



# TRXAG1VXIxMS

## Very Long Haul Gigabit Ethernet SFP Transceivers with Digital Diagnostics



### Features

- Lead Free Design & Fully RoHS Compliant
- Compatible with SFP MSA
- Digital Diagnostics through Serial Interface
- Internal Calibration for Digital Diagnostics
- APD Receiver
- Up to 120km with Single Mode Fiber
- Loss of Signal Output & Tx Disable Input
- Hot-pluggable
- Eye Safe (Class I Laser Safety)
- Duplex LC Optical Interface
- Single +3.3V Power Supply

### Description

The TRXAG1VXIxMS SFP fiber optic transceivers with integrated digital diagnostics monitoring functionality offer a quick and reliable interface for Gigabit Ethernet applications. 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 1550nm DFB laser and an ultra high sensitivity Avalanche Photodiode (APD) receiver to provide a minimum optical link power budget of 32dB, corresponding to a transmission distance of around 120km of single mode fiber (assuming a total connector and splice loss of 2dB, total system penalty of 3dB and fiber loss of 0.22dB/km). The transceivers satisfy Class I Laser Safety requirements in accordance with the U.S. FDA/CDRH and international IEC-60825 standards.

The TRXAG1VXIxMS 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 (“B” option) or -5°C to +85°C (“E” option). The housing is made of metal to enhance EMI protection.

### Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Storage Temperature	$T_{st}$	- 40	+ 85	°C
Operating Case Temperature <sup>1</sup>	"B" option	- 5	+ 70	°C
	"E" option	- 5	+ 85	
Supply Voltage	$V_{CC}$	0	+ 5.0	V
Maximum Input Optical Power (30 seconds max.)	-	-	+ 3.0	dBm
Input Voltage	$V_{in}$	0	$V_{CC}$	V
Lead Terminal Finish, Reflow Profile Limits and MSL	-	-	NA	-

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

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## Transmitter Performance Characteristics (over Operating Case Temperature, $V_{CC} = 3.13$ to $3.47V$ )

All parameters are guaranteed only at typical data rate

Parameter	Symbol	Minimum	Typical	Maximum	Units
Operating Data Rate <sup>1</sup>	$B$	-	1250	-	Mb/s
Optical Output Power	$P_o$	0	-	+ 5.0	dBm
Center Wavelength	$\lambda_c$	1500	1550	1580	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
Dispersion Penalty <sup>2</sup>	-	-	-	2.0	dB
Transmitter Output Eye	Compliant with Eye Mask Defined in IEEE 802.3z Standard				

<sup>1</sup>Data rate ranges from 125Mb/s to 1300Mb/s. However, some degradation may be incurred in overall performance.

<sup>2</sup>Specified at 2400ps/nm dispersion, which corresponds to the approximate worst-case dispersion for 120km G652 fiber respectively over the wavelength range of 1500 to 1580nm.

## Receiver Performance Characteristics (over Operating Case Temperature, $V_{CC} = 3.13$ to $3.47V$ )

All parameters are guaranteed only at typical data rate

Parameter	Symbol	Minimum	Typical	Maximum	Units
Operating Data Rate <sup>1</sup>	$B$	-	1250	-	Mb/s
Minimum Input Optical Power ( $10^{-12}$ BER) <sup>2</sup>	$P_{min}$	- 32.0	- 35.0	-	dBm
Maximum Input Optical Power ( $10^{-12}$ BER) <sup>2</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	-	1600	nm
Optical Return Loss	$ORL$	12	-	-	dB
Electrical 3dB Upper Cutoff Frequency	-	-	-	1500	MHz

<sup>1</sup>Data rate ranges from 125Mb/s to 1300Mb/s. However, some degradation may be incurred in overall performance.

<sup>2</sup>Measured with  $2^7-1$  PRBS at 1250Mb/s and 1550nm wavelength.

