ML5XX4 SERIES

FOR OPTICAL COMMUNICATION SYSTEMS

TYPE NAME

ML5784F

DESCRIPTION

The ML5XX4 series is a high-power semiconductor laser which provides a stable, single transverse mode oscillation with emission wavelength of 850 nm and standard continuous oscillation of 15 mW.

ML5XX4 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 the light sources for optical fiber broken-point detector and long-distance communication.

FEATURES

- High power (CW 20mW, pulse 80mW)
- Low threshold current, low operating current
- Built-in monitor photodiode
- High reliability, long operation life

APPLICATION

OTDR, optical communication system

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
P_O	Light output power	CW	20	mW
I_F	Forward current (Laser diode)	Pulse (Note 1)	450	mA
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~+50	℃
T_{stg}	Storage temperature	–	−55~+100	℃

Note 1 : Duty less than 1 %, pulse width less than 4 μ s.

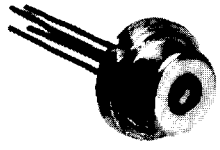
ELECTRICAL/OPTICAL CHARACTERISTICS (T_C = 25℃)

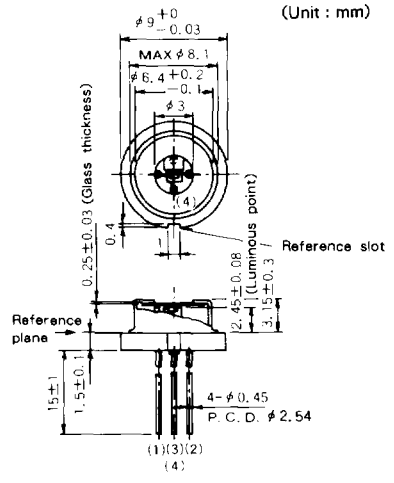
Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
I_{th}	Threshold current	CW	–	25	50	mA
I_{OP}	Operating current	CW, P_O = 15mW	–	50	90	mA
V_{OP}	Operating voltage	CW, P_O = 15mW	–	1.8	2.5	V
$P_{O(P)}$	Pulse light output	Pulse, I_F = 400mA (Note 2)	80	–	–	mW
λ_P	Peak wavelength	CW, P_O = 15mW	830	850	870	nm
$\theta_{//}$	Beam divergence angle (parallel)	CW, P_O = 15mW	8	11	16	deg.
$\theta_{\perp}$	Beam divergence angle (perpendicular)	CW, P_O = 15mW	20	30	40	deg.
I_m	Monitoring output current (Photodiode)	CW, P_O = 15mW, V_{RD} = 1V, R_L = 10 Ω (Note 3)	0.04	0.12	1.0	mA
I_D	Dark current (Photodiode)	V_{RD} = 10V	–	–	0.5	μ A
C_t	Total capacitance (Photodiode)	V_{RD} = 0V, f = 1MHz	–	7	–	pF

Note 2 : Pulse width 2 μ s, 0.2 % duty
3 : R_L is load resistance of the photodiode.

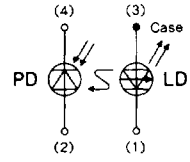
OUTLINE DRAWINGS

ML5784F





(φ 9mm, 4-pin low-cap package)



MITSUBISHI ELECTRIC

SAMPLE CHARACTERISTICS

1 Light output vs. forward current

Figure 1 shows the typical light output vs. current characteristic in the CW drive of ML5XX4. The threshold current Ith at room temperature is about 30mA. The optical output increases at currents larger than Ith and no kink is observed. An optical output of about 15mA can be obtained at I_{th} + 25mA. Figure 2 shows the typical optical output vs. current characteristic in the pulse drive at a pulse width of 2 μ m and duty cycle of 0.2%. An optical output of about 80mW or more can be obtained at room temperature with a forward current I_F of 400mA.

