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SFF-8682

Specification for

QSFP+ 4X Connector

Rev 1.1 June 8, 2018

Secretariat: SFF TA TWG

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 QSFP+ host receptacle mated to QSFP+ modules or cables.

This specification provides a common reference for systems manufacturers, system integrators, and suppliers.

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 specification.

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.

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Intellectual Property
The user's attention is called to the possibility that implementation of this Specification may require the use of an invention covered by patent rights. By distribution of this specification, no position is taken with respect to the validity of a claim or claims or of any patent rights in connection therewith. This specification is considered SNIA Architecture and is covered by the SNIA IP Policy and as a result goes through a request for disclosure when it is published. Additional information can be found at the following locations:

- Results of IP Disclosures: http://www.snia.org/sffdisclosures
- SNIA IP Policy: http://www.snia.org/ippolicy

Change History
May 30, 2012 (First draft):
- Produced from the SFF-8662 rev 2.2 with appropriate data rate changes to the text

Rev 0.4:
- Corrected speed ratings of this specification and referenced specifications.

Rev 0.5:
- Harmonized values of B20/B21 and C02/C03 with SFF-8662

Rev 0.6:
- Replaced Figure 4-1
- Added Datum H to Figure 6-1

Rev 0.7:
- Speed removed from title and text as it is referenced by multiple variants
- Corrected introduced error in Tolerance of A01*2

Rev 0.8:
- Expanded the list of references in Section 1.1 and Section 1.2
- Removed Style B from title

Rev 1.0 (March 2, 2018):
- Updated to SNIA format
- Revised abstract
- Reformatted Change History
- Fixed broken links in Foreword
- Updated Applications (Section 1.1)
- Added EIA document references
- Clarified “fixed” and “free” definitions
- All references to “pluggable modules,” “plugs,” or “modules” changed to “module”; added definition for module
- Minor editorial issues resolved
- The tolerance for lead-in chamfer (dimension A16) was changed from 0.05mm to 0.10mm. The 0.05mm tolerance was found to be too tight to be easily manufactured in large volumes. This change was made based on the results of the straw poll that closed January 12, 2018.
- Updated Section 7 (Connector Performance Requirements) to agree with other SFF documents for QSFP
- NOTE: During the review period for this revision, a comment to make the connector footprint informative was submitted. Resolution of this comment has been deferred until a future revision of this specification.

Rev 1.1 (June 8, 2018):
- Updated tolerance of dimension A14 in Table 6-1.

Foreword

The development work on this specification was done by the SNIA SFF TWG, an industry group. Since its formation as the SFF Committee in August 1990, the membership 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, connector location, between vendors. The SFF Committee provided a forum for system integrators and vendors to define the form factor of disk drives.

During their definition, other activities were suggested because participants in SFF faced more challenges than the form factors. 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.

In July 2016, the SFF Committee transitioned to SNIA (Storage Networking Industry Association), as a TA (Technology Affiliate) TWG (Technical Work Group).

Industry consensus is not a requirement to publish a 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 meets during the T10 (see www.t10.org) and T11 (see www.t11.org) weeks, and SSWGs (Specific Subject Working Groups) are held at the convenience of the participants.

Many of the specifications developed by SFF have either been incorporated into standards or adopted as standards by ANSI, EIA, JEDEC and SAE.

For those who wish to participate in the activities of the SFF TWG, the signup for membership can be found at:
http://www.snia.org/sff/join

The complete list of SFF Specifications which have been completed or are currently being worked on by the SFF Committee is contained in the document SFF-8000 which can be found at:
http://www.snia.org/sff/specifications

Suggestions for improvement of this specification will be welcome, they should be submitted to:
http://www.snia.org/feedback

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FIGURES

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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 0.8mm Connector. See SFF-8683 for the mechanical design of the Cage/Shield which enables a shielded interface and SFF-8661 for the physical embodiment of the mating module.

InfiniBand, Ethernet, 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

SAS, InfiniBand, IEEE, and Fibre Channel define respective electrical performance requirements for the transmission of multi-gigabit signals through this interface. When this connector is used for any of these applications, its performance shall meet the requirements of the appropriate standard. This connector shall intermate with previous generations of lower speed QSFP connectors.

