Style Definition: Heading 1
Style Definition: Heading 2
Style Definition: Heading 3

SFF TWG
Technology Affiliate

# SFF-8402

Specification for

# SFP+ 1X ~~28 Gb/s~~ Pluggable Transceiver Solution~~s~~ ~~(SFP28)~~

Rev 1.1.5 April 1, 2022

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 physical interface, low speed electrical, and management interface ~~and general performance~~ requirements of ~~the mating interface for a~~SFP+ 1x ~~0.8mm card edge connector for use in multigigabit applications using the upper row of contacts~~pluggable transceiver solutions including: SFP+ (4 Gb/s), SFP10, SFP16, SFP28, SFP56, and SFP112. ~~One such use is as the receptacle connector for Fibre Channel.~~

~~There are multiple generations of the Pluggable Transceiver Solution based on performance.~~
~~4 Gb/s SFP+ SFF-8084~~
~~10 Gb/s SFP10 SFF-8083~~
~~16 Gb/s SFP16 SFF-8081~~
~~28 Gb/s SFP28 SFF-8402~~

~~Connectors compliant to SFF-8402 are also compliant to SFF-8081, SFF-8083 and SFF-8084, but the reverse is not necessarily true.~~

POINTS OF CONTACT:
Alex Haser
Molex
2222 Wellington Ct.
Lisle, IL 60532
Email: alex.haser@molex.com

Chairman SFF TA TWG
Email: SFF-Chair@snia.org

## INTELLECTUAL PROPERTY

*EDITOR'S NOTE: Omit this section for Information (INF) and Reference (REF) documents.*

The user's attention is called to the possibility that implementation of this specification may require the use of an invention covered by patent rights. By distribution of this specification, no position is taken with respect to the validity of a claim or claims or of any patent rights in connection therewith.

This specification is considered SNIA Architecture and is covered by the SNIA IP Policy and as a result goes through a request for disclosure when it is published. Additional information can be found at the following locations:

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

## COPYRIGHT



## DISCLAIMER

The information contained in this publication is subject to change without notice. The SNIA makes no warranty of any kind with regard to this specification, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The SNIA shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this specification.

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

## FOREWORD

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

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 0.5**
-Restructured to reduce content which duplicates other speed variations

**Rev 0.6**
- Clarified meaning of last paragraph in Section 4

**Rev 0.7**
- Added multiple generations to Abstract

**Rev 0.9**
- Changed title to correlate with QSFP+ family of specifications
- Expanded Figure 3-1 (NOTE: This figure was removed from the document in Rev 1.2)

**Rev 1.0**
- Title change for commonality in style with QSFP

**Rev 1.1**
- Updates to reflect creation of SFF-8071 and SFF-8419 specifications

**Rev 1.1.1** *February 2, 2022:*
- Updated to new document template
- Changed specification title to reflect all SFP speed generations
- Removed original specification table in Section 4
- Added additional tables to reflect all SFP speed generations
- Minor editorial updates throughout

**Rev 1.1.2** *February 8, 2022:*
- Additional updates based on discussion

**Rev 1.1.3** *February 18, 2022:*
- Added text to Sections 5.1.1 and5.2
- Added Figure 5-2

**Rev 1.1.4** March 25, *2022:*
- Various editorial changes based on comments received during review ballot

**Rev 1.1.5** *April 1, 2022:*
- Various changes based on comment resolution discussion

**CONTENTS**



**FIGURES**

# 1. Scope

This specification defines the physical interface, low speed electrical, and management interface requirements of SFP+ 1x pluggable transceiver solutions including: SFP+ (4 Gb/s), SFP10, SFP16, SFP28, SFP56, and SFP112.~~terminology and physical requirements for the mating interface and physical characteristics of the 0.8 mm card edge connector to support multi-gigabit applications.~~

Other standards (e.g., IEEE, FC-PI-6, etc.)~~The using interfaces~~ define the performance requirements for SFP connectors~~ on the characteristic impedance and ability~~ used to transmit ~~multi-gigabit~~ signals at various data rates ~~to and from~~using ~~optical pluggable~~ modules or ~~, and in some cases via~~ cable assemblies. ~~When this connector is used in such an application, it is subject to the requirements of those documents.~~

# 2. References and Conventions

## 2.1 Industry Documents

The following documents are relevant to this specification:

- OIF Common Management Interface
- SFF-8071 SFP+ 1X 0.8mm Card Edge Connector
- SFF-8418 SFP+ High Speed Electrical Interface
- SFF-8419 SFP+ Low Speed Electrical Interface
- SFF-8432 SFP+ Module and Cage
- SFF-8433 SFP+ Ganged Cage Footprints and Bezel Openings
- SFF-8472 SFP+ Management Interface
- ~~T11/2221D FC-PI-6: Fibre Channel Physical Interface-6~~

## 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 will be welcome, they should be submitted to https://www.snia.org/feedback.

