Operator's Manual
Coherent CUBE™ Laser System

COHERENT
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Santa Clara, CA 95054

Technical Support

In the US:

Should you experience any difficulties with your laser or need any technical information, please visit our web site **www.Coherent.com**. Additional support can be obtained by contacting our Technical Support Hotline at 800-367-7890 (408-764-4557 outside the U.S.) or E-mail (clg.tech.services@Coherent.com). Telephone coverage is available around the clock (except U.S. holidays and company shutdowns).

If you call outside our office hours, your call will be taken by our answering system and will be returned when the office reopens.

If there are technical difficulties with your laser that cannot be resolved by support mechanisms outlined above, please E-mail or telephone Coherent Technical Support with a description of the problem and the corrective steps attempted. When communicating with our Technical Support Department via the web or telephone, the Support Engineer responding to your request will require the model and Laser Head serial number of your laser system.

Outside the U.S.:

If you are located outside the U.S. visit our web site for technical assistance or contact, by phone, our local Service Representative. Representative phone numbers and addresses can be found on the Coherent web site, **www.Coherent.com**.

Coherent provides telephone and web technical assistance as a service to its customers and assumes no liability thereby for any injury or damage that may occur contemporaneous with such services. These support services do not affect, under any circumstances, the terms of any warranty agreement between Coherent and the buyer. Operation of any Coherent laser with any of its interlocks defeated is always at the operator's own risk.

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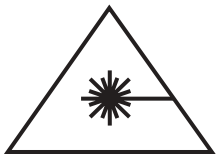
Preface

This manual contains user information for the Coherent CUBE laser system. The Coherent CUBE laser system includes a control box. The Coherent CUBE is shipped as a complete CDRH-compliant system.

Read this manual carefully before operating the laser for the first time. Special attention should be given to the material in Section One: Laser Safety, which describes the safety features built into the laser.



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

U.S. Export Control Laws Compliance

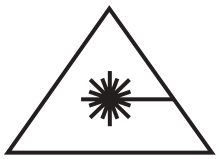
It is the policy of Coherent to comply strictly with U.S. export control laws.

Export and re-export of lasers manufactured by Coherent are subject to U.S. Export Administration Regulations, which are administered by the Commerce Department. In addition, shipments of certain components are regulated by the State Department under the International Traffic in Arms Regulations.

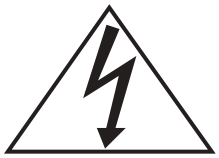
The applicable restrictions vary depending on the specific product involved and its destination. In some cases, U.S. law requires that U.S. Government approval be obtained prior to resale, export or re-export of certain articles. When there is uncertainty about the obligations imposed by U.S. law, clarification should be obtained from Coherent or an appropriate U.S. Government agency.

Symbols Used in This Document

This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.



This symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.



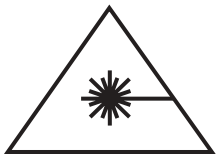
This symbol is intended to alert the operator to the presence of dangerous voltages within the product enclosure that may be of sufficient magnitude to constitute a risk of electric shock.

This symbol is intended to alert the operator to the danger of Electro-Static Discharge (ESD) susceptibility.

SECTION ONE: LASER SAFETY

Optical Safety

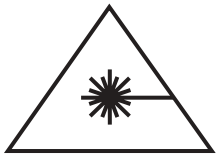
Because of its special properties, laser light poses safety hazards not associated with light from conventional sources. The safe use of lasers requires that all laser users, and everyone near the laser system, are aware of the dangers involved. The safe use of the laser depends upon the user being familiar with the instrument and the properties of coherent, intense beams of light.



Direct eye contact with the output beam from the laser will cause serious damage and possible blindness.

Laser beams can ignite volatile substances such as alcohol, gasoline, ether and other solvents, and can damage light-sensitive elements in video cameras, photomultipliers and photodiodes. Reflected beams may also cause damage. For these reasons, and others, the user is advised to follow the precautions below.

1. Observe all safety precautions in the Operator's Manual.
2. Extreme caution must be exercised when using solvents in the area of the laser.
3. Limit access to the laser to qualified users who are familiar with laser safety practices and who are aware of the dangers involved.
4. Never look directly into the laser light source or at scattered laser light from any reflective surface. Never sight down the beam into the source.
5. Maintain experimental setups at low heights to prevent inadvertent beam-eye encounter at eye level.



Laser safety glasses can present a hazard as well as a benefit; while they protect the eye from potentially damaging exposure, they block light at the laser wavelengths, which prevents the operator from seeing the beam. Therefore, use extreme caution even when using safety glasses.

6. As a precaution against accidental exposure to the output beam or its reflection, those using the system must wear laser safety glasses as required by the wavelength being generated.
7. Use the laser in an enclosed room. Laser light will remain collimated over long distances and therefore presents a potential hazard if not confined.
8. Post warning signs in the area of the laser beam to alert those present.
9. Advise all using the laser of these precautions. It is good practice to operate the laser in a room with controlled and restricted access.

Electrical Safety

The Coherent CUBE laser system does not contain hazardous voltages. Do not disassemble the enclosure. There are no user-serviceable components inside. All units are designed to be operated as assembled. Warranty will be voided if the enclosure is disassembled.

Electrostatic charges as high as 4000 V readily accumulate on the human body and equipment and can easily discharge without detection. Although the electronics features have impressive input protection, permanent damage may occur on devices subjected to high-energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation.

The most common ESD damage occurs while handling the device during installation or use. Please take necessary measures to protect the system from ESD.

Dry air and carpet can create even higher potential for ESD. Precautions or shielding need to be taken for demonstrations or trade show exhibitions.

Laser Safety Features

CDRH/EN60825-1 Compliance

The Coherent CUBE laser system complies with all of the requirements of CDRH (21 CFR Subchapter J) and EN60825-1 when used with this control box. The CDRH accession number is 0420530-00.

Laser Emission and Classification

The Coherent CUBE laser system is classified by the United States National Center for Device and Radiological Health (CDRH) as a CLASS IIIb laser product. It emits VISIBLE AND INVISIBLE LASER RADIATION of 0.3 – 1.0 µm wavelength from the aperture in the front of the laser head.

Protective Housing

The laser radiation is entirely contained within a metal protective housing except for the laser beam aperture. The protective housing should never be opened.

Remote Interlock

The control box is provided with a remote interlock circuit that prevents the generation of laser radiation when open. This interlock circuit is fail safe or redundant. The interlock circuit is described further in the paragraph titled "Interlock Requirements" in Section Five: Operation.

Key Control

The control box is provided with a keyswitch that prevents the generation of laser radiation when it is in the OFF position. Laser radiation may occur when the key is in the ON position. The key is removable when in the OFF position; it is not removable when it is in the ON position.

Laser Emission Indicators

The laser system control box provides a laser emission indicator. The indicator is located on the control box front panel. When the green control box indicator is not illuminated, laser radiation is not possible. When the control box indicator is illuminated, the laser should be considered dangerous; a laser beam may be created at any instant (via computer control, for example). After the illumination of the green control box indicator, there is a delay until actual laser emission, which will allow appropriate action to avoid exposure to the laser beam. The delay is at least 5-seconds in duration.

Secondary Emission Indicator

The Coherent CUBE laser system includes the capability to add a secondary emission indicator. The secondary emission indictor is sold as an accessory and connects directly to the standard Coherent CUBE interface cable. The secondary emission indicator can be mounted remotely at a distance up to 5 m from the laser system.

Radiation Exposure

Use of controls or adjustments or performance of procedures other than those specified in this manual may result in hazardous radiation exposure.

Shutter

The laser contains a manually operated shutter at the beam exit aperture on the front of the laser head. When the shutter is fully closed, there is no laser radiation emitted from the laser.

Location of Safety Labels

Figure 1-1. Safety Labels

SECTION TWO: DESCRIPTION AND SPECIFICATIONS

System Description

Coherent's CUBE laser system combines the very latest semiconductor laser technology with proven high-quality diode laser system manufacturing techniques. The Coherent CUBE is the most advanced compact full-feature laser system on the market today.

The Coherent CUBE laser system (Figure 2-1) is a complete system with laser head, control box, power supply and interface cables. The system can be mounted to a plate with the appropriate heat sink capability. The Coherent CUBE delivers power, stability, and performance in a small package and at an attractive price. The Coherent CUBE can operate in pulse or CW mode, and includes complete remote communication and control via RS-232 or USB connection.

The control box, when properly installed and operated, allows for the Class IIIb (CDRH)/Class 3B (IEC) laser system to conform to the CDRH 21 CFR 1040 and IEC60825-1 requirements for a "conforming" system. The system is tested and certified at the factory to ensure all the safety features are operational. Bypassing or otherwise disabling these safety features will invalidate the conformity to the CDRH and IEC regulations.

The optional heat sink accessory provides a solid foundation for cooling to a maximum ambient temperature of 40°C. The solid heat sink foundation is designed to maintain the specified system pointing stability. The heat sink includes a fan that connects directly to the power supply included with each system. English and metric mounting hardware is also included.

Figure 2-1. Coherent CUBE Laser System

Features

- Single transverse mode
- Thermoelectrically cooled for extended life
- Compact package
- High-quality glass optics
- Maximum digital pulse control 150 MHz
- Maximum analog output control 350 KHz
- Circular or elliptical beams
- RS-232 and USB remote communication
- Coherent CUBE connection software
- Shutter
- Control box for regulatory compliance
- Optional heat sink

Figure 2-2. Coherent CUBE Laser System Components

Laser Head

The Coherent CUBE laser system is a direct emitting semiconductor laser. The output beam of the diode is collimated by a high-aperture lens. Additionally, the beam is formed by a prism pair to achieve a round beam in the far field. A thermoelectric cooler is integrated for stabilizing the diode laser. Excess heat is removed via the baseplate of the laser. The construction details of the Coherent CUBE laser head are shown schematically in Figure 2-3. DE-15 pin functions are described in Table 3-4.

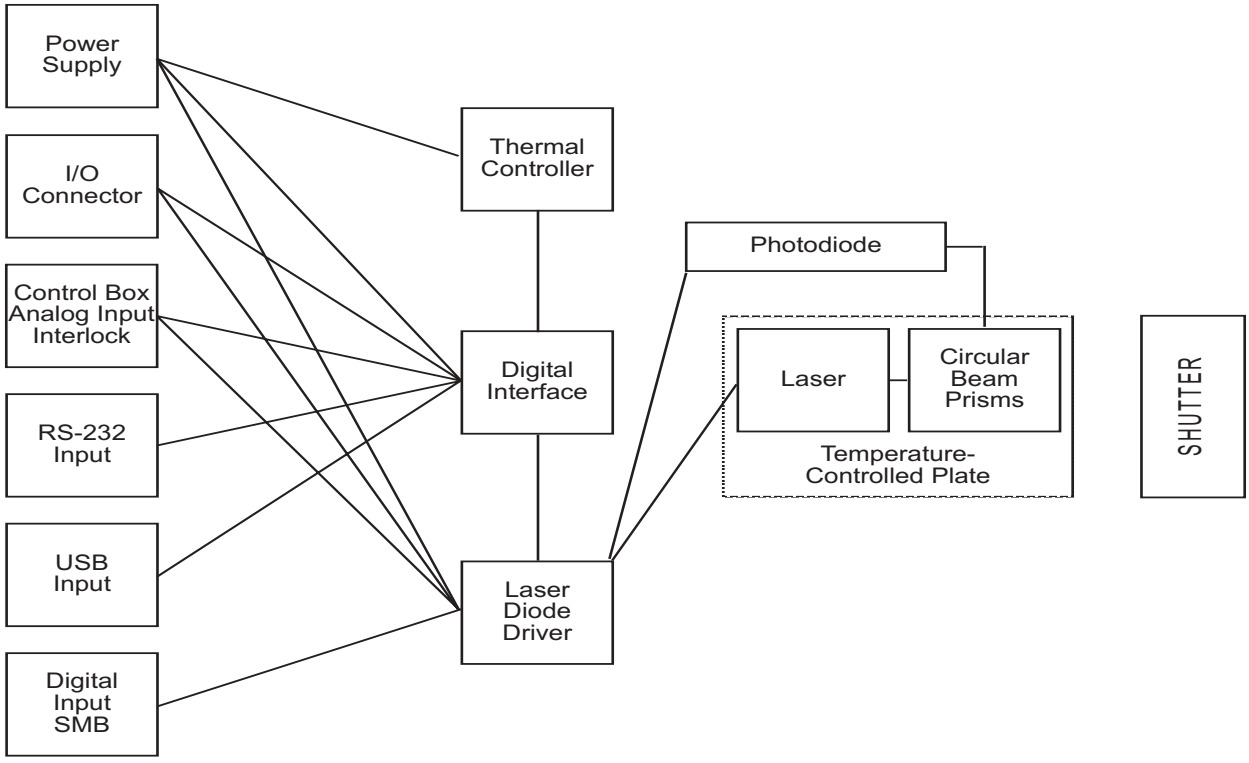


Figure 2-3. Coherent CUBE System Schematic

Optional Heat Sink

The optional heat sink is available to ensure heat sinking of the laser head if this is not covered by the OEM integration. This heat sink has sufficient cooling capacity for ambient temperatures up to 40ºC. For dimensions, see Figure 2-5.

Power Supply

The power supply is a universal AC input with a DC-regulated output. Use only the Coherent-approved power supply that comes standard with every system. Beware of other supplies that may look similar but have different output voltages that could damage the Coherent CUBE laser system. For dimensions, see Figure 2-6.

Control Box

The control box offers an ON/OFF keyswitch, a remote interlock, an emission indicator, and a 5-second delay. With these safety features, the system is compliant to CDRH regulations.

The modulation BNC connector is to be used for analog modulation or variable power control. Review Analog Modulation specifications for input requirements. For control box dimensions, see Figure 2-7.

Cables

The Coherent CUBE laser system is shipped with an interface cable and a USB cable. For detailed system description and installation instructions see Section Three: Installation.

Specifications

Specifications for the Coherent CUBE laser system are listed in Table 2-1.

Table 2-1. Specifications

PARAMETER	DESCRIPTION				
	CUBE 375	CUBE 405	CUBE 440	CUBE 635	CUBE 785
Wavelength	375 ± 5 nm	405 ± 5 nm	440 ± 5 nm	635 + 7 nm – 2 nm	785 ± 10 nm
Output Power	8 mW +10% –0%	50 mW +10% –0%	16 mW +10% –0%	25 mW +10% –0%	40 mW +10% –0%
Pulse Rise Time	< 2 ns				
Maximum Modulation Frequency (Digital)	150 MHz				
Minimum Modulation Depth @ 150 MHz (Digital)	150:1				
Maximum Modulation Frequency (Analog)	350 KHz				
Noise: (20 Hz - 10 MHz)	< 0.2% RMS				
Noise: (10 MHz - 500 MHz)	< 1% RMS				
Pointing Stability	< 6 urad/ºC				
Static Alignment	<± 1.0 mm, < 5 mrad angular				
Power Stability (8 hours)	< ± 2%				
ESD Protection	Level 4				
EMI/RFI Classification	EN 50081/50082-1				
All specifications are subject to change without notice.					

Table 2-1. Specifications (Continued)

PARAMETER	DESCRIPTION				
	CUBE 375	CUBE 405	CUBE 440	CUBE 635	CUBE 785
Dimensions (L x W x H)	100 mm x 40 mm x 40 mm				
Weight (excluding cable and external heat sink)	280 g (9.9 oz.)				
Operating Voltage/Current	4.8 – 6.5 VDC 2.5 A				
Warm Up Time	< 5 minutes				
Enable Time	< 10 seconds				
Digital Communication	USB and RS-232				
Data Rates	USB 1.1				
Data Rates (continued)	RS-232: 19,200 baud				
Plate Temperature	10 – 50ºC, 40ºC Max Ambient				
Auto Start Feature	Yes				
BEAM PARAMETERS					
Beam Diameter @ $1/e^2$ (Elliptical)	1 x 3 mm typical				
Beam Diameter @ $1/e^2$ (Circular)	1 mm typical				
Spatial Mode (Far-Field)	TEMoo				
Circularity (Far Field) $1/e^2$	> 80%				
Beam Divergence (Full Angle)	1 mrad Typical				
Polarization	> 100:1 linear +/- 5º Vertical				
M^2	< 1.5				
All specifications are subject to change without notice.					

Dimensions

The dimensions of the Coherent CUBE laser head, heat sink, power supply, and control box are shown in the figures below.

