OSFP SMT Connector

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity OSFP SMT Connector to determine its conformance to the requirements of Product Specification 108-130011 Rev A.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of the TE Connectivity OSFP SMT Connector. Testing was performed by the Harrisburg Electrical Components Test Laboratory between April 6, 2018 and May 1, 2018. Documentation is on file and maintained at the TE Harrisburg Electrical Components Test Laboratory under EA20180062T.

1.3 Conclusion

All TE OSFP Connector assemblies as listed in paragraph 1.5, conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-130011 Rev A.

1.4 Product Description

Designed to use eight electrical lanes to deliver 400GbE, OSFP is aimed at the upcoming generation of equipment that will operate with 50 Gbps electrical signaling. OSFP integrates thermal management directly into the form factor, eliminating the high thermal resistance between the module and the heat sink. The airflow design allows for cooling the downstream silicon switch or compute chips inside the equipment enclosure.

1.5 Test Specimens

The test specimens were representative of normal production lots, and the following part numbers were used for test:

Table 1 – Test Specimens

Test Group	Test Set	Quantity	Part Number	Description
1	1	5	2317416-1 Rev 2	OSFP 1x1 Cage
		5	2324689-4 Rev 2	OSFP Receptacle, Au Plating
	2	5	2317416-1 Rev 2	OSFP 1x1 Cage
		5	2311401-2 Rev 12	OSFP Receptacle, Au Flash over PdNi
2	3	5	2317416-1 Rev 2	OSFP 1x1 Cage
		5	2324689-4 Rev 2	OSFP Receptacle, Au Plating
3	4	5	2317416-1 Rev 2	OSFP 1x1 Cage
		5	2324689-4 Rev 2	OSFP Receptacle, Au Plating
	5	5	2317416-1 Rev 2	OSFP 1x1 Cage
		5	2311401-2 Rev 12	OSFP Receptacle, Au Flash over PdNi
4	6	5	2324689-4 Rev 2	OSFP Receptacle, Au Plating
5	7	5	2324689-4 Rev 2	OSFP Receptacle, Au Plating
6	8	5	2324689-4 Rev 2	OSFP Receptacle, Au Plating
1,2,3	1,2,3,4,5	5 Each	N/A	OSFP Test Plug Module (PCB P/N: 60-1935204-1)
1,2,3	1,2,3,4,5	3 Each	60-1935203-1 Rev A	OSFP LLCR Test PCB

1.6 Qualification Test Sequence

The specimens listed in paragraph 1.5 were subjected to the test sequences outlined below in Table 2.

Table 2 – Qualification Test Sequence

Test or Examination	Test Sets					
	1,2	3	4,5	6	7	8
	Test Groups					
	1	2	3	4	5	6
	Test Sequence (a)					
Initial Examination of Product	1	1	1	1	1	1
Low Level Contact Resistance	3,5,9	3,6	3,6,9			
Insulation Resistance				2,6		
Withstanding Voltage				3,7		
Random Vibration	6					
Mechanical Shock	7					
Durability	4 (b)					
Connector Solderability					2	
Resistance to Reflow Solder Heat						2
Thermal Shock				4		
Humidity-Temperature Cycling				5		
Temperature Life		4				
Mixed Flowing Gas			4			
Thermal Cycling			7			
Minute Disturbance	2,8	2,5	2,5,8			
Final Examination of Product	10	7	10	8	3	3

Note: *(a) The numbers indicate sequence in which tests were performed.*
(b) Ninety-five cycles of durability were performed.

1.7 Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

Temperature: 15°C to 35°C
Relative Humidity 20% to 80%

2. SUMMARY OF TESTING

2.1 Initial Examination of Product – All Test Groups

All specimens submitted for testing were representative of normal production lots. A Certificate of Conformance was issued by Product Assurance. Where specified, specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

2.2 Low Level Contact Resistance – Test Groups 1, 2, 3

Refer to Tables 3 through 5 for low level contact resistance summary data in milliohms. All recorded readings were below the requirement of a delta R (ΔR) of 20 milliohms maximum for LLCR.

