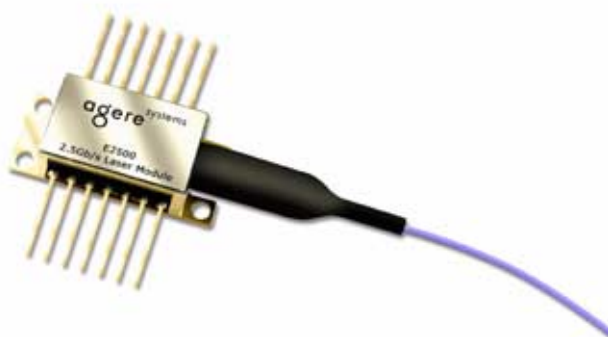


## E2500-Type 2.5 Gbits/s Electroabsorption Modulated Isolated Laser Module (EM-ILM) for Ultralong-Reach Applications

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The E2500 EM-ILM, the newest generation of the award-winning 266-Type EM-ILM, features an integrated modulator and laser chip, and provides a compact, cost-effective solution for extended-reach transmissions.

### Features

- Integrated electroabsorptive modulator
- 1.5  $\mu\text{m}$  wavelength
- Characterized for 2.5 Gbits/s operation
- Very low dispersion penalty over 600 km
- Low modulation voltage
- Temperature stabilized
- Wavelengths selectable to ITU-T standards
- Ultrastable wavelength aging performance for DWDM systems

### Applications

- SONET/SDH extended-reach applications
- High-capacity DWDM system applications
- High-speed data communications
- Digitized video

### Description

The E2500-Type EM-ILM is a 1.5  $\mu\text{m}$  laser with an integrated electroabsorptive modulator packaged in an industry-standard, 14-pin butterfly package. The device has been designed to be used in 2.5 Gbits/s extended-reach applications where the distances between regenerators is in the range of 150 km—1000 km. To boost the transmitter power high enough to reach the receiver, the device typically is coupled with an erbium-doped fiber amplifier (EDFA) such as Agere Systems Inc.'s 1724 EDFA. The standard product is specified for use up to 360 km (E2505 Series) and 600 km (E2502 Series).

The E2500 EM-ILM can replace external modulators in many applications. The nominal input impedance for the modulator is 50  $\Omega$ . By integrating the modulator with the laser chip, the device offers a compact, cost-effective solution for extended-reach transmission applications. It can also be specified for WDM applications where wavelength selection is required. Agere is providing devices compatible with the ITU-T wavelength standards.

**Description** (continued)

The package also contains a thermoelectric cooler, thermistor, back-facet monitor, and an optical isolator.

This device exhibits excellent wavelength stability, supporting operation at 100 Gbits/s channel spacing, assuming an end-of-life condition of  $< \pm 100$  pm over 20 years for wavelength aging, with very low FIT rates. Wavelength stabilization schemes are not required in DWDM systems of this type, using Agere's E2500-Type EM-ILM.

The E2500-Type EM-ILM is qualified for DWDM applications to Bellcore TA-TSY-000468.

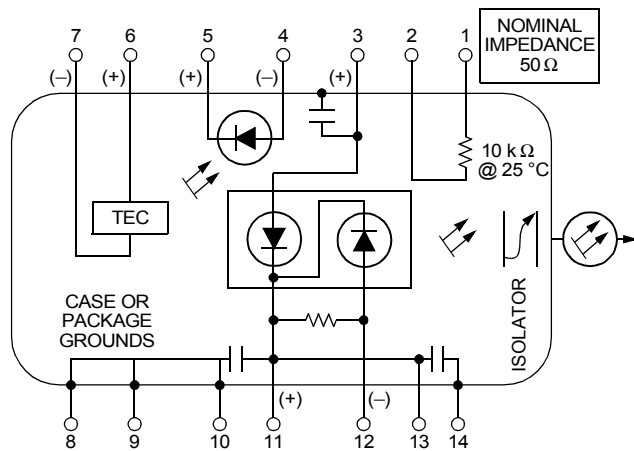
**Module Characteristics**

Package Type	14-pin butterfly with internal isolator
Fiber	Standard single mode
Connector	S7 <sup>®</sup>
RF Input	50 $\Omega$ nominal
Bit Rate	2.5 Gbits/s

