Multi-rate Gigabit Ethernet & FibreChannel SFP CWDM Transceivers with Digital Diagnostics

TRPEG1-G MR CWDM

Product Description

The TRPEG1-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 Fibre Channel applications. The transceivers are designed to support data rates ranging from 1.25Gb/s down to 125Mb/s. Diagnostics monitoring functionality (alarm and warning features) is integrated into the design via an I^2C serial interface per the Multi-Source Agreement (MSA) SFF-8472, Rev. 9.4.

There are eighteen center wavelengths available, from 1271nm to 1611nm. Two optical link power budget options are offered, YX (22dB minimum) and ZX (24dB minimum). They correspond to transmission distances of 62km and 70km respectively (assuming a total connector/splice/ CWDM mux and demux loss of 4.5dB, allocated system penalty of 2dB and fiber loss of 0.25dB/km). All modules satisfy Class I Laser Safety requirements in accordance with the U.S. FDA/CDRH and international IEC-60825 standards.

The TRPEG1-G MR 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 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
- ☑ Minimum Optical Link Power Budgets of 22dB and 24dB to Support 62km and 70km
- ☑ 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 Range		T_{ST}	- 40	+ 85	°C
Operating Case Temperature[1]	Commercial	T_{OP}	- 5	+ 70	°C
	Extended		- 5	+ 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.

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 [1]	YX	P_O	- 2.0	-	+ 3.0	dBm
	ZX		0	-	+ 5.0	
Center Wavelength		λ_C	See Ordering Information table			nm
Wavelength Deviation		$\Delta\lambda_C$	λ_C - 6.5	λ_C	λ_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		D_J	-	-	80	ps
Total Jitter		T_J	-	-	227	ps
Optical Rise/Fall Time (20% to 80%)		t_r, t_f	-	-	0.32	ns
Relative Intensity Noise		RIN	-	-	- 120	dB/Hz
Dispersion Penalty [2]		-	-	-	1.5	dB
Transmitter Output Eye		Compliant with IEEE 802.3z & FC-PI Eye Mask				

[1] Measured average power coupled into single mode fiber.
[2] Specified at 1360ps/nm (YX) and 1540ps/nm (ZX) dispersion, which corresponds to the approximate worst-case dispersion for 62km and 70km 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) [1]		P_{min}	- 24.0	-	-	dBm
Maximum Input Optical Power (10^{-12} BER) [1]		P_{max}	- 3.0	-	-	dBm
LOS Thresholds	Increasing Light Input	P_{los+}	-	-	- 24.0	dBm
	Decreasing Light Input	P_{los-}	- 35.0	-	-	
LOS Timing Delay	Increasing Light Input	t_loss_off	-	-	100	µs
	Decreasing Light Input	t_loss_on	-	-	100	
LOS Hysteresis		-	0.5	1.5	-	dB
Deterministic Jitter		D_J	-	-	80	ps
Total Jitter		T_J	-	-	266	ps
Wavelength of Operation		λ	1260	-	1620	nm
Optical Return Loss		ORL	12	-	-	dB
Electrical 3dB Upper Cutoff Frequency		-	-	-	1500	MHz

[1] Measured with 2^7-1 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 Performance 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 Fault) [3]	V_{OH}	2.0	-	V_{CC} + 0.3	V
Output LOW Voltage (TX Fault) [3]	V_{OL}	0	-	0.8	V

[1] Differential peak-to-peak voltage.
[2] There is an internal 4.7 to 10kΩ pull-up resistor to VccT.
[3] Open collector compatible, 4.7 to 10kΩ pull-up resistor to Vcc (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}	V_{CC} - 0.3	-	V_{CC} + 0.3	V
Output LOW Voltage (LOS) [2]	V_{OL}	0	-	0.5	V

[1] Differential peak-to-peak voltage across external 100Ω load.
[2] Open collector compatible, 4.7 to 10kΩ pull-up resistor to Vcc (Host Supply Voltage).

