Enhanced EVERCLEAR* Connector

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity Enhanced EVERCLEAR connector to determine its conformance to the requirements of Product Specification 108-2425, Revision A.

1.2 Scope

This report covers the electrical, mechanical and environmental performance of the Enhanced EVERCLEAR connector. Testing was performed at the Harrisburg Electrical Components Test Laboratory from May 28, 2010 to October 20, 2010 and January 14, 2013 to March 2, 2013. This documentation is on file at and available from the Harrisburg Electrical Components Test Laboratory under EA20100473 and EA20120613T.

1.3 Conclusion

All Part Numbers listed in Table 1 conformed to the electrical, mechanical and environmental performance requirements of Product Specification 108-2425, Revision A.

1.4 Product Description

The QSFP+ Enhanced EVERCLEAR Surface Mount Technology (SMT) connector interconnects with fiber optic or copper transceiver modules to host printed circuit boards (PCBs) used in the communications industry and peripheral component interconnect (PCI) applications. The connector has 38 positions with contact spacing on 0.8 mm centerlines. The card entry slot accepts 1.0 mm thick integrated circuit cards.

1.5 Test Specimens

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

Table 1 – Specimen Identification Information

Test Group	Quantity	Part Number	Description
1	5	2110819-2	Enhanced EVERCLEAR Connector, Au
2	5	2110819-3	Enhanced EVERCLEAR Connector, PdNi
3	5	2110819-2	Enhanced EVERCLEAR Connector, Au
3	5	2110819-3	Enhanced EVERCLEAR Connector, PdNi
4	5	2110819-3	Enhanced EVERCLEAR Connector, PdNi
5	5	2110819-3	Enhanced EVERCLEAR Connector, PdNi
6	5	2110819-3	Enhanced EVERCLEAR Connector, PdNi
1,2,3,4,6	30	1888631-3	QSFP Cage Assembly w/ Heat Sink/Clip
1,2,3,4,6	30	N/A	LLCR Transceiver
2,3,4	20	N/A	Blank LLCR Transceiver
1,2,3,6	25	60-1042052-2	Enhanced EVERCLEAR Test PCB

1.6 Qualification Test Sequence

Table 2 – Test Sequence

	Test Groups					
Test or Examination	1	2	3	4	5	6
	Test Sequence (a)					
Initial Examination of Product	1	1	1	1	1	1
Low Level Contact Resistance	3,7	2,4,6,8	2,4,6,8			2,4,6,8
Insulation Resistance				2,6		
Dielectric Withstanding Voltage				3,7		
Connector Solderability					2	
Random Vibration	5					
Mechanical Shock	6					
Durability	4(b)					
Plug Insertion Force	2					
Plug Extraction Force	8					
Thermal Shock				4(c)(d)		
Humidity-Temperature Cycling		7		5		
Temperature Life		3(c)(d)				
Mixed Flowing Gas			5			
Thermal Cycling						5
Dust						3(c)
Temperature Life, Preconditioning			3(c)(d)			
Minute Disturbance		5	7			7
Final Examination of Product	9	9	9	8	3	9

(a) The numbers indicate sequence in which tests were performed.
(b) Latches engaged
(c) Precondition specimens with 20 durability cycles with latches engaged.
(d) Mated to blank transceivers

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 and 5

All specimens were below the maximum delta R (ΔR) of 10 milliohms. Refer to Table 3 through Table 6 for the summary LLCR data.

Table 3 – LLCR Data in Milliohms, Test Group 1

Milliohms	Initial	After Vibe/Shock
	Actual	Delta R (ΔR)
Minimum	20.98	-1.56
Maximum	28.71	6.77
Mean	24.62	0.53
Std. Dev.	3.09	1.31
N =	190	190

NOTE The initial LLCR measurements contain values from rows of different lengths.

Table 4 – LLCR Data in Milliohms, Test Group 2

Milliohms	Initial	After Temp. Life	After Minute Disturbance	After Humidity/Temp. Cycling
	Actual	Delta R (ΔR)	Delta R (ΔR)	Delta R (ΔR)
Minimum	21.62	-0.56	-0.38	-0.73
Maximum	29.51	2.63	2.19	2.51
Mean	25.52	0.28	0.30	0.23
Std. Dev.	3.06	0.44	0.38	0.55
N =	190	190	190	190

NOTE The initial LLCR measurements contain values from rows of different lengths.

