Power Distribution Module

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Power Distribution Module (PDM) to determine its conformance to the requirements of Product Specification 108-2206, Revision A.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the PDM. Testing was performed at the Product Reliability Center. The test file numbers for this testing are 20050005ACL, 20050006ACL, 20050007ACL and 20050219ACL. This documentation is on file at and available from the Product Reliability Center.

1.3. Conclusion

The PDM listed in paragraph 1.5., conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2206, Revision A.

1.4. Product Description

The PDM consists of a 5 by 12 contact pattern base/seal assembly and cover. The PDM contact pattern is that of Tyco VJ28 and VF28 relays as well as mini fuses intended for use in this application. A fuse removal tool is housed in one of unused cavities.

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	1443912-1	Seal using silicone material
		1443995-2	Base using Valox 420SE0 material
		1443996-1	Cover using PBT Celanex 2002-2 material
		1443997-2	Base/seal assembly using Valox 420SE0 material
2,3,4,5,6, 7,8,9,12, 13,14,15, 16,17,18, 19	3 each	1443912-1	Seal using silicone material
		1443995-2	Base using Valox 508R material
			Base using Valox 420SE0 material
		1443996-1	Cover using PBT Celanex 2002-2 material
		1443997-2	Base/seal assembly using Valox 508R material
			Base/seal assembly using Valox 420SE0 material

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	2,12	3,13	4,14	5,15	6,16	7,17	8,18	9,19
	Test Sequence (b)								
Visual examination	1,15	1,5	1,5	1,6	1,5	1,5	1,10	1,6	1,6
Termination resistance, dry circuit, per single interface	2,5,8,11			2,5			2,5,9	2,5	2,4
Temperature rise vs current at elevated ambient conditions								3	
Dielectric withstanding voltage					2,4	2,4			
Fuse blow									3
Free fall				3					
Vibration, Z axis	4								
Vibration, Y axis	7								
Vibration, X axis	10								
Mechanical shock, Z axis	3								
Mechanical shock, Y axis	6								
Mechanical shock, X axis	9								
Housing locking mechanism strength		4							
Housing locking mechanism retention force to failure			4						
Secondary lock strength			3						
Connector cover durability at room ambient		3							5
Connector cover durability at -40˚C	14								
Durability, misaligned hinges		2							
Contact retention			2						
Fuse extractor durability, multiple fuse removal	12						7		
Fuse extractor durability, extractor retention	13						8		
Degree of protection, IP66							6		
Degree of protection, IP67				4			4		
Salt fog						3			
Temperature life								4	
Thermal shock							3		
Humidity-temperature cycling					3				

NOTE *(a) See paragraph 1.5.*
(b) Numbers indicate sequence in which tests are performed.

Figure 2

2. SUMMARY OF TESTING

2.1. Visual Examination - All Test Groups

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. Temperature Resistance, Dry Circuit, Per Single Interface - Test Groups 1, 4, 7, 8, 9, 14, 17, 18 and 19

All contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 10 times the initial interface resistance.

2.3. Temperature Rise vs Current At Elevated Ambient Conditions - Test Groups 8 and 18

All specimens had a temperature rise of less than 40˚C above ambient when tested using a baseline rated current of 10 amperes and loaded per Figure 3.

Cell Identification

	1	2	3	4	5	6	7	8	9	10	11	12
A	9.7		0,2	0.3	0.3	6.9	6.9			T		
B	0.2		9.7					4	4			
C				1.5	1.5	2.4	2.4			8.7		0.2
D	1,8		0.2					0.1	0.1	0.2		8.7
E	0.2		1.8	1.5	1.5	1.8	1.8					

NOTE *Numbers in cell indicates current in amperes, i.e. cell B1 = 0.2 amperes.*

Figure 3
Current Loading

2.4. Dielectric Withstanding Voltage - Test Groups 5, 6, 15 and 16

No dielectric breakdown or flashover occurred.

2.5. Fuse Blow - Test Groups 9 and 19

No damage occurred as a result of subjecting the specimens to 5 fuse openings.

2.6. Free Fall - Test Groups 4 and 14

No damage occurred as a result of subjecting the specimens to 8 drops.

2.7. Vibration - Test Group 1

No discontinuities were detected during vibration testing. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible. Excludes VF28 relay.

2.8. 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. Component population limited to fuses.

2.9. Housing Locking Mechanism Strength - Test Groups 2 and 12

Specimens did not disengage under an axial load of 100 N.

2.10. Housing Locking Mechanism Retention Force to Failure - Test Groups 3 and 13

All specimens withstood an axial load of 250 N before failing.

2.11. Secondary Lock Strength - Test Groups 3 and 13

Latch did not disengage under a load of 45 N.

2.12. Connector Cover Durability At Room Ambient - Test Groups 2, 9, 12 and 19

No damage occurred as a result of mounting and unmounting the cover 50 times at room ambient.

2.13. Connector Cover Durability At -40˚C - Test Group1

No damage occurred as a result of mounting and unmounting the cover 5 times at -40˚C.

2.14. Durability, Misaligned Hinges - Test Groups 2 and 12

No damage occurred as a result of attempting to install a misaligned cover 3 times.

2.15. Contact Retention - Test Groups 3 and 13

All contacts withstood an 80 N removal force before failing.