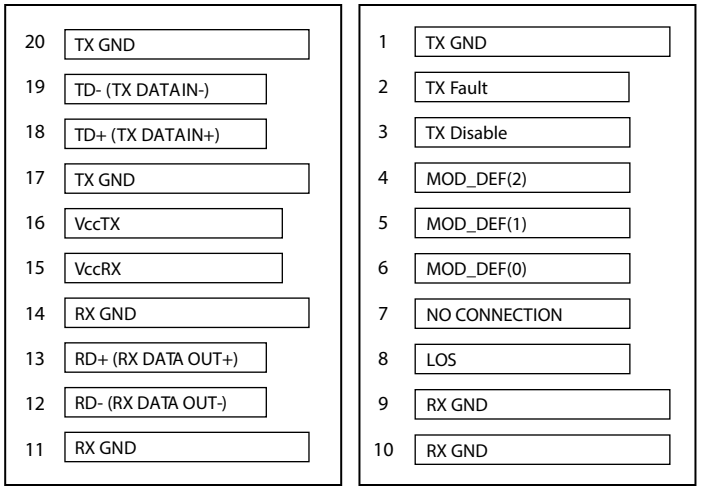
Electrical Power Supply Characteristics (Over Operating Case Temperature. V_{cc} = 3.13 to 3.47V)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	V_{CC}	3.13	3.30	3.47	V
Supply Current	I_{CC}	-	200	300	mA

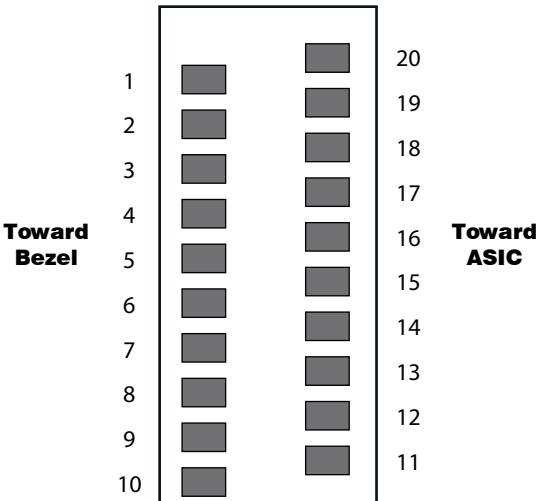
Module Definition

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

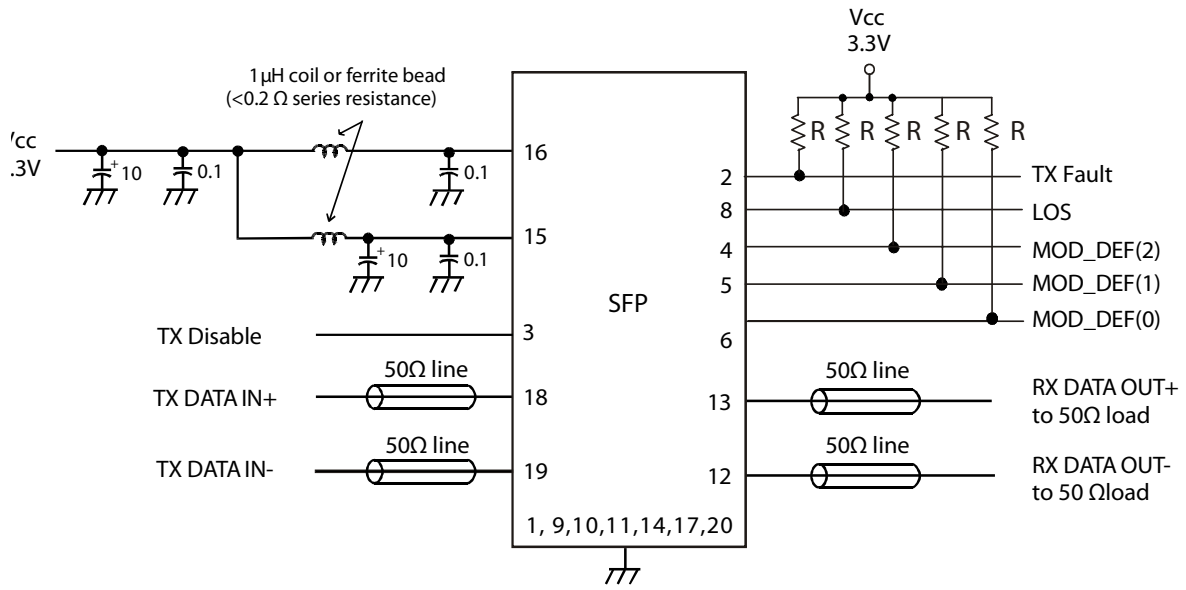
Electrical Pad Layout



Host Board Connector Pad Layout



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 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 that 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 (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).

