LaserBoxx series
User manual

LBX models – Laser diode sources

REVISION HISTORY

01499-E December 2014	Revised for version 3 of the LBX architecture
01499-F August 2016	Safety measures revised
	DE-15 HD connector with revised pin assignment

Thank you for purchasing this LaserBoxx source!

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

PREFACE

AUDIENCE

This manual should be read by all personnel who install or operate the LBX laser source.

Important

Read this manual carefully before operating this device for the first time.
Pay special attention to the “Safety information” section.

This manual is composed of the following sections:

1	Safety information	Be sure to read this section first in order to use the laser sources safely
2	Getting started	Describes the elements of the unit and how to install it
3	Operation	Describes some basic ways of operating the unit
4	Advanced operations	Describes other operations available on the unit
5	Troubleshooting	Instructions about to solve operation-related issues
6	Warranty and certification	Details the warranty applied on this device and its conformity to related standards
7	Technical documents	Miscellaneous technical information

HOW TO USE THIS MANUAL

This manual contains information required for safe operation, installation and routine maintenance of the equipment.

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

1. SAFETY INFORMATION

Please read, understand, and follow all safety information contained in these instructions prior to the use of this laser source. Retain these instructions for future reference.

Only authorized personnel, familiar with the potential dangers presented by laser equipment during operation or installation, should be allowed to work with the laser system. It is of utmost importance that personnel working with the system read, understand and observe the information and instructions in this manual.

If there are any questions or sections that are not understood, do not hesitate to contact Oxxius.

WARNING

Use of controls or adjustments or performance of procedures other than those specified herein may result in any of these hazards:

- Laser hazard
- Heat hazard
- Chemical hazard

The degree of seriousness of the hazard is indicated by the use of the following signal words:

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It is also used to alert the user against unsafe working practices and potential damage to the equipment.

QUALIFICATION AND TRAINING OF PERSONNEL

Personnel who install and/or operate the laser must be adequately qualified for the work concerned and should have read this manual. The user must clearly specify the sphere of responsibility, competence and certification for personnel concerned.

1-1 Laser safety

THE DANGER OF LASER SOURCES

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

- Lasers light sources produce a highly intense light, either visible or invisible to the human eye,
- Laser light is coherent which means that it 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 source should be aware of the risks involved. This awareness is not just a matter of time spent with lasers; on the contrary, long-term dealing with invisible risks (such as with infrared sources) tends to dull risk awareness.

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

- Use the laser in a room with access controlled by door interlocks. Post warning signs. Limit the area access to individuals who are trained in laser safety.
- The operator of the laser should be responsible for notifying the laser usage and for controlling the laser area.
- All personnel present in the area must be wearing personal protective equipment (in particular eyewear) before the laser emission is effective. This should include operators that are not directly using the laser system.
- Use the laser source in a brightly lit room so that the operators work with their pupils narrowed.
- Optical experiments should be carried out on an optical table with all laser beams travelling in the horizontal plane only, and all beams should be stopped at the edges of the table. Users should never put their eyes at the level of the horizontal plane where the beams are in case of reflected beams that leave the table.
- Watches and other jewelry that might enter the optical plane should dropped off. All non-optical objects that are close to the optical plane should have a mat finish in order to prevent specular reflections.
- Never look directly into the laser output port when the power is on.
- Alignment of beams and optical components should be performed at a reduced beam power whenever possible.
- Do not install or terminate fibers or collimators when the laser is active. Follow the dedicated instructions in this manual.
- Ensure that the work surface is properly vented. Gases, sparks or debris can be generated from the interaction between the laser and the work surface, posing additional safety hazards.

PROTECTIVE EYEWEAR

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

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

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

STANDARD COMPLIANCE OF "PLUG AND PLAY" AND "OEM" VERSIONS

A LaserBoxx source 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)).

A LaserBoxx source 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 source, OEM version, is used.

DESCRIPTION OF HAZARD CLASSES

LaserBoxx sources are either classified as class 3b or class 4 laser sources. Here are the different characteristics of these classes:

CLASS 3B LASER SOURCES	CLASS 4 LASER SOURCES
Have the potential to be hazardous when intrabeam ocular exposure occurs, including by an accidental, short-time exposure	
Diffuse reflections are usually safe for viewing	Diffuse reflections are not safe for viewing
May produce minor skin injuries	Can produce severe skin injuries
Pose a risk of igniting flammable materials (although this risk is only tangible when the beam has a small diameter or is focused)	Pose a risk of igniting flammable materials

SAFETY FEATURES ON THE LASERBOXX UNITS

Compliance with the aforementioned safety standards implies that some safety features are present on the LaserBoxx units, in order to prevent an accidental exposure. Some of these features are only present on the “Plug and Play” versions of the laser sources.

APERTURE LOCATION

This label indicated the aperture from which the laser radiation is emitted.

INTERLOCK CIRCUIT

The laser controller is fitted 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” VERSION ONLY)

The laser controller is fitted with an actuated key master control. On “Plug and Play” unit, this function is linked to a key lock controlling 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.

Moreover, this function controls the how the laser emission can be recovered after an uncommon interruption (power outage, interlock circuit opened):

- On class 3b laser units, the emission recovers as soon as the key is in its “ON” position.
- On class 4 laser units, the key needs to be turned OFF, then ON for the emission to recover. On an electrical point-of view, the corresponding signal needs to receive a TTL rising front.

EMISSION WARNING INDICATOR (FOR “PLUG AND PLAY” VERSION ONLY)

The laser controller is fitted with an emission indicator located on the front panel. From the moment where the emission is engaged, this indicator is lit and a 6-second delay is initiated until 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” VERSION ONLY)

A mechanical shutter, present on the laser bench, allows for a complete extinction of the beam.

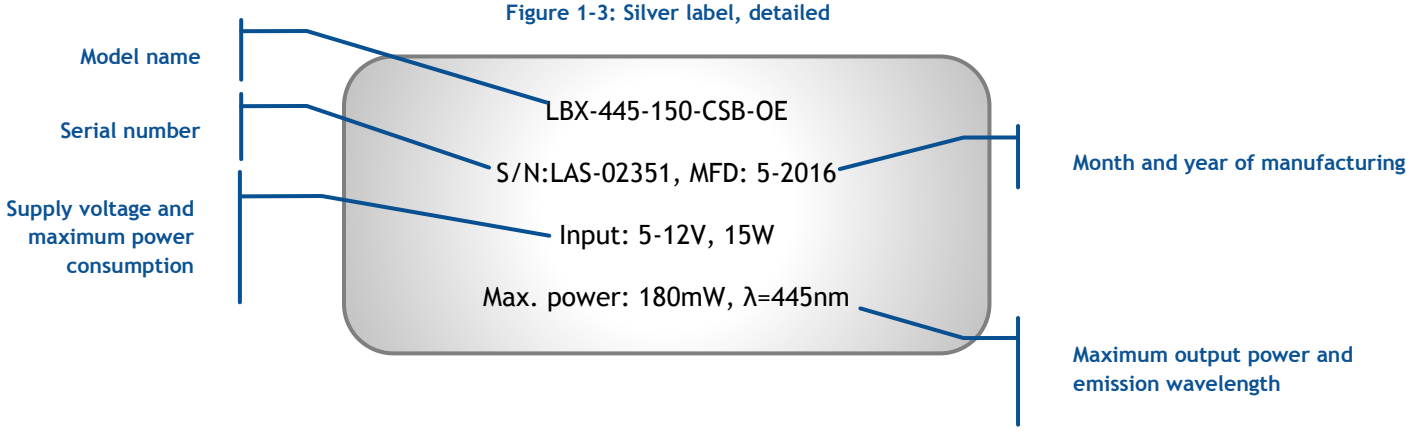
LABELLING

Advisory labels are applied where specific dangers exist, or where a specific attention is required. Do not remove nor tear these labels.

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: Position of the labels on the LBX LaserBoxx

Figure 1-3: Silver label, detailed



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

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

Here is a summary of the laser safety compliance:

	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 LBX laser source operates from low voltages, and does not contain hazardous voltages. In its Plug and play version, it still requires power supply fed by a power cord.

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.

LOW VOLTAGE DIRECTIVE 2006/95/EC

This directive ensures that electrical equipment within certain voltage limits provides a high level of protection for European citizens. 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. The LBX source complies with this directive.

1-3 Hazardous materials

The laser head contains indium used as a heat conductor. Indium is toxic; do not open the laser head.

ROHS 2 COMPLIANCE

The LaserBoxx sources comply with RoHS 2 directive.

1-4 Decommissioning and disposal

If the laser will be definitively taken out of service and decommissioned, disconnect and remove all signal and power cables.

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. In any case, dispose of the system according to appropriate local regulations, paying particular attention to disposal of indium components in the laser head.

2. GETTING STARTED

2-1 Overview

THE LASERBOXX LASER SOURCES

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

These laser sources feature:

- Ultraviolet, visible or infrared outputs (from 370nm 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 LBX LaserBoxx are models that embed a laser diode as their emitter. These laser sources are ideal for fluorescence, lithography, and other applications.

“PLUG AND PLAY” AND “OEM” VERSIONS

The LaserBoxx sources exist 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. 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 source without its controller is equivalent to using the source 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 dedicated controller.

2-2 Operating environment

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

- Indoor use,
- Altitude up to 2000 meters,
- Ambient air temperature: from +15°C to +38°C (operating temperature),
- Base plate temperature: from +15°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)

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. The LBX source is compliant with this directive.

About electrostatic discharges (ESD)

The LBX source has been tested successfully against the following levels of ESD: +/-4kV on contact, +/-8kV on air.

Although input protections are integrated, precautions against ESD are recommended to avoid any degradation.

Handling guidelines: A particular attention is required when handling the product in low-humidity atmosphere, or on a surface not designed against ESD (for example a floor covered with carpet or vinyl tiles). Under these conditions, Oxxius recommends using an antistatic wrist strap. These straps should be connected to earth bonding points (part of the grounding system). See the picture below.

Figure 2-1: Example of a wrist strap

2-3 Unpacking and installing

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

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

PACKING LIST

The table below list the standard elements and accessories shipped along the LBX.

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

Name	Quantity
LBX laser head	1
Laser controller	1
Laser head to controller cable	1
Power supply for the controller	1
Heatsink	Optional

Power supply for the heatsink	Optional
Power cable	1
USB cable (USB A to micro B)	1
Laser emission key	2
USB Flash drive	1
This user manual	1

UNPACKING

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

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

Follow the instructions below to install the LaserBoxx safely:

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

CAUTION

For fiber-terminated outputs: a special attention is required with devices terminated by an optical fiber (or patchcord).

An optical fiber is made of glass and is a fragile piece of equipment that should not receive excessive mechanical damage (shear stress, tight bending, etc.) under any circumstance.

The user is required to handle the delivery patchcord and its optical connectors with care and to have the necessary tools and knowledge to inspect and clean the end tips of the fiber.

2-4 Elements description

LASER HEAD

Here are the accessible elements on the laser head. For detailed drawings, refer to section 7, “Technical documents”, annex B.

Figure 2-3: Front view of the LBX laser head, “Plug and Play” version

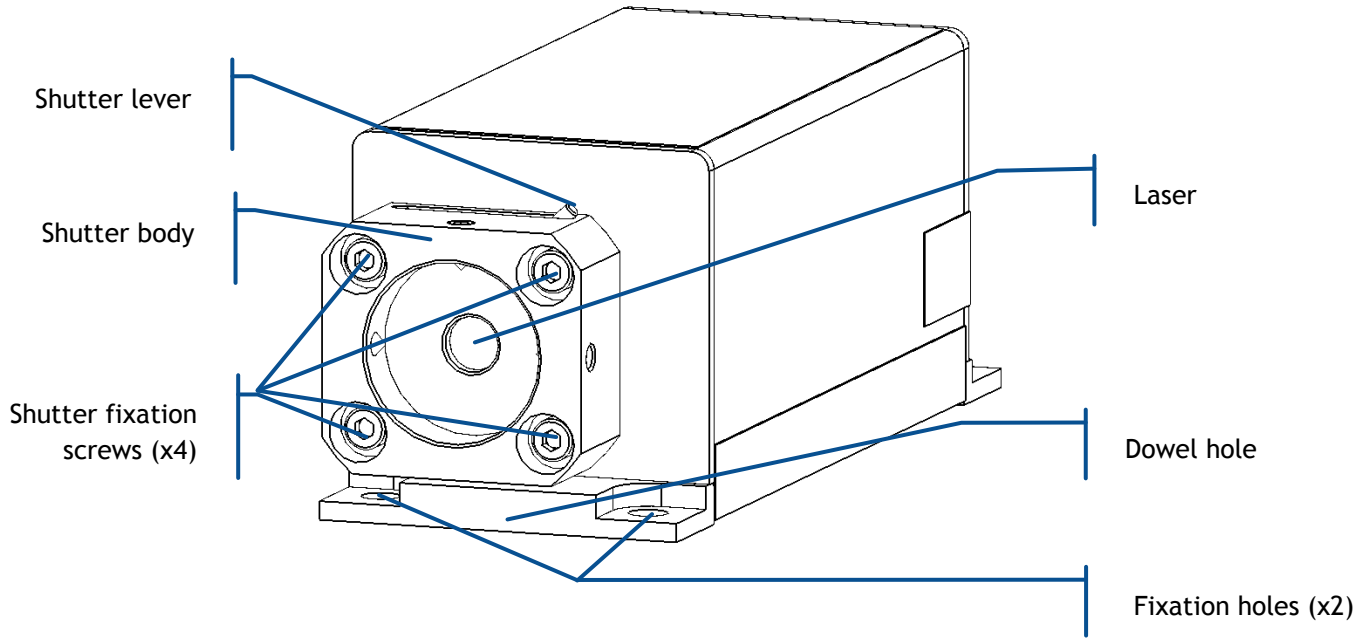
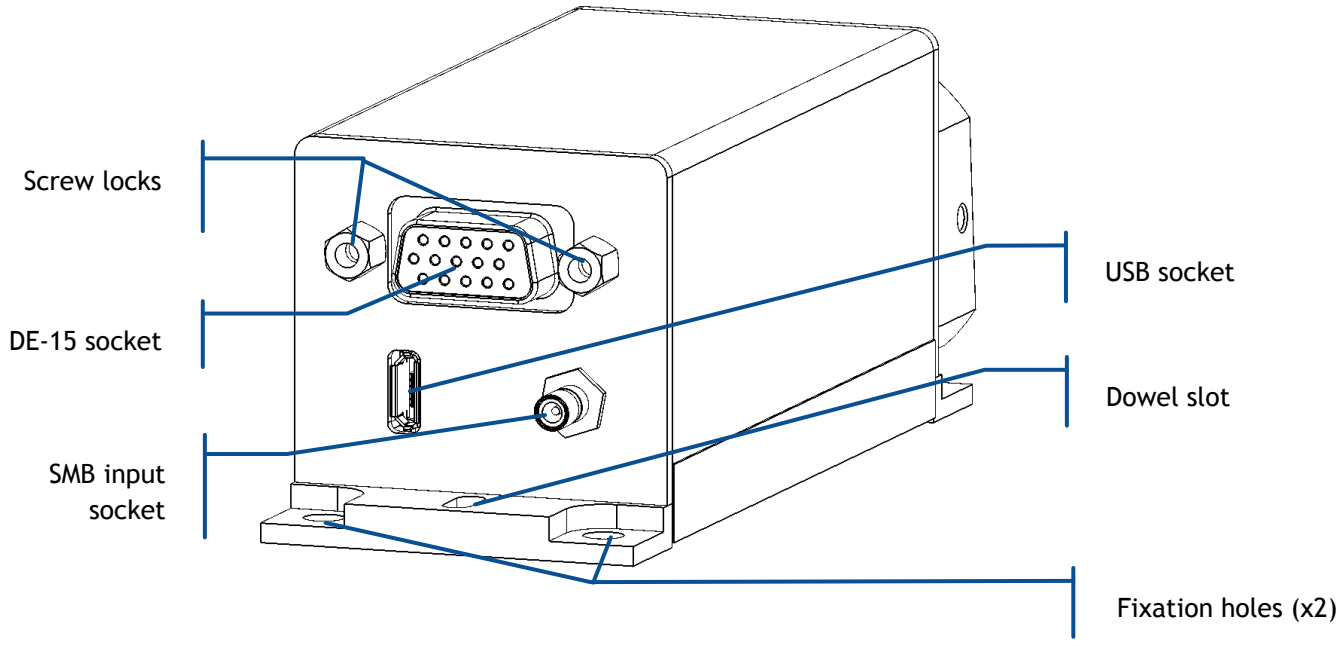


Figure 2-4: Rear view of the LBX laser head



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 is fixed to the laser head using these standoff screws.

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

- **SMB socket**: this socket holds the input terminal for fast digital modulation.

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

OPTIONAL HEATSINK

On a LBX LaserBoxx, a heatsink can be used to operate an improved dissipation of the heat generated during operation. Here are the accessible elements on this heatsink. For detailed drawings, refer to the section "Technical documents", annex B.

