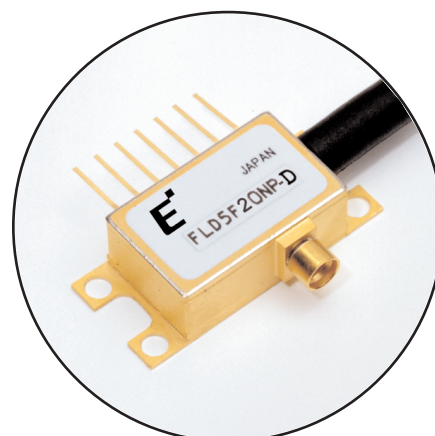


# 1,550nm Modulator Integrated DFB Laser

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

## OPTICAL & ELECTRICAL CHARACTERISTICS (T<sub>L</sub> = T<sub>set</sub>, T<sub>C</sub> = 25°C, BOL, unless otherwise specified)

Parameter	Symbol	Test Condition	Limits			Unit
			Min.	Type	Max.	
Peak Wavelength	$\lambda_p$	Note (2)	Note (4)			
Threshold Current	I <sub>th</sub>	CW, V <sub>m</sub> =V <sub>o</sub>	-	-	30	mA
Operating Current	I <sub>op</sub>	-	40	-	100	mA
Forward Voltage	V <sub>F</sub>	CW, I <sub>F</sub> =I <sub>op</sub> , V <sub>m</sub> =V <sub>o</sub>	-	1.4	2.0	V
Optical Output Power (Avg. Power)	P <sub>f</sub>	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 <sub>set</sub>		15	-	35	°C
Wavelength Drift (after 20 years)	-		-0.1	-	0.1	nm
Wavelength Stability with Case Temperature	-		-	-	±0.5	pm/°C
Optical Isolation	I <sub>s</sub>	T <sub>c</sub> =-20 to +70°C	25	35	-	dB
On Level Modulation	V <sub>O</sub>	-	-0.7	-	0	V
Modulator Drive Voltage	V <sub>mod</sub>	(V <sub>o</sub> -V <sub>mod</sub> )≥-3.3V, R <sub>ext</sub> =10dB	-	-	2.6	V
Extinction Ratio	R <sub>ext</sub>	f=10Gb/s, I <sub>F</sub> =I <sub>op</sub> , V <sub>m</sub> =V <sub>o</sub> /(V <sub>o</sub> -V <sub>mod</sub> )	10	-	-	dB
Rise Time	T <sub>r</sub>	Note (2), 20 to 80%	-	20	25	ps
Fall Time	T <sub>f</sub>		-	20	25	ps
Cut-off Frequency	S <sub>21</sub>	-3dB bandwidth, V <sub>m</sub> =V <sub>o</sub> -0.5 V <sub>mod</sub>  , I <sub>F</sub> =I <sub>op</sub>	10	-	-	GHz
RF Return Loss	S <sub>11</sub>	f=DC-5GHz, 50Ω Test Set, V <sub>m</sub> =V <sub>o</sub> , I <sub>F</sub> =I <sub>op</sub>	8	-	-	dB
RF Return Loss	S <sub>11</sub>	f=5-10GHz, 50Ω Test Set, V <sub>m</sub> =V <sub>o</sub> , I <sub>F</sub> =I <sub>op</sub>	5	-	-	dB
Monitor Current	I <sub>m</sub>	Note (2), V <sub>DR</sub> =5V	0.04	-	1.5	mA
In-Band Ripple	ΔG	I <sub>F</sub> =I <sub>op</sub> , f=0.1-10GHz, V <sub>m</sub> =V <sub>o</sub> -0.5 V <sub>mod</sub>	-	-	±1.0	dB
Relative Intensity Noise	RIN	f=10 MHz to 8.5 GHz, V <sub>m</sub> =V <sub>o</sub> , I <sub>F</sub> =I <sub>op</sub> , 8% Reflection	-	-	-120	dB/Hz
TEC Capacity	ΔT	P <sub>TEC</sub> =3.3W, I <sub>F</sub> =I <sub>op</sub>	70-T <sub>set</sub>	-	-	°C
TEC Current	I <sub>c</sub>	I <sub>F</sub> =I <sub>op</sub> , ΔT=(70-T <sub>set</sub> )[°C]	-	-	1.3	A
TEC Voltage	V <sub>c</sub>	I <sub>F</sub> =I <sub>op</sub> , ΔT=(70-T <sub>set</sub> )[°C]	-	-	2.5	V
TEC Power Dissipation	P <sub>c</sub>	I <sub>F</sub> =I <sub>op</sub>	-	-	3.3	W
Thermistor B Constant (Note 3)	B	T <sub>L</sub> =25°C, T <sub>C</sub> =+25°C	3,270	3,450	3,630	K
Thermal Resistance	R <sub>th</sub>		9.5	10.0	10.5	kΩ

