

APPROVED		CHARGED
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Specification of  
EAM/DFB-LD module for 2.5Gb/s,  
6400ps/nm, and 12800 ps/nm WDM application

**Type No.**

**FU-632SEA-V31Mxx**

**FU-632SEA-V61Mxx**

**FU-632SEA-W31Mxx**

**FU-632SEA-W61Mxx ( XX :9~91)**

A	B	C	D
	X		
Date		Approved	
14 Jan.2003		H.Watanabe	

MITSUBISHI (OPTICAL DEVICES)

# FU-632SEA-V31Mxx/W31Mxx

# FU-632SEA-V61Mxx/W61Mxx

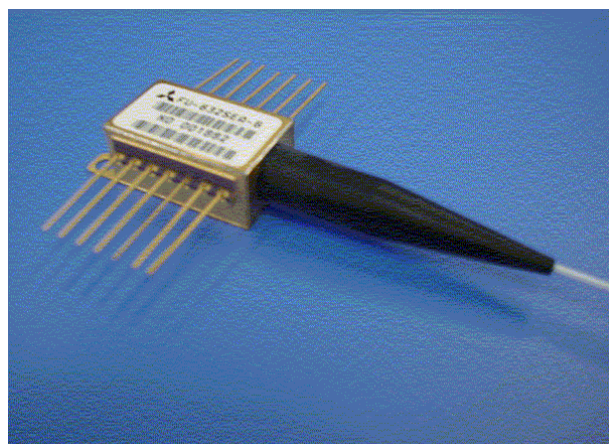
1.55  $\mu$ m EAM/DFB-LD MODULE WITH SINGLEMODE FIBER PIGTAIL(WDM)

## DESCRIPTION

Module type FU-632SEA-V61Mxx/-V31Mxx is an electro-absorption modulator integrated with 1.55 $\mu$ m DFB-LD module with single mode optical fiber.

This module is suitable to a light source in 2.5Gb/s digital optical communication systems where the distance is shorter than 640km.

This module is prepared in accordance with ITU-T recommendation wavelength channel plan for Dense-WDM transmission.



## FEATURES

- Input impedance is 50 $\Omega$
- Integrated Electroabsorption Modulator(EAM)
- Distributed feedback (DFB) Laser Diode
- Emission wavelength is the 1.55mm band
- Single-mode optical fiber pig-tail
- Built-in optical isolator
- Built-in thermal electric cooler
- Butterfly package

## APPLICATION

- 2.5Gbps, 6400ps/nm WDM application
- 2.5Gbps, 12800ps/nm WDM application

## ABSOLUTE MAXIMUM RATINGS (T<sub>ld</sub>=T<sub>set</sub>)

Parameter		Symbol	Conditions	Rating	Unit
Laser diode	Optical output power	Pf	CW	6	mW
	Forward current	If	CW	200	mA
	Reverse voltage	Vrl	CW	2	V
Modulator	Reverse voltage	Vrm	-	5	V
	Forward voltage	Vfm	-	1	V
Photodiode for monitoring	Reverse voltage	Vrd	-	20	V
	Forward current	lfd	-	2	mA
Thermoelectric cooler(Note 1)	Current	Ipe	-	1.5	A
	Voltage	Vpe	-	3	V
Operating case temperature		Tc	-	-20 to 70	$^{\circ}$ C
Storage temperature		Tstg	-	-40 to 85	$^{\circ}$ C

Note 1. Even if the thermoelectric cooler(TEC) is operated within the rated conditions, uncontrolled current loading or operation without heat sink may easily damage the module by exceeding the storage temperature range. Thermistor resistance should be properly monitored by the feedback circuit during TEC operation to avoid the catastrophic damage.

