MITSUBISHI LASER DIODES

ML6XX6 SERIES

FOR OPTICAL INFORMATION SYSTEMS

TYPE NAME **ML6706N**

T-41-05

DESCRIPTION

Mitsubishi ML6XX6 are AlGaAs laser diodes having two light emitting areas optically and electrically separated. The two emitting light areas lase independently and emit 10mW at operating currents of around 65mA. Both emitting light beams are around 780nm wavelength.

- A Monitoring photodiode is used commonly for two beams.

FEATURES

- 2 beam independent modulation
- Beam distance 100 μm
- High reliability, long operation life

APPLICATION

High performance laser beam printers, optical disk drives

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
P_O	Light output	CW	15/15	mW
V_{RL}	Reverse voltage (Laser diode)	—	2	V
V_{RD}	Reverse voltage (Photodiode)	—	15	V
I_{FD}	Forward current (Photodiode)	—	10	mA
T_C	Case temperature	—	−40~+60	°C
Tstg	Storage temperature	—	−55~+100	°C

ELECTRICAL/OPTICAL CHARACTERISTICS (T_C=25°C)(Note 1)

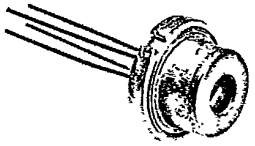
Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
I_{th}	Threshold current	CW	—	40	60	mA
I_{OP}	Operating current	CW, P_O=10mW	—	65	100	mA
V_{OP}	Operating voltage (Laser diode)	CW, P_O=10mW	—	2.0	2.5	V
P_O	Light output	CW, I_F=I_{th}+25mA	—	10	—	mW
λ_P	Lasing wavelength	CW, P_O=10mW	765	780	795	nm
$\theta_{//}$	Full angle at half maximum	CW, P_O=10mW	9	12	14	deg.
$\theta_{\perp}$			20	30	36	deg.
I_m	Monitoring output current	CW, P_O=10mW V_{RD}=1V R_L=10Ω (Note 2)	0.3	0.8	1.7	mA
I_D	Dark current (Photodiode)	V_{RD}=10V	—	—	0.5	μA

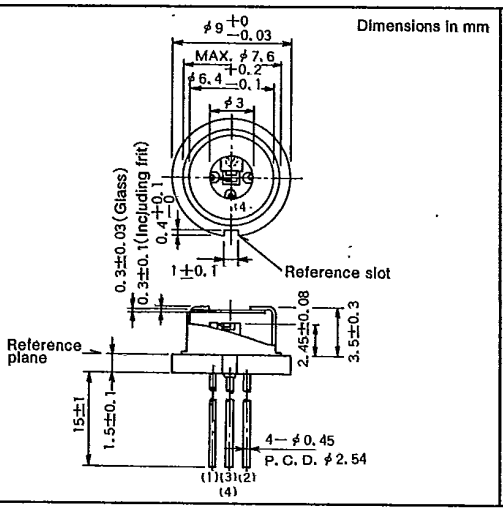
Note 1 : Characteristics on driving 2 beams independently.
Note 2 : R_L is load resistance of the photodiode.

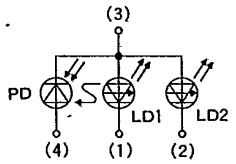
T-41-05

OUTLINE DRAWINGS

ML6706N







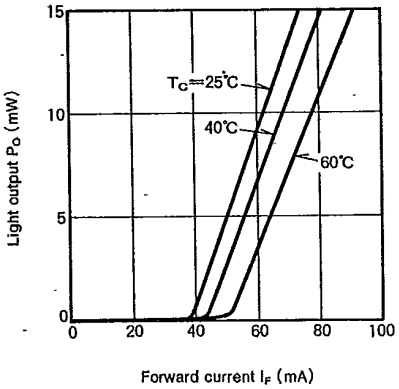
MITSUBISHI ELECTRIC

Example of characteristics on driving 2 beams independently

1 Light output vs. forward current

Typical light output vs. forward current characteristics are shown in Fig. 1. The threshold current for lasing is typically 40mA on LD1 and LD2 at room temperature. Above the threshold, the light output increases linearly with current, and no kinks are observed in the curves. As can be seen in Fig. 1, the threshold current and slope efficiency (dP_O/dI_F) depends on case temperature of the lasers. This suggests that automatic control of temperature or current is necessary to keep the light output constant since temperature variation is inevitable in practical systems. The automatic controls should be such that the maximum ratings for the light output and the case temperature are not exceeded. "OPERATING CONSIDERATIONS." gives an example of an automatic light output control circuit.

