SO-QSFP28-PAM4-Dxxxx

QSFP28, 100GBase, PAM4, DWDM, SM, DDM, 80km*, LC

OVERVIEW

The SO-QSFP28-PAM4-Dxxxx is a pluggable QSFP28 DWDM transceiver designed for high capacity 100 Gigabit Ethernet (100GbE) Data Center Interconnect (DCI) optical communication applications up to 80km.

Dual PAM4 modulated 56Gbps wavelengths are combined to create a single 100GHz spaced 100Gbps “super channel”. Integrated, high-gain FEC (Forward Error Correction) and advanced Rx ADC/DSP technology enable optical reaches up to 80 km* over an amplified, DWDM line system. The optical signals are transmitted and received from the module by standard duplex SMF and LC receptacles.

The electrical signals are transmitted and received from the host via a standard 38 pin connector described in the QSFP28 MSA (SFF-8679). The electrical interface is compliant to CAUI-4 (IEEE P802.3bm Annex 83E), splitting the 100Gbps signal in to four parallel 25Gbps NRZ streams.

PRODUCT FEATURES

- Hot pluggable QSFP28 form factor transceiver compatible with the QSFP28 MSA as described in SFF-8665
- PAM4 modulation format enabling 56Gbps on a single wavelength
- Two 56Gbps wavelength channels combined to create single 100Gbps 100GHz spaced “Super Channel”
- 4Tbps bandwidth over a 40 channel 100GHz spaced Mux/Demux
- Integrated high gain FEC encoder/decoder
- Up to 80km* reach over G.652 SMF (* requires DWDM line system with amplification and dispersion management)
- Advanced ADC/DSP receiver technology
- Optical and host loopback functionality
- Standard CAUI4 electrical interface
- Adaptive equalization (CTLE) on transmit side electrical input and adjustable output de-emphasis (3 tap FIR filter) to compensate for losses on host
- Maximum power consumption 5W
- RoHS-6 compliant (lead-free)
- I^2C interface with integrated Digital Diagnostic Monitoring

APPLICATIONS

- 100G Data Center Interconnect (DCI)
- 100G Embedded DWDM (DWDM transciever in to Ethernet switch with no OEO transponder requirement)

ORDERING INFORMATION

Part Number	Description
SO-QSFP28-PAM4-Dxxxx	QSFP28, 100GBase, PAM4, DWDM, SM, DDM, up to 80km, LC

ABSOLUTE MAXIMUM RATINGS

Parameter	Min	Max	Unit
Storage temperature[1]	-40	+85	°C
3.3V Power Supply	-0.5	3.6	V
Data input voltage, single ended	-0.5	Vcc +0.5	V
I^2C controls	-0.3	3.9	V
ESD: All pins		1000	V
Storage humidity	5	85	%

Note: 1. The environment in which the module is operated must be controlled to prevent condensation on actively cooled
2. Non-condensing environment

Stresses beyond those listed here may cause permanent damage to the device

These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated is not implied.

Exposure to absolute maximum rating conditions for extended periods may affect device reliability

OPERATING CONDITIONS

Parameter	Min	Typ	Max	Unit	Notes
3.3V supply range, Vcc	3.135	3.3	3.465	V	+/- 5%
Power supply noise			50	mVpp	F = 0-5MHz
Control input voltage high	2		Vcc +0.3	V	
Control input voltage low	-0.3		0.8	V	
Rx Diff data output load		100		Ω	
Case temperature[1], Tcc	20		70	°C	Measured at center of heatsink
Power Dissipation, PD			5.0	W	Tc=70°C, Vcc=3.465V, EOL
Instantaneous peak current @ hotplug			2000	mA	Instantaneous peak duration <50µS

Note: 1. The environment in which the module is operated must be controlled to prevent condensation on actively cooled photonics. Compliance with ambient temperature and humidity limits as defined in GR-62 are required.

OPTICAL CHARACTERISTICS – TRANSMITTER

Parameter	Min	Typ	Max	Unit	Notes
Signalling Speed per Lane	-100ppm	56.25	+100ppm	Gbps	With FEC & PAM4 signalling
Center wavelength spacing		50		GHz	
DWDM wavelengths	1529.55		1560.61	nm	40 DWDM dual lane ITU channels
Side-mode Suppression Ratio (SMSR)	30			dB	
Average Launch Power (per Lane)	-11	-10	-8	dBm	
Dispersion tolerance	-100		+100	ps/nm	Residual dispersion after DCM
Optical return loss tolerance			20	dB	
Transmitter reflectance			-12	dB	

Note: Transmitter optical characteristics are measured with a single mode fiber.

