

# ***InSight DeepSee Laser System***

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## ***User's Manual***

**Widely Tunable, Ultra-Fast, Solid-State Laser System**

This laser product with performance standards of United States Code of Federal Regulations, Title 21, Chapter 1 – Food and Drug Administration, Department of Health and Human Services, Subchapter J – Parts 1040.10 or 1040.11, as applicable.



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# Preface

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## About this Guide

This manual contains information needed in order to safely operate your *InSight™ DeepSee™* laser system.

This product has been tested and found to conform to the provisions of Directive 2006/95/EC governing product safety and to the provisions of Directive 2004/108/EM governing electromagnetic compatibility. Refer to the “CE Declaration of Conformity” in Chapter 2, “Laser Safety and Compliance,” for a complete list of directives to which this system has been tested and found in compliance.

This product conforms to the requirements of 21 CFR 1040.10 CDRH. This equipment has been designed and tested to comply with the limits for a Class A digital device pursuant to 47 CFR Part 15 of the FCC Rules.

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If you encounter any difficulty with the content or style of this manual, please let us know. The last page is a form to aid in bringing any such problems to our attention.

Thank you for purchasing Spectra-Physics instruments.

## Overview of this Guide

The *InSight DeepSee User’s Manual* includes the following sections:

- Chapter 1, “Introduction,” contains a brief description of the *InSight DeepSee* laser system, its power supply and chiller and the control devices. It concludes with specifications and outline drawings.
- Chapter 2, “Laser Safety and Compliance,” is an important chapter on laser safety. The *InSight DeepSee* is a Class IV laser and, as such, emits laser radiation that can permanently damage eyes and skin. This section contains information about these hazards and offers suggestions on how to safeguard against them, as well as maintenance that must be performed in order to keep the system in compliance with CDRH regulations. To ensure that your system remains in compliance with CDRH regulations and to minimize the risk of injury or expensive repairs, be sure to read this chapter and follow the instructions.
- Chapter 3, “Controls, Indicators, and Connections,” describes all the *InSight DeepSee* controls available to the user.

- Chapter 4, “Receiving and Inspecting,” section contains information on how to inspect your system upon receiving it to make sure that it sustained no damage during shipment. It also describes what to do if there is damage. *Do NOT unpack your InSight DeepSee system!* A Spectra-Physics service engineer unpacks and installs your system as part of you purchase agreement.
- Chapter 5, “Installation,” lists the site requirements for installation. Do NOT try to install the *InSight DeepSee* system yourself. Doing so voids your warranty and agreement with Spectra-Physics. A Spectra-Physics service engineer is the only person who should install or move this system.
- Chapter 6, “Operation” contains procedures for operating the laser and includes descriptions of the Windows-based GUI interface provided with the system.
- Chapter 7, “Maintenance and Diagnostics” provides maintenance instructions and covers some diagnostics that can be used to troubleshoot possible system problems.
- Chapter 8, “Customer Service,” includes warranty information and provides directions for contacting Spectra-Physics in the event a problem should occur. Should you experience any problems with any equipment purchased from Spectra-Physics, or if you are in need of technical information or support, please refer to the list of world-wide Spectra-Physics service centers at the end of this chapter. *Do NOT otherwise try to repair this system!*
- Appendix A, “Programming Guide,” explains the command/query structure required for writing your own control program and lists all the commands and queries that can be used to control the *InSight DeepSee* system.
- Appendix B, “Status Codes” lists all the status codes.
- Appendix C, “Mode Locking and GVD Compensation,” describes mode locking, ultra-short pulse propagation and dispersion (GVD) compensation.
- Appendix D, “MSDS Data Sheets,” contains the Material Safety Data Sheets.
- “Report Form for Problems and Solutions” is our feedback form, which you can use to report problems with our instruments or documentation, submit comments, suggest new features, or request more information.
- “Log/Notes” provides space to keep track of the service history for your *InSight DeepSee* laser.

# Environmental Specifications

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## CE Electrical Equipment Requirements

For information regarding the equipment needed to provide the electrical service listed under “Mechanical/Electrical Requirements” at the end of Chapter 1, refer to specification IEC 60309, “Plug, Outlet and Socket Couplers for Industrial Uses,” listed in the official *Journal of the European Communities*.

## Environmental Specifications

The environmental conditions under which the laser system functions are listed below. These specifications reflect *indoor use* conditions.

Feature	Specification
Altitude	Up to 2000 m
Storage temperature	15°C to 30°C
Operating temperature	20°C to 25°C
Relative humidity (shipment)	0 to 90%
Maximum relative humidity	50% at 30°C, increasing to 90% at 15°C
Mains supply voltage	Do not exceed $\pm 10\%$ of the nominal voltage
Insulation category	II
Pollution degree	2

## FCC Regulations

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, can cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user is required to correct the interference at his own expense.

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**Warning!**



*Modifications to the laser system not expressly approved by Spectra-Physics could void your right to operate the equipment.*

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## **CDRH Regulations**

This product conforms to the requirements of 21 CFR 1040.10 CDRH.



# Warning Conventions

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## Warning Symbols

The following symbols are used throughout this manual to draw your attention to situations or procedures that require extra attention. They warn of hazards to your health, damage to equipment, sensitive procedures, and exceptional circumstances. All messages are set apart by a thin line above and below the text as shown here.



---

  **Danger!**  
Laser Radiation *Laser radiation is present.*


---

**Danger!**  *Condition or action may present a hazard to personal safety.*


---

 **Danger!**  *Condition or action may present an electrical hazard to personal safety.*



---

**Warning!**  *Condition or action may cause damage to equipment.*


---

**Warning!**  
ESD  *Action may cause electrostatic discharge and cause damage to equipment.*

---

 **Caution!**  *Condition or action may cause poor performance or error.*

---

**Note**  *Text describes exceptional circumstances or makes a special reference.*

---

---

**Don't  
Touch!**



*Do not touch.*

---

**Eyewear  
Required**



*Appropriate laser safety eyewear should be worn during this operation.*

---



*Refer to the manual before operating or using this device.*

---



**Factory Trained**

*Serviceable only by Spectra-Physics factory trained personnel.*

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# Standard Abbreviations

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The following units, prefixes, and abbreviations are used in this Spectra-Physics manual.

## Unit Abbreviations

Quantity	Unit	Abbreviation
mass	kilogram	kg
length	meter	m
time	second	s
frequency	hertz	Hz
force	newton	N
energy	joule	J
power	watt	W
electric current	ampere	A
electric charge	coulomb	C
electric potential	volt	V
resistance	ohm	$\Omega$
inductance	henry	H
magnetic flux	weber	Wb
magnetic flux density	tesla	T
luminous intensity	candela	cd
temperature	Celsius	C
pressure	pascal	Pa
capacitance	farad	F
angle	radian	rad

# Prefixes

Prefix	Power	Abbreviation
tera	(10 <sup>12</sup> )	T
giga	(10 <sup>9</sup> )	G
mega	(10 <sup>6</sup> )	M
kilo	(10 <sup>3</sup> )	k
deci	(10 <sup>-1</sup> )	d
centi	(10 <sup>-2</sup> )	c

Prefix	Power	Abbreviation
milli	(10 <sup>-3</sup> )	m
micro	(10 <sup>-6</sup> )	μ
nano	(10 <sup>-9</sup> )	n
pico	(10 <sup>-12</sup> )	p
femto	(10 <sup>-15</sup> )	f
atto	(10 <sup>-18</sup> )	a

# Abbreviations and Acronyms

Abbreviation	Description
AC	alternating current
AR	antireflection
CDRH	Center for Devices and Radiological Health
DC	direct current
FWHM	full width half max (pulse measurement)
fs	femtosecond or 10 <sup>-15</sup> second
GVD	group velocity dispersion
IR	infrared
ps	picosecond or 10 <sup>-12</sup> second
RF	radio frequency
SCFH	standard cubic feet per hour
TEM	transverse electromagnetic mode
VAC	volts, alternating current
VDC	volts, direct current
λ	wavelength
WEEE	waste electrical and electronic equipment

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# CHAPTER 1: Introduction

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## InSight DeepSee Laser System

*InSight™ DeepSee™* laser system represents a revolution in ultra-fast, solid-state lasers that can generate ultra-short pulses over a gap-free range from 680 to 1300 nm.

The *InSight DeepSee* laser system is a pulsed, solid-state laser combined with dispersion compensation. The latter corrects for the dispersion caused by the user's optical system, thus allowing the system to deliver the shortest pulse possible to the sample without the need for complex external compensation. Control is automatic to ensure reliable operation over the entire tuning range. This allows the user to focus on experiments, rather than on laser adjustments.

An *InSight DeepSee* laser system comprises four main elements:

- *InSight DeepSee* mode-locked laser head
- Rack-mountable *IPS-300* power supply
- Rack-mountable *ThermoRack 401* chiller
- Rack for the power supply and chiller
- Optional Windows-based notebook computer with control software preinstalled

Figure 1-1 shows a typical standard *InSight DeepSee* laser system. In the figure, the *IPS-300* power supply and *ThermoRack* chiller are shown in the rack on the left. The *InSight DeepSee* laser head is on the right.



**Figure 1-1** *InSight DeepSee* mode-locked laser system

The *InSight DeepSee* laser is capable of hands-free, dropout-free wavelength tuning, enabling speedy collection of excitation profiles, all with a click of a mouse.

## IPS-300 Power Supply

The *IPS-300* power supply provides high DC current to the laser head to drive the laser diodes and control electronics. It also provides clean, dry air to the laser head to keep the laser cavity free of contaminants.

## ThermoRack 401 Chiller

A thermo-electric cooler (TEC) *ThermoRack 401* chiller is provided with the *InSight DeepSee* laser system to supply chilled coolant to the laser head for cooling the laser diodes.

## Control Software

Special graphical user interface (GUI) control software is provided by Spectra-Physics for controlling the *InSight DeepSee* system. This software comes preinstalled on a notebook computer optionally provided with the system. It is also provided on a CD-ROM or USB flash drive (located in the accessory kit supplied with the laser) for installation on your own Windows-based computer.



*In order to comply with CDRH safety requirements, during laser operation, run only the GUI software on a dedicated computer system. Do NOT run other software simultaneously on the computer that is operating the laser system.*

The *InSight DeepSee* laser system can also be automatically controlled using your own software program. A command line interface allows control of the laser system through the RS-232 or USB serial connection on the laser head. The command language is described in Appendix A, “Programming Guide.”

## Specifications

Table 1-1 lists the optical performance specifications for the *InSight DeepSee* laser system, Table 1-2 lists mechanical specifications, and Table 1-3 lists environmental specifications.

**Table 1-1** *InSight DeepSee* optical specifications<sup>a</sup>

Feature	Specifications
Tuning Range	680 nm to 1300 nm
Average Power <sup>b</sup>	600 mW @ 700 nm 1.0 W @ 900 nm 800 mW @ 1000 nm 600 mW @ 1200 nm 500 mW @ 1300 nm
Dual Option <sup>c</sup>	500 mW @ 1040 nm
Pulse Width <sup>d, e</sup>	< 120 fs
Repetition Rate	80 MHz ± 1 MHz
Noise <sup>f</sup>	<0.5%

**Table 1-1** *InSight DeepSee optical specifications<sup>a</sup> (Continued)*

Feature	Specifications
Stability <sup>g</sup>	< ±1%
Spatial Mode <sup>d</sup>	TEM <sub>00</sub> , M <sup>2</sup> < 1.2
Polarization	> 500:1 horizontal
Beam Divergence, full angle <sup>d</sup>	< 1.5 mrad
Beam Diameter at (1/e <sup>2</sup> ) <sup>d</sup>	< 1.1 ±0.2 mm
Beam Roundness <sup>d</sup>	0.8–1.2
Beam Pointing Stability	< 350 μrad full range
Tuning Speed	> 50 nm/sec full range
Dispersion Range	
680 nm	–12,000 fs <sup>2</sup> to –40,000 fs <sup>2</sup>
800 nm	0 fs <sup>2</sup> to –25,000 fs <sup>2</sup>
1050 nm	0 fs <sup>2</sup> to –10,000 fs <sup>2</sup>
1300 nm	–3000 fs <sup>2</sup> to –8,000 fs <sup>2</sup>

a. Due to our continuous product improvement program, specifications may change without notice.

b. Specifications only apply to the wavelength noted.

c. When configured with the Dual Option, average power specifications are reduced by 10%. Contact the factory for additional specifications with this option.

d. Specification applies to 900 nm only.

e. A sech<sup>2</sup> pulse shape is used to determine the pulse width as measured with a Newport PulseScout<sup>®</sup> autocorrelator.

f. Specification represents rms measured in a 10 Hz to 10 MHz bandwidth.

g. Percent power drift in any 2-hour period with < ±1°C temperature change after a 1-hour warm-up.

**Table 1-2** *Mechanical/electrical specifications*

Feature	Specifications	
	English Units	Metric Units
Size (L x W x H)		
<i>InSight DeepSee</i> Laser Head	19.76W x 35.83D x 7.25H in.	50.2W x 91.04D x 18.42H cm
<i>IPS-300</i> Power Supply	19.0W x 17.9D x 6.9H in.	49.26W x 45.52D x 17.57H cm
<i>ThermoRack 401</i> Chiller	19.0W x 20.0D x 6.9H in.	49.26W x 50.8D x 17.57H cm
Umbilical Length	10 ft	3 m
Weight		
<i>InSight DeepSee</i> Laser Head	140 lb	64 kg
<i>IPS-300</i> Power Supply	49.5 lb	22,5 kg
<i>ThermoRack 401</i> Chiller	55 lb	25 kg

**Table 1-2** Mechanical/electrical specifications (Continued)

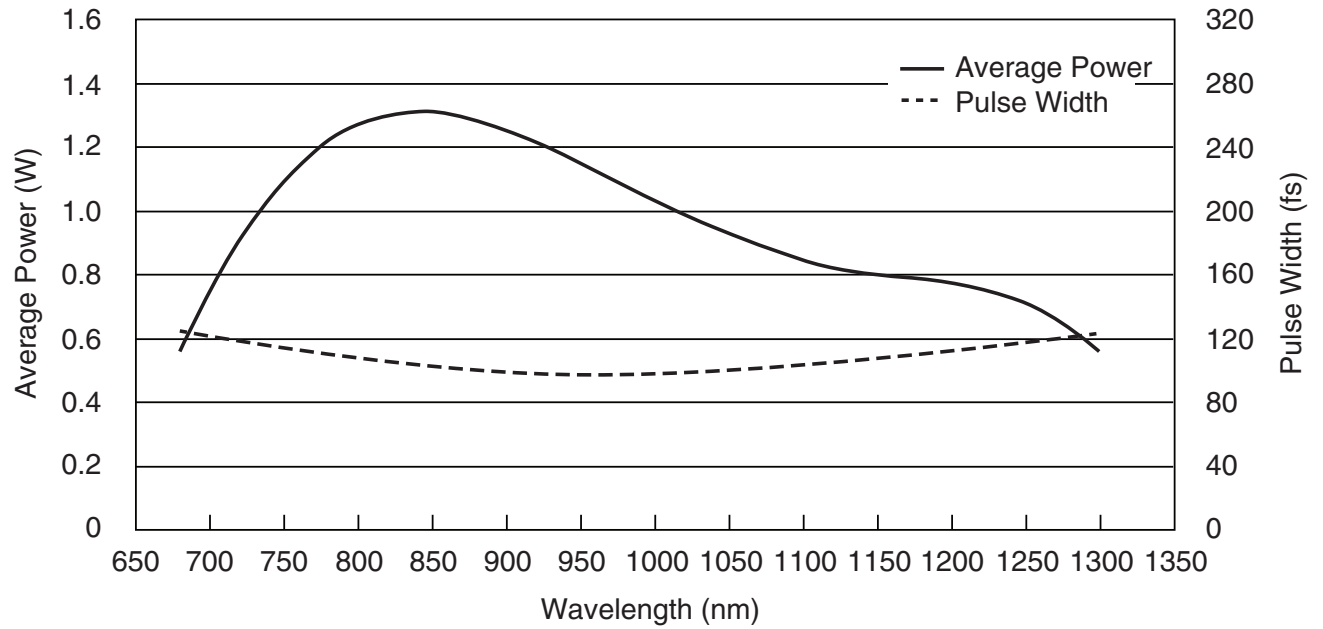
Feature	Specifications	
Power Requirements		
IPS-300 Power Supply ThermoRack 401 Chiller	110 Vac $\pm$ 10%, <10 A, 50/60 Hz 120–240 Vac, 15 A/9 A, 50/60 Hz	220 Vac $\pm$ 10%, <6 A, 50/60 Hz

The environmental conditions under which the laser system functions are listed below. These specifications reflect *indoor use* conditions.

