ModuleTek

DATA SHEET

MODULETEK: SFP-GE-SX-x-F13

1.25Gb/s SFP (Small Form Pluggable) Short Wavelength (850nm) Transceiver

SFP-GE-SX-x-F13 Overview

ModuleTek's SFP-GE-SX-x-F13 SFP optical transceivers are based on the Gigabit Ethernet IEEE 802.3 standard and Fibre Channel FC-PI Rev.5.0,providing a fast and reliable interface for GE/FC applications.The product implements digital diagnostics via a 2-wire serial bus,compliant with the INF-8074i Small Form Factor Pluggable Multi-Source Agreement (MSA) and SFF-8472 standard.

Product Features

- Up to 1.25 Gb/s bi-directional data links
- Compliant with IEEE 802.3z Gigabit Ethernet and 1000BASE-SX
- Compliant with SFP MSA
- Hot-pluggable SFP footprint
- 850nm VCSEL laser transmitter
- Duplex LC connector
- Built-in digital diagnostic functions
- Up to 550m on 50/125um MMF
- Up to 300m on 62.5/125um MMF
- Single power supply 3.3V
- RoHS Compliant
- Class 1 laser product complies with EN 60825-1
- Operating temperature range（Case Temperature）：Commercial Level：0°C to 70°C
  Extendted Level：−5°C to 85°C
  Industrial Level：−40°C to 85°C

Applications

- 1.25 Gb/s Gigabit Ethernet
- 1.063 Gb/s Fiber Channel

Ordering Information

Part Number	Product ID	Description	Color on Clasp
SFP-GE-SX-C-F13	M221715	GE/FC SFP 850nm LC Connectors 550m on MMF, with DOM function,Commercial Temperature	black
SFP-GE-SX-E-F13	M221716	GE/FC SFP 850nm LC Connectors 550m on MMF, with DOM function,Extended Temperature	black
SFP-GE-SX-I-F13	M221717	GE/FC SFP 850nm LC Connectors 550m on MMF, with DOM function,Industrial Temperature	black

Notes：
1.Product ID is the abbreviated order number of the standard model of our products

For More Information:
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General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR		1.25		Gb/s	1
	DR		1.063		Gb/s	2
Bit Error Rate	BER			10^{-12}		
Operating Temperature	T_C	0		70	°C	3
		-5		85	°C	3
		-40		85	°C	3
Storage Temperature	T_{STO}	-40		85	°C	4
Supply Current	I_{CC}		130	180	mA	5
Input Voltage	V_{CC}	3.14	3.3	3.46	V	
Maximum Voltage	V_{MAX}	-0.5		4	V	5

Notes:
1. IEEE 802.3
2. FC-PI-2 Rev 5
3. Case temperature
4. Ambient temperature
5. For electrical power interface

Link Distances

Data Rate	Fiber Type	Distance Range (m)
1.25 Gb/s	62.5/125um MMF	300
1.25 Gb/s	50/125um MMF	550

Optical – Characteristics – Transmitter

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

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Output Optical Power	P_{TX}	-9.5		-3	dBm	1
Optical Center Wavelength	λ_C	830		860	nm	
Extinction Ratio@1.25Gb/s	ER	9			dB	
Spectral Width (RMS)	$\Delta\lambda$			0.85	nm	
Optical Rise/Fall Time(20%-80%)	t_r/t_f			300	ps	
Relative Intensity Noise	RIN			-120	dB/Hz	
Deterministic Jitter Contribution	TX_DJ		20	60	ps	
Total Jitter Contribution	TX_TJ		65	125	ps	
Mask Margin			45		%	

Notes:
1. Average

Optical – Characteristics – Receiver

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

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Receiver Overload	P_{OL}	0			dBm	
Optical Center Wavelength	λ_C	770		860	nm	
Receiver Sensitivity @ 1.063Gb/s	R_{X_SEN1}			-23	dBm	1
Receiver Sensitivity @ 1.25Gb/s	R_{X_SEN2}			-23	dBm	2
Optical Return Loss	ORL	12			dB	
Receiver Electrical 3dB Upper cutoff frequency				1500	MHz	
LOS Assert	LOS_A	-30			dBm	
LOS De-Assert	LOS_D			-23	dBm	
LOS Hysteresis	LOS_H	0.5			dB	