**Pin Information**

**Table 1. Pin Assignments**

Pin Number	Description
1	Thermistor
2	Thermistor
3	Laser anode
4	Monitor anode
5	Monitor cathode
6	TEC (+)
7	TEC (-)
8	Case ground
9	Case ground
10	Case ground
11	Laser modulator ground
12	Modulator anode (-)/50 $\Omega$ RF input
13	Laser/modulator ground
14	Case ground



1-891a (F)

**Figure 1. E2500 EM-ILM Schematic**

## Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operations section of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Conditions	Limit	Unit
Laser Diode Reverse Voltage	CW	2	V
Laser Diode Forward Current	CW	150	mA
Optical Output Power	CW	10	mW
Modulator Reverse Voltage	—	5	V
Modulator Forward Voltage	—	1	V
Monitor Diode Reverse Voltage	—	10	V
Monitor Diode Forward Current	—	1	mA
Storage Temperature Range	—	-40 to +85	°C
Operating Temperature Range	—	0 to 70	°C

## Characteristics

Table 2. Optical and Electrical Specifications

Parameter	Symbol	Conditions	Min	Max	Unit
<b>Laser:</b> Laser T <sub>OP</sub> (temperature of laser submount) = 15 °C to 35 °C, except where noted.					
Threshold Current (BOL)	I <sub>TH</sub>	T <sub>LASER CHIP</sub> = T <sub>OP</sub>	5	35	mA
Forward Voltage	V <sub>F</sub>	I <sub>f</sub> = I <sub>OP</sub> @ T <sub>OP</sub>	—	2.0	V
Operating Current	I <sub>OP</sub>	T <sub>LASER CHIP</sub> = T <sub>OP</sub>	50	100	mA
Threshold Power	P <sub>TH</sub>	T <sub>LASER CHIP</sub> = T <sub>OP</sub> I <sub>f</sub> = I <sub>TH</sub> , V <sub>M</sub> = 0 V	—	80	μW
Fiber Output Power (peak)	P <sub>PK</sub>	T <sub>LASER CHIP</sub> = T <sub>OP</sub> V <sub>M</sub> = 0 V, I <sub>f</sub> = I <sub>OP</sub>	1	—	dBm
Peak Wavelength (wavelength can be specified to the ITU-T wavelength channels)	λ <sub>0</sub>	V <sub>M</sub> = 0 V T <sub>LASER CHIP</sub> = T <sub>OP</sub> , I <sub>f</sub> = I <sub>OP</sub>	1530	1563	nm
Side-mode Suppression Ratio	SMSR	V <sub>M</sub> = 0 V, I <sub>f</sub> = I <sub>OP</sub> , T <sub>OP</sub>	30	—	dB
Time Resolved Spectroscopy (chirp), E2505 Series	TRSP-P	2.5 Gbits/s V <sub>LOW</sub> = -1.5 V to -3.0 V V <sub>HIGH</sub> = 0 V I <sub>f</sub> = I <sub>OP</sub> @ T <sub>OP</sub>	—	0.25	Å
Time Resolved Spectroscopy (chirp), E2502 Series	TRSP-P	2.5 Gbits/s V <sub>LOW</sub> = -1.5 V to -3.0 V, V <sub>HIGH</sub> = -0.3 V I <sub>f</sub> = I <sub>OP</sub> @ T <sub>OP</sub>	—	0.15	Å
Dispersion Penalty	DP	2.5 Gbits/s 360 km (E2505) 600 km (E2502) V <sub>LOW</sub> = -1.5 V to -3.0 V V <sub>HIGH</sub> = 0 V (E2505), -0.3 V (E2502) I <sub>f</sub> = I <sub>OP</sub> @ T <sub>OP</sub>	—	2.0	dB

