



## General Description

The 100G ER1-nWDM8-40 Optical Transceiver module is a optical transceiver module designed for 8 channel O-band WDM with 400GHz Channel spacing (nWDM) over 40km optical transmissions. The module converts 4x25Gb/s NRZ electrical input data to single channel optical signals for 100Gb/s optical transmission, Reverseely, on the receiver side, the module optically converts a 100Gb/s optical input data to 4x25Gb/s NRZ electrical output data.

The product central wavelengths is nWDM8, the optical interface of the module is a duplex LC and is compliant to the QSFP28 MSA, 100G Lambda MSA. It provides an excellent solution for 100G data transmission up to 40km single mode fiber.

## Applications

- 100G multi-wavelength WDM
- Transmission over 40km

## Features

- Hot-pluggable QSFP28 form factor
- Supports 106.25Gb/s(PAM4)
- High Sensitivity APD Receiver
- Operation case temperature -5°C to +80°C
- Single 3.3V power supply
- Aligned with IEEE 802.3bs and 100G Lambda MSA
- Duplex LC receptacles
- I2C management interface
- RoHS-6 compliant
- Compliant with QSFP28 MSA
- nWDM 8 Wavelengths

## Functional Description

**Electrical interface:** All signal interfaces are compliant with the QSFP28 MSA specifications. The high speed DATA interface is differential AC-coupled internally and can be directly connected to a 3.3V SERDES IC. Hardware control and status reporting pins include a 2-wire serial interface (SCL and SDA) and five 3.3V LVTTTL hardware signals (ModSelL, ResetL, LPMode, ModPrsL, and IntL). The 2-wire interface pins are 3.3V LVCOMS compatible. Hosts shall use pull-up resistor connected to Vcc\_host on each of the 2-wire interface SCL, SDA, and all low speed status outputs.

**ModSelL:** The ModSelL is an input pin. When held low by the host, the module responds to 2-wire serial communication commands. The ModSelL allows the use of multiple modules on a single 2-wire interface bus. When the ModSelL is "High", the module shall not respond to or acknowledge any 2-wire interface communication from the host. ModSelL signal input node shall be biased to the "High" state in the module.

In order to avoid conflicts, the host system shall not attempt 2-wire interface communications within the ModSelL de-assert time after any modules are deselected. Similarly, the host shall wait at least for the period of the ModSelL assert time before communicating with the newly selected module. The assertion and de-asserting periods of different modules may overlap as long as the above timing requirements are met.

**ResetL:** The ResetL pin shall be pulled to Vcc in the module. A low level on the ResetL pin for longer than the minimum pulse length (t\_Reset\_init) initiates a complete module reset, returning all user module settings to their default state. Module Reset Assert Time (t\_init) starts on the rising edge after the low level on the ResetL pin is released. During the execution of a reset (t\_init) the host shall disregard all status bits until the module indicates a completion of the reset interrupt. The module indicates this by asserting "low" an IntL signal with the Data\_Not\_Ready bit negated. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

**LPMode:** The LPMode pin shall be pulled up to Vcc in the module. The pin is a hardware control used to put modules into a low power mode when high. By using the LPMode pin and a combination of the Power\_override, and Power\_set software control bits (Address A0h, byte 93 bits 0,1), the host controls how much power a module can dissipate. The allowed QSFP28 power consumption is shown in below truth table.

**ModPrsL:** ModPrsL is pulled up to Vcc\_Host on the host board and grounded in the module. The ModPrsL is asserted "Low" when inserted and deasserted "High" when the module is physically absent from the host connector.

**IntL:** IntL is an output pin. When IntL is "Low", it indicates a possible module operational fault or a status critical to the host system. The host identifies the source of the interrupt using the 2wire serial interface. The IntL pin is an open collector output and shall be pulled to host supply voltage on the host board. The INTL pin is deasserted "High" after completion of reset, when byte 2 bit 0 (Data Not Ready) is read with a value of '0' and the flag field is read (see SFF-8636).

LPMODE PIN State	Power_override bit	Power_set bit	Power Allowed
1	0	X	1.5W
0	0	X	5.5W
X	1	1	1.5W
X	1	0	5.5W

## Ordering Information

Part Number	Product Description
QSFP-100G-O-40-xxx	100G QSFP28 DWDM O-Band ER1 -5°C to +80°C

