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

TRP1G1xxXIxG CWDM

Product Description

The TRP1G1xxXIxG SFP series of multi-rate fiber optic transceivers 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. 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 eight center wavelengths available: 1471nm, 1491nm, 1511nm, 1531nm, 1551nm, 1571nm, 1591nm and 1611nm. Three optical link power budget options are offered, YX (22dB minimum), ZX (24dB minimum) and VX (32dB minimum). They correspond to transmission distances of 62km, 70km and 120km, 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 TRP1G1xxXIxG 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 temperature range of -40°C to +85°C (-40°C to 0°C is ambient, and 0°C to +85°C is case). The housing is made of metal for EMI immunity.

Features

- ☑ Industrial Operating Temperature Range
- ☑ Lead Free Design & Fully RoHS Compliant
- ☑ Eight (8) Wavelength CWDM Transceivers
- ☑ Compatible with 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, 24dB and 32dB to Support 62km, 70km and 120km
- ☑ Eye Safe (Class I Laser Safety)
- ☑ Duplex LC Optical Interface
- ☑ Loss of Signal Output & TX Disable Input
- ☑ Hot-pluggable
- ☑ Single +3.3V Power Supply

Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Storage Temperature	T_{st}	- 40	+ 85	°C
Operating Case Temperature[1]	T_{op}	- 40	+ 85	°C
Supply Voltage	V_{cc}	0	+ 4.5	V
Input Voltage	V_{in}	0	V_{cc}	V

[1]-40°C to 0°C is ambient, and 0°C to +85°C is case temperature. For case temperature, measure 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]	YX	P_o	- 2.0	-	+ 3.0	dBm
	ZX		0	-	+ 5.0	
	VX		0	-	+ 5.0	
Center Wavelength	1271nm	λ_C	1264.5	1271	1277.5	nm
	1291nm		1284.5	1291	1297.5	
	1311nm		1304.5	1311	1317.5	
	1331nm		1324.5	1331	1337.5	
	1351nm		1344.5	1351	1357.5	
	1371nm		1364.5	1371	1377.5	
	1391nm		1384.5	1391	1397.5	
	1411nm		1404.5	1411	1417.5	
	1431nm		1424.5	1431	1437.5	
	1451nm		1444.5	1451	1457.5	
	1471nm		1464.5	1471	1477.5	
	1491nm		1484.5	1491	1497.5	
	1511nm		1504.5	1511	1517.5	
	1531nm		1524.5	1531	1537.5	
	1551nm		1544.5	1551	1557.5	
	1571nm		1564.5	1571	1577.5	
	1591nm		1584.5	1591	1597.5	
	1611nm		1604.5	1611	1617.5	
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
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 Eye Mask Defined in IEEE 802.3z Standard				

[1]Measured average power coupled into single mode fiber.
[2]Specified at 1360ps/nm (YX), 1540ps/nm (ZX) and 2600ps/nm dispersion, which corresponds to the approximate worst-case dispersion for 62km, 70km and 120km G .652 fiber over the wavelength range of 1464.5 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
Minimum Input Optical Power (10^{-12} BER)[1]	YX, ZX		P_{min}	- 24.0	-	-	dBm
	VX			- 32.0	- 35.0	-	
Maximum Input Optical Power (10^{-12} BER)[1]	YX, ZX		P_{max}	- 3.0	-	-	dBm
	VX			- 10.0	-	-	
LOS Thresholds	Increasing Light Input	YX, ZX	P_{los+}	-	-	- 24.0	dBm
		VX		-	-	- 32.0	
	Decreasing Light Input	YX, ZX	P_{los-}	- 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
Electrical 3dB Upper Cutoff Frequency			-	-	-	1500	MHz

[1] When measured with 2^7-1 PRBS at 125Mb/s, 1062.5Mb/s and 1250Mb/s.

