

Features

- ◆ Compliant with the 300 pin SFF MSA
- ◆ Support multi-rate from 9.953Gb/s to 11.3Gbps
- ◆ Full C-band integrated tunable laser and MZ modulator
- ◆ High sensitivity PIN receiver
- ◆ 50GHz channel spacing
- ◆ ± 800 ps/nm chromatic dispersion
- ◆ 16-bit parallel 622.08Mbps LVDS data interface
- ◆ Compliant I2C MSA (Edition 4.0) interface for monitoring/control
- ◆ Built-in SBS dither
- ◆ Optional Optical Tx Trace ID (Tx_trace)
- ◆ Supply voltage: +5.0V, +3.3V, and -5.2V
- ◆ Compact size (2"x3"x0.53") or (2"x3"x0.45")
- ◆ Operating case temperature: -5°C to +70°C

Applications

- ◆ Metro/Regional/Long haul DWDM system
- ◆ SONET/SDH, Ethernet and Fiber Channel system at standard and FEC rates
- ◆ Sparring and inventory reduction
- ◆ Optical Transport Network (OTN) system



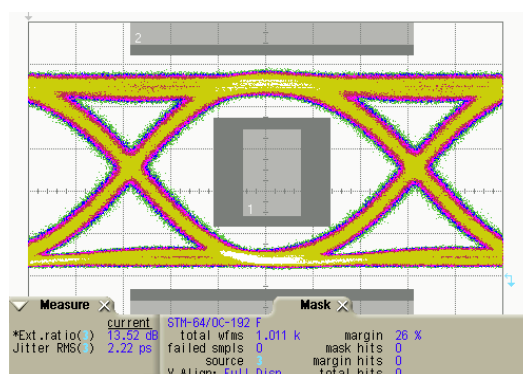
Description

TPT-MR-04-CCDL5A C-band tunable 300 pin SFF transponder is designed for DWDM system applications with dispersion window from -800 to +800ps/nm. It provides multi-rate capability from 9.95Gbps to 11.3Gbps.

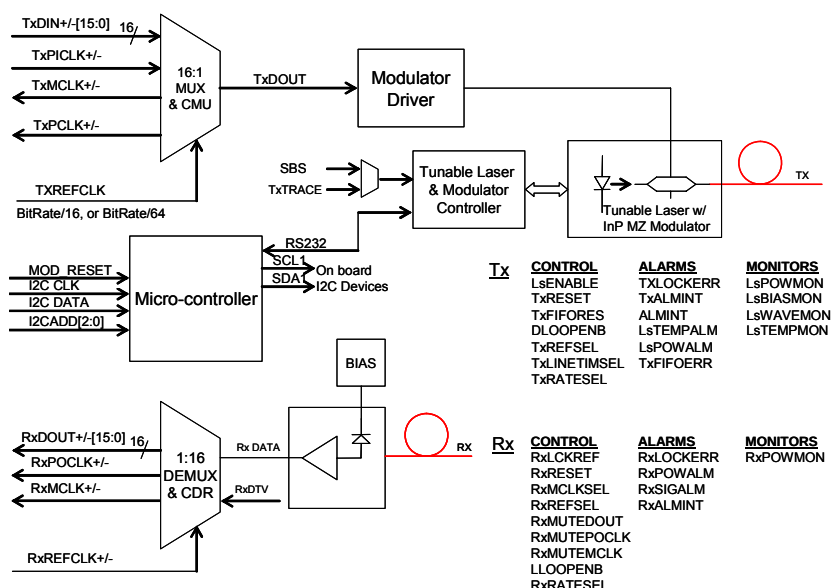
The integrated C band tunable laser and MZ modulator transmitter converts the electrical data into a 10Gbit/s optical signal. The low noise PIN receiver converts the incoming optical signal back to electrical data.

The MUX section multiplexes 16 parallel 622Mb/s electrical channels into a 10Gb/s serial data stream and sends it to the transmitter. The DEMUX section demultiplexes the 10Gb/s electrical data stream into 16 parallel 622Mb/s electrical channels. The parallel data is sent out to and receive from the 300-pin MSA (Multi Source Agreement) compliant connector.

