

# 40GBASE-SR Bi-Directional QSFP+ LC Duplex Transceiver for MMF

QSFP-BD-40G



## Application

- 40 Gigabit Ethernet interconnects
- Datacom/Telecom switch & router connections
- Data aggregation and backplane applications
- Proprietary protocol and density applications

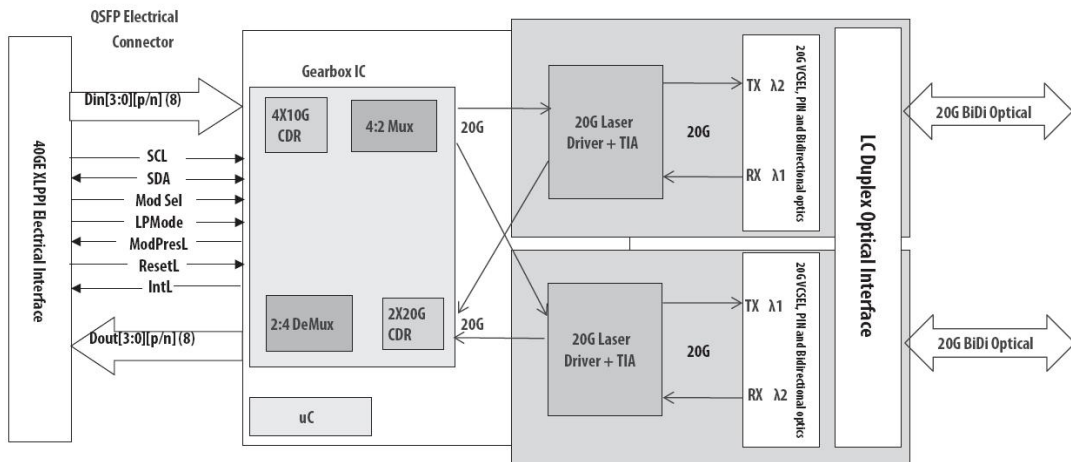
## Features

- Compliant to the 40GbE XLPI electrical specification per IEEE 802.3ba-2010
- Compliant to QSFP+ SFF-8436 Specification
- Aggregate bandwidth of > 40Gbps
- Operates at 10.3125 Gbps per electrical channel with 64b/66b encoded data
- QSFP MSA compliant
- Capable of over 100m transmission on OM3 Multimode Fiber (MMF) and 150m on OM4 MMF
- Single +3.3V power supply operating
- Built-in digital diagnostic functions
- Temperature range 0° C to 70° C
- RoHS Compliant Part
- Utilizes a standard LC duplex fiber cable allowing reuse of existing cable infrastructure

## Description

It is a Four-Channel, Pluggable, LC Duplex, Fiber-Optic QSFP+ Transceiver for 40 Gigabit Ethernet Applications. This transceiver is a high performance module for short-range duplex data communication and interconnect applications. It integrates four electrical data lanes in each direction into transmission over a single LC duplex fiber optic cable. Each electrical lane operates at 10.3125 Gbps and conforms to the 40GE XLPI interface.

The transceiver internally multiplexes an XLPI 4x10G interface into two 20Gb/s electrical channels, transmitting and receiving each optically over one simplex LC fiber using bi-directional optics. This results in an aggregate bandwidth of 40Gbps into a duplex LC cable. This allows reuse of the installed LC duplex cabling infrastructure for 40GbE application. Link distances up to 100 m using OM3 and 150m using OM4 optical fiber are supported. These modules are de- signed to operate over multimode fiber systems using a nominal wavelength of 850nm on one end and 900nm on the other end. The electrical interface uses a 38 contact QSFP+ type edge connector. The optical interface uses a conventional LC duplex connector.