Transmitter Electrical Interface (Over Operating Case Temperature, V_{CC} = 3.13 to 3.47V)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Input Voltage Swing (TD+ & TD-)[1]	$V_{PP\text{-}DIF}$	0.50	-	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 Interface (Over Operating Case Temperature, V_{CC} = 3.13 to 3.47V)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Output Voltage Swing (RD+ & RD-)[1]	$V_{PP\text{-}DIF}$	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

[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).

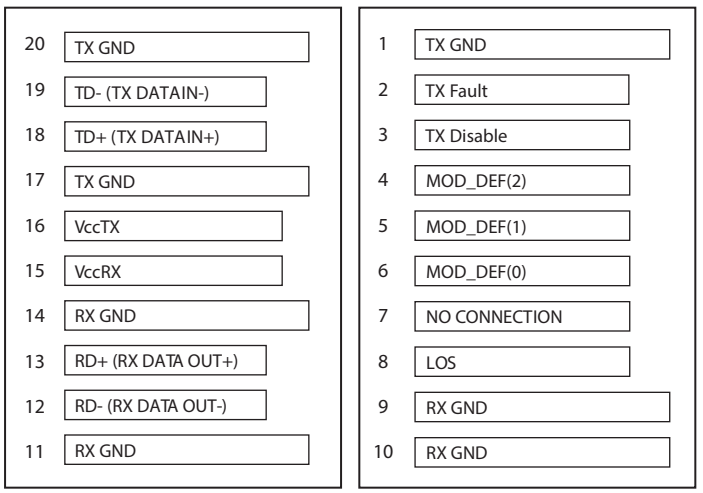
Electrical Power Supply Characteristics (Over Operating Case Temperature, V_{CC} = 3.13 to 3.47V)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Supply Voltage		V_{CC}	3.13	3.3	3.47	V
Supply Current	0°C to +85°C	I_{CC}	-	200	300	mA
	- 40°C to 0°C		-	-	550	

