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## 1.0 OBJECTIVE

This document summarizes qualification test results to demonstrate compliance of FCI QSFP+ cable and connector system to the requirements of the FCI QSFP+ product specification(s) listed in Section 5.0.

## 2.0 SCOPE

This summary includes results from qualification testing of QSFP+ cable assemblies consisting of 32AWG, 30AWG, 28AWG, 26AWG, & 24AWG wire gages as well as PCB's from both US and China. The connectors were qualified in accordance with FCI product specification GS-12-622.

## 3.0 CONCLUSION


The results obtained for all tested product configurations successfully met the requirements of FCI product specification GS-12-622.

## 4.0 DEFINITIONS

MIL-STD: Military Standard  
EIA: Electronic Industries Alliance  
ANSI: American National Standards Institute  
LLCR: Low Level Contact Resistance  
CR: Contact Resistance  
MFG: Mixed Flowing Gas  
IR: Insulation Resistance  
DWV: Dielectric Withstanding Voltage

## 5.0 REFERENCE DOCUMENTS

- 5.1 Product Specification GS-12-622, Rev. A
- 5.2 EIA 364 Series Test Procedures
- 5.3 U.S. Product Test Laboratory Report EL-2010-02-019, Rev. A

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## 6.0 QUALIFICATION SUMMARY


6.1 The qualification testing of the 30 micro-inch gold-plated QSFP+ cable and connector system was performed in 7 test groups, with multiple wire gauge samples represented in each group when applicable.

6.1.1 Test Group 1 – Mechanical with Differential Impedance. 3 each (12 total) cable assemblies 32AWG, 30AWG, 26AWG, & 24AWG. One receptacle test board assembly used for continuity monitoring during the wire flex test.

| TEST  | SPECIFICATION CRITERION  | RESULTS   |
|---|--|---|
| Differential Impedance<br>EIA-364-108<br>Per GS-12-622 Sec. 6.1.5   | <u>Condition:</u> 70 psec. rise time (20% - 80%)<br><br>Criterion: 100 Ω +/- 10 Ω  | <b>PASS</b><br>32AWG – 93Ω min, 107Ω max<br>30AWG – 92Ω min, 107Ω max<br>26AWG – 91Ω min, 105Ω max<br>24AWG – 91Ω min, 105Ω max |
| Cable Minimum Bend Radius<br>EIA-364-41<br>Per GS-12-622 Sec. 6.6.8 | <u>Condition:</u> 1 cycle in each of 4 perpendicular directions.<br><br>Criterion: No damage   | <b>PASS</b><br>No damage  |
| Differential Impedance<br>EIA-364-108<br>Per GS-12-622 Sec. 6.1.5   | <u>Condition:</u> 70 psec. Rise time (20% - 80%)<br><br>Criterion: 100 Ω +/- 10 Ω  | <b>PASS</b><br>32AWG – 93Ω min, 106Ω max<br>30AWG – 92Ω min, 107Ω max<br>26AWG – 91Ω min, 105Ω max<br>24AWG – 91Ω min, 105Ω max |
| Wire Flex<br>EIA 364-41E<br>Per FS-12-622 Sec. 6.6.7                | <u>Condition:</u> 15 cycles, 180°, 2.5 in. from back of shell to top of roller<br><br>Criterion: No damage, no discontinuity > 1 μsec. | <b>PASS</b><br>No damage<br>No discontinuity  |
| Differential Impedance<br>EIA-364-108<br>Per GS-12-622 Sec. 6.1.5   | <u>Condition:</u> 70 psec. rise time (20% - 80%)<br><br>Criterion: 100 Ω +/- 10 Ω  | <b>PASS</b><br>32AWG – 92Ω min, 106Ω max<br>30AWG – 92Ω min, 107Ω max<br>26AWG – 91Ω min, 105Ω max<br>24AWG – 91Ω min, 105Ω max |
| Cable Strain Relief<br><br>Per GS-12-452 Sec. 6.6.6                 | <u>Condition:</u> 25 mm/min., 90N min.<br><br>Criterion: No damage   | <b>PASS</b><br>No damage  |
| Differential Impedance<br>EIA-364-108<br>Per GS-12-622 Sec. 6.1.5   | <u>Condition:</u> 70 psec. rise time (20% - 80%)<br><br>Criterion: 100 Ω +/- 10 Ω  | <b>PASS</b><br>32AWG – 93Ω min, 109Ω max<br>30AWG – 92Ω min, 107Ω max<br>26AWG – 91Ω min, 105Ω max<br>24AWG – 91Ω min, 105Ω max |

