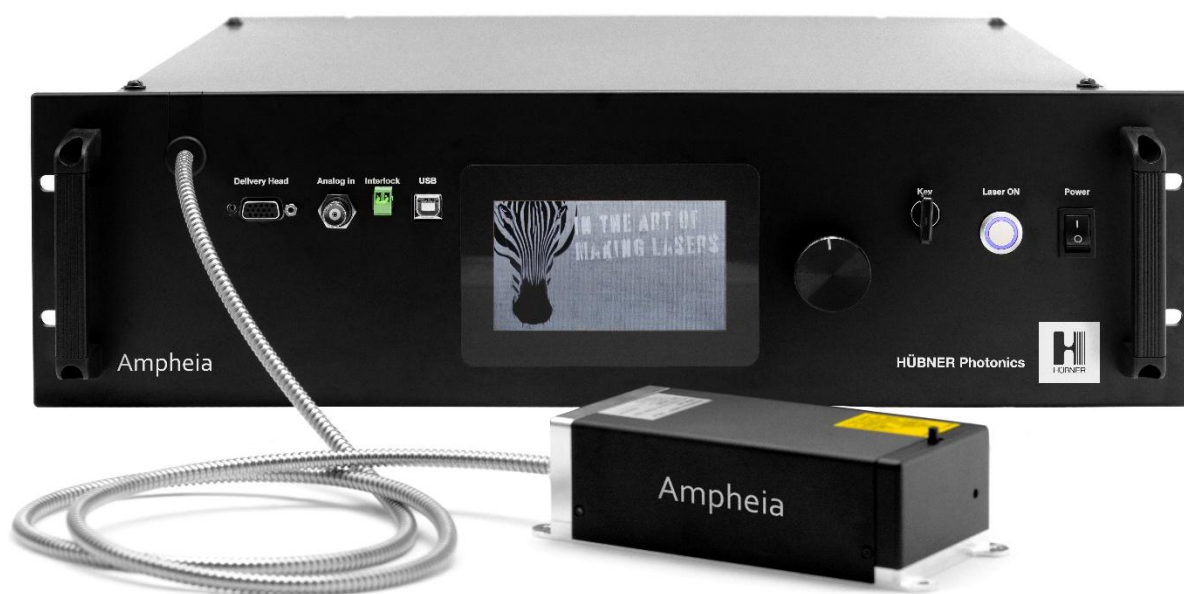


Ampheia™ - LS Series

Ultra-Low Noise | Single Frequency | Fiber Laser Systems

532 nm

1064 nm



HÜBNER Photonics



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1. Introduction

The Ampheia™ - LS Series fiber laser systems are continuous-wave (CW), ultra-low-noise, high-power lasers designed for demanding applications, including quantum technology and semiconductor inspection. Manufactured in Sweden by Cobolt AB, a part of Hübner Photonics, the Ampheia™ - LS Series features a single-stage fiber amplification system and integrated seed laser, delivering exceptional performance.

Ampheia™ - LS generate a high-quality, high-brightness laser beam with outstanding stability. Their single-frequency operation ensures a narrow spectral bandwidth and a long coherence length, making them ideal for precision applications. Designed and manufactured to meet stringent reliability standards and ensure consistent performance.

The Ampheia™ - LS Series is designed for use in both stand-alone laboratory environments and as OEM components integrated into specialized instruments. High-performance fiber laser systems are essential for accurate measurements and control and play a crucial role in atom trapping and cooling, atom manipulation, and quantum sensing and metrology. Ampheia™ - LS Series is also well-suited for optical interferometry, serving as coherent pump sources in advanced photonic systems. Addressing applications such as particle analysis and semiconductor inspection, the Ampheia™ -LS Series provides high-brightness required to enable detailed examination and characterization of microscopic structures.

2. Safety

2.1. General

The Ampheia™ - LS Series is Class IV (CDRH), Class 4 (CE) laser products, capable of emitting up to 50 W of laser radiation in the near-infrared (NIR) spectrum and up to 5 W in the visible (VIS) spectrum. The residual emission at wavelengths not specified on the warning label does not exceed Laser Class 1.



Symbols in the manual



WARNING – LASER RADIATION This symbol is used to call attention to important laser safety information



WARNING – STATIC MAGNETIC FIELD This symbol is used to call attention to important magnetic field safety information



CAUTION – GENERAL This symbol is used to call attention to important general operator and equipment safety information



NOTICE – GENERAL This symbol is used to call attention to best practices when using the equipment and does not indicate a hazard.

2.2. Accessible Emission

The table below describes the irradiance in W/cm² and appropriate level of eye protection in terms of optical density (OD) for each laser product. Be sure to consider the wavelength and power levels when selecting eye protection.



CAUTION Always wear the appropriate eye protection for the specified wavelengths. Verify the accessible emission wavelengths and power levels on the warning label before operating.

Product	Nominal power (W)	Warning label power (W)	Irradiance (kW/cm ²)	Max. Irradiance (kW/cm ²)	Eye protection Requirement
Ampheia™ - LS 532 nm	5	20	1	7	OD ₅
Ampheia™ - LS 1064 nm	50	200	11	35	OD ₅

The equations below describe how to use the nominal output power (kW) and the minimum beam area to calculate the irradiance (kW/cm²) and how to use the Warning Label (Max) Power (W) and the Accessible Emission Limit (AEL) (W) per laser safety standard IEC 60825-1:2014 to calculate the required optical density (OD) for eye protection per wavelength.

$$\text{Irradiance} \left(\frac{\text{kW}}{\text{cm}^2} \right) = \frac{110 \% \text{ of Nominal Laser Power (kW)}}{\text{Beam area at bottom tolerance (cm}^2\text{)}}$$

$$\text{Require Attenuation of Laser Safety Glasses (OD)} = \log_{10} \left\{ \frac{\text{Warning Label Power (W)}}{60825 - 1 \text{ Laser Class 1 AEL (W)}} \right\}$$

2.3. Beam Hazards

Eye and skin exposure to direct or reflected laser light is hazardous and may be extremely harmful. Always wear eye protection appropriate to the beam wavelength and intensity. Laser radiation may ignite flammable materials and combustible gases in the beam path. In the event of ignition gases and fumes may be generated. All equipment used in close proximity to the laser beam should be suitably fire resistant and the facility should be properly ventilated. It is advised to conduct a risk assessment for the facility and equipment prior to operating the laser. In the case of integration into a larger system, laser safety compliance to applicable standards must be evaluated in the end product. For laboratory use, the system must be operated in accordance with applicable laser safety regulations.



WARNING Remove all watches, rings, and other reflective jewelry before working with lasers. Always wear the appropriate eye protection from the wavelengths integrated into the system. Verify the accessible emission wavelength and power before operating. **Never look directly into a laser beam.**



The device must be handled by skilled personnel experienced with Class IV (CDRH), Class 4 (CE) lasers, in a laboratory environment and with access to adequate laser safety equipment. The fiber amplifier chassis and laser system delivery head clearly displays a yellow warning label that shows the location of the laser beam aperture. This label must be visible unless the laser beam is totally enclosed. If the fiber laser system does not function, do not attempt to open any part of the device, or the warranty will be voided. Call or e-mail your local Hübner Photonics representative for consultancy and to request a case number.



CAUTION Use of controls or adjustments, or performance of any procedures other than those specified herein may result in exposure to hazardous radiation.

2.4. Non-Beam Hazards

Strong Internal Magnet

The Ampheia™ - LS fiber amplifier chassis and the Ampheia™ - LS 1064 nm delivery head contain an optical isolator with strong permanent magnets. Proceed with caution when positioning the fiber amplifier chassis and when operating with tools which may be magnetized (e.g. screwdriver). Users with implanted medical devices should stay back at least 30 cm (12 inches).



