Fortis Zd* EMI Shield Connector Qualification

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity (TE) Fortis Zd* EMI Shield Connector to determine its conformance to the requirements of Design Objective 108-2409-1 Rev. A.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of the Fortis Zd EMI Shield Connector. Testing was performed at the Harrisburg Electrical Components Test Laboratory (HECTL) between August 12 and December 2, 2015. Shielding Effectiveness testing was performed at the Harrisburg EME Test Laboratory between September 10 and November 23, 2015. The test file number for this testing is EA20150431T. This documentation is on file at and available from the Harrisburg Electrical Component Test Laboratory.

1.3 Conclusion

The Fortis Zd EMI Shield Connector listed in paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of Design Objective 108-2409-1 Rev. A.

1.4 Product Description

The Fortis Zd EMI Shield Connector features enhanced EMI performance over the standard product. The connector system includes a shielded right-angle connector and a shielded vertical connector. The shielded product comes in 2 and 3-pair heights and can vary in length from 10 to 60 columns in 10-column increments.

1.5 Test Specimens

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

Table 1 – Specimen Identification

Test Group	Qty	Part #	Description
1	5 each	2102247-6 Rev. 5	Daughter card module, 60 column
		2102248-6 Rev. 4	Backplane module, 60 column
2	5 each	2102247-6 Rev. 5	Daughter card module, 60 column
		2102248-6 Rev. 4	Backplane module, 60 column
3	5 each	2102247-6 Rev. 5	Daughter card module, 60 column
		2102248-6 Rev. 4	Backplane module, 60 column
4	5 each	2102247-3 Rev. 5	Daughter card module, 30 column
		2102248-3 Rev. 4	Backplane module, 30 column

NOTE *(a) Test groups 1, 2, and 3 mounted on daughter card 60-1824076-2 Rev. A and backplane 60-1824075-2 Rev. A.*
(b) Test group 4 mounted on EMI daughter card 2102999-A Rev. 03 and EMI backplane 2102999-B Rev. 03.

1.6 Qualification Test Sequence

Table 2 - Test Sequence

Test or Examination	Test Group			
	1	2	3	4
	Test Sequence (a)			
Initial Examination of Product	1	1	1	1
Low Level Contact Resistance (LLCR)	3,6,8,10,12	2,4,6	2,4	
Shielding Effectiveness				2,4
Durability	5			
Random Vibration	7			
Mechanical Shock	9			
Mating Force	2			
Unmating Force	4			
Thermal Shock		3 (b)		
Humidity/Temperature Cycling		5		
Temperature Life			3 (b)	3 (b)
Salt Fog	11			
Final Examination of Product	13	7	5	5

NOTE *(a) Numbers indicate sequence in which test was performed.*
(b) Specimens preconditioned with 10 cycles of durability.

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 (C of C) 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 – Test Groups 1,2,3

2.2.1 LLCR, Signal and Ground Terminations

All low level contact resistance 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. Data is presented in Tables 3 through 5.

Table 3 – Test Group 1, Signal and Ground LLCR (milliohms)

Test Group 1	Initial	Durability	Vibration	Mechanical Shock	Salt Fog
	Actual	ΔR	ΔR	ΔR	ΔR
Signal Contacts (a)					
Min	11.20	-2.11	-1.93	-2.03	-2.02
Max	26.61	0.31	0.34	0.29	0.26
Avg	18.84	-0.46	-0.41	-0.39	-0.43
Stdev	4.65	0.41	0.40	0.39	0.40
Nv / Nr	360 /360	360 /360	360 /360	360 /360	360 /360
Ground Contacts (a)					
Min	12.38	-1.39	-1.28	-1.31	-4.34
Max	20.95	0.27	0.49	0.27	0.36
Avg	16.01	-0.47	-0.38	-0.37	-0.76
Stdev	2.15	0.36	0.36	0.34	1.09
Nv / Nr	60 / 60	60 / 60	60 / 60	60 / 60	60 / 60

NOTE (a) *Data represents combined sets of right-angle row contacts with different bulk resistance.*

Table 4 – Test Group 2, Signal and Ground LLCR (milliohms)

