SNIA™
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Technology Affiliate

SFF-TA-1027

Specification for

QSFP2 Cage, Connector, & Module Mechanical Specification

Rev 1.0.45 ~~October~~January ~~31~~21, 2024~~5~~

SECRETARIAT: SFF ~~TA~~ TWG

This specification is made available for public review at https://www.snia.org/sff/specifications. Comments may be submitted at https://www.snia.org/feedback. Comments received will be considered for inclusion in future revisions of this specification.

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

ABSTRACT: This specification defines the mechanical requirements of the pluggable QSFP2 which includes QSFP112 and QSFP224 cages, connectors, and modules that enable QSFP operation at greater signaling rates. This specification defines both 1x1 and 2x1 stacked cage/connector configurations. All combinations of cages and connectors defined in this specification are backwards compatible to accept legacy QSFP28 and QSFP+ modules. In addition, the modules defined are compatible with QSFP, QSFP+, QSFP28, and QSFP56 hosts and are capable of performing at those signaling rates with potentially improved thermal performance.

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FOREWORD

Much of the development work on this specification was done by the QSFP-DD MSA and given to the SFF ~~TA~~ TWG, a SNIA ~~Technical Affiliate~~ Technical Working Group, for continued development. Since its formation of the SFF Committee in August 1990, as well as since SFF's transition to SNIA in 2016, the membership has included a mix of companies that are leaders across the industry. ~~In 2016, the SFF Committee became a Technical Affiliate of SNIA (Storage Networking Industry Association).~~

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

REVISION HISTORY

Rev 1.0 *May 30, 2023:*

- First Publication

Rev 1.0.1 *September 05, 2023:*

- In Section 1, updated list of 1x1 connector styles. Added 1x1 connector Style C.
- In Section 4.1, updated list of 1x1 connector styles. Added 1x1 connector Style C. In Table 4-1, updated description of Style A & Style B and added Style C.
- Added Style A & Style B to caption for Figure 4-5.
- In Section 4.2, updated list of footprint pad numbering figures.
- Inserted new Figure 4-6 for 1x1 connector Style C footprint pad numbering and renumbered subsequent Section 4 figures.
- In Section 5.1, updated list of 1x1 connector footprint styles and added a description of Type 2 versus Type 1.
- In Section 5.2.1, identified 1x1 Type 1 and added 1x1 Type 2 connectors. Added new Figure 5-4 and renumbered subsequent Section 5 figures.
- Updated the 2x1 stacked connector figure, Figure 5-4, to show tolerance for the 16.60 slot width and to clarify that the 0±0.1 dimension applies to both the upper and lower ports.
- In Section 6.2, added a description of the angled-latch design, updated Figure 6-2.
- In Section 7.2.1, updated Figure 5-10 to include angled-latch design.
- In Section 8.1, updated number of 1x1 footprint styles. In Table 8-1, added 1x1 footprint Style C. Added new Figure 8-2 for 1x1 footprint Style C and renumbered subsequent Section 8 figures. Added new Figure 8-4 for 1x1 cage and connector footprint Style C.
- Added Appendix B for recommended footprint pin assignments.

Rev 1.0.2 *April 16, 2024:*

- Updated some of the wording in the Abstract in response to Review Ballot comments for the Rev 1.0.1 DRAFT.
- Updated some of the wording in the Section 1 Scope and noted specific cage and module styles in response to Review Ballot comments for the Rev 1.0.1 DRAFT.
- Updated the QSFP-DD Hardware specification title and description.
- In Section 3.2, added SMT.
- Added new text following Figure 4-6, Figure 4-7, and Figure 4-8 to clarify footprint pad numbering.
- Updated the descriptions of Datums in Table 4-5.
- Updated wording in Section 5.1.
- Updated the card slot depth dimension in Figure 5-3 (was 3.05 MIN).
- Updated the card slot width dimension (was 16.55±0.05) and the card slot depth dimension (was 3.05 MIN) in Figure 5-4 ~~**Error! Reference source not found.**~~.
- Updated the card slot depth dimension in Figure 5-4 (was 3.05 MIN).
- Added text regarding cage optional heat sink openings in Section 6.1.
- Updated text in Section 6.2.1 to add clarification for the angled-latch design vs. the legacy

latch design.
- Fixed typo in Note 1, deleted Note 12, and updated Note 13 for Figure 5-6.
- In Figure 5-8, added missing Note 11 indicator to the 73.7 MAX dimension, fixed a typo in Note 1, deleted Note 12, and updated Notes 11 and 13.
- In Figure 5-10, changed name of Detail View F to Detail View Y and Section E-E to Section Z-Z, updated the Datum D to Datum H dimension in Detail Y, changed "PULL TAB" to "LATCH RELEASE" in Section Z-Z, added Latch Stop View for added clarity. Also correctly identified the Notes as part of Figure 5-10 instead of as a separate Figure 7-3. Updated the remaining Section 7 figure numbers accordingly.
- Updated text in Section 7.2.3 for clarification.
- Updated caption for Figure 5-12 and added a new Figure 7-5~~Error! Reference source not found.~~.
- In Section 8.1, added a note regarding the possible use of SFF-8663 cages with QSFP2 connectors to point out the differences in the pitch of the side press-fit pins. Also, added clarification for the additional number of pads in the QSFP2 1x1 footprint Style C.
- In Appendix B, changed "Pin" to "Pad" in multiple places and updated Figure B-1 to show the second column of pads (in each case) are offset and not directly in line with the pads in the first column.

Rev 1.0.3 *July 12, 2024:*
- Created a new Section 5 to focus on QSFP112 and moved all of the previous Section 5 to a new Section 5.1, moved all of the previous Section 6 to a new Section 5.2, moved all of the previous Section 7 to a new Section 5.3, and moved all of the previous Section 8 to a new Section 5.4. Inserted a new Section 6 to focus on QSFP224. The previous Section 9 was renumbered as the new Section 7.
- Updated Section 4.1 and added a new Section 4.1.1 for Enhanced Options to Use for QSFP224 vs. QSFP112 including a new Table 4-4. As a result, renumbered the old Table 4-4 to become Table 4-5.
- Added recommended riding heat sink normal force in new Section 5.2.3 and in new Section 6.2.3.
- Updated Figure 5-10 (was Figure 7-2) to add additional height dimension values for Type 2B modules. Also, as this is now for QSFP112 only, removed information about the angled-latch design from Figure 5-10.
- The QSFP2 1x1 Type 1 connector is now the QSFP112 1x1 connector. The QSFP2 1x1 Type 2 connector is now the QSFP224 1x1 connector.
- Removed all QSFP224 drawing figures from the new Section 5 and moved them to the new Section 6.
- Updated the module drawing figures to include the angled-latch design only for the QSFP224 modules.
- Updated the 1x1 cage drawing figures to include the angled-latch design only for the QSFP224 cages.

Rev 1.0.4 *October 31, 2024:*
- Updated the title to include "Mechanical Specification".
- Added the PREFACE section.
- Updated the Scope section.
- Updated the Configuration Overview/Descriptions in Section 4.1.
- Updated text in Table 4-2 to remove unnecessary text, "with Angled-Latch Design", in 2 places.
- In Section 4.1.1, updated the paragraph text, changed the title of Table 4-4, updated the column headings of Table 4-4, and updated the text within Table 4-4 for better clarification.
- Replaced Figure 4-10 to remove reference dimension for the Angle-Latch Design modules.
- Updated the title of Section 5.1.3.

- Updated the paragraph text in Section 5.2.2.1 including deleting text that is no longer needed.
- In Section 5.3.1, changed "nearly identical" to simply "identical".
- In Section 5.3.2.3, added a missing figure reference.
- Updated the text in the paragraph in Section 6.1.1.
- In Section 6.2.2.1, deleted some text at the end of the second paragraph that no longer applies.
- Added new text immediately following Figure 6-4 with clarification on a method for obtaining a realistic and consistent measurement of the functional distance from the tip of the cage latch tab (cage flap) to Datum T (the cage hard stop for the module) with the use of a recommended cage gauge plug.
- In the Performance Tables (Table 7-1 and Table 7-3), changed the Mating Force and Unmating Force requirements to apply with or without the presence of a riding heat sink and increased the Unmating Force value limit to 40N MAX.
- In Appendix A, changed "QSFP2 1x1 cage" to "QSFP2 (QSFP112 or QSFP224) 1x1 cage".
- Added a new Appendix C.

Rev 1.0.5 *January 21, 2025:*

- Corrected the document title in the page footers and updated some boiler plate text.
- Changed "Footprint Style C" to "QSFP224 1x1 footprint" throughout the document.
- Removed the first column from Table 4-2.
- Update the title of Table 4-4 and reorganized and reformatted the list of enhancements, adding further descriptions.
- In Section 5.1.1, replaced vague pronouns with "The QSFP112 1x1 connector" and "The QSFP112 2x1 connector".
- In Section 5.2.2.1, fixed some formatting and moved the old NOTE 13 to become NOTE 12 to replace a previously deleted NOTE 12 in the NOTES for Figure 5-6.
- In Section 5.2.2.2, moved old NOTE 13, 14, & 15 to replace a previously deleted NOTE 12 and become the new NOTE 12, 13, & 14 in the NOTES for Figure 5-8.
- In Section 5.2.3, inserted the word "riding" between "Cage-mounted" and "heat sink".
- In Section 5.3.1, removed the reference to SFF-8661.
- In Section 5.3.2.3, removed the reference to QSFP224 module paddle card dimensions, removed the last sentence of the paragraph, and updated Figure 5-12 to add a few NOTES to identify the mating pad types.
- In Section 5.4.1, deleted the first and third sentences in the paragraph after Table 5-3 and updated Figure 5-13 to modernize the representation of Datum L to comply with ASME Y14.5-2009.
- In Section 5.4.2, deleted the first and sentence after Table 5-4.
- In Section 6.1.1, added several clarifications in response to several comments to improve upon the previous DRAFT revision.
- In Section 6.1.2.1, removed the old "Type 2" designation for the QSFP224 1x1 connectors and fixed a Section reference to be more accurate. Updated Figure 6-2 to indicate specific QSFP224 1x1 connector dimensions that differ from QSFP112 1x1 connectors.
- In Section 6.2.2.1, updated some text and fixed some paragraph formatting in response to comments on the previous DRAFT revision, moved some text to before Figure 6-4, and updated Figure 6-4 to indicate specific QSFP224 1x1 cage dimensions that differ from QSFP112 1x1 cages and changed the cage flap length dimension from 7.00 mm MIN to 7.00-9.00 mm limits. Moved the old NOTE 13 to replace the previously deleted NOTE 12 and added a new NOTE 13 and a new NOTE 14.
- In Section 6.2.3, inserted the word "riding" between "Cage-mounted" and "heat sink".
- In Section 6.3.2.1, updated Figure 6-6 and it's NOTES to indicate specific QSFP224 module dimensions that differ from QSFP112 modules, creating a new NOTE 15. Also corrected references within NOTE 11.

- In Section 6.3.2.3, revised text to remove references to SFF-8661 modules, updated Figure 6-8 to add a few NOTES to identify the mating pad types and to add indications of a few QSFP224 paddle card dimensions that differ from QSFP112 paddle card dimensions.
- In section 6.4.1, updated Figure 6-9 to add the missing Datum L and add indications of QSFP224 paddle card dimensions that differ from QSFP112 paddle card dimensions. Also, updated the title for Figure 6-10.
- In Section 7.1, updated the Performance Tables title to include QSFP2 (since it applies to both QSFP112 and QSFP224).
- In Appendix B, updated Figure B-1 to correct the footprint pad assignment titles and more accurately represent the scale of the QSFP112 1x1 footprints pads vs. the QSFP224 1x1 footprint pads.

CONTENTS

FIGURES

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PREFACE

The family of QSFP products have been around for many years. The first QSFP specification (for 4 x 1 Gbps per lane data rates) was created by the QSFP MSA (multi-source agreement) and was eventually brought into the SFF Committee as the INF-8438 specification. The SFF Committee created a derivative specification, SFF-8436, for QSFP+ which was improved in many areas and later updated to operate at up to 4 x 10 Gbps per lane data rates. In an attempt to accelerate the further advancement of the QSFP family, the bulk of the content within the SFF-8436 QSFP+ specification was divided into separate specifications for the modules, connectors, cages, low speed & general electrical, and the management interface. These specifications, together, make up what became known as QSFP10 (a marketing term for QSFP+ products capable of 4 x 10 Gbps per lane for a total of 40 Gbps) and later as QSFP14 (a marketing term for QSFP+ products capable of 4 x 14 Gbps per lane for a total of 56 Gbps). The next generation of QSFP+ products, referred to QSFP28 (a marketing term for QSFP+ products capable of 4 x 25 Gbps per lane for a total of 100 Gbps or capable of 4 x 28 Gbps per lane for a total of 112 Gbps). The same QSFP28 specifications also were used in the QSFP56 variants (a marketing term for QSFP+ products capable of up to a total of 200 Gbps). Although some early versions of QSFP112 products may have been built using components based on the older QSFP28 specifications, the SFF-TA-1027 specification is intended to define the mechanical specification for the cages, connectors, and modules for 400G QSFP or 800G QSFP products with data rates of up to 112Gbps (QSFP112) or 224Gbps (QSFP224). Refer to reference document REF-TA-1011 and the QSFP+ 4X Pluggable Transceiver Solutions specification, SFF-8665, for additional information.

1. Scope

This specification defines the mechanical requirements of the pluggable QSFP2 cages, connectors, and modules that enable QSFP operation at greater signaling rates (i.e. 112Gbps or 224Gbps) than previous generations of QSFP. This specification defines:

- Connector
  - QSFP112 1x1 (Footprint Styles A & B)
  - QSFP112 2x1 (Footprint Styles A, B, C, & D)
  - QSFP224 1x1 (QSFP224 1x1 Footprint ~~Style C~~)
- Cage (with or without an opening for a riding heat sink option)
  - QSFP112 1x1 & 2x1
  - QSFP224 1x1
- Module (Types 1, 2, 2A, & 2B)
  - QSFP112
  - QSFP224

The cages and connectors defined in this specification are backwards compatible supporting the data rates of the legacy module inserted. In addition, the modules defined are compatible with QSFP, QSFP+, QSFP28, and QSFP56 hosts with options for improved thermal performance. However, some conditions on the compatibility may exist with legacy hosts due to the narrower paddle card pads of the QSFP112 or QSFP224 modules and no tighter tolerance on the legacy host connector card slot width. Refer to SFF-8665 for additional information on legacy cages and modules and for implementation details for QSFP112 or QSFP224 including electrical and management interface specifications.

2. References and Conventions

2.1 Industry Documents

The following documents are relevant to this specification:

- ASME Y14.5 Dimensioning and Tolerancing
- EIA-364-1000 Environmental Test Methodology for Assessing the Performance of Electrical Connectors and Sockets Used in Controlled Environment Applications
- QSFP-DD/QSFP-DD800/QSFP-DD1600 HW QSFP-DD/QSFP-DD800/QSFP-DD1600 Hardware Specification for QSFP DOUBLE DENSITY 8X
- REF-TA-1011 Cross Reference to Select SFF Connectors
- SFF-8661 QSFP+ 4X Module
- SFF-8663 QSFP+ 28 Gb/s Cage (Style A)
- SFF-8665 QSFP+ 4X Pluggable Transceiver Solutions
- SFF-8679 QSFP+ 4X Hardware and Electrical Specification

2.2 Sources

The complete list of SFF documents which have been published, are currently being worked on, or that have been expired by the SFF Committee can be found at https://www.snia.org/sff/specifications. Suggestions for improvement of this specification are welcome and should be submitted to https://www.snia.org/feedback.

Other standards may be obtained from the organizations listed below:

Standard	Organization	Website
ASME	American Society of Mechanical Engineers (ASME)	https://www.asme.org
Electronic Industries Alliance (EIA)	Electronic Components Industry Association (ECIA)	https://www.ecianow.org
IEEE	Institute of Electrical and Electronics Engineers (IEEE)	https://www.ieee.org
OIF	Optical Internetworking Forum (OIF)	https://www.oiforum.com
QSFP-DD	QSFP-DD MSA	http://www.qsfp-dd.com

2.3 Conventions

The following conventions are used throughout this document:

Definitions: Certain words and terms used in this standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in the definitions or in the text where they first appear.

Order of Precedence: If a conflict arises between text, tables, or figures, the order of precedence to resolve the conflicts is text; then tables; and finally figures. Not all tables or figures are fully described in the text. Tables show data format and values.

Lists: Lists sequenced by lowercase or uppercase letters show no ordering relationship between the listed items.

EXAMPLE 1 - The following list shows no relationship between the named items:

a. red (i.e., one of the following colors):
    A. crimson; or
    B. pink;
b. blue; or
c. green.

Lists sequenced by numbers show an ordering relationship between the listed items.

EXAMPLE 2 -The following list shows an ordered relationship between the named items:

1. top;
2. middle; and
3. bottom.

Lists are associated with an introductory paragraph or phrase and are numbered relative to that paragraph or phrase (i.e., all lists begin with an a. or 1. entry).

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

Numbering 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

3. Keywords, Acronyms, and Definitions

For the purposes of this document, the following keywords, acronyms, and definitions apply.

3.1 Keywords

May: Indicates flexibility of choice with no implied preference.

Optional: 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.

Shall: Indicates a mandatory requirement. Designers are required to implement all such mandatory requirements to ensure interoperability with other products that conform to this specification.

Should: Indicates flexibility of choice with a strongly preferred alternative.

3.2 Acronyms and Abbreviations

PCB: Printed Circuit Board
Ra: The profile surface roughness parameter representing the arithmetic average of the surface roughness
SMT: Surface Mount Technology

3.3 Definitions

Basic (dimension): The theoretical exact size, profile, orientation, or location of a feature. It is used as the basis from which permissible variations are established by tolerances in notes or in feature control frames (GD&T).

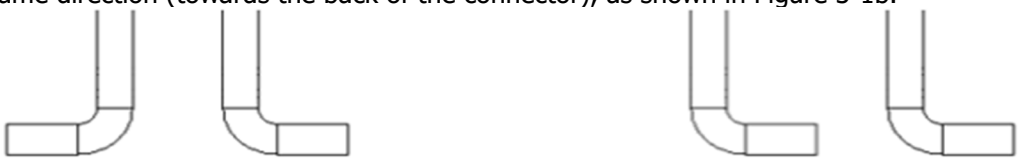
Connector: Each half of an interface that, when joined together, establish electrical contact and mechanical retention between two components. In this specification, the term connector does not apply to any specific gender; it is used to describe the receptacle, the plug or the card edge, or the union of receptacle to plug or card edge. Other common terms include: connector interface, mating interface, and separable interface.

Contacts: A term used to describe connector terminals that make electrical connections across a separable interface.

Datum: A point, line, plane, etc. assumed to be exact for the purposes of computation or reference, as established from actual features, and from which the location or geometric relationship of another feature is established.

JL: A connector contact configuration that describes the tail direction; connector contact tails in different rows point in opposite same directions ("J" towards front of connector, "L" towards back of connector) as shown in Figure 3-1a.

LL: A connector contact configuration that describes the tail direction; connector contact tails in different rows point in the same direction (towards the back of the connector), as shown in Figure 3-1b.



a. "JL" Tail Configuration **b. "LL" Tail Configuration**

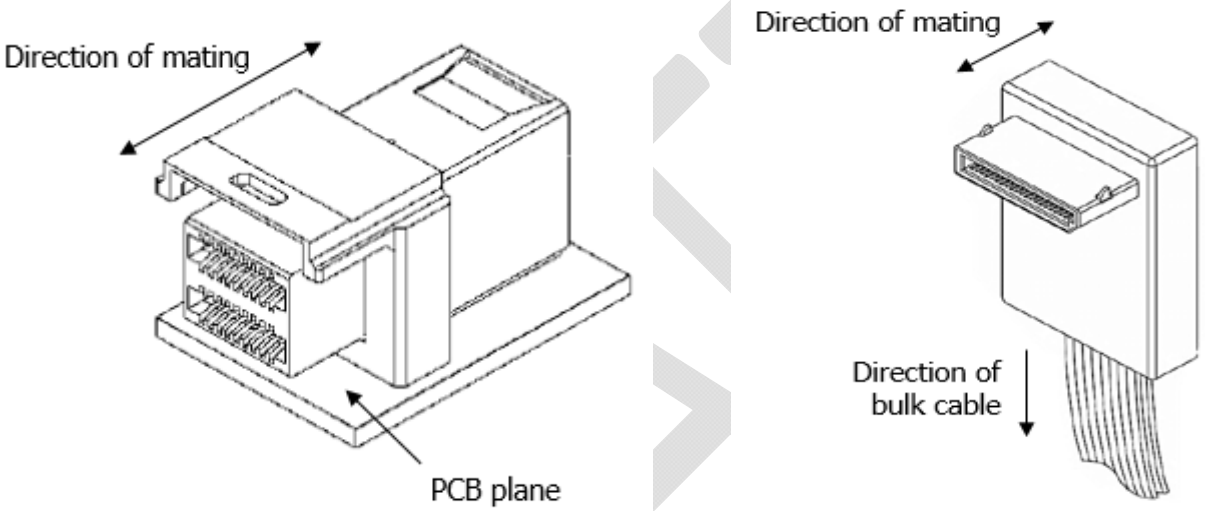
Figure 3-1 Connector Contact Configurations

Module: In this specification, module may refer to a plug assembly at the end of a copper (electrical) cable (passive or active), an active optical cable assembly, an optical transceiver, or a loopback.

Power class: A classification that dictates the maximum power a module is permitted to consume.

Reference (dimension): A dimension provided for information or convenience. It has no tolerance and is not to be used for inspection or conformance. It can be calculated from other tolerance dimensions or can be found elsewhere on the drawing with a tolerance. If removed, it would have no impact on the defined object or the ability to reproduce it.

Right Angle: A term used to describe either a connector design where the mating direction is parallel to the plane of the printed circuit board upon which the connector is mounted or a cable assembly design where the mating direction is perpendicular to the bulk cable.



a) Right angle connector b) Right angle cable assembly

Figure 3-2 Right Angle Connector and Cable Assembly

Surface mount: A term used to describe a termination style in which solder tails sit on pads on the surface of a PCB and are then soldered to keep the connector or cage in place. Other common terms are surface mount technology or SMT.

Wipe: The distance a contact travels on the surface of its mating contact during the mating cycle as shown in Figure 3-3.

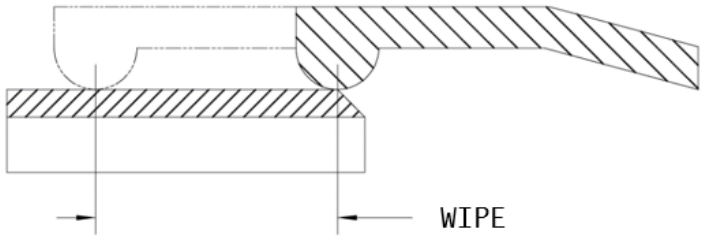


Figure 3-3 Wipe for a Continuous Contact

4. General Description

4.1 Configuration Overview/Descriptions

The QSFP112 and QSFP224 connector, cage, and module system have multiple components:

a. Connector
   A. QSFP112 1x1 (Footprint Styles A & B)
   B. QSFP112 2x1 (Footprint Styles A, B, C, & D)
   C. QSFP224 1x1 (QSFP224 1x1 Footprint ~~Style C~~)
b. Cage (with or without an opening for a riding heat sink option)
   A. QSFP112 1x1 & 2x1
   B. QSFP224 1x1
c. Module (Types 1, 2, 2A, & 2B)
   A. QSFP112
   B. QSFP224

Each of the above listed components are detailed in the following sections. For reference, the QSFP112 1x1 cage and connector are shown in Figure 4-1 and the QSFP112 2x1 stacked cage and connector are shown in Figure 4-3. Connectivity for the 1x1 and 2x1 configurations are shown in Table 4-1 and Table 4-3, respectively.

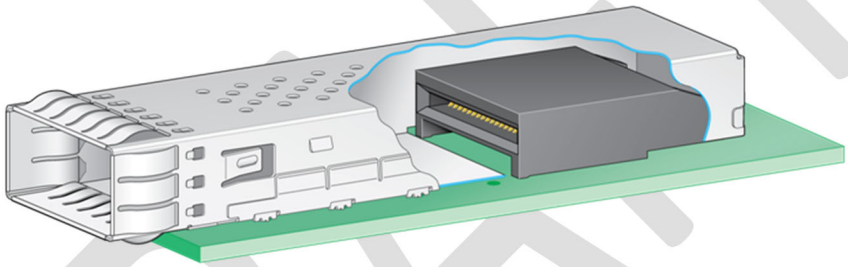


Figure 4-1 QSFP112 1x1 Cage and Connector

Table 4-1 QSFP112 1x1 Connector, Cage, and Module Implementations

1x1 Footprint Style	1x1 Connector Footprint Description	1x1 Cage	Module
Style A	0.8 pitch "LL" connector footprint	QSFP112 1x1 Cage (see Note 1), OR SFF-8663 Cage (see Note 2)	Type 1, 2, 2A, or 2B (see Note 3)
Style B	0.8 pitch "JL" connector footprint		

NOTES:
1. Refer to Section 5.2.2.1 for more information.
2. Refer to SFF-8663 for more information. See also Figure 5-15 for modified PCB Layout.
3. Refer to Section 5.3.2.1 for more information.

