

# 50GBASE-ER BiDi QSFP28 Optical Transceiver, Hot Pluggable Single LC +3.3V (KWHG40-2930/3029)

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## Features

- Compliant with QSFP28 Standard and 50GBASE-ER: SFF-8665 Revision 1.9, SFF-8636 Revision 2.9
- Compliant with IEEE802.3 50GAUI-2 C2M electrical interface
- Bi-directional application
- Single 3.3V Supply Voltage
- Maximum power consumption 4.5W
- 0-70 °C Case Operating Temperature
- EML laser and APD Receiver
- QSFP28 MSA package with single LC connector
- Two Wire Serial Interface with Digital Diagnostic Monitoring
- Complies with EU Directive 2011/65/EU (RoHS compliant)
- Class 1 Laser

## Absolute Maximum Ratings

**Table 1 – 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 | -       | 3.6  | V    |       |
| Relative Humidity<br>(non-condensing) | RH              | 5    | -       | 85   | %    |       |

## Recommended Operating Conditions

**Table 2 – Recommended Operating Conditions**

| Parameter                                    | Symbol              | Min.  | Typical | Max.   | Unit | Notes   |
|--|---------------------|-------|---------|--------|------|---------|
| Operating Case Temperature                   | T <sub>OPR</sub>    | 0     | -       | 70     | °C   |         |
| Power Supply Voltage                         | V <sub>CC</sub>     | 3.135 | 3.3     | 3.465  | V    |         |
| Steady state current                         | I <sub>supply</sub> | -     | -       | 1298.7 | mA   |         |
| Instantaneous peak current at hot plug       | I <sub>CC_IP</sub>  | -     | -       | 1800   | mA   | Per pin |
| Sustained peak current at hot plug           | I <sub>CC_SP</sub>  | -     | -       | 1485   | mA   | Per pin |
| Maximum Power Dissipation                    | P <sub>D</sub>      | -     | -       | 4.5    | W    |         |
| Maximum Power Dissipation,<br>Low Power Mode | P <sub>DLP</sub>    | -     | -       | 1.5    | W    |         |

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|  |     |   |           |       |         |  |
|--|-----|---|-----------|-------|---------|--|
| Data Rate  | DRL | - | 26.5625   | -     | GBaud/s |  |
|  |     | - | 26.5625x2 | -     | Gbit/s  |  |
| Two Wire Serial Interface Clock Rate                                     | -   | - | -         | 400   | kHz     |  |
| Power Noise and Ripple noise tolerance<br>10 Hz to 10 MHz (peak-to-peak) | -   | - | -         | 66    | mVpp    |  |
| Rx Differential Data Output Load   | -   | - | 100       | -     | ohms    |  |
| Operating Distance   | -   | 2 | -         | 40000 | m       |  |

## Optical and Electrical Characteristics

**Table 3 – Transmitter Optical Specifications**

| Parameter  | Symbol         | Min.    | Typical | Max.    | Unit | Notes |
|--|----------------|---------|---------|---------|------|-------|
| Wavelength   | $\lambda_A$    | 1294.53 | 1295    | 1296.59 | nm   | 1     |
|  | $\lambda_B$    | 1308.09 | 1309    | 1310.19 | nm   | 2     |
| Side-mode suppression ratio                                | SMSR           | 30      |         |         | dB   |       |
| Average launch power                                       | $P_{OUT}$      | 0.4     | -       | 6.63    | dBm  |       |
| Average launch power of OFF transmitter                    | $P_{OUT\_OFF}$ | -       | -       | -15     | dBm  |       |
| Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) | $P_{OUTL}$     | 3.4     | -       | 7.4     | dBm  |       |
| Extinction ratio   | ER             | 6       | -       | -       | dB   |       |
| Launch power in OMA <sub>outer</sub> minus TDECQ           | OMA-TDECQ      | 2       | -       | -       | dBm  |       |
| Transmitter and dispersion eye closure for PAM4 (TDECQ)    | TDECQ          | -       | -       | 3.2     | dB   | 3     |
| Transmitter reflectance                                    |                | -       | -       | -26     | dB   |       |

