QSL RF Connectors

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Tyco Electronics QSL RF Connectors to determine its conformance to the requirements of Product Specification 108-2324 Revision A.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of QSL RF Connectors. Testing was performed at the Engineering Assurance Product Testing Laboratory between 08Sep08 and 13Jan09. The test file number for this testing is EA20080798T Revision A. This documentation is on file at and available from the Engineering Assurance Product Testing Laboratory.

1.3. Conclusion

The QSL RF Connectors listed in paragraph 1.5., conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2324 Revision A.

1.4. Product Description

The QSL Connector system consists of a QSL Surface Mount (SMT) Printed Circuit Board (PCB) connector and a cable assembly.

1.5. Test Specimens

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

Test Group	Quantity	Part Number	Description
1,2,3,4,5,6,7,8,9	5 each	1274824-1	SMT PCB connector with Au contacts
	5 each	1274886-4	QSL cable assembly with Au contacts
1,2,4,6	5 each	1274824-1	SMT PCB connector with PdNi contacts
	5 each	1274886-4	QSL cable assembly with PdNi contacts
1,2,4,6	5 each	1274824-1	SMT PCB connector with Au contacts
	5 each	1274886-4	QSL cable assembly with PdNi contacts
1,2,4,6	5 each	1274824-1	SMT PCB connector with PdNi contacts
	5 each	1274886-4	QSL cable assembly with Au contacts
1,2,4,5,6,9	5 each	60-1042187-1	QSL receptacle PCB

Figure 1

1.6. Environmental Conditions

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

- Temperature: 15 to 35˚C
- Relative Humidity: 25 to 75%

1.7. Qualification Test Sequence

Test or Examination	Test Group (a)								
	1	2	3	4	5	6	7	8	9
	Test Sequence (b)								
Initial examination of product	1	1,5	1,7	1,5	1	1	1	1	1
Low Level Contact Resistance (LLCR)	3,5	2,4,7		2,4,7	2,4	2,4			2,4
Voltage Standing Wave Ratio (VSWR)							2		
Insulation resistance			2,5,9						
Withstanding voltage			3,6,10						
Contact-to-contact isolation							3		
Random vibration		3							
Mechanical shock		6							
Durability	4								
Mating force	2								
Unmating force	6								
Shear force								2	
Angled pull test									3
Thermal shock			4	3					
Humidity, steady state			8	6					
Temperature life					3				
Mixed flowing gas						3(c)			
Final examination of product	7	8	11	8	5	5	4	3	5

NOTE

(a) See paragraph 1.5.
(b) Numbers indicate sequence in which tests are performed.
(c) Precondition specimens with 10 durability cycles.

Figure 2

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

2.2. LLCR - Test Groups 1, 2, 4, 6 and 9

All LLCR measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 20 milliohms. Contacts had a change in resistance (ΔR) of less than 8 milliohms and shields had a change in resistance (ΔR) of less than 5 milliohms.

Test Group	Number of Data Points	Condition	Termination Resistance		
			Min	Max	Avg
Au Receptacle to Au Plug					
1 (Contacts)	15	Initial	13.32	14.49	13.85
	15	After Durability (ΔR)	-1.06	0.74	0.00
1 (Shields)	10	Initial	4.69	5.24	4.92
	10	After Durability (ΔR)	-0.14	0.30	0.09
2 (Contacts)	15	Initial	12.58	15.63	13.61
	15	After Random Vibration (ΔR)	-0.46	0.65	0.25
	15	After Mechanical Shock (ΔR)	-1.78	-0.25	-0.74
2 (Shields)	10	Initial	11.15	11.64	11.39
	10	After Random Vibration (ΔR)	-0.01	0.40	0.20
	10	After Mechanical Shock (ΔR)	-0.03	0.35	0.14
4 (Contacts)	15	Initial	13.16	14.89	14.30
	15	After Thermal Shock (ΔR)	-0.66	0.68	-0.24
	15	After Humidity, Steady State (ΔR)	-2.01	0.41	-0.65
4 (Shields)	10	Initial	4.71	5.63	5.05
	10	After Thermal Shock (ΔR)	0.50	1.08	0.74
	10	After Humidity, Steady State (ΔR)	1.20	2.34	1.75
5 (Contacts)	15	Initial	13.16	14.90	13.94
	15	After Temperature Life (ΔR)	-0.83	0.71	-0.03
5 (Shields)	10	Initial	4.74	5.61	4.99
	10	After Temperature Life (ΔR)	0.05	1.80	1.01
6 (Contacts)	15	Initial	13.53	14.45	13.98
	15	After Mixed Flowing Gas (ΔR)	-0.95	0.96	0.03
6 (Shields)	10	Initial	4.72	5.26	4.93
	10	After Mixed Flowing Gas (ΔR)	-0.20	0.37	0.11
9 (Contacts)	15	Initial	11.00	15.12	13.28
	15	Final (ΔR)	-1.80	1.00	-0.28
9 (Shields)	10	Initial	11.16	11.53	11.32
	10	Final (ΔR)	-0.08	0.17	0.03