- **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 2-5: Front view of the heatsink

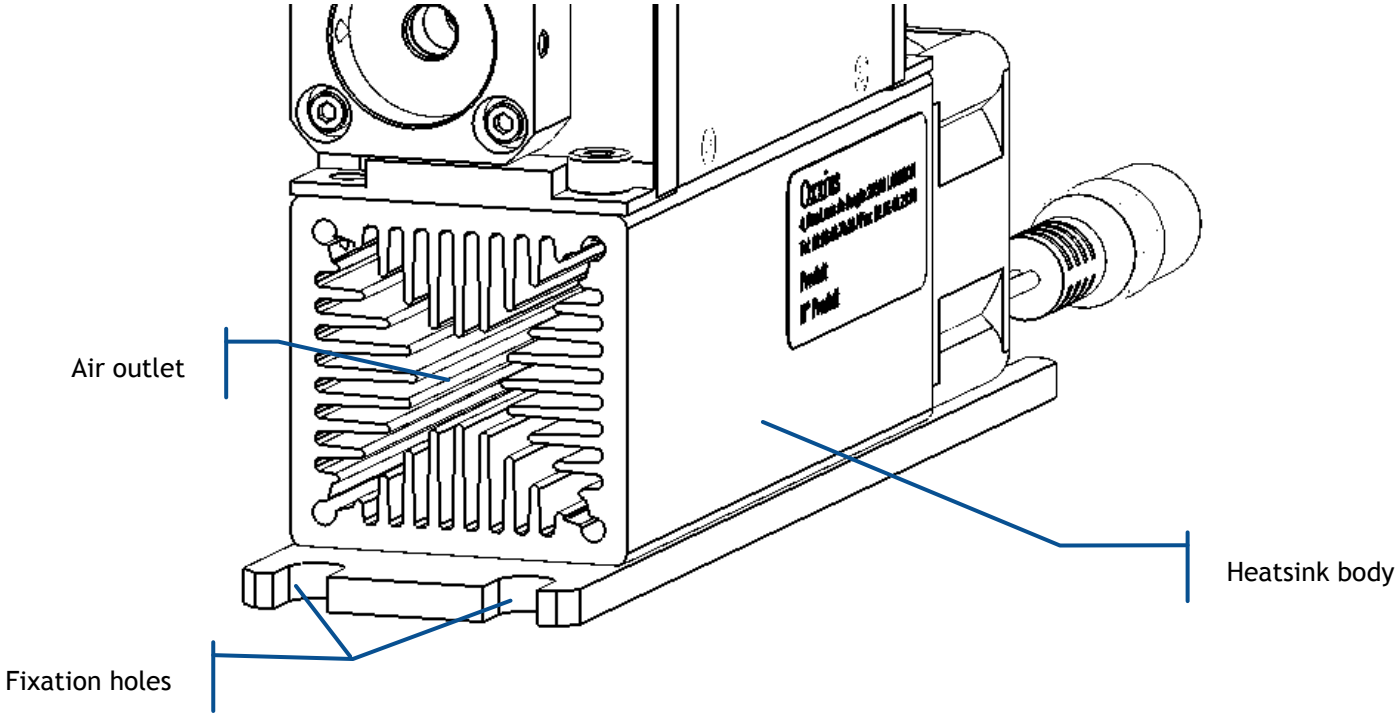
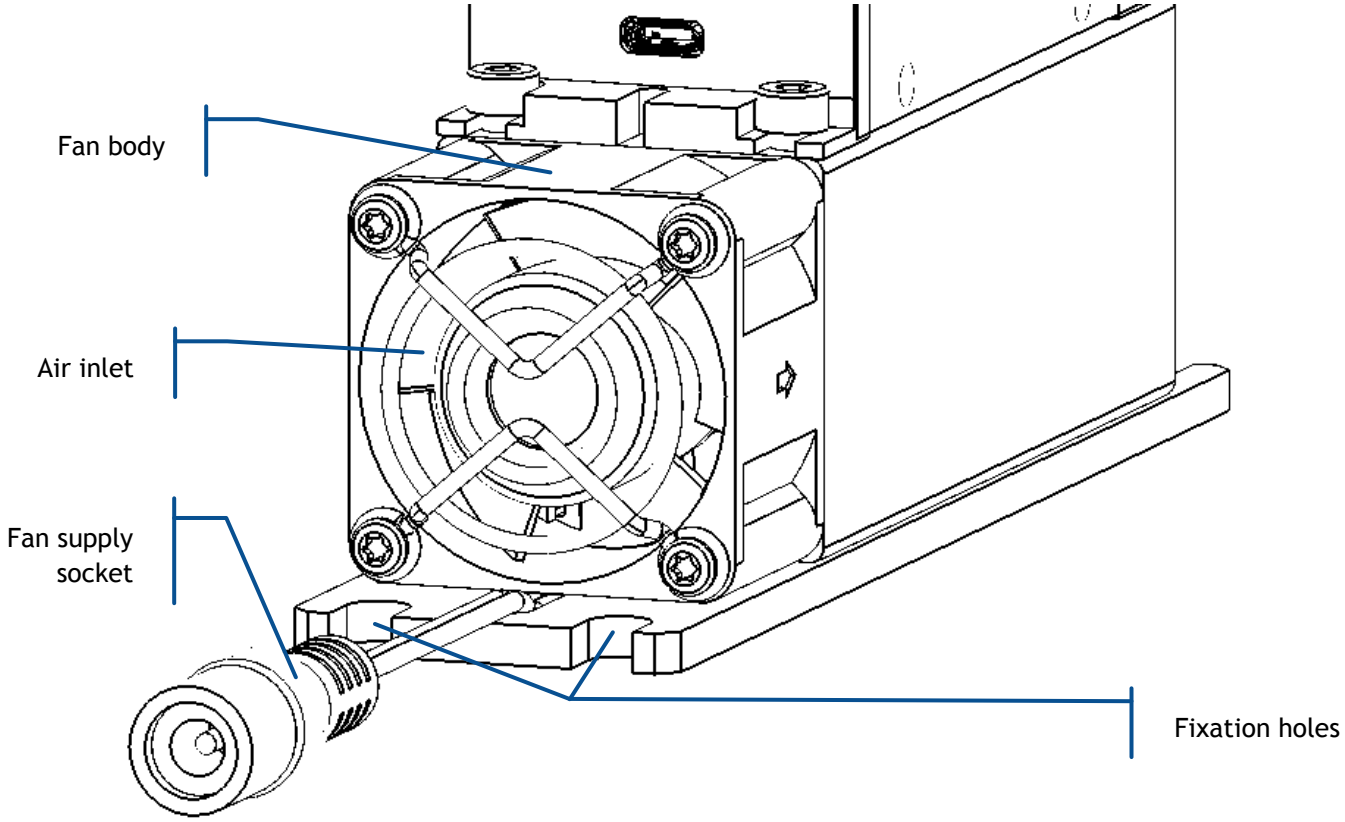


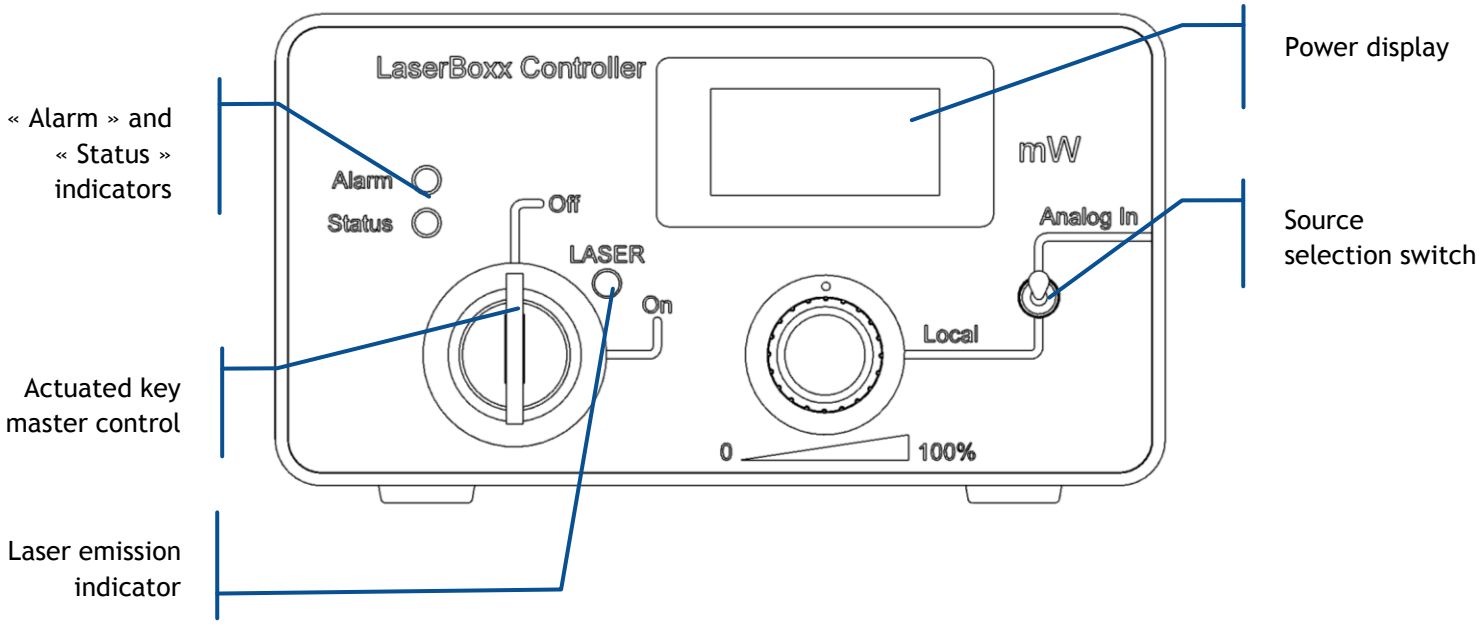
Figure 2-6: Rear view of the heatsink



CONTROLBOXX CONTROLLER

The ControlBoxx is the standard controller for LBX models. The figures below lists its accessible elements.

Figure 2-7: 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 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.

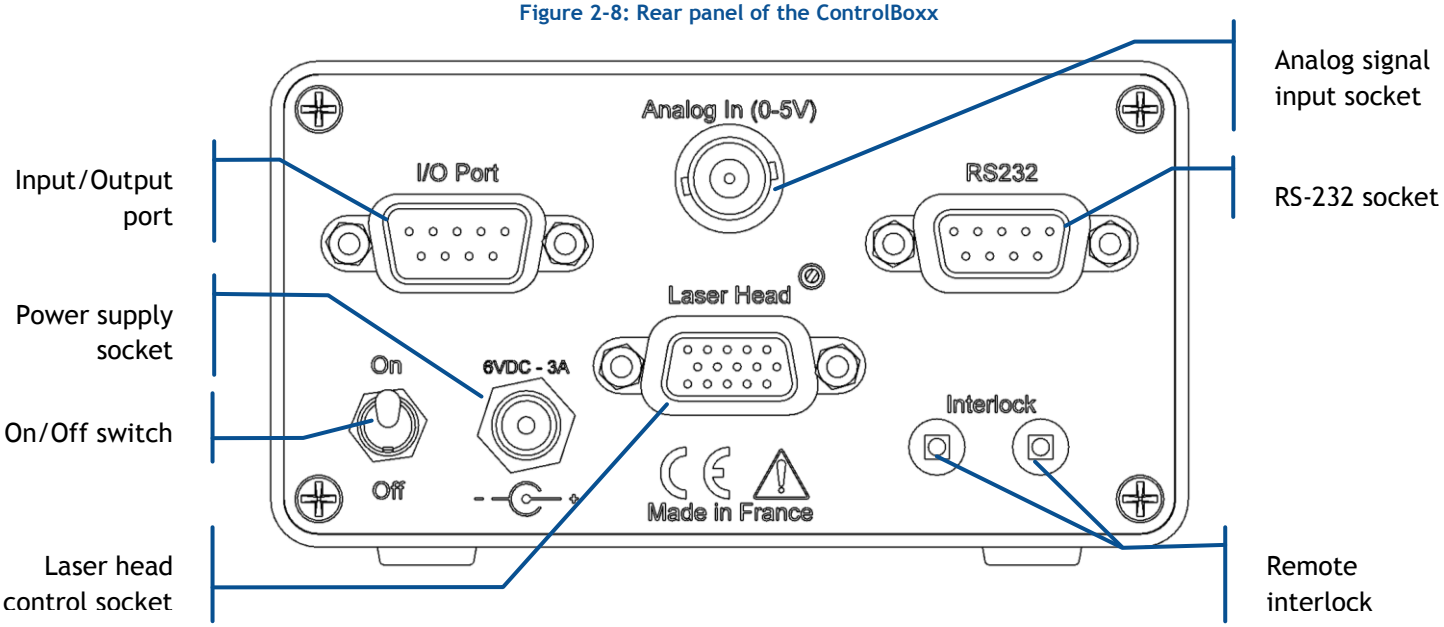
- **"Alarm" Indicator:** This indicator is a red LED indicating a warning or an alarm on the device.

- **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 2-8: 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.

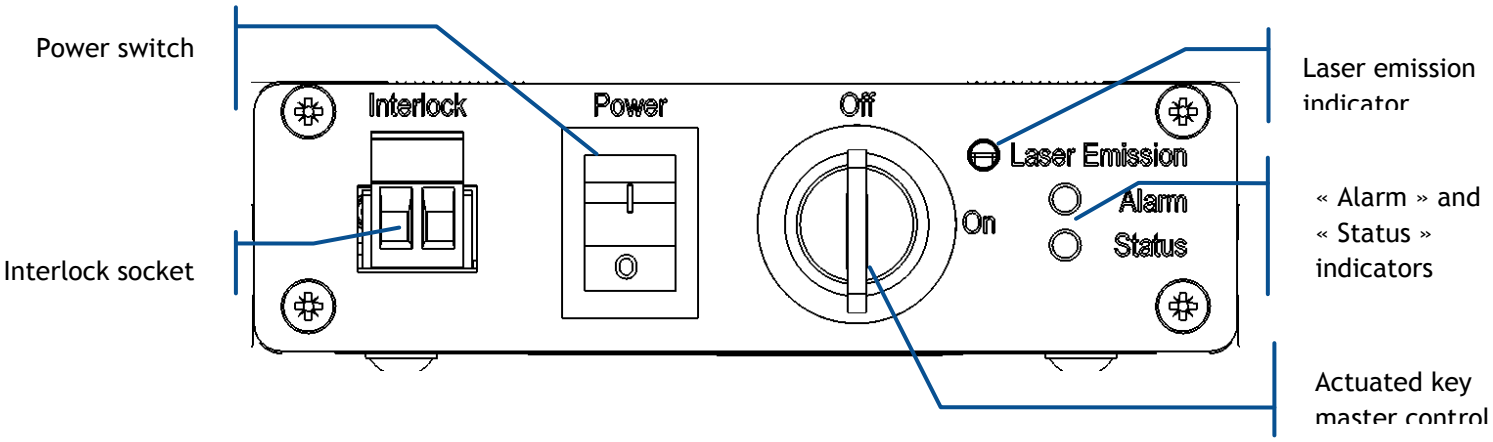
- **Laser head control socket (DE-15 HD Female):** This socket is supplying the laser head with power and signals. It must be connected to the controller using the dedicated cable (delivered with the LaserBoxx).

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

REMOTEBOXX CONTROLLER

The RemoteBoxx is a controller similar to the ControlBoxx, except that it does not display the instantaneous power, nor does it allow the user to modify this power manually. The figures below lists the accessible elements of the RemoteBoxx controller.

Figure 2-9: 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 sequence.

- **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 (besides, the white color of this LED is visible through most protective eyewear). In accordance with CDRH recommendations, this indicator is lit 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.

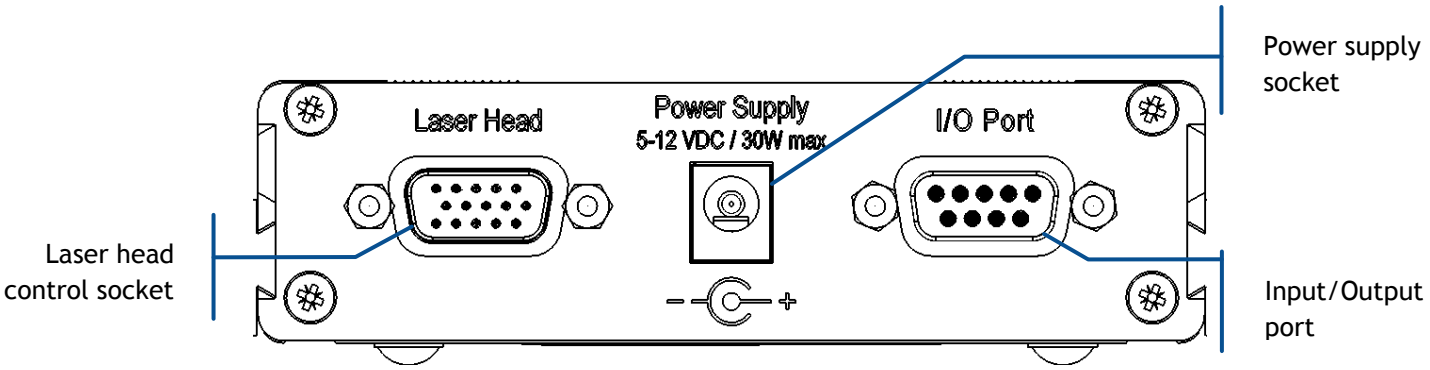
- **"Status" Indicator:** This indicator is a green LED indicating the status of the laser emission:
  - Blinking green: the laser emission is on and is being stabilized.

- Solid green: the laser emission is on and stabilized.

- **“Alarm” Indicator:** This indicator is a red LED indicating 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 RemoteBoxx to close this circuit and allow the emission.

