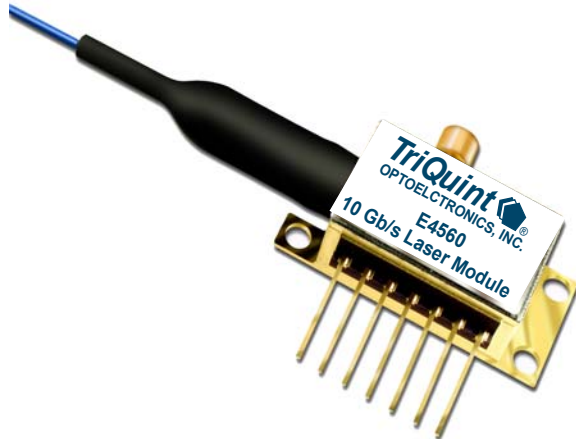


E4560-Type 10 Gb/s EML Modules for up to 40 km (800 ps/nm) Applications



Features

- Integrated electroabsorptive modulator
- 1.5 μm wavelength
- High output power
- Specified for 9.95 Gb/s operation
- For use up to 40 km (800 ps/nm)
- Low modulation voltage
- Temperature stabilized
- Wavelength selectable to ITU-T standards
- Ultrastable wavelength aging for DWDM

Applications

- SONET/SDH applications
- Ultrahigh capacity WDM system application
- High-speed data communication
- Digitized video

Description

The E4560-Type EML is designed for 10 Gb/s DWDM or TDM transmission applications. The EML integrates a CW laser with an electroabsorptive modulator in the same semiconductor chip and is an extension of TriQuint's existing E2500-series of devices. These devices can replace external modulators that are often bulkier, more expensive, and require more drive electronics than the EML. The E4560 uses a small-profile *GPO*[™] (SMP) connector to manage the RF signal. The package also contains a thermoelectric cooler, thermistor, rear-facet monitor photodiode, and an optical isolator.

The nominal input impedance of the E4560 version is 50 Ω . The package is qualified to the *Telcordia Technologies*[™] TA-TSY-000468 standard.

The E4560 is available in a range of ITU-T C-band wavelengths for use in DWDM systems operating at 10 Gb/s per channel. In addition, the E4560-Type is offered as a single-channel device operating within a wavelength range of 1530 nm—1563 nm

The devices exhibit excellent wavelength stability, supporting operation at 100 GHz channel spacing over 20 years (assuming an end-of-life aging condition of $<\pm 100$ pm). Typically, no external wavelength stabilization is required in systems of this type, using the TriQuint E4560 EML modules. The package exhibits excellent stability of wavelength vs. case temperature, with a maximum coefficient of ± 0.5 pm/ $^{\circ}\text{C}$.

Module Characteristics

Table 1. Module Characteristics

Parameter	Description
Package Type	7-pin package with SMP-type connector RF input.
Fiber	Standard single-mode fiber.
Optical Connector	Various connectors available on request. (See Table 6.)
RF Input (SMP-type connector)	Impedance 50 Ω (Exterior of RF connector is connected to case.)
Bit Rate	Up to 12.5 Gb/s.

Pin Information

Table 2. Pin Descriptions

Pin Number	Pin Name	Description
1	THERM	Thermistor
2	THERM	Thermistor
3	LASER+	Laser anode*
4	BACK DET-	Monitor anode (-)
5	BACK DET+	Monitor cathode (+)
6	TEC+	Thermoelectric cooler (+)
7	TEC-	Thermoelectric cooler (-)

* Laser cathode and modulator ground are connected to case.

