COHERENT

Operator's Manual
Coherent CUBE™ Laser System

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Operator's Manual
Coherent CUBE Laser System

COHERENT.
27650 SW 95th Ave.
Wilsonville, OR 97070

Patents referenced in this Operator's manual were active as of the printing date of the manual (see last page for date). The patents referenced herein may have expired. You are advised to check to see if the patents are still active: http://portal.uspto.gov/external/portal/pair.

Every effort has been made to ensure that the data given in this document is accurate. The information, figures, tables, specifications and schematics contained herein are subject to change without notice. Coherent makes no warranty or representation, either expressed or implied with respect to this document. In no event will Coherent be liable for any direct, indirect, special, incidental or consequential damages resulting from any defects in its documentation.

The rights which customers of Coherent receive through purchase of this product are restricted, and exclude any right to use the product in the telecommunications field.

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 1.800.367.7890 (1.408.764.4557 outside the U.S.) or e-mail (Product.Support@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, 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 US:

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, which includes a control box. This product is shipped as a complete CDRH-compliant system.

NOTICE!
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" (p. 1-1), which describes the safety features built into the laser.

WARNING!
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.

Signal Words and Symbols in this Manual

This documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

Signal Words

Four signal words are used in this documentation: **DANGER**, **WARNING**, **CAUTION** and ***NOTICE***.

The signal words **DANGER**, **WARNING** and **CAUTION** designate the degree or level of hazard when there is the risk of injury:

DANGER!
Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING!
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION!
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

The signal word "***NOTICE***" is used when there is the risk of property damage:

NOTICE!
Indicates information considered important, but not hazard-related.

Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

Symbols

The signal words **DANGER**, **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

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.

This symbol is intended to alert the operator to the danger of crushing injury.

This symbol is intended to alert the operator to the danger of a lifting hazard.

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.

DANGER!
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.

WARNING!
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 everyone 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.

NOTICE!

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. Take the necessary measures to protect the system from ESD.

Dry air and carpet can create an 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

When used with the control box, Coherent CUBE laser systems comply with all of the requirements of CDRH (21CFR Subchapter J) and EN60825-1.

The following table lists CUBE part or item numbers, and their corresponding CDRH accession number.

Table 1-1. CUBE CDRH Accession Numbers

PART/ITEM NUMBER	ACCESSION NUMBER	PART/ITEM NUMBER	ACCESSION NUMBER
1069408	0420530-043	1112774	0420530-043
1069410	0420530-043	1116078	0420530-043
1069413	0420530-043	1117004	0420530-043
1069415	0420530-043	1118915	0420530-043
1069416	0420530-043	1128264	0420530-043
1069417	0420530-043	1130061	0420530-043
1069418	0420530-043	1139603	0420530-043
1094060	0420530-043	1139604	0420530-043
1099208	0420530-043	1142279	0420530-043
1106207	0420530-043	1149209	0420530-043

In addition to complying with CDRH and EN60825-1 requirements, the CUBE family of products has been certified by an outside testing lab to be in compliance with the environmental and safety directives listed on the following page.

EMI Standard for Emissions per:

EN55011:2007
Class A Radiated Emissions

EN55011:2007
Class A Conducted Emissions

EN61000-3-2:2006
Power Line Harmonics

EN61000-3-3:1995:A1:2001:A2:2005
Power Line Voltage Fluctuation and Flicker

EMC Standard for Immunity per:

EN61000-4-2:2003
Electrostatic Discharge – Performance Criteria B

EN61000-4-3:2006
Radiated Immunity – Performance Criteria A

EN61000-4-4:2004
Electrical Fast Transient Immunity – Performance Criteria B

EN61000-4-5:2004
Electrical Slow Transient Immunity – Performance Criteria B

EN61000-4-6:2003
Conducted RF Immunity – Performance Criteria A

EN61000-4-11:2004
Power Line Interruptions, Dips, and Dropouts – Performance Criteria B

Low Voltage Directive 73/23/EEC Tests per:

EN61010-1:2001
Safety Requirements Part 1: General Requirements

MD – Machinery Directive for Laser Devices Tests per:

EN60825-1:2001
Safety of Laser Products – Part 1: Equipment Classification Requirement and User's Guide

EN60825-2:2005
Safety of Laser Products – Part 2: Safety of Optical Fiber Communication Systems

EN60825-12:2004
Safety of Laser Products – Part 12: Safety of Free Space Optical Communication Systems Used for Transmission of Information

21CFR 1040.10

Declaration of Conformity

D137646 Revision AA

Declaration of Conformity

We

Coherent, Inc.
27650 SW 95th Ave
Wilsonville, Oregon, USA 97070

declare under sole responsibility that the

CUBE Laser Family

meets the intent of Directives 2004/108/EC for Electromagnetic Compatibility and 2006/95/EEC for Product Safety for Measurement, Control and Laboratory Equipment including the following test specifications:

EN55011:2007 Class A Radiated Emissions
EN55011:2007 Class A Conducted Emissions
EN61000-3-2:2006 Powerline Harmonics
EN61000-3-3:1995:A1:2001:A2:2005 Powerline Voltage Fluctuation and Flicker
EN61000-4-2:2003 Electrostatic Discharge – Performance Criteria B
EN61000-4-3:2006 Radiated Immunity – Performance Criteria A
EN61000-4-4:2004 Electrical Fast Transient Immunity - Performance Criteria B
EN61000-4-5:2004 Electrical Slow Transient Immunity- Performance Criteria B
EN61000-4-6:2003 Conducted RF Immunity - Performance Criteria A
EN61000-4-11:2004 Power Line Interruptions, Dips, and Dropouts - Performance Criteria B
EN61010-1:2001 Safety Requirements Part 1: General Requirements
EN60825-1:2001 Safety of Laser Products – Part 1: Equipment Classification Requirement and User's Guide
EN60825-2:2005 Safety of Laser Products – Part 2: Safety of Optical Fiber Communication Systems
EN60825-12:2004 Safety of Laser Products – Part 12: Safety of Free Space Optical Communication Systems Userd for Transmission of Information

Director of Engineering Date: 8/25/09

Director, LSM Date: 8/25/09

Coherent, Inc.

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 to 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. Refer to Figure 1-1 (p. 1-7) for additional details on the interlock circuit configuration.

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, which 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 five seconds in duration.

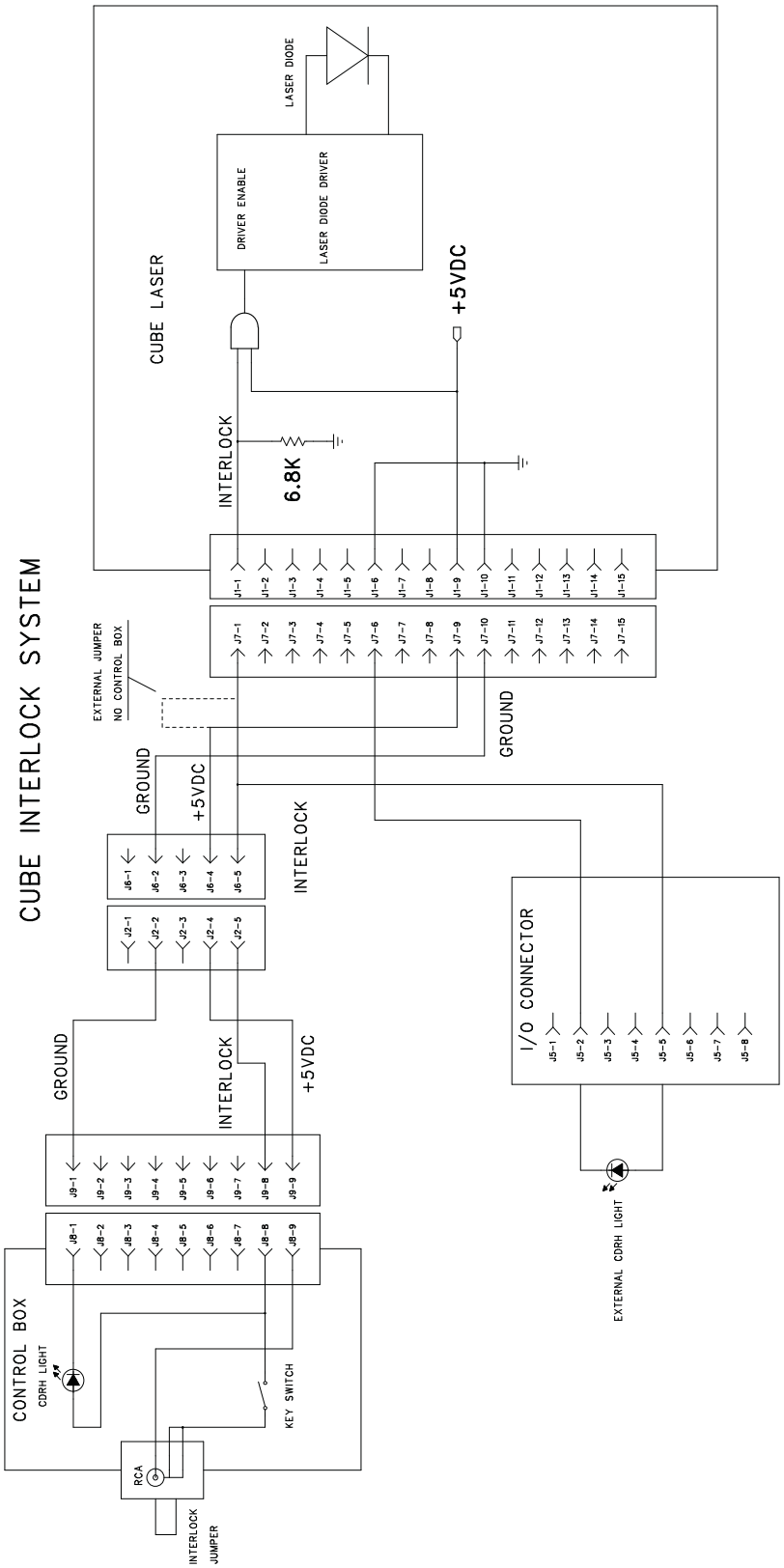


Figure 1-1. Interlock Diagram

Secondary Emission Indicator

The Coherent CUBE laser system includes the capability to add a secondary emission indicator. This indictor is sold as an accessory and connects directly to the standard Coherent CUBE interface cable. The secondary emission indicator (part number 1079150) can be mounted remotely at a distance up to 5 meters (16 feet) from the laser system.

Figure 1-2. Secondary Emission Indicator

Radiation Exposure

Use of controls, 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.

Waste Electrical and Electronic Equipment (WEEE, 2002)

The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) is represented by a crossed-out garbage container label. The purpose of this directive is to minimize the disposal of WEEE as unsorted municipal waste and to facilitate its separate collection. This crossed-out garbage container label is affixed to the cover of the CUBE.

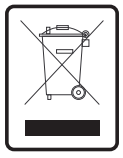
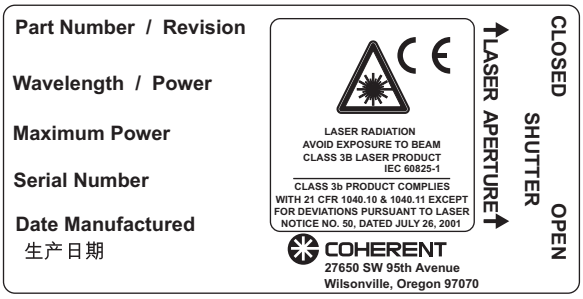
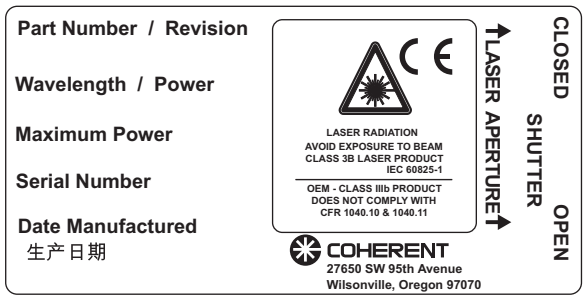


Figure 1-3. Waste Electrical and Electronic Equipment Label

Location of Safety Labels



Conforming Label



Nonconforming Label

Figure 1-4. Safety Labels

RoHS Compliance

To comply with the China RoHS (Restriction of Hazardous Substances) Directive effective March 1, 2007, a table of hazardous substances is included in this manual showing which of the offending substances is present in the CUBE.

Figure 1-5. China RoHS Table of Restricted Hazardous Substances

The table in Figure 1-5, above, shows that Lead (Pb) is present in the CUBE (due to the use of brass material) and that the environmental-friendly use period is 20 years as indicated by the 20 inside the circle.

Also, the China RoHS directive requires that the date of manufacture (in Chinese characters) for the CUBE be shown on the product. This is accomplished on the conforming/nonconforming label. Refer to the following figure.

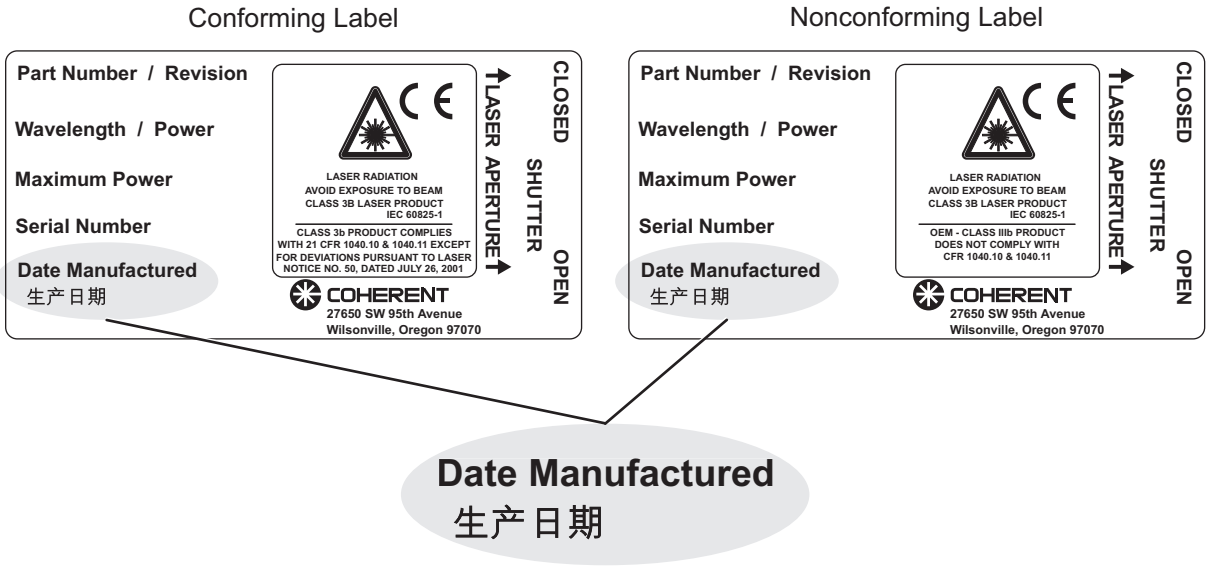


Figure 1-6. China RoHS Date of Manufacture

SECTION TWO: DESCRIPTION AND SPECIFICATIONS

System Description

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

The CUBE laser system—see Figure 2-1 (p. 2-2))—is a complete system with laser head, control box, power supply, and interface cables and can be mounted to a plate with the appropriate heat sink capability. This system delivers power, stability, and performance in a small package and at an attractive price. The CUBE laser system 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 that all of 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 50°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, which is included with each system. English and metric mounting hardware is also included.

Features

- Single transverse mode
- Thermoelectrically-cooled for extended life
- Compact package
- High-quality glass optics
- Maximum digital modulation control 150 MHz
- Maximum analog modulation control 350 KHz
- Circular or elliptical beams
- RS-232 and USB remote communication
- Coherent Connection software
- Shutter

- Control box for regulatory compliance
- Heat sink (optional)

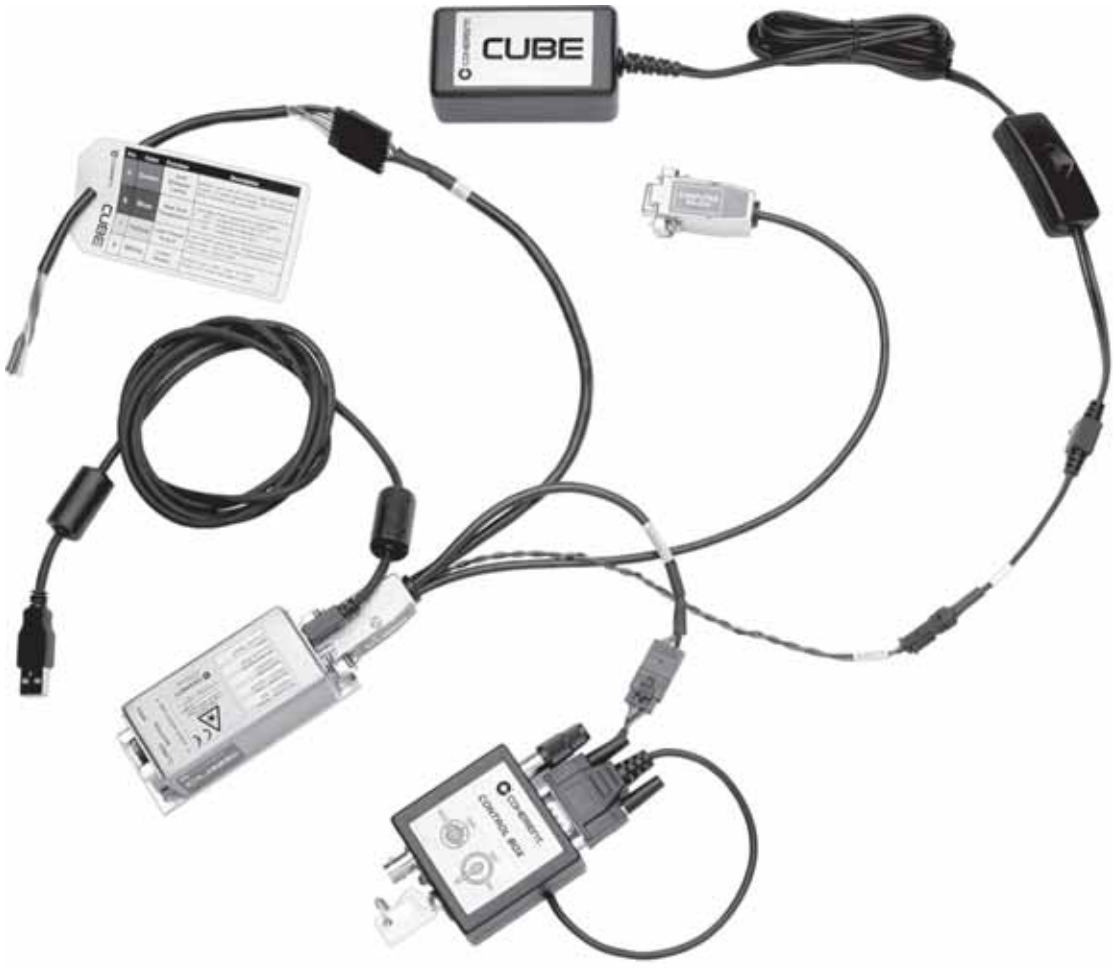


Figure 2-1. CUBE Laser System Components

Laser Head

The 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 base plate of

the laser. The construction details of the CUBE laser head are shown schematically in Figure 2-2, below. DE-15 pin functions are described in Table 3-5 (p. 3-11).

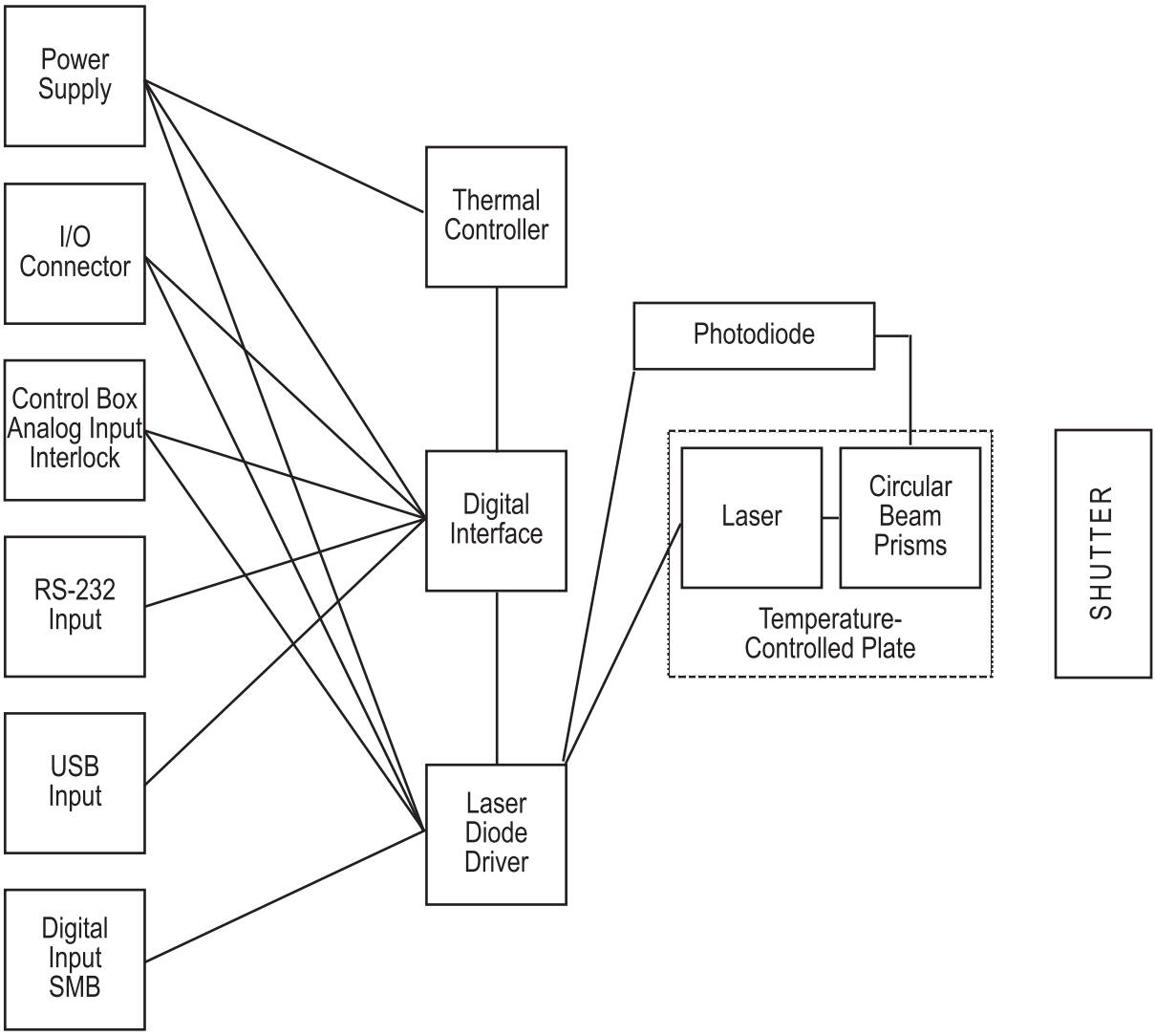


Figure 2-2. CUBE System Schematic

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 50ºC. For dimensions, refer to Figure 2-4 (p. 2-6).

