SFF-8665

Specification for

QSFP+ 4X Pluggable Transceiver Solutions

Rev 2.0 November 24, 2025

SECRETARIAT: SFF TWG
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ABSTRACT: This specification defines the physical interface, low speed electrical, and management interface requirements of QSFP+ 4X pluggable transceiver solutions including: QSFP10, QSFP14, QSFP28, QSFP56, QSFP112 and QSFP224.

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FOREWORD

The development work on this specification was done by the SFF TWG, an industry group. Since its formation as 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 which are leaders across the industry.

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

REVISION HISTORY

Rev 1.6

- Moved reference SFF specs to 2.1 Industry Documents and expanded the list
- Moved SFF-8672 and SFF-8683 to Figure 3-1 plus complementary sections
- Added using interfaces to Application Specific Criteria

Rev 1.7

- Clarified introductory paragraph of SFF-8662 and SFF-8672

Rev 1.8

- Add multiple generations to Abstract

Rev 1.9

- Modified Figure 3-1 to include explanatory details

Rev 2.0 *November 24, 2025*

- Reformatted entire document and added new boilerplate.
- Section 4 (General Description): Rewrote entire section and incorporated figures and descriptions for all generations of QSFP pluggable transceiver solutions from 10G to 200G.
- Section 5 (Overview of Referenced Specifications): Restructured into 3 subsections and moved any prior material that is still relevant into one of these sections.
- Added section 5.1 (Management Interfaces) which includes SFF-8636 and CMIS
- Added section 5.2 (General Electrical)
- Added section 5.3 (Connector, Cage, and Module specifications) and added details of existing and new components within this section
- Added section 6 (QSFP thermal recommendations)

CONTENTS

FIGURES

1. Scope

This specification defines the physical interface, low speed electrical, and management interface requirements of QSFP+ 4X pluggable transceiver solutions including: QSFP10, QSFP14, QFSP28, QSFP56, QSFP112, and QSFP224.

Other standards (e.g., IEEE, FC-PI-6, etc.) define the performance requirements for QSFP 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
- REF-TA-1011 Cross Reference to Select SFF Connectors and Modules
- SFF-TA-1027 QSFP2 Connector, Cage, and Module
- SFF-8636 Management Interface for 4-lane Modules and Cables
- SFF-8661 QSFP+ 4X Pluggable Module
- SFF-8662 QSFP+ 28 Gb/s 4X Connector (Style A)
- SFF-8663 QSFP+ 28 Gb/s Cage (Style A)
- SFF-8672 QSFP+ 4X 28 Gb/s Connector (Style B)
- SFF-8679 QSFP+ 4X Hardware and Electrical Specification
- SFF-8682 QSFP+ 4X Connector
- SFF-8683 QSFP+ Cage

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
IEEE	Institute of Electrical and Electronics Engineers (IEEE)	https://ieeexplore.ieee.org/browse/standards/get-program/page/series?id=68
Fibre Channel standards	InterNational Committee for Information Technology Standards (INCITS)	https://www.incits.org/standards-information/purchase-standards-or-download-dpans
OIF	Optical Internetworking Forum (OIF)	*https://www.oiforum.com/technical-work/implementation-agreements-ias/*
QSFP-DD MSA	QSFP-DD MSA	*http://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.

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

Obsolete: Indicates that an item was defined in prior specifications but has been removed from this specification.

Optional: 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.

Prohibited: Describes a feature, function, or coded value that is defined in a referenced specification to which this SFF specification makes a reference, where the use of said feature, function, or coded value is not allowed for implementations of this specification.

Reserved: Where the term is used for a signal on a connector contact, the 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.

Restricted: Refers to features, bits, bytes, words, and fields that are set aside for other standardization purposes. If the context of the specification applies to the restricted designation, then the restricted bit, byte, word, or field shall be treated as a value whose definition is not in scope of this document, and is not interpreted by this specification.

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.

Vendor specific: Indicates something (e.g., a bit, field, code value) that is not defined by this specification. Specification of the referenced item is determined by the manufacturer and may be used differently in various implementations.

3.2 Acronyms and Abbreviations

CMIS: Common Management Interface Specification
QSFP: Quad Small Form-factor Pluggable
QSFP+: 10 Gigabit Quad Small Form-factor Pluggable
SAS: Serial Attached SCSI

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.

Coherent: In coherent optical communication, data is transmitted by modulating a light wave's amplitude, phase, and/or polarization, and detected taking the phase into account.

4. General Description of Pluggable Solutions

This specification provides references to the required SFF specifications necessary to implement QSFP pluggable 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.

The specifications provide a common solution for combined four-channel ports that may support: Ethernet, Fibre Channel, InfiniBand, SAS, or SONET/SDH specifications. The connectors used in such applications are subject to the requirements of the appropriate standard. This specification is suitable for multimode and single mode modules, passive copper, active copper, and active optical cables.

4.1 10G and 14G Pluggable Solutions

A 10G or 14G pluggable solution, as shown in Figure 4-1, consists of an explicit combination of Management, Electrical, Connector, Cage and Pluggable Module specifications designed for up to 10 Gbps per lane or 14 Gbps per lane operation, respectively. These solutions are also known as QSFP+.

