10Gb/s EA Modulator and DFB Laser with GPO RF Connector

EML10ZCA

The Bookham EML10 Laser has an electro-absorption modulator monolithically integrated with a conventional Distributed Feedback Multi Quantum Well (MQW) laser. This allows the modulation voltage to be applied to the modulator section whilst the laser section operates

CW allowing extremely low wavelength chirping. Specifically designed for use in STM-64/OC-192 TDM applications over 40km, with low dispersion penalty at 9.953Gb/s, (<2dB). A high extinction ratio of 10dB. This device is available in a hermetic 7-pin ceramic butterfly package with SMP/GPO connector for modulation input. The EML10 includes an optical isolator, monitor photodiode, thermistor and thermo-electric cooler.

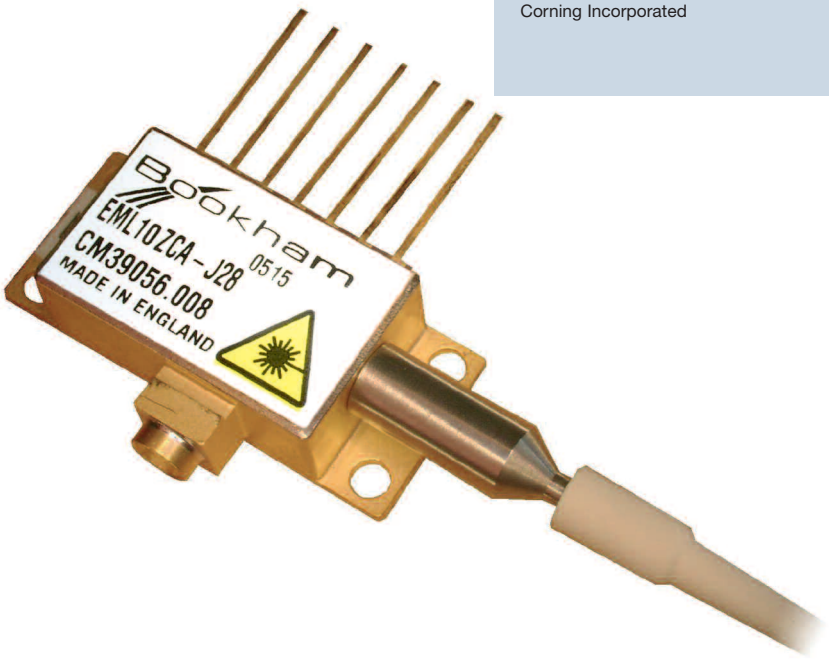
Features:

- High output power
- Low modulation voltage
- Long haul performance with negligible dispersion penalty
- Single 50Ω low voltage drive modulation input
- Integral thermo-electric cooler with precision NTC temperature control
- Hermetically sealed 7-pin butterfly package with optical isolator
- High extinction ratio >10dB
- RoHS compliant

Applications:

- Suitable for use:
- In SONET & SDH applications (~ 9.95Gb/s)
- With MetroCor™ and standard SMF-28™ fiber 40km applications

