

Features

- Compliant with the 300 pin SFF MSA
- Support multi-rate from 9.953Gb/s to 11.3Gbps
- C-band DWDM laser and PIN/APD receiver
- 100GHz channel spacing
- 800ps/nm chromatic dispersion
- 16-bit parallel 622.08Mbps LVDS data interface
- Compliant I2C MSA (Edition 4.0) interface for monitoring/control
- Supply voltage: +5.0V, +3.3V, +1.8V
- Operating case temperature: -5°C to +70°C

Applications

- Metro and Long haul DWDM system
- Forward Error Correction (FEC) system
- Optical Transport Network (OTN) System

Standard

Compliant with 300-PIN MSA
 Compliant with ITU-T G.691
 Compliant with ITU-T G.959.1
 Compliant with Telcordia GR-253
 Compliant with OIF SFI-4 interface
 Compliant with Telcordia GR-468-Core
 Compliant with IEC-60825-1 Class I



Description

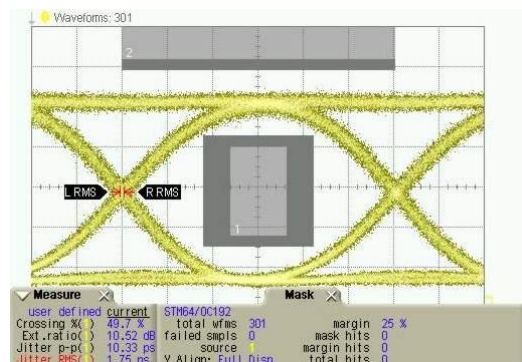
TPD-MR-04-XXXXX C-band DWDM 300 pin SFF transponder is intended for DWDM system applications with reaches of up to 40km, which provide multi-rate from 9.95Gbps to 11.3Gbps.

The transmitter converts the electrical data into 10Gbit/s optical signal, which uses externally EA modulated laser with specified driving circuit.

At the receiving side, the incoming data stream is received at 10Gb/s PIN/APD receiver, which converts it into a 10Gb/s electrical data stream.

The MUX section multiplexes 16 parallel 622Mb/s electrical channels into a 10Gb/s series data stream and sent it to the transmitter. And 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 get from the 300-pin MSA (Multi Source Agreement) compliant connector.

