Select Gold Mini Hermaphroditic Blade and Receptacle

1. INTRODUCTION

1.1 Purpose

The purpose of this testing was to ensure the conformance of the Select Gold Mini Hermaphroditic Blade and Receptacle Connectors to tests as outlined in TE Specification 108-106050, Rev D, Dated 23-June-2016.

1.2 Scope

Testing took place at the TE Connectivity Harrisburg Electrical Components Testing Laboratory (HECTL) between 11-January-2016 and 8-June-2016. The test file number for this testing is EA20160021T. This documentation is on file at and available from the Harrisburg Electrical Components Test Laboratory.

1.3 Conclusion

All specimens in all test sets met the requirements of TE product specification 108-106050 Rev D.

1.4 Product Description

The low profile SMT miniature hermaphroditic board-to-board connectors are designed to provide power between adjacent linear printed circuit boards. Ideal for use in compact spaces with features designed for vacuum pick and place that make it suitable for high volume automated manufacturing.

1.5 Test Specimens

The test specimens were representative of normal production lots, and the following part numbers were used for testing (see Table 1).

Table 1 – Specimen Description

Test Group	Test Set ID	Quantity	Part Number	Description
1	1	10	2213611-1	Select Gold Miniature Hermaphroditic Blade and Receptacle (2 Pos.)
1	2	10	2213611-2	Select Gold Miniature Hermaphroditic Blade and Receptacle (4 Pos.)
1	3	10	2213611-3	Select Gold Miniature Hermaphroditic Blade and Receptacle (6 Pos.)
2	1	20	2213611-1	Select Gold Miniature Hermaphroditic Blade and Receptacle (2 Pos.)
2	2	20	2213611-2	Select Gold Miniature Hermaphroditic Blade and Receptacle (4 Pos.)
2	3	20	2213611-3	Select Gold Miniature Hermaphroditic Blade and Receptacle (6 Pos.)
3	4	5	2213611-3	Select Gold Miniature Hermaphroditic Blade and Receptacle (6 Pos.) No Boards
4	5	5	2213611-3	Select Gold Miniature Hermaphroditic Blade and Receptacle (6 Pos.) No Boards
1, 2	1-3	90	60-1824110-1 Rev A	Printed Circuit Board

1.6 Qualification Test Sequence

Table 2 – Test Sequence

Test or Examination	Test Set			
	1,2,3	1,2,3	1	1
	Test Group per 108-106050			
	1	2 (a)	3	4
	Test Sequence (a)			
Initial Examination of Product	1	1	1	1
Low Level Contact Resistance	3,7	2,5,7,9,11		
Insulation Resistance			2,6	
Withstanding Voltage			3,7	
Temperature Rise vs. Current		3,12		
Resistance to Reflow Soldering				2
Random Vibration	5	10 (b)		
Mechanical Shock	6			
Durability	4			
Mating Force	2			
Unmating Force	8			
Thermal Shock		8	4	
Humidity/Temperature Cycling			5	
Temperature Life		6		
Mixed Flowing Gas Class IIA		4(c)(d)		
Final Examination of Product	9	13	8	3

Note: (a) Half of the specimens were subjected to initial T-Rise testing; the other half were subjected to the remainder of the test sequence.
(b) Energized at 18°C T-Rise.
(c) Mated specimens.
(d) Mixed Flowing Gas for Gold contacts per EIA-364-65B, Class IIA (4 gas) for 14 days.

1.7 Environmental Conditions

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

Temperature: 15°C to 35°C
Relative Humidity: 20% to 80%

2. SUMMARY OF TESTING

2.1 Initial Examination of Product – All Groups

No damage or defects were observed on any specimen when visually examined prior to any testing.

2.2 Low Level Contact Resistance – Test Group 1 and 2

All low level contact resistance measurements were less than the maximum requirement of 20 milliohms. The summary low level contact resistance data for the specimens in Test Group 1 and 2 are shown in Table 3 through 6

Table 3 – Test Group 1 Low Level Contact Resistance Summaries in Milliohms

Stats.	Test Set 1 2 Position		Test Set 2 4 Position		Test Set 3 6 Position	
	Initial	Final	Initial	Final	Initial	Final
Min	2.17	2.07	2.29	2.19	1.77	2.18
Max	2.93	2.99	2.80	2.49	3.50	2.67
Avg	2.44	2.40	2.51	2.32	2.75	2.37
Std Dev	0.21	0.26	0.13	0.09	0.40	0.11
N	10	10	20	20	30	30

