SFF specifications are available at http://www.snia.org/sff/specifications
or ftp://ftp.seagate.com/sff

SFF-8024

Specification for

SFF Cross Reference to Industry Products

Rev 4.1   June 27, 2016

Secretariat: SFF TA TWG

Abstract: This specification defines the naming conventions for the various
configurations of pluggable I/O solutions.

This specification is the reference source for identifiers assigned to interpret
the memory maps of self-identifying devices.

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

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.

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The members decided to treat this specification in the style of SFF-8000, and have it maintained by the Chair. Drawing attention to new revisions will be done at the discretion of the Chair.

Update History:

Rev 0.7 - Table 3-1 changed per comments received during ballot
         - Figure 3-3 example added
Rev 0.8 - As requested by Transceiver SSWG, added color to Figure 3-3
Rev 0.9 - As requested, filled in more cells for SFP+ and CXP.
Rev 1.0 - Corrected CXP 802.3ba as applicable to SFF-8647
Rev 1.1 - Removed logo on connectors in Figure 3-1 and Figure 3-2
Rev 1.2 - Changed '>' to 'and' in Table 3-1
         - Added master table for Identifier Values as per Transceiver SSWG
         - Added master table for Encoding Values
Rev 1.3 - Added SFP+ 4 Gb/s to Table 3-1
Rev 1.4 - Expanded the Identifier Values table
         - Added master table for Specification Compliance Codes
         - Added master table for Extended Specification Compliance Codes
Rev 1.5 - Expanded single sentence about SFF-8063 to a paragraph with emphasis
Rev 1.6 - Identified superseded specifications in Table 3-1
Rev 1.7 - Expanded HD to include unshielded and add 24 Gb/s
Rev 1.8 - Aligned SFP naming w/QSFP nomenclature
Rev 1.9 - Added 0Bh to the Extended Specification Compliance Codes
Rev 2.0 - Changed SFP Common Management Spec to SFF-8472
         - Deleted 802.3bj from 28 Gb/s CXP
Rev 2.1 - Aligned CXP and HD naming w/QSFP nomenclature
Rev 2.2 - Replaced duplicated codes 08-0Ah in the Extended Specification
           Compliance Codes
         - Clarified active cable and CWDM4 codes
Rev 2.3 - Expanded 0Bh in Identifier Values to include SFP+
         - Added 13-16h to the Extended Specification Compliance Codes
         - The Encoding Values which were thought to be common between SFF-8472
           and SFF-8636 are not. The table was deleted and restored to SFF-8636.
         - The Specification Compliance Codes are not subject to change. The table
           was deleted and restored to SFF-8636.
Rev 2.4 - Added 13h to Identifier Values
Rev 2.5 - Restored the Encoding Values from SFF-8472 and SFF-8636
         - Added Connector Types from SFF-8472 and SFF-8636
         - Added 07h to Encoding Values
         - Added 0Dh and 24h to Connector Types
         - Split Table 3-1 Integrated Pluggable Solution specifications which were
           referenced by another Integrated Pluggable Solution: o SFF-8084
           reference changed to SFF-8071
            o SFF-8431 reference changed to SFF-8419
            o SFF-8643 reference changed to SFF-8613
            o SFF-8644 reference changed to SFF-8614
            o SFF-8647 reference changed to SFF-8617
Rev 2.6 - Added note in 4.1 about overlap with CFP MSA codes
         - Removed IEEE references from CXP rows
Rev 2.7 - Added 14-15h Fanouts to Identifier Values
Rev 2.8 - Added specification numbers for QSFPx management
         - Added SFF-8418 to Table 3-1
Rev 2.9 - Added 16h 10GBASE-T with SFI electrical interface to Extended
           Specification Compliance Codes
Rev 3.0 - Added 17h QSFP28 100G CLR4 to Extended Specification Compliance Codes
Rev 3.1 - Renamed Table 3-1 and added Table 3-2 Device Connectors
Rev 3.2 - Renamed Mini-SAS HD as Mini Multilane HD in Figure 3-2
         - Updated Identifier Values with backward compatible cables and modules

