MULTIGIG RT* Signal Connectors, Tiers 1 and 2, RT2 Mezzanine and RT2 Ruggedized

1. INTRODUCTION

1.1. Purpose

Testing was performed on TE Connectivity (TE) MULTIGIG RT*, Tiers 1 and 2, RT2 Mezzanine, and RT2 Ruggedized connectors to determine their conformance to the requirements of Product Specification 108-2072 Revision E.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of MULTIGIG RT, Tiers 1 and 2, RT2 Mezzanine, and RT2 Ruggedized connectors. Testing was performed on Tier 1 product at the Engineering Assurance Product Test Laboratory between 20Jan02 and 14Aug02. The test file number for this testing is CTLB021367-068. Testing was performed on Tier 2 product at the Engineering Assurance Product Test Laboratory between 17Oct03 and 31Jan04. The test file number for this testing is CTLB039733-017. Testing was performed on RT2 Mezzanine product at the Engineering Assurance Product Test Laboratory between 11Apr07 and 11Nov07. The test file number for this testing is CTLB082641-001. Testing was performed on RT2 Ruggedized product at the Harrisburg Electrical Components Test Laboratory between 11Jun12 and 20Aug12. The test file number for this testing is EA20120364T. This documentation is on file at and available from the Harrisburg Electrical Components Test Laboratory.

1.3. Conclusion

The MULTIGIG RT, Tiers 1 and 2, RT2 Mezzanine, and RT2 Ruggedized connectors listed in paragraph 1.5., conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2072 Revision E.

1.4. Test Specimens

Test specimens were representative of normal production lots. Specimens identified with the following part numbers were used for test:

A. Tier 1 Product

Test Group	Quantity	Part Number	Description
1,2,3,4,5	8 each	1410210-1	Vertical receptacle backplane
	8 each	1410215-1	Right angle daughtercard assembly

NOTE

(1) All specimens were treated with Bellcore approved surface protection.
(2) Specimens in test groups 1, 2, 3 and 4 were split subjecting 4 specimens to low level contact resistance, and 4 specimens to low level compliant pin resistance.

Figure 1A

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B. Tier 2 Product

Test Group	Quantity	Part Number	Description
1,2	12 each	1410131-1	Vertical backplane connector
	12 each	1410132-1	Right angle daughtercard assembly
3,4	8 each	1410131-1	Vertical backplane connector
	8 each	1410132-1	Right angle daughtercard assembly
5	7	1410131-1	Vertical backplane connector
	7	1410132-1	Right angle daughtercard assembly
1,2,3,4	4 each	60-474187-1	Printed circuit board
1,2,3,4	8 each	60-474229-1	Printed circuit board
5	4	60-474229-1	Printed circuit board
1,2,3,4,5	4 each	60-474230-1	Printed circuit board

NOTE

(1) All specimens were treated with Bellcore approved surface protection.
(2) Specimens in test groups 1, 2, 3 and 4 were split subjecting 4 specimens to low level contact resistance, and 4 specimens to low level compliant pin resistance.

Figure 1B

C. RT2 Mezzanine Product

Test Group	Quantity	Part Number	Description
1,2	4 each	1410196-1	RT2 Mezzanine connector
	8 each	1410142-1	RT2 vertical backplane receptacle assembly

Figure 1C

D. RT2 Ruggedized Product

Test Group	Quantity	Part Number	Description
1,2,3	5 each	1410187-3	RT2 Right angle daughtercard assembly
	5 each	2102737-1	RT2 Ruggedized vertical backplane connector

NOTE

(1) All specimens were treated with Bellcore approved surface protection.
(2) Vertical backplane connector was mounted on printed circuit board part number 60-474649-1 and right angle daughtercard assembly was mounted on printed circuit board part number 60-474650-1.