Table 3 – Low Level Contact Resistance Summary Data in Milliohms, Test Group 1

Milliohms	Initial	After Durability	After Vibration & Mech. Shock
	Actual R	Delta (ΔR)	Delta (ΔR)
Test Set 1 – Au Plating			
Minimum	11.65	-1.95	-1.66
Maximum	16.33	1.23	1.07
Average	13.66	-0.23	-0.05
Test Set 2 – Au Flash over PdNi Plating			
Minimum	12.48	-2.20	-1.90
Maximum	17.25	0.86	4.16
Average	14.69	-0.47	-0.20

Table 4 – Low Level Contact Resistance Summary Data in Milliohms, Test Group 2

Milliohms	Initial	After Temp. Life
	Actual R	Delta (ΔR)
Test Set 3 – Au Plating		
Minimum	11.82	-0.89
Maximum	15.53	2.23
Average	13.57	0.19

Table 5 – Low Level Contact Resistance Summary Data in Milliohms, Test Group 3

Milliohms	Initial	After MFG	After Thermal Cycling
	Actual R	Delta (ΔR)	Delta (ΔR)
Test Set 4 – Au Plating			
Minimum	11.67	-0.93	-0.91
Maximum	15.50	3.26	2.65
Average	13.46	0.36	0.35
Test Set 5 – Au Flash over PdNi Plating			
Minimum	12.30	-0.95	-0.72
Maximum	17.25	7.60	13.17
Average	14.50	0.82	0.90

2.3 Insulation Resistance – Test Group 4

All insulation resistance measurements were greater than 1000 megohms.

2.4 Withstanding Voltage – Test Group 4

No dielectric breakdown or flashover occurred.

2.5 Random Vibration – Test Group 1

No apparent physical damage or discontinuities of one microsecond or greater occurred during testing.

2.6 Mechanical Shock – Test Group 1

No apparent physical damage or discontinuities of one microsecond or greater occurred during testing. The pulse velocity change was 79.5 inches per second.

2.7 Durability – Test Group 1

No physical damage detrimental to product performance was visible due to mating and unmating the specimens 95 times.

2.8 Connector Solderability – Test Group 5

All specimens under evaluation exhibited a continuous solder coating, free from defects, over the more than 95% of the critical surface areas. The critical area is defined as the underside of the lead, and the sides, up to 1 times the lead thickness as required by IPC/ECA JEDEC J-STD-002E, Test S1.

2.9 Resistance to Reflow Soldering Heat – Test Group 6

No defects, damage, or discoloration was observed on any specimen as a result of the moisture soak preconditioning. No melting, cracking, blistering or other damage was observed on any of the specimens.

2.10 Thermal Shock – Test Group 4

No physical damage detrimental to product performance was visible due to thermal shock exposure.

2.11 Humidity/Temperature Cycling – Test Group 4

No physical damage detrimental to product performance was visible due to humidity/temperature cycling.

2.12 Temperature Life – Test Group 2

No physical damage detrimental to product performance was visible due to temperature life exposure.

2.13 Mixed Flowing Gas – Test Group 3

No evidence of physical damage was visible to the mating interface as a result of exposure to the pollutants of mixed flowing gas. The average copper corrosion rate was 15.7µg/cm^2/day [EIA Required: 12-16].

2.14 Thermal Cycling – Test Group 3

No physical damage detrimental to product performance was visible due to thermal cycling.

2.15 Minute Disturbance – Test Groups 1, 2, 3

No physical damage detrimental to product performance was visible due to a minute disturbance.

2.16 Final Examination of Product – All Test Groups

Specimens were visually examined and no physical damage detrimental to product performance was visible.

3. TEST METHODS

3.1. Initial Examination of Product

A Certification of Conformance was issued stating that all specimens in this test package have been produced, inspected, and accepted as conforming to product drawing requirements, and made using the same core manufacturing processes and technologies as production parts. Testing was performed in accordance with EIA-364-18B.