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 CUBE laser system. For dimensions, refer to Figure 2-6 (p. 2-8).

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 used for analog modulation or variable power control. Review Analog Modulation specifications for input requirements. For control box dimensions, refer to Figure 2-7 (p. 2-8).

Cables

The CUBE laser system is shipped with an interface cable and a USB cable. For detailed system description and installation instructions, see "Section Three: Installation" (p. 3-1).

Humidity

The CUBE laser system includes an active thermoelectric cooler to maintain the diode and optics at 22°C. The humidity and ambient temperature around the laser needs to be considered to prevent condensation on the diode and optics. Table 2-1, below, contains boxes representing the dew point numbers. The diode set temperature is 22ºC. Dew points above 22ºC (shaded in gray) could cause concern for condensation.

Table 2-1. Safe Operating Humidity Levels

AIR TEMP °C	% RELATIVE HUMIDITY																		
	100	**95**	**90**	**85**	**80**	**75**	**70**	**65**	**60**	**55**	**50**	**45**	**40**	**35**	**30**	**25**	**20**	**15**	**10**
41	41	39	38	37	36	35	34	33	32	29	28	27	24	22	19	17	13	8	3
38	38	37	36	35	34	33	32	30	29	27	26	24	22	19	17	14	11	7	0
35	35	34	33	32	31	30	29	27	26	24	23	21	19	17	15	12	9	4	0
32	32	31	31	29	28	27	26	24	23	22	20	18	17	15	12	9	6	2	0
29	29	28	27	27	26	24	23	22	21	19	18	16	14	12	10	7	3	0	
27	27	26	25	24	23	22	21	19	18	17	15	13	12	10	7	4	2	0	
24	24	23	22	21	20	19	18	17	16	14	13	11	9	7	5	2	0		
21	21	20	19	18	17	16	15	14	13	12	10	8	7	4	3	0			

Dimensions

Figure 2-3 (below), and Figure 2-4 (p. 2-6), show the dimensions of the CUBE laser head and heat sink, respectively. Refer to Figure 2-5 (p. 2-7) for heat sink dimensions, and Figure 2-6 (p. 2-8) for power supply dimensions. Figure 2-7 (p. 2-8) lists the control box dimensions.

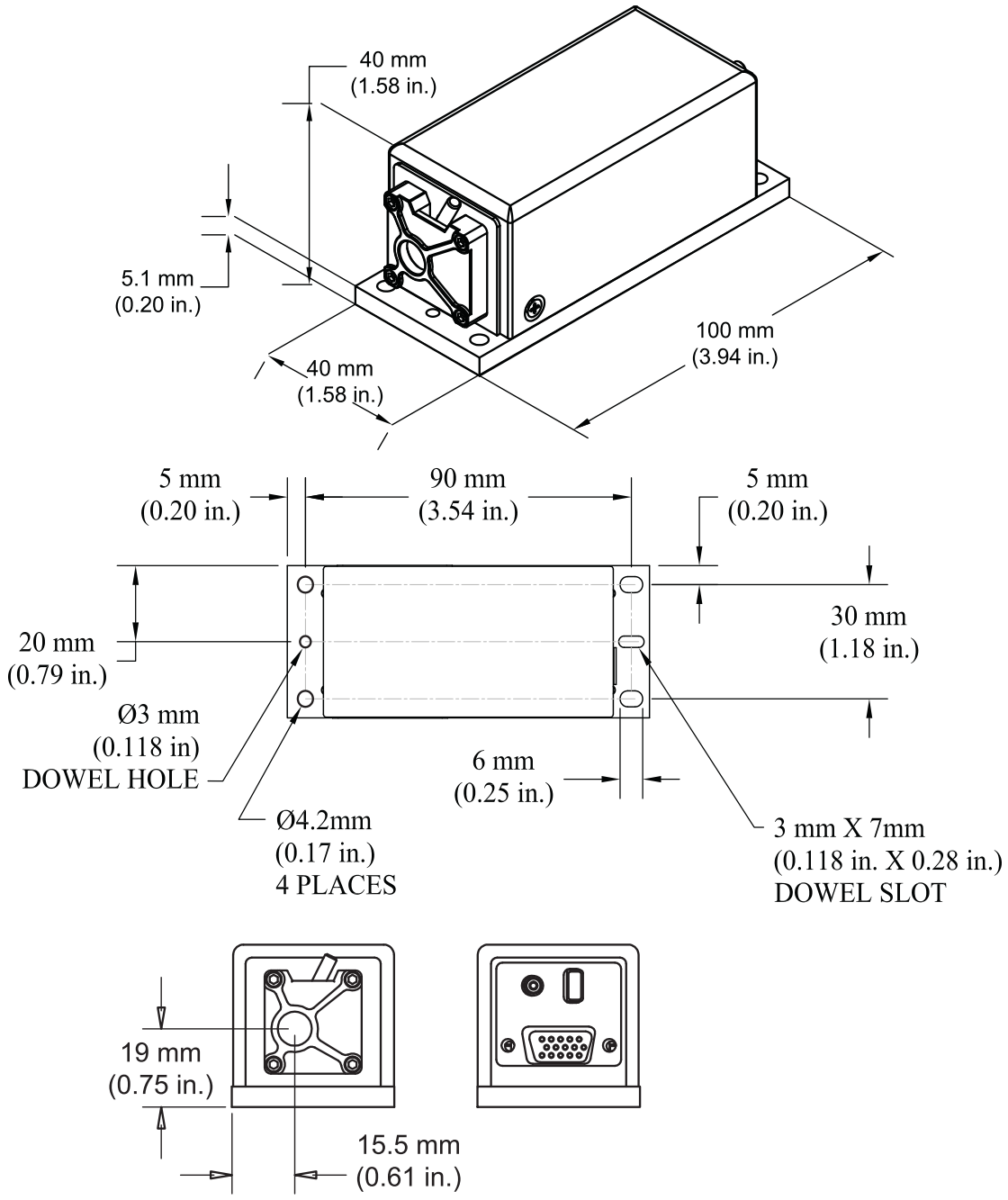


Figure 2-3. CUBE Laser Head Dimensions

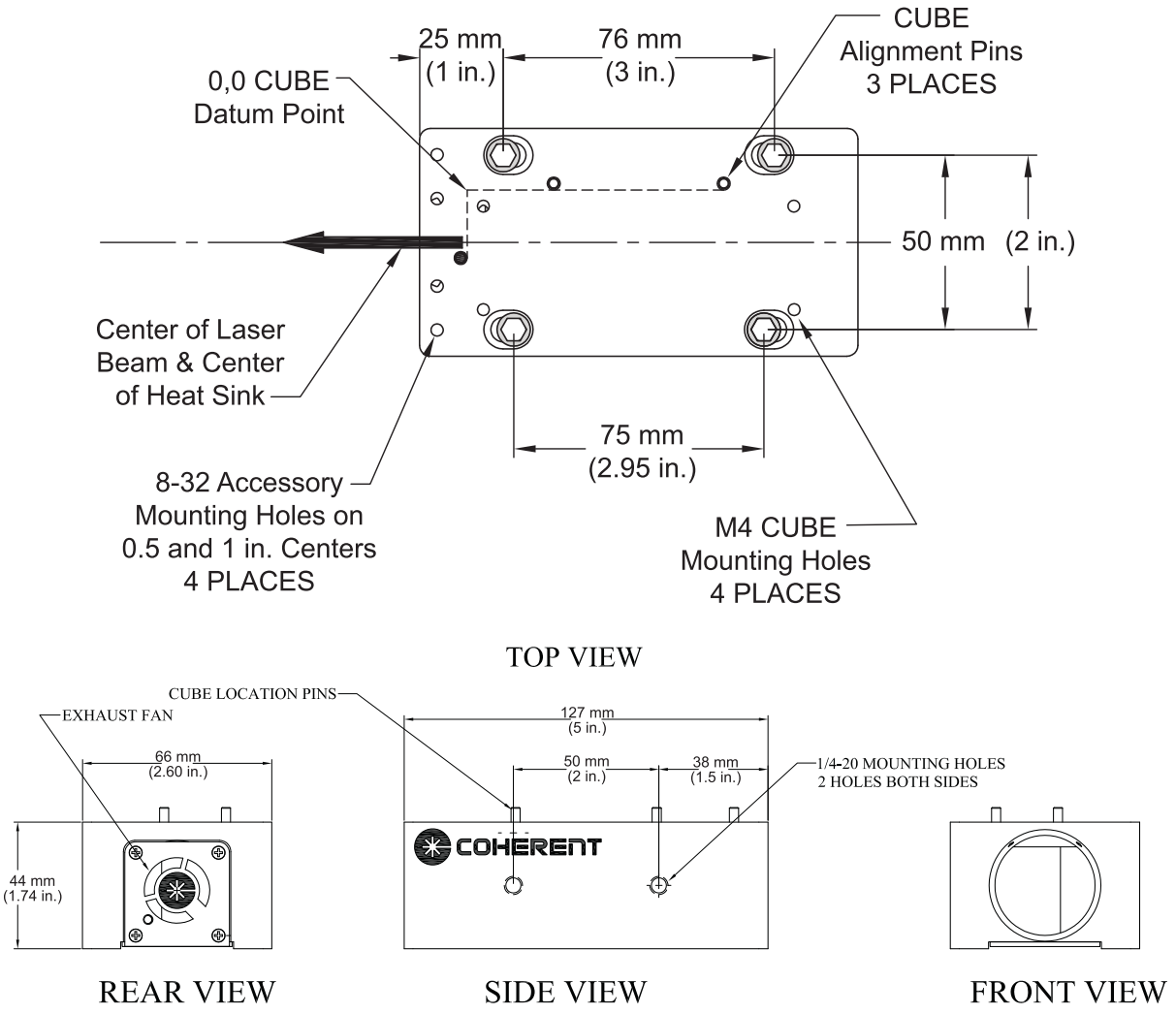


Figure 2-4. Optional Heat Sink Dimensions

NOTICE!
Heat sink mounting holes can be used to mount onto standard or metric hole patterns.

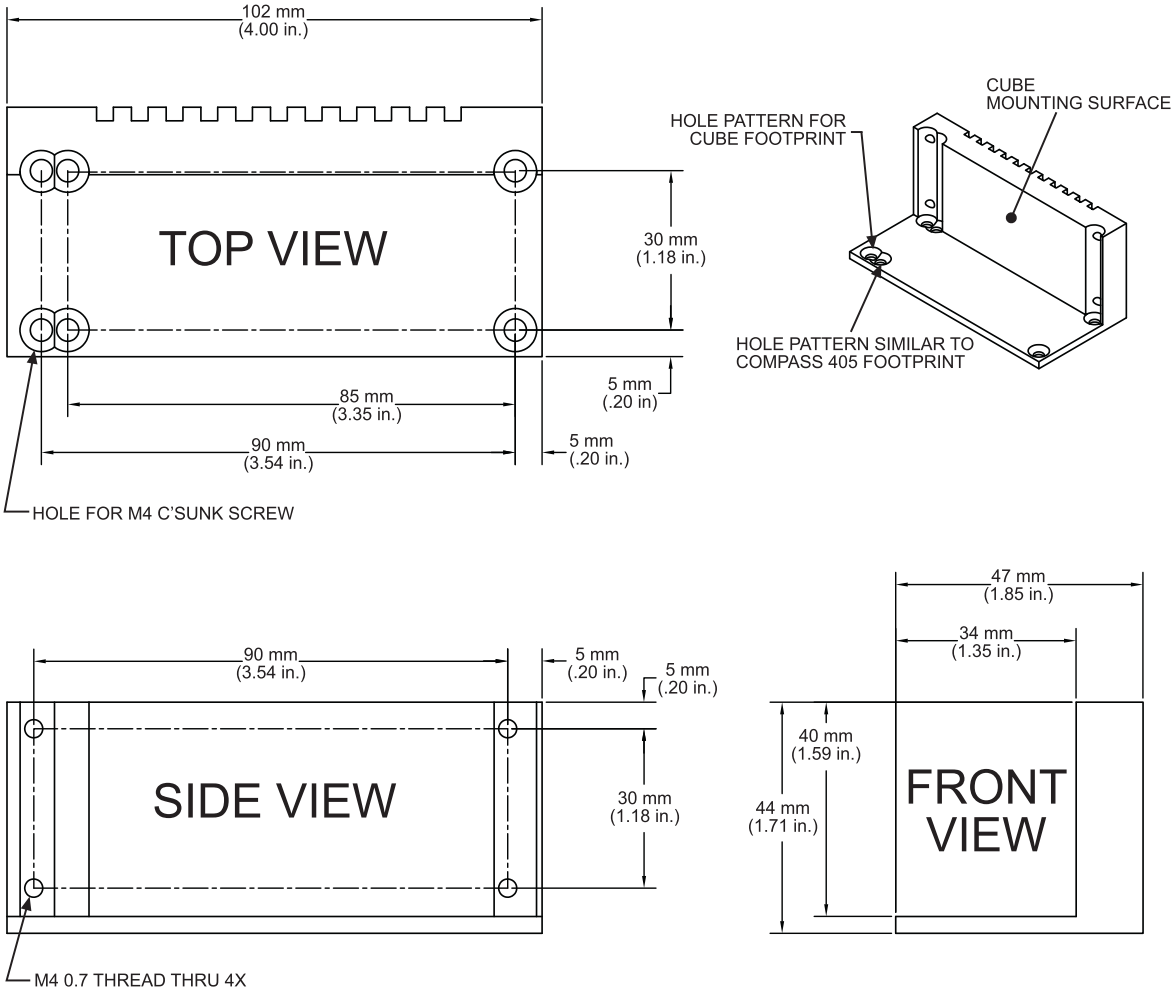


Figure 2-5. Right Angle Mount

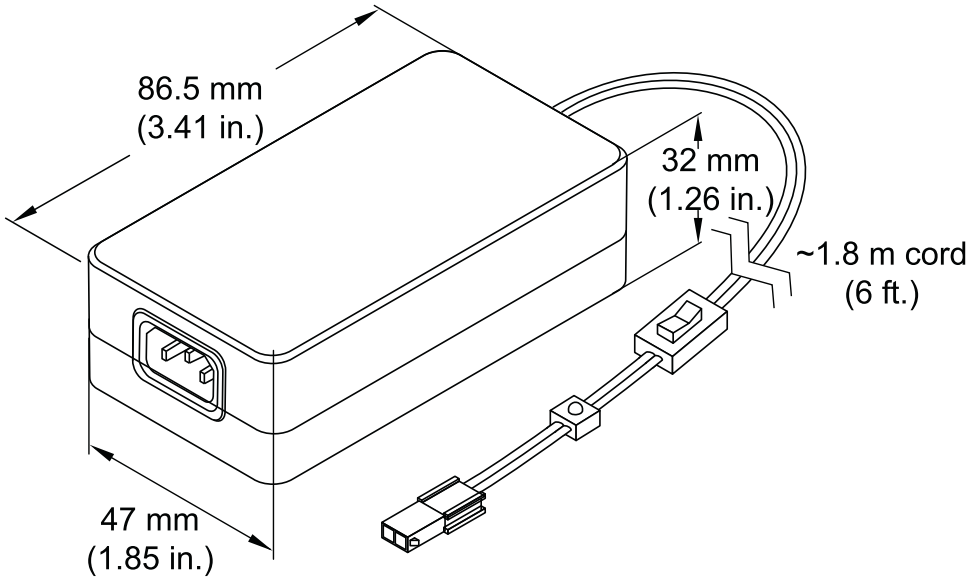


Figure 2-6. CUBE Power Supply Dimensions

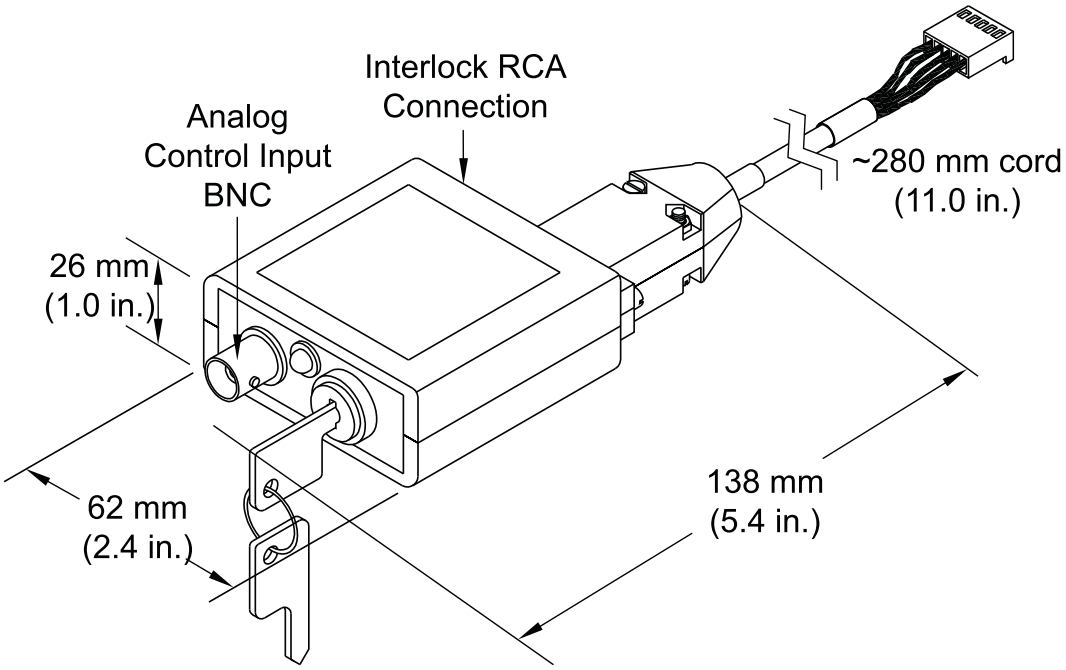


Figure 2-7. CUBE Control Box Dimensions

SECTION THREE: INSTALLATION

Receiving and Inspection

Inspect shipping boxes for signs of rough handling or damage and indicate any such signs on the bill of loading. Report any damage immediately to the shipping carrier and to Coherent Order Administration Department at 1.800.367.7890 (outside the US: 1.408.764.4557), or to an authorized Coherent representative.

NOTICE!
After unpacking the system, save the shipping boxes for potential later shipments—refer to "Section Nine: Repacking Procedure" (p. 9-1) for packing instructions.

Table 3-1. Packing List for CUBE Laser System

ITEM DESCRIPTION	QUANTITY
Coherent CUBE Laser	1
CUBE Power Supply	1
CUBE Manual	1
USA Style Power Cord	1
Coherent Connection Software CD	1
CUBE Control Box	1
CUBE Interface Cable	1
USB Cable	1
Modified M4 Mounting Screws	4
M4 Small Pattern Washer	4

NOTICE!
Take appropriate ESD precautions when handling and installing the laser. Refer to "Electrical Safety" (p. 1-2) for a complete description of the precautions.

Heat Sink Requirement

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

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

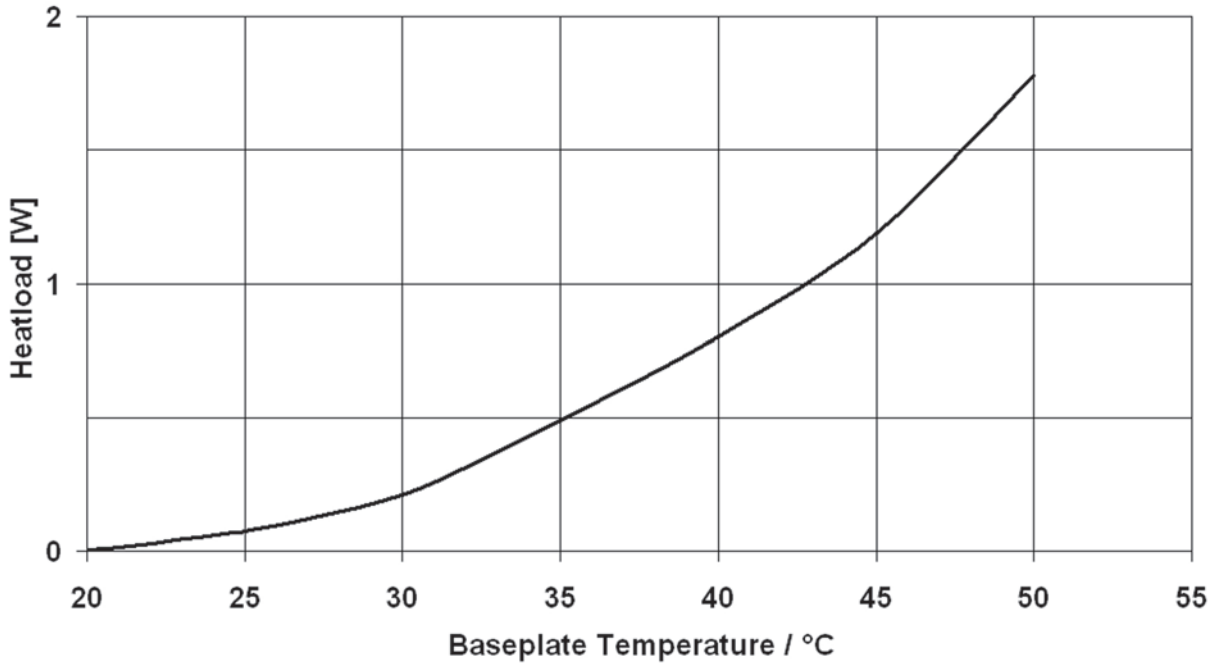


Figure 3-1. Estimated Heat Dissipation of the CUBE Laser Head

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Heat dissipation varies with diode current levels.

