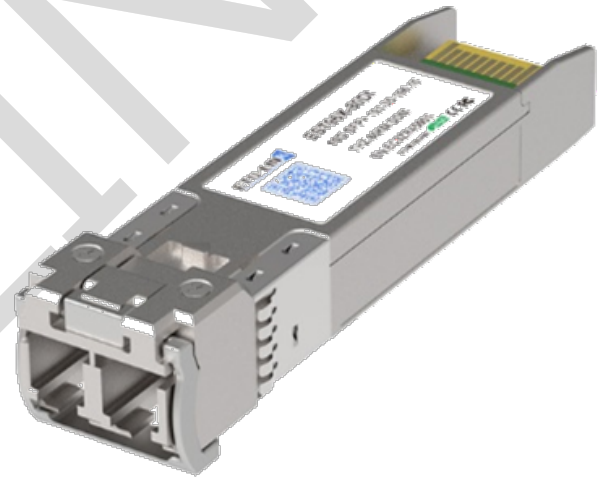


## ESTxxX-80D(I) Tunable

### 10Gb/s Tunable DWDM 80km SFP+ Transceiver

#### PRODUCT FEATURES

- Supports 9.95Gb/s to 11.3Gb/s bit rates
- Monolithically integrated full C-band tunable transmitter and APD receiver
- 50 GHz ITU channel spacing with integrated wavelength locker
- Up to 80km on 9/125µm SMF
- Hot-pluggable SFP+ footprint
- Compliant with SFP+ MSA with LC connector
- Metal enclosure, for lower EMI
- RoHS-10 compliant and lead-free
- Support Digital Diagnostic Monitoring interface
- Specifications compliant with SFF-8472 V11.3& SFF-8690 V1.4
- Single +3.3V power supply
- Temperature Range:
  - Commercial: 0°C ~70°C
  - Industrial: -40°C ~85°C



#### APPLICATIONS

- DWDM 10GBASE-ZR/ZW & 10G Ethernet
- DWDM SONET OC-192&SDH STM-64
- 10G Fiber Channel

## DESCRIPTIONS

The ETU-Link tunable transceiver is an integrated fiber optic transceiver that provides a high-speed serial link at signaling rates from 9.95 Gb/s to 11.3 Gb/s. The module complies with the 10 Gigabit Enhanced Small Form Factor Pluggable (SFP+) multisource agreement-MSA (SFF-8431) and SFF-8432, SFF-8690, SFF-8472. It complies with the ITU-T G.698.1 standard with 50 GHz channel spacing for SONET/SDH, IEEE DWDM 10GBASE-ZR for 80 km reach (Ethernet), and DWDM 10GFC for 80 km reach (Fiber Channel) applications.

The transceiver integrates the receiver and transmitter path on one module. The transceiver contain a C-band-tunable integrated Mach-Zehnder (MZ) laser, enabling data transmission over single-mode fiber through an industry-standard LC connector. On the receiver side, the 10 G/bps data stream is recovered from an APD/ trans-impedance amplifier, and passed to an output driver. This module features a hot-pluggable electrical interface.

ETU transceivers provide a unique enhanced digital diagnostic monitoring interface, which allows real-time access to device operating parameters such as transceiver temperature, laser bias current, transmitted optical power, and received optical power and transceiver supply voltage. It also defines a sophisticated system of alarm and warning flags, which alerts end-users when particular operating parameters are outside of a factory set normal range.

The SFP+ MSA defines a 256-byte memory map in EEPROM that is accessible over a 2-wire serial interface at the 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface makes use of the 8 bit address 1010001X (A2h), so the originally defined serial ID memory map remains unchanged.

