



LaserBoxx series User manual

LCX and LPX models - Diode-pumped solid-state laser sources

REVISION HISTORY

CO-02426-A	January 2016	First version
CO-02426-B	December 2017	Procedures revised with screenshots of the new version of the GUI. Added description and operation of the electro-mechanical shutter
CO-02426-C	July 2020	Description and operation of the LPX models
CO-02426-D	May 2023	Heatsinks suppressed on standard units

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1. SAFETY INFORMATION

To use the products safely, follow the instructions provided here. Keep the product documentation nearby and offer it to other users. Contact Oxxius or your local representative if you have any question, or if some parts of this manual are not understood.

QUALIFICATION AND TRAINING OF PERSONNEL

Personnel who operate the laser product must be adequately trained and qualified for the work concerned and should have read and understood this manual. The user must understand the potential dangers presented by a laser equipment and observe the recommendations of this manual. These users also have a sound knowledge of at least one of the languages in which the interfaces and the product documentation are available.

SIGNAL WORDS IN THE DOCUMENTATION

The following sidebars point out a risk that the operator needs to be aware of. The signal word indicates the severity of the safety hazard and how likely it will occur if the safety precautions are not followed.

WARNING - CAUTION - NOTICE



WARNING: Describes a potentially hazardous situation, that could result in serious injury if not avoided.

CAUTION: Describes a potentially hazardous situation, that could result in minor or moderate injury if not avoided.

NOTICE: Describes a potential risk of damage, that could result in damage to the supported product or to other property.

1-1 Safety instructions

In these safety instructions, the term “product” covers the LCX and LPX laser sources and their accessories (patch cables, etc.).

Use the product only for its intended use and within its performance limits. Intended use and limits are described in the product documentation such as the data sheet and the manuals. If you are unsure about the appropriate use, contact Oxxius customer service.

OPERATING SITE

Only use the product indoors. The product casing is not waterproof; water that enters can electrically connect the casing with live parts, which can lead to electric shock.

The product is suitable for pollution degree 2 environments where nonconductive contamination can occur. For more information on environmental conditions such as ambient temperature and humidity, see the data sheet.

In compliance with IEC EN 61010-1 standard, the plug-and-play version of the product is intended to be used in an environment meeting the following conditions:

- Altitude up to 2000 meters,
- Ambient air temperature: from +10 °C to +40 °C (operating temperature),
- Base plate temperature: from +10 °C to +50 °C (operating temperature),
- Maximum relative humidity of 80% for ambient air temperatures up to 31 °C, decreasing linearly to 50% at 40 °C,
- AC supply voltage fluctuating within +/- 10% of its nominal value,
- Transient over-voltages occurring up to the levels of overvoltage category II, as specified in standard IEC EN 61010-1,
- Temporary over-voltages occurring on the mains supply

ELECTROSTATIC DISCHARGES (ESD)

ESD are created when friction over objects create a deficit or an excess of charge. When this discharge occurs, the voltages involved are high enough to damage electronic circuits.

The products have been successfully tested against ESD of the following amplitudes: +/-4kV on contact, +/-8kV on air.

CAUTION



Although input protections are integrated in the laser sources, a particular attention is required when using the product in dry air and on a floor presenting a carpet or a vinyl-tiled surfaces: in such conditions, discharges in excess of 20kV can occur.

In order to prevent ESD damage during handling, use appropriate clothing and equipment (antistatic wrist straps, etc.).

CONNECTING TO POWER AND GROUNDING

The LCX and LPX operate from low voltages, and do not contain hazardous voltages.

The mains power supply input of the instrument complies with overvoltage category II. It has to be connected to a fixed installation used to supply energy-consuming equipment such as household appliances and similar loads. Be aware that electrically powered products have risks, such as electric shock, fire, personal injury or even death.

Take the following measures for your safety:

Before switching on the product, ensure that the voltage and frequency indicated on the product match the available power source.

- Only use the power cable delivered with the product. It complies with country-specific safety requirements. Only insert the plug into an outlet with protective conductor terminal.
- Only use intact cables and route them carefully so that they cannot be damaged. Check the power cables regularly to ensure that they are undamaged. Also ensure that nobody can trip over loose cables.
- In the event where the power cord has to be replaced, please make sure to use a power cord that meets the following characteristics :
 - Connector on wall plug side: in accordance to the local standard
 - Connector type on device side: C13
 - Current Rating: 10 A
- Use the power supply that is delivered with the product or that is recommended in the product documentation or a power supply that conforms to the country-specific regulations.
- Ensure that you can disconnect the product from the power source at any time. Pull the power plug to disconnect the product. The power plug must be easily accessible. If the product is integrated into a system that does not meet these requirements, provide an easily accessible circuit breaker at the system level.

HOW TO CLEAN THE PRODUCT

If necessary, use a dry, lint-free cloth to clean the casing product. When cleaning, keep in mind that the casing is not waterproof. Do not use liquid cleaning agents.

LASER SAFETY

The LCX and LPX models are sources of laser radiations, which present specific dangers.

Light produced by a laser source exhibits several proprieties that make it much different from sunlight or from the light emitted from a bulb. These proprieties induce specific hazards associated during operation and service of the laser source:

- Lasers light sources produce a highly intense light, either visible or invisible to the human eye,

- Laser light is coherent, which means that it can build stable interferences: vivid patterns that are more intense than non-coherent light of the same wavelength and power,
- Laser beams are often collimated or have a low divergence, so that they maintain their harmful properties over long distances.

BIOLOGICAL EFFECTS OF LASER BEAMS

Here are some known and documented effects of intense laser light over biological bodies:

- Ocular trauma: a collimated laser beam, focused by the eye lens, can create an extremely intense light over the retina, even more intense than what would result from a direct viewing of the sun. Such exposure can lead to a permanent damage of the vision.
- Thermal injury: following the absorption of laser energy, the tissue proteins are denatured due to the temperature rise. Tissue damage results from this kind of exposure.
- Other damage mechanisms have also been demonstrated for other specific wavelength ranges and/or exposure times. For example, photochemical reactions are the principal cause of threshold level tissue damage following exposures to either ultraviolet radiation (200nm to 315 nm) for any exposure time or "blue light" visible radiation (400nm to 550nm) when exposures are longer than 10 seconds.

Table 1-1: Summary of basic biological effects of light

Photobiological spectral domain	Effects on the eye	Effects on the skin
Ultraviolet A (315 to 400nm)	Photochemical UV cataract	Pigment darkening, skin burn
Visible (400 to 780nm)	Photochemical and retinal thermal injury	Photosensitive reactions, skin burn
Infrared (780nm to 10µm)	Retinal thermal injury	Skin burn

LASER CLASSIFICATION

The lasers sources are categorized according to their ability to harm the exposed bodies, from class 1 (no hazard during normal use) to class 4 (severe hazard to eyes and skin).

Standard LCX and LPX models either belong to class 3B or class 4.

- Class 3B laser sources: laser products that are normally hazardous when intraocular beam exposure occurs, including accidental short time exposure. Viewing diffuse reflections is normally safe. Class 3B lasers may produce minor skin injuries or even pose a risk of igniting flammable materials. However, this is only likely if the beam has a small diameter or is focused.
- Class 4 laser sources: laser products that are normally hazardous when intraocular beam exposure occurs, including accidental short time exposure. Viewing diffuse reflections is not safe. Class 4 lasers can produce severe skin injuries and can pose a risk of igniting flammable materials.

The classification of a laser is based on the concept of accessible emission limits (AEL) that are defined for each laser class. This is usually the maximum power (in Watts) or energy (in Joules) that can be emitted over a specified wavelength range and exposure time.

The following table lists the accessible power and irradiance at the output of each model:

Table 2-2: Accessible emission of LCX and LPX models

Model	Nominal optical power (mW)	Laser class	Irradiance (W.cm ⁻²)	Eye protection required
LCX-5xx-50	50	3B	4	≥ OD 3
LCX-5xx-100	100	3B	9	≥ OD 3
LCX-5xx-150	150	3B	14	≥ OD 3
LCX-5xx-200	200	3B	19	≥ OD 3
LPX-5xx-300	300	3B	29	≥ OD 3
LPX-5xx-500	500	4	49	≥ OD 4
where "5xx" stands for either 532, 553 or 561nm				
LPX-640-200	200	3B	19	≥ OD 3
LPX-640-500	500	4	49	≥ OD 4
LCX-1064-200	200	3B	19	≥ OD 3
LCX-1064-300	300	3B	29	≥ OD 3
LCX-1064-500	500	4	49	≥ OD 4

SAFETY GUIDELINES

Any person using a laser source should be aware of the risks involved. This awareness is not just a matter of time spent with lasers; on the contrary, long-term dealing with invisible risks (such as with infrared sources) tends to dull risk awareness.

Here are some guidelines to follow when dealing with laser sources:

- Use the laser source in a room with access controlled by door interlocks. Post warning signs. Limit the area access to individuals who are trained in laser safety.
- The operator of the laser should be responsible for notifying the laser usage and for controlling the laser area.
- All personnel present in the area must be wearing personal protective equipment (in particular eyewear) before the laser emission is effective. This should include operators that are not directly using the laser system.
- Use the laser source in a brightly lit room so that the operators work with their pupils narrowed.
- Optical experiments should be carried out on an optical table with all laser beams travelling in the horizontal plane only, and all beams should be stopped at the edges of the table. Users should never put their eyes at the level of the horizontal plane where the beams are in case of reflected beams that leave the table.
- Take off watches or any jewelry that might enter the optical plane. All non-optical objects that are close to the optical plane should have a mat finish in order to prevent specular reflections.
- Never look directly into the laser output port (or the delivery fiber) when the power is on.
- Alignment of beams and optical components should be performed at a reduced beam power whenever possible.

- Do not install or terminate fibers or collimators when the laser is active. Follow the dedicated instructions in this manual.
- Ensure that the work surface is properly vented. Gases, sparks or debris can be generated from the interaction between the laser and the work surface, posing additional safety hazards.

PROTECTIVE EYEWEAR

The use of eye protection is strongly recommended when operating lasers of any class beyond class 1.

Eyewear is rated for optical density (OD), which is the base-10 logarithm of the attenuation factor by which the eyewear is reducing beam power. For example, eyewear with OD 3 will reduce the beam power in the specified wavelength range by a factor of one thousand. In addition, laser eyewear used in situations where direct beam exposure is possible should be able to withstand a direct hit from the laser beam without breaking. The protective specifications (wavelengths and optical densities) are usually printed on the goggles themselves.

Refer to Table 1.2 to learn about the recommended eyewear of each model

Oxxius recommends that the user investigate any local, state, federal or governmental requirements as well as facility or building requirements that may apply to installing or using a laser or laser system.

STANDARD COMPLIANCE OF THE PLUG-AND-PLAY AND “OEM” VERSIONS

The LCX and LPX laser sources, in their plug-and-play version, complies with all the requirements of the European Laser Safety Standard 60825-1, dated May 2014, and with US FDA CFR 1040.10 and 1040.11, except for deviations pursuant to Laser Notice N° 56, dated May 19, 2019. (Laser Notice No. 56).

The laser source in its “OEM” version is intended for integration into a larger system under the control of our customers and should therefore not be used “as is” in another environment such as a laboratory. The equipment into which the laser is integrated must comply with the laser safety standards listed above. Therefore, Oxxius bears no responsibility in any lack of compliance with safety standards of the environment in which the laser source, OEM version, is used.

SAFETY FEATURES ON THE LASER UNITS

The aforementioned safety standards demand that some safety features are present on the laser units, in order to inform the user about the laser radiation and prevent an accidental exposure. Note that some of the following features are only present on the plug-and-play versions of the laser sources.

ACTUATED KEY MASTER CONTROL

The laser product features an actuated key master control on its remote control (refer to section 2, “Instrument tour”). This lock and key control the emission. The laser emission is not possible when the key is in “OFF” position, or out of the lock. The key is removable only when in “OFF” position.

APERTURE LOCATION

An aperture label indicates the position of the laser beam output (refer to figure 1-3). The laser radiation is generated within a protective housing which should never be opened.

REMOTE INTERLOCK

This function is usually used in conjunction with a door or a panel in order to control the access to the irradiated area. At this purpose, the controller of the LCX or LPX features a dedicated socket on the rear panel (refer to chapter 3-2, “Instrument tour”). The laser emission is unavailable as long as both terminals of the connector are not electrically connected.

EMISSION WARNING INDICATOR

Controllers are provided with an emission indicator (refer to chapter 2-4, “Instrument tour”). In compliance with CDRH requirements, this indicator is lit for 6 seconds from the moment where the emission command is received to the moment where the laser is actually emitting, thus providing a delay for the user to be warned about the imminent emission.

OPTICAL SHUTTER

A mechanical shutter, located at the aperture of the laser source, allows for a complete extinction of the beam.

LABELLING (ADVISORY LABELS)

It is the responsibility of the manufacturer to provide the correct classification of a laser, and to equip the laser with the appropriate warning labels and safety measures as prescribed by the regulations.

Along with text warnings, these labels include information pertaining to the emitted wavelength, the total output power and the laser classification of the device.

Refer to the following paragraph, “Labels on the product”.

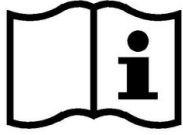
1-2 Labels on the product

Labels on the casing inform about:

- Personal and laser safety,
- Product and environment safety,
- Identification of the product

Do not remove nor tear these labels.

LABELS REGARDING PRODUCT AND ENVIRONMENT SAFETY



This symbol means that reading this instruction manual is mandatory prior to using the equipment or to performing any level of maintenance.



Labeling in line with EN 50419 for disposal of electrical and electronic equipment after the product has come to the end of its service life.

For more information, refer to chapter 5-6, “Disposal”.



This pictogram stands for “direct current”.

LABELS REGARDING LASER SAFETY

The labels present on the laser head inform about the laser class, the laser aperture location and the emission characteristics. Refer to the figures 1-2 and 1-3 to locate these labels on the product.

LASER APERTURE LABEL



This label indicates the aperture from where the laser emission will propagate.

LASER CLASS LABEL



This label indicates the class of the laser source, and warns about the potential hazards in case of exposure to the radiation.



This pictogram indicates that the labeled device has the potential to emit some laser radiation.



This pictogram urges the user to avoid any unprotected ocular contact with the beam



This pictogram urges the user to avoid any incidence of the beam over his or her unprotected body.

WAVELENGTH LABEL

Emission wavelength: 532 nm
Maximum power: 120 mW

This label indicates what are the accessible wavelengths, and their respective powers. This power is written as the maximum value the user can have access to during operation, it is therefore in most cases a larger value than the nominal power of the laser.

STANDARD COMPLIANCE LABEL

Complies with IEC 60825-1 Ed 3, 2014-05
and with FDA 21 CFR 1040.10 and
1040.11, except for deviations pursuant to
Laser Notice No. 56, dated May 8, 2019.

This label lists the product compliance of with the main laser safety standards (IEC 60825-1 and US FDA CFR 1040.10, 1040.11).

IDENTIFICATION LABEL

This label indicates the product model, its serial number, its month and year of manufacture.

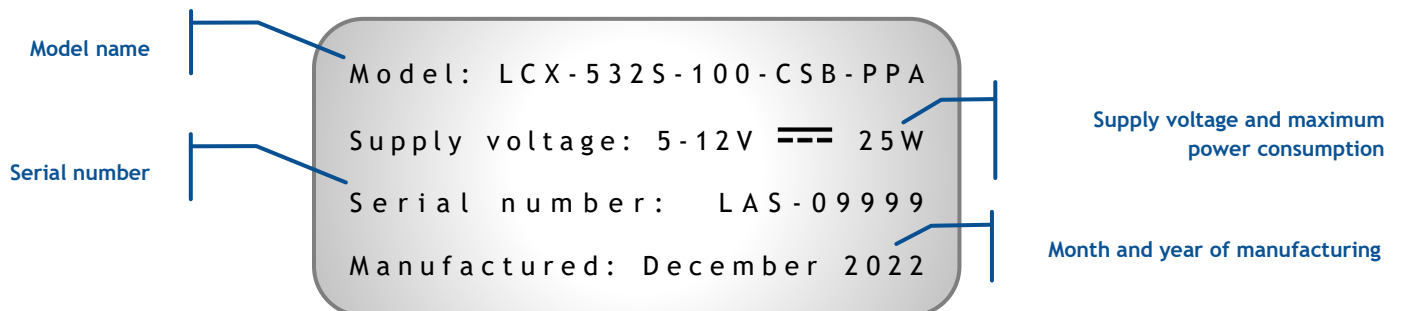
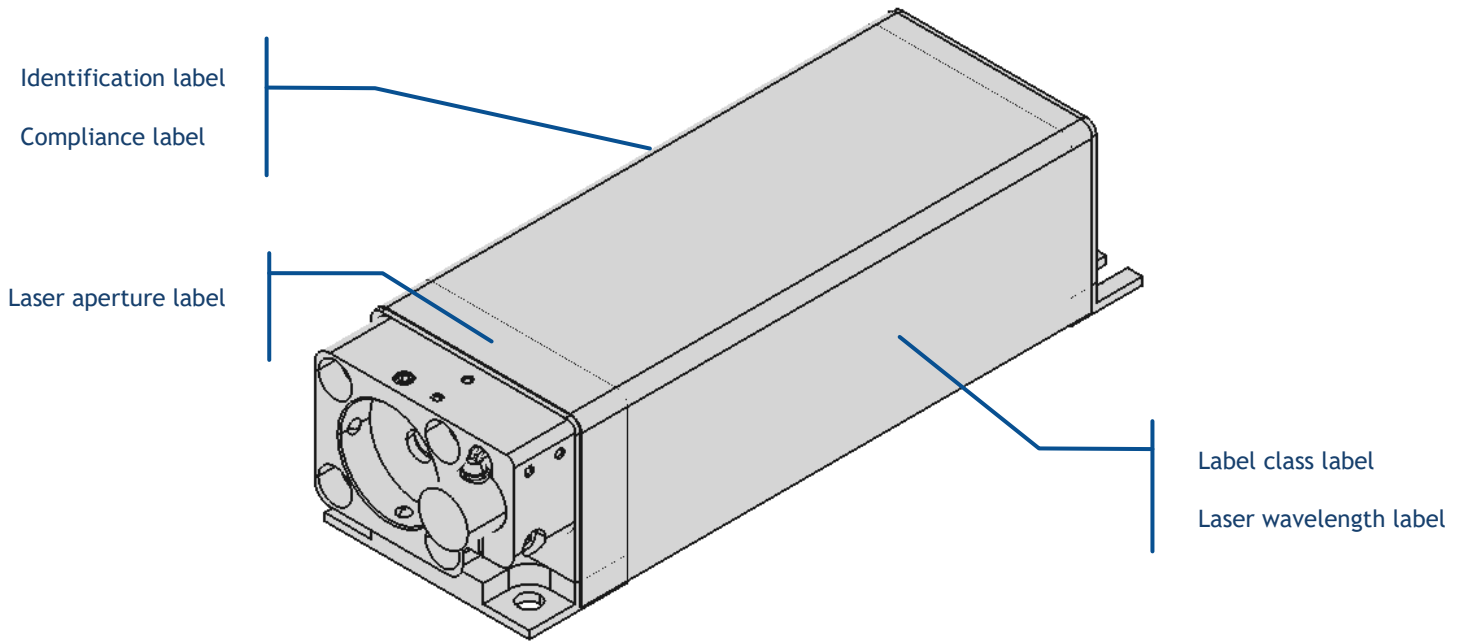


Figure 1-3: Position of the labels on a LCX or a LPX unit (layout may vary)



2. GETTING STARTED

2-1 Overview

THE LASERBOXX LASER SOURCES

The LaserBoxx is a family of laser sources based on a common platform and sharing the same footprint. Their architecture draws on state-of-the-art solid-state lasers, enabling rugged and maintenance-free sources providing a high optical power and a stable output in a compact footprint.

The LCX and LPX LaserBoxx are models that embed a monolithic diode-pumped solid state (DPSS) laser. These laser sources are ideal for high resolution Raman spectroscopy, interferometry or fluorescence applications.

These laser sources feature:

- Visible or infrared outputs, emitted from patented, alignment-free monolithic resonators,
- common mechanical and electrical interfaces,
- a low power consumption,
- Free space circular beams or fiber-coupled output beams,
- an outstanding power stability and low-noise emission,
- USB and RS232 communication ports,
- A “Plug-and-play” version with “ControlBoxx” or “RemoteBoxx” controllers

“PLUG-AND-PLAY” AND “OEM” VERSIONS

The LaserBoxx models are declined in two versions:

- The plug-and-play versions are meant to be handled by a human user. It mainly consists in the laser head and a controller, and offers access to important safety features. Refer to section 1, “Safety information” for a detailed list of these features.
- The Original Equipment Manufacturer (or “OEM”) version is designed for integration into an industrial device or system. This version generally does not include any controller nor as much safety features as the plug-and-play version.