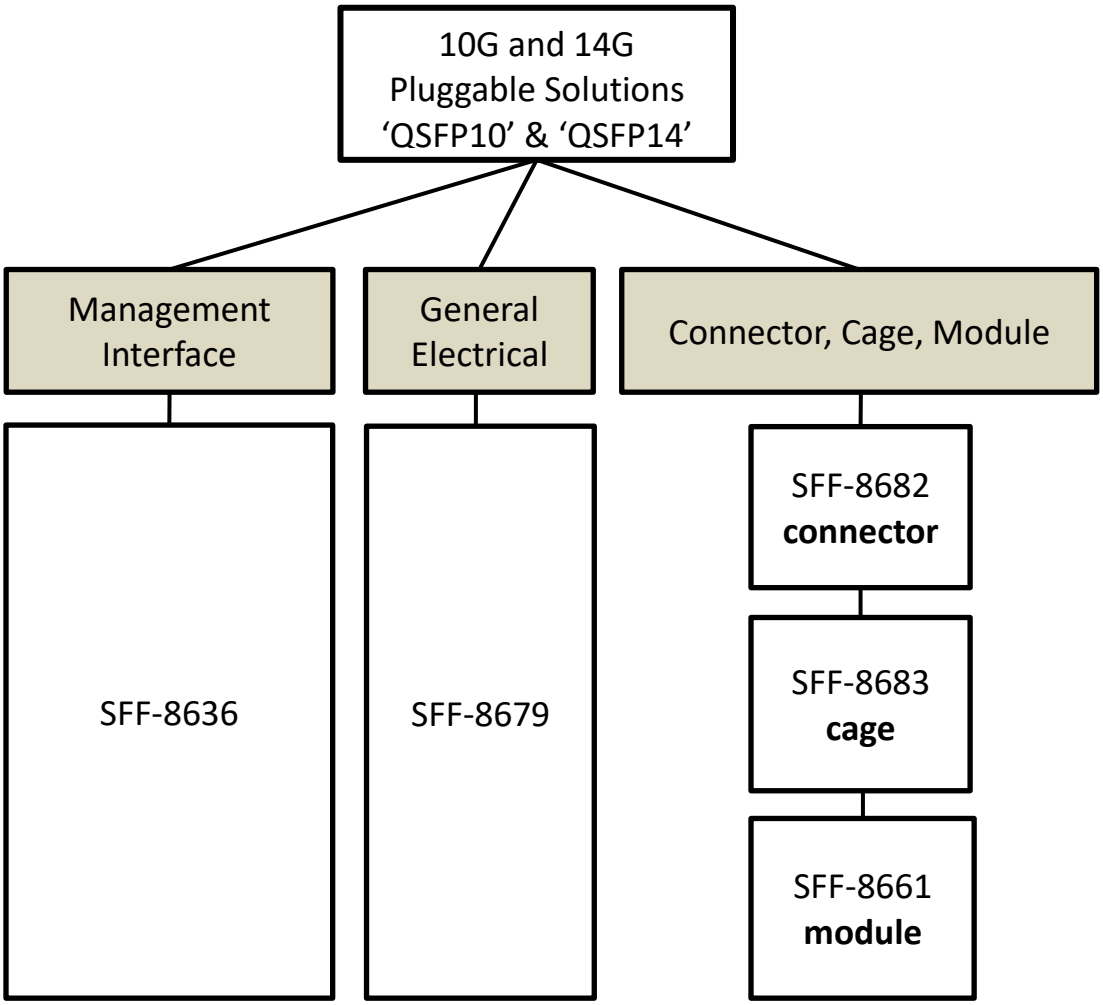

Figure 4-1 'QSFP10' and 'QSFP14' Pluggable Solutions

4.2 25G Pluggable Solutions

A 25G pluggable solution, as shown in Figure 4-2, consists of an explicit combination of Management, Electrical, Connector, Cage and Pluggable Module specifications designed for up to 28 Gbps per lane. It should be noted that the use of a QSFP112 or QSFP224 connector, cage or module refers to mechanical specifications and does not require the pluggable solution to support 112 Gbps or 224 Gbps per lane. The management interface for a 25G pluggable solution is SFF-8636 except for coherent modules which may use CMIS.

