

# VERY LONG HAUL MULTI-RATE GIGABIT ETHERNET SFP CWDM TRANSCEIVERS WITH DIGITAL DIAGNOSTICS

## TRPEG1KVX-G MR CWDM



### Product Description

The TRPEG1KVX-G MR CWDM SFP series of multi-rate fiber optic transceivers with integrated digital diagnostics monitoring functionality provide a quick and reliable interface for 1000BASE-LX Gigabit Ethernet and 1.062Gbd Fiber Channel applications. The transceivers are designed to support data rates ranging from 1.25Gb/s down to 125Mb/s. The diagnostic functions, alarm and warning features as described in the Multi-Source Agreement (MSA) document, SFF-8472 (Rev. 9.4), are provided via an I<sup>2</sup>C serial interface.

The transceivers use a high power DFB laser and an ultra high sensitivity Avalanche Photodiode (APD) receiver to provide a minimum optical link power budget of 32dB, corresponding to a minimum transmission distance of 120km of single mode fiber, assuming a total connector/splice/CWDM mux and demux loss of 4.6dB, allocated system penalty of 1dB and fiber loss of 0.22dB/km. There are eighteen (18) wavelengths available, from 1271nm to 1611nm. All transceivers are Class I Laser products per U.S. FDA/CDRH and international IEC-60825 standards.

The TRPEG1KVX-G MR CWDM multi-rate 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 an operating case temperature range of -5°C to +70°C (Commercial) or -5°C to +85°C (Extended). The housing is made of metal for EMI immunity.



### Features

- Eighteen (18) Wavelength CWDM Transceivers
- Lead Free Design & RoHS Compliant
- Compliant to SFP MSA
- Compatible with IEEE 802.3z Gigabit Ethernet 1000BASE-LX PMD Specifications
- Compatible with 1.062Gbd Fibre Channel 100-SM-LC-L FC-PI Standards
- Digital Diagnostics through Serial Interface
- Internal Calibration for Digital Diagnostics
- Up to 120km with Single Mode Fiber
- APD Receiver
- Eye Safe (Class I Laser Safety)
- Duplex LC Optical Interface
- Loss of Signal Output & TX Disable Input
- Hot-pluggable

### Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Storage Temperature	$T_{st}$	- 40	+ 85	°C
Operating Case Temperature <sup>1</sup>	Commercial	- 5	+ 70	°C
	Extended	- 5	+ 85	
Supply Voltage	$V_{cc}$	0	+ 4.5	V
Maximum Input Optical Power (30 seconds max.)	$P_{in, max}$	-	+ 3.0	dBm
Input Voltage	$V_{in}$	0	$V_{cc}$	V

<sup>1</sup> 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
Average Optical Output Power <sup>1</sup>	$P_o$	0	-	+ 5.0	dBm
Center Wavelength	$\lambda_c$	See Ordering Information table			nm
Wavelength Deviation	$\Delta\lambda_c$	$\lambda_c - 6.5$	$\lambda_c$	$\lambda_c + 6.5$	nm
Spectral Width (-20dB)	$\Delta\lambda_{20}$	-	-	1.0	nm
Side Mode Suppression Ratio	$SMSR$	30	-	-	dB
Extinction Ratio	$P_{hi}/P_{lo}$	9	-	-	dB
Deterministic Jitter	$DJ$	-	-	80	ps
Total Jitter	$TJ$	-	-	227	ps
Relative Intensity Noise	$RIN$	-	-	- 120	dB/Hz
Dispersion Penalty <sup>2</sup>	-	-	-	2.0	dB
Transmitter Output Eye	Compliant with Eye Mask Defined in IEEE 802.3z Standard				

<sup>1</sup> Measured average power coupled into single mode fiber.  
<sup>2</sup> Specified at 260ps/nm dispersion, which corresponds to the approximate worst-case dispersion for 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	$B$	125	-	1250	Mb/s
Receiver Sensitivity ( $10^{-12}$ BER) <sup>1</sup>	$P_{min}$	- 32.0	- 35.0	-	dBm
Maximum Input Optical Power ( $10^{-12}$ BER) <sup>1</sup>	$P_{max}$	- 10.0	-	-	dBm
LOS Thresholds	Increasing Light Input	$P_{los+}$	-	- 32.0	dBm
	Decreasing Light Input	$P_{los-}$	- 45.0	-	
LOS Timing Delay	Increasing Light Input	$t_{loss\_off}$	-	100	$\mu s$
	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	$\lambda$	1100	-	1620	nm
Optical Return Loss	$ORL$	12	-	-	dB
Electrical 3dB Upper Cutoff Frequency	-	-	-	1500	MHz

