Product Specification

40GBASE-LR4 QSFP+ 40G 1310nm 10km DOM
Duplex LC/UPC SMF Optical Transceiver Module

PN:QSFP-40G-LR4



Features

- Hot-pluggable QSFP+ form factor
- Aggregate data rate of 41.25Gb/s
- 4 × 10.3125Gb/s NRZ lanes
- Single +3.3V power supply
- Duplex LC/UPC connector
- Up to 10km transmission over single-mode fiber
- 4-channel CWDM MUX/DEMUX design
- CWDM DFB laser transmitters
- 4-channel PIN receiver array
- Maximum power consumption <2.5W
- Built-in digital diagnostic monitoring
- Commercial case temperature range of 0°C to 70°C

Compliance

- QSFP+ MSA
- SFF-8436
- SFF-8636 Management Interface
- IEEE 802.3ba (40GBASE-LR4)
- RoHS

Applications

- 40GBASE-LR4 Ethernet links
- QSFP+ switch and router ports
- Server and NIC connections
- Data center interconnects
- Enterprise and campus backbones

Description

The QSFP-40G-LR4 is a hot-pluggable QSFP+ optical transceiver designed for IEEE 802.3ba 40GBASE-LR4 Ethernet links over single-mode fiber. It operates using four independent 10.3125 Gb/s NRZ electrical lanes for an aggregate signaling rate of 41.25 Gb/s and supports transmission distances of up to 10 kilometers over SMF through a duplex LC/UPC optical interface.

The transmitter converts the four electrical lanes into four CWDM optical signals centered at 1271nm, 1291nm, 1311nm, and 1331nm. These wavelengths are multiplexed onto a single transmit fiber, while the receiver demultiplexes the incoming optical signal into four wavelength channels and converts them back into four electrical lanes. The optical subsystem uses CWDM DFB lasers and a four-channel PIN receiver array.

The module uses a standard 38-pin QSFP+ host interface and operates from a single 3.3V power supply. It supports a commercial case temperature range of 0°C to 70°C. Digital diagnostic monitoring is available through the 2-wire management interface, allowing compatible host equipment to monitor module temperature, supply voltage, transmit and receive optical power, and laser bias information.

Product performance Specifications

1、Absolute Maximum Rating

Parameter	Symbol	Min	Typ.	Max	Unit
Storage Temperature	TS	-40		+85	°C
Supply Voltage	VCC	-0.5		+3.6	V
Relative Humidity	RH	5		85	%

2、Recommended Operating Conditions

Parameter	Symbol	Min	Typ.	Max	Unit
Operating Case Temperature	TC	0		+70	°C
Power Supply Voltage	VCC	3.135	3.3	3.465	V
Power Dissipation	PD			2.5	W
Aggregate Data Rate	DR		41.25		Gb/s
Signaling Rate per Lane			10.3125 ±100ppm		Gb/s
Maximum Link Distance				10	km
Fiber Type			9/125 μm SMF		

3、High-Speed Electrical Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit
Differential Input Impedance	ZIN		100		Ω
Differential Output Impedance	ZOUT		100		Ω
Differential Data Input Swing	VIN,pp	120		1200	mVpp
Differential Data Output Swing	VOUT,pp	300		850	mVpp
Differential Termination Resistance Mismatch				5	%
Logic Input Voltage High	VIH	2.0		VCC + 0.3	V
Logic Input Voltage Low	VIL	0		0.8	V

Note1: Differential termination resistance mismatch is measured at 1MHz.

4、Transmitter Optical Characteristics — Per Lane

Parameter	Symbol	Min	Typ.	Max	Unit
Signaling Rate			10.3125 ±100ppm		GBd
Lane 0 Wavelength	λ0	1264.5	1271	1277.5	nm
Lane 1 Wavelength	λ1	1284.5	1291	1297.5	nm
Lane 2 Wavelength	λ2	1304.5	1311	1317.5	nm
Lane 3 Wavelength	λ3	1324.5	1331	1337.5	nm
Side-Mode Suppression Ratio	SMSR	30			dB
Total Average Launch Power	PT			8.3	dBm
Average Launch Power per Lane	PAVG	-7.0		+2.3	dBm
Optical Modulation Amplitude per Lane	OMA	-4.0		+3.5	dBm
Launch Power in OMA Minus TDP	OMA-TDP	-4.8			dBm
Transmitter and Dispersion Penalty	TDP			2.6	dB
Extinction Ratio	ER	3.5			dB
Relative Intensity Noise	RIN			-128	dB/Hz
Optical Return Loss Tolerance	ORL			20	dB
Transmitter Reflectance				-12	dB