The transmitter and receiver reference clock rates are selectable: divide by either 16 or 64.



Function Block Diagram



Absolute Maximum Ratings

Table 1 Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T _S	-40	85	°C
Supply Voltage	V _{CC}	-0.5	5.5	V
	V _{DD}	-0.5	3.575	V
	V _{EE}	-6.0	0.3	V
Max Rx Input Power	P _{in_max}		2	dBm
Operating Relative Humidity (non-condensing)	RH	5	85	%
Electro-Static Discharge	ESD	-	500	V

Recommended Operating Conditions

Table 2 - Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating Case Temperature	T _C	-5	-	70	°C
Supply Voltage	V _{CC}	4.75	5.0	5.25	V
	V _{DD}	3.13	3.3	3.46	V
	V _{EE}	-5.46	-5.2	-4.94	V
Supply Current	I _{CC}	-	-	250	mA
	I _{DD}	-	-	1800 ¹⁾	mA
	I _{EE}	-	-	800 ²⁾	mA
Power consumption	P _d	-	7	10	W
Power supply noise rejection		-	-	50	mVp-p
Bit Rate	BR	9.95	-	11.3	Gbps

Note: 1) Transient current up to 2000mA.

2) Transient current up to 1300mA.

Optical Interface Characteristics

Table 3 - Optical Characteristics

Parameter		Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter							
Wavelength Range		λ_C (f_C)	1528.77 (196.1)	-	1563.86 (191.7)	nm THz	1
Output Power		P _{OUT}	3	-	6	dBm	
Output Power Stability		ΔP	-0.5	-	0.5	dB	
Output Power at laser disable		P _{OUT-OFF}			-30	dBm	
Channel Spacing		CS	50	-	-	GHz	
Wavelength Tuning Accuracy		$\Delta\lambda$	-25		25	pm	
Wavelength Stability		λ_{drift}	-25		25	pm	
Tuning Time		T _{tuning}			30	s	
Side Mode Suppression Ratio		SMSR	45			dB	
Chirp (α)		α	-0.1		0.1		
Extinction Ratio		ER	12			dB	
Output Optical Eye		Compliant with Telcordia GR-253-CORE and ITU-T G.691					
Jitter Generation	20kHz~80MHz				0.3	UIpp	2
	4MHz~80MHz				0.1	UIpp	2
Receiver							
Centre Wavelength		λ_C	1528		1565	nm	3
Receiver Sensitivity		P _{in_L}		-18	-17	dBm	4
Receiver Overload		P _{in_H}	0			dBm	4
Optical Path Penalty		OPP			2	dB	
Chromatic Dispersion Tolerance		CDT	-800		800	ps/nm	
Reflection of Receiver					-27	dB	
Jitter Tolerance		Compliant with Telcordia GR-253 and ITU-T G.825					
Jitter Transfer		Compliant with Telcordia GR-253 and ITU-T G.825					
Mechanical Housing							
Fiber Pigtail Length		Fiber_L	1000		1200	mm	
Module Dimension		LxWxH	76.07x55.75x13.46			mm	5
			2.995x2.195x0.53			inch	5

Notes:

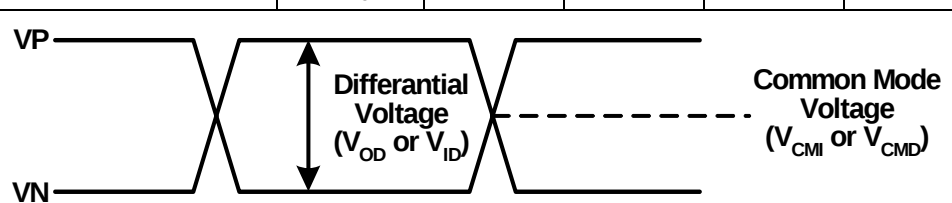
- 89 channel tuning range is the standard spec. Wider tuning range is available upon special request
- Measured with a NRZ PRBS 2³¹-1 test pattern @ 9.95328Gbps.
- The Rx can accept a wider input wavelength range from 1290 to 1605nm with some performance degradation.

