Fortis Zd* LRM Connector System

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity (TE) Fortis Zd* LRM Connector System to determine its conformance to the requirements of 108-2474 Rev A.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of the TE Fortis Zd LRM Connector System. Testing was performed at the TE Harrisburg Electrical Components Test Laboratory between April 1, 2013 and September 16, 2013. This documentation is on file and available from the TE Harrisburg Electrical Components Test Laboratory under EA20130154T.

1.3 Conclusion

The TE Fortis Zd LRM Connector System listed in paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of 108-2474 Rev A.

1.4 Product Description

TE Fortis Zd LRM Connector System uses a modular concept, two metal shells with multiple cavities that connect two printed circuit boards (PCBs). It has a matrix configuration of nine modules maximum combining between any number of Fortis Zd, Low Power (UPM Style), and High Power (MBXL Style) modules. The Fortis Zd module is a three pair differential pair connector, the Low Power (LP) module is a five-position power connector, and the High Power (HP) module is a two position power connector. All Fortis Zd, LP, and HP modules (receptacle and plug) have compliant terminations for connecting between two PCBs.

1.5 Test Specimens

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

Table 1 – Specimen Identification

Test Group (a)	Quantity	Part Number	Rev	Description
1,2,3	3 each	2102427-1	4	Right Angle Shell (b)
1,2,3	3 each	2102428-1	6	Vertical Shell (b)
1,2,3	12 each	2102436-3	6	Right Angle Fortis Zd Module
1,2,3	12 each	2102438-2	3	Vertical Fortis Zd Module
1,2,3	6 each	2102440-2	5	Right Angle HP Module
1,2,3	6 each	2102442-1	4	Vertical HP Module
1,2,3	6 each	2102444-1	7	Right Angle LP Module
1,2,3	6 each	2102446-1	3	Vertical LP Module
1,2,3	3 each	2102449-1	4	Blank Module
1,2,3	6 each	2102783-1	1	Right Angle Key
1,2,3	6 each	2102784-1	1	Vertical Key
1,2,3	12 each	2226170-1	1	Fortis Zd LRM Screw, T8 Six Lobe Drive

NOTE *(a) Specimens mounted to motherboard part number 60-1042998-1 Rev B and daughter card part number 60-1042999-1 Rev A for test group 1 and test group 3. Printed circuit boards consisted of 6 layers: 2 layers contained 5 ounce copper traces for energizing the HP modules and 2 layers contained 4 ounce copper traces for energizing the LP modules.*

(b) Shell contained 4 Fortis Zd modules, 2 HP modules, 2 LP modules and 1 blank module.

1.6 Qualification Test Sequence

Table 2 - Test Sequence

Test or Examination	Test Group		
	1	2	3
	Test Sequence (a)		
Initial Examination of Product	1	1	1
Low Level Contact Resistance (LLCR)	3,7,9,12,15		2,5
Insulation Resistance		2,6	
Dielectric Withstanding Voltage		3,7	
Temperature Rise vs Current	4,13		
Shell to Shell grounding			3,7
Vibration	10 (b)		
Mechanical Shock	11		
Durability, 50 Cycles	5		
Durability, 450 Cycles	14		
Mating Force	2		
Unmating Force	16		
Bench handling			4
Thermal Shock		4	
Humidity-Temperature Cycling		5	
Temperature Life	8		
Mixed flowing gas	6		
Salt fog			6
Final Examination of Product	17	8	8

NOTE
(a) Numbers indicate sequence in which tests were performed.
(b) HP contacts were energized at 18°C current level during vibration.

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 Visual Examination - All 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 LLCR – Groups 1, 3

2.2.1 LLCR, Fortis Zd Signal and Ground Contacts

All LLCR measurements taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 30 milliohms initially and had a change in resistance (ΔR) of less than 10 milliohms after testing for Fortis Zd signal and ground contacts.

