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SFF Committee

**SFF-8432 Specification for
SFP+ Module and Cage**

Rev 5.1 August 8, 2012

Secretariat: SFF Committee

Abstract: This specification defines the mechanical specifications for the SFP+ Module and Cage aka Improved Pluggable Formfactor (IPF).

The mechanical dimensioning allows backwards compatibility between IPF modules plugged into most SFP cages which have been implemented to SFF-8074i. It is anticipated that when the application requires it, manufacturers will be able to supply cages that accept SFP style modules. In both cases the EMI leakage is expected to be similar to that when SFP modules and cages are mated.

Superior EMI performance can only be expected with mated combinations of IPF modules and cages.

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

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

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

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

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EXPRESSION OF SUPPORT BY MANUFACTURERS

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

Amphenol
EMC
Emulex
ENDL
ETRI
FCI
Finisar
Fujitsu CPA
Hewlett Packard
JDS Uniphase
Molex
Picolight
Samsung
Sumitomo
Sun Microsystems
Toshiba America
Tyco AMP
Unisys
Vitesse Semiconductor

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

AMCC
Avago
Brocade
Clariphy
Comax
Cortina Systems
Foxconn
Hitachi GST
Intel
LSI Logic
Seagate

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

Update History

Rev 5.1

- Corrected T Ref and AJ dimensions in Figure 4-1 to S Ref and AK.
- Corrected '...Dimension V)' to '...Dimension U' in Figure 4-2
- Updated title 7/17/2014

Foreword

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

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

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

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

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

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

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

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

If you are interested in participating or wish to follow the activities of the SFF Committee, the signup for membership and/or documentation can be found at:

www.sffcommittee.com/ie/join.html

The complete list of SFF Specifications which have been completed or are currently being worked on by the SFF Committee can be found at:

<ftp://ftp.seagate.com/sff/SFF-8000.TXT>

If you wish to know more about the SFF Committee, the principles which guide the activities can be found at:

<ftp://ftp.seagate.com/sff/SFF-8032.TXT>

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

SFF Committee --

SFP+ Module and Cage

1. Scope

This specification defines the terminology and mechanical requirements for a pluggable transceiver module. This specification also includes critical dimensions of the IPF cage. This specification is also intended to facilitate the implementation of 1 x "n" ganged and the 2 x "n" stacked cage configurations.

The need for this specification became evident when it was realized that some SFP modules and cage designs do not perform adequately in terms of EMI leakage, and cannot meet the needs for higher data rates. The IPF is an improved transceiver style which has tighter mechanical tolerances on the module and enhanced EMI characteristics when mated with a cage designed for the IPF module. Please note that there are additional cage requirements specified in this document to allow proper function of the IPF modules in application. These improvements make the IPF suitable for current SFP applications as well as those at higher transfer rates.

1.1 Description of Clauses

Clause 1 contains the Scope and Purpose.
Clause 2 contains References and Related Standards and SFF Specifications.
Clause 3 contains the General Description.
Clause 4 contains the Module Dimensions.
Clause 5 contains examples of Cage Requirements.
Clause 6 contains examples of Cage Configurations.

2. References

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

2.1 Industry Documents

The following documents are relevant.

- ASME Y14.5.1M-1994, Mathematical Definition of Dimensioning and Tolerance Principles
- INF-8074i 1.0 SFP (Small Formfactor Pluggable) Transceiver
- SFF-8083 0.8mm SFP+ Compliant Card Edge Connector
- SFF-8431 SFP+

2.2 SFF Specifications

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

2.3 Sources

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

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

Copies of SFF, T10 (SCSI), T11 (Fibre Channel) and T13 (ATA) standards and standards still in development are available on the HPE version of CD_Access (<http://tinyurl.com/85fts>).

2.4 Conventions

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

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

2.5 Definitions

For the purpose of SFF Specifications, the following definitions apply:

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.

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

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

3. General Description

This specification defines the complete mechanical dimensions of the IPF transceiver module. The IPF module and cage system provide a superior alternative, in terms of interoperability and EMI control, to the SFP system.

The dimensions for the module are normative.

