Pre-Installation Manual
Libra Ultrafast Amplifier
Laser System

COHERENT®
5100 Patrick Henry Drive
Santa Clara, CA 95054 USA

Technical Support

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**. Should you need further assistance, please contact Coherent Technical Support via e-mail **Product.Support@Coherent.com** or telephone, 1-800-367-7890 (1-408-764-4050 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** for technical assistance, or phone our 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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Preface

This document contains pre-installation information for Libra systems, and is a supplement to the Coherent Libra Operator's Manual.

Read this Pre-Installation Manual carefully before operating the system for the first time.

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

Use of the system in a manner other than that described herein may impair the protection provided by the system.

U.S. Export Control Laws Compliance

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

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

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

Symbols Used in this Document and on the System

This symbol alerts the operator to the presence of dangerous voltages that may be of sufficient magnitude to constitute a risk of electric shock.

This symbol alerts the operator to the presence of important operating and maintenance instructions.

This symbol alerts the operator to the danger of exposure to hazardous visible and invisible laser radiation.

SECTION ONE: LASER SAFETY

This user information is in compliance with section 1040.10 of the CDRH Performance Standards for Laser Products from the Health and Safety Act of 1968.

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

This laser safety section must be reviewed thoroughly prior to operating the Libra laser system. Safety instructions presented throughout this manual must be followed carefully.

Hazards

Hazards associated with lasers generally fall into the following categories:

- Exposure to laser radiation that may damage the eyes or skin
- Electrical hazards generated in the laser power supply or associated circuits
- Chemical hazards resulting from contact of the laser beam with volatile or flammable substances, or released as a result of laser material processing

The above list is not intended to be exhaustive. Anyone operating the laser must consider the interaction of the laser system with its specific working environment to identify potential hazards.

Optical Safety

Laser light, because of its special qualities, poses safety hazards not associated with light from conventional sources. The safe use of lasers requires all operators, and everyone near the laser system, to be aware of the dangers involved. Users must be familiar with the instrument and the properties of coherent, intense beams of light.

The safety precautions listed below are to be read and observed by anyone working with or near the laser. At all times, ensure that all personnel who operate, maintain or service the laser are protected

from accidental or unnecessary exposure to laser radiation exceeding the accessible emission limits listed in 'Performance Standards for Laser Products,' *United States Code of Federal Regulations*, 21CFR1040 10(d).

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

The greatest concern when using a laser is eye safety. In addition to the main beam, there are often many smaller beams present at various angles near the laser system. These beams are formed by specular reflections of the main beam at polished surfaces such as lenses or beam splitters. While weaker than the main beam, such beams may still be sufficiently intense to cause eye damage.

Laser beams are powerful enough to burn skin, clothing or paint even at some distance. They can ignite volatile substances such as alcohol, gasoline, ether and other solvents, and can damage light-sensitive elements in video cameras, photomultipliers and photodiodes. The user is advised to follow the precautions below.

Recommended Precautions and Guidelines

1. Observe all safety precautions in the pre-installation and operator's manuals.
2. All personnel should wear laser safety glasses rated to protect against the specific wavelengths being generated. Protective eye wear vendors are listed in the *Laser Focus World, Lasers and Optronics,* and *Photonics Spectra* Buyer's guides. Consult the ANSI, ACGIH, or OSHA standards listed at the end of this section for guidance.
3. Avoid wearing watches, jewelry, or other objects that may reflect or scatter the laser beam.
4. Stay aware of the laser beam path, particularly when external optics are used to steer the beam.
5. Provide enclosures for beam paths whenever possible.
6. Use appropriate energy-absorbing targets for beam blocking.
7. Block the beam before applying tools such as Allen wrenches or ball drivers to external optics.
8. Limit access to the laser to qualified users who are familiar with laser safety practices. When not in use, lasers should be shut down completely and made off-limits to unauthorized personnel.

9. Use the laser in an enclosed room. Laser light can remain collimated over long distances and therefore presents a potential hazard if not confined. It is good practice to operate the laser in a room with controlled access.
10. Post warning signs in the area of the laser beam to alert those present.
11. Exercise extreme caution when using solvents in the area of the laser.
12. Never look directly into the laser light source or at scattered laser light from any reflective surface. Never sight down the beam.
13. Set up the laser so that the beam height is either well below or well above eye level.
14. Avoid direct exposure to the laser light. Laser beams can easily cause flesh burns or ignite clothing.
15. Advise all those working with or near the laser of these precautions.

Laser safety glasses protect the user from eye damage by blocking light at the laser wavelengths. However, this also prevents the operator from seeing the beam. Exercise extreme caution even while wearing safety glasses.

Electrical Safety

Normal operation of the Libra should not require access to the power supply circuitry. Removing the power supply cover will expose the user to potentially lethal electrical hazards. Contact an authorized service representative before attempting to correct any problem with the power supply.

Recommended Precautions and Guidelines

The following precautions must be observed by everyone when working with potentially hazardous electrical circuitry:

1. Disconnect main power lines before working on any electrical equipment when it is not necessary for the equipment to be operating.

2. Do not short or ground the power supply output. Protection against possible hazards requires proper connection of the ground terminal on the power cable, and an adequate external ground. Check these connections at the time of installation, and periodically thereafter.
3. Never work on electrical equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment, and who is competent to administer first aid.
4. When possible, keep one hand away from the equipment to reduce the danger of current flowing through the body if a live circuit is touched accidentally.
5. Always use approved, insulated tools.
6. Special measurement techniques are required for this system. A technician who has a complete understanding of the system operation and associated electronics must select ground references.

Component Lasers

The Libra system incorporates Coherent Vitesse™ and Evolution™ lasers as components. The beams from these lasers are hazardous. Refer to their respective Operator's Manuals for additional safety information.

Maximum Accessible Radiation Level

The Libra and its component lasers produce visible and invisible radiation over a wavelength range of 500 to 1100 nm, with a maximum of 40 Watts continuous wave power, and < 5 Watts maximum energy per 30 femtosecond to 6 picosecond pulse [CFR 1040.10 (h)(2)/ EN 60825-1/ IEC 608225-1, Clause 6].

Safety Features and Compliance with Government Requirements

The following features are incorporated into the instrument to conform to several government requirements. The applicable United States Government requirements are contained in 21 CFR, Subchapter J, part 1040 administered by the Center for Devices and Radiological Health (CDRH). The European Community requirements for product safety are specified in the Low Voltage Directive (LVD) (published in 73/23/EEC and amended in 93/68/EEC). The Low Voltage Directive requires that lasers comply with the standard EN 61010-1/IEC 61010-1 "Safety Requirements For Electrical Equipment For Measurement, Control and Laboratory Use" and EN 60825-1/IEC 60825-1 "Safety of Laser Products". Compliance of this laser with the LVD requirements is certified by the CE mark.

