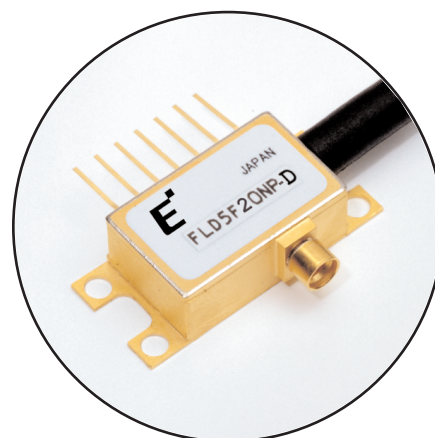


1,550nm Modulator Integrated DFB Laser

FLD5F20NP-D

FEATURES

- Modulator Integrated DFB Laser Diode Module
- CW operation of DFB laser section
- Available at C Band ITU-T grid wavelengths between 1529.55 - 1563.05nm
- Modulation voltage applied only to modulator section
- High speed butterfly package with GPO connection
- Built-in optical isolator, monitor photodiode, thermistor, and thermo-electric cooler



APPLICATION

This MI laser is intended for intermediate reach applications ($\leq 40\text{km}$) at 10Gb/s.

DESCRIPTION

The Modulator Integrated DFB Laser (MI DFB Laser) has an electro-absorption modulator monolithically integrated with a conventional Distributed Feed-Back (DFB) laser. The modulation voltage is applied to the modulator section while the laser section operates CW allowing extremely low wavelength chirping. Extinction ratios of more than 10 dB can be achieved with 2.6 Vp-p modulation. The MI laser is installed in a butterfly type package. The module incorporates a highly stable optical coupling system. The module includes an optical isolator, monitor photodiode, thermistor and a thermo-electric cooler.

ABSOLUTE MAXIMUM RATINGS ($T_{\text{op}}=25^{\circ}\text{C}$, unless otherwise specified)

Parameter	Symbol	Condition	Rating		Unit
			Min.	Max.	
Operating Case Temperature	T_{op}	-	-20	+70	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-	-40	+85	$^{\circ}\text{C}$
Optical Output Power	P_{f}	CW	-	5	mW
Laser Forward Current	I_{F}	CW	-	150	mA
Laser Reverse Voltage	V_{R}	CW	-	2	V
Modulator Forward Voltage	V_{m}	CW	-5	+1	V
Photodiode Forward Current	-	-	-	1	mA
Photodiode Reverse Voltage	V_{DR}	-	-	10	V
TEC Voltage	V_{c}	Cooling	-	+2.5	V
		Heating	-2.5	-	
TEC Current	I_{c}	Cooling	-	+1.4	A
		Heating	-0.9	-	
Thermistor Temperature	T_{th}	ATC Operation	-20	+70	$^{\circ}\text{C}$
Lead Soldering Time	-	260 $^{\circ}\text{C}$	-	10	sec

OPTICAL & ELECTRICAL CHARACTERISTICS ($T_L = T_{set}$, $T_C = 25^\circ\text{C}$, BOL, unless otherwise specified)

