

Cobolt Tor™ XS

Ultra-compact | Triggerable | Q-switched laser

532 nm

1064 nm



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1. Introduction

The Cobolt Tor™ XS lasers are high-performance triggerable Q-switched diode-pumped lasers that come in an ultra-compact design with fully integrated electronics. Each optical pulse emitted by the laser is triggered by an external trigger signal connected to the SMA connector on the backside of the laser. The repetition rate of the laser is controlled by the trigger signal. This makes it possible to trigger optical pulses on demand for various applications. The pulse properties remain constant at all repetition rates.

The lasers are manufactured using Cobolt's proprietary HTCure™ technology and packaged into a sealed laser head, offering an outstanding level of robustness and reliability and making these lasers highly suitable for OEM integration into demanding environments.

The combination of ultra-compact format, high level of robustness, high average power and pulse energy performance make the Cobolt Tor™ XS lasers ideal light sources for a large variety of industrial and scientific applications, especially LIDAR, hand-held LIBS and photoacoustic microscopy.

2. Safety

2.1. General

Cobolt Tor™ XS lasers are Class 3B (IEC) laser products that emit laser radiation in the Visible and Near Infrared (IR) 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.



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. Class 4 laser radiation may ignite flammable materials and combustible gases 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. 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 on the end product. 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 of the units, 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).

The table below describes the nominal lasers operation parameters.

Product	Average Power (mW)	Pulse Duration (ns)	Pulse Repetition Rate (kHz)	Pulse Energy (µJ)
Cobolt Tor™ XS 532 nm	50	2.5 ± 1.0	Single pulse to 1 kHz	50
Cobolt Tor™ XS 1064 nm	50 100	2.5 ± 1.0	Single pulse to 1 kHz	50 100

The table below describes the maximum energy density in mJ/cm² used for safety calculations and the appropriate level of eye protection in terms of optical density (OD) for each product line.

Product	Laser Class	Warning Label Power (mW)	Max Pulse (µJ)*	Max Energy Density (mJ/cm ²)**	Eye Protection Requirement***
Cobolt Tor™ XS 532 nm	3B / III	200	200	76	> OD 5 / I,R LB 6
Cobolt Tor™ XS 1064 nm	3B / III	300	300	153	> OD 5 / I,R LB 6

* Max Pulse (µJ) = Warning Label Power (W) ÷ Repetition Rate (Hz)

** Max Energy Density (mJ/cm²) = Warning Label Pulse (mJ) ÷ Beam Area at bottom tolerance (cm²)

*** Eye protection (OD) = Log₁₀(60825 · 1 Emission Limit : Class 1 (µJ) ÷ Max Pulse (µJ)), rounded up to the next integer/See EN 207



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

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 12 : 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 6.3 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 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 Key control box incorporates 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. The emission warning indicators are also visible in the Cobolt Monitor™ software, see section 8, 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.

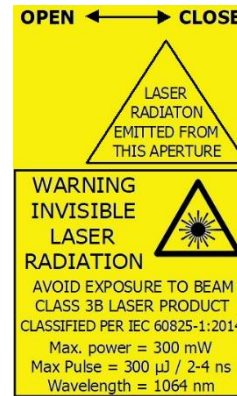
Manufacturer Identification Labels

Cobolt Tor™ XS
532 nm 50 μJ
 0532-06-71-XS-0050-200
 S/N: 12345 OEM LASER DEVICE
 Made in Sweden, 05-2020
 Input: VDC = 5 V, I_{MAX} = 5 A
 Cobolt AB, Vretenvägen 13
 SE-171 54 Solna, Sweden

OEM Label

Cobolt Tor™ XS
532 nm 50 μJ
 0532-06-71-XS-0050-100
 S/N: 12345 CE UK CA
 Made in Sweden, 09-2021
 Input: VDC = 5 V, I_{MAX} = 5 A
 Cobolt AB, Vretenvägen 13
 SE-171 54 Solna, Sweden

CE marking for CDRH models only



Aperture Warning Labels



Complies with 21 CFR 1040.10 and 1040.11
 except for deviations pursuant to
 Laser Notice No. 50, dated June 24, 2007

Laser Notice No. 50 Label

CDRH models shipped to USA

3. Start-up Instructions

As standard, all lasers are delivered set in Auto-start mode. As soon as power is supplied to the laser head the temperature control elements are operating to reach set-point values. Once the trigger signal is provided, the laser emission will start, unless the key-switch is enabled (CDRH model). An external input trigger signal is required to operate the laser.

3.1. Installation start-up operation

1. Mount the laser head on a suitable heat sink (see Section 5.4)



2. Attach the 15-pin D-SUB cable to the Control Box.



3. Attach the 10 pin Molex connector to the laser head.



4. Insert the interlock plug into the connector on the key control box.



- 5. Connect the input trigger signal to the SMA connector

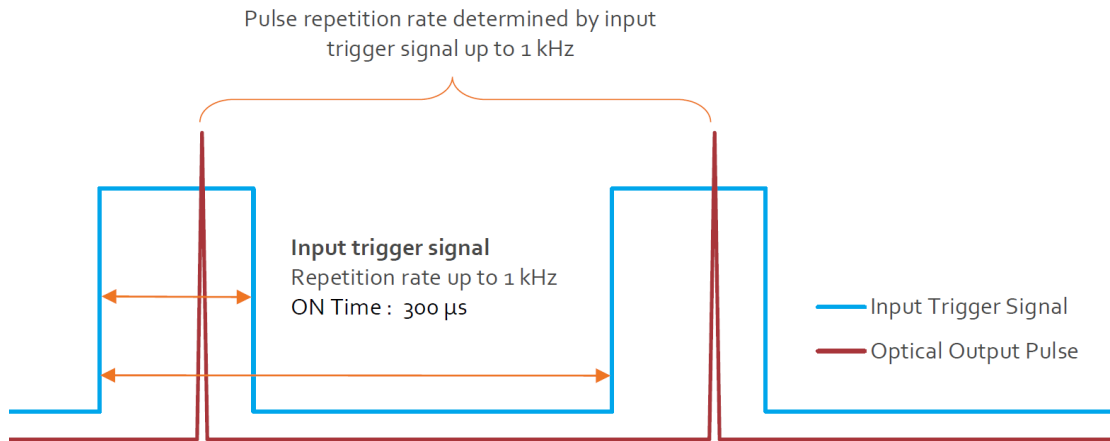


The trigger signal parameters should be:

- Square Pulse or Square wave
- Frequency : Single pulse up to 1 kHz
- V_{high} : 3.2 -5.0 V
- V_{low} : 0.0 V
- Signal ON time : 300 μ s



CAUTION Input signal pulse ON time more the 300 μ s can damage the laser, always verify the trigger signal before starting the laser.



Input trigger signal diagram. The laser will emit one optical pulse per electrical triggered pulse.

6. Connect the supplied 5V power supply unit to the socket on the laser head and plug it in to the mains.



The laser will go through the auto start sequence:

- | | |
|-------------------------|--|
| Waiting for Temp | Laser emission is not enabled until all temperatures have reached their set point and the TECs are stabilized. |
| Waiting for Key | Toggle the key to proceed, if the key is already in the ON position, turn of OFF and ON again. |
| Completed | The device is emitting or armed for emission. |

7. To start the laser, turn the key on the key control Box clockwise to the ON position. If it is already in the ON position, turn it to OFF and then ON again. At delivery all laser lines are 'ACTIVE' and 'ON', laser light will be emitted as soon as the key is turned.