Laser Classification

Governmental standards and requirements specify that the laser must be classified according to the output power or energy and the laser wavelength. The Libra is classified as Class IV based on 21 CFR, Subchapter J, part 1040, section 1040.10 (d). According to the European Community standards, Libra lasers are classified as Class 4 based on EN 60825-1, clause 9. In this manual, the classification will be referred to as Class 4.

Protective Housing

The laser head is enclosed in a protective housing that prevents human access to radiation in excess of the limits of Class I radiation as specified in the 21CFR, Part 1040 Section 1040.10 (f)(1) and Table 1-A/EN 60825-1/IEC 60825-1 clause 4.2 except for the output beam, which is Class 4.

Safety Interlocks

The system incorporates multiple safety interlocks which activate when the top cover of the Vitesse, Evolution, or any one of the three top covers of the Libra is removed. An interlock fault initiation will terminate all lasing by activating a shutter mechanism as well as removing power from the infrared diode lasers in each power supply. While installed, the interlock defeats are directly visible by anyone near the laser. It is not possible to replace the laser cover while the interlocks are installed

The laser interlocks should be defeated only for the purpose of maintenance and service by trained personnel aware of the hazards involved. Extreme caution must always be observed when operating the laser with its covers removed. [CFR 1040.10 (f)(2)/ EN 60825-1/IEC 608225-1, Clause 4.3].

Laser Radiation Emission Indicators

The LASER EMISSION LED on the laser head illuminates approximately 30 seconds before laser emission can occur. The indicator is visible without exposing the operator to laser emission. Amber light is used which is visible while wearing the proper type of safety glasses [CFR 1040.10(f)(5)/EN 60825-1/IEC 60825-1, clause 4.6].

Beam Attenuator

Internal shutters within the Vitesse and Evolution lasers prevent exposure to all laser radiation without removing power from the system [CFR 1040.10 (f)(6)/EN 60825-1/IEC 60825-1, clause 4.7].

Operating Controls

The laser controls are positioned so that the operator is not exposed to laser emission while manipulating the controls [CFR 1040.10(f)(7)/EN 60825-1/IEC 60825-1, clause 4.8].

Manual Reset Mechanism

Following an interlock fault or unexpected loss of electrical power, laser operation requires manual clearing of the fault condition(s) [CFR 1040.10(f)(10)/EN 60825-1/IEC 60825-1, clause 4.11].

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

Use of the system in a manner other than that described herein may impair the protection provided by the system.

Location of Safety Labels

Refer to Figure 1-1 for the location of all 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/ EN 60825-1/IEC 60825-1, Clause 5].

Electromagnetic Compatibility

The European requirements for Electromagnetic Compliance (EMC) are specified in the EMC Directive (published in 89/336/EEC).

Conformance to the EMC requirements is achieved through compliance with the harmonized standards EN55011 (1991) for emission and ENC50082-1 (1992) for immunity.

The laser meets the emission requirements for Class B, group 1 as specified in EN55011 (1991).

Compliance of this laser with the EMC requirements is certified by the CE mark.

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 1-1). The purpose of this directive is to minimize the disposal of WEEE as unsorted municipal waste and to facilitate its separate collection.

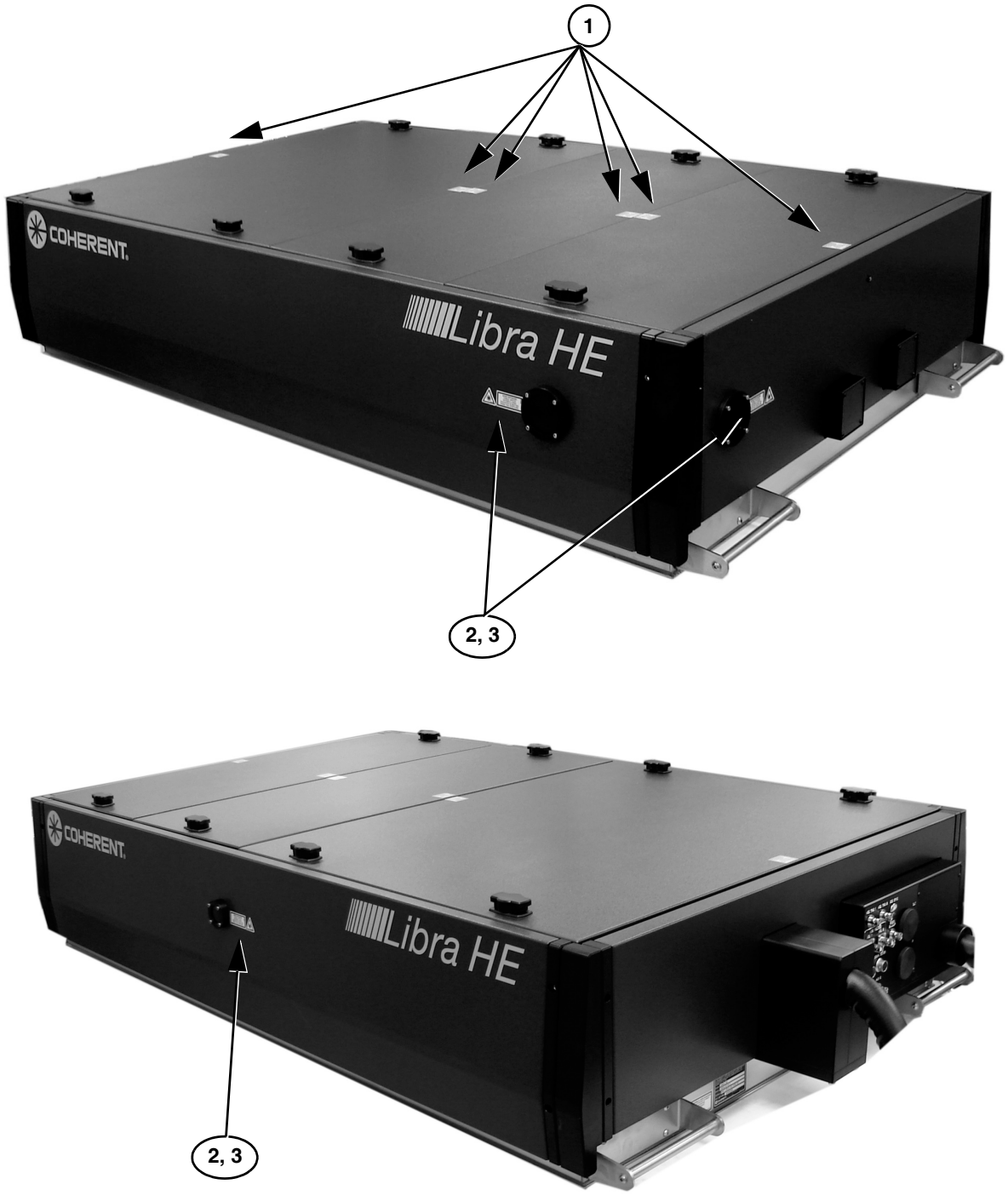
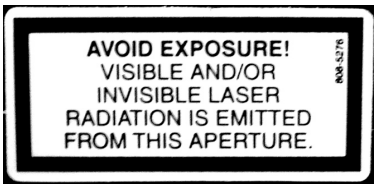


