SFF-8402

Specification for

SFP+ 1X Pluggable Transceiver Solutions

Rev 1.1.~~8~~7   ~~December~~October 2~~3~~1, 2022

SECRETARIAT: SFF TA TWG

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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 requirements of SFP+ 1x pluggable transceiver solutions including: SFP+ (4 Gb/s), SFP10, SFP16, SFP28, SFP56, and SFP112.

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

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1 **FOREWORD**

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

5

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

8

9 **REVISION HISTORY**

10 **Rev 1.0**   March 30, 2014

11   - Title change for commonality in style with QSFP

12 **Rev 1.1**   September 13, 2014

13   - Updates to reflect creation of SFF-8071 and SFF-8419 specifications

14 **Rev 1.1.1**   *February 2, 2022:*

15   - Updated to new document template

16   - Changed specification title to reflect all SFP speed generations

17   - Removed original specification table in Section 4

18   - Added additional tables to reflect all SFP speed generations

19   - Minor editorial updates throughout

20 **Rev 1.1.2**   *February 8, 2022:*

21   - Additional updates based on discussion

22 **Rev 1.1.3**   *February 18, 2022:*

23   - Added text to Sections 5.1.1 and 5.2

24   - Added Figure 5-3

25 **Rev 1.1.4**   March 25*, 2022:*

26   - Various editorial changes based on comments received during review ballot

27 **Rev 1.1.5**   *April 1, 2022:*

28   - Various changes based on comment resolution discussion

29 **Rev 1.1.6**   *October 28, 2022:*

30   - Various editorial changes based on comments received during approval ballot

31 **Rev 1.1.7**   *October 31, 2022:*

32   - Added Application Reference Model (Figure 5-1)

33 **Rev 1.1.8**   *December 2, 2022:*

34   - Various editorial changes based on comments received during approval ballot

35

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~~LIST OF~~ 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.

Other standards (e.g., IEEE, FC-PI-6, etc.) define the performance requirements for SFP connectors used to transmit signals at various data rates using optical modules or cable assemblies.

2. References and Conventions

2.1   Industry Documents

The following documents are relevant to this specification:

- OIF-CMIS   Common Management Interface Specification (CMIS)
- 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 for SFP+
- SFF-TA-1031   SFP2 Cage, Connector, and Module 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 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

1 ## 2.3   Conventions

2 The following conventions are used throughout this document:

3 **DEFINITIONS**

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

6 **ORDER OF PRECEDENCE**

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

10 **NUMBERING CONVENTIONS**

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

14

American	French	ISO
0.6	0,6	0.6
1,000.0 ~~1,000~~	1 000,0~~1 0000~~	1 000.0~~1 000~~
1,323,462.9	1 323 462,9	1 323 462.9

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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

CMIS: Common Management Interface Specification

SFP: Small Form-factor Pluggable.

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.

4. General Description

This specification provides references to the required SFF specifications necessary to implement 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, see Figure 4-1 and Figure 4-2.
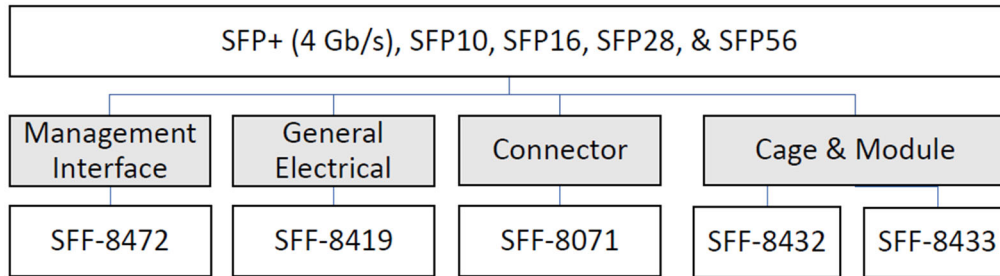

