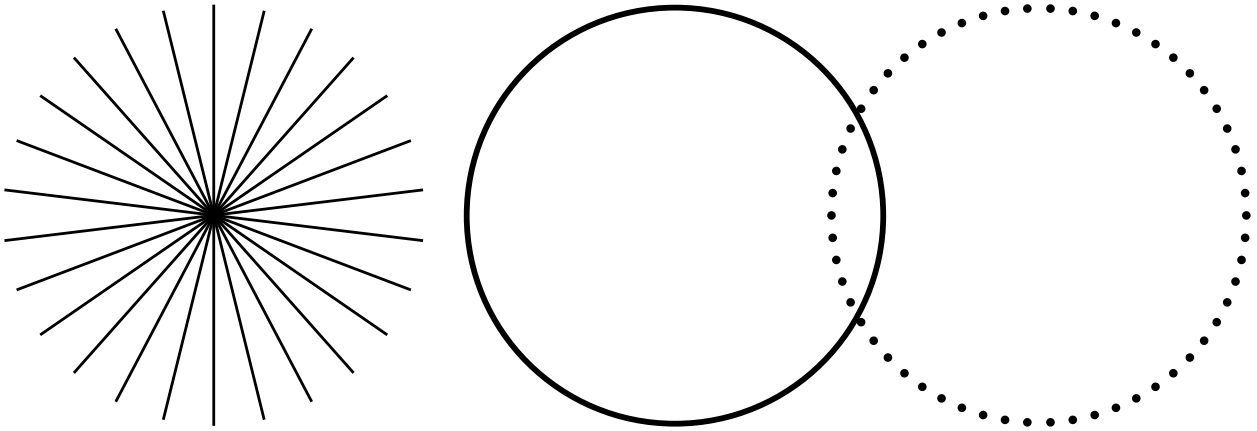
Rapid LX Laser System

Pre-Installation-Guide



INNOVATIONS THAT RESONATE

COHERENT

Edition July 2024

Patents referenced in this manual are active on release date of this document. Validity of active patents can be found here: www.coherent.com/company/patents.

Every effort was made to ensure that the data given in this document is accurate. The information, figures, tables, specifications, part numbers and schematics contained herein are subject to change without notice. Coherent makes no warranty or representation, either expressed or implied, related to this document. In no event will Coherent be liable for any direct, indirect, special, incidental, or consequential damages or injuries caused by any defects in its documentation.

This document replaces all previous versions.

TECHNICAL SUPPORT

Please be prepared to supply the model and laser head serial number of your laser system, the description of the problem and any attempted corrective steps to the Product Support Engineer responding to your request.

Should you experience any difficulties with your laser or need any technical information, visit our Web site www.coherent.com. Should you need further assistance, contact Coherent Technical Support by e-mail customer.support@coherent.com or telephone.

TABLE OF CONTENTS

SIGNAL WORDS AND SYMBOLS

This documentation contains sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

SIGNAL WORDS

Four signal words are used in this documentation: **DANGER**, **WARNING**, **CAUTION** and **NOTICE**. All of them include the additional possibility of device failure or damage if ignored.

The signal words **DANGER**, **WARNING** and **CAUTION** designate the degree or level of hazard when there is the risk of injury:

DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING

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

CAUTION

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates information considered important, but not hazard related. It is used when there is the risk of property damage.

Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

SYMBOLS

The signal words **DANGER**, **WARNING** and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.

This symbol is intended to alert the operator to the danger of exposure to hazardous visible and/or invisible laser radiation.

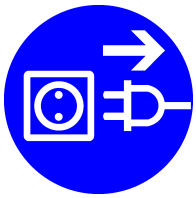
This symbol is intended to alert the operator to the presence of dangerous voltages within the product enclosure that may be of sufficient magnitude to constitute a risk of electrical shock.

This symbol is intended to alert the operator to the danger of lifting hazard and/or heavy weight.

This symbol indicates a magnetic and/or electro-magnetic field.

This symbol indicates health hazards due to e.g. corrosive, irritant components.

Eye protection and adequate protective clothing, which are appropriate for the existing (potentially various) laser radiation, have to be worn.



Switch off and unplug from mains before working with or opening the device.

Refers to important information and notes.

Refers to an external document for further information.

PRE-INSTALLATION GUIDE

INTRODUCTION

Thank you very much for your interest in our product. This document is intended for customers who decided (or are in the process) to purchase a Rapid LX picosecond industrial laser-system by Coherent.

Coherent reserves the right to change this information or perform technical modifications without notice. Furthermore we cannot guarantee the accuracy of information given in this document. Coherent will not take any responsibility for inappropriate preparation due to wrong or misunderstood information.

In order to prepare the customer site for installation, the Pre-Installation Guide includes information regarding positioning, connections and system start-up requirements. It is recommended to have the customer site prepared prior to receiving the laser shipment, so that the customer can have a "plug-and-play" installation of the laser system. The individual needs and expectations for each customer may require additional information or preparation. Contact Coherent if more information is needed.

The Pre-Installation guide (this document) can be found in https://www.coherent.com/search-results?query=rlx%20pre

The datasheet of the RLX can be found in https://www.coherent.com/lasers/laser/rapid-lx

The SMC chiller manual (HRS024-A-20 / HRS024-W-20) can be found in https://www.smcusa.com/products/chillers/General-Use-Compact-Chiller-~126798

LOCATION OF THE OPERATOR'S MANUAL

The Operator's Manual of the laser system can be found in the envelope included in delivery (blue Coherent USB-stick).

Alternatively open the ***About*** tab in the GUI and click on ***Laser Operator's Manual***.

If you do not use the GUI, open the terminal and enter:

`?IP`	returns the IP-address of the connected laser
`?MANUAL`	returns: checksum and operator's manual-name

Open a Web-browser (e.g. Microsoft Edge) or the Windows Explorer and enter: "http://"[IP-address] of the connected laser system (result of `?IP`) and the operator's manual-name (result of `?MANUAL` without checksum). Make sure to copy the exact syntax of the file-name. IP address and name separated by "/":

`http://[IP-address]/RAPID-LX__eng_1322266_[REV].pdf`

The Operator's Manual can be found on the USB-stick (included in delivery), in the GUI, via command (when connected to the laser system) or alternatively it can be provided by your Sales-representative.

NOTICE!
The GUI- installation- file can be found on the USB- stick (included in delivery).

CERTIFICATE OF CONFORMITY

The Certificate of Conformity (CoC) contains important system-individual technical information and final measurements. It is included in the system delivery box, located in the DIN A4 documentation envelope (printed on paper). Make sure to provide this document during installation as well as operation. The Operator's manual refers to certain parameters listed in the CoC. A number of parameters are system- individual and should be available for changing parameters; such as the pulse-mode, PulseEQ, max. selectable pulse-repeption-rate, etc.

The CoC is the final report indicating technical information and measurements. The content is important during installation as well as operation. Make sure to have this document available near the system-controlling computer.

SOFTWARE COMMANDS LIST

This chapter can be found in the external commands-list document.

For more information concerning commands, faults and warnings refer to the external commands-list document.

AMBIENT CONDITION

The ambient conditions must be observed during storage, transport, installation and operation of the laser system. Ensure reasonable transport conditions, free of major shocks, jolt or fall. Protect the whole system against frost, gases, moisture and dust. Use original packing material for relocation.

Before unpacking the laser wait for 6 hours to allow for thermalization of all components.

Temperature during transportation	-20°C to +60°C (-4°F up to 140°F)
Relative humidity during transport.	0% up to 90%, non-condensing

Temperature for optimal operation	+15°C up to +30°C (59°F up to 86°F)
Relative humidity during operation	0% up to 90%, non-condensing, dew-point < 22°C (71.6°F)
Maximum altitude for operation	2000 meters above sea level (800 – 1050 hPa)

Transportation at lower temperatures shall be avoided. The whole cooling system needs to be completely drained and blown dry (prior to transportation).

CAUTION

Environmental conditions that exceed these specifications could result in instrument failure. Keep the Rapid LX laser in a dry place. Moisture could cause malfunction. Mistreatment may damage the device, in particular the output window.

