PIV Lasers

Lamp Pumped Lasers for PIV Applications from Litron

Litron Total Laser Capability

Litron Lasers

PIV Lasers

Lamp Pumped Lasers for PIV Applications

Litron offers an extensive range of flashlamp pumped PIV laser systems with output energies of up to 1J per pulse and repetition rates of up to 200Hz. All of the systems are twin head devices, meaning that the PIV laser head contains two totally independent lasers. The range of PIV systems is based around both the ultra-compact Nano series and the larger invar stabilised LPY series. The overriding factor that sets Litron's products apart is quality. This is evidenced not only in the design and construction of the product, but also in its performance.

In any imaging application the beam quality is of paramount importance as this completely determines the light sheet quality. By choosing a suitable resonator configuration the output beam quality can be controlled to give a very smooth spatial profile which remains homogeneous as it propagates right into the far field. Such resonators are almost always of a stable or stable-telescopic configuration. Unstable Gaussian-coupled resonators are not in general ideal for visualisation applications. Such resonators yield output beams that contain very high spatial frequencies in the near field, and as they propagate a hole appears in the centre of the beam (a 'donut' beam profile). This is typical of any such resonator and is a result of the physics of the system. It is therefore quite clear that if the beam is to be used in the near or intermediate fields (within 10 metres of the laser output) the light sheet formed is unlikely to be uniform, as the laser beam is not.

It is our philosophy to provide a laser system that suits an application. A 'one system fits all' approach, as offered by most manufacturers, does not allow the customer to optimise their process. For applications such as PIV Litron has developed resonators that will yield extremely uniform light sheets whose pulse to pulse structure remains extremely constant. These are all based around our stable or stable- telescopic resonators.

Litron Lasers

PIV Lasers

Compact Lasers for PIV Applications
The Nano Series

NANO PIV FEATURES

- *Compact dual head design*
- *Dedicated PIV laser head*
- *Telescopic versions for low divergence*
- *Rugged for industrial installation*
- *3rd or 4th harmonics available for LIF and dual colour PIV*
- *Rep. rates to 100Hz*
- *Energies to 200mJ @ 532nm*

Nano PIV

The construction of the Nano series of PIV laser systems is extremely robust. They have been developed as industrial tools that can be handled without worry of misalignment or damage. The PIV head is formed by an aluminium gauge-plate onto which two standard Nano series heads are mounted. The output beams are combined by dielectric polarisers and then frequency doubled, and if desired can be frequency tripled, quadrupled or quintupled. Many of the Nano PIV systems are powered by a single power supply unit, making the overall package both powerful and portable.

There are two twin power supplies available, the LPU450-PIV and the LPU550- PIV, the latter allowing outputs of 200mJ at 532nm at 15Hz from each laser. The laser system is controlled via a remote controller. All trigger and synchronisation signals are TTL compatible, and each laser is controllable entirely independently. All Nano laser heads have a verified electronic intracavity safety shutter as standard, which ensures that the lasers cannot be started with the shutter open – an important safety feature.

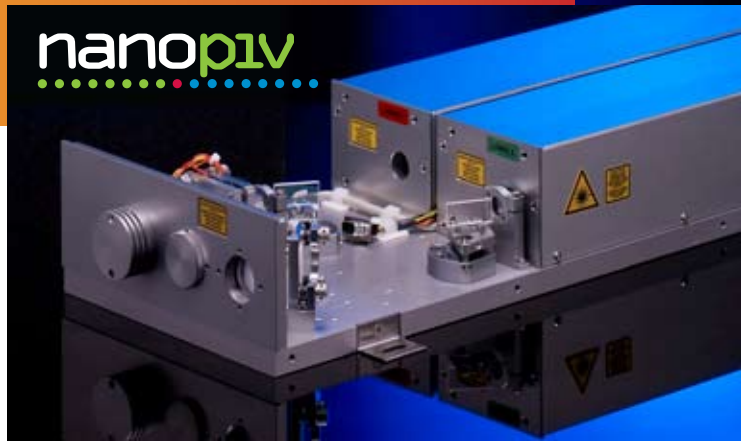
The Nano L PIV range also includes high repetition rate models giving energies of 50mJ per pulse at 100Hz from each laser from a power supply that is completely air cooled.