<sup>1</sup> When measured with 2<sup>7</sup>-1 PRBS at 125Mb/s, 1062.5Mb/s and 1250Mb/s.

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



**Oplink Communications, Inc.**

This product complies with  
21 CFR 1040.10 and 1040.11  
**Meets Class I 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-) <sup>1</sup>	$V_{PP-DIFF}$	0.35	-	1.75	V
Input HIGH Voltage (TX Disable) <sup>2</sup>	$V_{IH}$	2.0	-	$V_{CC}$	V
Input LOW Voltage (TX Disable) <sup>2</sup>	$V_{IL}$	0	-	0.8	V
Output HIGH Voltage (TX Fault) <sup>3</sup>	$V_{OH}$	2.0	-	$V_{CC} + 0.3$	V
Output LOW Voltage (TX Fault) <sup>3</sup>	$V_{OL}$	0	-	0.8	V

<sup>1</sup>Differential peak-to-peak voltage.  
<sup>2</sup>There is an internal 4.7 to 10kΩ pull-up resistor to  $V_{CC}$ .  
<sup>3</sup>Open collector compatible, 4.7 to 10kΩ 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-) <sup>1</sup>	$V_{PP-DIFF}$	0.4	-	1.75	V
Output HIGH Voltage (LOS) <sup>2</sup>	$V_{OH}$	$V_{CC} - 0.3$	-	$V_{CC} + 0.3$	V
Output LOW Voltage (LOS) <sup>2</sup>	$V_{OL}$	0	-	0.5	V

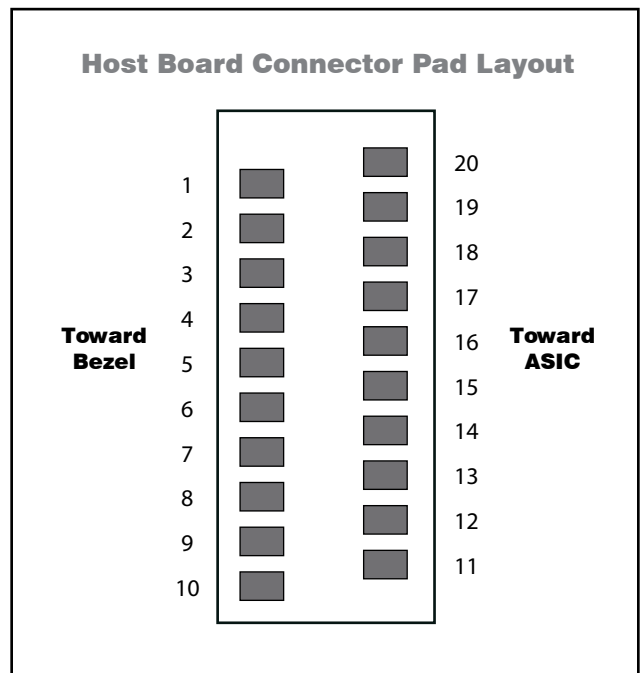
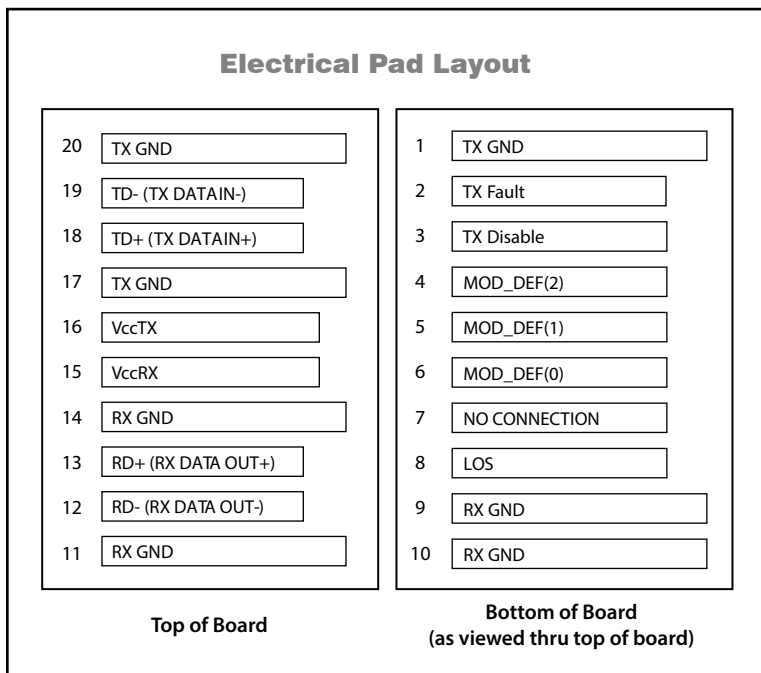
<sup>1</sup>Differential peak-to-peak voltage across external 100Ω load.  
<sup>2</sup>Open collector compatible, 4.7 to 10kΩ pull-up resistor to  $V_{CC}$  (Host Supply Voltage).

