Unico

1-Color Picosecond Laser

PicoQuant

Pulsed, CW and fast switched laser
with variable operating wavelength

User Manual

Document version 1.0.0

Table of Contents

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.
ESD	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	Indicate a hazardous situation which, if not avoided, could result in minor or moderate injury.
⚠ WARNING	Indicate a hazardous situation which, if not avoided, **could** result in death or serious injury.
⚠ DANGER	Indicate a hazardous situation which, if not avoided, **will** result in death or serious injury.
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).
	Disconnect the power cord from the electrical outlet.

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 contains no user serviceable components. Do not remove covers! Servicing of internal components is restricted to qualified personnel. Only use dedicated power supply.
	Disconnect the power cord from the electrical outlet before performing any maintenance.

1.3.   Laser Safety Instructions

⚠ WARNING	Class 3B / IIIb Laser - Visible and invisible laser radiation Avoid exposure to beam

The Unico can be equipped with laser diodes that can emit visible, infrared, or UV light. Infrared or UV light is not visible to the eye! **The Unico laser module can emit laser light of up to class 3b / IIIb.** Please refer to the labels affixed to the laser 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 related CAUTION and WARNING statement in the user manual. Read all instructions carefully BEFORE operating this device.

The Unico laser products are manufactured according to the International Laser Safety Standard IEC 60825-1 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 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).
- When using lasers of class 3B/IIIB, it is required to wear special eye protection (laser safety goggles).
- The room in which the system is installed must be labeled as a laser area.

⚠ WARNING	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. This includes jewelry, watches, etc.

- 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 laser unit. Observe all safety precautions relevant to Class 3b / IIIb lasers.

1.4.   Laser Safety Labels

On the Laser Device

The safety labels are affixed to the top and side of the laser module housing, with an arrow pointing towards the laser emission aperture (highlighted by red boxes in Fig. 1). The label states the laser product classification, certification, power, and wavelength range relevant for the classification.
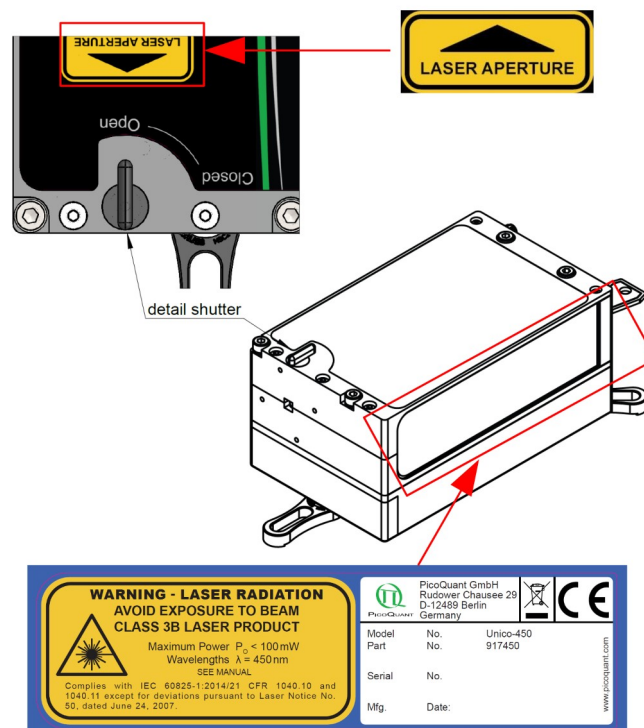
Fig. 1: Laser warning label, laser aperture indicator label and manual shutter as well as their location on the Unico laser module housing.

Please refer to the *laser delivery report* provided with each ordered laser for information on the central emission wavelengths, maximum achievable optical output powers and pulse shapes of your Unico laser module.

⚠ WARNING	For information on the wavelength and optical power for selecting the correct eye protection, see product label or laser delivery report!

The Unico 1-Color Picosecond Laser module also features a manually operated mechanical shutter (highlighted by a green box in Fig. 1). The shutter is operated by turning the black lever into the desired position:

- If the lever points towards the setting **CLOSED**, then laser emission is mechanically **blocked**.

- If the lever points towards the setting **OPEN**, then laser emission is **not blocked** by the shutter.

⚠ WARNING	Laser light can be emitted from the aperture when the shutter is open. Ensure that all applicable laser safety measures are observed before opening the mechanical shutter.

NOTICE	If the serial number is not legible, it can be read out using software.

1.5.   Remote Interlock Connector

A hardware lock as well as a remote interlock connector are part of the Unico 1-Color Picosecond Laser. Removing the green interlock connector (LEMO plug) or breaking the interlock circuit will immediately deactivate the power supply of the laser.

⚠ CAUTION	The Unico will resume laser emission as soon as the remote interlock circuit is closed or once power is restored after a power loss. An open interlock circuit (or activated Soft Lock) is indicated by white blinking "ON" LED.
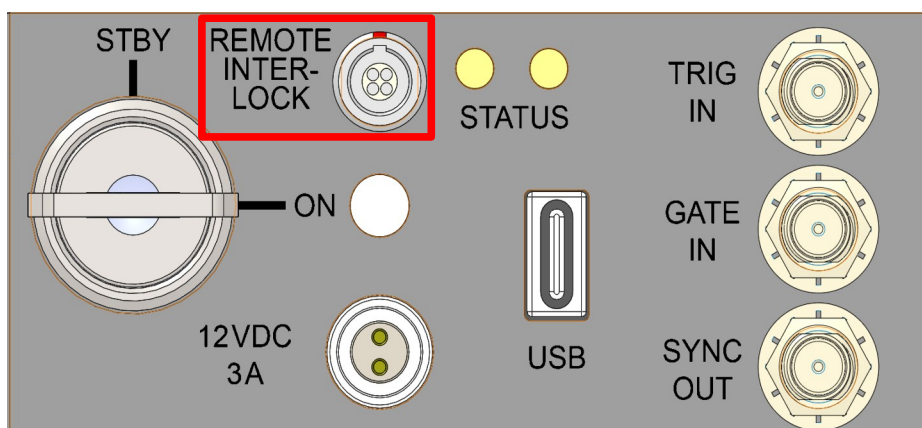
Fig. 2: Location of the remote interlock connector (highlighted with a red box) on the control panel of the Unico.

The remote interlock connector (LEMO connector) is located on the front panel as shown in Fig. 3.
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.