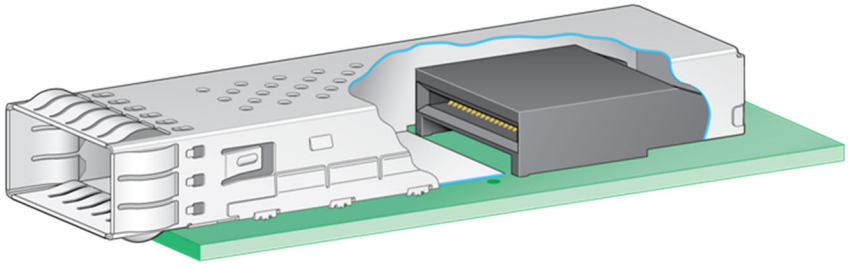


Figure 4-2 QSFP224 1x1 Cage and Connector

Table 4-2 QSFP224 1x1 Connector, Cage, and Module Implementations

QSFP224 1x1 Footprint Description	1x1 Cage	Module
0.6 pitch "LL" connector footprint	QSFP224 1x1 Cage (see Note 1)	Type 1, 2, 2A, or 2B (see Note 2)
NOTES: 1. Refer to Section 6.2.2.1 for more information. 2. Refer to Section 6.3.2.1 for more information.		

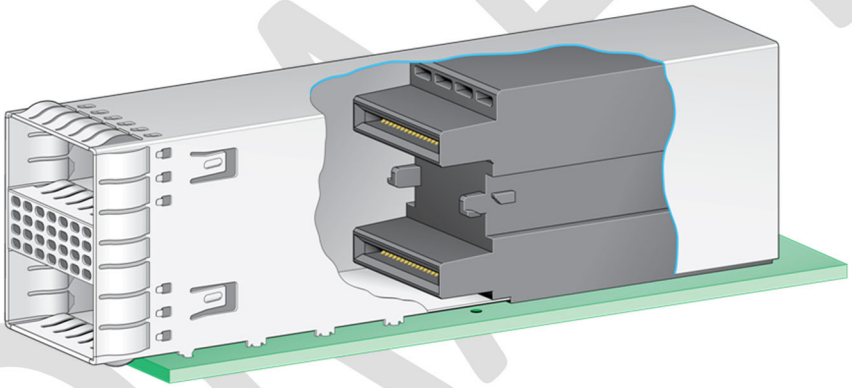


Figure 4-3 QSFP112 2x1 Stacked Cage and Connector

Table 4-3 QSFP112 2x1 Stacked Connector, Cage, and Module Implementations

2x1 Stacked Footprint Style	2x1 Stacked Connector Description	Cage	Module
Style A	"LL" connector footprint with retention pin	QSFP112 2x1 Stacked Cage (see Note 1)	Type 1, 2, 2A, or 2B (see Note 2)
Style B	"JL" connector footprint with retention pin		
Style C	"LL" connector footprint with glue pad		
Style D	"JL" connector footprint with glue pad		
NOTES: 1. Refer to Section 5.2.2.2 for more information. 2. Refer to Section 5.3.2.1 for more information.			

4.1.1 Enhanced Options to Use for QSFP224 vs. QSFP112

The QSFP2 component- enhancements will enable QSFP operation at signaling rates up to at least 112 Gbps per lane and are suitable for QSFP112 applications. ~~,~~ Certain combinations of the enhanced QSFP2 component options will enable improved signal integrity performance that, in turn, will enable signaling rates up to 224 Gbps per lane and are suitable for QSFP224 applications. The following table, Table 4-4, highlights the combination of enhanced components- that are needed to obtain the faster signaling rates.

Table 4-4 Enhancements~~d~~ ~~Components~~ for QSFP112 and QSFP224 Applications

Enhancement	Used for QSFP112	Used for QSFP224
Thermal Enhancements		
Cage contains optional heat sink opening to enable the use of a riding heatsink	Yes (See Section 5.2)	Yes (See Section 6.2)
Modules with enhanced flatness and surface roughness are recommended. Type 2, 2A, or 2B modules may also provide better heat dissipation	Yes (See Section 5.3)	Yes (See Section 6.3)
Enhancements Needed for Signaling Rates		
Strict requirements for the Cage Latch Tab (Cage Flap) to accommodate the Angled-Latch Design	No (See Section 5.2)	Yes (See Section 6.2)
QSFP224 1x1 Connectors with QSFP224 1x1 Footprint and reduced Card Slot Width Tolerance and adjustments to the 2 Locating Peg Diameters and the Tolerance for the distance of the Locating Pegs to the mating interface Contact Point	No (See Section 5.1)	Yes (See Section 6.1)
Angled-Latch Design Modules and QSFP224 Paddle Card with reduced Pad Sizes and reduced distance from Datum D (hard stop on module) to Datum H (leading edge of signal contact pads on module paddle card) for Improved SI Performance	No (See Section 5.3)	Yes (See Section 6.3)

~~Component~~	~~QSFP224 1x1 Cage (See Section 6.2)~~	~~QSFP224 1x1 Connector (See Section 6.1)~~	~~QSFP224 Module (See Section 6.3)~~
~~Thermal Enhancements~~	~~Optional Heatsink Opening to enable the use of a riding heat sink~~		~~Modules with enhanced flatness and surface roughness are recommended. Type 2, 2A, or 2B modules may also provide better heat dissipation~~
~~Enhancements Needed for Signaling Rates up to 224 Gbps~~	~~Stricter Requirements for the Cage Latch Tab (Cage Flap) to accommodate the Angled-Latch Design~~	~~QSFP224 1x1 Connectors with Style C Footprint and reduced Card Slot Width Tolerance~~	~~Angled-Latch Design and QSFP224 Paddle Card with Enhanced Pad Sizes for Improved SI Performance~~

4.2 Contact Numbering

The electrical contacts for the 1x1 connector are numbered as shown in Figure 4-4. The electrical contacts for the 2x1 stacked connector are numbered as shown in Figure 4-5. Additionally, the footprint pad numbering for the 1x1 and 2x1 connectors are shown in Figure 4-6, Figure 4-7, and Figure 4-8, respectively. Contact numbering on the module paddle card is shown in Figure 5-12.

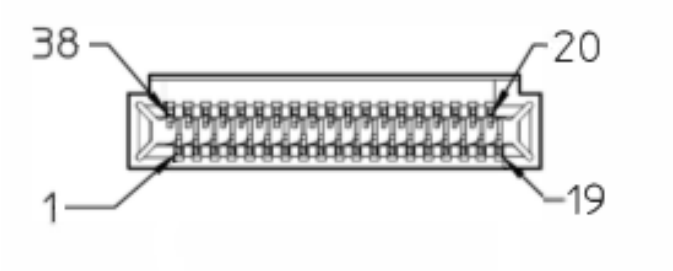


Figure 4-4 QSFP2 1x1 Connector Contact Numbering

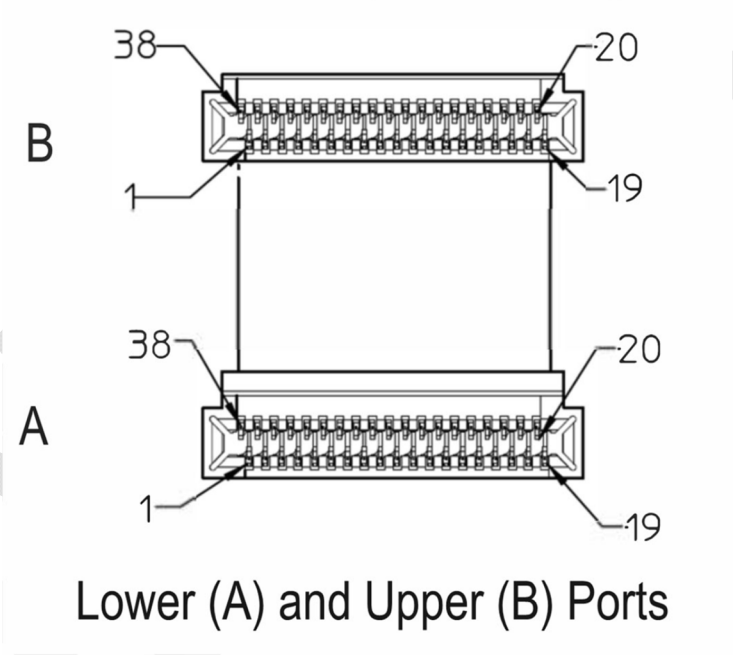


Figure 4-5 QSFP112 2x1 Stacked Connector Contact Numbering

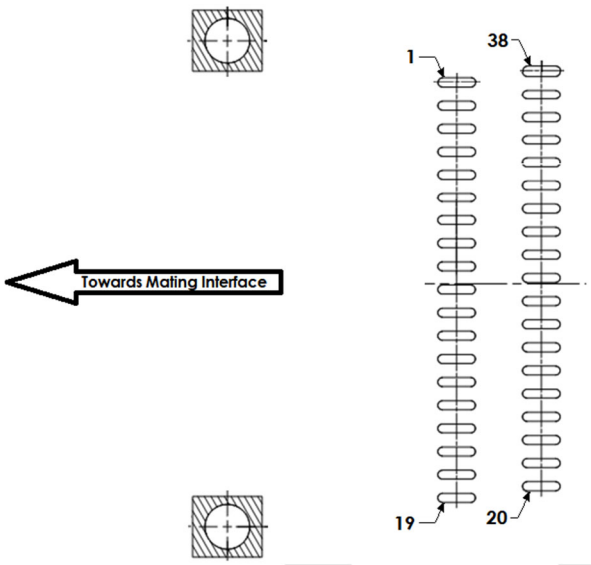


Figure 4-6 QSFP112 1x1 Connector Style A & Style B Footprint Pad Numbering

Refer to Section 5.4 for details regarding the QSFP112 1x1 connector footprints. See Appendix B for additional information regarding the differences in pad assignments for the QSFP112 1x1 footprint Style A and the QSFP112 1x1 footprint Style B versus the QSFP224 1x1 footprint ~~Style C~~.

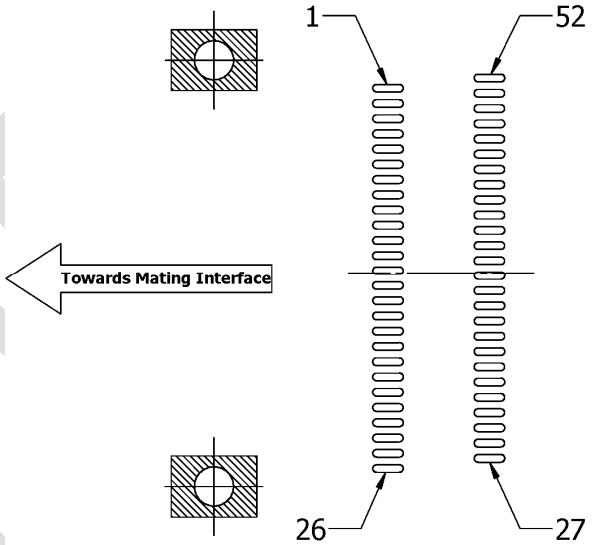


Figure 4-7 QSFP224 1x1 Connector ~~Style C~~ Footprint Pad Numbering

Refer to Section 6.4 for details regarding the QSFP224 1x1 connector footprints. See Appendix B for additional information regarding the differences in pad assignments for the QSFP112 1x1 footprint Style A and the QSFP112 1x1 footprint Style B versus the QSFP224 1x1 footprint ~~Style C~~.

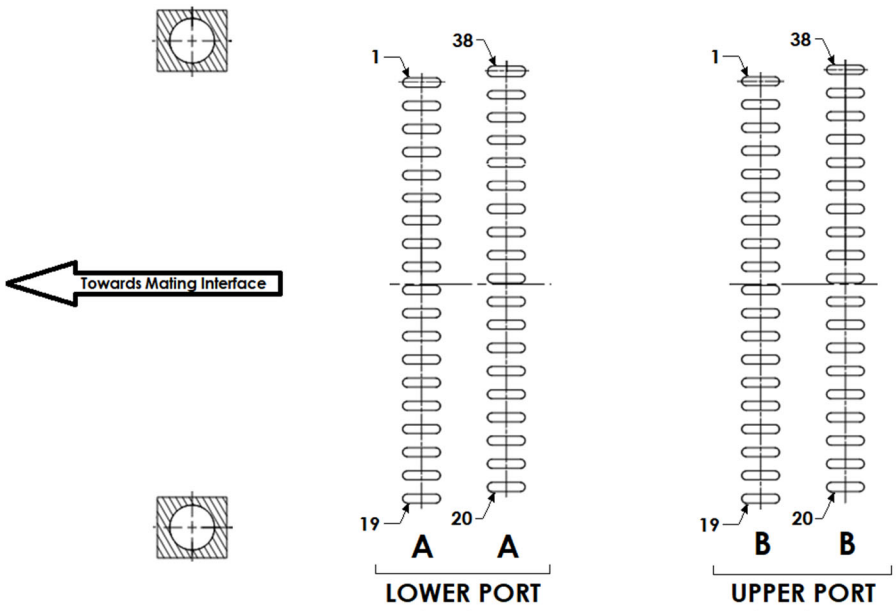


Figure 4-8 QSFP112 2x1 Stacked Connector Footprint Pad Numbering

Refer to Section 5.4.2 for details regarding the QSFP112 2x1 stacked connector footprints.

4.3 Datums

Datum definitions for the 1x1 and 2x1 stacked QSFP2 cages, connectors, and modules are shown in Figure 4-9 and Figure 4-10, respectively. Datum descriptions are provided in Table 4-5. The alignments of some of the datums are noted. To reduce the complexity of the drawings, all dimensions are considered centered unless otherwise specified. Dimensions and tolerancing conform to ASME Y14.5-2009. All dimensions are in millimeters.

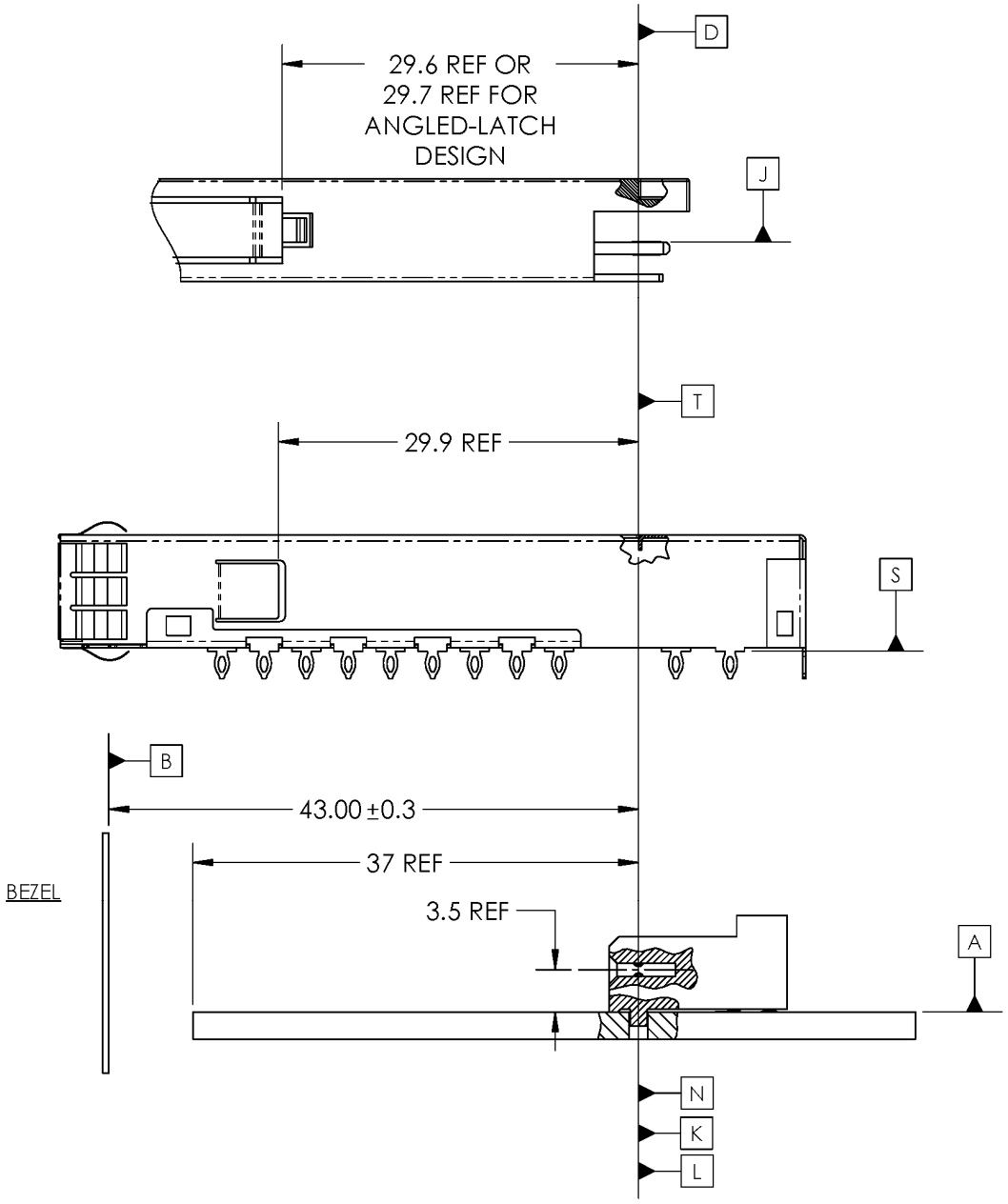


Figure 4-9 QSFP2 Module, 1x1 Connector, and 1x1 Cage Datums

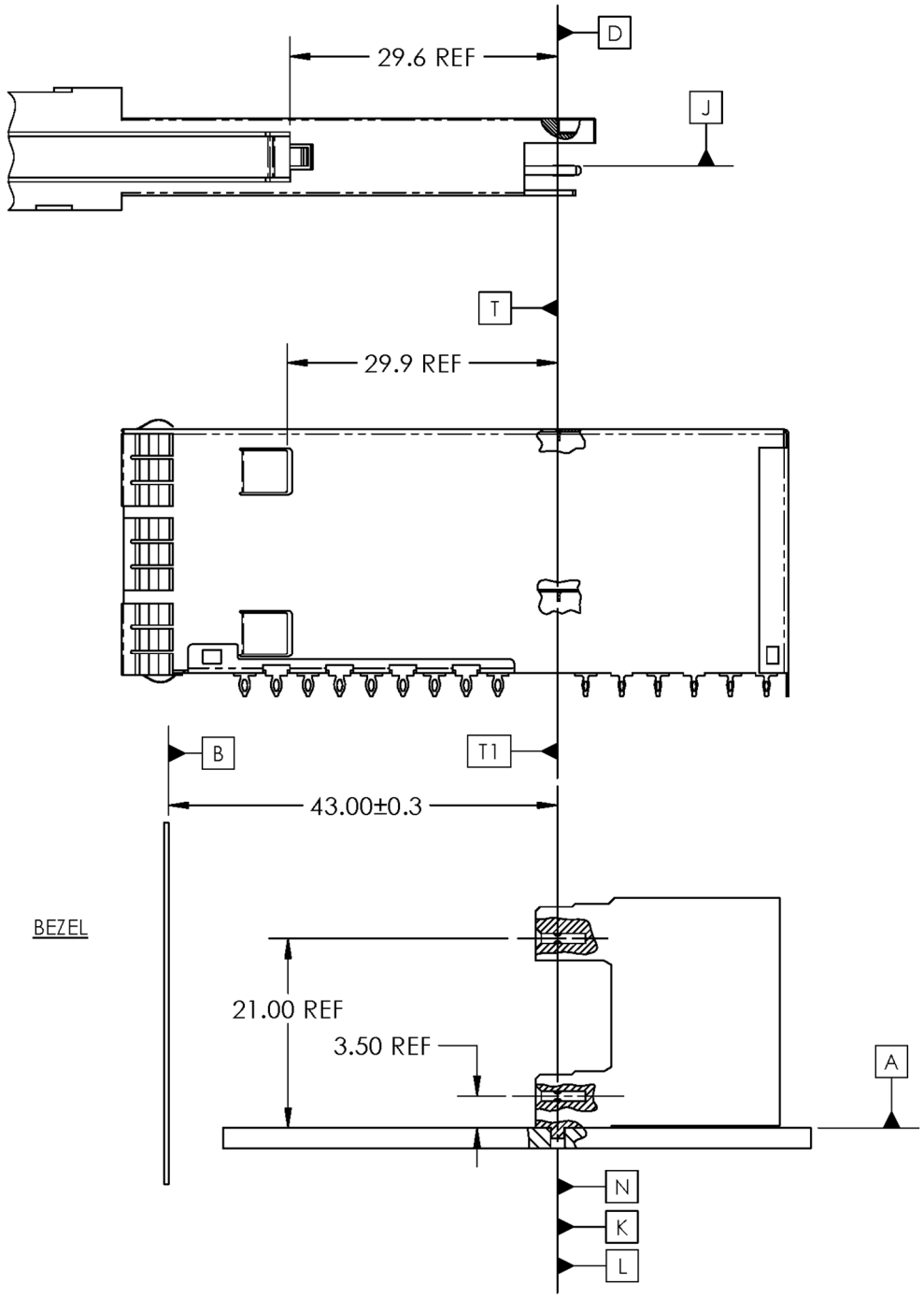


Figure 4-10 QSFP2 Module, 2x1 Stacked Connector, and 2x1 Stacked Cage Datums

Table 4-5 Datum Descriptions

Datum[1]	Description
A	Host board top surface
B	Inside surface of bezel
C	Distance between connector alignment holes on host board[3]
D	Hard stop on module[2]
E	Width of module[3]
F	Height of module housing
G	Width of module paddle card[3]
H	Leading edge of signal contact pads on module paddle card
J	Top surface of module paddle card
K	Host board through hole #1 to accept connector guidepost[2]
L	Host board through hole #2 to accept connector guidepost[2]
M	Width of bezel cut out[3]
N	Connector alignment post
P	Vertical centerline of internal surface of cage
S	Seating plane of cage on host board
T	Hard stop on cage[2]
AA	Connector slot width[3]
BB	Seating plane of connector on host board
DD	Top surface of module housing
FF	Centerline of upper port cage height
GG	Centerline of lower port cage height

Notes:
1. All dimensions are in mm.
2. Datums D, K, L, N and T are aligned when assembled (see Figure 4-9 and Figure 4-10).
3. Centerlines of datums C, E, G, M, and AA are aligned on the same vertical plane.

5. QSFP112 Mechanical Specification

5.1 QSFP112 Connector Mechanical Specification

5.1.1 Overview

QSFP112 connectors come in 1x1 and 2x1 stacked configurations. The QSFP112 1x1 connector, shown in Figure 5-1, is a right-angle connector with 38 contacts. ~~It~~The QSFP112 1x1 connector comes in two Footprint Styles: A and B; refer to Section 5.4.1 for details. The QSFP112 2x1 stacked connector, shown in Figure 5-2, is a right-angle connector with upper and lower ports, both of which contain 38 contacts. ~~It~~The QSFP112 2x1 connector comes in four Footprint Styles: A, B, C, and D; refer to Section 5.4.2 for details.

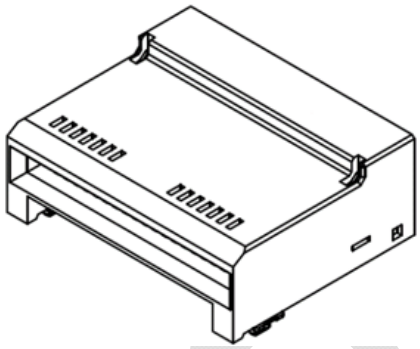


Figure 5-1 QSFP112 1x1 Connector

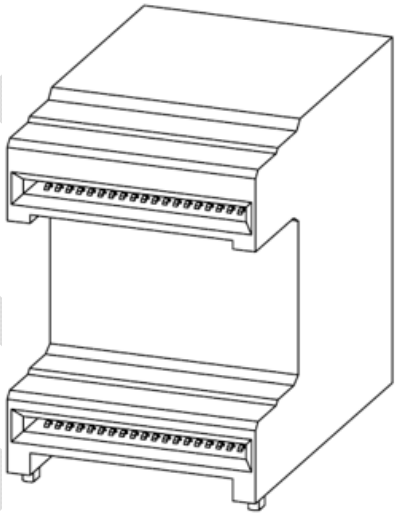


Figure 5-2 QSFP112 2x1 Stacked Connector

5.1.2 Mechanical Description: QSFP112 Connector

5.1.2.1 QSFP112 1x1 Connector

QSFP112 1x1 connector front and side views are shown in Figure 5-3. Refer to Section 5.4.1 for footprint information.