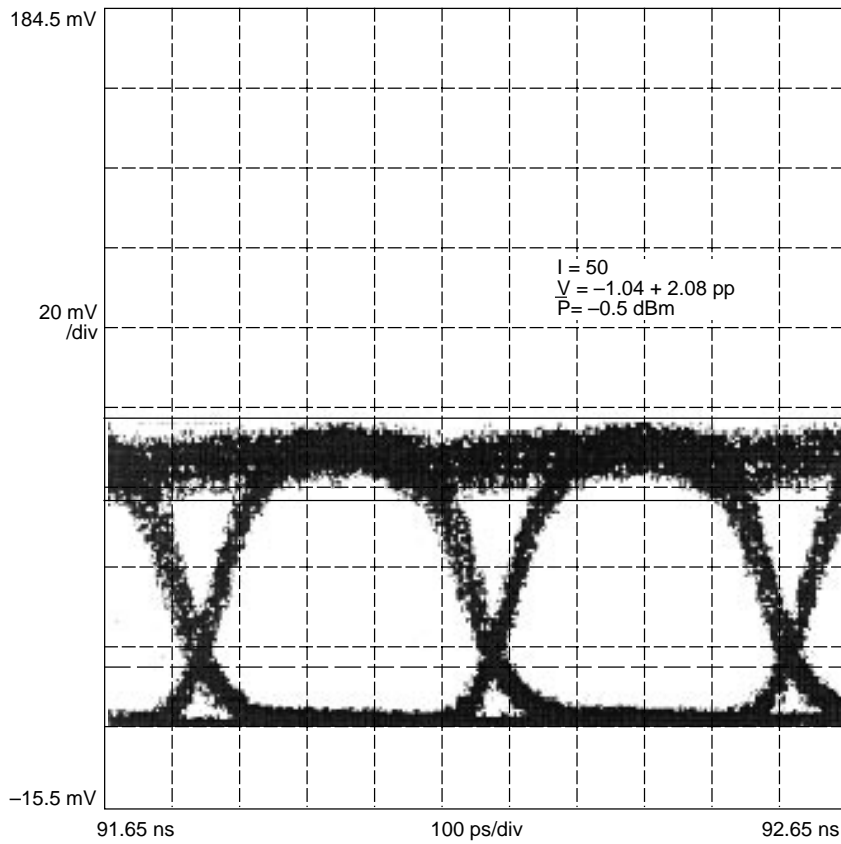
**Characteristics** (continued)

**Table 2. Optical and Electrical Specifications** (continued)

Parameter	Symbol	Conditions	Min	Max	Unit
<b>Modulator</b>					
Extinction Ratio	$E_{RRF}$	$V_M = 0\text{ V to } -3.0\text{ V}$ , 2.5 Gbits/s	10	—	dB
RF Return Loss (0 GHz to 2 GHz)	$S_{11}$	$V_M = -V_{PP}/2$ $I_f = I_{OP}$	10	—	dB
RF Return Loss (2 GHz to 3 GHz)	$S_{11}$	$V_M = -V_{PP}/2$ $I_f = I_{OP}$	7	—	dB
RF Return Loss (3 GHz to 5 GHz)	$S_{11}$	$V_M = -V_{PP}/2$ $I_f = I_{OP}$	3	—	dB
-3 dB Bandwidth	BW	$V_M = -V_{PP}/2$ $I_f = I_{OP}$	3.5	—	GHz
Modulator Current @ $V_M = 0\text{ V}$ , $I_f = 50\text{ mA}$	—	—	—	15	mA
Rise/Fall Time (20% to 80%)	$t_r/t_f$	—	—	125	ps
<b>Monitor Diode</b>					
Monitor Current	$I_{BD}$	$T_{LASER\ CHIP} = T_{OP}$ $V_{BD} = 5\text{ V}$ , $I_f = I_{OP}$	40	1100	$\mu\text{A}$
Dark Current	$I_D$	$T_{LASER\ CHIP} = T_{OP}$ , $V_{BD} = -5\text{ V}$	—	0.1	$\mu\text{A}$
Capacitance	C	$V_{BD} = 5\text{ V}$ , $f = 1\text{ MHz}$	—	25	pF
<b>Thermistor</b>					
Resistance	$R_{THERM}$	$T = 25\text{ }^\circ\text{C}$	9.5	10.5	k $\Omega$
Thermistor Current	$I_{TC}$	—	10	100	$\mu\text{A}$
Thermistor B Constant	B	—	3700	4100	—
<b>Thermoelectric Cooler</b>					
TEC Current	$I_{TEC}$	$T_{LASER\ CHIP} = 15\text{ }^\circ\text{C}$ $T_{CASE} = 70\text{ }^\circ\text{C}$	—	1.3	A
TEC Voltage	$V_{TEC}$	$T_{LASER\ CHIP} = 15\text{ }^\circ\text{C}$ $T_{CASE} = 70\text{ }^\circ\text{C}$	—	2.6	V
TEC Power	$P_{TEC}$	$T_{LASER\ CHIP} = 15\text{ }^\circ\text{C}$ $T_{CASE} = 70\text{ }^\circ\text{C}$	—	3.0	W
TEC Capacity	$\Delta T$	$T_{CASE} = 70\text{ }^\circ\text{C}$	*	—	$^\circ\text{C}$
<b>Laser Module</b>					
Optical Isolation	—	$T_{CASE} = 0\text{ }^\circ\text{C to } 65\text{ }^\circ\text{C}$	30	—	dB