Table 4 – Test Group 2 Low Level Contact Resistance Summaries in Milliohms

Stats.	Test Set 1 – 2 Position				
	Initial	Following MFG	Following Temp Life	Following Thermal Shock	Final
Min	2.29	2.23	2.40	2.22	2.41
Max	2.84	2.57	8.09	4.25	3.26
Avg	2.55	2.38	3.82	3.07	2.78
Std Dev	0.15	0.11	1.74	0.71	0.29
N	10	10	10	10	10

Table 5 – Test Group 2 Low Level Contact Resistance Summaries in Milliohms

Stats.	Test Set 2 – 4 Position				
	Initial	Following MFG	Following Temp Life	Following Thermal Shock	Final
Min	2.30	2.24	2.37	2.48	2.51
Max	3.55	3.05	6.14	15.89	3.86
Avg	2.64	2.53	3.37	4.34	2.82
Std Dev	0.28	0.21	0.97	3.23	0.34
N	20	20	20	20	20

Table 6 – Test Group 2 Low Level Contact Resistance Summaries in Milliohms

Stats.	Test Set 3 – 6 Position				
	Initial	Following MFG	Following Temp Life	Following Thermal Shock	Final
Min	1.67	2.28	2.03	2.33	2.40
Max	3.02	2.82	3.74	4.67	4.93
Avg	2.46	2.49	2.67	3.14	2.95
Std Dev	0.43	0.11	0.33	0.61	0.66
N	30	30	30	30	30

2.3 Insulation Resistance – Test Group 3

All specimens met the insulation resistance requirement of 100 megohm minimum when measured initially and after a thermal shock and humidity/temperature cycling environment exposure.

2.4 Withstanding Voltage – Test Group 3

All specimens met the withstanding voltage test requirement of 1,600 VAC applied to adjacent contacts with no breakdowns or flashover when measured initially and after thermal shock and humidity/temperature cycling environment exposures.

2.5 Temperature Rise vs Current – Test Group 2

All temperatures on all specimens were less than the 30°C maximum temperature rise requirement at 3 amperes.

2.6 Resistance to Reflow Soldering – Test Group 4

No visual evidence of melting, blistering, cracking or other damage was observed on any specimen as a result of the reflow heat exposure.

2.7 Random Vibration – Test Group 1 and 2

No apparent physical damage or discontinuities of one microsecond or greater occurred during testing for Test Group 1 specimens. No apparent physical damage occurred to energized specimens of Test Group 2.

2.8 Mechanical Shock – Test Group 1

No apparent physical damage or discontinuities of one microsecond or greater occurred during testing.

2.9 Durability – Test Group 1

No damage or defects were observed on any of the specimens as a result of 30 cycles of manual durability.

2.10 Mating Force – Test Group 1

All mating force measurements were less than the maximum requirement specified. Refer to Table 7 for the maximum force requirement.

Table 7 – Mating Force Requirement (Newton)

	TS 1 (2 Position)	TS 2 (4 Position)	TS 3 (6 Position)
Requirement	12 Max	24 Max	36 Max

2.11 Unmating Force – Test Group 1

All unmating force measurements exceeded the minimum requirement specified. Refer to Table 8 for the minimum force requirement.

Table 8 – Unmating Force Requirement (Newton)

	TS 1 (2 Position)	TS 2 (4 Position)	TS 3 (6 Position)
Requirement	0.7 Min	1.3 Min	2.0 Min

2.12 Thermal Shock - Test Group 2 and 3

No damage or defects were observed on any specimens as a result of the 250 cycles of thermal shock environmental exposure.

2.13 Humidity/Temperature Cycling – Test Group 3

No damage or defects were observed on any specimen as a result of ten days of humidity/temperature cycling environmental exposure.

2.14 Temperature Life – Test Group 2

No damage or defects were observed on any specimen as a result of temperature life environmental exposure of 130°C for 500 hours.

2.15 Mixed Flowing Gas Class IIA – Test Group 2

No damage detrimental to product performance was observed following exposure to mixed flowing gas. The Copper corrosion rate (Average) was 18.33 $\mu g/cm^2$/day.

2.16 Final Examination of Product – All Groups

No damage or defects were observed on any specimen when visually examined following testing.

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. Test Specification EIA-364-18B was used as a procedure for this procedure.

3.2 Low Level Contact Resistance

Low level contact resistance was measured using a four wire resistance method. Each specimen was wired in series and a test potential of 20 mV maximum open circuit voltage and 100 mA maximum current was used. The current was applied to the entire connector and the voltages were probed at the via hole for each position on the PCB. All specimen pairs were held in a fixed position with a test fixture in order to maintain the correct positioning and limit movement of the specimen halves during testing. Test Specification EIA-364-23C was used as a procedure for this test.