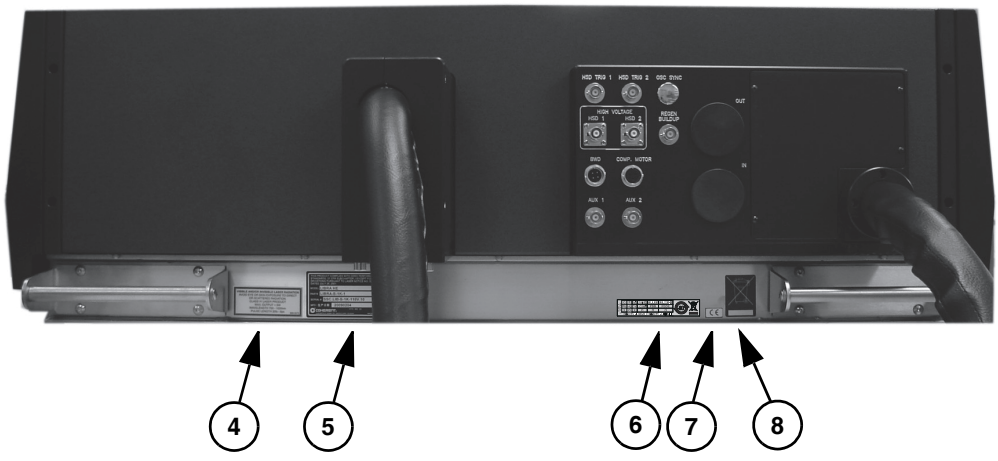
Figure 1-1. Libra Safety Labels

1. INTERLOCK DEFEAT LABEL



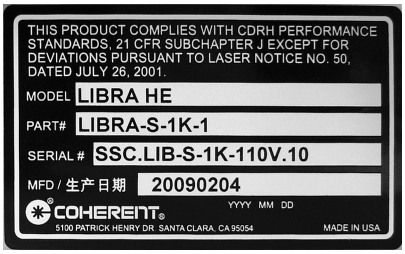
2. LASER APERTURE LABEL

3. RADIATION HAZARD WARNING LABEL



4. RADIATION OUTPUT CHARACTERISTICS LABEL

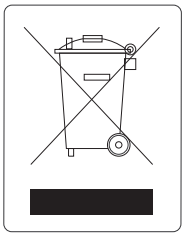
Figure 1-1. Libra Safety Labels (Continued)



5. IDENTIFICATION LABEL

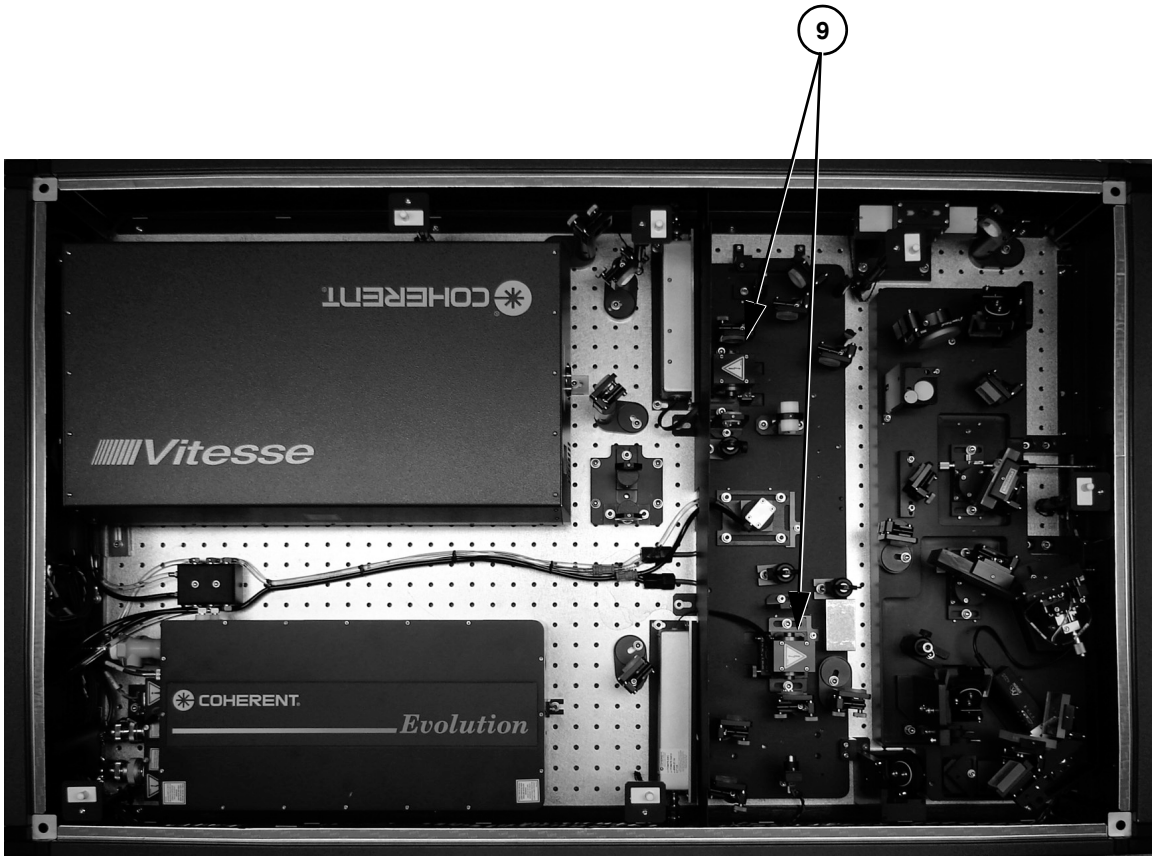
6. CHINA ROHS (Pb, Cd) LABEL

7. CE COMPLIANCE LABEL



8. WEEE COMPLIANCE LABEL

Figure 1-1. Libra Safety Labels (Continued)



9. ELECTRICAL HAZARD WARNING LABEL

Figure 1-1. Libra Safety Labels (Continued)

Sources of Additional Information

The following are sources for additional information on laser safety standards and safety equipment and training.