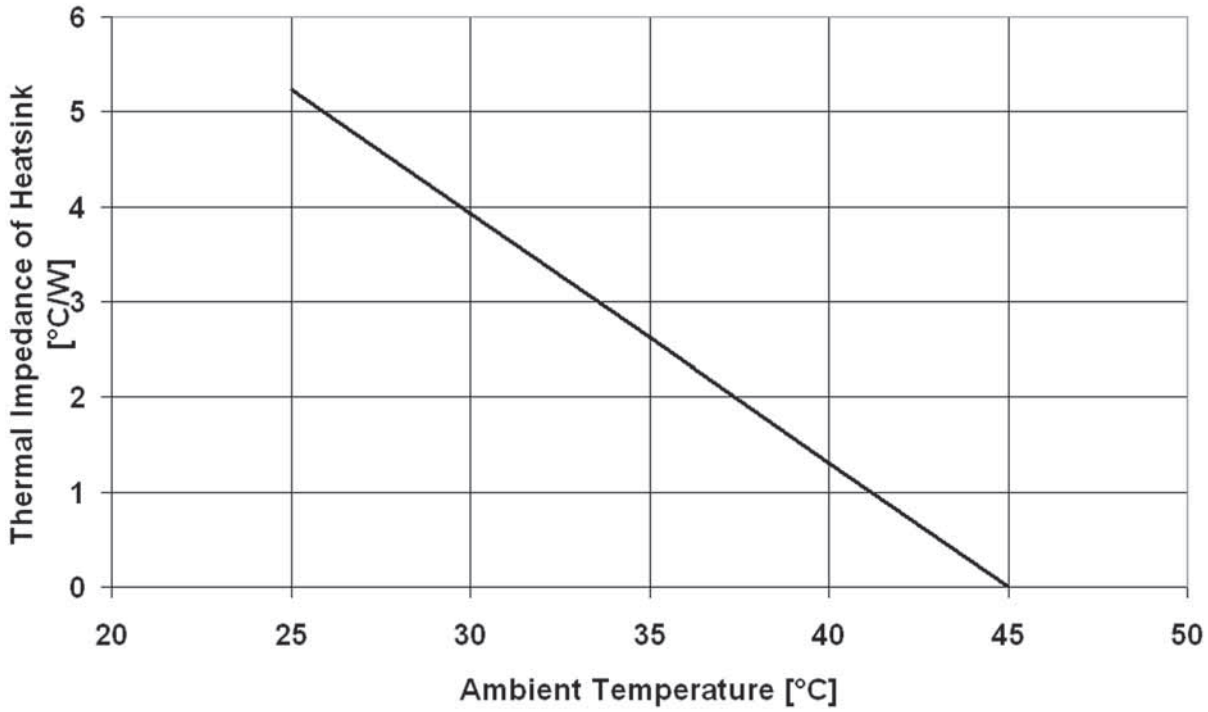


Figure 3-2. Estimated Heat Sink Requirements for an Ambient Temperature of 45ºC

NOTICE!

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 be milled flat (within < 0.05 mm over the mounting surface).

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

- 6.35 cm (2.5 in.) beam height
- Output beam centers on standard table 2.54 cm (1 in.) 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 the 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
Non-Metallic Flat Washers	4
3/16 Wrench	1
M6 Wrench	1

Heat Sink Installation

1. Secure the heat sink to the proposed laser location. Ensure the heat sink ends remain unobstructed for proper air flow.
2. (Optional): If additional thermal conduction is required, the only recommended thermal conductance aids are pyrolytic graphite pads or thermal materials, such as Sil-Pad or Indium foil. Thermal compound or any flowable compound that can enter into screw openings is not recommended. Refer to Figure 3-2 (p. 3-3) for heat sink requirements.

NOTICE!
The use of flowable thermal compounds can reduce the normal lifetime of a laser *and will void the CUBE and CUBE FP warranty.*

3. Secure the CUBE laser head to the heat sink with the modified M4 screws provided.
4. Tighten the screws in a diagonal pattern—refer to Figure 3-4 (p. 3-6)—to ensure optimum pointing stability. Torque the mounting screws to .23 N·m (32 oz·in.) in the following

sequence: 1-2-3-4. Use the same diagonal pattern for the final torque setting of 1 N·m (142 oz·in.).

Figure 3-4. CUBE Torque and Tightening Pattern

5. If fan operation is required, connect the fan to the 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 CUBE simultaneously.

6. Proceed with normal laser operation.

Right Angle Bracket

The Coherent optional Right Angle bracket is the result of a significant research, design, and testing program. The Right Angle bracket allows the CUBE laser to be rotated 90º without a change in beam position (if mounted as shown in Figure 3-5, below). CUBE pointing stability and environmental specifications are maintained with the use of the Right Angle bracket. The most common use of the Right Angle bracket is to change the CUBE polarization from vertical to horizontal.

Figure 3-5. Right Angle Bracket with CUBE Mounted

Features

- 19 mm (.75 in.) beam height is maintained
- CUBE and Compass 405 mounting bolt pattern
- Heat sink included for heat dissipation
- Proven pointing performance over temperature and time
- Safety shutter access
- Small footprint
- Rugged design
- Mounting hardware included

Table 3-3. Packing List for Right Angle Bracket

ITEM DESCRIPTION	QUANTITY
Right Angle Bracket	1
M4 Mounting Hardware	4
M4 Small Pattern Washers	4

Right Angle Bracket Installation

1. Secure the Right Angle bracket to the proposed mounting location, using the four flat head screws that are provided.

Figure 3-6. Right Angle Bracket

2. Torque the flat head mounting screws to 1 N·m (142 oz·in.), using the diagonal torque sequence shown in Figure 3-7, below.

Figure 3-7. CUBE Torque and Tightening Pattern

3. Using the modified M4 screws provided, mount the CUBE laser to the Right Angle bracket.

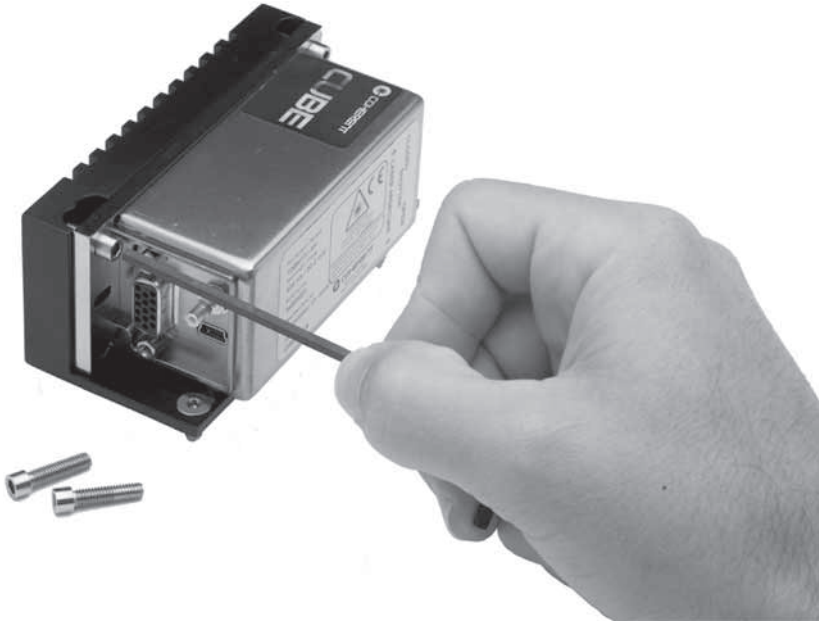


Figure 3-8. Torque Procedure

4. Tighten the screws in a diagonal pattern (refer to Figure 3-7, above) to ensure optimum pointing stability. Torque the CUBE mounting screws to .23 N·m (32 oz·in.) in the following sequence: 1-2-3-4. Use the same diagonal pattern for the final torque setting of 1 N·m (142 oz-in.).

5. Proceed with normal laser operation.

Mounting the Laser Head

For mounting the 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.

NOTICE!
Standard M4 socket head screws do not provide sufficient clearance for mounting holes.

Power Supply

The CUBE laser system includes a power supply, which has a power switch and power indicator. Power supply specifications are shown in Table 3-4, below.

Figure 3-9. DC Power Supply

Table 3-4. Power Supply Specifications

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

Interface Cable

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

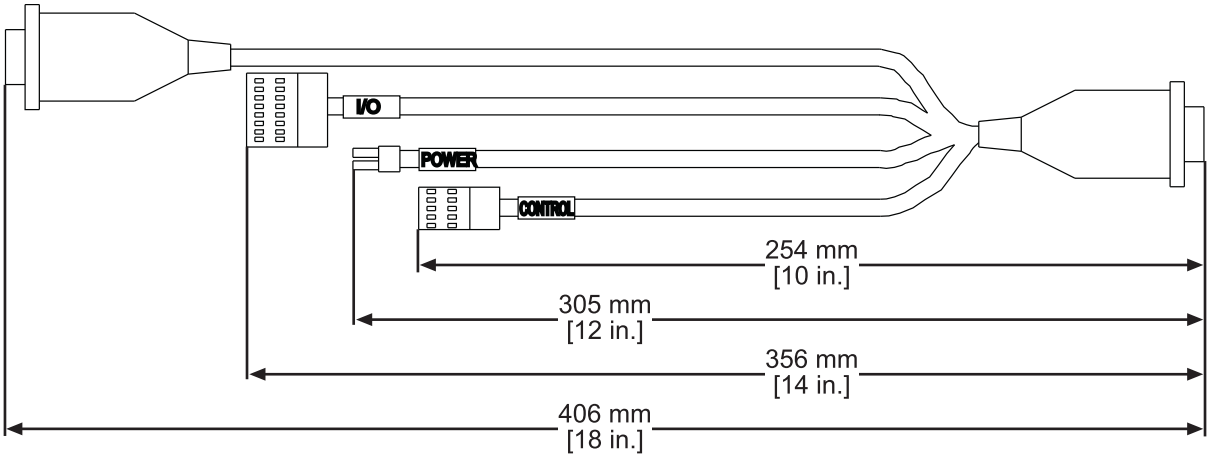


Figure 3-10. Interface Cable

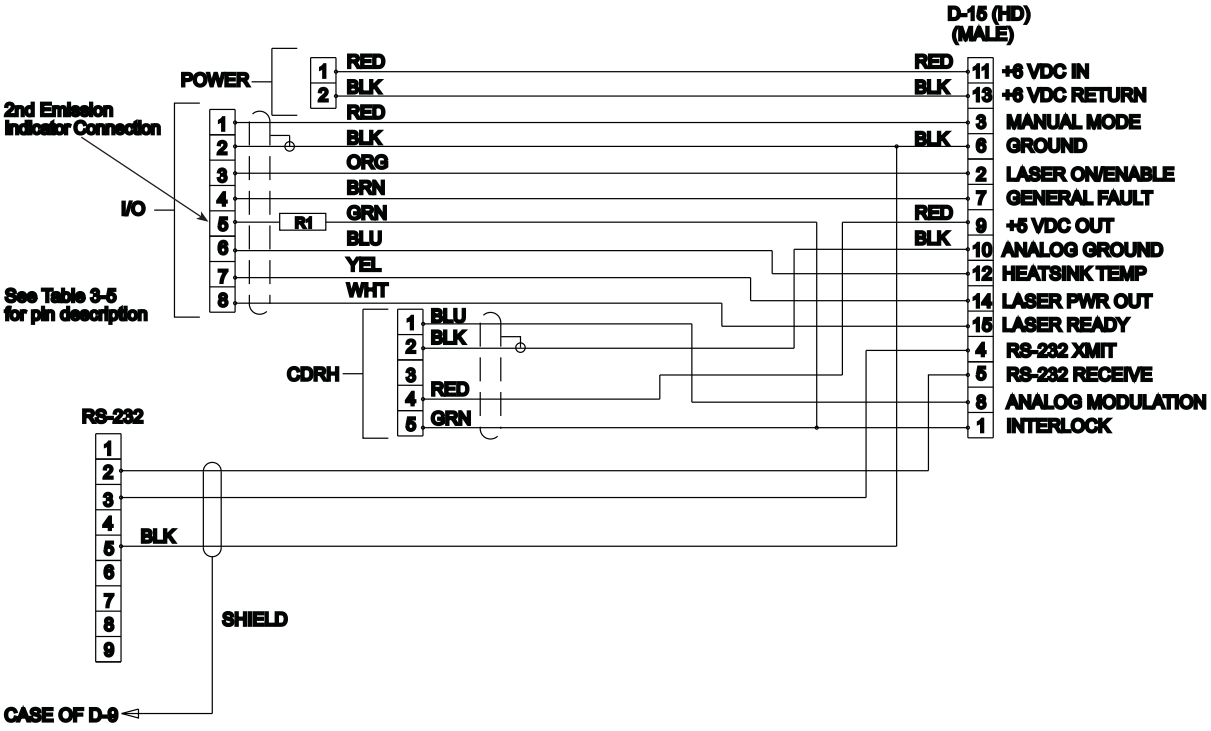


Figure 3-11. Interface Cable Description

Table 3-5. 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	Manual Mode	Input	0 = Computer Control 1 = Manual 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	2 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 to 6.5 VDC Power Input	2.5 A
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 power cable 2-pin connector mates to the supplied CUBE power supply. The connector is keyed to ensure correct polarity when plugged into the power supply.

NOTICE!
The power supply polarity is defined by the triangular tab and lock.

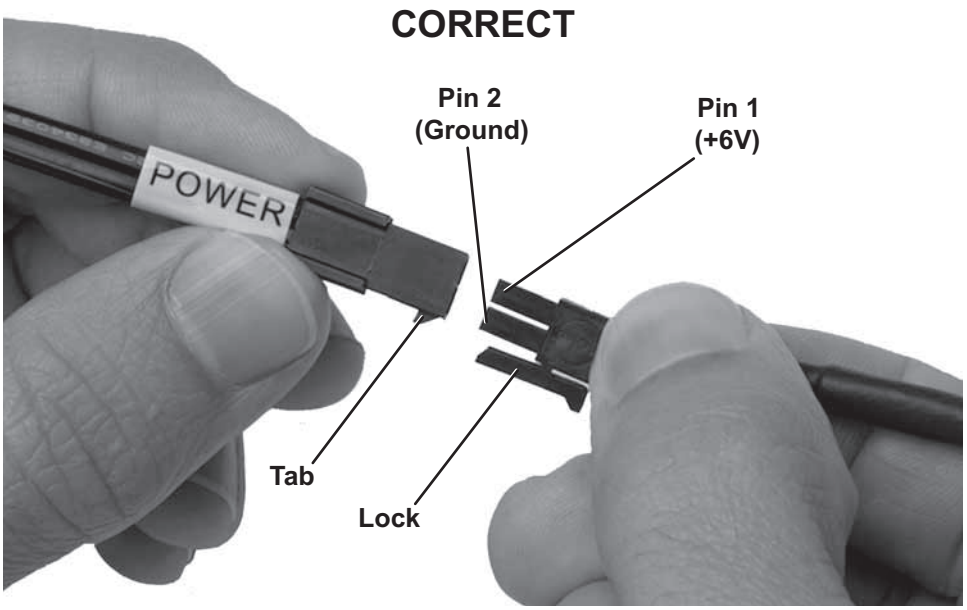


Figure 3-12. Correct Way for Power Cable 2-Pin Connector

NOTICE!
Connecting the power cable 2-pin connector incorrectly may cause internal damage and will void the warranty.

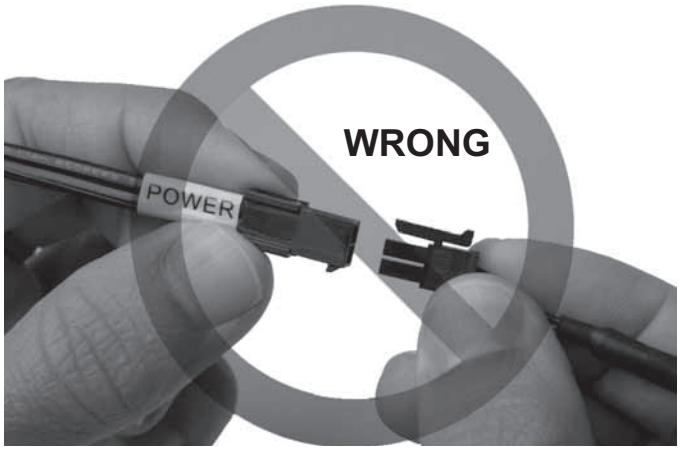


Figure 3-13. Wrong Way for Power Cable 2-Pin Connector

Control Box

The 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.

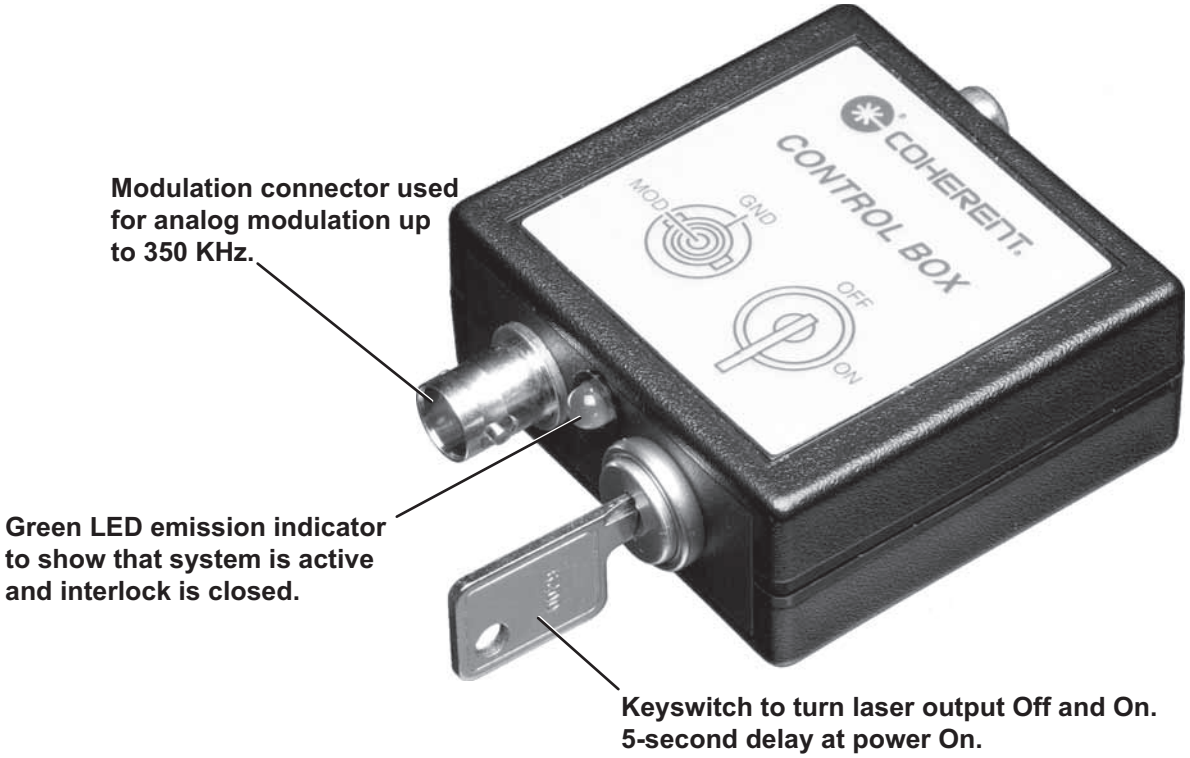


Figure 3-14. Control Box Front Panel View

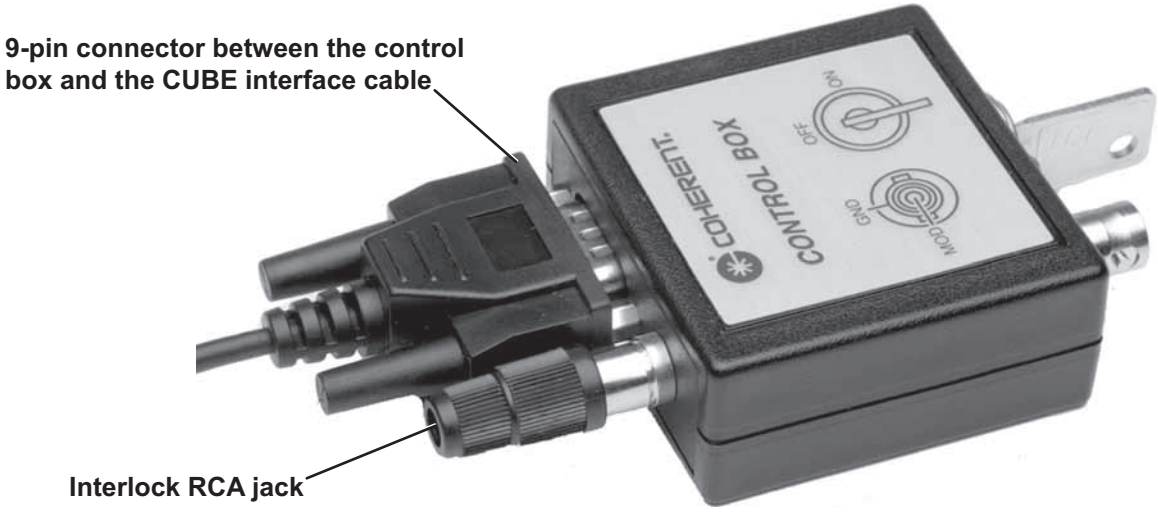


Figure 3-15. Control Box Back Panel View

Connecting the Laser to the Control Box

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

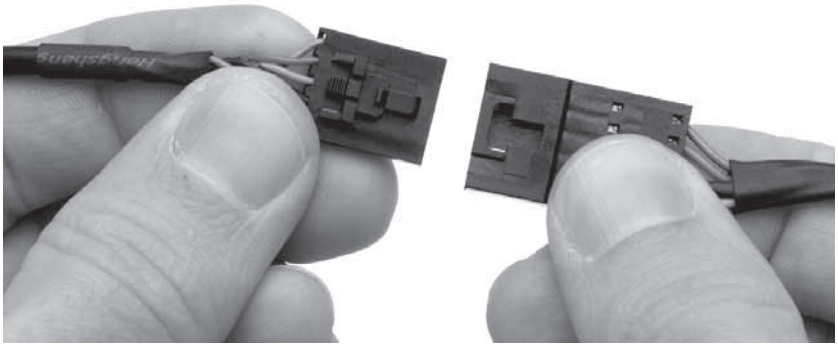


Figure 3-16. 5-Pin I/O Cable Connected to the Interface Cable

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

Figure 3-17. Control Box Keyswitch

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

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

Figure 3-18. 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.

