MFA1A00-xxxx 100Gb/s QSFP28 MMF Active Optical Cable Product Specifications

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Introduction

NVIDIA® MFA1A00 is a QSFP28 VCSEL-based (Vertical Cavity Surface-Emitting Laser) active optical cable (AOC) designed for use in 100Gb/s InfiniBand (IB) EDR (Enhanced Data Rate) and Ethernet systems.

The MFA1A00 AOC offers high port density and configurability, and a much longer reach than passive copper cables in the data centers. Since the AOC is hot pluggable, it is easy to install and replace.

The MFA1A00 has a standard SFF-8665 compliant QSFP28 port on the electrical side towards the host system. It contains four multi-mode fibers (MMF) optic transceivers per end, each operating at data rates of up to 26Gb/s.

The MFA1A00 offers selectable retiming per lane for both its optical transmitters and receivers for the 25-26Gbp/s rates, but the AOC also supports lower bit rates without retiming. The transmitters have programmable input equalizers and input squelch function, while the receivers have programmable output amplitude and pre-emphasis.

NVIDIA's unique-quality active fiber cable solutions provide power-efficient connectivity for data center interconnects. It enables higher port bandwidth, density and configurability at a low cost, and reduced power requirement in the data centers.

Rigorous production testing ensures the best out-of-the-box installation experience, performance, and durability.

Key Features

- Up to 100Gb/s data rate
- Programmable Rx output amplitude and pre-emphasis
- Programmable Tx input equalizer
- Selectable retiming
- SFF-8665 compliant QSFP28 port
- Single 3.3V power supply
- 2.2W power dissipation (typ., each end, with retiming)
- Up to 100m length
- Hot pluggable
- RoHS compliant
- SFF-8636 compliant I^2C management interface

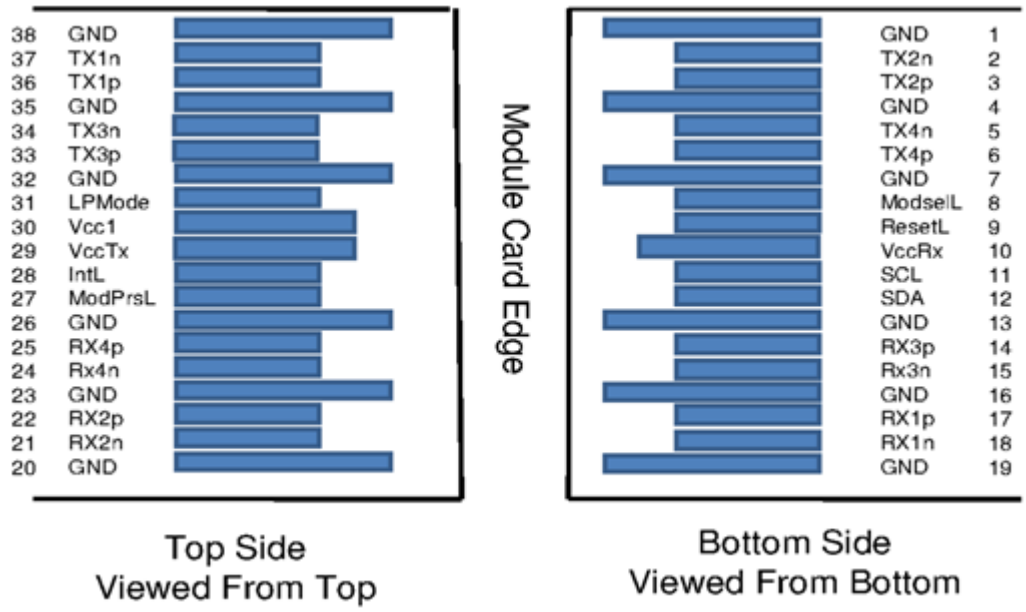
⚠ Images are for illustration purposes only. Product labels, colors, and lengths may vary.

