NVIDIA MMS4A20 800Gbps, DR4 Single-port OSFP, MPO, 1310nm Single Mode, RHS Transceiver

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1 Introduction

The NVIDIA MMS4A20 is an 800Gb/s single-mode optical transceiver supporting the XDR 800Gb/s InfiniBand protocol. It is used to link the Quantum-X800 QM3x00 switches using Twin-port OSFP 2x800Gb/s transceivers to the dual 800Gb/s ConnectX-8 mezzanine card in liquid cooled system and ConnectX-8 PCIE cards. OSFP cages are located in the compute tray front-panel.

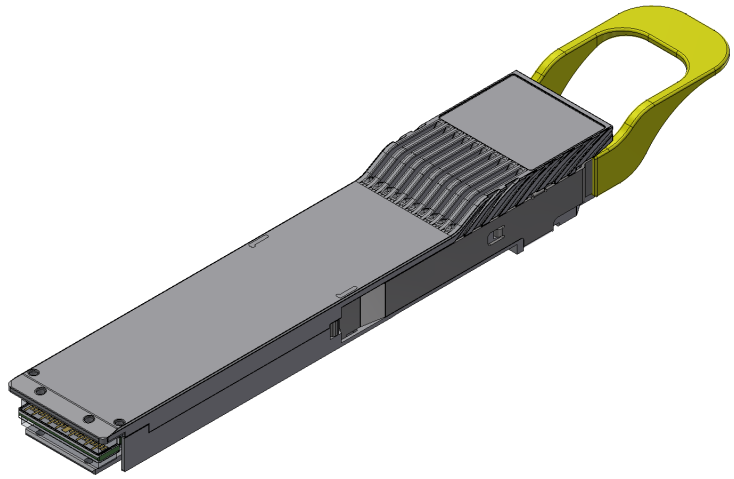
The line rate is 200Gb/s using Pulse Amplitude Modulation of 4- channels denoted as 200G-PAM4, enabling two data bits to be transferred per clock pulse. The electrical configuration is 4-channels of 200G-PAM4. The optical configuration has one, 500-meter, Datacenter Reach, 4-channel (DR4), 800Gb/s optical connector, and is a single Multiple Push-On 12-fiber, Angled Polished Connector or MPO-12/APC. One MPO-12/APC optical connector is used per transceiver.

Based on 9-um, single mode fibers, the 800G transceiver can reach up to 500-meters, supporting large GPU clusters.

The plug formfactor is a single-port OSFP (Octal Small Formfactor Plug) and uses a Riding Heat Sink (RHS) or flat-top OSFP connector with the cooling fins on top of the ConnectX-8 cage. This can also be used in liquid-cooled Riding Heat Sink (RHS) applications.

NVIDIA's transceivers guarantee optimal operation in NVIDIA end-to- end InfiniBand systems and rigorous production testing ensures the lowest bit error rates, low-latency, and best out-of-the-box installation experience, performance, and durability.

Flat Top Transceiver



Images are for illustration purposes only. Product labels, colors, and lengths may vary.

1.1 Key Features

- 800G single mode transceiver
- 4-channels and optical modulation
- OSFP Riding Heat Sink, flat top connector
- 1310nm laser

- Single MPO-12/APC optical connector
- 500m max reach
- Maximum reach: 500-meters
- 18W max power2W low-power mode
- Single 3V power supply
- Class 1 laser safety
- Hot pluggable, RoHS compliant
- OSFPmsa.org compliant
- Supports CMIS 4.0 functions
- Secure Firmware boot and update features

1.2 Applications

- Linking ConnectX-8 cards with Quantum-X800 QM3x00 Switches

2 Overview

The ConnectX-8 adapter is a PCIe Gen 6 bus adapter with an IC that converts 48 lanes of 64GT/s PCIe channels, modulation, and line rates to 4-channels of 200G-PAM4 for 800Gb/s XDR InfiniBand.

ConnectX-8 PCIe adapters cages use the 800G XDR 4-channel (4x200G-PAM4) transceiver and use the RHS format as the heat sinks are riding on top of the ConnectX-8 OSFP card cages and is exposed to system fan airflow. Used to connect GPU/CPU servers and storage to the QM3200 switches. For liquid cooled ConnectX-8 cards, the same RHS transceiver is used.

MPO Optical Connectors are Multiple Push-On 12-fiber, Angled Polished Connector or MPO-12/APC. Two MPO-12/APC optical connectors are used per 2x800G transceiver. The MPO-12/APC connector uses 8-fibers in the Angled Polished Connector (APC) with an 8-degree polish on the fiber end that deflects laser back reflections in the fiber/connector combination from corrupting the optical signals. The transceivers use four transmission (Tx) fibers and 4 receive (Rx) fibers and 4 positions in the connector block are not used for fibers and left blank. These optical connectors are the same type used for NDR.

Optical Fibers and Cables consist of the 9-um, OS1, single mode fiber type. NVIDIA manufactures straight crossover, type-B, 4-channel MPO-12/APC fiber cables in lengths from 1-to-500-meters. A 1:2 splitter fiber is also offered enabling four transceivers to be linked to the 2x800G transceiver with reaches from 1-50-meters. Crossover fiber cables are used to connect two transceivers directly together and aligning (crossing over) the transmit laser in one transceiver to the receive photodetectors in the second transceiver. Same fiber cables are used for NDR.

2.1 Transceiver Connectivity Scenarios

The Twin-ports enable several unique configurations to connect switches-to-switches at 2x800Gb/s or to two or four network adapters at 800Gb/s using two straight or 1:2 splitter fiber cables.

Using 1:2 fiber splitter cables in each of the two ports in the Twin-port OSFP, up to four RHS flat top single port transceivers can be configured with ConnectX-8 adapters at 800Gb/s each. This configuration uses two fibers per optical connector at 200G-PAM4 rate into the 800G transceivers to achieve 400Gb/s and are considered XDR400 rates, not NDR (4x100G-PAM4).