         - Added 25G Ethernet and AOC, ACC equivalents to Extended Specification
          Compliance Codes
Rev 3.3 - Added Extended SCC 17h microQSFP
Rev 3.4 - Added Extended SCC 1Ah 2 lambda DWDM 100G
        - Added Encoding Value 08h PAM4
Rev 3.5 - Replaced Table 3-2
Rev 3.6 - Removed reference to SFF-8436 for Extended Compliance Codes in 4
Rev 3.7 - Corrected entries for CWDM4
Rev 3.8 - Added 25GBASE to 03h and 04h 100GBASE
Rev 3.9 - Changed 1Ah acronym to 100GE-DWDM2 and added description
Rev 4.0 - Updated for operation as a SNIA TWG
Rev 4.1 - Added Encoding Value 18h QSFP-DD to Identifier Values

Foreword

The development work on this specification was done by the SNIA SFF 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.

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 SFF Committee provided a forum for system
integrators and vendors to define the form factor of disk drives.

During their definition, other activities were suggested because participants in
SFF faced more challenges than the form factors. 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.

In July 2016, the SFF Committee transitioned to SNIA (Storage Networking Industry
Association), as a TA (Technology Affiliate) TWG (Technical Work Group).

Industry consensus is not a requirement to publish a 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 meets during the T10 (see www.t10.org) and T11 (see www.t11.org) weeks, and
SSWGs (Specific Subject Working Groups) are held at the convenience of the
participants. Material presented to SFF becomes public domain, and there are no
restrictions on the open mailing of the presented material by Members.

Many of the specifications developed by SFF have either been incorporated into
standards or adopted as standards by ANSI, EIA, JEDEC and SAE.

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

The complete list of SFF Specifications which have been completed or are currently
being worked on by the SFF Committee can be found at:
                    http://www.snia.org/sff/specifications/SFF-8000.TXT

If you wish to know more about the SFF TWG, the principles which guide the
activities can be found at:
                    http://www.snia.org/sff/specifications/SFF-8032.PDF

Suggestions for improvement of this specification will be welcome, they should be
submitted to:
                    http://www.snia.org/feedback

CONTENTS

FIGURES

TABLES

1 Scope

This specification provides a cross reference between the industry use of terms to describe pluggable solutions and the SFF specifications which define them.

1.1 Copyright

1.2 Disclaimer

2 References

2.1 Industry Documents

- IBTA EDR   InfiniBand Enhanced Data Rate
- IBTA FDR   InfiniBand Fourteen Data Rate
- IBTA QDR   InfiniBand Quad Data Rate

- INCITS 417 SAS-1.1 (Serial Attached SCSI - 1.1)
- INCITS 457 SAS-2   (Serial Attached SCSI - 2)
- INCITS 478 SAS-2.1 (Serial Attached SCSI - 2.1)
- INCITS 519 SAS-3   (Serial Attached SCSI - 3)
- INCITS 534 SAS-4   (Serial Attached SCSI - 4)

