Oxxius
Simply Light

LaserBoxx series
User manual

LCX models – DPSS laser modules

LaserBoxx series

User manual

Reference: CO-02426-A

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The Oxxius team thanks you for purchasing the LaserBoxx module.

You will find information such as datasheets for your product on the Oxxius website (www.oxxius.com), along with updates on new product releases and participation to tradeshows.

The team is dedicated to providing customers with the highest quality products and services. Oxxius is also currently working on the ISO-9001 certification. In order to constantly improve our procedures, we have added to this manual the list of questions below.

We would be grateful if you could take the time to fill this form and fax it back to the number listed.

Please rate the following items (1: very poor, 2: poor, 3: average, 4: good, 5: excellent)

1	2	3	4	5	Questions
❑	❑	❑	❑	❑	Clarity of information contained in the website commercial datasheet
❑	❑	❑	❑	❑	Quality of the technical support received from Oxxius or its distributor prior to the laser purchase
❑	❑	❑	❑	❑	Responsiveness
❑	❑	❑	❑	❑	Shipment on time
❑	❑	❑	❑	❑	No items missing
❑	❑	❑	❑	❑	Quality of packaging
❑	❑	❑	❑	❑	Overall satisfaction with laser performance
❑	❑	❑	❑	❑	Clarity of the information contained in User's Guide
❑	❑	❑	❑	❑	How straightforward was the installation of the laser module
❑	❑	❑	❑	❑	If applicable, quality of the after-sales support received from the distributor / Oxxius
❑	❑	❑	❑	❑	Responsiveness of after-sales support

Other Comments / Suggestions: .....

.....

.....

.....

FAX BACK TO: Oxxius Sales at +33 2 9648 2190

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SECTION 1: SAFETY INFORMATION

Please read this manual carefully before using this device, in order to ensure a thorough understanding of all its functions and its efficient use.

If the device is used in a manner not specified by Oxxius, the protection provided by the device may be impaired. Note that Oxxius bears no responsibility for the result of operations caused by an incorrect or inappropriate use of this device.

ADVISORY LABELS

Advisory labels are applied to Oxxius products in locations where specific dangers exist, or where a specific attention is required. Pay careful attention to these labels during handling. Do not remove nor tear these labels. If you have any questions regarding warning labels, please ask your nearest Oxxius representative (refer also to chapter 5-6 of the present manual for worldwide contacts).

This symbol appears on the laser head (and its controller if any). It means that reading this instruction manual is mandatory prior to using the laser module or performing any level of maintenance.

This symbol warns the user against the danger of being exposed to hazardous visible or invisible laser radiation

1-1 Laser safety

THE DANGER OF LASER SOURCES

Light produced by a laser source exhibit proprieties that make it much different from sunlight or 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 is able to build stable interferences. These interferences can be intense patterns that are more hazardous than non-coherent light of the same wavelength and intensity,
- Laser beams are often collimated or diverge slowly, so that they maintain their harmful proprieties over long distances.

BIOLOGICAL EFFECTS OF LASER BEAMS

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

- Eye injury: because of its high degree of collimation, a laser beam act as an almost punctual source of intense light. A laser beam of sufficient power can in theory produce retinal intensities at greater magnitudes than conventional light sources, even greater than what would be a direct viewing of the sun. Permanent blindness can result from such exposures.
- Thermal injury: the most common cause of laser-induced tissue damage is thermal in nature, where the tissue proteins are denatured due to the temperature rise following absorption of laser energy.
- 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 actinic ultraviolet radiation (0.200 µm-0.315 µm) for any exposure time or "blue light" visible radiation (0.400 µm-0.550 µm) when exposures are greater 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 C (200 to 280nm)	Photokeratitis	Erythema (sunburn) Skin cancer
Ultraviolet B (280 to 315nm)	Photokeratitis	Accelerated skin aging Increased pigmentation
Ultraviolet A (315 to 400nm)	Photochemical UV cataract	Pigment darkening Skin burn
Visible (400 to 780nm)	Photochemical and thermal retinal injury	Photosensitive reactions 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).

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.

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.

The identification process is accomplished by affixing a warning label onto the product. Along with text warnings, these labels include information pertaining to the emitted wavelength, the total output power and the laser classification of the device.

SAFETY GUIDELINES

Any person using a laser should be aware of the risks involved. This awareness is not just a matter of time spent with lasers; to the contrary, long-term dealing with invisible risks (such as from infrared laser beams) tends to dull risk awareness, rather than to sharpen it. Please take time to read and understand this manual and to familiarize yourself with the operating and maintenance instructions that have provided before using the product. If there are any questions or sections that are not understood, do not hesitate to contact the manufacturer.

- 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.
- Watches and other jewelry that might enter the optical plane should not be allowed in the laboratory. All non-optical objects that are close to the optical plane should have a matte finish in order to prevent specular reflections.
- The operator of the laser is responsible for notifying the laser usage and for controlling the laser area.
- Use the laser in a room with access controlled by door interlocks. Post warning signs. Limit access to the area to individuals who are trained in laser safety while operating the laser.
- All operators that are in the area must be wearing appropriate laser safety eyewear prior to enabling laser emission. This would include operators that are not directly using the laser system.
- Alignment of beams and optical components should be performed at a reduced beam power whenever possible.
- Never look directly into the laser output port when the power is on.
- Do not install or terminate fibers or collimators when the laser is active. Follow the dedicated instructions in section 5.
- Always switch the laser off when working with the output such as mounting the fiber or collimator into a fixture, etc. If necessary, align the output at low output power and then increase the output power gradually.
- Ensure that the work surface is properly vented. The gases, sparks and debris that can be generated from interaction between the laser and the work surface can pose additional safety hazards.
- Avoid using the laser in a dark environment.
- For fiber-coupled laser sources: do not enable the laser without a coupling fiber or equivalent attached to the optical output connector.

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 to an optical density

sufficient to reduce beam power to below the maximum permissible exposure, laser eyewear used 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, generally near the top of the unit.

Oxxius recommends that laser users 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 “PLUG AND PLAY” AND “OEM” VERSIONS

The LaserBoxx in “Plug and Play” version complies with all the requirements of the European Laser Safety Standard 60825-1, and US FDA CFR 1040,10 and 1040,11 except for deviations pursuant to Laser Notice N° 50, dated June 24, 2007. (Laser Products – Conformance with IEC 60825-1 and IEC 60601-2-22; Guidance for Industry and FDA Staff (Laser Notice No. 50)).

The LaserBoxx in “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 LaserBoxx, OEM version, is used.

DESCRIPTION OF HAZARD CLASSES

The LaserBoxx laser sources either belong to class 3b or class 4.

Class 3b laser sources: laser products that are normally hazardous when intrabeam ocular 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 intrabeam ocular 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.

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. Some of these features are only present on the “Plug and Play” versions of the LaserBoxx laser sources.

LABELLING

The labels present on the laser head inform the user about the laser class, the location of the laser aperture and the emission wavelength. Refer to the following figures to locate these labels on the different LaserBoxx models.

Figure 1-2: Label for LCX models

Figure 1-3: Label for LBX models

APERTURE LOCATION

The laser radiation is generated within a metal protective housing which should never be opened. Laser beam output aperture is indicated.

INTERLOCK

LaserBoxx controllers are provided with an accessible interlock circuit. When this circuit is open (typically using dedicated terminals), the laser emission is cut.

ACTUATED KEY MASTER CONTROL (FOR "PLUG AND PLAY" VERSIONS ONLY)

LaserBoxx controllers are provided with an actuated key master control. This lock and key control the emission. The laser emission is not possible when the key is absent from the lock, or in "OFF" position. The key is removable only when in 'OFF' position.

Please note that this function is also present on the OEM version as a dedicated electrical pin. Please refer to the product description for detailed information.

EMISSION WARNING INDICATORS (FOR "PLUG AND PLAY" VERSIONS ONLY)

LaserBoxx controllers are provided with an emission indicator located on the front panel. 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. It is thus providing a delay for the user to be warned about the imminent emission.

OPTICAL SHUTTER (FOR "PLUG AND PLAY" VERSIONS ONLY)

A mechanical shutter fixed on the laser head allows for a complete extinction of the beam.

The laser compliance of the LaserBoxx is summarized in the following table:

	Oxxius LaserBoxx Plug and Play	**Remarks**	**Oxxius LaserBoxx OEM**	**Remarks**
	Laser Safety Compliance			
IEC60825-1	Yes		No	Designed for a use solely as component of a complying electronic product
21CFR1040.10	Yes	Complies with IEC 60825-1 and US FDA CFR 1040,10 and 1040,11 except for deviations pursuant to Laser Notice N° 50, dated June 24, 2007 (Laser Products – Conformance with IEC 60825-1 and IEC 60601-2-22; Guidance for Industry and FDA Staff (Laser Notice No. 50))	No	
21CFR1040.11	Yes		No	
CDRH compliance	Yes		No	

1-2 Electrical safety

The Oxxius LaserBoxx products do not contain hazardous voltages. Warranty will be voided if the enclosure is disassembled.

Electrostatic discharges (ESD)

One of the causes of ESD events is static electricity. Static is created when there is movement. When objects rub together there is friction and this causes the surfaces to interact. An excess of electrons appears on one surface while there will be a deficiency on the other. The surface with the excess of electrons becomes negatively charged, whereas the surface with the deficit becomes positively charged.

These charges will try to flow and neutralize the charge difference. They may leak away slowly, or the discharge may take place more quickly. However as many substances exhibit a very high resistance these charges can remain in place for a very long time and wait until a suitable path is created for the discharge to take place. When charges find a path through an electronic circuit, the high instantaneous currents can give rise to damage. As a result ESD is of great importance.

Although input protections are integrated in the LaserBoxx module, ESD precautions are recommended to avoid performance degradation.

The LaserBoxx platform has been tested successfully with these levels of ESD: +/-4kV on contact, +/-8kV on air.

Particular attention is required using the product in dry air and on a floor presenting a carpet or a vinyl tiled surface which could generate a discharge up to 20kV.

Safety guidelines

In order to prevent ESD damage during installation or use, use an antistatic wrist strap. Wrist straps in industry usually connect to Earth Bonding Points (part of the grounding system) via either a 4 mm plug or 10 mm press stud, whereas personally owned straps are likely to be connected to ground via a crocodile clip.

Figure 1-4: Example of a wrist strap

Power cord (for “Plug and Play” versions)

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 local standard
Connector on device side	C13 type
Current Rating	10 A

An external protection device (typically a circuit breaker) has to be present ahead the equipment.

1-3 Compliance with European directives

The LaserBoxx modules comply with the following directives:

Low Voltage Directive 2006/95/EC

The LVD ensures that electrical equipment within certain voltage limits both provides a high level of protection for European citizens and enjoys a single market in the European Union. The Directive covers electrical equipment with a voltage between 50 and 1000 V for alternating current and between 75 and 1500 V for direct current. It should be noted that these voltage ratings refer to the voltage of the electrical input or output, not to voltages that may appear inside the equipment.

Electromagnetic Compatibility Directive 2004/108/EC

The ECD directive describes the ability of a device, equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to anything in that environment.

WEEE (Waste Electrical Electronic Equipment) - European directive 2002/96/EC

This symbol on the product(s) and / or accompanying documents means that used electrical and electronic products should not be mixed with general household waste. For proper treatment, recovery and recycling, please return this product to your local representative. Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

This symbol is only valid in the European Union. If you wish to discard this product please contact your local authorities or dealer and ask for the correct method of disposal.

ROHS 2 compliance

In order to supply environment-friendly products to customers, we make all Oxxius products comply with RoHS 2 directive.

Mechanical resistance to shock and impact

The laser head is rated for impacts up to 5 Joules of energy levels.

SECTION 2: GETTING STARTED

This manual provides the information necessary to check the functionalities and operate the laser sources. Be sure to read this manual carefully in order to use them safely.

This manual is composed of the following sections:

1	Safety information	Be sure to read this section first to use the laser sources safely
2	Getting started	Describes the packing list, the environment the unit should be used in, and the install procedure
3	Operation	Describes the elements of the laser source and how to operate it
4	Advanced operations	Describes how to use the software interface, the electronic interface, and how to adjust the fiber couplers
5	Troubleshooting	Instructions about to solve operation-related issues
6	Warranty and certification	Details the warranty applied on this device and the conformity to related standards
7	Technical documents	Miscellaneous technical information

2-1 Overview

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.

These laser sources feature:

- Ultraviolet, visible or infrared outputs (from 375nm to 1100 nm), emitted from either laser diodes or from patented alignment-free monolithic resonators,
- common mechanical and electrical interfaces,
- a low power consumption,
- elliptic, circular beams or fiber-coupled output beams,

- an outstanding power stability and low-noise emission,
- temperature-stabilized emitters and beam-shaping optics,
- USB and RS232 communication channels
- “Plug and Play” versions of the modules with shutter and “ControlBoxx” or “RemoteBoxx” controllers

The LCX LaserBoxx are models that embed a monolithic diode-pumped solid state (DPSS) lasers.

The LaserBoxx sources consists of a laser head (from where the optical signal is emitted) and an optional controller. The set formed by the laser head, its controller and the cable linking them will be called a laser module in the present document.

“Plug and play” and “OEM” versions

The LaserBoxx lasers sources come in two versions:

- “Plug and play” versions are meant to be accessed physically by the user, typically in a laboratory or “bench-top” environment. It offers a direct access to most of the functions and to some important safety features:
    - Fixed power “Plug and play” (or “PPF”) models consist of a laser head linked to a “RemoteBoxx” controller. This controller offers a simple interface to release or shut off the laser output.
    - Adjustable power “Plug and play” (or “PPA”) models consist of a laser head linked to a “ControlBoxx” controller. This controller allows the user to visualize the actual output power and to tune it using a knob.

  Refer to section 1, “Safety information” for a detailed list of the safety features and the relevant standard compliance.

- Original Equipment Manufacturer (or “OEM”) versions are designed for integration into an industrial device or system. These versions generally do not include any controller nor any safety feature.

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.

2-2 Operating environment

In compliance with IEC EN 61010-1 standard, the “Plug and Play” LCX LaserBoxx are intended to be used in an environment meeting the following conditions:

- Indoor use,
- Altitude up to 2000 meters,
- Ambient air temperature: from +10°C to +38°C (operating temperature),
- Base plate temperature: from +10°C to +50°C (operating temperature),
- Maximum relative humidity of 80% for 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 the levels of overvoltage category II, as specified in standard IEC EN 61010-1,
- Temporary over-voltages occurring on the mains supply,
- Applicable pollution degree of the intended environment (pollution degree 2)

2-3 Unpacking and installing

The laser modules should be unpacked and used in an area satisfying the following conditions:

- a dust-free area,
- an area free from vibrations

PACKING LIST

The tables below list the standard elements and accessories shipped with the LaserBoxx modules.

Table 2-1: Packing list and accessories of the LaserBoxx, « Plug and Play » version

Name	Reference	Quantity
Laser head		1
“ControlBoxx” or “RemoteBoxx” controller	(m)	1
Laser head to controller cable	SE-01160	1
Power supply for the laser	(m)	1
Optical shutter	SE-01315	1
Fixation screws for the shutter	M2.5 x 14 DIN912	4
Heatsink	ACX-HTSK-LBX	1
Fixation screws for the shutter	M4 x 6 DIN912	3

Power supply for the heat sink	CO-01395	1
Power cable	(c)	1
USB cable (USB A to micro B)	CO-01644	1
Laser emission key	CO-00554	2
USB Flash drive	CO-01514	1
This user manual	CO-02426	1

(m) model-dependent (c) country-dependent

UNPACKING

Unpack the different elements of the package listed on table 2-1 and check that none of the items appears damaged.

Please contact your representative if you have to report any damage (see chapter 5-6 for contact information). Keep the packaging box to be able to ship the laser if necessary.

Follow the instructions below to install the module safely:

- avoid undue pressure or impact to the equipment during handling and installation,
- the laser head should be placed on a flat surface,
- do not put any objects on top of either the laser head or its controller,

For fiber-terminated lasers: special attention is required with the delivery fiber which should not be bent nor receive mechanical damage (shear stress, punching, etc.) under any circumstances. Optical fibers are made of glass and are fragile pieces of equipment. The user is required to handle the delivery fiber and its optical connector with care and to have the necessary tools and knowledge to inspect and clean the end tip of the fiber.

