OSFP 112G Receptacle

1. INTRODUCTION

1.1 Purpose

Qualification testing was performed on the TE Connectivity (TE) 60 Position OSFP 112G Receptacles to determine their conformance to the requirements of Product Specification 108-130011 Rev B.

1.2 Scope

This report covers the electrical, environmental, and mechanical performance of the OSFP 112G Receptacle. Testing was performed at the Harrisburg Electrical Components Test Laboratory (HECTL) between 24-Sep-2020 and 30-Oct-2020. Documentation is on file and maintained at HECTL under EA20200088T.

1.3 Conclusion

Specimens met the requirements listed in Product Specification 108-130011 Rev B. See Section 2 for detailed results.

1.4 Product Description

TE's Octal Small Form Factor Pluggable (OSFP) connectors and cable assemblies address next-generation data center needs by supporting aggregate data rates of 200 Gbps and up to 400 Gbps. These products are designed for both 28G NRZ and 56G PAM-4 protocols, with a roadmap to 112G PAM-4 for future system upgrades.

1.5 Test Specimens

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

Table 1 – Specimen Identification

Test Set	Qty	Part Number	Rev	Description
1	5	2344064-4	5	60 Position Right Angle OSFP 112G Receptacle Connector
	5	2317416-1	C	OSFP 1x1 Cage
	10	N/A	-	Test Transceiver Assembly w/ Test Paddlecard 60-1935204-1
	3	60-1935203-1	A	OSFP LLCR Test PCB
2	5	2344064-4	5	60 Position Right Angle OSFP 112G Receptacle Connector
	5	2317416-1	C	OSFP 1x1 Cage
	5	N/A	-	Test Transceiver Assembly w/ Test Paddlecard 60-1935204-1
	3	60-1935203-1	A	OSFP LLCR Test PCB
3	6	2344064-4	5	60 Position Right Angle OSFP 112G Receptacle Connector
	6	2317416-1	C	OSFP 1x1 Cage
	6	N/A	-	Test Transceiver Assembly w/ Test Paddlecard 60-1935204-1
	3	60-1935203-1	A	OSFP LLCR Test PCB
4	5	2344064-4	5	60 Position Right Angle OSFP 112G Receptacle Connector
	5	2317416-1	C	OSFP 1x1 Cage
5	5	2344064-4	5	60 Position Right Angle OSFP 112G Receptacle Connector
6	5	2344064-4	5	60 Position Right Angle OSFP 112G Receptacle Connector

1.6 Qualification Test Sequence

Table 2 – Test Sequence

Test or Examination	Test Group					
	1	2	3	4	5	6
	Test Set					
	1	2	3	4	5	6
	Test Sequence (a)					
Examination of Product	1,10	1,7	1,10	1,8	1,3	1,3
Low Level Contact Resistance	3,5,9	3,6	3,6,9			
Insulation Resistance				2,6		
Withstanding Voltage				3,7		
Random Vibration	6					
Mechanical Shock	7					
Durability	4					
Connector Solderability					2	
Resistance to Reflow Soldering Heat						2
Thermal Shock				4		
Humidity / Temperature Cycling				5		
Temperature Life		4				
Mixed Flowing Gas			4			
Thermal Cycling			7			
Minute Disturbance	2,8	2,5	2,5,8			

(a) The numbers indicate sequence in which tests were performed.

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 Examination of Product – All Test Groups

After subjecting the specimens to an initial and final visual inspection, there were no indications of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests on the specimens.

2.2 Low Level Contact Resistance – Test Groups 1, 2 & 3

Test Sets 1 through 3 met the 20 milliohm maximum delta requirement. See Tables 3 through 5 for a summary of the test results.