- SFF-8071   SFP+ 1X 0.8mm Card Edge Connector
- INF-8077   XFP 1X 10 Gb/s Pluggable Module
- SFF-8081   SFP+ 1X 16 Gb/s Pluggable Transceiver Solution (SFP16)

```
- SFF-8083    SFP+ 1X 10 Gb/s Pluggable Transceiver Solution (SFP10)
- SFF-8084    SFP+ 1X  4 Gb/s Pluggable Transceiver Solution
- SFF-8402    SFP+ 1X 28 Gb/s Pluggable Transceiver Solution (SFP28)
- SFF-8418    SFP+ 10 Gb/s Electrical Interface
- SFF-8419    SFP+ Power and Low Speed Interface
- SFF-8432    SFP+ Module and Cage
- SFF-8433    SFP+ Ganged Cage
- SFF-8436    QSFP+ 4X 10 Gb/s Pluggable Transceiver
- INF-8438    QSFP  4X  4 Gb/s Transceiver (Quad SFP)
- SFF-8449    Management Interface for SAS Shielded Cables
- SFF-8472    Management Interface for SFP+
- SFF-8482    Serial Attachment 2X Unshielded Connector
- SFF-8613    Mini Multilane  4/8X Unshielded Connector (HDun)
- SFF-8614    Mini Multilane  4/8X Shielded Cage/Connector (HDsh)
- SFF-8617    Mini Multilane 12X Shielded Cage/Connector (CXP)
- SFF-8630    Serial Attachment 4X 12 Gb/s Unshielded Connector
- SFF-8635    QSFP+ 4X 10 Gb/s Pluggable Transceiver Solution (QSFP10)
- SFF-8636    Management Interface for Cabled Environments
- SFF-8639    Multifunction 6X Unshielded Connector
- SFF-8640    Serial Attachment 4X 24 Gb/s Unshielded Connector
- SFF-8642    Mini Multilane 12X 10 Gb/s Shielded Connector (CXP10)
- SFF-8643    Mini Multilane  4/8X 12 Gb/s Unshielded Connector (HD12un)
- SFF-8644    Mini Multilane  4/8X 12 Gb/s Shielded Cage/Connector (HD12sh)
- SFF-8647    Mini Multilane 12X 14 Gb/s Shielded Cage/Connector (CXP14)
- SFF-8648    Mini Multilane 12X 28 Gb/s Shielded Cage/Connector (CXP28)
- SFF-8661    QSFP+ 4X Pluggable Module
- SFF-8662    QSFP+ 4X Connector (Style A)
- SFF-8663    QSFP+ Cage (Style A)
- SFF-8665    QSFP+ 4X 28 Gb/s Pluggable Transceiver Solution (QSFP28)
- SFF-8672    QSFP+ 4X Connector (Style B)
- SFF-8673    Mini Multilane  4/8X 24 Gb/s Unshielded Connector (HD24un)
- SFF-8674    Mini Multilane  4/8X 24 Gb/s Shielded Cage/Connector (HD24sh)
- SFF-8678    Serial Attachment 2X  6 Gb/s Unshielded Connector
- SFF-8679    QSFP+ 4X Base Electrical Specification
- SFF-8680    Serial Attachment 2X 12 Gb/s Unshielded Connector
- SFF-8681    Serial Attachment 2X 24 Gb/s Unshielded Connector
- SFF-8682    QSFP+ 4X Connector
- SFF-8683    QSFP+ Cage
- SFF-8685    QSFP+ 4X 14 Gb/s Pluggable Transceiver Solution (QSFP14)
```

2.2 Sources

There are several projects active within the SFF TWG. The complete list of specifications which have been completed or are still being worked on are listed in http://www.snia.org/sff/specifications/SFF-8000.TXT

Copies of ANSI standards may be purchased from the InterNational Committee for Information Technology Standards (http://www.techstreet.com/incitsgate.tmpl).

2.3 Conventions

The dimensioning conventions are described in ANSI-Y14.5M, Geometric Dimensioning and Tolerancing. All dimensions are in millimeters.

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

2.4 Glossary

Fanout Cable: A single connector cable assembly which splits into a number of connectors at the other end.

3 General Description

This specification provides a tabular representation of pluggable I/O configurations along with the naming conventions that are used. The relationship between industry brand names or general usage and the SFF Specifications which define them is not obvious in many cases.