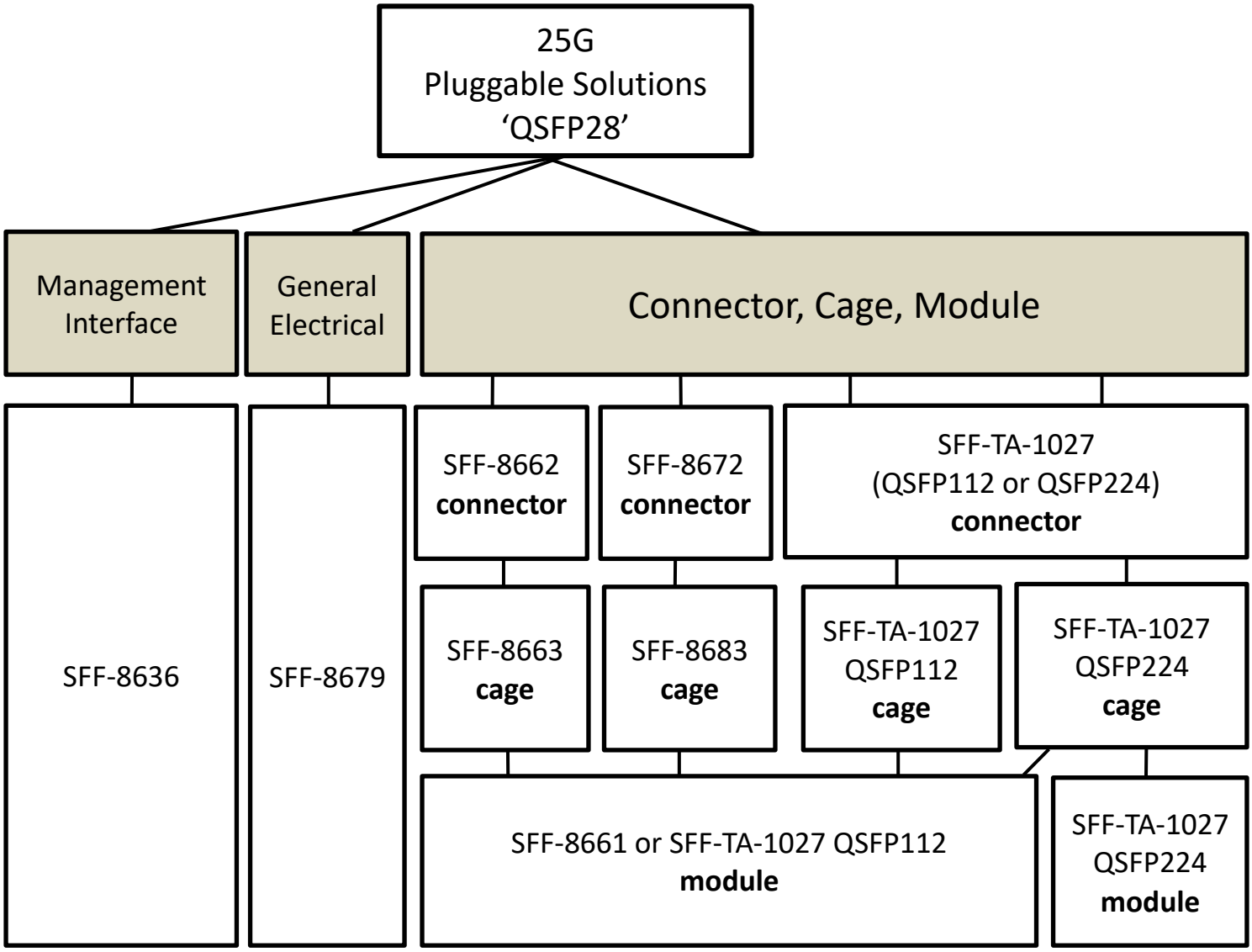

Figure 4-2 'QSFP28' Pluggable Solution

4.3 50G Pluggable Solutions

A 50G pluggable solution, as shown in Figure 4-3, consists of an explicit combination of Management, Electrical, Connector, Cage and Pluggable Module specifications designed for up to 56 Gbps per lane operation. It should be noted that the use of a QSFP112 or QSFP224 connector, cage or module refers to mechanical specifications and does not require the pluggable solution to support 112 Gbps or 224 Gbps per lane. The management interface for a 50G pluggable solution is SFF-8636 or CMIS. A module shall advertise which management interface it supports. A host may support either SFF-8636 or CMIS, or it may adapt to the management interface of the module.