Table 3 – Low Level Contact Resistance Summary for Test Set 1 in milliohms

	Initial	After Durability	After Vibration and Shock
	Actual (R)	Delta (ΔR)	Delta (ΔR)
Minimum	12.84	-2.46	-2.28
Maximum	18.98	1.65	4.15
Average	15.03	0.10	0.50
Std Dev	0.91	0.52	0.93
Count	300	300	300

Table 4 – Low Level Contact Resistance Summary for Test Set 2 in milliohms

	Initial	After Temperature Life
	Actual (R)	Delta (ΔR)
Minimum	12.58	-1.64
Maximum	18.18	2.98
Average	14.90	0.72
Std Dev	0.95	0.68
Count	300	300

Table 5 – Low Level Contact Resistance Summary for Test Set 3 in milliohms

	Initial	After 7 Days MFG Exposure	After 14 Days MFG Exposure	After Thermal Cycling
	Actual (R)	Delta (ΔR)	Delta (ΔR)	Delta (ΔR)
Minimum	12.45	-1.51	-1.40	-1.28
Maximum	17.77	2.23	3.87	5.10
Average	14.92	0.35	0.61	0.86
Std Dev	1.02	0.55	0.85	0.99
Count	360	360	360	360

2.3 Insulation Resistance – Test Group 4

All specimens had an insulation resistance greater than 100 gigohms, meeting the requirement listed in the product specification.

2.4 Withstanding Voltage – Test Group 4

After subjecting the specimens to withstanding voltage, there were no indications of either breakdown or flashover between adjacent contacts.

2.5 Random Vibration – Test Group 1

Following random vibration, there was no indication of cracking, breaking or other damage. No discontinuities of one microsecond or greater occurred during testing.

2.6 Mechanical Shock – Test Group 1

Following mechanical shock, there was no indication of cracking, breaking or other damage. No discontinuities of one microsecond or greater occurred during testing.

2.7 Durability – Test Group 1

Following durability, there was no indication of cracking, breaking or other damage.

2.8 Connector Solderability – Test Group 5

After subjecting the specimens to connector solderability, all specimens exhibited >95% solder wetting of the critical area of solderability as defined in IPC/ECA JEDEC J-STD-002E, Test S1. Figure 1 illustrates the critical area of solderability. Figure 2 shows typical contacts as received and Figure 3 contains photographs typical of all contacts after the solderability test.