The Nano T PIV range has been designed incorporating stable telescopic resonators, giving very low divergence output beams that allow thinner light sheets to be formed than from conventional stable resonators.

For large area illumination, high energies are achieved with the birefringence compensated Nano TRL range which achieves output energies of up to 450mJ per pulse at 532nm, 10Hz.

The footprint of the head is an extremely compact 850mm x 260mm.

All Nano series PIV lasers are available with the third and fourth harmonics.



Litron Lasers

PIV Lasers

High Energy & High Repetition Rate Lasers for PIV
The LPY Series

LPY PIV FEATURES

- *Dedicated PIV Laser Head*
- *Frequencies up to 200Hz*
- *High Pulse Energy to 1J*
- *True TEM_{00} output available*
- *Stable resonator design*
- *355nm & 266nm available for LIF and dual colour PIV*
- *Low profile INVAR optical rail*
- *Line narrowed versions*
- *Rugged industrial design*

LPY PIV

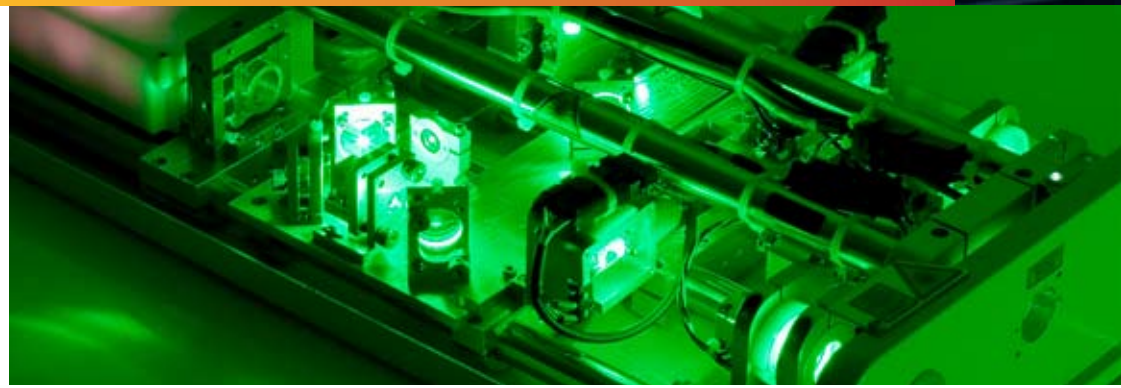
For higher energy systems or systems where very low divergences are required Litron offers twin configurations of its invar stabilised LPY series. Output energies of up to 1J per pulse of 532nm at repetition rates of up to 20Hz are available as standard, as are outputs of 100mJ at 532nm at 200Hz.

The LPY PIV series are based around a rugged, self supporting, invar rail. This imparts both a large degree of mechanical and thermal stability to the system suiting them to use in both research and industrial applications with little need for maintenance.

Several of the LPY PIV series include an intra-cavity telescope yielding low divergence outputs. All LPY700 series systems feature a birefringence compensating twin-rod design to give the best possible beam homogeneity, essential for the formation of uniform light sheets.

The modular construction of the LPY series laser heads allows for easy customisation of systems.

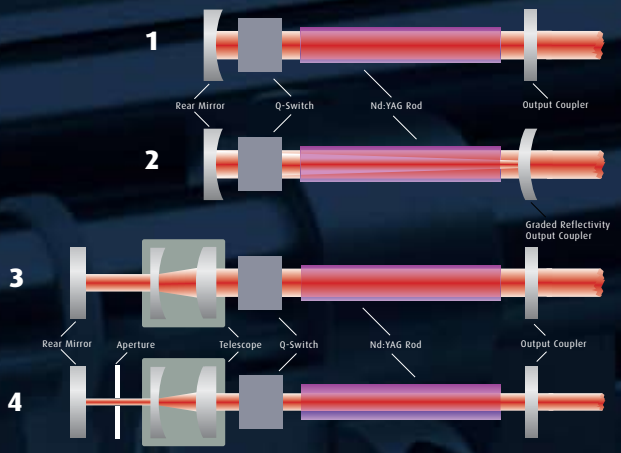
Options including variable optical attenuation, line-narrowing etalons and injection seeding are available upon request.