Note:

1. For K W HG40-2930;
2. For KWHG40-3029;
3. Measured with a PRBS2<sup>15</sup>-1 test pattern @53.125Gbps.

**Table 4 – Receiver Optical Specifications**

| Parameter                                    | Symbol       | Min.    | Typical | Max.                          | Unit | Notes |
|--|--------------|---------|---------|-------------------------------|------|-------|
| Wavelength                                   | $\lambda_A$  | 1308.09 | 1309    | 1310.19                       | nm   | 1     |
|  | $\lambda_B$  | 1294.53 | 1295    | 1296.59                       | nm   | 2     |
| Receiver sensitivity (OMA <sub>outer</sub> ) |              |         |         | max(-15.1,<br>SECQ –<br>16.5) | dBm  | 3     |
| Damage Threshold                             | $P_{damage}$ | -2.37   | -       | -                             | dBm  |       |
| Overload                                     |              | -3.37   | -       | -                             | dBm  |       |
| Average Receive Power                        | -            | -17.6   | -       | -3.37                         | dBm  |       |

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|                                       |      |     |   |      |     |  |
|---------------------------------------|------|-----|---|------|-----|--|
| Receive power (OMA <sub>outer</sub> ) | OMA  | -   | - | -2.6 | dBm |  |
| Receiver Reflectance                  | RXR  | -   | - | -26  | dB  |  |
| LOS assert                            | LOSA | -30 |   |      | dBm |  |
| LOS de-assert                         | LOSD |     |   | -20  | dBm |  |
| LOS hysteresis                        | LOSH | 0.5 |   |      | dB  |  |

Note:

1. For K W HG40-2930;
2. For KWHG40-3029;
3. Measured with a PRBS<sup>231</sup>-1 test pattern @53.125Gbps, BER ≤ 2.4E-4. IEEE 802.3cd clause 139 equation 139-2.

**Table 5 – Electrical Specifications**

**High-Speed Signal:** Compliant to 50GAUI-2 C2M (IEEE 802.3cd)

**Low-Speed Signal:** Compliant to SFF-8679

| Transmitter (Module Input)         |                      |                      |         |                      |      |                       |
|------------------------------------|----------------------|----------------------|---------|----------------------|------|-----------------------|
| Parameter                          | Symbol               | Min.                 | Typical | Max.                 | Unit | Notes                 |
| Differential Data Input Amplitude  | V <sub>IN,P-P</sub>  | -                    | -       | 900                  | mVpp | Note 1                |
| Differential Termination Mismatch  |                      | -                    | -       | 10                   | %    |                       |
| LPMode, Reset and ModSelL          | V <sub>IL</sub>      | -0.3                 | -       | 0.8                  | V    |                       |
|                                    | V <sub>IH</sub>      | 2                    | -       | V <sub>CC</sub> +0.3 | V    |                       |
| Receiver (Module Output)           |                      |                      |         |                      |      |                       |
| Differential Data Output Amplitude | V <sub>OUT,P-P</sub> | -                    | -       | 900                  | mVpp | Note 1                |
| Differential Termination Mismatch  |                      | -                    | -       | 10                   | %    |                       |
| Output Rise/Fall Time, 20%~80%     | T <sub>R</sub>       | 12                   | -       | -                    | ps   |                       |
| ModPrsL and IntL                   | V <sub>OL</sub>      | 0                    | -       | 0.4                  | V    | I <sub>OL</sub> =4mA  |
|                                    | V <sub>OH</sub>      | V <sub>CC</sub> -0.5 | -       | V <sub>CC</sub> +0.3 | V    | I <sub>OL</sub> =-4mA |

Note 1: Amplitude customization beyond these specs is dependent on validation in customer system.