In case customer components are being added to the system, consider that the environmental conditions could deviate (permitted range of ambient temperature, humidity, etc.).

SPACE AND POWER REQUIREMENTS

The Rapid LX laser head needs to be placed to an appropriate position.

Dimensions	The dimensions of the system can be found in section "Technical drawing" on page 34
Power – laser head	The laser head needs 48 VDC with a power consumption of approx. 500 W; refer to section "Power supply 1U" on page 19
Power – chiller	The power consumption of the chiller depends on the ordered type and the temperature-difference. In case of a SMC chiller (valid for HRS024) the cooling capacity is 2100/2400 W at 50/60 Hz; refer to section "SMC Chiller" on page 16
Ventilation	Guarantee proper ventilation for the power supply and (water-air) chiller by offering sufficient air flow and heat exchange, refer to the chiller manual for more details
Access	Make sure to provide sufficient accessibility for Service and measuring devices. These dimensions can be found in section "Technical drawing" on page 34. In case the space is critical we recommend to contact Coherent

SAFETY

WARNING

The product is a class IV / class 4 laser which is defined by regulations e.g. ANSI Z136 in the US and IEC 60825 internationally. All national and local safety regulations might be dependent on the location and need to be fulfilled. This is even more important for integrators who additionally need to fulfill the regulations of the final machine destination. All persons working in the area of the laser system or with the laser system need to be informed of possible hazards and safety regulations at all times.

WARNING

Laser safety requires the entire beam path housing (sealed and interlocked as applicable). Ensure the prevention of possible direct or indirect exposure, especially to the eyes and skin. Be aware of that IR is in the non-visible spectral range and can pose a hazard.

WARNING

All personnel working in the area of the laser beam must wear laser safety glasses rated for the specific wavelengths being generated by the laser system in accordance with EN207. Never work in the area of an exposed beam without laser eye protection!

WARNING

Make sure to announce a certified 'Laser safety officer' (LSO), refer to ANSI Z136 for more information.

WARNING

The implementation of an interlock-chain is required. Emergency stop button, system-activation key, door-interlocks, warning lamps, etc. are examples of such safety features; refer to section "Control connector" on page 31.

OEM REQUIREMENTS

The laser can only be used as an OEM component of a certified laser product.

To comply with the safety regulations according to IEC 60825-1 the integrator must:

- Integrate the laser head into an adequate housing, fulfilling laser safety
- Ensure the system is single fail-safe
- Install an interlock
- Install a key switch. The key switch must be able to disconnect all live conductors
- Install a shutter
- Install a laser emission warning
- Install an emergency stop button
- Ensure the laser head and power supply labels are accessible to view

The list might not be exhaustive. The integrator is responsible for verifying the necessary compliance requirements for applicable safety regulations.

SCOPE OF DELIVERY

The following table lists the delivered components. In order to check the completeness of all components use the checklist coming with the delivery or the contract.

Qty	Part
1	Rapid LX laser head
2	Handle, U-shaped, M6
4	Lifting eye bolt (ring-screw) DIN 580 M6 (for crane transportation)
1	Transportation cover in front of the output-window + O-ring + 3x M3x8 screws (Allen key, metric, 2.5 mm)
1	Envelope including CoC (report of measurements, print) and product documentation (USB-stick)

Qty	Part (depending on order)
1	Power supply, 19" unit, height 1U, 100-230 VAC (50/60 Hz); refer to section "Power supply 1U" on page 19
1	Mains cable, C13, with CEE 7/4 (Schuko-plug); length: 2 m
1	Power connection between power supply and laser head (48 V), length: 5 m

Qty	Part (included if SMC chiller is ordered)
1	SMC Chiller
1	Filterkit
1	Water hose, blue, length: 5 m
1	Water hose, red, length: 5 m
1	Line cord C13, with CEE 7/4 (Schuko-plug), length: 2 m
1	Coolflow IGE cooling fluid (ready to use)

Part number	Optional Part (can be ordered separately)
2217876	Safety Box (section "Safety box (optional)" on page 35) including 2 System keys
1308211	Cable assy for the Safety box, D-Sub 9 cable, length 5 m (16 feet)

UNPACKING THE SYSTEM ON DELIVERY

Check ShockWatch and TILTWatch Indicators outside and inside the crate. Also check for any damages. Take photos if necessary. Let the driver of the delivery company sign and inform Coherent.

Inspect the package & product together with the transportation company. In case of any damages, report this in the shipping documents (airway bill) and inform your transportation insurance (if contracted) as well as Coherent.

NOTICE

The laser system should acclimate for 8 hours in ambient room temperature prior to opening the shipping containers.

NOTICE

Preserve ALL packaging material for future shipments, e.g. for Service to Coherent or forwarding shipment to your own customer.

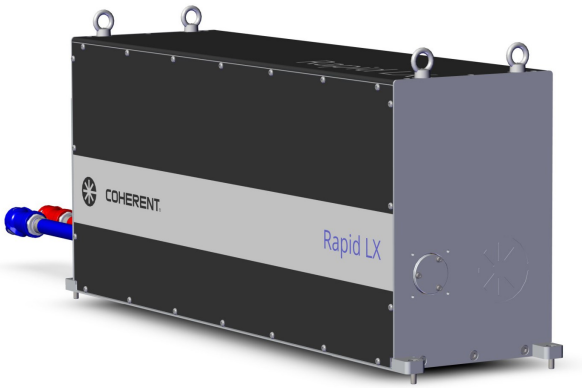
NOTICE

Ethernet- and both USB-connectors are sealed and closed by dust-caps. These seals MUST remain in place when the corresponding connector is not used.

For further information refer to the external document "Unpacking Rapid_LX_eng_1449377_*REV*".

TOOLS NECESSARY FOR INSTALLATION

- Forklift for transporting the pallet
- Allen-key set: metric or imperial for attaching the pedestals onto the customer's table (4x M6x18 or UNC Nr.12-24 screws to be provided by customer)
- Allen-key: metric, size 2.5 for M3 hex-screws in order to remove the output-window transportation-cover
- Allen-key: metric, size 3 and 4x M4 screws in case of attaching light devices in front of the output window. The threat depth is 8 mm, choose the length of the screws accordingly
- Tools for attaching the chiller filter-kit:
  - Allan-key: metric, size 4 (for the M5 hex-screws)
  - Metric Spanner (open-end wrench) 14 mm; (alternatively adjustable wrench)
- Wire cutter, cardboard cutter
- 2 persons for lifting the laser head out of the box (approx. 50 kg (110 lbs)); alternatively a (portable) lifting device. 2 attached handles as well as lifting eye-bolts are included in delivery (tapped holes are: M6x15, metric Allen-key 5)



- Trolley to transport the laser head and chiller
- Adequate table (granite, cast stone or alternatives with low thermal expansion) where the positions for the feet are prepared for attachment (tapped holes according to technical drawing)

- Beam dump for testing purposes (safety issue) and measurements
- Breadboard in order to safely attach measuring devices with a set of corresponding screws
- Computer (not included in delivery) in order to control the laser system via Ethernet (or alternatively USB or RS-232)
- Ethernet cable (recommended), alternatively RS-232 or USB-cable in case the laser system is supposed to not be controlled via Ethernet
- Fulfill laser safety in a lockable room or with protecting portable walls (laser safety goggles, warning signs, etc.)

SMC CHILLER REQUIRED SPACE

It is recommended to keep the space around the chiller shown in the following image. Consider that a water-air chiller might require more volume for the heat exchange. For maintenance, move the chiller into a space where maintenance work is possible.

