

# 100Gbps QSFP28 Passive Direct Attach Copper Twinax Cable Specification

## 1 Description:

The 100G QSFP28 Direct Connect Cable (DAC) is a 4-channel parallel passive copper product for storage, data centers and high-performance computing connections. Each channel is capable of transmitting data at 25 Gbps, enabling a 100 Gbps total data rate of 5 meters.

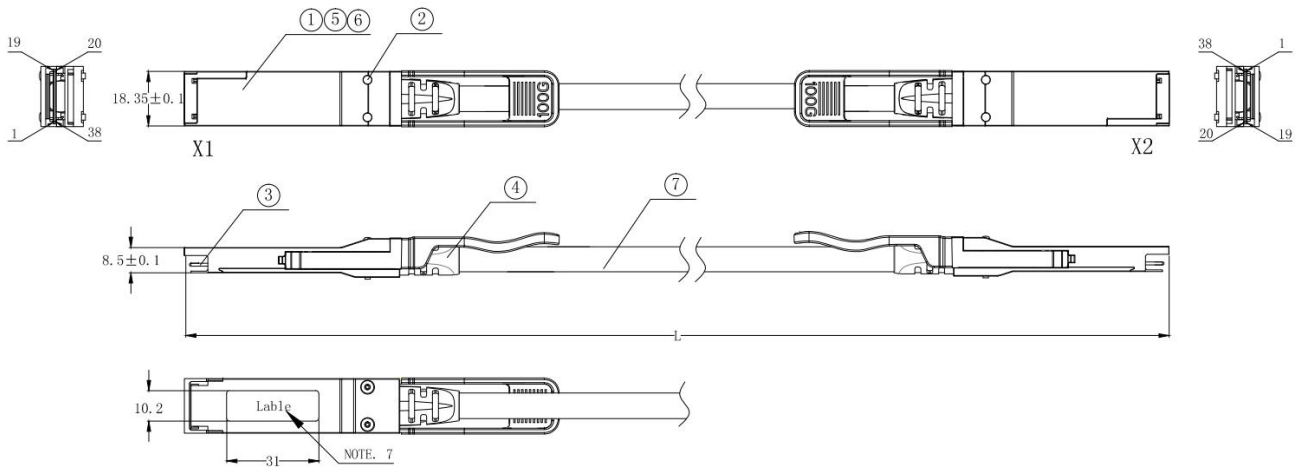
## 2 Features:

- Enhanced EMI / EMC performance
- 25Gbps data transfer rate per channel, up to 100Gbps
- Compliant with the IEEE 802.3bj standard and Infiniband EDR specifications
- Meets QSFP + MSA and SFF-8661 / SFF-8665 standards
- Support serial ID function through EEPROM
- 30AWG to 26AWG cable available
- RoHS and halogen-free options

## 3 Applications :

- Switch / router / HBA / SAN, NIC card
- 40G \ 100G Ethernet
- Storage, switch, data center, network center
- Infiniband, QDR / EDR

#### 4 Outline drawing :



#### 5 Wiring Diagram:

| X1   | X2   | REMARKS | X1  | X2  | REMARKS                         |
|--|--|---------|---|---|---------------------------------|
| 18(RX1-)   | 37(TX1-)   | pair    | 37(TX1-)                                      | 18(RX1-)                                      | pair                            |
| 17(RX1+)   | 36(TX1+)   |         | 36(TX1+)                                      | 17(RX1+)                                      |                                 |
| 15(RX3-)   | 34(TX3-)   | pair    | 34(TX3-)                                      | 15(RX3-)                                      | pair                            |
| 14(RX3+)   | 33(TX3+)   |         | 33(TX3+)                                      | 14(RX3+)                                      |                                 |
| 6 (TX4+)   | 25(RX4+)   | pair    | 25(RX4+)                                      | 6 (TX4+)                                      | pair                            |
| 5 (TX4-)   | 24(RX4-)   |         | 24(RX4-)                                      | 5 (TX4-)                                      |                                 |
| 3 (TX2+)   | 22(RX2+)   | pair    | 22(RX2+)                                      | 3 (TX2+)                                      | pair                            |
| 2 (TX2-)   | 21(RX2-)   |         | 21(RX2-)                                      | 2 (TX2-)                                      |                                 |
| 1, 4, 7, 13,<br>16, 19, 20,<br>23, 26, 32,<br>35, 38 | 1, 4, 7, 13,<br>16, 19, 20,<br>23, 26, 32,<br>35, 38 | GND     | 8, 9, 10,<br>11, 12, 27,<br>28, 29, 30,<br>31 | 8, 9, 10,<br>11, 12, 27,<br>28, 29, 30,<br>31 | EEPROM<br>point at<br>both ends |