\* Operation at a DT of 70 °C – TSET is guaranteed, where TSET is the laser temperature required to achieve the required ITU wavelength, over life, in a DWDM system (TSET range is 15 °C to 35 °C). In a non-WDM application, TSET is 25 °C.

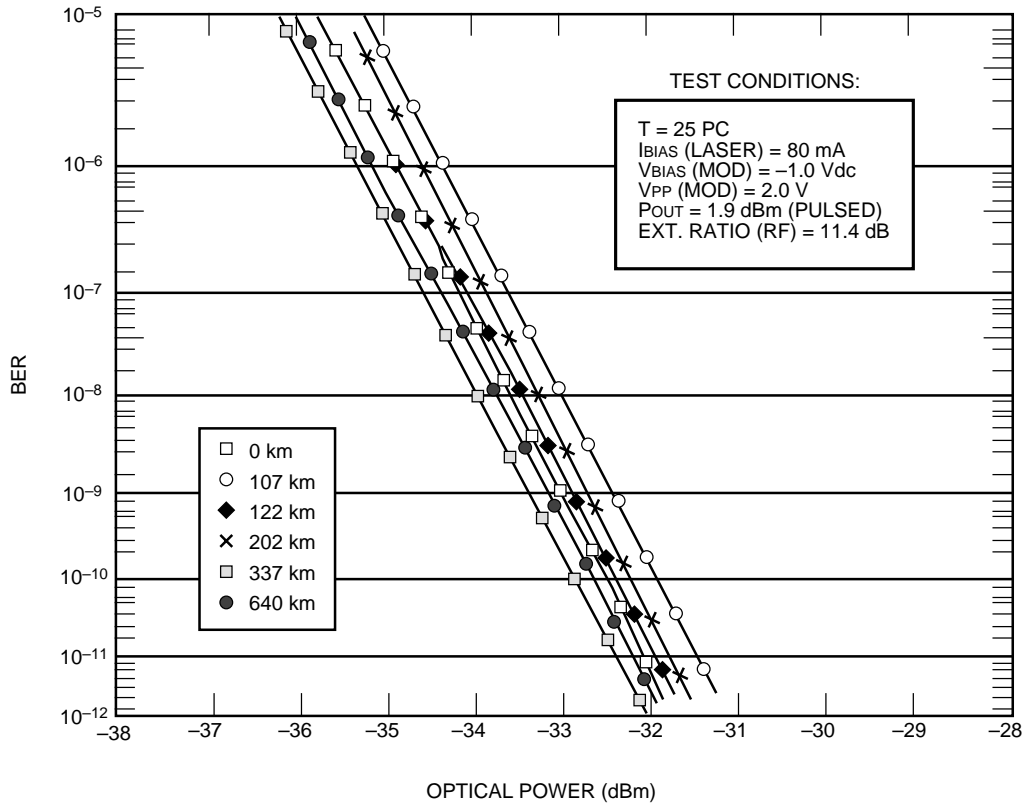
Characteristics (continued)



