

*Preinstallation Manual*  
*DIAMOND™ Series OEM/Industrial*  
*DIAMOND™ C-40 Air-Cooled Laser*



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*DIAMOND™ Series OEM/Industrial*  
*DIAMOND™ C-40 Air-Cooled Laser*



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Bloomfield, CT 06002

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#### **In the U.S.:**

Should you experience any difficulties with your laser or need any technical information, please visit our Web site [www.Coherent.com](http://www.Coherent.com). Should you need further assistance, please contact Coherent Technical Support via e-mail [Product.Support@Coherent.com](mailto:Product.Support@Coherent.com) or telephone, 1-800-367-7890 (1-408-764-4557 outside the U.S.). Please be ready to provide model and laser head serial number of your laser system as well as the description of the problem and any corrective steps attempted to the support engineer responding to your request.

Telephone coverage is available Monday through Friday (except U.S. holidays and company shutdowns). Inquiries received outside normal office hours will be documented by our automatic answering system and will be promptly returned the next business day.

#### **Outside the U.S.:**

If you are located outside the U.S., please visit [www.Coherent.com](http://www.Coherent.com) for technical assistance, or phone your local Service Representative. Service Representative phone numbers and addresses can be found on the Coherent web site.

Coherent provides telephone and web-based 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. Under no circumstances do these support services affect 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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## 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:

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#### **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.

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#### **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:



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

---



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

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**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.**

---



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

---



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

---



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

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## Preface

This is the Preinstallation Manual for the DIAMOND C-40™ Air-Cooled OEM/Industrial carbon dioxide (CO<sub>2</sub>) lasers manufactured by Coherent. These lasers are OEM systems, they are designed as components which are to be inserted by the original equipment manufacturer (OEM) prior to delivery to the end user. Coherent strongly recommends that the user read Section Two: Laser Safety, before operating the laser.



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### **WARNING!**

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

---

## **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 must be obtained from Coherent or an appropriate U.S. Government agency.

Products manufactured in the European Union, Singapore, Malaysia, Thailand: These commodities, technology, or software are subject to local export regulations and local laws. Diversion contrary to local law is prohibited. The use, sale, re-export, or re-transfer directly or indirectly in any prohibited activities are strictly prohibited.

**Notice  
Concerning  
Regulatory  
Status of  
DIAMOND  
Series Lasers**

This laser component does not include all safety features that are required by the United States Food and Drug Administration (FDA), Center for Devices and Radiological Health (CDRH) in laser systems sold to end users. It is sold solely to qualified manufacturers who in their end product, supply interlocks, indicators, and other required safety features, in full compliance with 21 CFR 1040, Subchapter J and/or other applicable national and local regulations.

**Notice  
Concerning  
Warranty**

Operation or handling of this laser component, inconsistent with this manual, may void the warranty.

## **SECTION ONE: DESCRIPTION AND SPECIFICATIONS**

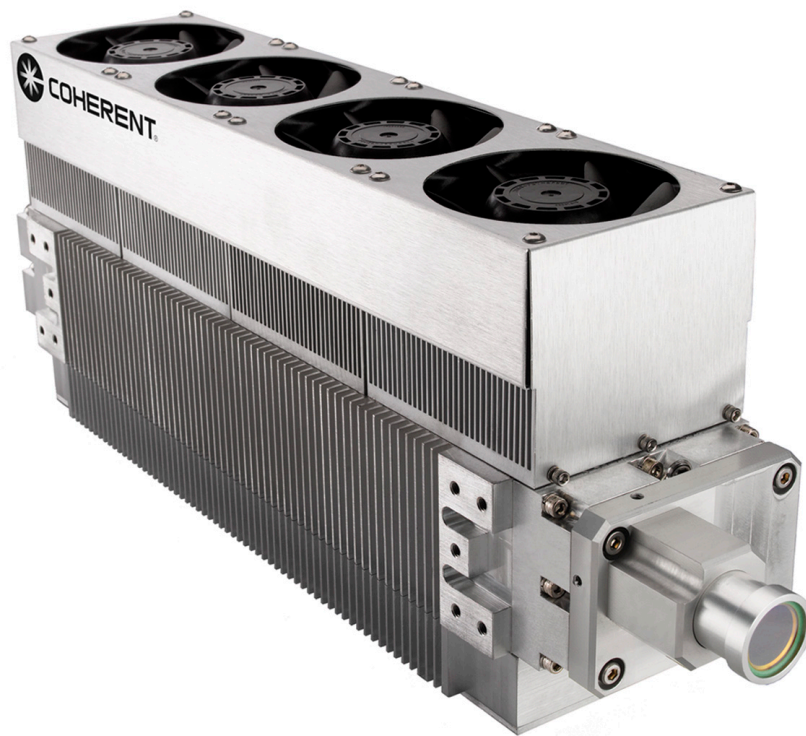
### ***Introduction***

This section details specifications and characteristics (including mechanical, thermal, electrical, and optical interfaces; environmental requirements, and limitations) of the DIAMOND C-40 laser.

The DIAMOND C-40 laser is a sealed-off, RF excited CO<sub>2</sub> laser, capable of continuous wave (CW) or modulated operation. From the laser safety point of view, this laser is considered to be a component and must be integrated into a system by a qualified original equipment manufacturer (OEM) prior to delivery to the end user. See the section titled “Laser Safety Requirements” on page 2-5 for a complete discussion of laser safety issues.

### ***Purpose of This Manual***

This manual is designed to assist the original equipment manufacturer (OEM) during the integration of the DIAMOND C-40 OEM laser. It contains information about the performance and operation of the laser as well as installation and control methods.



***Figure 1-1. DIAMOND C-40 Air-Cooled Laser***

## **Specifications and Input Requirements**

Table 1-2 on page 1-4 provides specifications and requirements for power inputs for the DIAMOND C-40 laser.

Figure 1-1 on page 1-1 illustrates the baseline configurations (i.e., without any optional hardware additions or deletions) of the DIAMOND C-40 laser. Each laser system consists of a laser head assembly and an integrated radio frequency (RF) power module. The RF power module converts 48 VDC,  $\leq 13$  A (20 A peak for 1 ms) power to radio frequency power.

Connection of the customer-supplied DC power supply to the DIAMOND C-40 is via a barrier strip with screw terminals on the RF power module. These terminals should also be used for the connection of wires for remote voltage sensing. Such sensing is recommended to control the voltage at the input to the RF power module more precisely.