Figure 1D

1.5. Environmental Conditions

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

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

1.6. Qualification Test Sequence

A. Tier 1 Product

Test or Examination	Test Group (a)				
	1	2	3	4	5
	Test Sequence (b)				
Initial examination of product	1	1	1	1	1
Low level contact resistance, circuit	3,7,10,15	3,7,9,12	2,5,7,10	2,5,7,9,12,14,16,19	
Low level contact resistance, compliant pin (c)	4,16	4,13	3,11	3,10,17	
Insulation resistance	5,13	14			
Withstanding voltage	6,14	15			
Temperature rise vs. current					2
Vibration			8		
Mechanical shock			9		
Durability		6	4	4,18(d)	
Mating force	2,12	2,17	13		
Unmating force	8,11	5,16	12		
Compliant pin insertion					3
Compliant pin retention	18	18	14	20	4
Minute disturbance				15	
Thermal shock		10			
Humidity/temperature cycling		11			
Temperature life	9				
Mixed flowing gas				6(e),8(e),11(f),13(f)	
Dust contamination		8	6		
Final examination of product	17	19	15	21	

NOTE

(a) See paragraph 1.4.
(b) Numbers indicate sequence in which tests are performed.
(c) Compliant pin design requires special test printed circuit board for low level contact resistance data collection. Separate, parallel test groups to be supplied where this data is required.
(d) Perform 100 cycles of durability before, and 100 cycles after mixed flowing gas testing.
(e) Exposure interval of 5 days with specimens unmated.
(f) Exposure interval of 5 days with specimens mated.

Figure 2A

B. Tier 2 Product

Test or Examination	Test Group (a)				
	1	2	3	4	5
	Test Sequence (b)				
Initial examination of product	1	1	1	1	1
Low level contact resistance, circuit	3,9,13	3,9,11,14	2,5,7,10	2,5,7,9,12,14,16,18	
Low level contact resistance, compliant pin (c)	4,10	4,17	3,11	3,10,19	
Insulation resistance	5,14	5,18			
Withstanding voltage	6,15	6,19			
Temperature rise vs current					2
Vibration			8		
Mechanical shock			9		
Durability		8	4	4,17(d)	
Mating force	2,12	2,16	13		
Unmating force	7,11	7,15	12		
Compliant pin insertion					3
Compliant pin retention	16	20	14	20	4
Minute disturbance				15	
Thermal shock		12			
Humidity/temperature cycling		13			
Temperature life	8				
Mixed flowing gas				6(e),8(e),11(f),13(f)	
Dust contamination		10	6		
Final examination of product	17	21	15	21	5

NOTE

(a) See paragraph 1.4.
(b) Numbers indicate sequence in which tests are performed.
(c) Compliant pin design requires special test printed circuit board for low level contact resistance data collection. Separate, parallel test groups to be supplied where this data is required.
(d) Perform 100 cycles of durability before, and 100 cycles after mixed flowing gas testing.
(e) Exposure interval of 5 days with specimens unmated.
(f) Exposure interval of 5 days with specimens mated.

Figure 2B

C. RT2 Mezzanine Product

Test or Examination	Test Group (a)	
	1	2
	Test Sequence (b)	
Initial examination of product	1	1
Low level contact resistance, circuit	2,4,6,9	2,4,6,8,10,12,14,16
Vibration	7	
Mechanical shock	8	
Durability	3	3,15(c)
Mating force	10	
Unmating force	11	
Minute disturbance		13
Mixed flowing gas		5(d),7(d),9(e),11(e)
Dust contamination	5	
Final examination of product	12	17

NOTE

(a) See paragraph 1.4.
(b) Numbers indicate sequence in which tests are performed.
(c) Perform 100 cycles of durability before, and 100 cycles after mixed flowing gas testing.
(d) Exposure interval of 5 days with specimens unmated.
(e) Exposure interval of 5 days with specimens mated.

