ModuleTek

DATA SHEET

MODULETEK: SFP-10G-BIDI-Txxxx/Rxxxx-10KM-x-G19

10Gb/s SFP+ Tx1270nm/Rx1330nm Bi-directional Transceiver
10Gb/s SFP+ Tx1330nm/Rx1270nm Bi-directional Transceiver

Overview

ModuleTek's SFP-10G-BIDI-Txxxx/Rxxxx-10KM-x-G19 SFP+ optical transceivers are based on 10G Ethernet IEEE 802.3 standard and SFF-8083 standard,providing a fast and reliable interface for 10G Ethernet applications. The product implements digital diagnostics via a 2-wire serial bus, compliant with the SFF-8472 standard.

Product Features

- Supports from 9.83Gb/s to 11.3Gb/s bit rates
- Compliant with IEEE 802.3 10GBASE-LR/LW
- Compliant with 10G FC 1200-SM-LL-L
- Compliant with SFF-8083
- Hot-pluggable SFP+ footprint
- DFB laser transmitter and PIN Receiver
- Single LC connector
- Built-in digital diagnostic functions
- Up to 10km on SMF
- Single power supply 3.3V
- RoHS Compliant
- Operating temperature range (Case Temperature): Commercial Level： 0°C to 70°C
  Industrial Level： −40°C to 85°C

Applications

- 10GBASE-LR/LW Ethernet
- 10G FC
- 10G CPRI

Ordering Information

Part Number	Product ID	Description	Color on Clasp
SFP-10G-BIDI-T1270/R1330-10KM-C-G19	M396535	10G SFP+ BIDI, TX1270nm/RX1330nm, 10km on SMF, Commercial Temperature	Yellow
SFP-10G-BIDI-T1270/R1330-10KM-I-G19	M396536	10G SFP+ BIDI, TX1270nm/RX1330nm, 10km on SMF, Industrial Temperature	Yellow
SFP-10G-BIDI-T1330/R1270-10KM-C-G19	M469835	10G SFP+ BIDI, TX1330nm/RX1270nm, 10km on SMF, Commercial Temperature	Blue
SFP-10G-BIDI-T1330/R1270-10KM-I-G19	M469836	10G SFP+ BIDI, TX1330nm/RX1270nm, 10km on SMF, Industrial Temperature	Blue

Notes：
1. Product ID is the abbreviated order number of our company's product standard model

For more information or to order the above products, please contact:

Email: sales@moduletek.com

Moduletek Web: www.moduletek.com

General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR	9.83		11.3	Gb/s	1
Bit Error Rate	BER			10^{-12}		
Operating Temperature	T_C	0		70	°C	2
		-40		85	°C	2
Storage Temperature	T_{STO}	-40		85	°C	3
Supply Current (Commercial Temperature)	I_{CC}		200	310	mA	4
Supply Current (Industrial Temperature)	I_{CC}		200	350	mA	4
Input Voltage	V_{CC}	3.14	3.3	3.46	V	
Power Dissipation (Commercial Temperature)	P_C		0.65	1.0	W	
Power Dissipation (Industrial Temperature)	P_I		0.65	1.2	W	
Maximum Voltage	V_{MAX}	-0.5		4	V	4

Notes:
1. IEEE 802.3
2. Case temperature
3. Ambient temperature
4. For electrical power interface

Link Distances

Data Rate	Fiber Type	Distance Range (km)
9.83 −11.3 Gb/s	9/125umSMF	10

Optical – Characteristics – Transmitter

V_{CC}=3.14V to 3.46V, T_C

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Output Optical Power	P_{TX}	-8.2		0.5	dBm	1
Optical Center Wavelength(T1270/R1330)	λ_{C1}	1260	1270	1280	nm	
Optical Center Wavelength(T1330/R1270)	λ_{C2}	1320	1330	1340	nm	
Extinction Ratio	ER	3.5			dB	
Spectral Width (-20dB)	$\Delta\lambda$			0.6	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Relative Intensity Noise	RIN			-128	dB/Hz	
Transmitter Dispersion Penalty	TDP			3.2	dB	
Launch Power of OFF Transmitter	P_{OUT_OFF}			-30	dBm	1