8. The laser will now start up in pulsed mode nominal energy level. The power and wavelength may continue to drift slightly for up to 3 minutes while the thermoelectric cooler (TEC) stabilizes.
9. Ensure that the remote interlock jumper is connected.

4. Cobolt Monitor™ Software

The Cobolt Monitor™ software provides a graphical way to monitor the laser performance; to view the average drive current and temperature settings. Cobolt Tor™ XS is compatible with Cobolt Monitor™ 6.0.8.0 and later.

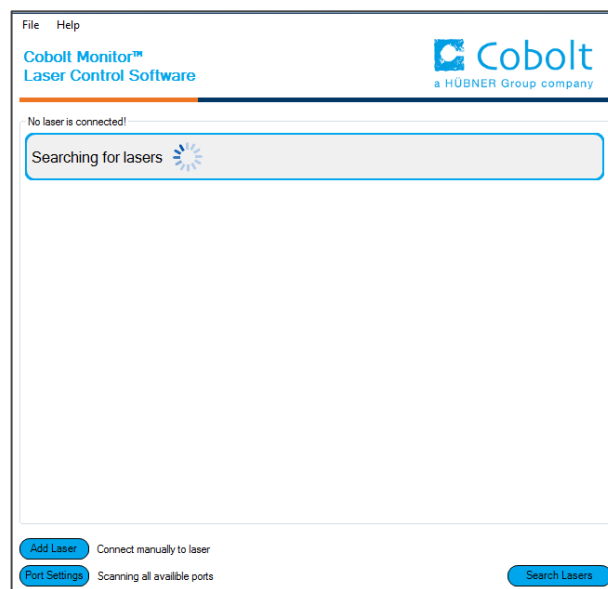
Cobolt Monitor™ has been tested with operating systems Windows XP, Windows Vista, Windows 7, Windows 8 and Windows 10. Microsoft .NET 4.0 is required to run the Cobolt Monitor™ software. Most computers with operating systems Windows XP, Windows Vista, Windows 7 and Windows 8 have this included as standard. When using versions of Windows older than Windows 10, a USB driver may be required. See Section 7.2 for details on installation.

4.1. Installation

Download the latest version of the Cobolt Monitor™ software from www.coboltlasers.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 to any storage device 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.

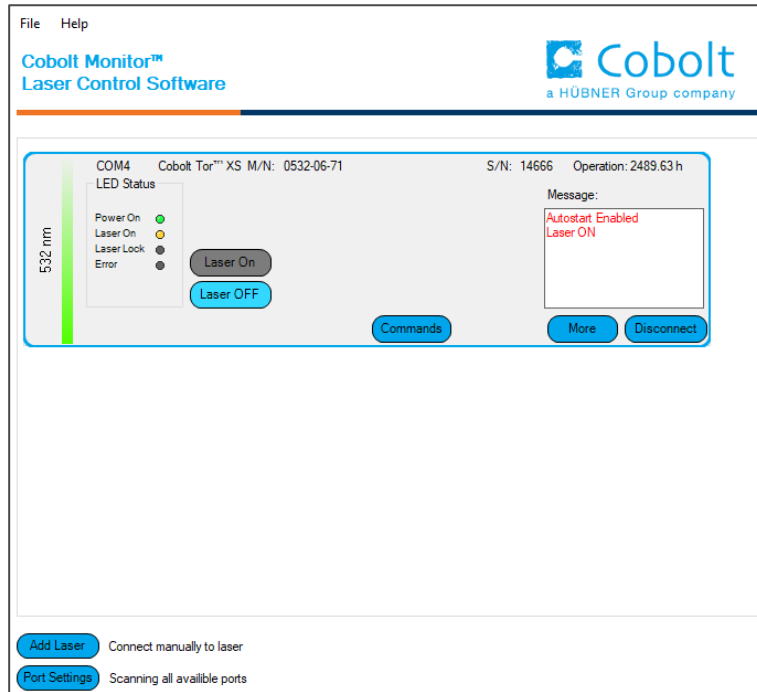
4.2. Software instructions

The software automatically searches for Cobolt devices 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 software.

Once the laser is connected it can be controlled from Cobolt Monitor™ software. Only the most critical information is displayed on this level, including the status the laser is in and the possibility to switch each line ON or OFF. Here follows a short description of how to use the Cobolt Monitor™ software on this level.



Cobolt Monitor™ Window when the laser is connected.

ON/OFF Use these buttons to toggle the individual laser lines ON and OFF after the autostart sequence has been completed.

Commands Opens a command communications window to send commands directly to the laser. See section 7.3 : Communication commands for more details on available commands.

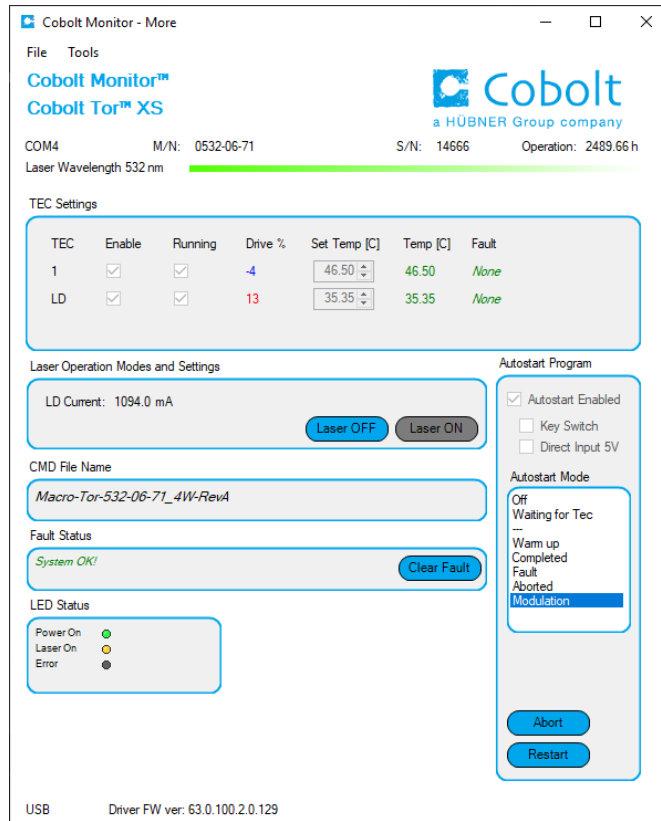
Message Highlights important information about the laser status to the user.

Disconnect Allows the user to disconnect from the Cobolt Monitor™ software in a controlled way.



NOTE The communication cable should not be removed when the software is in connect state. To 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.

More An additional Cobolt Monitor™ window will open containing more detailed information of that laser's status.



Cobolt Monitor™ software expanded to for more detailed monitoring.

TEC Settings Shows the running status and the fault status for the laser’s internal thermoelectric coolers (TEC).

Laser Operation Mode and Settings

Displays the average operation current. There are also the buttons “Laser OFF” and “Laser ON” which can be used to turn the laser on or off.