TABLE 3-1 PLUGGABLE CONNECTORS

Popular Name	Integrated Pluggable Solution	Per Lane Data Rate Gb/s	Low Speed and General Electrical Spec	Common Management Spec	Application Specific Management Spec	Single Card Module/ Plug Formfactor	Single Card Single SMT Connector	Single Card Single Cage	Single Card Ganged Cage
SFP	MSA	1	INF-8074			Superseded by SFP10, SFP16 et al			
SFP+	SFF-8084	4	SFF-8419 SFF-8418	SFF-8472	n/a	SFF-8432	SFF-8071	SFF-8432	SFF-8433
SFP10	SFF-8083	10	SFF-8419 SFF-8418	SFF-8472	n/a	SFF-8432	SFF-8071	SFF-8432	SFF-8433
SFP16	SFF-8081	16	SFF-8419	SFF-8472	n/a	SFF-8432	SFF-8071	SFF-8432	SFF-8433
SFP28	SFF-8402	28	SFF-8419	SFF-8472	n/a	SFF-8432	SFF-8071	SFF-8432	SFF-8433
XFP	MSA	10	INF-8077						
QSFP	MSA	4	INF-8438			Superseded by QSFP10, QSFP 14 et al			
QSFP+	SFF-8436	10	SFF-8436			Superseded by QSFP10, QSFP 14 et al			
QSFP10	SFF-8635	10	SFF-8679	SFF-8636	n/a	SFF-8661	SFF-8682	SFF-8683	
QSFP14	SFF-8685	14	SFF-8679	SFF-8636	n/a	SFF-8661	SFF-8682	SFF-8683	
QSFP28	SFF-8665	28	SFF-8679	SFF-8636	n/a	SFF-8661	SFF-8662 and SFF-8663 / SFF-8672 and SFF-8683	(Style A) / (Style B)	
						Dual Card Module/ Plug Formfactor	Dual Card Integrated Single PF Card/ Connector	Dual Card Integrated Ganged PF Cage/ Connector	
CXP10	EIA-965/ SFF-8642	10	IBTA QDR			EIA-965/ SFF-8642	EIA-965/ SFF-8642	EIA-965/ SFF-8642	
CXP14	SFF-8647	14	IBTA FDR			SFF-8617	SFF-8617	SFF-8617	
CXP28	SFF-8648	28	IBTA EDR			SFF-8617	SFF-8617	SFF-8617	
HD12un	SFF-8643	12	SAS 2.1/3	SFF-8636	SFF-8449	SFF-8613	SFF-8613	SFF-8613	
HD12sh	SFF-8644	12	SAS 2.1/3	SFF-8636	SFF-8449	SFF-8614	SFF-8614	SFF-8614	
HD24un	SFF-8673	24	SAS 4	SFF-8636	SFF-8449	SFF-8613	SFF-8613	SFF-8613	
HD24sh	SFF-8674	24	SAS 4	SFF-8636	SFF-8449	SFF-8614	SFF-8614	SFF-8614	

TABLE 3-2 DEVICE CONNECTORS

Connector	Application	Lane Data Rate Gb/s	# of ports	Single Or Dual Side SMT Foot Print	Common Management Spec	Application Specific Management Spec	Connector Mechanical Spec
SFF-8678	SAS 1.1	3	1 or 2	Single	SFF-8636	SFF-8449	SFF-8482
SFF-8680	SAS-2	6	2	Single	SFF-8636	SFF-8449	SFF-8482
SFF-8680	SAS-3	12	2	Single	SFF-8636	SFF-8449	SFF-8482
SFF-8681	SAS-4	24	2	Single	SFF-8636	SFF-8449	SFF-8482
SFF-8630	SAS-3	12	4	Dual	SFF-8636	SFF-8449	SFF-8639
SFF-8640	SAS-4	24	4	Dual	SFF-8636	SFF-8449	SFF-8639

Examples are: SFP+, QSFP+

**Single Card
Single Port
SMT Connector**

**Single Card
Ganged Ports
SMT Connector**

FIGURE 3-1 SINGLE CARD CONFIGURATIONS

Examples are: CXP, Mini Multilane HD
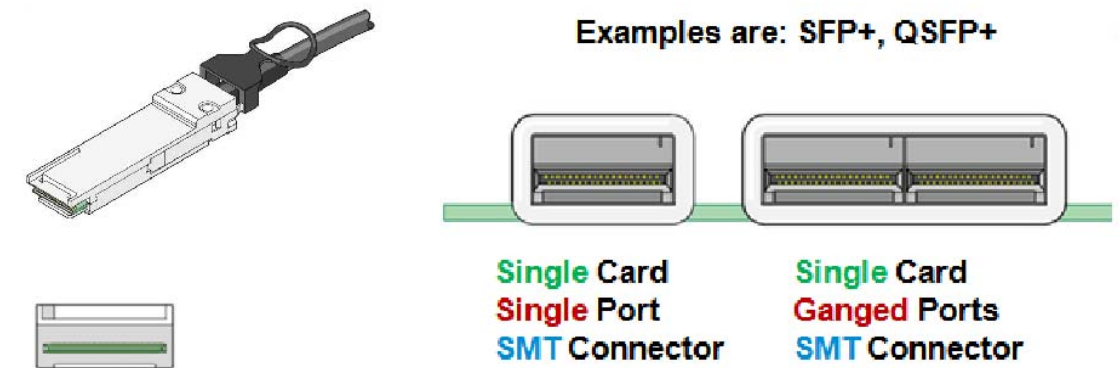
**Dual Card
Single Port
PF Connector**