Notes:
1. Average Optical Power

Optical – Characteristics – Receiver

V_{CC}=3.14V to 3.46V, T_C

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Receiver Overload	P_{OL}	0.5			dBm	
Optical Center Wavelength(T1270/R1330)	λ_{C1}	1320	1330	1340	nm	
Optical Center Wavelength(T1330/R1270)	λ_{C2}	1260	1270	1280	nm	
Receiver Sensitivity	R_{X_SEN}			-14.4	dBm	1
Receiver Reflectance	TR_{RX}			-12	dB	
LOS Assert	LOS_A	-30			dBm	
LOS De-Assert	LOS_D			-17	dBm	
LOS Hysteresis	LOS_H	0.5			dB	

Notes:
1. Average Optical Power, measured with test signal at 10.31Gbps and PRBS 2^{31}-1 for BER = 10^{-12}, and without fiber

Electrical – Characteristics – Transmitter

V_{CC}=3.14V to 3.46V, T_C

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Input differential impedance	R_{IN}		100		Ω	
Differential data input swing	V_{IN_PP}	180		700	mV	
Transmit disable voltage	V_D	2		V_{CC}	V	
Transmit enable voltage	V_{EN}	V_{EE}		$V_{EE}+0.8$	V	

Electrical – Characteristics – Receiver

V_{CC}=3.14V to 3.46V, T_C

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Differential data output swing	V_{OUT_PP}	300		850	mV	
Data output rise/fall time (20%-80%)	t_r/t_f	28			ps	
LOS Assert	V_{LOS_A}	2		V_{CC_HOST}	V	
LOS De-Assert	V_{LOS_D}	V_{EE}		$V_{EE}+0.5$	V	

A0h Memory Map

Byte	Size	Name	Description	Initial Value (hex)
0	1	Identifier	SFP+	03
1	1	Extended Identifier	Use IIC interface	04
2	1	Connector	Connector Type = LC	07
3-10	8	Transceiver	10GBASE-LR	20 00 00 00 00 00 00 00
11	1	Encoding	Encoding Type = 64B/66B	06
12	1	BR, Nominal	Nominal Bit Rate 10.3 Gb/s	67
13	1	Rate Identifier	No rate selection function	00
14	1	Length (9μm)-km	9 μm SMF Link Length = 10 km	0A
15	1	Length (9μm)-100m	9 μm SMF Link Length = 10 km	64
16	1	Length(50μm, OM2)-10m	50 μm OM2 MMF Link Length = N/A	00
17	1	Length (62.5μm, OM1)-10m	62.5 μm OM1 MMF Link Length = N/A	00
18	1	Length (50μm, OM4)-10m	50 μm OM4 MMF Link Length = N/A	00
19	1	Length (50μm, OM3)-10m	50 μm OM3 MMF Link Length = N/A	00
20-35	16	Vendor name	MODULETEK	4D 4F 44 55 4C 45 54 45 4B 20 20 20 20 20 20 20
36	1	Transceiver	Extended Compliance Codes	00
37-39	3	Vendor OUI	Without vendor OUI	00 00 00
40-55	16	Vendor PN	Part number in the Ordering Information	Defined by vendor
56-59	4	Vendor Revision Number	Manufacturer product version number	Defined by vendor
60-61	2	Wavelength	Laser Wavelength	Defined by vendor
62	1	Unallocated	Unallocated	00
63	1	CC_BASE	Check sum of bytes 0-62	Defined by vendor