OPTICAL CHARACTERISTICS – RECEIVER

Parameter	Min	Typ	Max	Unit	Notes
Signalling Speed per Lane	-100ppm	56.25	+100ppm	Gbps	With FEC & PAM4 signalling
Wavelength	1529.55		1560.61	nm	40 DWDM dual lane ITU channels
Damage threshold	10.0			dBm	
Average Receive Power, each Lane	-2.0		6.0	dBm	
Receiver Reflectance			-20	dB	
Required OSNR	31			dB	

DIGITAL DIAGNOSTIC FUNCTIONS

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

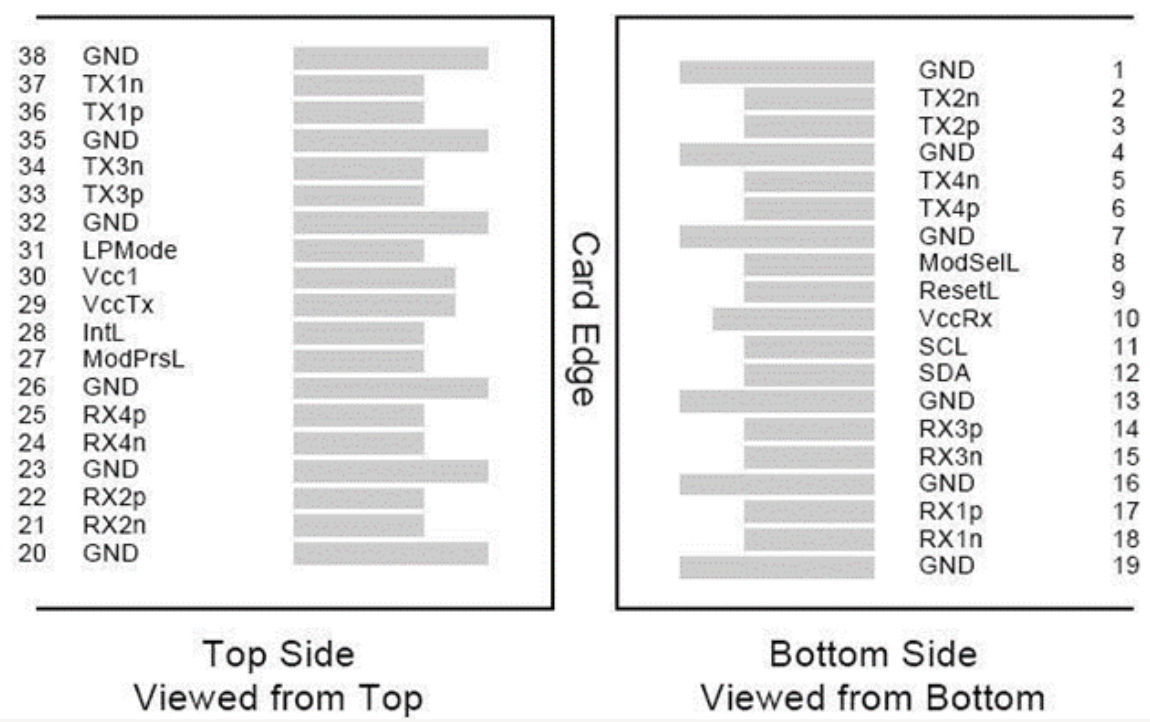
Parameter	Symbol	Min	Typ	Max	Unit	Notes
Temperature monitor absolute error	DMI_{TEMP}	-5		5	deg. C	Over operating temperature range
Supply voltage monitor absolute error	DMI_{VCC}	-0.1		0.1	V	Over Full operating range
Channel RX power monitor absolute error	DMI_{RX_CH}	-2		2	dB	1
Channel Bias current monitor	DMI_{Ibias_CH}	-10%		10%	mA	
Channel TX power monitor absolute error	DMI_{TX_CH}	-2		2	dB	1