The 2x800G transceiver in the QM3400 72-cage switch can link at 1600G to the QM3200 switch which offers 36 cages of 1600G or 72 ports of 800Gb/s. These cages also support the NDR family of cables and transceivers for backwards compatibility to NDR (4x100G-PAM4) and HDR (4x50G-PAM4).

Switch-to-Dual 800G ConnectX-8

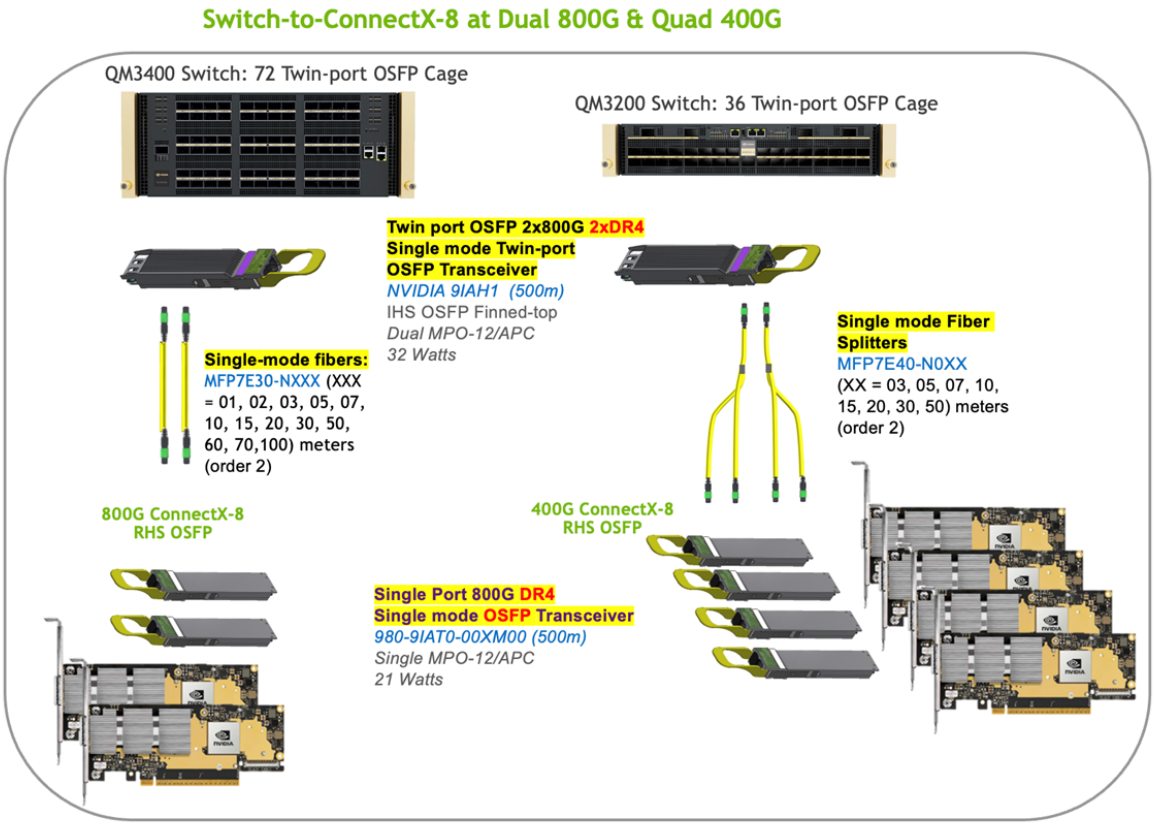
The Twin port OSFP in the QM3400 and QM3200 switches use two, 4-channel MPO-12/APC optical connectors with two, straight 4-channel fiber cables. Each fiber cable can link to single port 800Gb/ s OSFP RHS form-factor transceiver (NVIDIA part #: 980-9IAT0-00XM00) in two ConnectX-8 adapters.

Switch-to-Quad 400G ConnectX-8

The Twin port OSFP using two, 1:2 splitter fiber cables create four, 2x200G-PAM4 links or 400G a.k.a XDR400. Each 2-fiber cable connector can link to single port 800Gb/s OSFP RHS form-factor transceiver in four ConnectX-8 adapters. The 400G rate is achieved by using only 2-fibers at

200G- PAM4 in the 1:2 fiber cable ends into an 800G transceiver and are considered XDR400 rates - not

400G NDR which is 4x100G-PAM4. Power consumption is also reduced in the 800G transceivers. Separate XDR400G transceivers are not offered.



3 Pin Description

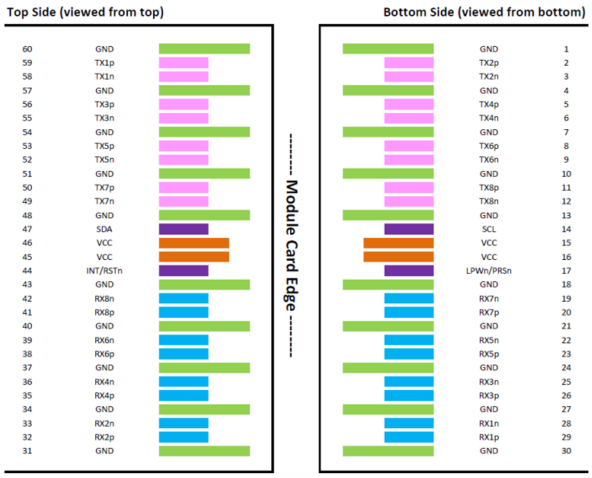
The device is OSFP MSA Specification for OSFP Octal Small Form Factor Pluggable Module Rev. 1.12 compliant, see www.osfpmsa.org.