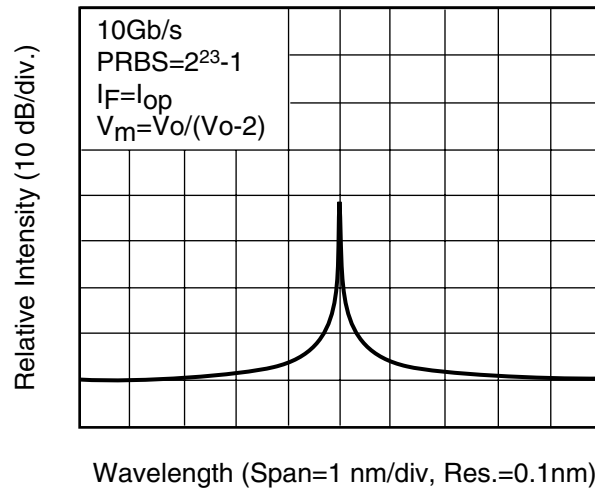
Note (1) Eudyna Test System 9.95328Gb/s, PRBS=2<sup>23</sup>-1, I<sub>F</sub>=I<sub>op</sub>, V<sub>m</sub>=V<sub>o</sub> and (V<sub>o</sub>-V<sub>mod</sub>) Dispersion=800ps/nm, Dispersion penalty at Bit Error Rate = 1.0E-10

Note (3) Relation between resistance and temperature (°K) is: R<sub>th</sub>(T) = R<sub>th</sub>(25°C)\*exp[B(1/T-1/298)]

Note (4) Reference Figure 7 for Wavelength Table

Note (2) Eudyna Test System 9.95328Gb/s, PRBS=2<sup>23</sup>-1, I<sub>F</sub>=I<sub>op</sub>, V<sub>m</sub>=V<sub>o</sub> and (V<sub>o</sub>-V<sub>mod</sub>)

**Fig. 1 Lasing Spectrum**



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

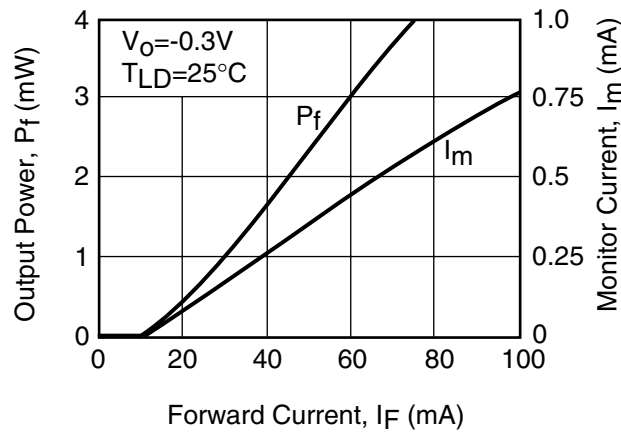


Fig. 3 Extinction Ratio vs. Modulation Applied Voltage

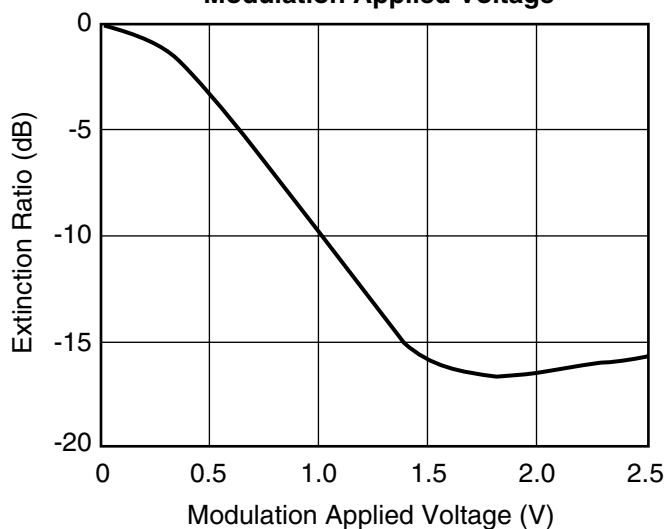


Fig. 4 Cut-off Frequency (S21)

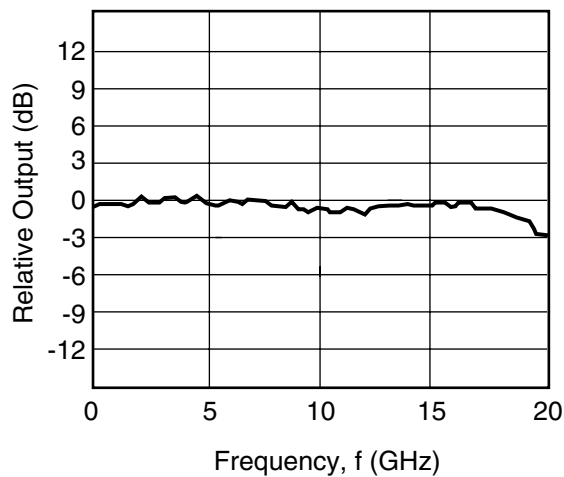


Fig. 5 RF Return Loss (S11)