## **Hardware Overview**

The DIAMOND C-40 laser is a waveguide, carbon dioxide (CO<sub>2</sub>) laser. RF electric fields provided by the RF power module excite the CO<sub>2</sub> gas mixture. The standard configuration of this laser operates at a wavelength near 10.6  $\mu\text{m}$  in the infrared region of the electromagnetic spectrum.

## **DC Input Power**

DC input power is provided by the user through customer-supplied bus wiring, which goes to the RF power module. The RF power module converts this DC electrical power into RF power which is used to excite the gas in the laser head. The DC power supply requirements are discussed in detail in the subsection titled, “DC Power Supply Requirements” on page 3-7.

## **Cooling Requirements**

Total heat dissipation for the laser is specified in Table 1-2 on page 1-4. The laser head typically dissipates 400 W from its base surface while the RF power module typically dissipates 200 W, for a total typical heat dissipation of 600 W (maximum total heat dissipation is 675 W). The DIAMOND C-40 must be provided adequate cooling to keep the laser operating temperature within acceptable limits. The cooling method that is used must not induce stresses that will result in misalignment of the laser resonator. The DIAMOND C-40 heat sinks are designed so the assembled structure remains free of excessive stress. Installation requirements related to cooling of the air-cooling version of the DIAMOND C-40 laser are discussed in detail in the subsection titled “Air Cooling” on page 3-5.

## Comparison of Air Cooling and Liquid Cooling (Reference)

Air cooling and liquid cooling each have distinct advantages. Table 1-1 describes the factors that should be taken into consideration when choosing a cooling system for a laser module.

Consideration should also be taken if condensable vapors are present and to take suitable measures to purge sensitive areas, such as optical surfaces, with a suitable gas.

**Table 1-1. Comparison: The Benefits of Air-Cooling vs. Liquid-Cooling Methods**

AIR COOLING	LIQUID COOLING
<ul style="list-style-type: none"> <li>• Low in cost</li> <li>• Low in complexity</li> <li>• Low service requirements</li> <li>• Easier to install</li> </ul>	<ul style="list-style-type: none"> <li>• Offers the highest process stability</li> <li>• Can yield the most compact arrangement</li> <li>• Suitable for applications in which the ambient air temperature exceeds 40°C</li> <li>• Better for applications in which the ambient air is laden with particulates</li> <li>• Easier to make a hermetically sealed system</li> </ul>



**NOTICE!**

**To avoid damage to the laser, never operate the laser without adequate air cooling.**

## Laser Head

The laser head takes RF input power and converts some of it to laser radiation. The rest of the RF input power is exhausted as waste heat. For the DIAMOND C-40 air-cooled laser, the waste heat is exhausted into the ambient air. The laser head consists of the folded optical waveguide resonator, the all-metal gas envelope structure, and RF power module. Infrared laser radiation is emitted from the optical aperture. Pictures and dimensions drawings for the DIAMOND C-40 air-cooled laser are shown in Figure 1-1 and Figure 3-1 on page 3-3.

## RF Power Module

The DIAMOND C-40 RF power module converts DC input power to RF energy, which is sent to the laser head. Heat from the RF power module flows into the integrated laser assembly and is exhausted into the surrounding air. An RJ-45-type connector is used to control the laser system. All of the user interfaces (DC power and signal interface) are on one panel of the RF power module.

## Specifications

Table 1-2 describes the specifications and input requirements for DIAMOND C-40 lasers.

**Table 1-2. Specifications and Input Requirements for DIAMOND C-40 Lasers**

<b>SYSTEM PERFORMANCE SPECIFICATIONS</b>	Wavelength	10.55 μm to 10.65 μm
	Optical Output Power <sup>1</sup>	40 W
	Power Stability <sup>2</sup>	± 5%
	Mode Quality	$M^2 < 1.3$
	Beam Size	3.6 ± 0.5 mm @ output aperture
	Beam Divergence	< 5.0 mRad, full angle
	Polarization	> 100 to 1 (Fixed linear, parallel to width dimension)
	Operating Frequency & Duty Cycle	0 to 25 kHz, 0 to 100% DC
<b>CONFIGURATION &amp; FACILITY REQUIREMENTS</b>	Weight	6.8 kg (15.0 lbs)
	Dimensions L x W x H	425 x 92.5 x 154.5 mm (16.73 x 3.64 x 6.08 in.)
	Input voltage <sup>3</sup>	48 VDC ± 2% regulation, < ± 1% P-P Noise/Ripple 13 A with 20 A peak for 1 mS minimum, measured at input terminals
	Heat Dissipation	< 675 W
	Maximum Case Temperature	< 60°C (140°F)
	Operating Environment - Temperature	5°C to 40°C (41°F to 104°F)
	Altitude	< 2,000 m (6,500 ft.)
	Humidity	Non-condensing
	Shipping/Storage Environment	- 10°C to 60°C (14°F to 140°F), Non-condensing
<sup>1</sup> Power measured @ 25°C & derated by 1%/°C for higher laser head temperatures <sup>2</sup> Power Stability based on $\pm (P_{max}-P_{min})/(2*P_{max})$ average power measurement @ constant duty cycle after 10-minute warm-up @ operating condition <sup>3</sup> Current requirement increases by 1 amp if optional fans are installed		

## SECTION TWO: LASER SAFETY

### ***Optical Safety***

The DIAMOND C-40 laser has undergone extensive testing to ensure that, with proper usage, it is a safe and reliable device.

Because of its special properties, laser light poses safety hazards not associated with light from other sources. The safe use of lasers requires that all laser users and everyone near a laser be aware of the dangers involved in laser operation.