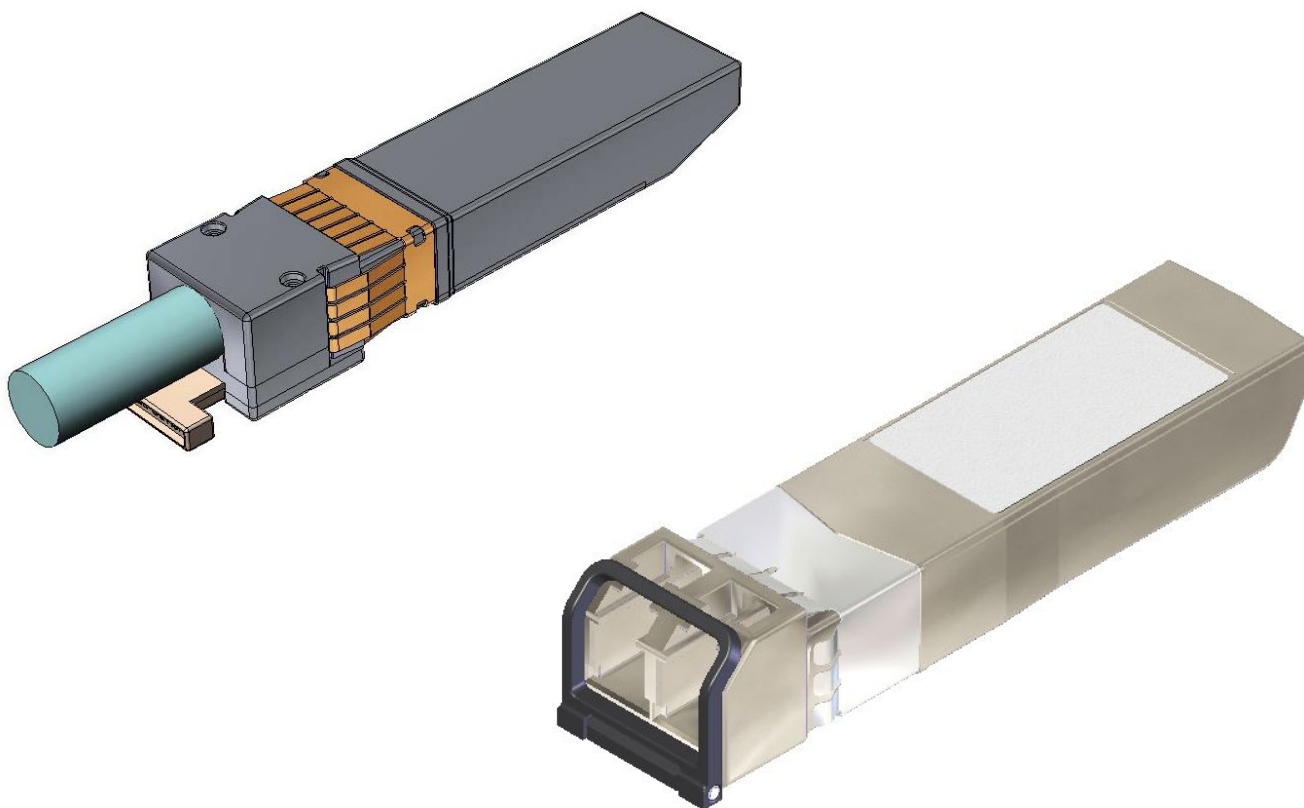


FIGURE 3-1: TYPICAL MODULES

4. IPF Module

The IPF module is described in Figure 4-1, Figure 4-2 and Figure 4-3.

