

Cobolt 05-01 Series

High Power | Single Frequency | CW Diode pumped lasers

320 nm	491 nm	640 nm
355 nm	515 nm	660 nm
457 nm	532 nm	1064 nm
473 nm	561 nm	



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1. Introduction

The Cobolt 05-01 Series lasers are continuous-wave diode pumped laser (DPL) devices operating at a fixed wavelength between 320 nm and 1064 nm. The Cobolt lasers are manufactured in Sweden by Cobolt AB, a part of HÜBNER Photonics. The lasers are built using proprietary HTCure™ manufacturing technology for ultra-robustness in a compact hermetically sealed package.

The Cobolt 05-iE is a fully integrated laser device, including all control electronics. The Cobolt 05-iE completely eliminates the need for an external controller, combining the trusted laser performance of Cobolt 05-01 Series in a compact, self-contained device.

The lasers emit a very high-quality laser beam with stable characteristics over a wide range of operating conditions. Single frequency operation provides a narrow spectral bandwidth and long coherence length. The lasers are designed and manufactured to ensure a high level of reliability.

The Cobolt 05-01 Series lasers are intended for stand-alone use in laboratory environments or for integration as OEM components in instruments for applications including fluorescence microscopy, flow cytometry, DNA sequencing, HCA, Raman spectroscopy, interferometry, holography and particle analysis.

2. Safety

2.1. General

Cobolt 05-01 lasers are Class IIIB (3B) and Class IV (4) laser products that emit laser radiation within the visible and Near Infrared (NIR) spectrum. Residual emissions from the pump diode are contained within the laser head housing via filtering optics. The residual emission does not exceed Laser Class 1.



Product	Wavelength (nm)	Nominal Output Power (mW)	Laser Class CDRH (IEC)
Zydeco™	320 nm	10, 20	IIIB (3B)
Zouk™	355 nm	10, 20	IIIB, (3B)
Twist™	457 nm	100, 200, 300	IIIB, (3B)
Blues™	473 nm	100, 200, 300	IIIB, (3B)
Calypso™	491 nm	200	IIIB (3B)
Fandango™	515 nm	300	IIIB (3B)
Samba™	532 nm	500, 1000, 1500	IV (4)
Jive™	561 nm	200, 300	IIIB (3B)
		500, 750, 1000	IV (4)
Bolero™	640 nm	500	IV (4)
Flamenco™	660 nm	100, 300	IIIB (3B)
		500	IV (4)
Rumba™	1064nm	500, 1000, 2000, 3000	IV (4)

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.

2.1. 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. Lasers may pose a risk of igniting flammable materials and in event of ignition gasses 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 perform a risk assessment for the facility and equipment prior to using the laser. In the case of integration into a larger system, laser safety compliance must be evaluated in the end product.



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 lasers, in a laboratory environment and with access to adequate laser safety equipment. The laser 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 laser 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 Cobolt representative for consultancy and to request an RMA number (see back cover for contact information).

Laser radiation may ignite flammable materials and combustible gasses in the beam path and, in event of ignition, 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.



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

The table below describes the irradiance in W/cm² and appropriate level of eye protection in terms of optical density (OD) for each product line.

Product	Wavelength (nm)	Nominal Output Power (mW)	Irradiance (W/cm ²)	Eye protection Requirement
Zydeco™	320 nm	10, 20	7	OD 5
Zouk™	355 nm	10, 20	7	OD 4
Twist™	457 nm	100, 200, 300	99	OD 4
Blues™	473 nm	300	99	OD 4
Calypso™	491 nm	200	66	OD 4
Fandango™	515 nm	300	99	OD 4
Samba™	532 nm	500, 1000, 1500	497	OD 4
Jive™	561 nm	200, 300	99	OD 4
		500, 750, 1000	166	OD 4
Bolero™	640 nm	500	166	OD 4
Flamenco™	660 nm	100, 300	99	OD 4
		500	166	OD 4
Rumba™	1064nm	500, 1000, 2000, 3000	466	OD 4

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

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

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



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

2.2. Safety features

The laser is equipped with all required safety features as described in the laser safety standard 60825-1. Disabling any safety features negate the CE/CDRH compliance of this product. If any part of the delivered equipment is replaced with a part not supplied by Cobolt or if the equipment is not properly grounded system may not conform to CE / CDRH compliance standards listed in section 14 : Compliance (CDRH models only). Disabling any of the safety features nullifies the CE marking and violates the laser safety standard.

Remote Interlock Connector

The remote interlock connector is a connector which 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 remote interlock connector permits easy addition of an external interlock in laser installation. See section Remote Interlock Connector for a detailed description of the remote interlock circuit and operation.

Manual Shutter (Beam Stop)

The laser head is equipped with a manual shutter, which functions as the beam stop, capable of preventing human access to laser radiation. The aperture location and the open and close positions of the shutter are indicated on the top surface of the laser head.

Key Control

The CDRH compliant model comes with a key-switch on the controller or the key control box which must be connected for the laser to operate. When the key is in the OFF position, the laser is prevented from emitting. The key must be actively turned to the ON position each time the laser is powered on. When the key is removed from the system laser radiation is not accessible.

Laser Radiation Emission Warning

The controller and the key control box incorporate information LEDs which display whether power is connected, the laser is on, or a fault has occurred. The "ON" LED is illuminated whenever the device is emitting or could emit light. See section 3.4 for details on the controller. The emission warning indicators are also visible in the Cobolt Monitor™ software, see section 9 for details on the control software.

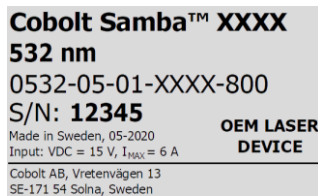
2.3. Equipment Safety

Always install all power supplies used in the laser system to properly grounded power outlets. The laser head and controller must be mounted on a common ground plane, such as an optical table. Cobolt lasers contain a laser diode which is sensitive to electrostatic discharge (ESD).

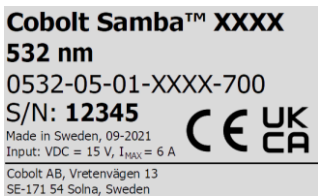
2.4. Warning and Identification Labels

The upper face of the laser head contains a yellow label with laser safety warning and classification information, the wavelength and maximum power of the unit. It also shows the location of the laser beam from the aperture and indicates the open and close positions of the manual shutter. This label must be visible unless the laser beam is totally enclosed. A silver label showing information about the laser model, manufacturer date and location, and the power supply voltage and current, is located on the laser head. Lasers shipped to customers in the USA also contain a label of CDRH compliance.

Manufacturer Identification Labels



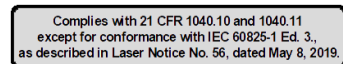
OEM Label



CE marking for CDRH models only



Aperture Warning Labels



Laser Notice No. 56 Label
CDRH models shipped to USA

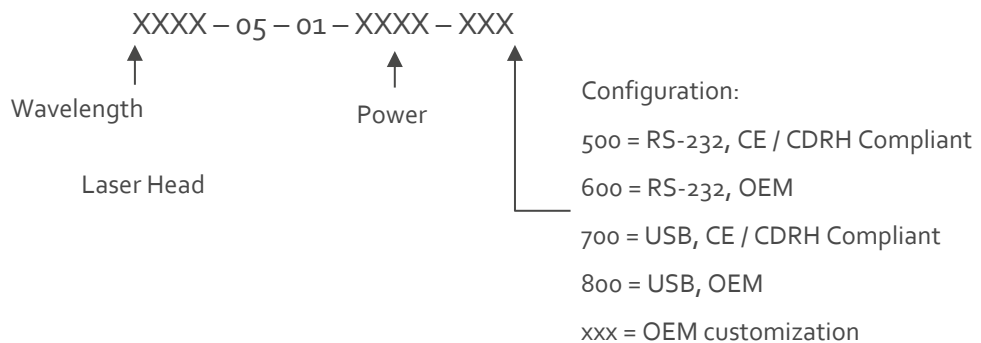
3. Overview – Cobolt 05-01

Cobolt 05-01 laser systems consist of four main parts: the laser head, the Controller, the Cable and the Power Supply (not shown). The cable provided should always be used to connect the laser head with the Controller. Always install the laser system to a properly grounded power outlet. If any part of the supplied equipment is replaced with a part not supplied by Cobolt or if the equipment is not properly grounded system may not conform to CE / CDRH compliance standards listed in section 14 : Compliance (CDRH models only). Disabling any of the safety features nullifies the CE marking and violates the laser safety standard.



3.1. Model number

Cobolt lasers are sold in two configurations: CDRH and OEM, described in section 3.2. The model numbers are composed as described below.



3.2. Configuration

3.2.1. CDRH Compliant

The CDRH compliant system is supplied with a key switch on the Controller, which must be connected, along with a remote interlock connector. Once power is supplied, laser radiation starts when the key is turned from the OFF position to the ON position. The status of operation can be monitored via LEDs on the Controller. Setting the key to its OFF position puts the laser in stand-by mode. **The CDRH model is CE compliant.**

The standard CDRH model consists of:

- Laser head
- Controller with key switch
- Keys
- 1 m Controller Cable
- 15 V / 6 A DC power supply unit

3.2.2. OEM

The OEM system is supplied **without** a key switch on the controller. Connecting the power supply to the controller initiates an automatic start-up sequence. If the remote interlock is connected, laser radiation will start automatically as soon as power is supplied, and internal temperatures are stabilized.