Average Launch Power of OFF Transmitter	POFF			-30	dBm

5、40GBASE-LR4 Optical Eye Mask

Parameter	Value
Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.40, 0.45, 0.25, 0.28, 0.40}
Hit Ratio	5×10^{-5}

6、Receiver Optical Characteristics — Per Lane

Parameter	Symbol	Min	Typ.	Max	Unit
Signaling Rate			10.3125 ±100ppm		GBd
Lane 0 Wavelength	λ0	1264.5	1271	1277.5	nm
Lane 1 Wavelength	λ1	1284.5	1291	1297.5	nm
Lane 2 Wavelength	λ2	1304.5	1311	1317.5	nm
Lane 3 Wavelength	λ3	1324.5	1331	1337.5	nm
Average Receive Power per Lane	RXPx	-13.7		+2.3	dBm
Receive Power (OMA) per Lane	RxOMA			+3.5	dBm
Receiver Sensitivity (OMA) per Lane[1]	Rsens			-11.5	dBm
Stressed Receiver Sensitivity (OMA) per Lane[2]	SRS			-9.6	dBm
Damage Threshold per Lane	THd	+3.3			dBm
Receiver Reflectance				-26	dB
LOS Assert	LOSA	-30			dBm
LOS De-assert	LOSD			-12.5	dBm
LOS Hysteresis	LOSH	0.5		6	dB

Note 1: Receiver sensitivity is specified in OMA at a BER of 1×10^{-12}.

Note 2: Stressed receiver sensitivity is measured using a 40GBASE-LR4 conformance test signal at TP3 at a BER of 1×10^{-12}.

Note 3: Optical transmitter and receiver specifications are defined per lane at a nominal signaling rate of 10.3125 GBd.

Note 4: The four optical lanes use nominal center wavelengths of 1271nm, 1291nm, 1311nm, and 1331nm and are multiplexed over a duplex single-mode fiber link.