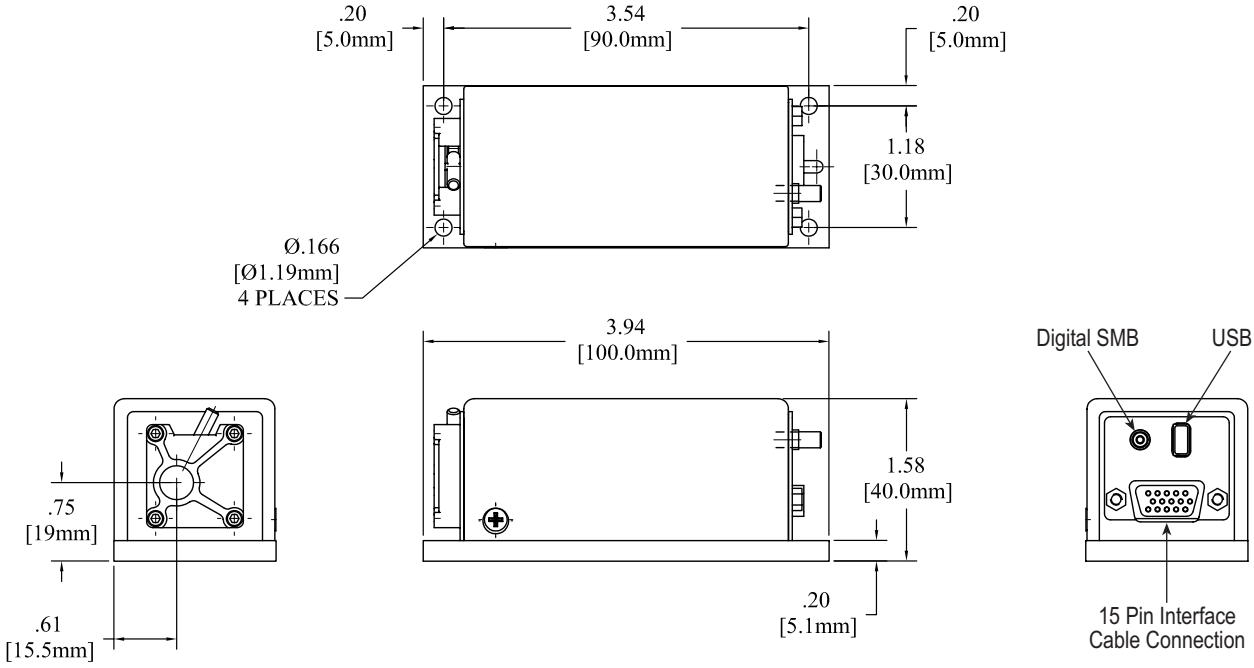


Figure 2-4. Coherent CUBE Laser Head Dimensions

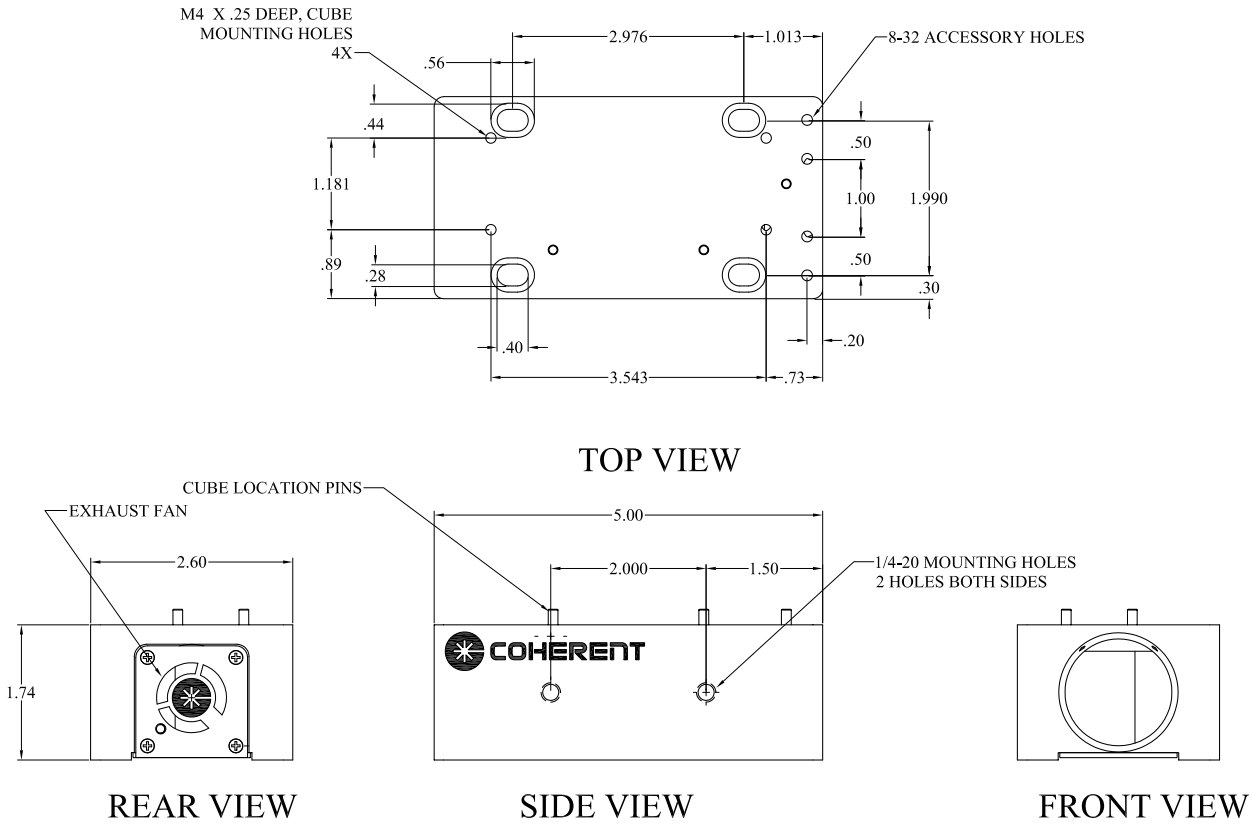


Figure 2-5. Optional Heat Sink Dimensions

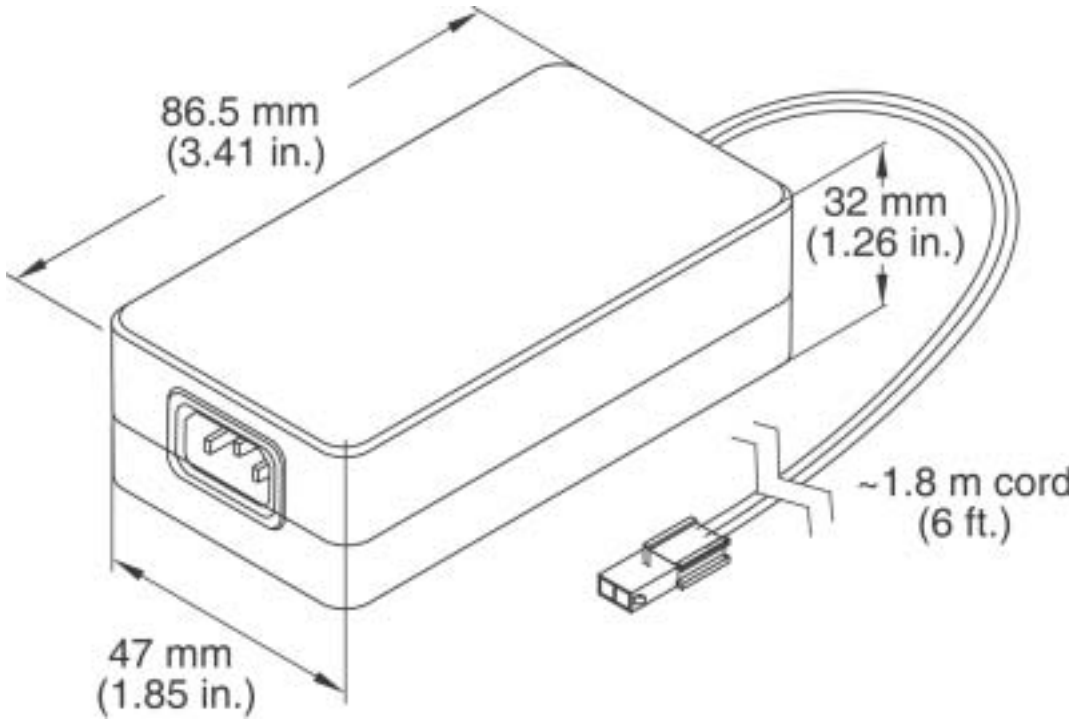


Figure 2-6. Coherent CUBE Power Supply Dimensions

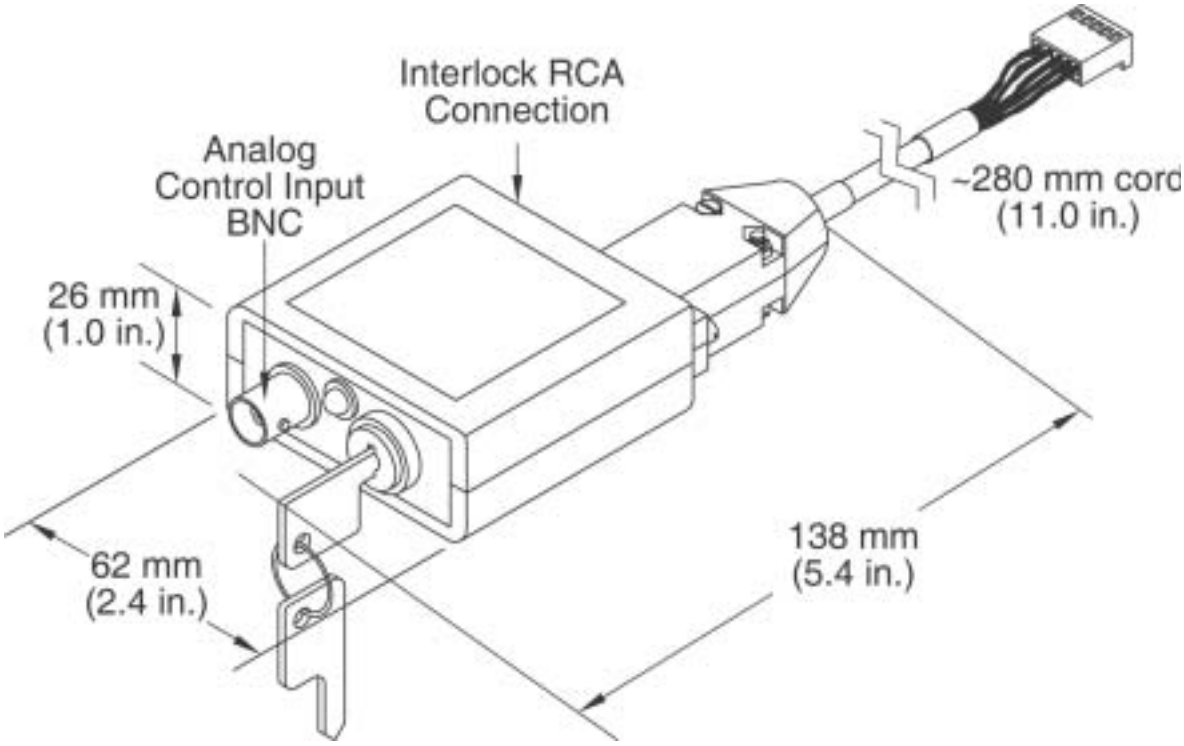


Figure 2-7. Coherent CUBE Control Box Dimensions

SECTION THREE: INSTALLATION

Receiving and Inspection

Inspect shipping boxes for signs of rough handling or damage. Indicate any such signs on the bill of loading. Report any damage immediately to the shipping carrier, and to Coherent Order Administration Department (in the US: 800-438-6323) or to an authorized Coherent representative.

After unpacking the system, save the shipping boxes for potential later shipments (See Section Nine: Repacking Procedure).

Table 3-1. Packing List for Coherent CUBE Laser System

ITEM DESCRIPTION	QUANTITY
Coherent CUBE Laser	1
Coherent CUBE Power Supply	1
Coherent CUBE Manual	1
CUBE Connection Software CD	1
Coherent CUBE Control Box	1
Coherent CUBE Interface Cable	1
USB Cable	1
Modified M4 Mounting Screws	4

Take appropriate ESD precautions when handling and installing the laser. Refer to page 1-2 for complete description.

Heat Sink Requirement

It is imperative that the laser head be adequately heat sinked; otherwise, it will overheat and shut down in a matter of seconds. Figure 3-1 shows the heat dissipation of the Coherent CUBE laser head for a given baseplate temperature. The graph on Figure 3-2 allows determination of the heat sink thermal impedance requirement based on the anticipated maximum ambient temperature of 40ºC.

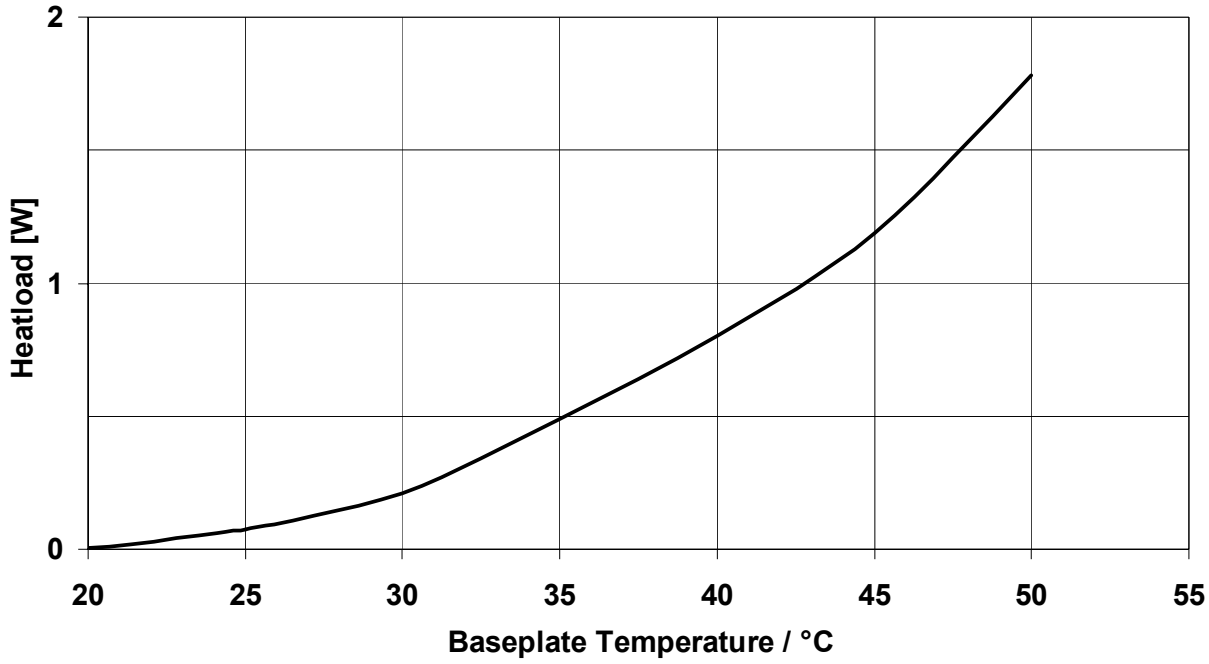


Figure 3-1. Estimated Heat Dissipation of the Coherent CUBE Laser Head
Note: Heat Dissipation Varies with Diode Current Level

For example, if the maximum expected ambient temperature is 35°C, the heat sink thermal impedance needs to be 2.7ºC/Watt.

The mounting surface of the heat sink must be flat to ensure good thermal contact and avoid damage to the laser head. Many extruded heat sinks are warped and the mounting surface should thus be milled flat (within < 0.05 mm over the mounting surface).

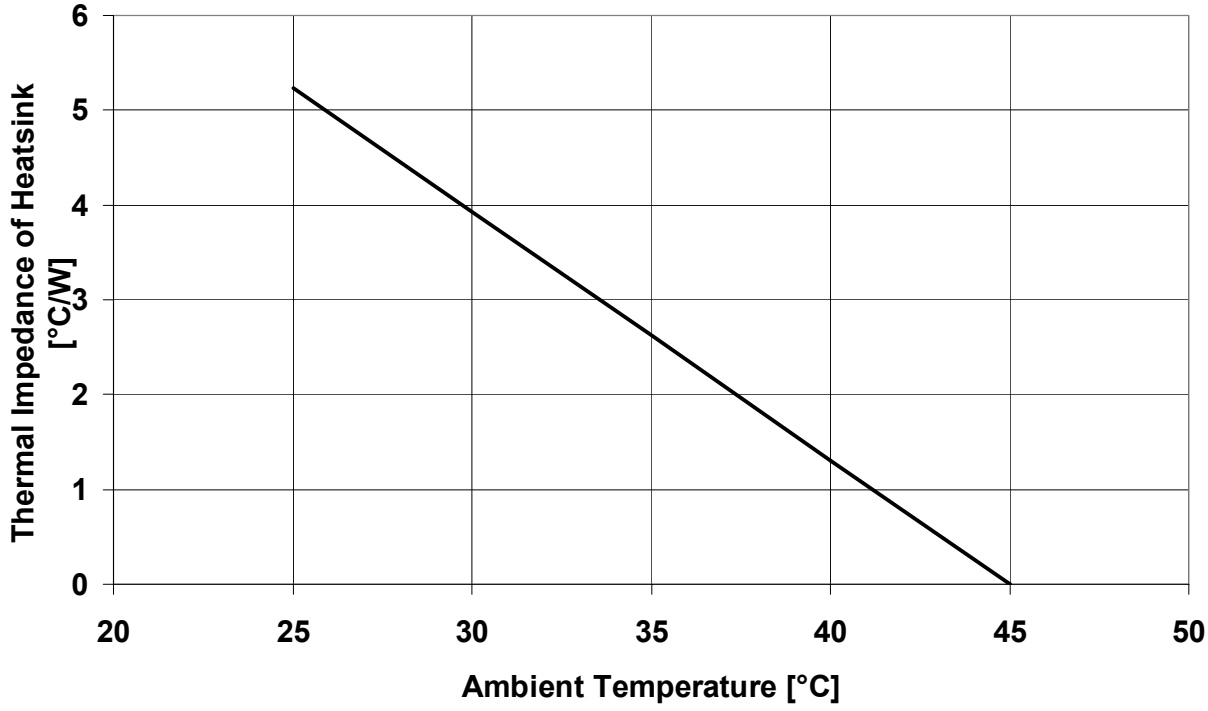


Figure 3-2. Estimated Heat Sink Requirements for an Ambient Temperature of 45ºC

Optional Heat Sink

Coherent's optional heat sink is the result of significant design research and testing. The mounting of any laser is important to extend the stability of the beam over time and temperature. The heat sink provides proper thermal dissipation and mechanical positioning. The safety shutter is easily accessible, and the rear panel is unobstructed for access and connections.

Figure 3-3. Optional Heat Sink

Features

- 2.5 inch beam height
- Output beam centers on standard table 1" bolt pattern
- Universal metric and English base bolt pattern
- Precision dowel pin laser positioning
- Integrated cooling fan
- Proven stable performance over time and temperature
- Safety shutter access
- Small footprint
- Rugged design

Table 3-2. Packing List for Coherent CUBE Heat Sink Accessory

ITEM DESCRIPTION	QUANTITY
Heat Sink	1
Fan Power Connector	1
1/4-20 Mounting Hardware	4
M6 Mounting Hardware	4
M4 Laser Mounting Hardware	4
3/16 Wrench	1
M6 Wrench	1

Heat Sink Installation

1. Secure the heat sink to proposed laser location. Ensure the heat sink ends remain unobstructed for proper air flow.
2. Apply a thin even coat of thermal compound to the Coherent CUBE laser head base.
3. Secure the Coherent CUBE laser head to the heat sink with the modified M4 screws provided.
4. Tighten screws in a diagonal pattern to ensure optimum pointing stability. Use the same diagonal pattern for the final torque setting of 10 in. lb. or 100 Ncm.
5. If the fan operation is required, connect the fan to the Coherent CUBE power supply with the cable provided with the heat sink. The fan cable will allow power to be supplied to the heat sink fan and the Coherent CUBE simultaneously.
6. Proceed with normal laser operation.

Mounting the Laser Head

For mounting the Coherent CUBE laser head without the Coherent optional heat sink, follow the same mounting procedure described for the optional heat sink. The laser system also includes modified M4 mounting hardware. Standard M4 socket head screws do not provide sufficient clearance for mounting holes.

Power Supply

The Coherent CUBE laser system includes a power supply. The Coherent CUBE power supply also includes a power switch and power indicator. The power supply specifications are shown below.

Figure 3-4. DC Power Supply

Table 3-3. Power Supply Specifications

INPUT	OUTPUT
Input Voltage: 90 VAC to 264 VAC Input Current: < 0.5 A at 90 VAC input Input Frequency: 47 Hz to 63 Hz	Output Voltage: 6 VDC Output Current: 2.5 A Rated Output Power: 15 W, Maximum Output Regulation: ± 5% Line Voltage Regulation: ± 1% Typical Measured at Full Load

Interface Cable

The Coherent CUBE system includes a full-function interface cable. The interface cable can access all functions available in the Coherent CUBE system. Separate connectors are provided for similar functions. Custom DE-15 cables can be constructed to interface directly to the Coherent CUBE system, for OEM applications.