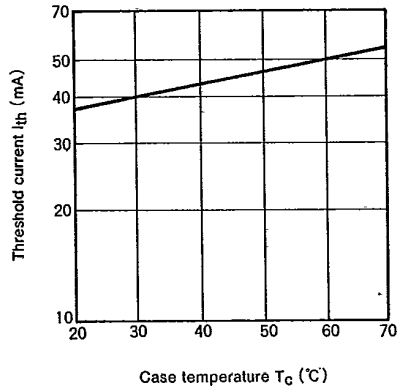
Fig. 1 Light output vs. forward current



2 Temperature dependence of threshold current (I_{th})

A typical temperature dependence of the threshold current is shown in Fig. 2. The characteristic temperature T_O of the threshold current is typically 140K in $T_C \leqq 60℃$, where the definition of T_O is $I_{th} \propto \exp(T_C/T_O)$.

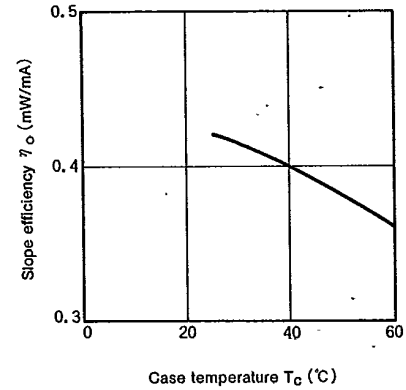
Fig. 2 Temperature dependence of threshold current



3 Temperature dependence of slope efficiency (η_O)

A typical temperature dependence of the slope efficiency η_O is shown in Fig. 3. The gradient is −0.001mW/mA/℃.

Fig. 3 Temperature dependence of slope efficiency

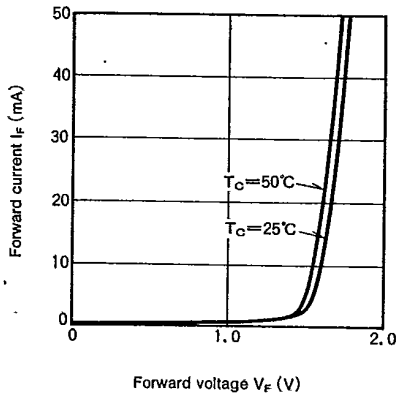


T-41-05

4 Forward current vs. voltage

Typical forward current vs. voltage characteristics are shown in Fig. 4. In general, as the case temperature rises, the forward voltage V_F decreases slightly against the constant current I_F. V_F varies typically at a rate of −2.0mV/℃ at I_F =1mA.

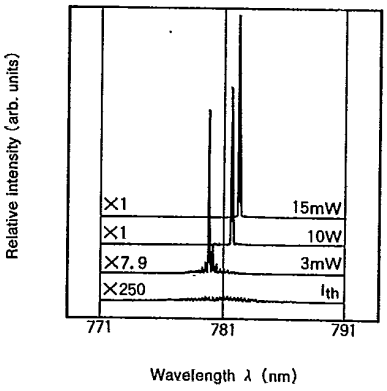
Fig. 4 Forward current vs. voltage characteristics



5 Emission spectra

Typical emission spectra under CW operation are shown in Fig. 5. In general, at an output of 10mW, single mode is observed. The peak wavelength depends on the operating case temperature and forward current (output level).

