Cobolt

Owners Manual

Model 04-05

May rev 1.00

Cobolt Modulated DPSS Lasers

DPSS lasers with integrated AOM

Cobolt Blues™	Modulated 473 nm DPSSL
Cobolt Calypso™	Modulated 491nm DPSSL
Cobolt Fandango™	Modulated 514.4 nm DPSSL
Cobolt Samba™	Modulated 532 nm DPSSL
Cobolt Jive™	Modulated 561 nm DPSSL
Cobolt Mambo™	Modulated 594 nm DPSSL

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1. Introduction

Cobolt Modulated DPSS (diode-pumped solid state) Lasers incorporates Cobolt 04-01 series diode-pumped solid-state laser devices with an Acusto-Optical Modulator (AOM) integrated into a single compact package allowing for fast and effective integration of a modulated DPSSL without time consuming external alignment.

Cobolt Modulated DPSS Lasers are operating at fixed wavelengths as defined in the specifications in Section 4. The laser beam is collimated and emitted through the manual shutter of the laser head. The laser head contains elements for fine temperature control of the laser cavity as well as the pump diode. The laser also features an optical feed-back loop which ensures long-term power stability of the emitted laser beam. The system can be operated in constant current or constant power mode. Control signals and drive currents are supplied via an electrical interface.

The lasers have a compact hermetically sealed package and emit a high quality beam with stable characteristics over a wide range of operating conditions. The laser is designed and manufactured to ensure a high level of reliability.

Cobolt lasers are intended for integration in analytical equipment used in e.g. flow cytometry, DNA sequencing, fluorescence microscopy, holography, interferometry and Raman spectroscopy.

2. Safety

2.1. General

All Cobolt Modulated DPSS Lasers are Class IIIB (CDRH), Class 3B (IEC) laser products that emit less than 500 mW of laser radiation within the visible and near-infrared 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. The device must be handled by personnel with experience in laser operation, 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, see section 2.3 for more information on labeling.

The table below described the maximum irradiance in W/cm^2 and appropriate level of eye protection in terms of optical density (OD) for each product line.

Product	Nominal Output power (mW)	Irradiance [W/cm^2]*	Eye Protection Requirement**
Blues™ 473nm	40	16	> OD 4
Calypso™ 491nm	80	31	> OD 4
Fandango™ 514.4nm	120	47	> OD 4
Samba™ 532nm	240	93	> OD 4
Jive™ 561nm	120	47	> OD 4
Mambo™ 594nm	80	31	> OD 4

* Irradiance (W/cm2) = 110% of Nominal Power (W) ÷ Beam Area at bottom tolerance (cm2)

** Eye protection (OD) = Log10(60825-1 Emission Limit : Class 1 (W) ÷ Max Power (W)) , rounded up to the next integer.

CAUTION – use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

2.2. Safety Features

Interlock

The laser is equipped with a remote interlock that prevents current flowing through the diode when it is open. See section 4.4 for a detailed description of the interlock.

Mechanical shutter

The Laser Head is equipped with a mechanical shutter that blocks all laser emission. The open and closed positions of the shutter are indicated on the Laser Head.

Key switch

The CDRH model comes with a key switch on the controller that be turned for the laser to operate. When the key is off, the diode is prevented from emitting. The key must be actively turned to the ON position each time the laser is powered on.

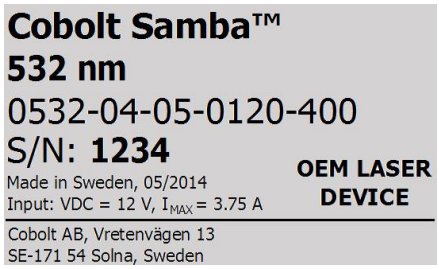
Information LEDs

The Controller 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.

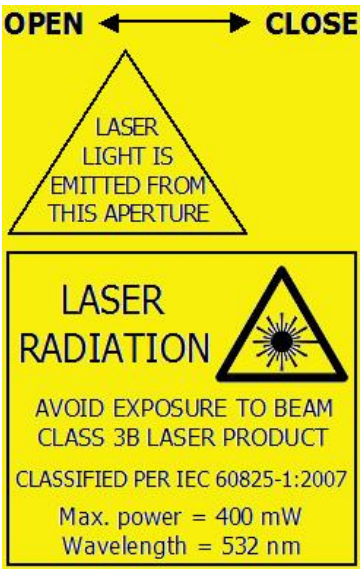
2.3. Warning labels and Identification

The upper face of the Laser Head contains a yellow label with laser safety warning and classification information, the wavelength and maximum average power of the unit. The laser safety label also shows the location of the laser beam from the aperture and indicates the open and closed positions of the manual shutter. This label must be visible unless the laser beam is totally enclosed. The Laser Head and Controller are provided with a manufacturer's identification label including a serial number which is unique for each laser system.

Placement of labels:



Manufacturers Certification label



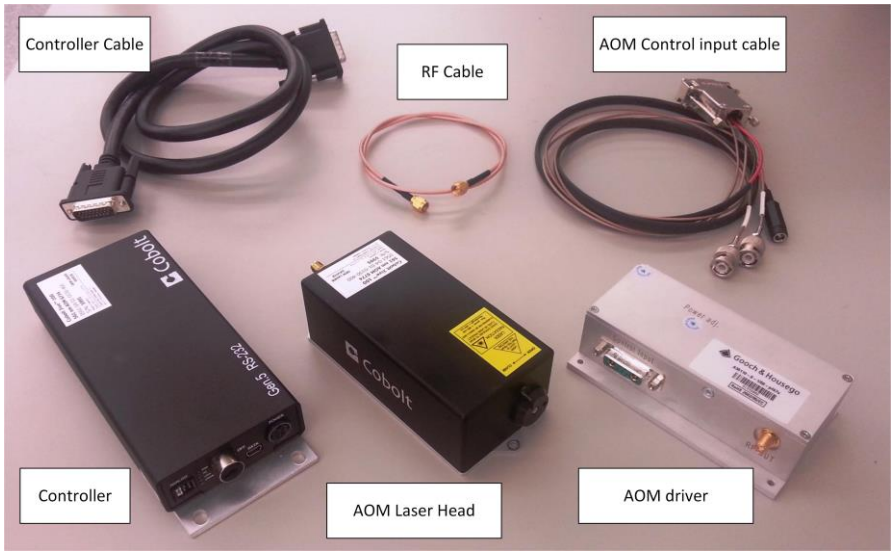
Hazard Symbol and Aperture Label

3. Laser System Description

The Cobolt Modulate DPSS laser systems consist of six main parts: the Laser Head with integrated AOM, the Controller, the Cable, a 12V/3.75A power supply for the laser controller, an AOM driver, a 24V/1.25Apower supply for the AOM driver, an RF cable and AOM control input cable. The input source is not included.

The Cable should always be used to connect the Laser Head with the Controller before supplying power to the system. Each Laser Head is unique to its Controller and will not operate to specification with mismatched Laser Heads and Controllers.

Always install the laser system to a properly grounded power outlet. Cobolt lasers contain a laser diode which is sensitive to electrostatic discharge (ESD). The device must be handled in an ESD protected workstation.



Cobolt 04-05 modulated laser system with Laser Head, cable, controller, AOM RF driver and cables.

3.1. Model Number

The model number is composed as follows for the Cobolt Modulated DPSS lasers:

XXXX – 04 – 05 – XXXX – XXX

- XXXX: Wavelength
- 04 – 05: Version
- XXXX: Power
- XXX: Controller Configuration:
  400 = Gen4 OEM Integration Only

3.2. Laser Head

The Laser Head contains pump diode, laser cavity, beam shaping optics and thermoelectric coolers (TEC) routing optics and an integrated AOM. The laser head contains an optical feed-back loop which measures the output power. The Laser Head gets electrical power and control signals from the Controller via a 26-pin HD Sub-D cable. The AOM does not require electrical power. There is an SMA connector on the laser for input modulation signals.

3.3. Controller

The Controller supplies driving current and control signals to the Laser Head. The operation set points are specific to each Laser Head and have been fixed during manufacturing. The operation set points are stored in the controller and must be used with the exact laser head it was delivered with.

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

POW	(green light)	Power is supplied.
ON	(orange light)	Laser light is on in constant current mode.
LOCK	(orange light)	Laser light is on and the output power has been locked to set point.
		The laser is operating according to specifications.
ERR	(red light)	An error has occurred. No laser light.

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 4.4. To make use of the remote interlock as a safety switch, remove the jumper and connect to an external switch.

3.3.1. Controller Configuration

Cobolt Modulated DPSS lasers are available with one standard controller configurations. The operation of the laser can be controlled and monitored via the data port that supports RS-232 commands and analog signals. See Section 6.3 for further details. RS-232 controllers may also be delivered with a RS-232 USB adaptor. The Controller is factory set so that no key is needed to turn the laser on. Connecting 11-24 VDC power supply to the Controller initiates an automatic start-up sequence. The laser will be running according to specifications in <2 min.

3.4. Cables

The Cable connects the Laser Head to the Controller. The standard Cable length is 1(m) and minimum bending radius 2 cm. When connected care should be taken not to bend or break any of the 26 pins. The RF cable connects the AOM to the AOM driver. The AOM control input cable is used to provide the AOM driver with the desired modulation.

3.5. Power supply requirements

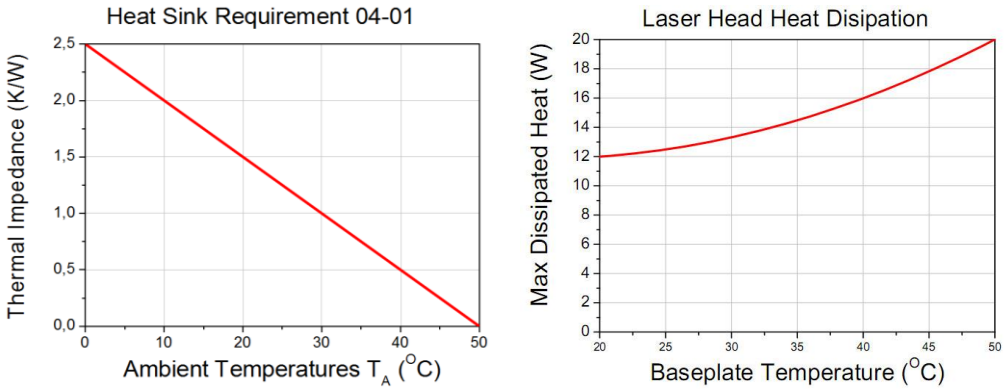
An appropriate Power Supply Unit (PSU) is supplied by Cobolt with the laser and must be plugged into a properly

grounded standard power outlet. The output from this PSU is 12 VDC/3.75 A. The power supply accepts 90 – 264 VAC and 47–663 Hz. Ripple and noise 1% peak-peak max, 20 MHz bandwidth. The controller accepts a voltage range is 11 V – 28 VDC. The appropriate 24V power supply for the AOM driver is delivered with the driver. The power supply is permanently connector to the driver.

3.6. Thermal Management

3.6.1. Laser Head

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 <0.5 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 (~20 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. For assistance in thermal management and system integration, please contact Cobolt's technical support.



Heat Sink Requirements and typical maximum heat dissipation for Cobolt 04-01 series

The AOM driver must also be mounted on an appropriate heat sink.

4. System Description

4.1. Specifications

4.1.1. Optical

	Centre wavelength (nm)[1]	Output power (mW) [2]
Blues™	473.0 ± 0.3	25, 40
Calypso™	491.5 ± 0.3	25, 50, 80
Fandango™	514.4 ± 0.3	25, 50, 100, 120
Samba™	532.1 ± 0.3	25, 50, 100, 150, 240
Jive™	561.2 ± 0.3	25, 50, 100, 120
Mambo™	593.6 ± 0.3	25, 50, 80

Product Wavelength	**473**	**491**	**514**	**532**	**561**	**594**
Rise/Fall time	< 300ns					
RF 3dB Bandwidth (analogue and digital)	DC-3MHz					
Extinction Ratio (free space) [5]	>30 dB (DC)					
Beam diameter at Aperture (1/e²)	700 ± 50 µm					
Beam divergence (full angle, 1/e²)	< 1.2 mrad					< 1.3 mrad
Noise 20 Hz – 20 MHz (pk-pk)	<2%	<3%	<2%			<3%
Noise 20 Hz – 20 MHz (rms)	<0.25%	<0.3%	<0.25%			<0.3%
Long-term power stability (8 hours)	<2%	<3%	<2%			<3%
Spatial mode	TEM_{00}, M^2 <1.1					
Spectral linewidth	<1 MHz					
Wavelength stability (after warm-up)	2 pm over ± 2 °C and 8 hrs					
Beam symmetry at aperture	>0.95 : 1					
Beam pointing stability (after warm-up)	<20 µrad/°C (over 10-40°C)					
Coherence length	>100 m					
Beam waist location (from exit window) [4]	± 20 cm					
Beam angle accuracy [3]	<5 mrad					
Beam position accuracy [3]	<0.25 mm					
Polarization ratio (linear, vertical)	>100:1					
Residual IR emission	<0.1 mW					

1. The wavelength is fixed with this accuracy, while drift is defined as Wavelength stability. The wavelength is specified in air.
2. The output power can be adjusted from 10-110% of nominal power using control commands, see Section 6.3. Specifications are guaranteed at 100% of nominal power. Recommended power range is 70-100%. Power accuracy 5%.
3. Relative to beam position reference pins, see Laser Head drawing under Section 4.2.
4. The exit window is located optically ~20cm before the laser head shutter.
5, Predominantly due stray light, fiber coupling will further improve the extinction ratio.

4.1.2. Operational and environmental requirements

Power supply – Laser	12 VDC, 3.75 A (alt. 4.2 A) 11–28 VDC accepted
Power supply of AOM driver	24VDC, 1.25A
Power consumption, total system (Laser Head + Controller)	< 50W
Maximum heat dissipation of Laser Head	< 25 W
Maximum Laser Head baseplate temperature	50°C
Warm-up time, from OFF	< 3 min
Ambient temperature, operation	10–40°C
Ambient temperature, storage	0–60°C
Humidity	0–90% RH non-condensing
Ambient Air pressure	950–1050 mbar
Shock tolerance, operational	60 g (8 ms impact)
Heat sink thermal resistance, Laser Head	<0.5 K/W

4.1.3. Operational and environmental requirements – AOM driver

Power consumption of AOM driver	<30W
AOM driver base plate temperature, operation*	10 – 60°C
AOM driver storage temperature	-20°C – +70°C, non-condensing
Heat sink	The heat sink must be capable of dissipating 30W
Warm-up time	10min

*) For optimum output power stability a constant base plate temperature should be provided

4.1.4. Electrical interfaces

Interfaces	Connector	Function
Input power	Kycon KPJX-45, 4-pin	Power supply to Controller
Laser Head to Controller	HD-sub 26-pin, male	Connection to Standard Laser Head
Controller to Laser Head	HD-sub 26-pin, female	Connection to Controller
Data port	USB-type mini B	Control and monitoring via control commands
Remote interlock & Analog signals	Molex 90130-3206	Analog input 5 – 12 V => laser on Analog input <2.7 V => laser off
Warm-up time		2 min
Control input connector – AOM Driver	D-Sub 7W2	Power supply to AOM driver, analogue modulation, digital modulation
RF output connector – AOM Driver	SMA female	Modulation signal to laser head
RF modulation input – Laser Head	SMA female	Modulation signal from AOM driver

4.1.5. Electrical characteristics – AOM driver:

Supply voltage	+24VDC
Output impedance – RF output connector	50 Ω (nom.)
Analogue modulation	
Impedance	50 Ω
Voltage range	0 – 1 V
RF ON/OFF ratio	65 dB
Absolute maximum ratings	-0.5V – +1.1V
Digital modulation	
Impedance	4.7 kΩ (pull-up)
High level	≥3V – 5V (=RF on)
Low level	0 – <2V (=RF off)
RF ON/OFF ratio	100 dB
Absolute maximum ratings	-0.5V – +5.5V

For more details on the specification of the AOM driver, see the website of Gooch & Housego,

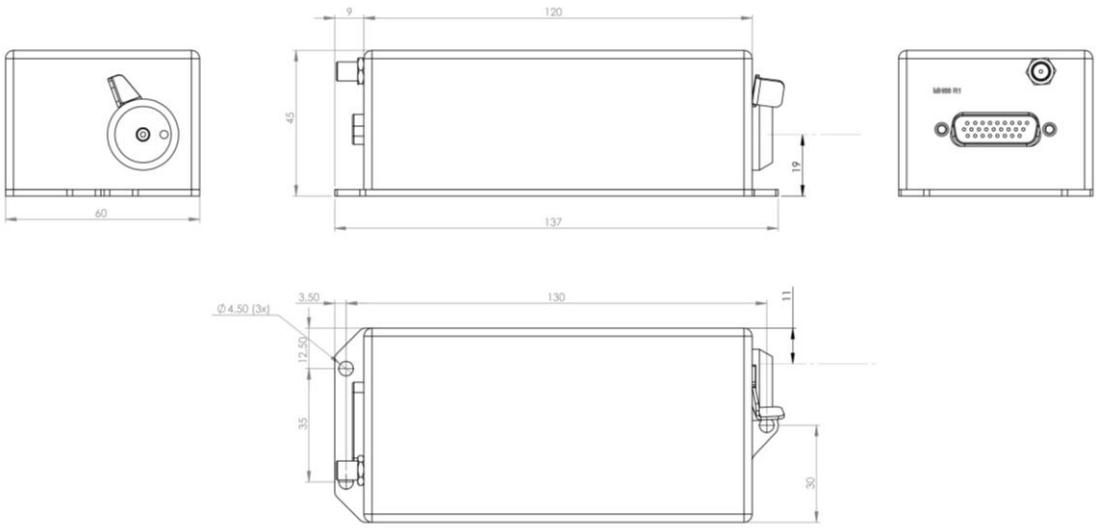
www.goochandhousego.com

4.1.6. Mechanical Interfaces

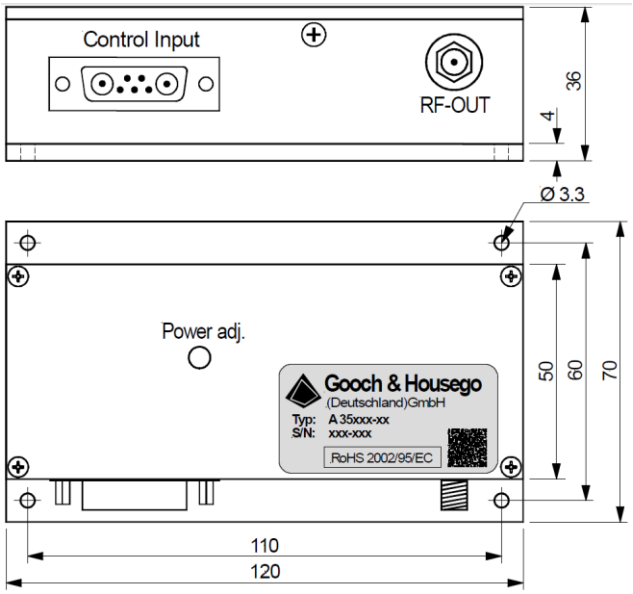
Dimensions:	
Laser Head	137x60x45 mm (4.1x2.4x1.6 inches)
Controller	190x72x28 mm (7.6x2.9x1.1 inches)
12V PSU	130x55x30 mm (5.2x2.2x1.2 inches)
AOM Driver	120x70x36 mm (4.7x2.75x1.4 inches)
24V Power Supply	121x50x30.8 mm (4.76x1.97x1.21 inches)
Fixation holes, Laser Head	3x 4.5mm holes (fitting M4/M3), see section **Fel! Hittar inte referenskälla.**.
Fixation holes, Controller	4x 6.4x8mm hole(fitting M6), see section **Fel! Hittar inte referenskälla.**.
Fixation holes, AOM Driver	4x 3.3 mm holes (fitting M3), see section **Fel! Hittar inte referenskälla.**.
Cable (Laser Head – Controller)	1 m length, >2 cm bending radius

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.

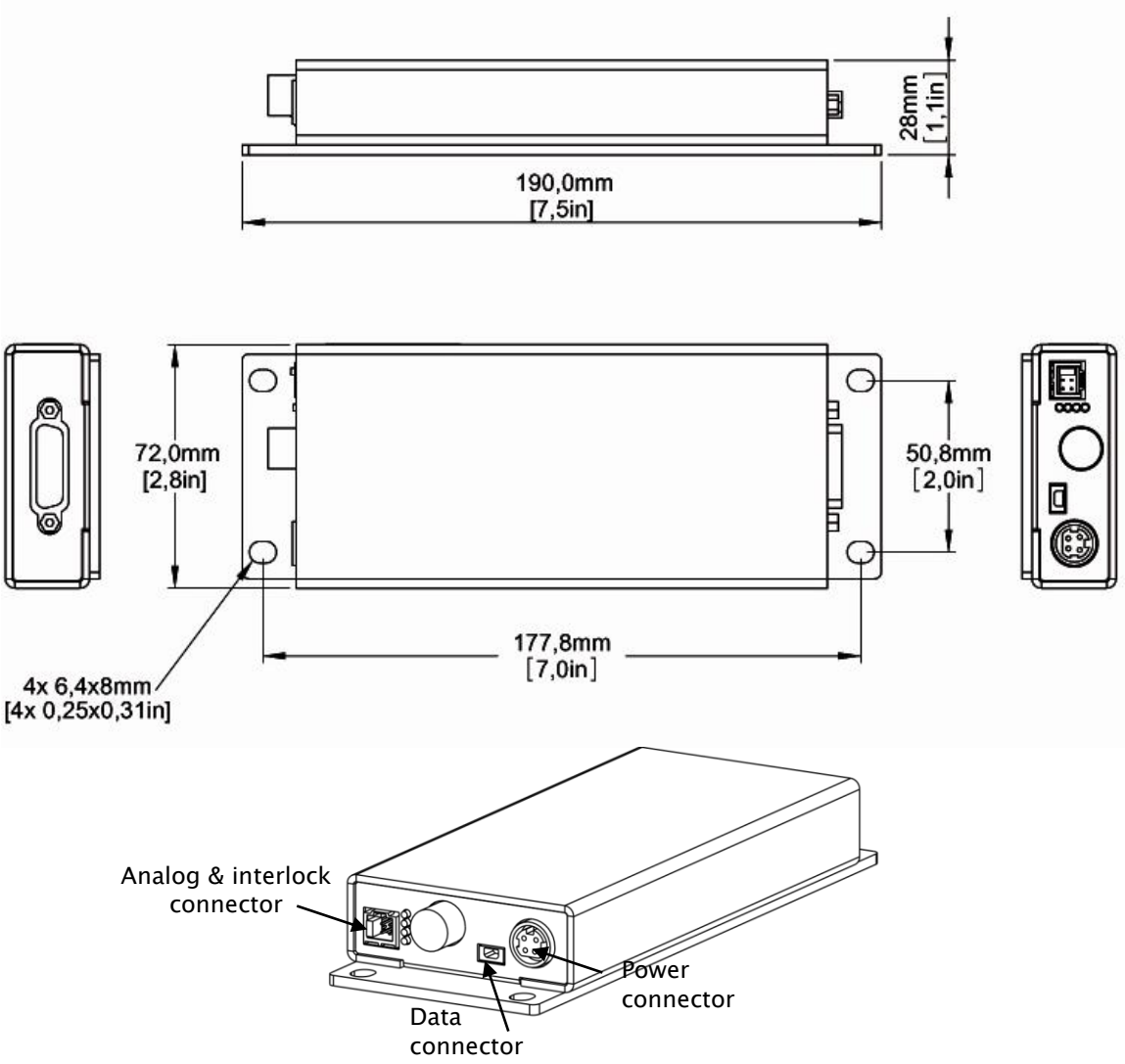
4.2. Mechanical Outlines



Modulated DPSSL head outline (dimensions in mm)



AOM driver mechanical outline (dimensions in mm)



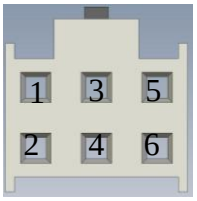
Controller mechanical outline. Dimensions in mm [inches].

4.3. Connector drawings & pin assignment

4.3.1. Analog connector & interlock connector

Manufacturer Molex 90130-3206, mates with 90142-0006.

Pin Function
1. Interlock (connect to pin 2 for enable)
2. GND
3. Analog on/off (Direct control)
4. TST (Internal Cobolt use only)
5. LED "Laser on" (5V)
6. LED "Error" (5V)

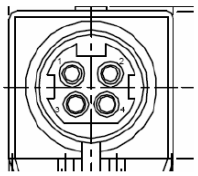


Warning: shortening pin 2 and 4, when the controller is powered up, will erase the controller memory.

4.3.2. Power 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

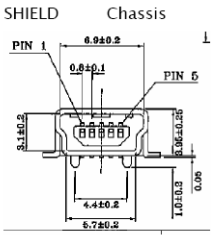


Front view of controller

4.3.3. Data connector

Connector USB-type, manufacturer Hsuan Mao C8320-05BFDSB0, mates with connector mini-B.

Pin Function
1. +5 V (in series with internal 10 Ohm resistor)
2. RS-232_TX
3. RS-232_RX
4. Not connected
5. 0 V (GND)

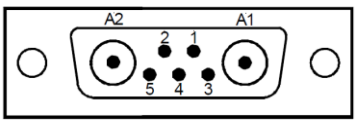


4.3.4. AOM Control input connector drawing

Connetor Mixed D-Sub 7W2, manufacturer Harting 09 69 200 9050.

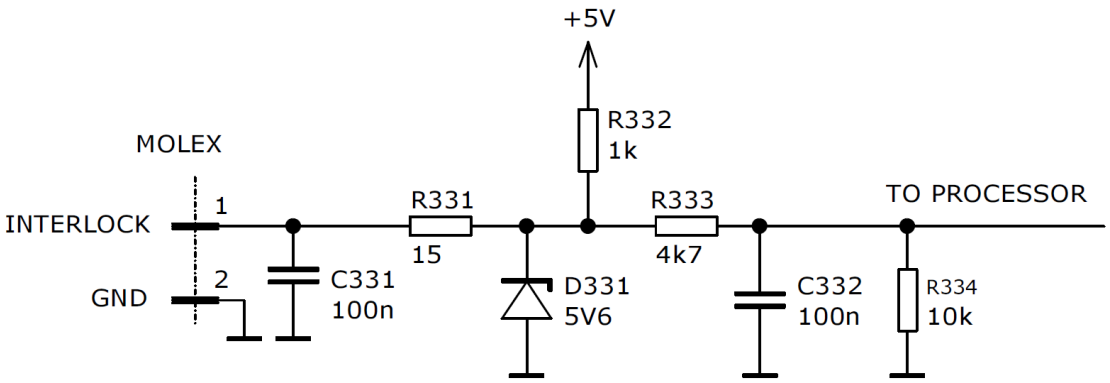
Pin Function
1. GND (case)
2. GND (case) (connected to pin 1 internally)
3. +24 VDC
4. Not connected
5. +24 VDC (connected to pin 3 internally)

A1. Analogue modulation (coaxial)
A2. Digital modulation (coaxial)



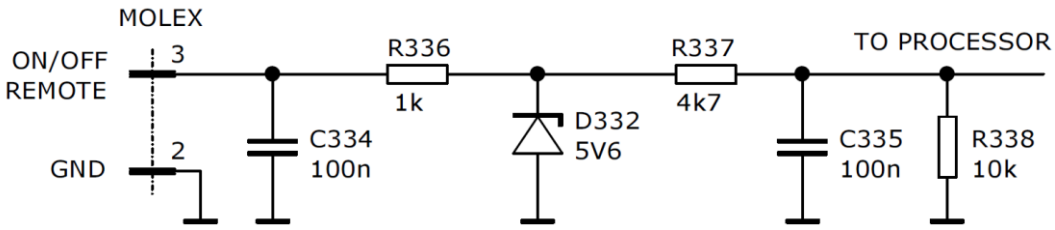
4.4. Interlock

The interlock is located at pin 1 and 2 of the molex connector on the back side of the laser head. The connector can be short-circuited with an interlock jumper (included at delivery) for operation of the laser. To use the interlock with an external switch, connect a pin 1 and 2 on a Molex plug. After the interlock 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 RS-232 commands, see Section 6.3 for further details. The signal level is between 0V and +5V with a pull up resistor (R225/R224), and the current required to ground the interlock is 5 mA. The time delay in the hardware is <1ms, but after filtering by the firmware the reaction time is extended to < 20ms. A diagram of the interlock electronics is shown below.



4.5. Direct On/Off Control

The Direct On/Off Control feature enables turning the laser ON/OFF using a 5-12 VDC signal. After having configured the Controller for Direct Control operation (factory set or by executing @cobasdr 1), the laser can only start-up when 5-12V VDC (max 12.5 VDC) is applied to pin 3 on the analog 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 (status LEDs is POW and not flashing). This input only controls the on/off state of the laser and cannot be used to modulate the power output. A diagram of the direct control electronics is shown below.



5. Operation instructions

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

5.1. Installation start-up operation

1. Mount the Laser Head on a suitable heat sink (see Section 3.6).
2. Ensure that the interlock jumper is connected.
3. Connect the Laser Head to the Controller with the Cable and fasten screws at both ends.
4. Connect the 12 VDC power supply to the mains outlet and then to the Controller.
5. The laser now goes through the following auto-start sequence:
   - Temperature stabilization (1-2 min). Status LEDs: POW flashing, then POW goes on.
   - The laser starts (light is emitted) in a constant warm-up current constant for 60 sec. Status LEDs: ON goes on.
   - The laser locks to pre-set output power (<2 min) and operates according to specifications. Status LEDs: LOCK goes on.
6. Switching the laser ON/OFF (to/from stand-by mode) via control commands or Direct Control is described under Section 4.1.

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

5.2. Modulation

5.2.1. Set-up

The AOM driver has to be set up as follows. Without an input signal from the AOM driver there is no laser beam emitted from the laser head. A typical source for digital and analogue modulation would be any type of function generator fulfilling the signal levels specified in the table below. Note that for combined analogue and digital modulation, two separate sources are required. For recommendation on a suitable function generator, please contact Cobolt's technical support.

1. Mount the AOM driver on a suitable heat sink. Make sure that the heat sink can provide adequate heat dissipation (see specification in table below).
2. Attach the RF-cable to the laser head.
3. Attach the other end of the RF-cable to the AOM driver.
4. Attach the D-Sub end of the control input cable to the AOM driver.
5. Attach the end of the input cable marked "digital" to the source* of the digital modulation.
6. Attach the end of the input cable marked "analogue" to the source* for the analogue modulation.
7. Connect the DC plug of the power supply to the socket of the control input cable.
8. Connect the power supply.
9. Allow at least 10 minutes warm-up time for the AOM driver for optimum stability.

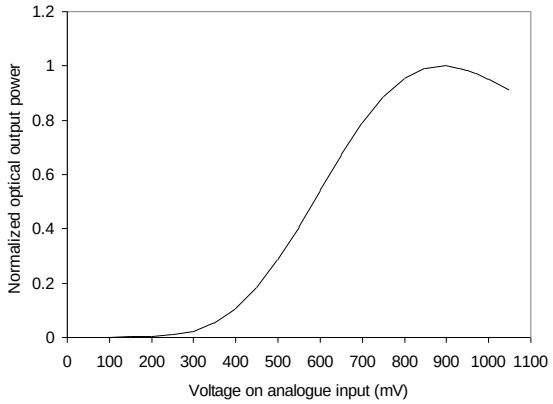
5.2.2. Modulation Options

The modulation can be digital, analogue or a combination of the two. If no signal is applied on either the digital or the analogue input, the AOM is in its off-state. The DPSS laser inside the device is however on and it is normal that some stray light in the µW range can be seen by the human eye when the AOM is in its off-state.

Analogue modulation

In pure analogue modulation, the digital modulation should be in on-state, i.e. a voltage of 3-5V should be applied on the digital input. It is also possible to leave the digital input open.

The output power of the laser head has an optimum for a specific voltage of the analogue input. This voltage is device specific and is stated on the test protocol, but can be easily found by measuring the output power as function of applied DC voltage on the analogue input. Make sure not to exceed the absolute minimum and maximum voltages for the analogue input as stated below. The output power as function of the applied analogue voltage is slightly nonlinear as can be seen in the plot below.



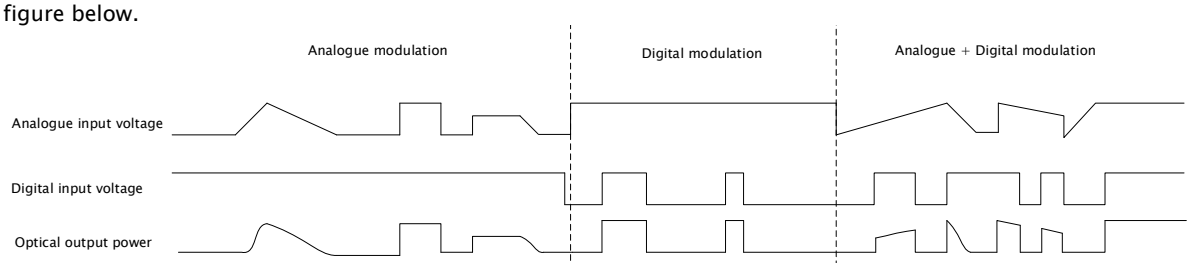
Plot of typical optical output power as function of the applied analogue voltage. There is a device specific maximum.

Digital modulation

In pure digital modulation, the analogue voltage determines the on-state optical output power in accordance with the plot above. E.g. if the amplitude of the digital modulation should be maximized, the analogue voltage corresponding to the maximum output power should be applied. In this way, the on-state optical power in digital modulation can be controlled.

Analogue + digital modulation

The analogue and digital modulation described above can be combined where the digital modulation can be seen as a control signal that can switch the analogue modulation on and off. The principle is schematically illustrated in the figure below.



Schematic illustration of the three different modulation modes.

5.3. Closedown operation

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

6. Operation via data port

6.1. Baud rates and serial port settings

To communicate with the laser, a communication cable needs to be ordered separately. Each Controller is shipped from the factory with a fixed baud rate (115200). The other serial port parameters are: 8 data bits, 1 stop bit and no parity. Hardware flow control is not supported. Each command to the Controller must be terminated by a carriage return. All commands are case-sensitive. Leading and trailing white space is ignored, but command arguments must be delimited by a single space character (ASCII 32).

6.2. Handshaking

Under no circumstances does the Controller initiate communication; it only transmits characters in response to a message. Every message to the Controller generates a response, either a numerical value or the acknowledgment string “OK”. In the event that the Controller 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 Controller response is terminated by a carriage return (ASCII 13) and a full stop is used with floating numbers.

6.3. Control commands

The laser is delivered with the Controller set in Auto-start mode (see section 5.1 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). The controller is factory set for RS-232 communication. As long as power is supplied to the Controller 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
ilk?	Get interlock state		0 = OK, 1 = interlock open
@cob1	Laser ON after interlock Forces the laser into Autostart without checking if autostart is enabled (OEM models).		
@cobas	Enable/disable autostart See sect 5.1 for description (to be used on OEM models only, disabling autostart means the laser no longer goes through its warm up routine).	0 = disable, 1 = enable	
@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).		
p?	Get set output power		Float (W)
p	Set output power	Float (W) (e.g. p 0.050 for 50 mW)	
pa?	Read output power		Float (W)
i?	Get drive current		Float (A)
slc	Set drive current	Float (A)	
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		
@cobasdr	Enable/disable direct control See sect 8.4 for description (OEM models).	0 = disable, 1 = enable	
@cobasdr?	Get direct control enable state		0 = disabled 1 = enabled
sn?	Get serial number		32-bit unsigned integer
hrs?	Get system operating hours		Float
@cobasky?	Get key switch state		0 = disabled, 1 = enabled
@cobasky	Enable/disable key switch With the key switch disabled the laser is not CDRH compliant and the laser safety standard no longer applies.	0 = disable, 1 = enable	

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. This command forces the laser into Auto-start enabled so Auto-start must be disabled if this is the required set up. On CDRH models the key switch is the only way to re-start. The output power can be adjusted from 10-110% of nominal power using the "p" command. Specifications are guaranteed at 100% of nominal power. Recommended power range is 70-100%.

7. 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 type of controller.

The latest version of the Cobolt Monitor is available for download at http://www.cobolt.se/software.html.

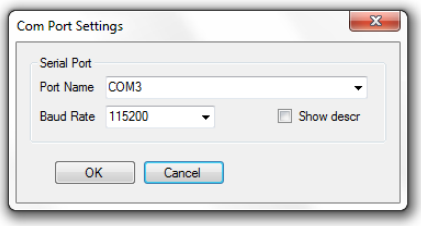
7.1. Installation

Microsoft .NET is required to run the Cobolt Monitor software, and this will be installed automatically if you do not already have the correct version. Follow the following steps to install the software:

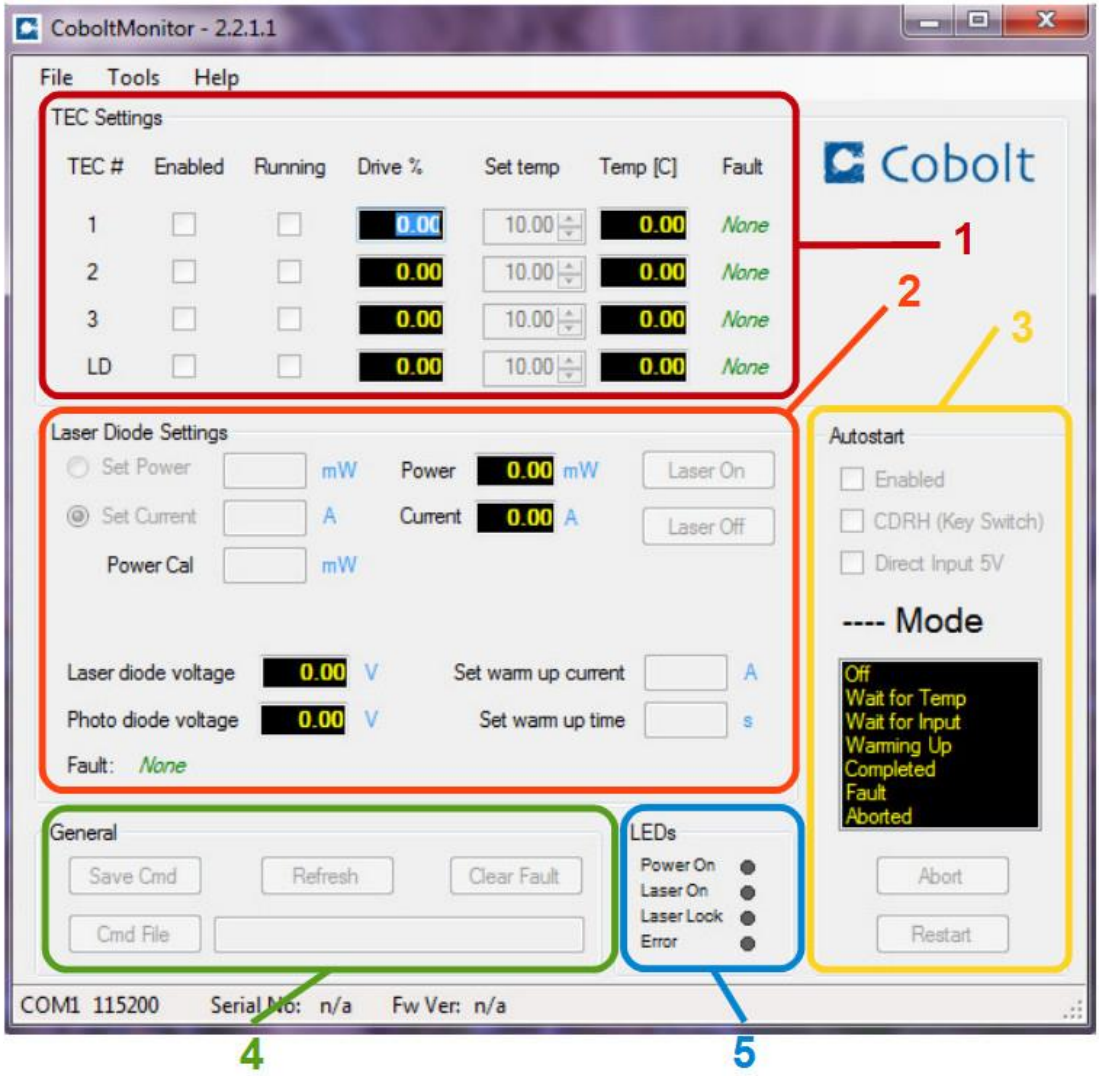
1. Extract the archive and run the **setup** file.
2. **Accept** the Microsoft .NET framework EULA.
3. Setup will now connect to the internet and download Microsoft .NET if it is required.
4. After a few security screens, setup will install .NET and Cobolt Monitor. A shortcut to software will be placed on the desktop and the program will run.

7.2. Software instructions

With the laser connected and powered, select “Options” from the “Tools” menu. The “Port name” drop-down box shows a list of available COM ports. Select the port which the laser is connected to and click OK. If the laser is connected via USB, it usually has the highest COM port number. See section 6.1 for correct port settings. For monitoring multiple lasers use multiple Cobolt Monitor windows with the correct port assignment.



To connect to the laser, choose “Connect” from the “File” menu. The window should now show the correct laser status along with various readings such as the laser power and current. The five different sections of the user interface are described below.



1. The **TEC Settings** section displays the internal temperature control of the Laser Head and the fault status for the laser's internal thermoelectric coolers (TEC). Depending on model the laser has two to four TEC active.

2. The **Laser Diode Settings** section 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.

3. The **Autostart** section displays whether the laser is in CDRH or OEM mode and displays the current laser operational status. 5V direct input is set here, see section 4.1. There are also buttons to abort the autostart sequence or restart the laser after a fault.

4. Under **General** there is a "Clear Fault" button. This can be used to restart the laser after the interlock has been removed and re-inserted.

5. The **LEDs** section displays the LEDs that are currently illuminated on the Control Box, see section 3.3. These are displayed even if the laser is in OEM mode.

8. Troubleshooting

In the unlikely case of a problem occurring, use the table below to help identify the error. 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. Call Cobolt support or your representative to identify corrective action.

LEDs	Status		Explanation	Action
	off	flashing		
POW	x		Mains power off	Check connections
POW		x	Temperatures not stabilized	Check if heatsink is sufficient
LOCK		x	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 >5s after start-up contact the factory.

9. Warranty and maintenance

Cobolt provides a warranty on Modulated DPSS Lasers of 12 months on faulty workmanship and 24 months on the laser itself.

The laser systems are designed for modular replacement or repair 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 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. Clean the aperture with a standard photographers' lens airbrush.

10. 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. Call or e-mail 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.

11. Declaration of conformity

All Cobolt Modulated DPSS Lasers are RoHS compliant as defined by the EU Directive 2011/65/EU.

12. Disclaimers

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.

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