

FEATURING

High Power Industrial Laser Stack Technology Super High Power Industrial Laser Diode Achieves 1 kW, the Industry's Highest Level

- High output power: 1 kW
- High optical power density (space-saving device)
- High reliability

Recently, lasers have become widely used for cutting, welding, and marking in the industrial machining area. Of these, the YAG laser, which is used for cutting and welding, becomes the mainstream in laser machining in place of the CO₂ laser, and the developments in this area have been remarkable. Higher efficiency and reliability from the standpoints of low cost and reduced environmental burden. Market stream changes from lamp pumped YAG lasers to laser diodes pumped YAG lasers, and furthermore laser diodes are used directly in machining applications. Therefore, to respond to this outlook for the laser machining field, Sony is applying its high-power laser diode technologies proven in optical disc laser diodes to promote the development of super high power laser diodes.

Sony has now arrived at the point where it can announce a stack laser with the industry's highest level of power. In this article, we introduce this technology from three viewpoints: high power, high optical power density, and high reliability.

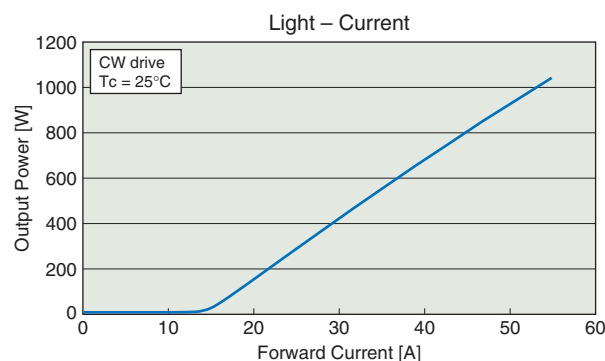
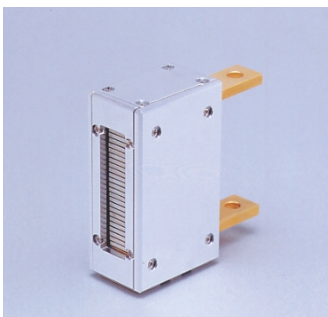
Stacking Technology = High Power Laser

The optical output of laser diodes used in DVD recording is around 150 mW. A stack laser with an optical output of 1 kW would be about 6600 times that power. This is such an enormous amount of energy that it defies the imagination.

Up to now, Sony has succeeded in developing a laser diode product (the SLD433S4) with an optical output of 60 W. It has now become possible, by applying Sony's engineering ingenuity to that technology, to increase that 60 W optical power to 1000 W.

This 'engineering ingenuity' consists of a 'stacking technology' that layers lasers on top of one another.

At the same time as providing highly efficient cooling, the water-cooled heat sink used in the SLD432S4 and SLD433S4 has the feature that it is extremely thin. Furthermore, since it has a structure in which the cooling water flows directly inside the heat sink, it provides a high degree of design flexibility and by ingenious design of water path, allows 'stacking', that is, direct stacking of heat sinks. By stacking 25 layers of 40 W power output lasers, Sony was able to create a practical module, a single one of which provides a 1 kW optical power output.



■ Figure 1 Output Characteristics

Making the Heat Sink Thin = High Optical Power Density

Unlike the light from an incandescent lamp, the light from a laser diode has the feature that a high optical power can be acquired from a smaller area. It has now become possible to mount laser diode chips even closer together using stacking technology, and thus to take even greater advantage of this feature of laser diodes. This also has the large advantage of saving space.

The development effort described here aimed at reducing the stack laser's emission pitch (the spacing between emission points when the laser diode are stacked) to under 2 mm. As we mentioned in the previous section on stacking technology, the water-cooled heat sink features a high degree of flexibility in the structural design and also provides powerful cooling. By performing simulations and revising the design, we succeeded in reducing the thickness of the heat sink while retaining the previous cooling capacity without change. This allowed us to achieve a stacking pitch of 1.9 mm, thus achieving our goal.

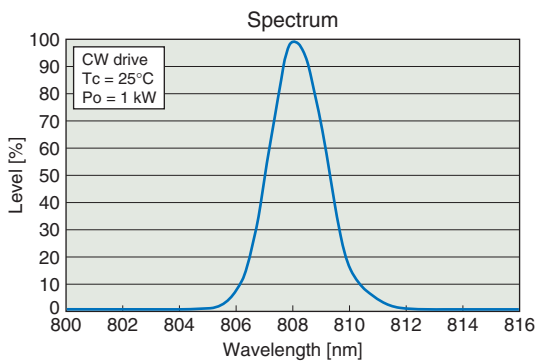
A device with 25 layers and a stack pitch of 1.9 mm has a height of 47.5 mm (a width of 10 mm and a height of 47.5 mm) and achieves the high optical power density of 211 W/cm² as its optical power per unit area.

High Reliability

When developing industrial lasers, the most important issue is the reliability. By adopting the stripe structure from the SLD430 Series, which are attractive products due to their high reliability and low operating current, and by adopting water-cooled heat sink technology that can provide high reliability even at the 60 W power level, we were able to assure high reliability in this stack array laser module.



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■ Figure 2 Wavelength Characteristics

■ Table 1 Stack Laser Diode Module Specifications (Values provided for reference purposes only)

Item	Symbol	Typ.	Unit
Threshold current	I _{th}	13	A
Operating current	I _{op}	53	
Operating voltage	V _{op}	46	V
Wavelength	λ	808	nm

Condition: T_c = 25°C
P_o = 1 kW@CW