2-4 Elements description

LASER HEAD

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

Figure 2-2: Front view of the laser head, “Plug and Play” version

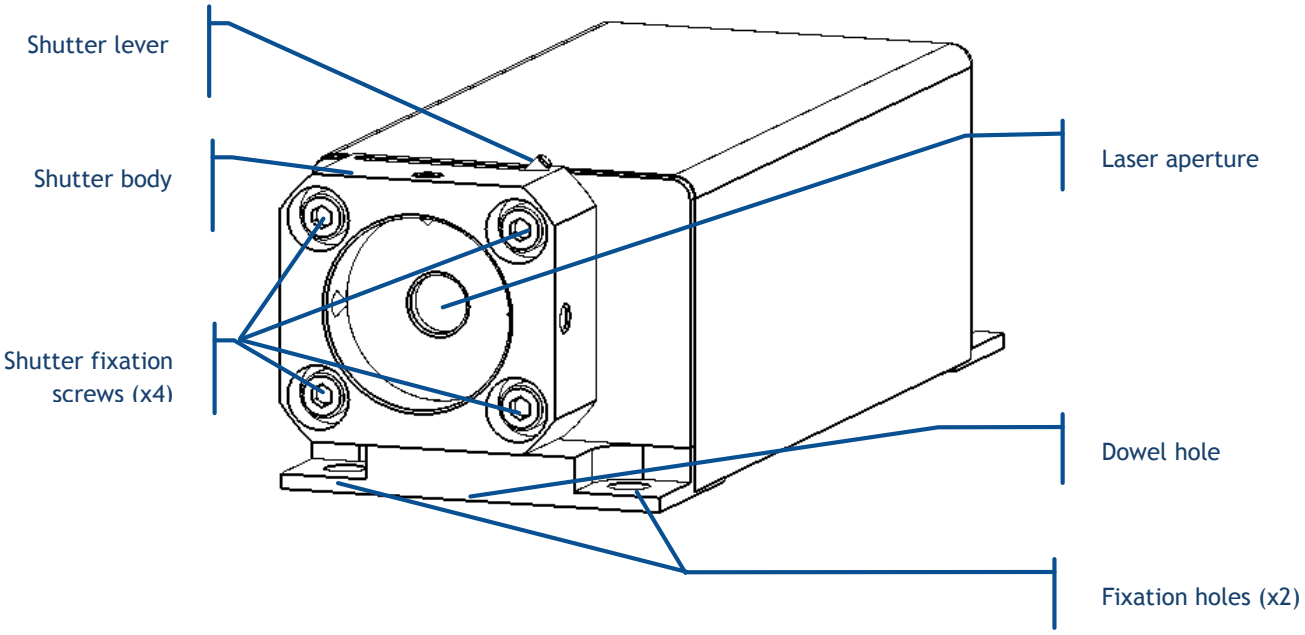
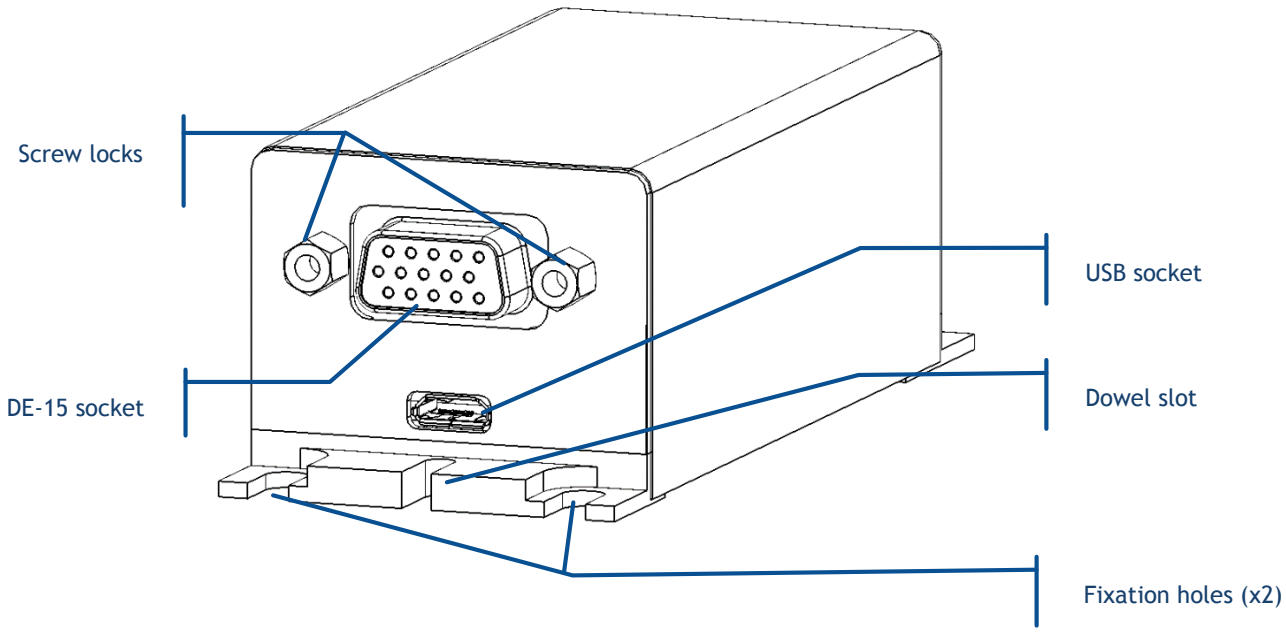


Figure 2-3: Rear view of the laser head



The following elements are accessible to the user:

- **Shutter fixation screws**: these screws are holding the shutter body onto the laser head. They can be used to adjust the center of the shutter aperture against the laser beam.

- **Shutter lever**: this lever is used to release or to block the laser beam. Both positions (open and closed) are indicated at the top of the laser head.

- **Laser aperture**: this is the aperture from which the laser beam is released. The aperture's position is also indicated by an arrow at the top of the laser head.

- **Base plate fixation holes**: these holes are used to fix the laser head to a baseplate or to a heatsink.

- **DE-15 HD socket**: this socket holds the electronic interface of the laser head. Refer to section 4-2 for a detailed description.

- **Screw locks**: the DE-15 HD connector should be fixed to the laser head using these standoff screws.

- **Micro-USB socket**: this socket holds the USB interface.

- **Dowel hole and dowel slot**: these elements are used a mechanical references for aligning the beam.

HEATSINK

On LCX LaserBoxx, a heatsink is necessary to ensure a stable operation over a broad range of temperatures. Here are the accessible elements on the heatsink. For detailed drawings, refer to the section "Technical documents", annex C.

- **Heatsink fixation holes**: these holes are used to fix the heatsink to a baseplate.

- **Air inlet and outlet**: ambient air will flow through these apertures and transfer the excess heat. Do not block these apertures and leave enough room around them to ensure a proper cooling of the laser unit.

- **Fan supply socket (2.1mm coaxial):** Input for the motorized fan inducing the air flow.

Figure 2-4: Front view of the heatsink

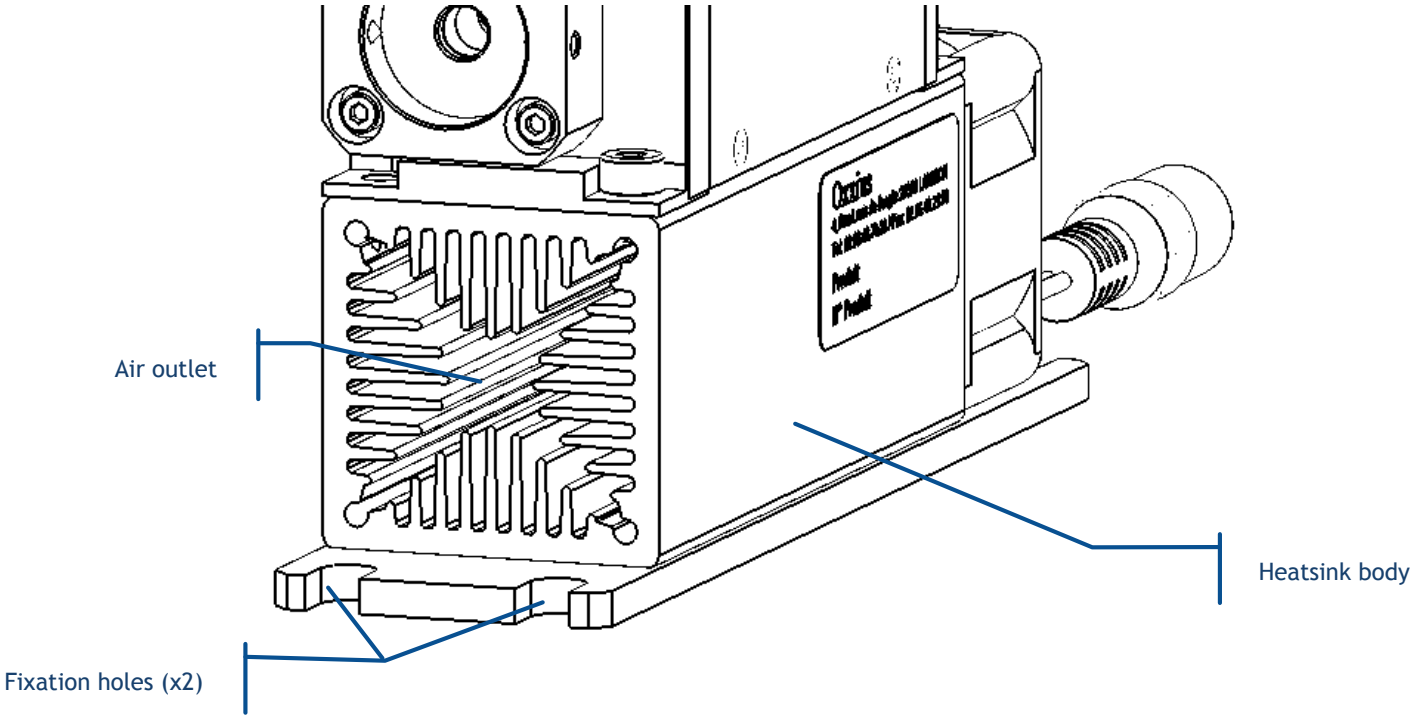
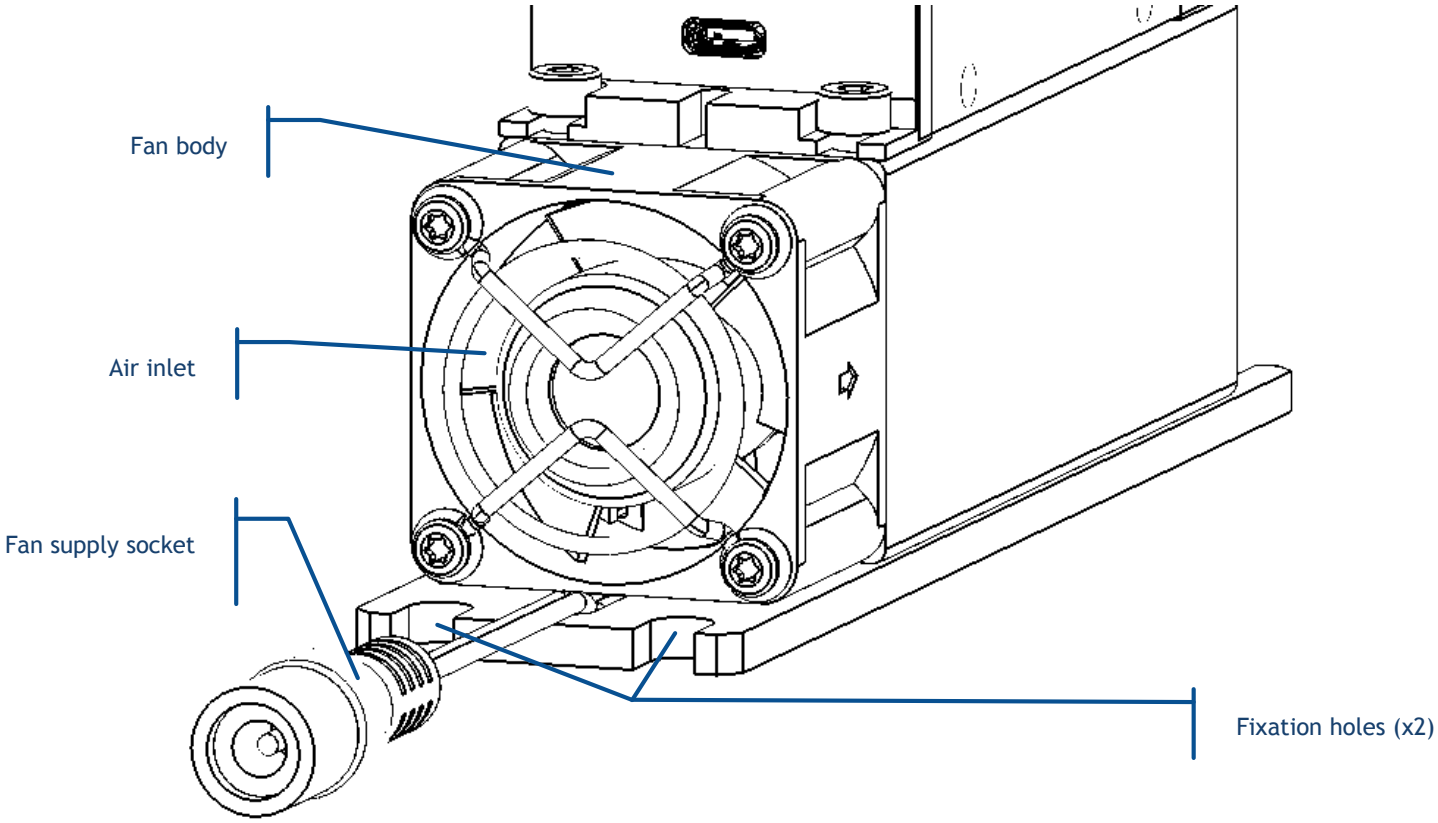


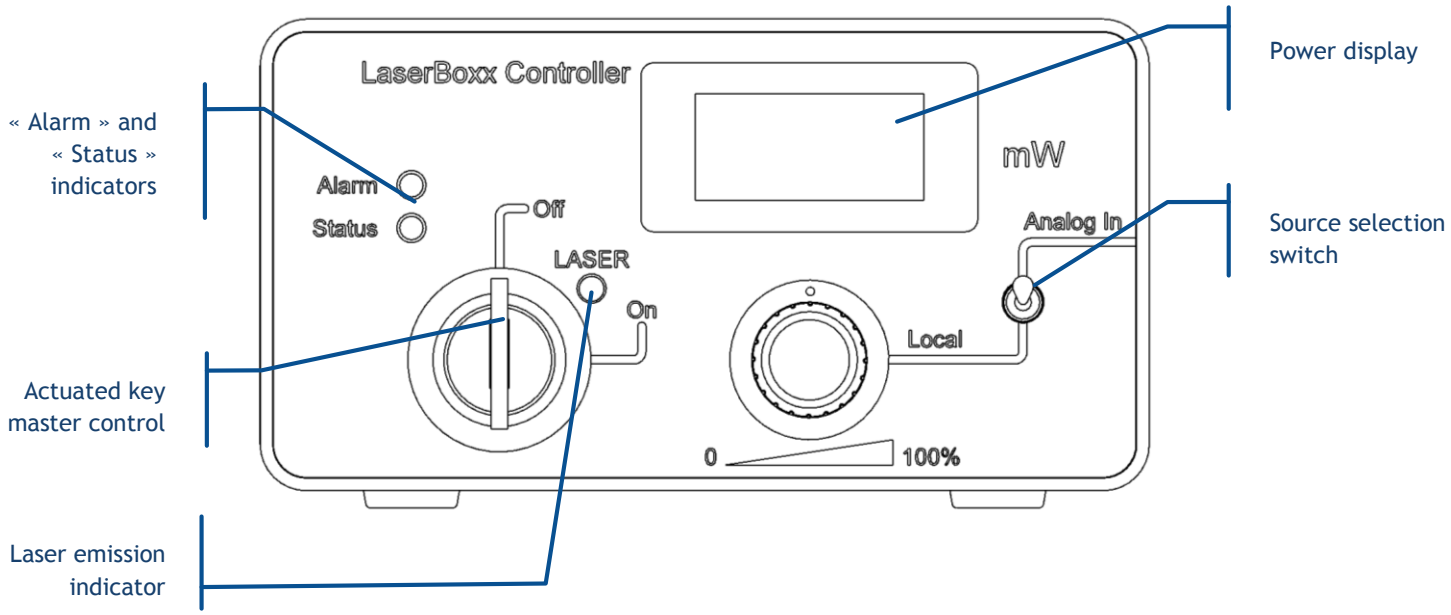
Figure 2-5: Rear view of the heatsink



CONTROLBOXX CONTROLLER (FOR MODELS WITH ADJUSTABLE POWER)

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

Figure 2-6: Front panel of the ControlBoxx



The following elements are accessible to the user:

- **Actuated key master control:** A class 3B or class 4 laser system must incorporate a key-operated control. The key is removable and laser radiation is not accessible when the key is removed. When the unit is ready, turning the key on will start the laser emission.

- **Laser emission indicator:** This indicator is a LED which lights in solid white when the key control is switched on, indicating that the emission is enabled. It is located on the front panel of the ControlBoxx so that it can be seen without requiring the user to face the laser radiation (the white color being used so that 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 that the device is turned on.

