

40Gbps QSFP+ LR4 Transceiver 10Km Reach

NM-6C9-LR4

1. Applications

- 40GBASE-LR4 Ethernet Links
- Infiniband QDR and DDR interconnects
- Client-side 40G Telecom connections



2. Features

- Quad Small Form-factor Pluggable (QSFP)
- 40GBASE-SR4 compliant
- Compliant with 40G Ethernet IEEE802.3ba and 40GBASE-LR4 Standard
- QSFP+ MSA compliant
- Compliant with QDR/DDR Infiniband data rates
- Up to 11.2Gb/s data rate per wavelength
- 4 CWDM lanes MUX/DEMUX design
- Up to 10km transmission on single mode fiber (SMF)
- Operating case temperature: 0 to 70 °C
- Maximum power consumption 2.5W
- LC duplex connector
- RoHS compliant

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3. Description

NEM Engine's NM-6C9-LR4 is a transceiver module designed for 2m-10km optical communication applications. The design is compliant to 40GBASE-LR4 of the IEEE P802.3ba standard. The module converts 4 inputs channels (ch) of 10Gb/s electrical data to 4 CWDM optical signals, and multiplexes them into a single channel for 40Gb/s optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 40Gb/s input into 4 CWDM channels signals, and converts them to 4 channel output electrical data.

The central wavelengths of the 4 CWDM channels are 1271, 1291, 1311 and 1331 nm as members of the CWDM wavelength grid defined in ITU-T G.694.2. It contains a duplex LC connector for the optical interface and a 148-pin connector for the electrical interface. To minimize the optical dispersion in the long-haul system, single-mode fiber (SMF) has to be applied in this module.

The product 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.

4. standard

- Compliant with IEEE 802.3ba-2010,Annex 86A for 40GBASE-LR4
- Compliant with QSFP MSA(SFF-8436)
- RoHS Compliant:lead-free
- Management interfaces for 4-lane pluggable transceiver modules(SFF-8636 ver2.5)

5. Performance Specifications

5.1. Absolute Maximum Ratings

These values represent the damage threshold of the module. Stress in excess of any of the individual Absolute Maximum Ratings can cause immediate catastrophic damage to the module even if all other parameters are within Recommended Operating Conditions.

Table.1 Absolute maximum ratings

Parameter	Conditions	Min	Max	Units
Storage Temperature	TS	-40	85	degC
Operating Case Temperature	TOP	0	70	degC
Power Supply Voltage	VCC	-0.5	3.6	V
Relative Humidity (non-condensation)	RH	0	85	%
Damage Threshold, each Lane	THd	3.3		dBm

5.2. Recommended Operating Conditions

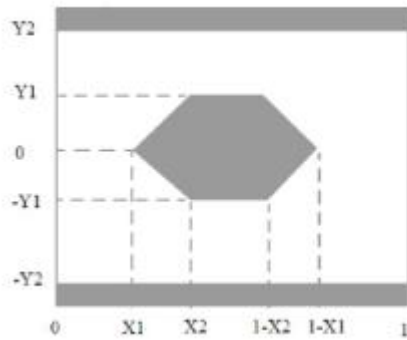
Table.2 Recommended Operating Conditions

Parameter	Conditions	Min	Typ.	Max	Units
Operating Case Temperature	TOP	0		70	degC
Power Supply Voltage	VCC	3.135	3.3	3.465	V
Data Rate, each Lane			10.3125	11.2	Gb/s
Control Input Voltage High		2		Vcc	V
Control Input Voltage Low		0		0.8	V
Link Distance with G.652	D	0.002		10	km

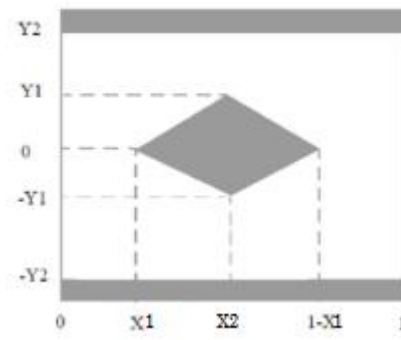
5.3. Transmitter Specification (Electrical)

Table.3 Transmitter Specification (Electrical)