Test Group 2	Initial	Thermal Shock	Humidity-temperature
	Actual	ΔR	ΔR
Signal Contacts (a)			
Min	11.18	-3.03	-3.04
Max	26.71	7.82	2.07
Avg	18.85	0.13	0.19
Stdev	4.69	0.75	0.55
Nv / Nr	360 /360	357 / 360 (b)	354 / 360 (b)
Ground Contacts (a)			
Min	12.47	-0.92	-3.18
Max	20.95	9.06	3.50
Avg	16.13	1.46	1.46
Stdev	2.26	1.25	1.10
Nv / Nr	60 / 60	59 / 60 (b)	56 / 60 (b)

NOTE (a) *Data represents combined sets of right-angle row contacts with different bulk resistance.*
(b) High resistance data caused by ruptured PCB traces were removed from data summary.

Table 5 – Test Group 3, Signal and Ground LLCR (milliohms)

Test Group 3	Initial	Temp Life
	Actual	ΔR
Signal Contacts (a)		
Min	11.25	-3.51
Max	27.13	0.86
Avg	18.98	-0.25
Stdev	4.71	0.42
Nv / Nr	360 /360	360 /360
Ground Contacts (a)		
Min	12.26	-2.01
Max	20.88	1.14
Avg	16.33	-0.06
Stdev	2.25	0.55
Nv / Nr	60 / 60	60 / 60

NOTE (a) *Data represents combined sets of right-angle row contacts with different bulk resistance.*

2.2.2 LLCR, Shield Ground Plane Termination

All shield ground plane LLCR measurements taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 100 milliohms. Data is presented in Tables 6 through 8.

Table 6 – Test Group 1, Shield Ground Plane LLCR (milliohms)

Test Group 1	Initial	Durability	Vibration	Mechanical Shock	Salt Fog
	Actual	Actual	Actual	Actual	Actual
Shield Ground Plane, Single Termination					
Min	6.89	21.44	16.02	17.02	15.10
Max	19.26	59.40	41.05	63.19	59.05
Avg	15.15	36.95	26.79	34.98	30.82
Stdev	3.67	15.76	8.39	20.01	16.14
Nv / Nr	10 / 10	10 / 10	10 / 10	10 / 10	10 / 10
Shield Ground Plane, Common Terminations					
Min	9.21	16.87	10.13	10.13	9.24
Max	12.23	46.60	40.80	57.50	66.03
Avg	10.76	29.35	22.01	26.80	28.13
Stdev	1.18	12.56	12.88	19.89	22.78
Nv / Nr	5 / 5	5 / 5	5 / 5	5 / 5	5 / 5

Table 7 – Test Group 2, Shield Ground Plane LLCR (milliohms)

Test Group 2	Initial	Thermal Shock	Humidity-temperature
	Actual	Actual	Actual
Shield Ground Plane, Single Termination			
Min	12.65	13.91	25.33
Max	21.26	20.97	60.51
Avg	16.73	16.98	41.63
Stdev	2.94	2.29	10.45
Nv / Nr	10 / 10	10 / 10	10 / 10
Shield Ground Plane, Common Terminations			
Min	7.26	5.68	15.43
Max	15.51	12.82	53.78
Avg	12.00	8.32	34.87
Stdev	3.49	2.68	13.68
Nv / Nr	5 / 5	5 / 5	5 / 5

Table 8 – Test Group 3, Shield Ground Plane LLCR (milliohms)

Test Group 3	Initial	Temp Life
	Actual	Actual
Shield Ground Plane, Single Termination		
Min	11.83	11.86
Max	25.24	24.07
Avg	16.49	17.03
Stdev	4.47	4.16
Nv / Nr	10 / 10	10 / 10
Shield Ground Plane, Common Terminations		
Min	8.02	7.09
Max	16.52	12.76
Avg	10.44	10.77
Stdev	3.53	2.69
Nv / Nr	5 / 5	5 / 5

2.3 Shielding Effectiveness – Test Group 4

Shielding Effectiveness was characterized by plots and are presented in Figure 1 and Figure 2.