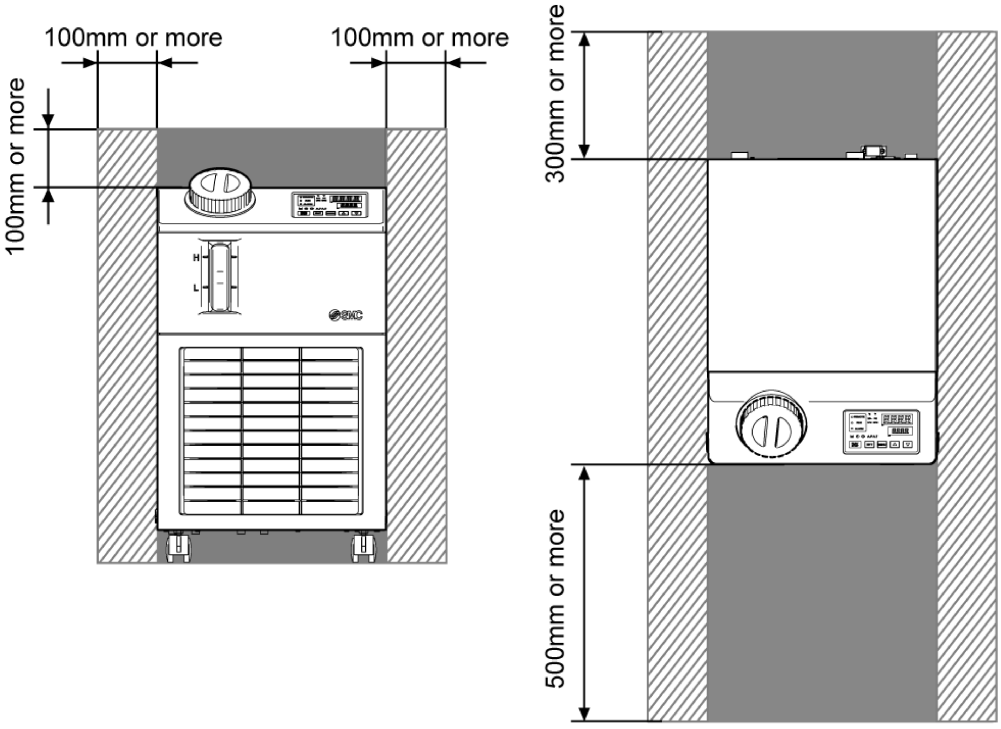


Figure 1: SMC chiller required space

SMC CHILLER REQUIRED HEAT EXCHANGE

WATER-TO-AIR CHILLER

Model	Heat Radiated (approx.) [kW]	Required ventilation amount [m³/min]	
		Differential temp. of 3°C in the installation area	Differential temp. of 6°C in the installation area
HRS024-A Water-Air	5	90	50

WATER-TO-WATER CHILLER

Model	Heat Radiated (approx.) [kW]	Facility water temperature range [°C]	Required facility water rate [L/min]		
			Facility water temperature		
			25°C	32°C	40°C
HRS024-W Water-Water	5	5 to 40 (Rating 25)	14	17	25

Refer to the external chiller manual (located on the documentation USB-stick) for more information.

SMC CHILLER

In order to operate the laser, a chiller is necessary. Coherent offers a chiller from SMC with the following power requirement:

- Single phase 200 to 230 VAC, 50/60 Hz

Deviating voltages require a transformer.

The SMC chiller has a nominal cooling capacity of 2100 W @ 50 Hz or 2400 W @ 60 Hz.

Two different versions concerning the cooling method are available, refer to next section.

CAUTION

In case of deviating mains voltage a transformer is necessary and needs to be ordered separately.

Figure 2: SMC chiller, front side

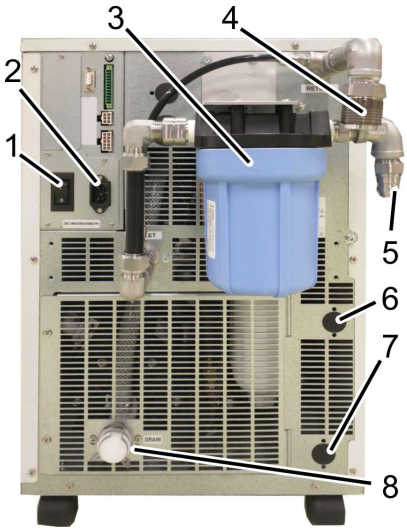


Figure 3: SMC chiller, rear side

POS	Description
1	Mains switch
2	C14 mains connector (female)
3	Filter, installed
4	Coolant return (warm)
5	Coolant outlet (cold)
6	Facility water outlet; (for WW-chiller)
7	Facility water inlet; (for WW-chiller)
8	Coolant drain

WATER-TO-AIR CHILLER

This chiller needs an adequate power connection and a sufficient air flow must be guaranteed at the front and at the back of the chiller. Ideally the exhausted air should be conducted out of the room.

WATER-TO-WATER CHILLER

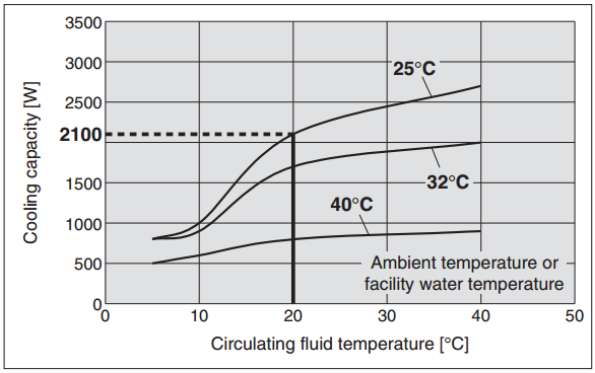
This chiller needs an adequate power connection and an additional primary water circuit, which needs to be connected to both Rc3/8 (female) ports at the rear side of the chiller (facility water inlet / outlet).

The chiller is not remotely switched on. It is necessary to switch on the chiller manually. The coolant flow is detected by an integrated flow sensor (inside the laser head). Set the chiller temperature to 23°C.

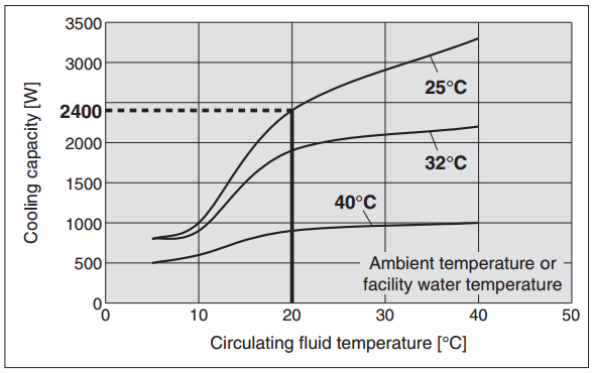
The temperature stabilization of the coolant can take approximately 20 min after a cold start.

Verify that the coolant in the chiller is at a proper level. Preventive maintenance for the chiller (changing water and filter at the same time) is mandatory.

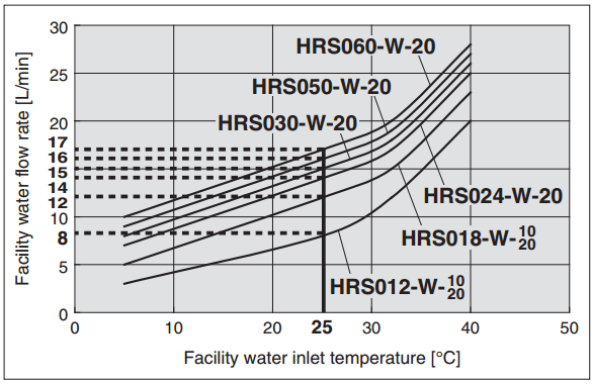
In order to ensure enough heat exchange (in case of a water to air system) make sure that there is sufficient amount of space behind the chiller (>0.5 m / >20 inches). Also the air circulation / ventilation and fresh air supply should not be constricted.



HRS024-A-20, **50 Hz**, water-air-chiller 200-230 VAC single phase



HRS024-A-20, **60 Hz**, water-air-chiller 200-230 VAC single phase



Required facility water flow rate (in case of water-water chiller)

NOTICE

Before the chiller can be operated, install the filter kit at the rear side of the chiller.

NOTICE

Programming the cooling specifications is required prior to system operation.

NOTICE

The long-term performance of the system is highly dependent on using the approved coolant. Using any other coolant will void the warranty.

Refer to the external chiller manual (located on the documentation USB-stick) for more information.