1.2 Copyright

1.3 Disclaimer

Suggestions for revisions should be directed to http://www.snia.org/feedback/

2. References

2.1 Industry Documents

- Ethernet IEEE 802.3ba 40 GbE
- Ethernet IEEE 802.3bj 100GbE copper
- Ethernet IEEE 802.3bm 100GbE optical
- Infiniband IBTA EDR
- Infiniband IBTA FDR
- InfiniBand IBTA QDR
- T10 SAS 2.1
- T10 SAS 3
- SFF-8410 High Speed Serial Testing for Copper Links
- SFF-8661 QSFP+ 4X Module
- SFF-8683 QSFP+ Cage
- EIA-364-1000 Environmental Test Methodology for Assessing the Performance of Electrical Connectors and Sockets Used in Controlled Environment Applications
- EIA-364-09 Durability Test Procedure for Electrical Connectors and Contacts
- EIA-364-13 Mating and Unmating Forces Test Procedure for Electrical Connectors
- EIA-364-20 Withstanding Voltage Test Procedure for Electrical Connectors, Sockets and Coaxial Contacts
- EIA-364-21 Insulation Resistance Test Procedure for Electrical Connectors, Sockets, and Coaxial Connectors
- EIA-364-23 Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets
- EIA-364-27 Mechanical Shock (Specified Pulse) Test Procedure for Electrical Connectors
- EIA-364-28 Vibration Test Procedure for Electrical Connectors and Sockets
- EIA-364-70 Temperature Rise versus Current Test Procedure for Electrical Connectors and Sockets

2.2 Sources

There are several projects active within the SFF TWG. The complete list of specifications which have been completed or are still being worked on is contained in the document SFF-8000 which can be found at http://www.snia.org/sff/specifications.

Copies of ANSI standards may be purchased from the InterNational Committee for Information Technology Standards (http://www.techstreet.com/incitsgate.tmpl).

2.3 Conventions

The dimensioning conventions are described in ANSI-Y14.5M, Geometric Dimensioning and Tolerancing. All dimensions are in millimeters, which are the controlling dimensional units (if inches are supplied, they are for guidance only).

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

2.4 Definitions

For the purpose of SFF Specifications, 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, straddle mount, pressfit.

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: 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. It is typically used to describe the gender of the mating side of the connector that accepts its mate upon mating. Other common terms are “receptacle,” “female,” and “socket connector.”

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: 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. It is typically used to describe the gender of the mating side of the connector that penetrates its mate upon mating. Other common terms are "plug” or “module," "male," and "pin connector.”.

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 media. 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.

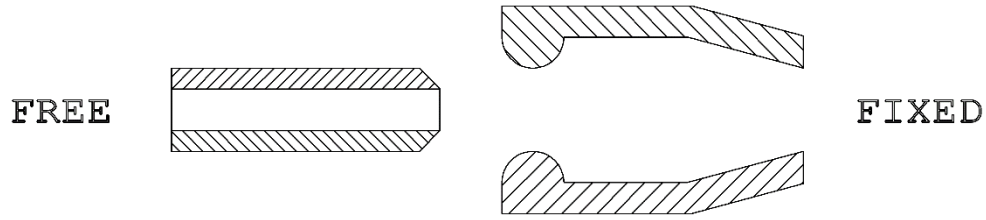

FIGURE 2-1 FIXED AND FREE DEFINITION

Module: In this specification, refers to direct attach copper (DAC), direct attach optics, and pluggable optics.

Offset: An alignment shift from the center line of the connector

Optional: This term describes features which 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

Reserved: Where this term is used for defining the signal on a connector contact 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 contact 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 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-8683 Cage.