The OEM model consists of:

- Laser head
- Controller
- Controller Cable
- 15 V / 6 A DC power supply unit

3.3. Laser Head

The laser head contains pump diode, laser cavity, beam shaping optics and thermoelectric coolers (TEC) for temperature control of the cavity and pump diode. The laser head contains an optical feed-back loop which ensures long-term power stability of the emitted visual beam. The laser head features a manual mechanical shutter as well as a laser hazard label and a laser classification label. The Laser Head gets electrical power and control signals from the Controller via a 26-pin HD Sub-D cable. All products covered in this manual are available with all CDRH and OEM controller configurations.

3.4. Laser Controller

The Controller supplies driving current and control signals to the Laser Head. All Laser Heads are delivered with a controller. The operation set points are specific to each Laser Head and have been fixed during manufacturing. The operation set points are stored in the laser head so the controller can be interchanged or replaced.

The status of the laser operation is given via LED indicators:

POW	Green	Power is supplied.
ON	Orange	Laser emission is on. This light is on in modulation mode if laser emission is possible.
LOCK	Orange	Laser light is on and the output power has been locked to set point. The laser is operating according to specifications.
ERROR	Red	An error has occurred.

When power is supplied to the Controller, regardless of on/off state, the temperature control elements are operating to reach set point values. The Controller includes a remote interlock connector, pin 1-2 according to Section 5.5 and

5.6. The operation of the laser can be controlled and monitored via the data port that supports either USB or RS-232 commands. See Section 8.3 for further details. RS-232 controllers may also be delivered with a RS-232 to USB adaptor.

3.5. Controller Cable

The controller cable connects the laser head to the Controller. The standard (CE compliant) cable length is 1 m. The cable has a minimum bending radius of 8 cm. When connected care should be taken not to bend or break any of the 26 pins.

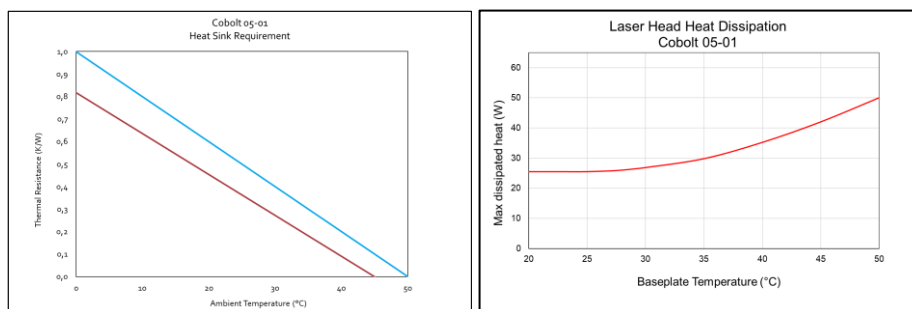
3.6. Power Supply Requirements

An appropriate Power Supply Unit (PSU) is supplied by Cobolt with the laser and must be plugged into a properly grounded standard power outlet. The output from this PSU is 15 VDC / 6 A. The power supply accepts 100 – 240 V AC and 50-60 Hz. Ripple and noise 1% peak-peak max, 20 MHz bandwidth. The accepted voltage range for the Cobolt Zydeco™ and Bolero™ are 15 V - 28 VDC; all other Cobolt 05-01 lasers accept 11 V - 28 VDC. Full performance is only guaranteed at 15 VDC / 6 A.

The power supply provided with Cobolt 05-01 lasers are certified to perform in an ambient temperature of 40°, 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 40°C.

3.7. Thermal Management

To ensure operation within given specifications and for the warranty to be valid, the Laser Head must be attached to a heat sink providing a thermal resistance of < 0.2 K/W or < 0.18 K/W for Cobolt Zydeco™ and Bolero™. This value is the difference between the maximum allowed Laser Head base plate temperature 50°C or 45° C for Cobolt Zydeco™ and Bolero™ and the maximum specified ambient temperature at the air-heatsink interface which is 40°C or 35°C for Cobolt Zydeco™ and Bolero™, divided by the maximum power dissipated from the laser which is 50W or 55 W for Zydeco™ and Bolero™. The mounting surface should be flat (within ± 0.05 mm over mounting surface). It is recommended to use a thermal heat compound between the Laser Head and the heat sink to provide good thermal contact. The Cobolt 'HS-04 Laser Head Heatsink with fans' meets these requirements, see <https://hubner-photonics.com/> for more information on heat sinks. For assistance in thermal management and system integration, please contact Cobolt's technical support.



Heat Sink Requirements (Cobolt Zydeco™ and Bolero™ shown in red, all other products in blue) and typical maximum heat dissipation for Cobolt 05-01 lasers.

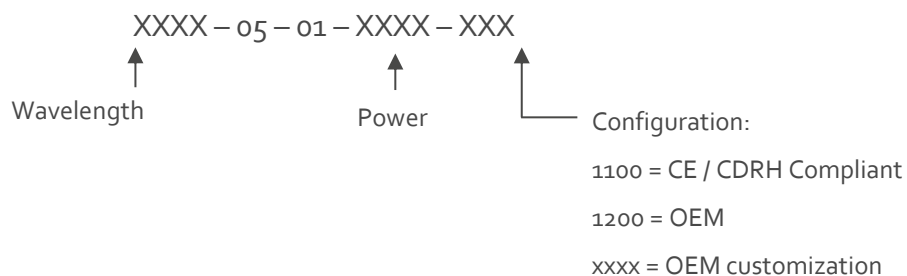
4. Overview – Cobolt 05-iE

Cobolt 05-iE laser systems consist of three main parts: the laser head, the key control box, and the Power Supply (not shown). The cable provided should always be used to connect the laser head with the Controller. Always install the laser system to a properly grounded power outlet. If any part of the supplied equipment is replaced with a part not supplied by Cobolt or if the equipment is not properly grounded system may not conform to CE / CDRH compliance standards listed in section 14 : Compliance (CDRH models only). Disabling any of the safety features nullifies the CE marking and violates the laser safety standard.



4.1. Model number

Cobolt lasers are sold in two configurations: CDRH and OEM, described in section 3.2. The model numbers are composed as described below. The Cobolt 05-iE lasers are not offered with the communication configurable between USB and RS-232 as all lasers are delivered as standard with the options accessible.



4.2. Configuration

4.2.1. CDRH Compliant

The CDRH compliant system is supplied with a key switch on the key control box, which must be connected, along with a remote interlock connector. Once power is supplied, laser radiation starts when the key is turned from the OFF position to the ON position. The status of operation can be monitored via LEDs on the key control box. Setting the key to its OFF position puts the laser in stand-by mode. **The CDRH model is CE compliant.**

The standard CDRH model consists of:

- Laser head
- Key control box
- Keys
- 12 V / 6.67 A DC power supply unit

4.2.2. OEM

The OEM system is supplied **without** a key switch on the key control box. Connecting the power supply to the to the laser head initiates an automatic start-up sequence. If the remote interlock is connected, laser radiation will start automatically as soon as power is supplied, and internal temperatures are stabilized.

The OEM model consists of:

- Laser head
- 12 V / 6.67 A DC power supply unit

4.3. Laser Head

The laser head contains pump diode, laser cavity, beam shaping optics and thermoelectric coolers (TEC) for temperature control of the cavity and pump diode. The laser head contains an optical feed-back loop which ensures long-term power stability of the emitted visual beam. The laser head features a manual mechanical shutter as well as a laser hazard label and a laser classification label. The Laser Head gets electrical power via a 4 pin Molex connector directly from the DC power supply. All products covered in this manual are available with both CDRH and OEM configurations.

4.4. Key Control box

The key control box allows the user to operate the laser with a CDRH-compliant key-switch. The control box has LEDs to indicate the laser status. When power is supplied to the laser head, regardless of on/off or key-switch state, the temperature control element will be active to reach its set point values.

The status of the laser operation is given via LED indicators:

ON	Orange	Laser emission is on.
ERROR	Red	An error has occurred.



