Quadrax Cable and PCB Connectors

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Tyco Electronics ARINC Size 8 Quadrax Contact to determine its conformance to the requirements of Product Specification 108-2131, Revision A.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the ARINC Size 8 Contacts. Testing was performed at the Engineering Assurance Product Test Laboratory between 31Jan03 and 28Mar03. The test file number for this testing is CTL B029593-001. This documentation is on file at and available from the Engineering Assurance Product Test Laboratory.

1.3. Conclusion

The ARINC Size 8 Quadrax Contacts listed in paragraph 1.5., conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2131, Revision A.

1.4. Product Description

The ARINC Size 8 Quadrax Contact is a multi-pin contact assembly used with quad axial cables in data bus applications on commercial aircraft per ARINC 600, 664 and 763 specifications. The ARINC Size 8 Quadrax Contact consists of 4 screw-machined pin or socket contacts in a size 8 shell; the Quadrax contacts are available in PCB mounted pin and crimp style pin and socket versions.

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
1,3,4	11 each	1445693-1	Size 8 Quadrax socket contacts, crimp style, AWG 24
2	10	1445693-1	Size 8 Quadrax socket contacts, crimp style, AWG 24
5	3	1445693-1	Size 8 Quadrax socket contacts, crimp style, AWG 24, 1 meter length
	3	1445693-1	Size 8 Quadrax socket contacts, crimp style, AWG 24, 11.25 meter length
2	5	1445692-1	Size 8 Quadrax pin contacts, crimp style, AWG 24
3	11	1445692-1	Size 8 Quadrax pin contacts, crimp style, AWG 24
5	6	1445692-1	Size 8 Quadrax pin contacts, PCB mounted
1,4	11 each	1445626-1	Size 8 Quadrax pin contacts, PCB mounted
2	5	1445626-1	Size 8 Quadrax pin contacts, PCB mounted

NOTE *Test groups 1, 3 and 4 socket and pin contacts were inserted into 11 position inserts. Cable socket insert part number 1484469-1, PCB pin insert part number 1484472-1, and cable pin insert part number 1663236-1 were placed into Size 2 plug and receptacle ARINC 600 connector shells for testing.*

Figure 1

* Trademark
| Indicates change

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
	Test Sequence (b)				
Initial examination of product	1	1	1	1	
Low level contact resistance	2,8				
Contact resistance at rated current	3,9			3,7	
Insulation resistance at ambient			2,6	4,8	
Insulation resistance at high temperature			8		
Withstanding voltage at sea level			3,7	5,9	
Withstanding voltage at altitude			9		
RF insertion loss					5
RF return loss					4
Characteristic impedance					1
Near End Crosstalk (NEXT)					2
Eye patterns					3
Vibration, random	5				
Mechanical shock	6				
Durability	7				
Mating/unmating force	4,10			2,10	
Salt spray		2(c)			
Thermal shock			4		
Humidity-temperature cycling			5		
Temperature life				6(d)	
Final examination of product	11	3	10	11	

NOTE

(a) See paragraph 1.5.
(b) Numbers indicate sequence in which tests are performed.
(c) Salt spray testing to be performed on contacts only.
(d) 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 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 Group 1

All low level contact resistance (center contacts only) measurements taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 15.0 milliohms initially and 30.0 milliohms after testing.

Test Group	Number of Data Points	Condition	Low Level Contact Resistance		
			Min	Max	Mean
1	20	Initial	3.044	4.241	3.630
		After mechanical	3.632	14.310	5.372

NOTE *All values in milliohms.*

Figure 3

2.3 Contact Resistance at Rated Current - Test Groups 1 and 4

All contact resistance (center contacts) measurements taken at 1.0 ampere were less than 15.0 milliohms initially and 30.0 milliohms after testing. All contact resistance (outer contact shell) measurements taken at 12.0 amperes were less than 3.0 milliohms initially and 4.0 milliohms after testing.

Test Group	Number of Data Points	Condition	Contact Resistance		
			Min	Max	Mean
Center Contact					
1	20	Initial	3.279	4.644	3.817
		After mechanical	3.606	8.220	5.001
4	20	Initial	2.957	3.750	3.431
		After temperature life	2.864	5.642	4.097
Outer Contact					
1	5	Initial	0.117	0.751	0.291
		After mechanical	0.435	0.811	0.619
4	5	Initial	0.221	0.688	0.365
		After temperature life	0.298	0.746	0.520

NOTE *All values in milliohms.*

Figure 4

2.4. Insulation Resistance at Ambient - Test Groups 3 and 4

All insulation resistance measurements were greater than 5000 megohms.