6.1.2 Test Group 2 – Cable Connector Retention to Cage, 3 each (9 total) cable assemblies 32AWG, 30AWG, & 26AWG, and 3 total receptacle test board assemblies.

| TEST  | SPECIFICATION CRITERION   | RESULTS                  |
|---|---|--------------------------|
| Cable Connector Retention in Cage<br>Per GS-12-622 Sec. 6.6.9 | <u>Condition:</u> 90 N min. axial load, latch engaged<br><br>Criterion: No damage | <b>PASS</b><br>No damage |

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6.1.3 Test Group 3 – Receptacle Cage Mechanical, 3 receptacle cages and 3 receptacle test boards.

| TEST  | SPECIFICATION CRITERION  | RESULTS                         |
|---|--|---------------------------------|
| Cage Press-Fit Insertion Force<br>EIA-364-09<br>Per GS-12-622 Sec. 6.6.10 | <u>Condition:</u> Axial load on top of cage<br><br>Criterion: 550 N max.                                 | <b>PASS</b><br><br>222.4 N max  |
| Cage Press-Fit Retention Force<br>EIA-364-09<br>Per GS-12-622 Sec. 6.6.10 | <u>Condition:</u> Axial load on all exposed press-fit tails simultaneously.<br><br>Criterion: 114 N min. | <b>PASS</b><br><br>133.4 N min. |

6.1.4 Test Group 4 – Thermal Shock and Humidity, one each AWG30 and AWG24 cable assembly mated to receptacle test boards for LLCR, two each AWG28 and AWG26 cable assemblies without paddleboard resistors mated to unassembled receptacles (no PCB or cage) for IR/DWV.

| TEST  | SPECIFICATION CRITERION   | RESULTS   |
|---|---|---|
| LLCR<br>EIA-364-23<br>Per Lab Modifications*            | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: None (Baseline)   | <b>PASS</b><br><br>Baseline   |
| IR<br>EIA-364-21<br>Per GS-12-622 Sec. 6.1.2            | <u>Condition:</u> 100 V DC, 60 seconds<br><br>Criterion: 1 GΩ min   | <b>PASS</b><br><br>23 GΩ min  |
| DWV<br>EIA-364-20<br>Per GS-12-622 Sec. 6.1.3           | <u>Condition:</u> 300 V DC, 60 seconds<br><br>Criterion: No breakdown or arc-over, .5 mA max. leakage current | <b>PASS</b><br><br>No breakdown or arc-over, .002 μA max. leakage current |
| Thermal Shock<br>EIA-364-32<br>Per GS-12-622 Sec. 6.7.1 | <u>Condition:</u> -55C to +85C, 25 1-hour cycles<br><br>Criterion: No damage                                  | <b>PASS</b><br><br>No damage  |
| LLCR<br>EIA-364-23<br>Per Lab Modifications*            | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: 20 mΩ max increase  | <b>PASS</b><br><br>0.67 mΩ max increase                                   |
| Humidity<br>EIA-364-31<br>Per GS-12-622 Sec. 6.7.3      | <u>Condition:</u> 10 18-hour cycles, 25C to 65C, exclude 7a and 7b<br><br>Criterion: No damage                | <b>PASS</b><br><br>No damage  |
| LLCR<br>EIA-364-23<br>Per Lab Modifications*            | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: 20 mΩ max increase  | <b>PASS</b><br><br>4.32 mΩ max increase                                   |
| IR<br>EIA-364-21<br>Per GS-12-622 Sec. 6.1.2            | <u>Condition:</u> 100 V DC, 60 seconds<br><br>Criterion: 1 GΩ min   | <b>PASS</b><br><br>1.59 GΩ min.   |
| DWV<br>EIA-364-20<br>Per GS-12-622 Sec. 6.1.3           | <u>Condition:</u> 300 V DC, 60 seconds<br><br>Criterion: No breakdown or arc-over, .5 mA max. leakage current | <b>PASS</b><br><br>No breakdown or arc-over, 0.57 μA leakage              |

