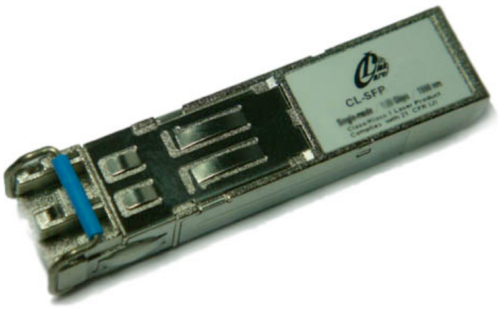
RoHS compliant
850 nm Multi-mode Transceiver
Small Form Pluggable (SFP+), with Diagnostic Monitoring
Multi Rate 0.6~10Gb/s CPRI/OBSAI



Features

- Operating Data Rate up to 11.3Gbps
- 850nm VCSEL Transmitter
- Distance up to 300m @50 / 125 um MMF
- Single 3.3V Power Supply and TTL Logic Interface
- Duplex LC Connector Interface, Hot Pluggable
- Compliant with MSA SFP+ Specification SFF-8431
- Compliant with IEEE 802.3ae 10GBASE-SR/SW
- Power Dissipation < 1.0W
- Dispersion Tolerance up to 40ps/nm over G.651
- Operating Case Temperature
- Industrial: -40°C~85°C
- Safety Certification: TUV/UL/FDA*Note1
- RoHS Compliant

Applications

- 10GBASE-SW at 9.953 Gbps
- 10GBASE-SR at 10.3125 Gbps
- OBSAI Rates 6.144 Gb/s, 3.072 Gb/s,
- 1.536 Gb/s, 0.768 Gb/s
- CPRI Rates 10.138 Gb/s, 9.830 Gb/s,
- 7.373 Gb/s, 6.144 Gb/s, 4.915 Gb/s,
- 2.458 Gb/s, 1.229 Gb/s, 0.614 Gb/s
- Other Optical Link

Ordering Information

PART NUMBER	INPUT/OUTPUT	SIGNAL DETECT	VOLTAGE	TEMPERATURE
CL-SFP+-300 CPRI	AC/AC	TTL	3.3V/5V	-40°C to 85 °C

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Product Description

The CL series multi-mode transceiver is SFP+ module for duplex optical data communications such as 10GBASE-SR and 10GBASE-SW. It is with the SFP+ 20-pin connector to allow hot plug capability. Digital diagnostic functions are available via an I2C. This module is designed for multi-mode fiber and operates at a nominal wavelength of 850 nm.
The transmitter section uses a Vertical Cavity Surface Emitted Laser (VCSEL) and is a Class 1 laser compliant according to International Safety Standard IEC 60825. The receiver section uses an integrated GaAs detector preamplifier (IDP) mounted in an optical header and a limiting post-amplifier IC.

Absolute Maximum Ratings*Note2

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T_S	-40	+85	°C
Supply Voltage	V_{CC}	-0.5	3.6	V
Input Voltage	Vin	-0.5	Vcc	V
Output Current	Io	-	50	mA
Relative Humidity*Note3	RH	0	85	%

Note 2: Exceeding any one of these values may destroy the device permanently.
Note 3: Non-condensing.

Recommended Operating Conditions

Parameter	Symbol		Min.	Typ.	Max.	Unit
Operating Case Temperature	T_C					°C
		CL	-40		85	
Power Supply Voltage	V_{CC}		3.15	3.3	3.45	V
Power Supply Current	I_{CC}				300	mA
Surge Current	I_{Surge}				+30	mA
Baud Rate			0.6		11.3	Gbps

Performance Specifications – Electrical

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Transmitter						
CML Inputs (Differential)	Vin	150		1200	mVpp	AC coupled inputs
Input Impedance (Differential)	Zin	85	100	115	ohms	Rin > 100 kohms @ DC

