

### 1. Absolute Maximum Ratings

| Parameter                 | Symbol | Min            | Max | Unit |
|---------------------------|--------|----------------|-----|------|
| Storage Temperature Range | TSTG   | -40            | +85 | °C   |
| Supply Voltage            | VCC    | 0              | 4   | V    |
| Relative Humidity         | RH     | 10% to 90%     |     |      |
|                           |        | non-condensing |     |      |

### 2. Operating Conditions

| Parameter                   | Symbol | Min  | Max                  | Unit |
|-----------------------------|--------|------|----------------------|------|
| Case Temperature- Operating | TCASE  | 0    | 70                   | °C   |
| Supply Voltage              | Vcc    | 3.14 | 3.46                 | V    |
| Power Consumption           | PDISS  |      | 12                   | W    |
| Pre-FEC Bit Error Ratio     |        |      | 2.4x10 <sup>-4</sup> |      |
| Link Distance               | 2      |      | 10,000               | M    |

### 3. Optical Characteristics

| Transmitter Parameter  | Lane   | Min        | Typical | Max    | Units |
|--|--------|------------|---------|--------|-------|
| Lane Wavelength Range  | Lane 0 | 1264.5     | 1271    | 1277.5 | nm    |
|  | Lane 1 | 1284.5     | 1291    | 1297.5 | nm    |
|  | Lane 2 | 1304.5     | 1311    | 1317.5 | nm    |
|  | Lane 3 | 1324.5     | 1331    | 1337.5 | nm    |
| Signal rate per lane   |        |            | 53.125  |        | GBd   |
| Average launch Power per lane  |        | -2.7       |         | 5.1    | dBm   |
| Total Average launch power   |        |            |         | 11.1   | dBm   |
| Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ), each lane    |        |            |         |        |       |
| for TDECQ<1.4 dB   |        | 0.3        |         | 4.4    | dBm   |
| for 1.4dB<=TDECQ<=3.9dB  |        | -1.1+TDECQ |         |        |       |
| Difference in launch power between any two lanes (OMA <sub>outer</sub> ) |        |            |         | 4      | dB    |
| Average Launch Power per Lane @ TX Off State                             |        |            |         | -16    | dBm   |
| Transmitter Eye Closure for PAM4(TECQ), each Lane                        |        |            |         | 3.9    | dB    |
| Transmitter and dispersion Eye Closure for PAM4(TDECQ), each Lane        |        |            |         | 3.9    | dB    |
| TDECQ – TECQ   |        |            |         | 2.5    | dB    |
| Extinction Ratio   |        | 3.5        |         |        | dB    |
| Relative Intensity Noise (OMA)   |        |            |         | -136   | dB/Hz |
| Side-Mode Suppression Ration (SMSR)                                      |        | 30         |         |        | dB    |
| Optical Return Loss Tolerance  |        |            |         | 15.6   | dB    |
| Transmitter Reflectance  |        |            |         | -26    | dB    |
| Transmitter over/under-shoot   |        |            |         | 25     | %     |

|                                |  |  |  |     |     |
|--------------------------------|--|--|--|-----|-----|
| Transmitter peak-to-peak power |  |  |  | 5.2 | dBm |
| Transmitter transition time    |  |  |  | 17  | ps  |

**Receiver Optical Specifications**

| Receiver Parameter  | Lane   | Min    | Typical | Max       | Units |
|---|--------|--------|---------|-----------|-------|
| Lane Wavelength Range                                       | Lane 0 | 1264.5 | 1271    | 1277.5    | nm    |
|   | Lane 1 | 1284.5 | 1291    | 1297.5    | nm    |
|   | Lane 2 | 1304.5 | 1311    | 1317.5    | nm    |
|   | Lane 3 | 1324.5 | 1331    | 1337.5    | nm    |
| Signal rate per lane  |        |        | 53.125  |           | GBd   |
| Damage Threshold  |        | 6.1    |         |           | dBm   |
| Average Receive Power, each lane                            |        | -9     |         | 5.1       | dBm   |
| Receiver Power, each lane (OMA)                             |        |        |         | 4.4       | dBm   |
| Receiver Reflectance  |        |        |         | -26       | dB    |
| Difference in receive Power between any Two Lanes(OMAouter) |        |        |         | 4.3       | dBm   |
| Receiver Sensitivity each lane (OMAouter)                   |        |        |         |           |       |
| for TECQ<1.4dB  |        |        |         | -6.8      | dBm   |
| for 1.4dB<=TECQ<=3.9dB                                      |        |        |         | -8.2+TECQ |       |
| Stressed Receiver Sensitivity (OMAouter), each              |        |        |         | -4.3      | dBm   |
| Stressed Conditions for Stress Receiver Sensitivity         |        |        |         |           |       |
| Stressed Eye Closure for PAM4 (SECQ),Lane under Test        |        |        | 3.9     |           | dB    |
| OMAouter of each Aggressor Lane                             |        |        | -0.4    |           | dBm   |