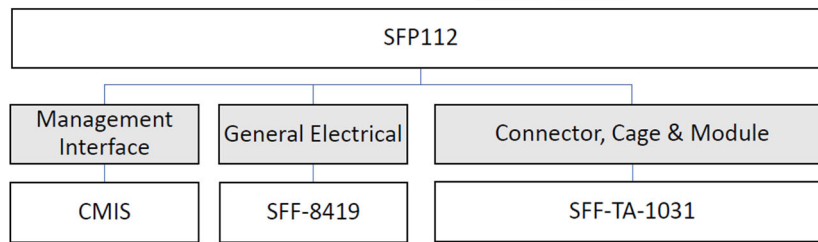**Figure 4-1 SFP+ (4 Gb/s), SFP10, SFP16, SFP28, and SFP56 Pluggable Transceiver Solutions**

Figure 4-2 SFP112 Pluggable Transceiver Solution

5. Overview of Referenced Specifications

5.1   Management Interfaces

5.1.1   SFF-8472

SFF-8472 defines a common memory map, ~~the Management Interface~~ for 1-lane pluggable transceiver modules (SFP, SFP+/SFP10, SFP16, SFP28, SFP56) and 1-channel managed external cables~~Modules and Cables Specification is intended for use by the modules~~ at 56 Gbps and below. It is backwards compatible to 1 Gbps INF-8074 modules.

~~SFF-8472 defines a common memory map and protocol that can be used to manage 1-channel pluggable transceiver modules and 1-channel managed external cable interface implementations. The memory map details, and communication protocol used to transfer the information are described in the SFF-8472.~~

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 set of optional features. Modules and cables may have paged memory or flat memory. Flat memory modules are Power Level 1, and typically provide read-only static data from an EEPROM.

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 host accesses a 256 bytes addressable memory window, and for modules and cables with paged memory there are mechanisms to dynamically switch 128 bytes sized data pages of a much larger management memory space into the upper half of that host addressable memory window.

This method can be traced back to SFF-8472 and allows simple transducers or transceivers to be CMIS managed. For complex modules, extension mechanisms are implemented on top of these basic elements.

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 scope of CMIS includes module types which may range from electrical cable assemblies and active transceiver modules to versatile coherent DWDM modules with integrated framers.

5.2   General Electrical

SFF-8419 defines the low speed electrical and management interface specifications for SFP+ (enhanced Small Formfactor Pluggable) modules and hosts. The SFP interface can support pluggable optical modules based on multi-mode or single mode fibers or passive or active copper cables.

~~Application reference model of SFP+, see Figure 5-1,~~The application reference model for an SFP+ optical module in Figure 5-1 shows the high-speed data interface between an ASIC and SFP+ modules. Not all optical modules or cables contain a Retimer or DSP.
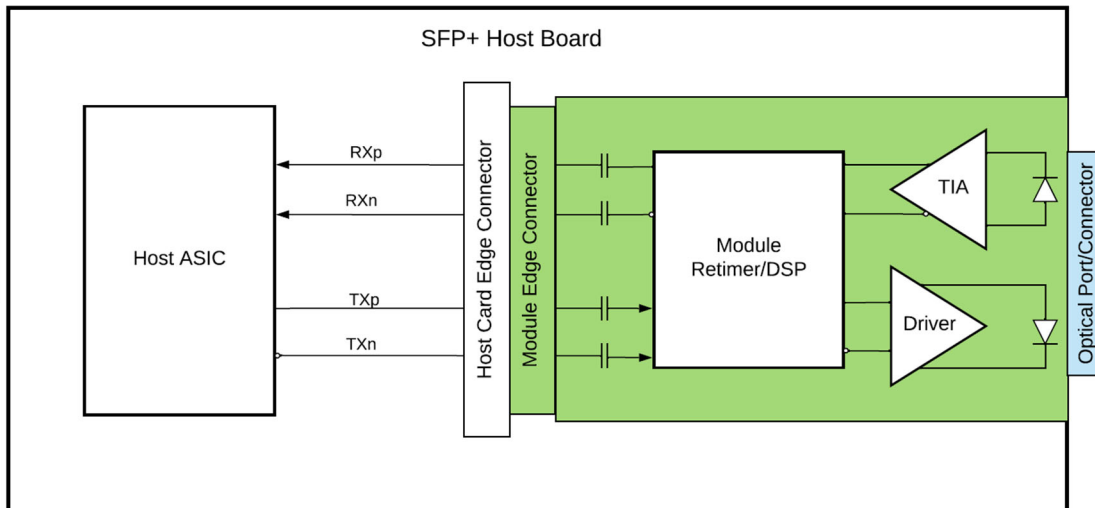
Figure 5-1: SFP+ Application Reference Model