2.5. Insulation Resistance at High Temperature - Test Group 3

All insulation resistance measurements were greater than 1000 megohms.

2.6. Withstanding Voltage at Sea Level - Test Groups 3 and 4

No dielectric breakdown or flashover occurred.

2.7. Withstanding Voltage at Altitude - Test Group 3

No dielectric breakdown or flashover occurred.

2.8. RF Insertion Loss - Test Group 5

Insertion loss measurements recorded in accordance with SFF-8410 were as follows:

Test Group	Number of Data Points	Frequency (MHz)	Insertion Loss		
			Min	Max	Mean
5	6	50	0.077	0.149	0.13
		62	0.172	0.209	0.19
		102	0.245	0.289	0.27
		502	0.785	0.916	0.87
		1002	1.275	1.471	1.39
		2002	2.309	3.152	2.48
		3002	3.154	3.375	3.29

NOTE *All values in decibels.*

Figure 5

2.9. RF Return Loss - Test Group 5

Return loss measurements recorded in accordance with SFF-8410 were as follows:

Test Group	Number of Data points	Frequency (MHz)	Return Loss		
			Min	Max	Mean
I Meter					
5	6	50	33.551	35.098	34.33
		62	34.136	38.220	36.03
		102	33.491	45.907	40.21
		502	19.784	23.058	21.21
		1002	12.177	14.598	13.34
		1954	8.574	10.490	9.32
		2950	9.396	11.112	10.27
11.25 Meters					
5	6	50	31.861	38.669	35.26
		62	30.970	44.891	36.87
		102	33.861	42.727	38.90
		502	23.678	27.905	26.02
		1002	13.942	15.291	14.62
		1798	11.159	12.111	11.74
		2502	11.463	14.412	13.34
		3702	5.645	7.859	6.54

NOTE *All values in decibels.*

Figure 6

2.10. Characteristic Impedance - Test Group 5

Characteristic impedance measurements recorded in accordance with SFF-8410 were as follows:

Test Group	Number of Data Points	Characteristic Impedance		
		Min	Max	Mean
5	6	100.85	103.2	102.85

NOTE *All values in ohms.*

Figure 7

2.11. Near End Crosstalk (NEXT) - Test Group 5

NEXT measurements recorded in the time domain in accordance with SFF-8410 were as follows:

Test Group	Number of Data Points	NEXT		
		Min	Max	Mean
5	13	0.6	1.42	0.89

NOTE *All values in percent.*

Figure 8

2.12. Eye Patterns - Test Group 5

The differential mode output eye opening measurements for a 1 volt launch voltage measured at 50% of the period in accordance with SFF-8410 were as follows:

Test Group	Number of Data Points	Output Eye Opening		
		Min	Max	Mean
1 Meter, 100 MHz Eye Opening				
5	6	921.6	931.2	928.53
1 Meter, 1.25 GHz Eye Opening				
5	7	828.8	851.2	839.77
11.2 Meter, 100 MHz Eye Opening				
5	8	707.2	774.4	761.60
11.2 Meter, 1.25 GHz Eye Opening				
5	6	304.0	329.6	315.20

NOTE *All values in millivolts.*

Figure 9

2.13. Vibration, Random - Test Group 1

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

2.14. Mechanical Shock - Test 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.

2.15. Durability - Test Group 1

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

2.16. Mating/Unmating Force - Test Groups 1 and 4

The maximum measured mating force was 2.67 pounds per contact. The minimum measured unmating force was 1.66 pounds per contact.

2.17. Salt Spray - Test Group 2

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

2.18. Thermal Shock - Test Group 3

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

2.19. Humidity-Temperature Cycling - Test Group 3

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

2.20. Temperature Life - Test Group 4

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

2.21. 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 manufactured using the same core manufacturing processes and technologies as production parts.

3.2. Low Level Contact Resistance

Contact resistance measurements at low level current were made using a 4 terminal measuring technique; 1 voltage-current probe was attached to the end of the wired contact, and 1 voltage-current probe was attached to the pin contact post on the back of the printed circuit board. The wire bulk resistance was subtracted from the measured resistance. The test current was maintained at 100 milliamperes maximum with a 20-millivolt maximum open circuit voltage.