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



Function Block Diagram

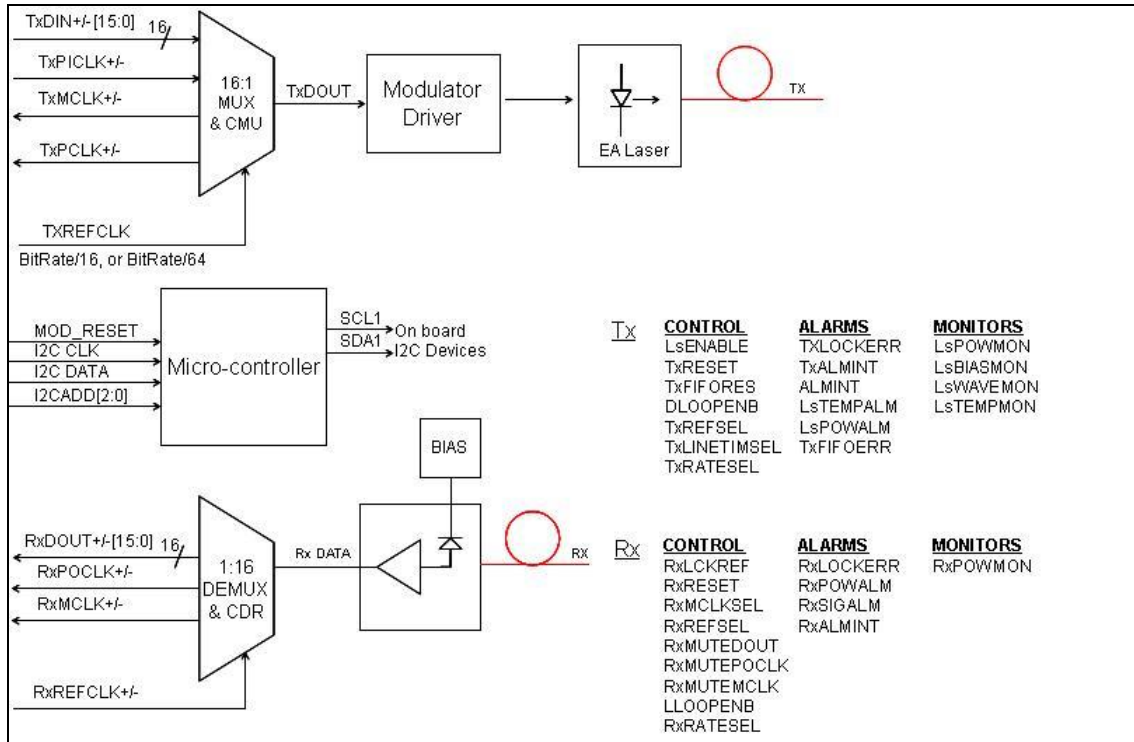


Figure 1, Function Block Diagram

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	6.0	V
	V _{dd1}	-0.5	4.2	V
	V _{dd2}	-0.5	3.3	V
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 _{dd1}	3.13	3.3	3.46	V
	V _{dd2}	1.71	1.8	1.89	V

Supply Current	I_{cc}	-	250	400	mA
	I_{dd1}	-	400	700	mA
	I_{dd2}	-	650	800	mA
Power consumption	P_d	-	3.8	6.0	W
Power supply noise rejection		-	-	50	mVp-p
Bit Rate	BR	9.95	-	11.3	Gbps

Optical Interface Characteristics

Table 3 - Optical Characteristics

Transmitter							
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes	
Wavelength Range	λ_c	1528.773	-	1565.047	nm		
	f_c	191.80	-	196.10	THz		
Output Power	P_{OUT}	-2	-	2	dBm	1	
Output Power Stability	ΔP	-0.5	-	0.5	dBm	1	
Output Power at laser disable	$P_{OUT-OFF}$	-	-	-30	dBm		
Channel Spacing		-	100	-	GHz		
Wavelength Stability		-100	-	100	pm		
Side Mode Suppression Ratio	SMSR	45	-	-	dB		
Extinction Ratio	ER	8.2	-	-	dB		
Chromatic Dispersion		-	-	800	ps/nm		
Output Optical Eye	Compliant with Telcordia GR-253-CORE and ITU-T G.691						
Jitter Generation	20kHz~80MHz	-	-	0.3	UI	2	
	4MHz~80MHz	-	-	0.1	UI	2	
Receiver							
Centre Wavelength	λ_c	1528	-	1565	nm		
Receiver Sensitivity	PIN	P_{IN}	-	-18	-17	dBm	3
	APD		-	-25	-24		
Receiver Overload	PIN	P_{IN-MAX}	0	-	-	dBm	3
	APD		-9	-	-		
Optical Path Penalty		-	-	2	dB		
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						

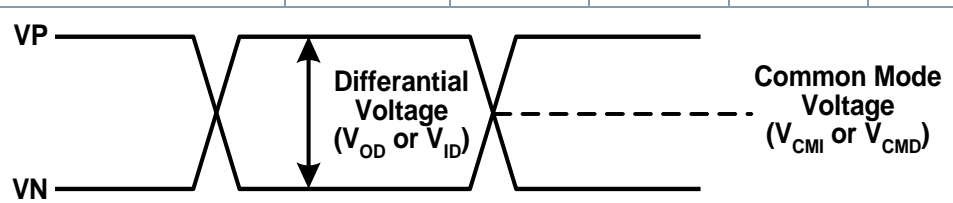
Notes:

1. The optical power is launched into SMF.
2. Measured with a NRZ PRBS $2^{31}-1$ test pattern @ 9.95328Gbps.
3. Measured with a NRZ PRBS $2^{31}-1$ test pattern @ 9.95328Gbps, BER $\leq 1 \times 10^{-12}$.