Recommended Host Board Power Supply Circuit

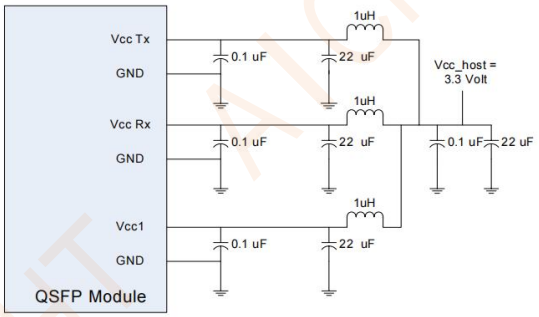


Figure 1: Recommended Host Board Power Supply Circuit

Recommended Interface Circuit

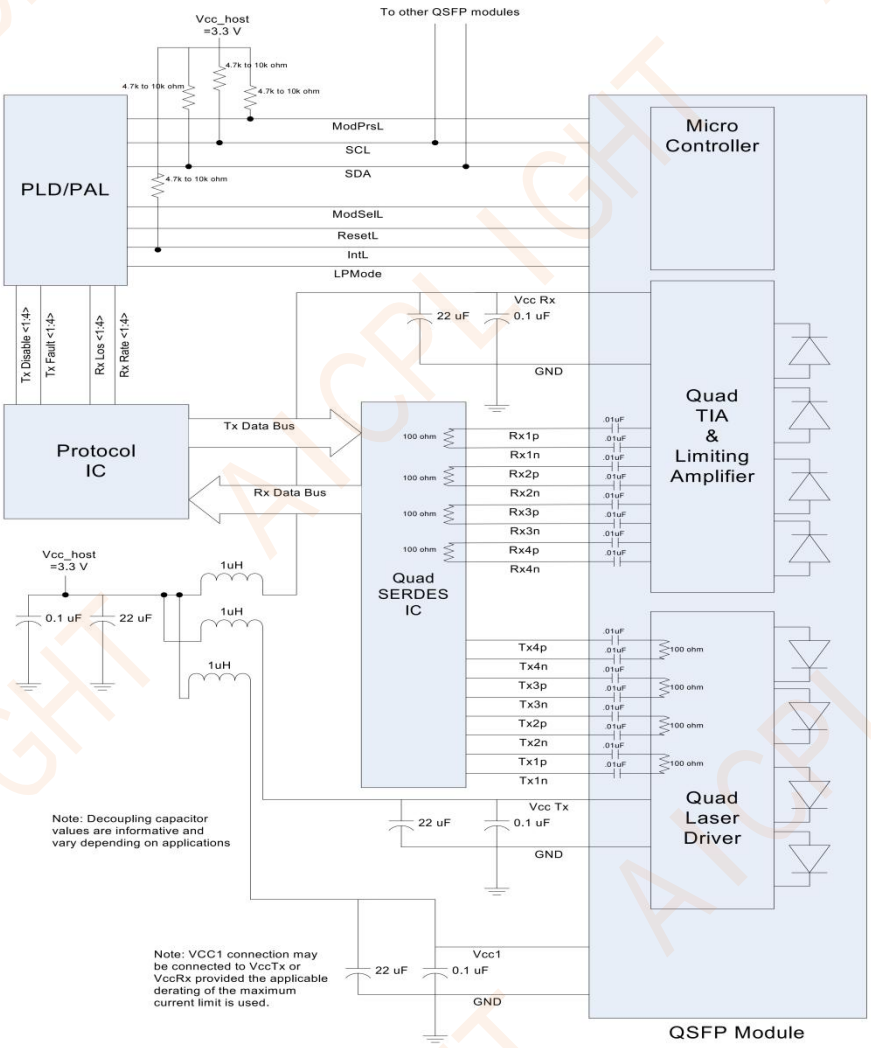


Figure2: Recommended Interface Circuit

Optical Interface

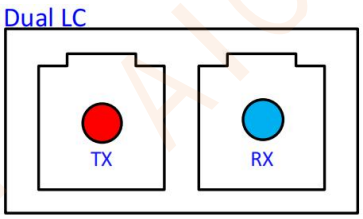


Figure3: Optical Lane Sequence

Pin-out Definition

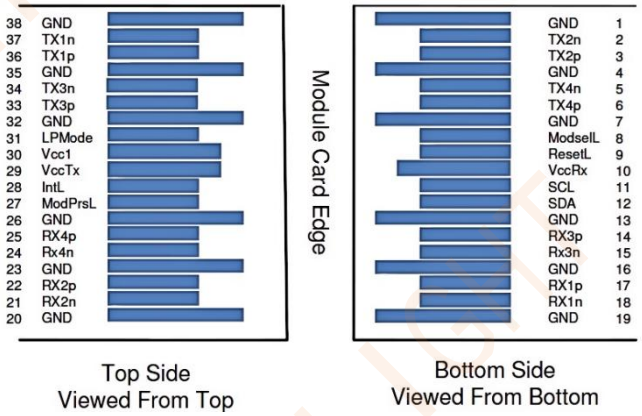


Figure4: Pin view

Pin Function Definitions

Pin	Logic	Symbol	Description	Note
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3
7		GND	Ground	1
8	LVTTL-I	ModSelL	Module Select	4
9	LVTTL-I	ReSelL	Module Select	4
10		Vcc Rx	+3.3V Power Supply Receiver	2
11	LVCMOS-I/O	SCL	2-wire serial interface clock	4
12	LVCMOS-I/O	SDA	2-wire serial interface data	4
13		GND	Ground	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3

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

Note1:GND is the symbol for signal and supply (power) common for the QSFP+ module. All are common within the QSFP+ module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.

Note2: Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently. Requirements

defined for the host side of the Host Edge Card Connector are listed in Table. Recommended host board power supply filtering is shown in Host board power supply circuit. Vcc Rx Vcc1 and Vcc Tx may be internally connected within the QSFP module in any combination. The connector pins are each rated for a maximum current of 500 mA.

Note3: High-speed signal interfaces require differential pairs (e.g. TX1+/TX1-) with tightly matched impedances (typically 100Ω).