Autostart Program

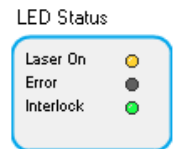
Displays whether the laser is in CDRH or OEM mode and displays the current laser operational status. There are also buttons to “abort” the autostart sequence or to “restart” the laser after a fault.

- Waiting for Temp** Laser emission is not enabled until all temperatures have reached their set point and the TECs are stabilized.
- Waiting for Key** Toggle the key to proceed, if the key is in the ON position, turn of OFF and ON again.
- Warm up** A current is provided to warm the laser before setting full power.
- Completed** The device is emitting or armed for emission.
- Fault** The device has a fault, the fault status must be cleared before the laser can be restarted.
- Aborted** The autostart sequence has been aborted, but the TECs are still running.

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.

LED Status Displays the LEDs that are currently illuminated on the key control box, see section 5.3.1. These are displayed even if the laser is in OEM mode.

Laser ON	Green	The laser is emitting or armed for emission.
ERROR	Red	An error has occurred.
INTERLOCK	Green	The interlock is in place.
	Red	The interlock is open.



4.3. Shutdown procedure operation

1. Turn the key switch to OFF first (CDRH models only).
2. Disconnect PSU from mains outlet.
3. Disconnect laser from PSU.

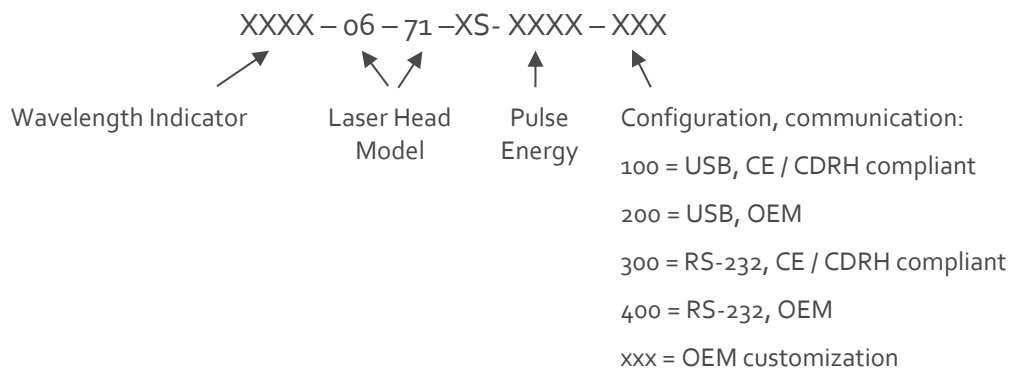
5. Overview

Cobolt Tor™ XS laser systems consist of the laser head, key control box, key control box cable and the power supply. 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 12. Disabling any of the safety features nullifies the CE marking and violates the laser safety standard.



5.1. Model number

Cobolt lasers are sold in two configurations: CDRH and OEM, described in section 5.2. The model numbers are composed as described below.



5.2. Configuration

5.2.1. CDRH Compliant

The CDRH compliant system is supplied with a key switch box, which must be connected, along with a remote interlock connector. Once power is supplied and the trigger signal is provided, 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 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
- 10 pin Molex to 15-pin D-SUB cable from laser head to key control box
- Keys
- 5 V / 5 A DC power supply unit (Art. Nr. 12613)

5.2.2. OEM

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

The OEM model consists of:

- Laser head
- 5 V / 5 A DC power supply unit (Art. Nr. 12613)

5.3. Laser Head

The Laser Head contains a passively Q-switched diode-pumped solid-state nanosecond pulsed laser cavity and thermoelectric coolers (TEC). The laser must be externally triggered through the SMA connector and emits one optical pulse per triggered event. The laser beam is not collimated. The laser head also features a manual mechanical shutter, a laser hazard label and a laser classification label. When power is supplied to the laser head, regardless of direct on/off or key-switch state, the temperature control element will be active to reach its set point values.

The mini-USB can each be used to communicate with the laser. In addition, the laser head supplies a Molex 10-pin connection, of which the pin 1 and pin 2 are used for the remote interlock function

5.3.1. Key control box

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

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

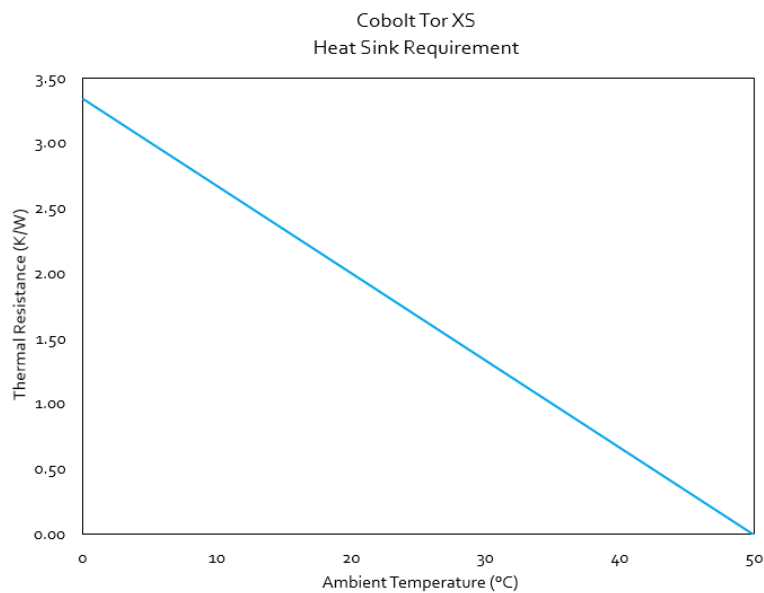
- ON** Orange Laser emission is on. This light is on in modulation mode if laser emission is possible.
- ERROR** Red An error has occurred.



5.4. 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 $< 0.67 \text{ K/W}$. This value is the difference between the maximum allowed Laser Head base plate temperature (50°C) and the maximum specified ambient temperature at the air-heatsink interface (40°C), divided by the maximum power dissipated from the laser, 15 W for the highest power models at high ambient temperatures. The mounting surface should be flat (within $\pm 0.05 \text{ mm}$ 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-03 Laser Head Heatsink with fans' meets these requirements, see www.coboltlasers.com for more information on heat sinks.

For assistance in thermal management and system integration, please contact Cobolt's technical support.



Heat Sink Requirements for Cobolt Tor™ XS.

5.5. 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 5 VDC / 5 A. The power supply accepts 90 – 264 V AC and 47-63 Hz. Ripple and noise 1% peak-peak max, 20 MHz bandwidth. The accepted voltage range is 11 V - 28 VDC; full performance is only guaranteed at 5 VDC / 5 A or 12 VDC/2 A.

The power supply provided with Cobolt Tor™ XS is 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.

6. System Description

The information presented here is believed to be accurate and is subject to change without notice. The specifications contained herein cannot be guaranteed outside of normal operational conditions. Specifications are guaranteed at 100% of nominal power.