Litron Lasers

PIV Lasers

Resonator Design
The Heart of the Litron System



Schematics showing oscillator design.
1) Stable
2) Gaussian
3) Telescopic Multimode
4) Telescopic TEM_{00}

Stable Resonator
A stable resonator provides the most flexibility in terms of output energy and repetition rate, as both parameters can be varied with minimal effect upon the alignment of the system. In general, the output of such systems is multi-mode. With the addition of an intra-cavity aperture, a TEM_{00} output can easily be realised at the expense of overall energy.

Gaussian Optics
In a Gaussian system, a graded reflectivity output mirror is used as part of a geometrically unstable resonator. Such systems give a high energy single transverse mode with a low beam divergence. The thermal lens formed by the laser rod is part of the optical arrangement. Therefore, Gaussian systems work best at a constant average input power (i.e. lamp energy and repetition frequency). As such, the laser is factory set at one pulse repetition frequency and output energy. To increase flexibility, Litron offers two options. The first option, the pulse repetition rate divider allows the user to divide the set repetition rate by 2, 4, 8 or 16. This works by allowing the flashlamp to pulse at a set frequency, thus maintaining almost the same thermal lens on the laser rod, but only switching the Pockels cell on the desired pulses (i.e. every other pulse for divide by two operation).

Telescopic Resonator
To obtain high energy, low divergence beams, the preferred method is the use of a telescopic resonator. In this configuration, an intra-cavity telescope is used to reduce the beam diameter in the rear of the resonator. This makes the resonator appear longer, increasing the lower order mode volumes, leading to a superior output beam with very low divergence. With no optical adjustment at all, the laser can be varied over a wide range of pulse energies and repetition rates, maintaining a high quality, low divergence beam. With slight adjustment to the telescope (a simple procedure) the full range of energies and repetition rates from single pulse to the maximum can be achieved. For high energy TEM_{00} beams, an intra-cavity aperture can be fitted behind the telescope. Varying the sizes of these apertures allow output beams that are to within 15% of the diffraction limit to about 3.5 times the diffraction limit. That is from an almost pure Gaussian TEM_{00} to full energy in a uniform spatial profile, giving a high degree of control over light sheet characteristics.

Optical Attenuator
Energy output can be controlled via the variable optical attenuator. The output energy of the laser can be attenuated by the use of an extra-cavity polariser and half wave plate, whilst maintaining the beam quality and divergence.

