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2



SFF-8024

SFF Cross Reference to Industry Products

Rev 4.5 May 19, 2018

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 at <http://www.snia.org/sff/specifications> and comments via <http://www.snia.org/feedback> are solicited. Such comments will be considered for future revisions of this specification.

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1 Intellectual Property

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3 Specification may require the use of an invention covered by patent rights. By
4 distribution of this specification, no position is taken with respect to the
5 validity of a claim or claims or of any patent rights in connection therewith.
6

7 This specification is considered SNIA Architecture and is covered by the SNIA IP
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9 Additional information can be found at the following locations:

10

- 11 • Results of IP Disclosures: <http://www.snia.org/sffdisclosures>
- 12 • SNIA IP Policy: <http://www.snia.org/ippolicy>

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15 Update History:

16

- 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- Rev 1.6 - Identified superseded specifications in Table 3-1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

17

- 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 - Added new codes 1Bh-20h in Extended compliance codes Table 4-4

- Rev 4.2 - Added new code 21h (100G PAM4 BiDi) in Extended compliance code Table 4-4
- Rev 4.3 - Added new code 19h for OSFP in Identifier values Table 4-1
 - Added new code 22h for 4WDM-10 MSA in Table 4-4
 - Added new code 23h for 4WDM-20 MSA in Table 4-4
 - Added new code 24h for 4WDM-40 MSA in Table 4-4
- Rev 4.4 - Incorporated changes from June 7 2017 meeting including:
 - Deleted all references to Seagate FTP site
 - Restructured Table 3-1
 - Updated Fig 3-3
 - Added multi-lane text to section 4.4
 - Changed ANSI reference to INCITS
- Rev 4.5 - May 19, 2018
 - Updated Tables 3-1, 3-2
 - Added new code 1Ah for SFP-DD in Table 4-1
 - Added new codes for CS and mini CS connectors
 - Added new codes for 50G/lane and 100G PMDs
 - Added new codes for 64GFC and 128GFC
 - Added Module-Host Electrical Interface Codes

1 **Foreword**

2

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

6

7 When 2 1/2" diameter disk drives were introduced, there was no commonality on
8 external dimensions e.g. physical size, mounting locations, connector type,
9 connector location, between vendors. The SFF Committee provided a forum for system
10 integrators and vendors to define the form factor of disk drives.

11

12 During their definition, other activities were suggested because participants in
13 SFF faced more challenges than the form factors. In November 1992, the charter was
14 expanded to address any issues of general interest and concern to the storage
15 industry. The SFF Committee became a forum for resolving industry issues that are
16 either not addressed by the standards process or need an immediate solution.

17

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

20

21

22

23 SFF meets during the T10 (see www.t10.org) and T11 (see www.t11.org) weeks, and
24 SSWGs (Specific Subject Working Groups) are held at the convenience of the
25 participants. Material presented to SFF becomes public domain, and there are no
26 restrictions on the open mailing of the presented material by Members.

27

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

30

31 For those who wish to participate in the activities of the SFF TWG, the signup for
32 membership can be found at:

33

<http://www.snia.org/sff/join>

34

35 The complete list of SFF Specifications which have been completed or are currently
36 being worked on by the SFF Committee is contained in the document SFF-8000 which
37 can be found at:

38

<http://www.snia.org/sff/specifications>

39

40 Suggestions for improvement of this specification will be welcome, they should be
41 submitted to:

42

<http://www.snia.org/feedback>

43

CONTENTS

1		
2	1	Scope 6
3	1.1	Copyright 6
4	1.2	Disclaimer 6
5	2	References 6
6	2.1	Industry Documents 6
7	2.2	Sources 7
8	2.3	Conventions 7
9	2.4	Glossary 8
10	3	General Description 8
11	4	Transceiver or Cable Management 11
12	4.1	Transceiver References 12
13	4.2	Encoding References 13
14	4.3	Connector References 14
15	4.4	Extended Specification Compliance References 14
16		
17		FIGURES
18		Figure 3-1 Single Card Configurations 9
19		Figure 3-2 Dual Card Configurations 10
20		Figure 3-3 Example of SFF-8436 QSFP+ restructuring 10
21		
22		TABLES
23		Table 3-1 Pluggable Connectors 8
24		Table 3-2 Device Connectors 9
25		Table 4-1 Identifier Values 12
26		Table 4-2 Encoding Values 13
27		Table 4-3 Connector Types 14
28		Table 4-4 Extended Specification Compliance Codes 15
29		Table 4-5 Module-Host Electrical Interface Codes 18
30		
31		
32		

1 1 Scope

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

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30 furnishing, performance, or use of this specification.