**Table 1-3** Environmental specifications

Feature	Specification
Altitude	Up to 2000 m
Storage temperature	15°C to 30°C
Operating temperature	20°C to 25°C
Relative humidity (shipment)	0 to 90%
Maximum relative humidity	50% at 30°C, increasing to 90% at 15°C
Mains supply voltage	Do not exceed $\pm$ 10% of the nominal voltage; see Table 1-2
Insulation category	II
Pollution degree	2
@20°C	775 watts typical, 1050 watts maximum
@25°C	1100 watts typical, 1350 watts maximum

## Typical Tuning Curves

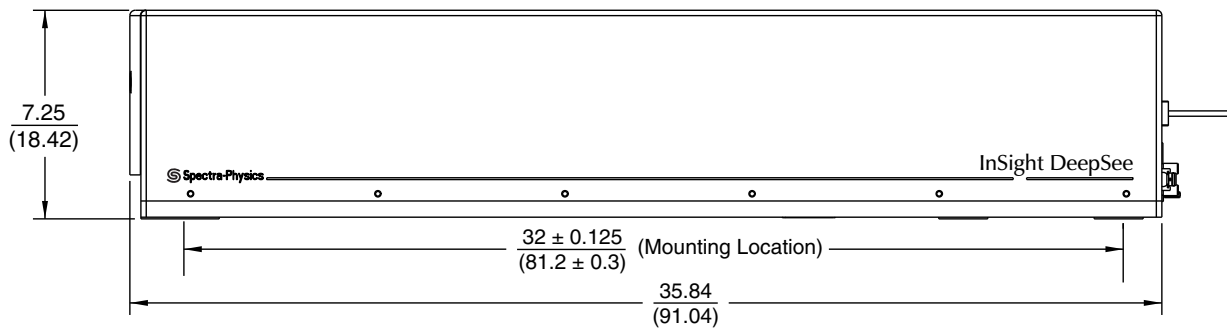


**Figure 1-2** Typical InSight DeepSee tuning curves

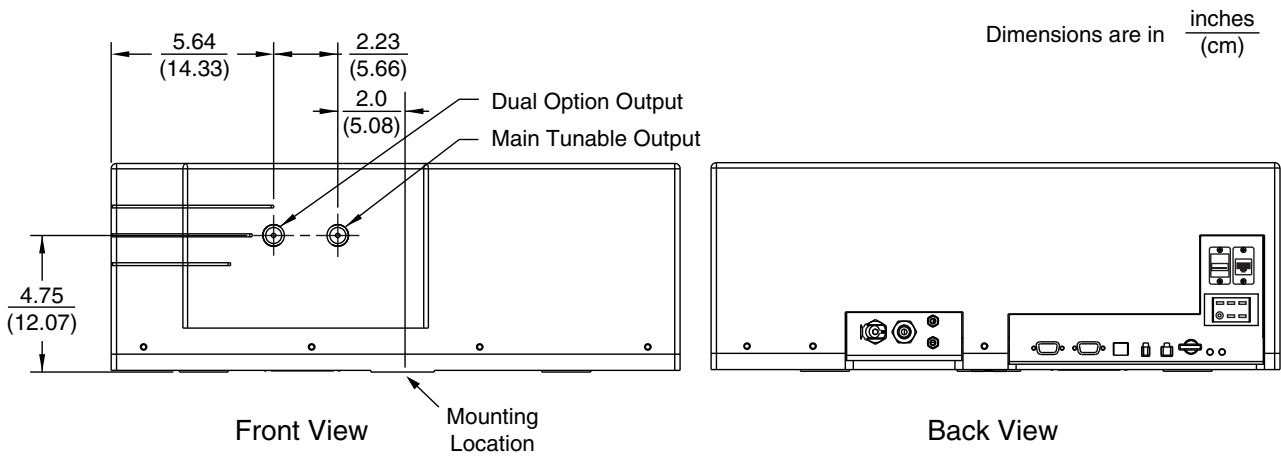
# Outline Drawings



Top View



Side View



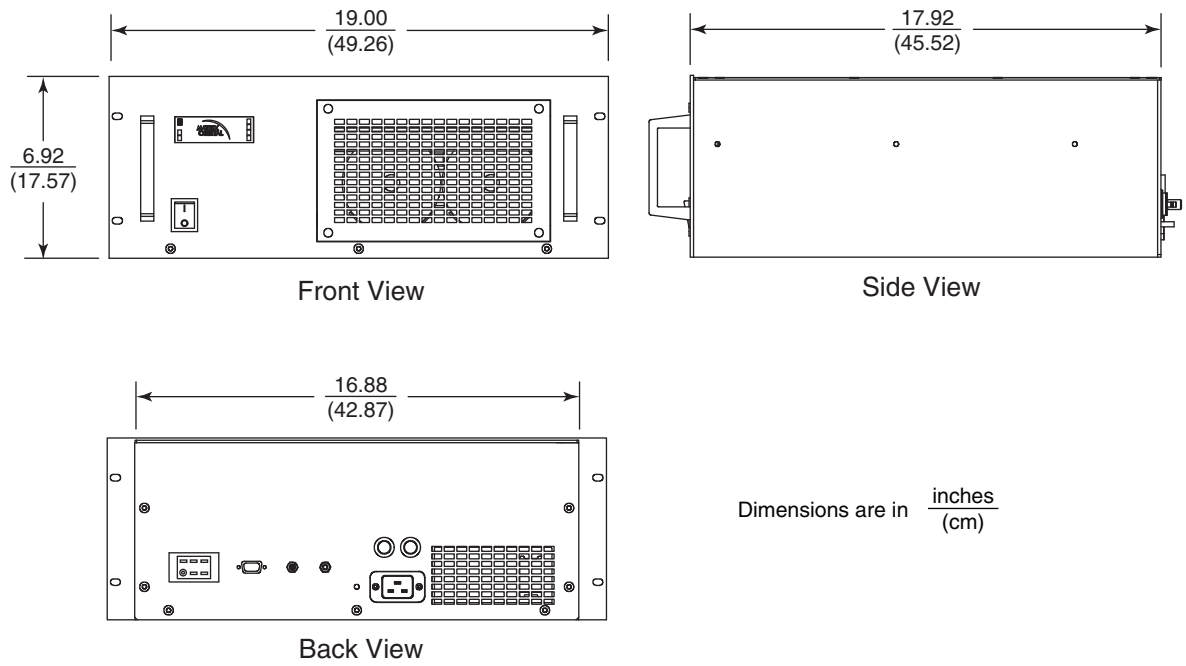
Front View

Mounting Location

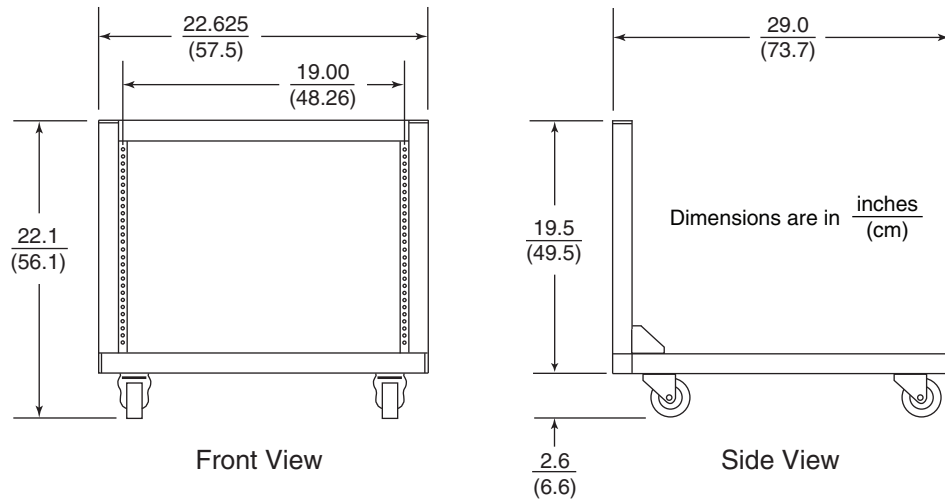
Back View

**Figure 1-3** Outline drawing, InSight DeepSee laser head





**Figure 1-4** Outline drawing, IPS-300 power supply



**Figure 1-5** Outline drawing, power supply and chiller rack

**Note**



Refer to the chiller manual for chiller drawings.



# CHAPTER 2: Laser Safety and Compliance

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The *InSight DeepSee* laser is a Class IV high-power laser and, as such, emits laser radiation that can permanently damage eyes and skin. This section contains information about these hazards and offers suggestions on safeguarding against them. Spectra-Physics recommends reading this chapter carefully, and following all safety precautions to prevent harm to yourself or the equipment. Follow all warnings marked on the equipment as well.

## Important Safety Notes

Before unpacking, setting up, or operating the *InSight DeepSee* laser or any of its components, review the safety information in this chapter carefully. Refer to Chapter 4, “Receiving and Inspecting,” for instructions on unpacking your system, and refer to and Chapter 5, “Installation,” for installation information.



A factory-trained Service Engineer is required to complete the installation.



The *InSight DeepSee* laser system is a Class IV—High-Power Laser, whose beam is, by definition, a safety and fire hazard. Take precautions to prevent exposure to direct and reflected beams. Diffuse as well as specular reflections can cause severe skin or eye damage.



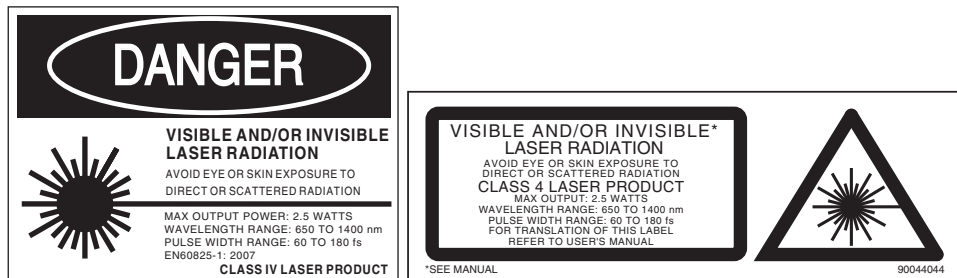
Because the *InSight DeepSee* laser emits pulsed infrared radiation, it is extremely dangerous to the eye. Infrared radiation passes easily through the cornea, which focuses it on the retina where it can cause instantaneous permanent damage.

## Safety Precautions for Class IV High Power Lasers

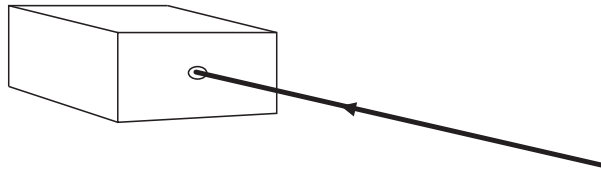


- Wear protective eyewear at all times. Eyewear selection depends on the wavelength and intensity of the radiation, the conditions of use, and the visual function required. Protective eyewear is available from suppliers listed in the *Laser Focus World*, *Lasers and Optonics*, and *Photonics Spectra* buyer’s guides. Consult the ANSI and ACGIH standards listed in “Sources for Additional Information” for guidance.
- Maintain a high ambient light level in the laser operation area. This keeps the eye’s pupil constricted, thus reducing the possibility of eye damage.
- Avoid looking at the output beam; even diffuse reflections are hazardous.
- Avoid wearing jewelry or other objects that may reflect or scatter the beam while using the laser.

- Use an infrared detector or energy detector (IR viewer) to verify that the laser beam is off before working in front of the laser.
- Operate the laser at the lowest beam intensity possible, given the requirements of the application.
- Expand the beam whenever possible to reduce beam power density.
- Avoid blocking the output beam or its reflection with any part of your body.
- Establish a controlled access area for laser operation. Limit access to those trained in the principles of laser safety.
- Post prominent warning signs near the laser operating area (Figure 2-1).
- Set up the laser so that the beam is either above or below eye level.
- Provide enclosures for beam paths whenever possible.
- Set up shields to prevent specular reflections.
- Set up an energy absorbing target to capture the laser beam, preventing unnecessary reflections or scattering (Figure 2-2).





**Figure 2-1** Safety warning labels (EN 60825-1: 2007, ANSI Z136.1 Section 4.7)



**Figure 2-2** Beam block

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**Caution!**

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

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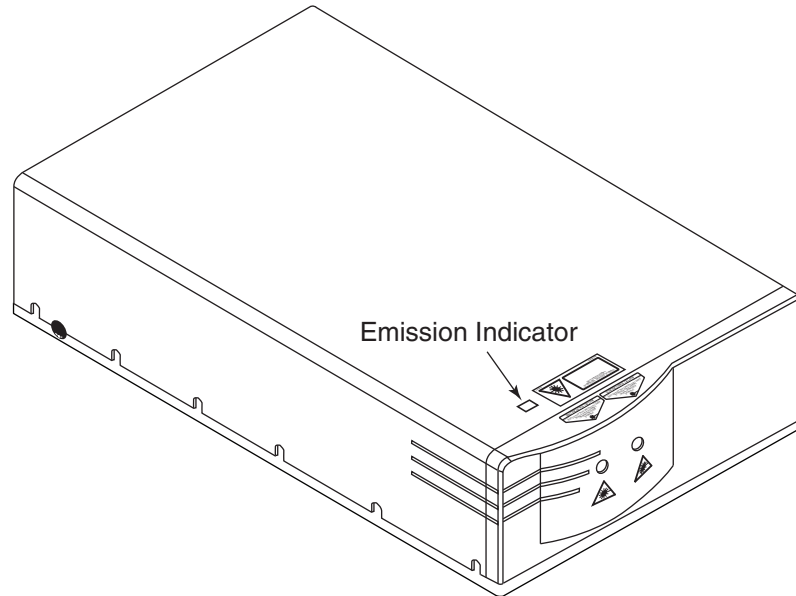
Follow the instructions contained in this manual for safe operation of your laser. At all times during operation, maintenance, or service of your laser, avoid unnecessary exposure to laser or collateral radiation<sup>1</sup> that exceeds the accessible emission limits listed in “Performance Standards for Laser Products,” *United States Code of Federal Regulations*, 21CFR1040 10(d).

1. Any electronic product radiation, except laser radiation, emitted by a laser product as a result of, or necessary for, the operation of a laser incorporated into that product.

# Safety Devices

## Emission Indicator

Figure 2-3 shows the location of the *InSight DeepSee* laser head emission indicator.

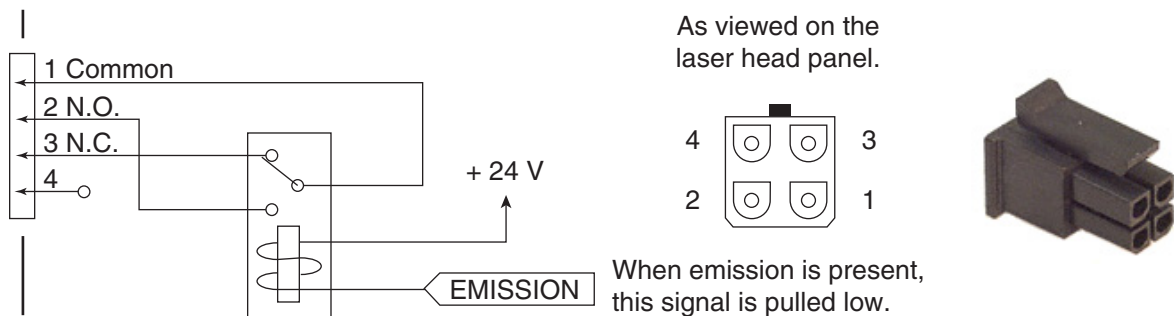


**Figure 2-3** Laser head emission indicator

## Emission Connector

The EMISSION connector on the back of the *InSight DeepSee* laser head (see Figure 2-4 and Figure 2-5) can be used to turn on and off a user-installed emission indicator. When the laser is off (i.e., when there is no emission), there is closure between pins 1 and 3 and an open between pins 1 and 2. The opposite is true when the laser is on, i.e., when there is emission or when emission is imminent. Pin 4 is not used. No power is supplied by these terminals. The circuit is rated for 120 VAC at 1 A.

The emission indicators turn on 3 seconds before actual emission occurs.



