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SFF Committee

SFF-8662

Specification for

QSFP+ 28 Gb/s 4X Connector (Style A)

Rev 2.7 July 24, 2014

Secretariat: SFF Committee

Abstract: This specification defines the physical interface and general performance requirements of the QSFP+ 0.8mm Connector that is designed for use in high speed serial interconnect applications. One such use is as the 28 Gb/s QSFP+ host receptacle and mating cable Plug as well as the mating interface in the 28 Gb/s Pluggable QSFP+ modules.

This specification provides a common reference for systems manufacturers, system integrators, and suppliers. This is an internal working specification of the SFF Committee, an industry ad hoc group.

This specification is made available for public review, and written comments are solicited from readers. Comments received by the members will be considered for inclusion in future revisions of this document.

The description of a connector in this specification does not assure that the specific component is actually available from connector suppliers. If such a connector is supplied it must comply with this specification to achieve interoperability between suppliers.

Support: This specification is supported by the identified member companies of the SFF Committee.

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EXPRESSION OF SUPPORT BY MANUFACTURERS

The following member companies of the SFF Committee voted in favor of this industry specification.

All Best
Amphenol
Broadcom
Cinch
ETRI
FCI
Finisar
Foxconn
Hewlett Packard
HGST
JDS Uniphase
Lotes Tech
LSI
Molex
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Shenzhen
Sumitomo
Sun Microsystems
TE Connectivity
Volex

The following member companies of the SFF Committee voted against this industry specification.

Avago

The following member companies of the SFF Committee voted to abstain on this industry specification.

Applied Micro
Dell Computer
EMC
Emulex
Intel
Luxshare-ICT
Sandisk
Seagate
Siemon
Toshiba
Xyratex
Yamaichi

The user's attention is called to the possibility that implementation to this Specification may require use of an invention covered by patent rights. By distribution of this Specification, no position is taken with respect to the validity of this claim or of any patent rights in connection therewith. Members of the SFF Committee, which advise that a patent exists, are required to provide a statement of willingness to grant a license under these rights on reasonable and non-discriminatory terms and conditions to applicants desiring to obtain such a license.

Change History

November 5, 2010:
  Section 3: 15 ps was 100 ps
  Section 5: Datum table added
  Section 6:
    Datums shown in figures changed to agree with SFF-8436
    Table 6-1: A09 & A11 descriptions reversed
    Table 6-2: B23 & B24 descriptions reversed, B21 spelling corrected
  Table 7-2: Vdc was vDC, 9.6 ps was 50 ps, 2 ps was 5 ps, additional test parameters added

November 30, 2010:
  Section 3: 25 Gigabits/second was gigabit, minimization was Minimization
  Table 6-1: A12: ±0.05 was ±0.03

December 15, 2010:
  Table 6-1: 16.42±0.08, 0.54±0.04 option added
  Table 6-2: contact zone definition added
  Table 7-3: 30 N was 20 N

December 22, 2010:
  Table 6-1: Datum H was Datum C
  Figure 6-1: Detail view added, pad lengths reflect pin assignment

April 6, 2011:
  Change History: Vdc was vDC, vDC was Vdc, 50 was 15
  Title & Footer: 32 Gbps was 25 Gb/s
  Abstract: 32 Gb/s was 25G
  Table of Contents: updated, bold removed from table area
  Table 6.2.1:
    B13 6.23 Max was 6.1010.13
    B18 12.82 Max was 12.6910.13
  Section 1: 32 Gb/s was 25G
  Section 2: 2.2 was 2.1, 2.3 was 2.2
  Section 3:
    32 Gb/s was 25G
    9.6(20-80) ps was 15 ps
  Section 4: "circuit board." was "circuit. board"
  Section 6:
    A10 - 0.90 was 0.40, A11 - 0.40 was 0.90
    B01 - 14.80 was 14.40, C11 - Pad was Pac
  Section 7:
    Table 7-2 was 7-3, Table 7-3 was 7-5, Table 7-4 was 7-6
    16 GHz was 25 GHz
    Table 7 For Reference Only added
    Table 7 "Includes host board interface, connector and edge card interface" was changed to "Includes connector cable to connector interface and board termination pads and vias."

May 5, 2011
  Title changed to 32 Gb/s

June 16, 2011
  Editorial pass to improve appearance
  Sections restructured to match 8661/8663
  'G' changed to Gb/s

June 29, 2011
Added explanation to Table 7-2 about testing to 28 GHz as per OIF

November 29, 2011
Corrected rating on power pins in Table 7-2.

January 31, 2012
All references to 32 Gb/s were replaced by 28 Gb/s
Added Section 1.2 as explanation of titling
Revised Table 7-2 Electrical Test Parameters

Rev 2.1 May 21, 2012
Removed note about 'fastest' rate in 1.2
Expanded list of Industry Documents

Rev 2.2 July 27, 2013
Harmonized values of B20/B21 and C02/C03 with SFF-8663

Rev 2.3 August 1 , 2013
Corrected A10 and A11 descriptions in Table 6-1, and added mating sequence

Rev 2.4 October 16, 2013
Updated Figure 6-1 with Datum H
Clarified note below Fig-1 title
Clarified PCB width to contact width descriptions in Table 6-1
Harmonized figures with SFF-8682

Rev 2.6 March 27, 2014
Updated Table 5-1 with correct dimensions for A01
Adopted common name of Pad Contact Width

Rev 2.7 July 24, 2014
Corrected introduced error in Tolerance of A01*2

Foreword

The development work on this specification was done by the SFF Committee, an industry group. The membership of the committee since its formation in August 1990 has included a mix of companies which are leaders across the industry.