Table 5 – LLCR Data in Milliohms, Test Group 3

Milliohms	Initial	After Temp. Life, Preconditioning	After Mixed Flowing Gas	After Minute Disturbance
	Actual	Delta R (ΔR)	Delta R (ΔR)	Delta R (ΔR)
PdNi				
Minimum	21.26	-0.51	-0.50	-0.46
Maximum	29.33	2.49	1.37	6.07
Mean	25.32	0.41	0.22	0.78
Std. Dev.	2.99	0.48	0.33	0.85
N =	190	190	190	190
Au				
Minimum	21.61	-0.75	-0.66	-0.85
Maximum	28.81	0.74	2.33	1.86
Mean	25.05	0.07	0.09	0.27
Std. Dev.	2.95	0.25	0.31	0.39
N =	190	190	190	190

NOTE The initial LLCR measurements contain values from rows of different lengths.

Table 6 – LLCR Data in Milliohms, Test Group 6

Milliohms	Initial	After Dust Exposure	After Thermal Cycling	After Minute Disturbance
	Actual	Delta R (ΔR)	Delta R (ΔR)	Delta R (ΔR)
Minimum	21.89	-1.16	-1.31	-1.30
Maximum	29.59	4.54	1.69	1.71
Mean	25.64	-0.03	-0.23	-0.21
Std. Dev.	3.00	0.47	0.39	0.35
N =	190	190	190	190

NOTE The initial LLCR measurements contain values from rows of different lengths.

2.3 Insulation Resistance – Test Group 4

All insulation resistance measurements were greater than 1000 megohms ($1x10^9$ ohms).

2.4 Dielectric Withstanding Voltage – Test Group 4

No dielectric breakdown, flashover or leakage current exceeding 5 milliamperes occurred on any specimen.

2.5 Connector Solderability – Test Group 5

The specimens under evaluation exhibited a continuous solder coating, free from defects, over 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. The specimens contained both “gull wing” type and “bottom only” type terminations.

2.6 Random Vibration – Test Group 1

No discontinuities of one microsecond or greater were detected during vibration. Following vibration, no cracks, breaks, loose parts or apparent physical damage on the specimens were visible.

2.7 Mechanical Shock – Test Group 1

No discontinuities of one microsecond or greater were detected during mechanical shock. Following mechanical shock testing, no cracks, breaks, loose parts or apparent physical damage on the specimens were visible.

2.8 Durability – Test Group 1

No physical damage occurred to the specimens as a result of mating and unmating the specimens 250 times.

2.9 Plug Insertion Force – Test Group 1

All specimens were below the 55 N maximum insertion force with a heat sink and clip.

2.10 Plug Extraction Force – Test Group 1

All specimens were below the 45 N maximum extraction force with a heat sink and clip.

2.11 Thermal Shock – Test Group 4

No evidence of physical damage was visible as a result of exposure to thermal shock.

2.12 Humidity/Temperature Cycling – Test Group 2 and 4

No evidence of physical damage was visible as a result of exposure to humidity-temperature cycling.

2.13 Temperature Life – Test Group 2

No evidence of physical damage was visible as a result of exposure to temperature life.

2.14 Mixed Flowing Gas – Test Group 3

No evidence of physical damage was visible as a result of exposure to the pollutants of mixed flowing gas.

2.15 Thermal Cycling – Test Group 6

No evidence of physical damage was visible as a result of exposure to thermal cycling.

2.16 Dust – Test Group 6

No evidence of physical damage was visible as a result of exposure to dust.

2.17 Temperature Life, Preconditioning – Test Group 3

No evidence of physical damage was visible as a result of exposure to temperature life, preconditioning.

2.18 Minute Disturbance – Test Group 2, 3 and 6

No evidence of physical damage was visible as a result of unmating and mating each specimen.

2.19 Final Examination of Product – All Test Groups

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

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.

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. The positive voltage and current were applied to the board access connectors, while the negative voltage and current was applied to the transceiver cable. The PCB in the transceiver had only 2 leads attached and contact pads were bussed together.

3.3 Insulation Resistance

A 500 VDC potential was applied to adjacent contacts of unmated connectors for 2 minutes. After 2 minutes the insulation resistance was recorded. Specimens were tested on PCB (PN 60-1042052-2). Pairs of contacts were bussed together and tested to reduce the amount of testing. Contact pairs were bussed together at the press fit access connectors. See Figure 1.

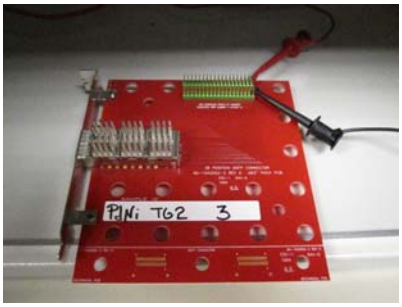

Figure – 1 IR & DWV Setup

3.4 Dielectric Withstanding Voltage

A 300 VAC was applied to adjacent contacts of unmated connectors. All even contacts were bussed together at the access connector. All odd contacts were bussed together at the access connector. Voltage was applied between the two bussed circuits at a rate of 500 volts per second and maintained for 1 minute. Specimens were tested on PCB (PN 60-1042052-2). See Figure 1.