Hot surfaces

When the emergency shutter is closed the front surface of the delivery head can reach up to 65 °C. The shutter is only to be used as an emergency beam stop. For controlled attenuation of the laser emission, use the power knob or the 'Laser ON' button on the fiber amplifier chassis. In the case of Ampheia™ - LS 1064 nm the shutter should not be closed for more than 30 seconds, the system will overheat and generate a fault. The fault will shut down the laser system to avoid further heat accumulation.

Heavy load

The Ampheia™ - LS fiber amplifier chassis weighs up to 20 kg, it is recommended to use a two person lift when installing the laser system. Adhere to all established safety protocols for lifting and carrying heavy equipment.

2.5. Safety Features

Ampheia™ - LS Series is equipped with the required safety features as described in the laser safety standard EN 60825-1. If any part of the delivered equipment is replaced with a part not supplied by Cobolt AB, a part of Hübner Photonics, or if the equipment is not properly grounded, the system may not conform to CE/CDRH compliance standards listed in section 12. Disabling any of the safety features invalidates the CE marking and violates the laser safety standard. If the Ampheia™ - LS does not function, do not attempt to open any part of the system, or the warranty will be voided.

Remote Interlock Connector

The remote interlock connector permits the connection of external controls placed apart from other components of the laser product. When the terminals of the connector are open-circuited, emission is interrupted, and no radiation will be accessible. The laser system is delivered with the interlock jumper removed to ensure there is no unexpected emission during startup. When installing the device for use, it is required to connect an interlock device to prevent any risk of eye contact. The final installation must be inspected according to applicable standards. See section 7.4 : Remote Interlock Connector for a detailed description of the remote interlock circuit and its operation.

Laser ON/OFF button (Beam stop or Attenuator)

Ampheia™ - LS Series is delivered with a 'Laser ON/OFF' button situated in the front panel of the fiber amplifier chassis. The 'Laser ON/OFF' button must be pushed on for the laser system to operate, and the same button be pushed again to

discontinue operation. The 'Laser ON/OFF' button functions as the beam stop, capable of preventing human access to laser radiation when in the OFF state. The 'Laser ON/OFF' button must be actively turned to the ON state each time the system is started. The 'Laser ON/OFF' button only functions when the key switch is turned in ON position.

Additionally, the delivery head is equipped with a manual shutter, capable of preventing human access to laser radiation. The manual shutter should only be used in case of emergency as the delivery head may become hot and cause the system to overheat and generate a fault. The aperture location and the open and close positions of the shutter are indicated on the top surface of the fiber amplifier delivery head.



CAUTION – Closing the manual shutter while the laser is emitting may cause significant heating and potential damage to the laser head. The manual shutter should only be used in case of emergency.

Key Control

All CE/CDRH compliant laser systems are delivered with a key control switch on the control panel on the front of the fiber amplifier chassis. The key control must be connected for the laser system to operate. When the key is in the OFF position, the system is prevented from emitting laser radiation. The key must be actively turned to the ON position each time the laser is powered on. When the key is removed from the laser system laser radiation is not accessible.

Laser Radiation Emission Warning

The 'Laser ON/OFF' button indicates the emission status of the Laser. The 'Laser ON/OFF' button is illuminated whenever the device is, emitting or could emit light. See section 8.1 for details on the laser states.

2.6. Equipment Safety

The system is not intended to be serviced by the user in any way. Always install all power supplies used in the fiber amplifier to properly grounded power outlets. The fiber amplifier head must be mounted on a common ground plane, such as an optical table. The fiber amplifiers contain a laser diode which is sensitive to electrostatic discharge (ESD).

Back Reflection Sensitivity

Emission reflected directly back into the delivery head can cause instability in the laser system performance, instantaneous damage, and a dramatic decrease in product lifetime. Ampheia™ - LS Series is provided with anti-reflection coating optics to prevent back reflections into the fiber amplifier. However, the back reflected power should not exceed 4 % of the output power.

Electrostatic discharge

Always install the laser system to a properly grounded power outlet and follow appropriate ESD precautions when installing the system. Ampheia™ - LS Series contains laser diodes which are sensitive to electrostatic discharge (ESD). Failure to follow ESD precautions may result in permanent damage to the system and will void the warranty.

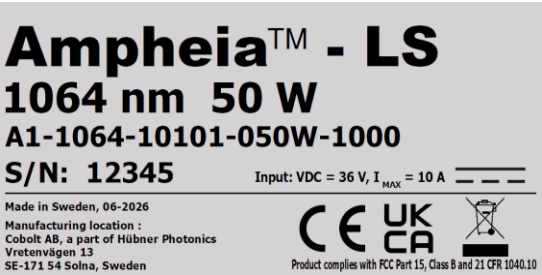
Optical Fiber Care

The laser system operates at high power, delivering up to 50 W at 1064 nm or 5 W at 532 nm. To ensure proper operation, avoid bending the fiber delivery connector beyond a bending radius of 15 cm. The fiber amplifier head is detachable from the rest of the system. If the delivery fiber collimator is disconnected, it must be handled with extreme care and the surface of the exposed lens must not be touched or scratched. Before reconnecting the collimator, the lens should be inspected. If needed the lens should be properly cleaned. If the lens is scratched or in anyway damaged, contact your local Hübner Photonics sales representative. See section Hardware Overview₄ for an overview of system hardware.

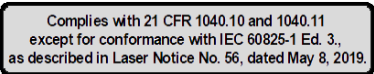
2.7. Warning and Identification Labels

Chassis Labels

The top of the fiber amplifier chassis contains a yellow label with laser safety warning and classification information, the wavelength range and maximum power of the delivery fiber. These labels must be visible unless the laser beam is completely enclosed. A label showing information about the system model, serial number, manufacturer date and location, and the power supply voltage and current, is located on back panel of the fiber amplifiers chassis. Systems delivered to customers in the USA also contain a label of CDRH compliance.