Notes:
1. FC-PI-2 Rev.5
2. IEEE 802.3

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	
Single ended data input swing	V_{IN_PP}	250		1200	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
Single ended data output swing	V_{OUT_PP}	250	450	550	mV	
Data output rise/fall time (20%-80%)	t_r/t_f		90	175	ps	
LOS Fault	V_{LOS_A}	2		V_{CC_HOST}	V	
LOS Normal	V_{LOS_D}	V_{EE}		$V_{EE}+0.5$	V	

A0H Register Description

| IIC Addr	Size	Name	Description	Values(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	1000BASE-SX	00 00 00 01 20 40 0C 01
11	1	Encoding	Encoding Type = 8B10B	01
12	1	BR, Nominal	Nominal Bit Rate 1.25Gb/s	0D
13	1	Rate Identifier	Without rate selection function	00
14	1	Length(9μm)-km	Link Length / SMF = N/A	00
15	1	Length (9μm)-100m	Link Length / SMF = N/A	00
16	1	Length (50μm)-10m	50μm MMF Link Length = 550m	37
17	1	Length (62.5μm)-10m	62.5μm MMF Link Length = 300m	1E
18	1	Length (Copper)	Copper Link Length = N/A	00
19	1	Reserved	Reserved	00
20-35	16	Vendor name	ModuleTek	Programmed by Factory
36	1	Reserved	Reserved	00
37-39	3	Vendor OUI	Without vendor OUI	00 00 00
40-55	16	Vendor PN	Part number in the Ordering Information	Programmed by Factory
56-59	4	Vendor Revision Number	Manufacturer product version number	Programmed by Factory
60-61	2	Wavelength	Laser Wavelength	03 52
62	1	Reserved	Reserved	00
63	1	CC_BASE	Checksum of bytes 0-62	Programmed by Factory
64-65	2	Transceiver Options	1.Tx_DIS 2.Rx_LOS 3.Tx_FAULT	00 1A
66	1	BR, max	NA	00
67	1	BR, min	NA	00
68-83	16	Vendor SN	Manufacturer serial number	Programmed by Factory
84-91	8	Date code	Date code	Programmed by Factory
92	1	Monitoring Type	Internal calibration of DOM RxPower measurement using average optical power	68
93	1	Enhanced Options	1.Monitor Alarm and Warning of TxPower and RxPower 2.Tx_DIS Monitor and Control 3.Rx_LOS Monitor 4.Tx_FAULT Monitor	F0
94	1	Compliance	Revision Implemented	08
95	1	CC_EXT	Check sum of bytes 64-94	Programmed by Factory
96-127	32	Vendor Specific	Vendor Specific Area	Programmed by Factory
128-255	128	Vendor Specific	Vendor Specific Area	Programmed by Factory

Digital Diagnostic Functions

SFP-GE-SX-x-F13 supports the 2-wire serial communication protocol as defined in SFP MSA. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP-GE-SX-x-F13 are internally calibrated by default. The internal micro control unit accesses the device operating parameters in real time,Such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage.The module implements the alarm function of the SFP MSA ,alerts the user when a particular operating parameter exceeds the factory-set normal range.

DDM Threshold Information

Parameter		Alarm Threshold		Warning Threshold	
		High Value	Low Value	High Value	Low Value
Temperature (°C)	C	75 (4B 00)	-5 (FB 00)	70 (46 00)	0 (00 00)
	E	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)		15 (1D 4C)	1 (01 F4)	12 (17 70)	2 (03 E8)
TxPower (dBm)		-2.71 (14 F0)	-9.97 (03 EF)	-3.50 (11 72)	-9.00 (04 EA)
RxPower (dBm)		3.01 (4E 20)	-26.02 (00 19)	0.00 (27 10)	-23.01 (00 32)