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**FU-632SEA-V31Mxx/W31Mxx****FU-632SEA-V61Mxx/W61Mxx**1.55  $\mu$ m EAM/DFB-LD MODULE WITH SINGLEMODE FIBER PIGTAIL(WDM)**ELECTRICAL/OPTICAL CHARACTERISTICS**(T<sub>ld</sub>=T<sub>set</sub>, T<sub>c</sub>=-20~70°C unless otherwise noted)

Parameter	Symbol	Test Conditions (Note 2)	Limits			Unit
			Min.	Typ.	Max.	
Laser operating Temperature	T <sub>set</sub>	CW, I <sub>f</sub> =I <sub>op</sub>	20	-	35	°C
Threshold current	I <sub>th</sub>	CW, V <sub>m</sub> =0V	5	-	30	mA
Operating current	I <sub>op</sub>	CW, V <sub>m</sub> =0V	40	60	70	mA
Operating voltage	V <sub>op</sub>	CW, V <sub>m</sub> =0V, I <sub>f</sub> =I <sub>op</sub>	-	-	1.7	V
Input impedance	Z <sub>in</sub>	I <sub>f</sub> =I <sub>op</sub>	-	50	-	$\Omega$
Optical output power from fiber end	P <sub>f_ave</sub>	(Note3,4)	-2	-	+2.5	dBm
Light emission central spectral wavelength	$\lambda_c$	CW, V <sub>m</sub> =0V, I <sub>f</sub> =I <sub>op</sub> , T <sub>ld</sub> =T <sub>set</sub>	see Table 1.			nm
Center wavelength drift with case temperature	$\Delta\lambda_c/\Delta T_c$	CW, V <sub>m</sub> =0V, APC T <sub>ld</sub> =T <sub>set</sub> , T <sub>c</sub> =-20~70°C	-1	-	0	pm/°C
Side mode suppression ratio	S <sub>r</sub>	(Note3,4)	35	40	-	dB
Spectral width	$\Delta\lambda_{cw}$	CW, V <sub>m</sub> =0V, I <sub>f</sub> =I <sub>op</sub>	-	3	10	MHz
	$\Delta\lambda_{mod}$	(Note3,4)	-	0.05	0.1	nm
Relative intensity noise	RIN	CW, V <sub>m</sub> =0V, I <sub>f</sub> =I <sub>op</sub> , 2.5GHz	-	-155	-140	dB/Hz
Power penalty	P <sub>p</sub>	(Note3,4) -V31Mxx @6400ps/nm	-	-	1.5	dB
		-V61Mxx @12800ps/nm	-	-	1.5	dB
Extinction ratio	Ex	(Note3,4)	11	-	-	dB
Rise/Fall time	tr/tf	(Note3,4), 20-80%	-	-	100	ps
Cutoff frequency	f <sub>c</sub>	I <sub>f</sub> =I <sub>op</sub> , V <sub>m</sub> =-1V	3.5	-	-	GHz
RF return loss	S <sub>11</sub>	I <sub>f</sub> =I <sub>op</sub> , V <sub>m</sub> =-1V, 0~2GHz	10	-	-	dB
		I <sub>f</sub> =I <sub>op</sub> , V <sub>m</sub> =-1V, 2~3GHz	7	-	-	dB
Tracking error	E <sub>r</sub>	T <sub>c</sub> =-20~70°C, APC, ATC (Note 5), V <sub>m</sub> =0V	-	0.3	0.5	dB
Monitor current	I <sub>mon</sub>	(Note3,4)	0.1	-	1.5	mA
Dark current(PD)	I <sub>d</sub>	V <sub>rd</sub> =5V, T <sub>ld</sub> =25°C	-	-	0.1	$\mu$ A
Capacitance(PD)	C <sub>t</sub>	V <sub>rd</sub> =5V, T <sub>ld</sub> =25°C, f = 1MHz	-	10	-	pF
Optical isolation	I <sub>so</sub>	T <sub>c</sub> =25°C	35	-	-	dB
		T <sub>c</sub> =-20~70°C	23	-	-	dB

Note 2. V<sub>m</sub> is EAM bias level at CW condition, V<sub>pp</sub> and V<sub>off</sub> are EAM amplitude and EAM high level offset voltage respectively at modulated condition.