**Figure 2-4** EMISSION connector schematic

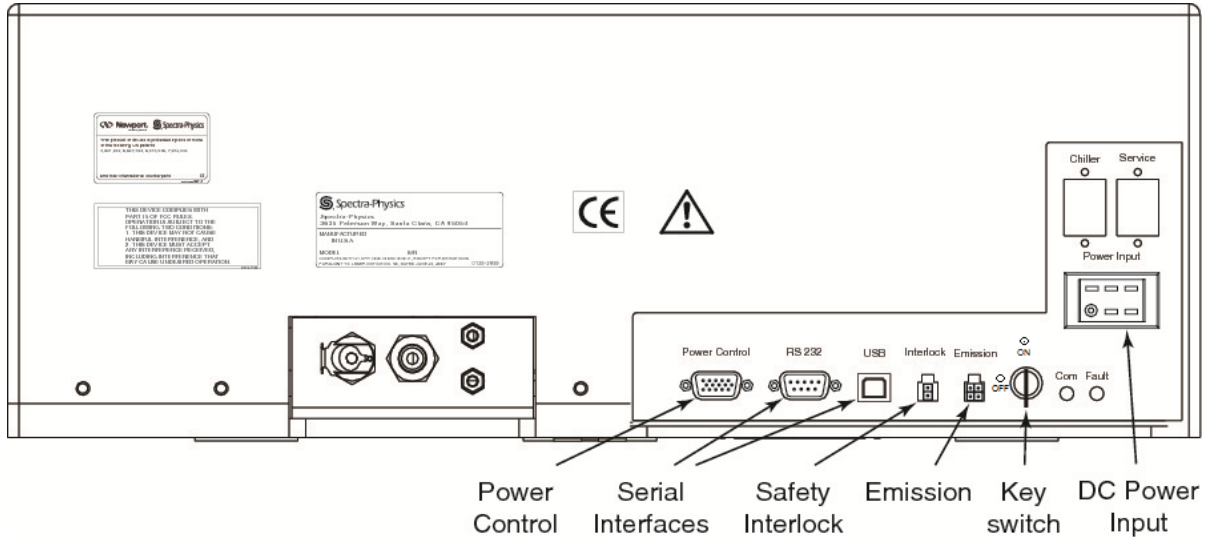


Figure 2-5 InSight DeepSee safety devices

## Shutter

The built-in laser shutter is electromechanical and is software controlled via the RS-232 or USB interface. If the safety interlock is opened or a fault occurs, the shutter closes immediately.

## Cover Safety Interlocks

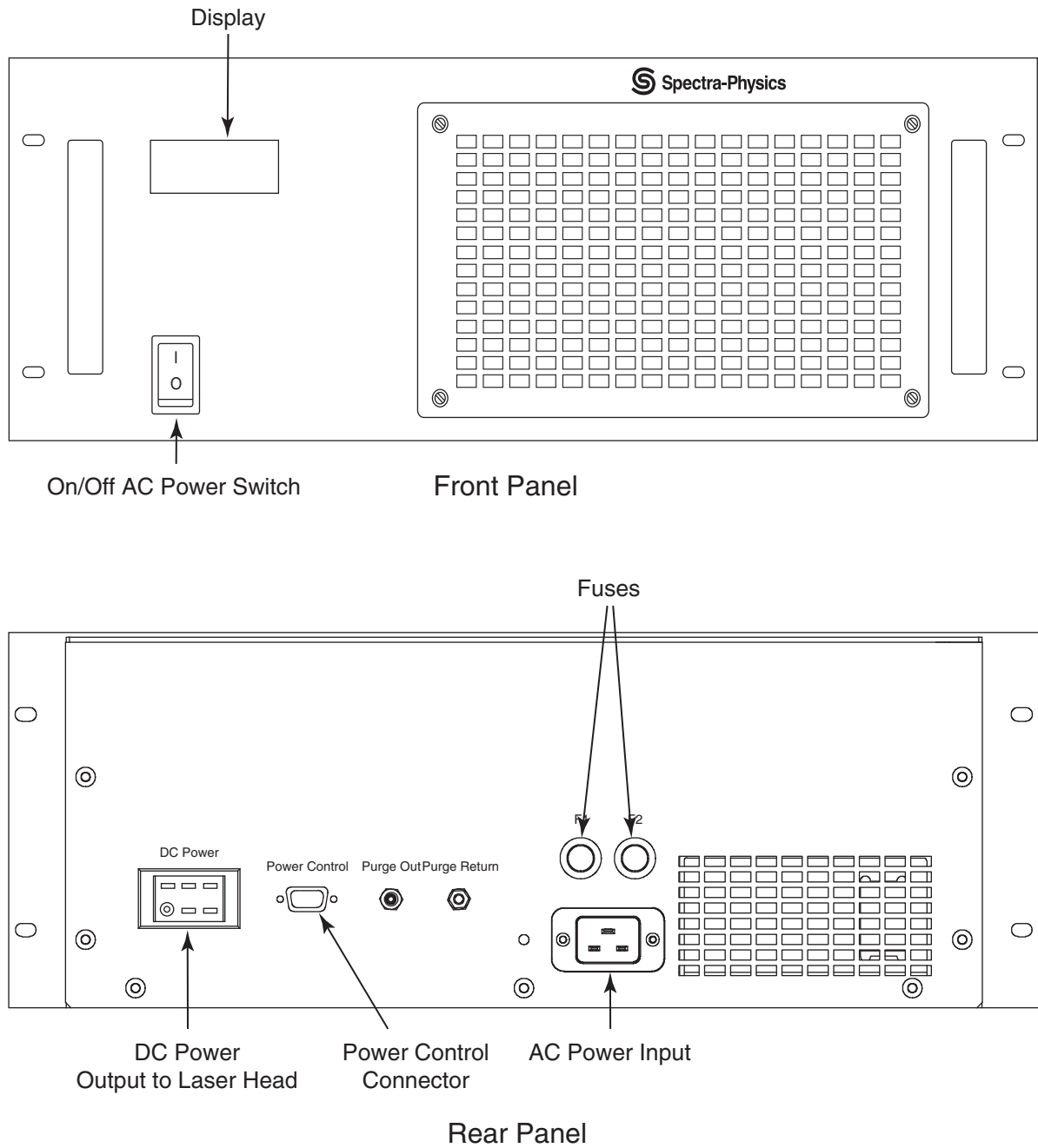
The laser head does not contain user-serviceable parts and is not to be opened by the user. Therefore, the laser head does not require cover interlocks. As a warning, a non-interlocked label is attached to the laser head as shown in Figure 2-8. Only someone trained by Spectra-Physics should be allowed to service the system.



*Operating the laser with the cover off may expose people to high voltages and high levels of radiation. It also increases the rate of optical surface contamination. There are no user-serviceable parts inside the InSight DeepSee laser head. Operating the laser or the power supply with the aluminum cover off is prohibited and doing so **voids your warranty**.*

## Interlock Keyswitch

The keyswitch on the rear panel of the laser head (Figure 2-5) provides interlock safety to prevent unauthorized personnel from using the InSight DeepSee laser system when the key is turned to the “off” (horizontal) position and the key is removed. Turning the key to the “enable” (vertical) position allows the diode lasers to be energized if (a) the power supply AC power switch is also on and (b) an “on” command is given.



**Figure 2-6** *IPS-300 power supply safety devices*

## On/Off AC Power Switch

The power switch provides AC power to the control circuits. The switch glows amber when AC power is supplied to the system.

## Interlock Connector

The 2-pin INTERLOCK connector on the laser head rear panel (Figure 2-5) can be wired to an external interlock switch. Either rewire the provided jumper plug (i.e., remove the short, Figure 2-7) or provide a similar plug and wire the two contacts to a perimeter safety switch that is attached to an access door or to auxiliary safety equipment. Wire the switch as “normally closed” so that when the door or safety device opens, the switch opens, thereby turning off the power to the diode lasers. This prevents unaware personnel from getting hurt.



**Figure 2-7** Interlock jumper plug

### Note



*In order for the power supply to turn on, the two contacts of the INTERLOCK connector must either be wired to a normally closed safety switch or be shorted together using the jumper plug provided.*

## CDRH Requirements for Operating the Laser System

The *InSight DeepSee* laser head and the power supply comply with all CDRH safety standards. However, if either is embedded into another system where an emission indicator is not readily visible or the power supply interlock key is not accessible, the following functions must be provided by the user to satisfy CDRH regulations:

- **Emission indicator**—indicates laser energy is present or can be accessed. It can be a “power-on” lamp, a computer display that flashes a statement to this effect, or an indicator on the control equipment used for this purpose. It need not be marked as an emission indicator so long as its function is obvious. *Its presence is required on any control panel that affects laser output, including the computer display panel.*
- **Safety key**—prevents unauthorized use. The password feature of your personal computer, either in the CMOS Setup program or the Windows operating system, meets this requirement.

## Maintenance for CDRH Compliance

This laser product complies with Title 21 of the *United States Code of Federal Regulations*, Chapter 1, subchapter J, parts 1040.10 and 1040.11, as applicable. To maintain compliance with these regulations, once a year or whenever the laser system has been subjected to adverse environmental conditions (e.g., fire, flood, mechanical



shock, spilled solvent), check to see that all the features of the product identified on the CE/CDRH radiation control drawings (shown on the next few pages) function properly. Also, make sure that all the warning labels remain firmly attached.

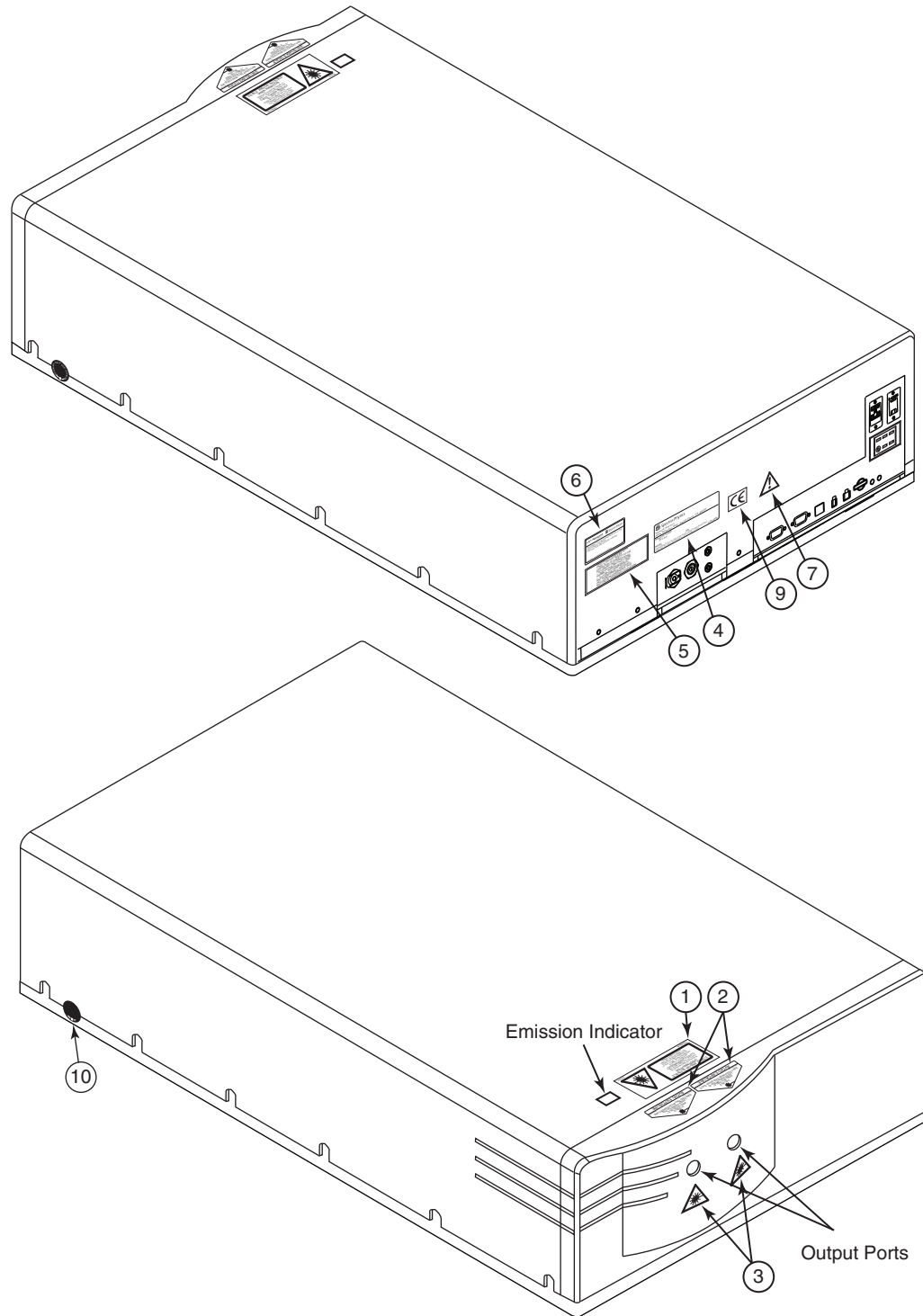
1. Verify that removing the INTERLOCK connector on the laser head prevents laser operation. Figure 2-5 on page 2-4 shows the interlock with the jumpered plug in place.
2. Verify that the laser can only be turned on when the keyswitch is in the “enable” (vertical) position and that the key can only be removed when the switch is in the “off” (horizontal) position.
3. Verify that the emission indicator provides a visible signal when the laser emits accessible laser radiation that exceeds the accessible emission limits for Class I.<sup>2</sup>
4. Verify that the time delay between the time the emission indicator turns on and the laser begins emission gives personnel enough warning to allow them to avoid exposure to laser radiation.
5. Verify that the beam attenuators (shutters) operate properly when the “close” command is issued and that they close when the control device is disconnected or the keyswitch is turned to the “off” position. Verify that the shutters actually block access to laser radiation.

---

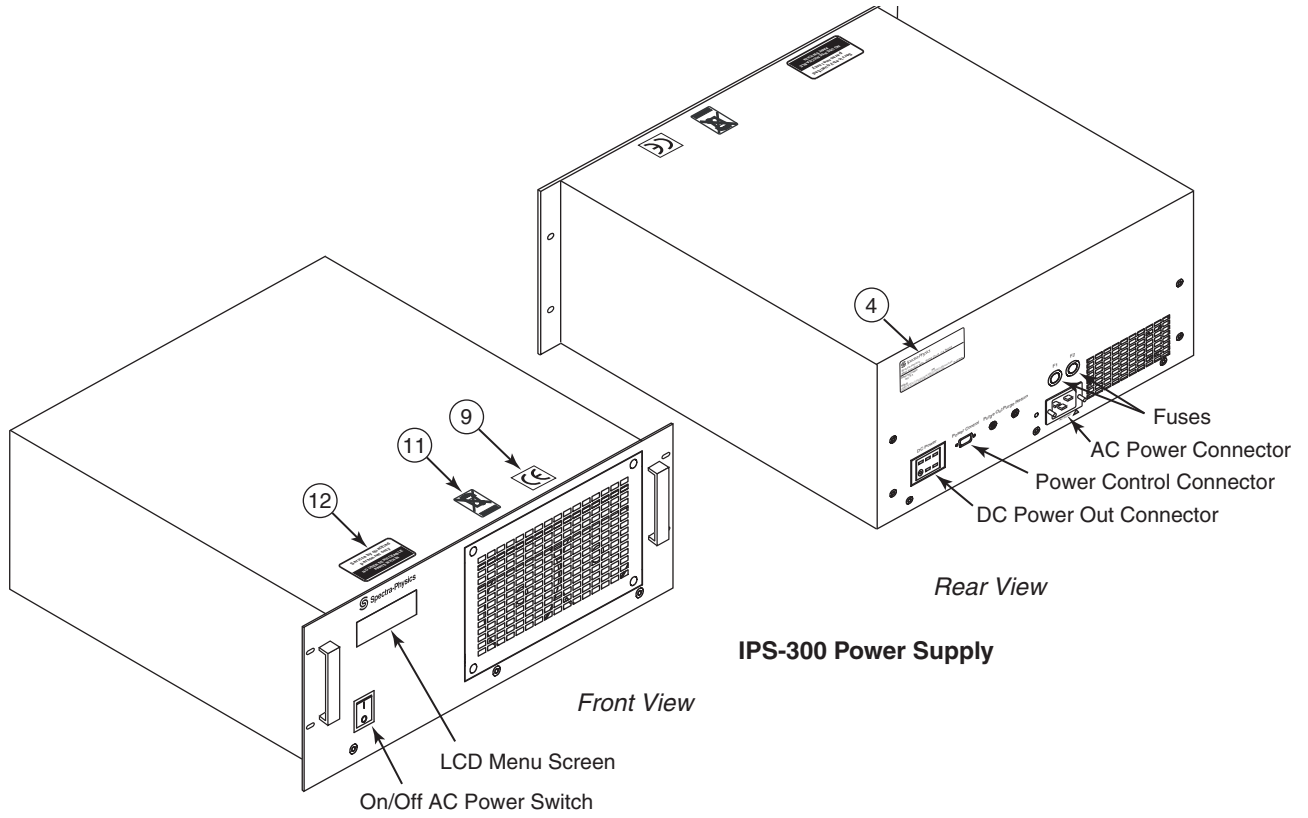
2. 0.39  $\mu$ W for continuous-wave operation where output is limited to the 400 to 1400 nm range.

