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1.0 SCOPE

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- 2.2 Dimensions, Materials, Plating and Markings
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- 7.1 Equipment Calibration
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9.0 REVISION RECORD

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1.0 SCOPE

This specification is applicable to the performance characteristics of QSFP+ cable to board connector system.

2.0 PRODUCT DESCRIPTION

2.1 PRODUCT NAME AND SERIES NUMBER(S)

Product	Series P/N	Test Sections Do Not Apply
10G QSFP Cable Assembly	10093084	
14G QSFP+ Cable Assembly	10119239	
28G QSFP+ Cable Assembly	10121178	
QSFP SMT Board Connector	10099113/10132344	
QSFP Cage	10099114/10128765/10130975	
QSFP Heat Sink	10099115	
QSFP Heat Sink Clip	10099116	
QSFP Cage with Sink and Clip Assembly	10116015/10128764	
Custom QSFP Cable Assembly	10110113	3.2, 6.4, 6.5
Custom QSFP Cable Assembly	10111727	3.2, 6.4, 6.5

2.2 DIMENSIONS, MATERIALS, PLATING AND MARKINGS

Refer to the applicable customer drawing for the related dimensional, material, plating, and marking information.

2.3 ADDITIONAL GENERAL SPECIFICATIONS

Plug PCB:

- Material: FR4
- Overall thickness: 1.05mm ±0.1(over pads)
- Mating interface plating: Hard gold over nickel

Bulk Cable:

• As listed on the cable specification drawings.

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3.0 REFERENCE DOCUMENTS

3.1 FCI DOCUMENTS

GS-14-1272	Cable Assembly Packaging Specification
GS-14-1400	Board Connector, Cage, and Heat Sink Packaging Specification
GS-20-126	Board Connector, Cage, and Heat Sink Product Application Specification.
SI-2009-09-004	10G QSFP+ Signal Integrity Performance Report (This Applies Only To
	Standard Part Number)
SI-VG-2012-04-001	14G QSFP+ Signal Integrity Performance Report (This only applies to the 14G
	QSFP+ Part Number)
SI-VG-2012-11-013	4x28G QSFP+ Signal Integrity Performance Reports (This applies only to
SI-VG-2012-11-021	the 28G P/N)
GS-29-622	10G Qualification Test Report Summary
EL-2012-05-033	14G Qualification Test Report
EL-2012-12-023	28G Qualification Test Report

3.2 INDUSTRY DOCUMENTS

FIT, FORM AND FUNCTION

SFF-8436	QSFP+ Copper and Optical Modules
SFF-8661	QSFP+ 28 Gb/s 4X Pluggable Module (Style A)
SFF-8662	QSFP+ 28 Gb/s 4X Connector (Style A) or
SFF-8672	QSFP+ 28 Gb/s 4X Connector (Style B)
SFF-8663	QSFP+ 28 Gb/s 4X Cage (Style A)
IEEE 802.3	Gigabit Ethernet Standard
Infiniband IBTA	FDR (This applies only to the 14G QSFP+ P/N)
InfiniBand IBTA	EDR (This applies only to the 4x28G QSFP+ P/N)
ITU-T G.957	Synchronous Digital Hierarchy Standard
Telcordia Techr	nologies GR-253-CORE
JEDEC JESD22	2-A-114B ESD Specification

TEST SPECIFICATON(S)

EIA 364 Series Electrical Connector Test Procedures Including Environmental Classifications with Test Procedure

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4.0 QUALIFICATION

Connector and cable assemblies furnished under this specification shall be capable of meeting the qualification test requirements specified herein and shall be uniform in quality, and void of all defects that would adversely affect life or serviceability.

