Series MMCX 50 Ohm Micro-Miniature Connectors

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Tyco Electronics Series MMCX 50 ohm micro-miniature connectors to determine their conformance to the requirements of Product Specification 108-2084 Revision A.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the Series MMCX 50 ohm micro-miniature connectors. Testing was performed at the Engineering Assurance Product Testing Laboratory and the EME Laboratory between 28Mar07 and 18Feb08. The test file numbers for this testing are CTL4468-002 and EME4468-003. This documentation is on file at and available from the Engineering Assurance Product Testing Laboratory and the EME Laboratory respectively.

1.3. Conclusion

The Series MMCX 50 ohm micro-miniature connectors listed in paragraph 1.5., conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2084 Revision A.

1.4. Product Description

The Series MMCX 50 ohm micro-miniature connectors are primarily intended for applications where minimum dimensions and space-saving designs are required. They are suitable for use up to 6 GHz and are provided with a reliable snap-on coupling mechanism. The connector family contains straight and right angle variants for cable or solder connection and SMD connectors for surface mount technology onto printed circuit boards.

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
1,2,3,5	9	1408149-2	MMCX right angle cable plug terminated to RG-316 cable
1,2,3,4,5,6,7,8	21	1408150-1	MMCX PCB straight jack
1,2,3,5	9	1408151-1	MMCX PCB right angle jack
1,2,3,4,5,6,7	18	1408312-1	MMCX straight cable plug terminated to RG-316 cable

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%

* Trademark
| Indicates change

1.7. Qualification Test Sequence

Test or Examination	Test Group (a)							
	1	2(b)	3(b)	4(b)	5(b)	6(b)	7(b)	8(b)
	Test Sequence (c)							
Visual examination	1,6	1,6	1,13	1,13	1,3	1,3	1,14	1,3
Contact resistance, center contact			2,5	2,5,9			2,8	
Contact resistance, outer contact			3,6	3,6,10			3,9	
Insulation resistance	5		8	11			5,10	
Voltage proof	4		9	7,12			6,11	
Reflection factor/VSWR					2			
Screening effectiveness						2		
Sinusoidal vibration			4					
Mechanical endurance				4				
Engaging force	2		12				13	
Separating force	3		11				12	
Contact captivation								2
Cable clamping device, axial (d)		4						
Cable clamping device, torsion (d)		3						
Bending moment.		5						
Rapid change of temperature		2					4	
High temperature				8				
Damp heat, steady state			7					
Salt mist			10					
Climatic sequence							7	

NOTE

(a) See paragraph 1.5.
(b) Test groups 2, 3, 4, 5, 6, 7 and 8 will be conducted on specimens that have successfully completed test group 1.
(c) Numbers indicate sequence in which tests are performed.
(d) Applicable to cabled connectors only.

Figure 2

2. SUMMARY OF TESTING

2.1. Visual 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. Contact Resistance - Test Groups 3, 4 and 7

All center contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 5 milliohms. All outer contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 2.5 milliohms. All values had the wire bulk resistance subtracted from the original measurement.

Test Group	Number of Data Points	Condition	Contact Resistance		
			Min	Max	Mean
Center Contact					
3	6	Initial	3.75	4.29	4.04
		After vibration (ΔR)	-0.05	0.33	0.13
4	3	Initial	3.79	4.23	4.04
		After mechanical endurance (ΔR)	-0.49	0.26	-0.15
		After high temperature (ΔR)	0.12	1.04	0.52
7	3	Initial	4.06	4.21	4.11
		After climatic sequence (ΔR)	-0.09	0.58	0.16
Outer Contact					
3	6	Initial	0.06	0.90	0.62
		After vibration (ΔR)	-0.62	0.32	-0.27
4	3	Initial	0.23	0.40	0.33
		After mechanical endurance (ΔR)	-0.18	-0.09	-0.14
		After high temperature (ΔR)	-0.74	-0.08	-0.36
7	3	Initial	0.11	0.34	0.25
		After climatic sequence (ΔR)	-0.54	0.31	-0.18

NOTE *All values in milliohms.*

Figure 3

2.3. Insulation Resistance - Test Groups 1, 3 and 7

All insulation resistance measurements were greater than 1000 megohms.

2.4. Voltage Proof - Test Groups 1, 3 and 7

No dielectric breakdown or flashover occurred.

2.5. Reflection Factor/VSWR - Test Group 5

All reflection factor measurements were less than 0.15 (1.35 VSWR) up to 2.7 GHz.

2.6. Screening Effectiveness - Test Group 6

All screening effectiveness measurements were greater than 35 dB from 200 MHz to 1 GHz.

2.7. Vibration - Test Group 3

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

2.8. Mechanical Endurance - Test Group 4

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

2.9. Engaging Force - Test Groups 1, 3 and 7

All engaging (mating) force measurements were less than 18 N [4.05 lbf].

2.10. Separating Force - Test Groups 1, 3 and 7

All separating (unmating) force measurements were greater than 6 N [1.34 lbf].

2.11. Contact Captivation - Test Group 8

All contact captivation measurements were greater than 10 N [2.25 lbf].

2.12. Cable Clamping Device, Axial - Test Group 2

All specimens maintained a minimum of 32 N [7.2 lbf].

2.13. Cable Clamping Device, Torsion - Test Group 2

All specimens maintained a minimum of 0.05 N [.04 lbf-ft].

2.14. Bending Moment - Test Group 2

All specimens maintained a minimum of 0.05 N [.04 lbf-ft].

2.15. Rapid Change of Temperature - Test Groups 2 and 7

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

2.16. High Temperature - Test Group 4

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

2.17. Damp Heat, Steady State - Test Group 3

No evidence of physical damage was visible as a result of exposure to steady state damp heat.

