

Sepia PDL 810

Computer Controlled
Picosecond
Diode Laser Driver



User Manual

Version 1.0.2

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1. General safety information








CAUTION!

Before using this device, make sure that you have read and understood the content of this user manual. Store this documentation in a safe and easily accessible place for future reference.

Incorrect handling of this product may result in personal injury or physical damage. The manufacturer assumes no responsibility and cannot be held liable for any injury / damages resulting from operating the device outside of the normal usage defined in this manual.

1.1. Warning Symbols and Conventions

The following symbols and conventions will be used throughout this manual. Please take time to familiarize yourself with their meaning before proceeding.

	The general safety alert symbol is used to alert you to hazards that may lead to personal injury or physical damage. Follow all associated safety instructions to avoid possible injury or death.
	A high voltage warning symbol is used to indicate the presence of un-insulated, dangerous voltage inside the enclosure. Note that this voltage may be sufficient to constitute a risk of shock.
	The laser radiation warning symbol alerts you that the device can generate laser radiation. Follow all applicable laser safety instructions to avoid injury or damages.
	The device's susceptibility to electrostatic discharge (ESD) is indicated by the ESD warning symbol . Ensure that you follow proper ESD protection rules to avoid damaging the device.
CAUTION!	Make sure to follow any instructions prefaced with " CAUTION! " to avoid personal injury or damaging the device.
WARNING!	The " WARNING! " label prefaced any instructions that shall be followed to avoid severe injury or death.
NOTICE	Important tips and information for device operation that do not include a risk of injury or damage are prefaced with the " NOTICE " label.
	This symbol indicates that an earth terminal shall be connected to the ground (to avoid risks of electrical shock).

1.2. Electrical Safety Instructions



WARNING! To avoid electric shock, the power cord's protective grounding conductor must be connected to the ground.

This device and laser heads contain no user serviceable components. Do not remove covers! Servicing of internal components is restricted to qualified personnel.

CAUTION! Never connect or disconnect any cable while the system is powered ON. Before plugging or unplugging any interconnection between laser driver and laser head, **switch off** all components using the ON/OFF switch at the rear panel. Charged cables can damage electronic devices!



Disconnect the power cord from the electrical outlet before performing any maintenance.

1.3. Laser Safety Instructions



WARNING! Visible and invisible laser radiation

Diode laser heads from the LDH or LDH-FA Series can be connected to and operated with the Sepia PDL 810. These lasers are available at different emission wavelengths and intensities. Some lasers can emit infrared light. Infrared light is not visible to the eye! **Some laser heads can emit laser light of up to class 3B / IIIB.** Please refer to the labels affixed to the laser head for information on classification.

Lasers can be hazardous and have unique safety requirements. Permanent eye injury and blindness is possible if lasers are used incorrectly. Pay close attention to each safety REMARK and WARNING statement in the user manual. Read all instructions carefully BEFORE operating this device.

The Sepia PDL 810 laser driver as well as laser diode heads of the LDH Series and LDH-FA Series are manufactured according to the International Laser Safety Standard IEC 60825-1:2014 and comply with the US law 21 CFR §1040.10 and §1040.11.

Required Laser Safety Measures

Please observe the laser safety measures for class 3B / IIIB or 3R / IIIR (depending on laser head) lasers in accordance with applicable national and federal regulations. The owner / operator is responsible for observing the laser safety regulations.

What does the owner / operator have to observe?

- The owner / operator of this product is responsible for proper and safe operation and for following all applicable safety regulations.
- The owner / operator is fully liable for all consequences resulting from the use of the laser for any purposes other than those listed in the operating manual. The laser may be operated only by persons who have been instructed in the use of this laser and the potential hazards of laser radiation.
- The owner / operator is responsible for performing and monitoring suitable safety measures (according to IEC/EN 60825-1 and the corresponding national regulations).
- The owner / operator is also responsible for naming a laser safety officer or a laser protection adviser (according to the standard IEC/EN 60825-1: "Safety of laser products, Part 1: Classification of systems, requirements and user guidelines" and the respective national regulations).

The following security instructions must be followed at all times.

CAUTION! Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure!

General Safety Instructions for Operation

- Never look directly into a laser beam or a reflection of the laser beam. Avoid all contact with the laser beam.
- Do not introduce any reflective objects into the laser beam path.
- Every person involved with the installation and operation of this device has to:
 - Be qualified
 - Follow the instructions of this manual

- As it is impossible to anticipate every potential hazard, please be careful and apply common sense when operating the Sepia PDL 810 laser driver and its associated diode laser heads. Observe all safety precautions relevant to class 3B / IIIB or class 3R / IIIR, respectively.
- For safety reasons, you should periodically check (on a monthly basis) the function of the emission indicators, remote interlock, and key switch on the laser driver, as well as verify that no scattered radiation can escape the collimator (e.g., by missing screws).
- **Do not dismantle the device or laser heads** under any circumstances! There are no user serviceable parts inside.

1.4. Laser Safety Labels

Laser heads from the LDH and LDH-FA Series use various types of housings depending on the model type. The following sections provide an overview of each housing type and the respective locations where laser safety and classification labels, as well as aperture warnings (with arrow pointing towards the aperture) are located.

The laser safety label states the laser product classification, certification, power, and wavelength range relevant for the classification. An overview of laser safety labels by model type can be found in the table of Appendix 11.2. Note that this list is not exhaustive and encompasses Sepia PDL 810 compatible laser heads available at the time that this manual was released.

Please refer to the *laser delivery report* provided with each ordered laser head for information on the central emission wavelength, maximum achievable optical output power, and pulse shape of the delivered LDH laser heads.

1.4.1. Short Cylindrical Heads (LDH Series)

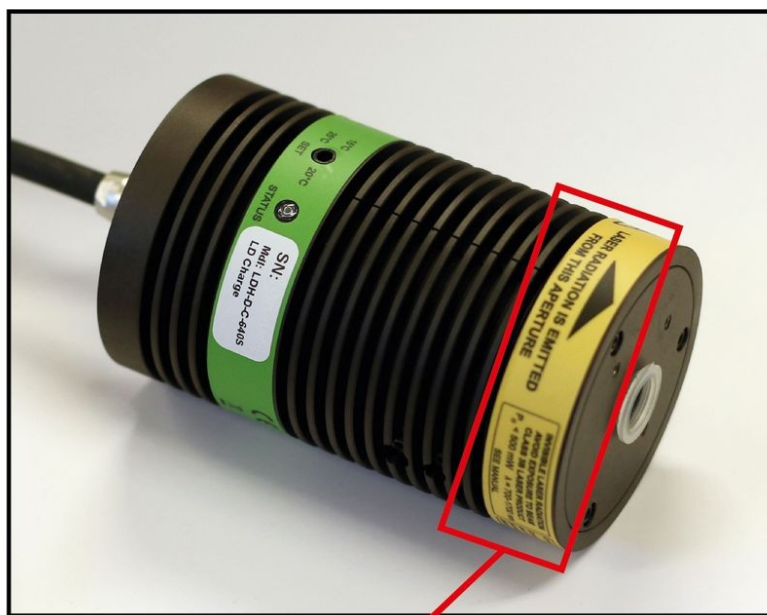


Fig. 1: Location of the laser warning, aperture indicator, certification, and laser classification label on laser heads built using short cylindrical housings (LDH-D-C-640 C is used as example here).

1.4.2. Long Cylindrical Heads (LDH Series)



Fig. 2: Location of the laser safety and warning labels as well as aperture indicator on a long cylindrical laser head (here an LDH-D-TA-530).

1.4.3. Flat Cuboid Heads (LDH-FA Series)

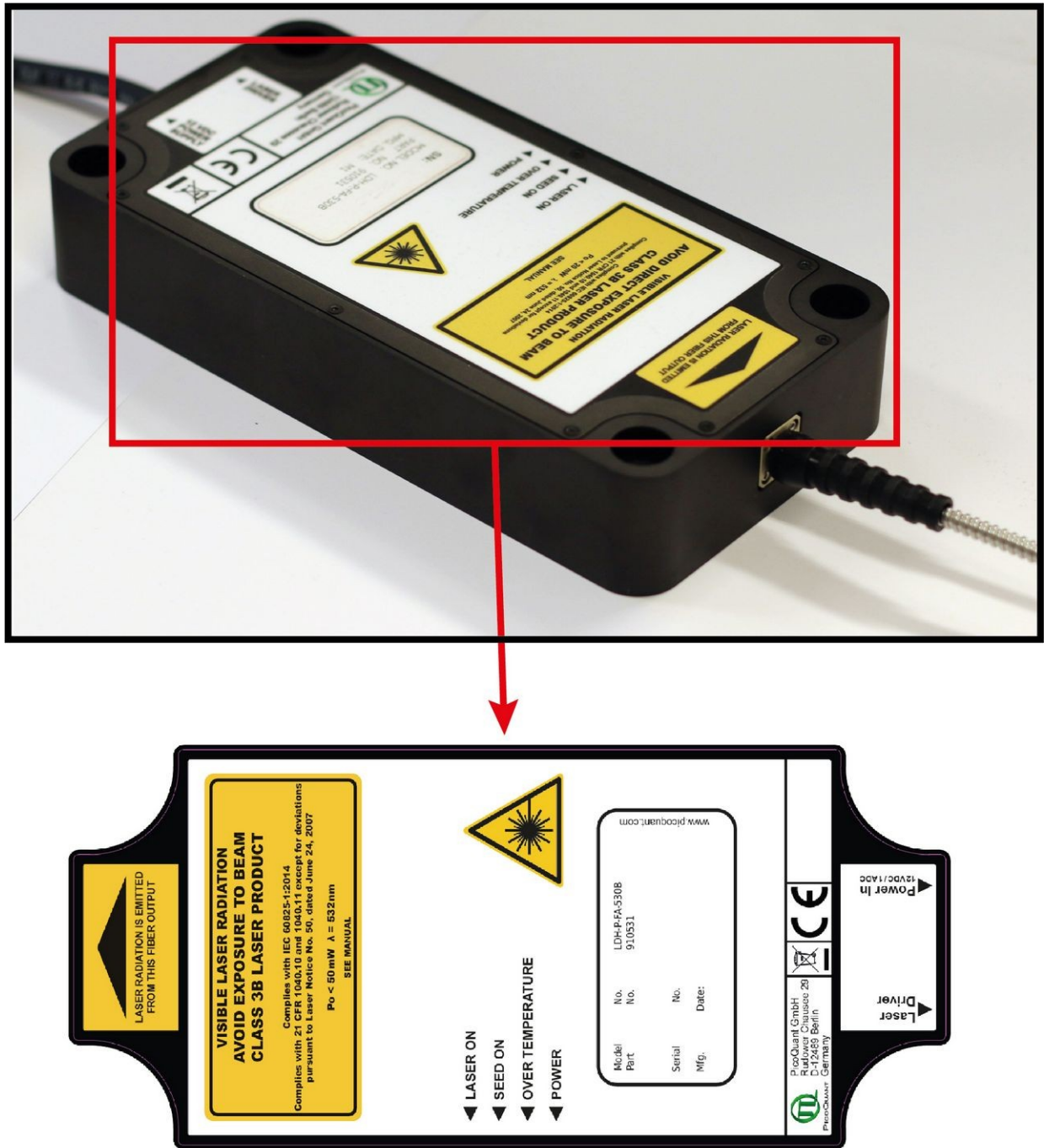


Fig. 3: Location of the laser safety and warning labels as well as aperture indicator on a flat cuboid laser head (here an LDH-P-FA-530B).

