

## **40Gb/s 150m QSFP+ Transceiver**

**Hot Pluggable, MTP/MPO Connector, 850nm, VCSEL, Multimode**

### **Features:**

- 4 independent full-duplex channels
- Up to 11.2Gbps per channel bandwidth
- Aggregate bandwidth of > 40Gbps
- MTP/MPO optical connector
- QSFP MSA compliant
- Digital diagnostic capabilities
- Capable of over 100m transmission on OM3 MMF (Multimode Fiber) and 150m on OM4 MMF
- CML compatible electrical I/O
- Single +3.3V power supply operating
- TX input and RX output CDR retiming
- Built-in digital diagnostic functions
- Temperature range 0°C to 70°C
- RoHS Compliant Part



### **Applications:**

- Rack to rack
- Data centers
- Metro networks
- Switches and Routers
- Infiniband 4x SDR, DDR, QDR

## Description:

- The LNK-QSFP-SR4 is a parallel 40Gbps Quad Small Form-factor Pluggable (QSFP) optical module that provides increased port density and total system cost savings. The QSFP full-duplex optical module offers 4 independent transmit and receive channels, each capable of 10Gbps operation for an aggregate bandwidth of 40Gbps 100m on OM3 Multimode Fiber (MMF) and 150m on OM4 MMF. An optical fiber ribbon cable with an MPO/MTP connector at each end plugs into the QSFP module receptacle. The orientation of the ribbon cable is “keyed” and guide pins are present inside the module’s receptacle to ensure proper alignment. The cable usually has no twist (key up to key up) to ensure proper channel to channel alignment. Electrical connection is achieved through a z-pluggable 38-pin IPASS® connector. The module operates from a single +3.3V power supply and LVCMOS/LVTTL global control signals such as Module Present, Reset, Interrupt and Low Power Mode are available with the modules. A 2-wire serial interface is available to send and receive more complex control signals and to obtain digital diagnostic information. Individual channels can be addressed and unused channels can be shut down for maximum design flexibility. The LNK-QSFP-SR4 is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference. The module offers very high functionality and feature integration, accessible via a two-wire serial interface.

## ● Absolute Maximum Ratings

Parameter	Symbol	Min	Typical	Max	Unit
Storage Temperature	TS	-40		+85	°C
Supply Voltage Relative	VCCT, R	-0.5		4 85	V %
Humidity	R RH	0			

## ● Recommended Operating Environment:

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

## ● Electrical Characteristics (T<sub>OP</sub> = 0 to 70 °C, VCC = 3.13 to 3.47 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Note
Data Rate per Channel		- -	10.312	11.2	Gbp	
Power Consumption			5 2.5	3.5	s W	
Supply Current	Icc		0.75	1.0	A V	
Control I/O Voltage-High	VIH	2.0		Vcc	V Ps	
Control I/O Voltage-Low	VIL	0		0.7	Us	
Inter-Channel Skew	TSK			150	ms	
RESETL Duration			10		ms	
RESETL De-assert time				100		
Power On Time				100		
<b>Transmitter</b>						
Single Ended Output Voltage Tolerance Common mode		0.3		4	V	1
Voltage Tolerance Transmit		15			mV	
Input Diff Voltage Transmit	VI	120		1200	mV	
Input Diff Impedance Data	ZIN	80	100	120		
Dependent Input Jitter Data	DDJ			0.1	UI	
Input Total Jitter	TJ			0.28	UI	

## Receiver

Single Ended Output Voltage Tolerance		0.3		4	V	
Rx Output Diff Voltage	V <sub>o</sub>		600	800	mV	
Rx Output Rise and Fall Voltage	Tr/Tf			35	ps	1
Total Jitter	TJ			0.7	UI	
Deterministic Jitter	DJ			0.42	UI	