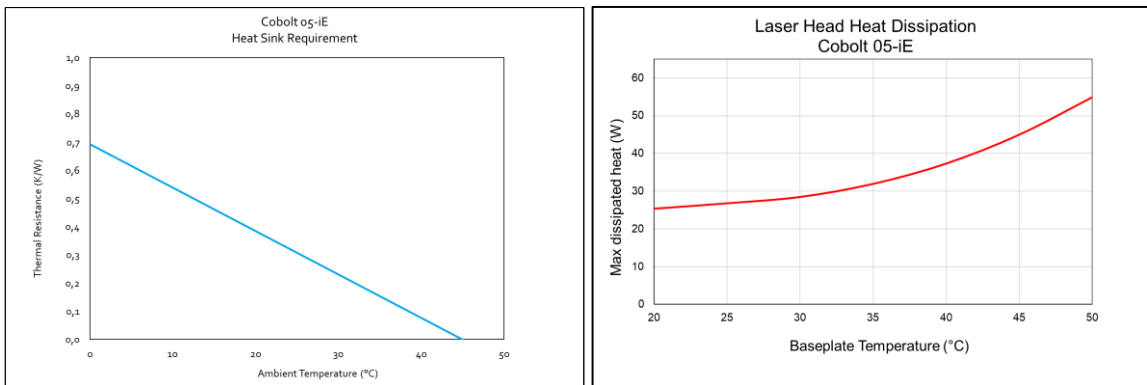
4.5. Power Supply Requirements

An appropriate Power Supply Unit (PSU) is supplied by Cobolt with the laser and must be plugged into a properly grounded standard power outlet. The output from this PSU is 12 VDC / 6.67 A. The power supply accepts 100 – 240 V AC and 50-60 Hz. Ripple and noise 1% peak-peak max, 20 MHz bandwidth. Cobolt 05-iE lasers accept 11.2 V – 13.2 VDC. Full performance is only guaranteed at 12 VDC / 6.67 A.

The power supply provided with Cobolt 05-iE lasers are certified to perform in an ambient temperature of 40°, 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 40°C.

4.6. Thermal Management

To ensure operation within given specifications and for the warranty to be valid, the Laser Head must be attached to a heat sink providing a thermal resistance of < 0.15 K/W. This value is the difference between the maximum allowed Laser Head base plate temperature (45°C) and the maximum specified ambient temperature at the air-heatsink interface (35°C), divided by the maximum power dissipated from the laser (65 W for the highest power models at high ambient temperatures). The mounting surface should be flat within ± 0.05 mm over mounting surface. It is recommended to use a thermal heat compound between the Laser Head and the heat sink to provide good thermal contact. The Cobolt HS-04 (Cobolt 05-01) and HS-05 (Cobolt 05-iE) 'Laser Head Heatsink with fans' meets these requirements, see <https://hubner-photonics.com/> for more options and information on heat sinks. For assistance in thermal management and system integration, please contact your local sales representative.



Heat Sink Requirements and typical maximum heat dissipation for Cobolt 05-iE Series.

5. System Description

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.

5.1. Specification

	Zydeco™	Zouk™	Twist™	Blues™	Calypso™	Fandango™	Samba™
Wavelength in air (nm)	319.8 ± 0.3	354.8 ± 0.3	457.0 ± 0.3	473.0 ± 0.3	491.5 ± 0.3	514.8 ± 0.3	532.1 ± 0.3
Output power (mW)	20	20	100 200 300	100 200 300	200	300	500 1000 1500
Power stability	< 2 % (± 2 °C, 8 hours)						
Noise 20 Hz – 20 MHz (rms)	< 0.5 %	< 0.2 %			< 0.5 %	< 0.2 %	< 0.1 %
Noise 20 Hz – 20 MHz (pk-pk)	< 5%	< 2%			< 5%	< 2%	< 1 %
Beam Diameter (µm)	700 ± 50						
Beam symmetry at aperture	> 0.90 : 1						> 0.95 : 1
Divergence (full angle, mrad)	< 0.8		< 1.2				
Spatial mode (TEM ₀₀)	M ² < 1.2	M ² < 1.1					
Spectral linewidth	< 1 MHz (Coherence length > 100 m)						
Wavelength stability	< 1 pm (± 2 °C, 8 hours)						
Beam waist location (vs exit)	± 200 mm						
Polarization ratio	> 100 : 1 (linear, vertical)						
Beam angle accuracy	< 5 mrad						
Beam position accuracy	< 0.25 mm						

	Jive™	Bolero™	Flamenco™	Rumba™
Wavelength in air (nm)	561.2 ± 0.3	639.6 ± 0.6	659.6 ± 0.3	1064.2 ± 0.6
Output power (mW)	200 300 500 750 1000	300 500	100 300 500	500 1000 2000 3000
Long-term power stability	< 2 %			
Noise 20 Hz – 20 MHz (rms)	< 0.1 %	< 1 %	< 0.1 %	
Noise 20 Hz – 20 MHz (pk-pk)	< 1 %	< 7 %	< 1 %	
Beam Diameter (µm)	700 ± 50			1000 ± 50
Beam symmetry at aperture	> 0.95 : 1			
Divergence (full angle, mrad)	< 1.2	< 1.4	< 1.5	< 1.6
Spatial mode (TEM ₀₀)	M ² < 1.1			M ² < 1.2
Spectral linewidth	< 1 MHz (Coherence length > 100 m)			
Wavelength stability	< 1 pm (± 2°C, 8 hours)			
Beam waist location (vs exit)	± 200 mm			
Polarization ratio	> 100 : 1 (linear, vertical)			
Beam angle accuracy	< 5 mrad			
Beam position accuracy	< 0.25 mm			

5.1.1. Operation and Environmental Specifications

	05-01	Zydeco /Bolero	05-iE*
Power supply	15 VDC, 6 A		12 V, 6.67 A
Power consumption, total system	< 65 W (typical < 30 W)		
Maximum Laser Head baseplate temperature	50°C	45°C	45 °C
Ambient temperature, operation	10 – 40 °C	10 – 35 °C	10 – 35 °C
Heat sink thermal resistance, Laser Head	< 0.2 K/W	< 0.18 K/W	< 0.15 K/W
Beam pointing stability	< 10 µrad / °C (over operation temperature range)		
Intended use environment	Laboratory (indoor)		
Pollution Degree	2		
Ambient temperature, storage	-10°C to +60 °C		
Humidity	0 - 60 % RH non-condensing		
Ambient Air pressure	950-1050 mbar		
Warm-up time, from OFF	< 3 min		
Communication protocol	USB or RS 232		USB and RS 232

* Cobolt Zydeco™, Zouk™ and Calypso™ are not available on the 05-iE platform.

5.1.2. Electrical Interfaces

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

Cobolt 05-01 Lasers

Interfaces	Location	Connector
Input power	Laser Head	Kycon KPJX-45, 4-pin
To Controller	Laser Head	HD-sub 26-pin, male
To Laser Head	Controller	HD-sub 26-pin, female
Data port	Controller	USB-type mini B
Remote interlock	Controller	6 pin Molex 90130-3206 (pin 1 and 2)
Direct Inputs	Controller	6 pin Molex 90130-3206 (pin 3)

Cobolt 05-iE Lasers

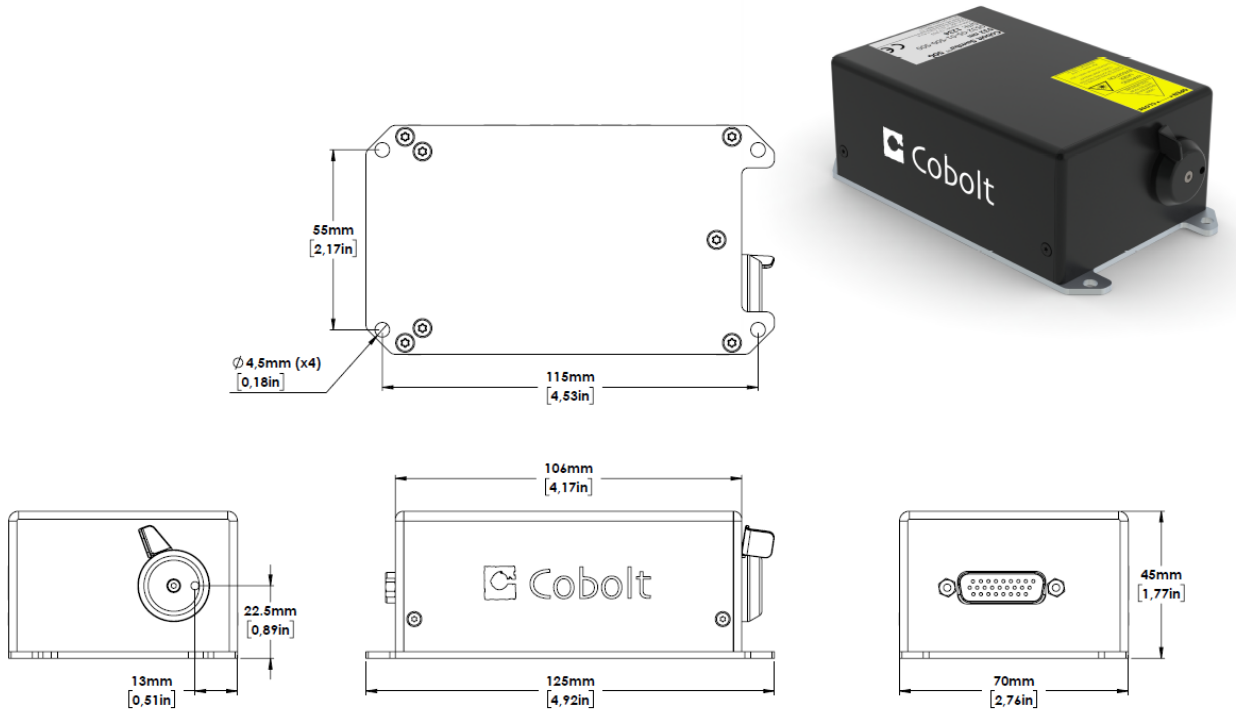
Interface	Location	Connector / pins
Input power	Laser Head	4 pin Molex (43650-0421)
Remote interlock	Laser Head	OEM : CTRL 14 pin Molex 87832-1420 (pin 1 and 2)
Direct Input	Laser Head	OEM : CTRL 14 pin Molex 87832-1420 (pin 12)
Data port (USB)	Laser Head	USB-type mini B
To Key control box	Laser Head	CTRL 14 pin Molex (87832-1420)
To Laser Head	Key control box	VGA D-SUB 15-pin male
Remote Interlock	Key control box	CDRH : 3.5 mm audio female
Data port (RS-232)	Key control box	Serial port, D-SUB 9-pin female