Table 3-6. Interlock Specifications

SYSTEM SPECIFICATIONS	VALUE
Interlock Control Input	
Maximum Bandwidth	7 Hz
Rise and Fall Time (10% to 90%)	< 1 µsec
Modulation Depth	Infinity, Complete On/Off
Input Impedance	7000 ohms

INTERLOCK
Open = Laser Off
Closed = Laser On

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

NOTICE!
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 3-7. I/O Connector

PIN	COLOR	FUNCTION	DIRECTION	RANGE	DESCRIPTION
1	Red	Manual Mode	Input	TTL - 0, TTL - 1	Default + 5 V for Manual mode (Auto-Start). Connect to ground for computer-start mode.
2	Black	Ground	Input	N/A	Ground
3	Orange	Laser On/Enable	Input	TTL - 0, TTL - 1	Default + 5 V for Laser is Enabled. Connect to ground to disable laser output.
4	Brown	General Fault	Output	N/A	Default: zero volts for no faults. Output + 5 V if a fault condition exists. Example: Base plate over-temperature
5	Green	2nd Emission Lamp	Output	TTL - 0, TTL - 1	Default: zero volts for interlock open and laser off. Output 5 V when laser enabled. Second emission lamp accessory sold separately.
6	Blue	Heat Sink Temperature	Output	0 V, 2.5 V, 5 V	Laser Base Plate Temperature output signal 0 VDC = Temperature less than 40°C + 2.5 VDC = Temperature between 40 and 50°C + 5 VDC = Temperature over 50°C
7	Yellow	Laser Power Output	Output	0 to 2 V	Laser Power output signal. Voltage proportional to laser power. Zero to + 2 V represents zero to 100% Laser Output Power
8	White	Laser Ready	Output	TTL - 0, TTL - 1	Default: Zero volts - laser not ready. Output + 5 V when the laser is ready.

RS-232 Connector

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

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

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

Table 3-8. RS-232 Pin Connections

DE-9 Interface Cable Connector	
Pin Number	**Description**
2	RS-232 Transmit
3	RS-232 Receive
5	Ground

CUBE OEM Head Only Installation

The following contains information for CUBE installation into a system without the cables and accessories provided with a standard CUBE system. Refer to Table 3-9, below, for a list of parts not included in a Head Only installation.

Table 3-9. Parts Not Included in a Head Only Installation

Description	Part Number
CUBE Power Supply	1072454
Interface Cable	1072166
USB Cable	1108906
Control Box	1039966
User Manual and CD	1079890
Power Cord, USA	1108063

These parts are available for purchase. Contact Coherent for further information.

Heat Sink Requirement

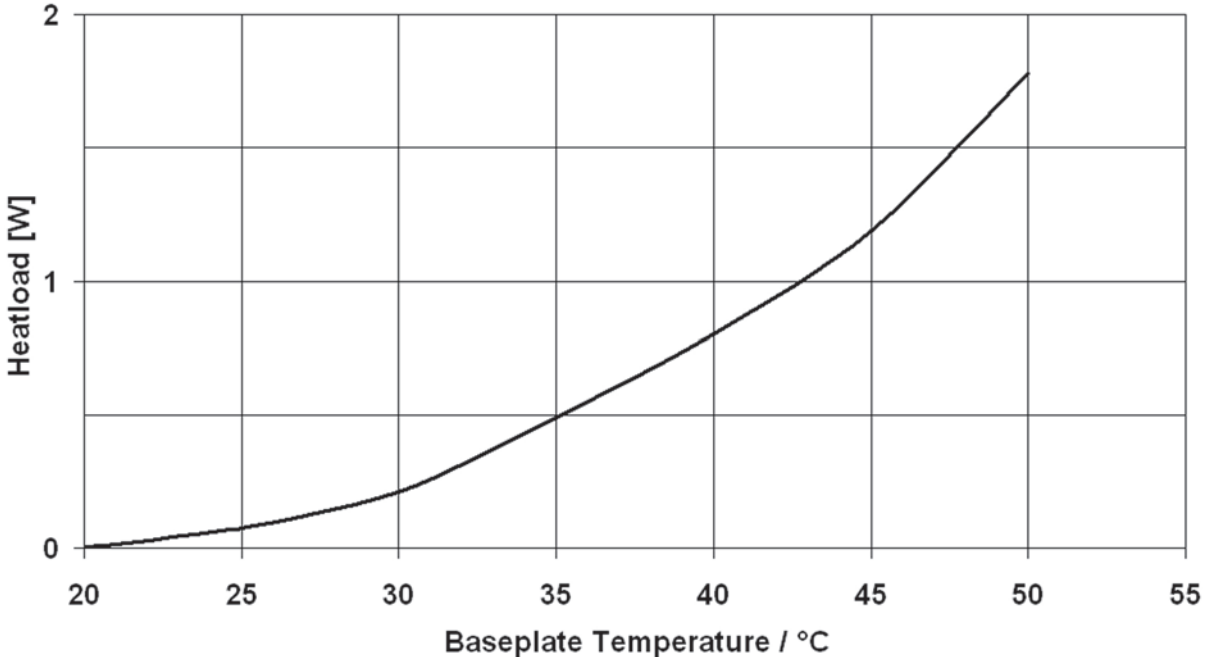


Figure 3-19. Thermal Dissipation

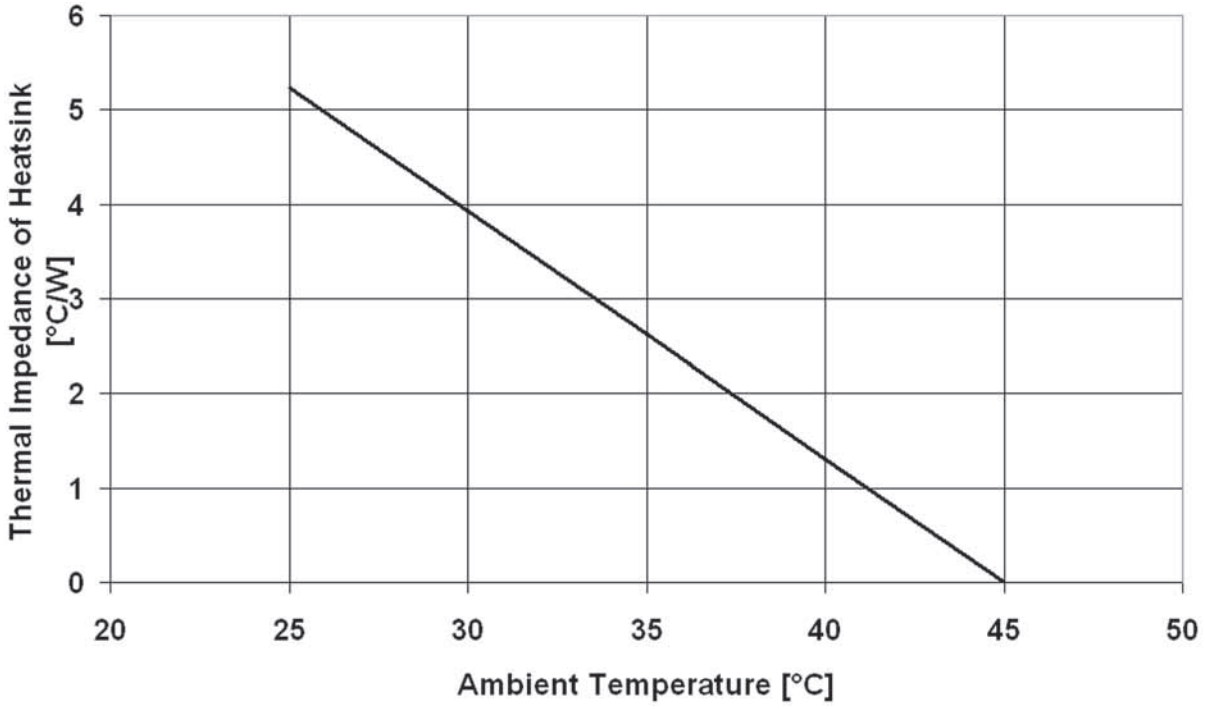


Figure 3-20. Thermal Impedance

Heat Sink Flatness Requirement - < 0.05 mm over entire mounting surface.

Mounting Hardware Recommendation

6-32 x 3/8 in. with small pattern flat washer

or

M4 x 10 mm with small pattern washer

Power Supply Requirements

4.8 to 6.5 VDC 2.5 A

Head Connections

SMB Digital Modulation Input

Table 3-10. SMB Digital Modulation Input

SYSTEM SPECIFICATIONS	VALUE
Digital Modulation	
Rise and Fall Time (10% to 90%)	< 2 nsec*
Modulation Depth at 0 Hz	> 1,000,000:1 (10^6:1)
Modulation Depth at 150 MHz	> 250:1
* Only on CUBE 445: Fall Time < 3 nsec with 125 MHz max. bandwidth.	

- 50 ohm Input Impedance
- V Input Low < 0.8 V
- V Input High > 2.6 V
- Maximum Modulation Frequency 150 MHz

Adjust duty cycle as necessary to achieve maximum modulation frequency.

DE-15 Input / Output Connector

Table 3-11. Power Supply Specifications

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

DE-15 Connector Recommendations

- Norcomp – 979-009-020-121
- Norcomp – 180-015-272-000

USB Connection

- Standard Mini-USB connection
- USB 1.1 or 2.0 Communication

USB Drivers

CUBE USB drivers are available on-line at www.Coherent.com

RS-232 Connection / Communication

Table 3-12. RS-232 Pin Connections

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

Communication Settings

Table 3-13. RS-232 Communications

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

Commands and Queries

The following is a complete list of CUBE control and query commands. For additional details, review the RS-232 Remote Control sections (page 5-2 for CW operation and page 5-16 for pulse operation).

---Control Commands---

>	=	Prompt
ANA	=	Analog Current Mode
CAL	=	Calibrate Laser Power In Pulse
CW	=	CW or Pulse Mode
CDRH	=	Laser Delay
CLS	=	Clear Text
E	=	Echo
EXT	=	External Laser Power Mode
L	=	Laser
OP	=	Operating Protocol
P	=	Laser Power Set
T	=	TEC On_Off

---Query commands---

?>	=	Prompt Status
?ANA	=	Analog Current Mode
?BT	=	Base Plate Temp
?C	=	Laser Diode Current
?CDRH	=	Laser Delay
?CW	=	CW or Pulse Mode
?DT	=	Diode Present Temp
?DST	=	Diode Set Temp

?E	=	Echo
?EXT	=	External Laser Power Mode
?F	=	Fault Code Decimal
?FF	=	Fault Bits Binary
?FL	=	Fault List
?HH	=	Hour Counter
?HID	=	Head ID Value
?INT	=	Interlock Status
?K	=	Interlock Status
?LC	=	Interlock Status
?L	=	Laser
?LT	=	Laser Type
?LF	=	Fault List
?M	=	Manual Auto Start
?MAXLP	=	Max Light Constant Pwr
?MINLP	=	Min Light Constant Pwr
?NOMP	=	Nominal Laser Pwr
?OP	=	Operating Protocol
?P	=	Present Laser Power
?PSH	=	Hours Power is ON
?PST	=	Computer Temp
?PVPS	=	Protocol VER
?S	=	Control Settings
?SP	=	Get Set Power
?STA	=	Operating Status Number
?SS	=	TEC
?SVPS	=	Software Version
?SVH	=	Software Version
?SV	=	Software Version
?T	=	TEC
?WAVE	=	Laser Wavelength

SECTION FOUR: QUICK START

Quick Start: CW Operation

1. Place the CUBE laser on either the optional CUBE heat sink or a mounting surface capable of providing adequate thermal dissipation. If additional thermal conduction is required, the only recommended thermal conductance aids are pyrolytic graphite pads or thermal materials, such as Sil-Pad or Indium foil. Thermal compound or any flowable compound that can enter into screw openings is not recommended. Refer to Figure 3-2 (p. 3-3) for heat sink requirements.

NOTICE!
The use of flowable thermal compounds can reduce the normal lifetime of a laser *and will void the CUBE and CUBE FP warranty.*

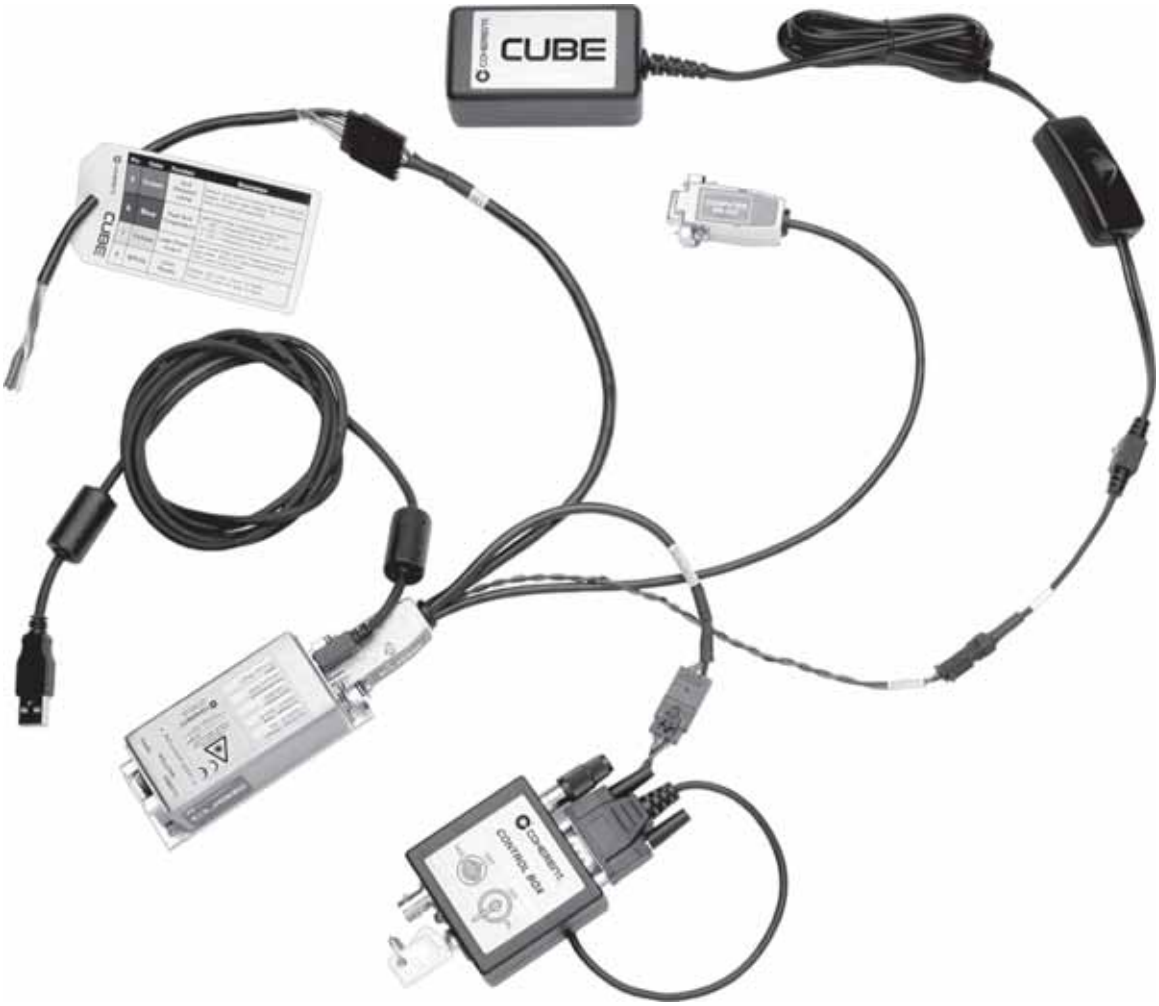


Figure 4-1. Cable Connection Setup

2. Using the provided modified M4 screws, mount the CUBE laser to the Right Angle bracket.

3. Tighten the screws in a diagonal pattern to ensure optimum pointing stability (refer to Figure 4-2, below). Torque the CUBE mounting screws to .23 N·m (32 oz·in.) in the following sequence: 1-2-3-4. Use the same diagonal pattern for the final torque setting of 1 N·m (142 oz·in.).

Figure 4-2. CUBE Torque and Tightening Pattern

4. Secure the laser to the mounting surface using 6-32 or M4 screws. Torque to 36 inch ounces using a diagonal pattern. For a complete description of the torque setting for different bolt types and the torque pattern, refer to "Section Three: Installation" (p. 3-1).

5. Connect the interface cable to the laser.

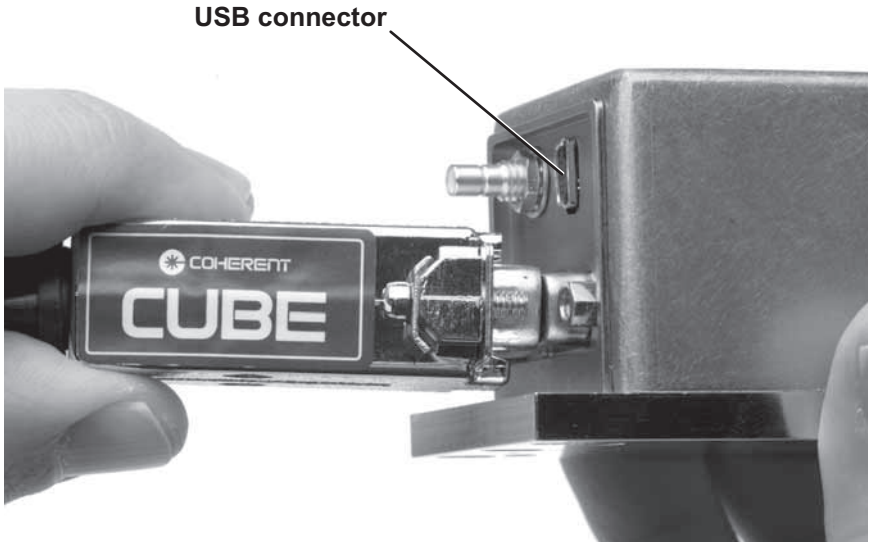


Figure 4-3. Connect the Interface Cable to the Laser

6. Tighten the connector shell screws to ensure reliable system operation. For additional information, refer to "Interface Cable" (p. 3-10).
7. Connect the power supply.

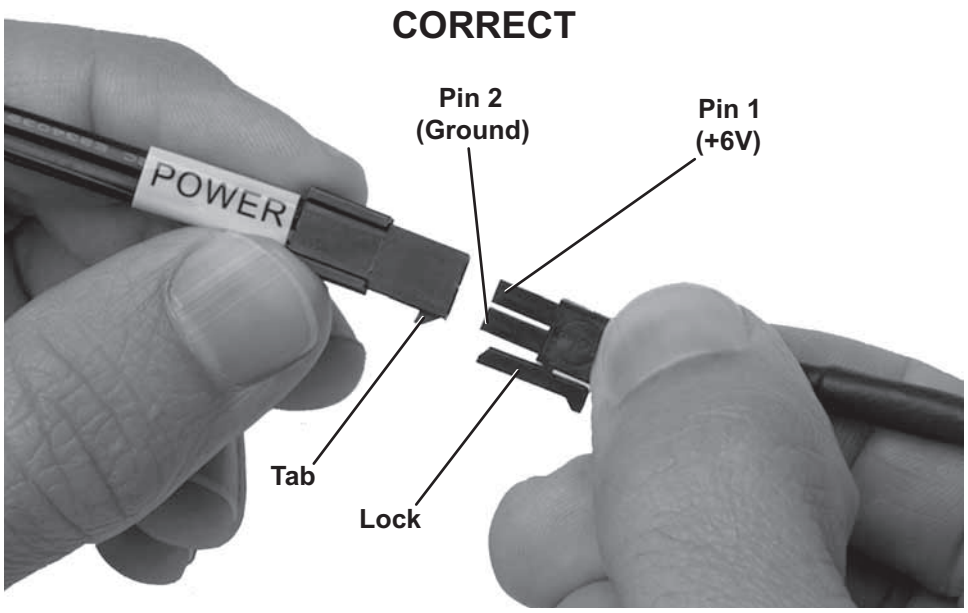


Figure 4-4. Correct Way for Power Cable 2-Pin Connector

NOTICE!
Connecting the power cable 2-pin connector incorrectly may cause internal damage and will void the warranty.

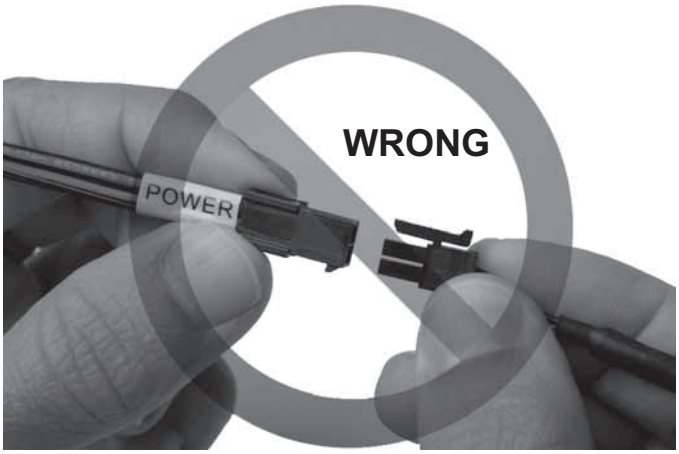


Figure 4-5. Wrong Way for Power Cable 2-Pin Connector

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

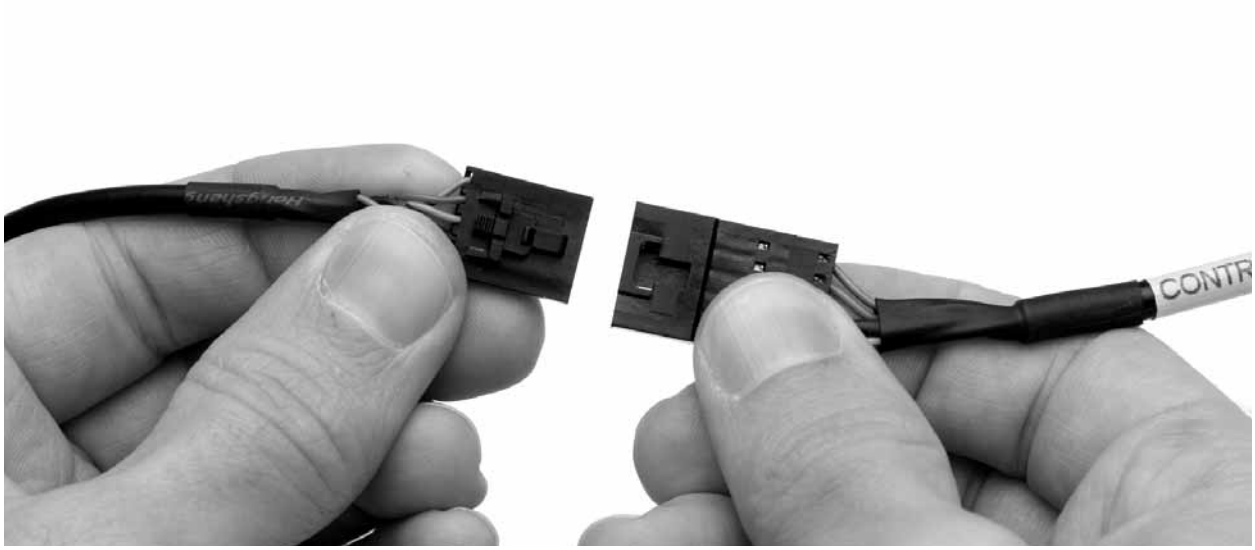


Figure 4-6. Connect the Control Box

9. If computer control is desired, connect the USB or serial interface cable. Review Table 3-8 (p. 3-17) for RS-232 pin connections.

