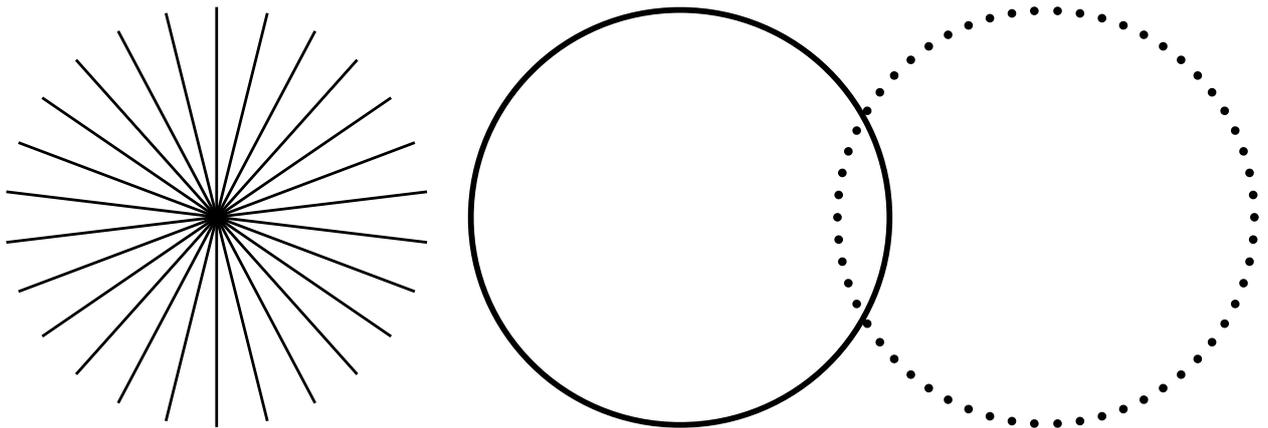


HyperRapid NXT/NX Laser System

Pre-Installation-Guide



Edition November 2023

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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.

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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.



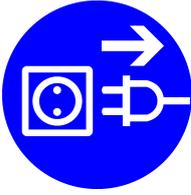
This symbol indicates a magnetic and/or electro-magnetic field.



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.

TYPOGRAPHIC CONVENTIONS

The following typographic conventions are used in this Pre-Installation-Guide:

Bold	Highlights an important statement
<i>Bold italic</i>	Indicates system features, (software) -functions, -dialogs or interfaces
<code>monospace</code>	Software commands, file names or directories
<CR>	Indicates a special character
[abc]	Indicates an (exemplary) variable or an index

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 HyperRapid NXT/NX 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/resources?query=pre%20hyper&resourceType=Manual>



The datasheet of the HNXT / HNX can be found in <https://www.coherent.com/lasers/laser/hyper-rapid-nx>



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/HNXT_HRNX_eng_1307716_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-repetition-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.

HARDWARE SIMULATOR

The HyperRapid NXT/NX simulator software is an external program (running in Microsoft Windows) which emulates some parts of the system-hardware. The behavior of the simulator is quite realistic with certain restrictions (such as safety features, etc.). The simulator can be connected via Ethernet to the Coherent GUI, terminal or customer software. A connection via RS-232 or USB cannot be simulated.

PURPOSE OF THE SIMULATOR

The simulator is meant mainly for new customers / integrators, who are not yet familiar with the system-features or would like to develop a customer-individual system-controlling software. Another benefit of the simulation might be the possibility to enhance an existing customer-software without using a real laser-system. The development might be requested to start prior to laser-system arrival or without occupying a tool necessary for production.



Contact Coherent Service to receive the hardware simulator program () and instruction (D168340).

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	-10°C to +50°C (14°F up to 122°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 HyperRapid NXT/NX laser in a dry place. Moisture could cause malfunction. Mis-treatment 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 HyperRapid NXT/NX 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 39
Power – laser head	The laser head needs 48 VDC with a power consumption of approx. 1800 W; refer to section "Power supply options" on page 21
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 18
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 39 . 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 "Safety Control \(D-Sub 15\)" on page 42](#).

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.

Amount	Part
1	HyperRapid NXT/NX laser head
5	Cable adapter, HD-BNC connector to BNC bulkhead, 75 Ohm
3	Plug terminator for the laser head input-connectors (rear side) [Ext Mod, Gate, Trigger] . Connect when inputs not in use
3	Pedestal for the laser head, provide 6x M6x20 or 1/4", length 3/4", provide 6 alignment pins (DIN 7) ø6x20 mm (if necessary)

Amount	Part (depending on order)	Alternative (depending on order)
1	Power supply, 19" unit, height 3U, 100-230 VAC (50/60 Hz); refer to section "Power supply 3U" on page 22	Power supply, 19" unit, height 1U, (consists of 3 x 1000 W devices) 100-230 VAC (50/60 Hz); refer to section "Power supply 1U" on page 25
1	1 Mains cable, open-end, with CEE 7/4 (Schuko-plug); length: 2 m for 3U-PSU	3 Mains cable, C13, with CEE 7/4 (Schuko-plug); length: 2 m for 1U-PSU
1	Power cable 48V with D-Sub connector for the laser head, length: 5 m	

Amount	Part (included if SMC chiller is ordered)
1	SMC Chiller
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)

Amount	Part
1	Safety Box with D-Sub 9 cable,length 5 m (16 feet) (section "Safety box" on page 45)
2	System key A126
1	Envelope including CoC (report of measurements, print) and product documentation (USB-stick, item: 1389654)
4	Handle, T-shaped M8
4	Lifting eye bolt (ring-screw) DIN 580 M8 (for crane transportation) with plastic washer
1	Transportation cover in front of the output-window

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 6 hours in ambient room temperature prior to opening the shipping containers.



NOTICE

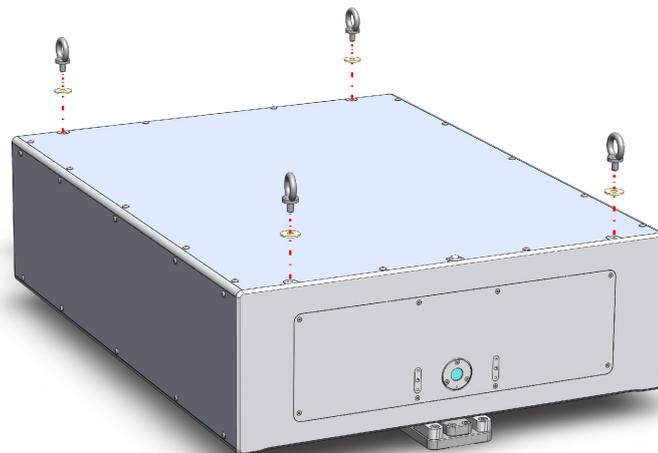
Preserve ALL packaging material for future shipments, e.g. for Service to Coherent or forwarding shipment to your own customer.



For further information refer to the external document "Unpacking HNXT_HRNX_eng_1317906_REV".

TOOLS NECESSARY FOR INSTALLATION

- Forklift for transporting the euro-pallet
- Cross-head screwdriver (PZ2) to open the crate-top-cover (do not open any Torx-screws located at the side-walls)
- Allen-key: metric, size 5 (for M6 hex-screws used in order to attach the laser head onto the pedestals)
- Allen-key: imperial, additionally needed in case of imperial screws for attaching the pedestals onto the customer's table
- Allen-key: metric, size 2.5 for M3 hex-screws in order to remove the output-window transportation-cover and optionally in case of attaching light devices in front of the output window
- 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
- 4 persons for lifting the laser head out of the box (approx. 65 kg (145 lbs)); alternatively a (portable) lifting device. 4 attachable handles as well as lifting eye-bolts are included in delivery (tapped holes are: M8x20). Use the plastic washers (included in delivery) to prevent scratches on the laser head top side.



- 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 and holes for the dowel pins 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 including network-card (or alternatively RS-232 interface)
- 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.)

CHILLER REQUIREMENTS

The cooling is important for the stability and operation of the laser system. Do not use any other chiller than the proposed one from Coherent, refer to [section "SMC chiller" on page 18](#). If there is a reason against this chiller, do not hesitate to contact Coherent.



