

# 25.78G SFP28 LR 10km Optical Transceiver

## Features

- Supports 25.78125Gb/s serial optical interface
- Up to 10km transmission on SMF
- 1310nm DFB laser and PIN receiver
- Hot-pluggable SFP28 footprint
- Built-in digital diagnostic functions
- Single +3.3V power supply
- Power consumption less than 1.5 W
- Operating case temperature: -5~+70°C/ -40°C ~ +85°C
- Internal CDR on both transmitter and receiver channel
- Support CDR bypass
- SFP28 MSA package with Duplex LC connector

## Applications

- 25GBASE-LR 25G Ethernet
- 25.78125 Gb/s single lane 100GE LR4
- Other optical links

## Standard

- Compliant with SFF-8402 and SFF-8472
- Compliant to SFF-8431 and SFF-8432
- Compliant with IEEE 802.3by 25GBASE-LR
- Compliant with FCC 47 CFR Part 15, Class B
- Compliant with Telcordia GR-468-CORE
- RoHS Compliant

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**Table 1. Regulatory Compliance**

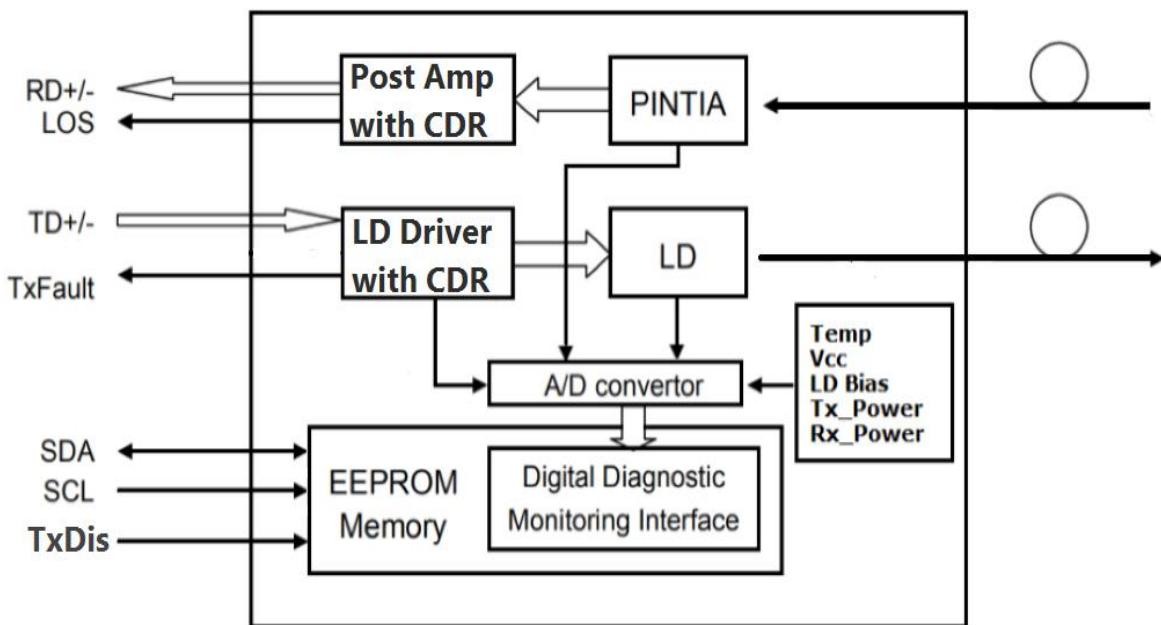
Product Certificate	Certificate Number	Applicable Standard
TUV	R50135086	EN 60950-1:2006+A11+A1+A12+A2 EN 60825-1:2014 EN 60825-2:2004+A1+A2
UL	E317337	UL 60950-1 CSA C22.2 No. 60950-1-07
EMC CE	AE 50285865 0001	EN 55022:2010 EN 55024:2010
FCC	WTF14F0514417E	47 CFR PART 15 OCT., 2013
FDA	/	CDRH 1040.10
ROHS	/	2011/65/EU

## Product Description

The SFP28 transceivers are high performance, cost effective modules supporting data rate of 25.78125Gbps and Up to 10km transmission on SMF.