3.3. Contact Resistance at Rated Current

Contact resistance measurements at rated current were made using a 4 terminal measuring technique; 1 voltage-current probe was attached to the end of the wired contact, and 1 voltage-current probe was attached to the pin contact post on the back of the printed circuit board. The wire bulk resistance was subtracted from the measured resistance. The test current for the center contacts was 1.0 ampere, and the test current for the outer contact shell was 12.0 amperes

3.4. Insulation Resistance at Ambient

Insulation resistance at ambient temperature was measured between adjacent contacts and between all center contacts and outer contact shell of unmated specimens. A test voltage of 500 volts DC was applied for 2 minutes before the resistance was measured.

3.5. Insulation Resistance at High Temperature

Insulation resistance at high temperature was measured between adjacent contacts and between all center contacts and the outer contact shell of unmated specimens. This test was performed after the specimens were exposed to a temperature of 125˚C for 30 minutes. The specimens remained in the chamber for insulation resistance measurements. A test voltage of 500 volts DC was applied for 2 minutes before the resistance was measured.

3.6. Withstanding Voltage at Sea Level

A test potential of 1000 volts AC rms was applied between the adjacent contacts of unmated specimens; a test potential of 500 volts AC rms was applied between all center contacts and the outer contact shell of unmated and mated specimens. This potential was applied for 1 minute and then returned to zero.

3.7. Withstanding Voltage at Altitude

Unmated and mated specimens were placed in a chamber and the altitude elevated to and maintained at 70000 feet above sea level for 30 minutes. After 30 minutes, the altitude was maintained and the withstanding voltage test was performed. A test potential of 125 volts AC rms was applied between adjacent contacts of unmated specimens; a test potential of 125 volts AC rms was applied between all center contacts and the outer contact shell of unmated and mated specimens. This potential was applied for 1 minute and then returned to zero.

3.8. RF Insertion Loss

Insertion loss measurements were recorded in accordance with SFF-8410.

3.9. RF Return Loss

Return loss measurements were recorded in accordance with SFF-8410.

3.10. Characteristic Impedance

Characteristic impedance measurements were recorded in accordance with SFF-8410.

3.11. Near End Crosstalk (NEXT)

NEXT measurements were recorded in the time domain in accordance with SFF-8410.

3.12. Eye Patterns

The differential mode output eye opening measurements for a 1 volt launch voltage measured at 50% of the period were recorded in accordance with SFF-8410.

3.13. Vibration, Random

Mated specimens were subjected to a random vibration test, specified by a random vibration spectrum, with excitation frequency bounds of 50 and 2000 Hz. The power spectral density 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 to 1000 Hz. The spectrum sloped down at 6 dB per octave to the upper bound frequency of 2000 Hz at which the PSD was 0.05 G^2/Hz. The root-mean square amplitude of the excitation was 16.4 G's rms. This was performed for 8 hours in each of 3 mutually perpendicular planes for a total vibration time of 24 hours. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes in the monitoring circuit.

3.14. Mechanical Shock

Mated specimens were subjected to a mechanical shock test having a half-sine waveform of 50 gravity units (G's peak) and a duration of 11 milliseconds. One shock in each direction was applied along the 3 mutually perpendicular planes for a total of 6 shocks. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

3.15. Durability

Specimens were mated and unmated 500 times at a maximum rate of 250 cycles per hour.

3.16 Mating/Unmating Force

The force required to mate and unmate individual specimens was measured using a tensile/compression device with the rate of travel at 0.5 inch per minute and a free-floating fixture. The average force per contact was calculated, as total mating and unmating force divided by 11 contacts per insert block.

3.17. Salt Spray

Mated specimens were subjected to a 5% salt spray environment for 48 hours. The temperature of the box was maintained at 95 +2/-3˚F, and the pH of the salt solution was between 6.5 and 7.2.

3.18. Thermal Shock

Mated specimens were subjected to 5 cycles of thermal shock with each cycle consisting of 30 minute dwells at -65 and 125˚C. The transition between temperatures was less than 1 minute.

3.19. Humidity-Temperature Cycling with Cold Shocks

Unmated specimens were exposed to 10 cycles of humidity-temperature cycling. Each cycle lasted 24 hours and consisted of cycling the temperature between 25C and 65˚C twice while maintaining high humidity. During 5 of the first 9 cycles, the specimens were exposed to a cold shock at -10˚C for 3 hours.

3.20. Temperature Life

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

3.21. Final Examination of Product

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