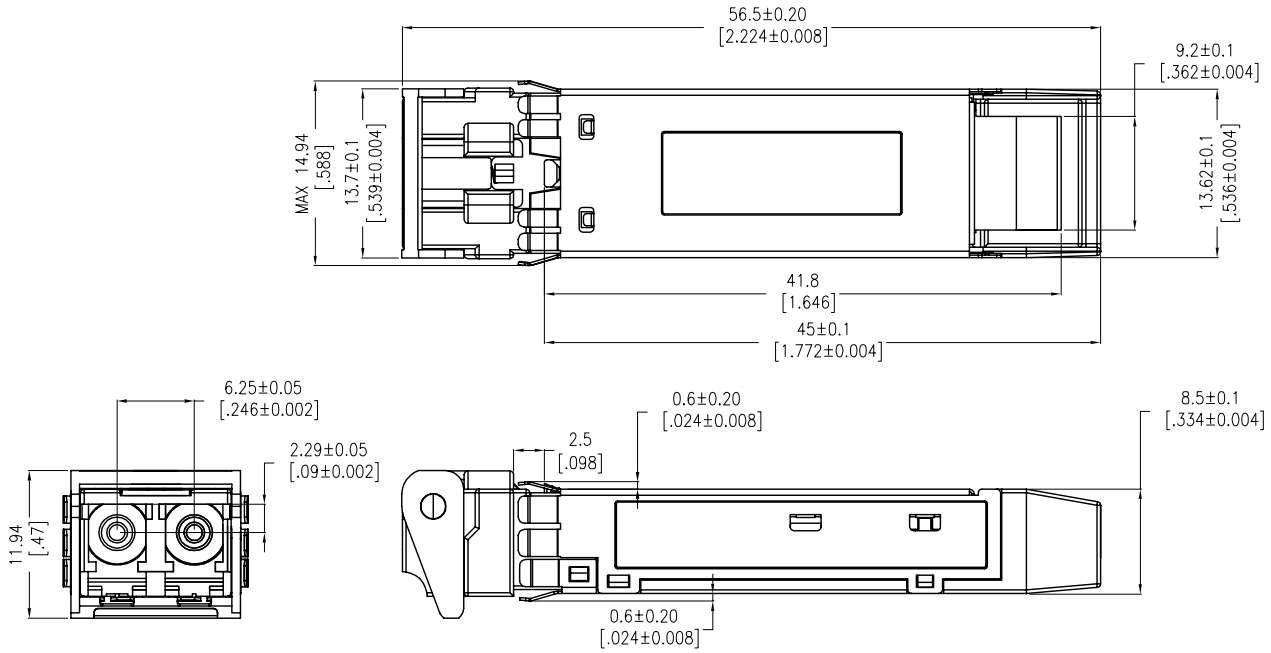
Upon power up, MOD_DEF(1:2) appear as NC (no connection), and MOD_DEF(0) is TTL LOW. When the host system detects this condition, it activates the serial protocol (standard two-wire I^2C serial interface) and generates the serial clock signal (SCL). The positive edge clocks data into the EEPROM segments 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 startand end of serial protocol activation. The supported monitoring functions are internal temperature, supply 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 SFPMSA, 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.