Note4: The management and control signals are based on LVTTL level logic and are used for functions such as module selection and reset.

Monitoring Specification

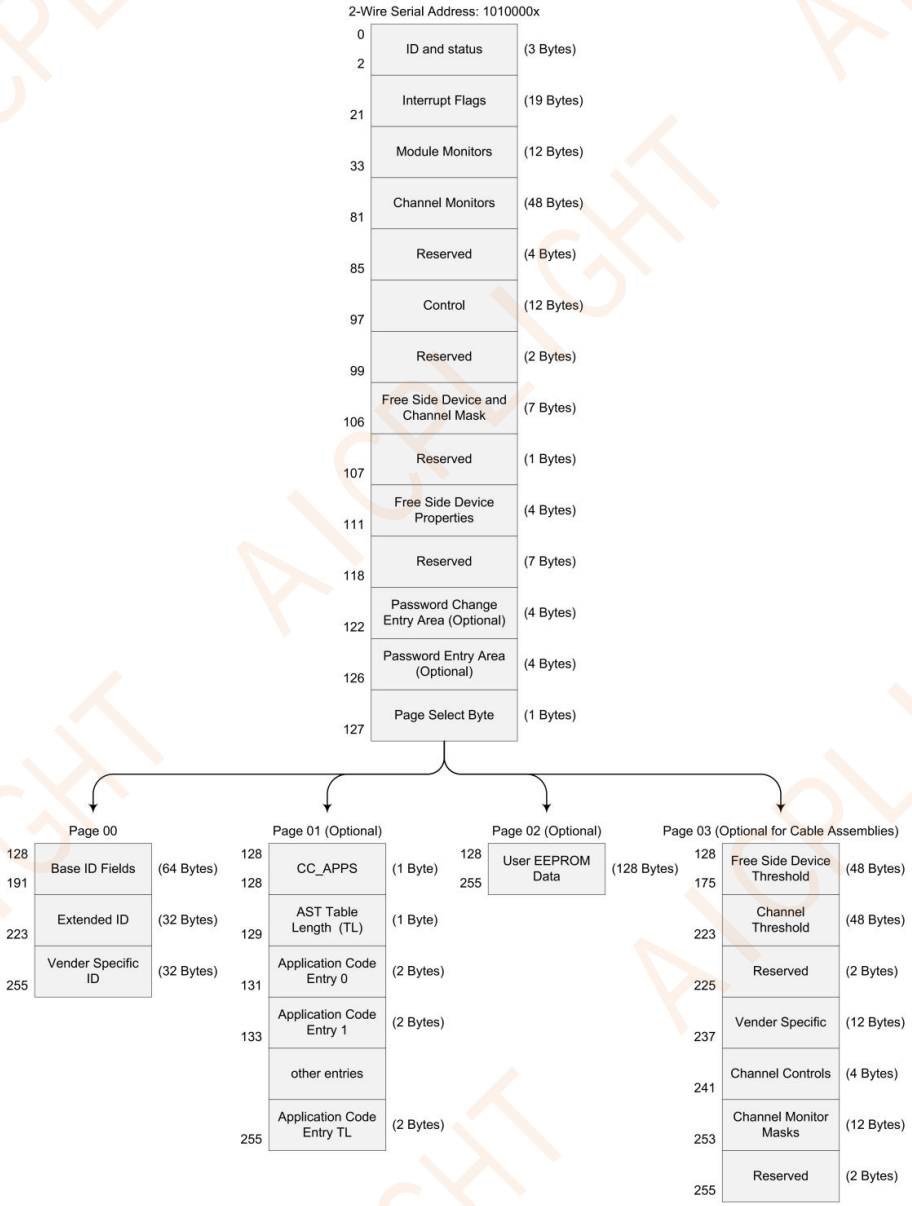


Figure5: Memory map

Memory map Table

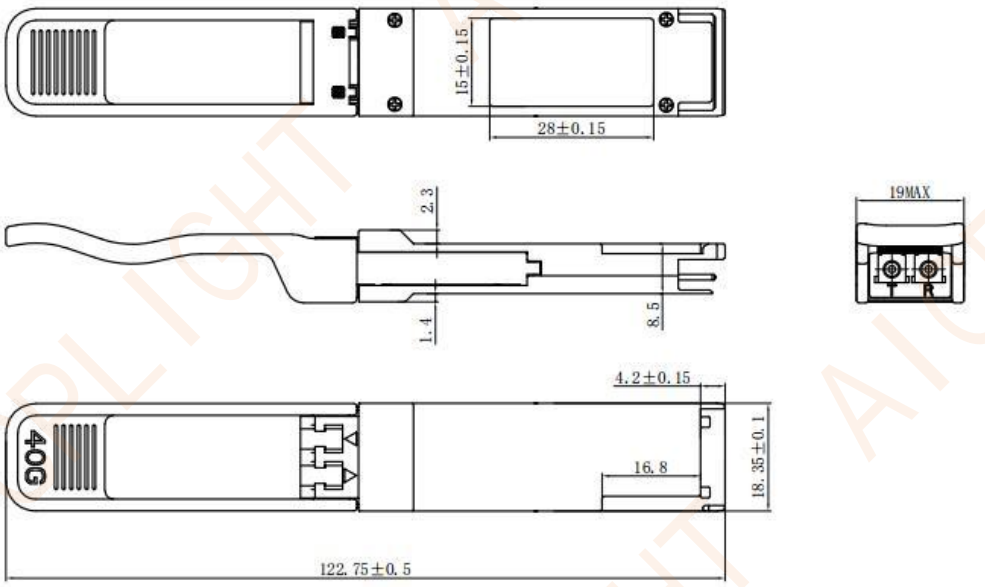
Byte	Unit	Name	Description
			Lower Page 00h
0	1	Identifier	Type of transceiver,Page 00h Byte 0 and Page 00h Byte 128 shall contain the same parameter values.
1	1	Status	Revision Compliance
2	1	Status	Status indicators
3-21	19	Interrupt Flags	Consist of interrupt flags for LOS, Tx Fault, warnings and alarms. The non-asserted state shall be 0b.
22	1	Temperature MSB	Internally measured temperature (MSB)
23	1	Temperature LSB	Internally measured temperature (LSB)
24-25	2	Reserved	Reserved
26	1	Supply Voltage MSB	Internally measured supply voltage (MSB)
27	1	Supply Voltage LSB	Internally measured supply voltage (LSB)