1.4.4. Tall Cuboid Heads (LDH-FA Series)

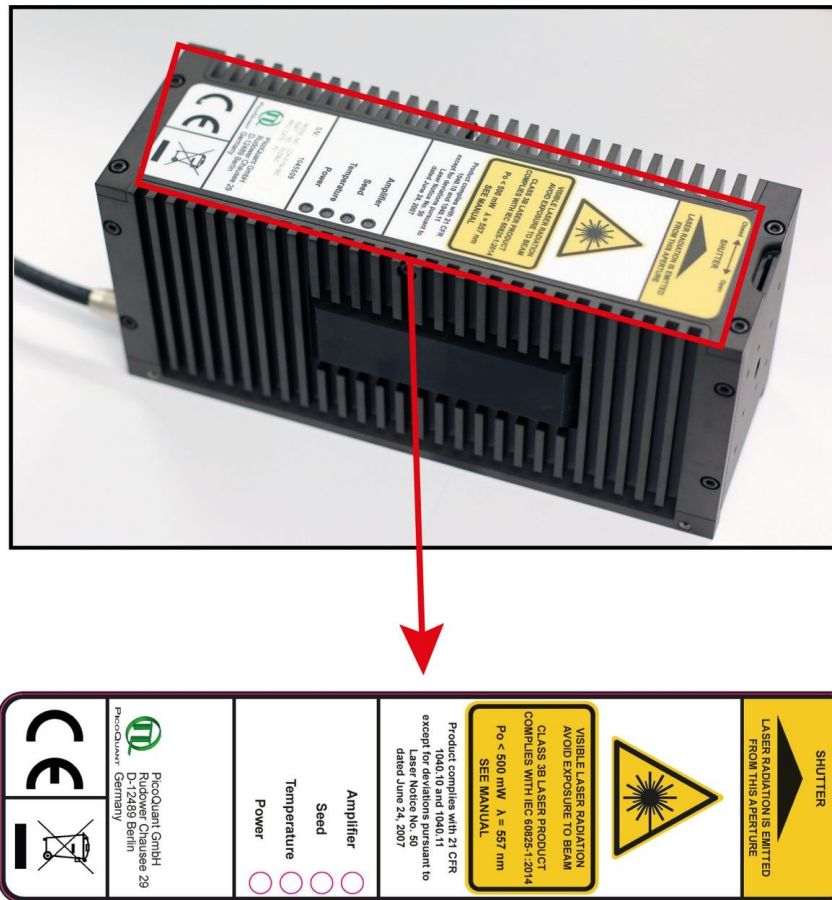


Fig. 4: Location of the laser safety and warning labels as well as aperture indicator on a tall cuboid laser head (here an LDH-P-FA-560).

1.5. Remote Interlock Connector

A hardware lock as well as a remote interlock connector are part of the Sepia PDL 810 laser driver. Removing the green interlock connector (LEMO plug) or breaking the interlock circuit will immediately deactivate the power supply of the laser.

CAUTION! The Sepia PDL 810 will resume laser emission as soon as the remote interlock circuit is closed or once power is restored after a power loss. Note that there is no indication of the status of the interlock. However there is an additional buzzer that always buzzes briefly when the laser radiation is switched on.

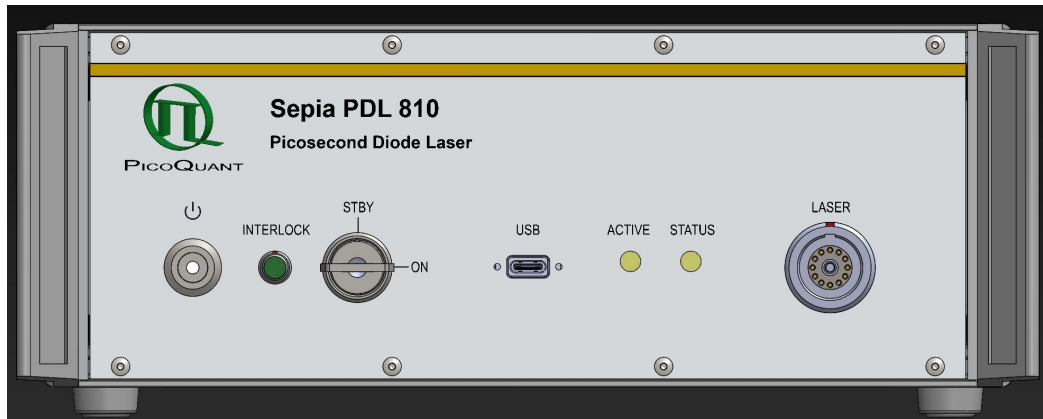


Fig. 5: Location of the remote interlock connectors on the front panel of the Sepia PDL 810 is between power switch and key-switch.

The green remote interlock connector (LEMO connector) is located on the front panel as shown in Fig. 5.

In order to meet laser safety regulations, you may need to install a remote interlock, e.g., a door switch, to deactivate the power to the laser when the door to the laser area is opened.

CAUTION! A green LEMO plug is delivered with the laser driver, which bridges pins 2 and 3. Using this plug is **NOT** intended for everyday use of the laser driver. The plug cannot act as a functional remote interlock circuit, since it has no capability to react to e.g., a door switch.

Pin assignment for the interlock

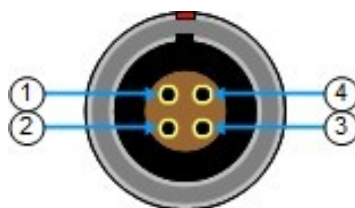


Fig. 6: Interlock LEMO connector

The interlock is a 4 pin LEMO EGG.00.304.CLL female connector as shown in Fig. 6. In order to activate laser emission, **pins 2 and 3** need to be bridged using a suitable adapter. Do **NOT** apply any voltage.

1.6. Third-party lasers

Only compatible laser heads (LDH or LDH-FA Series) or pulsed LEDs (PLS Series) manufactured by PicoQuant can be operated with the Sepia PDL 810 laser driver. Do **NOT** connect any non-PicoQuant supplied laser heads to the Sepia PDL 810.

PicoQuant declines any responsibility and cannot be held liable for any direct or indirect damages to the users and/or instrumentation resulting from the connection of non-approved third-party laser devices by the end-user.

2. Introduction

The Sepia PDL 810 system is a single channel pulsed diode laser driver system that allows operating a connected laser head in either pulsed or continuous wave (cw) mode. The driver may trigger the laser autonomously from its built-in crystal oscillator or, if a more complex triggering scheme is needed, can also be triggered by an external signal. Any output frequency from single shot (if triggered externally) to 80 MHz is supported.

The operating parameters of the Sepia PDL 810 laser driver (such as trigger source, repetition rate and pulse energy) are completely configured from a computer via USB, allowing for a quick set-up and easy storage of predefined set-ups. Standalone operation is possible, if no changes to the parameter set-up is required.

A Broad Selection of Light Sources

The user can choose from a wide palette of pulsed light sources with wavelengths ranging from ultra-violet (266 nm) to infrared (1990 nm). With some wavelengths, the laser head can also be optimized for either maximum possible power or shortest pulse width. Currently, more than 30 laser head and pulsed LED (down to 245 nm) models are available - and the choice is continuously growing! Please check our website www.picoquant.com to find your wavelength. The Sepia PDL 810 supports LDH or LDH-FA Series laser heads and pulsed LEDs (PLS Series).

3. Installation and Quick Start

This section contains information for the installation of the hardware and software of the device as well as a non-exhaustive quick start guide.

3.1. Hardware Installation

When selecting a location for the Sepia PDL 810, please ensure that sufficient air flow from the fan at the rear panel is available by keeping a distance of 10 cm to any obstacle. The venting slits at the bottom must **not** be covered.

Environmental conditions: +10 °C - +35 °C, relative humidity 20 % – 80 %.

Power input: 100 – 240 V, 50/60 Hz AC, power consumption < 45 W

The Sepia PDL 810 is controlled from a PC using a USB 2.0 connection (4, Fig. 8).

The device can be operated without a connected PC (stand alone mode), but only at fixed parameters (I.e, the last ones that were set). Modifications of the operation parameters require using the computer interface.

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

- Main power switch at the rear panel is in the OFF position.
- Key switch (3, Fig. 7) is set to the “STBY“ (vertical) position.

Remote Interlock

In order to meet laser safety regulations, it might be necessary 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. A Remote interlock connector is provided for this purpose.

See also chapter 1.5 for more details on the interlock connector.

Heat Dissipation

Ensure free air circulation. Do not cover the cooling fan on the rear panel or any of the venting slits of the device's housing (especially those located at the bottom of the housing).

3.1.1. Laser Diode Heads

Mount the laser heads firmly. Make sure they cannot be directed, even unintentionally, in such a way that laser light emitted from the collimator might cause any eye safety hazard.

CAUTION! Before connecting any heads to the driver consider that it is mandatory to comply with all applicable laser safety instructions (see chapter 1.3).

Use only laser heads of the LDH, LDH-FA or the PLS series supplied by PicoQuant. Connect the head to the via the large connector on the front of the Sepia PDL 810.