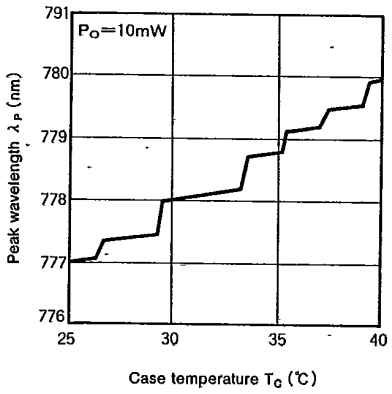
Fig. 5 Emission spectra under CW operation



6 Temperature dependence of peak wavelength

A typical temperature dependence of the peak wavelength at an output of 10mW is shown in Fig.6.
The peak wavelength of the beam shifts and jumps to adjacent longitudinal mode by variation of operating temperature.
Averaged temperature coefficient which includes the shifts and jumps is about 0.25nm/℃.

Fig. 6 Temperature dependence of peak wavelength



7 Far-field radiation pattern

The ML6XX6 laser diodes lase in fundamental transverse (TE_{00}) mode and the mode does not change with the current. They have a typical emitting area (size of near-field pattern) of $2.0 \times 0.7 \mu m^2$. Fig. 7 and Fig. 8 show typical far-field radiation patterns in "parallel" and "perpendicular" planes.

The full angles at half maximum points (FAHM) in parallel and perpendicular plane are typically 12° and 30°.

Fig. 7 Far-field patterns in plane parallel to heterojunctions

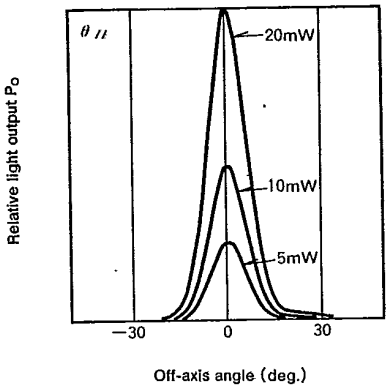
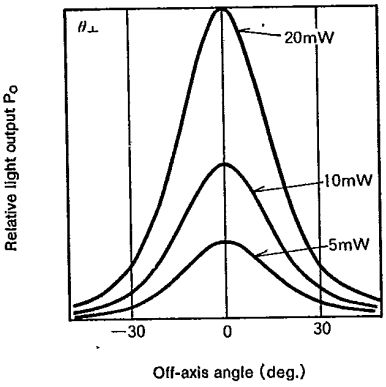


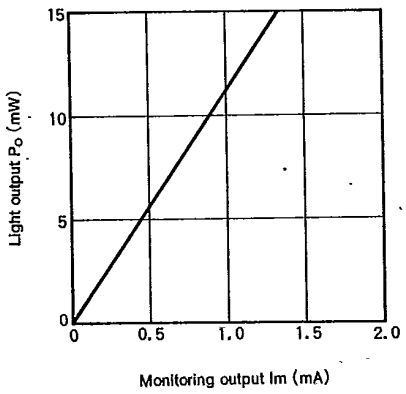
Fig. 8 Far-field patterns in plane perpendicular to heterojunctions



8 Monitoring output

The laser diodes emit beams from both of their mirror surfaces, front and rear surfaces (see the outline drawing). The rear beam can be used for monitoring power of front beam since the rear beam is proportional to the front one. In the case of ML6XX6 lasers, the rear beam powers are changed into photocurrent by the monitoring photodiodes. ML6XX6 have a single photodiode for 2 beam common use. Fig. 9 shows an example of light output vs. monitoring photocurrent characteristics. Above the threshold current, the monitored photocurrent linearly increases with the light output.

Fig. 9 Light output vs. monitoring output current



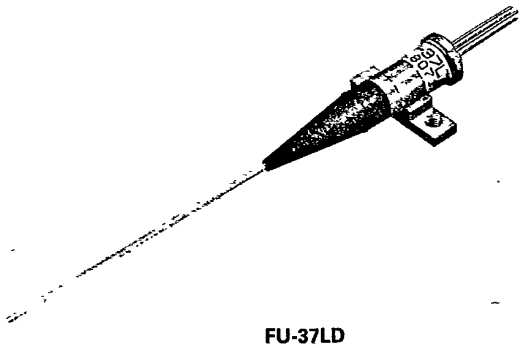
FU-37LD

1.3μm Connectorized LD Module for Multimode Fiber

T-41-07

Module type FU-37LD has been developed for coupling a multimode optical fiber and a 1.3μm wavelength InGaAsP LD (Laser diode).

