

Low-Noise Monolithic Two-Wavelength (Near Infrared/Red) Semiconductor Laser Diode Supports DVD, CD, and CD-R Playback

SLD6162RLI

The 650 nm band red semiconductor laser diode has become the key device for DVD, which has succeeded in growing to a central position in the optical disc business.

Sony already provides a product line of simple single mode lasers and multi-mode lasers that do not require a high-frequency superposing circuit. Furthermore, Sony led the industry in the release of the first monolithic two-wavelength laser diode that achieves DVD, CD, and CD-R playback in a single chip. This device was designed for and used in the PlayStation 2.

The two-wavelength laser diode, which has the potential to become the standard in the next generation, has now evolved even further with the low-noise technology of the SLD1134VL and SLD1138VL self pulsation for industry-leading DVD laser diodes.

- Two-wavelength (650 and 780 nm) monolithic laser diode
- High optical source position and beam angle precision
- Low power consumption self-pulsating device due to the low-loss waveguide path structure used in the DVD side
- No high-frequency superposing circuit required and 70°C operation achieved

Due to the increasing popularity of CD-R, the 780 nm band laser diode, which is used for CD-R playback in DVD-ROM drives and DVD players, is becoming an increasingly important device. Two years ago, Sony led the industry by releasing the first monolithic two-wavelength laser diode product. This device has the potential to become the next generation standard due to it combining the features of allowing a simply optical system to be used and being advantageous from an environmental perspective since it reduces the number of components required. In the SLD6162RLI, Sony has adopted a self-pulsating structure, which provides even more stable noise characteristics in the DVD side. Thus

this two-wavelength laser diode provides extremely high playability.

■ Two-Wavelength Monolithic Laser Diode

Sequential crystal growth steps are used to form 650 and 780 nm band laser diodes on a wafer using different materials. In particular, three crystal growth steps are used to form this monolithic two-wavelength laser diode that achieves DVD, CD, and CD-R playback with a single chip.

■ High Optical Source Position and Beam Angle Precision

There are stringent requirements on the precision of the source point positions of the beams in multi-beam lasers used for optical discs. Photolithography technology is used in the SLD6162RLI to achieve a precision of $110 \pm 1 \mu\text{m}$ in the beam spacing and a beam angle precision of ± 3 degrees. This level of precision, which would be extremely difficult to achieve with methods that mount two chips in the same package, was achieved by forming both laser diodes on a single chip. Achieving this optical source position and beam angle precision allows a single optical system to be used, and contributes significantly to reducing the number of components required, reducing the number of assembly steps, and increasing reliability.

■ Low Power Consumption Self-Pulsating Device Due to the Low-Loss Waveguide Path Structure Used in the DVD Side

Sony has developed a process technology that applies the low-loss waveguide path structure achieved in the SLD1138VL DVD playback self-pulsating laser diode (See CX-News, Vol. 26.) to the monolithic two-wavelength laser diode. By using this low-loss waveguide path structure, Sony was able to achieve both lower power consumption and stable self pulsation, characteristics that are normally in a tradeoff relationship. As a result, this device achieves an operating current of 50 mA at 4 mW operation, which is the industry's lowest power consumption level in a DVD playback self-pulsating laser diode.

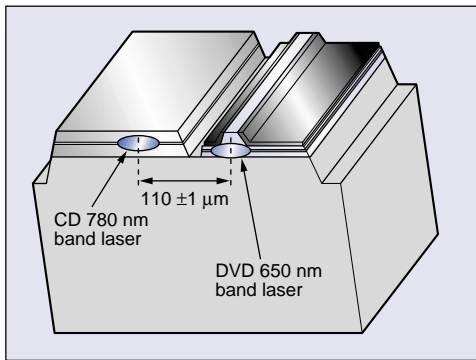
■ No High-Frequency Superposing Circuit Required and 70°C Operation Achieved

By adopting the Sony original TAPS*1 structure gain guide type, which has a proven track record in mass production, in the CD side, and by adopting a self-pulsating type in the DVD side, this device achieves low noise with no high-frequency superposing circuit required, and also achieves 70°C operation. Future development plans in this area to support further evolution of the optical disc drive include an index guide type that will support low operating current and high-temperature/high-power operation and devices that adopt self pulsation for both wavelengths to provide stable noise characteristics.

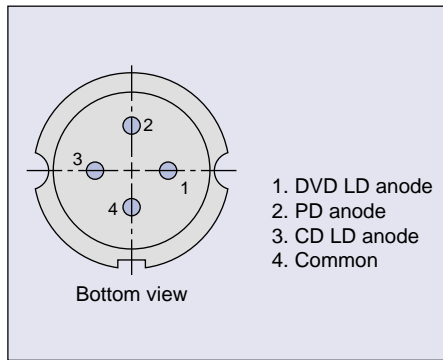
*1 TAPS: Tapered stripe

V O I C E

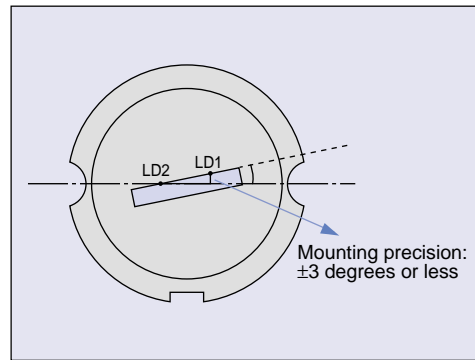
Two years ago, when we created a product of this type for the first time in the industry, I was struck by both the difficulty of the problems and by how fascinating I found the engineering and scientific issues associated with integrating lasers with different base materials. Since this project involved the development of a next generation device, we were able to incorporate technologies acquired through experience in mass production as well as new technologies. Still, I strongly felt the pressure of developing a commercial product in a timely manner. I am looking forward to developing more high value added and user-friendly products in the future.