Heat Dissipation

Temperature controlled laser heads (LDH-P/D-C series, LDH-FA series)

The LDH-...-C and LDH-FA series laser heads contain an active thermoelectric cooling device. This produces, depending on the ambient temperature, a considerable amount of heat. Sufficient air circulation must be ensured to prevent an overheating of the laser head.

3.2. Software Installation

Before installing and using the Sepia PDL 810, please make sure to have

1. a solid base onto which the Sepia PDL 810 can be placed (e. g. an optical table)

2. a computer to install and run the operation software. The computer needs to have a free USB slot as well as a Windows operating system.

Place the Sepia PDL 810 on its dedicated place, insert the power cord and connect the Sepia PDL 810 to the host computer using the delivered USB cable.

NOTICE The Sepia PDL 810 should not be powered on before the control software is installed on the host computer!

The control software “**PQLaserDrv.exe**” for your Sepia PDL 810 and other laser drivers manufactured by PicoQuant needs to be set-up by an installer and is supplied on the CD along with your device. Installing the software is straightforward and performed by a step-by-step installation wizard.

NOTICE In order to future-proof the software, a switch to a new USB driver architecture is required **starting with software version 1.2.xx.636** (changing from PQUSB to WinUSB). The two driver architectures are **NOT** compatible with each other. This means that once the new drivers have been installed and they have registered the PicoQuant laser driver(s), software packages relying on the older drivers will no longer be able to “see” or connect to these USB devices. The reverse is also true: i.e. a software package relying on the newer drivers will not be able to discover or communicate with laser drivers registered to the older USB driver architecture. An important consequence of this is that both the PQLaserDrv package as well as any software package requiring a connection to a PicoQuant laser driver (i.e. SymPhoTime 64 or EasyTau) should be fully updated together.

To install the software:

1. Insert the installation medium into the host computer
2. Launch the program: `PQLaserDrv_Setup.exe`
3. Follow the instructions on the screen
4. Accept the License agreement and click *Next* when requested
5. Define the destination folder for the installation of the software
6. Select the components to be installed (availability of which can change depending on product releases or discontinuations)
7. Select which launcher icons will be generated
8. Validate your choices by clicking on *Next* and then click on the *Install* button to start the installation

Important Remarks:

The PicoQuant Laser Driver Software can control not only the Sepia PDL 810 but also other Sepia devices from PicoQuant. In case you need to control multiple lasers, then it is necessary to install all relevant components (see point 6 in the above list).

It is recommended to choose at least one of the suggested icon options. For each icon option chosen, the installer automatically creates two software launchers corresponding to the “Bright” and “Dark” PicoQuant color themes. For more details about the software color themes please refer to section 5.1.

9. Click *Next* to start the installation of the drivers. It is possible that a *Windows Safety Warning* windows pops up. In that case confirm the installation when requested in order to continue with the installation.
10. Click *Next* when requested to complete the installation
11. Click *Finish* to close the Installation wizard

Once the software is installed, the Sepia PDL 810 can be turned on (see chapter 3.3.2). When the laser is powered on for the first time, Windows will detect a new device and install the necessary device drivers.

3.3. Quick Start Guide

Before proceeding with the quick start guide, please read chapter 1.3 and follow all required laser safety instructions.

CAUTION! Before powering the Sepia PDL 810 on, ensure that the key-switch is in the secure “STBY” position (vertical)!

Switch on the main power using the switch on the rear panel. The controller will then perform some internal checks before initializing and enable the laser drivers. This will take no longer than 45 seconds.

Before actually using the laser driver, the device has to be configured (see further sections of this manual). After configuration or if the laser driver has been configured before, laser emission can be unlocked with the key switch.

3.3.1. System Indicators and Controls

Fig. 7 shows the indicators and controls available on the front panel of a Sepia PDL 810:



Fig. 7: Location of the indicators on the front panel of the Sepia PDL 810

- 1 Power button and indicator. In general use, it is recommended to turn off the Sepia PDL 810 by using this button (standby mode).
- 2 Laser active indicator
- 3 Key switch for laser lock
- 4 Controller status indicator

3.3.2. System Start-Up

1. Make sure the key switch 3 is in the vertical position (STBY).
2. Switch on the main power using the switch at the rear panel of the device (not shown).
3. The STATUS indicator 4 should light up and flash red, then yellow and finally green. After approx. 15 seconds the STATUS indicator should permanently show green. The device is now ready for use. If the STATUS indicator shows red for more than 2 seconds, refer to chapter Fehler: Verweis nicht gefunden for error diagnosis.
4. Start the control software by double clicking on the corresponding desktop icon (see chapter 5, page 25).
5. Turn the key switch 3 to the ON position (horizontal)

6. Check the *Soft Lock* feature in the GUI. Clicking the button toggles the control that locks (enables / disables) the lasers. This is important should the lasers need to be shut down quickly through the software.
7. Get familiar with the GUI and its global functions (detailed explanations are given in chapter 5, page 25):
 - All parameter fields normally display the currently active values.
 - It is possible to change one or more parameters by entering new values, but the changes will not be effective until they are transferred to the Sepia PDL 810 using the *Apply* button. Values that have been changed but not yet submitted to the driver's hardware are highlighted with an orange box.
 - It is possible to undo changes highlighted with orange boxes in the GUI that are not yet transferred to the laser driver by clicking the *Discard* button.

NOTICE Start the GUI only when the status indicator 4 shows continuously green. Close the GUI before switching off the Sepia PDL 810.

3.3.3. Laser Driver and Laser Heads

CAUTION! Do not connect or disconnect any laser head unless the Sepia PDL 810 is completely powered down and the *Laser Active* indicator (item 2 in Fig. 7) is off.

The GUI shows the control panel for the installed laser driver to the right side as shown in Fig. 12 (item 23).

Triggering Modes

The pulse repetition rate of the Sepia PDL 810 can be derived either from its internal crystal oscillator or from an externally supplied trigger signal. The triggering source can be selected from the drop down menu labeled *Trigger Source*. It is possible to select one of the 6 internal frequencies (2.5 MHz to 80 MHz) or to select external triggering at either rising or falling edge.

Laser diode heads of the LDH-D-C-xxx series can also be operated in continuous wave emission mode. This mode can be enabled by un-checking the *Pulsed Mode* check box. Un-checking this box for laser heads from the LDH-P-xxx, LDH-P-C-xxx, LDH-P-FA-xxx or PLS series will disable their laser emission.

Synchronizing the detection system should be done directly from the sync output of the laser driver s.

Intensity

The intensity (optical output power) can be set by the spin edit field "Intensity". Note that the percentage displayed has no linear relationship to the output power, e. g. setting the percentage to 50% does not mean that the laser head will provide 50% of its maximal optical output power (see section 4.2.3).

NOTICE Always use only as much power as needed for your application to prolong the lifetime of the laser diode / LED.

4. Hardware Description

4.1. Startup Operation

At power up, the Sepia PDL 810 performs some basic checks on its hardware before the system is ready for operation. Once these tests are successfully completed, the “STATUS” indicator emits constant green light and the laser driver will operate according to its last settings.

If the check fails, the device may become blocked and the “STATUS” indicator will show approx. 15 sec. red light. Refer to chapter Fehler: Verweis nicht gefunden for details on error diagnosis.

4.2. Front Panel

NOTICE

The front panel of the Sepia PDL 810 does not feature any manual controls for the setting of operation parameter such as laser intensity, trigger source, internal repetition rate or operation mode. These parameters must be set via software.

Full details on how to set these parameters with the standard operating software using the graphical user interface (GUI) can be found in chapter 5.1.4 or in the separate manual covering the programming library (API).



Fig. 8: Sepia PDL 810 - front panel

- 1 **Power button** and indicator. Pressing this button switches the Sepia PDL 810 from stand by mode to on, and vice versa. The LED inside of the button lights up in red when the laser driver is standby by mode (main power switch is in the *ON* position). The LED turns off when the device is turned on.
- 2 **INTERLOCK** connector
- 3 **LASER LOCK** key switch: turning the key into the vertical position (STBY) puts the Sepia PDL 810 into standby mode where laser emission from the connected head is disabled. Turning the key to the horizontal (ON) position activates laser emission.
- 4 USB-C connector to interface the Sepia PDL 810 with the PC
- 5 LED indicators:
 - **STATUS:** green / yellow / red LED. A blinking sequence with various colors displays the device status during check-up and operation of the device. See chapter Fehler: Verweis nicht gefunden for more information.
 - **ACTIVE:** white LED. Lights up as soon as the power supply is on

WARNING!

Laser radiation can be emitted when the white **ACTIVE** LED is on. Refer to chapter 1.3 for laser safety instructions and chapter 3 for installation information. Turn the key switch to **STBY** (vertical position) in order to disable laser output from connected laser head.

- 6 **LASER** connector: the laser or LED head has to be connected to this port with its cable. Make sure that the red markings on both cable connector and output port are matched.

CAUTION! Do NOT connect or disconnect a laser head unless the Sepia PDL 810 is in standby mode (i.e. red LED in power button is lit and active LED is off) !

Laser Locking behavior

- The key switch 3 interrupts the laser power supply when it is in the vertical position. The key can be removed only in this position. It's a good practice to keep the key switch locked unless the connected laser heads can be operated according to safety regulations.
- The remote interlock 2 shuts the laser power supply off when the loop current is interrupted.
- To comply to the laser safety regulations, all lasers are locked off for at least the first 10 seconds after the main power has been switched on.
- The controller keeps the laser locked as long as it checks its hardware while powering up.
- The controller keeps the device locked off, if it detects any abnormal operating conditions.
- The controller can be instructed from the GUI or from any software using the programming library (API DLL) to hold the lasers locked off regardless of the position of the key switch. Refer to chapter 5 (GUI) and the separate API manual for more information on soft locking.

WARNING! Soft locking the laser does not ensure eye safety!

Laser Driver

The laser driver generates all of the signals and supply voltages for the picosecond laser heads and sub-nanosecond LED heads provided by PicoQuant. Only laser heads supplied by PicoQuant can be used with this laser driver. A direct connection of other types of laser diodes to the driver is not supported. The laser heads contain a unique circuit that matches the laser diodes to the driving electronics. Please contact us in advance if you have special laser diodes that need to be operated in picosecond pulsed mode.

The Sepia PDL 810 also supports LDH-D-C laser heads allowing for CW operation of these laser diodes.