Parameter	Test Point	Min	Max.	Units	Conditions
Single ended input voltage tolerance	TP1a	-0.3	4	V	Referred to TP1 signal common(Internally AC coupled)
Differential input voltage swing	TP1a	200	1600	mVpp	Peak to peak differential
AC common-mode input voltage tolerance	TP1a	15	-	mV	RMS
Differential input return loss	TP1	See IEEE 802.3ba 86A.4.1.1	-	dB	10MHz to 11.1GHz
Differential to common-mode input return loss	TP1	10	-	dB	10MHz to 11.1GHz
J2 jitter tolerance	TP1a	0.17	-	UI	
J9 jitter tolerance	TP1a	0.29	-	UI	
Data Dependent Pulse Width Shrinkage (DDPWS) tolerance	TP1a	0.07	-	UI	
Eye mask coordinates: X1, X2 Y1, Y2	TP1a	Specification values 0.11, 0.31 95, 350		UI mV	Hit ratio = 5×10^{-5} see Figure. 1(a)



a) Transmitter electrical input eye mask



(b) Receiver electrical output eye mask

Figure 1. Eye Mask

5.4. Transmitter Specification (Optical)
Table.4 Transmitter Specification (Optical)

Parameter	Test Point	Min	Typ	Max.	Units	Conditions
Wavelength Assignment	L0	1264.5	1271	1277.5	nm	
	L1	1284.5	1291	1297.5	nm	
	L2	1304.5	1311	1317.5	nm	
	L3	1324.5	1331	1337.5	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Total Average Launch Power	PT			8.3	dBm	
Average Launch Power, each Lane	PAVG	-7		2.3	dBm	
Optical Modulation Amplitude (OMA), each Lane	POMA	-4		3.5	dBm	1
Difference in Launch Power between any Two Lanes (OMA)	Ptx,diff			6.5	dB	
Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane		-4.8			dBm	
TDP, each Lane	TDP			2.6	dB	
Extinction Ratio	ER	3.5			dB	
Relative Intensity Noise	RIN			-128	dB/Hz	12dB reflection
Optical Return Loss Tolerance	TOL			20	dB	
Transmitter Reflectance	RT			-12	dB	
Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3}		{0.25,0.4,0.45,0.25,0.28,0.4}				
Average Launch Power OFF Transmitter, each Lane	Poff			-30	dBm	

5.5. Receiver Specification(Optical)

Table.5 Receiver Specification (Optical)

Parameter	Test Point	Min	Typ	Max.	Units	Conditions
Damage Threshold, each Lane	THd	3.3			dBm	2
Total Average Receive Power				8.3	dBm	
Average Receive Power, each Lane		-13.7		2.3	dBm	
Receiver Reflectance	RR			-26	dB	
Receive Power (OMA), each Lane				3.5	dBm	
Receiver Sensitivity (OMA), each Lane	SEN			-12.6	dBm	
Stressed Receiver Sensitivity (OMA), each Lane				-9.6	dBm	3
Difference in Receive Power between any Two Lanes (OMA)	Prx,diff			7.5	dB	
LOS Assert	LOSA	-28			dBm	
LOS Deassert	LOSD			-15	dBm	
LOS Hysteresis	LOSH	0.5			dB	
Receiver Electrical 3 dB upper Cutoff Frequency, each Lane	Fc			12.3	GHz	

Notes:

1. Even if the TDP < 0.8 dB, the OMA min must exceed the minimum value specified here.
2. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.
3. Measured with conformance test signal at receiver input for BER = 1×10^{-12} .
4. Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

5.6. Receiver Specification(Electrical)

Table.6 Receiver Specification (Electrical)

Parameter	Test Point	Min	Typ	Max.	Units	Conditions
Single-ended Output Voltage		-0.3		4.0	V	Referred to signal common
AC Common Mode Output Voltage				7.5	mV	RMS
Differential Output Voltage Swing	Vout,pp	300		850	mVpp	
Differential Output Impedance	Zout	90	100	110	Ohm	
Termination Mismatch at 1MHz				5	%	
Differential Output Return Loss		See IEEE 802.3ba 86A.4.2.1			dB	10MHz-11.1GHz
Common Mode Output Return Loss		See IEEE 802.3ba 86A.4.2.2			dB	10MHz-11.1GHz
Output Transition Time		28			ps	20% to 80%
J2 Jitter Output	Jo2			0.42	UI	
J9 Jitter Output	Jo9			0.65	UI	
Eye Mask Coordinates {X1, X2 Y1, Y2}		0.29, 0.5 150, 425			UI mV	Hit Ratio = 5x10-5