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

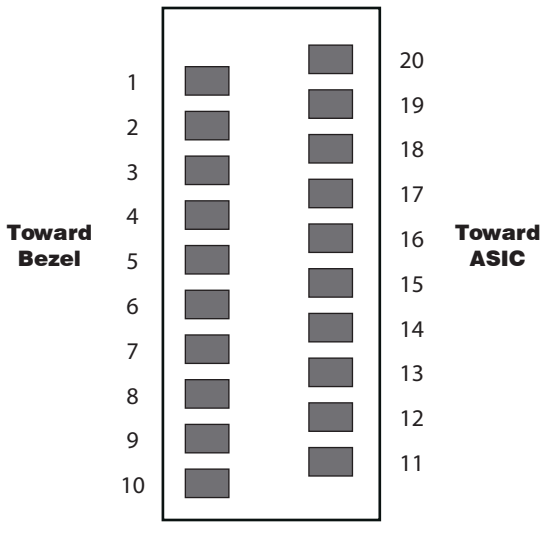
Electrical Pad Layout



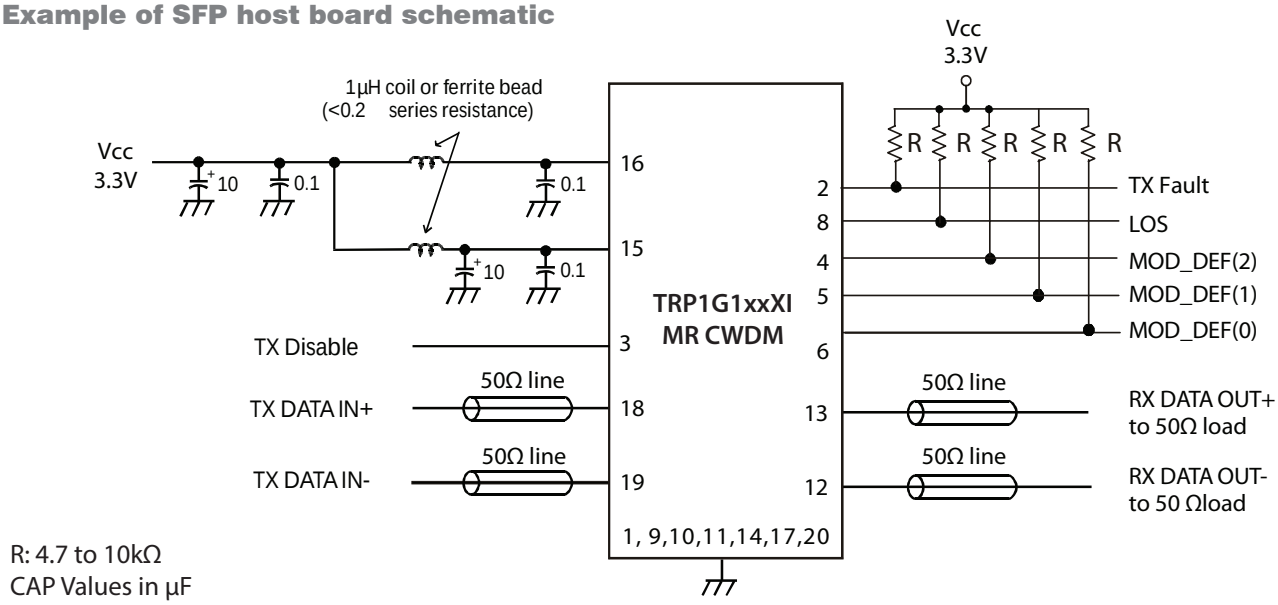
Top of Board

Bottom of Board (as viewed thru top of board)

Host Board Connector Pad Layout



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 0.1µF 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 -35dBm, -45dBm for F7G). Optical output is disabled from cold start until operating wavelength is within specified range.

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 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.

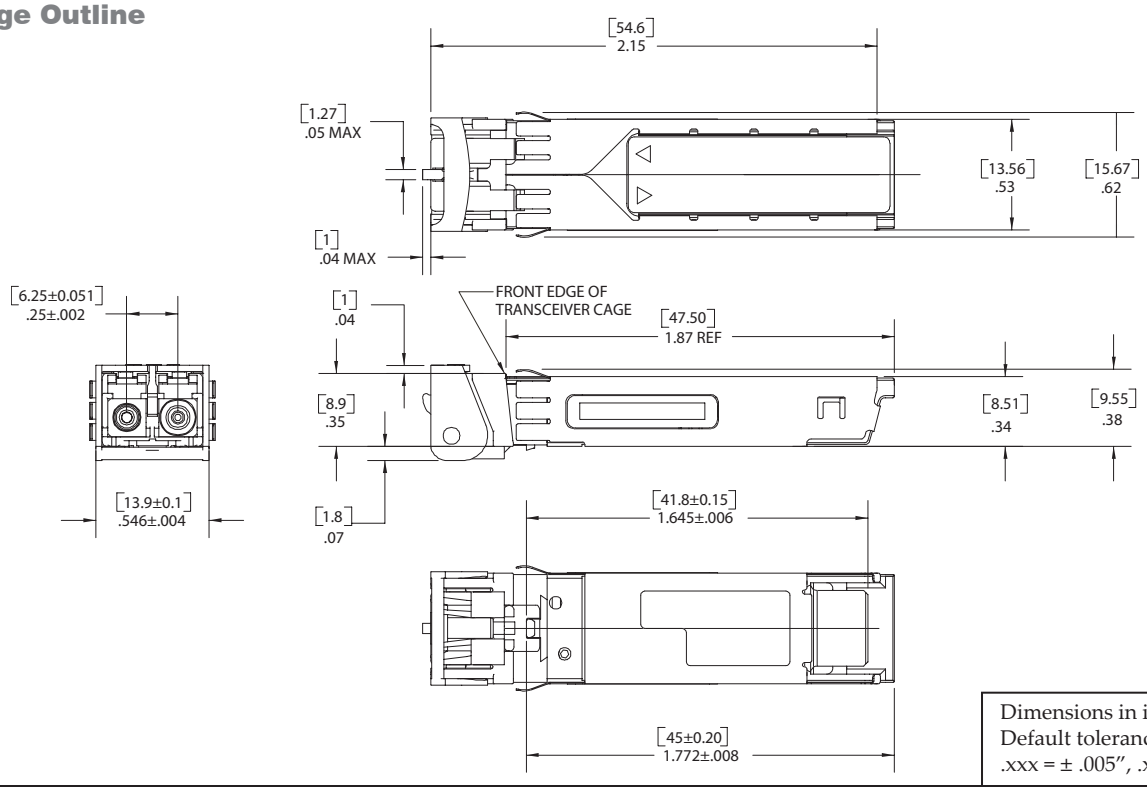
Power supply and grounding: The power supply line should be well-filtered. All 0.1µF power supply bypass capacitors should be as close to the transceiver module as possible.

