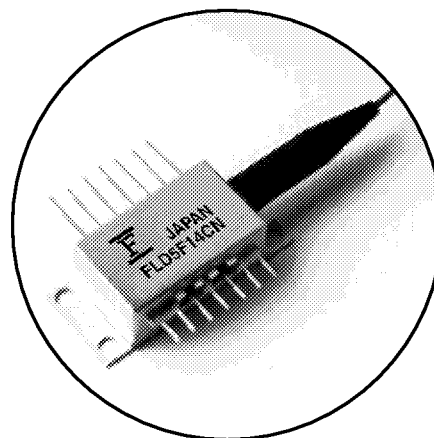


FEATURES

- Long transmission span over 600 km for 2.5 Gb/s system
- Modulator Integrated DFB Laser Diode Module
- CW laser operation
- Modulation voltage applied only on modulator section
- 1,550nm peak wavelength region and very low wavelength chirping
- 14 pin high speed butterfly package with fiber pigtail
- Built-in optical isolator, monitor photodiode, thermistor, and thermo-electric cooler
- Simplifies driver design
- $\lambda/4$ shifted MQW-DFB chip
- Selected wavelength according to ITU-T grid available

**APPLICATION**

This MI laser is intended for the application of 2.5 Gb/s long haul transmission over 600 km (potentially over 800 km) with Erbium Doped Fiber Amplifiers (EDFA).

DESCRIPTION

The Modulator Integrated DFB Laser (MI DFB Laser) has an electro-absorption modulator monolithically integrated with a conventional Distributed Feed-Back (DFB) $\lambda/4$ shifted Multi Quantum Well (MQW) laser. The modulation voltage is applied to the modulator section while the laser section operates CW allowing extremely low wavelength chirping. Transmission spans in excess of 600km are achievable. An extinction ratios of more than 10 dB is achieved with 2Vp-p modulation. The MI laser is installed in a butterfly type package. The module incorporates a highly stable YAG welded optical coupling system. The module includes an optical isolator, monitor photodiode, thermistor and a thermo-electric cooler. Selected wavelengths according to the ITU-T grid are available for Dense Wavelength Division Multiplexing (DWDM) applications.

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

Parameter	Symbol	Test Condition	Rating	Unit
Storage Temperature	T_{stg}	-	-40 to +70	$^\circ\text{C}$
Operating Case Temperature	T_{op}	-	-20 to +65	$^\circ\text{C}$
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 to +1	V
Photodiode Forward Current	-	-	1	mA
Photodiode Reverse Voltage	V_{DR}	-	20	V
TEC Voltage	V_c	-	2.5	V
TEC Current	I_c	-	1.4	A
Lead Soldering Time	-	260°C	10	sec
Environmental Operating Humidity	X_{op}	$T_{\text{op}} < 30^\circ\text{C}$	95	%
Environmental Storage Humidity	X_{st}	$T_{\text{stg}} < 30^\circ\text{C}$	95	%

MONITOR DIODE CHARACTERISTICS ($T_L = T_{\text{set}}$, $T_c = 25^\circ\text{C}$, BOL, unless otherwise specified)

Parameter	Symbol	Test Condition	Limits			Unit
			Min.	Typ.	Max.	
Monitor Current	I_m	CW, $I_F = I_{\text{op}}$, $V_m = V_o$, $V_{DR} = 5\text{V}$	50	-	2,000	μA
Monitor Dark Current	I_d	$V_{DR} = 5\text{V}$	-	2	100	nA
Monitor Diode Capacitance	C_t	$V_{DR} = 5\text{V}$, $f = 1\text{ MHz}$	-	2	20	pF

TEC AND THERMISTOR CHARACTERISTICS ($T_L = T_{\text{set}}$, $T_c = 25^\circ\text{C}$, BOL, unless otherwise specified)

Parameter	Symbol	Test Condition	Limits			Unit
			Min.	Typ.	Max.	
TEC Current	I_c	CW, $I_F = I_{\text{op}}$, $V_m = V_o$, $T_L = T_{\text{set}}$, $T_c = +65^\circ\text{C}$	-	-	1.0	A
TEC Voltage	V_c	CW, $I_F = I_{\text{op}}$, $V_m = V_o$, $T_L = T_{\text{set}}$, $T_c = +65^\circ\text{C}$	-	-	2.4	V
TEC Power Consumption	P_c	CW, $I_F = I_{\text{op}}$, $V_m = V_o$, $T_L = T_{\text{set}}$, $T_c = +65^\circ\text{C}$	-	-	2.4	W
TEC Resistance	R_{tec}	CW, $I_F = I_{\text{op}}$, $V_m = V_o$	2.0	2.3	3.2	Ω
Thermistor Resistance	R_{th}	$T_L = +15$ to $+35^\circ\text{C}$	6.3	-	15.4	k Ω
Thermistor B Constant	B	-	3,270	3,450	3,630	K
Tracking Error	TE	CW, $I_F = I_{\text{op}}$, $V_m = V_o$, $T_c = 0$ to $+65^\circ\text{C}$	-0.5	-	+0.5	dB