Figure 2-10: 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 LBX 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; **commercial RS-232 cables cannot be used** directly on this socket.

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

- Power supply socket (2.1mm coaxial): Input for the power supply.

2-5 Installing the LBX

WARNING

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

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

MECHANICAL INTERFACING

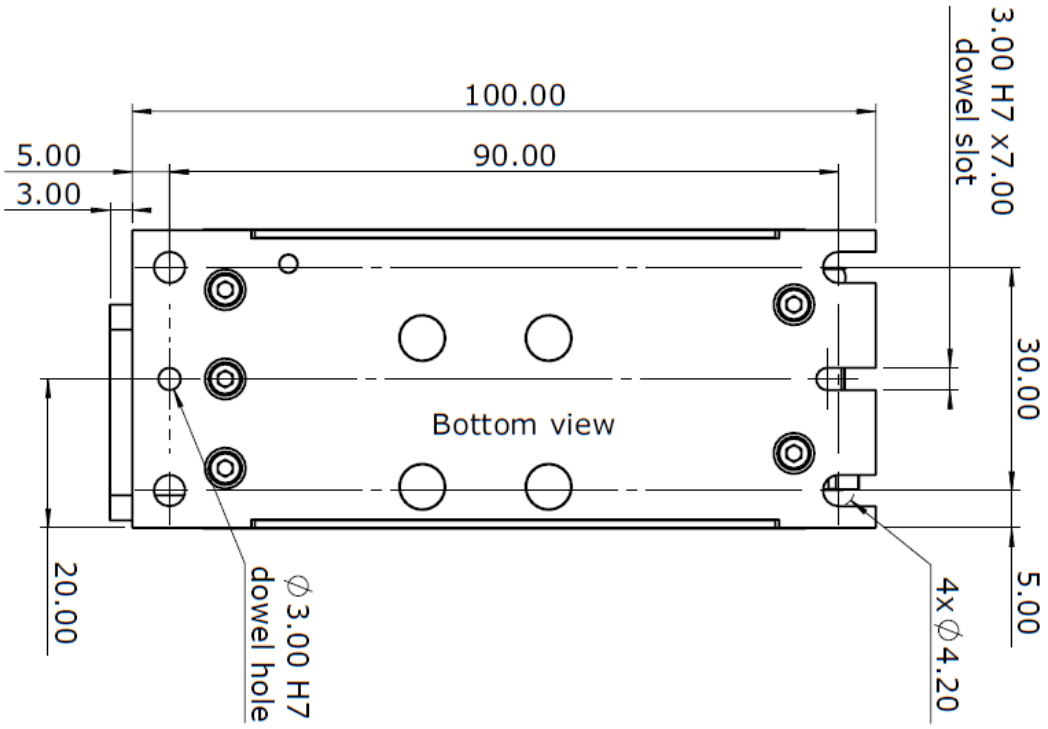
The laser head should be fixed to a metallic base which flatness is better than 0.05 mm. This requirement ensures that no excessive constraint is applied to the laser bench.

Standard machining of opto-mechanical components will typically meet this requirement; however a particular caution is required with extruded heatsinks which could exhibit an insufficient flatness.

The LBX is fixed using the rear brackets using three M4 x 10mm screws. These bolts should be tightened with a torque of 1.3 Nm. Refer to the figure below.

Figure 2-11: Mechanical specifications of the plate supporting the laser head

Units: millimeters



THERMAL MANAGEMENT

The laser source consumes an amount of electrical power that depends on the temperature of its base plate:

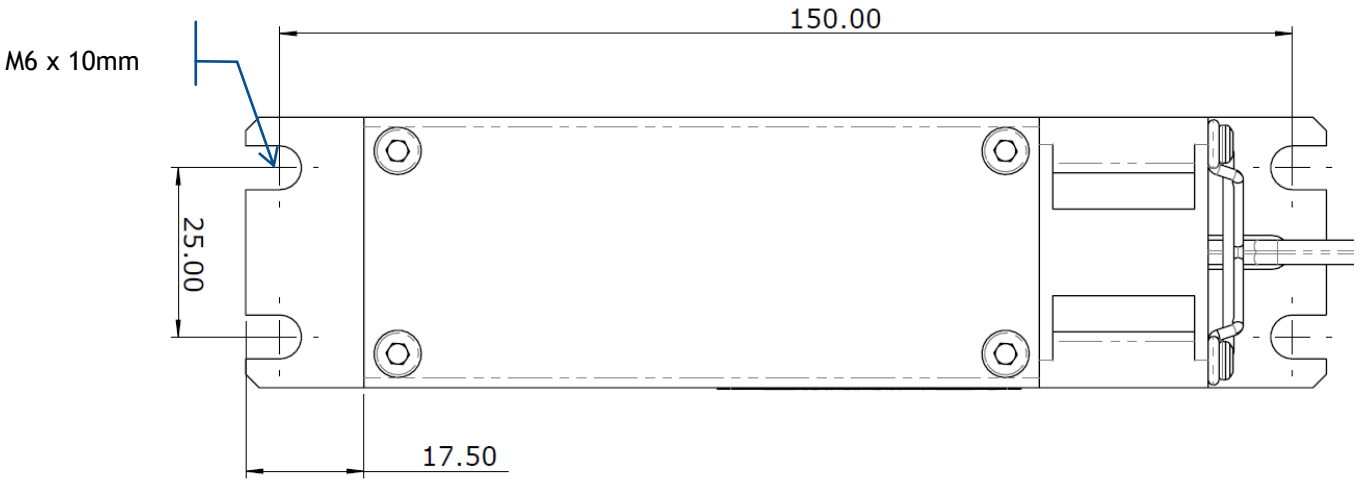
- The maximum consumed power is reached as the base plate is at its hottest,
- The minimum consumed power is reached in a zone typically between 15°C and 25°C

For those reasons, the supporting medium must ensure a proper dissipation of the generated heat. This is the purpose of the optional heatsink proposed with the LBX.

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 2-10 below and to the mechanical drawings in annex B.

Figure 2-12: Mechanical specifications of the plate supporting the laser head

Units: millimeters



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

OPTICAL OUTPUTS

Connect the optical connector of each of both channels to your own light path. Make sure to fasten the threaded ring of each optical connector.

CAUTION:	OPTICAL FEEDBACK
	The LBX can be damaged by optical feedback. This damage occurs on semiconductor laser diodes when their output is collimated and subsequently retro-reflected. In these conditions, the retro-reflected beam focuses back onto the laser diode facet and can create a power density high enough to melt this facet. This results in an irreversible degradation of the laser. Once this process begins it is not possible to repair the laser, moreover this failure mechanism is **not covered** under Oxxius' standard warranty. For this reason, Oxxius recommends the following precautions be taken when working with open beam laser modules: 1) All reflective surfaces in the optical path should be angled slightly so that surface reflections will not be retro-reflected, 2) Use angle-polished fibers when coupling the light into optical fibers, 3) Avoid using mirrors placed at normal incidence into the light path. If mirrors must be placed at normal incidence, use of an isolator is required. 4) Avoid focusing the beam the onto a mirrored surface without installing an isolator into the light path, 5) Avoid sweeping the beam back and forth across the laser during alignment operations (for example using a retro-reflected beam to align through a pinhole in a confocal microscope). If such a possibility is unavoidable, use an isolator at the output of the laser diode during the alignment process to prevent permanently damaging the laser

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 laser head. Secure both connectors using the locking screws.

- Connect your interlock safety circuit to the "Interlock" pins on the front 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” LBX 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	Output

- Voltage: 100/240 VAC
- Frequency: 50/60 Hz
- Protective ground
	- Voltage (direct current):
	  ○ Absolute ratings : 4.5V minimum, 12.5V maximum
	  ○ Specifications: Any voltage between 5.0V 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 communication device) to either a ControlBoxx, a RemoteBoxx or to the LaserBoxx directly.

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 2-13: USB A to micro B connection cable

RS-232 CONNECTIVITY USING THE CONTROLBOXX

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

Figure 2-14: 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 2-15: Wiring schematics between a computer and the laser head

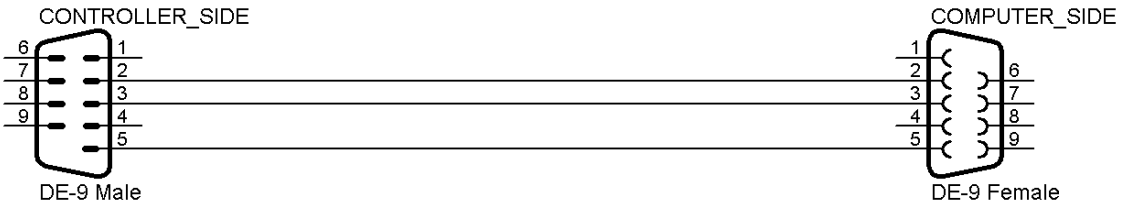


Table 2-15: Pin assignment of the RS-232 cable of figure 2-8

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

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

Figure 2-13: Wiring schematics between a computer and the laser head

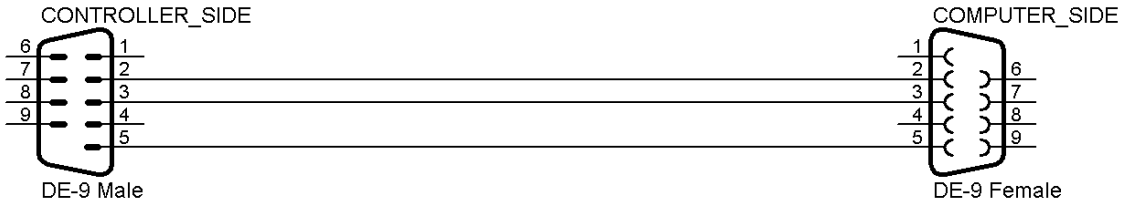


Table 2-14: Pin assignment of the RS-232 cable of figure 2-10

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

CAUTION

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 either the computer or the laser.

2-6 Installing the software suite

The “plug and play” version of the LaserBoxx modules can operated as a stand-alone device, but it is possible to control the LaserBoxx using a computer.

The control software allows the user to monitor and control several LaserBoxx sources at once, using either a serial port (RS-232 protocol) or a USB port (USB protocol or serial communication through virtualization).

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.

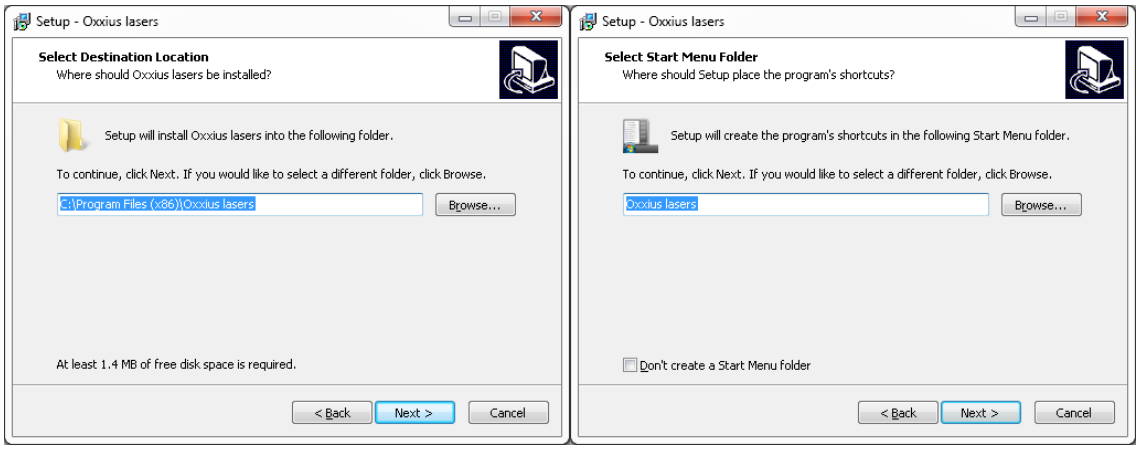
STEP 1: THE COMMAND SOFTWARE AND THE DRIVERS

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

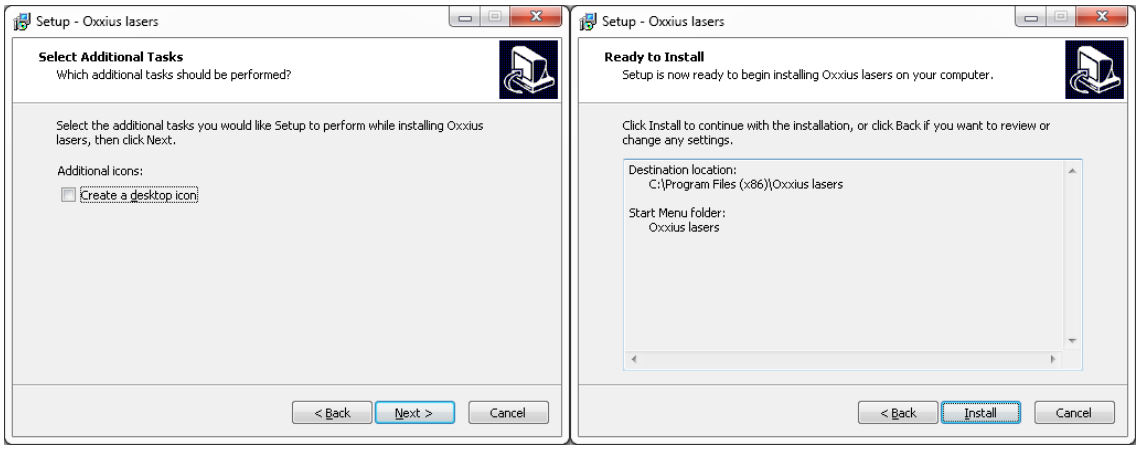
Alternatively, you can download the latest version of our control software from the following URL:

WWW.OXXIUS.COM/DOWNLOAD/F09512DD.EXE

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

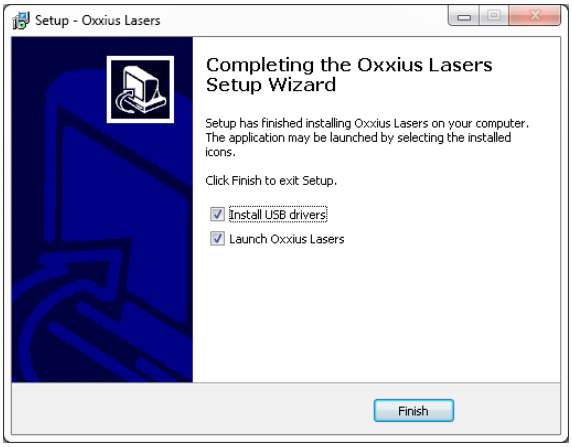


Click « Next » twice.



Click « Next », then “Install”.

The last step of the installation suggests to install the USB drivers (see the screenshot below). Proceed to 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.

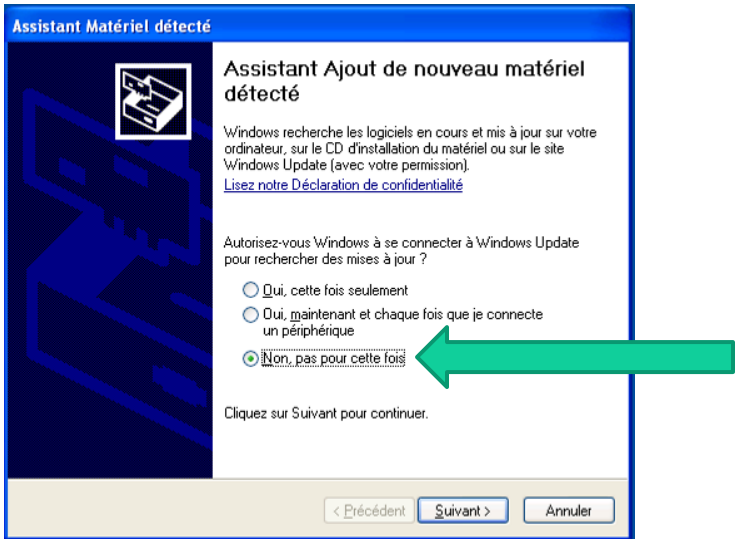
Press “Finish” to close the wizard and complete the installation.

STEP 2: DRIVERS FOR USB COMMUNICATION

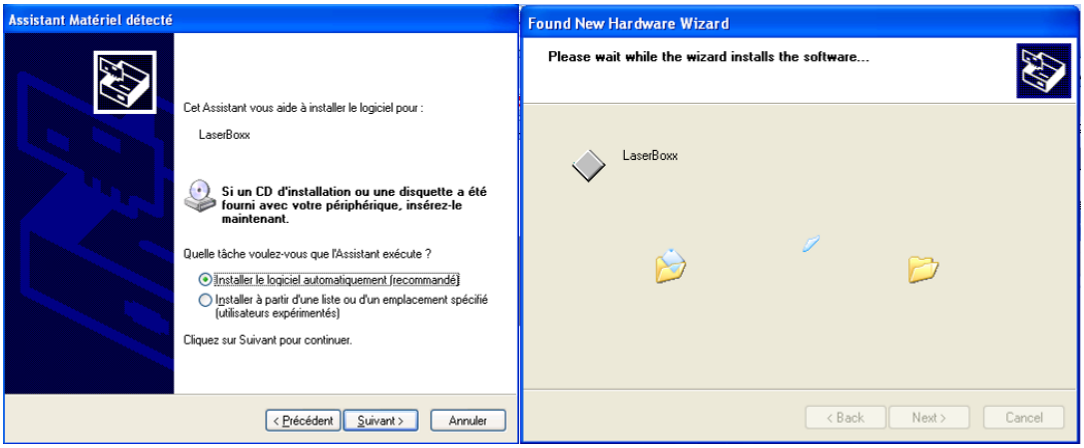
Using the USB interface of a Laserboxx unit will first require that this former is detected by the operating system.