NOTE *All values in milliohms.*

Figure 3A

Test Group	Number of Data Points	Condition	Termination Resistance		
			Min	Max	Avg
PdNi Receptacle to PdNi Plug					
1 (Contacts)	15	Initial	11.02	16.45	14.92
	15	After Durability (ΔR)	-1.58	2.00	0.44
1 (Shields)	10	Initial	5.63	6.54	6.09
	10	After Durability (ΔR)	0.15	0.64	0.35
2 (Contacts)	15	Initial	7.10	16.20	14.40
	15	After Random Vibration (ΔR)	-0.75	0.27	-0.27
	15	After Mechanical Shock (ΔR)	-122	-0.19	-0.67
2 (Shields)	10	Initial	13.54	14.43	14.16
	10	After Random Vibration (ΔR)	0.02	1.44	0.33
	10	After Mechanical Shock (ΔR)	-0.47	0.20	-0.05
4 (Contacts)	15	Initial	11.53	17.00	14.87
	15	After Thermal Shock (ΔR)	-0.58	0.68	0.01
	15	After Humidity, Steady State (ΔR)	-0.38	0.64	0.03
4 (Shields)	10	Initial	5.82	6.75	6.16
	10	After Thermal Shock (ΔR)	0.15	1.04	0.55
	10	After Humidity, Steady State (ΔR)	0.45	2.26	1.47
6 (Contacts)	15	Initial	11.91	15.99	14.59
	15	After Mixed Flowing Gas (ΔR)	-1.05	0.51	-0.16
6 (Shields)	10	Initial	5.71	6.62	6.14
	10	After Mixed Flowing Gas (ΔR)	-0.57	0.71	0.11

NOTE *All values in milliohms.*

Figure 3B

Test Group	Number of Data Points	Condition	Termination Resistance		
			Min	Max	Avg
Au Receptacle to PdNi Plug					
1 (Contacts)	15	Initial	11.24	14.49	13.74
	15	After Durability (ΔR)	0.06	2.34	0.65
1 (Shields)	10	Initial	5.89	6.74	6.15
	10	After Durability (ΔR)	-0.83	1.29	0.26
2 (Contacts)	15	Initial	5.73	15.18	13.14
	15	After Random Vibration (ΔR)	-2.02	3.01	-0.18
	15	After Mechanical Shock (ΔR)	-1.55	0.70	-0.65
2 (Shields)	10	Initial	13.48	14.23	13.94
	10	After Random Vibration (ΔR)	0.13	0.74	0.50
	10	After Mechanical Shock (ΔR)	-0.05	0.52	0.25
4 (Contacts)	15	Initial	10.71	15.96	13.75
	15	After Thermal Shock (ΔR)	-2.04	0.03	-0.38
	15	After Humidity, Steady State (ΔR)	-0.91	0.91	-0.25
4 (Shields)	10	Initial	6.10	7.32	6.57
	10	After Thermal Shock (ΔR)	-0.50	1.02	0.11
	10	After Humidity, Steady State (ΔR)	0.41	2.29	1.07
6 (Contacts)	15	Initial	12.90	14.54	13.96
	15	After Mixed Flowing Gas (ΔR)	-0.81	0.86	0.10
6 (Shields)	10	Initial	5.76	6.54	6.05
	10	After Mixed Flowing Gas (ΔR)	-0.53	0.45	0.11

