APPROVED	APPROVED	APPROVED
T.Nambara	A. Adachi	**T.Onodera**

Specification of 10Gb/s EML module

Module type:

FU-653SEA-2M series (Dispersion 800ps/nm)

FU-653SEA-3M series ## (Dispersion 1600ps/nm)

Under development

A	B	C	D
	x		
DATE		Approved	
14.June '02		T.Nambara	

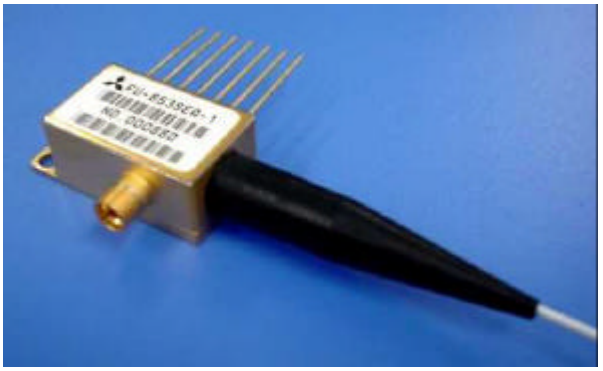
MITSUBISHI (OPTICAL DEVICES)

FU-653SEA-2Mxx
FU-653SEA-3Mxx

1.55 μm EA MODULATOR INTEGRATED DFB-LD MODULE
(7 PIN PACKAGE WITH GPO CONNECTOR, 10GB/s DIGITAL APPLICATION)

DESCRIPTION

Module type FU-653SEA-1Mx is a 1.55μm EA modulator integrated DFB-LD module with single-mode optical fiber.
This module is suitable to a light source for use in 10Gb/s digital optical communication systems.



FEATURES

- Input impedance is 50Ω
- Integrated Electro-absorption Modulator
- Distributed feed-back(DFB) Laser Diode
- Emission wavelength is 1.55μm band
- Single mode optical fiber pigtail
- Built-in optical isolator
- Built-in thermoelectric cooler
- 7-pin Butterfly package with GPO connector
- For DWDM application

APPLICATION

STM-64, OC192 application

ABSOLUTE MAXIMUM RATINGS

Item		Symbol	Condition	Rating	Unit
Laser diode	Optical output power	Pf	CW	10	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	Ifd	-	2	mA
Thermoelectric cooler(Note1)	Current	Ipe	-	1.5	A
	Voltage	Vpe	-	3	V
Operating case temperature		Tc	-	-20~70	°C
Storage temperature		Tstg	-	-40~85	°C

Note1
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.

MITSUBISHI (OPTICAL DEVICES)

FU-653SEA-2Mxx
FU-653SEA-3Mxx

1.55 μm EA MODULATOR INTEGRATED DFB-LD MODULE
(7 PIN PACKAGE WITH GPO CONNECTOR, 10GB/s DIGITAL APPLICATION)

1. **ELECTRICAL/OPTICAL CHARACTERISTICS** (Tc=25°C,chip temperature=Tld, unless otherwise noted)

Item	Symbol	Condition(Note2)	Min.	Typ.	Max.	Unit
Threshold current	Ith	CW,Vm=0V	5	-	30	mA
Operating current	Iop	CW,Vm=0V	50	70	100	mA
Operating voltage	Vop	CW, If=Iop, Vm=0V	-	-	1.7	V
Input impedance	Zin	If=Iop	-	50	-	Ω
Optical output power from fiber end	Pf	(Note 3,4)	-2	-	-	dBm
Side mode suppression ratio	Sr	(Note 3,4)	35	40	-	dB
Relative intensity noise	RIN	CW, If=Iop, Vm=0V,10GHz	-	-	-135	dB/Hz
Power penalty	Pp	(Note 3,4,), 800ps/nm	-	-	2.0	dB
		(Note 3,4,6), 1600ps/nm	-	-	2.0	dB
Extinction ratio	Ex	(Note 3,4)	10	-	-	dB
Rise/fall time	tr/tf	(Note 3,4),20-80%	-	-	45	ps
Cutoff frequency	fc	If=Iop,Vm=-1V	11	-	-	GHz
RF return loss	S11	If=Iop,Vm=-1V, f≤5GHz	10	15	-	dB
		If=Iop,Vm=-1V, f≤10GHz	5	7	-	dB
Tracking error	Er	If=Iop,Tc=-20~70°C, Note 5	-	0.3	0.5	dB
Monitor current	Imon	If=Iop,Vrd=-5V	0.1	-	1.5	mA
Dark current(PD)	Id	Vrd=-5V	-	-	0.1	μA
Capacitance(PD)	Ct	Vrd=-5V	-	10	-	pF
Optical isolation	Iso	Tc=25°C	35	-	-	dB
		Tc=-20~70°C	23	-	-	dB
Laser diode temperature	Tld	-	15	-	35	°C