Laser Safety Standards

Safe Use of Lasers (Z136.1)
American National Standards
Institute (ANSI)
1430 Broadway
New York, NY 10018
Tel: (212) 354-3300

Occupational Safety and Health Administration (OSHA)
U.S. Department of Labor
200 Constitution Avenue N.W.
Washington, DC 20210

A Guide for Control of Laser Hazards
American Conference of Governmental and Industrial Hygienists (ACGIH)
6500 Glenway Avenue, Bldg. D-7
Cincinnati, OH 45211
Tel: (513) 661-7881

Laser Safety Guide
Laser Institute of America
12424 Research Parkway, Suite 130
Orlando, FL 32826
Tel: (407) 380-1553

Equipment and Training

Laser Focus Buyer's Guide
Laser Focus World
One Technology Park Drive
P.O. Box 989
Westford, MA 01886-9938
Tel: (508) 692-0700

Photonics Spectra Buyer's Guide
Photonics Spectra
Berkshire Common
Pittsfield, MA 01202-4949
Tel: (413) 499-0514

Lasers and Optronics Buyer's Guide
Lasers and Optronics
301 Gibraltar Dr.
P.O. Box 650
Morris Plains, NJ 07950-0650
Tel: (210) 292-5100

SECTION TWO: DESCRIPTION AND LAYOUT

Libra System

The Libra is an all-in-one ultrafast oscillator and regenerative amplifier laser system. Solid-state laser technology is incorporated into a compact optical enclosure, providing reliable operation over thousands of hours.

The Libra laser system consists of six primary components:

- Libra optical bench assembly
- Synchronization & delay generator (SDG)
- Vitesse power supply
- Evolution power supply
- Closed-loop water chiller
- Laptop computer with control software

Figure 2-1. Libra Optical Bench Assembly

Libra Optical Bench Assembly

The Libra optical bench assembly comprises four modules (see Figure 2-2 on page 2-3):

- Vitesse seed laser
- Evolution pump laser
- Regenerative amplifier (RA)
- Stretcher/Compressor

The Coherent Vitesse™ serves as the seed laser for the Libra system. This module includes a modelocked Ti:Sapphire oscillator cavity pumped by the Coherent Verdi™, a continuous-wave diode-pumped green laser.

The Evolution is a diode-pumped second-harmonic Q-switched laser. Operating at 527 nm and a single-kHz repetition rate, it provides the pump power to the amplifier module. The Vitesse and Evolution are described in detail in their respective Operator's Manuals.

The Regenerative Amplifier is based on the Coherent Legend Elite™ platform. Designed in a compact, enclosed module with active cooling, the amplifier exhibits excellent stability and reduced sensitivity to environmental temperature changes. Included in this design is the Coherent Synchronization and Delay Generator (SDG™), whose operation is also described in its own Operator's Manual.

The stretcher and compressor are also contained within a robust modular enclosure. These are also based on the Legend Elite grating and curved mirror configuration, but with a more compact footprint.

Optical Component Labels

Figure 2-3 and Table 2-1 show a layout diagram, component labels, and descriptions.