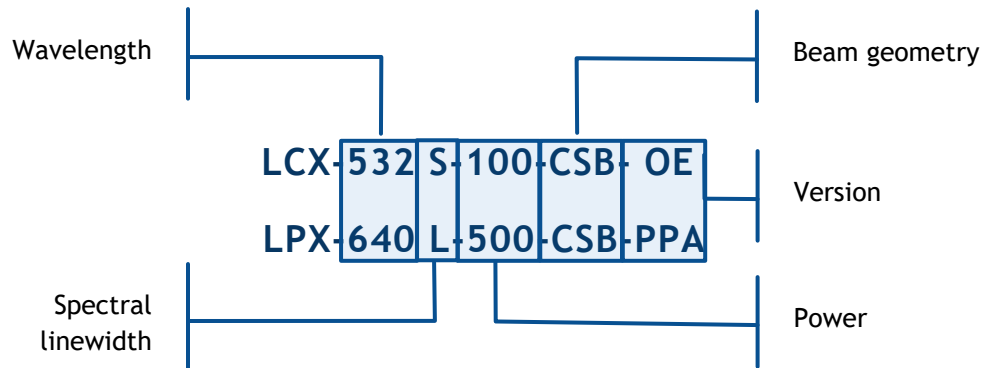
WARNING



Using the laser source without its controller is equivalent to using the source as an OEM part. Oxxius shall not bear any responsibility for lack of compliance with the applicable safety standards or local regulations, in the event where a plug-and-play LaserBoxx would be used without its dedicated controller.

PART NUMBERS

The models covered by this user manual have part numbers structured as follows:



Details of the variants are explained table below:

Table 2-1: Variants of the LPX and LCX order codes

Category	Possible values	Description
Wavelength	...	Emitted wavelength in nanometers; refer to the datasheet for available values
Power	...	Rated output power in milliwatts; refer to the datasheet for available values
Spectral propriety	L	Standard emission spectrum
	S	Single longitudinal mode, free from side-modes
Beam geometry	CSB	“Circular Small Beam”: 0.7mm diameter beam
Version	OE	OEM version
	PPF	Plug-and-play, fixed power
	PPA	Plug-and-play, adjustable power

2-2 Preparing for use

Please use the following information when setting up the instrument for the first time, or when changing its operating site.

OPERATING SITE

The LaserBoxx should be unpacked and installed in an area satisfying the following conditions:

- a dust-free area,

- an area free from vibrations

For information on environmental conditions such as ambient temperature and humidity, refer to “Operating site” on section 1.

ELECTROMAGNETIC COMPATIBILITY CLASS

The electromagnetic compatibility (EMC) class indicates where you can operate the product. The EMC class of the plug and play LaserBoxx is “class A”. Class A equipment is intended for use in industrial environments. It can cause radio disturbances in residential environments due to possible conducted and radiated disturbances. It is therefore not suitable for class B environments. If class A equipment causes radio disturbances, take appropriate measures to eliminate them.

MECHANICAL AND THERMAL CONSIDERATIONS

The laser head generates some heat while in operation. Refer to the following paragraph 2-5 below.

UNPACKING

The laser source is expected to be unpacked and installed in a dust-free area.

Unpack the different elements of the package and check that none of the items appears damaged.

Please contact your local representative if you have to report any damage (see our homepage www.oxxius.com for contact information). Keep the packaging box to be able to ship the laser back if necessary.

HANDLING PRECAUTIONS RELATIVE TO ELECTROSTATIC DISCHARGES (ESD)



Protection measures are integrated inside the LaserBoxx. Nevertheless, Oxxius recommends to enforce measures against ESD in order to avoid any risk of degradation.

A particular attention is required when handling the product in a low-humidity atmosphere, or on a surface that is not designed against ESD (for example a floor covered with carpet or vinyl tiles). In these cases, Oxxius recommends using an antistatic wrist strap, connected to earth bonding points.

CAUTION



For fiber-terminated outputs: a special attention is required with devices terminated by an optical patch cable or a pigtail.

An optical fiber is made of glass and is a fragile piece of equipment that should not, under any circumstance, receive excessive mechanical damage (shear stress, tight bending, etc.). The shards of a broken optical fiber are hazardous objects that require a specific safety management.

The user is required to handle the delivery patch cable and its optical connectors with care and to have the necessary tools and knowledge to inspect and clean the end tips of the fiber. Refer to chapter 4-3 for more detailed information on how to handle and inspect an optical fiber.

PACKING LISTS

Here are the standard elements and accessories shipped along the laser source.

Table 2-2: Packing list and accessories of a standard LCX model, plug-and-play version

	Quantity
LCX laser head	1
Manual shutter (mounted on the laser head)	1
Laser controller: RemoteBoxx (for fixed power models) or ControlBoxx	1
Head-to-controller umbilical cable	1
Remote switch to control the shutter	1
Power supply for the controller	1
Power cable	1
Laser emission key	2
Connectors to short-circuit the remote interlock circuit	1
USB cable (USB A to micro B)	1
USB Flash drive	1
This user manual	1

Table 2-3: Packing list and accessories of a standard LPX model, plug-and-play version

	Quantity
LPX laser head	1
Electro-mechanical shutter (mounted on the laser head)	1
Laser controller: RemoteBoxx (for fixed power models)	1
Head-to-controller umbilical cable	1
Remote switch to control the shutter	1
Power supply for the controller	1
Power cable	1
Laser emission key	2
Connectors to short-circuit the remote interlock circuit	1
USB cable (USB A to micro B)	1
USB Flash drive	1
This user manual	1

2-3 Instrument tour

LCX / LPX LASER HEAD

Here are the accessible elements on the laser head. For detailed drawings of your model, refer to the section “Technical documents”, annex B.

Figure 2-4: Front view a LCX or LPX laser head, with an electro-mechanical shutter

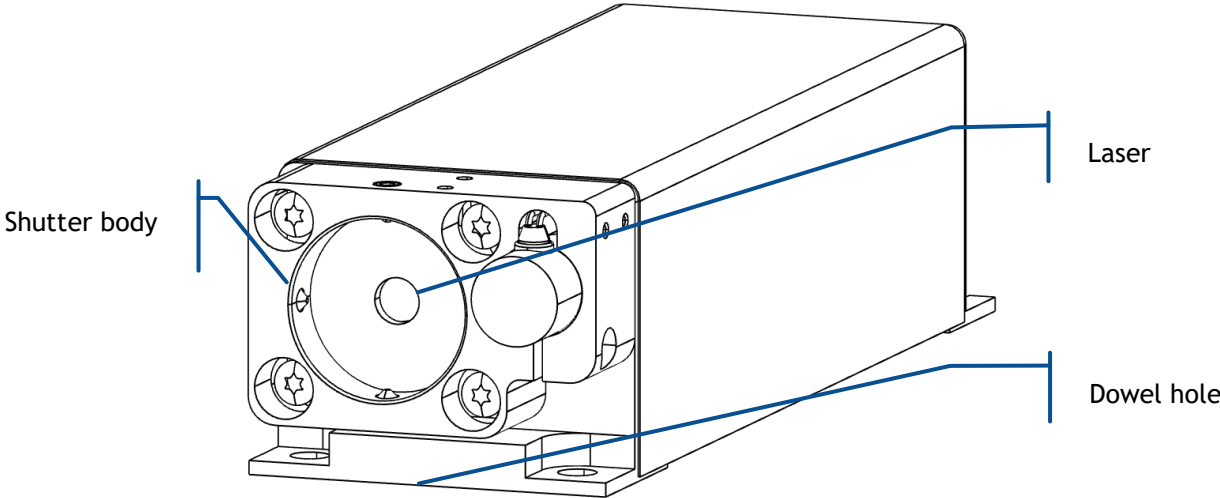


Figure 2-5: Rear view of the laser head

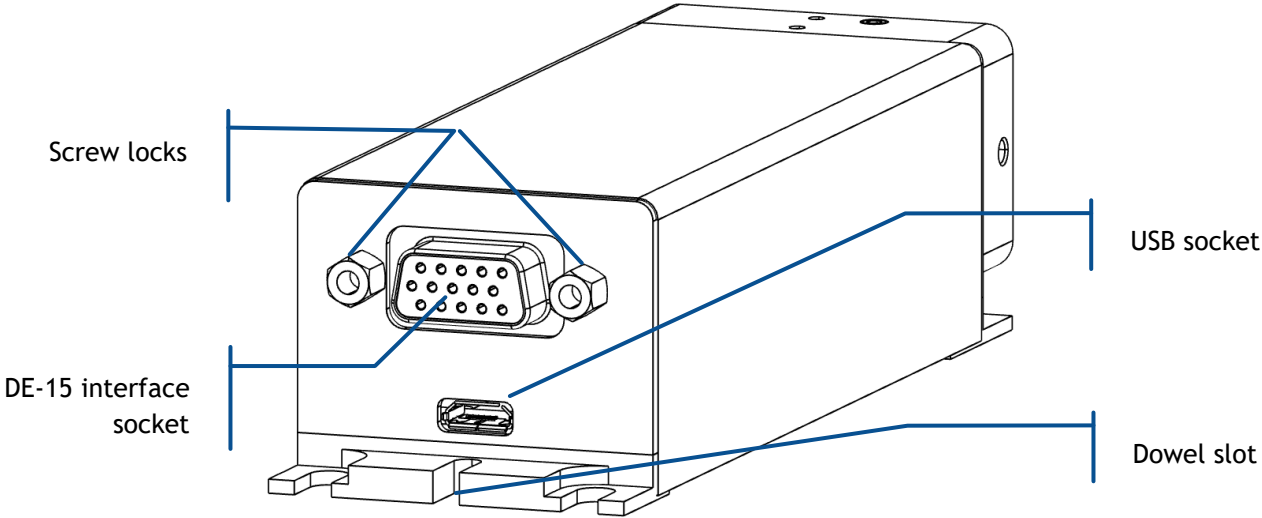
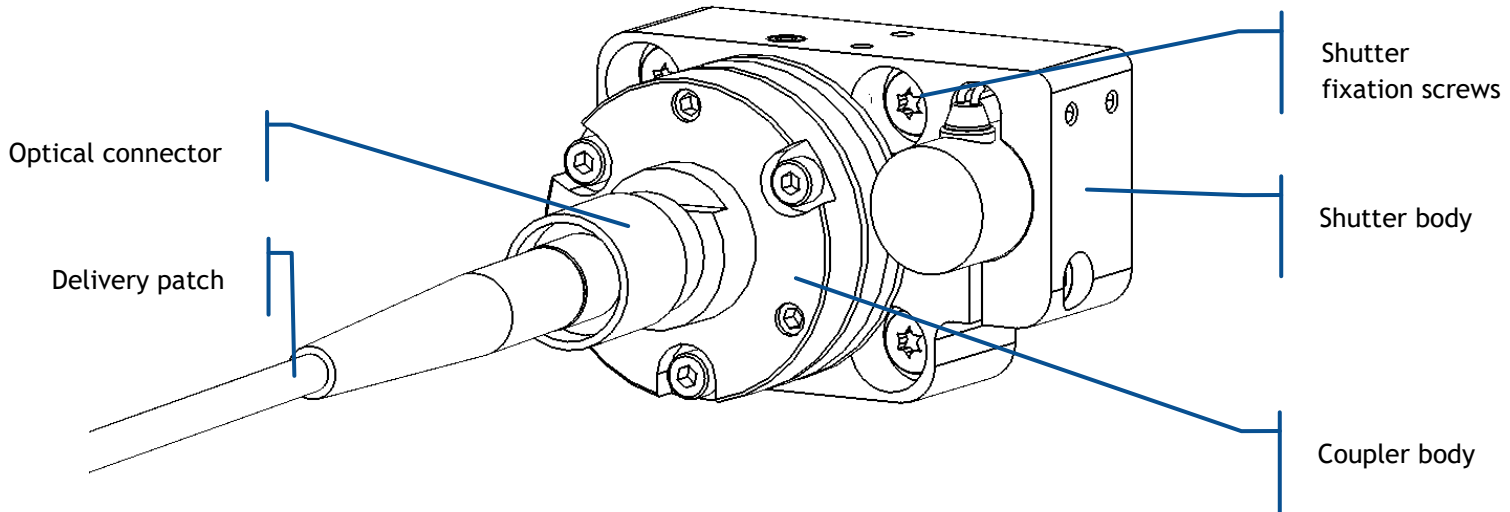


Figure 2-6: Detail of the output aperture with an electro-mechanical shutter and an optional fiber coupling system (ACX-FCPM or ACX-FCSM)



The following elements are accessible to the user:

- **Base plate fixation holes:** these holes are used to fix the laser head to a baseplate or to a heatsink. Refer to the following chapter 2-5 for detailed information.
- **Beam shutter:** This device is inserted on the light path and is designed to completely absorb the beam when activated. It is one of the safety features present on the plug-and-play models. It exists in two types:
 - o **Manual shutter:** Rotating the lever to release or to block the laser beam. Both states (“Open” and “Closed”) are indicated at the top of the shutter body.
 - o **Electro-mechanical shutter:** The shutter flap is activated by an electric coil. The user can operate this shutter by sending software commands (on model OPT-SHTE-LCX), or by applying a supply voltage at the terminals of the coil (on model ACX-SHTE-BRD).

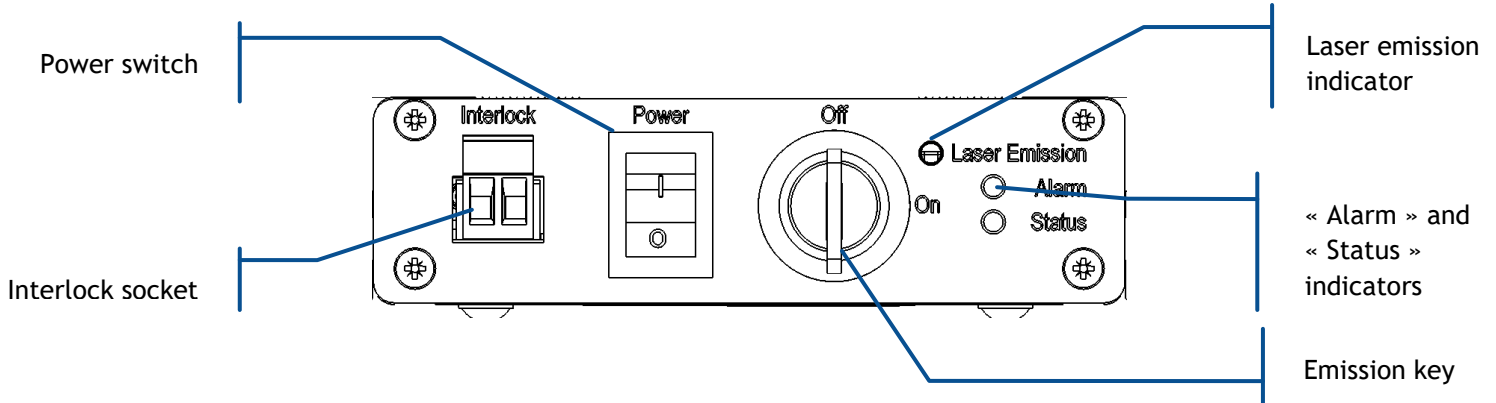
These shutters can also be used as a mount for optional elements. Note that the fixation screws are used to position the center of the shutter aperture against the laser beam. Therefore, it is generally not advisable to loosen these screws and disturb the positioning.
- **DE-15 HD socket:** this socket holds the electronic interface of the laser head. Refer to the following chapter 2-5 for a detailed description. Use the standoff screws to secure your connector to this socket.
- **Dowel hole and dowel slot:** References to be used for a precise mechanical alignment.
- **Laser aperture:** this is the aperture from which the laser beam is released. Its position is also indicated by a label on the laser head.
- **Micro-USB socket:** this socket provides access to the USB interface.

REMOTEBOXX CONTROLER (FOR “PPF” MODELS, FIXED POWER)

The figures below lists the accessible elements of the RemoteBoxx controller.

- **Emission key:** Also named “actuated key master control”, this component is one of the safety features present on the “plug and play” models. When the unit is ready, turning the key on will start the laser emission. The key is removable (in “off” position only), and the laser radiation is not accessible when the key is removed.

Figure 2-7: Front panel of the RemoteBoxx controller

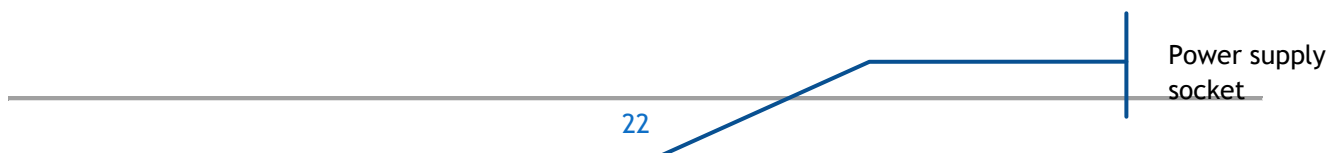


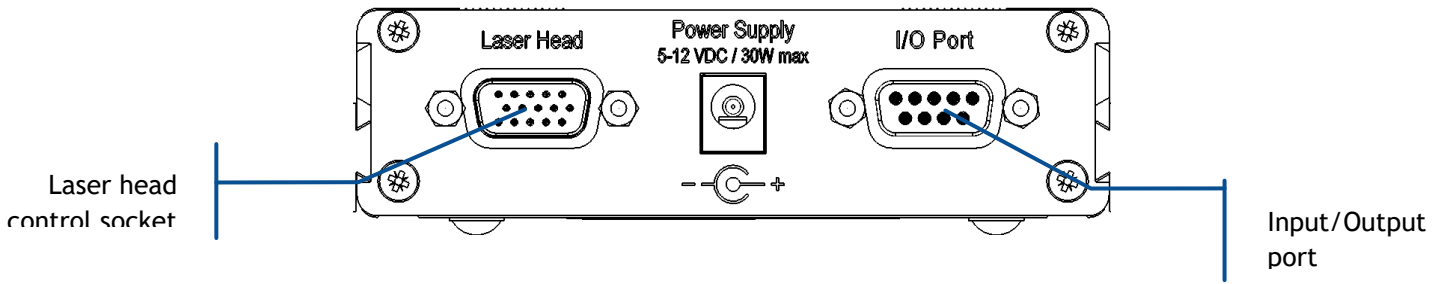
- **Laser emission indicator:** This LED lights in solid white when the key control is switched on, indicating that the emission is armed. It is meant to be seen without requiring the user to face the laser radiation (the white color being used so as to be visible through most protective eyewear). In accordance with CDRH recommendations, this indicator is blinking five seconds prior to the actual laser emission, in order to warn about the imminent hazard.

The two aforementioned elements are required by laser safety standards in order to protect the user from an inadvertent exposure.

- **“Status” Indicator:** This indicator is a green LED indicating the status of the laser emission:
 - o Blinking green: the laser emission is on and is being stabilized.
 - o Solid green: the laser emission is on and stabilized.
- **“Alarm” Indicator:** This indicator is a red LED indicating a warning or an alarm on the device.
- **Interlock socket:** the laser emission is disabled when the circuit between those terminals is open. This port is usually used in conjunction with a door or a panel to control the access to the irradiated area. A couple of mating connectors is provided with the LaserBoxx to close this circuit and allow the emission.

Figure 2-8: Rear panel of the RemoteBoxx





- **Input/Output port (DE-9 Male):** This interface has two purposes:
 1. To allow the user to control and monitor the LaserBoxx through specific signals.
 2. To provide a RS-232 communication channel with the laser head.

Refer to section 6, “Technical documents”, for the pin assignment. Note that this interface is specific; standard RS-232 link cables thus **cannot be used for communication**.

- **Laser head control socket (DE-15 HD Female):** This socket is supplying the laser head with power and signals. It must be connected to the controller using the dedicated umbilical cable (provided).
- **Power supply socket (2.1mm coaxial):** connect the power supply here.