31
32 Suggestions for revisions should be directed to <http://www.snia.org/feedback>

33 2 References

34 2.1 Industry Documents

- 35 - Infiniband Architecture Specification Volume 2
- 36
- 37 - CPRI V7.0
- 38 - G.709/Y.1331
- 39
- 40 - INCITS 417 SAS-1.1 (Serial Attached SCSI - 1.1)
- 41 - INCITS 457 SAS-2 (Serial Attached SCSI - 2)
- 42 - INCITS 478 SAS-2.1 (Serial Attached SCSI - 2.1)
- 43 - INCITS 519 SAS-3 (Serial Attached SCSI - 3)
- 44 - INCITS 534 SAS-4 (Serial Attached SCSI - 4)
- 45
- 46 - SFF-8071 SFP+ 1X 0.8mm Card Edge Connector
- 47 - INF-8077 XFP 1X 10 Gb/s Pluggable Module
- 48 - SFF-8081 SFP+ 1X 16 Gb/s Pluggable Transceiver Solution (SFP16)

1	- SFF-8083	SFP+ 1X 10 Gb/s Pluggable Transceiver Solution (SFP10)
2	- SFF-8084	SFP+ 1X 4 Gb/s Pluggable Transceiver Solution
3	- SFF-8402	SFP+ 1X 28 Gb/s Pluggable Transceiver Solution (SFP28)
4	- SFF-8418	SFP+ 10 Gb/s Electrical Interface
5	- SFF-8419	SFP+ Power and Low Speed Interface
6	- SFF-8432	SFP+ Module and Cage
7	- SFF-8433	SFP+ Ganged Cage
8	- SFF-8436	QSFP+ 4X 10 Gb/s Pluggable Transceiver
9	- INF-8438	QSFP 4X 4 Gb/s Transceiver (Quad SFP)
10	- SFF-8449	Management Interface for SAS Shielded Cables
11	- SFF-8472	Management Interface for SFP+
12	- SFF-8482	Serial Attachment 2X Unshielded Connector
13	- SFF-8613	Mini Multilane 4/8X Unshielded Connector (HDun)
14	- SFF-8614	Mini Multilane 4/8X Shielded Cage/Connector (HDsh)
15	- SFF-8617	Mini Multilane 12X Shielded Cage/Connector (CXP)
16	- SFF-8630	Serial Attachment 4X 12 Gb/s Unshielded Connector
17	- SFF-8635	QSFP+ 4X 10 Gb/s Pluggable Transceiver Solution (QSFP10)
18	- SFF-8636	Management Interface for Cabled Environments
19	- SFF-8639	Multifunction 6X Unshielded Connector
20	- SFF-8640	Serial Attachment 4X 24 Gb/s Unshielded Connector
21	- SFF-8642	Mini Multilane 12X 10 Gb/s Shielded Connector (CXP10)
22	- SFF-8643	Mini Multilane 4/8X 12 Gb/s Unshielded Connector (HD12un)
23	- SFF-8644	Mini Multilane 4/8X 12 Gb/s Shielded Cage/Connector (HD12sh)
24	- SFF-8647	Mini Multilane 12X 14 Gb/s Shielded Cage/Connector (CXP14)
25	- SFF-8648	Mini Multilane 12X 28 Gb/s Shielded Cage/Connector (CXP28)
26	- SFF-8661	QSFP+ 4X Pluggable Module
27	- SFF-8662	QSFP+ 4X Connector (Style A)
28	- SFF-8663	QSFP+ Cage (Style A)
29	- SFF-8665	QSFP+ 4X 28 Gb/s Pluggable Transceiver Solution (QSFP28)
30	- SFF-8672	QSFP+ 4X Connector (Style B)
31	- SFF-8678	Serial Attachment 2X 6 Gb/s Unshielded Connector
32	- SFF-8679	QSFP+ 4X Base Electrical Specification
33	- SFF-8680	Serial Attachment 2X 12 Gb/s Unshielded Connector
34	- SFF-8681	Serial Attachment 2X 24 Gb/s Unshielded Connector
35	- SFF-8682	QSFP+ 4X Connector
36	- SFF-8683	QSFP+ Cage
37	- SFF-8685	QSFP+ 4X 14 Gb/s Pluggable Transceiver Solution (QSFP14)
38		