Pin assignment for the interlock

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

Fig. 3: Interlock LEMO connector

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

2. Introduction

Unico is a compact, stand-alone, and affordable laser module offering one individual emission wavelength that can be operated in picosecond pulsed, nanosecond pulsed, and continuous wave (CW) mode.
The picosecond pulses can be triggered either by the module's internal clock or by an external oscillator up to 200 MHz. The module is fully computer controlled, making its operation very easy: Connect Unico to a PC via an USB port and all changes in operation parameters can be done via a convenient software interface.

The Unico laser system is engineered to deliver precise, high-quality pulses in the picosecond range, making it an ideal tool for time-resolved fluorescence spectroscopy and imaging. Our laser system is designed to be both compact and self-contained, ensuring easy integration into various experimental setups with a minimal footprint. The laser delivers a single, stable wavelength, ensuring consistent performance and reliability for your specific application need.

Pulsed, CW and fast switched emission modes

No matter what type of operation mode you need, Unico offers full flexibility and enables time-resolved or steady-state measurements as well as the use of the fast CW switching capability. Two picosecond pulsed modes can be driven either internally at selected repetition rates between 1 kHz to 200 MHz or externally at rates from single shot up to 200 MHz. Four nanosecond pulsed modes are limited to 100 MHz. CW emission can be either controlled via Gate In or via the module's free running burst generator for pulse lengths from 10 ns to 1 ms.

Each wavelength can achieve an average pulsed optical output power of typically 5-10 mW depending on the wavelength. In CW mode, higher average power (up to 50 mW) can be reached for each individual wavelength. Switching the CW emission between the ON and OFF states has a rise/fall time of less than 3 ns.
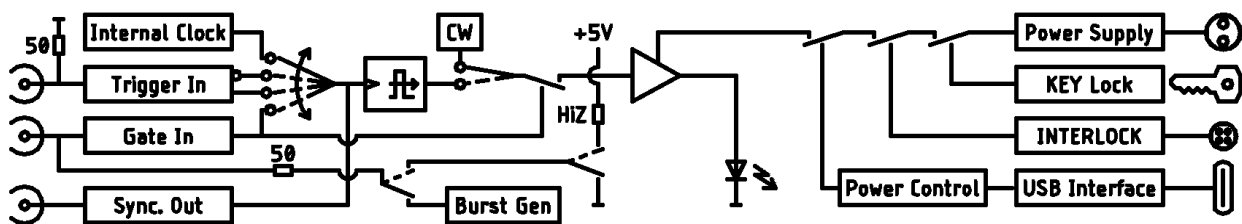
Fig. 4: Simplified schematic of the Unico

While constant repetition rates can be set internally, burst excitation patterns can be triggered by a suitable trigger source (such as the oscillator module of PicoQuant's Sepia PDL 828). You can even combine Unico with other laser diode heads to create even more sophisticated excitation patterns, including not only bursts, but also Pulsed Interleaved Excitation (PIE) or Alternative Laser Excitation (ALEX). This makes Unico a versatile tool that can be used in many environments.

Easy to use

Being a stand-alone module, Unico does not require any additional laser driver. The settings and operating parameters are fully computer controlled via an intuitive control software based on the well-known Sepia graphical user interface.
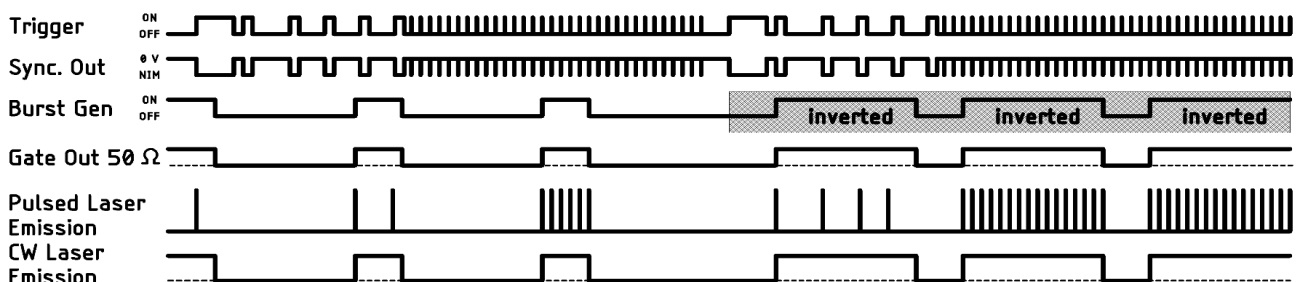
Fig. 5: Internal driven pulse pattern of the Unico

3. Hardware Description

3.1. Interface Panel

NOTICE	The interface panel does not feature any manual controls for setting the operating parameters (e.g., intensity, repetition rate, trigger source selection) of the Unico. These settings must be made via a Graphical User Interface (GUI), see section 5.2 for more details.
	However, the laser device can also be used without being connected to a PC. The Unico will then operate with the last set of operating parameters stored in its memory.
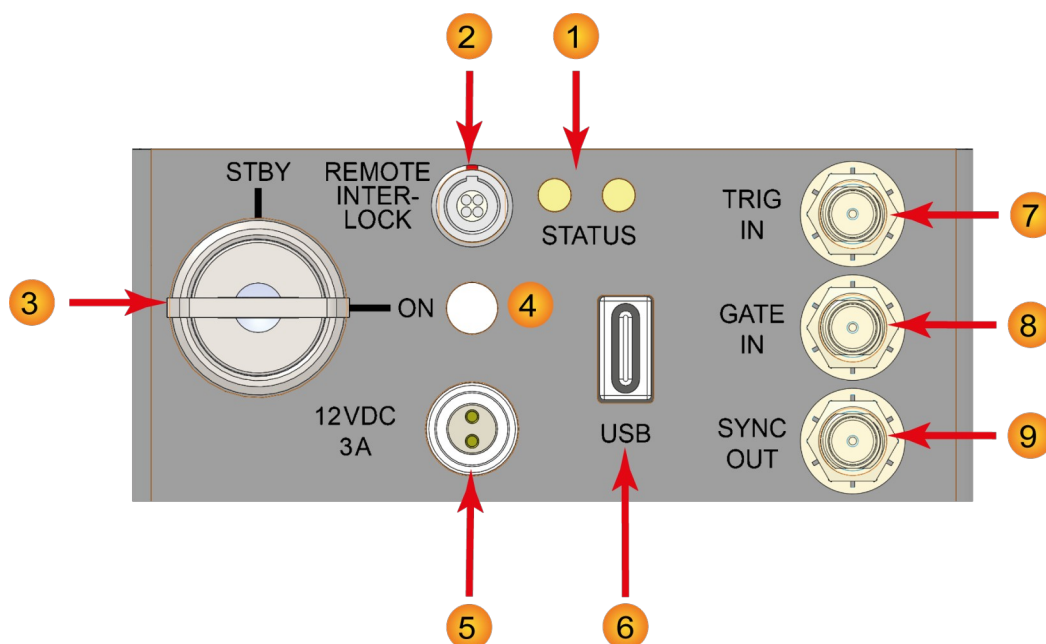
Fig. 6: Interface panel

1   **Status indicators**. These two LEDs provide information about the general operation status (left LED) as well as the emission mode and trigger status (right LED).