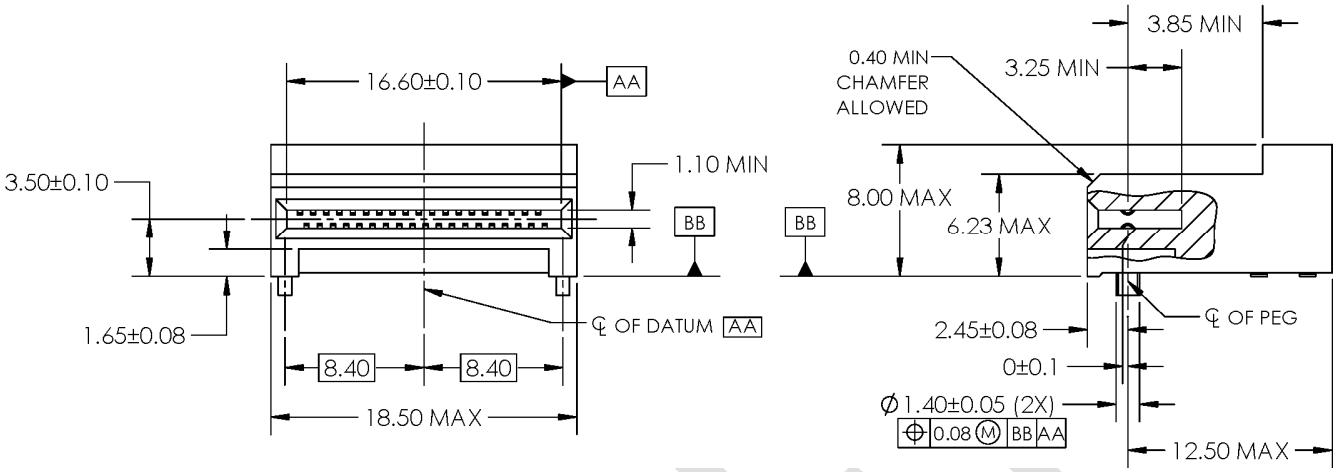


Figure 5-3 QSFP112 1x1 Connector Dimensions

5.1.3 QSFP112 2x1 Stacked Connector

QSFP112 2x1 stacked connector front and side views are shown in Figure 5-4. Refer to Section 5.4.2 for footprint information.

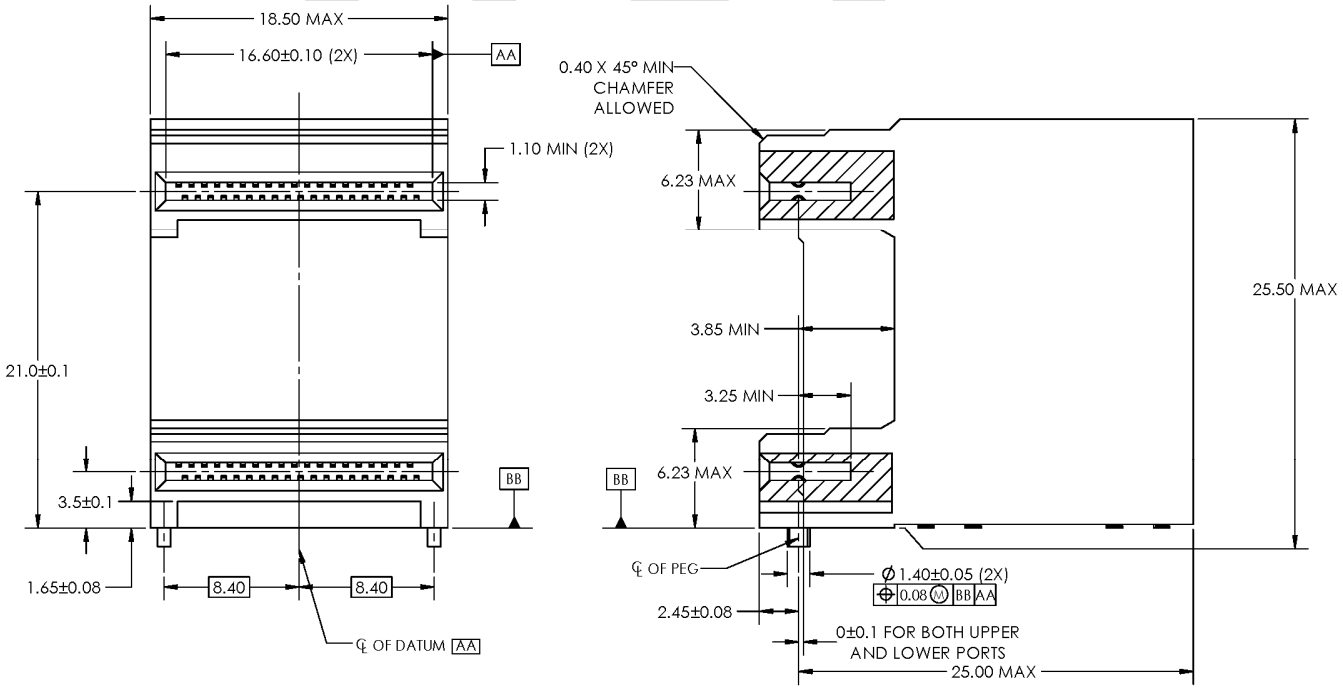


Figure 5-4 QSFP112 2x1 Stacked Connector Dimensions

5.2 QSFP112 Cage Mechanical Specification

5.2.1 Overview

Detailed drawings for QSFP112 cages are provided in the following sections. Refer to Section 5.4 for footprint details and Appendix A for information about bezel openings. The cage may or may not include an opening on the top surface for a riding heat sink. If the thermal requirements for an application do not need the added heat sink, then the cage should not include the optional opening. The riding heat sink designs are not defined in this specification. However, if heat sinks are used, they should be designed to be compatible with the optional opening detailed in Figure 5-6 or Figure 5-8.

5.2.2 Mechanical Description: QSFP112 Cage

5.2.2.1 QSFP112 1x1 Cage

The QSFP112 1x1 cage is illustrated in Figure 5-5 and is backwards compatible with QSFP, QSFP+, QSFP28, and QSFP56 modules. A detailed drawing is provided in Figure 5-6. The location of the footprint pattern on the host board is application specific. Refer to Section 5.4.1 for footprint information. Refer to Appendix A for information about bezel openings.

The legacy-latch modules (QSFP112) defined in this specification are mechanically compatible with all the cages defined in this specification.

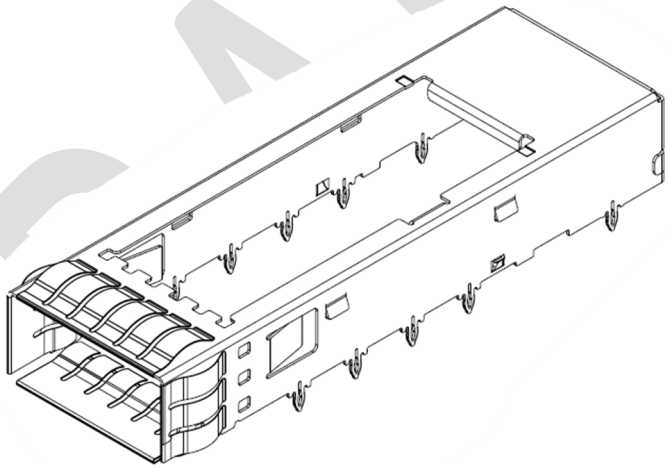


Figure 5-5 QSFP112 1x1 Cage

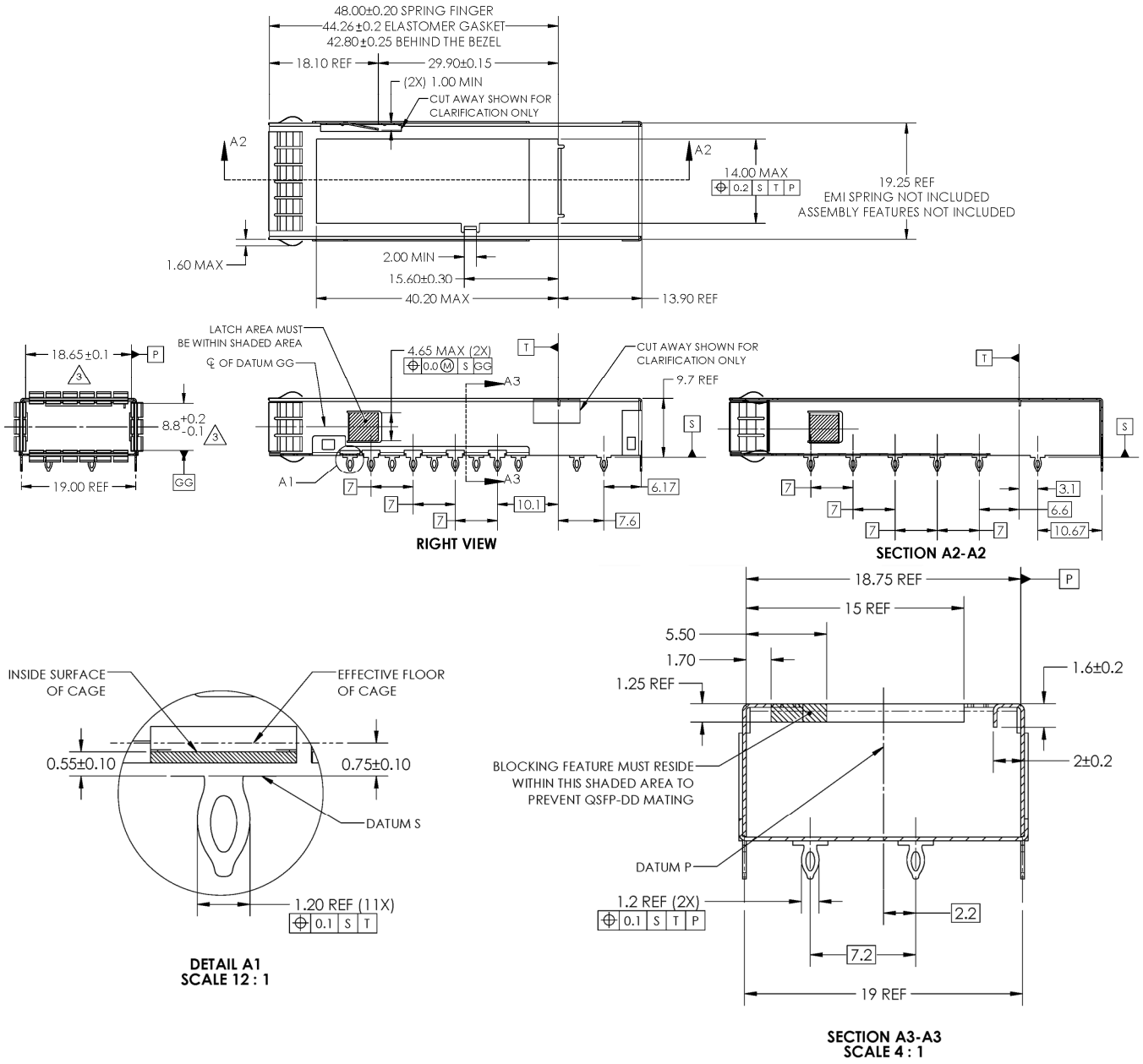


Figure 5-6 QSFP112 1x1 Cage Dimensions (1 of 2)

NOTES: (for QSFP112 1x1 cage dimensions)

1. DIMENSIONS AND TOLERANCING CONFORM TO ASME Y14.5-2009.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. DIMENSIONS FROM INSIDE SURFACES OF SPRING FINGERS WHEN FULLY DEPRESSED.
4. CONNECTOR REMOVED FOR CLARITY.
5. APPLIES TO ALL SPRING FINGERS ON ALL SIDES.
6. EXTERNAL CAGE DIMENSIONS DO NOT INCLUDE FOLDED ASSEMBLY TABS.
7. LENGTH OF CAGE AND SIGNAL TAILS
8. PRESS FIT CAGE PINS APPLY TO RIGHT SIDE OF CAGE.
9. PRESS FIT CAGE PINS APPLY TO LEFT SIDE OF CAGE.
10. PRESS FIT OFFSET BETWEEN RIGHT AND LEFT SIDE OF CAGE.
11. DIMENSIONS INCLUDE BACK COVER.
12. ~~(DELETED)~~OPENING FOR HEAT SINK IS OPTIONAL.
13. ~~OPENING FOR HEATSINK IS OPTIONAL.~~

Figure 5-6 QSFP112 1x1 Cage Dimensions (2 of 2)

5.2.2.2 QSFP112 2x1 Stacked Cage

The QSFP112 2x1 stacked cage is shown in Figure 5-7. A detailed drawing is provided in Figure 5-8. The location of the pattern on the host board is application specific. Refer to Section 5.4.2 for footprint information. Refer to Appendix A for information about bezel openings.

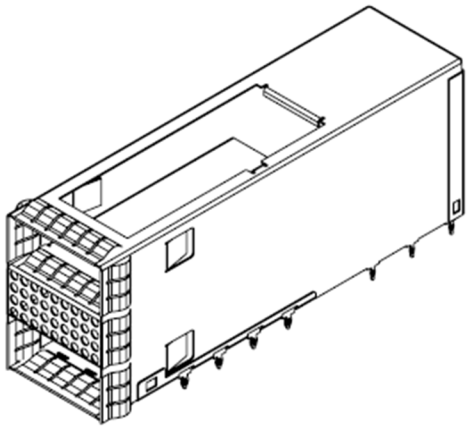


Figure 5-7 QSFP112 2x1 Stacked Cage

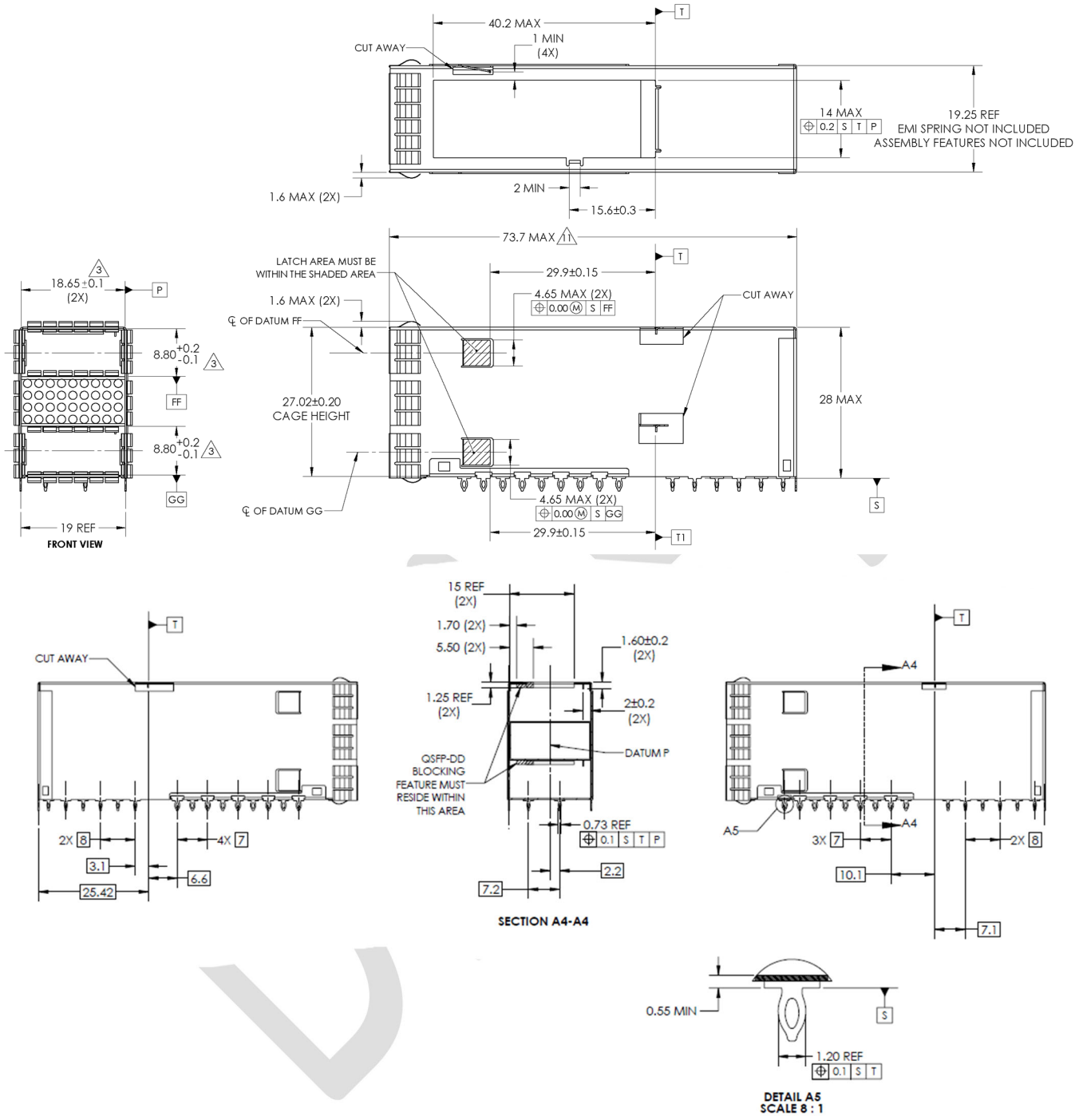


Figure 5-8 QSFP112 2x1 Stacked Cage Dimensions (1 of 4)

NOTES: (for QSFP112 2x1 cage dimensions)

1. DIMENSIONS AND TOLERANCING CONFORM TO ASME Y14.5-2009.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. DIMENSIONS FROM INSIDE SURFACES OF SPRING FINGERS WHEN FULLY DEPRESSED.
4. CONNECTOR REMOVED FOR CLARITY.
5. APPLIES TO ALL SPRING FINGERS ON ALL SIDES.
6. EXTERNAL CAGE DIMENSIONS DO NOT INCLUDE FOLDED ASSEMBLY TABS.
7. LENGTH OF CAGE AND SIGNAL TAILS
8. PRESS FIT CAGE PINS APPLY TO RIGHT SIDE OF CAGE.
9. PRESS FIT CAGE PINS APPLY TO LEFT SIDE OF CAGE.
10. PRESS FIT OFFSET BETWEEN RIGHT AND LEFT SIDE OF CAGE.
11. DIMENSION INCLUDES BACK COVER.
12. OPENING FOR HEAT SINK IS OPTIONAL. ~~(DELETED)~~
13. CONTACT PIN DIMENSION MEASURED FROM DATUM T.~~OPENING FOR HEATSINK IS OPTIONAL.~~
14. CONTACT PIN DIMENSION MEASURED FROM DATUM T1.
15. ~~CONTACT PIN DIMENSION MEASURED FROM DATUM T1.~~

Figure 5-8 QSFP112 2x1 Stacked Cage Dimensions (2 of 2)

5.2.3 Thermal Management for QSFP112

The thermal management of connectors systems and modules described in this document is the responsibility of the implementer. Each system is different and may require specialized solutions. This document outlines the physical characteristics of the module for interoperability with provisions to promote heat transfer. Type 2, Type 2A, and Type 2B modules offer the potential for better heat dissipation than the Type 1 modules but take up more space. The connectors/cages support external heat sinks, and in the case of the 2x1 stacked connector/cage, an internal heat sink between ports. The cages are not limited to specific heat sink or venting configurations. This document does not suggest any airflow requirements. The implementation of thermal components is not described.

Cage-mounted riding heat sink and retention clip thermal designs are application specific and not specifically defined by this specification. However, the recommended riding heat sink normal force should be at least 25 N to help facilitate heat transfer.

5.3 QSFP112 Module Mechanical Specification

5.3.1 Overview

The QSFP112 module mechanical dimensions are identical to QSFP+ and QSFP28 modules except where specified otherwise ~~(refer to SFF-8661)~~. For QSFP112 modules, the bottom surface of the module within the cage shall be flat without a pocket. The options for the position of the label could include the bottom surface of the module that protrudes outside the bezel of the cage or etched into the metal surface. Caution should be exercised so that any etchings do not affect thermal performance.

5.3.2 Mechanical Description: QSFP112 Module

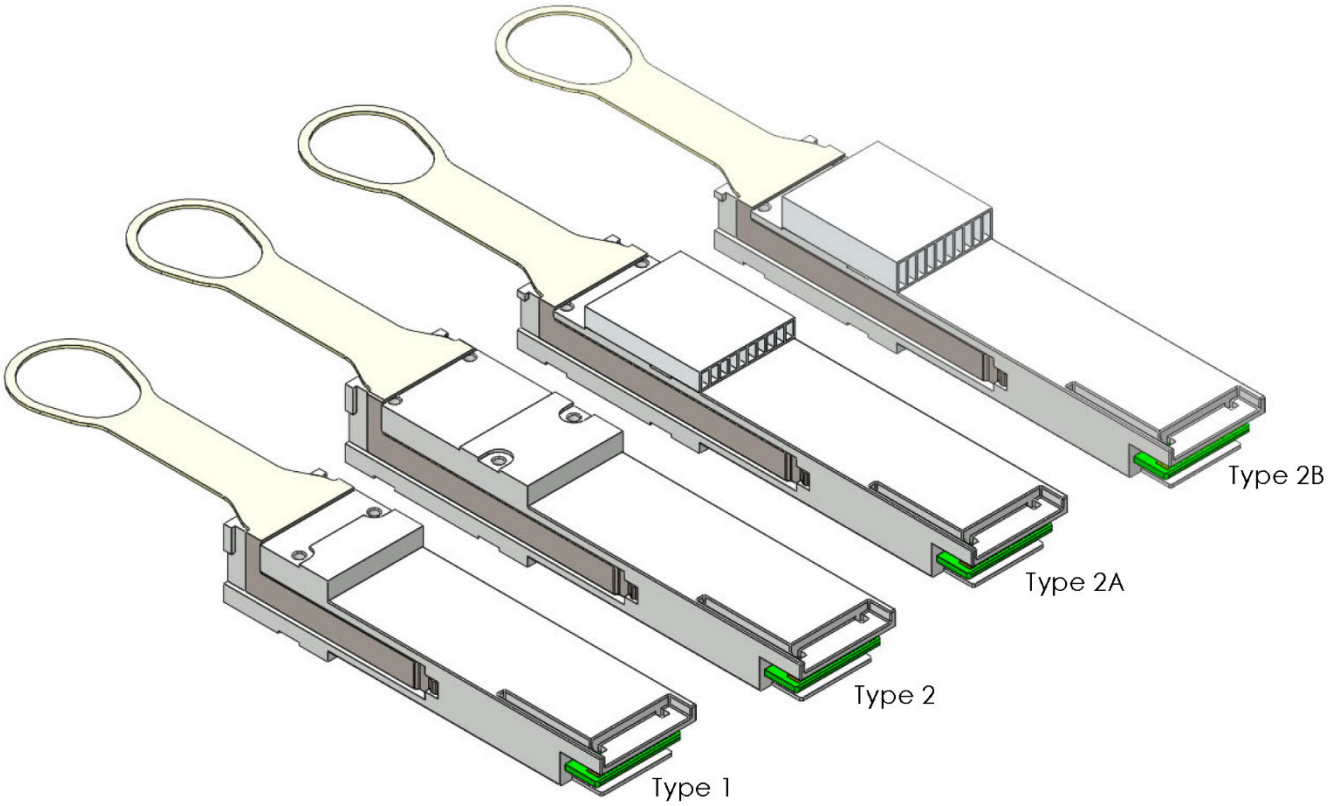
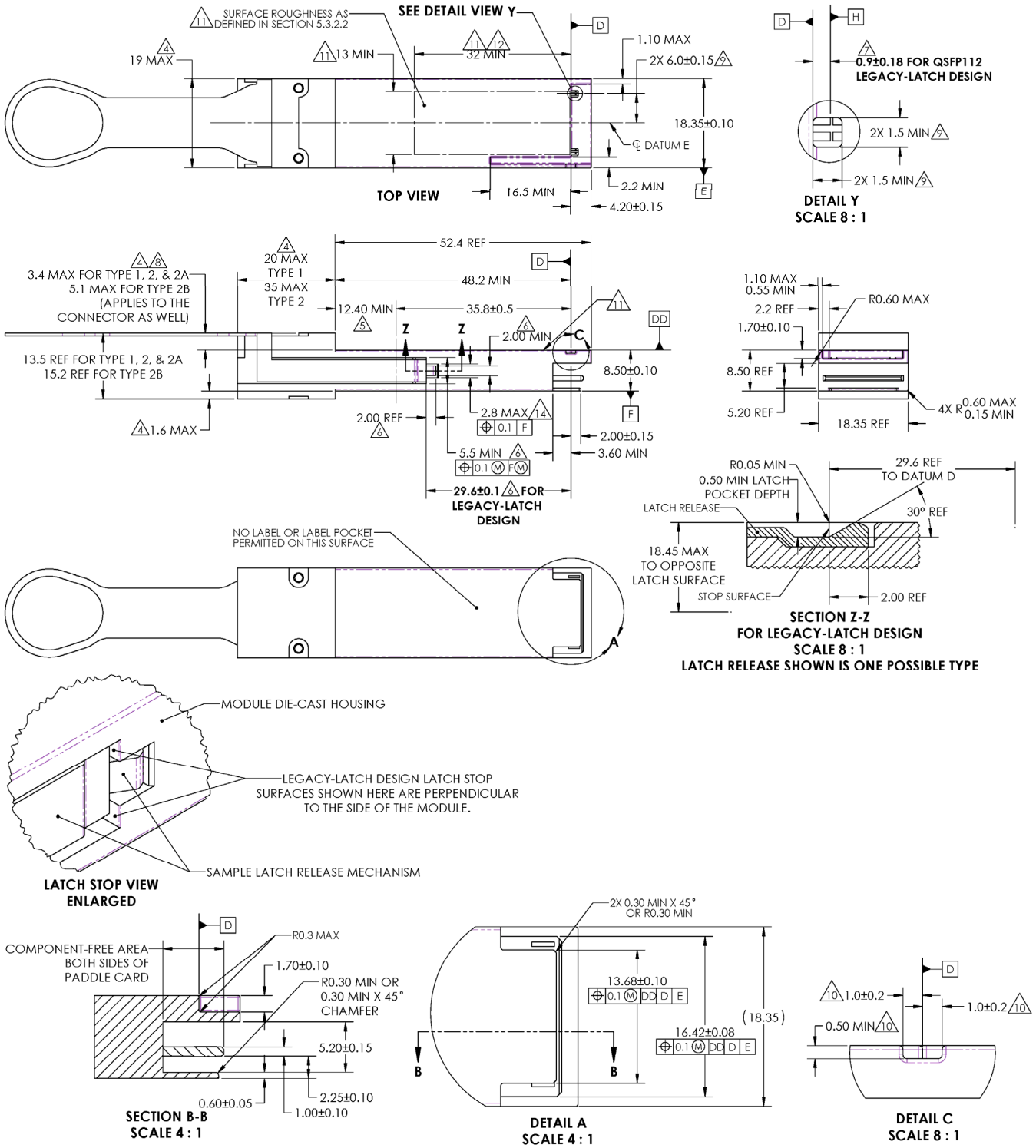


Figure 5-9 QSFP112 Module Types

5.3.2.1 QSFP112 Module Mechanical Dimensions



NOTE: Heat sink definitions for QSFP112 2A & 2B module types are shown in Figure 5-11.