39 2.2 Sources

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

43
44 Copies of INCITS standards may be purchased from the InterNational Committee for
45 Information Technology Standards (<http://www.techstreet.com/incitsgate.tmpl>).

46 2.3 Conventions

47
48 The ISO convention of numbering is used i.e., the thousands and higher multiples
49 are separated by a space and a period is used as the decimal point. This is
50 equivalent to the English/American convention of a comma and a period.

51

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

1 **2.4 Glossary**

2 **Fanout Cable:** A single connector cable assembly which splits into a number of
 3 connectors at the other end.
 4

5 **3 General Description**

6 This specification provides a tabular representation of pluggable I/O
 7 configurations along with the naming conventions that are used. The relationship
 8 between industry brand names or general usage and the SFF Specifications which
 9 define them is not obvious in many cases.
 10
 11
 12

TABLE 3-1 PLUGGABLE CONNECTORS

Pluggable Module Form Factor NAMES	Form Factor and Management Specifications										Connector Specifications			
	Pluggable Module Form Factor SPECS	Per Lane Signaling Rate GBd ¹	Low Speed and General Electrical Spec	Common Management Spec	Application Specific Management Spec	Single Card Module/ Cable Plug Form Factor Spec	Single Card Single SMT Connector Spec	Single Card Single Cage Spec	Single Card Ganged Cage Spec					
	SFP >	MSA	1	INF-8074	<i>Superseded by SFP10, SFP16 et al. – not recommended for new projects</i>									
SFP+ >	SFF-8084	4	SFF-8419 SFF-8418	SFF-8472	n/a	SFF-8432	SFF-8071	SFF-8432	SFF-8433					
SFP+10 >	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	INF-8077	INF-8077	INF-8077	INF-8077							
QSFP >	MSA	4	INF-8438	<i>Superseded by QSFP10, QSFP 14 et al. – not recommended for new projects</i>										
QSFP+ >	SFF-8436	10	SFF-8436	<i>Superseded by QSFP10, QSFP 14 et al. –not recommended for new projects</i>										
QSFP+10 >	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 (Style A)		SFF-8672 and SFF-8683 (Style B)					

						Dual Card Module/ Plug form factor	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	
HD12sh >	SFF-8674	12	SAS 2.1/3	SFF-8636	SFF-8449	SFF-8644	SFF-8644	SFF-8644	
HD24sh >	SFF-8674	24	SAS 4	SFF-8636	SFF-8449	SFF-8644	SFF-8614	SFF-8644	

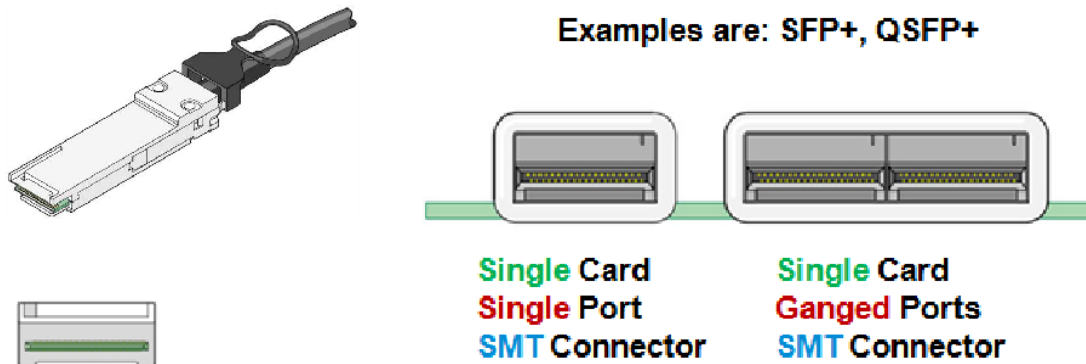
Note 1: high speed electrical lanes at the connector between module and host.