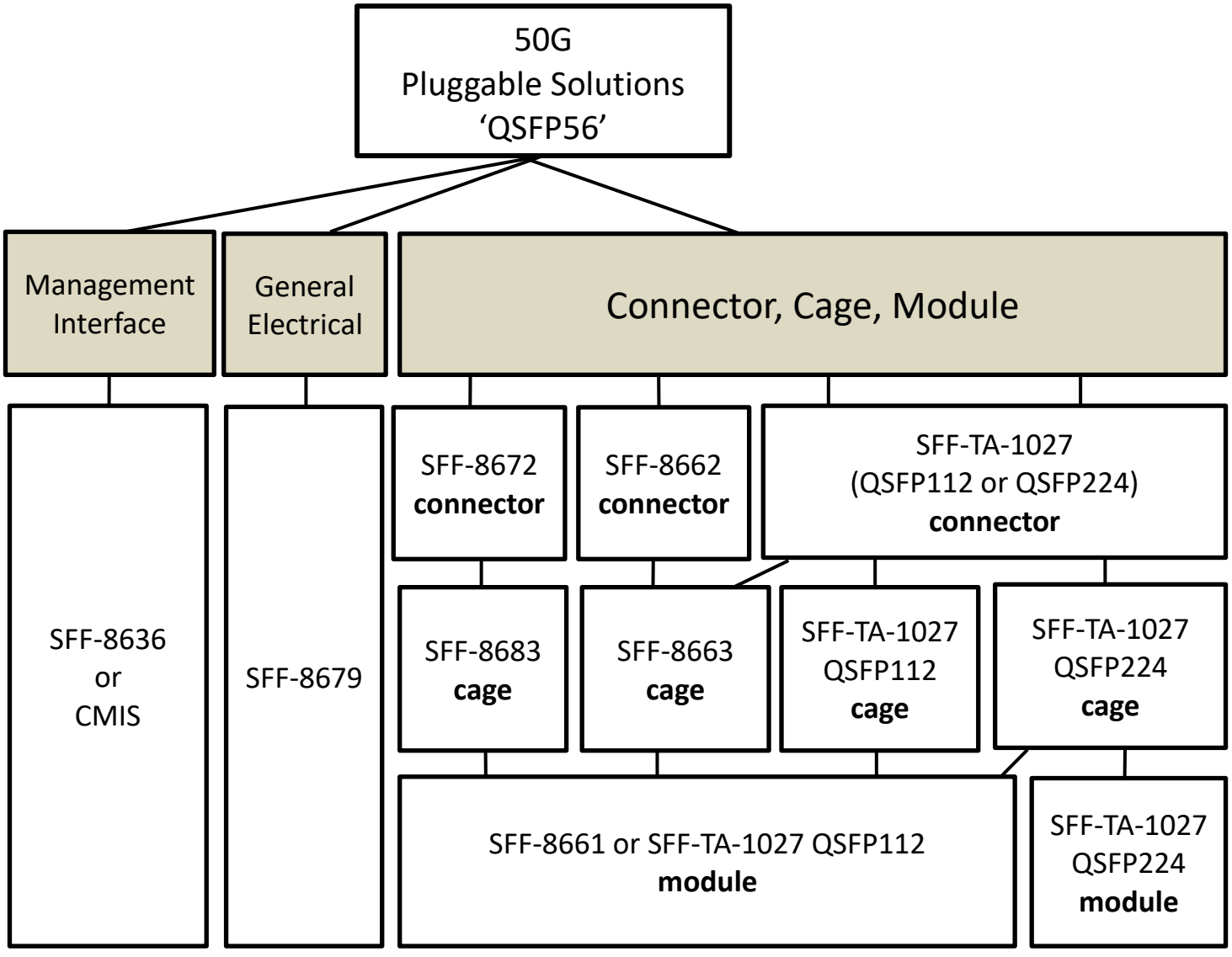

Figure 4-3 'QSFP56' Pluggable Solution

4.4 100G Pluggable solutions

A 100G pluggable solution, as shown in Figure 4-4, consists of an explicit combination of Management, Electrical, Connector, Cage and Pluggable Module specifications designed for up to 112 Gbps per lane operation. It should be noted that the use of a QSFP224 connector, cage or module refers to mechanical specifications and does not require the solution to support 224 Gbps per lane operation. The management interface for a 100G pluggable solution is SFF-8636 or CMIS for copper cables, and CMIS for active/optical modules. A module shall advertise which management interface it supports. A host may support either SFF-8636 or CMIS, or it may adapt to the management interface of the module.

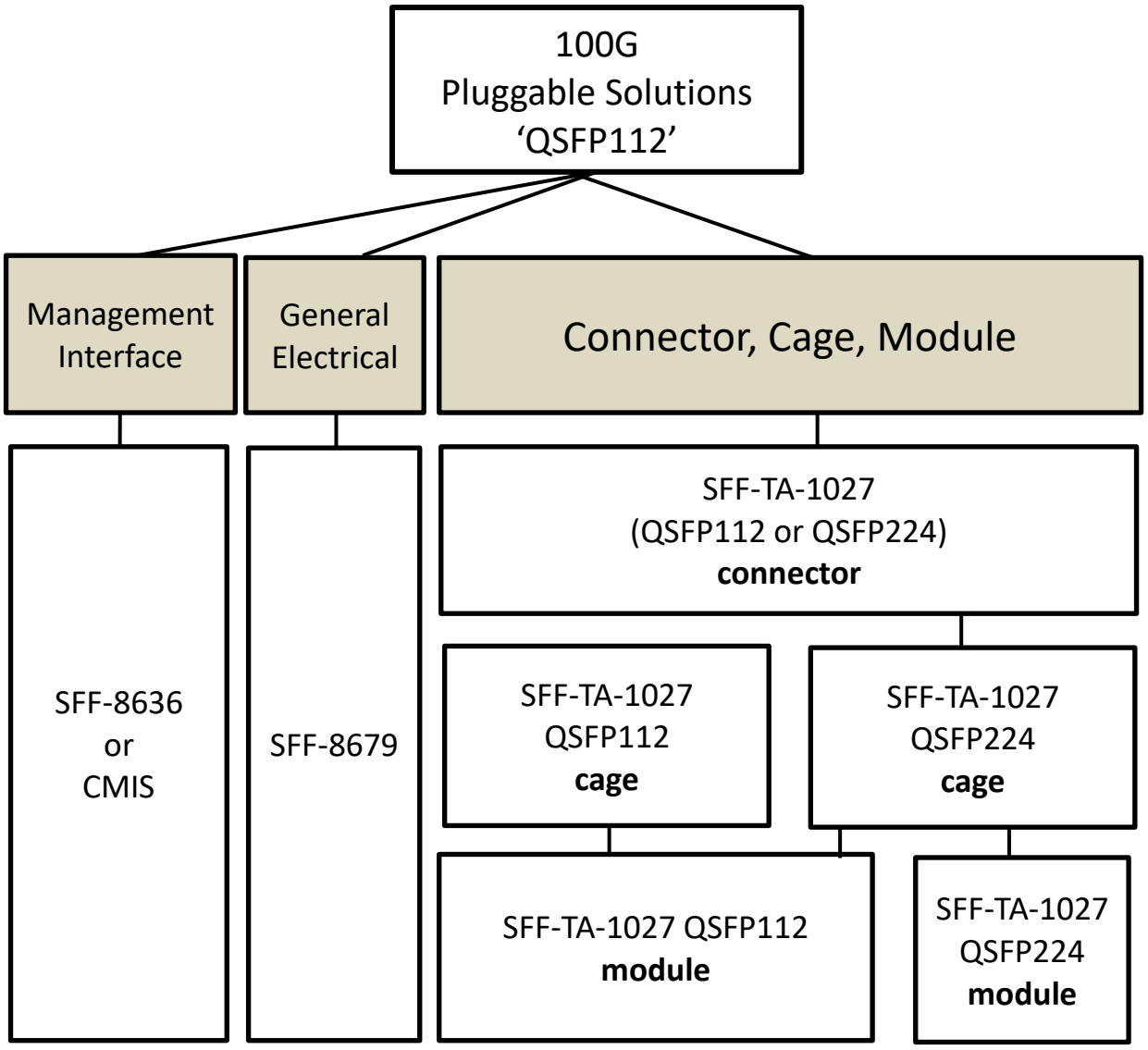

Figure 4-4 'QSFP112' Pluggable Solution

4.5 200G Pluggable Solutions

A 200G pluggable solution, as shown in Figure 4-5, consists of an explicit combination of Management, Electrical, Connector, Cage and Pluggable Module specifications designed for up to 224 Gbps per lane operation. The management interface for a 200G pluggable solution is CMIS.