- Connect the USB cable between your laser unit (laser head) on one end, and your computer on the other end,
- Turn on the supply voltage of the laser source,
- 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 highlighted in the screenshot below),

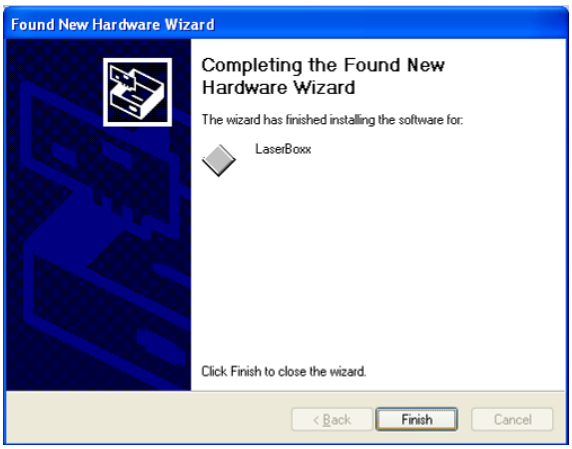


Force your operating system to install the software automatically:



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 wish to connect.

3. OPERATION

This section describes the principle of operation of the LBX, as well as the way to operate it.

3-1 Principle of operation

The LBX integrates a laser diode as its emitter. This diode is stabilize in temperature in order to guarantee a stable operation.

The LBX can be operated either at constant current or at constant power (henceforth referred as “ACC” and “APC” modes). See section 4-2 for detailed information.

3-2 Powering the unit on and releasing the laser emission

- 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. The laser head will instantly work to stabilize the temperature of its inner elements. At the same time, RS-232 and USB communications will be accessible.

- Make sure that the interlock circuit is closed, by either checking your own installation or by using the dedicated wire.

WARNING

At this stage, make sure that the necessary measures are taken to guarantee the safety of any personnel potentially exposed to the laser radiation. Refer to section 1 for more detailed recommendations.

- Turn the actuated key master control clockwise until the end stop. The laser emission indicator will light up in solid white, warning about the potential emission. At the same time, the status indicator will blink and the start-up sequence will begin; this may take up to 2 minutes.

- Once the status indicator has turned in solid green, the laser is emitting and its operation is stable. Open the shutter to release the laser beam.

3-3 Power tuning and modulation

The LBX supports power tuning. This consists in adjusting the diode current according to the set point entered by the user.

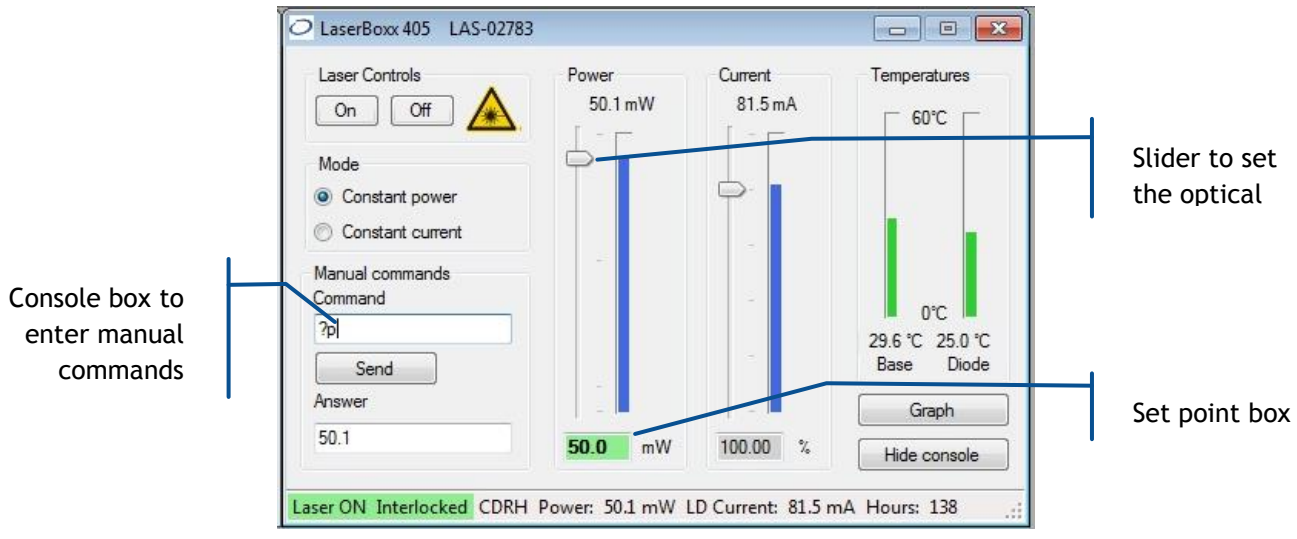
POWER TUNING USING THE CONTROLBOXX

Rotate the front knob of the ControlBoxx to adjust the power. Clockwise rotation will increase the power; the full range spans over ten turns. The power can be adjusted from 0mW to a maximum value determined by the set point currently in use. By default (factory setting), this maximum value is equal to the unit's nominal power.

POWER SET POINT ENTERED FROM THE GRAPHIC USER INTERFACE

It is possible to enter a new current 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



POWER TUNING USING 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).

POWER TUNING USING THE EXTERNAL ANALOG MODULATION

Changing the power set point is also possible by modulating the current according to a set point provided by an external source of voltage (between 0V and 5V).

Please note that this is the very function that is in use when the user is changing the power by rotating the front knob of the ControlBoxx.

Note also that a voltage of 0V will result in a nil power, while a voltage of 5V will have the LBX emitting according to the power (or current) **set point currently in use**.

To use this modulation function, proceed as follows:

- First locate the “Analog modulation” frame on the control panel (referring to figure 4-1), then select “Enable”,
- On the same control panel, select the power or current set point that will define the highest power level to be released,
- Locate the input terminal, depending on your configuration:
    - If you are using the ControlBoxx controller, the modulation input socket is located on its rear panel (refer to figure 2-8). You will then need to turn the source selection switch (located on the front panel, see figure 2-7) to “Analog In”.
    - If you are using the RemoteBoxx controller, apply your signal to pin number 6 of the “Input/Output” connector (referring to figure 2-10 and table 4-4)
    - If you are driving the laser head directly, apply your signal to pin number 8 of the DE-15 HD connector (referring to table 4-5)

- The power (or current) will now be released in proportion to the voltage applied on the analog input.

Pressing “disable” on the “Analog modulation” frame on the control panel frame will return to the internal setting: the user-defined, digital set point.

Refer to section 4-2 for detailed characteristics of the modulation functions.

DIGITAL HIGH SPEED MODULATION

It is possible to modulate the output power according to digital (TTL) signals ("on" or "off" states).

A TTL "low" voltage will result in a nil power, while TTL "high" voltage will have the LBX emitting according to the **current set point in use**.

To use this modulation function, proceed as follows:

- First locate the "Digital modulation" frame on the control panel (referring to figure 4-1), then select "Enable",
- Locate the "Mode" frame on the control panel (referring to figure 4-1), then select "Constant current",
- On the same control panel, select the power or current set point that will define the highest current to be released,
- Locate the input socket on the rear panel of the laser head (see figure 2-4) and apply your signal to this terminal,
- The current will now be modulated according to the input signal.

Pressing "disable" on the "Digital modulation" frame on the control panel frame will return to the internal current setting: the user-defined, digital set point.

Refer to section 4-2 for detailed characteristics of the modulation functions.

3-4 Turning the emission off and powering off the unit

- Close the shutter to secure your set-up,
- You can to turn the emission off using any of these methods:
  - On the controller, turn the actuated key master control counter-clockwise.
  - Send the software command "L 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).
- Once the emission is turned off, turn off the power switch on the controller. RS-232 and USB communication will no longer operate.
- Disconnect the power supply feeding the controller (and the heatsink if present) from your mains socket.

RESUMING THE EMISSION AFTER AN UNCOMMON INTERRUPTION

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.

Any of the following actions will unlock the unit:

- Using controller (ControlBoxx or RemoteBoxx), turn the actuated key master control back to its “OFF position”
- Using RS-232 or USB communication port, send the command “DL 0” or “RST”
- Using the software interface, re-activate the laser using the button ‘Reset’

4. ADVANCED OPERATIONS

This section provides detailed information and descriptions about the control software, the modulation functions, the electrical interfaces, the optional fiber coupling.

4-1 Using Oxxius software to operate the LaserBoxx

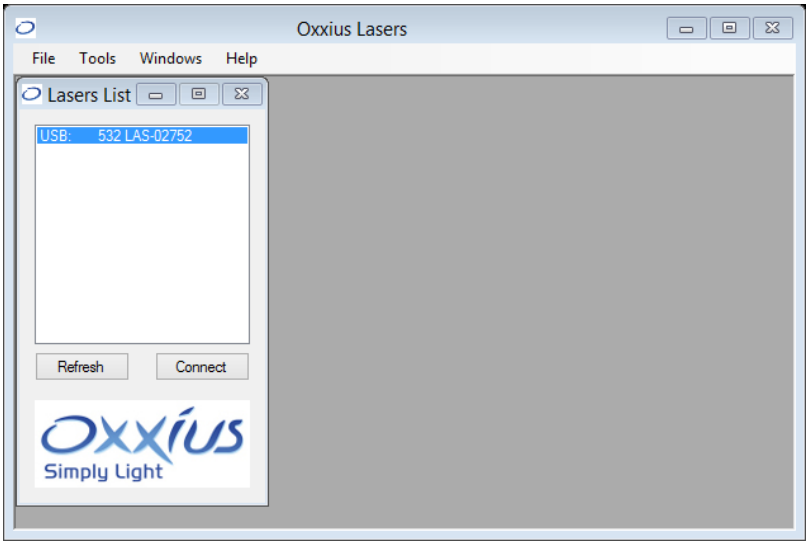
INSTALLING THE SOFTWARE SUITE

Refer to section 2, paragraph 2-6 to install the command software and the necessary drivers.

DESCRIPTION OF THE INTERFACE PANEL

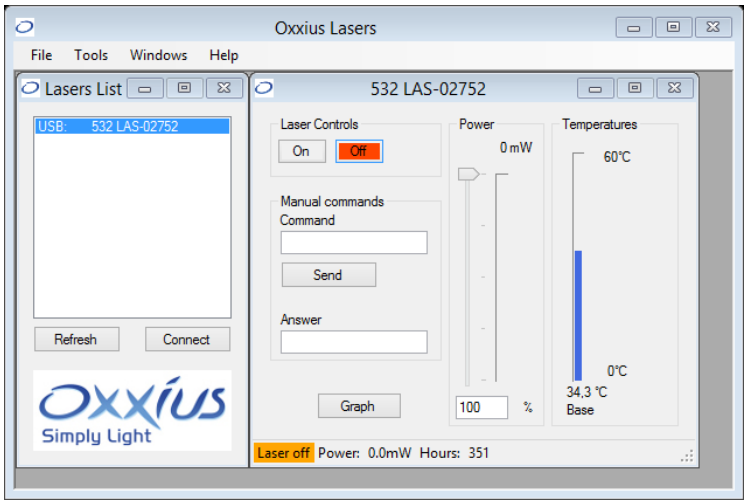
Once executed, the software will open a frame listing the LaserBoxx units detected on the computer:

- Units connected through USB appear automatically on the laser list,
- Units connected through any RS-232 port must be scanned manually. To do so, press the "Refresh" button located on the bottom left of the frame.



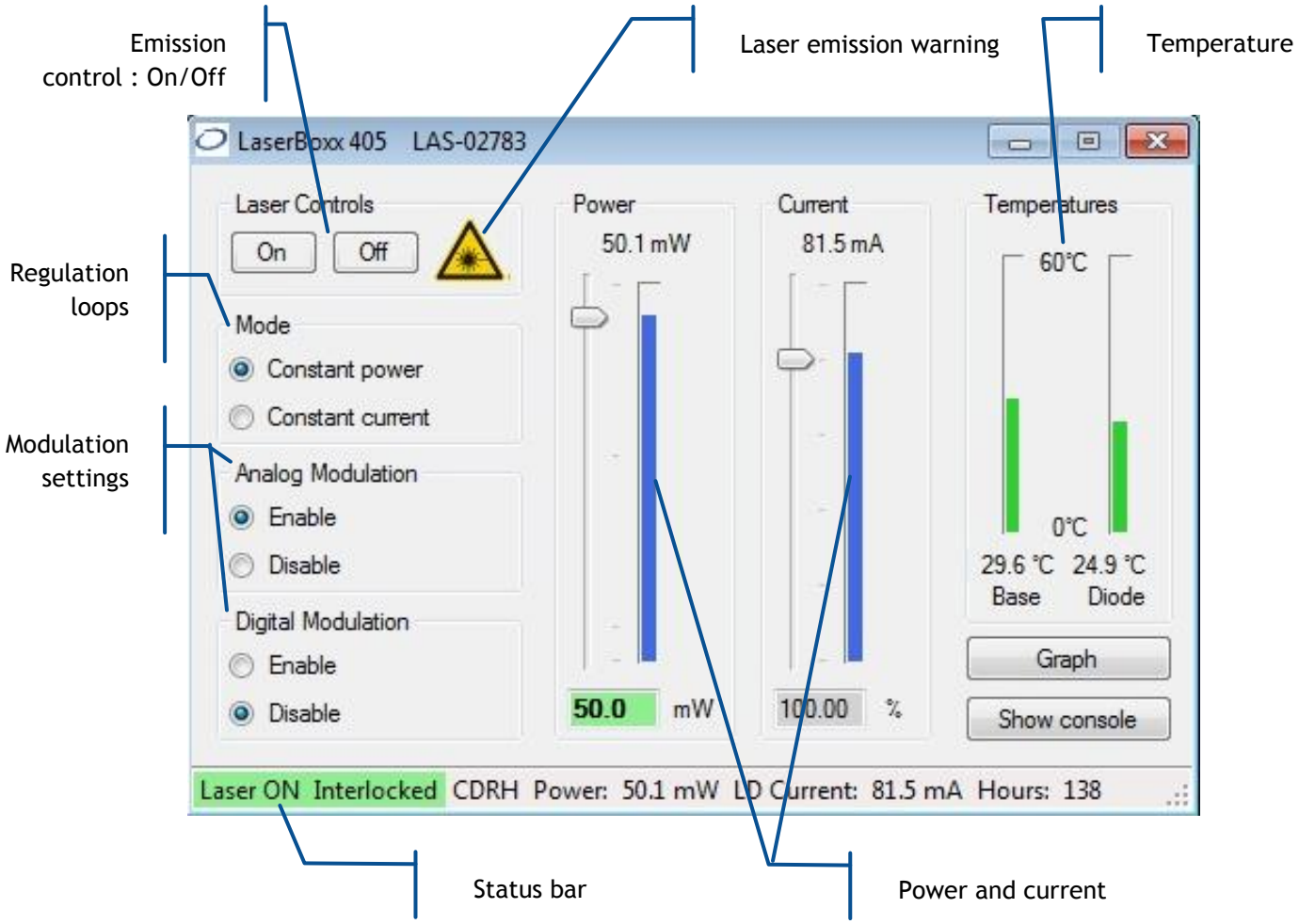
Each laser is identified on the list by its communication port, model, emission wavelength and serial number.

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



DESCRIPTION OF THE CONTROL PANEL

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



The control panel consists of the following elements:

- Buttons to control the laser emission,
- A picture indicating the emission (laser radiation warning),
- Boxes to send and receive software commands,
- Indicators displaying the measured output power, diode current and the monitored temperatures,
- Boxes and sliders to modify the output power and the diode current,
- A status bar to indicate the laser status, the output power, and the total hours of emission

EMISSION CONTROL

To start the emission, click on the "On" button. Click on the "Off" button to stop it. The standardized laser pictogram informs the user about the potential radiation hazard.

Priority management to command the emission

The "Laser controls" buttons on the GUI and the "laser enable" pin both drive the laser emission. As a result a priority scheme is enforced to avoid conflicts:

- On start-up, the unit to the "enable" pin (although this pin is not directly accessible on "Plug and Play" configurations),
- As soon as one of the "Laser controls" buttons is pressed, or one of the "enable" software commands ("L 0", "L 1") is sent, the priority is given to these software commands and consequently the "enable" pin is overridden,
- Two possibilities are available to revert this situation: either by sending the command "RST 0" to the laser, or by turning off the supply power. Refer also to section 7, annex A.

REGULATION AND MODULATION SETTINGS

The available regulation loops are either "constant current" (also named "automatic current control", or ACC mode), or "constant power" (also named "automatic power control", or APC mode).

The modulation settings allow the user to enable or disable the analog and digital modulations.

Refer to the paragraph 4-2 for detailed information about the regulation loops and the available modulation functions.

CURRENT SETTING

The diode current can be adjusted using the slider or entering a set-point into the box at the bottom of the level bar.

MONITORING

The measured optical power is displayed on the central bar of the frame.

The temperature of both the laser base plate and the diode emitter are displayed on the right hand side of the frame.

