Laser Coupling Unit
LCU
for LSM Upgrades

User's Manual and Technical Data

Version 2.4

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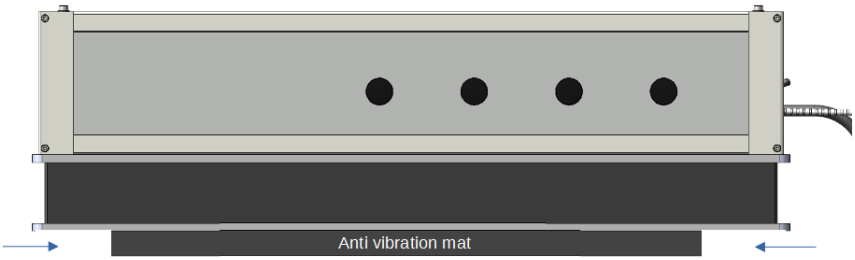
1. General safety information

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 Transportation

The Laser Combining Unit (LCU) should be lifted by at least two persons, its weight is approx. 35 kg.
The base plate of the LCU is placed 18 mm above ground supported by an anti vibration mat. In this way hands can lift the device by holding it on the lower side of the base plate (compare arrows in the figure below where the fingers can take hold).



1.2 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 prefaces any instructions that have to be followed to avoid sever 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 needs to be connected to the ground (to avoid risks of electrical shock).

1.3 Laser Safety Instructions

WARNING! Visible and invisible laser radiation

The LCU comes with one or more laser diode heads that can emit visible, infrared, or UV light. Infrared light is in not visible to the eye! **These diode lasers can emit laser light of up to class 3B / IIIB.** Please refer to the labels affixed to the laser head for information on classification. In general the LCU is not suitable for laser light of class 4 / IV.

Laser class 3B / IIIb require that special laser safety glasses are worn. The installation room of the LCU must be labeled as laser area.

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 laser diode heads of the LDH Series are manufactured according to the International Laser Safety Standard IEC 60825-1:2007 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 LCU is installed must be labeled as a laser area.

The following security instructions must be followed at all times.

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 laser diode heads and associated driver unit. Observe all safety precautions relevant to Class 3b / IIIb lasers
- Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- The laser power levels accessible if the unit is opened can cause instant blindness, skin burns and fires. Class 3B / IIIB lasers can present a major hazard through exposure to the direct (intra-beam) or reflected (specular or diffuse) laser beams when the laser is inadvertently “on” and there is a direct line-of-sight path to the laser beam or its reflection. If your instrument uses another excitation system, follow the safety instructions of the relevant manual.
- Never remove the optical fiber from the system when the lasers are powered.
- The delivered instruments are pre-set by PicoQuant to operate on the power outlet line voltage for the country of delivery. Nevertheless, please check that the actual line voltage corresponds to the value set on these instruments!
- Never connect or disconnect any cable while the data acquisition and control electronics are ON. Charged signal cables can destroy the devices!

1.4 Laser Safety Labels on the LCU

The Laser Coupling Unit (LCU) is equipped with laser devices complying with safety standards, including International Electrotechnical Commission (IEC) 60825 and its relevant national implementations. With specific regard to the laser, the equipment complies with laser product performance standards set by government agencies for a **class IIIB laser product**.

PicoQuant equipment is clearly labeled with warnings about the equipment radiation level. All warning labels must be read and understood by personnel before working with the equipment. Be sure to observe the following warnings when operating a product equipped with a laser device. Failure to observe these warnings could result in fire, bodily injury and damage to the equipment.

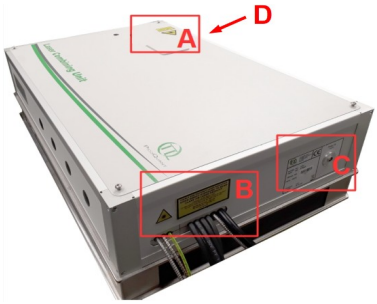


Fig. 1.1 Laser Combining Unit with Laser Warning Labels
The Laser Warning Labels are located on the cover of the LCU at the location (A) and on the side panel of the LCU (B). In Case of an AMOT-LCU the CE- and product Label is also located on the side panel of the LCU (C). Power and Wavelength Specifications Label (US) are located at (D).

Fig. 1.2 Laser Hazard Warning (A, B)
Laser warning label used in combination with other laser safety labels on the LCU

Fig. 1.3 Class IIIB Laser Product Warning Label on the lid of the LCU (A)

This label in particular identifies parts of the system which give access to the laser beam by opening a cover. (label on the lid of the LCU)

Fig. 1.4 Class IIIB Laser Power and Wavelength Specifications Label on the side of the LCU (B)

The LCU equipment contains Class IIIB laser products. The maximum output power is 500 mW with access in the 350-1060 nm wavelength range. Laser radiation presents a visible and invisible hazard, so personnel should avoid exposure to the laser beam.

