SFP+ PARALIGHT* Active Cable Assembly, 1 Lane

DESIGN OBJECTIVES
The product described in this document has not been fully tested to ensure conformance to the requirements outlined below. Therefore, TE Connectivity (TE) makes no representation or warranty, express or implied, that the product will comply with these requirements. Further, TE may change these requirements based on the results of additional testing and evaluation. Contact TE Engineering for further details.

1. SCOPE

1.1. Content

This specification covers performance, tests and quality requirements for the TE Connectivity (TE) PARALIGHT* Active Optical Cable Assembly, 1 Lane.

1.2. Qualification

When tests are performed on the subject product line, procedures specified in Figure 1 shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

2. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the latest edition of the document applies. In the event of conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

2.1. TE Documents

501-TBD: Qualification Test Report (SFP+ PARALIGHT* Active Cable Assembly, 1 Lane)

2.2. Industry Documents

- EIA-364: Electrical Connector/Socket Test Procedures Including Environmental Classifications
- FCC: Federal Communications Commission, Part 15, Class A
- GR-468-CORE, Issue 2: Generic Reliability Assurance Requirements for Optoelectronic Devices Used in Telecommunications Equipment
- JEDEC JESD22-A114-B: Electrostatic Discharge (ESD) Sensitivity Testing Human Body Model (HBM)
- SFF-8431: Enhanced Small Form Factor Pluggable Module SFP+
- TIA/EIA-455-B: Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components

2.3. Government Document

MIL-STD-883G: Department of Defense Test Method Standard: Microcircuits

2.4. Reference Documents

- 102-6: Quality Specification (Design Objectives)
- 109-197: Test Specification (TE Test Specifications vs EIA and IEC Test Methods)
- 408-TBD: Instruction Sheet (SFP+ PARALIGHT)
- SFF-8432: Improved Pluggable Form Factor

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3. REQUIREMENTS

3.1. Design and Construction

Product shall be of the design, construction and physical dimensions specified on the applicable product drawing(s).

3.2. Materials

Materials used in the construction of this product shall be as specified on the applicable product drawing(s).

3.3. Ratings

Performance	Value	Unit
Operating Case Temperature	0 to 70	°C
Storage Temperature	-40 to 85	°C
Test Temperature	25 ± 5	°C
Test Humidity	30 to 60	%RH
Test Signal Input Voltage (maximum)	Eye height >180 Eye Amplitude <700	mV
Supply Voltage	3.3 ± 5%	V
Fiber Type	50/125	µm
Connector Retention (minimum)	90	N
Durability	50	Cycles
Mating Force (maximum)	18	N
Unmating Force (maximum)	12.5	N

Figure 1

3.4. Performance and Test Description

Product is designed to meet the electrical, mechanical and environmental performance requirements specified in Figure 2. Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

3.5. Test Requirements and Procedures Summary

Test Description	Requirement	Procedure
Examination of product.	Meets requirements of product drawing.	TIA-455-13A. Visual, dimensional and functional per applicable quality inspection plan.
PARAMETRIC TESTS		
RX output eye width.	65 U.I. minimum for new product over operating range. 58 U.I. minimum for end of life. Note: Values are assuming 0 input jitter.	At a maximum BER of 10^{-12} using a 2^7-1 PRBS. The average of 3 measurements will be used before and after test. Interim measurement will not be averaged.

Figure 2 (continued)

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Test Description	Requirement	Procedure
RX output eye height.	300 millivolts minimum over operating range.	Measured at end of Module Compliance board trace.
RX output eye amplitude.	850 millivolts maximum over operating range.	Measured at end of Module Compliance board trace.
Supply current per cable end.	300 milliamperes maximum over operating range.	Measured at operating voltage.
ELECTRICAL INTEGRITY		
ESD, human body.	± 1 kilovolt minimum for high speed contacts. ± 2 kilovolt minimum for non-high speed contacts. 15 kV air discharge and 8kV direct contact discharge per EN61000-4-2. Decrease in eye width between pre- and post-test measurements shall be less than 15% at nominal voltage and room temperature. Eye width shall meet end of life requirement after test.	JEDEC JESD22-A114-B human body model. SFF-8431 Section 2.9.
EMI test.	Shall pass FCC Part 15, Class A requirements.	Transmission of random data.
MECHANICAL INTEGRITY		
Vibration, variable frequency.	Decrease in eye width between pre- and post-test measurements shall be less than 15% at nominal voltage and room temperature. Eye width shall meet end of life requirement after test. See Note.	GR-468-CORE. Subject entire cable assembly to 4 cycles of 20 to 2000 to 20 Hz, varied approximately logarithmically, in each of 3 mutually perpendicular planes. Each cycle shall be ≥ 4 minutes. Total test time ≥ 48 minutes. Specimens shall be mounted rigidly and vibrated with a simple harmonic motion with 1.52 mm [.06 in] (± 10%) peak to peak amplitude below the crossover frequency and 20 G +20/-0% peak acceleration above the crossover frequency.
Mechanical shock.	Decrease in eye width between pre- and post-test measurements shall be less than 15% at nominal voltage and room temperature. Eye width shall meet end of life requirement after test. See Note.	MIL-STD-883G. Subject entire cable assembly to 500 G's (distortion ≤ 20% of peak acceleration), 1.0 ms pulse duration with tolerances of the greater of ± 0.1 ms or ± 30%, half-sine waveform, 5 shocks in each direction of 3 mutually perpendicular planes (30 total shocks).