5.1.3. Mechanical Interfaces

	05-01	05-iE
Laser Head	125 x 70 x 45 mm (4.9 x 2.8 x 1.8 inches)	134 x 70 x 45 mm (5.3 x 2.8 x 1.8 inches)
Controller / Key box	190 x 72 x 28 mm (7.5 x 2.8 x 1.1 inches)	82 x 56.6 x 32 mm (3.2 x 2.2 x 1.3 inches)
Power Supply	115 x 50 x 35 mm (4.6 x 2.0 x 1.4 inches)	145 x 60 x 32 mm (5.7 x 2.4 x 1.3 inches)
Fixation holes, Laser Head	∅ = 4x 4.5 mm (M4) 115 mm x 55 mm	∅ = 4x 4.5 mm (M4) 134 mm x 55 mm
Fixation holes, Controller	∅ = 4x 6.4 mm (M6) 178 mm x 51 mm	n/a
Laser Head weight	< 0.6 kg	

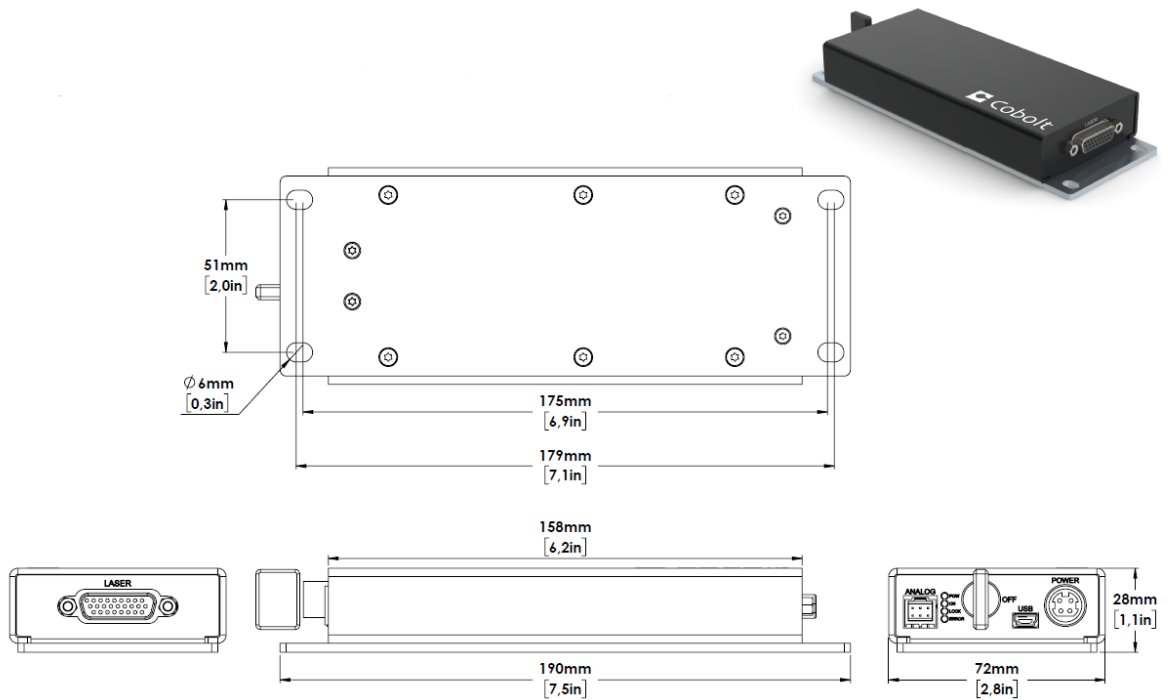
5.2. Mechanical Drawings

5.2.1. Laser Head 05-01



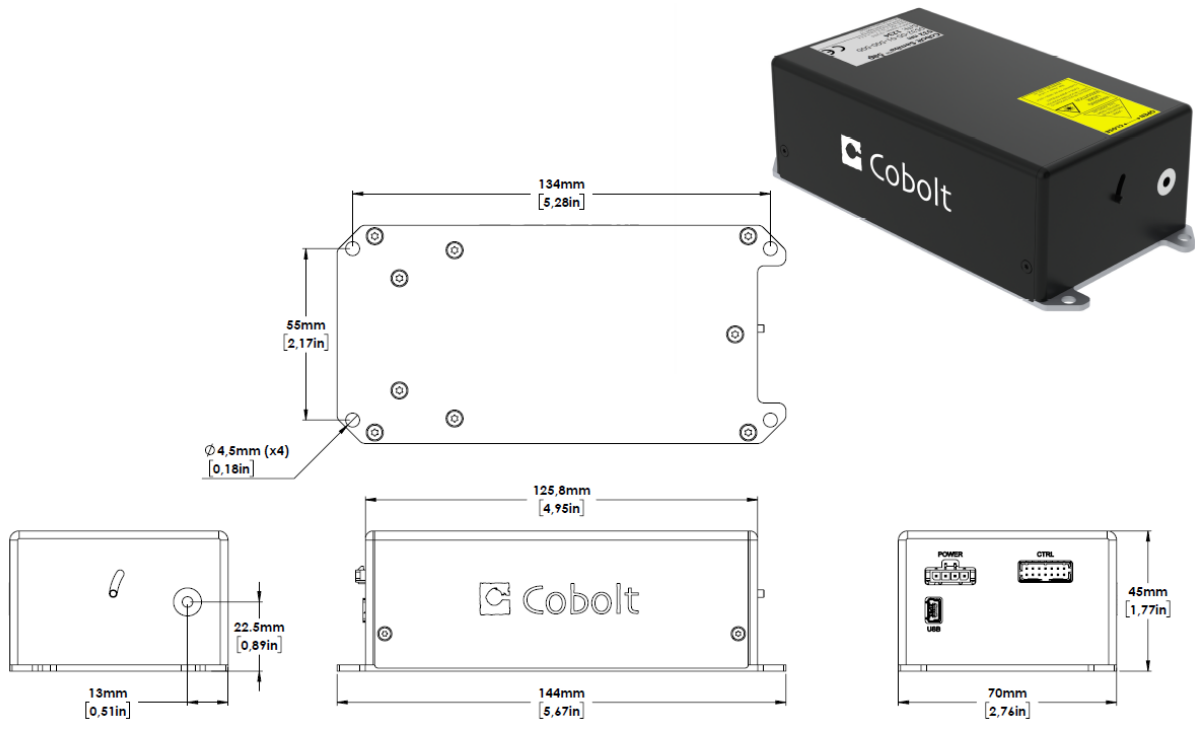
Laser head mechanical outline. Dimensions in mm [inches].

5.2.2. Laser Controller Gen 5b – 05-01



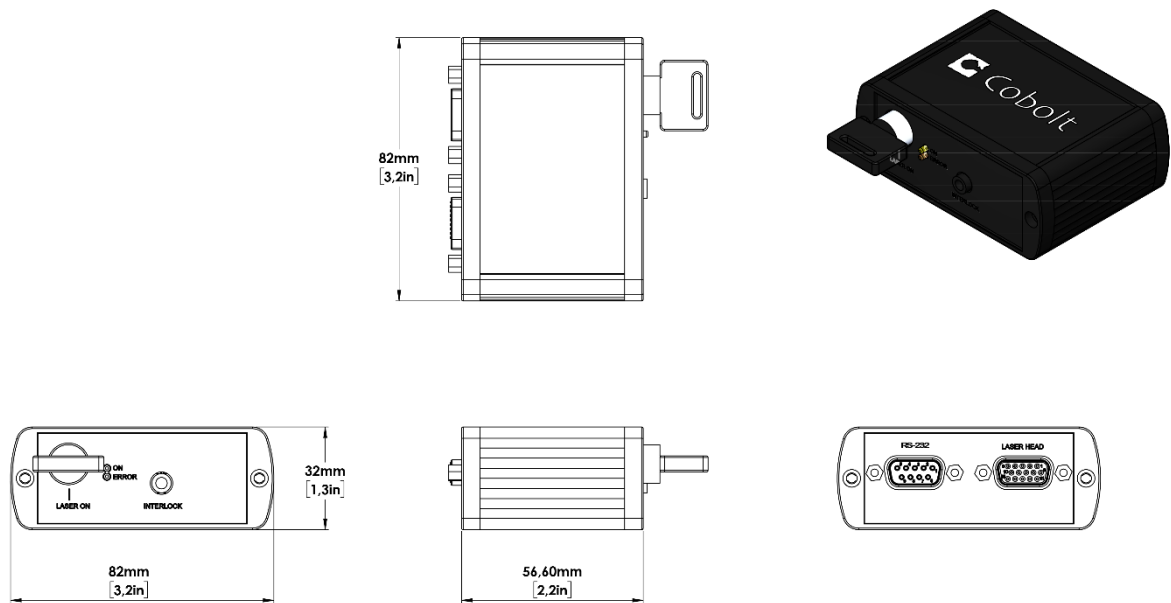
Controller mechanical outline. Dimensions in mm [inches].