PIN ASSIGNMENT DEFINITIONS ACCORDING TO MSA

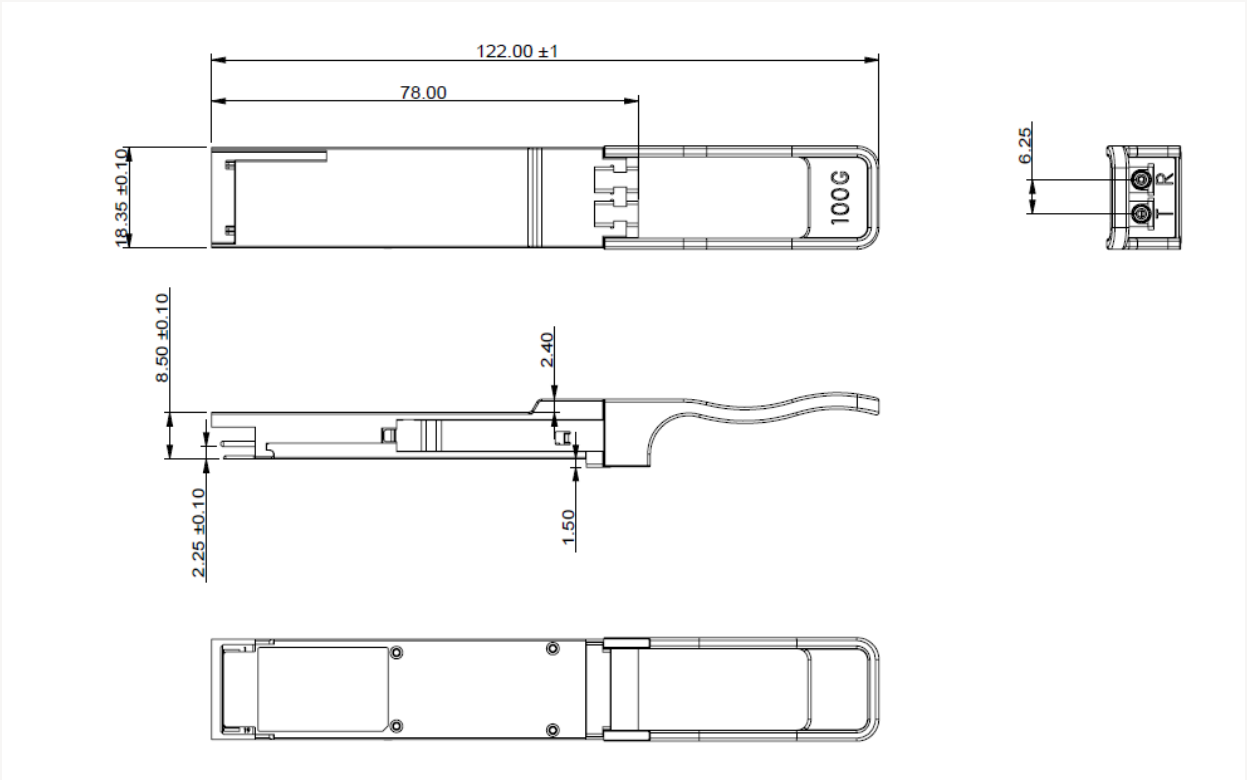
PIN	Signal Name	Description	PIN	Signal Name	Description
1	GND	Ground (1)	20	GND	Ground (1)
2	Tx2n	CML-I Transmitter 2 Inverted Data Input	21	Rx2n	CML-O Receiver 2 Inverted Data Output
3	Tx2p	CML-I Transmitter 2 Non-Inverted Data Input	22	Rx2p	CML-O Receiver 2 Non-Inverted Data Output
4	GND	Ground (1)	23	GND	Ground (1)
5	Tx4n	CML-I Transmitter 4 Inverted Data Input	24	Rx4n	CML-O Receiver 4 Inverted Data Output
6	Tx4p	CML-I Transmitter 4 Non-Inverted Data Input	25	Rx4p	CML-O Receiver 4 Non-Inverted Data Output
7	GND	Ground (1)	26	GND	Ground (1)
8	ModSelL	LVTLL-I Module Select	27	ModPrsL	Module Present
9	ResetL	LVTLL-I Module Reset	28	IntL	Interrupt
10	$V_{CC}R_x$	+3.3V Power Supply Receiver (2)	29	V_{CC}Tx	+3.3V Power Supply Transmitter (2)
11	SCL	LVCMOS-I/O 2-Wire Serial Interface Clock	30	V_{CC}1	+3.3V Power Supply
12	SDA	LVCMOS-I/O 2-Wire Serial Interface Data	31	LPMode	LVTLL-I Low Power Mode
13	GND	Ground (1)	32	GND	Ground (1)
14	Rx3p	CML-O Receiver 3 Non-Inverted Data Output	33	Tx3p	CML-I Transmitter 3 Non-Inverted Data Input
15	Rx3n	CML-O Receiver 3 Inverted Data Output	34	Tx3n	CML-I Transmitter 3 Inverted Data Input
16	GND	Ground (1)	35	GND	Ground (1)
17	Rx1p	CML-O Receiver 1 Non-Inverted Data Output	36	Tx1p	CML-I Transmitter 1 Non-Inverted Data Input
18	Rx1n	CML-O Receiver 1 Inverted Data Output	37	Tx1n	CML-I Transmitter 1 Inverted Data Input
19	GND	Ground (1)	38	GND	Ground (1)