CONTROLBOXX CONTROLLER (FOR “PPA” MODELS, ADJUSTABLE POWER)

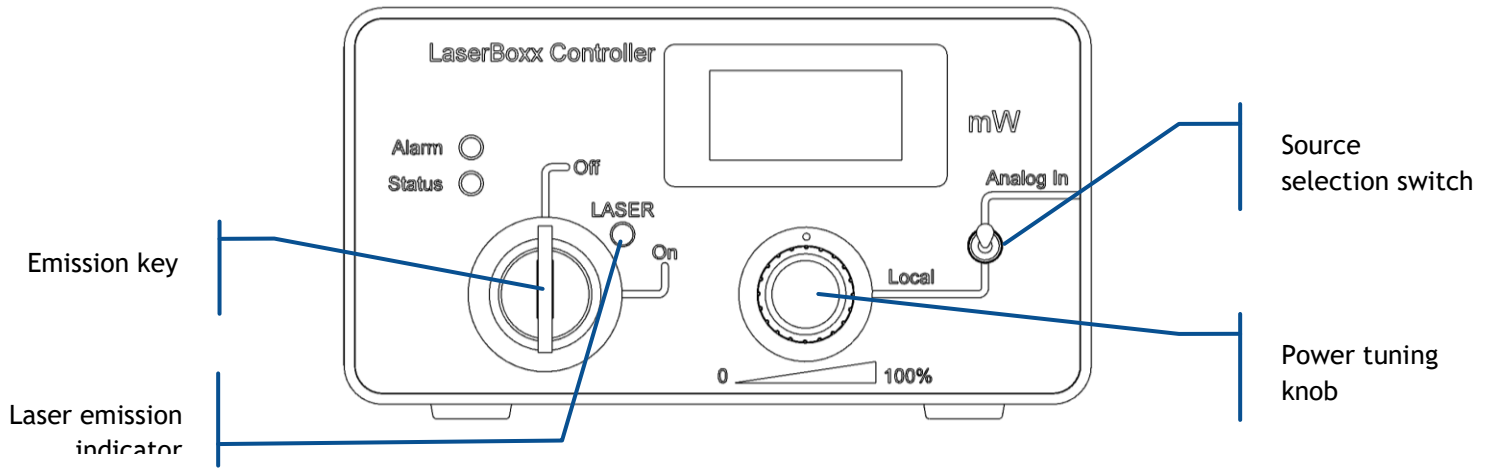
The figures below lists the accessible elements of the ControlBoxx controller.

- **Emission key:** Also named “actuated key master control”, this component is one of the safety features present on the “plug and play” models. When the unit is ready, turning the key on will start the laser emission. The key is removable (in “off” position only), and the laser radiation is not accessible when the key is removed.
- **Laser emission indicator:** This LED lights in solid white when the key control is switched on, indicating that the emission is armed. It is meant to be seen without requiring the user to face the laser radiation (the white color being used so as to be visible through most protective eyewear). In accordance with CDRH recommendations, this indicator is blinking five seconds prior to the actual laser emission, in order to warn about the imminent hazard.

The two aforementioned elements are required by laser safety standards in order to protect the user from an inadvertent exposure.

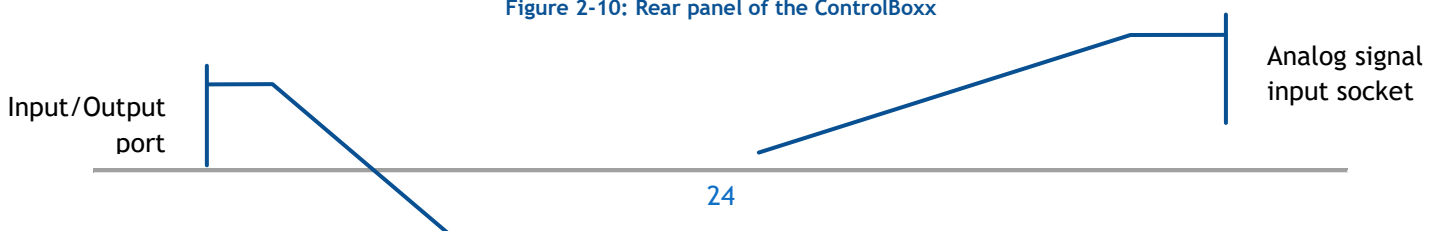
Figure 2-9: Front panel of the ControlBoxx

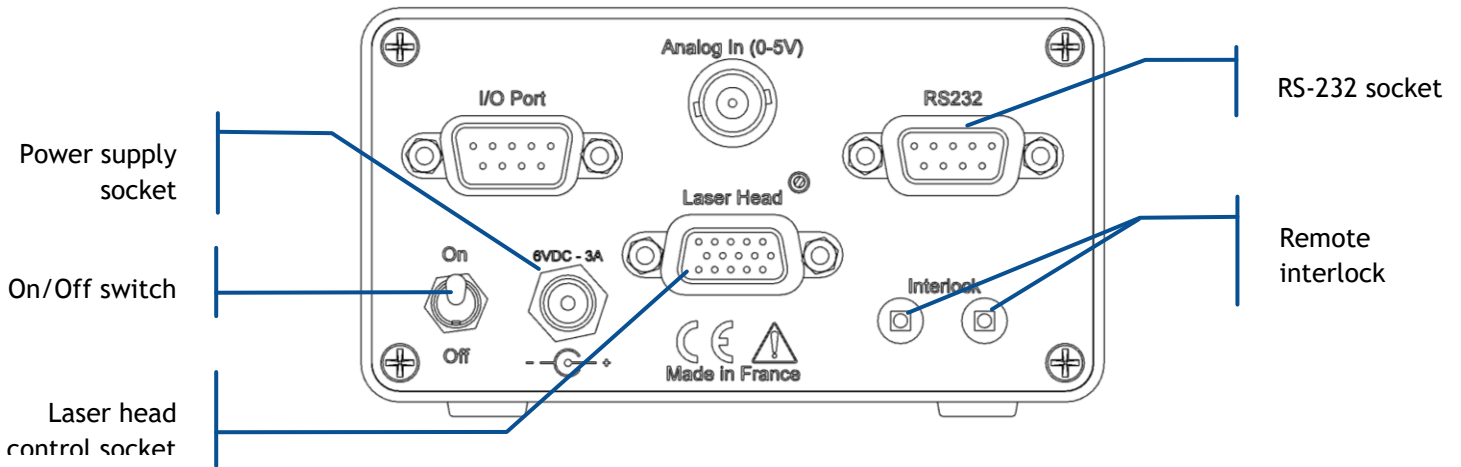




- **“Status” Indicator:** This indicator is a green LED indicating the status of the laser emission:
 - o Blinking green: the laser emission is on and is being stabilized.
 - o Solid green: the laser emission is on and stabilized.
- **“Alarm” Indicator:** This indicator is a red LED indicating a warning or an alarm on the device.
- **Source selection switch:** This switch allows the user to select the source used to set the optical power:
 - o The “Local” position allows the user to tune the optical power using the front knob,
 - o The “Analog In” position allows the user to control the set point by applying a voltage on the BNC socket located on the rear panel (the front knob is thus disabled).
- **Power display:** This panel displays the instantaneous output power (expressed in milliwatts). The accuracy of this monitoring is better than 5%.
- **Remote interlock (Φ2 mm banana sockets, two terminals):** the laser emission is disabled when the circuit between those terminals is open. This port is usually used in conjunction with a door or a panel to control the access to the irradiated area. A couple of mating connectors is provided with the LaserBoxx to close this circuit and allow the emission.
- **Analog signal input socket (BNC socket):** This input is used to control the optical power from an analogue voltage, allowing for power adjustment. Refer to section 4, “Advanced operation” for detailed information, and to the product specifications concerning the power adjustment.

Figure 2-10: Rear panel of the ControlBoxx



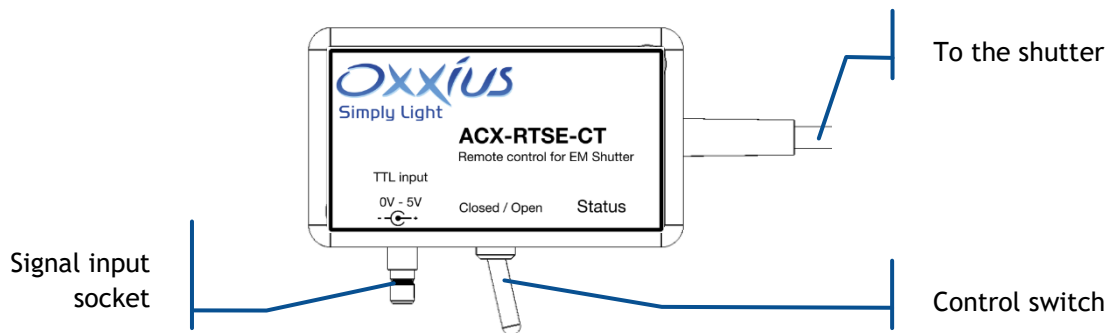


- **Input/Output port (DE-9 Male):** This interface allows to control and monitor the LaserBoxx through specific signals.
- **RS232 port (DE-9 Female):** This socket is used to establish a RS-232 communication. Note that no linking cable is provided with the LaserBoxx.
- **Laser head control socket (DE-15 HD Female):** This socket is supplying the laser head with power and signals. It must be connected to the controller using the dedicated umbilical cable (provided).
- **Power supply socket (2.1mm coaxial):** Input for power supply (delivered with the LaserBoxx) and ControlBoxx On/Off switch.

REMOTE CONTROL FOR SHUTTER (ACX-RTSE-RM/CT)

This component allows the user to drive the electro-mechanical shutter manually, or from an external signal.

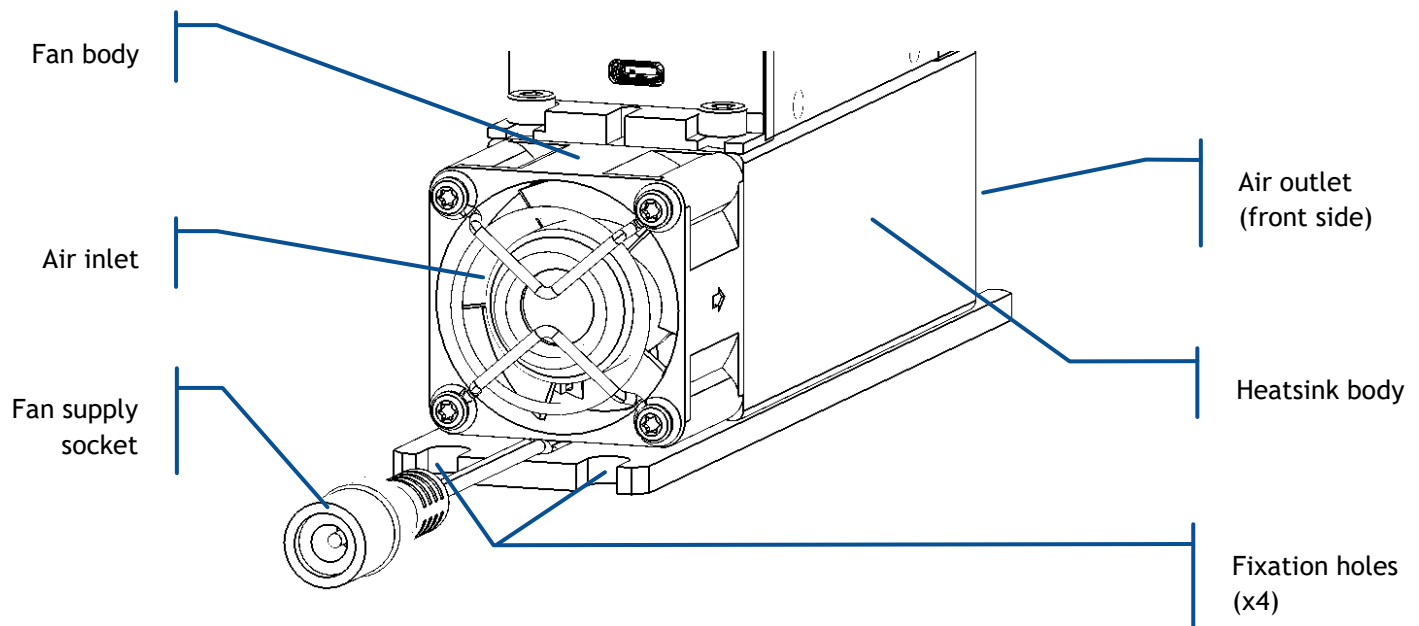
Figure 2-11: Body of the ACX-RTSE remote control



- **Signal input socket (SMB):** Input for the standard power supply. An example of mating connector (SMB male connector) can be found under the reference “BPSMBP1.5M174” at <https://ccsukltd.co.uk>
- **Control switch:** Activate this switch to control the shutter manually. If this switch is in “closed” position, the shutter will react according to the signal applied to the SMB socket.
- **Status:** This white LED is lit when the shutter is open.

OPTIONAL HEATSINK (ACX-HTSK-1 OR ACX-HTSK-7)

Figure 2-12: Rear view of the heatsink ACX-HTSK-1



The following elements are accessible to the user:

- **Air inlet and outlet:** ambient air will flow through these apertures and transfer the excess heat. Do not block these apertures and leave at least 5 cm around them to ensure a sufficient air flow.
- **Fan supply socket (2.1mm coaxial):** Input for the motorized fan inducing the air flow.

2-4 Installing the laser head

Warning



Prior to installing, please take into account the following safety recommendations:

- No user adjustment is possible inside the laser head. Any attempt to open it will void the warranty.
- Disconnecting the controller from its electrical supply can be achieved either by toggling the power switch off on the controller, or by disconnecting the supply connector from its socket (from the rear panel).

Remember to avoid any undue pressure or impact when installing or using your equipment.

MECHANICAL INTERFACING

These models are meant to be fixed on a flat baseplate, or a similar support like a heatsink. A flatness of less than 50µm over the surface of the support is expected in order to ensure a limited strain over the laser head. The laser head should be fixed using four M4 screws, located at each corner of its supporting plate. These bolts should be tightened with a torque of 2 Nm.

Refer to the mechanical drawings in section 7.

THERMAL MANAGEMENT

Fixing the laser head to a heatsink is highly recommended in order to dissipate the heat generated by the laser head. Depending on the anticipated air temperature and the model of laser, Oxxius propose either the ACX-HTSK-1 or the ACX-HTSK-7 models.

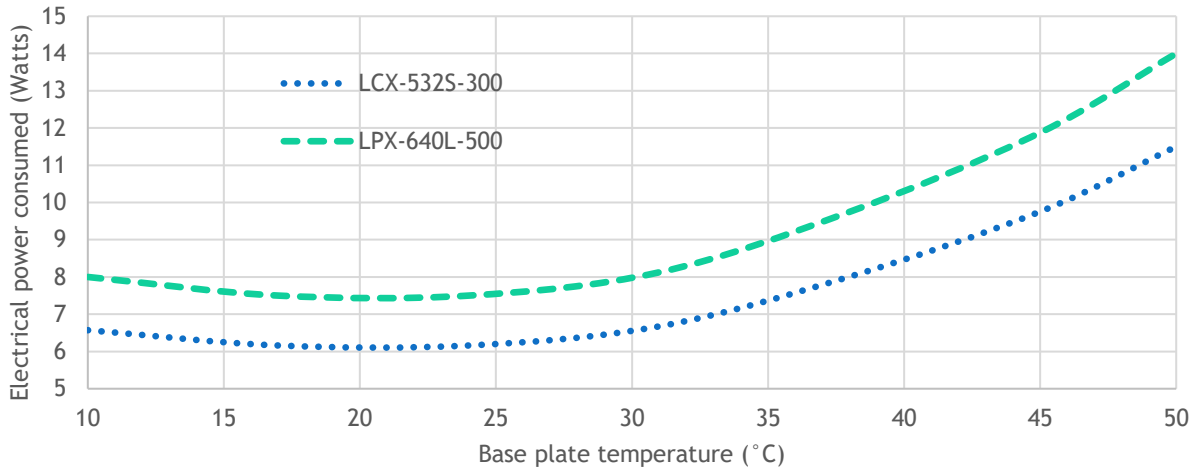
When a single mode fiber coupling is attached to the laser head, fixing this later to a heatsink is of utter importance because it improves the robustness of the coupling system against thermos-mechanical strains. Other options (like OPT-EXK-120-01) are also available to ensure a robust fiber coupling.

The laser source consumes a variable amount of electrical power depending on the temperature of its base plate:

- The consumed power is minimum over a typical interval of 15°C to 25°C
- The consumed power is maximum as the base plate is at its hottest (50°C maximum),

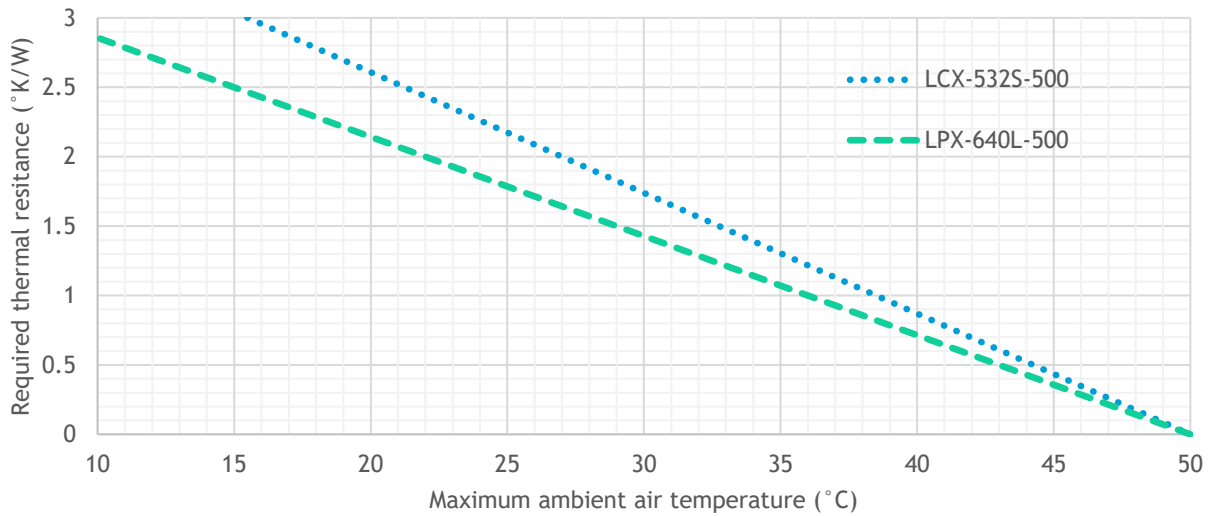
For this reason, it is important that the medium supporting the laser head ensures a proper dissipation of the generated heat. The following figure illustrates this phenomenon on typical LCX and LPX models at nominal power:

Figure 2-13: Typical consumption curves on some LCX and LPX models



The following figure can guide the user when selecting a heatsink (air heat exchanger). Its thermal resistance should be selected in accordance with both the hottest temperature of the ambient air, and the power consumed by your laser source.

Figure 2-14: Heatsink requirements for using on some typical LCX and LPX models



Contact your Oxxius representative to learn about the exact power consumed by your model, or for detailed guidance on this topic.

OPTICAL OUTPUT

On models with a free-space output: align the laser head into your own light path.

On fiber-coupled models: connect the optical connector of the delivery fiber to your light path. Make sure to fasten the threaded ring of the optical connector.

CAUTION: OPTICAL FEEDBACK



Optical feedback is the situation where the laser beam is reflected back into its source. In most cases, optical feedback disturbs the operation of the laser source. In some cases, damages to the resonator occur.

The following precautions should be taken when working with free-space beams:

- Any reflective surfaces on the optical path should be slightly angled so that the reflected beams are not directed back into the laser aperture. Likewise, avoid using mirrors placed at normal incidence into the light path.
- Avoid focusing the beam onto a reflective surface at normal incidence, without installing an isolator ahead on the light path
- Use angle-polished optical connectors when coupling the light into an optical fiber

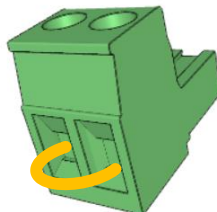
If these recommendations cannot be followed, the use of an isolator is required in order to protect the laser source. Contact your Oxxius representative for more detailed information.

ELECTRICAL CONNECTIONS

Procedure:

- Connect the umbilical cable between the rear panel of the controller and the rear side of the optical head. Secure both connectors using their locking screws.
- Connect your remote interlock circuit to the “Interlock” pins on the rear panel of the controller. If you are not using an interlock circuit, use the mating connector (provided) to short-circuit these pins.

Figure 2-15: Mating connector with shunt wire



WARNING



Using a shunt wire inside the mating connector will defeat the interlock circuit. As a result, the user will no longer be able to use this interlock circuit as a safeguard against accidental exposure to the laser beam.

- Plug the power supply connector into the rear panel of the controller. The power supply provided with the has the following characteristics:

	LCX or LPX source
Output voltage	from Volts ===
Power rating	40 Watts

WARNING



For electrical safety, Oxixus recommends to use the standard power supply supplied with this product. A protective ground connection integrating a grounding conductor is essential for a safe operation. To avoid electrical shock, plug the power cord into a properly wired receptacle.