BOL: Beginning of Life

1,550nm MQW-DFB Modulator Integrated Laser

FLD5F14CN-E

OPTICAL & ELECTRICAL CHARACTERISTICS (T_L= T_{set}, T_c = 25°C, BOL, unless otherwise specified)

Parameter	Symbol	Test Condition	Limits			Unit
			Min.	Type	Max.	
Laser Set Temperature	T _{set}	-	+15	-	+35	°C
On Level Modulation	V _o	-	-1	-	0	V
Threshold Current	I _{th}	CW, V _m =V _o	2	-	40	mA
Operating Current	I _{op}	CW	40	-	90	mA
Dispersion Penalty	dP	Note (1)	-	-	1.5	dB
Optical Output Power	P _f	CW, I _F =I _{op} , V _m =V _o	0	-	-	dBm
Forward Voltage	V _F	CW, I _F =I _{op}	-	1.4	2.0	V
Extinction Ratio	R _{ext}	CW, I _F =I _{op} , V _m =V _o /(V _o -2)	10	12	-	dB
Peak Wavelength (Note 4)	λ _p	Note (2)	Note (4)			nm
Wavelength Drift	-	After 20 years	-	-	0.2	nm
Wavelength Stability with Case Temperature	-	-	-	-	±2	pm/°C
Sidemode Suppression Ratio	SSR	Note (2)	33	38	-	dB
Spectral Width	Δλ	Note (3)	-	0.05	0.10	nm
Rise Time	T _r	Note (2), 20 to 80%	-	90	125	ps
Fall Time	T _f	Note (2), 20 to 80%	-	90	125	ps
Input Impedance	Z	CW, V _m <0	-	50	-	Ω
RF Return Loss	S ₁₁	f=2.5 GHz, 50Ω Test Set, V _m =V _o , I _F =I _{op}	10	-	-	dB
Cut-off Frequency	S ₂₁	-3dB bandwidth, 50Ω Test Set, V _m =V _o , I _F =I _{op}	3.5	-	-	GHz
Relative Intensity Noise	RIN	f=2.5 GHz, V _m =V _o , I _F =I _{op} , ORL=>24dB	-	-	-145	dB/Hz
Optical Isolation	I _s	T _c =-20 to +65°C	25	35	-	dB

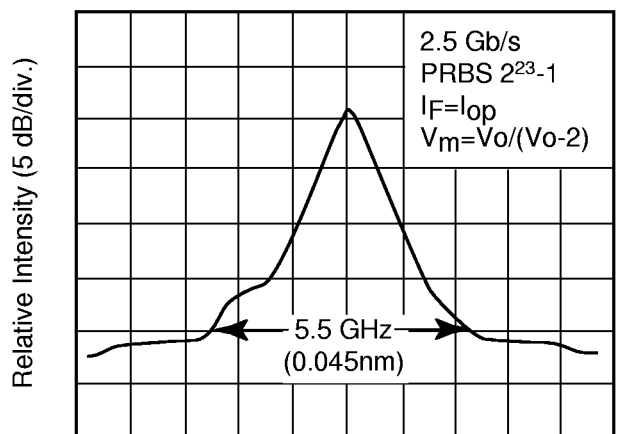
Note (1) FUJITSU Test System
2.48832Gb/s, PRBS, 2²³-1, I_b=I_{op}, V_m=V_o/(V_o-2)
Dispersion = 10,000ps/nm
Dispersion penalty at bit - error - rate = 10⁻¹⁰

Note (2) FUJITSU Test System
2.48832Gb/s, PRBS, 2²³-1, I_b=I_{op}, V_m=V_o/(V_o-2)

Note (3) Spectrum measurement equipment is "Monochrometer" or "Fabry-Perot Etalon".
Spectral width at -20dB under the modulation condition of Note (2)