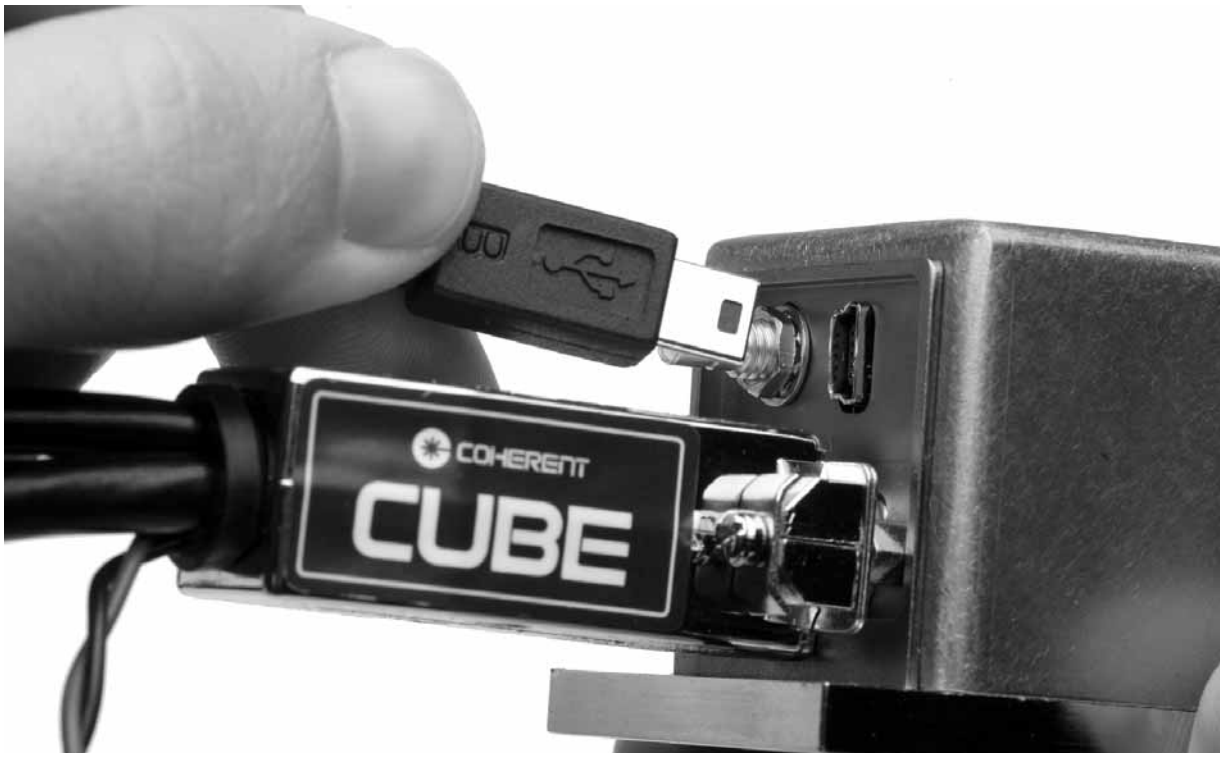


Figure 4-7. Connect the USB or Serial Interface Cable

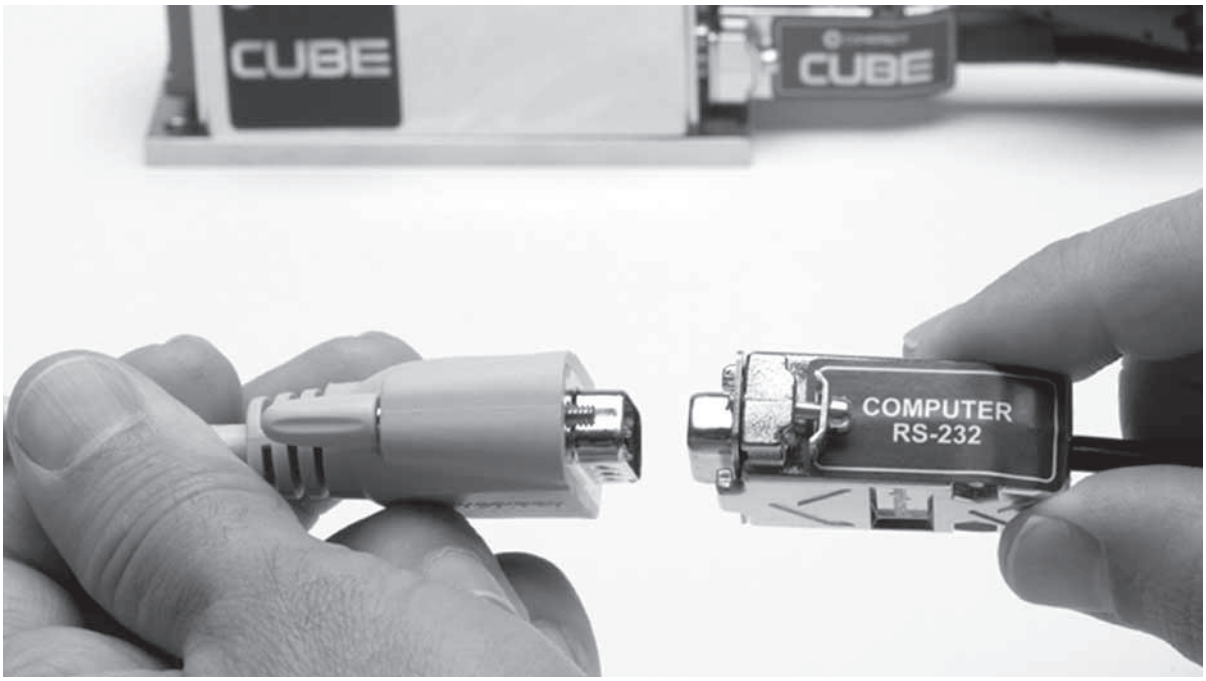


Figure 4-8. Optional RS-232 Control Cabling

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

NOTICE!
The CUBE laser system is shipped in CW Manual mode with a 5-second CDRH-required delay. The laser emission is active approximately five seconds after the keyswitch is set to the ON position.

12. Computer control is available without additional system configuration. The CUBE laser system will start automatically without additional computer or configuration settings.

Refer to "RS-232 Remote Control" (p. 5-2) 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: Pulse Operation

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

1. Place the CUBE laser on either the optional CUBE heat sink or a mounting surface capable of providing adequate thermal dissipation. If additional thermal conduction is required, the only recommended thermal conductance aids are pyrolytic graphite pads or thermal materials, such as Sil-Pad or Indium foil. Thermal compound or any flowable compound that can enter into screw openings is not recommended. Refer to Figure 3-2 (p. 3-3) for heat sink requirements.

NOTICE!
The use of flowable thermal compounds can reduce the normal lifetime of a laser *and will void the CUBE and CUBE FP warranty.*

Figure 4-9. Cable Connection Setup

2. Using the provided modified M4 screws, mount the CUBE laser to the Right Angle bracket.

3. Tighten screws in a diagonal pattern to ensure optimum pointing stability (refer to Figure 4-10, below). Torque the CUBE mounting screws to .23 N·m (32 oz·in.) in the following sequence: 1-2-3-4. Use the same diagonal pattern for the final torque setting of 1 N·m (142 oz·in.).

Figure 4-10. CUBE Torque and Tightening Pattern

4. Secure the laser to the mounting surface using 6-32 or M4 screws. Torque to .25 N·m (36 oz·in.) using a diagonal pattern. For a complete description of the torque setting for different bolt types and the torque pattern, refer to "Section Three: Installation" (p. 3-1).

5. Connect the Interface cable to the laser.

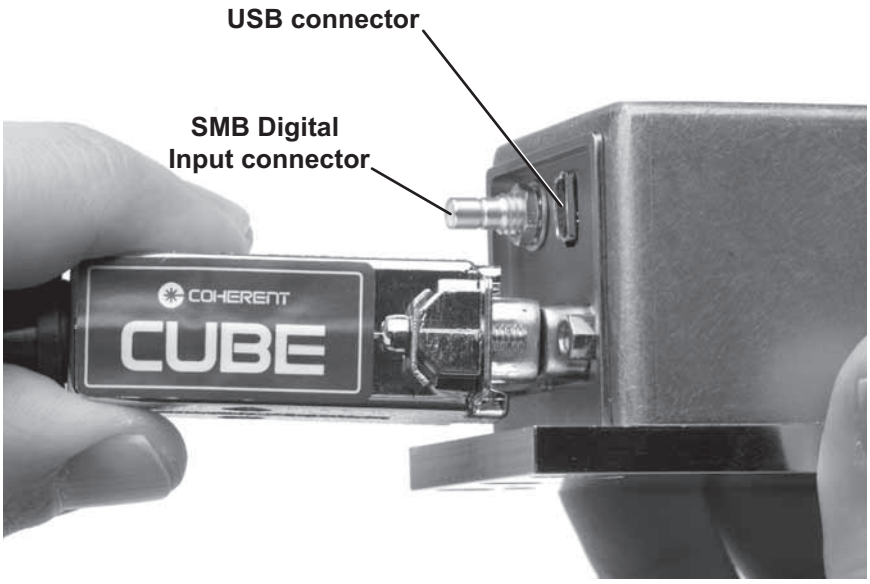


Figure 4-11. Connect the Interface Cable to the Laser

6. Tighten the connector shell screws to ensure reliable system operation. For additional information, refer to "Interface Cable" (p. 3-10).
7. Connect the power supply.

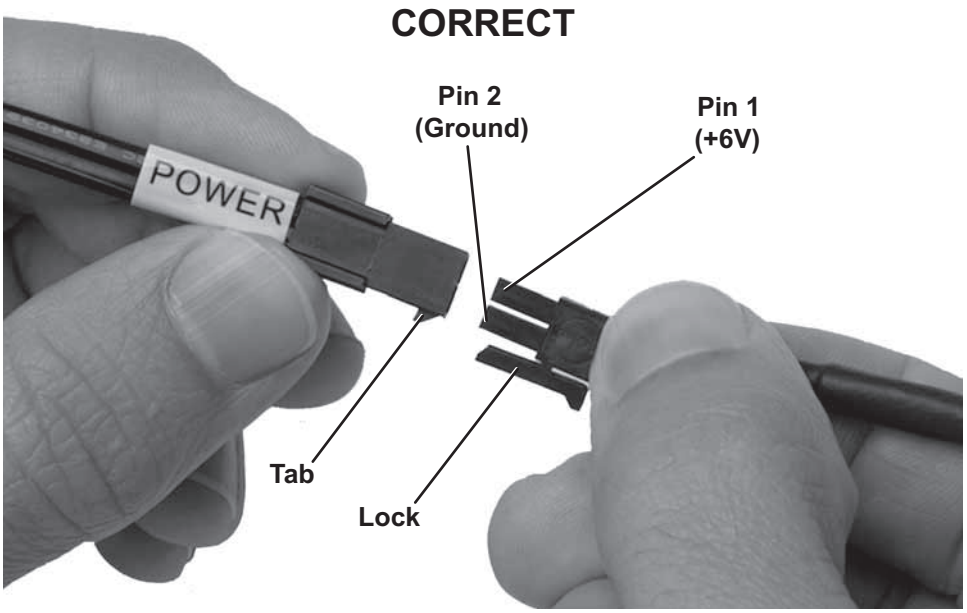


Figure 4-12. Correct Way for Power Cable 2-Pin Connector

NOTICE!
Connecting the power cable 2-pin connector incorrectly may cause internal damage and will void the warranty.

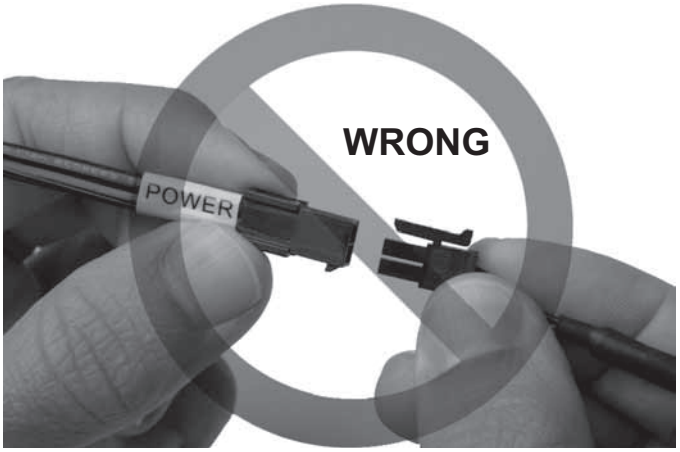


Figure 4-13. Wrong Way for Power Cable 2-Pin Connector

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

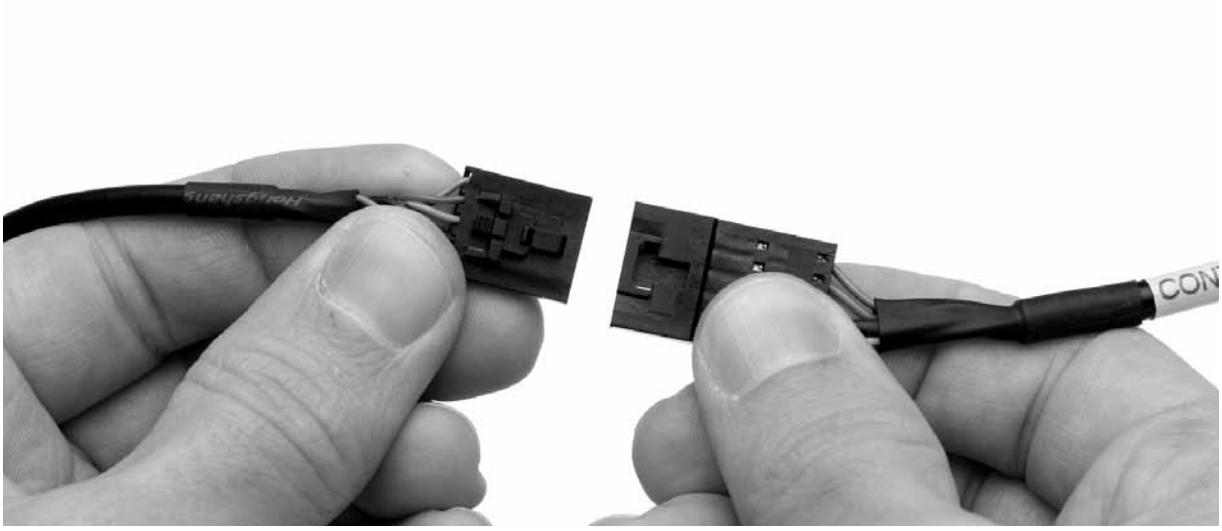


Figure 4-14. Connect the Control Box

9. Connect a computer to the USB interface connection—review Table 3-8 (p. 3-17) for RS-232 pin connections.

Figure 4-15. Connect the USB or Serial Interface Cable

NOTICE!
A null-modem cable will *not* operate the CUBE laser system.

Table 4-1. RS-232 Pin Connections

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

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

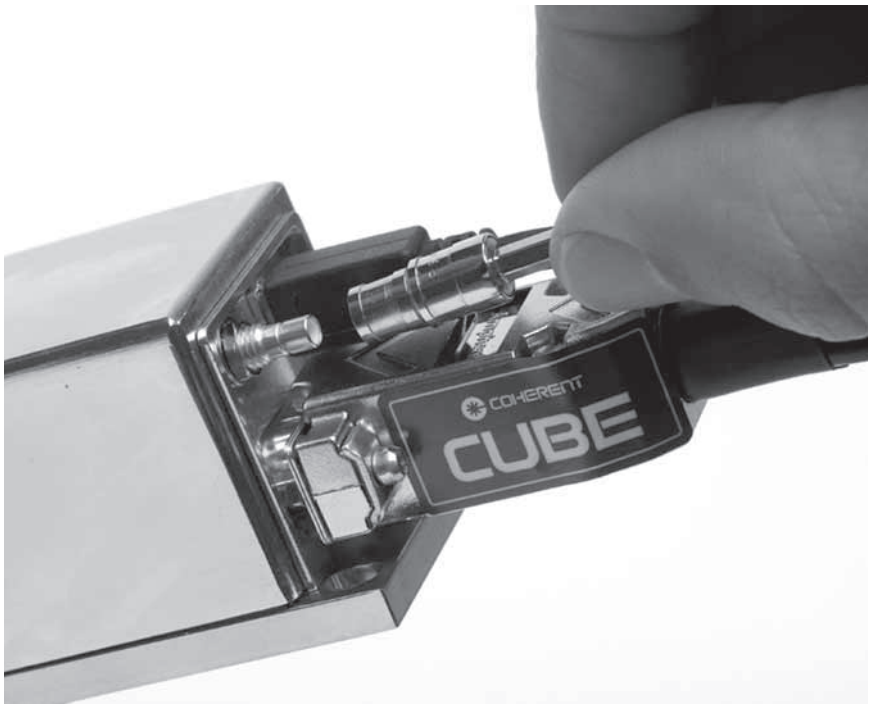


Figure 4-16. SMB Connection

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

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

11. Connect the optional RS-232 interface cable.

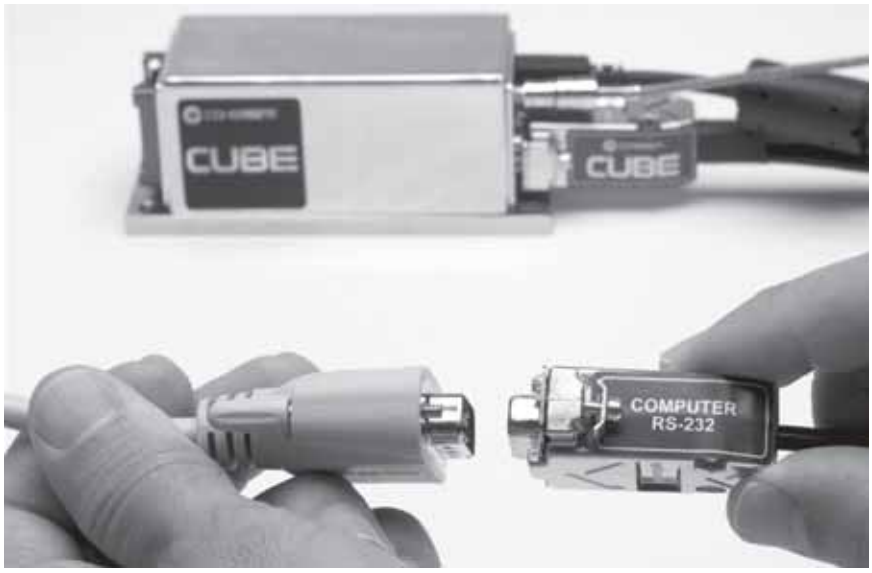


Figure 4-17. Optional RS-232 Connection

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

NOTICE!
The CUBE laser system is shipped in CW Manual mode with a 5-second CDRH-required delay. The laser emission is active approximately five seconds after the keyswitch is set to the ON position.

14. 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 start without additional hardware or settings required.

15. For RS-232 communication, use the settings shown in the following table.

Table 4-2. RS-232 Communications

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

16. For USB communication, refer to "USB Control" (p. 6-1).

17. 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.

18. 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 "RS-232 Remote Control" (p. 5-2) 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.

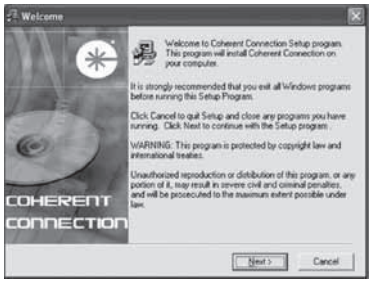
Quick Start: USB Control

1. *For CW operation*: Perform the entire procedure describe under "Quick Start: CW Operation" (p. 4-1) and then continue with step 2, below.

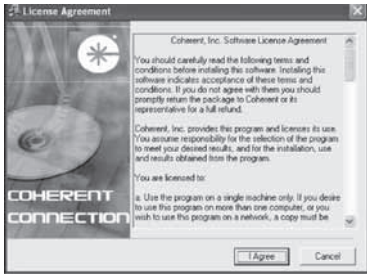
   For Pulsed operation: Perform the entire procedure described under "Quick Start: Pulse Operation" (p. 4-6) and then continue with step 2, below.

2. Place the Coherent Connection software CD into the computer CD drive. The software installation process will automatically start without additional action by the user.