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

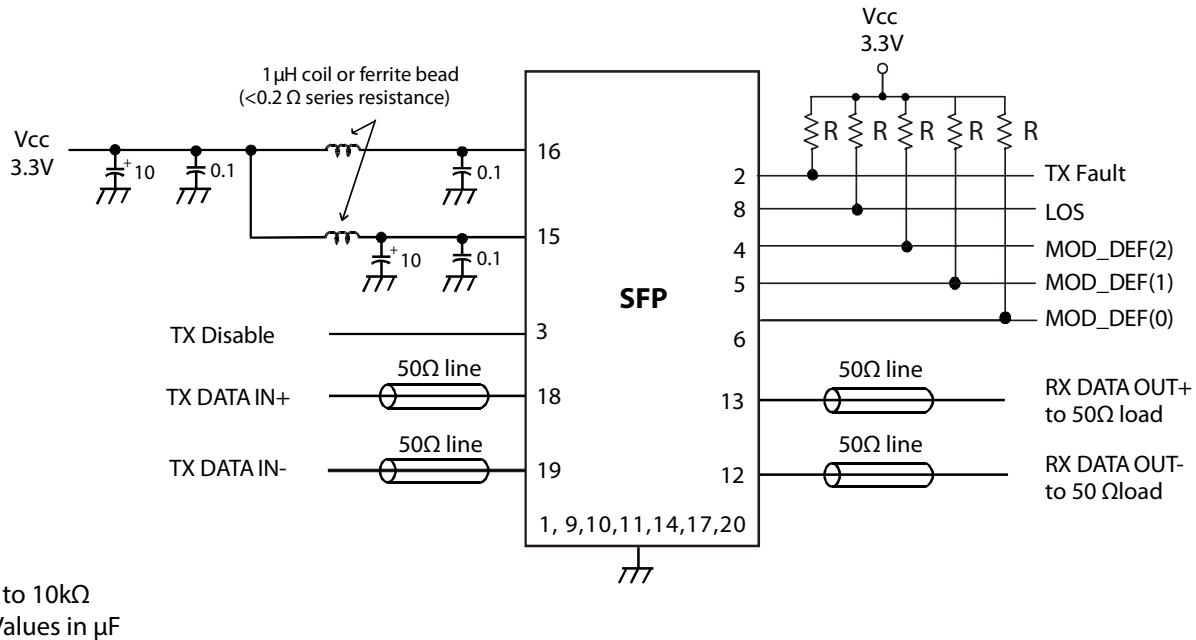
Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	$V_{CC}$	3.13	3.30	3.47	V
Supply Current	$I_{CC}$	-	210	300	mA

**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**



**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 1µF 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 non-latching (automatically deasserts when fault goes away).