The status bar contains the following information (from left to right):

- The status of the laser unit (refer to section for a detailed explanation about those status),
- The status of the “CDRH” variable (refer to section), indicating whether the safety delay is enforced or not,
- The measured optical power,
- The measured current,
- The total number of emission hours

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. Click on the “Console” button to make the console box appear, then type your query inside the box, and finally press “Enter” or press the button “Send”. Answers are displayed in the box immediately below.

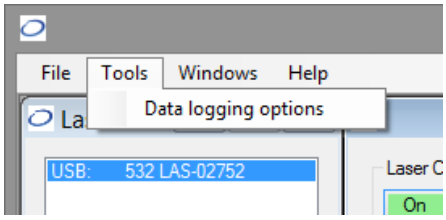
- The laser unit will answer “OK” to a command which has been acknowledged,
- A query which has been acknowledged by the laser returns the queried value or chain of characters
- The laser unit will answer “????” to a query or command which syntax is not understood.

Please refer to the Annex A, “software commands” for the list of these queries and commands.

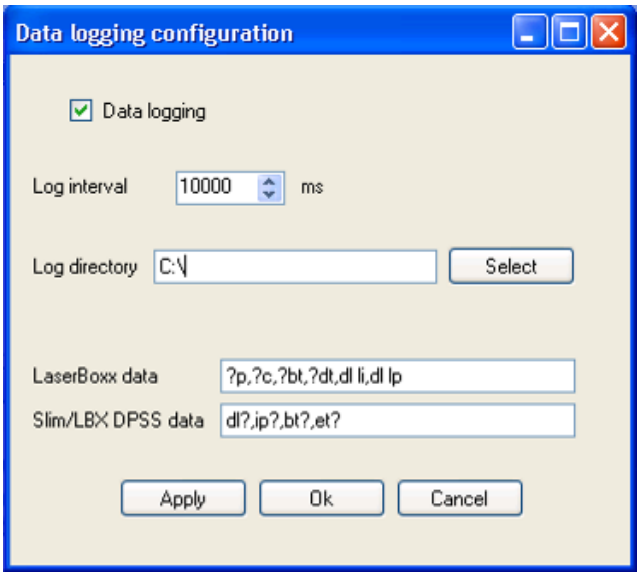
DATA LOGGING

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.

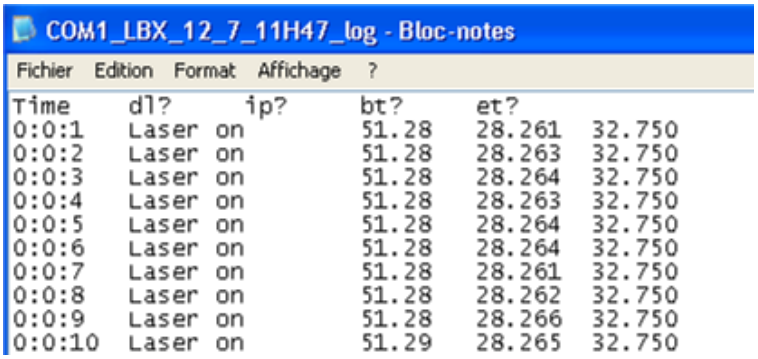


From top to bottom, here are the elements present inside this window:

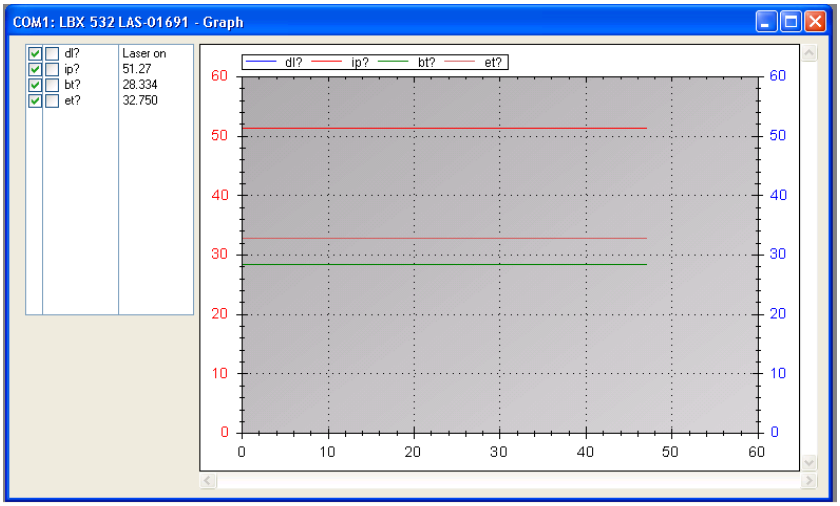
- Tick the box called “Data logging” to enable or disable data logging,
- The “log interval” determines how often the LaserBoxx will be polled for data. The default value is “1000 ms”.
- The “log directory” is where the record file will be created and the data will be saved. Click on the “Select” button 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 initialized.
- 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:



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

Bit rate	19200 bauds
Data bits	8
Parity	None
Stop bit	1

Flow control	None

Table 4-3: 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 section 7, annex B, “software commands” for the exhaustive list of the commands and queries.

COMMUNICATION OVER USB AND EXAMPLE PROGRAMS

Oxxius supplies a library that can be used to drive any LaserBoxx using the USB port. It can be used with either Visual C++, Visual C#, Visual Basic, Labview or any other languages supporting “.NET” libraries.

This library is located on the USB Flash drive shipped along each “Plug and Play” LaserBoxx (refer to table 2-2).

Additionally, this Flash drive also contains the corresponding documentation for this library (file “LaserBoxxUsbHelp.chm”), as well as a simple application program based on Labview version 8.6.

VIRTUAL SERIAL PORT

It is possible to turn the USB port into virtual serial port, so as to drive the LaserBoxx unit using only RS-232 commands. To do so, send the command “CDC 1” (CDC, <space>, 1) to your unit, then toggle its power supply off and on.

The command “CDC 0” reverts this setting.

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 Modulation in details

This chapter will provide detailed information about the regulation loops, power tuning and the modulation functions.

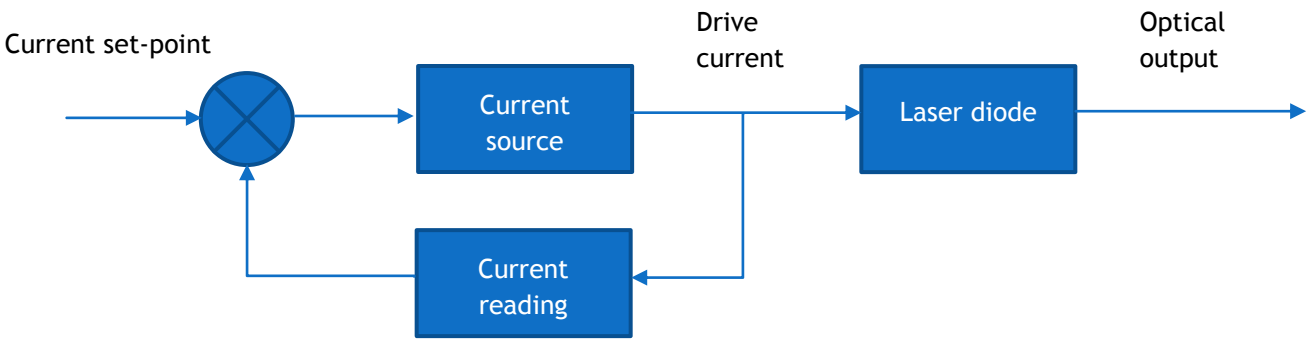
REGULATION LOOPS

The LaserBoxx laser sources operate by releasing an optical signal against a given set point. Two different loops exist to regulate the optical signal.

AUTOMATIC CURRENT CONTROL (ACC)

Using this control loop, the user sets a pump current that will drive the laser diode. The control loop consists in acting so that the actual current is equal to the user-defined set-point.

Here is the block diagram of the ACC loop:

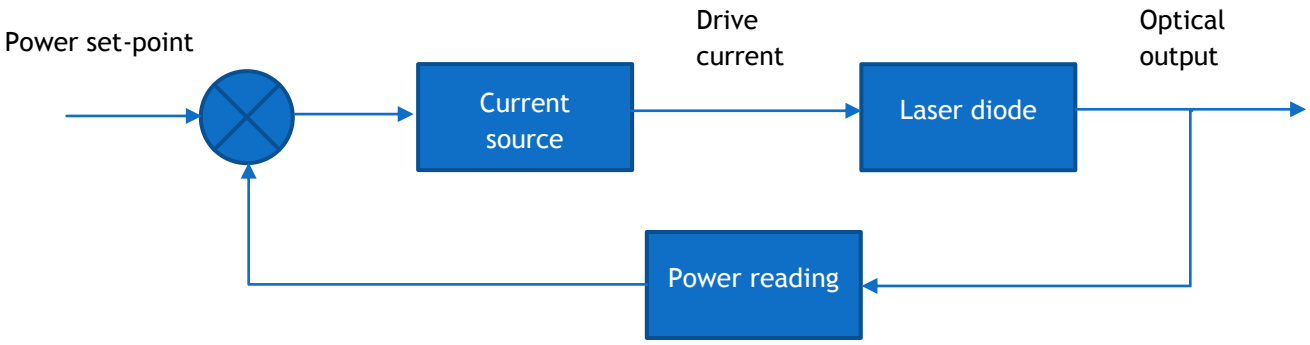


The ACC loop allows for a tight control over both the current and the temperature of the laser diode, and is therefore advisable in applications where, for example, a good wavelength stability is required.

AUTOMATIC POWER CONTROL (APC)

Using this control loop, the user sets the optical power to be released by the laser head. 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.

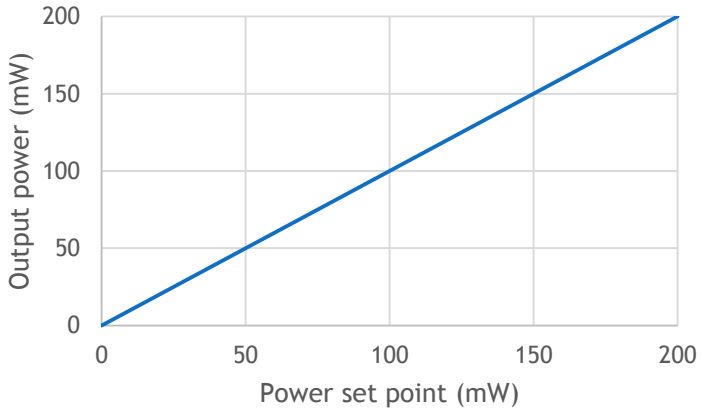
POWER/CURRENT AND MODULATION CHARACTERISTICS

Here are the typical characteristic functions obtained when driving the laser using one of these methods:

- setting an internal (=software) set point,
- using an external signal for analog modulation,
- using an external signal for digital modulation

APC MODE, INTERNAL SET POINT

Here is a typical characteristic curve of a LBX driven by an internal set point, in APC mode:



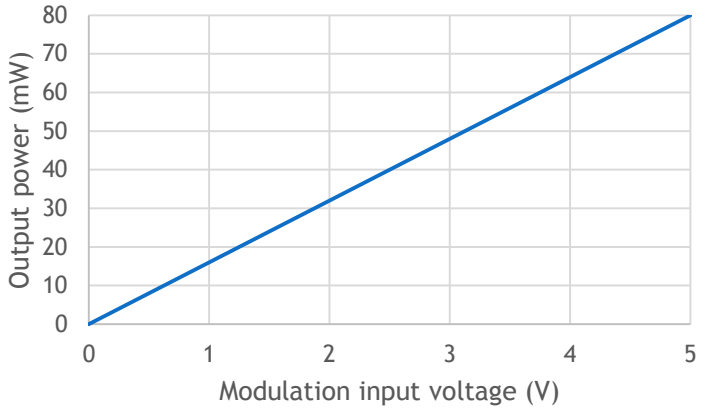
The characteristic curve is linear between 0mW and the nominal power, the effect of the APC loop being that the monitored power is strictly equal to the power set point. Note that the exact value of

the nominal power (200mW in the example above) is specified on the manufacturing test report of each LBX unit.

Reading or setting the optical power in done in milliwatt.

APC MODE, ANALOG MODULATION

Here is a typical characteristic curve of a LBX driven by an external voltage, in APC mode:



The characteristic curve is linear between 0V and 5V, the maximum reachable value being the last internal set point entered (80mW in the example above).

This analog function is also used when the LBX is driven by the ControlBoxx controller. As a consequence, modifying the power set point prior to using the ControlBoxx will allow the user to tune the output power more accurately between 0mW and this set point.

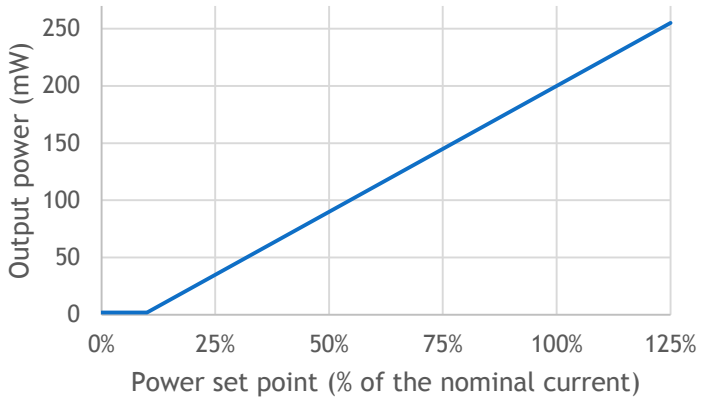
Standard specifications of this modulation function are as follows:

Rise time / fall time	≤ 200ns (APC mode)
Bandwidth at 3dB cut-off frequency	1 MHz (APC mode)
Modulation depth at 0Hz	Infinite (total extinction)
Input impedance	1.4 kΩ
Input signal range	0V to 5V

Refer to the specifications of your LBX model for exact speed and modulation characteristics.

ACC MODE, INTERNAL SET POINT

Here is a typical characteristic curve of a LBX driven by an internal set point, in ACC mode:



The characteristic curve is as follows:

- The output power almost nil between 0mA and the threshold current,
- From the threshold current and above, the relationship between the current and the optical power is linear
- The maximum allowable value is 125% of the nominal current

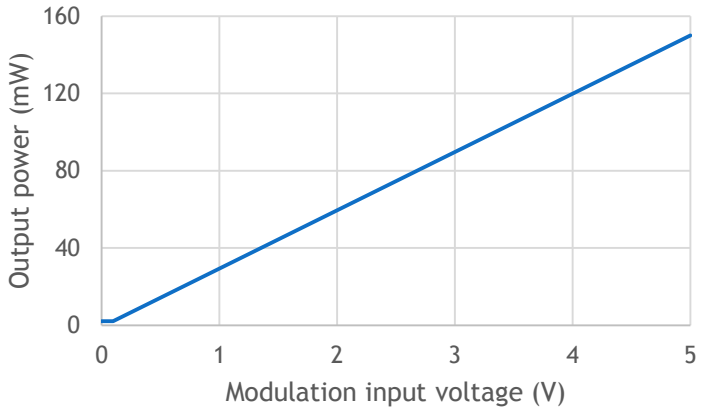
The value of the threshold current is highly model-dependent, there is no typical value for it. The nominal current is defined as the current that causes the LBX to emit at nominal power (200mW in the example above).

When setting the current, the unit used is the percentage of the nominal current. When reading the current, the returned value is expressed in milliAmperes.

Although the setting of “100%” is designed to drive the LBX at nominal power at the beginning of the unit’s lifespan, the user is allowed to set this current up to 125% of the nominal current in order to cope for a potential loss of efficiency due to aging.

ACC MODE, ANALOG MODULATION

Here is a typical characteristic curve of a LBX driven by an external voltage, in ACC mode:



The characteristic curve is as follows:

- The output power almost nil between 0V and a threshold voltage (unit-dependent),
- From that threshold voltage and above, the relationship between the input voltage and the optical power is linear

The units are optimized so that their threshold voltage is set to the lowest possible value, typically 0.1V.

The maximum reachable value is the last current set point entered (80% in this example).

Standard specifications of this modulation function are as follows:

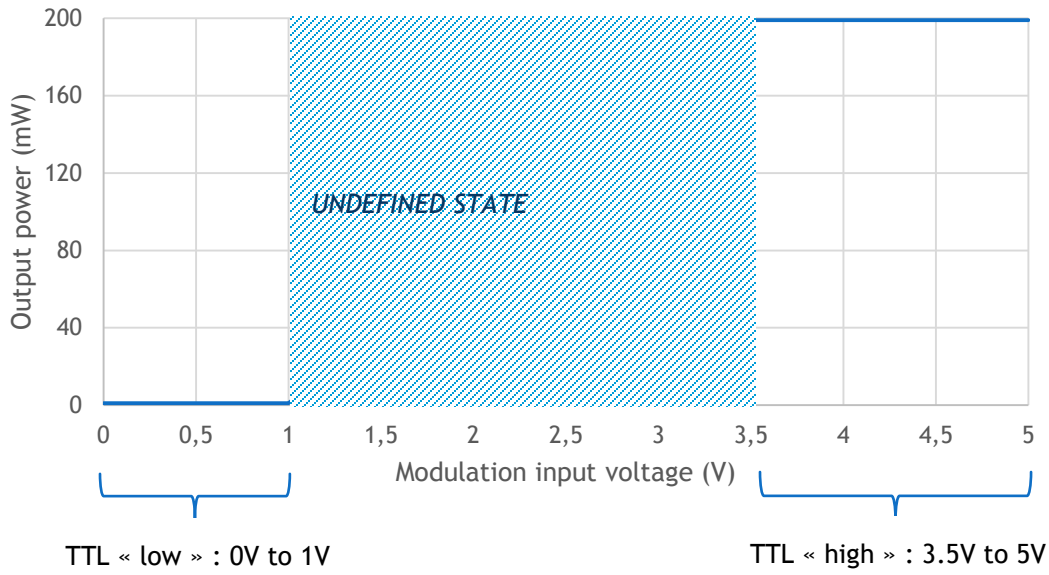
Rise time / fall time	≤ 150ns (ACC mode)
Bandwidth at 3dB cut-off frequency	3 MHz (ACC mode)
Modulation depth at 0Hz	Infinite (total extinction)
Input impedance	1.4 kΩ
Input signal range	0V to 5V

Refer to the specifications of your LBX model for exact speed and modulation characteristics.