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Tx_DISABLE Input Voltage – High		2		Vcc+0.3	V	
Tx_DISABLE Input Voltage – Low		0		0.8	V	
Tx_FAULT Output Voltage – High		2		Vcc+0.3	V	Io = 400μA; Host Vcc
Tx_FAULT Output Voltage – Low		0		0.8	V	Io = -4.0mA
Receiver						
CML Outputs (Differential)	Vout	350		700	mVpp	AC coupled outputs
Output Impedance (Differential)	Zout	85	100	115	ohms	
Rx_LOS Output Voltage – High		2		Vcc+0.3	V	Io = 400μA; Host Vcc
Rx_LOS Output Voltage – Low		0		0.8	V	Io = -4.0mA
MOD_DEF (2:0)	VoH	2.5			V	With Serial ID
	VoL	0		0.5	V	

Optical and Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit
50 / 125 um MMF			300		m
Data Rate		0.6		11.3	Gbps
Transmitter					
Centre Wavelength	λ_C	840	850	860	nm
Spectral Width (RMS)	$\Delta\lambda$			0.45	nm
Average Output Power	P_{out}	-6		-1	dBm
Extinction Ratio	ER	3.0	5.0		dB
Output Optical Eye		IEEE 802.3-2005 Compliant			
Transmitter Dispersion Penalty	TDP			3.9	dB
TX_Disable Assert Time	t_off			10	us
TX_DISABLE Negate Time	t_on	-	-	1	ms
TX_BISABLE time to Start Reset	t_reset	10	-	-	us
Time to Initialize, Include Reset of TX_FAULT	t_init	-	-	300	ms

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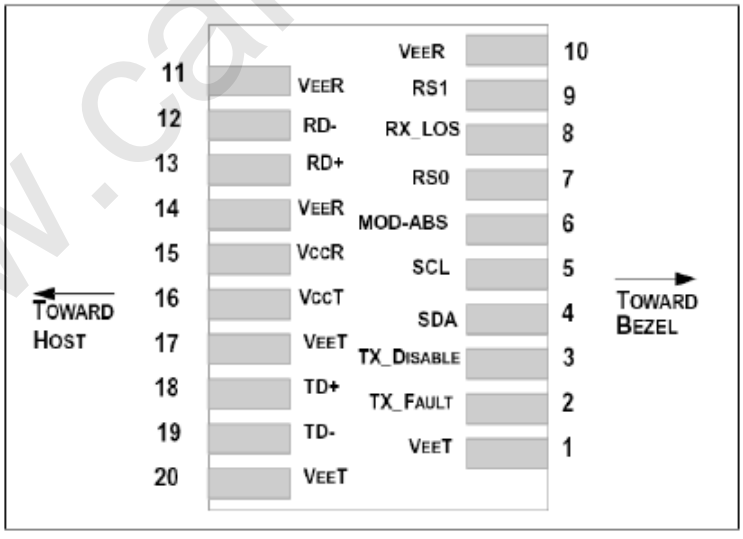
TX_FAULT from Fault to Assertion	t_fault	-	-	100	us
Total Jitter	TJ	-	-	0.28	UI(p-p)
Data Dependent Jitter	DDJ	-	-	0.1	UI(p-p)
Uncorrelated Jitter	UJ	-	-	0.023	RMS

Receiver					
Centre Wavelength	λ_C	840	850	860	nm
Receiver Sensitivity (OMA) *Note4	Pmin			-11.1	dBm
Stressed Receiver Sensitivity (OMA) *Note4	Pmin			-7.5	dBm
Receiver Overload	Pmax	-1			dBm
Optical Return Loss	ORL			-12	dB
LOS De-Assert	LOS_D			-12.5	dBm
LOS Assert	LOS_A	-25			dBm
LOS Hysteresis		0.5			dB