Notes:

1. All Ground (GND) are common within the QSFP+ module and all module voltages are referenced to this potential unless noted otherwise. Connect these directly to the host board signal common ground plane.
2. V_{cc}Rx, Vcc1 and V_{cc}Tx are the receiving and transmission power supplies and shall be applied concurrently. The connector pins are each rated for a maximum current of 500mA.



MECHANICAL DIMENSIONS

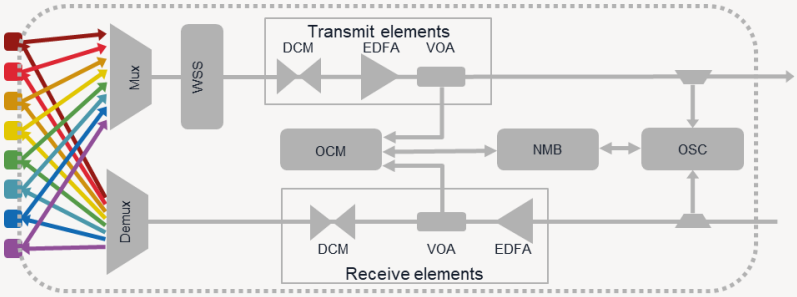


APPLICATION: EMBEDDED 0-80KM 100G DWDM DCI: PAM4 AND OPEN LINE SYSTEM

The QSFP28 PAM4 transceiver utilizes advanced PAM4 signaling and delivers up to 4Tb/s of bandwidth over a single fiber, allowing multiple data centers located up to 80km of each other to be connected and act like a single data center. The transceiver can be used in data switches with QSFP28 transceiver interfaces. The result is 100G networking with the smallest footprint, lowest power consumption and lowest capex/opex. Perfect for web scale data centers and Internet Exchanges looking to keep costs, inventory and rack space down. The transceiver requires a line system with amplification and dispersion compensation and Smartoptics DCP-M is the perfect accompaniment, enabling true open-line embedded 100G networking.