2.18. Salt Mist - Test Group 3

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

2.19. Climatic Sequence - Test Group 7

No evidence of physical damage was visible as a result of exposure to a climatic sequence. All specimens met the insulation resistance and voltage proof requirements during climatic sequence exposure.

3. TEST METHODS

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

3.2. Contact Resistance

Contact resistance measurements at low level current 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. All values had the wire bulk resistance subtracted from the original measurement.

3.3. Insulation Resistance

Insulation resistance was measured between the center and outer contacts of unmated specimens. A test voltage of 500 volts DC was applied for 1 minute before the resistance was measured.

3.4. Voltage Proof

A test potential of 500 volts AC was applied between the center and outer contacts of mated and unmated specimens. This potential was applied for 1 minute and then returned to zero.

3.5. Reflection Factor/VSWR

Specimens were subjected to Voltage Standing Wave Ratio (VSWR) testing using a network analyzer with a 7.0 to 3.5 mm adapter connected to port 1 of the analyzer. A 1 port calibration was performed using a 3.5 mm calibration kit. The network analyzer was calibrated with 1601 data points across a frequency range of 0.003747657 to 5.999998867 GHz. The VSWR testing was performed with the network analyzer in the S_{11} mode which transmits power from port 1 and receives the reflected signal back into port 1. Two test boards were evaluated: board A with SMA mounting on the signal side; and board B with SMA mounting on the ground side. An MMCX PCB straight jack and SMA were soldered on the boards and VSWR measurements were taken. Board B was used for final testing, it gave better results. Both right angle and straight MMCX PCB jacks were soldered to the ground side of the test board and were mated with MMCX jacks during testing (all possible combinations were tested). The SMA at the end of the cable plug assembly was connected to port 1 of the network analyzer with the other SMA at the far end terminated in 50 ohms. Gating parameters of Start: 2.376 ns and Stop: 3.584 ns. After VSWR measurements were taken, the following formula was used to calculate the reflection factor:

$$\text{Reflection Factor } (\Gamma) = (\text{VSWR}-1)/(\text{VSWR}+1)$$

3.6. Screening Effectiveness

Brass plates to mount the specimens were constructed, cleaned and mounted in a shielded chamber. A chamber gain measurement was performed by driving one set of antennas and measuring with the other. A noise floor measurement was also performed by terminating the driving SMA connector outside the room in 50 ohms and taking a measurement. Next, the specimen was placed in the shielded room and connected to the MMCX connectors on the brass plate with the far end of the specimen terminated in 50 ohms outside the room. The chamber was closed, the specimen energized at a specific frequency (200 MHz to 1 GHz) and a maximum hold performed with the mode stirrer in motion. This was repeated until all the specimens were measured for a total of 201 measurements. Data was recorded and screening effectiveness calculated using the formula:

$$\text{Calculated Screen Effectiveness} = \text{Raw RF Leakage (dBm)} - \text{Chamber Gain (dBm)}$$

3.7. Sinusoidal Vibration

Mated specimens were subjected to sinusoidal vibration, having a simple harmonic motion with an amplitude of 1.5 mm [.06 in], double amplitude. The vibration frequency was varied uniformly between the limits of 10 and 55 Hz and returned to 10 Hz in 1 minute. This cycle was performed 30 times in the longitudinal (mating) axis and 30 times in one of the other two remaining perpendicular axes. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

3.8. Mechanical Endurance

Specimens were manually mated and unmated 500 times at a maximum rate of 15 cycles per minute.

3.9. Engaging Force

The force required to engage (mate) individual specimens was measured using a tensile/compression device with a free floating fixture at a maximum rate of 12.7 mm [.5 in] per minute.

3.10. Separating Force

The force required to separate (unmate) individual specimens was measured using a tensile/compression device with a free floating fixture at a maximum rate of 12.7 mm [.5 in] per minute.

3.11. Contact Captivation

An axial force was applied to the center contact pin at a maximum rate of 12.7 mm [.5 in] per minute.

3.12. Cable Clamping Device, Axial

An axial force of 32 N [7.2 lbf] was applied to the cable at a maximum rate of 12.7 mm [.5 in] per minute and held for 1 minute.

3.13. Cable Clamping Device, Torsion

A rotational force of 0.05 N•m [.04 lbf-ft] was applied to the cable approximately 50 mm [1.97 in] from the rear of the specimen and held for 1 minute.

3.14. Bending Moment

A shearing force of 0.05 N [.04 lbf-ft] was applied to mated specimens in 2 mutually perpendicular planes and held for 1 minute.

3.15. Rapid Change of Temperature

Mated specimens were subjected to 5 cycles with each cycle consisting of 30 minute dwells at -55 and 125˚C and 2 to 3 minute transition between temperatures.

3.16. High Temperature

Mated specimens were exposed to a temperature of 155˚C for 1000 hours.

3.17. Damp Heat, Steady State

Mated specimens were exposed to 40˚C and 93% RH for 96 hours.

3.18. Salt Mist

Mated specimens were subjected to a salt spray environment for 48 hours.

3.19. Climatic Sequence

Mated specimens were subjected to the following:

- Sixteen hours of dry heat at 155˚C. Insulation resistance was performed during the last hour of this exposure.
- One, 24 hour damp heat cycle of 20 hours at 55˚C and 93% RH followed by a 2 hour recovery at ambient, followed by 2 hours at -55˚C.
- Low pressure (70,000 feet) for 1 hour. Voltage proof at 300 volts AC was performed during the final 5 minutes of this exposure.
- A second 24 damp heat cycle as described above. Voltage proof at 500 volts AC at sea level was performed during the final 15 minutes of damp heat cycle.