3.1 OSFP Pin Description

Pin	Symbol	Description	Pin	Symbol	Description
1	GND	Ground	31	GND	Ground
2	Tx2p	Transmitter Non-Inverted Data Input	32	Rx2p	Receiver Non-Inverted Data Output
3	Tx2n	Transmitter Inverted Data Input	33	Rx2n	Receiver Inverted Data Output
4	GND	Ground	34	GND	Grounds
5	Tx4p	Transmitter Non-Inverted Data Input	35	Rx4p	Receiver Non-Inverted Data Output
6	Tx4n	Transmitter Inverted Data Input	36	Rx4n	Receiver Inverted Data Output
7	GND	Ground	37	GND	Ground
8	Tx6p	Transmitter Non-Inverted Data Input	38	Rx6p	Receiver Non-Inverted Data Output
9	Tx6n	Transmitter Inverted Data Input	39	Rx6n	Receiver Inverted Data Output
10	GND	Ground	40	GND	Ground
11	Tx8p	Transmitter Non-Inverted Data input	41	Rx8p	Receiver Non-Inverted Data Output
12	Tx8n	Transmitter Inverted Data Input	42	Rx8n	Receiver Inverted Data Output
13	GND	Ground	43	GND	Ground
14	SCL	2-wire serial interface clock	44	INT / RSTn	Module Interrupt / Module Reset
15	VCC	+3.3V Power	45	VCC	+3.3V Power
16	VCC	+3.3V Power	46	VCC	+3.3V Power
17	LPWn / PRSn	Low-Power Mode / Module Present	47	SDA	2-wire Serial interface data
18	GND	Ground	48	GND	Ground
19	Rx7n	Receiver Inverted Data Output	49	Tx7n	Transmitter Inverted Data Input
20	Rx7p	Receiver Non-Inverted Data Output	50	Tx7p	Transmitter Non-Inverted Data Input
21	GND	Ground	51	GND	Ground
22	Rx5n	Receiver Inverted Data Output	52	Tx5n	Transmitter Inverted Data Input
23	Rx5p	Receiver Non-Inverted Data Output	53	Tx5p	Transmitter Non-Inverted Data Input

Pin	Symbol	Description	Pin	Symbol	Description
24	GND	Ground	54	GND	Ground
25	Rx3n	Receiver Inverted Data Output	55	Tx3n	Transmitter Inverted Data Input
26	Rx3p	Receiver Non-Inverted Data Output	56	Tx3p	Transmitter Non-Inverted Data Input
27	GND	Ground	57	GND	Ground
28	Rx1n	Receiver Inverted Data Output	58	Tx1n	Transmitter Inverted Data Input
29	Rx1p	Receiver Non-Inverted Data Output	59	Tx1p	Transmitter Non-Inverted Data Input
30	GND	Ground	60	GND	Ground

3.1.1 OSFP Module Pad Layout



The Active Optical Cable (AOC) pin assignment is SFF-8679 compliant.

3.2 Control Signals (OSFP)

This device supports CMIS 4.0 management interface features, and is OSFP MSA compliant form factor and interfaces. This implies that the control signals shown in the pad layout are implemented with the following functions:

Name	Function	Description
LPWn/PRSn	Input/output	Multi-level signal for low power control from host to module and module presence indication from module to host. This signal requires the circuit as described in the OSFP Specification.
INT/RSTn	Input,/output	Multi-level signal for interrupt request from module to host and reset control from host to module. This signal requires the circuit as described in the OSFP Specification.

Name	Function	Description
SCL	BiDir	2-wire serial clock signal. Requires pull-up resistor to 3.3V on host.
SDA	Bidir	2-wire serial data signal. Requires pull-up resistor to 3.3V on host.

3.3 Diagnostics and Other Features

The transceiver has a microcontroller with functions for monitoring supply voltage, temperature, laser bias current, optical transmit and receive levels with associated warning and alarm thresholds that can be read by the switch software and viewed remotely.
The transceiver supports the OSFP MSA specification and has the following key features:
Physical layer link optimization:

- Adaptive Tx input equalization
- Programmable Rx output amplitude
- Programmable Rx output pre-cursor
- Programmable Rx output post-cursor

Digital Diagnostic Monitoring (DDM):

- Rx receive optical power monitor for each lane
- Tx transmit optical power monitor for each lane
- Tx bias current monitor for each lane
- Supply voltage monitor
- Transceiver case temperature monitor
- Warning and Alarm thresholds for each DDM function (not user programmable)

Page 13h and 14h Module Diagnostics

- Host side and line side loopback
- PRBS generator and checker on host and line interfaces

Interrupt indications:

- Tx & Rx LOS indication
- Tx & Rx LOL indication
- Tx fault indication

Other CMIS functions

- FW upgrade supported via CDB commands.

4 Specifications

4.1 Absolute Maximum Specifications

Absolute maximum ratings are those beyond which damage to the device may occur.

Prolonged operation between the operational specifications and absolute maximum ratings is not intended and may cause permanent device degradation.

Parameter	Symbol	Min	Max	Units
Storage Temperature	TS	-40	85	°C
Operating Case Temperature	TOP	0	70	°C
Supply Voltage	Vcc	-0.5	3.6	V
Relative Humidity (non-condensing)	RH – Option 1	5	85	%
Control Input Voltage	VI	-0.3	Vcc+0.5	V

- Module temperature per DDMI readout of up to 75°C is allowed.