Target Specifications

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 operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Table 3. Absolute Maximum Ratings

Parameter	Conditions	Min	Max	Unit
Laser Diode Reverse Voltage	CW	—	2	V
Laser Diode Forward Current	CW	—	150	mA
Optical Output Power	CW	—	20	mW
Modulator Reverse Voltage	—	—	5	V
Modulator Forward Voltage	—	—	1	V
Monitor Diode Reverse Voltage	—	—	10	V
Monitor Diode Forward Voltage	—	—	1	V
Storage Temperature	—	—	-40 to +85	$^{\circ}\text{C}$
Operating Temperature	—	—	-10 to +75	$^{\circ}\text{C}$
Thermistor Temperature**	—	—	100	$^{\circ}\text{C}$
Thermoelectric Cooler in Heating Mode**	—	—	0.5	A

** To prevent package over-temperature conditions.

Target Specifications (continued)

Characteristics

Minimum and maximum values specified over operating case temperature range. Typical values are measured at room temperature (25 °C) unless otherwise noted. Chip operating temp. = 20 °C—35 °C, unless noted otherwise.

Table 4. Optical and Electrical Specifications

Parameter	Symbol	Conditions	Min	Max	Unit
Threshold Current (BOL)	I _{TH}	—	5	35	mA
Forward Voltage	V _F	I _F = I _{OP} @ T _{OP}	—	2.2	V
Operating Current	I _{OP}	—	50	100	mA
Threshold Power	P _{TH}	I _F = I _{TH} , V _M = 0 V Note 1	—	80	μW
Fiber Output Power (Average), BOL	P _{AVG}	Note 2	0.5	3.0	dBm
Fiber Output Power (Average), EOL	P _{AVG}		0	2.5	dBm
Peak Wavelength (Wavelength can be specified to the ITU wavelength channels. See Table 5.)	λ _{PK}	Note 2	1528	1564	nm
Side-mode Suppression Ratio	SMSR	V _M = 0, I _F = I _{OP} , T _{OP}	35	—	dB
Peak-to-Peak Modulator Voltage	V _{PP}	—	1.5	2.5	V
On-state Modulator Voltage	V _{ON}	—	-1.0	0	V
Dispersion Penalty, BER = 10 ⁻¹² D = 800 ps/nm	DP	Notes 2 and 3	—	2.0	dB
Modulator					
RF Extinction Ratio	ER _{RF}	Notes 2 and 5	10	—	dB
RF Return Loss (0 GHz to 8 GHz)	S ₁₁	V _M = -1 V, I _F = I _{OP}	10	—	dB
RF Return Loss (8 GHz to 10 GHz)	S ₁₁	V _M = -1 V, I _F = I _{OP}	8.5	—	dB
-3 dB Bandwidth	BW	V _M = -1 V, I _F = I _{OP}	11	—	GHz
Rise/Fall Time (20%—80%)	t _r /t _f	Note 5	—	40	ps
Monitor Diode					
Monitor Current	I _{BD}	V _{BD} = 5 V, I _F = I _{OP}	40	1100	μA
Dark Current	I _D	V _{BD} = 5 V	—	0.1	μA
Capacitance	C	V _{BD} = 5 V, F = 1 MHz	—	25	pF
Thermistor					
Resistance	R _{THERM}	T = 25 °C	9.5	10.5	kΩ
Thermistor Current	I _{TC}	—	10	100	μA
Thermistor B Constant	B	—	3700	4100	—

1. V_M = Modulator voltage (dc).
2. Modulated for 40 km (800 ps/nm) operation. Modulated operational values are defined to be I = I_{OP}, T = T_{OP} at all specified operating conditions; 9.95 Gb/s modulation, 2³¹ - 1 PRBS (operating parameters: I_{OP}, T_{OP}, V_{ON} for 40 km will be provided). Laser diode temperature can be set in a 20 °C to 35 °C range to take advantage of wavelength tuning, provided that it meets all other specifications at this preset temperature.
3. Over 800 ps/nm (80 km).
4. T_{CASE} = 75 °C, T_{OP(LASERCHIP)} = 20°C to 35 °C.
5. Without filter, O/E bandwidth > 20 GHz.
6. Maximum TEC current for heating is less than 0.5 A.