## Products Specifications

### I. Absolute Maximum Ratings

Data Rate Specifications	Symbol	Min	Typ.	Max	Unit
<b>Storage Temperature</b>	TS	-40		+85	° C
<b>Supply Voltage</b>	VCCT, R	-0.5		4	V
<b>Relative Humidity</b>	RH	0		85	%

## II. Recommended Operating Environment

Parameter	Symbol	Min	Typ.	Max	Unit
Case operating Temperature	TC	0		+70	° C
Supply Voltage	VCCT, R	+3.13	3.3	+3.47	V
Supply Current	ICC			1000	mA
Power Dissipation	PD			3.5	W

## III. Electrical Characteristics (TOP= 0 to 70 ° C, VCC = 3.15 to 3.45 Volts)

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Data Rate per Channel			10.3125	11.2	Gbps	
Power Consumption			2.5	3.5	W	
Supply Current			0.75	1.0	A	
Control I/O Voltage-High	Icc			Vcc	V	
Control I/O Voltage-Low	VIH	2.0		0.7	V	
Inter-Channel Skew	VIL	0		150	Ps	
RESETL Duration	TSK		10		Us	
RESETL De-assert time				100	ms	
Power On Time				100	ms	

### Transmitter

<b>Single Ended Output Voltage Tolerance</b>		0.3		4	V	1
<b>Common mode Voltage Tolerance</b>		15			mV	
<b>Transmit Input Diff Voltage</b>	VI	120		1200	mV	
<b>Transmit Input Diff Impedance</b>	ZIN	80	100	120		
<b>Data Dependent Input Jitter</b>	DDJ			0.1	UI	
<b>Data Input Total Jitter</b>	TJ			0.28	UI	

### Receiver

<b>Single Ended Output Voltage Tolerance</b>		0.3			4	V
<b>Rx Output Diff Voltage</b>	Vo		600		800	mV
<b>Rx Output Rise and Fall Voltage</b>	Tr/Tf				35	ps
<b>Total Jitter</b>	TJ				0.7	UI
<b>Deterministic Jitter</b>	DJ				0.42	UI

**Note:**

1.20~80%

#### IV. Optical Characteristics (TOP = 0 to 70 °C, VCC = 3.1 to 3.47 Volts)

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Transmitter</b>						
<b>Optical Wavelength CH1</b>	$\lambda$	832	850	868	nm	
<b>Optical Wavelength CH2</b>	$\lambda$	882	900	918	nm	
<b>RMS Spectral Width</b>	Pm		0.5	0.65	nm	
<b>Average Optical Power per Channel</b>	Pavg	-4	-2.5	+5.0	dBm	
<b>Laser Off Power Per Channel</b>	Poff			-30	dBm	
<b>Optical Wavelength CH1</b>	ER	3.5			dB	
<b>Relative Intensity Noise</b>	Rin			-128	dB/HZ	1
<b>Optical Return Loss Tolerance</b>				12	dB	
<b>Receiver</b>						
<b>Optical Center Wavelength CH1</b>	$\lambda$	882	900	918	nm	
<b>Optical Center Wavelength CH2</b>	$\lambda$	832	850	868	nm	
<b>Receiver Sensitivity per Channel</b>	R		-6		dBm	
<b>Maximum Input Power</b>	PMAX	+0.5			dBm	
<b>Receiver Reflectance</b>	Rrx	30		-12	dB	
<b>LOS De-Assert</b>	LOSD			-14	dBm	
<b>LOS Assert</b>	LOSA	-30			dBm	
<b>LOS Hysteresis</b>	LOSH	0.5			dB	

**Note:**

1. 12dB Reflection

## V. Diagnostic Monitoring Interface

Digital diagnostics monitoring function is available on all QSFP+ SRBD. A 2-wire serial interface provides user to contact with module. The structure of the memory is shown in flowing. The memory space is arranged into a lower, single page, address space of 128 bytes and multiple upper address space pages. This structure permits timely access to addresses in the lower page, such as Interrupt Flags and Monitors. Less time critical time entries, such as serial ID information and threshold settings, are available with the Page Select function. The interface address used is A0xh and is mainly used for time critical data like interrupt handling in order to enable a one-time-read for all data related to an interrupt situation. After an interrupt, IntL, has been asserted, the host can read out the flag field to determine the affected channel and type of flag.