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

This connector system was designed to satisfy the needs for high speed serial data transmission applications. Design goals were minimization of crosstalk and minimum transmission line impedance discontinuity across the connector interface 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

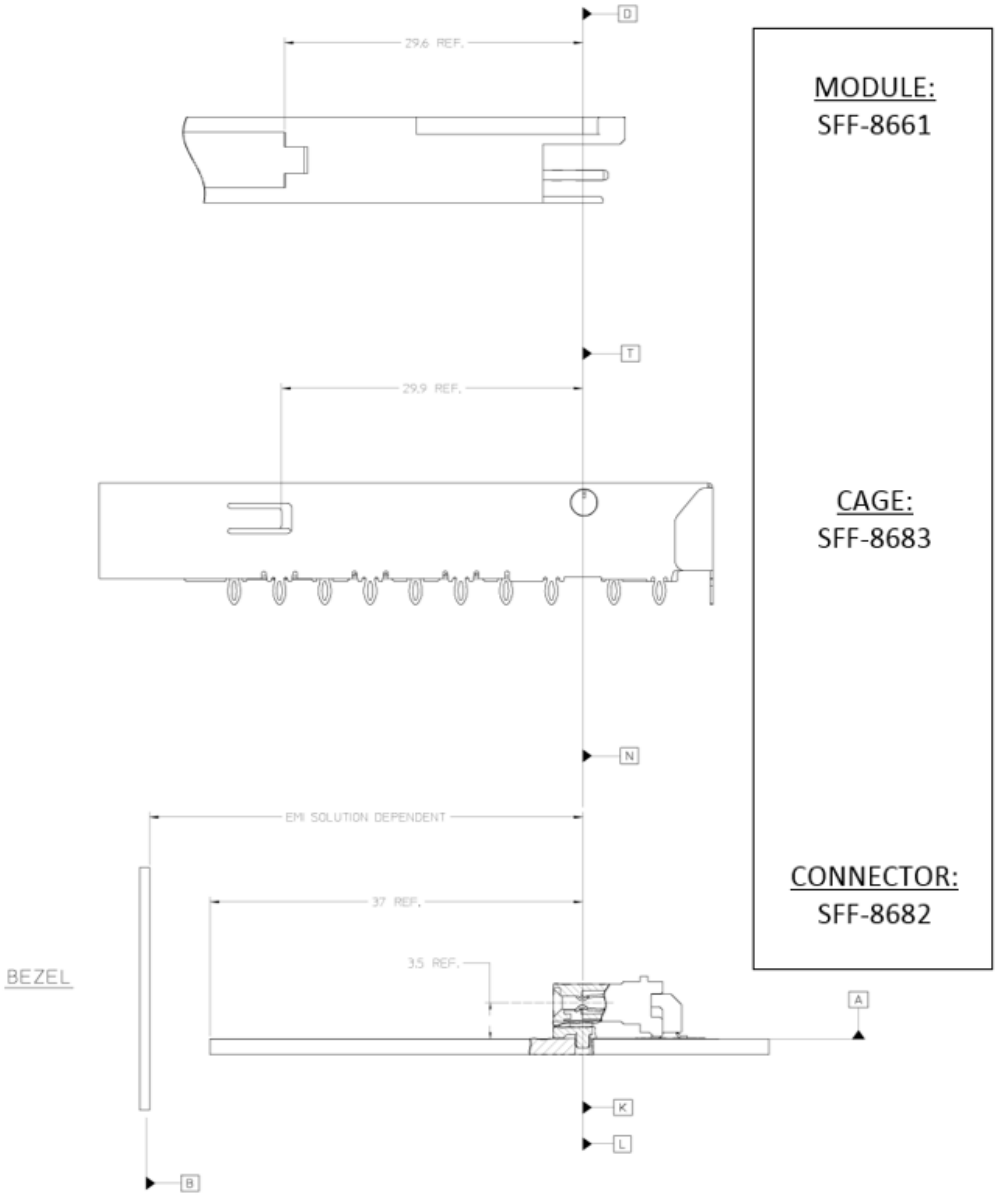

FIGURE 4-1 DATUM DEFINITIONS

TABLE 4-1 DATUM DESCRIPTIONS

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 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 module 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 module.