2.3 Shielding Effectiveness – Test Group 4 (cont'd)

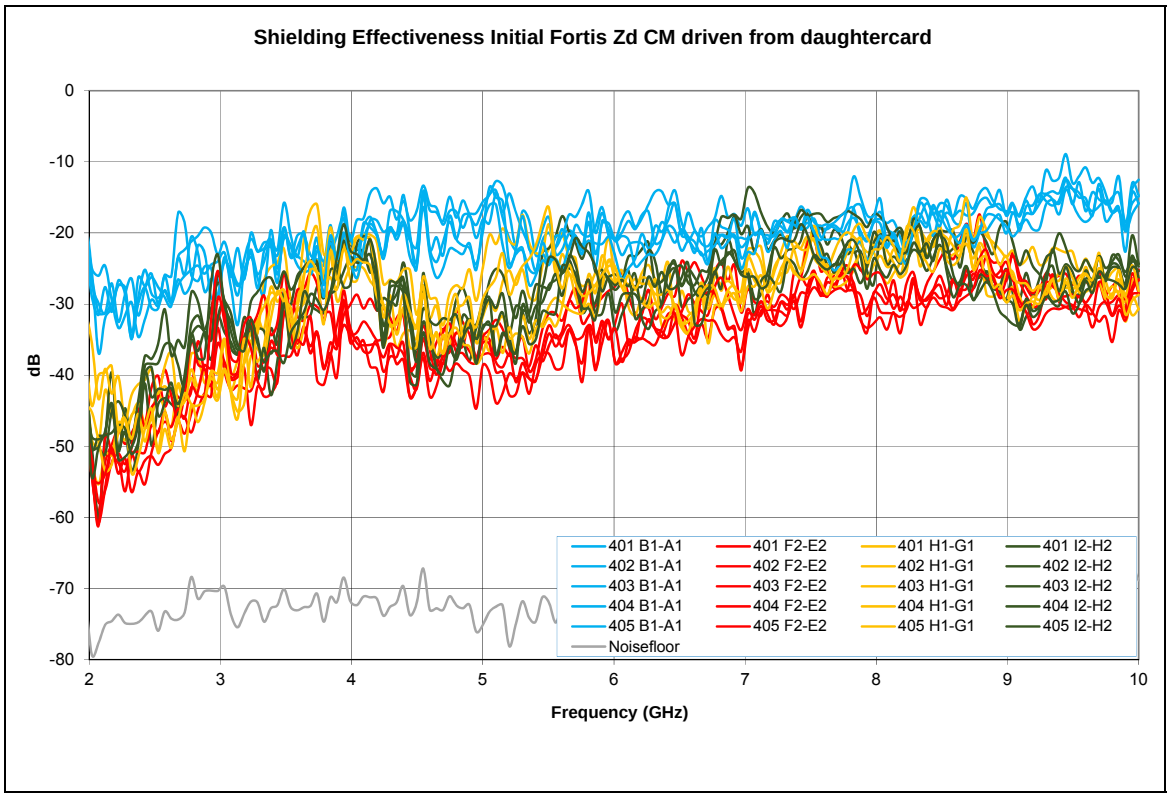

Figure 1 – Initial Shielding Effectiveness

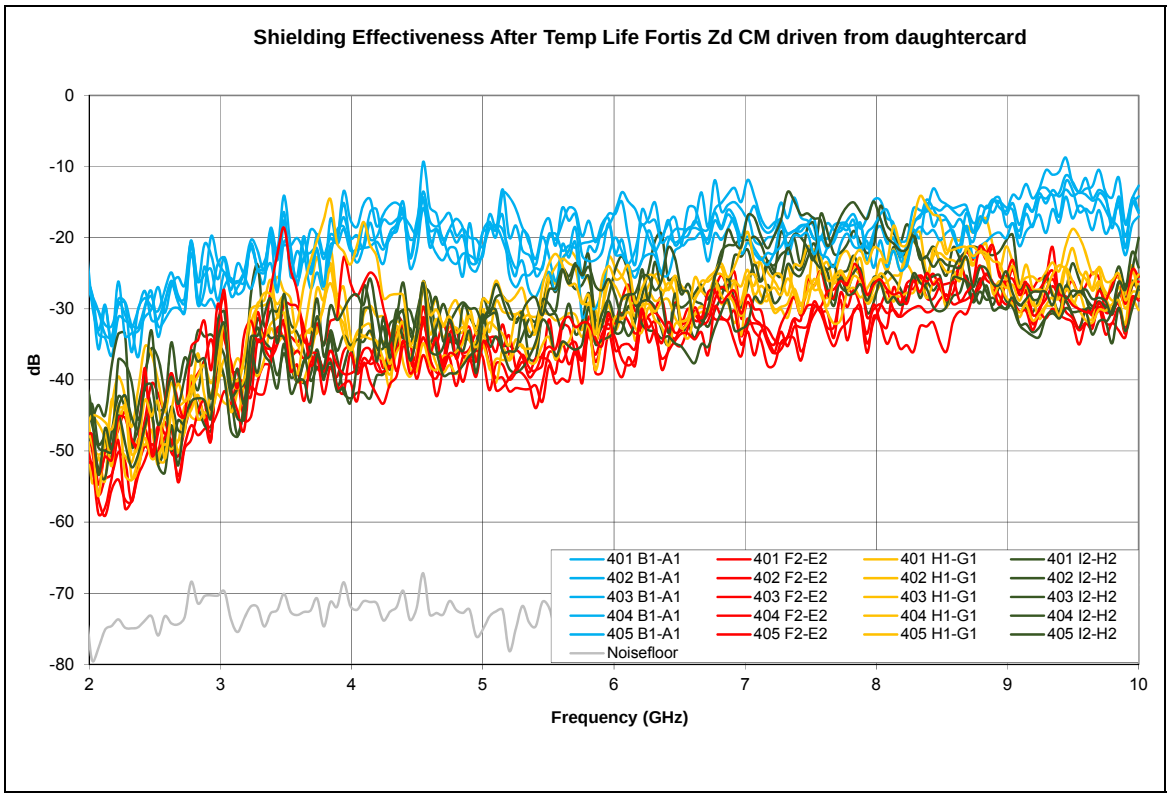

Figure 2 – Final Shielding Effectiveness, after Temperature Life

2.4 Durability – Test Group 1

No physical damage occurred to the specimens as a result of mating and unmating the specimens 500 times.

2.5 Random Vibration – Test Group 1

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

2.6 Mechanical Shock – Test Group 1

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

2.7 Mating Force – Test Group 1

All mating force measurements were less than 1.1 N (4.0 ozf) maximum average per signal and ground contact.

2.8 Unmating Force – Test Group 1

All unmating force measurements were greater than 0.4 N (1.44 ozf) maximum average per signal and ground contact.

2.9 Thermal Shock – Test Group 2

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

2.10 Humidity/Temperature Cycling – Test Group 2

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

2.11 Temperature Life – Test Groups 3,4

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

2.12 Salt Fog – Test Group 1

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

2.13 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 Examination of Product (EIA-364-18B)

