

**Multi-Beam Plus Power Distribution Connector System**

**1. INTRODUCTION**

1.1. Purpose

Testing was performed on Multi-beam Plus Power Distribution Connector System to determine its conformance to requirements of product Specification 108-128074

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of Multi-beam Plus Power Distribution Connector System. Testing was performed at the China Engineering Center Testing Laboratory.

1.3. Conclusion

The Multi-beam Plus Power Distribution Connector System conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 128074

1.4. Test Specimens

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

Part Number	Description
2334531-2	Right angle header, 20S+6P
2334571-1	Right angle receptacle, 20S+6P
2321806-2	Right angle header, 6P+3LP
2321805-2	Right angle receptacle, 6P+3LP
2385033-1	Right angle header, 2P+5LP+20S
2387228-1	Right angle receptacle, 2P+5LP+20S

Figure 1

1.5. Environmental Conditions

Unless otherwise stated. The following environmental conditions prevailed during testing

Temperature: 25°C  
Relative Humidity: 50%

1.6. Product Qualification and Requalification Test Sequence

Test or Examination	Test Group (a)						
	1	2	3	4	5	6(b)	7(b)
	Test Sequence (c)						
Initial examination of product	1	1	1	1	1	1	1
Low level contact resistance, signal and power contacts	2,5	3,7		2,4			
Low level contact resistance, power contacts only					2,6,8,10		
Contact resistance at rated current, power contacts					12		
Insulation resistance			2,6				
Withstanding voltage			3,7				
Temperature rise vs current					4,11		
Vibration, random		5			9(d)		
Mechanical shock		6					
Durability	3(e)	4			3(f)		
Mating force		2					
Unmating force		8					
Compliant pin insertion							2
Radial hole distortion							3
Compliant pin retention							5
Component heat resistance to wave soldering						2	
Solderability dip test						3	
Thermal shock			4				
Humidity-temperature cycling			5				
Temperature life				3	7		4
Mixed flowing gas	4				5		
Final examination of product	6	9	8	5	13	4	6

**NOTE**

- (a) See paragraph 1.4.
- (b) Split into subgroups as needed for on and off board tests.
- (c) Numbers indicate sequence in which tests are performed.
- (d) Energize at current for 18°C temperature rise.
- (e) Precondition specimens with 5 durability cycles.
- (f) Precondition specimens with 25 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 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, Signal and Power Contacts - 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 0.8 milliohms initially and 1.0 milliohms after testing for High power contacts, and less than 1.5 milliohms initially and 2.5 milliohms after testing for low power contacts, and less than 20 milliohms initially and 30 milliohms after testing for signal contacts.

Test Group	Condition	LLCR(milliohms)		
		Minimum	Maximum	Average
1	High power Contacts			
	Initial (actual)	0.14	0.27	0.21
	After Mixed flowing gas	0.12	0.21	0.15
	Low Power Contacts			
	Initial (actual)	0.81	0.98	0.89
	After Mixed flowing gas	0.80	1.02	0.89
	Signal Contacts			
	Initial (actual)	7.33	13.62	10.50
After Mixed flowing gas	7.32	15.29	11.04	
2	High power Contacts			
	Initial (actual)	0.11	0.24	0.16
	After mechanical shock	0.12	0.16	0.15
	Low power Contacts			
	Initial (actual)	0.79	1.28	0.98
	After mechanical shock	0.73	1.26	0.95
	Signal Contacts			
	Initial (actual)	7.29	14.60	10.67
After mechanical shock	6.71	15.02	10.70	
4	High power Contacts			
	Initial (actual)	0.18	0.27	0.21
	After Temperature life	0.20	0.33	0.26
	Low power Contacts			
	Initial (actual)	0.71	1.33	0.92
	After Temperature life	0.94	1.43	1.12
	Signal Contacts			
	Initial (actual)	7.65	14.29	11.00
After Temperature life	7.07	15.91	11.29	

Figure 3

### 2.3 Low Level Contact Resistance, Power Contacts Only - Test Group 5

All low level contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 0.8 milliohms initially and 1.0 milliohms after testing.

Test	Condition	LLCR(milliohms)		
Group		Minimum	Maximum	Average
5	High power Contacts			
	Initial (actual)	0.11	0.49	0.26
	After mated mixed flowing gas	0.36	0.70	0.52
	After temperature life	0.30	0.49	0.38
	After vibration,random	0.31	0.52	0.39
	Low Power Contacts			
	Initial (actual)	0.71	1.33	0.92
	After mated mixed flowing gas	1.36	1.51	1.43
	After temperature life	1.46	2.14	1.77
	After vibration,random	1.07	2.03	1.41

Figure 4

#### 2.4 Contact Resistance at Rated Current- Test Group 2

Contact resistance measurements for power contacts were less than the maximum requirement of 0.6 milliohms and low power contacts were less than the maximum requirement of 1.5 milliohms. All data was taken from specimens on 2 ounce copper 4 layer printed circuit boards. Values were measured per individual contacts.