**TX Disable:** When the TX Disable pin is at logic HIGH, the transmitter optical output is disabled (less than -45dBm).

**Serial Identification and Monitoring:** The module definition of SFP is indicated by the three module definition pins, MOD\_DEF(0), MOD\_DEF(1) and MOD\_DEF(2). Upon

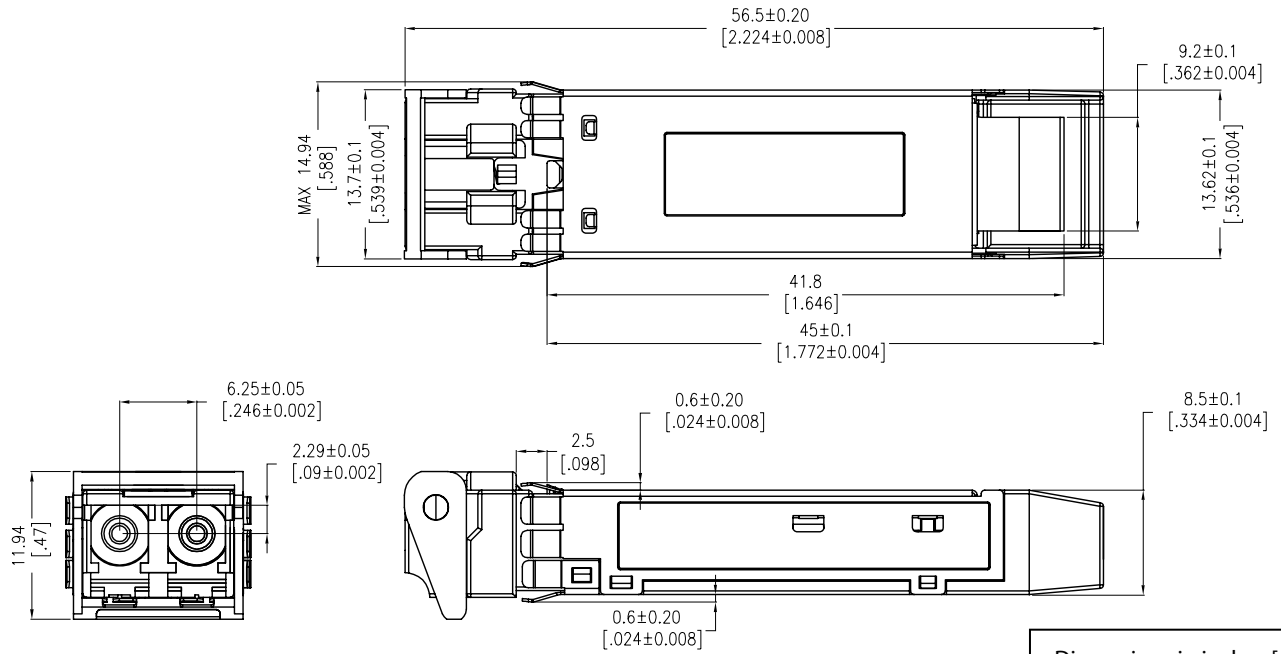
power up, MOD\_DEF(1:2) appear as NC (no connection), and MOD\_DEF(0) is TTL LOW. When the host system detects this condition, it activates the serial protocol (standard two-wire I<sup>2</sup>C serial interface) and generates the serial clock signal (SCL). The positive edge clocks data into the EEPROM 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. 9.4.

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

**Package Outline**



Dimensions in inches [mm]  
 Default tolerances:  
 .xxx = ± .005", .xx = ± .01"

