PDL 800-D

Picosecond Pulsed Diode Laser

PicoQuant GmbH
Unternehmen für optoelektronische Forschung und Entwicklung

User's Manual

Version 1.1

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1. System Description

The PDL 800-D is a pulsed diode laser driver unit featuring easy-to-use controls for both laser power level and pulse width (intensity) as well as the repetition frequency. Peak powers up to 1 Watt and pulses as short as 50 ps (FWHM) at repetition rates from single shot up to 80 MHz can be emitted, depending on the Laser Head in use. Additionally, with special featured Laser Heads also continuous wave (cw) mode is possible.

The driver unit features a pulse generator that generates a low jitter clock signal. The clock generator consists of two selectable Master Oscillators and a Frequency Divider. The Master Oscillators typically run at 80 MHz and 1 MHz which are divided binary by a factor between 1 and 32. This way a repetition frequency range from 31.25 kHz to 80 MHz can be covered. Alternatively, the laser pulses can be triggered by an external trigger input. This way the PDL 800-D can be synchronised with other instruments over the full frequency range from single shot to 80 MHz. A permanently active sync output allows the PDL 800-D to trigger other devices such as TCSPC electronics.

A simple change of the Laser Head allows a quick change of the wavelength. The Laser Heads are built either in a small 25mm diameter housing or as a temperature stabilized version with an internal Peltier cooler. Both include collimating optics and can be optionally fitted with single- or multi-mode optical fibres.

The PDL 800-D driver is designed for operation with the following types of Laser Heads:

- LDH-P Series picosecond pulsed diode lasers
- LDH-P-C Series cooled picosecond pulsed diode lasers
- LDH-D-C Series cooled dual-mode (pulsed and cw) diode lasers
- PLS Series sub-nanosecond pulsed LEDs

The Laser Heads contain a diode element and a power driver stage that features various adjustments and protection circuits. These parts are internally calibrated and then sealed after final inspection. Any tampering with these calibrations will void the guarantee.

The only user adjustable part of the Laser Head is the set-point for the thermoelectric (TE) cooler (LDH-X-C Series only). The temperature regulation is described in section 5.9.

2. Safety Instructions

To avoid hazardous radiation exposure, you should obey the following instructions:

1. Laser radiation can be emitted whenever the laser is powered and the white *"STBY" (standby) LED (1)* is illuminated. Never look directly into the laser beam. The Laser Head emits visible or invisible laser radiation from the collimator's aperture, shown below. The wavelength and maximum power that is emitted from your Laser Head model is indicated in the technical data sheet in the appendix of this manual and on the warning label on each Laser Head. The warning label and an aperture label are located on the Laser Head, as shown below

Figure 1: Model LDH Laser Head (not temperature controlled) - side view

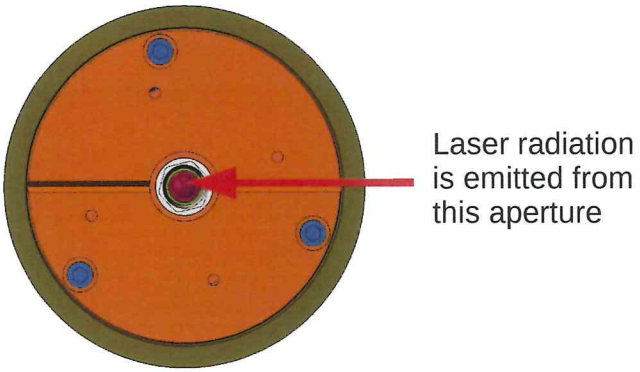


Figure 2: Model LDH-C Laser Head (temperature controlled)- front view

2. Always switch OFF the driving unit to remove or change the Laser Head or a fiber coupler.
3. Mount the Laser Head in your optical set-up in such a way that the laser light emitted from the collimator cannot cause any eye safety hazard. If a fibre output is installed, make sure that the fibre and the fibre coupler are mounted securely to the Laser Head. Mount the emitting end of the fibre in such a way that any exposure to the human eye is impossible.
4. Only use Laser Heads supplied by PicoQuant with the Laser Driver.
5. Never open the housing of the Laser Head or the driver unit. There is no need for maintenance beside visual inspection for damages and external cleaning. For safety reasons you should periodically (monthly) check the function of the emission indicators, the remote interlock and that no scattered radiation can leave the collimator (e.g. by lost screws).
6. **CAUTION - use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.**