POWER SUPPLY 1U

The TDK-Lambda power device is a 19"-frame. The height of the supply is 1 U (rack unit). The primary side of the Coherent power supply can be connected to a mains voltage of 100-230 VAC (50/60 Hz) via one C13 (IEC 60320) cable. Make sure to adequately fuse the power supply.

NOTICE

Make sure that the secondary poles remain potential-free. Do not ground the minus-pole.

FRONT VIEW PSU 1U

The power supply is a 19" rack unit with 1U height. . The cooling fans of the power supply should not be blocked as these provide cooling air flow from the front to rear. 3 LEDs indicate the voltage status: DC OK, DC FAIL, AC OK.

Figure 4: Front view of the power supply

REAR VIEW PSU 1U

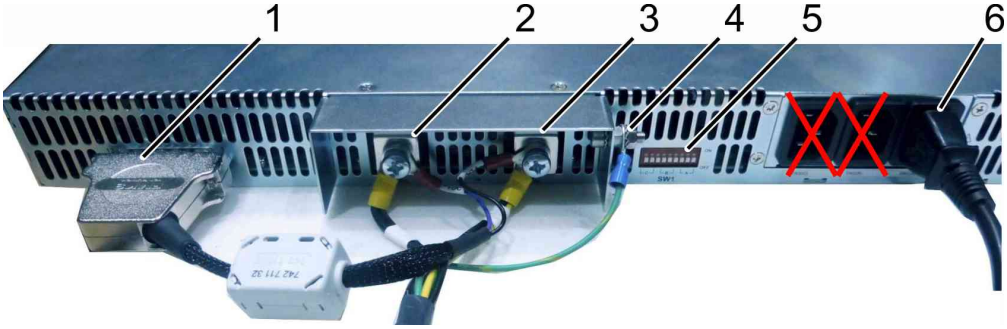
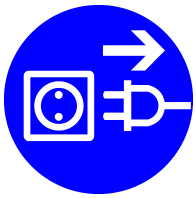


Figure 5: Rear view of the power supply

POS	Description
1	Sensor D-Sub connector
2	+ 48 VDC, up to 1000 W
3	0 VDC (do not ground)
4	GND, ground
5	DIP-switches, all in OFF-position
6	C14 (male) mains connector



WARNING

Unplug and disconnect from mains before starting the following procedure.

DANGER

Make sure to fulfill laser safety before the power supply is being connected to power. The laser beam needs to be guided to a defined point (e.g. beam block for testing purposes).

Connect the power supply according to the following procedure (numbers are referring to the position indicated in the figure above):

- Connect the sensor-connector (1) to the D-Sub plug
- Connect the red PLUS-cable from the sensor-connector and the PLUS-cable from laser head to (2)
- Connect the black MINUS-cable from the sensor-connector and the MINUS-cable from laser head to (3)
- Connect the Ground-cable to the housing-screw (4)
- Make sure that all DIP-switches (5) are set to OFF-position
- Connect the mains-cable (cable providing C13-female connector) to the main input (6). Use the plug-socket on the right side (refer to figure above); labeled with CN1(A). Do not use the other plug-sockets
- Connect the power-cable with mains. Make sure that it is fused adequately
- Make sure to protect the cable against disconnection

TOP VIEW PSU 1U

Refer to the drawing below. Units are displayed in Millimeter. Allow at least 120 mm behind the power supply for cables. The power supply front and rear should not be covered or obstructed to guarantee an efficient heat exchange.

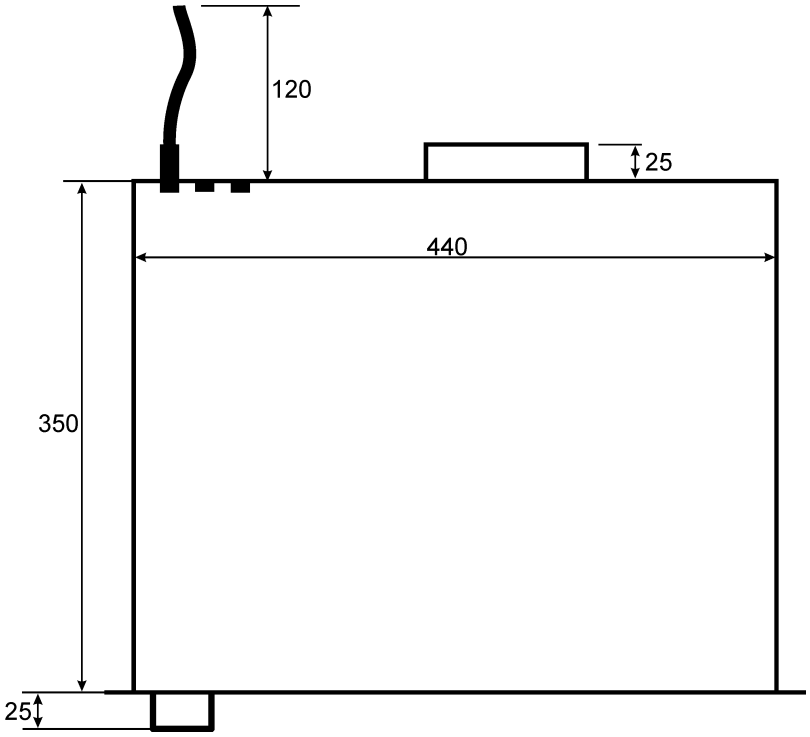


Figure 6: Top view of the power supply, dimensions in mm

ELECTRICAL POWER CONNECTIONS

The delivery of power cables is dependent on the order. A system without power supply does neither include the mains cable nor the 48 V-cable for the laser head. The mains cable will be delivered with the European CEE 7/4 (Type-F) connector. Make sure to provide the appropriate connector (to replace the CEE 7/4) suitable for your region (and region of end-customer in case of machine-integration).

Coherent recommends to fuse all components adequately. A multiple socket outlet is not recommended due to the fact that in total the wire cross section might be under-dimensioned.

Cable for PSU 1U (dependent on order)	Article	Device end	Cable length	Customer end	Image
System Power supply (connecting the power supply to mains), 1 cable	22475	C13 (IEC 60320)	2 m	CEE 7/4 (Schuko-plug)	
Laser head (48 V power cable between PSU 1U and laser head)	1426491	cable-lugs to be connected to power supply	5 m	D-Sub 2W2 female (for connection to laser head)	

Cable for SMC chiller (dependent on order)	Article	Device end	Cable length	Customer end	Image
SMC chiller HRS (mains power supply)	—	C13 (IEC 60320)	2 m	CEE 7/4 (Schuko-plug)	

WHAT NEEDS TO BE PREPARED

- The laser head shall be positioned horizontally, on a flat surface made of low expansion material (ideally granite) in order to eliminate temperature and vibration issues. (A modern alternative might be cast stone). This surface needs threaded holes in order to position and fix the laser head, refer to section "Technical drawing" on page 34
- The location of the laser should be relatively clean and free of condensation. For the environmental conditions refer to section "Ambient condition" on page 9
- Provide adequate electrical power plugs / connections (if deviating from the included ones)
- Provide a mains switch for the power supply
- Provide an Emergency Switch for the complete system
- Make sure to not ground the minus-pole of the secondary-side of the power supply (they have to remain potential-free)
- The chiller cooling liquid will be included in delivery (if the chiller is ordered). To maintain the chiller (liquid-exchange) it is recommended to attach a valve to the drain-outlet. A conversion fitting (material: POM, R3/8 male thread) is provided
- The HRS024-W-20 (SMC water-water) chiller is equipped with two female Rc3/8 pipe threads. Provide the corresponding fittings and facility water line equipment (refer to the separate chiller manual)
- A filter-system has to be attached (by the customer) to the rear side of the chiller