Manufacturer Identification label



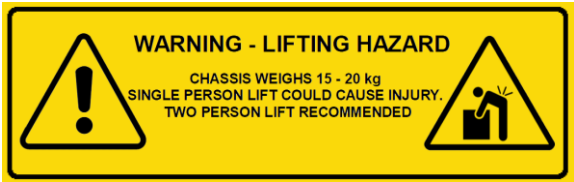
Laser Notice No. 56 label



Delivery fiber laser classification and warning label



Static magnet warning label

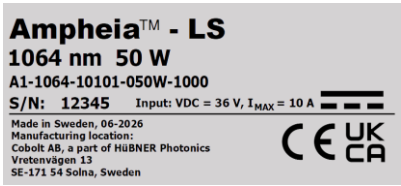


Lifting hazard warning label

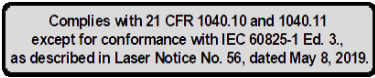


Laser Classification and Emission Warning label

Delivery Head Labels



Manufacturer Identification label



Laser Notice No. 56 label

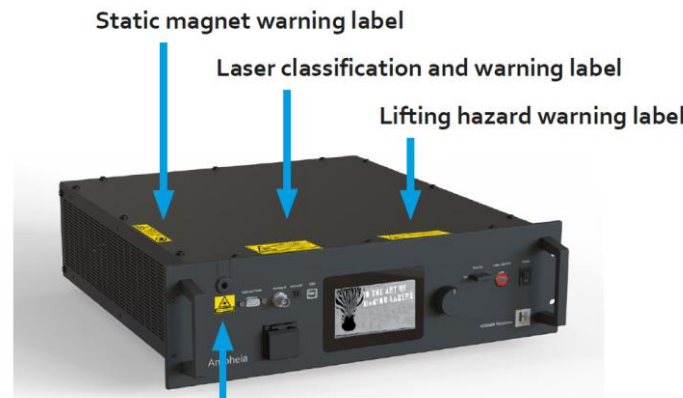


Static magnet warning label

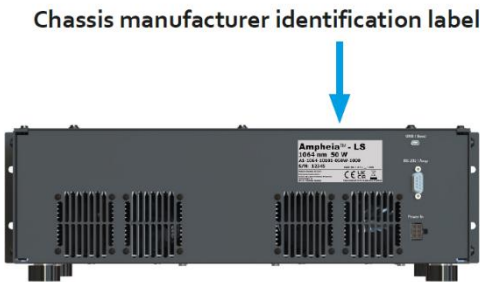


Laser Classification and Emission Warning label

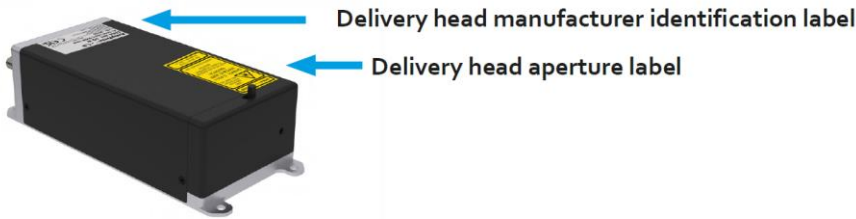
Label positions



Delivery fiber laser classification and warning label



Fiber amplifier chassis label positions



Delivery head label positions

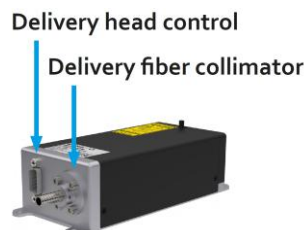
3. Installation and start-up operation



WARNING – CLASS 4 LASER RADIATION Read all safety recommendations and assembly instructions before working with the system. Up to 50 W of infrared emission is present in both the delivery and residual IR dump fiber.

Installation

1. Place the Ampheia™ - LS fiber amplifier chassis on a flat table or shelf with suitable vibration isolation and good airflow around the sides. The cooling air intake is located on the sides of the chassis, and the exhaust outlet is at the back. Be sure not to position the equipment so that it is difficult to remove the power connector located on back of the chassis or the mains plug from the wall.
2. Mount the delivery head on a suitably flat surface that provides adequate heat dissipation and connection to ground. A heat sink with a thermal impedance of 2 K/W or lower is recommended. Use the four holes on the delivery head's base plate to secure it. See section 4.5 for more information about thermal management.
3. If the delivery head is detached from the collimator: Connect the delivery fiber collimator from the fiber amplifier chassis to the delivery head. The alignment of the collimator is controlled by the mechanics, no force should be required to position the collimator within the delivery head. Use the four screws on the collimator flange to secure the delivery fiber collimator in place.



4. Connect the Delivery Head control cable to the fiber amplifier chassis and to the delivery head.
5. For Ampheia™ - LS 532 nm with an SHG delivery head – remove the protective cap and connect the Residual IR dump fiber from the delivery head to the fiber amplifier chassis and confirm that it is securely connected by tightening the screw cap of the SMA connector. Ampheia™ - LS 1064 nm do not require a residual IR dump fiber.
6. Insert the key into the key switch and verify that it is in the OFF position (horizontal).



Ensure the beam path is terminated and is safe for all users. The mechanical shutter can be kept in the closed position at start-up but must be opened before ramping up the power.

Power up

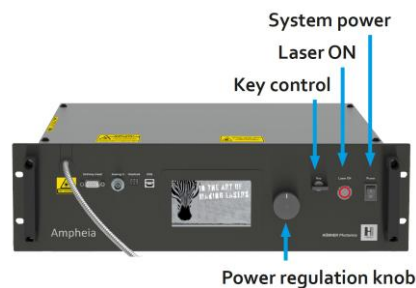
1. Connect the 36 V 10 A power supply delivered with the Ampheia™ - LS to the 'Power In' socket on the back of the fiber amplifier chassis.



2. Connect the PSU to the mains power supply. When connecting the plug to the mains outlet ensure that the plug remains easily accessible for disconnection.
3. Turn on the system with the 'Power' switch located on the front panel of the fiber amplifier chassis. The display should activate and show the Start-up menu. The system will initialize all temperature controllers and proceed to stand-by until the key switch is turned to the ON position.

Start laser emission

As standard, Ampheia™ - LS are delivered in constant power operation mode. In constant power mode, the power is monitored via an internal photodiode, and the current is regulated to maintain a constant power output from the delivery head. The laser state, power, pump operating current and set power are displayed on the control panel screen.



1. Connect the interlock to the laboratory safety interlock system or to the interlock circuit of the installed system.
2. Turn the Safety Key to the ON position (vertical). Once the key is turned the laser system will be ready to deliver Class 4 laser radiation once the Laser ON button is pushed.
3. Set the power by rotating the Power regulation knob to set the desired power setting or using the touch screen to enter the set point power.
4. Start emission by pushing the 'Laser ON/OFF' button. Once the laser is turned ON, the system will proceed through the automatic start up sequence. While the laser is starting the Laser ON indicator around the 'Laser ON/OFF' button will blink until the laser has started to ramp up the power. The laser will typically reach the set power within 90 seconds. For more information on the start-up states see section 8.1.



NOTICE If the power does not match the power as stated on the test sheet see Section 10: Service for more information.

3.1. Shutdown

1. Push the 'Laser ON/OFF' button to turn off the laser system. When using the 'Laser ON/OFF' button, the power set point will be stored, if the system is started using the 'Laser ON/OFF' button, the laser will deliver the set point power.
2. Turn the Safety Key to the OFF position (horizontal).
3. Turn off the System Power switch on the front panel of the fiber amplifier chassis. Once the power switch is used the laser set point power will be automatically turned down to 1 W for Ampheia™ - LS 1064 nm and 0.05 W for Ampheia™ - LS 532 nm.
4. To disconnect the system, unplug the power supply from the mains. Wait for the LED indicator on the AD/DC converter to go off. No special tools are required to disconnect the system.
5. Disconnect the power supply from the Power In socket on the back of the fiber amplifier chassis.

3.2. Cleaning and decontamination

The equipment is designed to be run in a clean dry environment. Compressed air can be used to remove dust build up on the fans.

4. Hardware Overview

Always install the fiber amplifier to a properly grounded power outlet. If any part of the supplied equipment is replaced with a part not supplied by Cobolt AB, a part of Hübner Photonics or if the equipment is not properly grounded the system may not conform to CE / CDRH compliance standards. Disabling any of the safety features invalidates the systems CE / CDRH compliance.

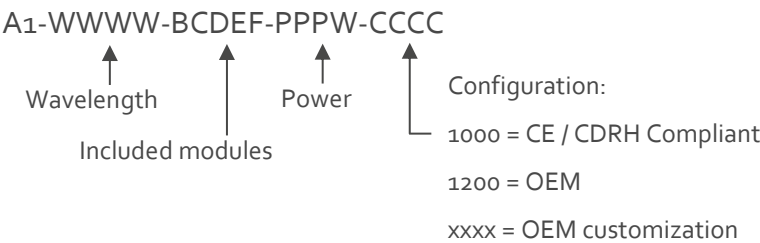


Ampheia™ - LS include:

- Fiber amplifier chassis – housed in a 3U 19-inch rack box with integrated delivery fiber.
- Keys
- Remote interlock plug – for connection to laboratory safety interlock system or to the interlock circuit.
- Delivery head control cable
- 36 V / 10 A DC power supply unit
- Delivery head – with or without integrated residual IR dump fiber depending on the configuration

4.1. Model number

Ampheia™ - LS are sold in two configurations: CE/CDRH and OEM. The model numbers are composed as described below.