4. Measured with a NRZ PRBS $2^{31}-1$ test pattern @ 9.95328Gbps, BER $\leq 1 \times 10^{-12}$, Back to back.
5. Thinner thickness of 0.449" or 11.40mm housing is also available.

Electrical Interface Characteristics

Table 4 - LVDS Input/Output Specification

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
LVDS interface						
Input High-voltage	V_{IH}	925		2400	mV	
Input Low-voltage	V_{IL}	825		1900	mV	
Input Common Mode Voltage	V_{IC}	850		1800	mV	
Single-ended Input-voltage Swing	V_{SIN}	100		650	mV	
Differential Input-voltage Swing	V_{DIN}	200		1300	mV	
Input Differential impedance	R_{ID}	80	100	120	Ω	
Output High-voltage	V_{OH}	1160		1550	mV	
Output Low-voltage	V_{OL}	925		1200	mV	
Output Common Mode Voltage	V_{CM}	1050		1425	mV	
Single-ended Output-voltage Swing	V_{SOUT}	250		450	mV	
Differential Output-voltage Swing	V_{DOUT}	500		900	mV	
Output Differential impedance	R_{OD}	40	100	140	Ω	
Rise Time/Fall time	$T_{rise/fall}$	100		250	ps	
Clock Signal Duty Cycle	T_{DC}	45	50	55	%	



Definition of Differential Voltage Levels

Table 5 - LVTTTL Input/Output Specification

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Input High Voltage	V_{IH}	2.0			V	
Input Low Voltage	V_{IL}			0.65	V	
Input High Current	I_{IH}			45	μA	
Input Low Current	I_{LH}			30	μA	
Output High Voltage	V_{IH}	2.4			V	$I_{OH}=600 \mu A$
Output Low Voltage	V_{IL}			0.4	V	$I_{OL}=-600 \mu A$
Rise Time/Fall time	$T_{rise/fall}$	1		15	ns	10pF capacitive load
Operating Frequency	$F_{operating}$			10	MHz	

Clock and Data Interfaces

Table 6- Reference Clock characteristics

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter						
Frequency	TxREFCLKP TxREFCLKN	155.52/622.08			MHz	Serial data-rate is 9.953Gbps
Frequency tolerance		-100		+100	ppm	±20ppm is required to meet SONET output frequency spec
Rise/Fall time	Tr/Tf	200		800	ps	155.52MHz, 20% to 80% amplitude
		100		300	ps	622.08MHz, 20% to 80% amplitude
Duty Cycle	T _{DC}	45	50	55	%	
Receiver						
Frequency	RxREFCLKP RxREFCLKN	155.52/622.08			MHz	Serial data-rate is 9.953Gbps
Frequency tolerance		-100		+100	ppm	
Rise/Fall time	Tr/Tf	200		800	ps	155.52MHz, 20% to 80% amplitude
		100		300	ps	622.08MHz, 20% to 80% amplitude
Duty Cycle	T _{DC}	45	50	55	%	

Table 7 - Transmitter/Receiver Parallel Data/Clock Interface

Parameter	Symbol	Level	Notes
Transmitter 16-bit parallel Data Input	TxDin[0:15]P/N	LVDS	TxDin0:LSB, TxDin15:MSB
Transmitter Source synchronous Parallel Input Clock	TxPICKLP/N	LVDS	
Transmitter Counter Clock	TxPCLKP/N	LVDS	
Receiver 16-bit parallel Data Output	RxDout[0:15]P/N	LVDS	RxDout0:LSB, RxDout15:MSB
Receiver Source synchronous Parallel Output Clock	RxPOCLKP/N	LVDS	