High Power Contact	Requirement	0.6 mΩ maximum, end of life
	Current	85A per pin
	N=	6 pos
	Minimum	0.56
	Maximum	0.34
	Average	0.45

Figure 5

#### 2.5 Insulation Resistance – Test Group 3

All insulation resistance measurements were greater than 500 megohms for signal contacts and greater than 1000 megohms for power and low power contacts.

#### 2.6 Withstanding Voltage – Test Group 3

No dielectric breakdown or flashover occurred

#### 2.7 Temperature Rise vs. Current – Test Group 5

Current listed in Figure 6 are for 30°C temperature rise at end of life., All data was taken from specimens on 2 ounce copper 4 layer printed circuit boards. Detailed T-rise graphs in Appendix 1 (The graphs have been curve fitted from the actual data).

Contact Type	Number of Contacts					
	Current (DC amperes)					
	1	2	3	4	5	6
High Power	140	120	N/A	95	N/A	90
Low Power	45	40	35	N/A	30	N/A

Figure 6

2.8 Random Vibration – Test Group 2 and 5

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

2.9 Mechanical Shock – Test Group 2

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

2.10 Durability – Test Group 1, 2 and 5

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

2.11 Mating Force – Test Group 2

All mating force measurements for high power contacts were less than 7 N per contact; All mating force measurements for low power contacts were less than 1 N per contact; All mating force measurements for signal contacts were less than 1 N per contact.

2.12 Unmating Force – Test Group 2

All Unmating force measurements for high power contacts were greater than 2.2N per contact; all unmating force measurements for lower power contacts were greater than 0.5N per contact; all unmating force measurements for signal contacts were greater than 0.2N per contact;

2.13 Radial hole distortion – Test Group 7

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

2.14 Component Heat Resistance to Wave Soldering – Test Group 6

No evidence of physical damage was visible as a result of subjecting the specimens to wave soldering.

2.15 Solderability dip test – Test Group 6

All solderable areas had a minimum of 95% solder coverage.

2.16 Thermal Shock – Test Group 3

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

2.17 Humidity/temperature cycling – Test Group 3

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

2.18 Temperature life – Test Group 4 and 5

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

#### 2.19 Mixed Flowing Gas – Test Group 1 and 5

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

#### 2.20 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 C of C was issued stating that all specimens in the test package were 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, Signal and Power Contacts

LLCR measurements at low level current were made using a four terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. Measurements were taken by applying current through the series wired boards via the plated ring holes. Voltage measurements were taken by applying voltage to each contact's plated via hole.

#### 3.3 Low Level Contact Resistance, Power Contacts Only

LLCR measurements at low level current were made using a four terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. Measurements were taken by applying current through the series wired boards via the plated ring holes. Voltage measurements were taken by applying voltage to each contact's plated via hole.

#### 3.4 Contact Resistance at Rated Current

Specimens were subjected to contact resistance testing in accordance with Design Specification 108-128074. and EIA –364-06. Specimens were energized at the current levels listed in paragraph 2.3 and resistance measurements were recorded.

#### 3.5 Insulation Resistance

Insulation resistance was measured between adjacent signal and power contacts of mated specimens. A test voltage of 500 volts DC was applied for 2 minutes before the resistance was measured, in accordance with EIA-364-21C

#### 3.6 Withstanding Voltage

A test potential of 1000 volts DC was applied between the adjacent signal and low power contacts of mated specimens. This potential was applied for 1 minute and then returned to zero. A test potential of 2500 volts DC was applied between the adjacent power contacts of mated specimens. This potential was applied for 2 minutes and then returned to zero. In accordance with EIA-364-20B Condition I

#### 3.7 Temperature Rise vs. Current

Infrared temperature measurement points, i.e. exposed contacts, were coated with Micatin powder which is used as an emissivity correction coating. This emissivity correction coating has a known value of 0.93 emittance. Raising and knowing the emittance value allows for accurate temperature measurements. The

infrared camera was used with the built-in standard optics (24° lens) to image the test specimens. ThermoCAM Researcher 2001 thermal imaging process system was used for data analysis. The area tool software feature was used to determine maximum temperature of the exposed contacts. The area tool software feature allows a shape, which can be sized, to be placed on an area of interest. The pixels inside the shape are analyzed giving minimum, maximum, average, and standard deviation measurements of that targeted temperature.