4.2 Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typ	Max	Units
Power Supply Voltage	VCC	3.135	3.3	3.465	V
Instantaneous peak current at hot plug	ICC_IP	-	-	8200	mA
Sustained peak current at hot plug	ICC_SP	-	-	6827	mA
Maximum Power Dissipation	PD	-	-	18	W
Maximum Power Dissipation, Low Power Mode	PDLP	-	-	2	W
Signaling Rate per Lane	SRL	-	106.25	-	GBd
Two Wire Serial Interface Clock Rate	-	100	-	1000	kHz
Power Supply Noise Tolerance (10Hz - 10MHz)	-	-	-	25	mV
Rx Differential Data Output Load	-	-	100	-	Ohm
Operating Distance	-	-	-	OPN dependant	m

4.3 Electrical Specifications

Parameter	Symbol	Min	Typ	Max	Units

Receiver (Module Output)					
Peak-peak AC common-mode voltage	VCMLF VCMFB	-	-	32 80	mV
Differential output Voltage (Long mode)		-	-	845	mV
Differential output Voltage (Short mode)		-	-	600	mV
Eye height, differential		15	-	-	mV
Differential Termination Mismatch		-	-	10	%
Transition Time (min, 20% to 80%)		8.5	-	-	ps
DC common mode Voltage		-350	-	2850	mV
Transmitter (Module Input)					
Differential pk-pk input Voltage tolerance		750	-	-	mV
Differential termination mismatch		-	-	10	%
Single-ended voltage tolerance range		-0.4	-	3.3	V
DC common mode Voltage		-350	-	2850	mV

Notes:

Amplitude customization beyond these specs is dependent on validation in customer system.

4.3.1 Electrical Specification for Low Speed Signal

Parameter	Symbol	Min	Max	Units
Module output SCL and SDA	VOL	0	0.4	V
	VOH	VCC-0.5	VCC+0.3	V
Module Input SCL and SDA	VIL	-0.3	VCC*0.3	V
	VIH	VCC*0.7	VCC+0.5	V

4.4 Optical Specifications

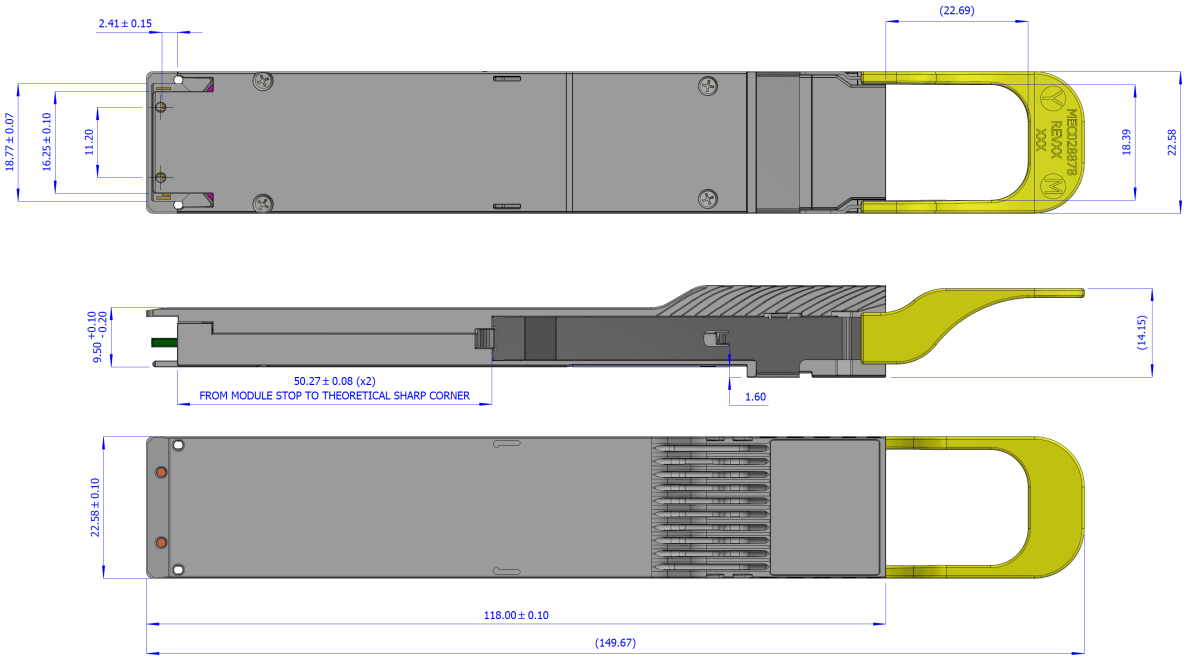
Parameter	Symbol	Min	Typ	Max	Unit	Notes
Transmitter						
Wavelength	λC	1304.5	1311	1317.5	nm	
Side Mode Suppression Ratio	SMSR	30	-	-	dB	
Average Launch Power, each lane	AOPL	2.5	3.5	4.0	dBm	1, 6
Outer Optical Modulation Amplitude (OMAouter), each lane	TOMA	2.0	3.0	5.0	dBm	2, 6
Launch Power in terms of OMAouter minus TDECQ, each lane	TOMA-TDECQ	-	-	-	dBm	
Transmitter and Dispersion Eye Closure for PAM4 (TDECQ), each lane	TDECQ	-	-	-	dB	

Average Launch Power of OFF Transmitter, each lane	TOFF	-	-	-15	dBm	
Extinction Ratio, each lane	ER	3.5	-	-	dB	6
RIN21.4OMA	RIN	-	-	-139	dB/Hz	
Optical Return Loss Tolerance	ORL	-	-	21.4	dB	
Transmitter Reflectance	TR	-	-	-26	dB	3
Receiver						
Wavelength	λC	1304.5	1311	1317.5	nm	
Damage Threshold, average optical power, each lane	AOPD	5	-	-	dBm	
Average Receive Power, each lane	AOPR	-1.0	-	4.0	dBm	6
Receive Power (OMAouter), each lane	OMA-R	-	-	5.0	dBm	
Receiver Reflectance	RR	-	-	-26	dB	
Receiver Sensitivity (OMAouter), each lane	SOMA	-	-	-	dBm	4
Stressed Receiver Sensitivity (OMAouter), each lane	SRS	-	-	-	dBm	5
Conditions of stressed receiver sensitivity test						
Stressed eye closure for PAM4 (SECQ)			3.4		dB	
OMAouter of each aggressor lane			4.2		dBm	