NOTICE

The laser system requires Coolflow IGE. Coherent cannot take responsibility for other coolants used. The chiller is dimensioned for exchanging the heat of the laser system. Do not include further devices into this chain.

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.

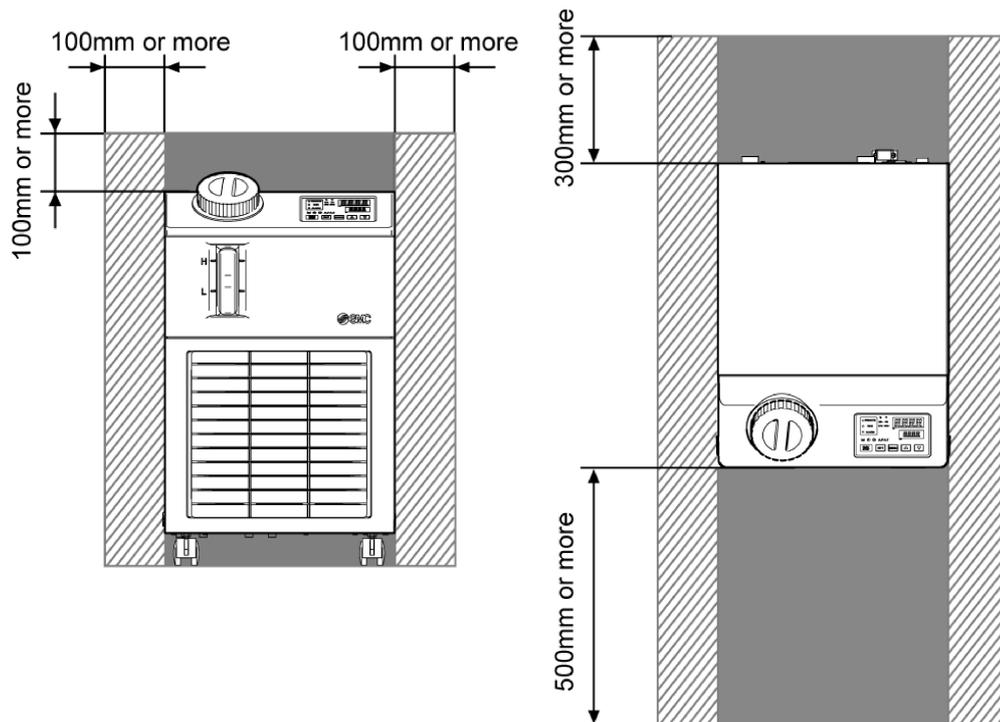


Figure 1: SMC chiller required space

SMC CHILLER REQUIRED HEAT EXCHANGE

WATER-TO-AIR CHILLER

Model	Heat Radiated (approx.) [kW]	Required ventilation amount [m ³ /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 temp. range [L/min]	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.



CAUTION

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



Figure 2: SMC chiller

Two different versions concerning the cooling method are available:

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).

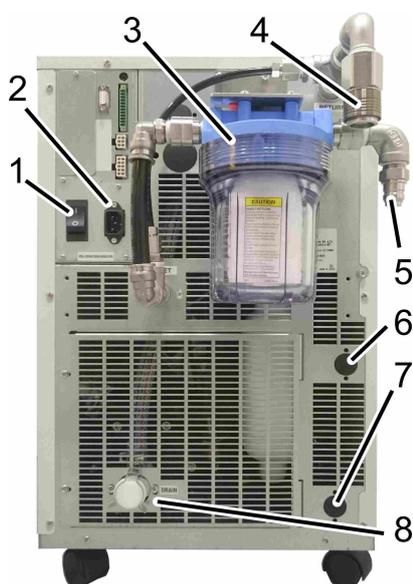


Figure 3: SMC chiller rear side

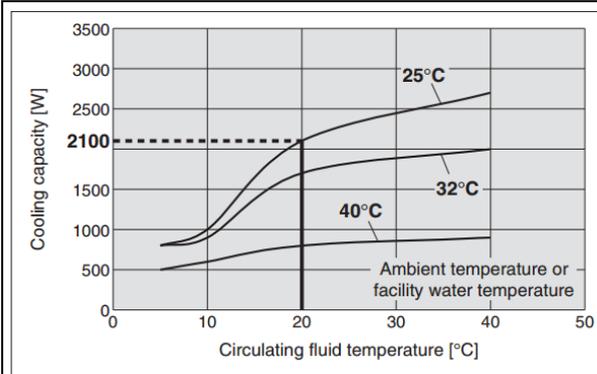
POS	Description
1	Mains switch
2	C14 mains connector (female)
3	Filter, installed
4	Coolant return (warm)
5	Coolant outlet (cold)
6	Facility water outlet; (for WW-chiller)
7	Facility water inlet; (for WW-chiller)
8	Coolant drain

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.

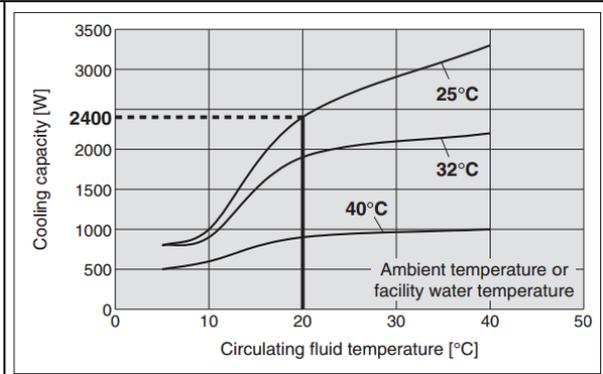
The temperature stabilization of the coolant can take approximately 20 min after a cold start.

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.

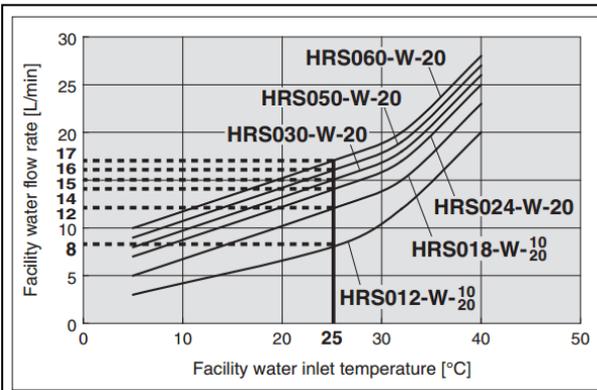
In order to ensure enough heat exchange (in case of a water to air system) make sure that there is sufficient amount of space behind the chiller (>0.5 m / >20 inches). Also the air circulation / ventilation and fresh air supply should not be constricted.



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 OPTIONS

The HyperRapid NXT/NX laser head requires +48 VDC +/-5% with >1800 W. Coherent provides two optional devices:

- 3 U power supply, 19" rack mount required in Europe (CE conform)
- 1 U TDK-Lambda power device, 19" rack mount including three single power supplies combined (integrator responsible for conformity topics)

The Coherent provided power supply is not allowed to be used for any other devices or applications than connecting to the HyperRapid NXT/NX.

It is recommended to add a strain-relief to the power cords (mains and umbilical). Additionally make sure to protect cables against mechanical forces (such as tension, traction, torsion, clamping, crushing, squeezing, cutting forces, etc.).

Refer to the following sections to find description of both devices. Delivery depends on the customer's order.



WARNING

Note that all electrical work (e.g. designing, configuring and connecting, etc.) shall be performed by a certified electrician.



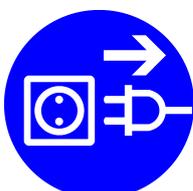
NOTICE

The power supply does not include a mains switch nor Emergency Stop button.



WARNING

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.



WARNING

Unplug and disconnect from mains before starting any work on the power supply.

POWER SUPPLY 3U

The 3 U 19" power supply provides +48 VDC. The height of the supply is 3 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).



NOTICE

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

FRONT VIEW PSU 3U

Two LED's are located on the right side of the power supply. They are illuminated green when the power supply gets connected to mains. The cooling fans of the power supply should not be obstructed in order to maintain an air flow from the front to rear. The device can be fixed into the 19" rack unit with 4 screws (M6).