This module is the optimum light source for use in short and medium haul digital local area network systems.



FU-37LD

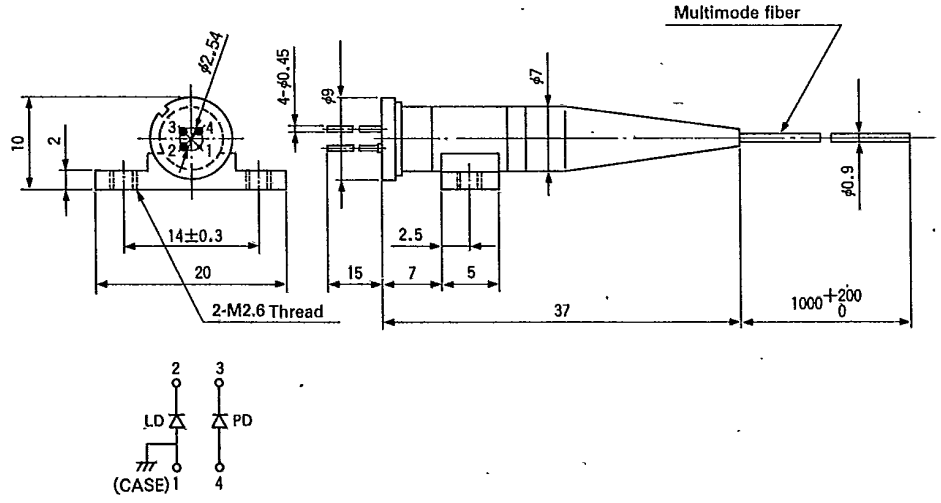
FEATURES

- High-speed response
- Emission wavelength is in 1.3μm band
- Low threshold current (10mA typ.)
- With photodiodes for optical output monitor
- Diodes are hermetically sealed

ABSOLUTE MAXIMUM RATINGS (T_C=25°C)

Items		Symbols	Conditions	Ratings	Units
Laser diode	Optical output power from fiber end	P_F	CW	3.6	mW
	Reverse Voltage	V_{RL}	—	2	V
Photodiode for monitoring	Reverse Voltage	V_{RD}	—	15	V
	Forward Current	I_{FD}	—	2	mA
Operating case temperature		T_C	—	−20~65	°C
Storage temperature		T_{stg}	—	−40~70	°C

OUTLINE DRAWINGS Unit (mm)



FU-37LD

FU-37LD

T-41-07

1.3μm LD Module with Multimode Fiber Pigtail

CHARACTERISTICS (T_C=25°C, unless otherwise noted)

Items	Symbols	Conditions	Min.	Typ.	Max.	Units
Threshold current	I_{th}	CW	—	10	30	mA
Operating current	I_{op}	CW	—	25	45	mA
Operating voltage	V_{op}	CW, I_F=I_{op} (Note 1)	—	1.2	1.6	V
Optical output power from fiber end	P_F	CW, I_F=I_{op}	1.5	3	—	mW
Central wavelength	λ_C	CW, I_F=I_{op}	1270	1300	1330	nm
Rise and fall times	t_r, t_f	I_B=I_{th}, 10~90% (Note 2)	—	0.3	—	ns
Tracking error (Note 3)	E_r	T_C=−20~65°C, APC	—	0.2	—	dB
Differential efficiency	η	—	—	0.12	—	mW/mA
Monitor current	I_{mon}	CW, I_F=I_{op}, V_{RD}=5V	0.2	0.6	—	mA
Dark current (Photodiode)	I_D	V_{RD}=5V	—	0.1	1	μA
Capacitance (Photodiode)	C_t	V_{RD}=5V, f=1MHz	—	10	—	pF