5.2.3. Laser Head 05-iE



Laser head mechanical outline. Dimensions in mm [inches].

5.2.4. Key control box - 05-iE



5.3. Remote Interlock Connector

The remote interlock connector is located at pin 1 and 2 of the Molex connector on the control I/O connector. The connector can be short-circuited with an interlock jumper (included at delivery) for operation of the laser. To use the remote interlock connector with an external switch, connect a pin 1 and 2 on a Molex plug. After the remote interlock connector has been opened the laser will need to be reset by disconnecting from and then reconnecting to the power supply in order to start again. Alternatively, it can be re-started using a special sequence of commands, see Section 8.3 for further details. The signal level is between 0 V and +5 V with a pull up resistor, and the current required to ground the remote interlock connector is 5 mA. The time delay in the hardware is < 1 ms, but after filtering by the firmware the reaction time is extended to < 20 ms.

5.4. Direct Input

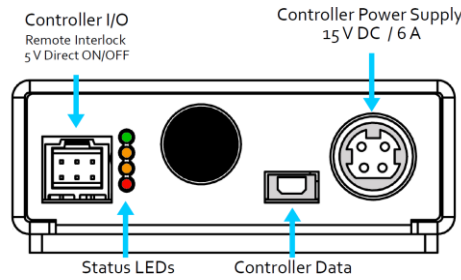
The Direct Input is a control feature that enables turning the laser ON and OFF using a 5 VDC signal. After having configured the control software for Direct Input operation (factory set or by executing @cobasdr 1), the laser can only start-up when a 5 VDC is applied to the appropriate pin on the Control I/O connector with 0 VDC on pin 2 as reference. Shifting the signal to 0 VDC on the appropriate Direct Input pin will turn the laser off and put the laser in stand-by mode (status LED:s is POW and not flashing). See section 5.5 and 5.6 for pin assignment.



NOTICE This function is not available for CDRH compliant models. The Direct Input ON/OFF control feature should never be used as remote interlock connector. A remote interlock socket is provided for this purpose on the laser head. This input only controls the ON/OFF state of the laser and cannot be used to modulate the power output.

5.5. Pin assignment – 05-01 Controller

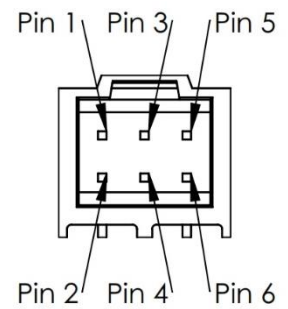
All equipment connected to the system should be limited energy as described by IEC 61010:1.



5.5.1. Controller I/O connector

Manufacturer Molex 90130-3206, mates with 90143-0006.

Pin	Function	Signal Details
1	Remote Interlock	3.3 V, Pull up
2	0 V - GND	
3	Direct Input	OFF = 0 – 1.5 V (In) ON = 3.0 – 12 V (In)
4	--	
5	LED 1B (LASER ON)	5 V, 470 Ω (out)
6	LED 2 (ERROR)	5 V, 470 Ω (out)

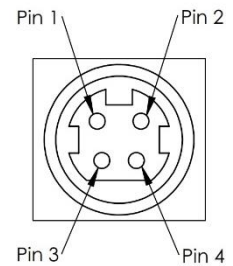


5.5.2. Power supply connector

Kycon KPJX-4S, mates with Kycon KPPX-4P. Grounded shield.

Pin	Function
1	0 V
2	+11-28 VDC
3	0 V
4	+11-28 VDC

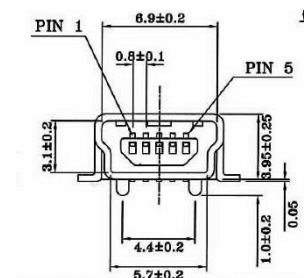
Pin	Function (Bolero)
1	0 V
2	+15 – 28 VDC
3	0 V
4	+15 – 28 VDC



5.5.3. Data connector

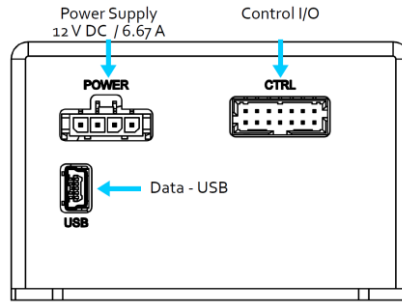
Connector USB-type, mates with connector mini-B.

Pin	Function (USB)	Function (RS-232)
1	+5 V	Not connected
2	D-	RS-232_TX
3	D+	RS-232_RX
4	Not connected	Not connected
5	0 V (GND)	0 V (GND)



5.6. Pin assignment – 05-iE

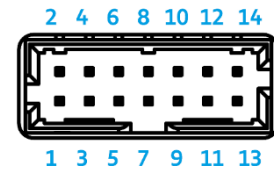
All equipment connected to the system should be limited energy as described by IEC 61010:1.



5.6.1. Laser head I/O - CTRL

The pin configuration for the 14 pin Molex connector on the laser head is described in the table below.

Pin	Function	Signal Detail
1	Remote interlock	3.3 V, Pull up
2	0 V – Ground	
3	0 V – Ground	
4	RS-232 TX	
5	RS-232 RX	
6	LED 1A (LASER ON)	3.3 V, 470 Ω (out)
7	LED 1B (LASER ON)	3.3 V, 470 Ω (out)
8	LED 2 (ERROR)	3.3 V, 470 Ω (out)
9	--	
10	--	
11	Key Switch	
12	Direct Input	OFF = 0 – 1.5 V (In) ON = 3.0 – 12 V (In)
13	0 V – Ground	
14	--	

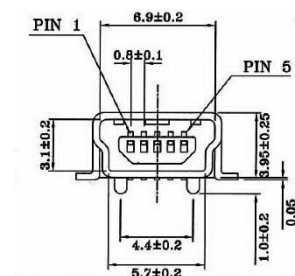


14 pin Molex socket on laser head

5.6.2. Data connector - USB

Connector USB-type, mates with connector mini-B.

Pin	Function
1	+5 V
2	D-
3	D+
4	Not connected
5	0 V (Ground)

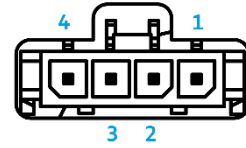


USB Connector

5.6.3. Power connector

The pin configuration for the Molex 4-pin connector is described below.

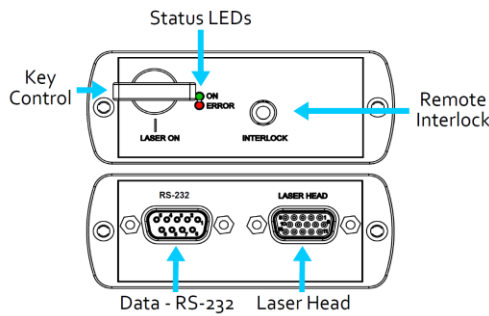
Pin	Function
1	0 V – Ground
2	0 V – Ground
3	+ 12 V - DC
4	+ 12 V - DC



4 pin Molex socket on laser head

5.7. Pin assignment – 05-iE - Key Control Box

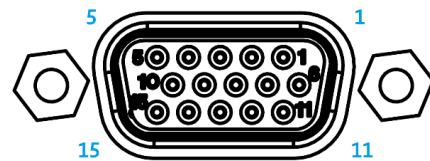
All equipment connected to the system should be limited energy as described by IEC 61010:1.



5.7.1. Laser head

The pin configuration for the 15 pin Sub-D (VGA) connector on the key control is described in the table below.

Pin	Function
1	LED 1A (LASER ON)
2	LED 2 (ERROR)
3	--
4	0 V – Ground
5	Key Switch
6	--
7	RS-232 TX
8	RS-232 RX
9	--
10	0 V – Ground
11	Remote interlock
12	--
13	--
14	--
15	0 V – Ground

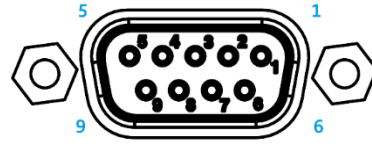


15 pin Sub-D connector on the laser head

5.7.2. Data connector – RS 232

The pin configuration for the 9 pin Sub-D (serial) connector on the key control is described in the table below.