Block-Diagram-of-Transceiver
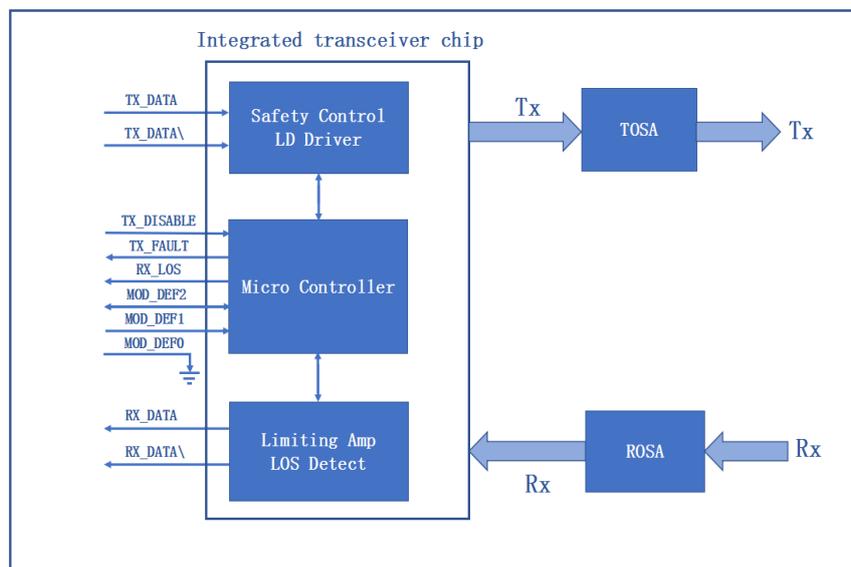
Functions Description

The transmitter is mainly composed of a laser driver part of the intelligent transceiver chip and a TOSA (light-emitting component), the TOSA includes a 850nm VCSEL laser and a backlight photodetection chip,When the module is working, the input signal is connected to the intelligent transceiver chip, at this time, the laser driver of the intelligent transceiver chip supplies the bias current and the modulation current to the laser.The intelligent transceiver chip simultaneously uses an automatic optical power control (APC) feedback loop to maintain a constant average optical power of the laser output. The purpose is to eliminate the change of the output optical signal due to temperature changes and aging of the light source device.When the transmitter enable pin (TX_Disable) is high (TTL logic "1"), the laser output is turned off. When TX_Disable is low (TTL logic "0"), the laser will turn on within 1ms.When the transmitter fault signal (TX_Fault) is reported as high,indicates a transmitter failure caused by the transmitter's bias current or transmitted optical power or laser tube temperature exceeding a preset alarm threshold. Low indicates normal operation.

The receiver is mainly composed of a limiting amplifier part of the intelligent transceiver chip and a ROSA (light-receiving component),the ROSA includes a PIN photodetector and a transimpedance amplifier chip.When the ROSA detects the incident light signal, it will be converted into a photo-generated current by the PIN 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 of the intelligent transceiver chip, then outputs a fixed-amplitude electrical signal to the host.When the amplitude of the electrical signal received from the incident light conversion of the opposite optical transceiver module is lower than the set threshold,the module reports that the received signal is lost,the RX_LOS pin is high (logic "1"),which can be used to diagnose whether the physical signal is normal.The signal is operated in TTL level.The microprocessor inside the module monitors the module's operating voltage, temperature, transmitted optical power, received optical power, and laser bias current value in real time. The host acquires this information over a 2-wire serial bus.