## ● Optical Parameters (TOP = 0 to 70 °C, VCC = 3.0 to 3.6 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref
<b>Transmitter</b>						
Optical Wavelength	$\lambda$	840		860	nm	
RMS Spectral Width	P <sub>m</sub>		0.5	0.65	nm	
Average Optical Power per Channel	P <sub>avg</sub>	-7.3	-2.5	+1.0	dBm	
Laser Off Power Per Channel	P <sub>off</sub>			-30	dBm	
Optical Extinction Ratio	ER	3.5			dB	
Relative Intensity Noise	R <sub>in</sub>			-128	dB/HZ	1
Optical Return Loss Tolerance				12	dB	
<b>Receiver</b>						
Optical Center Wavelength	$\lambda_C$	840		860	nm	
Receiver Sensitivity per	R			-11	dBm	
Channel Maximum Input	P <sub>MAX</sub>	+0.5			dBm	
Power Receiver Reflectance	R <sub>rx</sub>			-12	dB	
LOS De-Assert	LOSD			-14	dBm	
LOS Assert	LOSA	-30			dBm	
LOS Hysteresis	LOSH	0.5			dB	

## Diagnostic Monitoring Interface

Digital diagnostics monitoring function is available on all QSFP+ SR4. 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 Only
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

Byte Address	Description	Type
128-175	Module Thresholds (48 Bytes)	Read Only
176-223	Reserved (48 Bytes)	Read Only
224-225	Reserved (2 Bytes)	Read Only
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

## EEPROM Serial ID Memory Contents (A0h)

Data Address	Length (Byte)	Name of Length	Description and Contents
<b>Base ID Fields</b>			
128	1	Identifier	Identifier Type of serial Module(D=QSFP+)
129	1	Ext. Identifier	Extended Identifier of Serial Module(90=2.5W)
130	1	Connector	Code of connector type(C=MPO)
131-138	8	Specification compliance	Code for electronic compatibility or optical compatibility(40GBASE-SR4)
139	1	Encoding	Code for serial encoding algorithm(5=64B66B)
140	1	BR, Nominal	Nominal bit rate, units of 100 MBits/s(67=103)
141	1	Extended rateselect	Tags for extended rate select compliance
142	1	Length(SMF)	Link length supported for SMF fiber in km
143	1	Length(OM3 50um)	Link length supported for EBW 50/125um fiber(OM3), units of 2m (32=50)
144	1	Length(OM2 50um)	Link length supported for 50/125um fiber(OM2), units of 1m
145	1	Length(OM1 62.5um)	Link length supported for 62.5/125um fiber (OM1), units of 1m
146	1	Length(Copper)	Link length of copper or active cable, units of 1m Link length supported for 50/125um fiber (OM4), units of 2m when Byte 147 declares 850nm VCSEL as defined in Table 37
147	1	Device tech	Device technology
148-163	16	Vendor name	QSFP+ vendor name: Telco Systems(ASCII)

164	1	Extended Module	Extended Module codes for InfiniBand
165-167	3	Vendor OUI	QSFP+ vendor IEEE company ID(001C73)
168-183	16	Vendor PN	Part number: BTI40GSRQSFP(ASCII)
184-185	2	Vendor rev	Revision level for part number provided by vendor (ASCII) (2)
186-187	2	Wave length or Copper cable Attenuation	Nominal laser wavelength (wavelength=value/20 in nm) or copper cable attenuation in dB at 2.5GHz (Adrs 186) and 5.0GHz (Adrs 187) (4268=850)
188-189	2	Wavelength tolerance	Guaranteed range of laser wavelength(+/- value) from nominal wavelength. (wavelength Tol.=value/200 in nm) (2710=50)
190	1	Max case temp.	Maximum case temperature in degrees C (70)
191	1	CC_BASE	Check code for base ID fields (addresses 128-190)
Extended ID fields			
192-195	4	Options	Rate Select, TX Disable, Tx Fault, LOS, Warning indicators for: Temperature, VCC, RX, power, TX Bias
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 types of diagnostic monitoring are implemented (if any) in the Module. Bit 1, 0 Reserved (8=Average Power)
221	1	Enhanced Options	Indicates which optional enhanced features are implemented in the Module.
222	1	Reserved	
223	1	CC_EXT	Check code for the Extended ID Fields (addresses 192-222)
Vendor Specific ID Fields			
224-255	32	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.