4.2. Fiber amplifier chassis

The fiber amplifier chassis of Ampheia™ - LS 1064 nm and 532 nm are similar, with the exception of the residual IR dump fiber implemented in the Ampheia™ - LS 532 nm to safely redirect the unused IR power from the second-harmonic generation (SHG) delivery head. User interfaces and features of the fiber amplifier chassis are described below. All connections between the fiber amplifier chassis and the delivery head must be securely in place before starting the system.

Laser ON/OFF Button

The indicator on the Laser ON/OFF Button allows the user to know if laser emission is enabled. When the laser is active, the button lights up. The different states of the indicator on the Laser ON/OFF button are described in the table below.

Laser ON button	Laser state	Description
OFF	Seed and pump laser OFF	The laser is not yet enabled.
Blinking	Seed laser on, pump laser warming up	No measurable output power.
ON	Laser system ON	The laser is enabled and emitting.

4.3. Delivery head

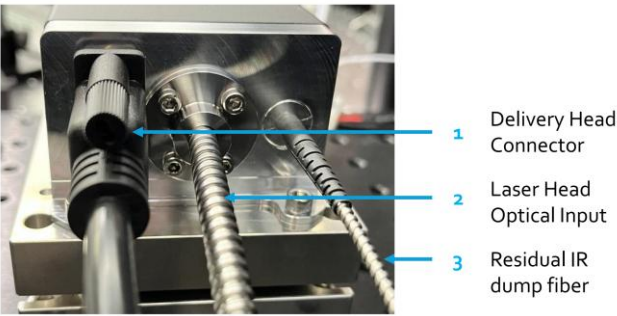
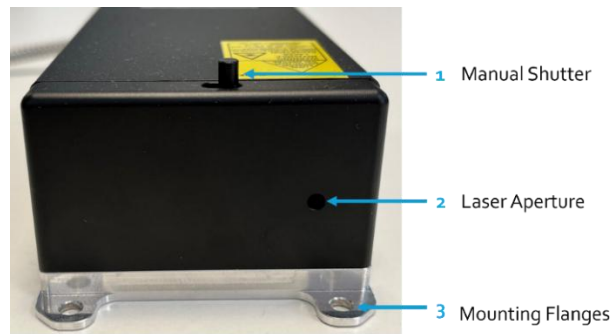
The Ampheia™ - LS Series delivery head is designed to be detachable to facilitate system integration. The system is not intended to be operated until the delivery fiber collimator is securely connected to the delivery head and the system will not start if the collimator is not connected. If applicable, the residual IR dump fiber is connected to the fiber amplifier chassis. The laser head also features an emergency manual mechanical shutter, a laser classification and emission warning label. When power is supplied and the switch turned on the temperature control element will be active and drive to reach its set point values. All connections between the fiber amplifier and the delivery head must be securely in place before starting the system.



WARNING – LASER RADIATION The laser system must be fully assembled before connecting the power supply to prevent unintended emission circumstances.



CAUTION – Maintenance of the laser system should only be performed by Cobolt AB, a part of Hübner Photonics personnel with appropriate laser safety equipment.

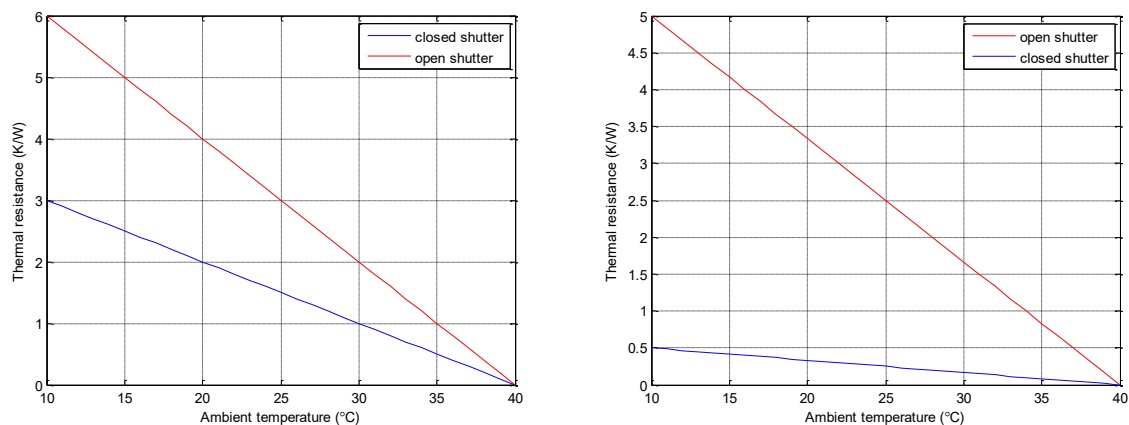


4.4. Power Supply

When power is supplied, regardless of ON/OFF state, the temperature control elements are operating to reach set point values. An appropriate Power Supply Unit (PSU) is supplied by Hübner Photonics with the fiber amplifier chassis and must be plugged into a properly grounded standard power outlet. The output from this PSU is 36 VDC / 10 A. The power supply accepts 100 – 240 V AC and 50-60 Hz. The power supply provided with Ampheia™ - LS are certified to perform in an ambient temperature of 18-30 °C, when integrating this power supply into a larger system care must be taken to ensure that the power supply is not exposed to temperatures above 30°C.

4.5. Thermal Management

To ensure operation within given specifications and for the warranty to be valid, the delivery head must be mounted on a flat surface (within ± 0.05 mm over mounting surface). For assistance in thermal management and system integration, please contact Hübner Photonics’s technical support.

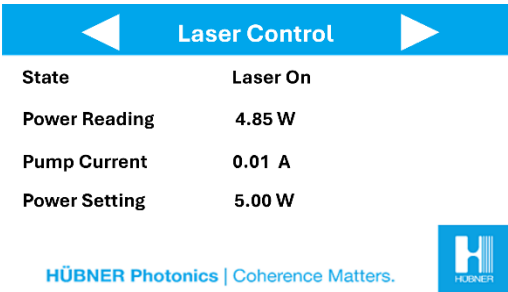


Heat Sink Requirements for Ampheia™ - LS 532 nm (left) and 1064 nm (right) delivery head.

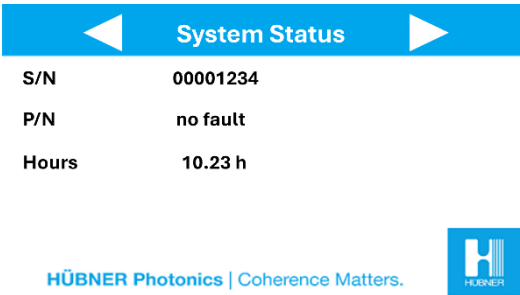
5. Operation via display

The users operate Ampheia™ - LS via the touch screen display on the front of the fiber amplifier chassis. Use the white arrows to navigate between pages. Change the set point power by touching the power setting and using the blue arrows to adjust each digit. The system will prevent the user from inputting values that are out of range.