When 2 1/2" diameter disk drives were introduced, there was no commonality on external dimensions e.g. physical size, mounting locations, connector type, and connector location, between vendors.

The first use of these disk drives was in specific applications such as laptop portable computers and system integrators worked individually with vendors to develop the packaging. The result was wide diversity, and incompatibility.

The problems faced by integrators, device suppliers, and component suppliers led to the formation of the SFF Committee as an industry ad hoc group to address the marketing and engineering considerations of the emerging new technology.

During the development of the form factor definitions, other activities were suggested because participants in the SFF Committee faced more problems than the physical form factors of disk drives. In November 1992, the charter was expanded to address any issues of general interest and concern to the storage industry. The SFF Committee became a forum for resolving industry issues that are either not addressed by the standards process or need an immediate solution.

Those companies which have agreed to support a specification are identified in the first pages of each SFF Specification. Industry consensus is not an essential requirement to publish an SFF Specification because it is recognized that in an emerging product area, there is room for more than one approach. By making the documentation on competing proposals available, an integrator can examine the alternatives available and select the product that is felt to be most suitable.

SFF Committee meetings are held during T10 weeks (see www.t10.org), and Specific Subject Working Groups are held at the convenience of the participants. Material presented at SFF Committee meetings becomes public domain, and there are no restrictions on the open mailing of material presented at committee meetings.

Most of the specifications developed by the SFF Committee have either been incorporated into standards or adopted as standards by EIA (Electronic Industries Association), ANSI (American National Standards Institute) and IEC (International Electrotechnical Commission).

If you are interested in participating or wish to follow the activities of the SFF Committee, the signup for membership and/or documentation can be found at:
www.sffcommittee.com/ie/join.html

The complete list of SFF Specifications which have been completed or are currently being worked on by the SFF Committee can be found at:
ftp://ftp.seagate.com/sff/SFF-8000.TXT

If you wish to know more about the SFF Committee, the principles which guide the activities can be found at:
ftp://ftp.seagate.com/sff/SFF-8032.TXT

Suggestions for improvement of this specification will be welcome. They should be sent to the SFF Committee, 14426 Black Walnut Ct, Saratoga, CA 95070.

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SFF Committee --

QSFP+ 28 Gb/s 4X Connector (Style A)

1 Scope

This specification was developed in conjunction with the InfiniBand Trade Association. It defines the terminology and physical requirements for the mating interface and physical embodiment of the 28 Gb/s 0.8mm Connector. See SFF-8663 for the mechanical design of the 28 Gb/s Cage/Shield which enables a shielded interface and SFF-8661 for the physical embodiment of the mating Module/plug.

InfiniBand, Ethernet, Fibre Channel, SAS, and other standards define requirements on the characteristic impedance and ability to transmit multi-gigabit signals for cable assemblies and backplanes. When this connector is used in such an application, it is subject to the requirements of the appropriate standard.

1.1 Application Specific Criteria

This connector is capable of meeting the interface requirements for the operation of:

- Ethernet IEEE 802.3bj 100GbE
- InfiniBand IBTA EDR
- T11 FC-PI-6 (Fibre Channel Physical Interface)

2 References

The SFF Committee activities support the requirements of the storage industry, and it is involved with several standards.

2.1 Industry Documents

The following interface standards and specifications are relevant to this Specification.

- Ethernet IEEE 802.3ba 40GbE
- Ethernet IEEE 802.3bj 100GbE
- Infiniband IBTA QDR/FDR/EDR
- T10 SAS 2-1 (Serial Attached SCSI)
- T10 SAS-3
- T11 FC-PI-5 (Fibre Channel Physical Interface)
- T11 FC-PI-6
- SFF-8410 High Speed Serial Testing for Copper Links
- SFF-8661 QSFP+ 28 Gb/s 4X Pluggable Module (Style A)
- SFF-8663 QSFP+ 28 Gb/s Cage (Style A)
- SFF-8665 QSFP+ 28 Gb/s 4X Pluggable Transceiver Solution (QSFP28)

2.2 SFF Specifications

There are several projects active within the SFF Committee. The complete list of specifications which have been completed or are still being worked on are listed in the specification at ftp://ftp.seagate.com/sff/SFF-8000.TXT

2.3 Sources

Those who join the SFF Committee as an Observer or Member receive electronic copies of the minutes and SFF specifications (http://www.sffcommittee.com/ie/join.html).

Copies of ANSI standards may be purchased from the InterNational Committee for Information Technology Standards (http://tinyurl.com/c4psg).

2.4 Conventions

The ISO convention of numbering is used i.e., the thousands and higher multiples are separated by a space and a period is used as the decimal point. This is equivalent to the English/American convention of a comma and a period.

American	French	ISO
0.6	0,6	0.6
1,000	1 000	1 000
1,323,462.9	1 323 462,9	1 323 462.9

2.5 Definitions

For the purpose of this specification, the following definitions apply:

Advanced grounding contacts: Connector contacts that make first and break last and are capable of carrying power ground return currents and performing electrostatic discharge. Other terms sometimes used to describe these features are: grounding pins, ESD contacts, grounding contacts, static drain, and pre-grounding contacts.

