

# Vitara-T & Vitara-T-HP Modelocked Ti:S Laser

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*Pre-Installation Manual*



*Pre-Installation Manual  
Vitara-T & Vitara-T-HP  
Modelocked Ti:S Laser*



**COHERENT®**

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Santa Clara, CA 95054 USA

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# 1 INTRODUCTION

## 1.1 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.

### 1.1.1 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.

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#### **CAUTION!**

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

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

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#### **NOTICE**

Indicates information considered important, but not hazard- related.

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

### 1.1.2

### 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 additional information.

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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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## 1.2

## Preface

This manual contains user information for the Vitara-T/T-HP.



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### **NOTICE**

Read this manual carefully before operating the laser for the first time. Failure to follow the instructions and safety precautions in this manual can result in serious injury or death. Special attention must be given to the material in “Laser Safety” (p. 9), that describes the safety features built into the laser. Keep this manual with the product and in a safe location for future reference.

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### **DANGER!**

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

---

## **1.3 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.

## **1.4 The Operator's Manual**

This Operator Manual is designed to familiarize the user with the Vitara-T/T-HP system and its designated use. It contains important information on how to install, operate, and troubleshoot the laser system safely, properly, and most efficiently. Observing these instructions helps to avoid danger, reduce repair costs, and downtimes and increase the reliability and lifetime of the laser system.

Installation, deinstallation, servicing, and detailed troubleshooting are only to be performed by formally trained and instructed personnel. Consequently, these procedures are not contained in the Operator's Manual but in the separate Service Manual.

This Manual:

- describes the physical hazards related to the laser system, the means of protection against these hazards, and the safety features incorporated in the design of the laser system
- briefly describes the purpose and operation as well as the primary features, system elements, subsystems, and fundamental laser control routines of the laser system
- describes the fundamental operation of the laser system

- describes the maintenance procedures for the laser system which can be performed by the end user. This includes a time schedule for all periodic routine replacement procedures and a basic troubleshooting section.



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**The screenshots in this manual are only examples and may show configurations or parameter settings which do not apply to the specified laser system. Changing parameter settings to correspond with screenshots may reduce laser performance or even damage the laser system!**

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#### 1.4.1

#### **Intended Audience**

The Operator's Manual is intended for all persons that are to work on or with the laser system. It assumes that the reader has participated in an introductory training course which has taught them the safe operation of the laser system.

None of the procedures described in this manual requires the defeating of safety interlocks. Where specific training is required to perform procedures, this is clearly indicated at the beginning of the corresponding section.

#### 1.4.2

#### **Availability and Use**

This Operator's Manual must always be available wherever the laser system is in use. Keep this manual in a safe location for future reference. It must be read and applied by any person in charge of carrying out work with and on the laser system, such as

- operation (including setting up, troubleshooting in the course of work, removal of production waste, care and disposal of consumables,
- service (maintenance, inspection, repair) and/or
- transport.

The sections are numbered continuously. Each step within a procedure is sequentially numbered. Each procedure starts with the step number one.

#### 1.4.3

#### **Typographic Conventions**

Menu commands, inquiries, and prompts are enclosed by quotation marks.

- Example: “Are you sure (Yes/No)?”

Single keys on the keyboard and terminal buttons to be pressed or touched are written in angled brackets.

- Example: Touch <Yes> to confirm and to continue.

Examples are written in non-proportional, upper-case letters to simulate the appearance of computer displays or printer output.

#### **1.4.4**

#### **Cited Standards**

Unless otherwise stated, all technical standards cited in this manual relate to the latest version of the standard that is applicable at the date of the publication of this manual.

This information is in compliance with the Performance Standards for Laser Products, 'United States Code of Federal Regulations', 21 CFR 1040.10(d). In many cases, the international standards (ISO and IEC standards) have been adopted wholly or in part by national or regional standards authorities and are known locally under the designation assigned by this authority. For instance, the IEC 60825-1 has been adopted by the European Committee for Standardization as the standard EN 60825-1 and, in turn, by various national standards authorities as standards such as DIN EN 60825 (Germany) and BS EN 60825 (United Kingdom). The exact content, number and revision date of the national standard may, however, vary from that of the corresponding international standard. For further information, please contact the publisher of the respective national standard.

### **1.5**

### **Laser Terminology**

ISO 11145 (“Optics and Optical Instruments - Lasers and Laser Related Equipment - Vocabulary and Symbols”) contains a list of laser terminology.

In addition to the terminology used by ISO 11145, IEC 60825-1 uses the term “laser product”. This term relates to any product or assembly of components which constitutes or is intended to incorporate a laser. In other words, the term “laser product” can be used in conjunction with any of the definitions contained in ISO 11145.

## 1.6 Units of Measurements

In this manual, units of measurement are used according to the metric system (international system of units (SI)), e.g. meter, millimeter, square meter, cubic meter, liter, kilogram, bar, pascal; and imperial system, e.g. tons, pounds, and ounces; gallons and quarts; miles, yards, feet, and inch.

Temperatures are primarily indicated in degrees Celsius (°C) and Fahrenheit (°F).

## 1.7 Feedback Regarding Documentation

If there are any comments regarding the documentation provided, please contact the Coherent Documentation Department.

In any correspondence, please provide the following:

- the document part number, revision, and date of issue,
- the section number, page number and, where applicable, the procedure step number,
- a description of any errors,
- a proposal for improvements.

### 1.7.1 Feedback Address

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**Post**                          Coherent Inc  
Documentation and Training Development Department  
5100 Patrick Henry Drive, MS-P2-49  
Santa Clara, CA. 95054  
USA





## 2 LASER SAFETY



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**NOTICE**

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.

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**WARNING!**

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 thoroughly reviewed prior to operation of the Vitara laser system. Safety instructions presented throughout this manual must be followed carefully.

### 2.1 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 any potential hazards.

## 2.1.1 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).



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### **WARNING!**

**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 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 carry sufficient intensity 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.

### 2.1.1.1 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 Optonics*, 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/or made off-limits to unauthorized personnel by removing the power supply key.
9. Use the laser in an enclosed room. Laser light may 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 that the laser is in use.
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.



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**WARNING!**

**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. Use extreme caution even while wearing safety glasses.**

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## **2.1.2**

### **Electrical Safety**

The Vitara uses AC and DC voltages in the laser head and controller. All units are designed to be operated with protective covers in place. Certain procedures in this manual require removal of the protective covers. These procedures shall be used by a qualified trained service personnel. Safety information contained in the procedures must be strictly observed by anyone using the procedures.

The Vitara controller should be connected to the AC input using a certified 3 conductor power cord, < 10 ft length, rated for at least 10 A operation, with a 16 AWG conductor. The power cord provided in the ship kit is rated for 1625 W.



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**DANGER!**

Normal operation of the Vitara 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.

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### 2.1.2.1

#### Recommended Precautions and Guidelines

The following precautions must be observed by anyone 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 assistance.
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 accidentally touched.
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.

## 2.2 Integrated Pump Lasers

The Vitara system incorporates a Coherent Verdi-G™ laser as a subcomponent. The beam from this laser is hazardous. Refer to the Verdi-G Operator's Manual for additional safety information.

### 2.2.1 Lifting Safety

Coherent recommends at least two people unpack and transport the Vitara laser system. Remove the laser head and controller from their shipping containers and install on a bench or machine.



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**CAUTION!**

The Vitara laser system weighs approximately 140 Lbs (64kg). Use a lifting device to move.

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**CAUTION!**

To avoid injury, never place any body parts below a lifted or suspended laser.

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## 2.3 Designated Use

The Vitara system has been built in accordance with state-of-the-art standards and recognized safety rules. Nevertheless, its use may constitute a risk to life and limb of the user or of third parties or cause damage to other material property.

The laser system shall only be used in technically perfect condition and in accordance with its designated use and the instructions set out in this manual, and only by safety conscious persons who are fully aware of the risks involved in operating the laser system. Any functional disorders, especially those affecting the safety of the laser system, should therefore be rectified immediately.

The Vitara system is a modelocked ultrafast laser oscillator designed for use in scientific applications and environments. Using the laser system for purposes other than those mentioned above is considered contrary to its

designated use. The manufacturer/supplier cannot be held liable for any damage resulting from such use. The risk of such misuse lies entirely with the user.

Operating the laser system within the limits of its designated use also involves observing the instructions set out in this manual and complying with the inspection and maintenance directives.

## **2.4 Maximum Accessible Radiation Level**

The Vitara and its component lasers produce visible and invisible radiation over a wavelength range of 500 to 1100 nm, with a maximum of 10 Watts continuous wave power, and 25 nJ maximum energy per < 200 fs pulse [CFR 1040.10 (h)(2)/ EN 60825-1/ IEC 60825-1, Clause 6].

## **2.5 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.

### **2.5.1 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 Vitara laser system is classified as Class IV based on 21 CFR, Subchapter J, part 1040, section 1040.10 (d). According to the European Community standards, Vitara lasers are classified as Class 4 based on EN 60825-1/IEC 60825-1, clause 9. In this manual, the classification will be referred to as Class 4.

## **2.5.2 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.

## **2.5.3 Safety Interlocks**

The system incorporates multiple safety interlocks which activate when the cavity cover of the laser head is removed. An interlock fault initiation will terminate all lasing by removing power from the infrared diodes. While installed, the interlock defeats are directly visible by anyone near the laser. It is not possible to replace the cavity cover while the interlocks are installed. Note that the external laser cover “beauty cover” is not interlocked and may be removed or re-installed at anytime.

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

## **2.5.4 Output Shutter**

A manual output shutter prevents 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].

## **2.5.5 Remote Interlock Connector**

The Vitara laser system is equipped with an external interlock connector on the rear panel of the power supply. The terminals of this connector must be electrically joined for the laser to operate [CFR 1040.10 (f)(3)/ EN 60825-1/IEC 60825-1, Clause 4.4].