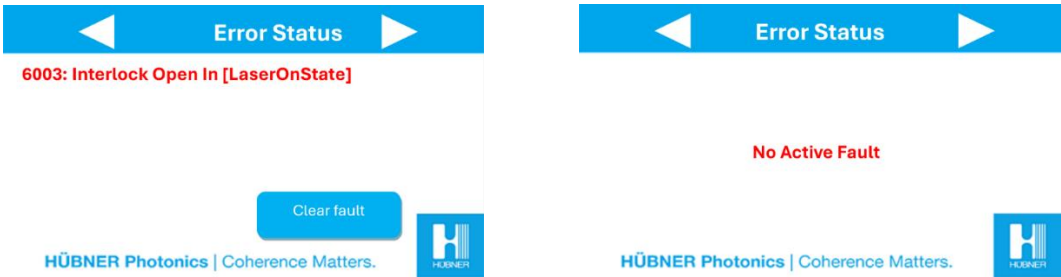
The 'Laser Control' menu shows operational information including the laser system state, the fault state, power setting and power reading.



The 'System Status' menu shows the serial number, the model number, and the operating hours of the laser system. This information is required when requesting service.



The 'Error Status' menu displays the fault code and description, alternately the screen displays the text 'No active Fault' if the system is the system does not incur a fault. The system will automatically display the 'Error Status' menu an error occurs. To reset the system, press the 'Clear Fault' button. If the error persists, contact your nearest distributor for assistance.



6. Operation via dataport

6.1. Remote Interface Configuration

Communication with the Ampheia™ - LS can be done either through RS-232 (back side) or USB (front side). The serial port settings are listed below.

6.2. Establishing serial port communication

Serial communication can be established with the laser using the following configuration:

- Baud rate: 115200
- No parity
- Termination for commands: CR
- Termination for answers: CR
- Byte size: 8 bits
- 1 stop bit

Once the serial port is opened, the laser system will not initiate communication under any circumstances, the laser system will only transmit a response to each command. Responses may be a numerical value, a string or the acknowledgment string 'OK'. If the system receives a command that it cannot interpret, it responds with 'Syntax error'. Commands are not case sensitive and command arguments must be delimited by a single space character (ASCII 32).

6.3. Command Syntax

The Cobolt laser command syntax listed in this section shows all commands as a mixture of upper- and lower-case letters. The upper-case letters indicate the abbreviated spelling for the command. The commands are not case sensitive. For shorter program lines, the abbreviated form is beneficial whereas the program readability greatly benefits from the long form.

Triangle brackets (< >) indicate that a value must be specified for the enclosed parameter. The square brackets ([]) indicate that part of the command is optional. Query commands must be followed by a question mark '?'. The response for each command is listed in the tables in the next section. If no response is listed, the laser will acknowledge the command with the response string 'OK'.

Arguments are not case sensitive but can be abbreviated in the same way as the commands themselves.

6.4. Command list

Below is a list of available commands. The name of the command links to the appropriate section with details of the function, arguments and returns.

Note: The command list is subject to change as the software is updated. Please contact HÜBNER Photonics for the latest version of the command list.

Command description	Argument	Return (data type) [units]
*IDN		
description		
ABORT		
Set laser in safe state		
Target pump current when Ampheia-LS is operating in constant power mode	<numeric_value> [W]	<numeric_value> [W]
AMPLifier:HOuRs		
Returns the operating time in hours.	Query only	<numeric_value> [hours]
AMPLifier:POWer:reading		
Returns the output power measured at the Ampheia-LS head.	Query only	<numeric_value> [W]
AMPLifier:PUMP:CURRent:reading		
Returns the current that running through the main pump diode.	Query only	<numeric_value> [A]
FAULT		
Displays a short description of any fault condition (or "no fault")	Query only	No fault <string>
FAULT:CLEar		
Clears any fault condition. Note: some fault conditions will retrigger immediately.	Query only	
FAULT:CODE		
Display a numeric code for the fault.	Query only	integer
FAULT:DESCription		
Displays a short description of the fault.	Query only	String
INTERlock:STATe:INVerted		
	Query only	
KEYswitch:state		
Returns the key switch state.	Query only	0 : OFF 1 : ON
REStart		
Used to exist the "aborted" state.		
STARt		
Starts the start-up sequence and results in laser emission once the 'Laser ON' state is reached.		
STATe		
Returns the state of the laser within the startup sequence.	Query only	Aborted InterlockOpen

		WaitingForKeyOn WaitingForTemperature LaserOnDelay WarmingUp LaserON CoolingDown Armed Fault
STOP		
Stops the laser emission and will set the laser in the 'Standby' state		
SYSTem:MODEl:NAME		
Returns the model name of system	Query only	<string>
SYSTem:MODEl:NUMBER		
Returns the model number of the system	Query only	<string>
SYSTem:SERial:NUMBER		
Returns the factory set laser serial number.	Query only	<string>

7. Specifications

The information presented here is believed to be accurate and is subject to change without notice. The specifications contained herein can only be guaranteed at 100% of nominal power after warm-up is complete, within the operation environment constraints listed below.

7.1. Optical Specification

		Ampheia™ - LS			
		532 nm	1064 nm		
Output power		5 W	20 W	40 W	50 W
Output power range		1 % to 100 %	5 % to 100 %	2.5 % to 100 %	2 % to 100 %
Spectral linewidth (FWHM)		< 100 kHz	< 50 kHz		
Optical signal to noise ratio (OSNR)		> 70 dB			
Wavelength stability (±2°C and 8hrs)		< 1 pm			
Power stability (±2°C and 8hrs)		< 1.0 %	< 0.5 %		
Noise, 100 Hz - 10 MHz (rms)		< 0.1 %	< 0.05 %		
Relative intensity noise (RIN)	1 kHz - 100 kHz	< - 125 dB/Hz	< - 130 dB/Hz		
	100 kHz - 1 MHz	< - 130 dB/Hz	< - 140 dB/Hz		
Beam diameter at aperture		1.0 ± 0.2 mm			
Beam symmetry at aperture		> 0.90:1			
Spatial mode (TEM ₀₀)		M ₂ < 1.05			
Beam divergence (full angle)		< 0.9 mrad	< 1.7 mrad		
Polarization extinction ratio (linear, vertical)		> 1000:1 [> 30 dB]			
Beam position accuracy (mm)		< 0.5			