In case you have to use your own power supply for the laser sources, the input voltage socket at the rear panel of the controller must be connected to a “SELV” source complying with the following specifications:

Input	Output
Voltage: 100-240 VAC	Voltage: any voltage from 5V to 12V ===
Frequency: 50-60 Hz	Power: 40 W
Protective ground	Regulation: +/- 5%
	Line voltage regulation: +/-1%

A SELV source, as stated by UL 60950-1, is a “secondary circuit which is so designed and protected that under normal and single default conditions, its voltages do not exceed a safe value”. This “secondary circuit” has no direct connection to the primary power (AC mains) and derives its power via a transformer, converter or equivalent isolation device.

The power supplies provided with the LCX or LPX LaserBoxx meet these requirements.

CONNECTION TO THE SHUTTER REMOTE CONTROL

- Connect the remote control to the I/O port of your controller:

- ACX-RTSE-CT on the ControlBoxx
 - ACX-RTSE-RM on the RemoteBoxx
- If you intend to drive the shutter using your own source of signal, connect it to the socket located on the side of the remote control (refer to the figure below), then move the control switch to “Closed”
- Voltage range: 0V (shutter closed) to +5V (shutter open)
 - Impedance: 10 kOhms

COMMUNICATION

Communication with your laser source is possible using either the USB or the RS-232 protocols. Different link schemes are listed below.

USB COMMUNICATION

USB communication is available on any model, using the socket located on the read side of the laser head. The required cable (provided with plug-and-play configurations) is a standard “USB A to micro-B” cable (see the illustration below).

Figure 2-16: USB A to micro B connection cable



RS-232 COMMUNICATION

RS-232 communication is also available on any model, but its implementation depends on the controller used (RemoteBoxx or ControlBoxx).

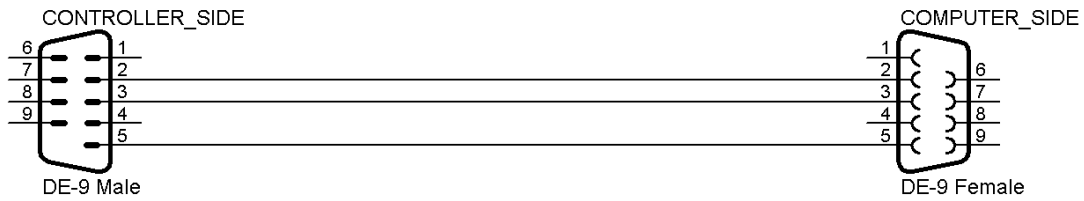
USING A REMOTEBOXX

Use a cable meeting the following specifications and connect it between the “I/O” interface of the RemoteBoxx and your own communicating device.

NOTE: A commercial RS-232 cable (null modem or straight cable) should not be used for a connection to the RemoteBoxx. Indeed, the “I/O” interface on the RemoteBoxx requires a dedicated wiring as stated above. Using a commercial cable might lead to a malfunction of the laser source.

Figure 2-17: Pin assignment and wiring schematics for RS-232 communication using a RemoteBoxx

RemoteBoxx side DE-9 male connector	Pin	Computer side DE-9 female connector	Pin
Rx	2	Rx	2
Tx	3	Tx	3
Ground	5	Ground	5
Case	Shield	Case	Shield



USING A CONTROLBOXX

Use a commercial **straight cable** terminated by DE-9 connectors (male <-> female).

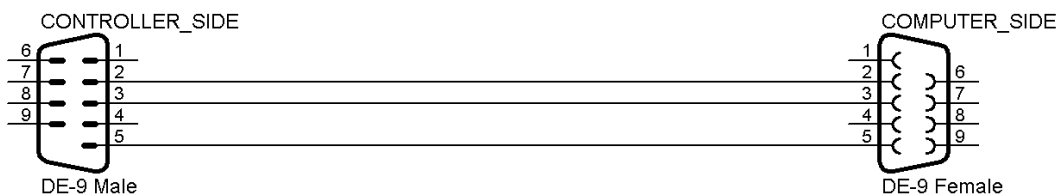
Figure 2-18: A commercial RS-232 cable



Alternatively, this cable can be built according to the schematics detailed below.

Figure 2-19: Pin assignment and wiring schematics for RS-232 communication using a ControlBoxx

ControlBoxx side DE-9 male connector	Pin	Computer side DE-9 female connector	Pin
Rx	2	Rx	2
Tx	3	Tx	3
Ground	5	Ground	5
Case	Shield	Case	Shield



2-5 Installing the software suite

The application software “Oxxius Laser” allows the user to monitor and control one or several LaserBoxx units linked to a personal computer.

PREREQUISITES

- Oxxius Laser requires either a serial port (for RS-232 communication) or a USB port (using either the native USB protocol or a virtualized serial communication).
- Oxxius Laser is compatible with the following operating systems:
 - Windows 10,
 - Windows 8 (32-bit and 64-bit versions),
 - Windows 7 (32-bit and 64-bit versions),
 - Windows Vista (32-bit and 64-bit versions),
 - Windows XP SP2 (32-bit version only)
- Microsoft’s “.NET 3.5” framework is required. If it is not installed, you will be prompted to download and install it.

INSTALLATION

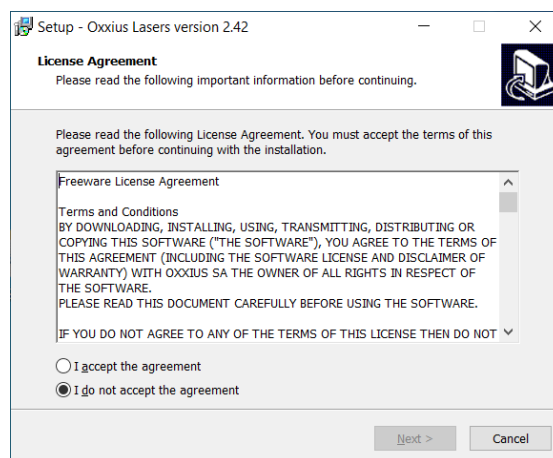
Locate the installer “setup.exe” on the USB flash drive provided with the laser source, and execute it.

Alternatively, you can download the latest version of our control software from the following URL:

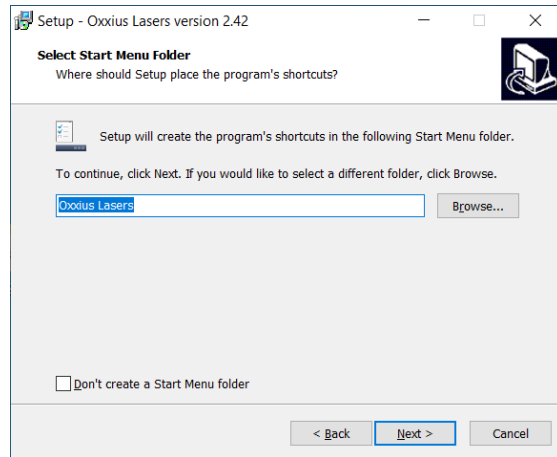
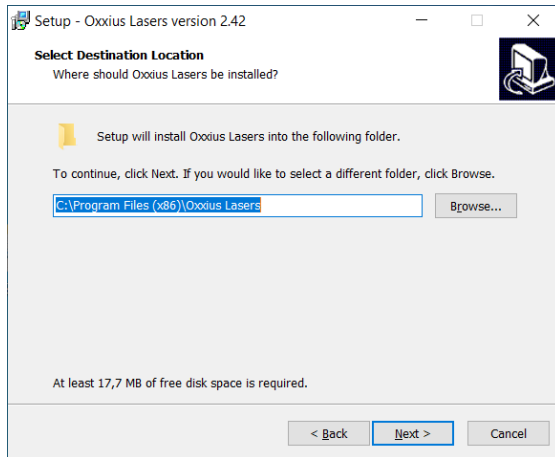
www.oxxius.com/download/f09512dd.exe

Executing the file “setup.exe” will prompt a standard installation wizard.

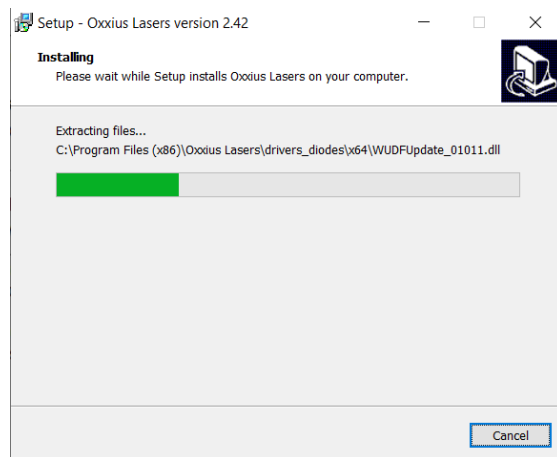
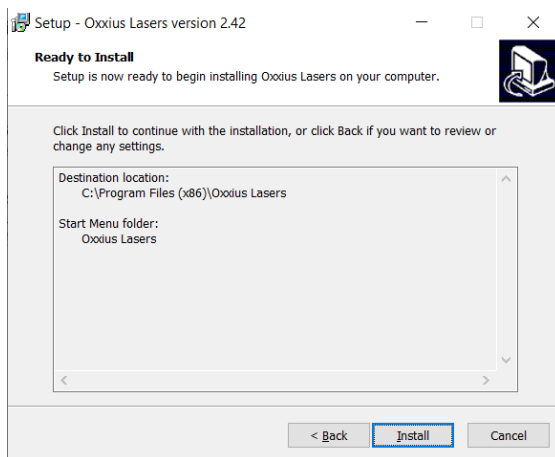
First, take note of the license agreement and proceed by selecting “I accept the agreement”



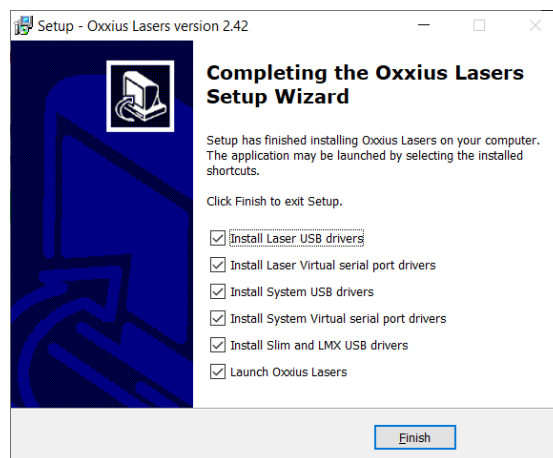
Click on « Next » twice, unless you need to set a specific save folder.



Click on « Install ».



The last step of the installation invites the user to install the USB drivers to communicate with miscellaneous models (see the screenshot below). Proceed to do so by selecting all the features proposed.



Press on “Finish” to close the wizard and complete the installation. Your operating system might require you to restart your computer.

3. OPERATION

This section describes how to operate the LCX and LPX LaserBoxx. The laser source is assumed to be correctly installed and connected. Refer to the previous section, “Starting up”, if necessary.

3-1 Basic operations

FOREWORD

Some of the following procedures rely on using Oxxius’ command software (“Oxxius Laser”); refer to chapter 4-4 for an introduction to this tool.

HOW TO POWER UP THE SOURCE AND RELEASE THE EMISSION

- Connect the power supply to the controller on one side and to your mains socket.
- Turn on the power switch on the controller (on the back panel of the ControlBoxx, or on the front panel of the RemoteBoxx). The laser head will instantly work to stabilize the temperature of its inner elements, and the RS-232 and USB communications will be accessible. On the ControlBoxx, the optical power will be displayed.
- Make sure that the interlock circuit is closed. Plug in the dedicated connector if necessary.

DANGER



Before proceeding further, make sure that the appropriate measures are enforced in order to guarantee the safety of any personnel potentially exposed to the laser radiation. Refer to section 1, “Safety Information”, for a list of recommendations.

- Turn the actuated key master control clockwise until the end stop. The laser emission indicator will light up in solid white, warning about the laser emission. At the same time, the status indicator will blink and the start-up sequence will begin. This may take up to 10 minutes. In any case, a 6-second safety delay is enforced between the moment the key is armed and the actual release of the emission.
- Once the status indicator has turned in solid green, the laser is emitting steadily. In case where a manual shutter is installed, release the beam by rotating the lever to the “Open” position.

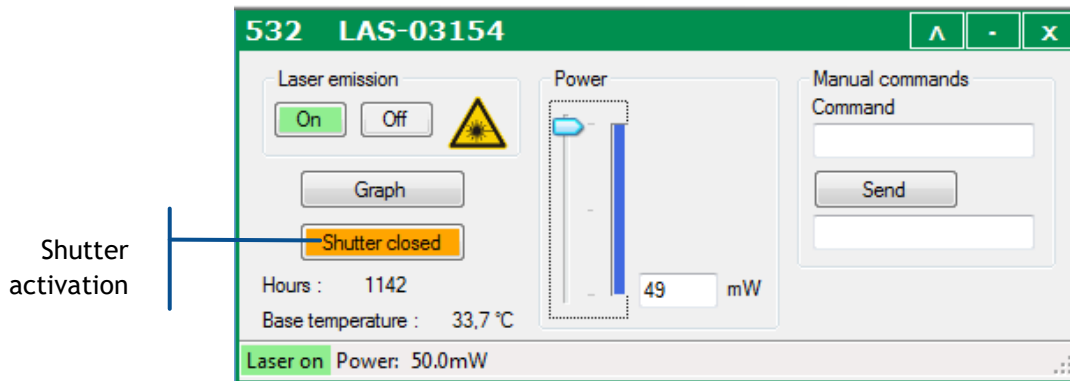
HOW TO OPERATE THE ELECTRO-MECHANICAL SHUTTER

The shutter can be activated by the laser head or by a remote control, depending on its configuration.

ELECTRO-MECHANICAL SHUTTER WITHOUT REMOTE CONTROL (ACX-SHTE-LCX)

This shutter is linked to the laser head and can be activated using one the following ways:

- Using the control software: open the control window and locate the shutter activation button (as in the picture below)

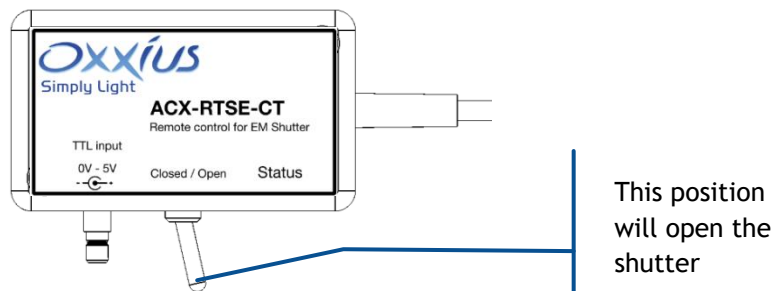


The button text describes the current states of the shutter. Press the button to modify this state (open or closed).

For safety reasons, operating the shutter is only possible when the emission is stabilized (“Laser on” state).

SHUTTER LINKED TO A REMOTE CONTROL (ACX-RTSE-RM OR ACX-RTSE-CT)

- Use the control switch to open or close the shutter, as mentioned on the label.



Note that the Status LED will lit in solid white as the switch is in “Open” position.

- Alternatively, apply an adequate voltage on the socket to operate the shutter. The switch must be in “Close” position
 - o A +5V voltage will open the shutter. The Status LED will lit in solid white.
 - o A 0V voltage will close the shutter. The Status LED will go off

HOW TO POWER DOWN THE LASERBOXX

Here is the normal sequence to turn the emission off and shut down your source:

- Close the shutter (on a manual shutter: rotate the lever to “Close”),
- Turn off the emission by rotating the master control key anti-clockwise,
- Turn off the power switch on the controller. RS-232 and USB communication will no longer operate.
- Disconnect the power supply feeding the controller from your mains socket.

HOW TO RESUME THE EMISSION AFTER AN UNCOMMON INTERRUPTION

If an alarm is raised, or if the interlock circuit is opened, the emission is then interrupted in a manner that is considered “uncommon”, and the LaserBoxx source is locked against further emission.

Any of the following actions will unlock the unit:

- Using the controller, turn the actuated key master control back to its “OFF” position
- Using the software interface, press the ‘Reset’ button

Another uncommon interruption occurs when the power supply is turned off while the actuated key master control still in “ON” position. In this case:

- A class 3B laser source will resume its emission immediately once after the power supply is turned back on,
- A class 4 laser source will not resume its emission as the power supply is simply turned back on. The user must first set the actuated key master control in “OFF” position before proceeding to the power-on sequence.

3-2 Power adjustment

Power adjustment is a native feature on some LaserBoxx models, and an optional feature on others. Please refer to the following table for its characteristics:

Model	Optional feature (OPT-PWR-LCX) on LCX-532, LCX-553, LCX-561 and LCX-1064	Native feature on LPX-640 and LPX-607
Adjustment range	30% to 100% of the nominal power on LCX-532 and LCX-561 models 50% to 100% on LCX-553 models	0% to 100% of the nominal power
Response time	Typically 10 seconds; up to 60 seconds.	Rise time or fall time: 20µs

Here are the different methods to modify the output power:

USING THE CONTROLBOX

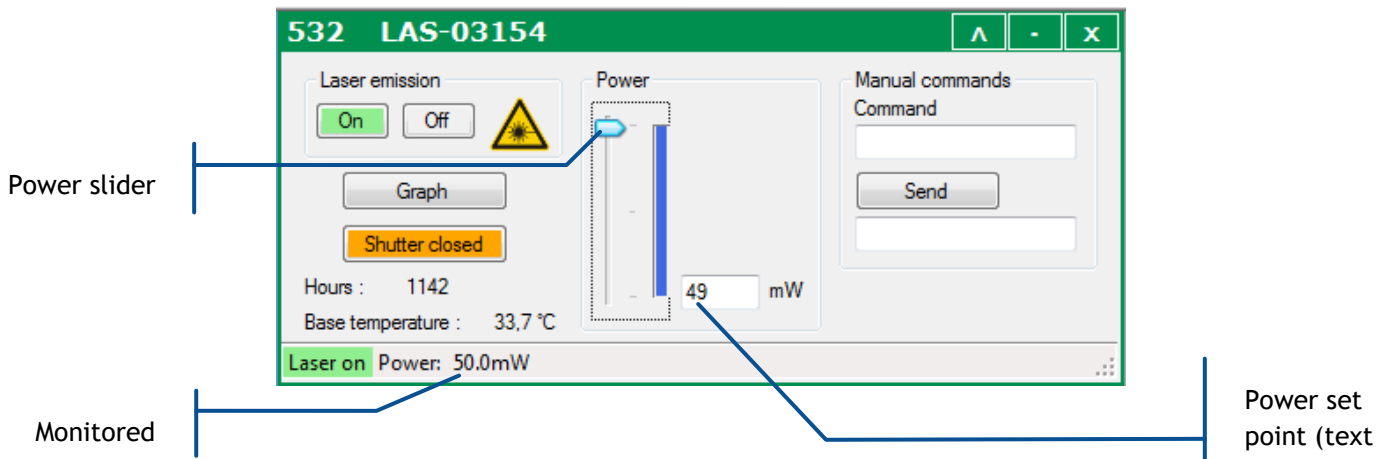
Make sure that the source selection switch on the front panel is positioned on “Local”, then turn the front knob in order to modify the power set point.

- a clockwise rotation will increase the power,
- each turn represents about 10% of the nominal power,
- the monitored power is displayed on the LED panel of the ControlBoxx,

USING THE GRAPHIC USER INTERFACE

- Locate the power slider and text box on the command window (refer to the following figure 3-1),

Figure 3-1: Entering a power set point using the graphic user interface



- Click in the text box and type a new power set point. Validate using the “Enter” key.
- Alternatively, you can click and drag the slider to a new value. The text box below should reflect this new value.
- The laser status will switch to “Waiting for stabilization” while the power is being adjusted to its new set point.

NOTE

On start-up, the laser first settles to its nominal power level (100%), before converging towards the set point.

3-3 Alignment beam

Some tasks or applications require a beam at low power, typically for aligning optical elements. The LaserBoxx models are able to release such a beam. Proceed as follows, depending on your model:

Model	LCX-532, LCX-553, LCX-561 and LCX-1064	LPX-640 and LPX-607
Activate the alignment beam	Make sure that the emission is turned off, then enter the software command "DL 2"	Set the laser power using a low set point (a few percent)
Deactivate the alignment beam	Press the button "Laser emission: off"	Press the button "Laser emission: off"

Warning



- Despite its relatively low level, the optical power released generally exceeds the level of a class 1 laser source. Appropriate laser safety measures should therefore be enforced without mitigation.
- Once the command has been sent, and the 5-second safety delay elapsed, the emission occurs much faster than for the standard emission mode (typically within one second).

4. ADVANCED OPERATIONS

This section provides detailed information about alternate means of controlling the laser source.

4-1 Using Oxxius software to operate the LaserBoxx

The LaserBoxx can be remotely controlled using a computer, using either a serial port (RS-232 protocol) or a USB port (covering a genuine USB communication, or a serial communication through virtualization).

