ML4XX2A SERIES

FOR OPTICAL INFORMATION SYSTEMS

TYPE NAME

ML4102A, ML4402A, ML4412A

DESCRIPTION

ML4XX2A is an AlGaAs semiconductor laser which provides a stable, single transverse mode oscillation with emission wavelength of 780nm and standard light output of 3mW.

ML4XX2 uses a hermetically sealed package incorporating the photodiode for optical output monitoring. This high-performance, highly reliable, and long-life semiconductor laser is suitable for such applications as optical disk reading and optical information processing.

FEATURES

- Low noise
- Built-in monitor photodiode
- High reliability, long operation life
- Multiple longitudinal mode

APPLICATION

Reading memory disk, video disk player, data link

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
P_O	Light output power	CW	5	mW
		Pulse (Note 1)	6	
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	℃
T_{stg}	Storage temperature	–	−55～+100	℃

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

ELECTRICAL/OPTICAL CHARACTERISTICS (T_C = 25℃)

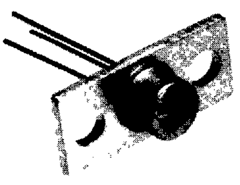
Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
I_{th}	Threshold current	CW	–	40	60	mA
I_{OP}	Operating current	CW, P_O = 3mW	–	50	70	mA
V_{OP}	Operating voltage	CW, P_O = 3mW	–	1.8	2.5	V
η	Slope efficiency	CW, P_O = 3mW	–	0.32	–	mW/mA
λ_P	Peak oscillation wavelength	CW, P_O = 3mW	765	780	795	nm
$\theta_{//}$	Beam divergence angle (parallel)	CW, P_O = 3mW	8	11	15	deg.
$\theta_{\perp}$	Beam divergence angle (perpendicular)	CW, P_O = 3mW	20	33	45	deg.
I_m	Monitoring output current (Photodiode)	CW, P_O = 3mW, V_{RD} = 1V, R_L = 10 Ω (Note 1)	0.15	0.4	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

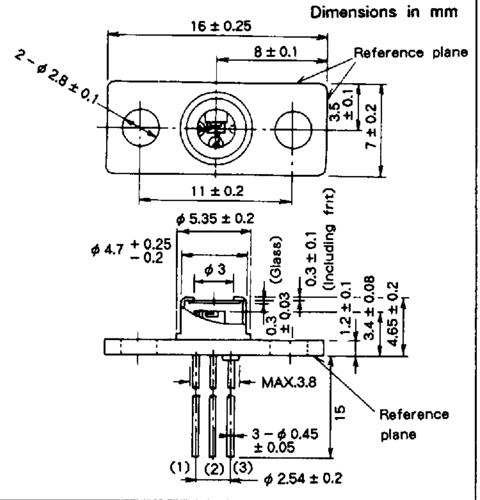
Note 2 : R_L is load resistance of the Photodiode.