## Transceiver Block Diagram

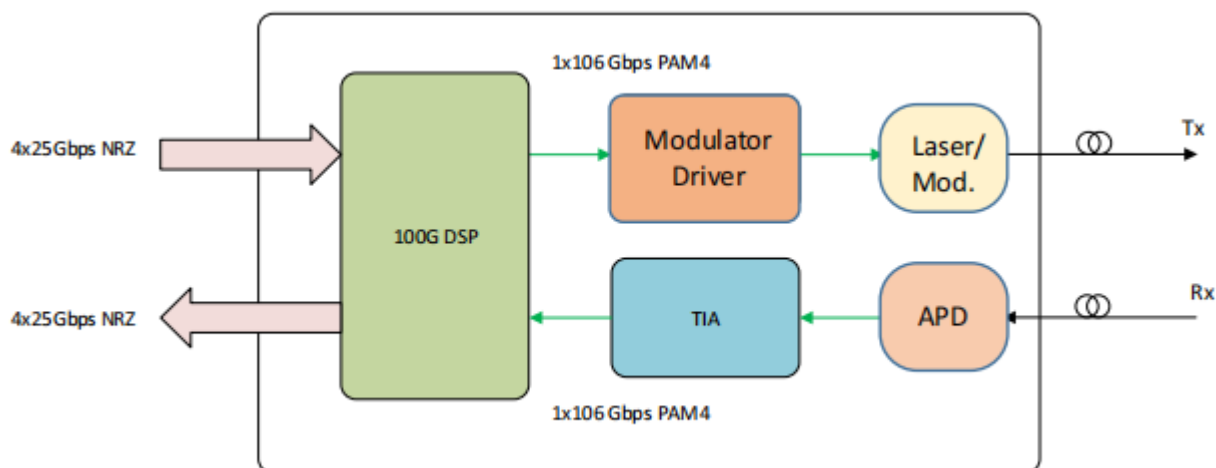


Figure 1. r Block Diagram

## Pin Assignment and Description

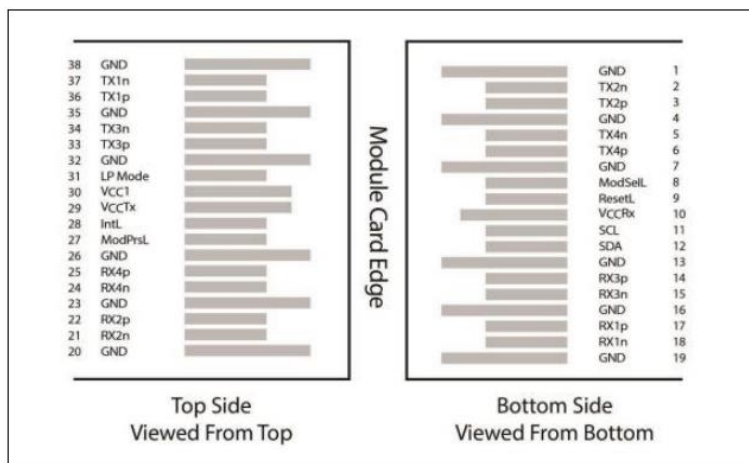


Figure 2. QSFP28 Connector Pad layout



## Module Connector Pad Definition

PIN	Logic	Symbol	Name/Description	Notes
1	GND	GND	Ground	
2	CML	Tx2n	Transmitter Inverted Data Input	
3	CML	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	GND	Ground	
5	CML	Tx4n	Transmitter Inverted Data Input	
6	CML	Tx4p	Transmitter Non-Inverted Data Input	
7	GND	GND	Ground	
8	LVTTL	ModSelL	Module Select	
9	LVTTL	ResetL	Module Reset	
10	VCC	VCC_Rx	+3.3V Receiver Power Supply	
11	LVC MOS	SCL	2-wire Serial Interface Clock	
12	LVC MOS	SDA	2-wire Serial Interface Data	
13	GND	GND	Ground	
14	CML	Rx3p	Receiver Non-Inverted Data Output	
15	CML	Rx3n	Receiver Inverted Data Output	
16	GND	GND	Ground	
17	CML	Rx1p	Receiver Non-Inverted Data Output	
18	CML	Rx1n	Receiver Inverted Data Output	
19	GND	GND	Ground	
20	GND	GND	Ground	
21	CML	Rx2n	Receiver Inverted Data Output	
22	CML	Rx2p	Receiver Non-Inverted Data Output	
23	GND	GND	Ground	
24	CML	Rx4n	Receiver Inverted Data Output	
25	CML	Rx4p	Receiver Non-Inverted Data Output	
26	GND	GND	Ground	
27	LVTTL	ModPrsL	Module Present, grounded inside the module	
28	LVTTL	IntL	Interrupt	
29	VCC	VCC_ Tx	+3.3V Transmitter Power Supply	
30	VCC	VCC1	+3.3V Power Supply	
31	LVTTL	LPMODE	Low Power Mode, active high	
32	GND	GND	Ground	
33	CML	Tx3p	Transmitter Non-Inverted Data Input	
34	CML	Tx3n	Transmitter Inverted Data Input	



35	GND	GND	Ground	
36	CML	Tx1p	Transmitter Non-Inverted Data Input	
37	CML	Tx1n	Transmitter Inverted Data Input	
38	GND	GND	Ground	