6.1. Specification

6.1.1. Optical Specifications

Centre wavelength in air (nm)	532.1 ± 0.3	1064.2 ± 0.6	
Pulse energy (µJ)	50 ± 5	50 ± 5	100 ± 10
Peak power ¹ (kW)	> 12	> 12	> 25
Repetition rate	Single pulse to 1 kHz		
Pulse width (ns)	2.5 ± 1.0		
Trigger-to-Pulse Jitter (µs)	< 2		
Average power @ 1 kHz (mW)	50 ± 5	50 ± 5	100 ± 10
Long-term average power stability (8 hours, (±3 °C))	< 3 %		
Pulse-to-Pulse amplitude stability	< 10 %		
Spatial mode	TEM ₀₀ , M ² < 1.3		
Beam divergence (full angle, 1/e ²) (mrad)	6 ± 1	9 ± 1.5	
Beam diameter at aperture (1/e ²) (mm)	0.4 ± 0.1	0.6 ± 0.1	
Beam symmetry at aperture	> 0.85: 1		
Polarization ratio (linear, vertical)	> 100:1		
Beam angle accuracy (mrad)	< 5		
Beam position accuracy (mm)	< 0.5		
Residual emission	< Class 1		

1. Assuming a top hat profile, Peak Power (kW) = Pulse Energy (µJ) at bottom tolerance ÷ Pulse width (ns) at top tolerance

6.1.2. Trigger signal specifications

Input trigger ON time	300 μ s
Input trigger frequency	Single pulse up to 1 kHz
Input trigger V_{low}	0.0 V
Input trigger V_{high}	+ 3.2 V
Input trigger V_{max}	+ 5.0 V
Input trigger waveform	Square
Delay (Input trigger to optical pulse) @ 1 kHz	200 – 250 μ s

6.1.3. Mechanical Interfaces

Dimensions:	
Laser Head	133 x 79 x 48 mm (5.2 x 3.1 x 1.8 inches)
PSU dimensions	145 x 60 x 32 mm
Fixation holes, Laser Head	$\varnothing = 4 \times 4.5$ mm (M4) ; 125 mm x 55 mm
Laser Head weight	< 0.6 kg

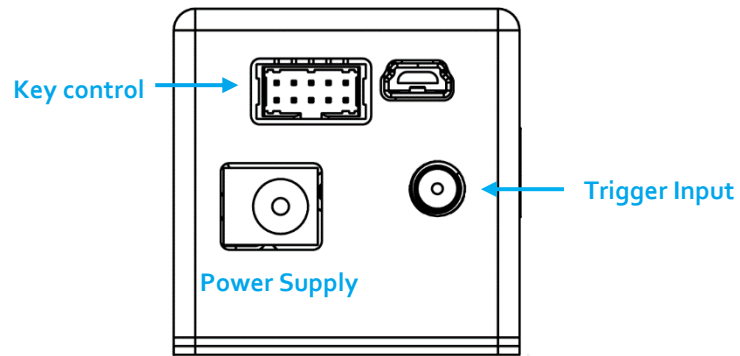
6.1.4. Operation and Environmental Specifications – Laser Head

Power supply	5 VDC, 5 A
Intended use environment	Laboratory (indoor)
Pollution Degree	2
Power consumption, total system	< 15 W
Maximum Laser Head baseplate temperature	50°C
Ambient temperature, operation	10 – 40 °C
Ambient temperature, storage	-10 °C to +60 °C
Humidity	0-60 % RH non-condensing
Ambient Air pressure	950-1050 mbar
Heat sink thermal resistance, Laser Head	< 0.67 K/W
Warm-up time, from OFF	< 5 min
Communication protocol	USB and RS 232

6.1.5. Electrical Interfaces

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

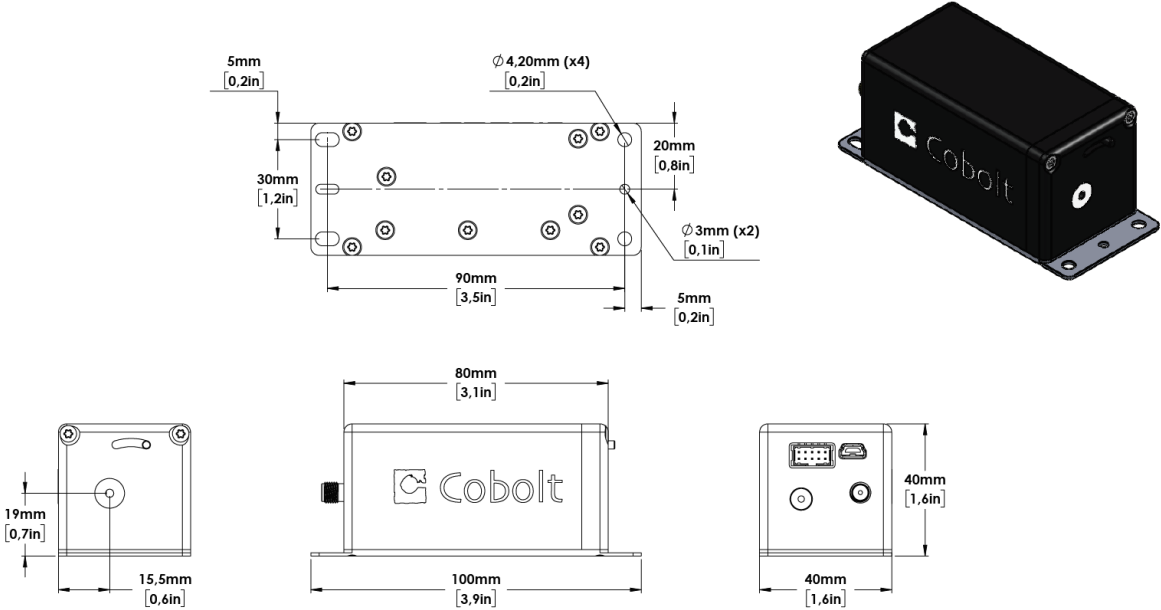
Interfaces	Location	Connector
Input power	Laser Head	DC plug 2.5 mm / 5.5 mm female
Key switch	Laser Head	10 pin Molex (87832-1020)
Trigger input signal	Laser Head	SMA
Data port	Laser Head	USB-type mini B (for both USB and RS-232)
Remote interlock	Laser Head	OEM : 10 pin Molex (87832-1020) (pin 1 and 2)
Laser head	Key box	VGA D-SUB 15-pin
Remote interlock	Key box	CDRH : 3.5 mm audio



Connectors on the back side of the laser head.