Figure 5-10 QSFP112 Module Dimensions (Type 1, 2, 2A, and 2B)

NOTES: (for QSFP112 module dimensions)

1. DIMENSIONS AND TOLERANCING CONFORM TO ASME Y14.5-2009.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. UNLESS OTHERWISE SPECIFIED, SHARP CORNERS, EDGES, AND BURRS ARE NOT ALLOWED. ROUND OFF ALL EDGES AND CORNERS TO A MINIMUM RADIUS OF 0.20 MM.

4 DIMENSION DEFINES ENLARGED SECTION OF MODULE THAT EXTENDS OUTSIDE OF CAGE TO ACCOMMODATE MATING PLUG AND ACTUATOR MECHANISM.

5 SURFACES ON ALL 4 SIDES OF THE 12.4 MIN DIMENSION TO BE CONDUCTIVE FOR CONNECTION TO CHASSIS GROUND.

6 DIMENSION APPLIES TO THE LATCH MECHANISM.

7 DIMENSION APPLIES TO THE LOCATION OF THE EDGE OF THE MODULE PADDLE CARD PAD, DATUM H. CONTACTS 21, 22, 36, AND 37 ARE VISIBLE.

8 DIMENSION TO INCLUDE BAIL TRAVEL.

9 DIMENSIONS APPLY TO OPENINGS IN THE HOUSING.

10 OPTIONAL FEATURE TO AID INSPECTION OF DIMENSIONS FROM DATUM D.

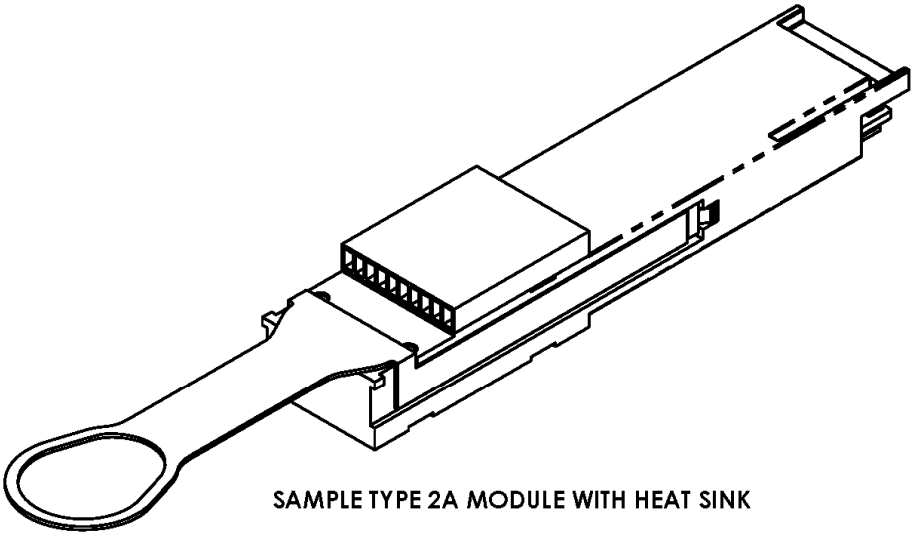
11 FLATNESS AND SURFACE ROUGHNESS (Ra) APPLIES FOR INDICATED LENGTH AND MIN WIDTH OF 13 MM. SURFACE TO BE THERMALLY CONDUCTIVE. SEE SECTION 5.3.2.2, Table 5-1, FOR FLATNESS AND ROUGHNESS REQUIREMENTS.

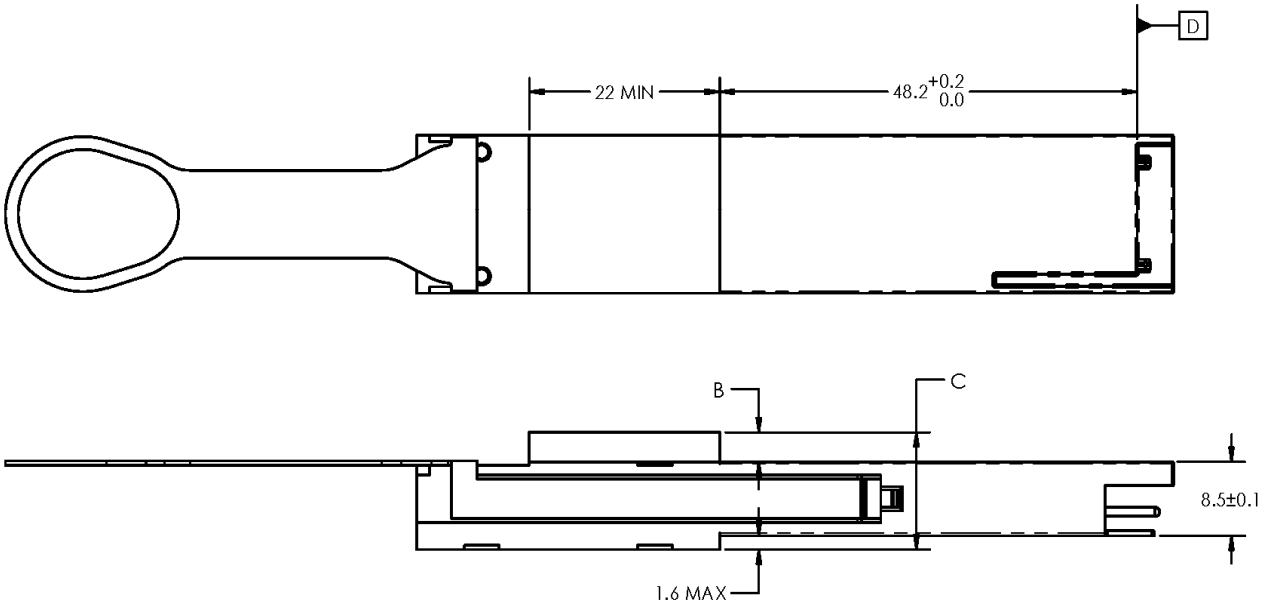
12 HIGHER WATTAGE MODULES MAY REQUIRE ADDITIONAL SPACE FOR COOLING.

13 NO LABEL MATERIAL SHALL BE APPLIED IN THIS AREA. ETCHINGS ARE ALLOWED BUT MUST NOT AFFECT THERMAL PERFORMANCE.

14 DIMENSION APPLIES TO LATCH POCKET.

Figure 5-10 QSFP112 Module Dimensions (Type 1, 2, 2A, and 2B) Continued





QSFP112 Module Type	Dim "B" (MAX)	Dim "C" (REF)
Type 2A	3.4	13.5
Type 2B	5.1	15.2

Figure 5-11 QSFP112 Module Type 2A, Type 2B Details

5.3.2.2 QSFP2 Module Flatness and Surface Roughness for QSFP112

Module flatness and surface roughness are specified for QSFP112 modules to improve thermal characteristics when used with a riding heat sink. Relaxed specifications are used for lower power modules to potentially reduce cost. The flatness and surface roughness specifications are shown in Table 5-1 and apply to the specified heat sink contact area. Flatness and roughness specifications apply to both top and bottom surfaces of modules. Power Class 1Cu is dedicated to passive copper cables with a more relaxed flatness of 0.15 mm.

Table 5-1 QSFP112 Module Flatness And Surface Roughness Specifications

Power Class[1]	Module Flatness (mm) Tol Zone	Surface Roughness (Ra, µm) MAX
1Cu[2]	0.15	1.6
1	0.075	1.6
2	0.075	1.6
3	0.075	1.6
4	0.075	1.6
5	0.075	1.6
6	0.075	1.6
7	0.075	1.6
8	0.050	0.8
1. Power Classes are defined in SFF-8679. 2. Power Class 1Cu maximum power dissipation is the same as Power Class 1.		

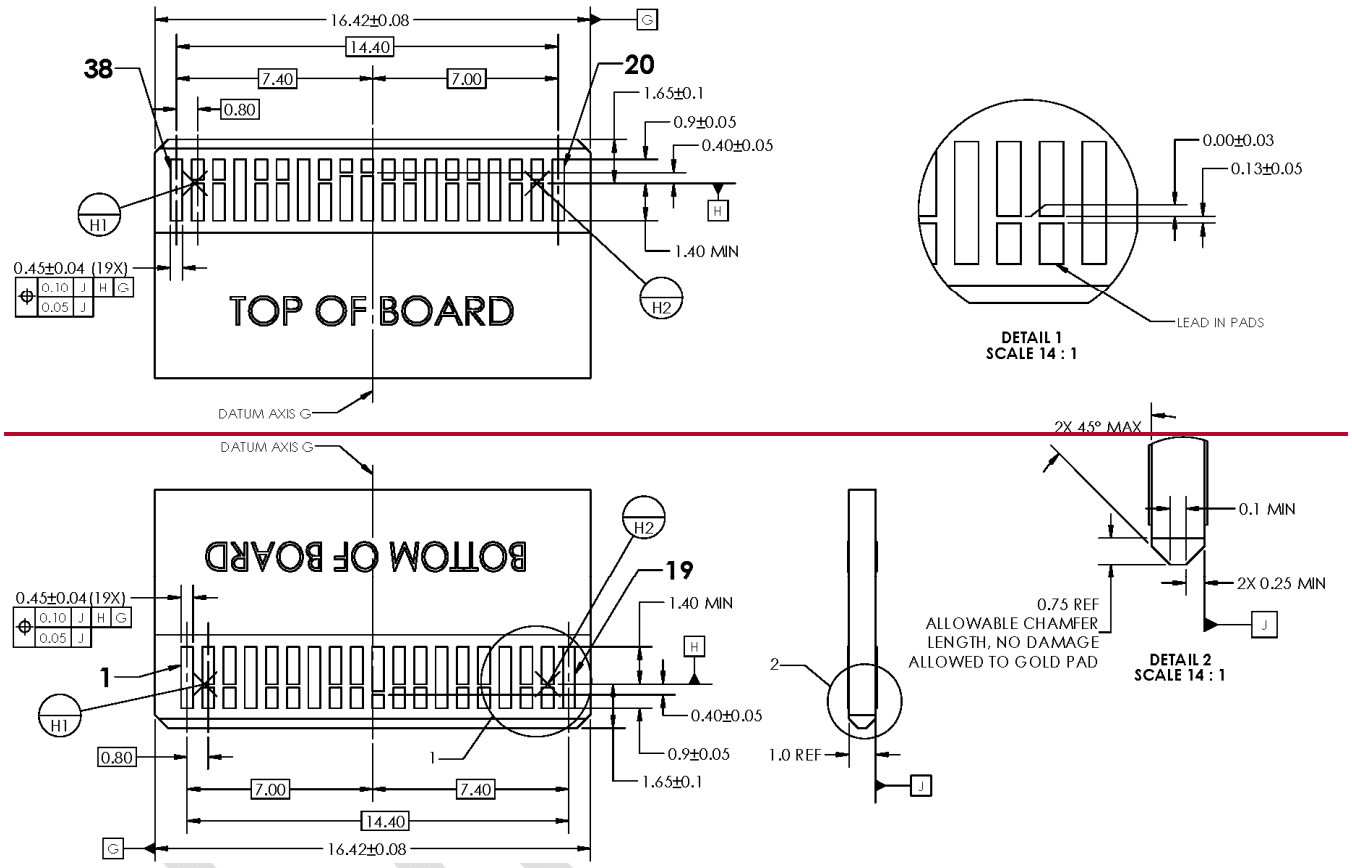
To improve thermal performance, optional enhanced surface specifications are specified in Table 5-2. This is an optional specification and does not override the required specifications in Table 5-1.

Table 5-2 Optional Enhanced QSFP112 Module Flatness Specifications

Power Class	Module Flatness (mm) Tol Zone	Surface Roughness (Ra, µm) MAX
8	0.025	0.4

5.3.2.3 QSFP112 Card Edge Description (Mechanical Interface)

The QSFP112 module paddle card width, pad, and chamfer dimensions have been modified compared to legacy QSFP+/QSFP28 module paddle cards (defined in SFF-8662) to support greater signaling rates. See Figure 5-12 for QSFP112 module paddle card dimensions. ~~See Figure 6-8 for QSFP224 module paddle card dimensions.~~ All other module paddle card dimensions, except for the card width, pads, and chamfers, remain the same as the QSFP+ and QSFP28 specifications. ~~Refer to SFF-8662 for more information, including Section 6.1 Free (Module) Paddle Card, where TABLE 6-1 FREE (MODULE) PADDLE CARD DIMENSIONS in that specification identifies the pad types.~~



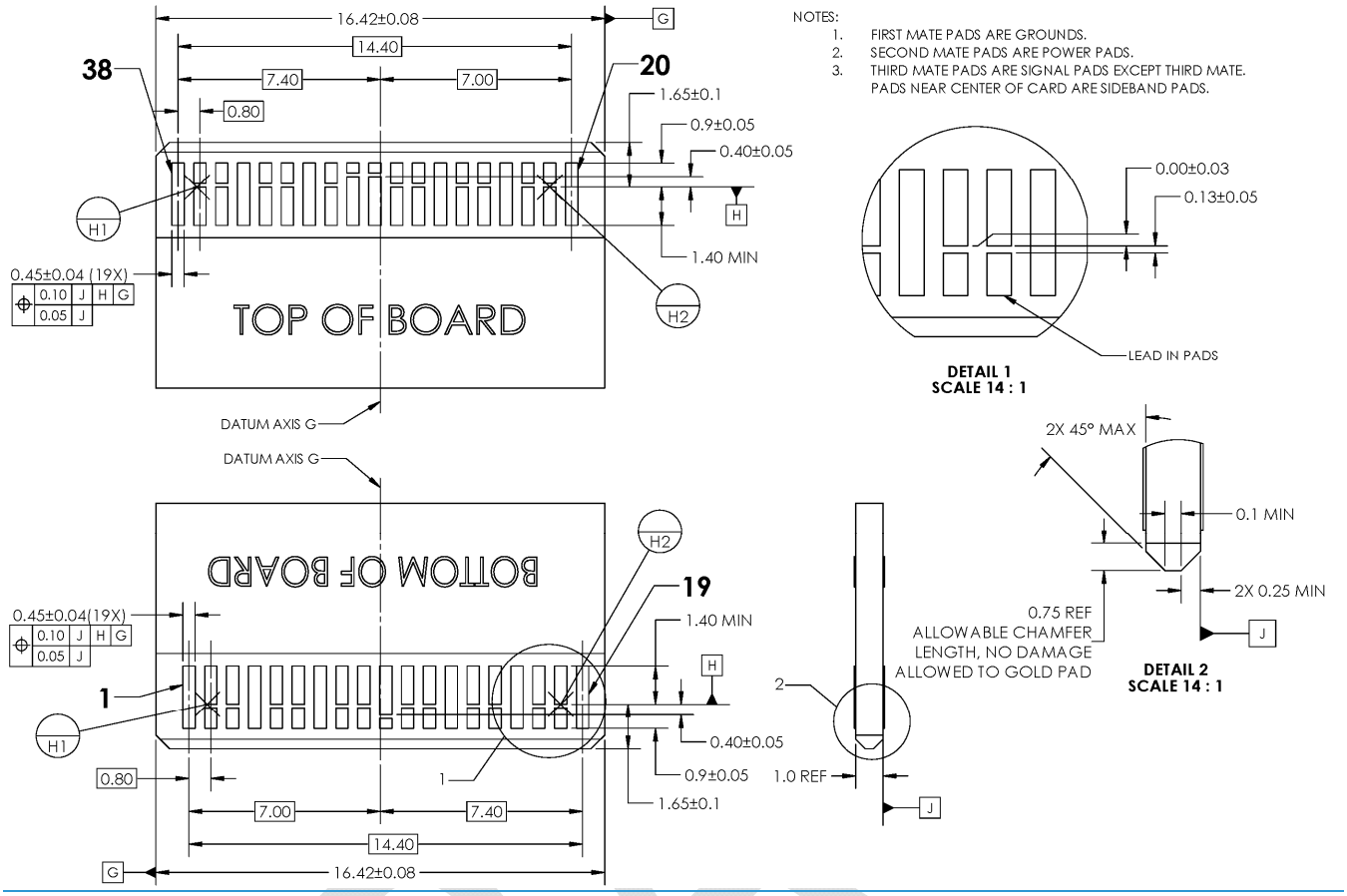


Figure 5-12 QSFP112 Paddle Card Dimensions

5.4 QSFP112 Footprints

To achieve operation at greater signaling rates, the QSFP112 footprint pad dimensions and associated tolerances have been improved compared to QSFP+ / QSFP28.

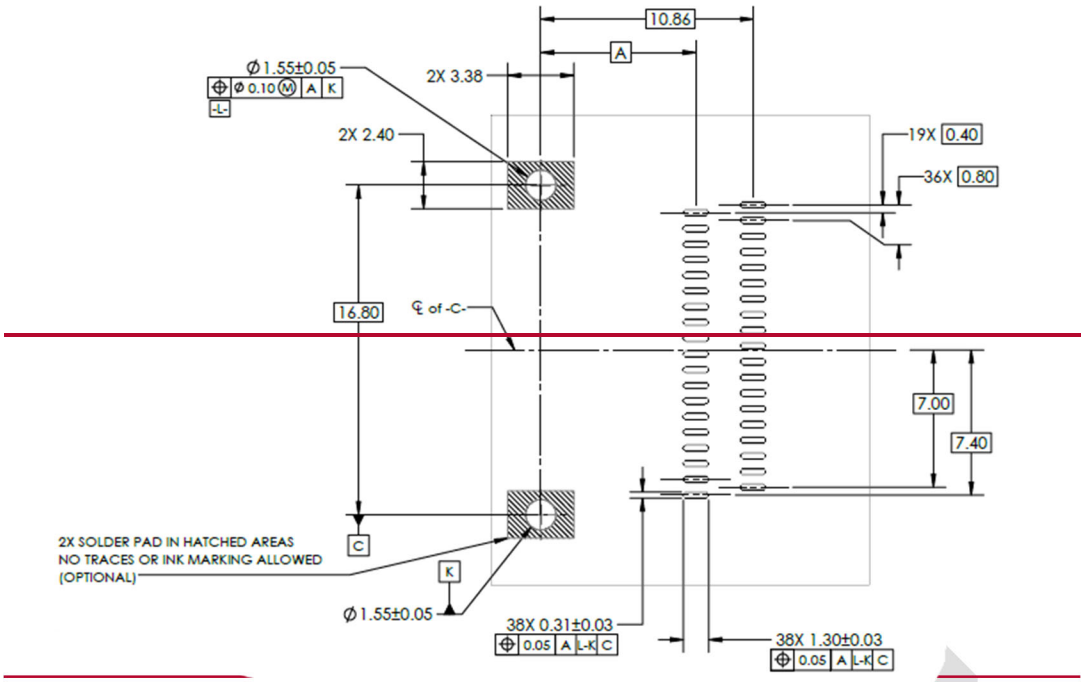
5.4.1 QSFP112 1x1 Connector Footprints

There are two QSFP112 1x1 footprint styles, summarized in Table 5-3, designed to aid in the implementation of different connector tail configurations:

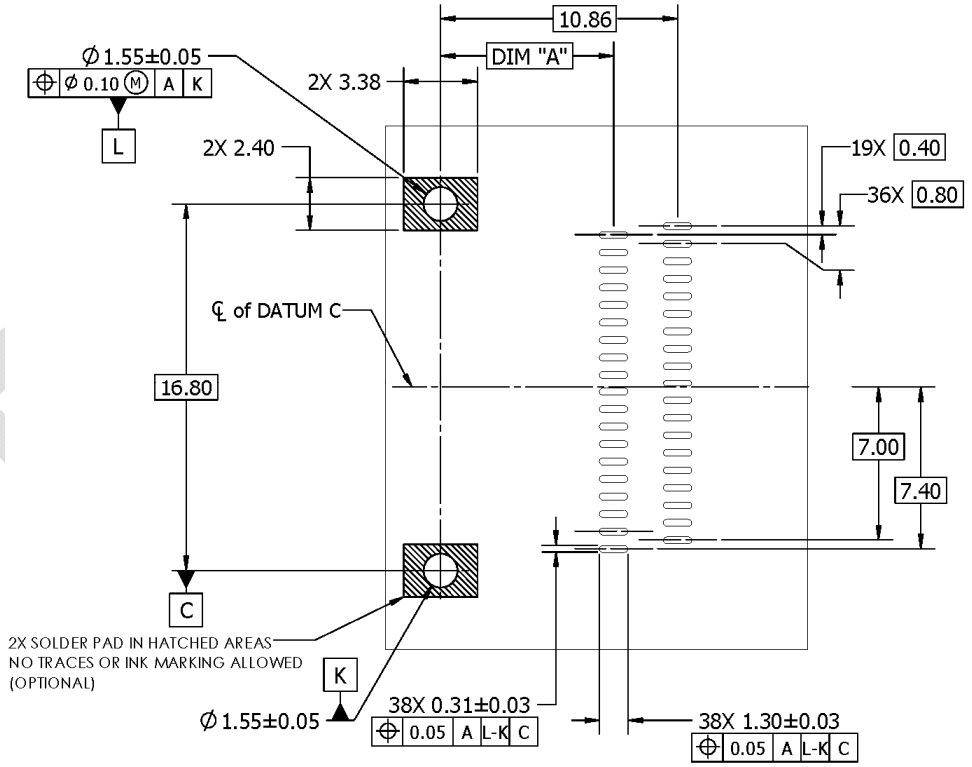
Table 5-3 QSFP112 1x1 Connector Footprint Styles

Footprint Style	Description
Style A	"LL" 0.8mm pitch connector footprint
Style B	"JL" 0.8mm pitch connector footprint

~~This document does not dictate connector tail directions. However,~~The QSFP112 1x1 connector Style A and Style B footprints are shown in Figure 5-13. ~~The QSFP224 1x1 connector Style C footprint is shown in Figure 6-9.~~ The mechanical layout for attaching the QSFP112 1x1 connector Style A or B and a cage to a host board is shown in Figure 5-14. Alternatively, a QSFP28 Style A cage can be used with the QSFP112 1x1 connector by combining the QSFP112 connector footprint with the QSFP28 cage footprint. Refer to SFF-8663 for more information. Note that the SFF-8663 cage footprint has a 9 mm pitch for the side press-fit pins to match the SFF-8663 cages while the QSFP112 cages use a 7 mm pitch for the side press-fit pins for improved board retention.