Figure 2 (continued)

Test Description	Requirement	Procedure
Durability.	Decrease in eye width between pre- and post-test measurements shall be less than 15% at nominal voltage and room temperature. Eye width shall meet end of life requirement after test. See Note.	EIA-364-09C. Mate and unmate one connector end of each specimen for 50 cycles at a maximum rate of 500 cycles per hour. Mate and unmate same connector end of each specimen for an additional 50 cycles at a maximum rate of 500 cycles per hour for information only.
Flex.	Output eye width shall meet specification at nominal voltage and room temperature after test. Decrease in eye width between pre- and post-test measurements shall be less than 15% at nominal voltage and room temperature. Eye width shall meet end of life requirement after test. See Note.	TIA/EIA-455-1B. Subject one end of each specimen to 200 total flexing cycles: 100 initial cycles, and 100 cycles with the connector rotated 90 degrees. Apply 4.9 N [1.1 lbf] load and flex at a maximum rate of 30 cycles per minute. One flex cycle is ± 90 degrees.
Twist.	Output eye width shall meet specification at nominal voltage and room temperature after test. Decrease in eye width between pre- and post-test measurements shall be less than 15% at nominal voltage and room temperature. Eye width shall meet end of life requirement after test. See Note.	TIA-455-36A. Subject one end of each specimen to 500 twisting cycles. Apply 14.7 N [3.3 lbf] load and twist at a maximum rate of 30 cycles per minute. One twist cycle is ± 90 degrees.
Insertion force.	18 N [4.05 lbf] maximum.	EIA/ECA-364-13D. Measure force necessary to mate specimens at a maximum rate of 12.7 mm [0.5 in] per minute. Test one end of each cable assembly. No cage kick-out springs.
Withdrawal force.	12.5 N [2.81 lbf] maximum.	EIA/ECA-364-13D. Measure force necessary to unmate specimens at a maximum rate of 12.7 mm [0.5 in] per minute. Test one end of each cable assembly. No cage kick-out springs.

Figure 2 (continued)

Test Description	Requirement	Procedure
Retention force.	Output eye height shall meet specification at nominal voltage and room temperature during test. Decrease in eye width shall be less than 15% at nominal voltage and room temperature during and after test. Eye width shall meet end of life requirement after test. See Note.	EIA/ECA-364-38B. Socket shall be rigidly attached to the test board. Subject one end of each mated specimen to a 90 N [20.23 lbf] axial load applied to the cable at a point 30.5 cm [1 ft] from the back end of the connector. Apply the load manually at a 0 degree pull angle. After holding the load for a minimum of 1 minute, measure eye height and width with load still applied. Remove load and re-measure eye width.
Off-axis load capability.	Output eye height shall meet specification at nominal voltage and room temperature during test. Decrease in eye width shall be less than 15% at nominal voltage and room temperature during and after test. Eye width shall meet end of life requirement after test. See Note.	Socket shall be rigidly attached to the test board. Subject one end of each mated specimen to a 22.2 N [5 lbf] static load applied to the cable at a point 30.5 cm [1 ft.] from the back end of the connector. Apply load manually at a 90 degree pull angle. After holding the load for a minimum of 1 minute, measure eye height and width with load still applied. Remove load, rotate connector mounting 90 degrees and repeat test. Perform test in a total of 4 directions (with load applied parallel and perpendicular to the I/O plate). After completion of testing, re-measure eye width.
Thermal shock.	Decrease in eye width between pre- and post-test measurements shall be less than 15% at nominal voltage and room temperature. Eye width shall meet end of life requirement after test. See Note.	GR-468-CORE. 0 +2/-10 to 100 +10/-2°C, 30 minute dwell time, hot temperature extreme first, 15 cycles, 10 second maximum transfer time. Performance data shall be collected at ambient conditions before and after the test.
Thermal operation (4 corners test).	At nominal voltage and ambient temperature, product shall meet minimum eye width for new product requirement. During test (at voltage and temperature extremes) eye width shall meet end of life requirements. Eye width shall meet end of life requirement after test. Output eye height and supply current shall meet product specification at each test condition.	Check operation at operating temperature extremes (0 and 70°C) with minimum and maximum power supply voltage. In addition, test at nominal voltage and room ambient + TRise temperature, to make a total of 5 sets of data. TX differential input voltage level shall be set to minimum value. Record the following information for each combination of temperature and voltage conditions: 1. RX output eye width; 2. RX output eye height; 3. Supply current. See Figure 3.