Left LED (status indicator): When the Unico is powered on, this LED lights up orange and starts flashing orange and then green after a few seconds. After approximately 15 seconds, this indicator should permanently show green. If the status indicator shows red for more than 2 seconds, an internal error occurred. The exact nature of the error can be read out via the software API. Please refer to the PQLaserDrv API Manual for more details.

Right LED (emission mode and trigger status indicator): This indicator lights up blue when the Unico is operating in picosecond pulsed mode, light blue when it is operating in nanosecond pulsed mode and orange when it is running in CW mode.
If the Unico is operated at either very low repetition rates, long gating periods, or with an invalid trigger level, the indicator will turn off after about 100 ms until the next event switches the LED back on.

NOTICE	The LED will only be lit when a valid trigger signal (either internal or external) is present, regardless of the position of the key switch **3**.

2   **REMOTE INTERLOCK** socket for remote interlock connector (see section 1.5).

3   **Key switch** (laser switch): Turning the key to the *ON* position activates the laser. Power to the laser can be locked off by turning the key to the *STBY* position and removing the key.

4   **Laser emission indicator**. The behavior of the LED and the associated different laser states are summarized in the following table:

LED behavior		Laser emission state	Condition
OFF	constant OFF	No laser emission	Power supply not connected
White	constant BLINKING with ~0.3sec color: dark white	No laser emission but ready to emit	Key switch = STBY and/or interlock not connected (resumes emission automatically when interlock is connected!)
	constant ON color: bright white	Laser active	Key switch = ON and interlock connected

5   Main **POWER** input socket for the power supply.

6   **USB-C** connector to interface the Unico with the PC.

NOTICE	Changing the operating parameters of the Unico requires a connection via the USB 2.0 interface to a PC running a compatible software application (e.g., PicoQuant's `PQLaserDrv.exe`).

7   **TRIGGER IN***: external trigger input with variable trigger threshold (female SMA connector)

8   **GATE IN**: gating input (female SMA connector)

The gating function affects the triggering mechanism. The gating input accepts TTL pulses and is effective if the Unico is being triggered either from the internal oscillator or from an external source. The gating function can perform transition between on and off states within nanoseconds. Presuming a precise timing, it can switch between two laser pulses, even at high repetition rates.

In CW mode, the laser emission follows the gate signal within nanoseconds to execute any arbitrary pulse length.

9   **SYNC OUT***: Synchronization output connector (female SMA connector)

3.2. Laser Locking Behavior

- The key switch **3** interrupts the laser power supply when it is in the vertical position (STBY). The key can only be removed in this position. It's a good practice to keep the key switch locked unless the Unico can be operated in accordance with the safety regulations.

- The remote interlock **2** shuts the laser power supply off when the loop current is interrupted.

- To comply with laser safety regulations, laser emission is locked off for at least the first 10 seconds after the main power is switched on.

- Laser emission is disabled as long as the Unico is checking its hardware while powering up.

- The Unico laser will be locked as soon as it detects abnormal operating conditions.

- Losing the trigger signal when the Unico is triggered externally does NOT activate the hardware lock.

- The controller can be instructed via the GUI or via any software that uses the programming library (API DLL) to hold the laser soft-locked regardless of the position of the key switch. Refer to section 5.2.3 (GUI) and the separate API manual for more information on soft locking.

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

3.3.   Optical Output

The Unico *features* one optical free beam output equipped with a manually controlled laser output shutter.

The laser output can be coupled into either multi mode (MM) or polarization maintaining (PM) single mode fibers, that are suitable for the respective wavelength.

If a fiber coupler is attached to the output:

- The fiber type used is indicated in the individual test report (see appendix).

- Do not remove the fiber from the coupling optics, as this will result in the loss of the coupling adjustment! Readjustment is a demanding task and needs experience.

3.4.   Product Label

The product label (see Fig. 7) can be found on the side of the Unico module, next to the laser safety label. It shows all relevant information needed to identify the device, including product name, part number, serial number, manufacturing date as well as the PicoQuant logo with address, CE label, and waste regulation identifier.

PicoQuant GmbH Rudower Chausee 29 D-12489 Berlin Germany		⚠ CE
Model	No.	Unico-488
Part	No.	917488
Serial	No.	
Mfg.	Date:	
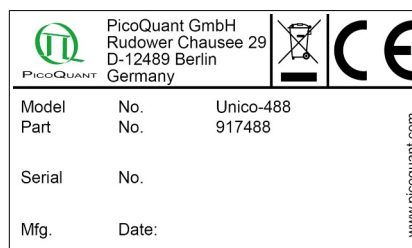
Fig. 7: Unico product label, example.

This product information must be communicated to PicoQuant in all communication and trouble shooting processes regarding this device.

3.5.   Orientation of laser polarization plane

The polarization plane is marked on the front of the laser housing with a round yellow label, as shown in Fig. 8.

NOTICE	All Unico models have a linear vertical polarization plane.

Fig. 8: Polarization plane label on Front side

3.6.   Cooling Fan – Heat Dissipation

To ensure stable laser emission, special heat dissipation design was required. The laser module is therefore equipped with cooling fans on the heat sink located at the bottom of the housing.

For best laser performance and stability, please ensure free air circulation around the whole laser module. By default, the cooling fans will be running when the Unico is powered on and **cannot** be switched off during operation.

⚠ CAUTION	Do not block the fan apertures. This might lead to laser instability or damage to the laser module!

NOTICE	A note on vibration-sensitive measurements: In all tests carried out at PicoQuant, there has never been a noticeable influence of fan vibrations on such measurements.

4.   Installation

4.1.   Unpacking and Preparations

Your Unico is delivered with a series of cables and accessories. Start by unpacking the delivery box and check that all components listed in the table below are present.

The manual and operation software can be downloaded from our website: www.picoquant.com/downloads.