Figure 4: Front view of the power supply

STAND ALONE PSU 3U

Attach the 4 feet (included in delivery) if the power supply is not integrated into a 19" rack. Insert each foot into the corresponding hole located on the bottom of the device. Lock the foot by carefully stamping the pin into the foot itself. In order to detach the feet again, remove the device ground plate (4 screws bottom view) and push the pin back out of the foot; no tool required. The height of the inserts are 7.2 mm (when attached).

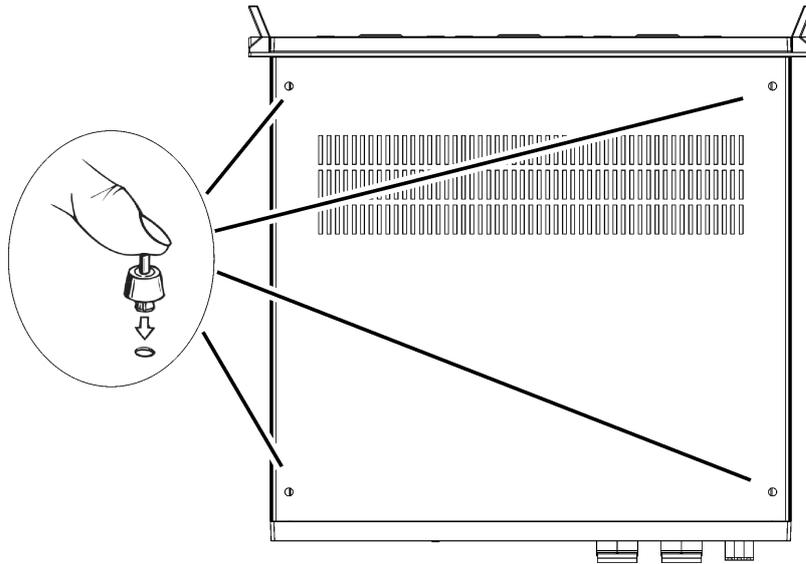


Figure 5: Bottom view of the power supply, feet inserts

SIDE VIEW PSU 3U

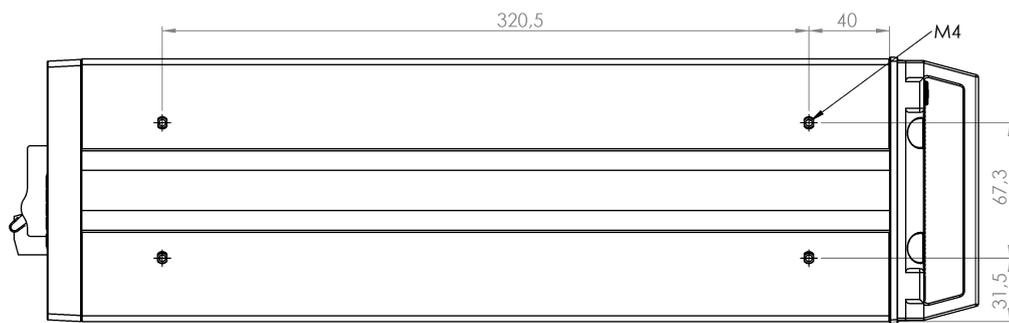


Figure 6: Side view of the power supply, dimensions in mm

REAR VIEW PSU 3U

The following components are located on the rear side of the power supply:

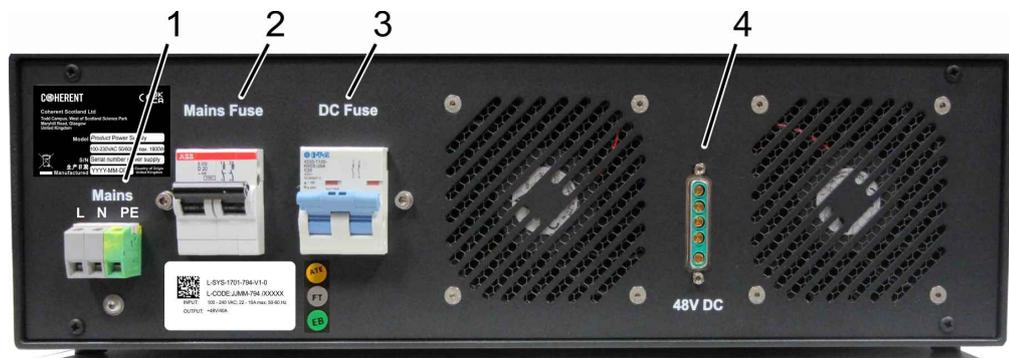


Figure 7: Rear view of the power supply

POS	Description
1	Mains connector single phase (L – phase, N – neutral and PE – ground), 100–230VAC (50/60 Hz)
2	Mains fuse
3	Output fuse
4	Output, 48V DC connector for the laser head; connect / disconnect only when PSU is disconnected from mains

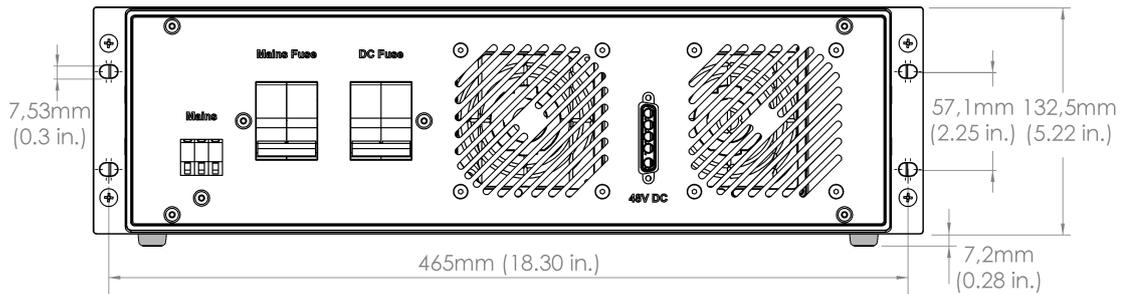


Figure 8: Rear view of the power supply, dimensions in mm



WARNING

Note that all electrical work (e.g. designing, configuring and connecting, etc.) shall be performed by a certified electrician.



WARNING

Make sure to protect the cables against disconnection, mechanical forces and against contact by hand (if necessary).

BOTTOM VIEW PSU 3U

Allow at least 100 mm behind the power supply for cables and the D-Sub connector. The power supply front and rear should not be covered or obstructed to guarantee an efficient heat exchange.

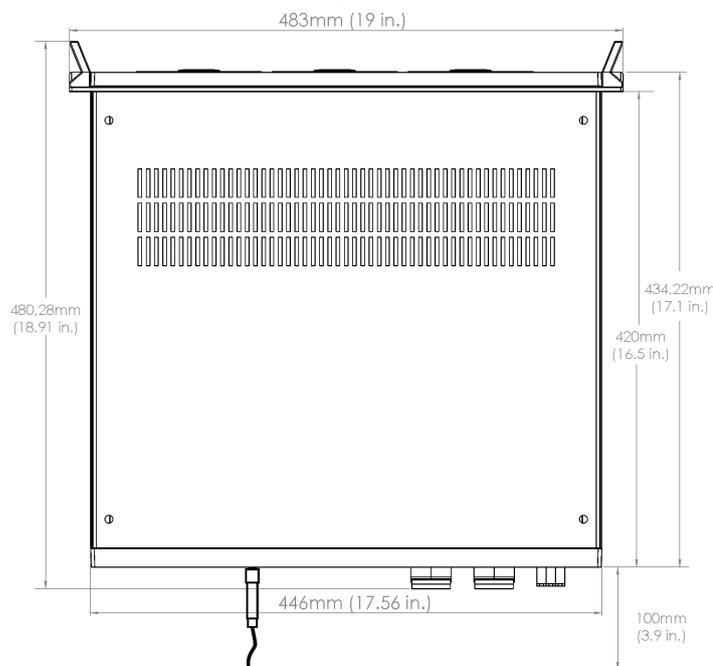


Figure 9: Bottom view of the power supply, dimensions in mm

POWER SUPPLY 1U

The TDK-Lambda power device is a 19"-frame including three single power supplies combined. 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 three C13 (IEC 60320) cables. Make sure to adequately fuse them.



NOTICE

Make sure to always turn on all 3 power supplies at the same time. Use one single circuit breaker to protect all 3 power supplies simultaneously.



