

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

TRPAG1M Single Mode

Product Description

The TRPAG1M 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. The diagnostic functions, alarm and warning features as described in the Multi-Source Agreement (MSA) document, SFF-8472 (Rev. 9.3), are provided via an I²C serial interface.

Four options are offered with minimum optical link power budgets of 11, 18, 22 and 24dB to support 10km to 80km link applications. Option "LX" uses a 1310nm Fabry Perot laser and provides a minimum optical link budget of 11dB, corresponding to a minimum distance of 10km, assuming fiber loss of 0.45dB/km. Option "EX" uses a 1310nm DFB laser and provides a minimum optical link budget of 18dB, corresponding to a minimum distance of 40km, assuming fiber loss of 0.35dB/km. Options "YX" and "ZX" use 1550nm DFB lasers and provide a minimum optical link budgets of 22dB and 24dB respectively, which correspond to minimum distances of 72km and 80km, assuming 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 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 three operating case temperature ranges of -5°C to +70°C, -40°C to +85°C, or -25°C to +85°C (for YX and ZX). The housing is made of plastic and metal for EMI immunity.



Features

- Compliant with IEEE 802.3z Gigabit Ethernet 1000BASE-LX PMD Specifications
- Compatible with SFP MSA
- Compliant with 1.062GBd Fibre Channel 100-SM-LC-L FC-PI Standards
- Digital Diagnostics through Serial Interface
- Internal Calibration for Digital Diagnostics
- Distance Options to Support 10km to 80km (Please see note on Distance in Ordering Information)
- Eye Safe (Class I Laser Safety)
- Duplex LC Optical Interface
- Loss of Signal Output & TX Disable Input
- 40°C to +85°C Operating Temperature Option
- 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	"B" option	- 5	+ 70	°C
	"A" option	- 40	+ 85	
	"C" option	- 25	+ 85	
Supply Voltage	V_{cc}	0	+ 5.0	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
Optical Output Power ¹	LX ²	P_O	- 9.0	-	- 3.0	dBm
	EX		- 4.5	-	0	
	YX		- 2.0	-	+ 3.0	
	ZX		0	-	+ 5.0	
Center Wavelength	LX	λ_c	1275	1310	1357	nm
	EX		1280	1310	1335	
	YX, ZX		1500	1550	1580	
Spectral Width (RMS)	LX	$\Delta\lambda_{RMS}$	-	-	2.5	nm
Spectral Width (-20dB)	EX, YX, ZX	$\Delta\lambda_{20}$	-	-	1.0	nm
Side Mode Suppression Ratio	EX, YX, ZX	$SMSR$	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 ³	YX	-	-	-	1.2	dB
	ZX		-	-	1.5	
Transmitter Output Eye	Compliant with Eye Mask Defined in IEEE 802.3z and FC-PI Rev. 13 Standards					
¹ Measured average power coupled into single mode fiber (SMF).						
² For 50 μ m or 62.5 μ m multimode fiber (MMF) operation, the output power is 0.5dB less and is measured after a SMF offset-launch mode-conditioning patch cord as specified in IEEE 802.3z.						
³ Specified at 1440ps/nm (YX) and 1600ps/nm (ZX) dispersion, which corresponds to the approximate worst-case dispersion for 72km and 80km G.652/G.654 fiber over the wavelength range of 1500 to 1580nm.						

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	LX	P_{min}	- 20.0	-	-	dBm
	EX		- 22.5	-	-	
	YX, ZX		- 24.0	-	-	
Maximum Input Optical Power (10^{-12} BER) ¹		P_{max}	- 3.0	-	-	dBm
LOS Thresholds	Increasing Light Input	LX	-	-	- 20.0	dBm
		EX	-	-	- 22.5	
		YX, ZX	-	-	- 24.0	
	Decreasing Light Input	LX	- 30.0	-	-	
EX, YX, ZX		- 35.0	-	-		
LOS Timing Delay	Increasing Light Input	t_{loss_off}	-	-	100	μ 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		λ	1100	-	1600	nm
Optical Return Loss		ORL	12	-	-	dB
Electrical 3dB Upper Cutoff Frequency		-	-	-	1500	MHz
Stressed Receiver Sensitivity		Compliant with IEEE 802.3z Standard				
¹ When measured with 2 ⁻¹ PRBS at 125Mb/s, 1062.5Mb/s & 1250Mb/s and 1310nm for LX & EX, and 1550nm for YX & ZX.						

