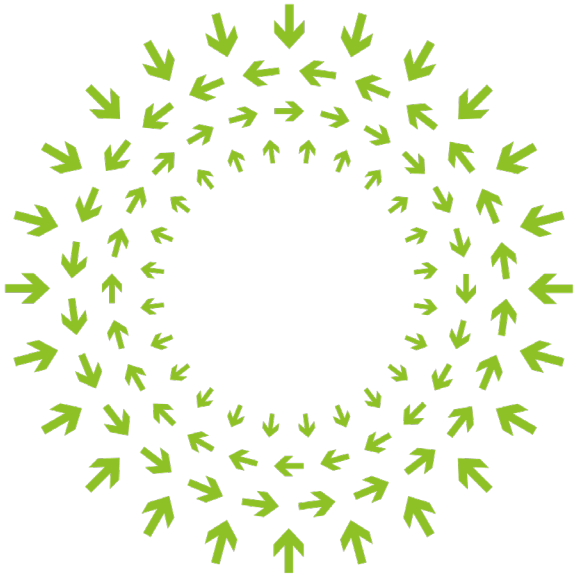

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Compute Project

200G FR4 OCP Optical Transceiver Specification

Rev0.3

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Scope & Overview

1.1 Scope

This document defines the technical specifications for the 200G FR4, QSFP56, optical transceivers used in large-scale data center applications.

1.2 Overview:

The 200G FR4 OCP optical specification is based on IEEE 200GBASE-FR4 as defined in IEEE 802.3 bs. It is optimized considering both the practical operating conditions of data centers and the overall cost/yield of the optical transceiver modules. The optimization is done in four areas: reach, temperature, wavelength and link budget. First, the reach is increased to 3km to address the longest intra-DC links. Second, most data centers operate under a well-controlled thermal environment, allowing the operating case temperature of the 200G FR4 optical transceivers to be relaxed from 0-70°C to 15-65°C. As a result, the operating wavelength range can be reduced from +/-6.5nm to +/-5.75nm around the center wavelengths. Finally, the minimum Tx AOP/OMA is relaxed by 1dB compared with 200G FR4 spec in IEEE 802.3 bs to allow for optimum yield across a range of transmitter technologies. The link budget is maintained by tightening the Rx sensitivity by 1dB, leveraging the capability of DSP-based receivers.

While this specification is focused on 200G operation, the module shall be compliant to the 100G CWDM4 MSA Technical Specifications Rev 1.1, when running in 100G mode. The operating conditions in 100G mode are the same as specified for 200G except for signaling rate.

2. Common Terms

The following terms are used in this document

- BER – Bit Error Rate
- ER – Extinction Ratio
- SMSR – Side Mode Suppression Ratio
- OMA – Optical Modulation Amplitude
- AOP – Average Optical Power
- TDECQ – Transmitter and Dispersion Eye Closure Quaternary
- SECQ – Stressed Eye Closure Quaternary
- CMIS – Common Management Interface Specification

3. Operating Conditions

Parameter	Symbol	Min	Typical	Max	Unit	Note
Operating case temperature	Tcase	15		65	°C	
Power consumption	P			6.5	W	In 200G mode
				6.0	W	In 100G mode

Table 1 Operating Conditions

4. Optical Specifications

4.1 Optical Transmitter Characteristics

The optical transmitter characteristics are based on IEEE 200GBASE-FR4 as defined in IEEE 802.3 bs, section 122.7.1, with the following deviations. When this specification and IEEE 802.3 bs do not agree, this specification will take precedence.

A. Reduced wavelength range
B. Reduced minimum Tx output AOP/OMA by 1dB
C. Added rise and fall time requirement
D. Added overshoot/undershoot requirement

When this specification and IEEE 802.3 bs do not agree, this specification will take precedence.

Parameter	Symbol	Min	Typical	Max	Unit	Note	Deviation
Center wavelength 1	WL1	1265.25	1271	1276.75	nm		A
Center wavelength 2	WL2	1285.25	1291	1296.75	nm		A
Center wavelength 3	WL3	1305.25	1311	1316.75	nm		A
Center wavelength 4	WL4	1325.25	1331	1336.75	nm		A
Side-mode suppression ratio	SMSR	30			dB		
Total average launch power	AOP_total			10.7	dBm		
Average launch power per lane	AOP	-5.2		4.7	dBm	Note 1	B
Outer optical modulation amplitude, each lane	OMAouter	-2.2		4.5	dBm		B
Difference in launch power between any two lanes (OMAouter)	dOMAouter			4	dB		
Launch power in OMAouter minus TDECQ, each lane	OMAouter-TDECQ	-3.5			dBm	Note 2	B
Transmitter and dispersion eye closure quaternary (TDECQ), each lane	TDECQ			3.3	dB		
Rise and fall time	tr/tf			20	ps	Note 3	C