28-29	2	Reserved	Reserved
30-33	4	Vendor Specific	Vendor Specific
34	1	Rx1 Power MSB	Internally measured Rx1 input power
35	1	Rx1 Power LSB	
36	1	Rx2 Power MSB	Internally measured Rx2 input power
37	1	Rx2 Power LSB	
38	1	Rx3 Power MSB	Internally measured Rx3 input power
39	1	Rx3 Power LSB	
40	1	Rx4 Power MSB	Internally measured Rx4 input power
41	1	Rx4 Power LSB	
42	1	Tx1 Bias MSB	Internally measured Tx1 bias
43	1	Tx1 Bias LSB	
44	1	Tx2 Bias MSB	Internally measured Tx2 bias
45	1	Tx2 Bias LSB	
46	1	Tx3 Bias MSB	Internally measured Tx3 bias
47	1	Tx3 Bias LSB	
48	1	Tx4 Bias MSB	Internally measured Tx4 bias
49	1	Tx4 Bias LSB	
50	1	Tx1 Power MSB	Internally measured Tx1 Power
51	1	Tx1 Power LSB	
52	1	Tx2 Power MSB	Internally measured Tx2 Power
53	1	Tx2 Power LSB	
54	1	Tx3 Power MSB	Internally measured Tx3 Power
55	1	Tx3 Power LSB	
56	1	Tx4 Power MSB	Internally measured Tx4 Power
57	1	Tx4 Power LSB	