Byte Address	Description	Type
0	Identifier(1 Byte)	Read Only
1-2	Status (2 Bytes)	Read Only
3-21	Interrupt Flags (31 Bytes)	Read Only
22-33	Module Monitors (12 Bytes)	Read Only
34-81	Channel Monitors (48 Bytes)	Read Only
82-85	Reserved (4 Bytes)	Read /Write
86-97	Control (12 Bytes)	Read /Write
98-99	Reserved (2 Bytes)	Read /Write
100-106	Module and Channel Masks ( 7 Bytes)	Read /Write
107-118	Reserved (12 Bytes)	Read /Write
119-122	Reserved (4 Bytes)	Read /Write
123-126	Reserved ( 4 Bytes)	Read /Write
127	Page Select Byte	Read /Write
128-175	Module Thresholds (48 Bytes)	Read Only
176-223	Reserved (48 Bytes)	Read Only
224-225	Reserved (2 Bytes)	Read /Write
226-239	Reserved (14 Bytes)	Read /Write
240-241	Channel Controls (2 Bytes)	Read /Write
242-253	Reserved (12 Bytes)	Read /Write
254-255	Reserved (2 Bytes)	Read /Write

2-wire serial address, 1010000x (A0h)\*

0	ID and status	(3 Bytes)
2		
21	Interrupt Flags	(10 Bytes)
33	Module Monitors	(12 Bytes)
81	Channel Monitors	(48 Bytes)
85	Reserved	(4 Bytes)
97	Control	(12 Bytes)
99	Reserved	(2 Bytes)
100	Module and Channel Mask	(7 Bytes)
118	Reserved	(12 Bytes)
122	Password Change Entry Area (Optional)	(4 Bytes)
126	Password Entry Area (Optional)	(4 Bytes)
127	Page Select Byte	(1 Bytes)

Page 00

128	Base ID Fields	(64 Bytes)
191		
223	Extended ID	(32 Bytes)
255	Vendor Specific ID	(32 Bytes)

Page 02 (Optional)

128	User EEPROM Data	(128 Bytes)
255		

Page 03

128	Module Threshold	(48 Bytes)
175		
223	Channel Threshold	(48 Bytes)
225	Reserved	(2 Bytes)
241	Vendor Specific Channel Controls	(16 Bytes)
253	Channel Monitor Masks	(12 Bytes)
255	Reserved	(2 Bytes)

Address	Name	Description
128	Identifier (1 Byte)	Identifier Type of serial transceiver
129	Ext. Identifier (1 Byte)	Extended identifier of Serial transceiver
130	Connector (1 Byte)	Code for connector type
131-138	Transceiver (8 Bytes)	Code for electronic compatibility or optical compatibility
139	Encoding (1 Byte)	Code for serial encoding algorithm
140	BR, nominal (1 Byte)	Nominal bit rate, units of 100 Mbits/s
141	Extended RateSelect Compliance (1 Byte)	Tags for Extended RateSelect compliance
142	Length SMF (1 Byte)	Link length supported for SM fiber in km
143	Length E-50 $\mu$ m (1 Byte)	Link length supported for EBW 50/125 $\mu$ m fiber, units of 2m
144	Length 50 $\mu$ m (1 Byte)	Link length supported for 50/125 $\mu$ m fiber, units of 1m
145	Length 62.5 $\mu$ m (1 Byte)	Link length supported for 62.5/125 $\mu$ m fiber, units of 1m
146	Length copper (1 Byte)	Link length supported for copper, units of 1m
147	Device Tech (1 Byte)	Device technology
148-163	Vendor name (16 Bytes)	QSFP vendor name (ASCII)
164	Extended Transceiver (1 Byte)	Extended Transceiver Codes for InfiniBand <sup>†</sup>
165-167	Vendor OUI (3 Bytes)	QSFP vendor IEEE vendor company (ASCII)
168-183	Vendor PN (16 Bytes)	Part number provided by QSFP vendor (ASCII)
184-185	Vendor rev (2 Bytes)	Revision level for part number provided by vendor (ASCII)
186-187	Wavelength (2 Bytes)	Nominal laser wavelength (Wavelength = value / 20 in nm)
188-189	Wavelength Tolerance (2 Bytes)	Guaranteed range of laser wavelength (+/- value) from Nominal wavelength (Wavelength Tol. = value/ 200 in nm)
190	Max Case Temp (1 Byte)	Maximum Case Temperature in Degree C



Address	Name	Description
191	CC-BASE (1 Byte)	Check code for Base ID fields (addresses 128-190)
192-195	Options (4 Bytes)	Rate Select, TX Disable, TX Fault, LOS
196-211	Vendor SN (16 Bytes)	Serial number provided by vendor (ASCII)
212-219	Date code (8 Bytes)	Vendor's manufacturing date code
220	Diagnostic Monitoring Type (1Byte)	Indicates which type of diagnostic monitoring is implemented
221	Enhanced Options (1Byte)	Indicates which optional enhanced features are implemented
222	Reserved (1Byte)	Reserved
223	CC-EXT	Check code for the Extended ID Fields ( addresses 192-222)
224-255	Vendor Specific (32 Bytes)	Vendor Specific EEPROM

Page02 is User EEPROM and its format decided by user.