3.3 Insulation Resistance

All specimens were tested in the unmated state and were not mounted on test boards. Specimens were placed inside the Faraday cage of the insulation resistance testing system. Each set of adjacent contacts on all unmated/unmounted specimens in Test Group 3 were tested by applying a 500 volt potential and waiting for two minutes or meter stabilization prior to recording the insulation resistance value. Test Specification EIA-364-21E was used as a procedure for this test.

3.4 Withstanding Voltage

All specimens were tested in the unmated state and were not mounted on the test boards. The same adjacent contacts on each specimen that were previously tested for insulation resistance, were subjected to the withstanding voltage test. Each specimen was placed inside the Faraday cage of the dielectric testing system. A test potential of 1,600 VAC was applied for 60 seconds at a ramp rate of approximately 500 volts per second. Maximum leakage current was set to 5 mA and leakage currents were recorded. The test potential was applied for a period of one minute while monitoring for any breakdowns or flashover. Test Specification, EIA-364-20E, Condition I was used as a procedure for this test.

3.5 Temperature Rise vs Current

The infrared temperature measurement point, i.e. contacts of the specimen, were coated with Equate powder, used as an emissivity correction coating. The emissivity correction coating has a known value which is 0.95. Raising and knowing the emittance value allows for accurate temperature measurements. The infrared camera was used with the standard optics (50 mm lens) to image the test specimens.

ExaminIR thermal imaging processing 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 the target temperature.

The test specimens were placed in the temperature rise enclosure and measurements were taken after temperature stabilization. The contacts were connected in series through the traces on the PCB. Test Specification, EIA-364-70C was used for the procedure for this test.

3.6 Resistance to Reflow Soldering

Prior to the reflow heat exposure, all specimen were measured for critical dimensions by the submitting test technician. After the dimensional measurements the specimens were placed in a temperature/humidity chamber and subjected to the conditions of 85°C and a relative humidity of 85%, for a period of 168 hours. The specimens were contained in a non-reactive mesh basket as not to be touching or overlapping each other for the entire exposure time. Upon completion of the moisture soak pre-conditioning, the specimens were removed and allowed to sit at ambient conditions for at least 15 minutes and prior to 4 hours were subjected to three reflow heat cycles.

The specimens were placed on 4 X 6 X 0.0395 inch ceramic substrate and placed on a conveyor belt through a convection air oven. The specimens were exposed to temperatures between 150°C and 200°C for 60 to 180 seconds and between the temperatures of 255°C and 260°C for 20 to 40 seconds, and above liquidus (217°C) for 60 to 150 seconds as specified in specification TEC-109-201, method A, condition B, dated 11-July-2011. The temperature on top of a setup specimen was monitored in order to enable temperature profiling. A temperature of 259°C was measured during the profile setup/verification. The specimens and substrates were allowed to cool to ambient temperatures and then run back through the oven a total of 3 times. After the reflow heat exposure, the specimens were returned to the responsible test technician for final measurements.

3.7 Random Vibration

All specimens were mounted on printed circuit boards. The specimens and circuit boards were mounted to the test fixtures. They were then subjected to Random Vibration per EIA-364-28F, Test Condition VII, Condition Letter D, 3.10 grms over a frequency range of 20 to 500 Hz for a 15-minute period in each of 3 mutually perpendicular axes. Total exposure time was 45 minutes. The samples in Test Group 1 were monitored for discontinuities of 1 microsecond or longer. The samples in Test Group 2 were energized at 3.0 Amperes. A photograph of the test setup is shown in Figure 1.