Unico 1-Color Picosecond Laser

2 keys for the laser key switch

Remote interlock stub plug (4 pin LEMO plug with green end cap)

Cable USB 3.0 C MALE TO USB 3.0 A MALE (2m, 6.5x ft)

12V power supply

Please download manual and operation software from our website: www.picoquant.com/downloads

picoquant.com/downloads
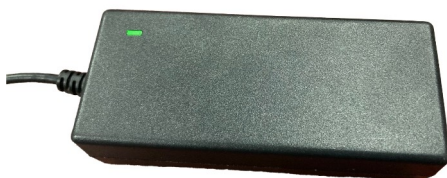
Before installing and using the Unico, please make sure to have

1. a solid base onto which the Unico can be placed (e.g., an optical table)

2. a computer to install and run the operating software. The computer needs to have a free USB slot as well as a Windows 10 or 11 operating system.

Ensure that all of the following conditions are met before proceeding with the installation (the numbering refers to the interface panel as shown in Fig. 6):

● Laser key switch ③ is set to the position *STBY* (vertical)

● Green remote interlock stub connector is plugged into the remote interlock socket ②

4.2.   Electrical Power and Signal Connections

● If desired, connect an external trigger signal to the connector labeled **TRIGGER IN** ⑦

● If desired, connect the **SYNC OUT** output connector ⑨ to an external device, e.g., TCSPC electronics from PicoQuant such as the TimeHarp 260, PicoHarp 300, MultiHarp 150, HydraHarp 400, or an oscilloscope.

● Plug the power cable into the **main power socket** ⑤, but do not plug the power cable into a power outlet until you have installed the PicoQuant laser driver software (see section 4.3)

4.3.   Software Installation

Once the Unico is in its dedicated place and the relevant cables have been inserted, connect the Unico to the host computer using the delivered USB-C cable.

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

The control software "`PQLaserDrv.exe`" for your Unico and other laser drivers manufactured by Pico-Quant needs to be set-up by an installer. The control software can be downloaded from our website: www.picoquant.com/downloads. 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 other drivers will no longer be able to "see" or connect to these USB device.
	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. SymPho-Time 64 or EasyTau) should be fully updated together.

To install the software:

1. Download the control software from our website: www.picoquant.com/downloads

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)

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

7. Select which launcher icons will be generated

NOTICE	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 5.2.

8. Validate your choices by clicking on *Next* and then click on the *Install* button to start the installation

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 Unico can be switched on (see chapter 5). When the laser is powered on for the first time, Windows will detect a new device and installs the necessary device drivers.

5. Operation

This section describes in detail step by step how to switch on the Unico and how to use the GUI to set the various laser module settings (e.g. power intensity, trigger source, repetition rate, fan control).

For optical power detection use a suitable powermeter and pay attention to the wavelength settings.

⚠ WARNING	Never look into the laser! Keep in mind, that some wavelengths at the edge of the visible range only appear to have low power for the eyes.

5.1. Powering the system ON

1. Ensure that the laser key switch ③ is set to the **STBY** (vertical) position.

2. Ensure that the green remote interlock connector is plugged into the remote interlock socket ②

3. Connect the external power supply to ⑤ and the power outlet to start up the Unico. The LED labeled **ON** ④ flashes dark white. The left status indicator LED ① lights up orange first, then flashes orange and then green for a few seconds until it lights up green continuously. After about 15 seconds the system is ready for operation.

NOTICE	There is a delay due to software startup. The Unico remains locked during this time and the ON ④ LED flashes dark white. In order to reach stable output power, please let the Unico laser warm-up for about one minute before activating the laser emission via the key switch.

4. Turn the key switch ③ to the *ON* position (horizontal). The LED labeled **ON** ④ lights up brighter and constantly white. The right status indicator LED ① will lights up blue when the Unico is operating in picosecond pulsed mode, light blue when it is operating in nanosecond pulsed mode and orange when it is running in CW mode.

⚠ WARNING	Before proceeding to the next steps, please make sure that all safety measures have been taken according to chapter 1.3 Laser Safety Instructions.

5. Open the laser output shutter.
6. Adjust the operating parameters through the appropriate software (e.g., with PQLaserDrv.exe).

If you cannot detect a laser beam, please check chapter 3.1, point ① .

5.2. Setting Operating Parameters with PQLaserDrv Graphical User Interface

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

The 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. However, for better readability, all screen shots in this manual correspond to the PicoQuant bright color scheme.

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 section 4.3).

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

An overview of the GUI with all control elements is shown in Fig. 9 below.
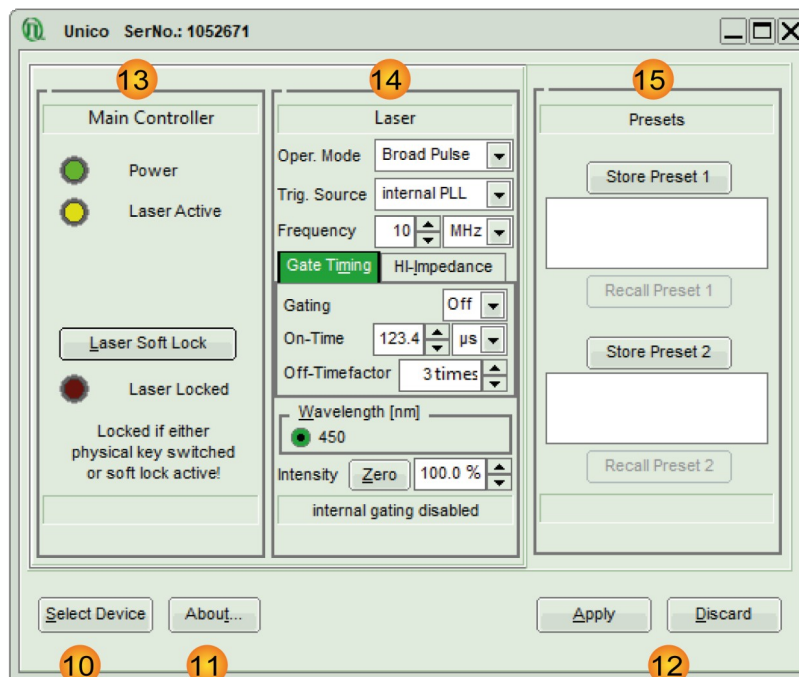
Fig. 9: PQLaserDrv GUI with a connected Unico laser - Overview of all main buttons and control groups

5.2.1. Select Device

The *Select Device* (10) function is useful if more than one Unico (or any other USB laser device from Pico-Quant) is connected to the same host computer. It can also be used to restore the USB connection to the device if it is interrupted for any reason during operation.

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

A modal dialogue with a *Cancel* and *OK* button presents a list box with the currently connected devices (Fig. 10). When opening the list box, all detected devices are listed by their serial number. The currently selected device is marked with an asterisk "*".