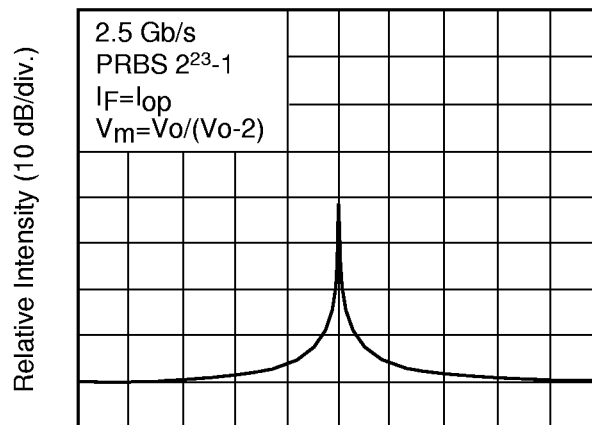
Note (4) The selected wavelength is available which is listed in Fig. 9.

Fig. 1 Lasing Spectrum



Wavelength (Span=1 GHz/div, Res.=100 MHz)

Fig. 2 Lasing Spectrum



Wavelength (Span=1 nm/div, Res.=0.1nm)

Fig. 3 Temperature Dependence of Wavelength

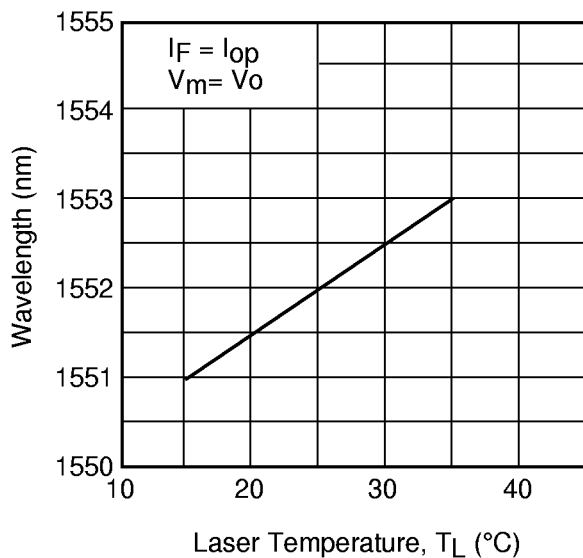
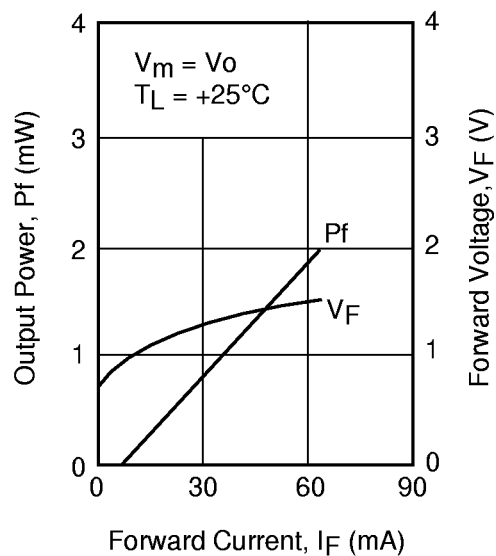


Fig. 4 Forward Current vs. Output Power and Forward Current vs. Forward Voltage



**Fig. 5 Extinction Ratio
vs. Modulation Voltage**

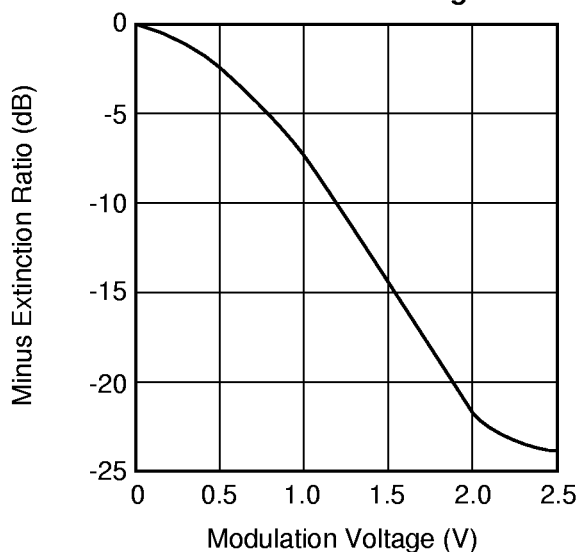


Fig. 6 Cut-off Frequency (S21)