Table 8 - Transmitter/Receiver Parallel Data/Clock Timing

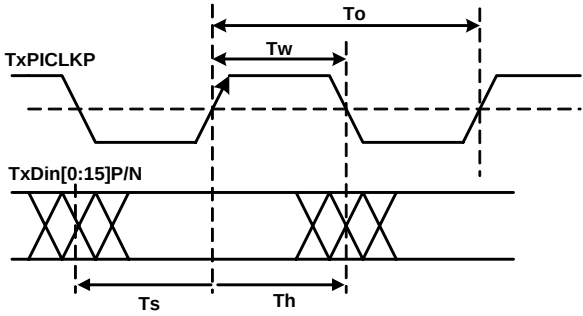
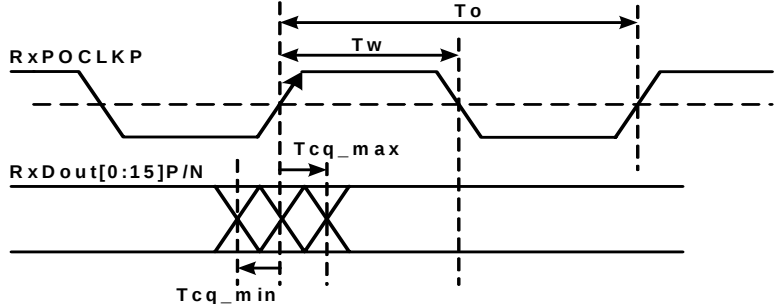
Parameter		Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter Data/Clock Timing: SERDES Input Timing at SERDES pin							
TxPICKLK	Duty Cycle(T_W/T_O)	T_{DC}	40	50	60	%	
	Rise and Fall time	T_r/T_f	100		300	ps	20 – 80%
TxDin	Setup time	T_s	300			ps	
	Hold time	T_h	300			ps	
 T_s: Measuring from the LHS inner data eye to the immediate rising edge of clock pulse T_h: Measuring from the rising edge of clock pulse to the inner RHS of data eye							
Receiver Data/Clock Timing: SERDES Output Timing at SERDES pin							
RxPOCLK	Duty Cycle(T_W/T_O)	T_{DC}	45		55	%	
	Rise and Fall time	T_r/T_f	100		300	ps	20 – 80%
Rx Dout	Data/Clock skew	T_{cq_min} ,	-250		250	ps	
		T_{cq_max}	-250		250	ps	
							

Table 9 - Monitor Clock

Parameter	Symbol	Level	Notes
Transmitter monitor clock	TxMCLKP/N	LVDS	The LVDS TxMCLK is either a 1/16 or 1/64 replica of the clock used to time the serial data output. The rate of the TxMCLK is always the same as that of the TxREFCLK
Receiver monitor clock	RxMCLKP/N	LVDS	The LVDS RxMCLK is a 1/16 or 1/64 replica of the clock recovered from the incoming data

Digital Control Signal

Table 10 - Input Digital signals

Function	Symbol	Level		Description	Note
Module RESET	MOD_RESET	LVTTL	L	Module reset	Reset both Tx and Rx section (LVTTL with pull-up resistor)
			H	Normal operation	
Transmitter					
Select the frequency of TxREFCLK	TxREFSEL	LVTTL	L	1/64 data-rate	(LVTTL with pull-up resistor)
			H	1/16 data-rate	
Enable internal Line Timing	TxLINETIMSEL	LVTTL	L	Enable	(LVTTL with pull-up resistor)
			H	Normal operation	
Enable/Disable Laser	LsENABLE	LVTTL	L	Normal operation	(LVTTL with pull-down resistor)
			H	Laser disabled	
MUX FIFO reset	TxFIFOES	LVTTL	L	MUX FIFO reset	Internally Tx FIFOERR is connected to Tx FIFOES, Tx FIFOERR will initiate a FIFO reset (LVTTL with pull-up resistor)
			H	Normal operation	
Receiver					
Select the frequency of RxREFCLK	RxREFSEL	LVTTL	L	1/64 data-rate	(LVTTL with pull-down resistor)
			H	1/16 data-rate	
Select the frequency of RxMCLK	RxMCLKSEL	LVTTL	L	1/64 data-rate	(LVTTL with pull-up resistor)
			H	1/16 data-rate	
Lock RxPOCLK to RxREFCLK	RxLCKREF	LVTTL	L	Lock to RxREFCLK	(LVTTL with pull-up resistor)
			H	Normal operation	
Mutes the RxDOOUT[0:15]	RxMUTEDOUT	LVTTL	L	Mutes the RxDOOUT[0:15]	(LVTTL with pull-up resistor)
			H	Normal operation	
Mutes the receiver output monitor clock	RxMUTEMCLK	LVTTL	L	Mutes the RxMCLK	(LVTTL with pull-up resistor)
			H	Normal operation	
Mutes receiver parallel output clock RxPOCLK	RxMUTEPOCLK	LVTTL	L	Mutes the RxPOCLK	(LVTTL with pull-up resistor)
			H	Normal operation	