Alignment guides: Connector features that preposition insulators prior to electrical contact. Other terms sometimes used to describe these features are: guide pins, guide posts, blind mating features, mating features, alignment features, and mating guides.

Board Termination Technologies: Surface mount single row, surface mount dual row, through hole, hybrid, and straddle mount.

Cable Termination: The attachment of wires to the termination side of a connector. Schemes commonly used in the industry are IDC (Insulation Displacement Contact), IDT (Insulation Displacement Termination), wire slots, solder, weld, crimp, braise, etc.

Contact mating sequence: Order of electrical contact during mating/unmating process. Other terms sometimes used to describe this feature are: contact sequencing, contact positioning, make first/break last, EMLB (early make late break) staggered contacts, and long pin / short pin.

Fixed: Used to describe the gender of the mating side of the connector that accepts its mate upon mating. This gender is frequently, but not always, associated with the common terminology "receptacle". Other terms commonly used are "female" and "socket connector". The term "fixed" is adopted from EIA standard terminology as the gender that most commonly exists on the fixed end of a connection, for example, on the board or bulkhead side. In this specification "fixed" is specifically used to describe the mating side gender illustrated in Figure 2-1.

Fixed Board: A connector that uses a fixed gender mating side and a termination side suitable for any of the printed circuit board termination technologies.

Free: Used to describe the gender of the mating side of the connector that penetrates its mate upon mating. This gender is frequently, but not always, associated with the common terminology "plug". Other terms commonly used are "male" and "pin connector". The term "free" is adopted from EIA standard terminology as the gender that most commonly exists on the free end of a connection, for example, on the cable side. In this specification "free" is specifically used to describe the mating side gender illustrated in Figure 2-1.

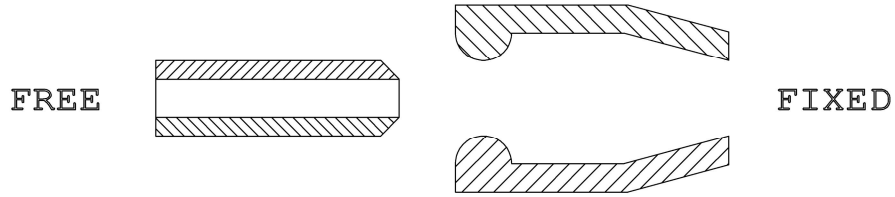
Free Board: A connector that uses a free gender mating side and a termination side suitable for any of the printed circuit board termination technologies.

Frontshell: That metallic part of a connector body that directly contacts the backshell

or other shielding material that provides mechanical and shielding continuity between the connector and the cable. Other terms sometimes used to describe this part of a cable assembly are: housing, nosepiece, cowling, and metal shroud.

Height: Distance from board surface to farthest overall connector feature.

Mating side: The side of the connector that joins and separates from the mating side of a connector of opposite gender. Other terms commonly used in the industry are mating interface, separable interface and mating face.



Note: The fixed gender is used on the device side except in the case of wire termination.
FIGURE 2-1 MATING SIDE GENDER DEFINITION

Offset: An alignment shift from the centerline of the connector.

Optional: This term describes features that are not required by the SFF Specification. However, if any feature defined by the SFF Specification is implemented, it shall be done in the same way as defined by the Specification. Describing a feature as optional in the text is done to assist the reader. If there is a conflict between text and tables on a feature described as optional, the table shall be accepted as being correct.

QSFP: Quad Small Formfactor Pluggable.

Reference Dimension: A dimension used for information purposes only. A reference dimension is a repeat of a dimension or is derived from other values shown on the drawing or on related drawings. It is considered auxiliary information and does not govern production or inspection operations.

Reserved: Where this term is used for defining the signal on a connector pin its actual function is set aside for future standardization. It is not available for vendor specific use. Where this term is used for bits, bytes, fields and code values; the bits, bytes, fields and code values are set aside for future standardization. The default value shall be zero. The originator is required to define a Reserved field or bit as zero, but the receiver should not check Reserved fields or bits for zero.

Right Angle: A connector design for use with printed circuit board assembly technology where the mating direction is parallel to the plane of the printed circuit board.

Single row: A connector design for use with surface mount printed circuit board assembly technology where the termination side points are arranged in one line.

Single sided termination: A cable termination assembly style and a connector design style where only one side of the connector is accessible when attaching wires. This style frequently has IDC termination points that point in the same direction.

SMT: Surface Mount Technology

Straddle mount: A connector design style and a printed circuit board design style that uses surface mount termination points on both sides of the board. The connector is

frequently centered between the top and bottom surfaces of the board.

Straight: A connector design for use with printed circuit board assembly technology where the mating direction is perpendicular to the plane of the printed circuit board.

Surface mount: A connector design and a printed circuit board design style where the connector termination points do not penetrate the printed circuit board and are subsequently soldered to the printed circuit board.

Termination side: The side of the connector opposite the mating side that is used for permanently attaching conductors to the connector. Due to pin numbering differences between mating side genders the termination side shall always be specified in conjunction with a mating side of a specific gender. Other terms commonly used in the industry are: back end, non-mating side, footprint, pc board side, and post side.

Through hole: A connector design and a printed circuit board design style where the connector termination points penetrates the printed circuit board and are subsequently soldered to the printed circuit board.

3 General Description

The 28 Gb/s 0.8 mm connection system is based on industry-proven card edge style contacts, which mate with a single wipe, and are physically robust.