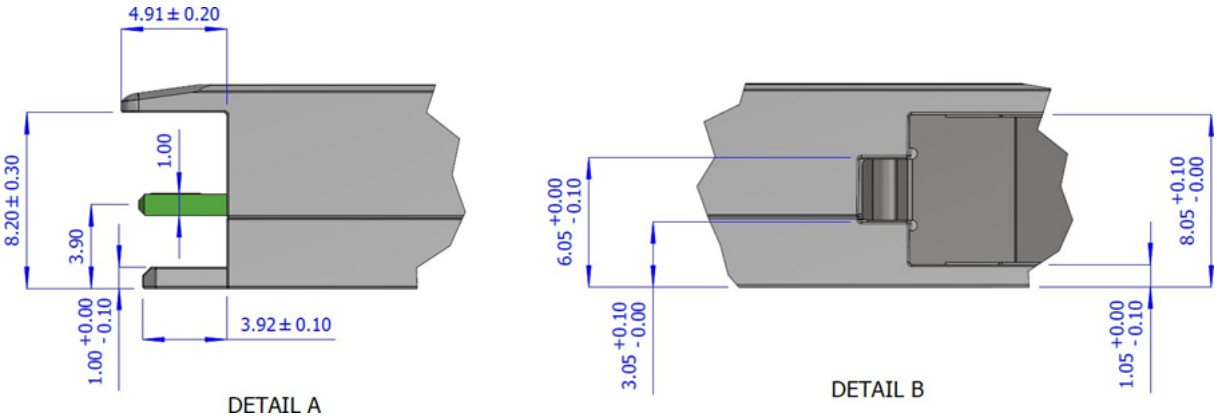
Notes:

1. Average launch power, each lane (min) is informative and not the principal indicator of signal strength.
2. Even if TDECQ < 1.4dB, OMAouter (min) must exceed this value.
3. Transmitter reflectance is defined looking into the transmitter.
4. Receiver sensitivity (OMAouter), each lane (max) is informative and is defined for a transmitter with SECQ of 0.9 dB.
5. Measured with conformance test signal at TP3 for the BER = 2.4x10-4
6. Measured at BER 1x10-6 and Error free post FEC