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TABLE 3-2 DEVICE CONNECTORS

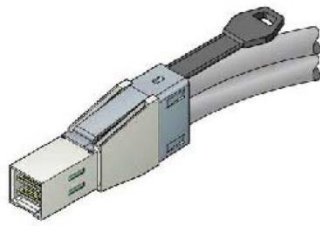
Connector	Application	Lane Data Rate Gb/s	# of ports	Single Or Dual Side SMT Foot Print	Common Management Spec	Application Specific Management Spec	Connector Mechanical Spec
SFF-8482	SAS 1.1	3	2	NA	NA	NA	SFF-8482
SFF-8482	SAS-2	6	2	NA	NA	NA	SFF-8482
SFF-8680	SAS-3	12	2	NA	NA	NA	SFF-8482
SFF-8482	SAS-4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

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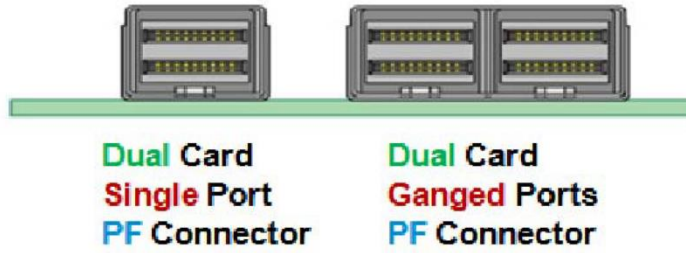


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FIGURE 3-1 SINGLE CARD CONFIGURATIONS