Note 4: Measured with a PRBS 2_{31} -1 test pattern @ 10.3125Gbps, BER≤10^{-12}

SFP+ Transceiver Electrical Pad Layout



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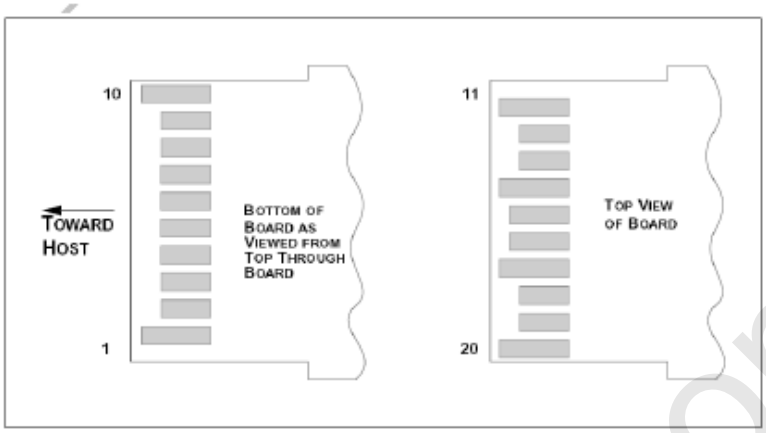

Pin Function Definitions

Pin Num.	Name	Function	Plug Seq.	Notes
1	VeeT	Transmitter Ground	1	Note 5
2	TX Fault	Transmitter Fault Indication	3	Note 1
3	TX Disable	Transmitter Disable	3	Note 2, Module disables on high or open
4	SDA	Module Definition 2	3	2-wire Serial Interface Data Line.
5	SCL	Module Definition 1	3	2-wire Serial Interface Clock.
6	MOD-ABS	Module Definition 0	3	Note 3
7	RS0	RX Rate Select (LVTTL).	3	No Function Implement
8	LOS	Loss of Signal	3	Note 4
9	RS1	TX Rate Select (LVTTL).	1	No Function Implement
10	VeeR	Receiver Ground	1	Note 5
11	VeeR	Receiver Ground	1	Note 5
12	RD-	Inv. Received Data Out	3	Note 6
13	RD+	Received Data Out	3	Note 6
14	VeeR	Receiver Ground	1	Note 5
15	VccR	Receiver Power	2	3.3V ± 5%, Note 7
16	VccT	Transmitter Power	2	3.3V ± 5%, Note 7
17	VeeT	Transmitter Ground	1	Note 5
18	TD+	Transmit Data In	3	Note 8
19	TD-	Inv. Transmit Data In	3	Note 8

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20	VeeT	Transmitter Ground	1	Note 5

Notes:

1) TX Fault is an open collector/drain output, which should be pulled up with a 4.7K – 10KΩ resistor on the host board. Pull up voltage between 2.0V and VccT/R+0.3V. When high, output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.
2) TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7K~10 K Ω resistor. Its states are:
Low (0 – 0.8V): Transmitter on
(>0.8, < 2.0V): Undefined
High (2.0 – 3.465V): Transmitter Disabled
Open: Transmitter Disabled
3) Module Absent, connected to VeeT or VeeR in the module.
4) LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K – 10KΩ resistor. Pull up voltage between 2.0V and VccT/R+0.3V. When high, this output indicates the received optical power is below the worst-case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.
5) The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.
6) RD-/+: These are the differential receiver outputs. They are AC coupled 100Ω differential lines which should be terminated with 100Ω (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board. The voltage swing on these lines will be between 370 and 700 mV differential (185 –350 mV single ended) when properly terminated.
7) VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V ±5% at the SFP+ connector pin. Maximum supply current is 300mA. Inductors with DC resistance of less than 1 ohm should be used in order to maintain the required voltage at the SFP+ input pin with 3.3V supply voltage. When the recommended supply-filtering network is used, hot plugging of the SFP+ transceiver module will result in an inrush current of no more than 30mA greater than the steady state value. VccR and VccT may be internally connected within the SFP+ transceiver module.
8) TD-/+: These are the differential transmitter inputs. They are AC-coupled, differential lines with 100Ω differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board. The inputs will accept differential swings of 150 – 1200 mV (75 – 600mV single-ended), though it is recommended that values between 150 and 1200 mV differential (75 – 600mV single-ended) be used for best EMI performance.