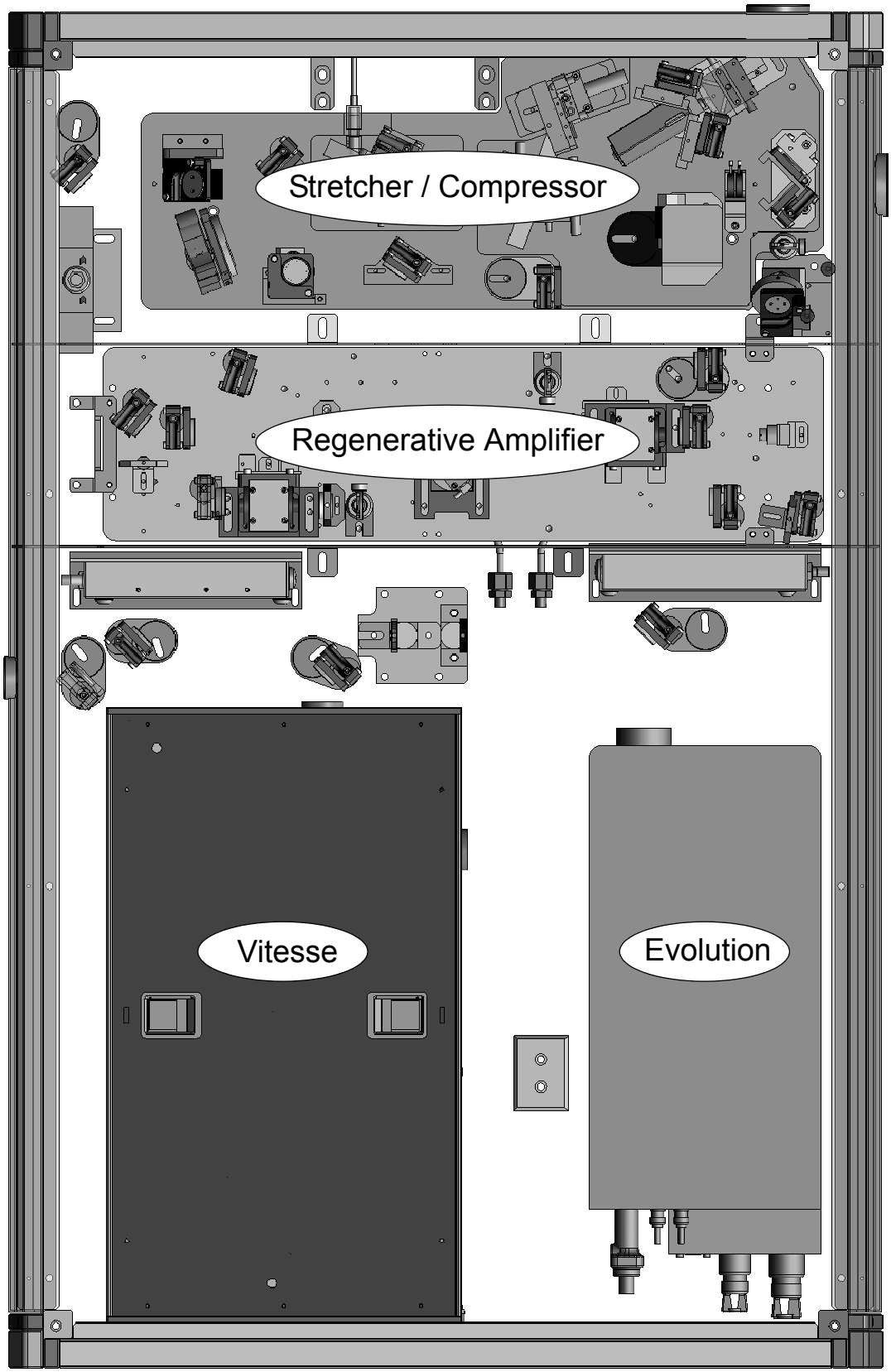


Figure 2-2. Libra Optical Bench Assembly Block Diagram

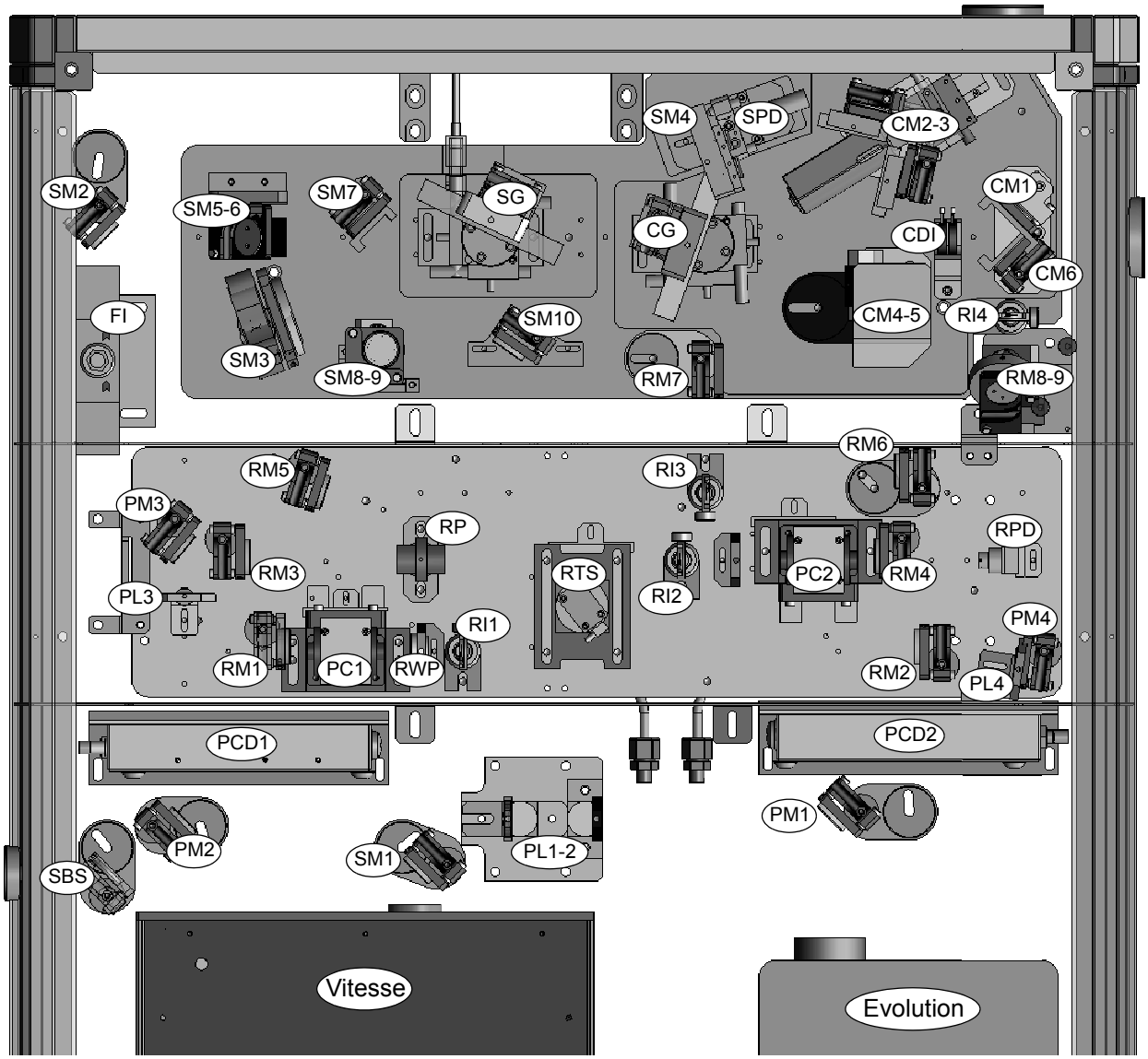


Figure 2-3. Libra Optical Layout Diagram

Table 2-1. Component Labels and Descriptions

SM1, SM2, SM7, SM10 Stretcher Routing Mirror	PM1-PM4 Pump Routing Mirror	RM1, RM4 Regen Cavity End Mirror	CM1 Compressor Routing Mirror
SBS Stretcher Beam Splitter (50%)	PL1-2 Pump Telescope	RM2, RM3 Regen Cavity Pump-through Folding Mirror	CDI Compressor Double Iris
FI Faraday Isolator	PL3, PL4 Pump Focusing Lens	PC1, PC2 Regen Pockels Cell	CG Compressor Grating
SG Stretcher Grating		PCD1, PCD2 Pockels Cell Driver	CM2-3 Compressor Horizontal Retroreflector
SM3 Stretcher Large Curved Mirror		RWP Regen Waveplate	CM4-5 Compressor Vertical Retroreflector
SM4 Stretcher Wide Flat Mirror		RI1-RI4 Regen Alignment Iris	CM6 Compressor Output Routing Mirror (optional)
SPD Stretcher Photodiodes		RTS Regen Ti:Sapphire crystal	
SM5-6 Stretcher Vertical Retroflector		RP Regen Polarizer	
SM8-9 Stretcher Periscope		RM5-RM6 Regen Output Telescope	
		RM7 Regen Output Routing Mirror	
		RM8-9 Regen Output Periscope	
		RPD Regen Photodiode	

Synchronization and Delay Generator (SDG)

The SDG controls the precise timing of the RA Pockels cells. It contains a high-speed power supply for the Pockels cells as well as a bandwidth detector (BWD) circuit, which serves as an interlock to protect the laser from operation at narrow bandwidth.