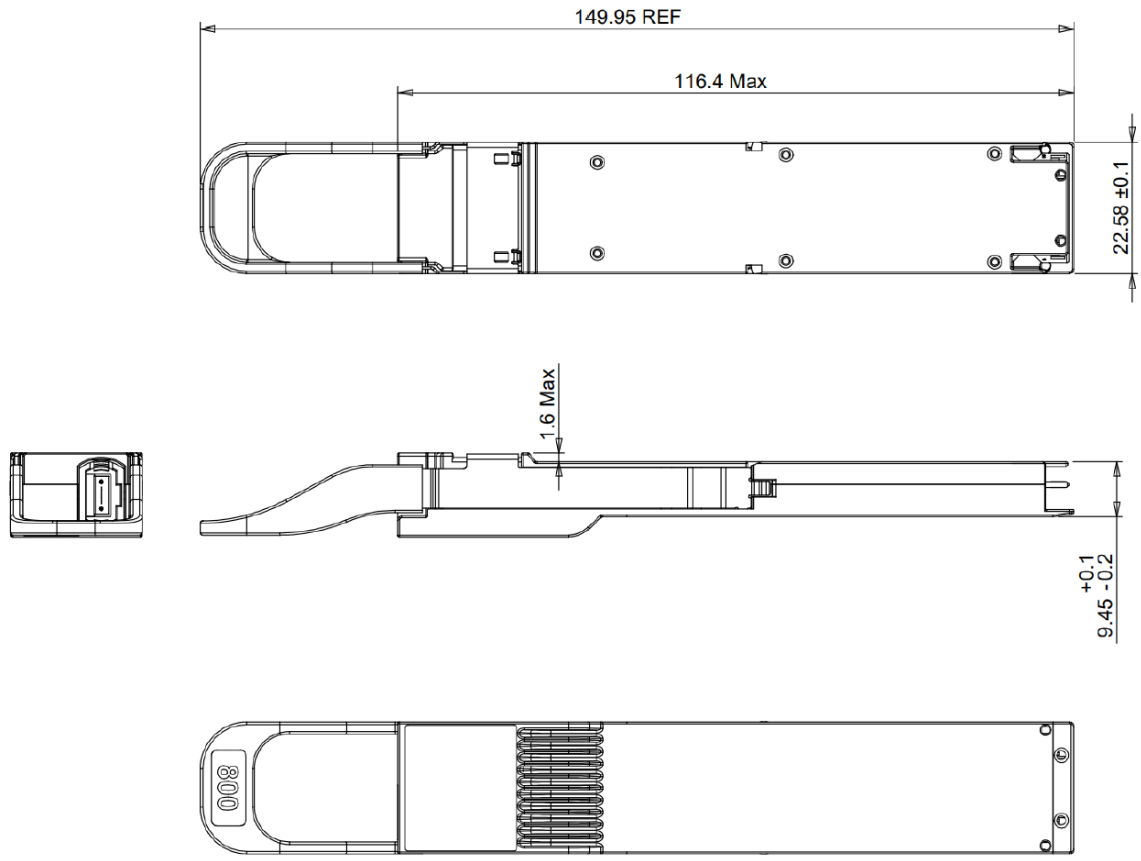
Mechanical Specifications



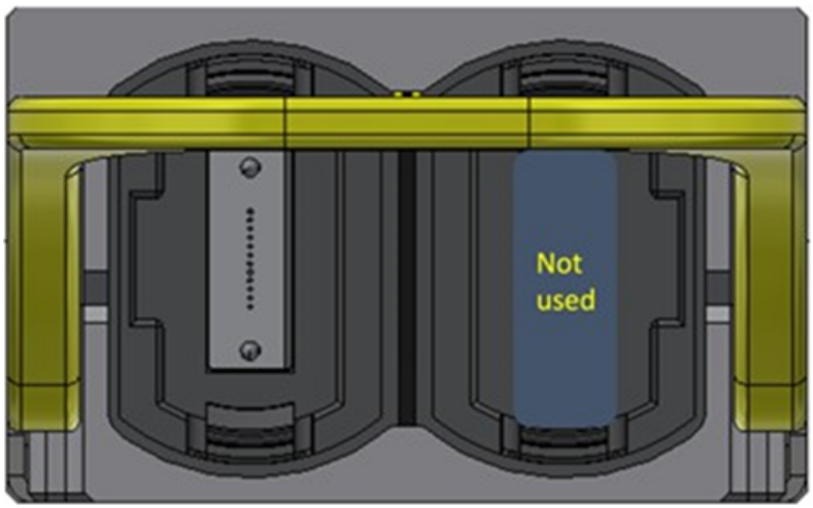
Enlarged view of detail A and B:



Alternate source mechanical drawings:



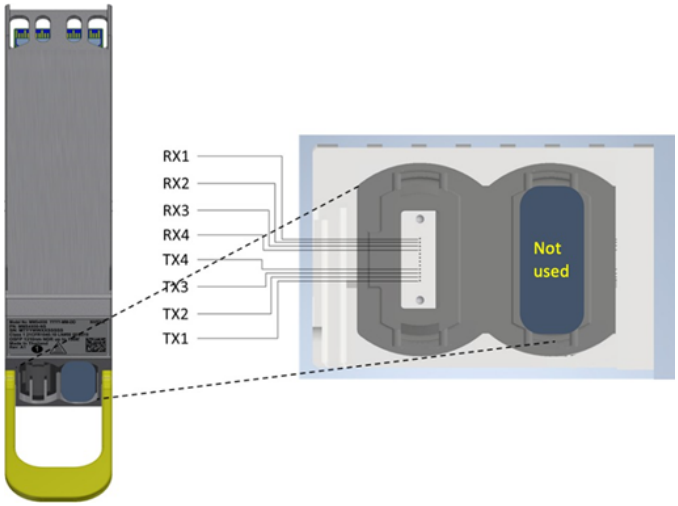
MPO/APC end view:



Images are for illustration purposes only. Product labels, colors, and form may vary.

4.5 Labels

4.5.1 Transceiver Labeling and Fiber Polarity



Transceiver port labeling and lane routing. Txn/Rxn refers to the OSFP pin description.

> ⚠ Images are for illustration purposes only. Product labels, colors, and form may vary.

4.5.2 Back shell Label

The label applied on the transceiver's back-shell is illustrated below. Note that the Images are for illustration purposes only. Labels look and placement may vary.

Transceiver Label (Illustration)

Images are for illustration purposes only. Product labels, colors, and form may vary.

4.5.2.1 Transceiver Back-Shell Label Serial Number Legend

Symbol	Meaning	Notes
MT	Manufacturer name	2 digits (alphanumeric)
YY	Year of manufacturing	2 last digits of the year (numeric)
WW	Week of manufacturing	2 digits (numeric)
XX	Manufacturer Site (FT)	Two characters
SSSSS	Serial number	5 digits (decimal numeric) for serial number, starting from 00001.

4.5.3 Regulatory Compliance

The transceiver is a Class 1 laser product. It is certified per the following standards:

Feature	Agency	Standard
Laser Eye Safety	FDA/CDRH	CDRH 21 CFR 1040 and Laser Notice 50
Electrical Safety	CB	IEC 62368

Feature	Agency	Standard
Electrical Safety	UL/CSA	UL 62368 and CAN/CSAN 62368

4.6 Connector and Cabling Details

4.6.1 MPO-12/APC Optical Connector

The Twin-port transceiver has a unique NVIDIA patented design enabling two, multiple-push-on/angled-polished-connector 12-fiber (MPO-12/APC) optical connectors per single OSFP form-factor by turning the optical connectors vertically in the twin-port transceiver end. This enables it to host two transceivers inside, each with its own MPO-12/APC optical connector operating independently that can link to another Twin-port transceiver or to a single-port transceiver.