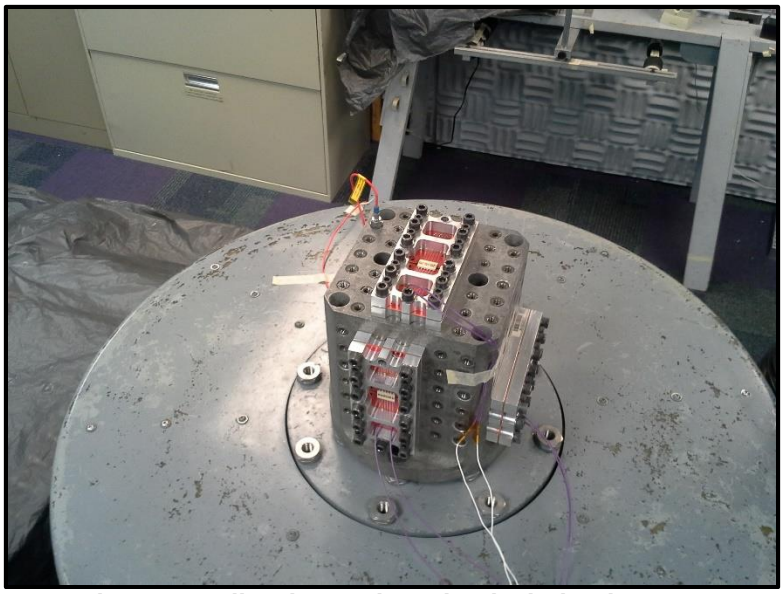

Figure 1 – Vibration and Mechanical Shock Setup

3.8 Mechanical Shock

The samples were subjected to Mechanical Shock per EIA-364-27C, Test Condition H, 30-g, 11-millisecond, half-sine shock pulses. Using the vibration shaker, 3 shock pulses were applied in each of 6 mutually orthogonal planes for a total of 18 shock pulses. The samples were monitored for discontinuities of 1 microsecond or longer. A Photograph of the setup is shown in Figure 1.

3.9 Durability

The specimens were subjected to 30 cycles of manual durability. One half of each specimen was loosened from the bars or fixture it was mounted to, and each specimens was carefully mated and unmated 30 times. Test Specification, EIA-364-9C was used as a procedure for this test.

3.10 Mating Force

Note: As per the previous qualification test, this data reflects the second mating of the test specimens. All specimens were mated manually in order to mount them on the PCB during the surface mounting operation prior to this mating force test.

One half of a specimen was secured in a vise mounted to an X-Y table on the base of a tensile compression testing machine. A fixture to hold the mating half on a PCB was mounted to the load cell on the cross head of the machine. The fixture on the load cell was left loose to provide float during the mating. The two mating halves were lined up to a point where mating would just start to take place. The cross head was started in the compression direction at a rate of 0.5 inches per minute pushing the halves together until fully mated, and the maximum force was recorded. Test Specification, EIA-364-13E was used as the procedure for this test.

3.11 Unmating Force

Each mated pair was placed in a vise mounted to a mill table on the base of a tensile/compression testing machine with one half secured in the vise. The opposite side of the mated pair was clamped into jaws that were mounted to the load cell on the cross head of the machine. The cross head was actuated in the tensile direction at a rate of 0.5 inches per minute pulling the mated halves apart until full unmating occurred, and the maximum force was recorded. Test Specification, EIA-364-13E was used as the procedure for this test.

3.12 Thermal Shock

Specimens were placed in a thermal shock chamber and subjected to 250 cycles of thermal shock exposure. Each cycle consisted on 30 minutes at each extreme of -40°C and 105°C with the transition time between cycles being one minute. Test Specification, EIA-364-32G, Test Condition VII was used as a procedure for this test.

3.13 Humidity/Temperature Cycling

The specimens in Test Group 3 were not board mounted and exposed unmated. The specimens, as described, were exposed to 10 cycles of humidity-temperature cycling. Each cycle lasted 24 hours and consisted of cycling the temperature between 25°C and 65°C twice while maintaining 80 to 100% humidity. Figure 2 illustrates one cycle of the environment. Test Specification, EIA-364-31D, Method III was used as a procedure for this test.

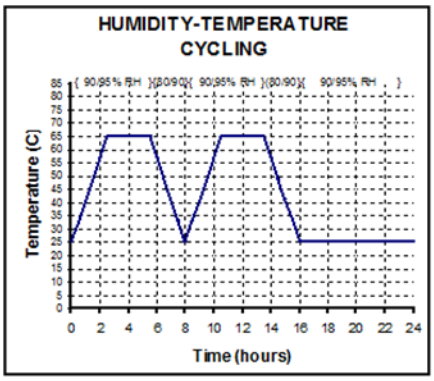

Figure 2 – Humidity/Temperature Cycling Profile

3.14 Temperature Life

All specimens in Test Sets 4, 5 and 6 were subjected to a temperature of 130°C for 500 hours in the mated condition. Test Specification, EIA-364-17C, Method A, Test Condition 5 was used as a procedure for this test.

3.15 Mixed Flowing Gas Class IIA

The specimens in Test Group 2 were subjected to a 4 gas environment in accordance with EIA-364-65B, Class IIA. The specimens were exposed for 14 days mated. Table 9 shows the MFG test parameters

Table 9 – MFG Test Parameters

Environment	**IIA**
Temperature (^{0}C)	**30**
Relative Humidity (%)	**70**
Chlorine (Cl2) Concentration (ppb)	**10±3**
Hydrogen Sulfide (H2S) Concentration (ppb)	**10±5**
Nitrogen Dioxide (NO2) Concentration (ppb)	**200±50**
Sulfur Dioxide (SO2) Concentration (ppb)	**100±20**
Exposure Period	**20 days**

3.16 Final Examination of Product

All specimens were visually examined after each sequential test for any evidence of damage or defects detrimental to product performance. Test Specification, EIA-364-18B was used as a procedure for this test.