Digital Alarm Signal

Table 11 - Alarms Digital signals

Function	Symbol	Level	Description		Note
Common Digital Signal					
Indicates all alarm active	ALMINT	LVTTL	L	Any alarm from both transmitter and receiver	Activation Time: 50ms Deactivation Time: 50ms
			H	Normal operation	
Transmitter					
Loss of Tx PLL lock	TxLOCKERR	LVTTL	L	Alarm active	Loss of transmitter PLL lock Activation Time: 1ms Deactivation Time: 1ms
			H	Normal operation	
MUX FIFO error	TxFIFOERR	LVTTL	L	Alarm active (FIFO overflow)	Internally TxFIFOERR is connected to TxFIFOES,
			H	Normal operation	
Laser bias out of range	LsBIASALM	LVTTL	L	Alarm active (laser bias current alarm)	Activation Time: 50 ms Deactivation Time: 50 ms
			H	Normal operation	
Laser temperature out of range	LsTEMPALM	LVTTL	L	Alarm active	Activation Time : 50ms Deactivation Time : 50ms
			H	Normal operation	
Laser output power out of range	LsPOWALM	LVTTL	L	Alarm active	BOL Activation Time : 50ms Deactivation Time : 50ms
			H	Normal operation	
Tx alarms	TxALMINT	LVTTL	L	Alarm from transmitter	Activation Time: 50 ms; Deactivation Time: 50 ms
			H	Normal operation	
Receiver					
Loss of Rx PLL lock	RxLOCKERR	LVTTL	L	Alarm active	Activation Time: 1ms Deactivation Time: 1ms
			H	Normal operation	
Loss of receiver signal power alarm	RxPOWALM	LVTTL	L	Alarm active	Activation Time: <100μs Deactivation Time: <100μs
			H	Normal operation	
Rx alarms	RxALMINT	LVTTL	L	Alarm from receiver	Activation Time: 50 ms; Deactivation Time: 50 ms
			H	Normal operation	

Analog Monitoring Signal

Table 12 - Monitor Signals

Function	Symbol	Min.	Typ.	Max.	Unit
Transmitter					
Normalized laser power monitor voltage BOL	LsPOWMON	0.47	0.5	0.53	V
Laser power monitor voltage slope		0.25 V change for 50% power variation			
Laser bias monitor voltage offset	LsBIASMON	0.2	0	2	V
Laser bias monitor voltage slope		18	20	22	mV/mA
Normalized laser temperature Monitor voltage	LsTEMPMON	2.4	2.5	2.6	V
Laser temperature Monitor voltage slope		23	25	27	mV/°C
Receiver					
Input optical power monitor voltage slope	RxPOWMON	6	8	10	V/mW
Input optical power monitor error		-2		+2	dB

I2C Serial Interface

Table 13 – I2C Interface

Function	Symbol	Level	Description	Note
I2C Address	I2CAD0	LVTTL	I2C address input for module addressing (LSB)	(LVTTL with pull-down resistor)
	I2CAD1	LVTTL	I2C address input for module addressing	(LVTTL with pull-down resistor)
	I2CAD2	LVTTL	I2C address input for module addressing (MSB)	(LVTTL with pull-down resistor)
I2C Clock	I2CCLOCK	Open collector	I2C clock input/output for remote access	N/A
I2C Data	I2CDATA	Open collector	I2C data input/output for remote access	N/A