3. User Interface - Operating Controls and Connections

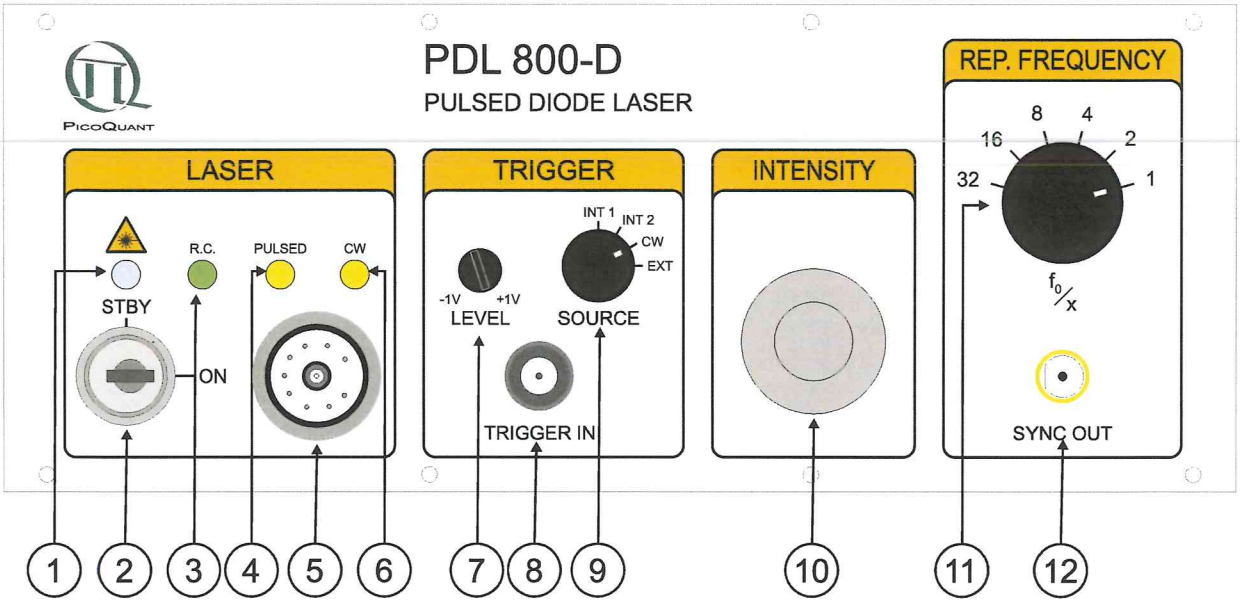


Figure 3: Front Panel

1. *Main Power indicator* - white “STBY“ (standby) LED indicates that the PDL 800-D is ON and that laser radiation can be emitted.
2. *Key switch* (Laser power switch). Power to the laser can be locked OFF by turning the key to the “STBY“ position and removing the key.
3. *Remote Control* - (optional)
4. *Laser Pulsed* - yellow LED indicates that the laser is running in pulsed mode and triggered.
5. *Laser output* (multi-pin connector)
6. *Laser CW*- yellow LED indicates that the laser is running in cw mode
7. *Trigger level threshold control*
8. *External trigger input*, (female BNC connector)
9. *Trigger source selector*

   INT1 - Laser is triggered by the first internal oscillator (typically 80 MHz)

   INT2 - Laser is triggered by the second internal oscillator (typically 1 MHz)

   CW - Laser is running in Continuous Wave mode

   EXT - Laser is triggered by an external signal, provided that the Trigger Level threshold (7) is set correctly.
10. *Laser intensity control* - pulse shape (intensity and length) or cw -power can be adjusted
11. *Repetition frequency selector*: repetition frequency = the base frequency divided by the selector setting
12. *Synchronisation signal output* (SMA connector)

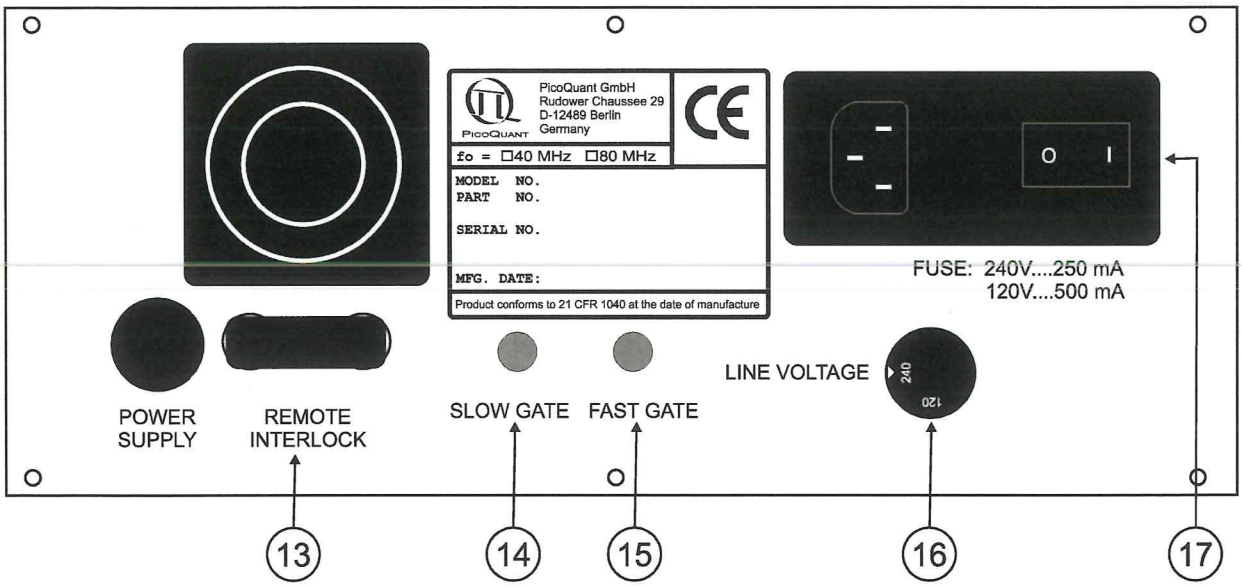


Figure 4: Back Panel

13. *Remote interlock connector*
14. *Slow Gate input (see section 5.10)*
15. *Fast Gate input (see section 5.10)*
16. *Line voltage selector 120 / 240 V*
17. *Main power input socket with fuse and ON / OFF switch*

4. Installation

Before making any connections, be sure that all of the following conditions are met:

- *Main power ON / OFF switch (17)* is in the "0" position.
- *Line voltage selector (16)* is set to the correct voltage
- *Key switch (2)* is set to the "STBY" (standby) position.
- *Laser intensity control (10)* is set to the lowest setting

4.1. Electrical Power and Signal Connections

Connect the Laser Head to the Laser Head output connector (5).