The detail description of low memory and page00,page03 upper memory please see SFF-8436 document.

## VI. Timing for Soft Control and Status Functions

Parameter	Symbol	Max	Unit	Conditions
<b>Initialization Time</b>	t_init	2000	ms	Time from power on <sup>1</sup> , hot plug or rising edge of Reset until the module is fully functional <sup>2</sup>
<b>Reset Init Assert Time</b>	t_reset_init	2	μs	A Reset is generated by a low level longer than the minimum reset pulse time present on the ResetL pin.
<b>Serial Bus Hardware Ready Time</b>	t_serial	2000	ms	Time from power on <sup>1</sup> until module responds to data transmission over the 2-wire serial bus
<b>Monitor Data Ready Time</b>	t_data	2000	ms	Time from power on <sup>1</sup> to data not ready, bit 0 of Byte 2, deasserted and IntL asserted
<b>Reset Assert Time</b>	t_reset	2000	ms	Time from rising edge on the ResetL pin until the module is fully functional <sup>2</sup>
<b>LPMode Assert Time</b>	ton_LPMode	100	μs	Time from assertion of LPMode (Vin:LPMode =Vih) until module power consumption enters lower Power Level
<b>IntL Assert Time</b>	ton_IntL	200	ms	Time from occurrence of condition triggering IntL until Vout:IntL = Vol
<b>IntL Deassert Time</b>	toff_IntL	500	μs	toff_IntL 500 μs Time from clear on read <sup>3</sup> operation of associated flag until Vout:IntL = Voh. This includes deassert times for Rx LOS, Tx Fault and other flag bits.
<b>Rx LOS Assert Time</b>	ton_los	100	ms	Time from Rx LOS state to Rx LOS bit set and IntL asserted
<b>Flag Assert Time</b>	ton_flag	200	ms	Time from occurrence of condition triggering flag to associated flag bit set and IntL asserted
<b>Mask Assert Time</b>	ton_mask	100	ms	Time from mask bit set <sup>4</sup> until associated IntL assertion is inhibited
<b>Mask De-assert Time</b>	toff_mask	100	ms	Time from mask bit cleared <sup>4</sup> until associated IntL operation resumes

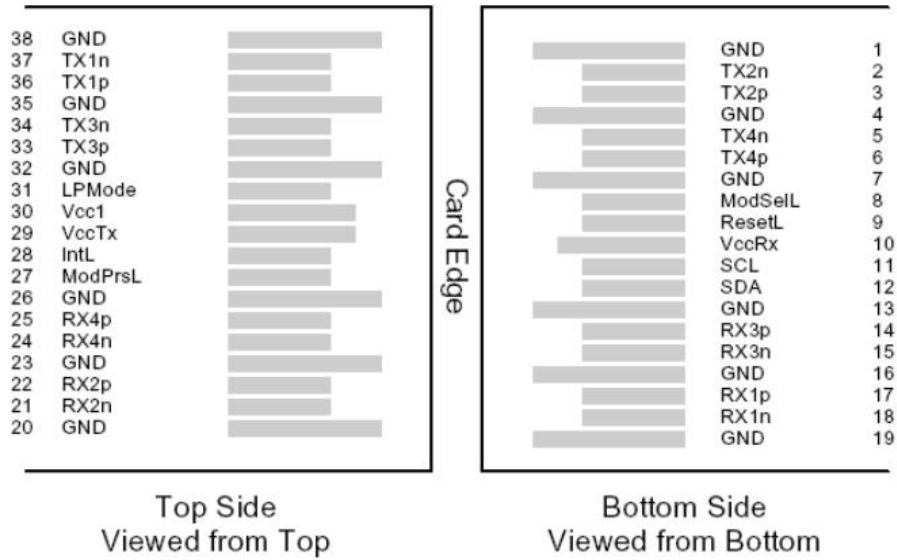
## VI. Timing for Soft Control and Status Functions