Figure 2 (continued)

Test Description	Requirement	Procedure
Temperature cycling, non-operating.	Eye width shall meet end of life requirement after test. See Note.	GR-468-CORE. -40 +0/-10 to 85 +10/-0°C, 30 minute dwell time, cold temperature extreme first, 100 cycles. Temperature ramp rate ≥ 10°C per minute (12.5 minute maximum transfer time). Allow specimens to remain at ambient conditions for at least 1 hour prior to obtaining performance data before and after the test.
Moisture resistance.	Eye width shall meet end of life requirement after test. See Note.	GR-468-CORE. 20 cycles, minimum 24 hours/cycle. Profile temperature extremes are: -10 +2/-5°C, 25 +10/-2°C and 65 ± 2°C, with 90 to 100% RH during ramp to and dwell at maximum temperature. RH shall be 80 to 100% during ramp to and dwell at 25°C. Uncontrolled humidity during cold temperature subcycle. Low temperature subcycle shall be performed on 10 cycles starting with the first cycle and repeating every other cycle. No initial conditioning. Initial performance measurements recorded at ambient conditions. Units powered during test and performance measured before and after test. No power during -10°C exposure. Monitor unit case temperatures. After test, specimens shall be conditioned for 24 hours at room ambient conditions prior to recording performance measurements. Final measurements shall be completed within 48 hours after removal from the chamber.

Figure 2 (continued)

Test Description	Requirement	Procedure
Humidity (life test).	Output eye height and supply current shall meet specification at nominal voltage and room temperature after 1000 hours exposure. Eye width shall meet end of life requirement after 1000 hours. See Note.	GR-468-CORE. 85 ± 2°C (case temperature), 85 ± 2% RH, bias, release at 1000 hours (qualification), continue testing to 5000 hours for information purposes. Performance data to be collected at 500, 1000, 2000, 3000, 4000 and 5000 hours. Precondition specimens in a dry oven (low humidity) at 40 ± 5°C for 24 hours. At each measurement interval during test, performance data shall be obtained as soon as possible after specimens have been conditioned at room ambient for 1 hour.
Accelerated aging (life test).	Output eye height and supply current shall meet specification at nominal voltage and room temperature after 1000 hours exposure. Eye width shall meet end of life requirement after 1000 hours. See Note.	GR-468-CORE. 85 ± 2°C, bias and low humidity, release at 1000 hours (qualification), continue testing to 5000 hours for information purposes. Performance data to be collected at 500, 1000, 2000, 3000, 4000 and 5000 hours. Allow specimens to remain at ambient conditions for at least 1 hour prior to obtaining performance data at each measurement interval.

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 Figure 4.*

Figure 2 (end)

Power Supply Voltage	Operating Case Temperature (°C)		
	0	Room Ambient + TRise	70
Minimum	3.13 volts	-----	3.13 volts
Nominal	-----	3.3 volts	-----
Maximum	3.47 volts	-----	3.47 volts

Figure 3
Temperature and Voltage Combinations for Thermal Operation and 4 Corners Test

3.6. Product Qualification and Requalification Test Sequence

Test or Examination	Test Group (a)							
	1	2	3	4	5	6	7	8
	Specimen Size (20% Lot Tolerance Percent Defective (LTPD))							
	18	18	18	32	18	11	5	1
	Test Sequence (b)							
Examination of product	1	1	1	1	1	1	1	1
RX output eye width	2,7,9,11	2,7,12,14	2,7	2,7	2,7,9,13	2,7,9,13	2,7	2
RX output eye height	3	3,8	3,8	3,8	3,10,14	3,10,14	3	3
RX output eye amplitude	4	4,9	4,9	4,9	4,11,15	4,11,15	4	4
Supply current per cable end	5	5,10	5,10	5,10	5,16	5,16	5	5
ESD, human body							6	
EMI test								6
Vibration, variable frequency	6							
Mechanical shock	8							
Durability					6			
Flex					8			
Twist					12			
Insertion force						6		
Withdrawal force						7		
Retention force						8		
Off-axis load capability						12		
Thermal shock	10							
Thermal operation (4 corners test)		6						
Temperature cycling, non-operating		11						
Moisture resistance		13						
Humidity (life test)			6					
Accelerated aging (life test)				6				

NOTE *(a) See paragraph 4.1.A.*
(b) Numbers indicate sequence in which tests are performed.

Figure 4

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4. QUALITY ASSURANCE PROVISIONS

4.1. Qualification Testing

A. Specimen Selection

Specimens shall be prepared in accordance with applicable Instruction Sheets and shall be selected at random from current production per Figure 4. The same specimens may be used for more than one test group.

B. Test Sequence

Qualification inspection shall be verified by testing specimens as specified in Figure 2.

4.2. Requalification Testing

If changes significantly affecting form, fit or function are made to the product or manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality and reliability engineering.

4.3. Acceptance

Acceptance is based on verification that the product meets the requirements of Figure 1. Failures attributed to equipment, test setup or operator deficiencies shall not disqualify the product. If product failure occurs, corrective action shall be taken and specimens resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

4.4. Quality Conformance Inspection

The applicable quality inspection plan shall specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.