ULN-Series

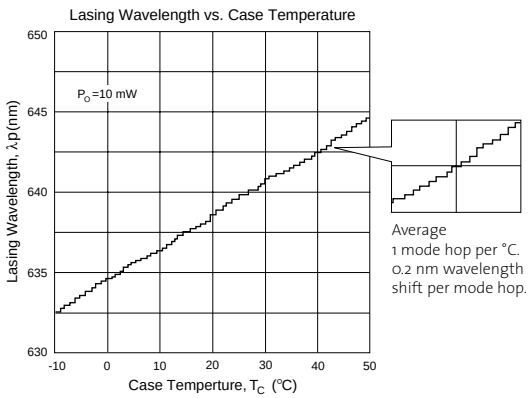
Ultra Low Noise Diode Laser Modules

More Stable than a HeNe Laser

Coherent's ULN-Series diode laser modules are designed for applications that require particularly low noise or mode hop noise-free operation. The sophisticated drive electronics incorporated into the ULN-Series lasers ensure low noise output. Typical RMS noise is 0.06% or better for detector bandwidth from 10 Hz to 10 MHz, with no warm-up or equalization time. In addition to the low noise characteristics of this diode laser, this module is designed with our MicroBlaze™ beam circularization technology. The result is a high-brightness diffraction-limited circular beam that is fully collimated with low divergence. ULN-Series lasers are ideal for biomedical instrument design. This low noise, compact 638 nm laser is the ideal replacement for HeNe lasers that have higher power requirements and generate more heat. These diode laser modules can be easily incorporated into applications such as particle counting, flow cytometry, confocal microscopy or spectroscopy.

Mode Hopping

One of the major problems with single-mode 635 nm diode lasers is that they are prone to high levels of mode hop noise. A typical diode laser will have mode hops as the laser changes with temperature and age. Mode hopping is defined as a sudden shift from one longitudinal mode to another during single-mode operation. The mode hop is caused by a change in the laser cavity length as the temperature increases. The graph below shows a typical wavelength vs. temperature curve for a 635 nm diode. The step function illustrates the large number of modes close together, averaging one mode every degree celsius. Mode hopping creates a higher RMS noise level and can be responsible for increasing noise on the output power by a factor of 10 (0.5% RMS noise). The graph on page 2 shows the RMS noise vs. temperature for a typical diode and our ULN-Series diode. The ULN-Series has eliminated the noise due to mode hopping, and thus has stable output over a broad temperature range.



KEY FEATURES

- ***Lower noise than HeNe, typically 0.06% RMS noise (Bandwidth 10 Hz to 10 MHz)***
- ***No mode hop noise***
- ***No warm-up period***
- ***Patented MicroBlaze™ technology produces high-brightness diffraction-limited circular beam***
- ***Wavelength 638 nm ±5 nm***
- ***Output Power ≥5 mW output***
- ***Patented AlignLock™ collimation technology***
- ***Gaussian beam profile with typical M^2 <1.2***
- ***ESD protected to class 2***
- ***Long lifetime, more than 20,000 hours @ 25°C***
- ***Integral drive circuitry with active power control***

KEY APPLICATIONS

- ***Flow Cytometry***
- ***Genomics***
- ***Particle Counting***
- ***Confocal Microscopy***
- ***High Throughput Drug Screening***
- ***Particle Sizing***
- ***Optical Storage***

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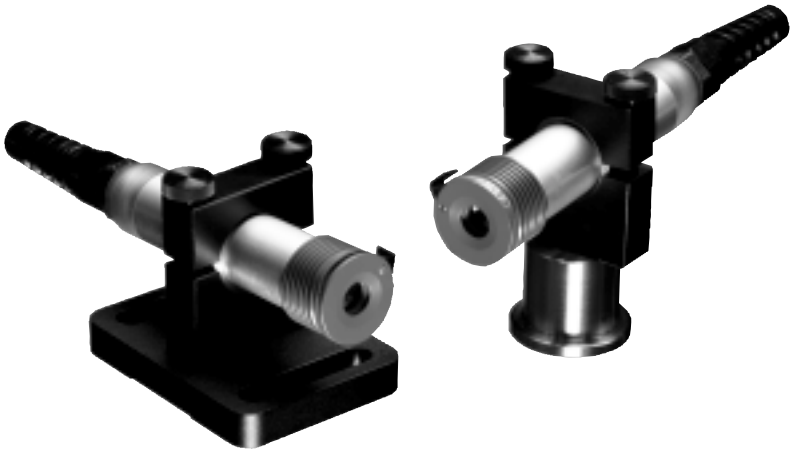