Target Specifications (continued)

Characteristics (continued)

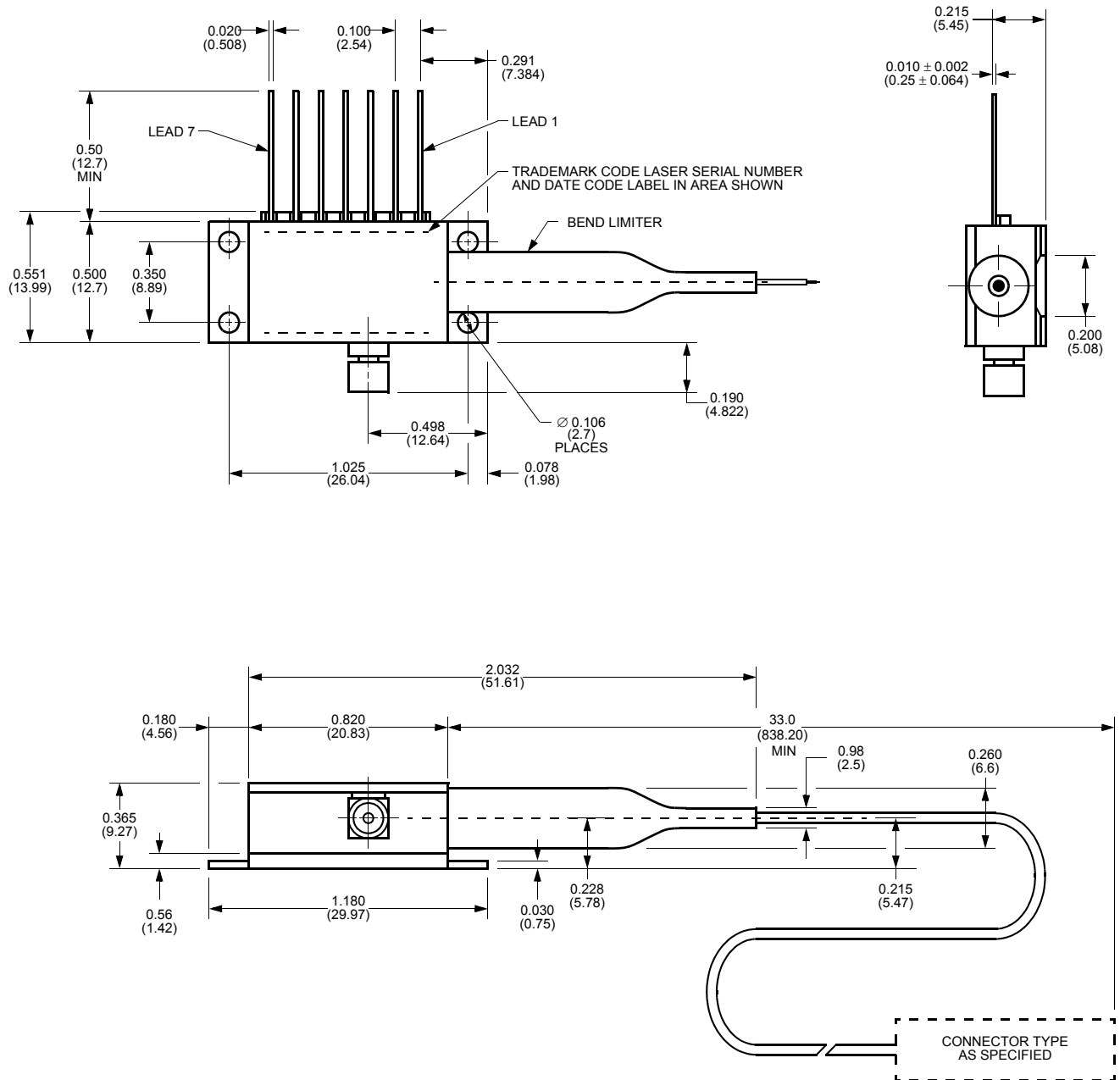
Table 4. Optical and Electrical Specifications (continued)