**Dual Card
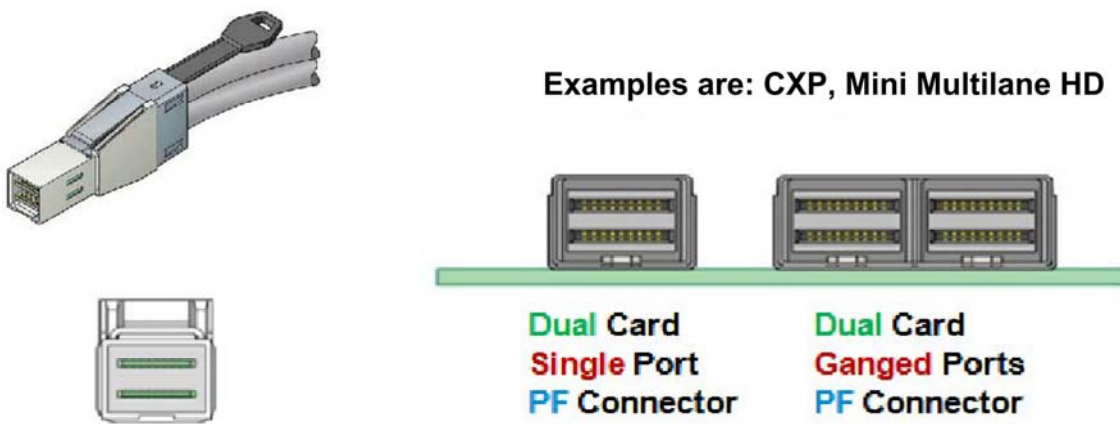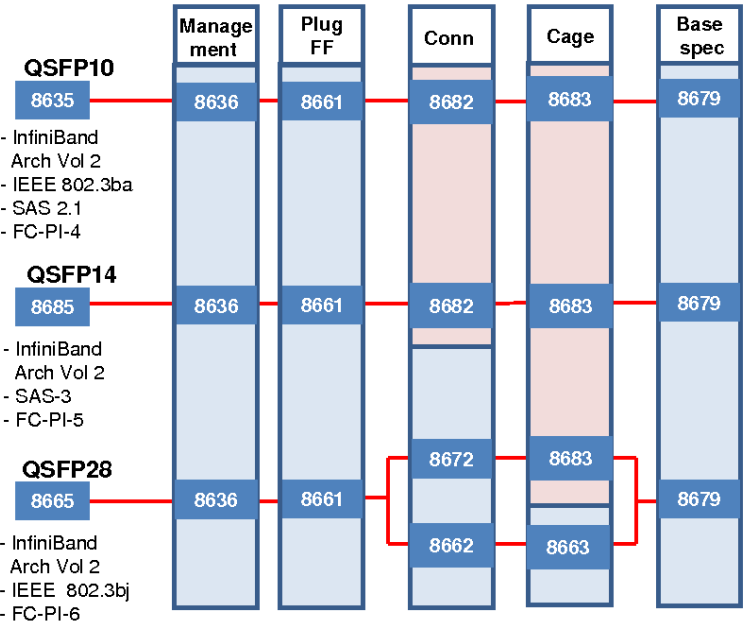Ganged Ports
PF Connector**

FIGURE 3-2 DUAL CARD CONFIGURATIONS

SFF-8635 QSFP+ 10 Gb/s 4X Pluggable Transceiver Solution (QSFP10)
SFF-8665 QSFP+ 28 Gb/s 4X Pluggable Transceiver Solution (QSFP28)
SFF-8685 QSFP+ 14 Gb/s 4X Pluggable Transceiver Solution (QSFP14)

SFF-8636 Management Interface
(common to all 3 specs)

