Low Profile Terminal Block Assembly

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Tyco Electronics Low Profile Terminal Block Assembly to determine its conformance to the requirements of Product Specification 108-2136 Revision A.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the Low Profile Terminal Block Assembly. Testing was performed at the Engineering Assurance Product Test Laboratory between 30Jul03 and 11Nov03. The test file number for this testing is CTL B042700-007. This documentation is on file at and available from the Engineering Assurance Product Test Laboratory.

1.3. Conclusion

The Low Profile Terminal Block Assembly listed in paragraph 1.5., conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2136 Revision A.

1.4. Product Description

The Low Profile Terminal Block Assembly is a Cu/Al rated, UL approved, three position terminal block ideal for appliance and HVAC applications. It is intended to serve as the primary field wire connection point for building wiring to HVAC equipment or appliances. With its unique construction, it can accommodate up to six ring tongues on the equipment side terminations, thereby enabling it to be the primary distribution point for power within the equipment enclosure. The field wiring side of the block affords field equipment installers the maximum flexibility by accommodating copper or aluminum wire as well as terminated ¼ inch ring tongues. Termination is easily accomplished with a simple nut driver or cross-drive screwdriver.

1.5. Test Specimens

Test specimens were representative of normal production lots. Part number 1604532-2 was used for test. Test specimens were terminated to various wire sizes as indicated in Figure 1. The torque value for all field wiring side screws without ring tongue terminals was 35 inch-pounds. The torque value for all ring tongue terminal screws on the factory and field wiring sides was 20 inch-pounds.

Test Group	Quantity	Field Wiring Side	Number of Strands Field Wiring Side	Factory Wiring Side (all with terminals)
1-1	5	6 AWG copper wire with terminal	19	6 AWG copper wire
2-1	5	4 AWG aluminum wire, compacted	7	6 AWG copper wire
2-2	5	6 AWG aluminum wire, compacted	7	8 AWG copper wire
2-3	5	8 AWG aluminum wire, compacted	7	10 AWG copper wire
2-4	5	6 AWG copper wire	19	6 AWG copper wire
2-5	5	10 AWG copper wire	19	10 AWG copper wire
2-6	5	10 AWG copper wire, solid	1	10 AWG copper wire

Figure 1 (cont)

* Trademark
| Indicates change

Test Group	Quantity	Field Wiring Side	Number of Strands Field Wiring Side	Factory Wiring Side (all with terminals)
2-7	5	6 AWG copper wire with terminal	19	6 AWG copper wire
3-1	5	None	None	None
4-1	5	4 AWG aluminum wire, compacted	7	6 AWG copper wire
4-2	5	6 AWG aluminum wire, compacted	7	8 AWG copper wire
4-3	5	8 AWG aluminum wire, compacted	7	10 AWG copper wire
4-4	5	6 AWG copper wire	19	6 AWG copper wire
4-5	5	10 AWG copper wire	19	10 AWG copper wire
4-6	5	10 AWG copper wire, solid	1	10 AWG copper wire
4-7	5	6 AWG copper wire with terminal	19	6 AWG copper wire
5-1	5	4 AWG aluminum wire, compacted	7	6 AWG copper wire
5-2	5	6 AWG aluminum wire, compacted	7	8 AWG copper wire
5-3	5	8 AWG aluminum wire, compacted	7	10 AWG copper wire
5-4	5	6 AWG copper wire	19	6 AWG copper wire
5-5	5	10 AWG copper wire	19	10 AWG copper wire
5-6	5	10 AWG copper wire, solid	1	10 AWG copper wire

Figure 1 (end)

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	1
Low level contact resistance	2,5	2,5,7,9		2,4	
Insulation resistance			2,6		
Withstanding voltage			3,7		
Temperature rise vs current		3,10			
Current cycling				3	
Vibration, sinusoidal	3	8(c)			
Mechanical shock	4				
Screw torque	6				
Wire retention					3
Thermal shock			4		2
Humidity-temperature cycling		4	5		
Temperature life		6			
Final examination of product	7	11	8	5	4

NOTE

(a) See paragraph 1.5.
(b) Numbers indicate sequence in which tests are performed.
(c) Discontinuities shall not be measured. Energize at 18˚C level for 100% loadings per Specification 102-950.

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

2.2. Low Level Contact Resistance - Test Groups 1, 2 and 4

All low level contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 0.5 milliohm both initially and after testing.

Test Group	Number of Data Points	Condition	Termination Resistance		
			Min	Max	Mean
1	10	Initial	0.057	0.078	0.068
		After mechanical (ΔR)	-0.011	0.018	0.003
2	70	Initial	0.046	0.120	0.074
		After vibration (ΔR)	-0.009	0.076	0.021
3	70	Initial	0.043	0.105	0.070
		After current cycling (ΔR)	-0.010	0.090	0.010

NOTE *All values in milliohms.*

Figure 3

2.3. Insulation Resistance - Test Group 3

All insulation resistance measurements were greater than 5000 megohms.