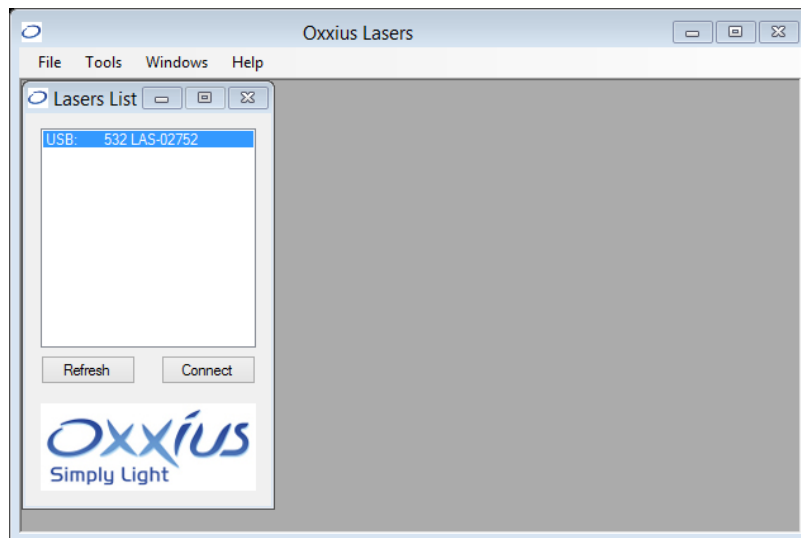
The control software allows the user to monitor and control several LaserBoxx sources at once.

INSTALLATION

Refer to section 2 to install the software and the required drivers.

CONNECTION TO A UNIT

Launch the executable file from your “Program” menu or from the installation directory. On start-up, the left-hand side frame lists the devices that the user can connect to:



- The units connected through USB are automatically listed,

- The units connected through RS-232 or a virtual serial port must be scanned manually. To proceed, press the “Refresh” button located on the bottom left of the frame.

Each laser is identified on the list by its communication port, model, emission wavelength and serial number.

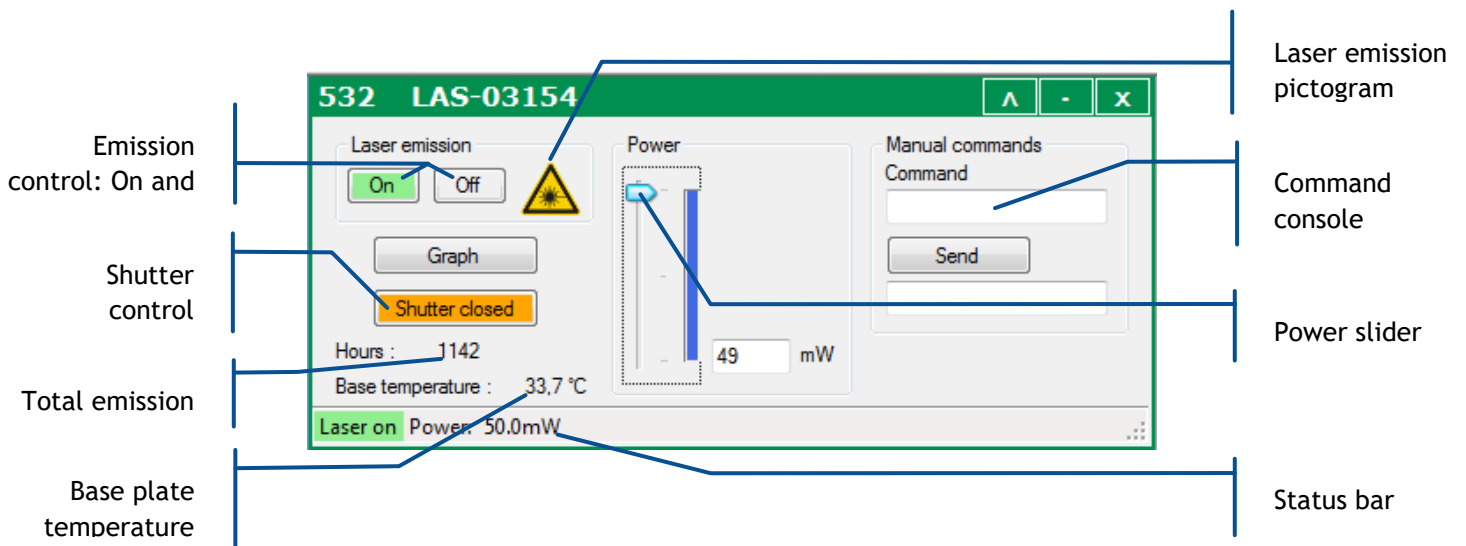
Select one laser on the list and click on the “Connect” button.

DESCRIPTION OF THE CONTROL WINDOW

The control window consists of the following elements:

- “On” and “Off” buttons to control the laser emission,
- A pictogram warning about the laser radiation,
- A button to display some of the operational data on a chart,
- A button to control the output shutter,
- Some indicators displaying the monitored temperature and the cumulated emission time,
- A box and a slider to modify the output power,
- A command console to send software commands and queries,
- A status bar to indicate the laser status and the output power

Figure 4-1: Control panel of a single laser unit



TYPICAL USAGE OF THE CONTROL PANEL

Once the laser source is installed and the required safety measures are enforced, you can click on the “On” button to start the emission. Once the emission is stable, the shutter button will be made accessible so that you can activate it.

The output can be adjusted (if available) by using the slider or by entering a new power set point into the text box.

The status of the laser source is displayed at the bottom-left corner of the window.

Priority management to command the emission

The actuated key master control and the “Laser controls” buttons on the GUI both drive the laser emission. As a result, the following priority scheme is meant to avoid conflicts:

- On start-up, the unit reacts to the actuated key master control (or its equivalent “enable” pin),
- As soon as one of the “Laser controls” buttons is pressed or one of the “enable” software commands (“DL 0”, “DL 1” or “DL 2”) is received, the priority is given to these commands and consequently the signals on the “enable” pin are ignored,
- Different possibilities are available to revert this situation: either send the “RST” command to the laser, or turn off the supply power

SENDING QUERIES AND COMMANDS

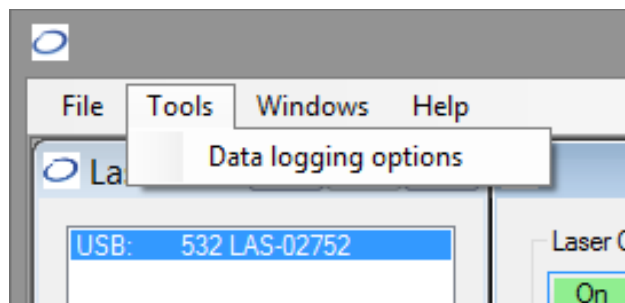
Communication with the laser source is performed by transmitting queries and commands. Any query or commands can be entered manually using the command box. Please refer to the Annex B, “software commands” for the list of these commands. Type your query inside the box, then press “Enter” or press the button “Send”. Answers are displayed in the box below.

- The laser unit will answer “????” to a query or a command which syntax is not understood.
- The laser unit will answer “OK” to a command which has been acknowledged
- A query which has been acknowledged by the laser returns the queried value or chain of characters

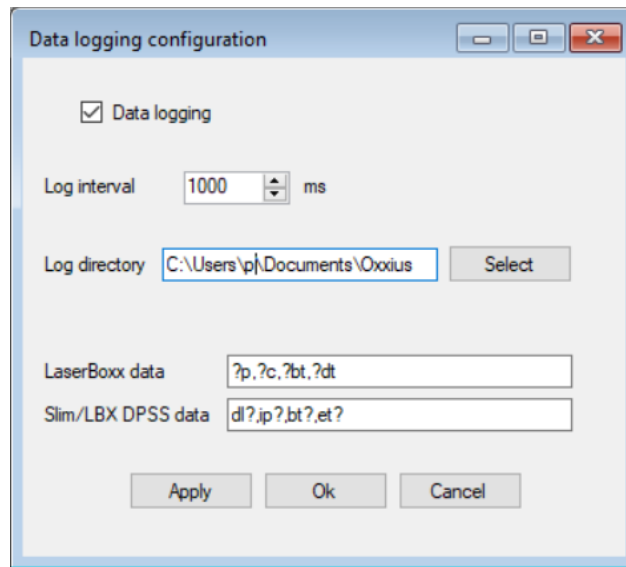
DATA LOGGING AND DISPLAY

Data logging is a function that allows the user to record the functional status of the LaserBoxx over time.

First, click on the “Tools” menu and select “Data logging options.”



This will open a separate configuration window.



From top to bottom:

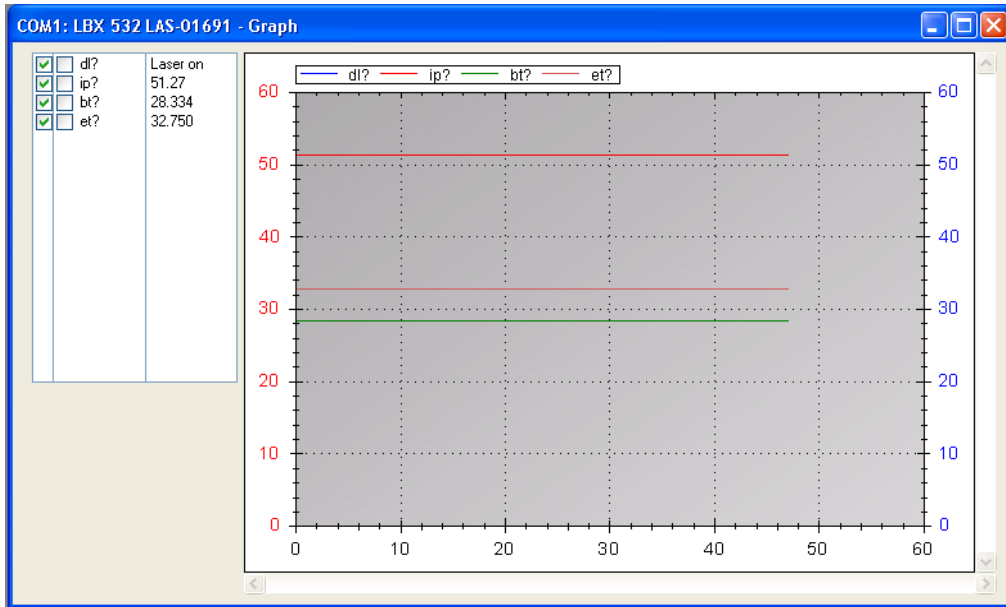
- Tick the box called “Data logging” to enable or disable data logging,
- The “log interval” determines how often the LaserBoxx will be polled for data. The default value is “1000 ms” (one poll every second).
- The “log directory” is where the record file will be created and the data will be saved. Click on the “Select” button to change this directory.
Warning: Make sure that this location is a directory you have the appropriate rights for (to create and modify a file). Failing to do so will result in an error when the record is launched.
- The two following boxes contain the set of queries the LaserBoxx will be polled for. Edit the box named “LaserBoxx data” by listing the queries you need to record (separated by a comma “,”).
- Click the “Ok” button once you are done.

A file named COM~~XX~~-LBX-~~MM~~_DD_HHHH_log will be created in the record directory, where “XX” is the number of communication port (identical to the one appearing in the laser list), “MM” is the current month, “DD” the current day and “HHHH” the current time.

This record consists of plain text, so that it can be opened by any text editor:

COM1_LBX_12_7_11H47_log - Bloc-notes					
Fichier	Edition	Format	Affichage	?	
Time	dl?	ip?	bt?	et?	
0:0:1	Laser	on	51.28	28.261	32.750
0:0:2	Laser	on	51.28	28.263	32.750
0:0:3	Laser	on	51.28	28.264	32.750
0:0:4	Laser	on	51.28	28.263	32.750
0:0:5	Laser	on	51.28	28.264	32.750
0:0:6	Laser	on	51.28	28.264	32.750
0:0:7	Laser	on	51.28	28.261	32.750
0:0:8	Laser	on	51.28	28.262	32.750
0:0:9	Laser	on	51.28	28.266	32.750
0:0:10	Laser	on	51.29	28.265	32.750

It is also possible to display the logged parameters in real time using the “Graph” button in the command panel. This will open a separate window containing plots of the recorded parameters (ordinate) against time (abscissa).



The frame on the top left allows the user to select which parameter should appear on the graph, and on which axis. Tick on the boxes before each parameter to make its data on the left axis, on the right axis or on none of them.

RESSOURCES FOR DEVELOPPERS

Software resources are available for users who wish to develop their own control program.

COMMUNICATION LIBRARIES AND EXAMPLE PROGRAMS

The USB Flash drive delivered along each unit contains the following resources for developers (refer to table 2-2):

- A USB library to drive the LaserBoxx. It can be used with either Visual C++, Visual C#, Visual Basic, Labview or any other languages supporting “.NET” libraries.
- The documentation for this library (file “LaserBoxxUsbHelp.chm”),
- an application program based on Labview (version 8.6)

RS-232 COMMUNICATION

The parameters for RS-232 communication are on the following tables. In order to avoid leakage currents and potential damage to the equipment, both the power supply of the LaserBoxx (or its

controller) and the remote equipment used for the RS-232 communication should be connected to the same electrical network.

Table 4-2: communication parameters of the RS-232 communication

Bit rate	38400 bauds
Data bits	8
Parity	None
Stop bit	1
Flow control	None

Table 4-3: Syntax for queries and commands

		Acknowledgement
Query	?QUERY<LF> or QUERY?<LF>	QUERY=TXT<CR><LF>
Command	COMM AND=TXT<LF> or COMMAND TXT<LF>	COMMAND=TXT<CR><LF>

Where “Command” is a string of ASCII character, <CR> is the “Carriage Return” ASCII code 13 and <LF> represents the “Line Feed” ASCII code 10.

Refer to Section 7, for a list of useful commands and queries.

VIRTUAL SERIAL PORT

The USB port can be configured as a virtual serial port. To proceed, send the command “CDC 1” (CDC, <space>, 1) to your unit, then restart it (toggle its power supply off and on).

The command “CDC 0” reverts this setting.

MICROMANAGER SUPPORT

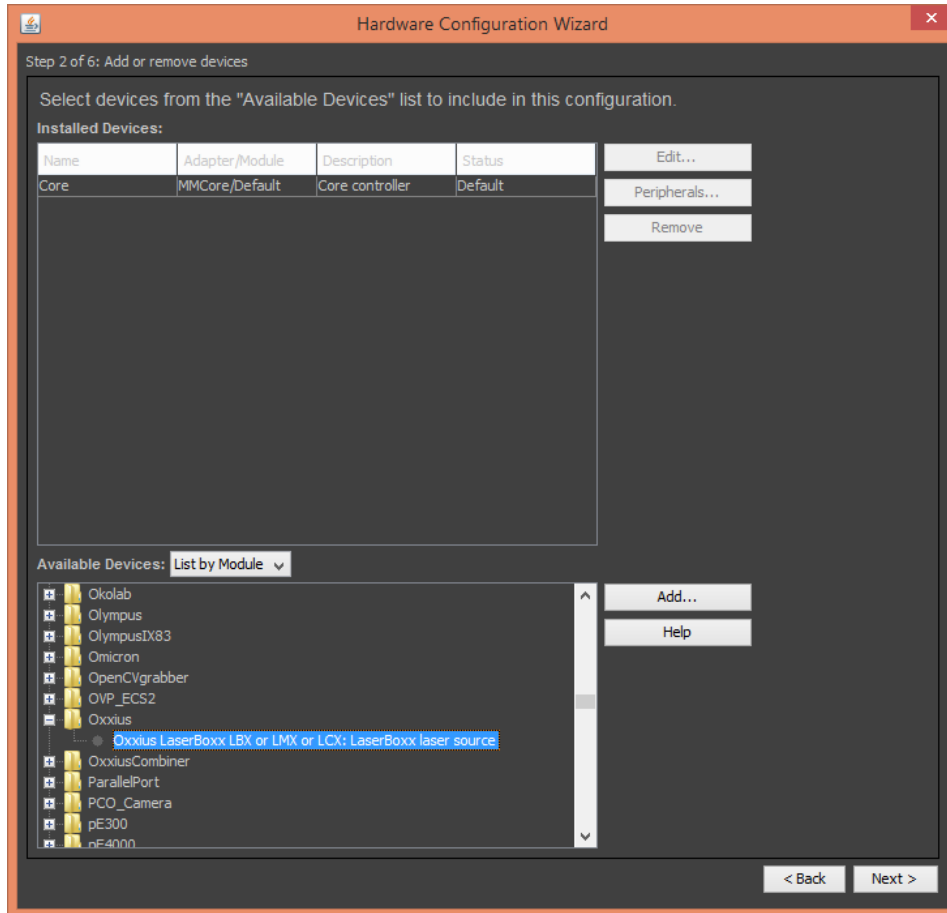
The LaserBoxx sources are supported by Micro-Manager, the open-source microscopy software.

<https://micro-manager.org/wiki/Oxxius>

The communication between a LaserBoxx with Micro-manager is handled exclusively through serial communication:

- Either turn the USB port into a virtual serial port (refer to the previous paragraph)
- Or use the native RS-232 port of the laser source (refer to paragraph 2-5),

Use Micro-Manager’s “Hardware Configuration Wizard” to designate and configure the Device Adapter for your LaserBoxx, found in a directory named “Oxxius”:



Configure the COM port of your laser source and enter the parameters of table 4-2 to set the serial communication.

4-2 External modulation (LPX models only)

It is possible to modulate the power against an external source of voltage. Here is how to proceed:

- Connect your source of signal to the BNC socket on the rear side of the ControlBoxx. Applying 5V to the central terminal of the connector will correspond to the last recorded power set point.
- On the front panel of the ControlBoxx: position the source selection switch on “Analog In”,

- Open the control software, locate the “Analog modulation” frame (referring to the figure 3-2), then select “Enable”
- Start the emission as described in paragraph 3-1.

NOTES

- On LPX-640 models, the power set point defines the highest value reachable through the modulation (applying 5V)
- On LCX-532, LCX-553 or LCX-561 models, 5V corresponds to nominal power (“100%” set point).
- The front knob of the ControlBoxx uses the analog modulation function; this former must be enabled when the user intends to change the power by rotating the front knob (refer also to paragraph 3-2 or 3-3).

4-3 Electrical interfacing

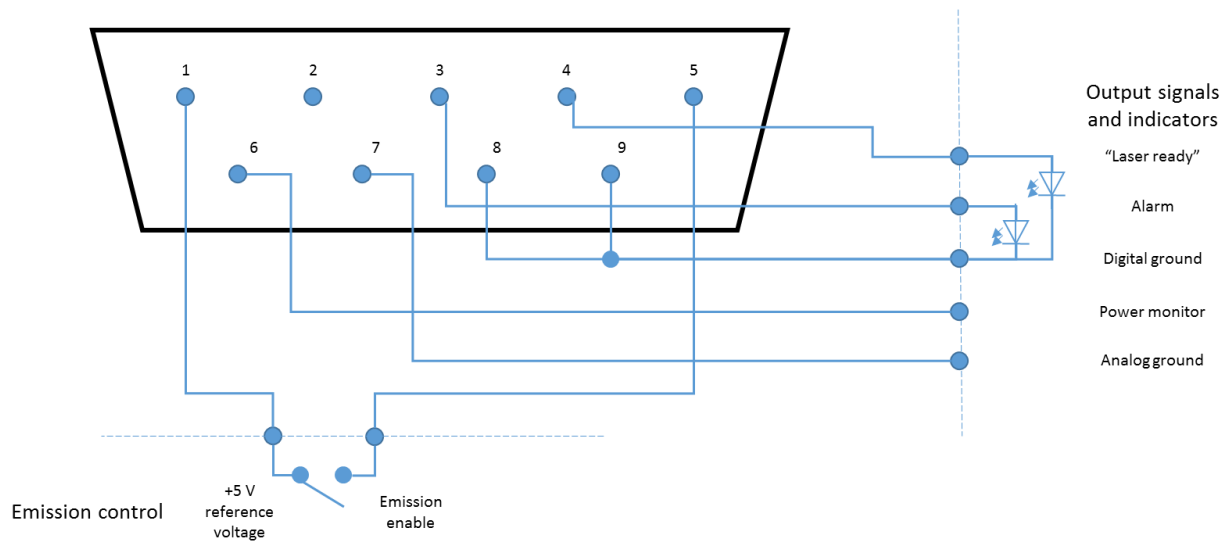
The plug-and-play LaserBoxx can also be driven through electrical signals, in order to facilitate its integration within larger systems.

