

MULTI-RATE GIGABIT ETHERNET & FIBER CHANNEL SFP CWDM TRANSCEIVERS WITH DIGITAL DIAGNOSTICS

TRPUG1KxXx000x0G



Product Description

The TRPUG1KxXx000x0G SFP with integrated digital diagnostics monitoring functionality provide a quick and reliable interface for Gigabit Ethernet and 1.062GBd Fibre Channel applications. The transceivers are designed to support data rates ranging from 1.25Gb/s down to 125Mb/s.

All modules satisfy Class 1 Laser Safety requirements in accordance with the US FDA/CDRH and international IEC-60825 standards. The transceivers are compliant with the SFP Multi-Source Agreement (MSA).

The TRPUG1KxXx000x0G CWDM transceivers connect to standard 20-pad SFP connectors for hot plug capability. This allows the system designer to make configuration changes or maintenance by simply plugging in different types of transceivers without removing the power supply from the host system.

The transceivers have colored bail-type latches, which offer an easy and convenient way to release the modules. The latch is compliant with the SFP MSA.

The transmitter and receiver DATA interfaces are AC coupled internally. LV-TTL Transmitter Disable control input and Loss of Signal output interfaces are also provided.

The transceivers operate from a single +3.3V power supply over operating case temperature ranges of -5°C to +70°C (Commercial), -5°C to +85°C (Extended) or -40°C to +85°C (Industrial). The housing is made of metal for EMI immunity.



Features

- Eighteen (18) Wavelength CWDM Transceivers
- Industrial Operating Temperature Range
- Compatible with SFP MSA
- Compatible with IEEE 802.3z Gigabit Ethernet 100BASE-LX PMD Specifications
- Compatible with 1.062GBd Fiber Channel 100-SM-LC-L FC-PI Standards
- Support 80km and 120km
- Digital Diagnostics through Serial Interface
- Internal Calibration for Digital Diagnostics
- Eye Safe (Class 1 Laser Safety)
- RoHS6 Compliant
- Duplex LC Optical Interface
- Loss of Signal Outputs & TX Disable Input
- Hot-pluggable
- Single +3.3V Power Supply

Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Storage Temperature Range	T_{ST}	- 40	+ 85	°C
Operating Case Temperature ¹	Commercial	- 5	+ 70	°C
	Extended	- 5	+ 85	
	Industrial	- 40	+ 85	
Supply Voltage	V_{CC}	0	+ 4.5	V
Input Voltage	V_{IN}	0	V_{CC}	V

¹ Measured on top side of SFP module at the front center vent hole of the cage.

² -40°C to 0°C is ambient, and 0°C to +85°C is case temperature. For case temperature, measured on top side of SFP module at the front center vent hole of the cage.

Transmitter Performance Characteristics (Over Operating Case Temperature. $V_{CC} = 3.13$ to $3.47V$)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Operating Data Rate		B	125	-	1250	Mb/s
Optical Output Power ¹	ZX	P_o	0	-	+ 5.0	dBm
	VX		0	-	+ 5.0	
Center Wavelength		λ_c	See Ordering Information table			nm
Wavelength Deviation		$\Delta\lambda_c$	$\lambda_c - 6.5$	λ_c	$\lambda_c + 6.5$	nm
Spectral Width (-20dB)		$\Delta\lambda_{20}$	-	-	1.0	nm
Side Mode Suppression Ratio		$SMSR$	30	-	-	dB
Extinction Ratio		ER	9	-	-	dB
Deterministic Jitter		DJ	-	-	80	ps
Total Jitter		TJ	-	-	227	ps
Optical Rise/Fall Time (20% to 80%)		tr, tf	-	-	0.32	ns
Relative Intensity Noise		RIN	-	-	- 120	dB/Hz
Dispersion Penalty ²		DP	-	-	1.5	dB
Transmitter Output Eye		<i>Compliant with Eye Mask Defined in IEEE 802.3z Standard</i>				