The mating interfaces of paddle card to receptacle body and receptacle body to circuit board are enabled with SFF-8663 Cage.

The cage/shield is mounted separately to the host board so that the stress imposed by insertion and removal of the cable plug does not affect the signal/body solder joints.

This connector system was designed to satisfy the needs for 28 Gigabits/second serial data transmission applications where signals have rise times typically in the range of 9.6(20-80) ps over a nominal 100 ohm differential balanced copper link. Design goals were minimization of crosstalk and minimum transmission line impedance discontinuity across the connector interface at speeds of up to 28 Gigabits/second on both rows of contacts.

The transmission line impedance of the connector itself (not including the termination interface to the wire or board) matches the electrical bulk cable within the tolerances allowed for the bulk cable. This connection scheme may be used in multiple places within a cabling environment. Though it has been designed for a 100 ohm environment this connector will function acceptably at other impedance levels (to be optimized on a case by case basis).

This specification includes the Minimum lengths, widths and positional tolerances of the contacts.

The connector is of a straightforward construction that does not rely on advanced materials or processes while offering superior performance.

4 Datums

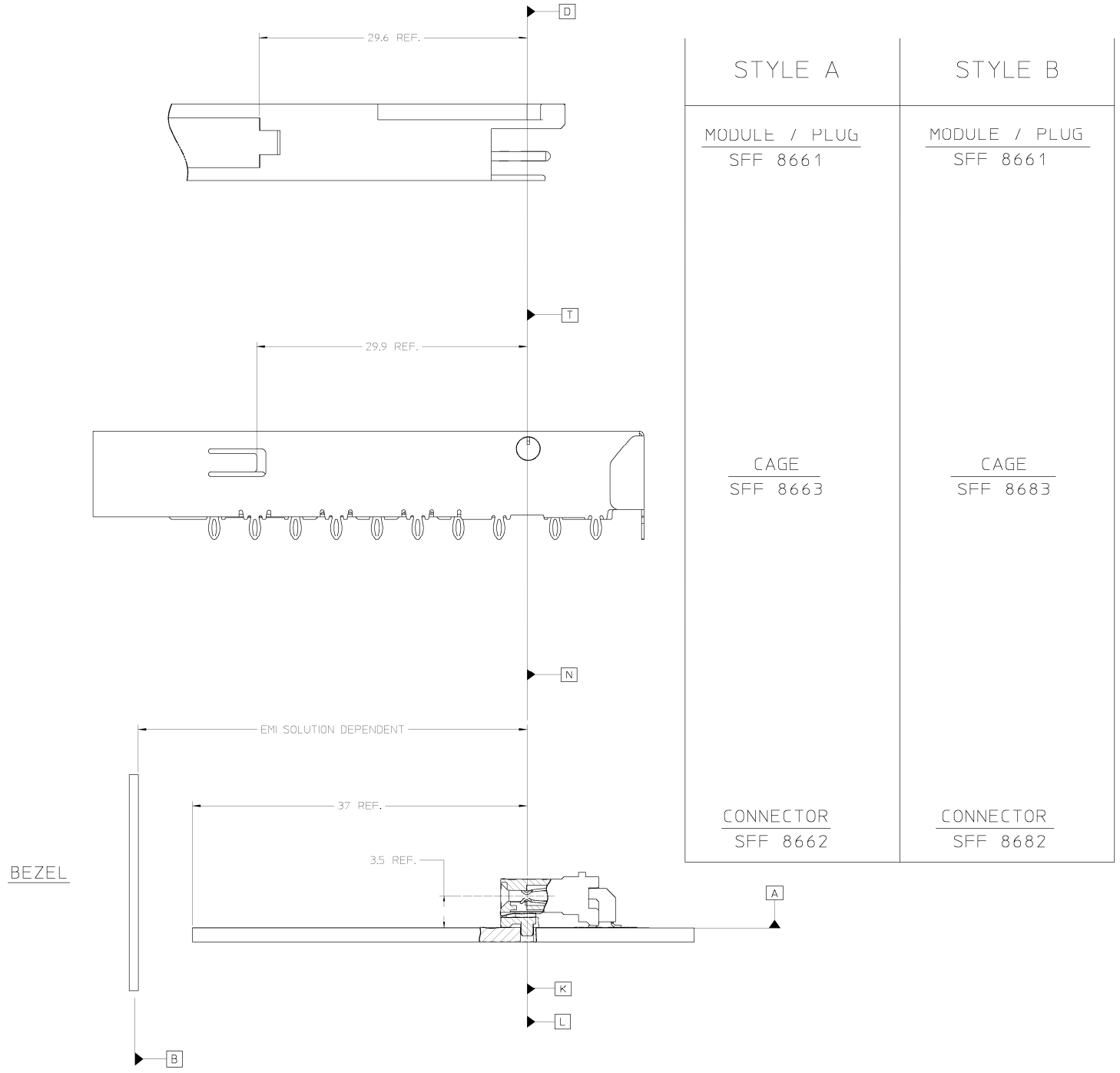


FIGURE 4-1 DATUM DEFINITIONS

TABLE 4-1 DATUM DEFINITIONS

Datum	Description
A	Host Board Top Surface
C	Distance between Connector Housing Pegs on host board
G	Width of Module pc board
H	Leading edge of signal contact pads on Module pc board
J	Top surface of Module pc board
K	Host board thru hole #1 to accept connector guide post
L	Host board thru hole #2 to accept connector guide post
N	Connector alignment pin
AA	Connector slot width
BB	Seating plane of cage on host board

5 Connector Description

The 28 Gb/s 0.8mm connector relies on a receiving body and paddle card, which are the primary elements to construct connectors.