5.7. Pin Definitions

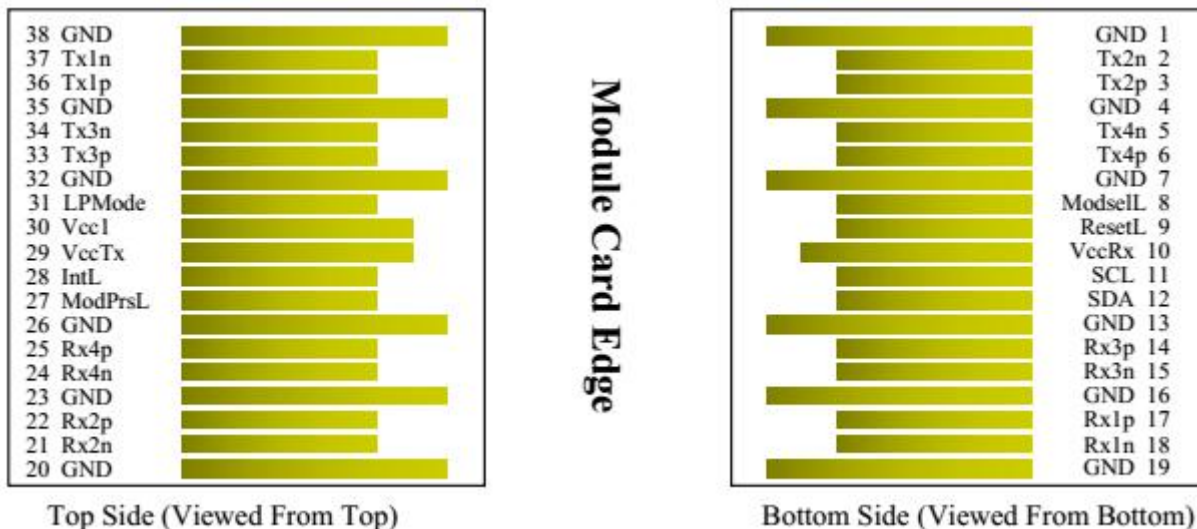


Table.7 Pin Definitions

Pin number	Logic	Symbol	Signal	Description
1		GND	Signal Ground	Ground
2	CML-I	Tx2n	Tx2n	Transmitter Inverted Date Input.AC coupled
3	CML-I	Tx2p	Tx2p	Transmitter Non_Inverted Date Input.AC coupled
4		GND	Signal Ground	Ground
5	CML-I	Tx4n	Tx4n	Transmitter Inverted Date Input.AC coupled
6	CML-I	Tx4p	Tx4p	Transmitter Non_Inverted Date Input.AC coupled
7		GND	Signal Ground	Ground
8	LVTTL-I	ModSelL	ModSelL	Module Select pin.Selected when held low by the host.
9	LVTTL-I	ResetL	LPMODE_Reset	Module Reset.A"low" pulse induces a reset on the module.
10		Vcc Rx	Vcc Rx	+3.3V Power Supply Receiver
11	LVC MOS-I/O	SCL	SCL	2-wire serial interface
12	LVC MOS-I/O	SDA	SDA	
13		GND	Signal Ground	Ground
14	CML-O	Rx3p	Rx3p	Receiver Non_Inverted Date Input.AC coupled
15	CML-O	Rx3n	Rx3n	Receiver Inverted Date Input.AC coupled
16		GND	Signal Ground	Ground
17	CML-O	Rx1p	Rx1p	Receiver Non_Inverted Date Input.AC coupled
18	CML-O	Rx1n	Rx1n	Receiver Inverted Date Input.AC coupled
19		GND	Signal Ground	Ground
20		GND	Signal Ground	Ground
21	CML-O	Rx2n	Rx2n	Receiver Inverted Date Input.AC coupled
22	CML-O	Rx2p	Rx2p	Receiver Non_Inverted Date Input.AC coupled
23		GND	Signal Ground	Ground
24	CML-O	Rx4n	Rx4n	Receiver Inverted Date Input.AC coupled
25	CML-O	Rx4p	Rx4p	Receiver Non_Inverted Date Input.AC coupled
26		GND	Signal Ground	Ground
27	LVTTL-O	ModPrsL	ModPrsL	Module Present pin.Internally grounded inside the module.
28	LVTTL-O	IntL	IntL	Interrupt by the QSFP module."Low"indicates an Alarm/Warning.
29		Vcc Tx	Vcc Tx	+3.3V Power Supply Transmitter

