



## Series LDP Diode-Pumped Nd:YAG Lasers

Lee Laser introduces the Series LDP, Diode-Pumped CW and Q-switched Nd:YAG Lasers as a complement to the lamp-pumped Series 800 Nd:YAG Lasers. Designed with the same industrial-grade ruggedness as our highly successful Series 700 and Series 800 CW (continuous-wave) and Q-switched Nd:YAG Lasers, the new Series LDP brings Lee Laser performance reliability to diode-pumped Nd:YAG laser technology.

### Optical "Pumping" with Laser Diodes

The Series LDP lasers use solid-state laser diodes rather than an arc lamp as the optical pump source for the Nd:YAG laser rod. Unlike the krypton arc lamps that emit a broad spectrum of light, much of it in the form of unusable infrared (heat), the emission spectrum of the laser diodes is exactly matched with the absorption spectrum of the neodymium ions that are suspended in the YAG rod. This means that the optical "pump" efficiency of the Series LDP lasers is much greater than the lamp-pumped Series 800 lasers.

For example, to achieve the 50-Watt output from the Model LDP-50MQ, electrical power to the laser diodes is less than 400 Watts. The Model 850MQ, lamp-pumped Nd:YAG laser, requires more than 2.5 kW of arc lamp power to produce 50 Watts. The laser diodes inside the Model LDP-100MQ consume less than 800 Watts compared with 4.0 kW for the 8100MQ laser. The electrical power to cool the diode-pumped YAG lasers is equally thrifty. Consider the cooling requirements of a laser to be equivalent to the electrical power requirements.

### Improved Beam Quality and Pulse Stability

The Series LDP lasers bring several remarkable design features to the industrial laser market place. Among the most significant is their exceptional beam quality which is crucial for almost all industrial laser applications:

- highly circular beam cross-section
- superior  $m^2$  values for multimode models
- stability < 3 % rms up to 20 kHz

This kind of beam quality and pulse stability is not available in lamp-pumped Nd:YAG lasers. These qualities are valuable to marking systems integrators that seek a combination of high power and high frequency pulse stability for high-speed marking capability and fast production throughput.

Twenty-six Series LDP lasers are now available, eight of which are frequency doubled. Eight lasers are designed for TEM<sub>00</sub>-mode operation.

<u>Model</u>	<u>Wavelength</u>	<u>Mode</u>	<u>CW Power</u>	<u>Q-switched Avg. Power*</u>	<u>Beam Diameter</u>	<u>Beam Divergence</u>
LDP-10T	1064 nm	TEM <sub>00</sub>	10 Watts		.9 mm	2.0 mr
LDP-10TQ	1064 nm	TEM <sub>00</sub>	10 Watts	6 Watts	.9 mm	2.0 mr
LDP-15T	1064 nm	TEM <sub>00</sub>	15 Watts		1.0 mm	2.0 mr
LDP-15TQ	1064 nm	TEM <sub>00</sub>	15 Watts	12 Watts	1.0 mm	2.0 mr
LDP-100TQ	1064 nm	TEM <sub>00</sub>	18 Watts	15 Watts	1.0 mm	1.6 mr
LDP-20M	1064 nm	Multi	20 Watts		<2.0 mm	4 mr
LDP-20MQ	1064 nm	Multi	20 Watts	14 Watts	<2.0 mm	4 mr
LDP-50M	1064 nm	Multi	50 Watts		<2.0 mm	6 mr
LDP-50MQ	1064 nm	Multi	50 Watts	35 Watts	<2.0 mm	6 mr
LDP-100M	1064 nm	Multi	100 Watts		<2.0 mm	6 mr
LDP-100MQ	1064 nm	Multi	100 Watts	70 Watts	<2.0 mm	6 mr
LDP-200M	1064 nm	Multi	200 Watts		2.0 mm	6 mr
LDP-200MQ	1064 nm	Multi	200 Watts	140 Watts	2.0 mm	10 mr
LDP-300M	1064 nm	Multi	300 Watts		2.5 mm	14 mr
LDP-300MQ	1064 nm	Multi	300 Watts	225 Watts	2.5 mm	14 mr
# MHR-800MQ	1064 nm	Multi	800 Watts	660 Watts	3.7 mm	12 mr
+ R-650MQ	1064 nm	Multi				
+ R-450MQ	1064 nm	Multi				
LDP-10TQG	532 nm	TEM <sub>00</sub>		3 Watts	1.0 mm	1 mr
LDP-15TQG	532 nm	Low-order		8 Watts	1.0 mm	2.0 mr
LDP-100TQG	532 nm	TEM <sub>00</sub>		12 Watts	1.0 mm	1.5 mr
LDP-20MQG	532 nm	Multi		10 Watts	<2.0 mm	3 mr
LDP-50MQG	532 nm	Multi		25 Watts	<2.0 mm	4 mr
LDP-100MQG	532 nm	Multi		50 Watts	<2.0 mm	4 mr
LDP-200MQG	532 nm	Multi		100 Watts	<2.0 mm	5 mr
LDP-300MQG	532 nm	Multi		150 Watts	2.0 mm	7 mr

\* 10 kHz

# Preliminary

+ Call for information

### Optical Resonator Design

The Series LDP lasers will use the same modular, optical rail design as the Series 800 lasers. While the head block that contains the diode lasers and YAG rod is noticeably smaller, the other optical components (mirror mounts, shutter assembly and the like) will be shared by both series of lasers.