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. Where specified, specimens were visually examined with the unaided eye, corrected to normal vision.

3.2 Low Level Contact Resistance (EIA-364-23C)

Low level contact resistance measurements at low level current were made using a four terminal measuring technique (Figure 3). The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage.

Figure 3 – Typical Low Level Contact Resistance Measurement Points

3.3 Shielding Effectiveness (EIA-364-66A)

Shielding effectiveness of mated specimens was characterized with plots between 2 GHz to 10 GHz.

3.4 Durability (EIA-364-09C)

Specimens were mated and unmated 500 times at a maximum rate of 500 cycles per hour.

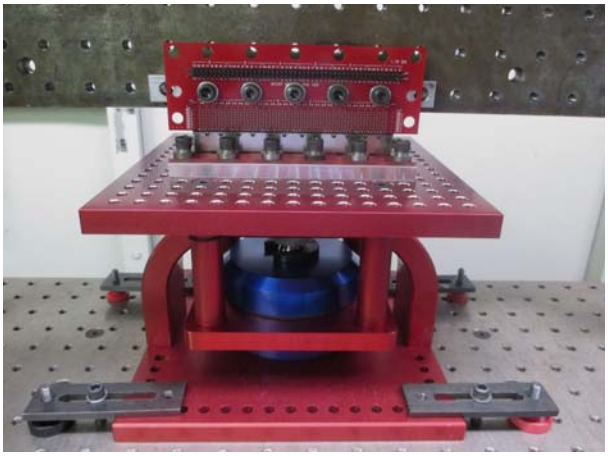

Figure 4 – Durability Setup

3.5 Random Vibration (EIA-364-28F, test condition V, test condition letter E)

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 is 0.050 G^2/Hz. The spectrum slopes up at 6 dB per octave to a PSD of 0.20 G^2/Hz at 100 Hz. The spectrum is flat at 0.20 G^2/Hz from 100 Hz to 1000 Hz. The spectrum slopes down at 6 dB per octave to a PSD of 0.050 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 three mutually perpendicular planes for a total vibration time of 24 hours. Specimens were monitored for discontinuities of one microsecond or greater using a current of 100 milliamperes in the monitoring circuit.