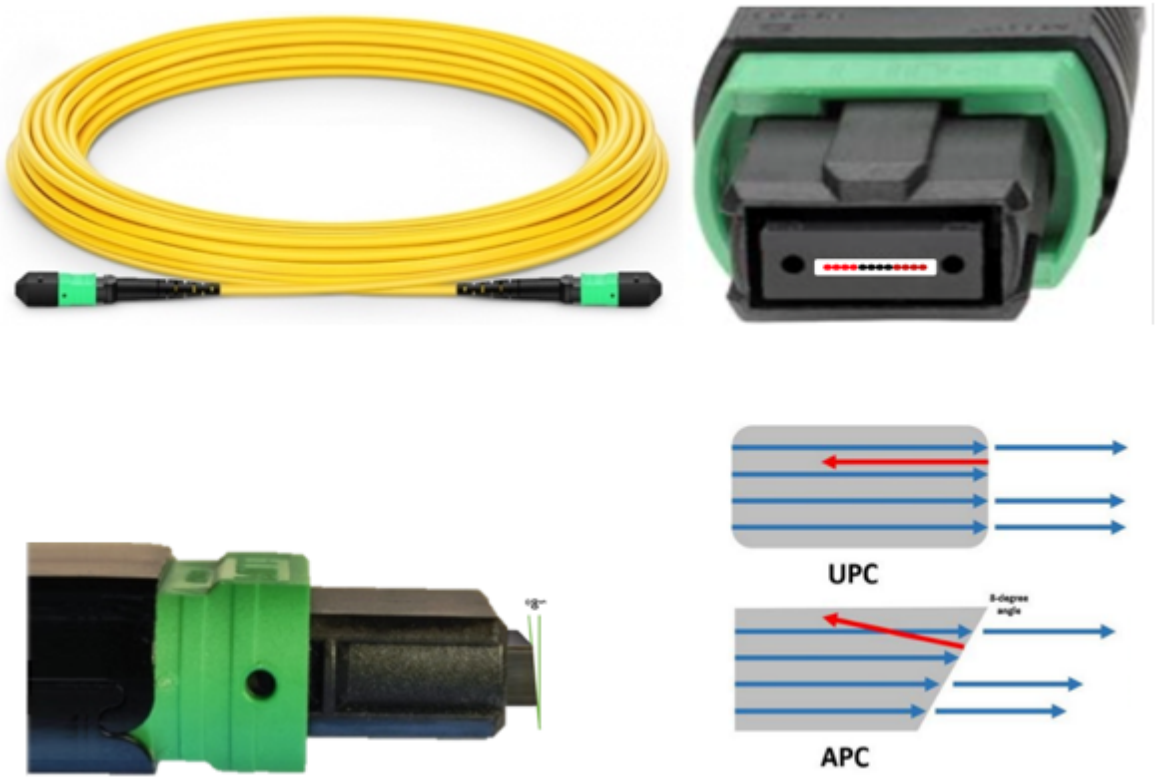
The MPO-12 has a 12-fiber ribbon but only 8-fibers are used – four transmit and four receive fibers for the 8-channels 200G-PAM4.

- The APC design minimizes back reflections and signal interference by diverting back reflected light from the fiber face to be absorbed into the fiber cladding.
- A positioning key on top of the connector together with the alignment pins define the fiber position numbering scheme to align pin 1 in the optical connector to pin 1 in the transceiver also called “polarity”
- Transceivers have alignment pins for precise positioning of the cable connector against the optical beams. The fiber cable has alignment holes matching the transceiver’s pins.
- Important to note that transceivers have pins. Optical connectors have holes used with transceivers have holes. Optical connectors with pins are not compatible with transceivers and used in trunk cabling to connect two fiber cables together.

The MPO-12/APC optical connector is used in both the 200G-PAM4 based single mode and multimode fiber cables.

Single mode optics is denoted by a yellow-colored pull tab and yellow-colored optical fiber. Green plastic shell on the MPO-12/APC connector denotes Angled Polish Connector and is not compatible with Ultra-flat Polished Connectors (UPC) used with slower line rate transceivers.

MPO-12/APC Showing 4-Transmit and 4-Receive Fibers and Angled Polish Connector End face

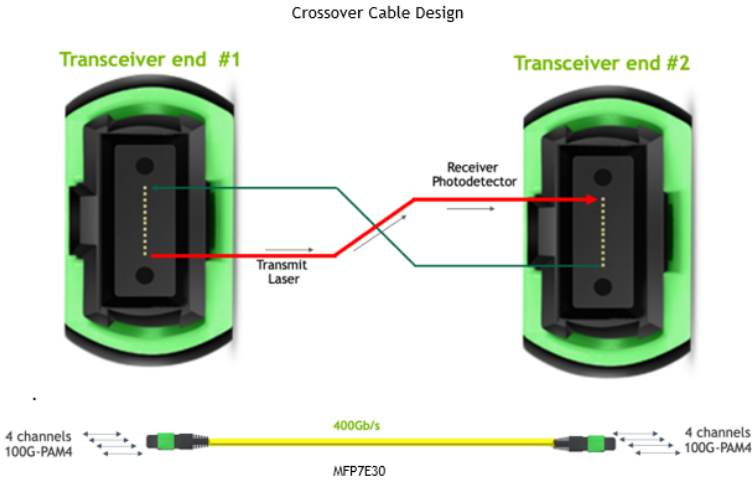


4.6.1.1 NVIDIA Supplied Crossover Type-B Fiber Cables

Linking two transceivers directly together requires aligning the transceiver laser sources with the correct photo detectors in the receive transceiver. Transmit and receive fibers are switched inside the cable enabling two transceivers to be directly connected to each other. This is called a Type-B crossover fiber.

Each of the two 4-channel XDR ports in the Twin-port transceiver has its own 4-channel optical cable that can link to two single-port 800Gb/s transceiver. Two fiber cables are needed for each Twin-port transceiver. Fiber cables are crossover cable Type-B that aligns the transmit laser with the opposite transceiver's receiver photodetector allowing to directly connect two transceivers together to maintain minimum optical losses, lowest back reflections, longest reach and increased reliability without the use of optical patch panels.

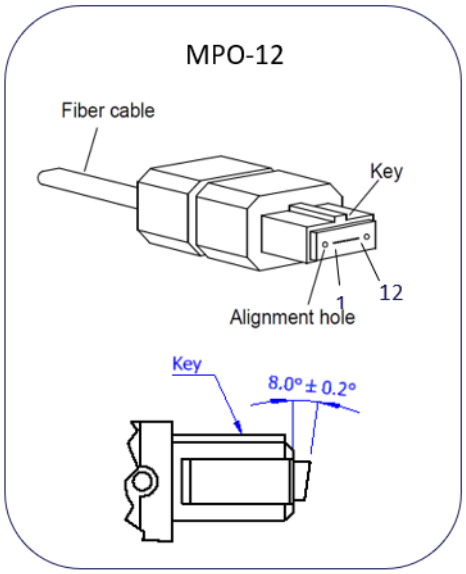
NVIDIA supplies crossover, single mode fiber cables up to 100-meters. For length from 100-to-500-meters, a crossover fiber segment must be implemented in the link to align transmit lasers with receiver photodetectors. This can be implemented by building the fiber cable as a crossover cable, or adding a NVIDIA crossover cable in the link, or via an optical patch panel with a crossover segment.