NOTICE

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

FRONT VIEW PSU 1U

The PSU consists of three power supplies which are identical to each other and can be extracted and exchanged (make sure to disconnect from mains prior to exchanging). The cooling fans of the power supply should not be blocked as these provide cooling air flow from the front to rear. 3 LEDs (located on each power supply) indicate the voltage status: DC OK, DC FAIL, AC OK.



Figure 10: Front view of the power supply

REAR VIEW PSU 1U

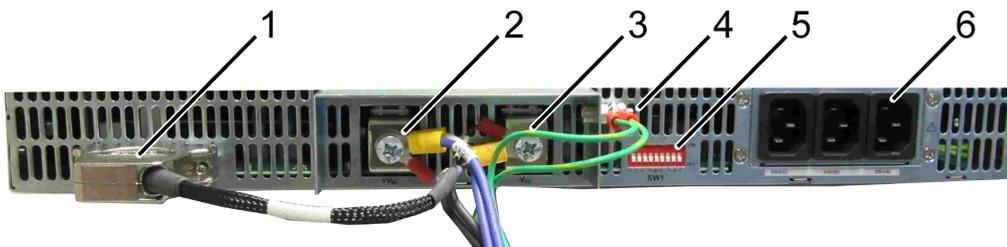
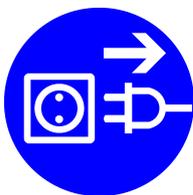


Figure 11: Rear view of the power supply

POS	Description
1	Sensor D-Sub connector
2	+ 48 VDC, up to 3000 W
3	0 VDC (do not ground)
4	GND, ground
5	DIP-switches, all in OFF-position
6	C14 (male) mains connectors, make sure to connect all 3 plugs



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 blue PLUS-cable from the sensor-connector and both PLUS-cables from laser head to (2)
- Connect the black MINUS-cable from the sensor-connector and both MINUS-cables from laser head to (3)
- Connect the Ground-cables to the housing-screw (4)
- Make sure that all DIP-switches (5) are set to OFF-position
- Connect all three plugs (6) to mains-cables (cable providing C13 (female) connectors)
- Connect all 3 power-cables with mains. Make sure that they are adequately fused
- Make sure to protect each 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.

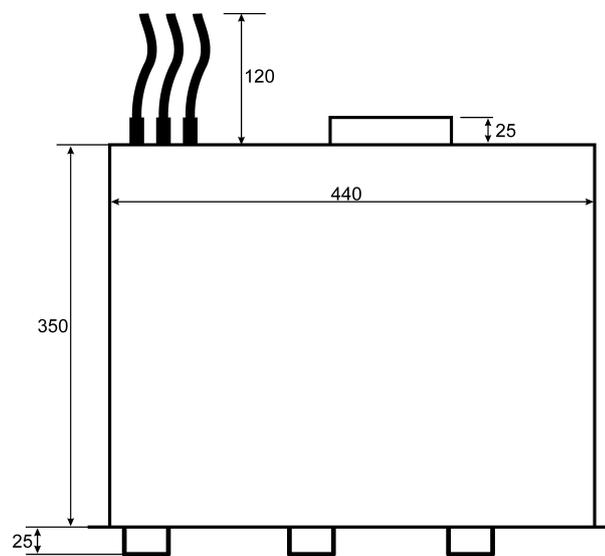


Figure 12: Top view of the power supply, dimensions in mm

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 3U (dependent on order)	Article	Device end	Cable length	Customer end	Image
System Power supply (connecting the 3U power supply to mains)	22475	open cable ends	2 m	CEE 7/4 (Schuko-plug)	
Laser head (48 V power cable between PSU 3U and laser head)	1317273	D-Sub 5W5 male (for connection to PSU)	5 m	D-Sub 5W5 female (for connection to laser head)	

Cable for PSU 1U (dependent on order)	Article	Device end	Cable length	Customer end	Image
System Power supply (connecting the power supply to mains), 3 cables	22475	C13 (IEC 60320)	2 m	CEE 7/4 (Schuko-plug)	
Laser head (48 V power cable between PSU 1U and laser head)	1298434	cable-lugs to be connected to power supply	5 m	D-Sub 5W5 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
- The location of the laser should be relatively clean and free of condensation. For the environmental conditions refer to [section "Ambient condition" on page 11](#)

- 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
- Download the HNXT / HNX GUI from: <https://www.coherent.com/resources?query=hyper&resourceType=Software>
- BNC-signal lines: Gate, Trigger, Sync, Ext Mod, Pulse Monitor. 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. The laser head provides HD-BNC-plugs (bulkheads). Adapter-cables to BNC are included in the delivery (length 30 cm, 12 inch). Alternatively use HD-BNC cables with **75 Ω**.

Adapter cable connectors	
BNC bulkhead for customer cable	HD-BNC plug to the laser head 75 Ω
	

- 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: RS-232 cable in case the system shall be controlled via RS-232 (instead of Ethernet or USB)
- Optional: USB cable in case the system shall be controlled via USB (instead of Ethernet or RS-232)
- 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 "Safety box" on page 45](#)

- D-Sub 15 cable with male connector to use the Safety Control features; refer to [section "Safety Control \(D-Sub 15\)" on page 42](#). Provide an adequate interlock-chain which can be connected to the interface. Bridging these safety circuits is not allowed and would decrease the Functional Safety Performance Level. The responsibility to fulfill relevant safety-regulations remains with the customer. Choose the appropriate Mode (0 software control, 1 hardware control) with integrating the corresponding interfaces (relays, safety interlocks, push button, active safety device, etc.; not included in delivery)
- Optional: D-Sub 25 cable with a male connector to use Status outputs
- 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.

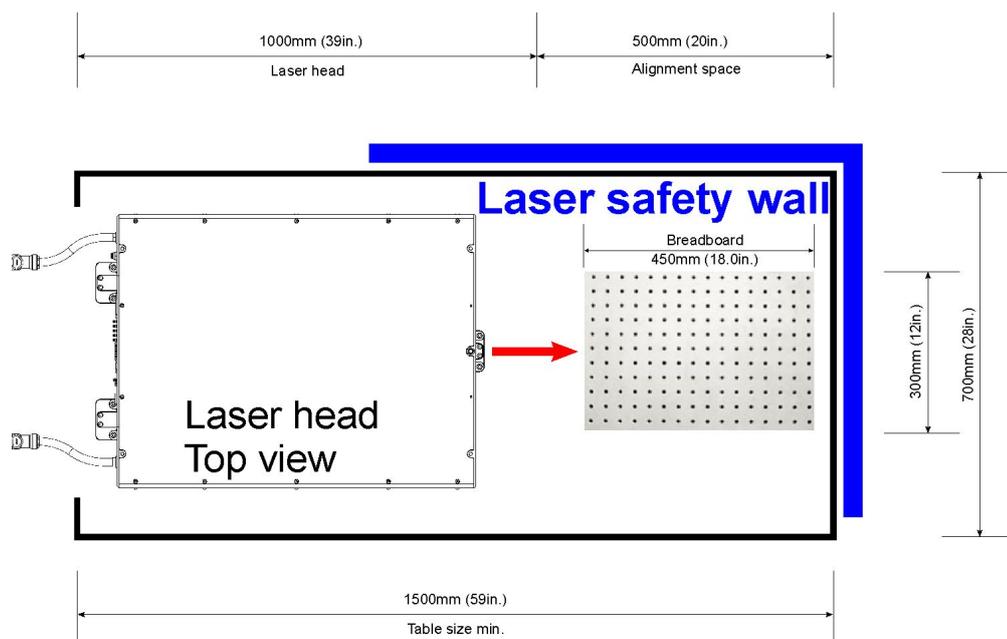


Figure 13: Alignment table, top view

MECHANICAL DIMENSIONS OF THE LASER HEAD

Refer to the technical drawing ([section "Technical drawing" on page 39](#)) 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
- Attenuator
- Modulator
- Optional: a second (SHG, 532 nm) or third (THG, 355 nm) harmonic generator
- Safety shutter