**Table 6 – 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 | 0.4 to 6.63          | ±3       | dB   | Internal    |
| Rx Power        | -17.6 to -3.37       | ±3       | dB   | Internal    |

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**Table 7 – Control and status timing requirement**

| Item                                       | symbol       | Min | Max | Unit | Notes |
|--|--------------|-----|-----|------|-------|
| Initialization time                        | t_init       |     | 10  | s    | 1     |
| Reset Init Assert Time                     | t_reset_init | 10  |     | us   |       |
| Serial Bus Hardware Ready Time             | t_serial     |     | 2   | s    |       |
| Monitor Data Ready Time                    | t_data       |     | 2   | s    |       |
| Reset Assert Time                          | t_reset      |     | 10  | s    | 1     |
| LPMode Assert Time                         | ton_LPMode   |     | 100 | ms   |       |
| LPMode De-assert Time                      | toff_LPMode  |     | 10  | s    | 1     |
| IntL Assert Time                           | ton_IntL     |     | 200 | ms   |       |
| IntL Deassert Time                         | toff_IntL    |     | 500 | us   |       |
| Rx LOS Assert Time                         | ton_los      |     | 100 | ms   |       |
| Flag Assert Time                           | ton_flag     |     | 200 | ms   |       |
| Mask Assert Time                           | ton_mask     |     | 100 | ms   |       |
| Mask Deassert Time                         | toff_mask    |     | 100 | ms   |       |
| Power_over-ride or Power-set Assert Time   | ton_Pdown    |     | 100 | ms   |       |
| Power_over-ride or Power-set Deassert Time | toff_Pdown   |     | 10  | s    | 1     |

Note 1: Timing not compliant with SFF-8679 V1.8.

**Table 8 – Squelch and disable timing**

| Item                            | symbol     | Min | Max | Unit | Notes |
|---------------------------------|------------|-----|-----|------|-------|
| Rx Squelch Assert Time          | ton_Rxsq   |     | 15  | ms   |       |
| Rx Squelch Deassert Time        | toff_Rxsq  |     | 350 | ms   | 1     |
| Tx Squelch Assert Time          | ton_Txsq   |     | 400 | ms   |       |
| Tx Squelch Deassert Time        | toff_Txsq  |     | 400 | ms   |       |
| Tx Disable Assert Time          | ton_txdis  |     | 100 | ms   |       |
| TX_Disable Deassert Time        | toff_txdis |     | 400 | ms   |       |
| Rx Output Disable Assert Time   | ton_rxdis  |     | 100 | ms   |       |
| Rx Output Disable Deassert Time | toff_rxdis |     | 350 | ms   | 1     |
| Squelch Disable Assert Time     | ton_sqdis  |     | 100 | ms   |       |
| Squelch Disable Deassert Time   | toff_sqdis |     | 100 | ms   |       |

Note 1: Timing not compliant with SFF-8679 V1.8.

**Table 9 – Pin Definitions**

| Pin | Logic | Symbol | Description                         | Plug Sequence | Notes |
|-----|-------|--------|-------------------------------------|---------------|-------|
| 1   |       | GND    | Ground                              | 1             | 1     |
| 2   | CML-I | Tx2n   | Transmitter Inverted Data Input     | 3             |       |
| 3   | CML-I | Tx2p   | Transmitter Non-Inverted Data Input | 3             |       |
| 4   |       | GND    | Ground                              | 1             | 1     |