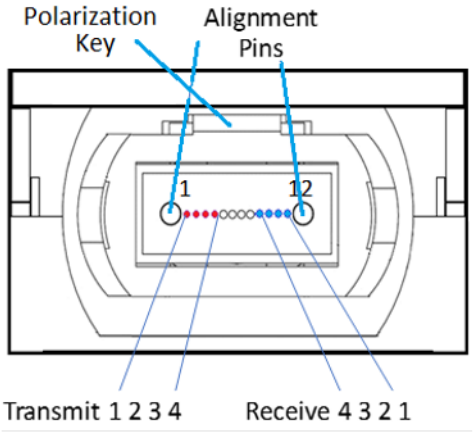


Note: Refer to the Recommended Fiber Cables table for more information.

Transceivers have alignment pins for precise positioning of the cable connector against the optical beams. The fiber cable has alignment holes matching the transceiver's pins.

MPO Connector with Alignment Holes and Positioning Key





NDR transceiver: MPO Receptacle, Lane Assignment, and Positioning Key (front view)

Reference: IEC specification IEC 61754-7

4.6.2 Handling and Cleaning

The transceiver can be damaged by exposure to current surges and over voltage events. Take care to restrict exposure to the conditions defined in Absolute Maximum Ratings. Observe normal handling precautions for electrostatic discharge-sensitive devices.

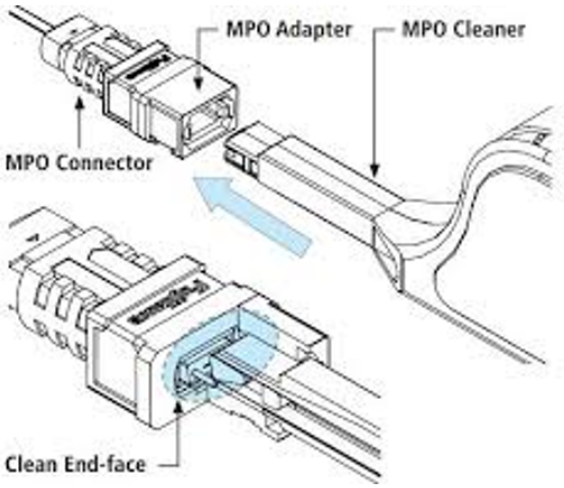
The transceiver is shipped with dust caps on both the electrical and the optical port. The cap on the optical port should always be in place when there is no fiber cable connected. The optical connector has a recessed connector surface which is exposed whenever it has no cable nor cap.

Important note 1: *Keep both the fiber and transceiver dust caps.*

Important note 2: *Clean both transceiver receptacle and cable connector* prior to insertion of the fiber cable, to prevent contamination from it.

The dust cap ensures that the optics remain clean during transportation. Standard cleaning tools and methods should be used during installation and service. Liquids must not be applied.

Important note 3: *80% of transceiver link problems are related to dirty optical connectors*.



4.6.3 Cable Management Guidelines

For more information and general interconnect management and installation, see NVIDIA Cable Management Guidelines and FAQ Application Note.

5 Ordering Information

5.1 Part Numbers and Description

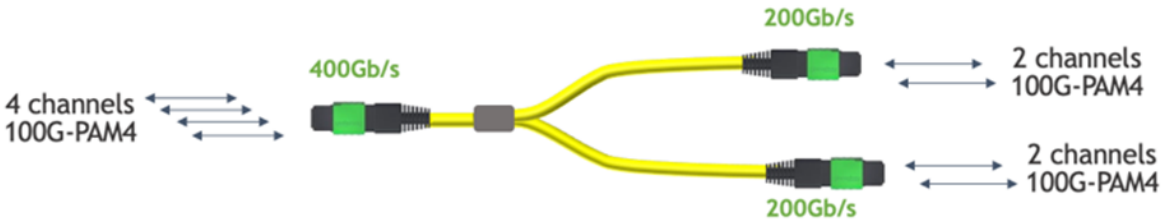
Model Number	OPN	Description
MMS4A20-XM800	980-9IAT0-00XM00	NVIDIA single port transceiver, 800Gbps,OSFP DR4, MPO,APC 1310nm SMF, up to 500m, RHS

6 Recommended NVIDIA Supplied Crossover Fiber Cables Part Numbers

Single-mode, Straight Crossover Fibers

OPN	4-channel MPO/APC to 4-channel MPO/APC
MFP7E30-N001	1m
MFP7E30-N002	2m
MFP7E30-N003	3m
MFP7E30-N005	5m
MFP7E30-N007	7m
MFP7E30-N010	10m
MFP7E30-N015	15m
MFP7E30-N020	20m
MFP7E30-N030	30m
MFP7E30-N050	50m
MFP7E30-N060	60m
MFP7E30-N070	70m
MFP7E30-N100	100m

⚠ Lengths beyond 100-meters is not offered but available from third-party suppliers



Single-mode, 1:2 Splitter Crossover Fibers

OPN	4-channel MPO/APC to Two 2-channel MPO/APC
MFP7E40-N003	3m
MFP7E40-N005	5m
MFP7E40-N007	7m
MFP7E40-N010	10m
MFP7E40-N015	15m
MFP7E40-N020	20m
MFP7E40-N030	30m
MFP7E40-N050	50m

7 Document Revision History

Rev	Date	Description
1.2	Jul. 2025	Updated the document to indicate CMIS 4.0. Added alternate source mechanical drawings. Minor text edits.
1.1	May. 2025	Updated: ▪ Introduction ▪ Ordering Information
1.0	Jul. 2024	Preliminary release.

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