58-65	8	Reserved	Reserved channel monitor set 4
66-73	8	Reserved	Reserved channel monitor set 5
74-81	8	Vendor Specific	Vendor Specific
82-85	4	Reserved	Reserved
86-99	14	Control	Control
100-106	7	Free Side Device and Channel Masks	Free Side Device and Channel Masks
107-110	4	Free Side Device Properties	Free Side Device Properties
111-112	2	Assigned for use by PCI Express	Used for:
			- The PCI Express External Cable Specification
			- The PCI Express OCuLink Specification
113-117	4	Free Side Device Properties	Free Side Device Properties
118	1	Reserved	Reserved
119-122	4	Password Change Entry Area	Password Change Entry Area
123-126	4	Password Entry Area	Password Entry Area
127	1	Page Select Byte	Page Select Byte
Upper Page 00h			
128	1	Identifier	Identifier Type of free side device.(See SFF-8024 Transceiver Management)
129	1	Ext. Identifier	Extended Identifier of free side device. Includes power classes, CLEI codes, CDR capability.
130	1	Connector Type	Code for media connector type. (See SFF-8024 Transceiver Management)
131-138	8	Specification Compliance	Code for electronic or optical compatibility.
139	1	Encoding	Code for serial encoding algorithm. (See SFF-8024 Transceiver Management)
140	1	Signaling rate, nominal	Nominal signaling rate, units of 100 MBd. For rate > 25.4 GBd, set this to FFh and use Byte 222.
141	1	Extended Rate Select Compliance	Tags for extended rate select compliance.
142	1	Length (SMF)	Link length supported at the signaling rate in byte 140 or page 00h byte 222, for SMF fiber in km *. A value of 1 shall be used for reaches from 0 to 1 km.
143	1	Length (OM3 50 um)	Link length supported at the signaling rate in byte 140 or page 00h byte 222, for EBW 50/125 um fiber (OM3), units of 2 m *
144	1	Length (OM2 50 um)	Link length supported at the signaling rate in byte 140 or page 00h byte 222, for 50/125 um fiber (OM2), units of 1 m *
145	1	Length (OM1 62.5 um) or Copper	Link length supported at the signaling rate in byte 140 or page 00h byte 222, for 62.5/125 um fiber (OM1), units of 1 m *, or copper cable attenuation in dB at 25.78 GHz.

		Cable Attenuation	
146	1	Length (passive copper or active cable or OM4 50 um)	Length of passive or active cable assembly (units of 1 m) or link length supported at the signaling rate in byte 140 or page 00h byte 222, for OM4 50/125 um fiber (units of 2 m) as indicated by Byte 147. See 6.3.12.
147	1	Device technology	Device technology
148-163	16	Vendor name	Free side device vendor name (ASCII)
164	1	Extended Module	Extended Module codes for InfiniBand.
165-167	3	Vendor OUI	Free side device vendor IEEE company ID.
168-183	16	Vendor PN	Part number provided by free side device vendor(ASCII)
184-185	2	Vendor rev	Revision level for part number provided by the vendor(ASCII)
186-187	2	Wavelength or Copper Cable Attenuation	Nominal laser wavelength (wavelength=value/20 in nm) or copper cable attenuation in dB at 2.5 GHz (Byte 186) and 5.0 GHz (Byte 187)
188-189	2	Wavelength tolerance or Copper Cable Attenuation	The range of laser wavelength (+/- value) from nominal wavelength. (wavelength Tol. =value/200 in nm) or copper cable attenuation in dB at 7.0 GHz (Byte 188) and 12.9 GHz (Byte 189)
190	1	Max case temp	Maximum case temperature
191	1	CC_BASE	Check code for base ID fields (Bytes 128-190)
192	1	Link codes	Extended Specification Compliance Codes (See SFF-8024)
193-195	3	Options	Optional features implemented.
196-211	16	Vendor SN	Serial number provided by vendor.(ASCII)
212-219	8	Date Code	Vendor's manufacturing date code.
220	1	Diagnostic Monitoring Type	Indicates which type of diagnostic monitoring is implemented (if any) in the free side device. Bit 1,0 Reserved.
221	1	Enhanced Options	Indicates which optional enhanced features are implemented in the free side device.
222	1	CC_EXT	Check code for the Extended ID Fields (Bytes 192-222)
224-255	32	Vendor Specific	Vendor Specific EEPROM
Page 02h (Optional)			
221	1	Enhanced Options	Indicates which optional enhanced features are implemented in the free side device.
222	1	CC_EXT	Check code for the Extended ID Fields (Bytes 192-222)
224-255	32	Vendor Specific	Vendor Specific EEPROM
Page 02h (Optional)			
128-255	128	User EEPROM Data	
Page 03h (Optional)			
128-129	2	Temp High Alarm	MSB at lower byte address
130-131	2	Temp Low Alarm	MSB at lower byte address
132-133	2	Temp High Warning	MSB at lower byte address
134-135	2	Temp Low Warning	MSB at lower byte address
136-143	8	Reserved	Reserved
144-145	2	Vcc High Alarm	MSB at lower byte address
146-147	2	Vcc Low Alarm	MSB at lower byte address
148-149	2	Vcc High Warning	MSB at lower byte address
150-151	2	Vcc Low Warning	MSB at lower byte address