INTERFACING WITH THE CONTROLBOXX (ON “PPA” VERSIONS)

Table 4-4: Pin assignment of the ControlBoxx “I/O port” interface

Pin number	Signal name and function	Direction	Description	Drive or load
1	Reference voltage	Output	+5V DC. Use this reference to drive your inputs on this I/O port	100 Ω
2	Not connected	-	-	-
3	Alarm TTL low: Normal TTL high: Default	Output	Indicates the presence of an alarm. A LED can be connected directly to this output	610 Ω for a LED connection (5 mA)
4	“Laser ready” TTL low: Laser not ready TTL high: Laser ready	Output	Indicates that the laser source is ready for emission. A LED can be connected directly to this output	610 Ω for a LED connection (5 mA)
5	“Laser enable” TTL low: Emission off TTL high: Emission on	Input	Enables or disables the emission.	3 k Ω Internally pulled-up
6	Optical power monitor Delivers a voltage between 0 and 2V.	Output	The voltage is proportional to the optical output. Note that the maximum voltage can vary between units.	2.5 k Ω
7	Analog ground	Ground	Analog ground of pin number 6	
8, 9	Digital Ground	Ground	Digital ground for TTL signals	

The following diagram presents an example of interfacing:



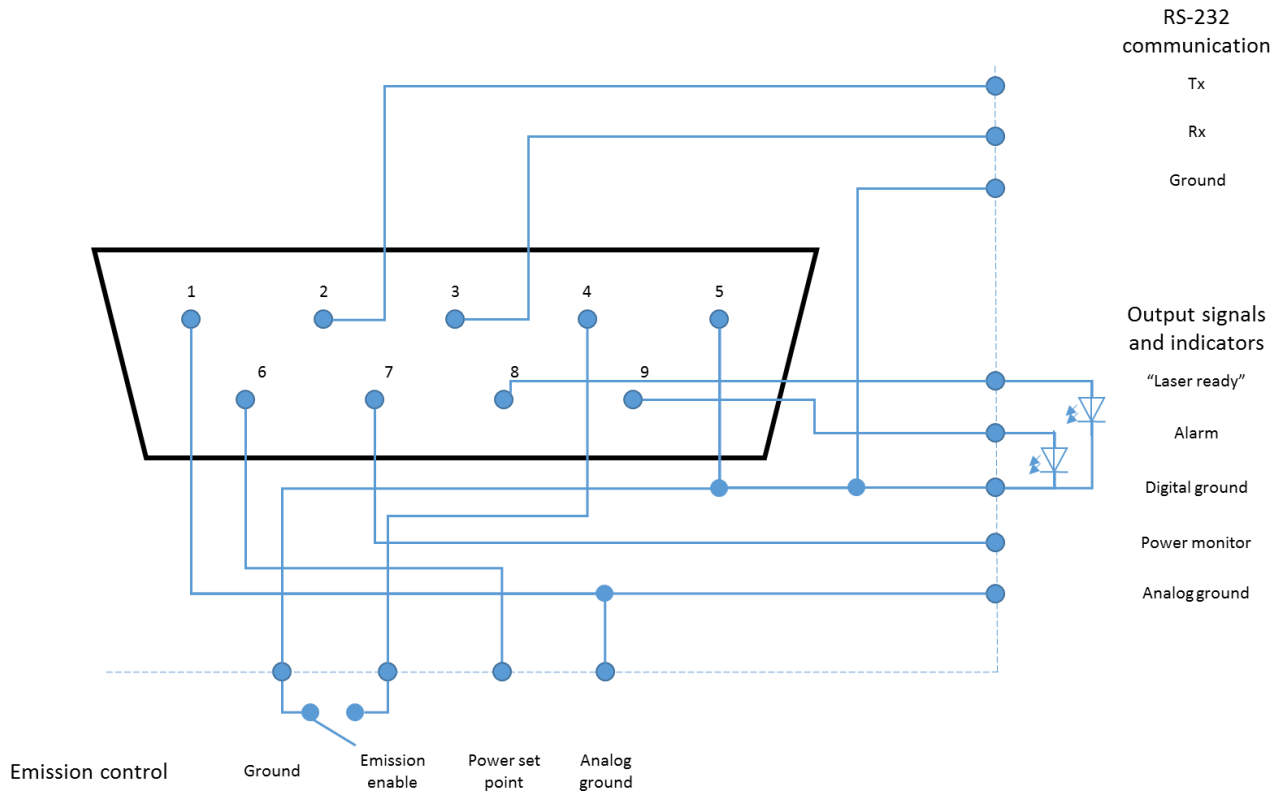
INTERFACING WITH THE REMOTEBOXX (ON “PPF” VERSIONS)

Here are the signals present on the “Input/Output” interface of the RemoteBoxx:

Table 4-5: Pin assignment of the RemoteBoxx interface

Pin number	Signal name and function	Direction	Description	Drive or load
1	Analog ground	Ground	Analog ground of pin number 6	
2	Tx	Output	RS-232 Tx port	
3	Rx	Input	RS-232 Rx port	
4	“Laser enable” TTL low: Emission off TTL high: Emission on	Input	Enables or disables the emission.	Internally Pulled up: 3 k Ω
5	Digital ground	Ground	Digital ground for pin number 2 and 3	
6	Power adjustment channel	Input	The power set point is proportional to the input voltage. Refer to section 3, “Operation” for detailed information	2.5 k Ω
7	Optical power monitor Delivers a voltage between 0 and 2V.	Output	The voltage is proportional to the optical output. Note that the maximum voltage can vary between units.	2.5 k Ω
8	“Laser ready” TTL low: Laser not ready TTL high: Laser ready	Output	Indicates that the laser source is ready for emission. A LED can be connected directly to this output	610 Ω for a LED connection (5 mA)
9	Alarm TTL low: Normal TTL high: Default	Output	Indicates the presence of an alarm. A LED can be connected directly to this output	610 Ω for a LED connection (5 mA)

The following diagram presents an example of interfacing:



4-4 Fiber-coupling options on a LaserBoxx

These options are meant to inject the output laser beam into the core of an optical fiber which will guide the optical signal along.

A fiber-coupling option is composed of an injection component (or “fiber coupler”), fixed to the laser head, to which a patch cable is attached. They differ depending on the type of optical fiber employed:

- ACX-FCMM indicates a coupling option on a multimode fiber,
- ACX-FCSM indicates a coupling option on a single mode fiber,
- ACX-FCPM indicates a coupling option on a polarization-maintaining single mode fiber,

HANDLING PRECAUTIONS AND INSTALLATION

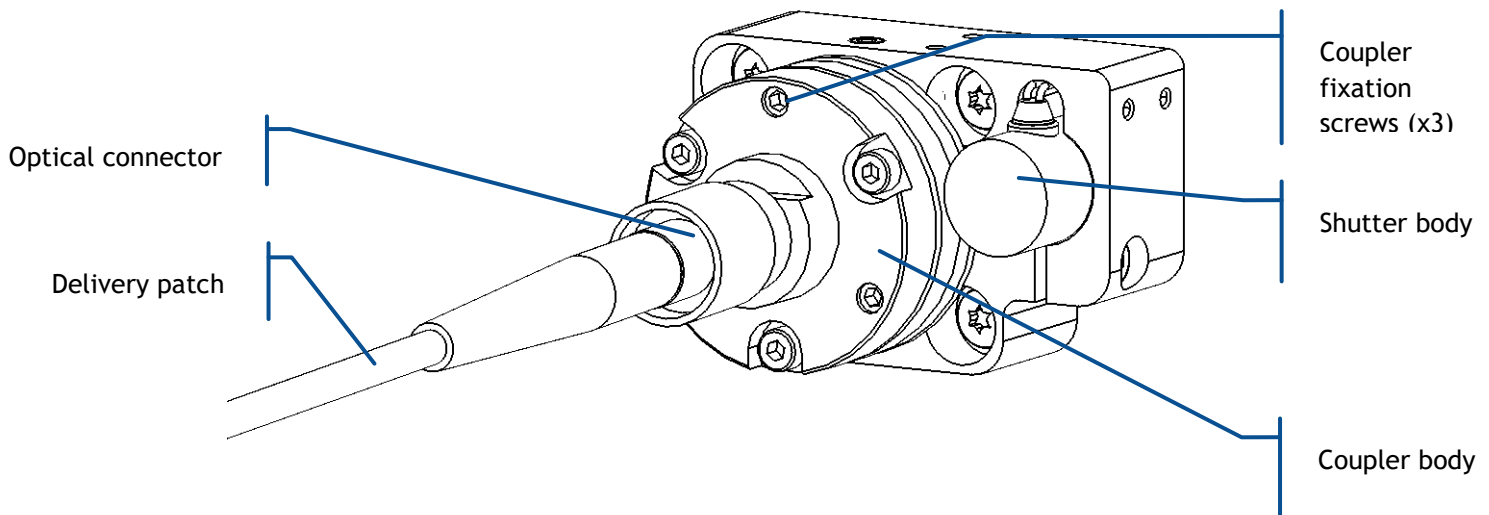
An optical fiber is made of glass and is a fragile piece of equipment. It is generally sheathed inside a patch cable, terminated by optical connectors on both ends. A specific attention is required with these components which should not be bent nor receive mechanical damage (shear stress, punching, etc.).

The user is expected to handle the patch cable with care, but also to have the necessary tools and knowledge to inspect and clean the end tip of the fiber. These tools are:

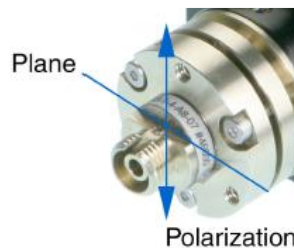
- A specific scope to inspect the end tip of the fiber. Oxxius recommends using a 200x magnification device, as the “FS201” available from www.thorlabs.com
- Some consumables to clean the optical connectors. Oxxius recommends using some lens cleaning paper (from Kodak or other brands), some pure ethanol (or isopropyl alcohol) and a CLETOP tool (“A” type) from NTT-AT.

INSTALLATION

- In most cases, the fiber coupler is housed inside the shutter body and aligned with the output beam (refer to the figure above). The patch cable is attached to the fiber coupler.



- On polarization-maintaining fiber: the orientation of the coupler determines the orientation of the polarization of the signal being injected. On a standard set-up, the plane of the coupler will be perpendicular to the direction of the incoming polarization (as in the following picture)



- Contact your local Oxixus representative if the shutter is no longer fixed to the laser head, or the coupler no longer aligned with the beam.
- Follow the instructions of chapter 2-5 to install the laser head.

NOTE: The coupling efficiency can be altered once the laser head has been fixed to its support, especially with single mode fibers. As a consequence, a fine adjustment of the injection is often required after the laser head has been fixed. Additionally, applying some thermal cycles on the laser head should reduce the mechanical stress and improve the stability of the adjustment.

DAILY ROUTINE MAINTENANCE

- If the fiber is not in use (or the patch cable is not terminated), make sure to close the fiber connector with its cap in order to protect the end face of the fiber.
- Whenever the optical connector is being pulled out from its adapter, check the ferrule using an inspection microscope and clean it if necessary (refer to the detailed procedure below).

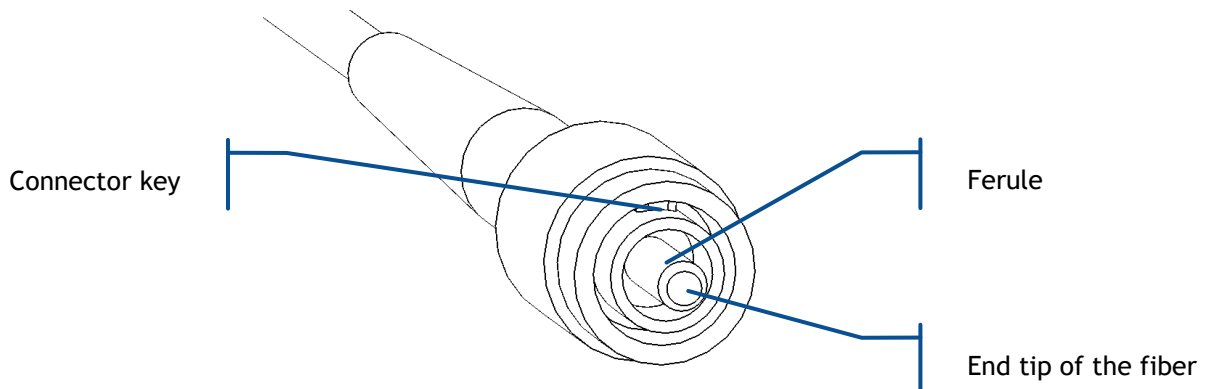
CLEANING PROCEDURE FOR OPTICAL CONNECTORS

DANGER



Prior to viewing the optical connector and the delivery end of the fiber, make sure that the laser source is unable to emit (master key turned off, or power supply off).

1. Check the circumference of the ferrule, where metal dust often accumulates. Clean any dirt using lens cleaning paper soaked in alcohol.



2. Use the microscope to visualize the end face of the ferule and the tip of the fiber:
 - If some particles (foreign materials) are in view, swipe the ferule on the CLETOP to remove them off the surface of the ferule
 - The presence of numerous or large particles might require to first swipe the ferule on a sheet of lens cleaning paper. Fold the paper in eight or sixteen to get a sufficiently soft layer, soak it in alcohol then gently scrub the ferule in it. Use acetone instead of alcohol for oily or persistent materials.
 - The presence of scratches or shards in the vicinity of the fiber core are damages that need to be addressed. Contact your Oxixus representative to get help on how to polish the optical connector.

TROUBLESHOOTING

Refer to paragraph 5-2, “Recovering missing power”.

5. TROUBLESHOOTING

5-1 Operating status and alarms

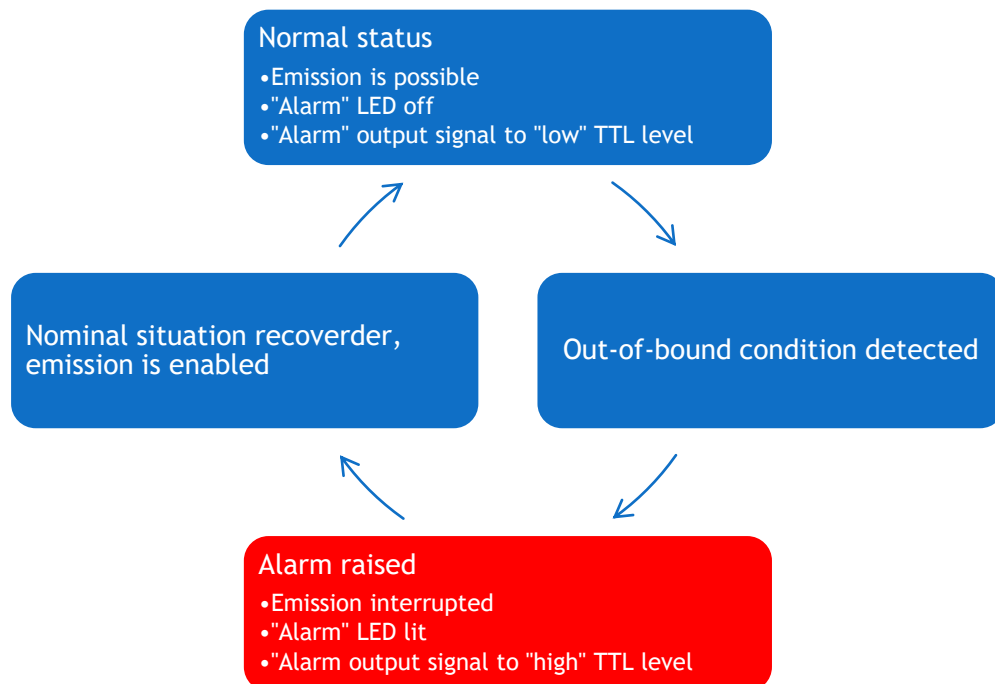
An alarm is a status informing of off-limits operational conditions. When an alarm is raised, laser operation is not possible until the cause of the alarm is fixed. Resuming the emission requires that the unit is re-activated by the emission key.

An alarm status is expressed to the user by any of these means:

- the "Alarm" LED is lit in solid red on the controller,
- the alarm electrical signal raised on either electronic interface (on the LaserBoxx or either controller),
- the software query "AL?" return the specific identification of the alarm

The alarm sequences are summarized in the following chart:

Table 5.1 Alarm status and their transition sequences



The possible sources of alarms and recommended measures are detailed in the following table:

Table 5.2 Alarm status detailed

Alarm	Cause for the alarm	Action
Power supply alarm	The DC supply voltage is outside its limit range	Check the supply voltage: - using the RS-232 command "VA?" Refer to the specifications for allowable voltage ranges
Laser head temperature alarm	The base temperature of the laser head is outside its nominal range of]10°C , 50°C[Check the installation of the laser head (section 3), in particular the effectiveness of the heat dissipation beneath the base plate. Refer to the specifications for allowable temperature ranges
Interlock alarm	The interlock circuit is open	Check the continuity of the interlock circuit

Once an alarm is raised, the emission is interrupted and can be resumed only once the cause of the alarm is cleared. The resume sequence is as follows:

1. On class 4 laser units only: it is first necessary to send a rising edge on the actuated key master control. On class 3b laser unit: apply a "high" signal on this pin.
2. On laser units of any class: Any of the following actions will resume the emission:
 - Using the electronic interface, re-activate the laser using the pin 'Enable'
 - Using the software interface, re-activate the laser using the button 'Reset'
 - Using RS-232 or USB communication port, send the command "DL 0". The emission can now be resumed using the command "DL 1"

5-2 Issues with supply voltage

A non-suited power supply may impair the operation of the laser unit. In particular, an undersized power supply might lead to:

- A drop of the supply voltage during operation. An alarm is raised when the supply voltage is detected as insufficient
- Instabilities of the optical output power

To check if the voltage supplied to the laser unit is sufficient and stable, use the query "VA?". Refer to section 4, chapter 4-1 for detailed instructions about sending software queries.

5-3 Recovering missing power

This paragraph refers to models that are coupled to an optical fiber. If the performances of the injection are below the original specifications, please check the following points:

1. Fiber connectors

- Check the cleanliness of the connectors and clean them if necessary (refer to paragraph 4-3, “Cleaning procedure”),
- If the connector is damaged, replace the patch cable or re-polish the connector.

2. Fiber coupler

- Perform the “thumb test” (refer to the next paragraph “Coupling on a single mode fiber”) to check that the injection on the fiber coupler is centered,
- If the injection is not centered, follow the procedure corresponding to your coupler in the following paragraphs

3. Mechanical fixation

In some cases, the fixation of the laser head can induce some mechanical stress that will lower the injection ratio and create an unstable coupling. To check this, loosen the screws maintaining the laser head on its support while observing how the delivered power fluctuates. Solutions to these fluctuations are:

- Improving the flatness of the mechanical support,
- Applying some thermal cycles on the laser and its support in order to relieve the stress,
- Using an flange (model ACX-EXK) in order to improve the stability of the coupling

4. Injected power

The software provided by Oxxius monitors the amount of power injected into the fiber coupling. Check that this value is sufficient with regards to the conditions listed in the manufacturing test report.

5. External aspect of the patch cable

If the delivered power is nearly nil at the delivery end of the fiber, check the integrity of the patch cable. Marks or tight bends might be the sign of a severed optical fiber.

6. Measurement equipment

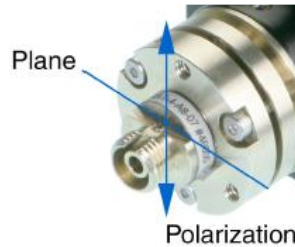
Check that your power meter is set to the appropriate wavelength, or check its calibration.

5-4 How to optimize the coupling ratio

The alignment between the laser beam and the delivery fiber is performed and tested at Oxxius' facilities. However, small adjustments might be necessary after positioning the system in its final location. The following paragraphs will describe how to use and adjust these elements.

COUPLING ON A SINGLE-MODE FIBER

Single mode (SM) or polarization maintaining (PM) fiber coupling are options that employ a beam coupler from Schäfter and Kirschhoff, ensuring a long-term stability. More information about these coupled is available on www.SuKHamburg.de



The following procedure explains how to maximize the coupling efficiency (i.e. the fraction of the lasers's power successfully injected into the fiber), for example when you need to change or disassemble the delivery fiber.

REQUIRED EQUIPMENT:

- A 1.5mm hexagonal key (provided)
- A 1.2mm flat screw driver (provided)
- An optical power-meter adapted to the range of power and wavelengths to be measured (typically a few hundreds of milliwatts from 375nm to 980nm; refer to the manufacturing test report),

Refer to the packing list in section 2, "Getting started".

CAUTION SHUTTER AND COUPLER CENTRING



We recommend not to detach the shutter from its supporting base. Indeed, the shutter is aligned with regards to the the beam. This delicate alignment requires some specific tools (not provided).