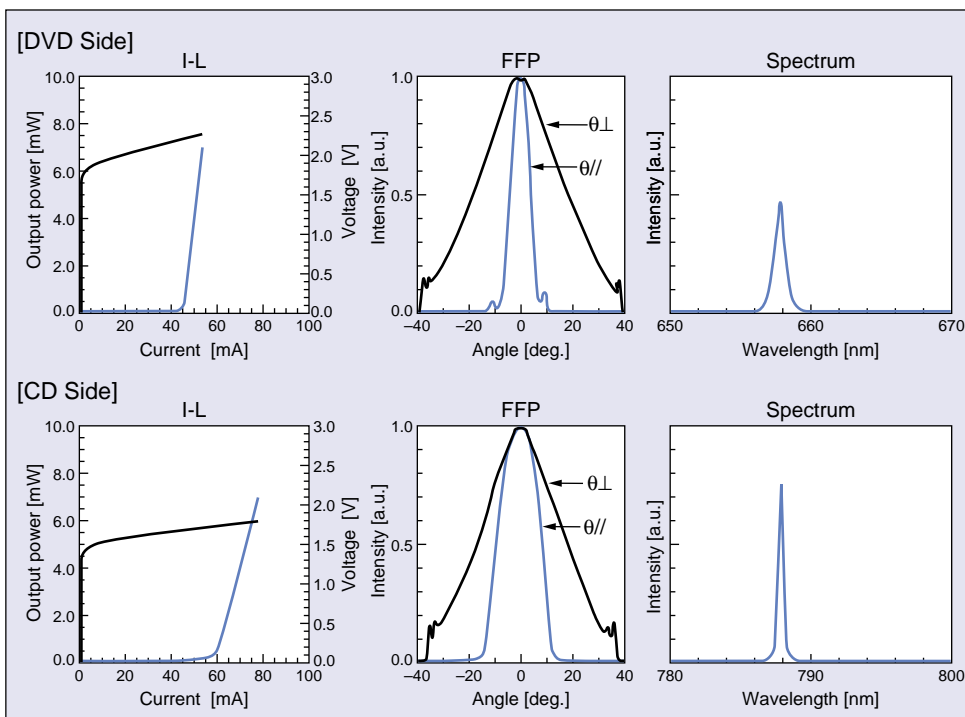
■ Figure 1 SLD6162RLI Laser Structure



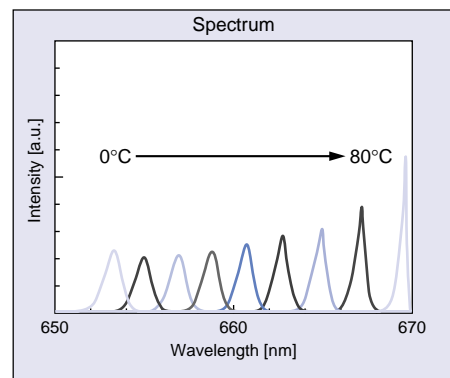
■ Figure 2 Pin Configuration



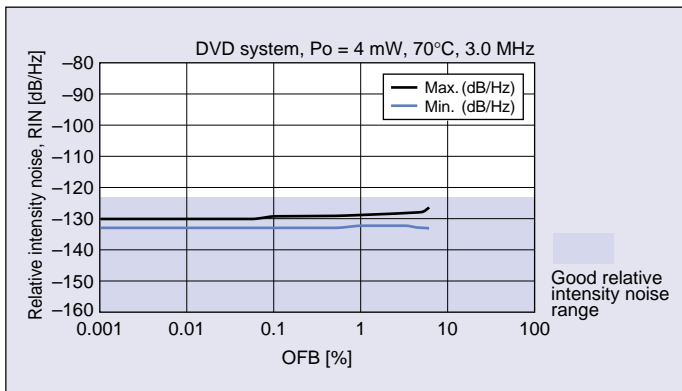
■ Figure 3 Mounting Precision



■ Figure 4 SLD6162RLI Representative Characteristics



■ Figure 5 Spectrum Temperature Dependency [DVD side]



■ Figure 6 Relative Intensity Noise (RIN) [DVD side]

■ Table 1 SLD6162RLI Main Characteristics

Item	Symbol	DVD side	CD side	Unit
Threshold current	I_{th}	45	55	mA
Operating current	I_{op}	50	70	
Operating voltage	V_{op}	2.2	1.9	V
Wavelength	λ_p	655	790	nm
Radiation angle	Parallel	$\theta_{//}$	8.5	deg.
	Perpendicular	θ_{\perp}	35	
Differential efficiency	η_D	0.6	0.4	mW/mA

Conditions: $T_c = 25^\circ\text{C}$
 $P_o = 4 \text{ mW @ CW}$