XFP Copper Module Direct Attach Cable Assembly and Cage

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Tyco Electronics XFP Copper Module Direct Attach Cable Assembly and Cage to determine its conformance to the requirements of Product Specification 108-2127 Revision B.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the XFP Copper Module Direct Attach Cable Assembly and Cage. Testing was performed at the Engineering Assurance Product Test Laboratory between 25Aug05 and 08Dec05. The test file number for this testing is CTLB039432-004. Additional testing was performed between 30Mar07 and 13Jul07. The test file number for this testing is CTLH986-001. This documentation is on file at and available from the Engineering Assurance Product Test Laboratory.

1.3. Conclusion

The XFP Copper Module Direct Attach Cable Assembly and Cage listed in paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2127 Revision B.

1.4. Product Description

XFP Copper Module Direct Attach Cable Assembly and Cage are designed to meet requirements for applications such as connecting XFP fiber optic or copper transceiver modules to host Printed Circuit Boards (PCBs) used in the communications industry.

1.5. Test Specimens

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

Test Group	Quantity	Part Number	Description
1,2,3,4,5	5 each	1489951-1	XFP cage assemblies
1,2,3,4,5	5 each	1653924-1	Direct attach cables with transceiver PCB
1,2,3,4,5	5 each	60-474631-1	PCB
1,2,5	5 each	9334-0000C	Bezel
1,2,5	5 each	1489948-2	XFP heat sink clip
1,2,5	5 each	1542706-2	XFP network application heat sink

Figure 1

1.6. Environmental Conditions

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

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

* Trademark
| Indicates change

1.7. Qualification Test Sequence

Test or Examination	Test Group (a)				
	1	2	3	4	5
	Test Sequence (b)				
Initial examination of product	1	1	1	1	1
Low level contact resistance	3,7		3,6	3,5	
Vibration, random	5				
Mechanical shock	6				
Durability	4				
Mating force, XFP module to PCB connector and XFP cage	2				
Unmating force, XFP module from PCB connector and XFP cage	8				
Cage latch strength	10				
Cage press fit insertion force			2	2	
Cage press fit extraction force			7	6	
Cable pull, cage		2			
Cable retention force	9				2
Cable side load force					3
Cable longitudinal force					4
Thermal shock			4		
Humidity/temperature cycling			5		
Temperature life				4(c)	
Final examination of product	11	3	8	7	5

NOTE

(a) See paragraph 1.5.
(b) Numbers indicate sequence in which tests are performed.
(c) Precondition specimens with 10 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 was issued by Product Assurance. Where specified, specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

2.2. Low Level Contact Resistance - Test Groups 1, 3 and 4

All low level contact resistance measurements were less than 35 milliohms, nor did they exhibit a change in resistance (ΔR) of more than 10 milliohms after testing. Both signal and ground shield circuits were measured, see Figure 3.

Low Level Contact Resistance (milliohms)						
Condition	Min	Max	Mean	Min (ΔR)	Max (ΔR)	Mean (ΔR)
Test Group 1, Signal Contacts N=150						
Initial	12.85	18.39	15.70	---	---	---
Final	12.53	18.33	15.54	-1.05	0.38	-0.16

Figure 3 (continued)

Low Level Contact Resistance (milliohms)						
Condition	Min	Max	Mean	Min (ΔR)	Max (ΔR)	Mean (ΔR)
Test Group 1, Ground Contacts N=5						
Initial	1.33	1.60	1.43	---	---	---
Final	2.23	3.25	2.55	0.77	1.66	1.12
Test Group 3, Signal Contacts N=150						
Initial	12.65	18.50	15.50	---	---	---
Final	12.38	18.05	15.21	-0.74	0.15	-0.29
Test Group 3, Ground Contacts N=5						
Initial	0.63	1.19	0.97	---	---	---
Final	1.48	2.35	1.75	0.29	1.73	0.78
Test Group 4, Signal Contacts N=150						
Initial	12.36	17.81	15.23	---	---	---
Final	12.18	17.71	15.06	-0.71	2.25	-0.16
Test Group 4, Ground Contacts N=5						
Initial	1.03	1.37	1.20	---	---	---
Final	1.55	1.69	1.62	0.29	1.26	0.56

Figure 3 (end)

2.3. Vibration, Random - Test Group 1

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

2.4. 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.

2.5. Durability - Test Group 1

No physical damage occurred as a result of manually mating and unmating the specimens 100 times with latches enabled.

2.6. Mating Force, XFP Module to PCB Connector and XFP Cage - Test Group 1

All mating force measurements were less than 40 N [9 lbf] for product without heat sink and clip, and 55 N [12.3 lbf] for product with heat sink and clip.

2.7. Unmating Force, XFP Module from PCB Connector and XFP Cage - Test Group 1

All unmating force measurements were less than 30 N [6.75 lbf] for product without heat sink and clip, and 67 N [15 lbf] for product with heat sink and clip.