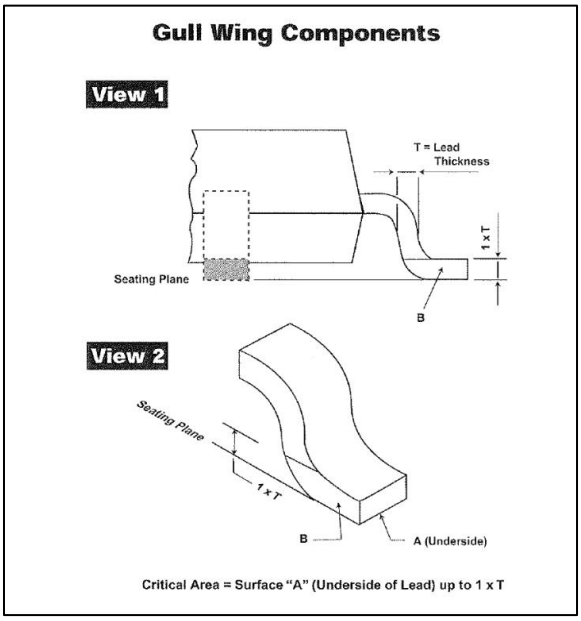

Figure 1 – Critical Area of Solderability

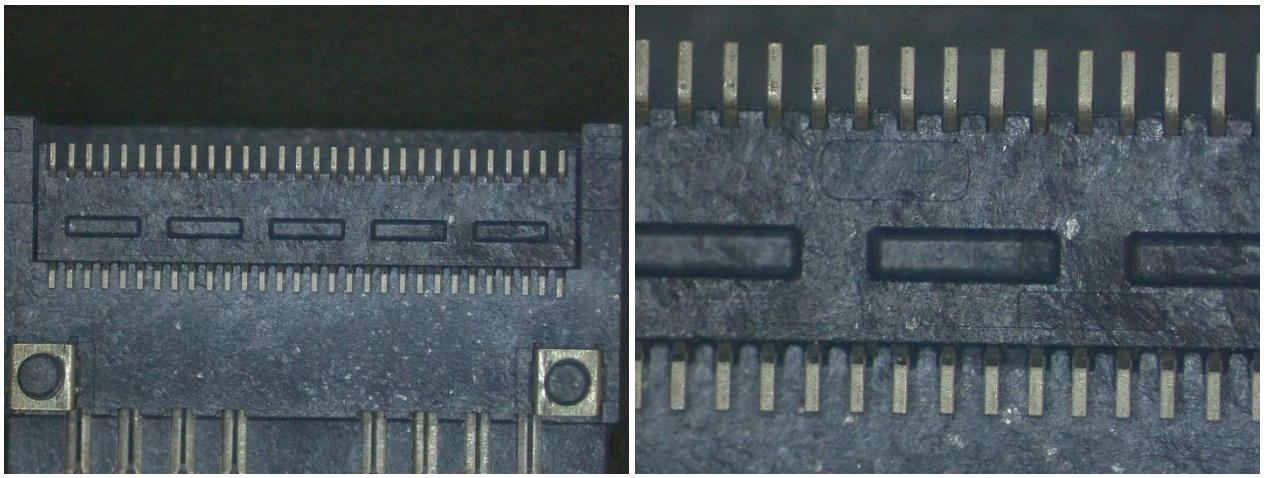

Figure 2 – Solder Contacts as Received

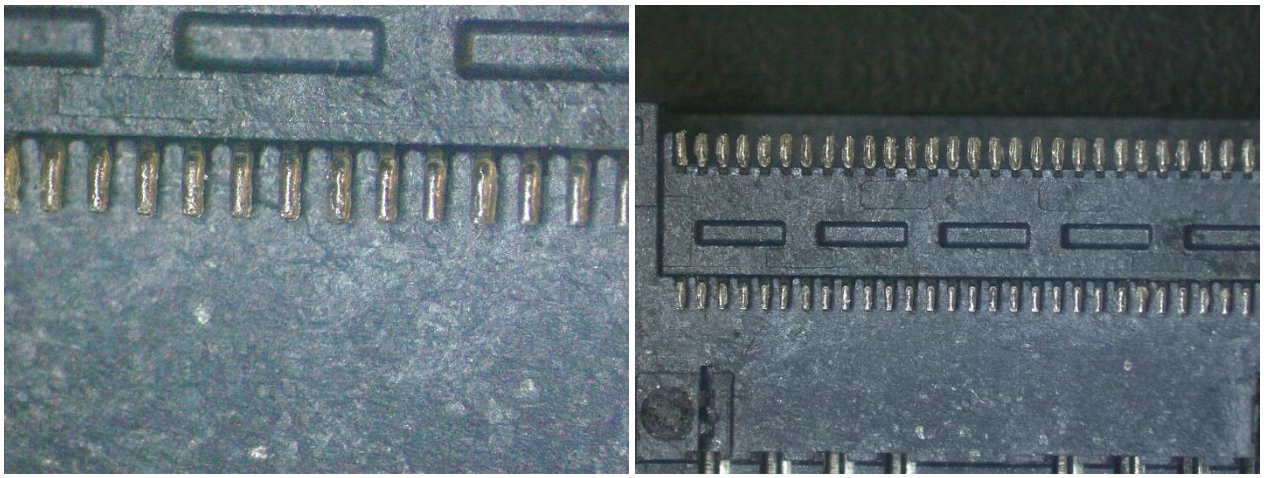

Figure 3 – Typical Contacts after Solderability Test

2.9 Resistance to Reflow Soldering Heat – Test Group 6

After the first reflow heat exposure, there was no visual evidence of blistering, cracking, melting, delamination or other damage on any specimen. There were no obvious visual changes after the second and third reflow heat exposures, as compared to the visual examination after the first reflow heat exposure.

2.10 Thermal Shock – Test Group 4

No physical damage detrimental to product performance was visible due to thermal shock exposure.

2.11 Humidity / Temperature Cycling – Test Group 4

No physical damage detrimental to product performance was visible due to humidity / temperature cycling.

2.12 Temperature Life – Test Group 2

No physical damage detrimental to product performance was visible due to temperature life.

2.13 Mixed Flowing Gas – Test Group 3

No physical damage detrimental to product performance was visible due to exposure to the pollutants of mixed flowing gas. The average copper corrosion rate was 14.0μg/cm^2/day.

2.14 Thermal Cycling – Test Group 3

No physical damage detrimental to product performance was visible due to thermal cycling.

2.15 Minute Disturbance – Test Groups 1, 2 & 3

No physical damage detrimental to product performance was visible due to minute disturbance.