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.
DATE OF MANUFACTURE:

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

Package Outline



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

Ordering Information

Model Name			Operating Temperature	Nominal Wavelength (nm)	Latch Color
22dB Link Budget (62km Reach, YX)[1]	24dB Link Budget (70km Reach, ZX)[1]	32dB Link Budget (120km Reach, VX)[1]			
TRP1G1HYXI000L0G	TRP1G1KZXI000L0G	TRP1G1KVXI000L0G	- 40°C to +85°C	1271	Light Violet
TRP1G1HYXI000K0G	TRP1G1KZXI000K0G	TRP1G1KVXI000K0G	- 40°C to +85°C	1291	Sky blue
TRP1G1HYXI000J0G	TRP1G1KZXI000J0G	TRP1G1KVXI000J0G	- 40°C to +85°C	1311	Lime
TRP1G1HYXI000H0G	TRP1G1KZXI000H0G	TRP1G1KVXI000H0G	- 40°C to +85°C	1331	Dark Green
TRP1G1HYXI000G0G	TRP1G1KZXI000G0G	TRP1G1KVXI000G0G	- 40°C to +85°C	1351	Pink
TRP1G1HYXI000F0G	TRP1G1KZXI000F0G	TRP1G1KVXI000F0G	- 40°C to +85°C	1371	Beige
TRP1G1HYXI000D0G	TRP1G1KZXI000D0G	TRP1G1KVXI000D0G	- 40°C to +85°C	1391	White
TRP1G1HYXI000C0G	TRP1G1KZXI000C0G	TRP1G1KVXI000C0G	- 40°C to +85°C	1411	Silver
TRP1G1HYXI000B0G	TRP1G1KZXI000B0G	TRP1G1KVXI000B0G	- 40°C to +85°C	1431	Black
TRP1G1HYXI000A0G	TRP1G1KZXI000A0G	TRP1G1KVXI000A0G	- 40°C to +85°C	1451	Magenta
TRP1G1HYXI00010G	TRP1G1KZXI00010G	TRP1G1KVXI00010G	- 40°C to +85°C	1471	Gray
TRP1G1HYXI00020G	TRP1G1KZXI00020G	TRP1G1KVXI00020G	- 40°C to +85°C	1491	Violet
TRP1G1HYXI00030G	TRP1G1KZXI00030G	TRP1G1KVXI00030G	- 40°C to +85°C	1511	Blue
TRP1G1HYXI00040G	TRP1G1KZXI00040G	TRP1G1KVXI00040G	- 40°C to +85°C	1531	Green
TRP1G1HYXI00050G	TRP1G1KZXI00050G	TRP1G1KVXI00050G	- 40°C to +85°C	1551	Yellow
TRP1G1HYXI00060G	TRP1G1KZXI00060G	TRP1G1KVXI00060G	- 40°C to +85°C	1571	Orange
TRP1G1HYXI00070G	TRP1G1KZXI00070G	TRP1G1KVXI00070G	- 40°C to +85°C	1591	Red
TRP1G1HYXI00080G	TRP1G1KZXI00080G	TRP1G1KVXI00080G	- 40°C to +85°C	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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