3. 2.48832Gb/s, NRZ, PRBS<sup>23</sup>-1, I<sub>f</sub>=I<sub>op</sub>, V<sub>pp</sub>=2.5V, V<sub>off</sub>= -0.2V, T<sub>ld</sub>=T<sub>set</sub>, Back to back.

4. Optical return loss of the connectors should be greater than 40dB in order to get specified performance.

5. E<sub>r</sub>=MAX|10×log(P<sub>f</sub>(T<sub>c</sub>)/P<sub>f</sub>(25°C))|

**FU-632SEA-V31Mxx/W31Mxx****FU-632SEA-V61Mxx/W61Mxx**1.55  $\mu\text{m}$  EAM/DFB-LD MODULE WITH SINGLEMODE FIBER PIGTAIL(WDM)**THERMAL CHARACTERISTICS** ( $T_{\text{ld}}=T_{\text{set}}$ ,  $T_{\text{c}}=-20\sim 70^{\circ}\text{C}$ )

Parameter	Symbol	Test Conditions	Limits			Unit
			Min.	Typ.	Max.	
Thermistor resistance	Rth	$T_{\text{ld}}=25^{\circ}\text{C}$	9.5	10	10.5	$\text{k}\Omega$
B constant of Rth	B	-	-	3950	-	K
Cooler current	Ipe	$I_{\text{f}}=I_{\text{op}}, T_{\text{ld}}=T_{\text{set}}, T_{\text{c}}=70^{\circ}\text{C}$	-	0.7	1.2	A
Cooler voltage	Vpe	$I_{\text{f}}=I_{\text{op}}, T_{\text{ld}}=T_{\text{set}}, T_{\text{c}}=70^{\circ}\text{C}$	-	1.7	2.5	V

**FIBER PIGTAIL SPECIFICATIONS**

Parameter	Limits	Unit
Type	SM	-
Mode field diameter	$9.3\pm 1$	$\mu\text{m}$
Cladding diameter	$125\pm 2$	$\mu\text{m}$
Secondary coating outer diameter	$0.9\pm 0.1$	mm
Connector type	FC/PC or SC/PC*	-
Optical return loss of connector	40 (min)	dB

\*FC/PC connector is for FU-632SEA-V31Mxx and -V61Mxx series.

SC/PC connector is for FU-632SEA-W31Mxx and -W61Mxx series.

