

NUMBER <b>GS-12-216</b>	TYPE <b>PRODUCT SPECIFICATION</b>		
TITLE EyeMax™ Cable Assemblies		PAGE 1 of 12	REVISION B
		AUTHORIZATION Tom Feng	DATE 14 Oct. 13
CLASSIFICATION <b>UNRESTRICTED</b>			

## 1.0 Objective

This specification defines the performance, test, quality and reliability requirements of the EyeMax™ Cable Assembly system. This specification applies specifically to cable assemblies constructed using EyeMax™ components and approved vendor cable.

## 2.0 Scope

This specification is applicable to the performance characteristics of the EyeMax™ Cable Assembly. See specification GS-12-209 for characteristics specific to the EyeMax™ Plugs and Receptacles.

## 3.0 General

This document is composed of the following sections:

<u>Paragraph</u>	<u>Title</u>
1.0	OBJECTIVE
2.0	SCOPE
3.0	GENERAL
4.0	APPLICABLE DOCUMENTS
5.0	REQUIREMENTS
5.1	Qualification
5.2	Material
5.3	Finish
5.4	Design and Construction
6.0	ELECTRICAL CHARACTERISTICS
7.0	MECHANICAL CHARACTERISTICS
8.0	ENVIRONMENTAL CONDITIONS
9.0	QUALITY ASSURANCE PROVISIONS
9.1	Equipment Calibration
9.2	Inspection Conditions
9.3	Sample Quantity and Description
9.4	Acceptance
9.5	Qualification Testing
9.6	Requalification Test
TABLE 1	QUALIFICATION TESTING MATRIX
FIGURE 1	FLEX TEST FIXTURE
FIGURE 2	BEND TEST DIAGRAM

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#### 4.0 Applicable Documents

##### 4.1 Specifications

4.1.1	10007290	4X Cable Assembly Drawings
4.1.2	10010260	12X Cable Assembly Drawings
4.1.3	58368 or 58369	4X Receptacle Drawings
4.1.4	58366 or 58367	12X Receptacle Drawings
4.1.5	GS-12-209	EyeMax™ Connector Specification

##### 4.2 Other Standards and Specifications

4.2.1	EIA 364:	Electrical Connector/Socket Test Procedures Including Environmental Classifications.
4.2.2	Volume 2:	InfiniBand Architecture
4.2.3	MIL-C-45662:	Equipment Calibration
4.2.4	ASTM-D-4565:	Physical and Environmental Performance Properties of Insulation and Jacket for Telecommunications Wire and Cable.

##### 4.3 FCI Specifications

4.3.1	BUS-03-107	Cable Shielding Effect Measurement
4.3.2	BUS-03-108	Cross-Talk Methods
4.3.3	BUS-03-110	Characteristic Impedance
4.3.4	BUS-03-111	Propagation Delay Measurement
4.3.5	BUS-03-117	Eye Pattern Measurement

##### 4.4 FCI Lab Reports - Supporting Data

4.4.1	SI-2002-09-005	4X EyeMax™ Cable Assembly Pre-Qualification
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## 5.0 Requirements

### 5.1 Qualification

Cable assemblies furnished under this specification shall be capable of meeting the qualification test requirements specified herein.

### 5.2 Material

5.2.1 The material for each component shall be as specified herein or equivalent.

5.2.2 EyeMax™ Plug Assembly

5.2.2.1 Reference GS-12-209

5.2.3 Raw Cable

5.2.3.1 All raw cable used EyeMax™ must meet the requirements of [10026988](#). All raw cable structure must meet the requirements of ASTM-D-4565.

### 5.3 Designs And Construction

5.3.1 Mating. The connector shall be capable of mating and unmating without the use of special tools.

5.3.2 Workmanship. Connectors shall be uniform in quality, and void of all defects that would adversely affect life or serviceability.

5.3.3 Temperature Environment. The receptacles and cable assemblies should be capable of withstanding storage and operating temperature between –10°C and 60°C.