## 6 Electrical Performance:

### 6.1 Signal Integrity

| (ITEM)  |   | (REQUIREMENT) | (TEST CONDITION)                    |        |         |          |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
|---|---|---------------|-------------------------------------|--------|---------|----------|--------|--------|-------|----------|-------------|-------|-------|-------|-------|-------|--------|----------------|-------|-------|--------|--------|--------|--------|-------------|-------|-------|--------|--------|--------|--------|--|--|--|--|--|--|--|---------------|
| (Differential Impedance)  | Cable Impedance   | 105+5/-10Ω    | Rise time of 25ps<br>(20 % - 80 %). |        |         |          |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
|   | Paddle Card Impedance   | 100±10Ω       |                                     |        |         |          |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
|   | Cable Termination Impedance   | 100±15Ω       |                                     |        |         |          |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
| [Differential (Input/Output)Return loss S <sub>DD11</sub> /S <sub>DD22</sub> ]                | $\text{Return\_loss}(f) \geq \left\{ \begin{array}{ll} 16.5-2\sqrt{f} & 0.05 \leq f < 4.1 \\ 10.66-14\log_{10}(f/5.5) & 4.1 \leq f \leq 19 \end{array} \right\}$ <p>Where<br/>f is the frequency in GHz<br/>Return loss(f) is the return loss at frequency f</p>  | 10MHz≤f≤19GHz |                                     |        |         |          |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
| [Differential to common-mode (Input/Output)Return loss S <sub>CD11</sub> /S <sub>CD22</sub> ] | $\text{Return\_loss}(f) \geq \left\{ \begin{array}{ll} 22-(20/25.78)f & 0.01 \leq f < 12.89 \\ 15-(6/25.78)f & 12.89 \leq f \leq 19 \end{array} \right\}$ <p>Where<br/>f is the frequency in GHz<br/>Return_loss(f) is the Differential to common-mode return loss at frequency f</p>   | 10MHz≤f≤19GHz |                                     |        |         |          |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
| [Common-mode to Common-mode (Input/Output)Return loss S <sub>CC11</sub> /S <sub>CC22</sub> ]  | $\text{Return\_loss}(f) \geq 2\text{dB} \quad 0.2 \leq f \leq 19$ <p>Where<br/>f is the frequency in GHz<br/>Return_loss(f) is the common-mode to common-mode return loss at frequency f</p>  | 10MHz≤f≤19GHz |                                     |        |         |          |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
| [Differential Insertion Loss (S <sub>DD21</sub> Max.)]  | <p>(Differential Insertion Loss Max. For TP<sub>a</sub> to TP<sub>b</sub> Excluding Test fixture )</p> <table border="1"> <thead> <tr> <th>F AWG</th> <th>1.25GHz</th> <th>2.5GHz</th> <th>5.0GHz</th> <th>7.0GHz</th> <th>10Ghz</th> <th>12.89Ghz</th> </tr> </thead> <tbody> <tr> <td>30(1m) Max.</td> <td>4.5dB</td> <td>5.4dB</td> <td>6.3dB</td> <td>7.5dB</td> <td>8.5dB</td> <td>10.5dB</td> </tr> <tr> <td>30/28(3m) Max.</td> <td>7.5dB</td> <td>9.5dB</td> <td>12.2dB</td> <td>14.8dB</td> <td>18.0dB</td> <td>21.5dB</td> </tr> <tr> <td>26(3m) Max.</td> <td>5.7dB</td> <td>7.2dB</td> <td>9.9 dB</td> <td>11.9dB</td> <td>14.1dB</td> <td>16.5dB</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> |               |                                     | F AWG  | 1.25GHz | 2.5GHz   | 5.0GHz | 7.0GHz | 10Ghz | 12.89Ghz | 30(1m) Max. | 4.5dB | 5.4dB | 6.3dB | 7.5dB | 8.5dB | 10.5dB | 30/28(3m) Max. | 7.5dB | 9.5dB | 12.2dB | 14.8dB | 18.0dB | 21.5dB | 26(3m) Max. | 5.7dB | 7.2dB | 9.9 dB | 11.9dB | 14.1dB | 16.5dB |  |  |  |  |  |  |  | 10MHz≤f≤19GHz |
| F AWG   | 1.25GHz   | 2.5GHz        | 5.0GHz                              | 7.0GHz | 10Ghz   | 12.89Ghz |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
| 30(1m) Max.   | 4.5dB   | 5.4dB         | 6.3dB                               | 7.5dB  | 8.5dB   | 10.5dB   |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
| 30/28(3m) Max.  | 7.5dB   | 9.5dB         | 12.2dB                              | 14.8dB | 18.0dB  | 21.5dB   |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
| 26(3m) Max.   | 5.7dB   | 7.2dB         | 9.9 dB                              | 11.9dB | 14.1dB  | 16.5dB   |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |
|   |   |               |                                     |        |         |          |        |        |       |          |             |       |       |       |       |       |        |                |       |       |        |        |        |        |             |       |       |        |        |        |        |  |  |  |  |  |  |  |               |