4.2.1. Back Panel

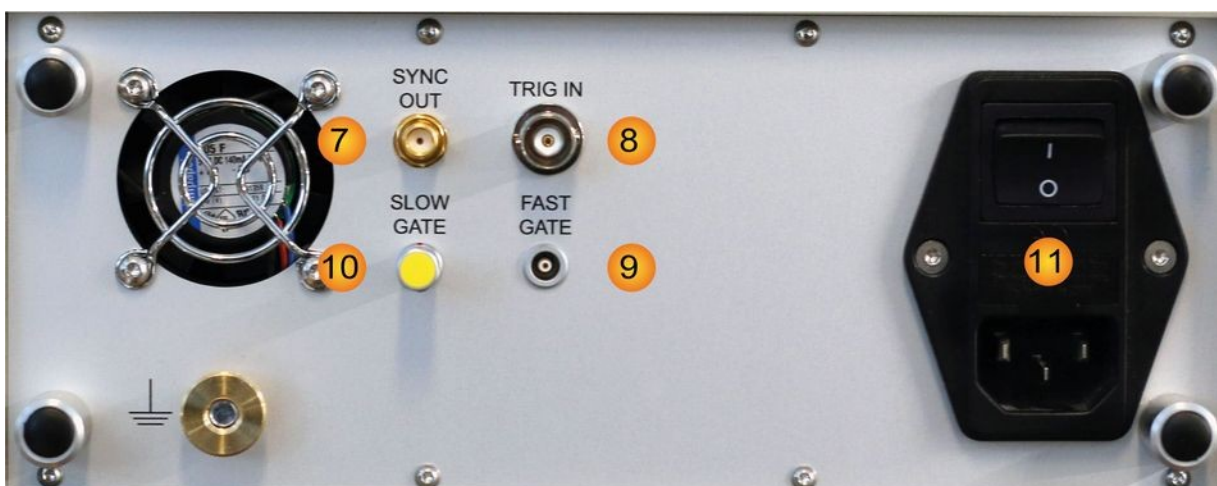


Fig. 9: Sepia PDL 810 – back panel

- 7 **SYNC OUT:** delivers a NIM compatible electrical signal synchronized to each laser pulse. This output is active in all triggering modes.
- 8 **TRIG. IN:** the trigger input is used to trigger laser pulses by an external NIM compatible signal.

- 9 / 10 FAST GATE / SLOW GATE:** Gating inputs can be used to disable the laser output through a TTL signal. Note that the SLOW GATE input cannot be left open: The yellow tipped 4-pin LEMO (00.304 Series) stub connector (provided with the device) needs to be plugged in if no other source is connected to the SLOW GATE.

The Slow Gate input is isolated by an opto-coupler and a voltage of 5 V between pin 1 and pin 2 of the connector must be fed into the input to unblock the Slow Gate. The pin assignment of the LEMO connector is shown in Fig. 10 Alternatively you can use an external generator delivering 5 V signal into 500 Ohm (ca. 10 mA).

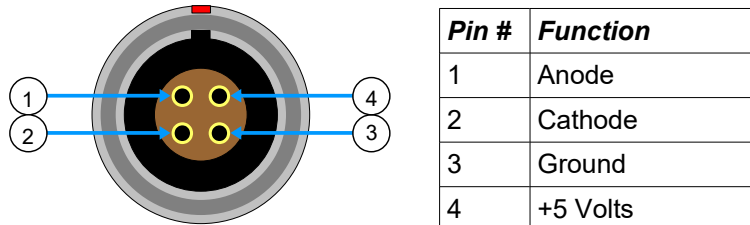


Fig. 10: Pin assignment of the SLOW GATE input port.

11 Main power switch and power socket

4.2.2. Operation Mode and Triggering

The Sepia PDL 810 laser driver can be operated in either pulsed mode (triggered by internal oscillator or via external trigger) or in CW mode.

Internal trigger or CW mode:

- The laser driver can be **triggered from its internal local oscillator** at six user-selectable frequencies: 80 MHz, 40 MHz, 20 MHz, 10 MHz, 5 MHz, or 2.5 MHz.

The synchronization output of the laser driver (7 in Fig. 9) delivers a synchronization signal along with each laser pulse. This synchronization output is particularly helpful in independent operation. It can be connected to the detection electronics such as, e. g., a TCSPC unit from PicoQuant. A suitable LEMO-SMA or LEMO-BNC adapter cable can be obtained from PicoQuant.

The shortest possible pulse width can be achieved in this configuration and the drift between synchronization signal and optical pulse will be at its lowest.

- Another independent mode of operation is the **continuous (CW) mode**. It can be used with any CW mode compatible laser heads from PicoQuant, such as the **LDH-D-C series**.

External triggered operation:

- The Sepia PDL 810 can be triggered externally by a suited NIM compatible trigger signal connected to the trigger input **TRIG. IN** (8 in Fig. 9).

The Sepia PDL 810 triggers at a fixed trigger level of approx. -0.3 volts from either edge. Triggering on the falling edge of the NIM signal is recommended for best results. Maximum repetition rate is 80 MHz.

External triggering with other types of trigger signal (e.g., TTL):

- It is not recommended to connect any other type of signal (e.g., TTL) directly to the external trigger input of the Sepia PDL 810. Even though this should in principle not cause any significant damage, it will lead to an unstable triggering or no triggering at all.
- PicoQuant recommends to use a TTL to NIM converter as e.g. the SIA 400. Please contact PicoQuant or your local PicoQuant distributor for more information about this.

Please note that the maximum user selectable frequency might exceed the maximum pulse repetition frequency (PRF) supported by some laser heads. This could result in overheating of the laser head. Although PicoQuant laser heads are protected against damages caused by excess PRF, it is strongly recommended to avoid such situations. Refer to the delivery report of your laser head for its individual maximum PRF.

4.2.3. Emission Intensity

The intensity of the laser emission is controlled via internal voltage in steps of 1‰ of its full scale value. It is important to note that this voltage does not correlate linearly to its optical output power. Also note that some high-powered laser heads may only operate at very high levels of the intensity control.

The emission pulse shape varies noticeably with increasing output power. Typically, the shortest pulses (without any "tails" or after pulses) can be achieved at output power settings slightly above the lasing threshold. Increasing the power results in higher pulse energy but also broader pulses. It depends on the application and particularly on the detector whether shorter pulses or higher power will be needed.

Please keep in mind that operating the laser at high power decreases the lifetime of the laser diode. To ensure safer working conditions and to prolong the lifetime of the laser, reduce the laser intensity to the lowest possible value supported by your experiment. Full laser power should only be selected when absolutely necessary.

Changing the repetition rate may change the shape of the pulses. In some cases, these changes can be compensated for by adjusting the intensity control.

There are also minimal variations in the output characteristics for each laser driver (typically < 1%). For laser heads with very steep transfer functions, the maximum power or output at a given intensity setting may, however, differ by up to 10%.

For long-term stability of the output power, allow the laser to warm-up for at least 20 minutes. This is especially important for temperature stabilized laser heads.

4.2.4. Gating Functions

For special applications, such as in scanning devices, the Sepia PDL 810 has two gating functions allowing suppression of laser emission by an external signal.

FAST GATE

The fast gate function affects the trigger input line **TRIG. IN**.

It is thus only effective when the laser driver is being triggered from an external source. The fast gate input will have no effect if either the internal oscillator is active or if the laser is operated in CW mode.

The gating function can perform the on/off transition within nanoseconds. It can therefore switch the laser state between two pulses, even at high repetition rates.

To use this gating mechanism, connect a low-active TTL signal to the "FAST GATE" connector (9 in Fig. 9). The input has an internal pull-up resistor to "High" level.

SLOW GATE

The slow gate function modulates the laser activity by switching the output power voltage to zero. This method will be effective regardless of the trigger source and will also minimize drift effects. However, this method is a comparably slow modulation with respect to high repetition rates of the laser.

The slow gate input is isolated by an opto-coupler and a current must be fed into the input to activate the laser. When this gating function is not used, the yellow LEMO connector stub (included with the device) must be plugged into Slow Gate connector (10 in Fig. 9) to keep the laser always active.

4.3. Laser Heads / LED Heads

4.3.1. Temperature Controlled (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 collimating optics at a constant level. The factory pre-set value is approximately 20 °C. The desired temperature can be set via the Temperature Set-Point Adjustment potentiometer located inside the LDH (see Fig. 11). For temperature adjustments a non conductive potentiometer adjustment tool is required.

CAUTION! Please note that adjusting the set-point temperature is not meant to be a “daily” process. Constantly changing the temperature set-point will wear out the plastic adjustment potentiometer. Only change the set-point value if the temperature in your laboratory is regularly above (or below) +20 °C.

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 silver colored collimator holder to determine whether condensation is forming.



WARNING! Laser Safety

Do NOT look into the laser optics when the laser is ON indicated by ACTIVE LED!

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 head will switch off if the LED is “red” and the diode element is warmer than approx. 28 °C. Under normal conditions, allow about 2 to 5 minutes after start-up for the TE cooler to reach the set-point temperature. The *status LED* will change to “green” when the set-point temperature has been reached.



Fig. 11: Top-view of LDH-C series laser head

Check the *temperature control status LED* on the laser head. If it is:

- green – the laser diode element is operating at the set-point temperature,
- red – the temperature is not at its set-point, if it is too high, the laser will be shut off.

Check the *status LED* periodically. If it is “red”, the TE cooler is operating but not able to maintain the diode element temperature below 28 °C. 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. Software Description

5.1. PQLaserDrv – The Graphical User Interface (GUI) for Sepia PDL 810

NOTICE The Sepia PDL 810 must be turned on and the initialization process completed, before the software can be started!

The Sepia PDL 810 GUI is available in three different **color schemes**: PicoQuant bright scheme, PicoQuant dark scheme and a standard Windows scheme. The latter can be customized using the standard Window control panel.

The dark scheme is intended for light sensitive set-ups and experiments such as, e.g., photon counting and single molecule sensitive spectroscopy set-ups, where ambient light perturbation should be minimized as far as possible. Note that some screen shots in this manual correspond to the PicoQuant bright scheme, while others use the PicoQuant dark scheme to showcase these two color schemes.

The color scheme is applied by the command line parameter `/style=<scheme>` where the placeholder `<scheme>` could be one of the legal values `“dark”, “bright”` or `“windows”`.