Pin Definitions

Table 14 - Pin Function Definitions

	K	J	H	G	F	E	D	C	B	A
1	+5V	NUC	GND	RxDout12P	NUC	RxDout8P	GND	RxDout4P	GND	RxDout0P
2	+5V	FFU	GND	RxDout12N	NUC	RxDout8N	GND	RxDout4N	GND	RxDout0N
3	RxRATESEL0	RxRATESEL1	NUC	GND	RxPOWMON	GND	I2CAD0	GND	RxDTV	GND
4	+3.3V	NUC	GND	RxDout13P	+3.3V	RxDout9P	GND	RxDout5P	GND	RxDout1P
5	+3.3V	NUC	GND	RxDout13N	+3.3V	RxDout9N	GND	RxDout5N	GND	RxDout1N
6	RxRESET	NUC	DLOOPENB	GND	RxPOWALM	GND	I2CAD1	GND	RxMUTE DOUT	GND
7	+3.3V	FFU	GND	RxDout14P	+3.3V	RxDout10P	GND	RxDout6P	GND	RxDout2P
8	+3.3V	FFU	GND	RxDout14N	+3.3V	RxDout10N	GND	RxDout6N	GND	RxDout2N
9	RxMUTEPOCLK	NUC	FFU	GND	NUC	GND	I2CAD2	GND	RxLCKREF	GND
10	-5.2V	NUC	GND	RxDout15P	-5.2V	RxDout11P	GND	RxDout7P	GND	RxDout3P
11	-5.2V	NUC	GND	RxDout15N	-5.2V	RxDout11N	GND	RxDout7N	GND	RxDout3N
12	RxMUTEMCLK	NUC	FFU	GND	RxSIGALM	GND	MOD_RESET	GND	RxMCLKSEL	GND
13	-5.2V	FFU	GND	FFU	-5.2V	RxPOCLKP	GND	RxMCLKP	GND	RxREFCLKP
14	-5.2V	RxALMINT	GND	FFU	-5.2V	RxPOCLKN	GND	RxMCLKN	GND	RxREFCLKN
15	I2CCLOCK	NUC	ALMINT	GND	RxREFSEL	GND	FFU	GND	RxLOCKERR	GND
16	+5V	TxALMINT	GND	TxDin12P	NUC	TxDin8P	GND	TxDin4P	GND	TxDin0P
17	+5V	FFU	GND	TxDin12N	NUC	TxDin8N	GND	TxDin4N	GND	TxDin0N
18	I2CDATA	NUC	FFU	GND	LsBIASMON	GND	LsPOWMON	GND	NUC	GND
19	+3.3V	NUC	GND	TxDin13P	+3.3V	TxDin9P	GND	TxDin5P	GND	TxDin1P
20	+3.3V	NUC	GND	TxDin13N	+3.3V	TxDin9N	GND	TxDin5N	GND	TxDin1N
21	TxRATESEL0	TxRATESEL1	FFU	GND	LsENABLE	GND	LsTEMPMON	GND	NUC	GND
22	+3.3V	FFU	GND	TxDin14P	+3.3V	TxDin10P	GND	TxDin6P	GND	TxDin2P
23	+3.3V	FFU	GND	TxDin14N	+3.3V	TxDin10N	GND	TxDin6N	GND	TxDin2N
24	TxRESET	NUC	FFU	GND	LsBIASALM	GND	FFU	GND	FFU	GND
25	-5.2V	NUC	GND	TxDin15P	-5.2V	TxDin11P	GND	TxDin7P	GND	TxDin3P
26	-5.2V	NUC	GND	TxDin15N	-5.2V	TxDin11N	GND	TxDin7N	GND	TxDin3N
27	TxFIFORES	NUC	LLOOPENB	GND	LsTEMPALM	GND	FFU	GND	TxPICKSEL	GND
28	-5.2V	FFU	GND	TxPICKLP	-5.2V	TxPCLKP	GND	TxMCLKP	GND	TxREFCLKP
29	-5.2V	TxTRACE	GND	TxPICKLN	-5.2V	TxPCLKN	GND	TxMCLKN	GND	TxREFCLKN
30	TxFIFOERR	NUC	LINETIMESEL	GND	TxREFSEL	GND	LsPOWALM	GND	TxLOCKERR	GND
FFU: Reserved for Future Use				NUC: No Use Connection						

Mechanical Design Diagram

The mechanical design diagram is shown in Figure 2.