Power Supplies

The Libra system includes two individual power supplies, for the Vitesse and Evolution modules. Refer to the Vitesse and Evolution Operator's Manuals for additional information.

Water Chiller

The closed-loop water chiller dissipates the heat generated by the system and stabilizes the Vitesse, Evolution, and amplifier cavity. The temperature is optimized in the factory and is typically ~21 °C. Refer to the chiller Operator's manual for further details.

Laptop Computer

The system is shipped with a laptop computer with Windows-based control software for the Vitesse, Evolution, and SDG already installed.

These components may be controlled remotely through RS-232 serial connections on the Vitesse power supply, Evolution power supply, and SDG rear panel. Multiple serial-to-USB adaptors are used for simultaneous control from one computer.

Specifications

The Customer Data Sheet shipped with each Libra provides a detailed description of system performance. Specifications for all Coherent products can be found at **www.Coherent.com**.

SECTION THREE: PRE-INSTALLATION

Receiving and Inspection

Inspect shipping containers for signs of rough handling or damage. Indicate any such signs on the bill of lading. Report any damage immediately to the shipping carrier and to the Coherent Order Administration Department (800-438-6323) or authorized representative.

Retain shipping containers. The containers will be required if the system is returned to the factory for service. The containers may also be needed to support a shipping damage claim.

The following items are included with a standard Libra laser system:

1. Libra optical bench assembly
2. Synchronization & delay generator (SDG)
3. Vitesse power supply
4. Evolution power supply
5. Closed-loop water chiller
6. Laptop computer and control software
7. Vitesse and Evolution maintenance kit
8. Operator's manual

Initial installation must be performed by an authorized Coherent personnel. Do not remove the system from its shipping containers.

Utility and Environmental Requirements

The following tables provide pertinent information concerning the installation of the Libra.

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Table 3-1. Libra Utility Requirements

SYSTEM COMPONENT	110 ± 10 V 50/60 HZ (AMPS)	220 ± 20 V 50 HZ (AMPS)
Vitesse Power Supply	15	10
Evolution Power Supply	15	10
Water Chiller[1]	15	10
SDG Elite	1	0.5
Laptop computer	1.5	1
[1] All system components will operate on either 110 V or 220 V line voltage <u>EXCEPT</u> the water chiller. Make sure that the chiller received is compatible with your country line voltage before establishing electrical connection. Contact Coherent Sales with any questions.		

Table 3-2. Environmental Requirements

PARAMETER	REQUIREMENT
Ambient Temperature [1]	20 to 24 °C (70 to 75 °F)
Relative Humidity [1]	30 to 55 % non-condensing
Altitude	Sea level to 3000 m (10,000 ft)
[1] Coherent recommends the following temperature and humidity ranges to assure optimum operation of the Libra amplifier system.	

Table 3-3. Water Chiller Specifications

PARAMETER	REQUIREMENT
Flow Rate	16.7 liters/minute (4.4 gallons/minute)
Capacity[1]	8 liters (2 gallons)
[1]Only distilled water may be used to fill-up the water chiller. Refer to the Evolution Operator's manual or contact Coherent Service for more details.	

System Dimensions and Weight

Table 3-4. System Dimensions and Weight

	LIBRA OPTICAL BENCH[1]	EVOLUTION POWER SUPPLY	VITESSE POWER SUPPLY	SDG ELITE	CHILLER
Length	125.57 cm (49.44 in)	43.68 cm (17.2 in)	45.2 cm (17.8 in)	30.48 cm (12.0 in)	62.3 cm (24.5 in)
Width	80.98 cm (31.88 in)	48.26 cm (19.0 in)	43.4 cm (17.1 in)	42.55 cm (16.75 in)	37.6 cm (14.8 in)
Height	26.19 cm (10.31 in)	13.25 cm (5.22 in)	25.4 cm (10.0 in)	9.73 cm (3.83 in)	67.3 cm (26.5 in)
Weight	184 kg (404 lbs)[2]	43 kg (94 lbs)	35 kg (77 lbs)	4.5 kg (10 lbs)	55 kg (122 lbs)

[1] Listed dimensions are for standard Libra systems. Your system's size may differ if custom options were added. Contact Coherent sales with any questions regarding your system size.

[2] The weight listed for the Libra optical bench includes the weight of the Vitesse laser head and power supply as they are both shipped in the same crate.