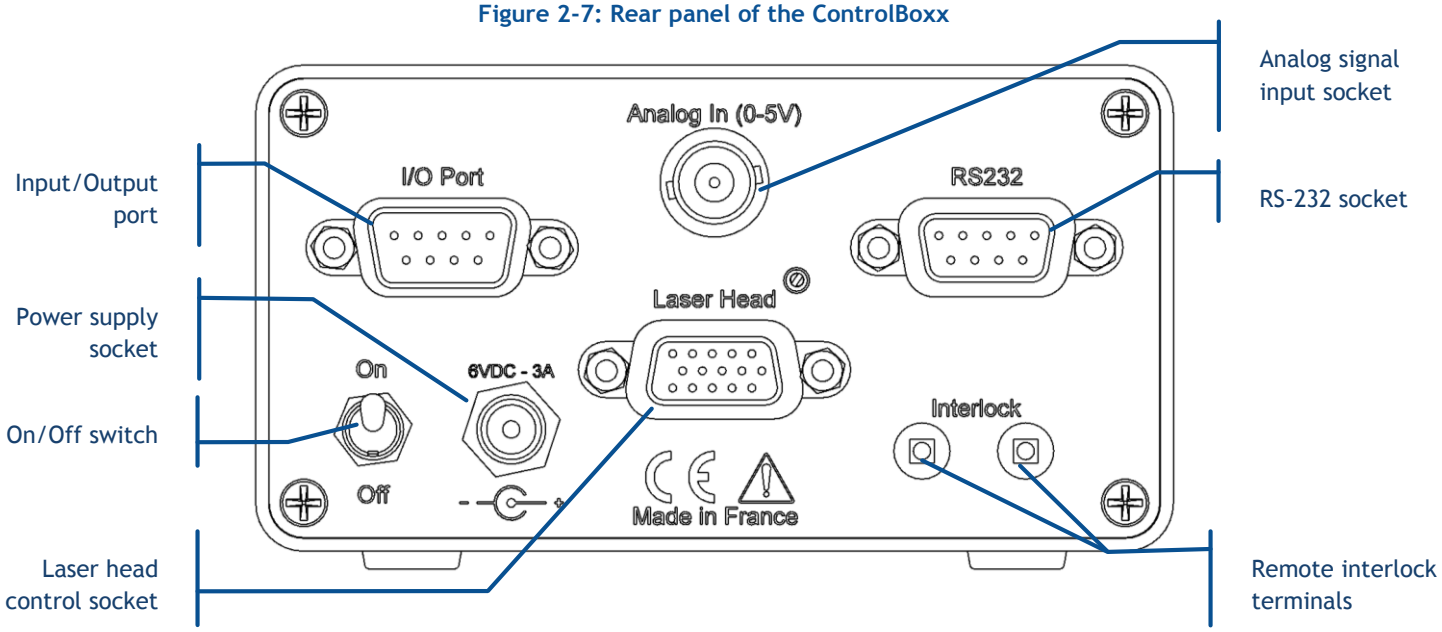
- **“Alarm” Indicator:** This indicator is a red LED indicating a warning or an alarm on the device.

- **Source selection switch (model dependent):** This switch allows the user to select the source used to set the optical power:

    - The “Local” position activates the front panel potentiometer and allows the user to tune the optical power using the front knob,
    - The “Analog In” position disables the front panel potentiometer and allows the control of the set point applying a voltage on the BNC socket located on the rear panel.

- **Power display:** This panel displays the instantaneous output power (expressed in milliwatts). The accuracy of this monitoring is better than 5%.

Figure 2-7: Rear panel of the ControlBoxx



- **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 fast modulation. This voltage can modulate either the optical power (in APC mode) or the diode current (in ACC mode). Refer to section 4, “Advanced operation” for detailed information, and to the product specifications concerning the modulation characteristics.

- **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 can be used to establish a RS-232 communications. Note that no linking cable is provided with the LaserBoxx.

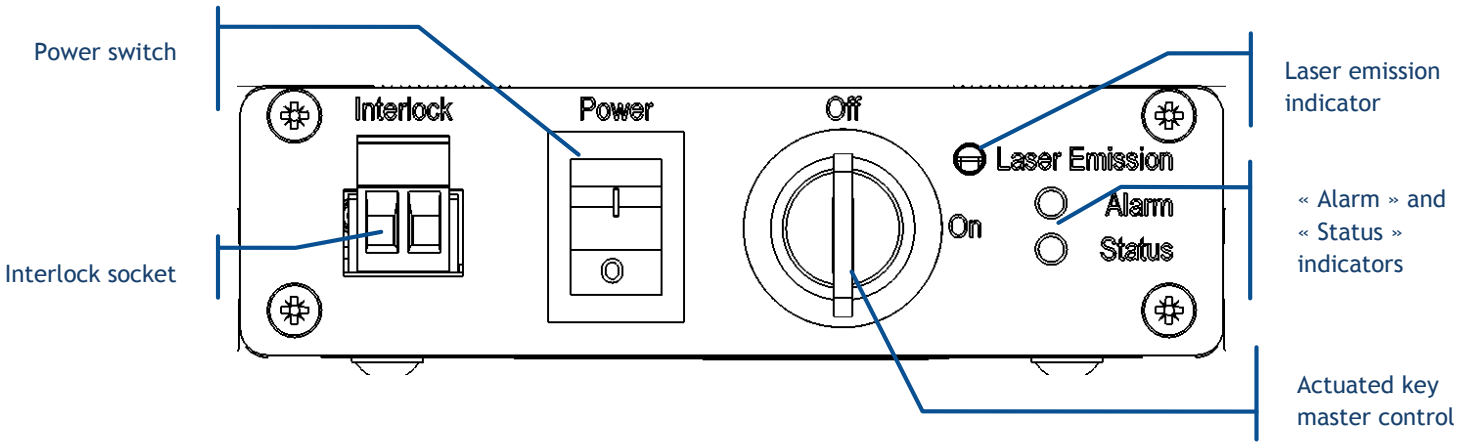
- **Laser head control socket (DE-15 HD Female):** This socket is supplying the laser head with power and signals. It must be connected to the controller using the dedicated cable (delivered with the LaserBoxx).

- **Power supply socket (2.1mm coaxial):** Input for power supply (delivered with the LaserBoxx) and ControlBoxx On/Off switch.

REMOTEBOXX CONTROLLER (FOR FIXED POWER MODELS)

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

Figure 2-8: Front panel of the RemoteBoxx controller



- **Actuated key master control:** A class 3B or class 4 laser system must incorporate a key-operated control. The key is removable and laser radiation is not accessible when the key is removed. When the unit is ready, turning the key on will start the laser emission.

- **Laser emission indicator:** This indicator is a LED which lights in solid white when the key control is switched on, indicating that the emission is enabled. It is located on the front panel of the RemoteBoxx so that it can be seen without requiring the user to face the laser radiation (the white color being used so that 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.

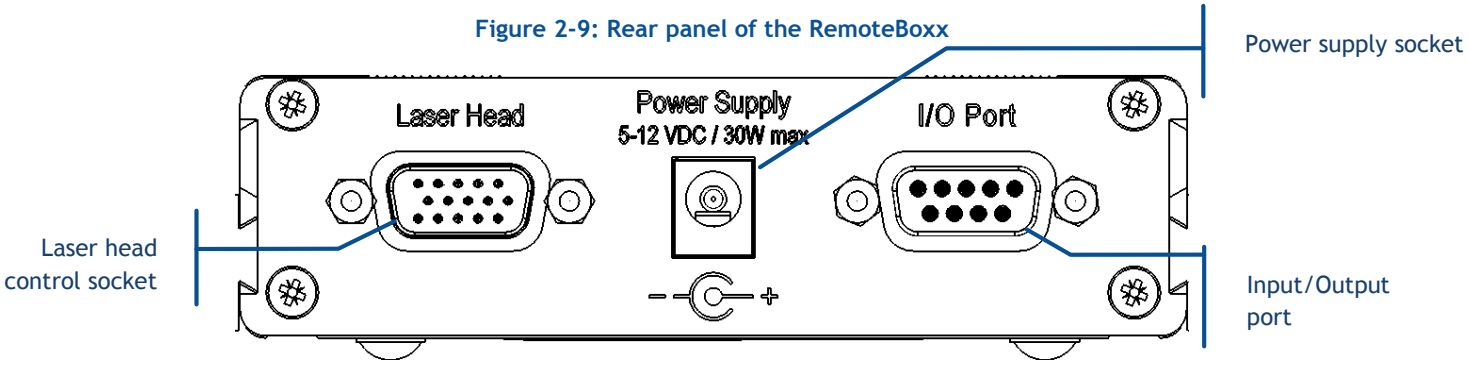
  The two aforementioned elements are required by laser safety standards in order to protect the user from an inadvertent exposure.

- **"Status" Indicator:** This indicator is a green LED indicating the status of the laser emission:
  - Blinking green: the laser emission is on and is being stabilized.
  - 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 2-9: Rear panel of the RemoteBoxx



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

    Refer to section 5, “Technical reference”, for the pin assignment. Note that this interface is specific; **standard RS-232 linking cables** 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 cable (delivered with the LaserBoxx).

- **Power supply socket (2.1mm coaxial):** Input for power supply (delivered with the LaserBoxx).

2-5 Installing the laser head

Warning

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

- No user adjustment is possible inside the laser. Never open the laser module. Any attempt to open the laser module will damage it and void the warranty.
- Disconnecting the device from its electrical supply can be achieved either by toggling the power switch off, or by disconnecting the DB-15 connector from its socket.

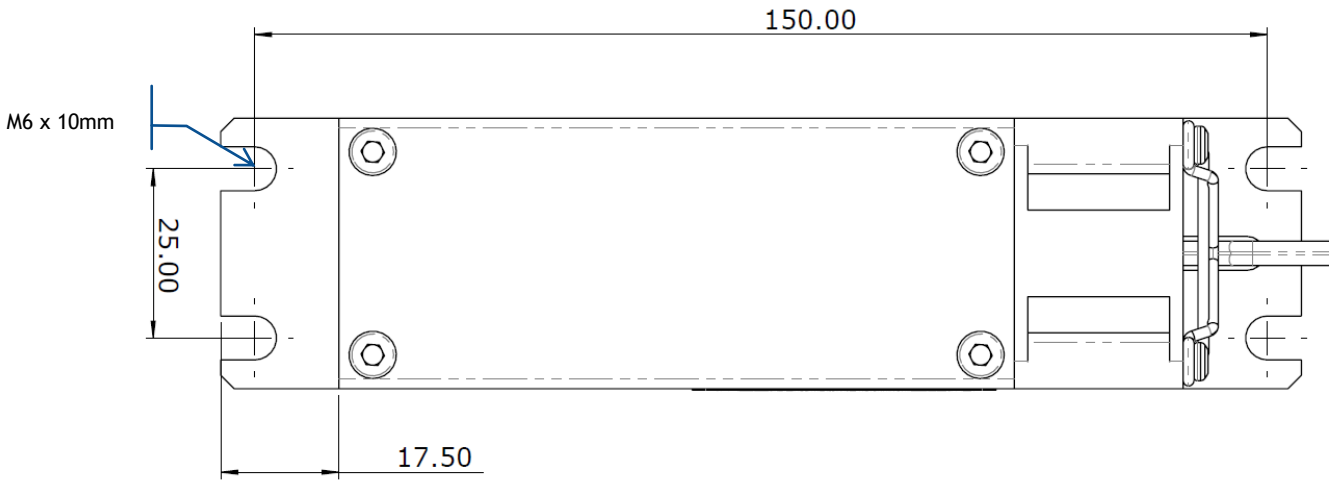
MECHANICAL INTERFACING

The laser head should to be fixed to a metallic base which flatness is better than 0.05 mm. This requirement ensures that no excessive constraint is applied to the laser head. Standard machining of opto-mechanical components will typically meet this requirement. A particular caution is required with extruded heat sinks which could exhibit an insufficient flatness.

A drawing of the supporting plate is presented in figure 2-10 below.

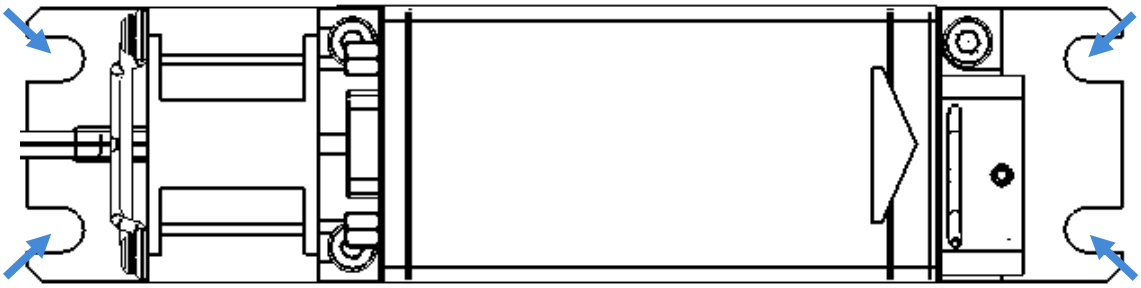
Figure 2-10: Mechanical specifications of the plate supporting the laser head

Units: millimeters



The heatsink is fixed using four M6 x 10mm screws. These bolts should be tightened with a torque of 1.3 Nm. Refer to figure 2-11 below.

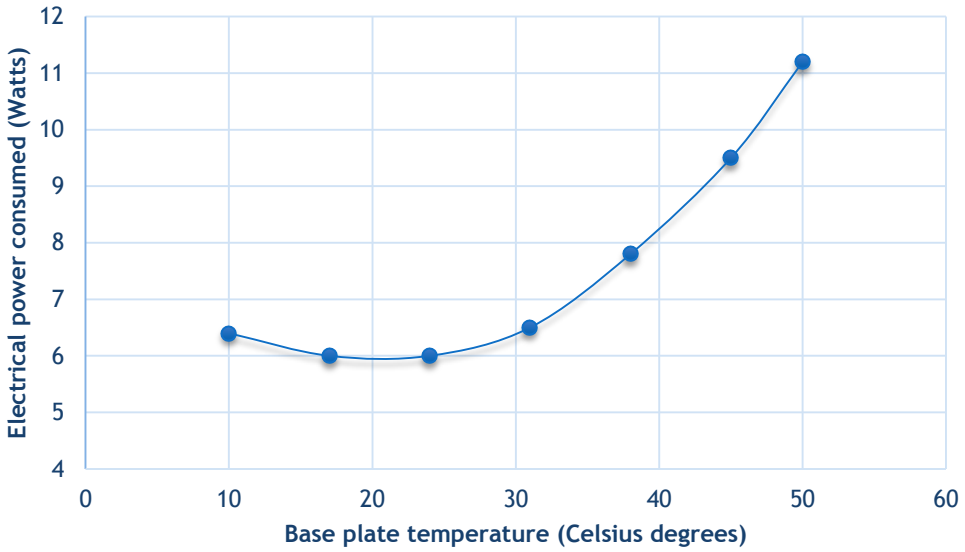
Figure 2-11: Positioning of the screws for the "Plug and Play" version of the LCX LaserBoxx



THERMAL MANAGEMENT

The laser source generates some heat while in operation. The amount of heat released is sharply increasing as the temperature of the module's baseplate is itself increasing. As an illustration, here is the typical electrical power consumed by a LCX against the temperature of its base plate:

Figure 2-12: Typical power consumption of a LCX module (532nm, 500mW output, laser head only)



Noticeable features of this characteristic are:

- The maximum consumed power is reached as the base plate is at its hottest,
- The minimum consumed power is reached in a zone typically between 15°C and 25°C

For those reasons, the supporting medium must ensure a proper dissipation of the generated heat. This is the purpose of the heatsink provided with each Plug and Play LCX.

A free space of 10 centimeters should be maintained in front of both air vents of the heat sink to let the air flow.

ELECTRICAL CONNECTIONS

Procedure:

- Connect the DE-15 cable to the socket located on the rear panel of the controller. Connect the opposite side of the cable to the rear panel of the optical head. Secure both connectors using the locking screws.

- Connect your interlock safety circuit to the “Interlock” pins on the rear panel of the controller. If you are not using any interlock circuit, use the interlock wire (provided) to short-circuit these pins.

- Plug the 2.1mm power supply connector into the rear panel of the controller

Characteristics of the power supply:

The power supply provided with each “Plug and Play” LaserBoxx has the following characteristics:

- Output voltage (direct current): 9 Volts
- Power rating: 40 Watts

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

Input:

- Voltage: 100/240 VAC
- Frequency: 50/60 Hz
- Protective ground

Output:

- Voltage (direct current):
  - Absolute ratings : 4.5V minimum, 12.5V maximum
  - Specifications: Any voltage between 5V and 12.0V
- Power: 30 W minimum
- 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 supply provided with each “Plug and Play” model meets these requirements.

Warning

For electrical safety, Oxxius 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.

