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 APD receiver
- 50GHz channel spacing
- 1600ps/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
- Sparing and inventory reduction
- Optical Transport Network (OTN) system

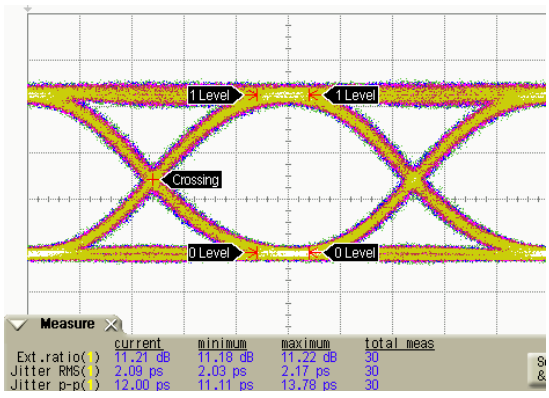
Description

TPT-MR-08-CCDL5A C-band tunable 300 pin SFF transponder is designed for DWDM system applications with dispersion window from 0 to 1600ps/nm. It provides multi-rate capability from 9.95Gbps to 11.3Gbps.

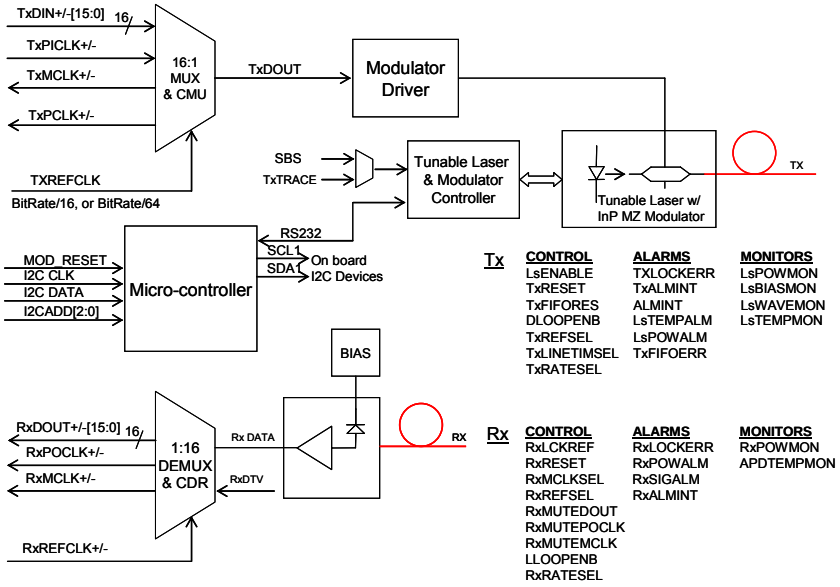
The integrated C band tunable laser and MZ modulator transmitter converts the electrical data into a 10Gbit/s optical signal. The low noise APD receiver converts the incoming optical signal back to electrical data.

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	Pd	-	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		Δλ	-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	-0.6	-0.7	-0.8		
Extinction Ratio		ER	10.5			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}		-26	-24	dBm	4
Receiver Overload		P_{in_H}	-5			dBm	4
Optical Path Penalty		OPP			2	dB	
Chromatic Dispersion Tolerance		CDT			1600	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:

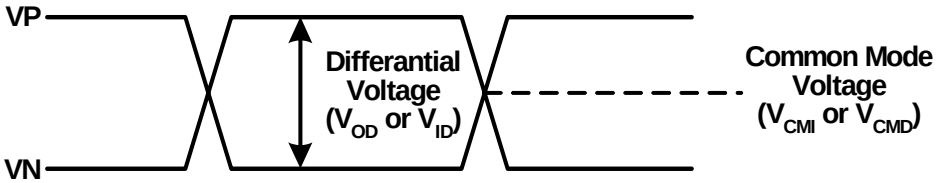
1. 89 channel tuning range is the standard spec. Wider tuning range is available upon special request
2. Measured with a NRZ PRBS 2^{31}-1 test pattern @ 9.95328Gbps.
3. The Rx can accept a wider input wavelength range from 1290 to 1605nm with some performance degradation.

4. Measured with a NRZ PRBS 2^{31}-1 test pattern @ 9.95328Gbps, BER ≤1x10-12, 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	VCM	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 Differantial Voltage Levels

Table 5 - LVTTL 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 μA
Output Low Voltage	V_{IL}			0.4	V	I_{OL}=-600 μA
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

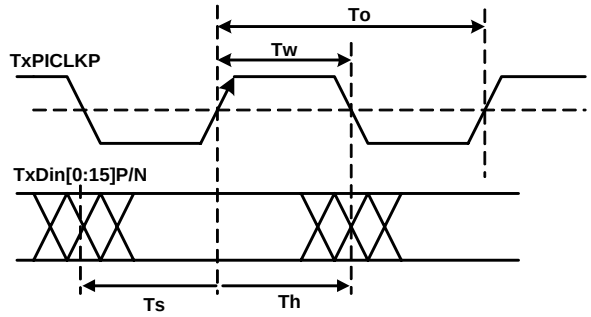
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter						
Frequency	TxREFCLKP TxREFCLKN	155.52/622.08			MHz	Serial data-rate is 9.953Gbps
Frequency tolerance		-100		+100	ppm	±20ppm is required to meet SONET output frequency spec
Rise/Fall time	Tr/Tf	200		800	ps	155.52MHz, 20% to 80% amplitude
		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 Date Input	TxDin[0:15]P/N	LVDS	TxDin0:LSB, TxDin15:MSB
Transmitter Source synchronous ParallelInput Clock	TxPICLKP/N	LVDS	
Transmitter Counter Clock	TxPCLKP/N	LVDS	
Receiver 16-bit parallel Date 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							
TxPICLK	Duty Cycle(T_W/T_O)	T_{DC}	40	50	60	%	
	Rise and Fall time	Tr/Tf	100		300	ps	20 – 80%
TxDin	Setup time	Ts	300			ps	
	Hold time	Th	300			ps	