Pin	Function
1	--
2	RS-232 TX
3	RS-232 RX
4	--
5	0 V – Ground
6	--
7	--
8	--
9	--



9 pin Sub-D connector for RS-232 communication

6. Operating Instructions

As standard, all lasers are delivered in Auto-start mode. As soon as power is supplied to the system the temperature control elements are operating to reach set-point values and the laser emission will start, unless the key-switch is enabled (CDRH model).

6.1. Installation start-up operation

1. Mount the Laser Head on a suitable heat sink (see Section 3.5).
2. Ensure that the remote interlock jumper is connected.
3. Connect the Laser Head to the controller or key control box with the Cable and fasten screws at both ends.
4. Connect the power supply to the mains outlet and then to the system.
5. The laser now goes through the following auto-start sequence:
 - Temperature stabilization (1-2 min). Status LEDs: POW flashing, then POW goes on.
 - Turn the key switch to start the laser. Status LEDs: ON goes on (CDRH model only)
 - The laser starts (light is emitted) in a constant warm-up current constant for 60 sec. Status LEDs: ON goes on, either in the software (05-iE) or on the controller (05-01).
 - The laser locks to pre-set output power (<2 min) and operates according to specifications. Status LEDs: LOCK goes on, either in the software (05-iE) or on the controller (05-01).



NOTICE If the power does not match the power as stated on the test sheet see Section 12: Service for more information.

7. Operating Modes

There are two operating modes: constant power and constant current. The default mode for Cobolt 05-01 series lasers when shipped is constant power. In constant power mode the power is monitored on an internal photodiode, and this is used to regulate the current to maintain a constant power level. In constant current mode the laser runs at a set current level.

8. Operation via data port

Cobolt 05-01 lasers

To communicate with a Cobolt 05-01 lasers use the mini-USB data port on the external controller. The appropriate communication cable is provided with all lasers. Determine which communication protocol (USB or RS-232) your system is configured for by either checking the label on the mini-USB data port or from the model number (see 3.1).

Cobolt 05-iE lasers

For a Cobolt 05-iE lasers, use the mini-USB port on the laser head for USB communication. RS-232 communication is available via the serial port on the key-box or via pin 4-5 on the I/O-CTRL port. A mini-USB to USB cable for USB communication is provided with all Cobolt 05-iE lasers.

8.1. Remote Interface Configuration

RS-232 configured controllers

To communicate with a laser, a PC needs to have a serial port. Alternatively, a RS-232-to-USB converter can be used. The serial port settings are listed in Section 8.2.

USB configured controllers

When using Cobolt Monitor™ with Windows 10, the USB device is automatically detected. When using Windows 8 or earlier (e.g Windows 7, Vista, XP) it is necessary to install the Cobolt signed USB driver, please refer to Section 8.4. The computer will recognize the device as a virtual serial port and assign it a COM port.

8.2. 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

Commands to operate the lasers are listed in Section 8.3. All commands are case sensitive and command arguments must be delimited by a single space character (ASCII 32). Under no circumstances does the system initiate communication; it only transmits a response to each command, either a numerical value, a string or the acknowledgment string "OK". In the event that the system receives a command that it cannot interpret, it responds: "Syntax error: illegal command".

To get started using a Cobolt laser with a program written C++ or Python, please refer to our example codes at the Hübner Photonics GitHub: <https://github.com/cobolt-lasers>.

8.3. Communication commands

The laser is delivered set in Auto-start mode (see section 6.1 for Auto-start sequence description). As long as DC power is supplied to the system the temperature control elements are always operating to reach set-point values and the laser will be idle waiting for the next command. All arguments are in lower case and separated by a space (ASCII 32). For more information during system integration contact your local sales representative.

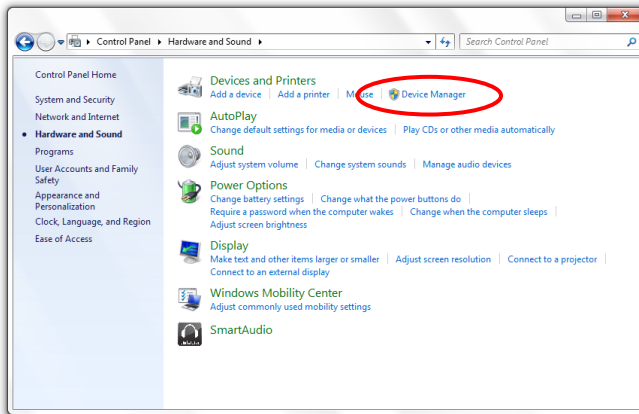
Command	Function	Argument	Returned value
l?	Get laser ON/OFF state		0 = OFF 1 = ON
@cob1	Laser ON Starts the laser via a fixed warm-up phase (nominal 60 sec) with constant drive current, even if Auto-start mode has been disabled.		
l0	Laser OFF		
p?	Get set output power		Power (W)
p	Set output power	Power (W)	
pa?	Read output power		Power (W)
i?	Get drive current		Current (A)
slc	Set drive current	Current (A)	
cp	Enter constant power mode		
ci	Enter constant current mode		
ilk?	Get interlock state		0 = interlock closed (OK) 1 = interlock open
leds?	Status of 4 LEDs		Int [0:15] Bit 0 = "POWER ON" Bit 1 = "LASER ON" Bit 2 = "LASER LOCK" Bit 3 = "ERROR" 1 = LED on 0 = LED off
f?	Get operating fault		0 = no fault 1 = temperature error 3 = open interlock 4 = constant power fault
cf	Clear fault		
sn?	Get serial number		Serial number
hrs?	Get system operating hours		Operation hours

For re-starting the laser with commands after having opened the remote interlock switch, execute "cf" for clear fault followed by "@cob1" to restart the laser. For CDRH models, toggling the key switch is the only way to re-start.

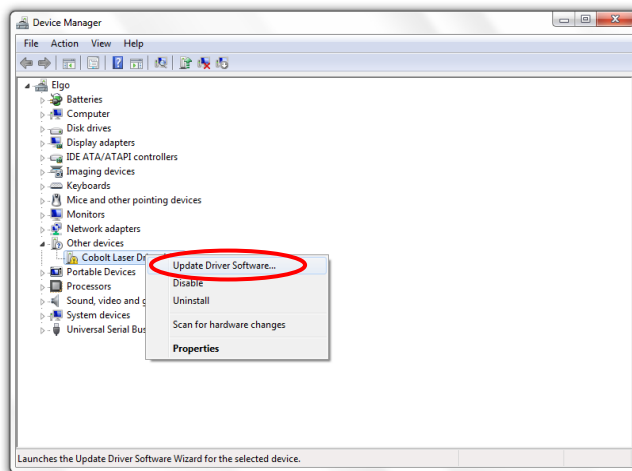
8.4. Installation of the USB driver

When connecting a Cobolt laser with to a computer using Windows 8 or earlier (e.g Windows 7, Vista, XP) it is necessary to install the Cobolt signed USB driver. The USB driver can be downloaded from the Cobolt website (hubner-photonics.com). When installed, is will be possible to establish connection as described previously in this section. To install the USB driver in Windows 7 follow these instructions:

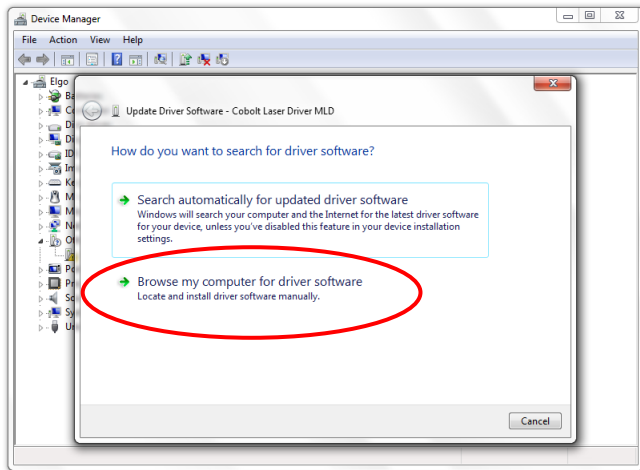
1. Go to the **Control Panel** and choose **Hardware and Sound**.



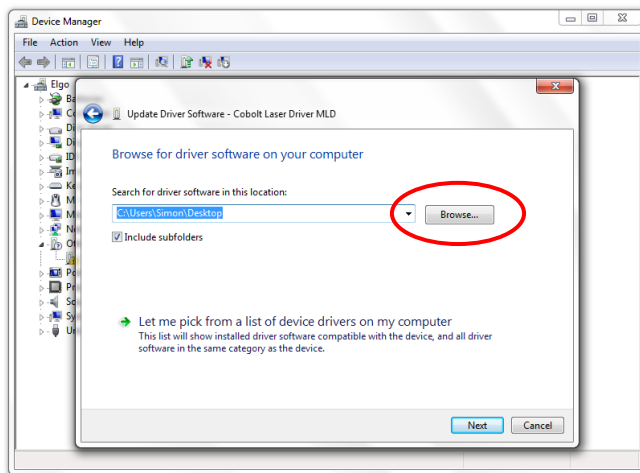
2. Under the **Devices and Printers** section, choose **Device Manager**.
3. Under **Other devices**, find the device called **Cobolt Laser Driver**. Right-click it and chose **Update Driver Software**.