3. Install the Coherent Connection software by accepting all of the installation defaults shown below.

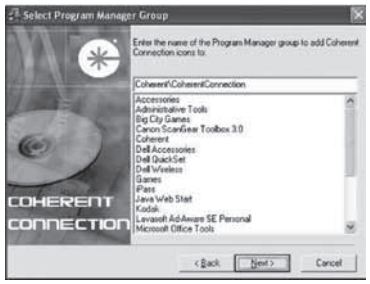


Click "Next"

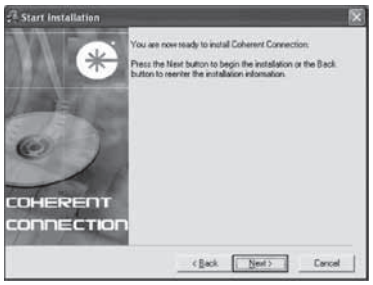


Click "I Agree"

Click "Next"

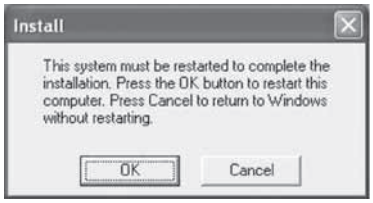


Click "Next"



Click "Next"

Click "Finish"



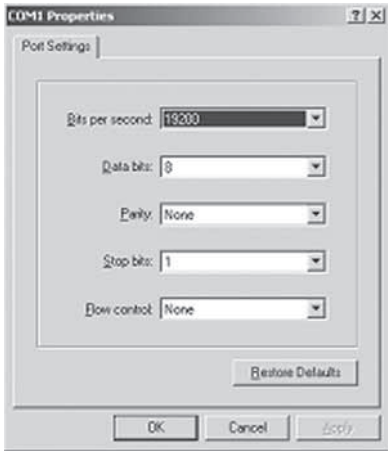
Click "OK"

4. When the computer restart is complete, a Coherent Connection shortcut icon will appear on the computer desktop. Double-click on the icon to start the Coherent Connection software.

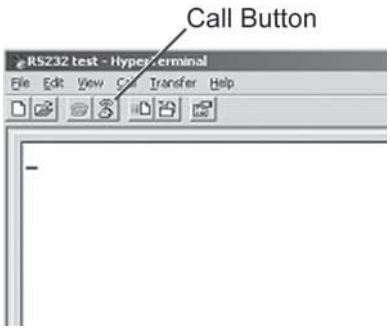
5. Refer to "Section Six: Computer Control" (p. 6-1) for detailed Coherent Connection software operation.

Quick Start: CUBE Communications Through HyperTerminal

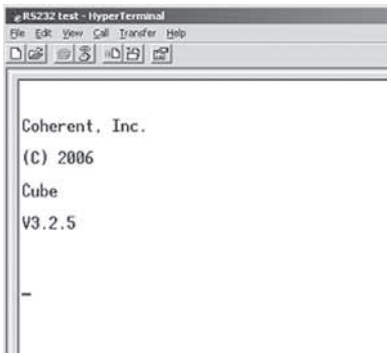
1. Switch the CUBE laser OFF.
2. Connect the CUBE to the computer through the RS-232 port (a standard straight-through serial cable can be used).
3. Open HyperTerminal and create a file name for the new connection.
4. Select the appropriate COM port on the computer and follow the recommended HyperTerminal menu settings shown below.



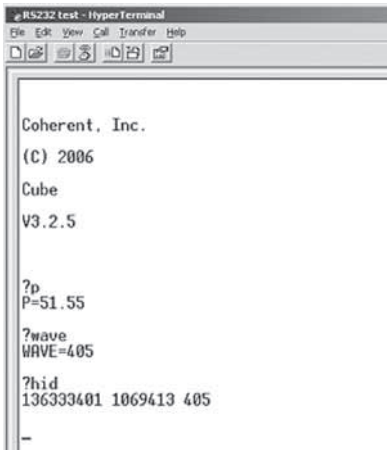
5. Go to the HyperTerminal main window and activate the connection by pressing the Call button.



6. Switch the CUBE laser ON. If a proper connection is established, it will automatically reply to HyperTerminal with the information shown below.



7. Commands described in other sections of this manual can be used to communicate with the laser. In the following example, a few query commands are used to check the power level, wavelength, and the serial number of the laser.



SECTION FIVE: OPERATION

Introduction

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

1. The laser system has been mounted with the proper heat sink and torque specifications. Refer to "Section Three: Installation" (p. 3-1) 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 ("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

Manual Mode

NOTICE!
The CUBE laser system is shipped in CW Manual mode with a 5-second CDRH-required delay. The laser emission is active approximately five 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—allow for computer control without additional configuration settings.

For a complete list of computer controls and queries, refer to "RS-232 Remote Control" below. 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 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 volts. A normal DC type voltage input provides direct CW power control.

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

The CUBE laser system provides a complete set of input and output controls through the DE-15 connector. For a complete list of connector functions, refer to Table 3-5 (p. 3-11).

RS-232 Remote Control

The CUBE laser system includes complete remote control capability through USB and RS-232. For USB control information, refer to "USB Control" (p. 6-1). The laser system is shipped in Manual mode. All of the RS-232 commands and queries are available in Manual mode.

RS-232 Connections. The CUBE uses a standard RS-232 connection. Refer to the information in Table 5-1 (p. 5-3) to connect directly to the CUBE DE-15 connector or the CUBE interface cable DE-9 connector.

NOTICE!
A null-modem cable will not operate the CUBE laser system—the CUBE is a DCE device and requires a standard serial cable.

Table 5-1. RS-232 Pin Connections

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

The CUBE laser system uses the RS-232 remote communication settings shown in the table, below.

Table 5-2. RS-232 Communication Settings

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

Syntax:

`Command=<value>` A CUBE command is used to change a present setting. The syntax used for 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 CUBE query is defined by a question mark (“?”) prior to the query. The current state of CUBE commands can be

displayed with a "?" prior to the command. Use the "?S" query to display a complete list of current settings.

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

The CUBE command prompt provides feedback associated with the current system status and the command or query entered. Refer to the "?F" query—Table 5-4 (p. 5-5)—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 3)

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 five-second emission delay on and off.
?BT	*Base Plate Temp	0 to 55	Returns (in degrees Celsius) the present base plate temperature. The hardware resolution for this measurement is 0.06ºC.
?C	*Laser Diode Current	0 to 255	Returns (in milliamps) the present operating current of the laser diode. The hardware resolution for this measurement is 0.1 mA.
CLS	**Clear Screen	N/A	Clears text from a serial communication screen.
?DST	Diode Set Temp.	15 to 35	Returns (in degrees Celsius) the present set temperature of the laser diode. The hardware resolution for this measurement is 0.029ºC.
?DT	*Diode Present Temp.	15 to 35	Returns (in degrees Celsius) the present measured temperature of the laser diode.
E	**Echo ON-OFF	N/A	Sets or reads the Echo Off feature. This feature turns character echo on or off on a serial communication terminal and is useful if a computer script/program—rather than a person—is controlling the laser.
?F	*Fault Number	See Table 5-5 (p. 5-8) for fault codes.	Returns the present system status as a decimal value corresponding to the binary system status. Review the ?F table for a complete list of error conditions.
?FF	*Fault Binary Code	See Table 5-5 (p. 5-8) for fault codes.	Checks for faults in the system and returns a two-byte result. No system fault returns 0000 0000 0000 0000—see Table 5-5 (p. 5-8).
?FL	*Fault List	See Table 5-5 (p. 5-8) for fault codes.	Checks for faults in the system and returns an ASCII result. No system fault returns “System OK”—see Table 5-5 (p. 5-8).
?HH	*Usage Hours Head	0 to 100000	Returns the present head hours with a resolution of one second. The head hours are tracked in one-minute intervals when the system is powered down and restored.
?HID	*Head ID Value	N/A	Returns (as a comma-delimited string) the head serial number, head type, and nominal wavelength.

Table 5-4. CW RS-232 Commands and Queries (Sheet 2 of 3)

COMMAND	FUNCTION	RANGE	DESCRIPTION
L	***Laser ON-OFF	0, 1	Sets the laser status. Setting L=1 enables the laser On. TEC servo MUST be ON (T=1) to set L=1. Setting L=0 turns off the laser output.
?LT	Laser Type	N/A	When OP=2 operating mode is active, this query returns Sapphire laser types. Review the Sapphire manual for additional information.
OP	***Operating Protocol	1,2,3	Determines the response format for commands and queries. OP=1 returns data in the format described in the CUBE manual. OP=2 returns data to match responses from Coherent Sapphire lasers. OP=3 returns data to match responses from Coherent Compass 405 lasers. Review Coherent Sapphire and Compass 405 manuals for detailed response information.
P	***Laser power	0, MAXLP	Sets (in mW) the laser power. The range of P values is based on the minimum laser threshold power (?MINLP) and the maximum laser power (?MAXLP).
?PSH	Power Hours	0/100000	Returns the present Laser Hours.
?PST	Computer Temperature	N/A	Returns the present computer temperature in OP=2 operating mode.
?SP	*Set Power Out	0,MAXLP	Returns (in mW) the present laser power setting. This value represents the last value entered with the P command.
?SS	TEC	0,1	Returns TE status 1=ON, 0=OFF.
?SV ?SVH	*Software Version	N/A	Reads the CUBE firmwand version.
?STA	*Operating Status #	N/A	Returns an integer value representing the present CUBE system operating status. 1: Warm Up 2: Standby 3: Laser ON 4: Error 5: System Halted (Fatal Error)
?M	*Manual Mode	0,1	Returns the status of the Manual mode control DE-15 pin 3. The Manual mode pin normally floats high with no connection. When this pin is tied to ground, all laser operations require computer control.
?MINLP	*Min. Light Cont. Pwr.	N/A	Returns (in mW) the minimum power available in CW light control mode.

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

COMMAND	FUNCTION	RANGE	DESCRIPTION
?MAXLP	*Max. Light Cont. Pwr.	N/A	Returns (in mW) the maximum laser power available in CW light control mode.
?NOMP	*Nominal Laser Pwr.	N/A	Returns (in mW) the nominal CW laser output power.
?WAVE	*Laser Wavelength	N/A	Returns the laser operating wavelength, based on a diode temperature of 25 degrees Celsius.
?INT, ?LCK ?K	*Interlock Status	0,1	The ?INT or ?LCK query returns the status of the interlock DE-15 pin 1 status. A value of 1 corresponds to a closed status and a value of 0 corresponds to an open status.
?PVPS	*Protocol Version	N/A	Reads the software protocol version. If the CUBE firmware is imbedded into a process, this query can be used to check for changes in command structure. If the firmware version changes without changes to the command structure, the this query returns the same value for separate firmware versions.
T	***Turns TE ON	0,1	Reads or sets the TEC status. Setting T=1 enables the temperature control of the laser diode. Setting T=0 disables the temperature control.
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 runs at the threshold power if no voltage is present at the digital pulse input connector.
ANA	***Analog Control Mode	0,1	Switches the Laser Diode parameter controlled by the external analog signal from current (ANA=1) to power (ANA= 0). In CW mode, the CUBE is always in light-regulation, so the ANA value will remain zero (0).
EXT	***Ext. Analog Laser Pwr. Control	0,1	Commands either the power or current to be set by the external analog modulation input. Querying this command returns the command status: EXT=1 for external or EXT=0 for internal. The external connector is located at laser pin 8 on the DE-15 connector.

Additional pulse-specific commands are listed in Table 5-10 (p. 5-17).

?F - The ?F query returns the fault status as a decimal value representing the sum of all current faults. If there is no fault in the system, it returns a value of zero.

?FF - The ?FF query returns the fault status in a 16-bit binary format representing the sum of all faults. The table below shows the decimal equivalent. If there is no fault in the system, it returns a value of 0000 0000 0000 0000 or [0].

?FL - The ?FL query returns the fault status as text and lists all the current faults. If there is no fault in the system, it returns the text message "System OK."

Table 5-5. Fault Codes (Sheet 1 of 2)

?F/?FF ERROR VALUE	DESCRIPTION/?FL	CAUSE	POSSIBLE SOLUTION
0	System OK		
1	Bad Command	Syntax error associated with the command	Review and correct the command syntax
2	Bad Data	Entered data is out of range or there is a syntax error associated with the data	Review the range of entered data or correct the syntax
4	EEPROM Checksum Error	Error associated with the system EEPROM	Reboot the laser system—contact Coherent Technical Support if the problem persists
8	Base Plate Temperature	Base plate temperature is greater than 50ºC	Improve heat sink to reduce the base plate temperature.
16	Laser Diode Temperature	Difference between the diode set temperature and the measured diode temperature is greater than 5ºC	Improve heat sink to reduce the diode temperature
32	Interlock Fault	Interlock is open	Close the Interlock connection
64	I2C Error	Processor-to-hardware communication error	Reboot the laser system—contact Coherent Technical Support if the problem persists
128	Value out of Range	Command entered correctly with a value that is excessive or deficient for the command	Review the range of entered data and correct, as necessary
256	nc		
512	nc		
1024	Flash Reset	Internal error caused a reset condition for all present settings	Enter the desired values for all system parameters

Table 5-5. Fault Codes (Sheet 2 of 2)

?F/?FF ERROR VALUE	DESCRIPTION/?FL	CAUSE	POSSIBLE SOLUTION
2048	Over Current	Laser current exceeded 120% of the new system current—result of diode degradation over time	Contact Coherent Technical Support
4096	Reset Clock	Internal error caused system clock reset	
8192	System Time Out	Command is not acknowledged by the processor	Contact Coherent Technical Support if the problem persists
16384	Buffer Overflow	Excessive number of commands is issued—typical command response time is 250 msec.	Space commands by 250 msec
32768	Fatal Error	Processor error	Reboot the laser system—contact Coherent Technical Support if the problem persists

Pulse Operation

The CUBE laser system provides the capability of 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. For actual wavelength and power performance values, refer to the product data sheet specific to your laser.

Modulation Performance

The CUBE lasers offer five separate control features. These controls can be operated independently or combined for multi-function purposes. The five control input types are:

1. Analog Modulation
2. Digital Modulation
3. Laser Enable
4. Interlock
5. Computer Control via RS-232 or USB

The following table lists performance characteristics of the various modulation methods.

Table 5-6. Performance Characteristics

SYSTEM SPECIFICATIONS	VALUE
Digital Modulation	
Maximum Bandwidth	150 MHz
Rise and Fall Time (10 to 90%)	< 2 nsec*
Modulation Depth at 0 Hz	> 1,000,000:1 (10^6:1)
Modulation Depth at 150 MHz	> 250:1
Input Impedance	50 ohms
Analog Modulation	
Maximum Bandwidth	350 KHz
Rise and Fall Time (10 to 90%)	< 1 µsec
Modulation Depth	> 10,000:1
Input Impedance	2000 ohms
Laser Enable Control Input	
Maximum Bandwidth	130 KHz
Rise and Fall Time (10 to 90%)	<1 µsec
Modulation Depth	Infinity, Complete On/Off
Input Impedance	7000 ohms
Interlock Control Input	
Maximum Bandwidth	7 Hz
Rise and Fall Time (10 to 90%)	< 1 µsec
Modulation Depth	Infinity, Complete On/Off
Input Impedance	7000 ohms
* Only on CUBE 445: Fall Time < 3 nsec with 125 MHz maximum bandwidth. Actual performance values are listed in the product data sheet for your lasers wavelength and power.	

Digital Control

The 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 ohm..

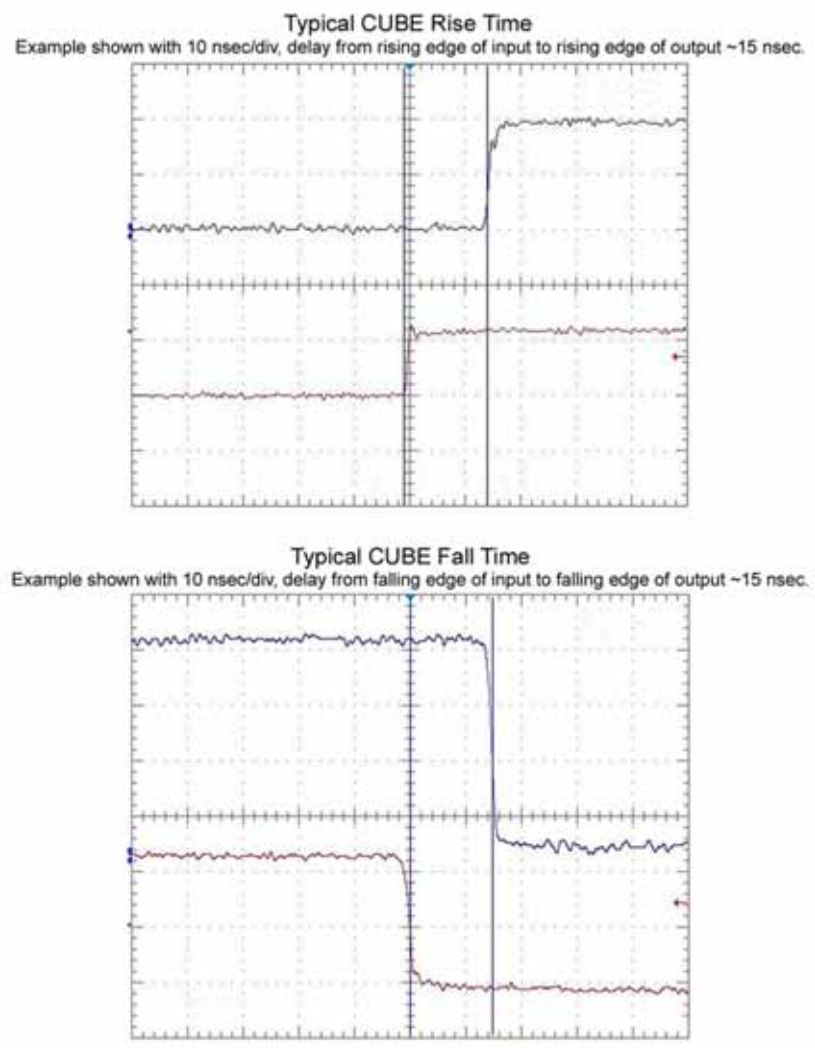


Figure 5-1. Pulse Timing Diagrams

1. Connect the laser as shown in “Section Three: Installation” (p. 3-1).
2. Connect a signal generator cable (impedance $Z = 50\ \Omega$) between the laser head and 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 (p. 5-11).

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

The control box BNC connector can be used to control the amplitude of the digital modulation output. This feature allows simultaneous amplitude control of the digital modulation at a maximum rate of 350 KHz. Refer to the example in the following figure.

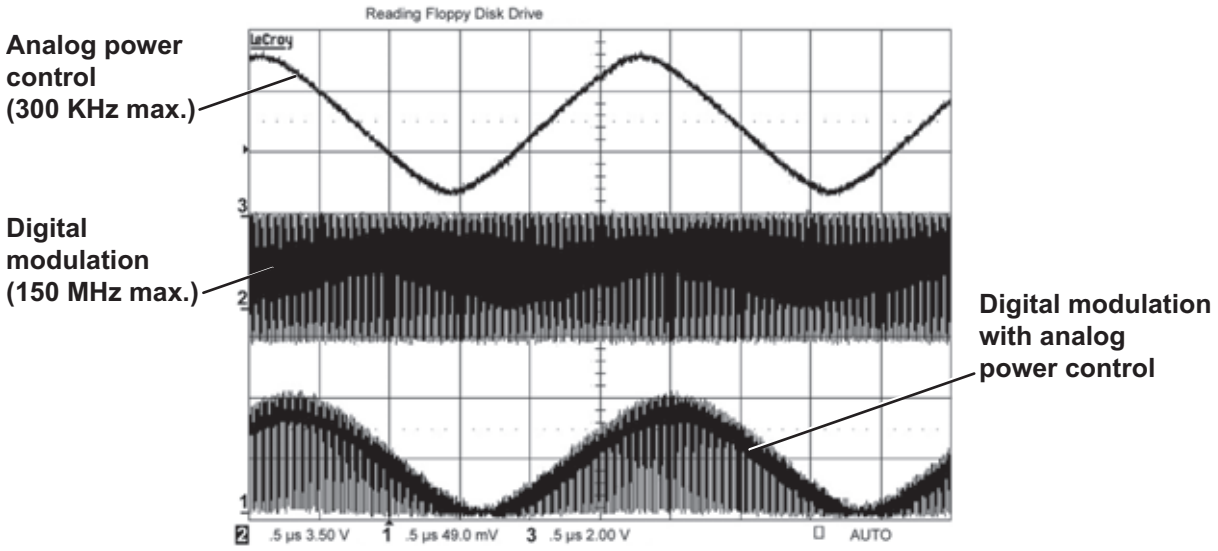


Figure 5-2. Digital Modulation with Analog Power Control

NOTICE!

Based on differences between optical Rise Time and Fall Time—combined with the associated delay difference between the digital input and optical output—150 MHz modulation is not achievable with a 50-50 duty cycle. Adjust the duty cycle as needed to achieve maximum optical pulse amplitude at the desired modulation frequency.

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. For actual wavelength and power performance values, refer to the product data sheet specific to your laser.

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

Table 5-7. Modulation Input Connections

DE-15 CONNECTOR		
PIN NUMBER	**RANGE**	**DESCRIPTION**
8	0 to 5V	Analog Input (+) 350 KHz Maximum Bandwidth
10	N/A	Analog Input (–) Ground for Analog Input
SMB CONNECTOR		
PIN NUMBER	**RANGE**	**DESCRIPTION**
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

Using CUBE in Pulsed Mode With Analog Control

The CUBE laser system has two operating modes: CW light regulation (constant power) and Pulse (constant current). The Pulse mode offers advantages of both digital and analog inputs. In many applications these laser features can help replace external modulation controls to save cost and space. The following descriptions clarify the Light Regulation mode, Pulse mode, and the details on how to replace an AOM with the CUBE.

Light Regulation (Constant Power) Mode

The Light Regulation mode uses a sample of the laser output power to control the laser diode current and establish a light output power level by this feedback. The computer sets the maximum laser output power by varying the reference voltage to the light feedback error amplifier. Analog modulation operates the same way by varying the reference voltage from the maximum set by the computer. See the following figure.