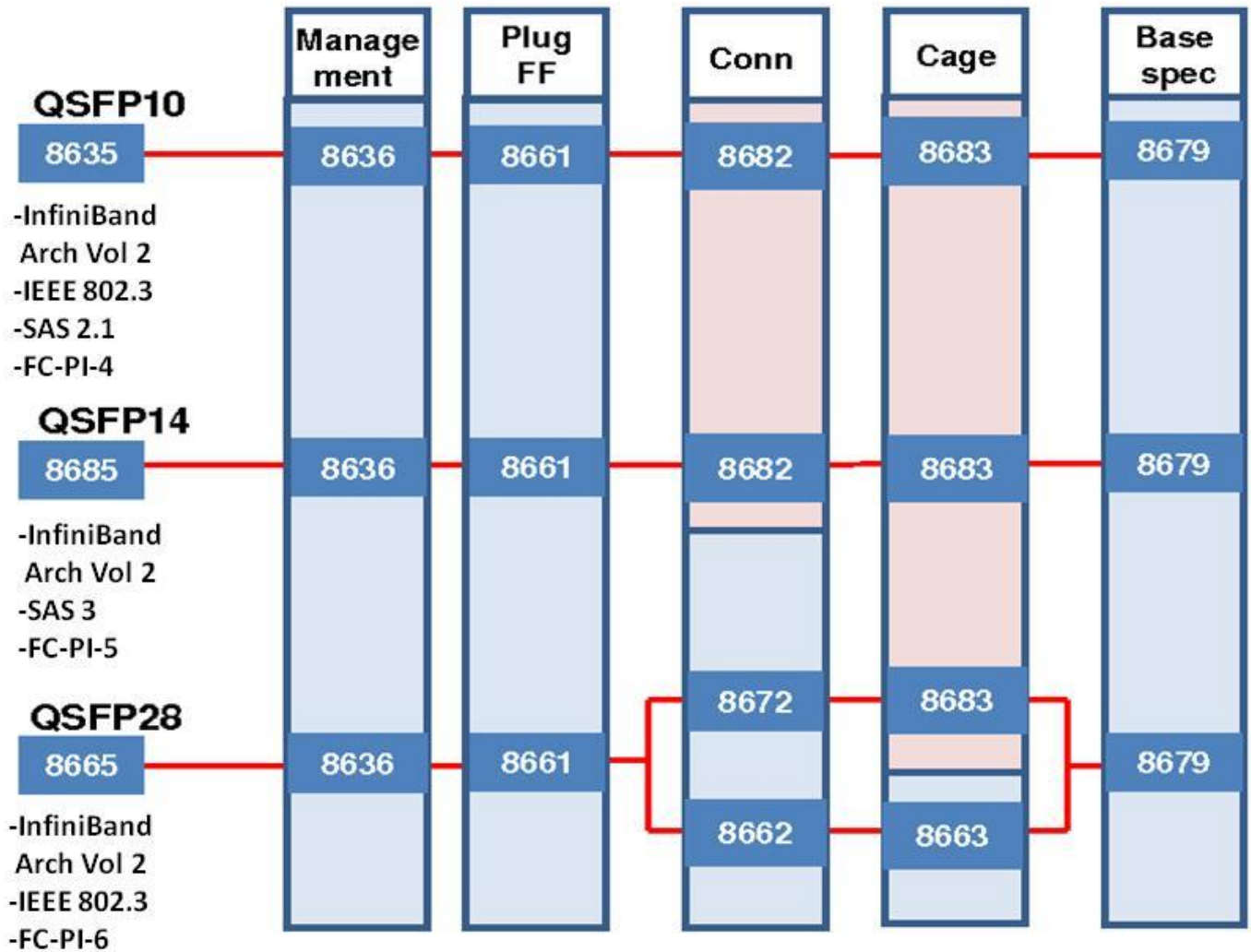


Examples are: CXP, Mini Multilane HD



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FIGURE 3-2 DUAL CARD CONFIGURATIONS



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

1 **4 Transceiver or Cable Management**

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

4
5 The information will only be current if the developers of new modules and the
6 standards incorporating new speeds and technologies request updates to the tables.
7

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

To request a new identifier (Table 4-1), connector type (Table 4-3), or compliance code (Table 4-4) please send an email request to points of contact listed on title page.

8
9 The tables below are referenced by the using specifications because either the
10 content is common, or the contents are regularly updated. Maintaining the tables in
11 SFF-8024 avoids having to revise specifications for non-technical changes. The
12 registers for each table are:
13

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

14

1 **4.1 Transceiver References**

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

4 **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)
19h	QSFP 8X Pluggable Transceiver
1Ah	SFP-DD Double Density 2X Pluggable Transceiver
1Bh	
1Ch	
1Dh	
1Eh	
1Fh	
20h	
-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	

5
 6 NOTE: The Identifier Values assigned by the CFP MSA overlap with the above, and
 7 this should not be an issue because CFP does not use I2C for the management
 8 protocol, it uses MDIO. Software which bases actions on Identifier Values needs to
 9 recognize that synonyms exist and qualify the values by the management protocol.

1 **4.2 Encoding References**

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

5
 6

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. In case of a conflict between modulation and coding, use the code for modulation. i.e. for 200GAUI-4 use PAM4 code.			

7

1 4.3 Connector References

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

4
5 **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
25h	CS optical connector
26h	Mini CS optical connector
-7Fh	Reserved
80h-FFh	Vendor specific
Note: 01h to 05h are not SFP-compatible, and are included for compatibility with GBIC standards.	

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7 4.4 Extended Specification Compliance References

8 The Extended Specification Compliance Codes identify the electronic or optical
9 interfaces which are not included in SFF-8472 Optical and Cable Variants
10 Specification Compliance or SFF-8636 Specification Compliance Codes. A multi-lane
11 pluggable module may support more than a single instantiation of the specified

1 compliance code.