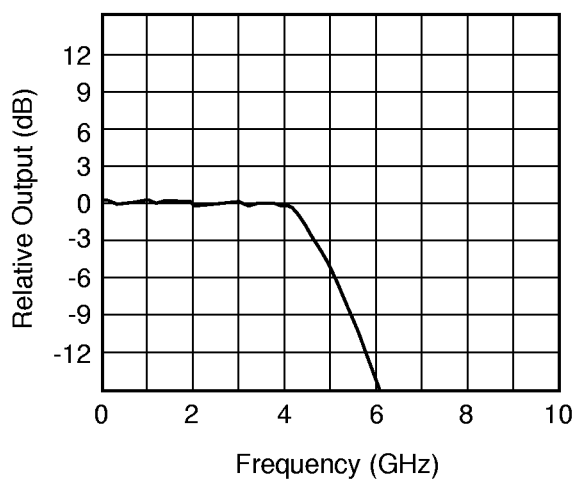


Fig. 7 RF Return Loss (S11)

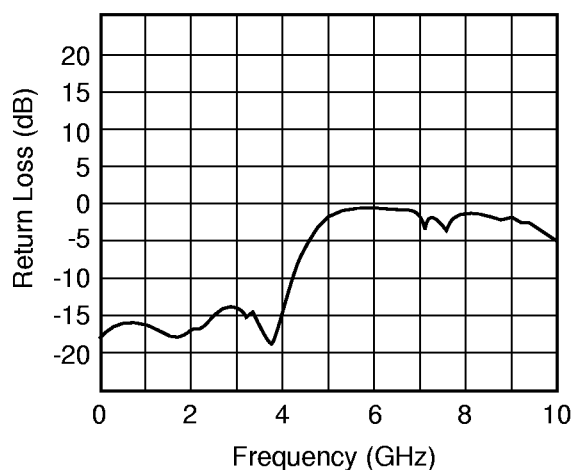
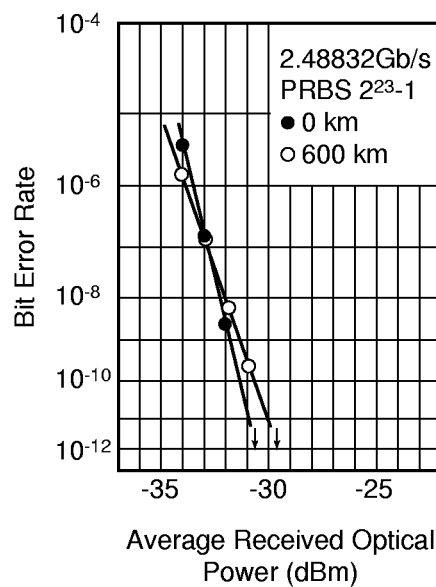


