Qualification Test Report

QSFP Copper Module Direct Attach Cable Assembly &Cage

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1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity (TE) Quad Small Form Factor Pluggable (QSFP) Copper Module Direct Attach Cable Assembly and Cage to determine it conformance to the requirements of Design Objective 108-2286, Rev O8;

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of QSFP Copper Module Direct Attach Cable Assembly and Cage. Testing was performed at TE Connectivity Shanghai Electrical Components Test Laboratory from 03Nov2011 to 28Dec2011. The test file number for this testing is TR-60367-I Rev. A.

1.3 Product Description

Part No.	Name	Quantity
1888972-2	1X1 Cage Assembly, Thru Bezel, w/ heat sink and light pipe, QSFP	3
1888968-3	1X1 Cage Assembly, Behind Bezel, w/ heat sink and light pipe, QSFP	15
2057042-3	1X3 Cage Assembly, Behind Bezel, w/ heat sink and light pipes, QSFP	3
2057183-3	1X4 Cage Assembly, Behind Bezel, w/ heat sink and light pipes, QSFP	3
2143331-3	1X6 Cage Assembly, Behind Bezel, w/ heat sink and light pipes, QSFP	8

Figure 1

1.4 Environmental Conditions

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

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

1.5 Qualification Test Sequence

Test of Examination	Test Group				
	1	2	3	4	5
	Test Sequence(a)				
Initial Examination of Product	1	1	1	1	1
LLCR	3,5,7,9	3,5,7	3,5		
Vibration(Random)	6				
Mechanical Shock	8				
Durability	4				
Mating force, QSFP module to PCB connector and QSFP cage	2				
Unmating force, QSFP module to PCB connector and QSFP cage	10				
Cage Compliant Pin Insertion Force		2	2		2
Cage Compliant Pin Retention Force		8	6		3
Cable Lateral Force				2	
Cable Longitudinal Force				3	
Thermal Shock		4			
Humidity /Temperature Cycling		6			
Temperature Life			4(b)		
Final Examination of Product	11			4	

NOTE

(a) Numbers indicate sequence in which tests are performed.
(b) Precondition specimens with 10 durability cycles.

Figure 2

2. TEST METHODS

No.	2.1
Test Item	Examination of product
Requirement	No evidence of physical damage detrimental to product performance was observed.
Procedures	Visual, dimensional and functional per applicable inspection plan. EIA-364-18.
Electrical	
No.	2.2
Test Item	Low level contact resistance
Requirement	△R 10 milliohms maximum for signal and ground contacts.
Procedures	Subject mated specimens to 100milliamperes maximum and 20millivolts maximum open circuit voltage. EIA-364-23.
Mechanical	
No.	2.3
Test Item	Mechanical Shock
Requirement	No discontinuities of 1 microsecond or longer duration. See Note.
Procedures	Pulse shape half sine, peak acceleration 30 G, pulse 11 ms, 3 shocks in both directions in XYZ axis (18 shocks). EIA-364-27.
No.	2.4
Test Item	Mating force, QSFP module to PCB connector and QSFP cage
Requirement	40 N [9 lbf] maximum, without heat sink and clip; 55 N [12.4 lbf] maximum, with heat sink and clip.
Procedures	Measure force necessary to mate specimens at a maximum rate of 12.7 mm [.5 in] per minute. EIA-364-13.
No.	2.5
Test Item	Unmating force, QSFP module to PCB connector and QSFP cage
Requirement	30 N [6.75 lbf] maximum, without heat sink and clip; 45 N [10.12 lbf] maximum, with heat sink and clip.
Procedures	Measure force necessary to unmate specimens at a maximum rate of 12.7 mm [.5 in] per minute with latches disabled. EIA-364-13.
No.	2.6
Test Item	Durability
Requirement	See note.
Procedures	Manually mate and unmate the QSFP module to the PCB connector interface for 250 cycles with latches enabled. EIA-364-09.
No.	2.7
Test Item	Cage compliant pin insertion force
Requirement	37.8 N [8.5 lbf] maximum average per pin.
Procedures	Measure force necessary to push cage into the host board at a maximum rate of 12.7 mm [.5 in] per minute. TE Spec 109-41.
No.	2.8
Test Item	Cage compliant pin retention force
Requirement	9.3 N [2.1 lbf] minimum average per pin.