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## 6.0 Electrical Characteristics

- 6.1 Eye Pattern - The eye opening shall exceed the diamond shaped mask when measured in accordance with EIA 364-107. The following details shall apply:
- a. Data Rate – 2.5 Gb/s
  - b. 1.0 Vpp excitation
  - c. Mask Width – .75 unit intervals or 300 ps minimum
  - d. Mask Height – 316 mV minimum
- 6.2 Jitter - The peak-to-peak jitter shall not exceed .25 unit intervals or 100 ps when measured in accordance with EIA 364-107. The following details shall apply:
- a. Data Rate – 2.5 Gb/s
- 6.3 Differential Impedance – Regardless of length, the average value measured for the cable assembly shall be  $100 \pm 10 \Omega$ . The following details shall apply:
- a. Rise time – .25 unit intervals or 100 ps. (20% to 80%)
  - b. Points of measurement - Includes test board, connector interface, and the cable assembly.
  - c. Reference – EIA 364-108.
- 6.4 Between Pair Skew – The average value measured over the propagation delay of the mated connector and cable assembly shall not exceed 50 ps/meter. The following details shall apply:
- a. Rise time - 100 ps.
  - b. Points of measurement - Includes connector, cable to connector interface, and termination pads.
  - c. Reference – EIA 364-103.
- 6.5 Differential Insertion Loss - The insertion loss of mated connectors and cable assembly shall not exceed 10.0 dB. The following details shall apply:
- a. Frequency – up to 1.25 GHz.
  - b. Reference – test board effects removed per EIA 364-101.
- 6.6 Differential Return Loss - The return loss of mated connectors and cable assembly shall be greater than 10.0 dB. The following details shall apply:
- a. Frequency – up to 1.25 GHz.
  - b. Reference - test board effects removed per EIA 364-101.
- 6.7 EMI Effectiveness - The shielding performance of mated connectors and cable assembly shall exceed 40.0 dB. The following details shall apply:
- a. Frequency – up to 1.00 GHz.
  - b. Reference - EIA 364-66A.

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6.8 Near End Crosstalk - The specification requirement, measured on the transmitter side, shall be satisfied when evaluated in accordance with EIA 364-90 and the following details:

- a. Specification requirement – Sum of 4 pairs: Less than 4%.
- b. Rise time – 100 ps.
- c. Sample test conditions – Input signal to 1 pair and measure the effects in adjacent 2 pairs.
- d. Measurements taken in the time domain

6.9 Far End Crosstalk - The specification requirement, measured on the receiver side, shall be satisfied when evaluated in accordance with EIA 364-90 and the following details:

- a. Specification requirement – Sum of 4 pairs: Less than 4%.
- b. Rise time – 100 ps.
- c. Sample test conditions – Input signal to 1 pair and measure the effects in adjacent 2 pairs.
- d. Measurements taken in the time domain

6.10 Low Level Contact Resistance (LLCR) – LLCR is measured before and after mechanical and environmental tests. All bulk resistance not associated with the connectors or termination will be subtracted out of the measurement. The test is in accordance with EIA 364-23 and the following details.

- a. Test Voltage – 50 mV maximum
- b. Test Current – 100 mA maximum
- c. Initial Resistance – 70 milliohm maximum
- d. Post Test Resistance – 90 milliohm maximum

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## 7.0 Mechanical Characteristics

- 7.1 Mating/Unmating Force – The force readings to mate a receptacle connector and compatible plug is detailed in GS-12-209.
- 7.2 Connector Durability - The cycle life shall exceed 250 mating cycles. Reference GS-12-209.
- 7.3 Retention Force – In accordance with EIA 364-38, the force required to dislodge the cable from the back shell assembly shall not be less than 16.9 lbs. (75 N). The cable assembly should not display any physical damage and meet the requirements of paragraph 6.3 and 6.10.
- a. Head Speed – 25.4 mm / minute
- 7.4 Vibration (Random) - In accordance with EIA 364-28, the cable assembly shall meet the requirements 6.10 following testing.
- a. Test Condition – VII, Letter D  
b. Vibration Amplitude- 0.2 G<sup>2</sup>/Hz. Between 20-500Hz. Minimum.  
c. Duration – 15 minutes along each of three perpendicular directions  
d. Mounting - Rigidly mount assemblies  
e. No discontinuities greater than 1 microsecond
- 7.5 Minimum Bend Radius – For raw cable less than or equal to ½ inch in diameter, the minimum distance to complete a 90 degree bend including the connector is 4 inches. For larger diameter cable, the minimum inside radius is 4 times the cable diameter plus 2.000 inches for the connector. The single-ended cable assembly should be bent one time over the correct mandrel in 4 independent directions. See Figure 1. The cable assembly should meet the requirements of 6.3 and 6.10
- 7.6 Flex Test – Flex testing is used to evaluate the quality of the raw cable. See Figure 2 for test set-up. For raw cable less than or equal to ½ inch in diameter, the fixture radius is 6 inches. For larger diameter cable, the fixture radius is 4 times the cable diameter plus 4.00 inches for the connector and relief. After 15 cycles the cable assembly shall meet the requirements of paragraph 6.3 and 6.10.

Note: Flex testing is an FCI internal specification. InfiniBand only requires one cycle at the minimum bend radius.