¹ Measured average power coupled into single mode fiber.
² Specified at 1540ps/nm (ZX) and 2600ps/nm (VX) dispersion, which corresponds to the approximate worst-case dispersion for 80km and 120km G.652 fiber over the wavelength range of 1264.5 to 1617.5nm

Receiver Performance Characteristics (Over Operating Case Temperature. $V_{CC} = 3.13$ to $3.47V$)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Operating Data Rate ¹		B	125	-	1250	Mb/s
Receiver Sensitivity (10^{-10} BER) ¹	ZX	P_{min}	-	-	- 24.0	dBm
	VX		-	-	- 32.0	
Maximum Input Optical Power (10^{-10} BER) ¹	ZX	P_{max}	- 3.0	-	-	dBm
	VX		- 10.0	-	-	
LOS Thresholds	Increasing Light Input	ZX	-	-	- 24.0	dBm
		VX	-	-	- 32.0	
	Decreasing Light Input	ZX	- 35.0	-	-	
		VX	- 45.0	-	-	
LOS Timing Delay	Increasing Light Input	t_{loss_off}	-	-	100	μs
	Decreasing Light Input	t_{loss_on}	-	-	100	
LOS Hysteresis		-	0.5	-	-	dB
Deterministic Jitter		DJ	-	-	170	ps
Total Jitter		TJ	-	-	266	ps
Wavelength of Operation		λ	1260	-	1620	nm
Optical Return Loss		ORL	12	-	-	dB

¹ When measured with 2⁷-1 PRBS at 125Mb/s, 1062.5Mb/s and 1250Mb/s.

Laser Safety:

All transceivers are Class 1 Laser products per FDA/CDRH and IEC-60825 standards. They must be operated under specified operating conditions.

**Oplink Communications, LLC.**

This product complies with
21 CFR 1040.10 and 1040.11
Meets Class 1 Laser Safety Requirements

Transmitter Electrical Characteristics (Over Operating Case Temperature. $V_{CC} = 3.13$ to $3.47V$)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Input Voltage Swing (TD+ & TD-) ¹	$V_{PP-DIFF}$	0.5	-	2.4	V
Input HIGH Voltage (TX Disable) ²	V_{IH}	2.0	-	V_{CC}	V
Input LOW Voltage (TX Disable) ²	V_{IL}	0	-	0.8	V
Output HIGH Voltage (TX Disable) ³	V_{OH}	2.0	-	$V_{CC} + 0.3$	V
Output LOW Voltage (TX Disable) ³	V_{OL}	0	-	0.8	V

¹Differential peak-to-peak voltage.

²There is an internal 4.7 to 10kΩ pull-up resistor to V_{CC} .

³Open collector compatible, 4.7 to 10 kΩ pull-up resistor to V_{CC} (Host Supply Voltage)

Receiver Electrical Characteristics (Over Operating Case Temperature. $V_{CC} = 3.13$ to $3.47V$)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Output Voltage Swing (RD+ & RD-) ¹	$V_{PP-DIFF}$	0.6	-	2.0	V
Output HIGH Voltage (LOS) ²	V_{OH}	2.0	-	$V_{CC} + 0.3$	V
Output LOW Voltage (LOS) ²	V_{OL}	0	-	0.5	V

¹Differential peak-to-peak voltage across external 100Ω load.