Parameter	Symbol	Max	Unit	Conditions
<b>ModSelL Assert Time</b>	ton_ModSelL	100	μs	Time from assertion of ModSelL until module responds to data transmission over the 2-wire serial bus
<b>ModSelL Deassert Time</b>	toff_ModSelL	100	μs	Time from deassertion of ModSelL until the module does not respond to data transmission over the 2-wire serial bus
<b>Power_override or Power-set Assert Time</b>	ton_Pdown	100	ms	Time from P_Down bit set 4 until module power consumption enters lower Power Level
<b>Power_override or Power-set De-assert Time</b>	toff_Pdown	300	ms	Time from P_Down bit cleared <sup>4</sup> until the module is fully functional <sup>3</sup>

### Notes:

1. Power on is defined as the instant when supply voltages reach and remain at or above the minimum specified value.
2. Fully functional is defined as IntL asserted due to data not ready bit, bit 0 byte 2 de-asserted.
3. Measured from falling clock edge after stop bit of read transaction.
4. Measured from falling clock edge after stop bit of write transaction.

## VII. Pin Description



**Diagram of Host Board Connector Block Pin Numbers and Name**

Pin	Logic	Symbol	Name/Description	Ref.
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Output	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Output	
7		GND	Ground	1
8	LVTTTL-I	ModSelL	Module Select	
9	LVTTTL-I	ResetL	Module Reset	
10		VccRx	+3.3V Power Supply Receiver	2

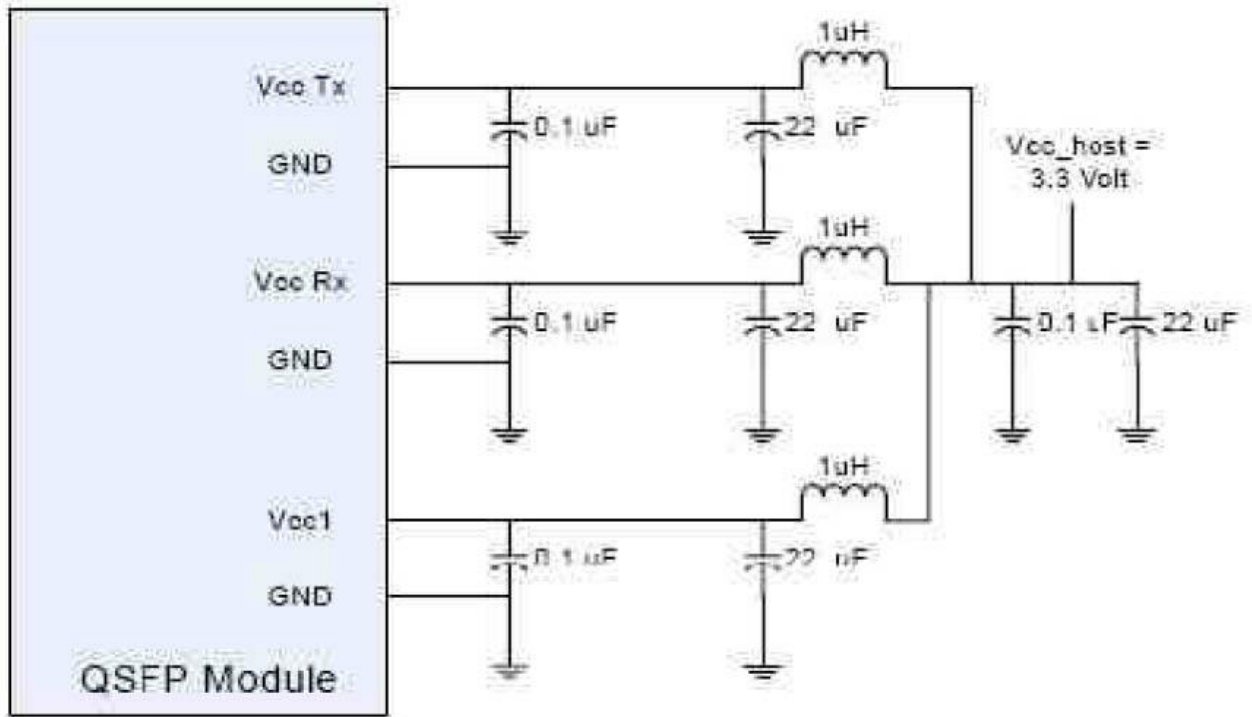
Pin	Logic	Symbol	Name/Description	Ref.
11	LVC MOS-I/O	SCL	2-Wire Serial Interface Clock	
12	LVC MOS-I/O	SDA	2-Wire Serial Interface Data	
13		GND	Ground	1
14	CML-O	Rx3p	Receiver Inverted Data Output	
15	CML-O	Rx3n	Receiver Non-Inverted Data Output	
16		GND	Ground	1
17	CML-O	Rx1p	Receiver Inverted Data Output	
18	CML-O	Rx1n	Receiver Non-Inverted Data Output	
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LV TTL-O	ModPrsL	Module Present	
28	LV TTL-O	IntL	Interrupt	
29		VccTx	+3.3V Power Supply Transmitter	2
30		Vcc1	+3.3V Power Supply	2
31	LV TTL-I	LPMode	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Inverted Data Output	