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



**Optical Communication Products, Inc.**  
DATE OF MANUFACTURE:

MANUFACTURED IN THE USA

This product complies with  
21 CFR 1040.10 and 1040.11

**Meets Class I Laser Safety Requirements**

# TRXAG1VXIxMS

## 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-) <sup>1</sup>	$V_{PP-DIF}$	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 10k $\Omega$  pull-up resistor to  $V_{CC}$ .  
<sup>3</sup>Open collector compatible, 4.7 to 10k $\Omega$  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-) <sup>1</sup>	$V_{PP-DIF}$	0.4	-	1.75	V
Output HIGH Voltage (LOS) <sup>2</sup>	$V_{OH}$	$V_{CC} - 1.3$	-	$V_{CC} + 0.3$	V
Output LOW Voltage (LOS) <sup>2</sup>	$V_{OL}$	0	-	0.5	V

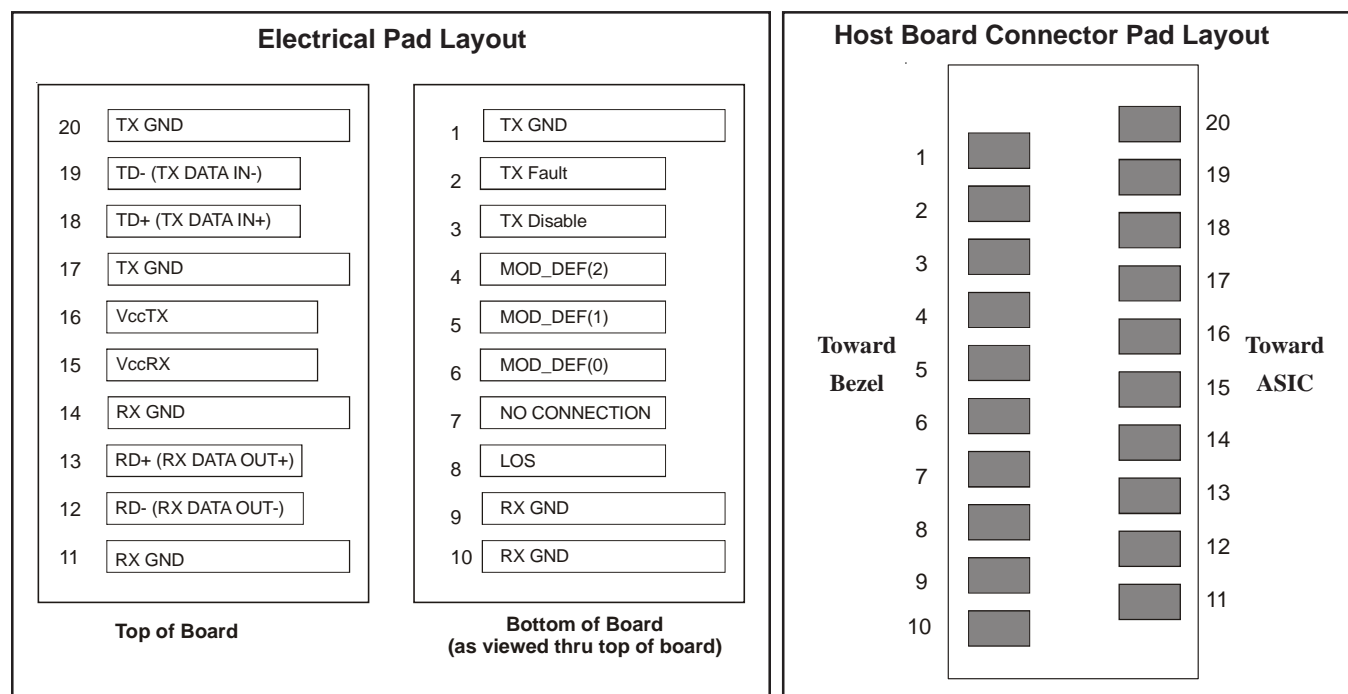
<sup>1</sup>Differential peak-to-peak voltage across external 100 $\Omega$  load.  
<sup>2</sup>Open collector compatible, 4.7 to 10k $\Omega$  pull-up resistor to  $V_{CC}$  (Host Supply Voltage).