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|    |             |               |                                     |   |   |
|----|-------------|---------------|-------------------------------------|---|---|
| 5  | CML-I       | Tx4n          | Transmitter Inverted Data Input     | 3 | 3 |
| 6  | CML-I       | Tx4p          | Transmitter Non-Inverted Data Input | 3 | 3 |
| 7  |             | GND           | Ground                              | 1 | 1 |
| 8  | LVTTL-I     | ModselL       | Module Select                       | 3 |   |
| 9  | LVTTL-I     | ResetL        | Module Reset                        | 3 |   |
| 10 |             | Vcc Rx        | +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 | 1 |
| 14 | CML-O       | Rx3p          | Receiver Non-Inverted Data Output   | 3 | 3 |
| 15 | CML-O       | Rx3n          | Receiver Inverted Data Output       | 3 | 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 | 3 |
| 25 | CML-O       | Rx4p          | Receiver Non-Inverted Data Output   | 3 | 3 |
| 26 |             | GND           | Ground                              | 1 | 1 |
| 27 | LVTTL-O     | ModPrsL       | Module Present                      | 3 |   |
| 28 | LVTTL-O     | IntL/Rx LOS   | Interrupt/Rx LOS                    | 3 | 4 |
| 29 |             | Vcc Tx        | +3.3V Power supply transmitter      | 2 | 2 |
| 30 |             | Vcc1          | +3.3V Power supply                  | 2 | 2 |
| 31 | LVTTL-I     | LPMMode/TxDis | Low Power Mode/Tx disable           | 3 | 4 |
| 32 |             | GND           | Ground                              | 1 | 1 |
| 33 | CML-I       | Tx3p          | Transmitter Non-Inverted Data Input | 3 | 3 |
| 34 | CML-I       | Tx3n          | Transmitter Inverted Data Input     | 3 | 3 |
| 35 |             | GND           | Ground                              | 1 | 1 |
| 36 | CML-I       | Tx1p          | Transmitter Non-Inverted Data Input | 3 |   |
| 37 | CML-I       | Tx1n          | Transmitter Inverted Data Input     | 3 |   |
| 38 |             | GND           | Ground                              | 1 | 1 |

Note 1: GND is the symbol for signal and supply (power) common for the QSFP+ module. All are common within the QSFP+ module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.

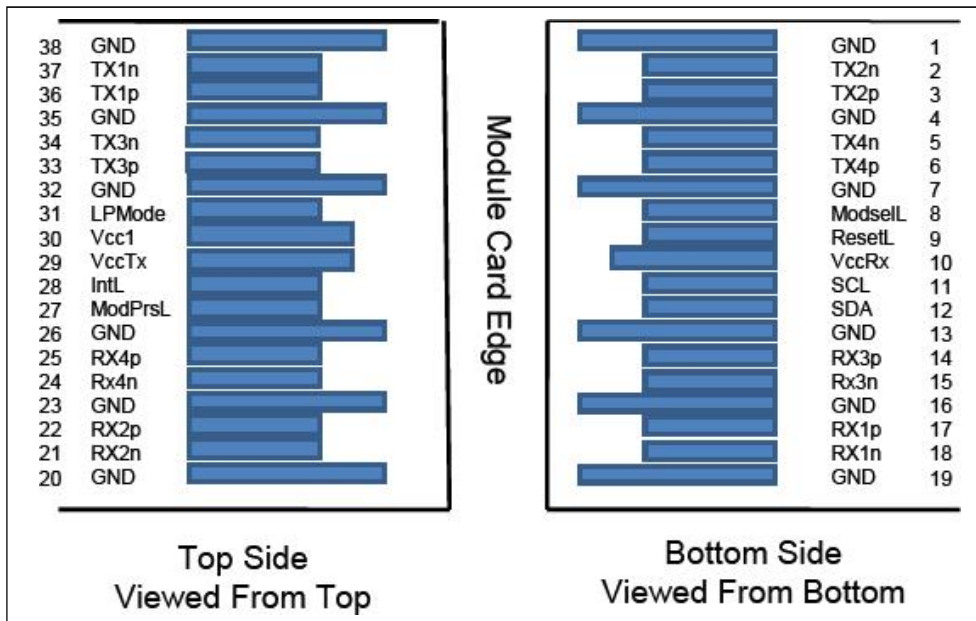
Note 2: Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently.

Note 3: Not used.

Note 4: Dual function pin as specified into SFF-8679.