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

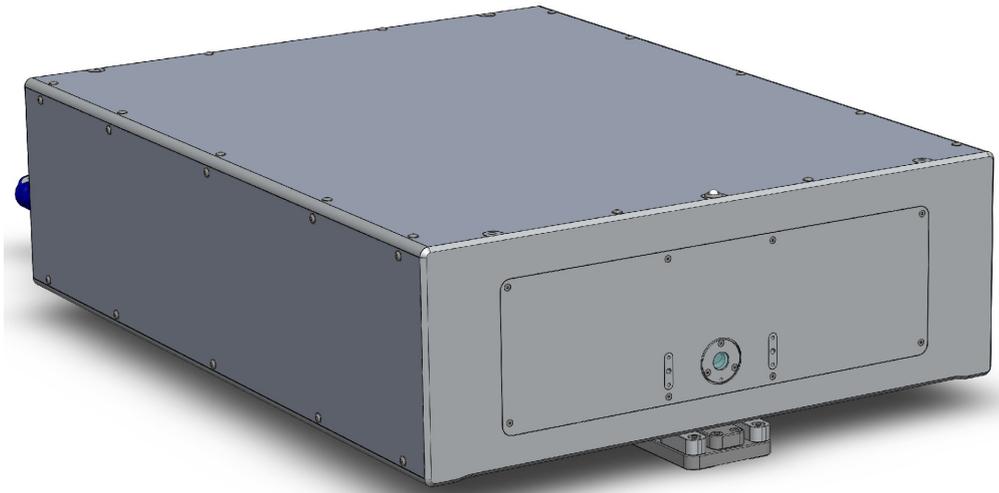


Figure 14: Perspective front view of laser head

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

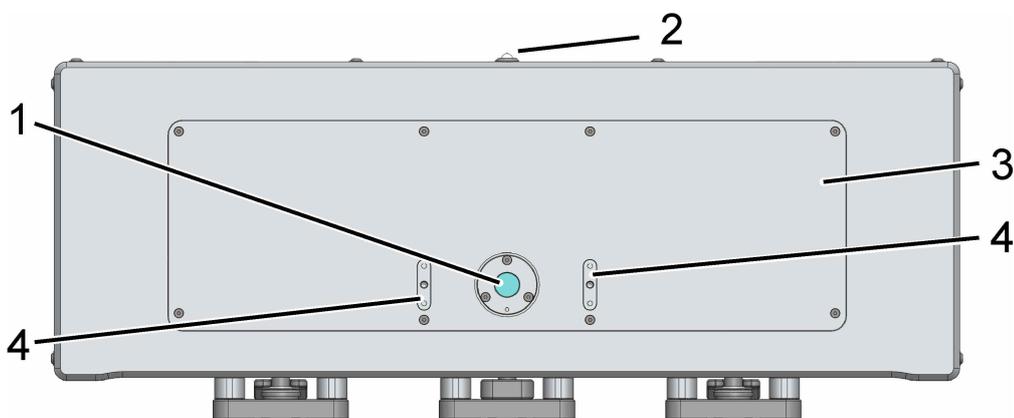


Figure 15: Front view of the laser head

POS	Description
1	Output window (cover removed)
2	Laser emission indicator
3	Front cover, DO NOT OPEN, Coherent Service only
4	Adapter threads for housing / tubing / protecting elements, refer to section "Output window" on the facing page

OUTPUT WINDOW

Located on the laser head front side there are 4 thread holes (M4, 8 mm depth) and 2 dowel pin-holes (\varnothing 4.02 mm); refer to the image below. Attaching a beam-tube or a telescope in front of the output window is possible using these holes. 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).

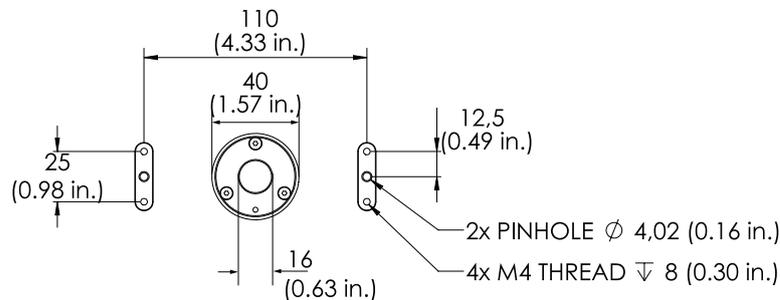


Figure 16: Output window, dimensions in mm (and inch)



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

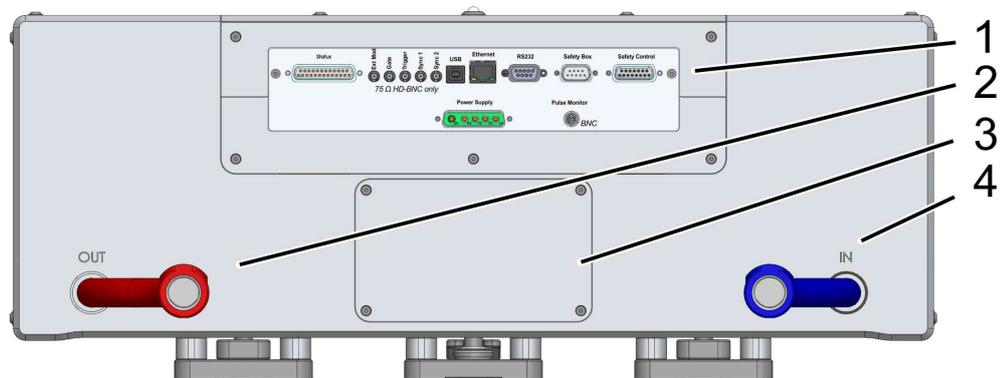


Figure 17: Rear view of the laser head

POS	Description
1	Electrical interface; refer to section "Connectors" on the facing page
2	Coolant return, warm water to chiller
3	Compartment of the desiccant; refer to external maintenance document
4	Coolant supply, cold water from chiller

CONNECTORS

The function and characteristics of each interface is described in the list below. All round connectors are HD-BNC & BNC (bulkhead) connectors. The connectors can be found on the rear side of the laser head.



NOTICE

Make sure to use 75 Ω HD-BNC connectors for position 1-5. Adapter cables HD-BNC to Standard-BNC connectors are included in delivery. 50 Ω HD-BNC connectors are not allowed due to deviating pin-size.



NOTICE

Input connectors (POS 1, 2, 3) are covered by a terminating resistor cap. Use these terminating caps as long as the signal is generated internally. Limit the signal to max. 5 V in case of external supply (provided by a function generator or scanner-device, etc.).



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.

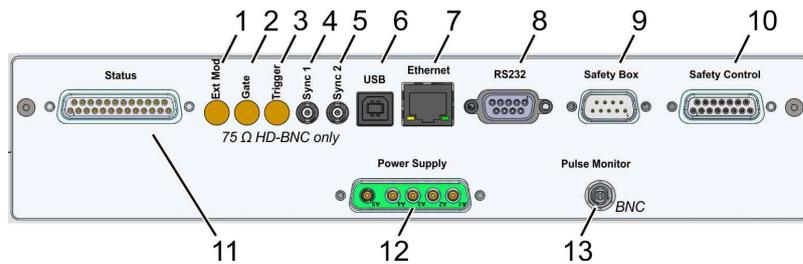


Figure 18: User connector panel

POS	Name	Signal	Description
1	Ext Mod	0–5 V Impedance: 10 kΩ	INPUT: analog signal to modulate the output power, relation is not linear, select the corresponding feature in the Software. Use HD-BNC connector with 75 Ω or the adapter-cable included in delivery. Use the terminating resistor (included in delivery) if the input is not used