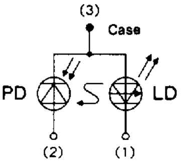
FOR OPTICAL INFORMATION SYSTEMS

OUTLINE DRAWINGS

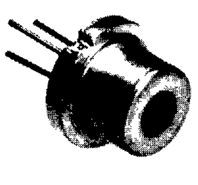
ML4102A

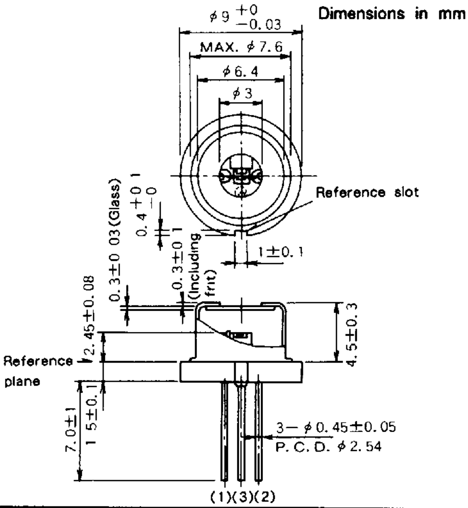


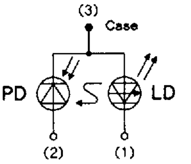




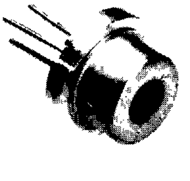
ML4402A

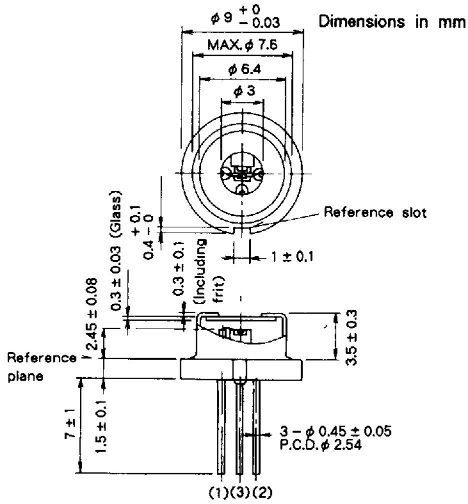


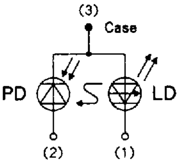




ML4412A







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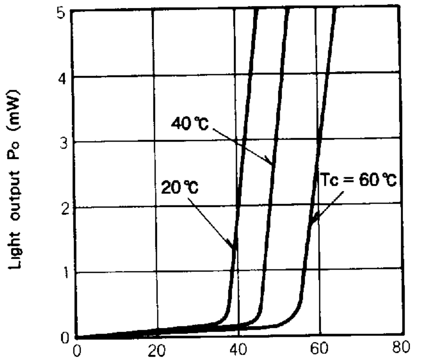
SAMPLE CHARACTERISTICS

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 40mA 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} + 10mA.

Because 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 Tc or the laser current. (Control the case temperature or laser current such that the output current of the built-in monitor PD becomes constant.)

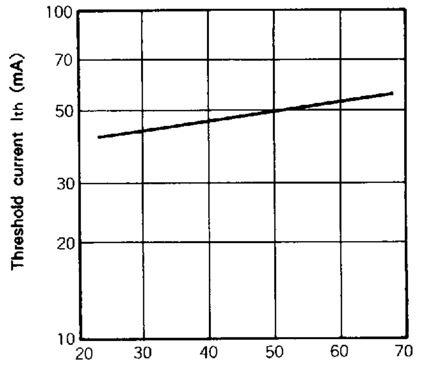
Fig. 1 Light output vs. forward current



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

A typical temperature dependence of the threshold current is shown in Fig.2. The characteristic To of the threshold current is typically 140K in Tc≦70℃, where the definition of To is $I_{th} \propto \exp(T_c/T_o)$

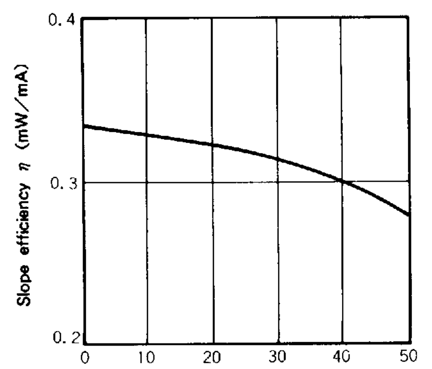
Fig. 2 Temperature dependence of threshold current



3 Temperature dependence of slope efficiency

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

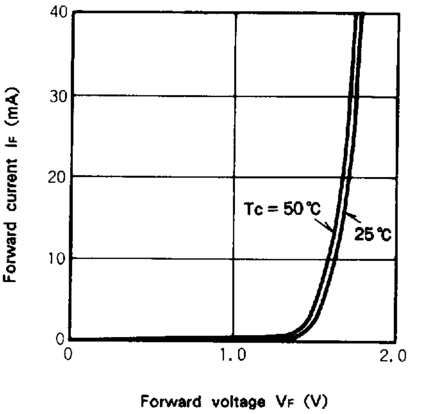
Fig. 3 Temperature dependence of slope efficiency



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.