Mechanical Package



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

Ordering Information

Oplink Part Number		Operating Temperature		Nominal Wavelength (nm)	Latch Color
22dB Link Budge (62km Distance)[1]	24dB Link Budget (70km Distance)[1]				
TRPEG1HYXC000L0G	TRPEG1KZXC000L0G	- 5°C to +70°C	Commercial	1271	Light Violet
TRPEG1HYXC000K0G	TRPEG1KZXC000K0G	- 5°C to +70°C	Commercial	1291	Sky Blue
TRPEG1HYXC000J0G	TRPEG1KZXC000J0G	- 5°C to +70°C	Commercial	1311	Dark Green
TRPEG1HYXC000H0G	TRPEG1KZXC000H0G	- 5°C to +70°C	Commercial	1331	Magenta
TRPEG1HYXC000G0G	TRPEG1KZXC000G0G	- 5°C to +70°C	Commercial	1351	Pink
TRPEG1HYXC000F0G	TRPEG1KZXC000F0G	- 5°C to +70°C	Commercial	1371	Beige
TRPEG1HYXC000D0G	TRPEG1KZXC000D0G	- 5°C to +70°C	Commercial	1391	White
TRPEG1HYXC000C0G	TRPEG1KZXC000C0G	- 5°C to +70°C	Commercial	1411	Silver
TRPEG1HYXC000B0G	TRPEG1KZXC000B0G	- 5°C to +70°C	Commercial	1431	Black
TRPEG1HYXC000A0G	TRPEG1KZXC000A0G	- 5°C to +70°C	Commercial	1451	Lime
TRPEG1HYXC00010G	TRPEG1KZXC00010G	- 5°C to +70°C	Commercial	1471	Gray
TRPEG1HYXC00020G	TRPEG1KZXC00020G	- 5°C to +70°C	Commercial	1491	Violet
TRPEG1HYXC00030G	TRPEG1KZXC00030G	- 5°C to +70°C	Commercial	1511	Blue
TRPEG1HYXC00040G	TRPEG1KZXC00040G	- 5°C to +70°C	Commercial	1531	Green
TRPEG1HYXC00050G	TRPEG1KZXC00050G	- 5°C to +70°C	Commercial	1551	Yellow
TRPEG1HYXC00060G	TRPEG1KZXC00060G	- 5°C to +70°C	Commercial	1571	Orange
TRPEG1HYXC00070G	TRPEG1KZXC00070G	- 5°C to +70°C	Commercial	1591	Red
TRPEG1HYXC00080G	TRPEG1KZXC00080G	- 5°C to +70°C	Commercial	1611	Brown

Oplink Part Number		Operating Temperature		Nominal Wavelength (nm)	Latch Color
22dB Link Budge (62km Distance)[1]	24dB Link Budget (70km Distance)[1]				
TRPEG1HYXE000L0G	TRPEG1KZXE000L0G	- 5°C to +85°C	Extended	1271	Light Violet
TRPEG1HYXE000K0G	TRPEG1KZXE000K0G	- 5°C to +85°C	Extended	1291	Sky Blue
TRPEG1HYXE000J0G	TRPEG1KZXE000J0G	- 5°C to +85°C	Extended	1311	Dark Green
TRPEG1HYXE000H0G	TRPEG1KZXE000H0G	- 5°C to +85°C	Extended	1331	Magenta
TRPEG1HYXE000G0G	TRPEG1KZXE000G0G	- 5°C to +85°C	Extended	1351	Pink
TRPEG1HYXE000F0G	TRPEG1KZXE000F0G	- 5°C to +85°C	Extended	1371	Beige
TRPEG1HYXE000D0G	TRPEG1KZXE000D0G	- 5°C to +85°C	Extended	1391	White
TRPEG1HYXE000C0G	TRPEG1KZXE000C0G	- 5°C to +85°C	Extended	1411	Silver
TRPEG1HYXE000B0G	TRPEG1KZXE000B0G	- 5°C to +85°C	Extended	1431	Black
TRPEG1HYXE000A0G	TRPEG1KZXE000A0G	- 5°C to +85°C	Extended	1451	Lime
TRPEG1HYXE00010G	TRPEG1KZXE00010G	- 5°C to +85°C	Extended	1471	Gray
TRPEG1HYXE00020G	TRPEG1KZXE00020G	- 5°C to +85°C	Extended	1491	Violet
TRPEG1HYXE00030G	TRPEG1KZXE00030G	- 5°C to +85°C	Extended	1511	Blue
TRPEG1HYXE00040G	TRPEG1KZXE00040G	- 5°C to +85°C	Extended	1531	Green
TRPEG1HYXE00050G	TRPEG1KZXE00050G	- 5°C to +85°C	Extended	1551	Yellow
TRPEG1HYXE00060G	TRPEG1KZXE00060G	- 5°C to +85°C	Extended	1571	Orange
TRPEG1HYXE00070G	TRPEG1KZXE00070G	- 5°C to +85°C	Extended	1591	Red
TRPEG1HYXE00080G	TRPEG1KZXE00080G	- 5°C to +85°C	Extended	1611	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.

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