Parameter	Symbol	Conditions	Min	Max	Unit
Thermoelectric Cooler (TEC)					
TEC Cooling Current (Note 6)	I_{TEC}	Note 4	—	1.3	A
TEC Voltage	V_{TEC}		—	2.6	V
TEC Power	P_{TEC}		—	3.4	W
TEC Cooling Capacity	ΔT		—	55	C
Optical Isolation					
Optical Isolation	—	—	30	—	dB
Package					
Wavelength vs. Case Temp.	$d\lambda/dT$	$T_{CASE} = -10\text{ }^{\circ}\text{C to }+75\text{ }^{\circ}\text{C}$	-0.5	0.5	pm/ $^{\circ}\text{C}$
Output Power Stability	—	$T_c = -10\text{ }^{\circ}\text{C}/+25\text{ }^{\circ}\text{C}/+75\text{ }^{\circ}\text{C}$	—	1.0	dB

1. V_M = Modulator voltage (dc).
2. Modulated for 40 km (800 ps/nm) operation. Modulated operational values are defined to be $I = I_{OP}$, $T = T_{OP}$, at all specified operating conditions, 9.95 Gb/s modulation, $2^{31} - 1$ PRBS (operating parameters: I_{OP} , T_{OP} , V_{ON} for 40 km will be provided). Laser diode temperature can be set in a 20 $^{\circ}\text{C}$ to 35 $^{\circ}\text{C}$ range to take advantage of wavelength tuning, provided that it will meet all other specifications at this preset temperature.
3. Over 800 ps/nm (80 km).
4. $T_{CASE} = 75\text{ }^{\circ}\text{C}$, $T_{OP(LASERCHIP)} = 20\text{ }^{\circ}\text{C}$ to 35 $^{\circ}\text{C}$.
5. Without filter, O/E bandwidth > 20 GHz.
6. Maximum TEC current for heating is less than 0.5 A.

Outline Diagram

Dimensions are in inches and (millimeters).



Laser Safety Information

Class IIIb Laser Product

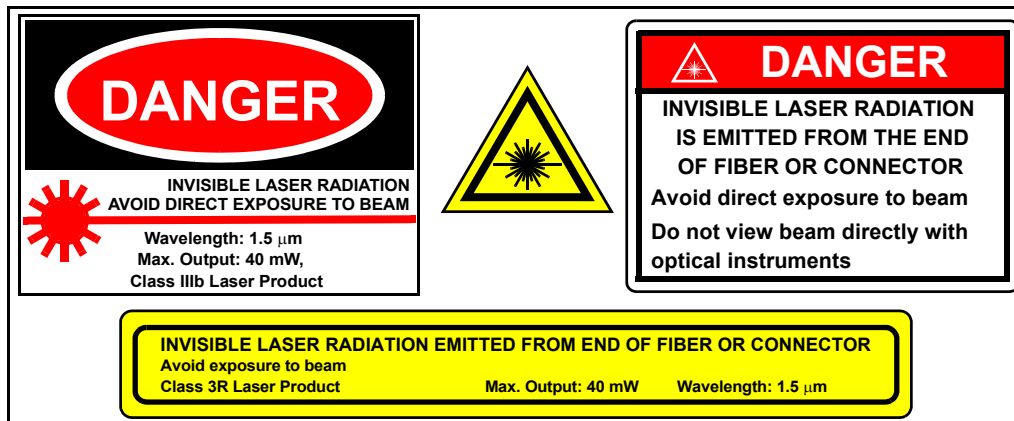
FDA/CDRH Class IIIb laser product. All versions are Class IIIb laser products per CDRH, 21 CFR 1040 Laser Safety requirements. All versions are classified Class 3R laser products consistent with IEC[®] 60825-1: 1993. This device family has been classified with the FDA under accession number 8720010. Measurements were made to classify the product per IEC60825-1: 1993.