Only use Laser Heads supplied by PicoQuant, with the Laser Driver.

Only connect or disconnect a Laser Head when the driver unit is switched off.

- Connect (if necessary) the "REMOTE INTERLOCK" (13) to a switch loop (see below) or use the installed short circuit bridge if no interlock is needed.

- If desired, connect an external trigger signal to the "TRIGGER IN" connector *(8).*
- If desired, connect the "SYNC OUT" connector (12*)* to an external device, e.g. the TimeHarp or PicoHarp TCSPC electronics or an Oscilloscope.
- Plug in the power cable.

Remote Interlock Connector

In order to meet laser safety regulations, you may need to install a remote interlock, e.g. a door switch, to deactivate power to the laser when the door to the laser area is opened. The "REMOTE INTERLOCK" connector (13) on the back panel is provided for this purpose. When the contacts are open the laser is then locked off.

Remove the bridge and connect your remote interlock (door) switch to the "REMOTE INTERLOCK" connector (13). Standard banana plugs can be used for the connection. The loop resistance of the cabling plus the switch must be less than 10 Ohms. The voltage that is present on this connector is < 7 VDC.

4.2. Heat Dissipation

Driver Unit:

Please ensure free air circulation and do not cover the cooling fan at the back panel.

Temperature Controlled Laser Heads (LDH-C Models):

The LDH-C series Laser Heads contain an active thermoelectric cooling mechanism. Depending on the ambient temperature, this can produce a considerable amount of heat at the housing.

A sufficient air circulation must be ensured to prevent overheating of the Laser Head. If possible, mount the Laser Head on little posts as shown in Figure 5 to allow air convection around the whole surface. Mounting material as shown there is available from PicoQuant as an accessory.

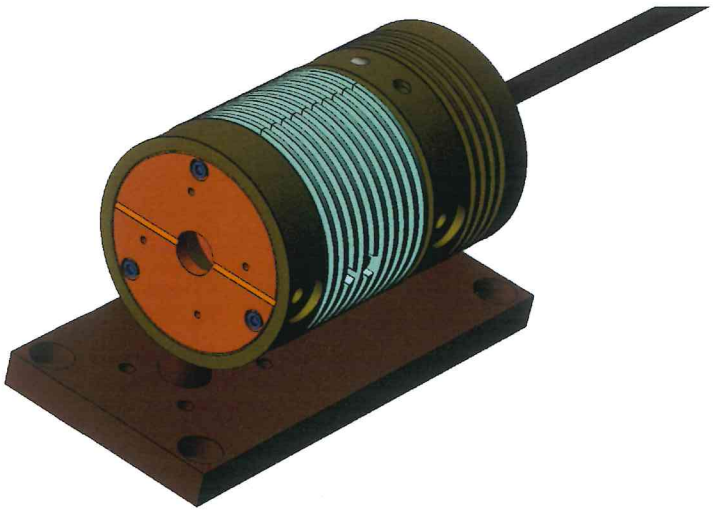


Figure 5: Mounting of a cooled Laser Head for best heat dissipation

Standard Laser Head (LDH Models)

The output power of Laser Heads without temperature stabilisation changes with the case temperature. They deliver better long term stability if they are operated in a temperature conducting mount.

If you own a high power, but not temperature controlled Laser Head, an extra heat sink may be required. Otherwise the self-heating of the Laser Head would lead to a significant drop of the output power and also a shorter lifetime of the laser diode. It is mentioned in the test sheet of your Laser Head in the Appendix if a heat sink is mandatory. Placing the Laser Head into a metal bracket directly connected to a surface of some square centimetres is sufficient in most cases.

5. Operation

5.1. Power ON

1. **Put the key switch (2) to the stand-by position ("STBY").**
2. **Ensure that no one is looking into the aperture of the Laser Head.**
3. Switch the *Main power switch (17)* to ON and the white *"STBY" (standby) LED (1)* will illuminate. **If the key switch (2) was not in the "STBY" position when the main power switch (17) was turned on, then, for the first 10 seconds the laser output will be blocked. After that time the laser will start by itself according to the settings on the front panel !**
4. Set the "TRIGGER SOURCE" selector (9) to the appropriate position:

   INT1 - Pulsed mode, triggering from the first internal oscillator (usually 80 MHz)

   INT2 - Pulsed mode, triggering from the second internal oscillator (usually 1 MHz)

   CW - Continuous Wave mode

   EXT - Pulsed mode; laser is triggered by an external signal (Trigger level must be adjusted correctly, see section 5.4)
5. With temperature stabilized Laser Heads (LDH-C series) wait until the STATUS LED of the Laser Head turns green.
6. Turn the key switch (2) to "ON".
7. The yellow "PULSED" LED (4) or the "CW" LED (6) will illuminate depending on the mode set at the "TRIGGER SOURCE" selector (9)
8. Adjust the laser power level with the "INTENSITY" control (10)

If you cannot detect a laser beam, check the following:

<table>
<tr><td colspan="4">A yellow "laser on" indicator LED (4 or 6) is on ?</td></tr>
<tr><td>Yes</td><td colspan="3">No</td></tr>
<tr><td rowspan="4">Has the Slow Gate switched off? (see section 5.10) If no Slow Gate is used, a bridge must be plugged into the connector (14)</td><td colspan="3">Trigger source selector (9) ?</td></tr>
<tr><td>CW</td><td>INT</td><td>EXT</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Is the selected frequency above an internally set limit (see section 5.2) ? Check rear panel for a note.</td><td>Is the trigger level set correctly ?</td></tr>
<tr><td>Does the triggering signal meet the specifications of pulse width and amplitude ? See section 5.4</td></tr>
<tr><td>For temperature stabilized Laser Heads (LDH-C models): Does the "STATUS" LED of the temperature control light green ?</td><td></td><td colspan="2">Has the Fast Gate switched off ? (see section 5.10) A short circuit on the "FAST GATE" connector (15) switches off the laser.</td></tr>
<tr><td rowspan="2">Is the "INTENSITY" control (5) set to the upper region ?</td><td colspan="3">Is the key switch (2) in the "ON" position ?</td></tr>
<tr><td colspan="3">Is the Remote Interlock loop closed ? See section 4</td></tr>
</table>

NOTE: The output of pulsed UV-LEDs (PLS 265 to PLS 340) is hard to detect. The wavelengths are far from the visible spectrum and the output power is very low (1 µW region). You need to use a sensitive optical power meter or an appropriate indicator card to recognize any output.

5.2. Selecting the Repetition Frequency

The repetition frequency at internal triggering can be chosen in a wide range from 31.25 kHz to 80 MHz. The triggering signal is derived from one of two internal crystal oscillators.

Base Frequencies

The Base Frequencies are typically 80 MHz and 1 MHz. The base frequency oscillator is chosen with the "TRIGGER SOURCE" switch (9).

INT1 selects the first oscillator (typically 80 MHz), INT2 the second oscillator (typically 1 MHz). Different frequencies are possible on request, check at the rear panel for the actual base frequencies of your driver.

Binary Divider

The Base Frequency can be binary divided by six division ratios from 1 to 32. The repetition frequency division ratio is chosen with the rotary switch (11). The following table gives an overview of all possible repetition frequencies from the internal oscillator at the standard Base Frequencies of 1 and 80 MHz.

Oscillator (switch 9) ***Division ratio (switch 11)***	***INT 1***	***INT 2***
1	80 MHz	1 MHz
2	40 MHz	500 kHz
4	20 MHz	250 kHz
8	10 MHz	125 kHz
16	5 MHz	62.5 kHz
32	2.5 MHz	31.25 kHz

When the repetition frequency is changed, the average power of the laser will also change. As the pulse energy is constant for a wide range of repetition frequencies the average power typically doubles or halves respectively with each step on the division ratio switch (11).

Note that for repetition frequencies above 20 MHz saturation effects can occur which cause a slight drop of pulse energy and consequently lower average power levels that the expected double of the previous frequency.

For the safe operation with light sources which are specified for a maximum repetition frequency lower than 80 MHz the higher frequencies can be blocked by factory. A note on the rear panel indicates a reduced maximum frequency. When switching to an internally blocked frequency, the "PULSED" LED (4) will go off.

5.3. Changing the Pulse Intensity

The energy of the laser-pulses can be changed with the "INTENSITY" control (10). At higher settings the pulses will not only be more intense, but also longer and a slight after-pulsing may occur.

Changing the repetition frequency may change the shape of the pulses. In some instances, these changes can be compensated by adjusting the "INTENSITY" control (10), in order to retain the desired pulse form.

For long-term stable output power, allow the laser to warm-up for at least 20 minutes. This is especially important for temperature stabilised Laser Heads.

Some higher power Laser Heads may only operate in the upper range of the intensity setting. Keep in mind that operation at higher power decreases the lifetime of the laser diode. To ensure safer working conditions and to prolong the lifetime of the laser element, select a power setting that is as low as possible for your needs. Full laser power should not be selected unless it is absolutely needed.

5.4. External Triggering of the Laser

The laser can also be triggered by an external signal source at any frequency

- First, set the key-switch (2) to the "STBY" position.
- Connect the trigger signal generator to the "TRIGGER IN" connector (8). The maximum limits for the trigger signal input voltage are -5 V and +5 V. To prevent reflections, the output impedance of the signal source and the characteristic impedance of the cable and coaxial connectors must be exactly 50 Ohms.
- Set the "TRIGGER SOURCE" selector (9) to the "EXT" position.
- Adjust the trigger level between -1 V to +1 V with the "TRIGGER LEVEL" control (7). The trigger level may have to be "fine tuned" to achieve the shortest possible pulse width. If the pulses are significantly broader than with internal triggering or if there are multiple pulses, the external triggering is not ideally locked. Readjusting the trigger level may help with weak input signals. The ringing of the signal source can lead to multiple pulses (consequently, the trigger level should not be set too close to zero).

When the yellow "PULSED" LED illuminates laser pulses are triggered at the rising edge of the trigger signal.

Trigger signal recommendations

Special care has to be taken to the quality of the triggering signal. To maintain the picosecond pulse to pulse stability the signal source itself must have the appropriate quality. A good trigger signal has steep slopes (few nanoseconds), low noise and a stable periodicity.

Although the trigger input is designed as quite sensitive the best results are achieved with amplitudes between 1 and 2 Volts and pulse width greater than 5 ns.

When using TTL signals an attenuator of 10 dB may deliver better results. Per specification the low level of a TTL signal may be as high as 0.8 Volts which is already very close to the highest settable trigger level.

5.5. Continuous Wave Operation

With Laser Heads of the LDH-D-C series also a continuous wave operation is possible. This mode is selected by switching the "TRIGGER SOURCE" selector to "CW".