1



2

QSFP112 1x1 Footprint Style	Dim "A"
Style A	7.93
Style B	7.05

3 **Figure 5-13 PCB Layout for QSFP112 1x1 Connector (Footprint Styles A & B)**

4

5

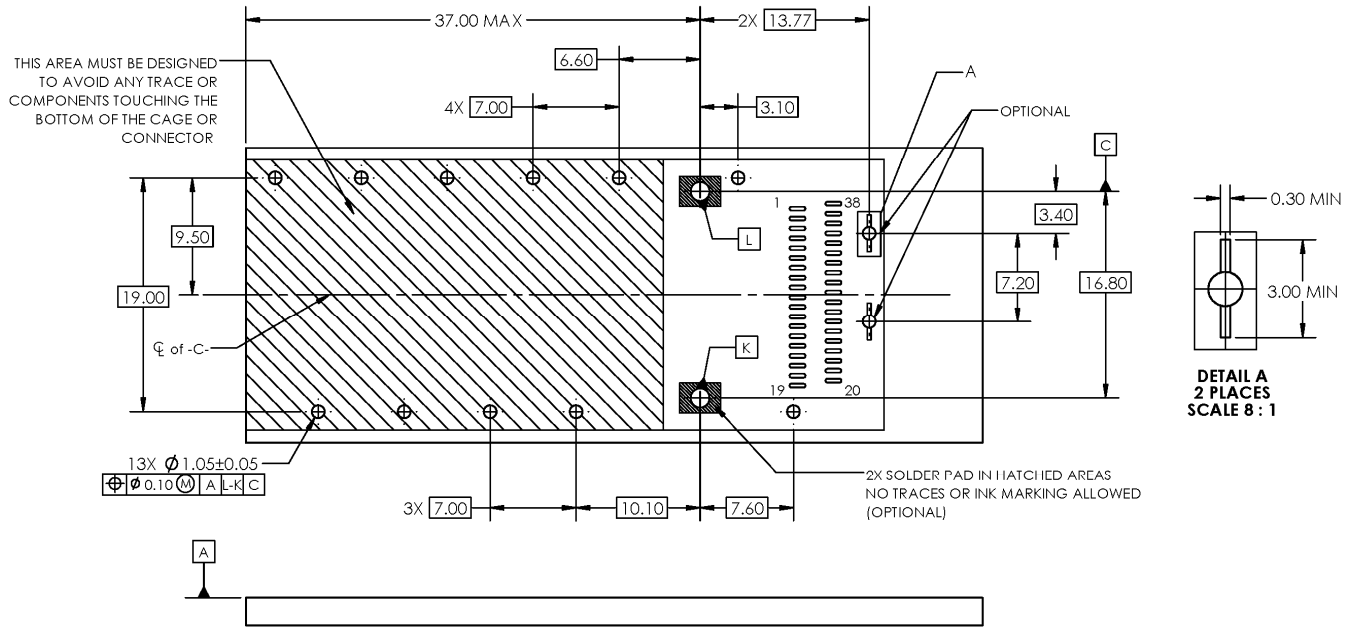


Figure 5-14 PCB Layout for QSFP112 1x1 Cage & Connector (Footprint Styles A & B)

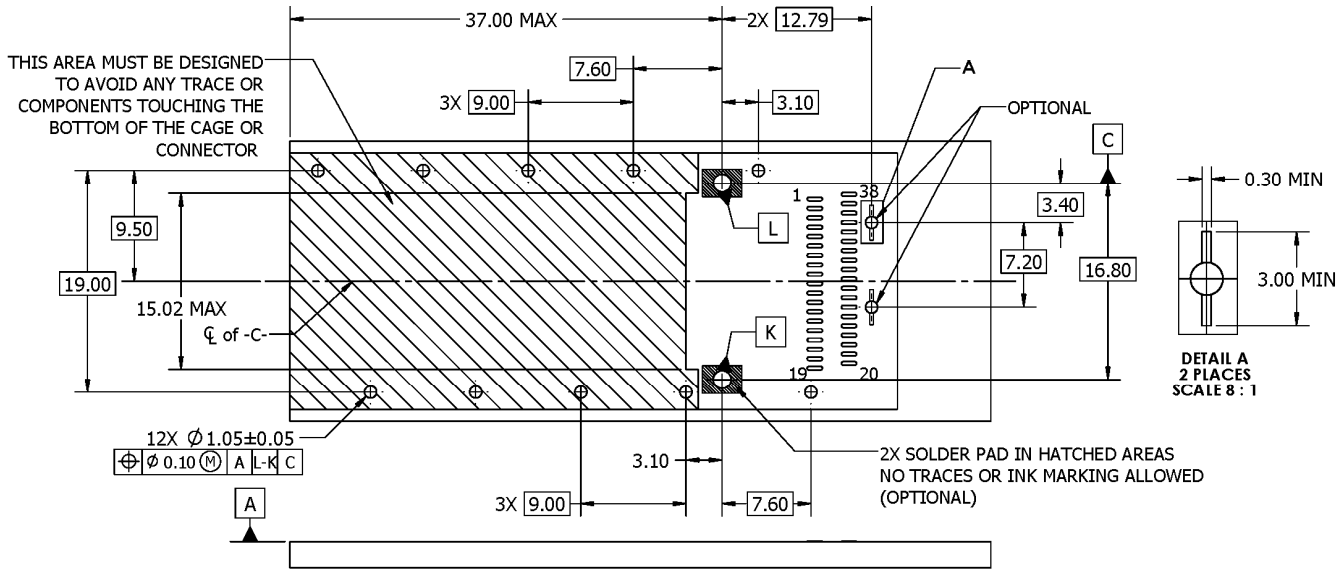


Figure 5-15 PCB Layout for 1x1 SFF-8663 Cage and QSFP112 Connector (Footprint Styles A & B)

5.4.2 QSFP112 2x1 Stacked Connector Footprints

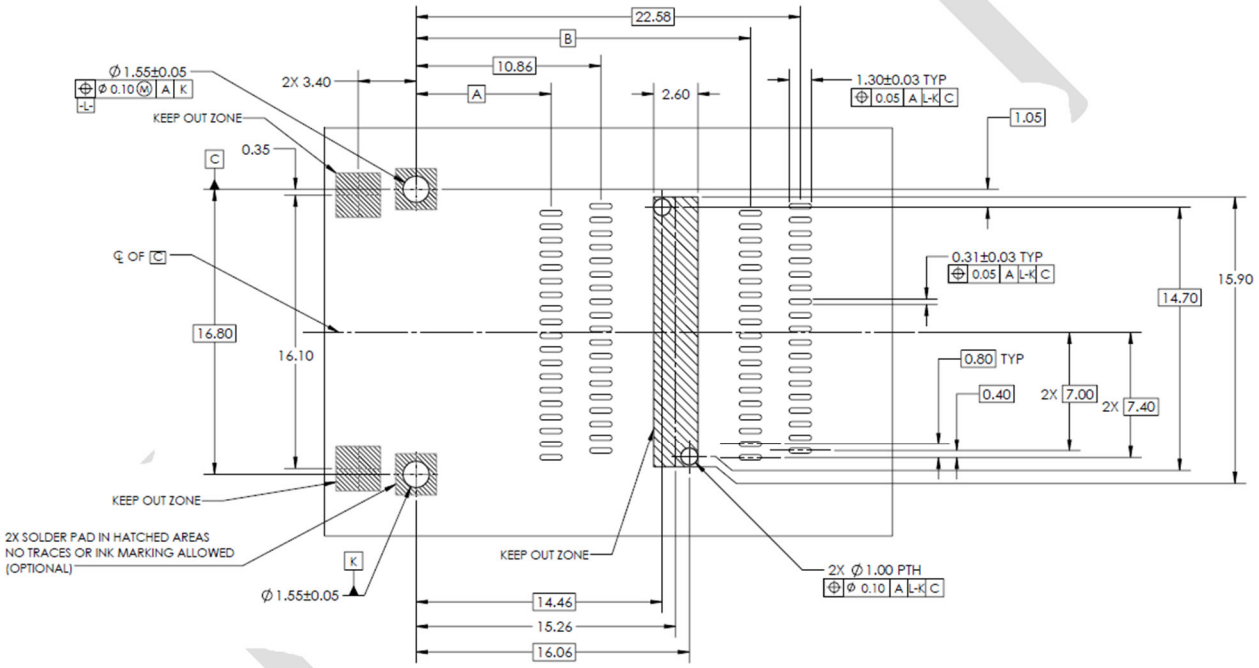
There are four QSFP112 2x1 stacked footprint styles, summarized in Table 5-4, designed to aid in the implementation of different connector tail configurations:

Table 5-4 QSFP112 2x1 Stacked Connector Footprint Styles

Style	Retention Method	Description
Style A	Retention Pin	"LL" 0.8mm pitch connector footprint with retention pin
Style B	Retention Pin	"JL" 0.8mm pitch connector footprint with retention pin
Style C	Glue	"LL" 0.8mm pitch connector footprint with glue pad
Style D	Glue	"JL" 0.8mm pitch connector footprint with glue pad

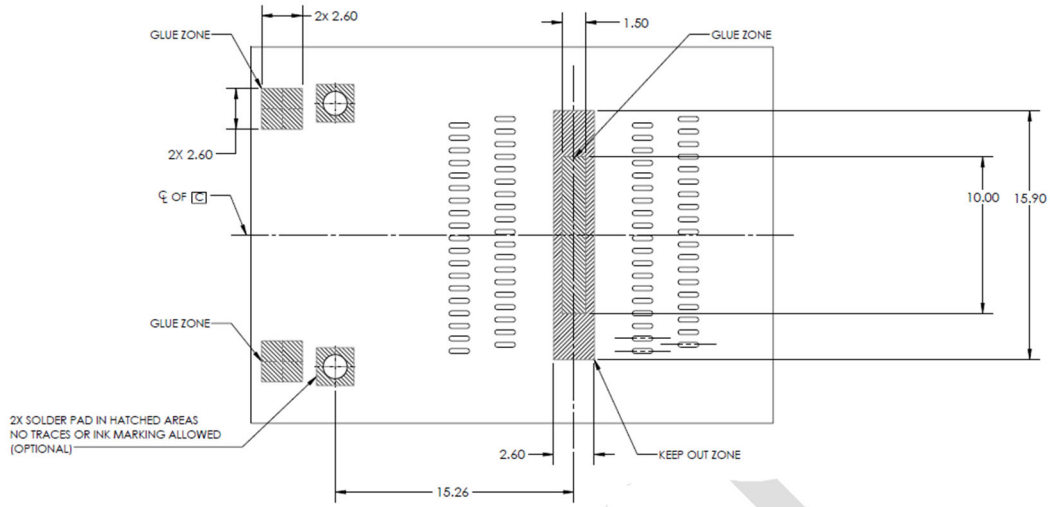
~~This document does not dictate the connector tail directions. However,~~The QSFP112 2x1 stacked connector footprints are shown in Figure 5-16 and Figure 5-17.

The mechanical layout for attaching the QSFP112 2x1 stacked connector and cage to a host board is shown in Figure 5-18.



QSFP112 2x1 Stacked Footprint Style	Dim "A"	Dim "B"
Style A	7.93	19.65
Style B	7.05	18.77
Style C (see Note)	7.93	19.65
Style D (see Note)	7.05	18.77
NOTE: Styles C & D utilize glue pads instead of retention pins. Refer to Figure 5-17 for details.		

Figure 5-16 PCB Layout for QSFP112 2x1 Stacked Connector (Footprint Styles A, B, C, & D)



NOTE: For remaining dimensions, including values for Dim A & Dim B, refer to Figure 5-16.

Figure 5-17 PCB Layout for QSFP112 2x1 Stacked Connector (Footprint Styles C & D)

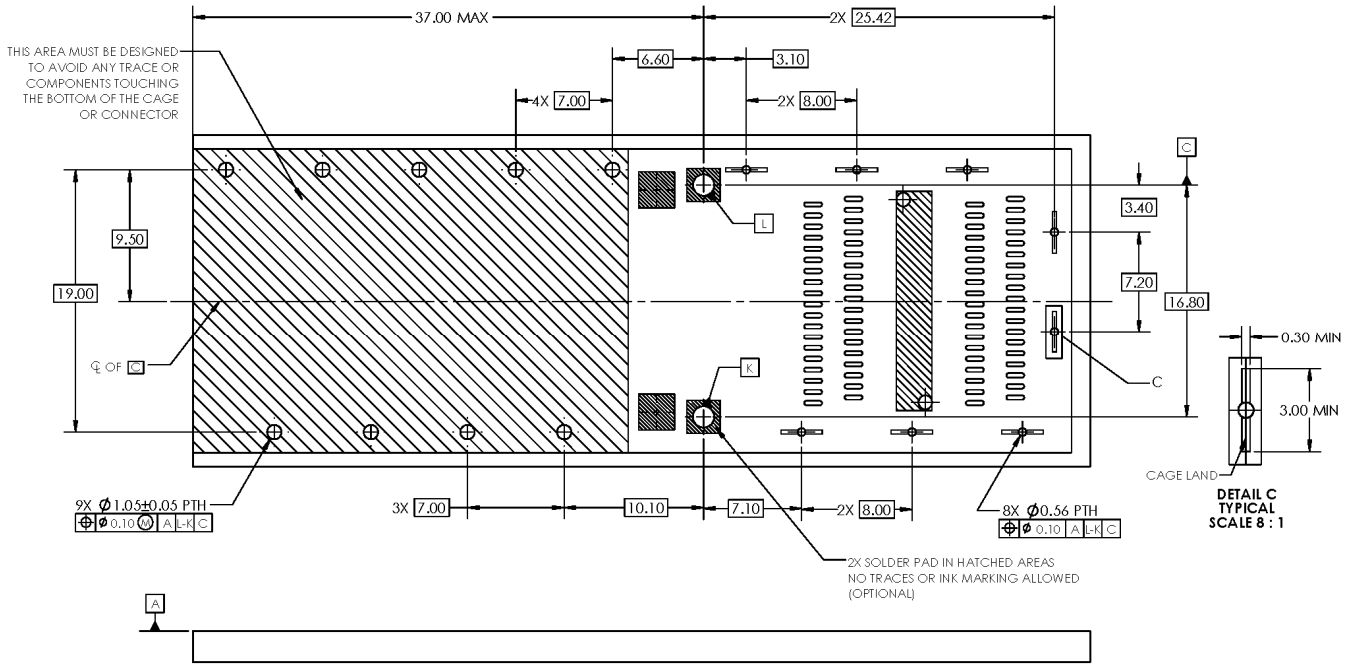


Figure 5-18 PCB Layout for QSFP112 2x1 Stacked Cage & Connector (Footprint Styles A, B, C, & D)

6. QSFP224 Mechanical Specification

6.1 QSFP224 Connector Mechanical Specification

6.1.1 QSFP224 Connector Overview

QSFP224 connectors come in a 1x1 configuration. The QSFP224 1x1 connector, shown in Figure 5-1, is a right-angle connector with 38 mating contacts and 52 solder tails. ItThe QSFP224 1x1 connector comes in one Ffootprint Style: Cfor the 52 solder tails; refer to Section 5.4.16.4.1 for the footprint details. See also Appendix B for the recommended footprint pad assignments. The QSFP224 1x1 connector contains enhancements to the QSFP112 connectors and, along with the use of the QSFP224 1x1 Ffootprint Style C, provide improved performance for greater signaling rates.

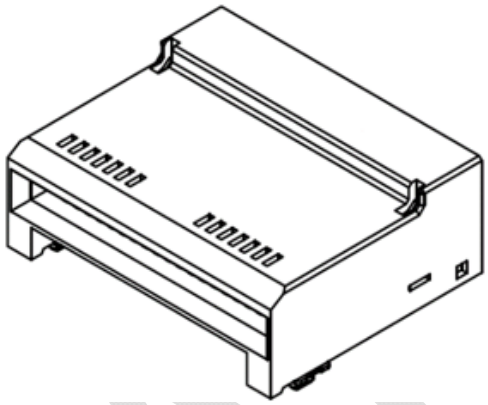
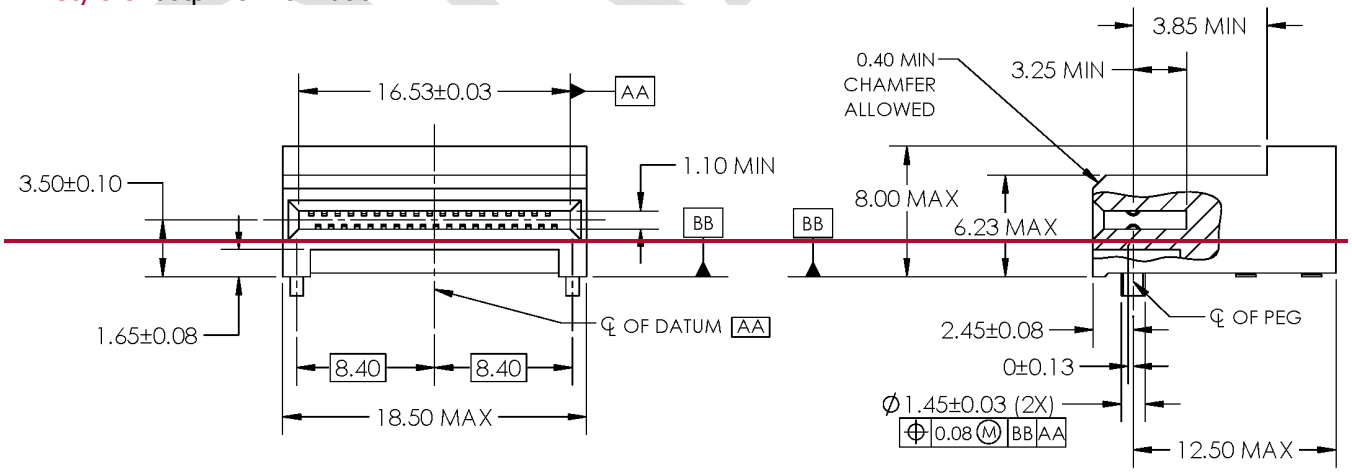


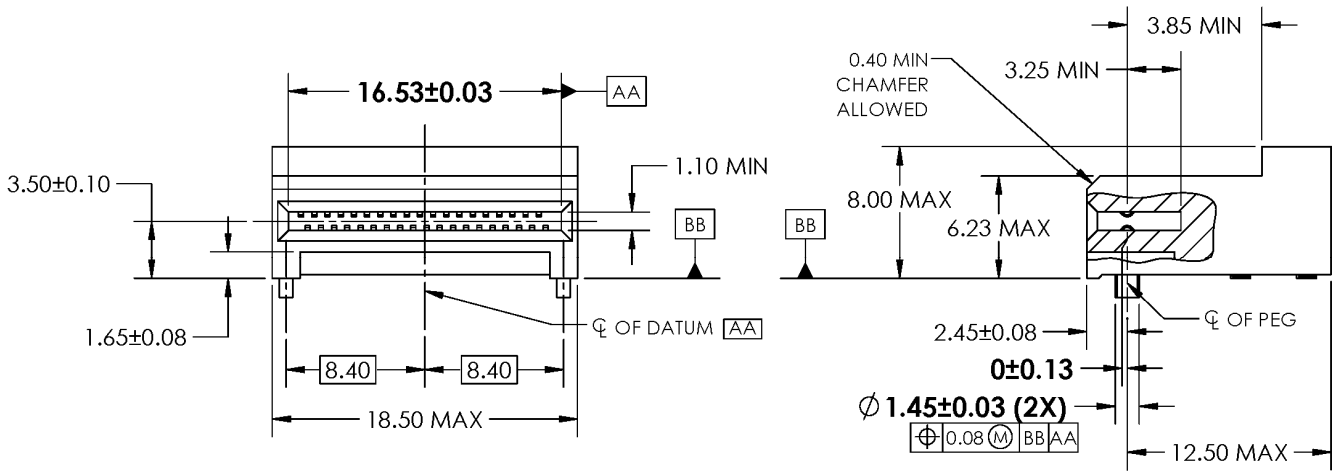
Figure 6-1 QSFP224 1x1 Connector

6.1.2 Mechanical Description: QSFP224 Connector

6.1.2.1 QSFP224 1x1 Type 2 Connector

QSFP224 1x1 Type 2 connector front and side views are shown in Figure 6-2. Refer to Section 6.46.4.1 for QSFP224 1x1 Style C footprint information.





NOTE: BOLD DIMENSIONS INDICATE A DIFFERENCE FROM THE QSFP112 1X1 CONNECTOR

Figure 6-2 QSFP224 1x1 Connector Dimensions

6.2 QSFP224 Cage Mechanical Specification

6.2.1 Overview

Detailed drawings for QSFP224 cages are provided in the following sections. Refer to Section 6.4 for footprint details and Appendix A for information about bezel openings. The cage may or may not include an opening on the top surface for a riding heat sink. If the thermal requirements for an application do not need the added heat sink, then the cage should not include the optional opening. The riding heat sink designs are not defined in this specification. However, if heat sinks are used, they should be designed to be compatible with the optional opening detailed in Figure 6-2 or Figure 6-4.

6.2.2 Mechanical Description: QSFP224 Cage

6.2.2.1 QSFP224 1x1 Cage

The QSFP224 1x1 cage is illustrated in Figure 6-3 and is backwards compatible with QSFP+ and QSFP28 ~~cages~~modules. A detailed drawing is provided in Figure 6-4. These cages are intended to be used with the angled-latch design type of latches (see below for additional details). The location of the footprint pattern on the host board is application specific. Refer to Section 6.4.1 for footprint information. Refer to Appendix A for information about bezel openings.

An angled-latch design for module and cage reduces the amount of forward and backward movement capable between the cage and module while fully mated. This reduced movement allows for more precise positioning of the mating interface signal pads of the module with respect to the mating interface contacts of the connector. When the angled-latch design is combined with a QSFP224 1x1 ~~Type 2~~ connector (which includes some tighter tolerances) and the QSFP224 1x1 ~~connector Style C~~ footprint (which provides improved isolation between signal contacts at the footprint), improved signal integrity performance is possible. The angled-latch design requires greater definition of the cage flap length (as shown in Figure 6-4) and the module latch pocket depth (as shown in Figure 6-6 QSFP224 Module Dimensions (Type 1, 2, 2A, and 2B)). The angled-latch design modules are mechanically compatible with the legacy-latch design cages defined in this specification or defined in SFF-8663. However, the full benefits of the angled-latch design would not be fully realized. The legacy-latch modules defined in this specification are mechanically compatible with all the cages defined in this specification.

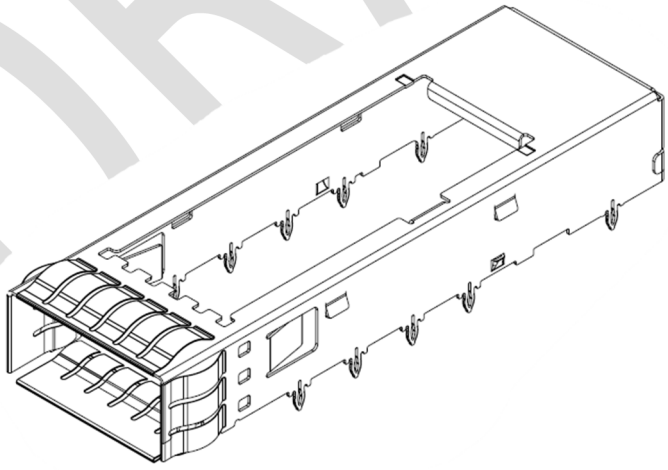
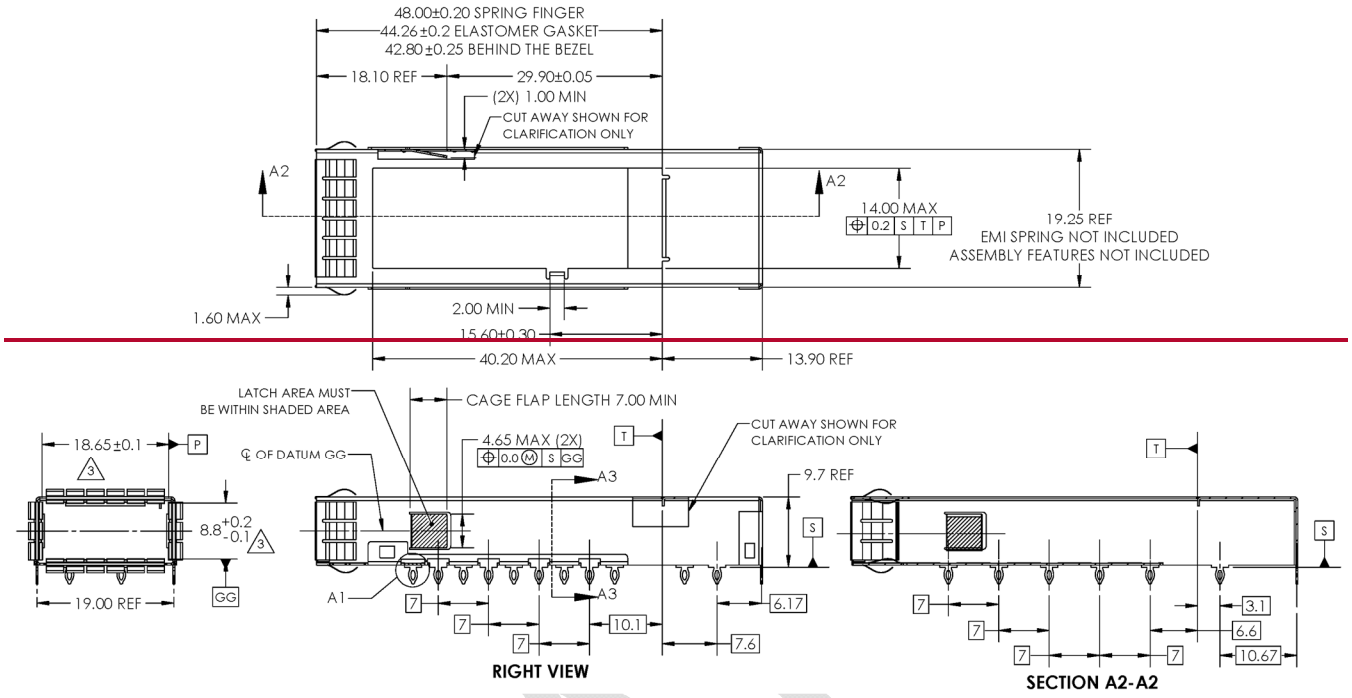


Figure 6-3 QSFP224 1x1 Cage

It is recommended that the 29.90±0.05 mm dimension (see Figure 6-4) from the tip of the cage flap (cage latch tab) to Datum T (the cage hard stop for the module) and the 7.00-9.00 mm cage flap length be measured in a mated condition, either with a mating module plugged in or a gauge plug inserted into the cage to simulate the size of a module. See Appendix C for a sample of a recommended cage gauge plug.

