

## QFP-BPxxHG-20DC

### 100Gb/s QSFP28 BIDI LR1 20km DDM Transceiver

#### Features

- Lane signaling rate 106.25Gb/s with PAM4
- Up to 20km transmission on SMF
- EML Laser and PIN receiver
- 4x25.78Gb/s with NRZ electrical interface (CAUI-4)
- Support KP4 FEC inside the module
- High speed I/O electrical interface
- I2C interface with integrated Digital Diagnostic monitoring
- QSFP28 MSA package with simplex LC connector
- Single +3.3V power supply
- Power consumption <4W
- Compliant to SFF-8636&SFF-8679 standard
- Compliant to 100G Lambda MSA 100G-LR1 Optical Specifications
- Complies with EU Directive 2015/863/EU
- Operating case temperature: 0 to +70 °C

#### Applications

- Data Center
- 100GBASE-LR BIDI

#### Absolute Maximum Ratings

| Parameter                   | Symbol          | Min. | Typical | Max. | Unit | Notes |
|-----------------------------|-----------------|------|---------|------|------|-------|
| Storage Temperature         | T <sub>s</sub>  | -40  |         | +85  | °C   |       |
| Supply Voltage              | V <sub>cc</sub> | -0.5 |         | +4.0 | V    |       |
| Operating Relative Humidity | RH              |      |         | +85  | %    |       |

## Recommended Operating Conditions

| Parameter                  | Symbol          | Min. | Typical | Max. | Unit | Notes    |
|----------------------------|-----------------|------|---------|------|------|----------|
| Operating Case Temperature | T <sub>C</sub>  | 0    |         | +70  | °C   |          |
| Power Supply Voltage       | V <sub>CC</sub> | 3.13 | 3.3     | 3.47 | V    |          |
| Transmission Distance      | TD              |      |         | 20   | km   | Over SMF |

## Optical and Characteristics

| Parameter  | Symbol               | Min.      | Typical | Max.              | Unit  | Notes          |
|--|----------------------|-----------|---------|-------------------|-------|----------------|
| <b>Transmitter</b>   |                      |           |         |                   |       |                |
| Center Wavelength  | CW                   | 1284.5    | 1291    | 1297.5            | nm    |                |
|  |                      | 1304.5    | 1311    | 1317.5            | nm    |                |
| Signaling Rate   | SR                   |           |         | 53.125            | GBd   |                |
| Frequency Offset   | Foffset              | -100      |         | 100               | ppm   |                |
| Average Launch Power   | PTX                  | -0.2      |         | 6.6               | dBm   | 1              |
| Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) (min) for TDECQ < 1.4 dB for 1.4 dB ≤ TDECQ ≤ TDECQ (max) | OMA <sub>outer</sub> | 2.8       |         |                   | dBm   | TDECQ < 1.4 dB |
|  |                      | 1.4+TDECQ |         |                   | dBm   | TDECQ > 1.4 dB |
| Transmitter and dispersion eye closure for PAM4 (TDECQ) (max)  | TDECQ                |           |         | 3.6               | dBm   |                |
| Average Output Power (Laser Turn off)  | P <sub>off</sub>     |           |         | -30               | dBm   |                |
| Side Mode Suppression Ratio  | SMSR                 | 30        |         |                   | dB    |                |
| Extinction Ratio   | ER                   | 3.5       |         |                   | dB    |                |
| RIN_OMA  | RIN                  |           |         | -136              | dB/Hz |                |
| Transmitter reflectance  | T <sub>ref</sub>     |           |         | -26               | dB    |                |
| Optical Return Loss Tolerance  | ORLT                 |           |         | 15.6              | dB    |                |
| <b>Receiver</b>  |                      |           |         |                   |       |                |
| Center Wavelength  | CW                   | 1284.5    | 1291    | 1297.5            | nm    |                |
|  |                      | 1304.5    | 1311    | 1317.5            | nm    |                |
| Damage threshold   | P <sub>damage</sub>  | 7.6       |         |                   | dBm   | 2              |
| Average Rx Power   | PR <sub>x</sub>      | -10       |         | 6.6               | dBm   | 3              |
| Receive power _OMA <sub>outer</sub>  | POMA                 |           |         | 6.8               | dBm   |                |
| Receiver sensitivity _OMA <sub>outer</sub> for TDECQ < 1.4 dB  | SEN<br>_OMA          |           |         | -7.6<br>-9 + TECQ | dBm   | 4              |