Parameter	Symbol	Test Condition	Limits			Unit
			Min.	Type	Max.	
Peak Wavelength	λ_p	Note (2)	Note (4)			
Threshold Current	I_{th}	CW, $V_m=V_o$	-	-	30	mA
Operating Current	I_{op}	-	40	-	100	mA
Forward Voltage	V_F	CW, $I_F=I_{op}$, $V_m=V_o$	-	1.4	2.0	V
Optical Output Power (Avg. Power)	P_f	Note (2)	-2.0	-	-	dBm
Dispersion Penalty	dP	Note (1)	-	-	2	dB
Sidemode Suppression Ratio	SSR	Note (2)	35	-	-	dB
Laser Set Temperature (BOL)	T_{set}		15	-	35	$^\circ\text{C}$
Wavelength Drift (after 20 years)	-		-0.1	-	0.1	nm
Wavelength Stability with Case Temperature	-		-	-	± 0.5	pm/ $^\circ\text{C}$
Optical Isolation	I_s	$T_c=-20$ to $+70^\circ\text{C}$	25	35	-	dB
On Level Modulation	V_o	-	-0.7	-	0	V
Modulator Drive Voltage	V_{mod}	$(V_o-V_{mod}) \geq -3.3\text{V}$, $R_{ext}=10\text{dB}$	-	-	2.6	V
Extinction Ratio	R_{ext}	$f=10\text{Gb/s}$, $I_F=I_{op}$, $V_m=V_o/(V_o-V_{mod})$	10	-	-	dB
Rise Time	T_r	Note (2), 20 to 80%	-	20	25	ps
Fall Time	T_f		-	20	25	ps
Cut-off Frequency	S_{21}	-3dB bandwidth, $V_m=V_o-0.5V_{mod}$, $I_F=I_{op}$	10	-	-	GHz
RF Return Loss	S_{11}	$f=\text{DC}-5\text{GHz}$, 50Ω Test Set, $V_m=V_o$, $I_F=I_{op}$	8	-	-	dB
RF Return Loss	S_{11}	$f=5-10\text{GHz}$, 50Ω Test Set, $V_m=V_o$, $I_F=I_{op}$	5	-	-	dB
Monitor Current	I_m	Note (2), $V_{DR}=5\text{V}$	0.04	-	1.5	mA
In-Band Ripple	ΔG	$I_F=I_{op}$, $f=0.1-10\text{GHz}$, $V_m=V_o-0.5V_{mod}$	-	-	± 1.0	dB
Relative Intensity Noise	RIN	$f=10\text{ MHz to } 8.5\text{ GHz}$, $V_m=V_o$, $I_F=I_{op}$, 8% Reflection	-	-	-120	dB/Hz
TEC Capacity	ΔT	$P_{TEC}=3.3\text{W}$, $I_F=I_{op}$	$70-T_{set}$	-	-	$^\circ\text{C}$
TEC Current	I_c	$I_F=I_{op}$, $\Delta T=(70-T_{set})[^\circ\text{C}]$	-	-	1.3	A
TEC Voltage	V_c	$I_F=I_{op}$, $\Delta T=(70-T_{set})[^\circ\text{C}]$	-	-	2.5	V
TEC Power Dissipation	P_c	$I_F=I_{op}$	-	-	3.3	W
Thermistor B Constant (Note 3)	B	$T_L=25^\circ\text{C}$, $T_c=+25^\circ\text{C}$	3,270	3,450	3,630	K
Thermal Resistance	R_{th}		9.5	10.0	10.5	k Ω

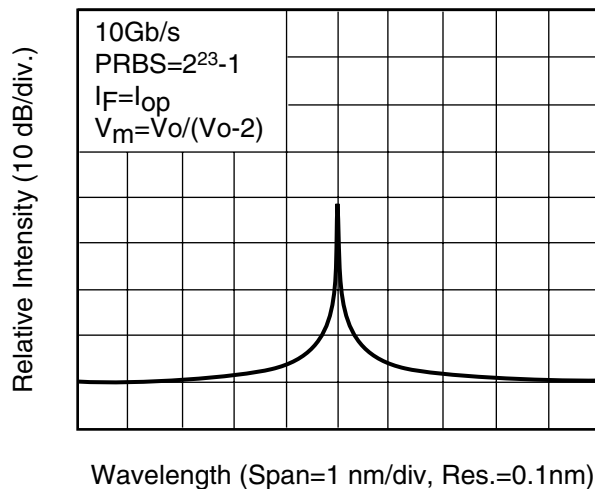
Note (1) Eudyna Test System
9.95328Gb/s, PRBS=2²³-1, $I_F=I_{op}$, $V_m=V_o$ and (V_o-V_{mod})
Dispersion=800ps/nm, Dispersion penalty at
Bit Error Rate = 1.0E-10

Note (3) Relation between resistance and temperature ($^\circ\text{K}$) is:
 $R_{th}(T) = R_{th}(25^\circ\text{C}) \cdot \exp[B(1/T - 1/298)]$

Note (4) Reference Figure 7 for Wavelength Table

Note (2) Eudyna Test System
9.95328Gb/s, PRBS=2²³-1, $I_F=I_{op}$, $V_m=V_o$ and (V_o-V_{mod})