## 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	$I_{CC}$	-	175	300	mA

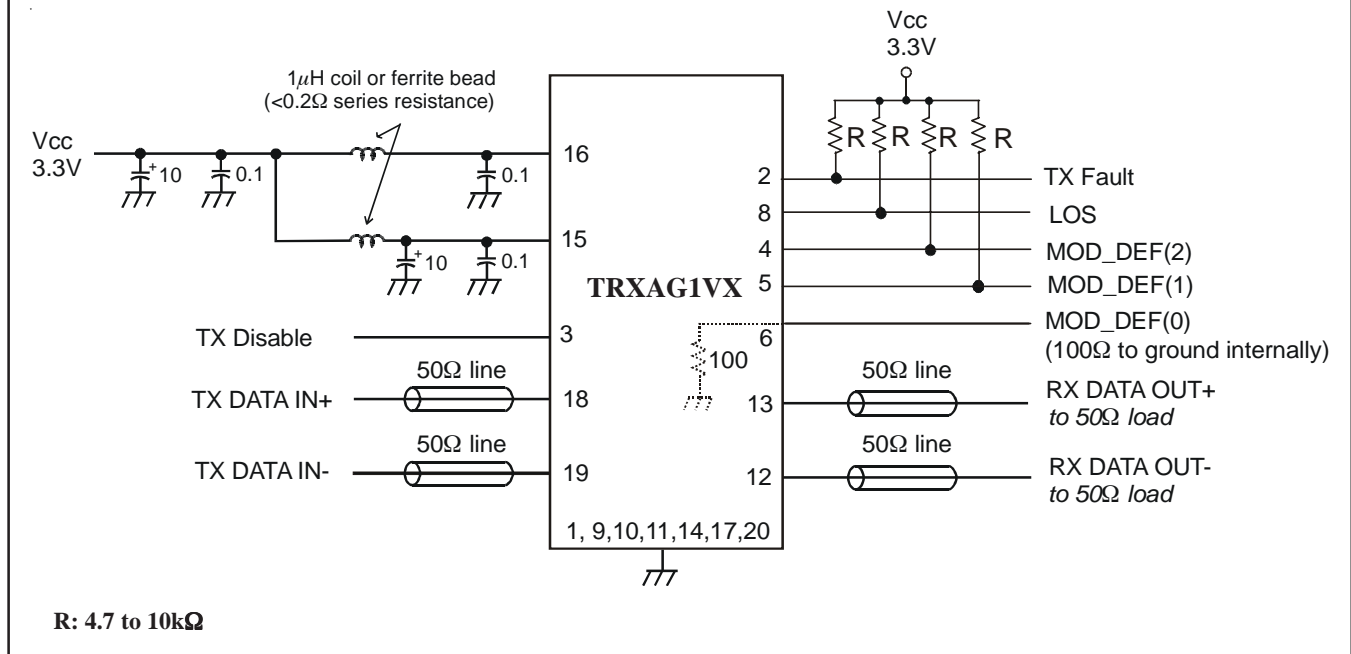
## Module Definition

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



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## 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 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).