Procedures	Measure force necessary to remove cage from the host board at a maximum rate of 12.7 mm [.5 in] per minute. TE Spec 109-30.
No.	2.9
Test Item	Cable lateral force
Requirement	No discontinuities of 1 microsecond or longer duration. Shall remain mated. See Note.
Procedures	Apply force of 75 N [16.9 lbf] to the cable module parallel to the test board and perpendicular to the cage in either direction for 10 minutes. EIA-364-38.
No.	2.10
Test Item	Cable longitudinal force
Requirement	No discontinuities of 1 microsecond or longer duration. Shall remain mated. See Note.
Procedures	Apply force of 75 N [16.9 lbf] to the cable module perpendicular to the test board and downward for 10 minutes. EIA-364-38.
No.	2.11
Test Item	Vibration (Random)
Requirement	No discontinuities of 1 microsecond or longer duration. See Note.
Procedures	Subject mated specimens to 3.10G's rms between 20 to 500 Hz. Fifteen minutes in each of 3 mutually perpendicular planes. EIA-364-28.
Environmental	
No.	2.12
Test Item	Thermal Shock
Requirement	See Note.
Procedures	Subject samples to the condition: 10 cycle of Ta= -55°C for 0.5 h then change to 25°C max.5 min then Tb=105 °C for 0.5 h, then cool to ambient. Recovery 2 h at ambient atmosphere. EIA-364-32.
No.	2.13
Test Item	Humidity/ Temperature Cycling
Requirement	See Note
Procedures	Subject mated specimens to 10 cycles (10 days) between 25°C and 65°C at 80 to 100% RH. (-10°C performed, omit 7b). EIA-364-31.
No.	2.14
Test Item	Temperature Life
Requirement	See Note.
Procedures	Subject mated specimens to 105°C for 500 hours. EIA-364-17.

NOTE Shall meet visual requirements, show no physical damage, and meet requirements of additional tests as specified in the Product Qualification and Requalification Test Sequence shown in Fig 2.

3. TEST RESULT

3.1 Test 1: 1888972-2 (1X1 QSFP Cage Assembly, Through Bezel)

Group	Test Item	Qty.	Condition	Test Result			Requirement	Judgment
				Max	Min	Ave		
5	Initial examination of product	3	Initial	No physical damage occurred			No abnormalities	Pass
	Cage compliant pin insertion force	3	Initial	32.33N	31.75N	32.04N	37.8N Ave. Max	Pass
	Cage compliant pin retention force	3	Final	14.07N	9.85N	12.03N	9.3N Ave. Min.	Pass

3.2 Test 2: 1888968-3 (1X1 QSFP Cage Assembly, Behind Bezel)

Group	Test Item	Qty	Condition	Test Result			Requirement	Judgment
				Max	Min	Ave		
1	Initial examination of product	3	Initial	No physical damage occurred.			No abnormalities	Pass
	Mating force, QSFP module to PCB connector and QSFP cage(w/ Heat sinks)	3	Initial	38.01N	24.19N	23.97N	55N Max.	Pass
	Mating force, QSFP module to PCB connector and QSFP cage (w/o Heat sinks)	3	Initial	28.56N	19.97N	21.31N	40N Max.	Pass
	LLCR	3	Initial	32.53m Ω	22.26m Ω	26.47m Ω	ΔR10mΩ Max.	/
	Durability	3	Final	No physical damage occurred.			No abnormalities	Pass
	LLCR	3	Final	6.60mΩ	-2.23mΩ	0.85mΩ	ΔR10mΩ Max.	Pass
	Vibration (Random)	3	Final	No discontinuities of 1 microsecond or longer duration.			No abnormalities	Pass
	LLCR	3	Final	0.27mΩ	-5.07mΩ	-1.11mΩ	ΔR10mΩ Max.	Pass
	Mechanical Shock	3	Final	No discontinuities of 1 microsecond or longer duration.			No abnormalities	Pass
	LLCR	3	Final	6.54mΩ	-2.14mΩ	1.22mΩ	ΔR10mΩ Max.	Pass