The transceiver consists of three sections: a 1310nm DFB laser transmitter, a PIN photodiode integrated with a trans-impedance preamplifier (TIA) and MCU control unit. All modules satisfy class I laser safety requirements.

The transceivers are compatible with SFP Multi-Source Agreement and SFF-8472 digital diagnostics functions.



**Figure 1. Transceiver functional Block Diagram**

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## Absolute Maximum Ratings

**Table 2. Absolute Maximum Ratings**

(Exceeding the limits below may damage the transceiver module permanently)

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Maximum Supply Voltage	Vcc	-0.5	-	+4.0	V	
Storage Temperature	Ts	-40	-	+85	°C	
Case Operating Temperature	TA	-10	-	+75	°C	
Relative Humidity	RH	5	-	85	%	1

**Notes:**

1. Non-condensing.

## Recommend Operation Environment

**Table 3. Recommend Operation Environment**

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Data Rate	BR	-	25.78125	-	Gbps	
Power Supply Voltage	Vcc	3.13	3.3	3.47	V	
Power Supply Current	Icc	-	-	350	mA	
Power Dissipation	PD	-	-	1.2	W	
Case Operating Temperature	TA	-5	-	+70	°C	
Transmission Distance	TD	-	-	10	km	1

**Notes:**

1. Measured with ITU-T G.652 SMF

## Electrical Characteristics

**Table 4. Electrical Characteristics(Top = -5 to +70 °C, Vcc = 3.13 to 3.47 V)**

Parameter	Symbol	Min	Typ	Max	Unit	Notes
<b>Transmitter</b>						
Differential Data Input Amplitude	V <sub>IN,P-P</sub>	180	-	900	mVpp	1
Input Differential Impedance	Z <sub>IN</sub>	90	100	110	Ω	
Transmitter Fault Output-High	V <sub>OH</sub>	2.0	-	Vcc	V	
Transmitter Fault Output-Low	V <sub>OL</sub>	0	-	0.8	V	
Transmitter Disable Voltage- High	V <sub>IH</sub>	2.0	-	Vcc	V	
Transmitter Disable Voltage- low	V <sub>IL</sub>	0	-	0.8	V	
<b>Receiver</b>						
Differential output voltage swing	V <sub>OUT,P-P</sub>	300	-	850	mVpp	1
Output Differential Impedance	Z <sub>OUT</sub>	90	100	110	Ω	
Deterministic Jitter	DJ	-	-	0.42	UI	
Total Jitte	TJ	-	-	0.70	UI	
LOS Output Voltage-High	V <sub>LOSH</sub>	2.0	-	Vcc	V	
LOS Output Voltage-Low	V <sub>LOSL</sub>	-	-	0.8	V	