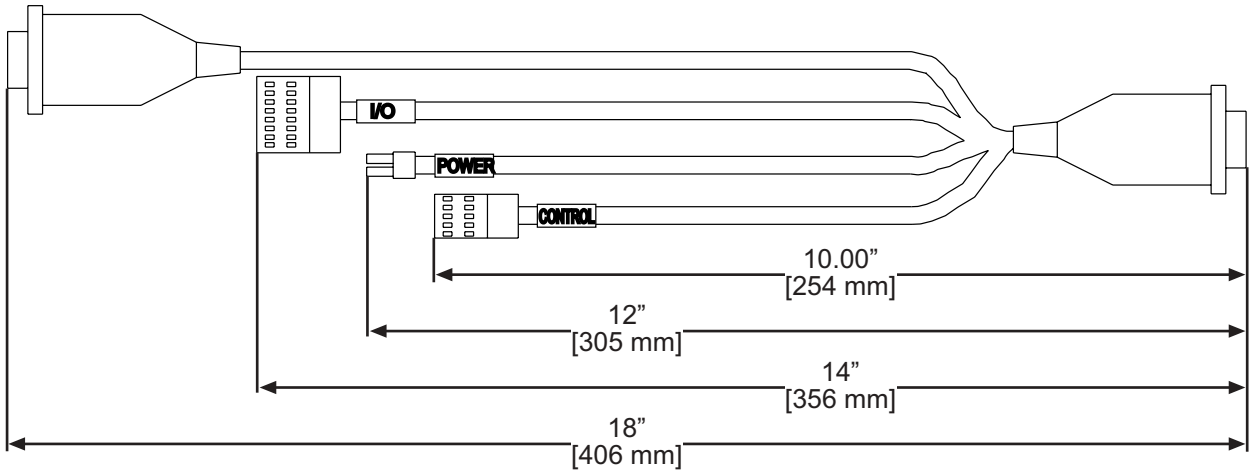


Figure 3-5. Interface Cable

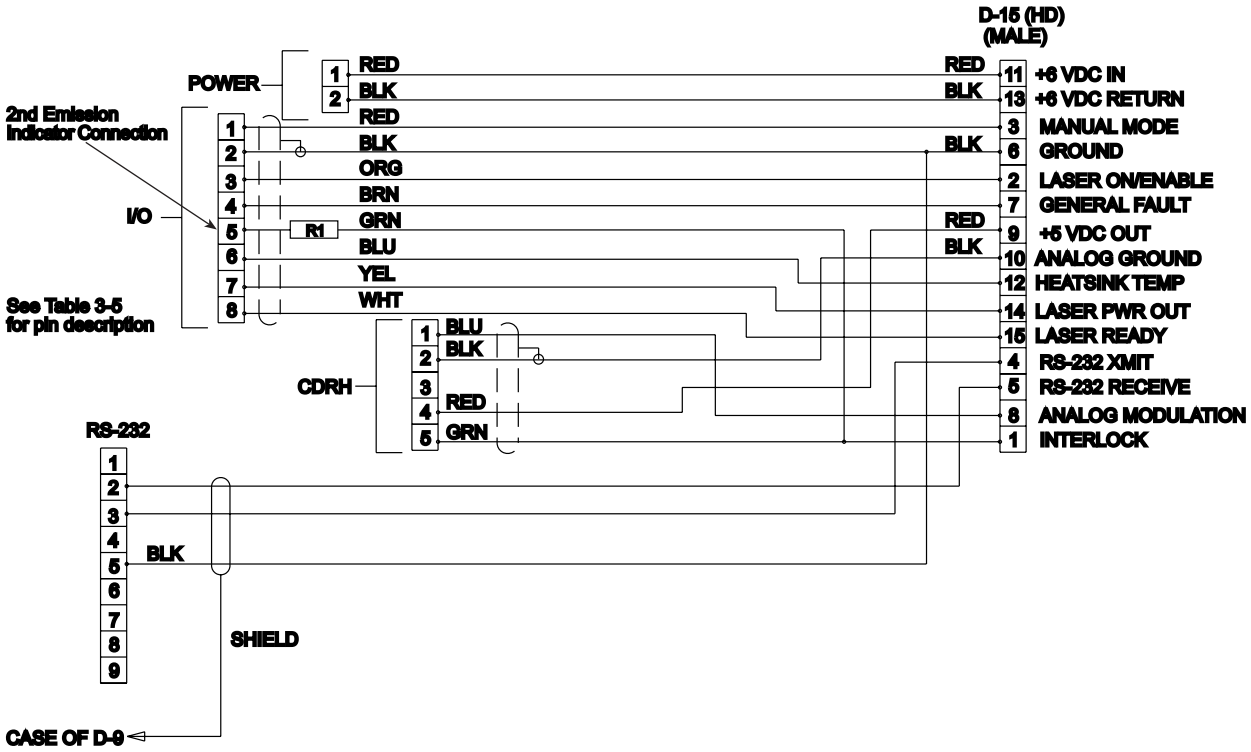


Figure 3-6. Interface Cable Description

Table 3-4. DE-15 Connector Summary

PIN #	FUNCTION	DIRECTION	DESCRIPTION	DRIVE/LOAD
1	Interlock	Input	0 = Open, Ground (normal) 1 = Closed, TTL High	7 K Ohm internally pulled down
2	Laser On (Enable)	Input	0 = Laser Off 1 = Laser On, TTL High	7 K Ohm internally pulled up
3	Auto-start	Input	0 = Computer Control 1 = Auto Start Mode, +5 VDC (normal)	7 K Ohm internally pulled up
4	RS-232 Receive	Output	DE-9 Pin 3	Standard
5	RS-232 Transmit	Output	DE-9 Pin 2	Standard
6	Signal Ground (For use with all signal inputs except the analog modulation)	Input	DE-9 Pin 5	Ground
7	General Fault	Output	0 = No Faults 1 = Fault condition, +5 VDC	7 K Ohm
8	Analog Modulation	Input	0 to +5 VDC = Threshold – 100% Power Control	15 K Ohm
9	+5 VDC Output	Output	Reference Output, + 5.0 VDC	100 ma Maximum Drive
10	Analog Modulation Ground	Output	Ground	Ground
11	Power Supply Input +6 VDC	Input	4.8 V – 6.5 V DC Power Input	2.5 amps
12	Over-Temperature Heat sink	Output	0 VDC = Base plate Temperature less than 40ºC +2.5 VDC = Base plate Temperature between 40 and 50°C +5 VDC = Base plate Temperature over 50°C	2 K Ohm
13	Power Supply Ground	Input	Ground	Ground
14	Laser Power Out	Output	0 to +2 VDC = 0 to 100% Laser Power	750 Ohm
15	Laser Ready	Output	0 = Laser Not Ready 1 = Laser Ready, +5 VDC	2 K Ohm
Shell	Chassis Ground		Ground	Ground

Power Connection

The interface cable 2-pin connector mates to the supplied Coherent CUBE power supply. The connector is keyed to ensure correct polarity when plugged into the power supply.

The power supply polarity is defined by the triangular tab located at the top of the connector.

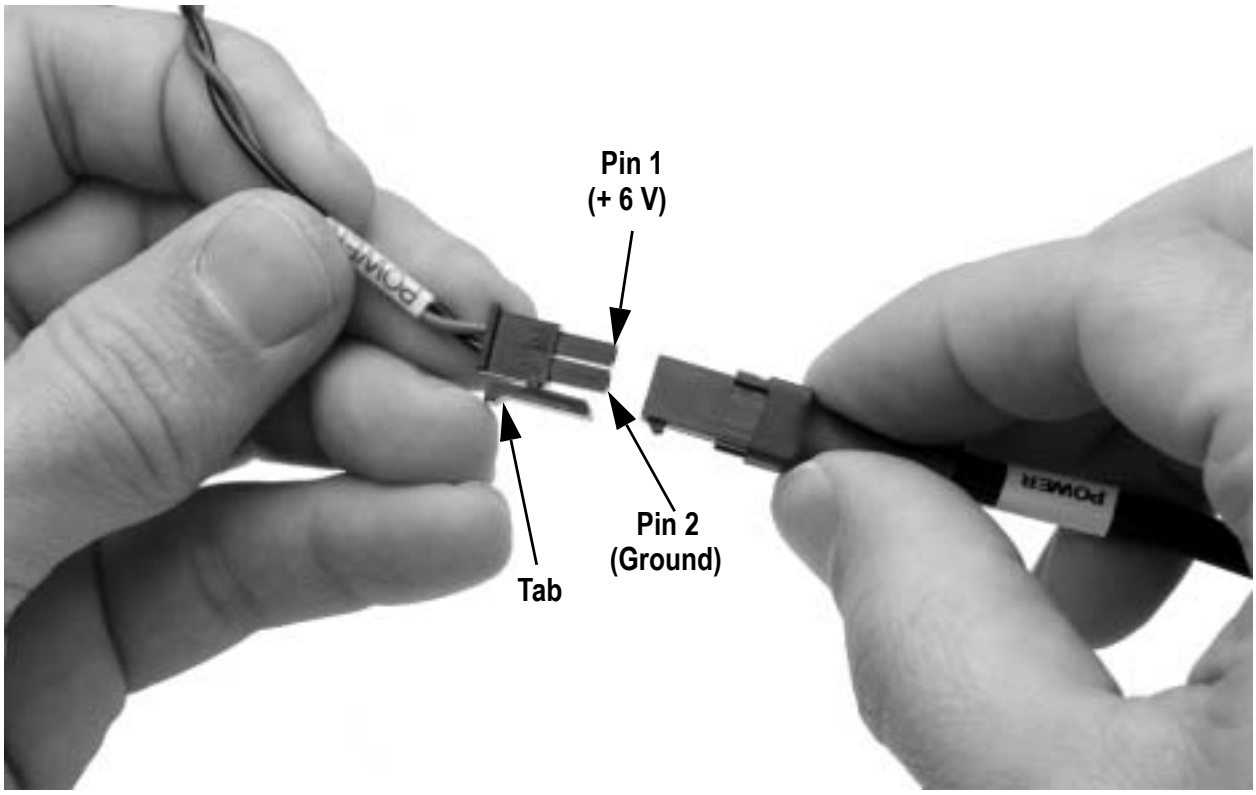


Figure 3-7. Interface Cable 2-Pin Connector

Control Box

The Coherent CUBE control box is connected to the laser interlock. The keyswitch will initiate or interrupt laser emission in the same fashion as the interlock. The BNC connector provides access to the CW power control line for laser power control up to 350 KHz. Use the RCA rear connector in series with an external interlock.

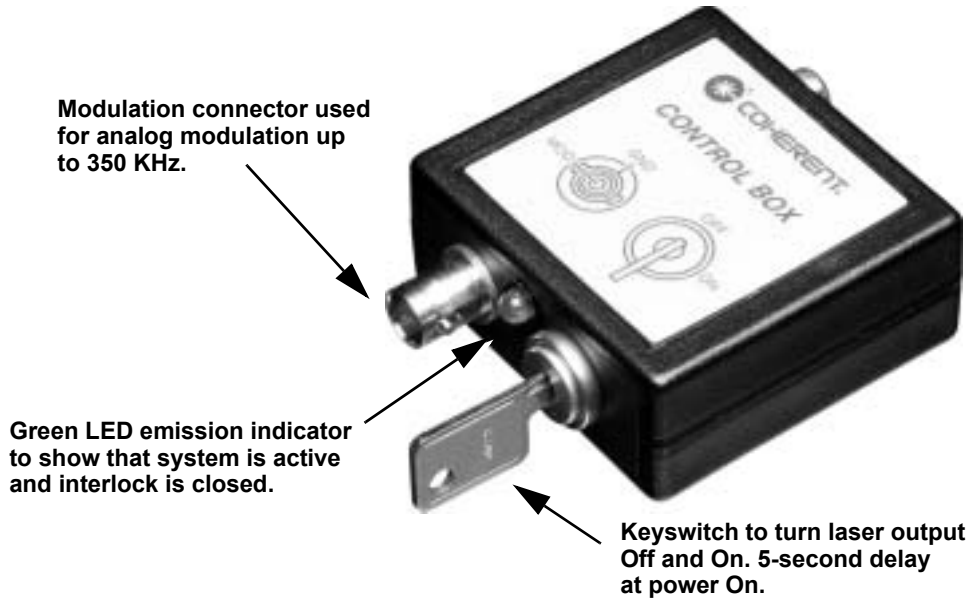


Figure 3-8. Control Box Front Panel View

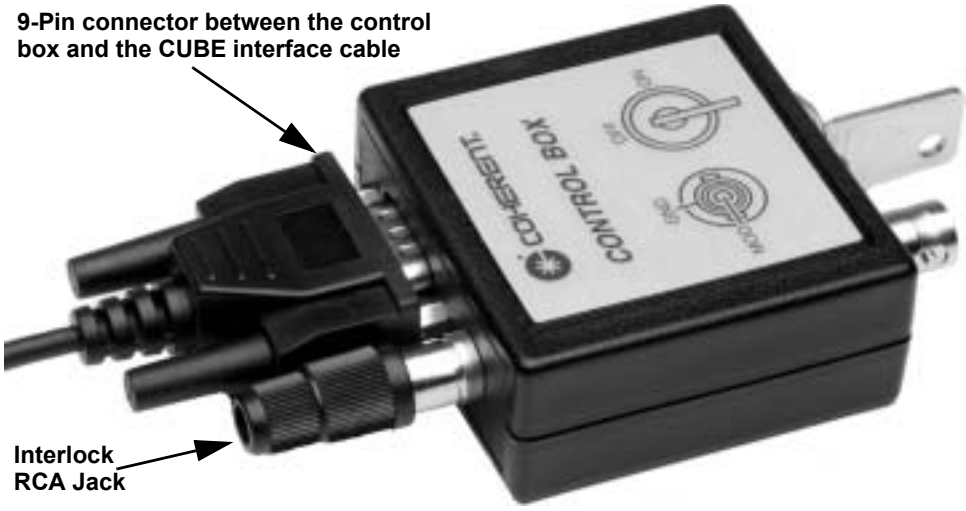


Figure 3-9. Control Box Back Panel View

Connecting the Laser to the Control Box

1. Connect the 5-pin I/O cable of the control box cable to the interface cable.

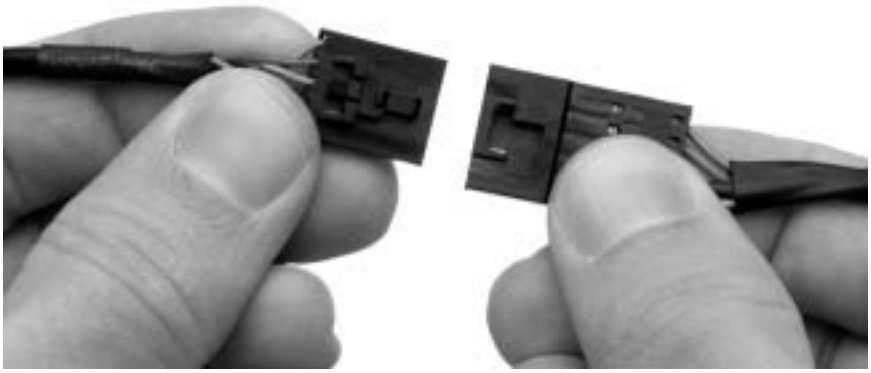


Figure 3-10. 5-Pin I/O Cable Connected to the Interface Cable

2. Confirm the control box keyswitch is in the OFF position.

Figure 3-11. Control Box Keyswitch

3. Close the interlock with the supplied shorted RCA plug or connect the interlock to a remote interlock switch.

The interlock is a fused +5 VDC signal line. Do not connect to a ground circuit or the internal fuse may blow.

Figure 3-12. Control Box Interlock Connection

Interlock Control

The control box can be connected to a remote switch to disable the system, in the event that a door or panel is opened. The interlock switch must be wired in series with the interlock RCA connector.

INTERLOCK
Open = Laser Off
Closed = Laser On

The interlock is a fused +5 VDC line. Do not ground the interlock or apply any outside power to the circuit.

When the interlock is returned to the closed position, a 5-second delay will occur before laser emission.

I/O Connector

The eight-pin I/O connector is provided for access to the laser control and status pins. Use the following table to determine the functions required for your application.

Table 3-5. I/O Connector

PIN	FUNCTION	DIRECTION	RANGE	DESCRIPTION
1	Auto-start	Input	TTL - 0, TTL - 1	The auto-start pin is active with no connection. When auto-start is active, the laser will start automatically following the 5-second CDRH-required delay. Computer control is available in auto-start. When the auto-start is not active, all laser functions are computer controlled.
2	Ground	Input	N/A	Signal/Digital Ground
3	Laser On/Enable	Input	TTL - 0, TTL - 1	The Laser On/Enable pin is used to trigger laser emission externally. Even when the laser emission is not active, the temperature control is enabled.
4	General Fault	Output	N/A	The general fault pin is active when a fault condition exists. A low condition indicates normal operation.
5	Interlock	Input	TTL - 0, TTL - 1	The interlock is closed with no connection. This pin is used to terminate laser emission when the interlock is open.
6	Heat Sink Temperature	Output	0 V, 2.5 V, 5 V	0 VDC = Base plate Temperature less than 40ºC + 2.5 VDC = Base plate Temperature between 40 and 50°C + 5 VDC = Base plate Temperature over 50°C
7	Laser Power Output	Output	0-2 V	The laser power output pin is used to indicate the current laser output power. The voltage is proportional to the laser output. 2 V represents 100% laser power.
8	Laser Ready	Output	TTL - 0, TTL - 1	The laser ready pin indicates laser emission. When the pin is active, the laser emission is active.

RS-232 Connector

The RS-232 connector will connect directly to the RS-232 computer connector. A standard serial extension cable can be used to connect between the Coherent CUBE interface cable and a computer COMM port.

A null modem cable is not compatible with the Coherent CUBE Laser System.

RS-232 Connections. The descriptions for the RS-232 connector correspond to the computer input pin descriptions.

Table 3-6. RS-232 Pin Connections

PIN NUMBER	DESCRIPTION
DE-9 INTERFACE CABLE CONNECTOR	
2	RS-232 Transmit
3	RS-232 Receive
5	Ground

SECTION FOUR: QUICK START

Quick Start for CW Operation

1. Apply thermal compound to the Coherent CUBE laser head base and place the laser on the optional Coherent CUBE heat sink or mounting surface capable of providing adequate thermal dissipation. Refer to Figure 3-2 for heat sink requirements.
2. Secure laser to mounting surface using 6-32 or M4 screws. Torque to 10 in. lb. using a diagonal pattern.