## solute Maximum Ratings

Parameter	Symbol	Min	Max	Units	Notes
Maximum Supply Voltage	VCC	0	0.36	V	
Storage Temperature	TS	-40	85	°C	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold	THd	-2.4		dBm	

## Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Units	Notes
Supply Voltage	VCC	3.135	3.3	3.465	V	
Supply Curren	ICC			1.8	A	
Power Consumption			4.7@-5°C 4.4@25°C 5.2@80°C	5.0@-5°C 4.8@25°C 5.5@80°C	W	
Operating Case Temperature	TOP	-5		80	°C	
Link Distance	D			20	km	

## Electrical Characteristic

Parameter	Test Point	Min	Typical	Max	Units	Notes
Transmitter (each Lane)						
Signaling rate	Rate	25.78125±100ppm			Gbps	
Differential Input Impedance	Zd	-	100	-	Ω	
Differential Input Voltage per lane	-	-	-	900	mV	
Input impedance mismatch	-	-	-	10	%	
Input High Voltage	VIH	2	-	Vcc+0.3	V	
Input LOW Voltage	VIL	-0.3	-	0.8	V	
Receiver (each Lane)						
Signaling rate	Rate	25.78125±100ppm			Gbps	



Common mode voltage	Vcm	-350	-	2850	mV	
Common Mode Noise, rms	-	-	-	17.5	mV	
Differential Termination Resistance Mismatch (at 1 MHz)	-	-	-	10	%	
Differential Return Loss (SDD22)	-	-	-	Per CEI- 28G-VSR	dB	
Common Mode to Differential conversion and Differential to Common Mode Conversion (SDC22,SCD22)	-	-	-	Per CEI- 28G-VSR	dB	
Common Mode Return Loss(SCC22)-from 250 MHz to 30 GHz	-	-	-	-2	-	
Transition Time: 20/80%	-	9.5	-	-	ps	
Vertical Eye Closure	VEC	-	-	6.5	dB	
Eye width at 10- 15probability	EW15	0.57	-	-	UI	
Eye height at 10-15probability	EH15	228	-	-	mV	

## Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Units	Notes
Transmitter						
Data Rate (each Lane)		53.125 ± 100 ppm			GBd	
Modulation Format		PAM4				
Wavelength	DO-8040C-EN1	1311.03	1311.43	1311.83	nm	
	DO-7040C-EN1	1308.74	1309.14	1309.54	nm	
	DO-6040C-EN1	1306.45	1306.85	1307.25	nm	
	DO-5040C-EN1	1304.18	1304.58	1304.98	nm	
	DO-4040C-EN1	1301.91	1302.31	1302.71	nm	
	DO-3040C-EN11	1299.65	1300.05	1300.45	nm	
	DO-2040C-EN1	1297.40	1297.80	1298.20	nm	



	DO-1040C-EN1	1295.16	1295.56	1295.96	nm	
Side-mode Suppression ratio	SMSR	30			dB	
Average launch power <sup>1</sup>	PAVG	1.7		7.1	dBm	
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) TDECQ<1.4dB TDECQ>1.4dB	POMA	3.5 2.1+TDECQ		7.9	dBm	
Transmitter and Dispersion penalty <sup>2</sup>	TDECQ			3.9	dB	
TECQ	TECQ			3.9	dB	
TDECQ-TECQ  (max)				2.7	dB	
Extinction Ratio		5.0			dB	
Optical Return Loss Tolerance				15.6	dB	
Transmitter Reflectance <sup>3</sup>	RL			-26	dB	
Average Launch Power OFF Transmitter	Poff			- 15	dBm	
RIN15.6 OMA	RIN			- 136	dB/Hz	
<b>Receiver</b>						
Data Rate (each Lane)		53.125 ± 100 ppm			GBd	
Modulation Format		PAM4				
Lane Wavelength	$\lambda$	1295.04~1311.96			nm	
Damage Threshold <sup>4</sup>		-2.4			dBm	
Average receive power <sup>5</sup>		-15.7		-3	dBm	
Receive Power(OMA <sub>outer</sub> )				-2.6	dBm	
Receiver Reflectance				-26	dB	
Receiver sensitivity(OMA <sub>outer</sub> )				Max(-13.5, TECQ-14.9)	dBm	
Stressed receiver sensitivity (OMA <sub>outer</sub> ), each laned (max) <sup>6</sup>	SRS			- 11.3	dBm	
Transmitter Reflectance				-26	dB	
LOS Assert	LOSA	-30		- 19.5	dBm	
LOS De-assert	LOSD			- 16.5	dBm	
LOS Hysteresis	LOSH	0.5			dB	
<b>Conditions of Stress Receiver Sensitivity Test</b>						
Stressed Eye Closure for PAM4(SECQ), lane under test				3.9	dB	

Notes:

1. Average launch power, each lane min is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance .

1. Average launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be



- compliant; however, a value above this does not ensure compliance.
- 2. TDECQ test based on 20km fiber.
  - 3. Transmitter Reflectance is defined looking into the transmitter.
  - 4. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane.
  - 5. Average receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
  - 6. Measured with conformance test signal at TP3 for the BER specified in IEEE Std 802.3cd.