1



2

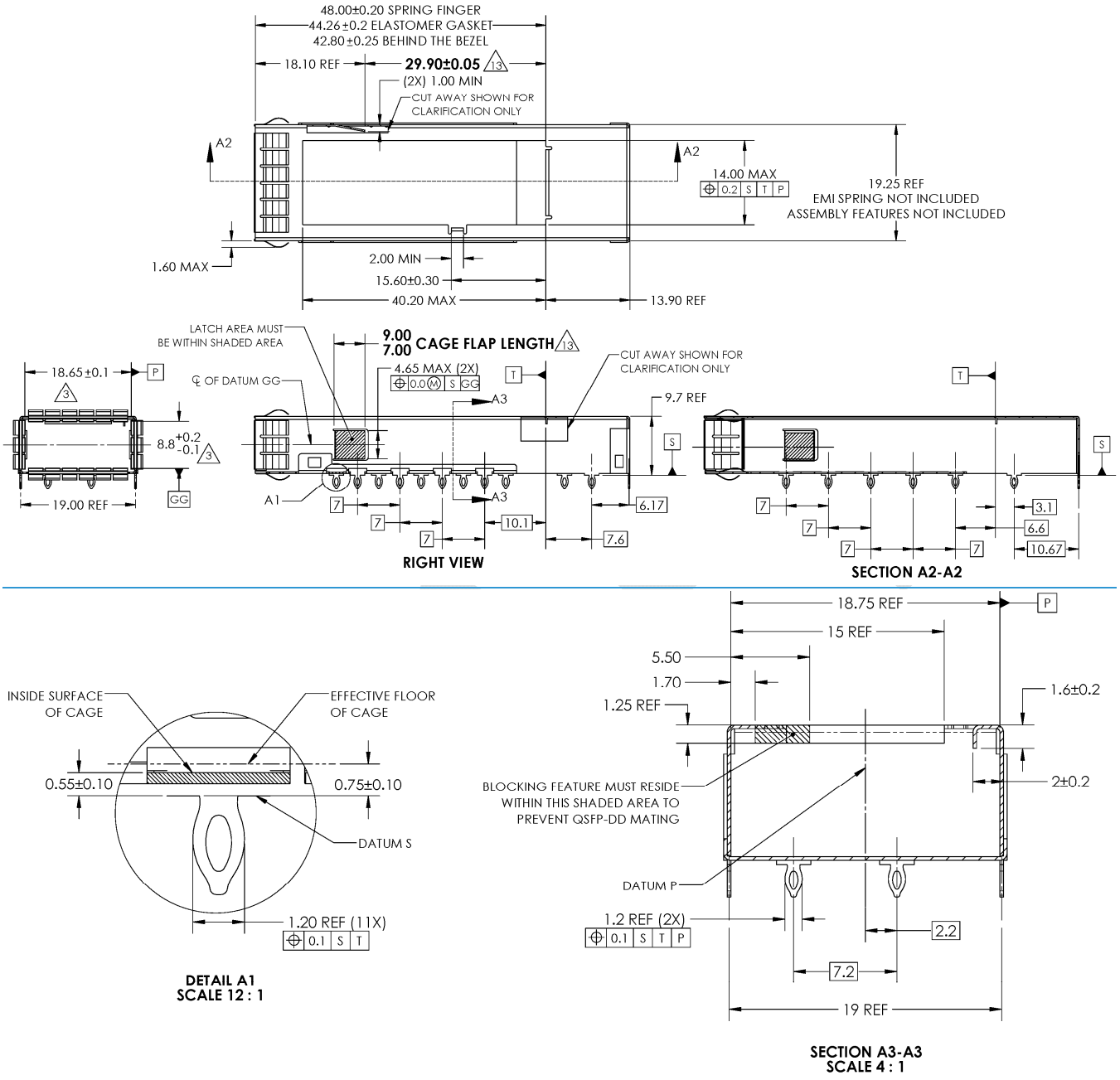


Figure 6-4 QSFP224 1x1 Cage Dimensions (1 of 2)

NOTES: (for QSFP224 1x1 cage dimensions)

1. DIMENSIONS AND TOLERANCING CONFORM TO ASME Y14.5-2009.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. DIMENSIONS FROM INSIDE SURFACES OF SPRING FINGERS WHEN FULLY DEPRESSED.
4. CONNECTOR REMOVED FOR CLARITY.
5. APPLIES TO ALL SPRING FINGERS ON ALL SIDES.
6. EXTERNAL CAGE DIMENSIONS DO NOT INCLUDE FOLDED ASSEMBLY TABS.
7. LENGTH OF CAGE AND SIGNAL TAILS
8. PRESS FIT CAGE PINS APPLY TO RIGHT SIDE OF CAGE.
9. PRESS FIT CAGE PINS APPLY TO LEFT SIDE OF CAGE.
10. PRESS FIT OFFSET BETWEEN RIGHT AND LEFT SIDE OF CAGE.
11. DIMENSIONS INCLUDE BACK COVER.
12. ~~(DELETED)~~OPENING FOR HEAT SINK IS OPTIONAL.
13. ~~OPENING FOR HEATSINK IS OPTIONAL.~~SEE THE PARAGRAPH BEFORE FIGURE 6-4 FOR THE RECOMMENDED WAY TO MEASURE THE INDICATED DIMENSIONS.
14. BOLD DIMENSIONS INDICATE A DIFFERENCE FROM THE QSFP112 1X1 CAGE DIMENSIONS.

Figure 6-4 QSFP112 1x1 Cage Dimensions (2 of 2)

~~It is recommended that the 29.90±0.05 mm dimension from the tip of the cage flap (cage latch tab) to Datum T (the cage hard stop for the module) be measured in a mated condition, either with a mating module plugged in or a gauge plug inserted into the cage to simulate the size of a module. See Appendix C for a sample of a recommended cage gauge plug.~~

6.2.3 Thermal Management for QSFP224

The thermal management of connectors systems and modules described in this document is the responsibility of the implementer. Each system is different and may require specialized solutions. This document outlines the physical characteristics of the module for interoperability with provisions to promote heat transfer. Type 2, Type 2A, and Type 2B modules offer the potential for better heat dissipation than the Type 1 modules but take up more space. The connectors/cages support external heat sinks. The cages are not limited to specific heat sink or venting configurations. This document does not suggest any airflow requirements. The implementation of thermal components is not described.

Cage-mounted riding heat sink and retention clip thermal designs are application specific and not specifically defined by this specification. However, the recommended riding heat sink normal force should be at least 25 N to help facilitate heat transfer.

6.3 QSFP224 Module Mechanical Specification

6.3.1 Overview

The QSFP224 module mechanical dimensions are nearly identical to QSFP112 modules. For QSFP224 modules, the bottom surface of the module within the cage shall be flat without a pocket. The options for the position of the label could include the bottom surface of the module that protrudes outside the bezel of the cage or etched into the metal surface. Caution should be exercised that any etchings do not affect thermal performance.

6.3.2 Mechanical Description: QSFP224 Module

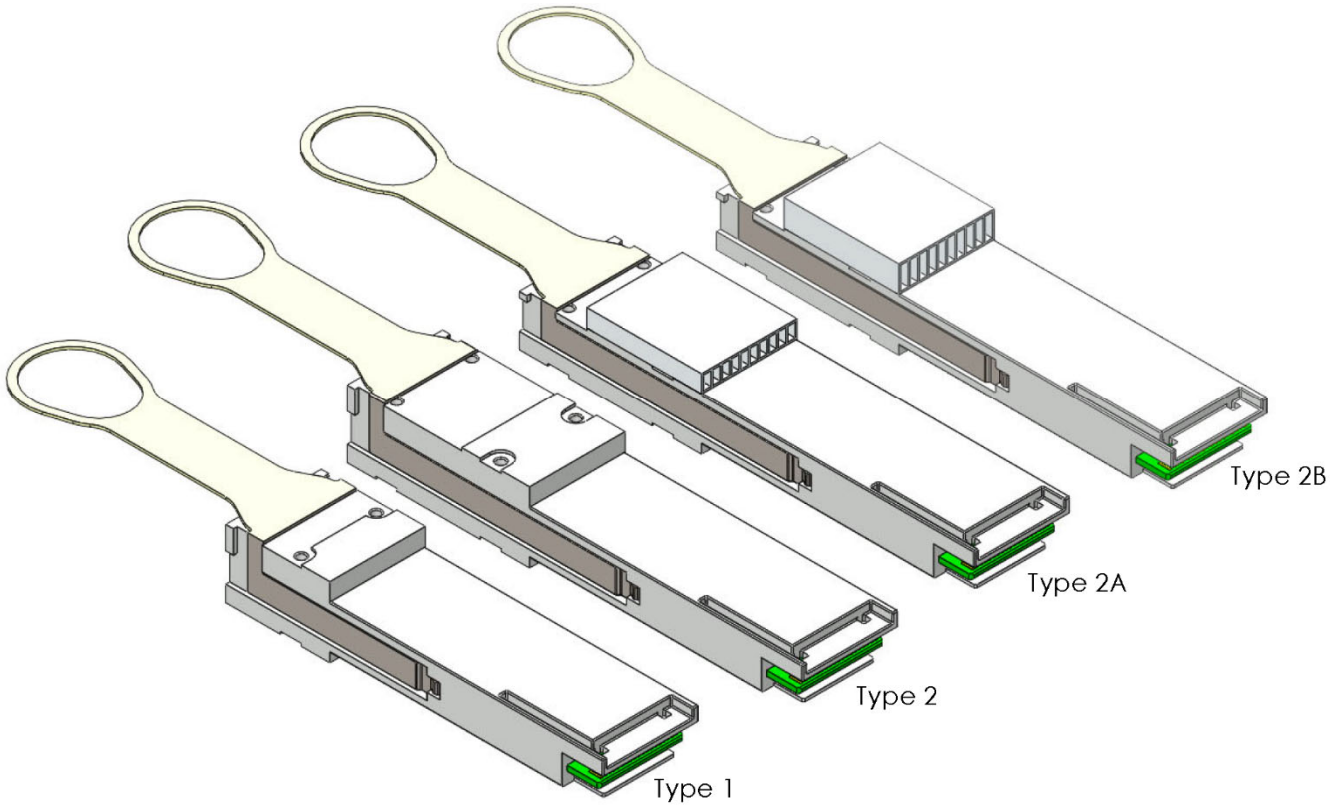
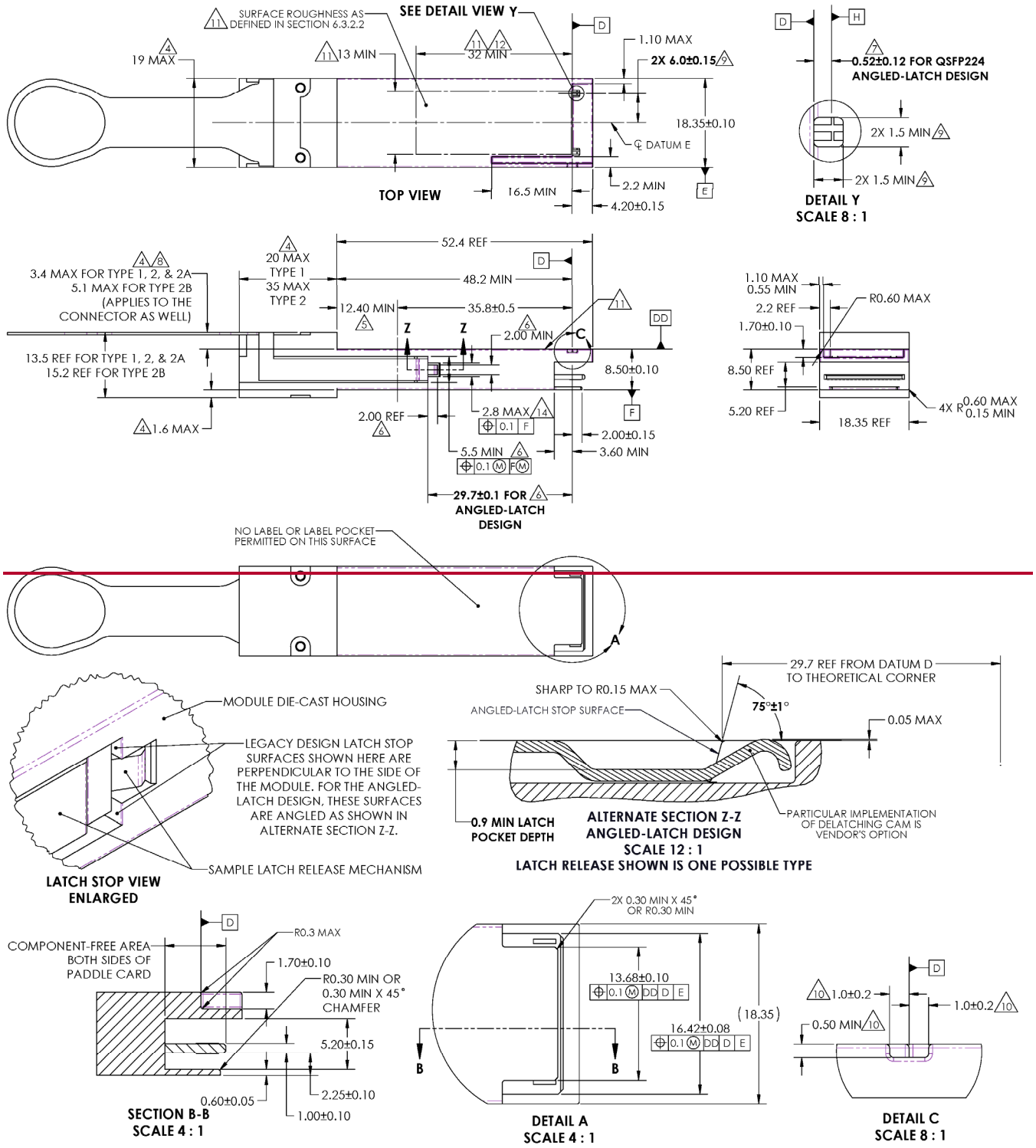
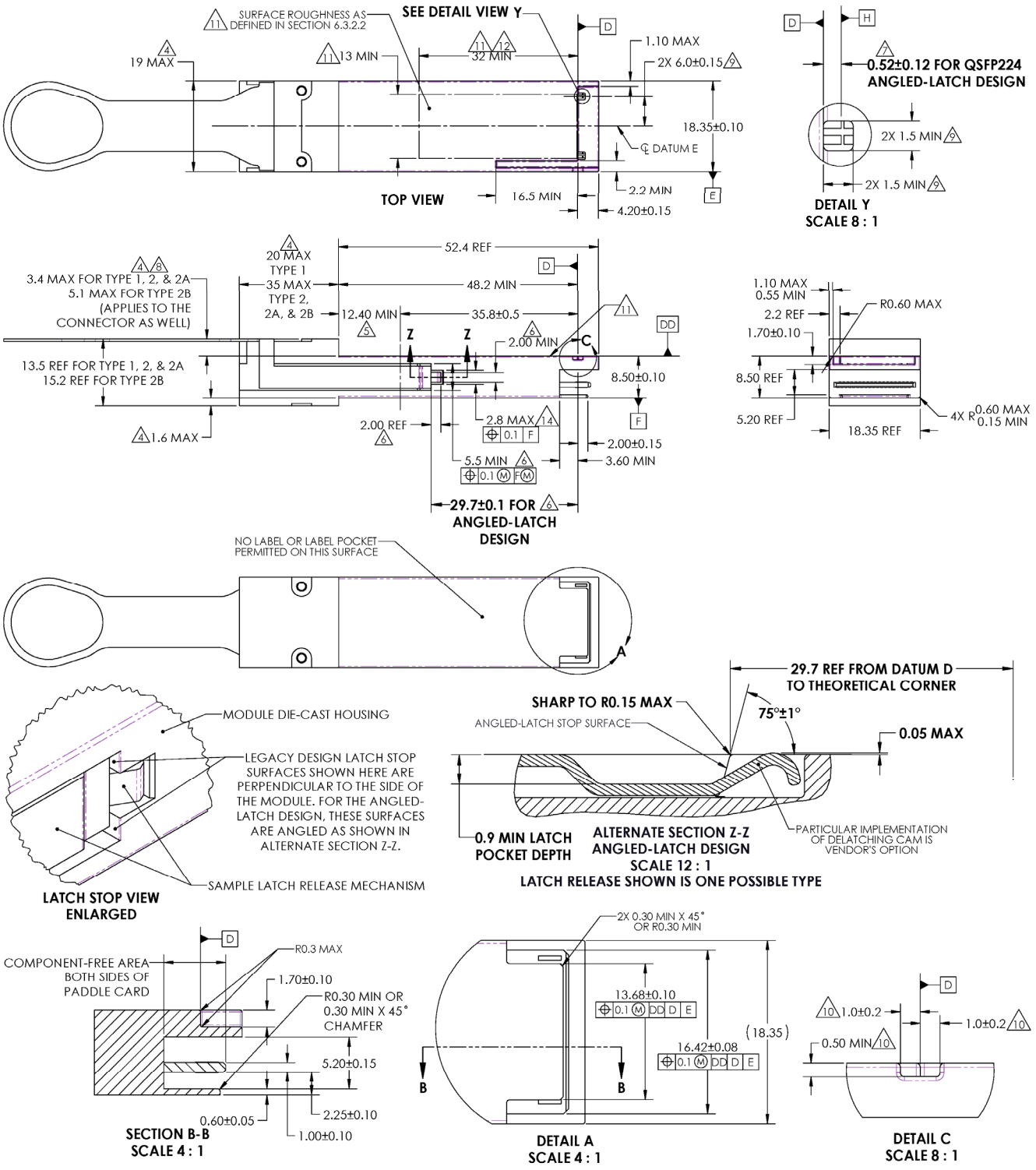


Figure 6-5 QSFP2 Module Types

6.3.2.1 QSFP224 Module Mechanical Dimensions





NOTE: Heat sink definitions for QSFP2 2A & 2B module types are shown in Figure 6-7.

Figure 6-6 QSFP224 Module Dimensions (Type 1, 2, 2A, and 2B)

NOTES: (for QSFP224 module dimensions)

1. DIMENSIONS AND TOLERANCING CONFORM TO ASME Y14.5-2009.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. UNLESS OTHERWISE SPECIFIED, SHARP CORNERS, EDGES, AND BURRS ARE NOT ALLOWED. ROUND OFF ALL EDGES AND CORNERS TO A MINIMUM RADIUS OF 0.20 MM.

4 DIMENSION DEFINES ENLARGED SECTION OF MODULE THAT EXTENDS OUTSIDE OF CAGE TO ACCOMMODATE MATING PLUG AND ACTUATOR MECHANISM.

5 SURFACES ON ALL 4 SIDES OF THE 12.4 MIN DIMENSION TO BE CONDUCTIVE FOR CONNECTION TO CHASSIS GROUND.

6 DIMENSION APPLIES TO THE LATCH MECHANISM.

7 DIMENSION APPLIES TO THE LOCATION OF THE EDGE OF THE MODULE PADDLE CARD PAD, DATUM H. CONTACTS 21, 22, 36, AND 37 ARE VISIBLE.

8 DIMENSION TO INCLUDE BAIL TRAVEL.

9 DIMENSIONS APPLY TO OPENINGS IN THE HOUSING.

10 OPTIONAL FEATURE TO AID INSPECTION OF DIMENSIONS FROM DATUM D.

11 FLATNESS AND SURFACE ROUGHNESS (Ra) APPLIES FOR INDICATED LENGTH AND MIN WIDTH OF 13 MM. SURFACE TO BE THERMALLY CONDUCTIVE. SEE SECTION 6.3.2.2~~7.2.2~~, Table 6-1~~TABLE 7-1~~, FOR FLATNESS AND ROUGHNESS REQUIREMENTS.

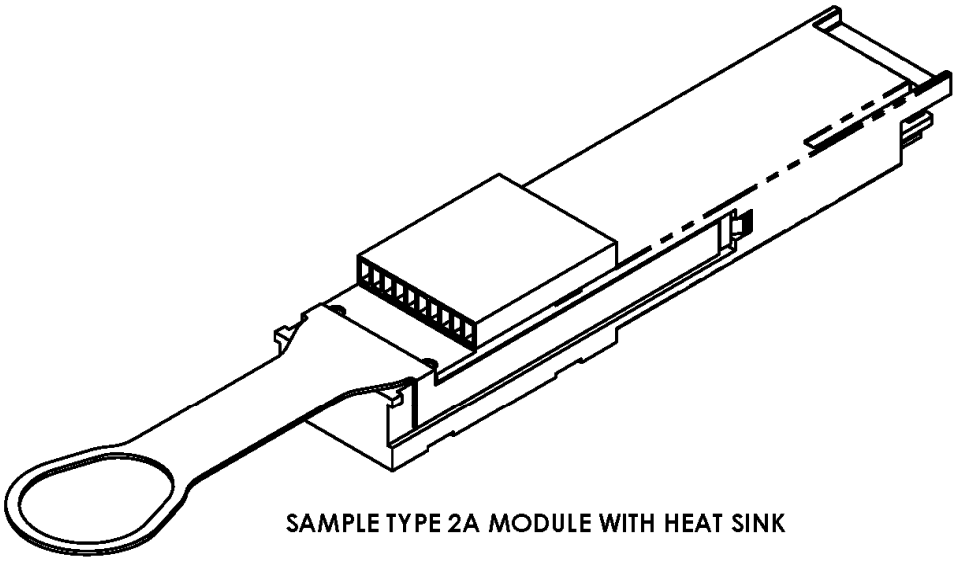
12 HIGHER WATTAGE MODULES MAY REQUIRE ADDITIONAL SPACE FOR COOLING.

13 NO LABEL MATERIAL SHALL BE APPLIED IN THIS AREA. ETCHINGS ARE ALLOWED, BUT MUST NOT AFFECT THERMAL PERFORMANCE.

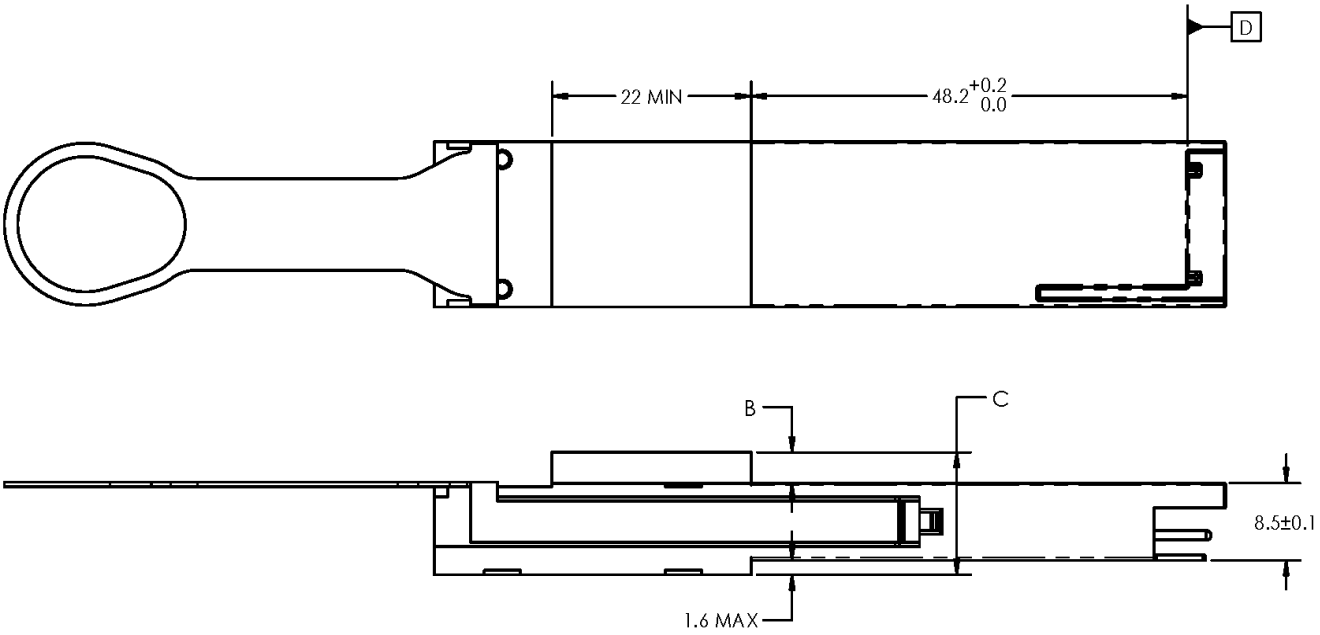
14 DIMENSION APPLIES TO LATCH POCKET.

15. BOLD DIMENSIONS INDICATE A DIFFERENCE FROM THE QSFP112 1X1 MODULE DIMENSIONS.

Figure 6-6 QSFP224 Module Dimensions (Type 1, 2, 2A, and 2B) Continued



SAMPLE TYPE 2A MODULE WITH HEAT SINK



QSFP224 Module Type	Dim "B" (MAX)	Dim "C" (REF)
Type 2A	3.4	13.5
Type 2B	5.1	15.2

Figure 6-7 QSFP224 Module Type 2A, Type 2B Details

6.3.2.2 QSFP2 Module Flatness and Surface Roughness for QSFP224

Module flatness and surface roughness are specified for QSFP224 modules to improve thermal characteristics when used with a riding heat sink. Relaxed specifications are used for lower power modules to potentially reduce cost. The flatness and surface roughness specifications are shown in Table 6-1 and apply to the specified heat sink contact area. Flatness and roughness specifications apply to both top and bottom surfaces of modules. Power Class 1Cu is dedicated to passive copper cables with a more relaxed flatness of 0.15 mm.