POS	Name	Signal	Description
2	Gate	TTL Impedance: 10 k Ω	INPUT: provide application-signal to toggle the optical output. Use HD-BNC connector with 75 Ω or the adapter-cable included in delivery. Use the terminating resistor (included in delivery) if the input is not used
3	Trigger	TTL Impedance: 10 k Ω	INPUT: provide signal of the requested repetition-rate. Use HD-BNC connector with 75 Ω or the adapter-cable included in delivery. Use the terminating resistor (included in delivery) if the input is not used; apply a duty cycle of 50% or a fixed signal-length between 150 ns to 300 ns. Note for HyperRapid NX: Additionally define an internal trigger frequency (in the GUI or via command) smaller than this signal (external trigger)
4	Sync 1	The signal is deviating for HyperRapid NXT & HyperRapid NX, refer to next table below	
5	Sync 2	The signal is deviating for HyperRapid NXT & HyperRapid NX, refer to next table below	
6	USB	—	USB-B interface connector
7	Ethernet	—	Network connector for communication
8	RS-232	—	D-Sub 9 (female) RS-232 interface for alternative communication
9	Safety box	—	D-Sub 9 (male) connector for the Safety Box, refer to section "Safety box" on page 45
10	Safety Control	—	D-Sub 15 (female) connector for the Safety control, refer to section "Safety Control (D-Sub 15)" on page 42
11	Status	—	Output: D-Sub 25 connector, refer to section "Status connector" on page 47
12	Power Supply	48 V, <60 A	Mixed D-Sub 5W5 female, connected to power supply A1, A2: + 48 VDC, $\pm 5\%$ A3, A4: GND; A5: Earth
13	Pulse Monitor	Impedance: 50 Ω	OUTPUT: electrical signal synchronized to the optical pulses (photodiode signal for diagnostics), variable amplitude. Reserved for Coherent Service, use BNC connector

HYPERRAPID NXT, SYNC

The assignment of the Sync-connectors was changed for this product.

POS	Name	Signal	Description
4	Sync 1	—	not connected; signal is internally used
5	Sync 2	Impedance: 75 Ω	OUTPUT signal synchronous to the internal trigger frequency (GATE-status is not included). Use this signal to synchronize external devices. Signal width can be adjusted by the command <code>SYNC2DW</code> . Signal delay can be changed by the command <code>SYNC2DT</code> , refer to the command list. Use HD-BNC connector with 75 Ω or the adapter-cable included in delivery

HYPERRAPID NX, SYNC

This assignment of the Sync-connectors is exclusively valid for the HyperRapid NX systems.

POS	Name	Signal	Description
4	Sync 1	TTL Impedance: 75 Ω (pulse width: 18 \pm 2 ns)	OUTPUT signal of internal amplifier frequency, signal does not include the Gate-information); reserved for Coherent-Service. Use HD-BNC connector with 75 Ω or the adapter-cable included in delivery
5	Sync 2	Impedance: 75 Ω (pulse width: 700 \pm 200 ns)	OUTPUT signal synchronous to emitted pulses (or burst groups), signal including GATE-status (independent of the shutter state). Use this signal to synchronize external devices. Use HD-BNC connector with 75 Ω or the adapter-cable included in delivery



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

DRILL PATTERN ON CUSTOMER TABLE

The pedestals (for mounting the laser head onto the table) are designed to match metric as well as imperial optical breadboards. The dimensions of the drill pattern are displayed in mm (green is indicated in Inch). Make sure to choose blue (for metric system) OR green (for imperial system). All dimensions are toleranced with ± 0.1 mm.

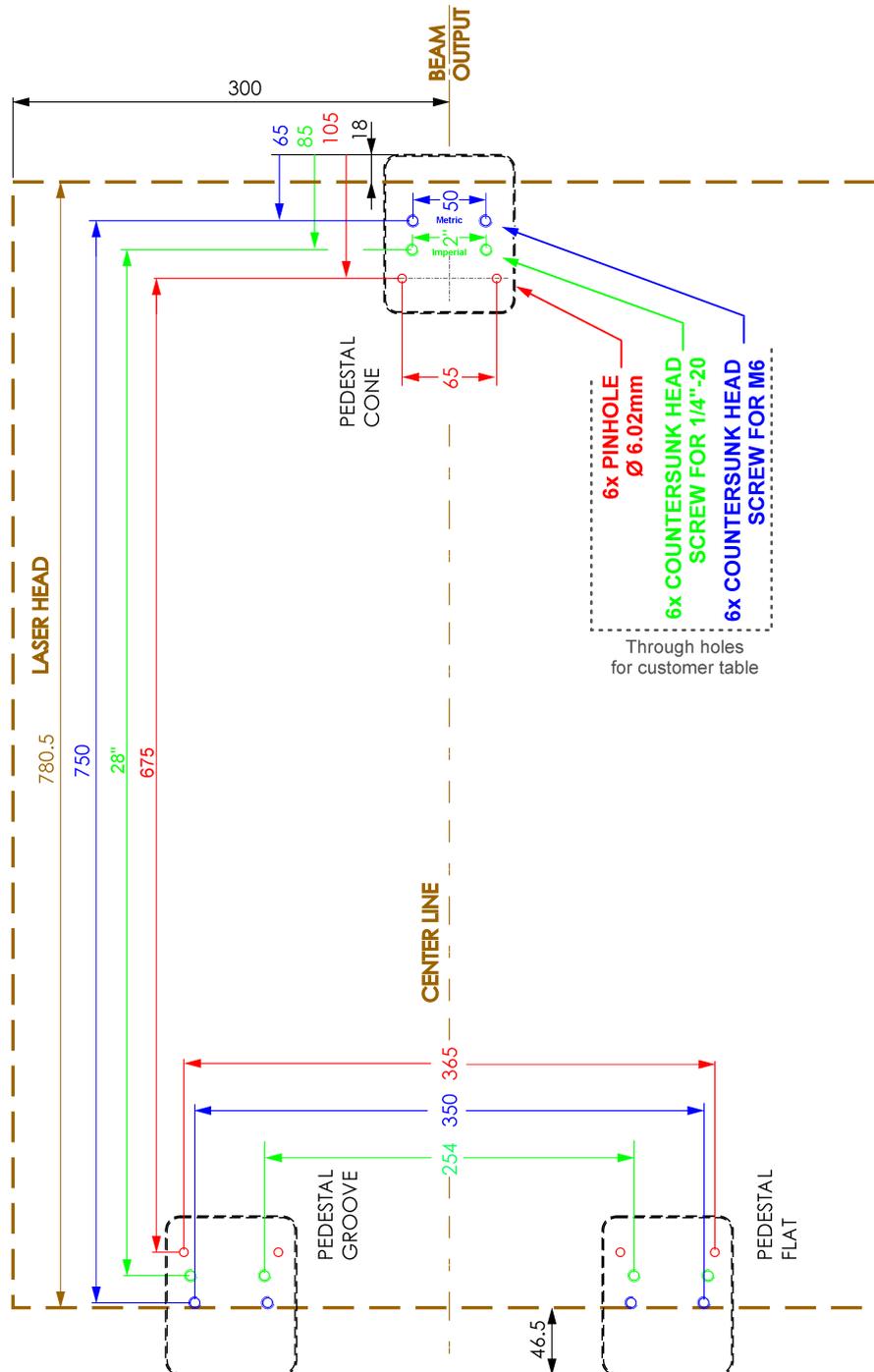


Figure 20: Drill holes, top view

FUNCTIONAL SAFETY

The HyperRapid NXT/NX incorporates a functional safety board (FS). In case the customer considers to create a risk assessment evaluation, the functional safety board might help to increase the safety performance level (dependent on further customer-specific situations / circumstances). This electronic-board monitors the status of the **Safety Box** (D-Sub 9 connector) and the **Safety Control** Interface (D-Sub 15 connector). It gives feedback on fault conditions and is equipped with a self-detection (upon signal redundancy). A feedback of the actual system status is delivered with the **Status connector** (D-Sub 25 connector).

The safety board controls the following functions:

- **Safety Box** includes a key-switch, emergency stop button, a green Power On LED and a white Laser Emission LED. Alternatively replace the device by your own machine integrated safety elements, refer to [section "Safety box" on page 45](#)
- The **Safety Control** provides two possible modes (refer to [section "Safety Control \(D-Sub 15\)" on the facing page](#)) in order to control the shutter via software or externally by customer hardware
- The **Status connector** provides output signals indicating the actual status of the system (independent of the software), refer to [section "Status connector" on page 47](#)

SAFETY CONTROL (D-SUB 15)

The interface **Safety Control** (D-Sub 15) offers two different options for controlling the shutter. The modes can be switched via software command. Send `SMOD=0` or `SMOD=1`. Send `?SMOD` to query the current mode with the response of 0 or 1. The status of the mode is saved and reloaded on start-up:

- Mode 0: Software Control
The shutter can be operated by software (GUI or serial commands) if appropriate hardware contacts are closed and no faults existing
- Mode 1: External User Control
The system is activated by a push-button (provided by customer, e.g. for machine integration). This is the initial system-release-signal after the system has been powered on (and key-switch turned) or to confirm an error-correction. If the functional-safety-board (FS) is error free, the laser diodes will be enabled but not las-
ing

In order to turn on the laser diodes, send the corresponding software-signal (in the GUI or via command), refer to [section "Operating sequence" on page 49](#). In order to confirm an error-correction, send the command `FACK=1` and press the **Start Release Push button**. The shutter is operated by two independent hardware interfaces.

