1.0 OBJECTIVE

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

2.0 SCOPE

This summary includes results from qualification testing of SFP+ cable assemblies consisting of 32AWG, 30AWG, 28AWG, 26AWG, & 24AWG wire gages, US or China-sourced paddleboards, and Leoni or LTK cable. The connectors were qualified in accordance with FCI product specification GS-12-616.

3.0 CONCLUSION

The results obtained for all tested product configurations successfully met the requirements of FCI product specification GS-12-616.

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-12-616, Rev. C
5.2 EIA 364 Series Test Procedures
5.3 U.S. Product Test Laboratory Report EL-2010-01-037, Rev. C

6.0 QUALIFICATION SUMMARY

6.1 The qualification testing of the gold-plated SFP+ 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 (15 total) US PCB cable assemblies 32AWG, 30AWG, and 24AWG with Leoni cable and US PCB cable assemblies 26AWG and 24AWG with LTK cable. One receptacle test board assembly used for continuity monitoring during the wire flex test.

TEST	SPECIFICATION CRITERION	RESULTS
Differential Impedance EIA-364-108 Per GS-12-616 Sec. 6.1.5	Condition: 70 psec. Rise time (20% - 80%) Criterion: 100 Ω +/- 10 Ω	**PASS** 32AWG Leoni – 91Ω min, 103Ω max 30AWG Leoni – 91Ω min, 102Ω max 24AWG Leoni – 90Ω min, 101Ω max 28AWG LTK – 90Ω min, 101Ω max 26AWG LTK – 91Ω min, 100Ω max
Cable Minimum Bend Radius EIA-364-41 Per GS-12-616 Sec. 6.5.8	Condition: 1 cycle in each of 4 perpendicular directions. Criterion: No damage	**PASS** No damage
Wire Flex EIA-364-41 Per FS-12-616 Sec. 6.5.7	Condition:15 cycles, 180°, 2.5 in. from back of shell to top of roller Criterion: No damage, no discontinuity > 1 µsec.	**PASS** No damage No discontinuity
Cable Strain Relief Per GS-12-616 Sec. 6.5.6	Condition: 25 mm/min., 90N min. Criterion: No damage	**PASS** No damage
Differential Impedance EIA-364-108 Per GS-12-616 Sec. 6.1.5	Condition: 70 psec. Rise time (20% - 80%) Criterion: 100 Ω +/- 10 Ω	**PASS** 32AWG Leoni – 91Ω min, 104Ω max 30AWG Leoni – 91Ω min, 104Ω max 24AWG Leoni – 91Ω min, 103Ω max 28AWG LTK – 91Ω min, 102Ω max 26AWG LTK – 92Ω min, 103Ω max

6.1.2 Test Group 2 – Latch Strength and Cable Connector Retention to Cage, 1 each (3 total) cable assemblies 28AWG, 26AWG, & 24AWG with Leoni cable.

TEST	SPECIFICATION CRITERION	RESULTS
Latch Strength Per GS-12-616 Sec. 6.5.9	Condition: 180 N min., 12.7 mm/min. max. Criterion: No damage	**PASS** No damage
Cable Connector Retention in Cage Per GS-12-616 Sec. 6.5.10	Condition: 90 N min. / 170 N. max. axial load Criterion: No damage	**PASS** No damage

6.1.3 Test Group 3 – Receptacle Cage Mechanical, 3 receptacle cages for insertion/retention, 3 receptacle cages for kick-out, and 3 receptacle test boards.

TEST	SPECIFICATION CRITERION	RESULTS
Cage Press-Fit Insertion Force EIA-364-09 Per GS-12-616 Sec. 6.5.12	Condition: Axial load on top of cage Criterion: 40 N max. / pin	**PASS** 22.4 N max
Cage Press-Fit Retention Force EIA-364-09 Per GS-12-616 Sec. 6.5.12	Condition: Axial load on all exposed press-fit tails simultaneously. Criterion: 10 N min. / pin	**PASS** 11.0 N min.
Cage Spring Kick-out Force Per GS-12-616 Sec. 6.5.11	Condition: Mate / unmate cable assembly to cage Criterion: 10 N min., 22 N max.	**PASS** 10.6 N min. 12.2 N max.

