ML3XX1 SERIES

FOR OPTICAL INFORMATION SYSTEMS

TYPE NAME

ML3101, ML3411

DESCRIPTION

ML3XX1 is an AlGaAs semiconductor laser which provides a stable, single transverse mode oscillation of a standard light output of 3mW around emission wavelength of 850nm.

ML3XX1 uses a hermetically sealed package incorporating the photodiode for optical output monitoring. This high-perfomance, highly reliable, and long-life semiconductor laser is suitable for such applications as optical information processing and precision telemetry.

FEATURES

- Single longitudinal mode
- Short astigmatic distance (1 μm standard)
- Low threshold current, low operating current
- Built-in monitor photodiode
- High reliability, long operation life

APPLICATION

Laser beam printer, telemetry, instrumentation, alignment, and optical communication

ABSOLUTE MAXIMUN RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
P_O	Light output power	CW	3.5	mW
		Pulse (Note 1)	6	
V_{RL}	Reverse voltage (Laser diode)	–	3	V
V_{RD}	Reverse voltage (Photodiode)	–	15	V
I_{FD}	Forward current (Photodiode)	–	10	mA
T_C	Case temperature	–	−40~+60	℃
T_{stg}	Storage temperature	–	−55~+100	℃

Note 1 : Duty less than 50 %, pulse width less than 1 μs.

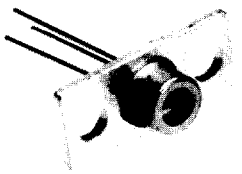
ELECTRICAL/OPTICAL CHARACTERISTICS (T_C = 25 ℃)

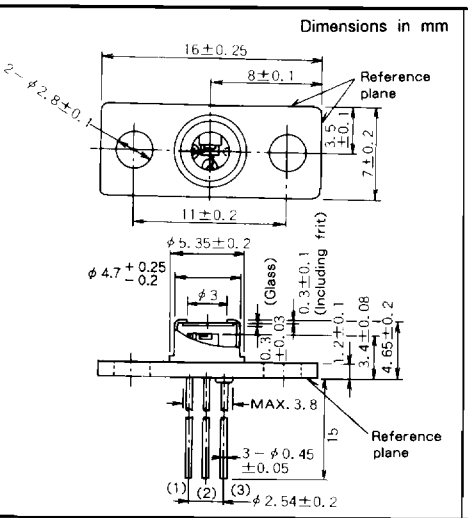
Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
I_{th}	Threshold current	CW	–	20	40	mA
I_{OP}	Operating current	CW, P_O = 3mW	–	30	50	mA
V_{OP}	Operating voltage	CW, P_O = 3mW	–	1.8	2.5	V
η	Slope efficiency	CW, P_O = 3mW	–	0.3	–	mW/mA
λ_P	Peak wavelength	CW, P_O = 3mW	830	850	870	nm
$\theta_{//}$	Beam divergence angle (parallel)	CW, P_O = 3mW	8	11	18	deg.
$\theta_\perp$	Beam divergence angle (perpendicular)	CW, P_O = 3mW	20	30	50	deg.
I_m	Monitoring output current (Photodiode)	CW, P_O = 3mW, V_{RD} = 1V, R_L = 10 Ω (Note 2)	0.1	0.3	0.7	mA
I_D	Dark current (Photodiode)	V_{RD} = 10V	–	–	0.5	μA
C_t	Total capacitance (Photodiode)	V_{RD} = 0V, f = 1MHz	–	7	–	pF

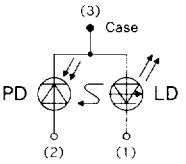
Note 2 : R_L is load resistance of the photodiode.

