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

TRPAG1M CWDM MR

The TRPAG1M 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 I2C serial interface per the Multi-Source Agreement (MSA) SFF-8472, Rev. 9.3.

There are eight center wavelengths available: 1471nm, 1491nm, 1511nm, 1531nm, 1551nm, 1571nm, 1591nm and 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 accordanc with the U.S. FDA/ CDRH and international IEC-60825 standards.

The TRPAG1M 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 ACcoupled 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 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 plastic and metal for EMI immunity.



Features

- ☑ 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 and 24dB to Support 62km and 70km (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
- ☑ Hot-pluggable

Absolute Maximum Ratings

Parameter		Symbol	Minimum	Maximum	Units
Storage Temperature		T_{ST}	- 40	+ 85	°C
Operating Case Temperature[1]	"B" Option	T_{OP}	- 5	+ 70	°C
	"E" Option		- 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
Optical Output Power [1]	YX	P_O	- 2.0	-	+ 3.0	dBm
	ZX		0	-	+ 5.0	
Center Wavelength	1471	λ_C	1464.5	1471	1477.5	nm
	1491		1484.5	1491	1497.5	
	1511		1504.5	1511	1517.5	
	1531		1524.5	1531	1537.5	
	1551		1544.5	1551	1557.5	
	1571		1564.5	1571	1577.5	
	1591		1584.5	1591	1597.5	
	1611		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 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 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
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		*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] Measured with 27-1 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.
DATE OF MANUFACTURE:

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-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-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

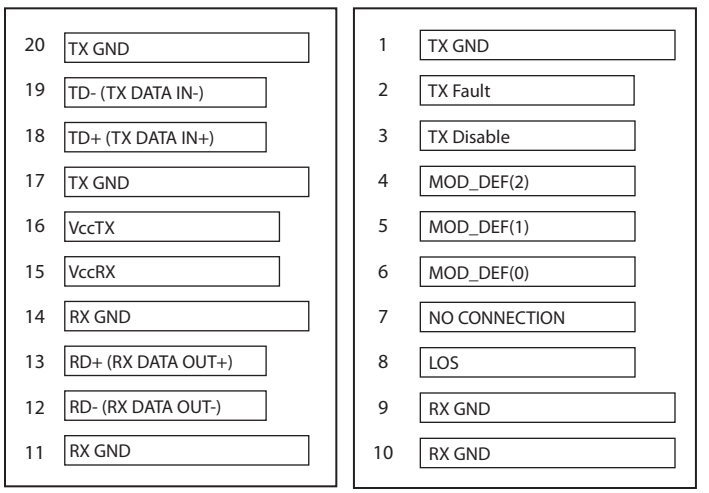
(Over Operating Case Temperature. V_{CC} = 3.13 to 3.47V))