64	1	Transceiver Options	BIT7:6=0 Reserved BIT5=0 Power Level = 2, < 1.5 W BIT4=1 Paging function is implemented BIT3=0 Without retimer or CDR circuit BIT2=0 Non-cooled laser transmitter BIT1=1 Power Level = 2, < 1.5 W BIT0=0 Receiver output is conventional limiting	12
65	1	Transceiver Options	BIT7=0 Receiver decision threshold is not implemented BIT6=0 The transmitter wavelength is not tunable BIT5=0 RATE_SELECT functionality is not implemented BIT4=1 TX_DISABLE is implemented BIT3=1 TX_FAULT is implemented BIT2=0 Signal Detect is not implemented BIT1=1 RX_LOS is implemented BIT0=0 Reserved	1A
66	1	BR, max	Upper signaling rate margin	00
67	1	BR, min	Lower signaling rate margin	00
68-83	16	Vendor SN	Manufacturer serial number	Defined by vendor
84-91	8	Date code	Date	Defined by vendor
92	1	Monitoring Type	BIT7=0 Compatible with SFF-8472 requirements BIT6=1 Digital diagnostic function is implemented BIT5=1 Internal calibration is implemented BIT4=0 Externally calibration is not implemented BIT3=1 Received power measurement type is average power BIT2=0 No address change required BIT1:0=0 Reserved	68

|				
93	1	Enhanced Options	BIT7=1 Optional Alarm/Warning flags are implemented for all monitored quantities BIT6=1 Optional soft TX_DISABLE control and monitoring are implemented BIT5=1 Optional soft TX_FAULT monitoring is implemented BIT4=1 Optional soft RX_LOS monitoring is implemented BIT3=0 Optional soft RATE_SELECT control and monitoring are not implemented BIT2=0 Optional Application Select control is not implemented per SFF-8079 BIT1=0 Optional soft Rate Select control is not implemented per SFF-8431 BIT0=0 Reserved	F0
94	1	Compliance	Includes functionality described in Rev 12.3 of SFF-8472	08
95	1	CC_EXT	Check sum of bytes 64-94	Defined by vendor
96-127	32	Vendor Specific	Vendor specific memory addresses	Defined by vendor
128-255	128	Vendor Specific	Vendor specific memory addresses	Defined by vendor

Digital Diagnostic Function

The module supports the 2-wire serial communication protocol defined in SFF-8472, which provides access to digital diagnostic information through a 2-wire interface. Digital diagnostics are internally calibrated, and the internal microcontroller provides real-time access to module operating parameters such as module temperature, laser bias current, transmit optical power, receive optical power and module supply voltage. The module implements the SFF-8472's alarm function, which alerts the user when specific operating parameters are out of normal range.

DDM Threshold Information

Parameter		Alarm Threshold		Warning Threshold	
		High Value	Low Value	High Value	Low Value
Temperature (°C)	C	90 (5A 00)	-10 (F6 00)	85 (55 00)	-5 (FB 00)
	I	90 (5A 00)	-45 (D3 00)	85 (55 00)	-40 (D8 00)
Vcc (V)		3.63(8D CC)	2.97 (74 04)	3.46 (87 28)	3.13 (7A 44)
Bias (mA)		100 (C3 50)	2 (03 E8)	80 (9C 40)	4 (07 D0)
TxPower (dBm)		1.3 (34 98)	-9.2 (04 BA)	0.5 (2B D4)	-8.2 (05 E9)
RxPower (dBm)		3.0 (4E 20)	-18.0 (00 9E)	0.0 (27 10)	-15.0 (01 3C)

Block-Diagram-of-Transceiver
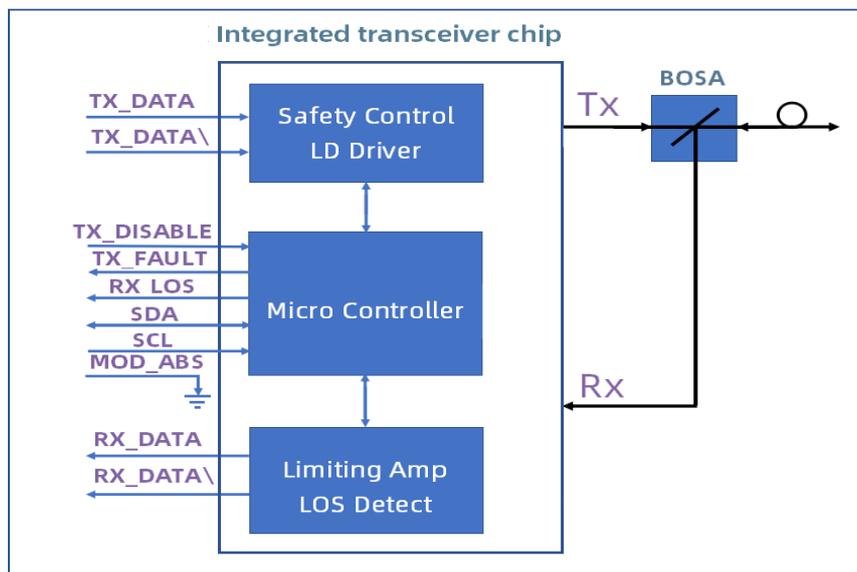
Functions Description