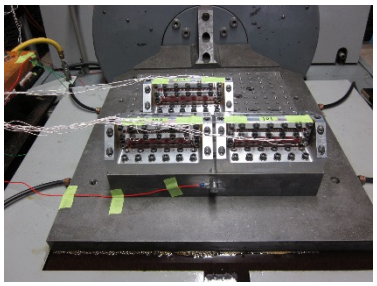

Figure 5 – Vibration Setup

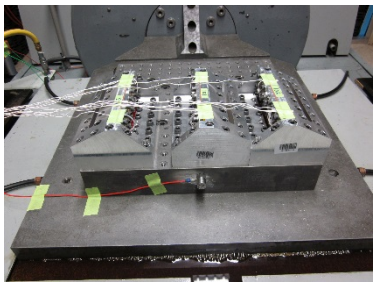

Figure 6 – Vibration Setup

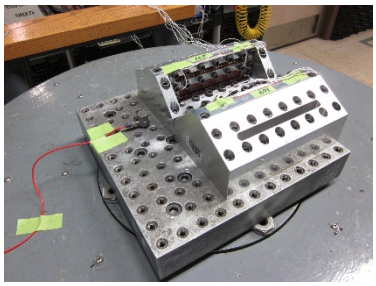

Figure 7 – Vibration Setup

3.6 Mechanical Shock (EIA-364-27C, test condition G)

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 18 shocks. Specimens were monitored for discontinuities of one microsecond or greater, using a current of 100 milliamperes DC.

3.7 Mating Force (EIA-364-13E, method A)

The force required to mate individual specimens was measured using a tensile/compression device with the rate of travel at 0.5 inch/minute and a free floating fixture. The average force per individual signal and ground contact was calculated.

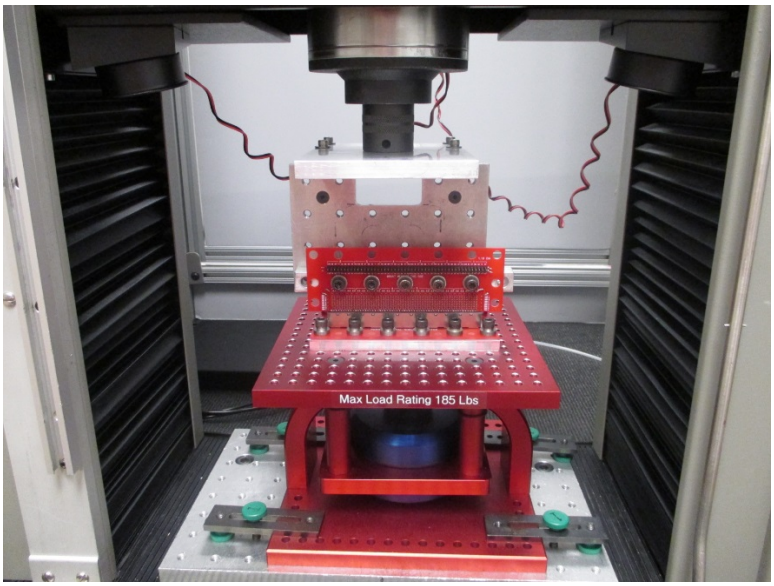

Figure 8 – Mating/Unmating Force Setup

3.8 Unmating Force (EIA-364-13E, method A)

The force required to unmate individual specimens was measured using a tensile/compression device with the rate of travel at 0.5 inch/minute and a free floating fixture. The average force per individual signal and ground contact was calculated.

3.9 Thermal Shock (EIA-364-32G)

Mated specimens were subjected to 500 cycles of thermal shock with each cycle consisting of 1 hour dwells at -65 and 125°C. The transition between temperatures was less than one minute. Specimens were preconditioned with 10 cycles of durability.