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 content 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.And this version of the module does not support users to modify the security level 1 password.
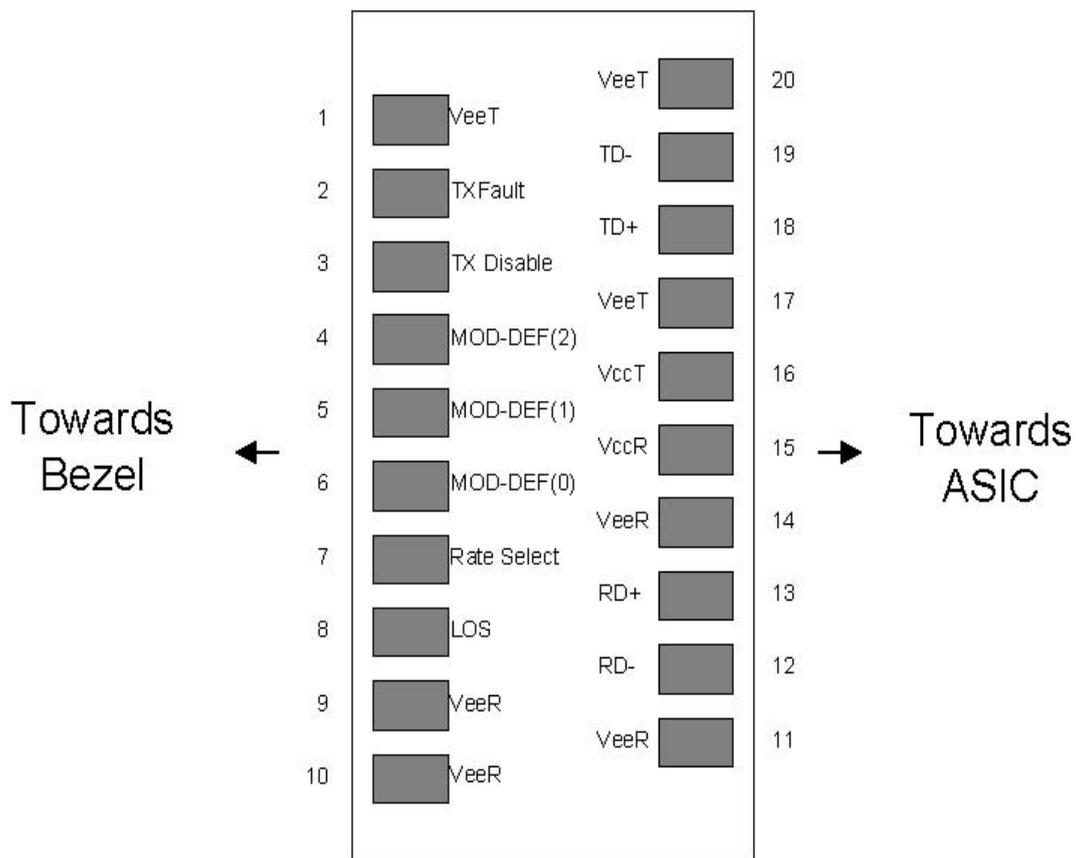
Product Weight

Net weight of module ： 15.5g/pcs
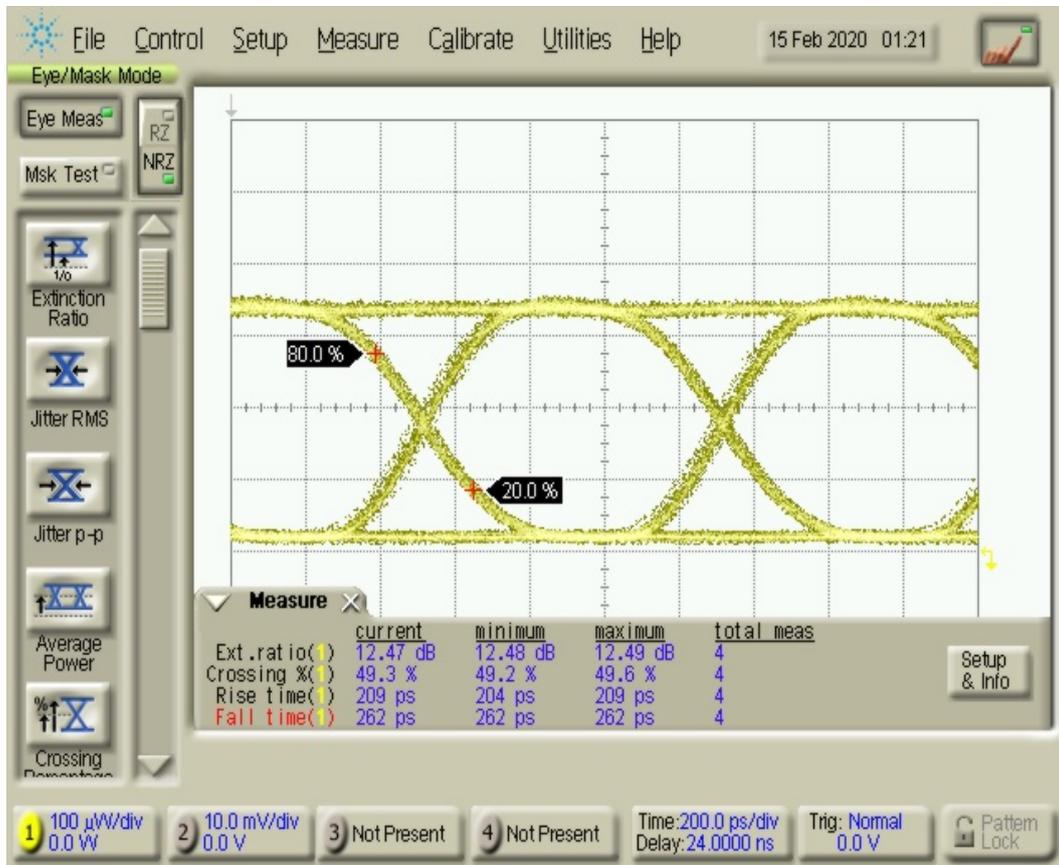Net weight of dust cap： 0.95g/pcs

