

DATA SHEET

MODULETEK: SFP-25G-LR-x-E17

25Gb/s SFP28 LR 10km Transceiver

Overview

ModuleTek's SFP-25G-LR-x-E17 optical transceivers are based on 25G Ethernet IEEE 802.3 standard. They are compliant with SFF-8402 and SFF-8472, providing a fast and reliable interface for 25G Ethernet applications. The product supports digital diagnostics via a 2-wire serial bus and is compliant with the SFF-8472 standard.

Product Features

- Operating data rate support 24.3Gbps - 26.5Gbps
- Compliant with IEEE 802.3
- Compliant with SFF-8402
- Compliant with SFF-8472
- Internal CDR on both Transmitter and Receiver channel
- Hot-pluggable SFP28 footprint
- 1310nm DFB laser transmitter and PIN PD Receiver
- Duplex 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

- 25GBASE-LR Ethernet

Ordering Information

Part Number	Product ID	Description	Bail Color
SFP-25G-LR-C-E17	M004806	25GBASE-LR SFP28 1310nm LC Connectors 10km on SMF, Commercial Temperature	Blue
SFP-25G-LR-I-E17	M004807	25GBASE-LR SFP28 1310nm LC Connectors 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	24.3		26.5	Gb/s	1
Bit Error Rate	BER			5×10^{-5}		2
Operating Temperature	T_C	0		70	°C	3
		-40		85	°C	3
Storage Temperature	T_{STO}	-40		85	°C	4
Input Voltage	V_{CC}	3.14	3.3	3.46	V	
Power Dissipation	P_I		0.8	1.3	W	
Maximum Voltage	V_{MAX}	-0.5		4	V	5

Notes:

- IEEE 802.3
- Measured with data rate at 25.78Gb/s, PRBS $2^{31} - 1$
- Case temperature
- Ambient temperature
- For electrical power interface

Link Distances

Data Rate	Fiber Type	Distance Range (km)	Remarks
25.78 Gb/s	9/125um SMF	10	1

Notes:

1. This module requires RS-FEC on the host ports for operation at 25G

Optical Characteristics - Transmitter

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

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Output Optical Power	P_{TX}	-7		2	dBm	1
Optical Center Wavelength	λ_C	1295	1310	1325	nm	
Transmitter and Dispersion Penalty	TDP			2.7	dB	
Extinction Ratio	ER	3.0			dB	
Spectral Width (-20dB)	$\Delta\lambda$			1	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Transmitter Reflectance				-12	dB	
Launch Power of OFF Transmitter	P_{OUT_OFF}			-30	dBm	1

Notes:

1. Average

Optical - Characteristics - Receiver

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

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Optical Center Wavelength	λ_C	1260		1390	nm	
Receive Overload	P_{OL}	2			dBm	
Receiver Sensitivity	R_{X_SEN}			-13.3	dBm	1
Receiver Reflectance	TR_{RX}			-26	dB	
LOS Assert	LOS_A	-30			dBm	
LOS De-Assert	LOS_D			-17	dBm	
LOS Hysteresis	LOS_H	0.5			dB	

Notes:

1. Average, measured with test signal at 25.78Gbps and PRBS $2^{31}-1$ for $BER = 5 \times 10^{-5}$, 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}	200		900	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		1000	mV	
LOS Assert	V_{LOS_A}	2		V_{CC_HOST}	V	
LOS De-Assert	V_{LOS_D}	V_{EE}		$V_{EE}+0.8$	V	

A0H Register Description

IIC Addr	Size	Name	Description	Values(HEX)
0	1	Identifier	SFP/SFP+/SFP28	03
1	1	Extended Identifier	Use IIC interface	04
2	1	Connector	Connector Type = LC	07
3-10	8	Transceiver	25G Base LR	00 00 00 00 00 00 00 00
11	1	Encoding	Encoding Type = NRZ	03
12	1	BR, Nominal	Nominal Bit Rate 25.78Gb/s	FF
13	1	Rate Identifier	Without rate selection function	00
14	1	Length(9μm)-km	Link Length / SMF = 10km	0A
15	1	Length(9μm)-100m	Link Length / SMF = 10km	64
16	1	Length(50um)-10m	50μm MMF Link Length = N/A	00
17	1	Length(62.5μm)-10m	62.5μm MMF Link Length = N/A	00
18	1	Length(OM4)-10m	Link Length in OM4 MMF	00
19	1	Length(OM3)-10m	Link Length in OM3 MMF	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	25G Base LR	03
37-39	3	Vendor OUI	Without vendor OUI	00 00 00
40-55	16	Vendor PN	Part number in the Ordering Information	Defined by the vendor
56-59	4	Vendor Revision Number	Manufacturer product version number	Defined by the vendor
60-61	2	Wavelength	Laser wavelength 1310nm	05 1E
62	1	Reserved	Reserved	00
63	1	CC_BASE	Checksum of bytes 0-62	Defined by the vendor