# CE/CDRH Radiation Control Drawings

**NOTE:** The label numbers marked in the following figures are shown in Figure 2-10.

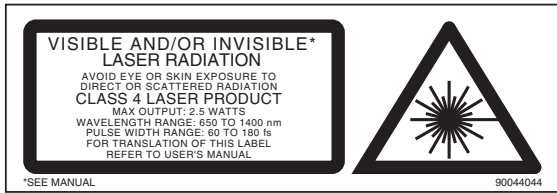


**Figure 2-8** CE/CDRH radiation control drawing



**Figure 2-9** CE/CDRH radiation control drawing, IPS-300 power supply

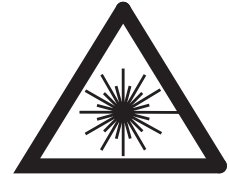
# CE/CDRH Warning Labels



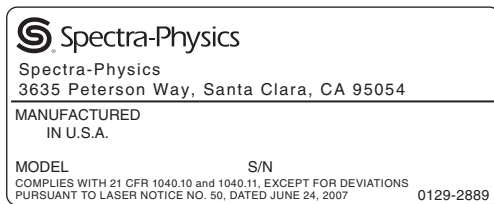
CE Danger Label  
Laser Radiation, Laser Head (1)



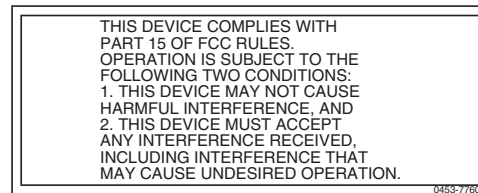
CDRH Aperture Label  
Laser Head (2)



CE Aperture Label  
Laser Head (3)



Model/Serial Identification Label  
Power Supply (4)



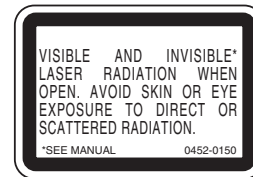
FCC Label (5)



Patent Label  
Laser Head (6)



CE Caution Label  
Power Supply (7)



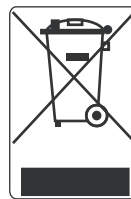
Caution—Noninterlocked  
Housing Label, Laser Head (8)



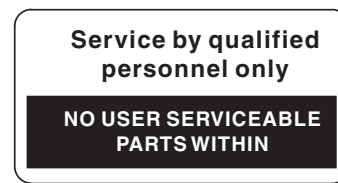
CE Certification  
Label (9)



Void Label  
(10)



WEEE Label (11)



Service Label (12)

**Figure 2-10** CE/CDRH warning labels

## Label Translations

For safety, the following translations are provided for non-English speaking personnel. The number in parenthesis in the first column corresponds to the label number listed on the previous page.

**Table 2-1** Label translations

Label	French	German	Spanish	Dutch
CE Warning Label (1)	Rayonnement laser visible et/ou invisible. Exposition dangereuse de l'oeil ou de la peau au rayonnement direct ou diffus. Appareil a laser de Classe IV. Puissance maximum: 2.5 W. Longueur d'onde 650 – 1400 nm. Durée d'impulsion: 60– 180 fs. EN60825-1:2007.	Austritt von sichtbarer und/oder unsichtbarer Laserstrahlung. Augen- und Hautkontakt mit direkter Strahlung oder Streustrahlung vermeiden. Laser Klasse IV. Maximale Ausgangsleistung 2.5 W. Wellenlänge 650 – 1400 nm Pulsbreite 60– 180 fs. EN60825-1:2007.	Radiación láser visible y/o invisible. Evitar la exposición de los ojos o la piel a la radiación, ya sea directa ó difusa. Producto láser Clase IV. Potencia máxima 2.5 W. Longitud de onda: 650 – 1400 nm. Longitud de pulso: 60– 180 fs. EN60825-1:2007.	Zichtbare en/of onzichtbare laser-straling. Vermijd blootstelling van oog of huid aan directe of gereflecteerd e straling. Klasse 4 laser product. Max. output vermogen: 2.5 W. Golflengtebereik: 650 – 1400 nm. Pulsduur bereik: 60– 180 fs. EN60825-1:2007. Zie de gebruikershandleiding voor vertaling van dit label.
Aperture Label (2)	Un rayonnement visible et/ou invisible est émis par cette ouverture. Ouverture Laser.	Austritt von sichtbarer und unsichtbarer Laserstrahlung! Bestrahlung vermeiden!	Por esta abertura se emite radiación láser visible e invisible; evite la exposición.	Vanuit dit apertuur wordt zichtbare en onzichtbare laserstraling geëmitteerd! Vermijd blootstelling!
RF Caution Label (5)	Danger: Rayonnement electro-magnétique radio fréquence in cas d'ouverture.	Achtung! Sichtbare, unsichtbare und Hochfrequenz Strahlung bei geöffnetem Gerät!	Advertencia. Visible o invisible radiación electromagnética de radio frecuencia (RF) cuando esta abierta. Consulte el manual.	Waarschuwing. Zichtbare, onzichtbare en RF elektromagnetische straling wanneer geopend.
Patent Label (6)	Ce produits est fabriqué sous l'un ou plusieurs des brevets suivants.	Dieses Produkt wurde unter Verwendung einer oder mehrerer der folgenden US-Patente hergestellt.	Este producto esta fabricado con una o más de las siguientes patentes de los Estados Unidos.	Dit product is gefabriceerd met een of meer van de volgende USA patenten.
Danger, Non Interlocked Label (8)	Danger: Rayonnement laser visible et/ou invisible en cas d'ouverture. Exposition dangereuse de l'oeil et de la peau au rayonnement direct ou diffus.	Vorsicht; beim Öffnen Austritt von sichtbarer und unsichtbarer Laserstrahlung; Bestrahlung von Auge oder Haut durch direkte oder Streustrahlung vermeiden.	Peligro, Cuando se abre existe Radiación Láser Visible e Invisible; Evite que los ojos y la piel queden expuestos tanto a la radiación directa como a la dispersa.	Gevaar; zichtbare en niet zichtbare laser-straling wanneer geopend; vermijd blootstelling aan huid of oog aan directe straling of weerkaatsingen.

## WEEE Recycling Label

To our customers in the European Union:

As the volume of electronics goods placed into commerce continues to grow, the European Union is taking measures to regulate the disposal of waste from electrical and electronic equipment. Toward that end, the European Parliament has issued a directive instructing European Union member states to adopt legislation concerning the reduction, recovery, re-use and recycling of waste electrical and electronic equipment (WEEE).

In accordance with this directive, the accompanying product has been marked with the WEEE symbol (Label 11 on page 2-10).

The main purpose of the symbol is to designate that at the end of its useful life, the accompanying product should not be disposed of as normal municipal waste, but should instead be transported to a collection facility that will ensure the proper recovery and recycling of the product's components. The symbol also signifies that this product was placed on the market after August 13, 2005. At this time, regulations for the disposal of waste electrical and electronic equipment vary within the member states of the European Union. Please contact a Newport/Spectra-Physics representative for information concerning the proper disposal of this product.

# CE Declaration of Conformity

We,

Spectra-Physics, a Newport Corporation Brand  
3635 Peterson Way  
Santa Clara, CA 95054  
United States of America

declare under sole responsibility that the

## ***InSight DeepSee Family of Ultrafast Lasers***

Manufactured after January 3, 2012

meet the intent of EMC Directive 2004/108/EC for Electromagnetic Compatibility and 2006/95/EC for the Low Voltage Directive. Compliance was demonstrated to the following specifications as listed in the official *Journal of the European Communities*:

### **EMC Directive 2004/108/EC**

**EN 61000-3-2: 2006:** Limits for harmonic current emissions (equipment input up to and including 16A per phase).

**EN 61000-3-3: 2008:** Section 3: Limitation of voltage changes, voltage fluctuations and flicker.

**EN 61000-4-2: 2009:** Part 4: Section 2: Electrostatic discharge immunity test.

**EN 61000-4-3: 2011:** Part 4: Section 3: Testing and measurement techniques—radiated, radio-frequency, electromagnetic field.

**EN 61000-4-4: 2010:** Part 4-4: Testing and measurement techniques—electrical fast transient/burst immunity test.

**EN 61000-4-5: 2006:** Testing and measurement techniques—surge immunity test.

**EN 61000-4-6: 2009:** Part 4-6: Testing and measurement techniques—immunity to conducted disturbances induced by radio-frequency fields.

**EN 61000-4-8: 2010:** Testing and measurement techniques—power frequency magnetic field immunity test.

**EN 61000-4-11: 2004:** Testing and measurement techniques—voltage dips, short interruptions and voltage variations immunity.

**EN 61000-6-2: 2005:** Generic standards—Immunity standard for industrial environments.


**EN 61000-6-4: 2007:** Emission standard for industrial environments—generic standards.

### **Low Voltage Directive 2006/95/EC**

**EN 61010-1: (2010):** Safety requirements for electrical equipment for measurement, control and laboratory use—Part 1 General requirements.

**EN 60825-1: (2007):** Part 1: Safety of Laser Products—Equipment classification, Requirements and Users Guide

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directives and Standards.



David Allen  
Vice-President/General Manager  
Spectra-Physics, a Newport Corporation Brand  
January 3, 2012

## Sources for Additional Information

### Laser Safety Standards

Laser Safety Standards

*Safe Use of Lasers* (Z136.1)

American National Standards Institute (ANSI)

1899 L Street, NW, 11<sup>th</sup> Floor

Washington, DC 20036

Tel: (202) 293-8020

Occupational Safety and Health Administration (OSHA Standard, 01-05-001-pub8-1.7)

U. S. Department of Labor

200 Constitution Avenue N. W., Room N3647

Washington, DC 20210

Tel: (800) 321-6742

Web site: <http://www.osha.gov>

*A Guide for Control of Laser Hazards*, Pub. REP-GCLH-090

American Conference of Governmental and

Industrial Hygienists (ACGIH)

1330 Kemper Meadow Drive

Cincinnati, OH 45240

Tel: (513) 742-2020

Web site: <http://www.acgih.org/home.htm>

Laser Institute of America

13501 Ingenuity Drive, Suite 128

Orlando, FL 32826

Tel: (800) 345-2737

Web site: <http://www.lia.org>

International Electrotechnical Commission

*Journal of the European Communities*

IEC 60825-1 Safety of Laser Products—Part 1: Equipment classification, requirements and user's guide

IEC Central Office

3, Rue de Varembe

P.O. Box 131

Switzerland

Tel: +41 22 919 02 11 Fax: +41 22 919 03 00

Web site: <http://www.iec.ch>

Document Center, Inc.

121 Industrial Way, #8

Belmont, CA 94002-8208

Tel: (650) 591-7600

Web site: <http://www.document-center.com>



## Equipment and Training

*Laser Safety Guide*  
Laser Institute of America  
13501 Ingenuity Drive, Suite 128  
Orlando, FL 32826  
Tel: (800) 345-2737  
Web site: <http://www.lia.org>

*Laser Focus World Buyer's Guide*  
Laser Focus World  
Pennwell Publishing  
98 Spit Rock Road  
Nashua, NH 03062  
Tel: (603) 891-0123  
Web site: <http://buyersguide.lfw.optoiq.com/search/33809/newport-corp.html>

*Photonics Spectra Buyer's Guide*  
Photonics Spectra  
Laurin Publications  
Berkshire Common  
PO Box 4949  
Pittsfield, MA 01202-4949  
Tel: (413) 499-0514  
Web site: <http://www.photonics.com>



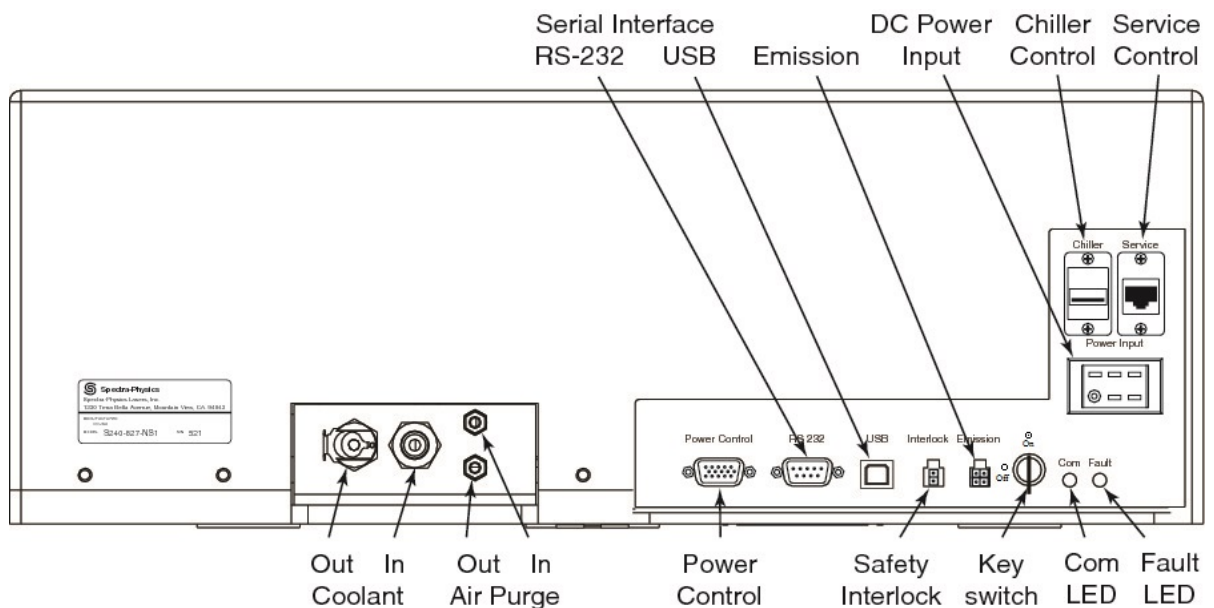
# CHAPTER 3: Controls, Indicators, and Connections

## Introduction

This chapter defines and explains the user controls, indicators and connections of the *InSight™ DeepSee™* laser system. It is divided into three sections: the *InSight DeepSee* laser head, the *IPS-300* power supply and the connector interface descriptions. (Chapter 6, “Operation,” explains how to use the included *InSight DeepSee* GUI control software.) Information on the chiller can be found in the chiller user’s manual that is shipped with that unit.

Each section below describes the various controls from top to bottom, left to right.

## Laser Head



**Figure 3-1** *InSight DeepSee* rear panel controls, indicators, and connectors

## Controls

**Laser enable interlock keyswitch**—provides interlock safety to prevent unauthorized personnel from using the *InSight DeepSee* laser system when the key is turned to the “off” (horizontal) position and the key is removed. Turning the key to the “enable” (vertical) position allows the diode lasers to be energized if the AC power switch on the power supply is also on and the ON command is given.

## Indicators

**Emission indicator light**—warns of present or imminent laser radiation. This white-light CDRH indicator is located on top of the laser near the output bezel. A 3-second built-in delay between the turn on of the lamp and actual emission allows for evasive action in the event the system was started by mistake and the shutter is open.

**COM indicator (amber LED)**—is on steady while the laser boots up (about 2 minutes). It then blinks slowly at  $\frac{1}{2}$  Hz if there is no command, or an invalid command. It glows steadily for about 5 seconds when a valid command is received.

**FAULT indicator (amber LED)**—is off when no fault exists and blinks slowly at  $\frac{1}{2}$  Hz if there is a warning (the system does not shut down). If a major fault occurs, the laser shuts off and this indicator blinks at a 2 Hz rate. Refer to the Main tab display for error codes, and to Chapter 7, “Maintenance and Diagnostics,” for information on resolving this issue.

## Connections

**CHILLER connector (USB, type A)**—is for use only by Spectra-Physics service personnel.

**SERVICE connector (Ethernet)**—is for use only by Spectra-Physics service personnel.

**DC POWER INPUT connector**—provides connection for the high-current DC power from the *IPS-300* power supply. Power is provided to the laser diodes as well as to the laser head control circuits.