6.1.4 Test Group 4 – Thermal Shock and Humidity, 10 each US and NT PCB cable assemblies with 28AWG cable (20 total). Five cables of each type mated were mated to receptacles for LLCR. Remaining 5 cables of each type were mated to unassembled receptacles for IR/DWV. IR/DWV measured on 2 adjacent signal pairs or each assembly (10 measurements per PCB type). All assemblies with Leoni cable.

TEST	SPECIFICATION CRITERION	RESULTS
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: None (Baseline)	**PASS** Baseline
IR EIA-364-21 Per GS-12-616 Sec. 6.1.2	Condition: 100 V DC, 60 seconds Criterion: 1 GΩ min.	**PASS** US – 16.2 GΩ min. NT – 16.1 GΩ min.
DWV EIA-364-20 Per GS-12-616 Sec. 6.1.3	Condition: 300 V DC, 60 seconds Criterion: No breakdown, arc-over, or leakage	**PASS** US – No breakdown or arc-over, 4.29 µA max. leakage NT – No breakdown or arc-over, 4.39 µA max. leakage
Thermal Shock EIA-364-32 Per GS-12-616 Sec. 6.6.1	Condition: -55C to +85C, 10 cycles Criterion: No damage	**PASS** No damage
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max increase	**PASS** US – 0.03 mΩ max. increase NT – 1.14 mΩ max. increase
Humidity EIA-364-31 Per GS-12-616 Sec. 6.6.3	Condition: 10,18-hour cycles, 25C to 65C, 80% to 100% RH Criterion: No damage	**PASS** No damage
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max increase	**PASS** US – 1.23 mΩ max. increase NT – 1.31 mΩ max. increase
IR EIA-364-21 Per GS-12-616 Sec. 6.1.2	Condition: 100 V DC, 60 seconds Criterion: 1 GΩ min.	**PASS** US – 6.1 GΩ min. NT – 1.0 GΩ min.

6.1.4 Test Group 4 (continued)

DWV EIA-364-20 Per GS-12-616 Sec. 6.1.3	Condition: 300 V DC, 60 seconds Criterion: No breakdown or arc-over	**PASS** US – No breakdown or arc-over, 33.4 µA max. leakage NT – No breakdown or arc-over, 49.0 µA max. leakage

* Product specification GS-12-616 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.

6.1.5 Test Group 5 – High Temperature Life, 1 30AWG, 2 28AWG, and 2 26AWG US PCB cable assemblies; 4 30AWG and 1 24AWG NR cable assemblies. Each cable assembly was mated to a receptacle test board assembly (10 total) for LLCR. All with Leoni cable.

TEST	SPECIFICATION CRITERION	RESULTS
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: None	**PASS** Baseline
High Temp. Life EIA-364-17 Per GS-12-616 Sec. 6.6.2	Condition: 500 Hrs. @ 70C Criterion: No damage	**PASS** No damage
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max increase	**PASS** US – 3.10 mΩ max. NT – 2.15 mΩ max.

* Product specification GS-12-616 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, 1 30AWG, 2 28AWG, and 2 26AWG US PCB cable assemblies; 3 30AWG and 2 24AWG NR cable assemblies. Each cable assembly was mated to a receptacle test board assembly (10 total) for LLCR. All with Leoni cable.

TEST	SPECIFICATION CRITERION	RESULTS
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: None	**PASS** Baseline
Mating / Unmating Force Per GS-12-616 Sec. 6.5.5	Condition: 5 cycles Criterion: 18 N max. mating, 12.5 N max. unmating	**PASS** US PCB: 14.2 N max. mating, 10.2 N max. unmating NT PCB: 14.7 N max. mating, 12.5 N max. unmating
Pre-Condition Durability EIA-364-09 Per GS-12-616 Sec. 6.5.2	Condition: 25 cycles, 10 cyc. Per min. max. Criterion: No damage	**PASS** No damage
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max. increase	**PASS** US PCB 0.20 mΩ max. incr. NT PCB 1.40 mΩ max. incr.