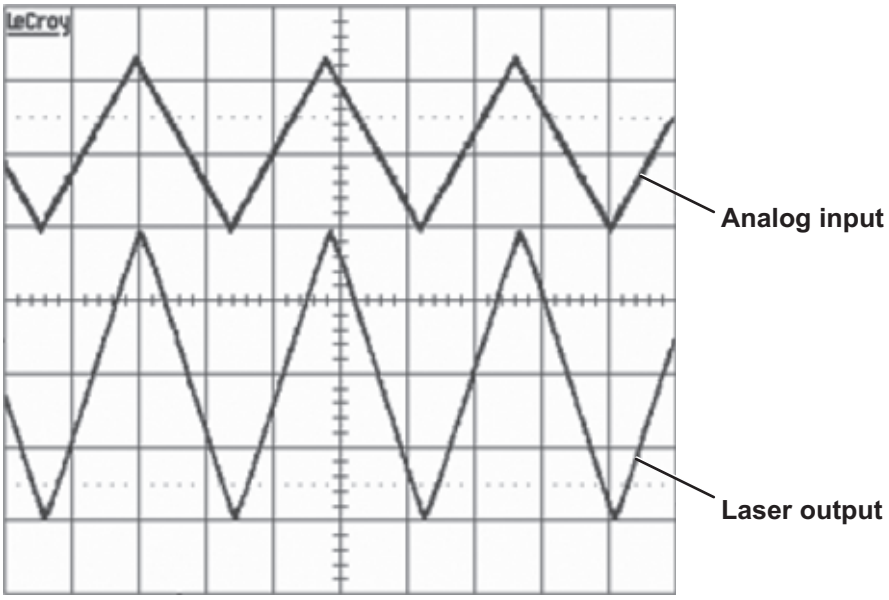


Figure 5-3. Example: CUBE Analog Modulation in Light Regulation (CW) Mode

To access the analog modulation input, connect to the BNC on the front of the control box.

The Light Regulation mode has the advantage of compensating for aging in the diode by sampling the light output level directly and always driving the necessary current through the laser diode to maintain the power level. Another advantage is that light output verses modulation input voltage is forced to be linear and directly proportional.

Pulse (Constant Current) Mode

The Pulse mode sets the laser diode drive to a constant current value. The amount of current drive is adjusted to a level necessary to produce the set output power level. The digital modulation input is used to turn the output power on and off, with On being a TTL high input. The computer sets the output power level to the proper value at the time the mode is entered, or by the user issuing a "CAL" command. In this mode, the analog modulation operates to decrease the operating current proportional the input voltage. The effect of this input voltage on the power output is dependent upon the laser diode slope of current verses power. See the following figure.

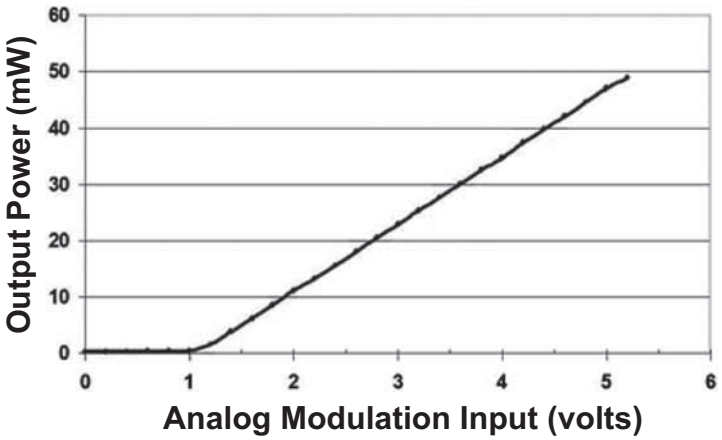


Figure 5-4. Example: CUBE Analog Modulation in Pulse Mode

The level at which the light output reaches a minimum is also dependent upon the diode and will vary from diode to diode. To assure that a given maximum output power is available, a "CAL=" command should be issued on a regular schedule to compensate for laser diode aging.

Replacing External Modulation System with the CUBE

The equivalent of a Laser operating through an AOM can be achieved by using the CUBE Laser in Pulse mode. The ON-OFF control line connects to the Digital modulation input (SMB connector, 50 ohm input) and the output level control line connects to the Analog modulation input (CUBE DE-15 connector). This arrangement allows the output power level to be controlled by the Analog input voltage and be turned ON-OFF by the Digital modulation input voltage (TTL High is ON). The "CAL=" command sets the maximum output power when the Analog modulation is at + 5 VDC and the Digital modulation is set to TTL high. The rise and fall times for the Digital modulation input are less than 2 ns with a maximum bandwidth of greater than 150 MHz.

RS-232 Remote Control

The CUBE laser system includes complete remote control capability through USB and RS-232. For information about USB control, refer to "USB Control" (p. 6-1).

The CUBE is shipped in Manual mode. All of the RS-232 commands and queries are still available in Manual mode. Defeating Manual mode allows exclusive computer control, locking out control cable and I/O cable controls.

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

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

NOTICE!
A null-modem cable will not operate the CUBE laser system. The CUBE is a DCE device and requires a standard serial cable.

Table 5-8. RS-232 Pin Connections

DE-9 Interface Cable Connector	
Pin Number	**Description**
2	RS-232 Transmit
3	RS-232 Receive
5	Ground
DE-15 Laser Connector	
Pin Number	**Description**
4	RS-232 Transmit
5	RS-232 Receive
6	Ground

The CUBE laser system uses the RS-232 remote communication settings listed in Table 5-9 (p. 5-17).

Table 5-9. 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 5-10. 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 in 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 five-second emission delay on and off.
?BT	*Base Plate Temp	0 to 55	Returns (in degrees Celsius) the present base plate temperature. The hardware resolution for this measurement is 0.06ºC.
?C	*Laser Diode Current	0 to 255	Returns (in milliamps) the present operating current of the laser diode. The hardware resolution for this measurement is 0.1 mA.
CLS	**Clear Screen	N/A	Clears text from a serial communication screen.
?DST	Diode Set Temp.	15 to 35	Returns (in degrees Celsius) the present set temperature of the laser diode. The hardware resolution for this measurement is 0.029ºC.
?DT	*Diode Present Temp.	15 to 35	Returns (in degrees Celsius) the present measured temperature of the laser diode.
E	**Echo ON-OFF	N/A	Sets or reads the Echo Off feature. This feature turns character echo on or off on a serial communication terminal and is useful if a computer script/program—rather than a person—is controlling the laser.

Table 5-10. Pulsed RS-232 Commands and Queries (Sheet 2 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
?F	*Fault Number	See Table 5-5 (p. 5-8) for fault codes.	Returns the present system status as a decimal value corresponding to the binary system status. Review the ?F table for a complete list of error conditions.
?FF	*Fault Binary Code	See Table 5-5 (p. 5-8) for fault codes.	Checks for faults in the system and returns a two-byte result. No system fault returns 0000 0000 0000 0000—see Table 5-5 (p. 5-8).
?FL	*Fault List	See Table 5-5 (p. 5-8) for fault codes.	Checks for faults in the system and returns an ASCII result. No system fault returns "System OK"—see Table 5-5 (p. 5-8).
?HH	*Usage Hours Head	0 to 100000	Returns the present head hours with a resolution of one second. The head hours are tracked in one-minute intervals when the system is powered down and restored.
?HID	*Head ID Value	N/A	Returns (as a comma-delimited string) the head serial number, head type, and nominal wavelength.
L	***Laser ON-OFF	0, 1	Set the laser status. Setting L=1 enables the laser ON. TEC servo MUST be ON (T=1) to set L=1. Setting L=0 turns off the laser output.
LT	Laser Type	N/A	When OP=2 operating mode is active, this query returns Sapphire laser types. Review the Sapphire manual for additional information.
OP	***Operating Protocol	1,2,3	Determines the response format for commands and queries. OP=1 returns data in the format described in the CUBE manual. OP=2 returns data to match responses from Coherent Sapphire lasers. OP=3 returns data to match responses from Coherent Compass 405 lasers. Review Coherent Sapphire and Compass 405 manuals for detailed response information.
P	***Laser power	0, MAXLP	Sets (in mW) laser power. The range of P values is based on the minimum laser threshold power (?MINLP) and the maximum laser power (?MAXLP).
?PSH	Power Hours	0 to 100000	Returns the present Laser Hours.
?PST	Computer Temperature	N/A	Returns present computer temperature in OP=2 operating mode.
?SP	*Set Power Out	0, MAXLP	Returns (in mW) the present laser power setting. This value represents the last value entered with the P command.
?SS	TEC	0,1	Returns TE status: 1=ON, 0=OFF

Table 5-10. Pulsed RS-232 Commands and Queries (Sheet 3 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
?SV ?SVH	*Software Version	N/A	Reads the CUBE firmware version.
?STA	*Operating Status #	N/A	Returns an integer value representing the present CUBE system operating status. 1: Warm Up 2: Standby 3: Laser ON 4: Error 5: System Halted (Fatal Error)
?M	*Manual Mode	0, 1	Returns the status of the Manual mode control DE-15 pin 3. The Manual mode pin normally floats high with no connection. When this pin is tied to ground, all laser operations require computer control.
?MINLP	*Min. Light Cont. Pwr.	N/A	Returns (in mW) the minimum power available in CW light control mode.
?MAXLP	*Max. Light Cont. Pwr.	N/A	Returns (in mw) the maximum laser power available in CW light control mode.
?NOMP	*Nominal Laser Pwr.	N/A	Returns (in mw) the nominal CW laser output power.
?WAVE	*Laser Wavelength	N/A	Returns the laser operating wavelength, based on a diode temperature of 25ºC.
?INT, ?LCK ?K	*Interlock Status	0,1	The ?INT or ?LCK query returns the status of the interlock DE-15 pin 1 status. A value of 1 corresponds to a closed status and a value of 0 corresponds to an open status.
?PVPS	*Protocol Version	N/A	Reads the software protocol version. If the CUBE firmware is imbedded into a process, this query can be used to check for changes in the command structure. If the firmware version changes without changes to the command structure, this query returns the same value for separate firmware versions.
T	***Turns TE ON	0, 1	Reads or sets the TEC status. Setting T=1 enables the temperature control of the laser diode. Setting T=0 disables the temperature control.
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 runs at the threshold power if no voltage is present at the digital pulse input connector.

Table 5-10. Pulsed RS-232 Commands and Queries (Sheet 4 of 4)

COMMAND	FUNCTION	RANGE	DESCRIPTION
ANA	***Analog Control Mode	0, 1	Switches the Laser Diode parameter controlled by the external analog signal from current (ANA=1) to power (ANA=0). In CW mode, the CUBE is always in light-regulation, so the ANA value will remain zero (0).
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 command status: 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 and adjusting the current to bring the power back to a specified set level. Enter a value for the CAL command to set the amplitude of a digital pulse to a specified level.

?F - The ?F query returns the fault status as a decimal value representing the sum of all current faults. If there is no fault in the system, it returns a value of zero.

?FF - The ?FF query returns the fault status in a 16-bit binary format representing the sum of all faults. Table 5-11 (p. 5-21) shows the decimal equivalent. If there is no fault in the system, it returns a value of 0000 0000 0000 0000 or [0].

?FL - The ?FL query returns the fault status as text and lists all the current faults. If there is no fault in the system, it returns the text message "System OK."

Table 5-11. Fault Codes

?F/?FF ERROR VALUE	DESCRIPTION/?FL	CAUSE	POSSIBLE SOLUTION
0	System OK		
1	Bad Command	Syntax error associated with the command	Review and correct the command syntax
2	Bad Data	Entered data is out of range or there is a syntax error associated with the data	Review the range of entered data or correct the syntax
4	EEPROM Checksum Error	Error associated with the system EEPROM	Reboot the laser system—contact Coherent Technical Support if the problem persists
8	Base Plate Temperature	Base plate temperature is greater than 50ºC	Improve heat sink to reduce base plate temperature
16	Laser Diode Temperature	Difference between the diode set temperature and the measured diode temperature is greater than 5ºC	Improve heat sink to reduce diode temperature
32	Interlock Fault	Interlock is open	Close the Interlock connection
64	I2C Error	Processor-to-hardware communication error	Reboot the laser system—contact Coherent Technical Support if the problem persists
128	Value out of Range	Command entered correctly with a value that is excessive or deficient for command	Review the range of entered data and correct, as necessary
256	nc		
512	nc		
1024	Flash Reset	Internal error caused a reset condition for all present settings	Enter the desired values for all system parameters
2048	Over Current	Laser current exceeded 120% of the new system current—result of diode degradation over time	Contact Coherent Technical Support
4096	Reset Clock	Internal error caused system clock reset	
8192	System Time Out	Command is not acknowledged by the processor	Contact Coherent Technical Support if the problem persists
16384	Buffer Overflow	Excessive number of commands is issued—typical command response time is 250 msec.	Space commands by 250 msec
32768	Fatal Error	Processor error	Reboot the laser system—contact Coherent Technical Support if the problem persists

Syntax:

`Command=<value>` A CUBE command is used to change a present setting. The syntax used for 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 CUBE query is defined by a ? prior to the query. The current state of CUBE commands can be displayed with a ? prior to the command. Use the "?S" query to display a complete list of current settings.

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

The 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 5-12. 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 CUBE laser system includes USB laser control. The USB remote communication provides the ability to control and query a maximum of 127 CUBE laser systems simultaneously. Each CUBE laser system includes Coherent Connection software for USB laser control in a graphical user interface (GUI) environment.

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

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

CUBE OEM Tools (Active X Controls)

This ActiveX control interfaces with any CUBE laser. To aid in the development of an OEM application, Coherent is providing a custom ActiveX control. This control provides a development environment with a set of tools. These tools enable the programmer to quickly and efficiently communicate with the CUBE laser.

The CUBE OEM Tools ActiveX control contains the following methods, properties, and events.

- Methods: CUBEStart, CUBESendData
- Properties: CUBEAdded, CUBERemoved, CUBECount
- Events: CUBEDeviceFound, CUBEDeviceRemoved
- Command Set: CommandSet

Refer to the Coherent Connection software installation location for detailed information on the previously-listed items. The default location is C:\Program Files\Coherent\Coherent Connection and open the file “CUBEOCX.hlp”.

Coherent Connection Software

The Coherent 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. This software offers a terminal window to enter standard RS-232 commands as text for program development purposes. CUBE RS-232 command protocol requires capital letters for each command or query.

The Coherent Connection software generally operates intuitively; however, the limits of adjustable parameters and operation of binary functions are described under "RS-232 Remote Control" (p. 5-2). This software includes on-line help to assist in resolving issues associated with software functions and is compatible with all USB versions of Coherent CUBE systems.

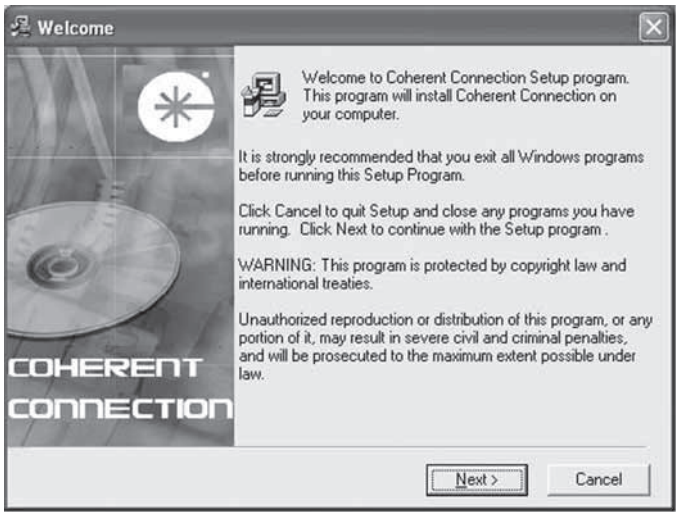
The Coherent Connection software also supports simultaneous control of Coherent Sapphire lasers and Coherent Compass 405 lasers via RS-232.

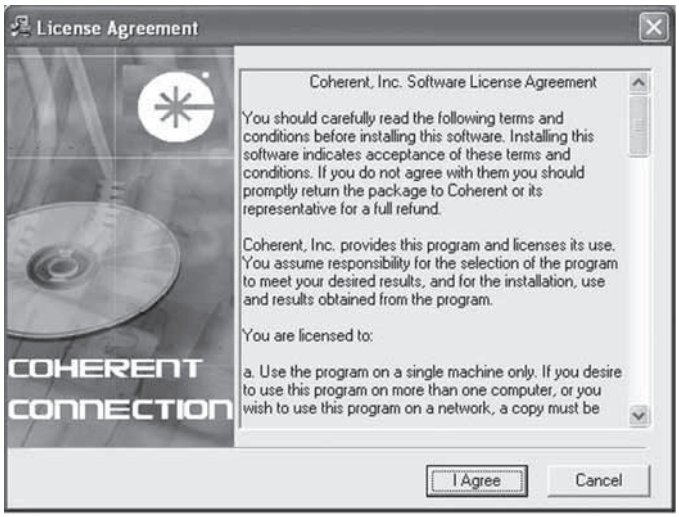
Coherent Connection Software Installation

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

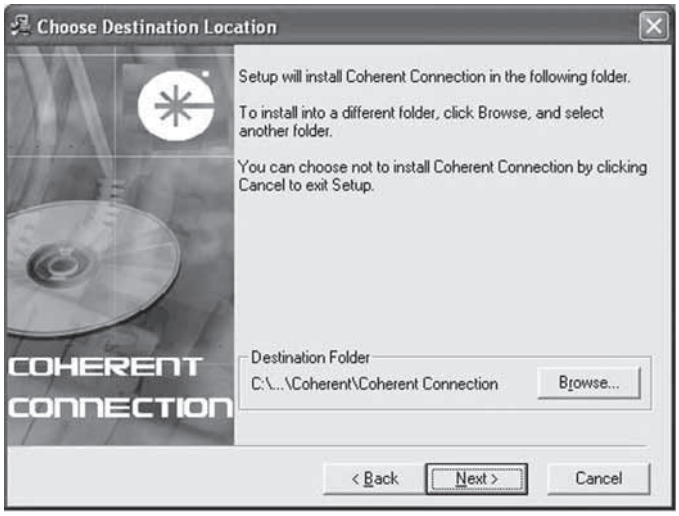
1. The first installation dialog welcomes the user. It also provides provides brief copyright information.

   Click "Next" to continue the installation process.

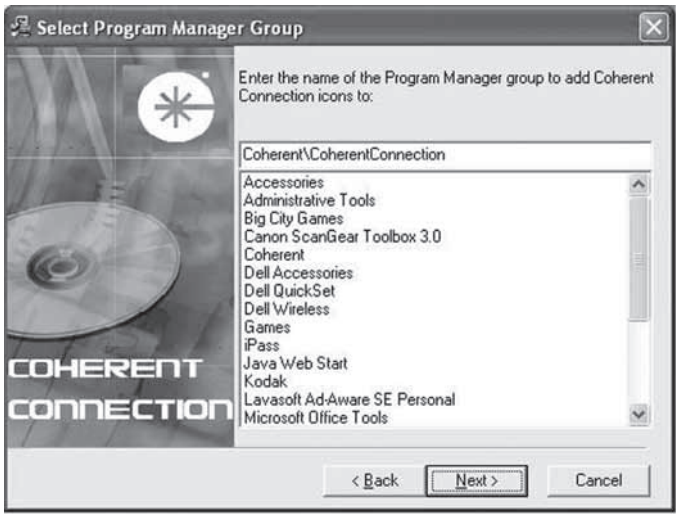




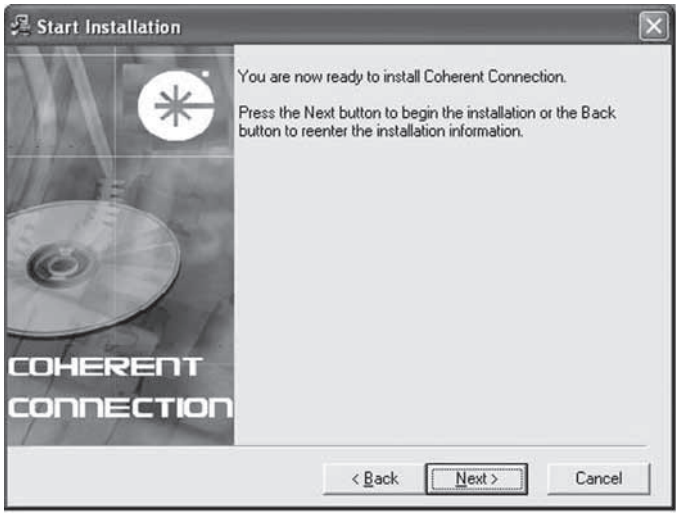
2. The second installation dialog displays the default location for the Coherent Connection software installation. Click "Next" to continue the installation or click "Browse" to select a desired installation location.



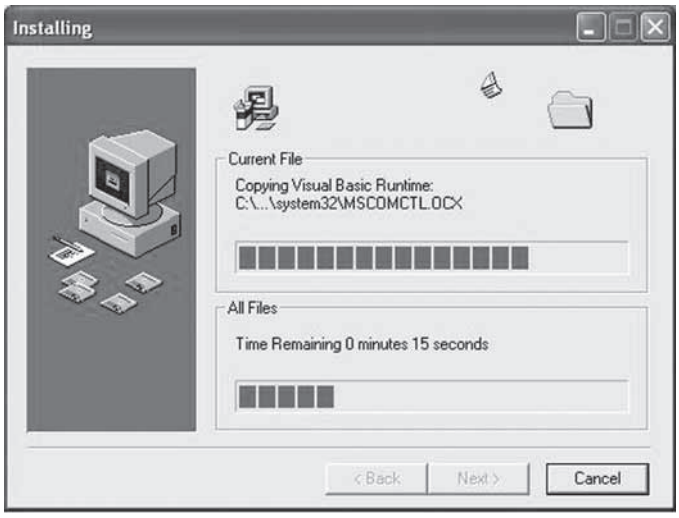
3. The third installation dialog displays the program manager designation for the Coherent Connection software. The text appears when you click "Start" then "Programs" in Windows.



4. The fourth installation dialog completes the location settings associated with the software installation. Click the "Back" button to change the present settings. Click the "Next" button to install the software in the selected location.

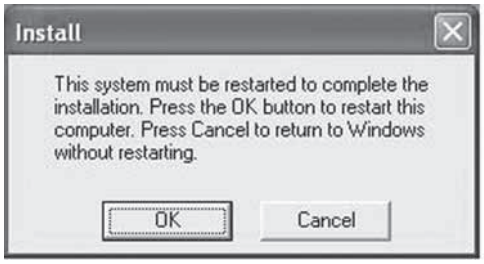


5. The fifth installation dialog displays the progress of the software installation.



6. The sixth installation dialog confirms the successful installation of the Coherent Connection software.

7. Click the "OK" button to restart the computer and register the Coherent Connection supporting files and USB drivers.



The Coherent Connection software installation is complete.

Coherent Connection Tool Bar

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

Open Button

 The Open button displays a standard Windows Open dialog. The default file type is .cfg, representing a Configuration file. The Configuration file is used to store and recall all Coherent Connection settings.

Save Button

 The Save button displays a standard Windows Save dialog. Enter a desired file name and click "Save" to store all current Coherent 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 Coherent Connection window. Select the type of print function and then click "OK" to print on the selected printer.