## Ordering Information

Part No.	Data Rate(optical)	Laser	Fiber Type	Distance	Optical Interface	Temp	DDMI	Latch Color
ESTxxX-80D	10.3125Gbps	EML	SMF	80km	LC	0~70°C	Y	Green
ESTxxX-80DI	10.3125Gbps	EML	SMF	80km	LC	-40~85°C	Y	Green

## Wavelength Selection: C-band $\lambda$ c Wavelength Guide Pin Descriptions

Channel	Wavelength (nm)	Frequency (THZ)	Channel	Wavelength (nm)	Frequency (THZ)
1	1566.72	191.35	50	1546.92	193.8
2	1566.31	191.4	51	1546.52	193.85
3	1565.9	191.45	52	1546.12	193.9
4	1565.5	191.5	53	1545.72	193.95
5	1565.09	191.55	54	1545.32	194
6	1564.68	191.6	55	1544.92	194.05
7	1564.27	191.65	56	1544.53	194.1
8	1563.86	191.7	57	1544.13	194.15

9	1563.45	191.75	58	1543.73	194.2
10	1563.05	191.8	59	1543.33	194.25
11	1562.64	191.85	60	1542.94	194.3
12	1562.23	191.9	61	1542.54	194.35
13	1561.83	191.95	62	1542.14	194.4
14	1561.42	192	63	1541.75	194.45
15	1561.01	192.05	64	1541.35	194.5
16	1560.61	192.1	65	1540.95	194.55
17	1560.2	192.15	66	1540.56	194.6
18	1559.79	192.2	67	1540.16	194.65
19	1559.39	192.25	68	1539.77	194.7
20	1558.98	192.3	69	1539.37	194.75
21	1558.58	192.35	70	1538.98	194.8
22	1558.17	192.4	71	1538.58	194.85
23	1557.77	192.45	72	1538.19	194.9
24	1557.36	192.5	73	1537.79	194.95
25	1556.96	192.55	74	1537.4	195
26	1556.55	192.6	75	1537	195.05
27	1556.15	192.65	76	1536.61	195.1
28	1555.75	192.7	77	1536.22	195.15
29	1555.34	192.75	78	1535.82	195.2
30	1554.94	192.8	79	1535.43	195.25
31	1554.54	192.85	80	1535.04	195.3
32	1554.13	192.9	81	1534.64	195.35
33	1553.73	192.95	82	1534.25	195.4
34	1553.33	193	83	1533.86	195.45
35	1552.93	193.05	84	1533.47	195.5
36	1552.52	193.1	85	1533.07	195.55
37	1552.12	193.15	86	1532.68	195.6
38	1551.72	193.2	87	1532.29	195.65
39	1551.32	193.25	88	1531.9	195.7
40	1550.92	193.3	89	1531.51	195.75
41	1550.52	193.35	90	1531.12	195.8
42	1550.12	193.4	91	1530.72	195.85
43	1549.72	193.45	92	1530.33	195.9
44	1549.32	193.5	93	1529.94	195.95
45	1548.91	193.55	94	1529.55	196.00
46	1548.51	193.6	95	1529.16	196.05
47	1548.11	193.65	96	1528.77	196.10
48	1547.72	193.7			

49	1547.32	193.75			
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Notes:

1. When a tunable module is plugged in for the first time, it will go to a default channel, ETU default channel is 1568.36nm, compatible with channel range from 1 to 96
2. When the module is power cycled it will automatically go to the last channel selected, or when Tx\_Disable asserted and then re-enabled, the module returns to the last channel selected.

### Absolute Maximum Ratings

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Storage Temperature	T <sub>s</sub>	-40		85	°C	
Power Supply Voltage	V <sub>CC</sub>	-0.5		3.6	V	
Relative Humidity (non-condensation)	RH	5		95	%	
Damage Threshold	TH <sub>d</sub>	0			dBm	

### Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Case Operating Temperature	Top	0	-	70	°C	Commercial
		-40		85		Industrial
Power Supply Voltage	V <sub>CC</sub>	3.135	3.3	3.465	V	
Data Rate			10.3125		Gb/s	
Control Input Voltage High		2		V <sub>CC</sub>	V	
Control Input Voltage Low		0		0.8	V	
Link Distance (SMF)	D			80	km	9/125um