3.2 Low Level Contact Resistance

Low level contact resistance measurements at low level current were made using a four terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. Positive current and voltage was applied to the discrete headers on the PCB. Negative current and voltage was connected to the paddle card bus. Refer to Figure 1 for an image of the typical test setup. Testing was performed in accordance with EIA-364-23C.

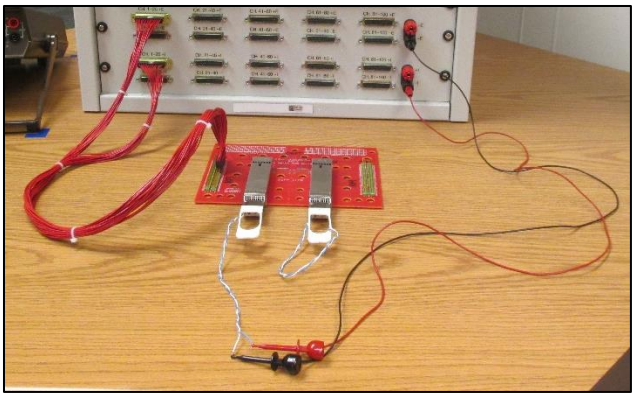

Figure 1 – Typical LLCR Test Setup

3.3 Insulation Resistance

Insulation resistance was measured between adjacent signal contacts of unmated specimens. A test voltage of 100 volts DC was applied for one minute before the resistance was measured. Refer to Figure 2 for an image of the typical test setup. Testing was performed in accordance with EIA-364-21E.

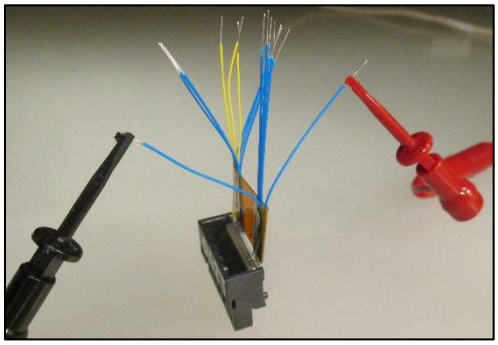

Figure 2 – Typical IR/DWV Test Setup

3.4 Withstanding Voltage

A test potential of 300 volts AC was applied between the adjacent signal to signal and signal to ground contacts of unmated specimens. This potential was applied for one minute and then returned to zero. Refer to Figure 2 (above) for an image of the typical test setup. Testing was performed in accordance with EIA-364-20E.

3.5 Random Vibration

The test specimens were subjected to a random vibration test in accordance with specification EIA-364-28F, test condition “VII”, test condition letter “D”. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes. Refer to Figure 3 for an image of the typical test setup.

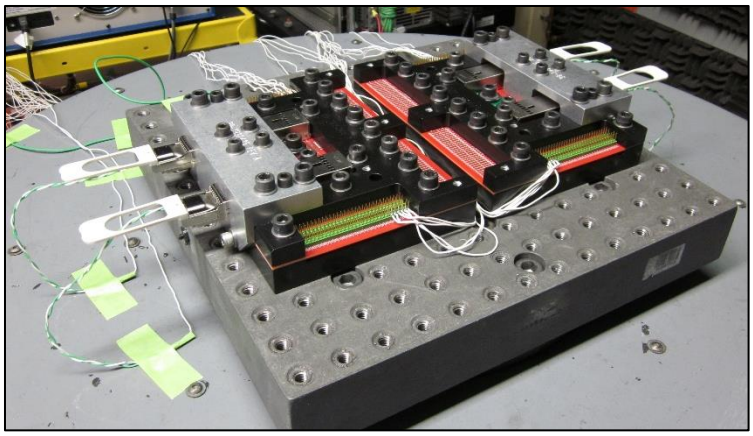

Figure 3 – Typical Random Vibration Test Setup

3.6 Mechanical Shock

The test specimens were subjected to a mechanical shock test in accordance with specification EIA-364-27C, test condition “H”. Three shocks in each direction were applied along the three mutually perpendicular axes of the test specimens, for a total of eighteen shocks. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes. Refer to Figure 4 for an image of the typical test setup.