The primary elements provide a flexible means to implement solutions for diverse applications e.g., direct board-to-board implementations can incorporate the plug into the side of one board and mate directly to a receiving body on the other.

Figure 5-1 is an example, which illustrates a receiving body and how it becomes a receptacle to receive the plug.

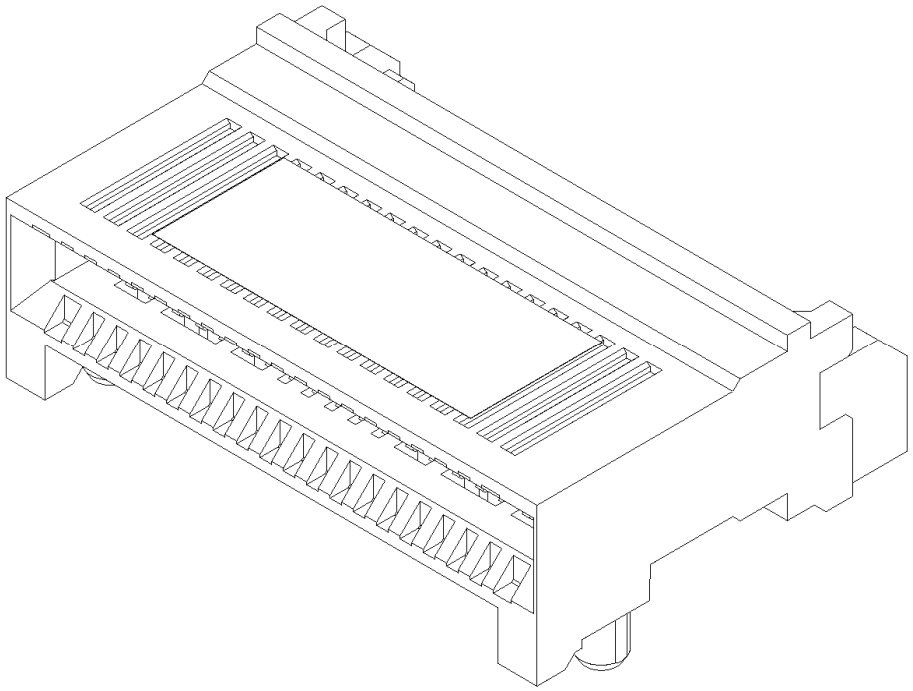


FIGURE 5-1 GENERAL VIEW OF FIXED (RECEPTACLE)

The entire interface is defined and controlled by SFF-8661, SFF-8662, and SFF-8663.

SFF-8661 defines the free (plug) cable plug/pluggable module that incorporates the paddle card and the shell, which are used to form a complete assembly for use in shielded applications.

SFF-8663 defines the shell/cage which provides guidance and retention for the free (plug) cable connector, and absorbs the stress imposed by insertion and removal of the free (plug) cable connector or pluggable module. This protects the signal quality of the solder joints to the body.

6 Connector Dimensions

The dimensioning conventions are described in ANSI-Y14.5M, Dimensioning and Tolerancing. All dimensions are in millimeters.

Dimension related requirements for the connector system addressed in this specification are specified in the tables and figures in this clause.