	Unmating force, QSFP module to PCB connector and QSFP cage(w/ Heat sinks)	3	Final	28.97N	18.28N	17.41N	45N max	Pass
	Unmating force, QSFP module to PCB connector and QSFP cage(w/o Heat sinks)	3	Final	20.97N	13.47N	15.28N	30N Max	Pass
	Final examination of product	3	Final	No physical damage occurred.			No abnormalities	Pass
2	Initial examination of product	3	Initial	No physical damage occurred.			No abnormalities	Pass
	Cage compliant pin insertion force	3	Initial	29.67N	26.00N	27.78N	37.8N Ave. Max	Pass
	LLCR	3	Initial	30.95mΩ	21.66mΩ	26.23mΩ	ΔR10mΩ Max.	/
	Thermal Shock	3	Final	No physical damage occurred.			No abnormalities	Pass
	LLCR	3	Final	2.29mΩ	-0.85mΩ	0.04mΩ	ΔR10mΩ Max.	Pass
	Humidity/ Temperature Cycling	3	Final	No physical damage occurred.			No abnormalities	Pass
	LLCR	3	Final	5.60mΩ	-0.94mΩ	0.90mΩ	ΔR10mΩ Max.	Pass
	Cage compliant pin retention force	3	Final	15.80N	13.83N	14.92N	9.3N Ave. Min.	Pass
3	Initial examination of product	3	Initial	No physical damage occurred.			No abnormalities	Pass
	Cage compliant pin insertion force	3	Initial	27.50N	25.08N	26.11N	37.8N Ave. Max	Pass
	LLCR	3	Initial	29.76mΩ	21.90mΩ	25.91mΩ	ΔR10mΩ Max.	/
	Temperature life	3	Final	No physical damage occurred.			No abnormalities	Pass
	LLCR	3	Final	3.09mΩ	-0.93mΩ	0.70mΩ	ΔR10mΩ Max.	Pass
	Cage compliant pin retention force	3	Final	12.86N	10.61N	11.64N	9.3N Ave. Min.	Pass
4	Initial examination of product	3	Initial	No physical damage occurred.			No abnormalities	Pass

	Cable lateral force	3	Final	No physical damage occurred.			No abnormalities	Pass
	Cable longitudinal force	3	Final	No physical damage occurred.			No abnormalities	Pass
	Final examination of product	3	Final	No physical damage occurred.			No abnormalities	Pass
5	Initial examination of product	3	Initial	No physical damage occurred.			No abnormalities	Pass
	Cage compliant pin insertion force	3	Initial	26.67N	23.92N	21.85N	37.8N Ave. Max	Pass
	Cage compliant pin retention force	3	Final	15.51N	10.77N	10.43N	9.3N Ave. Min.	Pass

3-1-3: Test 3: 2057042-3 (1x3 QSFP Cage Assembly, Behind Bezel)

Group	Test Item	Qty.	Condition	Test Result			Requirement	Judgment
				Max	Min	Ave		
5	Initial examination of product	3	Initial	No physical damage occurred			No abnormalities	Pass
	Cage compliant pin insertion force	3	Initial	29.76N	26.90N	28.18N	37.8N Ave. Max	Pass
	Cage compliant pin retention force	3	Final	16.02N	13.14N	14.63N	9.3N Ave. Min.	Pass

3-1-4: Test 4: 2057183-3 (1x3 QSFP Cage Assembly, Behind Bezel)