EEPROM

The serial interface uses the 2-wire serial CMOS EEPROM protocol. When the serial protocol is activated, the host generates the serial clock signal (SCL). The positive edge clocks data into those segments of the EEPROM that are not writing protected within the SFP+ transceiver. The negative edge clocks data from the SFP+ transceiver. The serial data signal (SDA) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.
The Module provides diagnostic information about the present operating conditions. The transceiver generates this diagnostic data by digitization of internal analog signals. Calibration and alarm/warning threshold data is written during device manufacture. Received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring all are implemented. If the module is defined as external calibrated, the diagnostic data are raw A/D values and must be converted to real world units using calibration constants stored in

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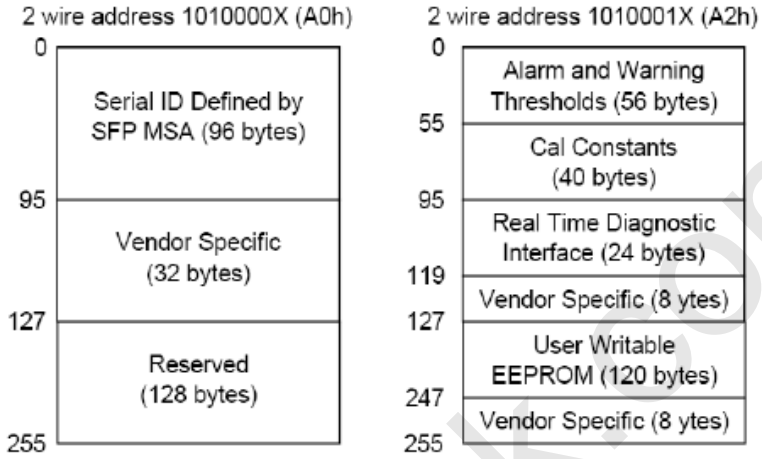
EEPROM locations 56 – 95 at
wire serial bus address A2H. The digital diagnostic memory map
specific data field define as following. For detail EEPROM information, please refer to the related
document of SFF 8472 Rev 10.2.



Data Addr	Field Size (Byte)	Name Of filed	Description of field	Coded value	Hex
BASE ID FIELDS					
0	1	Identifier	Type of serial transceiver	SFP+	03
1	1	Ext.Identifier	Extended identifier of Type of serial transceiver	MOD_DEF 4	04
2	1	Connector	Code for connector type	LC	07
3	8	Transceiver	10G Ethernet Compliance Codes & Infiniband Compliance Codes	10G Base-SR	10
4			Part of SONET Compliance Codes		00
5			SONET Compliance Codes		00
6			Ethernet Compliance Codes		00
7			Fiber Channel link length & part of Fibre Channel technology		00
8			Part of Fiber Channel transmitter technology		00
9			Fiber Channel Transmission media		00
10			Fiber Channel speed		00

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11	1	Encoding	Code for high speed serial encoding algorithm	64B/66B	06
12	1	BR, Nominal	Nominal signalling rate, units of 100MBd.	10.3Gbps	67
13	1	Rate Identifier	Type of rate select functionality		00
14	1	Length(SMF,km)	Link length supported for single mode fiber, units of km		00
15	1	Length (SMF)	Link length supported for single mode fiber, units of 100 m		00
16	1	Length (50um)	Link length supported for 50 um OM2 fiber, units of 10 m	80(m)	08
17	1	Length (62.5um)	Link length supported for 62.5 um OM1 fiber, units of 10 m	30(m)	03
18	1	Length (Copper)	Link length supported for copper, units of meters		00
19	1	Length (OM3)	Link length supported for 50 um OM3 fiber, units of 10 m	300(m)	1E
20	16	Vendor name	Vendor name (ASCII)	E	45
21				o	6F
22				p	70
23				t	74
24				o	6F
25				l	6C
26				i	69
27				n	6E
28				k	6B
29				<space>	20
30				<space>	20
31				<space>	20
32				<space>	20
33				<space>	20
34				<space>	20
35				<space>	20
36	1	Reserved			00
37	3	Vendor OUI	SFP vendor IEEE company ID		00
38					00
39					00
40	16	Vendor PN	Part number provided by vendor (ASCII)	E	45
41				O	4F
42				L	4C