MetroCor™ and SMF-28™ are registered trademarks of Corning Incorporated



Characteristics

Tcase = 25°C, Tlaser = 25°C unless otherwise stated

Parameter	Conditions	Min	Typ	Max	Unit
CW Laser					
Threshold current		5	20	35	mA
Threshold power			0.001	1	uW
Operating current SOL	@Iop	50	80	90	mA
Operating current EOL	@Iop			100	mA
Laser forward voltage	If=80mA @ 25°C, CW		1.2	2	V
Peak wavelength		1530		1563	nm
Wavelength drift vs life time	15 years typical life	-100		100	pm
Side mode suppression ratio (SMSR) @ Iop		36	45		dB
Spectral width @ Iop	-20dBr, Note [2]	0.2	0.27	0.3	nm
Optical Modulator					
Modulator drive voltage		2		2.8	Vpp
Bias voltage for 'on' level		-0.7		0	V
Fibre output power	Note [1]	-1	0.5	2	dBm
Case temperature tracking error	Tcase = -20 to +70 °C	-0.5	+/-0.1	0.5	dB
S21 Optical bandwidth		8	12.5		GHz
S11 return loss (0 GHz to 7 GHz)			-15	-8	dB
S11 return loss (7 GHz to 10 GHz)			-10	-5	
Optical rise/fall time	20 to 80%, Notes [1] [3]	15	20	30	ps
Dynamic optical extinction ratio	Notes [1] [3]	10	11		dB
OC192/SDH64 mask margin	Notes [1] [3]	15	25		%
Dispersion penalty (RX power penalty)	Notes [1] [4]		0.5	1.7	dB

Characteristics (continued)

Parameter	Conditions	Min	Typ	Max	Unit
Photodiode Monitor					
Monitor diode bias voltage		1	5	10	V
Monitor diode current	Note [1] @I_{op}	0.2	0.85	1.5	mA
Dark current			0.001	0.1	uA
Capacitance				15	pF
Thermo Electric Cooler System					
Thermistor resistance @ Tsub=25degC		9.5	10	10.5	kΩ
Thermistor Steinhart-Hart coefficient C1			1.03E-03		
Thermistor Steinhart-Hart coefficient C2			2.39E-04		
Thermistor Steinhart-Hart coefficient C3			1.56E-07		
Thermistor B constant	0/50k	3539	3575	3611	
Thermistor current		1	10	100	uA
Laser submount temperature		20	25	35	°C
TEC current (EOL)				1.3	A
TEC voltage (EOL)				2.5	V
TEC power dissipation				3.3	W
Other					
Optical isolation	Tcase = -20 to +70 °C	25	30		dB
Fibre Length		0.8		1.2	m

Notes:

[1] Applied modulation is 9.95328Gb/s, 2^23-1 PRBS NRZ data sequence.

[2] Linewidth is measured using 0.06nm resolution bandwidth.

[3] Optical eye parameters measured with a Communications Analyser with Agilent plug-in module 86106B (or equivalent). Optical 0/1 crossing typically 50%.

[4] Fiber characteristics are derived from the following equation;

$$D(\lambda) = \frac{S_0}{4}\left(\lambda - \frac{\lambda_0^4}{\lambda^3}\right) ps/(nm^2.km)$$

Where So = 0.092 ps/(nm2.km) and l0 = 1302nm. Receiver sensitivity measured at a BER of 1e-10. RX OSNR > 35dB, optimised RX CDR phase adjust and 50% CDR slice level.

Absolute Maximum Ratings

Tcase = 25°C unless otherwise stated

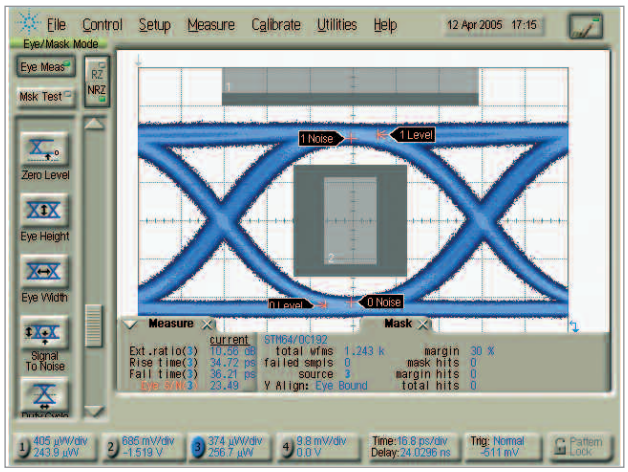
The table below provides maximum and/or minimum values of critical parameters which will not permanently damage the device, but for which the operating specification may not hold.