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## QSFP28 Module Pad Layout

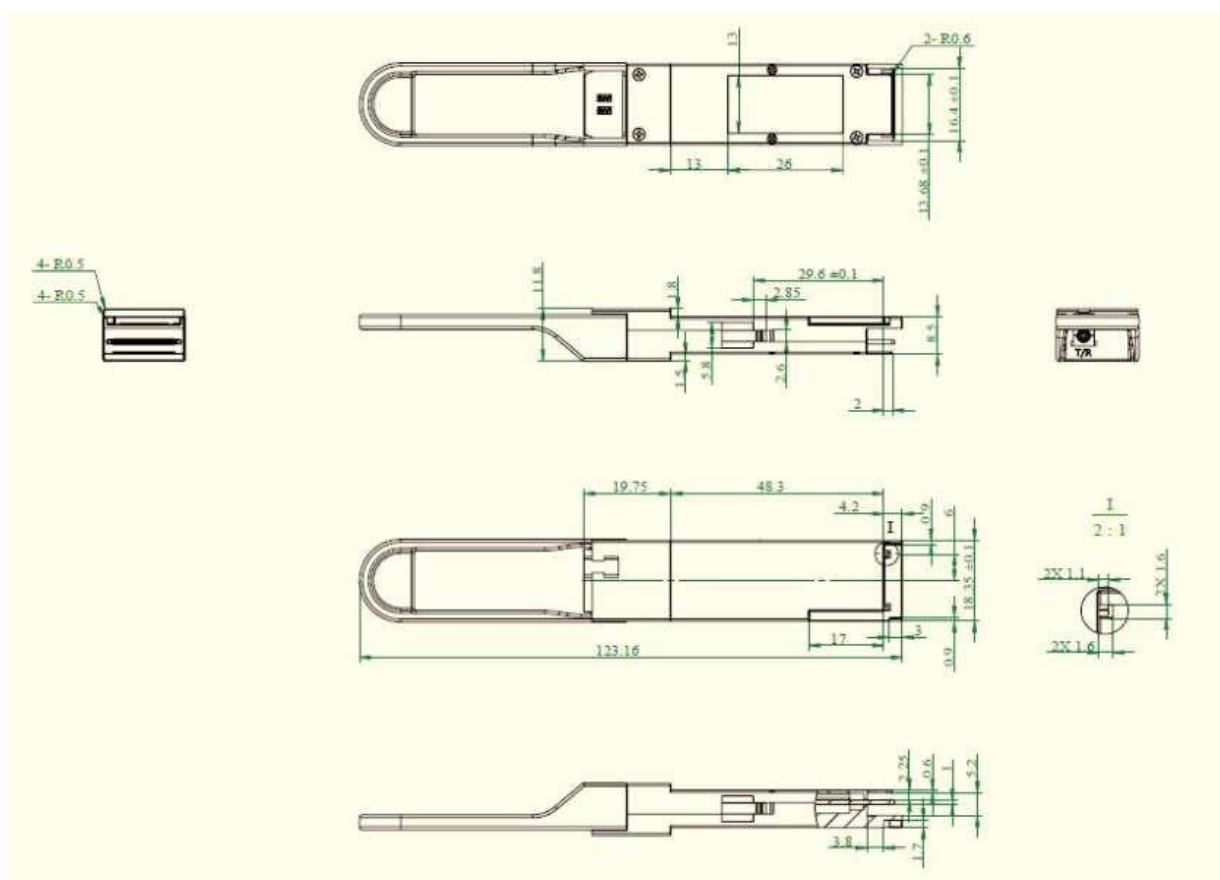


## Recommended Host Board Power Supply Filtering

See SFF-8679

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## Mechanics drawing



## Order Information

Table 10 – Order Information

| Part No.    | Application  | Data Rate   | Laser Source | Fiber Type |
|-------------|--------------|-------------|--------------|------------|
| KWHG40-2930 | 50GBASE-ER   | 53.125 Gb/s | EML Laser    | SMF        |
| KWHG40-3029 | Bi-direction |             |              |            |