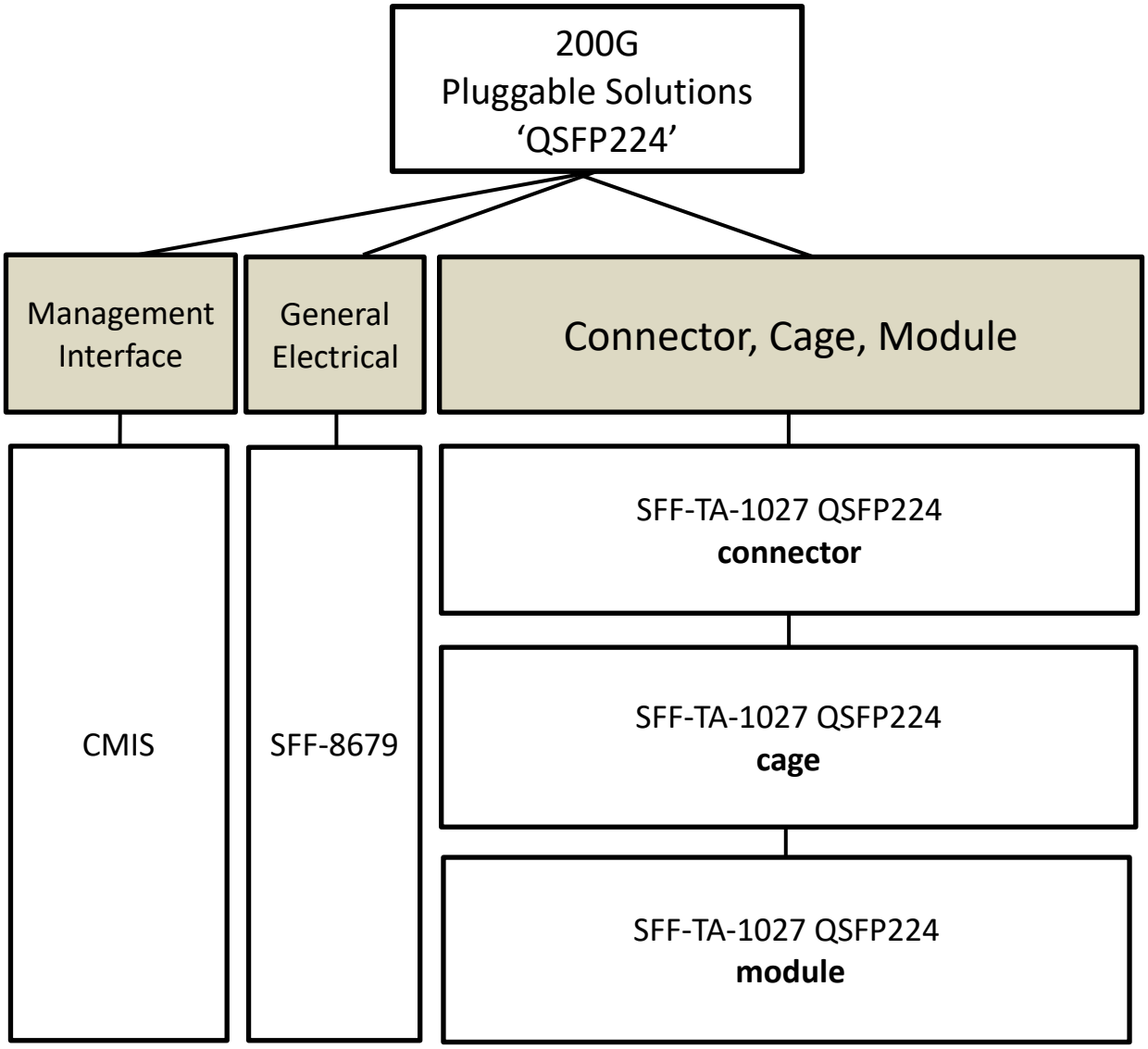

Figure 4-5 'QSFP224' Pluggable Solution

5. Overview of Referenced Specifications

5.1 Management Interfaces

These specifications define a common management interface for 4-lane cable assemblies. They define a common non-volatile memory map and protocol utilized for managed external cable interface implementations based on a Two-Wire-Interface (TWI) as described on https://www.i2c-bus.org/twi-bus.

Memory map details and communication protocol used to transfer the information are described within this specification. This approach facilitates a common memory map and management interface for applications with different mechanical, physical layer and otherwise different implementations.