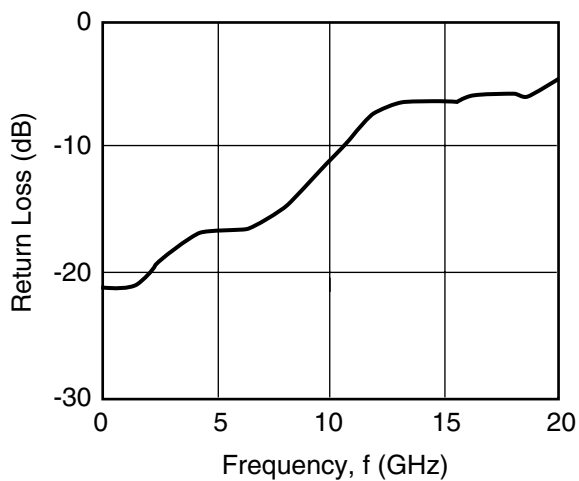
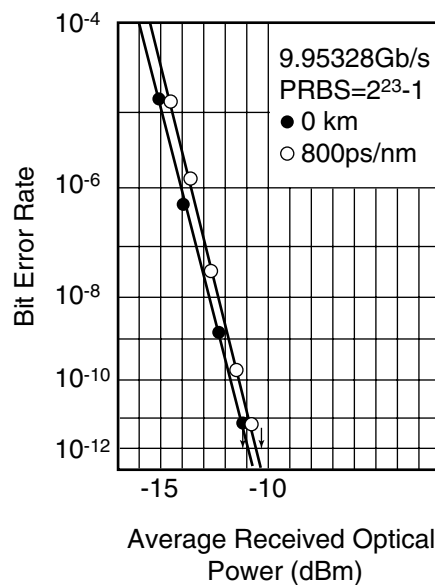
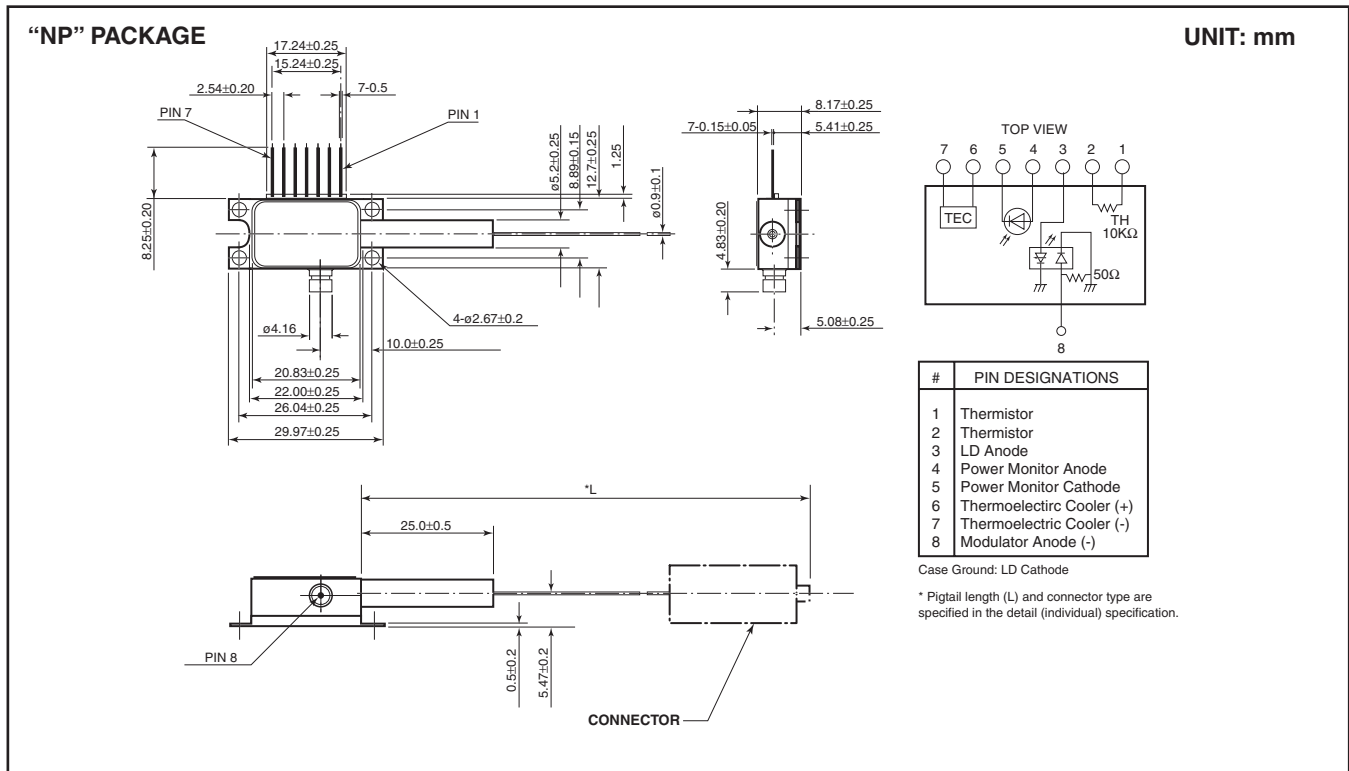


Fig. 6 Transmission Characteristics



**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



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