2.4. Withstanding Voltage - Test Group 4

No dielectric breakdown or flashover occurred.

2.5. Temperature Rise vs Current - Test Group 2

All specimens had a temperature rise less than 30˚C above ambient when tested using a baseline rated current of 65, 55 or 45 amperes as specified for the wire size.

2.6. Current Cycling - Test Group 4

No physical damage occurred as a result of current cycling.

2.7. Vibration, Sinusoidal

A. Test Group 1

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

B. Test Group 2

Specimens in each sub-group maintained the required current flow and exhibited no apparent physical damage during testing. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

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.

2.9. Screw Torque - Test Group 1

No thread stripping or cracked housings occurred as a result of applying 3.5 N•m to the #10 screws and 5.5 N•m to the M-6 screws.

2.10. Wire Retention - Test Group 5

No physical damage occurred to either the terminal blocks or the housings, and no wires dislodged from the terminal blocks or contacts as a result of applying the specified axial load to the wires.

2.11. Thermal Shock - Test Groups 3 and 5

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

2.12. Humidity-temperature Cycling - Test Groups 2 and 3

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

2.13. Temperature Life - Test Group 2

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

2.14. 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 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

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

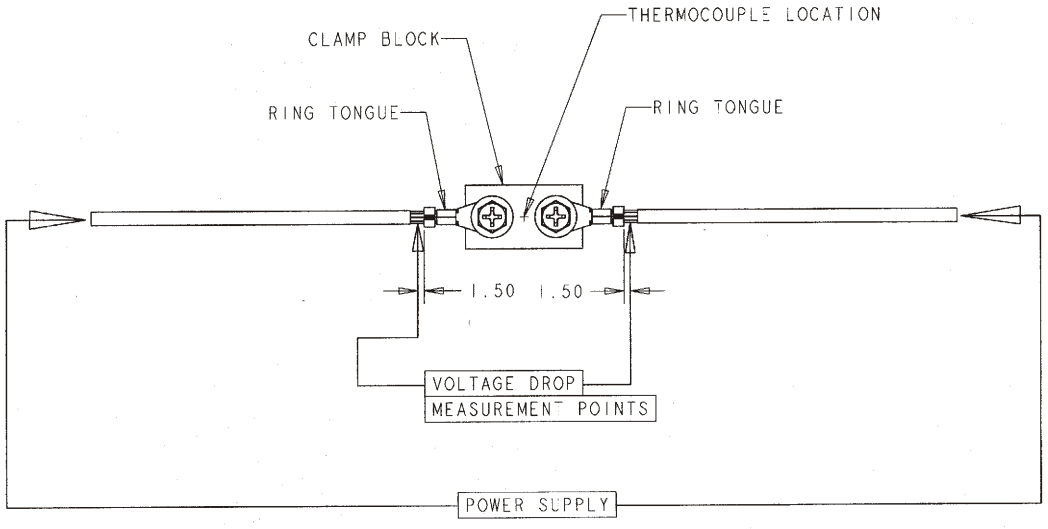

Figure 4A
Low Level Contact Resistance Measurement Points

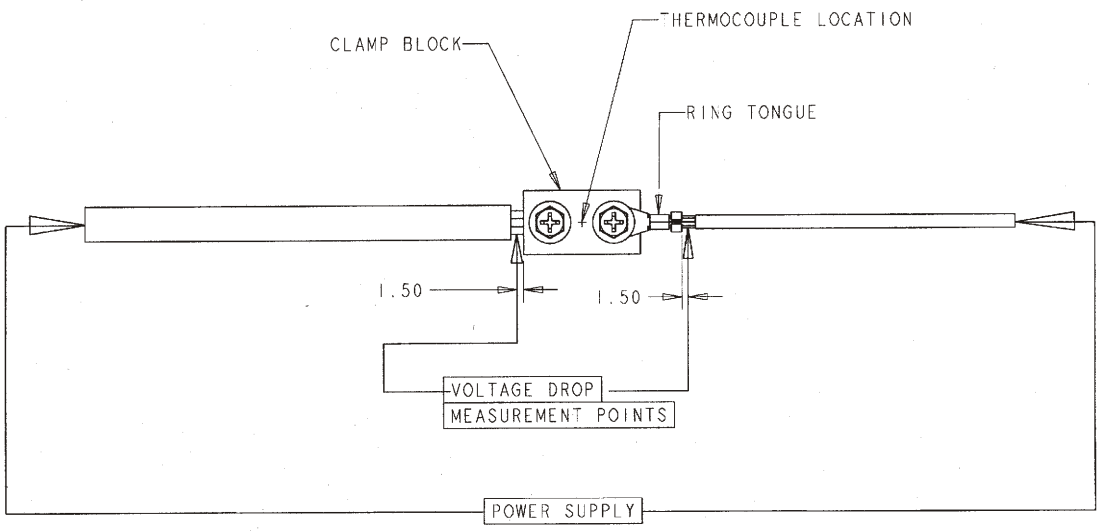

Figure 4B
Low Level Contact Resistance Measurement Points

3.3. Insulation Resistance

Insulation resistance was measured between adjacent contacts (power contact and center ground contact) of unmated specimens. A test voltage of 500 volts DC was applied for 2 minutes before the resistance was measured.