5.0 RATINGS

5.1 VOLTAGE

30 Volts AC per Contact (RMS)/DC Max.

5.2 CURRENT

0.5 Amps Max (per contact) 1.0 Amp Max (per power pin)

5.3 TEMPERATURE

Operating: -40°C to +85°C

6.0 PERFORMANCE

6.1 ELECTRICAL CHARACTERISTICS

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT
6.1.1	LLCR	Mate connectors: apply a maximum voltage of 320 mV and a current of 10 mA. (EIA 364-6)	20 milliohm maximum change from initial after environmental exposure
6.1.2	Insulation Resistance	After 100 VDC for 1 minute, measure the insulation resistance between adjacent mated contacts. (EIA 364-21)	1000 mΩ Minimum between adjacent contacts
6.1.3	Dielectric Withstanding Voltage	Apply a voltage of 300 VDC for 1 minute hold between adjacent mated terminals. (EIA 364-20, method B)	No defect between adjacent contacts
6.1.4	Temperature Rise (via Current Cycling)	Mate connectors: measure the temperature rise at the rated current after 96 hours (45 minutes ON and 15 minutes OFF per hour). Testing as required.	Temperature rise: +30 °C MAX.

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6.1.5	Differential Impedance	Rise time of 70ps (20% to 80%) (EIA 364-108)	No significant electrical change
6.1.6	Continuity	Verify the continuous electrical path of all expected connections	No unexpected opens, shorts, or high resistance areas.

6.2 ESD Requirements

The module shall meet ESD requirements given in EN61000-4-2, criterion B test specification such that when installed in a properly grounded cage and chassis the units are subjected to 15KV air discharges during operation and 8KV direct contact discharges to the case.

The QSFP+ module and host SFI contacts (High Speed Contacts) shall withstand 1000V electrostatic discharge based on human body model per JEDEC JESD22-A114-B.

The QSFP+ module and host SFI contacts with the exception of the SFI contacts (High Speed Contacts) shall withstand 2kV electrostatic discharge based on human body model per JEDEC JESD22-A114-B.

The QSFP+ module shall meet ESD requirements given in EN61000-4-2, criterion B test specification such that units are subjected to 15kV air discharges during operation and 8kv direct contact discharges to the case.

6.3 EMI Protection

The chassis ground of the QSFP+ module is isolated from the modules circuit ground to provide the equipment designer flexibility regarding connections between external electromagnetic interference shields and circuit ground of the module.

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6.4 QSFP+ Cable Assembly Pin Assignment (Figure 3). See Specification SFF- 8436 section 4. Module mechanicals meet the requirements of specification SFF-8436.



TOP SIDE VIEWED FROM TOP BOTTOM SIDE VIEWED FROM BOTTOM

FIGURE 3 QSFP+ Module Contact Definition

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6.5 2 Wire Interface EEPROM

The QSFP+ serial ID provides access to sophisticated identification information that describes the Transceiver's capabilities, standard interfaces, manufacturer, and other information. The EEPROM on the QSFP+ passive cable assembly is designed for 255 addresses.

10G QSFP+ & 14G FDR & 28G EDR EEPROM information and source Refer to below document

