Small Factor Pluggable (SFP)+ Single-Port Cages, Ganged Cages, and Copper Module Direct-Attach Cable Assembly

1. INTRODUCTION

1.1. Purpose

Testing was performed on the SFP+ single-port cages, ganged cages, and copper module direct-attach cable assemblies to determine conformance to the requirements of product specification 108-2364, rev B.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the SFP+ single-port cages, ganged cages, and copper module direct-attach cable assemblies. Testing was performed at the Harrisburg Electrical Components Test Laboratory between 18Sep08 and 21Sep09. The test file numbers are EA20080824T, EA20090247T, and EA20090532T. Additional testing was performed between 11Jan10 and 05Mar10. The test file numbers are EA20100014T and EA20100140T. Documentation is on file at and available from the Harrisburg Electrical Components Test Laboratory.

1.3. Conclusion

The SFP+ single-port cages, ganged cages, and copper module direct-attach cable assemblies listed in Figure 1 conformed to the electrical, mechanical, and environmental performance requirements of 108-2364, rev B.

1.4. Test Specimens

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

Test Group	Qty	Part Number	Description
1,2,3,4,6,7	30	2007198-1	1x1 SFP+ Cage
	60	2074402-1	SFP+ Test Cable Assembly with 24 AWG Wire
		1888247-1	20-Position SFP+ PT Connector
1,2,3,4,7	25	2007135-1	1x4 SFP+ Ganged Cage
1	5	2007464-3	1x1 SFP+ Cage
		1829905-2	Heat Sink
		1367646-1	Clip
5	5	2007194-1	1x1 SFP+ Cage With Solder tail
1,5,7	10	2316664-1	1x1 SFP+ Cage One Piece Type With Solder tail
		2324523-3	1X3 ZSFP+ Cage One Piece Type With Solder tail
1,3,4,7	20	2170680-1	1x1 SFP+ Cage One Piece Type With EON

Figure 1

1.5. Environmental Conditions

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

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

1.6. Qualification Test Sequence

TEST OR EXAMINATION	TEST GROUP (a)						
	1	2	3	4	5	6	7
	TEST SEQUENCE (b)						
Initial Examination of Product	1	1	1	1	1	1	1
LLCR	3,7		3,6	3,5		2,4(c)	
Solderability					2		
Random Vibration	5						
Mechanical Shock	6						
Durability	4						
Transceiver Insertion Force	2						
Transceiver Extraction Force	8						
Cage Latch Strength	9						
Cage Press Fit Insertion Force			2	2			
Cage Press Fit Extraction Force			7	6			
Rotational Cable Pull		2					
Cable Retention Force							2(c)
Cable Side Load Force							3(c)
Cable Longitudinal Force							4(c)
Thermal Shock			4(d)				
Humidity/Temperature Cycling			5(d)				
Temperature Life				4(d)(e)			
Mixed Flowing Gas						3(c)(e)	
Final Examination of Product	10	3	8	7	3	5(c)	5(c)

(a) See paragraph 1.4.

(b) Numbers indicate sequence that tests were performed.

(c) Applies to SFP+ direct-attach cable assemblies only.

(d) Mated to blank transceivers.

(e) Pre-condition specimens with 20 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 of 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. LLCR—Test Groups 1, 3, 4, and 6

All LLCR measurements taken at 100 milliamperes (maximum) and 20 millivolts (maximum) open circuit voltage were initially less than 35 milliohms and had a change in resistance (ΔR) of less than 10 milliohms after testing.