NOTE *All values in milliohms.*

Figure 3C

Test Group	Number of Data Points	Condition	Termination Resistance		
			Min	Max	Avg
PdNi Receptacle to Au Plug					
1 (Contacts)	15	Initial	14.06	15.62	14.71
	15	After Durability (ΔR)	-1.20	0.11	-0.50
1 (Shields)	10	Initial	4.81	5.39	5.02
	10	After Durability (ΔR)	-0.05	0.41	0.15
2 (Contacts)	15	Initial	12.97	16.12	14.08
	15	After Random Vibration (ΔR)	-1.44	-0.07	-0.93
	15	After Mechanical Shock (ΔR)	-1.67	0.02	-0.90
2 (Shields)	10	Initial	11.16	11.88	11.46
	10	After Random Vibration (ΔR)	-0.10	0.68	0.11
	10	After Mechanical Shock (ΔR)	-0.05	0.52	0.18
4 (Contacts)	15	Initial	14.25	15.74	14.96
	15	After Thermal Shock (ΔR)	-0.47	0.56	-0.18
	15	After Humidity, Steady State (ΔR)	-4.60	0.04	-1.25
4 (Shields)	10	Initial	5.18	5.80	5.50
	10	After Thermal Shock (ΔR)	-0.06	0.81	0.28
	10	After Humidity, Steady State (ΔR)	0.83	2.63	1.90
6 (Contacts)	15	Initial	11.56	15.39	14.34
	15	After Mixed Flowing Gas (ΔR)	-0.74	2.52	-0.07
6 (Shields)	10	Initial	4.70	5.01	4.87
	10	After Mixed Flowing Gas (ΔR)	-0.61	0.33	0.08

NOTE *All values in milliohms.*

Figure 3D

2.3. VSWR

All VSWR measurements were less than 1.30 from DC to 3 GHz, and less than 1.45 from 3 to 6 GHz.

2.4. Insulation Resistance - Test Group 3

All insulation resistance measurements were greater than 100 megohms.

2.5. Withstanding Voltage - Test Group 3

No dielectric breakdown or flashover occurred.

2.6. Contact-to-contact Isolation

All contact-to-contact isolation measurements were greater than 35 dB.

2.7. Random Vibration - Test Group 2

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 - Test Group 2

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 - Test Group 1

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

2.10. Mating Force - Test Group 1

All mating force measurements were less than 30 N for 3 port specimens and less than 20 N for 1 port specimens.

2.11. Unmating Force - Test Group 1

All unmating force measurements were less than 30 N and greater than 8N.

2.12. Shear Force - Test Group 8

All shear force measurements were greater than 60 N.

2.13. Angled Pull Test - Test Group 9

No discontinuities were detected when subjected to a force of 20 N during angled pull testing.

2.14. Thermal Shock - Test Groups 3 and 4

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

2.15. Humidity, Steady State - Test Groups 3 and 4

No evidence of physical damage was visible as a result of steady state humidity testing.

2.16. Temperature Life - Test Group 5

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

2.17. Mixed Flowing Gas - Test Group 6

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

2.18. 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 C of C 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. LLCR

LLCR measurements were made using a 4 terminal measuring technique (Figure 4). The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. Measurements from Test Groups 1, 4, 5 and 6 included approximately 3 inches of wire bulk. Measurements from Test Groups 2 and 9 included approximately 11 inches of wire bulk. One inch of Au contact wire equals 7.2 milliohms, 1 inch of PdNi contact wire equals 6.4 milliohms.