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 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

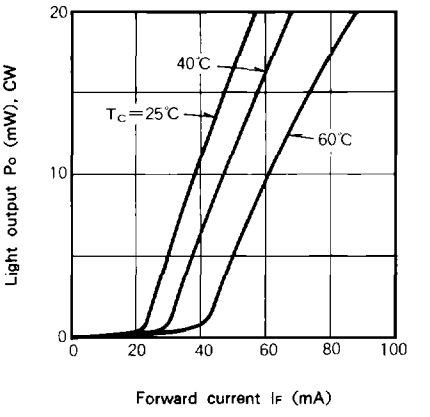
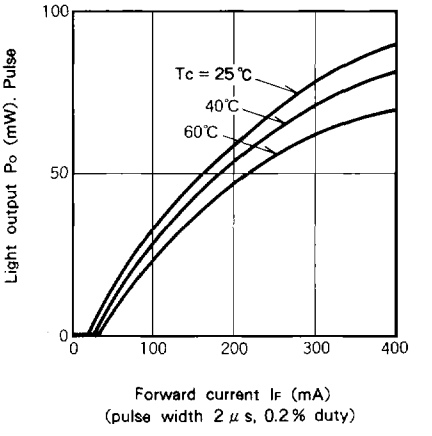


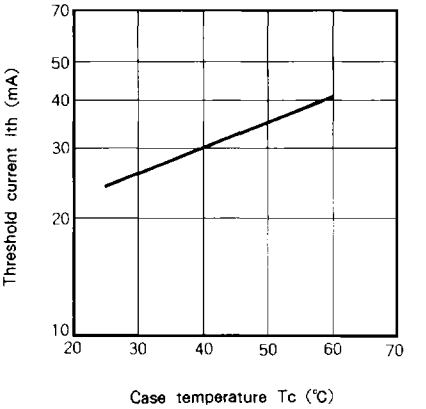
Fig. 2 Light output vs. forward current



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

A typical temperature dependence of the threshold current is shown in fig.3. The characteristic temperature To of the threshold current is typically 65K in $T_C \leqq 50$℃, where the definition of To is $I_{th} \propto \exp(T_C/T_O)$.

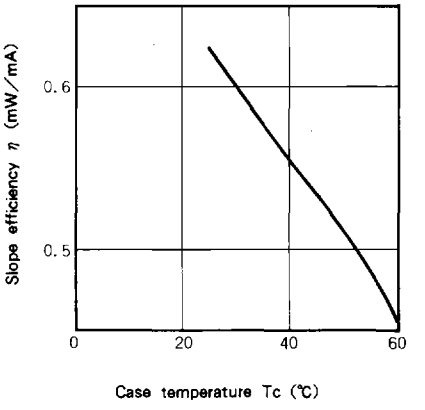
Fig. 3 Temperature dependence of threshold current



3 Temperature dependence of slope efficiency(η o)

A typical temperature dependence of the slope efficiency η is shown in Fig.4. The gradient is − 0.005mW/mA/℃.

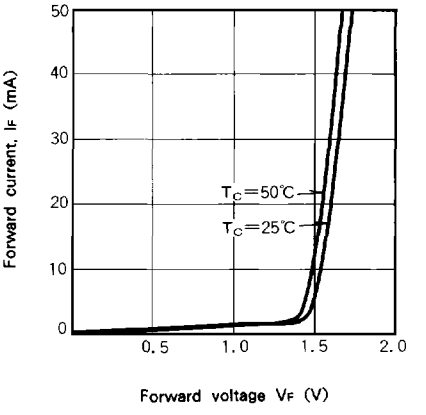
Fig. 4 Temperature dependence of slope efficiency



4 Forward current vs. voltage

Typical forward current vs. voltage characteristics are shown in Fig.5. 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 tate of − 2.0mV/℃ at I_F = 1mA.