64	1	Transceiver Options	BIT7=0 Reserved BIT6=0 Power Level 2, < 1.5W BIT5=0 Power Level 2, < 1.5W BIT4=1 Paging function is implemented BIT3=1 Retimer or CDR indicator BIT2=0 Non-cooled laser transmitter BIT1=1 Power Level 2, < 1.5W BIT0=0 A conventional limiting receiver output	1A
65	1	Transceiver Options	BIT7=0 Receiver decision threshold is not implemented BIT6=0 Tunable wavelength lasers are not used BIT5=0 RATE_SELECT functionality is not implemented BIT4=1 TX_DISABLE is implemented BIT3=1 TX_FAULT signal is implemented BIT2=0 Signal Detect is not implemented BIT1=1 Loss of Signal is implemented BIT0=0 Reserved	1A
66	1	BR, max	103% for 25.78Gbit/s	67
67	1	BR, min	NA	00
68-83	16	Vendor SN	Manufacturer serial number	Defined by the vendor
84-91	8	Date code	Date code	Defined by the vendor
92	1	Diagnostic Monitoring Type	BIT7=0 Compatible with SFF-8472 requirements BIT6=1 Realize digital diagnostic function BIT5=1 Internal calibration is implemented BIT4=0 Externally calibration is not implemented BIT3=1 Received power is the averaged power BIT2=0 Don't need address change BIT1=0 Reserved BIT0=0 Reserved	68

93	1	Enhanced Options	BIT7=1 Optional Alarm/warning flags is implemented for all monitored quantities BIT6=1 Optional soft TX_DISABLE control and monitoring is 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 is not implemented BIT2=0 The optional soft rate selection control function is not implemented by SFF-8079 BIT1=0 The optional soft rate selection control function is not implemented by 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 the vendor
96-127	32	Vendor Specific	Vendor specific memory addresses	Defined by the vendor
128-255	128	Vendor Specific	Vendor specific memory addresses	Defined by the vendor

Digital Diagnostic Functions

SFP-25G-LR-x-E17 supports the 2-wire serial communication protocol as defined in SFF-8472. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for the transceiver are internally calibrated by default. A micro controller unit inside the transceiver gathers the monitoring information and reports the status of transceiver, such as Transceiver Temperature, Supply Power, TX bias current, TX output power and RX received optical power.

DDM Threshold Information

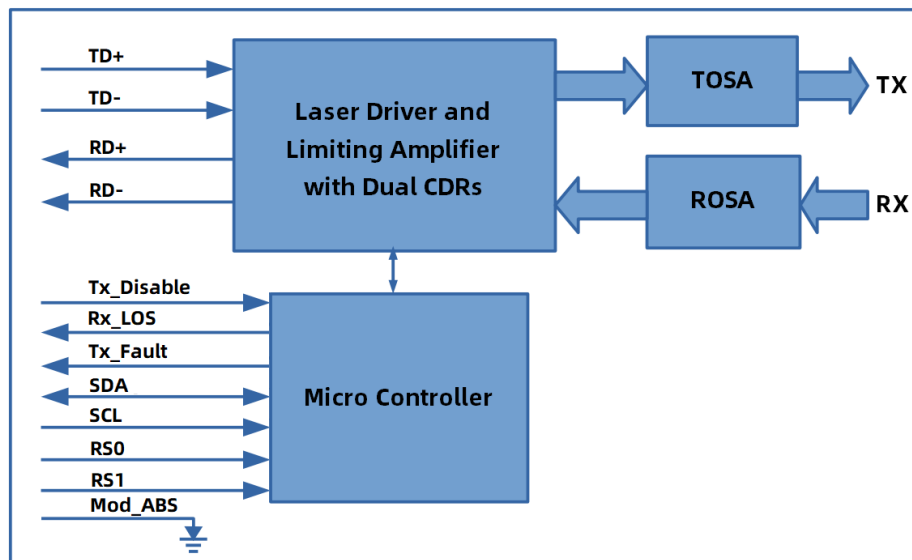
Parameter		Alarm Threshold		Warning Threshold	
		High Value	Low Value	High Value	Low Value
Temperature (°C)	C	75 (4B 00)	-5 (FB 00)	70 (46 00)	0 (00 00)
	I	90 (5A 00)	-45 (D3 00)	85 (55 00)	-40 (D8 00)
Vcc (V)		3.63(8D CC)	2.97 (74 04)	3.46 (87 5A)	3.13 (7A 76)
Bias (mA)		90 (AF C8)	6.5 (0C B2)	80 (9C 40)	8 (0F A0)
TxPower (dBm)		5.0 (7B 87)	-11.0 (03 1A)	2.0 (3D E9)	-7.0 (07 CB)
RxPower (dBm)		5.0 (7B 87)	-17.3 (00 BA)	2.0 (3D E9)	-13.3 (01 D4)

