ELCON Mini cable-to-board power connector system, Three Position

1. INTRODUCTION

1.1. Purpose

Testing was performed on the ELCON Mini three position cable-to-board connector system, using connectors with the optional coding contacts, and cable connectors with Pull-tab to determine their conformance to the requirements of Product Specification 108-128027.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of 3 Positon Cable to Board Power Connectors.

1.3. Conclusion

3 Positon Cable to Board Power Connectors listed in paragraph 1.4, conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-128027.

** Rev. A1: Vertical 3 Position ET (Part Number 2204585-1) has the same design and the equivalent test results as the originally tested products except for the action pin. Test results for action pin are added in this report.

1.4. Test Specimens

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

Part Number	Description	Quantity per Test Group									
		1	2	3	4	5	6	7	8	9	10
2204529-1	3 Position right angle, Solder tail	5	3	5	5		5		5		
2204581-1	3 Position right angle, Complaint tail									5	
2204585-1	3 Position vertical, Action Pin									5	
2204535-1	Stack 3 position right angle, Solder tail		3		5						
2204534-1	Cable connector, 3 position	5	9	5	20		5				
1241818-5	Standard Timer contact, 12-10AWG		27			10					
927837-5	Standard Timer contact, 14AWG			15	30	5					
927831-5	Standard Timer contact, 18AWG	15			15	5					
PCB	3 Position ET test PCB								5	5	
2204534-3	Standard Timer contact, 10AWG	15			15	5					5
2366837-1	Standard Timer contact, 12-10AWG, Au					15			5	5	
2204535-4	Stack 3 position right angle, Solder tail, Au	5		5		5					

Figure 1

1.5. Environmental Conditions

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

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

1.6. Qualification Test Sequence

Test or examination	Para	TEST-GROUP (a)									
		1	2	3	4	5	6	7	8	9	10
		TEST-SEQUENCE (b)									
Examination of product	3.4.01	1,9,13	1,6	1,9	1,17	1,4	1,6	1,3(c)	1	1, 5	1
Termination resistance	3.4.10	2,6,10	2,5	2,4,6,8	2,6,10,14						
Insulation resistance	3.4.11				3,7,11,15						
Voltage proof	3.4.12				4,8,12,16						
Electrical load and temperature	3.4.13		4								
Current temperature derating curve	3.4.14		3								
Short-circuit capacity power contacts	3.4.15							2(c)			
Resistance at crimp	3.4.16					2					
Vibration Sinusoidal	3.4.20	4									
Physical shock	3.4.21	5									
Insertion/withdrawal force(No contacts)	3.4.22	3,12									
Latch activation force	3.4.23						2,5				
Mechanical operation(half of number)	3.4.24			3,7							
Contact retention force in cable connector	3.4.25	11									
Cable pull in 5 directions	3.4.26	7									
Locking latch strength	3.4.27	8									
Crimp tensile	3.4.28					3					
Mounting force in to PCB	3.4.29								2		
Complaint pin insertion	3.4.30									2	
Complaint pin distortion	3.4.31										
Complaint pin retention	3.4.32									4	
Break force of pull tab	3.4.33										2
Rapid change of temperature	3.4.40				5						
Climatic sequence	3.4.41				9						
Damp/heat steady state	3.4.42				13						
Corrosion mixed flowing gas	3.4.43			5(d)							
Thermal shock	3.4.44						3				
Temperature life	3.4.45						4			3	

Figure 2

NOTE *(a) See paragraph 1.4.*
(b) Numbers indicate sequence in which tests are performed.

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. Low Level Contact Resistance (LLCR) - Test Groups 1, 2, 3, 4.

All power contacts LLCR measurements, taken at 100mA maximum and 20 millivolts maximum open circuit voltage were less than 2.0 mΩ for resistance 1 and 0.8 mΩ for resistance 3 initially and after testing.

***Notes:** Termination resistance 3 values below are excl. bulk resistance of wire (approx.: 18AWG cable is 1.50mΩ, 14AWG cable is 0.64mΩ, 12AWG is 0.27mΩ, 10AWG is 0.22mΩ). The values of termination resistance 3 below are calculated by resistance 1 subtracting resistance 2.*

