Features:

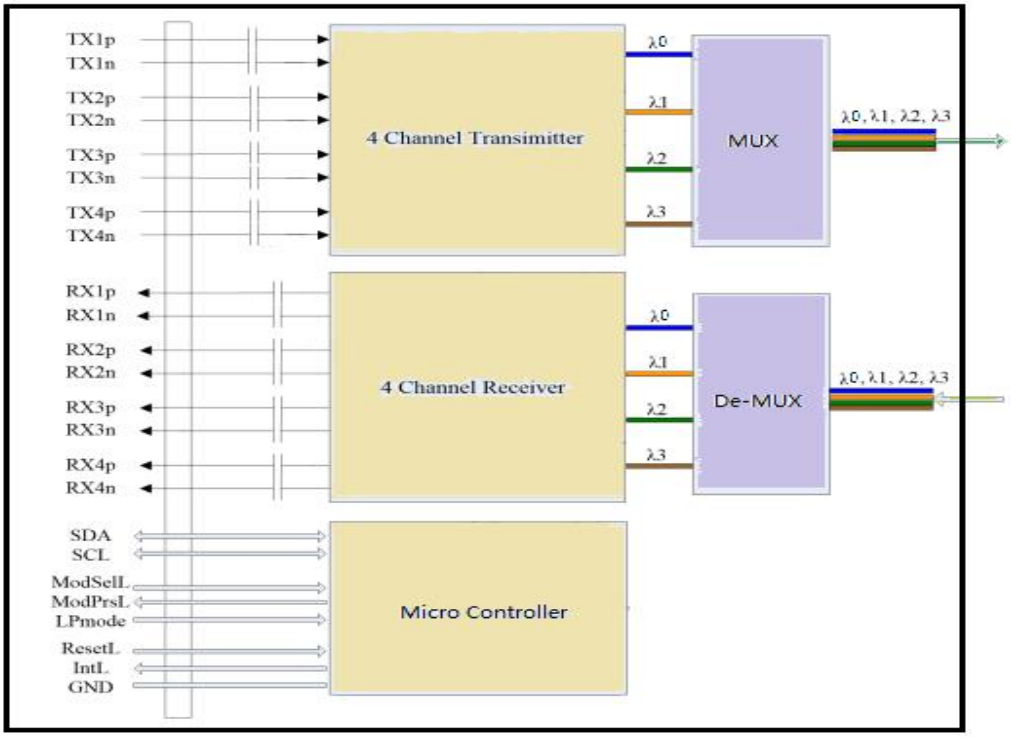
- Supports 41.2Gbps aggregate bit rates
- Uncooled 4x10.3Gbps CWDM transmitter
- High-sensitivity PIN-TIA receiver
- Up to 2km on SMF
- Duplex LC receptacles
- Hot pluggable QSFP+ form factor
- Power dissipation < 3.5W
- All-metal housing for superior EMI performance
- RoHS6 compliant (lead free)
- Operating case temperature:
- Commercial: 0ºC to +70°C

Applications:

- 40GBASE-LR4
- InfiniBand QDR and DDR interconnects
- 40G Telecom connections

Specification:

- **Module Block Diagram**



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Optical Characteristics

Parameter	Symbol	Min.	Typical	Max.	Unit	Note
Transmitter Section						
Lane Centre Wavelength (range)	λ_0	1264.5	1271	1277.5	nm	
	λ_1	1284.5	1291	1297.5	nm	
	λ_2	1304.5	1311	1317.5	nm	
	λ_3	1324.5	1331	1337.5	nm	
Spectral Width (-20dB)	$\Delta\lambda$			1	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Average Optical Power per Lane	P_{out}	-5.0		+2.3	dBm	1
OMA Power per Lane	OMA	-4		3.5	dBm	1
Laser Off Power per Lane	P_{off}	-	-	-30	dBm	
Extinction Ratio	ER	3.5	-	-	dB	2
Relative Intensity Noise	RIN	-	-	-128	dB/Hz	
Optical Return Loss Tolerance		-	-	20	dB	
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	Compliant with IEEE802.3ba {0.25, 0.4, 0.45, 0.25, 0.28, 0.4}					2
Receiver Section						
Lane Center Wavelength (range)	λ_0	1264.5		1277.5	nm	
	λ_1	1284.5		1297.5	nm	
	λ_2	1304.5		1317.5	nm	
	λ_3	1324.5		1337.5	nm	
Average Receiver Power per Lane	RXP_X	-13.7		2.3	dBm	3
OMA Sensitivity per Lane	RX_{sens}			-11.5	dBm	3
Los Assert	LOS_A	-30	-	-	dBm	
Los Dessert	LOS_D	-	-	-16	dBm	
Los Hysteresis	LOS_H	0.5	-	5	dB	
Overload per Lane	P_{in-max}	-	-	2.3	dBm	3
Receiver Reflectance		-	-	-12	dB	
Damage Threshold per Lane		-	-	3.5	dBm	

Notes:

1. The optical power is launched into 9/125μm SMF.
2. Measured with a PRBS 2^{31}-1 test pattern @10.3125Gbps.
3. Measured with a PRBS 2^{31}-1 test pattern @10.3125Gbps, ER=4dB, BER <10^{-12}.

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Electrical Characteristics

Parameter	Symbol	Min.	Typical	Max.	Unit	Note
Transmitter Section						
Input Differential Impedance	R_{in}	90	100	110	Ω	
Differential Data Input Swing	$V_{in\ PP}$	180		1000	mV	1
Receiver Section						
Differential Data Output Swing	$V_{out\ PP}$	300		850	mV	

Notes:

1. Connected directly to TX data input pins. AC coupling from pins into laser driver IC.

Absolute Maximum Ratings: (T_C=25℃)

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T_{ST}	-40	+85	℃
Operating Temperature	T_{IP}	0(-40)	+70(+85)	℃
Input Voltage	T_{CC}	0	+5	V

Recommended Operating Environment:

Parameter	Symbol	Min.	Typical	Max.	Unit
Supply Voltage	V_{CC}	+3.0	+3.3	+3.6	V
Operating Temperature	T_{OP}	0	-	+70	℃
Power Supply Voltage	V_{CC}	3.13	3.3	3.46	V
Power Supply Current	I_{CC}		500	1000	mA
Power Dissipation	P_D			3.5	W
Operating Case Temperature	T_C	0		+70	℃
Aggregate Data Rate	-		41.25		Gbps
Bit Rate per Lane	BR		10.3125		Gbps

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Timing Characteristics:

Parameter	Symbol	Min.	Typical	Max.	Unit
TX_DISABLE Assert Time	t_off		3	10	usec
TX_DISABLE Negate Time	t_on		0.5	1	msec
Time to Initialize Include Reset of TX_FAULT	t_int		30	300	msec
TX_FAULT from Fault to Assertion	t_fault		20	100	usec
TX_DISBEL Time to Start Reset	t_reset	10			usec
Receiver Loss of Signal Assert Time (Off to On)	T_A,RX_LOS			100	usec
Receiver Loss of Signal Assert Time (On to Off)	T_d,RX_LOS			100	usec

Serial ID Memory Contents:

Data Address	Length (Byte)	Name of Length	Description and Contents
Base ID Fields			
0	1	Identifier	Type of Serial transceiver (03h=SFP28)
1	1	Reserved	Extended identifier of type serial transceiver (04h)
2	1	Connector	Code of optical connector type (07=LC)
3-10	8	Transceiver	Gigabit Ethernet 1000Base-SX & Fiber Channel
11	1	Encoding	8B10B (01h)
12	1	BR,Nominal	Nominal baud rate, unit of 100Mbps
13-14	2	Reserved	(0000h)
15	1	Length(9um)	Link length supported for 9/125um fiber, units of 100m
16	1	Length(50um)	Link length supported for 50/125um fiber, units of 10m
17	1	Length(62.5um)	Link length supported for 62.5/125um fiber, units of 10m
18	1	Length(Copper)	Link length supported for copper, units of meters
19	1	Reserved	
20-35	16	Vendor Name	SFP28 vendor name
36	1	Reserved	
37-39	3	Vendor OUI	SFP28 transceiver vendor OUI ID
40-55	16	Vendor PN	Part Number
56-59	4	Vendor rev	Revision level for part number
60-62	3	Reserved	
63	1	CCID	Least significant byte of sum of data in address 0-62
Extended ID Fields			
64-65	2	Option	Indicates which optical SFP28 signals are implemented (001Ah = LOS, TX_FAULT, TX_DISABLE all supported)
66	1	BR, max	Upper bit rate margin, units of %

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67	1	BR, min	Lower bit rate margin, units of %
68-83	16	Vendor SN	Serial number (ASCII)
84-91	8	Date code	Manufacturing date code
92-94	3	Reserved	
95	1	CCEX	Check code for the extended ID Fields (addresses 64 to 94)
Vendor Specific ID Fields			
96-127	32	Readable	specific date, read only

● Digital Diagnostic Monitoring Functions

2-wire serial bus address 1010001X (A2h) is used to access measurement of transceiver temperature, internally measured supply voltage, TX bias current, TX optical output power and RX optical input power which are shown in table 1. Each diagnostic parameter has a corresponding high alarm, low alarm, high warning and low warning threshold which are shown in table 2.

Table 1. Diagnostic Parameters

Diagnostic Parameter	Range		LSB	Accuracy	Address	Note
	Min	Max				
Transceiver Temperature (Temp)	-50[℃]	+80[℃]	1/256[℃]	±3[℃]	96-97	A 16bit signed two's complement value
Supply Voltage (Voltage)	+3.0[V]	+3.6[V]	100[μV]	±3[%]	98-99	A 16bit unsigned integer
TX Bias Current (Bias)	3[mA]	95[mA]	2.0[μA]	±10[%]	100-101	A 16bit unsigned integer
TX Optical Output Power (TX Power)	-5[dBm]	+2.3[dBm]	0.1[μW]	±3 [dB]	102-103	A 16bit unsigned integer
RX Optical Input Power (RX Power)	-11.5[dBm]	+0[dBm]	0.1[μW]	±3 [dB]	104-105	A 16bit unsigned integer

Table 2. Alarm and Warning Thresholds

Parameter	Warning		Alarm		Unit
	Low	High	Low	High	
Transceiver Temperature (Temp)	-10	+80	-20	+90	℃
Supply Voltage (Voltage)	+3.13	+3.47	+3.0	+3.6	V
TX Bias Current (Bias)	5	85	3	95	mA
TX Optical Output Power (TX Power)	-5	+2.3	-6	+3.3	dBm
RX Optical Input Power (RX Power)	-10.5	+1	-11.5	+2	dBm