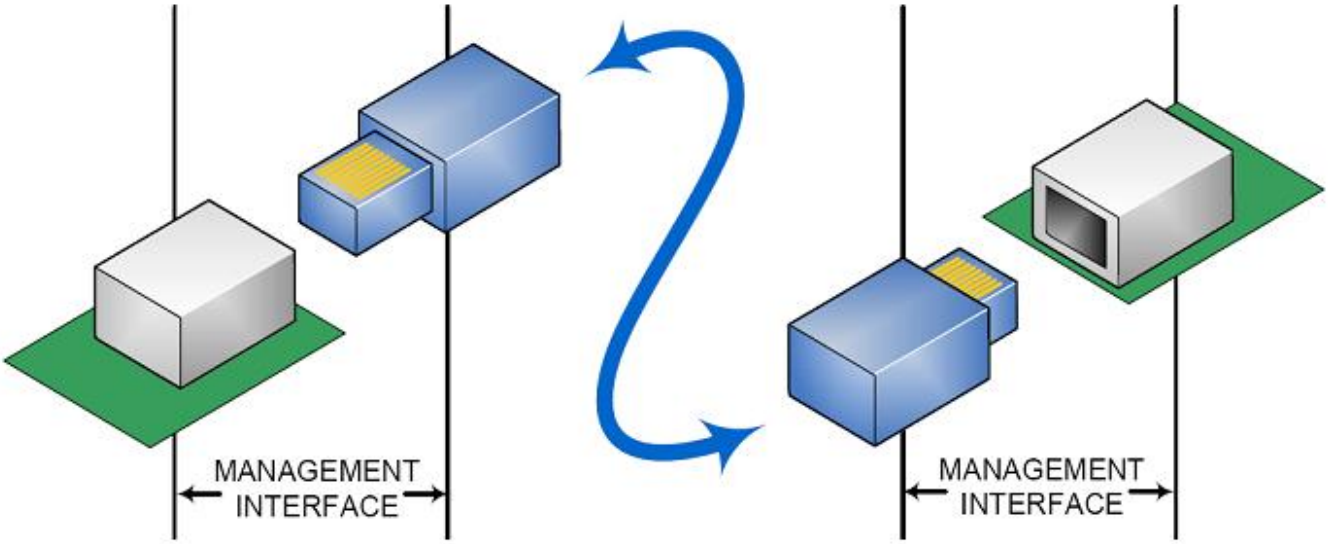

Figure 5-1 Management Interface

5.1.1 SFF-8636

The 'Management Interface for 4-lane Modules and Cables Specification' is intended for use by modules at 56 Gbps and below but may also be used at 112 Gbps in some cases when CMIS is not needed for 112 Gbps operations. It is backwards compatible to 1 Gbps modules.

SFF-8636 defines a common memory map and protocol that can be used to manage both 4-channel pluggable transceiver modules and 4-channel managed external cable interface implementations. Physical layer and mechanical details of the interface are outside the scope of the document. Memory map details and communication protocol used to transfer the information are described in the document. This approach facilitates a common memory map and management interface for modules or cable assemblies with different mechanical, physical layer, and other characteristics. Examples include the QSFP+ family and mini multilane connectors for SAS (see REF-TA-1011).

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 for an 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.

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.

5.2 General Electrical

SFF-8679 defines the contact pads, the electrical, the optical, the power supply, the ESD and the thermal characteristics of the cable plugs and pluggable modules.

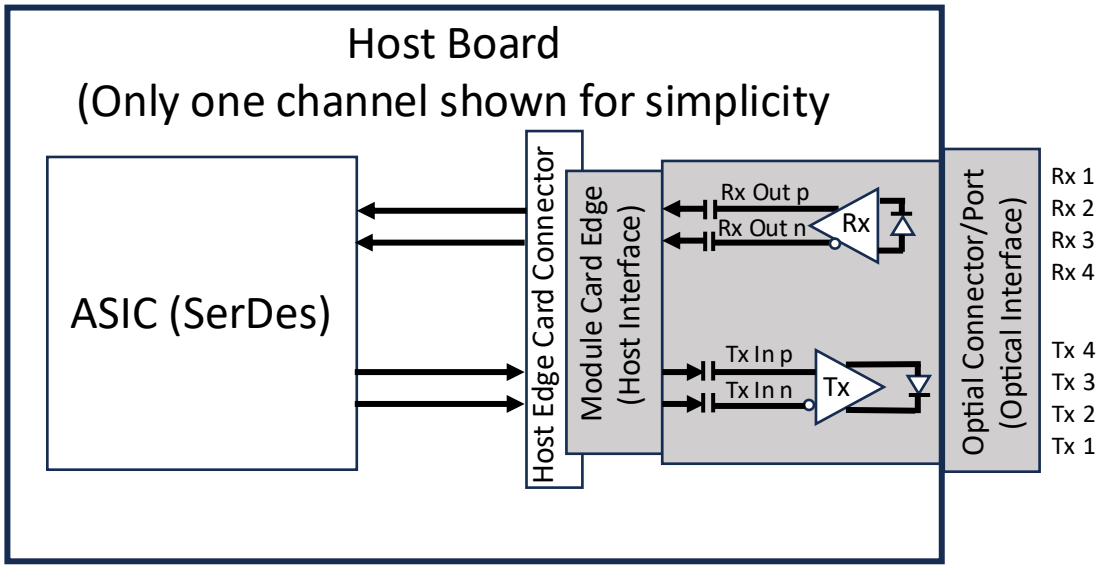

Figure 5-2 Application Reference Model

5.3 Connector, Cage, and Module Specifications

5.3.1 Connectors

There are multiple SFF specifications (SFF-8662, SFF-8672, SFF-8682, and SFF-TA-1027) that define the physical interface and general performance requirements of QSFP connector variants. Figure 4-1, Figure 4-2, Figure 4-3, Figure 4-4, and Figure 4-5 summarize the connectors and cages that make up QSFP+ pluggable transceiver solutions and shows which cages are used with specific connectors.