Test Group		Test Sequence	Termination resistance 3	Spec	Jud.
1	10AWG Wire with 2204529-1	2	0.46mΩ Max.	0.8mΩ Max.	OK
		6	0.54mΩ Max.		OK
		10	0.48mΩ Max		OK
2	10AWG Wire with 2204529-1	2	0.35mΩ Max.		OK
		5	0.46mΩ Max.		OK
	10AWG Wire with 2204535-1	2	0.40mΩ Max.		OK
		5	0.66mΩ Max.		OK
3	10AWG Wire with 2204529-1	2	0.42mΩ Max.		OK
		4	0.46mΩ Max.		OK
		6	0.55mΩ Max		OK
		8	0.49mΩ Max.		OK
4	10AWG Wire with 2204529-1	2	0.35mΩ Max.		OK
		6	0.40mΩ Max.		OK
		10	0.50mΩ Max		OK
		14	0.51mΩ Max.		OK
	10AWG Wire with 2204535-1	2	0.38mΩ Max.		OK
		6	0.58mΩ Max.		OK
		10	0.59mΩ Max		OK
		14	0.61mΩ Max.		OK

Figure 3

2.3. Insulation Resistance - Test Group 4

Test Group	Test Sequence	Insulation Resistance	Spec.	Jud.

4	3	$5.0x10^{11}\Omega$ Min.	$5x10^{3}$ MΩ	OK
	7	$5.8x10^{11}\Omega$ Min.	$1x10^{3}$ MΩ	OK
	11	$1.0x10^{12}\Omega$ Min.		OK
	15	$1.12x10^{12}\Omega$ Min.		OK

Figure 4

2.4. Voltage Proof - Test Group 4

Test Group	Test Sequence	Insulation Resistance	Spec.	Jud.
4	4	No break-down or flash-over was observed.	No breakdown or flashover.	OK
	8	No break-down or flash-over was observed.		OK
	12	No break-down or flash-over was observed.		OK
	16	No break-down or flash-over was observed.		OK

Figure 5

2.5. Electrical load and temperature– Test Group 2
The data was taken from board connectors that were connected with 10AWG wire in series as well as for cable connector. The max. temperature rise at 35A for single row connector of 2204529-1 was 21.2°C and 28.1°C for stack connector of 2204535-1 at ambient temperature of 65°C.

2.6. Temperature rise and de-rating curve – Test Group 2
The temperature rise and derating curve was taken from specimens connected to 10AWG wire for single and dual row board connector as well as for cable connector. T-rise data were for different wire size in figure 7.

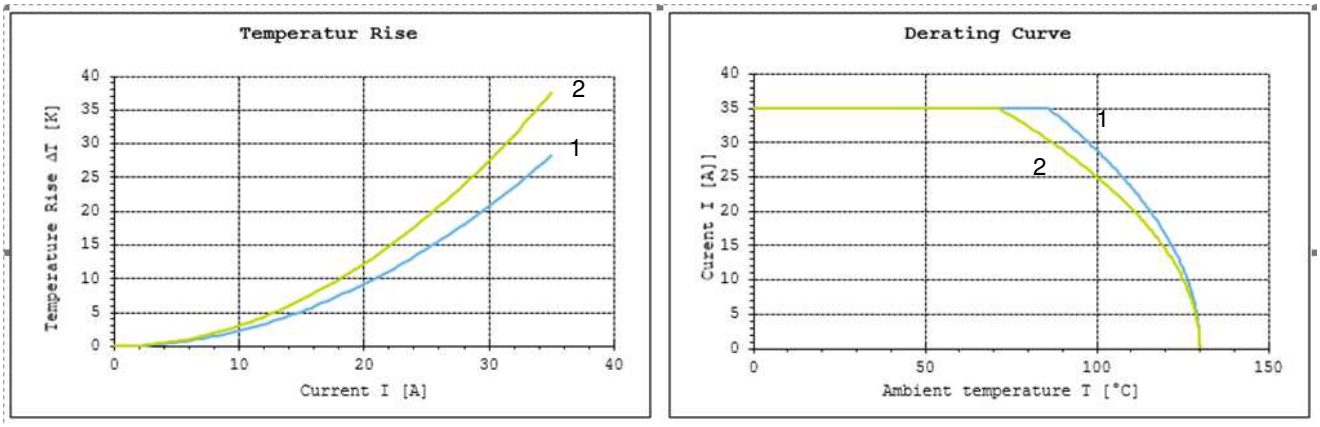

Figure 6 T-rise data were for different wire size.

Note, 1 indicates the curve for single row.
2 indicates the curve for dual (stack) row.