152-159	8	Reserved	Reserved
160-175	16	Vendor Specific	Vendor Specific
176-177	2	Rx Power High Alarm	MSB at lower byte address
178-179	2	Rx Power Low Alarm	MSB at lower byte address
180-181	2	Rx Power High Warning	MSB at lower byte address
182-183	2	Rx Power Low Warning	MSB at lower byte address
184-185	2	Tx Bias High Alarm	MSB at lower byte address
186-187	2	Tx Bias Low Alarm	MSB at lower byte address
188-189	2	Tx Bias High Warning	MSB at lower byte address
190-191	2	Tx Bias Low Warning	MSB at lower byte address
192-193	2	Tx Power High Alarm	MSB at lower byte address
194-195	2	Tx Power Low Alarm	MSB at lower byte address
196-197	2	Tx Power High Warning	MSB at lower byte address
198-199	2	Tx Power Low Warning	MSB at lower byte address
200-207	8	Reserved	Reserved thresholds for channel parameter set 4
208-215	8	Reserved	Reserved thresholds for channel parameter set 5
216-223	8	Vendor Specific	Vendor Specific
224	1	Tx EQ & Rx Emphasis Magnitude ID	Tx EQ & Rx Emphasis Magnitude ID
225	1	Rx output amplitude support indicators	Rx output amplitude support indicators
226-229	4	Control options advertising	Control options advertising
230-241	12	Optional Channel Controls	Optional Channel Controls
242-247	6	Channel Monitor Masks	Channel Monitor Masks
248-249	2	Reserved	Reserved channel monitor masks set 4
250-251	2	Reserved	Reserved channel monitor masks set 5
252-255	4	Reserved	Reserved

Mechanical Dimension



Handling and Safety Precautions：

- **ESD Precautions:** Follow standard electrostatic discharge (ESD) handling procedures when handling, installing, or removing the module. Use a grounded wrist strap or other appropriate ESD protection.
- **Hot-Plug Handling:** The QSFP+ module is hot-pluggable. Insert or remove the module only by holding the module housing and using the pull tab or release mechanism as intended.
- **Optical Connector Protection:** Keep the optical interface clean and protected from dust, moisture, oil, and other contaminants. Keep the dust cap installed whenever the optical connector is not in use.
- **Connector Cleaning:** Inspect and clean the MTP/MPO or LC connector end faces before connection. Do not touch the optical end faces directly with fingers or unapproved materials.
- **Fiber Cable Handling:** Avoid excessive bending, pulling, twisting, crushing, or other mechanical stress on the fiber cable. Follow the minimum bend-radius requirements specified for the fiber assembly.
- **Installation and Removal:** Ensure the module is correctly aligned with the QSFP+ cage before insertion. Do not force the module into the port or remove it without releasing the latch or pull tab.
- **Optical and Laser Safety:** Do not look directly into the optical port or the end of a connected fiber while the module is powered. Avoid direct eye exposure to emitted optical radiation.
- **Mechanical Handling:** Do not drop, crush, strike, or apply excessive mechanical force to the module, optical receptacle, housing, or pull tab.
- **Operating Environment:** Do not operate the module outside the specified temperature, humidity, supply-voltage, or power limits. Ensure sufficient airflow around the module during operation.
- **Disassembly:** Do not disassemble, modify, or attempt to repair the module. Opening the module may damage the optical and electronic components and affect product performance.

Ordering Information

PN	Description
QSFP-40G-SR4	40GBASE-SR4 QSFP+ 40G 850nm 150m DOM MTP/MPO-12 UPC MMF Optical Transceiver Module
QSFP-40G-LR4	40GBASE-LR4 QSFP+ 40G 1310nm 10km DOM Duplex LC/UPC SMF Optical Transceiver Module