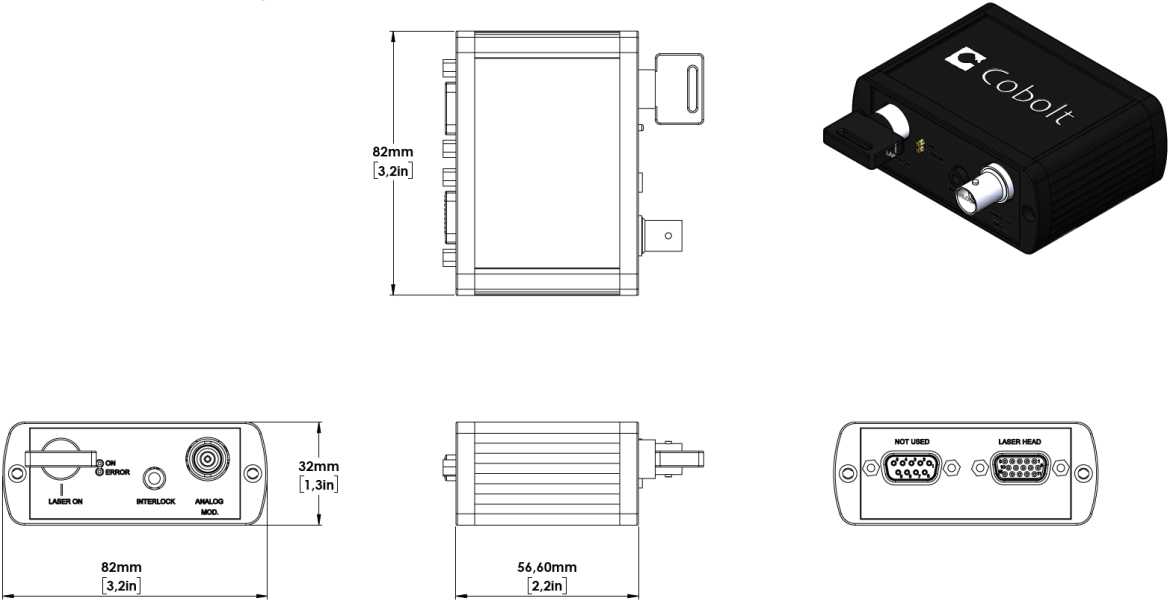
6.2. Mechanical Drawings

6.2.1. Laser Head



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

6.2.1. Key control box

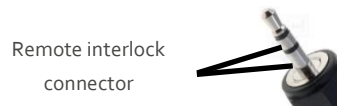


Tor Series Key control box, mechanical outline. Dimensions in mm [inches].

6.3. Remote Interlock Connector

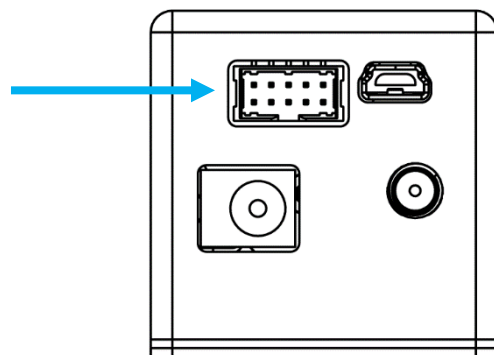
The remote interlock connector is located at pin 1 and 2 of the Molex connector on the laser head. The connector can be short-circuited with an interlock jumper (included at delivery) for operation of the laser. To use the remote interlock connector with an external switch, connect a pin 1 and 2 on a 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 7.3 for further details. The signal level is between 0V and +5V 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 < 20ms.

The remote interlock connector on the key switch box is a 3.5 mm female stereo (TRS) audio socket on the key control box. The ring and sleeve (see figure) must be connected for the laser to operate. To use the remote interlock connector with an external switch, connect a stereo plug instead.



6.1. Direct On/Off control

The Direct On/Off control feature enables turning the laser On/Off using a 5 VDC signal. After having configured the laser for Direct Input operation (factory set or by executing @cobasdr 1), the laser can only start-up when 5 VDC (max 12.5 VDC) is applied to pin 3 on the Molex connector with 0 VDC on pin 2 as reference. Shifting the signal to 0 VDC on pin 3 will turn the laser off and put the laser in stand-by mode. This input only controls the on/off state of the laser and cannot be used to modulate the power output. The remote interlock connection between pin 1 and 2 must also be made as described above.



Molex connector on back side of laser head.

! **NOTE** This function is not available for CDRH compliant models and cannot be used with key control box.

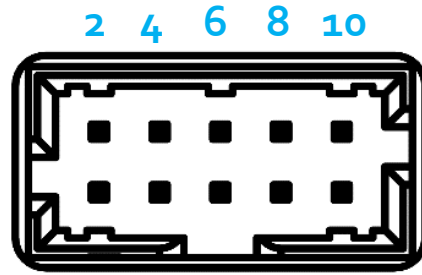
6.2. Pin assignment

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

6.2.1. Laser head

The pin configuration for the 10 pin Molex connector on the laser head is described in the table below.

Pin	Signal
1	Remote interlock
2	0 V – Ground
3	Direct On/Off (+5 V Input) – OEM Only
4	Key Switch
5	LED 1A (Laser On)
6	LED 2 (Error)
7	LED 1B (Laser On - Redundant)
8	<i>Not used</i> (test)
9	<i>Not used</i> (Ground)
10	<i>Not used</i>

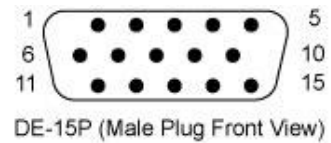


10 pin Molex socket on laser head

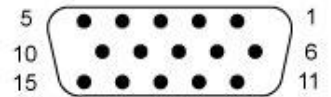
6.2.2. Key box

The pin configuration for the 15-pin D-SUB on the key control box are described in the table below.

Pin	Function
1	LED1 (A and B) - Laser on
2	LED2 – Error
3	<i>Not used</i>
4	0 V (ref pin 1,2,5,11)
5	Key Switch
6	<i>Not used</i>
7	<i>Not used</i>
8	<i>Not used</i>
9	<i>Not used</i>
10	0 V GND (ref pin 5)
11	Remote interlock connector
12	<i>Not used</i>
13	<i>Not used</i>
14	<i>Not used</i>
15	<i>Not used</i>



DE-15P (Male Plug Front View)

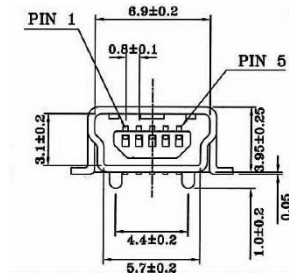


DE-15S (Female Socket Front View)

6.2.3. Data connector

Connector USB-type, manufacturer Hsuan Mao C8320-05BFDSBo, mates with connector mini-B.

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



7. Operation via data port

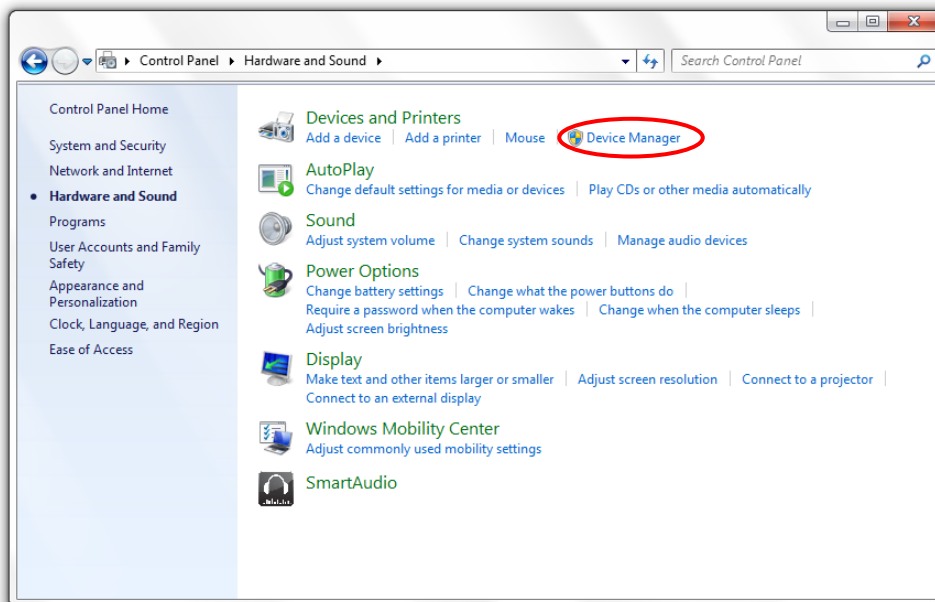
7.1. Handshaking

Under no circumstances does the system initiate communication; it only transmits characters in response to a message. Every message generates a response, either a numerical value or the acknowledgment string "OK". In the event that the system receives a message that it cannot interpret, it responds: "Syntax error:" followed by the complete command string (minus the termination character) that caused the error. Every system response is terminated by a carriage return (ASCII 13) and a full stop is used with floating numbers.