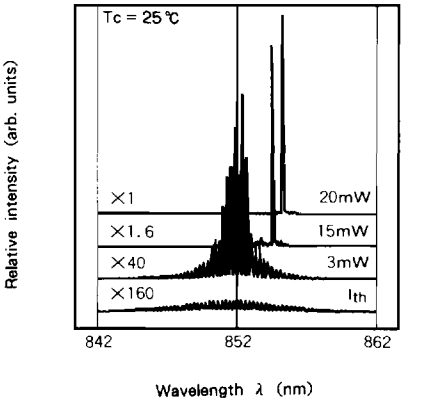
Fig. 5 Forward current vs. voltage



5 Emission spectra

Typical emission spectra under CW operation are shown in Fig.6. In general, at an output of 15mW, single mode is observed. The peak wavelength depends on the operating case temperature and forward current (output level).

Fig. 6 Emission spectra under CW operation



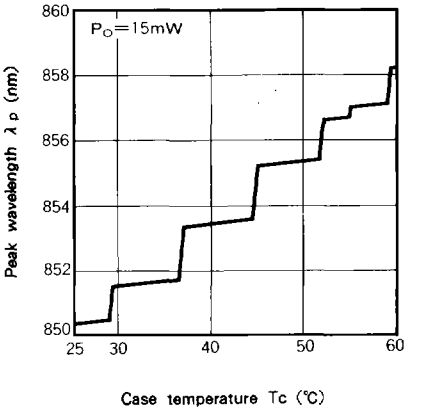
MITSUBISHI ELECTRIC

6 Temperature dependence of peak wavelength

A typical temperature dependence of the peak wavelength at an output of CW, 15mW is shown in Fig.7.

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

Fig. 7 Temperature dependence of peak wavelength



7 Far-field pattern

The ML5XX4 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 2.3×0.8 μm². Fig.8 and Fig.9 show typical far-field radiation patterns in "parallel" and "perpendicular" planes.

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

Fig. 8 Far-field patterns in plane parallel to heterojunctions $\theta //$

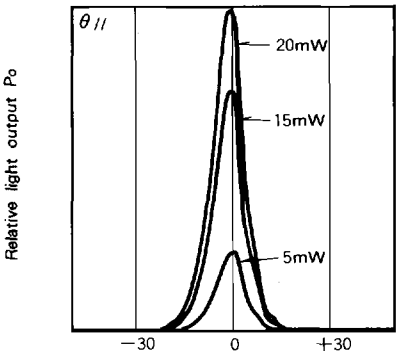
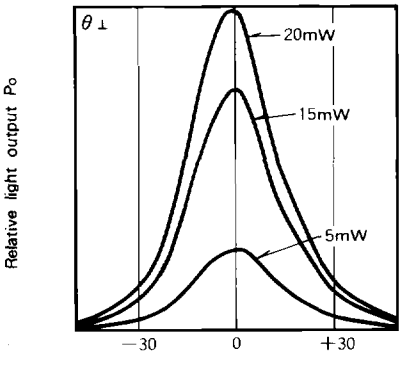


Fig. 9 Far-field patterns in plane perpendicular to heterojunctions $\theta \perp$

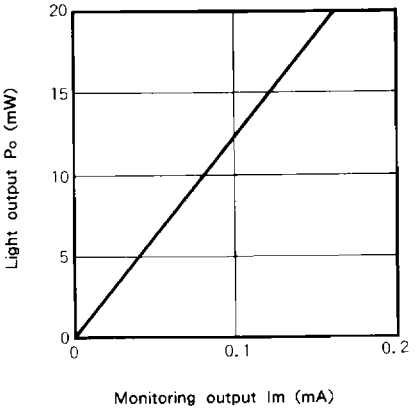


8 Monitoring output

The laser diodes emit beams from both of their mirror surfaces, front and rear sufaces. 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 15mW, the monitor output becomes about 0.12mA.

Fig. 10 Light output vs. monitoring output current



9 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 = 0.7of ML5XX4 is shown in Fig.11.

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. 11 Astigmatic distance