COMMUNICATION

Communication with the LaserBoxx can be achieved by connecting a computer (or other similar device) to either a ControlBoxx, a RemoteBoxx or to the LaserBoxx directly.

a) RS-232 connectivity using the ControlBoxx

The connection can be achieved using a commercial **straight** cable terminated by DE-9 connectors (male/female).

Figure 2-13: A commercial RS-232 cable

Alternatively, this cable can be build according to the schematics of figure 2-14 and table 2-15. The interface requires pins number 2, 3 and 5 to be connected:

Figure 2-14: Wiring schematics between a computer and the laser head

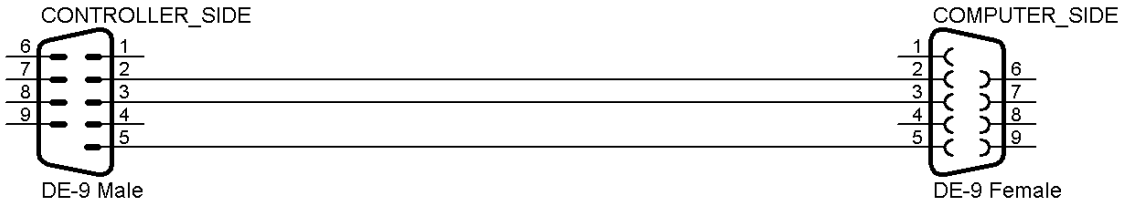


Table 2-15: Pin assignment of the RS-232 cable of figure 2-8

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

b) RS-232 connectivity using the RemoteBoxx

The connection can be achieved using a meeting the description of figure 2-16 and table 2-17.

Figure 2-16: Wiring schematics between a computer and the laser head

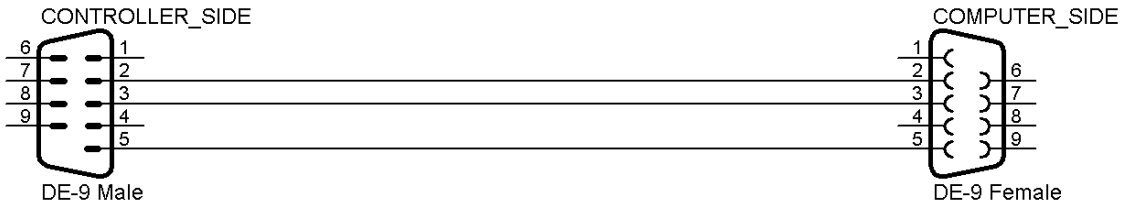


Table 2-17: Pin assignment of the RS-232 cable of figure 2-10

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

Warning

The “I/O” port of the RemoteBoxx **should not** be connected to a computer using a commercial RS-232 cable (null modem or straight cable).

This interface requires a dedicated wiring as stated below. Using a commercial cable might lead to damage on either the computer or the laser.

c) USB interface

It is possible to control the LaserBoxx remotely using a USB interface. The USB socket is located on the rear 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 2-18: USB A to micro B connection cable

SECTION 3: OPERATION

The laser module is assumed to be correctly installed and connected. Refer to the previous section, “Starting up”, if necessary.

3-1 Turning the power on

- Connect the power supply feeding the controller to your mains socket, and connect the power supply of the heatsink 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. At the same time, RS-232 and USB communication ports will be accessible.
  If the controller is a ControlBoxx, the optical power will be displayed.

- Turn the actuated key master control clockwise until the end stop. The laser emission indicator will light up in solid white, warning about the potential emission. At the same time, the status indicator will blink and the start-up sequence will begin; this may take up to 10 minutes for LCX models.

- Once the status indicator has turned in solid green, open the shutter to release the laser beam.

3-2 Power tuning (“PPA” option)

As an optional feature, the LCX supports power tuning. This consists in adjusting the optical power according to the set point entered by the user.

3-2-1 STANDARD POWER TUNING ON LCX LASERBOXX

This function allows the user to adjust the output power within a given range. The laser is designed so that this adjustment occurs continuously, without mode hop.

The standard adjustment range is 30% to 100% of the nominal power, however other ranges can be achieved on specific configurations.

Here are the different methods to modify the output power:

MANUAL TUNING FROM THE CONTROLBOXX (IF IN USE)

Turning the knob on the front panel of the ControlBoxx will modify the power set point. First make sure that the source selection switch on the front panel to the position “Local”.

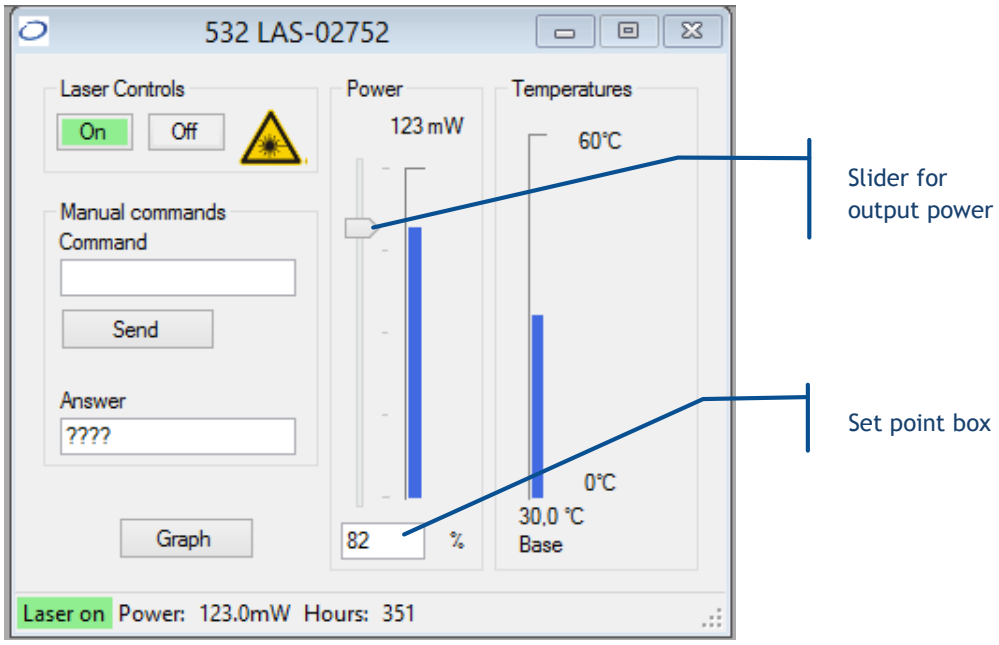
This adjustment has the following characteristics:

- The power set point increases as the knob is turned clockwise,
- Each turn represents about 10% of the nominal power,
- Considering that the minimum adjustment value is 30% (on standard configurations), the first three turns starting from the lower position will result in a set point of 30%

POWER SET POINT ENTERED FROM THE GRAPHIC USER INTERFACE

It is possible to enter a new power set point in the command panel of the control software (control box or slide bar, see the figure 3-1 below). Refer to section 4, “Advanced operations”, for a detailed description of the control software.

Figure 3-1: Entering a power set point using the command software



SOFTWARE COMMANDS

Changing the power set point is also possible by sending an appropriate command through one of the communication ports (USB or RS-232). Refer to Annex B, “Software commands” for their detailed description.
Alternatively, this command can be entered on the console of the control software (see figure 3-1 above).

EXTERNAL ANALOG TUNING USING THE CONTROLBOXX

The power set point can be defined by applying an analogue voltage (from 0V to +5V) to the “Analog In” port of the ControlBoxx. It is first necessary to set the source selection switch of the front panel to the position “Analog In”.

Considering that the minimum adjustment value is 30% (on standard configurations), the range from 0V to 1.5V will result in a set point of 30%.

Refer to the chapter “Interfacing with the ControlBoxx” in Section 4 for a detailed description of this interface.

EXTERNAL ANALOG TUNING USING THE REMOTEBOXX (IF IN USE)

Similarly, the power set point can be defined by applying an analogue voltage (from 0V to +5V) to the "Input/Output" port of the RemoteBoxx.

Considering that the minimum adjustment value is 30% (on standard configurations), the range from 0V to 1.5V will result in a set point of 30%.

Refer to the chapter "Interfacing with the RemoteBoxx" in Section 4 for a detailed description of this interface.

Specific behavior of the LCX LaserBoxx with power adjustment:

- It takes a few seconds (less than one minute) for the LCX to stabilize to a new power set-point.

- When the emission is starting-up, the laser first settles to its nominal power level (100%), then reaches the specific set-point previously set.

3-2-2 "ALIGNMENT MODE" LOW POWER BEAM

Some specific task or application might require to release the output beam at a low power level (typically for aligning optical elements). The LCX meets this requirement. In this case, the output's characteristics are as follows:

- optical power between 1% and 2% of the nominal level,

- optical noise, power stability and static beam pointing are not guaranteed as per the standard specifications

To turn on this mode of emission, proceed as follows:

- Prepare the unit for emission as described on the preceding paragraph "Turning the power on",

- Instead of turning the emission on (using either the key, a software command or the "Enable" signal), send the software command "DL 2" to the LCX.

Warning

- Despite its relatively low level, the optical power released generally exceeds the level of an “eye-safe” (class 1) laser source. Appropriate laser safety measures should therefore be enforced without mitigation.

- Once the command has been sent, and the 5-second safetey delay ellapsed, the emission occurs much faster than for the standard emission mode (typically within one second).

In order to return to the standard mode of emission, proceed as follows:

- Send the command “DL 1”, or

- Apply a TTL “low”, then a “high” signal on the “emission key”

3-3 Turning the power off

First close the shutter to secure your set-up.

You can to turn the emission off using any of these methods:

- Turn the actuated key master control counter-clockwise.

- Send the software command “DL 0” through one of the communication ports (USB or RS-232). Refer to Annex B, “Software commands” for a detailed description.

- Open the interlock circuit. This will also lock the laser and prevent any emission (see “resuming the emission” below).

Resuming the emission

In the event where an alarm is raised or if the interlock circuit is opened, the emission is then interrupted in a manner that is considered to be “uncommon”, and the unit is locked.

The resume sequence is as follows:

1. On class 4 laser units only: it is first necessary to first turn the actuated key master control off (counter-clockwise) then on. On class 3b lasers sources, leaving the key on is enough.

2. Any of the following actions will resume the emission:
    - Using RS-232 or USB communication port, send the command “DL 0”. The emission can now be resumed using the command “DL 1”
    - Using the software interface, re-activate the laser using the button ‘Reset’

SECTION 4: ADVANCED OPERATIONS

This section describes how to use the control software, how to control the LaserBoxx through the electrical interface, and how to adjust the coupling of the laser in an optical fiber.

4-1 Using Oxxius software to operate the LaserBoxx

It is possible to control the LaserBoxx remotely using a computer, using either a serial port (RS-232 protocol) or a USB port (USB protocol or serial communication through virtualization).

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

COMPUTER REQUIREMENTS

Oxxius software is compatible with the following operating systems:

- Windows XP SP2 (32-bit version),
- Windows Vista (32-bit and 64-bit versions),
- Windows 7 (32-bit and 64-bit versions),
- Windows 8 (32-bit and 64-bit versions),
- Windows 10

Microsoft .NET 3.5 framework is required. If it is not installed, you will be asked to download and install it.

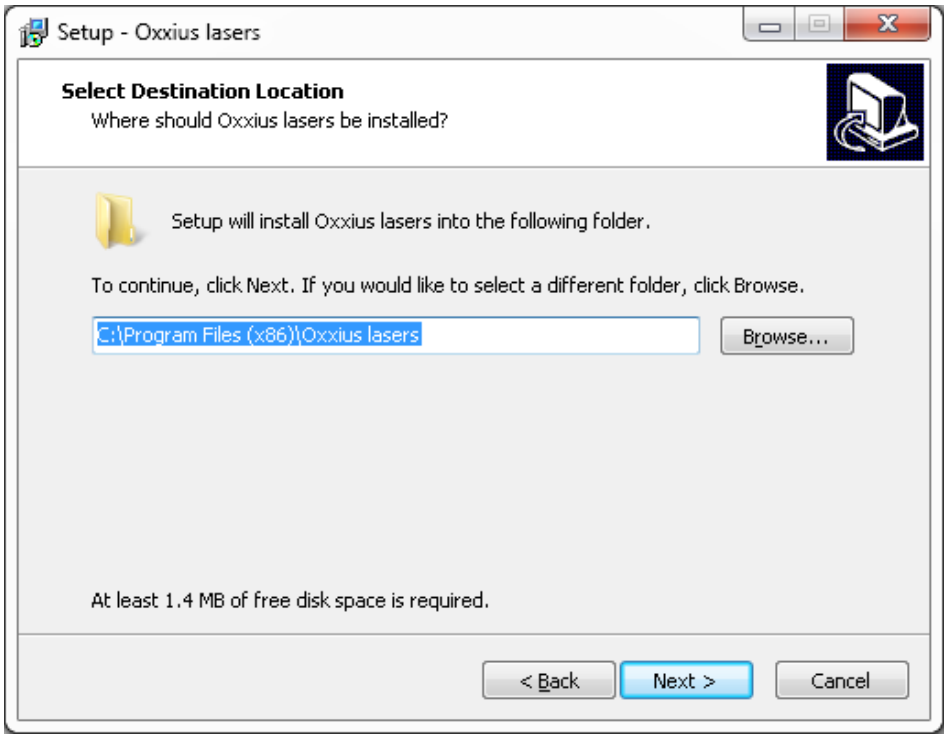
INSTALLING THE SOFTWARE SUITE

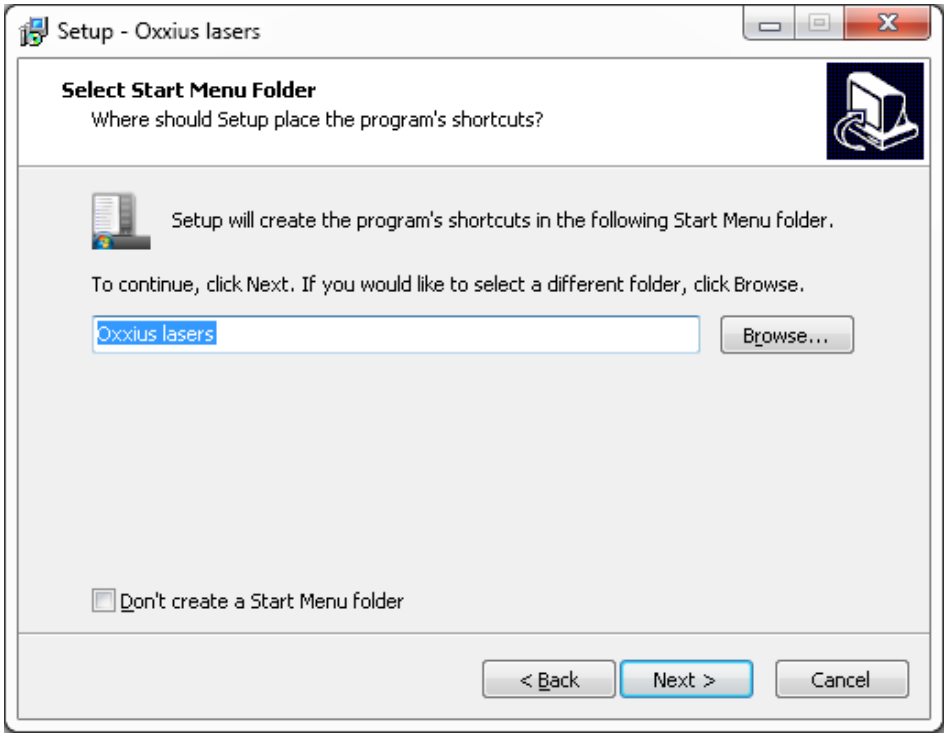
Oxxius control software is installed by running the setup.exe file located on the USB flash drive provided with the laser.