## **2.5.6 Key Control**

Operation of the Vitara requires that the power supply and/or key switch be in the ON position. The key is removable and the system cannot be operated when the key is removed [CFR 1040.10 (f)(4)/ EN 60825-1/ IEC 60825-1, Clause 4.5].

## 2.5.7 Laser Radiation Emission Indicators

The LASER EMISSION indicators on both the power supply and the laser head illuminate a few seconds after power is applied to the pump power supply. The indicators are visible without exposing the operator to laser emission. Amber or white light are used which are visible while wearing the proper type of safety glasses [CFR 1040.10(f)(5)/ EN 60825-1/ IEC 60825-1, clause 4.6].

## 2.5.8 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].

## 2.5.9 Display Screen

The display screen on the front panel of the pump laser power supply may be viewed without exposing the operator to laser emission [CFR 1040.10(f)(8)/EN 60825-1/IEC 60825-1, clause 4.9].

## 2.5.10 Manual Reset Mechanism

Following an interlock fault or unexpected loss of electrical power, laser operation is resumed keying the power supply off and then on. [CFR 1040.10(f)(10)/EN 60825-1/IEC 60825-1, clause 4.11].



---

### **NOTICE**

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

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---

### **CAUTION!**

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

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## **2.5.11 Location of Safety Labels**

Refer to Figure 2-1 through Figure 2-6 for the location of all safety labels. These include warning labels indicating removable or transportable 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].

## **2.6 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 standard EN61326-1.

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

## **2.7 Environmental Compliance**

### **2.7.1 RoHS Compliance**

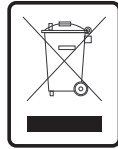
The RoHS directive restricts the use of certain hazardous substances in electrical and electronic equipment. All components of the Vitara system are RoHS compliant.

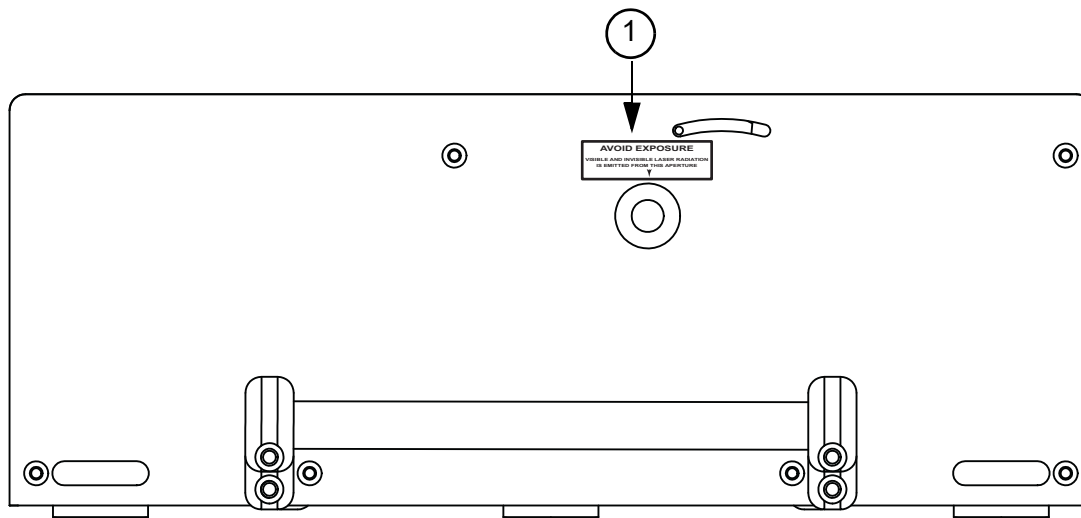
### **2.7.2 China-RoHS Compliance**

The China-RoHS directive restricts the use of certain hazardous substances in electrical and electronic equipment. Refer to the figures below for product components that are China-RoHS compliant. There are different labels for the laser head and electronics controller.

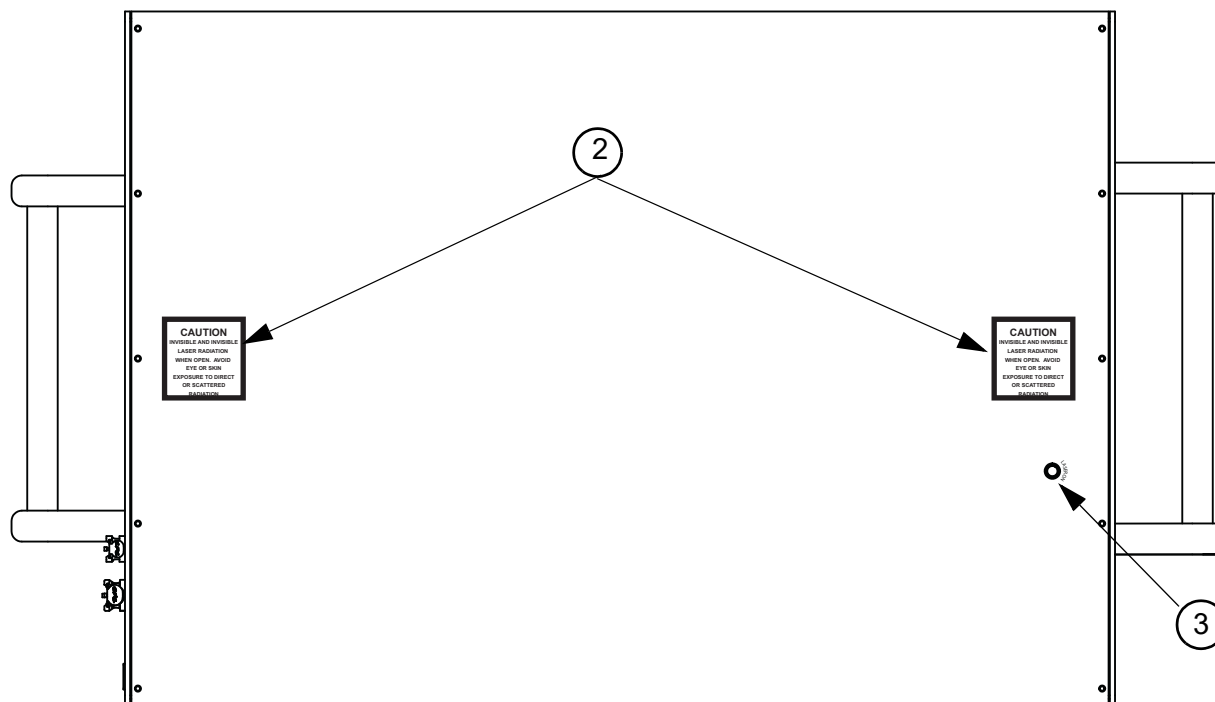
### **2.7.3 Waste Electrical and Electronic Equipment (WEEE, 2002)**

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.

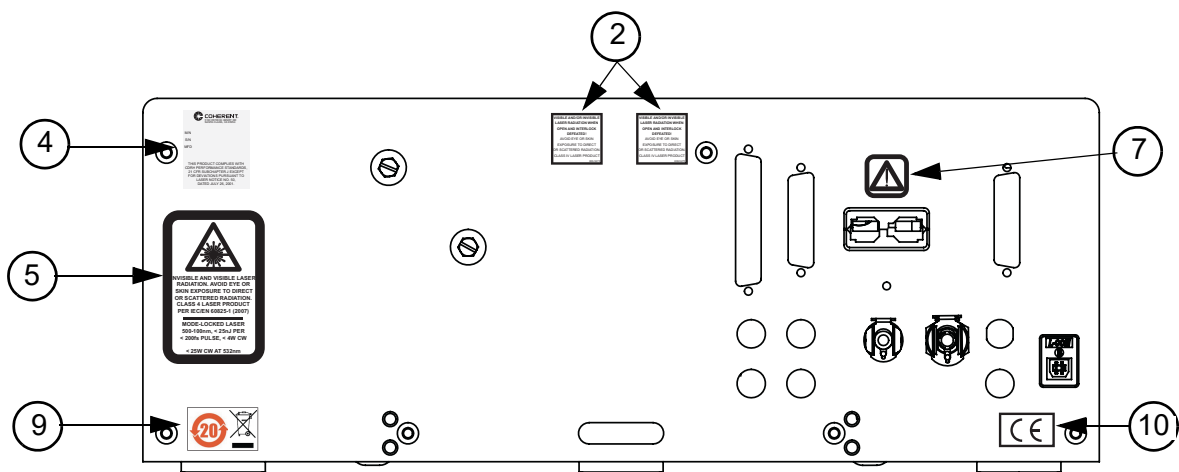




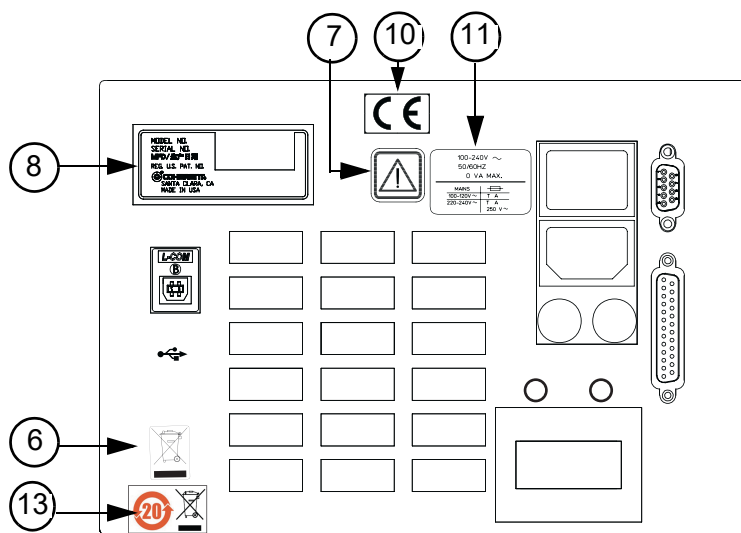
**Figure 2-1. Safety Label Locations on Front Bezel of the Vitara Laser Head**