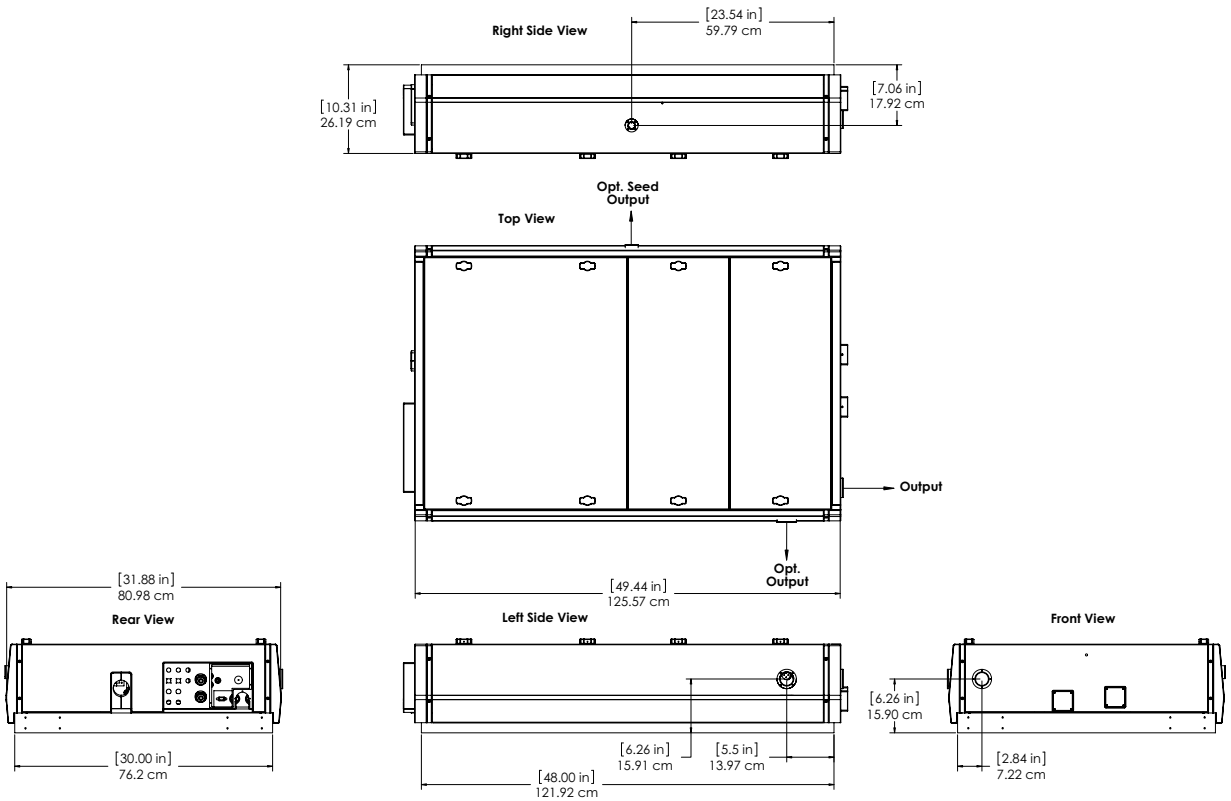

Figure 3-1. Libra Optical Bench Assembly Dimensions

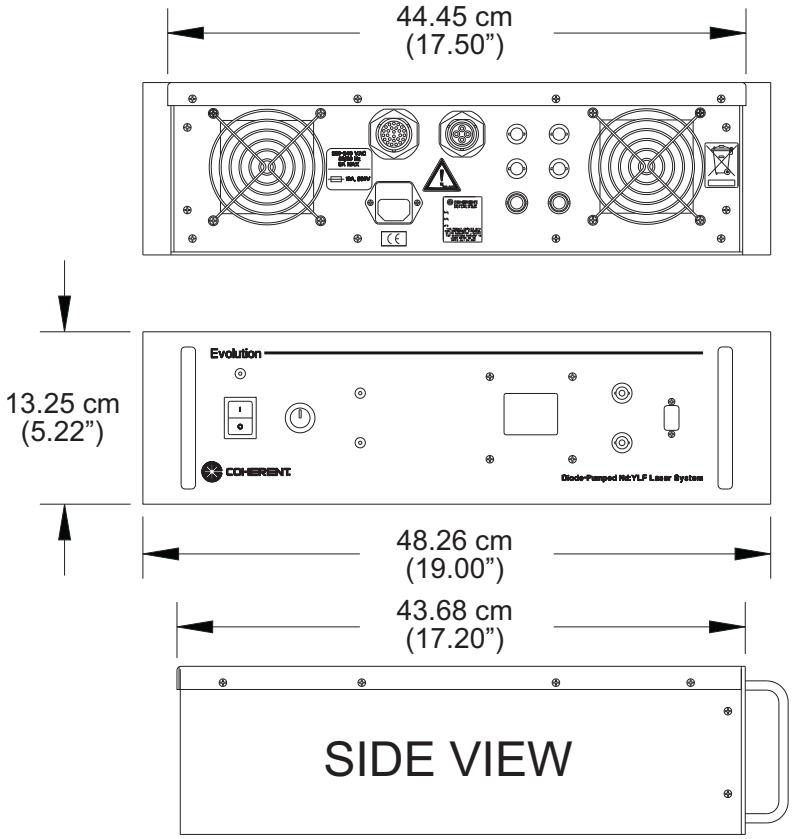

Figure 3-2. Evolution Power Supply Dimensions

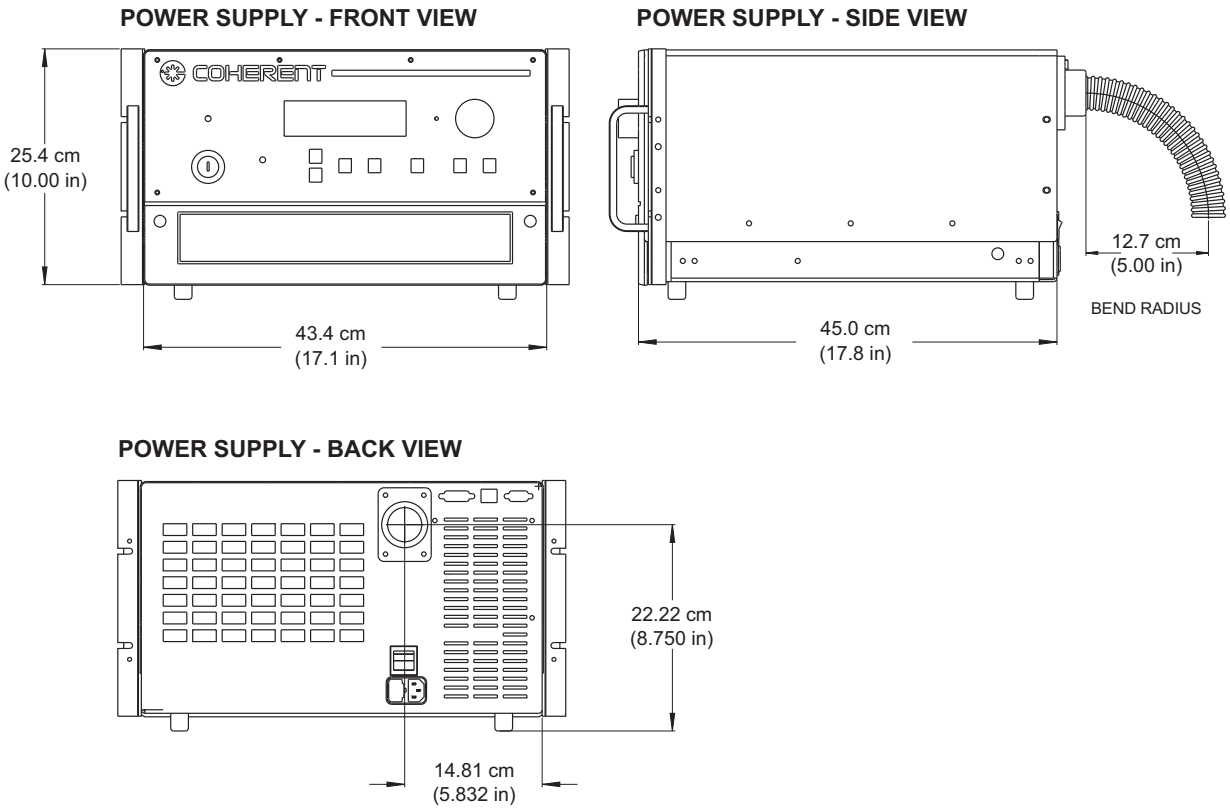

Figure 3-3. Vitesse Power Supply Dimensions

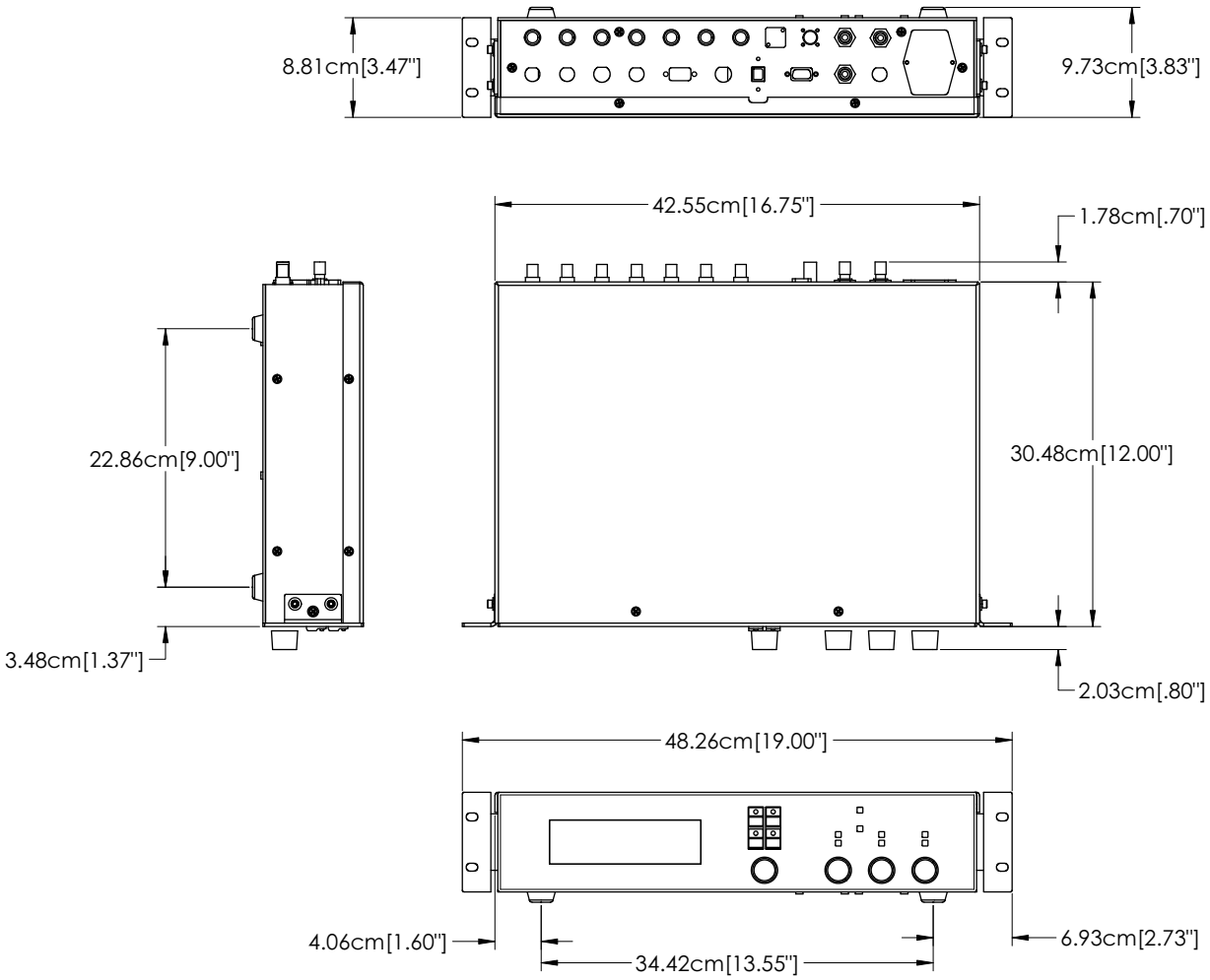

Figure 3-4. SDG Elite Dimensions

External Interlock

The use of system interlocks is important to assure safe operation of the laser system.

An external interlock connector is provided on the SDG Elite rear panel. In the event of an interlock fault during normal operation, the Pockels cells are disabled which terminates Libra output. Refer to the SDG Elite Operator's manual for more details.

Alternatively, the interlock connector may be wired to an external circuit such as a door switch. Many types of switches may be used, but the switch should have its contacts closed when it is safe to operate the laser and open when it is not safe.

The Vitesse and Evolution power supplies are also equipped with interlock connectors, as described in their respective Operator's Manuals. The system is shipped with interlock defeats installed over these connectors.

Pre-Installation Checklist

In order to perform a smooth integration of the your new laser system into your facility, it is necessary to prepare in advance. A pre-installation checklist outlining the general requirements is provided below.

Table 3-5. Pre-installation Checklist

ACTIVITY AND EQUIPMENT	GENERAL REQUIREMENTS	REFERENCE(S)
Laser Environment	☐ Temperature and humidity in specification. ☐ Laser area layout planned according to system dimensions.	See "Utility and Environmental Requirements" on page 3-2.