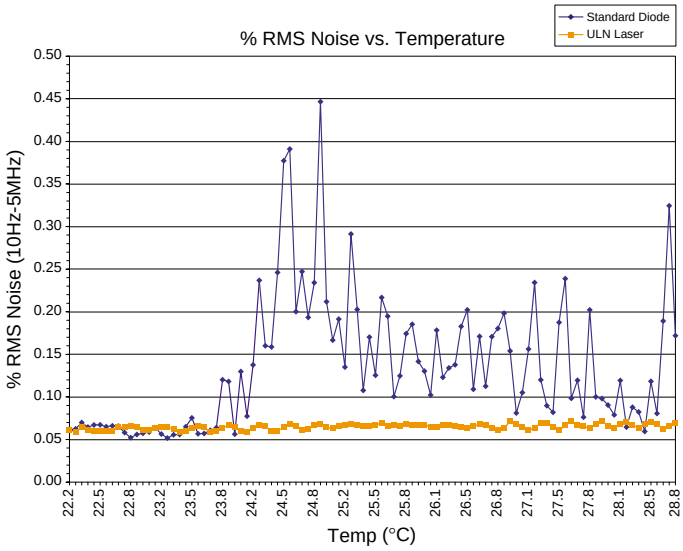
Difficulties with TE Cooling for 635 nm Diode Laser Modules

The most common technique for stabilizing a diode laser is temperature regulation through TE cooling. This may not be the best option for 635 nm lasers for the following reasons:

1. In 635 nm diodes there are many modes close together in the temperature domain. It can be difficult to regulate the temperature in a sufficiently tight range to assure single mode operation.
2. 635 nm diodes have a significant amount of part-to-part variation in their mode hop characteristics.
3. Noise and mode hop characteristics tend to change over the lifetime of the diode. This would require re-tuning temperature set points to maintain single mode operation over the life of the product.

Engineered for Low Noise Operation

The ULN-Series of diode laser modules have been engineered with an alternative solution to the mode hop problem. Rather than regulate temperature, a special modulation is used to force the laser into a multi-longitudinal mode. While a normal laser will operate in a single-mode longitudinal or oscillate between two strong modes, the modulation creates several modes of lower intensity. As the laser temperature changes, these modes move like a caterpillar across the wavelength spectrum. The movement does not allow abrupt changes so the system operates as if there were no mode hops. The result is low RMS noise (~0.06%), which is stable over temperature and the life of the diode laser module.