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## 8.0 Environmental Conditions

After exposure to the following environmental conditions in accordance with the specified test procedure and/or details, the product shall show no physical damage.

8.1 Thermal Shock – In accordance with EIA 364-32, cycle the cable assemblies in a thermal chamber. After 5 cycles, the cable assembly shall meet the requirements 6.10.

- a. Test Duration – 5 cycles.
- b. Temperature Range - Between -55 and +85 degrees Celsius
- c. Time at Each Temperature - 30 minutes
- d. Transfer Time - 5 minutes, maximum

8.2 High Temperature Life – In accordance with EIA 364-17, loosely coiled cable assemblies should be placed in the test environment. After exposure the cable assembly shall meet the requirements 6.10.

- a. Test Method A
- b. Test Condition 2
- c. Test Duration – 456 hours
- d. Temperature – +90 degrees Celsius

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## 9.0 QUALITY ASSURANCE PROVISIONS

### 9.1 Equipment Calibration

All test equipment and inspection facilities used in the performance of any test shall be maintained in a calibration system in accordance with MIL-C-45662.

### 9.2 Inspection Conditions

Unless otherwise specified herein, all inspections shall be performed under the following ambient conditions:

- a. Temperature: 25 +/- 5 degrees Celsius
- b. Barometric Pressure: Local ambient

### 9.3 Sample Quantity And Description

Test group 1, electrical testing, consists of at least 3 complete cable assemblies. Test groups 2 through 5, mechanical and environmental testing, consists of at least 3 single-ended pigtailed with 1 meter of cable.

### 9.4 Acceptance

- 9.4.1 Electrical and mechanical requirements placed on test samples as indicated in paragraphs 6.0 and 7.0 shall be established from test data using appropriate statistical techniques. All samples tested in accordance with this product specification shall meet the stated requirements.
- 9.4.2 Failures attributed to equipment, test set-up, or operator error shall not disqualify the product. If product failure occurs, corrective action shall be taken and samples resubmitted for qualification.

### 9.5 Qualification Testing

Qualification testing shall be performed on sample units produced with equipment and procedures normally used in production. The test sequence shall be as shown in Table 1.

### 9.6 Requalification Testing

If any of the following conditions occur, the responsible product engineer shall initiate requalification testing consisting of all applicable parts of the qualification test matrix, Table 1.

- a. A significant design change is made to the existing product, which impacts the product form, fit or function.

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- b. A significant change is made to the manufacturing process, which impacts the product form, fit or function.
- c. A significant event occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.

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**TABLE 1 - QUALIFICATION TESTING**

TEST	PARA.	TEST GROUP				
		1	2	3	4	5
		TEST SEQUENCE				
Examination of Product	5.3	1	1,9	1,5	1,5	1,5
Eye Pattern	6.1	2				
Jitter	6.2	3				
Characteristic Impedance	6.3	4	2,7			
Between Pair Skew	6.4	5				
Diff. Insertion Loss	6.5	6				
Diff. Return Loss	6.6	7				
EMI Effectiveness	6.7	8				
Near End Cross-Talk	6.8	9				
Far End Cross-Talk	6.9	10				
LLCR	6.10		3,8	2,4	2,4	2,4
Retention Force	7.3		4			
Vibration	7.4			3		
Minimum Bend Radii	7.5		5			
Flex Test	7.6		6			
Thermal Shock	8.1				3	
High Temperature Life	8.2					3

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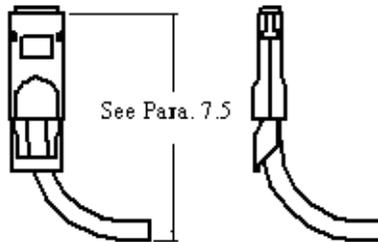


Figure 1 - Minimum Bend

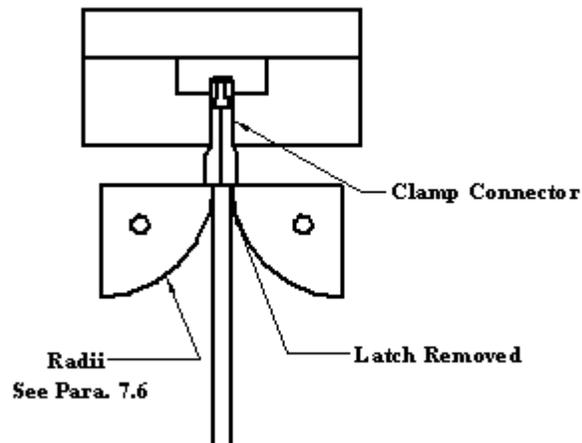


Figure 2 - Flex Test

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