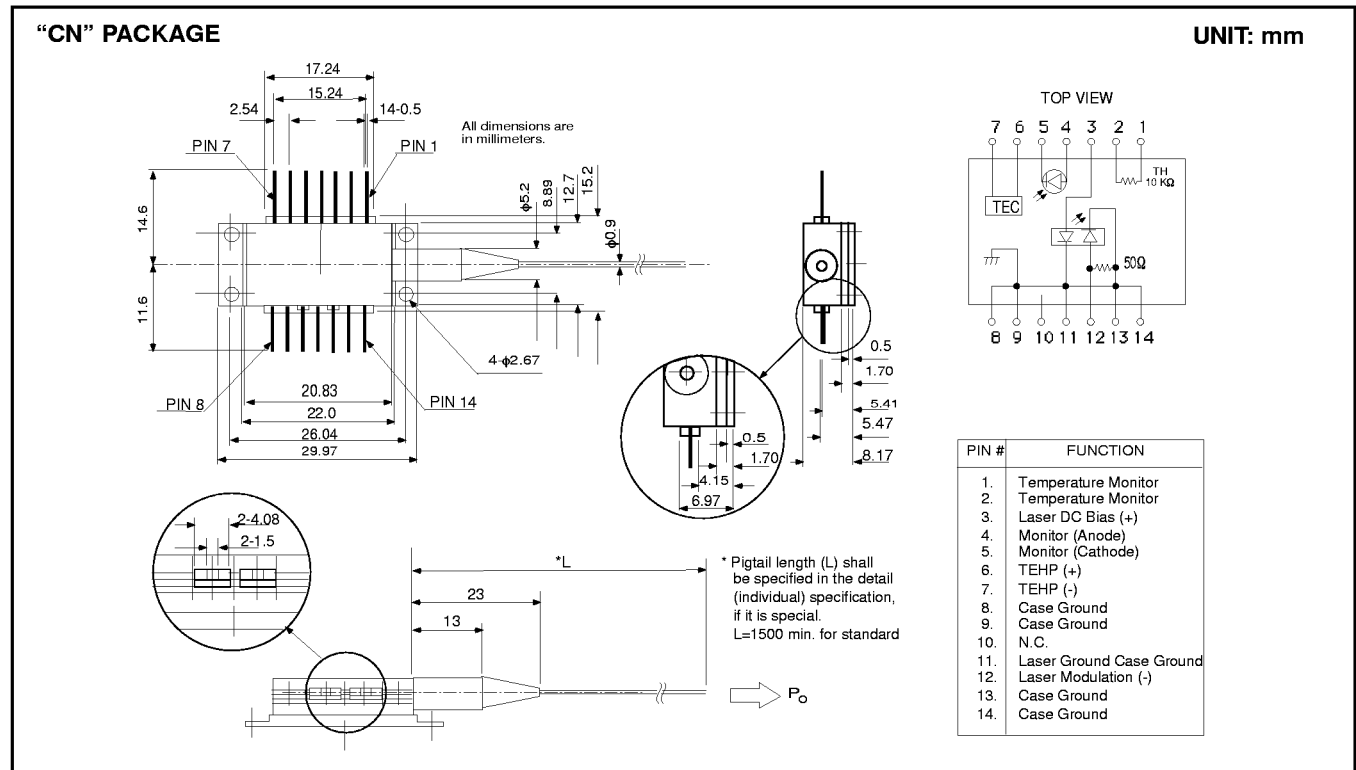
Fig. 8 Transmission Characteristics



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Fig. 9 Wavelength Table

Part Number	Wavelength (nm) (TL=Tset) (in vacuum)	Tolerance (nm)	Part Number	Wavelength (nm) (TL=Tset) (in vacuum)	Tolerance (nm)
FLD5F14CN-E59	1530.33	±0.1	-E39	1546.12	±0.1
-E58	1531.12	±0.1	-E38	1546.92	±0.1
-E57	1531.90	±0.1	-E37	1547.72	±0.1
-E56	1532.68	±0.1	-E36	1548.51	±0.1
-E55	1533.47	±0.1	-E35	1549.32	±0.1
-E54	1534.25	±0.1	-E34	1550.12	±0.1
-E53	1535.04	±0.1	-E33	1550.92	±0.1
-E52	1535.82	±0.1	-E32	1551.72	±0.1
-E51	1536.61	±0.1	-E31	1552.52	±0.1
-E50	1537.40	±0.1	-E30	1553.33	±0.1
-E49	1538.19	±0.1	-E29	1554.13	±0.1
-E48	1538.98	±0.1	-E28	1554.94	±0.1
-E47	1539.77	±0.1	-E27	1555.75	±0.1
-E46	1540.56	±0.1	-E26	1556.55	±0.1
-E45	1541.35	±0.1	-E25	1557.36	±0.1
-E44	1542.14	±0.1	-E24	1558.17	±0.1
-E43	1542.94	±0.1	-E23	1558.98	±0.1
-E42	1543.73	±0.1	-E22	1559.79	±0.1
-E41	1544.53	±0.1	-E21	1560.61	±0.1
-E40	1545.32	±0.1			



1,550nm MQW-DFB Modulator Integrated Laser

FLD5F14CN-E

For further information please contact:

FUJITSU COMPOUND SEMICONDUCTOR, INC. Americas & R.O.W.

2355 Zanker Rd.
San Jose, CA 95131-1138, U.S.A.
Phone: (408) 232-9500
FAX: (408) 428-9111

55 Schanck Road,
Suite A-2
Freehold, NJ 07728-2964, U.S.A.
Phone: (732) 303-0282
FAX: (732) 431-3393

www.fcsi.fujitsu.com

FUJITSU MIKROELEKTRONIK GmbH

Quantum Devices Division
Network House
Norreys Drive
Maidenhead, Berkshire SL6 4FJ, UK
Phone: +44 (0)1628 504800
FAX: +44 (0)1628 504888

FUJITSU QUANTUM DEVICES, LTD. Asia & Japan

2-7-1, Nishi Shinjuku
Shinjuku-ku, Tokyo 163-0721
Japan
Phone: 3-5322-3356
FAX: 3-5322-3398

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