Figure 4-1. Cable Connection Setup

3. Connect the interface cable to the laser.

Figure 4-2. Connect the Interface Cable to the Laser

4. Tighten the connector shell screws to ensure reliable system operation. For additional information, refer to paragraph titled "Interface Cable" In Section Three: Installation.

5. Connect the power supply.

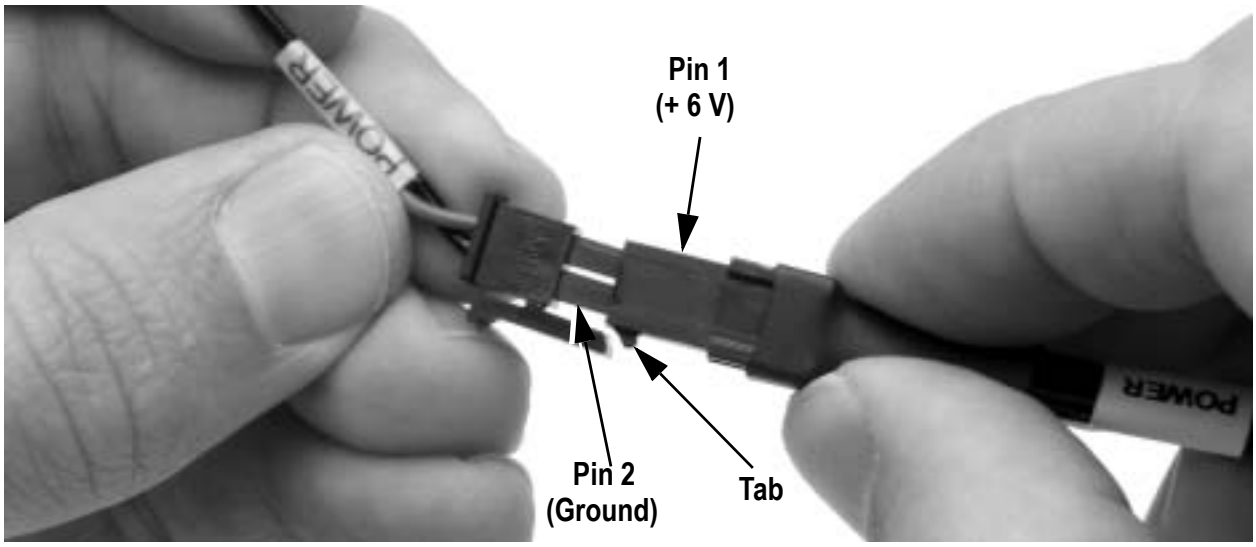


Figure 4-3. Connect the Power Supply

6. Connect the control box. Ensure the keyswitch is in the OFF position.

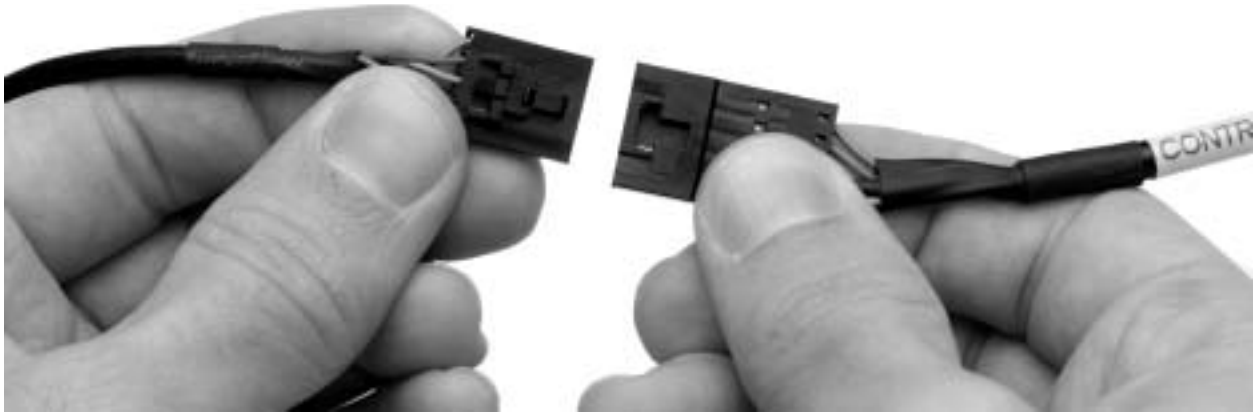


Figure 4-4. Connect the Control Box

7. If computer control is desired, connect the USB or serial interface cable. Review Table 3-6 For RS-232 Connection Details

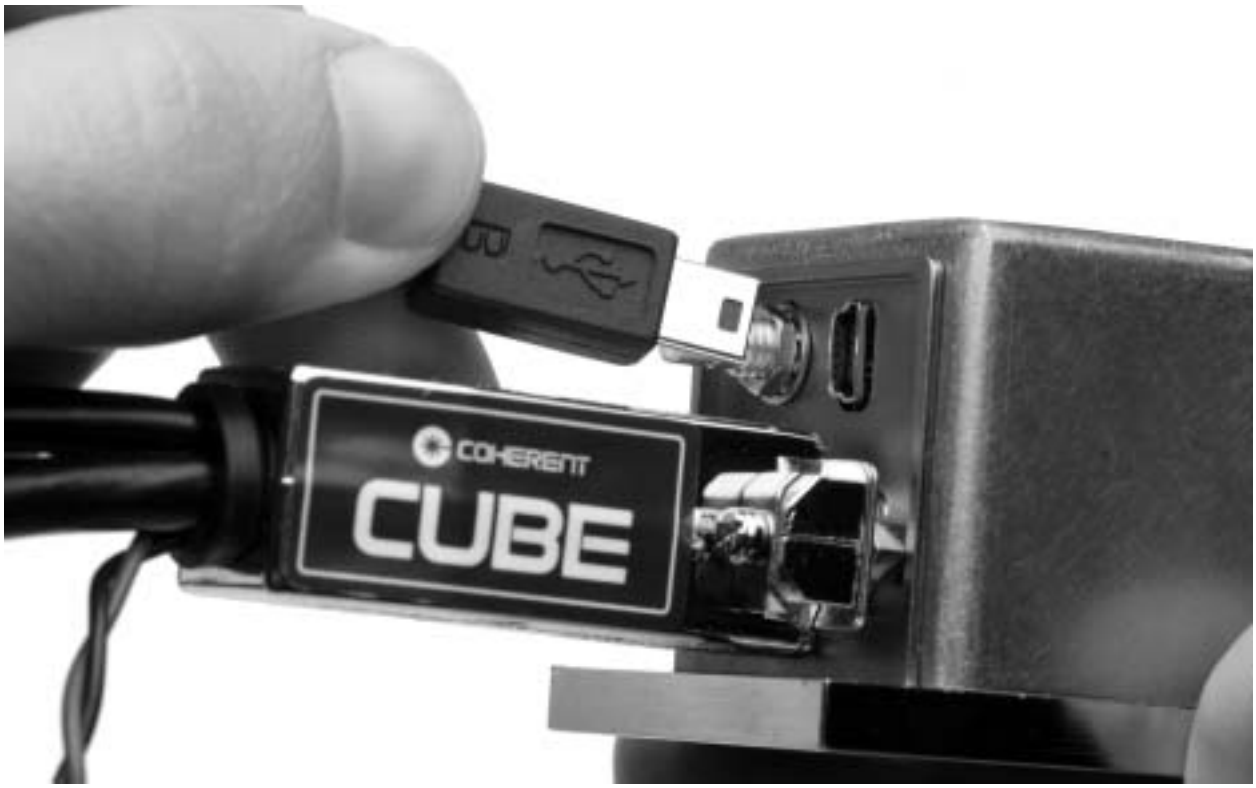


Figure 4-5. Connect the USB or Serial Interface Cable

8. Apply power to the laser using the power supply rocker switch.
9. Turn the control box keyswitch to the ON position to initiate laser emission.

The Coherent CUBE laser system is shipped in CW auto-start mode with a 5-second CDRH-required delay. The laser emission will be active approximately 5-seconds after the keyswitch is set to the ON position.

10. Computer control is available without additional system configuration. The Coherent CUBE laser system will Auto-start automatically without additional computer or configuration settings.

Refer to the paragraph titled "RS-232 Remote Control" in Section Five: Operation, for a complete list of computer controls and queries. All remote computer settings are stored each time the system is powered down. Use the "?S" query to display a complete list of current settings.

Quick Start for Pulse Operation

Pulse operation requires external computer control. Pulse operation can be accomplished with RS-232 or USB communication.

1. Apply thermal compound to the Coherent CUBE laser head base and place the laser on the Coherent CUBE heat sink accessory or mounting surface capable of providing adequate thermal dissipation. Refer to Figure 3-2 for heat sink requirements.
2. Secure laser to mounting surface using 6-32 or M4 screws. Torque to 10 in. lb. using a diagonal pattern.

Figure 4-6. Cable Connection Setup

3. Connect the Interface cable to the laser.

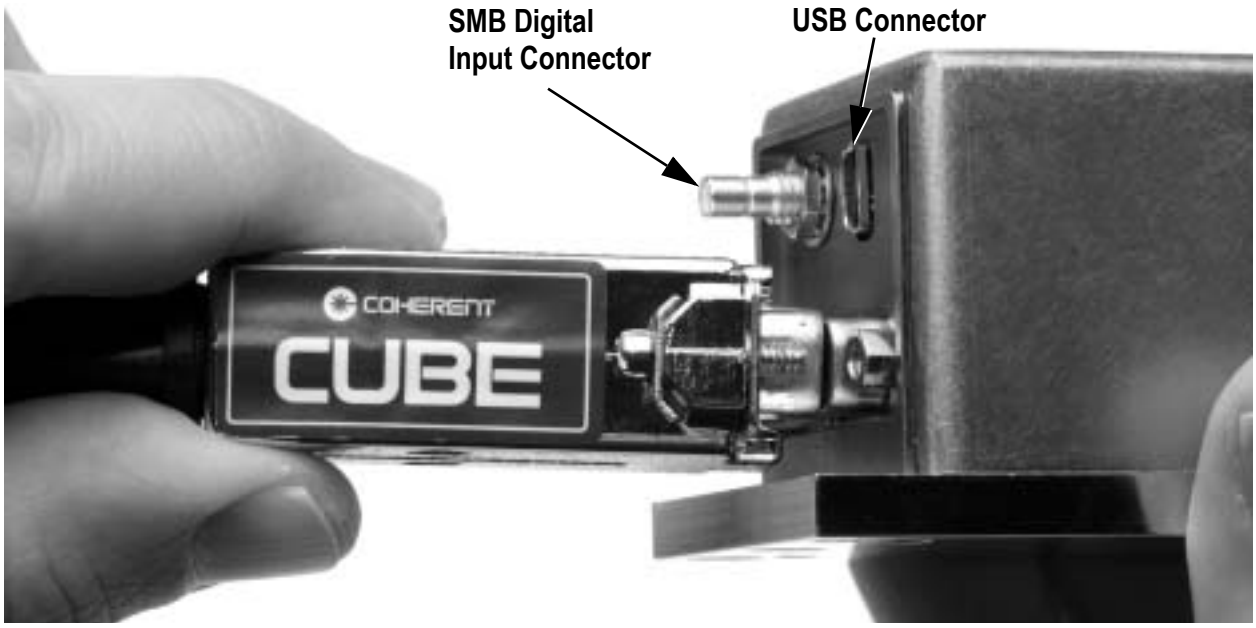


Figure 4-7. Connect the Interface Cable to the Laser

4. Tighten the connector shell screws to ensure reliable system operation. For additional information refer to the paragraph titled "Interface Cable" in Section Three: Installation.

5. Connect the power supply.

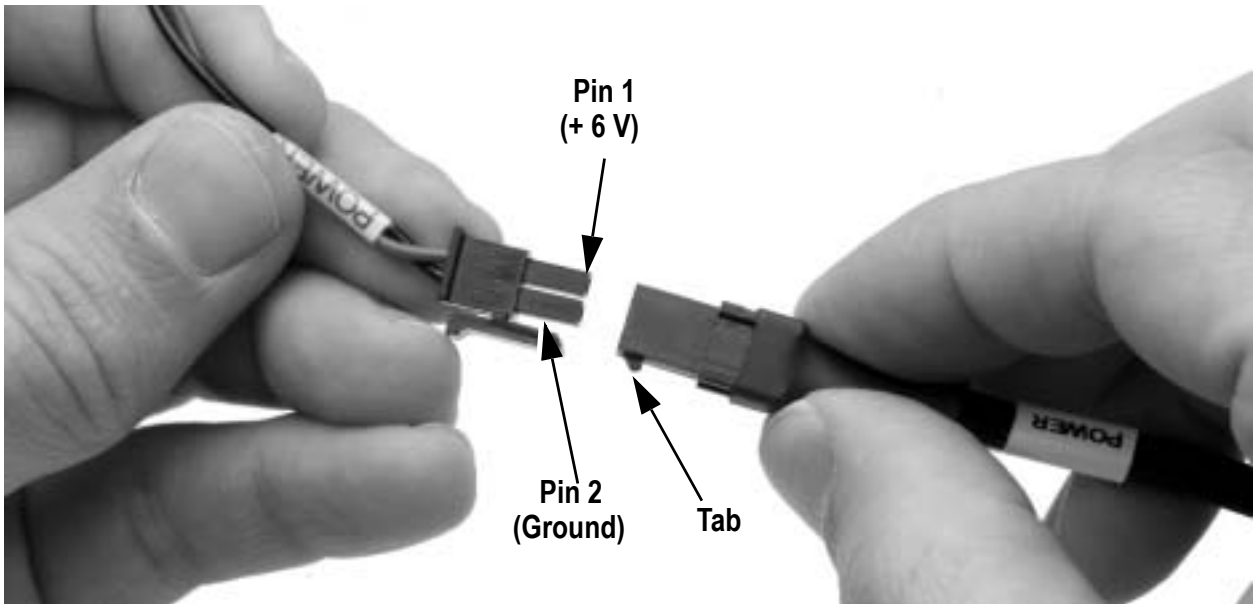


Figure 4-8. Connect the Power Supply

6. Connect the control box. Ensure the keyswitch is in the OFF position.

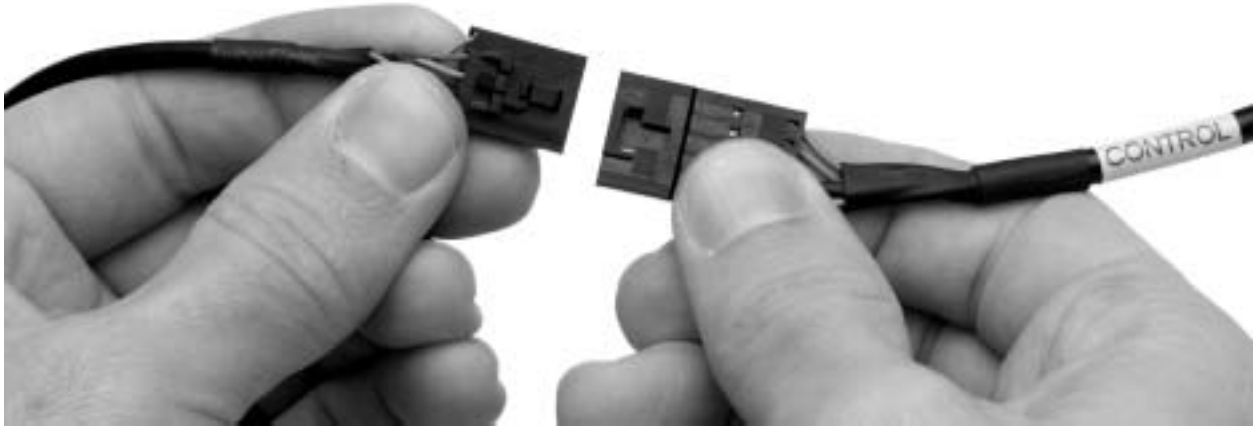


Figure 4-9. Connect the Control Box

7. Connect a computer to USB or serial interface connection. Review Table 3-6 For RS-232 Connection Details

Figure 4-10. Connect the USB or Serial Interface Cable

A null-modem cable <u>will not</u> operate the Coherent CUBE laser system.

Table 4-1. RS-232 Pin Connections

PIN NUMBER	DESCRIPTION
DE-9 INTERFACE CABLE CONNECTOR	
2	RS-232 Transmit
3	RS-232 Receive
5	Ground
DE-15 LASER CONNECTOR	
4	RS-232 Transmit
5	RS-232 Receive
6	Ground

8. Connect the external pulse source to the SMB connector.

The SMB input connector requires a 50 Ω input impedance. The digital input requires a TTL high for laser on and TTL low for laser off.

The laser will start in CW mode at full power prior to sending the CW=0 command for pulse operation.

9. Apply power to the laser using the power supply rocker switch.
10. Turn the control box keyswitch to the ON position to initiate laser emission.

The Coherent CUBE laser system is shipped in CW Auto-start mode with a 5-second CDRH-required delay. The laser emission will be active approximately 5 seconds after the keyswitch is set to the ON position.

11. The factory default system configuration and the procedure described above will allow for computer control without additional configuration settings. If computer control is not desired, the system will auto-start without additional hardware or settings required.

12. For RS-232 communication, use the following settings:

Table 4-2. RS-232 Communications

Baud	19200
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	None

13. For USB communication, refer to the paragraph titled "USB Control" in Section Five: Operation.

14. Once remote communication is established, use the “CW=0” command to set pulse operation mode. When pulse mode is active, the laser modulation will be controlled by the TTL input through the SMB connector.

15. Use the “CAL” command to control the amplitude of the pulse output. Enter a power <value> in mW using the following command for example. “CAL=<value>”.

Refer to the paragraph titled "RS-232 Remote Control" in Section Five: Operation for a complete list of computer controls and queries. All remote computer settings are stored each time the system is powered down. Use the “?S” query to display a complete list of current settings.

SECTION FIVE: OPERATION

Introduction

Normal operation assumes that the following initial configuration steps have been taken:

1. Laser system has been mounted with the proper heat sink and torque specifications. Refer to the Section Three: Installation, for heat sink and torque requirements.
2. The interface cable has been connected to the laser, power supply and control box.
3. The main power switch on the power supply is in the OFF (the "0") position.
4. The keyswitch on the control box is in the OFF position.
5. The laser has been connected to the power supply.
6. The power supply has been connected to electrical power.

CW Operation

Auto-start

The Coherent CUBE laser system is shipped in CW auto-start mode with a 5-second CDRH-required delay. The laser emission will be active approximately 5-seconds after the keyswitch is set to the ON position.