Note 2 : Vm is EAM bias voltage at CW condition, Vpp and Voff are EAM amplitude and EAM high level offset voltage respectively at modulation condition.
Note 3 : 9.95328Gbps, NRZ, PRBS2^23-1, If=Iop,Vpp=2.5V,Voff=0V to –1V
Note 4 : Optical return loss of the connectors should be greater than 40dB in order to get specified performance.
Note 5 : Er=10×log[Pf(Tc)/Pf(25°C)]
Note 6 : Under development

MITSUBISHI (OPTICAL DEVICES)

FU-653SEA-2Mxx
FU-653SEA-3Mxx

1.55 μm EA MODULATOR INTEGRATED DFB-LD MODULE
(7 PIN PACKAGE WITH GPO CONNECTOR, 10GB/s DIGITAL APPLICATION)

THERMAL CHARACTERISTICS

Parameter	Symbol	Conditions (Note2)	Limits			Unit
			Min.	Typ.	Max.	
Thermistor resistance	Rth	Tc=Tld=25°C,	9.5	10	10.5	Ω
B constant of Rth	B	-	-	3950	-	K
Cooling capacity	ΔT	Tld=25°C	45	-	-	°C
Cooler current	Ipe	If=Iop, Tc=70°C,Tld=25°C	-	0.6	1.2	A
Cooler voltage	Vpe	If=Iop, Tc=70°C,Tld=25°C	-	1.2	2.5	V

FIBER PIGTAIL SPECIFICATIONS

Parameter	Specification	Unit
Type	SM	-
Mode field diameter	9.5±1	μm
Cladding diameter	125±2	μm
Secondary coating outer diameter	0.9±0.1	mm
Connector	See OUTLINE DIAGRAM	
Optical return loss of connector	40(min)	dB

DOCUMENTATION

· Threshold current (Ith)
· Laser forward current (Iop)
· Monitor current (Imon)
· Central wavelength (λc)
· Laser set temperature(Tld)
· Extinction ratio
· Offset voltage

MITSUBISHI (OPTICAL DEVICES)

FU-653SEA-2Mxx
FU-653SEA-3Mxx

1.55 μm EA MODULATOR INTEGRATED DFB-LD MODULE
(7 PIN PACKAGE WITH GPO CONNECTOR, 10GB/s DIGITAL APPLICATION)

Wavelength table

Extension		Wavelength(nm)	Extension		Wavelength(nm)
Dispersion 800ps/nm	Dispersion 1600ps/nm		Dispersion 800ps/nm	Dispersion 1600ps/nm	
-2M11	-3M11	1530.33	-2M53	-3M53	1546.92
-2M12	-3M12	1530.72	-2M54	-3M54	1547.32
-2M13	-3M13	1531.12	-2M55	-3M55	1547.72
-2M14	-3M14	1531.51	-2M56	-3M56	1548.11
-2M15	-3M15	1531.90	-2M57	-3M57	1548.51
-2M16	-3M16	1532.29	-2M58	-3M58	1548.91
-2M17	-3M17	1532.68	-2M59	-3M59	1549.32
-2M18	-3M18	1533.07	-2M60	-3M60	1549.72
-2M19	-3M19	1533.47	-2M61	-3M61	1550.12
-2M20	-3M20	1533.86	-2M62	-3M62	1550.52
-2M21	-3M21	1534.25	-2M63	-3M63	1550.92
-2M22	-3M22	1534.64	-2M64	-3M64	1551.32
-2M23	-3M23	1535.04	-2M65	-3M65	1551.72
-2M24	-3M24	1535.43	-2M66	-3M66	1552.12
-2M25	-3M25	1535.82	-2M67	-3M67	1552.52
-2M26	-3M26	1536.22	-2M68	-3M68	1552.93
-2M27	-3M27	1536.61	-2M69	-3M69	1553.33
-2M28	-3M28	1537.00	-2M70	-3M70	1553.73
-2M29	-3M29	1537.40	-2M71	-3M71	1554.13
-2M30	-3M30	1537.79	-2M72	-3M72	1554.54
-2M31	-3M31	1538.19	-2M73	-3M73	1554.94
-2M32	-3M32	1538.58	-2M74	-3M74	1555.34
-2M33	-3M33	1538.98	-2M75	-3M75	1555.75
-2M34	-3M34	1539.37	-2M76	-3M76	1556.15
-2M35	-3M35	1539.77	-2M77	-3M77	1556.55
-2M36	-3M36	1540.16	-2M78	-3M78	1556.96
-2M37	-3M37	1540.56	-2M79	-3M79	1557.36
-2M38	-3M38	1540.95	-2M80	-3M80	1557.77
-2M39	-3M39	1541.35	-2M81	-3M81	1558.17
-2M40	-3M40	1541.75	-2M82	-3M82	1558.58
-2M41	-3M41	1542.14	-2M83	-3M83	1558.98
-2M42	-3M42	1542.54	-2M84	-3M84	1559.39
-2M43	-3M43	1542.94	-2M85	-3M85	1559.79
-2M44	-3M44	1543.33	-2M86	-3M86	1560.20
-2M45	-3M45	1543.73	-2M87	-3M87	1560.61
-2M46	-3M46	1544.13	-2M88	-3M88	1561.01
-2M47	-3M47	1544.53	-2M89	-3M89	1561.42
-2M48	-3M48	1544.92	-2M90	-3M90	1561.83
-2M49	-3M49	1545.32	-2M91	-3M91	1562.23
-2M50	-3M50	1545.72	-2M92	-3M92	1562.64
-2M51	-3M51	1546.12	-2M93	-3M93	1563.05
-2M52	-3M52	1546.52	-	-	-