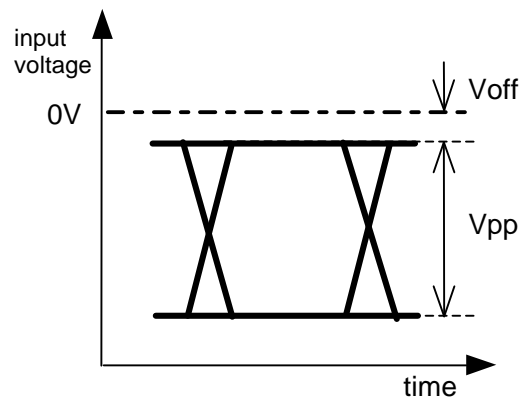


fig1. Definition of Electrical input

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**FU-632SEA-V31Mxx/W31Mxx**

**FU-632SEA-V61Mxx/W61Mxx**

**1.55  $\mu$ m EAM/DFB-LD MODULE WITH SINGLEMODE FIBER PIGTAIL(WDM)**

## DOCUMENTATION (T<sub>ld</sub>=T<sub>set</sub>)

- Fiber output power vs. Laser forward current at V<sub>m</sub>=0V, T<sub>ld</sub>=T<sub>set</sub>
- Fiber output power (P<sub>f\_ave</sub>) at I<sub>f</sub>=I<sub>op</sub>, 2.48832Gb/s modulation, T<sub>ld</sub>=T<sub>set</sub> and T<sub>c</sub>=25°C
- Threshold current (I<sub>th</sub>) at T<sub>ld</sub>=T<sub>set</sub> and T<sub>c</sub>=25°C.
- Laser forward current (I<sub>op</sub>) at P<sub>f\_ave</sub> > -1dBm, V<sub>m</sub>=0V, T<sub>ld</sub>=T<sub>set</sub> and T<sub>c</sub>=25°C.
- Laser forward voltage (V<sub>op</sub>) at I<sub>f</sub> = I<sub>op</sub>, V<sub>m</sub>=0V, T<sub>ld</sub>=T<sub>set</sub> and T<sub>c</sub>=25°C.
- Laser operating temperature (T<sub>set</sub>) at  $\lambda$ c. (Note 7)
- Monitor current (I<sub>mon</sub>) at I<sub>f</sub> = I<sub>op</sub>, V<sub>m</sub>=0V, T<sub>ld</sub>=T<sub>set</sub> and T<sub>c</sub>=25°C.
- Thermistor resistance (R<sub>th</sub>) at  $\lambda$ c. (Note 7).
- Cooler current (I<sub>pe</sub>) at I<sub>f</sub> = I<sub>op</sub>, V<sub>m</sub>=0V, T<sub>ld</sub>=T<sub>set</sub> and T<sub>c</sub>=70°C.
- Cooler voltage (V<sub>pe</sub>) at I<sub>f</sub> = I<sub>op</sub>, V<sub>m</sub>=0V, T<sub>ld</sub>=T<sub>set</sub> and T<sub>c</sub>=70°C.
- Power penalty at I<sub>f</sub>=I<sub>op</sub>, 2.48832Gb/s modulation, T<sub>ld</sub>=T<sub>set</sub> and T<sub>c</sub>=25°C.

Note: 7. T<sub>set</sub> is attached as a reference data. R<sub>th</sub> should be used in order to tune the wavelength to the specified value accurately.