Electrical Interface Characteristics

Table 4 - LVDS Input/Output Specification

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Input Differential Voltage	V_{ID}	200	-	-	mV	
Input Differential impedance	R_{ID}	80	100	120	Ω	
Output Differential Voltage	V_{OD}	500	-	800	mV	
Output Differential impedance	R_{OD}	80	100	120	Ω	
Output Common Mode Voltage	V_{CM}	1.1	1.2	1.3	V	
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_{dd1}	V	
Input Low Voltage	V_{IL}	GND	-	0.8	V	
Output High Voltage	V_{IH}	2.4	-	V_{dd1}	V	
Output Low Voltage	V_{IL}	GND	-	0.4	V	

Clock and Data Interfaces

Table 6 - Reference Clock characteristics

Transmitter						
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Frequency	TxREFCLKP TxREFCLKN	155.52/622.08			MHz	Serial data-rate is 9.953Gbps
Frequency tolerance		-100	-	+100	ppm	
Rise/Fall time	T_r/T_f	-	-	500	ps	
Duty Cycle	T_{DC}	40	50	60	%	
Receiver						
Frequency	RxREFCLKP RxREFCLKN	155.52/622.08			MHz	Serial data-rate is 9.953Gbps

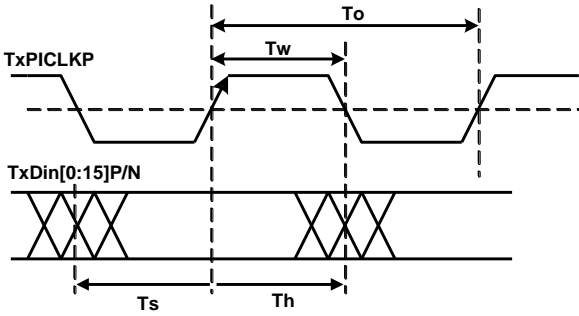
Frequency tolerance		-100	-	+100	ppm	
Rise/Fall time	T_r/T_f	-	-	500	ps	
Duty Cycle	T_{DC}	40	50	60	%	

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	TxPICLK/N	LVDS	
Transmitter Counter Clock	TxPCLK/N	LVDS	
Receiver 16-bit parallel Data Output	RxDout[0:15]P/N	LVDS	RxDout0:LSB, RxDout15:MSB
Receiver Source synchronous Parallel Output Clock	RxPOCLK/N	LVDS	

Table 8 - Transmitter/Receiver Parallel Data/Clock Timing

Transmitter Data/Clock Timing: SERDES Input Timing at SERDES pin							
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes	
TxPICLK	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	250	-	-	ps	
	Hold time	T_h	250	-	-	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							
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes	
RxPOCLK	Duty Cycle(T_w/T_o)	T_{DC}	40	-	60	%	
	Rise and Fall time	T_r/T_f	100	-	250	ps	20 – 80%
RxDout	Data/Clock skew	T_{cq_min}	-	-	200	ps	
		T_{cq_max}	-	-	200	ps	