- An external PC with Microsoft Windows 10 or 11 installed; monitor, keyboard and mouse connected; necessary to control the laser system
- The GUI can be found on the USB-stick (included in delivery)
- BNC-signal lines: Gate, Trigger, Sync, Ext Mod. The number of required connections depends on the application but in order to drive a scanner or positioning-table at least the Gate-Input needs to be connected. BNC-cables are not included in the delivery.
- Local area network connection: Ethernet cable (not included in delivery) with category CAT.5 (100 Mbit/s) minimum (optionally: cross-link cable might be required for computer-to-computer-connection)
- Optional: D-Sub 9 cable with female connector if the Safety Box is replaced by machine integrated safety functions (emergency stop, laser emission indicator, power on LED, key-switch); refer to section "Control connector" on page 31
- Laser safety requirements must always be satisfied. Certified laser eye protection has to be worn by all personnel working in the area of the laser. All persons working with and around the laser must be aware of and informed about hazards associated with laser radiation
- Check if a laser safety officer (LSO) might be required. He needs to be authorized by the management to conduct such duties
- In case the system is being implemented into an enclosed laser-processing-area, adequate door-locking devices as well as shutter control via safety devices (e.g. PILZ automation) might be required and implemented into the interlock chain
- Consider a protection of the power supply cables against mechanical forces
- The laser beam path might need to be covered by an adequate housing, tubes, cabinet, etc.
- A scanner-card (or a function-generator) might be needed to create TTL-signals (GATE). This is dependent on your application
- Power meter in order to measure the optical output; refer to https://www.coherent.com/laser- power- energy- measurement/laser- measurement- help- center (e.g. the PowerMax USB meter)
- Establish an Ethernet connection: When using a firewall on the external PC (or network), ensure that the specified communication port is available. It is recommended to use DHCP in order to find the corresponding IP-address. The IP-address of the system can be changed and individually defined by sending the command: `IP nnn.nnn.n.n` and rebooting the system
- In case of external software control, e.g. for a machine integration, it is either possible to use the Coherent GUI or customer-individual software-control

SAFETY – REQUIREMENTS FOR SERVICE

To safely position test equipment (beam profiling and power sensors) in front of the laser head, the customer must provide an **optical breadboard**. We recommend to use a thin aluminum bench plate with thread holes for screws. The customer can choose either metric or imperial units for the breadboard. Provide at least 10 corresponding screws that fit the thread size of the breadboard.

Aluminum plates are available from e.g. Thorlabs:

- [300 x 450 x 12.7] mm with M6 taps, approx. weight 6 kg
- [12 x 18 x 1/2] inch with 1/4 in taps, approx. weight 13 lbs

Help us to ensure the highest possible safety! Do not hesitate to contact Coherent in case of any doubt about the (laser) safety of the measurement procedures, so that a solution can be found in advance.

WARNING

Coherent Service technicians are engaged to check the laser-safety situation provided by the customer and might request further provisions which could delay the installation procedure.

Provide a stable table (150 x 70 cm or larger) for positioning the laser head and the optical breadboard in front. In order to secure the beam output area, provide a protective housing such as laser safety curtains or black-anodized aluminum plates with a height of 25 cm (10 inches) which can be positioned vertically as a frame.

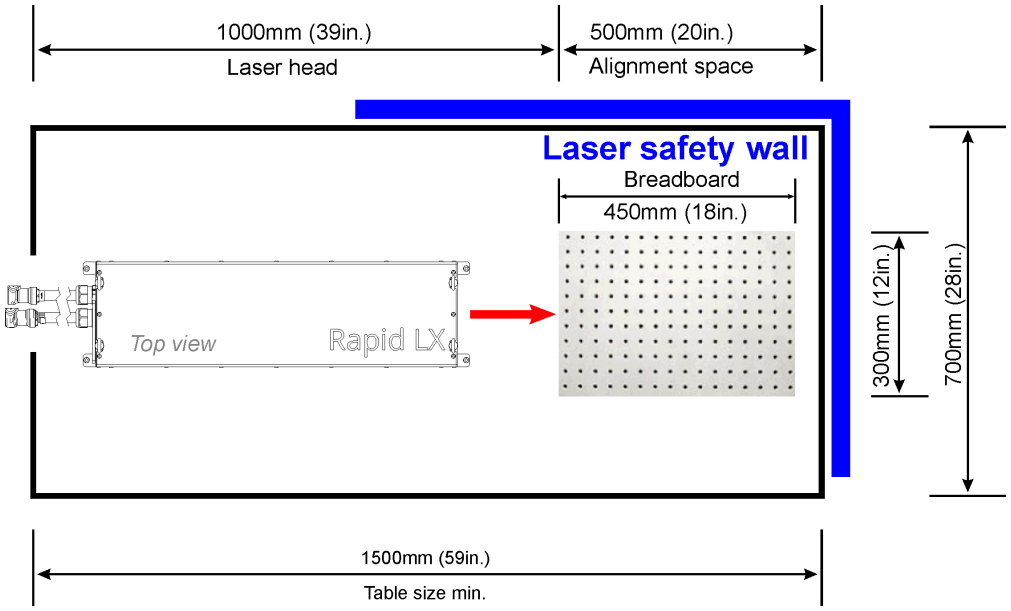


Figure 7: Alignment table, top view

MECHANICAL DIMENSIONS OF THE LASER HEAD

Refer to the technical drawing (section "Technical drawing" on page 34) in order to find dimensions of the laser head.

Sufficient access to the laser head in an integrated machine must be provided for service & maintenance (defined in the technical drawing). Also, make sure a power meter can be placed into the optical beam path for diagnostic purposes.

Coherent recommends to leave at least 160 mm (6.3 inches) at the back side of the laser head for the electrical wires and water hoses. Also include adequate cover tubing, guiding systems or protections against mechanical forces (if necessary).

Do not hesitate to contact your Coherent representative in case you need further support.

If requested Coherent can provide a 3D CAD-STEP file of the laser head.

LASER HEAD

The laser head consists of a

- Seeder comprising of a mode-locked oscillator and a pulse-picker
- Amplifier
- Modulator

The direction of polarization (vertical or horizontal) is dependent on the output wavelength and defined in the specification data sheet.

Figure 8: Perspective front view of the laser head

Always ensure that the following conditions are met to prevent damage to the system:

- No moisture can condense on the unit
- No aggressive gases penetrate the case
- The laser system is protected against frost

Such conditions may destroy the laser system.

FRONT VIEW

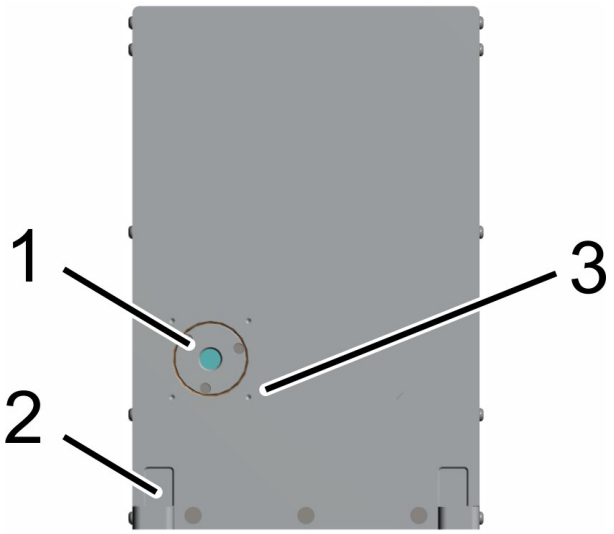


Figure 9: Front view of the laser head

POS	Description
1	Output window (cover removed)
2	Pedestals
3	Threads for adapting telescope or protecting elements, refer to section "Output window" on the facing page

OUTPUT WINDOW

The output window of the Rapid LX (located on the laser head front side) is covered by a transportation cap (3x M3x8). Remove this cap (using a metric Allen key 2.5) before powering the laser head.

