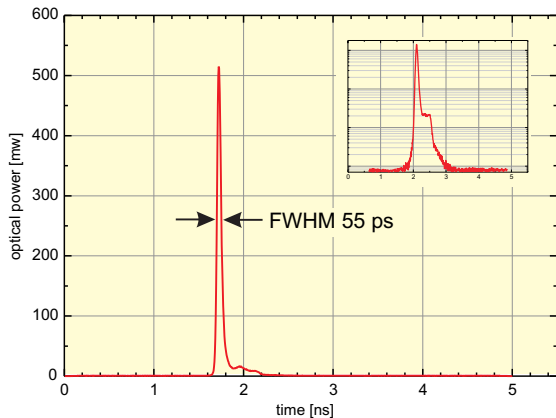


# LDH Series



## Picosecond Laser Diode Heads for PDL 800-B/-D/808/828



- Wavelengths from 375 to 1990 nm
- Peak power up to 1 W
- Pulse widths as short as 50 ps (FWHM)
- Repetition rates from single shot to 80 MHz
- Collimating optics, optional fiber coupler and peltier cooling
- Optional dual mode: cw and pulsed operation



## Applications

- Time-resolved fluorescence spectroscopy/microscopy
- Biochemical analytics
- Time-response characterization of optoelectronic devices
- Diffuse Optical Tomography (DOT)
- Seed for fiber lasers
- Single photon sources
- Quantum optics
- Optical Time Domain Reflectometry (OTDR)

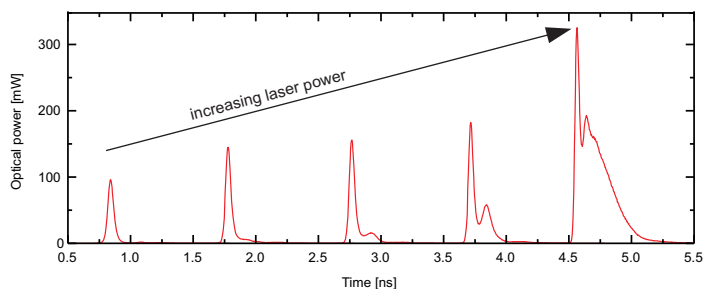
# Picosecond Laser Diode Heads

The system consists of a pulsed diode laser driver of the PDL Series (PDL 800-B, PDL 800-D, PDL 808 "Sepia" or PDL 828 "Sepia II") and interchangeable laser heads of the LDH Series. Laser heads with wavelengths from 375 to 1990 nm are available, including frequency converted models at 530 and 595 nm. The LDH Series laser heads include an integrated collimator or a fiber pigtail. A TE cooler is mandatory for some laser heads and can be provided for other laser heads as an option.

The LDH Series picosecond diode laser heads produce light pulses as short as 50 ps FWHM at repetition rates from single shot to 80 MHz. For selected wavelengths peak powers up to 1 W can be emitted. The pulse widths perfectly match the time resolution characteristics of standard detectors, but at one tenth the price of typical Ti:Sa or Argon-ion lasers. A combination of interchangeable LDH Series laser heads, together with a driver of the PDL Series, satisfies the demand for a compact and affordable excitation source that covers a wide range of wavelengths. The LDH Series offer the benefits of low cost and compact size in an integrated turn-key system, together with high repetition rates desired for fast Time-correlated Single Photon Counting (TCSPC). These capabilities open the door for entirely new applications beyond the research lab, e.g. in bioanalytics, biochemistry, genetics, semiconductor characterization and quality control. The latest generation of laser heads, the LDH-D Series, work in pulsed and cw mode. This dual feature is only supported by the PDL 800-D or the PDL 828 "Sepia II" driver.

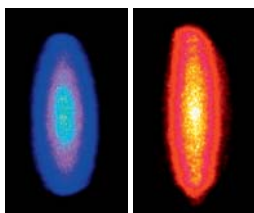
## Pulse shape vs. output power

The PDL Series of laser drivers feature easy-to-use controls for laser power level either by means of a potentiometer on the front panel or by a setting in the control software (PDL 828). The pulse width can, however, not be controlled directly. Instead, the pulse width and pulse shape depend on the laser power level. An example of this behaviour is shown on the right for a typical LDH-P-780 @ 40 MHz. The different curves are generated by simply changing the laser power level. "Clean" and near symmetrical pulses can only be achieved close to the lasing threshold (Low Power Level) while at maximum power the pulse is broadened by shoulder and/or additional peaks (High Power Level). As a second effect, a shift in the central emission wavelength can sometimes also be seen with increasing laser power.