5.3.1.1 QSFP10 and QSFP14 connector

The QSFP10 and QSFP14 connector is defined in SFF-8682. It defines the terminology and physical requirements for the mating interface and physical embodiment of the 0.8 mm connector. The connector intermates with previous generations of lower speed QSFP modules. The requirements on the characteristic impedance and ability to transmit multi-gigabit signals for cable assemblies and backplanes are defined in the appropriate standard.

5.3.1.2 QSFP28 and QSFP56 connector

The connector variants for QSFP28 and QSFP56 are defined in SFF-8672, SFF-8662 and SFF-TA-1027. The connector specifications define the complete mechanical dimensions of the 28 GBd 0.8 mm connector. The connector system has a nominal 100 ohm differential impedance with a common mode impedance of 32.5 ohm. SFF-8672 defines the Style B connector and SFF-8662 defines the Style A connector.

5.3.1.3 QSFP112 connector

The QSFP112 connector is defined in SFF-TA-1027. SFF-TA-1027 defines a 1x1 connector with footprint Styles A & B and a 2x1 connector with footprint Styles A, B, C, & D. The requirements on the differential impedance and the common mode impedance are defined in the appropriate standard.

5.3.1.4 QSFP224 connector

The QSFP224 connector is defined in SFF-TA-1027. SFF-TA-1027 defines a 1x1 connector with QSFP224 footprint. The requirements on the differential impedance and the common mode impedance are defined in the appropriate standard.

Examples of QSFP connectors are shown in Figure 5-3 through Figure 5-6.

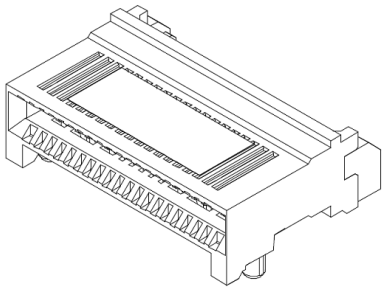

Figure 5-3 SFF-8662 Connector

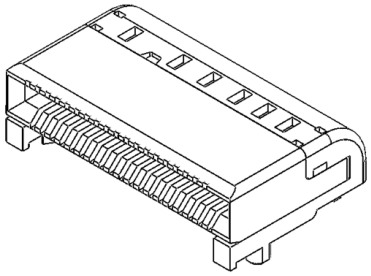

Figure 5-4 SFF-8672 Connector

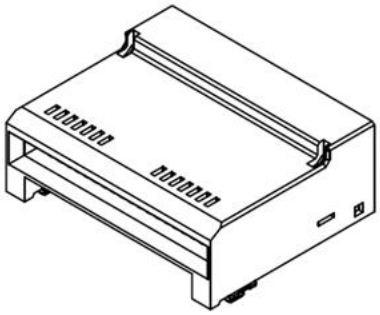

Figure 5-5 SFF-TA-1027 Connector

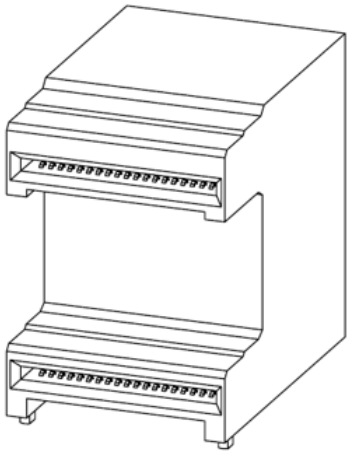

Figure 5-6 SFF-TA-1027 Stacked Connector

5.3.2 Cages

There are multiple SFF specifications (SFF-8663, SFF-8683, and SFF-TA-1027) that define the physical interface and general performance requirements of QSFP cage variants. The cage systems provide several implementation alternatives in terms of interoperability and EMI control.

5.3.2.1 QSFP10 and QSFP14 cage

The SFF-8683 specification defines the complete mechanical dimensions of the QSFP10 and QSFP14 cage. The cage system provides several implementation alternatives in terms of interoperability and EMI control that provide the data rate capability required for high speed applications. The cage system supports optional heat sink attachment and spring finger, elastomeric gasket, and behind the bezel cages for EMI control.

5.3.2.2 QSFP28 and QSFP56 cage

The QSFP28 and QSFP56 cage specifications are defined in SFF-8663, SFF-8683, and SFF-TA-1027. SFF-8663 and SFF-8683 define the terminology and mechanical requirements for a 28 Gbps and 56 Gbps cages. These specifications also intend to facilitate the implementation of 1 x "n" ganged cages and the 2 x "n" stacked cage configurations. There are cage dimensional requirements specified in these documents to enable assembly with the 28 Gbps and 56 Gbps connectors specified in SFF-8662 (for SFF-8663) and SFF-8672 (for SFF-8683). These requirements do not affect the mating compatibility of QSFP+ modules with these cages.

5.3.2.3 QSFP112 cage

The QSFP112 cage is defined in SFF-TA-1027. SFF-TA-1027 defines a 1x1 cage with or without a riding heatsink and a 2x1 stacked cage with or without a riding heatsink. Examples of QSFP cages are shown in Figure 5-7 through Figure 5-9.

5.3.2.3.1 QSFP224 cage

The QSFP224 cage is defined in SFF-TA-1027. SFF-TA-1027 defines a 1x1 cage with or without a riding heatsink. Examples of QSFP cages are shown in Figure 5-7 through Figure 5-9.