3. TEST METHODS

3.1. Initial Examination of Product

A C of 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. Specimens were subjected to a visual examination with an unaided eye in accordance with EIA 364-18B.

3.2 Low Level Contact Resistance

Specimens were subjected to a low level contact resistance test in accordance with EIA 364-23C. See Figure 4 for a representative image of the test setup.

Resistance measurements were taken using a 4-point measurement technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. Positive current and voltage was applied to the discrete headers on the PCB. Negative current and voltage was connected to the paddle card bus.

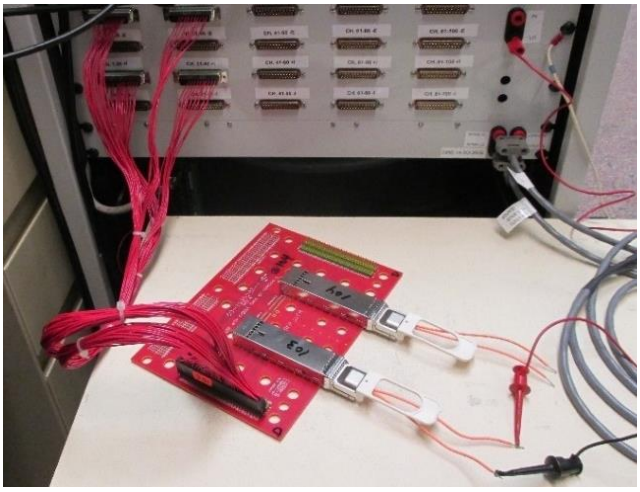

Figure 4 – Low Level Contact Resistance Test Setup

3.3 Insulation Resistance

Specimens were subjected to an insulation resistance test in accordance with EIA 364-21F. See Figure 5 for a representative image of the test setup.

Insulation resistance was measured between adjacent signal contacts of unmated specimens. A test voltage of 100 volts DC was applied for one minute before the resistance was measured. Four adjacent signal pairs and two adjacent auxiliary pairs per connector were tested for a total of 30 measurements.

3.4 Withstanding Voltage

Specimens were subjected to an insulation resistance test in accordance with EIA 364-20F. See Figure 5 for a representative image of the test setup.

A test potential of 300 volts AC was applied between the adjacent signal to signal and signal to ground contacts of unmated specimens. This potential was applied for one minute and then returned to zero. Four adjacent signal pairs, six adjacent signal to ground contacts, and two adjacent auxiliary pairs were tested per connector for a total of 60 measurements.

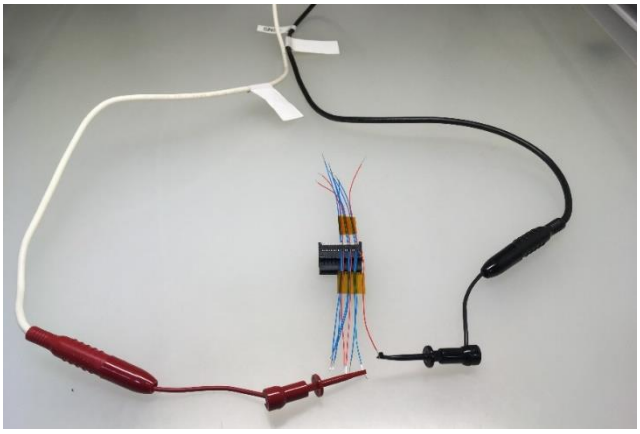

Figure 5 – Insulation Resistance and Withstanding Voltage Test Setup

3.5 Random Vibration

The test specimens were subjected to a random vibration test in accordance with specification EIA-364-28F, test condition “VII”, test condition letter D. See Figure 6 for representative images of the test setup.

The parameters of this test condition are specified by a random vibration spectrum with excitation frequency bounds of 20 and 500 Hertz (Hz). The spectrum remains flat at 0.02G²/Hz from 20 Hz to the upper bound frequency of 500 Hz. The root-mean square amplitude of the excitation was 3.10 GRMS. The test specimens were subjected to this test for 15 minutes in each of the three mutually perpendicular axes, for a total test time of 45 minutes per test specimen.