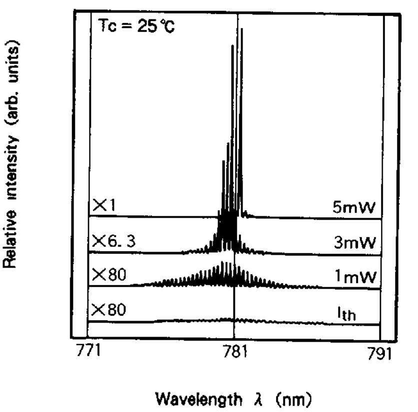
Fig. 4 Forward current vs. voltage



5 Optical output dependence of emission spectra

Typical emission spectra under CW operation are shown in Fig.5. Generally, at the output of about 3mW, the laster oscillates in the multi-mode; when the output is raised to about 5mW, it begins oscillating in the single mode. The peak wavelength depends on the operating case temperature and forward current (output level).

Fig. 5 Emission spectra under CW operation

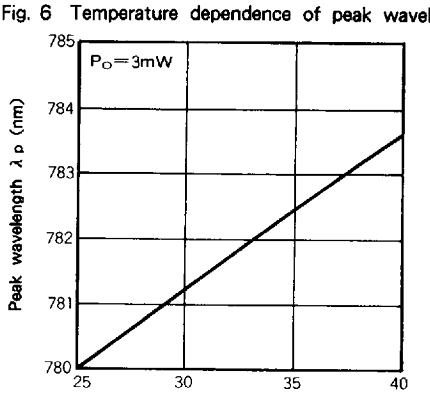


6 Temperature dependence of peak wavelength

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



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7 Far-field pattern

ML4XX2A 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 2.1 μm^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) are typically 11° and 33°.

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

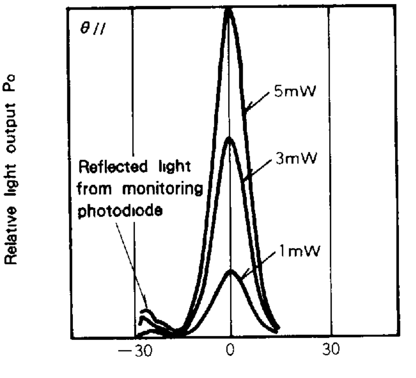
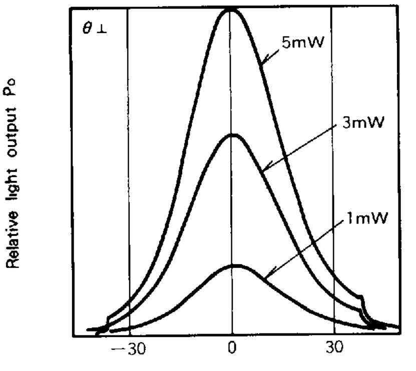


Fig. 8 Far-field patterns in plane perpendicular to heterojunctions $\theta_{\perp}$

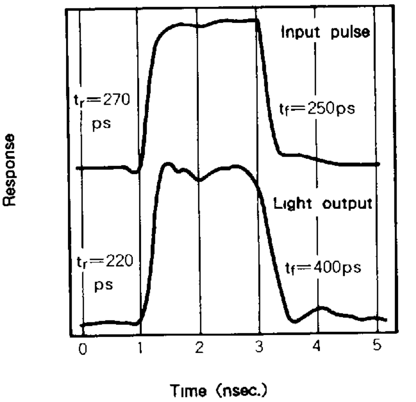


8 Pulse response waveform

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.

Generally, the laser diode is biased up to near the threshold current to minimize oscillation delay time. Figure 9 shows a standard response waveform obtained by biasing ML4XX2A to Ith and applying a square pulse current (top of Fig.9) up to 3mW. The rise time and the fall time in Fig.9 are typically 0.3ns and 0.4ns. They are limited by response speed of the detecter.

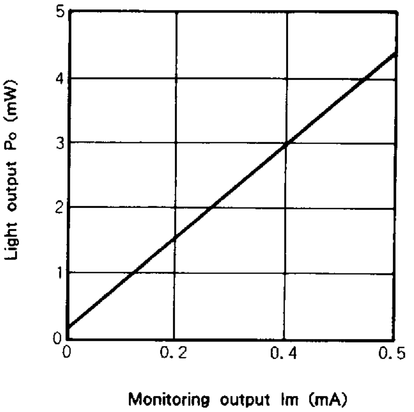
Fig. 9 Pulse response waveform



9 Light output vs. monitoring output characteristic

The laser diodes emit beams form 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 beam output is 3mW, the monitor output becomes 0.4mA.