Fig. 1 Lasing Spectrum



**Fig. 2 Output Power & Monitor Current
vs. Forward Current**

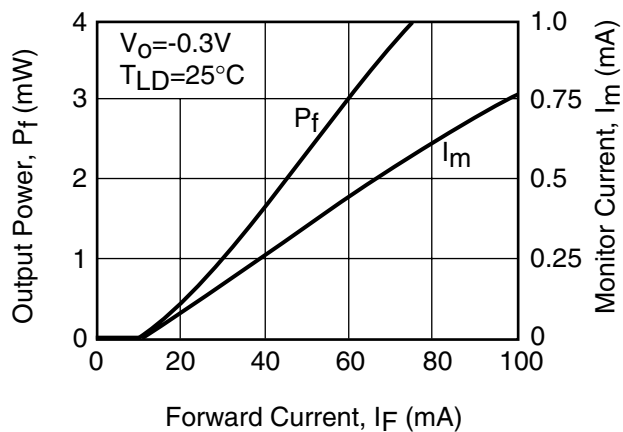


Fig. 3 Extinction Ratio vs. Modulation Applied Voltage

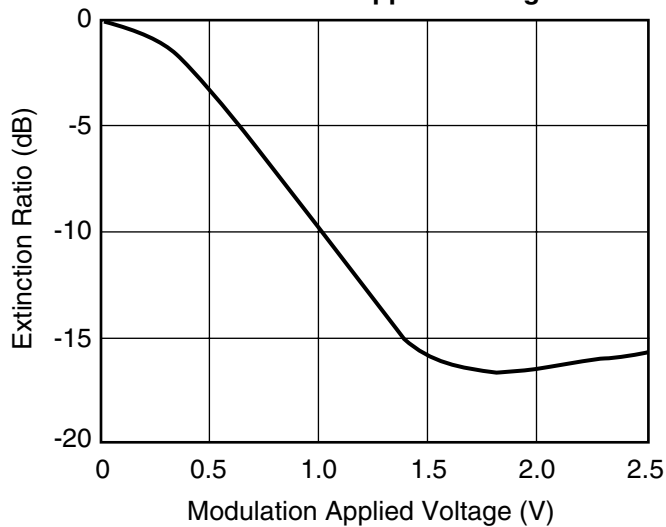


Fig. 4 Cut-off Frequency (S21)

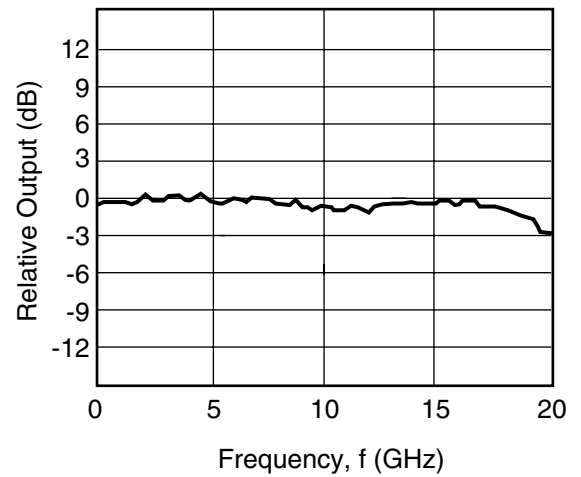


Fig. 5 RF Return Loss (S11)