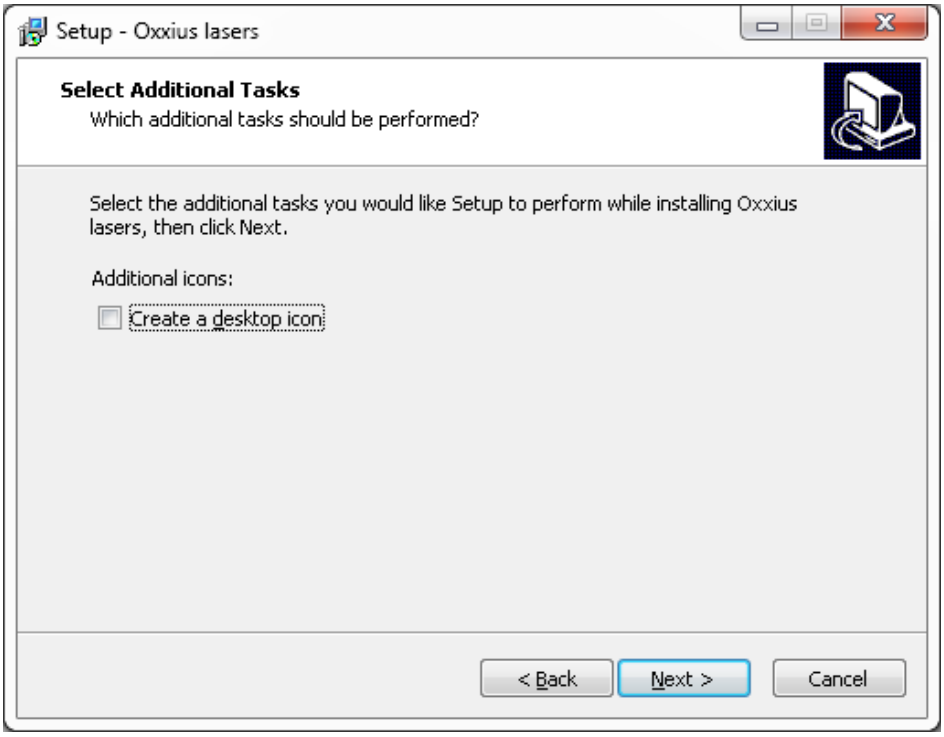
Alternatively, you can download the latest version of our control software from the following URL:

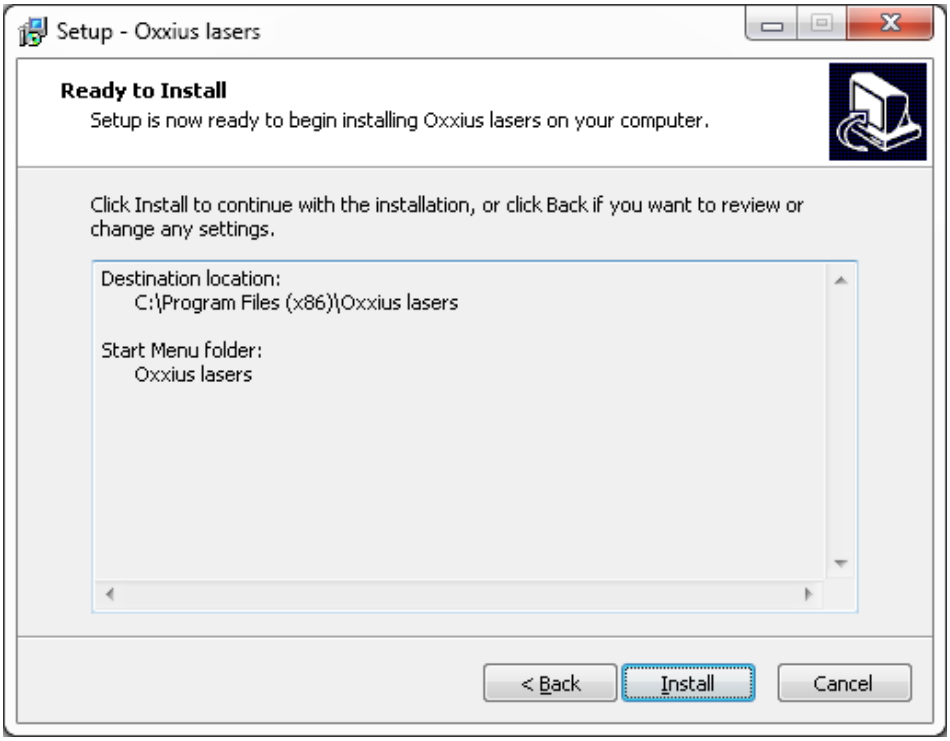
www.oxxius.com/download/f09512dd.exe

- Executing the file “setup.exe” prompts a standard installation wizard:

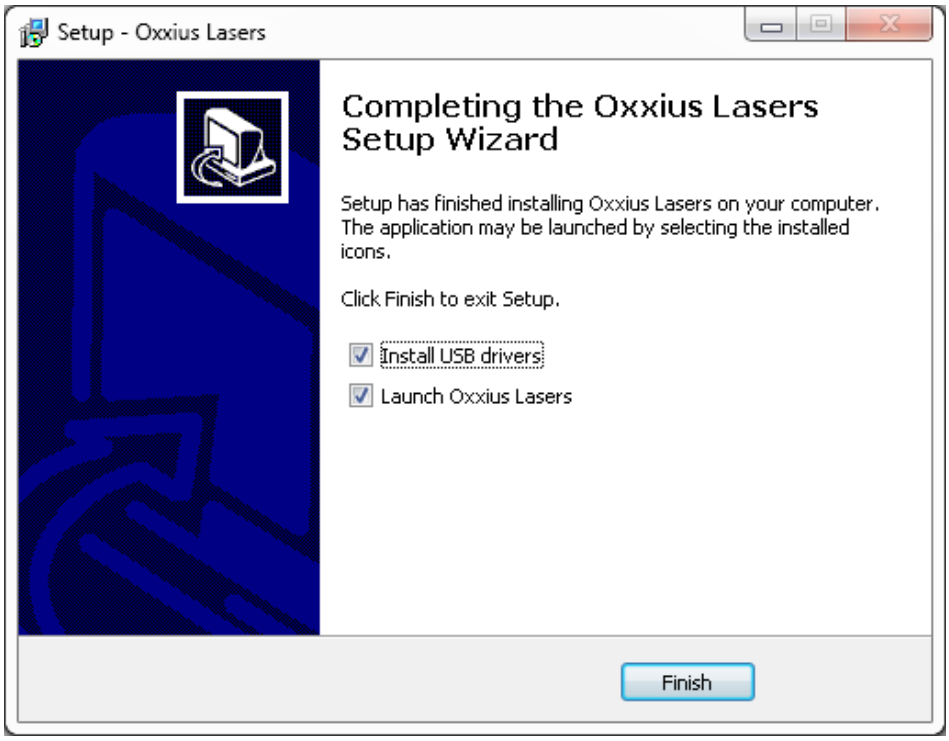





Setup - Oxxius lasers
Select Additional Tasks
Which additional tasks should be performed?
Select the additional tasks you would like Setup to perform while installing Oxxius lasers, then click Next.
Additional icons:
Create a desktop icon
< Back
Next >
Cancel


Setup - Oxxius lasers
Ready to Install
Setup is now ready to begin installing Oxxius lasers on your computer.
Click Install to continue with the installation, or click Back if you want to review or change any settings.
Destination location:
C:\Program Files (x86)\Oxxius lasers
Start Menu folder:
Oxxius lasers
< Back
Install
Cancel

- The last step of the installation suggests to install the USB drivers (see the screenshot below). Oxxius recommends that you do so.

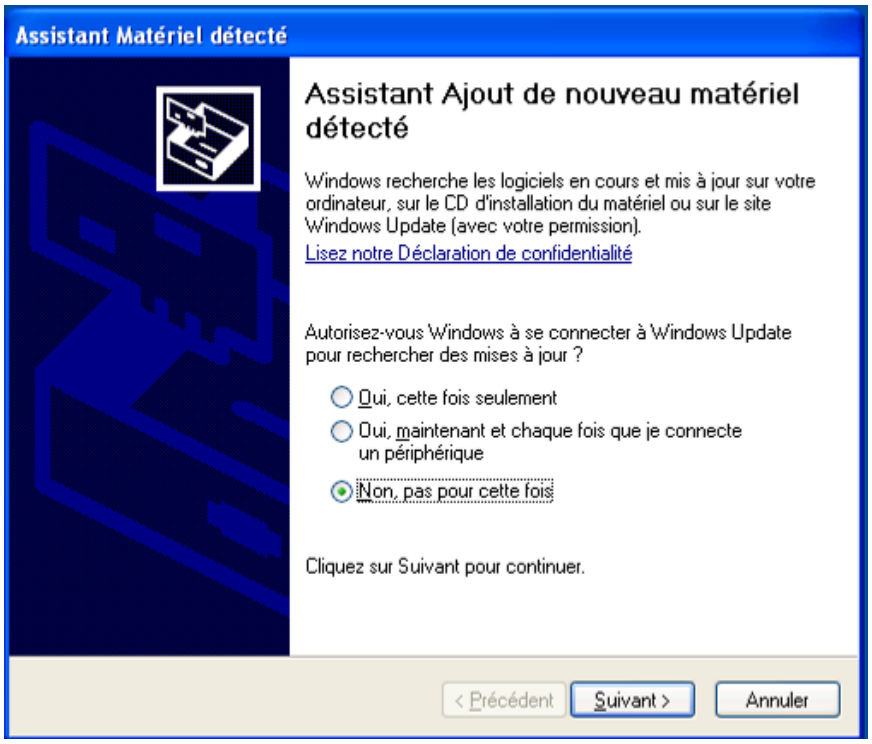


- Depending on the operating system of the computer, it might be necessary to restart the computer. With 64-bit OS, a warning will appear.
- Press “Finish” to close the wizard and complete the installation.

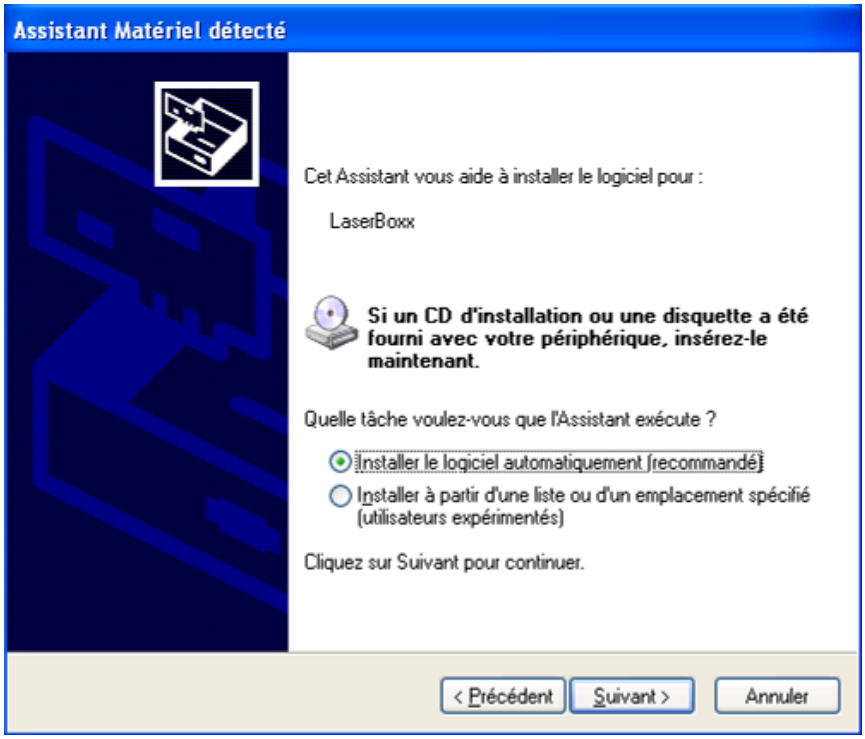
Device installation over a USB port

Using the USB interface of a LaserBoxx unit will first require that this former is detected by the operating system.

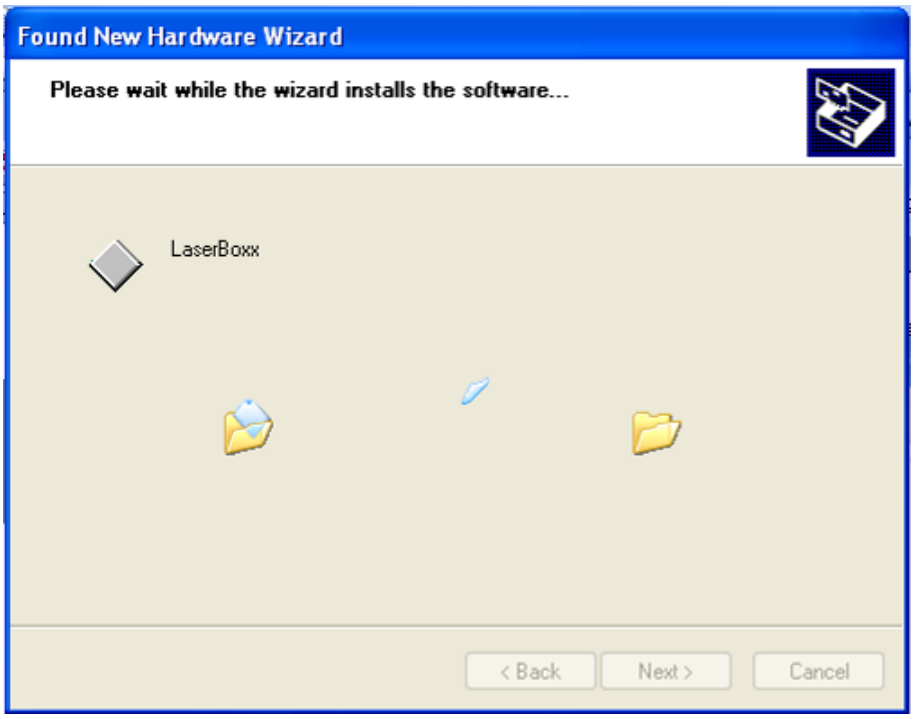
- Connect the USB cable between both the LaserBoxx head and your computer,
- Turn on the supply voltage of the laser,
- Depending on the operating system, the installation is either automatic or requires some confirmations
- If prompted, do not authorize Windows to connect to Windows Update (as in the screenshot bellow),



- Force your operating system to install the software automatically,



- Eventually, Windows will be copying the driver files onto your computer

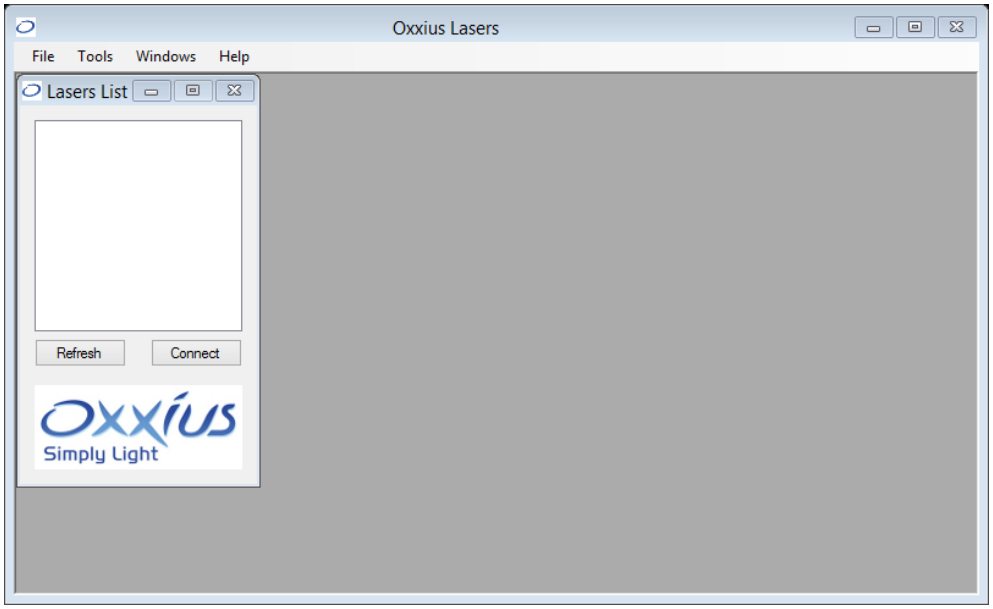


- The installation process is finished when the following message appears :

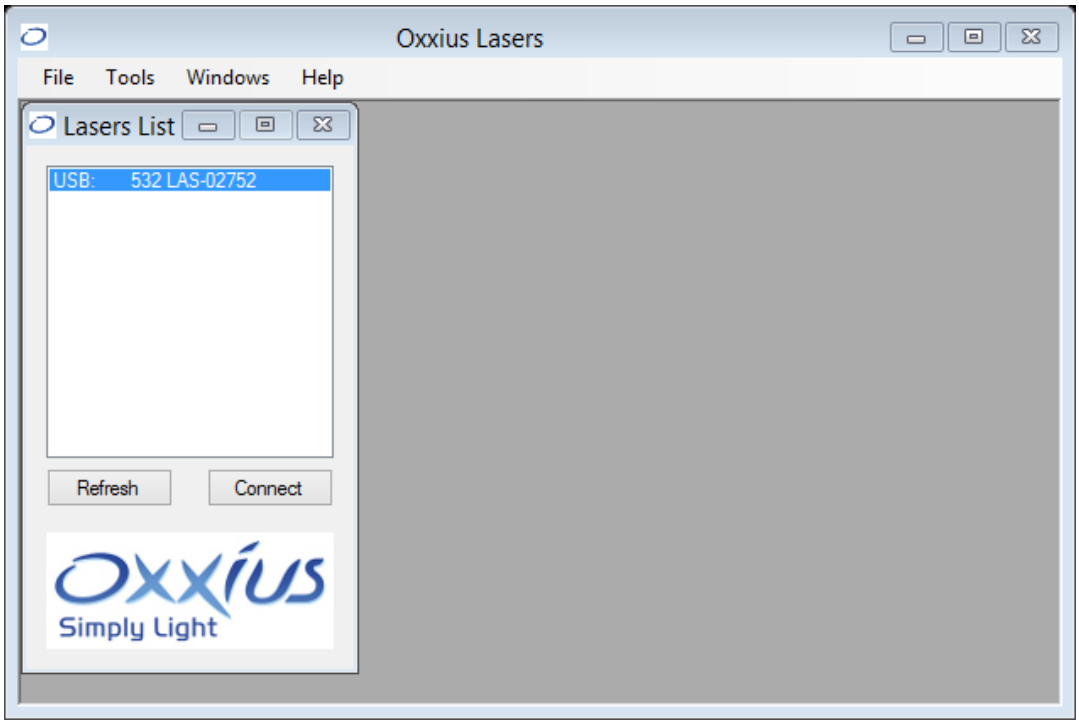
You are now ready to use the USB port of your LaserBoxx. Depending on the operating system, you might have to repeat these steps with each single LaserBoxx unit you intend to use.