**Ordering Information**

Part Number	Operating Temperature		Latch Color	Nominal Wavelength	Optical Link Power Budget	Distance <sup>1</sup>
TRPEG1KVXC000LOG	-5°C to +70°C	Commercial	Light Violet	1271nm	32dBm	120km
TRPEG1KVXC000KOG	-5°C to +70°C	Commercial	Sky Blue	1291nm	32dBm	120km
TRPEG1KVXC000JOG	-5°C to +70°C	Commercial	Dark Green	1311nm	32dBm	120km
TRPEG1KVXC000HOG	-5°C to +70°C	Commercial	Magenta	1331nm	32dBm	120km
TRPEG1KVXC000GOG	-5°C to +70°C	Commercial	Pink	1351nm	32dBm	120km
TRPEG1KVXC000FOG	-5°C to +70°C	Commercial	Beige	1371nm	32dBm	120km
TRPEG1KVXC000DOG	-5°C to +70°C	Commercial	White	1391nm	32dBm	120km
TRPEG1KVXC000COG	-5°C to +70°C	Commercial	Silver	1411nm	32dBm	120km
TRPEG1KVXC000BOG	-5°C to +70°C	Commercial	Black	1431nm	32dBm	120km
TRPEG1KVXC000AOG	-5°C to +70°C	Commercial	Lime	1451nm	32dBm	120km
TRPEG1KVXC0001OG	-5°C to +70°C	Commercial	Gray	1471nm	32dBm	120km
TRPEG1KVXC0002OG	-5°C to +70°C	Commercial	Violet	1491nm	32dBm	120km
TRPEG1KVXC0003OG	-5°C to +70°C	Commercial	Blue	1511nm	32dBm	120km
TRPEG1KVXC0004OG	-5°C to +70°C	Commercial	Green	1531nm	32dBm	120km
TRPEG1KVXC0005OG	-5°C to +70°C	Commercial	Yellow	1551nm	32dBm	120km
TRPEG1KVXC0006OG	-5°C to +70°C	Commercial	Orange	1571nm	32dBm	120km
TRPEG1KVXC0007OG	-5°C to +70°C	Commercial	Red	1591nm	32dBm	120km
TRPEG1KVXC0008OG	-5°C to +70°C	Commercial	Brown	1611nm	32dBm	120km

Part Number	Operating Temperature		Latch Color	Nominal Wavelength	Optical Link Power Budget	Distance <sup>1</sup>
	- 5°C to +85°C	Extended				
TRPEG1KVXE000LOG	- 5°C to +85°C	Extended	Light Violet	1271nm	32dBm	120km
TRPEG1KVXE000K0G	- 5°C to +85°C	Extended	Sky Blue	1291nm	32dBm	120km
TRPEG1KVXE000J0G	- 5°C to +85°C	Extended	Dark Green	1311nm	32dBm	120km
TRPEG1KVXE000H0G	- 5°C to +85°C	Extended	Magenta	1331nm	32dBm	120km
TRPEG1KVXE000G0G	- 5°C to +85°C	Extended	Pink	1351nm	32dBm	120km
TRPEG1KVXE000F0G	- 5°C to +85°C	Extended	Beige	1371nm	32dBm	120km
TRPEG1KVXE000D0G	- 5°C to +85°C	Extended	White	1391nm	32dBm	120km
TRPEG1KVXE000C0G	- 5°C to +85°C	Extended	Silver	1411nm	32dBm	120km
TRPEG1KVXE000B0G	- 5°C to +85°C	Extended	Black	1431nm	32dBm	120km
TRPEG1KVXE000A0G	- 5°C to +85°C	Extended	Lime	1451nm	32dBm	120km
TRPEG1KVXE00010G	- 5°C to +85°C	Extended	Gray	1471nm	32dBm	120km
TRPEG1KVXE00020G	- 5°C to +85°C	Extended	Violet	1491nm	32dBm	120km
TRPEG1KVXE00030G	- 5°C to +85°C	Extended	Blue	1511nm	32dBm	120km
TRPEG1KVXE00040G	- 5°C to +85°C	Extended	Green	1531nm	32dBm	120km
TRPEG1KVXE00050G	- 5°C to +85°C	Extended	Yellow	1551nm	32dBm	120km
TRPEG1KVXE00060G	- 5°C to +85°C	Extended	Orange	1571nm	32dBm	120km
TRPEG1KVXE00070G	- 5°C to +85°C	Extended	Red	1591nm	32dBm	120km
TRPEG1KVXE00080G	- 5°C to +85°C	Extended	Brwon	1611nm	32dBm	120km

<sup>1</sup> These are target distances to be used for classification and not for specification, per Telcordia GR-253-CORE/ITU-T Recommendation G.957.

<sup>1</sup> The indicated transmission distance is for guidelines only, not guaranteed. The exact distance is dependent on the fiber loss, connector and splice loss, and allocated system penalty. Longer distances can be supported if the optical link power budget is satisfied.