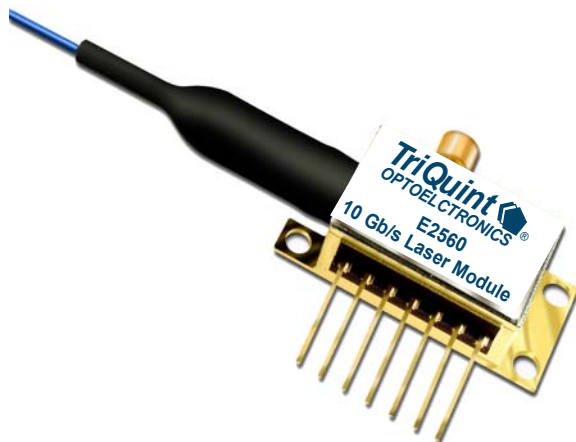


## E2560-Type 10 Gb/s EML Modules for 2 km—40 km Transmission

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### Features

- Integrated electroabsorptive modulator
- 1.5  $\mu\text{m}$  wavelength
- Characterized for 10 Gb/s operation
- For use up to 40 km at 10 Gb/s
- Low modulation voltage
- Temperature stabilized
- Wavelength selectable to ITU-T standards
- Ultrastable wavelength aging for DWDM

### Applications

- SONET/SDH
- Ultrahigh capacity WDM systems
- High-speed data communications
- Digitized video

### Description

The E2560-type EML (without integral driver IC) is designed for 10 Gb/s DWDM or TDM transmission applications. They integrate a CW laser with an electroabsorptive modulator in the same semiconductor chip and are 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. They incorporate a small-profile *GPO*™ connector to handle the RF signal. The package also contains a thermoelectric cooler, thermistor, rear-facet monitor photodiode, and an optical isolator.

The E2560-type is available for transmission distances of up to 20 km or 40 km.

The nominal input impedance of the E2560 version is 50  $\Omega$ . The package is qualified to the *Telcordia Technologies*™ TA-TSY-000468 standard.

The short-haul (2 km—20 km) version of the E2560-type (E2566) is offered as a single-channel device operating within a wavelength range of 1530 nm—1563 nm. For 40 km, E2560 is available in a range of ITU-T wavelengths for use in DWDM systems operating at 10 Gb/s per channel.

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 E2560 EMLs. The package also offers excellent stability of wavelength vs. case temperature, with a maximum coefficient of  $\pm 0.5$  pm/°C.

## Module Characteristics

**Table 1. Module Characteristics**

Parameter	Description
Package Type	7-pin package with GPO connector RF input.
Fiber	Standard single-mode fiber.
Optical Connector	Various connectors available on request.
RF Input (SMP-type connector)	Impedance 50 $\Omega$ (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, LASER-, CASE	Combined Thermistor/Laser Cathode/Case.
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	—	10	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	°C
Operating Temperature	—	—	-10 to +70	°C
Thermistor Temperature <sup>1</sup>	—	—	100	°C
Thermoelectric Cooler in Heating Mode <sup>1</sup>	—	—	0.5	A