Beam angle accuracy (mrad)	< 5
Fiber delivery cable length (m)	1.0

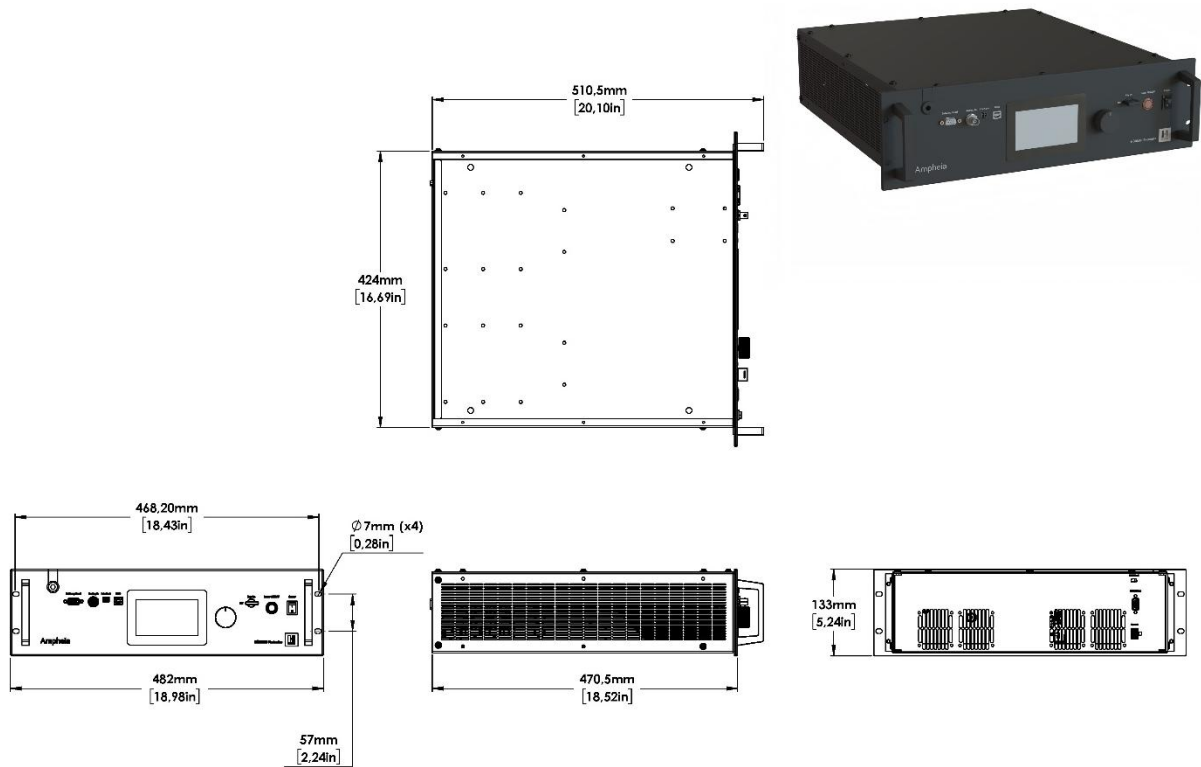
7.2. Operational Environmental Specifications

Power supply requirements	36 VDC, 10 A
Voltage acceptance a	36 V
System power consumption	300 W
Maximum delivery head heat dissipation	5 W
Ambient temperature, operation	18 - 30°C
Maximum baseplate temperature	40 °C
Laser Head heat sink thermal impedance at 30 °C	< 2 K/W
Ambient temperature, storage	-10 °C to +60°C
Intended use environment	Laboratory (indoor), pollution degree 2
Humidity	0-60 % RH non-condensing
Altitude	0 – 2000 m
Ambient Air pressure	800 - 1050 mbar
Overvoltage category	II

7.3. Mechanical Specifications

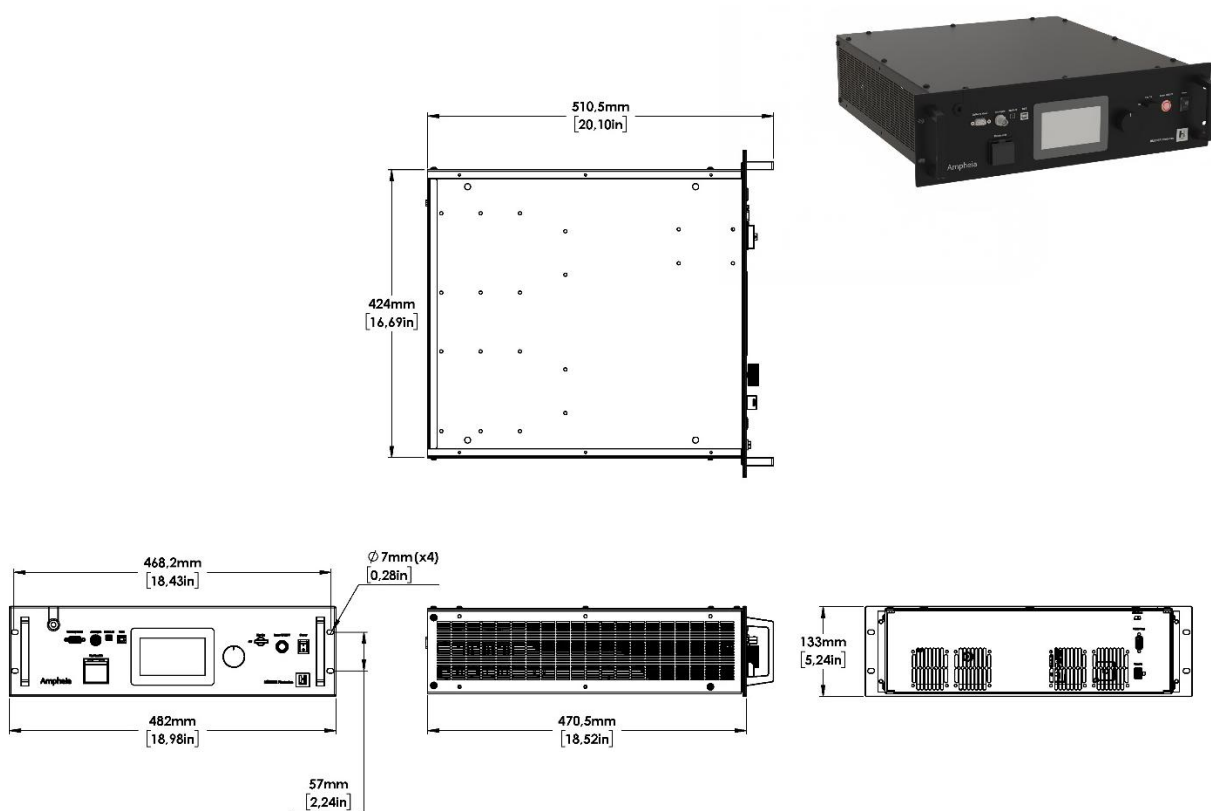
	Ampheia™ - LS	
Wavelength	532.1 ± 0.3 nm	1064.2 ± 0.6 nm
Fiber amplifier chassis weight	19 kg (41 lbs.)	18 kg (39 lbs.)
Fiber amplifier chassis dimensions (LxWxH)	470.5 x 423 x 133 mm (18.52 x 16.65 x 5.24 in.)	
Delivery head weight	0.62 kg (1.37 lbs.)	0.76 kg (1.68 lbs.)
Delivery head dimensions (LxWxH)	155 x 55 x 45 mm (6.10x2.17x0.87 in.)	

Ampheia™ -LS 1064 nm - Fiber amplifier chassis dimensions:



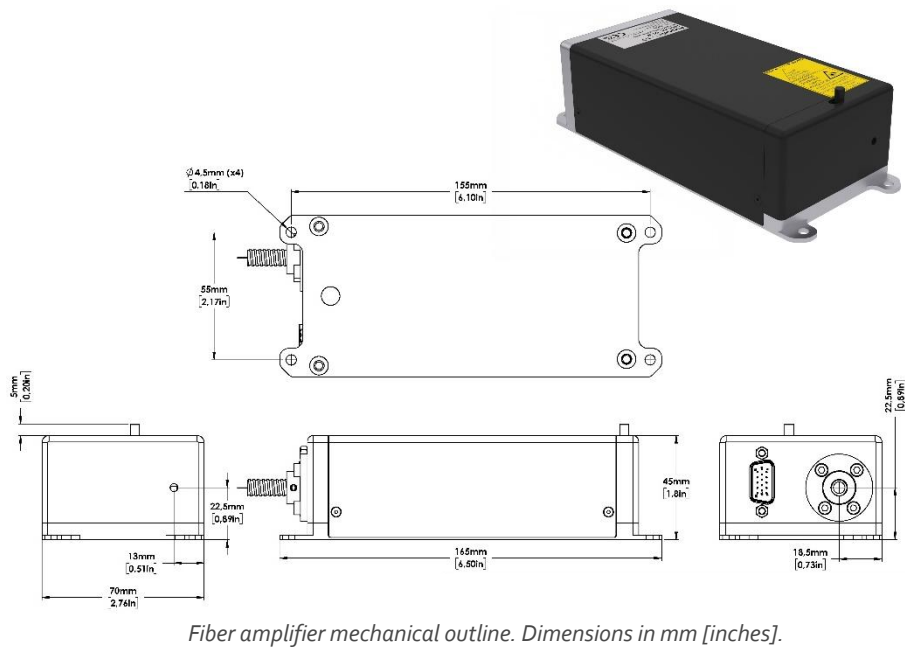
Fiber amplifier mechanical outline. Dimensions in mm [inches].