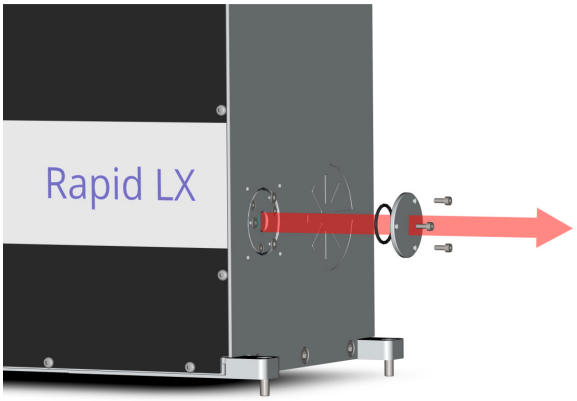


Figure 10: Remove transportation cap

It is recommended to seal the output window with a beam tube or beam expander (to be defined by customer, not included in delivery).

The optical window is replaceable by the customer.

In order to attach an element (such as a protection tube or telescope) onto the output window, use the 4 thread holes (M4, 10 mm depth); refer to the technical drawing in section "Technical drawing" on page 34. Additionally it is necessary to support the element with an adequate stand (to prevent influences on the output-laser-beam due to mechanical forces). Make sure, that the screws are not longer than the threads itself (prevent mechanical forces inside the threads).

In case your system emits UV-light, it is necessary to protect the output-window (against dust and particles) by a sealed beam-path-tubing (carried by adequate stands).

WARNING

We recommend to protect the output window with a sealed tube. In case of UV lasers, this is mandatory.

WARNING

Make sure to turn off the laser system and protect against unintended activation when working on the beam output.

REAR VIEW

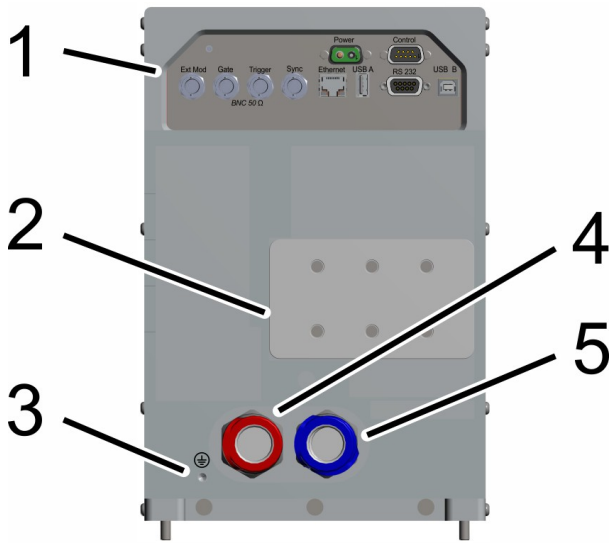


Figure 11: Rear view of the laser head

POS	Description
1	Electrical interface, refer to section "Connectors" on the facing page
2	Desiccant inside
3	Ground (housing to be connected to GND), M6, thread depth 10 mm
4	Coolant return, warm water to chiller
5	Coolant supply, cold water from chiller

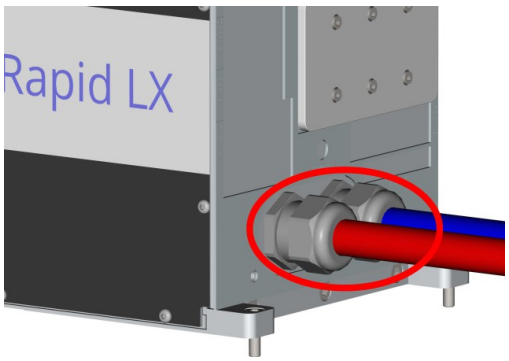


Figure 12: Laser head rear side; do not loosen these screws

NOTICE

Do not loosen the metal screws locking the blue and red chiller hoses.

CONNECTORS

The function and characteristics of each interface is described in the list below. The connectors can be found on the rear side of the laser head.

NOTICE

Limit the signal to max. 5 V (Ext Mod to max. 10 V) in case of external supply (provided by a function generator or scanner-device, etc.).

NOTICE

Ethernet- and both USB-connectors are sealed and closed by dust-caps. These seals MUST remain in place when the corresponding connector is not used.

CAUTION

Emission of radiation is possible when *Ext Mod* is selected but no termination or driver is connected. Residual radiation is possible at any time.

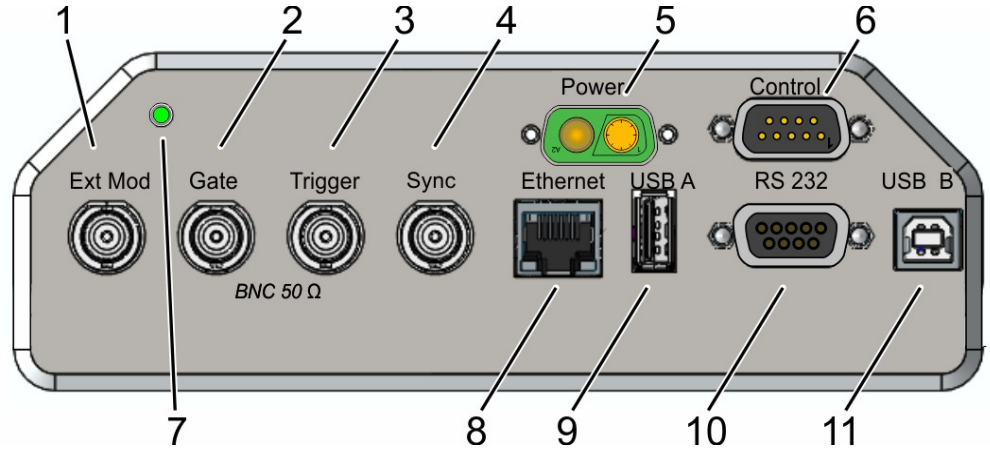


Figure 13: User connector panel

POS	Name	Signal	Description
1	Ext Mod	default: 0–5 V; programmable via software 0-10 V (use command: `A2RNG=5` or `A2RNG=10`) Impedance: 10 kΩ Limit signal to 10 V max.	INPUT: analog signal to modulate the output power; relation is linear; select the corresponding feature in the software or use the command `EM=x` (refer to the external commands list)
2	Gate	TTL (5 V) Impedance: 10 kΩ	INPUT: provide application-signal to toggle the optical output.
3	Trigger	TTL (5 V) Impedance: 10 kΩ	INPUT: provide signal of the requested repetition-rate; apply a duty cycle of 50% or a fixed signal-length > 50 ns
4	Sync	Pulse width: default: 200 ns; Pulse delay: 75 ns; amplitude is above 3.5 V with 50 Ω load	OUTPUT signal synchronous to emitted pulses (or burst groups), signal is programmable, see `SYNCCONFIG`. Use this signal to synchronize external devices. Signal-width and signal-delay can be changed with command `SYNC1DW`, `SYNC1DT`. Unit is the seeder-clock; refer to the external "Commands list"
5	Power	48 VDC	INPUT: appropriate power to be provided by power supply; refer to section "Power connector laser head" on page 32
6	Control	—	D-Sub 9 (male) connector for safety control and interlock, refer to section "Control connector" on the facing page
7	Voltage Warning LED	—	Illuminated green when (laser head input-) voltage ok; illuminated red when polarity wrong or voltage too low or too high
8	Ethernet	—	Network connector for communication, refer to section "Ethernet connection" on page 36
9	USB A	—	USB-A interface connector
10	RS-232	—	D-Sub 9 (female) RS-232 interface for alternative communication
11	USB B	—	USB-B interface connector, refer to section "USB Connection" on page 37

Note that the impedance of the Inputs is dependent on the signal frequency. The value decreases above a signal-frequency of 1 kHz.

CONTROL CONNECTOR

The Control connector is located at the rear side of the laser head. Refer to the following table to find the corresponding interfaces. In case the optional Safety box was ordered, it can be connected for testing purposes, refer to section "Safety box (optional)" on page 35.