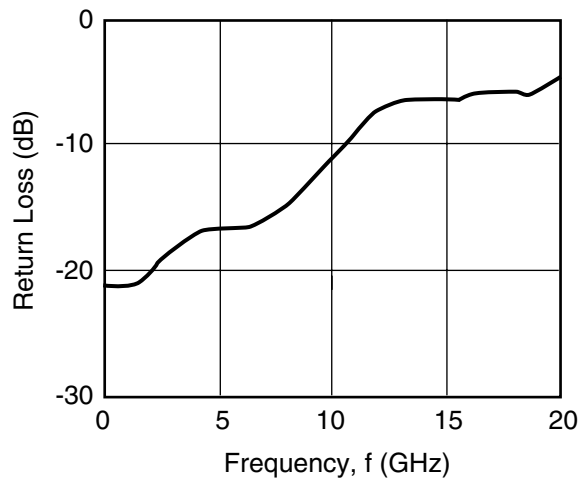


Fig. 6 Transmission Characteristics

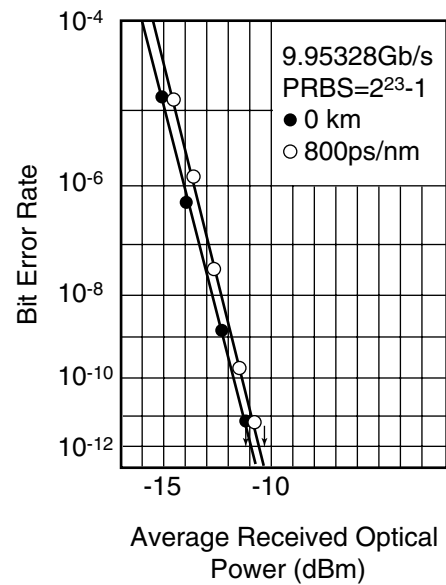
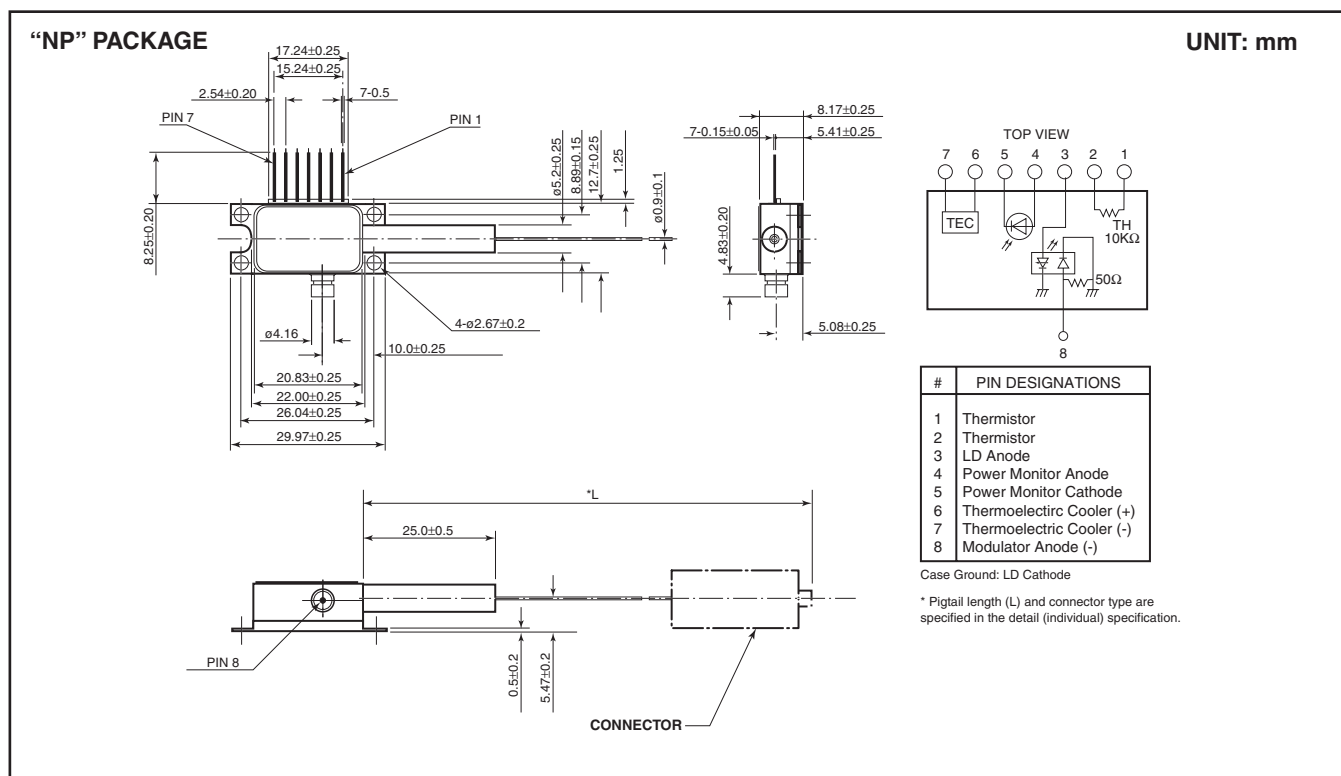