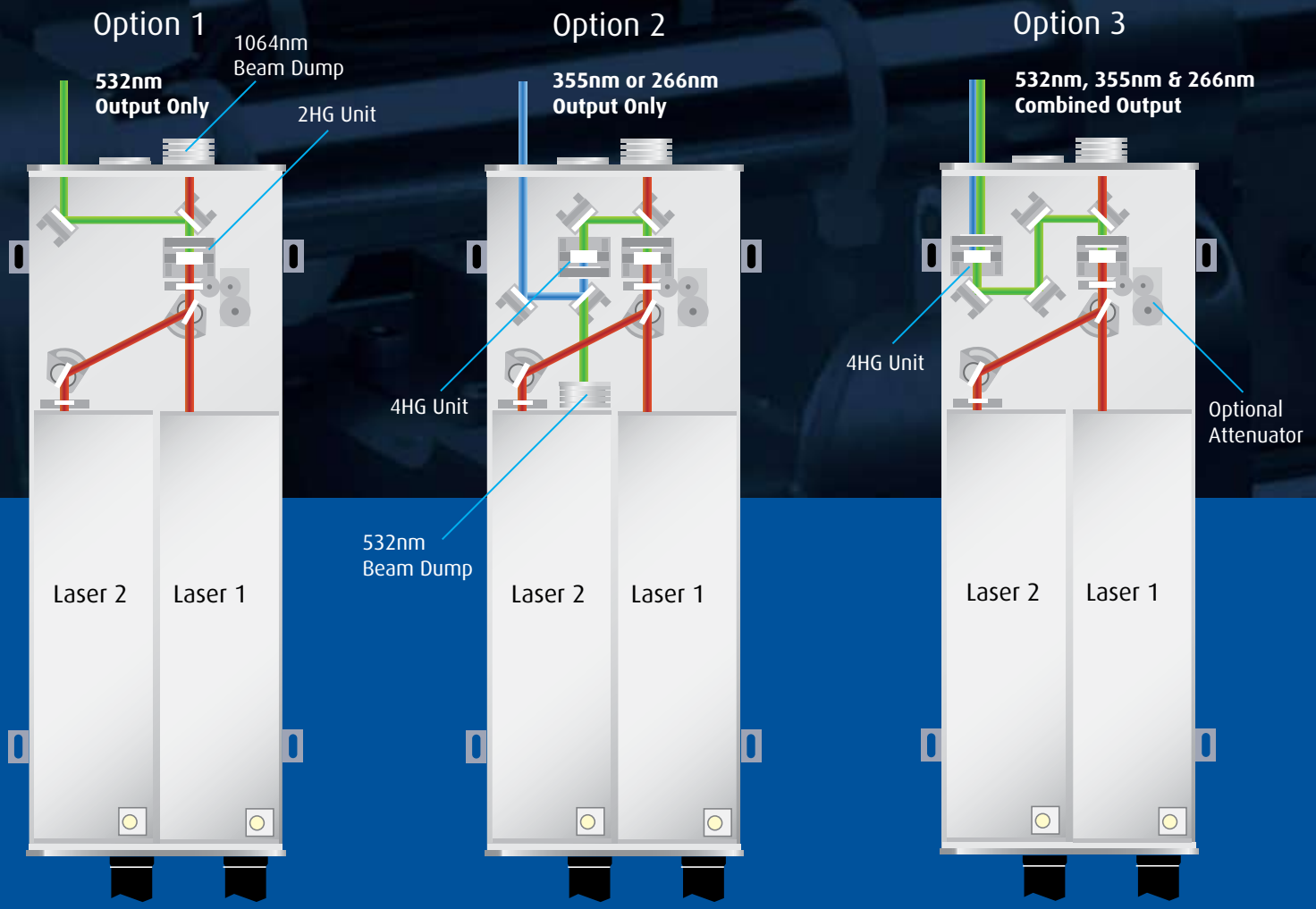
This also has the advantage that the pulse to pulse stability is maintained even at very low output energies.