Board Connector	Wire Size (AWG)	Current	Temperature Rise(°C)
2204529	10	35	28.36 (36.95A@30T-rise)
	12	26	20
	14	20	22.84
	18	10	11.7
2204535	10	35	33.59 (31.75 for 30T-rise)

12	26	21.81
14	20	29.55
18	10	12.47

Figure 7

Note: Single row: 2204529-1 and Dual (stack): 2204535-1 for 10AWG wire
T-rise for different wire shown in figure 7

2.7. Resistance with bulk (Resistance 2)

Test Group		Test Sequence	Termination resistance 1	Spec	Jud.
5	18AWG	2	1.52mΩ Max.	1.5mΩ Avg.	OK
	14AWG		0.64mΩ Max.		OK
	12AWG		0.27mΩ Max		OK
	10AWG		0.22mΩ Max.		OK

Figure 8

2.8. Vibration Sinusoidal – Test Group 1

No discontinuity greater than 1microsecond were detected; No physical damage.

2.9. Physical Shock - Test Groups 1

No discontinuity greater than 1microsecond were detected; No physical damage.

2.10. Insertion/withdrawal forces – Test Group 1

Test Group	Test Sequence	Insertion force	Spec.	Jug.	Withdrawal force	Spec.	Jug.
1	3	39.15~53.06N	60N Max.	OK	29.15~43.04N	6N Min	OK

Figure 9

2.11. Latch activation force (no power contact) – Test Group 6

Test Group	Test Sequence	Latch activation force	Spec	Jug.
6	2	17.23N ~ 27.07 N	30N Max.	OK
	5	12.73N ~ 25.54 N		OK

Figure 10

2.12. Mechanical operation - Test Groups 3

No physical damage occurred as a result of mating and un-mating 50 cycles.

2.13. Contact retention force in cable connector – Test Group 1

Apply 50N straight force at a contact of the cable connector, in un-mating direction during 10 sec, all maximum displacement smaller than 0.20mm.

2.14. Cable pull in 5 directions – Test Group 1

No functional damage was observed and the latch still in place.

2.15 Locking latch strength – Test Group 1

No functional damage was observed and the latch staid in place.

2.16 Crimp tensile – Test Group 5

Test Group		Test Sequence	Crimp tensile	Spec.	Jug.
5	18AWG Wire	3	172N Min.	100N Min.	OK
	14AWG Wire	3	320N Min.	200N Min.	OK
	12AWG Wire	3	458N Min.	250N Min.	OK
	10AWG Wire	3	507N Min.	300N Min.	OK

Figure 11

2.17 Mounting force in to PCB – Test Group 8

The mounting force were less than 20N per contact.

2.18. Complaint pin insertion – Test Group 9 and 10

EON: All complaint pin insertion measurements were less than 110N per pin.
Action Pin: All action pin insertion measurements were between 100N and 155N per pin.

2.19. Complaint pin distortion – Test Group 9

All radial hole distortion measurements were less than 0.070 mm with a minimum of 0.008 mm copper wall remaining.

2.20. Complaint pin Retention – Test Group 9 and 10

EON: All complaint pin retention measurements were larger than 6.7N per pin
Action Pin: All action pin retention measurements were between 80N and 120N per pin.

2.21. Rapid change of temperature – Test Group 4.

No physical damage was found after test.

2.22. Climatic sequence – Test Group 4.

No evidence of abnormities was found after test.

2.23. Damp/heat steady state – Test Group 4.

No evidence of abnormities was found after test.

2.24. Corrosion mixed flowing gas – Test Group 3.

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

2.25. Thermal shock – Test Group 6.

No functional damage was observed and the latch staid in place.

2.26. Temperature life – Test Group 9.

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

2.27. Break force of pull tab – Test Group 10.

The break force was higher than 240N

3. TEST METHODS

3.1. Initial Examination of Product

A C o f 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. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage.

3.3. Insulation Resistance

Insulation resistance was measured between adjacent contacts of mated specimens. A test voltage of 100 volts DC was applied for 1 minutes before the resistance was measured.

3.4. Voltage Proof

A test potential of 500 volts rms was applied between adjacent contacts of mated specimens. These potentials were applied for 1 minute and then returned to zero.

3.5. Electrical load and temperature

Specimens were placed in a chamber, the temperature of which is 65°C for 1000 hours. Current were slowly increased until it reached 35A.

3.6. Current temperature derating curve

Temperature rise was measured on connectors using thermocouple in a circuit in series for board connector 2204529-1. Specimens were prepared by attaching the thermocouple in the middle of the contact for 2204529-1 and lower middle for 2204535-1.

- Nice specimens of 2204534-1 with 27 contacts crimped on 10 AWG wire
- Three specimens of 2204529-1 were connected with 10 AWG wire at the solder tail
- Three specimens of 2204535-1 were connected with 10 AWG wire at the solder tail

3.7. Resistance with bulk resistance

Specimens were prepared with 100 mm length for different AWG wire size.