**4. Electrical Characteristics**

| Parameter  | Min                   | Typical | Max  | Unit | Notes |
|--|-----------------------|---------|------|------|-------|
| <b>Receiver electrical output characteristics at TP4</b> |                       |         |      |      |       |
| Signaling rate per lane                                  |                       | 26.5625 |      | GBd  |       |
| AC common-mode output voltage(RMS)                       |                       | -       | 17.5 | mV   |       |
| Differential peak-to-peak output voltage                 |                       |         | 900  | mV   |       |
| Near-end ESMW (Eye symmetry mask width)                  |                       | 0.265   |      | UI   |       |
| Near-end Eye height, differential                        | 70                    |         |      | mV   |       |
| Near-end vertical eye closure                            |                       |         | 7.5  | dB   |       |
| Far-end ESMW (Eye symmetry mask width)                   |                       | 0.20    |      | UI   |       |
| Far-end Eye height, differential                         | 30                    |         |      | mV   |       |
| Far-end vertical eye closure                             |                       |         | 7.5  | dB   |       |
| Far-end pre-cursor ISI ratio                             | -4.5                  |         | 2.5  | %    |       |
| Common mode to differential conversion return loss       | 802.3 Equation(83E-3) |         |      | dB   |       |
| Differential output return loss                          | 802.3 Equation(83E-2) |         |      | dB   |       |
| Differential termination mismatch                        |                       |         | 10   | %    |       |
| Transition time (min, 20% to 80%)                        |                       | 9.5     |      | ps   |       |
| DC common mode voltage                                   | -350                  |         | 2850 | mV   |       |

| Transmitter electrical input characteristics at TP1 |                       |         |      |     |
|---|-----------------------|---------|------|-----|
| Signaling rate, per lane                            |                       | 26.5625 |      | GBd |
| Differential peak-to-peak input voltage tolerance   | 900                   |         |      | mV  |
| Differential input return loss                      | 802.3 Equation(83E-5) |         |      |     |
| Differential to common mode input return loss       | 802.3 Equation(83E-6) |         |      | mV  |
| AC common-mode output voltage(RMS)                  |                       |         | 17.5 | mV  |
| Single-ended voltage tolerance range                | -0.4                  |         | 3.3  | V   |
| Module stressed input                               | 802.3 120E.3.4.1      |         |      | UI  |
| Differential termination mismatch                   |                       |         | 10   | %   |
| DC common mode voltage                              | -350                  |         |      | mV  |

### 5. Receiver Output Power Thresholds for Loss of Signal(LOS)

| Parameter                | Min   | Typical | Max   | Unit |
|--------------------------|-------|---------|-------|------|
| RX_LOS_Assert Min/Max    | -20.0 |         |       | dBm  |
| RX_LOS_De-Assert Min/Max |       |         | -12.2 | dBm  |
| RX_LOS_Hysteresis        | 0.5   |         |       | dB   |

### 6. Digital Diagnostic Monitoring Specifications

|  |    |       |
|--|----|-------|
| Temperature Monitor absolute error         | °C | ± 3   |
| Supply Voltage Monitor absolute error      | %  | ± 5   |
| I_bias Monitor absolute error              | %  | ± 10  |
| Received Power (Rx) Monitor absolute error | dB | ± 3.0 |
| Transmit Power (Tx) Monitor absolute error | dB | ± 3.0 |

### 7. QSFP-DD Edge Connector and Pinout Description

The electrical pinout of the QSFP-DD module is shown in Figure 1 below.