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-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 V_{CC} .
³ Open collector compatible, 4.7 to 10kΩ pull-up resistor to V_{CC} (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-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

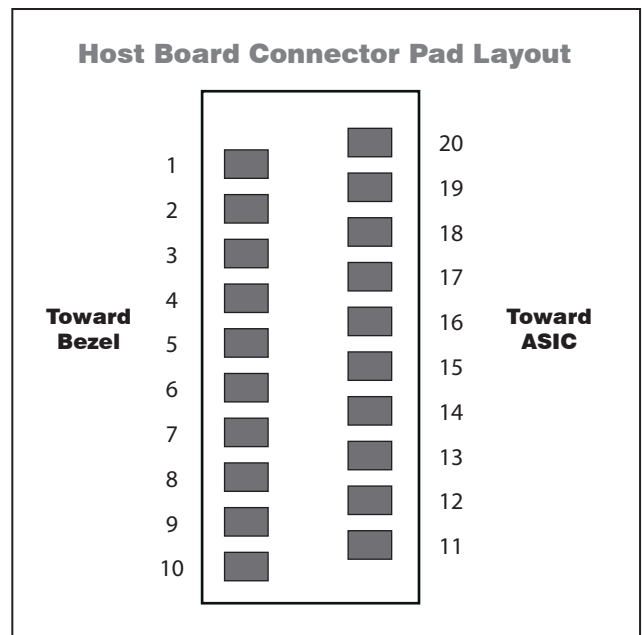
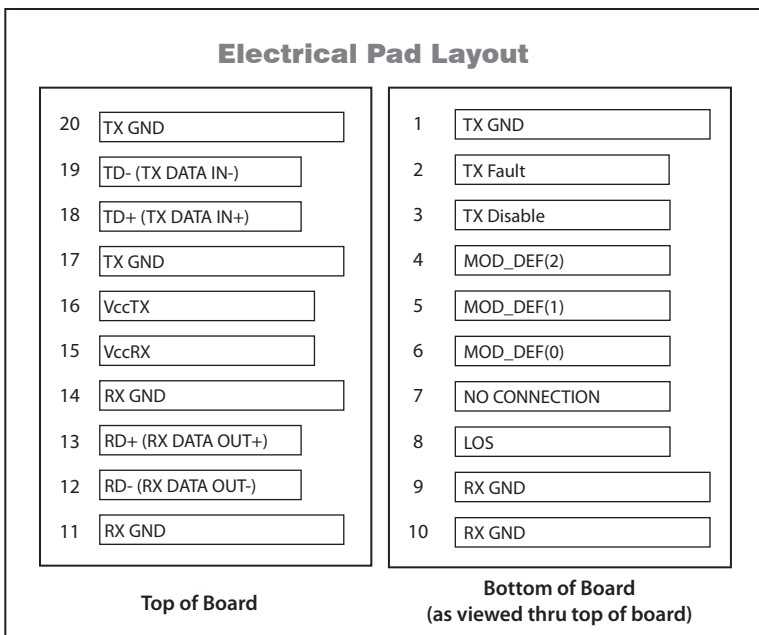
¹ Differential peak-to-peak voltage across external 100Ω load.
² Open collector compatible, 4.7 to 10kΩ pull-up resistor to V_{CC} (Host Supply Voltage).