- Five specimens of 927831-5 crimped on 18 AWG wire
- Five specimens of 927837-5 crimped on 14 AWG wire
- Five specimens of 1241818-5 crimped on 12 AWG wire
- Five specimens of 1241818-5 crimped on 10 AWG wire

3.8. Vibration Sinusoidal

Mated specimens were subjected to a random vibration test, specified by a random vibration spectrum, with excitation frequency bounds of 10 and 500 Hz. The root-mean square amplitude of the excitation was 10 G. This was performed for 30 minutes in each of 3 mutually perpendicular planes for a total vibration time of 90 minutes. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

3.9. Physical Shock

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

3.10. Insertion/withdrawal 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 10 mm per minute.

3.11. Latch Activation Force

The force were required to open the latch was measured using a tensile/compression device with a free floating fixture.

3.12. Mechanical Operation

Specimens were mated and unmated 50 cycles at a maximum rate of 500 cycles per hour.

3.13 Contact Retention Force in Cable Connector

Contact retention of the contacts was measured using a tensile/compression device. The contacts were pulled from the housing by using clamping the connector in the axial direction with 50N during 10 sec.

3.14. Cable Pull in 5 Direction

Contact retention of the contacts was measured using a tensile/compression device. The contacts were pulled from the housing by using clamping the connector in five directions of un-mating, up, down, left and right with 50N during 10 sec.

3.15. Locking Latch Strength

The force were required to open the latch was measured using a tensile/compression device. Mated samples were pulled by 100N in un-mating direction.

3.16. Crimp Tensile

The specimens were clamped in a vise at the contact. Air jaw were used to grip the wire end and the loads was applied in the vertical motion. The load was applied at the rate of 25mm per minute.

3.17. Mounting Force in to PCB

The force were required to insert the board connector with hold down only in to the PCB. Force was measured for different PCB hole sizes.

3.18. Compliant Pin Insertion

The force required to apply the specimens to a PCB was measured using a tensile / compression device with a rate of travel of 12.7 mm per minute. A flat rock technique was used to press the connectors off the PCB. In accordance with EIA–364-05.

3.19. Radial holes distortion

A total of 6 randomly picked pin/holes from 1 specimen were cross-sectioned horizontally as close as possible to the area of maximum deformation. These cross-sections were used to determine mean and maximum radial deformation/distortion as follows: Using an optical video probe with variable magnification of 100 to 300X, measurements were made using a round template affixed to the screen of the video monitor. The lines were matched to the radius of the plated thru-holes by adjusting the magnification of the probe. This line was placed on the original holes radius, and the difference

between the original radius and the maximum and minimum deformation/distorted radius was measured for each of the 6 pin/holes. The same 6 pin/holes that were cross sectioned to measure hole deformation were also used to determine holes damage and minimum copper thickness between the pin and the PCB laminate. The holes were also examined for any evidence of cracks or breaks in the copper wall.

3.20 Compliant Pin Retention

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

3.21. Rapid Change of Temperature

Mated specimens were subjected to a rapid change of temperature test with the following parameters:
One cycle consists of:
Upper temperature: 90°C for 30 minutes.
Lower temperature: -40°C for 30 minutes.
Number of cycles: 5

3.21 Climatic Sequence

Mated specimens were subjected to the following tests:
Dry heat: 90°C, 16 hours.
Damp heat cyclic: 25°C/ 55°C, RH 93%, 24 hours, 1 cycle.
Cold: -40°C, 2 hours.
Damp heat cyclic: 25°C/ 55°C, RH 93%, 24 hours, 5 cycles.

3.22 Damp/heat Steady State

Mated specimens were exposed to the temperature of 40°C and 95% relative humidity for 21 days.

3.23. Corrosion Mixed Flowing Gas

Mated specimens were exposed for 10 days to a mixed flowing gas exposure, of which exposure is defined as a temperature of 25°C and a relative humidity of 75% with the pollutants of Cl_2 at 10 ppb, NO_2 at 200 ppb, H_2S at 10 ppb and SO_2 at 200 ppb.

3.24. Thermal Shock

Mated specimens were subjected to 5 cycles of thermal shock with each cycle consisting of 120 minute dwells at -40 and 105°C and 5 minute maximum transition between temperatures.

3.25. Temperature Life

Mated specimens were exposed to a temperature of 105°C for 1000 hours. In accordance with EIA–364-17, Method B, Test Condition 4, Test Time Condition C.

3.26. Break force of pull tab

Break force was measured by using a tensile/compression device. The pull tab were pulled away from the housing by using a round bar to holding the pull tab in the axial direction until the pull tab breaks.