1. 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

**Table 4. Optical and Electrical Specifications** (Chip operating temp. = 15 °C to 35 °C, except where noted.)

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	$P_{TH}$	$I_F \sim I_{TH}$ , $V_M^1 = 0V$	—	80	$\mu W$
Fiber Output Power (Average)	$P_{AVG}$	Note 2	-2	—	dBm
Peak Wavelength (Wavelength can be specified to the ITU wavelength channels. See Table 5.)	$\lambda_{PK}$	$V_M = V_{ON}$ $T_{LASER CHIP} = T_{OP}$ $I_F = I_{OP}$	1530	1563	nm
Side-mode Suppression Ratio	SMSR	$V_M = 0 V$ $I_F = I_{OP}$ , $T_{OP}$	35	—	dB
Dispersion Penalty, BER = $10^{-10}$ D = 400 ps/nm (E2566 version) D = 800 ps/nm (E2560, version)	DP	Note 2, 3	— —	2.0 2.0	dB dB
<b>Modulator</b>					
Peak to Peak Modulator Voltage	$V_{PP}$		1.5	2.5	V
On-State Modulator Voltage	$V_{ON}$		-1.0	0	V
Extinction Ratio: E2560, 40 km version E2566, 20 km version	$ER_{RF}$	Note 2, 4	10 9	— —	dB dB
RF Return Loss (0 GHz to 6 GHz)	$S_{11}$	$V_M = -1 V$ , $I_F = I_{OP}$	10	—	dB
RF Return Loss (6 GHz to 8 GHz)	$S_{11}$	$V_M = -1 V$ , $I_F = I_{OP}$	7	—	dB
RF Return Loss (8 GHz to 10 GHz)	$S_{11}$	$V_M = -1 V$ , $I_F = I_{OP}$	5	—	dB
-3 dB Bandwidth (E2560-series)	BW	$V_M = -1 V$ , $I_F = I_{OP}$	10	—	GHz
Rise/Fall Time(20%—80%)	$tr/tf$	Note 4	—	40	ps
<b>Monitor Diode</b>					
Monitor Current	$I_{BD}$	$V_{BD} = 5 V$ , $I_F = I_{OP}$	40	1100	$\mu A$
Dark Current	$I_D$	$V_{BD} = 5 V$	—	0.1	$\mu A$
Capacitance	C	$V_{BD} = 5 V$ , $F = 1 MHz$	—	25	pF
<b>Thermistor</b>					
Resistance	$R_{THERM}$	$T = 25 ^\circ C$	9.5	10.5	k $\Omega$
Thermistor Current	$I_{TC}$	—	10	100	$\mu A$
Thermistor B Constant	B	—	3700	4100	—

1.  $V_M$  = modulator voltage (dc).

2. Modulated operational values are defined as  $I = I_{OP}$ ,  $T = T_{OP}$ , at all specified operating conditions, 9.95328 Gb/s modulation,  $2^{31} - 1$  PRBS (operating parameters:  $I_{OP}$ ,  $T_{OP}$ ,  $V_{ON}$  for E2560 will be provided). Laser diode temperature can be set within a range of 15 °C to 35 °C to take advantage of wavelength tuning, provided that it will meet all other specs at this preset temperature.

3. 800 ps/nm (40 km) for E2560 and 400 ps/nm (20 km) for E2566.

4. Without filter, O/E bandwidth > 20 GHz.

**Target Specifications** (continued)

**Table 4. Optical and Electrical Specifications** (Chip operating temp. = 15 °C to 35 °C, except where noted.)  
(continued)

Parameter	Symbol	Conditions	Min	Max	Unit
<b>Thermoelectric Cooler</b>					
TEC Current	$I_{TEC}$	Note 5	—	1.1	A
TEC Voltage	$V_{TEC}$	Note 5	—	2.6	V
TEC Power	$P_{TEC}$	Note 5	—	2.9	W
TEC Capacity	$\Delta T$	Note 5	—	55	°C
<b>Optical Isolation</b>					
Optical Isolation	—	Note 5	30	—	dB
<b>Package</b>					
Output Power Stability		$T_{CASE} = -10\text{ °C to }+70\text{ °C}$	-0.5	0.5	dB
Wavelength vs. Case Temperature	$d\lambda/dT$	$T_{CASE} = -10\text{ °C to }+70\text{ °C}$	-0.5	0.5	pm/°C

1.  $V_M$  = modulator voltage (dc).