3.10 Humidity/Temperature Cycling (EIA-364-31D)

Mated 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. During five of the first nine cycles, the specimens were exposed to a cold shock at –10°C for 3 hours (Figure 9).

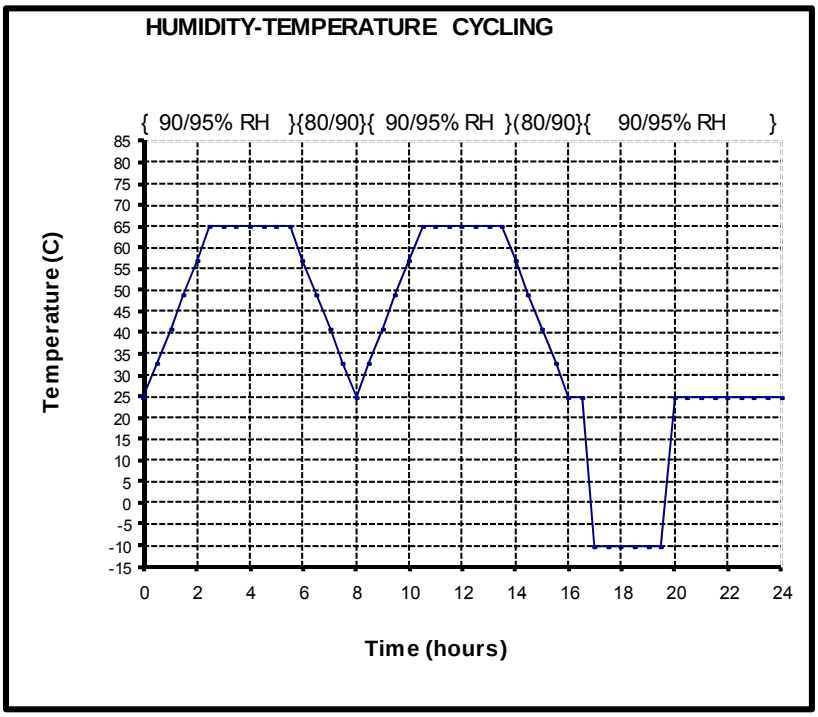

Figure 9 – Typical Humidity-Temperature Cycling Profile

3.11 Temperature Life (EIA-364-17C)

Mated specimens were exposed to a temperature of 125°C for 1000 hours. Specimens were preconditioned with 10 cycles of durability.

3.12 Salt Fog (EIA-364-26C)

Mated specimens were mounted in an enclosure with drain holes simulating a plug-in unit (Figure 10) and placed in a 5% salt spray environment for 48 hours. The temperature of the chamber was maintained at 35 +1/-2°C, and the pH of the salt solution was between 6.5 and 7.2.

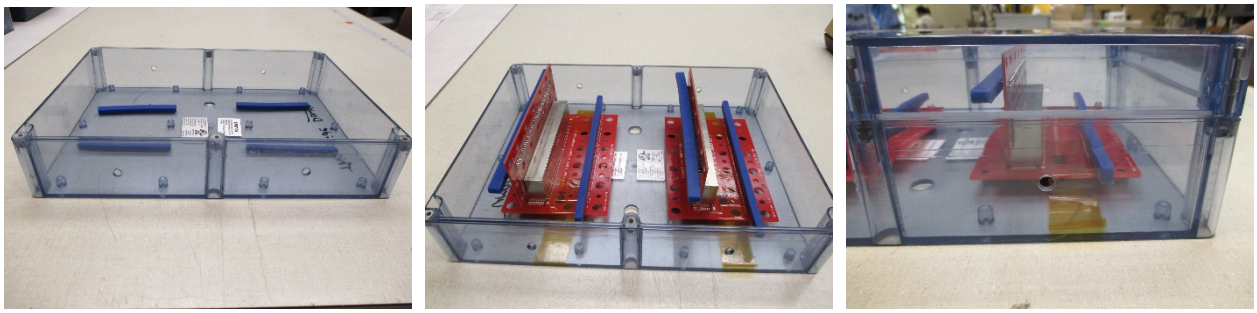

Figure 10 – Plug-in Unit Enclosure for Salt Fog Test

3.13 Final Examination of Product (EIA-364-18B)

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed. Specimens were visually examined with the unaided eye, corrected to normal vision.