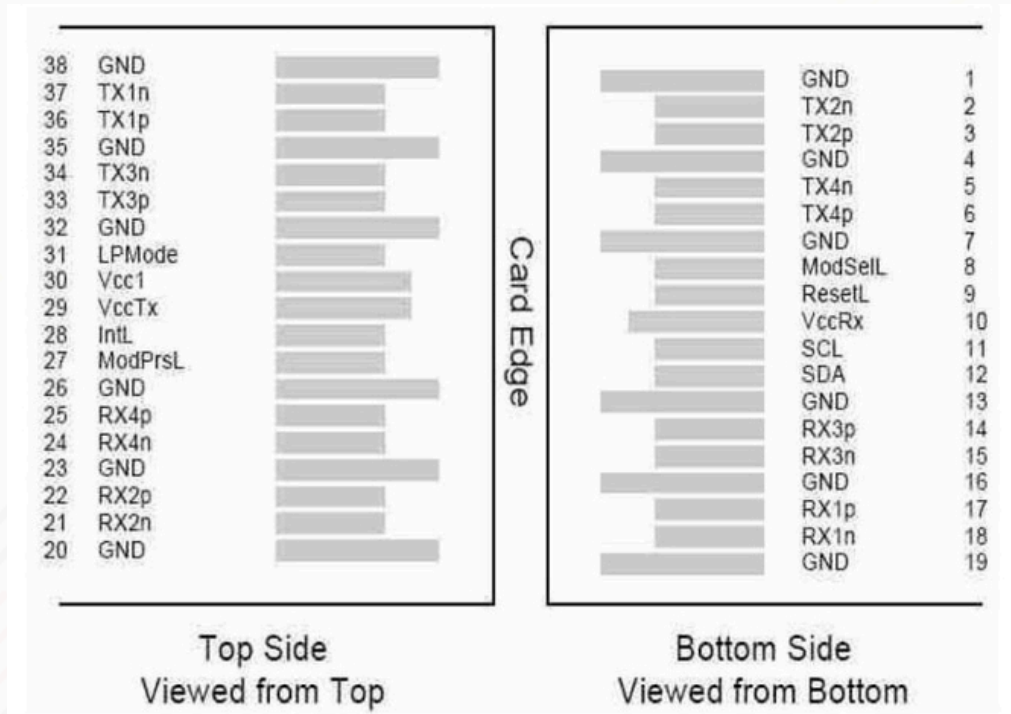
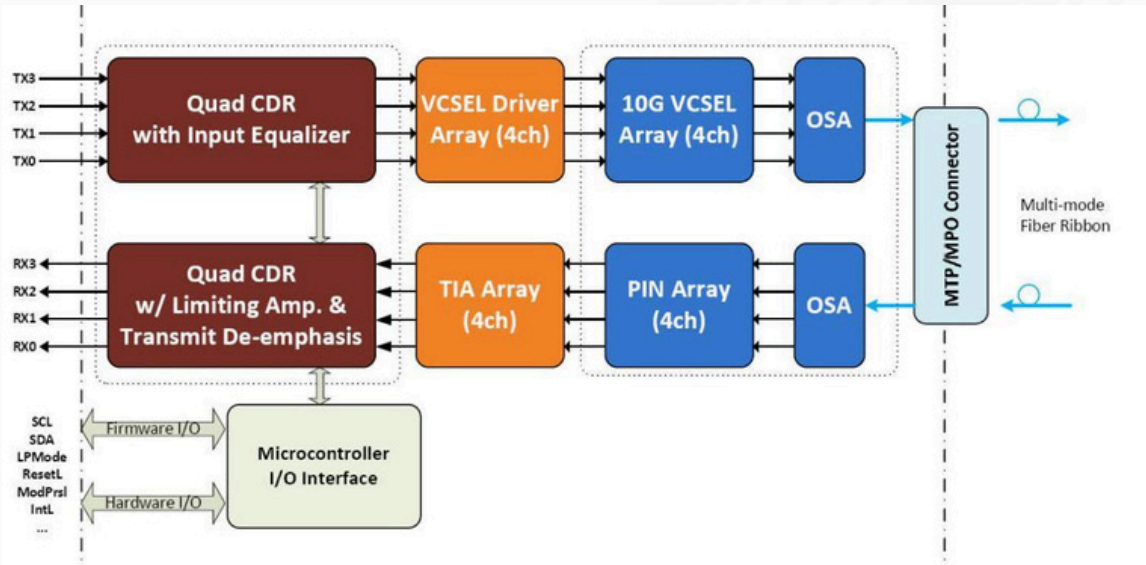
## ● Timing for Soft Control and Status Functions