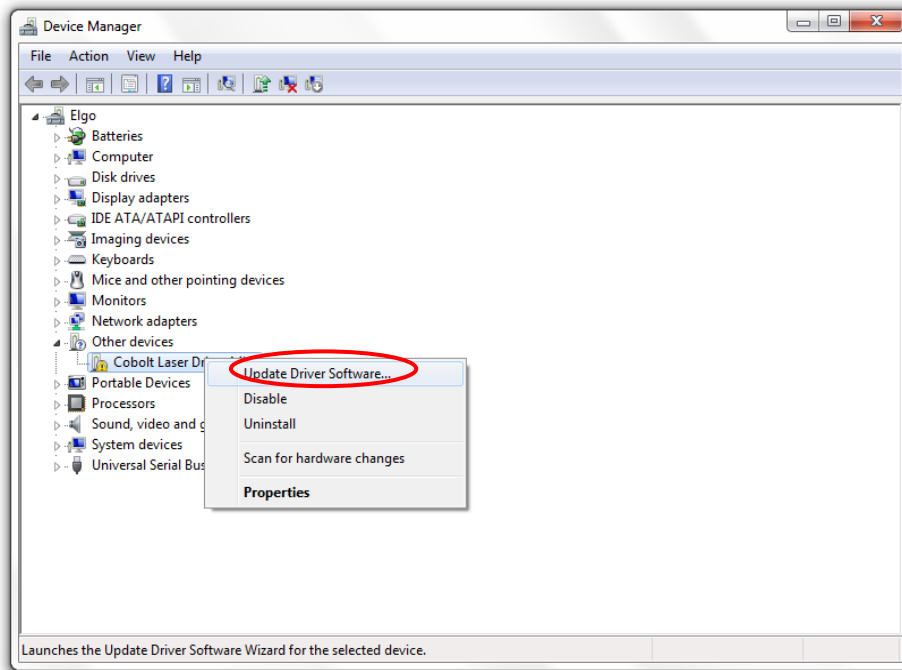
7.2. USB driver

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. To be able to connect to a Cobolt Tor™ XS laser via USB, a USB driver must be installed on the computer. The USB driver can be downloaded from the Cobolt website (www.coboltlasers.com). When installed, a virtual COM port will be created to communicate with the laser. To install the USB driver in Windows 7 follow these instructions:

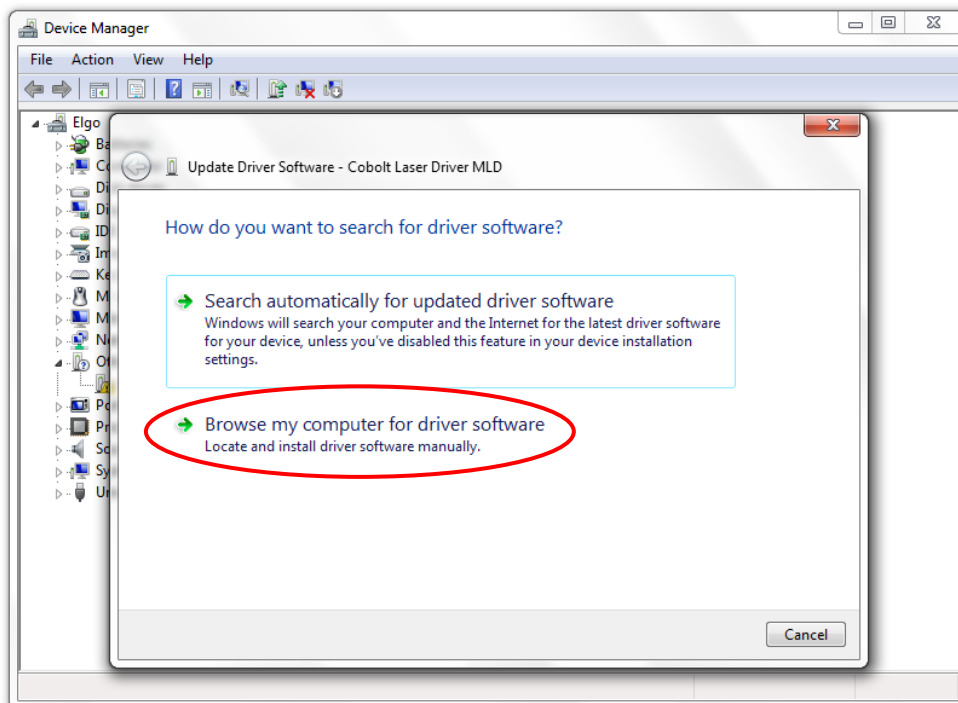
1. Go to the **Control Panel** and choose **Hardware and Sound**.



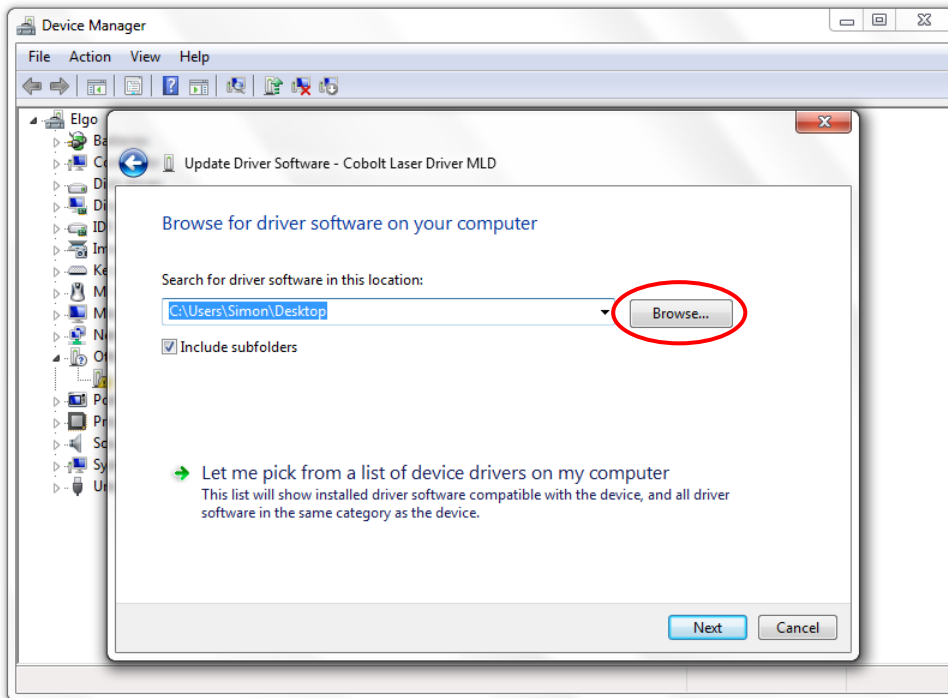
2. Under the **Devices and Printers** section, choose **Device Manager**.
3. Under **Other devices**, find the device called **Cobolt Laser Driver MLD/DPL**. Right-click it and chose **Update Driver Software**.