3.5 Connector Solderability

Prior to testing, specimens were prepared by removing the locating studs. This was done to enable the specimens to sit flush on the ceramic substrate. A solder paste with a composition of 96.5% Ag, 3% Sn, & 0.5% Cu, RMA, Visc./KCPS 1000 ±10%, with a mesh of –325 +500 was then placed onto a stencil with pad geometry, opening, and thickness that was appropriate for the specimens being tested. The stencil was supplied with the specimens. The solder paste was printed onto a 4 x 6 inch ceramic substrate. The screen was removed and the specimens were placed onto the solder paste print under appropriate magnification. Care was taken to ensure that the specimens were not contaminated in any way and were tested in the “as received” condition. The specimens and ceramic substrates were placed on a conveyor belt through an infrared oven. The specimens were exposed to 60-120 seconds between the temperatures of 150°C and 180°C and to 30-60 seconds between the temperatures of 230°C and 250°C as specified in J-STD-002. The temperature on the ceramic substrate, at a point close to the specimen, was monitored to enable temperature profiling. All specimens were examined using a microscope for solder wetting. Specimens with a pitch >0.5mm were examined at 10X, and specimens with a pitch of 0.5mm or less were examined at 30X as applicable. Figure 2 illustrates the temperature profile.

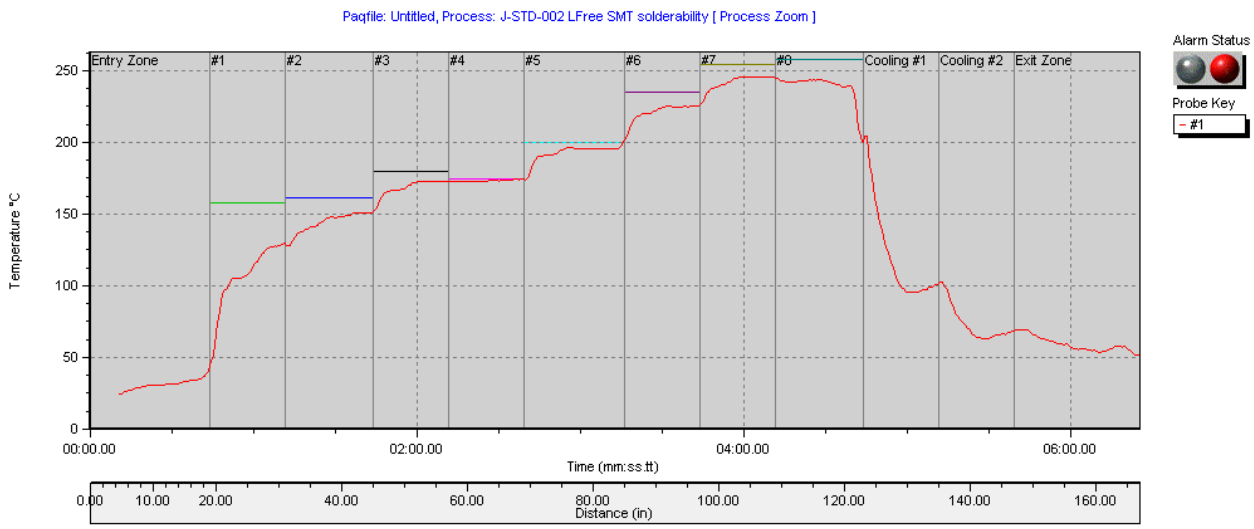

Figure 2 – Solderability Profile

3.6 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”. Refer to Figure 3 for typical vibration setup photographs. The parameters of this test condition are specified by a random vibration spectrum with excitation frequency bounds of 20 and 500 Hertz (Hz). The spectrum remains flat at 0.02 G^2/Hz from 20 Hz to the upper bound frequency of 500 Hz. The root-mean square amplitude of the excitation was 3.10 GRMS. The test specimens were subjected to this test for 15 minutes in each of the three mutually perpendicular axes, for a total test time of 45 minutes per test specimen. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

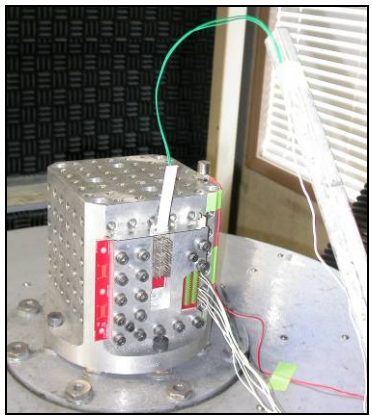

Figure 3 – Typical Vibration & Shock Setup

3.7 Mechanical Shock

The test specimens were subjected to a mechanical shock test as stated in accordance with specification EIA-364-27C, test condition A. See Figure 3 for a typical mechanical shock setup image. The parameters of this test condition are a half-sine waveform with an acceleration amplitude of 50 gravity units (g's peak) and a duration of 11 milliseconds. 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.