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**Notes:**

1. CML input/output, internally AC-coupled and terminated.

**Optical Characteristics****Table 5. Optical Characteristics (TOP = -5 to +70 °C, Vcc = 3.13 to 3.47 V)**

Parameter	Symbol	Min	Typ	Max	Unit	Notes
<b>Transmitter</b>						
Optical Center Wavelength	$\lambda_c$	1295	1310	1325	nm	
Data Rate	BR	-	25.78125	-	Gbps	
Average Output Power	Po	-7.0	-	+2.0	dBm	
Optical Modulation Amplitude	POMA	-4.0	-	+2.2	dBm	
Optical Extinction Ratio	ER	3.5	-	-	dB	
RMS Spectral Width (-20dB)	$\Delta\sigma$	-	-	1.0	nm	
Side Mode Suppression Ratio	SMSR	30	-	-	dB	
Relative Intensity Noise	RIN	-	-	-130	dB/Hz	
Optical Return Loss Tolerance	ORL	-	-	20	dB	
Transmitter Reflectance	R <sub>T</sub>	-	-	-12	dB	
Average Launch power of Tx OFF	P <sub>OFF</sub>	-	-	-30	dBm	
Optical Eye Mask	Compliant with IEEE 802.3by					
<b>Receiver</b>						
Center Wavelength Range	$\lambda_c$	1260	-	1620	nm	
Data Rate	BR	-	25.78125	-	Gbps	
Maximum Receiver Power (OMA)	R <sub>POMA</sub>	-	-	+2.2	dBm	1
Average Receive Power	R <sub>P0</sub>	-13.3	-	+2.0	dBm	
Receiver Sensitivity(OMA)	R <sub>SENS</sub>	-	-	-12	dBm	1
Stressed Receiver Sensitivity (OMA)	R <sub>RSRS</sub>	-	-	-9.5	dBm	1
LOS Assert	LOS <sub>A</sub>	-25	-	-	dBm	
LOS De-Assert	LOS <sub>D</sub>	-	-	-15	dBm	
LOS Hysteresis	LOS <sub>H</sub>	0.5	-	5	dB	
Receiver Reflectance	R <sub>R</sub>	-	-	-26	dB	
Optical Return Loss	ORL	12	-	-	dB	

**Notes:**

1. Measured with worst ER=2.0dB, RPBS 2^31-1 test pattern @25.78125Gbs BER=<5E-5.

**Table 6. Timing and Electrical**

Parameter	Symbol	Min	Typ	Max	Unit
Tx Disable Negate Time	t <sub>_on</sub>	-	-	1	ms
Tx Disable Assert Time	t <sub>_off</sub>	-	-	10	$\mu$ s
Time To Initialize, including Reset of Tx Fault	t <sub>_init</sub>	-	-	300	ms
Tx Fault Assert Time	t <sub>_fault</sub>	-	-	100	$\mu$ s
Tx Fault To Reset	t <sub>_reset</sub>	10	-	-	$\mu$ s
LOS Assert Time	t <sub>_loss_on</sub>	-	-	100	$\mu$ s
LOS De-assert Time	t <sub>_loss_off</sub>	-	-	100	$\mu$ s

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Rate-Select Change Time	$t_{ratesel}$	-	-	10	$\mu s$
Serial ID Clock Rate	$f_{serial\_clock}$	-	100	400	KHZ
SDA, SCL, MOD_ABS High Level	VH	2.0	-	VCC	V
SDA, SCL, MOD_ABS Low Level	VL	-	-	0.8	V

## Pin Assignment

**Table 7. Pin Descriptions**

Pin	Symbol	Name/Description	Notes
1	VEET	Module Transmitter Ground	
2	Tx_Fault	Module Transmitter Fault	1
3	Tx_Disable	Transmitter Disable, Turns off transmitter laser output	2
4	SDA	2 wire serial interface data input/output (SDA)	1
5	SCL	2 wire serial interface clock input (SCL)	1
6	MOD_ABS	Module Absent, connected to VeeT or VeeR in the module	1
7	RS0	Receiver Rate Select	
8	Rx_LOS	Loss of Signal indication, Logic 0 indicates normal operation	3
9	RS1	Transmitter Rate Select, Not Used for this product	
10	VEER	Module Receiver Ground	
11	VEER	Module Receiver Ground	
12	RD-	Receiver Inverted Data Output, AC Coupled	4
13	RD+	Receiver Non-Inverted Data Output, AC Coupled	4
14	VEER	Module Receiver Ground	
15	VccR	Module Receiver 3.3 V Supply	
16	VccT	Module Transmitter 3.3 V Supply	
17	VEET	Module Transmitter Ground	
18	TD+	Transmitter Non-Inverted Data Input, AC Coupled	5
19	TD-	Transmitter Inverted Data Input, AC Coupled	5
20	VEET	Module Transmitter Ground	

**Notes:**

1. Open collector/drain output, which should be pulled up with a  $4.7k\Omega$  to  $10k\Omega$  resistor on the host board if intended for use. Pull up voltage should be between 2.0V to 3.6V. 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  $<0.8V$ .
2. Laser output disabled on  $Tx\_Disable > 2.0V$  or open, enabled on  $Tx\_Disable < 0.8V$ .
3. LOS is open collector output. Should be pulled up with  $4.7k\Omega$  to  $10k\Omega$  on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.
4. RD-/+: These are the differential receiver outputs. They are internally AC-coupled  $100\Omega$