Fig. 10: Select device

Cancel   Back to the main window without any changes.

OK   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.

5.2.2. Apply / Discard

The *Apply* and *Discard* buttons 12 must be used to confirm or discard the configuration changes made in
the GUI. The label of any control panel on which changes have been made but not yet committed, will high-
lighted in orange. These highlights are retained until the changes are either applied or discarded.

5.2.3. Soft Lock and Unlock of the Unico

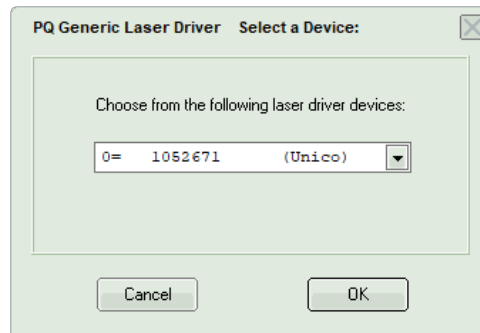The Unico can be locked (no laser light emission) not only with the hardware key switch 3 on the interface
panel, but also via the GUI by clicking on the button labeled *Laser Soft Lock / Laser Soft Unlock* in the Main
Controller panel 13 on the left side of the software window.

The mechanism behind the soft lock is similar to that of an interrupt via the interlock loop.

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

The *Laser Unlocked* state is recognizable in the software by the *Laser Locked* indicator turning dark red (see
Fig. 11, left). In addition, the ON LED 4 on the Unico is blinking dark white if the key switch 3 is in ON-
position and the interlock connector 2 is not connected, or if the key switch is in STBY-position. If the key
switch is in ON-position and the interlock connector is connected, the ON LED 4 lights up bright white con-
stantly.

The *Laser Soft 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 switch 3 or
remote interlock circuit (see Fig. 11, middle), or *Laser Soft Unlock* (see Fig. 11, right) 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) with respect to the
hardware LED on the front panel of the Unico.

NOTICE	The soft lock state is not persistently stored in the system; it is lost after power down / power up.

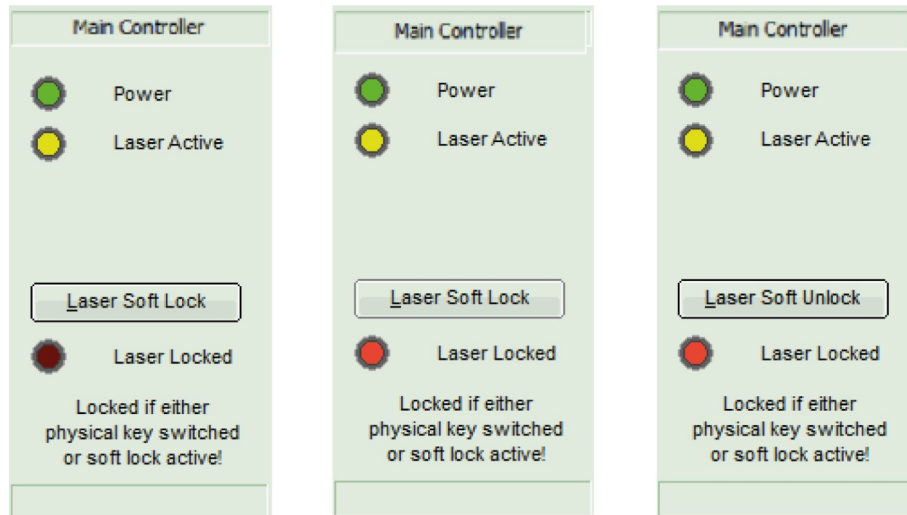| ⚠ **WARNING**	Before unlocking the laser, please refer to chapter 1.3 for laser safety instructions.

Fig. 11: Unico locking status indicator in the GUI: laser unlocked (left), laser hard locked via key switch (middle), laser soft locked (right)

5.2.4. Laser Control Panel

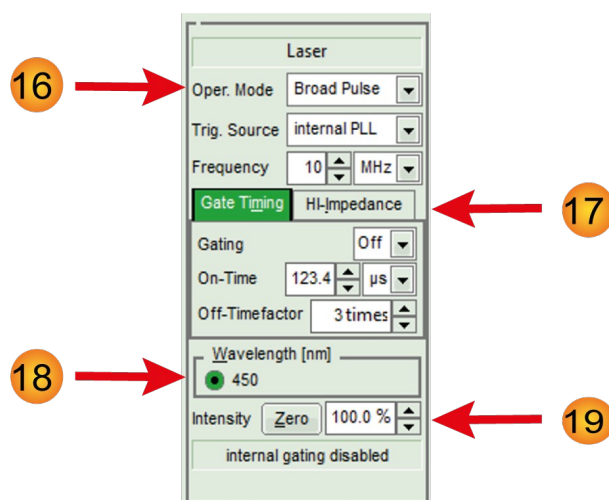(14)   Fig. 12 shows the laser control elements available for the Unico.

Fig. 12: GUI control panel *Laser* for the Unico 1-Color Picosecond laser

16   **Oper. Mode:**
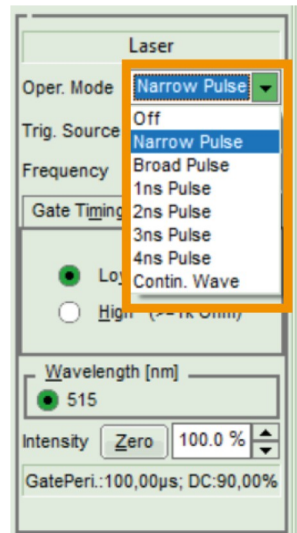
Fig. 13: list of operation modes under selection box "Oper. Mode"

Use the top selection box to choose the operation mode for the Unico. Note that the control elements located just below from the mode selection box will change depending on the chosen operation mode. The following operation modes are available for the Unico:

- *Off:* Selecting this option will turn laser emission off. No additional controls will appear below the selection box when the Unico's operating mode is set to *Off*.

- *Narrow Pulse*: This option enable the emission of picosecond laser pulses with narrow temporal pulse widths and steep falling edge without afterpulse. Pulses from the Unico 1-Color Picosecond Laser module can be triggered either internally or externally up to 200 MHz.

- *Broad Pulse*: In this operation mode, the Unico will generate picosecond laser pulses in a similar way as in the *Narrow pulse* mode. The main difference being that pulses will have a higher optical output power but with a broader pulse width (typ. < 1 ns, depending on wavelength). Again, the pulses can be triggered internally or externally up to 200 MHz.