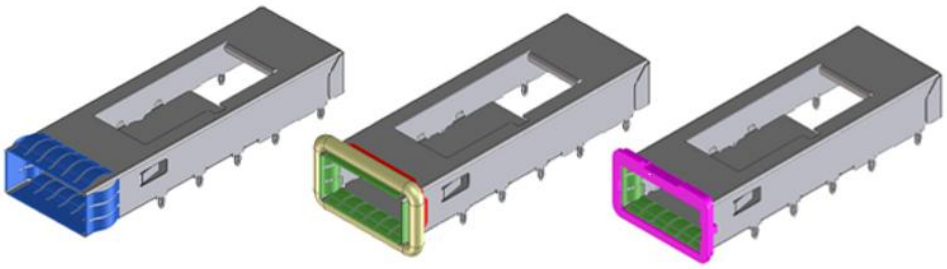

Figure 5-7 SFF-8663 and SFF-8683 Cages

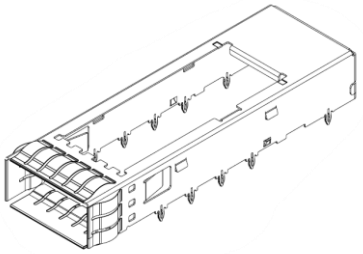

Figure 5-8 SFF-TA-1027 Cage

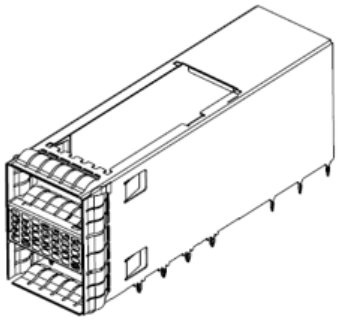

Figure 5-9 SFF-TA-1027 Stacked Cage (QSFP112 only)

5.3.3 Modules

SFF-8661 and SFF-TA-1027 define the terminology and mechanical requirements for a pluggable transceiver module / plug. These two specifications define modules / plugs that are backwards compatible mechanically, though SFF-TA-1027 enables use at higher data rates. Examples of QSFP modules are shown in Figure 5-10.

5.3.3.1 QSFP10, QSFP14, QSFP28 and QSFP56 module

SFF-8661 defines the complete mechanical dimensions of the QSFP+ 4x module. This module provides interoperability and EMI control for the QSFP system. The QSFP+ module contains a printed circuit board that mates with an appropriately designed connector.

5.3.3.2 QSFP112 module

The QSFP112 module is defined in SFF-TA-1027. The SFF-TA-1027 QSFP112 module mechanical dimensions are designed to support up to 112 Gbps per lane signaling, but can be applied to a broad range of QSFP+ pluggable solutions. See Figure 4-2, Figure 4-3, and Figure 4-4. For QSFP112 modules, the bottom surface of the module within the cage is flat without a pocket.

5.3.3.3 QSFP224 module

The QSFP224 Module is defined in SFF-TA-1027. The SFF-TA-1027 QSFP224 module mechanical dimensions are designed to support up to 224 Gbps per lane signaling, but can be applied to a broad range of QSFP+ pluggable solutions if specific compatibility conditions are met.

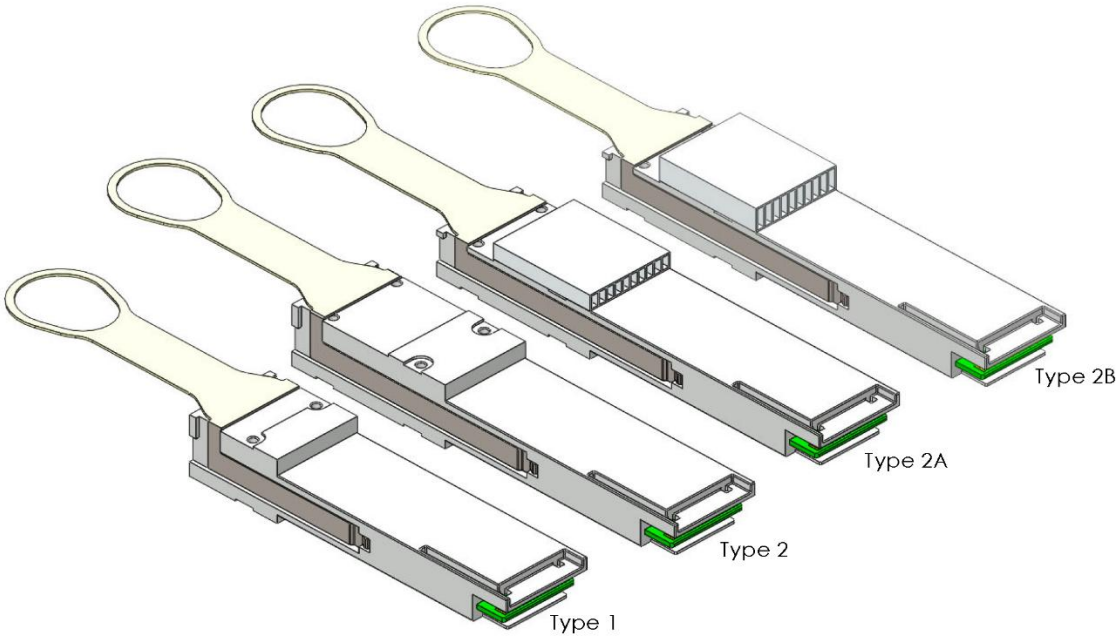

Figure 5-10 Typical QSFP+ Cable Plugs or Pluggable Modules

6. QSFP Thermal Recommendations

The QSFP-DD MSA thermal whitepaper explains techniques that can be applied to QSFP module design and QSFP system design. That whitepaper provides both experimental and simulation studies to demonstrate their efficacy. (See www.qsfp-dd.com for thermal white paper).