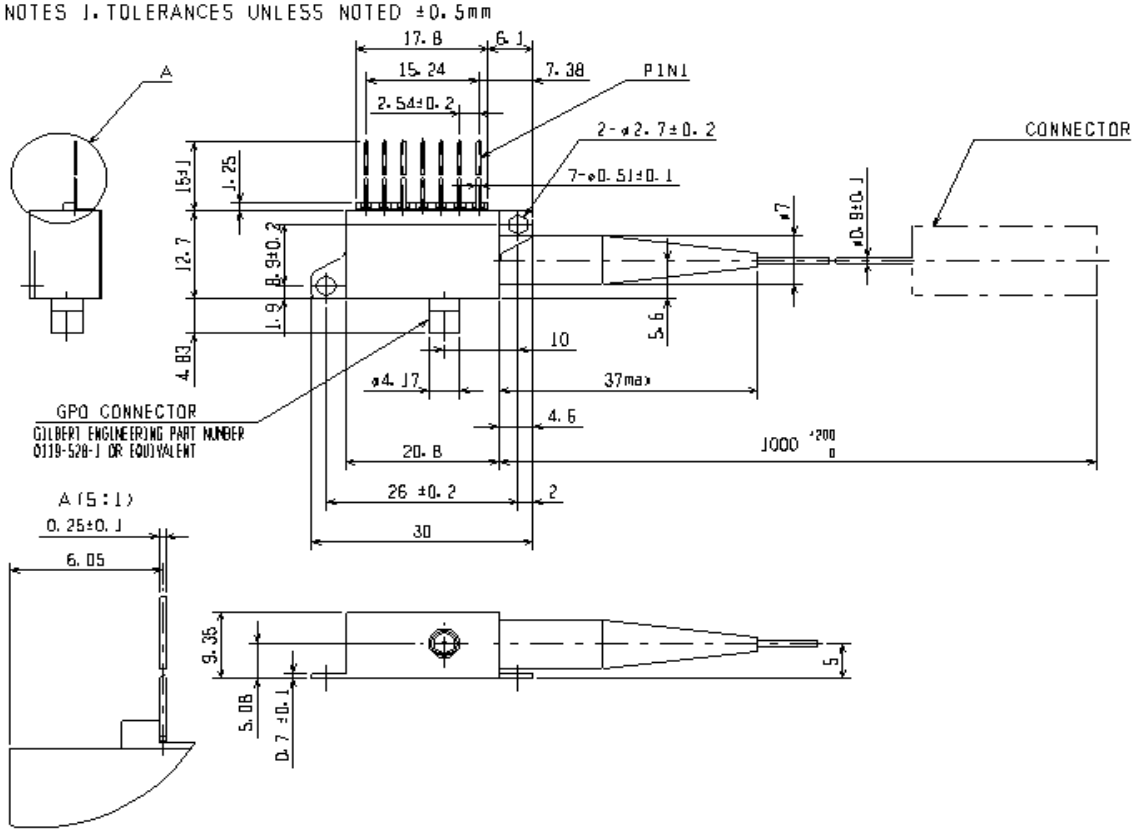
All wavelengths are referred to vacuum.
Extension -3Mseries(dispersion =1600ps/nm) is under development.