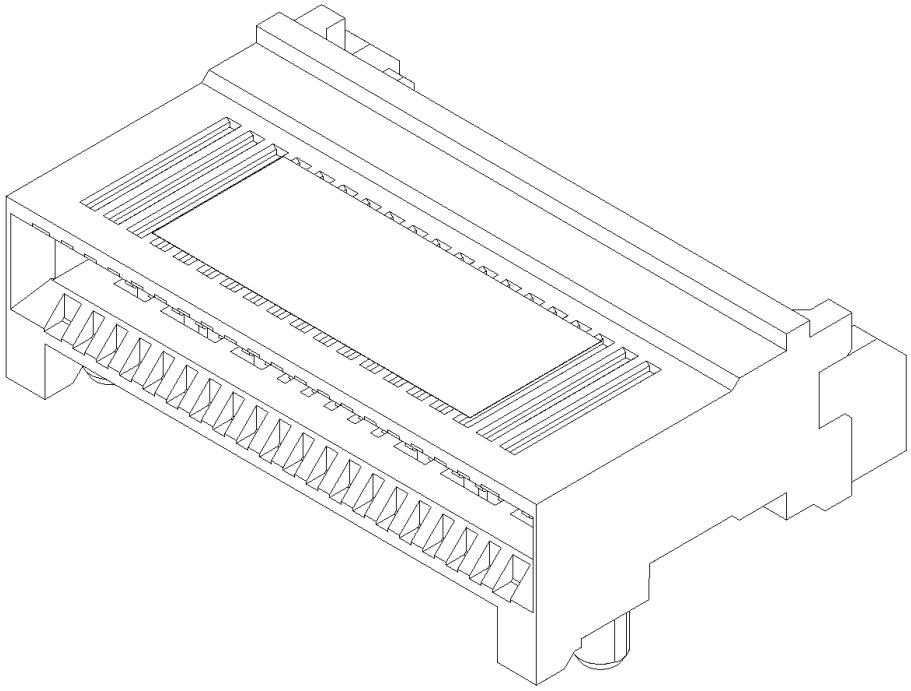

FIGURE 5-1 GENERAL VIEW OF FIXED (RECEPTACLE)

The entire interface is defined and controlled by SFF-8661, SFF-8682, and SFF-8683.

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

SFF-8683 defines the shell/cage which provides guidance and retention for the free module, and absorbs the stress imposed by insertion and removal of the 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 (Module) Paddle Card