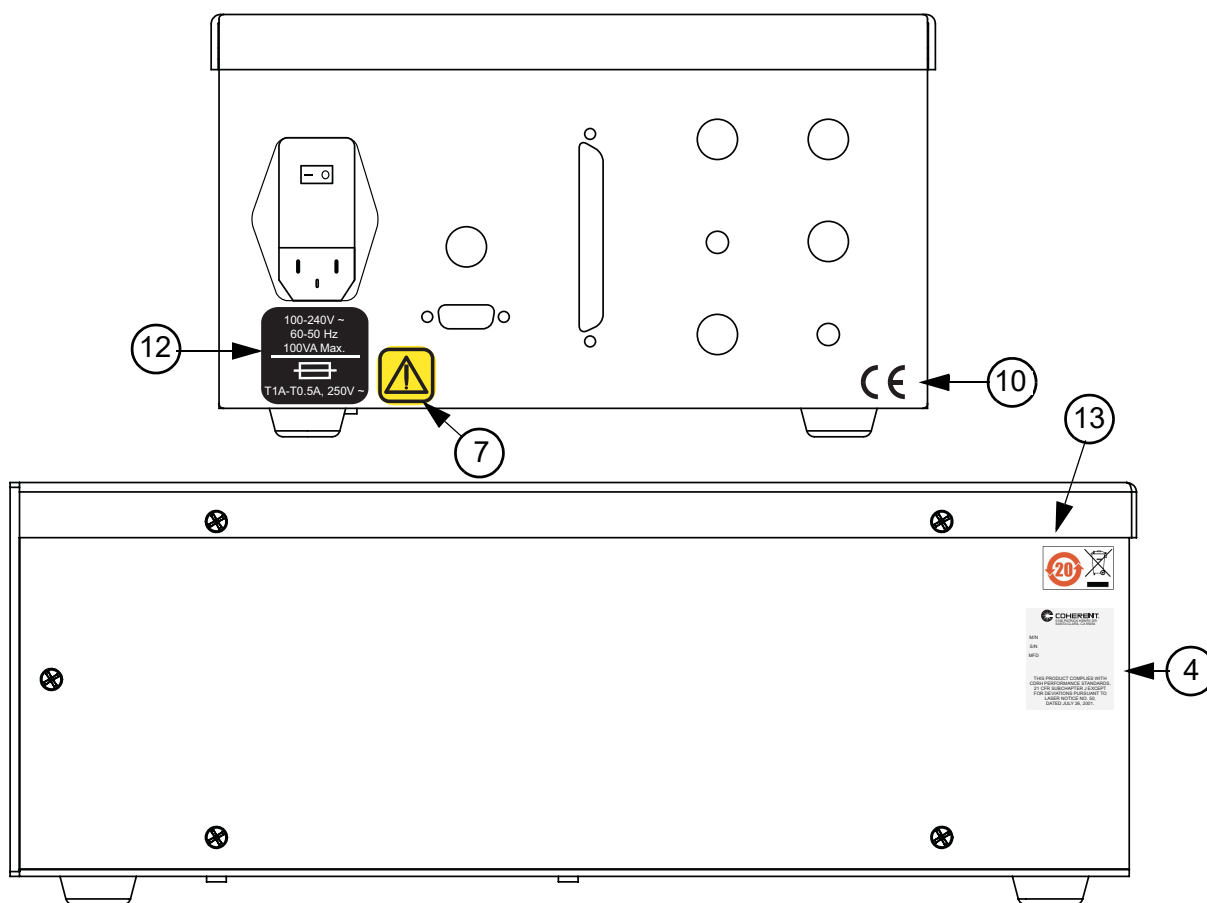
**Figure 2-2. Safety Label Location on Top Cover of the Vitara Laser Head**



**Figure 2-3. Safety Label Locations on Back Bezel of VitaraLaser Head**



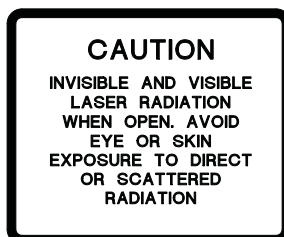
**Figure 2-4. Safety Label Locations on Pump Laser Power Supply**



**Figure 2-5. Safety Label Locations on the Vitara Controller**



1. Avoid Exposure to Laser Beam Emitted from Aperture



2. Exposure to Laser Radiation When Interlock Defeated

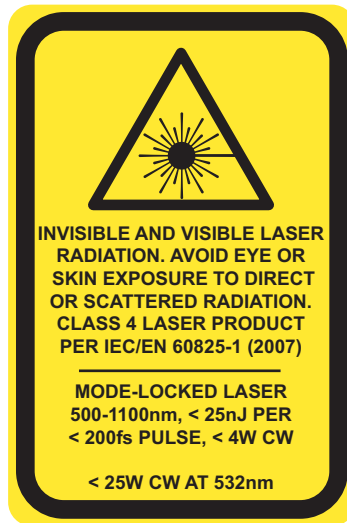
LASER  
EMISSION

3. Laser Emission (Silk Screen) for System Emission LED



4. SERIAL NUMBER IDENTIFICATION (LASER HEAD & VITARA CONTROLLER)

**Figure 2-6. Safety Label Descriptions (Sheet 1 of 3)**



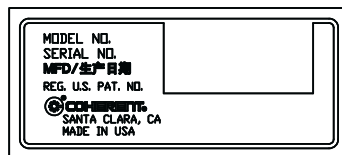
5. System Power, Bandwidth and Pulse Width Identification (Laser Head)



6. WEEE (Waste Electrical and Electronic Equipment) Silk Screen or Sticker



7. Caution Mark



8. Serial Number Identification (Verdi G-Series Power Supply)

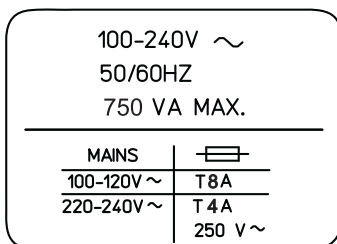
**Figure 2-6. Safety Label Descriptions (Sheet 2 of 3)**



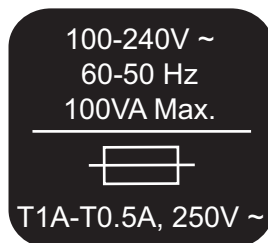
9. China RoHS, Laser Head



10. CE Certification (silk screen or sticker)



11. Voltage Rating Verdi G-Series Power Supply (Silk Screen)



12. Voltage Rating (Vitara Controller)



13. China RoHS, Controller/Power Supply

**Figure 2-6. Safety Label Descriptions (Sheet 3 of 3)**



## **2.8 Sources of Additional Information**

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

### **2.8.1 Laser Safety Standards**

#### *Safe Use of Lasers*

Document Z136.1

American National Standards

Institute (ANSI)

[www.ansi.org](http://www.ansi.org)

#### *Guidelines for Laser Safety and Hazard Assessment*

Directives PUB 8-1.7

Occupational Safety and Health  
Administration (OSHA)

U.S. Department of Labor

[www.osha.gov](http://www.osha.gov)

#### *A Guide for Control of Laser Hazards*

American Conference of Governmental  
and Industrial Hygienists (ACGIH)

[www.acgih.org](http://www.acgih.org)

#### *Laser Safety Guide*

Laser Institute of America

[www.lia.org](http://www.lia.org)



## **3 DESCRIPTION AND SPECIFICATIONS**

### **3.1 Introduction**

The Vitara-T/T-HP is a Titanium:Sapphire laser oscillator system capable of producing modelocked pulses with bandwidths exceeding 125 nm and a pulse width <12 fs for the Vitara-T, and bandwidths exceeding 100 nm with <15 fs pulse width for the Vitara-HP. Excellent power stability is achieved by integrating the proven Coherent Verdi G-series™ pump laser, PowerTrack™ beam steering technology, and a compact cavity design into a single laser head. Bandwidth and center wavelength are conveniently adjusted through the proprietary control software provided with the system.