MITSUBISHI (OPTICAL DEVICES)

FU-653SEA-2Mxx
FU-653SEA-3Mxx

1.55 μm EA MODULATOR INTEGRATED DFB-LD MODULE
(7 PIN PACKAGE WITH GPO CONNECTOR, 10GB/s DIGITAL APPLICATION)

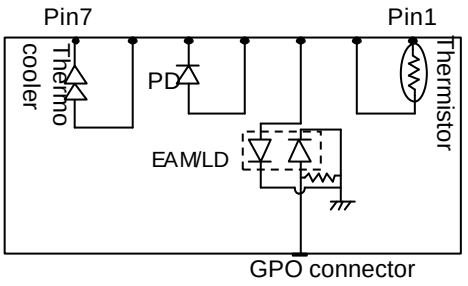
OUTLINE DIAGRAM



FU-653SEA-2Mxx/3Mxx

Connector type	Identical type number	Dispersion
No connector	FU-653SEA-2Mxx	800ps/nm
	FU-653SEA-3Mxx	1600ps/nm
SC/PC	FU-653SEA-W2Mxx	800ps/nm
	FU-653SEA-W3Mxx	1600ps/nm
FC/PC	FU-653SEA-V2Mxx	800ps/nm
	FU-653SEA-V3Mxx	1600ps/nm

Pin No.	Pin No.
1	Thermistor
2	Thermistor
3	LD bias (Anode)
4	Monitor PD (Anode)
5	Monitor PD (Cathode)
6	Cooler (Anode)
7	Cooler (Cathode)



MITSUBISHI (OPTICAL DEVICES)

FU-653SEA-2Mxx
FU-653SEA-3Mxx

1.55 μm EA MODULATOR INTEGRATED DFB-LD MODULE
(7 PIN PACKAGE WITH GPO CONNECTOR, 10GB/s DIGITAL APPLICATION)

For additionally informations please contact:
Internet: www.mitsubishichips.com
Japan: **Overseas Marketing Division**, Semicondoctor Group, Mitsubishi Electric Corporation, 2-2-3, Marunouchi, Chiyoda-Ku, Tokyo 100-8310, Japan,
Americas: **Tel**:+81 (03) 3218-3472, FAX: +81(03) 3218-2724
Europe: **Tel**:+81 (03) 3218-2863, FAX: +81(03) 3218-2894
Asia, Pacific: **Tel**:+81 (03) 3218-3199, FAX: +81(03) 3218-2723
China: **Tel**:+81 (03) 3218-2796, FAX: +81(03) 3218-2722
Europe: **Mitsubishi Electric Europe B.V**., German Branch, Gothaer Str.8, D-40880 Ratingen, Germany,
Tel:+49 2102-486-0, FAX:+049 2102-486-367
U.S.A.: Mitsubishi Electric and Electronics USA, Inc, Electronic Device Group, 1050 East Arques Avenue, Sunnyvale, CA 94086 , **Tel**:+41 (408) 730-5900, FAX:+41 (408) 732-9382
China: **Ke Ling Electric (Shanghai) Co.,Ltd,** Room 1601/1602, OOCL Plaza No.841 Yan An Road(M), Jin An District,
Shanghai 2000 40, China, **Tel**: +86 21-6289-4430, FAX:+86-21-6289-4440
HongKong: **Mitsubishi Electric (H.K.) Co. Ltd Semiconductor Division,** 41st Floor, Manulife Tower, 169 Electric Road,
North Point, Hong Kong, **Tel**: +852-2510-0555, FAX:+852-2510-9822
Taiwan: **Mitsubishi Electric Taiwan Co., Ltd. Semiconductor Department,** 9th Floor, 88 Sec.6, Chung shan North Road, Taipei, Taiwan, **Tel**:+ 886-2-2836-5288, FAX:+ 886-2-2833-9793
Singapore: **Mitsubishi Electric Asia Pte. Ltd. Semiconductor Division,** 307 Alexandra Road #05-01/02, Mitsubishi Electric Building, Singapore 159943, **Tel**:+65 4732308, FAX: +65 4738944