DESCRIPTION OF THE INTERFACE PANEL

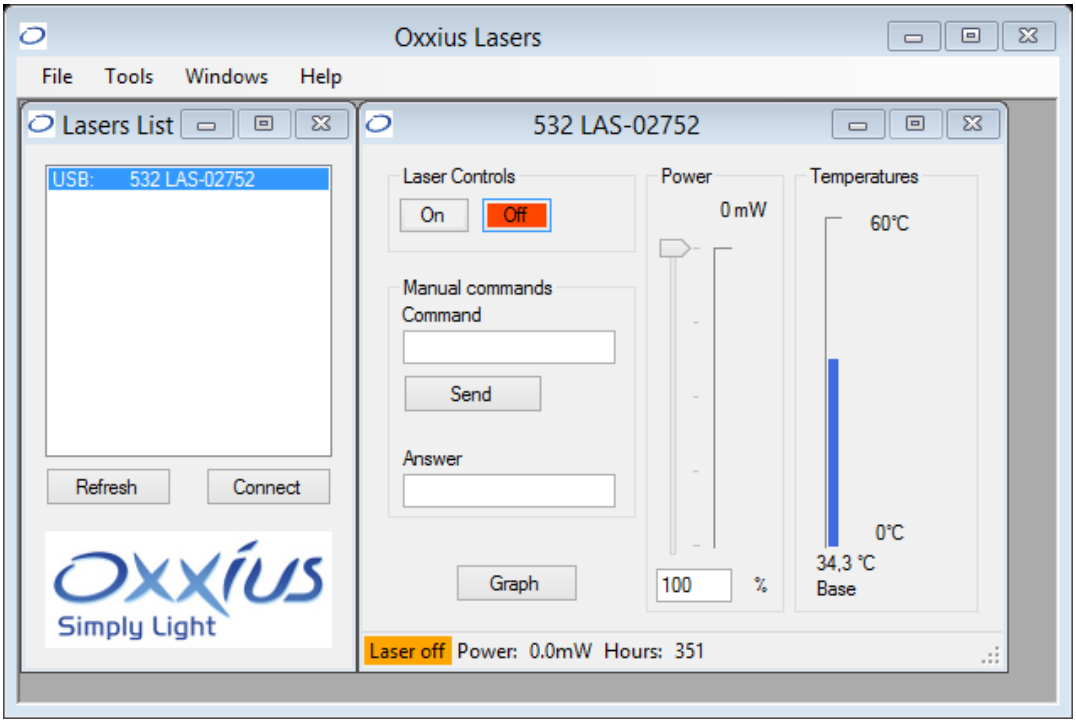
Once executed, the software lists the LaserBoxx units connected to the computer. If no laser is detected, the screen appears blank as following:

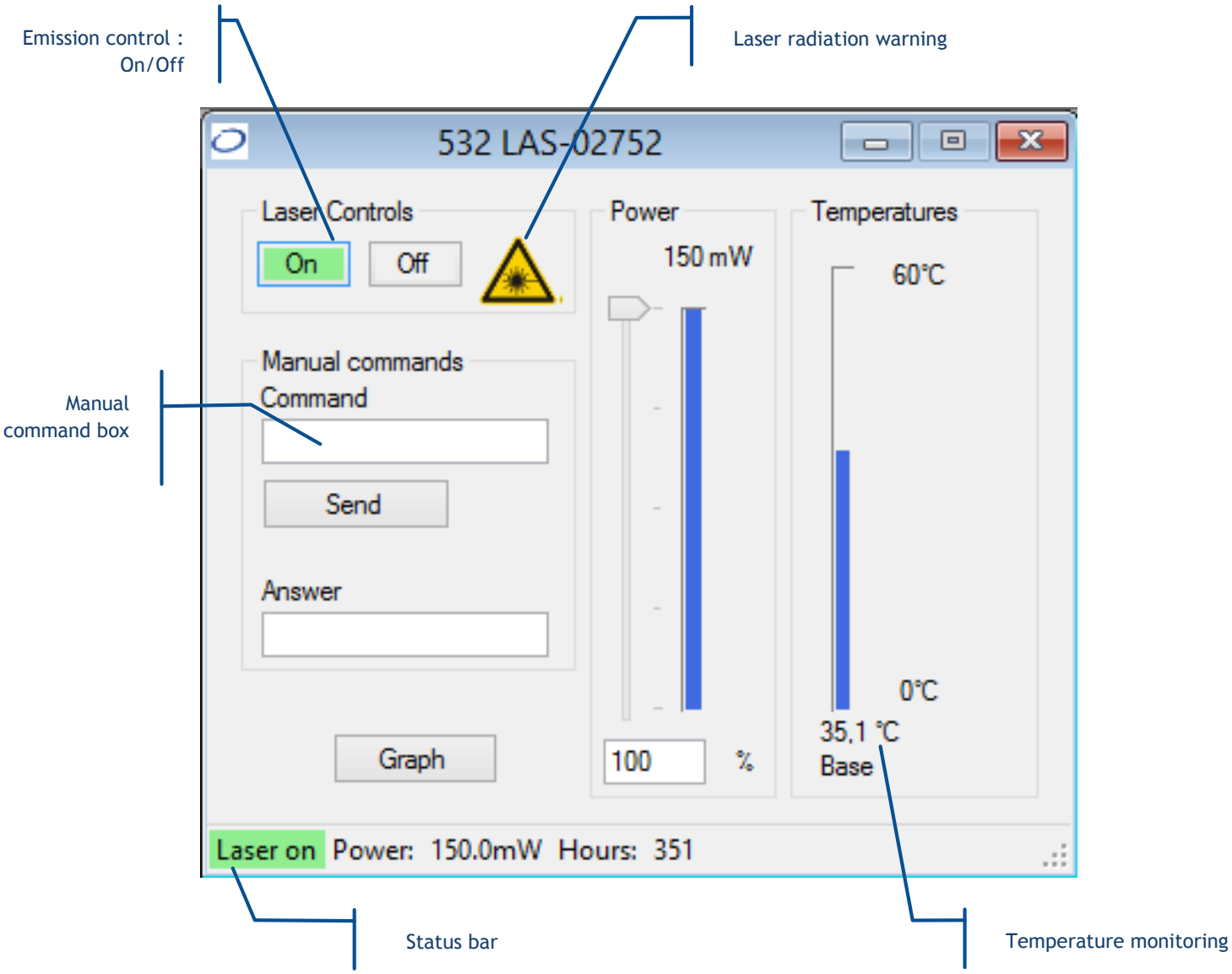


As a LaserBoxx is connected to a USB port it appears automatically on the laser list. For RS-232 connections, however, it is necessary to click on the “Refresh” button. Each laser is identified on the list by its communication port, model, emission wavelength and serial number.



Select one laser on the list and click the “Connect” button. Alternatively, double-clicking on the line will also open the control panel.





The control panel consists of the following elements:

- Buttons to control the laser emission,
- A picture to indicate the emission (laser radiation warning),
- Boxes to send and receive software commands,
- Indicators displaying the measured output power and the temperature of the base plate,
- A box and a slider to modify the output power
- A status bar to indicate the laser status, the output power, and the total hours of emission

To start the emission, click on the “On” button. The output can be adjusted (on specific models) using the slider or entering a set-point into the box.

The status of the laser 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 a priority scheme has been enforced to avoid conflicts:

- On start-up, the unit reacts to the actuated key master control or the “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

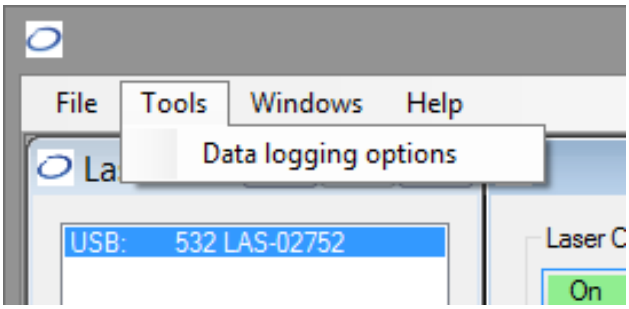
Communication with the laser source is performed by transmitting queries and commands. Any query or commands can be entered manually using the command box. Please refer to the Annex B, “software commands” for the list of these commands. Type your query inside the box, then press “Enter” or press the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

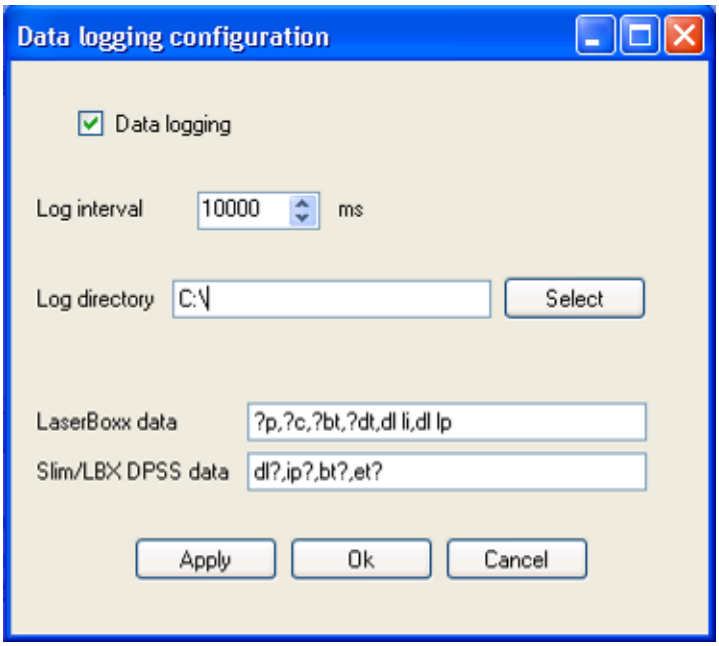
DATA LOGGING

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

To do so, it is first necessary to configure this function: first click on the “Tools” menu and select “Data logging options.”



This will open a separate configuration window.



From top to bottom, here are the elements present inside this window:

- 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”.
- 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.

This will create a file named `COM`**`XX`**`-LBX-`**`MM_DD_HHHH`**`_log` 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.

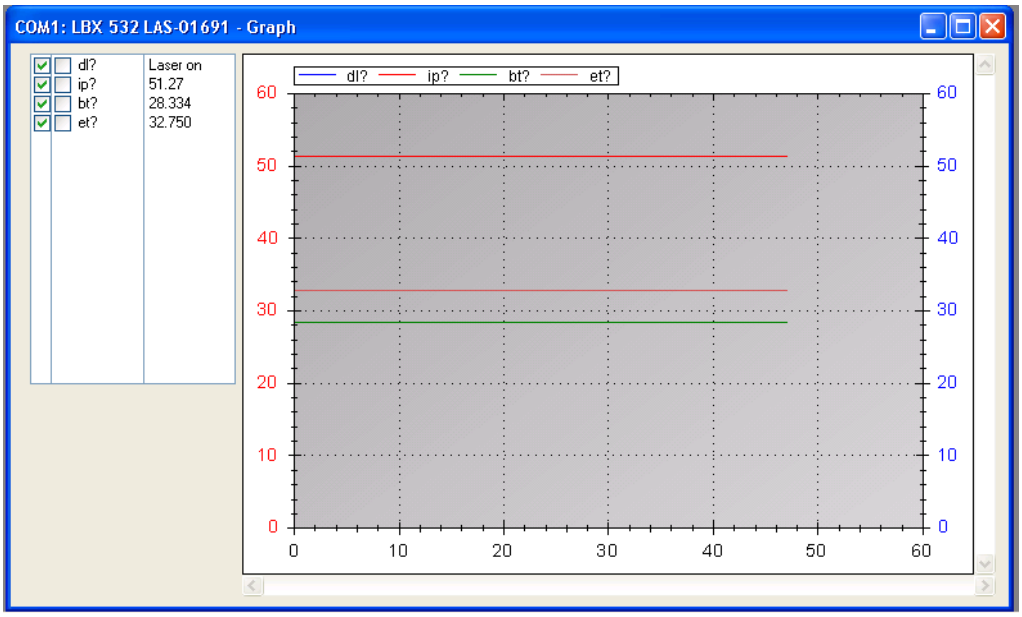
The syntax of this record is plain text, so that it can be opened by any text editor as in the following example:

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 visualize the logged parameters in real time using the “Graph” button in the command panel. This will open a separate window displaying 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.

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 4-1: communication parameters of the RS-232 communication

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

Table 4-2: syntax for queries and commands

Query	**Acknowledgement**
?QUERY<LF> or QUERY?<LF>	QUERY=TXT<CR><LF>
Command	**Acknowledgement**
COMMAND=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 Annex B, “software commands” for the exhaustive list of the commands and queries.

USB COMMUNICATION

On the Flash drive contains a library used to drive an Oxxius LaserBoxx with USB port. It can be used with either Visual C++, Visual C#, Visual Basic, Labview or any other languages supporting ".NET" libraries.

The file "LaserBoxxUsbHelp.chm" contains the corresponding documentation for this library.

You will also find a simple example program based on Labview version 8.6.

MICROMANAGER SUPPORT

The LaserBoxx modules are supported by µManager, the open-source microscopy software. For detailed information, please consult the homepage of the project: micro-manager.org .

4-2 Operating the laser using an electronic interface

LaserBoxx units can be driven using electronic signals, to facilitate the integration with other electronic devices.