During the installation setup of the software, the installer can optionally generate separate desktop as well as quick launch icons for the respective bright and dark schemes (see chapter 3.2).

In the interest of ergonomics, all relevant active controls (button, edit box, etc.) change color when the mouse pointer hovers above them.

An overview of the GUI with all control elements is shown in Fig. 12 below.

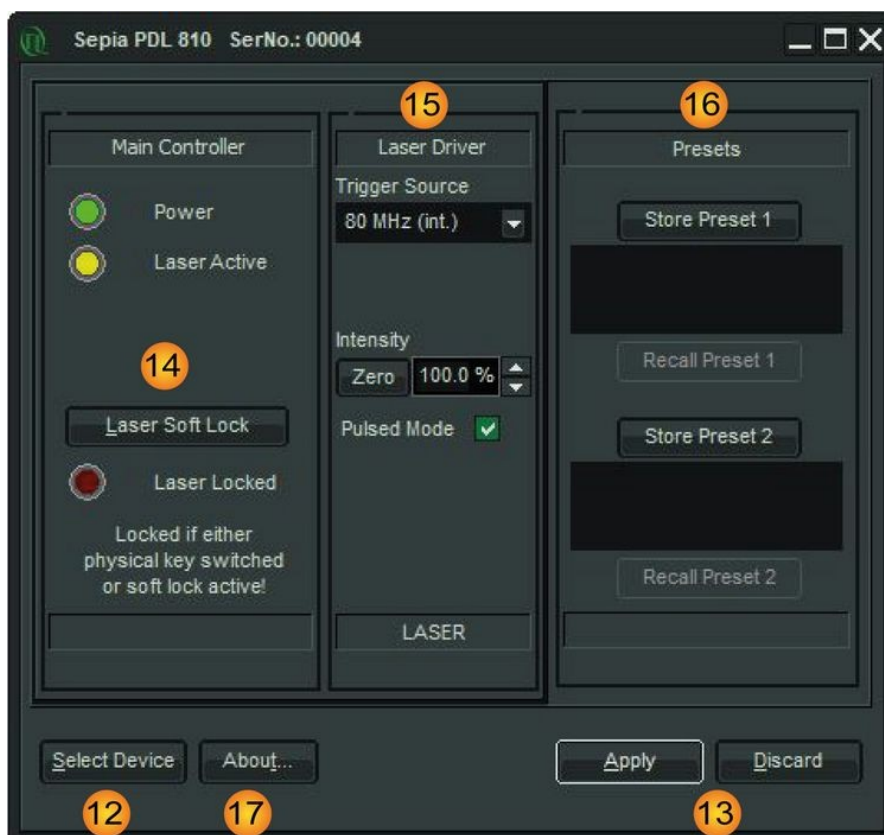


Fig. 12: Sepia PDL 810 GUI - Overview

5.1.1. Select Device

The *Select Device* **12** function is useful if more than one Sepia PDL 810 (or any other USB laser device from PicoQuant's Sepia family) are connected to the same host computer. It can also be used to restore the USB connection to the device should it be lost during operation for any reason. In this case, the label of the *OK* button changes to *Reconnect*.

A mouse click on the *Select Device* button will start a scan for supported devices connected to the PC.

A modal dialogue with an *OK* and *Cancel* button presents a list box with the currently connected devices (Fig. 13). When opening the list box, all detected devices are listed by their serial number. The currently selected device is marked with an asterisk "*".

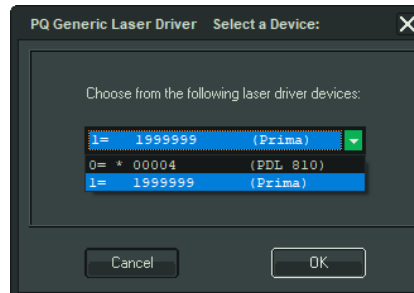


Fig. 13: Select device

<i>Cancel</i>	Back to the main window without any changes.
<i>OK</i>	Change to the newly selected device. Note that this might lead to changes in the GUI, if a device of different type or configuration is selected. The serial number of the currently selected device is always displayed in the title bar of the software.

5.1.2. Apply / Discard

Apply and *Discard* buttons **13** must be used to confirm or discard the configuration changes made in the GUI. In the example shown in Fig. 14, changes have been made to the parameters of the trigger source. The *Laser Driver* label and the *Apply* button are therefore highlighted in orange and remain highlighted until the changes are either applied or discarded.

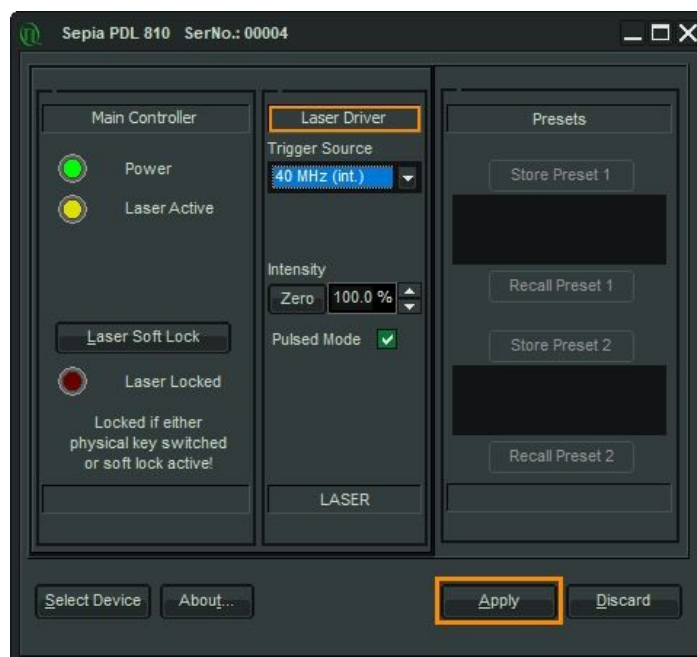



Fig. 14: Elements highlighted in orange indicate a recent change of parameters, which have to be applied or discarded

5.1.3. Soft Lock and Unlock of the Sepia PDL 810

The Sepia PDL 810 can be locked (no laser light emission) and unlocked (laser light is emitted) not only with the hardware key switch on the front panel, but also via the GUI by clicking on the button labeled *Laser Soft Lock* / *Laser Soft Unlock* , which is located in the controller frame on the left side of the software window.

The *Laser Unlocked* state is recognizable in the software by the *Laser Locked* indicator turning dark red (see Fig. 15).

The *Laser Locked* state is recognizable in the software by the *Laser Locked* indicator turning bright red. The button text could be either *Laser Soft Lock* in case the system was hard locked by key or remote interlock circuit (see Fig. 16), or *Laser Soft Unlock* (see Fig. 17) in case the system was soft locked (This even masks a hard lock state).

Please note that the lock state indicated in the GUI may refresh with a slight delay (< 1 s). **Consider:** The soft lock state is not persistently stored in the system; After power down / power up it is lost.

WARNING! Before unlocking the laser, please refer to chapter 1.3 for laser safety instructions. Allow about 3 – 5 minutes warm-up time after unlocking the laser to reach a stable output power.



Fig. 15: Laser unlocked



Fig. 16: Laser hard locked (key switch or interlock)



Fig. 17: Laser soft locked

5.1.4. Laser Driver

The control element for the laser driver **15** is shown in Fig. 18 below:



Fig. 18: Laser Driver GUI

18 Trigger source:

- 5 user selectable internal repetition rates of 80, 40, 20, 10, 5 or 2.5 MHz.
- 2 external trigger input settings: *rising* or *falling*

19 Intensity:

- The intensity of the laser head can be set on a freely adjustable scale from 0 to 100 %. Please note that the optical output power of a laser head does not correlate linearly with the intensity scale. Each laser head has a particular threshold value for laser emission, a particular slope and a particular maximal power value.
- The *Zero* button provides an easy toggle between any intensity value and zero intensity. This is useful in case a laser needs to be switched off quickly. The button memorizes the intensity previously set. Pressing it again restores this intensity setting (and vice versa).

38 Pulsed mode:

This check box permits to deactivate the pulsed mode. If pulsed mode is deactivated, laser heads that support the Continuous Wave mode (e.g., from the LDH-D-C, LDH-TA, and LDH-D-FA series) will emit in Continuous Wave mode (CW emission).

CAUTION! While most “pulsed only” laser heads that do NOT support the Continuous Wave mode (e. g., from the LDH-P, LDH-P-C, and LDH-P-FA series) will shut down if switched to CW operation, some laser heads, especially if manufactured before 2006, might turn into an undefined state. Unchecking *Pulsed Mode* does therefore not guarantee that a “pulsed only” laser head will behave safely!

5.1.5. Presets

Two working configurations can be saved and recalled under in the frame labeled *Presets* **16**. Each preset stores all working parameters of the device. The currently applied configuration can be saved by clicking on the *Store Preset 1* or *Store Preset 2* button (see Fig. 19). A pop up window gives the possibility to include a short comment with a maximal length of 64 characters for each stored configuration (see Fig. 20). A stored configuration can simply be recalled by clicking on the button labeled *Recall Preset 1* or *Recall Preset 2*.



Fig. 19: Save a configuration



Fig. 20: Edit comment for a preset

Note: The presets are stored in the internal memory of the device and not on the host computer. They can therefore also be recalled if the device is connected to a different host computer.

NOTICE

Clicking on a *Recall Preset* leads to an immediate configuration change without the need to manually apply the changes! The process itself can, however, take some time depending on the difference between current and recalled settings!

5.1.6. “About...” button

Extended information about the device, including hardware version, serial number, operating hours, software and firmware version etc. can be brought up by clicking on the button labeled *About...* **17**

For every support request its is recommend to save the entire information by clicking on the button labeled *Copy Support Infos* (see Fig. 21), save the information as a plain text file, and send it per mail to

support@picoquant.com

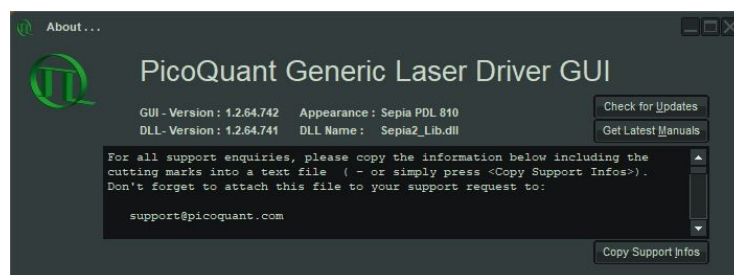


Fig. 21: The “About” window includes extended information about the status of the device

It is also possible to search for possible software updates by clicking on the button labeled *Check for Updates* (Fig. 21). If an update is available, a download link to the latest version will be provided. The button labeled “Get Latest Manuals” will also check online if newer versions of applicable manuals are available. An example of such a search result is shown in Fig. 22.