A0h, A2h Write Protection

Security Level 1 Password (Factory value)		
Password Entry ADDR	Size	Vaules(HEX)
Page A2h, 7Bh-7Eh	4	00 00 10 11

Write protection is enabled for A0h and A2h address. Users can enter the working state of security level 1 and write to module's A0h device as well as table 00h and table 01h of A2h. The method to enter the working state of security level 1 is to write the security level 1 password in the 7Bh-7Eh register of the module A2h address sequentially. After entering the security level 1, the user can directly write the contents of the A0h device address, or by modifying the contents of the 7Fh table selection register in the A2h address, write to table 00h or table 01h.

Block Diagram of Transceiver



Functions Description

The transmitter consists of a laser driver (LD) chip with integrated clock data recovery function (CDR) and a TOSA (Transmitter Optical Sub-Assembly). The TOSA integrates a 1310 nm DFB laser 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 and retimes the input signal. 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 1 ms. 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.

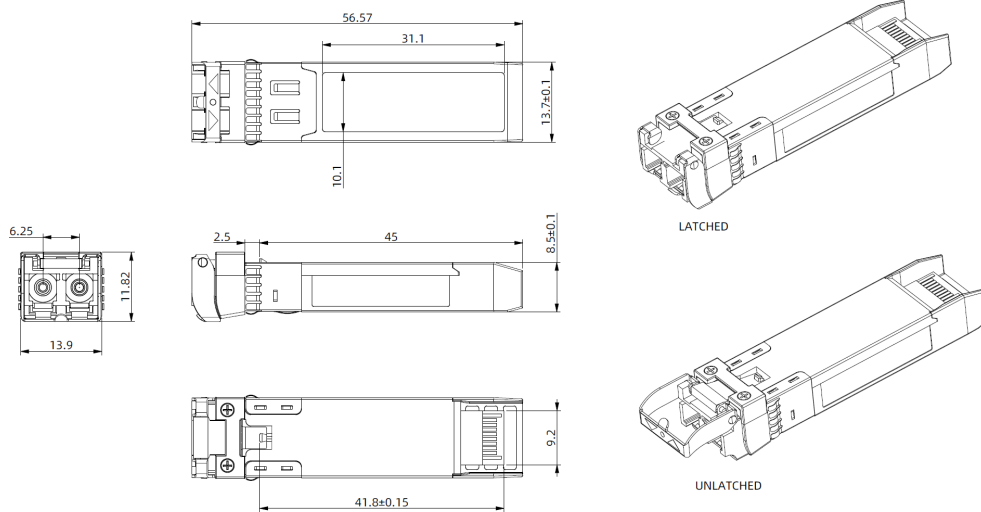
The receiver consists of a limiting amplifier (LA) chip with integrated clock data recovery function (CDR) and a ROSA (Receiver Optical Sub-Assembly). The ROSA integrates a PIN photodiode and a transimpedance amplifier (TIA) chip. During operation, the light signal is converted into a photo-generated 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 and retimed 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 optical modulation amplitude (OMA). When the amplitude of the electrical signal 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"). During input signal loss, the receiver output is squelched and the oscilloscope shows that the waveform of the output electrical signal is a straight line.