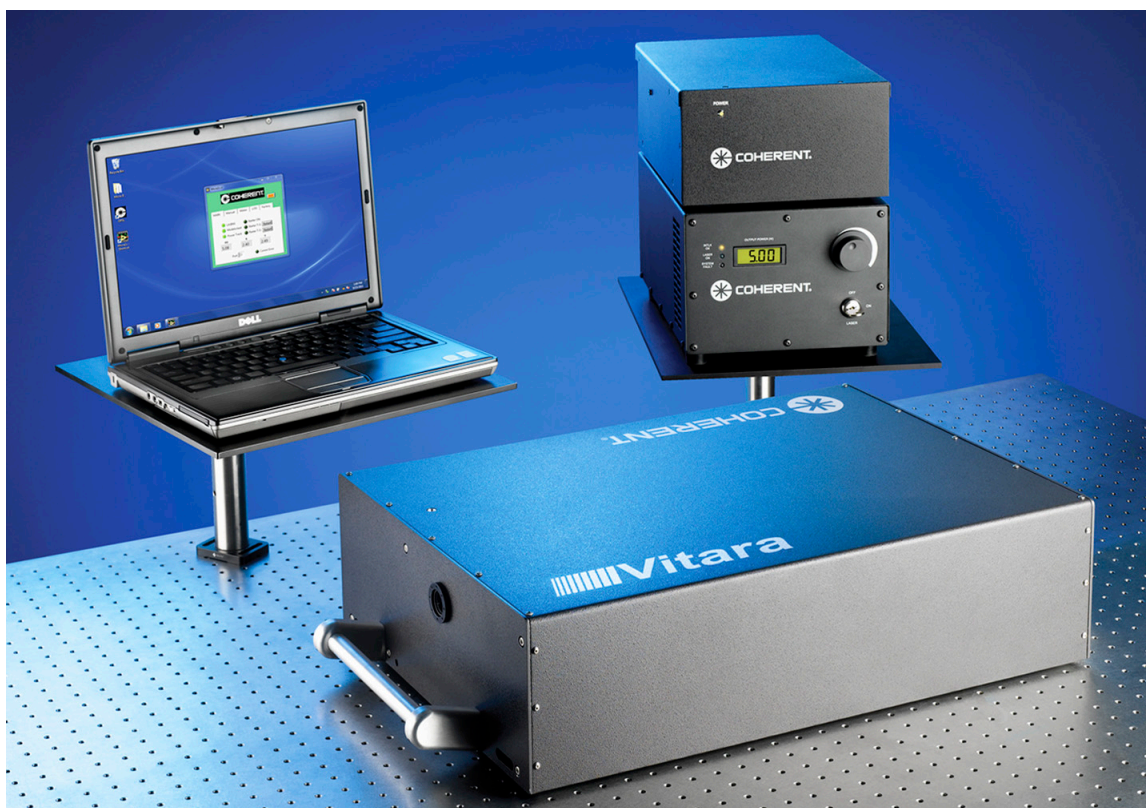
The primary components are the laser head, power supply and Vitara controller as shown in Figure 3-1. Also included is a stand-alone closed-loop water chiller to provide thermal stability for the entire system.

### **3.2 Vitara-T/T-HP Laser Head**

A key feature of the Vitara-T/T-HP laser system is the incorporation of the Verdi G-series pump laser into one box with the oscillator cavity. Advantages of this design include a smaller overall footprint, very low optical noise and increased thermal and mechanical stability.

Optimal alignment of the pump beam into the oscillator cavity is maintained by the PowerTrack beam steering system. A feedback loop controls the orientation of the first pump steering optic while monitoring the Vitara-T/T-HP output power level. PowerTrack greatly reduces system warm-up time to less than one minute and provides excellent long term stability and hands-free operation.

The oscillator itself employs Kerr lens modelocking in combination with an intracavity prism pair to generate low-noise, large-bandwidth, and high-peak power ultrafast pulses. The prisms are adjustable along with a slit assembly to provide tunability of the bandwidth and center wavelength. Precise control of the spatial mode profile allows stable operation at bandwidth in excess of 125 nm for the Vitara-T and in excess of 100 nm for the Vitara-T/T-HP while maintaining high-quality mode. The cavity also features automated modelocking that can be initiated by a solenoid mount or a PZT-driven movable mirror mount (depending on the Vitara model).



**Figure 3-1. Vitara-T & Vitara-T-HP Laser System**

### **3.3 Verdi G-series Laser Head**

Based on optically pumped semiconductor laser (OPSL) technology, the Verdi G-series is a robust multiwatt-level continuous-wave, low noise and high performance pump laser. The compact cavity design employs intracavity second harmonic generation to produce green (532 nm) visible light output, key for ultrafast Ti:Sapphire pumping. OPSL technology offers many advantages inherited from its monolithic semiconductor chip used to produce laser light. Unprecedented flexibility in terms of variable output power with no effect on beam quality or beam pointing and extremely low noise are characteristics of OPSL lasers. In addition, the short upper-state lifetime of the OPS chip removes the “green noise” problem as seen in diode pumped solid-state (DPSS) lasers. Verdi G-Series lasers are available as single or multi-transverse mode.

Constructed within a cleanroom environment, the resonator optics are installed using Coherent’s exclusive PermAlign™ manufacturing process, resulting in a permanently aligned resonator structure that is extremely stable.

## **3.4 Vitara Controller**

The Vitara controller includes the necessary electronics to control several laser head sub-systems and serves as the interface between the laser head and control computer. The Vitara controller also manages all on-board controls and diagnostics features of the laser such as PowerTrack, systems to control bandwidth and center wavelength, and to monitor and initiate modelocking.

## **3.5 Specifications**

The Customer Data Sheet shipped with each Vitara provides a detailed description of system performance. Specifications for all other laser parameters can be found at [www.coherent.com](http://www.coherent.com).



# 4

## INSTALLATION AND UTILITY REQUIREMENTS

### 4.1 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 or authorized representative.



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**NOTICE**

**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.**

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The following items are included with a Vitara-T/T-HP laser system:

1. Laser head
2. Pump Laser power supply
3. Vitara controller
4. Laptop computer and software
5. System accessory package
6. Water chiller: Thermotek Model T257P or equivalent (specific models only)
7. Vitara ship kit
8. Operator's manual



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**NOTICE**

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

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**NOTICE**

The Vitara is a sealed cavity, hands-free laser system. Coherent prohibits users from breaking or removing the warranty seals. Doing so will void the warranty as stated in the warranty section of this manual.

## 4.2 Utility and Environmental Requirements

The following tables provide pertinent information concerning the installation of the Vitara. The power supply and controller are shipped with one 110V power cable, plus an additional cable with no plug. The laptop computer and chiller are shipped with one 110V power cable only.

**Table 4-1. Utility Requirements**

| Parameter                                                                              | Requirement    | Max. Power Consumption |
|----------------------------------------------------------------------------------------|----------------|------------------------|
| Verdi G-Series Power Supply                                                            | 100 to 240 VAC | 750 VA                 |
| Vitara Controller                                                                      | 90 to 250 VAC  | 110 VA                 |
| Water Chiller                                                                          | 100 to 240 VAC | 600 W                  |
| Line Frequency                                                                         | 47 to 63 Hz    | -                      |
| <b>Note:</b> All specifications and requirements are subject to change without notice. |                |                        |

**Table 4-2. Operational Environmental Requirements**

| Parameter           | Requirement                     |
|---------------------|---------------------------------|
| Ambient Temperature | 20 to 24 °C (70 to 75 °F)       |
| Relative Humidity   | 30 to 55 % non-condensing       |
| Altitude            | Sea level to 3000 m (10,000 ft) |



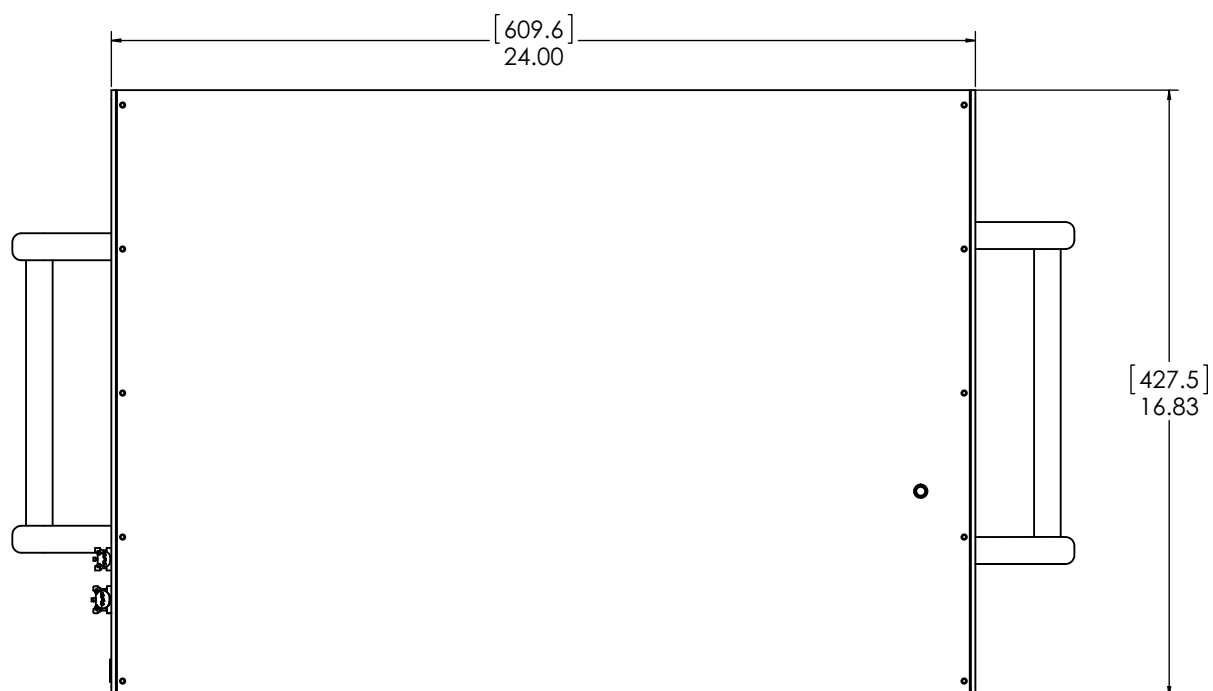
**Table 4-3. Water Chiller Specifications**

| Parameter                                              | Requirement                                          |
|--------------------------------------------------------|------------------------------------------------------|
| Flow Rate                                              | 1.0 to 1.5 liters/minute (0.2 to 0.4 gallons/minute) |
| Maximum Pressure                                       | 200 kPa (30 psi)                                     |
| Operating Water Temperature<br>Vitara-T<br>Vitara-T-HP | 20 °C (68 °F)<br>17 °C (62.6 °F)                     |