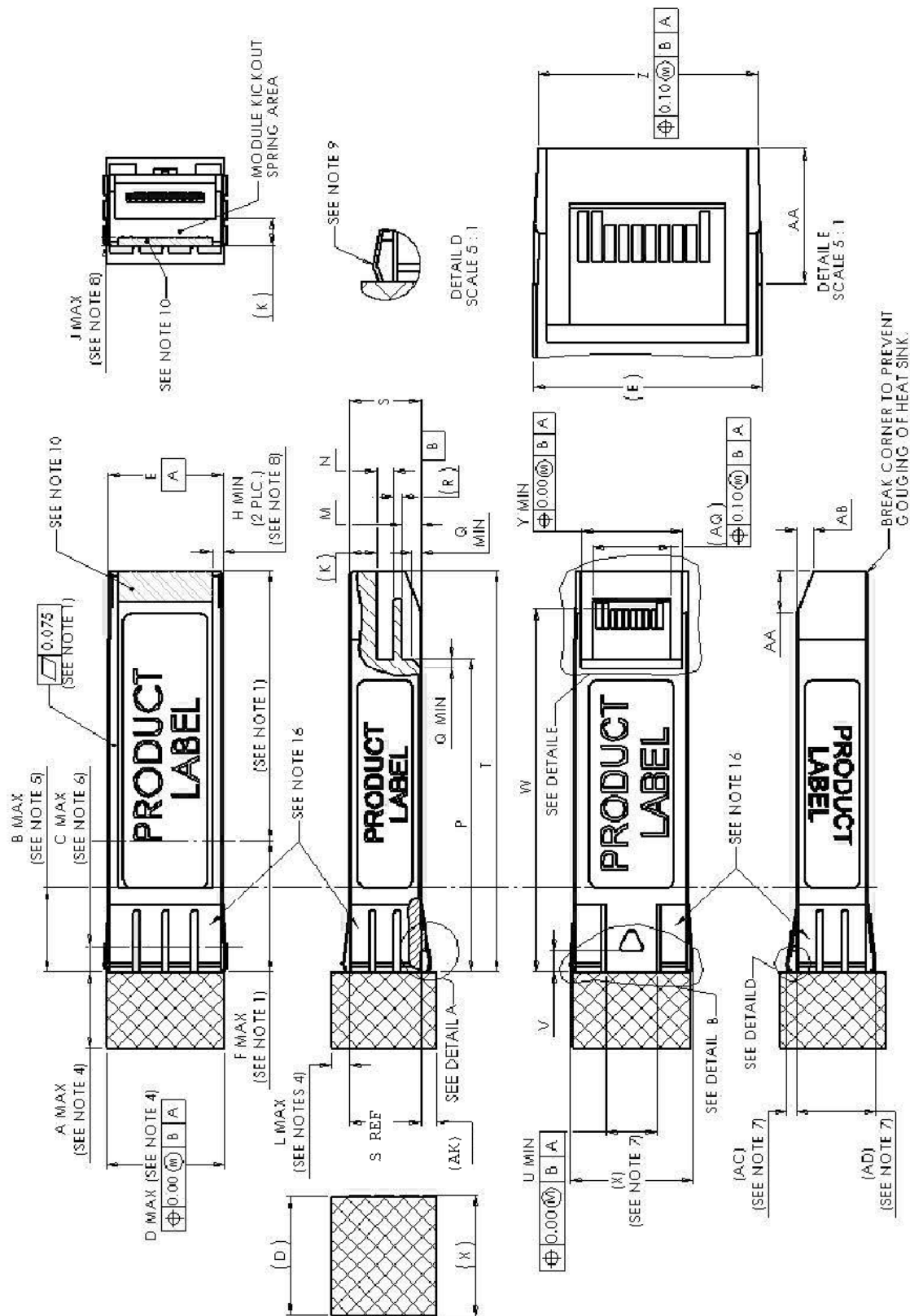


FIGURE 4-1: IPF MODULE

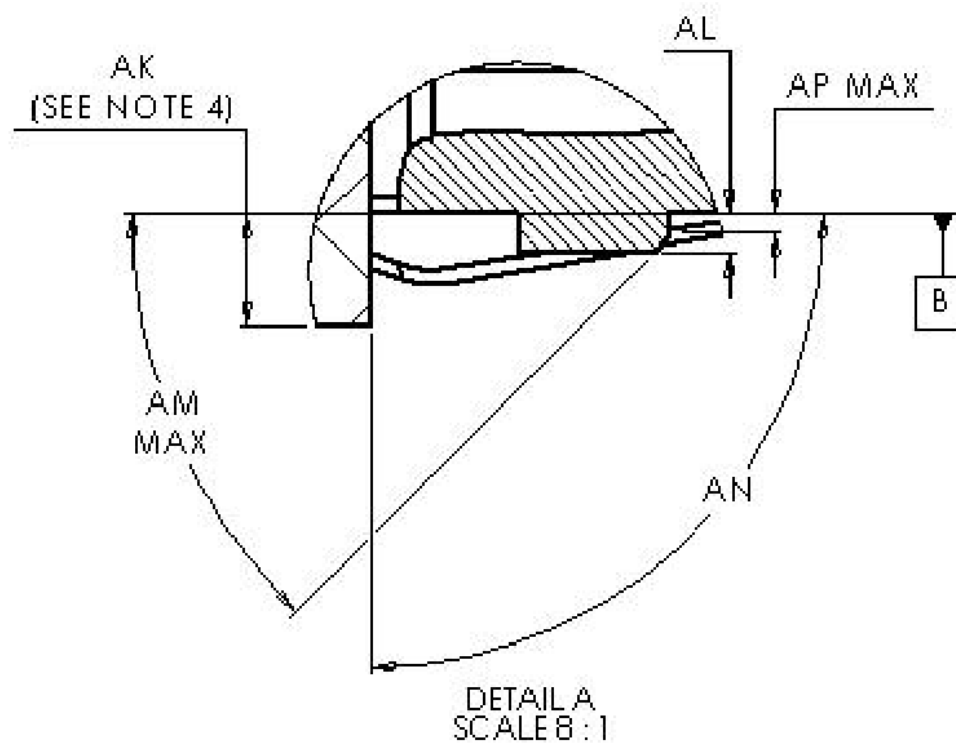
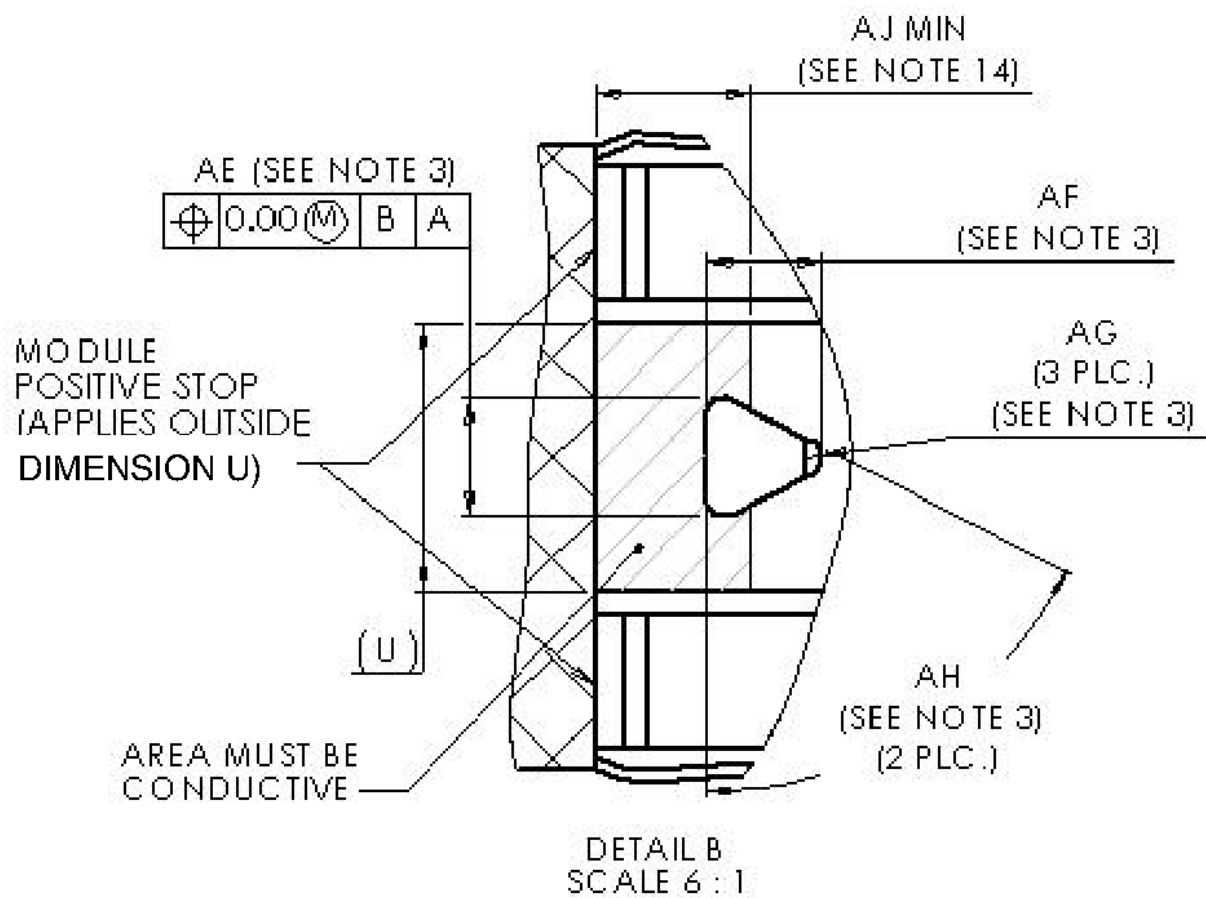


FIGURE 4-2: LATCH POST DETAIL

The IPF module contains a printed circuit board that mates with an appropriately designed connector. The pads are designed for a sequence mating:

- First mate – ground contacts
- Second mate – power contacts
- Third mate – signal contact