|  |   |       |        |        |        |        |        |                |
|--|---|-------|--------|--------|--------|--------|--------|----------------|
|  | 26/25(5 m)Max.  | 7.8dB | 10.0dB | 13.5dB | 16.0dB | 19.0dB | 22.0dB |                |
| [Insertion Loss Deviation]   | $-0.176*f - 0.7 \leq \text{ILD} \leq 0.176* f + 0.7$  |       |        |        |        |        |        | 50MHz≤f ≤19GHz |
| Differential to common-mode Conversion Loss-Differential Insertion Loss(S <sub>CD21</sub> -S <sub>DD21</sub> ) | $\text{Conversion\_loss}(f) - \text{IL}(f) \geq \begin{cases} 10 & 0.01 \leq f < 12.89 \\ 27-(29/22)f & 12.89 \leq f < 15.7 \end{cases}$ <p>Where<br/>f is the frequency in GHz<br/>Conversion_loss(f) is the cable assembly differential to common-mode conversion loss<br/>IL(f) is the cable assembly insertion loss</p> |       |        |        |        |        |        | 10MHz≤f ≤19GHz |
| [MDNEXT(multiple disturber near-end crosstalk)]  | ≥35dB @12.89GHz   |       |        |        |        |        |        | 10MHz≤f ≤19GHz |
| [Intra Skew]   | 15ps/m,   |       |        |        |        |        |        | 10MHz≤f ≤19GHz |

## 6.2 Other Electrical Performance

| (ITEM)                            | (REQUIREMENT)                  | (TEST CONDITON)  |
|-----------------------------------|--------------------------------|--|
| [Low Level Contact Resistance]    | 70milliohms Max. From initial. | EIA-364-23:Apply a maximum voltage of 20mV<br>And a current of 100 mA.   |
| Insulation Resistance             | 10Mohm(Min.)                   | EIA364-21:AC 300V 1minute  |
| [Dielectric Withstanding Voltage] | NO disruptive discharge.       | EIA-364-20:Apply a voltage of 300 VDC for 1minute between adjacent terminals<br>And between adjacent terminals and ground. |

## 7 Environment Performance

| (ITEM)                                      | (REQUIREMENT)   | (TEST CONDITON)  |
|---|---|--|
| [Operating Temp. Range]                     | -20°C to +75°C  | Cable operating temperature range.   |
| [Storage Temp. Range (in packed condition)] | -40°C to +80°C  | Cable storage temperature range in packed condition.                             |
| [Thermal Cycling Non-Powered]               | No evidence of physical damage                                      | EIA-364-32D, Method A, -25 to 90C, 100 cycles, 15 min. dwells                    |
| [Salt Spraying]                             | 48 hours salt spraying after shell corrosive area less than 5%.     | EIA-364-26   |
| Mixed Flowing Gas                           | Pass electrical tests per 3.1 after stressing. (For connector only) | EIA-364-35 Class II,14 days.   |
| Temp. Life                                  | No evidence of physical damage                                      | EIA-364-17C w/ RH, Damp heat 90°C at 85% RH for 500 hours then return to ambient |
| Cable Cold Bend                             | 4H, No evidence of physical damage                                  | Condition: -20°C±2°C, mandrel diameter is 6 times the cable diameter.            |

## 8 Mechanical and Physical Characteristics

| (ITEM)                       | (REQUIREMENT)                                  | (TEST CONDITON)   |
|------------------------------|--|---|
| Vibration                    | Pass electrical tests per 3.1 after stressing. | Clamp & vibrate per EIA-364-28E, TC-VII, test condition letter – D, 15 minutes in X, Y & Z axis.  |
| Twist                        | No evidence of physical damage                 | Twist cable 180° ( $\pm 90^\circ$ from nominal position) for 100 cycles at 30 cycles per minute with a 0.5kg load applied to the cable jacket.<br>Clamp position: 300mm   |
| Cable Flex                   | No evidence of physical damage                 | Flex cable 180° for 20 cycles ( $\pm 90^\circ$ from nominal position) at 12 cycles per minute with a 1.0kg load applied to the cable jacket. Flex in the boot area 90° in each direction from vertical. Per EIA-364-41C |
| Cable Plug Retention in Cage | 90N Min.<br>No evidence of physical damage     | Force to be applied axially with no damage to cage. Per SFF 8661 Rev 2.1<br>Pull on cable jacket approximately 1 ft behind cable plug. No functional damage to cable plug below 90N.<br>Per SFF-8432 Rev 5.0            |
| Cable Retention in Plug      | 90N Min.<br>No evidence of physical damage     | Cable plug is fixtured with the bulk cable hanging vertically. A 90N axial load is applied (gradually) to the cable jacket and held for 1 minute. Per EIA-364-38B   |
| Mechanical Shock             | Pass electrical tests Per 3.1 after stressing. | Clamp and shock per EIA-364-27B, TC-G,3 times in 6 directions, 100g, 6ms.   |
| Cable Plug Insertion         | 40N Max.(QSFP28)                               | Per SFF8661 Rev 2.1   |
| Cable plug Extraction        | 30N Max. (QSFP28)                              | Place axial load on de-latch to de-latch plug.Per SFF8661 Rev 2.1   |
| Durability                   | 50 cycles, No evidence of physical damage      | EIA-364-09, perform plug & unplug cycles: Plug and receptacle mate rate: 250times/hour. 50times for QSFP28/SFP28 module (CONNECTOR TO PCB)  |