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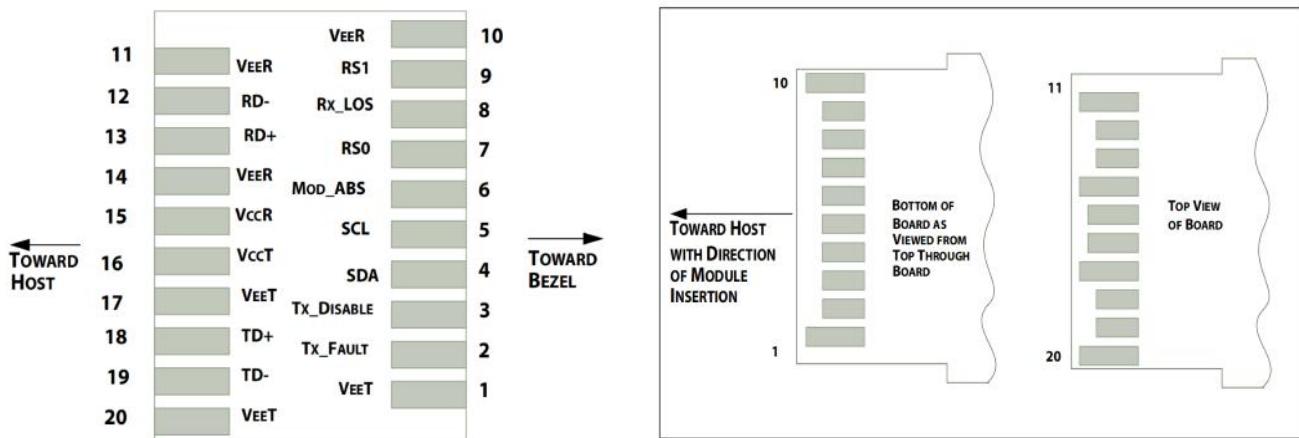
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differential lines which should be terminated with  $100\Omega$  (differential) at the user SERDES.

5. TD-/+: These are the differential transmitter inputs. They are internally AC-coupled, differential lines with  $100\Omega$  differential termination inside the module.

### Pin Assignment (continued)



**Figure 2. Host PCB SFP+ pad assignment top view and Names.**

## Digital Diagnostic Memory Map

The transceivers provide serial ID memory contents and diagnostic information about the present operating conditions by the 2-wire serial interface (SCL, SDA). The diagnostic information with internal calibration or external calibration all are implemented, including received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring.

The digital diagnostic memory map specific data field defines as following.

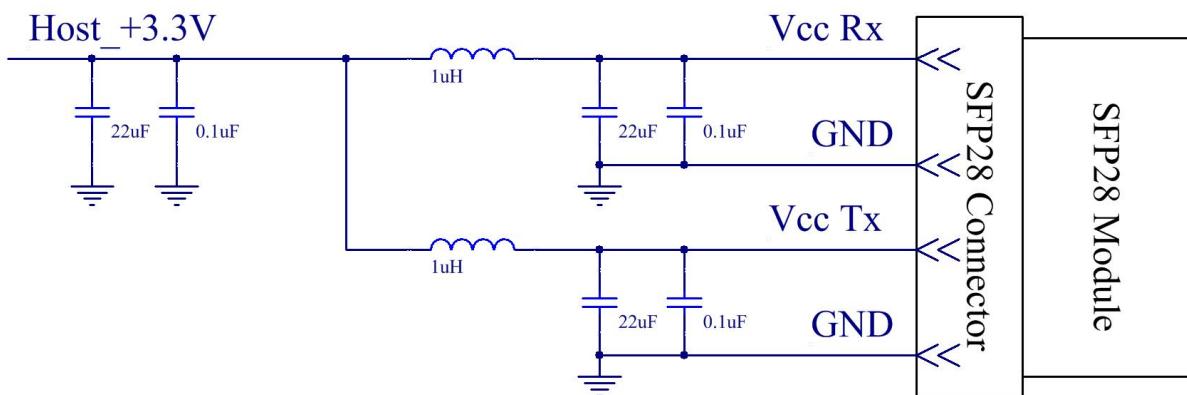
**Table 8. Digital Diagnostic Memory Map (Specific Data Field Descriptions)**