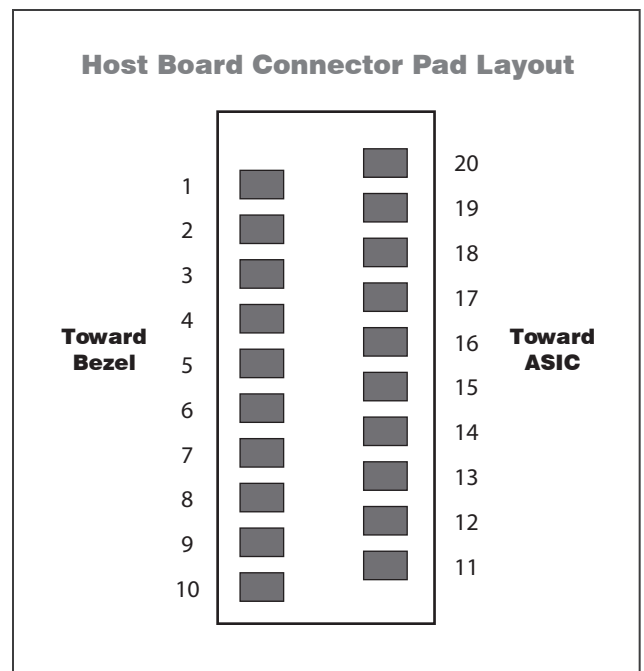
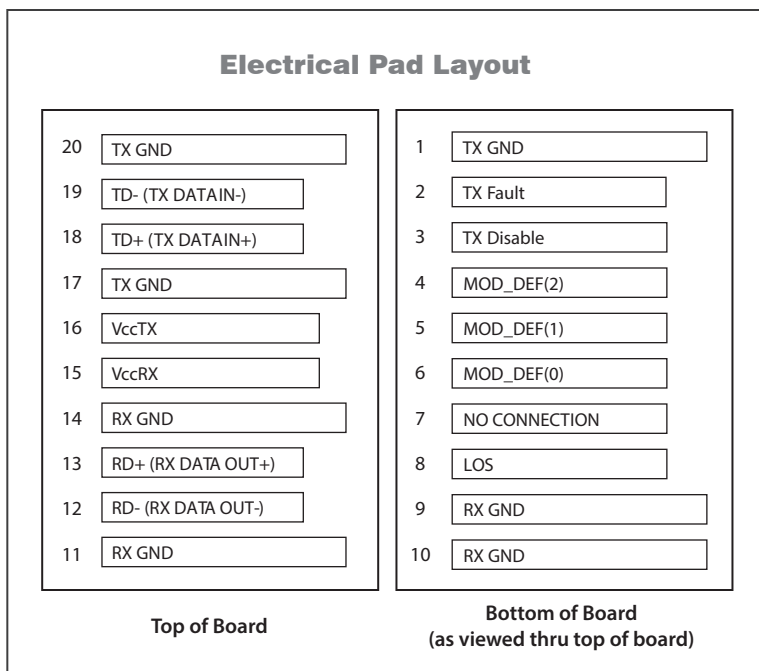
²Open collector compatible, 4.7 to 10kΩ pull-up resistor to V_{CC} (Host Supply Voltage).

Electrical Power Supply Characteristics (Over Operating Case Temperature. $V_{CC} = 3.13$ to $3.47V$)

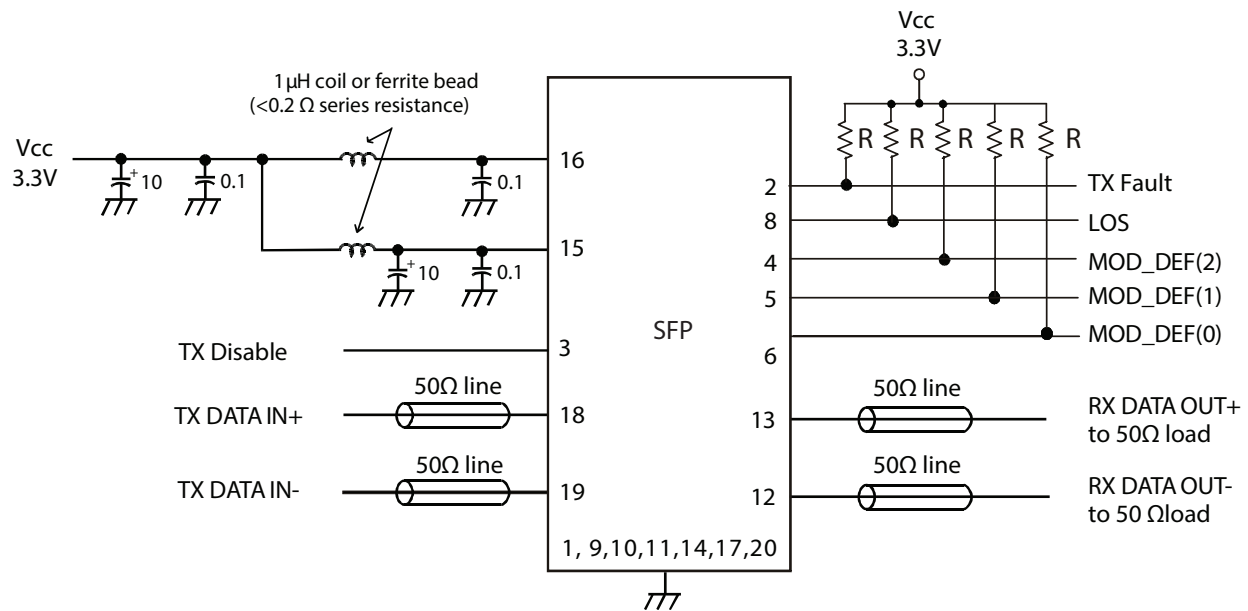
Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	V_{CC}	3.13	3.3	3.47	V
Power Dissipation	C-temp/E-temp	-	-	1	W
	I-temp	-	-	1.5	