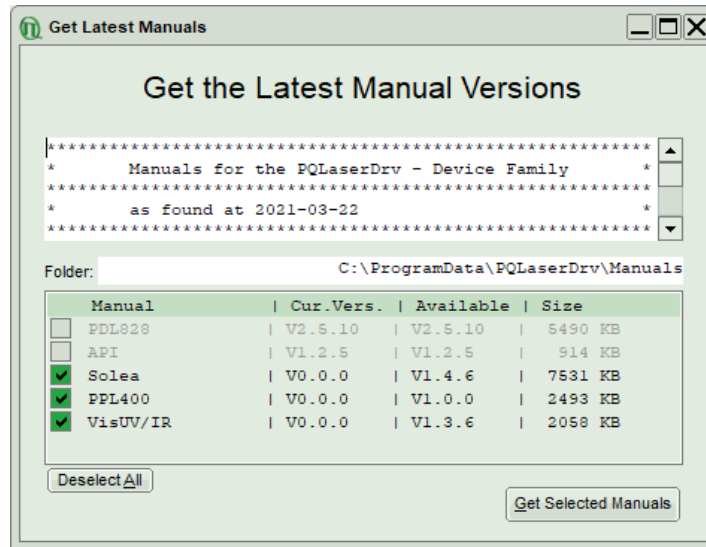


Fig. 22: A potential result screen after searching for latest manual versions

Lines corresponding to manuals that are up-to-date will be greyed out. Manuals that are currently not installed are listed as v0.0.0 in the column *Cur. Vers.*

To download the latest version of one or more manuals, tick the corresponding check-boxes and click on “*Get Selected Manuals*”.

6. Application Hints

6.1. Choosing the Correct Laser Intensity

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 used unless it is absolutely needed. This applies especially to laser diodes in the ultraviolet to blue region, which still have a shorter lifetime than red or infrared laser diodes. It is recommended to switch these lasers off by disabling the trigger or by the key-switch whenever possible.

6.2. Side Effects of Laser Settings

- An increased **laser intensity** will influence:

Pulse shape: Pulses with a higher amplitude but a broader base will be produced. After-pulsing may occur.

Pulse position: The peak shifts to an earlier time (arrives sooner) in relation to the SYNC signal.

Wavelength shift: Shift of the emitted light to a shorter or longer wavelength (depending on the laser material).

- The **repetition rate** can slightly change the **pulse energy**. Consequently slight variations caused by laser intensity changes are possible. At repetition rates of 10 MHz or less, the pulse energy remains fairly constant.
- When changing the orientation of the **polarization** plane, different **pulse shapes** and intensities may be detected. Also the amount of **background luminescence** observed by the detector may change.

7. Technical Data / Specifications

Power and Dimensions

Power supply..... 115/230 VAC, 50/60 Hz, max. 45 W
 Dimensions..... 237 × 310 × 97 mm (w × d × h)

Laser Driver

Inputs..... 1 trigger (NIM), 2 gating (TTL)
 Outputs..... 1 synchronization (NIM)
 Operation modes..... pulsed or continuous-wave
 Master oscillator frequency..... 80 MHz
 Repetition frequency..... 80, 40, 20, 10, 5, or 2.5 MHz (user-selectable)

Gating Inputs

Slow gate..... Transition time < 100 ms (pulsed and cw operation)
 Internal impedance > 500 Ohms
 Signal type: TTL (5 V)
 Connector type: 4-pin LEMO socket – 00.304 Series
 Example of connector: FGG.00.304.CLA

Fast gate..... Transition time typically 10 ns (pulsed only)
 Internal impedance 50 Ohms
 Signal type: TTL (5 V)
 Connector type: 1-pin LEMO socket – 00.250 Series
 Example of connector: FFA.00.250.NTA

Computer

Operating system..... Windows™ 10
 PC interface..... USB 2.0

Retraction of Old Devices

Waste electrical products must not be disposed of with household waste. This equipment should be taken to your local recycling center for safe treatment.
 WEEE-Reg.-No. DE 96457402



8. Support

Should you encounter problems that require sending the device in for inspection / repair, please contact us first at: <https://support.picoquant.com> or support@picoquant.com and request an RMA number before shipping the device. Please include the serial number of your device. Observe precautions against static discharge under all circumstances during handling, packaging and shipping. Use original or equally protective packaging material. Inappropriate packaging voids any warranty.

In case of a support request, please provide us with some additional information such as the serial number of the laser head and the driver and also the about file (see 5.1.6).

8.1. Troubleshooting

If you have another laser head from PicoQuant, then you can do a cross-check, to find out if the laser head or the laser driver is malfunctioning.

8.1.1. Checklist – Device can't power up

Is the power cord correctly inserted in power socket (11)?					
NO	YES				
Attach power cord correctly	Is the main power switch (11) in ON position				
	NO	YES			
	Bring power switch (11) in ON position	Is power button (1) lit red?			
		NO		YES	
		Check if fuse blown (11)		Push power button (1)	
		NO	YES	Does device response to button press, by switching red LED (1) OFF and ACTIVE LED ON (2)	
		Contact PicoQuant's support.	Replace fuse, see label at backside of device for type of fuse	NO	YES
		Contact PicoQuant's support.	Connect device with PC and start PQLaserDrv		

8.1.2. Checklist – No Laser Emission


WARNING! Under no circumstances look directly into the laser!

For LDH-FA Series laser heads: is shutter open						
NO	YES					
Open shutter	Is key-switch (3) in ON position					
	NO	YES				
	Bring key-switch in ON Position	Is Interlock (2) closed				
		NO	YES			
		Attach green stub connector, this is only for test purposes	Is the softlock unlocked (see 5.1.3)?			
			NO	YES		
		Unlock softlock using PQLaser Drv	Is the yellow stub connector attached to slow gate (10)			
			NO	YES		
		Attach the yellow stub connector	Is laser head cable correctly attached th the laser driver connector (6)			
			NO	YES		
			Power of device and reattach laser head properly	Is the laser head correctly detected by the laser driver. If this is so , the term 'LASER' should appear in GUI, see fig. 18		
		NO		YES		
	Contact PicoQuant's support.	Set driver to pulse mode and select the highest possible repetition rate for the attached laser head.				

8.2. Firmware Start-Up Diagnosis

After power up, several phases during the self test sequence can be distinguished:

Self Test Procedure

phase id.	start up phase	Duration	STATUS LED
	booting the controller	approx. 5.0 sec	off
00	checking controller hardware	approx. 0.5 sec	continuously red
10	initialize device mapping	min. 4.0 sec	blinking yellow (or red and green)
20	device mapping		
30	checking frame	approx. 4.0 sec	blinking green 
40	checking modules		
50	checking configuration		
60	modules' calibration		
70	modules' initialization		
80	successfully up and free running, ready to release laser soft lock	until error detection or power down	continuously green
??	on error	repeating sequence until power down	long red interval, pause, yellow blink code..., pause, long red interval, pause, ...

If a device from the Sepia family remains blocked by a failure, the error may be further diagnosed by software. Start e. g., "ReadAllDataByDelphi.exe" from the demo section of the programming library. This program will help to identify the reasons. Please refer to separate manual for the API for details.

Note that in order to ensure a safe shutdown, the Sepia PDL 810 has an internal capacitor. This capacitor can supply the device with electricity for a short period of time. For this reason we recommend to unplug the Sepia PDL 810 from the main power supply and to wait for ca. 3 minutes to ensure a complete reset of the device.

An error may also occur during the operation if a laser head was removed or added without powering off the device. The best way to avoid this situation is to **power OFF the Sepia PDL 810 before removing or attaching a laser head.**

9. Legal Terms

9.1. Copyright

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9.2. Trademarks

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10. Further Reading

10.1. PicoQuant Bibliography

PicoQuant maintains a database of publications mentioning PicoQuant devices. It can be found at our website <https://www.picoquant.com/scientific/references>. It is a valuable source if you would like to know which laboratories are using PicoQuant products or how broad the field of various applications is.

10.2. Download of Technical Notes / Application Notes

PicoQuant, along with our customers, continuously writes and publishes short documents about techniques, methods and applications that are possible with our hardware or software. The download section can be found at <https://www.picoquant.com/scientific/technical-and-application-notes>