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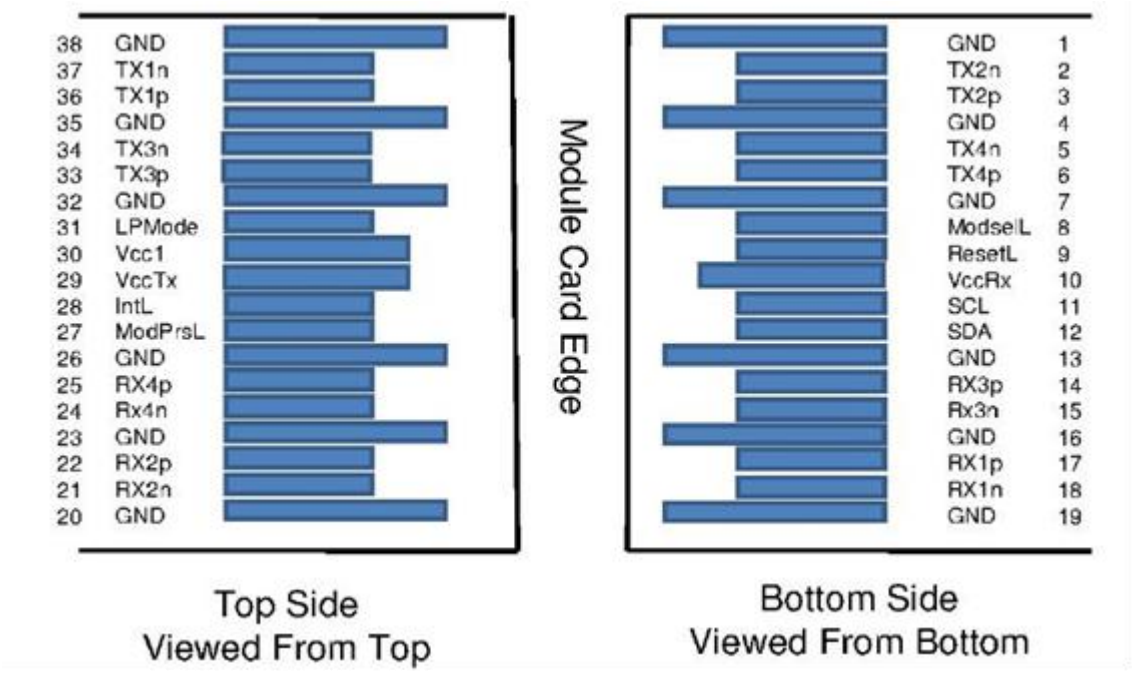
Pin Assignment



- **Pin Description:**

Pin	Symbol	Description	Plug Seq.	Notes
1	Ground	Ground	1	1
2	Tx2n	Transmitter Inverted Data Input	3	
3	Tx2p	Transmitter Non-Inverted Data Input	3	
4	Ground	Ground	1	1
5	Tx4n	Transmitter Inverted Data Input	3	
6	Tx4p	Transmitter Non-Inverted Data Input	3	
7	Ground	Ground	1	1
8	ModSelL	Module Select	3	
9	ResetL	Module Reset	3	
10	VccRx	+3.3 V Power supply receiver	2	2
11	SCL	2-wire serial interface clock	3	
12	SDA	2-wire serial interface data	3	
13	Ground	Ground	1	1
14	Rx3p	Transmitter Non-Inverted Data Input	3	
15	Rx3n	Transmitter Inverted Data Input	3	
16	Ground	Ground	1	1
17	Rx1p	Transmitter Non-Inverted Data Input	3	

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18	Rx1n	Transmitter Inverted Data Input	3	
19	Ground	Ground	1	1
20	Ground	Ground	1	1
21	Rx2n	Transmitter Inverted Data Input	3	
22	Rx2p	Transmitter Non-Inverted Data Input	3	
23	Ground	Ground	1	1
24	Rx4n	Transmitter Inverted Data Input	3	
25	Rx4p	Transmitter Non-Inverted Data Input	3	
26	Ground	Ground	1	1
27	ModPrsL	Module Present	3	
28	IntL	Interrupt	3	
29	VccTx	+3.3 V Power supply transmitter	2	2
30	Vcc1	+3.3 V Power Supply	2	2
31	LPMode	Low Power Mode	3	
32	Ground	Ground	1	1
33	Tx3p	Transmitter Non-Inverted Data Input	3	
34	Tx3n	Transmitter Inverted Data Input	3	
35	Ground	Ground	1	1
36	Tx1p	Transmitter Non-Inverted Data Input	3	
37	Tx1n	Transmitter Inverted Data Input	3	
38	Ground	Ground	1	1