Test Group	Part Number	Number of Data Points	Condition	LLCR			
				Minimum	Maximum	Average	Standard Deviation
1	2007198-1 1×1 Signal Contacts	100	Initial	11.66	17.50	14.65	2.32
			After mechanical shock (ΔR)	-2.36	0.95	0.07	0.50
	2007198-1 1×1 Shield	45	Initial	8.92	24.57	12.05	3.82
			After mechanical shock (ΔR)	-6.58	4.83	0.89	1.84
	2007464-3 1×1 Signal Contacts	100	Initial	11.02	17.36	14.23	2.50
			After mechanical shock (ΔR)	1.28	1.59	0.22	0.48
	2007464-3 1×1 Shield	45	Initial	8.66	14.82	10.85	1.63
			After mechanical shock (ΔR)	-0.18	4.86	1.52	0.94
	2007135-1 1×1 Signal Contacts	100	Initial	13.31	17.98	16.04	1.47
			After mechanical shock (ΔR)	-1.41	1.55	0.21	0.43
	2007135-1 1×1 Shield	45	Initial	8.45	19.02	10.82	3.39
			After mechanical shock (ΔR)	-2.75	4.84	1.31	1.09
3	2007198-1 1×1 Signal Contacts	100	Initial	11.71	17.63	14.64	2.35
			After Humidity/Temperature Cycling (ΔR)	-1.13	1.57	0.10	0.45
	2007198-1 1×1 Shield	45	Initial	4.86	17.75	7.81	3.87
			After Humidity/Temperature Cycling (ΔR)	-5.42	6.23	0.42	1.93
	2007135-1 1×1 Signal Contacts	95	Initial	13.04	16.77	15.09	1.25
			After Humidity/Temperature Cycling (ΔR)	-0.92	0.76	0.01	0.31
	2007135-1 1×1 Shield	45	Initial	3.89	16.63	7.99	4.06
			After Humidity/Temperature Cycling (ΔR)	-4.49	1.97	0.14	1.34
4	2007198-1 1×1 Signal Contacts	100	Initial	11.78	17.53	14.63	2.38
			After Temperature Life (ΔR)	-0.46	1.44	0.38	0.38
	2007198-1 1×1 Shield	45	Initial	3.80	18.60	7.68	3.92
			After Temperature Life (ΔR)	-5.92	4.28	1.02	1.80
	2007135-1 1×1 Shield	100	Initial	13.25	17.99	15.99	1.45
			After Temperature Life (ΔR)	-0.85	1.65	0.39	0.43
	2007135-1 1×1 Signal Contacts	45	Initial	5.08	18.50	7.86	3.93
			After Temperature Life (ΔR)	-7.27	4.68	0.53	2.37
6	2007135-1 1×1 Signal Contacts	100	Initial	11.70	17.59	14.56	2.39
			After Mixed Flowing Gas (ΔR)	-0.87	1.17	-0.09	0.31
	2007135-1 1×1 Shield	45	Initial	5.45	7.43	6.52	0.45
			After Mixed Flowing Gas (ΔR)	0.38	3.07	1.14	0.51

Figure 3

2.3. Solderability—Test Group 5

All contact leads had a minimum of 95% solder coverage.

2.4. Random Vibration—Test Group 1

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

2.5. Mechanical Shock—Test Group 1

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

2.6. Durability—Test Group 1

No physical damage occurred as a result of mating and unmating the specimens100 times.

2.7. Transceiver Insertion Force—Test Group 1

All transceiver insertion force measurements performed on cages without heat sinks and clips were less than 34 N [7.64 lbf]. All measurements performed on cages with heat sinks and clips were less than 45.37 N [10.2 lbf].

2.8. Transceiver Extraction Force—Test Group 1

All transceiver extraction force measurements performed on cages without heat sinks and clips were less than 12.5 N [2.8 lbf]. All measurements performed on cages with heat sinks and clips were less than 14.36 N [3.23 lbf].

2.9. Cage Latch Strength—Test Group 1

No physical damage occurred to the specimens as a result of applying an axial load of 91.2 N [20.5 lbf] to the cage latch for 1 minute.

2.10. Cage Press fit Insertion Force—Test Groups 3 and 4

All cage insertion forces measured on single-port cages were less than 44.5 N [10 lbf].
All measurements on ganged cages were less than 73 N [16.4 lbf].

2.11. Cage Press Fit Extraction Force—Test Groups 3 and 4

All cage extraction forces measured on single-port and ganged cages were greater than 8.9 N [2.0 lbf].

2.12. Rotational Cable Pull—Test Group 2

All specimens maintained a minimum axial load of 33.4 N [7.5 lbf].

2.13. Cable Retention Force—Test Group 7

All specimens remained mated and no discontinuities greater than 1 microsecond were detected.

2.14. Cable Side Load Force—Test Group 7

All specimens remained mated and no discontinuities greater than 1 microsecond were detected.

2.15. Cable Longitudinal Force—Test Group 7

All specimens remained mated and no discontinuities greater than 1 microsecond were detected.

2.16. Thermal Shock—Test Group 3

No evidence of physical damage was visible as a result of exposure to thermal shock.

2.17. Humidity/Temperature Cycling—Test Group 3

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

2.18. Temperature Life—Test Group 4

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

2.19. Mixed Flowing Gas—Test Group 6

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 this test package were produced, inspected, and accepted according to the requirements of the product drawing, and manufactured using the same core manufacturing processes and technologies as production parts.

3.2. LLCR

LLCR measurements were made using a 4-terminal measuring technique. The test current was maintained at 100 milliamperes (maximum) with a 20-millivolt (maximum) open circuit voltage.