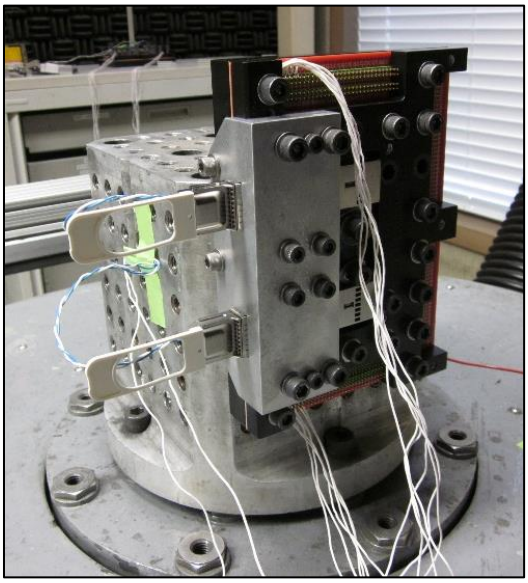

Figure 4 – Typical Mechanical Shock Test Setup

3.7 Durability

The specimens were mated and unmated 95 times by hand at a rate less than 300 cycles per hour. Testing was performed in accordance with EIA-364-09D.

3.8 Connector Solderability

A solder paste with a composition of Sn96.5, Ag3.0, Cu0.5 was used for testing. The specimens were testing using a convection reflow oven. All specimens were examined using a microscope for solder wetting. Testing was performed in accordance with IPC/ECA J-STD-002E, Test S1.

3.9 Resistance to Reflow Soldering Heat

3.9.1 Moisture Soak

Specimens were placed in a clean, dry, shallow container in such a manner that they did not overlap or touch and were exposed to 85°C at 85% relative humidity for 168 hours. Within 15 minutes to 4 hours after removal from the moisture soak, the specimens were subjected to the heat exposure described in paragraph 3.9.2.

3.9.2 Component Heat Resistance to Lead Free Reflow Soldering Testing

The specimens were placed on 4 x 6 x 0.0395 inch ceramic substrates and placed on a conveyor belt through a convection reflow oven. The specimens were exposed to temperatures between 150°C and 200°C for 60 to 180 seconds and between the temperatures of 255°C and 260°C for 20 to 40 seconds, and above liquidus (217°C) for 60 to 150 seconds. The specimens and substrates were allowed to cool to ambient temperatures and then run back through the oven a total of 3 times.

3.10 Thermal Shock

Unmated specimens were subjected to 5 cycles of thermal shock with each cycle consisting of 30 minute dwells at -55 and 85°C. The transition between temperatures was less than one minute. Testing was performed in accordance with EIA-364-32G.

3.11 Humidity/Temperature Cycling

Unmated specimens were exposed to 10 cycles of humidity-temperature cycling. Each cycle lasted 24 hours and consisted of cycling the temperature between 25°C and 65°C twice while maintaining high humidity. Testing was performed in accordance with EIA-364-31E.

3.12 Temperature Life

Mated specimens were subjected to 85°C for a duration of 250 hours. Testing was performed in accordance with EIA-364-17C.

3.13 Mixed Flowing Gas

The specimens were subjected to a 4-gas environment in accordance with EIA 364-65B, Class IIA for 14 days. Two specimens from each set were unmated for the first 7 days (receptacle only) and mated for the final 7 days. The remaining three specimens were mated for the entire 14-day exposure period.

3.14 Thermal Cycling

Mated and board mounted specimens were subjected to 10 temperature cycles between 15 ±3°C and 85±3°C as measured on the specimen. The ramp time was > 2°C per minute with dwell times long enough to ensure the contacts reached the temperature extremes (5 minutes minimum). Testing was performed in accordance with EIA-364-110.

3.15 Minute Disturbance

Specimens were mated and unmated 5 times by hand.

3.16 Final Examination of Product

Specimens were visually examined with the unaided eye. Testing was performed in accordance with EIA-364-18B.