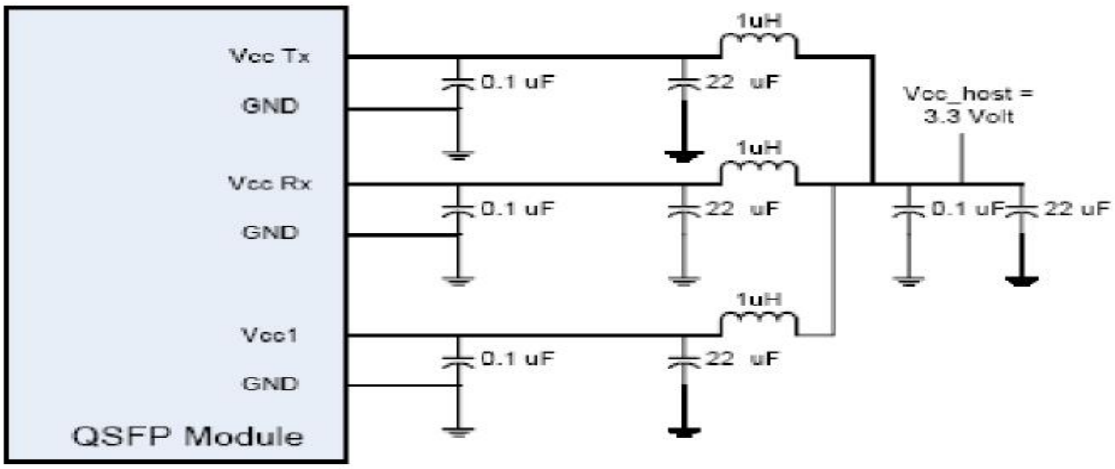
Notes:

Plug Seq.: Pin engagement sequence during hot plugging.

1. Module ground pins GND are isolated from the module case.

2. VccRx, Vcc1 and VccTx are the receiver and transmitter power supplies and shall be applied concurrently.

● Recommended Power Interface Circuit



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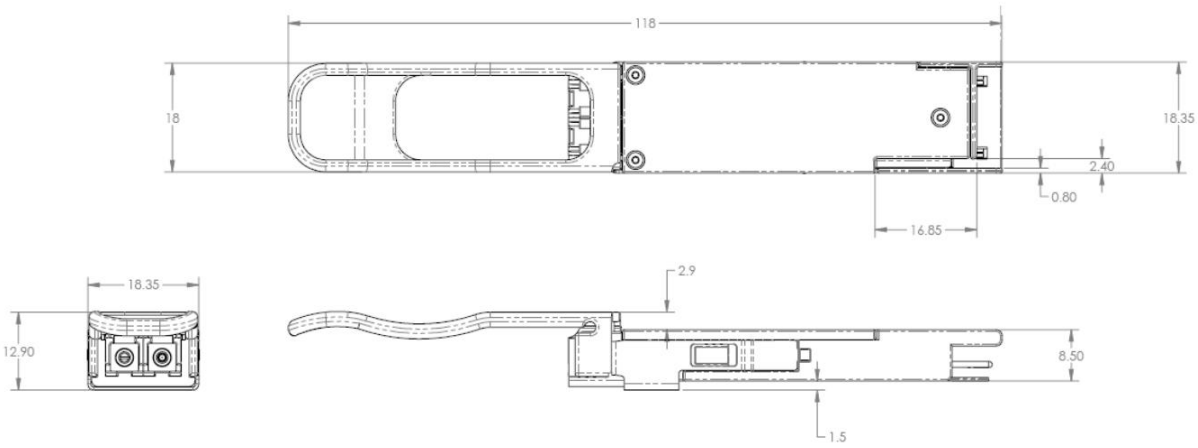
- **Ordering information:**

Part Number	Package	Rate	Fiber type	Distance	Wavelength (nm)	Temperature (℃)
TM-OFFAx -233E	SFP28	40Gbps	SMF	2km	1310	0/+70