Parameter	Conditions	Min	Typ	Max	Unit
Operating temperature		-20		70	°C
Storage temperature		-40		85	°C
Lead soldering time	T=260°C			10	s
Fiber bend radius		20			mm
Axial force on fiber				5	N
Laser forward current	CW @ 30C			150	mA
Laser reverse voltage				2	V
Modulator forward voltage				1	V
Modulator reverse voltage		-5		1	V
Monitor diode reverse voltage				20	V
Photodiode forward current				1	mA
TEC voltage				2.5	V
TEC current				1.4	A
ESD	Note [5]	500			V

Note: [5] In accordance with Telcordia TR-NWT-000870, ESD class 3, human body model.

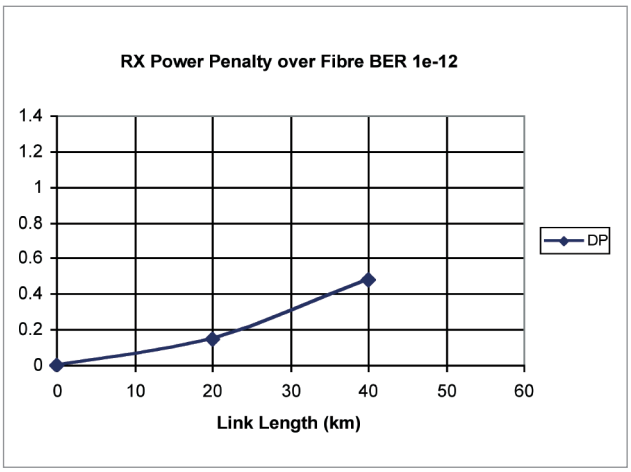
Optical Systems Performance

Optical Eye Diagram



Test conditions: 9.95328Gb/s 2^23-1 PRBS NRZ data.

Dispersion Penalty Plots



Test conditions: 9.95328Gb/s 2^23-1 PRBS NRZ data.