Other standards may be obtained from the organizations listed below:

| Standard | Organization | Website |
|---|---|---|
| IEEE | Institute of Electrical and Electronics Engineers (IEEE) | https://www.ieee.org |
| Fibre Channel standards | International Committee for Information Technology Standards (INCITS) | https://www.incits.org |
| OIF | Optical Internetworking Forum (OIF) | https://www.oiforum.org |

Formatted Table

Field Code Changed

Formatted: Hyperlink, Font: (Default) Tahoma, Not Italic

Formatted: Hyperlink, Font: (Default) Tahoma, Not Italic

## 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.

**May or may not:** Indicates flexibility of choice with no implied preference.

**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.

## 3.2 Acronyms and Abbreviations

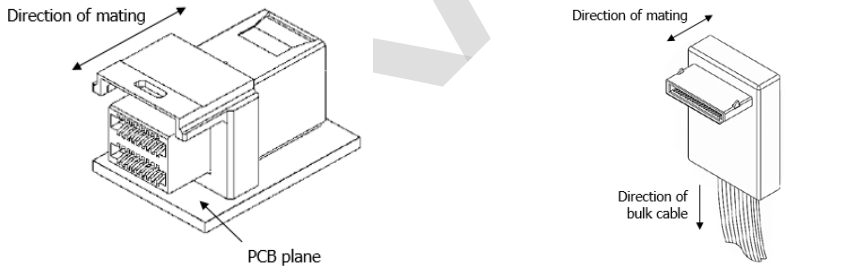
~~**RA:** Right Angle~~
~~**SMT:** Surface Mount Technology~~There are no acronyms or abbreviations defined for this document.

## 3.3 Definitions

**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.

**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.

~~**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 2-2 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.~~

# 4. General Description

This specification provides references to the required SFF specifications necessary to implement ~~a 28 Gb/s~~ SFP transceiver modules that operate at various speeds. It includes mechanical specifications required by the host i.e., the host connector, the host card cage, and mechanical specifications of the pluggable module. ~~In addition, the SFF specifications necessary to implement the module management interface and the common electrical/optical base specifications are referenced.~~

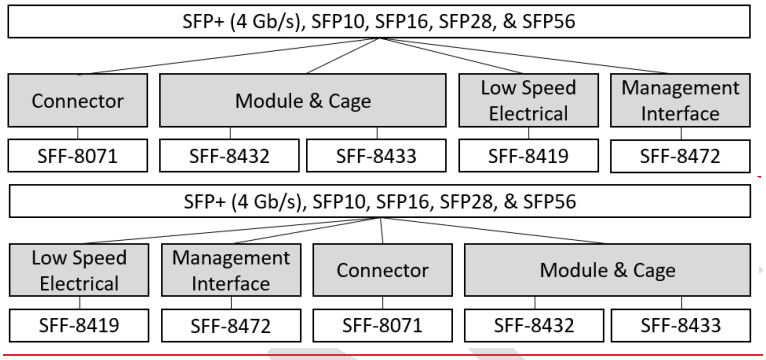



**Figure 4-1 SFP+ (4 Gb/s), SFP10, SF16, SFP28, and SFP56 Pluggable Transceiver Solutions**

~~The mechanical form factor defined in SFF-8071 applies to all of the generations. However, as the performance requirements have increased over time, the performance compliance has also changed for the connector.~~

~~This specification identifies the documentation required to implement a Pluggable Transceiver Solution using an 0.8mm card edge connector for speeds suitable to the using applications, as illustrated in the following pictorial representation.~~