Both modes are described in the next chapter.

SAFETY CONTROL MODE 0

The Mode 0 offers the control of the shutter via software (GUI or command). The shutter can be opened as long as the indicated conditions are fulfilled. All contacts are potential free. Use these contacts to implement a customer-individual safety circuit (e.g. cabinet-door indicator or open-request device, etc.) via relay or mechanical switches.

Both user-connectors (UC1&UC2) must be closed before the start-release can be activated. This is also the condition for an operable shutter. Opening one (or both) switches would establish an interlock. In this case both connectors would have to be opened and closed again and fault acknowledged by command `FAACK=1`.

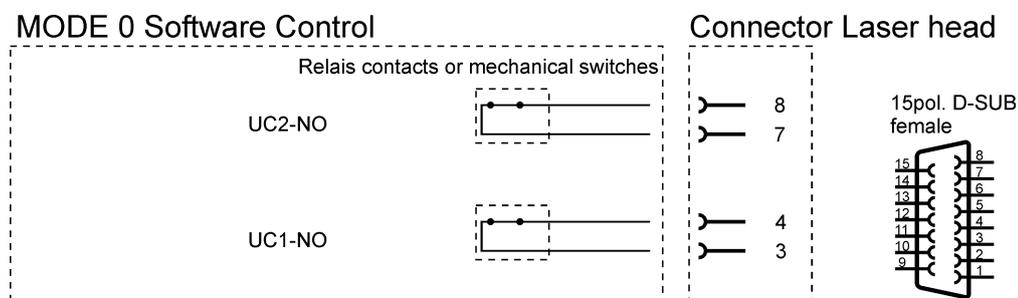


Figure 21: Safety Control, Mode 0, start-up condition

User connector	Description
UC1 (normally open)	PIN 3 connect to PIN 4 in order to enable the shutter (refer to UC2 for additional requirement)
UC2 (normally open)	PIN 7 connect to PIN 8 in order to enable the shutter (refer to UC1 for additional requirement)



NOTICE

In order to operate the shutter (via software), UC1 AND UC2 have to be closed. Any other condition closes the shutter or prevents opening.



WARNING

Make sure to fulfill laser safety before opening the shutter via GUI or command.



WARNING

Make sure to implement an adequate interlock chain (such as e.g. door-interlock or active safety device). Bridging the connectors is not allowed and would decrease the functional safety performance level.

SAFETY CONTROL MODE 1

The Mode 1 offers a hardware control of the shutter. All contacts are potential free. The **Start release push button** needs to be integrated by customer and pressed once on start-up or after eliminating an error; the activation is edge triggered. Closing this connection permanently is also possible, but after eliminating an error, as well as after system start-up (power-on), the connection would have to be reset (open and close) in order to confirm the error correction.

Both user-connectors (UC1&UC2) must be open before the start-release can be activated. After system start-up use both connectors to operate the shutter. In case of an interlock or fault condition, make sure that **both** UC's are **opened** (so that the shutter can resume operation).

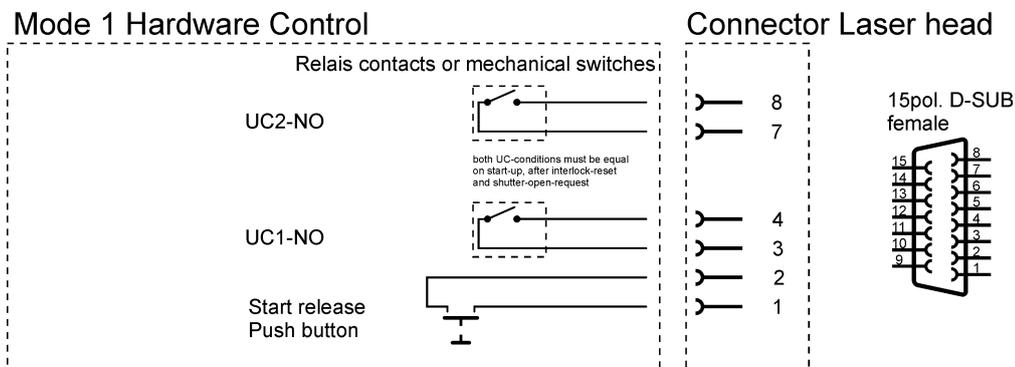


Figure 22: Safety Control, Mode 1, start-up condition; shutter is closed

User connector	Description
Start release	Push-button (between PIN 1&2) in order to enable the system on start-up or after eliminating an error
UC1 (normally open)	PIN 3 connect to PIN 4 in order to enable the shutter (in order to open the shutter UC2 must be closed also)
UC2 (normally open)	PIN 7 connect to PIN 8 in order to enable the shutter (in order to open the shutter UC1 must be closed also)



Shutter opens when UC1 AND UC2 are closed. Any other condition closes the shutter or prevents opening.



WARNING

Make sure to fulfill laser safety before closing both user-connectors (in order to open the shutter).



WARNING

Make sure to implement an adequate interlock chain (such as e.g. door-interlock or active safety device). Bridging the connectors is not allowed and would decrease the functional safety performance level.

SAFETY BOX

The safety box (connected to the D-Sub 9 plug) 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. In this case, provide the same circuit as shown in the schematics. The Laser Emission LED is monitored by the functional safety board (FS). Connect a LED or use a resistor (180-200 Ω) between Pin 1 and Pin 2 (of the D-Sub 9 plug). This is necessary for the laser to operate.



Figure 23: 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 (independent of the shutter status). Identical to laser emission LED on the laser head.

POS	Name	Description
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

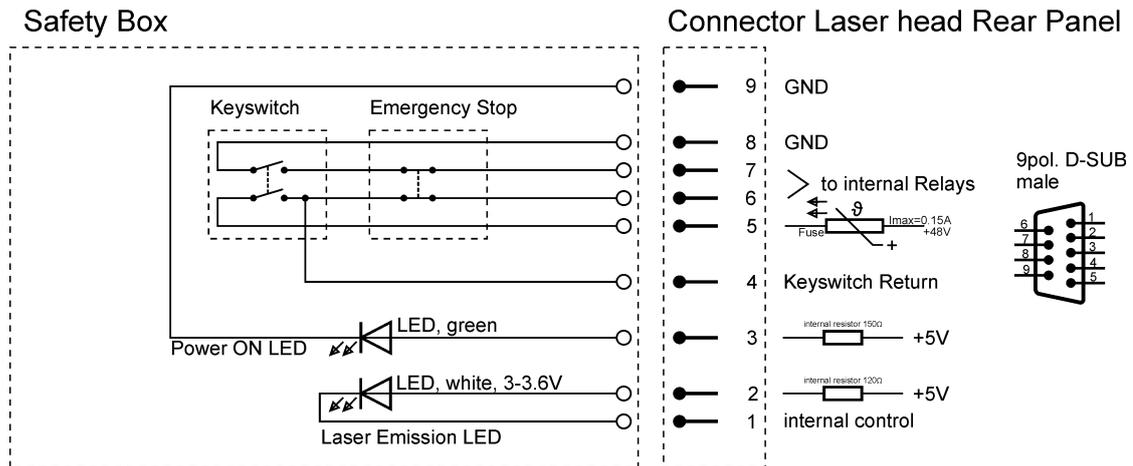


Figure 24: Safety Box, pin assignment

Refer to table below for the PIN-assignment of the D-Sub 9 connector:

Feature	Description
Laser Emission LED	Connect a white LED (specified for 3-3.6V, without internal resistor) between PIN 1 & 2. Alternatively bridge 1&2 with a resistor of 180-200 Ω). The FS will create an error without the LED or alternatively the resistor
Power ON LED	Connect a green LED between PIN 3 & 9 (optionally); not necessary to bridge without LED
Key-switch & Emergency Stop button	Connect system key-switch and emergency stop button (both provided by customer) according to schematics
GND	PIN 8 & 9: ground



NOTICE

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



In case of system integration, replace the Safety box by a system circuit and add the features described in [section "Safety Control \(D-Sub 15\)" on page 42.](#)

STATUS CONNECTOR

The status outputs are potential free, max. voltage and current are 60 V, 1 A. Refer to table below for the PIN-assignment of the D-Sub 25 female connector:

Feature	Description
Laser ready	PIN 3 connected to PIN 2 when Laser ready PIN 3 connected to PIN 4 when Laser not ready
Laser emission	PIN 6 connected to PIN 5 when internal emission existing PIN 6 connected to PIN 7 when internal emission not activated
Shutter	PIN 9 connected to PIN 8 when shutter open PIN 9 connected to PIN 10 when shutter closed
Emergency Stop	PIN 12 connected to PIN 11 when Emergency Stop not activated PIN 12 connected to PIN 13 when Emergency Stop activated (which results in shut-down of internal laser-sources)
Faults	PIN 14 connected to PIN 15 when faults present (send command ?F to verify and FACK=1 after eliminating a fault) PIN 14 connected to PIN 1 when faults not present

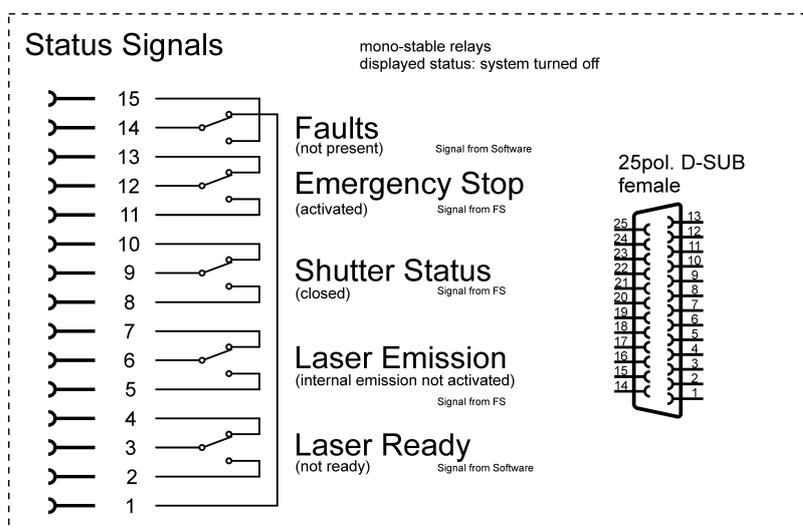


Figure 25: Status Signals

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>.

SWITCHING THE SAFETY CONTROL MODE

The decision is necessary if the system is supposed to be operated with a software-controlled or hardware-controlled shutter. In order to change the safety control mode, a few conditions must be fulfilled. In case the shutter is supposed to be operated via software (GUI or command), no action required because SMOD=0 is the default value. The command `SMOD` is memorized by the system and needs to be defined just once, see also [section "Safety Control \(D-Sub 15\)" on page 42](#).

SMOD=1 → SMOD=0 shutter supposed to be software controlled	SMOD=0 → SMOD=1 shutter supposed to be hardware controlled
Key switch "0" (off)	Key switch "0" (off)
UC1&UC2 are open	UC1&UC2 are open
Send <code>FACK=1</code> (or press Clear in the GUI) to acknowledge and clear faults	
Send <code>?F</code> to query the faults. Eliminate all faults if existing (except "Emergency Stop")	
Send <code>SMOD=0</code>	Send <code>SMOD=1</code>
Key switch "1" (on)	Key switch "1" (on)
—	Press push button
—	Send <code>FACK=1</code> (or press Clear in the GUI) again
Follow the starting procedure, refer to section "Operating sequence" on the next page	

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.

- Make sure that the power supply is not connected to mains at that time
- Connect the laser head to the power supply (48V cable) and secure against disconnection (to prevent damages on the laser head)
- Turn on the chiller
- Check that the Emergency Stop button is released
- Make sure that the Ethernet or COM-Port connection is established
- Make sure that the Safety Control Mode is correctly defined, refer to [section "Safety Control \(D-Sub 15\)" on page 42](#)
- Connect the power supply to mains



WARNING

Make sure to protect the cables against disconnection, mechanical forces and against contact by hand (if necessary).

- Set key-switch (of the Safety box) to "I" position, see [section "Safety box" on page 45](#)
- Depending on the Safety Control Mode following deviating procedures are necessary:

In case SMOD=0 is defined; shutter is software controlled	In case SMOD=1 is defined; shutter is hardware controlled
Make sure that both user-connectors UC1&UC2 are closed (Interlock-chain)	Make sure that both user-connectors UC1&UC2 are open
Send <code>FAACK=1</code> (or press Clear in the GUI) to acknowledge all existing faults	
Send <code>?F</code> to display active faults. Correction of faults necessary	
Send <code>?W</code> to display active warnings. Follow the corresponding advise if necessary	
Send <code>FAACK=1</code> (or press Clear in the GUI) to acknowledge faults (exclusively necessary if faults were present and are solved now)	
—	Press the hardware push-button, refer to section "Safety Control (D-Sub 15)" on page 42
—	Send <code>FAACK=1</code> (or press Clear in the GUI) again; <code>?F</code> returns "System OK"
Press the Start-button in the GUI or send the command <code>START</code>	
Send <code>?STATE</code> to query the system status, loop this query (max. once per second) and wait until the return value is "1" (on)	

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.



NOTICE

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
- `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 in kHz

In case of a requested closed loop (with power regulation active) send:

- Query `?PRIDLETIMEOK` after system-start up (in a loop) until it returns 1
- `PRENABLE=1` to set the control mode of the variable attenuator to closed loop (regulated)
- `PATTSET=nn` defines the requested power in Watt (which will be actively regulated by the attenuator). The maximum of this value can be checked by sending `?MAXIRPOWER`
- `?PATTSET` to query the requested power (valid for closed loop only)
- `RL=nnn` defines the analog level of output of the Modulator in percent (if `EM=0`)
- `S=1` to open the shutter (make sure to fulfill laser safety and block the beam into an adequate beam dump for testing purposes)
- `?POUT` to query the optical output power in Watt
- `S=0` to close the shutter
- `HB=0` to turn off the heartbeat function prior to turn-off
- `STOP` to stop the laser system

In case of a requested open loop (without active power regulation) send:

- `PRENABLE=0` to activate open loop
- `TATT=n` to set the optical output power to n%
- `?POUT` to query the optical output power in Watt

It is recommended to loop and periodically query certain values. 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. Various actions might be required due to individual warnings; system remains operational.

If the command returns warning code 537, 538, 539 or 540: consider at your own convenience sending `S=0` to close the shutter, send `STOP` to turn off the laser diodes (system remains powered in status READY) and send `MAINT` to start the software maintenance. Loop `?MAINT` until it returns 0. Then query `?PPLLINFO` to get an information on the result of the maintenance sequence.

Resuming operation requires to begin the loop as described at the beginning of this section.

In order to repeat procedures (such as e.g. MAINT) after certain operating hours, ?HH (head hours) can be used for time-calculation.

Periodically send ?F to query the fault status of the system. Various actions might be required due to individual situations; system will stop the operation in case of a fault condition.



It is important to wait for the feedback of a command. Sending the next command before the current one is finished could result in an error. Queries should be sent sequentially (one after the other) and the frequency of sending commands / queries should be limited to once a second (or less often). Queries like "operating hours" are precise enough if updated a few times a day.

APPLICATION SIGNALS INTRODUCTION

The features and namings of the application-input-signals deviate for various laser systems. Refer to the Operator's manual of the corresponding system 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" on the next page](#). 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	$\sim 9.5 \pm 5$ mm	Yes
SmartCleave Advanced 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	$\sim 21.5 \pm 5$ 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	$\sim 6.5 \pm 2$ 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	$17.5 \text{ mm} \pm 5$ mm	Yes



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



INNOVATIONS THAT RESONATE