Figure 7 Wavelength Table

Part Number	Wavelength (nm) (TL=Tset) (in vacuum)	Frequency (THz)	Tolerance (nm)
FLD5F20NP-D60	1529.55	196.00	±0.1
FLD5F20NP-D59	1530.33	195.90	±0.1
FLD5F20NP-D58	1531.12	195.80	±0.1
FLD5F20NP-D57	1531.90	195.70	±0.1
FLD5F20NP-D56	1532.68	195.60	±0.1
FLD5F20NP-D55	1533.47	195.50	±0.1
FLD5F20NP-D54	1534.25	195.40	±0.1
FLD5F20NP-D53	1535.04	195.30	±0.1
FLD5F20NP-D52	1535.82	195.20	±0.1
FLD5F20NP-D51	1536.61	195.10	±0.1
FLD5F20NP-D50	1537.40	195.00	±0.1
FLD5F20NP-D49	1538.19	194.90	±0.1
FLD5F20NP-D48	1538.98	194.80	±0.1
FLD5F20NP-D47	1539.77	194.70	±0.1
FLD5F20NP-D46	1540.56	194.60	±0.1
FLD5F20NP-D45	1541.35	194.50	±0.1
FLD5F20NP-D44	1542.14	194.40	±0.1
FLD5F20NP-D43	1542.94	194.30	±0.1
FLD5F20NP-D42	1543.73	194.20	±0.1
FLD5F20NP-D41	1544.53	194.10	±0.1
FLD5F20NP-D40	1545.32	194.00	±0.1
FLD5F20NP-D39	1546.12	193.90	±0.1
FLD5F20NP-D38	1546.92	193.80	±0.1
FLD5F20NP-D37	1547.72	193.70	±0.1
FLD5F20NP-D36	1548.51	193.60	±0.1
FLD5F20NP-D35	1549.32	193.50	±0.1
FLD5F20NP-D34	1550.12	193.40	±0.1
FLD5F20NP-D33	1550.92	193.30	±0.1
FLD5F20NP-D32	1551.72	193.20	±0.1
FLD5F20NP-D31	1552.52	193.10	±0.1
FLD5F20NP-D30	1553.33	193.00	±0.1
FLD5F20NP-D29	1554.13	192.90	±0.1
FLD5F20NP-D28	1554.94	192.80	±0.1
FLD5F20NP-D27	1555.75	192.70	±0.1
FLD5F20NP-D26	1556.56	192.60	±0.1
FLD5F20NP-D25	1557.36	192.50	±0.1
FLD5F20NP-D24	1558.17	192.40	±0.1
FLD5F20NP-D23	1558.98	192.30	±0.1
FLD5F20NP-D22	1559.79	192.20	±0.1
FLD5F20NP-D21	1560.61	192.10	±0.1
FLD5F20NP-D20	1561.42	192.00	±0.1
FLD5F20NP-D19	1562.23	191.90	±0.1
FLD5F20NP-D18	1563.05	191.80	±0.1



For further information please contact:

Eudyna Devices USA Inc.

2355 Zanker Rd.
San Jose, CA 95131-1138, U.S.A.
TEL: (408) 232-9500
FAX: (408) 428-9111
www.us.eudyna.com

Eudyna Devices Europe Ltd.

Network House
Norreys Drive
Maidenhead, Berkshire SL6 4FJ
United Kingdom
TEL: +44 (0) 1628 504800
FAX: +44 (0) 1628 504888

Eudyna Devices Asia Pte Ltd.

Hong Kong Branch
Rm. 1101, Ocean Centre, 5 Canton Rd.
Tsim Sha Tsui, Kowloon, Hong Kong
TEL: +852-2377-0227
FAX: +852-2377-3921

Eudyna Devices Inc.

Sales Division
1, Kanai-cho, Sakae-ku
Yokohama, 244-0845, Japan
TEL: +81-45-853-8156
FAX: +81-45-853-8170

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