6.1 Free (Plug) Paddle Card

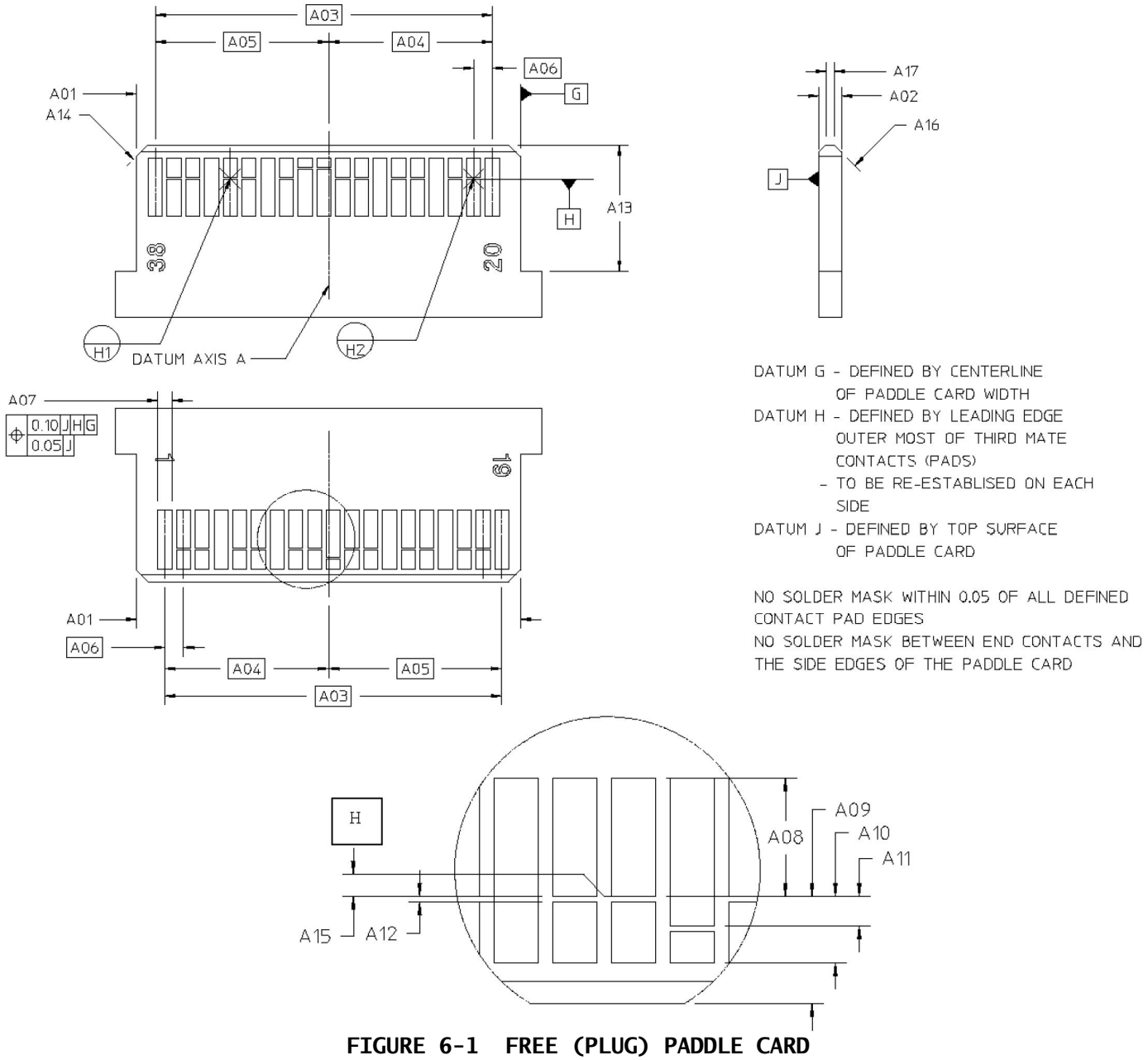


FIGURE 6-1 FREE (PLUG) PADDLE CARD

TABLE 6-1 FREE (PLUG) PADDLE CARD

Designator	Description	Dimension	Tolerance (±)
A01 (*1)	Paddle Card Width (Pad Contact Width 0.54)	16.42	0.08
A01 (*2)	Paddle Card Width (Pad Contact Width 0.60)	16.40	0.10
A02	Paddle Card Thickness (across pads)	1.00	0.10
A03	First to Last Pad Centers	14.40	Basic
A04	Card Center to Outer Pad Center	7.00	Basic
A05	Card Center to Outer Pad Center	7.40	Basic
A06	Pad Center to Center (Pitch)	0.80	Basic
A07 (*1)	Pad Contact Width (Paddle Card Width 16.42)	0.54	0.04
A07 (*2)	Pad Contact Width (Paddle Card Width 16.40)	0.60	0.03
A08	Pad Length - Third Mate	1.60	Min.
A09	Third Mate to Card Edge (see note re Datum H)	1.45	0.10
A10	Third Mate to First Mate	0.90	0.05
A11	Third Mate to Second Mate	0.40	0.05
A12	Pad to Pre-Pad	0.10	0.05
A13	Component Keep Out Area	5.40	Min.
A14	Lead-in Chamfer x 45 degrees	0.50	0.05
A15	Third Mate Pad to Datum H	0.00	0.03
A16	Lead-in Chamfer x 45 degrees	0.30	0.05
A17	Lead-in Flat	0.40	Ref
Mating sequence: First Mate - Ground Contacts Second Mate - Power Contacts Third Mate - Signal Contacts			
(*) Dimensions of the Pad Contact Width and the Paddle Card Width are such that the centerline of the terminal does not go off the edge of the Pad. An implementer may use either 16.42/0.54 or 16.40/0.60 for the A01/A07 dimensions.			