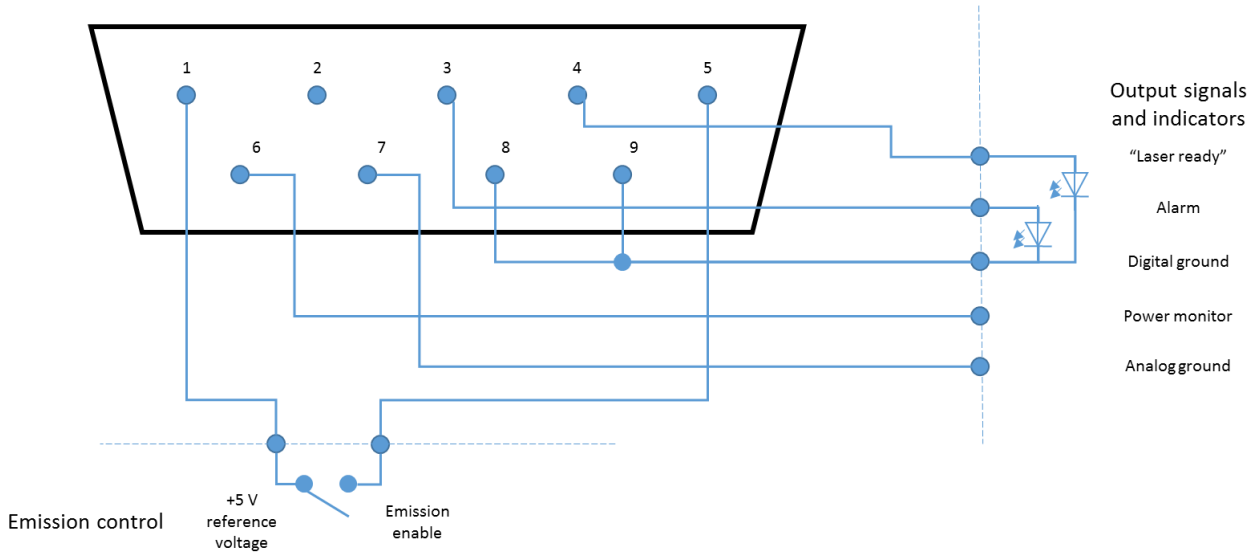
INTERFACING WITH THE CONTROLBOXX

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

Table 4-3: Pin assignment of the ControlBoxx 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.	Internally Pulled up: 3 kΩ
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 kΩ
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:



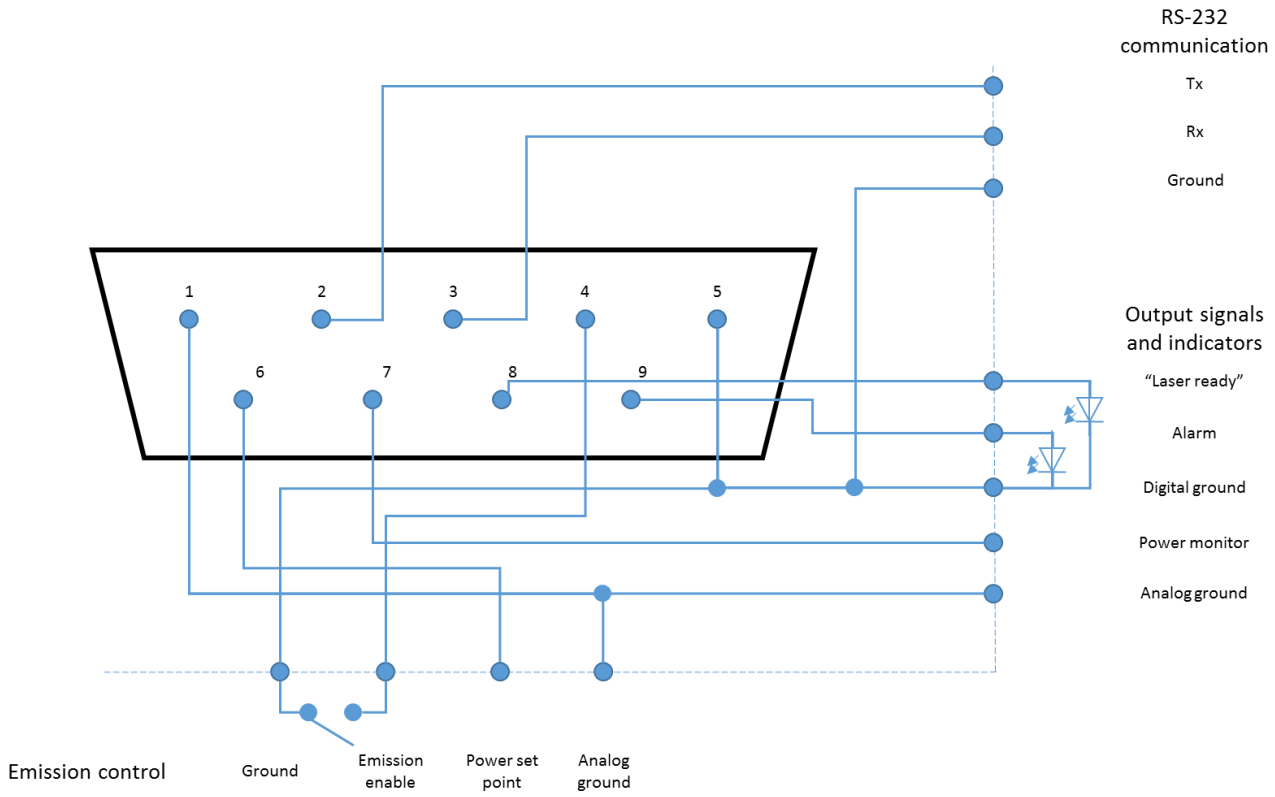
INTERFACING WITH THE REMOTEBOXX

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

Table 4-4: 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 kΩ
5	Digital ground	Ground	Digital ground for pin number 2 and 3	
6	Power adjustement channel	Input	The power set point is proportional to the input voltage. Refer to section 3, "Operation" for detailed information	2.5 kΩ
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 kΩ
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:



4-3 LaserBoxx with fiber-coupling

When a LaserBoxx is provided with a fiber coupling option, a laser beam coupler is attached to the optical head. Its function is to inject the laser beam into the core of the delivery fiber. The alignment between this optical fiber and the laser beam is performed and tested at Oxxius' manufacturing facilities. However optimizing the coupling ratio might be required afterwards.

The following sections 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.

More information is available on www.SuKHamburg.de

The high quality of these couplers guaranties a long-term stability.

HANDLING PRECAUTIONS AND INSTALLATION

Optical fibers are made of glass and are fragile pieces of equipment. They are used under the form of a patchcord which protects the fiber from the most common sources of degradation. A specific attention is required with these delivery patchcords which should not be bent nor receive mechanical damage (shear stress, punching, etc.) under any circumstances.

The user is required to handle the patchcords and their connectors with care, and also to have the necessary tools and knowledge to inspect and clean the end tip of the fiber.

These tools are:

- A specific microscope to inspect the end tip of the fiber. Oxxius recommends using a 200x magnification microscope, as the "F1VM200" available from www.fiberinstrumensales.com
- Some consumables to clean the optical connectors. Oxxius recommends using "type A" CLETOP tools available from NTT-AT.

Installation

The fiber coupler is delivered installed and aligned onto the laser head.

In order to fix the laser head, use the same procedure as described in chapter 2-5, "Installing the laserhead".

WARNING: The coupling efficiency can be altered if you fix the laser head on a plate with an insufficient flatness.

USING THE COUPLED FIBER

To prevent damaging the fiber, check the ferrule it before each use and clean it if necessary. Use a fiber connector cap to protect the end face of the fiber whenever it is not in use.

Turn on the LaserBoxx (See section 3, "Operation") and check your output power using an optical power-meter.

TROUBLESHOOTING

If your product do not reach the level measured at factory, please check the following points:

- **Fiber connector:**
  - Check the end face of the fiber using a dedicated microscope
  - Clean the connector using a connector cleaner (Warning: the laser emission must be absolutely be turned off during this operation)
  - If the connector is damaged, replace the patchcord or re-polish its end face.

- **Patchcord external aspect:**
  Check integrity of the patchcord (marks, small curvatures on the cable issue from transportation)

- **Mechanical mount:**
  - If the flatness of the base is insufficient, it will induce a mechanical tilt on the LaserBoxx and modify the coupling efficiency.
  - To check this, unscrew the three maintaining screws of the LaserBoxx and observe how the delivered power fluctuates. If the variations are important, the flatness of the mechanical mount needs to be improved.

- **Incident power:**
  - Check the incoming power on the coupler using the software provided by Oxxius.
  - If it is insufficient, adjust its value using one of the method described in section 3, "Operation".

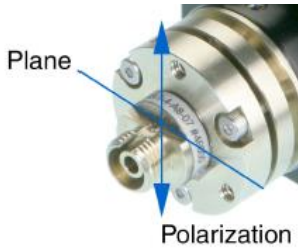
- **Measurement material:**
  - Check that your powermeter is set to the correct wavelength, or check its calibration.

If after all these checks, the delivered fiber is not high enough (in other words: if the coupling ratio is insufficient), it is then necessary to readjust the coupling, referring to the following procedure.

COUPLING PROCEDURE

This procedure in this section 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.

We recommend not to change the centration of the coupler holder and the coupler's orientation because the coupler holder is aligned with the beam in the factory and the fiber coupler's orientation is adjusted to be aligned with the laser's polarization.

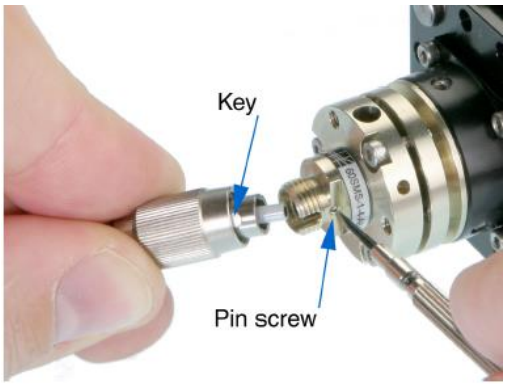


Attaching a single mode fiber cable to the laser beam coupler

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 insertion of the ferrule into its holder (see Figure 4-5). Failing to do so can damage the connector;
- Approach the fiber connector at an angle (as shown on Figure 4-5) 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, use only your hand);
- 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 4-5: Pin screw (coupler side) and connector's key



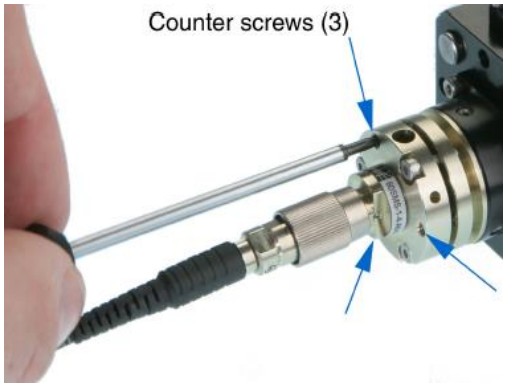
Finding a signal

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 4-6) are loosened by 2 or 3 full turns.

Figure 4-6: Position of the counter-screws



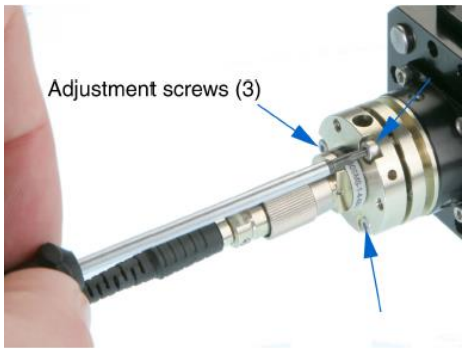
Procedure:

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

Warning: the laser is now emitting. Proper protection measures against laser light shall be enforced.

- 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 (they have a 1.5 mm hex cylindrical head, see Figure 4-7) 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 4-7: Position of the adjustements screws



It is sometimes useful to loosen a bit the box nut on the fiber connector and to pull back slightly the fiber connector. Some defocussing will happen and the light's spot on the connector end face is larger and therefore 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 adjustement 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 adjusting 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.

Before proceeding to the next step, check that the insertion losses (i.e. the difference between the laser's power settings and the output power as measured by the power meter at the fiber's end) 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 4-6)

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 in the same way. 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.

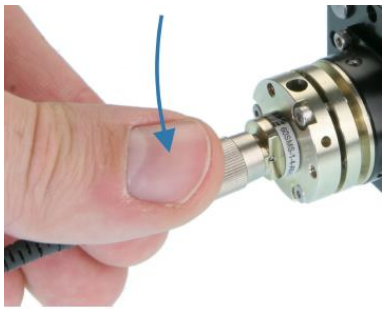
You can now gradually increase the output power up to its nominal set point. As a final check, make sure that the transmission ratio has not decreased.

Checking the alignment

A possible way to check the alignment's robustness is by pressing gently on the connector in all directions (see Figure 4-8): 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 sould be tightened.) Use this information to re-optimize the coupling.

Figure 4-8: Checking the stability of the adjustement



COUPLING ON A MULTI-MODE FIBER

Fiber coupling on LaserBoxx is also available with multimode fibers. The standard fiber have a numerical aperture of 0.22, a core diameter of 50 microns. Contact Oxxius if you need to connect fibers of alternative specifications.

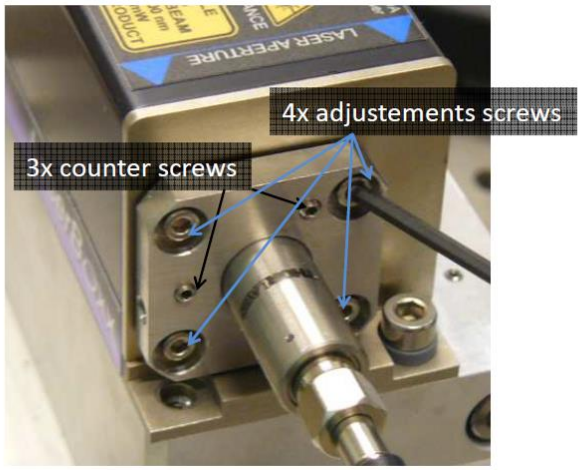
This procedure explains how to retrieve an optimal coupling efficiency. We recommend not to change the centration of the coupler holder.

Warning

To avoid damage of the fibers end face, the following adjustment procedure has to be performed at low optical power (P ≤ 40 mW).

It is highly recommended to switch to ACC regulation mode in order to prevent optical feedback during fiber alignment.

Figure 4-9: Position of the adjustement screws and counter-screws



- Do not translate the mechanical holder: centering is done by Oxxius,
- Unscrew slightly each counter screws by two turns,
- The next steps consists in maximizing the signal's power by turning the adjustement screws one by one:
    - Start with one adjustment screw and steer it slowly until the optical signal reaches a relative maximum. Then fasten this first screw a little more so that the power decreases by a few percents.
    - 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

SECTION 5: TROUBLESHOOTING

Warning

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

5-1 Operating Status and alarms

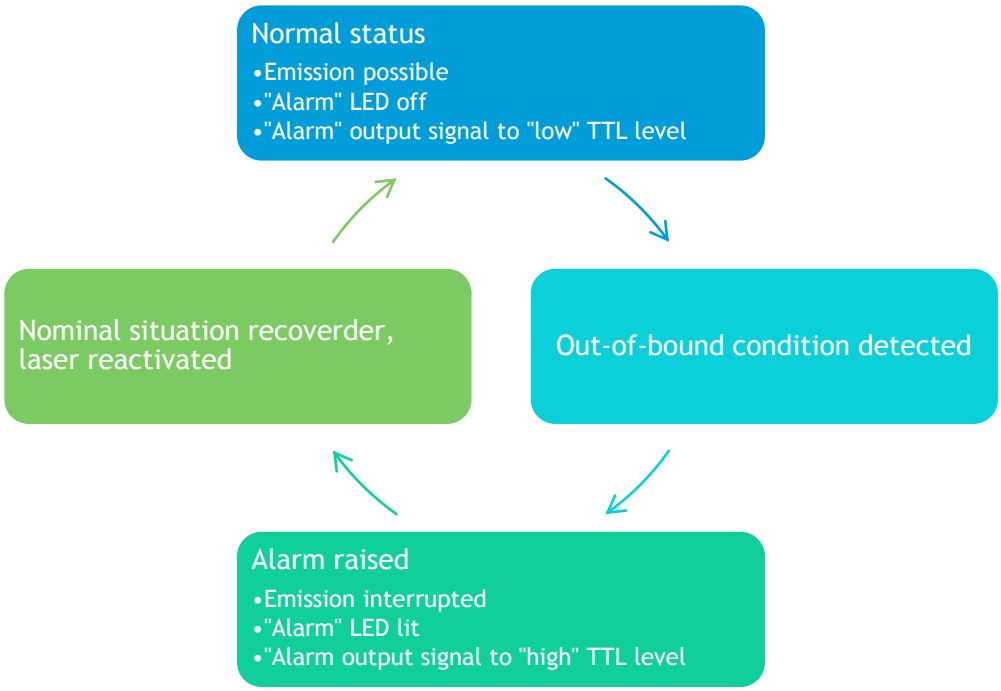
Alarms are a category of status informing of off-limits operational conditions. When an alarm is raised, laser operation is not possible until the cause of the alarm is fixed. Resuming the emission requires that the unit is re-activated by the emission key.

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

- the "Alarm" LED in solid red on the "ControlBoxx" or "RemoteBoxx" controllers,
- 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 input 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 3.2), 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 lasers: apply a “high” signal on this pin.

2. On laser units of any class: Any of the following actions will resume the emission:
    - Using RS-232 or USB communication port, send the command “DL 0”. The emission can now be resumed using the command “DL 1”
    - Using the electronic interface, re-activate the laser using the pin ‘Enable’
    - Using the software interface, re-activate the laser using the button ‘Reset’

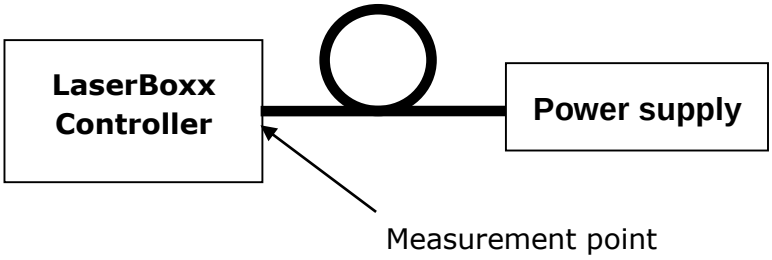
5-2 Issues with supply voltage

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 using this query.

The wires supplying the current from the power supply to the laser head will cause a voltage drop, depending on their length and section. The voltage measured at the inlet socket of the controller –as indicated on the schematic below– must be within its nominal operating range.



5-3 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.