Pin	Logic	Symbol	Name/Description	Ref.
34	CML-I	Tx3n	Transmitter Non-Inverted Data Output	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Inverted Data Output	
37	CML-I	Tx1n	Transmitter Non-Inverted Data Output	
38		GND	Ground	1

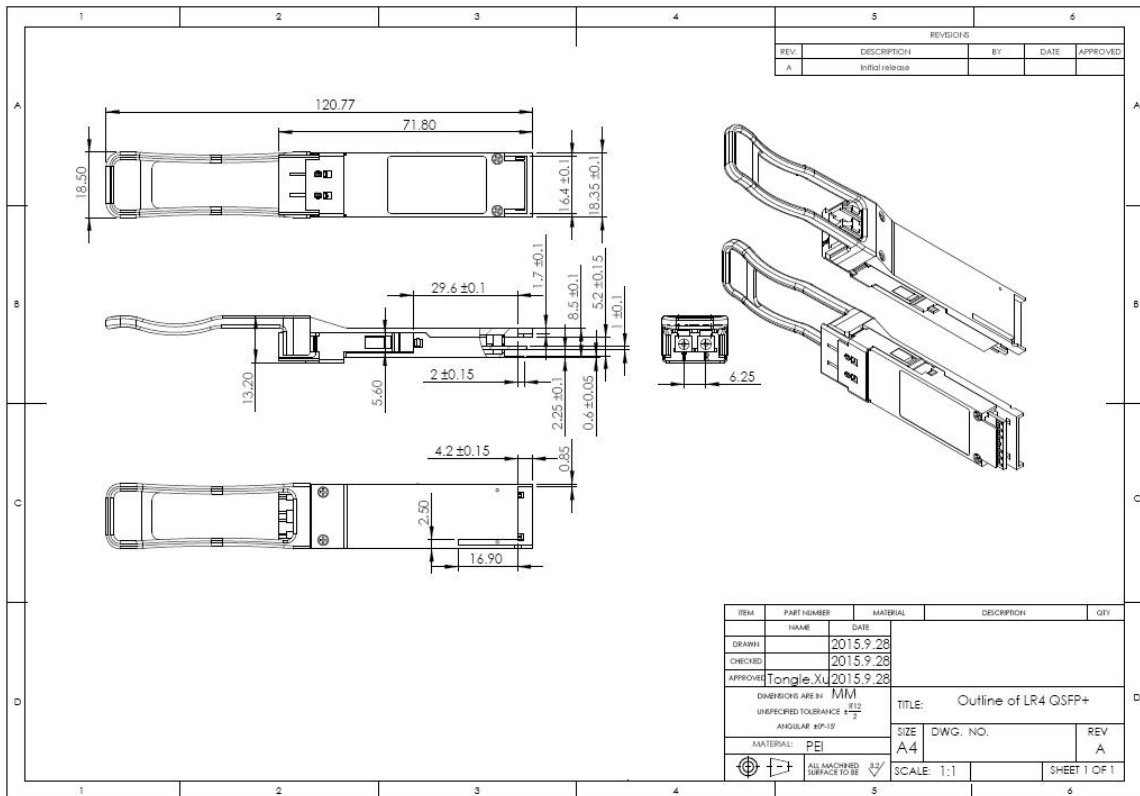
**Notes:**

1. GND is the symbol for single and supply(power) common for QSFP modules, All are common within the QSFP module and all module voltages are referenced to this potential otherwise noted. Connect these directly to the host board signal common ground plane. Laser output disabled on TDIS >2.0V or open, enabled on TDIS <0.8V.
2. VccRx, Vcc1 and VccTx are the receiver and transmitter power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. VccRx, Vcc1 and VccTx may be internally connected within the QSFP transceiver module in any combination. The connector pins are each rated for maximum current of 500mA.