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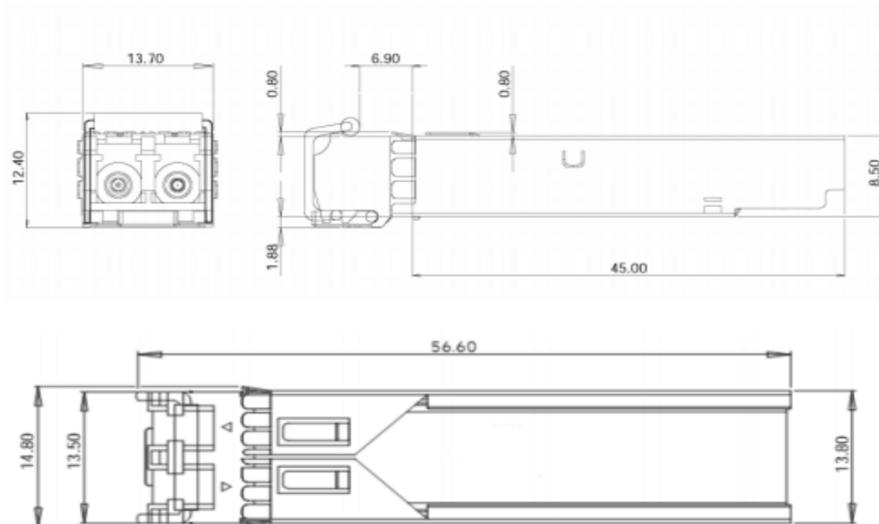
ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED
UNIT: mm

Electrical Pad Layout

Typical Eye Diagram

Pin Assignment

PIN #	Symbol	Description	Remarks
1	V_{EET}	Transmitter ground (common with receiver ground)	1
2	TX_FAULT	Transmitter Fault. Not supported	
3	TX_DISABLE	Transmitter Disable. Laser output disabled on high or open	2
4	MOD_DEF(2)	Module Definition 2. Data line for serial ID	3
5	MOD_DEF(1)	Module Definition 1. Clock line for serial ID	3
6	MOD_DEF(0)	Module Definition 0. Grounded within the module	3
7	Rate Select	No connection required	
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation	4
9	V_{EER}	Receiver ground (common with transmitter ground)	1
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 isolated from chassis ground
2. Disabled: $T_{DIS} > 2V$ or open, Enabled: $T_{DIS} < 0.8V$
3. Should Be pulled up with 4.7k —10k ohm on host board to a voltage between 2V and 3.6V
4. LOS is open collector output

References

1. IEEE standard 802.3. IEEE Standard Department,2002.

2. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000.

3. Fiber Channel Draft Physical Interface Specification (FC-PI-2 Rev.5).

4. Digital Diagnostics Monitoring Interface for Optical Transceivers —SFF-8472.