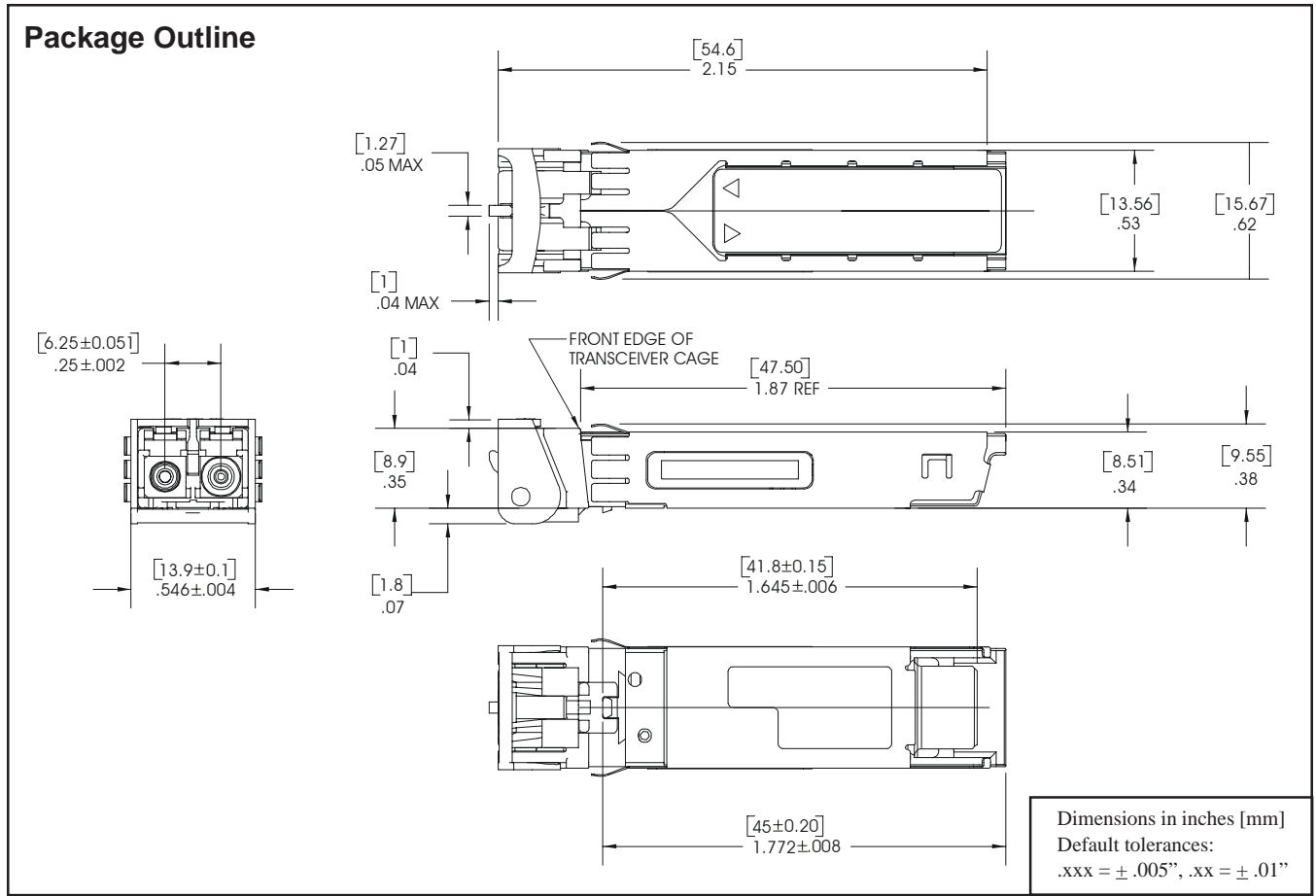
Upon power up, MOD\_DEF(1:2) appear as NC (no connection), and MOD\_DEF(0) is TTL LOW. When the host system detects this condition, it activates the serial protocol (standard two-wire I<sup>2</sup>C serial interface) and generates the serial clock signal (SCL). The positive edge clocks data into the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

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## Ordering Information

Model Name	Operating Temperature	Latch Color	Nominal Wavelength	Optical Link Power Budget	Distance <sup>1</sup>
TRXAG1VXIBMS	- 5°C to +70°C	Magenta	1550nm	32dB min.	120km <sup>2</sup>
TRXAG1VXIEMS	- 5°C to +85°C	Magenta	1550nm	32dB min.	120km <sup>2</sup>

<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.

<sup>2</sup>Assuming a total connector and splice loss of 2dB, total system penalty of 3dB and fiber loss of 0.22dB/km.

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