Ts: Measuring from the LHS inner data eye to the immediate rising edge of clock pulse
Th: 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	Tr/Tf	100		300	ps	20 – 80%
RxDout	Data/Clock skew	Tcq_min,	-250		250	ps	
		Tcq_max	-250		250	ps	

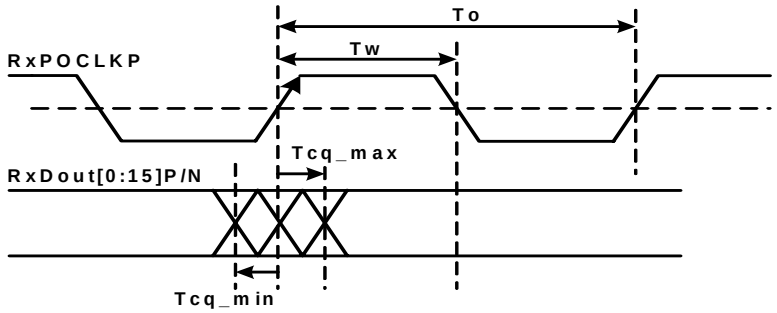


Table 9 - Monitor Clock

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	TxFIFORES	LVTTL	L	MUX FIFO reset	Internally TxFIFOERR is connected to TxFIFORES, TxFIFOERR 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 RxDOUT[0:15]	RxMUTEDOUT	LVTTL	L	Mutes the RxDOUT[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 TxFIFORES,
			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/℃
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	APDTEMPMON	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	TxPICLKSEL	GND
28	-5.2V	FFU	GND	TxPICLKP	-5.2V	TxPCLKP	GND	TxMCLKP	GND	TxREFCLKP
29	-5.2V	TxTRACE	GND	TxPICLKN	-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.

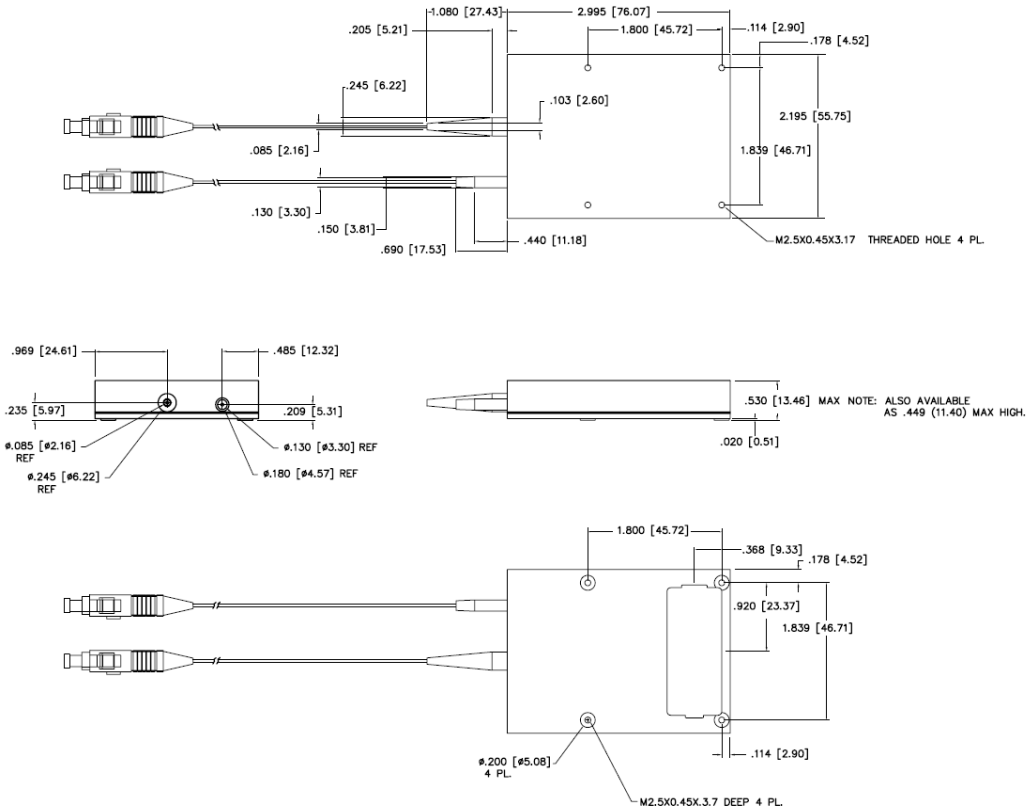


Figure 2, Mechanical Diagram

Ordering Information

Example:

Part No.	Product Description
TPT-MR-08-CCDL5A-XXX	General C-band Tunable, 9.95~11.3Gbps, pre-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 — **Connetor Type**: **F**: FC (UPC polish); **L**: LC (UPC polish); **S**: SC (UPC polish); **X**: Cusomer Specify
- 9, 10 — **Manufacture Internal Use**
- 8 — **Tuing 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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