2 wire address 1010000X (A0h)	2 wire address 1010001X (A2h)																						
<table border="1"> <tr> <td>0</td> <td>Serial ID Defined by SFP MSA (96 bytes)</td> </tr> <tr> <td>95</td> <td>Vendor Specific (32 bytes)</td> </tr> <tr> <td>127</td> <td>Reserved (128 bytes)</td> </tr> <tr> <td>255</td> <td></td> </tr> </table>	0	Serial ID Defined by SFP MSA (96 bytes)	95	Vendor Specific (32 bytes)	127	Reserved (128 bytes)	255		<table border="1"> <tr> <td>0</td> <td>Alarm and Warning Thresholds (56 bytes)</td> </tr> <tr> <td>55</td> <td>Cal Constants (40 bytes)</td> </tr> <tr> <td>95</td> <td>Real Time Diagnostic Interface (24 bytes)</td> </tr> <tr> <td>119</td> <td>Vendor Specific (8 bytes)</td> </tr> <tr> <td>127</td> <td>User Writable EEPROM (120 bytes)</td> </tr> <tr> <td>247</td> <td>Vendor Specific (8 bytes)</td> </tr> <tr> <td>255</td> <td></td> </tr> </table>	0	Alarm and Warning Thresholds (56 bytes)	55	Cal Constants (40 bytes)	95	Real Time Diagnostic Interface (24 bytes)	119	Vendor Specific (8 bytes)	127	User Writable EEPROM (120 bytes)	247	Vendor Specific (8 bytes)	255	
0	Serial ID Defined by SFP MSA (96 bytes)																						
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95	Real Time Diagnostic Interface (24 bytes)																						
119	Vendor Specific (8 bytes)																						
127	User Writable EEPROM (120 bytes)																						
247	Vendor Specific (8 bytes)																						
255																							

**Table 9. Digital Diagnostic Monitor Characteristics**

Parameter	Calibration	Range	Accuracy	Unit
Transceiver Internal Temperature	Internal	-5 to +70°C	±3.0	°C
Vcc3 Internal Supply Voltage	Internal	3.0 to 3.6V	±3.0	%
Laser Bias Current	Internal	0 to 90mA	±10	%
Tx Output Power	Internal	-7.0 to +3.0dBm	±3.0	dBm
Rx Input Power	Internal	-14.0 to +3.0dBm	±3.0	dBm