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30		Vccl	Vccl	+3.3V Power Supply
31	LVTTL-I	LPMode	LPMode	Low Power Mode
32		GND	Signal Ground	Ground
33	CML-I	Tx3p	Tx3p	Transmitter Non_Inverted Date Input.AC coupled
34	CML-I	Tx3n	Tx3n	Transmitter Inverted Date Input.AC coupled
35		GND	Signal Ground	Ground
36	CML-I	Tx1p	Tx1p	Transmitter Non_Inverted Date Input.AC coupled
37	CML-I	Tx1n	Tx1n	Transmitter Inverted Date Input.AC coupled
38		GND	Signal Ground	Ground
Housing			Chassis Ground	

5.8. Mechanical Specifications

Table.8 Mechanical Specifications

Parameter	Min	Max.	Unit	Notes
Cable bend radius(Installation)	30		mm	
Cable bend radius(Operating)	60			
QSFP module insertion		40	N	
QSFP module extraction		30	N	
Retention Load	100		N	No damage to module below 100N
Insertion/removal cycles	200		Cycles	Number of cycles for an individual module

5.9. Overview of Cable Assembly

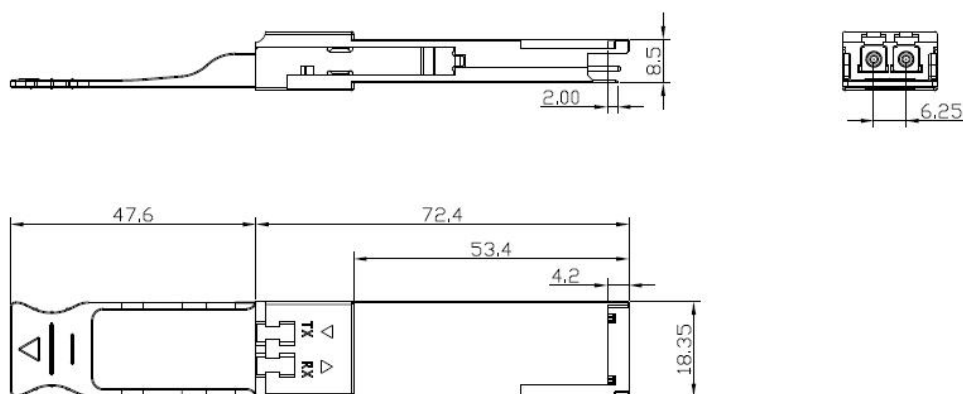


Figure 6: Overview of Cable Assembly

6. Application Cautions

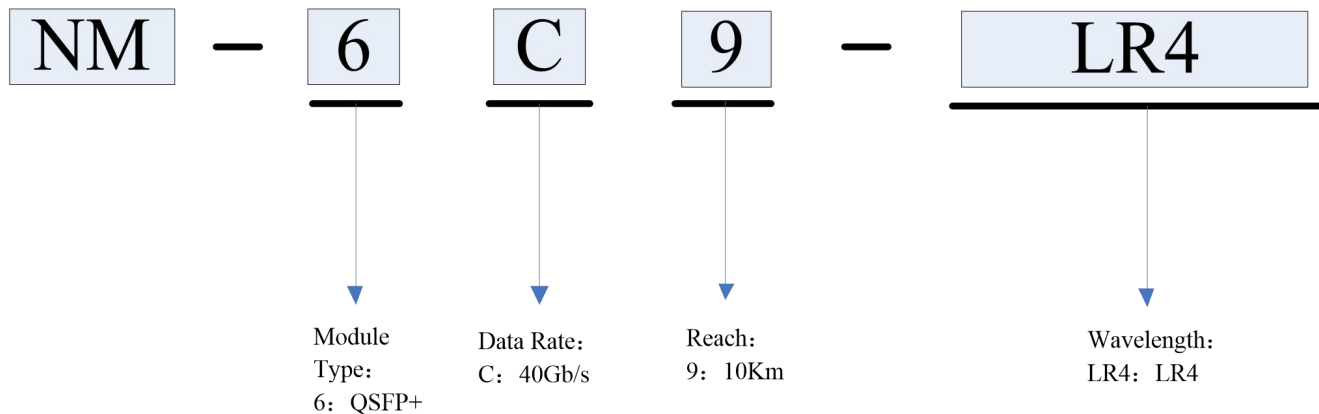
6.1. ESD

This transceiver is specified as ESD threshold 1kV for high speed pins and 2kV for all other electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

6.2. LASER SAFTY

This is a Class 1 Laser Product according to IEC 60825-1:1993:+A1:1997+A2:2001. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (July 26, 2001)

7. Order Information



Further Information

For further information, please contact NEME.

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