2.8. Cage Latch Strength - Test Group 1

The aluminum transceiver module block did not become disengaged from its respective cages when subjected to a force of 180 N [40.5 lbf] and held for 1 minute.

2.9. Cage Press Fit Insertion Force - Test Groups 3 and 4

All cage insertion force values were less than 550 N [123.6 lbf].

2.10. Cage Press Fit Extraction Force - Test Groups 3 and 4

All cage extraction force values were greater than 133 N [29.9 lbf].

2.11. Cable Pull, Cage - Test Group 2

No cable plugs became disengaged from their respective cages when subjected to a force of 100 N [22.5 lbf].

2.12. Cable Retention Force - Test Groups 1 and 5

No cable plugs became disengaged from their respective cages nor were there any discontinuities when subjected to a force of 100 N [22.5 lbf] and held for 10 minutes.

2.13. Cable Side Load Force - Test Group 5

No cable plugs became disengaged from their respective cages nor were there any discontinuities when subjected to a force of 75 N [16.9 lbf] and held for 10 minutes.

2.14. Cable Longitudinal Force - Test Group 5

No cable plugs became disengaged from their respective cages nor were there any discontinuities when subjected to a force of 100 N [22.5 lbf] and held for 10 minutes.

2.15. Thermal Shock - Test Group 3

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

2.16. Humidity/temperature Cycling - Test Group 3

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

2.17. Temperature Life - Test Group 4

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

2.18. Final Examination of Product - All Test Groups

None of the specimens exhibited any apparent damage caused from testing.

3. TEST METHODS

3.1. Initial Examination of Product

Where specified, specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

3.2. Low Level Contact Resistance

Contact resistance measurements at low level current 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. Thirty signal contacts and 1 ground (shield) circuit were measured on each mated specimen.

NOTE

1. *Ground (shield) circuit resistances have been adjusted by removing any bulk resistance in the cable. The resistance values depicted in the data table reflect that adjustment.*
2. *Signal contacts were directly measured through the transceiver PCB. No adjustments were needed.*

3.3. Vibration, Random

Mated and fixtured specimens were subjected to a random vibration test, specified by a random vibration spectrum, with excitation frequency bounds of 20 and 500 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 3.10 GRMS. This was performed for 15 minutes in each of 3 mutually perpendicular planes for a total vibration time of 45 minutes.

NOTE *Six different signal contacts on each mated assembly, for a total of 30 throughout the test group, were monitored for 1 microsecond discontinuity using a 100 milliampere DC current. The ground (shield) circuit was not monitored.*

3.4. Mechanical Shock, Half-sine

Mated and fixtured 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. The same signal contact pairs as in vibration were monitored for discontinuities of one microsecond or greater using a 100 milliampere DC current.

3.5. Durability

Specimens were manually mated and unmated 100 times with latches enabled.

3.6. Mating Force, XFP Module to PCB Connector and XFP Cage

The force required to mate individual specimens was measured using a tensile/compression device with the rate of travel at 12.7 mm [.5 in] per minute and a free floating fixture. Latches remained enabled for the test.

3.7. Unmating Force, XFP Module from PCB Connector and XFP Cage

The force required to unmate individual specimens was measured using a tensile/compression device with the rate of travel at 12.7 mm [.5 in] per minute and a free floating fixture. Cable modules were pulled out by wrapping a section of buss wire around the locking mechanism on the transceiver plug and applying an upward force on it until the module was completely unmated from the cage.

3.8. Cage Latch Strength

Each board mounted specimen was initially mated with an aluminum module block with a wire attached on the end. The specimens were fixtured on a vertical backplate with the wired end of the aluminum module block pointing down toward the floor. Next, the wire on the block was then attached to a 180 N [40.5 lbf] steel weight placed on an adjustable height table placed on the floor. The table was slowly lowered until the weight became suspended in free air for a duration of 1 minute. After 1 minute, the table was raised to remove the load and separate the weight from the cable.

3.9. Cage Press Fit Insertion Force

Each cage was pressed onto their PBBs using the tensile machine. The PCBs were placed under the load cell and the cages were "flat-rocked" onto their respective PCBs at a maximum speed of 12.7 mm [.5 in] per minute. The compression force was applied until the cages were fully seated.

3.10. Cage Press Fit Extraction Force

Testing consisted of removing the cage from their respective PCBs using the tensile machine. After initially inserting an aluminum module into each cage, the mated assembly was fixtured on the tensile machine by first attaching the assembly to the load cell and lowering the crosshead down to where the PCB laid flat on the top of the X-Y table. Next, the mated assembly was secured to the X-Y table using aluminum bars. Finally, the crosshead was energized in an upward direction and was allowed to continue until the cage was completely separated from its PCB. Test speed was 12.7 mm [.5 in] per minute maximum.