**Coolant in connector**—provides connection for the output coolant hose from the chiller. This connection is polarized to prevent incorrect flow direction. To connect the hose, insert the hose into the connector and push it in until a click is heard; to release it, press the side clip and pull the hose out. To prevent leakage, this connector has an automatic shut off mechanism when the hose is removed.

**Coolant out connector**—provides connection for the return coolant hose to the chiller. This connection is polarized to prevent incorrect flow direction. To connect the hose, insert the hose into the connector and push it in until a click is heard; to release it, press the side clip and pull the hose out. To prevent leakage, this connector has an automatic shut off mechanism when the hose is removed.

**Air purge in connector**—provides connection for the hose from the AIR OUT port on the power supply that provides clean, dry air for the laser cavity. This connection is polarized to prevent incorrect flow direction. Simply push the hose connector onto the panel connector to secure it (you should hear a “click”). To remove the hose, push the hose connector outer jacket toward the laser and pull the hose free.

**Air purge out connector**—provides connection for the return hose to the AIR IN port on the power supply. This connection is polarized to prevent incorrect flow direction. Simply push the hose connector onto the panel connector to secure it (you should hear a “click”). To remove the hose, pull back the hose connector outer jacket and pull the hose free.

**POWER CONTROL connector**—provides connection for the power control cable that connects to the matching connector on the power supply. As the name implies, it delivers control signals from the laser head to the power supply to control the power to the laser head.

**RS-232 connector (9-pin, D-sub)**—is intended to operate the laser with user-developed software in lieu of the supplied GUI software. To use this port, connect the host computer to this interface using a standard M/F serial cable. Refer to “Command/Query/Response Format” on page A-1 for information on sending commands to the *InSight DeepSee* system. Refer to “RS-232 Port Connector” on page 3-7 for pin connections.

Use either the RS-232 or the USB port for communications, *but not both*.

**USB connector**—is intended to be used to operate the laser using the supplied GUI software or user-developed software in lieu of the GUI software. Prior to using this port, the USB driver provided on CD-ROM or a USB flash drive (located in the accessory kit) *must* be installed. If the optional notebook computer is used, the GUI software and USB driver are already installed.

To use this port with user-developed software, refer to “Command/Query/Response Format” on page A-1 for information on sending commands to the *InSight DeepSee* system.

Use either the RS-232 or the USB port for communications, *but not both*.

**INTERLOCK connector (2-pin)**—provides attachment for a safety switch that can be used to turn off the system in an emergency. These two contacts must be shorted together before the laser can turn on. A defeating jumper plug (Figure 3-2) is installed at the factory to permit operation without a safety switch. Replace this plug with a similar, non-shorting plug that is wired to auxiliary safety equipment (such as a door switch) to shut off the laser when actuated (the switch opens). Such a switch must be designed for 24 volt, 100 ma signal.

The mating connector is a Molex 43025-0200 using pins 43030-0003.



**Figure 3-2** Mating interlock connector

**EMISSION connector (4-pin)**—provides access to relay contacts that close when emission is present. This can be connected to a supply voltage and lamp to provide remote indication of laser emission. When the laser is off (i.e., when there is no emission), there is closure between pins 1 and 3 (refer to “EMISSION Connector” on page 3-7). When the laser is on, there is closure between pins 1 and 2. Pin 4 is not used. No power is supplied by these terminals. This circuit is rated for 120 Vac at 1 A.

The mating connector is a Molex 43025-0400 using pins 43030-0003.



*Figure 3-3 Mating emission connector*

## IPS-300 Power Supply

The *IPS-300* power supply is air-cooled. It provides high-current DC power to the laser diodes in the *InSight DeepSee* laser head and low-current DC power to the laser head control circuits. It also provides clean, dry air to the laser head to keep the laser cavity free of contaminants.

This section defines the user controls, indicators and connections of this power supply. The front and rear panels are described from left to right, top to bottom.

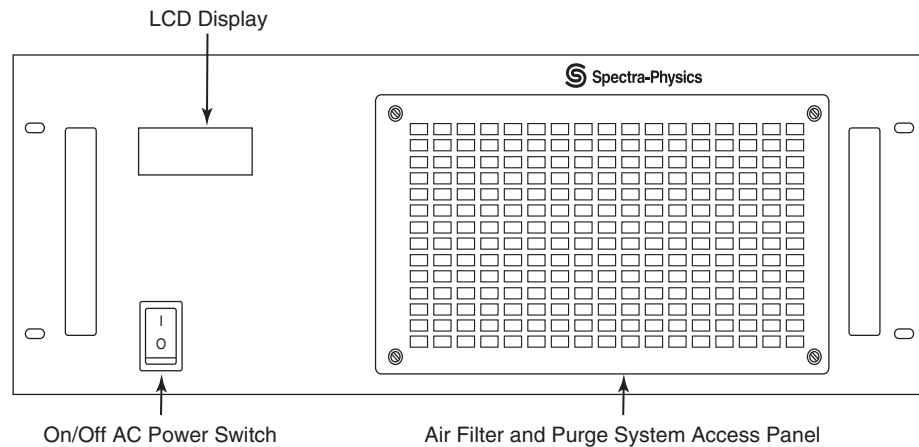


**Caution!**



*Provide at least 6 inches of room on the front and back of the power supply to allow cool air to enter the front and for the heated exhaust air to exit the rear panel. Inadequate cooling causes the system to overheat. Damage to components caused by insufficient cooling is not covered by your warranty.*

## Front Panel



**Figure 3-4** IPS-300 power supply front panel

**LCD display**—displays the current wavelength as well as the status of the power supply during normal operation and any status or fault codes that are generated by the power supply. During start up, this panel displays the status of the self-diagnostics program. If problems ever occur, monitor this panel to see where it occurs. All warnings, including errors generated by the system and indications related to proper system operation, are displayed on the control computer as well.

**AC power on/off switch**—provides AC power to the power supply. The switch glows amber when the switch is providing AC power to the system.



**Caution!**

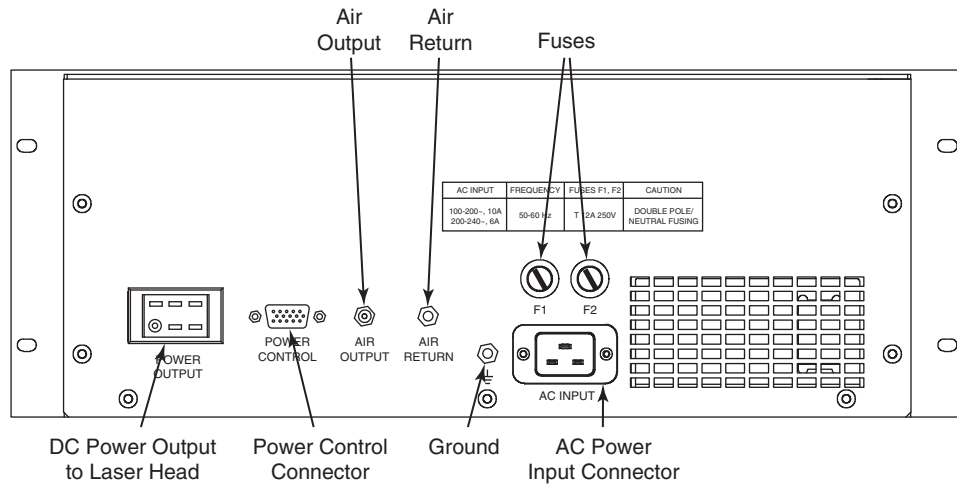


*Never turn off the power switch before exiting the laser GUI or using RS232/USB commands to shutdown the laser.*

*Refer to Chapter 6, “Operation,” for a detailed explanation of how to shut down the laser safely.*

**Air intake and purge canister access panel**—allows cooling air to be drawn into the power supply. The heated exhaust air is then vented from the rear panel. This is also the access panel to the purge system and it must be removed in order to replace the purge canisters behind it (see Chapter 7, “Maintenance and Diagnostics”).

## Rear Panel



**Figure 3-5** IPS-300 power supply rear panel

**POWER OUTPUT connector**—provides connection for the high-current cable that connects to the matching connector on the laser head. It provides DC power for the laser diodes as well as for the laser head control circuits.

**POWER CONTROL connector**—provides connection for the power control cable that connects to the matching connector on the laser head. It accepts control signals from the laser head to control the power to the laser head.

**AIR OUT connector**—provides connection for the “clean” air hose that delivers clean, dry air to the lower “air in” port on the *InSight DeepSee* laser. The hose connections are polarized to ensure proper air flow is achieved. Simply push the hose connector onto the panel connector to secure it (you should hear a “click”). To remove the hose, pull back the hose connector outer jacket and pull the hose free.

**AIR IN air connector**—provides attachment for the return line from the upper “air out” port on the laser head. The hose connections are polarized to ensure proper air flow is achieved. Simply push the hose connector onto the panel connector to secure it (you should hear a “click”). To remove the hose, pull back the hose connector outer jacket and pull the hose free.

**Ground lug**—provides a chassis earth ground connection for the AC power cord in addition to the ground pin that is part of the receptacle. Connect this point to a good earth ground if there is reason to suspect a problem with the ground in the line-cord.

**F1/F2 fuse holders**—hold the two line fuses. Refer to the table below for fuse type and size.

AC Input	Frequency	Fuses F1, F2	Caution
100–200~, 10A 200–240, 6A	50–60 Hz	T 12A 250V	Double pole/ neutral fusing

**AC POWER connector**—provides connection for the IEC power cable that provides AC power to the power supply.

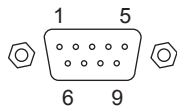


**Air exhaust**—allows heated air to be expelled from the power supply. This vent must be unobstructed and clean during use.

## Connector Interface Descriptions

### RS-232 Port Connector

The *InSight DeepSee* system uses four of the nine RS-232 pins: one pin each for the transmit and receive signals, and two pins for ground. Table 3-1 describes pin usage.



**Figure 3-6** 9-pin RS-232 port

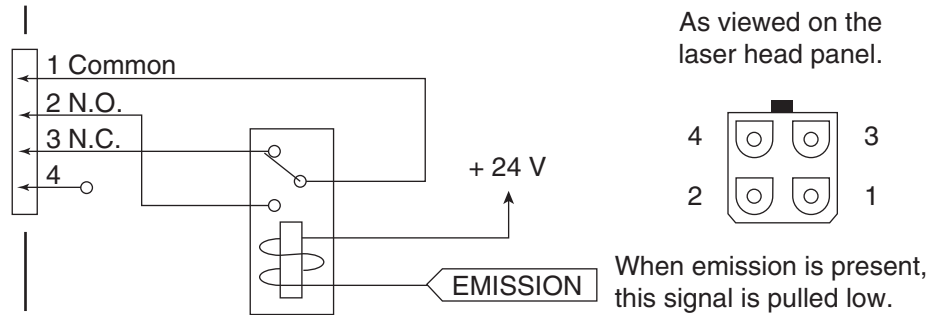
**Table 3-1** RS-232 port connections

RS-232-C Signal Name	Computer or Terminal			<i>InSight DeepSee</i> Laser Head	
	Signal	Pin No. (25 pin)	Pin No. (9-Pin)	Pin No.	Signal
Transmit data	TXD	2	3	3	RXD
Receive data	RXD	3	2	2	TXD
Signal ground		7	5	5	
Protective ground		1	SHELL	SHELL	

### EMISSION Connector

This connection can be used to turn an external EMISSION light on and off. No power is provided by this connector. Instead, the connector is attached to a single-pole, double-throw relay whose contact pins 1 and 2 close when emission occurs or is imminent. This circuit is rated for 120 Vac at 1 A.

The mating connector is a Molex 43025-0400 using pins 43030-0003.



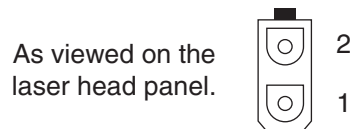
**Figure 3-7** InSight DeepSee laser head emission connector and circuit

**Table 3-2** Emission connector pin descriptions

Pin #	Description
1	Wiper
2	Normally open
3	Normally closed
4	Not used

## Safety INTERLOCK Connector

The connector shown in Figure 3-8 is part of a system interlock system. It is intended for use by the operator. All interlocks, including this one, must be *closed* (shorted) before the laser can be turned on. Opening this interlock turns *off* the diode lasers immediately.



**Figure 3-8** InSight DeepSee laser head interlock connector



**Caution!**



If a normally closed switch is not attached to this connector, the provided shorting plug must be attached or the laser does not turn on.

**Table 3-3** Interlock connector pin descriptions

Pin #	Description
1	System interlock
2	System interlock return

## Chiller

Refer to the *ThermoRack 401* chiller user's manual supplied with that unit for a description of its controls and for directions on how to operate it.

Use ONLY *Nalco 460-PCCL104* liquid corrosion inhibitor as a coolant. *Do not use deionized water.*

Chiller

# CHAPTER 4: Receiving and Inspecting

## Inspecting the Shipment

Your *InSight DeepSee* laser system was packed with great care, and its containers were inspected prior to shipment—they left Spectra-Physics in good condition. Upon receiving your system, immediately inspect the outside of the shipping containers. If there is any sign of damage, call Spectra-Physics immediately and insist that a representative of the carrier be present when the contents are unpacked.

**Warning!**



**Do NOT open ANYTHING unless directed to do so by Spectra-Physics!**

Inspect the system in the following order:

1. Do a complete exterior inspection.
2. Photograph any damage thoroughly for insurance purposes.
3. Contact the factory if damage is apparent.
4. Open the container(s) *only when requested to do so by the factory*, and follow their directions as you inspect the system.

## Exterior Inspection



Figure 4-1 Tilt and shock watches

Note any of the following conditions, if they occur, on the carriers receipt:

- Verify that the tilt and shock watches (Figure 4-1) on the side of each container indicate whether or not the units were safely shipped.
- Verify that boxes were shipped on their side.
- Note any sign of water damage.
- Note any physical damage such as holes, tears, or dents in the packaging.

If the indicator on any shock watch shows that the crate has sustained possible damage, follow the instructions printed on the label and notify the carrier and the factory immediately. If any damage appears severe, the factory may request that you open the packaging to determine the system condition. However, **do so only at the factory's direction!**

## Packaging Description

The *InSight DeepSee* laser is installed on site by a factory-trained installation engineer. *Do not* open the laser packaging prior to the engineer's arrival unless specifically told to do so by the factory.

Here is a summary of how your new *InSight DeepSee* laser is packaged in the event the factory instructs you to open the crates and/or boxes.

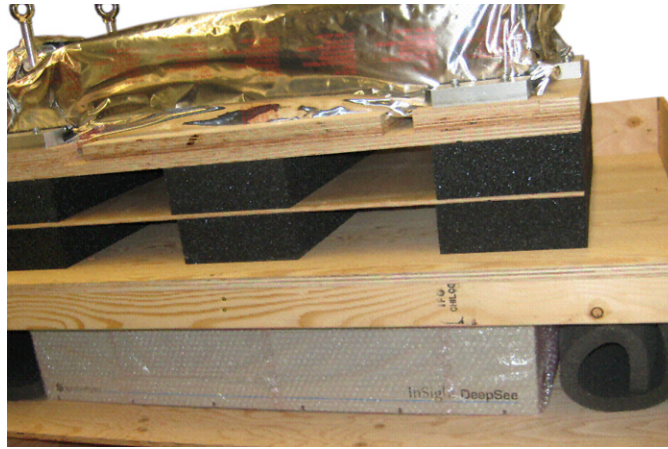
### Laser Head Packaging

The laser head is shipped in a two-layer crate (Figure 4-2) with the laser itself in the top section and the laser head cover in the bottom (Figure 4-3).



**Figure 4-2** *Crate with latches unfastened*

Eight spring-loaded clamps (three on each side and one on each end) secure the wooden crate top cover in place. When unlatched as shown in Figure 4-2, the top cover can be lifted off. When the cover is removed, the *InSight DeepSee* laser head is immediately visible (Figure 4-4). The laser head is covered in a mylar bag to prevent moisture and dust from getting on the laser. *Do not open this bag!*



**Figure 4-3** Open crate showing laser head (top layer) and its cover (lower layer)



**Figure 4-4** Laser head shown inside mylar bag as shipped

Protruding from the top of the mylar bag are three eye-bolts. These bolts can be used to lift the laser using a forklift.

A forklift or crane and sturdy cart should be available at the time of installation. The installation engineer lifts the laser head and sets it on the cart for transportation to the installation site.