### 3.8 Random Vibration

Mated specimens were subjected to a random vibration test, specified by a random vibration spectrum with excitation frequency bounds of 20 and 500 Hz. The spectrum remained flat at 0.05 G<sup>2</sup>/Hz from 20 Hz to upper bound frequency of 500 Hz. The root-mean square amplitude of excitation was 4.90 GRMS. The specimens were subjected to this test time of 45 minutes per specimen. Specimens were monitored for discontinuities of microsecond or greater using an energizing current of 100 milliamperes. In accordance with EIA-364-28D Condition VII

### 3.9 Mechanical Shock

Mated specimens were subjected to a mechanical shock test having a half-sine waveform of 50 gravity units (g peak) and 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 one microsecond or greater using a current of 100 milliamperes DC. In accordance with EIA-364-27B Method A

### 3.10 Durability

Specimens were mated and unmated 500 cycles at a maximum rate of 500 cycles per hour. In accordance with EIA-364-09

### 3.11 Mating 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 12.7 mm per minute. In accordance with EIA-364-13B.

### 3.12 Unmating 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 12.7 mm per minute. In accordance with EIA-364-13B

### 3.13 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

### 3.14 Radial Hole Distortion

A total of 10 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 hole radius, and the difference between the original radius and the maximum and minimum deformation/distorted radius was measured for each of the 10 pin/holes. The same 10 pin/holes that were cross-sectioned to measure hole deformation were also used to determine hole 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.

### 3.15 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 [.5 in] per minute.

### 3.16 Component Heat Resistance to Wave Soldering

All specimens were checked dimensionally before and after exposure to heat. The solderable areas of the specimens were immersed in Kester 145 type ROL0 flux for 5 to 10 seconds. This flux is a non-activated rosin flux having a nominal composition of 25% by weight of water white gum rosin in a solvent of 99% isopropyl alcohol. The specific gravity of the flux was between 0.838 and 0.858. The flux was maintained at room temperature. The specimens were then removed from the flux and the excess was allowed to drain off for 5 to 20 seconds. The specimens were attached to a dipping machine and immersed at a maximum rate of 25.4 mm [1 in] per second into a soldering bath filled with melted lead free solder (96.5% Sn, 3.0% Ag and 0.5% Cu) controlled at  $265 \pm 5^{\circ}\text{C}$  [509/F] until the solderable surface was coated. The specimens were held in the solder bath for 10 seconds. The specimens were then removed from the solder bath at a maximum rate of 25.4 mm [1 in] per second and subjected to a 5 minute cleaning in isopropyl alcohol. The specimens were then given a visual examination using 30X magnification.

### 3.17 Solderability Dip Test

The solderable areas of the specimens were immersed in Kester 145 type ROL0 flux for 5 to 10 seconds. This flux is a non-activated rosin flux having a nominal composition of 25% by weight of water white gum rosin in a solvent of 99% isopropyl alcohol. The specific gravity of the flux was between 0.838 and 0.858. The flux was maintained at room temperature. The specimens were then removed from the flux and the excess was allowed to drain off for 5 to 20 seconds. The specimens were immersed at a maximum rate of 25.4 mm [1 in] per second into a soldering bath filled with melted lead free solder (96.5% Sn, 3.0% Ag and 0.5% Cu) controlled at  $245 \pm 5^{\circ}\text{C}$  [473/F] until the solderable surface was coated. The specimens were held in the solder bath for 4 to 5 seconds. The specimens were then removed from the solder bath at a maximum rate of 25.4 mm [1 in] per second and subjected to a 5 minute cleaning in isopropyl alcohol. The specimens were then given a visual examination using 30X magnification.

### 3.18 Thermal shock

Mated specimens were subjected to 36 cycles of thermal shock with each cycle consisting of 30 minute dwells at  $-40^{\circ}$  and  $125^{\circ}\text{C}$ . The transition between temperatures was less than 1 minute. In accordance with EIA-364-32C.

### 3.19 Humidity-temperature Cycling

Mated specimens were exposed to 10 cycles of humidity-temperature cycling. Each cycle lasted 24 hours and consisted of cycling the temperature between 25 and  $40^{\circ}\text{C}$  at 80 to 100 %RH. In accordance with EIA-364-31B Method III

### 3.20 Temperature Life

Mated specimens were exposed to a temperature of  $125^{\circ}\text{C}$  for 504 hours (21 days). In accordance with EIA-364-17B Method A

### 3.21 Mixed Flowing Gas

Mated specimens were exposed for 14 days to a mixed flowing gas Class IIA exposure. Class IIA exposure is defined as a temperature of  $30^{\circ}\text{C}$  and a relative humidity of 70% with the pollutants of  $\text{Cl}_2$  at 10 ppb,  $\text{NO}_2$  at 200 ppb,  $\text{H}_2\text{S}$  at 10 ppb and  $\text{SO}_2$  at 100 ppb. In accordance with EIA-364-65 Class IIA

### 3.22 Final examination of product

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