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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 $5 \times 10^{(-5)}$
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 $5 \times 10^{(-5)}$
09h	Obsolete (assigned before 100G CWDM4 MSA required FEC)
0Ah	Reserved
0Bh	100GBASE-CR4 or 25GBASE-CR CA-25G-L
0Ch	25GBASE-CR CA-25G-S
0Dh	25GBASE-CR CA-25G-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)
1Bh	100G 1550nm WDM (4 wavelengths)
1Ch	10GBASE-T Short Reach (30 meters)
1Dh	5GBASE-T
1Eh	2.5GBASE-T
1Fh	40G SWDM4
20h	100G SWDM4
21h	100G PAM4 BiDi
22h	4WDM-10 MSA (10km version of 100G CWDM4 with same RS(528,514) FEC in host system)
23h	4WDM-20 MSA (20km version of 100GBASE-LR4 with RS(528,514) FEC in host system)
24h	4WDM-40 MSA (40km reach with APD receiver and RS(528,514) FEC in host system)
25h	100GBASE-DR, with CAUI-4 without FEC
26h	100G-FR, with CAUI-4 without FEC
27h	100G-LR, with CAUI-4 without FEC
28h - 2Fh	Reserved
30h	Active Copper Cable with 50GAUI, 100GAUI-2 or 200GAUI-4 C2M. Providing a worst BER of $10^{(-6)}$ or below
31h	Active Optical Cable with 50GAUI, 100GAUI-2 or 200GAUI-4 C2M. Providing a worst BER of $10^{(-6)}$ or below
32h	Active Copper Cable with 50GAUI, 100GAUI-2 or 200GAUI-4 C2M. Providing a worst BER of $2.6 \times 10^{(-4)}$ for ACC, $10^{(-5)}$ for AUI, or below
33h	Active Optical Cable with 50GAUI, 100GAUI-2 or 200GAUI-4 C2M. Providing a worst BER of $2.6 \times 10^{(-4)}$ for AOC, $10^{(-5)}$ for AUI, or below

34h – 3Fh	Reserved
40h	50GBASE-CR, 100GBASE-CR2, or 200GBASE-CR4
41h	50GBASE-SR, 100GBASE-SR2, or 200GBASE-SR4
42h	50GBASE-FR or 200GBASE-DR4
43h	200GBASE-FR4
44h	200G 1550nm PSM4
45h	50GBASE-LR
46h	200GBASE-LR4
47h – 4Fh	Reserved
50h	64GFC EA
51h	64GFC SW
52h	64GFC LW
53h	128GFC EA
54h	128GFC SW
55h	128GFC LW
56h – FFh	Reserved

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TABLE 4-5 MODULE-HOST ELECTRICAL INTERFACE CODES

ID	Code (Hex)	Name	Data Rate, Gb/s	Lane Count	Lane Signaling Rate, GBd	Modulation	b/sym
0	0	Undefined					
		Ethernet Applications					
1	1	1000BASE-CX (Clause 39)	1.25	1	1.25	NRZ	1
2	2	XAUI (Clause 47)	12.50	4	3.125	NRZ	1
3	3	XFI (SFF INF-8071i)	10.31	1	10.3125	NRZ	1
4	4	SFI (SFF-8431)	10.31	1	10.3125	NRZ	1
5	5	25GAUI C2M (Annex 109B)	25.78	1	25.78125	NRZ	1
6	6	XLAUI C2M (Annex 83B)	41.25	4	10.3125	NRZ	1
7	7	XLPI (Annex 86A)	41.25	4	10.3125	NRZ	1
8	8	LAUI-2 C2M (Annex 135C)	51.56	2	25.78125	NRZ	1
9	9	50GAUI-2 C2M (Annex 135E)	53.13	2	26.5625	NRZ	1
10	A	50GAUI-1 C2M (Annex 135G)	53.13	1	26.5625	PAM4	2
11	B	CAUI-4 C2M (Annex 83E)	103.13	4	25.78125	NRZ	1
12	C	100GAUI-4 C2M (Annex 135E)	106.25	4	26.5625	NRZ	1
13	D	100GAUI-2 C2M (Annex 135G)	106.25	2	26.5625	PAM4	2
14	E	200GAUI-8 C2M (Annex 120C)	212.50	8	26.5625	NRZ	1
15	F	200GAUI-4 C2M (Annex 120E)	212.50	4	26.5625	PAM4	2
16	10	400GAUI-16 C2M (Annex 120C)	425.00	16	26.5625	NRZ	1
17	11	400GAUI-8 C2M (Annex 120E)	425.00	8	26.5625	PAM4	2
18	12	Reserved					
19	13	10GBASE-CX4 (Clause 54)	12.50	4	3.125	NRZ	1
20	14	25GBASE-CR CA-L (Clause 110)	25.78	1	25.78125	NRZ	1
21	15	25GBASE-CR CA-S (Clause 110)	25.78	1	25.78125	NRZ	1
22	16	25GBASE-CR CA-N (Clause 110)	25.78	1	25.78125	NRZ	1
23	17	40GBASE-CR4 (Clause 85)	41.25	4	10.3125	NRZ	1
24	18	50GBASE-CR (Clause 126)	53.13	1	26.5625	PAM4	2
25	19	100GBASE-CR10 (Clause 85)	103.13	10	10.3125	NRZ	1
26	1A	100GBASE-CR4 (Clause 92)	103.13	4	25.78125	NRZ	1
27	1B	100GBASE-CR2 (Clause 136)	106.25	2	26.5625	PAM4	2
28	1C	200GBASE-CR4 (Clause 136)	212.50	4	26.5625	PAM4	2
29	1D	400G CR8 ()	425.00	8	26.5625	PAM4	2
30	1E	1000BASE-T (Clause 40)	1.12	4	0.125	PAM5	2.236068
31	1F	2.5GBASE-T (Clause 126)	2.50	4	0.200	PAM16	3.125