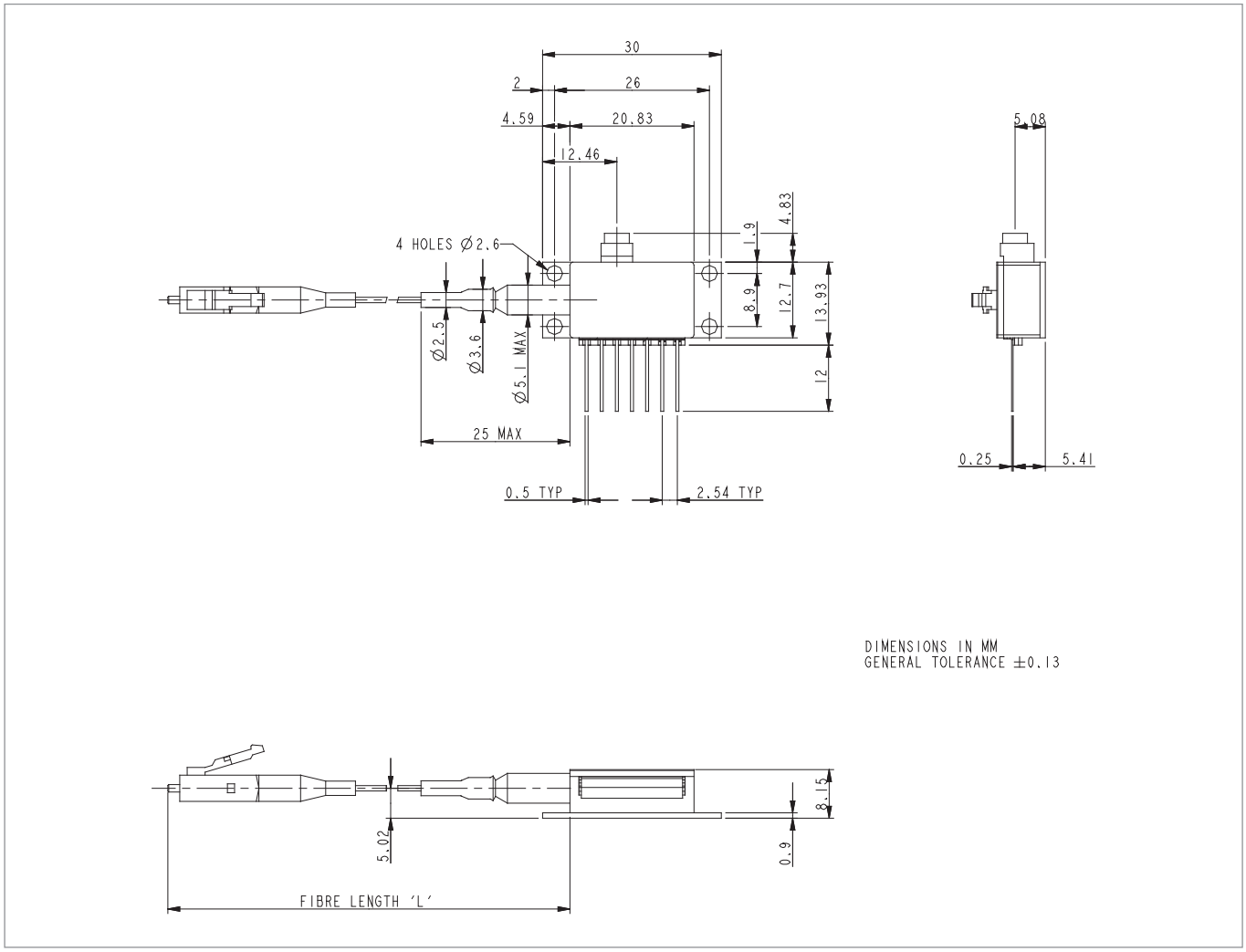
Applications Support

The following documents are available to support customers using this product:

Document Title	Document Referrence
Performance Comparison of commercially available RF drivers for the Bookham EML11.	AN0140

Optical component evaluation platforms are available for all Bookham optical components. Contact your regional sales representative for further information.

Outline Drawing



Connections

Pin #		Pin #	
1	Thermistor	5	BFM Cathode
2	Thermistor	6	Cooler (+)
3	Laser bias (+) Anode	7	Cooler (-)
4	BFM Anode		

Notes:
Laser cathode is case ground. SMP/GPO center is EA modulation(-).
Pin 1 is nearest the fiber tail.

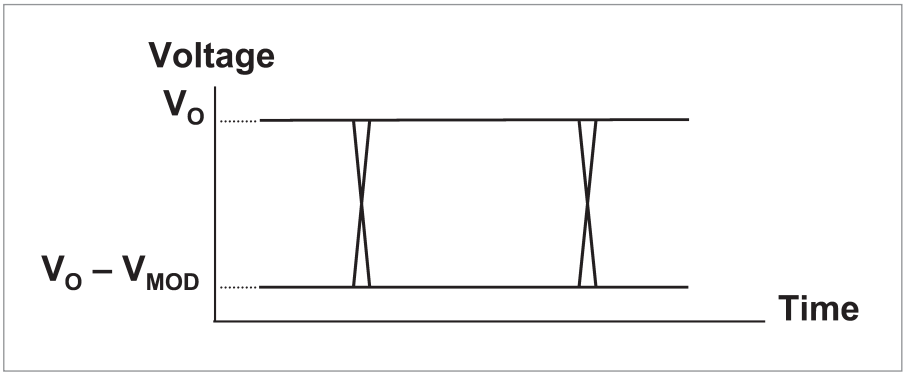
Deliverable Data

The following data file is provided using an Electronic Data Exchange (EDE) process, a paper copy will also be provided with each module.