6.1.6 Test Group 6 (continued)

Mixed Flowing Gas 1st Half EIA-364-65 Per GS-12-616 Sec. 6.6.4	Condition: Class IIa, 7 days, unmated receptacles Criterion: No damage	**PASS** No damage
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max. increase	**PASS** US PCB 0.57 mΩ max. increase NT PCB 1.41 mΩ max. increase
Mixed Flowing Gas 2nd Half EIA-364-65 Per GS-12-616 Sec. 6.6.4	Condition: Class IIa, 7 days mated Criterion: No damage	**PASS** No damage
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max. increase	**PASS** US PCB 1.57 mΩ max. incr. NT PCB 0.62 mΩ max. incr.
Thermal Disturbance EIA-364-32 Per GS-12-616 Sec. 6.6.5	Condition: 15C to 85C, 5 min. dwells min., 10 cycles Criterion: No damage	**PASS** No damage
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max. increase	**PASS** US PCB 1.42 mΩ max. incr. NT PCB 1.00 mΩ max. incr.
Mating / Unmating Force Per GS-12-616 Sec. 6.5.5	Condition: 5 cycles Criterion: 18 N max. mating, 12.5 N max. unmating	**PASS** US PCB: 12.2 N max. mating, 8.9 N max. unmating NT PCB: 14.0 N max. mating, 8.0 N max. unmating
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max. increase	**PASS** US PCB 1.66 mΩ max. incr. NT PCB 7.11 mΩ max. incr.

* Product specification GS-12-616 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, 5 each 32AWG and 24 AWG US PCB cable assemblies; 3 24AWG and 3 30AWG NT PCB cable assemblies. Each cable assembly was mated to a receptacle test board assembly (15 total) for LLCR. All with Leoni cable.

TEST	SPECIFICATION CRITERION	RESULTS
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: None	**PASS** Baseline
Mating / Unmating Force Per GS-12-616 Sec. 6.5.5	Condition: 5 cycles, kick-out springs and latches disengaged Criterion: 18 N max. mating, 12.5 N max. unmating	**PASS** US PCB: 13.3 N max. mating, 10.7 N max. unmating NT PCB: 15.1 N max. mating, 9.8 N max. unmating
Durability EIA-364-09 Per GS-12-616 Sec. 6.5.1	Condition: 50 cyc. cable, 100 cyc. receptacle, 10 cyc./min. max. Criterion: No damage	**PASS** No damage

6.1.7 Test Group 7 (continued)

LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max. increase	**PASS** US PCB: 2.89 mΩ max. increase NT PCB: 0.94 mΩ max. increase
Mechanical Shock EIA-364-27 Per GS-12-616 Sec. 6.5.3	Condition: ½ sine, 30 G, 11 msec. Criterion: No damage	**PASS** No damage
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max. increase	**PASS** US PCB: 1.01 mΩ max. increase NT PCB: 0.72 mΩ max. increase
Vibration EIA-364-28 Per GS-12-616 Sec. 6.5.4	Condition: Random, Condition VII D, 20-500 Hz., 15 min. axis Criterion: No damage	**PASS** No damage
LLCR EIA-364-23 Per Lab Modifications*	Condition: 20mV, 100mA Criterion: 20 mΩ max. increase	**PASS** US PCB: 0.62 mΩ max. increase NT PCB: -0.65 mΩ max. increase
Mating / Unmating Force Per GS-12-616 Sec. 6.5.5	Condition: 5 cycles, kick-out springs and latches disengaged Criterion: 18 N max. mating, 12.5 N max. unmating	**PASS** US PCB: 12.5 N max. mating, 10.2 N max. unmating NT PCB: 14.2 N max. mating, 7.3 N max. unmating

* Product specification GS-12-616 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

REVISION RECORD

REV	PAGE	DESCRIPTION	EC #	DATE
A	ALL	NEW RELEASE	V10-0177	4/26/2010