Group	Test Item	Qty.	Condition	Test Result			Requirement	Judgment
				Max	Min	Ave		
5	Initial examination of product	3	Initial	No physical damage occurred			No abnormalities	Pass
	Cage compliant pin insertion force	3	Initial	26.90N	25.02N	26.48N	37.8N Ave. Max	Pass
	Cage compliant pin retention force	3	Final	12.82N	10.52N	11.68N	9.3N Ave. Min.	Pass

3-1-5: Test 5: 2143331-3 (1x6 QSFP Cage Assembly, Behind Bezel)

Group	Test Item	N	Condition	Test Result			Requirement	Judgment
1				Max	Min	Ave		
	Initial examination of product	2	Initial	No physical damage occurred.			No abnormalities	Pass
	Mating force, QSFP module to PCB connector and	2	Initial	36.87N	33.12N	35.41N	55N max	Pass

	QSFP cage(w/ Heat sinks)							
	Mating force, QSFP module to PCB connector and QSFP cage(w/o Heat sinks)	2	Initial	36.53N	27.38N	25.22N	40N Max	Pass
	LLCR	2	Initial	25.55mΩ	17.81mΩ	22.06mΩ	ΔR10mΩ Max.	/
	Durability	2	Final	No physical damage occurred.			No abnormalities	Pass
	LLCR	2	Final	6.13mΩ	-1.46mΩ	2.45mΩ	ΔR10mΩ Max.	Pass
	Vibration, Random	2	Final	No discontinuities of 1 microsecond or longer duration.			No abnormalities	Pass
	LLCR	2	Final	1.34mΩ	-7.57mΩ	-5.57mΩ	ΔR10mΩ Max.	Pass
	Mechanical Shock	2	Final	No discontinuities of 1 microsecond or longer duration.			No abnormalities	Pass
	LLCR	2	Final	5.59mΩ	-0.89mΩ	3.78mΩ	ΔR10mΩ Max.	Pass
	Unmating force, QSFP module to PCB connector and QSFP cage(w/ Heat sinks)	2	Final	30.10N	25.00N	26.67N	45N Max	Pass
	Unmating force, QSFP module to PCB connector and QSFP cage(w/o Heat sinks)	2	Final	23.28N	24.78N	22.94N	30N Max	Pass
	Final examination of product	2	Final	No physical damage occurred.			No abnormalities	Pass
3	Initial examination of product	2	Initial	No physical damage occurred.			No abnormalities	Pass
	Cage compliant pin insertion force	2	Initial	27.44N	27.11N	27.28N	37.8N Ave. Max	Pass
	LLCR	2	Initial	27.92mΩ	21.90mΩ	25.91mΩ	ΔR10mΩ Max.	/
	Temperature life	2	Final	No physical damage occurred.			No abnormalities	Pass
	LLCR	2	Final	9.25mΩ	-2.84mΩ	3.07mΩ	ΔR10mΩ Max.	Pass

	Cage compliant pin retention force	2	Final	27.50N	25.00N	26.25N	9.3N Ave. Min.	Pass
4	Initial examination of product	2	Initial	No physical damage occurred.			No abnormalities	Pass
	Cable lateral force	2	Final	No physical damage occurred.			No abnormalities	Pass
	Cable longitudinal force	2	Final	No physical damage occurred.			No abnormalities	Pass
	Final examination of product	2	Final	No physical damage occurred.			No abnormalities	Pass
5	Initial examination of product	2	Initial	No physical damage occurred.			No abnormalities	Pass
	Cage compliant pin insertion force	2	Initial	25.33N	24.10N	24.68N	37.8N Ave. Max	Pass
	Cage compliant pin retention force	2	Final	23.25N	24.00N	24.63N	9.3N Ave. Min.	Pass

Note For LLCR test groups, connectors were soldered on PC board.

4. CONCLUSION

The QSFP Copper Module Direct Attach Cable Assembly and Cage conformed to the electrical, mechanical, and environmental performance requirements of Design Objective 108-2286, Rev. O8.