|  |       |     |  |      |     |   |
|--|-------|-----|--|------|-----|---|
| for $1.4 \text{ dB} \leq \text{TDECQ} \leq 3.4 \text{ dB}$ |       |     |  |      |     |   |
| Reflectance  | Ref   |     |  | -26  | dB  |   |
| Los Assert   | LosA  | -26 |  |      | dBm |   |
| Los De-Assert  | LosDA |     |  | -10  | dBm |   |
| Los Hysteresis   | LosH  | 0.5 |  |      | dB  |   |
| Stressed receiver sensitivity<br>_OMAouter                 | SRS   |     |  | -5.4 | dBm | 5 |
| Conditions of stressed receiver sensitivity teste :        |       |     |  |      |     |   |
| Stressed eye closure for PAM4<br>(SECQ)                    |       |     |  | 3.6  | dB  |   |

**Notes:**

1. The optical power is launched into SMF.
2. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level. The receiver does not have to operate correctly at this input power.
3. Average receive power, each lane (min) is informative and not the principal indicator of signal strength.
4. Measured with conformance test signal at TP3 using the test pattern PRBS31Q or scrambled idle for stressed receiver sensitivity for the BER=  $2.4 \times 10^{-4}$ .
5. Measured with conformance test signal at TP3 (see3.11) for the BER specified in IEEE Std 802.3cu

## Electrical Characteristics

| Parameter                               | Symbol              | Min. | Typical | Max.                 | Unit | Notes |
|---|---------------------|------|---------|----------------------|------|-------|
| <b>Transmitter (Module Input)</b>       |                     |      |         |                      |      |       |
| Input Differential Impedance            | Rin                 |      | 100     |                      | Ohm  |       |
| Differential Data Input Amplitude       | V <sub>IN,P-P</sub> |      |         | 900                  | mVpp |       |
| Differential termination mismatch (max) | D-mismatch          |      |         | 10                   | %    |       |
| DC common-mode input voltage            |                     | -0.3 |         | 2.8                  | V    |       |
| Transition time(20%~80%)                | Tr Tf               | 10   |         |                      | ps   |       |
| LPMode, Reset and ModSelL / Tx dis      | V <sub>IL</sub>     | -0.3 |         | 0.8                  | V    |       |
| LPMode, Reset and ModSelL / Tx          | V <sub>IH</sub>     | 2.0  |         | V <sub>CC</sub> +0.3 | V    |       |

| dis                                     |                               |                      |     |                      |      |  |
|---|-------------------------------|----------------------|-----|----------------------|------|--|
| Receiver (Module Output)                |                               |                      |     |                      |      |  |
| Output Differential Impedance           | R <sub>out</sub>              |                      | 100 |                      | Ohm  |  |
| Differential Data Output Amplitude      | V <sub>OUTP-P</sub>           |                      |     | 900                  | mVpp |  |
| Differential termination mismatch (max) | D-mismatch                    |                      |     | 10                   | %    |  |
| Transition time, 20% to 80%             | T <sub>r</sub> T <sub>f</sub> | 12                   |     |                      | ps   |  |
| ModPrsL and IntL/ Rx los                | V <sub>OL</sub>               | 0                    |     | 0.4                  | V    |  |
| ModPrsL and IntL/ Rx los                | V <sub>OH</sub>               | V <sub>CC</sub> -0.5 |     | V <sub>CC</sub> +0.3 | V    |  |