## Recommended Circuit



**Figure 3, Recommended Host Board Power Supply Circuit**

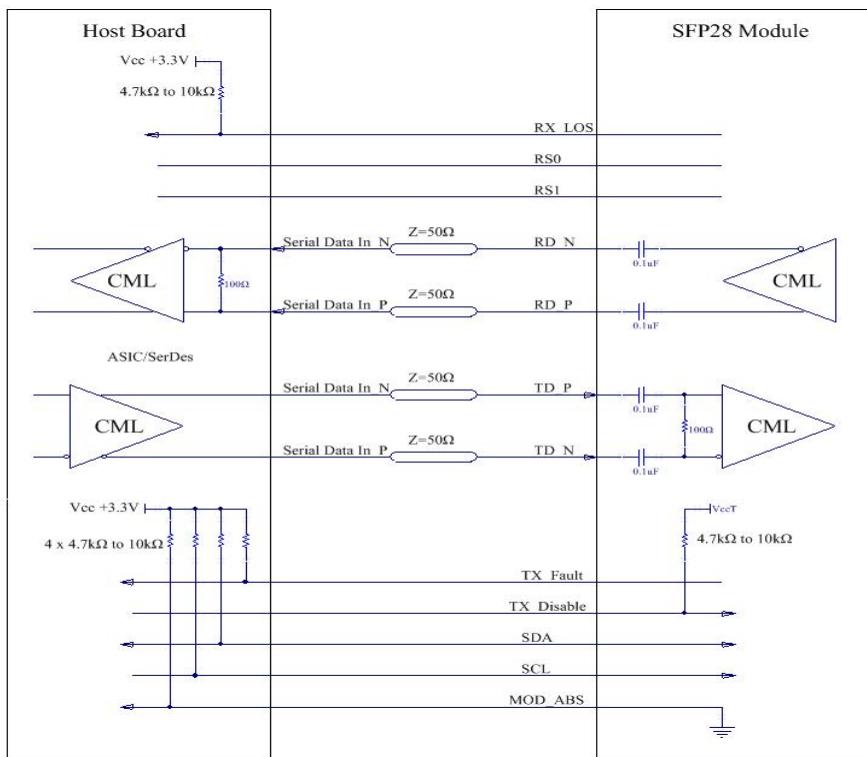
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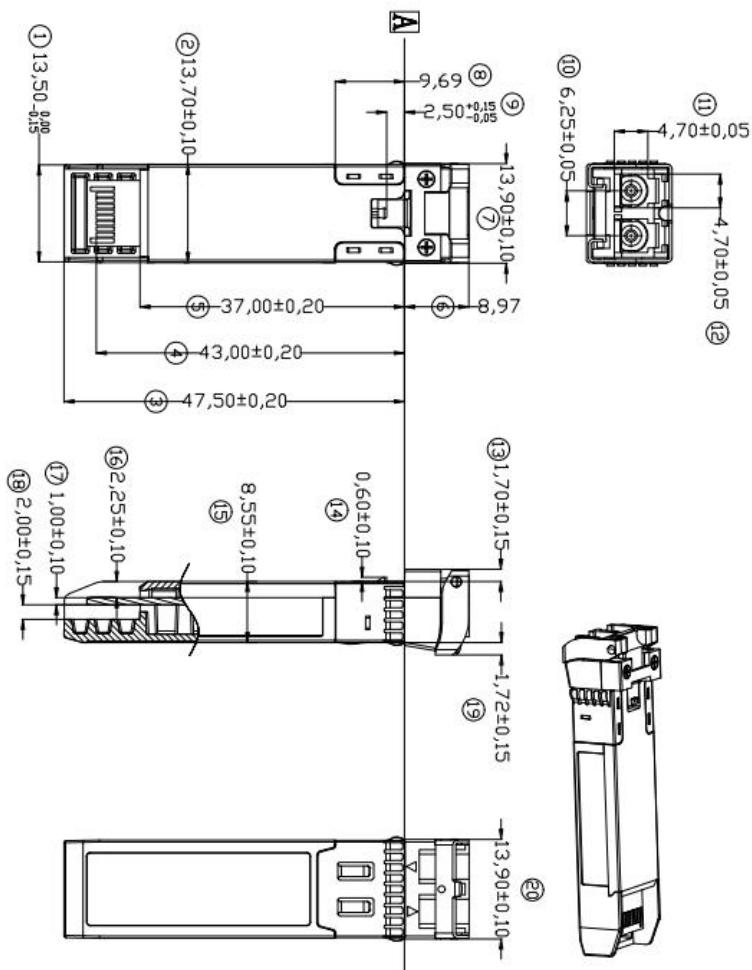
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**Figure 4, Recommended Interface Circuit**

# Mechanical Dimensions



## Ordering information

Table 10. Ordering information

Part Number	Product Description
YS25GC10	1310nm DFB, 25.78125Gbps,SMF 10km, -5°C ~ +70°C
YS25GC10E	1310nm DFB, 25.78125Gbps,SMF 10km, -20°C ~ +85°C
YS25GC10I	1310nm DFB, 25.78125Gbps,SMF 10km, -40°C ~ +85°C

## Warnings

**Handling Precautions:** This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

**Laser Safety:** Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

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