11. Appendix

11.1. Naming scheme of the LDH Series laser heads

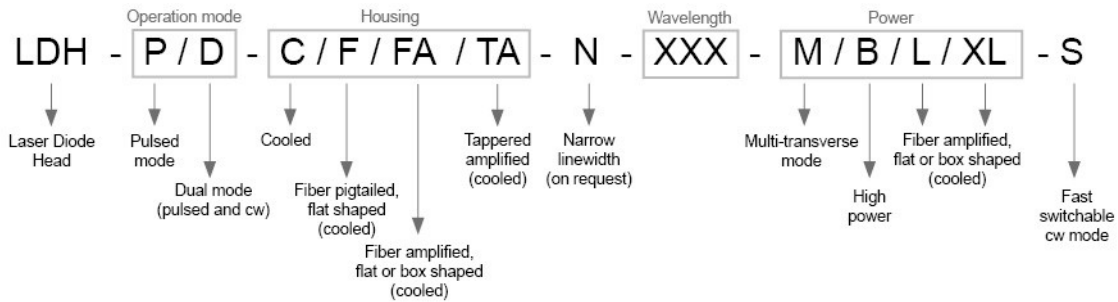





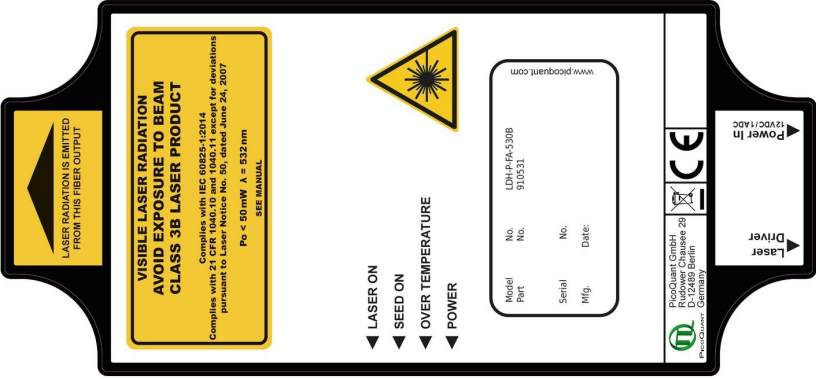

Fig. 23: PicoQuant laser head naming convention




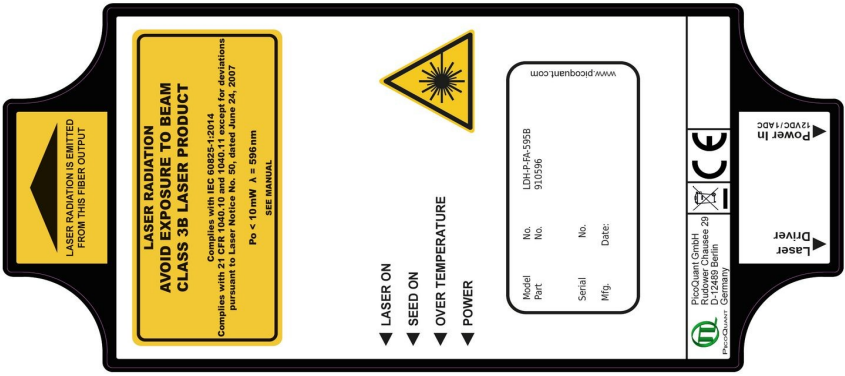

11.2. Overview of Laser Warning Labels by Model Type






The table in this section provides an overview of laser warning labels by model type. Note that this list is not exhaustive and encompasses Sepia PDL 810 compatible laser heads available at the time this manual was released.

Model type	Warning label on the laser head
LDH Series	
315-400 nm P₀ < 500 mW	
400-700 nm P₀ < 5 mW	
400-700 nm P₀ < 500 mW	
700-1700 nm P₀ < 500 mW	
blank nm blank mW	

Model type	Warning label on the laser head	
<p>LDH-D-TA-532 Part No.: 912531 / 912532 / 912533</p>		
<p>LDH-D-TA-595 Part No.: 912594 / 912595 / 912596</p>		
<p>LDH-D-TA-5 Part No.: 912561 / 912562 / 912563</p>		
<p>LDH-FA Series</p>		

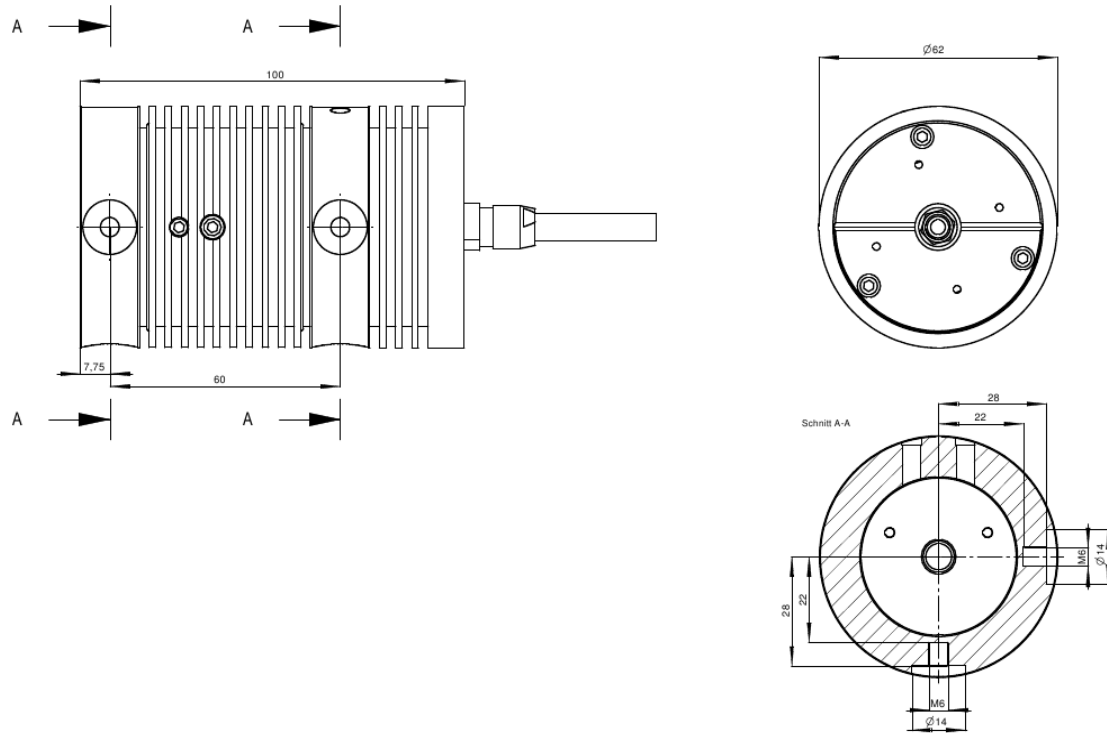
Model type	Warning label on the laser head
<p>LDH-P-FA-266 Part No.: 910266</p>	 <p>The label for LDH-P-FA-266 includes a shutter status indicator (Closed/Open), a laser radiation warning, a Class 3B laser product warning (Po < 1,5 mW, λ = 266 nm), compliance information (IEC 60825-1:2014, CFR 1040.10 and 1040.11), and four status indicators for Amplifier, Seed, Temperature, and Power.</p>
<p>LDH-P-FA-355 Part No.: 910355</p>	 <p>The label for LDH-P-FA-355 includes a shutter status indicator, a laser radiation warning, a Class 3B laser product warning (Po < 50 mW, λ = 355 nm), compliance information, and four status indicators for Amplifier, Seed, Temperature, and Power.</p>
<p>LDH-P-FA-515L Part No.: 910517</p>	 <p>The label for LDH-P-FA-515L includes a shutter status indicator, a laser radiation warning, a Class 3B laser product warning (Po < 100 mW, λ = 515 nm), compliance information, and four status indicators for Amplifier, Seed, Temperature, and Power.</p>
<p>LDH-P-FA-530B Part No.: 910531</p>	 <p>The label for LDH-P-FA-530B is a large, complex label with a fiber output warning, a Class 3B laser product warning (Po < 50mW, λ = 532nm), a laser radiation warning, and a registration table for Model, Part, Serial, and Mfg. It also includes a date field and a PicoQuant logo.</p>
<p>LDH-D-FA-530L Part No.: 912534</p>	 <p>The label for LDH-D-FA-530L includes a shutter status indicator, a laser radiation warning, a Class 3B laser product warning (Po < 100 mW, λ = 532 nm), compliance information, and four status indicators for Amplifier, Seed, Temperature, and Power.</p>

Model type	Warning label on the laser head								
<p>LDH-P-FA-530L Part No.: 910533</p>	 <p>The label for LDH-P-FA-530L includes a shutter status indicator (Closed/Open), a laser radiation warning, a Class 3B laser product warning (Po < 100 mW, λ = 532 nm), regulatory compliance text (CFR 1040.10 and 1040.11), and four status indicators: Amplifier, Seed, Temperature, and Power.</p>								
<p>LDH-P-FA-530XL Part No.: 910534</p>	 <p>The label for LDH-P-FA-530XL includes a shutter status indicator, a laser radiation warning, a Class 3B laser product warning (Po < 500 mW, λ = 532 nm), regulatory compliance text, and four status indicators: Amplifier, Seed, Temperature, and Power.</p>								
<p>LDH-P-FA-560 Part No.: 910560</p>	 <p>The label for LDH-P-FA-560 includes a shutter status indicator, a laser radiation warning, a Class 3B laser product warning (Po < 500 mW, λ = 557 nm), regulatory compliance text, and four status indicators: Amplifier, Seed, Temperature, and Power.</p>								
<p>LDH-P-FA-595B Part No.: 910596</p>	 <p>The label for LDH-P-FA-595B is a large, complex label with a central warning box (Po < 10 mW, λ = 595 nm), a list of warnings (LASER ON, SEED ON, OVER TEMPERATURE, POWER), a registration table, and a CE mark with 'Laser Driver' and 'Power In' labels.</p> <table border="1" data-bbox="1043 1196 1174 1451"> <tr> <td>Model No.</td> <td>LDH-PFA-595B</td> </tr> <tr> <td>Part No.</td> <td>910596</td> </tr> <tr> <td>Serial No.</td> <td></td> </tr> <tr> <td>Mfg. Date:</td> <td></td> </tr> </table>	Model No.	LDH-PFA-595B	Part No.	910596	Serial No.		Mfg. Date:	
Model No.	LDH-PFA-595B								
Part No.	910596								
Serial No.									
Mfg. Date:									
<p>LDH-D-FA-765L Part No.: 912766</p>	 <p>The label for LDH-D-FA-765L includes a shutter status indicator, a laser radiation warning, an invisible laser radiation warning (Po < 100 mW, λ = 766 nm), regulatory compliance text, and four status indicators: Amplifier, Seed, Temperature, and Power.</p>								