OUTLINE DRAWINGS

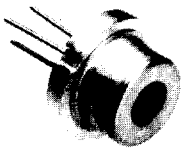
ML3101

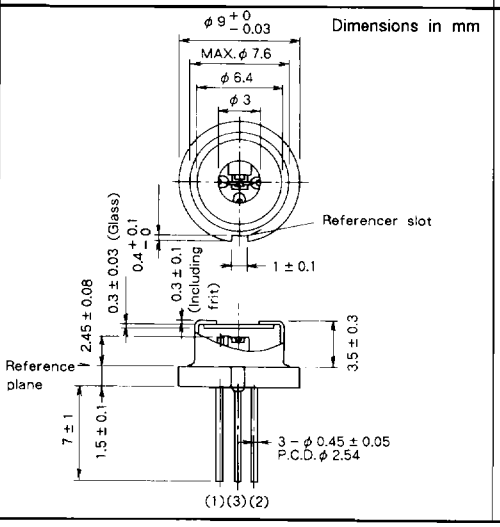


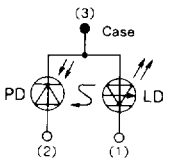




ML3411







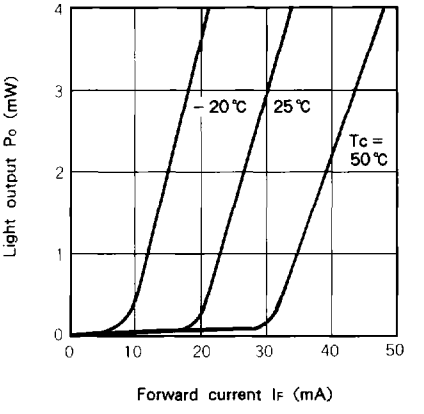
SAMPLE CHARACTERISTICS

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 20mA at room temperature. Above the threshold, the light output increases linearly with current, and no kinks are observed in the curves. An optical power of about 3mW is obtained at I_{th} + 10 mA.

Beacause I_{th} and slope efficiency η (dP_O/dI_F) is temperature dependent, obtaining a constant output at varying temperatures requires to control the case temperature T_C or the laser current. (Control the case temperature or laser current such that the output current of the built-in monitor PD becomes constant.)

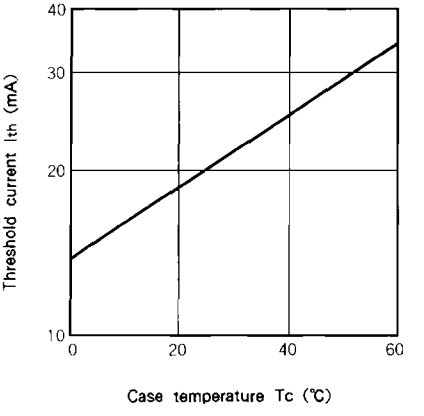
Fig. 1 Light output vs. forward current



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 65K in $T_C \leqq 50℃$, where the definition of T_O is $I_{th} \propto \exp(T_C/T_O)$

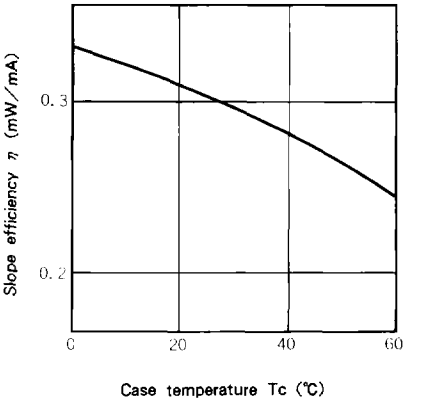
Fig. 2 Temperature dependence of threshold current



3 Temperature dependence of slope efficiency

A typical temperature dependence of the slope efficiency η is shown in Fig.3. The gradient is – 0.0015mW/mA/℃.

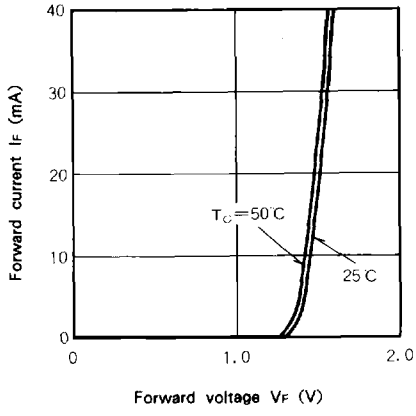
Fig. 3 Temperature dependence of slope efficiency



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 $I_F = 1mA$.