\*Product specification GS-12-622 calls for LLCR to be performed per EIA-364-6. This test was not possible with these assemblies, and EIA-364-23 was used per agreement.

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6.1.5 Test Group 5 – High Temperature Life, one each 30AGW, 28AWG, and 26AWG cable assembly mated to receptacle test board assemblies (3 total) for LLCR measurement.

| TEST  | SPECIFICATION CRITERION                                      | RESULTS                                |
|---|--|--|
| LLCR<br>EIA-364-23<br>Per Lab Modifications*              | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: None         | <b>PASS</b><br><br>Baseline            |
| High Temp. Life<br>EIA-364-17<br>Per GS-12-622 Sec. 6.7.2 | <u>Condition:</u> 500 Hrs. @ 70C<br><br>Criterion: No damage | <b>PASS</b><br><br>No damage           |
| LLCR<br>EIA-364-23<br>Per Lab Modifications*              | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: None         | <b>PASS</b><br><br>.03 mΩ max increase |

\*Product specification GS-12-622 calls for LLCR to be performed per EIA-364-6. This test was not possible with these assemblies, and EIA-364-23 was used per agreement.

6.1.6 Test Group 6 – Mixed Flowing Gas, one 32AWG, 30AWG, and 28AWG cable assembly mated to receptacle test board assemblies for LLCR measurement.

| TEST   | SPECIFICATION CRITERION  | RESULTS   |
|--|--|---|
| LLCR<br>EIA-364-23<br>Per Lab Modifications*                           | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: None   | <b>PASS</b><br><br>Baseline                                     |
| Mating / Unmating Force<br>EIA-364-13<br>Per GS-12-622 Sec. 6.6.5      | <u>Condition:</u> 5 cycles, kick-out springs and latches disengaged<br>Criterion: 40 N max. mating, 30 N max. unmating | <b>PASS</b><br><br>31.36 N max. mating<br>21.61 N max. unmating |
| Pre-Condition Durability<br>EIA-364-09<br><br>Per GS-12-622 Sec. 6.6.2 | <u>Condition:</u> 25 cycles, 10 cyc. Per min. max.<br><br>Criterion: No damage   | <b>PASS</b><br><br>No damage                                    |
| LLCR<br>EIA-364-23<br>Per Lab Modifications*                           | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: 20 mΩ max. increase  | <b>PASS</b><br><br>1.48 mΩ max. increase                        |
| Mixed Flowing Gas 1st Half<br>EIA-364-65<br>Per GS-12-622 Sec. 6.7.4   | <u>Condition:</u> Class IIa, 7 days unmated<br><br>Criterion: No damage  | <b>PASS</b><br><br>No damage                                    |
| LLCR<br>EIA-364-23<br>Per Lab Modifications*                           | Condition: 20mV, 100mA<br><br>Criterion: 20 mΩ max. increase   | <b>PASS</b><br><br>5.11 mΩ max. increase                        |
| Mixed Flowing Gas 2nd Half<br>EIA-364-65<br>Per GS-12-622 Sec. 6.7.4   | <u>Condition:</u> Class IIa, 7 days mated<br><br>Criterion: No damage  | <b>PASS</b><br><br>No damage                                    |