## ORDERING INFORMATION

**FU-632SEA- V 6 1 M 13**

**Wavelength Code :** (See Table 1)

**Transmission Distance**

**3:** 6400ps/nm , **6:** 12800ps/nm

**Fiber Connector Type**

**V:** FC/PC , **W:** SC/PC

No indication : no connector

# FU-632SEA-V31Mxx/W31Mxx

# FU-632SEA-V61Mxx/W61Mxx

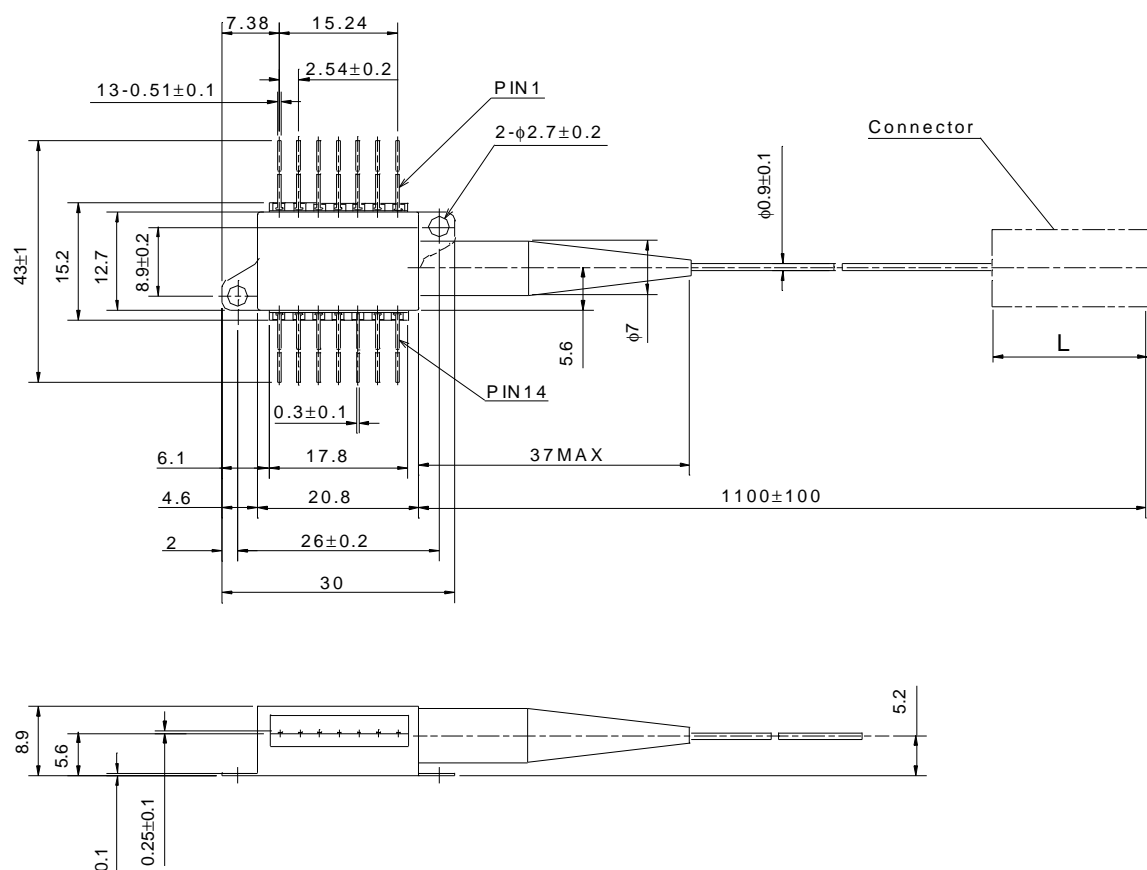
1.55  $\mu\text{m}$  EAM/DFB-LD MODULE WITH SINGLEMODE FIBER PIGTAIL(WDM)