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43				P	50
44				-	2D
45				8	38
46				5	35
47				9	39
48				6	36
49				-	2D
50				0	30
51				2	32
52				-	2D
53				I/<space>	49/20
54				<space>	20
55				<space>	20
56	4	Vendor rev	Revision level for part number provided by vendor (ASCII)	1	31
57				.	2E
58				0	30
59				<space>	20
60	2	Wavelength	Laser Wavelength	850nm	05
61					32
62	1	Reserved			00
63	1	CC_BASE	Check code for Base ID Fields (addresses 0 to 62)	Note5	xx
64	2	Options	Indicates which optional transceiver signals are implemented	TX_DISABLE, TX_FAULT signal,Rx_LOS	00
65					1A
66	1	BR, max	Upper bit rate margin, units of %		00
67	1	BR, min	Lower bit rate margin, units of %		00
68	16	Vendor SN	Serial number provided by vendor (ASCII)	x	xx
69				x	xx
70				x	xx
71				x	xx
72				x	xx
73				x	xx
74				x	xx
75				x	xx
76				x	xx
77				x	xx
78				<space>	20

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79				<space>	20
80				<space>	20
81				<space>	20
82				<space>	20
83				<space>	20
84	8	Date code	Vendor's manufacturing date code	Year	xx
85				Year	xx
86				Month	xx
87				Month	xx
88				Day	xx
89				Day	xx
90				<Space>	20
91				<Space>	20
92	1	Diagnostic Monitoring Type	Type of diagnostic monitoring is implemented	DD Implemented; Internally Calibrated; Average Power	68
93	1	Enhanced Options	Optional enhanced features are implemented	Optional Alarm/warning Flags Implemented,Optional soft TX_FAULT monitoring,Optional soft RX_LOS monitoring	B0
94	1	SFF-8472 Compliance	Revision of SFF-8472 the transceiver complies with	Rev 10.2 of SFF-8472.	03
95	1	CC_EXT	Check code for the Extended ID Fields (addresses 64 to 94)	Note6	

Note5: The check code shall be the low order 8 bits of the sum of the contents of all the bytes from byte 0 to byte 62, inclusive.

Note6: The check code shall be the low order 8 bits of the sum of the contents of all the bytes from byte 64 to byte 94, inclusive.

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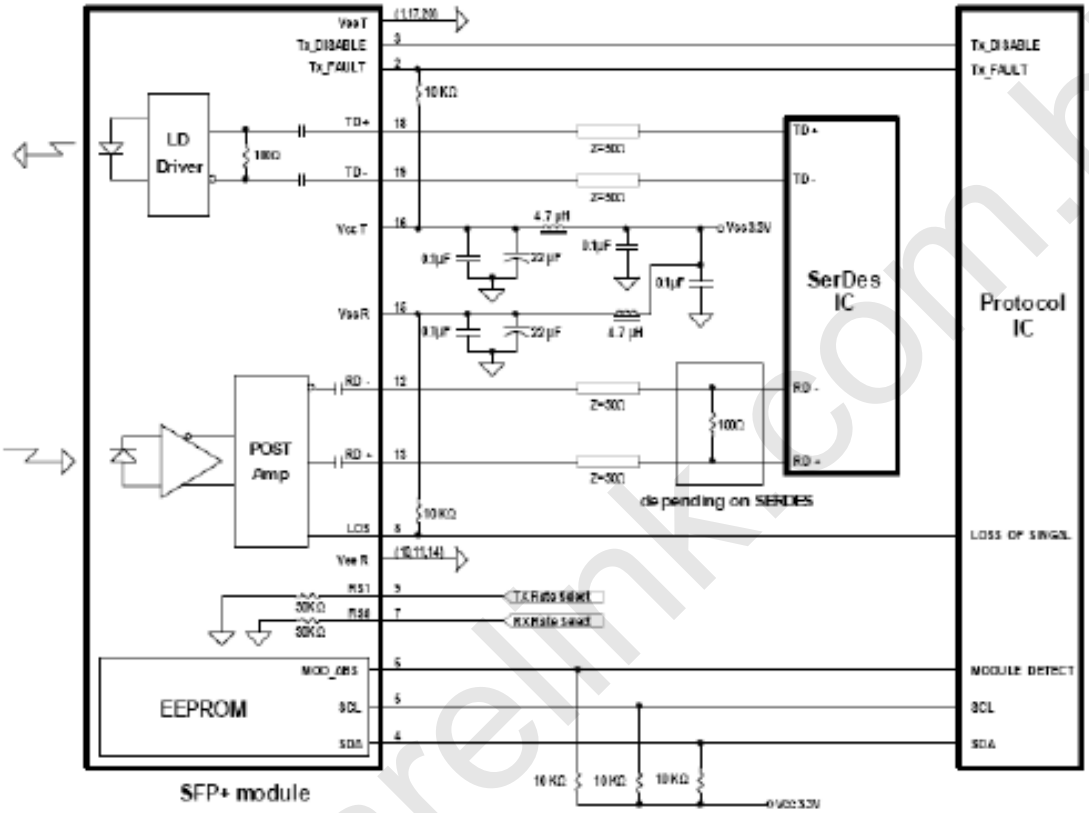
Recommend Circuit Schematic