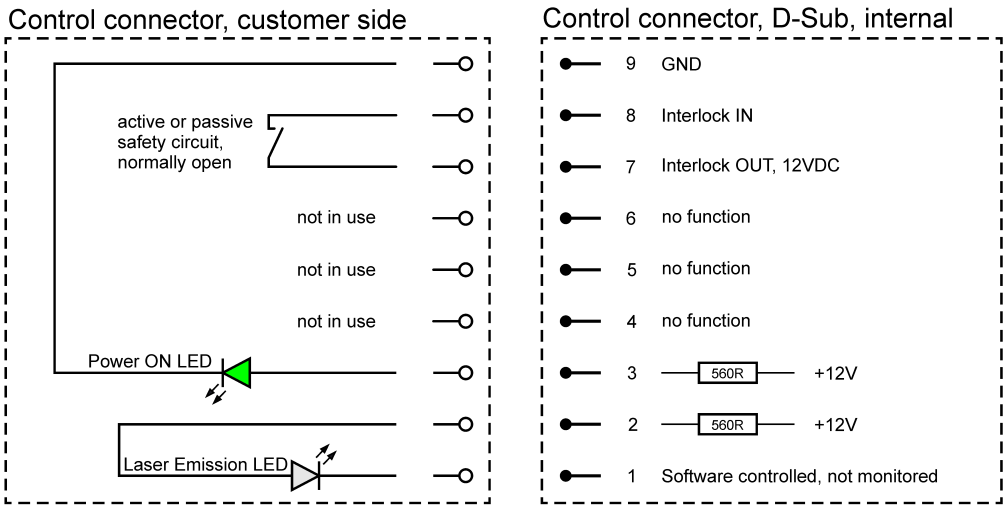


Figure 14: Control PIN assignment

Feature	PIN	Description
Laser Emission LED	1&2	Connect a white LED (series resistor implemented internally). Alternatively do not connect both Pins; this feature is not monitored internally (LED is optional)
Power ON LED	3&9	Connect a green LED (series resistor implemented internally). Alternatively do not connect both Pins, this feature is not monitored internally (LED is optional)
Interlock	7&8	Connect PIN 7 with 8 to close the Interlock. Do NOT bridge these contacts permanently (which would deactivate this feature). It is obligatory to implement a safety switch / circuit (such as e.g. key-switch, emergency stop button, etc.). The laser will not start with open loop. Observe polarity in case of an active interlock. Opening the interlock will deactivate the laser diodes and process-shutter; GUI and communication will remain active

Feature	PIN	Description
GND	9	System ground

The Interlock must be closed to start the laser.

DANGER

As soon as the Interlock gets closed, laser emission is possible and emits. This is also valid for pressing the *Clear* button in the GUI or sending the command `FACK=1`.

NOTICE

The system cannot start if the Interlock chain is open.

POWER CONNECTOR LASER HEAD

The power connector located at the laser head rear side needs to be connected with the power cable (optionally provided by Coherent) or provided by the customer. The connector needs to be supplied with + 48 VDC and ground (connected to the indicated pins).

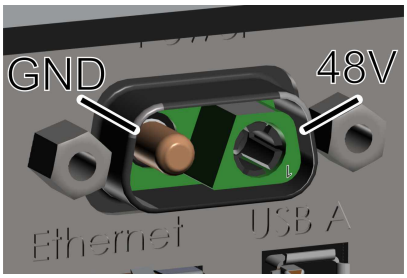
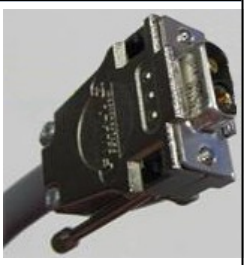


Figure 15: Power connector (laser head)

Connector items (for the cable)	Manufacturer Part Number	Manufacturer	Image of the cable-plug
Connector, D-Sub Mixed Plug Housing, 2W2	F2W2SC-K121	FCT Electronic GmbH (Germany), Molex Group	
Metal case D-Sub	FMK1G		
High power contact, male, straight, solder	FMP007P103		
High power contact, female, straight, solder	FMP007S103		

The connector integrated into the laser head (rear side), also contains the D-Sub Mixed Receptacle Housing, 2W2, but using the part-number "F2W2SC-K12**0**" instead of "F2W2SC-K12**1**". By using this combination, a reverse voltage protection is included.

The ***Voltage Warning LED*** (refer to section "Connectors" on page 29) is illuminated green, when the polarity of the laser head input-voltage is correct. The signal would be red, if the +/- wires are mismatched or voltage not sufficient or too high.

NOTICE

Make sure to not mismatch the polarity of the wires (inside the plug) as well as the other the end of the cable (when connecting to the power supply).

TECHNICAL DRAWING

Find the functional dimensions of the laser head in the following drawing. There is another version existing with deviating measurements.

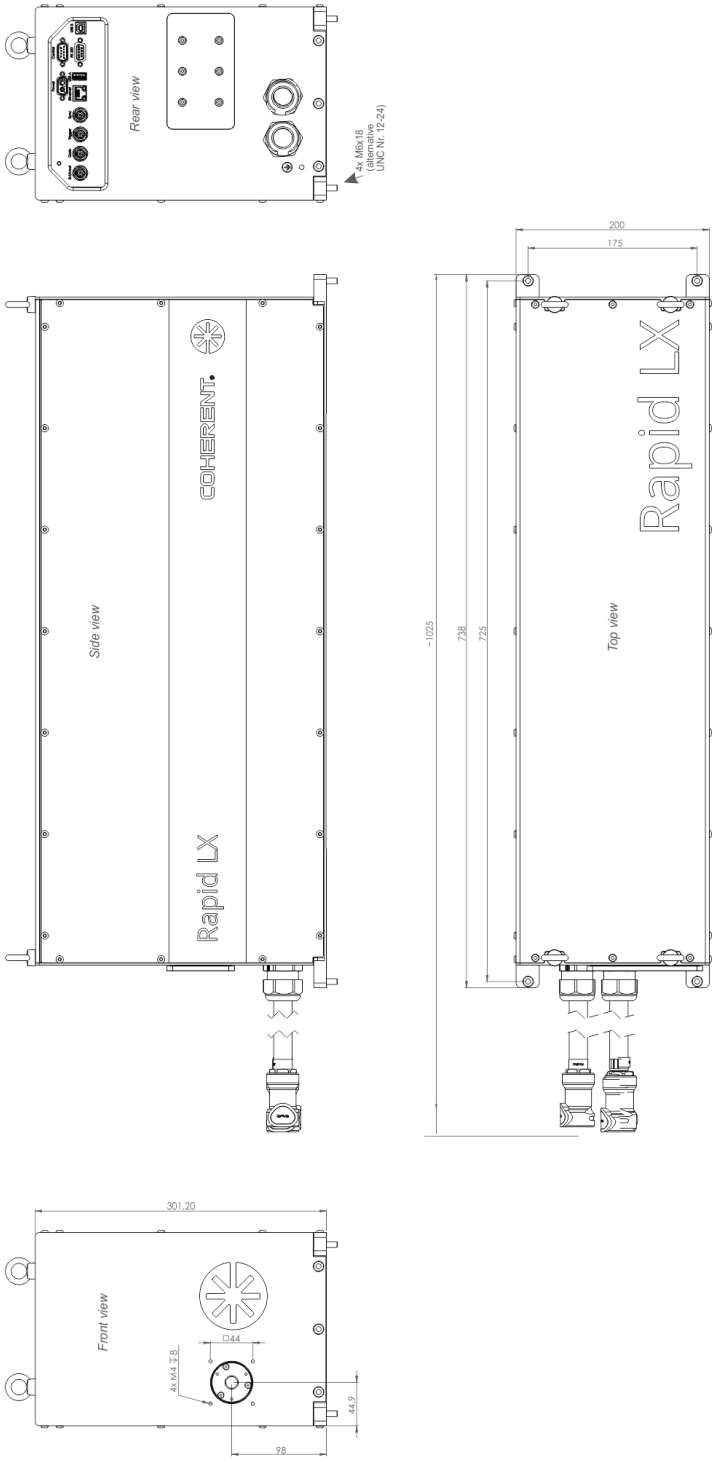


Figure 16: Technical drawing of laser head, dimensions in mm

SAFETY BOX (OPTIONAL)

The safety box is meant for testing purposes only and needs to be ordered additionally (if required), refer to section "Scope of delivery" on page 12. It can be connected to the D-Sub 9 plug (located at the rear side of the laser head) and offers the functions described below. In order to integrate the laser into a machine it is necessary to **replace** the safety box with corresponding functions of the machine, refer to section "Control connector" on page 31.