Litron Lasers

piv lasers

Laser Head Design

Nano PIV Series Harmonic Generation Options



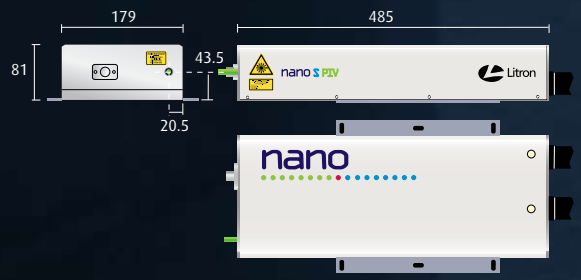
Litron Lasers

The Nano S PIV Pulsed Nd:YAG Laser System

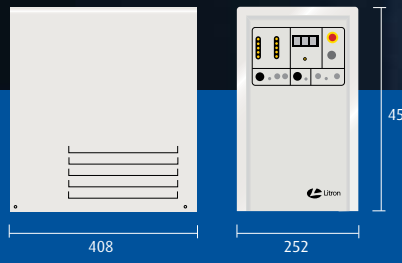
Technical Data

Model	Nano S 30-15 PIV	Nano S 30-30 PIV	Nano S 50-20 PIV	Nano S 65-15 PIV
Repetition Rate per Laser Head (Hz)	0-15	0-30	0-20	0-15
Output Energy at 532nm per Laser Head (mJ)	**15**	**30**	**50**	**65**
Parameter				
Pulse - Pulse Stability (±%)	2	2	2	2
Beam Diameter (mm)	3	3	4	4
Beam Divergence (mrad)	~2.0	~2.0	~2.5	~2.5
Pulse Length @ 1064nm (ns)	5-8	5-8	6-8	6-8
Pointing Stability (µrad)	<100	<100	<100	<100
Resonator Type	Stable	Stable	Stable	Stable
Lamp Life (pulses)	>5x10^7	>5x10^7	>5x10^7	>5x10^7
Timing Jitter (ns)	<0.5	<0.5	<0.5	<0.5
Services				
Voltage (VAC)	90-250	90-250	90-250	90-250
Frequency (Hz)	47-63	47-63	47-63	47-63
Power	Single Phase	Single Phase	Single Phase	Single Phase
Ambient (°C)	18-30	18-30	18-30	18-30
Consumption (W)	<350	<350	<350	<350
Power supply	LPU450	LPU450	LPU450	LPU450

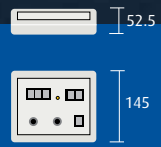
PIV Laser Head



LPU450 PSU



Remote Control Box



All dimensions shown in mm

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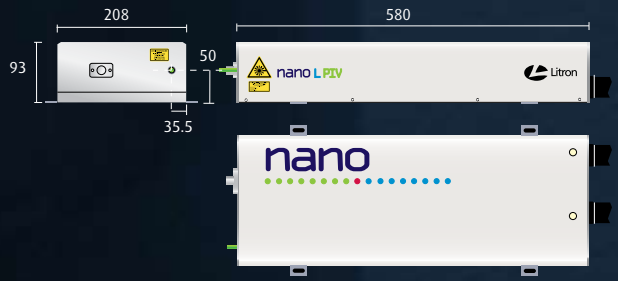
Litron Lasers

The Nano L PIV Pulsed Nd:YAG Laser System

Technical Data

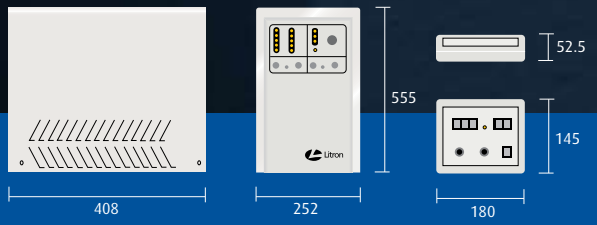
Model	Nano L 200-15 PIV	Nano L 135-15 PIV	Nano L 50-50 PIV	Nano L 100-50 PIV	Nano L 50-100 PIV
Repetition Rate per Laser Head (Hz)	0-15	0-15	0-50	0-50	0-100
Output Energy at 532nm per Laser Head (mJ)	**200**	**135**	**50**	**100**	**50**
Parameter					
Pulse - Pulse Stability (±%)	2	2	2	2	2
Beam Diameter (mm)	6.5	5	4	4	4
Beam Divergence (mrad)	~3	~3	~2	~2	~2
Pulse Length @ 1064nm (ns)	6-9	6-9	5-8	5-8	5-8
Pointing Stability (µrad)	<100	<100	<100	<100	<100
Resonator Type	Stable	Stable	Stable	Stable	Stable
Lamp Life (pulses)	>5x10^7	>5x10^7	>5x10^7	>5x10^7	>5x10^7
Timing Jitter (ns)	<0.5	<0.5	<0.5	<0.5	<0.5
Services					
Voltage (VAC)	90-250	90-250	90-250	200-250	200-250
Frequency (Hz)	47-63	47-63	47-63	47-63	47-63
Power	Single Phase	Single Phase	Single Phase	Single Phase	Single Phase
Ambient (˚C)	18-30	18-30	18-30	18-30	18-30
Consumption (W)	<800	<650	<800	<2500	<2500
Power Supply	LPU550	LPU550	LPU550	2xLPU1000	2xLPU1000