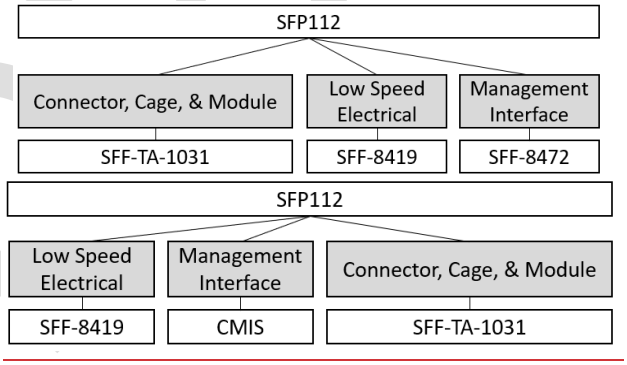



**Figure 4-2 SFP112 Pluggable Transceiver Solution**

## ~~4.1 Application Specific Criteria~~

~~This connector is capable of meeting the interface requirements for the operation of T11 FC-PI-6 (Fibre Channel Physical Interface - 6).~~

# 5. Overview of Referenced Specifications

## 5.1 Management Interfaces

### 5.1.1 SFF-8472

SFF-8472 defines an enhanced memory map with a digital diagnostic monitoring interface for optical transceivers that allows pseudo real time access to device operating parameters. The interface is an extension of the 2-wire interface ID defined in the GBIC specification as well as INF-8074. Both specifications define a 256 byte memory map which is accessible over a 2-wire serial interface at the 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface makes use of the 8 bit address 1010001X (A2h), so the originally defined 2-wire interface ID memory map remains unchanged. The interface is backward compatible with both the GBIC specification and INF-8074. In order to provide memory space for future extensions, multiple optional pages are defined for the upper 128 bytes of the A2h memory space.

### 5.1.2 CMIS

The Common Management Interface Specification (CMIS) defines a generic management communication interface together with a generic management interaction protocol between hosts and managed modules.

The CMIS specification was developed to allow host and module software implementers to utilize a common code base across a variety of form factors and across a variety of module capabilities, and to foster the possibility of vendor agnostic management for standardized module functions.

To this end CMIS specifies a small core of basic functionality that all modules must implement and a larger evolving set of optional features whose implementation is advertised in the so-called management memory map of a module. This advertisement approach allows host software to adapt to optional module capabilities at runtime while ensuring interoperability with all modules at a basic level.

CMIS-compliant modules transfer a well-defined set of management operations and associated data over a CMIS-defined Management Communication Interface (MCI); e.g., an I2C-based interface. The basic management operations are simple and allow the host to access a 256 byte addressable memory window, with mechanisms to dynamically switch 128 byte sized data pages of a much larger management memory space into the upper half of that host addressable memory window.

Note: This limited set of basic operations and the very small byte-oriented memory window are traced back to SFF-8636 and allow simple transducers or transceivers to be CMIS managed. For complex modules, extension mechanisms are implemented on top of these basic elements.

The physical form factor scope of CMIS includes pluggable or onboard form factors such as QSFP-DD, OSFP, or 21 COBO. However, CMIS is developed as a generic management interface specification and can be implemented in a variety of existing form factors, such as QSFP, or also in future form factors. Generic advertisement fields in the management memory map inform the host about the particular form factor and whether a module can be managed in a CMIS compliant fashion.

The functional scope of CMIS includes module types which may range from electrical cable assemblies (also referred to as modules, unless cable assemblies are specifically mentioned) and active transceiver modules to versatile coherent DWDM modules with integrated framers.

The following classifications can be used to distinguish functional module types or module applications:

a. **Data agnostic** ("basic") **system interfaces** map bit streams from host lanes to media lanes and vice versa, without knowledge of data formats and without participation in any communication protocol for that bit stream. Examples include cable assemblies and transceivers at lower lane data rates, e.g., 100GBASE-SR4 modules

b. **Data format aware** ("complex") **system interfaces** perform interface related single-lane or multi-lane data processing (such as lane de-skewing and FEC coding); e.g., 400ZR modules
c. **Client encapsulation** ("multiplex") **applications** encapsulate one or more (single or multi-lane) host signals into a newly framed (single or multi-lane) network signal that may be transmitted and monitored independent of the host signals. Such modules employ framers with additional overhead for independent media side data link termination, encapsulating host signals as payload, and comprising functionality like framing, mapping, aggregation (multiplexing), switching, or distribution (inverse multiplex) functionality

The specification scope of this CMIS revision covers both system interface modules and client encapsulation modules with at most (multiples of) eight host lanes and with management communication based on I2C.

Additional information:

a. The management memory map defines registers and memory locations that are accessible to the host.
b. Versatile modules may be programmed to behave like modules of different classes
c. System interfaces employing network side forward error correction (FEC) merely for media channel enhancement, not for independent network link operation, are not considered to be client encapsulating.