The transmitter consists of a laser driver (LD) chip and a light emitting component in a BOSA (Bi-directional Optical Sub-Assembly). The light-emitting component of the BOSA includes a DFB diode and a monitor photodiode (MPD). During operation, the input signal is routed to the laser driver chip which provides both bias current and modulation current to the laser. The laser driver chip employs an Automatic Power Control (APC) feedback loop to maintain constant average optical output power of the laser, compensating for temperature drift and laser aging effects. When the transmitter disable pin (TX_DISABLE) is high (logic "1"), the laser output is turned off. When TX_DISABLE is low (logic "0"), the laser is turned on within 1ms. When the transmitter fault signal (TX_FAULT) is reported as high, it indicates that a fault has occurred on the transmitter side. A low level indicates normal operation. The transmitter output power remains constant regardless of whether an input signal is present. The transmitter output remains active even during input signal loss, and is not squelched.

The receiver consists of a limiting amplifier (LA) chip and a light receiving component part in a BOSA (Bi-directional Optical Sub-Assembly). The light receiving components of the BOSA includes a PIN photodiode and a transimpedance amplifier (TIA) chip. During operation, the light signal is converted into a photo-generated current by the photodetector. The photo-generated current is converted into an electrical signal after passing through the transimpedance amplifier. The electrical signal is further amplified by the limiting amplifier and then sent to the host at a fixed amplitude. The receiver detects and reports the RX_LOS status based on average optical power (AVG). When the photo-generated current from the photodetector is lower than the preset threshold, the module reports signal loss and sets the RX_LOS pin to high level (logic "1"). The receiver output remains active even during input signal loss, and is not squelched.

After the module is powered on, the read value of the security level access registers 7BH - 7EH of A2H is replaced with 0x00. After the content of this group of registers is updated, the read value is the last written value. The security level 1 password of this module is 0x00001011. The method to enter the security level 1 working state is to convert and write the security level 1 password in the A2H 7BH - 7EH registers of the module, namely 0x00, 0x00, 0x10, 0x11. After entering the security level 1 working state, the user can directly write to the contents of the A0H device address, or modify the content of the A2H 7FH table selection register to write to the contents of Table 00 or Table 01. This version of the module does not support users to modify the security level 1 password.