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5.3   Connector, Cage, and Module Specifications

5.3.1   Connectors

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.
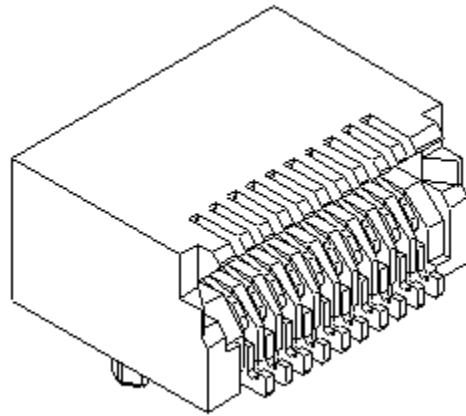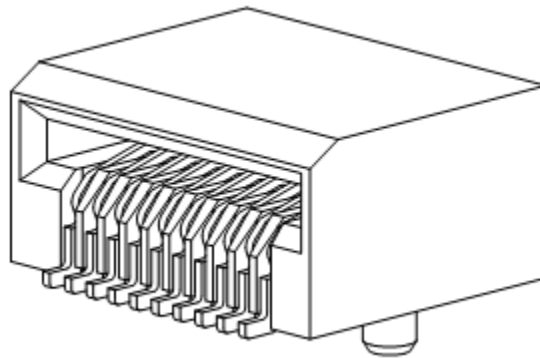
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Figure 5-2 SFF-8071 Connector

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Figure 5-3 SFF-TA-1031 Connector

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1 ### 5.3.2   Cages

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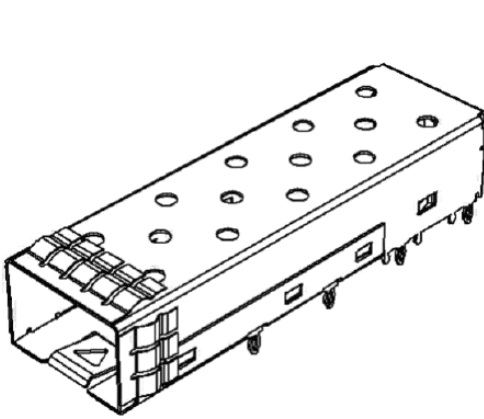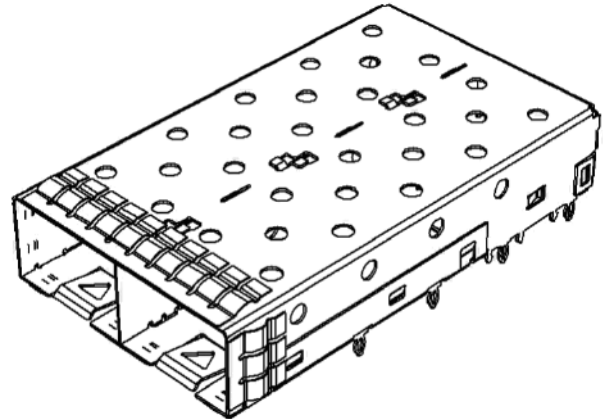4 components.

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

5

6 ### 5.3.3   Modules

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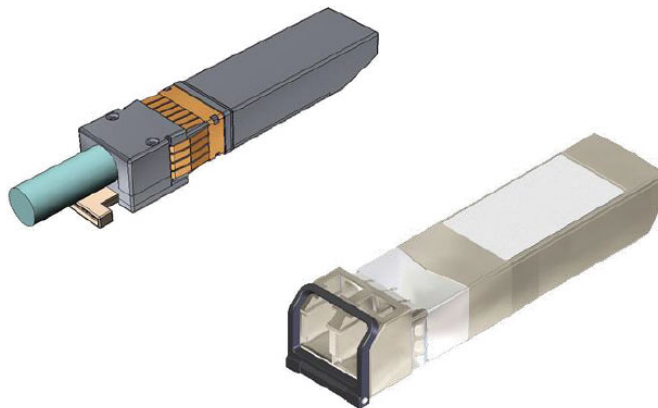9 compatible to SFP+ connectors and cages.

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11
12   **Figure 5-6 SFF-8432 Modules**