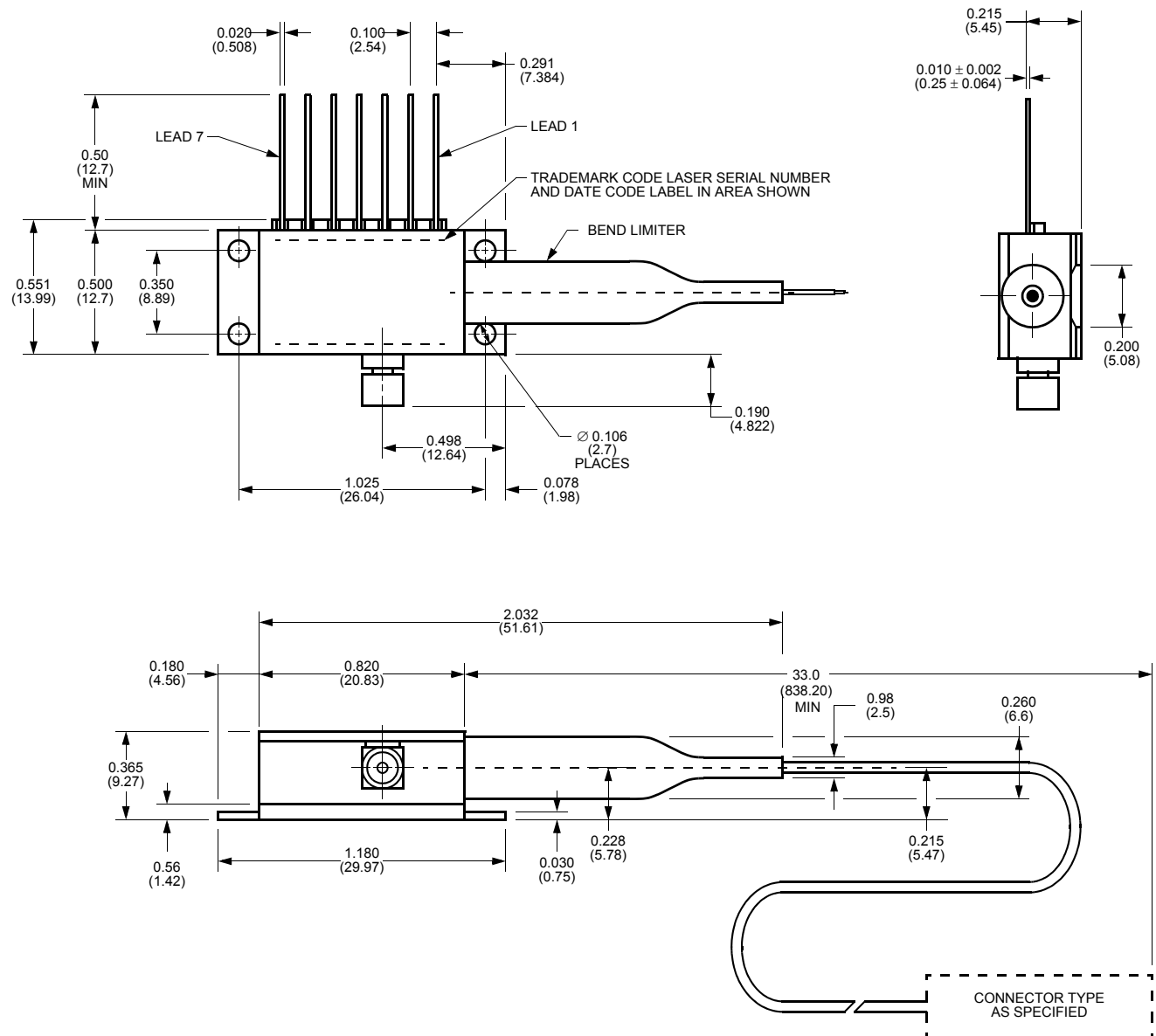
2. Modulated operational values are defined as  $I = I_{OP}$ ,  $T = T_{OP}$ , at all specified operating conditions, 9.95328 Gb/s modulation,  $2^{31} - 1$  PRBS (operating parameters:  $I_{OP}$ ,  $T_{OP}$ ,  $V_{ON}$  for E2560 will be provided). Laser diode temperature can be set within a range of 15 °C to 35 °C to take advantage of wavelength tuning, provided that it will meet all other specs at this preset temperature.

3. 800 ps/nm (40 km) for E2560 and 400 ps/nm (20 km) for E2566.

4. Without filter, O/E bandwidth > 20 GHz.

5.  $T_{CASE} = 70\text{ °C}$ ,  $T_{OP}(LASERCHIP) = 15\text{ °C to }35\text{ °C}$ .

## Outline Diagram



## 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 Semiconductor 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 $\Omega$ , capacitance = 100 pF) is widely used and can be used for comparison purposes.

## 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 3B 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 *IEC*60825-1: 1993.

This product complies with 21 CFR 1040.10 and 1040.11.