6.2 Fixed (Receptacle) Right Angle Connector

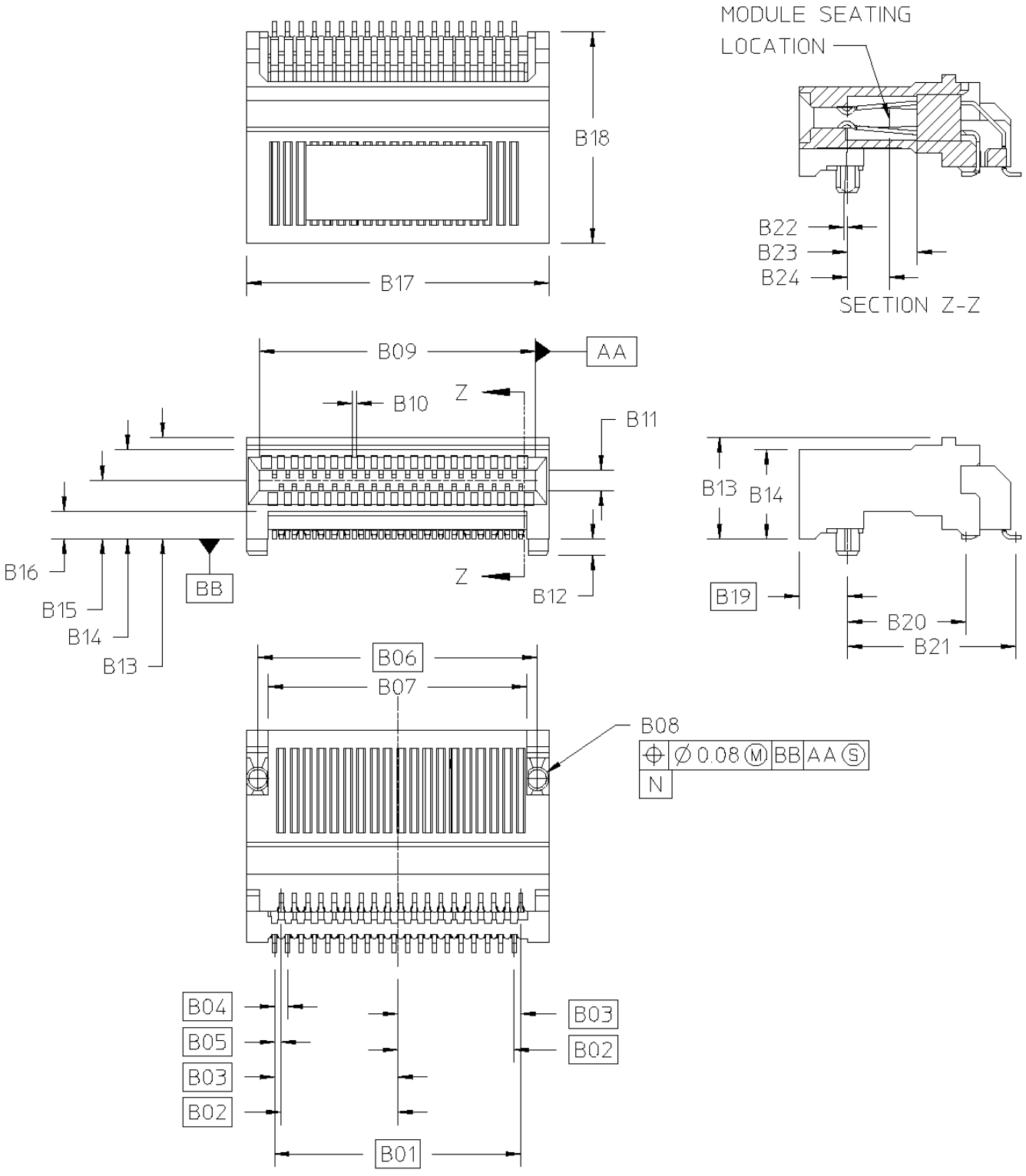


FIGURE 6-2 FIXED (RECEPTACLE) RIGHT ANGLE CONNECTOR

TABLE 6-2 FIXED (RECEPTACLE) RIGHT ANGLE CONNECTOR

Designator	Description	Dimension	Tolerance (±)
B01	First to Last Contact	14.80	Basic
B02	Centerline to First Contact	7.00	Basic
B03	Centerline to Last Contact	7.40	Basic
B04	Contact Pitch (within Row)	0.80	Basic
B05	Contact Pitch (Row to Row)	0.40	Basic
B06	Peg to Peg	16.8	Basic
B07	Leg to Leg	15.53	0.13
B08	Peg Diameter	1.40	0.05
B09	Card Slot Width	16.60	0.10
B10 (*)	Contact Zone (0.18 wide terminal)	0.30	Max
	Contact Zone (0.20 wide terminal)	0.32	Max
	Contact Zone (0.22 wide terminal)	0.34	Max
	Contact Zone (0.25 wide terminal)	0.37	Max
B11	Card Slot Height	1.14	Min
B12	Peg Length	0.95	0.13
B13	Overall Height	6.23	Max
B14	Mating Zone Height	5.35	0.13
B15	PCB to Card Slot Centerline	3.50	0.10
B16	Height Under Receptacle	1.65	0.08
B17	Receptacle Width	18.20	0.10
B18	Receptacle Length	12.82	Max
B19	Front Face to Peg	2.90	Basic
B20	Peg to Row A	7.37	0.10
B21	Peg to Row B	9.88	0.10
B22	Peg to Contact Centerline	0.00	0.10
B23	Card Slot Depth	3.25	Min
B24	Paddle Card Seating Location	2.50	Ref
(*) Note: Contact Zone is defined as a zone with its centerline located at the theoretical contact centerline and the contact must always be completely located within it			