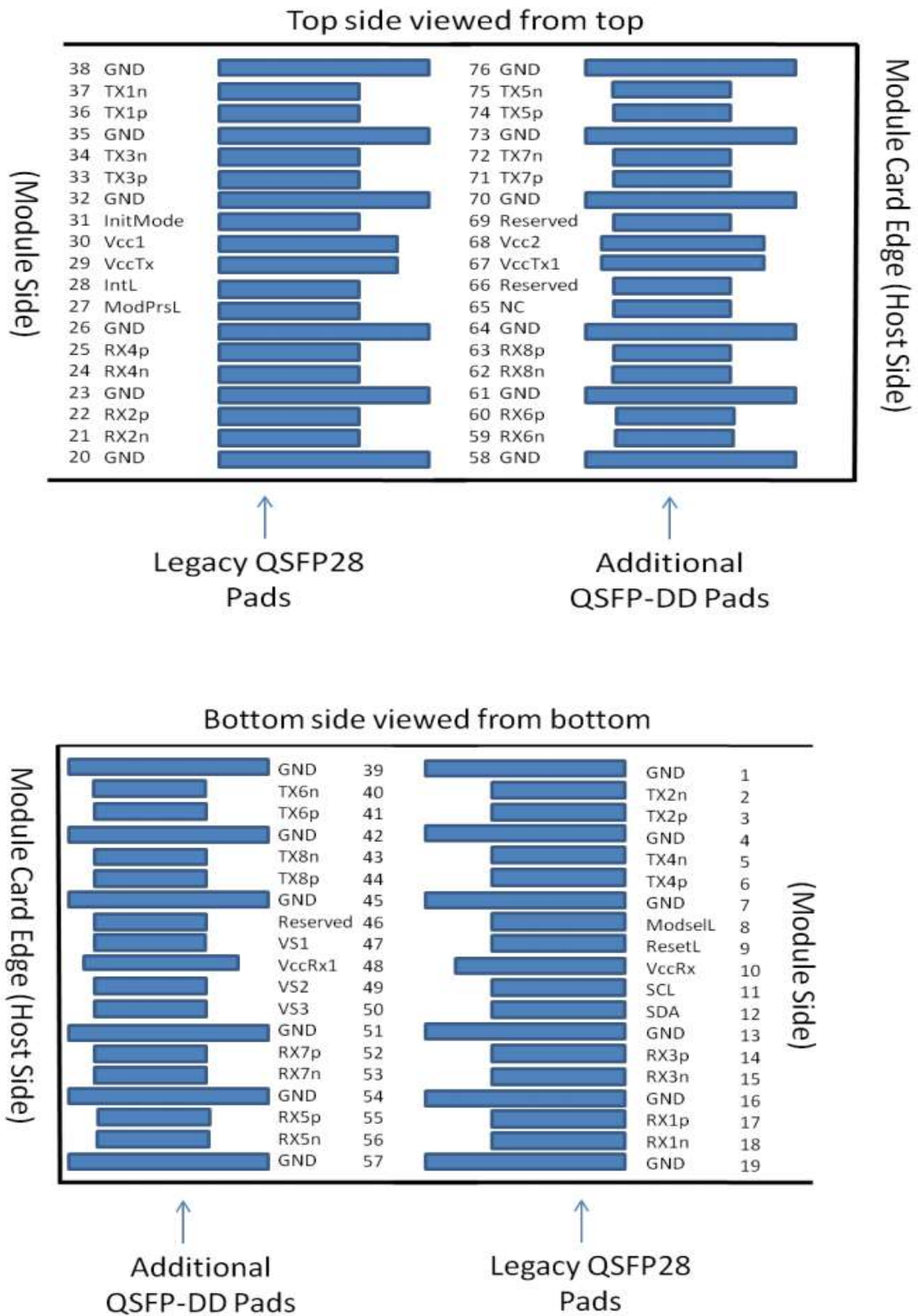


Figure 1. QSFP-DD pad assignment top view

| Pin No. | Symbol    | Description                          | Note |
|---------|-----------|--------------------------------------|------|
| 1       | GND       | Ground                               | 1    |
| 2       | Tx2n      | Transmitter Inverted Data Input      |      |
| 3       | Tx2p      | Transmitter Non-Inverted Data output |      |
| 4       | GND       | Ground                               | 1    |
| 5       | Tx4n      | Transmitter Inverted Data Input      |      |
| 6       | Tx4p      | Transmitter Non-Inverted Data output |      |
| 7       | GND       | 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       | Ground                               | 1    |
| 14      | Rx3p      | Receiver Non-Inverted Data Output    |      |
| 15      | Rx3n      | Receiver Inverted Data Output        |      |
| 16      | GND       | Ground                               | 1    |
| 17      | Rx1p      | Receiver Non-Inverted Data Output    |      |
| 18      | Rx1n      | Receiver Inverted Data Output        |      |
| 19      | GND       | Ground                               | 1    |
| 20      | GND       | Ground                               | 1    |
| 21      | Rx2n      | Receiver Inverted Data Output        |      |
| 22      | Rx2p      | Receiver Non-Inverted Data Output    |      |
| 23      | GND       | Ground                               | 1    |
| 24      | Rx4n      | Receiver Inverted Data Output        |      |
| 25      | Rx4p      | Receiver Non-Inverted Data Output    |      |
| 26      | GND       | 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      | Init Mode | Initialization mode                  |      |
| 32      | GND       | Ground                               | 1    |
| 33      | Tx3p      | Transmitter Non-Inverted Data Input  |      |
| 34      | Tx3n      | Transmitter Inverted Data Output     |      |
| 35      | GND       | Ground                               | 1    |
| 36      | Tx1p      | Transmitter Non-Inverted Data Input  |      |
| 37      | Tx1n      | Transmitter Inverted Data Output     |      |
| 38      | GND       | Ground                               | 1    |

|    |          |                                      |   |
|----|----------|--------------------------------------|---|