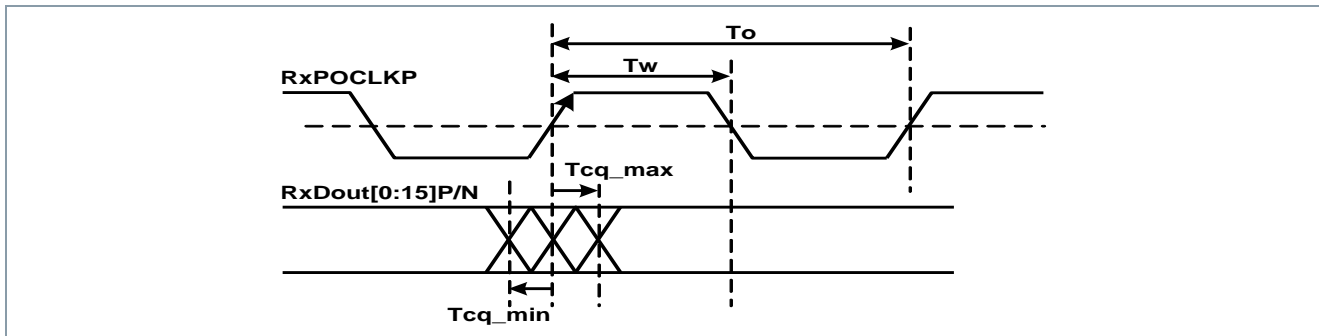


Table 9 - Monitor Clock

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	LVTTTL	L	Module reset	(LVTTTL with pull-up resistor)
			H	Normal operation	
Diagnostic Loopback	DLOOPENB	LVTTTL	L	Enable Loopback	(LVTTTL with pull-up resistor)
			H	Normal operation	
Line Loopback	LLOOPENB	LVTTTL	L	Enable Loopback	(LVTTTL with pull-up resistor)
			H	Normal operation	
Transmitter					
Reset MUX	TxRESET	LVTTTL	L	Reset MUX	(LVTTTL with pull-up resistor)
			H	Normal operation	
Transmitter Bit Rate Select	TxRATESEL1 TxRATESEL0	LVTTTL	0,0	10.3G	(LVTTTL with pull-up resistor)
			0,1	11.1/11.3G	
			1,0	10.7G	
			1,1	9.9G	
Select the frequency of TxREFCLK	TxREFSEL	LVTTTL	L	1/64 data-rate	(LVTTTL with pull-up resistor)
			H	1/16 data-rate	
Enable internal Line Timing	TxLINETIMSEL	LVTTTL	L	Enable	(LVTTTL with pull-up resistor)
			H	Normal operation	
Enable/Disable Laser	LsENABLE	LVTTTL	L	Normal operation	(LVTTTL with pull-down resistor)
			H	Laser disabled	

MUX reset	FIFO	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						
Reset DEMUX	RxRESET	LVTTL	LVTTL	L	Reset DEMUX	(LVTTL with pull-up resistor)
				H	Normal operation	
Receiver Bit Rate Select	RxRATESEL1 RxRATESEL0	LVTTL	LVTTL	0,0	10.3G	(LVTTL with pull-up resistor)
				0,1	11.1/11.3G	
				1,0	10.7G	
				1,1	9.9G	
Select the frequency of RxREFCLK	RxREFSEL	LVTTL	LVTTL	L	1/64 data-rate	(LVTTL with pull-down resistor)
				H	1/16 data-rate	
Select the frequency of RxMCLK	RxMCLKSEL	LVTTL	LVTTL	L	1/64 data-rate	(LVTTL with pull-up resistor)
				H	1/16 data-rate	
Lock RxPOCLK to RxREFCLK	RxLCKREF	LVTTL	LVTTL	L	Lock to RxREFCLK	(LVTTL with pull-up resistor)
				H	Normal operation	
Mutes the RxDOOUT[0:15]	RxMUTEDOUT	LVTTL	LVTTL	L	Mutes the RxDOOUT[0:15]	(LVTTL with pull-up resistor)
				H	Normal operation	
Mutes the receiver output monitor clock	RxMUTEMCLK	LVTTL	LVTTL	L	Mutes the RxMCLK	(LVTTL with pull-up resistor)
				H	Normal operation	
Mutes receiver parallel output clock RxPOCLK	RxMUTEPOCLK	LVTTL	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	
Indicates all alarm active	ALMINT	LVTTL	L	Any alarm from both transmitter and receiver	Activation Time: 10ms Deactivation Time: 10ms
			H	Normal operation	
Transmitter					