Five more spring clamps hold the bottom section side cover in place. These are released and the side cover is removed to access the laser cover shown in Figure 4-3. After the laser is installed and operating properly at the desired location, the installation engineer installs this cover on the laser and places warranty seals on the cover sides.

If no damage to the laser or the laser cover is apparent, replace the crate cover and wait for the Spectra-Physics installation engineer who will install your system.

## IPS-300 Power Supply/ThermoRack Chiller Packaging

The power supply, chiller and rack are shipped in a second crate shown in Figure 4-5.



**Figure 4-5** Power supply, chiller, and rack crate

The power supply and chiller are shipped in their own cardboard boxes along with the rack as shown in Figure 4-6. In the figure, the power supply is in the box on the right, the chiller is in the box under the rack on the left.



**Figure 4-6** Cover removed from the power supply, chiller, and rack crate

To inspect these boxes for damage, unlatch the six latches around the bottom of the crate and remove the top.

If no damage to the boxes and rack is apparent, replace the crate cover and wait for the Spectra-Physics installation engineer who will install your system. If damage *is* apparent, call your Spectra-Physics representative, then continue reading the sections below.



## If Damage to the Box(es) is Apparent

Do *NOT* open the boxes unless specifically told to do so by Spectra-Physics. The following instructions are provided in the event your Spectra-Physics representative instructs you to open the power supply and/or chiller boxes. Have a camera or smartphone available.

### Opening the Power Supply Box

If told to do so:

1. Open the power supply box and remove the center foam piece (Figure 4-7) then open the inner bag (Figure 4-8).



**Figure 4-7** Power supply box shown opened with center foam piece removed



**Figure 4-8** Power supply box shown with inner bag opened

2. Open the inner box and remove the white styrofoam piece.
3. **The power supply is heavy!** If instructed to remove the power supply, two people may be needed to lift it out of the box, one on each side of the box. Using the handles in the inner box, lift the cradle and power supply out of the box and place it on a sturdy surface for inspection.
4. The installation engineer instructs you on how to inspect the power supply for damage. If damage is found, they may ask you to photograph the damage and send it to them via email or smartphone.
5. If no damage is found, the installation engineer may instruct you to return the power supply to its box and seal it. Wait for the Spectra-Physics installation engineer to arrive who will install your system as part of the sales agreement.

## Opening the Chiller Box

If told to do so:

1. Open the chiller box and remove the white packing foam on either end of the chiller (Figure 4-9, left).



*Figure 4-9 Chiller box opened with foam pieces removed*

2. Lift the chiller out of the box by grasping the center of the chiller (refer to Figure 4-9, right) and lift it out of the box and place it on a sturdy surface for inspection.
3. Remove the bottom packing foam.
4. The installation engineer instructs you on how to inspect the chiller for damage. If damage is found, they may ask you to photograph the damage and send it to them via email or smartphone.
5. If no damage is found, the installation engineer may instruct you to return the chiller to its box and seal it. Wait for the Spectra-Physics installation engineer to arrive who will install your system as part of the sales agreement.

## Packing the Laser System for Transportation or Return to Spectra-Physics

To return the *InSight DeepSee* system to Spectra-Physics for service, repair, or upgrade, retain the original crates, boxes, bags, and packing material for the engineers to repack the system.

We encourage you to use the original crates and packing material to secure the instruments during shipment. If shipping crates, boxes, bags, or packing material have been lost or destroyed, we recommend that you order new ones. A kit is available for repacking the laser system. Replacement shipping materials can be found on the FRU list in “Replacement Parts.” We can return instruments to you only in Spectra-Physics containers.

Refer to “Instrument Repair” for instructions on shipping the system back to Spectra-Physics.

# CHAPTER 5: Installation

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## System Installation

A Spectra-Physics service engineer will install your system. *Do NOT install it yourself.*

## Site Considerations

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### Warning!



*All InSight™ DeepSee™ systems are initially installed by Spectra-Physics as part of the purchase agreement. Relocating an InSight DeepSee system after installation requires a service call to Spectra-Physics. An InSight DeepSee system can only be moved by an authorized Spectra-Physics service representative who is trained in this procedure.*

---

### Warning!



*The IPS-300 power supply, laser head and chiller are heavy. If you must move them, ask for help. Do not attempt to move these items by yourself.*

---

This chapter assumes that the system has already been inspected by you for damage upon receiving it (refer to Chapter 4, “Receiving and Inspecting”). It also assumes that the system has been carefully unpacked by a Spectra-Physics service engineer, and that the system is now at the installation site.

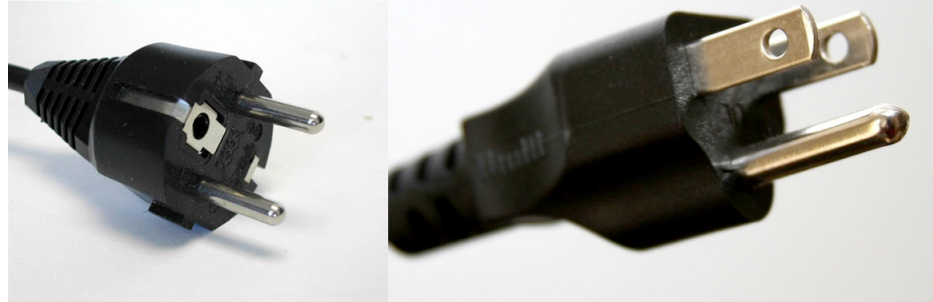
This chapter does NOT provide typical installation instructions for the *InSight DeepSee* laser system. *A Spectra-Physics service representative will install the system as part of your purchase agreement.*

## System Installation Considerations

A Spectra-Physics service engineer will install your *InSight DeepSee* laser system. While operating the system, be sure to follow all safety precautions listed in Chapter 2, “Laser Safety and Compliance.” Verify that all laser safety devices are in place before using the laser.

Have the following available for when the Spectra-Physics service engineer arrives:

- A stable mounting platform that can handle a 130 lb. (60 kg) laser head
- A mounting platform with ¼-20 or M6 threaded mounting holes. see Figure 1-3 for mounting hole locations.
- 90–240 VAC, 47–63 Hz electrical service for the *IPS-300* power supply and the *ThermoRack 401* chiller



**Figure 5-1** Electrical plugs

- Room to place the rack-mounted power supply and chiller within 6 ft (2 m) of the laser head

Both the power supply and chiller are air cooled and rack mounted, and they require at least 6 in. (15 cm) of clearance at the rear of each unit for proper cooling.

The power supply, chiller and laser head together produce less than 1500 W (5 kBTU per hour) of waste heat. Provide enough room cooling capacity to prevent the system from over-heating.

**Keep the shipping containers.** If you file a damage claim, you may need them to demonstrate that the damage occurred as a result of shipping. If you need to return the system for service at a later date, the specially designed containers assures adequate protection.

## Chiller Requirements

A *ThermoRack 401* thermo-electric cooler (TEC) is provided with the *InSight DeepSee* laser system to supply coolant to the laser head.

---

**Warning!**



**Always fill and maintain the chiller reservoir with full strength *Nalco 460-PCCL104* liquid corrosion inhibitor. Do not use deionized water.**

---

Appendix D, “MSDS Data Sheets,” contains the material safety data sheet (MSDS) for the *Nalco* product. Be sure to follow the safety measures listed in this document when transporting and using the *Nalco* product. The service engineer installing your system fills the chiller the first time and instructs you on its use. If, after the initial installation, you have any questions regarding the use of this product, contact your Spectra-Physics service representative. Address and telephone numbers are listed at the end of Chapter 8, “Customer Service.”

Maintain the chiller temperature for operation at 21°C.

---

**Warning!**



**The chiller must always be on when the power supply is on, even if the diode lasers are not on!**

---

It takes the chiller about 15 minutes to stabilize the temperature of the laser head cold plate and, thus, the output of the laser. Leaving the chiller on between periods of laser use eliminates this stabilization period. In general, if the laser is used often, leave the chiller on between laser usage; if it is used infrequently, turn off the power supply, then turn off the chiller. *The chiller must be on whenever the power supply is on!*

## Installing the Control Software

Your Spectra-Physics service engineer installs the GUI control software as well as the USB driver for you when they install the system. The instructions below are provided in the event that a different computer is used or the software must be installed again. This software is already installed on the laptop optionally provided with this system.

The GUI control software provided with the laser is optimized for startup, maintenance and general-purpose use. It may be desirable to develop your own custom software to support specialized uses. Such software should be developed based on the *InSight DeepSee* command language described in Appendix A, “Programming Guide.”

The GUI control software and USB driver are provided on CD-ROM or a USB flash drive (located in the accessory kit). The following two sub-sections provide directions for installing the software.

In order to run the GUI control software, the control computer must meet these minimum requirements.

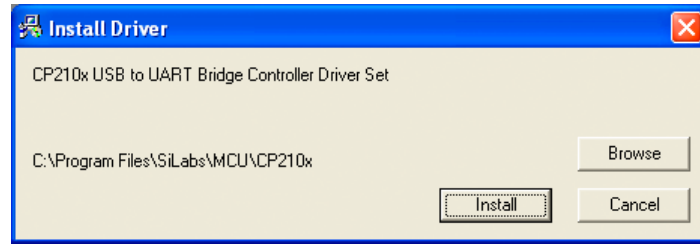
- Intel or AMD 32 or 64-bit, single or multi-core processor with >1 GHz clock speed
- 1 GB RAM
- 10 MB available disk space for installation
- A CD-ROM or DVD-ROM drive
- A mouse or other Windows-compatible pointing device
- A video display with 1024 x 768 (SVGA) or higher resolution
- An available USB port
- Microsoft Windows XP or Windows 7 operating system

## Installing the InSight DeepSee USB Driver

This section describes how to install the *InSight DeepSee* USB driver software. This driver must be installed before connecting the USB cable between the laser head and the control computer.

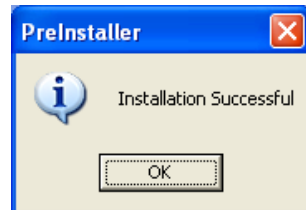
1. Place the *InSight DeepSee* software CD-ROM in the CD/DVD drive or place the USB flash drive into a spare USB port.
2. Browse to the “*InSight DeepSee* USB Driver” folder on the CD or USB flash drive and open it.
3. Double-click the “Preinstaller” icon.

The following window opens:



**Figure 5-2** Install screen

4. Click **Install**.
5. Click through any other screens that might come up and accept the default installation directory.
6. When the following screen appears, select **OK**.



**Figure 5-3** Installation Successful message

7. Attach the USB cable between the *InSight DeepSee* laser head and the control computer, then turn on the chiller and the *IPS-300* power supply AC power switch. Various messages in the task bar similar to the one shown in Figure 5-4 appear.



**Figure 5-4** Found New Hardware message

Wait for the message that says, “Device Successfully Installed.”

8. Turn off the power supply.

This completes the installation of the *InSight DeepSee* USB driver software.

## Installing the InSight DeepSee GUI Control Software

This section describes how to install the supplied GUI control software. As mentioned earlier, your Spectra-Physics service representative will do this for you when he installs the system. The instructions below are provided in the event a different computer is used and the software must be installed again.

1. If you have not already done so, place the CD-ROM in the CD/DVD drive or the USB flash drive in a spare USB port. Double-click `Setup.exe` and follow any prompts that appear during installation.

The software create the folder `C:\Program Files\Spectra-Physics\InSight` and installs itself in this location (you can select the drive location; the default drive is C). It also installs run-time components into the `C:\windows\system` directory. Finally, the software places an *InSight DeepSee* icon on the desktop and on the start menu under the `Spectra-Physics` folder. When you are ready to start operation, double-click the desktop icon to start the control software.

This completes the installation of the *InSight DeepSee* GUI control software.





# CHAPTER 6: Operation

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This chapter describes the operation of the *InSight DeepSee* system, including system notices.

Read Chapter 2, “Laser Safety and Compliance,” before turning on the *InSight DeepSee* system.

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**Danger!**



*The InSight™ DeepSee™ laser is a Class IV—High-Power Laser, whose beam is, by definition, a safety and fire hazard. Take precautions to prevent exposure to direct and reflected beams. Diffuse as well as specular reflections cause severe skin or eye damage.*

---



*The InSight DeepSee laser emits infrared radiation that is extremely dangerous to the eye. Infrared radiation passes easily through the cornea, which focuses it on the retina where it can cause instantaneous permanent damage.*

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There are no controls to adjust or optics to change inside the *InSight DeepSee* laser head. The laser head should never be opened.

The *InSight DeepSee* can either be controlled locally using the custom Windows-based control software provided, or it can be controlled remotely using your own software program running on a computer or terminal.

---

**Warning!**



*When using a personal computer as a controller, ONLY run the GUI control software on the computer. If other software is run, it may cover up the laser STATUS screen!*

---

The first part of this chapter describes the *DeepSee* component and its associated “objectives.” Please read this section before continuing on to laser operation using the GUI control software. The latter part describes the RS-232 and USB connections. Appendix A describes the command/query language that must be used when writing a program for controlling the system remotely.

## DeepSee Component

The *DeepSee* component is located inside the *InSight DeepSee* laser housing, just after the laser output beam. The *DeepSee* component provides automated group velocity dispersion (GVD) compensation to achieve the shortest pulses possible at the sample (the target).

The Objective tab of the GUI control software (refer to “Objectives Tab Display” on page 6-11) provides a user interface that allows the operator to create and modify objective settings to compensate for external dispersion of *InSight DeepSee* pulses. The amount of dispersion, or GVD, compensation provided for each wavelength is governed by the position of the *DeepSee* motor that moves optical material on a stage within the beam path.

The motor position, as displayed on the GUI screen, is measured in units of percent of full motor travel. At each wavelength there is only a certain range of motor positions available that are determined by upper and lower “soft limits.” The accessible motor position range at each wavelength is between about 25 to 30 percent, again depending on the wavelength. These motor limits prevent the beam from missing the optical elements in the *DeepSee* component in order to maintain beam transmission through the *DeepSee* component no matter how far the motor is commanded to move.

The laser stores calibration files, called “objective tables,” that correlate wavelength to motor position. Typically, the operator selects the objective table that best matches his equipment, and it is displayed on the controller screen. When the *InSight DeepSee* wavelength is changed, the motor moves according to the currently active table. These tables usually store just a few calibration points, and the motor positions for wavelengths between these calibration points are calculated by linear interpolation using the two closest points. These objective tables can be created, modified, calibrated and deleted.

The operator can change the *InSight DeepSee* wavelength via the GUI control software or a user-written program.

## Objective Tables

A *DeepSee* objective calibration file comprises a microscope magnification factor, an immersion selection (water, glycol, air or oil) and a numeric aperture. This “lens” is further defined by including a table containing several “points” on a graph where the wavelength at each point is matched to the motor position that maximizes fluorescence at the target.

When the *InSight DeepSee* wavelength is changed, *DeepSee* adjusts according to the objective table selected.

### Creating and Using an Objective Table

For an experiment using a particular optical setup, the operator can select an objective from a list of stored objectives or create a new one with new calibration data. A new objective can be created by cloning it from an existing one then modifying it accordingly. Except for the read-only template (a special objective used as a starting point), each objective can be created by the operator, then modified, saved, erased or replaced. A total of 200 objectives can be created.

An objective table must contain at least three calibration points, but it is usually calibrated at several wavelengths in the range of interest. The maximum number of points is limited to the number of integer wavelengths in the range of the *InSight DeepSee* laser. For example, the *InSight DeepSee* objective table for a wavelength range of 680 to 1300 nm, is 620 points (one for each 1 nm change).

Calibration is done by creating a new objective and adjusting the motor position (or point) to optimize the fluorescence signal at the target at each wavelength of interest, and then saving these “points” in the table. Finally, the table is saved as a new “objective.” Usually 30–50 nm increments between calibration wavelengths are good enough to approximate the dispersion for the intermediate wavelengths.

The operator can now select and display the new calibrated objective. The dispersion for a particular experimental setup can now be automatically compensated for according to the objective table when the wavelength is changed, thus providing the shortest pulses possible (and the brightest multi-photon fluorescence signal) for any wavelength in the calibration range.

If conditions change during the experiment (e.g., the imaging depth changes), the operator can adjust the motor position slightly (using the MOTOR POSITION control; see Figure 6-8) during the experiment to modify the dispersion from the calibrated value.

As mentioned earlier, motor positions for non-calibrated wavelengths are calculated from the adjacent calibration points on either side of the current wavelength using linear extrapolation. If a calibration point is missing from one side, the motor position value is set to be equal to the existing adjacent calibration wavelength.