Table 3 – LLCR, Fortis Zd Signal Contacts (milliohms)

Test Group	Number of Data Points	Condition	Min	Max	Mean	Std Dev
1	144	Initial	11.85	27.02	19.10	4.73
		After mixed flowing gas (ΔR)	-0.66	0.51	-0.08	0.18
		After temp life (ΔR)	-0.85	0.64	-0.17	0.23
		After mechanical shock (ΔR)	-0.39	6.56	0.80	1.31
		After final durability (ΔR)	-0.80	0.83	0.15	0.30
3	144	Initial	12.02	27.08	19.20	4.61
		After bench handling (ΔR)	-0.75	0.74	0.16	0.21

NOTE *Fortis Zd signal contact data contains multiple rows of contacts with varying bulk resistance.*

Table 4 – LLCR, Fortis Zd Ground Contacts (milliohms)

Test Group	Number of Data Points	Condition	Min	Max	Mean	Std Dev
1	24	Initial	11.44	16.88	14.98	1.79
		After mixed flowing gas (ΔR)	-0.95	0.32	-0.16	0.32
		After temp life (ΔR)	-0.84	0.66	-0.09	0.36
		After mechanical shock (ΔR)	-0.44	2.18	0.40	0.57
		After final durability (ΔR)	-0.36	1.21	0.26	0.35
3	24	Initial	11.69	17.51	15.16	1.81
		After bench handling (ΔR)	-0.05	0.74	0.30	0.21

2.2.2 LLCR , HP Contacts

All LLCR measurements taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 10 milliohms initially and 20 milliohms after testing for HP contacts.

Table 5 – LLCR, HP Contacts (milliohms)

Test Group	Number of Data Points	Condition	Min	Max	Mean	Std Dev
1	12	Initial	0.20	0.24	0.21	0.01
		After mixed flowing gas	0.22	0.35	0.27	0.05
		After temp life	0.22	0.33	0.26	0.03
		After mechanical shock	0.22	0.31	0.26	0.03
		After final durability	0.23	0.44	0.30	0.06
3	12	Initial	0.21	0.25	0.22	0.01
		After bench handling	0.21	0.25	0.23	0.01

2.2.3 LLCR, LP Contacts

All LLCR measurements taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 5 milliohms for LP contacts.

Table 6 – LLCR, LP Contacts (milliohms)

Test Group	Number of Data Points	Condition	Min	Max	Mean	Std Dev
1	30	Initial	0.53	0.77	0.65	0.06
		After mixed flowing gas	0.51	0.68	0.60	0.04
		After temp life	0.57	0.91	0.71	0.08
		After mechanical shock	0.52	0.77	0.64	0.07
		After final durability	0.52	0.74	0.62	0.05
3	30	Initial	0.61	0.80	0.72	0.05
		After bench handling	0.59	0.92	0.70	0.08

2.3 Insulation Resistance – Group 2

All insulation resistance measurements were greater than 10,000 megohms initially, and greater than 5,000 megohms after testing.

2.4 Withstanding Voltage – Group 2

No dielectric breakdown or flashover occurred. Leakage current was less than 5 milliamperes.

2.5 Temperature Rise vs. Current – Group 1

Specimens had less than a 30 degree C temperature rise with HP contacts energized at 55 amps DC.

2.6 Shell to Shell Grounding – Group 3

All shell to shell resistance measurements were less than 4 milliohms.

2.7 Random Vibration – Group 1

Specimens showed no apparent physical damage while energizing HP contacts during vibration. No discontinuities were detected for Fortis Zd and LP contacts. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

2.8 Mechanical Shock – Group 1

No discontinuities were detected during mechanical shock testing. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

2.9 Durability – Group 1

No physical damage occurred to the specimens as a result of initially mating and unmating the specimens 50 times and after an additional 450 times.

2.10 Mating Force – Group 1

Mating force was less than 430N, which was the connector sum of maximum per contact requirements for the Fortis Zd (1.11N), HP (5.0N) and LP (1.0N) modules.

2.11 Unmating Force – Group 1

Unmating force was greater than 158N, which was the connector sum of minimum per contact requirements for the Fortis Zd (0.4N), HP (2.2N) and LP (0.5N) modules.

2.12 Bench Handling – Group 3

No physical damage occurred to the specimens as a result of performing bench handling test.

2.13 Thermal Shock – Group 2

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

2.14 Humidity/Temperature Cycling – Group 2

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

2.15 Temperature Life – Group 1

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

2.16 Mixed Flowing Gas – Group 1

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

2.17 Salt Fog – Group 3

No evidence of corrosion was visible as a result of exposure to salt fog atmosphere.