DIGITAL HIGH-SPEED MODULATION, ACC MODE

The digital modulation allows for a high-speed, binary modulation driven by a signal to be applied on the rear panel of the laser head (see section 3-3 for the procedure).

Here is a typical characteristic curve of a LBX modulated by this scheme, in ACC mode:



A TTL “low” voltage will result in a nil power, while TTL “high” voltage will have the LBX emitting according to the last current set point entered.

Standard specifications of this modulation function are as follows:

Terminal	Core of the SMB female socket
Rise time / fall time	≤ 2ns
Bandwidth at 3dB cut-off frequency	150 MHz
Modulation depth at 0Hz	Infinite (total extinction)
Input impedance	50 Ω
TTL low input	0V to 1V
TTL high input	3.5V to 5V

Refer to the specifications of your LBX model for exact speed and modulation characteristics.

DIGITAL MODULATION USING “ENABLE”

The “enable” signal can be used to apply a digital modulation on the optical signal, either in APC or ACC mode.

The typical characteristic curve of this modulation is the same as in the case of the high-speed digital modulation (see the previous paragraph). A TTL “low” voltage will result in a nil power, while TTL “high” voltage will have the LBX emitting according to the last current (or power) set point entered.

The standard specifications of this modulation function are as follows:

Terminal	Pin 2 of the DE-15 HD connector
Rise time / fall time	≤ 1 µs
Bandwidth at 3dB cut-off frequency	1 kHz
Modulation depth at 0Hz	Infinite (total extinction)
Input impedance	10 kΩ
TTL low input	0V to 1V
TTL high input	3.5V to 4.5V

Refer also to the following chapter “4-3 Operating the laser using an electronic interface”.

4-3 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

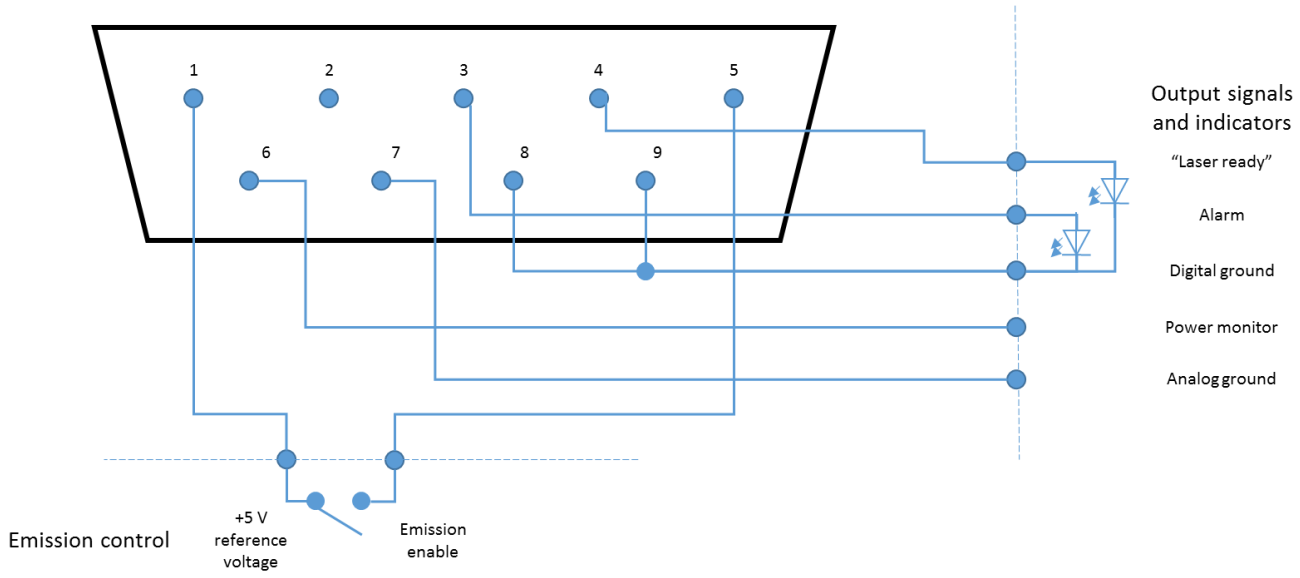
Here are the signals present on the “Input/Output” interface of the ControlBoxx:

Table 4-4: Pin assignment of the ControlBoxx interface

Pin number	Name and function	Direction	Description	Drive or load
1	+5V DC	Output	5V reference voltage	10 mA maximum
2	Not connected			
3	Alarm	Output	TTL Low: No alarm TTL High: An alarm is raised	2 kΩ, available to supply a LED (2mA)
4	Laser Status	Output	Blinking (for units in Plug and Play configuration): Emission is not stable TTL High: Emission is ready	2 kΩ, available to supply a LED (2mA)

5	Laser Enable	Input	TTL Low = Emission is enabled TTL High= Emission is disabled Note that this pin is overridden by the software commands “DL”. See the paragraph 4-1 “Emission control”	10 kΩ pulled up
6	Laser Power Out	Output	Voltage between 0 to 2V maximum. Note: The maximum voltage may vary between units.	2.5 kΩ
7	Analog Ground	Ground	Ground for analog signals (pin 6 and BNC socket)	
8 and 9	Power supply GND	Ground	Ground for pins 1, 3, 4, 5.	
Shell	Power supply GND	Ground	Ground for pins 1, 3, 4, 5.	

The following diagram presents an example of interfacing:



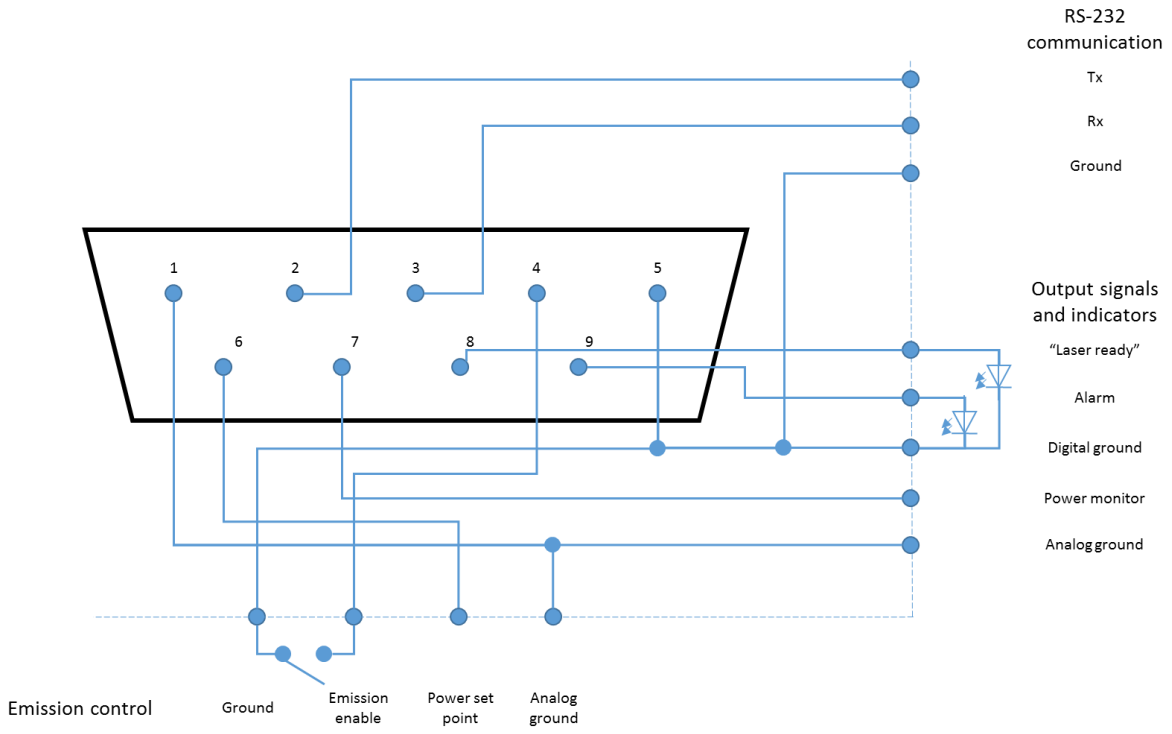
INTERFACING WITH THE REMOTEBOXX

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

Table 4-5: Pin assignment of the RemoteBoxx interface

Pin number	Signal name and function	Direction	Description	Drive or load
1	Analog ground	Ground	Analog ground of pin number 6	
2	Tx	Output	RS-232 Tx port	
3	Rx	Input	RS-232 Rx port	
4	“Laser enable” TTL low: Emission off TTL high: Emission on	Input	Enables or disables the emission.	10 kΩ , pulled up
5	Digital ground	Ground	Digital ground for pin number 2 and 3	
6	Power adjustement	Input	The power or current set point is proportional to the input voltage. Refer to section 3, “Operation” for detailed information	1.4 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 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	2 kΩ, available to supply a LED (2mA)
9	Alarm TTL low: Normal TTL high:Default	Output	Indicates the presence of an alarm. A LED can be connected directly to this output	2 kΩ, available to supply a LED (2mA)

The following diagram presents an example of interfacing:



INTERFACING WITH 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.

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”.

Table 4-6: Pin assignment of the DE-15 HD interface

Pin number	Name and function	Direction	Description	Drive or load
1	Actuated key master control	Input	TTL Low: No emission is possible TTL High: Laser emission is possible for: - Class 3b units in Plug and Play configuration - Any unit in OEM configuration (command “CDRH=0”, refer also to paragraph 7-A) TTL rising edge: Class 4 units in Plug and Play configuration Refer to paragraph 1-1, “Actuated key master control” for detailed information.	10 kΩ pulled down
2	Laser Enable	Input	TTL Low = Emission is enabled TTL High= Emission is disabled Note that this pin is overridden by the software commands “DL”. See the paragraph 4-1 “Emission control”	10 kΩ pulled up

3	Interlock	Input	TTL Low, or left open: Laser emission is not possible. An error is raised. TTL High: Laser emission is possible	10 kΩ pulled 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: An alarm is raised	2 kΩ, available to supply a LED (2mA)
8	Analog modulation	Input	0V to 5V DC (0% to 100% of the power or current)	1.4 kΩ
9	+5V DC	Output	5V reference voltage	10 mA maximum
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)	2.5 A maximum
13	Power Supply GND	Ground	Ground for pin 11 and 12	Ground
14	Laser Power Out	Output	Voltage between 0 to 2V maximum. Note: The maximum voltage may vary between units.	2 kΩ
15	Laser Status	Output	TTL Low (for units in OEM configuration): Emission is not stable Blinking (for units in Plug and Play configuration): Emission is not stable TTL High: Emission is ready	2 kΩ, available to supply a LED (2mA)

Shell	Chassis Ground		Ground	

NOTE CONCERNING THE SUPPLY PINS

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.

4-3 LaserBoxx with fiber-coupling

When a LaserBoxx is provided with a fiber coupling option, a 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, an optimization of 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”.

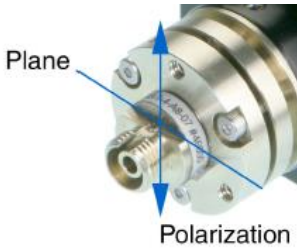
- Measurement material:
  - Check that your powermeter is set to the correct wavelength, or check its calibration.

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.

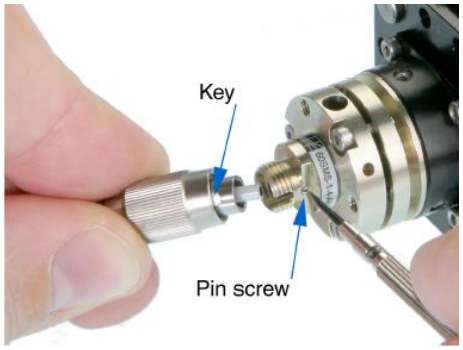


Attaching a single mode fiber cable to the laser beam coupler

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 4-6). Failing to do so can damage the connector;
- Approach the fiber connector at an angle (as shown on Figure 4-6) 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 4-7: Pin screw (coupler side) and connector's key



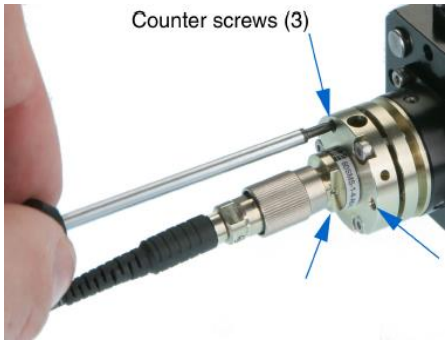
FINDING A SIGNAL

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 4-7) are loosened by 2 or 3 full turns.

Figure 4-8: Position of the counter-screws



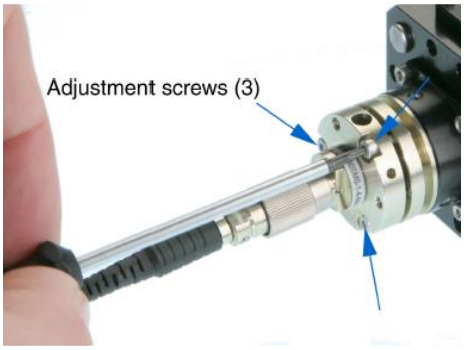
- Power up the laser, set the optical output to a value below 50mW and turn the emission on;

CAUTION

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 4-8) 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 4-9: 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 4-7)

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.

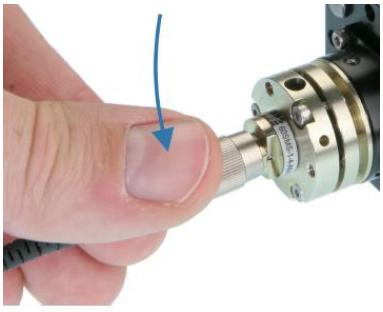
You can now gradually increase the output power up to its nominal set point. As a final check, make sure that the transmission ratio has not decreased.

CHECKING THE ALIGNMENT

A possible way to check the alignment's robustness is by pressing gently on the connector in all directions (see Figure 4-9): 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 4-10: Checking the stability of the adjustement



COUPLING ON A MULTI-MODE FIBER

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

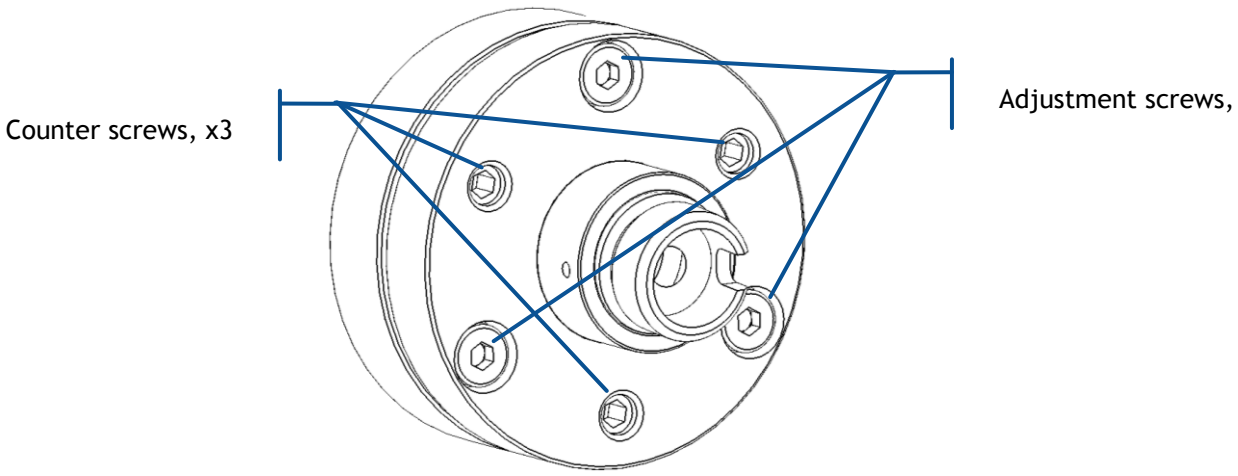
The coupler consists of a mechanical holder positioned inside the laser shutter. Refer to section 2-4 for a description of the laser shutter. On the front face of the holder are the screws that will define the alignment of the fiber against the beam. See figure 4-10.

This procedure explains how to retrieve an optimal coupling efficiency.

WARNING

To avoid damaging the fiber end face, the following adjustment procedure should be performed at low optical power (P ≤ 40 mW), using the "alignment mode" low power beam (refer to section 3, "Operation" for detailed information).