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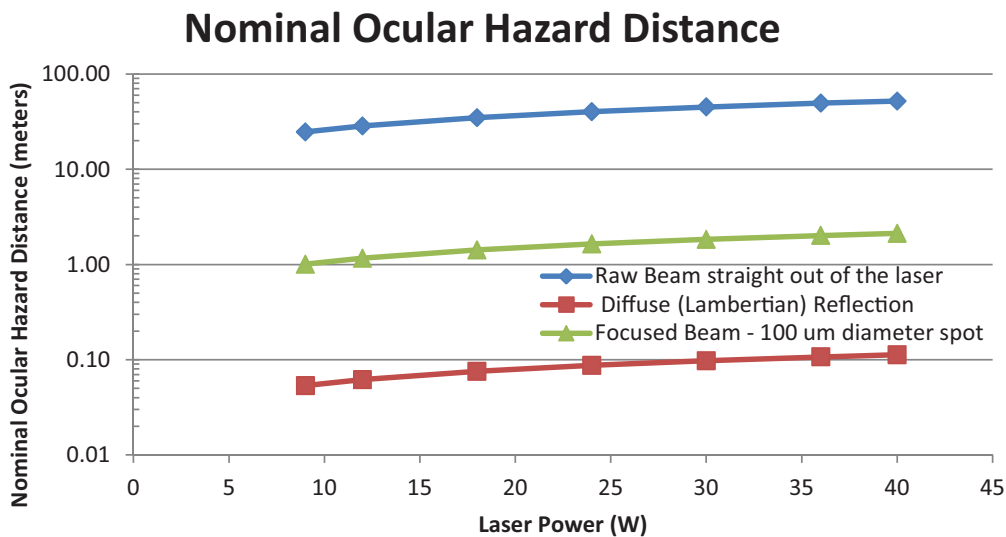
#### **WARNING!**

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

---

## Viewing Distance

The C-40 lasers produce optical power levels that are dangerous to the eyes and skin if exposed directly or indirectly. These products must be operated only with proper eye and skin protection at all times. Never view directly emitted or scattered radiation with unprotected eyes. When viewing the laser during operation, the operator must maintain the Nominal Ocular Hazard Distance (NOHD) between the laser or scattered radiation and the operator's eyes. Figure 2-1 summarizes the NOHD for the power range of the C40 for direct viewing of the collimated beam along with two other common configurations. The NOHD in this figure is based on the Maximum Permissible Exposure (MPE = 0.1 W/cm<sup>2</sup>) level for each power condition as specified in ANSI Z136.1-2007 and IEC 60825-1-2007 (Rule 2 applies over nearly all of the operating range of this laser).



**Figure 2-1. Nominal Ocular Hazard Distance (NOHD) for indicated conditions calculated per ANSI Z136.1-2007**

All personnel in the same room as the laser or anyone who may be exposed to the laser beam should be informed that a laser is in operation. All personnel must wear laser safety glasses which protect against the wavelengths in use.




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### WARNING!

**There is no visible indication at the DIAMOND C-40 laser head that it is operating. Use extreme care when working around or near the laser output to avoid hazardous radiation exposure. Failure to do so could result in serious injury.**

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**CAUTION!**

**Exercise caution to protect against specular reflections since reflections at the DIAMOND C-40 laser wavelength are invisible. These reflections, while weaker than the main beam, may be sufficiently intense to cause eye damage.**

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Eye safety is a great concern when using a high-power laser such as the DIAMOND C-40 laser. There are often many secondary beams present at various angles near the laser. These beams are specular reflections of the main beam from polished surfaces. While weaker than the main beam, such beams may still be sufficiently intense to cause eye damage.

Laser beams are also powerful enough to burn skin, clothing or paint. They can ignite volatile substances such as alcohol, gasoline, ether, and other solvents and can damage the light-sensitive elements in video cameras, photomultipliers, and photodiodes.

Coherent provides the following recommendations to promote the safe use of the DIAMOND C-40 laser. Operators are advised to adhere to these recommendations and employ sound laser safety practices at all times.

- Use protective eyewear when operating the laser and guard against inadvertent exposure to skin or clothing. Select eyewear which is suitable for use with the wavelengths and radiation intensity that the laser emits. Refer to the *Guide for Selection of Laser Eye Protection*, Laser Institute of America (6<sup>th</sup> Edition), 2007.
- The beam path should be enclosed with a protective cover (ideally with an interlock scheme) and these covers should not be removed during normal use.
- Never look directly into the laser output port when the power is on.
- Set up the laser and all optical components used with the laser away from eye level. Provide enclosures for the laser beam.
- Use the laser in a room with access controlled by door interlocks. Post warning signs. When operating the laser, limit access to the area to individuals who are trained in laser safety.
- Avoid operating the laser in a darkened environment.
- Do not use the laser in the presence of flammables, explosives, or volatile solvents such as alcohol, gasoline, or ether.

For additional information on laser safety, refer to the following publications:

- *American National Standard for the Safe Use of Lasers*, Z136.1-2007, American National Standards Institute, 2007.
- *Performance Standard for Laser Products*, United States Code of Federal Regulations, 21CFR1040 10(d).
- *Laser Safety Guide*, Laser Institute of America. (11<sup>th</sup> Edition). Orlando, FL 2007.
- *Guide for Selection of Laser Eye Protection*, Laser Institute of America (6<sup>th</sup> Edition), 2007.
- D. Sliney and M. Wolbarsht. *Safety with Lasers and Other Optical Sources*,. Plenum Publishing Company, New York, N.Y., 1980.

Many of these documents on Laser Safety are available through Laser Institute of America, 13501 Ingenuity Drive, Suite 128, Orlando, CA 32826. Phone 800-345-2737 and on their website [www.lia.org](http://www.lia.org).

## Electrical Safety

The DIAMOND C-40 RF power module requires only 48 VDC input voltage. This voltage and other voltages derived within this laser can be lethal. Every portion of the electrical system should be treated as if it is at a dangerous voltage level.



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### **DANGER!**

**To avoid potentially fatal electrical shock hazards from electrical equipment, follow all applicable electrical codes such as (in the U.S.) the National Electrical Code.**

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## Laser Head

High voltages are present in the laser head when the power is on. There are no serviceable parts or optics within the laser head. Do not remove any covers or make any adjustments to any screw.



---

### **DANGER!**

**To avoid potentially fatal electrical shock hazards from electrical equipment, follow all applicable electrical codes such as (in the U.S.) the National Electrical Code.**

---

## **Laser Safety Requirements**

This laser does not conform to the United States or Foreign Government requirements for laser safety. In the United States, it is the responsibility of the Buyer to ensure that the product sold to the end user complies with all laser safety requirements prior to resell. These laser safety requirements are contained in 21 CFR, Sub Chapter J and are administered by the Center for Devices and Radiological Health (CDRH).

The text of this federal law is available from the U.S. Government Printing Office Bookstore located in most major cities in the U.S. as well as Washington, D.C. A report detailing how the laser product complies with the Federal law is required before the product is shipped. The form of this report is covered in a pamphlet entitled: *Guide for Preparing Product Reports for Lasers and Products Containing Lasers*, Sept. 1995:

U.S. Department of Health and Human Services  
Public Health Service  
Food and Drug Administration  
Center for Devices and Radiological Health  
Division of Small Manufacturers Assistance  
Rockville, Md 20857  
Voice phone: 1-800-638-2041  
Web site: <http://www.fda.gov/cdrh>

For jurisdictions outside of the United States, it is the responsibility of the Buyer of this laser device to ensure that it meets the local laser safety requirements. Additional regulatory information is available at the CDRH web site [www.fda.gov/cdrh](http://www.fda.gov/cdrh).

## Safety Interlocks

The RF power module and laser head covers are not interlocked. These covers should never be removed. There are no user serviceable components inside.



---

### **DANGER!**

**To avoid potentially fatal electrical shock hazards from electrical equipment, follow all applicable electrical codes such as (in the U.S.) the National Electrical Code.**

---



---

### **WARNING!**

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

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## Compliance to Standards Relevant to CE Mark

The DIAMOND C-40 lasers are OEM products, and are sold as components for integration into complete laser systems by a system integrator. These products are tested and CE Marked as independent products. For specific details regarding what applicable compliance directives and standards the products have been tested to, please refer to the Declaration of Conformity which is available upon request from Coherent, per contact information on page ii of this manual.

Compliance to applicable standards for a particular laser tool incorporating DIAMOND C-40 lasers must be demonstrated by the manufacturer of the complete system. The primary issue for the system integrator is to design covers, shielding, grounding, routing of electrical cable assemblies, and control elements with the proper safety features so that during subsequent testing the system meets the appropriate standards.

Coherent recommends the following guidelines to control the amount of radiated interference:

- Use high quality cables and connectors for all electrical connections
- Verify grounding of cable shields, generally at both ends of the cable

## Environmental Compliance

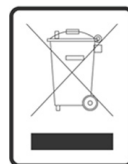
1. The DIAMOND C-40 complies with European Union Directive 2002/95/EC Restriction of Hazardous Substances. Upon request, Coherent Technical Support will supply a materials declaration (please specify Coherent Part/Item Number).
2. The DIAMOND C-40 complies with the China Ministry of Information Order #39: Management Methods for Controlling Pollution by Electronic Information Products. Refer to Figure 2-2.

铅	汞	镉	六价铬	多溴联苯	多溴二苯醚	
Pb	Hg	Cd	Cr6 <sup>+</sup>	PBB	PBDE	
X	O	O	O	O	O	
O≡小于最高浓度值 X≡大于最高浓度值						

*Figure 2-2. Hazardous Substance Table & Environment-Friendly Use Period (EFUP)*

## Waste Electrical and Electronic Equipment (WEEE, 2002)

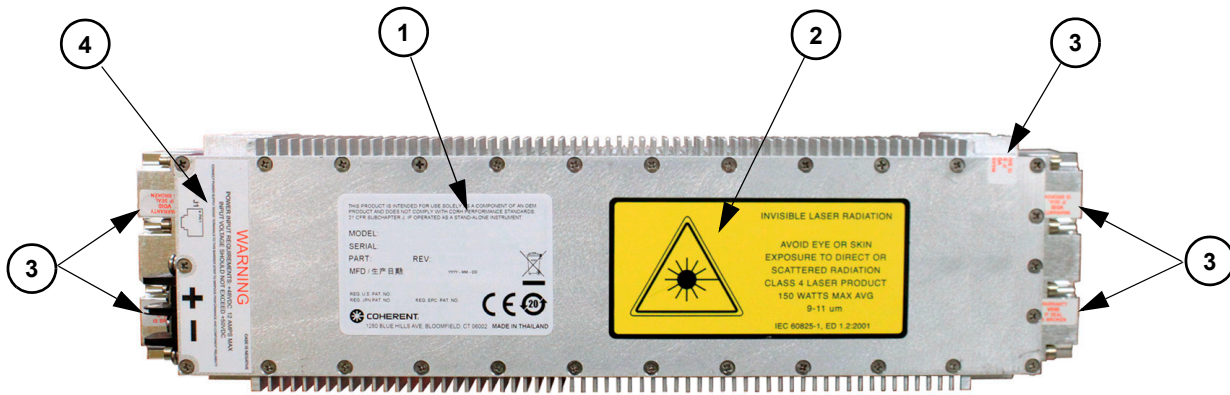
The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) is represented by a crossed-out garbage container label (see Figure 2-3). The purpose of this directive is to minimize the disposal of WEEE as unsorted municipal waste and to facilitate its separate collection.



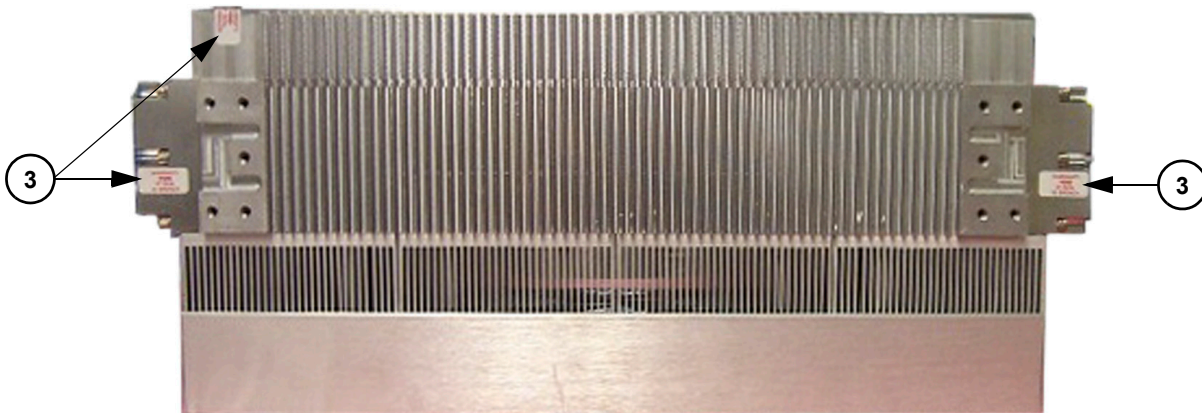
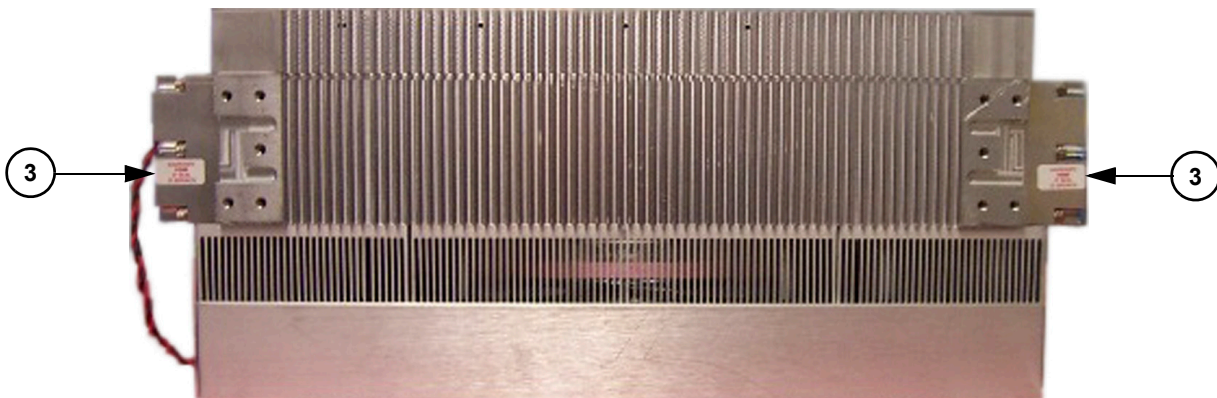
*Figure 2-3. Waste Electrical and Electronic Equipment Label*

## Location of Safety Labels

Refer to Figure 2-4 for a description and location of all required safety labels. These include warning labels indicating removable or displaceable protective housings, apertures through which laser radiation is emitted and labels of certification and identification [CFR 1040.10(g), CFR 1040.2, and CFR 1010.3/EN60825-1, Clause 5].

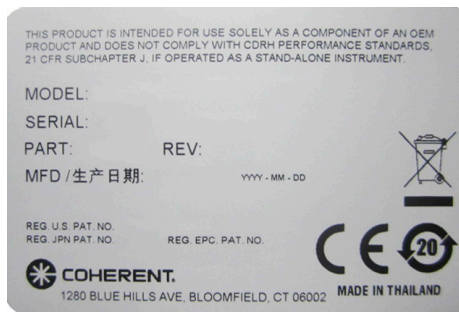
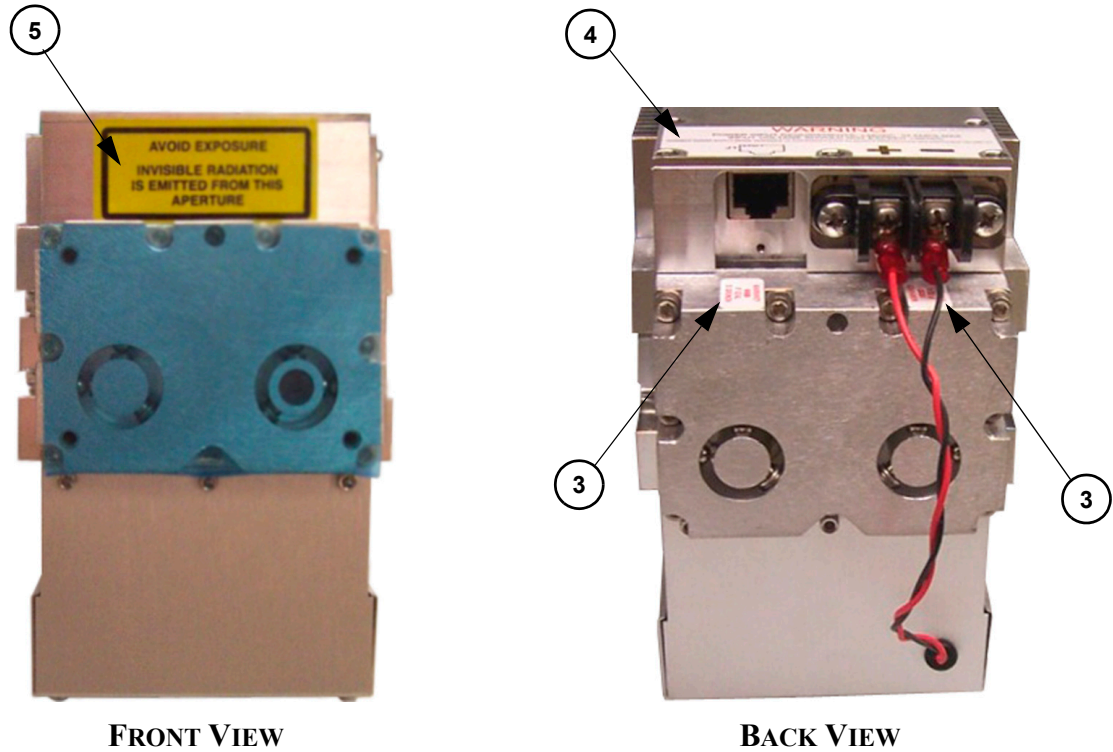


TOP VIEW

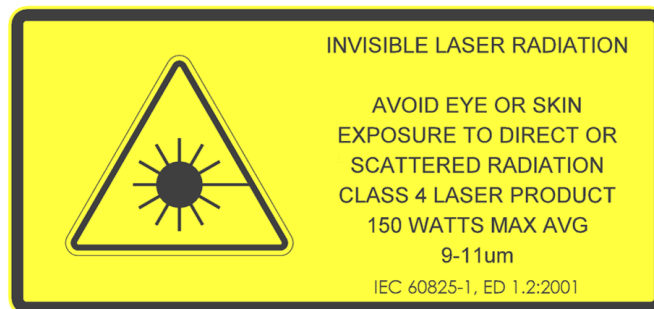


SIDE VIEWS

Figure 2-4. Location of Safety Labels (Sheet 1 of 3)



**1. IDENTIFICATION LABEL**



**2. DANGER OF LASER RADIATION LABEL**

*Figure 2-4. Location of Safety Labels (Sheet 2 of 3)*

**WARRANTY  
VOID  
IF SEAL  
IS BROKEN**

### 3. TAMPER PROOF LABEL



### 4. VOLTAGE WARNING LABEL



### 5. WARNING APERTURE LABEL

*Figure 2-4. Location of Safety Labels (Sheet 3 of 3)*



## **SECTION THREE: UTILITY REQUIREMENTS AND SYSTEM INSTALLATION**

### ***Introduction***

This section covers unpacking and installation of the DIAMOND C-40 laser. Specific operating instructions are detailed in Section Four: Laser Operation.

### ***Unpacking and Inspection***

Before unpacking the laser components, inspect the shipping carton for evidence of rough handling, and note any damage. If damage to the shipping carton is evident, request that the carrier's agent be present when the unit is unpacked. Inform the shipping carrier and Coherent of any evidence of damage in shipment. The Buyer and shipping carrier is responsible for any damage which might occur during shipment.

### ***Verifying Delivery***

The shipping container contains the following:

- Laser head and integral RF power module
- Final test sheet
- This Operating Manual

If any of these items are missing, report this to Coherent immediately.

### ***Checking Delivered Items***

Verify that the delivered laser head model received is the one ordered. If there is any discrepancy found, contact Coherent immediately.

Coherent recommends that the shipping box and packing materials be saved, as these will be required should the laser need to be shipped back to the factory.

## Safety Issues in Laser Installation

Installation of the DIAMOND C-40 laser must comply with all applicable electrical safety and laser safety laws and regulations. Review Section Two: Laser Safety for important information relating to safety.

The negative (return) side of the DC input connection to the DIAMOND C-40 RF power module is connected internally to the chassis. The user must ensure that the system into which the DIAMOND C-40 is built protects against the possibility that the DIAMOND C-40 laser head or RF power module chassis could be at a hazardous voltage and that personnel could be exposed to these voltages.



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### **DANGER!**

**To avoid potentially fatal electrical shock hazards from electrical equipment, follow all applicable electrical codes such as (in the U.S.) the National Electrical Code.**

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The laser must be secured properly to avoid the possibility of the laser shifting unexpectedly during operation, creating a hazardous condition. The location of the output beam of the DIAMOND C-40 laser head is shown in Figure 3-1. The laser output is emitted from the aperture shown in the referenced figures and propagates within a full cone angle up to 5°. The acceptance angle of the system aperture must intercept all of the output of the laser.

It is also extremely important to understand the direction, divergence, and magnitude of all reflections that will occur from optical surfaces. Infrared (IR) beams, such as those from DIAMOND C-40 lasers, can also be located with commercially available IR screens, such as those produced by Macken Instruments, Inc. [tel. (707) 566-2110]. Coherent recommends that all beam propagation paths be enclosed and that personnel operating the laser be qualified optical technicians who are familiar with this type of hardware.

## Mechanical Mounting

The dimensions for the DIAMOND C-40 laser head is shown in Figure 3-1. Mechanical mounting of the DIAMOND C-40 laser head must result in no distortion or stress the laser head is in any way. Otherwise, optical alignment and power stability could be adversely affected.

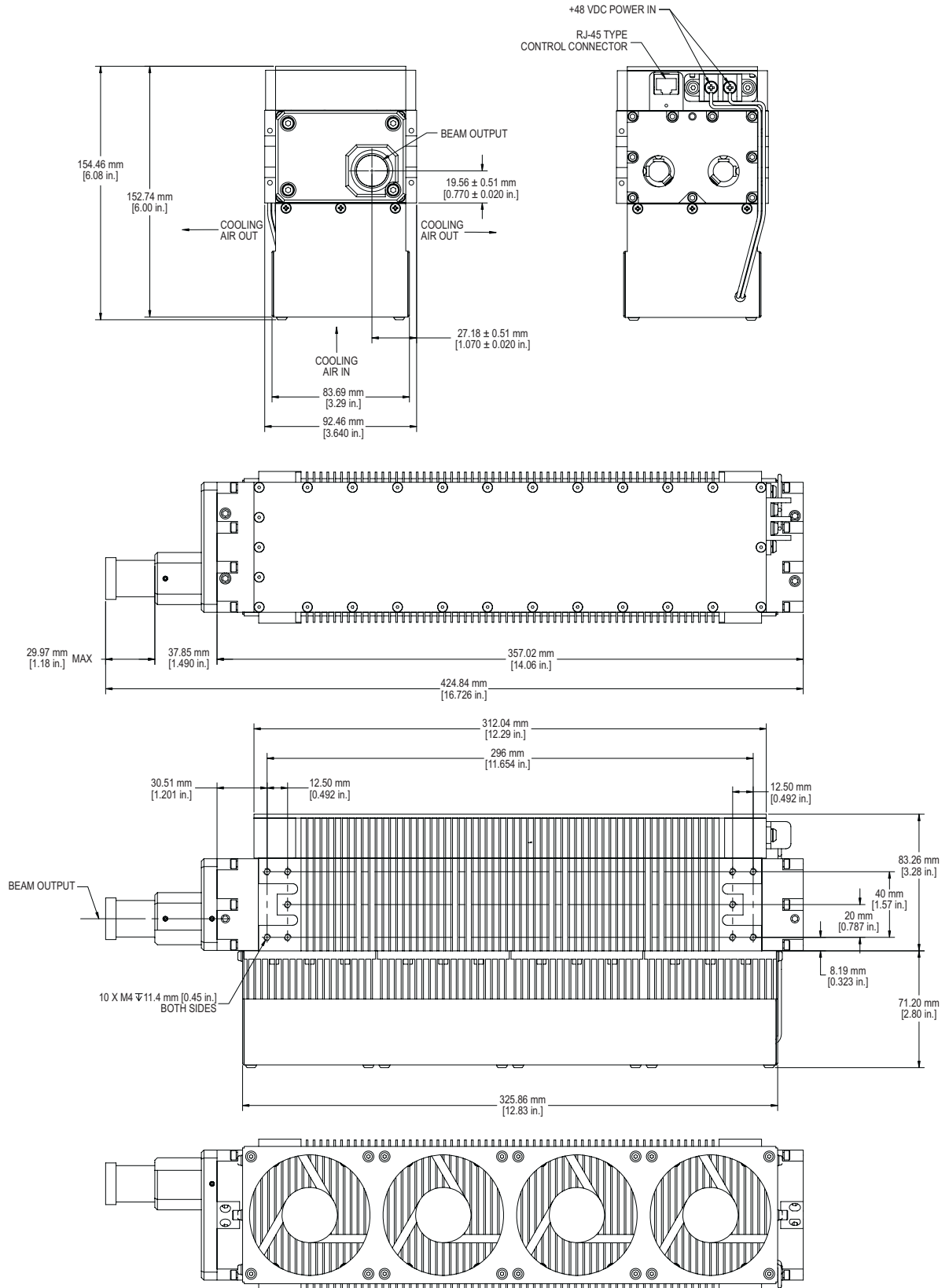


Figure 3-1. DIAMOND C-40 Air-Cooled Laser Head Dimensions

## **Mounting Considerations for DIAMOND C-40**

Certain aspects of specific customer applications may preclude absolute interchangeability of laser heads. For example, for certain applications, the sensitivity of the application to optical beam pointing errors may require external optical realignment after the laser head is replaced in the customer's integrated system. Depending on the method of mounting and the sensitivity of the integrated customer system to beam pointing errors, even removing a laser head from the customer's system, then replacing the same laser head back into the customer's system may require external optical realignment. This external alignment would be a repositioning of the head itself or adjustment of beam delivery mirrors (positions and angle). Consult Coherent if there is any question about such interchangeability issues.

Coherent recommends using optional brackets (part number 1101-12-0016 for a set of 4) that are designed for mounting the laser safely without inducing any stress onto the laser. Care must be taken not to induce stress onto the laser head, as optical mis-alignment of the laser resonator can occur that would require the laser to be returned to Coherent for service. A mechanical drawing for this bracket is provided in the Appendix A. Coherent strongly encourages use of this bracket or one of similar design in order to accommodate the temperature changes in operation while providing secure mounting.

## **Ambient Air Cleanliness**

DIAMOND C-40 laser heads are designed for use in a dust-free or nearly dust-free environment. They should be installed in a protective housing that prevents dust or debris from contaminating the optical output window. Do not turn the laser on if there is water, dust, or dirt on the output element; otherwise, damage to the coating on this optical element may occur. To prevent such optical damage, never allow the output window to become contaminated.

Do not allow the fins on the heat sinking elements to become clogged with dirt, dust, or debris. They must be cleaned periodically, as indicated in the maintenance section of this manual.



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**NOTICE!**

**In the case of the DIAMOND C-40 air-cooled laser, a dust- and particle- free environment must be maintained around the heat sinks. Dust or particles can clog the fans and heat sinks, and degrade their performance significantly. Coherent recommends that the OEM set up a regular preventive maintenance schedule to clean these cooling fins every 6 months or as needed in the OEM's operating environment.**

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The Coherent warranty covers defects in material and workmanship relating to the output optical element, but this warranty does not cover damage to the external output optical surface that is the result of contamination to the surface, or abrasion of the surface.

## **Air Cooling**

The DIAMOND C-40 air-cooled laser incorporates heat sinks cooled by forced air (blown by fans). The four fans draw 1 A of current when supplied with the required 48 VDC electrical power. Running the fans at higher voltages will reduce the operating life and is strongly discouraged. The user must provide the correct voltage polarity to the fans in order for the airflow direction and the resulting volume to be sufficient to cool the laser adequately.

## **Air Flow**

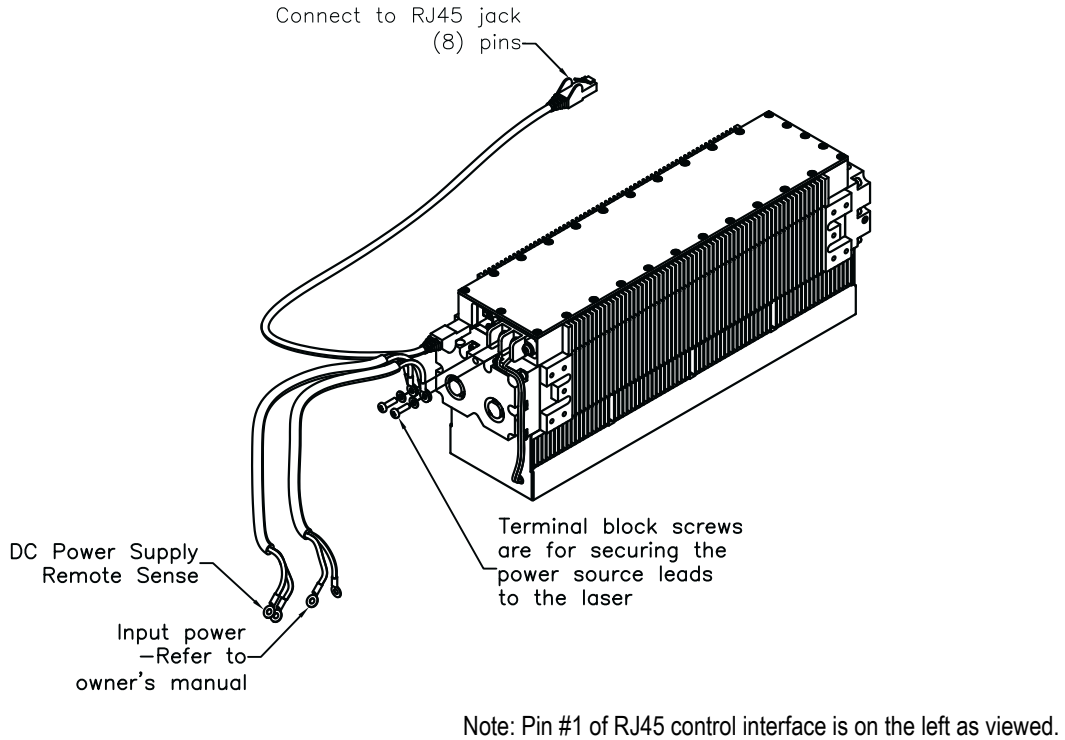
Open-air flow for the laser is critical. Therefore, Coherent requires clear access to free air within 60 mm of the cooling fans and fins for the laser system. The air used to cool the DIAMOND C-40 must be clean and free of contaminants. This requirement can be fulfilled by filtering the air at the input to the laser cavity or system equipment.

## **Signal Interface**

Coherent uses a temperature interlock to ensure that the fans are operating and supplying sufficient air cooling. It is recommended that both RF Enable and Control Enable be commanded to the OFF state when the airflow interlock system detects an over-temperature fault. The system also provides a temperature warning that should be used to alert the user to a need for maintenance of the cooling system to return the performance to the normal full cooling capacity. Failure to take action regarding the temperature warning will result in poorer product performance (outside specifications) and lesser product life time. These signals are listed in Table 4-1 and are described in subsections of Section Four: Laser Operation.

## Electrical Power Connection

The DIAMOND C-40 laser requires 48 VDC input DC power. This power is carried from the power source to the system through the terminal block on the DIAMOND C-40. The maximum current required is 13 A (20 A peak for minimum of 1 ms).



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### **NOTICE!**

To avoid damage to the system, connect leads to the user-supplied power source last after other connection are made.

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**Figure 3-2. Electrical Connections to DIAMOND C-40**

The negative (return) side of the DC input connection to the DIAMOND C-40 RF power module is connected internally to the chassis. The user must assure that the system into which the DIAMOND C-40 is built protects any personnel against the possibility that the DIAMOND C-40 chassis could contain a hazardous voltage and be exposed to these voltages.




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**DANGER!**

**To avoid potentially fatal electrical shock hazards from electrical equipment, be sure to follow all applicable electrical codes, such as (in the U.S.) the National Electrical Code.**

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Coherent strongly recommends that the user review the precautions described in Section Two: Laser Safety regarding electrical safety before using the DIAMOND C-40 laser. It is the user's responsibility to provide circuit breakers and/or fusing of the AC power source, in accordance with all applicable laws and regulations.

**DC Power Supply Requirements**

Requirements for the customer-supplied DC power supplies include standards regarding DC power supply cabling and over-voltage tripping.

DC Voltage	48 VDC measured at the terminals.
Peak Current	20 A for a minimum of 1 ms with a maximum voltage drop of 1.5 V
Regulation	< ± 2%
Regulation Sensing	Remote at load
Ripple and Noise	< 1% p-p (20 MHz BW limit)
Overload Protect	Automatic Recovery
ShortCircuit Protect	Automatic Recovery

**DC Power Supply Cabling Requirements**

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**Coherent strongly recommends the use of remote voltage sense/regulation at the DIAMOND C-40. This requires a 4-wire cable (2 supply currents and 2 voltage senses).**

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The following requirement minimizes the voltage loss from the supply to the DIAMOND C-40:

WIRE LENGTH (IN METERS)	AWG
0-2	18
2-3	16
3-5	14
5-8	12
8-12	10
12-20	8

### DC Power Supply Over-Voltage Tripping

In the event that the DC power supply trips because of the current, there are two countermeasures that can be applied:

- Remote sensing, in which four wires are used to sense the regulation of the DC power supply
- Increased capacitance at the laser connection; to do this, add a capacitor at the DC power supply connection of the laser, using a capacitor of 470  $\mu$ F or greater, rated at > 60 VDC

### Control Signal Connection

Electrical control of the DIAMOND C-40 laser is achieved via a RJ-45 connector built into the system. The signals carried on each of the pins are indicated in Table 4-1. Details about controlling the laser through the signal interface are discussed in Section Four: Laser Operation.



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#### **NOTICE!**

**Coherent highly recommends use of shielded interface cables. The interface cable shield must connect to the chassis ground of the controller. In addition to proper shielding, this shield provides a secondary connection for the signal ground (Pin 8).**

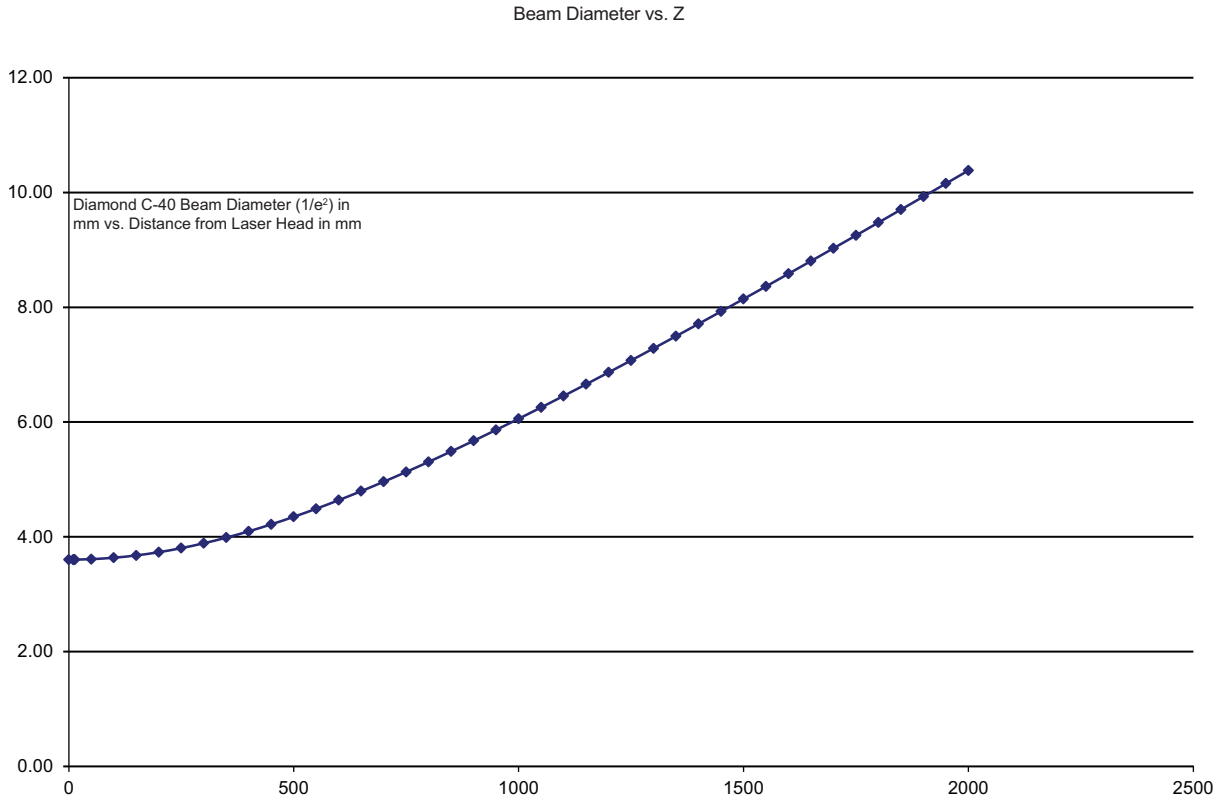
**A floating ground connection (use of un-shielded interface cable or no return path between the host control electronics and the laser) can present an unsafe condition and result in unstable or unexpected operation of the laser. This condition can arise when the control signal ground connection (Pin 8) is lost and the Control Enable (Pin 7) and RF Enable (Pin 1) remain high. Therefore, Coherent strongly recommends that a second safety ground be provided either via a shielded control cable or common potential chassis mounting between the laser head and the control electronics. Inadequate or nonexistent grounding between the laser and the external control system can result in loss of control of the laser and damage to the laser electronics or the external control electronics.**

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## Beam Propagation

The DIAMOND C-40 delivers a 3.6 mm  $1/e^2$  diameter beam with a 5.0 mrad  $1/e^2$  full angle divergence. The typical beam diameter as a function of distance from the laser is shown in Figure 3-3.



**Figure 3-3. Beam Diameter vs. Distance from Laser Head**