SFF-8661 QSFP+ Module/Plug Form-factor
(common to all 3 specs)

SFF-8682 10G QSFP+ Connector
 - same component as what is in the original MSA
   and the current SFF-8436 all-in-one spec
 - picked up in the restructured SFF-8436 and in the
   SFF-8685 14G QSFP+ spec

SFF-8683 10G QSFP+ Cage
 - same component as what is in the original MSA
   and the current SFF-8436 all-in-one spec
 - picked up in the restructured SFF-8436 and in the
   SFF-8685 14G QSFP+ spec

SFF-8679 Base Electrical Spec
 (common to all 3 specs)
 - collected all that remained after the management,
   Plug FF, connector and cage were removed from
   the original MSA/SFF-8436 all-in-one spec

SFF-8662 28G QSFP+ Connector

SFF-8672 28G QSFP+ Connector

SFF-8663 28G QSFP+ Cage

FIGURE 3-3 EXAMPLE OF SFF-8436 QSFP+ RESTRUCTURING

4 Transceiver or Cable Management

Self-identifying information is provided by modules or cables that use the 2-wire interface as described in SFF-8436, SFF-8472 and SFF-8636.

The information will only be current if the developers of new modules and the standards incorporating new speeds and technologies request updates to the tables.

The tables below are not static. They have been removed from the subject specifications to prevent multi-revisions with no new technical content.

Use the SFF-8063 SFF Request Template to request an addition.

ftp.seagate.com/sff/SFF-8063.PDF

The tables below are referenced by the using specifications because either the content is common, or the contents are regularly updated. Maintaining the tables in SFF-8024 avoids having to revise specifications for non-technical changes. The registers for each table are:

```
    Table 4-1 Identifier Values
            SFF-8472 A0h, Byte 0
            SFF-8636 Page 00h Byte 0 and Page 00h Byte 128
    Table 4-2 Encoding Values
            SFF-8436 Page 00h Byte 139
            SFF-8472 A0h Byte 11
            SFF-8636 Page 00h Byte 139
    Table 4-3 Connector Types
            SFF-8436 Page 00h Byte 130
            SFF-8472 A0h Byte 2
            SFF-8636 Page 00h Byte 130
    Table 4-4 Extended Specification Compliance Codes
            SFF-8472 A0h Byte 36
            SFF-8636 Page 00h Byte 192
```

4.1 Transceiver References

The Identifier Value assigned to the physical device is essential to interpreting the contents of the memory map.

TABLE 4-1 IDENTIFIER VALUES

Value	Description of Physical Device
00h	Unknown or unspecified
01h	GBIC
02h	Module/connector soldered to motherboard (using SFF-8472)
03h	SFP/SFP+/SFP28
04h	300 pin XBI
05h	XENPAK
06h	XFP
07h	XFF
08h	XFP-E
09h	XPAK
0Ah	X2
0Bh	DWDM-SFP/SFP+ (not using SFF-8472)
0Ch	QSFP (INF-8438)
0Dh	QSFP+ or later (SFF-8436, SFF-8635, SFF-8665, SFF-8685 et al) *1
0Eh	CXP or later
0Fh	Shielded Mini Multilane HD 4X
10h	Shielded Mini Multilane HD 8X
11h	QSFP28 or later (SFF-8665 et al) *2
12h	CXP2 (aka CXP28) or later
13h	CDFP (Style 1/Style2)
14h	Shielded Mini Multilane HD 4X Fanout Cable
15h	Shielded Mini Multilane HD 8X Fanout Cable
16h	CDFP (Style 3)
17h	microQSFP
18h	QSFP-DD Double Density 8X Pluggable Transceiver (INF-8628)
-7Fh	Reserved
80-FFh	Vendor Specific
*1 0Dh is the preferred coding, it supports multi-speed implementations and provides backward compatibility *2 11h may prevent the use of new 25G-class modules on old hosts	

NOTE: The Identifier Values assigned by the CFP MSA overlap with the above, and this should not be an issue because CFP does not use I2C for the management protocol, it uses MDIO. Software which bases actions on Identifier Values needs to recognize that synonyms exist and qualify the values by the management protocol.