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

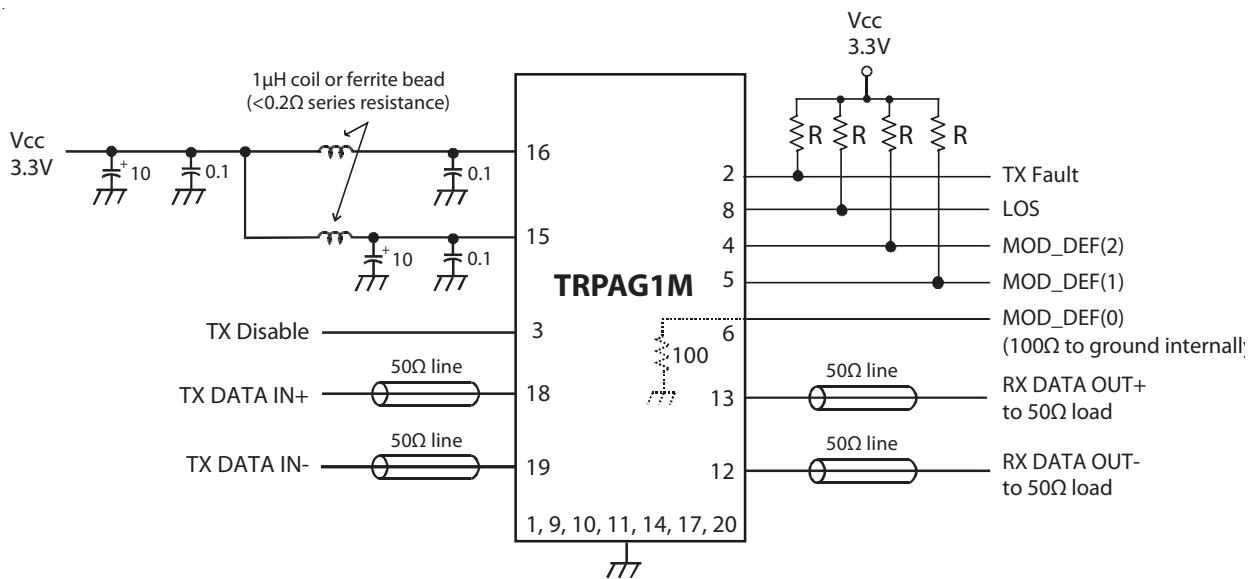
Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	V_{CC}	3.13	3.3	3.47	V
Supply Current	I_{CC}	-	200	300	mA

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



Example of SFP host board schematic



R: 4.7 to 10kΩ

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 in 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)

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

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.