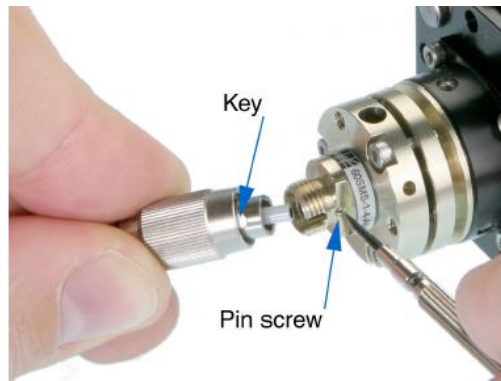
How to attach the fiber cable to the laser beam coupler

Only use fiber cables terminated with FC-APC (8° angle) connectors as provided by Oxxius. To attach such a fiber:

- Make sure that the pin screw holding the connector ferrule is loosened and does not impair the movement of the ferrule into its holder (see Figure 4-3). Failing to do so might damage the connector;

- Approach the fiber connector at an angle (as shown on Figure 4-3) and insert the ferrule into the beam coupler, carefully avoiding any contact on the ferrule's end face;
- Once the ferrule is inserted, align the connector's key with the notch on the coupler, then gently push the connector inside the coupler and lock the connector's box nut by rotating it to the right (do not use any tools to fasten the connector);
- Fasten the coupling nut of the connector completely;
- Slightly and gently fasten the pin screw in order to reduce the slackness of the ferrule inside the alignment sleeve. Be warned that fastening the screw too hard can affect the polarization state in the fiber and damage the screw.

Figure 5-3: Pin screw (coupler side) and connector's key



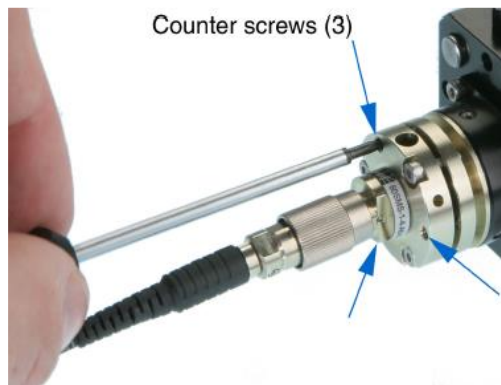
Finding a signal

To inject a laser beam into a fiber, one has to align the focus point of the coupling lens with the center of the fiber's core. Given the core size of a single-mode fiber (typically a few microns), the alignment procedure is painstaking and requires both patience and precision in the handling of the coupler.

You will need an optical power meter equipped to accept your fiber's connector and able to measure optical powers ranging from a few tens of μW to a few tens of mW .

Firstly, make sure that the three counter screws (see Figure 4-4) are loosened by 2 or 3 full turns.

Figure 5-4: Position of the counter-screws



Procedure:

- Power up the laser, set the optical output to a value below 50mW and turn the emission on;

WARNING

LASER RADIATION HAZARD

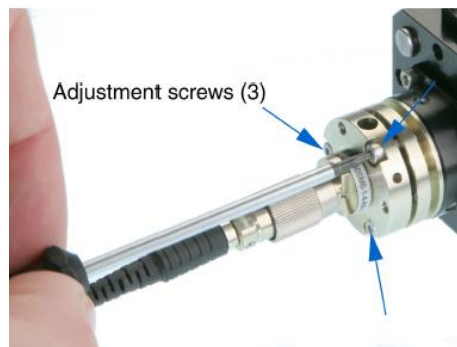


The laser is now emitting. Proper protection measures against laser light shall be enforced

To avoid damaging the fiber end face, the following adjustment procedure should be performed at low optical power (50mW or below)

- Set your power meter to its smallest power range (so it can detect even small differences in optical power) and attach it to the fiber's end. Locate the adjustment screws (1.5 mm hex cylindrical head, see Figure 4-5) and turn them one by one (with an Allen 50HD-15 wrench) until the power meter's reading indicates that optical power has been detected. A good adjustment sequence should be so that any possible position is scanned once.

Figure 5-5: Position of the adjustments screws



It is sometimes useful to slightly loosen the nut on the fiber connector, then to pull back slightly the fiber connector (after having loosen the ferule screw, then the connector nut). Thus doing, defocussing occurs so that the spot is easier to find. Fasten the box nut again when you have detected optical power.

Increasing the signal

Once an optical signal is detected, the power meter's sensitivity shall be changed accordingly. The next step consists in maximizing the signal's power by turning the adjustment screws one by one.

Start with one adjustment screw and tighten it slowly until the optical signal reaches a relative maximum. Then fasten this first screw a little more so that the signal's power decreases by a few percents.

Repeat the operation with the next adjustment screws, proceeding in the same way. After having adjusted the three screws, start a second round and re-adjust the first screw, and so on. Make sure to always adjust the screws in the same sequence (for example, (1) -> (2) -> (3) -> (1) -> (2) -> (3)). The maximum power level is typically achieved after three rounds of adjustment.

Be aware that repetitive squeaks indicate that a screw is tightened too strongly, a situation that should be avoided.

The coupling losses can be defined as being the difference between the power level monitored by the laser source and the power actually measured at the far end of your patchcord. Before proceeding to the next step, check that these coupling losses do not exceed 100 mW.

Fine adjustment and locking

Take note of the power delivered at the output fiber, and compute the transmission ratio (i.e. the measured output power divided by the raw output power obtained at the same set point).

The fiber's coupler adjustment is now near its optimum and you can proceed with the final phase: achieving the maximum coupling efficiency by adjusting the three counter screws (the small pin screws, see figure 4-4)

Using the same procedure as before, start from a state where all three counter screws are equally loosened. Then tighten slowly the first counter screw until the optical signal reaches a relative maximum, and fasten it a little more so that the signal's power decreases slightly.

Repeat the operation with the other counter screws, proceeding likewise. After adjusting the three screws, start a second round and re-adjust the first counter screw, and so on.

At the end of the last round, tighten the last counter screw so as to maximize the output power level.

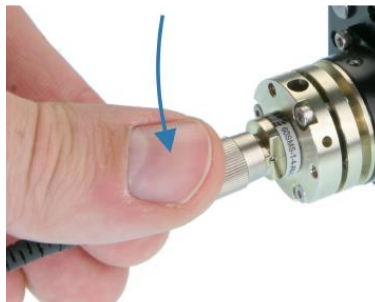
You can now gradually increase the output power up to its nominal set point. As a final check, make sure that the transmission ratio has not decreased.

Checking the alignment

A possible way to check the alignment's robustness is by pressing gently on the connector in all directions (see Figure 4-6): when thus pressing, the signal's power should decrease but it should then recover its initial value once the pressure is released.

If this is not the case, the coupler's alignment is not optimized. The test gives a hint about the direction where more pressure should be applied to the fiber (i.e. which counter screw should be tightened.) Use this information to re-optimize the coupling.

Figure 5-6: Checking the stability of the adjustment



COUPLING ON A MULTI-MODE FIBER

Fiber coupling is also available with multimode fibers. The coupler consists of a mechanical holder positioned inside the laser shutter (referring to figure 5-7). On the front face of the holder are the screws that will define the alignment of the fiber against the beam.

This procedure explains how to retrieve an optimal coupling efficiency.

WARNING

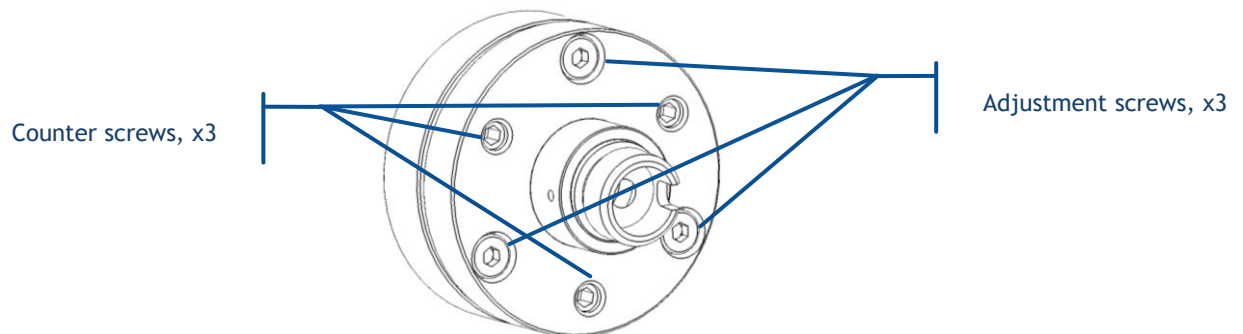
LASER RADIATION HAZARD



Proper protection measures against laser light must be enforced.

To avoid damaging the fiber end face, the following adjustment procedure should be performed at low optical power (50mW or below)

Figure 5-7: Position of the adjustment screws and counter-screws



- The mechanical holder has been centered with regards to the beam (using the positioning screws of the shutter). This operation is performed at Oxxius and we recommend not to disturb this positioning.
- Unscrew slightly each counter screws by two turns,
- The next steps consists in maximizing the signal's power by turning the adjustment screws one by one:
 - o Start with one adjustment screw and steer it slowly until the optical signal reaches a relative maximum. Continue steering this screw a little more so that the power decreases by a few percents.
 - o Repeat the operation with the next adjustment screws, proceeding using the same maneuver. After having the three screws adjusted, start a second round and re-adjust the first screw, and so on. Make sure to always adjust the screws in the same sequence (for example, (1) -> (2) -> (3) -> (1) -> (2) -> (3)). The maximum power level is typically achieved after three rounds of adjustment.
- Secure the optimum position (at maximal power) by tightening the counter screws,

- Your transmission ratio is now maximized

5-5 Issues with back reflection

An excessive light entering the laser module, either from back-reflections of its beam or from other light sources in the setup will lead to an unstable operation of the LaserBoxx.

In order to assert this cause of instability it is recommended to start the laser with its shutter closed (or using any other beam dump) and to note whether the laser starts normally under these conditions.

Oxxius also recommends the following precautions be taken when working with open beam laser modules:

- 1) All reflective surfaces in the optical path should be angled slightly so that surface reflections will not be retro-reflected,
- 2) Utilize angle-polished fibers when coupling the light into optical fibers,
- 3) Avoid using mirrors placed at normal incidence into the light path. If mirrors must be placed at normal incidence, use of an isolator is required.
- 4) Avoid focusing the beam the onto a mirrored surface without installing an isolator into the light path

5-6 Uninstalling and repacking procedures

If your LaserBoxx unit does not seem to be operating correctly, please take contact with your local representative for support.

Warning



Attempting to open the laser head or the controller is likely to result in damages and will void the product's warranty.

If a unit needs to be returned, it is necessary to obtain a returned merchandise authorization (RMA) from Oxxius prior to returning the product.

5-7 Oxxius worldwide contacts

Your local representative can be found on our website: www.oxxius.com

Corporate headquarters:

Oxxius S.A.

4 rue Louis de Broglie

F-22300 Lannion, France

Phone: +33 296 48 70 28

Fax: +33 296 48 21 90

E-mail: support@oxxius.com

5-8 Disposal

Oxxius is committed to making careful, ecologically sound use of natural resources and minimizing the environmental footprint of our products. Help us by disposing of waste in a way that causes minimum environmental impact.

A product labeled as follows cannot be disposed of in normal household waste



Disposal via collection points for waste electrical and electronic equipment is not permitted either. As a manufacturer, Oxxius completely fulfills its obligation to take back and dispose of electrical and electronic waste. Contact your local service representative to dispose of the product.

6. WARRANTY AND CERTIFICATION

6-1 Standard warranty

Limited Lifetime Warranty

During the warranty period, Oxxius will, at its option, either repair or replace product.

The Oxxius representative from whom you purchased your device should be the first point of contact when service of any kind is required for your Oxxius devices.

All transportation, insurance and freight charges associated with warranty service and repairs on Oxxius devices are the responsibility of the purchaser.

User's responsibilities

Technical specifications have to be followed by the user in order to respect the conditions for which the product has been developed. Improper electronics levels or environmental conditions (such as condensation, moisture, dust ...) will void the warranty.

Limitations of warranty

This warranty applies when this device is purchased only from Oxxius or from an Authorized Oxxius representative and is subject to the limitations set forth herein.

The following items are not covered by this warranty:

Any damage to the device resulting from customization or modification integrating products from others manufacturers.

Any device, whose serial number is missing, altered.

Any repairs or adjustments made by unauthorized people.

Any attempts to open the laser device.

Any use in improper environmental conditions (condensation, dust ...).

Any faulty customer equipment system.

Fiber optic patch cables and coupling optimization.

Scratches on optical output windows or on any other optical component supplied with options due to bad cleaning method.

Repaired or replaced parts are warranted for the duration of the original warranty period only.

THE FOREGOING CONSTITUTES THE ONLY WARRANTY WITH RESPECT TO THE PRODUCT AND IS MADE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED AND DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL LOSS.

OXXIUS makes no warranty of any kind with regard to the information contained in this guide, included but not limited to, implied warranties of merchantability and suitability for a particular purpose.

6-2 Declaration of conformity

We, Oxxius S.A
of 4, rue Louis de Broglie
22300 Lannion, FRANCE

declare on our sole responsibility that the products:

Name: LCX and LPX laser sources, and their accessories

Models: LCX-*www*[L/S]-*ppp*-CSB-[PPA/PPF/OE]
LPX-*www*[L/S]-*ppp*-CSB-[PPA/PPF/OE],
ACX-FC[SM/PM/MM],
ACX-HTSK-1,
ACX-RMTB-LBX,

where “*www*” is the emitted wavelength (in nm), and “*ppp*” the nominal optical power (in mW)

have been designed to comply with the requirements of the following directives and standards:

- Directive 2014/35/EU (26 February 2014):
 - o EN IEC 61010-1:2010 : Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1
 - o EN IEC 60825-1:2014 : Safety of laser products - Part 1
- Directive 2014/30/EU (26 February 2014):
 - o IEC 61326-1:2012 / EN 61326-1:2013 : Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1
- Directive 2015/863 (31 March 2015) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS):
 - o EN IEC 63000:2018 : Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
- Directive 2012/19 (4 July 2012) on on waste electrical and electronic equipment (WEEE):
 - o EN 50625-1:2014: Collection, logistics & Treatment requirements for WEEE - Part 1
- Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

Tested in year: 2015

By : Laboratoire d’essais Alcatel-Lucent
4, rue de Broglie - 22304 Lannion - FRANCE

Test report numbers:

- 8BA 04903 0175 QZZZA - ed. 01 for IEC/EN 61010-1:2010
- 8BA 04700 1705 QZZZA - ed. 01 for EMC

Signature:

Thierry Georges, PDG (CEO), Lannion, December 2021



7. TECHNICAL DOCUMENTS

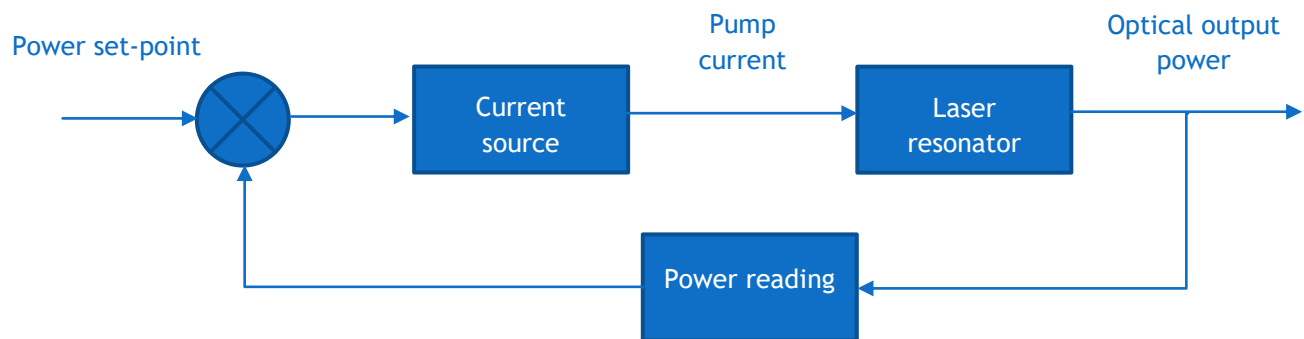
This section lists the software commands and as well as the mechanical drawings of the laser head and the controllers.

Annex A: Principle of operation

Only one type of loop exists to control the emission on both LCX and LPX models: “Automatic power control” (or “APC loop”).

Using this control loop, the user sets an optical power that will drive the laser cavity. The control loop consists in acting so that the actual power is equal to the user-defined set-point.

Here is the block diagram of the APC loop:



The APC loop offers the best performance concerning optical power stability, since it monitors the actual output power and is able to react against eventual deviations. It is therefore preferably employed in most applications.

Annex B: Software commands

COMMAND AND QUERIES FOR THE LCX OR LPX LASERBOX

The following tables lists the set of queries and commands to be sent to the laser unit.

Once a command is successfully received and processed, the acknowledgement message “OK” is returned. If the entered command or query is not understood by the unit, the following error message is returned: “????”

Communication and identification:

Purpose	Query or command	Result and syntax
Configuration of the USB port: standard or virtual serial port. A cold reboot of the laser is required once this parameter has been modified.	CDC	CDC 0 (CDC,<space>,0) : Standard USB CDC 1 (CDC,<space>,1) : USB port configured as a virtual serial port
Retrieves the configuration of the USB port	?CDC	“0” Standard USB “1” USB port configured as a virtual serial port
Configuration of the USB port: standard or virtual serial port. A cold reboot of the laser is required once this parameter has been modified.	CDC	CDC 0 (CDC,<space>,0) : Standard USB CDC 1 (CDC,<space>,1) : USB port configured as a virtual serial port
Retrieves the unit’s serial number	?HID HID?	“LAS-XXXXX”, where XXXXX is a five-digit number
Retrieves the type of laser	INF?	“LCX-532-50” for a 50mW LCX emitting at 532nm
Retrieves the version of the embedded software	?SV VE?	“1.6.8” for firmware version 1.6.8

Configuration and status:

Purpose	Command or Query	Syntax and examples
Retrieves the temperature of the base plate of the laser head (expressed in Celsius degrees)	?BT BT?	“22.1” “22.1 C”
Activate or deactivate the CDRH-compliant five-second delay prior to laser emission. See section 1, “Safety information”, for further details.	CDRH	CDRH 1 (CDRH,<space>,1): a five-second delay is enforced between the emission command and the actual emission, as per CDRH directives.