2.18 Final Visual Examination – All Groups

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

3. TEST METHODS

3.1 Initial Visual Examination

A Certificate of Conformance was issued stating that all specimens in this test package were produced, inspected, and accepted as conforming to product drawing requirements, and were manufactured using the same core manufacturing processes and technologies as production parts. Where specified, specimens were visually examined and no evidence of physical damage detrimental to product performance was observed. Testing was performed in accordance with EIA-364-18B.

3.2 LLCR

LLCR measurements were made using a 4 terminal measurement technique at a test current of 100 milliamperes maximum and a 20 millivolt maximum open circuit voltage. Current was supplied to the PCBs through individual series wired circuits for each of the HP, LP and Fortis Zd connector modules. Voltage probe points were on the backplane and daughter card PCBs. Testing was performed in accordance with EIA-364-23C.

3.3 Insulation Resistance

Mated and unmounted connectors were subjected to insulation resistance measurements between adjacent contacts and contact to shell. A 500 volt DC potential was applied and maintained for a maximum of 2 minutes. Testing was performed in accordance with EIA-364-21D.

3.4 Withstanding Voltage

Mated and unmounted connectors were subjected to dielectric withstanding voltage between adjacent contacts and contact to shell. A 750 volt AC RMS potential was applied at a rate of approximately 500 volts per second and maintained for a period of 1 minute. Testing was performed in accordance with EIA-364-20D.

3.5 Temperature Rise vs. Current

Temperature rise measurements for mated and mounted specimens were obtained while series energizing both contacts of the 2-position HP module. Thermocouples were mounted with thermally conductive epoxy to the inside contact of both HP modules for each specimen. Testing was performed in accordance with EIA-364-70B.

3.6 Shell to Shell Grounding

Shell to shell resistance measurements were taken using a 4 terminal measurement technique at a test current of 1 ampere and 1.5 volts maximum. Current was applied to the keying post mounting screws and one of the shell/PCB mounting screws on the vertical backplane connector and one of the center shell mounting screws on the right angle daughter card connector. Voltage probe points were on one of the vertical backplane connector shell/PCB mounting screws and on one of the mounting holes located on the right angle daughter card connector shell. This configuration measured resistance across both keying posts and the connector shells in parallel. Testing was performed on mated and mounted connectors in accordance with EIA-364-83 dated August 1999.

3.7 Random Vibration

Mated specimens were subjected to a random vibration test specified by a random vibration spectrum with excitation frequency bounds of 50 and 2000 Hertz (Hz). The power spectral density (PSD) at 50 Hz was 0.05 G^2/Hz. The spectrum sloped up at 6 dB per octave to a PSD of 0.2 G^2/Hz at 100 Hz. The spectrum was flat at 0.2 G^2/Hz from 100 Hz to 1000 Hz. The spectrum sloped down at 6 dB per octave to a PSD of 0.05 G^2/Hz at the upper bound frequency of 2000 Hz. The root-mean square amplitude of the excitation was 16.91 GRMS. This was performed for 8 hours in each of the three mutually perpendicular planes, for a total vibration time of 24 hours. The HP contacts were energized with a DC current of 60.8 amperes during test. The contacts of the Fortis Zd and LP connectors were monitored for discontinuities of one microsecond or greater using a current of 100 milliamperes DC. Testing was performed in accordance with EIA-364-28F, test condition V, condition letter E.

3.8 Mechanical Shock

Mated specimens were subjected to a mechanical shock test having a sawtooth waveform of 100 gravity units (g peak) and a duration of 6 milliseconds. Three shocks in each direction were applied along the three mutually perpendicular planes for a total of eighteen shocks. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 millamperes DC. Testing was performed in accordance with EIA-364-27C, method G.

3.9 Durability

Specimens were mated and unmated 50 times prior to environmental exposure. After environmental exposure, specimens were mated and unmated 450 additional times. Specimens were mated and unmated at a maximum rate of 250 cycles per hour. Testing was performed in accordance with EIA-364-9C.