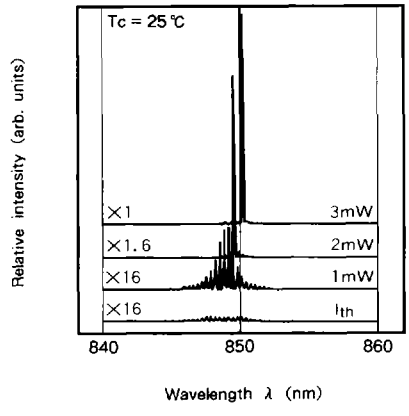
Fig. 4 Forward current vs. voltage



5 Optical output dependence of emission spectra

Typical emission spectrum under CW operation are shown in Fig.5. In general, at an output of 3mW, 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

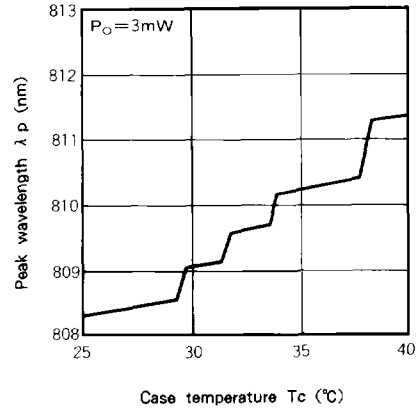


6 Temperature dependence of peak wavelength

A typical temperature dependence of the peak wavelength at an output of CW, 3mW is shown in Fig.6.

As the temperature rises, the peak wavelength shifts to the long wavelength side at a rate of about 0.25nm/℃ typical.

Fig. 6 Temperature dependence of peak wavelength



7 Far-field pattern

ML3XX1 oscillates in the standard transverse mode (TE_{00}) regardless of the optical output level. They have a typical emitting area(size of near-field pattern) of $2.2 \times 0.8\,\mu m^2$. Fig.7 and Fig.8 show typical farfield radiation patterns in "parallel" and "perpendicular" planes.

The full angles at half maximum points (FAHM) are typically 11° and 30° .

Fig. 7 Far-field patterns in plane parallel to heterojunctions $\theta_{//}$

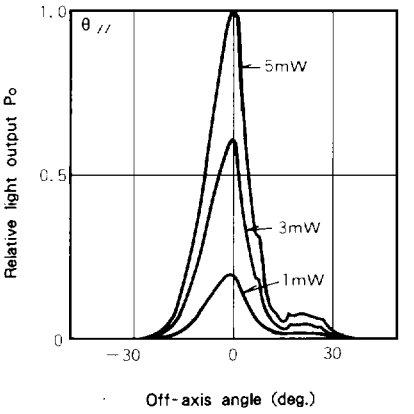
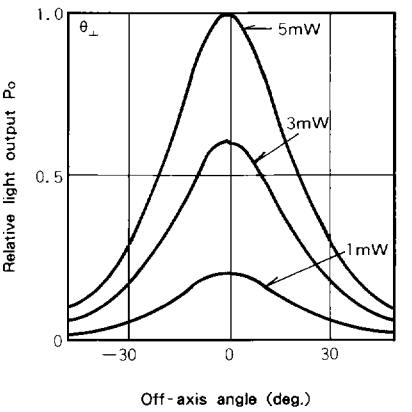


Fig. 8 Far-field patterns in plane perpendicular to heterojunctions $\theta_{\perp}$

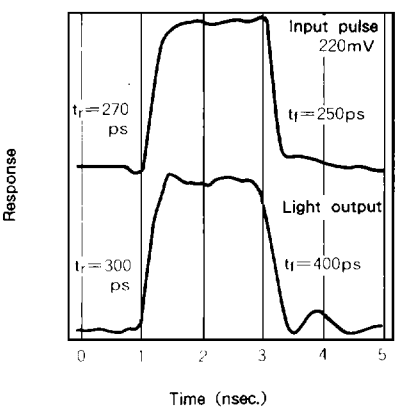


8 Pulse response waveform

In the digital optical transmission systems, the response waveform and speed of the light output against the input current pulse waveform is one of the main concerns.

In order to shorten the oscillation delay time, the laser diode is usually biased close to the threshold current. Figure 9 shows a standard response waveform obtained by biasing ML3XX1 to Ith and applying a square pulse current (top of Fig. 9) up to 3mW. A quick response is obtained with rising and falling times being 0.3ns and 0.4ns typical respectively.