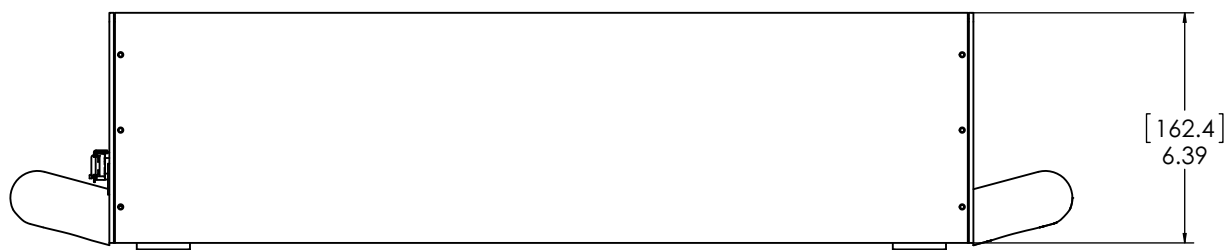
## 4.3 Dimensions and Weight

**Table 4-4. Dimensions and Weight**

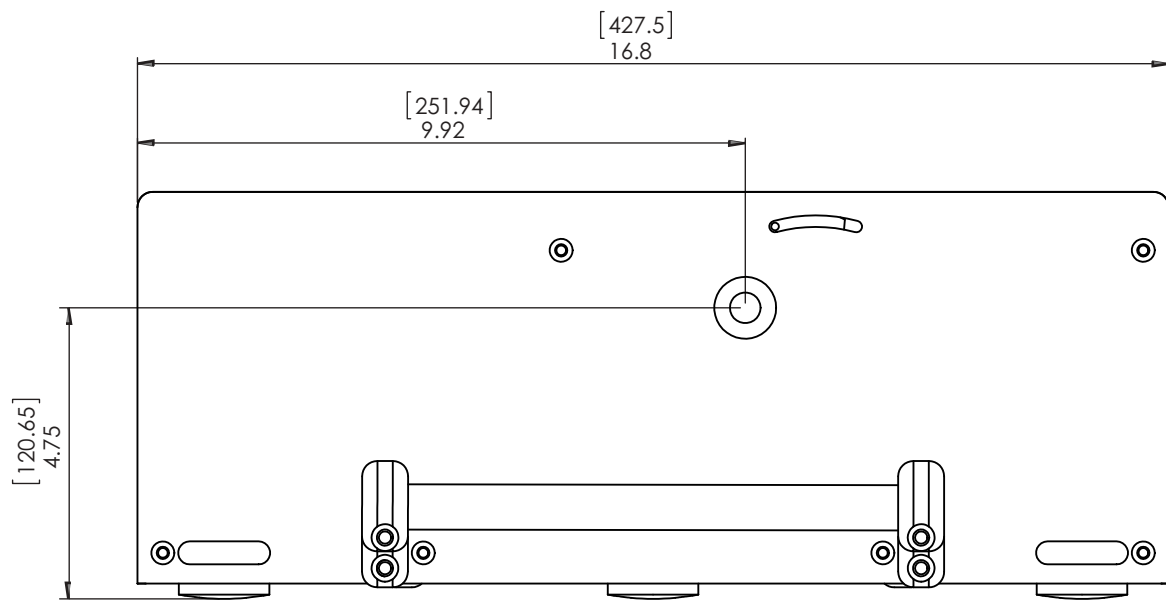
|        | Laser Head        | Pump Power Supply | Vitara Controller | Chiller           | Crate               |
|--------|-------------------|-------------------|-------------------|-------------------|---------------------|
| Length | 61 cm (24 in)     | 36.1 cm (14.2 in) | 36.3 cm (14.3 in) | 27.7 cm (10.9 in) | 151.8 cm (59.75 in) |
| Width  | 42.8 cm (16.8 in) | 22.9 cm (9.0 in)  | 23.4 cm (9.2 in)  | 20.3 cm (8.0 in)  | 69.2 cm (27.25 in)  |
| Height | 16.3 cm (6.4 in)  | 16.0 cm (6.3 in)  | 13.7 cm (5.4 in)  | 38.6 cm (15.2 in) | 59.1 cm (23.25 in)  |
| Weight | 63 kg (140 lbs)   | 6 kg (13.2 lbs)   | 3.4 kg (7.5 lbs)  | 8.8 kg (19.4 lbs) | 55 kg (121 lbs)     |



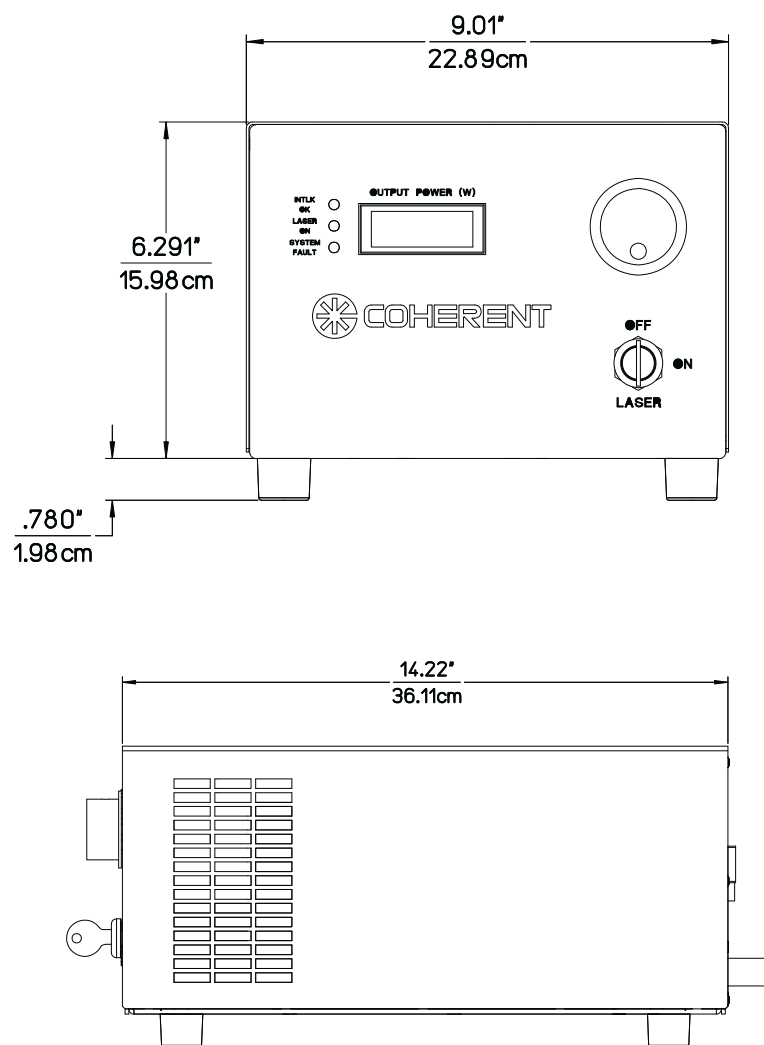
**Figure 4-1. Vitara Laser Head Dimensions (Top View)**



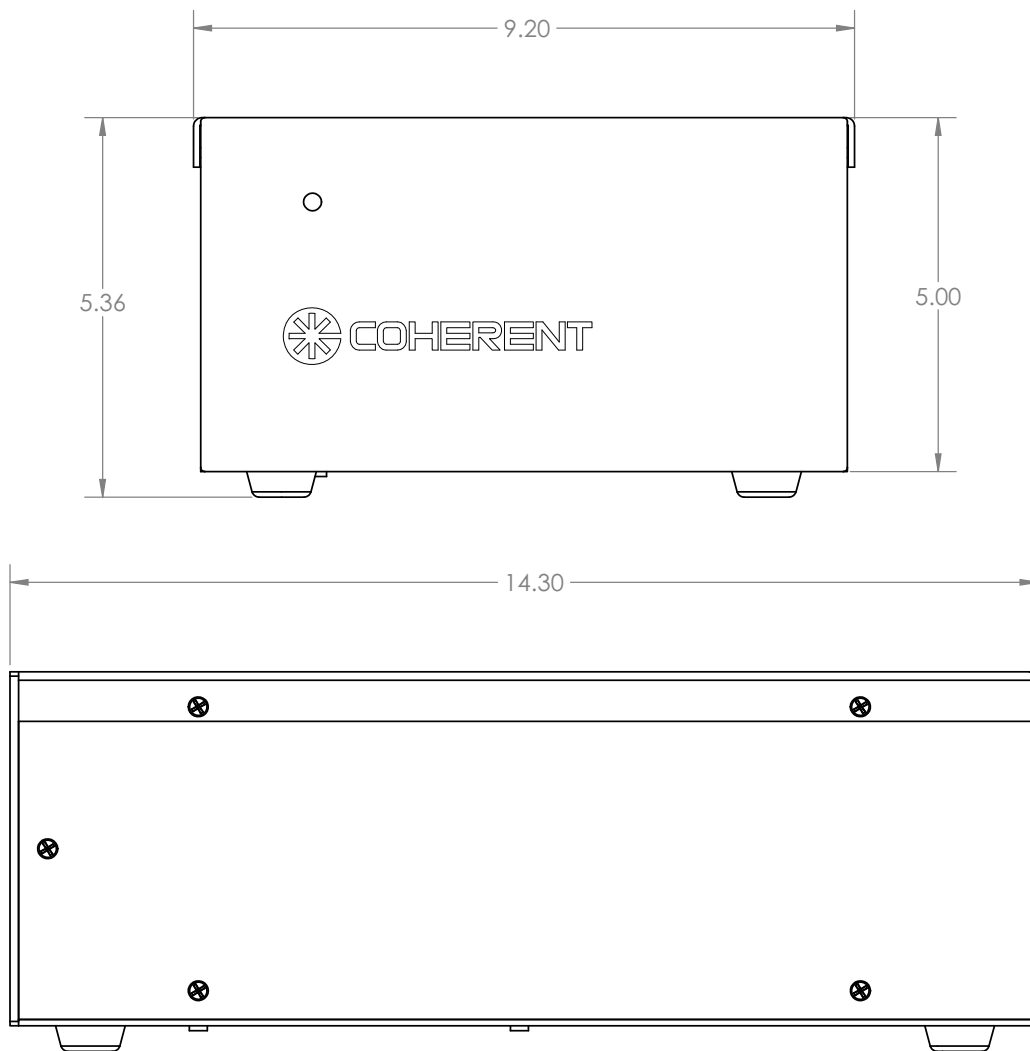
**Figure 4-2. Vitara Laser Head Dimensions (Side View)**



**Figure 4-3. Vitara Laser Head Dimensions (Front View)**



**Figure 4-4. Verdi-G Power Supply Dimensions**

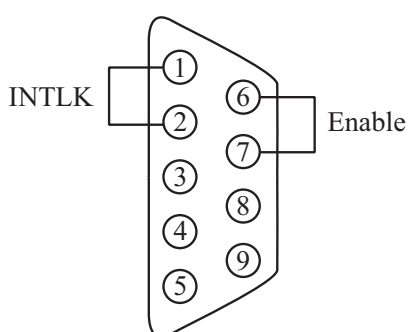


**Figure 4-5. Vitara Controller Dimensions**

## 4.4 External Interlock

An interlock connector is located on the pump laser power supply rear panel. If the interlock is open, laser emission will terminate, and the SYSTEM FAULT LED (red) will illuminate. The system ships with an interlock defeat which is installed to close the interlock loop.