Note 1) I_F: Forward current (LD)
Note 2) I_B: Bias current (LD)
Note 3) E_r=MAX $\left|10\cdot\log\frac{P_F}{P_F\ (25°C)}\right|$

FIBER PIGTAIL SPECIFICATIONS

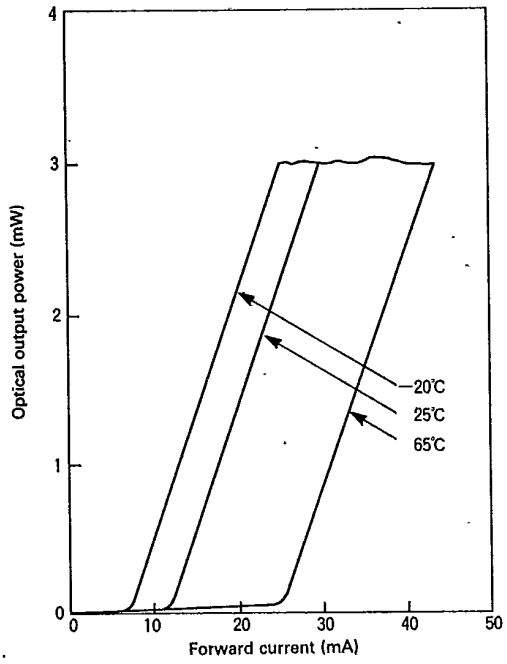
Items	Specifications	Units
Type	GI	—
Core dia.	50±3	μm
N.A.	0.2	—
Cladding dia.	125±3	μm
Jacket dia.	0.9	mm

FU-37LD

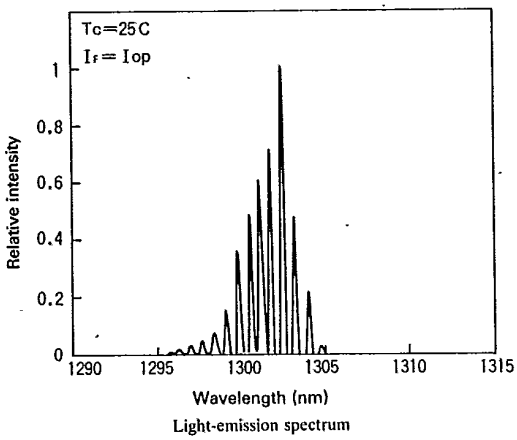
T-41-07

1.3μm LD Module with Multimode Fiber Pigtail

EXAMPLE OF CHARACTERISTICS



Forward current vs. optical output power



Light-emission spectrum

FU-16LE-N

1.3μm LED Module for Multimode Fiber

T-41-07

LED module, FU-16LE-N contains a highly-reliable 1.3μm band InGaAsP/InP Light-emitting diode and is used as a light source for digital optical communication systems.

FEATURES

- High optical output
- High-speed modulation (f_c=150MHz)
- High reliability
- Connectorized package for FC connector

ABSOLUTE MAXIMUM RATINGS (T_C=25°C)

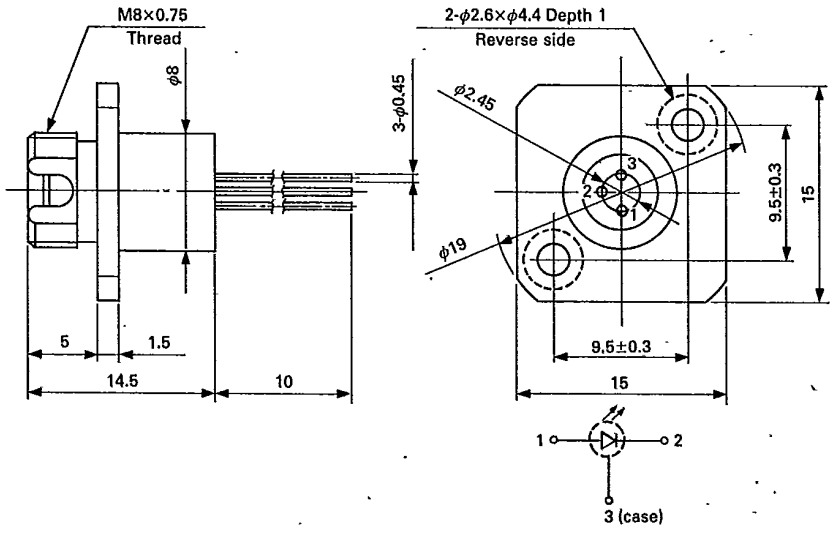
Items	Symbols	Conditions		Ratings	Units
Forward current (Note 1)	I_F	T_C≦50°C	DC	120	mA
			Pulse (Note 2)	150	
Reverse voltage	V_R	—		2	V
Operating case temperature	T_C	—		−20~65	°C
Storage temperature	T_{stg}	—		−40~70	°C