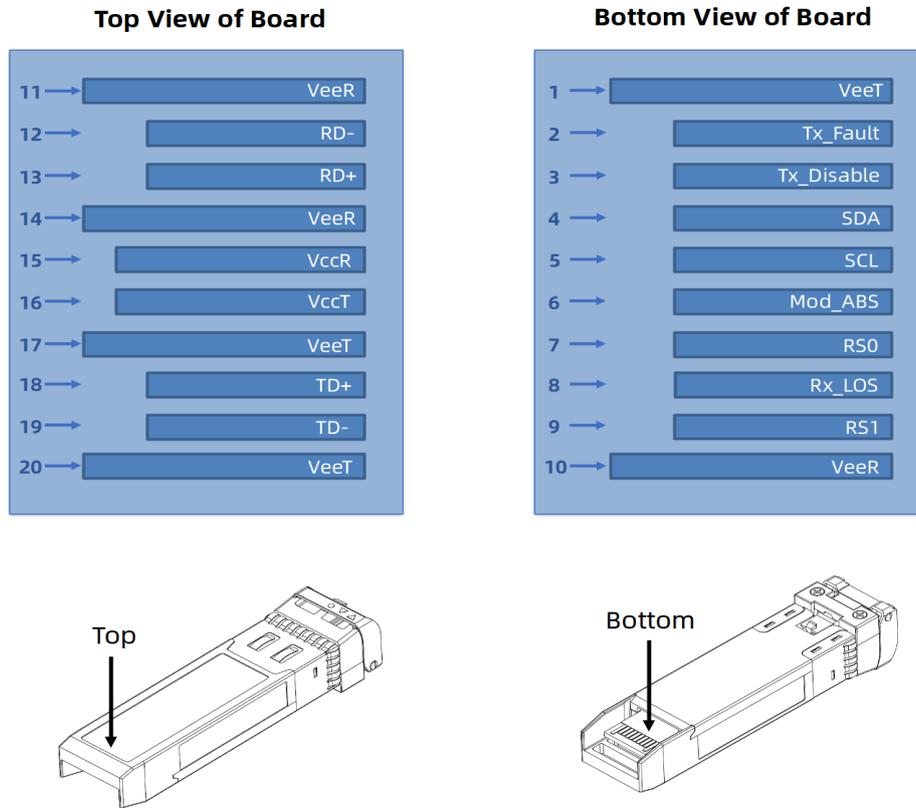## Product Weight

Net weight of module ： 19.0g/pcs
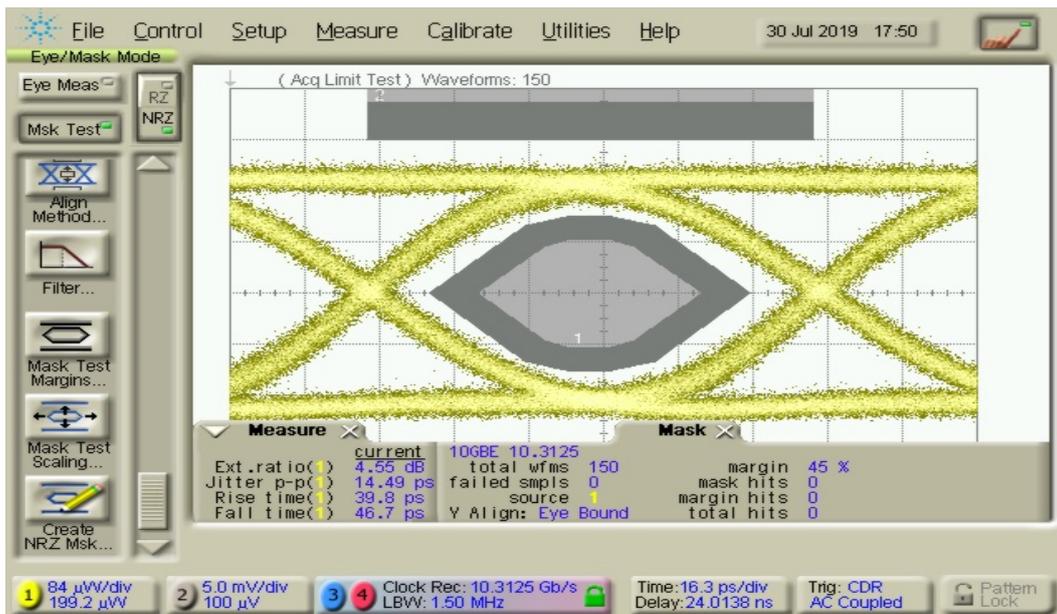Net weight of dust cap： 0.60g/pcs