Figure 2C

D. RT2 Ruggedized Product

Test or Examination	Test Group (a)		
	1	2	3
	Test Sequence (b)		
Initial examination of product	1	1	1
Low level contact resistance, circuit	3,6	2,4,6,9	2,4,6,8,10,12,14,16
Vibration		7	
Mechanical shock		8	
Durability		3	3,15(c)
Mating force	2,8	11	
Unmating force	4,7	10	
Minute disturbance			13
Temperature life	5		
Mixed flowing gas			5(d),7(d),9(e),11(e)
Dust contamination		5	
Final examination of product	9	12	17

NOTE

(a) See paragraph 1.4.
(b) Numbers indicate sequence in which tests are performed.
(c) Perform 100 cycles of durability before, and 100 cycles after mixed flowing gas testing.
(d) Exposure interval of 5 days with specimens unmated.
(e) Exposure interval of 5 days with specimens mated.

Figure 2D

2. SUMMARY OF TESTING

2.1. Initial Examination of Product

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

2.2. Low Level Contact Resistance, Circuit

All low level contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 80 milliohms initially, had a maximum average change in resistance (ΔR) of less than 5 milliohms after testing, and a maximum individual change in resistance (ΔR) of less than 10 milliohms after testing.

2.3. Low Level Contact Resistance, Compliant Pin

All low level contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 1 milliohm initially, and had a maximum average change in resistance (ΔR) of less than 1 milliohm after testing.

2.4. Insulation Resistance

All insulation resistance measurements were greater than 1000 megohms.

2.5. Withstanding Voltage

No dielectric breakdown or flashover occurred.

2.6. Temperature Rise vs Current

All specimens had a temperature rise of less than 30°C above ambient when tested using a baseline rated current of 1 ampere DC, single circuit in free air using thermography.

2.7. Vibration

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

2.8. Mechanical Shock

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

No physical damage occurred as a result of mating and unmating the specimens 200 times.

2.10. Mating Force

All mating force measurements were less than 0.75 N [2.7 oz] per contact.

2.11. Unmating Force

All unmating force measurements were greater than 0.15 N [0.54 oz] per contact.

2.12. Compliant Pin Insertion

All insertion force measurements were less than 31 N [7 lbf].

2.13. Compliant Pin Retention

All retention force measurements were greater than 13.35 N [3 lbf].

2.14. Minute Disturbance

No evidence of physical damage was visible as a result of mating and unmating the specimens a distance of approximately 0.1 mm [.004 in].

2.15. Thermal Shock

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

2.16. Humidity/temperature Cycling

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

2.17. Temperature Life

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

2.18. Mixed Flowing Gas

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

2.19. Dust Contamination

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

2.20. Final Examination of Product

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 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.

3.2. Low Level Contact Resistance, Circuit

Low level contact resistance measurements were made using a 4 terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage.

3.3. Low Level Contact Resistance, Compliant Pin

Measurements at low level current were made using a 4 terminal measuring technique. Current was applied at the interface end of a contact and the pad surrounding the thru-hole. One voltage probe was attached to the end of the contact protruding from the bottom of the thru-hole and the other was attached to the pad surrounding the thru-hole. The test current was maintained at 100 milliamperes maximum with a 20-millivolt maximum open circuit voltage.

3.4. Insulation Resistance

Insulation resistance was measured between any adjacent pair of signal contacts, or from any signal contact to an adjacent ground pin of mated specimens. A test voltage of 100 volts DC was applied for 2 minutes before the resistance was measured.

3.5. Withstanding Voltage

A test potential of 500 volts AC was applied between any adjacent pair of signal contacts, or from any signal contact to an adjacent ground pin of mated specimens. This potential was applied for 1 minute and then returned to zero.

3.6. Temperature Rise vs. Current

A. Tier 1 Product

Temperature rise was measured on unstressed connectors using infrared imaging. The specimens were prepared by drilling a small hole in the housing to expose the contact. Twenty-eight AWG wire was soldered to the compliant pins to provide a means to energize the connector. A single circuit was energized at 1.0 amperes DC and allowed to stabilize for 30 minutes before the temperature was measured. The entire connector was imaged after applying an emissivity correction coating (Micatin foot powder). The emittance of the emissivity correction factor is 0.93. Raising this emittance value allows for accurate temperature measurements. The infrared camera was used with standard optics. ThermaGRAM™ thermal image processing was used for data analysis. The software has a temperature box measurement feature to determine maximum temperature of the contact. This software feature allows a measurement of the area inside the box when placed on an area of interest. The specimens were placed in a stable air environment of a temperature rise enclosure.