Lee Laser has designed the Series LDP lasers for extended lifetime of the internal laser diodes. In this regard, the specified output power of these lasers is achieved with the laser diodes operating well below their design power ratings.

The standard length of the optical for the Series LDP lasers will be 40" (about 1 meter, options dependent), same as with the Series 800 lasers. Most laser micro-machining applications, such as marking, require a minimum pulse width for maximum effectiveness. If laser pulses are too short, then the machining process may actually become less efficient. Therefore, the length of the Series LDP optical resonators is much the same as with Series 800 lasers. However, the shorter head block will make it possible to reduce the length of the optical resonator if short pulse width performance is desired.

### **Laser Cooling System**

Unlike other diode-pumped Nd:YAG lasers, the Lee Laser optical design for the Series LDP lasers is insensitive to small fluctuations in cooling water temperature. The match of the laser diode emission spectra and neodymium ion absorption spectra can be maintained with temperature variations as great as 1.0° C. Therefore, it is not necessary to utilize a highly precise, expensive and inefficient, refrigerated cooling system to maintain constant diode temperature.

Instead, Lee Laser uses the same design of water/water cooling system that has proved to be so reliable for the company's popular Series 800 lamp-pumped Nd:YAG lasers. Smaller, of course, than the Series 800 cooling system, the Series LDP cooler is highly efficient, simple in design and inexpensive to manufacture.

To remove heat from the laser, the user must provide a source of external cooling water, such as city water. The quantity of water is much smaller than what is required for lamp-pumped Nd:YAG lasers, only 2-60 l/min, maximum at 15° C.

For end users that are not able to provide an external source of cooling water, Lee Laser offers an optional, fully self-contained chiller unit that is integrated into the laser's power station cabinet. Heat removed from the laser is vented into the room in which the power station is located. The optional chiller is available on all models with output power up to 200 Watts at 1064-nm wavelength.

### **Electrical Power Consumption**

The inherent efficiency of the LDP Series lasers means that much less electrical power is required to operate them. All laser models require 220-VAC, 1-phase input power, 50 or 60 Hz. For most models, total power consumption does not exceed 2 kW (< 10 Amperes), even with a variety of options included with the laser (such as Q-switch, HeNe laser, internal refrigerated chiller, etc.). For the Models LDP-200MQ and LDP-200MQG, total electrical power consumption is < 3 kW (< 15 Amperes) with water/water heat exchanger.

## **Frequency-Doubled Models**

The low-beam-divergence performance of the Series LDP lasers makes them ideal for efficient harmonic generation. Eight (8) frequency-doubled models have been configured, with Q-switched average output power up to 150 Watts at 532-nm wavelength.

These lasers contain LBO (lithium borate) as the SHG crystal. LBO is the most durable SHG crystal that is commercially available, as much as seven (7) times more damage resistant than KTP. For best performance, LBO must be maintained at an elevated temperature. For this reason, the crystal is housed inside a temperature controlled oven.

## **Laser Diode Lifetime**

Perhaps the greatest concern of all purchasers of the Series LDP lasers is the expected and guaranteed lifetimes of the laser diodes. Lee Laser has taken extraordinary measures to maximize diode lifetime, which is vital for cost justification and return on investment in the industrial laser marketplace, and to prolong diode replacement.

The Series LDP lasers are characterized by the following design criteria:

1. Laser diodes are rated by their manufacturers for operation up to 45-Amperes
2. Lee Laser current limits the diode power supplies at maximum of 37-Amperes
3. All Series LDP lasers typically achieve their rated output power level at a diode current level less than 28-Amperes

Simply stated, unlike our competitors Lee Laser uses many more diodes in each Series LDP laser than is needed to meet that laser's performance specifications. With more diodes to share the optical pumping load, the diodes are operated at a much reduced current level, which greatly extends diode lifetime.

The expected lifetime of the laser diodes in Series LDP lasers is 10,000 to 20,000 hours.

Since Lee Laser began delivery of the Series LDP lasers in June 1998, Lee Laser has delivered approximately 800 diode-pumped lasers with output power levels that range up to 300 Watts at 1064 nm and 150 Watts at 532 nm. The diode modules of many of the earliest lasers now have been returned to Lee Laser for diode replacement. The recorded lifetimes from hour meters attached to the diode modules are averaging more than 20,000 hours.