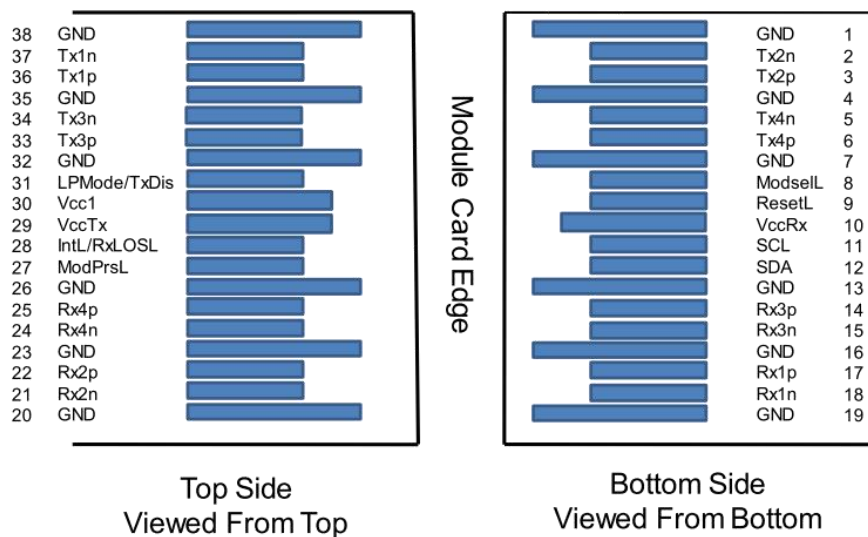
## Digital Diagnostics

| Parameter       | Range                | Accuracy | Unit | Calibration |
|-----------------|----------------------|----------|------|-------------|
| Temperature     | 0 to 70              | ±3       | °C   | Internal    |
| Voltage         | 0 to V <sub>CC</sub> | ±3%      | V    | Internal    |
| Tx Bias Current | 0 to 100             | ±10%     | mA   | Internal    |
| Tx Output Power | -0.2 to 6.8          | ±3       | dB   | Internal    |
| Rx Input Power  | -10 to 6.6           | ±3       | dB   | Internal    |

## Communication Interface Timing Characteristics

| Parameter           | Symbol            | Min | Max | Unit | Calibration  | Notes            |
|---------------------|-------------------|-----|-----|------|--|------------------|
| Initialization time | t <sub>init</sub> |     | 10  | s    | Time from power on or hot plug until the module is fully functional. This time applies to Power Class 2 or higher modules when LPMode is pulled low by the host, and to all Power Class 1 modules. | Room Temperature |

## Pin Diagram



## Pin Definitions

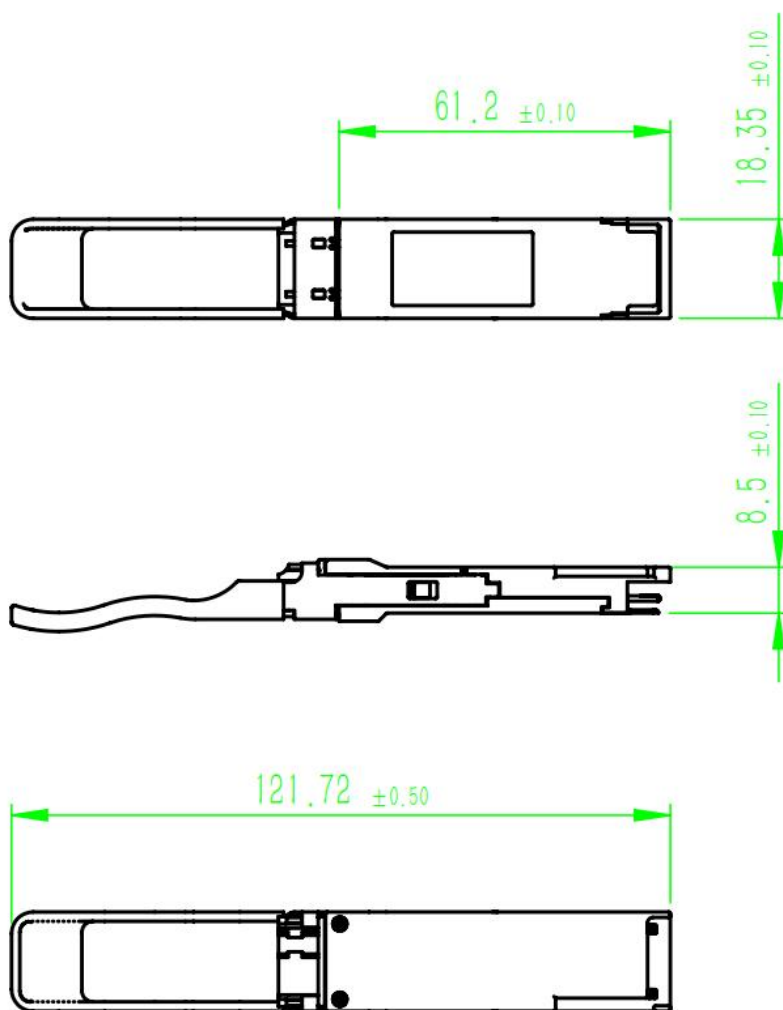
| PIN | Logic       | Symbol  | Description                          | Plug Seq. | Notes |
|-----|-------------|---------|--------------------------------------|-----------|-------|
| 1   |             | GND     | Ground                               | 1         | 1     |
| 2   | CML-I       | Tx2n    | Transmitter Inverted Data Input      | 3         |       |
| 3   | CML-I       | Tx2p    | Transmitter Non-Inverted Data output | 3         |       |
| 4   |             | GND     | Ground                               | 1         | 1     |
| 5   | CML-I       | Tx4n    | Transmitter Inverted Data Input      | 3         |       |
| 6   | CML-I       | Tx4p    | Transmitter Non-Inverted Data output | 3         |       |
| 7   |             | GND     | Ground                               | 1         | 1     |
| 8   | LVTLL-I     | ModSelL | Module Select                        | 3         |       |
| 9   | LVTLL-I     | ResetL  | Module Reset                         | 3         |       |
| 10  |             | VccRx   | + 3.3V Power Supply Receiver         | 2         | 2     |
| 11  | LVC MOS-I/O | SCL     | 2-Wire Serial Interface Clock        | 3         |       |
| 12  | LVC MOS-I/O | SDA     | 2-Wire Serial Interface Data         | 3         |       |
| 13  |             | GND     | Ground                               | 1         |       |
| 14  | CML-O       | Rx3p    | Receiver Non-Inverted Data Output    | 3         |       |
| 15  | CML-O       | Rx3n    | Receiver Inverted Data Output        | 3         |       |
| 16  |             | GND     | Ground                               | 1         | 1     |
| 17  | CML-O       | Rx1p    | Receiver Non-Inverted Data Output    | 3         |       |
| 18  | CML-O       | Rx1n    | Receiver Inverted Data Output        | 3         |       |