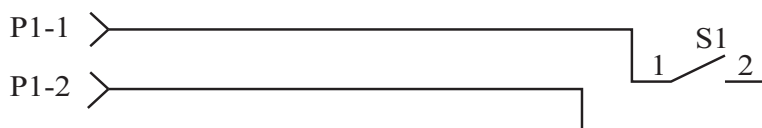
Alternatively, if you want to incorporate an external safety interlock circuit into the laser system, follow the instructions given below. Figure 4-6 displays the pin diagram for the interlock connector. The interlock defeat shorts pins 1 and 2 as well as pins 6 and 7.



Pins 3,4,5,8, and 9 are for factory use only. Do not connect these pins.

**Figure 4-6. “Sub-D” Interlock Connector Pin Diagram.**

Install the external switch between pins 1 and 2 of the connector, and install a short between pins 6 and 7. Figure 4-7 shows a wiring diagram for the switch. The switch must have its contacts closed when it is safe to operate the laser and open when it is not safe. The switch is shown in the open position, which is the condition where the laser will not operate.



**Figure 4-7. External Interlock Circuit**

**NOTICE**

Do not make any electrical contact with pins 3,4,5,8 or 9. These are for factory use only. Improper use of these pins can cause permanent failure of the system.

## 4.5 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 4-5. Pre-installation Checklist**

| Activity & Equipment | General Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Reference(s)                                                     |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Laser Environment    | <ul style="list-style-type: none"> <li>[ ] Temperature and humidity in specification.</li> <li>[ ] Laser area layout planned according to system dimensions.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | See "Utility and Environmental Requirements" (p. 32).            |
| Receive and Inspect  | <ul style="list-style-type: none"> <li>[ ] Area is clean and large enough to uncrate the laser and chiller.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | See "Receiving and Inspection" on p. 31                          |
| Utility Requirements | <ul style="list-style-type: none"> <li>[ ] Utility outlets (115V/20A, typical) available nearby installation area.</li> <li>[ ] (x1) 100 to 240VAC outlet available for Vitara Power Supply.</li> <li>[ ] (x1) 90 to 250VAC outlet available for Vitara controller.</li> <li>[ ] (x1) 90 to 250VAC outlet available for water chiller.</li> <li>[ ] (x1) 90 to 250VAC outlet available for laptop computer.</li> <li>[ ] (x1) 90 to 250VAC outlet available for Synchro-lock AP (if purchased with system).</li> <li>[ ] (x4) extra outlets available for instrumentation (e.g., power meter, oscilloscope, spectrometer,...).</li> </ul> | See "Utility and Environmental requirements" on p. 32            |
| System Chiller       | <ul style="list-style-type: none"> <li>[ ] Distilled water available on-site (~2 liters). Do not use deionized water.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                  |
| Laser Safety         | <ul style="list-style-type: none"> <li>[ ] Laser Safety Officer (LSO) identified (recommended).</li> <li>[ ] Laser Safety Training completed.</li> <li>[ ] Laser controlled area established.</li> <li>[ ] Personal protective equipment (Laser safety eye wear) available.</li> <li>[ ] External interlock system in place (optional)</li> </ul>                                                                                                                                                                                                                                                                                         | See the "Laser Safety" section and 'External interlock' on p. 38 |

**Table 4-5. Pre-installation Checklist (Continued)**

| Activity & Equipment | General Requirements                                                                                                                                                                                                                                                                        | Reference(s) |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Cleaning Material    | <ul style="list-style-type: none"> <li>[ ] Fresh spectroscopic / spectrophotometric-grade or electronic grade methanol and acetone available.</li> <li>[ ] Hemostat</li> <li>[ ] Lens Tissues</li> <li>[ ] Powder-less latex or nitrile gloves</li> </ul>                                   |              |
| Laser Equipment      | <ul style="list-style-type: none"> <li>[ ] Power meter and head (e.g., Coherent FieldMate with LM10, LM2 heads).</li> <li>[ ] Intensity calibrated spectrometer (e.g., StellarNet Blue-wave NIR2-14).</li> <li>[ ] A beam splitter to send part of the beam to the spectrometer.</li> </ul> |              |

## 4.6 Installation

At least two people are recommended to unpack the Vitara. The laser head weighs about 140 pounds (63 kg). The laser head, power supply and Vitara controller should be located away from heat sources. The power supply cooling air intake and exhaust (rear, left and right sides) must not be obstructed, and the front panel key and control knob should be easily accessible.

Once an appropriate location for the Vitara laser head has been selected, secure it using the specially designed foot clamps provided in the accessory kit. The Vitara handles may be removed if desired.

If the system is sold with a carrier-envelope phase stabilization (CEP) system and/or a Synchro-Lock Advanced Performance (SLAP) system, the front handle should be removed to allow enough room for the installation of the CEP module. Refer to the Vitara CEP/Vitara-SLAP operator's manuals for further information on the CEP module and/or SLAP installation.



## 4.7

**Electrical and Cable Connections**

Once the laser head, power supply and Vitara controller are properly located, establish all electrical and cable connections as described below:

1. Remove the plugs from the inlet and outlet on the water chiller. Note that water may escape when this occurs.
2. Connect the water lines from the laser head to the chiller. The direction of the flow is not important. Fill up the chiller with distilled water.

**NOTICE**

**Do not use tap or deionized water to fill up the chiller as it may lead to algae/limestone buildup and impair the cooling efficiency.**

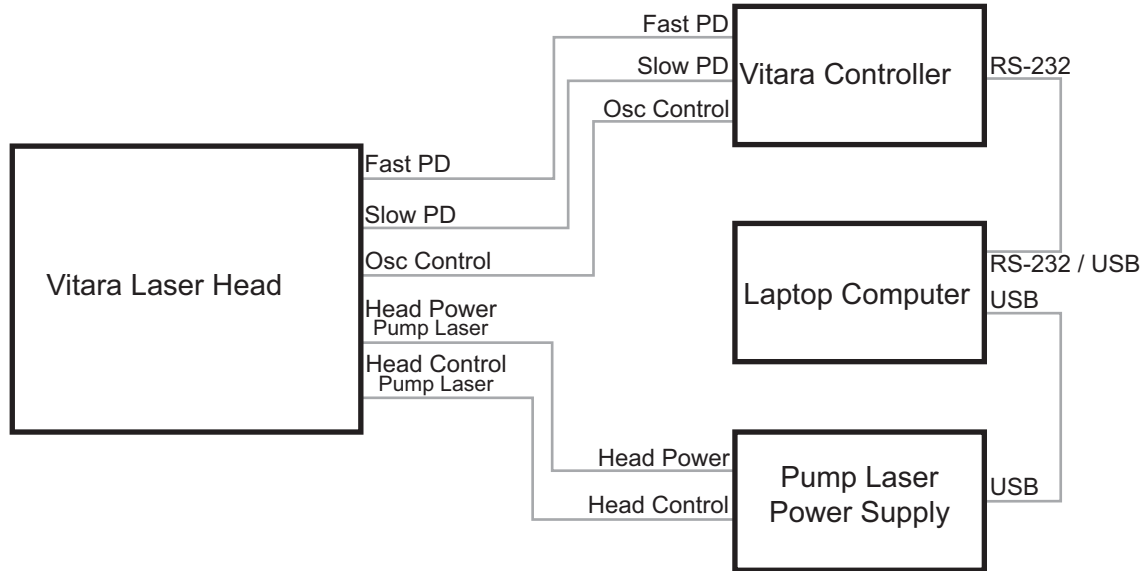
3. Turn on the water chiller and verify the temperature set point is 20°C (17°C for Vitara-T-HP). If the operating temperature set point differs, adjust it using the front display:

MENU > SET TEMPERATURE > (UP OR DOWN ARROW) > MENU  
(to confirm).

4. For SLAP Options refer to the Vitara-SLAP operator's manual for cable connections and installation instructions.
5. Connect the interlock defeat to the EXTERNAL INTERLOCK connector on the back of the power supply, or ensure that any external interlocks are closed. The interlock defeat is located in the accessory kit or installed on the rear of the power supply. If an interlock fault appears on the front panel, key OFF and ON to clear it.

For the following steps, refer to Figure 4-8.