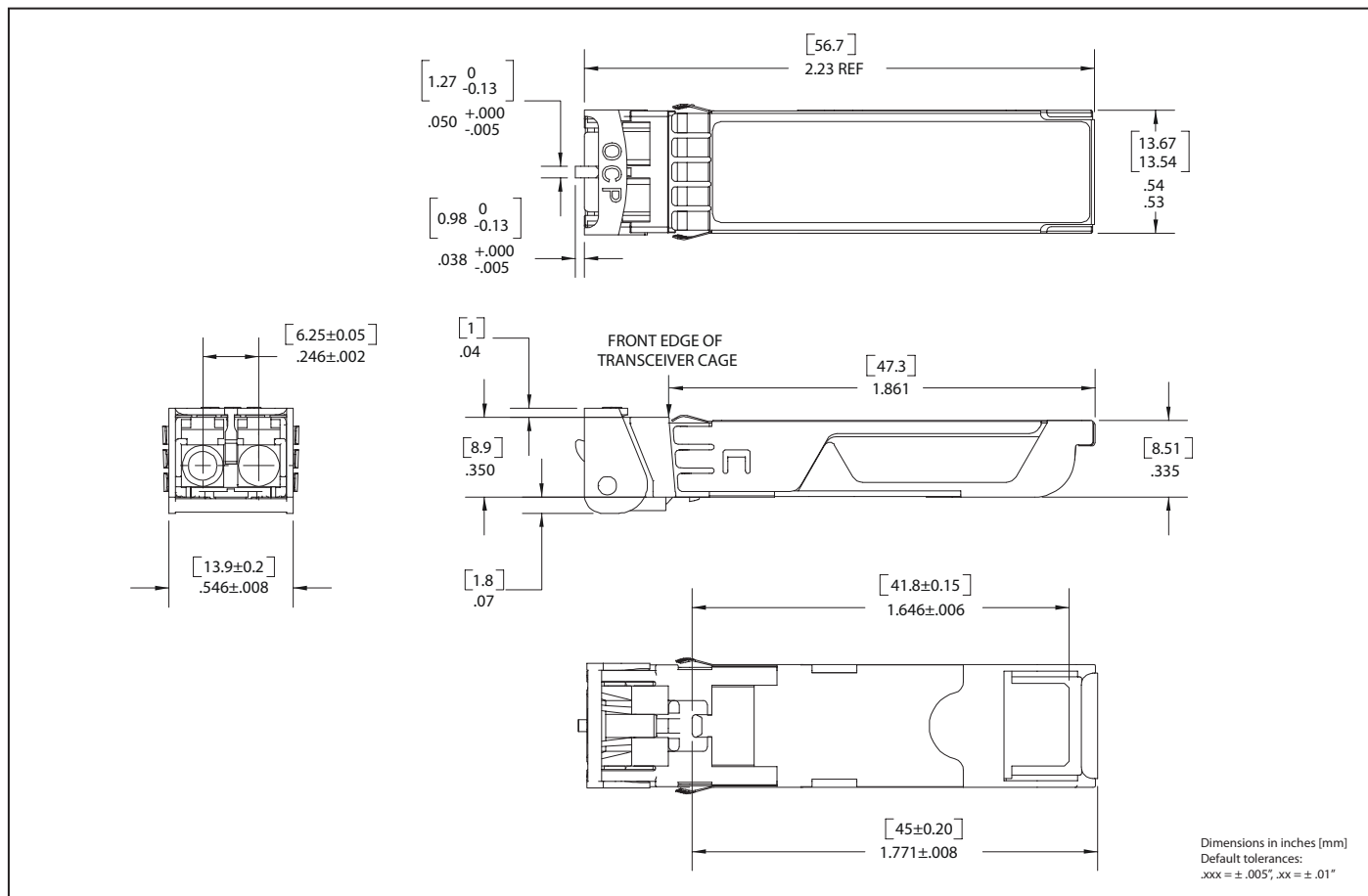
The data transfer protocol and the details of the mandatory and vendor specific data structures are defined in the SFP MSA, and SFF-8472, Rev. 9.3.

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.



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

Ordering Information

Oplink can provide a remarkable range of customized optical solutions. For detail, please contact Oplink's Sales and Marketing for your requirements and ordering information (510) 933-7200 or Sales@oplink.com.

Model Name	Operation Temperature	Latch Color	Nominal Wavelength	Optical Link Power Budget	Reach ¹
TRPAG1LXDDBM	-5°C to +70°C	Blue	1310nm	11dB min.	12/2km
TRPAG1EXJBNM	-5°C to +70°C	Brown	1310nm	18dB min.	21/15km
TRPAG1YXHBOM	-5°C to +70°C	Orange	1550nm	22dB min.	42/40km
TRPAG1ZXIBGM	-5°C to +70°C	Green	1550nm	24dB min.	85/80km
TRPAG1LXDABM	40°C to +85°C	Blue	1310nm	11dB min.	12/2km
TRPAG1EXJANM	40°C to +85°C	Brown	1310nm	18dB min.	21/15km
TRPAG1YXHCOM	-25°C to +85°C	Orange	1550nm	22dB min.	42/40km
TRPAG1ZXICGM	-25°C to +85°C	Green	1550nm	24dB min.	85/80km

¹ 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.
² Assuming a total connector and splice loss of 2dB, total system penalty of 2dB and fiber cable loss of 0.35dB/km.
³ Assuming a total connector and splice loss of 2dB, total system penalty of 2dB and fiber cable loss of 0.25dB/km.