Table 6-1 QSFP224 Module Flatness And Surface Roughness Specifications

Power Class[1]	Module Flatness (mm) Tol Zone	Surface Roughness (Ra, µm) MAX
1Cu[2]	0.15	1.6
1	0.075	1.6
2	0.075	1.6
3	0.075	1.6
4	0.075	1.6
5	0.075	1.6
6	0.075	1.6
7	0.075	1.6
8	0.050	0.8
1. Power Classes are defined in SFF-8679. 2. Power Class 1Cu maximum power dissipation is the same as Power Class 1.		

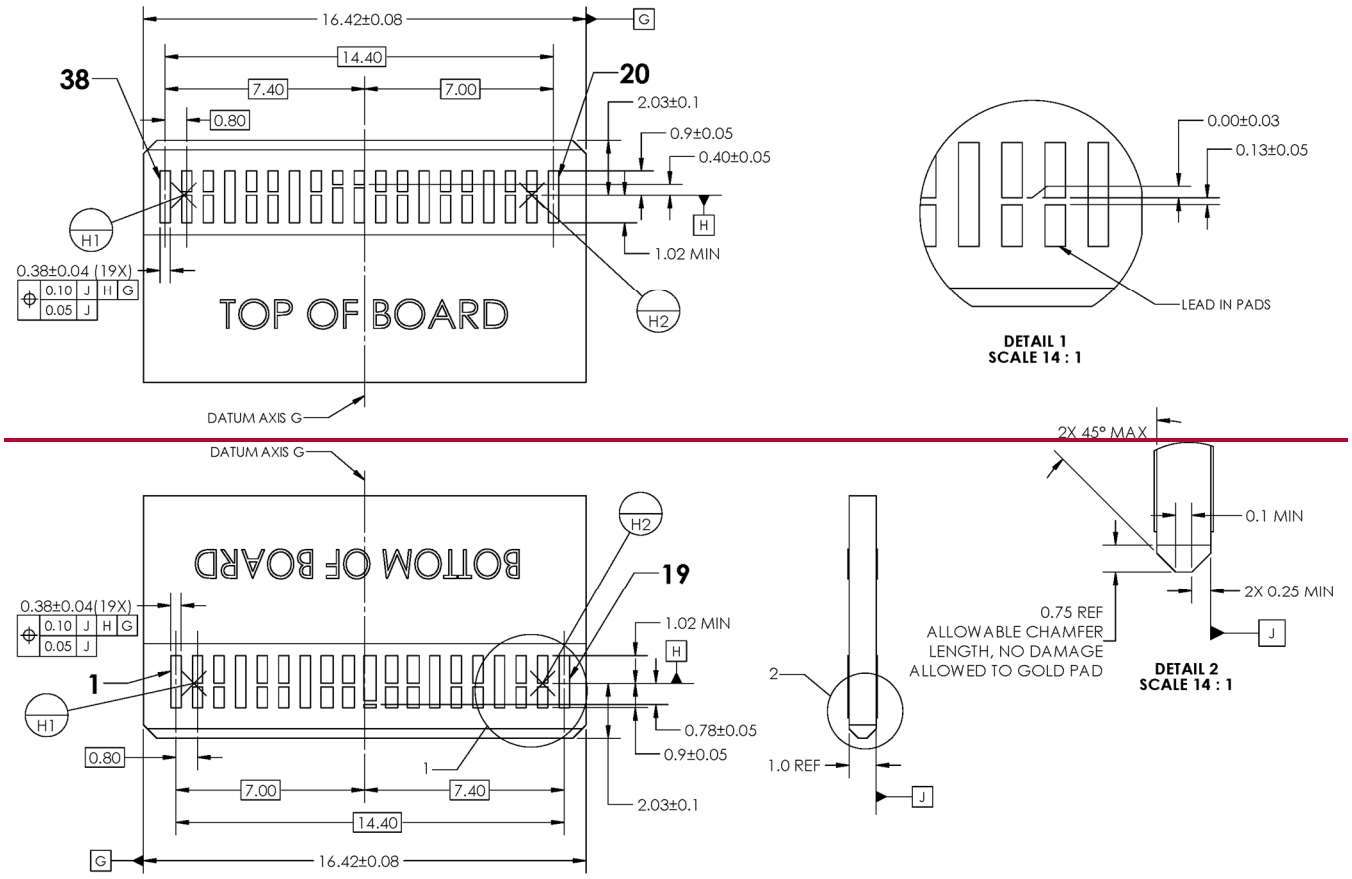
To improve thermal performance, optional enhanced surface specifications are specified in Table 6-2. This is an optional specification and does not override the required specifications in Table 6-1.

Table 6-2 Optional Enhanced QSFP224 Module Flatness Specifications

Power Class	Module Flatness (mm) Tol Zone	Surface Roughness (Ra, µm) MAX
8	0.025	0.4

6.3.2.3 QSFP224 Card Edge Description (Mechanical Interface)

The QSFP224 module paddle card ~~width,~~ pad~~, and chamfer~~ dimensions have been modified compared to ~~legacy QSFP+/QSFP28 module paddle cards (defined in SFF-8662) and~~ QSFP112 module paddle cards to support greater signaling rates. See Figure 6-8 for QSFP224 module paddle card dimensions. ~~All other module paddle card dimensions, except for the card width, pads, and chamfers, remain the same as the QSFP+ and QSFP28 specifications. Refer to SFF-8662 for more information, including Section 6.1 Free (Module) Paddle Card, where TABLE 6-1 FREE (MODULE) PADDLE CARD DIMENSIONS in that specification identifies the pad types.~~



1

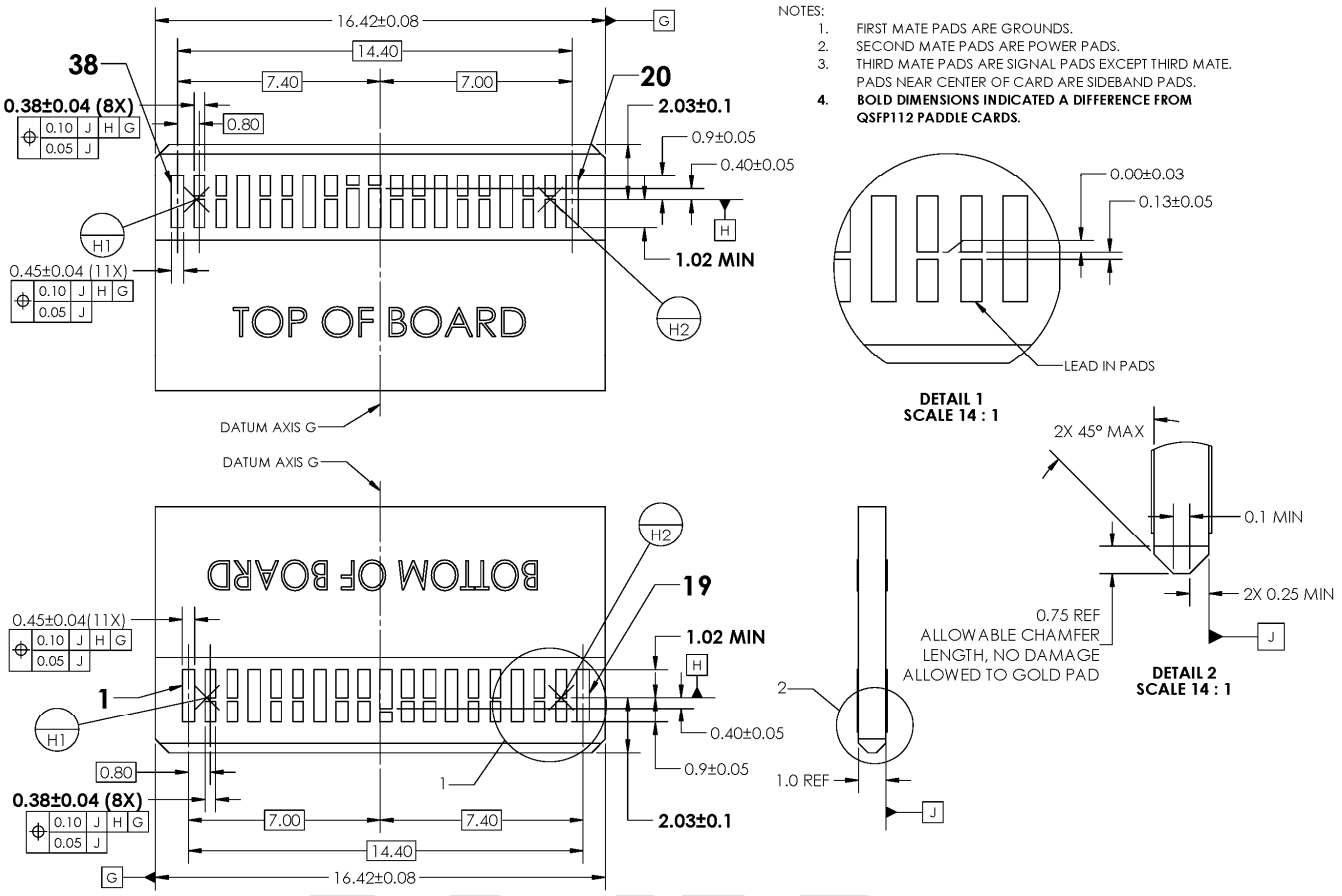


Figure 6-8 QSFP224 Paddle Card Dimensions

6.4 QSFP224 Footprints

To achieve operation at greater signaling rates, the QSFP224 footprint pad dimensions and associated tolerances have been improved compared to QSFP+ / QSFP28 / QSFP112.

6.4.1 QSFP224 1x1 Connector Footprints

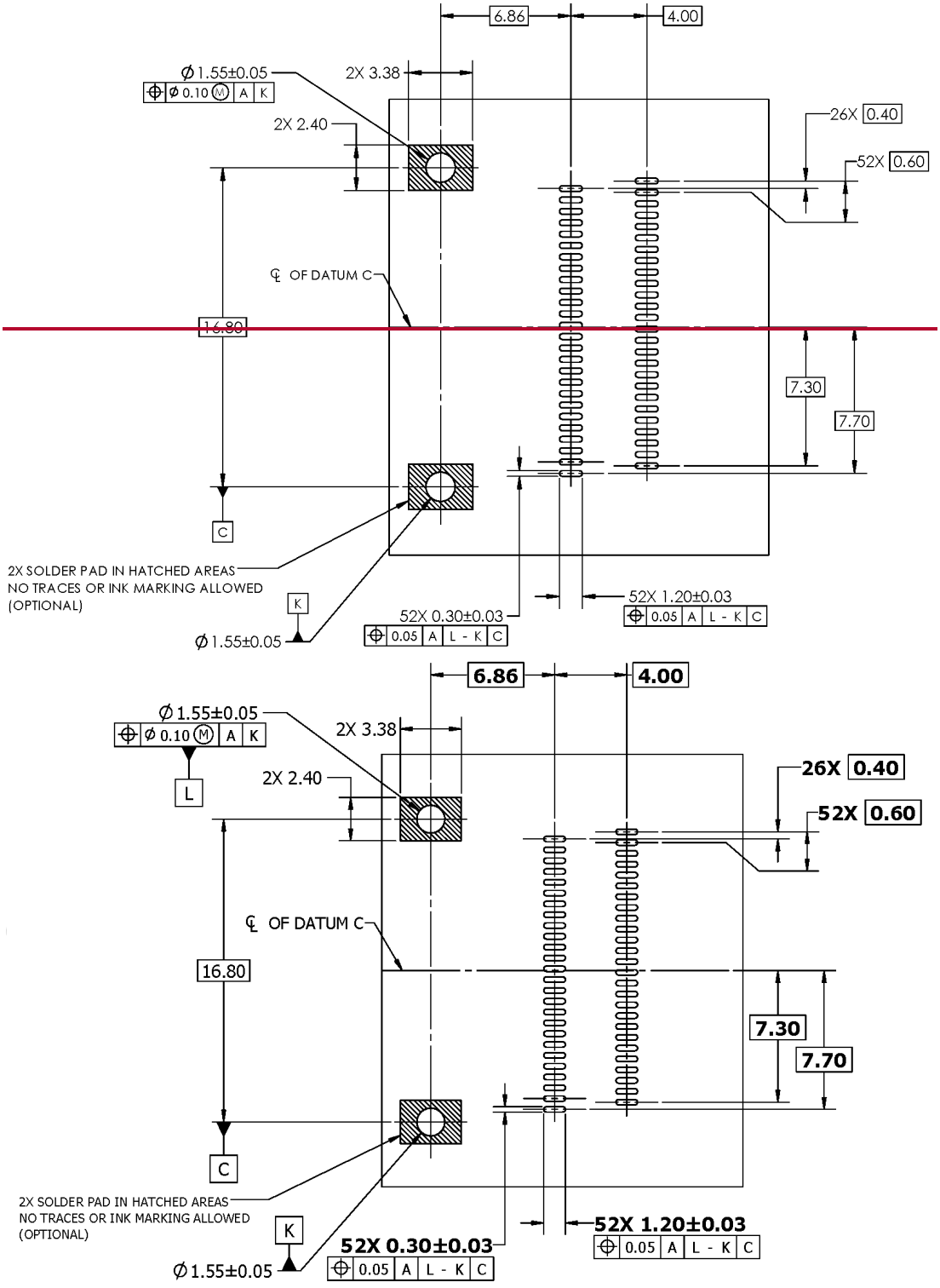
There is one QSFP224 1x1 footprint style~~, Style C,~~ summarized in Table 6-3:

Table 6-3 QSFP224 1x1 Connector Footprint ~~Styles~~

1x1 Footprint ~~Style~~	Description
~~Style C~~QSFP224 1x1	"LL" 0.6mm pitch connector footprint

The QSFP224 1x1 connector ~~Style C~~ footprint is shown in Figure 6-9. The mechanical layout for attaching the QSFP224 1x1 connector with ~~Style C~~ the QSFP224 1x1 footprint and cage to a host board is shown in Figure 6-10.

Within the QSFP224 1x1 connectors ~~for footprint Style C~~, some of the 38 contact positions at the mating interface are divided into two solder tails at the footprint interface resulting in a greater number of solder tails and requiring a greater number of footprint pads. The following mating interface contact positions are divided at the solder tail end: Contact Number 1, 4, 7, 10, 13, 16, 19, 20, 23, 26, 29, 32, 35, and 38. The result is 52 solder tails requiring 52 footprint pads as shown in Figure 6-9 (also see Appendix B).



NOTE: BOLD DIMENSIONS INDICATE A DIFFERENCE FROM THE QSFP112 1X1 FOOTPRINT DIMENSIONS

Figure 6-9 PCB Layout for QSFP224 1x1 Connector ~~(~~Footprint ~~Style C)~~

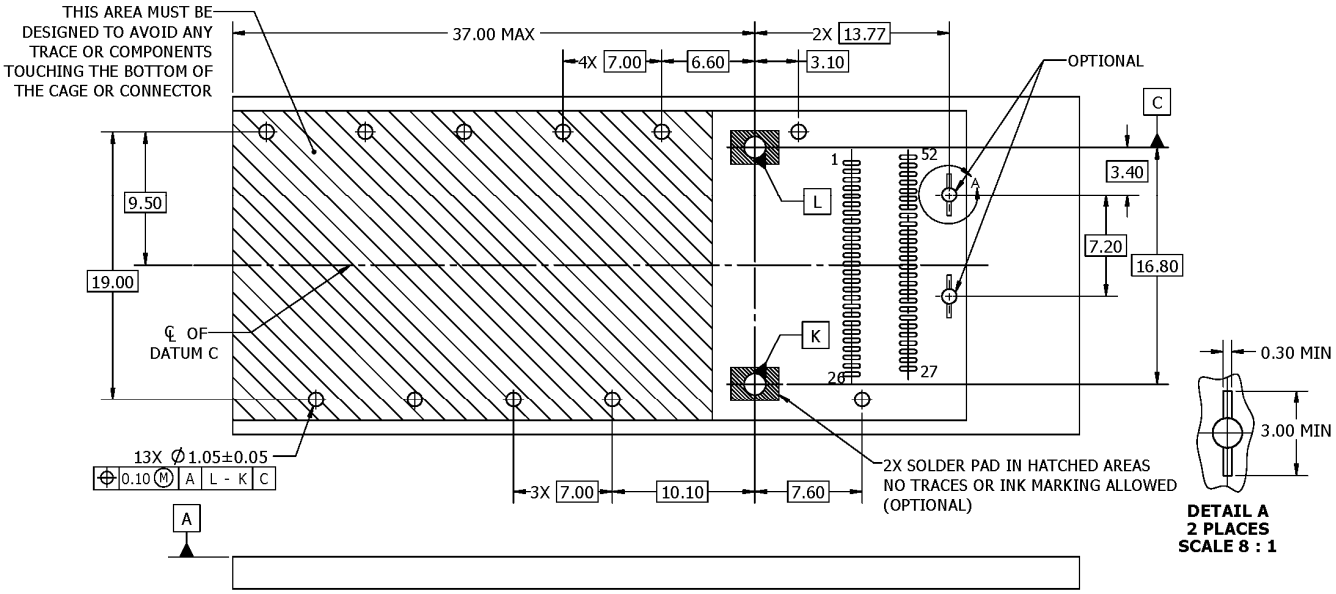


Figure 6-10 PCB Layout for QSFP224 1x1 Cage & QSFP224 1x1 Connector Footprint ~~Style C~~

7. Test Requirements and Methodologies (TS-1000, etc.)

7.1 QSFP2 Performance Tables

EIA-364-1000 (TS-1000) shall be used to define the test sequences and procedures for evaluating the connector system described in this document. Where multiple test options are available, the manufacturer shall select the appropriate option where not previously specified. The selected procedure should be noted when reporting data. If there are conflicting requirements or test procedures between EIA-364 procedures and those contained within this document, this document shall be considered the prevailing authority.

Unless otherwise specified, procedures for sample size, data, and collection to be followed as specified in EIA-364-1000. See EIA-364-1000 Annex B for objectives of tests and test groups.

Table 7-1 summarizes the performance criteria that are to be satisfied by the connector described in this document. Most performance criteria are validated by EIA-364-1000 testing, but this test suite leaves some test details to be determined. To ensure that testing is repeatable, these details are identified in Table 7-2. Finally, testing procedures used to validate any performance criteria not included in EIA-364-1000 are provided in Table 7-3.

Table 7-1 Form Factor Performance Requirements

Performance Parameters	Description/ Details	Requirement
Mechanical/ Physical Requirements		
Plating Type	Plating type on connector contacts	Precious
Surface Treatment	Surface treatment on connector contacts, if surface treatment is applied, Test Group 6 is required.	Manufacturer to specify
Wipe length	Designed distance a contact traverses over a mating contact surface during mating and resting at a final position. If less than 0.127 mm, Test Group 6 is required	Manufacturer to specify
Rated Durability Cycles	The expected number of durability cycles a component is expected to encounter over the course of its life	Connector/ cage: 100 MIN cycles Module: 50 MIN cycles
Mating Force* (See Note 2)	Amount of force needed to mate a module with a connector (with or without the presence of a riding heat sink) when latches are deactivated	60 N MAX
Unmating Force* (See Note 2)	Amount of forced needed to separate a module from a connector (with or without the presence of a riding heat sink) when latches are deactivated	40 N MAX
Latch Retention* (See Note 2)	Amount of force the latching mechanism can withstand	90 N MIN
Cage Latch Strength*	The amount of force that the cage latches can hold without being damaged.	125 N MIN
Cage Retention to Host Board*	Amount of force a cage can withstand without separating from the host board	114 N MIN
Environmental Requirements		
Field Life	The expected service life for a component	10 years
Field Temperature	The expected service temperature for a component (ambient air temperature around the component)	65°C, applicable to the mated cage, connector, and module only
Electrical Requirements		
Current	Maximum current to which a contact is exposed in use	0.5 A per signal contact MAX 1.5 A per power contact MAX
Operating Rating Voltage	Maximum voltage to which a contact is exposed in use	29.9 V DC per contact MAX

NOTES:
1. Performance criteria denoted with stars (*) are not validated by EIA-364-1000 testing. Refer to Table 7-3 for test procedures and pass/fail criteria.
2. Refer to the QSFP-DD MSA for the interactions of QSFP modules with QSFP-DD connectors and cages.

Table 7-2 describes the details necessary to perform the tests described in the EIA-364-1000 test sequences. Testing shall be done in accordance with EIA-364-1000 and the test procedures it identifies in such a way that the parameters/ requirements defined in Table 7-1 are met. Any information in this table supersedes EIA-364-1000.

Table 7-2 EIA-364-1000 Test Details

Test	Test Descriptions and Details	Pass/ Fail Criteria
Mechanical/ Physical Tests		
Durability (preconditioning)	EIA-364-09 To be tested with connector, cage, and module (Latches may be locked out to aid in automated cycling)	No evidence of physical damage
Durability (see Note 1)	EIA-364-09 To be tested with connector, cage, and module (Latches may be locked out to aid in automated cycling)	No visual damage to mating interface or latching mechanism
Environmental Tests		
Cyclic Temperature and Humidity	EIA-364-31 Method IV omitting step 7a. Test Duration B	No intermediate test criteria
Vibration	EIA-364-28 Test Condition VII Test Condition Letter D Test set-up: Connectors may be restrained by a plate that replicates the system panel opening as defined in this specification. External cables may be constrained to a non-vibrating fixture a minimum of 8 inches from the module. For cabled connector solutions: Wires may be attached to PCB or fixed to a non-vibrating fixture.	No evidence of physical damage -AND- No discontinuities longer than 1 µs allowed
Mixed Flowing Gas	EIA-364-65 Class II See Table 4.1 in EIA-364-1000 for exposure times. Test option per EIA-364-1000: Option 3	No intermediate test criteria during the EIA-364-65 portion of the EIA-364-1000 Group 4 testing
Electrical Tests		
Low Level Contact Resistance (see Note 2)	EIA-364-23 20 mV DC MAX, 100 mA MAX To include wire termination or connector-to-board termination	20 mΩ MAX change from baseline
Dielectric Withstanding Voltage	EIA-364-20 Method B 300 VDC minimum for 1 minute Applied voltage may be product / application specific	No defect or breakdown between adjacent contacts -AND- 5 mA Max Leakage Current
NOTES: 1. Since the durability requirement on the connector and cage is greater than that of the module, modules may be replaced after their specified durability rating. 2. The first low level contact resistance reading in each test sequence is used to determine a baseline measurement. Subsequent measurements in each sequence are measured against this baseline.		

Table 7-3 describes the testing procedures necessary to validate performance criteria not validated by EIA-364-1000 testing. The tests are to be performed in such a way that the parameters/ requirements defined in Table 7-1 are met.

Table 7-3 Additional Test Procedures

Test	Test Descriptions and Details	Pass/ Fail Criteria
Mechanical/ Physical Tests		
Mating Force (See Note 1)	EIA-364-13 To be tested with cage, connector, and module. Latching mechanism deactivated (locked out).	Refer to Table 7-1 -AND- No physical damage to any components
Unmating Force (See Note 1)	EIA-364-13 To be tested with cage, connector, and module. Latching mechanism deactivated (locked out).	
Latch Retention	EIA-364-13 To be tested with cage, connector, and module without heat sinks Latching mechanism engaged (not locked out)	
Latch Strength	An axial load applied using a static load or ramped loading to the specified load. To be tested with cage, connector, and module or module representative tool without heat sinks Latching mechanism engaged (not locked out).	
Cage Retention to Host Board	Tested with module, a module analog, or fixtures mated to cage. Pull cage in a direction perpendicular to the board at a rate of 25.4mm/min to the specified force.	No physical damage to any components -AND- Cage shall not separate from board
Electrical Tests		
Current	EIA-364-70 Method 3, 30-degree temperature rise. Contacts energized: All signal and power contacts tested simultaneously.	Refer to Table 7-1 for current magnitude
NOTES: 1. Values listed in Table 7-1 for these tests apply with or without the presence of a riding heat sink.		

Appendix A. Bezel Panel Cut-Out Recommendations (Informative)

A.1 1x1 Bezel Panel Cut-Out

The recommended bezel panel cut-out for a QSFP2 (QSFP112 or QSFP224) 1x1 cage is shown in Figure A-1. An example of a QSFP2 1x1 bezel design for use with Type 2A & 2B modules is shown in Figure A-2.