DCP-M40, 1U TRUE OPEN LINE SYSTEM

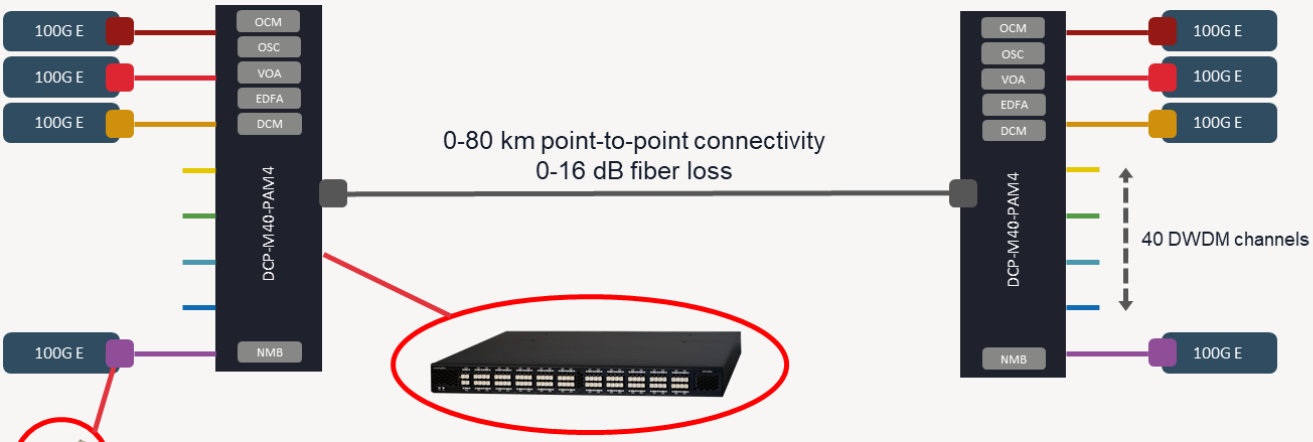
Form factor and appearance



Generic DCP-M40-xxxx schematic diagram

DCP-M AND PAM4 ADVANTAGES:

- The only 1U true plug and play PAM4 connectivity solutions on the market
- No transponders required; fewer transceivers and electrical points of failure. Reduced cost, complexity and time to service
- New 100G interconnects added in the same way as a DWDM transceiver is added to an embedded DWDM network
- Simple provisioning and management
- New high capacity DCs and services brought on line as integrated elements of a larger infrastructure
- Flexible expansion to new lower cost locations with no change in architecture
- Standardization for geographically distributed topologies
- Lower opex. No incremental software or support services needed
- No transport platform training or services are needed beyond basic CLI skills
- Removes the transport issue from all metro builds. Only access to fiber is needed



PAM4 QSFP28 DWDM TRX
Embedded in to 100G switch

DCP-M – True Open Line System
- 40 Channel DWDM mux/demux
- Integrated amplification • Dispersion management • Optical monitoring and control
- Any DWDM modulation format: PAM4 • NRZ(16/10/8G) • Coherent (QPSK/8QAM/16QAM)