3.8 Durability

Specimens were mated and unmated for 250 cycles by hand at a maximum rate of 500 cycles per hour with the cage latch operable.

3.9 Plug Insertion Force

Specimens were mounted vertically in a vise. An aluminum block was placed under the cage to support it during testing. The cable module was started into the cage but not fully inserted. Using a slotted plate fixture attached to the moveable crosshead of a tensile/compression machine, force was applied at a rate of 0.25 inches per minutes to the back of the cable module. The force was applied until the module was completely mated. Refer to Figure 4 for an image of the test setup.

Figure 4 – Typical Plug Insertion Force Test Setup

3.10 Plug Extraction Force

Specimens were mounted vertically in a vise. The latching mechanism was disabled by pulling the tab to disengage the latching mechanism and then taping it to the strain relief to keep it disengaged. The tab was placed into a wedge clamp and then force was applied in an upward direction until the module was completely unmated. Refer to Figure 5 for an image of the typical test setup.

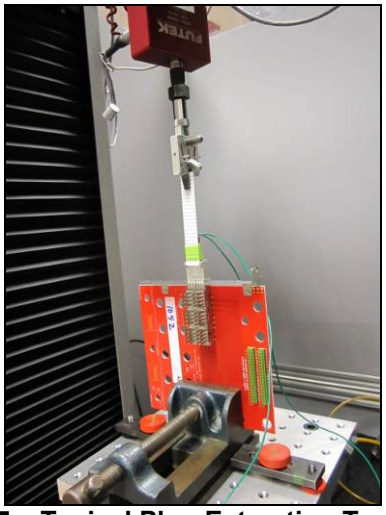

Figure 5 – Typical Plug Extraction Test Setup

3.11 Thermal Shock

Mated specimens were subjected to 10 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. Specimens were preconditioned with 20 cycles of durability.

3.12 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.

3.13 Temperature Life

Mated specimens (w/ blank transceivers) were exposed to a temperature of 90°C for 840 hours.

3.14 Mixed Flowing Gas

All specimens were subjected to a Mixed Flowing Gas test in accordance with EIA 364-65B. Test parameters listed in Table 7. The test specimens consisted of 10 connector assemblies. Half of the specimens were exposed in the unmated condition for the first 7 days (receptacle half exposed) and mated for the final 7 days and half were exposed in the mated condition for the test duration. No LLCR measurements were required during the exposure.

Table 7 – MFG Test Parameters

Environment	Class IIA
Temperature (^{0}C)	**30 ± 1**
Relative Humidity (%)	**70 ± 2**
Chlorine (Cl2) Concentration (ppb)	**10 ± 3**
Hydrogen Sulfide (H2S) Concentration (ppb)	**10 ± 5**
Nitrogen Dioxide (NO2) Concentration (ppb)	**200 ± 50**
Sulfur Dioxide (SO2) Concentration (ppb)	**100 ± 20**
Exposure Period	**14 Days**

3.15 Thermal Cycling

Mated specimens were subjected to 10 cycles between 15 and 85°C as measured on the specimen. Ramp time was 2°C per minute minimum with 30 minute dwells at temperature extremes. Humidity was not controlled.

3.16 Dust

Prior to exposure, the dust composition #1 (Benign) was placed in a container and evenly spread. The dust was placed in an oven and dried at 50 °C for 1 hour. A dust mass of 9 grams per cubic foot of chamber volume or a total of 120 grams was used. Unmated specimens were placed in the dust chamber at various orientations as shown in Figure 4. The chamber had an air flow rate of 1000 ft/minute. The specimens were exposed for 1 hour. Following the exposure the specimens remained in the chamber for an additional hour. Each specimen was tapped 5 times for removal of excess dust. Refer to Figure 6 for a typical test setup image.

Figure 6 – Typical Dust Test Setup

3.17 Temperature Life, Preconditioning

Mated specimens (w/ blank transceivers) were exposed to a temperature of 90°C for 360 hours.

3.18 Minute Disturbance

Specimens were unmated and mated one time by hand.

3.19 Final Examination of Product

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.