Fig. 9 Pulse response waveform

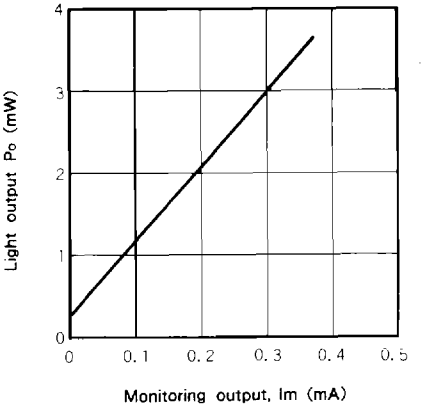


MITSUBISHI ELECTRIC

9 Light output vs. monitoring output characteristic

The laser diodes emit beams from both of their mirror surfaces, front and rear surfaces. The rear beam can be used for monitoring power of front beam since the rear beam is proportional to the front one. Fig.10 shows an example of light output vs monitoring photocurrent characteristics. When the front baeam output is 3mW, the monitor output becomes 0.3mA.

Fig. 10 Light output vs. monitoring output current

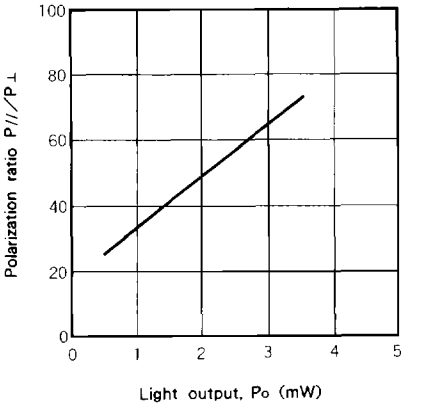


10 Polarization ratio vs. light output characteristic

The main polarization of ML3XX1 is made in the direction parallel to the active layer. Polarization ratio refers to the intensity ratio of the light polarized in parallel to the active layer to the light polarized in perpendiculat to it. Figure 11 shows the standard polarization ratio vs. total light output characteristic.

The polarization ratio increases with the light power.

Fig. 11 Polarization ratio vs. light output

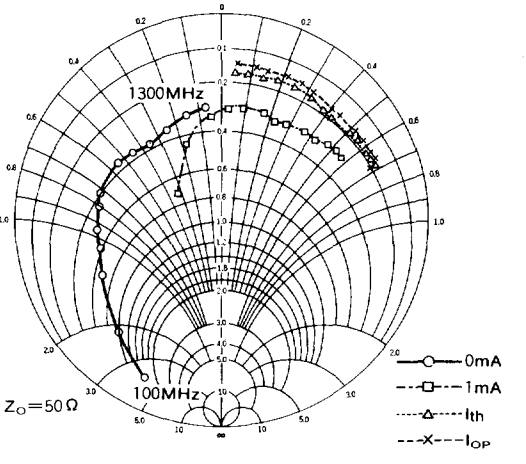


11 Impedance characteristics

Typical impedance characteristics of the ML3XX1, with lead lengths of 2mm, is shown in Fig.12 with the bias currents as the parameter. Test frequency is swept from 100MHz to 1300MHz with 100MHz steps.

Above the threshold current, the impedance of the ML3XX1 is nearly equal to a series connection of a resistance of 5ohm and an inductance of 5nH.

Fig. 12 Impedance characteristics



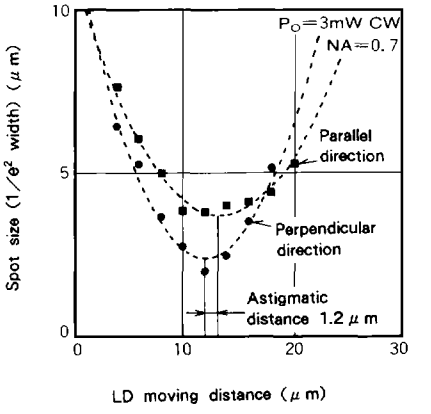
12 Astigmatic distance

There seems to be a difference in luminous point in the parallel and perpendicular direction with the laser beam. This distance between the two points is the astigmatic focal distance. Therefore, when the laser beam is focused, there is a difference in focal point in the two directions, making it difficult to converge the beam spot to the diffraction limit.

The typical astigmatic focal distance at NA=0.7 of ML3XX1 is shown in Fig.13.

The LD position which minimizes the horizontal and vertical spot diameters is obtained. The astigmatic distance is the difference in moved distances thus obtained.

Fig. 13 Astigmatic distance



MITSUBISHI ELECTRIC