Pin Description

QSFP28 Pin Function Definition

Pin	Symbol	Description	Pin	Symbol	Description
1	GND	Ground	20	GND	Ground
2	Tx2n	Transmitter Inverted Data Input	21	Rx2n	Receiver Inverted Data Output
3	Tx2p	Transmitter Non-Inverted Data Input	22	Rx2p	Receiver Non-Inverted Data Output
4	GND	Ground	23	GND	Grounds
5	Tx4n	Transmitter Inverted Data Input	24	Rx4n	Receiver Inverted Data Output
6	Tx4p	Transmitter Non-Inverted Data Input	25	Rx4p	Receiver Non-Inverted Data Output
7	GND	Ground	26	GND	Ground
8	ModSelL	Module Select	27	ModPrsL	Module Present
9	ResetL	Module Reset	28	IntL	Interrupt
10	Vcc Rx	+3.3V Power Supply Receiver	29	Vcc Tx	+3.3V Power Supply Transmitter
11	SCL	2-wire Serial Interface Clock	30	Vcc1	+3.3V Power Supply
12	SDA	2-wire Serial Interface Data	31	LPMode	Low Power Mode
13	GND	GND	32	GND	Ground
14	Rx3p	Receiver Non-Inverted Data Output	33	Tx3p	Transmitter Non-Inverted Data Input
15	Rx3n	Receiver Inverted Data Output	34	Tx3n	Transmitter Inverted Data Input
16	GND	Ground	35	GND	Ground
17	Rx1p	Receiver Non-Inverted Data Output	36	Tx1p	Transmitter Non-Inverted Data Input
18	Rx1n	Receiver Inverted Data Output	37	Tx1n	Transmitter Inverted Data Input
19	GND	Ground	38	GND	Ground

QSFP28 Module Pad Layout



Top Side
Viewed From Top

Bottom Side
Viewed From Bottom

Features

The transceiver complies with the SFF 8665 specification and has the following key features:

- Physical layer link optimization:
  - Programmable Tx input equalization
  - Programmable Rx output amplitude
  - Programmable Rx output pre-emphasis
  - Tx/Rx CDR control
- Digital Diagnostic Monitoring (DDM):
  - Rx receive optical power monitor
  - Tx transmit optical power monitor
  - Tx bias current monitor
  - Supply voltage monitor
  - Transceiver case temperature monitor
- Other SFF-8636 functions and interrupt indications:
  - Tx & Rx LOS indication
  - Tx & Rx LOL indication
  - Tx fault indication

Specifications

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	Min	Max	Units
Supply voltage	-0.3	3.6	V
Data input voltage	-0.3	3.465	V
Control input voltage	-0.3	4.0	V
Damage Threshold	3.4	---	dBm

Environmental Specifications

This table shows the environmental specifications for the product.

Parameter	Min	Max	Units
Storage temperature	-40	85	°C

Operational Specifications

This section shows the range of values for normal operation. The host board power supply filtering should be designed as recommended in the SFF Committee Spec.

Parameter	Min	Typ	Max	Units	Notes
Supply voltage (V_{CC})	3.135	3.3	3.465	V	---
Power dissipation (each end, no retiming)	---	1.5	1.8	W	---
Power dissipation (each end, retiming on all lanes)	---	2.2	2.5	W	---
Supply noise tolerance (10 Hz - 10 MHz)	66	---	---	mVpp	---
Operating case temperature	0	---	70	°C	---
Operating relative humidity	5	---	85	%	---

Electrical Specifications

Parameter (per lane)	Min	Typ	Max	Units
Signaling rate	-100 ppm	25.78125	+100 ppm	Gb/s

Parameter (per lane)	Min	Typ	Max	Units
Signaling rate (without retiming)	0.3		25.784	Gb/s
BER (Bit Error Rate)[1]	---	---	10^{-15}	---
Transmitter				
Differential data input swing at TP1a	According to IEEE 802.3bm 83E.3.1.2[2]	---	900	mV_{pp}
Differential input return loss	Meets equation (83E-5) in IEEE 802.3bm			dB
Receiver				
Differential output return loss	Meets equation (83E-5) in IEEE 802.3bm			dB
Differential data output swing at TP4	300	---	480	mVpp
Common Mode output return loss	---	---	-6	dB
Output eye width (EW15)	0.57	---	---	UI
Output eye height (EH15)	228	---	---	mV
Output Transition time, 20 to 80%	17	---	---	ps
Output Eye Crossing	45	---	---	%

Notes:
[1] BER performance was verified with a PRBS31 test pattern in accordance with the IEEE 802.3bm specifications, as part of the product qualification.
[2] Requires optimization of the input equalizer.

Interoperability

For configurations tested with the AOCs please refer to the system level product quality assurance (SLPQA) report.

Digital Diagnostic Monitoring

The transceiver has digital diagnostic monitoring (DDM) functions implemented in firmware version 32.20.124 and higher. The DDM functions are implemented according to SFF-8636 for reading the following key parameters with associated warning and alarm thresholds:

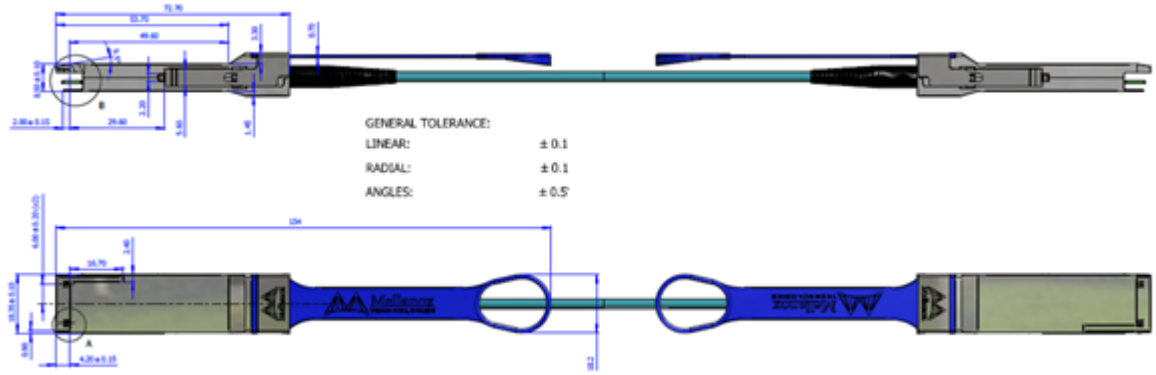
- Temperature with warning/alarm
- Supply voltage with warning/alarm
- Laser bias current with warning/alarm
- Transmitted optical power with warning/alarm
- Received optical power with warning/alarm

Mechanical Specifications

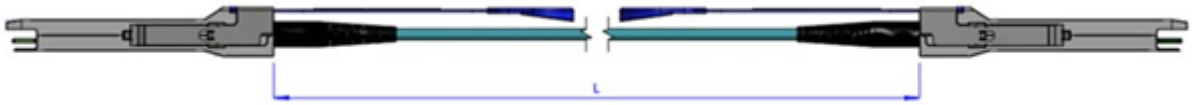
Parameter	Value	Units
Diameter	3 +/-0.2	mm
Minimum bend radius	30	mm
Length tolerance	Length < 5 m: +300 /-0 5 m ≤ length < 50 m: +500 / -0 50 m ≤ length: +1000 /-0	mm
Cable color	Aqua	---

Mechanical Dimensions

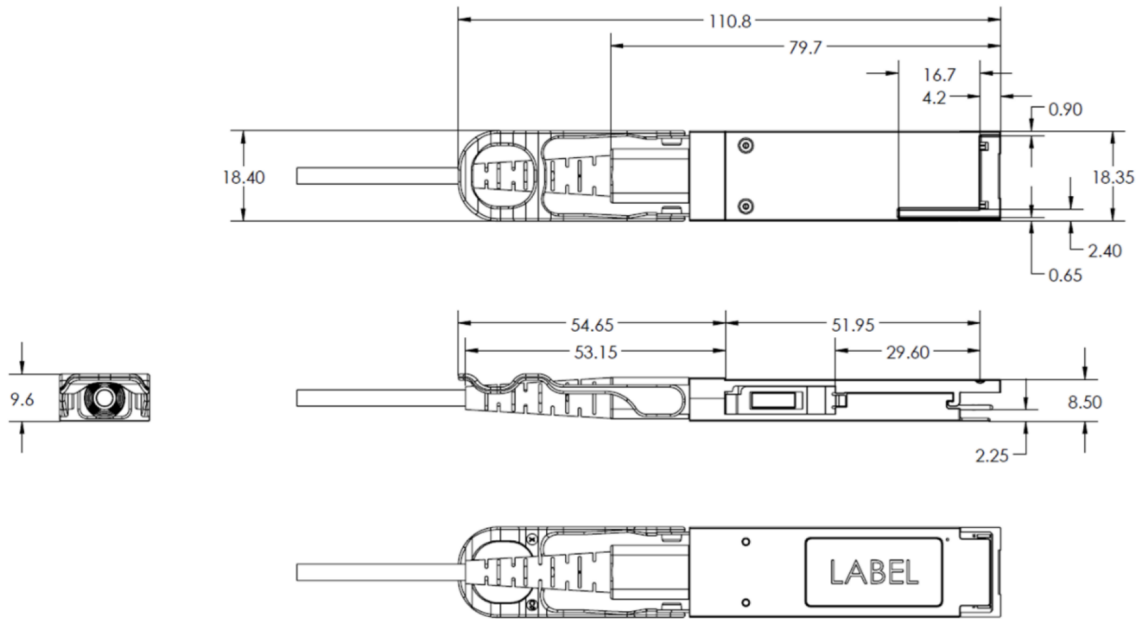
Option 1:



Cable Length Definition

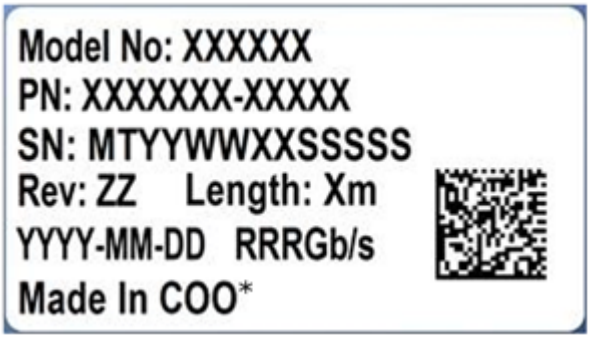


Option 2:



Labels

The following label is applied on the transceiver's back-shell:



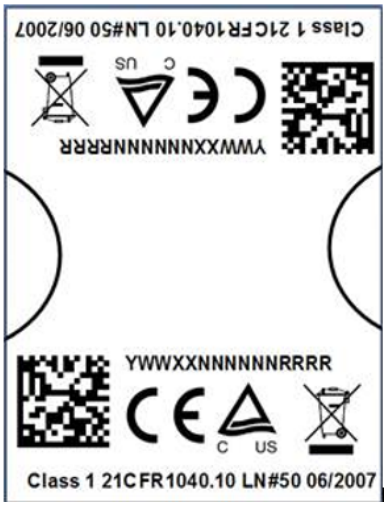
(sample illustration)

*COO – Country of Origin

Back-Shell Label SN (Serial Number) Legend

Symbol	Meaning	Notes
MT	Customer name (Mellanox/NVIDIA)	2 digits (alphanumeric)
YY	Year of manufacturing	2 digits (numeric)
WW	Week of manufacturing	2 digit (numeric)
XX	Manufacturer site	Two characters
SSSSS	Serial number	5 digits (decimal numeric) for serial number, starting from 00001

The following label is applied on the cable's jacket:



(sample illustration)

Regulatory Compliance and Classification

The laser module is classified as class I according to IEC 60825-1, IEC 60825-2 and 21 CFR 1040 (CDRH).

- Safety: CB, cTUVus, CE
- EMC: CE, FCC, ICES, RCM, VCCI

Ask your FAE for a zip file of the certifications for this product.

FCC Class A Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

References

1. LinkX® Memory Map Application Note (MLNX-15-5926)

For documentation, please contact your sales representative or the support team.

Ordering Information

Max Data Rate	Ordering Part Number	Description
EDR InfiniBand	MFA1A00-E001	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 1m
	MFA1A00-E01A	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 1.5m
	MFA1A00-E002	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 2m
	MFA1A00-E003	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 3m
	MFA1A00-E004	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 4m
	MFA1A00-E005	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 5m
	MFA1A00-E010	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 10m
	MFA1A00-E015	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 15m
	MFA1A00-E020	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 20m
	MFA1A00-E030	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 30m
	MFA1A00-E050	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 50m
	MFA1A00-E100	Active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 100m
100Gb/s Ethernet	MFA1A00-C003	Active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 3m
	MFA1A00-C005	Active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 5m
	MFA1A00-C010	Active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 10m
	MFA1A00-C015	Active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 15m
	MFA1A00-C020	Active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 20m
	MFA1A00-C030	Active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 30m
	MFA1A00-C050	Active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 50m
	MFA1A00-C100	Active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 100m

Refer to cable length definition.

Document Revision History

Revision	Date	Description
2.1	Jul. 2023	Added mechanical drawing for option 2.
2.0	Nov. 2021	Reformatted and rebranded; migrated to on-line file. Removed BER bullet.
1.9	Mar. 22, 2018	Table: Absolute Maximum Ratings – Changed Supply voltage Max from 3.465 to 3.6V. Table: Operational Specifications - Changed Supply voltage Max from 3.6 to 3.465V.
1.8	Sep. 28, 2017	Table: Electrical Module Specifications – Added BER. Regulatory Compliance and Classification – Added VCCI and CE mark. Table: Ordering Part Number and Description – Added MFA1A00-E001, MFA1A00-E01A, MFA1A00-E002, MFA1A00-E004.
1.7	Jul. 27, 2017	New document layout with minor changes. Table: Operational Specifications - Power dissipation (no retiming) Typ changed from 1.8 to 1.5W, Max from 2.0 to 1.8 W,Power dissipation (retiming) Typ changed from 2.3 to 2.2W. Table: Electrical Module Specifications - Differential data output swing at TP4 Min changed to 300. Regulatory Compliance and Classification – Updated.
1.6	Mar. 13, 2017	Table: Electrical Absolute Maximum Ratings – Updated Storage temperature. Figure: Mechanical Dimensions – Updated with tolerance.
1.5	Dec. 29, 2016	Table: Operational Specifications – Updated Supply voltage min, Power dissipation Typ and Max. Table: Electrical Specifications – Major update. Table: Cable Mechanical Specifications – Updated length tolerance. Product Label – Updated labels, legend. Digital Diagnostic Monitoring – New section.
1.4	Jun. 2016	Updated storage temperature
1.3	Apr. 2016	Updated storage temperature
1.2	Aug. 2015	Updated product description for IB cables
1.1	May 2015	Edited specifications tables
1.0	Mar. 2015	Initial revision

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