Home Button

 The Home button switches to the Home screen. Review the Home screen for additional detail associated with screen functions.

Settings Button

 The Settings button switches to the Settings screen. Review the Settings screen for additional detail associated with screen functions.

Information Button

 The Information button switches to the Information screen. Review the Information screen for additional detail associated with screen functions.

Terminal Button

 The Terminal button switches to the Terminal screen. Review the Terminal screen for additional detail associated with screen functions.

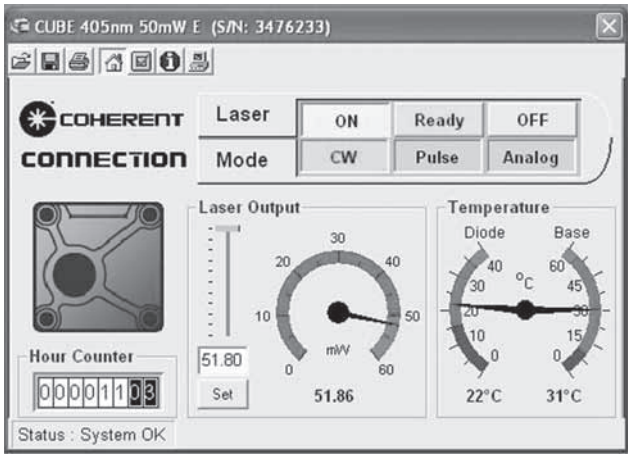
System Status

The System Status displays at the bottom of all Coherent 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 is interrupted until the fault is resolved.

Coherent Connection Screens

Home Screen

The Home screen displays common information associated with the laser operation. The Current gauge is displayed or hidden with a check box on the Setting screen. Specific faults are displayed on the Fault screen.

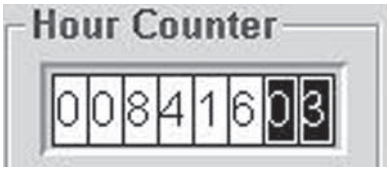


Wavelength Icon

The displayed icon color indicates the wavelength of the laser connected to the Coherent 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 screen 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 represents the hours of the installed diode.



Laser Emission Status

The Laser Emission Status screen indicates 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.

Laser Mode Status

The Laser Mode Status indicators display the current output status for the CUBE. When the Pulse is active, the laser output is controlled by an external digital signal to the back panel SMB connection. When the Analog is active, the laser output is controlled by an external voltage source input to the Control Box BNC connector.

NOTICE!
If lower power CW is observed, ensure both the Pulse and Analog are displayed in a disabled condition.

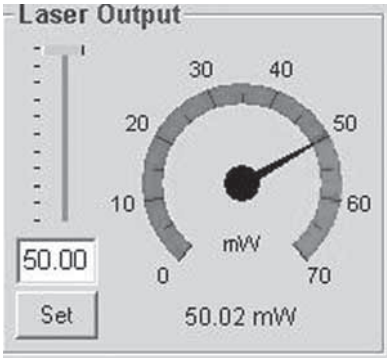
NOTICE!
When the Pulse is active, the laser runs at threshold power. A laser running at threshold power can be interpreted as a CW laser problem. Click the CW indicator to restore normal CW power levels. Laser modulation is controlled by a TTL digital signal through the SMB connector.

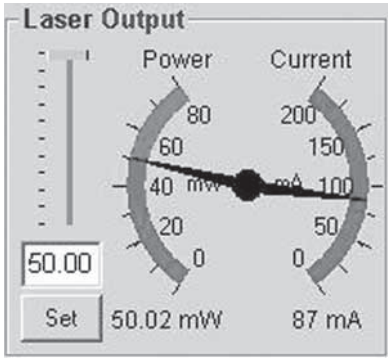
Laser Output Indicator

The laser output indicator is a relative display of laser output power. Coherent recommends using one of the external laser power meters—listed in "Appendix C: Accessories" (p. C-1)—for precision measurement of laser output power.

Laser output power can be changed by using either of the following methods:

- Entering a value and then clicking the Set button.
- Dragging the slider and then clicking Set.



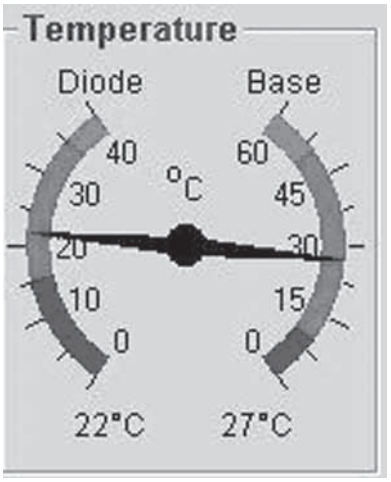


Add a relative laser current display by checking the Show combination Power/Current gauge on the Home Screen box on the Settings screen. The displayed current should be considered a relative value.

The Green to Red transition indicates maximum laser power.

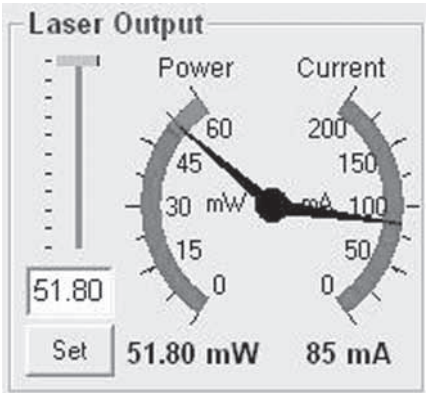
Temperature Display

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.



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

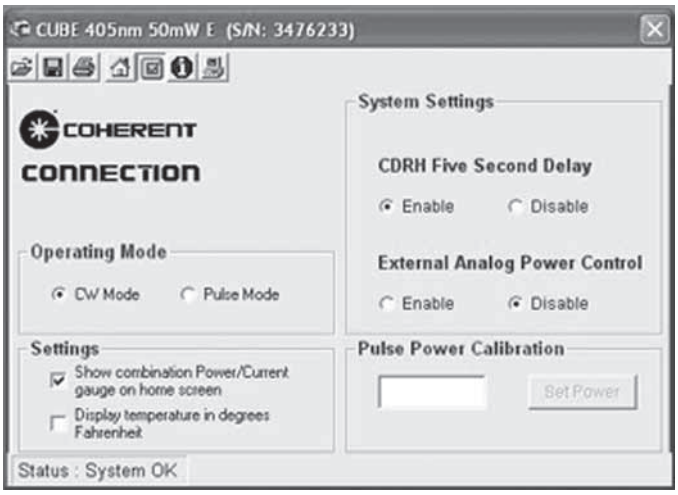
Double-click the Temperature gauge to display values in Fahrenheit. Double-click again to return values to Celsius.



Double-click the Power Gauge to display laser current. Double-click again to return the display to power only.

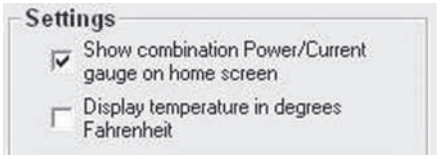
Settings Screen

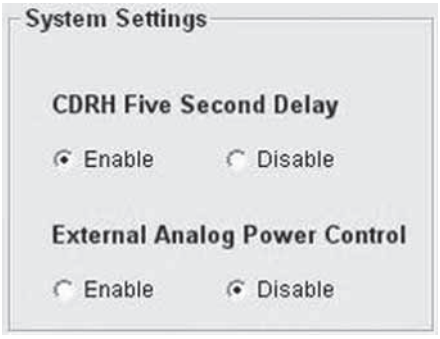
The Settings screen is used to change various system and display parameters. All settings displayed on the Settings screen are stored when the application is closed. Laser-specific settings are stored in the laser when the laser is powered down.



Settings

The Settings section contains check boxes used to set Home screen display options and the laser status when exiting Sleep mode. Use the first check box to show or omit the current display, in combination with the power display on the Home screen. Use the second check box 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. If the third check box is checked, the previous laser emission status is restored when the system exits Sleep mode. If the box is not checked, laser emission is automatically restored when the system exits Sleep mode.





System Settings

The System Settings section is used to control the CDRH delay and External Analog power control status for the connected CUBE laser.

CDRH Five-Second Delay

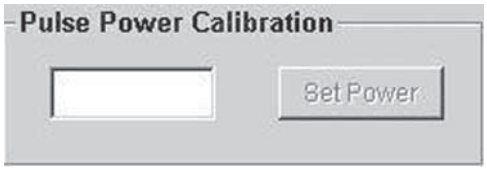
The CDRH Five-Second Delay radio buttons are used to toggle emission delay status. When the Enable button is selected, a five-second delay is applied each time laser emission is interrupted. These interruptions include an open interlock and fault conditions. When the Disable button is selected, laser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

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 Coherent Connection software.

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.

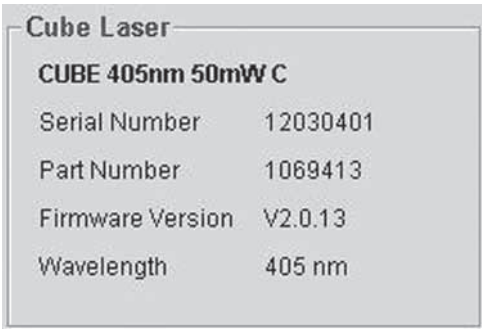


Information Screen

The Information screen displays 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 lists of operating parameters. The information shown below represents a typical 405 nm system.

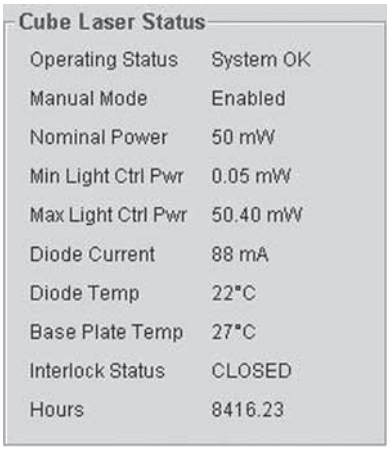


Table 6-1. Operating Parameters

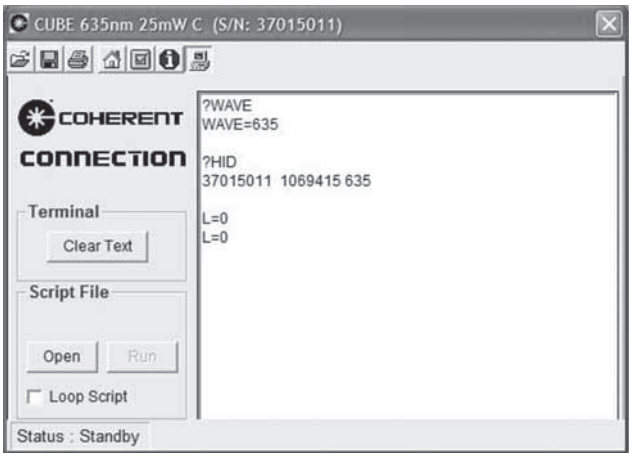
PARAMETER	DESCRIPTION
Operating Status	Operating Status displays the Standby, Fault, or Ready condition of the system.
Manual Mode	Manual mode represents the Start-up mode for the selected system. When Manual mode is active, laser emission is automatic, following diode temperature stabilization and CDRH 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 controlled by the state of pin 3 on the DE-15 or pin 1 on the I/O connector. No connection to this pin defaults to Manual mode (Auto-start). When this pin is pulled low, laser emission must be initiated with computer control.
Nominal Power	Nominal Power represents the normal laser output power. Refer to **Max Light Ctrl Pwr**, below, for the maximum laser output power available.
Min Light Ctrl Pwr	Minimum Light Control Power represents the laser threshold output power. The value listed corresponds to the laser output power when the system is running in Pulse mode without a digital input to the SMB connector.
Max Light Ctrl Pwr	Maximum Light Control Power represents the maximum power setting available.
Diode Current	Diode Current displays the relative laser diode current. This is an indirect measurement and is not considered absolute. Use this parameter as a tool to observe changes in diode current.
Diode Temp	Diode Temperature is the measured diode temperature. This value is updated continuously.
Base Plate Temp	Base Plate Temperature is updated continuously. If the base plate temperature exceeds 50ºC, the software protects the diode by interrupting laser emission. When the temperature returns below 50ºC, laser emission is automatically restored.
Interlock Status	Interlock Status is updated continuously. When the Control Box key is in the On position, the status displays as closed. If the key is switched to the Off position, the status displays as open.
Hours	The Hours 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 represents the hours of the installed diode.

Faults

Faults display on the Status bar. Specific information displays when a temperature fault—including Base Plate and Diode Temperature—is present. Other faults display with a Fault indicator. To obtain details for other faults, use the Terminal screen and enter ?F. Compare the returned value to information contained in Table 5-5 (p. 5-8).

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.

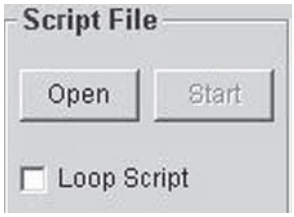


Terminal

The Clear Text button clears all information displayed in the Terminal window.

Script File

The Open button displays a standard Windows Open dialog. To load a Script file into the Terminal window, select the desired file and click Open. Then click the Start button to execute the displayed script. Checking the Loop Script box will continually run the display script.



SECTION SEVEN: ADVANCED PROCEDURES

CDRH Feature

The Coherent CUBE is shipped as a CDRH-compliant laser system. The CDRH-required delay of approximately five 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 remotely toggled on and off.

Disable CDRH Procedure

1. Refer to "USB Control" (p. 6-1) and "RS-232 Remote Control" (p. 5-2) to establish remote communication with the 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. Use the "CDRH=1" command to restore the CDRH-required delay.

WARNING!
This operation defeats 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.

System Standby and Sleep Mode

For users requiring intermittent use of the 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.

Laser output can be immediately initiated 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 "RS-232 Remote Control" (p. 5-2) for additional computer control information relating to the "L" and "T" conditions.

SECTION EIGHT: TROUBLESHOOTING

Introduction

If you experience problems with the CUBE laser system, refer to Table 8-1, below. If you are not successful in solving the problem or need further assistance, either contact Coherent Technical Support (in the US: 1.800.367.7890), or a worldwide local Coherent service representative (see www.Coherent.com for worldwide contacts).

Review the ?F RS-232 query for additional troubleshooting information.

NOTICE!
Take appropriate ESD precautions when handling and installing a laser. Refer to "Electrical Safety" (p. 1-2) for a complete description of ESD precautions.

Troubleshooting Procedures

Listed below are possible problems with a reference to the associated Troubleshooting checklist.

Table 8-1. Troubleshooting Procedures

PROBLEM	REFERENCE
Interlock Fault	Checklist 1 (p. 8-2)
No Laser Emission at Start-up	Checklist 2 (p. 8-2)
System Shuts Down (RS-232 Control)	Checklist 3a (p. 8-3)
System Shuts Down (Analog Control and Manual Mode)	Checklist 3b (p. 8-3)
Low Power (RS-232 Control)	Checklist 4a (p. 8-4)
Low Power (Manual Mode)	Checklist 4b (p. 8-4)
Excessive Scattered Light (All Operating Modes)	Checklist 5 (p. 8-5)
Output Power Not Stable (All Operating Modes)	Checklist 6 (p. 8-5)
Beam Noise Out of Spec (All Operating Modes)	Checklist 7 (p. 8-5)
No RS-232 Communication	Checklist 8 (p. 8-5)
Transverse Mode is Not TEM_{oo}	Checklist 9 (p. 8-6)
Base Plate Over Temperature	Checklist 10 (p. 8-6)

Checklist 1:

Interlock Fault

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

[ ] Cycle DC power OFF/ON.

[ ] Verify the supply voltage is between 4.8 and 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, contact Coherent Technical Support.

Checklist 2:

No Laser Emission at Start-up

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

[ ] Cycle DC power OFF/ON.

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

[ ] Verify the supply voltage is between 4.8 and 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, contact Coherent Technical Support.

[ ] 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 the "?F" command

[ ] If fault #8 or #16 is 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, contact Coherent Technical Support 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. Contact Coherent Technical Support.

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

- **[ ]** Check for proper heat sinking of the laser head—refer to "Checklist 10: Base Plate Over Temperature" (p. 8-6).
- **[ ]** Check for proper grounding of the laser head (the laser head cover must be at earth ground).
- **[ ]** Issue the "?F" command
- **[ ]** If fault #8 or #16 is 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, contact Coherent Technical Support 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. Contact Coherent Technical Support.

Checklist 3b: System Shuts Down (Analog Control and Manual Mode)

- **[ ]** Check for proper grounding of the laser head (the head cover must be at earth ground potential).
- **[ ]** Verify the power supply is providing a voltage between 4.8 and 6.5 VDC.
- **[ ]** Measure the base plate temperature. If it exceeds 50ºC, check for proper laser head heat sinking—refer to "Checklist 10: Base Plate Over Temperature" (p. 8-6).
- **[ ]** If using external interlocks, verify all external interlocks are closed.
- **[ ]** Contact Coherent Technical Support.

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

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

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

[ ] Make sure the output window is clean.

[ ] Use the ?P RS-232 query to check current laser power. If the returned value does not represent the expected laser power, use 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, contact Coherent Technical Support.

[ ] 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.

[ ] Use the ?EXT query to check for active external analog power control. If ?EXT returns a value of 1, laser power is reduced. Enter EXT=0 to ensure normal power levels.

Checklist 4b:
Low Power (Manual Mode)

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

In Manual mode, the CUBE allows for computer control and queries. Refer to "Checklist 3a: System Shuts Down (RS-232 Control)" (p. 8-3) for appropriate computer connections and settings.

[ ] Verify the output window is clean.

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

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

[ ] Make sure the output window is clean.

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

[ ] If "?P" response indicates low power, contact Coherent Technical Support.

Checklist 5:
Excessive Scattered Light (All Operating Modes)

- [ ] Observe the output beam prior to hitting any external optics. If the output beam is OK, clean the external optics.
- [ ] Verify the output window is clean.
- [ ] Contact Coherent Technical Support.

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

- [ ] 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 the output window is clean.
- [ ] Verify all cable connections are secure.
- [ ] Measure base plate temperature over a 5-minute period. If the base plate temperature is not stable, check for proper heat sinking—refer to "Checklist 10: Base Plate Over Temperature" (p. 8-6).
- [ ] If using the control box for laser power control, verify a stable input voltage to the BNC connector.
- [ ] Contact Coherent Technical Support.

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

- [ ] Make sure beam noise is measured prior to any external optics.
- [ ] Verify the output window is clean.
- [ ] Check for proper heat sinking.
- [ ] Verify there is no vibrations at the laser.
- [ ] Check for proper grounding of the laser cover.
- [ ] Contact Coherent Technical Support.

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 (16.4ft).
- [ ] Use a second computer to exclude a defective RS-232 port at the controlling computer.
- [ ] Contact Coherent Technical Support.

Checklist 9:
Transverse Mode is Not TEM_{oo}

- [ ] Make sure the beam is observed prior to external optics. If the beam quality is correct, clean the external optics.
- [ ] Verify the output window is clean.
- [ ] Contact Coherent Technical Support.

Checklist 10:
Base Plate Over Temperature

- [ ] Verify the proper size of the heat sink—refer to "Heat Sink Requirement" (p. 3-2) for more information.
- [ ] Verify proper operation of the heat sink (that is, 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 the ambient temperature does not exceed 50ºC.

SECTION NINE: REPACKING PROCEDURE

This section describes the factory-recommended repacking procedure for the 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 need to be shipped or returned.

The CUBE laser system requires one shipping box. The following table lists the components shipped with the system.

Table 9-1. CUBE Shipping Box Contents

ITEM DESCRIPTION	QUANTITY
Coherent CUBE Laser	1
Coherent CUBE Power Supply	1
Coherent CUBE Manual	1
USA Style Power Cord	1
Coherent Connection Software CD	1
Coherent CUBE Control Box	1
Coherent CUBE Interface Cable	1
USB Cable	1
Modified M4 Mounting Screws	4
M4 Small Pattern Washer	4

Product Shipping Instructions

To prepare the product for shipping:

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

APPENDIX A: 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.

APPENDIX B: PARTS LIST

The following parts can be ordered by contacting our Technical Support Hotline at 1.800.367.7890 (1.408.764.4557 outside the U.S.); through e-mail (Product.Support@Coherent.com); or your local Coherent service representative. When communicating with our Technical Support Department, via telephone or e-mail, the model and Laser Head serial number of your laser system will be required by the Support Engineer responding to your request.

Effective January 1, 2007 this Coherent laser system was released as RoHS-compliant. If your laser system was purchased prior to January 1, 2007 you should contact Coherent Technical Support to determine if the items listed below are the appropriate part numbers for your laser system. You can locate the date of manufacturing for your laser system on the system serial number label.

Table B-1. Parts List

DESCRIPTION	PART NUMBER
CUBE Power Supply, 6 VDC, 2.5A, Switched	1072454
Accessory, Heat Sink, Coherent CUBE	1073840
Accessory, Right Angle Bracket, Coherent CUBE	1116779
Interface Cable, Coherent CUBE	1072166
USB Cable	1108906
Control Box	1039966
Manual and CD	1079890
Secondary Emission Indicator Lamp	1079150
Non-shorted RCA Plug	1040408
Cable, Extension, DE-9 M/F, 6 ft. (1.8 m)	1080090
Power Cord, USA	1108063

APPENDIX C: ACCESSORIES

Power Meter Accessories

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

For the most common diagnostics need—measuring the output power of the Coherent CUBE—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 these power levels. The PS10Q sensor is a temperature-stabilized thermopile sensor designed for measurements in the ~100 µW to 1 W region.

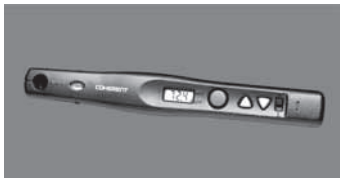
We recommend the FieldMaxII-TOP to go with the PS10Q. An affordable, versatile, easy-to-use digital meter designed for field service and production applications, this meter features an easy-to-read LCD with a backlight, as well as direct button-driven commands for simple, no-hassle use.

PS10Q High-Sensitivity Thermopile Sensor (RoHS)	Part Number 1098400

FieldMaxII-TOP™ Laser Power and Energy Meter (RoHS)	Part Number 1098580

Alternative Recommendation

LaserCheck is 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 power from 0.5 µW to 1 W.



LaserCheck™ Handheld Power Meter (RoHS)	Part Number 1098293

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
oz·in.	Ounce inches
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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