**Formatted:** Numbered + Level: 1 + Numbering Style: a, b, c, … + Start at: 1 + Alignment: Left + Aligned at: 0.25" + Indent at: 0.5"

## 5.2 Low Speed Electrical

SFF-8419 defines the low speed electrical and management interface specifications for SFP+ (enhanced Small Formfactor Pluggable) modules and hosts. The SFP+ module could be an electrical-to-optical or an electrical-to-electrical device.

## 5.3 Connector, Cage, and Module Specifications

### ~~4.1.1~~5.3.1 Connector~~s Configuration~~

SFP+ connectors are defined in SFF-8071. SFP2 connectors, defined in SFF-TA-1031, feature enhancements that enable use at higher data rates compared to connectors defined in SFF-8071. SFP2 connectors are backwards compatible to SFP+ components. ~~The mechanical dimensioning of this specification provides backwards mechanical compatibility between generations of various speeds. Figure 3-1 illustrates one style of receiving body.~~

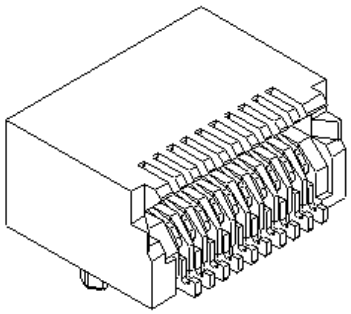


**Figure 5-1~~3-1 General View of Right-Angled Body Receptacle~~SFF-8071 Connector**

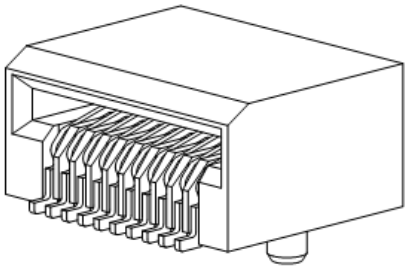


**Figure 5-2 SFF-TA-1031 Connector**

Formatted: Caption, Don't keep with next, Don't keep lines together

~~The mechanical representation of this connector looks the same as previous generations, however, there may have been changes to the internal design which enable it to perform at the characteristics required of this specification.~~

~~Connectors manufactured to meet this specification can be expected to perform satisfactorily in systems designed for lower data rates, but they may not meet the needs of systems that require higher data rates.~~

### 5.3.2 Cages

Commented [HA1]: Add figure for SFF-TA-1031

SFP+ cages are defined in SFF-8432. SFP2 cages, defined in SFF-TA-1031, feature enhancements that enable use at higher data rates compared to cages defined by SFF-8432. SFP2 cages are backwards compatible to SFP+ components.

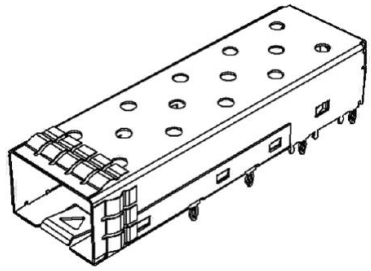


**Figure 5-3 SFF-8432 Cage**

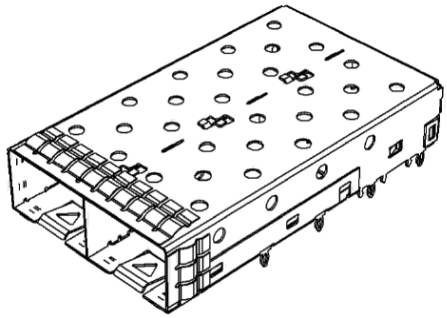


**Figure 5-4 SFF-8432 Ganged Cage**

### 5.3.3 Modules

Commented [HA2]: Add figure for SFF-TA-1031

SFP+ modules are defined in SFF-8432. SFP2 modules, defined in SFF-TA-1031, have feature enhancements that enable use at higher data rates compared to modules defined by SFF-8432. SFP2 modules are backwards compatible to SFP+ connectors and cages.

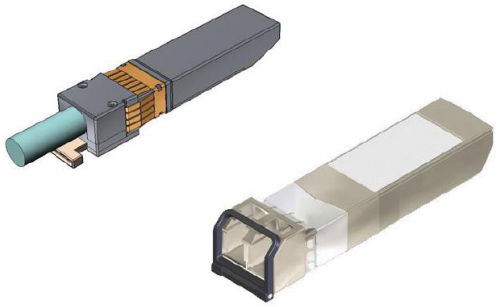


**Figure 5-5 SFF-8432 Modules**