1-500(C).d

Figure 2. Typical Eye Pattern at 2.5 Gbits/s

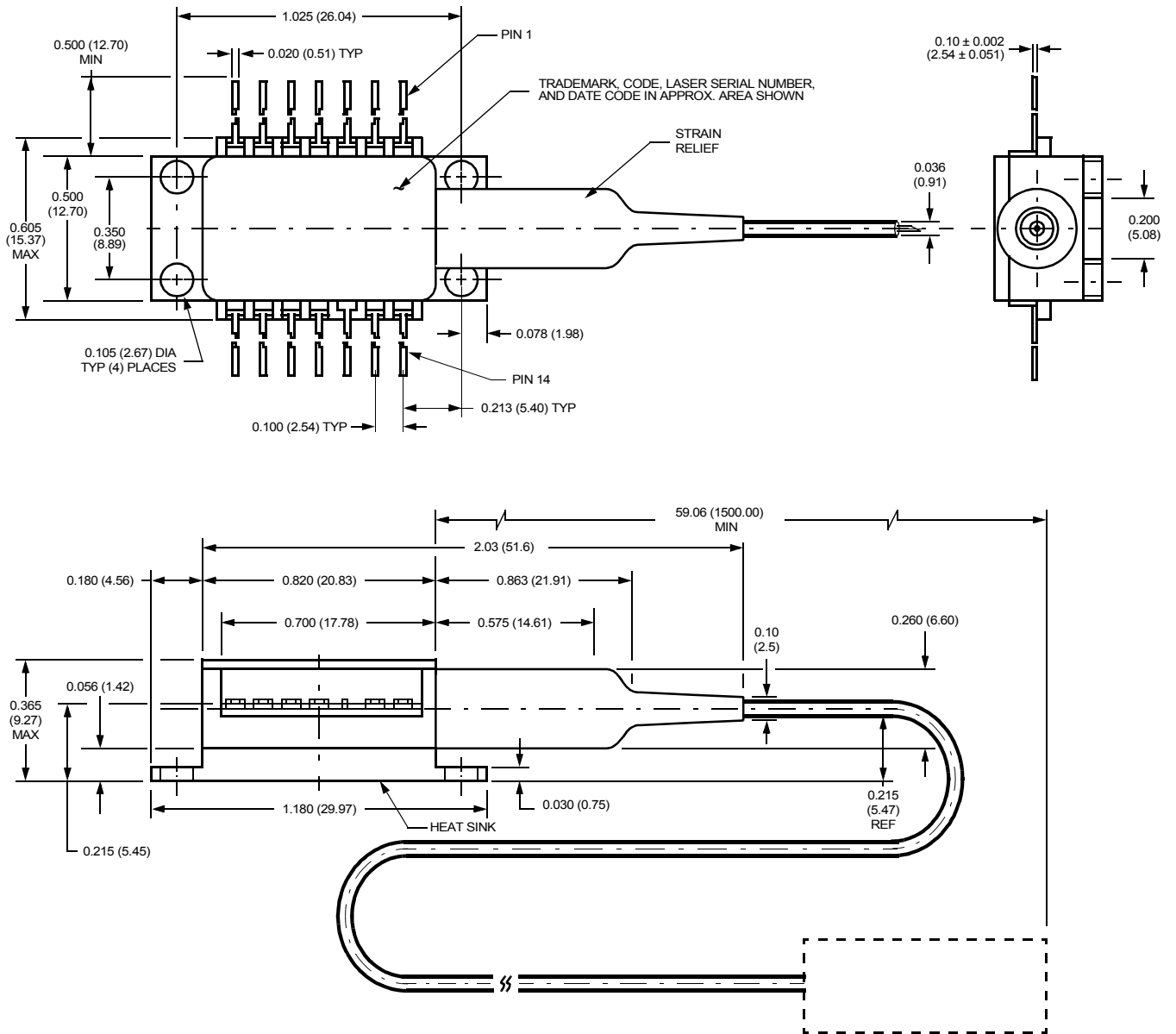
Characteristics (continued)



1-930(C).c

Figure 3. BER vs. Optical Power (Typical)

Outline Diagram



1-520.h (F)