PIV Laser Head

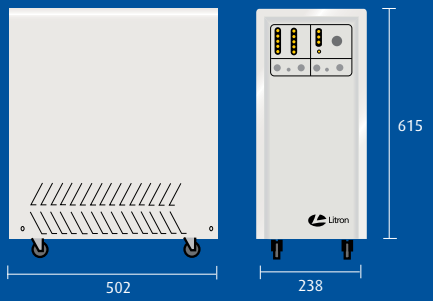


LPU550 PSU

Remote Control Box



LPU1000 PSU



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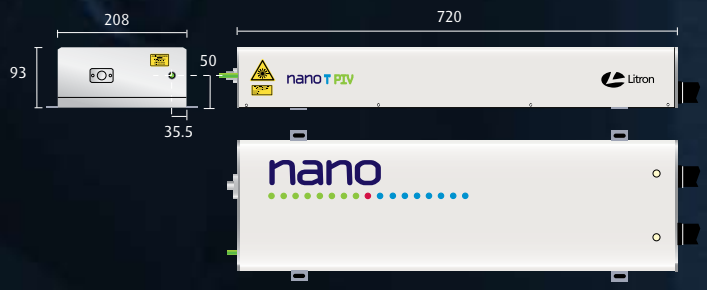
Litron Lasers

The Nano T PIV Pulsed Nd:YAG Laser System

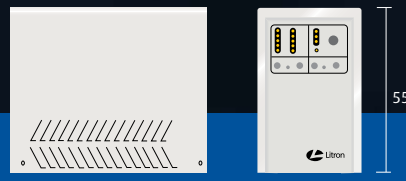
Technical Data

Model	Nano T 180-15 PIV	Nano T 135-15 PIV
Repetition Rate		
Per Laser Head (Hz)	15	15
Output Energy at 532nm		
Per Laser Head (mJ)	180	135
Parameter		
Pulse - Pulse Stability (±%)	2	2
Beam Diameter (mm)	6.35	5
Beam Divergence (mrad)	0.8	0.8
Pulse Length @ 1064nm (ns)	7-9	7-9
Pointing Stability (µrad)	100	100
Resonator Type	Telescopic	Telescopic
Lamp Life (pulses)	$5x10^7$	$5x10^7$
Timing Jitter (ns)	0.5	0.5
Services		
Voltage (VAC)	90-250	90-250
Frequency (Hz)	47-63	47-63
Power	Single Phase	Single Phase
Ambient (°C)	18-30	18-30
Consumption (W)	<800	<650
Power Supply	LPU550	LPU550

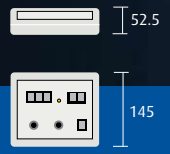
PIV Laser Head



LPU550 PSU



Remote Control Box



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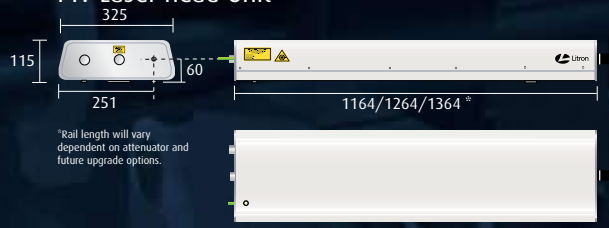
Litron Lasers