6. Connect a BNC cable from the fast photodiode (Fast PD) on the laser head to the fast photodiode (Fast PD) on the Vitara controller.
7. Connect a BNC cable from the slow photodiode (Slow PD) on the laser head to the slow photodiode (Slow PD) on the Vitara controller.
8. Connect the 37-pin control cable from the oscillator control (Osc Control) connector on the laser head to the oscillator control (Osc Control) connector on the Vitara controller.
9. Connect the power cable from the Head Power/Pump laser on the laser head to the Head Power on the Pump laser power supply.



**Figure 4-8. Vitara-T/T-HP System Connections**



**CAUTION!**

Never turn on the laser unless you are sure the diode current cable between the Verdi head and power supply is completely seated. Failure to do so may result in severe damage to the pump laser. Push the connector all the way in until a click is heard. Never check the diode cable connection while the Verdi power supply is powered ON (i.e. power cord plugged into AC wall plug and power switch on the back panel ON). If the connector is not fully seated, arcing may occur as the cable connector is pushed in, which could damage the laser.

10. Connect the 25-pin control cable from the Head Control/Pump Laser on the laser head to the Head Control on the pump laser power supply.



**CAUTION!**

Do not connect the 25-pin control cable from the Head Control on the pump laser power supply to the SLAP Motor connector on the rear of the laser head. This will result in damage to the SynchroLock AP Vitara internal stepper motor.

11. Establish a USB connection between the laptop and the pump laser power supply.

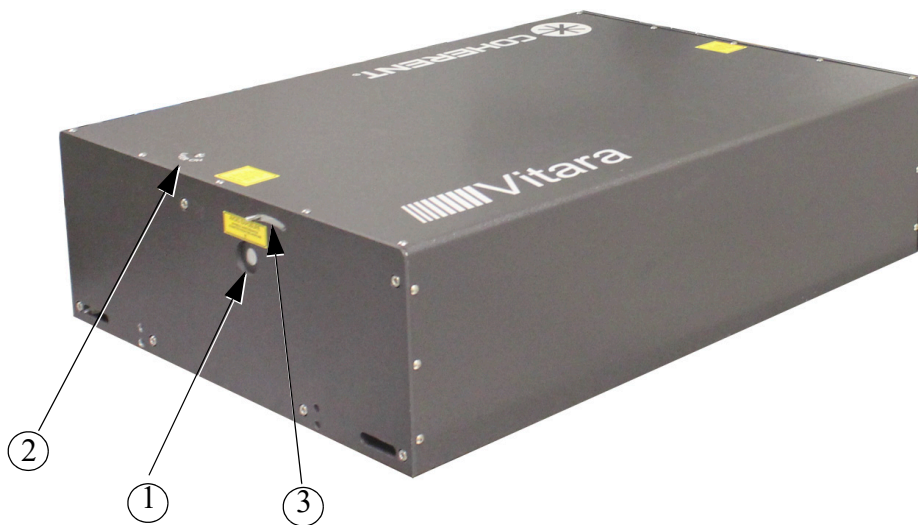
12. Establish an RS-232 connection between the laptop and the Vitara controller. Use an RS-232 to USB converter if the laptop is not equipped with an RS-232 port.
13. Connect the pump laser power supply, Vitara controller and laptop computer to facility power. Refer to Table 4-1 for utility requirements.



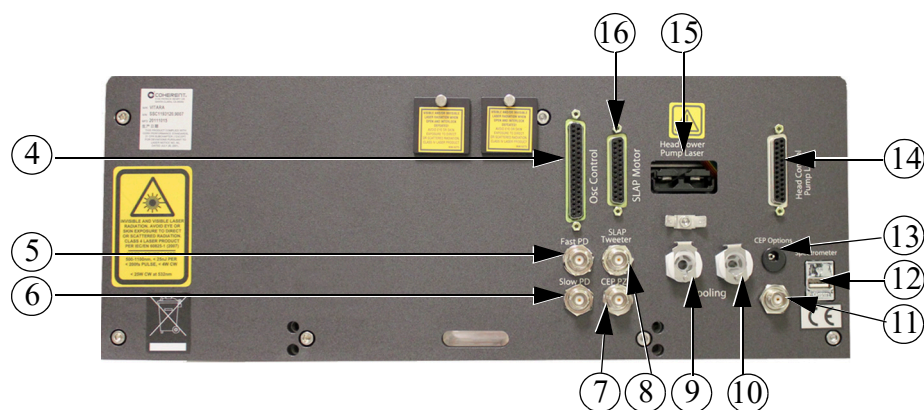
# 5 CONTROLS, INDICATORS AND FEATURES

## 5.1 Controls and Indicator Locations

Figure 5-1 through Figure 5-3 and Table 5-1 through Table 5-3 identify and describe the features of the Vitara-T/T-HP laser head, power supply and Vitara controller. For features on the chiller, please reference the manufacturer's manual.



**Figure 5-1. Laser Head Indicators and Features**



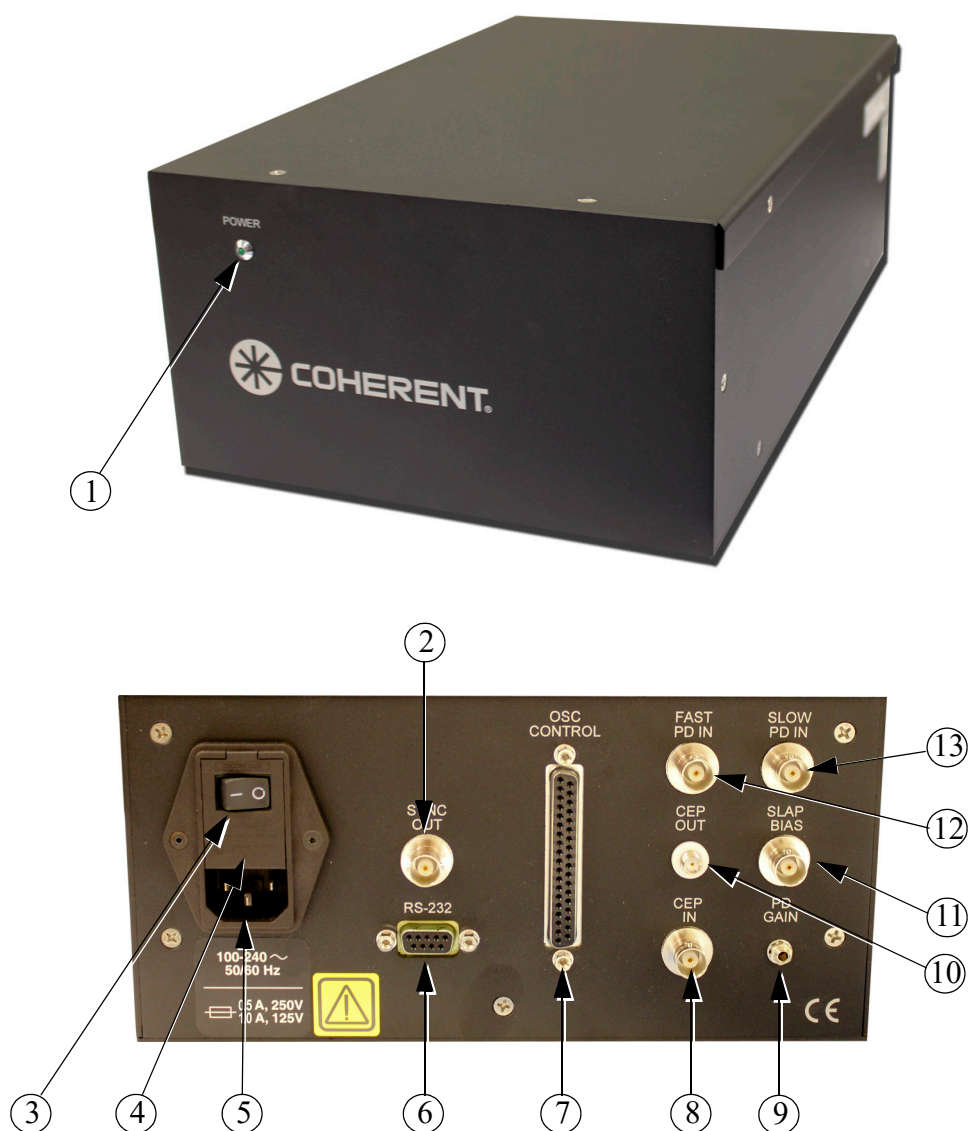
- |                           |                                     |
|---------------------------|-------------------------------------|
| 1. Laser Output Aperture  | 9. Cooling Water Connectors         |
| 2. Emission Indicator     | 10. Cooling Water Connector         |
| 3. Shutter                | 11. CEP Options                     |
| 4. OSC Control            | 12. Spectrometer Output/Service Use |
| 5. Fast Photodiode Output | 13. CEP Options                     |
| 6. Slow Photodiode Output | 14. Head Control / Pump Laser       |
| 7. CEP PZT                | 15. Head Power / Pump Laser         |
| 8. SLAP Tweeter           | 16. SLAP Motor Input                |