## Using the Chiller

Refer to the chiller user’s manual for information on how to operate that unit. In general, the reservoir should always be full before turning on the unit, and the chiller should be set to 21°C whenever the laser is running.

It takes the chiller about 15 minutes to stabilize at the coolant temperature of 21°C. Due to its mass, it takes the laser housing longer to reach steady state temperature. Leaving the chiller on between periods of laser use eliminates this stabilization period. In general, if the laser is used often, leave the chiller on between laser usage. If the laser is used infrequently, turning the chiller and power supply off saves energy, but a longer warm up time should be expected.

---

**Warning!**



*The chiller must be on whenever the power supply is on!*

---

## Operating the System Using the GUI Control Software

Operating the *InSight DeepSee* is easy when the supplied GUI control software is used. The Main tab display allows the operator to monitor the laser, turn the laser on and off, open and close the shutter and set the operation wavelength. It also shows laser output power, shutter position and laser/controller communication.

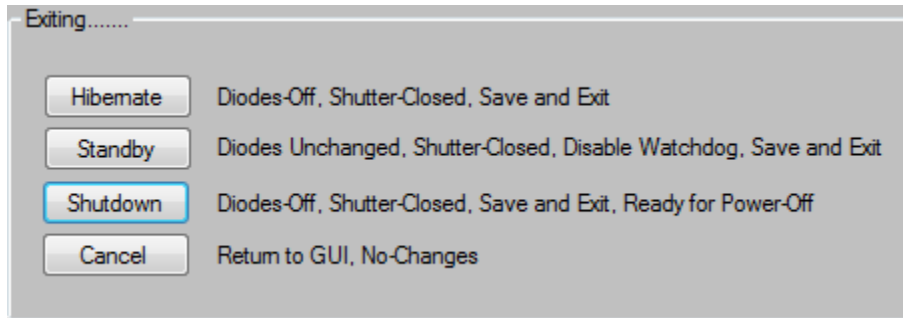
There are three other tab displays: Objectives, Diagnostics, and About. These displays and their functions are described on the next several pages. To exit the control program, click the red “X” in the upper right corner.

**Warning!**



*To shut down the laser, it is imperative that you follow the shutdown procedure outlined below to ensure trouble-free operation.*

Clicking the “X” brings up the shutdown options shown in Figure 6-1.



**Figure 6-1** GUI exit choices

**HIBERNATE**—shuts off the laser diodes, closes the shutters, and saves the wavelength and motor positions. It also closes the GUI. Using Hibernate DOES NOT shut down the laser internal computer operations, so the laser can be restarted without the delay of the internal computers rebooting. Because Hibernate does not shut down the internal computers, the power supply **MUST BE LEFT ON** when using the Hibernate mode. **DO NOT TURN OFF THE POWER!**

**STANDBY**—does *not* shut off the laser diodes. It closes the shutters and disable the watchdog timer so that the laser does not stop when the GUI is closed. It also saves the last set wavelength and motor positions, and it leaves all other components powered up and operating. Because the laser diodes are operating, simply opening the shutter results in laser emission. **DO NOT** leave the laser unattended in this mode.

**SHUTDOWN**—choose when the laser is turned off completely. Shutdown shuts off the diodes, closes any shutters, saves any changes to calibration tables, stores the last set wavelength and motor positions, and shuts down the laser internal computers. It then closes the GUI. *This option must be used prior to turning off the power supplies.*

**CANCEL**—aborts the shutdown sequence. It closes the shutdown options box and returns the GUI to operation at the point just before the user clicked the red X to exit.

## The Left Panel

Figure 6-2 shows the left portion of the Main panel. This portion is always displayed no matter which tab is chosen. It contains the emission indicator, the on/off diode laser control, the open/close shutter control and the fault indicator. A standard system display is shown on the left; a system that includes the optional 1040 nm accessory and, thus, a second shutter, is shown on the right.



**Figure 6-2** Left panel: standard system showing a fault (left), IR option system (right)

**EMISSION indicator**—when red, it signals that the laser diodes are on and that laser output is imminent or available (the shutter must be open for actual emission); when gray, the laser diodes are off. For safety, this indicator turns on at least 3 seconds before laser output is possible.

**On/Off button**—turns the laser diodes on and off. Click and hold down the button 3 to 5 seconds until the EMISSION light turns on. There is a second 3-second safety delay before the diodes are actually energized. Click the button again to turn the laser diode off immediately.

**NOTE:** Actual emission occurs only when the shutter is open.

**MAIN SHUTTER control**—opens and closes the integral shutter. To open the shutter, click the shutter icon and hold the button down until the “aperture” icon opens (about 3 to 5 seconds). To close the shutter, click the SHUTTER icon again and the shutter closes immediately, blocking the laser beam. The “aperture” icon also closes. Closing this shutter does NOT automatically close the IR shutter (if present).

**IR SHUTTER control**—opens and closes the integral shutter on the 1040 nm option, which provides IR output from a second output port. To open the shutter, click the shutter icon and hold it down until the icon “aperture” opens (about 3 to 5 seconds). To close the shutter, click the SHUTTER icon again and this shutter closes immediately, blocking the IR laser beam. The “aperture” icon also closes.

**FAULT indicator**—displays “normal” when no fault has occurred and turns yellow and displays “Fault” when a fault occurs. When a fault is displayed, click the display box to bring up the Diagnostics tab to allow further diagnostics of the fault.

## The Right Panel

The right panel shows the Main, Objectives, Diagnostics, and About tabs. Selecting a tab by clicking it displays the menu that corresponds to that tab. The Main menu for the 1040 nm option is shown selected in Figure 6-3.

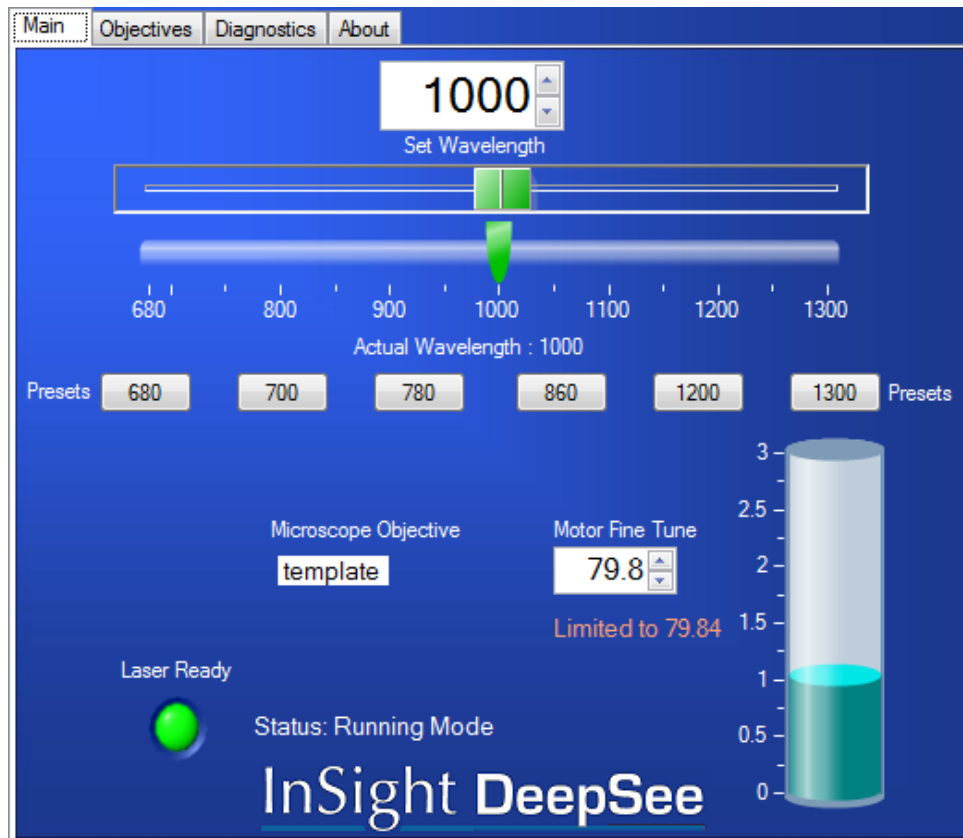


Figure 6-3 Right panel

## Turning On the System

### Warning!



The chiller must **always** be on when the IPS 300 power supply is on, even if the diode lasers are not switched on!

1. Verify that all connectors are plugged into the laser head; they should NEVER be disconnected.
2. Verify that the chiller reservoir is full.
3. If the chiller was turned off, turn it on and verify that it is set to 21°C.
4. Turn on the power supply AC power switch.

When power is applied to the system, all internal computer components boot up and the motor goes to a “home” location before it moves to the commanded position. This process typically takes between 30 and 60 seconds, but in some cases can take as much as 4 minutes. Allow 5 minutes before cycling power if boot-up is delayed. As the system starts up, the following message sequence is displayed on the power supply LCD screen:

“Please wait, initializing...”

Following the initialization, the wavelength setting that was in use when the laser was last used is displayed.

Wait approximately 30 minutes for the power supply LCD screen to indicate “100% warm-up,” which indicates it is ready for use. If an error occurs, refer to the LCD screen for status/error messages, then refer to Appendix B, “Status Codes.”

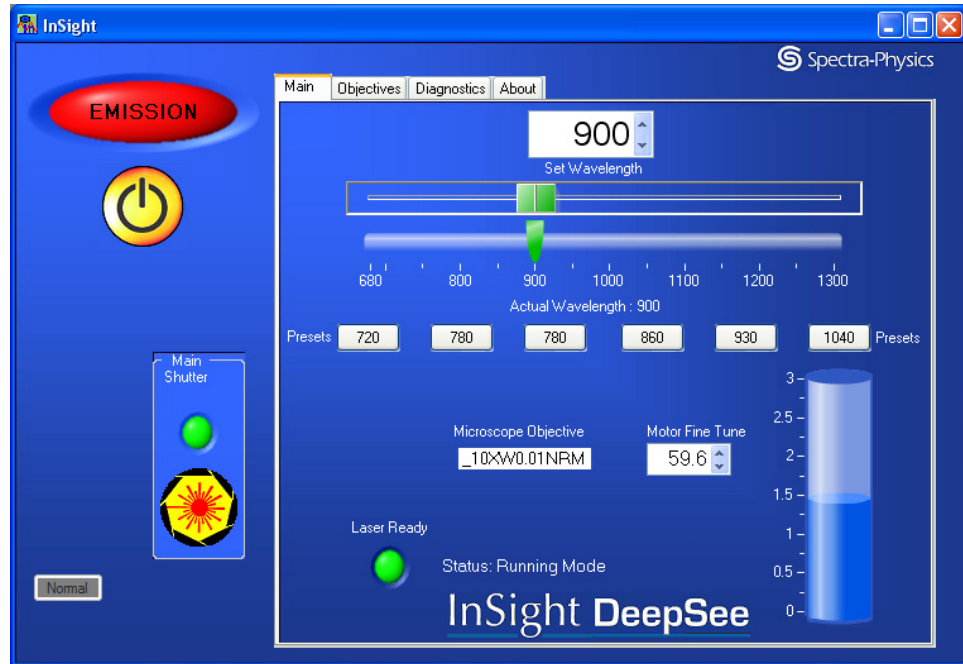
5. Turn on the host computer and start the GUI control program.
6. The program looks for the *InSight DeepSee* system and, when found, displays the Main tab display shown in Figure 6-4. Note: Turning the key to the “enable” (vertical) position allows the diode lasers to be energized if (a) the power supply AC power switch is also on and (b) an “on” command is given. Until the keyswitch on the laser head is turned to the “enable” position, the FAULT LED on the laser head is on. Wait until the status line (seen at the bottom center of the screen) says “Ready” before turning on the laser.



*To ensure that the beam is safely captured, install a beam block or power meter in front of any laser output ports.*

---

7. Turn on the laser.
  - a. Turn the keyswitch to the enable (vertical) position.
  - b. Click and hold down the yellow on/off button (shown under the red EMISSION indicator in Figure 6-4) 3 to 5 seconds until the EMISSION light turns on (turns red). The white emission light on the laser also turns on. (Note: After these lights turn on, there is a 3-second safety delay before the laser diodes are actually energized.) Although the EMISSION light is on and the laser diodes are on, no light is emitted until the shutter is opened in Step 9.



**Figure 6-4** Main tab display showing laser on and shutter open

**NOTE:** The left portion of the display (the section with the EMISSION indicator and the on/off and MAIN SHUTTER controls) is always displayed no matter which tab is selected on the right.

Laser power climbs gradually and the system enters pulsing (mode-locked) operation.

8. Set the desired wavelength by moving the upper horizontal slider, then wait for the lower “actual wavelength” slider to move to that same position.
9. Open the shutter.  
Click and hold down the appropriate shutter icon until the icon “opens” (turns yellow—it takes about 3 seconds). When the shutter opens, laser emission is present.
10. Output power should reach maximum output within 30 minutes.  
This completes the turn on sequence.

## Turning Off the System

### Warning!

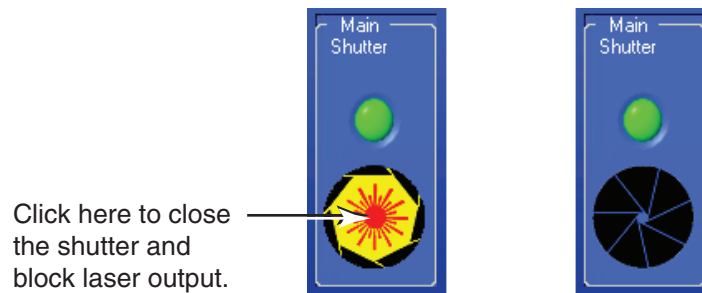


To shut down the laser, it is imperative that you follow the shutdown procedure outlined on page 6-3 to ensure trouble-free operation.

1. To temporarily block laser output without turning off the laser, click the red and yellow MAIN SHUTTER or IR SHUTTER icon (Figure 6-5).



The shutter closes, emission is blocked, and the shutter icon “closes” (turns black). However, the EMISSION lights remain on to warn of possible emission (the laser diodes are still on).



**Figure 6-5** Emission on (left); emission off and shutter closed (right)

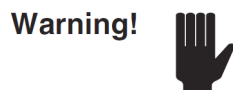
To resume operation, open the shutter again by clicking the appropriate shutter icon and holding the button down for 3 seconds.



*When the shutter is closed, treat the laser with the same safety precautions you would observe if the shutter was open! Wear proper eye protection at all times!*

2. When done using the laser, click the on/off button to turn off the laser. The laser turns off immediately, as does the EMISSION indicator.
3. If done for the day and you wish to turn off the computer, click the red “x” to exit the control program, then select “hibernate,” “standby” or “shutdown” from the pop-up menu to set the off mode (refer to page 6-3 for further explanation).
4. Turn the laser head keyswitch to the off (horizontal) position and remove the key to prevent unauthorized use.

It takes the system about 30 minutes to warm up. To minimize this start-up stabilizing time, leave the power supply AC power switch in the “on” position and leave the chiller on.



*The chiller must always be on when the IPS 300 power supply is on, even if the diode lasers are not switched on!*

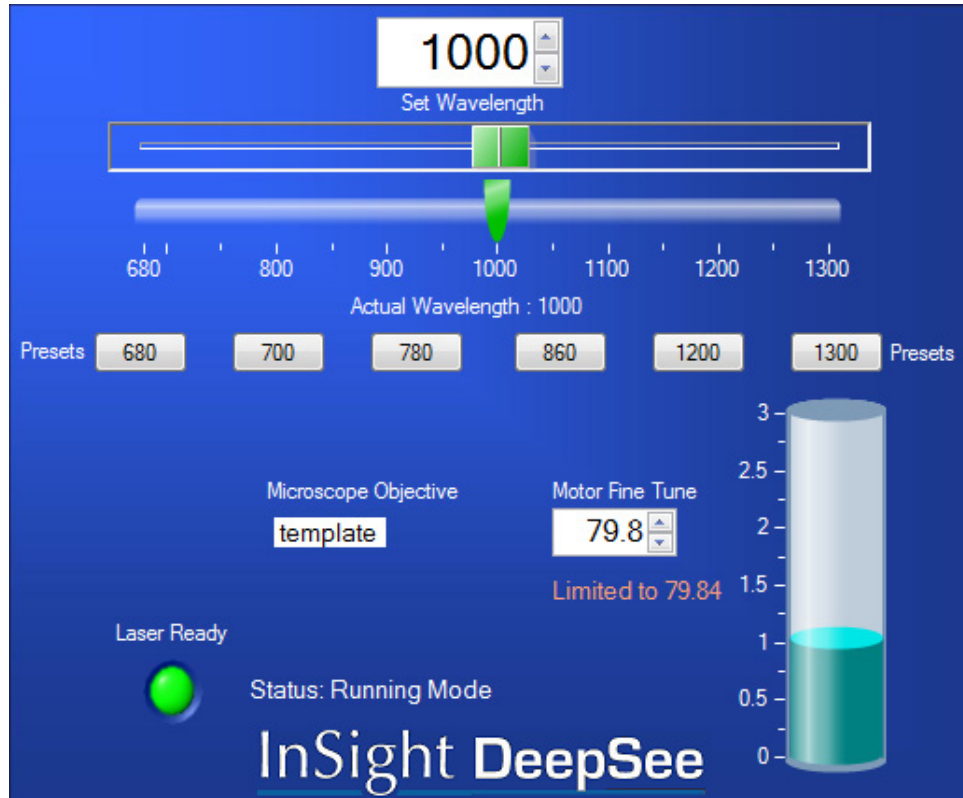
This is the preferred “off” mode for day-to-day operation or anytime a quick turn-on is preferred.