ТҮРЕ	FCI PN
FCI STANDARD QSFP+	10093084
FCI STANDARD FDR	10119329
FCI STANDARD EDR	10121178

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IBTA Vo SFF-863	IBTA Volume2 - v2r1_3_1.140226-Draft and SFF-8636 revision 1.4				QSFP+ to QSFP+	QSFP+ to QSFP+	QSFP+ to QSFP+	FCI 10G QDR QSFP+ to QSFP+	FCI 14G FDR QSFP+ to QSFP+	FCI 28G EDR QSFP+ to QSFP4
			Add	ress	10093084-	10119239-	10121178-	10093084-	10119239-	10121178-
		Name of Field	Addr (Dec)	Addr (Herr)	Value (Hex)	(Hex)	(Hex)	Value	Value	Value
	Identifier		0	0	D	D	D	(4001)	(4001)	(4001)
ID and	Revision		1	1	2	4	4	1		
status	Compliance	With MOULL 0x02 -						-		
	Status	With MCU : 0X02 , Without MCU : 0X06 ;	2	2	6	6	6			
			3	3	0	0	0	1		
			4	4	0	0	0			
0	L		5	5	0	0	0	-		
			7	7	0	0	0	1		
			8	8	0	0	0	1		
			9	9	0	0	0			
			10	A	0	0	0	4		
Interrupt			12	c	0	0	0	1		
Flags			13	D	0	0	0	1		
			14	E	0	0	0			
			15	F 10	0	0	0	4		
			17	11	0	0	0	1		
			18	12	ŏ	ŏ	ŏ	1		
5			19	13	0	0	0	4		
	L		20	14	0	0	0	4		
			21	16	0	0	0	1		
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			24	18	0	0	0]		
			25	19	0	0	0	4		
			26	1A	0	0	0	4		
			27	18	0	0	0	4		
			28	10	0	0	0	-		
			30	15	0	0	0	1		
			31	1F	0	0	0	1		
			32	20	0	0	0	1		
2			33	21	0	0	0	1		
			34	22	0	0	0]		
			35	23	0	0	0]		
			36	24	0	0	0			
			37	25	0	0	0	4		
			38	26	0	0	0	4		
			39	27	0	0	0	4		
			40	28	0	0	0	-		
			42	28	0	0	0	1		
			43	2B	0	0	0	1		
			44	2C	0	0	0	1		
			45	2D	0	0	0]		
1			46	2E	0	0	0			
			47	2F	0	0	0	4		
	L		48	30	0	0	0	4		
			49	31	0	0	0	4		
			50	32	0	0	0	4		
Monitors			52	33	0	0	0	1		
			53	35	0	0	0	1		
			54	36	0	0	0	1		
			55	37	0	0	0]		
			56	38	0	0	0			
1			57	39	0	0	0	4		
0	L		58	3A.	0	0	0	4		
			59	38	0	0	0	4		
	L		60	30	0	0	0	4		
J			62	30	0	0	0	1		
9			63	35	0	0	0	1		
J	<u> </u>		64	40	0	0	0	1		
1			65	41	0	0	0	1		
			66	42	0	0	0]		
			67	43	0	0	0]		
			68	44	0	0	0			
			69	45	0	0	0	4		
	L		70	46	0	0	0	4		
1	L		71	47	0	0	0	4		

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10				72	48	0	0	0
П.				73	49	0	0	0
1				74	4A	0	0	0
D				75	48	0	0	0
Σ.				76	40	0	0	0
6				77	40	0	0	0
ŭ				79	40	0	0	0
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1				86	56	0	0	0
0				87	57	0	0	0
3				88	58	0	0	0
0				89	59	0	0	0
				90	5A	0	0	0
	Control			91	5B	0	0	0
				92	5C	0	0	0
				93	5D	0	0	0
L.				94	5E	0	0	0
<u>ه</u>				95	5F	0	0	0
2				96	60	0	0	0
				97	61	0	0	0
•••	Reserved			98	62	0	0	0
-	Heselveu			99	63	0	0	0
Ð				100	64	0	0	0
3	Free Side			101	65	0	0	0
0	Device			102	66	0	0	0
	and			103	67	0	0	0
	Channel			104	68	0	0	0
	Masks			105	69	0	0	0
				106	6A	0	0	0
do la	Reserved			107	6B	0	0	0
ő				108	6C	0	0	0
	Free Cide			109	6D	0	0	0
Ē	Device Properties	Far Far end doe	end complies with SFF 8636: 0x08 ; esn't complies with SFF 8636: 0x00 ;	110	6E	8	8	8
Ð				111	6F	0	0	0
3				112	70	0	0	0
0				113	71	0	0	0
_				114	72	0	0	0
	Reserved			115	73	0	0	0
				116	74	0	0	0
				117	75	0	0	0
				118	76	0	0	0
- m	Deceword			119	77	0	0	0
E,	Change			120	78	0	0	0
ñ.	Entry Area			121	79	0	0	0
	(Optional)			122	74	0	0	0
5				122	79	0	0	0
۳.	Password			124	70	0	0	0
5	Entry Area			125	70	0	0	0
0	(Optional)			120	70	0	0	0
	Dago Calent	Buto		120	75	0	0	0
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۲				213	D6	34	34	34		-	0	
				215	D7	35	35	35	5	5	5	
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				217	D9	38	38	38	8	8	8	
0				218	DA	20	20	20				
D				219	DB	20	20	20				
Ра		Diagnostic Monitoring Type		220	DC	0	0	0				
τ.		Enhanced Options		221	DD	0	0	0				
5		BR, nominal		222	DE	0	0	0				
ŏ		CC_EXT		223	DF	A5	AF	BA				
5				224	EO	0	0	0	-			
-				220	EI	0	0	0	-			
2	<			220	E2	0	0	0	-			
				227	F4	0	0	0	-			
	۱D			229	E5	0	0	0	-			
	14			230	E6	0	0	0	-			
Ó				231	E7	0	0	0				
O				232	E8	0	0	0				
5	4			233	E9	0	0	0				
Δ	l M			234	EA	0	0	0	_			
s.,	¥.			235	EB	0	0	0	-			
۵	l '			230	ED	0	0	0	-			
ŏ	10			23/	EE	0	0	0	-			
0	(U)			239	EF	0	0	Ő	-			
	5			240	F0	0	0	0				
7	U			241	F1	0	0	0				
	LΨ			242	F2	0	0	0				
	W			243	F3	0	0	0				
L.	\mathbf{O}			244	F4	0	0	0	_			
Ξ				245	H5	0	0	0	-			
0				240	F0	0	0	0	-			
0				247	FR	0	0	0	-			
Ц	U.			249	F9	0	0	0	1			
1				250	FA	0	0	0				
۵				251	FB	0	0	0				
0				252	FC	0	0	0				
0				253	FD	0	0	0	4			
				254	FE	0	0	0	-			
		1		265	+F	0	0	0	1			