### Electrical Characteristics

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Power Consumption	p			2	W	
Supply Current	I <sub>CC</sub>			606	mA	
<b>Transmitter (Module Input)</b>						
Single-ended Input Voltage Tolerance	V <sub>CC</sub>	-0.3		4.0	V	
AC Common Mode Input Voltage Tolerance (RMS)		15			mV	
Differential Input Voltage Swing	V <sub>in,pp</sub>	240		910	mV <sub>pp</sub>	
Differential Input Impedance	Z <sub>in</sub>	90	100	110	Ohm	1
Transmit Disable Assert Time				10	us	

Transmit Disable Voltage	Vdis	Vcc-1.3		Vcc	V	
Transmit Enable Voltage	Ven	Vee		Vee +0.8	V	2
<b>Receiver (Module Output)</b>						
Differential Output Voltage Swing	Vout,pp	350		800	mVpp	
Differential Output Impedance	Zout	90	100	110	Ohm	3
Data output rise/fall time	Tr/Tf	30			ps	4
LOS Assert Voltage	VlosH	Vcc-1.3		Vcc	V	5
LOS De-assert Voltage	VlosL	Vee		Vee +0.8	V	5
Power Supply Rejection	PSR	100			mVpp	6

Notes:

1. Connected directly to TX data input pins. AC coupled thereafter.
2. Or open circuit.
3. Input 100 ohms differential termination.
4. These are unfiltered 20-80% values.
5. Loss of Signal is LVTTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.
6. Receiver sensitivity is compliant with power supply sinusoidal modulation of 20 Hz to 1.5 MHz up to specified value applied through the recommended power supply filtering network.

## Optical and Characteristics

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
<b>Transmitter</b>						
Center Wavelength	$\lambda_c$ _BOL	z-1.5	z	Z+1.5	GHz	
Center Wavelength	$\lambda_c$ _EOL	z-2.5	z	Z+2.5	GHz	
Center Wavelength Spacing			50		GHz	
Optical Spectral Width	$\Delta\lambda$			1	nm	
Side Mode Suppression Ratio	SMSR	35			dB	
Average Optical Power	P <sub>AVG</sub>	-1		4	dBm	1
Optical Extinction Ratio	ER	8.2			dB	
Transmitter and Dispersion Penalty	TDP			3	dB	
Transmitter Eye Mask		Compliant with IEEE802.3ae				
<b>Receiver</b>						
Center Wavelength	$\lambda_c$	1270		1610	nm	
Receiver Sensitivity( Average power)	Sen.			-23	dBm	2
Input Saturation Power (overload)	P <sub>sat</sub>	-6			dBm	
LOS Assert	LOSA	-36			dB	
LOS De-assert	LOSD			-27	dBm	
LOS Hysteresis	LOSH	0.5			dBm	

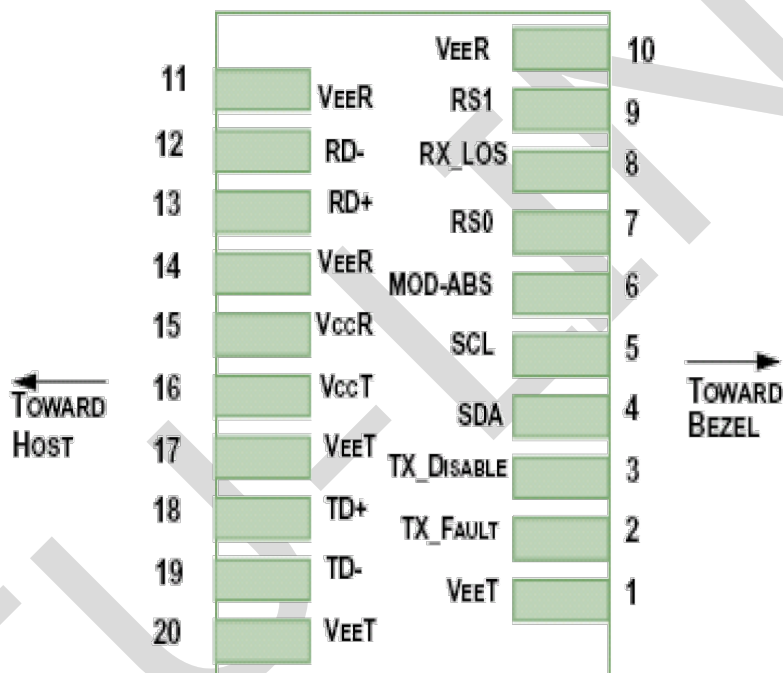
Notes:

1. Class 1 Laser Safety per FDA/CDRH and IEC-825-1 regulations.
2. Measured with Light source 1529.16~1568.36nm, ER=6.0dB; BER =<10<sup>-12</sup> @10.3125Gbps, PRBS=2<sup>31</sup>-1 NRZ.

## Digital Diagnostics

Parameter	Symbol	Min.	Max	Unit	Notes
Temperature monitor absolute error	DMI_Temp	-3	3	degC	Over operating temp
Supply voltage monitor absolute error	DMI_VCC	-0.1	0.1	V	Full operating range
RX power monitor absolute error	DMI_RX	-3	3	dB	
Bias current monitor	DMI_bias	-10%	10%	mA	
TX power monitor absolute error	DMI_TX	-3	3	dB	

## Pin Diagram



## Pin Definitions

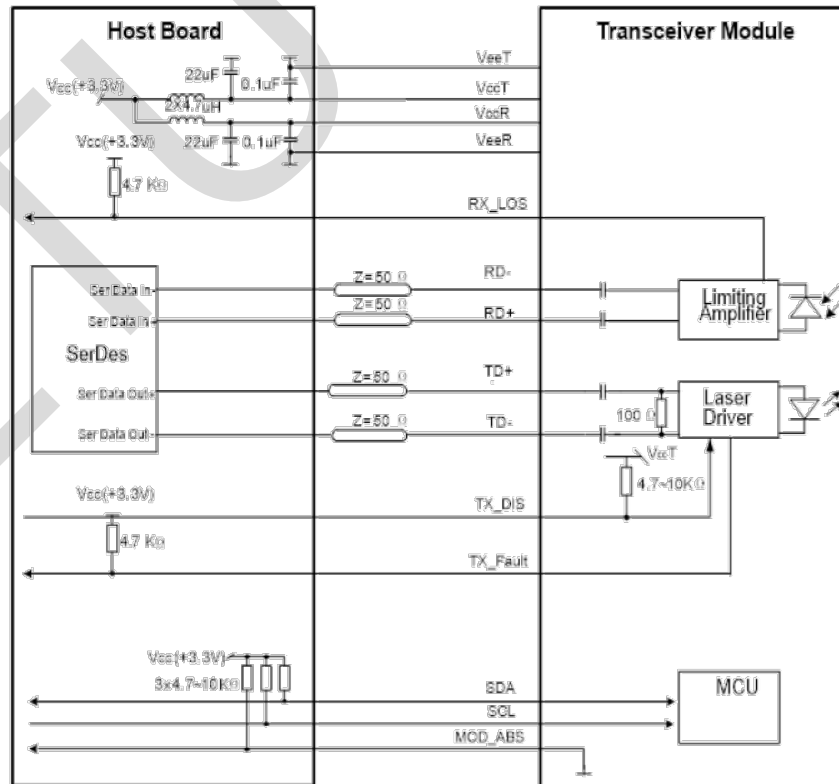
PIN #	Name	Function	Notes
1	V <sub>EET</sub>	Transmitter Ground (Common with Receiver Ground)	1
2	T <sub>FAULT</sub>	Transmitter Fault.	2
3	T <sub>DIS</sub>	Transmitter Disable. Laser output disabled on high or open.	3
4	SDA	2-wire Serial Interface Data Line	4
5	SCL	2-wire Serial Interface Clock Line	4
6	MOD_ABS	Module Absent. Grounded within the module	4
7	RS0	Rate Select 0	5
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation.	6
9	RS1	No connection required	
10	V <sub>EER</sub>	Receiver Ground (Common with Transmitter Ground)	1