Figure 17: Safety Box

POS	Name	Description
1	Emergency Stop	Hit in order to activate (rotate and pull in order to release, interlock has to be confirmed)
2	Laser Emission LED	Illuminated white when laser radiation is generated internally.
3	Power ON LED	Illuminated green when system power supply is connected to mains
4	Key-switch	Position I enables the system Position 0 disables the system Key is removable in position 0

NOTICE

The system cannot start if the corresponding connections are not established (key-switch, emergency stop).

ETHERNET CONNECTION

The Ethernet connection uses the industry standard receptacle for an RJ45 connector. It can be connected to a switch, router or PC using a CAT 5 cable. The IP address of the laser system is **192.168.0.2**. DHCP is deactivated by default. In order to activate DHCP use the command `DHCP=1`.

If the network does not have a DHCP server (for example, in a tool with a private network), it is recommended to use the IP address **192.168.0.1**. Use the commands `AUTOIP=1` to scan for an unused IP address in the range of **192.168.0.1** and **192.168.0.255** or change the range with the `IPMIN` and `IPMAX` commands, respectively.

The laser can assign a static IP address by setting `AUTOIP=0` and `IP=nn.nn.nn.nn`. There are other commands that could be useful to a network administrator for unusual configurations. Enter the query `?HELP NET` or `?HELP DHCP` to see them all.

The Coherent GUI can find the IP address of the laser as long as the computer is on the same subnet as the laser. To see the IP address, from the GUI Main menu press the ***Connection*** button, then the ***Search*** button. This establishes the GUI connection with the selected laser and returns the GUI to the Main tab.

For further information refer to the external commands-list document.

RS-232 CONNECTION

The customer RS-232 connection is a standard female 9-pin D-Sub (DE-9) connector. A cable with a male connector is required (and needs to be provided by customer) to use this interface. In order to establish the communication via RS-232 refer to the following pin-assignments. The supported data rate is 19200 Baud. Make sure to use an adequate cable.

PIN	SIGNAL NAME	DESCRIPTION
3	TxD	Transmit data (RX to laser)
2	RxD	Receive data (TX from laser)
5	GND	Common ground
1,4,6,7,8,9	—	No connection

CONFIGURATION	DCE, NO HANDSHAKING
Data bits	8
Parity	none
Stop bits	1
Flow control	none
Baud rate	19200 (fixed setting)

USB CONNECTION

The USB connector (located on the laser head rear side) uses the industry standard type B receptacle. The USB interface uses the RNDIS standard. RNDIS is a Microsoft standard that implements a virtual Ethernet connection on top of a USB connection.

The Coherent GUI must be installed on the customer computer before using the USB connection to the laser.

Once Windows has configured the USB driver, the Rapid LX can be accessed on IP-address **169.254.21.151** as shown in the following image via any Telnet terminal.

Figure 18: Tera Term connection

In case you want to connect the RLX with the Coherent GUI (via USB), open the GUI and choose: ***Connect > USB Port***.

GUI INSTALLATION

Install the GUI on the external client PC (provided by the customer) running Microsoft Windows 10 or 11 operating system. Unzip the file ***Coherent GUI.zip*** and start the setup program. Follow the displayed procedure.

The GUI-installation-file can be found on the USB-stick (included in delivery) and from the following link: https://www.-coherent.com/resources.

OPERATING SEQUENCE

This section shows an example of sequence to start the system and define parameters (without the GUI). Integrating further commands is dependent on individual purposes.

- Connect the laser head to the power supply and the power supply to mains
- Turn on the chiller
- Check that the Interlock chain is active and closed
- Make sure that the Ethernet or USB-Port connection is established

The Interlock must be closed to start the laser.

DANGER

As soon as the Interlock gets closed, laser emission is possible and emits. This is also valid for pressing the *Clear* button in the GUI or sending the command `FACK=1`.

- Make sure to observe laser safety (guide the beam to a known place or into a beam dump for testing purpose) before continuing
- Press ***Clear*** in the GUI or send `FACK=1` to confirm that no faults are present
- Press the ***Start*** button in the GUI or send `Start`. This procedure might take up to 2 minutes for initialization (takes longer for a cold-start). Laser radiation will be emitted (make sure to guide the laser beam at least into an adequate beam dump for testing purposes, fulfill laser safety)

Further commands are customer-individual and application dependent. The listed procedures are meant as simple examples of command sequences. Parameters are not stored and need to be defined on each start-up.

- `HB=n` to start the heartbeat function with n seconds timeout, recommended command for safety reasons. Make sure to regularly send or query a command within the timeout period n (otherwise the system would shut down the laser diodes)
- `PM=n` to set the pulse mode, see section "Application signals" on page 1
- `EM=0` to set the modulation to ***Internal*** (software-control)
- `BURST=n` to set the amount of bursts
- `RRAMPSET=n` to define the requested pulse repetition rate
- `CLPE=1` or `CLEE=1` if the activation of closed loop (power- or energy -regulation) is requested
- `SETPOWER=xx` or alternatively `SETENERGY=xx` to define the requested output power
- `?POUT` or `?EOUT` for monitoring the output -power or -energy,

It is recommended to periodically query certain values (limit the period to 1/sec or less often). Refer to the corresponding commands in the external commands-list document (sorted by function, table Monitoring).

Periodically send `?W` to query the warning status of the system (limit the period to 1/sec or less often). Various actions might be required due to individual warnings; system remains operational.

In order to repeat procedures after certain operating hours, `?HH` (head hours) can be used for time-calculation.

Periodically send `?F` to query the fault status of the system (limit the period to 1/sec or less often). Various actions might be required due to individual situations; system will stop the operation in case of a fault condition.

For more information concerning commands, faults and warnings refer to the external commands-list document.

APPLICATION SIGNALS INTRODUCTION

The features and namings of the application-input-signals depend on individual customer requirements and specific application(s).

Refer to the Operator's manual for more information.

PLAN MAINTENANCE SLOTS

Refer to the Operator's Manual for the maintenance intervals. The maintenance must be observed and we recommend to schedule corresponding maintenance slots.

BRITTLE MATERIAL CUTTING

Coherent provides SmartCleave laser systems, optimized for brittle material cutting. In order to achieve best results, these laser systems take advantage of burst mode and PulseEQ.

Brittle material cutting applications might require additional beam shape conversions provided by optional optics. In order to provide best results for different materials and applications Coherent offers various optics, refer to section "SmartCleave optics" below. Do not hesitate to contact your Coherent representative for support with your application as needed.

Coherent offers an optional protection glass. More information can be found in the corresponding operator's manual.

SMARTCLEAVE OPTICS

The following table gives an overview of the existing SmartCleave optics.

Name	Item number	Description	Thickness range	Working distance (depends on application and material)	Compatible to optional protection-glass
SmartCleave Advanced Classic	101145223	The classic version of SmartCleave is our work horse and suitable for many applications. It is designed to create strong filaments for easy cleaving	up to 1.6 mm	~ 9.5 ± 5 mm	Yes
SmartCleave Adanced LongFi	101141842	SmartCleave optics optimized for cutting of thicker glass (up to ~3 mm in single pass, depending on application, coatings and glass type), cost effectively	up to 3 mm	~ 21.5 ± 5 mm	Yes
SmartCleave Advanced Low Damage	101141761	SmartCleave optics optimized for cutting thinner glass with minimized damage to coatings, foils or structures located near the cutting path; not compatible with the protection glass	<1 mm	~ 6.5 ± 2 mm	No
SmartCleave Advance High Efficiency	101147091	SmartCleave High Efficiency optics for cutting of 2 mm thick glass with low pulse energy. Also excellent results for (stacked) UTG (ultra thin glass) cutting	up to 2 mm	17.5 mm ± 5 mm	Yes

Coherent offers a protection glass which can be exchanged by customer when needed.

COHERENT

INNOVATIONS THAT RESONATE

Rapid LX Laser System Pre-Installation-Guide

Part No. 1448513 Rev. AC