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MECHANICAL CHARACTERISTICS

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT
6.6.1	Durability	Cable Assembly: 50 Cycles Board Connector: 100 cycles Test Condition: 10 cycles per minute max. Latches to be disabled. (EIA 364-09, 364-23)	 Max. 20mΩ change from initial readings No visual damage
6.6.2	Pre-conditioning	Mate and un-mate samples 25 times. Test condition: 10 cycles per minute max. (EIA 364-09, 364-23)	No Physical Damage
6.6.3	Mechanical Shock	Mated samples subject to 30G, half-sine shock pulses of 11 milliseconds duration. 3 shocks in each direction applied in 3 mutually perpendicular planes (18 total). EIA 364-27, Method H	No Physical Damage
6.6.4	Random Vibration	Mate samples subjected to 3.10G rms between 20 and 500 Hz for 15 minutes in each of 3 mutually perpendicular planes EIA 364- 28, Test Condition: VII	 Max. 20mΩ change from initial readings No visual damage No discontinuances greater than 1µs
6.6.5	(Insertion & Extraction) Mating & Un-mating Forces	Mate and un-mate samples 5 times. Measure the forces with the kick-out springs and latches disengaged.	 40N max mating force 30N max un-mating force
6.6.6	Cable Strain Relief	Place axial load on cable. Test Condition: 25mm/min head speed	 90N Minimum No physical damage. Verify continuity No significant electrical change (Diff Impedance)
6.6.7	Wire Flex	Cable flex 180° - 15 Cycles Test Condition : See Table 1 and Figure 2 (EIA 364-41)	 No physical damage. No loss of continuity during test. No significant electrical change (Diff Impedance)
6.6.8	Cable Minimum Bend Radius	The cable is bent one time over the correct mandrel of size specified in Table 1 in each of 4 perpendicular directions. (Figure 1)	 No physical damage. Verify continuity No significant electrical change (Diff Impedance)
6.6.9	Latch Strength	Mate connectors and place an axial load on the cable connector.	 90N Minimum No physical damage to the module or cage.
6.6.10	Cage Press Fit Insertion & Withdrawal Force	Place axial load on the cage to measure the insertion and withdrawal force of the press-fit sections into and out of the PCB.	 550N Max. Insertion per press-fit section. 114N Min. Extraction per press-fit section.