| 39 | GND      | Ground                               | 1 |
| 40 | Tx6n     | Transmitter Inverted Data Input      |   |
| 41 | Tx6p     | Transmitter Non-Inverted Data output |   |
| 42 | GND      | Ground                               | 1 |
| 43 | Tx8n     | Transmitter Inverted Data Input      |   |
| 44 | Tx8p     | Transmitter Non-Inverted Data output |   |
| 45 | GND      | Ground                               | 1 |
| 46 | Reserved | For Future Use                       | 3 |
| 47 | VS1      | Module Vendor Specific 1             | 3 |
| 48 | VccRx1   | 3.3V Power Supply                    | 2 |
| 49 | VS2      | Module Vendor Specific 2             | 3 |
| 50 | VS3      | Module Vendor Specific 3             | 3 |
| 51 | GND      | Ground                               | 1 |
| 52 | Rx7p     | Receiver Non-Inverted Data Output    |   |
| 53 | Rx7n     | Receiver Inverted Data Output        |   |
| 54 | GND      | Ground                               | 1 |
| 55 | Rx5p     | Receiver Non-Inverted Data Output    |   |
| 56 | Rx5n     | Receiver Inverted Data Output        |   |
| 57 | GND      | Ground                               | 1 |
| 58 | GND      | Ground                               | 1 |
| 59 | Rx6n     | Receiver Inverted Data Output        |   |
| 60 | Rx6p     | Receiver Non-Inverted Data Output    |   |
| 61 | GND      | Ground                               | 1 |
| 62 | Rx8n     | Receiver Inverted Data Output        |   |
| 63 | Rx8p     | Receiver Non-Inverted Data Output    |   |
| 64 | GND      | Ground                               | 1 |
| 65 | NC       | No Connect                           | 3 |
| 66 | Reserved | For Future Use                       | 3 |
| 67 | VccTx1   | 3.3V power supply                    | 2 |
| 68 | Vcc2     | 3.3V power supply                    | 2 |
| 69 | Reserved | For Future Use                       | 3 |
| 70 | GND      | Ground                               | 1 |
| 71 | Tx7p     | Transmitter Non-Inverted Data Input  |   |
| 72 | Tx7n     | Transmitter Inverted Data Output     |   |
| 73 | GND      | Ground                               | 1 |
| 74 | Tx5p     | Transmitter Non-Inverted Data Input  |   |
| 75 | Tx5n     | Transmitter Inverted Data Output     |   |
| 76 | GND      | Ground                               | 1 |