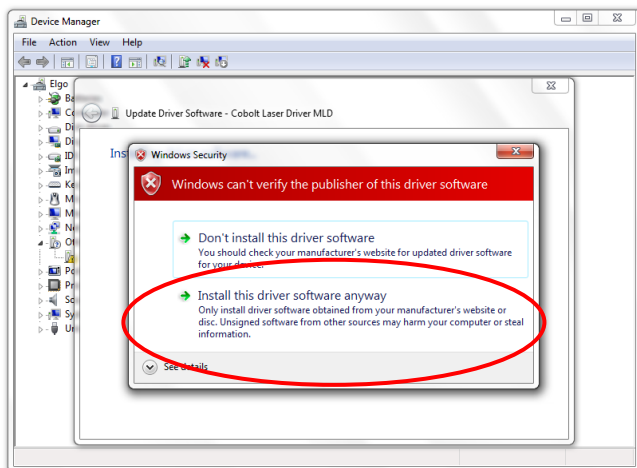
4. On the next screen chose the **Browse my computer for driver software** option.



5. Click **browse**, and find folder on your computer where the USB driver is stored.



6. Windows security may warn you that the publisher of the driver is unverified. Choose **Install this driver software anyway**.



7. The installation should now be complete.

9. Cobolt Monitor™ Software

The Cobolt Monitor™ software provides a graphical way to monitor the laser performance and to change power, operation mode and other settings. The software can connect to the laser either via RS-232 port or via USB, depending on the system configuration. When using Cobolt Monitor™ with Windows 10, the USB device is automatically detected. When using Windows 8 or earlier the USB driver must be installed manually and can be downloaded from the Cobolt website (<https://hubner-photonics.com/>), see section 8.4.

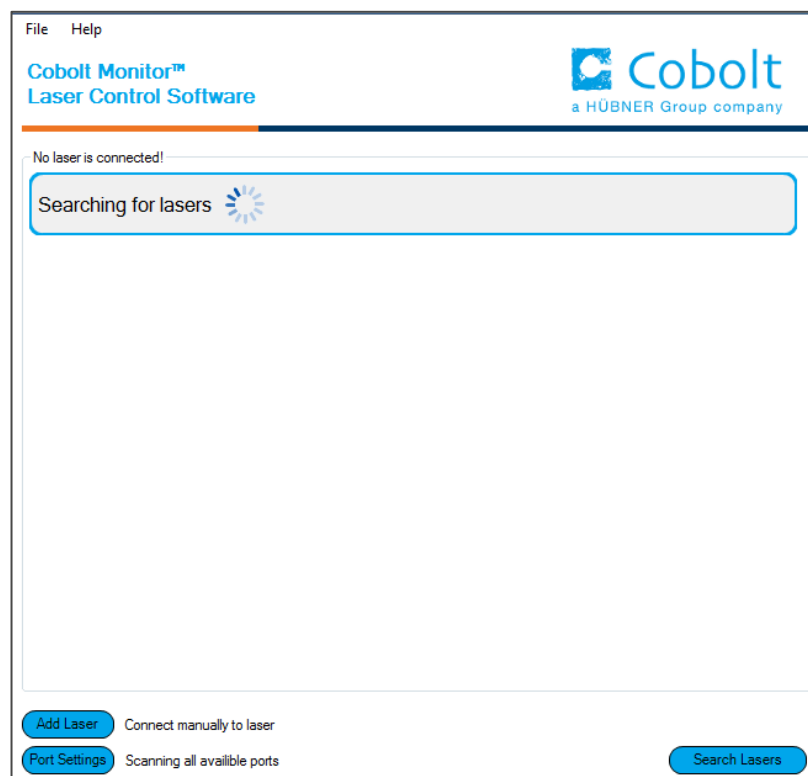
Cobolt Monitor™ has been tested with operative systems Windows 10, Windows 7, Windows 8, Windows XP and Vista. Microsoft .NET 4.0 is required to run the Cobolt Monitor™ software. Most computers with operative systems have this included as standard.

9.1. Installation

Download the latest version of the Cobolt Monitor™ software from <https://hubner-photonics.com/>. The Cobolt Monitor™ software is a stand-alone executable, the executable file is packaged with other files needed to run the program in a .zip file. Save the .zip file and extract all files. The folder created after extracting the files can be placed on any storage device and Cobolt Monitor™ can be run from there. All files and folders contained in the .zip file must be present for the program to function properly.

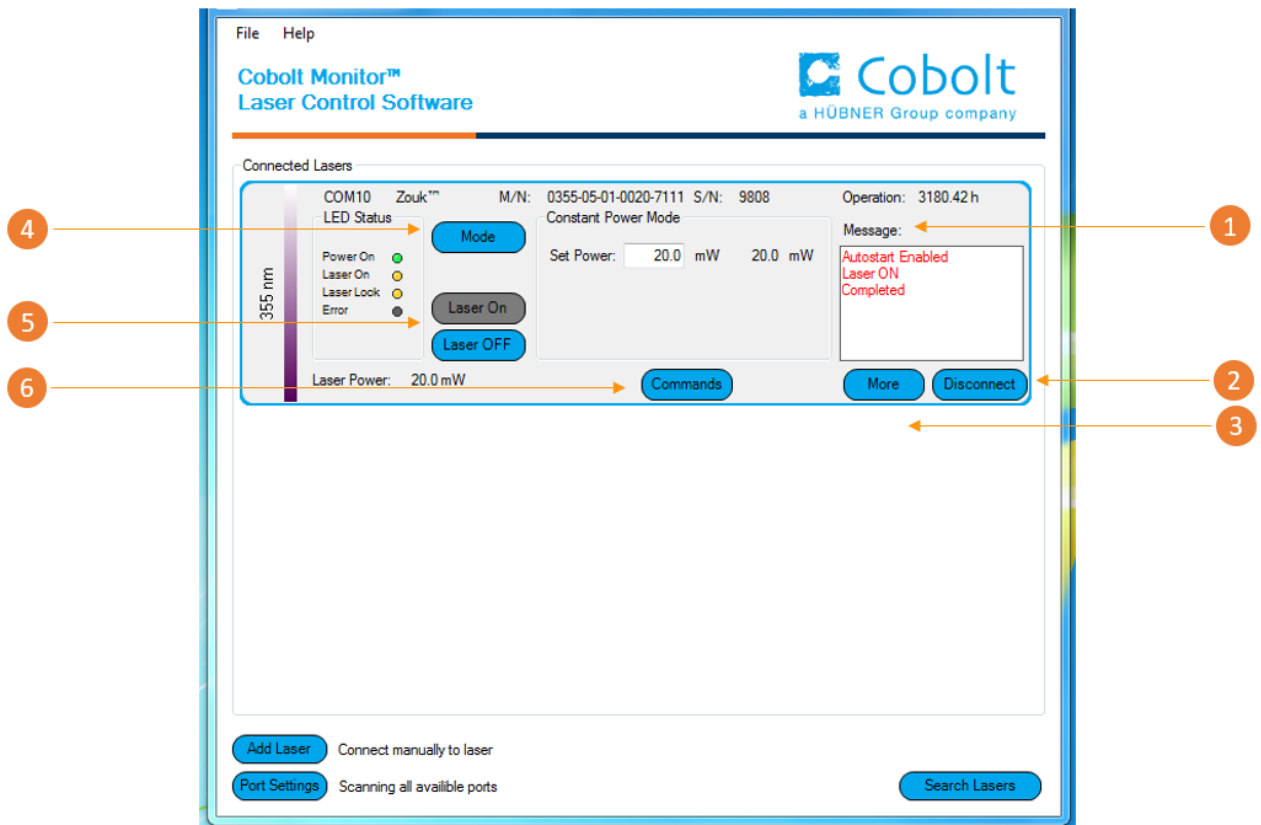
9.2. Software instructions

The software automatically searches for Cobolt devices every 5 seconds and automatically connects the laser if detected. The software can identify USB connected lasers as well as RS232 connected lasers.



The first Cobolt Monitor™ window that appears in the Cobolt Monitor software.

Once the laser is connected it can be controlled from the box dedicated for the laser. The interface, found in the following figure, is intended for typical user cases. Only the relevant information is presented on this level, displaying only the status the laser is in and relevant choices to make. Here follows a short description of how to use the Cobolt Monitor™ software on this level.



Cobolt Monitor™ software. Laser successfully connected.

1 **Message** – highlights important information of the laser status to the user.