The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

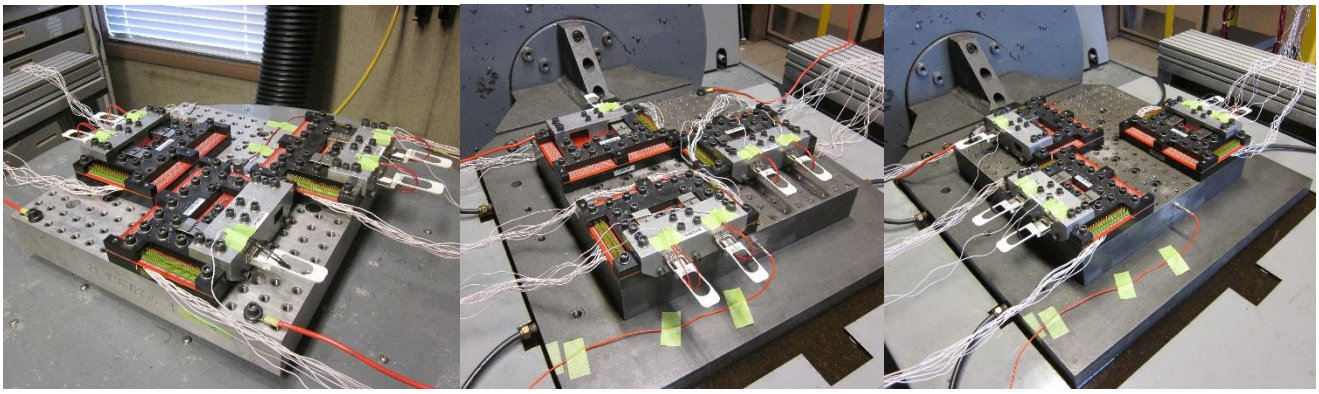

Figure 6 – Random Vibration Test Setup

3.6 Mechanical Shock

The test specimens were subjected to a mechanical shock test in accordance with specification EIA-364-27C, test condition H. See Figure 7 for representative images of the test setup.

The parameters of this test condition are a half-sine waveform with an acceleration amplitude of 30 gravity units (g's peak) and a duration of 11 milliseconds. Three shocks in each direction were applied along the three mutually perpendicular axes of the test specimens, for a total of eighteen shocks.

The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

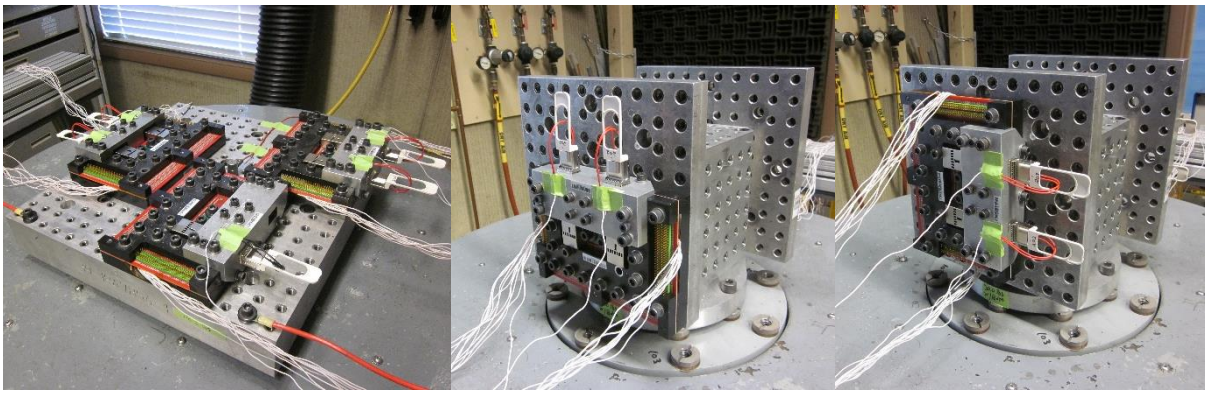

Figure 7 – Mechanical Shock Test Setup

3.7 Durability

The specimens were subjected to a durability test in accordance with EIA 364-09D. Specimens were mated and unmated 95 times by hand with a dummy transceiver at a rate less than 300 cycles per hour.