- **Mechanical Dimensions:**



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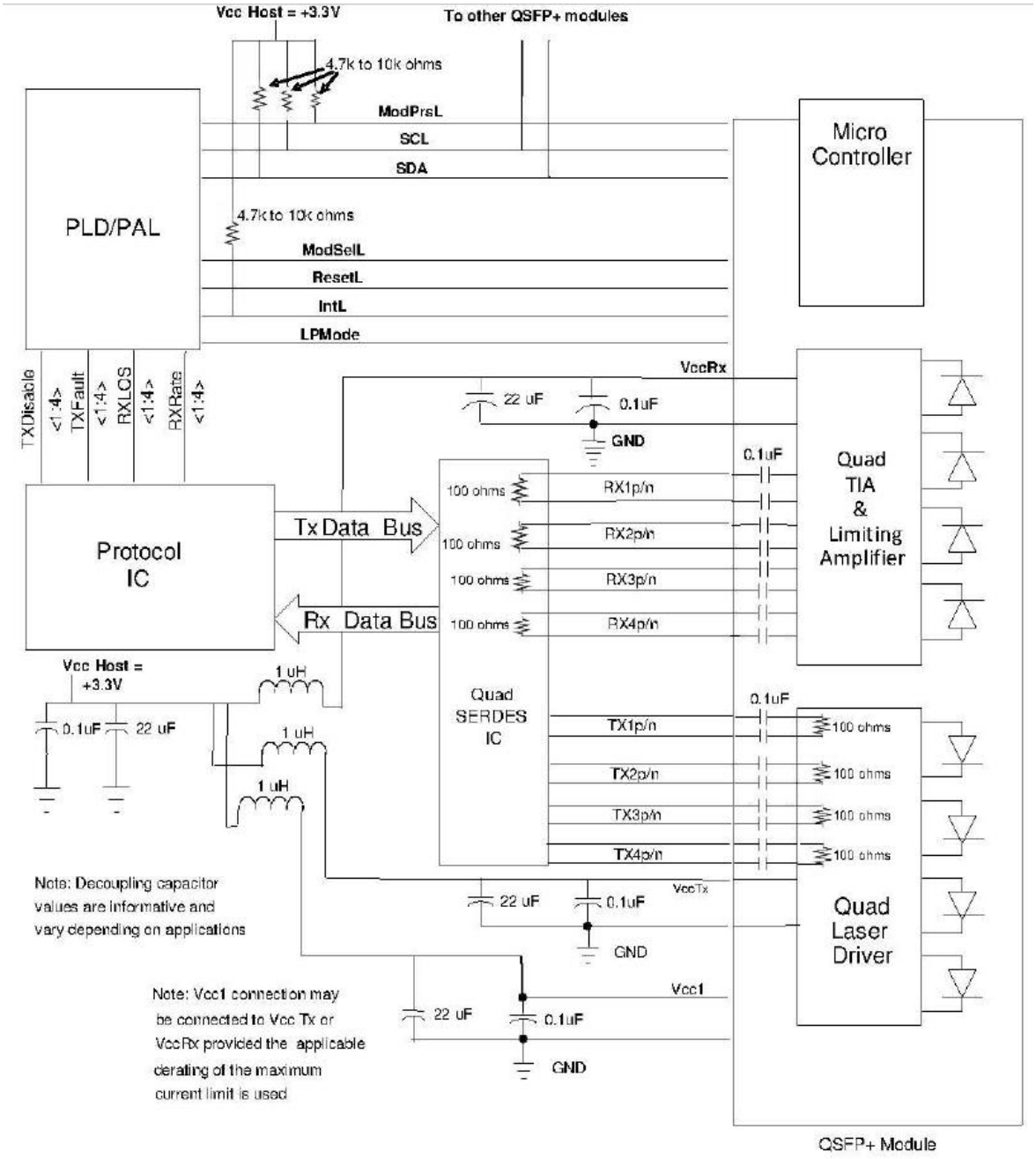
- **Recommended Interface Circuit**



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