1. Apply system power with the power supply rocker switch.
2. Turn the control box keyswitch to the ON position to initiate laser emission. Laser emission occurs approximately 5-seconds after the keyswitch is set to the ON position.
3. Take appropriate safety measures to avoid exposure to direct or reflected laser radiation.
4. Move the laser shutter to the OPEN position as indicated on the laser head top label.
5. The factory default system configuration and the procedure described above will allow for computer control without additional configuration settings.

Refer to the paragraph titled "RS-232 Remote Control" in this section for a complete list of computer controls and queries. All remote computer settings are stored each time the system is powered down. Use the "?S" query to display a complete list of current settings.

Analog Control

The Coherent CUBE laser system provides the capability to control the output power with an external voltage source. Input the analog voltage through the control box BNC connector. The Analog Control can change the output power at a maximum bandwidth of 350 KHz. The external analog input provides the capability to vary the output power from minimum to 100% with a corresponding input analog voltage from 0 to 5 V. A DC Input provides direct CW power control.

Note: You must send the EXT=1 command through RS-232 or USB for the Analog Power Control to be active.

The Coherent CUBE laser system provides a complete set of input and output controls through the DE-15 connector. Review the DE-15 connector summary for a complete list of functions.

RS-232 Remote Control

The Coherent CUBE laser system includes complete remote control capability through USB and RS-232. For USB control information, refer to the paragraph titled "USB Control" in this Section Six. The Coherent CUBE is shipped in auto-start mode. All of the RS-232 commands and queries are available in auto-start mode. To defeat the auto-start mode, short pins 1 and 2 on the interface cable I/O connector.

RS-232 Connections. The Coherent CUBE uses a standard RS-232 connection. Refer to the information below to connect directly to the Coherent CUBE DE-15 connector or the Coherent CUBE interface cable DE-9 connector.

A null-modem cable <u>will not</u> operate the Coherent CUBE laser system.

Table 5-1. RS-232 Pin Connections

PIN NUMBER	DESCRIPTION
DE-9 INTERFACE CABLE CONNECTOR	
2	RS-232 Transmit
3	RS-232 Receive
5	Ground
DE-15 LASER CONNECTOR	
4	RS-232 Transmit
5	RS-232 Receive
6	Ground

The Coherent CUBE laser system uses the following RS-232 remote communication settings.

Table 5-2. RS-232 Communication Settings

Baud	19200
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	None

Syntax:

`Command=<value>` A Coherent CUBE command is used to change a present setting. The syntax used for Coherent CUBE commands is the command followed by an equal sign and a value. No spaces are used between the command, equal sign and the value.

`?Query` A Coherent CUBE query is defined by a question mark ("?") prior to the query. The current state of Coherent CUBE commands can be displayed with a "?" prior to the command. Use the "?S" query to display a complete list of current settings.

All Coherent CUBE commands and queries must be entered using all capital letters.

All Coherent CUBE command settings are stored when the system is powered down.

The Coherent CUBE command prompt provides feedback associated with the current system status and the command or query entered. Refer to the "?F" query for a complete list of values returned with the command prompt.

Table 5-3. Factory Default Settings

SETTING	DESCRIPTION
>=1	Command prompt on
CDRH=1	5-second emission delay active
DST=22	Diode set temperature is 22ºC
E=1	Echo on
P=<Nominal Laser Power>	Output power set to nominal
CW=1	CW laser emission
ANA=0	External analog connector power control
EXT=0	External power control off

Coherent CUBE CW Commands

*Query only `?<query>`
**Command `command=<value>`
***Both

`?H` displays a list of the commands and the associated descriptions

Table 5-4. CW RS-232 Commands and Queries (Sheet 1 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
>	***Prompt ON-OFF	0, 1	Turns the command prompt on or off. This setting is stored into memory, so it remains the same even after a power on/off cycle.
CDRH	***5-Second Delay ON-OFF	0, 1	Toggles the CDRH-required 5-second emission delay on and off.
?BT	*Base Plate Temp	0-55	Returns the present base plate temperature in degrees Celsius.
?C	*Laser Diode Current	0-255	Returns the present operating current of the laser diode in mA.
CLS	**Clear Screen	N/A	Clears text from a serial communication screen.
DST	*Diode Set Temp.	15-35	Returns the set temperature of the laser diode in degrees Celsius.
?DT	*Diode Present Temp.	15-35	Returns the present measured temperature of the laser diode in degrees Celsius.
E	**Echo ON-OFF	N/A	Sets or reads “Echo Off” feature. This feature turns the echo (on the serial communication terminal) on or off. This feature is useful if a computer script/program instead of a person were controlling the laser.
?F	*Fault Number	See Table 5-5 for fault codes.	
?FF	*Fault Binary Code	See Table 5-5 for fault codes.	
?FL	*Fault List	See Table 5-5 for fault codes.	
?HH	*Usage Hours Head	N/A	Returns the present head hours with a ####.## resolution. The head hours are stored in 1-minute intervals.
?HID	*Head ID Value	N/A	Returns head serial number, system part number and nominal wavelength. The value is returned as a comma-delimited string.
L	***Laser ON-OFF	0, 1	Sets the laser status: 1 = Turns the laser on. The TEC servo must be on (T = 1) to set L = 1. 0 = Turns the laser output off.
P	***Laser power	0, MAXLP	Sets laser power in mW. The range of P values is based on the minimum laser threshold power (?MINLP) and the maximum laser power (?MAXLP). ?P returns the present laser power.

Table 5-4. CW RS-232 Commands and Queries (Sheet 2 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
?H	Help	N/A	The ?H query displays all available RS-232 Commands and Queries. The output associated with the ?H query is shown below. ?H *0=OFF, 1=ON* ---Control Commands--- >= Prompt ABIAS= Diode Threshold Current ANA= Analog Current Mode CAL= Calibrate Laser Power In Pulse CW= CW or Pulse Mode CDRH= Laser Delay CLS Clear Text DST= Diode Set Temp E= Echo EXT= External Laser Power Mode L= Laser P= Laser Power IN & OUT T= TEC ---Query commands--- ?> Prompt status ?ABIAS Diode Threshold Current ?ANA Analog Current Mode ?BT Base Plate Temp ?C Laser Diode Current ?CDRH Laser Delay ?CW CW or Pulse Mode ?DST Get Diode Temp ?DT Diode Present Temp ?E Echo ?EXT External Laser Power Mode ?F Fault Bits Decimal ?FF Fault Bits Binary ?FL Fault List ?HH Hour Counter ?HID Head ID Value ?INT Interlock Status ?LCK Interlock Status ?L Laser ?M Manual Auto Start ?MAXLP Max Light Constant Pwr ?MINLP Min Light Constant Pwr ?NOMLP Nominal Laser Pwr ?OT Over Temp ?PVPS Protocol ?SP Get Laser Power ?STA Operating Status Number ?SVPS Software ?SV Software Version ?T TEC ?WAVE Laser Wavelength
?S	Status	N/A	The ?S query displays the current system settings. The output associated with the ?S query is shown below: (The displayed values represent a 405 nm system running in pulse mode.) CUBE:0> ?S CDRH=1 DST=22.00 SP=50.00 L=1 T=1 CW=0 ANA=1 EXT=0

Table 5-4. CW RS-232 Commands and Queries (Sheet 3 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
?SP	*Set Power Out	0, MAXLP	Returns the present laser power setting in mW. This value represents the last value entered with the P command.
?SV	*Software Version	N/A	Reads the Coherent CUBE firmware version.
?STA	*Operating Status #	N/A	Returns an integer value representing the present Coherent CUBE laser system operating status. 1 = Warm-up 2 = Standby 3 = Laser ON 4 = Error 5 = System Halted (Fatal Error)
?M	*Auto-start	0, 1	Returns the status of the auto-start control DE-15 pin 3. The auto-start pin normally floats high with no connection. When this pin is tied to ground, computer control is required for laser emission.
?MINLP	*Min. Light Cont. Pwr.	N/A	Returns the minimum power available in CW light control mode. The value is returned in mW.
?MAXLP	*Max. Light Cont. Pwr.	N/A	Returns the maximum laser power available in CW light control mode. The value is returned in mW.
?NOMP	*Nominal Laser Pwr.	N/A	Returns the nominal CW laser output power in mW.
?WAVE	*Laser Wavelength	N/A	Returns the laser operating wavelength, based on a diode temperature of 25ºC.
?INT or ?LCK	*Interlock Status	0, 1	Returns the status of the interlock DE-15 pin 1 status. 1 = Closed 0 = Open
?PVPS	*Protocol Version	N/A	Reads the software protocol version. If the Coherent CUBE firmware is imbedded into a process, the ?PVPS query can be used to check for changes in the command structure. If the firmware version changes without changes to the command structure, the ?PVPS query will return the same value for separate firmware versions.

Table 5-4. CW RS-232 Commands and Queries (Sheet 4 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
EXT	***Ext. Analog laser pwr. control	0,1	Commands either the power or current to be set by the external Analog Modulation input. A query of this command returns the status of this command. EXT=1 for external EXT=0 for internal. The external connector is located at the laser pin 8 on the DE-15 connector.
T	***Turns TE ON	0, 1	Reads or Sets the TEC status. 1 = Enables temperature control of the laser diode 0 = Disables the temperature control and turns off the laser emission automatically
CW	***CW or Pulse Mode	0, 1	Switches the operating mode from CW (CW=1) to pulse (CW=0). If pulse mode is set, the laser will run at the threshold power if no voltage is present at the digital pulse input connector.

?F - The ?F fault returns the fault status as an integer value representing the sum of all current faults.

?FF - The ?FF fault returns the fault status as a two byte binary representation of the current fault.

0000 0000 0000 0000
MSB LSB

?FL - The ?FL query returns the fault status as a binary string.

Table 5-5. Fault Codes

?F	?FF	?FL	DESCRIPTION	CAUSE	POSSIBLE SOLUTION
ERROR VALUE	BIT	BIT			
0			System OK		
1	0 LSB	1	Bad Command	Syntax error associated with the command	Review and correct command syntax
2	1	2	Bad Data	Entered data is out of range or syntax error associated with the data	Review range of entered data or correct syntax
4	2	3	EEPROM Checksum Error	Error associated with system EEPROM	Reboot the laser system. If the problem persists, return to Coherent for service.

Table 5-5. Fault Codes (Continued)

?F	?FF	?FL	DESCRIPTION	CAUSE	POSSIBLE SOLUTION
ERROR VALUE	BIT	BIT			
8	3	4	Base Plate Temperature	Base Plate temperature greater than 50ºC	Improve heat sink to reduce base plate temperature.
16	4	5	Laser Diode Temperature	Difference between diode set temperature and measured diode temperature is greater than 5ºC.	Improve heat sink to reduce diode temperature.
32	5	6	Interlock Fault	Interlock Open	Close Interlock Connection
64	6	7	I2C Error	Processor to Hardware communication error.	Reboot the laser system. If the problem persists, return to Coherent for service.
128	7	8	Value out of Range	Command entered correctly with a value that is excessive or deficient for command.	Review range of entered data and correct as necessary.
256	8	9	nc		
512	9	10	nc		
1024	10	11	Flash Reset	Internal Error causes a reset condition for all present settings.	Enter desired values for all system parameters.
2048	11	12	Over Current	Laser Current exceeds 120% of the new system current. This is a result of diode degradation over time.	Return to Coherent for diode replacement.
4096	12	13	Reset Clock	Internal Error causes system clock reset.	
8192	13	14	System Time Out	Command is not acknowledged by the processor.	If the problem persists, return the system to Coherent for repair.
16384	14	15	Buffer Overflow	An excessive number of commands are issued. The typical command response time is 250msec.	Space commands by 250msec.
32768	15	16	Fatal Error	Processor error	Reboot the laser system. If the problem persists, return to Coherent for service.

Additional pulse specific commands are listed in the Table 5-9.

Pulse Operation

The Coherent CUBE laser system provides the capability to provide CW or pulsed laser emission. The pulsed output must be controlled with external analog or digital signals. The control box BNC provides analog input control to 350 KHz. The laser SMB connector provides digital TTL input laser control to 150 MHz.

Digital Control

The Coherent CUBE laser system requires a remote computer control box to initiate digital pulse operation.

The control box BNC connector has an input impedance of 2.2 K Ohm. The laser SMB connector has an input impedance of 50 Ohms.

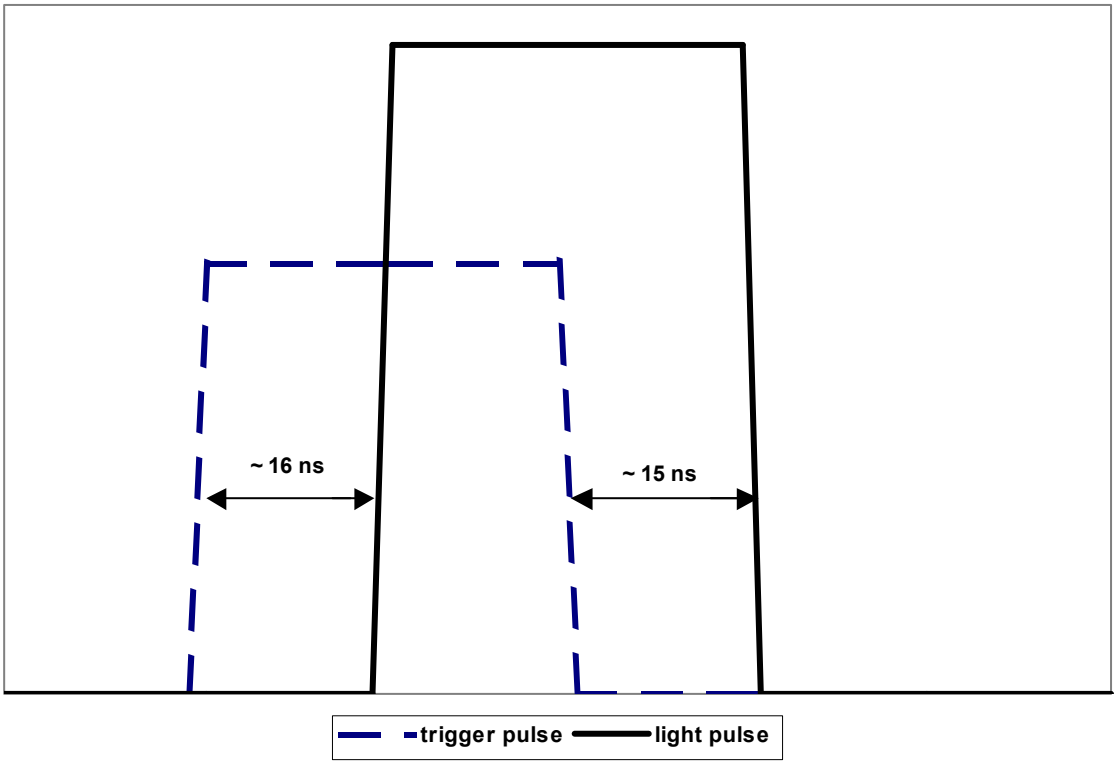


Figure 5-1. Pulse Timing Diagram

1. Connect the laser as shown in the Section Three: Installation.
2. Connect a signal generator cable (impedance Z = 50Ω) between the laser head and to the RF-source (maximum frequency < 150 MHz).

   The RF-Output has to be TTL-level (VIL< 0.8 V and VIH> 2.6 V) with an impedance of 50 Ω.

   The TTL levels must be maintained for a minimum of 2.5 ns. The logic of the laser head electronics is "active high", which means that the TTL high level is equal to laser on. For delays between Trigger pulse and light output, refer to Figure 5-1.

   The control box BNC connector can be used to control the laser power between threshold and 100% with a voltage of 0 V to 5 V respectively. The maximum frequency is 350 KHz.

Analog Control

The control box BNC connector can be used to control the laser power at rates up to 350 KHz. The control box BNC connector provides the capability to control the laser power with an analog input proportional to the laser output. The analog input can be combined with the digital input to control the amplitude of the high frequency modulation signal at the 350 KHz rate. For example: the laser can be modulated at 150 MHz with a continuously changing amplitude up to 350 KHz.

Note: You must send the EXT=1 command through RS-232 or USB for the Analog Power Control to be active.

Table 5-6. Modulation Input Connections

Pin Number	Range	Description
DE-15 Connector		
8	0 – 5 V	Analog Input (+) 350 KHz Maximum Bandwidth
6	N/A	Analog Input (–) Ground for Analog Input
SMB CONNECTOR		
Center	< 0.8 V	TTL Low Signal = Laser Threshold Power
	> 2.6 V	TTL High Signal = Nominal or Stored Laser Power
Outside		SMB Connector Ground

RS-232 Remote Control

The Coherent CUBE laser system includes complete remote control capability through USB and RS-232. For USB control information, refer to the USB Control section.

The Coherent CUBE is shipped in Auto-start mode. All of the RS-232 commands and queries are available in Auto-start mode.

To defeat the Auto-start mode, insert a jumper between pins 1 and 2 on the interface cable I/O connector.

RS-232 Connections. The Coherent CUBE uses a standard RS-232 connection. Refer to the information below to connect directly to the Coherent CUBE DE-15 connector or the Coherent CUBE interface cable DE-9 connector.

A Null-modem cable <u>will not</u> operate the Coherent CUBE laser system.

Table 5-7. RS-232 Pin Connections

PIN NUMBER	DESCRIPTION
DE-9 INTERFACE CABLE CONNECTOR	
2	RS-232 Transmit
3	RS-232 Receive
5	Ground
DE-15 LASER CONNECTOR	
4	RS-232 Transmit
5	RS-232 Receive
6	Ground

The Coherent CUBE laser system uses the following RS-232 remote communication settings.

Table 5-8. RS-232 Communication Setting

Baud	19200
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	None

The following table contains a complete list of RS-232 commands and queries. Use the "?S" query to display a list of current settings.

*Query only ?<query>
**Command command=<value>
***Both

Table 5-9. Pulsed RS-232 Commands and Queries (Sheet 1 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
>	***Prompt ON-OFF	0, 1	Turns the command prompt on or off. This setting is stored into memory so that it remains the same even after a power on/off cycle.
CDRH	***5 Sec. Delay ON-OFF	0, 1	Toggles the CDRH-required 5-second emission delay on and off.
?BT	*Base Plate Temp	0-55	Returns the present base plate temperature in degrees Celsius.
?C	*Laser Diode Current	0-255	Returns the present operating current of the Laser diode in mA.
CLS	**Clear Screen	N/A	Clears text from a serial communication screen.
DST	*Diode Set Temp.	15-35	Returns the set temperature of the Laser diode in degrees Celsius.
?DT	*Diode Present Temp.	15-35	Returns the present measured temperature of the laser diode in degrees Celsius.
E	**Echo ON-OFF	N/A	Sets or reads the Echo Off feature. This feature turns character echo on serial communication terminal on or off. This feature is useful if a computer script/program rather than a person was controlling the laser.
?F	*Fault Number	See Table 5-5 for fault codes.	
?FF	*Fault Binary Code	See Table 5-5 for fault codes.	
?FL	*Fault List	See Table 5-5 for fault codes.	
?HH	*Usage Hours Head	N/A	Returns the present head hours with ####.## resolution. The head hours are stored in 1-minute intervals.
?HID	*Head ID Value	N/A	Returns head serial number, system part number and nominal wavelength. The value is returned as a comma-delimited string.

Table 5-9. Pulsed RS-232 Commands and Queries (Sheet 2 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
L	***Laser ON-OFF	0, 1	Sets the laser status. L = 1 enables the laser On. TEC servo MUST be ON (T=1) to set L=1. Setting L = 0 turns the laser output off.
P	***Laser power	0, MAXLP	Sets laser power in mW. The range of P values is based on the minimum laser threshold power (?MINLP) and the maximum laser power (?MAXLP). ?P returns the present laser power.
?SP	*Set Power Out	0, MAXLP	Returns the present laser power setting in mW. This value represents the last value entered with the P command.
?SV	*Software Version	N/A	Reads the Coherent CUBE firmware version.
?STA	*Operating Status #	N/A	Returns an integer value representing the present Coherent CUBE laser system operating status. 1 = Warm Up 2 = Standby 3 = Laser ON 4 = Error 5 = System Halted (Fatal Error)
?M	*Auto-start	0, 1	Returns the status of the Auto-start control DE-15 pin 3. The Auto-start pin normally floats high with no connection. When this pin is tied to ground, computer control is required for laser emission.
?MINLP	*Min. Light Cont. Pwr.	N/A	Returns the minimum power available in CW light control mode. The value is returned in mW.
?MAXLP	*Max. Light Cont. Pwr.	N/A	Returns the maximum laser power available in CW light control mode. The value is returned in mW.
?NOMP	*Nominal Laser Pwr.	N/A	Returns the nominal CW laser output power in mW.
?WAVE	*Laser Wavelength	N/A	Returns the laser operating wavelength, based on a diode temperature of 25ºC.

Table 5-9. Pulsed RS-232 Commands and Queries (Sheet 3 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
?H	Help	N/A	The ?H query displays all available RS-232 Commands and Queries. The output associated with the ?H query is shown below. ?H *0=OFF, 1=ON* ---Control Commands--- >= Prompt ABIAS= Diode Threshold Current ANA= Analog Current Mode CAL= Calibrate Laser Power In Pulse CW= CW or Pulse Mode CDRH= Laser Delay CLS Clear Text DST= Diode Set Temp E= Echo EXT= External Laser Power Mode L= Laser P= Laser Power IN & OUT T= TEC ---Query commands--- ?> Prompt status ?ABIAS Diode Threshold Current ?ANA Analog Current Mode ?BT Base Plate Temp ?C Laser Diode Current ?CDRH Laser Delay ?CW CW or Pulse Mode ?DST Get Diode Temp ?DT Diode Present Temp ?E Echo ?EXT External Laser Power Mode ?F Fault Bits Decimal ?FF Fault Bits Binary ?FL Fault List ?HH Hour Counter ?HID Head ID Value ?INT Interlock Status ?LCK Interlock Status ?L Laser ?M Manual Auto Start ?MAXLP Max Light Constant Pwr ?MINLP Min Light Constant Pwr ?NOMLP Nominal Laser Pwr ?OT Over Temp ?PVPS Protocol ?SP Get Laser Power ?STA Operating Status Number ?SVPS Software ?SV Software Version ?T TEC ?WAVE Laser Wavelength
?S	Status	N/A	The ?S query displays the current system settings. The output associated with the ?S query is shown below: (The displayed values represent a 405 nm system running in pulse mode.) CUBE:0> ?S CDRH=1 DST=22.00 SP=50.00 L=1 T=1 CW=0 ANA=1 EXT=0

Table 5-9. Pulsed RS-232 Commands and Queries (Sheet 4 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
?INT or ?LCK	*Interlock Status	0, 1	Returns the status of the interlock DE-15 pin 1 status. 1 = Closed 0 = Open
?PVPS	*Protocol Version	N/A	Reads the software protocol version. If the Coherent CUBE firmware is imbedded into a process, the ?PVPS query can be used to check for changes in the command structure. If the firmware version changes without changes to the command structure, the ?PVPS query will return the same value for separate firmware versions.
T	***Turns TE ON	0, 1	Reads or Sets the TEC status. 1 = Enables temperature control of the laser diode. 0 = Disables the temperature and turns the laser emission off, automatically.
CW	***CW or Pulse Mode	0, 1	Switches the operating mode from CW (CW=1) to pulse (CW=0). If pulse mode is set, the laser will run at the threshold power if no voltage is present at the digital pulse input connector.
ANA	***Analog Control Mode	0, 1	Switches between control of the current (ANA=1) or power (ANA=0) by the external analog control line. A query of this command returns the status of this command. The ANA=1 command is not available in CW mode.
EXT	***Ext. Analog laser pwr. control	0,1	Commands either the power or current to be set by the external Analog Modulation input. A query of this command returns the status of this command. EXT=1 for external EXT=0 for internal. The external connector is located at the laser pin 8 on the DE-15 connector.
CAL	***Cal. Laser Power in Pulse	Threshold - MAXLP	Sets the calibration of the laser output power (in pulse mode) by: – Closing the light feedback loop – Adjusting the current to bring the power back to a specified set level Entering a value for the CAL command sets the amplitude of a digital pulse to a specified level.

Syntax:

`Command=<value>` A Coherent CUBE command is used to change a present setting. The syntax used for Coherent CUBE commands is the command followed by an equal sign and a value. No spaces are used between the command, equal sign and the value.

`?Query` A Coherent CUBE query is defined by a ? prior to the query. The current state of Coherent CUBE commands can be displayed with a ? prior to the command. Use the "?S" query to display a complete list of current settings.

All Coherent CUBE commands and queries must be entered using all CAPITAL LETTERS.

All Coherent CUBE command settings are stored when the system is powered down.

The Coherent CUBE command prompt provides feedback associated with the current system status and the command or query entered. Refer to the "?F" query for a complete list of values returned with the command prompt.

Table 5-10. Factory Default Settings

SETTING	DESCRIPTION
>=1	Command prompt on
CDRH=1	5-second emission delay active
DST=22	Diode set temperature is 22ºC
E=1	Echo on
P=<Nominal Laser Power>	Output power set to nominal
CW=1	CW laser emission
ANA=0	External analog connector power control
EXT=0	External power control off

SECTION SIX: COMPUTER CONTROL

USB Control

The Coherent CUBE laser system includes USB laser control. The USB remote communication provides the ability to control and query a maximum of 127 Coherent CUBE laser systems simultaneously. Each Coherent CUBE laser system includes Coherent CUBE connection software for USB laser control in a graphical user interface (GUI) environment.

Note: All RS-232 commands and queries are available via USB. Review the RS-232 Remote Control section for additional information.

Each Coherent CUBE laser system includes a USB interface cable. The Coherent CUBE bandwidth represents USB 1.1 speed.

Note: Coherent does not guarantee simultaneous CUBE operation with other USB devices.

Coherent CUBE Connection Software

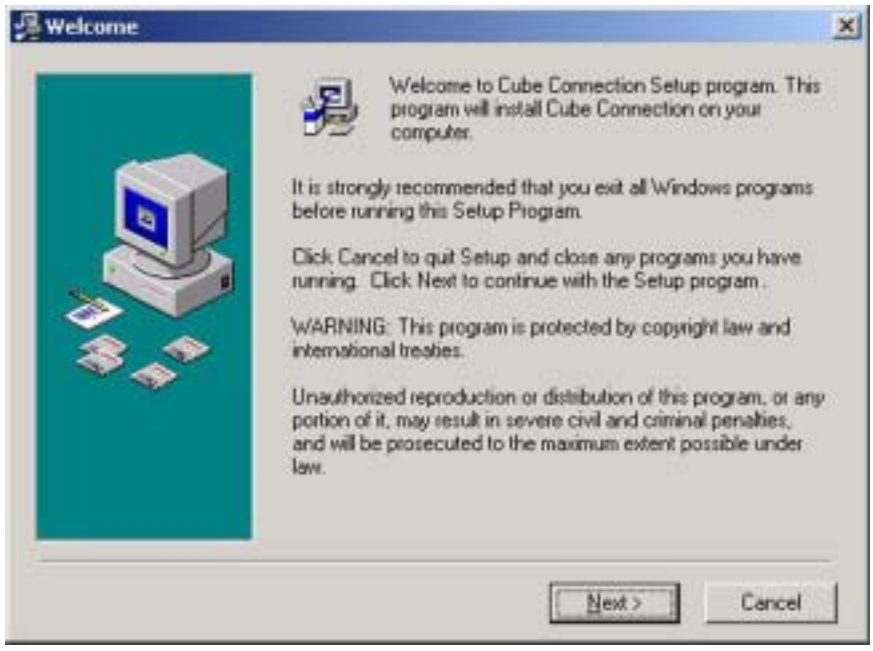
The Coherent CUBE connection software provides simple graphical access to the Coherent CUBE system. Variable settings are graphically displayed and binary functions are set with the click of a mouse. The CUBE connection software offers a terminal window to enter standard RS-232 commands as text for program development purposes. The Coherent CUBE RS-232 command protocol requires capital letters for each command or query. The Coherent CUBE connection software converts lower case commands to the upper case requirement automatically.

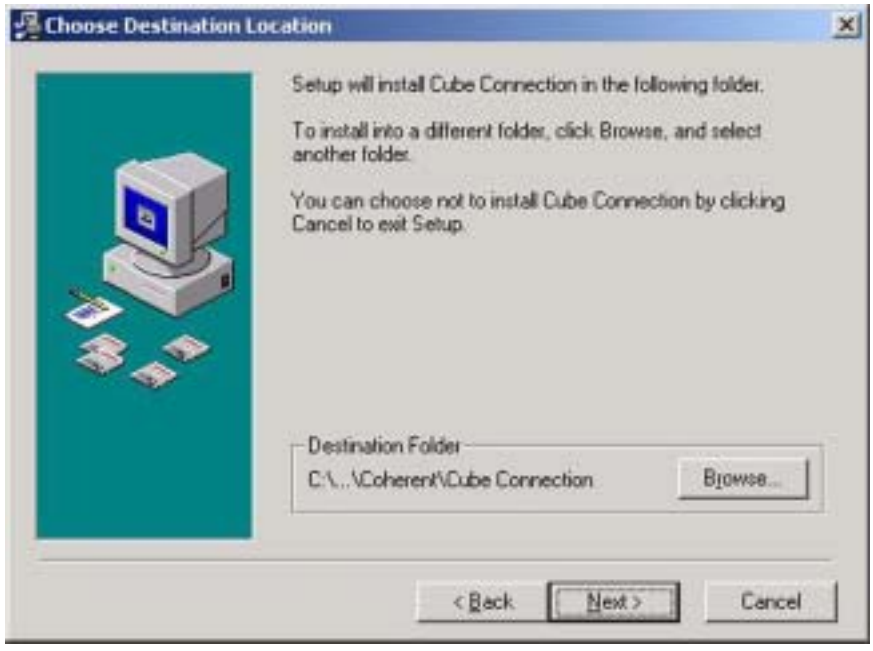
The Coherent CUBE connection software generally operates intuitively. The limits of adjustable parameters and operation of binary functions are described in the paragraph titled "RS-232 Remote Control" in Section Five. The Coherent CUBE connection software includes on-line help to assist in resolving issues associated with software functions. The CUBE connection software is compatible with all USB versions of Coherent CUBE systems.

CUBE Connection Software Installation

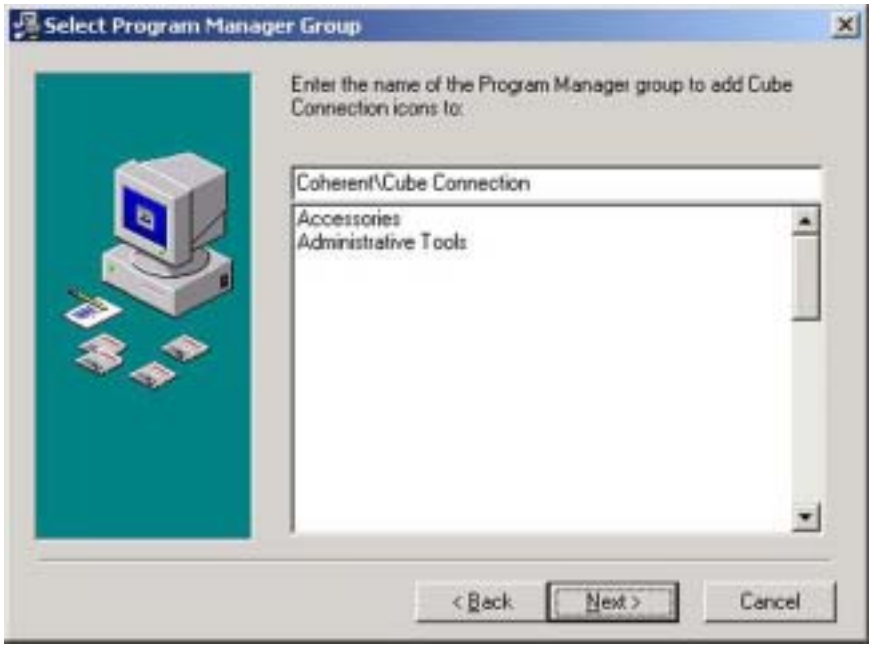
The Coherent CUBE connection software CD contains the software and USB drivers necessary to operate the Coherent CUBE remotely via USB. To start the installation process, insert the Coherent CUBE connection CD into the your computer CD drive. The Coherent CUBE connection software installation will Auto-start. The Coherent CUBE connection software installation process will load the necessary USB drivers automatically. The following text and illustrations will walk you through the software installation process.

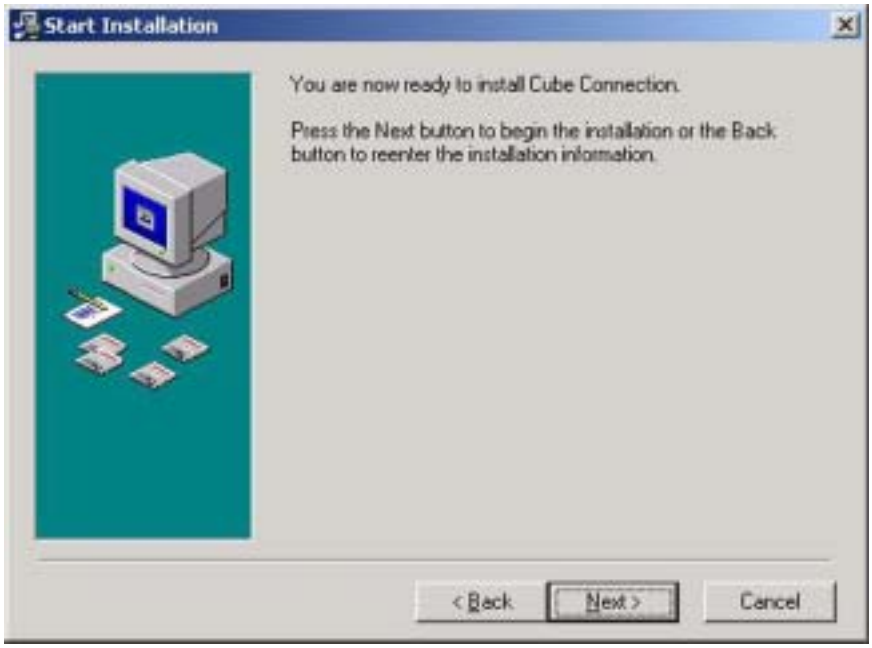
1. The Coherent CUBE connection software installation will be initiated with the preceding dialog.
2. The first installation dialog will prompt the user to close all windows programs prior to proceeding with the installation. Click "Next" to continue the installation process.
3. The second installation dialog will display the default location for the Coherent CUBE connection software installation. Click "Next" to continue the installation or click "Browse" to select a desired installation location.
4. The third installation dialog displays the program manager designation for the Coherent CUBE connection software. The text will appear when you click "Start" then "Programs" in Windows.
5. The fourth installation dialog completes the location settings associated with the Coherent CUBE connection software installation. Click the "Back" button to change the present settings. Click the "Next" button to install the software in the selected location.





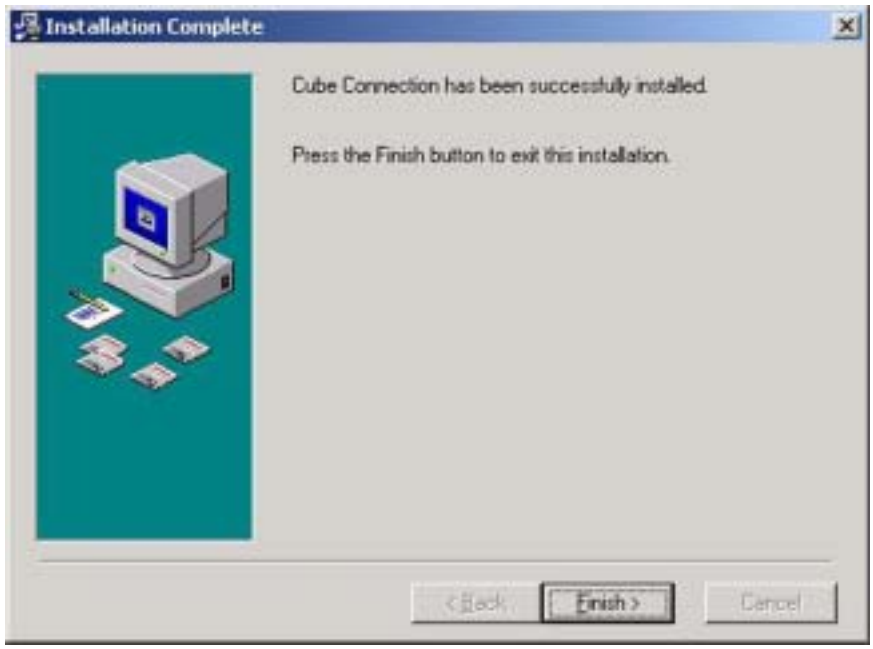
6. The fifth installation dialog displays the progress of the Coherent CUBE connection software installation.
7. The sixth installation dialog will confirm the successful installation of the Coherent CUBE connection software.
8. The computer must be restarted to register the Coherent CUBE connection supporting files and USB drivers.





9. The Coherent CUBE connection software installation complete.


Installing
Current File
Skipping Visual Basic Runtime:
C:\WINNT\system32\mfc42.dll
All Files
Time Remaining 0 minutes 3 seconds
< Back
Next >
Cancel


Installation Complete
Cube Connection has been successfully installed.
Press the Finish button to exit this installation.
< Back
Finish >
Cancel


Install
This system must be restarted to complete the installation. Press the OK button to restart this computer. Press Cancel to return to Windows without restarting.
OK
Cancel

CUBE Connection Tool Bar

The CUBE Connection Tool Bar provides quick access to CUBE Connection screens and functions. Menu access to the Open, Save and Print functions is located in the File menu. Menu access to CUBE Connection screens is located in the View menu.

Open Button

 – The Open button will display a standard Windows Open dialog. The default file type is .cfg representing Configuration file. The Configuration file is used to store and recall all CUBE Connection settings.

Save Button

 – The Save button will display a standard Windows Save dialog. Enter a desired file name and click "Save" to store all current CUBE Connection settings to a .cfg file. Use the "Open" button to restore these settings later.

Print Button

 – The Print button provides the capability to print Configuration files or the active CUBE Connection window. Select the type of print function and click "OK" to print on the selected printer.

Home Button

 – The Home button will switch to the Home screen. Review the Home screen for additional detail associated with screen functions.

Settings Button

 – The Settings button will switch to the Settings screen. Review the Settings screen for additional detail associated with screen functions.

Information Button

 – The Information button will switch to the Information screen. Review the Information screen for additional detail associated with screen functions.

Fault Button

 – The Fault button will switch to the Fault screen. Review the Fault screen for additional detail associated with screen functions.

Terminal Button

 – The Terminal button will switch to the Terminal screen. Review the Terminal screen for additional detail associated with screen functions.

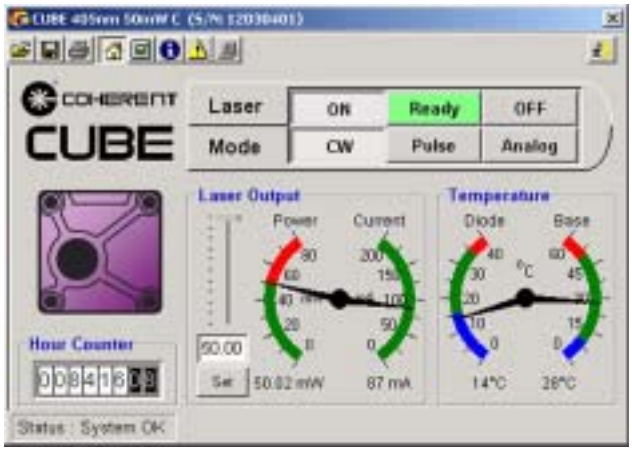
System Status

– The System Status is displayed at the bottom of all CUBE Connection screens. The status indicates normal operation or fault condition. If a fault condition is indicated, check the Fault Screen for the specific fault. If a fault has the capability to reduce laser diode life, laser emission will be interrupted until the fault is resolved.

CUBE Connection Screens

Home Screen

The CUBE Connection Home Screen displays common information associated with the laser operation. The Current Gauge can be displayed or hidden with a check box on the Setting Screen. Specific Faults are displayed on the Fault Screen.



Wavelength Icon

The displayed icon color indicates the wavelength of the laser connected to the CUBE Connection software. The values listed do not indicate the exact laser wavelength. The specific diode wavelength is shown on the system serial number label.

Hour Counter

The Hour Counter displays the current hours of laser diode operation. The counter increments when laser emission is active. When the laser is in Standby, the counter does not increment. If the laser diode is replaced, the hour counter will represent the hours of the installed diode.

Laser Emission Status

The laser emission status indicate the current state of laser output and system status. The central indicator also shows Standby, CDRH Delay and System Faults. The ON and OFF buttons are used to toggle laser emission on and off.

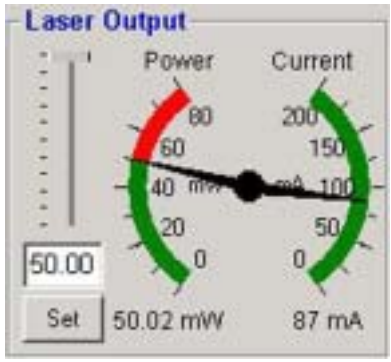
Laser Mode

The Laser Mode buttons are used to set the laser output mode. The Analog button is used to activate the External Analog Input. When the Analog button is active, the laser output is controlled by an external voltage source input to the Control Box BNC connector.

Note: When the Pulse button is active, the laser will run at threshold power. A laser running at threshold power can be interpreted as a CW laser problem. Click the CW button to restore normal CW power levels. Laser modulation is controlled by a TTL digital signal through the SMB connector.

Laser Output Indicator

The laser output indicator is a relative display of laser output power. Coherent recommends using one of the external laser power meters listed in the back of the user manual for precision measurements of laser output power. The laser output power can be changed by two methods. Enter a value and click the "Set" button to change laser power. A mouse can be used to drag the slider and click "Set" to change the laser power.

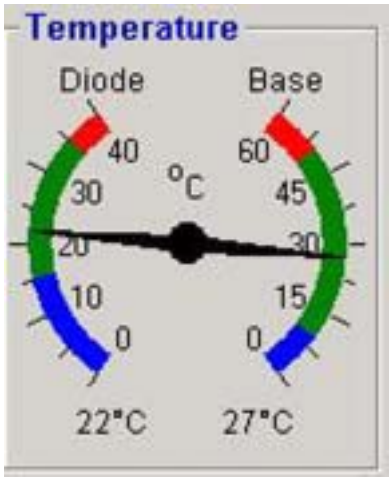


Add a relative laser current display by checking the "Show combination Power/Current gauge on home screen" box on the "Settings" screen. The displayed current should be considered a relative value.

The Green to Red transition indicates maximum laser power.

Temperature Display

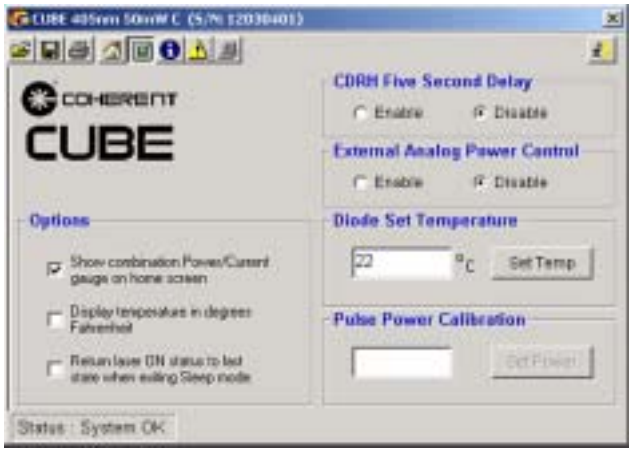
The temperature display shows a combination of the current diode and base plate temperature. The diode temperature represents the measured diode temperature and not the set temperature. Use the Settings screen to change the diode temperature.



Note: The Red to Green transition represents maximum diode and base plate temperature.

Options Screen

The Options Screen is used to change various system and display parameters. All settings displayed on the Options Screen are stored when the application is closed. Laser specific settings are stored in the laser with the laser is powered down.



Options

The Options section contains check boxes to set Home Screen display options and the laser status when exiting Sleep mode. The first check box is used to show or omit the current display in combination with the power display on the Home screen. The second check box is used to set the units for the diode and base plate temperature display on the Home screen. If the box is not checked, degrees Celsius is displayed on the Home screen. The third check box is checked, the previous laser emission status is restored with the system exits Sleep mode. If the box is not checked, laser emission is automatically restored when the system exits Sleep mode.

CDRH Five Second Delay

The CDRH Five Second Delay radio button are used to toggle emission delay status. When the Enable button is selected, a five second delay is applied each time laser emission is interrupted. These interruptions include an open interlock and fault conditions. When the Disable button is selected laser emission will be immediately restored. The system is shipped with the CDRH delay active to maintain compliance with CDRH regulations.

External Analog Power Control

The External Analog Power Control radio button is used to set the state of power control. When the External Analog Power Control is enabled, the laser output power is directly controlled by the Analog signal input through the Control Box BNC connector. When the External Analog Power Control is disabled, the laser output power is controlled by the CUBE Connection software.

Diode Set Temperature

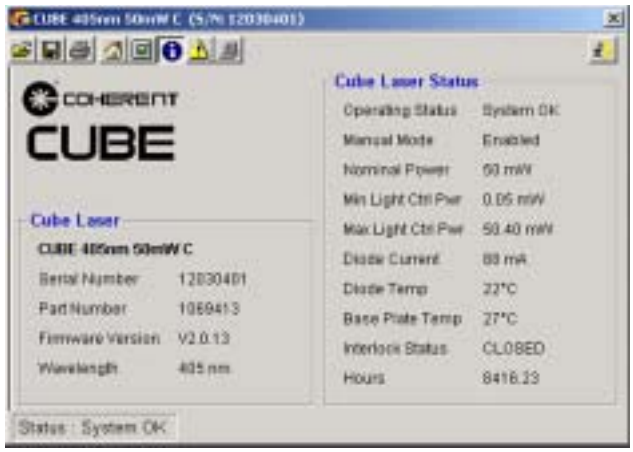
The Diode Set Temperature is an advanced procedure not recommended for a normal user. Normally the diode temperature is only changed to produce slight changes in the laser wavelength. Elevated diode temperatures can significantly reduce the diode lifetime. To change the diode temperature, enter a desired value between 15 and 35 degrees Celsius and click “Set Temp”. The factory default diode temperature is 22 degrees.

Pulse Power Calibration

The Pulse Power Calibration function sets the amplitude of the digital laser pulses. This function is only available in Pulse mode. Secondary control of the pulse amplitude is available though a voltage input to the Control Box BNC, with the External Analog Power Control active. To change the amplitude of the digital laser pulses, enter a laser power value and click “Set Power”.

Information Screen

The Information screen displays a list of system information and current performance parameters.



CUBE Laser Information

The CUBE Laser Information section contains static information associated with the selected laser. The Model Name, Serial Number, Part Number and Nominal Wavelength are read from the selected laser EEPROM. The displayed wavelength is a nominal value. The exact wavelength is shown on the system serial number label.

CUBE Laser Status

The CUBE Laser Status section contains a list of operating parameters. The information shown below represents a typical 405 nm system.

Table 6-1. Operating Parameters

PARAMETER	DESCRIPTION
Operating Status	The Operating Status displays the Standby, Fault or Ready condition of the system.
Manual Mode	The Manual Mode status represents the start-up mode for the selected system. When Manual Mode is active, laser emission is automatic following diode temperature stabilization and CDRH delay condition. When Manual Mode is disabled, the Laser On button on the Home Screen must be clicked to initiate laser emission. Manual Mode is also referred to as "Auto-start" and is controlled by the state of Pin 1 on the DE-15 or I/O connector. No connection to this pin defaults to Auto-start enabled. When this pin is pulled low, laser emission must be initiated with the CUBE Connection software.
Nominal Power	The Nominal Power represents the normal laser output power. Refer to the Max Light Ctrl Pwr for the maximum laser output power available.
Min Light Ctrl Pwr	The Minimum Light Control Power represents the laser threshold output power. The value listed will correspond to the laser output power with the system is running in Pulse Mode without a digital input to the SMB connector.
Max Light Ctrl Pwr	The Maximum Light Control Power represents the maximum power setting available.
Diode Current	The diode current displays the relative laser diode current. This is an indirect measurement and is not considered absolute. Use diode current as a tool to observe changes in diode current.
Diode Temp	The diode temperature is the measured diode temperature. This value is updated continuously. The diode set temperature is displayed on the Options screen.
Base Plate Temp	The base plate temperature is updated continuously. If the base plate temperature exceeds 50 degrees, the software will protect the diode by interrupting laser emission. When the temperature returns below 50 degrees, laser emission will be restored automatically.
Interlock Status	The interlock status is updated continuously. When the Control Box key is in the On position, the status will display as closed. If the key is switched to the Off position, the status will display as open.
Hours	The Hour Counter displays the current hours of laser diode operation. The counter increments when laser emission is active. When the laser is in Standby, the counter does not increment. If the laser diode is replaced, the hour counter will represent the hours of the installed diode.

Fault Screen

The Fault Screen displays the status of available system faults. This screen is updated continuously. When a fault is cleared, the associated fault indicator will be removed.

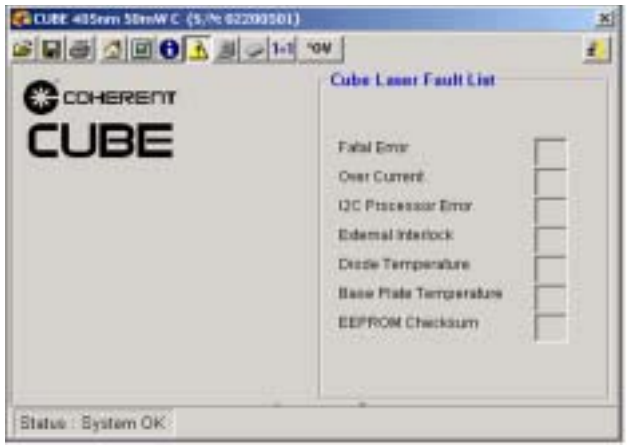
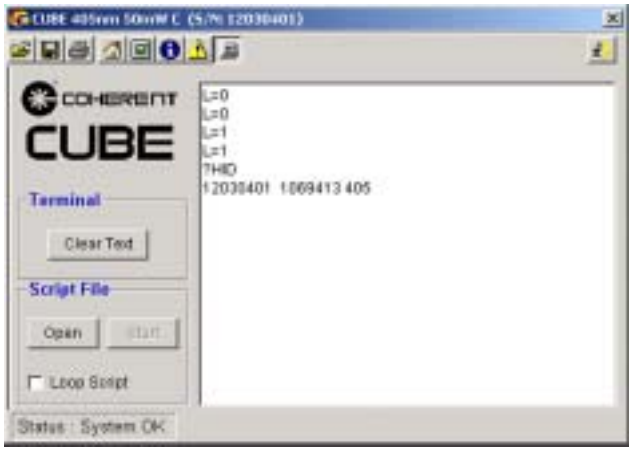


Table 6-2. Fault List

FAULT	DESCRIPTION
Fatal Error	A fatal error occurs with the CUBE firmware does not have the capability to control all laser operation parameters. Checks and balances are made continuously to ensure proper laser operation. If the laser firmware does not receive acknowledgment associated with proper system operation, the Fatal Error fault will be set. If restarting the laser system does not clear this error, the system should be returned to Coherent for repair.
I2C Processor Error	This error occurs when the process sends a command to the hardware and the appropriate response does not occur. If the processor and hardware do not synchronize, the I2C Processor Error is set. If restarting the laser does not clear the error, the system should be returned to Coherent for repair.
External Interlock	When the Control Box key switch is set to the Off position, the External Interlock fault is set. When the key switch is returned to the On position, the fault will immediately be cleared. Laser emission will be restored following verification of diode temperature and CDRH delay status.
Diode Temperature	The Diode Temperature fault is set when the measured diode temperature exceeds a difference of 5 degrees from the set temperature. When the Diode Temperature fault is set, laser emission is interrupted to protect the diode from damage. When the diode temperature difference is less than 5 degrees, laser emission will be restored, following verification of CDRH status.
Base Plate Temperature	The Base Plate Temperature fault is set when the base plate temperature exceeds 50 degrees. When the Base Plate Temperature fault is set, laser emission is interrupted to protect the diode from damage. When the base plate temperature returns to less than 50 degrees, laser emission will be restored, following verification of CDRH status.
EEPROM Checksum	Each time the laser system starts, the EEPROM checksum is compared to the value stored when the system was powered down. If the values do not agree, the EEPROM checksum fault will be set. When this fault occurs, the system will have to be returned to Coherent for repair.

Terminal Screen

The Terminal Screen is used to send individual commands or scripts to the CUBE through USB. Review the RS-232 commands and queries for a complete list of items available through the Terminal Screen. The CUBE laser requires all commands and queries to be entered as capital letters. The CUBE Connection Terminal screen automatically converts lower case to capital letters.



Terminal

The Clear Text button will clear all information displayed in the Terminal Window.

Script File

The Open button will display a standard Windows Open dialog. Select the desired Script file and click “Open”. The Script file will be loaded into the Terminal window and the “Start” button will be active. Click the “Start” button to execute the displayed script. When the “Loop Script” box is checked, the displayed script will continue to run.

Interlock Requirements

The Coherent CUBE laser system is equipped with external interlock capabilities. The interlock circuit is internally pulled low and must be connected to + 5 V to operate. 5 V on the DE-15 pin 1 represents a normal operating condition. The interlock will halt the laser output when DE-15 pin 1 is low. The interlock uses DE-15 pin 6 as a ground connection.

System Standby and Sleep Mode

For users requiring intermittent use of the Coherent CUBE laser system, two levels of non-lasing conditions are offered. The "Standby" condition represents the thermoelectric cooler (TEC) maintaining constant diode temperature with the laser diode off. A "Sleep Mode" condition includes a laser off condition combined with no TEC temperature control.

The laser output can be initiated immediately in a Standby condition. When the system is in sleep mode, it requires a warm-up cycle (not to exceed five minutes) prior to laser emission.

Standby Condition	`L=0  T=1`
Sleep Mode	`L=0  T=0`

Review the paragraph titled "RS-232 Remote Control" in Section Five for additional computer control information relating to the "L" and "T" conditions.

SECTION SEVEN: ADVANCED PROCEDURES

Diode Temperature Control

The Coherent CUBE laser system offers the ability for the user to adjust the diode operating temperature. Diode temperature variation is primarily to used make small wavelength adjustments. The diode temperature adjustments are made through remote computer commands only.

Note: Small changes in diode temperature may reduce CW laser noise resulting from Mode Hops. Change the diode temperature in 0.5 degree increments while monitoring laser noise.

The Coherent CUBE laser system provides safeguards to ensure the laser diode is never exposed to temperatures that could cause damage.

Elevated diode temperatures are proven to reduce diode lifetime. The factory default temperature is 22°C.

The maximum difference between the base plate temperature and the diode temperature is 28°C. For example: the factory diode set temperature is 22°C to allow for a maximum base plate temperature of 50°C. If the diode set temperature is reduced to 20°C, the maximum base plate temperature will be 48°C.

Reduced diode temperatures combined with elevated base plate temperatures may cause damage to the laser diode and the system electronics. The Coherent CUBE laser system will log overtemperature events and void the warranty.

Diode Temperature Adjustment Procedure

1. Refer to the USB and RS-232 computer control sections to establish remote communication with the Coherent CUBE laser system.
2. Enter the "DST=<value>" command to set the diode temperature. The number that you enter for the "<value>" represents an integer value for the proposed diode temperature. Fractional diode temperature adjustments are allowed with the Coherent CUBE laser system, with ##.# precision.

3. The range of diode temperature values allowed with the Coherent CUBE laser system is 15 to 35°C.
4. The maximum base plate temperature allowed is 50°C. The Coherent CUBE system will automatically shut the diode output down when the maximum base plate temperature is exceeded.

Diode set temperatures below 20ºC may cause condensation within the system in high humidity environments.

5. The Coherent CUBE laser system will report the current diode temperature with the "?DT" query.
6. The Coherent CUBE laser system will report the current diode set temperature with the "?DST" query. This value represents the set temperature stored in the system EEPROM.
7. The Coherent CUBE laser system will report the current base plate temperature with the "?BT" query.

CDRH Feature

The Coherent CUBE is shipped as a CDRH-compliant laser system. The CDRH-required delay of approximately 5-seconds occurs between a laser ready condition and emission of laser light. This delay allows the user to take appropriate safety precautions prior to laser emission. Once the system is running, the CDRH-required delay is not applied each time the laser emission is toggled on and off remotely.

Disable CDRH Procedure

1. Refer to the paragraph titled, "USB Control" in Section Six and the paragraph titled, "RS-232 Remote Control" in Section Five: Operation to establish remote communication with the Coherent CUBE laser system.
2. Use the "CDRH=0" command to defeat the CDRH-required delay.
3. The current CDRH-required delay state can be interrogated by the computer with the "?CDRH" query.
4. The CDRH-required delay can be restored with the "CDRH=1" command.

This operation will defeat the safety controls required by the appropriate regulatory agencies. With the use of these commands the customer assumes all responsibility for safety and proper compliance to CDRH 21 CFR 1040 and IEC60825-1.

The ability to change the state of the CDRH-required delay requires remote communication to the Coherent CUBE laser system via USB or RS-232.

The CDRH setting is stored in memory.

Diode Threshold Calibration

The Coherent CUBE laser system provides the ability to adjust the diode threshold level. The diode threshold adjustment is made to optimize pulse performance in regards to modulation depth or pulse repetition bandwidth. A secondary requirement for the threshold adjustment is to maintain specified modulation bandwidth as the laser diode ages.

The ability to change the diode threshold level requires remote communication to the Coherent CUBE laser system through USB or RS-232.

A higher diode threshold level increases the modulation bandwidth and decreases the modulation depth. A lower diode threshold level decreases the modulation bandwidth and increases the modulation depth.

Diode Threshold Adjustment Procedure

1. Refer to the paragraph titled, "USB Control" and the paragraph titled, "RS-232 Remote Control" in Section Five: Operation to establish remote communication with the Coherent CUBE laser system.
2. Use the “ABIAS=<value>” command to adjust the diode threshold level. A larger value increases the laser threshold output power. A smaller value decreases the laser output power. The values are entered in mA, with an available range of 25 mA to 75 mA. Use the “ABIAS” command to reset the Threshold level to 1/200 of the nominal laser power.

3. Use an external power meter to measure the laser threshold level. Dividing the full laser output power by the threshold level represents the modulation depth.
4. The present diode threshold level is stored in memory.
5. The "ABIAS" command does not effect CW laser operation.

This factory setting was tested to ensure both modulation bandwidth and modulation depth.

SECTION EIGHT: TROUBLESHOOTING

Introduction

If you experience problems with the Coherent CUBE laser system, explore the following checklist. If you are not successful in solving the problem or need further assistance, please contact Coherent Technical Support in the US 1-800-367-7890, or worldwide local Coherent service representative (see **www.Coherent.com** for contacts worldwide). Note: Review the ?F RS-232 query for additional troubleshooting information.

ESD Caution: Take appropriate ESD precautions when handling and installing laser. Refer to page 1-2 for complete description.

Troubleshooting Procedures

Listed below are possible problems with a reference to the associated Troubleshooting checklist located in this section.

Table 8-1. Troubleshooting Procedures

PROBLEM TROUBLESHOOTING	REFERENCE
Interlock Chain Not Closed	Checklist 1
System Does Not Turn On	Checklist 2
System Shuts Down (RS-232 Control)	Checklist 3a
System Shuts Down (Analog Control and Auto-start)	Checklist 3b
Low Power (RS-232 Control)	Checklist 4a
Low Power (Autostart Mode)	Checklist 4b
Excessive Scattered Light (All Operating Modes)	Checklist 5
Output Power Not Stable (All Operating Modes)	Checklist 6
Beam Noise Out of Spec (All Operating Modes)	Checklist 7
Control Box Does Not Communicate with RS-232	Checklist 8
Transverse Mode is Not TEMoo	Checklist 9
Base Plate Temperature Exceeds 50ºC	Checklist 10

Checklist 1:

Interlock Fault

If an interlock fault is suspected, execute the following steps.

[ ] Cycle DC power OFF/ON.

[ ] Verify supply voltage is between 4.8 VDC to 6.5 VDC.

[ ] Connect a computer and send the "?LCK" or "?INT" query. If a value of 0 is returned, check all interlock connections.

[ ] If the interlock connections are verified to be closed and the "?INT" or "?LCK" query return a 0 (Open) condition, return the system to Coherent for service.

Checklist 2:

No Laser Emission at Start-up

Laser emission should be present within 5-minutes after start-up.

[ ] Cycle DC power OFF/ON.

[ ] Ensure DE-15 connector is properly secured with locking screws.

[ ] Verify supply voltage is between 4.8 VDC to 6.5 VDC.

[ ] Use a computer to send "?LCK" or "?INT". If the response is 0, check all interlock connections.

[ ] Send the L=1 command. If laser emission is not detected, return the system to Coherent for service.

[ ] Check for proper heat sinking of the laser head. Use the "?BT" query to ensure the base plate temperature is less than 50°C.

[ ] Issue "?F" command

[ ] If fault #8 or 16 are returned, ensure the ambient temperature is less than 40°C and the base plate temperature is less than 50°C.

[ ] If fault #4 is returned, call Coherent for information on restoring factory calibration settings.

[ ] If fault #32 is returned, verify all system interlocks are closed.

[ ] If fault #64 or #32768 is returned, the system has experienced a serious problem. Return the system to Coherent for service.

Checklist 3a:
System Shuts Down (RS-232 Control)

[ ] Check for proper heat sinking of the laser head. Refer to checklist #10.

[ ] Check for proper grounding of the laser head (laser head cover must be at earth ground.

[ ] Issue "?F" command

[ ] If fault #8 or 16 are returned, ensure the ambient temperature is less than 40°C and the base plate temperature is less than 50°C.

[ ] If fault #4 is returned, call Coherent for information on restoring factory calibration settings.

[ ] If fault #32 is returned, verify all system interlocks are closed.

[ ] If fault #64 or #32768 is returned, the system has experienced a serious problem. Return the system to Coherent for service.

Checklist 3b:
System Shuts Down (Analog Control and Auto-start)

[ ] Check for proper grounding of the laser head (head cover must be at earth ground potential).

[ ] Verify the power supply is providing a voltage between 4.8 VDC and 6.5 VDC.

[ ] Measure base plate temperature. If it exceeds 50ºC, check for proper laser head heat sinking (refer to checklist #10).

[ ] If using external interlocks, verify all external interlocks are closed.

[ ] Return the system to Coherent for service.

Checklist 4a:
Low Power (RS-232 Control)

Please measure power only with a calibrated power meter prior to any external optics, or use "?P" command to obtain output power.

[ ] If the system does not achieve the specified maximum power level, use the "?SP" and "?MAXLP" query to ensure the output power is set to a maximum (MAXLP).

[ ] Make sure output window is clean.

[ ] Use the ?P RS-232 query to check the current laser power. If the returned value does not represent the expected laser power, use the P=<value> to set the desired laser power.

[ ] If system does not respond to the "?P" command, verify proper RS-232 set up.

[ ] If the value returned by ?P differs from the set power by more than 1.5 mW, return the system to Coherent for service.

[ ] Use the ?CW query to check for pulse mode. If CW=0, and no voltage is present on the SMB connector, the laser output will represent threshold. The threshold output is normally in the microwatt range.

Checklist 4b: Low Power (Auto-start Mode)

Please make sure laser power is measured by a calibrated power meter, prior to external optics.

The Coherent CUBE allow for computer control and queries in auto-start mode. Refer to RS-232 control section for appropriate computer connections and settings.

[ ] Verify output window is clean.

[ ] If using the control box for external power control, verify expected voltage to the BNC connector.

[ ] If the system does not achieve the specified maximum power level, use the "?SP" and "?MAXLP" query to ensure the output power is set to a maximum (MAXLP).

[ ] Make sure output window is clean.

[ ] Verify proper RS-232 command is issued. For example issue the P=10 command. The "?P" query or external power measurement should result in 10 mW (?P=10 mW).

[ ] If system does not respond to the "?P" command, verify proper RS-232 set up.

[ ] If "?P" response indicates low power, return the system to Coherent for service.

Checklist 5: Excessive Scattered Light (All Operating Modes)

[ ] Observe output beam prior to hitting any external optics. If output beam is OK, clean the external optics.

[ ] Verify the output window is clean.

[ ] Return the system to Coherent for service.

Checklist 6: Output Power Not Stable (All Operating Modes)

[ ] Please measure power only with a calibrated power meter prior to any external optics.

[ ] Allow the system to warm up for at least 5-minutes.

[ ] Verify output window is clean.

- [ ] Verify all cable connections are secure.
- [ ] Measure base plate temperature over a 5-minute period. If base plate temperature is not stable, check for proper heat sinking (Refer to checklist #10).
- [ ] If using the control box for laser power control, verify a stable input voltage to the BNC connector.
- [ ] Return the system to Coherent for service.

Checklist 7:
Beam Noise Out of Spec (All Operating Modes)

- [ ] Please make sure beam noise is measured prior to any external optics.
- [ ] Verify output window is clean.
- [ ] Check for proper heat sinking.
- [ ] Verify there is no vibrations at laser.
- [ ] Check for proper grounding of laser cover.
- [ ] Return the system to Coherent for service.

Checklist 8:
No RS-232 Communication

- [ ] Verify all connections are secure.
- [ ] Verify RS-232 setting (baud rate, etc.) See RS-232 control section.
- [ ] Ensure the communication cable is not a Null-modem.
- [ ] Verify cable length does not exceed 5 m.
- [ ] Use a second computer to exclude a defective RS-232 port at the controlling computer.
- [ ] Return the system to Coherent for service.

Checklist 9:
Transverse Mode is Not TEMoo

- [ ] Please make sure beam is observed prior to external optics. If the beam quality is correct, clean the external optics.
- [ ] Verify output window is clean.
- [ ] Return the system to Coherent for service.

Checklist 10:
Base Plate Over Temperature

[ ] Verify proper size of the heat sink (refer to heat sink requirements).

[ ] Verify proper operation of the heat sink (i.e., if a fan is used to cool the heat sink make sure it is operating properly.)

[ ] Verify the heat sink compound, if used, is applied evenly between the laser head and the heat sink.

[ ] Verify the surface of the heat sink contacting the laser head is flat.

[ ] Verify ambient temperature does not exceed 40ºC.

SECTION NINE: REPACKING PROCEDURE

The following is the factory recommended repacking procedure for the Coherent CUBE laser system. This procedure must be followed if the laser system is to be shipped to another location after initial installation, or returned to the factory for service.

Coherent recommends that the shipping box and packing materials be saved after initial purchase, as they will be required should the laser later be shipped or returned.

The Coherent CUBE laser system requires one shipping box, available as part #1065875. Table 9-1 is a complete listing of the components of the shipping crate when the system is shipped from Coherent.

Table 9-1. Coherent CUBE Shipping Box Contents

ITEM DESCRIPTION	QUANTITY
Coherent CUBE Laser	1
Coherent CUBE Power Supply	1
Coherent CUBE Manual	1
CUBE Connection Software CD	1
Coherent CUBE Control Box	1
Coherent CUBE Interface Cable	1
USB Cable	1

1. Repack laser into ESD-safe bag.
2. Repack laser into ESD-safe foam and black box.
3. Repack power supply into box.
4. Place laser and power supply into the system box.
5. Replace top foam over parts.
6. Close box and tape securely.
7. Always write the RMA number on the outside of the box if returning the product for service.

WARRANTY

Coherent, Inc. warrants the Coherent CUBE™ laser systems to the original purchaser (the Buyer) only; that the laser system that is the subject of this sale, (a) conforms to Coherent's published specifications, and (b) is free from defects in materials and workmanship.

Laser systems are warranted to conform to Coherent's published specifications and to be free from defects in materials and workmanship for a period of twelve (12) months*. Replacement units shipped within warranty, carry the remainder warranty of the failed unit.

Responsibilities of the Buyer

The Buyer is responsible for providing the appropriate utilities and an operating environment as outlined in the product literature. Damage to the laser system caused by failure of Buyer's utilities or failure to maintain an appropriate operating environment, is solely the responsibility of the Buyer and is specifically excluded from any warranty, warranty extension, or service agreement.

The Buyer is responsible for prompt notification to Coherent of any claims made under warranty. In no event will Coherent be responsible for warranty claims made later than seven (7) days after the expiration of warranty.

Limitations of Warranty

The foregoing warranty shall not apply to defects resulting from any of the following conditions:

- Components and accessories manufactured by companies other than Coherent, which have separate warranties
- Improper or inadequate maintenance by the Buyer
- Buyer-supplied interfacing
- Operation outside the environmental specifications of the product
- Unauthorized modification or misuse
- Improper site preparation and maintenance
- Opening the housing

Coherent assumes no responsibility for customer-supplied material. The obligations of Coherent are limited to repairing or replacing, without charge, equipment that proves to be defective during the

warranty period. Replacement sub-assemblies may contain reconditioned parts. Repaired or replaced parts are warranted for the duration of the original warranty period only. The warranty on parts purchased after expiration of system warranty is ninety (90) days. This warranty does not cover damage due to misuse, negligence or accidents; or damage due to installations, repairs or adjustments not authorized specifically by Coherent.

This warranty applies only to the original purchaser at the initial installation point in the country of purchase, unless otherwise specified in the sales contract. The warranty is transferable to another location or to another customer only by special agreement, which will include additional inspection or installation at the new site. Coherent disclaims any responsibility to provide product warranty, technical or service support to a customer that acquires products from someone other than Coherent or an authorized representative.

THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED, AND DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL LOSS. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

PARTS LIST

DESCRIPTION	PART NUMBER
SYS, CUBE 375-8 ELLIPTICAL, 375nm, 8mW	1069407
SYS, CUBE 405-50 ELLIPTICAL, 405nm, 50mW	1069408
SYS, CUBE 440-16 ELLIPTICAL, 440nm, 16mW	1069409
SYS, CUBE 635-30 ELLIPTICAL, 635nm, 30mW	1069410
SYS, CUBE 785-45 ELLIPTICAL, 785nm, 45mW	1069411
SYS, CUBE 375-8 CIRCULAR, 375nm, 8mW	1069412
SYS, CUBE 405-50 CIRCULAR, 405nm, 50mW	1069413
SYS, CUBE 440-16 CIRCULAR, 440nm, 16mW	1069414
SYS, CUBE 635-25 CIRCULAR, 635nm, 25mW	1069415
SYS, CUBE 785-40 CIRCULAR, 785nm, 40mW	1069416
CUBE Power Supply, 6 VDC, 2.5A, Switched	1072454
Accessory, Heat Sink, Coherent CUBE	1073840
Interface Cable, Coherent CUBE	1072166
USB Cable, Coherent CUBE	1073053
Control Box	1039966
Manual and CD	1079890
2nd Emission Lamp	1079150
Non-shorted RCA Plug	104080
Cable, Extension, DE-9 M/F, 6 ft. (1.8 m)	1080090

ACCESSORIES

Power Meter Accessories

Coherent offers a variety of instruments for laser test and measurement. For additional detailed information, including product selection guides, please visit our web site at **www.Coherent.com**.

For the most common diagnostics need – measuring the output power of the Coherent CUBE – below we recommend two different types of power meters, that are ideal fits to the Coherent CUBE product family.

First Recommendation

We have a great product combination that covers that entire wavelength range at those power levels. The sensor is a temperature stabilized thermopile that was designed for measurements in the ~100 µW-1 W region called a PS10Q. We recommend the FieldMax-TOP to go with the PS10Q.

An affordable, versatile, easy-to-use digital meter designed for field service and production applications. This meter features an easy-to-read LCD with a backlight, as well as direct button-driven commands for simple, no-hassle use.

FieldMax Top™ Power Meter	Part Number 0012-3790

PS10Q High Sensitivity Amplified Sensors	Part Number 0012-4600

Alternative Recommendation

A hand-held, inexpensive laser power meter specifically designed to provide power measurements in a small, lightweight, self-contained package that can easily be stored in a pocket or tool kit. With its compact size, it enables measurements at places in optical set-ups, where a standard detector head would not fit. With its built-in attenuator this device is ready to measure output powers from 0.5 µW up to 1 W.

LaserCheck™ Power Meter	Part Number 33-1553

NOTE: LaserCheck does not measure below 400 nm so it is not recommended for the Coherent CUBE 375 system.

GLOSSARY

°C	Degrees centigrade or Celsius
°F	Degrees Fahrenheit
µ	Micron(s)
µm	Micrometer(s) = 10^{-6} meters
µrad	Microradian(s) = 10^{-6} radians
µsec	Microsecond(s) = 10^{-6} seconds
$1/e^2$	Beam diameter parameter = 0.13534
AC	Alternating current
Amp	Ampere(s)
BNC	Type of connector
CDRH	Center for Devices and Radiological Health
cm	Centimeter(s)
CW	Continuous wave
DC	Direct current
ESD	Electrostatic Discharge
g	Gram(s) or earth's gravitational force (gravity)
GUI	Graphical user interface
HeNe	Helium Neon
Hz	Hertz or cycles per second (frequency) (= 1/pulse period)
IR	Infrared (wavelength)
I/O	Input/Output
kg	Kilogram(s) = 10^3 grams
KHz	Kilohertz = 10^3 hertz
Kohm	Kilohm(s)
LCD	Liquid Crystal Display
LED	Light emitting diode
m	Meter(s) (length)
mA	Milliamp(s) = 10^{-3} Amperes
mAmp	Milliampere(s)
MHz	Megahertz = 10^6 hertz
mm	Millimeter(s) = 10^{-3} meters
mrad	Milliradian(s) = 10^{-3} radians (angle)
ms	Millisecond(s) = 10^{-3} seconds
mV	Millivolt(s)
MVP	Modulation and variable power
mW	Milliwatt(s) = 10^{-3} Watts (power)
NA	Numerical aperture

nm	Nanometer(s) = 10^{-9} meters (wavelength)
n-m	Newton meter
OEM	Original equipment manufacturer
rms	Root mean square (effective value of a sinusoidal wave)
RMA	Return material authorization
TEC	Thermo-electric cooler
TEM	Transverse electromagnetic mode (cross-sectional laser beam mode)
TTL	Transistor-transistor logic
UV	Ultra violet
V	Volt(s)
VAC	Volts, alternating current
VDC	Volts, direct current
W	Watt(s) (power)

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Coherent CUBE™ Laser System Operator's Manual

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