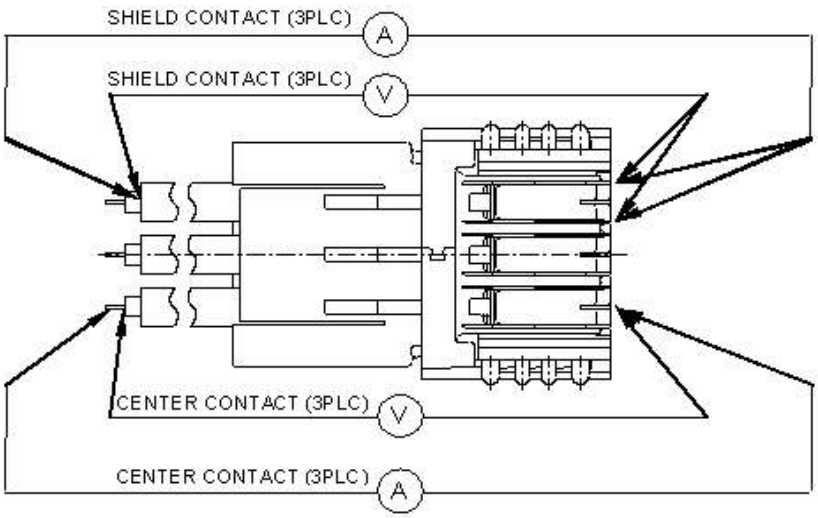

Figure 4
LLCR Measurement Points

3.3. VSWR

Specimens were tested using an HP 8510C network analyzer. The 2.4 to 3.5 mm (f) adapter and 3.5 to 3.5 mm (m) adapter were connected to Port 1 of the network analyzer. A 1 port calibration was performed employing an Agilent 85052B 3.5 mm calibration kit. The network analyzer was set to collect 801 data points across a frequency range of 0.045 to 18.05 GHz. The QSL at the end of the cable assembly was mated with the QSL of the SMP PCB connector at the end of the cable assembly. The appropriate SMA of channel (1, 2 or 3) of the SMA PCB connector was connected to channel 1 of the network analyzer. VSWR measurements were taken from the driven from the SMA PCB end of the mated cable assembly. All open pairs were terminated in 50 ohms. VSWR was tested with the network analyzer in the S_{11} mode which transmits power from Port 1 and receives the reflected signal back into Port 1. All 3 channels of each specimen were measured. Gating was applied in the center of the PCB trace and the mid-point of the cable using the parameters of Start: 180.635 ns and Stop: 1.093 ns.

3.4. Insulation Resistance

Insulation resistance was measured between adjacent contacts of mated specimens. A test voltage of 500 volts DC was applied for 2 minutes before the resistance was measured.

3.5. Withstanding Voltage

A test potential of 800 volts AC was applied between adjacent contacts of mated specimens. This potential was applied for 1 minute and then returned to zero.

3.6. Contact-to-contact Isolation

Specimens were tested using an HP 8753E network analyzer. Two 7.0 to 3.5 mm (m) adapters were connected to Port 1 and Port 2 of the network analyzer. Two Stantron cables were connected to the (m) adapters from Port 1 and Port 2 of the network analyzer. A full 2 port calibration was performed employing an Agilent 85033D 3.5 mm calibration kit. The 3.5 mm (f to f) adapter was used for the through portion of the calibration procedure. The network analyzer was set to collect 401 data points across a frequency range of 0.030 to 6 GHz. The QSL at the end of the cable assembly was mated with the QSL of the SMP PCB connector. The appropriate SMA of channel (1, 2 or 3) of the SMA PCB connector was connected to Port 1 of the network analyzer. The appropriate SMA of channel (1, 2 or 3) at the far end of the cable assembly was connected to the cable from Port 2. All possible pair combinations were measured, 1-2, 1-3 and 2-3. All open pairs were terminated in 50 ohms. The contact-to-contact isolation test was performed with the network analyzer in the S_{21} mode which transmits power from Port 2 and receives the signal into Port 1 in a “through” type measurement.

3.7. Random Vibration

Mated specimens were subjected to a random vibration test, specified by a random vibration spectrum, with excitation frequency bounds of 20 and 500 Hz. The Power Spectral Density (PSD) remained flat at 0.02 G^2/Hz from 20 to 500 Hz. The root-mean square amplitude of the excitation was 3.10 GRMS. This was performed for 15 minutes in each of 3 mutually perpendicular planes for a total vibration time of 45 minutes. The inner conductors of the specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

3.8. Mechanical Shock

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. The inner conductors of the 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 500 times at a maximum rate of 500 cycles per hour.

3.10. Mating Force

The force required to mate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm per minute.

3.11. Unmating Force

The force required to unmate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm per minute.

3.12. Shear Force

The force required to shear the specimen from the board was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm per minute. The force was applied to the specimen from the front.

3.13. Angled Pull Test

Force was applied to the specimens in each of the 8 reference directions (N, S, E, W, NW, NE, SW and SE) using a tensile/compression device with a free floating fixture. The specimen was placed between fixtures with the top fixture modified to allow mounting of the receptacle connector panel. The fixture and the specimen were secured in a vice placed on a free floating table at the base of the tensile/compression device. The cable of the specimen was gripped with jaws attached to the moveable crosshead.

3.14. Thermal Shock

Unmated specimens were subjected to 5 cycles of thermal shock with each cycle consisting of 30 minute dwells at -20 and 80˚C and 1 minute transition between temperatures.

3.15. Humidity, Steady State

Unmated specimens were exposed to a temperature 40˚C and 90 to 95% RH for 504 hours.

3.16. Temperature Life

Mated specimens were exposed to a temperature of 85˚C for 1000 hours.

3.17. Mixed Flowing Gas, Class IIA

Mated specimens were exposed for 7 days to a mixed flowing gas Class IIA exposure. Class IIA exposure is defined as a temperature of 30˚C and 70% RH 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. Specimens were preconditioned with 10 cycles of durability.

3.18. Final Examination of Product

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