Note that significantly higher output power will be produced than in pulsed mode, especially compared to low repetition frequencies generated in the "INT2" setting.

The power can be adjusted by the same "INTENSITY" regulator (10).

During cw operation the synchronisation output (12) delivers the same signal as in the "INT1" setting of the "SOURCE" selector (9). This can be useful to perform correlation measurements with TCSPC electronics like "TimeHarp" or "PicoHarp".

5.6. Fibre Coupling

Fibre coupling is an option for all types of Laser Heads. They can be equipped with either single-mode (SM) or multi-mode (MM) fibres as well as with polarisation maintaining (PM) fibres. If applicable, the fibre type for each specific Laser Head is indicated in the individual Test Report in the Appendix.

Please do not remove the fibre cord from the coupling optics, the adjustment of the coupling will be lost ! Re-adjustment is a demanding task and needs some experience.

5.7. Polarisation

The laser beam which is emitted from the collimated output is linearly polarised. The polarisation extinction ratio for diode lasers is typically about 20dB or 100:1. The polarisation plane of the laser output is marked by a groove at the front plate of the LDH-C type Laser Heads and might be different for different types of Laser Heads.

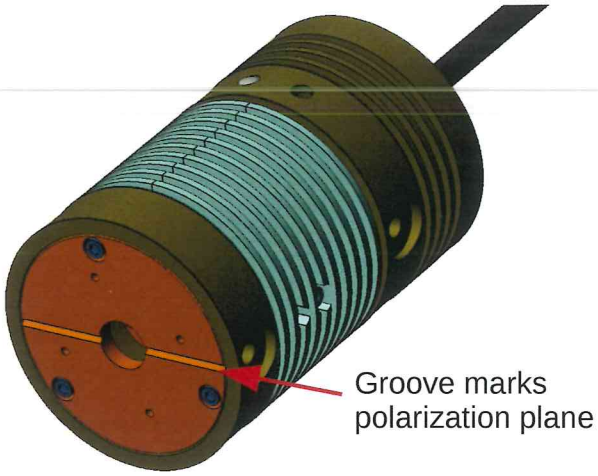


Figure 6: Polarisation of collimated output

5.8. Triggering other Devices with the Synchronisation Signal

With each laser pulse a synchronisation signal is provided at the “SYNC OUT” connector (12). This can be used to synchronise other devices for any kind of time correlated measurements or to synchronise multiple light sources.

The amplitude corresponds to the NIM Standard (< -800 mV at 50 Ohms) and has a pulse width of about 6 ns.

The synchronisation signal is always synchronised to the trigger source (internal or external depending on the setting of the “SOURCE” selector (9). In cw mode a synchronisation signal according to the “INT1” mode is present at the output.

When the laser is switched off at the key-switch (2) the synchronisation signal is still running according to the settings of switches (9) and (11).

For operation with the “TimeHarp” Time Correlated Single Photon Counting boards, an “LTT100” pulse converter, available from PicoQuant, must be used.

5.9. Temperature Control (model LDH-C Laser Heads only)

The only user adjustable part of the Laser Head is the set-point for the thermoelectric (TE) cooler. Since the output power at a given potentiometer setting depends slightly on the temperature of the diode element, the set-point should only be changed if absolutely necessary, e.g. if the ambient temperature is too high.

The thermoelectric (TE) cooler maintains the temperature of the diode element and the collimating optics at a constant level. The factory pre-set value is approximately 20°C. Before first operating the diode laser, verify that the temperature control potentiometer is set correctly. The desired temperature can be set via the Set-point Adjustment potentiometer (see figure 7 below) using a screwdriver.

The temperature level can be set from +15 to +25°C. The temperature should be chosen with respect to the ambient temperature and humidity conditions. The outer case acts as a heat sink. To prevent overheating, the temperature should not be set to the lowest value if the ambient temperature is higher than 30°C. Also, if the ambient humidity is high, water may condense on the collimator. **Switch the laser OFF** and look at the collimating lens to determine if condensation is forming. **DO NOT look into the laser optics when the laser is ON!**

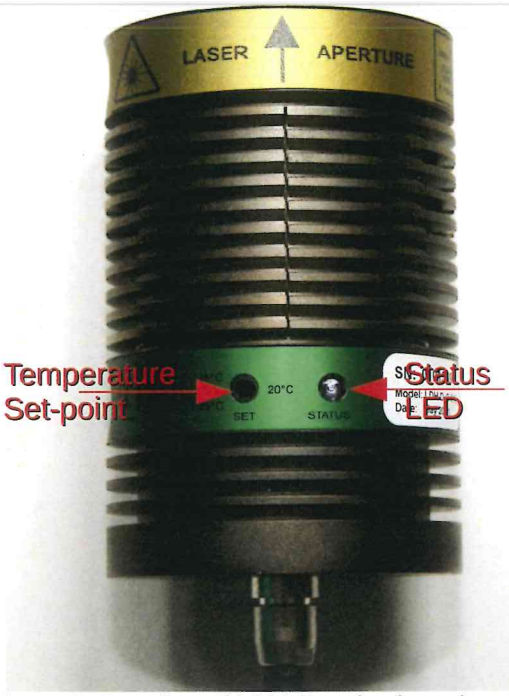


Figure 7: Top-view of LDH-C series laser head

The temperature of the diode element needs to reach the set-point temperature for stable operation. At start-up the "STATUS" LED may be red. The laser is switched off when the diode temperature is too high. It is indicated by the LED lighting red. Allow about 2 to 5 minutes after start-up, under normal conditions, for the TE cooler to reach the set-point temperature. The "STATUS" LED will change to green when the temperature has reached the set-point.