8.8  $\mu$ m/125  $\mu$ m single-mode fiber pigtail and connector.

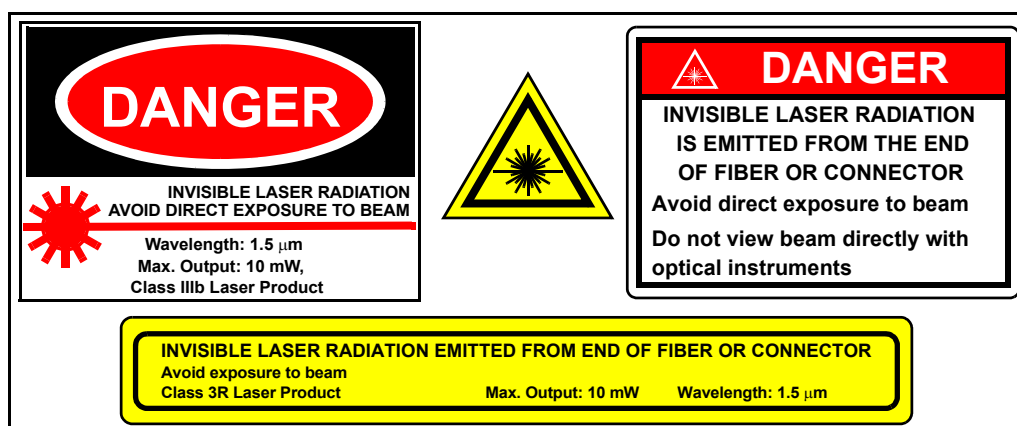
Wavelength = 1530 nm—1563 nm.

Maximum power = 10 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.



## Ordering Information

Table 5. Ordering Information: 40 km Code\*

Parameter		Device Description	
ITU-T Wavelength (nm)	Frequency	E2560-Type, 40 km	
		Code	Comcode
1530.33	195.9	E2560H59	108414722
1531.12	195.8	E2560H58	108414780
1531.90	195.7	E2560H57	108414798
1532.68	195.6	E2560H56	108414806
1533.47	195.5	E2560H55	108414814
1534.25	195.4	E2560H54	108414822
1535.04	195.3	E2560H53	108414830
1535.82	195.2	E2560H52	108414848
1536.61	195.1	E2560H51	108414855
1537.40	195.0	E2560H50	108414863
1538.19	194.9	E2560H49	108414871
1538.98	194.8	E2560H48	108414889
1539.77	194.7	E2560H47	108415142
1540.56	194.6	E2560H46	108414897
1541.35	194.5	E2560H45	108414905
1542.14	194.4	E2560H44	108414913
1542.94	194.3	E2560H43	108414921
1543.73	194.2	E2560H42	108414939
1544.53	194.1	E2560H41	108414947
1545.32	194.0	E2560H40	108414954
1546.12	193.9	E2560H39	108414962
1546.92	193.8	E2560H38	108414970
1547.72	193.7	E2560H37	108414988
1548.51	193.6	E2560H36	108414996
1549.32	193.5	E2560H35	108415001
1550.12	193.4	E2560H34	108415019
1550.92	193.3	E2560H33	108415027
1551.72	193.2	E2560H32	108415035
1552.52	193.1	E2560H31	108415043
1553.33	193.0	E2560H30	108415050
1554.13	192.9	E2560H29	108415068
1554.94	192.8	E2560H28	108415076
1555.75	192.7	E2560H27	108415084
1556.56	192.6	E2560H26	108415092
1557.36	192.5	E2560H25	108415100
1558.17	192.4	E2560H24	108415118
1558.98	192.3	E2560H23	108415126
1559.79	192.2	E2560H22	108415134
1560.61	192.1	E2560H21	108415159
1561.42	192.0	E2560H20	108415167
1562.23	191.9	E2560H19	108415175
1528—1564	—	E2560H	108422494

\* With ST connector; other connectors available upon request.

## Ordering Information (continued)

**Table 6. Ordering Information: 20 km Code**

Product Code	Product Description	Comcode
E2566H	2 km—20 km, single-channel, ST Connector	108743337M

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.

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### Additional Information

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

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