3.11. Cable Pull, Cage

Testing consisted clamping each specimen between 2 nylon plates and attaching the assembly to a machinist's indexer held at a 45 degree angle from vertical with the cable pointing down. After attaching the free end of the module cable to a 100 N [22.5 lbf] steel weight placed on an adjustable table on the floor, the table was lowered until the weight was suspended in free air and the indexer was rotated 1 time through 360 degrees with the weight attached. The table was then raised and the cable was separated from the mated assembly. Test speed was 12.7 mm [.5 in] per minute maximum.

3.12. Cable Retention Force

Mated specimens were fixtured on a vertical backplate with the free end of the transceiver cable pointing down toward the floor. Next, the cable was attached to a 100 N [22.5 lbf] steel weight placed on an adjustable height table placed on the floor. The table was slowly lowered until the weight became suspended in free air for a duration of 10 minutes. After the 10 minute period, the table was raised to remove the load and separate the weight from the cable. Test speed was 12.7 mm [.5 in] per minute maximum.

NOTE *Six different signal contacts on each mated assembly, for a total of 30 throughout the test group, were monitored for 1 microsecond discontinuity using a 100 milliampere DC current. The ground braid circuit was not monitored.*

3.13. Cable Side Load Force

Testing consisted of applying a side load force to the mated assembly in a plane parallel to the bezel in the direction of the larger dimension of the cage. Each mated specimen was fixtured on a workbench mounted vertical backplate with the cable pointing parallel with the workbench surface. The free end of the transceiver cable was then attached to a 75 N [16.9 lbf] steel weight located on an adjustable height table on the floor. The table was slowly lowered until the weight was suspended in free air and was allowed to remain suspended for a period of 10 minutes. After the 10 minute period, the table was raised to remove the load and separate the weight from the cable. Test speed was 12.7 mm [.5 in] per minute maximum.

NOTE *Six different signal contacts on each mated assembly, for a total of 30 throughout the test group, were monitored for 1 microsecond discontinuity using a 100 milliampere DC current. The ground braid circuit was not monitored.*

3.14. Cable Longitudinal Force

Testing consisted of applying a front load force to each mated assembly in a plane parallel to the bezel in the direction of the smaller dimension of the cage. Each assembly was fixtured on a workbench mounted horizontal backplate with the cable pointing parallel with the workbench surface. The free end of the transceiver cable was then attached to a 100 N [22.5 lbf] steel weight located on an adjustable height table on the floor. The table was slowly lowered until the weight was suspended in free air was allowed to remain suspended for a period of 10 minutes. After the 10 minute period, the table was raised to remove the load and separate the weight from the cable. Test speed was 12.7 mm [.5 in] per minute maximum.

NOTE *Six different signal contacts on each mated assembly, for a total of 30 throughout the test group, were monitored for 1 microsecond discontinuity using a 100 milliampere DC current. The ground braid circuit was not monitored.*

3.15. Thermal Shock

Board mounted and mated specimens were subjected to 5 cycles of thermal shock with each cycle consisting of 30 minute dwells at -10 and 70˚C. The transition between temperatures was less than 1 minute.

3.16. Humidity/temperature Cycling

Board mounted and mated specimens were exposed to 10 cycles of humidity/temperature cycling. Each cycle lasted 24 hours and consisted of cycling the temperature between 25 and 65˚C twice while maintaining high humidity, see Figure 4.

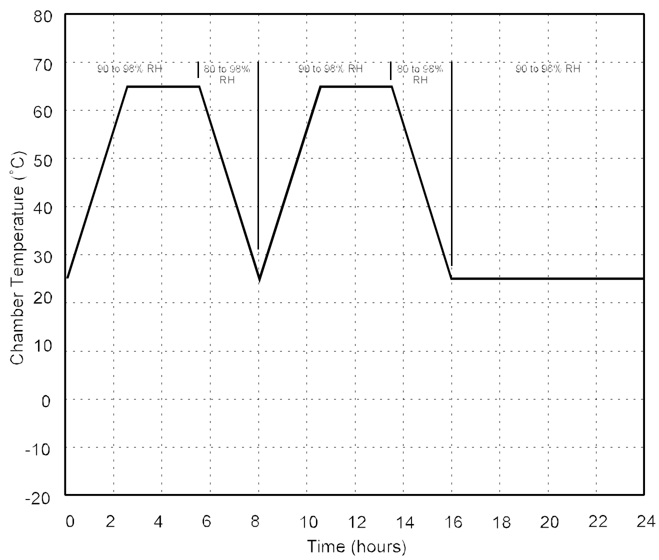

Figure 4

3.17. Temperature Life

Board mounted and mated specimens were exposed to a temperature of 70˚C for 500 hours. Specimens were preconditioned with 10 cycles of manual durability with the locks enabled.

3.18. Final Examination of Product

Specimens were visually inspected for any apparent damage.