5-4 Uninstalling and repacking procedures

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

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

5-5 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

WARRANTY AND CERTIFICATION

6-1 Standard warranty

Limited Lifetime Warranty

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

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 patchcords 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

Certificate

Manufacturer: Oxxius France

Adress: 4, rue Louis de Broglie
22300 Lannion

Declares that the following products:

Name of products: LCX lasers, LBX lasers

References or models:

LCX products

LCX-wwwS-ppp-CIR/CSB-OE/PP

LCX-wwwL-ppp-CIR/CSB-OE/PP

LBX products

LBX-www-ppp-ELL/CSB/HPE-OE/PP

LBX-wwwS-ppp-ELL/CSB-OE/PP

www for wavelength [in nm], ppp for power [in mW]

Are certified according to the following standard(s):

Electrical safety:	Directive 2006/95/EC (2006/12/12)
	NF EN 61010-1 June 2010 Edition
EMC:	Directive 2004/108/EC (December 2004)
	IEC 61326-1 Ed 2 (2012)
	NF EN 61000-3-2 (P&P)
	NF EN 61000-3-3 (P&P)
	NF EN 61000-4-2 (P&P)
	NF EN 61000-4-3 (OEM and P&P)
	NF EN 61000-4-4 (P&P)
	NF EN 61000-4-5 (P&P)
	NF EN 61000-4-6 (P&P)
	NF EN 61000-4-11 (P&P)
Laser:	IEC 60825-1 Ed 2 / 2007-03 (P&P)

Signature

_____

(Thierry Georges, PDG (CEO), Lannion, September 2014)

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

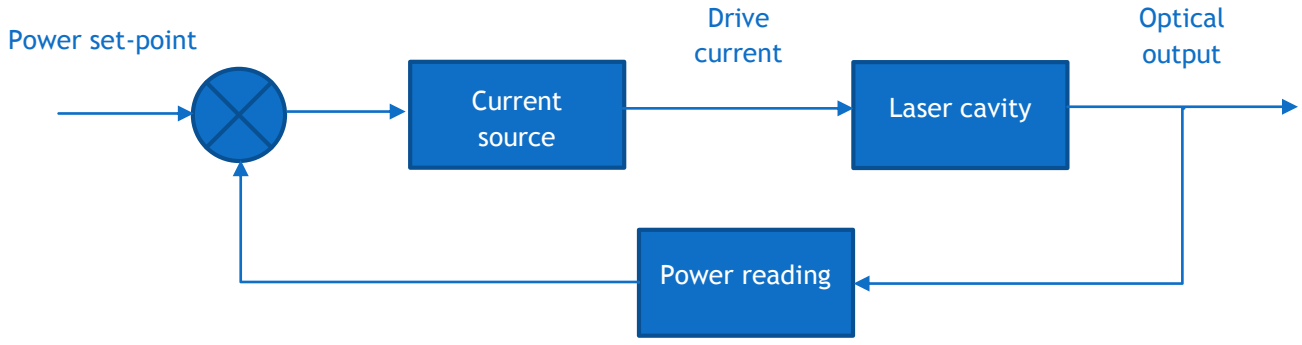
LaserBoxx laser sources operate by releasing an optical signal against a given set point. The following chapters detail some of the concepts involved in the laser's operation.

AUTOMATIC POWER CONTROL

Only one type of loop exists to control the optical power on the LCX: "Automatic power control" ("APC" for short).

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 LASERBOXX

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

Purpose	Query (and aliases)	Result and syntax
Retrieves the temperature of the base plate of the laser head (expressed in Celsius degrees)	?BT BT?	"22.1" "22.1 C"
Retrieves the configuration of the USB port	?CDC	"0" Standard USB "1" USB port configured as a virtual serial port
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 AL?	"?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) AL? returns one of the following messages: "Laser Head Temperature" "Interlock" "Power Supply" "Other" "No alarm"

Retrieves the laser operation time, in hours	?HH TM?	"49" "TIME= 49 hrs, 38 min"
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 status of the interlock circuit	?INT INT? ?LCK	"0" Interlock open, laser emission is not authorized "1" Interlock closed, laser emission is authorized
Measures the voltage suppling the laser head (expressed in Volts)	?IV VA?	"6.601" "6.168 V"
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
Retrieves the emission status	?L	"0" Emission is off "1" Emission is off "2" Emission is on at low power
Retrieves the laser's measured output power (in milliwatts)	?P IP?	"53.6" "53.6 mW"
Retrieves the temperature of the electronic board embedded inside the laser head (expressed in Celsius degrees)	?PST ET?	"33.6" "33.6 C"
Retrieves the laser's power set point (in milliwatts)	?SP	"40.0"
Queries the state of the laser module (see section "Troubleshooting" for more information concerning the laser status)	?STA DL?	?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 "DL?" returns one of the following text messages: "Laser off" "Setting temperature"

		"Waiting for stabilization" "Starting up" "Laser on" "Laser alarm"
Retrieves the version of the embedded software	?SV VE?	"1.6.8" for firmware version 1.6.8
Retrieves the status of the temperature regulation loop	?T T?	"0" Temperature regulation loop is deactivated "1" Temperature regulation loop is activated

Purpose	**Command (and aliases)**	**Syntax and examples**
Configuration of the USB port: standard or virtual serial port	CDC	CDC 0 (CDC,<space>,0): Standard USB CDC 1 (CDC,<space>,1): USB port configured as a virtual serial port
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.
Control of the laser emission	DL L	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
Re-initialize the unit	RST	RST 0 (RST,<space>,0) Resets the microcontroller
Switches the temperature regulation loop ON or OFF. This regulation loop is necessary for the emission to occur. Switching it off helps reducing the power consumption.	T	T 0 (T,<space>,0): switches the regulation loop off T 1 (T,<space>,1): switches the emission on

After having received and successfully processed a command, the LaserBoxx returns an acknowledgement message: “OK”.

If the entered command or query is not understood by the unit, the following error message is returned: “????”

Annex C: Electrical interface of the laser head

It is possible to interact directly with the laser head using the electrical interface on its rear panel.

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 kΩ
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 kΩ
15	Laser Ready	Output	TTL Low = Laser not ready TTL High= Laser ready	2 kΩ
Shell	Chassis Ground		Ground	

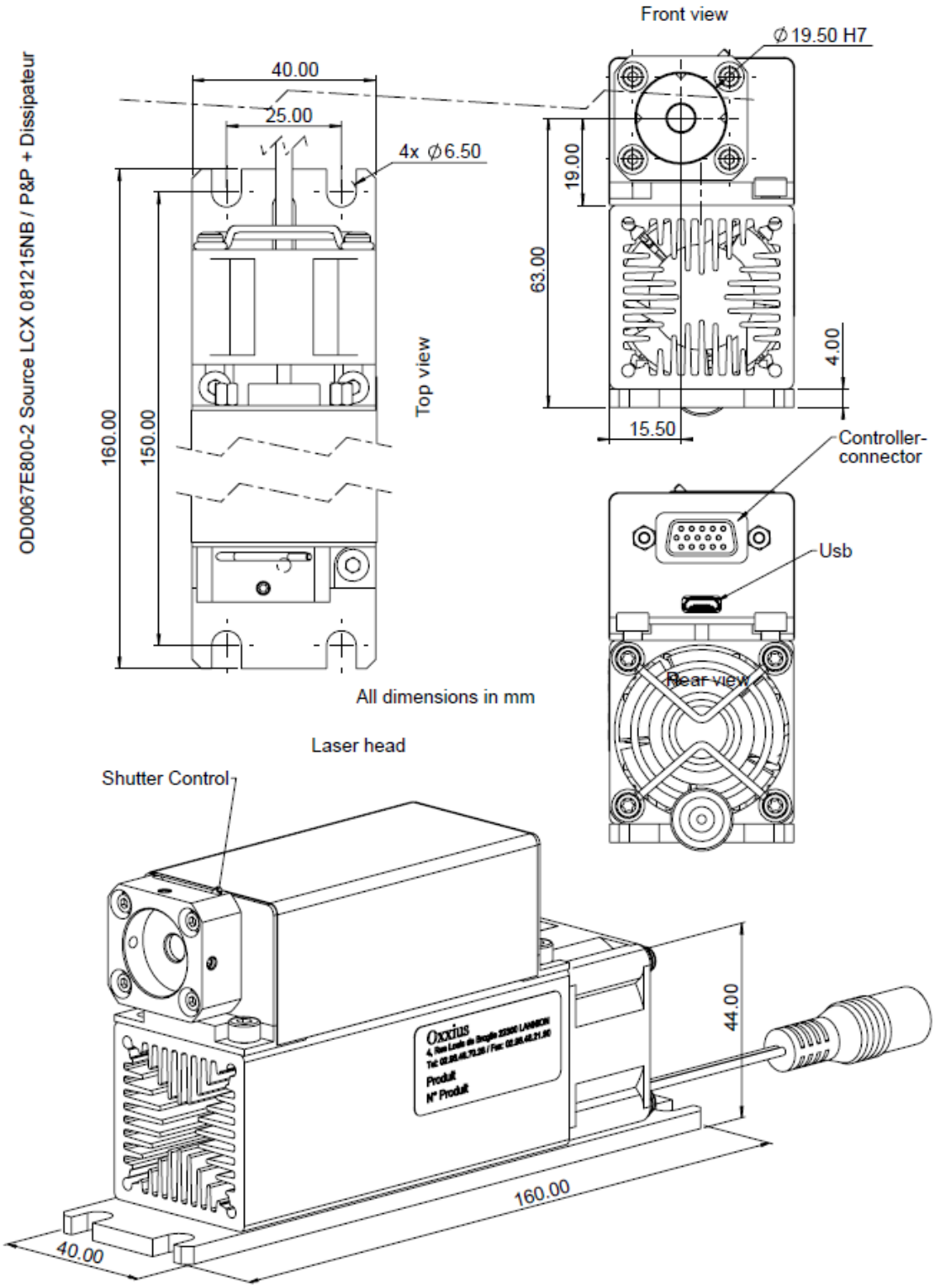
The connector of the interface on the laser head is a female 15-pin Sub-D type. The mating male connector can be found on Radio Spares under the reference “674-0953”.

Note concerning the pins supplying the current:

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

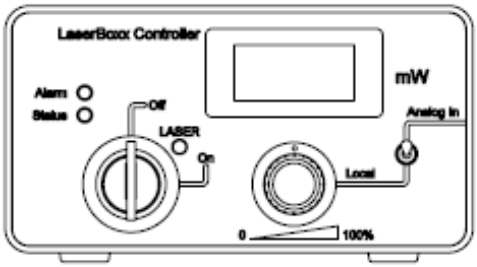
Annex D: Mechanical drawings

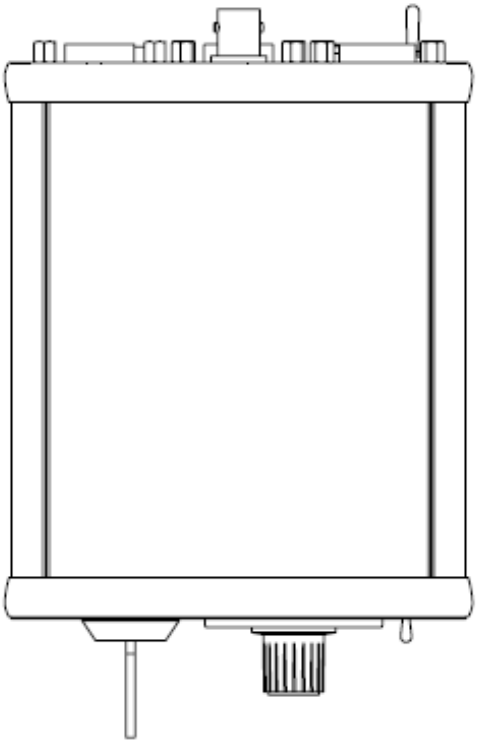
LCX LASER HEAD, PLUG AND PLAY VERSION



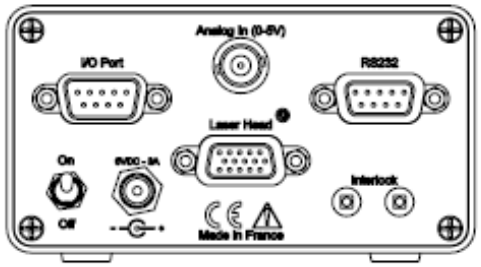
Front view

Top view

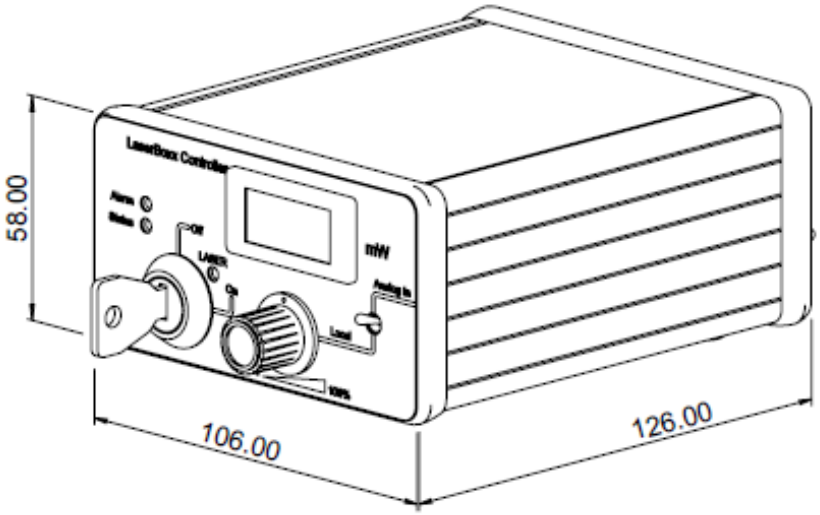


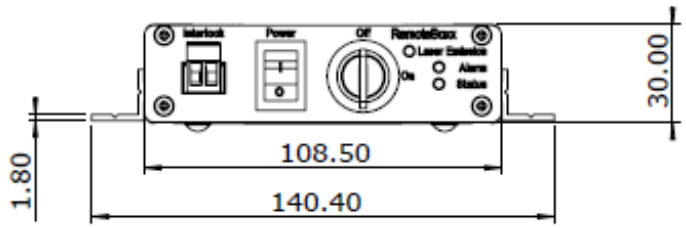


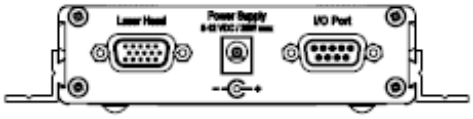
Rear view

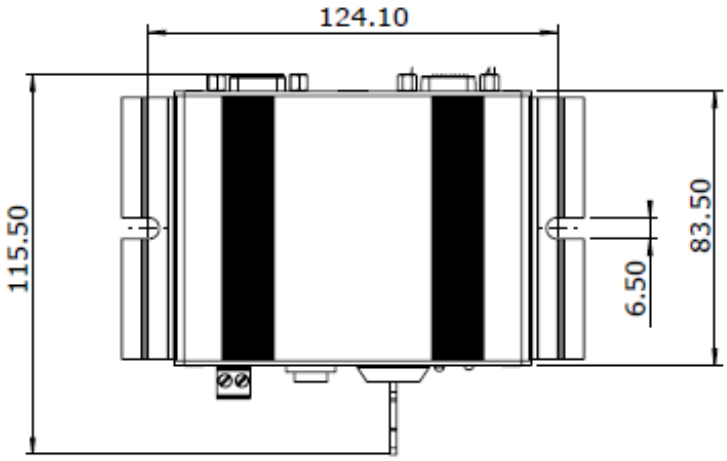


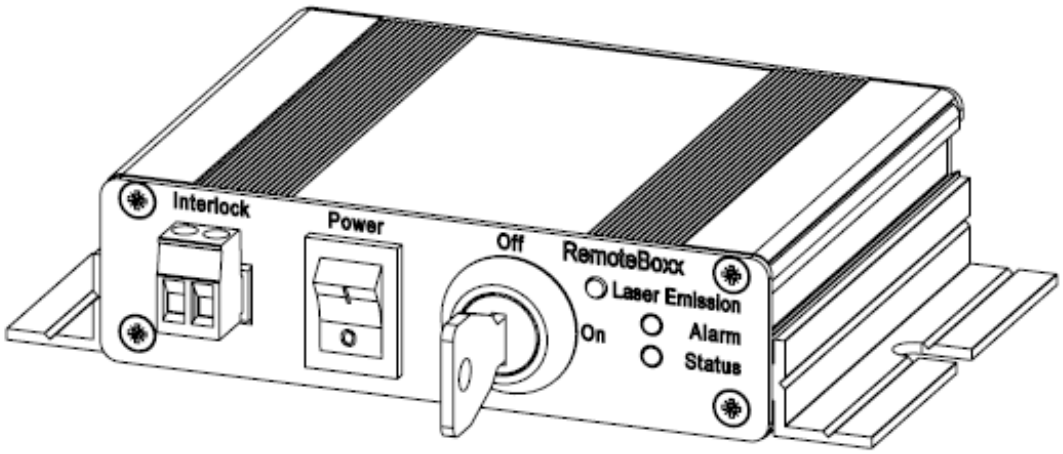
All dimensions in mm




30.00
108.50
140.40
1.80




124.10
115.50
83.50
6.50


Interlock
Power
Off
RemoteBoxx
Laser Emission
On
Alarm
Status

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