Overview Interacing The Transceiver

Host can determine the characteristic and status of the transceiver through a 2-wire common management interface. The interface also provides host a mechanism to control the operation of a module. SFF-8636 describes the interface details such as memory map and communication protocol used to transfer information between host and a module.

The common memory map is arranged into a single lower page address space (A0h) of 128 bytes and multiple upper address pages. This structure permits timely access to addresses in the lower page such as interrupt flags and monitors. Less time critical entries such as serial ID information and threshold settings are available with the page select function.

Lower Memory Overview

Address	Size	Subject Area	Description
0 - 3	4	ID and Status Area	Module ID from SFF-8024 list, version number, Type and status
			Flat mem indication, CLEI present indicator, Maximum TWI speed, Current state of Module, Current state of the Interrupt signal
4 - 7	4	Lane Flag Summary	Flag summary of all lane flags on pages 10h-1Fh
8 - 13	6	Module-Level Flags	All flags that are not lane or data path specific
14-25	12	Module-Level Monitors	Monitors that are not lane or data path specific
26-30	5	Module Global Controls	Controls applicable to the module as a whole
31-36	6	Module-Level Flag Masks	Masking bits for the Module-Level flags
37-38	2	CDB Status Area	Status of most recent CDB command
39-40	2	Module Firmware Version	Module Firmware Version.
41-63	23	Reserved Area	Reserved for future standardization

64-82	19	Custom Area	Vendor or module type specific use
83-84	2	Inactive Firmware Version	Version Number of Inactive Firmware.Values of 00h indicates module supports only a single image.
85- 117	33	Application Advertising	Combinations of host and media interfaces that are supported by module data path(s)
118-125	8	Password Entry and Change	
126	1	Bank Select Byte	Bank address of currently visible Page
127	1	Page Select Byte	Page address of currently visible Page

## Digital Diagnostic Functions

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

Parameter	Symbol	Min	Max	Units	Notes
Temperature Monitor Absolute Error	DMI_Temp	-3	3	degC	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	-3	3	dB	1
Channel Bias current monitor	DMI_Ibias_Ch	- 10%	10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-3	3	dB	1

Notes:

1. Due to measurement accuracy of different single mode fibers, there could be an additional +/- 1 dB fluctuation, or a +/- 3 dB total accuracy.

## Mechanical Dimensions

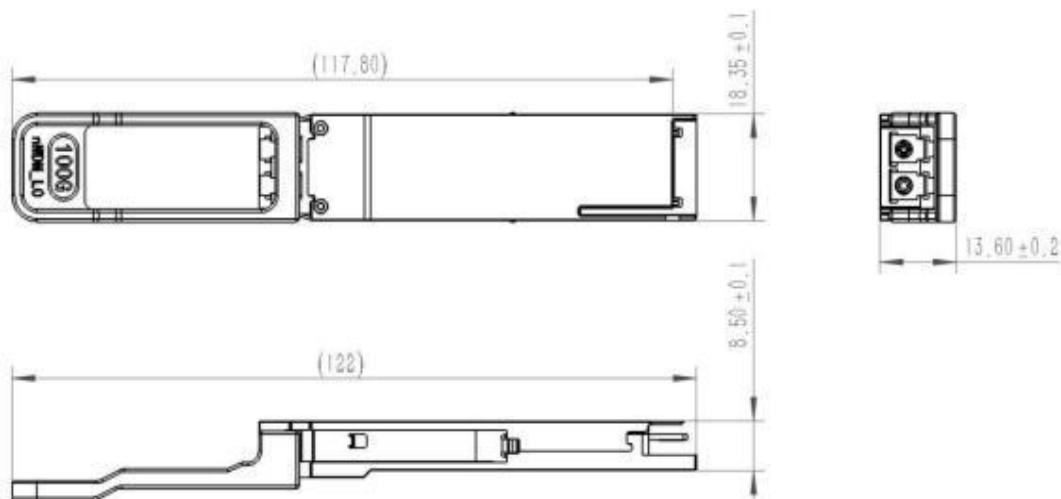


Figure 3. Mechanical Outline



**ESD**

This transceiver is specified as ESD threshold 1kV for high speed data 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.

**Laser Safety**

This is a Class 1 Laser Product according to EN 60825- 1:2014. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007). Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure .