



QSFP112 SMT RECEPTACLE CONNECTOR

1. INTRODUCTION

1.1 Purpose

Qualification testing was performed on TE Connectivity (TE) QSFP112 SMT Receptacle Connector to evaluate its conformance to Product Specification 108-160225 Rev A1.

1.2 Scope

This report covers the electrical, mechanical and environmental performance of TE QSFP112 Receptacles (part number: 2372928-2, 2401838-1, 2401838-2, 2401838-3, 2401838-4). Testing was performed at TE Connectivity Shanghai Electrical Test Laboratory between 2022-02-24 and 2022-07-13. The associated test number is TP-22-00397.

1.3 Conclusion

Specimens met the requirements listed in Product Specification 108-160225 A1. Detailed results are located in Section 2.

1.4 Product Description

TE's QSFP112 (Quad Small Form-factor Pluggable) is the next generation of QSFP interconnects with a Quad-lane electrical interface capable of 56 Gbps NRZ or 112 Gbps PAM-4 to achieve 56 or 112 Gbps per port. The QSFP112 portfolio's backwards compatibility allows existing QSFP modules to be plugged into QSFP112 ports.

1.5 Test Specimens

The test specimens were representative of normal production lots, and the following part numbers were used:

Table 1 – Test Specimens

Qty	Part Number	Description
30	2372928-2	QSFP112 SMT RECEPTACLE CONNECTOR

1.6 Qualification Test Sequence

Specimens identified in Table 1 were subjected to the test sequences listed in Table 2.

Table 2 – Test Sequence

Test or Examination	Test Group (a)					
	1	2	3	4	5	6
	Test Sequence (b)					
Initial examination of product	1	1	1	1	1	1
Low Level Contact Resistance	3,5,8	2,4,	2,5,7			
Insulation resistance				2,6		
Withstanding voltage				3,7		
Random vibration	6					
Mechanical shock	7					
Durability	4					
Mating force	2					
Un-mating force	9					
Connector solderability					2	
Resistance to reflow soldering heat						2
Thermal shock				4		
Humidity/temperature cycling				5(d)		
Temperature life		3(c)				
Mixed flowing gas			4			
Thermal cycling			6			
Re-Seating			3			
Final examination of product	10	5	8	8	3	3



NOTE

- See paragraph 4.1.A
- Numbers indicate sequence in which tests are performed.
- Precondition specimens with 20 durability cycles with latches disengaged
- Un-Mated

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

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

2.2 Low Level Contact Resistance

Specimens met the required maximum delta of 20 mohm. Refer to Table 3 to Table 5 for LLCR summary data.

Table 3 – LLCR Summary Data in milliohms, Test Group 1

Reading	Initial Reading (Actual R)	After Durability (ΔR)	After Vibration, Shock (ΔR)
Minimum	9.18	-5.29	-9.93
Maximum	36.79	7.09	14.62
Average	19.89	-1.01	-0.76

Table 4 – LLCR Summary Data in milliohms, Test Group 2

Reading	Initial Reading (Actual R)	After Temp Life (ΔR)
Minimum	9.18	-3.56
Maximum	18.66	10.13
Average	13.16	1.39

Table 5 – LLCR Summary Data in milliohms, Test Group 3

Reading	Initial Reading (Actual R)	After MFG (ΔR)	After Thermal Cycling (ΔR)
Minimum	8.87	-2.08	-13.72
Maximum	35.71	14.81	13.79
Average	19.31	0.48	0.18

2.3 Durability - Test Group1

No physical damage detrimental to product performance was visible due to durability.

2.4 Mating Force - Test Group1

Meet the spec. Mating force is less than 39.73N with average 31.98N.

2.5 Un-mating Force - Test Group1

Meet the spec. Un-mating force is less than 18.54N with average 15.83N.

2.6 Random Vibration - Test Group1

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

2.7 Mechanical Shock - Test Group1

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

2.8 Re-Seating - Test Group3

No physical damage detrimental to product performance was visible due to mating and unmating the specimens 1 time.

2.9 Temperature Life - Test Group2

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

2.10 Humidity / Temperature Cycling - Test Group4

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

2.11 Mixed Flowing Gas - Test Group3

No physical damage detrimental to product performance was visible due to mixed flowing gas.

2.12 Thermal Cycling - Test Group3

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

2.13 Insulation Resistance - Test Group4

All specimens had an insulation resistance greater than 1000 Megaohms, meeting the testing requirements.

2.14 Withstanding Voltage - Test Group4

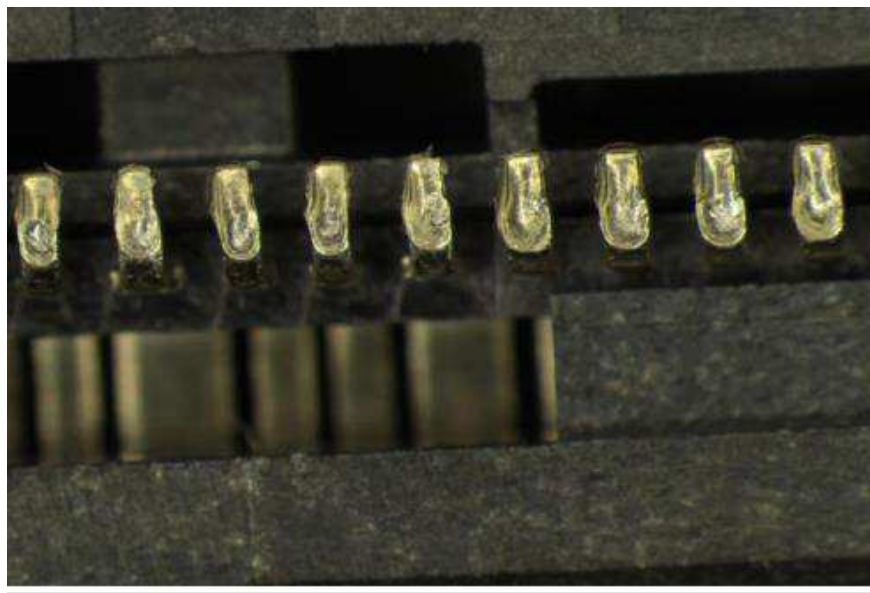
No breakdown or flashover occurred between adjacent contacts.

2.15 Thermal Shock - Test Group4

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

2.16 Connector Solderability - Test Group5

The specimens under evaluation exhibited a continuous solder coating, free from defects, over the more than 95% of the critical surface areas. See Figure 1 for a representative image of the typical contacts as tested.



20X magnification after test

Figure 1 – Connector Solderability Results – Typical Contacts Tested

2.17 Resistance to Reflow Soldering Heat - Test Group6

No defects, damage, or discoloration was observed on any specimen as a result of the moisture soak preconditioning.

No visual evidence of melting, cracking, blistering or other damage was observed on any of the other specimens after the first, second, or third reflow heat exposure.

2.18 Final Examination of Product

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 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

Specimens were subjected to low level contact resistance in accordance with test procedure EIA 364-23C. See Figure 2 for a representative image of the test setup.

Low level contact resistance 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. Positive voltage and current were applied to the access headers of the PCB and negative voltage and current were applied to wires of the transceiver module.

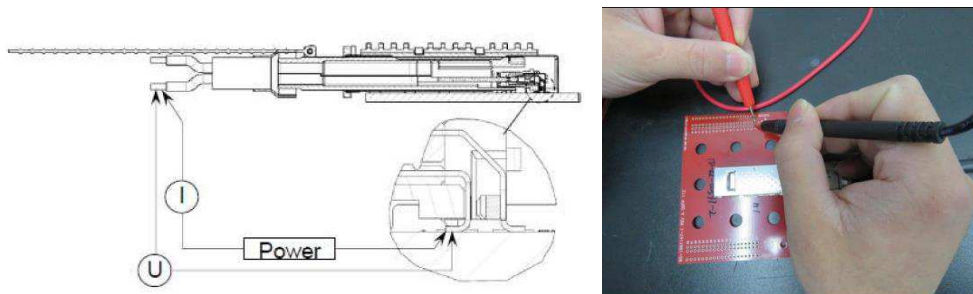


Figure 2 – Low Level Contact Resistance Test Setup

3.3 Insulation Resistance

Insulation resistance was measured between adjacent contacts of unmated specimens. A test voltage of 100 volts DC was applied for one minute before the resistance was measured. Testing was conducted in accordance with EIA-364-21E.

3.4 Withstanding Voltage

A test potential of 300 volts AC was applied between the adjacent contacts of unmated specimens. This potential was applied for one minute and then returned to zero. Testing was conducted in accordance with EIA-364-20F condition I.

3.5 Random Vibration

The test specimens were subjected to a random vibration test in accordance with test procedure EIA 364-28F, test condition VII, test condition letter D. See Figure 3 for a representative image 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 0.01 G²/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.

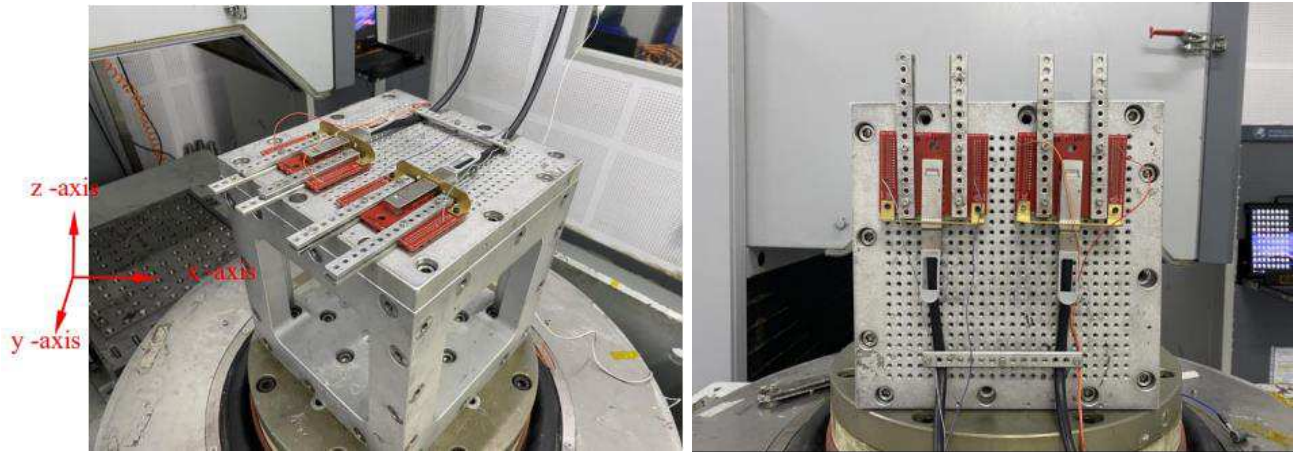


Figure 3 – Random Vibration Test Setup

3.6 Mechanical Shock

The test specimens were subjected to a mechanical shock test in accordance with test procedure EIA 364-27C, test condition H. See Figure 4 for a representative image 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. 3 shocks in each direction were applied along the three mutually perpendicular axes of the test specimens, for a total of 18 shocks.

The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes. See Figure 10 through 12 for mechanical shock test setups.



Figure 4 – Mechanical Shock Test Setup

3.7 Durability

The specimens were cycled 100 times by hand. A new module was used for durability and was replaced every 50 cycles. Testing was conducted in accordance with EIA-364-9D.

3.8 Connector Solderability

Specimens were subjected to connector solderability in accordance with test procedure IPC/ECA J-STD-002. See Figure 5 for the reflow profile. See Figures 6 and 7 for representative images of the test setup.

A solder paste with a composition of Sn, Ag3.0, Cu0.5 with flux in the paste having an activation of L0 was then placed onto a stencil, with pad geometry, opening, and thickness that was appropriate for the specimens being tested. The solder paste was printed onto PCB. The screen was removed, and a specimen was placed onto the solder paste print under appropriate magnification (see Figure 6). 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 PCB were placed on a conveyor belt through a convection oven (see Figure 7). 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 pre-heat and soak parameters were as specified in J-STD-002. The temperature on the ceramic substrate, at a point on a SMT contact was monitored to enable temperature profiling and the recorded temperature profile is shown in Figure 5.

All specimens were examined using a microscope for solder wetting. The specimens were examined at 10X for solder wetting of the critical area of solderability.