Product Weight

Net weight of module : 20 g/pcs

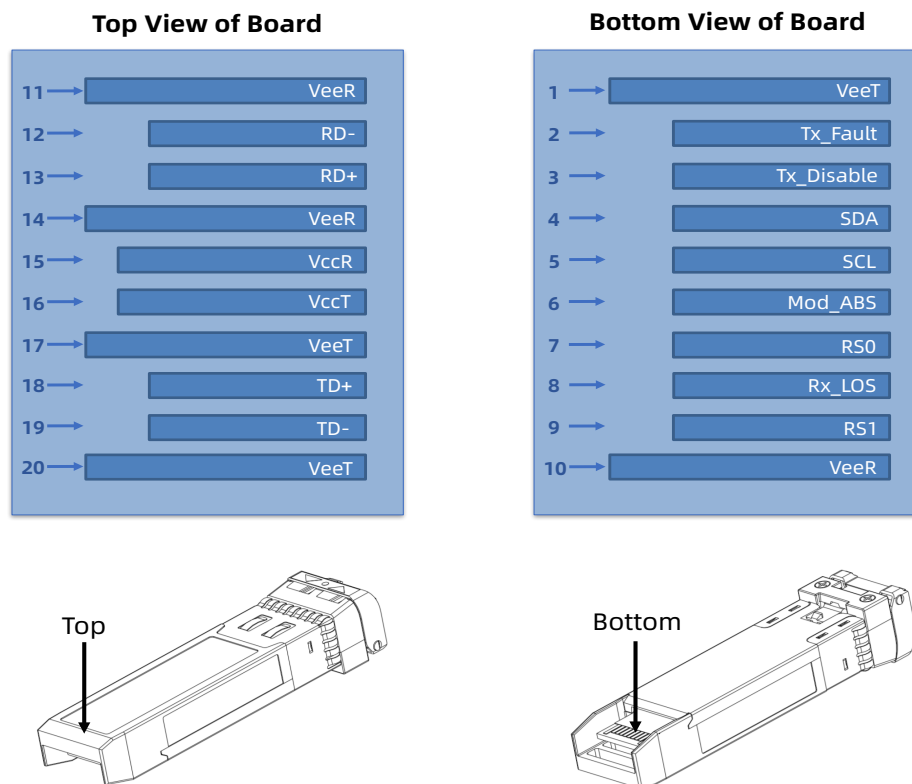
Net weight of dust cap: 1 g/pcs

Dimensions

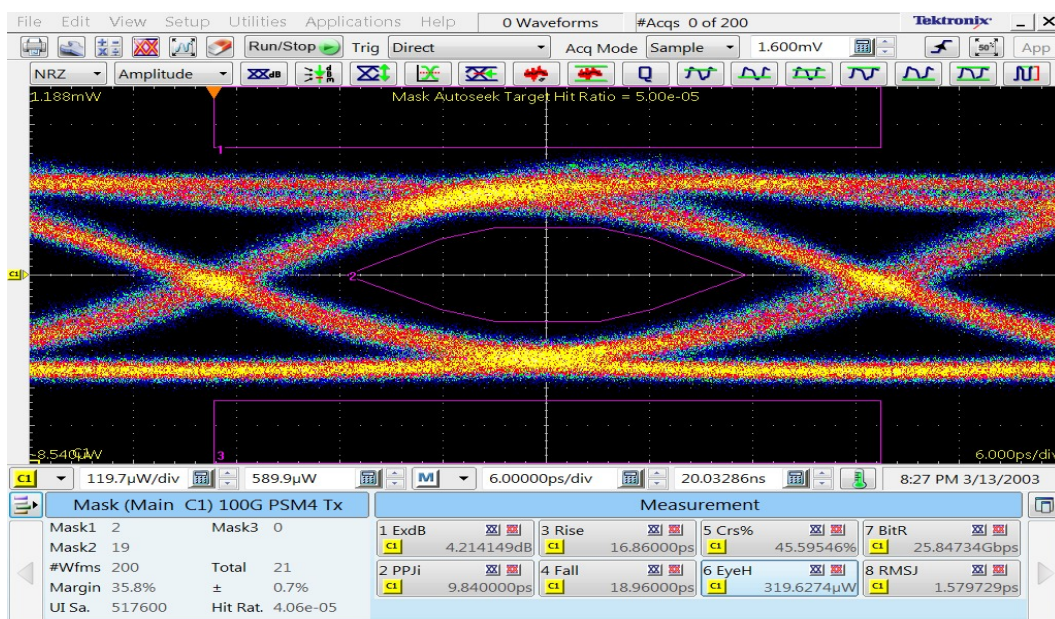


ALL DIMENSIONS ARE ± 0.2 mm UNLESS OTHERWISE SPECIFIED
UNIT: mm

Electrical Pad Layout



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-8402 Specification for SFP+ 1X 28 Gb/s Pluggable Transceiver Solution (SFP28)
3. SFF-8472 Specification for Management Interface for SFP+