2.16. Fuse Extractor Durability, Multiple Fuse Removal - Test Groups 1, 7 and 17

No damage occurred as a result of 6 fuse removals from the cover and 12 fuse removals from the base.

2.17. Fuse Extractor Durability, Extractor Retention - Test Groups 1, 7 and 17

No damage occurred as a result of 10 fuse extractor insertions into the base.

2.18. Degree of Protection, IP 66 - Test Groups 7 and 17

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

2.19. Degree of Protection, IP 67 - Test Groups 4, 7, 14 and 17

No evidence of physical damage was visible as a result of water immersion.

2.20. Salt Fog - Test Groups 6 and 16

No evidence of physical damage was visible as a result of salt fog testing.

2.21. Temperature Life - Test Groups 8 and 18

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

2.22. Thermal Shock - Test Groups 7 and 17

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

2.23. Humidity-temperature Cycling - Test Groups 5 and 15

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

3. TEST METHODS

3.1. Visual Examination

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

3.2. Temperature Resistance, Dry Circuit, Per Single Interface

Dry circuit 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. Temperature Rise vs Current At Elevated Ambient Conditions

Temperature rise curves were produced by measuring individual energized contacts (see Figure 3) at 80˚C, these measurements were plotted to produce a temperature rise vs current curve. The ambient temperature was then subtracted from this measured temperature to find the temperature rise. When the temperature rise of 3 consecutive readings taken at 5 minute intervals did not differ by more than 1˚C, the temperature measurement was recorded.

3.4. Dielectric Withstanding Voltage

A test potential of 500 volts DC was applied between adjacent circuit positions. This potential was applied for 2 minutes and then returned to zero.

3.5. Fuse Blow

A 30 ampere fuse was subjected to a load of 12 volts DC battery voltage and current until the fuse opened 5 times.

3.6. Free Fall

Specimens affixed to a 750 mm cable and loaded per Figure 3, routed symmetrically, were subjected to 8 drops, rotated 45 degrees each drop.

3.7. Vibration

Specimens were subjected to vibration per Figure 4. Eight hours in each of 3 mutually perpendicular planes. Specimens were monitored for discontinuities of 10 microseconds or greater using a current of 100 milliamperes at less than 20 millivolts DC.

Breakpoint Frequency (Hz)	Magnitude (G^2/Hz)	Slope Between Breakpoint (dB/Octave) (see Note 1)
10 (see Note 1)	.070	0.0
20 (see Note 1)	.070	-5.42
40	.020	0.0
350	.020	-9.20
550	.005	-20.02
700	.001	-100.12
750	.0001	0.0
2000	.0001	0.0

NOTE

1. *Linear slopes on log-log plots only.*
2. *RMS G Level: - 3.2 G's maximum G level limited to 3 x the RMS level.*
3. *Tolerance: ± 4 db from 10 to 2000 Hz.*
4. *Wires to be firmly supported within 150 mm from PDM base wire exits. Device oriented to horizontal and vertical plane.*
5. *Excludes VF28 relay monitoring.*

Figure 4
Vibration Outline

3.8. Mechanical Shock

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 10 microseconds or greater using a current of 100 milliamperes DC.

3.9. Housing Locking Mechanism Strength

Specimens were subjected to a force of 100 N for 1 minute.

3.10. Housing Locking Mechanism Retention Force to Failure

Specimens with latches engaged were pulled to failure.

3.11. Secondary Lock Strength

A force of 45 N was applied to the latch unit with the secondary lock engaged while attempting to remove the cover.

3.12. Connector Cover Durability At Room Ambient

Covers were manually mounted and unmounted 50 times at ambient temperature.

3.13. Connector Cover Durability At -40˚C

Covers were manually mounted and unmounted 5 times at -40˚C.

3.14. Durability, Misaligned Hinges

Misaligned covers (1 hinge latched in the correct position with the other outside the base latch) were subjected to 3 cycles of a 100 N force applied for 1 minute at a maximum rate of 20 mm per minute.

3.15. Contact Retention

Specimens were subjected to a force of 80 N applied at a maximum rate of 50 mm per minute.

3.16. Fuse Extractor Durability, Multiple Fuse Removal

Specimens were subjected to 6 manual fuse removals from the cover and 12 manual fuse removals from the base.

3.17. Fuse Extractor Durability, Extractor Retention

Specimens were subjected to 10 manual fuse extractor insertions into the base.

3.18. Degree of Protection, IP 66

Specimens were subjected to a water flow rate of approximately 22 gallons per minute from all possible directions for approximately 3 minutes 15 seconds.

3.19. Degree of Protection, IP 67

Specimens were submerged in water to a depth of 1 meter and held for 30 minutes.

3.20. Salt Fog

Specimens were exposed to a 5% salt concentration for 1000 hours at 35˚C and 95% RH.

3.21. Temperature Life

Specimens were exposed to a temperature of 80˚C for 96 hours.

3.22. Thermal Shock

Specimens were subjected to 50 cycles of thermal shock with each cycle consisting of 60 minute dwells at -55 and 85˚C for a total test time of 100 hours.

3.23. Humidity-temperature Cycling

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, with a cold shock (-10˚C) during the 7th cycle.