## Beam shape

Due to diffraction, the beam diverges rapidly after leaving the laser chip, typically at 30 degrees at the vertical (fast) axis by 10 degrees at the horizontal (slow) axis. This leads to an elliptical beam shape after the collimating optics with typical dimensions of 1.5 x 3.5 mm. The beam shape can be influenced using optical fibers or an anamorphic beam shaper:



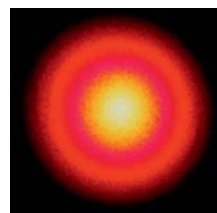
### Direct emission

All lasers emit a collimated beam with an elliptical beam shape with typical dimensions of 1.5 x 3.5 mm.



### Behind a multimode fiber

In case of a multimode fiber, the beam shape after the fiber is nearly round. A speckle pattern emerges by interference of multiple modes inside the fiber.



### Behind a single mode fiber

In case of a singlemode fiber, the beam shape after the fiber is a nice Gaussian profile as only one mode is transmitted within the fiber.

## Specifications

### Beam Parameters

Optics focus length	$f = 4.5 \text{ mm}$
Numerical aperture	0.55
Typical divergence with optics	Theta II 0.32 mrad, Theta $\perp$ 0.11 mrad*
Polarisation	typ. linear, perpendicular to the fast axis*
Polarisation degree	> 90 %*
Sidemode suppression ratio (SMSR)	< 0.01*

### Cooling (optional)

Peltier cooling stability . . . . . better than 1 K for ambient temperature between 15 °C and 30 °C

**Spectral Width** <sup>1)</sup> . . . . . < 900 nm: approx. 2 - 8 nm, > 900 nm: approx. 10 - 20 nm, cw: < 1 nm

### Power Stability (cooled)

12 hours,  $\Delta T_{\text{ambient}} < 3 \text{ K}$  . . . . . 1 % RMS, 3 % peak to peak

### Dimensions

Cooled ( $\varnothing \times$ length)	62 x 100 mm, with fiber coupling: 62 x 132 mm
Uncooled ( $\varnothing \times$ length)	25 x 76 mm, with fiber coupling: 25 x 106 mm
Flat type (l x w x h)	195 x 112 x 24 mm

1) for spectral width of laser heads with narrow bandwidth, please see table on third page

\* typical values

## Fiber coupling

All laser heads of the LDH Series can be coupled to optical fibers: multimode, singlemode or polarisation maintaining singlemode with different connector types. For the majority of applications an angled FC/APC connector is recommended to prevent backreflections into the fiber that could interfere with the laser stability. Coupling of the laser into an optical fiber has the benefit that the elliptical beam shape is transformed into a round beam at the output of the fiber. For a singlemode fiber, the resulting beam is nicely gaussian shaped. However, fiber coupling also leads to a reduced output at the end of the fiber. Typical coupling efficiencies are around 40 % for a singlemode fiber and around 80 % for a multi mode fiber.