**Note:** Options are based on the system ordered. Some options may not be active.

**Figure 5-1. Laser Head Indicators and Features (Continued)**

**Table 5-1. Laser Head Feature Descriptions**

| Item                          | Feature                   | Description                                                                                                                                                                |
|-------------------------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Laser Head Front Panel</b> |                           |                                                                                                                                                                            |
| 1                             | Output Aperture           | Main output aperture of the Vitara-T/T-HP.                                                                                                                                 |
| 2                             | Emission Indicator        | LED active for powered laser head and no interlock faults.                                                                                                                 |
| 3                             | Shutter                   | Manual beam shutter                                                                                                                                                        |
| <b>Laser Head Back Panel</b>  |                           |                                                                                                                                                                            |
| 4                             | OSC Control               | Enables communication between the laser head and the Vitara controller.                                                                                                    |
| 5                             | Fast PD                   | Fast photodiode (PD) signal to monitor the oscillator output pulse train. The signal is proportional to (but not linear) with the oscillator output pulse energy or power. |
| 6                             | Slow PD                   | Slow photodiode (PD) signal to monitor the oscillator output. The DC signal is proportional to (but not linear) with the oscillator output power.                          |
| 7                             | CEP PZT (slow actuator)   | Piezoelectric transducer (PZT) signal input (if equipped).                                                                                                                 |
| 8                             | SLAP Tweeter              | Synchro-Lock Advanced Performance (SLAP) input from SLAP controller (if equipped).                                                                                         |
| 9                             | Cooling Water Connector   | Coolant IN or OUT to chiller                                                                                                                                               |
| 10                            | Cooling Water Connector   | Cooling IN or OUT from chiller                                                                                                                                             |
| 11                            | CEP Options               | Reserved for CEP options (if equipped).                                                                                                                                    |
| 12                            | Spectrometer              | Built-in spectrometer output signal (if equipped).                                                                                                                         |
| 13                            | CEP Options               | Reserved for CEP options (if equipped).                                                                                                                                    |
| 14                            | Head Control / Pump Laser | Enables communication between the pump laser head and the pump power supply.                                                                                               |
| 15                            | Head Power / Pump Laser   | Power connection between the pump laser head and pump power supply.                                                                                                        |
| 16                            | SLAP Motor                | Synchro-Lock Advanced Performance (SLAP) stepper motor signal input from SLAP controller (if equipped).                                                                    |



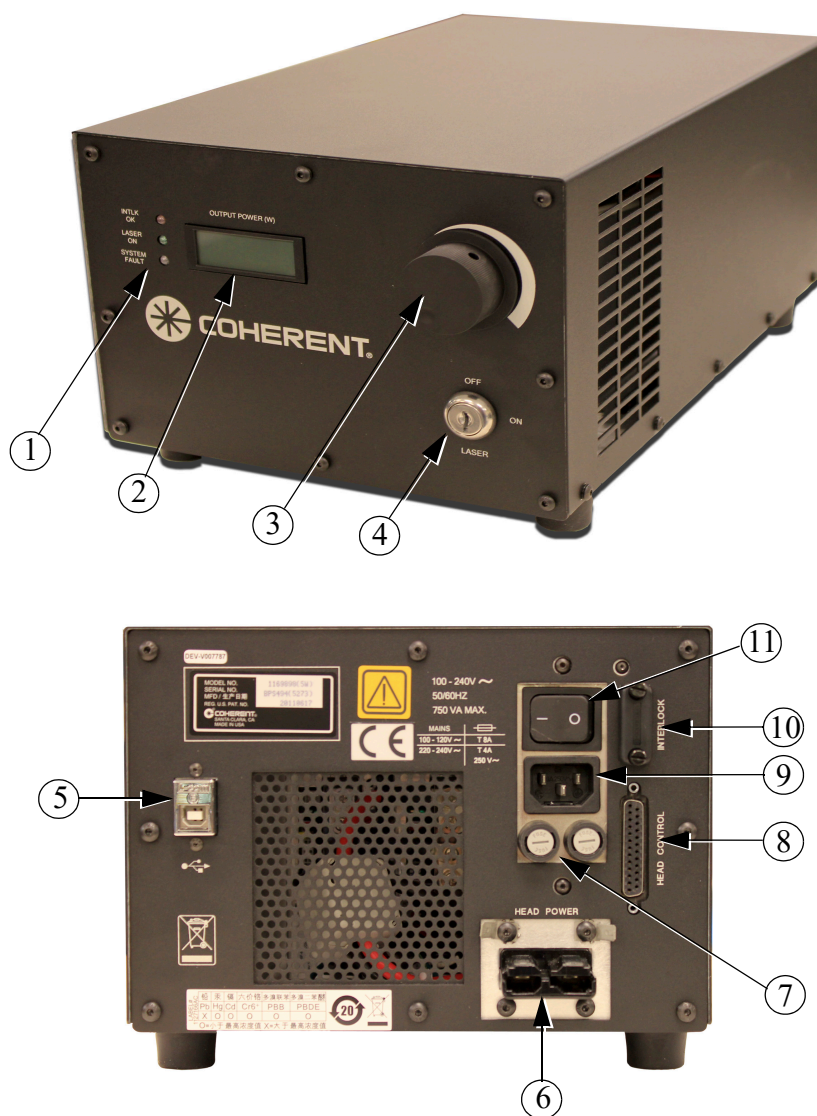
- |                        |                                                           |
|------------------------|-----------------------------------------------------------|
| 1. Power LED indicator | 8. CEP IN (Not available for Vitara-S)                    |
| 2. SYNC OUT            | 9. PD Gain                                                |
| 3. Main Power Switch   | 10. CEP OUT (Not available for Vitara-S)                  |
| 4. Fuse Cover          | 11. SLAP BIAS Input (Not available for Vitara-S)          |
| 5. Facility Power Plug | 12. Fast Photodiode Signal Input (from Vitara laser head) |
| 6. RS-232 Connector    | 13. Slow Photodiode Signal Input (from Vitara laser head) |
| 7. OSC Control         |                                                           |

**Figure 5-2. Vitara Controller Indicators and Features**



**Table 5-2. Vitara Controller Feature Descriptions**

| Item                                 | Feature             | Description                                                                                                                                             |
|--------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Vitara Controller Front Panel</b> |                     |                                                                                                                                                         |
| 1                                    | Power LED indicator | LED active when controller is powered.                                                                                                                  |
| <b>Vitara Controller Back Panel</b>  |                     |                                                                                                                                                         |
| 2                                    | Sync Out            | Amplified fast photodiode signal. Typical signal is ~ 80 MHz, ~ 600 mV Pk-Pk.                                                                           |
| 3                                    | Main Power Switch   | Main power switch to the Vitara controller.                                                                                                             |
| 4                                    | Fuse Cover          | Vitara controller fuse cover. Fuses must be manually changed for 110 V or 220 V operation. See "Fuse Replacement" (p. 144)                              |
| 5                                    | Facility Power Plug | Facility power (AC) input. The controller accepts 100-240 VAC, 50-60 Hz.                                                                                |
| 6                                    | RS-232 Connector    | External RS-232 computer connection.                                                                                                                    |
| 7                                    | OSC Control         | Communication line between the Vitara laser head and the Vitara controller.                                                                             |
| 8                                    | CEP IN              | Only available on Vitara CEP systems. Refer to the Vitara CEP Operator's Manual for details.                                                            |
| 9                                    | PD Gain             | Slow photodiode gain adjustment.                                                                                                                        |
| 10                                   | CEP OUT             | Only available on Vitara CEP systems. Refer to the Vitara CEP Operator's Manual for details.                                                            |
| 11                                   | SLAP Bias input     | Only available on systems fitted with Synchro-Lock AP. Synchro-Lock AP BIAS signal from SLAP controller. Only available on Vitara Synchro-Lock systems. |
| 12                                   | FAST PD IN          | Fast photodiode signal input from the Vitara rear bezel.                                                                                                |
| 13                                   | SLOW PD IN          | Slow photodiode signal input from the Vitara rear bezel.                                                                                                |



- |                                    |                                            |
|------------------------------------|--------------------------------------------|
| 1. Power Supply LEDs               | 7. Fuses                                   |
| 2. Front Panel Display             | 8. Pump Laser Head Control D-sub Connector |
| 3. Power Supply Control Knob       | 9. Facility Power Plug                     |
| 4. Key switch                      | 10. Interlock D-sub Connector              |
| 5. USB Connector                   | 11. Main Power Switch                      |
| 6. Pump Laser Head Power Connector |                                            |

**Figure 5-3. Power Supply Indicators, Controls and Features**

**Table 5-3. Power Supply Feature Descriptions**

| Item                            | Feature                                 | Description                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Power Supply Front Panel</b> |                                         |                                                                                                                                                                                                                                                                                                                                                    |
| 1                               | Power Supply LEDs                       | INTLK OK lights when the laser head cover is in place or the cover interlocks are defeated.<br>LASER ON lights when the key switch is in the ON position. The LED blinks for the first few seconds while the pump laser power is ramping.<br>SYSTEM FAULT lights when there is a fault condition. The laser will not operate with an active fault. |
| 2                               | Front Panel Display                     | Displays the pump laser output power.                                                                                                                                                                                                                                                                                                              |
| 3                               | Power Supply Control Knob               | Turn the knob to set the pump laser output power. Pushing the knob in and then turning provides coarse adjustment.                                                                                                                                                                                                                                 |
| 4                               | Key switch                              | The key switch must be in the ON position for the laser to operate.                                                                                                                                                                                                                                                                                |
| <b>Power Supply Back Panel</b>  |                                         |                                                                                                                                                                                                                                                                                                                                                    |
| 5                               | USB Connector                           | USB connection to enable communication with the pump laser control software.                                                                                                                                                                                                                                                                       |
| 6                               | Pump Laser Head Power Connector         | Power connection between the laser head and power supply.                                                                                                                                                                                                                                                                                          |
| 7                               | Fuses                                   | Power supply fuses. The fuses must be manually changed for 110 V or 220 V operation. See "Fuse Replacement" (p. 144)                                                                                                                                                                                                                               |
| 8                               | Pump Laser Head Control D-sub Connector | Enables communication between the laser head and power supply.                                                                                                                                                                                                                                                                                     |
| 9                               | Facility Power Plug                     | Connects the power supply to facility power.                                                                                                                                                                                                                                                                                                       |
| 10                              | Interlock D-sub Connector               | Provides an external interlock which must be closed for the laser to operate. See "External Interlock" (p. 38) for more information.                                                                                                                                                                                                               |
| 11                              | Main Power Switch                       | Applies or removes power to the power supply.                                                                                                                                                                                                                                                                                                      |