Fig. 10 Light output vs. monitoring output current

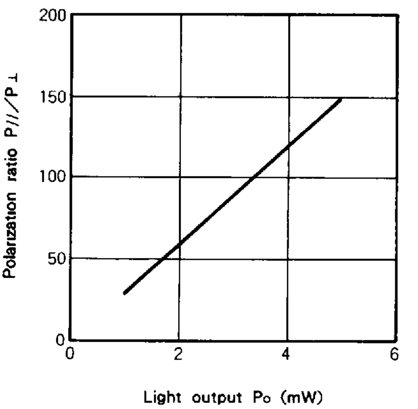


10 Polarization ratio vs. light output characteristic

The main polarization of ML4XX2A 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 perpendicular 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

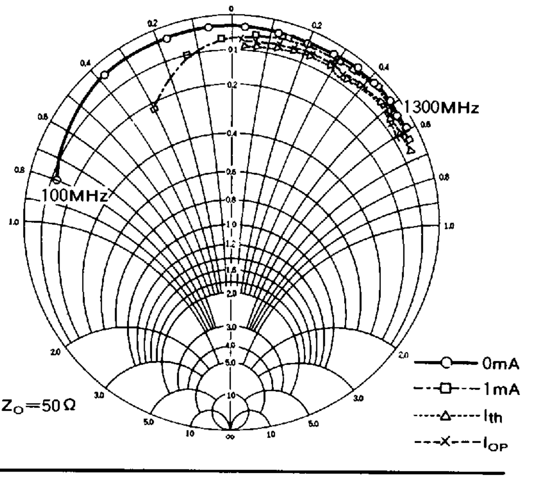


11 Impedance characteristics

Typical impedance characteristics of the ML4XX2A, with lead lengths of 2mm, and shown in Fig.12 with the bias currents as the parameter.

Test frequency is swept from 100MHz to 1300MHz with 100MHz steps.

Fig. 12 Impedance characreristics



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12 S/N vs. optical feedback ratio

S/N vs optical feedback ratio, where the frequency is 20kHz and the bandwidth is 300Hz is shown in Fig.13.

That where the frequency is 10MHz and the bandwidth is 300kHz is shown in Fig.14.

The S/N value is the worst value obtained at case temperatures of 25℃ to 50℃.

Fig. 13 S/N vs. optical feedback ratio
f=20kHz, BW=300Hz, T_C=25−50℃

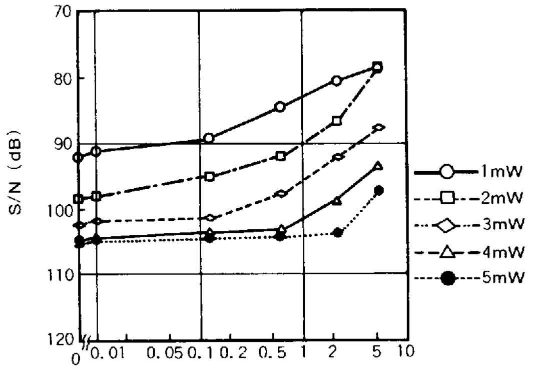
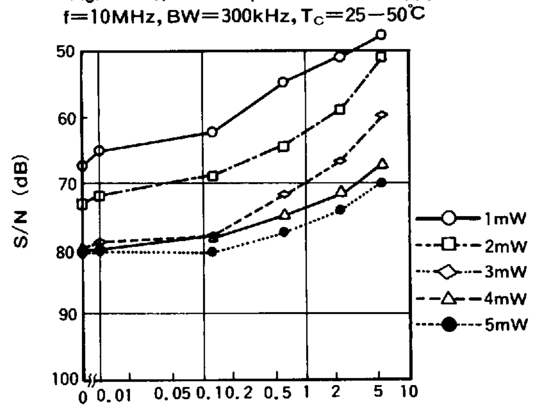


Fig. 14 S/N vs. optical feedback ratio
f=10MHz, BW=300kHz, T_C=25−50℃



13 Astigmatic distance

There seems to be a difference in luminous point in the parallel and perpendicular direction with 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 ML4XX2A is shown in Fig.15.

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. 15 Astigmatic distance