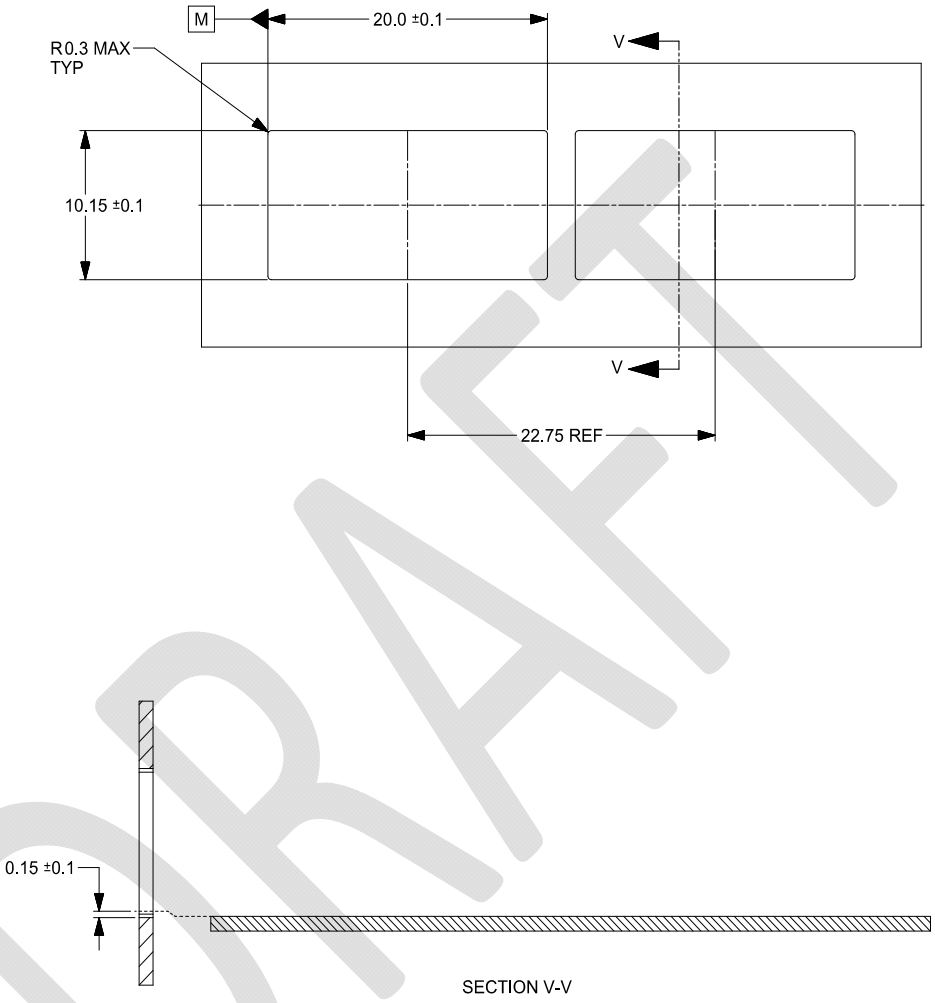


Figure A-1 Recommended QSFP2 1x1 Bezel Panel Cut-Out

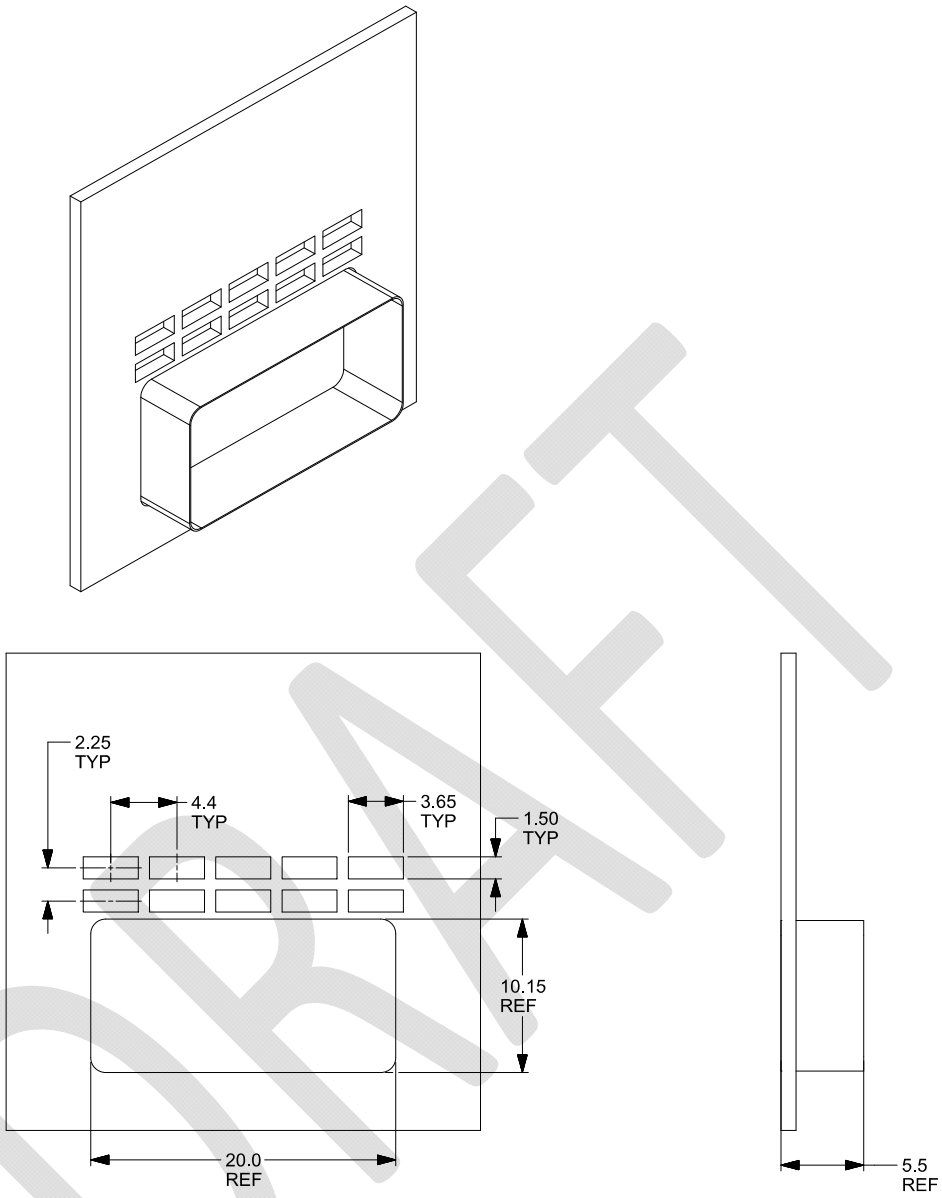


Figure A-2 Example of QSFP2 1x1 Bezel Design for Use with Type 2A & 2B Modules

A.2 Stacked 2x1 Bezel Panel Cut-Out

The recommended bezel panel cut-out for a QSFP112 2x1 stacked cage is shown in Figure A-3. An example of a QSFP112 2x1 stacked bezel design for use with Type 2A & 2B modules is shown in Figure A-4.

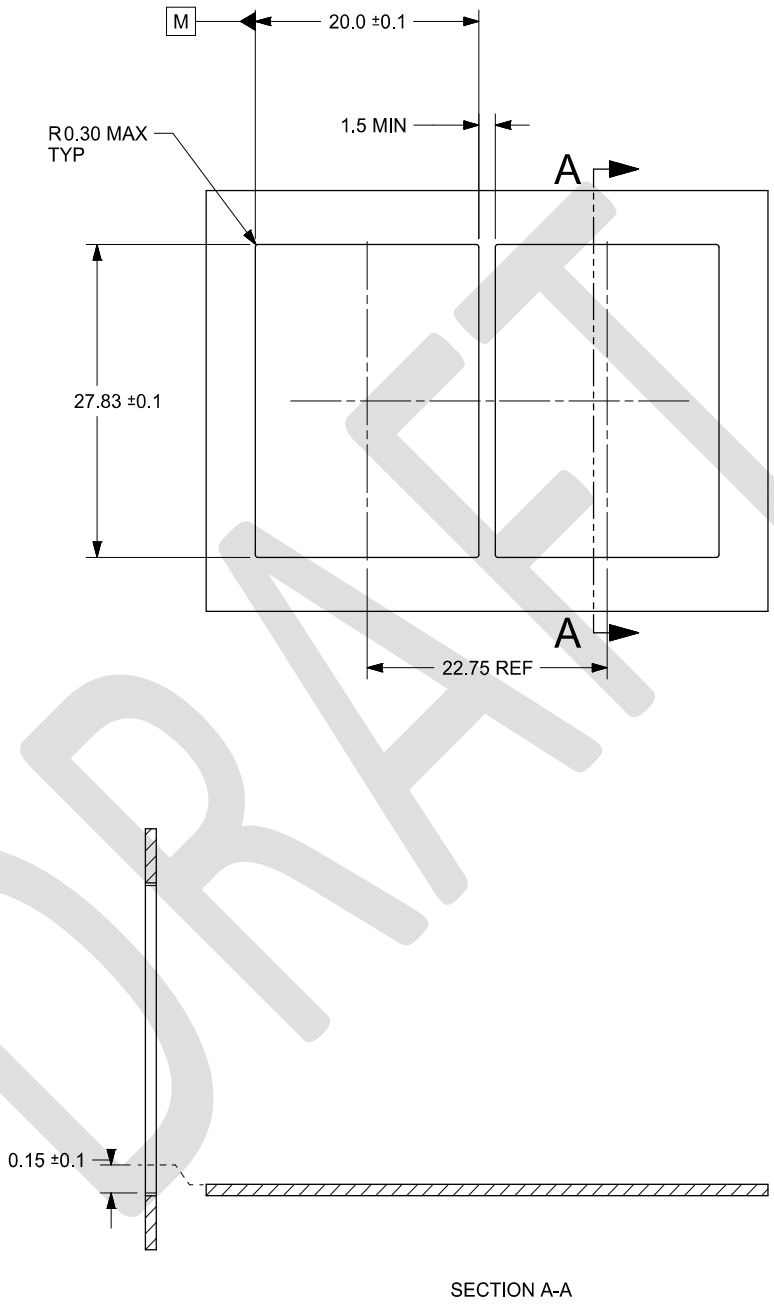


Figure A-3 Recommended QSFP112 2x1 Stacked Bezel Panel Cut-Out

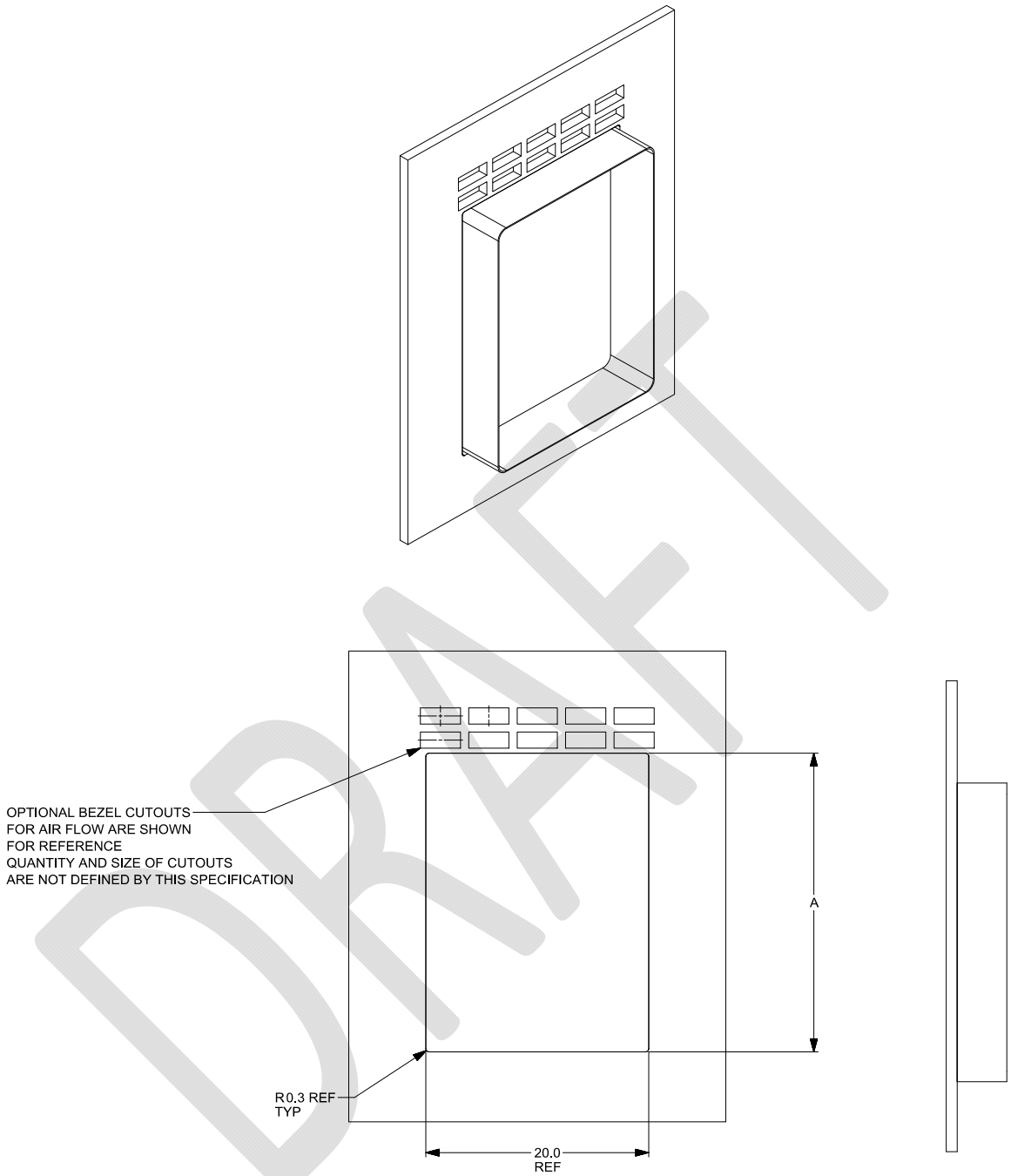
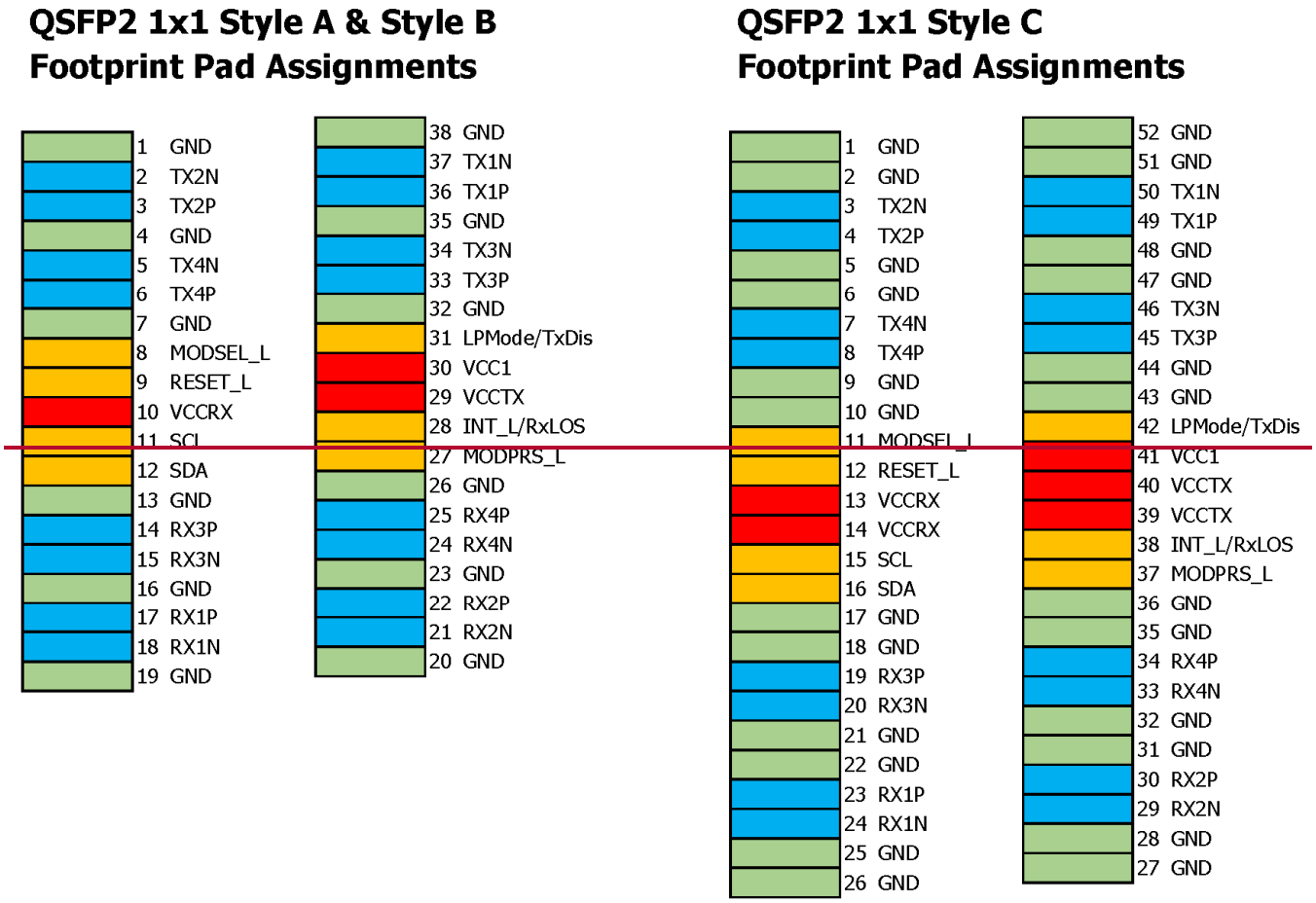


Figure A-4 Example of QSFP112 2x1 Stacked Bezel Design for Use with Type 2A & 2B Modules

Appendix B. Footprint Pad Assignments

B.1 QSFP112 1x1 Style A & B versus QSFP224 1x1~~Style C~~ Footprint Pad Assignments

The recommended pad assignments for QSFP112 1x1 footprint Style A and B versus QSFP224 1x1 footprint ~~Style C~~ are shown in Figure B-1.



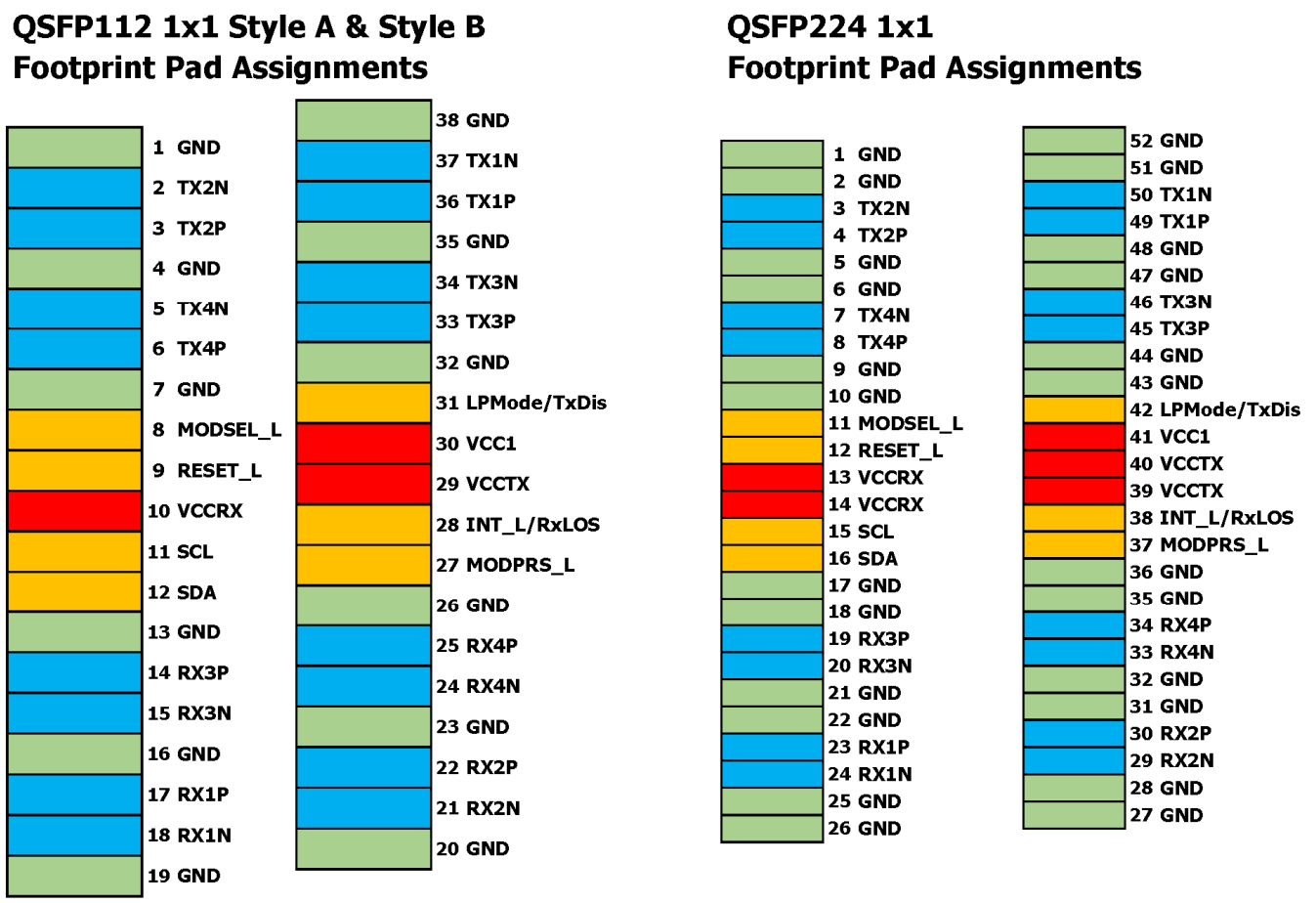


Figure B-1 QSFP112 1x1 Style A & B versus QSFP224 1x1~~Style C~~ Footprint Pad Assignments

Appendix C. Recommended Cage Gauge Plug

C.1 Recommended Cage Gauge Plug for QSFP224 Cages

Here is a sample of a recommended cage gauge plug to be used to position the cage latch tab (cage flap) as it would be in the mated condition in order to obtain a realistic and consistent measurement of the functional distance from the tip of the cage latch tab (cage flap) to Datum T (the cage hard stop for the module).

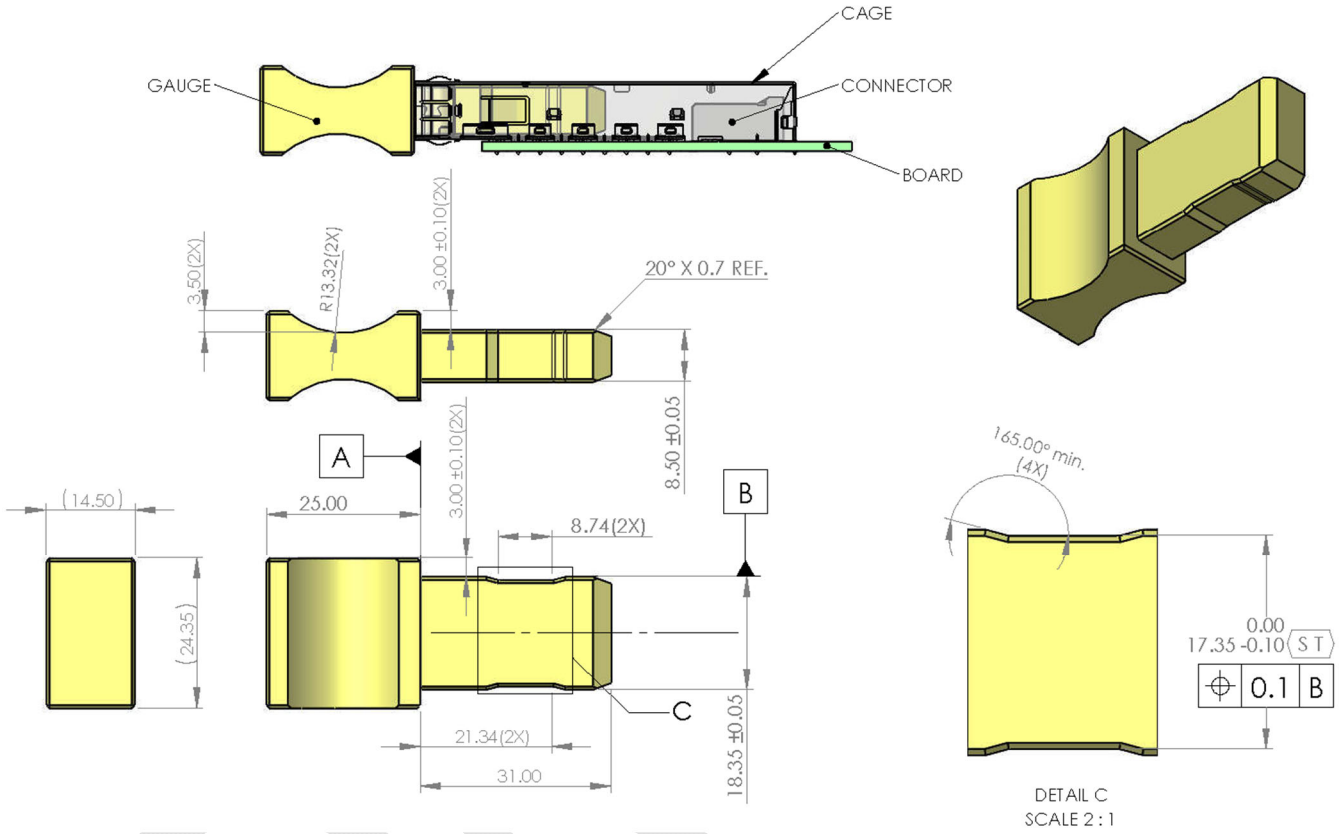


Figure C-1 Recommended Cage Gauge Plug