- *1 ns Pulse, 2 ns Pulse, 3 ns Pulse and 4 ns Pulse*: In one of these operation modes, the Unico will generate ns laser pulses in a similar way as gated CW. However, these pulses can be triggered internally or externally up to 100 MHz. The 1...4 ns time actually refers to laser current time base and can result in sligthly shorter optical pulse length depending on lasing wavelength and intensity setting.

- *Contin. Wave*: By choosing this option, the Unico will generate laser light as a continuous wave (CW).

After selecting one of the Pulse Modes, a new selection box called **Trig. Source** will appear below the mode selection box. The following trigger modes are available for the Unico:
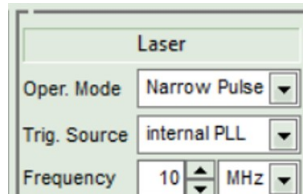
Fig. 14: Additional control
elements for internal triggering
in both narrow and broad
pulsed mode

Choose the option **internal PLL** to use the Unico's internal clocks for triggering the picosecond and nanosecond pulses. Upon selecting this option, a spin edit box labeled Frequency appears, which allows setting the repetition rate from 1 kHz to 200 MHz or from 1 kHz to 100 MHz in case of ns pulses (see Fig. 14). The frequency unit (kHz or MHz) can be selected from the selection box next to it.
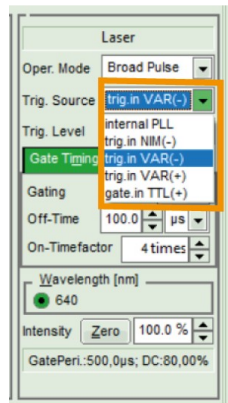
Fig. 15: trigger source
options under selction
box Trig. Source

- Select one of the options **trig.in NIM(-)**, **trig.in VAR(-)**, **trig.in VAR(+)**, **gate.in TTL(+)** to trigger the Unico laser module via an external signal source.

- Choose **trig.in NIM(-)** or **gate.in TTL(+)** when using the corresponding signal type as trigger source. No additional control element will appear in this case. The preconfigured settings in the background read
  trig.in NIM(-)   :   -0.4 V, falling edge
  gate.in TTL(+)   :   +1.2 V, rising edge
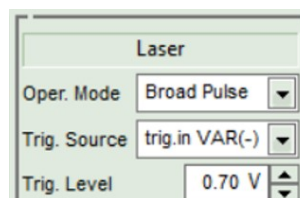
Fig. 16: Additional control
elements for external triggering
in both narrow and broad
pulsed mode

- The option **trig.in VAR(-)** will trigger upon the falling edge of an electrical pulse, while **trig.in VAR(+)** does the same on the rising edge of such a signal. Both of these options will also spawn an additional spin edit box called **Trig. Level**, where the threshold of the trigger signal can be set in V between -1 V to +1 V (see Fig. 16)

- **Contin. Wave**: By choosing this option, the Unico will generate laser light as a continuous wave (CW).

  ○ In this mode, the laser produces no picosecond pulses. However, the laser can still be modulated on a longer time scale (i.e. 10 ns...1 ms) via internal gating or arbitrary length with external gating.

  ○ No additional controls will appear below the *Operating Mode* selection box when the Unico is running in *CW*-mode.

  ○ In Contin. Wave mode, the desired electrical synchronization output can be selected via Trig. Source.

17   **Gating and Gate Timing:**

- Unico's laser emission can be gated both internally and externally, even simultaneously (i.e. turned on and off in various pattern) in all emission modes.

- Internal Gating is activated by choosing On or Inv. option of Gating spin edit box.
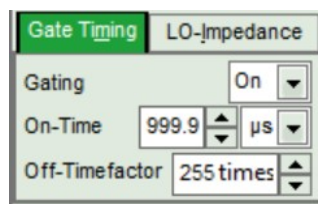
Fig. 17: Gating Timing options

- On option results in short on times and long off times.

- Inv. option results in long on times and short off times.

- Off option turns internal gating generator off.

- The *On-Time* spin edit box allows setting the time period where the Unico is emitting laser light. The time unit (ns, µs, ms) can be selected from the selection box located next to it.

- The time period in which the laser emission is kept turned off is defined by the value in the *Off-Timefactor* edit box. The time period during which the laser will be equal to the *On-Time* value multiplied by the *Off-Timefactor*. The resulting duty cycle and period time is displayed at the bottom.

- External gating must be provided by a gating signal fed into the GATE IN input connector, see Fig. 6   **8** .

- With gate impedance set to 50 Ohm and gating ON or Inverted GATE IN acts as an output for burst generator monitoring:

- The tab on the right side allows selecting the impedance for the applied external gating sig-nal via two radio buttons: either *Low* (50 Ohm => 0 Volt) or *High* (≥ 1 kOhm => +5 Volt). Note that the tab's label will change accordingly to *HI-Impedance* or *LO-Impedance* depending on the chosen option.

NOTICE	The tab's label will change accordingly to *HI-Impedance* or *LO-Impedance* depending on the chosen option.
	Setting the impedance to *Low* disables the laser emission until a valid external gating signal is provided, while setting to *High* leads to classic emission gating.
	The state of the internal gating (enabled or disabled) is displayed at the bottom of the Laser control panel.

18   **Intensity:**

- The intensity of the Unico's driving current can be set on a freely adjustable scale from 0 to 100 %, with a step width of 0.1%.

NOTICE	The optical output power does not correlate linearly with the current intensity scale. Each wavelength 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 the Unico needs to be switched off quickly. The button saves the previously set intensity, which is also indicated by the fact that the name of the button changes from *Zero* to the corresponding percentage value. Pressing the button again restores this intensity setting (or vice versa).

NOTICE	When entering an invalid intensity value (i.e. outside of the 0 to 100% range or with a step width lower than 0.1%), the edit box will show a red outline and the "Apply" button will be disabled.

5.2.5. Presets

15   Two working configurations can be saved and recalled in the control panel labeled *Presets,* see Fig. 9 . 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. 18).

Fig. 18: Save a configuration

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. 19). A stored configuration can simply be recalled by clicking on the button labeled *Recall Preset 1* or *Recall Preset 2.*
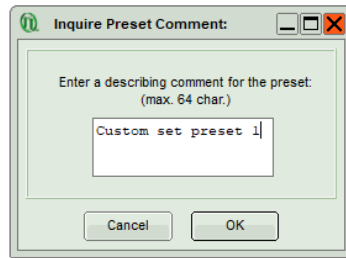
Fig. 19: Edit comment for a preset

NOTICE	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* button 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!

5.2.6. "About..." button

11 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…*, see Fig. 9.