3.4. Withstanding Voltage

A test potential of 1600 volts AC was applied between adjacent contacts. This potential was applied for 1 minute and then returned to zero.

3.5. Temperature Rise vs Current

Temperature rise at rated current was determined by measuring individual contact temperatures at the rated current (see Figure 5). Thermocouples were attached to individual contacts to measure their temperatures. 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.

Wire Size (Field Wiring Side)	Rated Current (Amperes)
4 AWG aluminum wire	65
6 AWG copper wire	65
6 AWG copper wire with terminal	65
6 AWG aluminum wire	55
8 AWG aluminum wire	45
10 AWG copper wire, stranded and solid	45

Figure 5

3.6. Current Cycling

Specimens were subjected to 500 cycles of current cycling with each cycle having current ON for 45 minutes and OFF for 15 minutes. Test current was 82 amperes DC for test groups 4-1, 4-4 and 4-7; 69 amperes DC for test group 4-2; and 57 amperes DC for test groups 4-3, 4-5 and 4-6. Test currents were approximately 125% of the rated current.

3.7. Vibration, Sinusoidal

A. Test Group 1

Mated specimens were subjected to sinusoidal vibration, having a simple harmonic motion with an amplitude of 1.5 mm [0.06 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 120 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.

B. Test Group 2

Specimens were energized during vibration testing at a current level that produced a specimen temperature rise of approximately 18˚C. Test currents were determined using initial condition specimens. Specimen temperatures were not measured during vibration testing. Test currents are shown in Figure 6.

Test Group	Field Wiring Side	Factory Wiring Side	Test Current (amperes)
2-1	4 AWG aluminum wire	6 AWG copper wire	74
2-2	6 AWG aluminum wire	8 AWG copper wire	60
2-3	8 AWG aluminum wire	10 AWG copper wire	45
2-4	6 AWG copper wire	6 AWG copper wire	74
2-5	10 AWG copper wire	10 AWG copper wire	45
2-6	10 AWG copper wire, solid	10 AWG copper wire	45
2-7	6 AWG copper wire with terminal	6 AWG copper wire	74

Figure 6

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. Screw Torque

A force of 3.5 N•m was applied to the #10 screws using a torque wrench. A force of 5.5 N•m was applied to the M-6 screws using the same method.

3.10. Wire Retention

A specified axial load (see Figure 7) was applied to each wire and held for 60 seconds. Dead weights were suspended from the specimen wires in a direction that would cause removal of the wire from the terminal block.

Wire Size (AWG)	Pullout Force (N)
4 aluminum	160
6 copper	94
6 aluminum	124
8 copper	90
8 aluminum	44
10 copper	80

Figure 7

3.11. Thermal Shock

Specimens were subjected to 25 cycles of thermal shock with each cycle consisting of 30 minute dwells at -40 and 105˚C. The transition between temperatures was less than 1 minute.

3.12. Humidity-temperature Cycling

Unmated 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 (Figure 8).

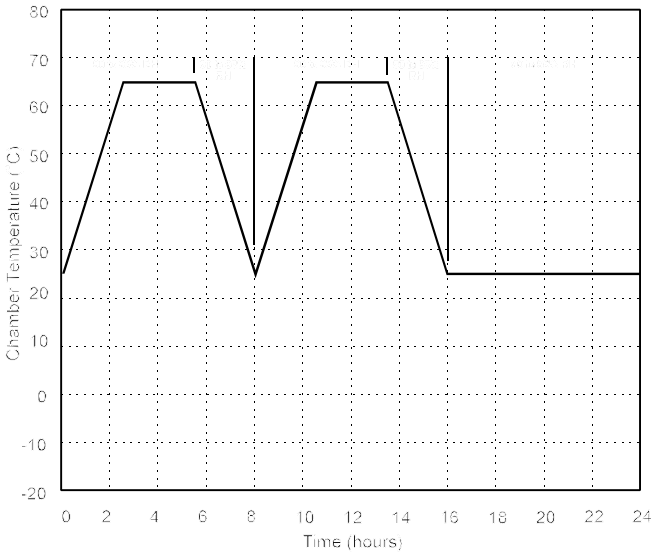

Figure 8
Typical Humidity-Temperature Cycling Profile

3.13. Temperature Life

Specimens were exposed to a temperature of 105˚C for 500 hours.

3.14. Final Examination of Product

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