11	V <sub>EER</sub>	Receiver Ground (Common with Transmitter Ground)	1
12	RD-	Receiver Inverted DATA out. AC Coupled	
13	RD+	Receiver Non-inverted DATA out. AC Coupled	
14	V <sub>EER</sub>	Receiver Ground (Common with Transmitter Ground)	1
15	V <sub>CCR</sub>	Receiver Power Supply	
16	V <sub>CCT</sub>	Transmitter Power Supply	
17	V <sub>EET</sub>	Transmitter Ground (Common with Receiver Ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	
19	TD-	Transmitter Inverted DATA in. AC Coupled.	
20	V <sub>EET</sub>	Transmitter Ground (Common with Receiver Ground)	1

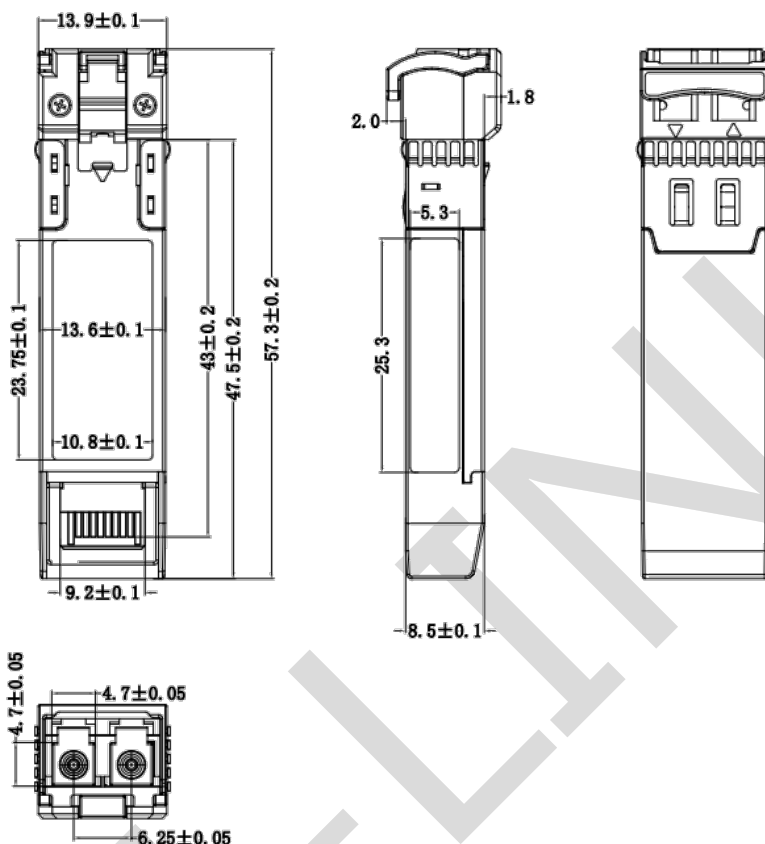
Notes:

1. Circuit ground is internally isolated from chassis ground.
2. TFAULT is an open collector/drain output, which should be pulled up with a 4.7kΩ-10 kΩ resistor on the host board if intended for use. Pull up voltage should be between 2.0V to V<sub>cc</sub> + 0.3V. A high output indicates a transmitter fault caused by either the TX bias current or the TX output power exceeding the preset alarm thresholds. A low output indicates normal operation. In the low state, the output is pulled to <0.8V.
3. Laser output disabled on TDIS >2.0V or open, enabled on TDIS <0.8V.
4. Should be pulled up with 4.7kΩ-10kΩ on host board to a voltage between 2.0V and 3.6V. MOD\_ABS pulls line low to indicate module is plugged in.
5. Internally pulled down per SFF-8431 Rev 4.1.
6. LOS is open collector output. It should be pulled up with 4.7kΩ-10kΩ on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

## Recommended Interface Circuit



## Mechanical Diagram



## Revision History

Version No.	Date	Description
1.0	July 26, 2023	Preliminary datasheet
2.0	September 27, 2024	Format change

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