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Raw Cable AWG 8 Pair	Minimum Bending	Minimum Bending
Standard	Radius Repeated	Radius Single
32AWG	2.007"(51mm)	1.004" (25.5mm)
30AWG	2.598"(66mm)	1.299"(33mm)
28AWG	2.952"(75mm)	1.476"(37.5mm)
26AWG	3.385" (86mm)	1.693"(43mm)
24AWG	3.818"(97mm)	1.909" (48.5mm)
Raw Cable AWG 8 Pair	Minimum Bending	Minimum Bending
4x28G	Radius Repeated	Radius Single
30AWG	2.520"(64mm)	1.260" (32mm)
26AWG	3.189"(81mm)	1.614" (41mm)

* Minimum Bend Radius for all non standard cables will use the following formula: Repeated Bending = 10 X Cable Diameter and Single Bending = 5 X Cable Diameter

Table 1 – Cable Minimum Bend Radius (See Figure 1 & 2)

6.6 ENVIRONMENTAL REQUIREMENTS

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT
6.7.1	Thermal Shock	Test Condition: 10 cycles -55°C to +85°C. (EIA 364-32C, condition I)	Max. 2 0 milliohm change from initial readings
6.7.2	Temperature Life	Cable should be mated and subject 70°C for 500 hours EIA 364-17, Method A, Condition 2, Time Condition C	Max. 20 milliohm change from initial readings
6.7.3	Humidity Temperature Cycling	Cables unmated specimens to 10 cycles between 25°C and 65°C at 80% to 100% relative humidity EIA 364-31, Method III excluding steps 7a & 7b	Max. 2 0 milliohm change from initial readings
6.7.4	Mixed Flowing Gas	Subject the board mounted receptacle to environmental Class IIA for 7 days unmated followed by 7 days mated (14 days total) EIA 364-65, Class IIA	Max. 2 0 milliohm change from initial readings
6.7.5	Thermal Disturbance	Cables are cycled between 15±3 and 85±3°C as measured on the part. Ramps at min 2°C/minute and dwells ensuring contacts reach extremes for 5 minutes minimum. Humidity not controlled. 10 cycles	Max. 20 milliohm change from initial readings

7.0 QUALITY ASSURANCE PROVISIONS

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7.1 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.

7.2 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

7.3 Sample Quantity And Description

Test Group	Number of Cables	Cable Description	Number of Board Connectors
1	3	Each AWG, double ended, 1 meter min	1
2	3	Any AWG, single ended, 0.5 meter	3
3	1	Any AWG, single ended, 0.5 meter	6 Cages and 3 PCB
4	6	Any AWG, single ended, 0.5 meter	3 Board Connectors and 3 Loose Piece connectors
5	3	Any AWG, single ended, 0.5 meter	3
6	3	Any AWG, single ended, 0.5 meter	3
	3	Smallest AWG, single ended, 0.5 meter	3
7	3	Largest AWG, single ended, 0.5 meter	3
	3 per wire gage tested	Non-terminated cables for board side connector durabilty	3 Paddle Boards and 1 Cage

For qualification test samples, DC blocking capacitors on the receive channels are to be replaced by 0 ohm resistors so that LLCR measurements can be taken on the receive channels.

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7.4 Acceptance

- 7.4.1 Electrical and mechanical requirements placed on test samples as indicated in section 6.0 shall be established from test data using appropriate statistical techniques. All samples tested in accordance with this product specification shall meet the stated requirements.
- 7.4.2 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.

7.5 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 2.

7.6 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 2.