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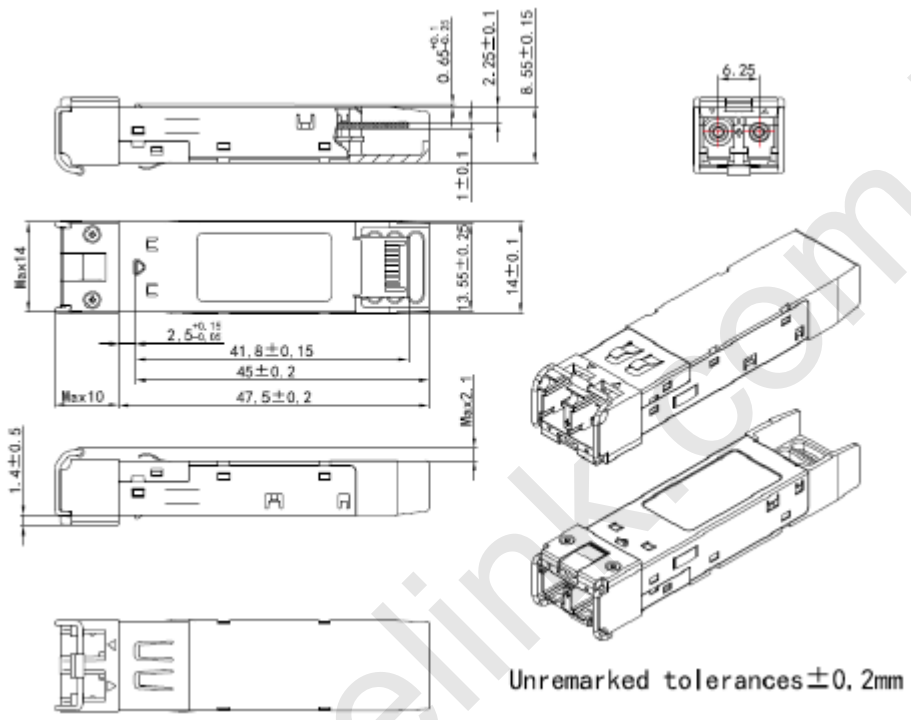
Mechanical Specifications



*This 2D drawing only for reference, please check with Carelink before ordering

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Eye Safety

This Multi-Mode transceiver is a Class 1 laser product. It complies with IEC-60825 and FDA 21 CFR 1040.10 and 1040.11. The transceiver must be operated within the specified temperature and voltage limits. The optical ports of the module shall be terminated with an optical connector or with a dust plug.

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