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

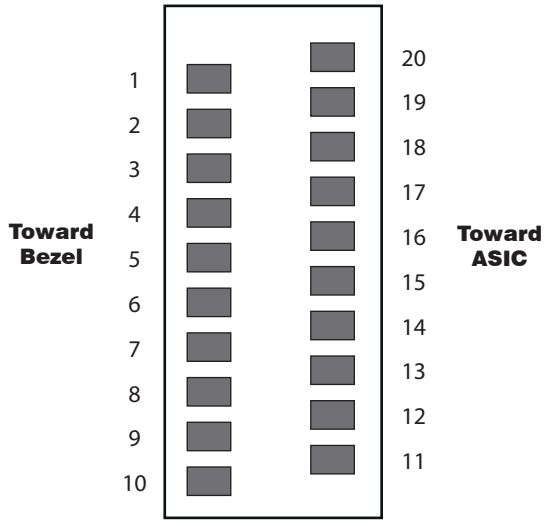
Module Definition

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

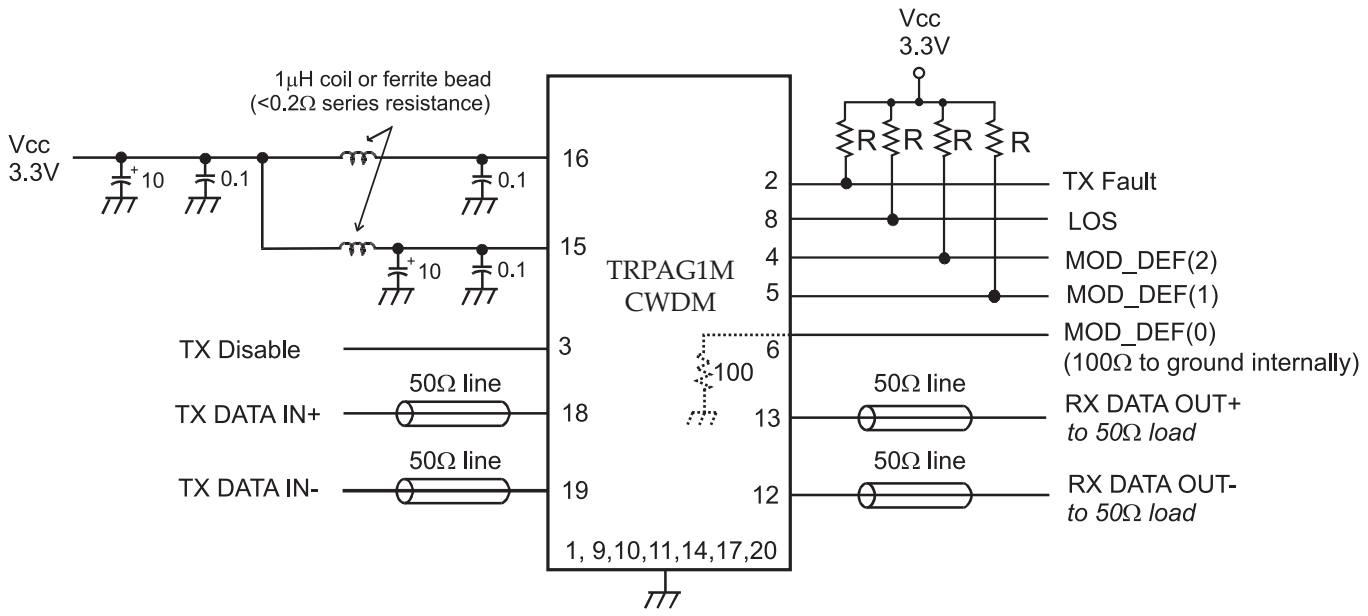
Electrical Pad Layout



Host Board Connector Pad Layout



Example of SFP host board schematic



R: 4.7 to 10kΩ

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 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).