Figure 5 – Solderability Test Setup - Reflow Profile

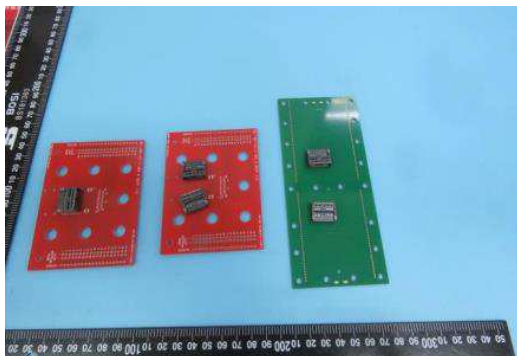


Figure 6 – Solderability Test Setup – Test Specimen and Solder Paste

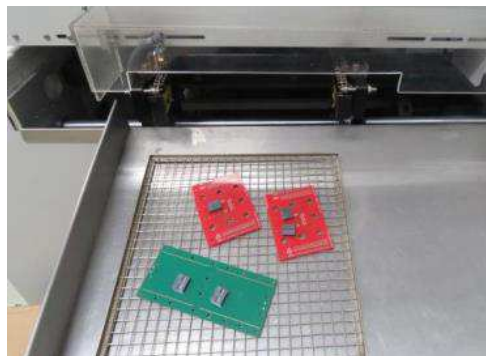


Figure 7 – Solderability Test Setup – Test Specimen on Oven Conveyor

3.9 Resistance to Reflow Soldering Heat

Specimens were subjected to resistance to reflow soldering heat in accordance with test specification TEC-109-201, Method A, Condition B, Revision E. See Figure 8 for the reflow profile.

Moisture Soak

Specimens were placed in a clean, dry, shallow container in such a manner that they did not overlap or touch and were exposed to 85°C at 85% relative humidity for 168 hours. Not sooner than 15 minutes, and within 4 hours after removal from the moisture soak, the specimens were subjected to the heat exposure described below.

Component Heat Resistance to Lead Free Reflow Soldering Testing

The specimens were placed on 102 X 87 X 2.25mm PCB 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. The temperature on top of the specimen was monitored to enable temperature profiling. The specimens and PCB were allowed to cool to ambient temperatures, were visually examined, and then run back through the oven a total of 3 times.



Figure 8 – Resistance to Reflow Soldering Heat – Reflow Profile

3.10 Thermal Shock

Specimens were subjected to thermal shock testing in accordance with test procedure EIA 364-32G, Method A, Test Condition VII.

Unmated specimens were subjected to 5 cycles between -55°C and 105°C with 30-minute dwells at temperature extremes and less than 5 minutes transitions between temperatures.

3.11 Humidity / Temperature Cycling

Specimens were subjected to humidity / temperature cycling in accordance with test procedure EIA 364-31F, Method IV.

Specimens were subjected to 10 cycles (24-hours per cycle) between 25°C and 65°C at 80 to 100%RH. Specimens from Test Set 2 were mated and specimens from Test Set 4 were unmated for the environmental exposure.

3.12 Temperature Life

Specimens were subjected to temperature life in accordance with test procedure EIA 364-17C, Method A.

Mated specimens were exposed to a temperature of 105°C for 1000 hours. Specimens were preconditioned with 20 cycles of durability with the latches disengaged.

3.13 Mixed Flowing Gas

Specimens were subjected to mixed flowing gas in accordance with test procedure EIA 364-65B, Class IIA. See Table 7 for the mixed flowing gas test parameters.

The test specimens were subjected to a 4-gas environment for 14 days. 2 specimens were exposed in the unmated condition for the first 7 days with the plugs not exposed and in the mated condition for the final 7 days. The other 3 specimens were exposed mated for the 14-day exposure. LLCR measurements were taken after 7 days on all specimens.

Table 7 – Mixed Flowing Gas Test Parameters

Environment	Class IIA
Temperature (°C)	30 ± 1
Relative Humidity (%)	70 ± 2
Chlorine (Cl ₂) Concentration (ppb)	10 ± 3
Hydrogen Sulfide (H ₂ S) Concentration (ppb)	10 ± 5
Nitrogen Dioxide (NO ₂) Concentration (ppb)	200 ± 50
Sulfur Dioxide (SO ₂) Concentration (ppb)	100 ± 20
Exposure Period [actual]	14 Days
Chamber Volume Exchange Rate [3-10 per Hour]	8.8 per Hour

3.14 Thermal Cycling

Specimens were subjected to thermal cycling in accordance with test procedure EIA 364-110, Test Condition A, Test Duration A.

Mated specimens were subjected to 10 cycles between 15±3° and 85±3° with 30 minute dwell times at each temperature extreme and ramp times greater than 2°C per minute.

3.15 Re-Seating

Specimens were manually unmated and mated 1 time by hand.

3.16 Final Examination of Product

The specimens were visually examined in accordance with test procedure EIA-364-18B for evidence of physical damage that would be detrimental to the operation of the parts.