## Available laser heads

Pulsed mode (LDH-P Series)			These laser heads can be driven by the PDL 800-B, PDL 800-D, PDL 808 "Sepia" or PDL 828 "Sepia II" driver units.					
wavelength (± 10 nm) nm	type	low power level (narrow pulse)			high power level (wide pulse)			
		pulse (FWHM) ps	average power 40 MHz 80 MHz mW		pulse (FWHM) ps	average power 40 MHz 80 MHz mW		
375	LDH-P-C-375	<70	0.3	-	<300	1.0	-	
375	LDH-P-C-375B	<70	0.3	-	<300	3.0	-	
405	LDH-P-C-405	<70	0.4	0.8	<300	2.0	4.0	
405	LDH-P-C-405B	<70	1.0	-	<300	3.0	-	
405	LDH-P-C-405M	<70	2.5	-	<600	20.0	-	
440	LDH-P-C-440	<90	0.3	-	<300	1.0	-	
440	LDH-P-C-440B	<70	0.3	-	<500	3.0	-	
440	LDH-P-C-440M	<70	3.0	-	<500	20.0	-	
450	LDH-P-C-450B	<70	0.7	-	<300	5.0	-	
470	LDH-P-C-470	<90	0.3	-	<300	1.0	-	
470	LDH-P-C-470B	<90	0.3	-	<500	3.0	-	
485	LDH-P-C-485	<100	0.3	-	<500	2.0	-	
485	LDH-P-C-485B	<100	0.6	-	<550	5.0	-	
500	LDH-P-C-500	<130	0.5	-	<500	2.0	-	
510	LDH-P-C-510	<130	0.3	-	<600	2.0	-	
531	LDH-P-FA-530	please see separate data sheet						
596	LDH-P-FA-595	please see separate data sheet						
635	LDH-P-635	<90	0.3	0.6	<400	2.5	4.0	
640	LDH-P-C-640B	<100	0.7	1.5	<400	4.5	9.0	
655	LDH-P-650	<70	0.4	0.9	<400	3.0	6.0	
660	LDH-P-660	<90	0.5	1.0	<500	5.0	10.0	
670	LDH-P-670	<70	0.3	0.7	<300	1.0	2.0	
665	LDH-P-670B	<90	0.3	0.7	<400	2.0	4.0	
690	LDH-P-690	<70	0.5	1.0	<400	4.0	8.0	
705	LDH-P-705	<70	1.2	2.5	<400	5.0	10.0	
735	LDH-P-730	<130	0.3	0.6	<400	1.7	3.5	
757	LDH-P-760	<90	0.4	0.9	<300	3.0	6.0	
785	LDH-P-780	<70	0.5	1.0	<500	5.0	10.0	
806	LDH-P-810	<90	0.4	0.9	<500	5.0	10.0	
830	LDH-P-830	<70	0.2	0.4	<300	4.0	8.0	
835	LDH-P-840	<90	1.0	2.0	<750	6.0	12.0	
850	LDH-P-850	on request						
905	LDH-P-905	<90	0.5	1.0	<300	4.0	8.0	
952	LDH-P-950	<90	0.2	0.4	<400	2.0	4.0	
965	LDH-P-965	<90	1.2	2.5	<400	10.0	20.0	
975	LDH-P-980**	<90	0.6	1.2	<750	10.0	20.0	
1025	LDH-P-F-1030	<90	1.0	2.0	<550	5.0	10.0	
1060 (± 20 nm)	LDH-P-1060	<50	1.0	2.0	<50	10.0	20.0	
1080	LDH-P-C-1080*	-	-	-	<50	2.5	5.0	
1120	LDH-P-C-1120*	-	-	-	<90	2.5	5.0	
1310 (± 20 nm)	LDH-P-1310	<50	0.1	0.2	<500	1.0	2.0	
1550 (± 30 nm)	LDH-P-1550	<50	0.01	0.02	<400	0.5	1.0	
1990	LDH-P-F-1990	<120	0.05	0.1	<500	0.15	0.3	

Option B: high power version.  
Option C: laser head with thermoelectric cooler, mandatory for some laser heads, optional for all other laser heads.  
Option M: transversal multimode structure, reduced coupling efficiency into singlemode fibers  
Option F: laser head emits a divergent beam from FC/APC fiber output connector  
\* pulse width independent from selected power level  
\*\* not suited for fiber coupling

Short pulses (on selection)			These laser heads can be driven by the PDL 800-B, PDL 800-D, PDL 808 "Sepia" or PDL 828 "Sepia II" driver units.	
wavelength (± 10 nm) nm	typ. pulse width (FWHM) ps	average power 40 MHz 80 MHz mW		
		655	54	0.4
670	39	0.3	0.7	
690	54	0.5	1.0	
785	54	0.5	1.0	
830	44	0.3	0.7	