**Table 1.** (All wavelengths are referred to vacuum. Tolerance is  $\lambda c \pm 0.05\text{nm}$ .)

Mitsubishi Wavelength Code	Frequency f (THz)	Wavelength $\lambda c$ (nm)	Type No.	
			6400ps/nm	12800ps/nm
9	196.00	1529.55	FU-632SEA-V31M9	FU-632SEA-V61M9
11	195.90	1530.33	FU-632SEA-V31M11	FU-632SEA-V61M11
13	195.80	1531.12	FU-632SEA-V31M13	FU-632SEA-V61M13
15	195.70	1531.90	FU-632SEA-V31M15	FU-632SEA-V61M15
17	195.60	1532.68	FU-632SEA-V31M17	FU-632SEA-V61M17
19	195.50	1533.47	FU-632SEA-V31M19	FU-632SEA-V61M19
21	195.40	1534.25	FU-632SEA-V31M21	FU-632SEA-V61M21
23	195.30	1535.04	FU-632SEA-V31M23	FU-632SEA-V61M23
25	195.20	1535.82	FU-632SEA-V31M25	FU-632SEA-V61M25
27	195.10	1536.61	FU-632SEA-V31M27	FU-632SEA-V61M27
29	195.00	1537.40	FU-632SEA-V31M29	FU-632SEA-V61M29
31	194.90	1538.19	FU-632SEA-V31M31	FU-632SEA-V61M31
33	194.80	1538.98	FU-632SEA-V31M33	FU-632SEA-V61M33
35	194.70	1539.77	FU-632SEA-V31M35	FU-632SEA-V61M35
37	194.60	1540.56	FU-632SEA-V31M37	FU-632SEA-V61M37
39	194.50	1541.35	FU-632SEA-V31M39	FU-632SEA-V61M39
41	194.40	1542.14	FU-632SEA-V31M41	FU-632SEA-V61M41
43	194.30	1542.94	FU-632SEA-V31M43	FU-632SEA-V61M43
45	194.20	1543.73	FU-632SEA-V31M45	FU-632SEA-V61M45
47	194.10	1544.53	FU-632SEA-V31M47	FU-632SEA-V61M47
49	194.00	1545.32	FU-632SEA-V31M49	FU-632SEA-V61M49
51	193.90	1546.12	FU-632SEA-V31M51	FU-632SEA-V61M51
53	193.80	1546.92	FU-632SEA-V31M53	FU-632SEA-V61M53
55	193.70	1547.72	FU-632SEA-V31M55	FU-632SEA-V61M55
57	193.60	1548.51	FU-632SEA-V31M57	FU-632SEA-V61M57
59	193.50	1549.32	FU-632SEA-V31M59	FU-632SEA-V61M59
61	193.40	1550.12	FU-632SEA-V31M61	FU-632SEA-V61M61
63	193.30	1550.92	FU-632SEA-V31M63	FU-632SEA-V61M63
65	193.20	1551.72	FU-632SEA-V31M65	FU-632SEA-V61M65
67	193.10	1552.52	FU-632SEA-V31M67	FU-632SEA-V61M67
69	193.00	1553.33	FU-632SEA-V31M69	FU-632SEA-V61M69
71	192.90	1554.13	FU-632SEA-V31M71	FU-632SEA-V61M71
73	192.80	1554.94	FU-632SEA-V31M73	FU-632SEA-V61M73
75	192.70	1555.75	FU-632SEA-V31M75	FU-632SEA-V61M75
77	192.60	1556.55	FU-632SEA-V31M77	FU-632SEA-V61M77
79	192.50	1557.36	FU-632SEA-V31M79	FU-632SEA-V61M79
81	192.40	1558.17	FU-632SEA-V31M81	FU-632SEA-V61M81
83	192.30	1558.98	FU-632SEA-V31M83	FU-632SEA-V61M83
85	192.20	1559.79	FU-632SEA-V31M85	FU-632SEA-V61M85
87	192.10	1560.61	FU-632SEA-V31M87	FU-632SEA-V61M87
89	192.00	1561.42	FU-632SEA-V31M89	FU-632SEA-V61M89
91	191.90	1562.23	FU-632SEA-V31M91	FU-632SEA-V61M91

**FU-632SEA-V31Mxx/W31Mxx****FU-632SEA-V61Mxx/W61Mxx**1.55  $\mu$ m EAM/DFB-LD MODULE WITH SINGLEMODE FIBER PIGTAIL(WDM)**OUTLINE DIAGRAM**

(Unit : mm)



Ideantified type number	Connector type	L
FU-632SEA-V31Mxx,V61Mxx	FC/PC	28REF
FU-632SEA-W31Mxx,W61Mxx	SC/PC	36REF
FU-632SEA-31Mxx,61Mxx	no connector	-

**FU-632SEA-x31Mxx/FU-632SEA-x61Mxx**

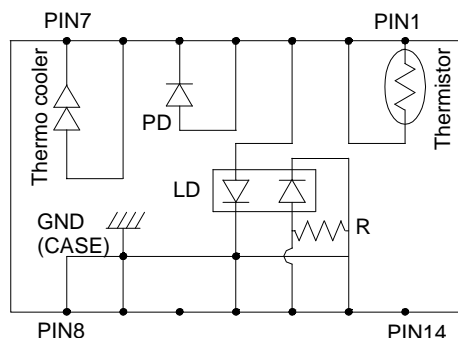
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# FU-632SEA-V31Mxx/W31Mxx

# FU-632SEA-V61Mxx/W61Mxx

1.55  $\mu$ m EAM/DFB-LD MODULE WITH SINGLEMODE FIBER PIGTAIL(WDM)

## PIN ASSIGN



PIN NO	Function
1	Thermistor
2	Thermistor
3	LD bias (+)
4	PD anode
5	PD cathode
6	Thermo cooler (+)
7	Thermo cooler (-)
8	GND
9	GND
10	NC
11	GND,LD(-),EA(+)
12	EA modulator (-)
13	GND,LD(-),EA(+)
14	NC

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