6.3 Fixed (Receptacle) Right Angle Connector Footprint

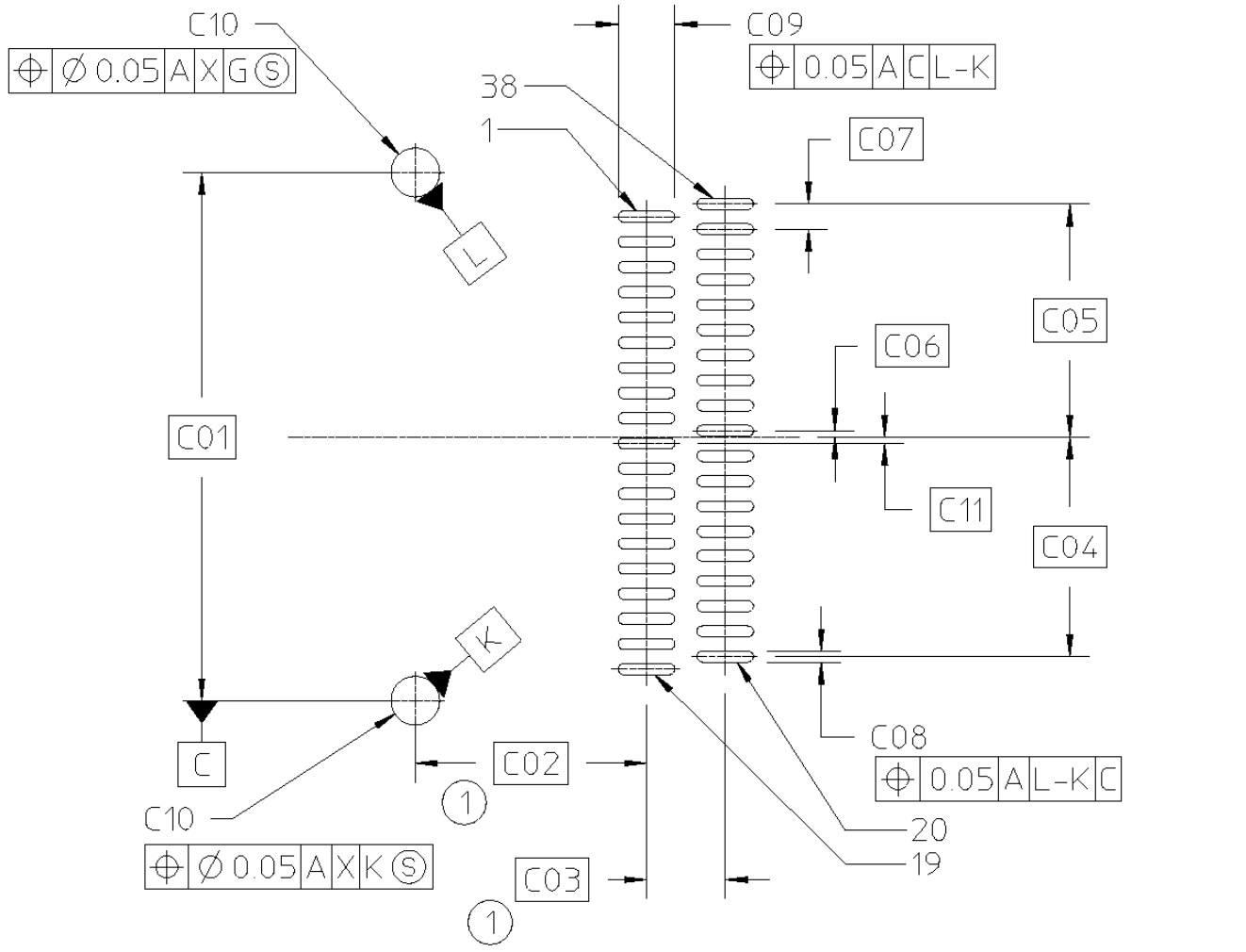


FIGURE 6-3 FIXED (RECEPTACLE) RIGHT ANGLE CONNECTOR FOOTPRINT

TABLE 6-3 FIXED (RECEPTACLE) RIGHT ANGLE CONNECTOR FOOTPRINT

Designator	Description	Dimension	Tolerance (±)
C01	Locating Hole to Hole	16.80	Basic
C02	Locating Hole to Row A	7.37	Basic
C03	Row A to Row B	2.51	Basic
C04	Card Center to Outer Pad Center	7.00	Basic
C05	Card Center to Outer Pad Center	7.40	Basic
C06	Card Center to Inner Pad Center	0.20	Basic
C07	Pad Pitch	0.80	Basic
C08	Pad Width	0.35	0.03
C09	Pad Length	1.80	0.03
C10	Locating Hole Diameter	1.55	0.05
C11	Card Center to Pad Center	0.20	Basic

7 Connector Performance Requirements

The connector conforms to the test sequence as defined in EIA-364 TS-1000. The following tables define the performance criteria and test procedures for those test sequences.

TABLE 7-1 TS-1000 TEST PARAMETERS

Test Parameter	Criteria
Rated Durability Cycles	250
Field Life (3, 5, 7, or 10 years)	10 year
Field Temperature (57, 60, 65, 75, or 85C)	65˚C
Test Group 4 Option	Not Applicable
Plating Type (Precious / non-Precious)	Precious
Surface Treatment (Lubricated or non-Lubricated)	Manufacturer to specify

TABLE 7-2 ELECTRICAL TEST PARAMETERS

Parameter	Test Condition	Specification
Current		0.5 A per contact *1
Voltage		30V DC per contact
Low Level Contact Resistance	EIA 364-23 20 mVdc, 10 mA	Baseline
Insulation Resistance	100V DC	1000M ohms minimum Between adjacent contacts
Dielectric Withstanding Voltage	300V DC minimum for 1 minute	No defect or breakdown between adjacent contacts
*1 Rating on designated power pins is 1.0 A per contact (Vcc T, Vcc R, and Vcc 1) Note: Testing is as per recommendations of OIF (Optical Internet Forum)		

TABLE 7-3 MECHANICAL PERFORMANCE REQUIREMENTS

Parameter	Test Condition	Specification
Mating Force	EIA 364-13	60 N maximum
Unmating Force	EIA 364-13	30 N maximum
Contact Normal Force		0.5 N minimum
Vibration	EIA 364-28	No Damage No discontinuity longer than 1µsec allowed. 20 mOhms maximum change from initial (baseline) contact resistance
Mechanical Shock	EIA 364-27	No Damage 20 mOhms maximum change from initial (baseline) contact resistance

TABLE 7-4 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

Parameter	Test Condition	Specification
Storage Temperature		-20˚C to +85˚C
Humidity		80% Relative Humidity