3.3. Solderability

The areas of the specimens to be tested were immersed in an RA-type highly active flux maintained at room temperature for 5 to 10 seconds and allowed to drain for 5 to 20 seconds. The solder tails were then immersed in the molten solder at a rate of approximately 25.4 mm [1 in.] per second and held for 4 to 5 seconds, and then withdrawn at a rate of approximately 25.4 mm [1 in.] per second. After a 5-minute cleaning in isopropyl alcohol, the specimens were visually examined using 10X magnification for solder coverage. The solder used for testing was an Sn 96.5/Ag 3.0/Cu 0.5 composition and was maintained at a temperature of 245± 5°C.

3.4. Random Vibration

Mated specimens were subjected to a random vibration test and specified by a random vibration spectrum with excitation frequency bounds of 5 and 500 Hz. The power spectral density (PSD) at 5 Hz was 0.000312 G^2/Hz. The spectrum sloped up at 6 dB per octave to a PSD of 0.02 G^2/Hz at 14 Hz. The spectrum was flat at 0.02 G^2/Hz from 20 to 500 Hz. The root-mean-square amplitude of the excitation was 3.13 Grms. This was performed for 15 minutes in each of 3 mutually perpendicular planes for a total vibration time of 45 minutes. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

3.5. Mechanical Shock

Mated specimens were subjected to a mechanical shock test having a half sine waveform of 30 gravity units (g peak) and a 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 1 microsecond or greater using a current of 100 milliamperes DC.

3.6. Durability

Specimens were mated and unmated 100 times at a maximum rate of 500 cycles per hour.

3.7. Transceiver Insertion Force

The force necessary to insert the module into the connector and cage until the retention mechanism latched was measured using a tensile/compression device with a maximum rate of travel of 12.7 mm [.5 in.] per minute. Kick out springs were not disabled for testing.

3.8. Transceiver Extraction Force

The force necessary to remove the module from the connector and cage was measured using a tensile/compression device with a maximum rate of travel of 12.7 mm [.5 in.] per minute. Kick out springs were not disabled for testing.

3.9. Cage Latch Strength

An axial load of 91.2 N [20.5 lbf] was applied to the latch using a tensile/compression device with a maximum rate of travel of 12.7 mm [.5 in.] per minute and held for 1 minute.

3.10. Cage Press Fit Insertion Force

The force necessary to insert the cage into the host board was measured using a tensile/compression device with a maximum rate of travel of 12.7 mm [.5 in] per minute.

3.11. Cage Press Fit Extraction Force

The force necessary to remove the cage from the host board was measured using a tensile/compression device with a maximum rate of travel of 12.7 mm [.5 in] per minute.

3.12. Rotational Cable Pull

The cable module was held in a test fixture at an angle of approximately 40 degrees. A 33.4-N [7.5-lbf] weight was attached to the end of the cable. The cable end with the weight was rotated 360 degrees at a rate of approximately 4 rpm.

3.13. Cable Retention Force

An axial load of 80 N [18 lbf] was applied to the free cable end at a maximum rate of 12.7 mm [.5 in.] per minute and held for 10 minutes. The specimens were monitored for discontinuities through 6 of the signal contacts during the loading.

3.14. Cable Side Load Force

A load of 80 N [18 lbf] was applied to the free cable end in a plane parallel to the bezel at a maximum rate of 12.7 mm [.5 in.] per minute and held for 10 minutes. The specimens were monitored for discontinuities through 6 of the signal contacts during the loading.

3.15. Cable Longitudinal Force

A load of 100 N [22.5 lbf] was applied to the cable plug in a plane perpendicular to the bezel at a maximum rate of 12.7 mm [.5 in.] per minute and held for 10 minutes. The specimens were monitored for discontinuities through 6 of the signal contacts during the loading.

3.16. Thermal Shock

Specimens were subjected to 5 cycles of thermal shock with each cycle consisting of 30-minute dwells at 55° and 105°C. The transition between temperatures was less than 1 minute.

3.17. Humidity/Temperature Cycling

Specimens were exposed to 10 humidity/temperature cycles. Each cycle lasted 24 hours and consisted of cycling the temperature twice between 25° and 65°C while maintaining high humidity.

3.18. Temperature Life

Mated specimens were exposed to a temperature of 105°C for 240 hours. Specimens were preconditioned with 20 cycles of durability.

3.19. Mixed Flowing Gas, Class IIA

Mated specimens were exposed for 20 days to a mixed flowing gas class IIA exposure.

NOTE
Class IIA exposure is defined as a temperature of 30°C and a relative humidity of 70% with the pollutants of Cl_2 at 10 ppb, NO_2 at 200 ppb, H_2S at 10 ppb, and SO_2 at 100 ppb. Specimens were preconditioned with 20 cycles of durability.

3.20. Final Examination of Product

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