This product complies with 21 CFR 1040.10 and 1040.11.
8.8 μm /125 μm single-mode fiber pigtail and connector
Wavelength = 1528 nm—1563 nm
Maximum power = 40 mW

Because of size constraints, laser safety labeling (including an FDA Class IIIb label) 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.



Electrostatic Discharge

CAUTION: This device is susceptible to damage as a result of electrostatic discharge. Take proper precautions during both handling and testing. Follow guidelines such as JEDEC Publication No. 108-A (Dec. 1988).

TriQuint Optoelectronics employs a human-body model (HBM) for ESD-susceptibility testing and protection-design evaluation. ESD voltage thresholds are dependent on the critical parameters used to define the model. A standard HBM (resistance = 1.5 k Ω , capacitance = 100 pF) is widely used and can be used for comparison purposes.

Ordering Information

Table 5. Ordering Information

ITU-T Wavelength (nm)	Frequency	Device Code ¹
1530.33	195.9	E4560H59
1531.12	195.8	E4560H58
1531.90	195.7	E4560H57
1532.68	195.6	E4560H56
1533.47	195.5	E4560H55
1534.25	195.4	E4560H54
1535.04	195.3	E4560H53
1535.82	195.2	E4560H52
1536.61	195.1	E4560H51
1537.40	195.0	E4560H50
1538.19	194.9	E4560H49
1538.98	194.8	E4560H48
1539.77	194.7	E4560H47
1540.56	194.6	E4560H46
1541.35	194.5	E4560H45
1542.14	194.4	E4560H44
1542.94	194.3	E4560H43
1543.73	194.2	E4560H42
1544.53	194.1	E4560H41
1545.32	194.0	E4560H40
1546.12	193.9	E4560H39
1546.92	193.8	E4560H38
1547.72	193.7	E4560H37
1548.51	193.6	E4560H36
1549.32	193.5	E4560H35
1550.12	193.4	E4560H34
1550.92	193.3	E4560H33
1551.72	193.2	E4560H32
1552.52	193.1	E4560H31
1553.33	193.0	E4560H30
1554.13	192.9	E4560H29
1554.94	192.8	E4560H28
1555.75	192.7	E4560H27
1556.56	192.6	E4560H26
1557.36	192.5	E4560H25
1558.17	192.4	E4560H24
1558.98	192.3	E4560H23
1559.79	192.2	E4560H22
1560.61	192.1	E4560H21
1561.42	192.0	E4560H20
1562.23	191.9	E4560H19
1528—1564	—	E4560H

1. ST is the default connector. Other connectors are available on request (see Table 6).

Ordering Information (continued)

Table 6. Ordering Information: Connector Type

Device Code¹	Connector Type²
E4560Dxx	SC
E4560Hxx	ST
E4560Sxx	LC
E4560Gxx	FC

1. The xx notation in the device code refers to the ITU channel designation (for details, see Table 5).
2. Other connectors available on request

GPO is a trademark of Gilbert Engineering.
Telcordia Technologies is a trademark of Telcordia Technologies, Inc.
IEC is a registered trademark of The International Electrotechnical Commission.

Additional Information

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about TriQuint:

Web: www.triquint.com **Tel:** (484) 397-3800
E-mail: info_opto@tqs.com **Fax:** (484) 397-3592

For technical questions and additional information on specific applications:

E-mail: info_opto@tqs.com

The information provided herein is believed to be reliable; TriQuint assumes no liability for inaccuracies or omissions. TriQuint assumes no responsibility for the use of this information, and all such information shall be entirely at the user's own risk. Prices and specifications are subject to change without notice. No patent rights or licenses to any of the circuits described herein are implied or granted to any third party.
TriQuint does not authorize or warranty any TriQuint product for use in life-support devices and/or systems.