3.10 Mating Force

The force required to mate mounted specimens was measured using a tensile/compression device with a free floating fixture at a maximum rate of travel of 12.7 mm [0.5 inch] per minute. Maximum force prior to connector bottoming was recorded. Testing was performed in accordance with EIA-364-13E.

3.11 Unmating Force

The force required to unmate mounted specimens was measured using a tensile/compression device with a free floating fixture at a maximum rate of travel of 12.7 mm [0.5 inch] per minute. Testing was performed in accordance with EIA-364-13E.

3.12 Bench Handling

Unmated motherboard and daughter card PCB mounted specimens were subjected to a bench drop test onto a solid wood bench top at least 4.25 cm [1.67 inch] thick. The bench drop test consisted of raising one edge of the PCB mounted specimen to the lesser of a height of 122 mm [4.8 inch] or a 45 degrees angle between the PCB and the bench top, while allowing the opposite edge of the PCB to remain at rest on the bench as a pivot. The upper edge of the PCB was released to allow the specimen to drop to a static position toward the largest flat surface. This was conducted for each of the four edges of the PCB with the specimen mounted on the top of the PCB and repeated again for each of the four edges with the specimen mounted on the bottom of the PCB for a total of 8 bench drops for each of the unmated and mounted specimens. Testing was conducted per MIL-STD-810G, method 516.6, procedure VI.

3.13 Thermal Shock

Mated and unmounted specimens were subjected to 500 cycles of thermal shock with each cycle consisting of 30-minute dwells at -65 and 125°C. The transition time between temperatures was less than one minute. Testing was performed in accordance with EIA-364-32F, Method A.

3.14 Humidity/Temperature Cycling

Mated and unmounted specimens were exposed to 10 humidity/temperature cycles. Each cycle lasted 24 hours and consisted of cycling between 25 and 65°C twice while maintaining high humidity. During five of the first nine cycles, the specimens were exposed to a cold shock at –10°C for 3 hours (Figure 1). Testing was performed in accordance with EIA-364-31C, Method III.

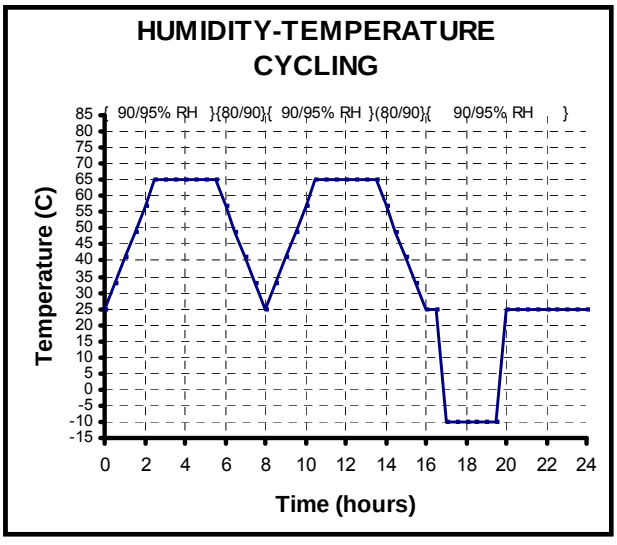

Figure 1 – Typical Humidity-Temperature Cycling Profile

3.15 Temperature Life

Mated and mounted specimens were subjected to a temperature of 125°C for 1000 hours in an air-circulating oven. Testing was performed in accordance with EIA-364-17C, Method A.

3.16 Mixed Flowing Gas

Mated and mounted specimens were subjected to a mixed flowing gas Class IIA exposure for 20 days. Class IIA exposure is defined as a temperature of 30°C and a relative humidity of 70% with the pollutants of Cl_2 at 10 ppb, NO_2 at 200 ppb, H_2S at 10 ppb, and SO_2 at 100 ppb. Testing was performed in accordance with EIA-364-65B.

3.17 Salt Fog

Mated and mounted specimens were subjected to 5% salt-laden atmosphere for 48 hours in an enclosure with drain holes simulating a plug-in unit. Testing was performed in accordance with EIA-364-26B Condition B.

3.18 Final Visual Examination

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed. Testing was performed in accordance with EIA-364-18B.