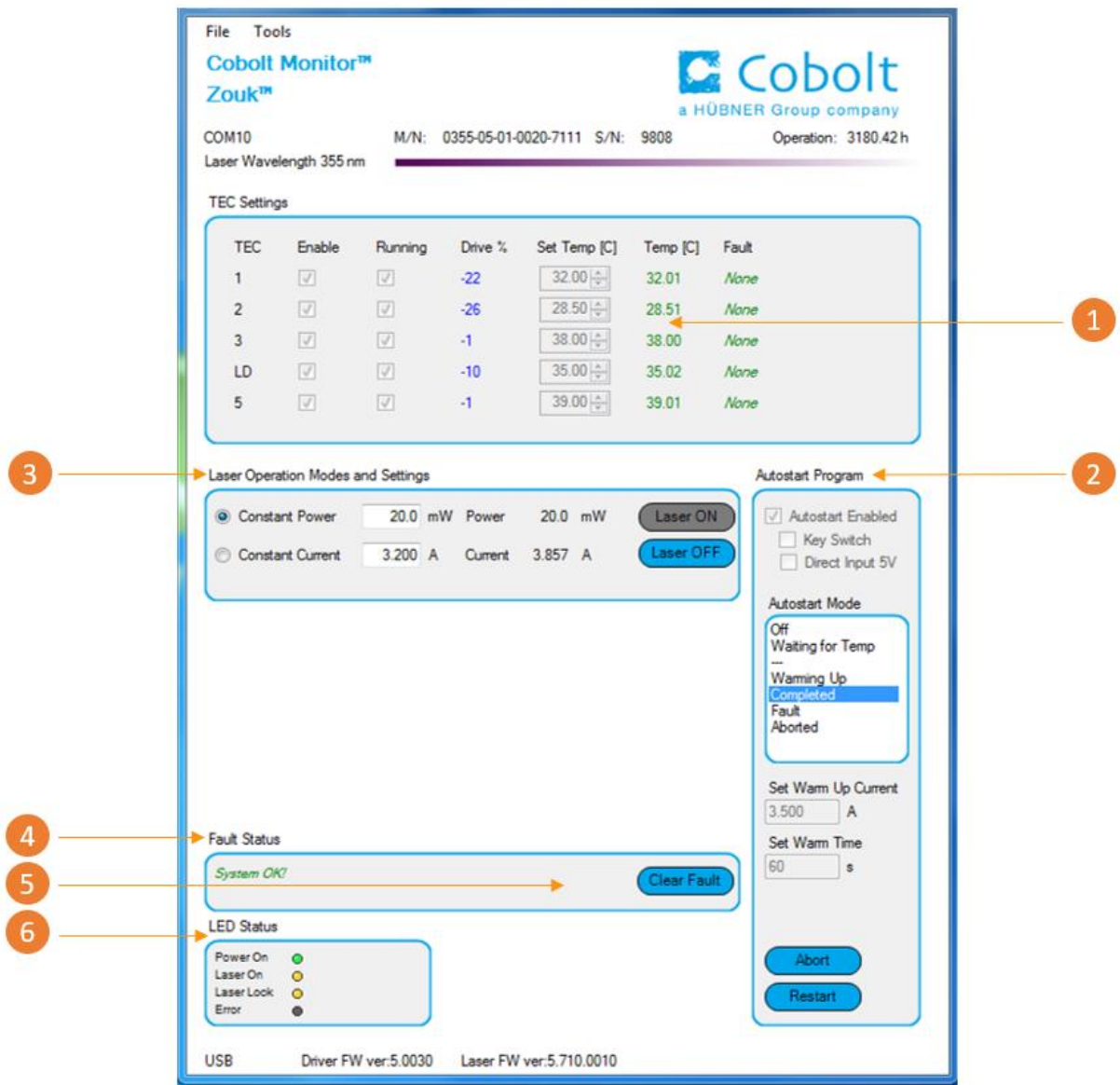
2 **Disconnect** – allows the user to disconnect from the software in a controlled way.

! Note: The communication cable should not be removed when the software is in connect state. communication may then malfunction and this might require a power restart of the system disconnect the laser, click “Disconnect” or close Cobolt Monitor™ completely. It is also possible to disconnect by powering the laser OFF. In this case Cobolt Monitor™ will automatically close the window for that laser.

3 **More** –an additional Cobolt Monitor™ window will open containing more detailed information of that laser’s status.

- 4 **Mode** – Gives a choice of operational modes possible to choose for the laser model. Cobolt Tor™ Series Constant Power, Constant Current, Burst Mode and Constant Repetition Rate (OEM only) operation can be chosen. Only relevant choices are presented to the mode of operation chosen. Only relevant choices are presented to the mode of operation chosen.
- 5 **Laser ON** – Turns the laser ON. If the laser is in autostart mode this is equivalent to “restart”.
Laser OFF – Turns the laser OFF.
- 6 **Commands** – opens a command communications window to send commands directly to the laser controller.

Once **More** button is pressed the additional window containing more detailed information of that laser’s status will open.



Cobolt Monitor™ software expanded to for more detailed monitoring.

- 1 **TEC Settings** – shows the running status and the fault status for the laser’s internal thermoelectric coolers (TEC).
- 2 **Autostart Program** - displays whether the laser is in CDRH or OEM mode and displays the current laser operational status. Direct input enabled state is set here, see section 5.4. There are also buttons to “abort” the autostart sequence or to “restart” the laser after a fault.
! Note Specifications are only guaranteed in constant power mode, at 100 % of nominal power.
- 3 **Laser Operation Mode and Settings** - displays the set laser power. The user can switch between constant power mode and constant current mode. Likewise, there are boxes to set the constant power level and constant current level. The output power (as monitored measured on an internal photodiode) and the current through the laser pump diode are both displayed.
- 4 **Fault Status** – displays ERROR messages. In the event of an ERROR, the laser action is stopped. When the reason for the ERROR event is understood and the problem is addressed the fault status can be cleared with “Clear Fault”. If the Autostart Program is enabled, click restart to restart the laser
- 5 **Clear Fault** - is displayed in the event of a fault. The user can deal with the cause of the fault and t press “Clear Fault” and then restart the laser by clicking “Laser ON”. Example: if the remote inter loop is open the user must make sure the loop is closed again before issuing a “Clear Fault” followe “Laser On”.
- 6 **LED Status** - displays the LED Status. For Cobolt 05-01 lasers this will correspond to the LEDs that are currently illuminated on the Controller, see section 3.4. These are displayed even if the laser is in OEM mode.

10. Troubleshooting

In the unlikely case of a problem occurring, use the table below to help identify the error.

LEDs	Status	Explanation	Action
POW	OFF	Mains power off	Check connections
POW	Flashing	Temperatures not stabilized	Check if heatsink is sufficient
LOCK	Flashing	Laser cannot lock in constant power, current limit has been reached	Check for back reflections. Contact the factory.
ERROR	ON	Error in laser parameters	If lights at start-up check cable connections, if lights >5 s after start-up contact the factory.

Some faults can be fixed remotely. Back reflections into the cavity can cause instability of operation. Isolators are available as an option. In case of a sudden voltage drop the laser will turn itself off and restart. If it is in CDRH configuration it will require that the key is turned on again. Contact Cobolt support or your local representative to identify corrective action.

11. Warranty and Maintenance

The manufacturer provides warranty as follows:

Warranty period	Cobolt lasers
12 months	Cobolt Zydeco™, Zouk™, Twist™, Blues™, Fandango™, Jive™ (1000 mW), Bolero™
24 months (unlimited hours of operation)	Cobolt Calypso™, Samba™, Jive™ (≤ 750 mW), Flamenco™, and Rumba™

The laser systems are designed for modular repair or replacement in the event that the Laser Head or Controller malfunctions. Warranty is invalid if the laser system is operated outside of the specific limits and conditions as outlined in this document.

The Cobolt lasers are contained in sealed enclosures and should not be opened for any reason. 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. All laser parameters are set at the factory, and there are no adjustments required. Maintenance is limited to wiping dirt off the enclosures and cleaning the aperture.

12. Service

Due to accuracy tolerances, calibration differences and allowed power drift there may be discrepancies between the Cobolt measurement of the optical output power and the customer measurement equipment. If the output power deviates from the reported value please contact your local sales representative for an online re-calibration. If the laser 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 to request an RMA number (see back cover for contact information). If an RMA number is issued and the laser needs to be shipped back to Cobolt or your local representative, please pack the complete system for shipment using the original package or equivalent. Ensure the unit is free from thermal paste before packing. The warranty covers repair or replacing the unit at the option of the manufacturer.

13. Disclaimers

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. 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. 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 Hübner Photonics.

14. Compliance (CDRH models only)

The CDRH model lasers (-1100, and -5/700) are designed and manufactured to comply with the EC Low Voltage Directive and the EC EMC Directive in the CDRH-compliant configuration. Cobolt 05-01 laser system consist of a laser head, 1 m controller cable, controller, key and Cobolt-supplied power supply. Cobolt 05-iE laser systems consist of a laser head, key control box, < 1 m key control box cable, key and a Cobolt-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 Cobolt or if the equipment is not properly grounded, the system may not conform to CE / CDRH compliance standards listed in section 14. 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	IEC-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	IEC 61326-1 EN 55011 Electromagnetic Emission, Class A Electromagnetic Immunity – Table 1 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, 3 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 your sales representative for a copy of the full Declaration of Conformity.



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