Check the Temperature Control "STATUS" LED on the Laser Head, if it is:

green - the laser diode is operating at the set-point temperature

red - the laser diode temperature is too high and the laser will automatically turn off

Check the "STATUS" LED periodically. If it is red the TE cooler is operating but not able to maintain the diode element temperature. In this case, switch the laser off and wait until the Laser Head has cooled down. Then, adjust the temperature set-point to a higher value, reduce the ambient temperature or increase the ventilation near the diode laser housing.

At higher operating temperatures the diode laser can provide approximately 10 % more output power, but the diode element lifetime will be much longer if operated at a lower temperature.

5.10. Gating

For special applications like scanning devices the PDL 800-D has two gating functions which allow to suppress the laser emission by an external signal.

Fast Gate

The Fast Gate function affects the triggering mechanism. It is effective when the module is being triggered either from the internal oscillators or from an external source. If the laser is in CW mode then the fast gate input has no effect.

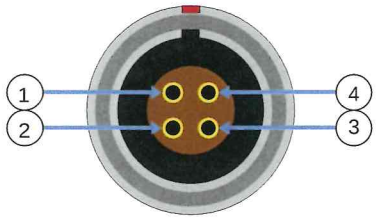
This gating function can perform transition within nano-seconds; presumed a precise timing it can switch between two laser pulses, even at high repetition rates. However, due to thermal effects a certain settling effect will be observed. The temporal position and the pulse height might be different for a certain amount of pulses at the beginning of a burst. The actual settling time changes with the Laser Head and the driving conditions. Either longer burst length or shorter burst periods help to increase the percentage of stable pulses in one burst. Finding a good ratio between burst-length and burst-period is an empirical process to reduce the influence of the settling effects to the measurement results to a minimum.

To use the fast gating mechanism connect a high-active TTL signal to the “FAST GATE” connector (15). The input has an internal pull up resistor to TTL “High” level.

The yellow “PULSED” LED (4) will turn off when the Fast Gate has switched off for more than 100 ms.

Slow Gate

With the Slow Gate function the voltage that controls the output power is switched to zero. That way it works regardless which trigger mode is active as well as in cw mode and drift effects are minimised. However, this is a comparable slow modulation of the high repetition rate pulses.



Pin #	*Function*
1	Anode
2	Cathode
3	Ground
4	+5 Volts

Figure 8: Pin Assignment of the SLOW GATE input

The Slow Gate input is isolated by an opto-coupler and a current must be fed into the input to activate the laser. Applying a voltage of 5 Volts to pin 1 and 2 of the connector activates the laser. When this gating function is not used, a bridged connector, that connects pin 2 with 3 and pin 1 with pin 4 must be plugged into the “SLOW GATE” connector (15) to hold the laser always active. The bridge connector is installed per default at the factory.

Note that at Slow Gating only the Laser Head is gated. The yellow indicator lamps will still be on when the laser is switched off by the Slow Gate signal.

6. Application Tips

The PDL 800-D was designed for indoor laboratory use. The laser element, inside the Laser Head, is somewhat sensitive, i.e. overloads or stress may quickly damage it. Therefore, the Laser Head includes protection circuitry that may seem to hinder the user, but is absolutely essential for long-term reliable performance.

Remember to follow these basic operating rules :

- Ensure that no one is looking into the aperture of the Laser Head during operation.
- Do not connect or disconnect the Laser Head from the base unit until the power has been switched OFF for at least 5 seconds.
- Do not connect the Laser Head to any driver other than the PDL series (PDL 800-B, PDL 800-D, PDL 808, PDL 828) or any other driver designated by PicoQuant as compatible. If any other supply voltages or signals are connected to the Laser Head, the system can be damaged and / or uncontrolled laser radiation could result.
- The voltage at the “TRIGGER IN” connector (8) should never exceed the range from -5 V to +5 V, otherwise the electronics may be damaged. To prevent reflections, the output impedance of the trigger signal source and the coaxial connector must be exactly 50 Ohms.
- There are no operator serviceable parts inside the Laser Heads or the driver unit. Repairs or recalibration should be left to qualified personnel authorized by PicoQuant GmbH. Especially do not try to remove the 4 screws at the front of the uncooled Laser Head! Doing this will easily damage the laser diode.
- An external signal should only be connected to / disconnected from the “TRIGGER IN” connector (8) when the *Key switch (2)* is in the "STBY" (standby) position. This will prevent “glitches“ that might result in unwanted laser radiation.
- To ensure safer working conditions and to prolong the lifetime of the laser element, select a lower power setting (approx. 35% of full power). Full laser power should not be selected unless it is absolutely needed. This applies especially to the laser diodes in the ultraviolet and blue region, which still have a more limited lifetime. It is recommended to switch off these lasers at the key switch (2) whenever possible. The main power switch of the driver can be left on to maintain the stabilised temperature.

The pulse shape will be influenced by:

- Laser intensity setting - a higher intensity setting may produce:
  - –Pulses with a higher amplitude and broader base. After-pulsing may also occur.
  - –Peak shift to an earlier time (arrives sooner) in relation to the SYNC signal.
  - –Peak shift of the emitted light to a shorter or longer wavelength (depending on the laser material).

- Repetition frequency - a higher repetition frequency may produce:
  - –Pulses with a different shape or pulse width
  - –Pulses with a lower peak power per individual pulse.
  - –Pulses with lower energy per individual pulse.

  In most cases, the energy of the individual pulses is not the same at each frequency setting, e.g. the energy at the 80 MHz setting is lower than at the 40 MHz setting. Changing the repetition frequency setting will not result in the same pulse energy until the setting is ≤ 10 MHz.

- Polarisation / orientation of the laser - rotating the Laser Head 90^0 may produce pulses with a different shape and a different intensity. This may also reduce the amount of background luminescence observed by the detector.

7. Support

The PDL 800-D has gone through extensive testing by PicoQuant and various users. It is based on the technology of the PDL 800-B which has proven to be reliable for many years. Nevertheless this approved technology has gone through several optimisation processes and will be continually improved in the future.

In any case, we would like to offer you our complete support. Please do not hesitate to contact PicoQuant if you would like assistance with your system.

If you observe any errors or bugs, please try to find a reproducible error situation. E-mail a detailed description of the problem and relevant circumstances to *info@picoquant.com.* Your feedback will help us to further improve the product and documentation.

Of course we also appreciate good news: If you have obtained exciting results with one of our systems, we would also like to know!

8. Limited Warranty

The laser diode is excluded from the warranty since it is subject to natural degradation. However, PicoQuant does offer the following replacement credit for Laser Heads:

The laser diode will be replaced free of charge should it fail within the first two months after delivery. After the second month, we offer replacement at material cost during the warranty period. All shipping costs (including insurance, taxes, duties, etc.) are the responsibility of the customer.

9. Retraction Of Old Devices

Waste electrical products must not be disposed of with household waste. This equipment should be taken to your local recycling centre for safe treatment.

WEEE-Reg.-No. DE 96457402

10. Specifications - PDL 800-D Driver

Internal Oscillator

Type	crystal locked
Master frequencies	80 MHz and 1MHz standard (see label on back panel) other frequencies available upon request
Repetition frequencies	64 frequencies between 31.25 kHZ and 80 MHz (user-selectable)

External Trigger Input

Amplitude	-5 to +5 V_{PP} (maximum limits)
Trigger level (adjustable)	-1 to +1 V_{TH} (negative slope)
Pulse width	> 5 ns
Frequency range	10 Hz to 80 MHz
Delay	35 ± 5 ns (from trigger input to optical output), jitter < 40 ps
Impedance	50 Ohms (dynamic) / 500 Ohms (static)
Connector type	BNC (female)

Synchronisation Output

Amplitude	< -800 mV into 50 Ohms (NIM)
Pulse width	6 ns
Delay	12 ns (from falling edge to laser output), jitter < 20 ps
Impedance	50 Ohms
Connector type	SMA (female)

Remote Interlock

Voltage	< 7 VDC
Loop Resistance	10 Ohms max

Power Supply

Line voltage	220/240 or 110/120 VAC, 50/60 Hz (see label on back panel)
Power consumption	45 Watts max.

Dimensions

Driver Unit	237 x 310 x 97 mm (w x d x h)
Laser Heads	see next page

Operation Conditions

Temperature Range	+10 .. +40 °C
Rel. Humidity	< 80%

PicoQuant GmbH
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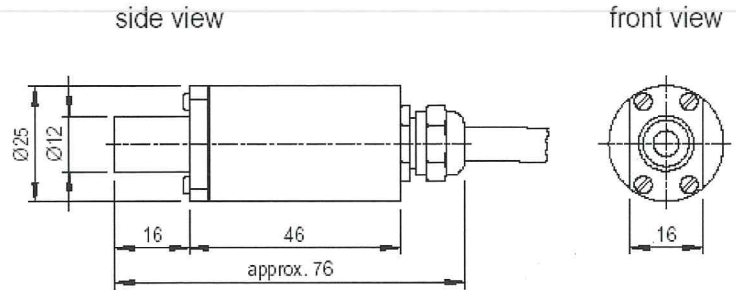
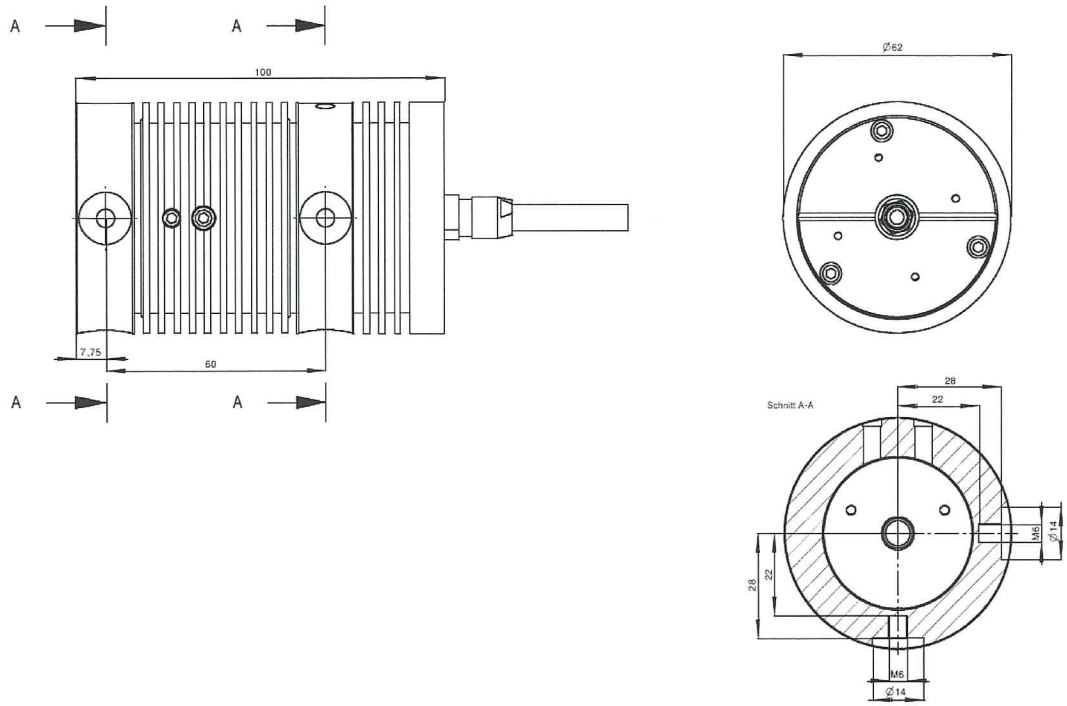
Dimensions of the Laser Heads:

LDH model:

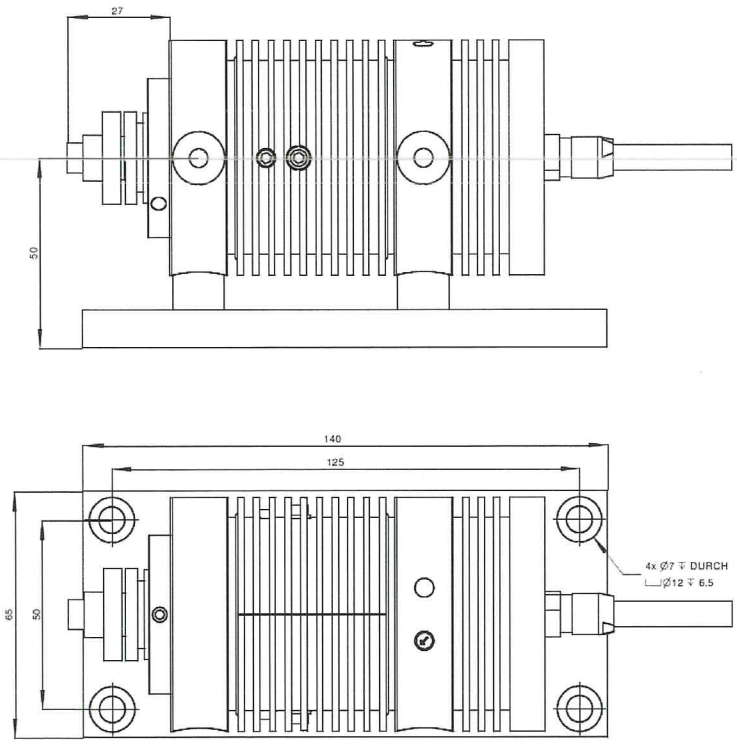
standard laser head (without Peltier cooling) all dimensions in mm



LDH-C model:



LDH-C model on holder:



11. Glossary

FWHM (Full Width Half Maximum)
A quantity for the description of pulse or distribution widths, in which the full width of the curve shape is taken at a height of half of the maximum.

IRF (Instrument Response Function)
The instrument response function is ideally the response of the instrument to the input of a signal consisting of a Dirac delta function. All data measured with an instrument are the convolution of the actual input signal with its IRF.

LDH, LDH-C (Laser Diode Head)
Model numbers of the PicoQuant Laser Heads:
LDH: without cooling
LDH-C: with thermoelectric cooler (TEC)

LED (Light Emitting Diode)
are used here in two different functions:
1. as a simple indicator light on the front panel
2. high power LEDs inside the →PLS light sources as the emitter of sub-nanosecond pulses

PLS (Pulsed Light Source)
Model Number of the LED based sub-nanosecond pulsed light sources for the PDL 800-B from PicoQuant

PMT (Photomultiplier Tube)
Photodetector with high sensitivity, dynamics and time resolution, commonly used for →TCSPC

NIM
The NIM standard (DOE/ER-0457), originally an acronym for Nuclear Instrumentation Methods, was established in 1964 for the nuclear and high energy physics communities. The goal of NIM was to promote a system that allows for the interchangeability of modules. Even today experimenters use NIM modules to assemble a system, which meets the specific requirements of their experiment. The NIM standard also specifies three sets of logic levels. In fast-negative logic, usually referred to as NIM logic, logic levels are defined by current ranges. Since the standard also requires 50 Ohms input/output impedances, these current ranges correspond to voltages of 0 V and -0.8 V for logic 0 and 1, respectively. Fast-negative logic circuitry can provide NIM signal with rise times of order 1 nsec
(Source : http://www-esd.fnal.gov/esd/catalog/intro/intronim.htm)

Peltier
The basic concept behind thermoelectric coolers (→TEC) is the Peltier effect, which was discovered in 1834. The Peltier effect occurs whenever current passes through the circuit of two dissimilar conductors; depending on the current direction, the junction of the two conductors will either absorb or release heat.

SPAD (Single Photon Avalanche Diode)
Semiconductor based photodetector with single photon sensitivity.

TCSPC (Time Correlated Single Photon Counting)
A light detection technique of high sensitivity, dynamics and time resolution that registers the arrival time of each single photon relative to a synchronisation signal from a repetitive pulsed light source. See our Tech Note on TCSPC for more details.

TEC (Thermoelectric Cooler)
Electrical cooling (or heating) device based on →Peltier elements.

A Appendix