Dual mode: cw and pulsed operation (LDH-D Series)			These laser heads can only be driven by the PDL 800-D or the PDL 828 "Sepia II" driver units.					
wavelength (± 10 nm) nm	type	cw power mW	low power level (narrow pulse)			high power level (wide pulse)		
			pulse (FWHM) ps	average power 40 MHz 80 MHz mW		pulse (FWHM) ps	average power 40 MHz 80 MHz mW	
375	LDH-D-C-375	10	<70	0.3	-	<300	3.0	-
405	LDH-D-C-405	20	<70	1.0	-	<300	3.0	-
405	LDH-D-C-405M	400	<70	2.5	-	<600	20.0	-
440	LDH-D-C-440	20	<70	0.3	-	<500	3.0	-
440	LDH-D-C-440M	400	<70	3.0	-	<500	20.0	-
450	LDH-D-C-450	10	<70	0.7	-	<300	5.0	-
470	LDH-D-C-470	10	<90	0.3	-	<500	3.0	-
485	LDH-D-C-485*	30	<100	0.6	-	<550	5.0	-
500	LDH-D-C-500	5	<130	0.5	-	<500	2.0	-
510	LDH-D-C-510	10	<130	0.3	-	<600	2.0	-
635	LDH-D-C-635M	100	<100	2.0	4.0	<400	10.0	20.0
640	LDH-D-C-640	20	<100	0.7	1.5	<400	4.5	9.0
660	LDH-D-C-660	30	<70	0.7	1.5	<500	4.5	9.0
670	LDH-D-C-670	15	<90	0.3	0.7	<400	2.0	4.0
690	LDH-D-C-690	20	<70	0.5	1.0	<500	4.0	8.0
730	LDH-D-C-730	8	<120	0.3	0.7	<800	1.7	3.5
830	LDH-D-C-830	20	<70	0.2	0.4	<300	4.0	8.0
1080	LDH-D-C-1080**	30	-	-	-	<50	2.5	5.0
1120	LDH-D-C-1120**	20	-	-	-	<90	2.5	5.0

other wavelengths are available on request

Option C: laser head with thermoelectric cooler  
Option M: transversal multimode structure, reduced coupling efficiency into singlemode fibers  
\* different coupling efficiency into optical fibers for pulsed and cw operation due to astigmatism  
\*\* pulse width independent from selected power level

Narrow spectral bandwidth			These laser heads can be driven by the PDL 800-B, PDL 800-D, PDL 808 "Sepia" or PDL 828 "Sepia II" driver units.					
central nm	wavelength variation nm	spectral width (FWHM) nm	low power level (narrow pulse)			high power level (wide pulse)		
			pulse (FWHM) ps	average power 40 MHz 80 MHz mW		pulse (FWHM) ps	average power 40 MHz 80 MHz mW	
772	± 3	<1.0	<120	1.2	2.5	<350	3.5	7.0
784	± 3	<0.3	<100	0.9	1.6	<500	4.0	8.0
852	± 3	<0.3	<100	0.7	1.5	<350	5.0	9.0
976*	± 3	<0.5	-	-	-	<90	5.0	10.0
1063	± 3	<0.5	<100	0.4	0.9	<700	5.0	10.0
1063**	± 3	<0.5	<100	7.5	15.0	<500	15.0	30.0
1064	± 3	<1.0	<130	0.6	1.3	<600	5.0	10.0
1275	± 7	0.5	<40	0.01	0.03	<250	0.6	1.3
1300	± 7	0.5	<40	0.01	0.03	<250	0.6	1.3
1310	± 7	0.5	<40	0.01	0.03	<250	0.6	1.3
1325	± 7	0.5	<40	0.01	0.03	<250	0.6	1.3
1349	± 7	0.5	<40	0.01	0.03	<250	0.6	1.3
1417	± 3	0.2	<100	0.01	0.03	<400	0.5	1.0
1470	± 3	0.2	<40	0.02	0.05	<500	0.6	1.3
1490	± 3	0.2	<40	0.02	0.05	<500	0.6	1.3
1510	± 3	0.2	<40	0.02	0.05	<500	0.6	1.3
1530	± 3	0.2	<40	0.02	0.05	<500	0.6	1.3
1550	± 3	0.2	<40	0.02	0.05	<500	0.6	1.3
1530 to 1560	any wavelength	0.5	<100	0.4	0.9	<900	4.5	9.0
1570	± 3	0.2	<40	0.02	0.05	<500	0.6	1.3
1590	± 3	0.2	<40	0.02	0.05	<500	0.6	1.3
1610	± 3	0.2	<40	0.02	0.05	<500	0.6	1.3

available upon request (± 3 nm): 760, 763, 780, 795, 937, 1083 nm

Only available with option C: laser head with thermoelectric cooler  
\* pulse width independent from selected power level  
\*\* incl. fiber amplifier

**Please check our webpage for all available wavelengths and updated information.**

Other wavelengths as well as wavelength selection are available upon special request. All measurements shown may be subject to a 10 % calibration error.

**Each laser head undergoes an extensive burn-in test to ensure long-term stability and is shipped with a comprehensive set of test data. This test data is kept in our database, which already holds records of more than 10 years.**



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