Module Definition

MOD_DEF(0) pin 6	MOD_DEF(1) pin 5	MOD_DEF(2) pin 4	Interpretation by Host
TTL LOW	SCL	SDA	Serial module definition protocol



Example of SFP host board schematic



R: 4.7 to 10kΩ
CAP Values in μF

Application Notes

Electrical interface: All signal interfaces are compliant with the SFP MSA specification. The high speed DATA interface is differential AC-coupled internally with 1 μF and can be directly connected to a 3.3V SERDES IC. All low speed control and sense output signals are open collector TTL compatible and should be pulled up with a 4.7 - 10kΩ resistor on the host board.

Loss of Signal (LOS): The Loss of Signal circuit monitors the level of the incoming optical signal and generates a logic HIGH when an insufficient photocurrent is produced.

TX_Fault: The output indicates LOW when the transmitter is operating normally and HIGH with a laser fault including laser end-of-life. TX Fault is an open collector/drain output and should be pulled up with a 4.7 - 10kΩ resistor on the host board. TX Fault is latched per SFP MSA.

TX_Disable: When the TX Disable pin is at logic HIGH, the transmitter optical output is disabled.

Serial Identification and Monitoring: The SFP module definition is indicated by the three module definition pins, MOD_DEF(0), MOD_DEF(1) and MOD_DEF(2). Upon power up, MOD_DEF(1:2) appear as NC (no connection), and