For every support request its is recommend to save the entire information by clicking on the button labeled *Copy Support Infos* (see Fig. 20), save the information as a plain text file, and send it per mail to

support@picoquant.com
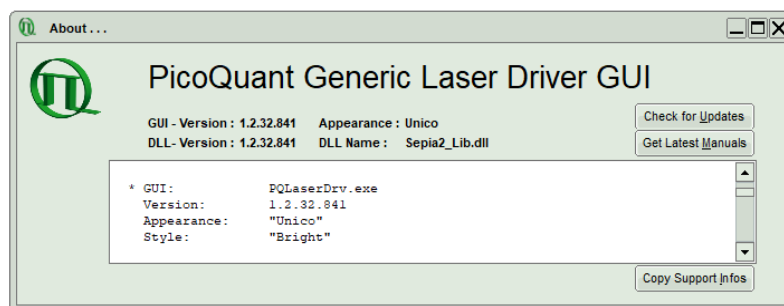
Fig. 20: The "About" window includes extended information about the status of the device

It is also possible to search for possible software updates by clicking on the button labeled *Check for Updates* (Fig. 20). 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. 21.
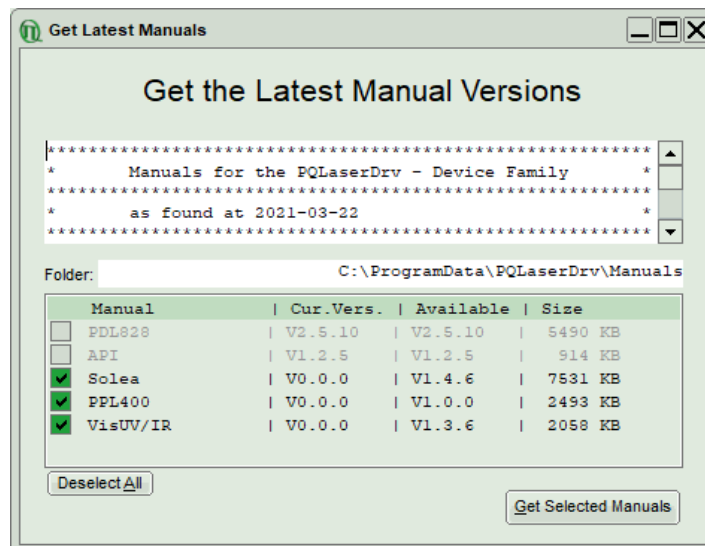
Fig. 21: A potential result screen after searching for latest manual versions

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. Troubleshooting, Tips and Tricks

6.1. Power stability

Please allow a start-up and warm-up time of about one minute between powering up the laser module and activating it through the laser key switch. This thermal equilibration time will ensure the ideal stability of the optical output power.

6.2. Pulse Repetition Rate and Intensity Settings

Changes to the pulse repetition rate have an impact on the total average output power of the laser. The pulsed average power is typically proportional to repetition rate, however pulse energy may not scale linearly especially at higher repetition rates.

The intensity setting allows for variation of the laser drive current under all operation modes. In CW mode, the power scales nearly linear. Under pulsed operation, the optical pulse energy is nonlinear related to the drive current and as such may shown a high threshold value and steep increase thereafter for the intensity setting.

7. Technical Data / Specifications

Optical output

Available wavelengths[1]........................ 375 nm, 405 nm, 450 nm, 488 nm, 515 nm and 640 nm
Nominal max. pulsed power[2].............. up to 10 mW
Nominal cw power.............................. up to 50 mW
Average Beam dimension[3]................. 1.0 ± 0.3 mm
Average Beam circularity[4].................. > 0.3
Polarization....................................... linear, vertical
Polarization Extinction Ratio (PER)..... typ. > 30 : 1 (> 15 dB)
Spectral width (pulsed, FWHM).......... < 7 nm (depends on wavelengths modul, please see delivery report)
Spectral width (CW, FWHM).............. < 3 nm (depends on wavelengths modul, please see delivery report)

Repetition rates

Internal
Range.. user selectable in 1200 steps; 1...999 kHz and 1...200 MHz

External
Range.. single shot to 200 MHz
Trigger level..................................... -1 to +1 V into 50 Ohm
Trigger voltage.................................. -3 to +5 V into 50 Ohm
Timing Jitter..................................... < 12 ps (rms)
Connector... SMA

Synchronization output

Amplitude... < -800 mV into 50 Ohm (NIM)
Connector... SMA

Gating

Rise / Fall Time................................. < 3 ns
ON Time (or inverted: OFF Time)........ free adjustable from < 10 ns to 1 ms
OFF Time (or inverted: ON Time)........ free adjustable factor from 1 to 255 of On (or OFF) Time
Impedance (switchable)...................... High Impedance selected 10 kOhm with pull-up
.... Low Impedance selected 50 Ohm terminated
Connector... SMA

Dimensions

Size (h x w x l).................................. 75 x 83 x 140 mm
Weight.. approx. 1 kg

---

1 Typical value in pulsed mode. A slight shift to longer wavelengths in CW mode.

2 This is the maximum average power at maximum intensity setting and maximum repetition rate. A pulse broadening up to 1 ns FWHM is possible at maximum intensity setting.

3 Measured at 1 m distance from laser aperture

4 Measured at 1 m distance from laser aperture

Operation

Temperature range.............................. 10 to 35 °C
Max. power consumption..................... < 30 W
External 12 V power supply…………… Input 110-240V

Interface

PC interface.. USB 2.0
Connector... USB-C
Operating system............................... Windows^{TM} 10 and 11

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

7.2. Dimensions of the Unico laser module (all values given in mm):

Back

83

STBY
REMOTE
INTER-
LOCK
STATUS
TRIG
IN

ON

GATE
IN

12VDC
3A
USB
SYNC
OUT

71

Bottom

140

(24,50)

Front

24,2

4

50

(90,3)
adjustable

Side

WARNING - LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT

Maximum Power P_O < 100 mW
Wavelengths λ = 450 nm
SEE MANUAL

Complies with IEC 60825-1:2014/21 CFR 1040.10 and
1040.11 except for deviations pursuant to Laser Notice No.
50, dated June 24, 2007.

PicoQuant GmbH
Rudower Chaussee 29
D-12489 Berlin
Germany

CE

Model   No.   Unico-450
Part   No.   917450

Serial   No.

Mfg.   Date:

(54)

(190,70)
adjustable

8. Support

8.1. Returning Products for Repair

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.