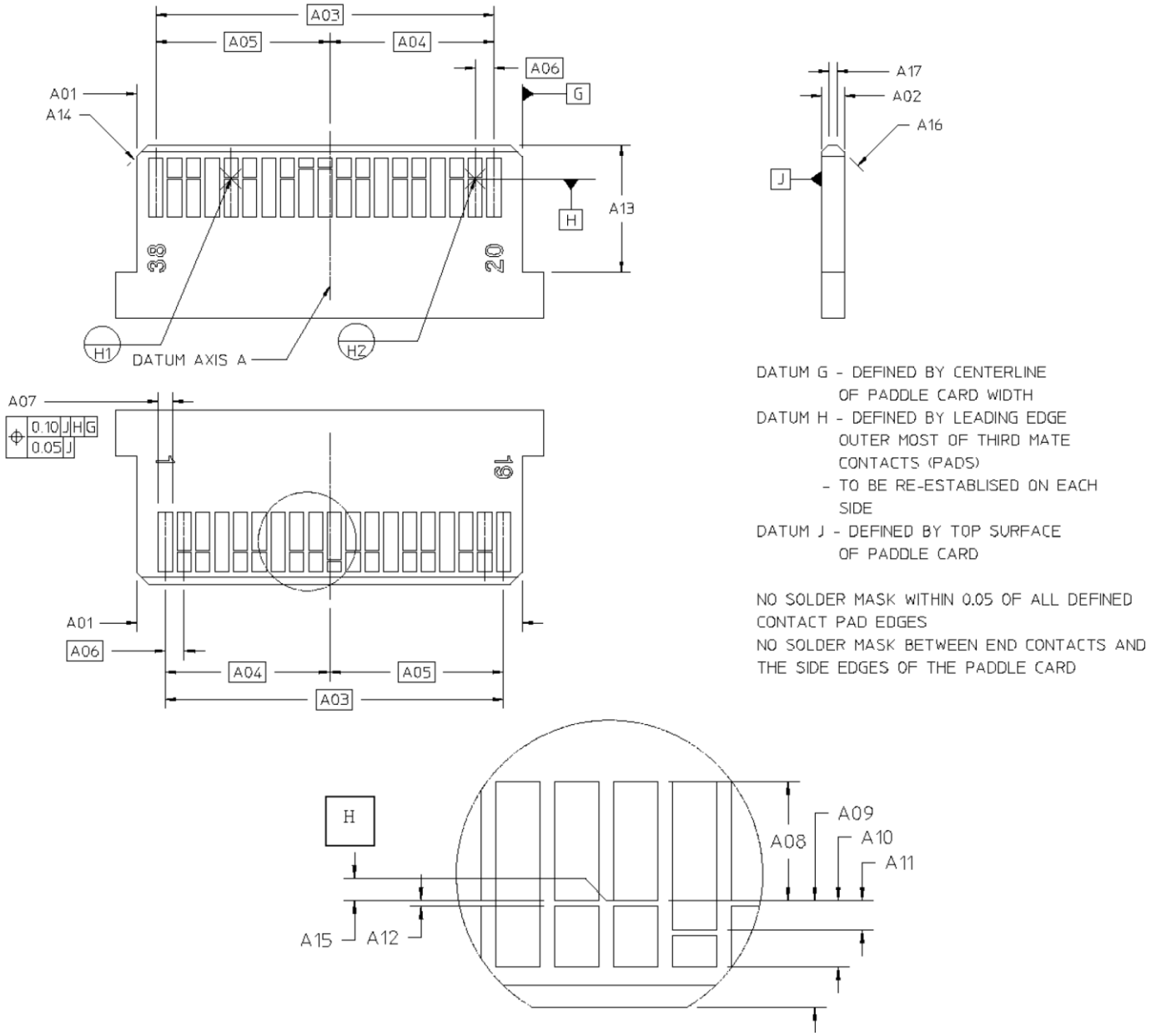

FIGURE 6-1 FREE (MODULE) PADDLE CARD

TABLE 6-1 FREE (MODULE) PADDLE CARD DIMENSIONS

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	0.10
A15	Third Mate Pad to Datum H	0.00	0.03
A16	Lead-in Chamfer x 45 degrees	0.30	0.10
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