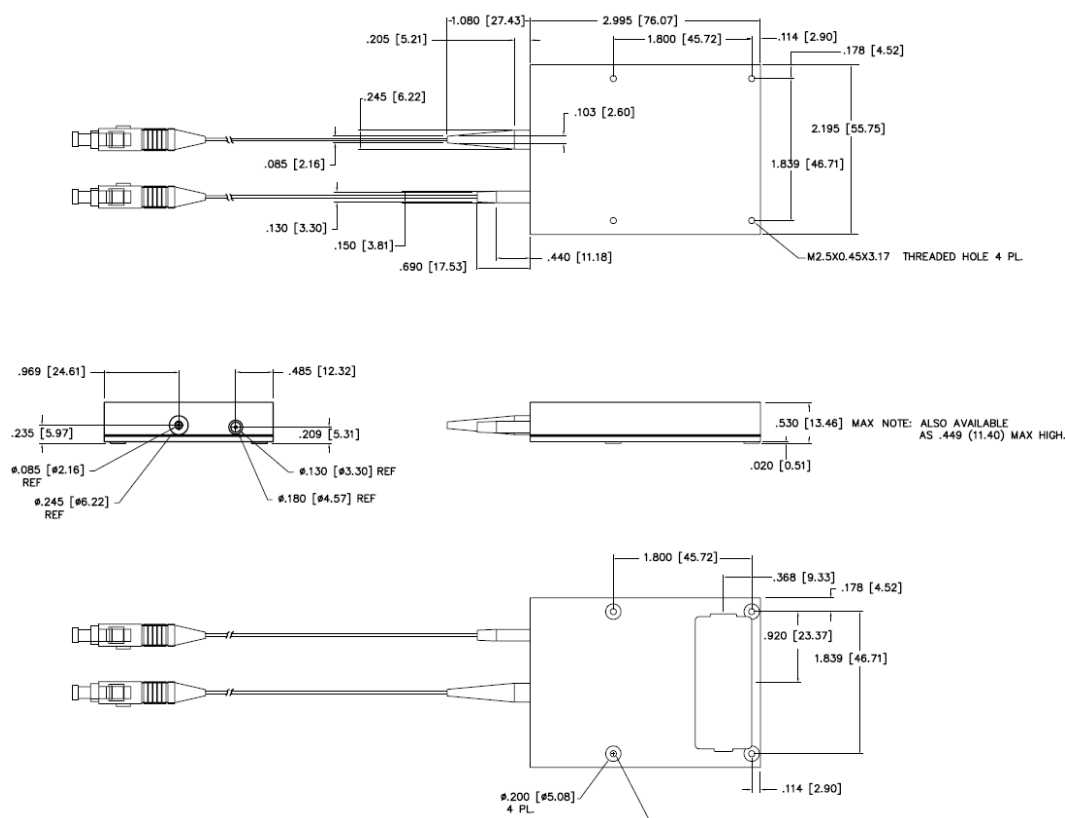


Figure 2, Mechanical Diagram

Ordering Information

Example:

Part No.	Product Description
TPT-MR-04-CCDL5A-XXX	General C-band Tunable, 9.95~11.3Gbps, zero-chirped optical transmitter, 10G SFF 300pin, LC connector, -5°C~+70°C

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
T P T - M R - X X - X C D X X A - X X X

- 14, 15, 16 Customer Code:
- 13 Revision: A: Revision A; B: Revision B;...
- 12 ROHS Compliance: 0: non ROHS; 5: RoHS compliant with all exemptions; F: RoHS compliant, lead free solder;
- 11 Connector Type: F: FC (UPC polish); L: LC (UPC polish); S: SC (UPC polish); X: Customer Specify
- 9, 10 Manufacture Internal Use
- 8 Tuning Range: C: C band; L: L band; S: S band
- 6, 7 Chirp Value: 04: 0 chirp; 08: pre-chirped
- 4, 5 Multi-rate: Fixed
- 1, 2, 3 10G SFF 300 PIN Tunable Transponder

Warnings

Handling Precautions: This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

Laser Safety: Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

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