Receive and Inspect	☐ Area is clean and large enough to uncrate the laser, power supplies and chiller.	See "Receiving and Inspection" on page 3-1
Utility Requirements	☐ Utility outlets (115V/20A, typical) available nearby installation area. ☐ (x1) 100 to 240VAC outlet available for Vitesse Power Supply. ☐ (x1) 100 to 240VAC outlet available for Evolution Power Supply. ☐ (x1) 100 to 240VAC outlet available for water chiller (Note: Verify chiller specifications before establishing electrical connection). ☐ (x1) 100 to 240VAC outlet available for laptop computer. ☐ (x1) 100 to 240VAC outlet available for SDG ELite controller. ☐ (x4) extra outlets available for instrumentation (*e.g.,* power meter, oscilloscope, ...).	See "Utility and Environmental requirements" on page 3-2
System Chiller	☐ Distilled water available on-site (~8 liters).	

Table 3-5. Pre-installation Checklist

ACTIVITY AND EQUIPMENT	GENERAL REQUIREMENTS	REFERENCE(S)
Laser Safety	☐ Laser Safety Officer (LSO) identified (recommended). ☐ Laser Personnel Safety Training completed. ☐ Laser controlled area established. ☐ Personal protective equipment (Laser safety eyewear) available. ☐ External interlock system well thought out (optional)	See the "Laser Safety" section and 'External interlock" on page 3-8
Cleaning Material	☐ Fresh spectroscopic / spectrophotometric-grade or electronic grade methanol and acetone available. ☐ Hemostat ☐ Lens Tissues ☐ Powderless latex or nitrile gloves	
Laser Equipment	☐ Power meter and head (*e.g.*, Coherent FieldMate with LM10, LM2 heads). ☐ An oscilloscope (300 MHz or higher)	

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