3.8 Connector Solderability

The specimens were subjected to a connector solderability test in accordance with J-STD-002, TE Specification 108-130011, Revision A. See Figure 8 for the recorded temperature profile.

Prior to testing, specimens were prepared by removing the locating studs. This was done to enable the specimens sit flush on the ceramic substrate.

A solder paste with a composition of Sn96.5, Ag3.0, Cu0.5 with flux in the paste having an activation of L0, was placed onto a stencil (located in inventory at HECTL) with pad geometry, opening, and thickness that was appropriate for the specimens being tested. The solder paste was printed onto a ceramic substrate, the screen was removed, and a specimen was placed onto the solder paste print under appropriate magnification. Care was taken to ensure that the specimens were not contaminated in any way and were tested in the “as received” condition.

The specimen and ceramic substrate were then placed on a conveyor belt through a convection oven. The specimen was exposed for 60-120 seconds between the temperatures of 150°C and 180°C and for 30-60 seconds between the temperatures of 230°C and 260°C. The temperature on the ceramic substrate, at a point on a SMT contact, was monitored to enable temperature profiling. All specimens were examined using a microscope at 10X magnification for solder wetting of the critical area of solderability.

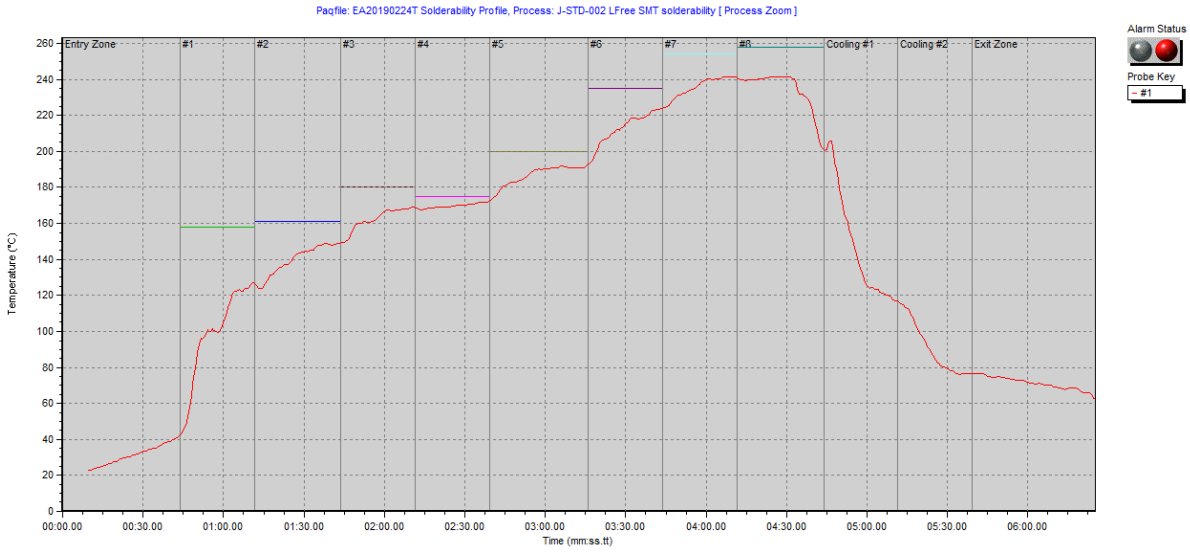

Figure 8 – Typical Connector Solderability Reflow Profile

3.9 Resistance to Reflow Soldering Heat

The specimens were subjected to a resistance to reflow soldering heat test in accordance with TE-109-201B. See Figure 9 for the reflow profile and Figure 10 for the reflow results.

All specimens were placed on 4 x 6 x 0.0395 inch ceramic substrates and placed on a conveyor belt through a convection air oven. The specimens were exposed to temperatures conforming to the requirements of TE-109-201B and the peak temperature was between 255°C and 260°C. The temperature on top of a setup specimen was monitored to enable temperature profiling, with the peak temperature being recorded as 259.1°C. The specimens and substrates were allowed to cool to ambient temperatures and then run back through the oven a total of 3 times.