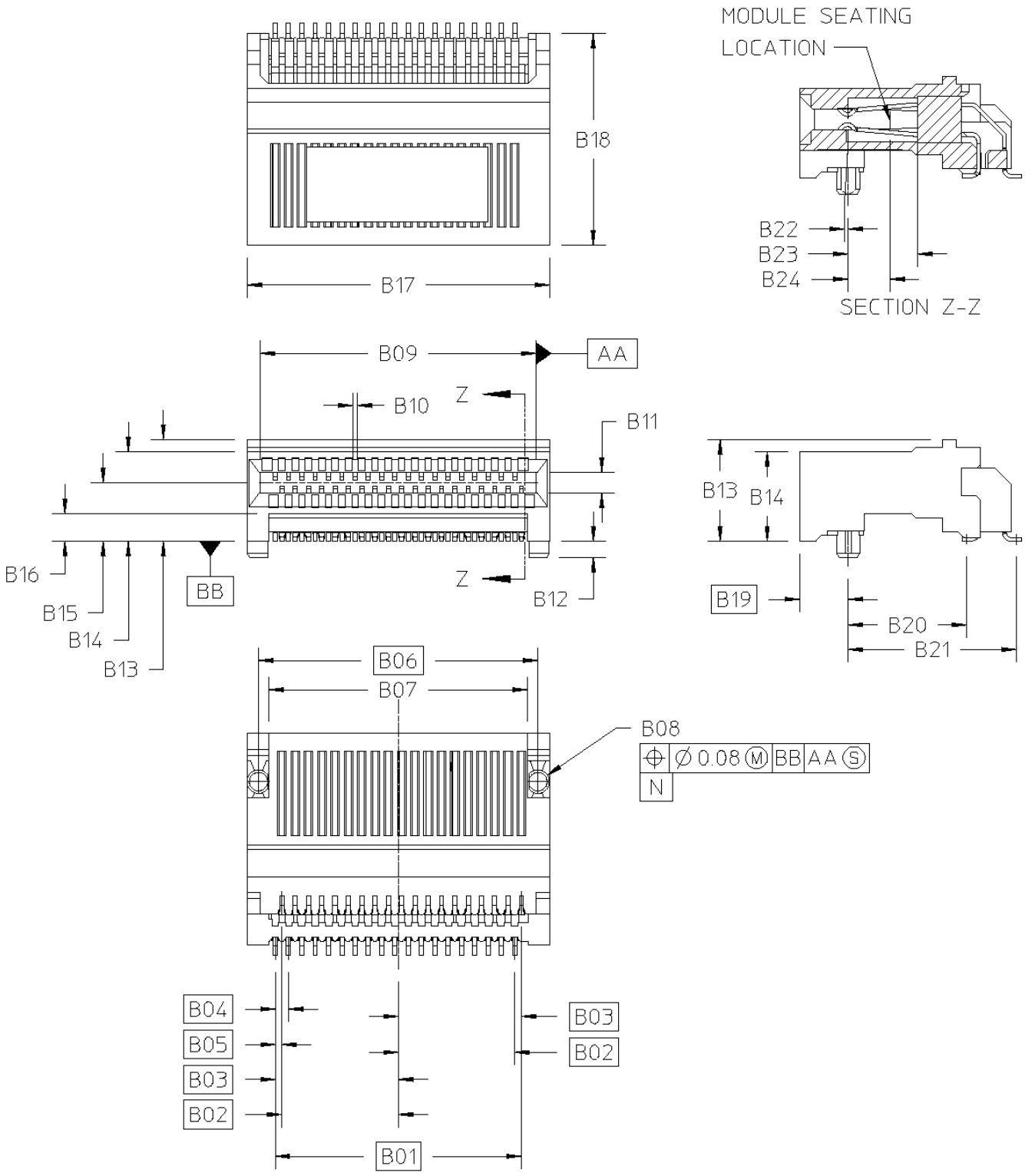

FIGURE 6-2 FIXED (RECEPTACLE) RIGHT ANGLE CONNECTOR

TABLE 6-2 FIXED (RECEPTACLE) RIGHT ANGLE CONNECTOR DIMENSIONS

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	5.18	0.10
B21	Peg to Row B	7.69	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