The LPY PIV High Energy Pulsed Nd:YAG Laser System

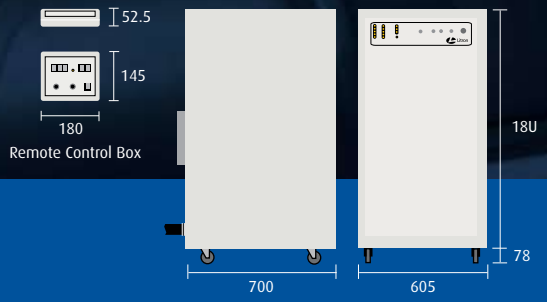
Technical Data

Model	LPY 706-20PIV	LPY 707-20PIV	LPY 704-30PIV	LPY 706-15PIV	PLY 707-15PIV
Repetition Rate per Laser Cavity (Hz)	20	20	30	15	15
Output Energy at 532nm per laser head (mJ)	**300**	**400**	**200**	**325**	**425**
Parameter					
Pulse Stability @ 532nm (±%)	<3	<3	<3	<3	<3
Beam Diameter (mm)	8	9	6.5	8	9
Beam Divergence (mrad)	0.8	~3	0.8	0.8	~3
Pulse Length @ 532nm (ns)	7-11	7-11	7-11	7-11	7-11
Pointing Stability (µrad)	<70	<70	<70	<70	<70
Lamp Life (pulses)	$5x10^7$	$5x10^7$	$5x10^7$	$5x10^7$	$5x10^7$
Timing Jitter (ns)	<0.5	<0.5	<0.5	<0.5	<0.5
Services					
Voltage (VAC)	200-250	220-250	220-250	220-250	220-250
Frequency (Hz)	47-63	50-60	50-60	50-60	50-60
Power	Single Phase	Single Phase	Single Phase	Single Phase	Single Phase
Water Temp Max. (°C)	20	20	20	20	20
Inlet Pressure (bar)	<2	<2	<2	<2	<2
Power Supply	2 x LPU1000	18U Rack	18U Rack	18U Rack	18U Rack

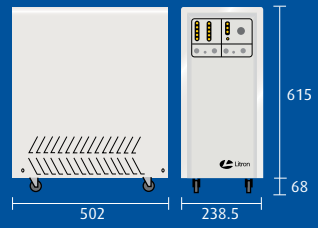
PIV Laser head Unit



Rack-mount PSU



LPU1000 PSU



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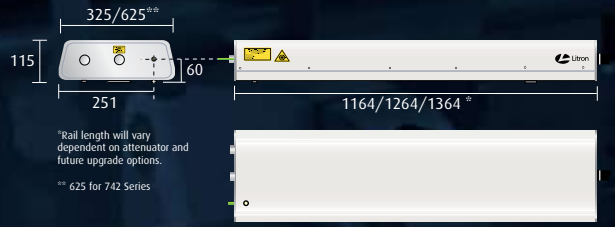
Litron Lasers

The LPY PIV High Rep. Rate Pulsed Nd:YAG Laser System

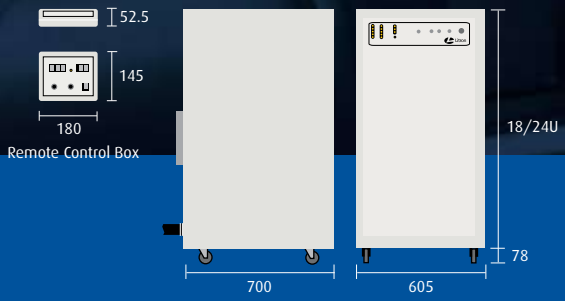
Technical Data

Model	LPY 704-100PIV	LPY 703-200PIV	LPY 742-100PIV	LPY 742-200PIV
Repetition Rate per Laser Cavity (Hz)	**100**	**200**	**100**	**200**
Output Energy at 532nm per laser head (mJ)	100	50	200	100
Parameter				
Pulse Stability @ 532nm (±%)	<3	<3	<3	<3
Beam Diameter (mm)	6.5	4	6.5	6.5
Beam Divergence (mrad)	~3	~3	~3	~3
Pulse Length @ 532nm (ns)	10-12	10-12	10-12	10-12
Pointing Stability (µrad)	<70	<70	<70	<70
Lamp Life (pulses)	10^8	10^8	10^8	10^8
Timing Jitter (ns)	<0.5	<0.5	<0.5	<0.5
Services				
Voltage (VAC)	220-250	220-250	220-250	220-250
Frequency (Hz)	50-60	50-60	50-60	50-60
Power	Single Phase	Single Phase	Single Phase	Single Phase
Water Temp Max. (˚C)	20	20	20	20
Inlet Pressure (bar)	<2	<2	<2	<2
Power Supply	18U Rack	18U Rack	24U rack	24U Rack

PIV Laser head Unit



Rack-mount PSU



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