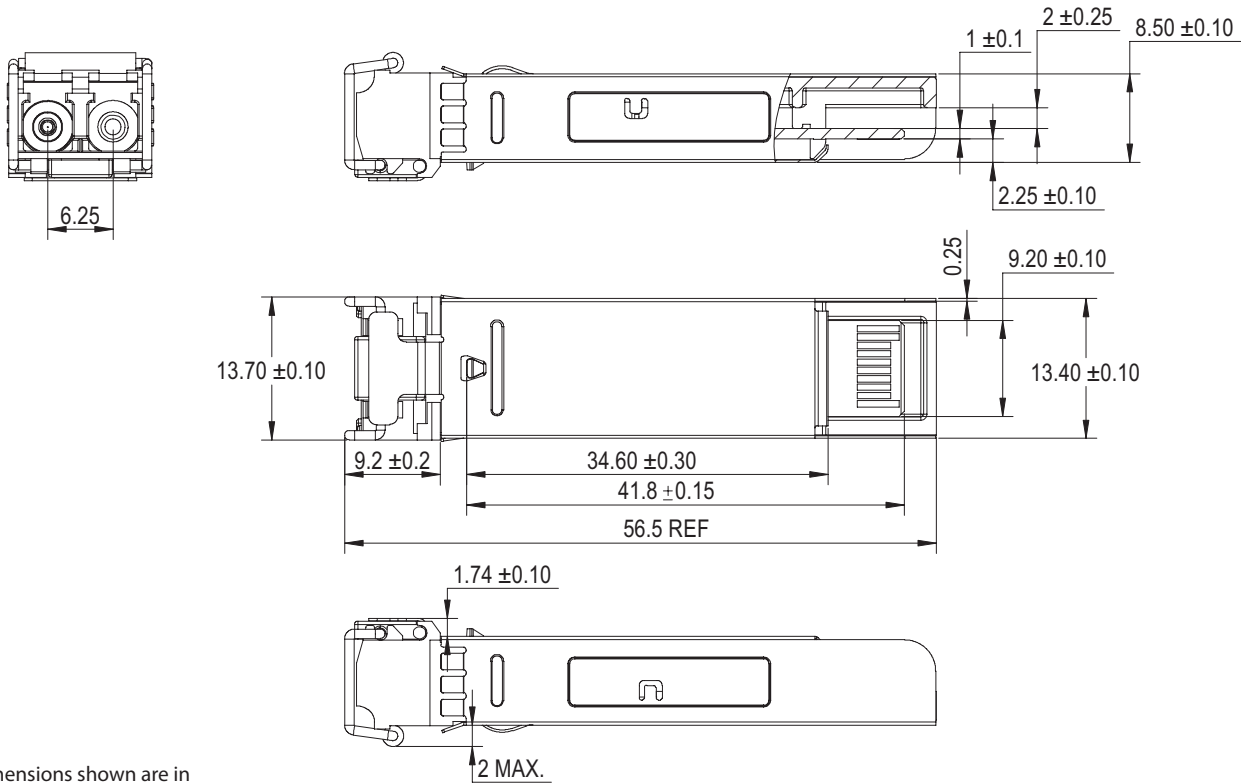
MOD_DEF(0) is TTL LOW. When the host system detects this condition, it activates the serial protocol (standard two-wire I²C serial interface) and generates the serial clock signal (SCL). The positive edge clocks data into the EEPROM segments of the SFP that are not write protected, and the negative edge clocks data from the SFP.

The serial data signal (SDA) is for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The supported monitoring functions are temperature, voltage, bias current, transmitter power, average receiver signal, all alarms and warnings, and software monitoring of TX Fault/LOS. The device is internally calibrated.

The data transfer protocol and the details of the mandatory and vendor specific data structures are defined in the SFP MSA, and SFF-8472, Rev. 11.0.

Power supply and grounding: The power supply line should be well-filtered. All 0.1 μF power supply bypass capacitors should be as close to the transceiver module as possible.

Mechanical Package



All dimensions shown are in [inches] and millimeters
 Millimeters are the primary units.
 Tolerances are in accordance with SFF-8432 Rev.5.

Ordering Information

Oplink PN			Center Wavelength (nm)	Distance ¹	Latch Color
C-temp	E-temp	I-temp			
TRPUG1KZXC000LOG	TRPUG1KZXE000LOG	TRPUG1KZXI000LOG	1271	80km	Light Violet
TRPUG1KZXC000K0G	TRPUG1KZXE000K0G	TRPUG1KZXI000K0G	1291	80km	Sky blue
TRPUG1KZXC000J0G	TRPUG1KZXE000J0G	TRPUG1KZXI000J0G	1311	80km	Lime
TRPUG1KZXC000H0G	TRPUG1KZXE000H0G	TRPUG1KZXI000H0G	1331	80km	Dark Green
TRPUG1KZXC000G0G	TRPUG1KZXE000G0G	TRPUG1KZXI000G0G	1351	80km	Pink
TRPUG1KZXC000F0G	TRPUG1KZXE000F0G	TRPUG1KZXI000F0G	1371	80km	Beige
TRPUG1KZXC000D0G	TRPUG1KZXE000D0G	TRPUG1KZXI000D0G	1391	80km	White
TRPUG1KZXC000C0G	TRPUG1KZXE000C0G	TRPUG1KZXI000C0G	1411	80km	Silver
TRPUG1KZXC000B0G	TRPUG1KZXE000B0G	TRPUG1KZXI000B0G	1431	80km	Black
TRPUG1KZXC000A0G	TRPUG1KZXE000A0G	TRPUG1KZXI000A0G	1451	80km	Magenta
TRPUG1KZXC00010G	TRPUG1KZXE00010G	TRPUG1KZXI00010G	1471	80km	Gray
TRPUG1KZXC00020G	TRPUG1KZXE00020G	TRPUG1KZXI00020G	1491	80km	Violet
TRPUG1KZXC00030G	TRPUG1KZXE00030G	TRPUG1KZXI00030G	1511	80km	Blue
TRPUG1KZXC00040G	TRPUG1KZXE00040G	TRPUG1KZXI00040G	1531	80km	Green