Parameter	Symbol	Min	Typical	Max	Unit	Note	Deviation
Outer rail overshoot/undershoot				30	%	Note 4	D
Average launch power of OFF transmitter, each lane	Toff			-30	dBm		
Extinction ratio, each lane (min)	ER	3.5			dB		
$RIN_{17.1}OMA$	RIN_OMA			-132	dB/Hz	Note 5	
Optical return loss tolerance	ORL			17.1	dB		
Transmitter reflectance	Tx_Ref			-26	dB	Note 6	

Notes:

1. Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
2. Even if the TDECQ < 1.4 dB for an extinction ratio of ≥ 4.5 dB or TDECQ < 1.3 dB for an extinction ratio of < 4.5 dB, the OMAouter must exceed this value.
3. Between 20% and 80%. It can be measured by applying PRBS15 and search for pattern “00003333000”. There is a built-in function in the Keysight DCA-X to enable this measurement.
4. Measured based on cumulative distribution function (CDF) of vertical histogram of PAM4 eye.
5. RIN on OMA measured with 17.1dB return loss.

Transmitter reflectance is defined looking into the transmitter.

Table 2 Optical Transmitter Characteristics

4.2 Optical Receiver Characteristics

The optical receiver characteristics are based on IEEE 200GBASE-FR4 as defined in IEEE 802.3 bs section 122.7.2, with the following deviations. When this specification and IEEE 802.3 bs do not agree, this specification will take precedence.

A. *Reduced the wavelength range*
B. *Reduced minimum Rx AOP/OMA by 1dB*
C. *Added BER floor requirement*

Parameter	Symbol	Min	Typical	Max	Unit	Note	Deviation
Center wavelength 1	WL1	1265.25	1271	1276.75	nm		A
Center wavelength 2	WL2	1285.25	1291	1296.75	nm		A
Center wavelength 3	WL3	1305.25	1311	1316.75	nm		A
Center wavelength 4	WL4	1325.25	1331	1336.75	nm		A
Average receive power, each lane	AOP	-9.2		4.7	dBm	Note 1	B
Difference in receive power between any two lanes (OMAouter)	dOMAouter			4.1	dB		
Receiver reflectance	Rx_Ref			-26	dB		
Outer optical modulation amplitude, each lane	OMAouter	-7 (Note 2)		4.5	dBm		B
Stressed receiver sensitivity (OMA outer), each lane	SRS			-4.6	dBm	Note 3	B
Bit error ratio floor	BER_FL			3.4E-6		Note 4	C

Note:
1. Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
2. Receiver sensitivity (OMAouter), each lane is informative and is defined for a transmitter with SECQ of 0.9 dB.
3. Measured with conformance test signal at TP3 for the BER = 2.4E-4. The stressed conditions are shown in Table 4.
4. Measured with a reference transmitter to produce SECQ greater than or equal to 2dB. The BER at receiver must stay within the specified limit over an OMA range of -5.9dBm to 4.5dBm

Table 3 Optical Receiver Characteristics

Parameter	Value
Stressed eye closure for PAM4 (SECQ), lane under test	3.3
OMAouter of each aggressor lane	0.5

Table 4 Stressed Receiver Sensitivty Test Conditions

4.3 Optical Fiber Link Model

The reference optical fiber link model is based on 3km SMF-28 fiber. The total link loss and dispersion budget are shown in Table 5. Refer to IEEE 802.3 bs, section 122.11.2.2 for the return loss budget.

Parameter	Symbol	Min	Typical	Max	Unit	Note
Total fiber link loss	IL			4.0	dB	
Dispersion	CD	-18		10	ps/nm	

Table 5 Fiber Optical Link Budget

5. Form Factor

The QSFP28 form factor described in SFF-8665 will be used. This form factor is commonly referred to as QSFP56 for 200G applications, indicating the 56Gb/s host interface speed.

6. Management Interface

The module is compliant to Common Management Interface Specification (CMIS) Rev. 4.0, in both 100G and 200G mode.

Note that the standard management interface specification(MIS) for QSFP28 modules is SFF-8636. Here we have specified the MIS for QSFP-DD modules, as it offers enhanced diagnositics and firmware upgrade capability.

7. References

The following documents are referenced in this specification:

- [1] “IEEE Std 802.3bs”, 2017.
- [2] “Common Management Interface Specification”, 2019, Rev 4.0, http://www.qsfp-dd.com/wp-content/uploads/2019/05/QSFP-DD-CMIS-rev4p0.pdf
- [3] “100G CWDM4 MSA Technical Specifications”, 2015, Rev 1.1, http://www.cwdm4-msa.org/wp-content/uploads/2015/12/CWDM4-MSA-Technical-Spec-1p1-1.pdf
- [4] “SFF-8665, QSFP+ 28 Gb/s 4x Pluggable Transceiver Solution (QSFP28)”, 2013, Rev 1.8, http://www.fiberonsale.com/media/pdf/SFF-8665.pdf

- [5] “SFF-8636, Specification for Management Interface for 4-lane Modules and Cables”, 2019, Rev 2.10a, https://members.snia.org/document/dl/26418

8. Revisions

Rev	Date	Description
0.3	April, 16, 2020	Initial draft for review