Hitachi Releases "MARU Beam Series" of Red Laser Diodes Achieving World First of Circular Beam with 1.2 (typ.) Aspect Ratio in 635 nm Band Wavelength

—For simpler optical system configuration in laser application products such as laser markers, together with lower current dissipation—

Tokyo, June 25, 2001—Hitachi, Ltd. (TSE: 6501) today announced the "MARU Beam Series" of red laser diodes offering the world's first circular beam with a 1.2 (typ.) aspect ratio*[1] by laser diodes in the 635 nm band wavelength. As the first products in this series, the HL6335G Series using ø 9mm package with 5mW optical output and the HL6340MG Series using ø 5.6mm package with 5mW optical output are developed. Sample shipments will begin in July 2001 for the HL6335G Series, and in August 2001 for the HL6340MG Series in Japan.

The shift from the previous elliptical beam to this circular beam with a 1.2 (typ.) aspect ratio will make it possible to simplify the beam-forming mechanism in laser levelers and similar laser markers, and equipment with a built-in sensor, and facilitate connection to an optical fiber in optical fiber checkers, resulting in higher efficiency.

At 25 mA(typ.) (Po = 5 mW, Tc = 25°C), the operating current (Iop) is approximately 40% lower than that of Hitachi's previous low-operating-current type products, enabling the HL6335G to be used in the same environments as current Hitachi models while offering an extended battery life.

< Background >

635 nm band wavelength laser diodes are the brightest and most visible of all semiconductor laser diodes currently in mass production, and as such are widely used as the light source for construction-site straight-line laser levelers, laser markers for position control and the like, as well as fiber checkers and similar devices. Hitachi currently has a variety of 635 nm band wavelength products in mass production, with optical outputs ranging from 3 to 35 mW.

An ideal laser diode beam has an aspect ratio (ratio of perpendicular direction to parallel direction) of 1.0, but because of difficulties in construction, the aspect ratio of current 635 nm band devices is 3.5 to 4.0, with that of Hitachi's HL6312G Series (635 nm/5 mW) being 3.8. As a result, efficient use of light in application products requires the use of a lens with a large aperture or a large angle of light capture, and the elliptical beam from a laser diode must be formed into a circular beam by means of a cylindrical lens or the like. There is consequently a great demand for laser diodes in which the light source is a circular beam from the outset.

To meet this need, Hitachi has developed the " MARU Beam Series" of circular-beam laser diodes, achieving the world's first 1.2 (typ.) aspect ratio in the 635 nm band wavelength.

< About these Products >

The use of a Self aligned Refractive Index (SRI) structure*[2] developed by Hitachi, together with optimization of structural parameters such as active layer thickness and end-face reflectance ratio, has enabled the laser diodes in this series to achieve the world's first circular beam with a 1.2 (typ.) aspect ratio in the 635 nm band wavelength. Eliminating the necessity of forming a circular beam in the laser application equipment has made it possible to reduce the number of component parts in the optical system, and simplify its design.

The use of an SRI structure and optimization of the strained Multi-Quantum Well (MQW) structure*[3] have resulted in current dissipation ranking among the best in the world for 635 nm band devices. The first model in the series, the 635 nm/5 mW HL6335G Series and HL6340MG Series, features an operating current (Iop) of 25 mA (typ.) (Po = 5 mW, Tc = 25°C), approximately 40% lower than that of Hitachi's previous low-operating-current type HL6325G Series (635nm/5mW), for longer battery-powered operation.

An operating temperature of 50°C has been achieved, and the use of a ø 9 mm package (HL6335G Series) and a ø 5.6mm package (HL6340MG Series) providing efficient heat radiation makes it possible to use the same heat radiation design as with previous Hitachi models such as the HL6325G Series, while also simplifying mounting design.

Future plans include higher output for the 635 nm band wavelength, 1.2 (typ.) aspect ratio "MARU Beam Series," and the development of a series of circular beam products.

Notes: 1. Aspect ratio (beam divergence ratio): With general semiconductor lasers, the light emitting section (active layer) is several µm in the parallel direction and about 0.05 µm in the perpendicular direction, with consequent divergence of laser light due to diffraction.

The perpendicular-direction ($\theta\perp$) beam divergence and ratio to the parallel direction ($\theta//$) (aspect ratio = $\theta\perp/\theta//$) is an important parameter in lens connection and optical fiber connection. A circular beam with an aspect ratio of 1 is ideal.

2. Self aligned Refractive Index (SRI) structure: A wave-path structure whereby a parallel-direction block layer is formed simultaneously at the time of crystal growth that inserts the active layer of the laser diode in a clad layer for which there is a difference in refractive index. As the perpendicular-direction clad layer and the parallel-direction block layer are formed simultaneously, the width of each layer can be controlled precisely, and a low aspect ratio can be achieved.

3. Strained Multi-Quantum Well (MQF): In MQF construction, the active layer of the laser diode is a laminated structure comprising quantum well layers and barrier layers with a thickness of several nm. By regulating the composition of the quantum well layers that constitute the light-emitting area, and using a crystal with a smaller lattice constant than the substrate, tensile strain is introduced into the quantum well layers. The band structure varies due to this strain, resulting in a lower threshold current and higher slope efficiency.

< Typical Applications >

- Laser markers (laser levelers, line markers, etc.)
- Laser sensors (optical fiber checkers, chip mounters, etc.)
- Educational and experimental equipment

< Prices in Japan > (For Reference)

Part Number		Package	Sample Price (Yen)
HL6335G Series	HL6335G	Ø 9mm	8,500
	HL6336G		
HL6340MG Series	HL6340MG	Ø 5.6mm	9,000
	HL6341MG		

* HL6335G and HL6340MG are the type that anode connects to flange.
  HL6336G and HL6341MG are the type that cathode connects to flange.

< Specifications >

1. Absolute Maximum Ratings (Tc = 25 ± 3°C)

Item	Symbol	Value	Unit
Optical output	Po	5	mW
Optical output (pulse)	Po (Pulse)	6*	mW
LD reverse voltage	VR (LD)	2	V
PD reverse voltage	VR (PD)	30	V
Operating temperature	Topr	- 10 to + 50	°C
Storage temperature	Tstg	- 40 to + 85	°C

Note: * Pulse conditions: Pw = 1 μs, duty = 50%

2. Electrical and Optical Characteristics (Tc = 25 ± 3°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Optical output	Po	5	–	–	mW	Kink-free*
Threshold current	Ith	–	20	40	mA	
Slope efficiency	ηs	–	0.9	–	mW/mA	3 (mW) / (I (4 mW) – I (1 mW))
Operating current	Iop	–	25	60	mA	Po = 5 mW
Operating voltage	Vop	–	2.4	–	V	Po = 5 mW
Beam divergence (parallel)	θ//	–	17	–	deg	Po = 5 mW
Beam divergence (perpendicular)	θ⊥	–	20	–	deg	Po = 5 mW
Aspect ratio	θ⊥/θ//	–	1.2	1.5	–	Po = 5mW
Oscillation wavelength	λp	630	635	640	nm	Po = 5 mW
Monitor current — Ø 9mm pkg.	Is	–	0.1	–	mA	Po = 5 mW, VR = (PD) = 5 V
Monitor current — Ø 5.6mm pkg.	Is	–	0.05	–	mA	Po = 5 mW, VR = (PD) = 5 V

Note: * The kink-free condition has been confirmed at a temperature of 25°C.