Figure 4-11: Position of the adjustement screws and counter-screws



- The mechanical holder has been centered with regards to the beam (using the positioning screws of the shutter). This operation is performed at Oxxius and we recommend not to disturb this positioning.

- Unscrew slightly each counter screws by two turns,

- The next steps consists in maximizing the signal's power by turning the adjustement screws one by one:

    - Start with one adjustment screw and steer it slowly until the optical signal reaches a relative maximum. Continue steering this screw a little more so that the power decreases by a few percents.
    - Repeat the operation with the next adjustment screws, proceeding using the same maneuver. After having the three screws adjusted, start a second round and re-adjust the first screw, and so on. Make sure to always adjust the screws in the same sequence (for example, (1) -> (2) -> (3) -> (1) -> (2) -> (3)). The maximum power level is typically achieved after three rounds of adjustment.

- Secure the optimum position (at maximal power) by tightening the counter screws,

- Your transmission ratio is now maximized

5. TROUBLESHOOTING

5-1 Emission interrupted by an alarm

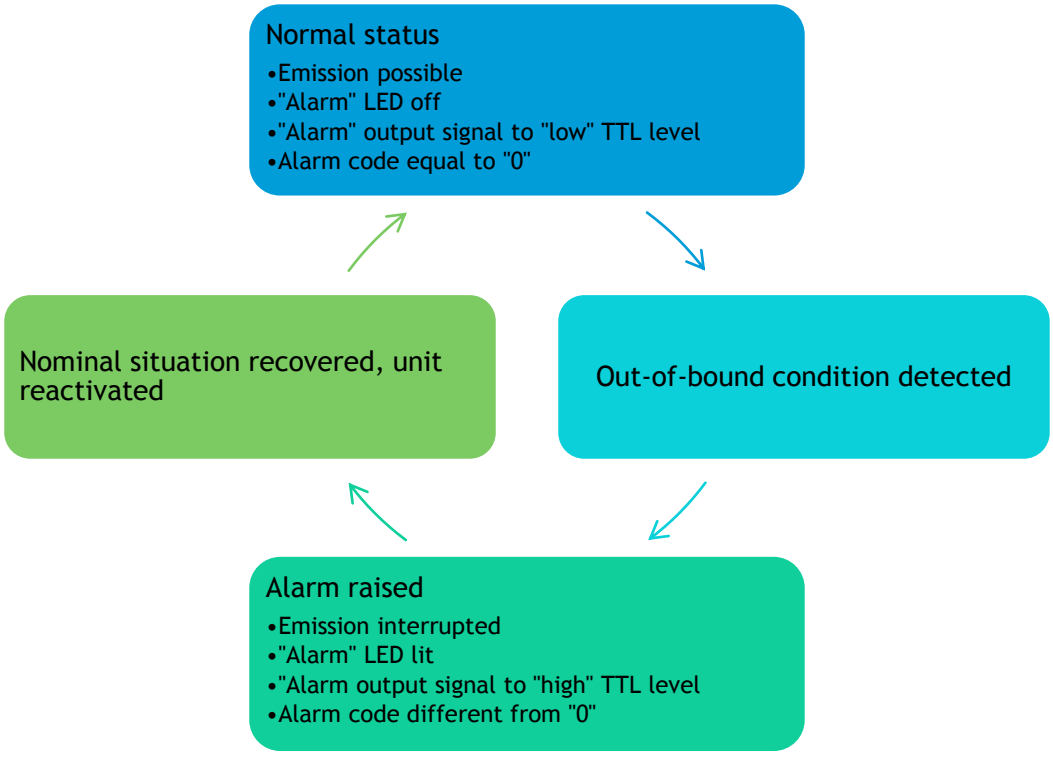
Alarms are a category of status informing of off-limits operational conditions. When an alarm is raised, laser operation is not possible until the cause of the alarm is fixed. Resuming the emission requires that the unit is re-activated by the emission key.

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

- the “Alarm” LED in solid red on the ControlBoxx or RemoteBoxx controller,
- the alarm electrical signal raised on either electronic interface (on either the controller or the laser head),
- the software query “AL?” return the specific alarm code (first column of table 5-2 below)

The alarm sequences are summarized in the following chart:

Firgure 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 code	Description	Cause for the alarm	Action required
0	No alarm	None	None
1	Diode current	The diode current has exceeded the maximum allowable current (see to the corresponding query listed in paragraph 7-A). Most likely raised in APC mode, as the unit tries to reach the power set point by increasing the current.	In ACC mode, check that the current/power characteristic is as expected.
2	Laser power	The optical power has exceeded the maximum allowable power (see to the corresponding query listed in paragraph 7-A). Most likely raised in ACC mode as the optical power monitored by the unit exceed the expected value.	In ACC mode, check that the current/power characteristic is as expected.
3	Power supply alarm	The supply voltage of the unit is outside its specified range. Refer to paragraph 2-5 “Installing the BX” and to your specification sheet for allowable voltage ranges	Check the input voltage by either: - using the RS-232 command “VA?” - measuring the voltage at the input terminals of the laser head (see the paragraph 5-2 below)
4	Diode temperature	The temperature of the emitter cannot be regulated properly	Check the diode temperature using the query “?DT”.
5	Laser head temperature alarm	The base temperature of the laser head is outside its nominal range of]10°C , 50°C[	Check the effectiveness of the heat dissipation beneath the base plate (see paragraph 2-5). Refer to the specifications for allowable temperature ranges
7	Interlock	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. 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’

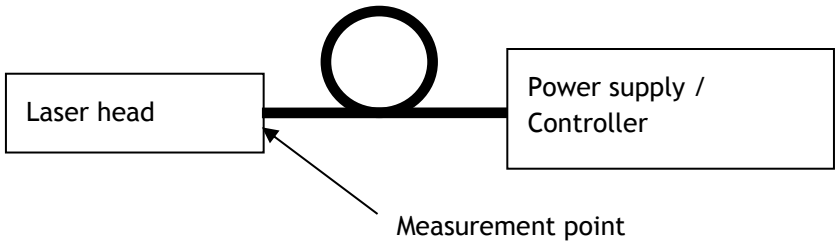
5-2 Issues with supply voltage

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 chapter 4-1 for detailed information about how to send queries.

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

The LBX units can be damaged by optical feedback.

This damage occurs on semiconductor laser diodes when their output is collimated and subsequently retro-reflected. In these conditions, the retro-reflected beam focuses back onto the laser diode facet and can create a power density high enough to melt this facet. This results in an irreversible degradation of the laser. Once this process begins it is not possible to repair the laser, moreover this failure mechanism is not covered under Oxxius’ standard warranty.

For this reason, Oxxius recommends the following precautions be taken when working with open beam laser modules:

1) All reflective surfaces in the optical path should be angled slightly so that surface reflections will not be retro-reflected,

2) Utilize angle-polished fibers when coupling the light into optical fibers,

3) Avoid using mirrors placed at normal incidence into the light path. If mirrors must be placed at normal incidence, use of an isolator is required.

4) Avoid focusing the beam the onto a mirrored surface without installing an isolator into the light path,

5) Avoid sweeping the beam back and forth across the laser during alignment operations (for example utilizing a retro-reflected beam to align through a pinhole in a confocal microscope). If such a possibility is unavoidable, use an isolator at the output of the laser diode during the alignment process to prevent permanently damaging the laser

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

6. WARRANTY AND CERTIFICATION

6-1 Standard warranty

Limited Lifetime Warranty

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

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

CE **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)

7. TECHNICAL DOCUMENTS

This section lists some principle of operation, the software commands and as well as the mechanical drawings of the laser head and its controller.

Annex A: Command and queries for the LBX

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 regulation loop. See also "?APC".	?ACC ?ANA	"1" when the ACC mode is set "0" when the ACC mode is not set
Retrieves the status for analog modulation	?AM ?EXT	"1" when the external modulation is engaged "0" when the set point is internal
Retrieves the regulation loop. See also "?ACC".	?APC	"1" when the APC mode is set "0" when the APC mode is not set
Retrieves the temperature of the base plate of the laser head	?BT	"22.1" for 22.1°C
Retrieves the monitored current of the laser diode	?C	"550.4" for 550.4 mA
Retrieves the status of CDRH-compliant five-second delay prior to laser emission. See section 1, "Safety information", for further details.	?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 status for digital high-speed modulation	?CW	"1" when engaged "0" when disabled
Retrieves the diode temperature set point.	?DST	"25.000" for 25.000°C
Retrieves the monitored diode temperature.	?DT	"25.0" for 25.0°C
Alarm codes: retrieves the cause of the last alarm raised (see also section "Troubleshooting" for more information about alarms)	?F	Returns a number corresponding to one of the following alarms: "0" : No alarm

		"1" : Diode current "2" : Laser power "3" : Power supply "4" : Diode temperature "5" : Base temperature "7" : Interlock
Retrieves the laser operation time, in hours	?HH	"49" for 49 hours. The increment interval in one minute.
Retrieves the unit's serial number and wavelength	?HID	"LAS-XXXXX,LLL", where XXXXX is the serial number (over five digits), and LLL is the central emission wavelength.
Retrieves the status of the interlock circuit	?INT ?LCK	"0" Interlock open, laser emission is not authorized "1" Interlock closed, laser emission is authorized
Retrieves the measured voltage suppling the laser head (expressed in Volts)	?IV	"6.601" for 6.601V.
Retrieves the emission status	?L	"0" Emission is off "1" Emission is on
Retrieves the maximum allowable laser current	?MAXLC	"1300.0" for 1300.0 mA
Retrieves the maximum allowable laser power	?MAXLP	"600.0" for 600.0 mW
Retrieves the measured optical power	?P	"53.6" for 53.6 mW
Retrieves the temperature of the microcontroller inside the laser head	?PST	"33.6" for 33.6°C
Retrieves the current set point	?SC	"400.0" for 400.0 mA
Retrieves the optical power set point	?SP	"40.0" for 40.0 mW
Queries the operating status (see section "Troubleshooting" for more information concerning the laser status)	?STA	?STA returns a number corresponding to one of the following status: "1" : Warm-up phase "2" : Stand-by phase "3" : Emission ON "4" : Internal error raised "5" : Alarm present "6" : Sleep mode (see also the query "?T")
Retrieves the version of the embedded software	?SV	"3.2.8" for firmware version 3.2.8
Retrieves the status of the temperature regulation loop	?T ?SS	"0" Temperature regulation loop is deactivated, unit is in "sleep" mode

		"1" Temperature regulation loop is activated

Purpose	Command (and aliases)	Syntax and examples
Sets the regulation loop (see also "APC")	ACC ANA	ACC 1 (ACC,<space>,1): set the ACC mode ACC 0 (ACC,<space>,0): set the APC mode
Sets the analog modulation	AM EXT	AM 1 (AM,<space>,1): enables the analog modulation AM 0 (AM,<space>,0): disables the analog modulation
Sets the regulation loop (see also "ACC")	APC	APC 1 (APC,<space>,1): set the APC mode APC 0 (APC,<space>,0): set the ACC mode
Sets the laser diode current, then saves this value as the new default.	C	C 40 (C,<space>,40) sets the optical power at 40% of the nominal current. Values allowed between 0% and 125%.
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.
Sets the laser diode current, but does not record this value in memory, thus sparing stress on the internal EEPROM. Prefer this command to "C" if you need to change the current at high frequency (ten times per second or higher).	CM	CM 40 (CM,<space>,40) sets the optical power at 40% of the nominal current. Values allowed between 0% and 125%.
Sets the digital high-speed modulation	CW	CW 1 (CW,<space>,1): disables the digital modulation CW 0 (CW,<space>,0): enables the digital modulation
Laser emission control	L	L 0 (L,<space>,0): switches the emission off L 1 (L,<space>,1): switches the emission on
Sets the laser power, then saves this value as the new default.	P	P 20 (P,<space>,20) sets the optical power at 20mW. Values allowed between 0 and the maximum power (see the query ?MAXLP).
Sets the laser power, but does not record this value in memory, thus sparing stress on the internal EEPROM. Prefer this command to "P" if you need to change the power at high frequency (ten times per second or higher).	PM	PM 20 (PM,<space>,20) sets the optical power at 20mW. Values allowed between 0 and the maximum power (see the query ?MAXLP).

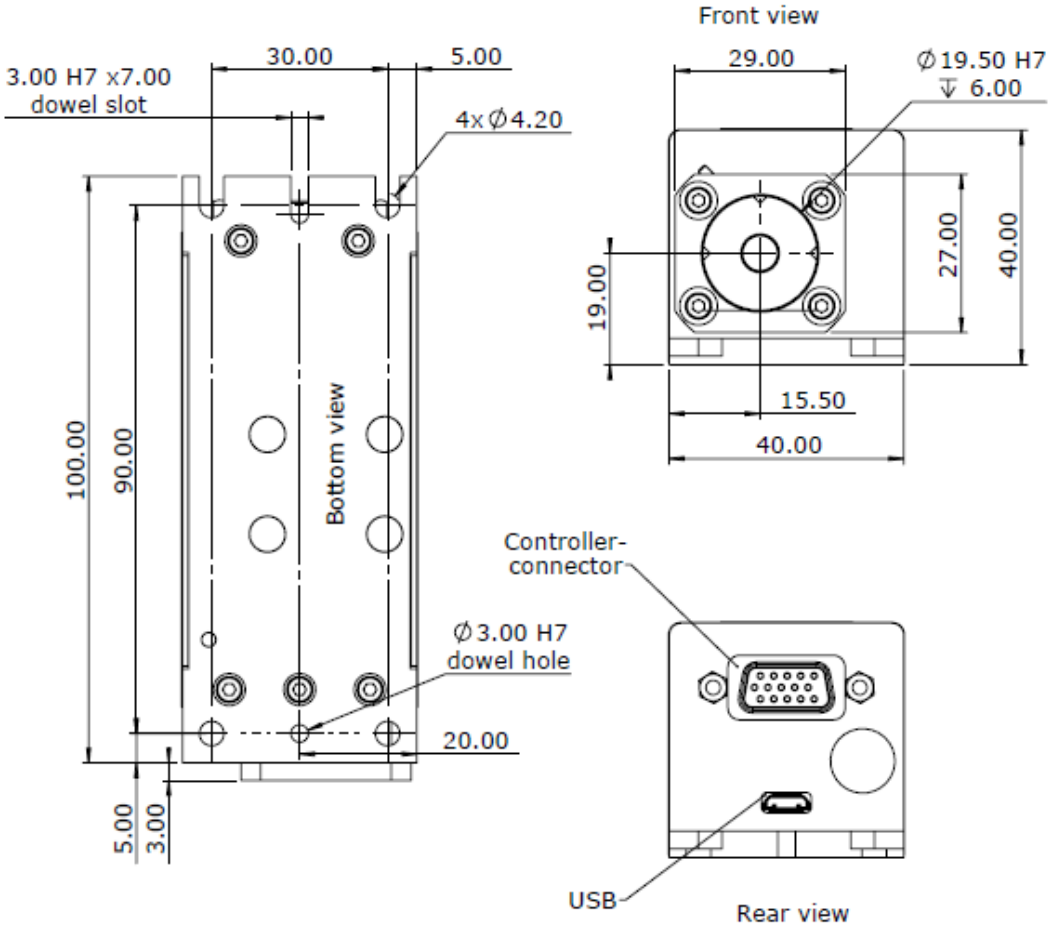
Clears the alarms	RST	`RST` clears any alarm (see chapter 3-4)
Resets the laser unit	RST	`RST 0` (RST,<space>,0): resets the laser unit (see chapter 4-1, paragraph “Emission control”
Switches the temperature regulation loop ON or OFF. This regulation loop is necessary for the emission to occur. Switching it off reduces the power consumption.	T	`T 0` (T,<space>,0): switches the regulation loop off, and sets the operating status to “sleep” mode (see “STA”). `T 1` (T,<space>,1): switches the regulation loop back on. The unit is no longer in “sleep” mode.
Sets the digital high-speed modulation	TTL	`TTL 1` (TTL,<space>,1): enables the digital modulation `TTL 0` (TTL,<space>,0): disables the digital modulation

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

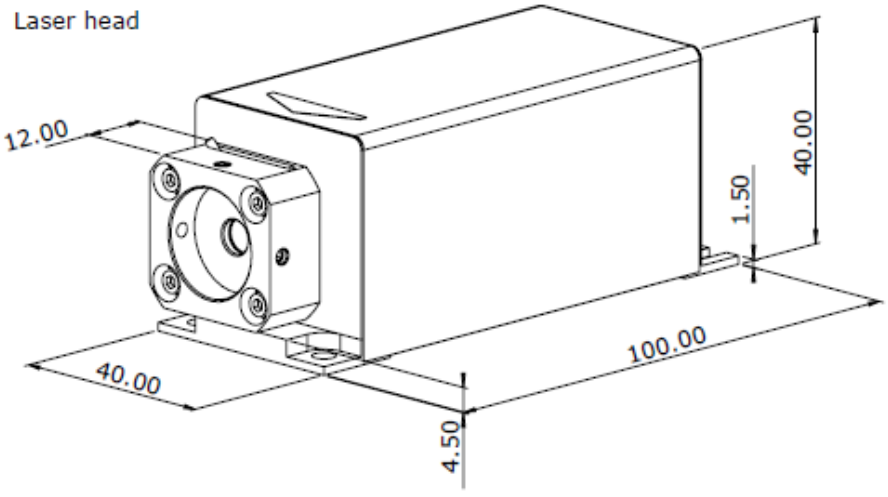
If the entered command or query is not understood by the unit, the following error message is returned: “`????`”