Note 1) Forward current at T_C>50°C

$I_F(T_C) = I_F(T_C \leqq 50°C) \frac{100-T_C}{50}$

Note 2) Frequency>100kHz, Duty ratio<50%

OUTLINE DRAWINGS Unit (mm)



FU-16LE-N

MITSUBISHI ELECTRIC

FU-16LE-N

T-41-07

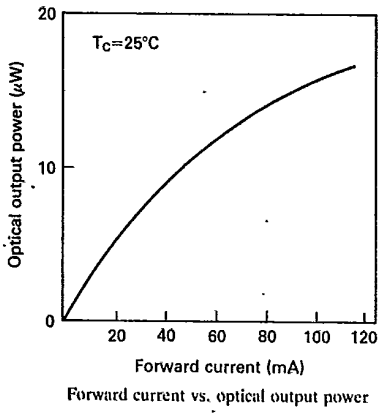
1.3μm LED Module for Multimode Fiber

CHARACTERISTICS (T_C=25°C, unless otherwise noted)

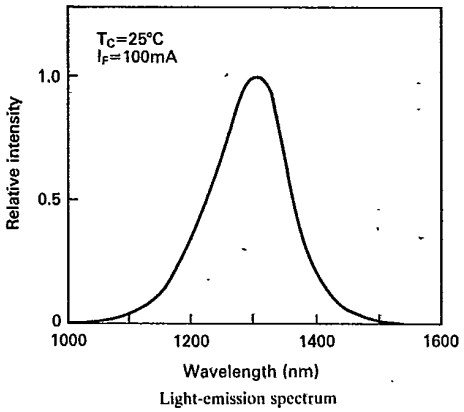
Items	Symbols	Conditions	Min.	Typ.	Max.	Units
Central wavelength	λ_C	I_F=100mA	1260	1300	1340	nm
Spectral bandwidth (FWHM)	$\Delta\lambda$	I_F=100mA	—	130	150	nm
Optical output power from fiber end (Note 1)	P_F	I_F=100mA	10	15	—	μW
Cutoff frequency (−1.5dB)	f_c	I_F=100mA+4mA$_{p\text{-}p}$	—	150	—	MHz
Forward voltage	V_F	I_F=100mA	—	1.5	2	V
Reverse current	I_R	V_R=2V	—	300	—	μA
Optical connector type	—	—	FC			—

Note 1) Fiber: GI type with core dia. 50μm and N.A.0.2

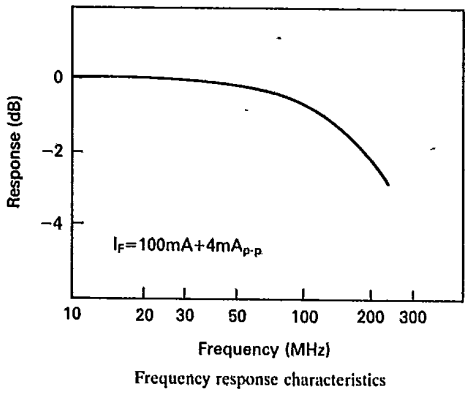
EXAMPLE OF CHARACTERISTICS



Forward current vs. optical output power



Light-emission spectrum



Frequency response characteristics