8. Module Block Diagram

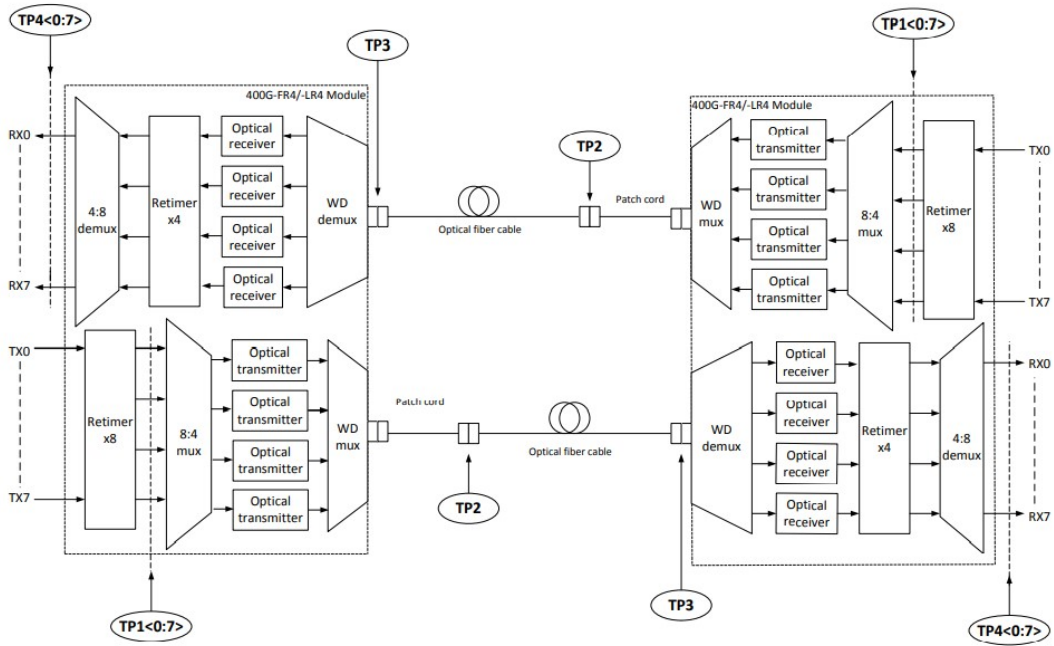
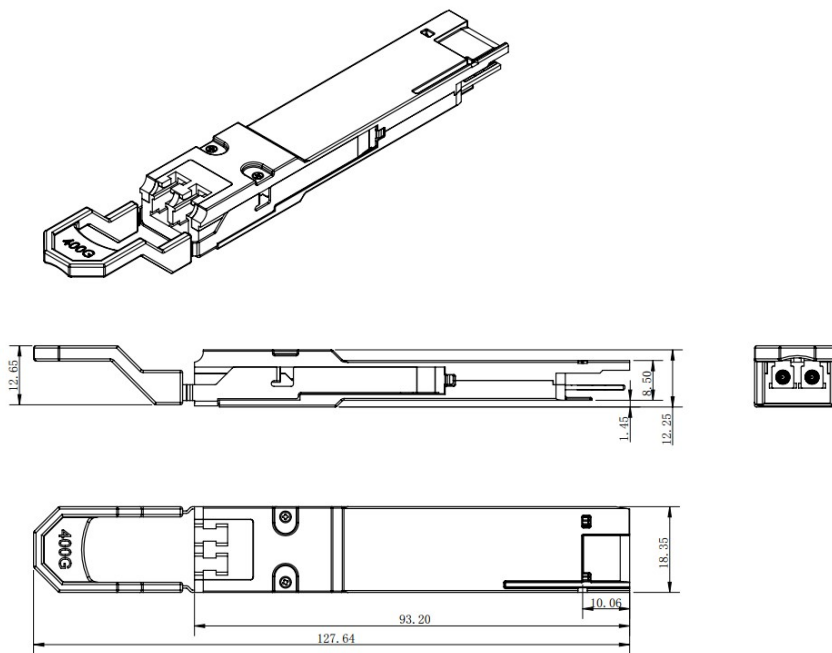


Figure 2. Module Block Diagram

9. Memory map

Compatible with CMIS 5.0

10. Mechanical Specifications





**11. Ordering information**

| Part Number | Description                                     |
|-------------|---|
| RQ-400G-LR4 | 400G QSFP-DD LR4 CWDM4 10KM Optical Transceiver |