(Tlaser = 25ºC, Tcase = 25ºC unless otherwise specified)

Parameter	Symbol	Condition	Format	Unit
On level modulation	V_O		Value	V
Modulator Drive Voltage (pk-pk)	V_{MOD}		Value	V
CW Laser Threshold Current	I_{TH}	CW, $V_{MOD}=V_O$	Value	mA
CW Laser Operating Current	I_{OP}	CW	Value	mA
Monitor Photocurrent	I_M	Note [6]	Value	mA
Peak Wavelength	L_{PK}	Note [6]	Value	nm
Mean Modulated Optical Power	P_O	Note [6]	Value	dBm

Note: [6] Bookham Test Conditions, 9.95328Gb/s, 2^23-1 PRBS NRZ DATA.



Reliability

Bookham has a corporate policy for continuous improvement, to provide optical components with superior quality in terms of opto-electronic performance and operational life and reliability. The Bookham EML10 and EML11 Integrated Electro-absorption laser products use a ridge waveguide structure for the laser and modulator, which provides superior reliability compared to buried heterostructures. It has been subjected to a stringent reliability assurance program, the conclusions of which confirm product reliability exceed the generic requirements of Telcordia GR-468 CORE.

More than 965,000 device-hours of data under accelerated life test conditions have been analysed, which for the purpose of characterising random failure rate, is equivalent to 28,300,000 device hours at 25ºC operating temperature [7]. Electro-optic parameters for a 15 year service life at operating temperature of 25ºC have been estimated. The estimated delta over life for specific device parameters is shown in the table below.

Parameter	Maximum allowed change	Change over 15 years @ 25 °C Mean (std. deviation)
EA - Extinction rate ER	0.5 dB	-0.03 dB (0.2 dB)
Laser threshold current	10 %	0.01 % (0.3 %)
Laser efficiency	10 %	-0.2 % (0.4 %)
Laser current for constant output power	10 %	0.2 % (0.4 %)
Laser power at constant current (100 mA)	10 %	-0.2 % (0.4 %)

The reliability failure rate statistics are summarized in the table below. The results are reported for the operation of the device against a laser bias of 100 mA drive current. The resultant low MTTF [8], essentially demonstrating minimal component wear out over the rated 15-year lifetime of the component [7].

Parameter	Value	Units
Median life (ML) at 25°C	528[1]	Years
σ (standard deviation of the natural logarithms of the TTFs)	0.64	
μ (mean of the natural logarithms of the TTFs)	6.27	
Maximum wear-out failure rate	0	FITs
Average wear-out failure rate over 15 years life	0	FITs
Wear-out thermal activation energy	0.5	eV
Random failure rate at 25°C at 60% confidence	33	FITs
Random failure rate activation energy	0.35	eV

Notes:

[7] Refer to QR1524, qualification report for the Bookham 10Gb/s Electro-Absorption Modulated Laser.

[8] Bookham Technology's policy is to derive random failure rates from actual field data.

RoHS Compliance

Bookham is fully committed to environment protection and sustainable development and has set in place a comprehensive program for removing polluting and hazardous substances from all of its products. The relevant evidence of RoHS compliance is held as part of our controlled documentation for each of our compliant products. RoHS compliance parts are available to order, please refer to the ordering information section for further details.

Ordering Information:

EML10ZCA - [Connector Type]
J28 = SC/PC
J34 = FC/PC
J57 = LC
J59 = MU

Example
EML10ZCA-J28 is an EA laser with GPO RF connector with SC/PC fiber connector for 40km reach applications.

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INVISIBLE LASER RADIATION DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS CLASS 1M LASER PRODUCT
REFERENCE IEC 60825-1 Edition 1.2

DANGER
INVISIBLE LASER RADIATION - AVOID DIRECT EXPOSURE TO BEAM
OUTPUT POWER 43 mW WAVELENGTH >1520 nm
CLASS III b LASER PRODUCT
THIS PRODUCT COMPLIES WITH 21CFR 1040.10

ISO14001:1996
EMS 504193
TL9000 Rev 3.0 (ISO9001:2000)
FM15040

CAUTION
STATIC SENSITIVE DEVICE
OBSERVE PRECAUTIONS
Caution - use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

BH12939 Rev 2.0 January 2007.