|    |         |              |                                     |   |   |
|----|---------|--------------|-------------------------------------|---|---|
| 19 |         | GND          | Ground                              | 1 | 1 |
| 20 |         | GND          | Ground                              | 1 | 1 |
| 21 | CML-O   | Rx2n         | Receiver Inverted Data Output       | 3 |   |
| 22 | CML-O   | Rx2p         | Receiver Non-Inverted Data Output   | 3 |   |
| 23 |         | GND          | Ground                              | 1 | 1 |
| 24 | CML-O   | Rx4n         | Receiver Inverted Data Output       | 3 | 1 |
| 25 | CML-O   | Rx4p         | Receiver Non-Inverted Data Output   | 3 |   |
| 26 |         | GND          | Ground                              | 1 | 1 |
| 27 | LVTTL-O | ModPrsL      | Module Present                      | 3 |   |
| 28 | LVTTL-O | IntL/Rx_LOS  | Interrupt/Rx_LOS                    | 3 | 3 |
| 29 |         | VccTx        | +3.3 V Power Supply transmitter     | 2 | 2 |
| 30 |         | Vcc1         | +3.3 V Power Supply                 | 2 | 2 |
| 31 | LVTTL-I | LPMODE/TxDIS | Low Power Mode/Tx_Disable           | 3 | 3 |
| 32 |         | GND          | Ground                              | 1 | 1 |
| 33 | CML-I   | Tx3p         | Transmitter Non-Inverted Data Input | 3 |   |
| 34 | CML-I   | Tx3n         | Transmitter Inverted Data Output    | 3 |   |
| 35 |         | GND          | Ground                              | 1 | 1 |
| 36 | CML-I   | Tx1p         | Transmitter Non-Inverted Data Input | 3 |   |
| 37 | CML-I   | Tx1n         | Transmitter Inverted Data Output    | 3 |   |
| 38 |         | GND          | Ground                              | 1 | 1 |

**Notes:**

1. GND is the symbol for signal and supply (power) common for the QSFP28 module. 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. Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently. Requirements defined for the host side of the Host Edge Card Connector are listed in MSA. The connector pins are each rated for a maximum current of 1000 mA.
3. Two Multi-Purpose Pin for supporting Tx\_DIS and Rx\_LOS function in the 100G QSFP28 LR1 BIDI module.

## Mechanical Diagram



## Ordering information

| Part Number     | Product Description   |
|-----------------|---|
| QFP-BP23HG-20DC | 1291T/1311R, 106.25Gbps, LC, 20km, 0°C~+70°C, Latch Color: Purple |
| QFP-BP32HG-20DC | 1311T/1291R, 106.25Gbps, LC, 20km, 0°C~+70°C, Latch Color: Red    |

## For More Information

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