		CDRH 0 (CDRH,<space>,0): no delay is present between the emission command and the actual emission. The unit thus does not comply with CDRH directives.
Retrieves the status of CDRH-compliant five-second delay prior to laser emission. See section 1, “Safety information”, for further details.	?CDRH CDRH?	“1” : a five-second delay is enforced between the emission command and the actual emission, as per CDRH directives. “0” : no delay is present between the emission command and the actual emission. The unit thus does not comply with CDRH directives.
Retrieves the cause of the latest alarm (see section “Troubleshooting” for more information about alarms)	?F	“?F” returns a number corresponding to one of the following alarms: “0” : No alarm “1” : Diode current “2” : Laser power “3” : Power supply “4” : Module temperature “5” : Base temperature “7” : Interlock “8” : User-generated alarm (using the command RST)
Retrieves the status of the interlock circuit	?INT INT?	“0” Interlock open, laser emission is not authorized “1” Interlock closed, laser emission is authorized
Measures the voltage supplying the laser head (expressed in Volts)	?IV	“6.6” for a supply voltage of 6.6 Volts
Retrieves the laser operation time, in hours	?HH	“49” for a total emission time of 49 hours
Retrieves the status of the emission key, or the “Key” signal on the DE-15 electrical interface	?KEY KEY?	“0” Signal low, laser emission is not activated “1” Signal high, laser emission is activated
Re-initialize the unit	RST	RST 0 (RST,<space>,0) Resets the microcontroller
Queries the state of the laser module (see section “Troubleshooting” for more information concerning the laser status)	?STA	?STA returns a number corresponding to one of the following status: “1” : Warm-up phase “2” : stand-by phase “3” : Emission ON “5” : Alarm present “3” : Sleep mode “7” : Searching for SLM point
Switches the temperature regulation loop ON or OFF. This regulation loop is necessary for the emission to occur.	T	T 0 (T,<space>,0): switches the regulation loop off T 1 (T,<space>,1): switches the emission on

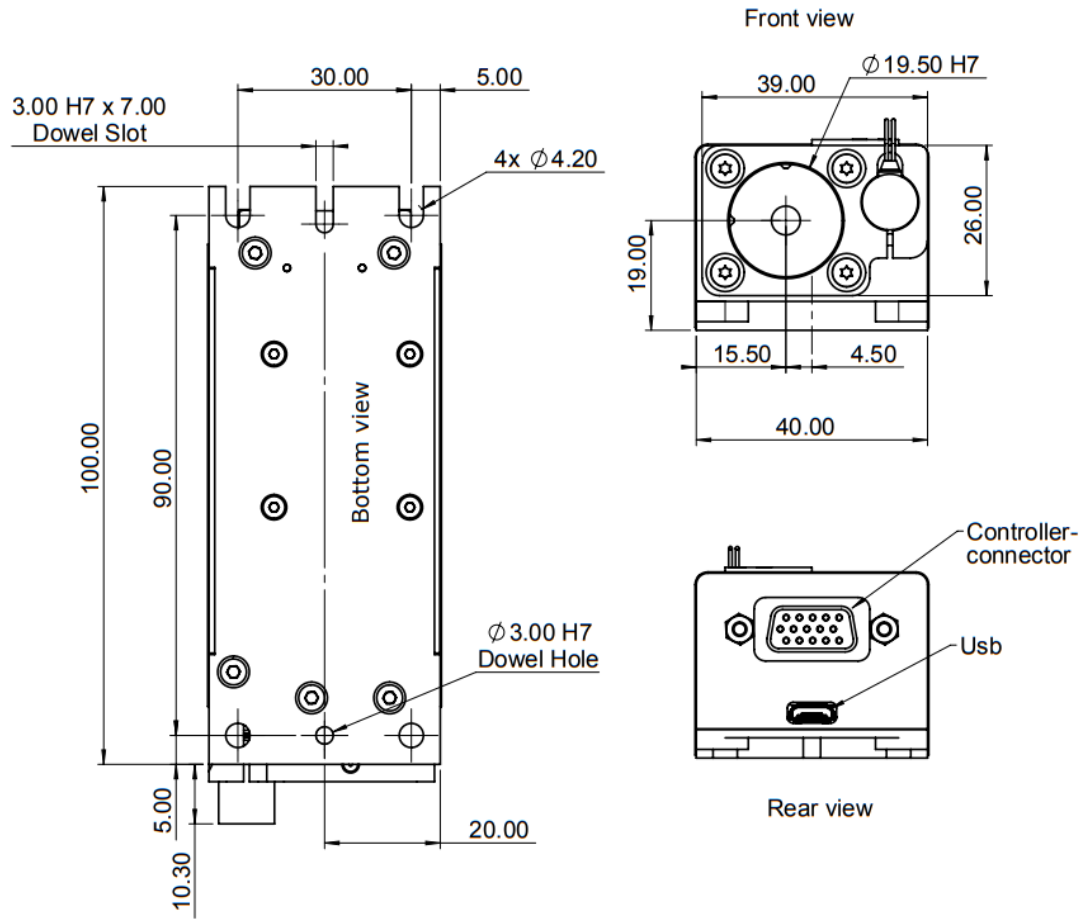
Switching it off helps reducing the power consumption.		
Retrieves the status of the temperature regulation loop	?T T?	“0” Temperature regulation loop is deactivated “1” Temperature regulation loop is activated

Power and operational settings:

Purpose	Command or Query	Syntax and examples
Control of the laser emission	DL	DL 0 (DL,<space>,0): switches the emission off DL 1 (DL,<space>,1): switches the emission on DL 2 (DL,<space>,2): switches the emission on at low power for optical alignment purpose
Modifies the power set point (for models that accept power adjustment)	IP P	IP 100 (IP,<space>,100) sets the optical power at 100% of the nominal power. IP 50 (IP,<space>,50) sets the optical power at 50% of the nominal power. P 250.3 (P,<space>,250,<dot>,3) sets the optical power at 250.3mW
Retrieves the laser’s measured output power (in milliwatts)	?P	“53.6” for a power of 53.6mW
Retrieves the emission status	?L	“0” Emission is off “1” Emission is off “2” Emission is on at low power
Opens or close the (optional) electro-mechanical shutter	SH	SH 0 (SH,<space>,0) Closes the shutter SH 1 (SH,<space>,1) Opens the shutter
Retrieves the laser’s power set point (in milliwatts)	?SP	“40.0” for a set point of 40.0mW

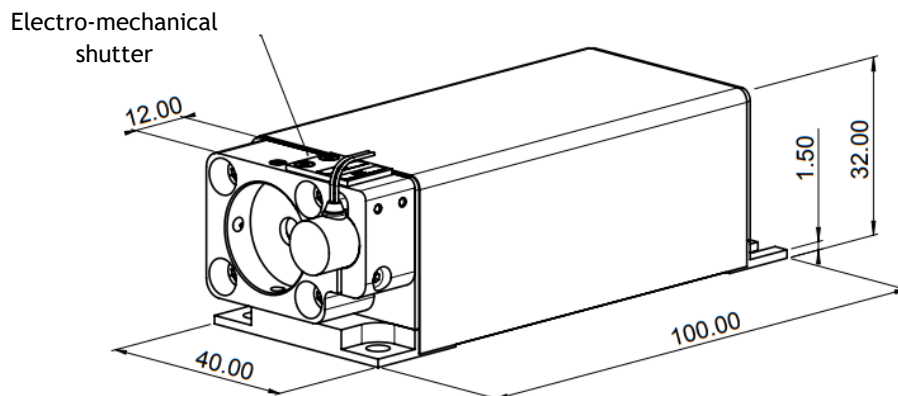
Annex C: Mechanical drawings

LCX LASER HEAD, PLUG AND PLAY VERSION

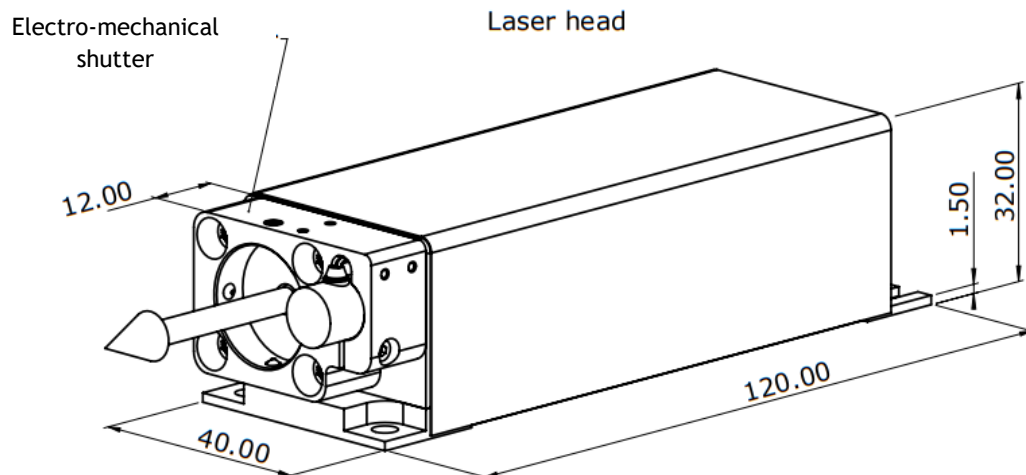
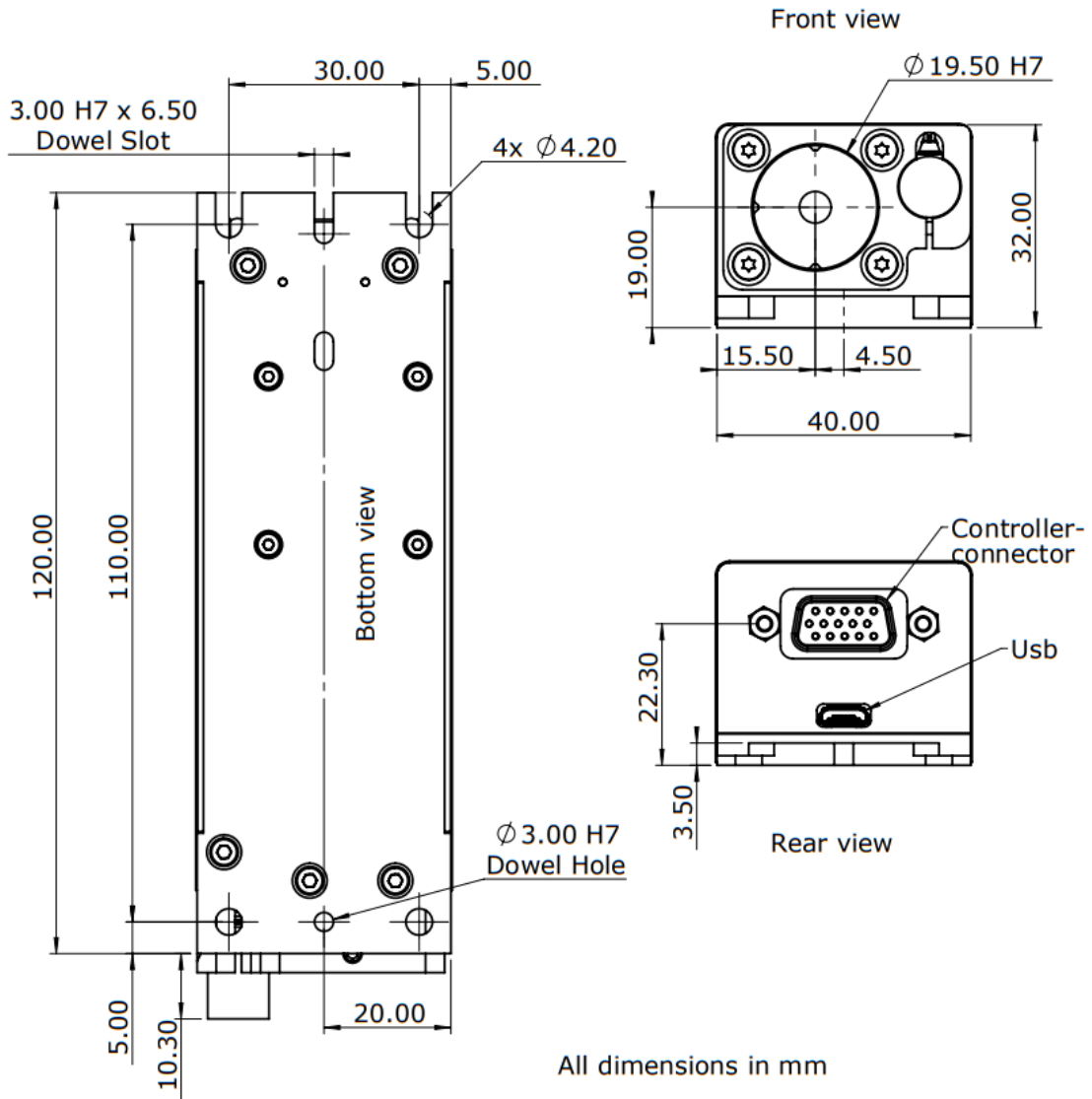


All dimensions in mm

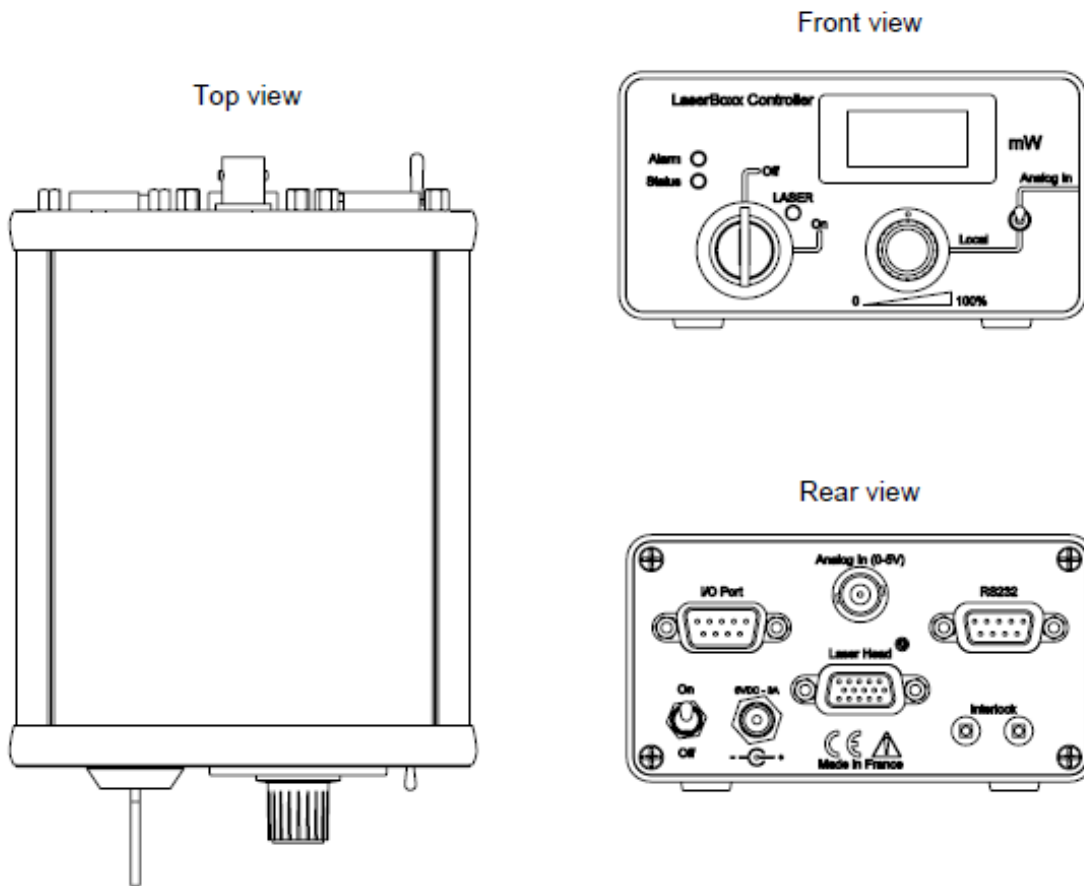
Laser head



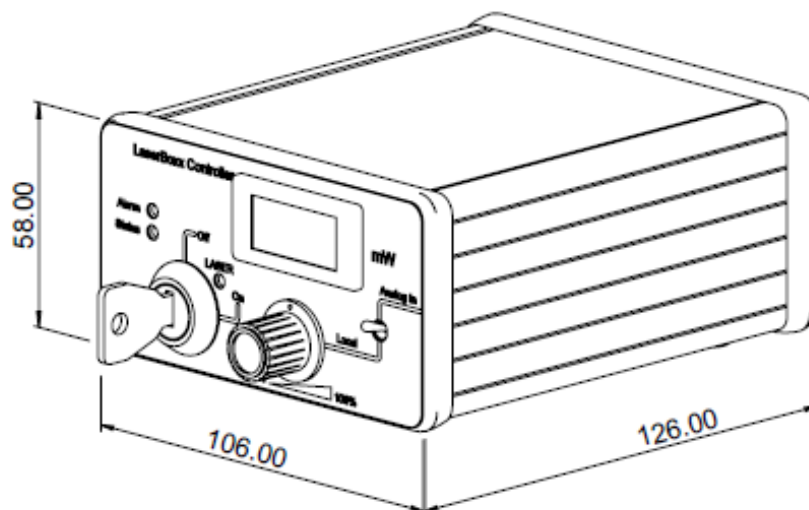
LPX LASER HEAD, PLUG AND PLAY VERSION



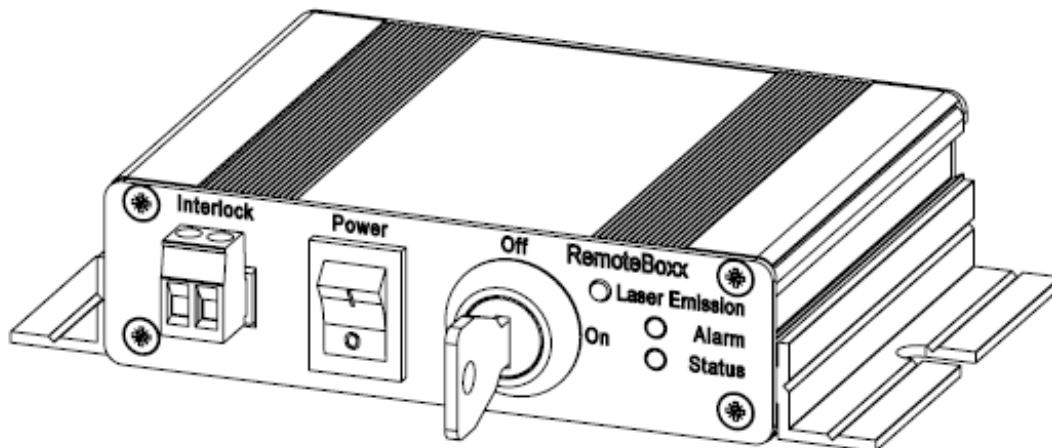
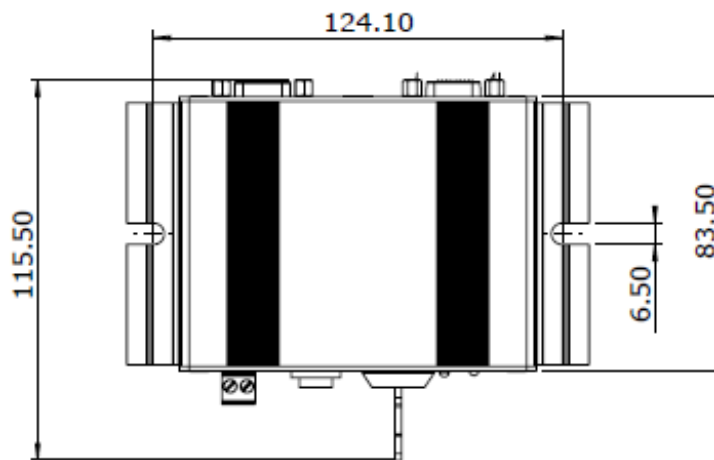
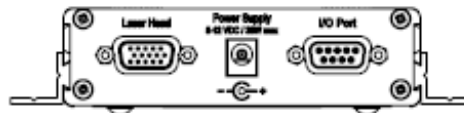
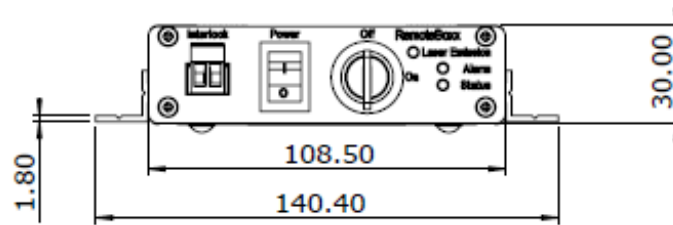
CONTROLBOXX (FOR “PPA” VERSIONS)



All dimensions in mm



REMOTEBOXX (“PPF” VERSIONS)



Annex D: Electrical interface of the laser head

For integration purpose; it is possible to interact directly with the laser head using its electrical interface.

Warning



Using the laser head without its controller is equivalent to using the laser as an OEM part. The OEM version is intended for integration into a larger system supervised by the user and should therefore not be used "as is" in another environment such as a laboratory. The equipment into which the laser is integrated must comply with the laser safety standards listed in section "Warranty and certification".

Oxxius bears no responsibility in any lack of compliance with safety standards of the environment in which the LaserBoxx is used without its controller.

Here are the signals present on this interface:

Pin #	Name, function	Type	Description	Drive or load
1	Actuated key master control	Input	TTL Low = No emission for OEM use (CDRH=0) TTL High= Laser emission for OEM use (CDRH=0) Rising edge= Laser emission for CRDH use (CDRH=1)	100 kΩ pull down
2	Laser Enable	Input	TTL Low = Laser Off TTL High= Laser On	100 kΩ pull down
3	Interlock	Input	Open(TTL Low) = No emission Closed to +5V (TTL High)= Laser emission is possible	100 kΩ pull down
4	RS-232 Rx	Input	To computer Pin 3 (Tx)	
5	RS-232 Tx	Output	To computer Pin 2 (Rx)	
6	Power supply GND	Ground	Ground for pins 4, 5, 11, 12 and TTL signals.	
7	Alarm	Output	TTL Low = No alarm TTL High= Alarm present	2 kΩ

8	Power adjustment (once the option is activated)	Input	0V to 5V DC (30% to 100% of the optical power)	1.25 k Ω
9	+5V DC	Output	5V DC output	
10	Analog Ground	Ground	Ground for analog signals (pins 8 and 14)	
11.12	Power Supply In	Supply	DC power supply Input (min +5V, max +12V)	< 25 Watts
13	Power Supply GND	Ground	Ground for pin 11 and 12	Ground
14	Laser Power Out	Output	Voltage between 0 to 2V maximum. Note: Max voltage can change from one unit to another	2 k Ω
15	Laser Ready	Output	TTL Low = Laser not ready TTL High= Laser ready	2 k Ω
Shell	Chassis Ground		Ground	

The connector of the interface on the laser head is a female 15-pin Sub-D type.

Note concerning the current-supplying pins:

The four pins 6, 13, 11 and 12 all have to be connected to your power supply in order to operate the connector and its socket within specifications.