Loss of Tx PLL lock	TxLOCKERR	LVTTTL	L	Alarm active	Loss of transmitter PLL lock Activation Time: 10ms Deactivation Time: 10ms
			H	Normal operation	
MUX FIFO error	TxFIFOERR	LVTTTL	L	Alarm active (FIFO overflow)	Internally TxFIFOERR is connected to TxFIFORES,
			H	Normal operation	
Laser bias out of range	LsBIASALM	LVTTTL	L	Alarm active (laser bias current alarm)	Alarm when laser bias changes by a factor of 2 from beginning of life Activation Time: 10 ms Deactivation Time: 10 ms
			H	Normal operation	
Laser temperature out of range	LsTEMPALM	LVTTTL	L	Alarm active	Laser temperature 5°C from nominal, Activation Time : 10ms Deactivation Time : 10ms
			H	Normal operation	
Laser output power out of range	LsPOWALM	LVTTTL	L	Alarm active	Output power degrades 3dB below the BOL Activation Time : 10ms Deactivation Time : 10ms
			H	Normal operation	
Tx alarms	TxALMINT	LVTTTL	L	Alarm from transmitter	Activation Time: 10 ms; Deactivation Time: 10 ms
			H	Normal operation	
Receiver					
Loss of Rx PLL lock	RxLOCKERR	LVTTTL	L	Alarm active	Activation Time: 10ms Deactivation Time: 20ms
			H	Normal operation	
Loss of receiver average power alarm	RxPOWALM	LVTTTL	L	Alarm active	Activation Time: <10ms Deactivation Time: <10ms
			H	Normal operation	
Loss of receiver a.c.power alarm	RxSIGALM	LVTTTL	L	Alarm active	Activation Time: 10 ms; Deactivation Time: 10 ms
			H	Normal operation	
Rx alarms	RxALMINT	LVTTTL	L	Alarm from Receiver	Activation Time: 10 ms; Deactivation Time: 10 ms
			H	Normal operation	

Analog Monitoring Signal

Table 12 - Monitor Signals

Transmitter					
Function	Symbol	Min.	Typ.	Max.	Unit
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 slop			23	25	27	mV/°C
Normalized laser wavelength monitor voltage		LsWAVEMON	-	1.25	-	V
Laser temperature monitor voltage slop			-	200	-	mV/GHz
Receiver						
Input optical power monitor voltage slope	PIN	RxPOWMON	0.8	1	1.0	V/mW
	APD		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	LVTTTL	I2C address input for module addressing (LSB)	(LVTTTL with pull-down resistor)
	I2CAD1	LVTTTL	I2C address input for module addressing	(LVTTTL with pull-down resistor)
	I2CAD2	LVTTTL	I2C address input for module addressing (MSB)	(LVTTTL 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 15 - Pin Function Definitions

	K	J	H	G	F	E	D	C	B	A	
1	+5V	NUC	GND	RxDout12P	+1.8V	RxDout8P	GND	RxDout4P	GND	RxDout0P	
2	+5V	FFU	GND	RxDout12N	+1.8V	RxDout8N	GND	RxDout4N	GND	RxDout0N	
3	RxRATESEL0	RxRATESEL1	FFU	GND	RxPOWMON	GND	I2CAD0	GND	FFU	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	NUC	NUC	GND	RxDout15P	NUC	RxDout11P	GND	RxDout7P	GND	RxDout3P	
11	NUC	NUC	GND	RxDout15N	NUC	RxDout11N	GND	RxDout7N	GND	RxDout3N	
12	RxMUTEMCLK	NUC	FFU	GND	RxSIGALM	GND	MOD RESET	GND	RxMCLKSEL	GND	
13	NUC	FFU	GND	FFU	NUC	RxPOCLKP	GND	RxMCLKP	GND	RxREFCLKP	
14	NUC	RxALMINT	GND	FFU	NUC	RxPOCLKN	GND	RxMCLKN	GND	RxREFCLKN	
15	I2CCLOCK	NUC	ALM INT	GND	RxREFSEL	GND	FFU	GND	RxLOCKERR	GND	
16	+5V	TxALMINT	GND	TxDin12P	+1.8V	TxDin8P	GND	TxDin4P	GND	TxDin0P	
17	+5V	FFU	GND	TxDin12N	+1.8V	TxDin8N	GND	TxDin4N	GND	TxDin0N	
18	I2CDATA	NUC	FFU	GND	LsBIASMON	GND	LsPOWMON	GND	NUC	GND	
19	+3.3V	FFU	GND	TxDin13P	+3.3V	TxDin9P	GND	TxDin5P	GND	TxDin1P	
20	+3.3V	FFU	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	NUC	NUC	GND	TxDin15P	NUC	TxDin11P	GND	TxDin7P	GND	TxDin3P	
26	NUC	NUC	GND	TxDin15N	NUC	TxDin11N	GND	TxDin7N	GND	TxDin3N	
27	TxFIFORES	NUC	LLOOPENB	GND	LsTEMPALM	GND	FFU	GND	TxPICKSEL	GND	
28	NUC	LsWAVEMON	GND	TxPICKLP	NUC	TxPCLKP	GND	TxMCLKP	GND	TxREFCLKP	
29	NUC	FFU	GND	TxPICKLN	NUC	TxPCLKN	GND	TxMCLKN	GND	TxREFCLKN	
30	TxFIFOERR	NUC	TxLINETIMESEL	GND	TxREFSEL	GND	LsPOWALM	GND	TxLOCKERR	GND	
FFU: Reserved For Future Use				NUC: No Use Connection							

Mechanical Diagram

The mechanical design diagram is shown in Figure 2.

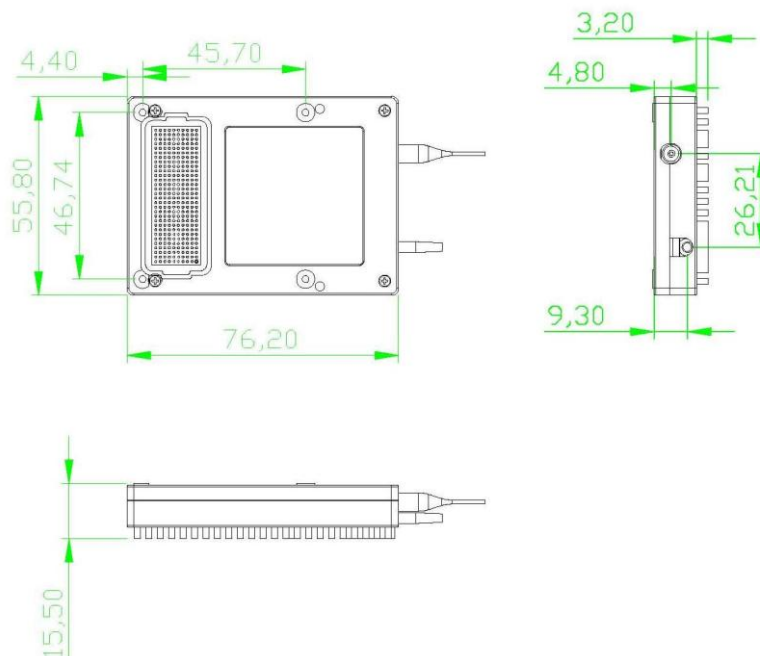


Figure 2, Mechanical Diagram

Ordering Information

Part No.	Product Description
TPD-MR-04-XXCDL5A	C-band DWDM Wavelength, 9.95~11.3Gbps, 40km, PIN receiver, 10G SFF 300pin, LC connector, -5°C~+70°C,
TPD-MR-04-XXCDL5B	C-band DWDM Wavelength, 9.95~11.3Gbps, 40km, APD receiver, 10G SFF 300pin, LC connector, -5°C~+70°C,
TPD-MR-04-XXCDS5A	C-band DWDM Wavelength, 9.95~11.3Gbps, 40km, PIN receiver, 10G SFF 300pin, SC connector, -5°C~+70°C,
TPD-MR-04-XXCDS5B	C-band DWDM Wavelength, 9.95~11.3Gbps, 40km, APD receiver, 10G SFF 300pin, SC connector, -5°C~+70°C,
TPD-MR-04-XXCDF5A	C-band DWDM Wavelength, 9.95~11.3Gbps, 40km, PIN receiver, 10G SFF 300pin, FC connector, -5°C~+70°C,
TPD-MR-04-XXCDF5B	C-band DWDM Wavelength, 9.95~11.3Gbps, 40km, APD receiver, 10G SFF 300pin, FC connector, -5°C~+70°C,

Note: XX is from 18 (191.80THz) to 61(196.10THz), 100GHz spacing.

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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