Annex B: Mechanical drawings

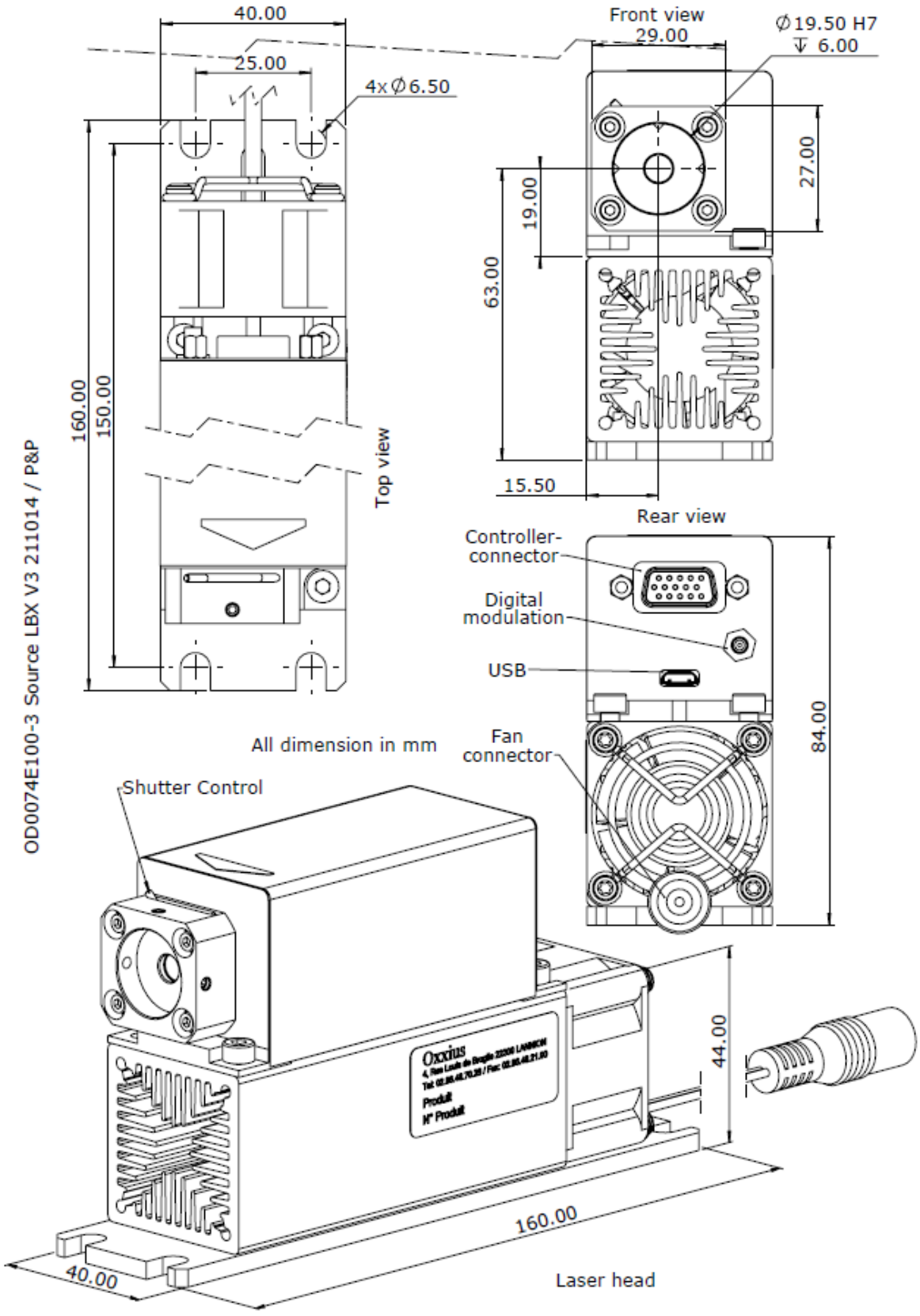
LBX LASER HEAD, PLUG AND PLAY VERSION



All dimension in mm

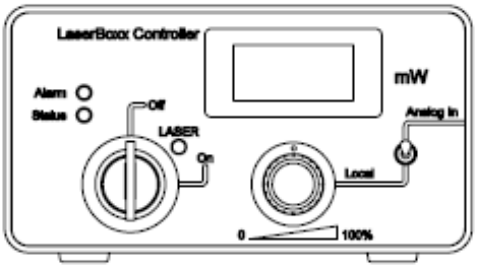


LBX LASER HEAD WITH HEATSINK, PLUG AND PLAY VERSION

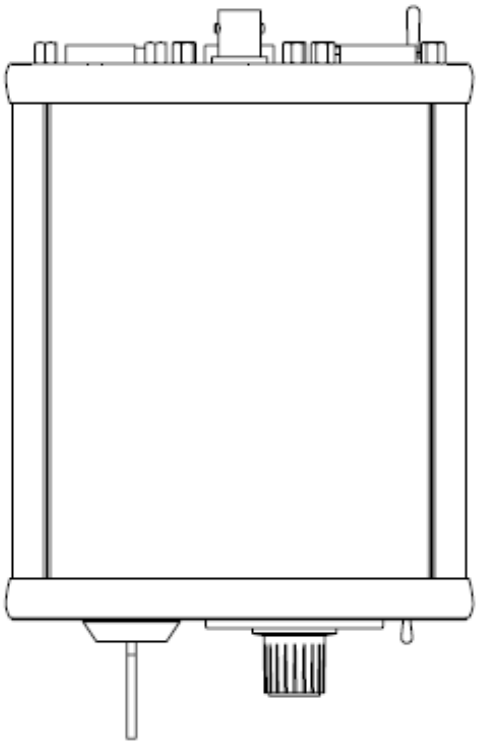


CONTROLBOXX CONTROLLER

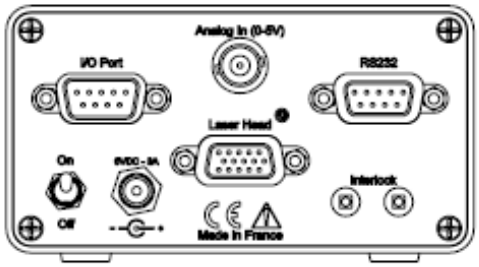
Front view



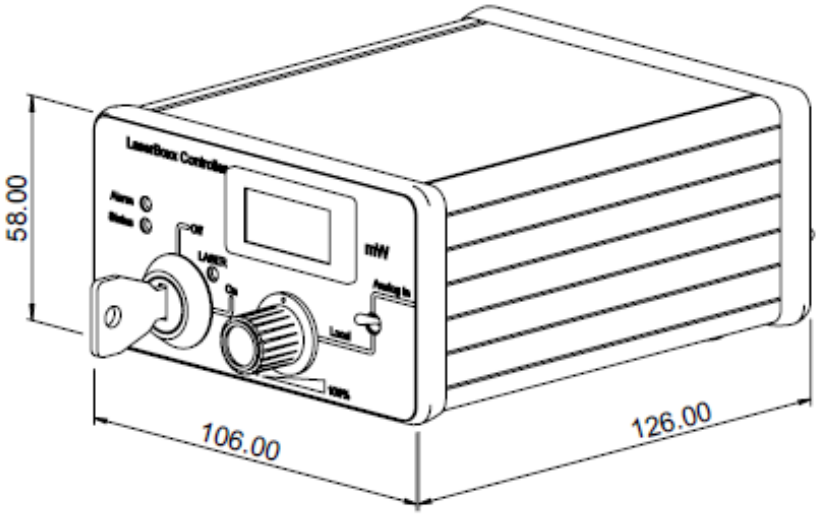
Top view



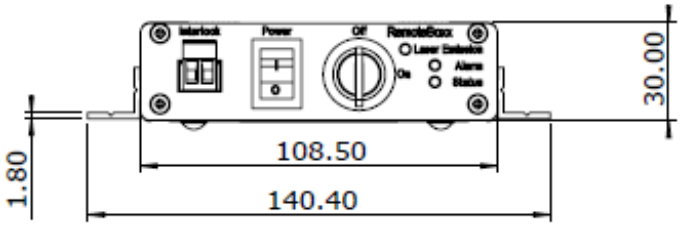
Rear view

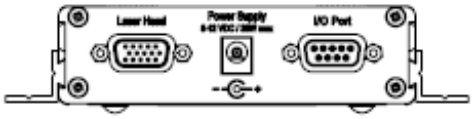


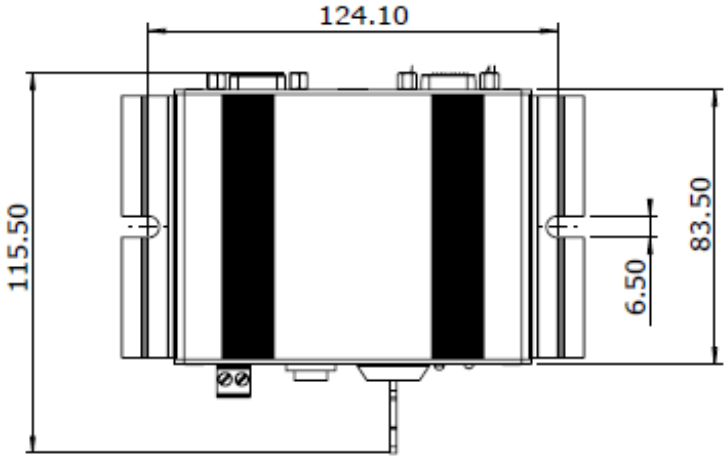
All dimensions in mm

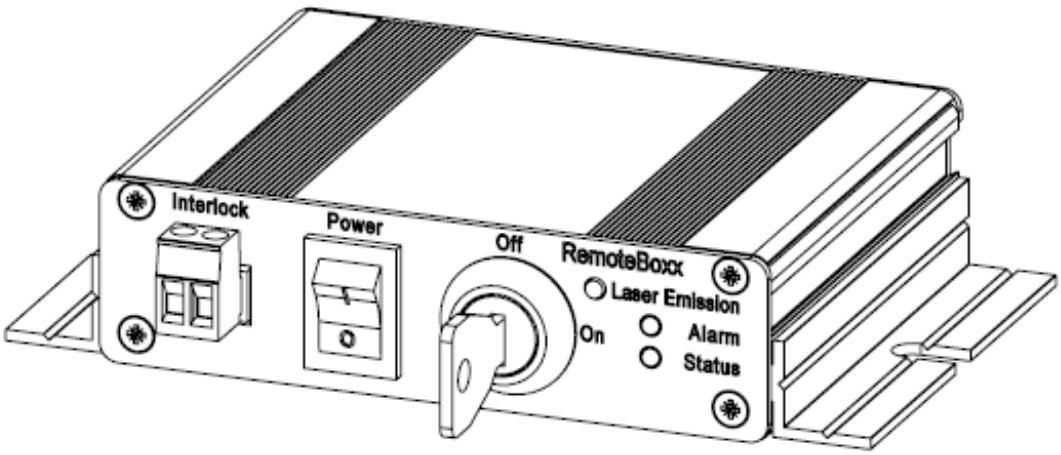


REMOTEBOXX CONTROLLER









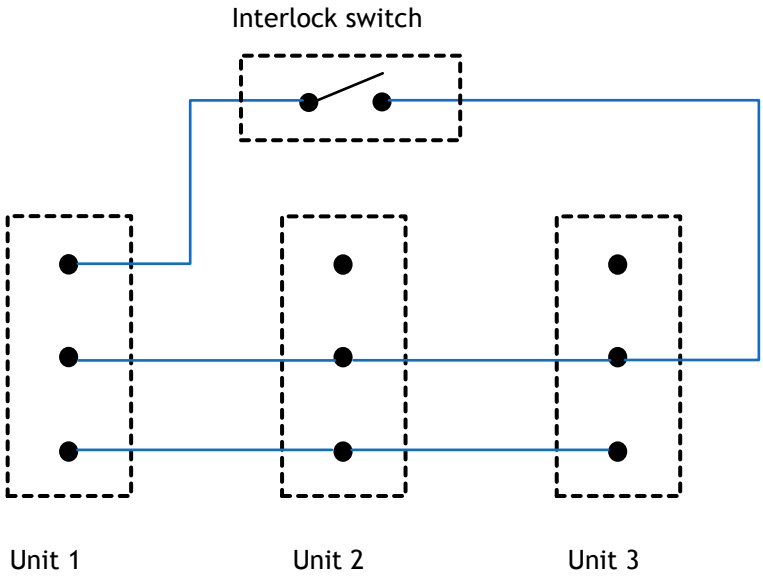
Annex C: Merging interlocks on several laser units

Here is the method to merge the interlock circuits of several units into one single function. This is helpful when you laser radiation zone includes several LaserBoxx units that should behave in the same manner when the interlock is activated.

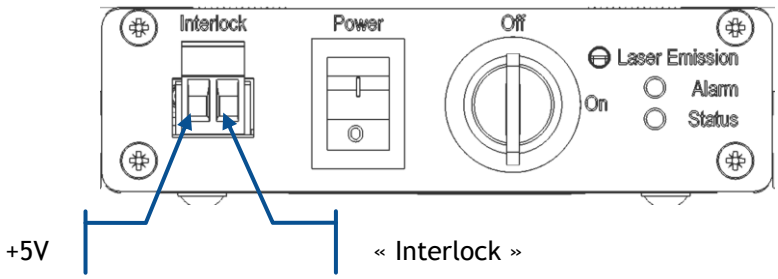
METHOD 1: CHAIN-LINKING

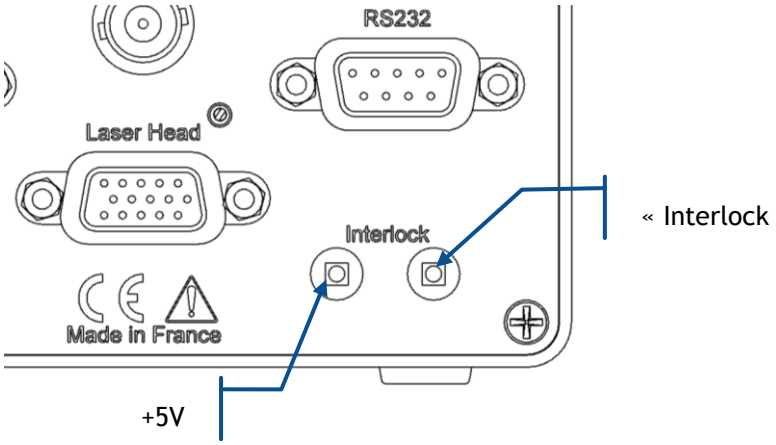
This method consists in using the +5V output of one of the units, and dispatch it to the “Interlock” sensors of all units. Here is an example with three units:

Function	Pin on DE-15 HD interface
+5V	# 9
Interlock	# 6
Ground	# 3



The aforementioned pins can be also accessed from the RemoteBoxx or the ControlBoxx; refer to the following picture to locate the “Interlock” and the +5V output:



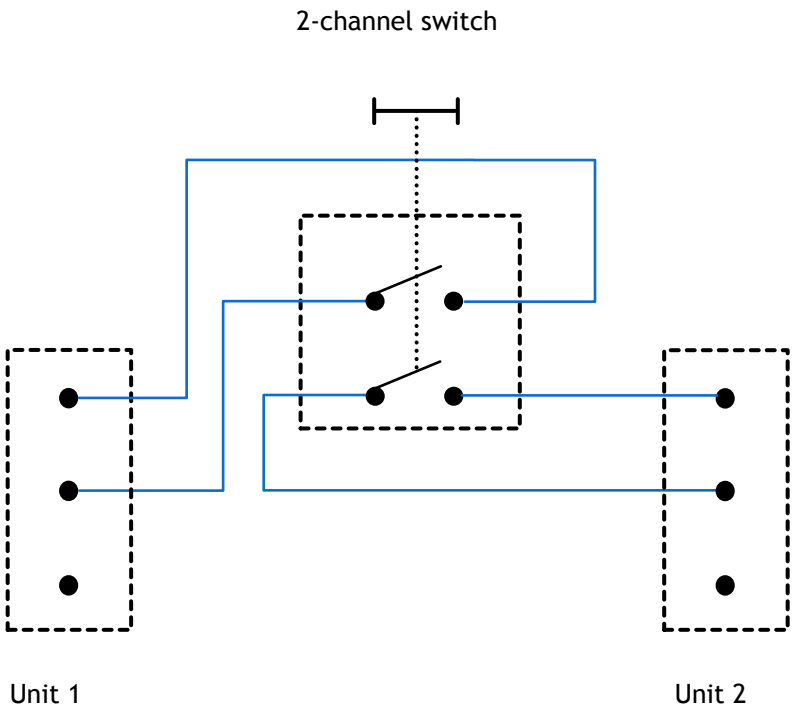


This method can be used to merge the interlocks of LBX, LBX-S and LCX models. It cannot be used to merge (older) LMX models with LBX, LBX-S or LCX.

METHOD 2: USING A MULTI-CHANNEL SWITCH

This method consists in linking the interlock circuits of the different units to the independent channels of a switch. Here is an example with two units:

Function	Pin on DE-15 HD interface
+5V	# 9
Interlock	# 6
Ground	# 3



This method can be used to merge the interlocks of any LaserBoxx model, even with LMX models.