### VIII.Recommended Circuit



### IX. Mechanical Dimensions



## Test Center

FS.COM transceivers are tested to ensure connectivity and compatibility in our test center before shipped out. FS.COM test center is supported by a variety of mainstream original brand switches and groups of professional staff, helping our customers make the most efficient use of our products in their systems, network designs and deployments.

The original switches could be found nowhere but at FS.COM test center, eg: Juniper MX960 & EX 4300 series, Cisco Nexus 9396PX & Cisco ASR 9000 Series, HP 5900 Series & HP 5406R ZL2 V3(J9996A), Arista 7050S-64, Brocade ICX7750-26Q & ICX6610-48, Avaya VSP 7000 MDA 2, etc.



Cisco ASR 9000 Series(A9K-MPA-1X40GE)



ARISTA 7050S-64(DCS-7050S-64)



Juniper MX960



Brocade ICX 7750-26Q



Extreme Networks X670V VIM-40G4X



Mellanox M3601Q



Dell N4032F



HP 5406R ZL2 V3(J9996A)

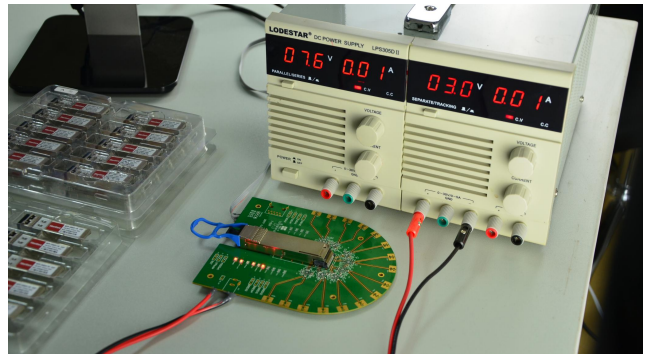


AVAYA 7024XLS(7002QQ-MDA)



## Test Assured Program

FS.COM truly understands the value of compatibility and interoperability to each optics. Every module FS.COM provides must run through programming and an extensive series of platform diagnostic tests to prove its performance and compatibility. In our test center, we care of every detail from staff to facilities—professionally trained staff, advanced test facilities and comprehensive original-brand switches, to ensure our customers to receive the optics with superior quality.



Our smart data system allows effective product management and quality control according to the unique serial number, properly tracking the order, shipment and every part.

Our in-house coding facility programs all of our parts to standard OEM specs for compatibility on all major vendors and systems such as Cisco, Juniper, Brocade, HP, Dell, Arista and so on.



With a comprehensive line of original-brand switches, we can recreate an environment and test each optics in practical application to ensure quality and distance.

The last test assured step to ensure our products to be shipped with perfect package.

## Order Information

Part Number	Description
QSFP-SR4-40G	40GBASE-SR4 QSFP+ 850nm 150m MTP/MPO Transceiver for MMF
QSFP-CSR4-40G	40GBASE-CSR4 QSFP+ 850nm 400m MTP/MPO Transceiver for MMF
QSFP-PIR4-40G	40GBASE-PLRL4 QSFP+ 1310nm 1.4km MTP/MPO Transceiver for SMF
QSFP-LX4-40G	40GBASE-UNIV QSFP+ 1310nm 2km LC Transceiver for SMF&MMF
QSFP-IR4-40G	40GBASE-LR4L QSFP+ 1310nm 2km LC Transceiver for SMF
QSFP-LR4-40G	40GBASE-LR4 and OTU3 QSFP+ 1310nm 10km LC Transceiver for SMF
QSFP-PLR4-40G	40GBASE-PLR4 QSFP+ 1310nm 10km MTP/MPO Transceiver for SMF
QSFP-ER4-40G	40GBASE-ER4 and OTU3 QSFP+ 1310nm 40km LC Transceiver for SMF
QSFP-BD-40G	40GBASE-SR Bi-Directional QSFP LC Duplex Transceiver for MMF

### Notes:

1.40G QSFP+ transceiver module is individually tested on corresponding equipment such as Cisco, Arista, Juniper, Dell, Brocade and other brands, and passes the monitoring of FS.COM intelligent quality control system.



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