Fig. 1.5 Class IIIB Laser Power and Wavelength Specifications Label (US) on the side of the LCU (D)

The LCU equipment contains Class IIIB laser products. The maximum output power is 500 mW with access in the 350-1060 nm wavelength range. Laser radiation presents a visible and invisible hazard, so personnel should avoid exposure to the laser beam.

The LCU can only be operated in a room which is equipped with signs explaining the existence of a potential laser hazard. These **laser area warning signs** should be posted prominently at the entrance to the service area and in the vicinity of the installation area where laser and laser-furnished fiber optic equipment is installed, in accordance with IEC 60825. Since the service area is a temporary laser-controlled area, these signs should signal that access is limited to authorized personnel. The symbol for a laser hazard is to be prominently displayed at the top of this sign.

Personnel must be qualified in laser safety procedures and must use proper eye protection before working on this equipment. Please inform your local **laser safety officer** to arrange according laser safety precautions.

WARNING!

Do not operate controls, make adjustments, or perform procedures to a laser device other than those specified in the operation manual or in the laser device installation guide. Allow only PicoQuant authorized service technicians to repair the laser equipment.

2. Introduction and Principle of Operation

The LCU can be equipped with up to 5 diode laser heads (LDH) for the manual version and up to 4 LDHs for the motorized version (AMOT-LCU). Additional lasers can also be included using the free laser entrance port. The motorized version allows to remotly adjust the laser intensity without changing of the pulse width of the pulsed lasers. A single mode polarization maintaining fiber delivers the laser light to the laser scanning microscoope.

2.1 Attenuation Unit (only manual version)

The LCU provides a graded and a continuous intensity attenuation by two different elements. With the filter wheel the attenuation is adjustable in three steps by changing the filter in the beam path.

0 = 100 % Transmission
1 = 10 % Transmission
2 = 1 % Transmission
3 = 0.1 % Transmission

The additional scaffold allows a continuous attenuation (100 % − 0 %) by clipping of the laser beams. The scaffold is controlled with a micrometer head and allows a precise intensity control.

Note that the Attenuation Unit is placed in a position where all laser beams come through. That ensures that the attenuation of the ND-filters (neutral density filters) is for all beams equal. However, the attenuation achieved with the scaffold can be different for the specific laser beams due to differences in the shape and orientation of the beam profile.

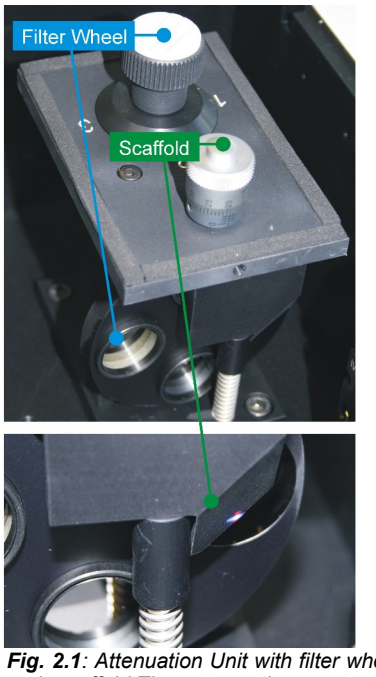


***Fig. 2.1**: Attenuation Unit with filter wheel and scaffold.The attenuation parts are not visible to the user.*

2.2 Shutter Integration for Zeiss

The confocal laser scanning microscope from Zeiss are using a special shutter control, which is delivered by Zeiss and integrated in the LCU. Therefore the LCU is equipped with two additional Lemo Connectors, called “safety” and ”power” for connection of the Zeiss shutter control.

2.3 Optical fibers

WARNING! Visible and invisible laser radiation

Never remove or mount the optical fibre while the laser is powered on

The **LCU** is assembled and aligned according to the the customer needs. One optical fiber is delivering the laser light to the microscope. Please do not bend this fiber since it is very sensitive.

2.4 Motorized attenuation (AMOT-LCU)

The LCU is in the standard configuration equipped with motorized laser attenuators (AMOT-LCU). The motorized attenuators allow to control the laserpower in the software. This adjustment does not change the pulse width of the lasers. The range of the adjustment is two orders of magnitude (between 1% and 100%). Please note that the intensity values given in the LSM software do not correspond accurately to intensity values emitted by the Laser combining unit.

3. Technical Data

3.1 Specifications

Connectors Main-LCU

Laser Cable	Lemo.3B.812
SM Fiber	Endcap FC-AFC

Connectors motorized Version

NIDAQ Electronic Cable	SUB-D 37 pol.
Power	Kycon 4pol. KPJX-PM-4S-S, 12V DC, max. 45W

Connectors Zeiss Upgrade Version

Shutter Controll	Lemo female

Temperature Range	19°C - 25°C
Humidity	< 60% rel. humidity
Location Hight	max. 2000 m over sea level

Dimensions (Depth x Width x Height, in mm)

Main-LCU	400 x 600 x 230

Weight

Main-LCU	~ 35 kg

Retraction of old Devices

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

WEEE-Reg.-Nr. DE 96457402

4. Support

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

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

Of course, we also appreciate good news: If you have obtained exciting results with the system, we would also like to know!

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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