- a. A significant design change is made to the existing product, which impacts the product form, fit or function.
- 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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	PARA	TEST GROUP						
TEST		1	2	3	4	5	6	7
		TEST SEQUENCE						
Examination of Product		1,12	1,3	1,4	1,11	1,5	1,14	1,11
LLCR	6.1.1				2,6,8	2,4	2,5,7,9,11,1 3	2,5,7,9
Insulation Resistance (IR)	6.1.2				3,9			
Dielectric Withstanding Voltage (DWV)	6.1.3				4,10			
Differential Impedance	6.1.5	3,6,8, 11						
Continuity	6.1.6	2,5,10						
Durability	6.6.1							4
Pre-conditioning	6.6.2						4	
Mechanical Shock	6.6.3							6
Random Vibration	6.6.4							8
Mating/Un-mating Force	6.6.5						3,12	3,10
Cable Strain Relief	6.6.6	9						
Wire Flex	6.6.7	7						
Minimum Bend Radii	6.6.8	4						
Latch Strength	6.6.9		2					
Cage Press-fit Insertion Force	6610			2				
Cage Press-fit Withdrawal	0.0.10			3				
Thermal Shock	6.7.1				5			
Temperature Life	6.7.2					3		
Humidity Temperate Cycling	6.7.3				7			
Mixed Flowing Gas	6.7.4						6,8	
Thermal Disturbance	6.7.5						10	

TABLE 2 - QUALIFICATION TESTING MATRIX

GS-12-622		TYPE Product Specification	FCJ	
TITLE		PAGE 17 of 19	REVISION M	
	QSFP+ Cable to Board Connector System			DATE Jan-21-2015
			TED	

8.0 SUPPORTING INFORMATION



 $\label{eq:Figure 1-Single Minimum Bending Radius} (\,See \, Mechanical \, Characteristics \, 6.1.9 \, and \, Table \, 1 \,)$

Form E-3334 Rev F





PDS: Rev :M

GS-01-001

GS-12-622	Product Specification	FCJ	
TITLE	PAGE 19 of 19	REVISION M	
QSFP+ Cable to	AUTHORIZED BY Michael Zhou	DATE Jan-21-2015	
			TED

9.0 REVISION RECORD

REV.	PAGE	DESCRIPTION	ECR	DATE
Α	All	Release from Preliminary	V10-0131	4-05-10
В	All	Rev. A to B, Changed bend radius in Table 1 Repeatable .97 to	V10-0290	7-07-10
		2.007, 1.61 to 2.598, 1.69 to 2.952, 1.93 to 3.385, 2.20 to 3.818		
		and Single, .69 to 1.004, .81 to 1.299, .85 to 1.476, .96 to 1.693,		
		1.10 to 1.909		
C	2	Adding new P/N 10116015	ECN-ELX-N-003201-1	3-14-11
D	All	Removed E-Prom Address from specification.	ECN-ELX-V-010413-1	2-27-12
E	2/3	Added applicable information for 14G QSFP+ Cable Assembly Add EEPROM Section back into Spec	ECR-ELX-V-011521	5-02-12
F	8	Updated contents of address 131 to comply with the latest rev	ECR-ELX-V-13361	11-02-12
		of SFF-8436		
G	29	Update Test Plan to remove LLCR Step 11 from Test Group 4	ECN-ELX-V-14334-1	3-25-13
Н	All, 5,	Added applicable information for 28G QSFP+ Cable Assembly	ECN-ELX-V-15186-1	7-09-13
	7, 26,	Updated Impedance requirement, 6.1.5, 6.6.6, 6.6.7, 6.6.8;		
	27	Added 6.1.6, Updated memory map, Updated the table in		
		section 7.3, Change repeated bend radius		
J	5, 8,	Corrected revision change description for Rev H.	ECN-ELX-N-15503-1	8-27-13
	15, 29,	Changed requirement in section 6.1.5, Corrected dec equivalent		
	32	on address 131, Corrected Vendor OUI, Updated table 2 to add		
		continuity and update sequence of test group 1		
K	7-15	Delete previous EEPROM content and add FCI standard QDR	ECN-ELX-N-16985-1	5-06-14
		& FDR & EDR EEPROM		
L	8-11	Update the QSFP Plus Attenuation table	ECN-ELX-N-17658-1	7-18-14
Μ	2	Adding new P/N 10132344、10128764、10128765、	ECN-ELX-DG-20036-1	1-21-15
		10130975		



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