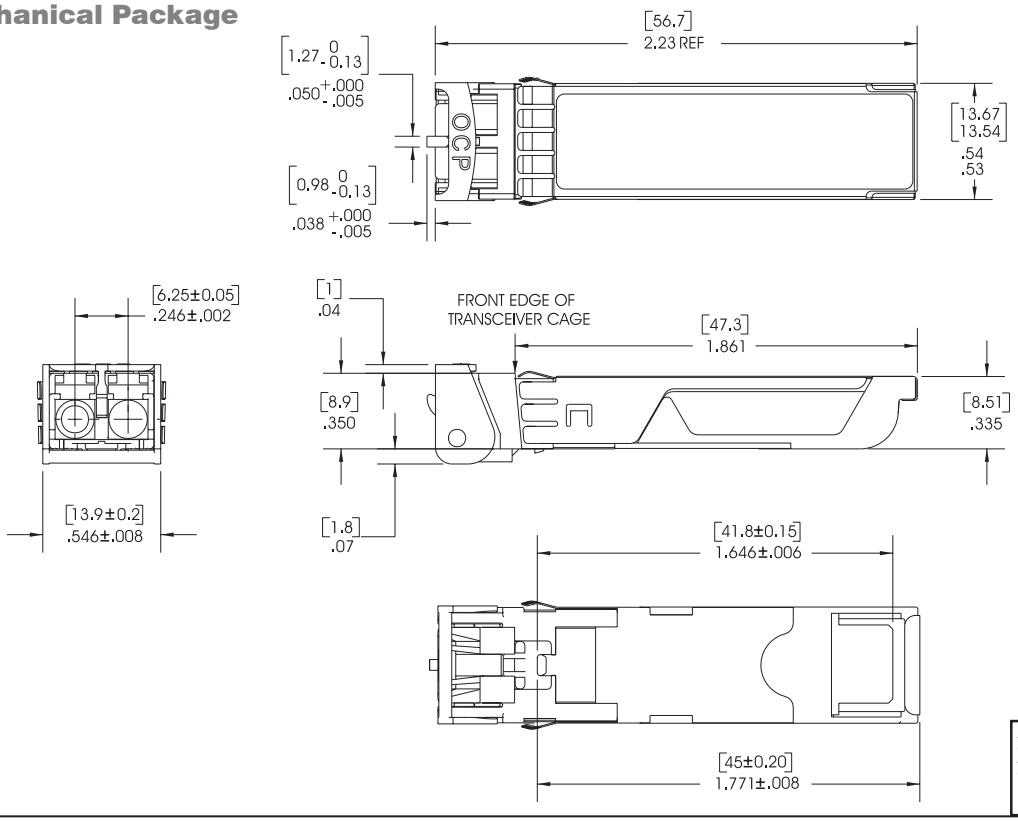
Upon power up, MOD_DEF(1:2) appear as NC (no connection), and MOD_DEF(0) is TTL LOW. When the host system detects this condition, it activates the serial protocol (standard two-wire I^2C serial interface) and generates the serial clock signal (SCL). The positive edge clocks data into the EEPROM segments 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 mandatoryand vendor specific data structures are defined in the SFPMSA, and SFF-8472, Rev. 9.4

Power supply and grounding: The power supply line shouldbe 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

Model Name		Operating Temperature	Nominal Wavelength (nm)	Latch Color
22dB Link Budget Color (62km Distance)[1]	24dB Link Budget (70km Distance)[1]			
TRPAG1YXHBAM1	TRPAG1ZXIBAM1	- 5°C to +70°C	1471	Gray
TRPAG1YXHBVM2	TRPAG1ZXIBVM2	- 5°C to +70°C	1491	Violet
TRPAG1YXHBBM3	TRPAG1ZXIBBM3	- 5°C to +70°C	1511	Blue
TRPAG1YXHBGM4	TRPAG1ZXIBGM4	- 5°C to +70°C	1531	Green
TRPAG1YXHBYM5	TRPAG1ZXIBYM5	- 5°C to +70°C	1551	Yellow
TRPAG1YXHBOM6	TRPAG1ZXIBOM6	- 5°C to +70°C	1571	Orange
TRPAG1YXHBRM7	TRPAG1ZXIBRM7	- 5°C to +70°C	1591	Red
TRPAG1YXHBNM8	TRPAG1ZXIBNM8	- 5°C to +70°C	1611	Brown
TRPAG1YXHEAM1	TRPAG1ZXIEAM1	- 5°C to +85°C	1471	Gray
TRPAG1YXHEVM2	TRPAG1ZXIEVM2	- 5°C to +85°C	1491	Violet
TRPAG1YXHEBM3	TRPAG1ZXIEBM3	- 5°C to +85°C	1511	Blue
TRPAG1YXHEGM4	TRPAG1ZXIEGM4	- 5°C to +85°C	1531	Green
TRPAG1YXHEYM5	TRPAG1ZXIEYM5	- 5°C to +85°C	1551	Yellow
TRPAG1YXHEOM6	TRPAG1ZXIEOM6	- 5°C to +85°C	1571	Orange
TRPAG1YXHERM7	TRPAG1ZXIERM7	- 5°C to +85°C	1591	Red
TRPAG1YXHENM8	TRPAG1ZXIENM8	- 5°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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