Dimensions
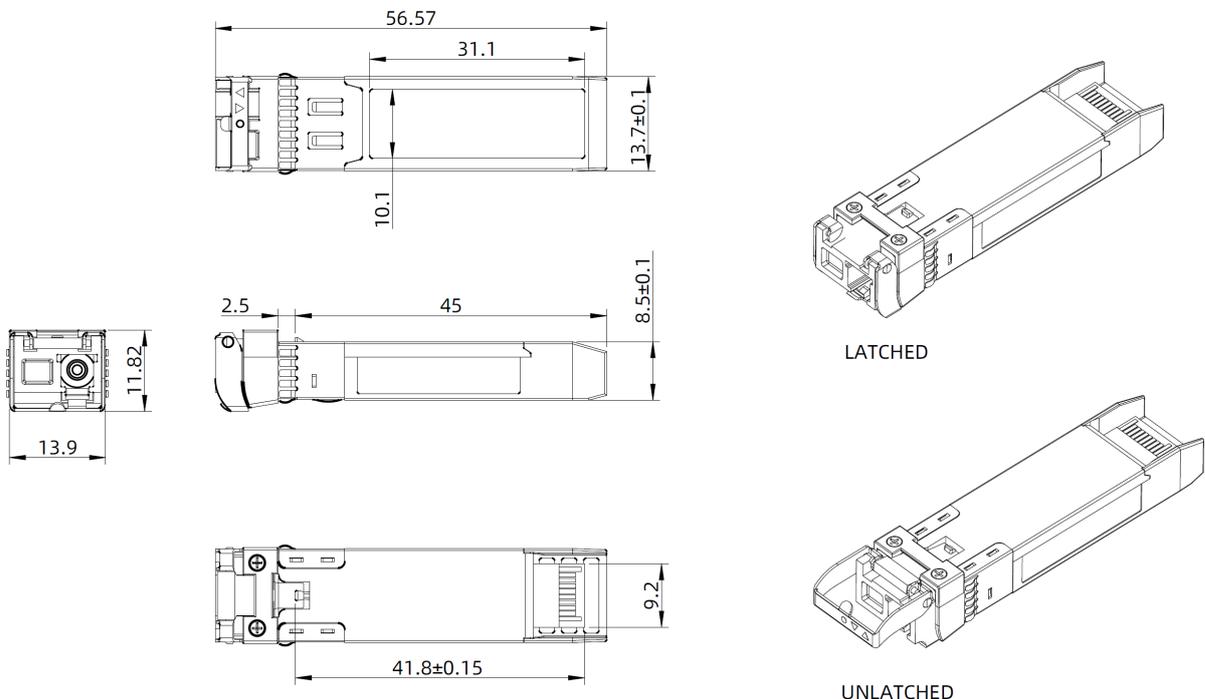
ALL DIMENSIONS ARE ± 0.2 mm UNLESS OTHERWISE SPECIFIED
UNIT: mm

Electrical Pad Layout

Top View of Board

11 →	VeeR
12 →	RD-
13 →	RD+
14 →	VeeR
15 →	VccR
16 →	VccT
17 →	VeeT
18 →	TD+
19 →	TD-
20 →	VeeT

Bottom View of Board

1 →	VeeT
2 →	Tx_Fault
3 →	Tx_Disable
4 →	SDA
5 →	SCL
6 →	Mod_ABS
7 →	RS0
8 →	Rx_LOS
9 →	RS1
10 →	VeeR

Top

Bottom

Typical Eye Diagram

Pin Assignment

PIN #	Symbol	Description	Remarks
1	VeeT	Transmitter ground (common with receiver ground)	1
2	Tx_Fault	Transmitter Fault	
3	Tx_Disable	Transmitter Disable. Laser output disabled on high or open	
4	SDA	2-wire Serial Interface Data Line	
5	SCL	2-wire Serial Interface Clock Line	
6	Mod_ABS	Module Absent. Grounded within the module	
7	RS0	No connection required	
8	Rx_LOS	Loss of Signal indication. Logic 0 indicates normal operation	
9	RS1	No connection required	
10	VeeR	Receiver ground (common with transmitter ground)	1
11	VeeR	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	VeeR	Receiver ground (common with transmitter ground)	1
15	VccR	Receiver power supply	
16	VccT	Transmitter power supply	
17	VeeT	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	VeeT	Transmitter ground (common with receiver ground)	1

Notes:
1. Circuit ground is internally isolated from case

References

1. IEEE standard 802.3
2. SFF-8083 Specification for SFP+ 1X 10 Gb/s Pluggable Transceiver Solution (SFP10)
3. SFF-8472 Specification for Management Interface for SFP+