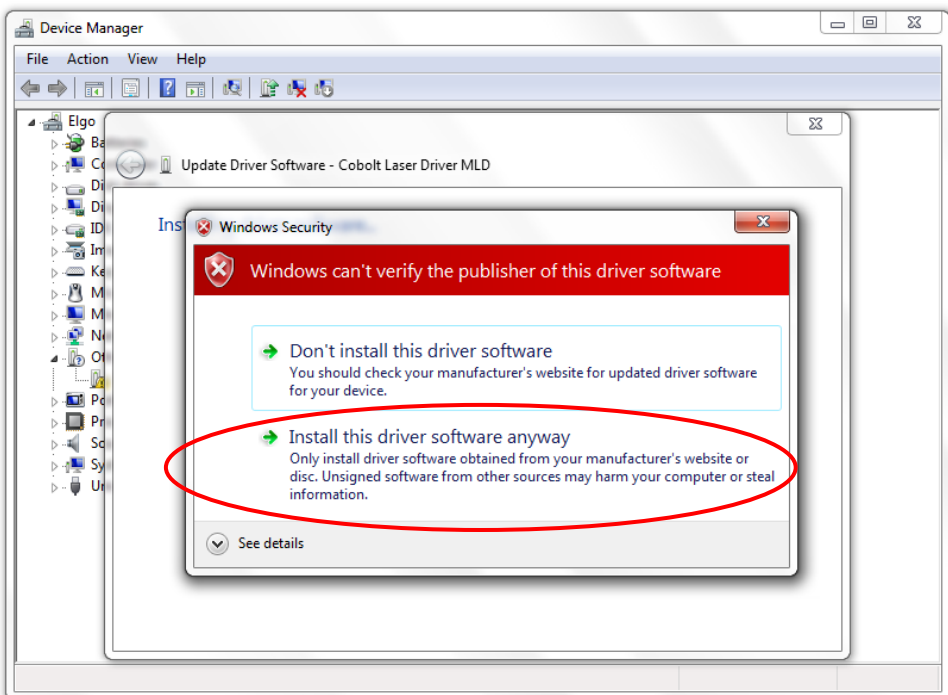
4. On the next screen chose the **Browse my computer for driver software** option.



- 5. Click **browse** and find the 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.

7.3. Communication commands

The laser is delivered with the system set in Auto-start mode (see section 3.1 for Auto-start sequence description). For system integration the Auto-start sequence can be disabled and the following commands can be used to control the laser (NOTE some commands require Auto-start to be disabled but others will work when Auto-start is active). As long as 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).

Command	Function	Argument	Returned value
hrs?	Get laser head operating hours		Float
ilk?	Get interlock state		0 = OK, 1 = interlock open
@cobas?	Get autostart enable state		0 = disabled, 1 = enabled
l?	Get laser ON/OFF state		0 = OFF, 1 = ON
l1	Laser ON Requires autostart disabled. Use this command for manual ON (OEM models).		
l0	Laser OFF Use this command for manual OFF (OEM models).		
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
cf	Clear fault		
sn?	Get serial number		32-bit unsigned integer
@cob1	Laser ON after interlock Forces the laser into Autostart without checking if autostart is enabled (OEM models).		

For restarting the laser with control commands after having opened the remote interlock switch, execute "cf" for clear fault followed by "@cob1" to restart the laser. On CDRH models the key switch is the only way to restart.

8. Cobolt Monitor™ Software

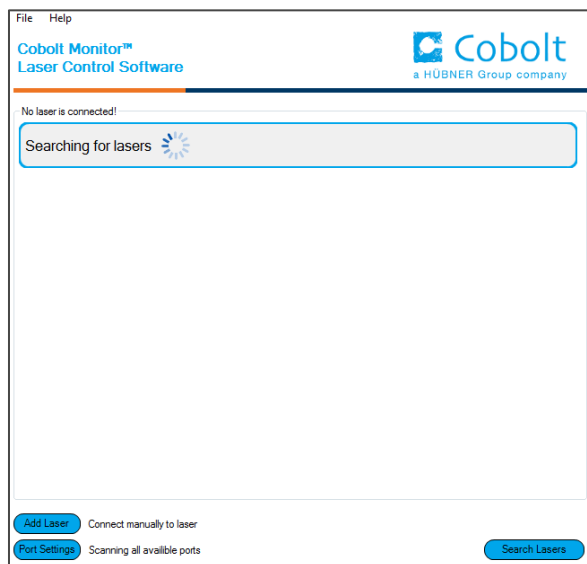
The Cobolt Monitor™ software provides a graphical way to monitor the laser performance and to change power, operation mode and other settings. The USB driver must be installed manually and can be downloaded from the Cobolt website (www.cobolt.se), see section 7.2. Cobolt Monitor™ has been tested with operative systems Windows XP, Windows Vista, Windows 7 and Windows 8. Microsoft .NET 2.0 is required to run the Cobolt Monitor™ software. Most computers with operative systems Windows XP, Windows Vista, Windows 7 and Windows 8 have this included as standard.

8.1. Installation

Download the latest version of the Cobolt Monitor™ software from www.cobolt.se. 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 in any storage device 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.

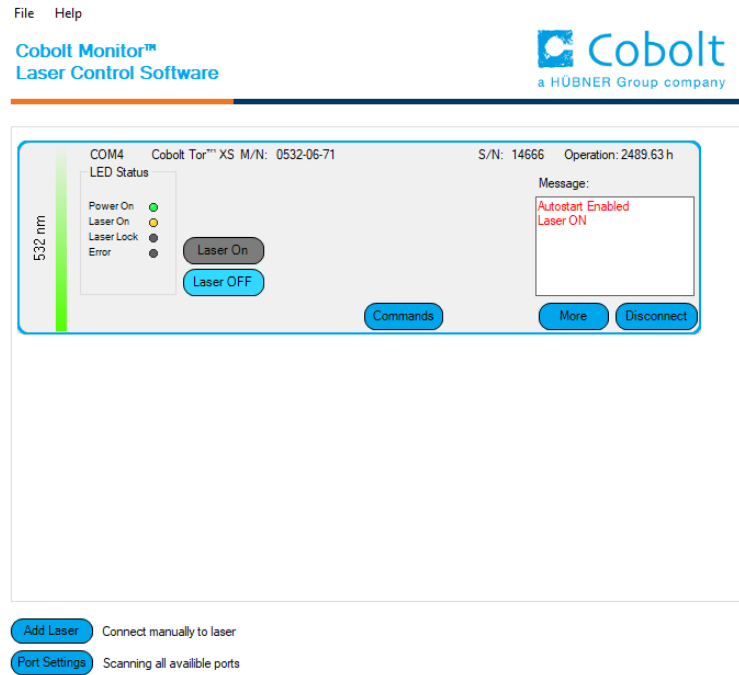
8.2. Software instructions

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.