**Ordering Information**

**Table 3. Ordering Information**

Parameter		Device Description			
ITU-T Wave-length (nm)	Frequency (THz)	E2505 Series 360 km, Standard Fiber		E2505 Series 600 km, Standard Fiber	
		Code	Comcode	Code	Comcode
1530.37	195.9	E2505H59	108319146	E2502H59	108319112
1531.15	195.8	E2505H58	108319138	E2502H58	108319104
1531.90	195.7	E2505H57	108319120	E2502H57	108319096
1532.68	195.6	E2505H56	108031683	E2502H56	108030990
1533.46	195.5	E2505H55	108031675	E2502H55	108030982
1534.25	195.4	E2505H54	108031667	E2502H54	108030974
1535.04	195.3	E2505H53	108031659	E2502H53	108030966
1535.82	195.2	E2505H52	108031642	E2502H52	108030958
1536.61	195.1	E2505H51	108031634	E2502H51	108030941
1537.4	195.0	E2505H50	108031626	E2502H50	108031006
1538.19	194.9	E2505H49	108031618	E2502H49	108030925
1538.98	194.8	E2505H48	108031600	E2502H48	108030917
1539.77	194.7	E2505H47	108031592	E2502H47	108030909
1540.56	194.6	E2505H46	108031584	E2502H46	108030891
1541.35	194.5	E2505H45	108031576	E2502H45	108030883
1542.14	194.4	E2505H44	108031568	E2502H44	108030875
1542.94	194.3	E2505H43	108031550	E2502H43	108030867
1543.73	194.2	E2505H42	108031543	E2502H42	108030859
1544.53	194.1	E2505H41	108031535	E2502H41	108030842
1545.32	194.0	E2505H40	108031527	E2502H40	108030933
1546.12	193.9	E2505H39	108031519	E2502H39	108030826
1546.92	193.8	E2505H38	108031501	E2502H38	108030818
1547.72	193.7	E2505H37	108031196	E2502H37	108030800
1548.51	193.6	E2505H36	108031188	E2502H36	108030792
1549.31	193.5	E2505H35	108031170	E2502H35	108030784
1550.12	193.4	E2505H34	108031162	E2502H34	108030776
1550.92	193.3	E2505H33	108031154	E2502H33	108030768
1551.72	193.2	E2505H32	108031147	E2502H32	108030750
1552.52	193.1	E2505H31	108031139	E2502H31	108030743
1553.33	193.0	E2505H30	108031493	E2502H30	108030834
1554.13	192.9	E2505H29	108031113	E2502H29	108030727
1554.94	192.8	E2505H28	108031105	E2502H28	108030719
1555.75	192.7	E2505H27	108031097	E2502H27	108030701
1556.55	192.6	E2505H26	108031089	E2502H26	108030693
1557.36	192.5	E2505H25	108031071	E2502H25	108030685
1558.17	192.4	E2505H24	108031063	E2502H24	108030677
1558.98	192.3	E2505H23	108031055	E2502H23	108030669
1559.79	192.2	E2505H22	108031048	E2502H22	108030651
1560.61	192.1	E2505H21	108031030	E2502H21	108030644
1561.42	192.0	E2505H20	108031121	E2502H20	108030735
1562.23	191.9	E2505H19	108031022	E2502H19	108030636
1530 to 1565	—	E2505H	108031691	E2502H	108031014



## Related Product Information

Table 4. Related Product Information

Description	Part Number	Document Number
1.5 mm EDFA	1724-Type	DS98-412LWP
2.5 Gbits/s Receiver	1319-Type	DS97-106LWP
1.5 mm Digital DFB Laser	D2500-Type	DS97-114LWP
1.3 mm Digital DFB Laser	D2300-Type	DS97-122LWP
2.5 Gbits/s Receiver with Clock Recovery	1320-Type	DS97-113LWP

## Laser Safety Information

### Class IIIb Laser Product

This product complies with 21 CFR 1040.10 and 1040.11.

Single-mode connector.

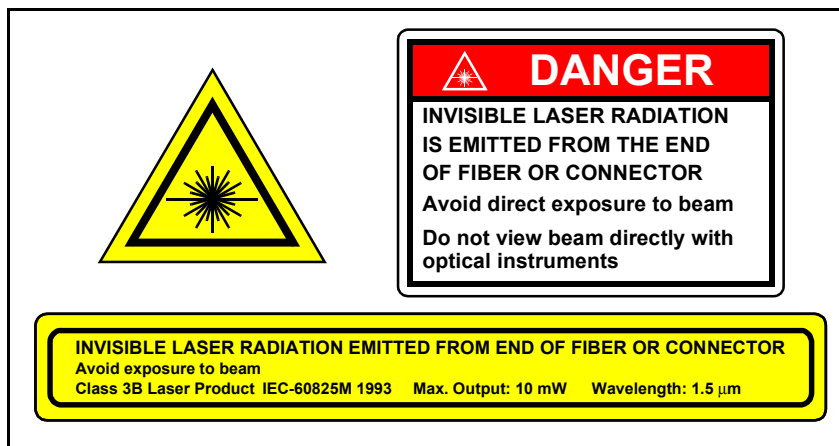
Wavelength = 1.5  $\mu\text{m}$ .

Maximum power = 10 mW.

Because of size constraints, laser safety labeling is not affixed to the module but attached to the outside of the shipping carton.

Product is not shipped with power supply.

**Caution: Use of controls, adjustments, and procedures other than those specified herein may result in hazardous laser radiation exposure.**



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