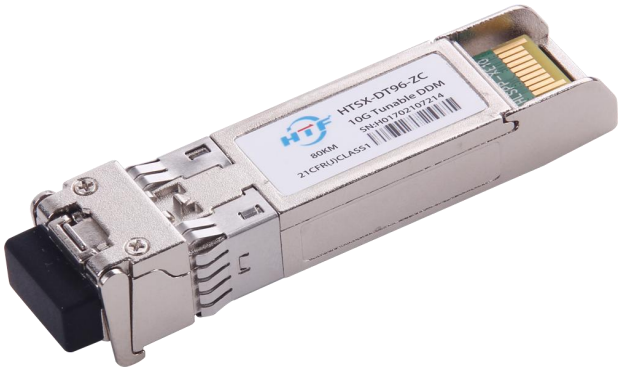
10Gb/s Tunable DWDM 80km SFP+ Optical Transceiver Module
HTSX-DT96-80

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 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
- Case operating temperature



Applications

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

Part Number Ordering Information

Part Number	Data Rate (Gb/s)	Wavelength (nm)	Transmission Distance(m)	Temperature (°C) (Operating Case)
HTSX-DT96-80C	10.3125	Refer to wavelength selection	80km SMF	0~70 commercial

Wavelength Selection: C-band λc Wavelength Guide Pin Descriptions

Channel	Wavelength	Frequency	Channe	Wavelength	Frequency

	(nm)	(THZ)	I	(nm)	(THZ)
C06	1568.36	191.15	C55	1548.51	193.60
C07	1567.95	191.20	C56	1548.11	193.65
C08	1567.54	191.25	C57	1547.72	193.70
C09	1567.13	191.30	C58	1547.32	193.75
C10	1566.72	191.35	C59	1546.92	193.80
C11	1566.31	191.40	C60	1546.52	193.85
C12	1565.90	191.45	C61	1546.12	193.90
C13	1565.50	191.50	C62	1545.72	193.95
C14	1565.09	191.55	C63	1545.32	194.00
C15	1564.68	191.60	C64	1544.92	194.05
C16	1564.27	191.65	C65	1544.53	194.10
C17	1563.86	191.70	C66	1544.13	194.15
C18	1563.45	191.75	C67	1543.73	194.20
C19	1563.05	191.80	C68	1543.33	194.25
C20	1562.64	191.85	C69	1542.94	194.30
C21	1562.23	191.90	C70	1542.54	194.35
C22	1561.83	191.95	C71	1542.14	194.40
C23	1561.42	192.00	C72	1541.75	194.45
C24	1561.01	192.05	C73	1541.35	194.50
C25	1560.61	192.10	C74	1540.95	194.55
C26	1560.20	192.15	C75	1540.56	194.60
C27	1559.79	192.20	C76	1540.16	194.65
C28	1559.39	192.25	C77	1539.77	194.70
C29	1558.98	192.30	C78	1539.37	194.75
C30	1558.58	192.35	C79	1538.98	194.80
C31	1558.17	192.40	C80	1538.58	194.85

C32	1557.77	192.45	C81	1538.19	194.90
C33	1557.36	192.50	C82	1537.79	194.95
C34	1556.96	192.55	C83	1537.40	195.00
C35	1556.55	192.60	C84	1537.00	195.05
C36	1556.15	192.65	C85	1536.61	195.10
C37	1555.75	192.70	C86	1536.22	195.15
C38	1555.34	192.75	C87	1535.82	195.20
C39	1554.94	192.80	C88	1535.43	195.25
C40	1554.54	192.85	C89	1535.04	195.30
C41	1554.13	192.90	C90	1534.64	195.35
C42	1553.73	192.95	C91	1534.25	195.40
C43	1553.33	193.00	C92	1533.86	195.45
C44	1552.93	193.05	C93	1533.47	195.50
C45	1552.52	193.10	C94	1533.07	195.55
C46	1552.12	193.15	C95	1532.68	195.60
C47	1551.72	193.20	C96	1532.29	195.65
C48	1551.32	193.25	C97	1531.90	195.70
C49	1550.92	193.30	C98	1531.51	195.75
C50	1550.52	193.35	C99	1531.12	195.80
C51	1550.12	193.40	CA0	1530.72	195.85
C52	1549.72	193.45	CA1	1530.33	195.90
C53	1549.32	193.50	CA2	1529.55	195.95
C54	1548.91	193.55	CA3	1529.55	196.00
Non-ITU	Peak wavelength between 1528.77nm-1563.86		CA4	1529.16	196.05

Notes:

1. When a tunable module is plugged in for the first time, it will go to a default channel, HTSX-DT96-80C default channel is 1568.36nm, compatible with channel range from 1 to 99
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.

1. Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min	Max	Unit	Notes
Storage Temperature	T_S	-40	85	°C	
Power Supply Voltage	V_{CC}	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	5	95	%	
Damage Threshold	TH_d	0		dBm	

2. Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Operating Case Temperature	T_{OP}	0		70	°C	commercial
		-40		85	°C	Industrial
Power Supply Voltage	V_{CC}	3.135	3.3	3.465	V	
Data Rate			10.3125		Gb/s	
Control Input Voltage High		2		Vcc	V	
Control Input Voltage Low		0		0.8	V	
Link Distance (SMF)	D			80	km	9/125um

3. General Description

HTF'HTSX-DT96-80x 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.

HTSX-DT96-80x 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, 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.

4. Pin Assignment and Pin Description

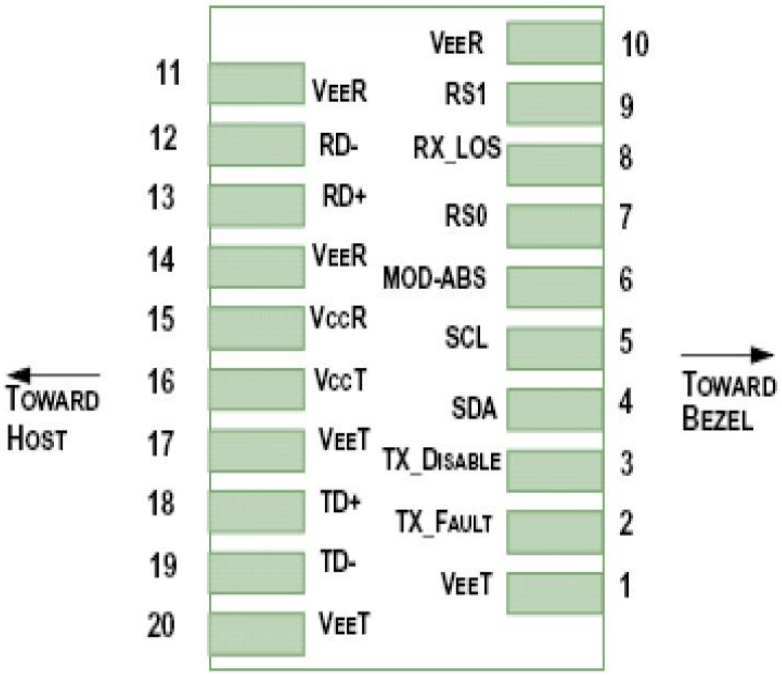


Figure1. Diagram of host board connector block pin numbers and names

Pin	Symbol	Name/Description	Notes
1	V_{EET}	Transmitter Ground (Common with Receiver Ground)	1
2	T_{FAULT}	Transmitter Fault.	2
3	T_{DIS}	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_{EER}	Receiver Ground (Common with Transmitter Ground)	1
11	V_{EER}	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_{EER}	Receiver Ground (Common with Transmitter Ground)	1
15	V_{CCR}	Receiver Power Supply	
16	V_{CCT}	Transmitter Power Supply	
17	V_{EET}	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_{EET}	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 Vcc + 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.

5. Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max	Unit	Notes
Power Consumption	p			1.5	W	
Supply Current	Icc			450	mA	

Transmitter						
Single-ended Input Voltage Tolerance	Vcc	-0.3		4.0	V	
AC Common Mode Input Voltage Tolerance (RMS)		15			mV	
Differential Input Voltage Swing	Vin,pp	240		910	mVpp	
Differential Input Impedance	Zin	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
Receiver						
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 LVTTL. 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.