4.2 Encoding References

The values established by SFF-8436 and SFF-8636 are similar but not identical to those assigned by SFF-8472. Maintaining a single reference will prevent further divergence.

TABLE 4-2 ENCODING VALUES

Description of Encoding mechanism	Modules		
	8472	**Common**	**8x36**
Unspecified		00h	
8B/10B		01h	
4B/5B		02h	
NRZ		03h	
Manchester	04h		06h
SONET Scrambled	05h		04h
64B/66B	06h		05h
256B/257B (transcoded FEC-enabled data)		07h	
PAM4		08h	
Reserved		-FFh	
Note: For devices supporting multiple encoding types, the primary product application dictates the value chosen e.g. for Fibre Channel 16G/8G/4G or Ethernet 10G/1G, the value of 64B/66B should be chosen.			

4.3 Connector References

The Connector Types are common between SFF-8436, SFF-8472 and SFF-8636. Maintaining a single reference will prevent divergence.

TABLE 4-3 CONNECTOR TYPES

Value	Description of Media Connector
00h	Unknown or unspecified
01h	SC (Subscriber Connector)
02h	Fibre Channel Style 1 copper connector
03h	Fibre Channel Style 2 copper connector
04h	BNC/TNC (Bayonet/Threaded Neill-Concelman)
05h	Fibre Channel coax headers
06h	Fiber Jack
07h	LC (Lucent Connector)
08h	MT-RJ (Mechanical Transfer - Registered Jack)
09h	MU (Multiple Optical)
0Ah	SG
0Bh	Optical Pigtail
0Ch	MPO 1x12 (Multifiber Parallel Optic)
0Dh	MPO 2x16
-1Fh	Reserved
20h	HSSDC II (High Speed Serial Data Connector)
21h	Copper pigtail
22h	RJ45 (Registered Jack)
23h	No separable connector
24h	MXC 2x16
-7Fh	Reserved
80h-FFh	Vendor specific
Note: 01h to 05h are not SFP-compatible, and are included for compatibility with GBIC standards.	

4.4 Extended Specification Compliance References

The Extended Specification Compliance Codes identify the electronic or optical interfaces which are not included in SFF-8472 Optical and Cable Variants Specification Compliance or SFF-8636 Specification Compliance Codes.

TABLE 4-4 EXTENDED SPECIFICATION COMPLIANCE CODES

Code	Description of Module Capability
00h	Unspecified
01h	100G AOC (Active Optical Cable) or 25GAUI C2M AOC. Providing a worst BER of 5 × 10^(-5)
02h	100GBASE-SR4 or 25GBASE-SR
03h	100GBASE-LR4 or 25GBASE-LR
04h	100GBASE-ER4 or 25GBASE-ER
05h	100GBASE-SR10
06h	100G CWDM4
07h	100G PSM4 Parallel SMF
08h	100G ACC (Active Copper Cable) or 25GAUI C2M ACC. Providing a worst BER of 5 × 10^(-5)
09h	Obsolete (assigned before 100G CWDM4 MSA required FEC)
0Ah	Reserved
0Bh	100GBASE-CR4 or 25GBASE-CR CA-L
0Ch	25GBASE-CR CA-S
0Dh	25GBASE-CR CA-N
-0Fh	Reserved
10h	40GBASE-ER4
11h	4 x 10GBASE-SR
12h	40G PSM4 Parallel SMF
13h	G959.1 profile P1I1-2D1 (10709 MBd, 2km, 1310nm SM)
14h	G959.1 profile P1S1-2D2 (10709 MBd, 40km, 1550nm SM)
15h	G959.1 profile P1L1-2D2 (10709 MBd, 80km, 1550nm SM)
16h	10GBASE-T with SFI electrical interface
17h	100G CLR4
18h	100G AOC or 25GAUI C2M AOC. Providing a worst BER of 10^(-12) or below
19h	100G ACC or 25GAUI C2M ACC. Providing a worst BER of 10^(-12) or below
1Ah	100GE-DWDM2 (DWDM transceiver using 2 wavelengths on a 1550nm DWDM grid with a reach up to 80km)
-FFh	Reserved