Oplink PN			Center Wavelength (nm)	Distance ¹	Latch Color
C-temp	E-temp	I-temp			
TRPUG1KZXC00050G	TRPUG1KZXE00050G	TRPUG1KZXI00050G	1551	80km	Yellow
TRPUG1KZXC00060G	TRPUG1KZXE00060G	TRPUG1KZXI00060G	1571	80km	Orange
TRPUG1KZXC00070G	TRPUG1KZXE00070G	TRPUG1KZXI00070G	1591	80km	Red
TRPUG1KZXC00080G	TRPUG1KZXE00080G	TRPUG1KZXI00080G	1611	80km	Brown
TRPUG1KVXC000L0G	TRPUG1KVXE000L0G	TRPUG1KVXI000L0G	1271	120km	Light Violet
TRPUG1KVXC000K0G	TRPUG1KVXE000K0G	TRPUG1KVXI000K0G	1291	120km	Sky blue
TRPUG1KVXC000J0G	TRPUG1KVXE000J0G	TRPUG1KVXI000J0G	1311	120km	Lime
TRPUG1KVXC000H0G	TRPUG1KVXE000H0G	TRPUG1KVXI000H0G	1331	120km	Dark Green
TRPUG1KVXC000G0G	TRPUG1KVXE000G0G	TRPUG1KVXI000G0G	1351	120km	Pink
TRPUG1KVXC000F0G	TRPUG1KVXE000F0G	TRPUG1KVXI000F0G	1371	120km	Beige
TRPUG1KVXC000D0G	TRPUG1KVXE000D0G	TRPUG1KVXI000D0G	1391	120km	White
TRPUG1KVXC000C0G	TRPUG1KVXE000C0G	TRPUG1KVXI000C0G	1411	120km	Silver
TRPUG1KVXC000B0G	TRPUG1KVXE000B0G	TRPUG1KVXI000B0G	1431	120km	Black
TRPUG1KVXC000A0G	TRPUG1KVXE000A0G	TRPUG1KVXI000A0G	1451	120km	Magenta
TRPUG1KVXC00010G	TRPUG1KVXE00010G	TRPUG1KVXI00010G	1471	120km	Gray
TRPUG1KVXC00020G	TRPUG1KVXE00020G	TRPUG1KVXI00020G	1491	120km	Violet
TRPUG1KVXC00030G	TRPUG1KVXE00030G	TRPUG1KVXI00030G	1511	120km	Blue
TRPUG1KVXC00040G	TRPUG1KVXE00040G	TRPUG1KVXI00040G	1531	120km	Green
TRPUG1KVXC00050G	TRPUG1KVXE00050G	TRPUG1KVXI00050G	1551	120km	Yellow
TRPUG1KVXC00060G	TRPUG1KVXE00060G	TRPUG1KVXI00060G	1571	120km	Orange
TRPUG1KVXC00070G	TRPUG1KVXE00070G	TRPUG1KVXI00070G	1591	120km	Red
TRPUG1KVXC00080G	TRPUG1KVXE00080G	TRPUG1KVXI00080G	1611	120km	Brown

¹ The indicated transmission distance is for guidelines only, not guaranteed. It assumes a total connector/splice/CWDM mux and demux loss of 4.5dB, allocated system penalty of 2dB and fiber loss of 0.25dB/km. Longer distances can be supported if the optical link power budget is satisfied.