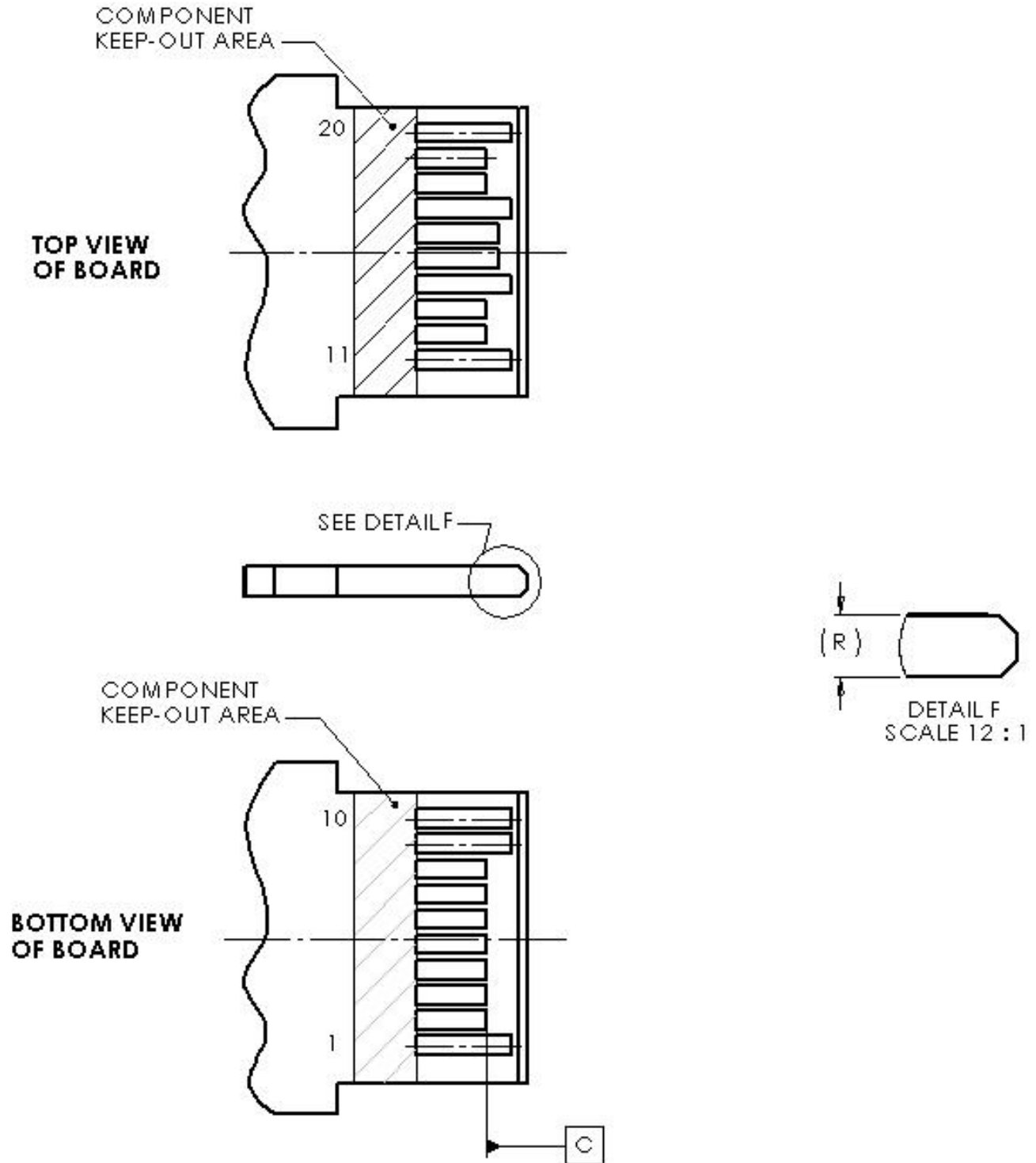


FIGURE 4-3: MODULE ELECTRICAL INTERFACE

(View is shown for reference only. See SFF-8083 for dimensional values.
See INF-8074i, Figure 3, for example of Electrical Pad Layout.)

4.1 Module Retention and Extraction

The IPF module contains multiple features to be used for retention inside a corresponding cage. A forward stop is defined by the feature envelope extending outside the cage. The other retention feature is defined by the leading edge of the retention posts. The interaction of these two features is meant to retain the module inside a properly defined cage. The extraction of the module from the cage shall be accomplished by using one of the four techniques defined below or a functional equivalent thereof. The corresponding cage retention device shall release the module from the cage when any of the four techniques shown here are applied.

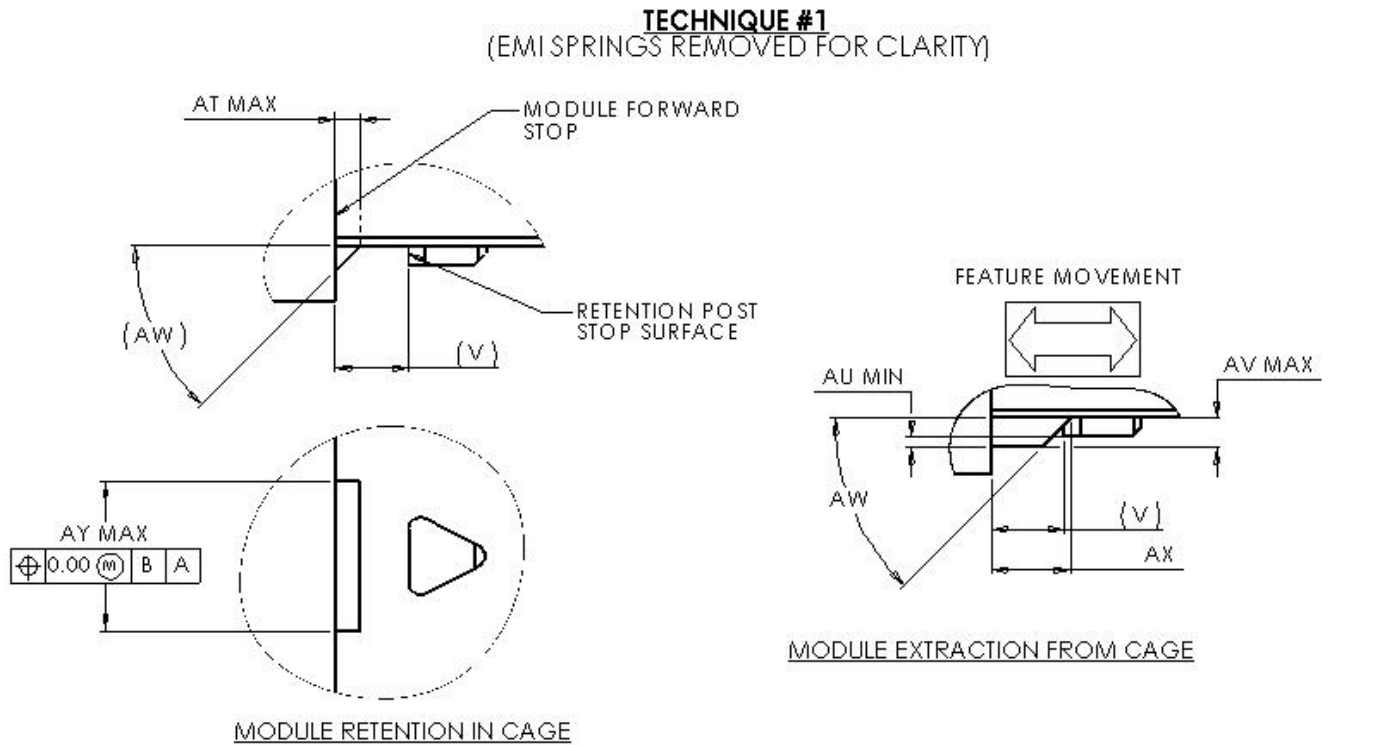


FIGURE 4-4: RETENTION TECHNIQUE 1

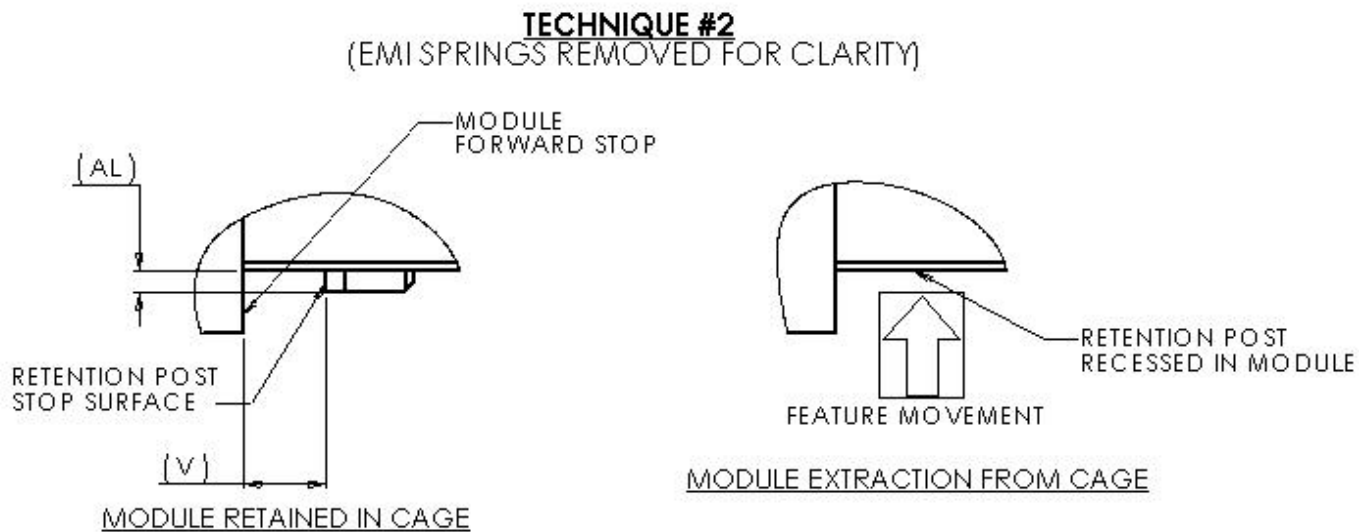


FIGURE 4-5: RETENTION TECHNIQUE #2

TECHNIQUE #3
(EMI SPRINGS REMOVED FOR CLARITY)

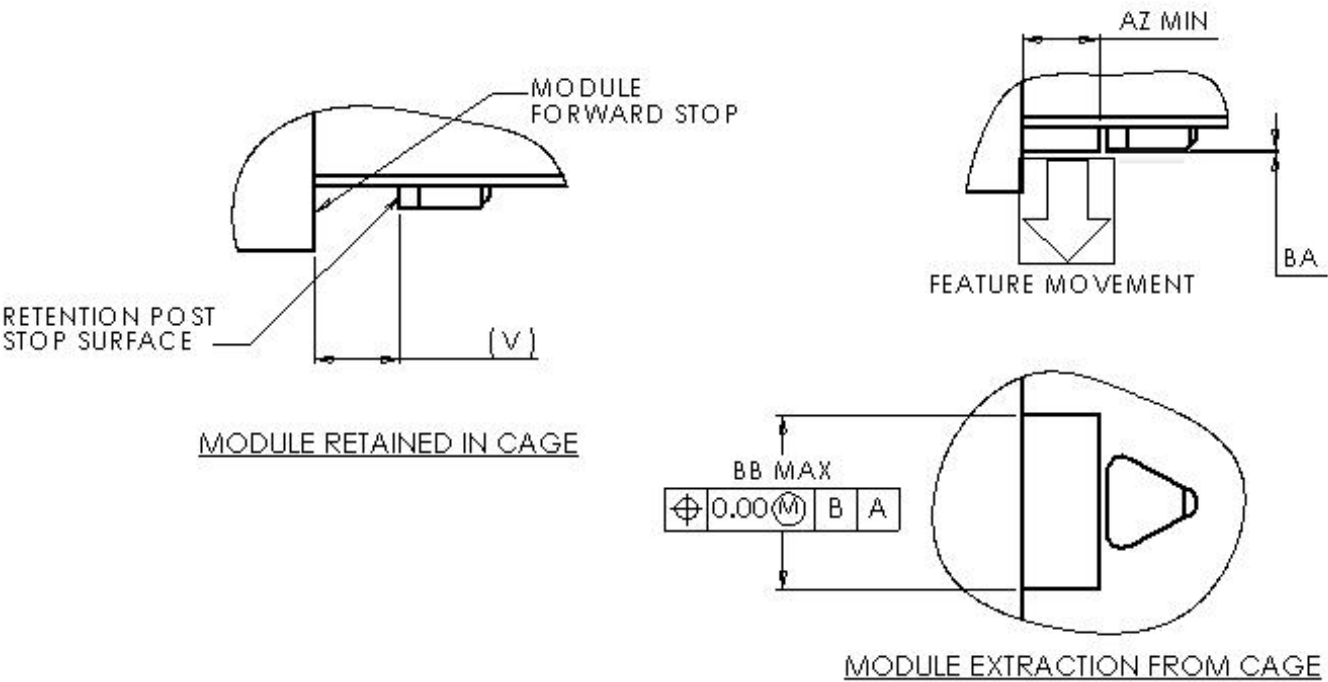


FIGURE 4-6: RETENTION TECHNIQUE #3

TECHNIQUE #4
(EMI SPRINGS REMOVED FOR CLARITY)

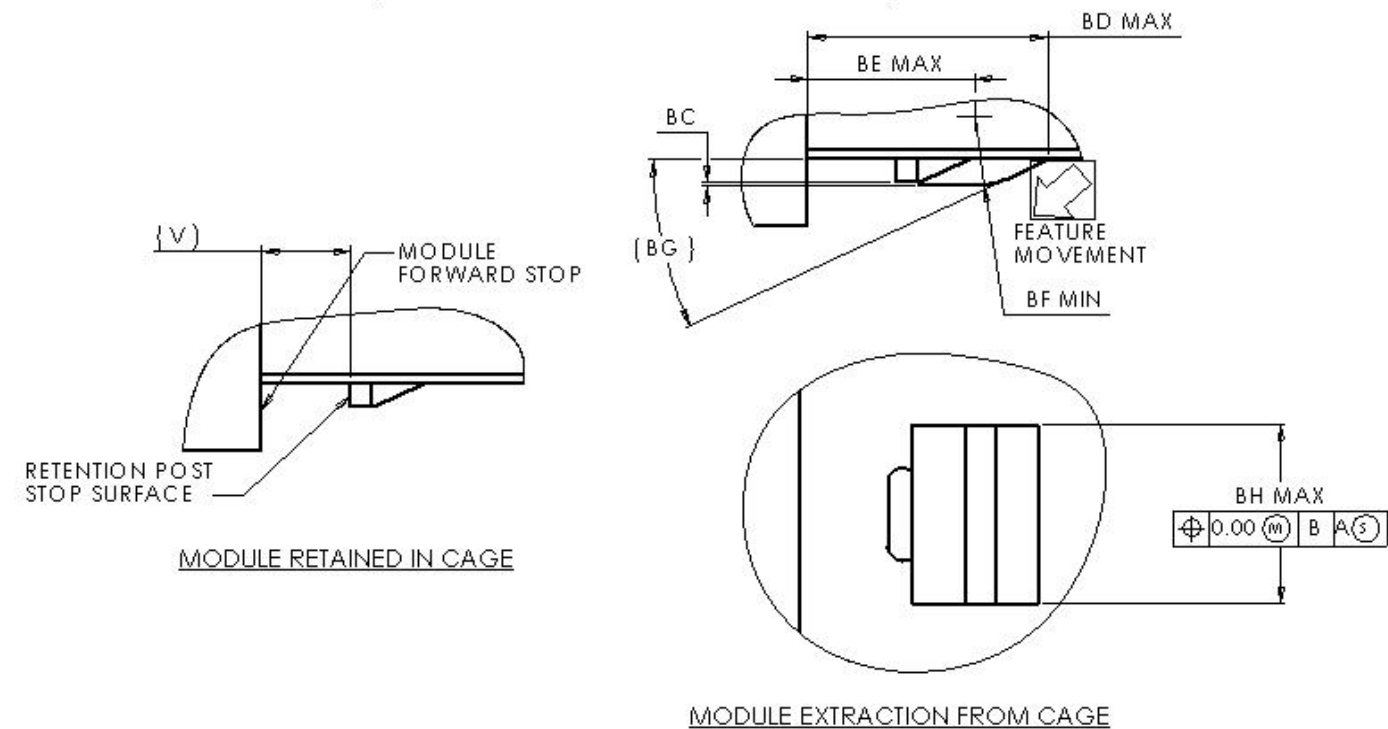


FIGURE 4-7: RETENTION TECHNIQUE #4

4.2 Insertion, Extraction and Retention Forces for IPF Module

TABLE 4-1: INSERTION, EXTRACTION AND RETENTION FORCES

Measurement	Minimum	Maximum	Units	Comments
IPF module insertion	0	18	Newtons	Measure without the force from any cage kick-out springs. Module to be inserted into nominal cage.
IPF module extraction	0	12.5	Newtons	Measure without the aid of any cage kick-out springs. Module to be inserted into nominal cage.
IPF module retention in cage	90	170	Newtons	No functional damage to module below 90N

4.3 IPF Durability

TABLE 4-2: DURABILITY

Measurement	Minimum	Units	Comments
Insertion/removal cycles into cage/connector	50	Module Cycles	No functional damage to module, cage or connector
	100	Cage/Connector Cycles	

4.4 IPF Module Dimensions

All of the dimensions for the IPF module and minimum requirements for a IPF style cage are listed in Table 4-3.

TABLE 4-3: DIMENSION TABLE FOR IPF MODULE

Designator	Dimension (mm)	Tolerance (mm)	Comments
A	10.00	Recommended Maximum	Module length extending outside of cage, see Note 4. Other lengths are application specific.
B	10.00	Maximum	Designated EMI ground spring area, see Note 5
C	3.00	Maximum	EMI spring/Cage Contact Point, see Note 6
D	14.00	Maximum	Module width extending outside of cage, see Note 4
E	13.55	±0.25	Module width
F	15.50	Maximum	Distance to front end of optional heat sink area, see Note 1
H	1.25	Minimum	Top slot distance from edge, see note 8
J	1.00	Maximum	Top slot depth, see note 8
K	3.25	Reference	Height of module kick-out spring area
L	2.10	Maximum	Module top height extending outside of cage see Note 4
M	2.25	±0.10	Distance from bottom of Module to printed circuit board
N	2.00	±0.25	Distance from rear shoulder to printed circuit board
P	37.10	±0.30	Distance from positive stop to bottom opening of Module and beginning of bottom rear relief

Designator	Dimension (mm)	Tolerance (mm)	Comments
Q	1.10	Minimum	Chamfer on bottom of Module opening
R		Reference	Thickness of printed circuit board from pad to pad. (See SFF-8083 for dimensional value)
S	8.55	± 0.15	Module height
T	47.50	± 0.20	Distance from positive stop to rear of Module
U	6.00	Minimum	Clearance Area for Cage Tab
V	2.50	$+0.15/-0.05$	Distance from Retention Post to Positive stop
W	43.00	± 0.20	Distance from positive stop to end of PCB signal pad
X	14.55	Reference	Overall width of EMI springs, see note 7
Y	11.90	Minimum	Module width of bottom opening
Z	13.40	$+0.10/-0.5$	Taper module width at PCB end
AA	6.00	± 4.0	Length of taper and relief at rear of module
AB	1.00	$+1.0/-0.75$	Height of bottom rear relief
AC	1.20	Reference	Height of bottom EMI springs, see note 7
AD	9.35	Reference	Height of top EMI springs, see note 7
AE	2.65	N/A	Width of Retention Post, see Note 3
AF	2.60	N/A	Length of Retention Post, see Note 3
AG	0.40	N/A	Retention Post Radius, see Note 3
AH	62.8°	N/A	Retention Post angle, see Note 3
AJ	3.50	Minimum	Module/Cage tab EMI Contact Zone, see Note 14
AK	1.40	± 0.50	Module bottom height extending outside of cage. (Height of bottom positive stop), see Note 4
AL	0.65	$+0.10/-0.25$	Retention Post height
AM	45°	Maximum	Retention Post lead-in angle
AN	90°	$\pm 5^\circ$	Positive stop angle
AP	0.30	Maximum	Distance from bottom of Module to latch angle
AT	0.85	Maximum	Technique #1 ramp distance during retention
AU	0.25	Minimum	Technique #1 ramp height from top of retention post
AV	1.00	Maximum	Technique #1 Maximum ramp height
AW	45°	$\pm 3^\circ$	Technique #1 ramp angle
AX	2.95	± 0.25	Technique #1 ramp distance during extraction
AY	5.10	Maximum	Technique #1 ramp width
AZ	2.25	Minimum	Technique #3 pusher length
BA	0.10	$+0.10/-0.05$	Technique #3 pusher height from top of retention post
BB	5.10	Maximum	Technique #3 pusher WIDTH
BC	0.10	$+0.10/-0.05$	Technique #4 pusher height from top of retention post

Designator	Dimension (mm)	Tolerance (mm)	Comments
BD	6.75	Maximum	Technique #4 pusher length from stop
BE	4.70	Maximum	Technique #4 length from stop to pusher radius
BF	2.00	Minimum	Technique #4 pusher radius
BG	25°	Reference	Technique #4 pusher angle
BH	5.10	Maximum	Technique #4 pusher width
BJ	14.00	±0.10	Cage opening width
BK	8.95	±0.15	Cage opening height
BL	0.35	Maximum	Cage opening Radius
BM	5.10	Maximum	Cage retention tab width
BN	3.00	Minimum	Cage conductive surface for Module EMI spring contact point, See note 11
BP	10.00	Minimum	Smooth cage area to accept Module EMI springs, See note 12

Notes:

1. Dimension only applies for modules that require a heat sink. Dimension applies for indicated length for heat sink modules, surface shall be thermally conductive.
2. Labels permitted on top, bottom and both sides within indicated dimensions. Label to be zero thickness or recessed below external surfaces of module. Label contents and positions to be determined by module manufacturer. The label(s) shall not interfere with the mechanical, thermal or EMC properties of the system.
3. Dimensions define a maximum envelope for module post. The post may have a different shape as long as the post cross-section does not exceed the maximum envelope.
4. Indicated outline defines maximum envelope outside of cage. The surfaces of the maximum envelop may be contacted by an adjacent module EMI springs during insertion or extraction of the module from the cage. The surfaces shall not have any shapes or materials that can damage the adjacent module EMI springs or be damaged themselves by the springs.
5. Dimension defines the maximum EMI ground spring position on module.
6. Dimension defines EMI spring contact point with module cage.
7. Maximum aggregated EMI spring force shall not exceed 9 Newtons on any one side. Minimum aggregate EMI spring force shall be greater than 4 Newtons on any side. Maximum force occurs when a module with EMI springs at their maximum dimension is inserted, to the cage stop, into a nominal cage opening (see figure 6-1). Minimum force occurs when a module with EMI springs at their minimum dimension is inserted into a maximum cage opening (see figure 6-1).
8. Slot is only required when placing a label on top of the module.
9. Spring ends shall be formed in such a way as to prevent catching on the cage or an adjacent module during insertion or extraction or on any external item during handling. Springs may contact an adjacent module(s) during insertion. However, the springs shall be designed to contact only the cage upon full insertion in cage.
10. The label slot is not required to extend to the end of the module.
11. Designated area on cage shall be conductive and free of holes, dimples, seams or any other feature that may catch on EMI springs.
12. Designated area on cage shall be free of holes, dimples, seams or any other feature that may catch on EMI springs.
13. Color code: An exposed colored feature of the transceiver (a feature or

Designator	Dimension (mm)	Tolerance (mm)	Comments
			surface extending outside the cage assembly) shall be color coded as follows; Black or beige for multi-mode, Blue for single mode.
14.			Dimension defines the minimum size zone for EMI contact between the cage tab and the bottom of the module.
15.			Maximum cage tab force may not exceed 7.0 Newtons. Minimum cage tab force shall be greater than 1.5 Newtons. Maximum force occurs when a module at its maximum height dimension (Dim S) is inserted into a nominal cage opening (see figure 10). Minimum force occurs when a module at its minimum dimension (Dim S) is inserted into a maximum cage opening (see figure 6-1).
16.			Number of EMI springs shown is for reference only. Actual number of springs will be determined by manufacturer.

5. IPF Cage Requirements

In order to take full advantage of the EMI spring definition and improvements, there are three areas of the cage that need to be defined, cage opening, width of cage tab and the area of conductive surface. All three are shown below, in Figure 5-1.

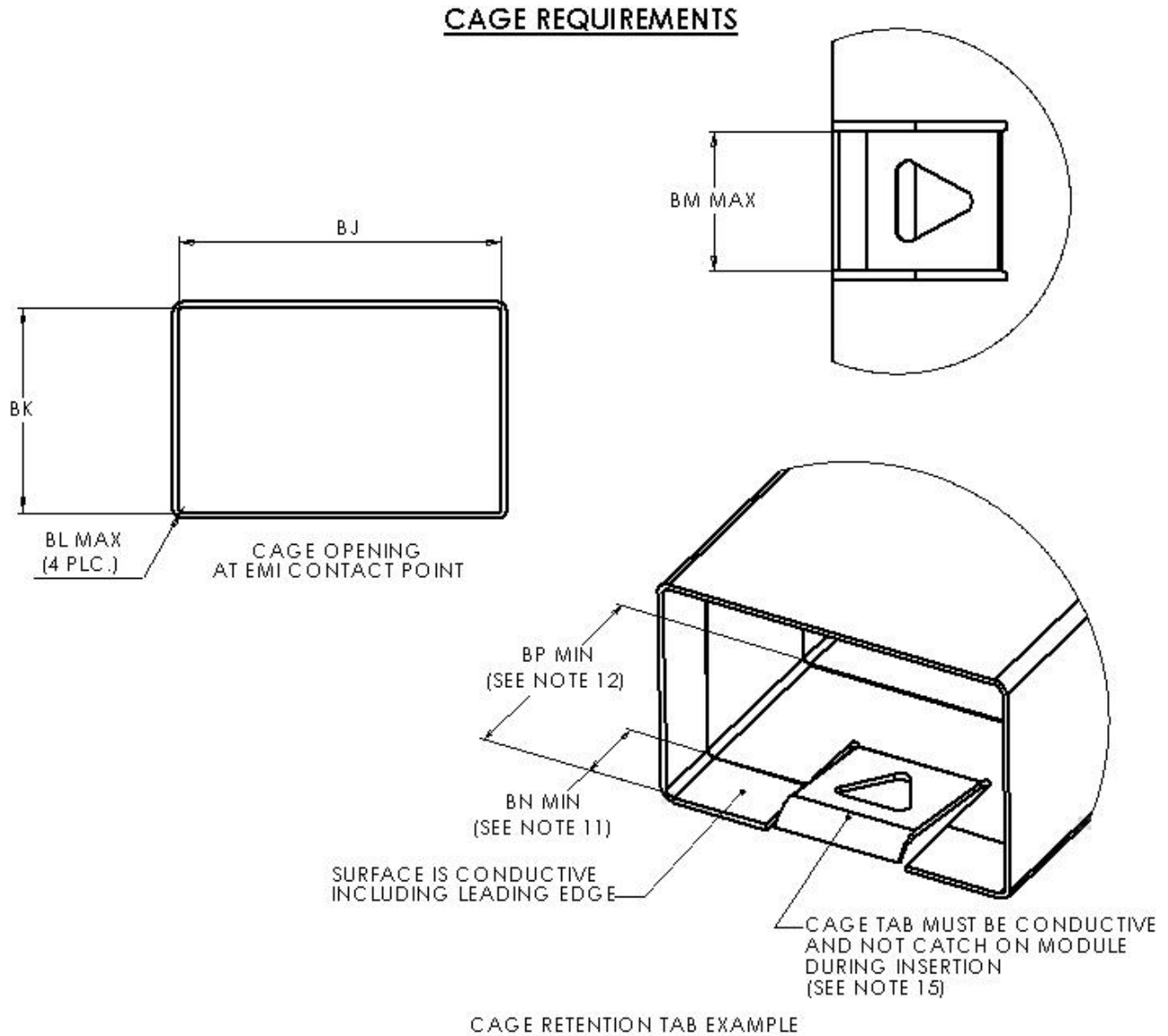


FIGURE 5-1: CAGE REQUIREMENTS

6. Examples of IPF Transceiver Cage Configurations

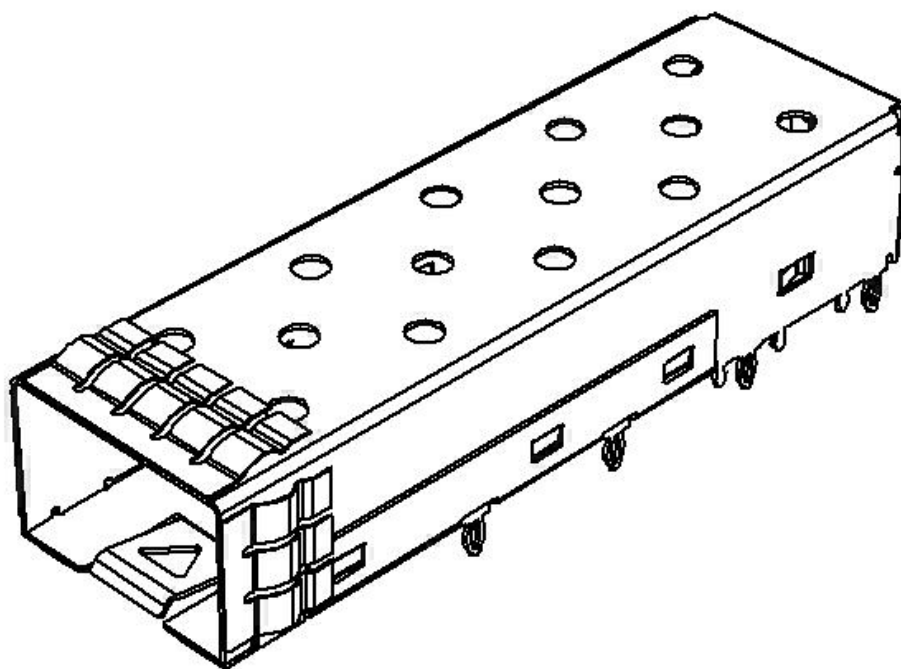


FIGURE 6-1: SINGLE PORT CAGE EXAMPLE

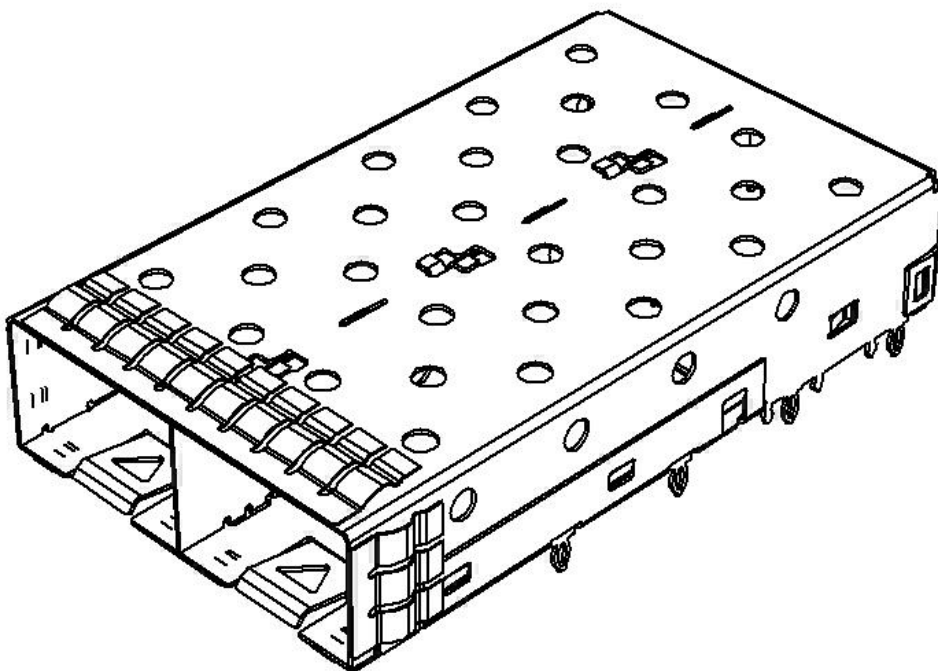


FIGURE 6-2: (2) PORT CAGE EXAMPLE