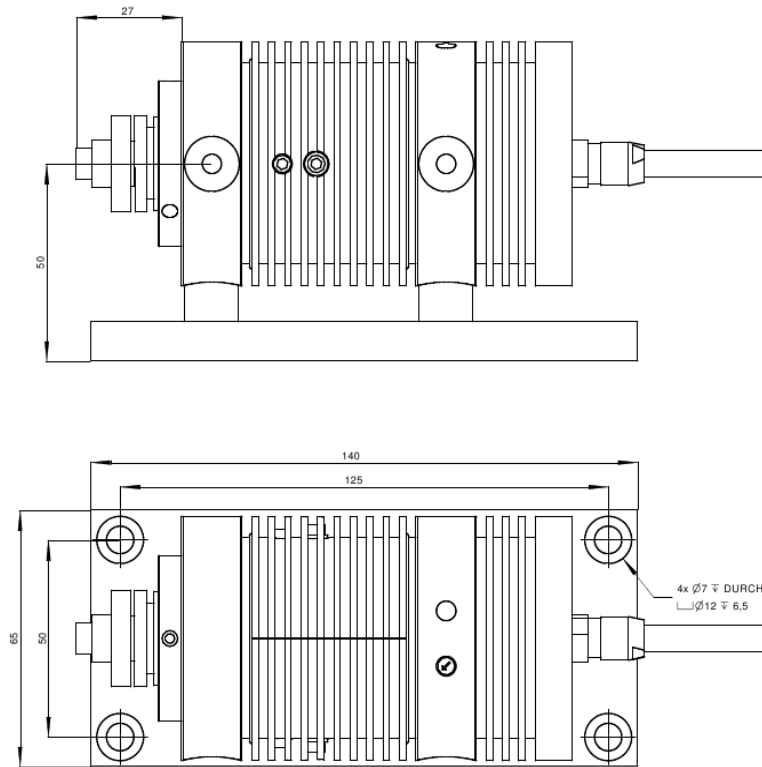
Model type	Warning label on the laser head
<p>LDH-P-FA-765XL Part No.: 910765</p>	 <p>The warning label for LDH-P-FA-765XL includes a shutter status indicator (Closed to Open), a laser radiation warning symbol, and technical specifications: $P_o < 100 \text{ mW}$, $\lambda = 766 \text{ nm}$. It also states 'INVISIBLE LASER RADIATION AVOID EXPOSURE TO BEAM' and 'CLASS 3B LASER PRODUCT COMPLIES WITH IEC 60825-1:2014'. Regulatory information includes CFR 1040.10 and 1040.11, and a Laser Notice No. 50 dated June 24, 2007. Safety features are listed as Amplifier, Seed, Temperature, and Power, each with a corresponding circle icon. The label also features the PicoQuant logo, company address (Rudower Chaussee 29, D-12489 Berlin, Germany), and CE and WEEE symbols.</p>
<p>LDH-P-FA-775B Part No.: 910765</p>	 <p>The warning label for LDH-P-FA-775B includes a shutter status indicator (Closed to Open), a laser radiation warning symbol, and technical specifications: $P_o < 200 \text{ mW}$, $\lambda = 766 \text{ nm}$. It also states 'VISIBLE LASER RADIATION AVOID EXPOSURE TO BEAM' and 'CLASS 3B LASER PRODUCT COMPLIES WITH IEC 60825-1:2014'. Regulatory information includes CFR 1040.10 and 1040.11, and a Laser Notice No. 50 dated June 24, 2007. Safety features are listed as Amplifier, Seed, Temperature, and Power, each with a corresponding circle icon. The label also features the PicoQuant logo, company address (Rudower Chaussee 29, D-12489 Berlin, Germany), and CE and WEEE symbols.</p>
<p>LDH-P-FA-1060 Part No.: 911065</p>	 <p>The warning label for LDH-P-FA-1060 includes a shutter status indicator (Closed to Open), a laser radiation warning symbol, and technical specifications: $P_o < 500 \text{ mW}$, $\lambda = 1064 \text{ nm}$. It also states 'INVISIBLE LASER RADIATION AVOID EXPOSURE TO BEAM' and 'CLASS 3B LASER PRODUCT COMPLIES WITH IEC 60825-1:2014'. Regulatory information includes CFR 1040.10 and 1040.11, and a Laser Notice No. 50 dated June 24, 2007. Safety features are listed as Amplifier, Seed, Temperature, and Power, each with a corresponding circle icon. The label also features the PicoQuant logo, company address (Rudower Chaussee 29, D-12489 Berlin, Germany), and CE and WEEE symbols.</p>
<p>LDH-P-FA-1060XL Part No.: 911066</p>	 <p>The warning label for LDH-P-FA-1060XL includes a shutter status indicator (Closed to Open), a laser radiation warning symbol, and technical specifications: $P_o < 500 \text{ mW}$, $\lambda = 1064 \text{ nm}$. It also states 'INVISIBLE LASER RADIATION AVOID EXPOSURE TO BEAM' and 'CLASS 3B LASER PRODUCT COMPLIES WITH IEC 60825-1:2014'. Regulatory information includes CFR 1040.10 and 1040.11, and a Laser Notice No. 50 dated June 24, 2007. Safety features are listed as Amplifier, Seed, Temperature, and Power, each with a corresponding circle icon. The label also features the PicoQuant logo, company address (Rudower Chaussee 29, D-12489 Berlin, Germany), and CE and WEEE symbols.</p>
<p>LDH-P-FA-1530XL Part No.: 911532</p>	 <p>The warning label for LDH-P-FA-1530XL includes a shutter status indicator (Closed to Open), a laser radiation warning symbol, and technical specifications: $P_o < 500 \text{ mW}$, $\lambda = 1532 \text{ nm}$. It also states 'INVISIBLE LASER RADIATION AVOID EXPOSURE TO BEAM' and 'CLASS 3B LASER PRODUCT COMPLIES WITH IEC 60825-1:2014'. Regulatory information includes CFR 1040.10 and 1040.11, and a Laser Notice No. 50 dated June 24, 2007. Safety features are listed as Amplifier, Seed, Temperature, and Power, each with a corresponding circle icon. The label also features the PicoQuant logo, company address (Rudower Chaussee 29, D-12489 Berlin, Germany), and CE and WEEE symbols.</p>

11.3. Dimensions of LDH Series Laser Heads

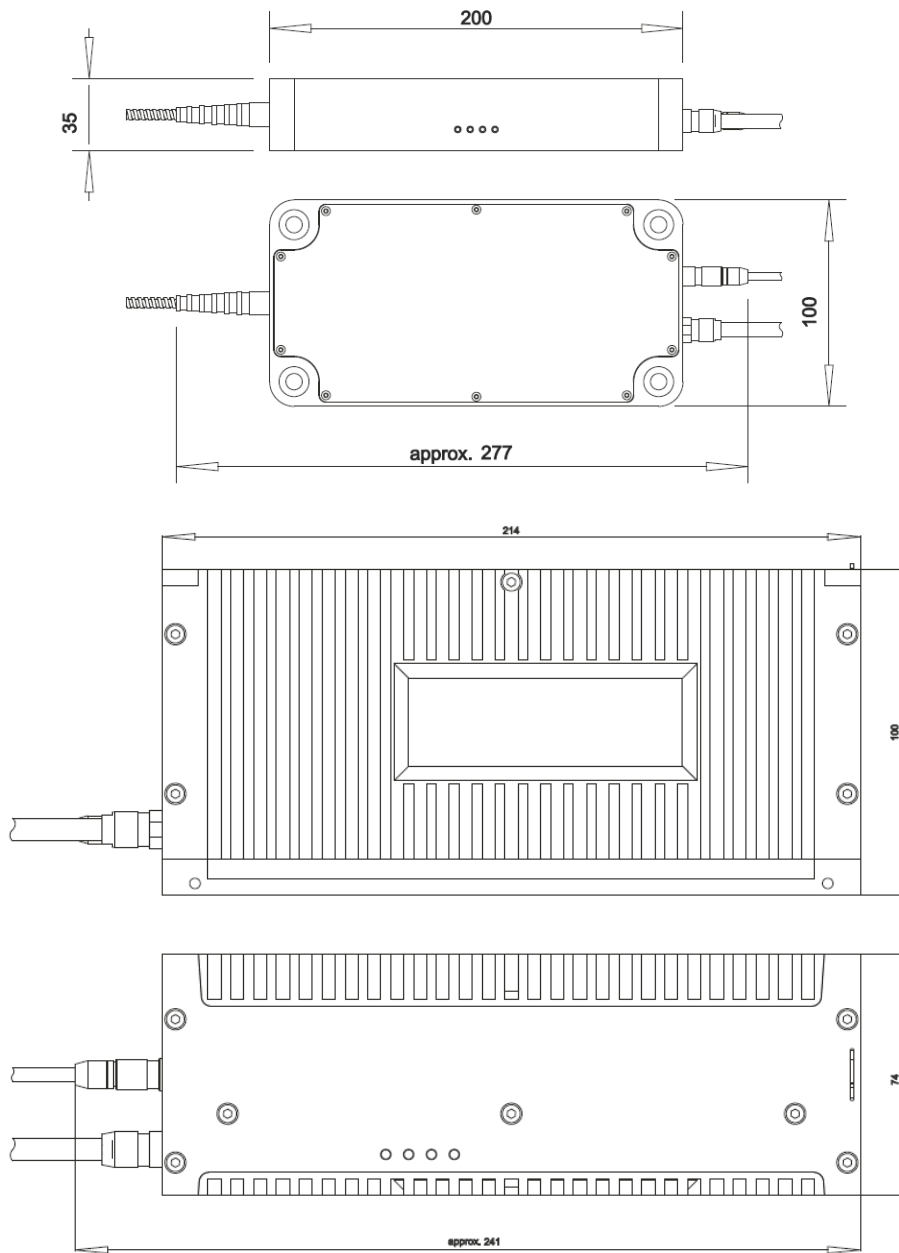
LDH-C model:



LDH-C model on holder with fiber coupler:



LDH-FA models:



11.4. Laser Delivery Report

The delivery report of your lasers, including all final production test results for pulse shape, optical power, and line width is attached to this user manual. A PDF copy can be provided on request.

11.5. Abbreviations

API	Application Programming Interface
BNC	British Naval Connector or Bayonet Nut Connector or Bayonet Neill Concelman
CAMAC	Corporations and Markets Advisory Committee
CW	Continuous Wave
DLL	Dynamic Link Library
GUI	Graphical User Interface
IEC	International Electrotechnical Commission
LDH	Laser Diode Head
LED	Light Emitting Diode
NIM	Nuclear Instrumentation Methods
PRF	Pulse Repetition Frequency
RMA	Return Merchandize Authorization
SCM	Sepia Controller Module
SLM	Sepia Laser Module
SEM	Sepia Extension Module
SMA	Sub-Miniature version A (connector type)
SOM	Sepia Oscillator Module
TCSPC	Time-Correlated Single Photon Counting
TTL	Transistor-Transistor Logic
USB	Universal Serial Bus
WEEE	Waste Electrical and Electronic Equipment

All information given here is reliable to our best knowledge. However, no responsibility is assumed for possible inaccuracies or omissions. Specifications and external appearances are subject to change without notice.



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