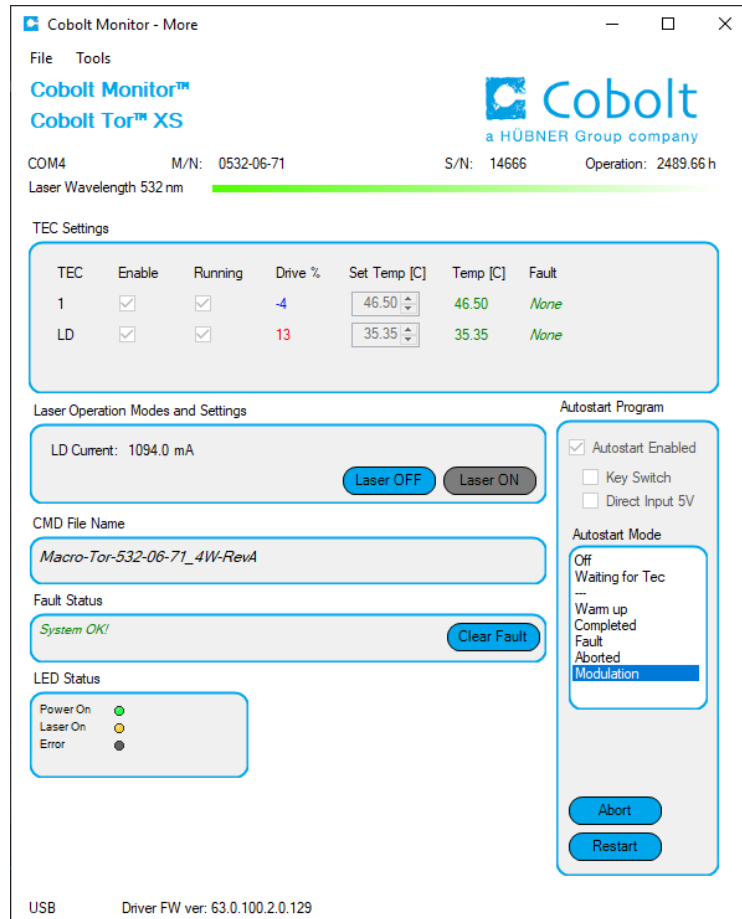
Laser successfully connected.

- Laser ON** Turns the laser ON. If the laser is in autostart mode, this is equivalent to “restart”.
- Laser OFF** Turns the laser OFF.
- Commands** Opens a command communications window to send commands directly to the laser controller.
- Message** Highlights important information of the laser status to the user.
- Disconnect** Allows the user to disconnect from the Cobolt Monitor™ software in a controlled way.



The communication cable should not be removed when the software is in connect state. The communication within the controller may then malfunction and this might require a power restart of the driver. To 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.

- Clear Fault** The user can deal with the cause of the fault and then press “Clear Fault” and then restart the laser by clicking “Laser ON”. Example: if the remote interlock loop is open the user must make sure the loop is closed again before issuing a “Clear Fault” followed by “Laser On”.
- More** An additional Cobolt Monitor™ window will open containing more detailed information of that laser’s status.



Cobolt Monitor™ software expanded to for more detailed monitoring.

TEC Settings Shows the running status and the fault status for the laser’s internal thermoelectric coolers (TEC).

Laser Operation Mode and Settings

Shows the average current supplied to the laser. There are also the buttons “Laser OFF” and “Laser ON” which can be used to turn the laser on or off.

Autostart Program

Displays whether the laser is in CDRH or OEM mode and displays the current laser operational status. 5V direct input is set here. There are also buttons to “abort” the autostart sequence or to “restart” the laser after a fault.

! Specifications are only guaranteed in constant power mode, at 100% of nominal power.

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.

LED Status Displays the LEDs that are currently illuminated on the key control box, see section 5.3.1. These are displayed even if the laser is in OEM mode.

9. Troubleshooting

In the unlikely case of a problem occurring, use the list below to help identify the error. Some faults can be fixed remotely. 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.

No laser emission 3 minutes after start-up

1. Verify that the Input Trigger Signal is connected and according the specifications in section 6.1.2.
2. Verify that the remote interlock connector is connected and restart the laser.
3. Ensure the laser has adequate heat sinking.
4. Verify that autostart is enabled. Click the restart button in the Monitor software or send the command "@cob1" to force a restart of the laser.
5. Verify the supply voltage is within the range stated in section 5.5.
6. Check the base plate temperature (this is displayed in the Cobolt Monitor™ software). If it is outside of the range 20-50 °C the laser may take longer to stabilize the temperature or be unable to do so.
7. Send the command "f?"
8. If fault code 1 is returned, check that the heat sink is adequate, and that the ambient temperature is under 40°C.
9. If fault code 3 is returned, see interlock fault checklist.
10. Contact Cobolt technical support.

Interlock fault

1. If using a custom interlock system, connect the Cobolt-supplied remote interlock connector plug to check whether the interlock is correctly wired.
2. This remote interlock connector should be connected as described in section 6.3.
3. In the software, check that "Interlock Fault" is not displayed. Send the command "ilk?" to confirm the Remote Remote interlock connector is not open (returns a 1 if closed).
4. If it is verified that the Remote Interlock Connector system is closed yet an interlock fault is returned, contact Cobolt technical support.

Laser emission stops

1. Ensure the laser has adequate heat sinking.
2. Ensure the Input Trigger Signal is active, connected and fulfills the specifications in section 6.1.2
3. Check the base plate temperature (this is displayed in the Cobolt Monitor™ software). If it is outside of the range 20-50 °C the laser may take longer to stabilize the temperature or be unable to do so.
4. Check that the Remote Interlock Connector is connected.
5. Send the command "f?"
6. If fault code 1 is returned, check that the heat sink is adequate, and that the ambient temperature is under 40°C.
7. If fault code 3 is returned, see interlock fault checklist.
8. Contact Cobolt technical support.

10. Warranty and Maintenance

Cobolt provides a warranty of 12 months with unlimited number of operation hours. The laser systems are designed for modular repair or replacement in the event that the laser head 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 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.

11. 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 Cobolt 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 Cobolt 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 Cobolt.

12. Compliance (CDRH models only)

The CDRH model lasers (-1/300) are designed and manufactured to comply with the EC Low Voltage Directive and the EC EMC Directive in the CDRH-compliant configuration of laser head, key control box, key and 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 here. 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.

13. Disclaimer

Cobolt will assume no responsibility for damage incurred by faulty customer equipment, such as measurement equipment, cables etc, used in conjunction with Cobolt lasers. Cobolt 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 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.



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Optek Ltd

www.optek.lv

France

Optoprim

www.optoprim.com

India

Spectral Instrument System

www.spectralinstruments.com

Israel

Lahat Technologies Ltd

www.lahat.co.il

Italy

Crisel Instruments

www.crisel-instruments.com

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Kantum Electronics Co Ltd

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Pneum Co, Ltd Japan

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Poland

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www.amecam.pl

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www.azimp.ru

Russia and Belarus

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SM Tech

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