Ampheia™ -LS 532 nm - Fiber amplifier chassis dimensions:

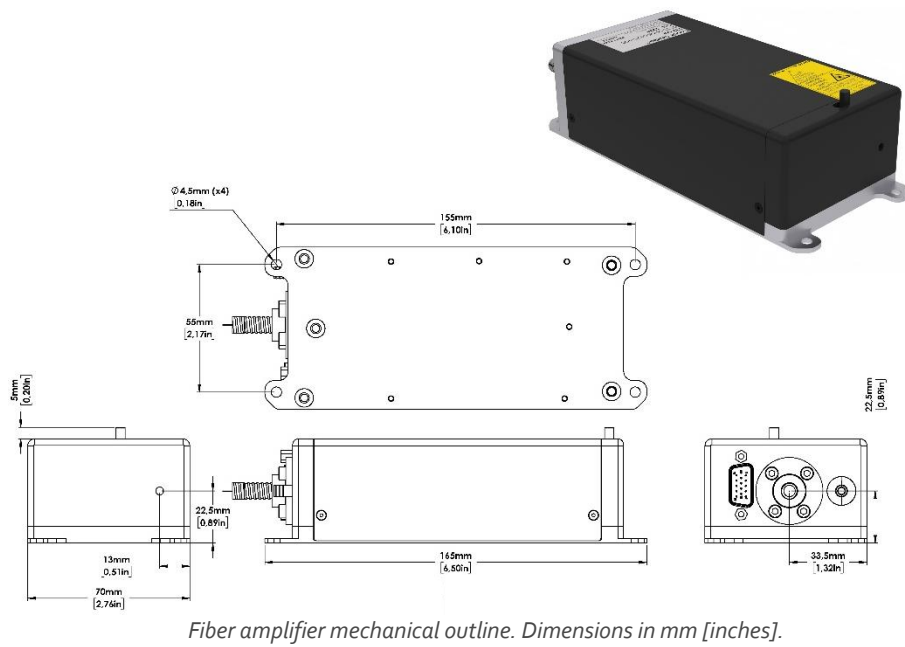


Fiber amplifier mechanical outline. Dimensions in mm [inches].

Ampheia™ -LS 1064 nm - Delivery head dimensions:



Ampheia™ -LS 532 nm - Delivery head dimensions:



7.4. Electrical interfaces

Interface specifications

All equipment connected to the system should be limited energy as described by IEC 61010:1.

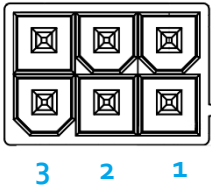
System Interfaces	Location	Connector description
Input power	Fiber amplifier chassis – back side	6-pin Molex (50362462)
Serial data port	Fiber amplifier chassis – back side	RS-232 (9-pin SubD)

Remote Interlock	Fiber amplifier chassis – front side	2-pin Phoenix (1788505)
USB data port	Fiber amplifier chassis – front side	USB-B
Internal Interfaces	Location	Connector description
<i>Service port –seed laser</i>	<i>Fiber amplifier chassis – back side</i>	<i>USB-type mini-B – FACTORY USE ONLY!</i>
<i>Delivery Head connector</i>	<i>Fiber amplifier chassis – front side</i>	<i>15-pin Sub-D socket (internal interface)</i>
<i>Delivery Head connector</i>	<i>Delivery head</i>	<i>15-pin Sub-D plug (internal interface)</i>

Pin assignment

Power In – Chassis back side
Connector 6 pin Molex (50362462)

Pin	Function
1	+36 V
2	+36 V
3	+36 V
4	GND
5	GND
6	GND



Serial data port – Chassis backside
Connector 9-pin SubD

Pin	Function
1	<i>Not used</i>
2	RS-232 TX
3	RS-232 RX
4	<i>Not used</i>
5	GND
6	<i>Not used</i>
7	<i>Not used</i>
8	<i>Not used</i>
9	<i>Not used</i>
Shield	GND

USB data port – Chassis front side
Connector USB-B

Pin	Function
1	VBUS / +5 V
2	D-
3	D+

4	GND
Shield 1	GND
Shield 2	GND

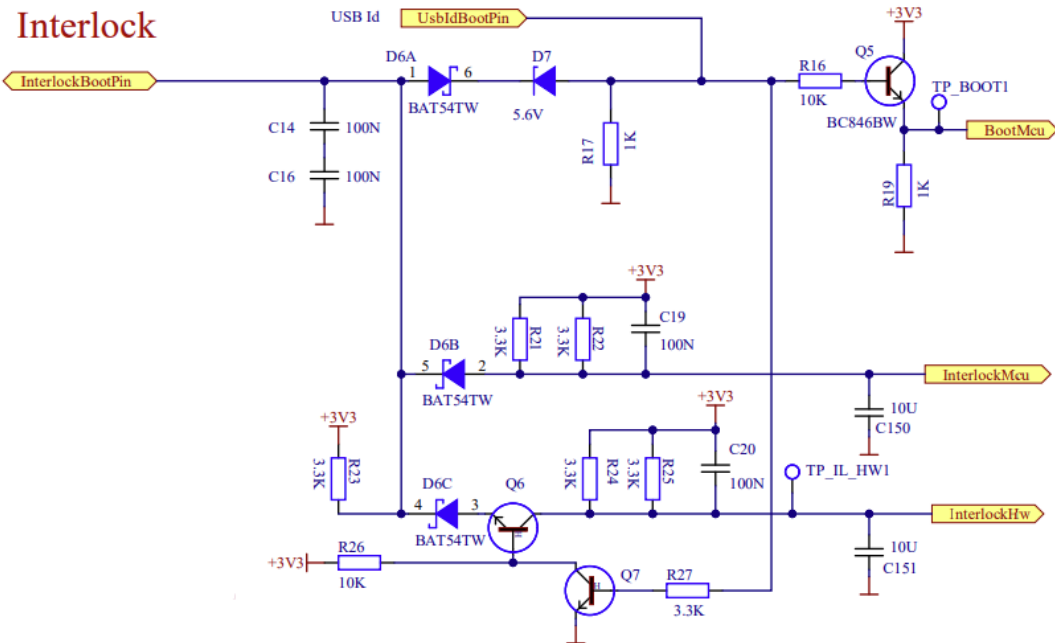
Remote interlock - Chassis

Connector 6 pin Phoenix contact (1788505)

Pin	Function
1	Interlock
2	GND

Remote Interlock Connector

The laser system is equipped with a remote interlock circuit that, when open, prevents current flow through the pump laser and opens the interlock on the seed laser control board, preventing the flow of current to the seed laser pump diode. The interlock is closed when pins are grounded.



Interlock circuit diagram.

8. System state and run mode descriptions

Detailed description of the laser start-up states and run modes can be found in this section. This section is intended to provide a deeper knowledge of how the laser works to allow the user to have full understanding and control of the laser operation.

8.1. Startup states

Init

The system is initiating.