9. Legal Terms

9.1. Copyright

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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
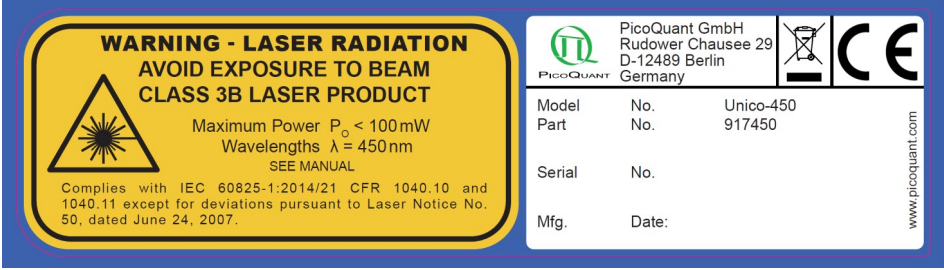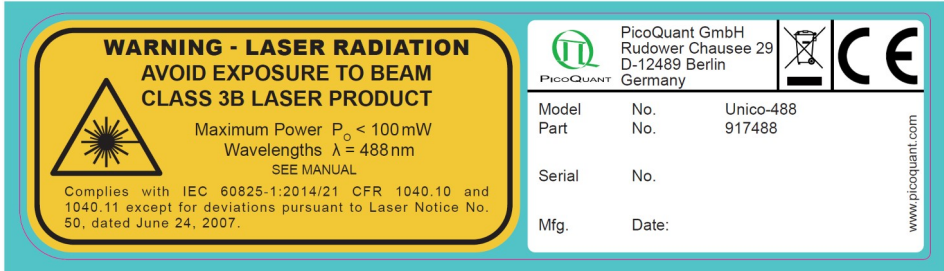
11.   Appendix
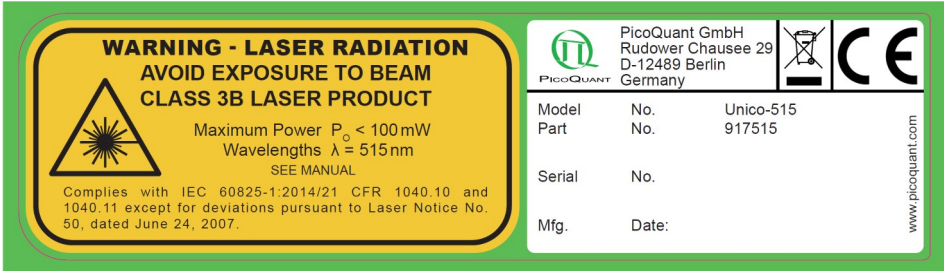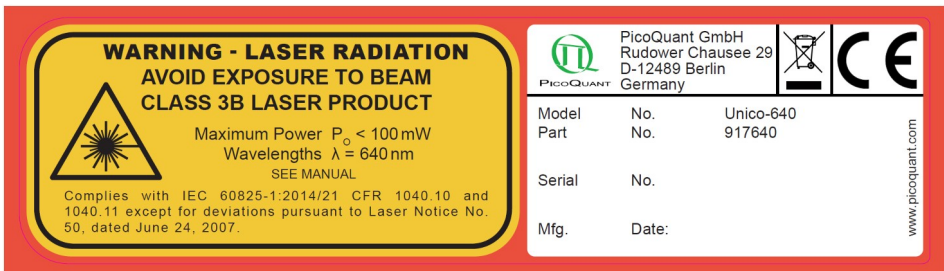
11.1.   Abbreviations

BNC	British Naval Connector or Bayonet Nut Connector or Bayonet Neill Concelman
CAMAC	Corporations and Markets Advisory Committee
FWHM	Full Width at Half Maximum
IEC	International Electrotechnical Commission
IR	Infra-red
IRF	Instrument Response Function
LED	Light Emitting Diode
MOFA	Master Oscillator Fiber Amplifier
NIM	Nuclear Instrumentation Methods
RMA	Return Merchandise Authorization
SMA	Sub-Miniature version A (connector type)
STED	STimulated Emission Depletion
TCSPC	Time-Correlated Single Photon Counting
TTL	Transistor-Transistor Logic
UV	Ultra-violet
VIS	Visible
WEEE	Waste Electrical and Electronic Equipment

11.2.   Overview of Laser Warning Labels by Module Type

The table in this section provides an overview of laser warning labels by model type. Note that this list includes all Unico models available at the time this manual was published.

Model type	Warning label
Unico- 375	
Unico- 405	

Model type	Warning label
Unico- 450	**WARNING - LASER RADIATION** AVOID EXPOSURE TO BEAM CLASS 3B LASER PRODUCT Maximum Power $P_O < 100\,mW$ Wavelengths $\lambda = 450\,nm$ SEE MANUAL Complies with IEC 60825-1:2014/21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007. PicoQuant GmbH, Rudower Chausee 29, D-12489 Berlin, Germany CE Model No. Unico-450 Part No. 917450 Serial No. Mfg. Date: www.picoquant.com
Unico- 488	**WARNING - LASER RADIATION** AVOID EXPOSURE TO BEAM CLASS 3B LASER PRODUCT Maximum Power $P_O < 100\,mW$ Wavelengths $\lambda = 488\,nm$ SEE MANUAL Complies with IEC 60825-1:2014/21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007. PicoQuant GmbH, Rudower Chausee 29, D-12489 Berlin, Germany CE Model No. Unico-488 Part No. 917488 Serial No. Mfg. Date: www.picoquant.com
Unico- 515	**WARNING - LASER RADIATION** AVOID EXPOSURE TO BEAM CLASS 3B LASER PRODUCT Maximum Power $P_O < 100\,mW$ Wavelengths $\lambda = 515\,nm$ SEE MANUAL Complies with IEC 60825-1:2014/21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007. PicoQuant GmbH, Rudower Chausee 29, D-12489 Berlin, Germany CE Model No. Unico-515 Part No. 917515 Serial No. Mfg. Date: www.picoquant.com
Unico- 640	**WARNING - LASER RADIATION** AVOID EXPOSURE TO BEAM CLASS 3B LASER PRODUCT Maximum Power $P_O < 100\,mW$ Wavelengths $\lambda = 640\,nm$ SEE MANUAL Complies with IEC 60825-1:2014/21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007. PicoQuant GmbH, Rudower Chausee 29, D-12489 Berlin, Germany CE Model No. Unico-640 Part No. 917640 Serial No. Mfg. Date: www.picoquant.com

11.3. Laser Delivery Report

The delivery report of your laser, including all final production test results for pulse shape, optical power, and linewidth is delivered with each laser source. A PDF copy can be provided on request.

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