32	20	5GBASE-T (Clause 126)	5.00	4	0.400	PAM16	3.125
33	21	10GBASE-T (Clause 55)	10.00	4	0.800	PAM16	3.125
34	22	25GBASE-T ()					
35	23	40GBASE-T ()					
36	24	50GBASE-T ()					
		Fibre Channel					
37	25	8GFC (FC-PI-4)	8.50	1	8.500	NRZ	1
38	26	10GFC (10GFC)	10.52	1	10.51875	NRZ	1
39	27	16GFC (FC-PI-5)	14.03	1	14.025	NRZ	1
40	28	32GFC (FC-PI-6)	28.05	1	28.050	NRZ	1
41	29	64GFC (FC-PI-7)	57.80	1	28.900	PAM4	2
42	2A	128GFC (FC-PI-6P)	112.20	4	28.050	NRZ	1
43	2B	256GFC (FC-PI-7P)	231.20	4	28.900	PAM4	2
		InfiniBand					
44	2C	IB SDR (Arch.Spec.Vol.2)	2.5-30	1,2,4,8,12	2.5	NRZ	1
45	2D	IB DDR (Arch.Spec.Vol.2)	5.0-60	1,2,4,8,12	5.0	NRZ	1
46	2E	IB QDR (Arch.Spec.Vol.2)	10-120	1,2,4,8,12	10.0	NRZ	1
47	2F	IB FDR (Arch.Spec.Vol.2)	14-169	1,2,4,8,12	14.0625	NRZ	1
48	30	IB EDR (Arch.Spec.Vol.2)	25-300	1,2,4,8,12	25.78125	NRZ	1
49	31	IB HDR (Arch.Spec.Vol.2)	50-600	1,2,4,8,12	26.5625	PAM4	2
50	32	IB NDR	Nx100G				
		CPRI					
51	33	E.96 (CPRI Specification V7.0)	9.83	1	9.8304	NRZ	1
52	34	E.99 (CPRI Specification V7.0)	10.14	1	10.1376	NRZ	1
53	35	E.119 (CPRI Specification V7.0)	12.17	1	12.16512	NRZ	1
54	36	E.238 (CPRI Specification V7.0)	24.33	1	24.33024	NRZ	1
		OTN					
55	37	OTL3.4 (ITU-T G.709/Y.1331 S.58)	10-43	1,4	10.7546	NRZ	1
56	38	OTL4.10 (ITU-T G.709/Y.1331 S.58)	11-112	1,4,10	11.1810	NRZ	1
57	39	OTL4.4 (ITU-T G.709/Y.1331 S.58)	28-118	1,4	27.9525	NRZ	1
58	3A	OTLC.4 (ITU-T G.709/Y.1331 S.58)	28-112	1,4	28.0762	NRZ	1
59	3B	FOIC1.4 (ITU-T G.709/Y.1331 S.58)	28-112	1,4	27.9524	NRZ	1

60	3C	F0IC1.2 (ITU-T G.709/Y.1331 S.58)	56-112	1,2	27.9524	PAM4	2
61:19 1	3D:BF	Reserved					
192:2 55	C0:FF	Custom					

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