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6.1.6 Test Group 6 continued

|   |  |   |
|---|--|---|
| LLCR<br>EIA-364-23<br>Per Lab Modifications*                      | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: 20 mΩ max. increase  | <b>PASS</b><br><br>2.88 mΩ max. increase                        |
| Thermal Disturbance<br>EIA-364-32<br>Per GS-12-622 Sec. 6.7.5     | <u>Condition:</u> 15C to 85C, 5 min. dwells min., 10 cycles<br><br>Criterion: No damage                                | <b>PASS</b><br><br>No damage                                    |
| LLCR<br>EIA-364-23<br>Per Lab Modifications*                      | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: 20 mΩ max. increase  | <b>PASS</b><br><br>2.41 mΩ max. increase                        |
| Mating / Unmating Force<br>EIA-364-13<br>Per GS-12-622 Sec. 6.6.5 | <u>Condition:</u> 5 cycles, kick-out springs and latches disengaged<br>Criterion: 40 N max. mating, 30 N max. unmating | <b>PASS</b><br><br>26.72 N max. mating<br>17.60 N max. unmating |
| LLCR<br>EIA-364-23<br>Per Lab Modifications*                      | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: 20 mΩ max. increase  | <b>PASS</b><br><br>1.32 mΩ max. increase                        |

\*Product specification GS-12-622 calls for LLCR to be performed per EIA-364-6. This test was not possible with these assemblies, and EIA-364-23 was used per agreement.

6.1.7 Test Group 7 – Shock and Vibration, three 32AWG, and three 24AWG cable assemblies mated to receptacle test board assemblies (total of six) for LLCR measurement.

| TEST  | SPECIFICATION CRITERION  | RESULTS   |
|---|--|---|
| LLCR<br>EIA-364-23<br>Per Lab Modifications*                      | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: None   | <b>PASS</b><br><br>Baseline                                     |
| Mating / Unmating Force<br>EIA-364-13<br>Per GS-12-622 Sec. 6.6.5 | <u>Condition:</u> 5 cycles, kick-out springs and latches disengaged<br>Criterion: 40 N max. mating, 30 N max. unmating             | <b>PASS</b><br><br>27.58 N max. mating<br>17.79 N max. unmating |
| Durability<br>EIA-364-09<br>Per GS-12-622 Sec. 6.6.1              | <u>Condition:</u> Cable – 50 cycles, Board – 100 cycles<br>10 cyc. / min. max. Latches to be disabled.<br><br>Criterion: No damage | <b>PASS</b><br><br>No damage                                    |
| LLCR<br>EIA-364-23<br>Per Lab Modifications*                      | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: 20 mΩ max. increase  | <b>PASS</b><br><br>2.44 mΩ max. increase                        |
| Mechanical Shock<br>EIA-364-27B<br>Per GS-12-622 Sec. 6.6.3       | <u>Condition:</u> ½ sine, 30 G, 11 msec.<br><br>Criterion: No damage   | <b>PASS</b><br><br>No damage                                    |
| LLCR<br>EIA-364-23<br>Per Lab Modifications*                      | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: 20 mΩ max. increase  | <b>PASS</b><br><br>1.80 mΩ max. increase                        |


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6.1.7 Test Group 7 continued

|   |  |   |
|---|--|---|
| Vibration<br>EIA-364-28<br>Per GS-12-622 Sec. 6.6.4               | <u>Condition:</u> 20-500 Hz., 15 min. axis<br><br>Criterion: No damage   | <b>PASS</b><br><br>No damage                                |
| LLCR<br>EIA-364-23<br>Per Lab Modifications*                      | <u>Condition:</u> 20mV, 100mA<br><br>Criterion: 20 mΩ max. increase  | <b>PASS</b><br><br>1.02 mΩ max. increase                    |
| Mating / Unmating Force<br>EIA-364-13<br>Per GS-12-622 Sec. 6.6.5 | <u>Condition:</u> 5 cycles, kick-out springs and latches disengaged<br>Criterion: 40 N max. mating, 30 N max. unmating | <b>PASS</b><br>27.58 N max. mating<br>14.23 N max. unmating |

\*Product specification GS-12-622 calls for LLCR to be performed per EIA-364-6. This test was not possible with these assemblies, and EIA-364-23 was used per agreement.

**7.0** NOTES

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**REVISION RECORD**

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