6. Optical Characteristics

The following optical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max	Unit	Notes
Transmitter						

Optical Wavelength	λc	λc -0.05		λc +0.05	nm	1
Center Wavelength Spacing			50		GHz	
Optical Spectral Width	Δλ			1	nm	
Side Mode Suppression Ratio	SMSR	35			dB	
Average Optical Power	P_{AVG}	-1		4	dBm	2
Optical Extinction Ratio	ER	8.2			dB	
Transmitter and Dispersion Penalty	TDP			3	dB	
Transmitter off Output power	Poff			-30	dBm	
Frequency stability (BOL)	-1.5			1.5	GHz	
Frequency stability (EOL)	-2.5			2.5	GHz	
Transmitter Eye Mask		Compliant with IEEE802.3ae				
Receiver						
Center Wavelength	λ_C	1270		1610	nm	
Receiver Sensitivity(Average power)	Sen.			-23	dBm	3
Input Saturation Power (overload)	Psat	-6			dBm	
LOS Assert	LOSA	-36			dB	
LOS De-assert	LOSD			-27	dBm	
LOS Hysteresis	LOSH	0.5			dBm	

Notes:

1. λc refer to wavelength selection, and corresponds to approximately 0.4 nm
2. Class 1 Laser Safety per FDA/CDRH and IEC-825-1 regulations.
3. Measured with Light source 1529.16~1568.36nm, ER=6.0dB; BER =<10^-12 @10.3125Gbps, PRBS=2^31-1 NRZ.

7. Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the Recommended Operating Environment unless otherwise specified. It is compliant to SFF8472 Rev10.2 with internal calibration mode. For external calibration mode please contact our sales staff.

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	-0.15	0.15	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	

8. Mechanical Dimensions

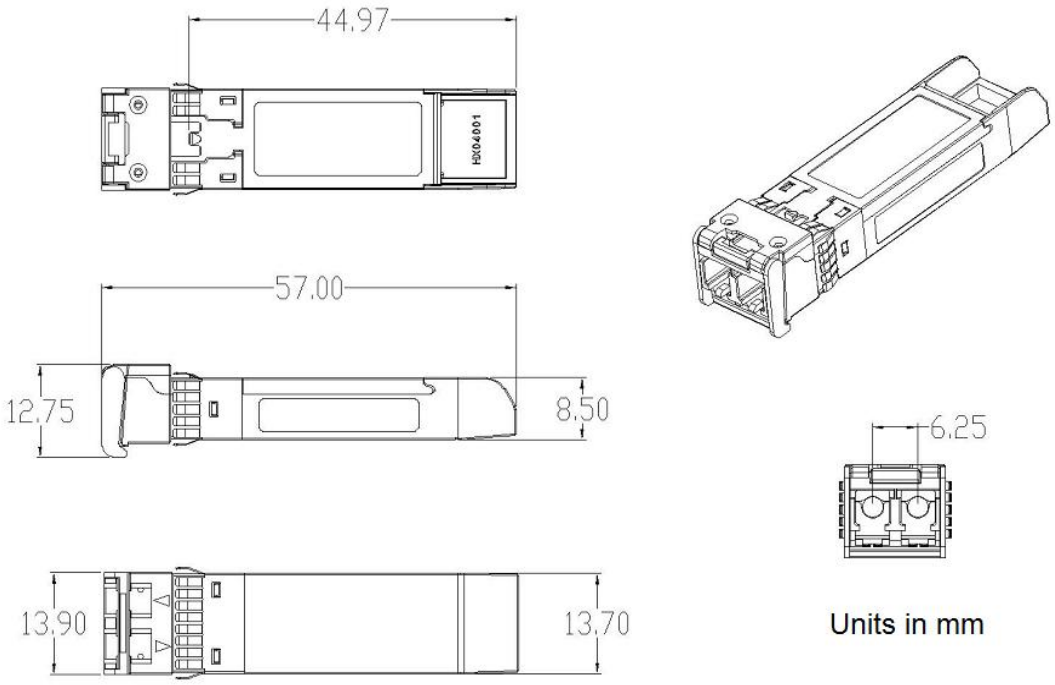


Figure2. Mechanical Outline