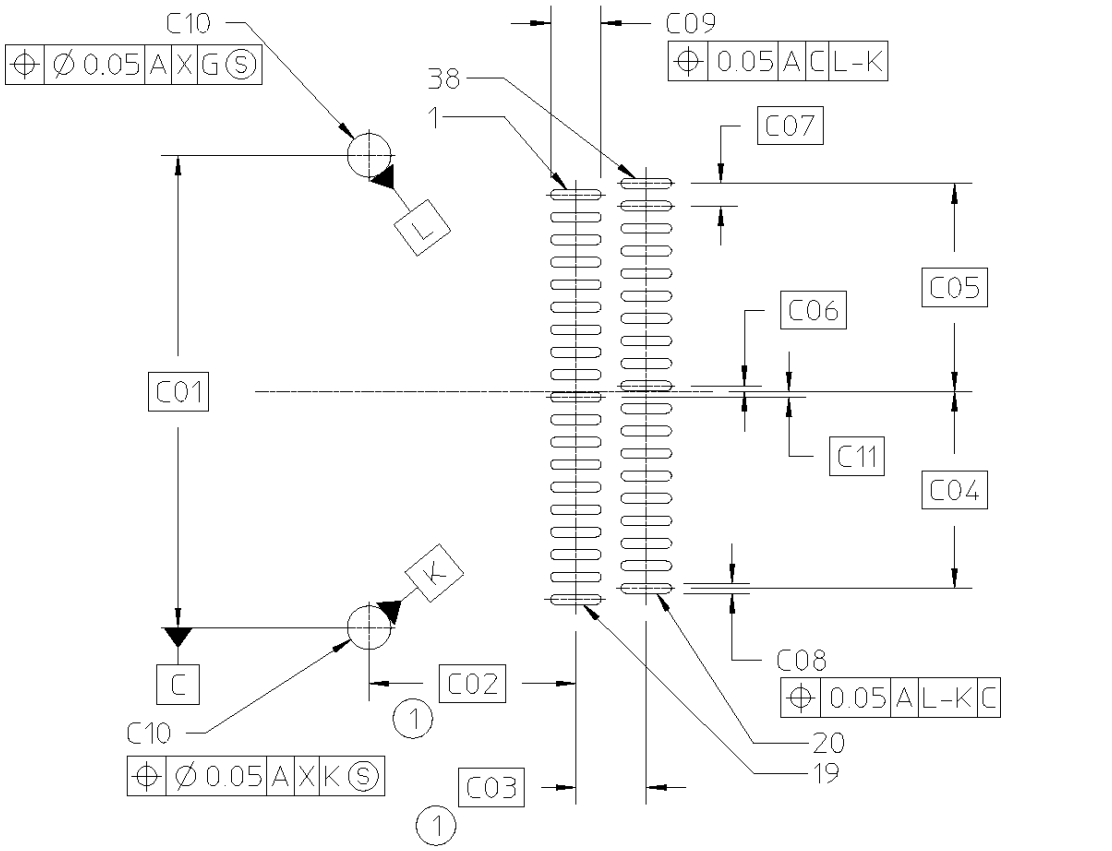

FIGURE 6-3 FIXED (RECEPTACLE) RIGHT ANGLE CONENCTOR FOOTPRINT

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

Designator	Description	Dimension	Tolerance (±)
C01	Locating Hole to Hole	16.80	Basic
C02	Locating Hole to Row A	5.18	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
Durability	Pre-condition: 25 cycles Group 7: 100 cycles
Field Life (3, 5, 7, or 10 years)	10 years
Field Temperature (57, 60, 65, 75, or 85C)	65 degrees C
Test Group 4 Option	Manufacturer to specify
Plating Type	Precious
Surface Treatment	Manufacturer to specify

TABLE 7-2 ELECTRICAL TEST PARAMETERS

Parameter	Test Condition	Specification
Current	EIA 364-70 30 degree C temperature rise	-Signal contacts: 0.5 A per contact MAX -Designated power contact: 1.0 A per contact MAX
Low Level Contact Resistance	EIA 364-23 20 mVdc, 100 mA	20 mOhms deviations from initial (baseline) contact resistance
Insulation Resistance	EIA 364-21 100 VDC between adjacent contacts	1000M ohms minimum
Dielectric Withstanding Voltage	EIA 364-20 300 VDC minimum for 1 minute between adjacent contacts	-1 mA MAX leakage -No breakdown
Vibration	EIA 364-28	-No damage -No discontinuity longer than 1 microsecond allowed -20 mOhm MAX change from initial (baseline) contact resistance
Mechanical Shock	EIA 364-27	-No damage -20 mOhm MAX change from initial (baseline) contact resistance

TABLE 7-3 MECHANICAL PERFORMANCE REQUIREMENTS

Parameter	Procedure	Requirement[1]
Mating Force	EIA 364-13 Test with connector, cage & module (latch disengaged, without heat sink)	60N MAX
Unmating Force	EIA 364-13 Test with connector, cage & module (latch disengaged, without heat sink)	30N MAX
Contact Normal Force	Manufacturer specified test to evaluate the normal force applied by a single contact	0.5N MIN
Connector/ Cage Durability	EIA 364-09 Test with connector, cage & module[2]	100 cycles MIN
Module Durability	EIA 364-09 Test with connector, cage & module	50 cycles MIN

NOTES:
1. In addition to the requirements listed, all parts must be free of visible damage after testing.
2. Modules may be replaced every 50 cycles.

TABLE 7-4 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

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