B. Tier 2 Product

Temperature rise testing consisted of measuring 3 unstressed mated connectors using infrared imaging. The backplane halves were prepared by removing the end wall of each housing to expose the interface. 30 AWG wire was soldered to the compliant pins to provide a means to energize the connectors. After applying an emissivity coating, a single wafer circuit on each specimen was energized at 1.0 ampere DC and allowed to stabilize prior to taking temperature measurements using the infrared camera. All 8 circuits were tested on each wafer.

3.7. Vibration, Sinusoidal

Mated specimens were subjected to sinusoidal vibration, having a simple harmonic motion with an amplitude of 1.5 mm [0.06 in], double amplitude (maximum total excursion) or 10 gravity units (g peak) whichever is less. The vibration frequency was varied uniformly between the limits of 10 and 500 Hz and returned to 10 Hz in 15 minutes. This cycle was performed 8 times in each of 3 mutually perpendicular planes for a total vibration time of 6 hours. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

3.8. Mechanical Shock, Half-sine

Mated specimens were subjected to a mechanical shock test having a half-sine waveform of 30 gravity units (g peak) and a duration of 11 milliseconds. Three shocks in each direction were applied along the 3 mutually perpendicular planes for a total of 18 shocks. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

3.9. Durability

Specimens were mated and unmated (daughterboard with its respective motherboard) 200 times at a maximum rate of 500 cycles per hour.

3.10. Mating Force

The force required to mate individual specimens (daughtercard and backplane) was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm [.5 in] per minute. The average force per contact was calculated.

3.11. Unmating Force

The force required to unmate individual specimens (daughtercard and backplane) was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm [.5 in] per minute. The average force per contact was calculated.

3.12. Compliant Pin Insertion

The force required to insert individual specimens onto the printed circuit board was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm [.5 in] per minute.

3.13. Compliant Pin Retention

A force of 13.35 N [3 lbf] was applied to individual contacts at a rate of travel of 12.7 mm [.5 in] per minute while observing for movement.

3.14. Minute Disturbance

The daughter board was lifted a distance of approximately 0.1 mm [.004 in] from the motherboard and then fully remated.

3.15. Thermal Shock

Mated specimens were subjected to 5 cycles of thermal shock with each cycle consisting of 30 minute dwells at -55 and 105°C. The transition between temperatures was less than 1 minute.

3.16. Humidity/temperature Cycling

Mated specimens were exposed to 10 cycles of humidity/temperature cycling. Each cycle lasted 24 hours and consisted of cycling the temperature between 25 and 65°C twice while maintaining high humidity.

3.17. Temperature Life

Mated specimens were exposed to a temperature of 105°C for 500 hours.

3.18. Mixed Flowing Gas, Class IIA

Mated and unmated specimens were exposed for 20 days (10 days unmated, 10 days mated) to a mixed flowing gas Class IIA exposure. 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.

3.19. Dust Contamination

Unmated specimens were exposed to a dust mixture that conformed to Composition #1 (benign) as described in EIA Standard TP-91. After drying the dust for 1 hour at 50°C, a quantity of dust equal to 9 grams per cubic foot of chamber area (40 grams total) was placed in the dust chamber. The connectors were suspended vertically in the chamber with their long axis parallel to the direction of airflow. The chamber was then sealed and the air and dust within recirculated for 1 hour at a flow rate of 360 cubic feet per minute. After turning the fans off, the specimens remained in the chamber for an additional hour. When they were removed, they were tapped on a wooden surface 5 times at a rate of 1 inch per second to remove excess dust.

3.20. Final Examination of Product

Specimens were visually examined for evidence of physical damage detrimental to product performance.