Aborted

The laser enters the 'Aborted' state when the start-up sequence has been aborted either by the user sending the Abort command or after a fault. While the laser is in the Aborted state, laser emission is disallowed and the TECs will not be running. If the laser operation is aborted due to a fault, the laser will first go into the Fault state, the fault must be cleared before the laser can proceed to the 'Aborted' state and then be restarted.

Interlock Open

The system will remain in the 'Interlock Open' state if the remote interlock circuit is not closed. Once the remote interlock circuit is closed the system to the next state in the startup sequence.

Wait for Key

In the 'Waiting for Key' state the system is waiting for the user to manually toggle the key switch. If the key is in the ON position it is necessary to turn it to the OFF position and back to the ON position before the laser will proceed through the start-up sequence.

Wait for Temperature

In the 'Waiting for Temp' state the temperature controllers are regulating and have not yet reached their set point temperatures. Once the TECs have all reached the set point, the laser system will proceed through the start-up sequence through Warming up to Laser ON.

Laser OFF

The laser is OFF and not emitting.

Laser Starting

The laser has begun the start-up sequence.

Warm Up

The laser system is warming up and has not reached the set power yet.

Laser ON

The laser is operating normally and emitting. The laser will show Laser on during the warm-up of the seeing and ramping of the pump current. The laser may not emit at full nominal power immediately after being turned ON.

Cool Down

The shut down procedure is running.

Fault

The laser is experiencing a fault. The user must address the fault and clear the fault. After clearing the fault, the laser will proceed to the Aborted state (see above).

8.2. Laser Run Modes and Settings

Fiber laser system with integrated seed lasers are delivered in Constant Power run mode.

Constant Power

Constant power mode is designed to allow the operation of the laser at a fixed output power. The user may input any power setting up to the nominal power. Use the power adjustment knob on the front panel of the chassis or the touch screen interface to adjust the power setting. The minimum power level is determined by the seed laser output power.

9. Warranty and Maintenance

The Ampheia™ - LS Series should not be opened for any reason. The warranty will be void if any of the system units are opened. All parameters are set at the factory, and there are no adjustments required. Disassembly of any part of the system (including the cable) means the system no longer complies with the EMC standards and will void the warranty.

Cobolt AB, a part of Hübner Photonics provides a system warranty of according to the specification in section 7, and may depend on the wavelength and power level. The warranty is invalid if the laser system is operated outside of the specific limits and conditions as outlined in this document.

10. Service

Due to accuracy tolerances, calibration differences and allowed power drift there may be discrepancies between the Cobolt AB, a part of Hübner Photonics measurement of the optical output power and the customer measurement equipment. If the output power deviates from the reported values, please contact your local sales representative for an online re-calibration. If the laser system does not function, **do not** attempt to open any of the units, or the warranty will be voided. Contact your local sales representative for consultancy and request an RMA number (see back cover for contact information). If an RMA number is issued and the laser system needs to be shipped back to Cobolt AB, a part of Hübner Photonics or your local representative, pack the complete system for shipment using the original package. Ensure the unit is free from thermal paste before packing. The warranty covers repair or replacing the unit at the option of the manufacturer.

Manufacturer contact information:

Cobolt AB, a part of Hübner Photonics
Vretenvägen 13

17154 Solna, Sweden

11. Disclaimers

Cobolt AB, a part of Hübner Photonics will assume no responsibility for damage incurred by faulty customer equipment, such as measurement equipment, cables etc., used in conjunction with Cobolt lasers and fiber amplifiers. Cobolt AB, a part of Hübner Photonics makes no warranty of any kind with regard to the information contained in this guide, included but not limited to, implied warranties of merchantability and suitability for a particular purpose. Cobolt AB, a part of Hübner Photonics shall not be liable for errors contained herein nor for incidental or consequential damages from the furnishing of this information. No part in this manual may be copied, reproduced, recorded, transmitted, or translated without the express written permission by Cobolt AB, a part of Hübner Photonics.

12. Compliance (CDRH models only)

The CDRH model fiber amplifiers (-1100) are designed and manufactured to comply with the EC Low Voltage Directive and the EC EMC Directive in the CDRH-compliant configuration. Ampheia™ - LS consist of a fiber amplifier chassis, a delivery head, delivery head control cable and Hübner Photonics-supplied power supply. All equipment must be mounted on a common ground plane, such as an optical table. If any part of the delivered equipment is replaced with a part not supplied by Hübner Photonics or if the equipment is not properly grounded, the system may not conform to CE / CDRH compliance standards listed in this section. Disabling any of the safety features nullifies the CE marking and violates the laser safety standard.

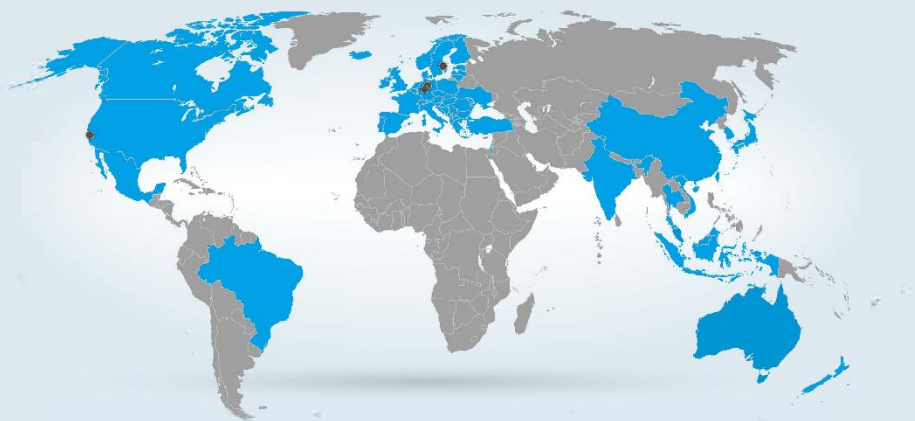


The following harmonized and limits standards have been applied:

Electrical Safety	EN 61010-1, IEC-61010-1, UL 61010-1 (Limited Energy System)	
	UK S.I. 2016 No. 1101 : The Electrical Equipment (Safety) Regulations 2016	
Laser Safety/Class	EN 60825-1	
	FDA / CDRH : Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.	
EMC	EN 61326-1	
	EN 55011	Electromagnetic Emission , Class A
	Electromagnetic Immunity – Table 2 Requirements	
	EN 61000-4-2	Electrostatic Discharge
	±4 kV contact discharge and	
	±2 kV, ±4 kV, ±8 kV air discharge	
	EN 61000-4-3	Radiated electromagnetic fields
	80 – 1000 MHz, 10 V/m with 80 % AM @ 1 kHz	
	1.4 – 2.7 GHz, 3 V/m with 80 % AM @ 1 kHz	
	EN 61000-4-4	Fast transient / Burst
	AC Power input port ±2,0 kV	
	EN 61000-4-5	Surge

	AC Power input port ±0,5 kV, ±1,0 kV, ±2,0 kV Com. Mode
	AC Power input port, ±0,5 kV, ±1,0 kV Diff. Mode
EN 61000-4-6	Conducted Immunity
	3 V with 80 % AM @ 1 kHz
EN 61000-4-11	Dips and Interruptions
	50 Hz and 60 Hz. Test voltages: 100 V and 230 V
	UK S.I. 2016 No. 1091 : Electromagnetic Compatibility Regulations 2016
	FCC 47 CFR - Part 15 (2009): Subpart B, Class A
RoHS	EU Directive 2011/65/EU, EU 2015/863 and amendment EU 2017/2102
	UK S.I. 2012 No. 3032

Contact the local sales representative for a copy of the full and up to date Declaration of Conformity.



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