SFF-8402

Specification for

SFP+ 1X 112 Gb/s Pluggable Transceiver Solutions (SFP112)

Rev 1.1.75        April 1October 31, 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 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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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   March 30, 2014
- Title change for commonality in style with QSFP

Rev 1.1   September 13, 2014
- 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 1.1.15.1.1 and 5.2
- Added Figure 5-3, Figure 5-2
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# Connector, Cage, and Module Specifications

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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 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

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:

<table>
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<th>Website</th>
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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
  - A. pink;
- a. blue; or
- a. 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;
1. middle; and
2. 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.

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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

There are no acronyms or abbreviations defined for this document.

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 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 bytes memory map which is accessible over a 2-wire serial interface at the 8 bits address 1010000X (A0h). The digital diagnostic monitoring interface makes use of the 8 bits 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.

SFF-8472, the Management Interface for 1-lane (SFP, SFP+/SFP10, SFP16, SFP28, SFP56) 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 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. 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 basic management operations are simple and allow the host to access a 256 bytes addressable memory window, with 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.

Note: This limited set of basic operations and the very small byte-oriented memory window are a method can be traced back to SFF-8472636 and allows 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 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:

**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.

**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.

**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:

The management memory map defines registers and memory locations that are accessible to the host.

Versatile modules may be programmed to behave like modules of different classes.

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.

### 5.2 Low Speed 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 multimode or single mode fibers or passive or active copper cables; module could be an electrical-to-optical or an electrical-to-electrical device.

Application reference model of SFP+, see Figure 5-1, shows the high-speed data interface between an ASIC and SFP+ modules.
5.3 Connector, Cage, and Module Specifications
5.2.15.3.1 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.
5.2.25.3.2 Cages

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 5-45-3 SFF-8432 Cage

Figure 5-55-4 SFF-8432 Ganged Cage

5.2.25.3.3 Modules

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 5-65-5 SFF-8432 Modules