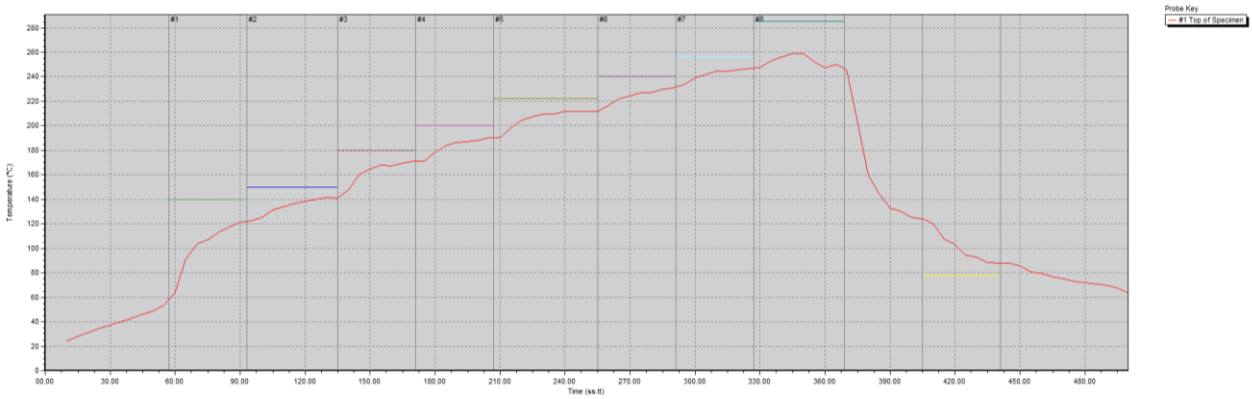

Figure 9 – Resistance to Reflow Soldering Heat – Reflow Profile

Reflow Results

Probe	Positive Slope (°C/sec)	Positive Slope Time (ss.tt)	Rise Time (150.0 - 200.0°C) (ss.tt)	Rise Time 50.0°C to Peak (ss.tt)	Mean Slope to Peak (°C/sec)	Time Above Liquidus (217.0°C) (ss.tt)	Peak Temperature (°C)	Time Above Peak minus 5.0°C (ss.tt)
#1 (°C) Top of Specimen	4.00	65.00	75.00	290.00	0.68	110.00	259.1	15.00

Figure 10 – Resistance to Reflow Soldering Heat – Reflow Results

3.10 Thermal Shock

The specimens were subjected to a thermal shock test in accordance with EIA 364-32G Method A, Test Condition I. Mated specimens were subjected to 5 cycles between -55° and 85°C with 30 minute dwells at temperature extremes and 1 minute transition between temperatures.

3.11 Humidity / Temperature Cycling

The specimens were subjected to a humidity/temperature cycling test in accordance with EIA 364-31F, Method IV. Mated specimens were subjected to 10 cycles (10 days) between 25° and 65°C at 80 to 100% RH with no preconditioning.

3.12 Temperature Life

The specimens were subjected to a temperature life test in accordance with EIA 364-17C, Method A. Mated specimens were subjected to 85°C for 250 hours.

3.13 Mixed Flowing Gas

The specimens were subjected to a mixed flowing gas test in accordance with EIA 364-65B, Class IIA.

Specimens were subjected to a 4-gas environment for 14 days. Three samples from each set were exposed in the unmated condition for the first 7 days and mated for the final 7 days. The remaining three samples from each set were exposed in the mated condition for the test duration. All samples were removed from the test chamber after 7 days for LLCR measurements. See Table 6 for the MFG test parameters.

Table 6 – MFG Test Parameters

Environment	Class IIA
Temperature (^{0}C)	30±1
Relative Humidity (%)	70±2
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	14 days
Chamber Volume Exchange Rate [minimum of 6/hr.]	8.8/hr (a)

(a) Volume exchange rate for 105-liter test chamber [Total flow rate of 15.4 L/Min]

3.14 Thermal Cycling

The specimens were subjected to thermal cycling in accordance with EIA 364-09D. Mated specimens were subjected to 10 cycles between 15° and 85°C with ramp times greater than 2°C per minute and dwell times long enough to ensure contacts reach the temperature extremes (5 minutes minimum). The humidity was not controlled.

3.15 Minute Disturbance

The specimens were subjected to a durability test in accordance with EIA 364-09D. Specimens were mated and unmated 5 times by hand at a rate less than 300 cycles per hour.