Parameter	Symbol	Max	Unit	Conditions
Initialization	t_init	2000	ms	Time from power on1, hot plug or rising edge of Reset until the module is fully functional2 A Reset is generated by a low
Time Reset Init Assert Time	t_reset_init	2	μs	level longer than the minimum reset pulse time present on the ResetL pin. Time from power on1 until module responds to data
Serial Bus Hardware Ready Time	t_serial	2000	ms	transmission over the 2-wire serial bus Time from power on1 to data not ready, bit 0 of Byte 2, deasserted and IntL
Monitor Data Ready Time	t_data	2000	ms	asserted Time from rising edge on the ResetL pin until the module is fully
Reset Assert Time	t_reset	2000	ms	functional2 Time from assertion of LPMode
LPMode Assert Time	ton_LPMod e	100	μs	(Vin:LPMode =Vih) until module power consumption enters lower Power Level

### Note

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.

IntL Assert Time	ton_IntL	200	ms	Time from occurrence of condition triggering IntL until Vout: IntL = Vol toff_IntL
IntL Deassert Time	toff_IntL	500	µs	500 µs Time from clear on read3 operation of associated flag until Vout: IntL = Voh. This includes deassert times for Rx LOS, Tx Fault and other flag bits.
Rx LOS Assert Time	ton_los	100	ms	Time from Rx LOS state to Rx LOS bit set and IntL asserted
Flag Assert Time	ton_flag	200	ms	Time from occurrence of condition triggering flag to associated flag bit set and IntL asserted
Mask Assert Time	ton_mask	100	ms	Time from mask bit set4 until associated IntL assertion is inhibited
Mask De-assert Time	toff_mask	100	ms	Time from mask bit cleared4 until associated IntL operation resumes
ModSelL Assert Time	ton_ModSelL	100	µs	Time from assertion of ModSelL until module responds to data transmission over the 2-wire serial bus
ModSelL Deassert Time	toff_ModSelL	100	µs	Time from deassertion of ModSelL until the module does not respond to data transmission over the 2-wire serial bus
Power_over-ride or Power-set Assert Time	ton_Pdown	100	ms	Time from P_Down bit set 4 until module power consumption enters lower Power Level
De-assert Power_over-ride Power-set Time	toff_Pdown	300	ms	Time from P_Down bit cleared4 until the module is fully functional3



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

## ● Pin Description

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	LVTTL-I	ModSelL	Module Select	
9	LVTTL-I	ResetL	Module Reset	
10		VccRx	+3.3V Power Supply Receiver	2
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

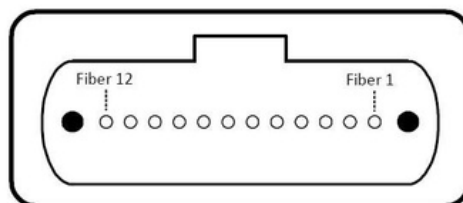
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		VccTx	+3.3V Power Supply Transmitter	2
30		Vcc1	+3.3V Power Supply	2
31	LVTTL-I	LPMode	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Inverted Data Output	
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.

## Optical Interface Lanes and Assignment

Below figure shows the orientation of the multi-mode fiber facets of the optical connector



## Outside View of the QSFP Module MPO

Fiber No.	Lane Assignment
1	RX0
2	RX1
3	RX2
4	RX3
5	Not Used
6	Not Used

## Recommended Circuit