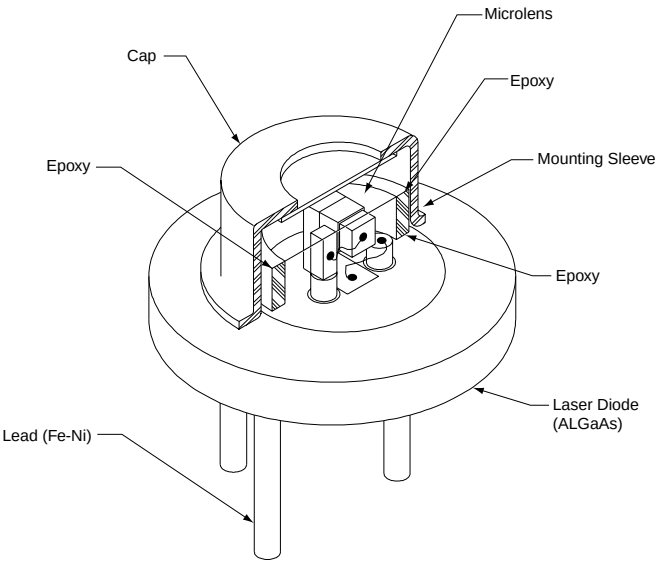
Coherent Auburn Quality Construction

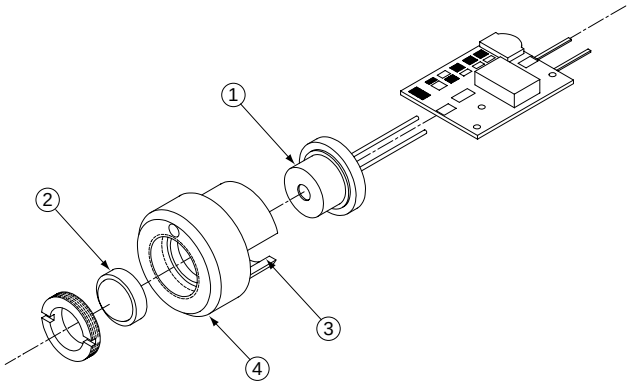
The ULN-Series of standard laser modules are circularized using our MicroBlaze™ technology. This technique involves accurately positioning a tiny fiber microlens inside the can of the diode laser. This microlens corrects the divergence of the fast axis only and once collimated, transforms the beam from elliptical to circular. The diagram below shows a cross section through a diode laser package that has been modified in this way. ULN-Series lasers are also available with an unmodified elliptical beam. Please call for a quotation.

As with all Coherent compact diode laser modules, the ULN-Series diode laser modules are constructed using our patented Alignlock™ technology. This accurately mounts the diode laser and high quality optics together in the same brass housing. This method of manufacture is rapid and repeatable, and allows us to manufacture high quality modules in large quantities at very competitive prices.

Advantages of ULN Technology

- Low RMS noise (typically ~0.06% RMS)
- ULN is instantly on. It requires no warm-up period
- ULN stabilizes both power and noise during temperature changes, (note: wavelength varies with the standard temperature coefficient of the diode, ~0.2 nm/°C)
- ULN controls noise over the lifetime of the laser and will not develop mode hop noise as the laser ages
- ULN does not change the spatial qualities of the laser beam so the beam can be focused to the same spot size, profile and shape





1. Diode lasers are sorted real-time for beam quality.
2. Lenses are sorted real-time for performance to maximize the beam quality.
3. Interference fit and adhesive to hold the critical spacing throughout the process to final potting.
4. Patented Align-Lock™ positioning of diode and lens to meet the critical spacing constraints required to make the perfect beam.

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Ultra Low Noise Diode Laser Modules

		ULN-Series
System Specifications	Noise	<0.1% RMS at less than 10 MHz
	Output Power (quasi CW)	5 mW
	Power Stability	Typically ±1%
	Emission Wavelength	635 ±5 nm
	Temperature Coefficient λ	0.2 nm/°C
	Spatial Mode	TEM_{00}
	Longitudinal Mode	Multi-mode
	M^2	<1.2
	Beam Pointing Accuracy (Boresight)	<4.3 mrad on most modules
	Beam Divergence	<1 mrad
	Beam Pointing Stability (8 hour)	Better than 50 µrad, typical
	Astigmatism	<λ /4
	Polarization Ratio	>100:1
	MTTF	Estimated at 20,000 hours @ 25°C
	Module Cooling Required	Heat sink through module case
	ESD Protection	MIL Spec Std 1686B, Class 3a
	Drive Circuitry	Shielded, reverse polarity protected
	AC Power Requirements	90-130 or 180-260 VAC 50/60 Hz
	Storage Temp	-40 to +80°C
	Operating Temp	+10 to +50°C
	Agency Compliance	CDRH certified, CE compliant Class IIIa for Power between 1-5 mW Class IIIb for Power above 5 mW
	Warranty	1 year parts and labor
	Patents	US #5,111,476 and #5,121,188

COHERENT

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Coherent follows a policy of continuous product improvement. Specifications are subject to change without notice.

Coherent offers a limited warranty for all ULN-Series systems. For full details on warranty coverage, please refer to the Service and Support section at www.CoherentInc.com, or contact your local Sales or Service Representative.

Coherent's scientific and industrial lasers are certified to comply with the Federal Regulations (21 CFR Subchapter J) as administered by the Center for Devices and Radiological Health on all systems ordered for shipment after August 2, 1976.

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