EXTENDED ORDERING INFORMATION

Part Number	Description	Frequency (THz)	Center Wavelength
SO-QSFP28, PAM4, D9210	QSFP28, 100GBase, PAM4, 1560.61nm, SM, DDM, 80km, LC	192.1	1560.61
SO-QSFP28, PAM4, D9220	QSFP28, 100GBase, PAM4, 1559.79nm, SM, DDM, 80km, LC	192.2	1559.79
SO-QSFP28, PAM4, D9230	QSFP28, 100GBase, PAM4, 1558.98nm, SM, DDM, 80km, LC	192.3	1558.98
SO-QSFP28, PAM4, D9240	QSFP28, 100GBase, PAM4, 1558.17nm, SM, DDM, 80km, LC	192.4	1558.17
SO-QSFP28, PAM4, D9250	QSFP28, 100GBase, PAM4, 1557.36nm, SM, DDM, 80km, LC	192.5	1557.36
SO-QSFP28, PAM4, D9260	QSFP28, 100GBase, PAM4, 1556.55nm, SM, DDM, 80km, LC	192.6	1556.55
SO-QSFP28, PAM4, D9270	QSFP28, 100GBase, PAM4, 1555.75nm, SM, DDM, 80km, LC	192.7	1555.75
SO-QSFP28, PAM4, D9280	QSFP28, 100GBase, PAM4, 1554.94nm, SM, DDM, 80km, LC	192.8	1554.94
SO-QSFP28, PAM4, D9290	QSFP28, 100GBase, PAM4, 1554.13nm, SM, DDM, 80km, LC	192.9	1554.13
SO-QSFP28, PAM4, D9300	QSFP28, 100GBase, PAM4, 1553.33nm, SM, DDM, 80km, LC	193.0	1553.33
SO-QSFP28, PAM4, D9310	QSFP28, 100GBase, PAM4, 1552.52nm, SM, DDM, 80km, LC	193.1	1552.52
SO-QSFP28, PAM4, D9320	QSFP28, 100GBase, PAM4, 1551.72nm, SM, DDM, 80km, LC	193.2	1551.72
SO-QSFP28, PAM4, D9330	QSFP28, 100GBase, PAM4, 1550.92nm, SM, DDM, 80km, LC	193.3	1550.92
SO-QSFP28, PAM4, D9340	QSFP28, 100GBase, PAM4, 1550.12nm, SM, DDM, 80km, LC	193.4	1550.12
SO-QSFP28, PAM4, D9350	QSFP28, 100GBase, PAM4, 1549.32nm, SM, DDM, 80km, LC	193.5	1549.32
SO-QSFP28, PAM4, D9360	QSFP28, 100GBase, PAM4, 1548.51nm, SM, DDM, 80km, LC	193.6	1548.51
SO-QSFP28, PAM4, D9370	QSFP28, 100GBase, PAM4, 1547.72nm, SM, DDM, 80km, LC	193.7	1547.72
SO-QSFP28, PAM4, D9380	QSFP28, 100GBase, PAM4, 1546.92nm, SM, DDM, 80km, LC	193.8	1546.92
SO-QSFP28, PAM4, D9390	QSFP28, 100GBase, PAM4, 1546.12nm, SM, DDM, 80km, LC	193.9	1546.12
SO-QSFP28, PAM4, D9400	QSFP28, 100GBase, PAM4, 1545.32nm, SM, DDM, 80km, LC	194.0	1545.32
SO-QSFP28, PAM4, D9410	QSFP28, 100GBase, PAM4, 1544.53nm, SM, DDM, 80km, LC	194.1	1544.53
SO-QSFP28, PAM4, D9420	QSFP28, 100GBase, PAM4, 1543.73nm, SM, DDM, 80km, LC	194.2	1543.73
SO-QSFP28, PAM4, D9430	QSFP28, 100GBase, PAM4, 1542.94nm, SM, DDM, 80km, LC	194.3	1542.94
SO-QSFP28, PAM4, D9440	QSFP28, 100GBase, PAM4, 1542.14nm, SM, DDM, 80km, LC	194.4	1542.14
SO-QSFP28, PAM4, D9450	QSFP28, 100GBase, PAM4, 1541.35nm, SM, DDM, 80km, LC	194.5	1541.35
SO-QSFP28, PAM4, D9460	QSFP28, 100GBase, PAM4, 1540.56nm, SM, DDM, 80km, LC	194.6	1540.56
SO-QSFP28, PAM4, D9470	QSFP28, 100GBase, PAM4, 1539.77nm, SM, DDM, 80km, LC	194.7	1539.77
SO-QSFP28, PAM4, D9480	QSFP28, 100GBase, PAM4, 1538.98nm, SM, DDM, 80km, LC	194.8	1538.98
SO-QSFP28, PAM4, D9490	QSFP28, 100GBase, PAM4, 1538.19nm, SM, DDM, 80km, LC	194.9	1538.19
SO-QSFP28, PAM4, D9500	QSFP28, 100GBase, PAM4, 1537.40nm, SM, DDM, 80km, LC	195.0	1537.40
SO-QSFP28, PAM4, D9510	QSFP28, 100GBase, PAM4, 1536.61nm, SM, DDM, 80km, LC	195.1	1536.61
SO-QSFP28, PAM4, D9520	QSFP28, 100GBase, PAM4, 1535.82nm, SM, DDM, 80km, LC	195.2	1535.82
SO-QSFP28, PAM4, D9530	QSFP28, 100GBase, PAM4, 1535.04nm, SM, DDM, 80km, LC	195.3	1535.04
SO-QSFP28, PAM4, D9540	QSFP28, 100GBase, PAM4, 1534.25nm, SM, DDM, 80km, LC	195.4	1534.25
SO-QSFP28, PAM4, D9550	QSFP28, 100GBase, PAM4, 1533.47nm, SM, DDM, 80km, LC	195.5	1533.47
SO-QSFP28, PAM4, D9560	QSFP28, 100GBase, PAM4, 1532.68nm, SM, DDM, 80km, LC	195.6	1532.68
SO-QSFP28, PAM4, D9570	QSFP28, 100GBase, PAM4, 1531.90nm, SM, DDM, 80km, LC	195.7	1531.90
SO-QSFP28, PAM4, D9580	QSFP28, 100GBase, PAM4, 1531.12nm, SM, DDM, 80km, LC	195.8	1531.12
SO-QSFP28, PAM4, D9590	QSFP28, 100GBase, PAM4, 1530.33nm, SM, DDM, 80km, LC	195.9	1530.33
SO-QSFP28, PAM4, D9600	QSFP28, 100GBase, PAM4, 1529.55nm, SM, DDM, 80km, LC	196.0	1529.55