If the laser is not to be used for an extended period of time, shut down the GUI as described on page 6-3, then turn off the power supply, then turn off the chiller.

This completes the turn off sequence.

## Main Tab Display

The Main tab display shown in Figure 6-6 appears upon program start-up (it appears right after the Communication Setup menu is displayed). Large and easily seen from a distance, it serves as both a monitor and an input screen.



**Figure 6-6** Main tab display

The eight control features include:

- Set wavelength slide control and field entry
- Actual wavelength bar graph indicator
- Wavelength preset buttons
- Microscope objective indicator
- Motor fine-tune control
- Output power indicator
- Laser ready indicator
- System status monitor

These menu functions are described below as they appear on the screen from top to bottom, left to right.

**SET WAVELENGTH slide control and field entry**—allows the user to select an operation wavelength from 680 to 1300 nm.

There are several ways to set the wavelength: by using the up/down arrows to the right of the SET WAVELENGTH field, by typing a number into the field itself, by using the wavelength preset buttons or by dragging the slide selector in the upper bar graph to the desired location (wavelength numbers corresponding to its position displays in the SET WAVELENGTH field).

**ACTUAL WAVELENGTH bar graph indicator**—shows the actual output wavelength value.

When the system is active, the arrow in the lower bar graph indicates the present output wavelength. When the control bar in the SET WAVELENGTH field is moved, the arrow in the lower field moves toward that same value as the system automatically adjusts the wavelength. When the ACTUAL WAVELENGTH value matches the “Set” value, the arrow stops moving and aligns with the upper bar.

Note that there is no power setting control; the system automatically optimizes output power at each wavelength.

**Wavelength PRESETS buttons**—allows the user to quickly change the wavelength to a preset value by pressing one of the six buttons. The buttons are programmed by selecting a new wavelength using the slider or one of the other methods, then pressing and holding the desired button for a few seconds. The text in the button changes to the currently set wavelength.

**MICROSCOPE OBJECTIVE indicator**—shows which objective is currently selected (from the Objective tab).

**MOTOR FINE TUNE control**—allows the user to optimize dispersion compensation by making fine adjustments to the *DeepSee* motor. Use the up/down arrows to the right of the field or type a number directly into the field itself.

The limits are factory set and change depending on the wavelength. These limits are represented by the blue lines on the Objective tab (see Figure 6-8).

**Output Power indicator**—(the vertical cylinder on the right) displays current system output power from 0 to 3 W. This is a relative indicator of performance. The calibration is not accurate to a few percent and it should not be used as an absolute measurement of laser power. An optical power meter should be used for performance monitoring.

**Laser Ready indicator**—is green when the laser is operating correctly and producing light. The system is ready for the shutter to be opened.

**STATUS monitor**—provides system status information. Some examples are:

Status: Initializing, 20% warmed up

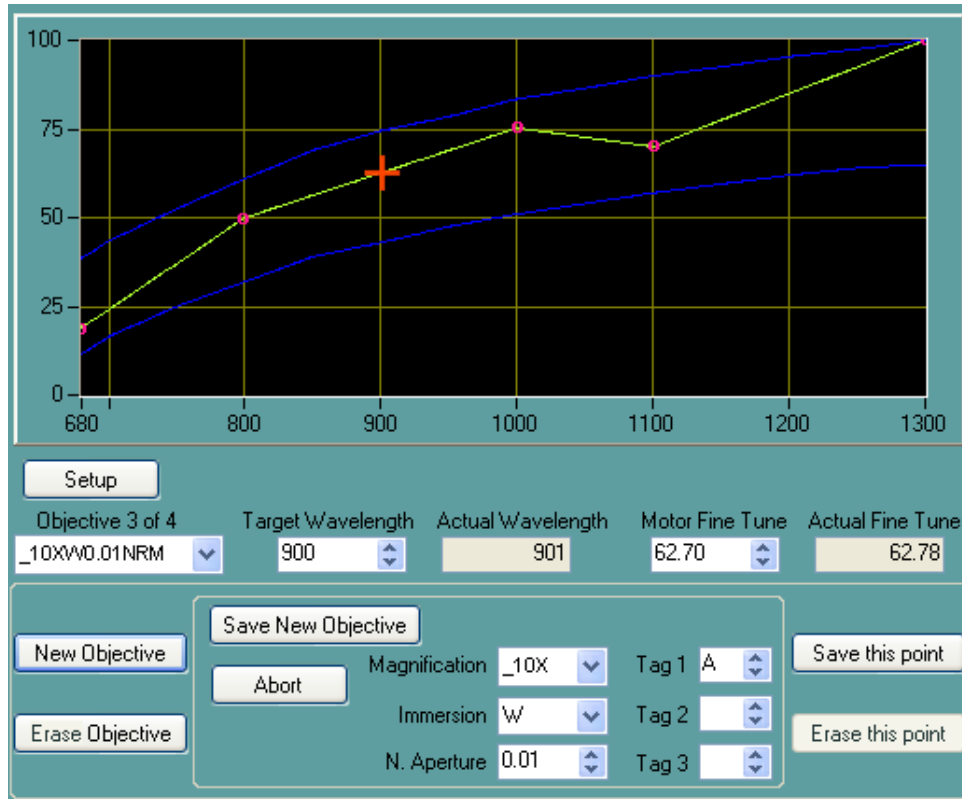
Status: Ready

Status: Turning on

Status: Running Mode

## Objectives Tab Display

The Objectives tab (Figure 6-7) allows the user to modify and create different objectives. Refer to “Objective Tables” on page 6-2 for an explanation of “objectives” and how to create and use them. This section simply describes the function of each control and display.



**Figure 6-7** Objectives tab display

The Objectives tab display has two sections.

The upper section (Figure 6-8) includes:

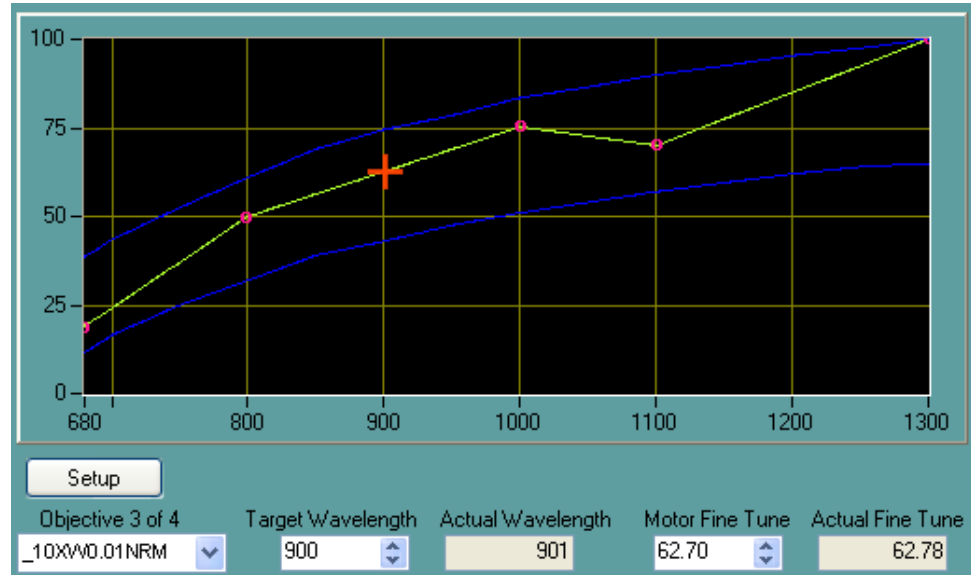
- An X-Y plot of the interpolated *DeepSee* motor position vs. wavelength coordinate points
- The basic, frequently used functions and indicators for a selected objective
- Mouse selectable and numerical entry controls for setting the *InSight DeepSee* wavelength and the *DeepSee* motor position

The lower section (Figure 6-9, when opened via the SETUP button) provides tools to:

- Calibrate the table entry
- Add or delete points for each objective table
- Add or delete objective tables

Refer to “Changing Wavelength Motor Position” on page 6-15 for information on how to change motor position for a particular wavelength, and to “Calibration Points” on page 6-16 for information on creating calibration points.

## The Upper Section



**Figure 6-8** Upper section of the Objectives tab

**X-Y Plot**—shows the *DeepSee* motor position vs. the *InSight DeepSee* wavelength. The center green line indicates the *DeepSee* motor values for any given wavelength. The red circles on the green curve are the actual user calibrated points. The green line is a best fit interpretation. The upper and the lower curves (blue) represent the upper and lower value limits for the motor position for any given wavelength.

**SETUP button**—when pressed for more than 6 seconds, it opens the lower panel (Figure 6-9), which is used to create, save and delete objective tables and to create, save and delete points that define that objective table.

**OBJECTIVE field**—is a drop-down list of all the objective tables that have already been created, plus the read-only template table, “!!template.” Use this list to select a predefined objective table. Making a new selection causes the plot to update.

**TARGET WAVELENGTH field**—allows the user to tell the *DeepSee* controller to move to the new *InSight DeepSee* wavelength.

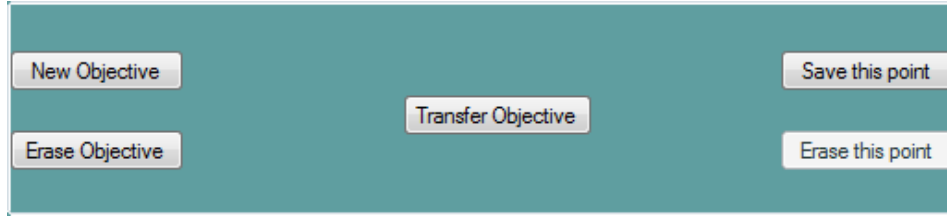
**ACTUAL WAVELENGTH monitor**—shows the current *InSight DeepSee* wavelength.

**MOTOR FINE TUNE field**—allows the user to tell the *DeepSee* controller to move the motor to a new position in percent of total possible motor motion. However, for any given wavelength, the motor position is bounded to less than 0 to 100% by the soft limits of travel. The red cross hair indicates the new position for the motor.

**ACTUAL FINE TUNE monitor**—shows the current motor position in percent.

## Lower Section

Figure 6-9 shows the default lower section that serves as a starting point for creating or deleting an objective or data point. It also allows the operator to transfer objective files from *InSight DeepSee* to the control computer and vice versa. Figure 6-10 shows the lower section after the **New Objective** button has been pushed.



**Figure 6-9** Default lower section display of Objectives tab

The following text describes each of the controls on this panel. The fields can be updated using the up/down arrows to the right of the field or by typing directly into the field itself. When typing, any number entered outside the permitted range is ignored.

**NEW OBJECTIVE button**—when pressed, opens the center panel, which is used to enter information to describe a new objective table (refer to Figure 6-10 on page 6-14).

Pressing this button causes a template objective with a temporary name to open, and all controls for the objective and the name construction are presented.

**ERASE OBJECTIVE button**—when pressed, causes the ERASE OBJECTIVE NOW button to pop up for further confirmation. Pressing the latter button deletes the current objective table and archives the objective list. During the time an objective is deleted and the record is updated, the SELECT OBJECTIVE button is disabled.

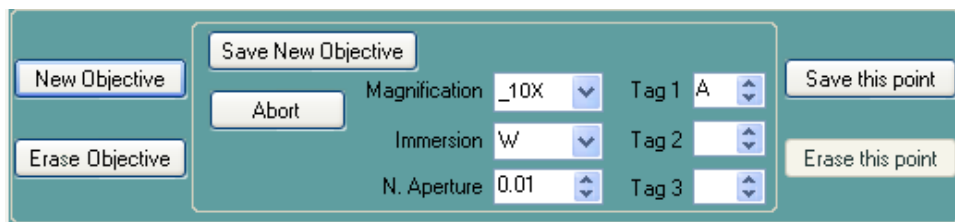
**TRANSFER OBJECTIVE button**—when pressed, allows the operator to transfer a file from *InSight DeepSee* to the control computer and vice versa. Contact your service representative for more information.

**SAVE THIS POINT button**—when pressed, saves a point on the graph created by moving the motor to the new desired location. This is indicated by the red cross hair. It also archives the table with the change(s) just made and updates the plot with a new interpolation.

**ERASE THIS POINT button**—when pressed, deletes the current point on the graph and the plot is updated with a new interpolation. Note that there must be at least 3 points in a table. When only two points are detected, this button is disabled.

### New Objective Lower Panel

When the NEW OBJECTIVE button is pressed on the default lower panel, the panel changes to the one shown in Figure 6-10.



**Figure 6-10** New Objective panel

**SAVE NEW OBJECTIVE button**—saves the objective table just created and closes the new objective panel. It also scans the entry fields to evaluate whether the new name already exists in the objective list. The objective name is composed of the value for “Magnification, Immersion, Numerical Aperture, Tag1, Tag2, Tag3” without the commas or spaces. If the objective name already exists, a message box informs you that the name currently exists. The message box allows you to cancel, overwrite the currently named objective file, or rename the new objective before saving it. (Refer to “Commands and Queries” on page A-2 for the objective name syntax.)

More than 200 objective tables can be created.

During the time an objective is saved and the record is updated, the SELECT OBJECTIVE button is disabled.

**ABORT button**—when pressed, ignores any new objective information and closes the new objective panel.

**MAGNIFICATION field**—allows the user to choose a magnification level (from a drop-down list) for the new objective that best matches the user’s microscope. Values are:

2.5 x	25 x
4 x	40 x
5 x	50 x
10 x	60 x
15 x	63 x
20 x	100 x

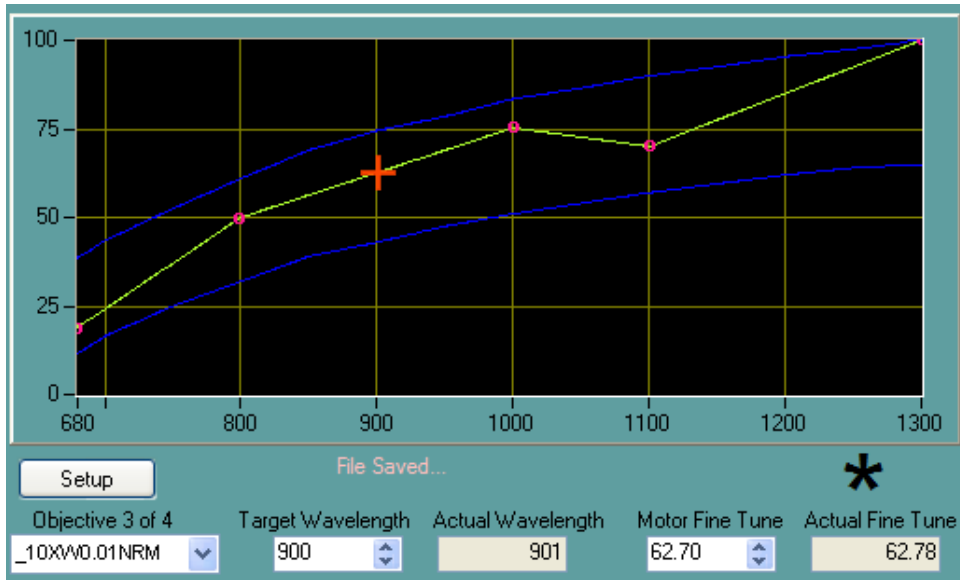
**IMMERSION field**—allows the user to select water, glycol, air or oil.

**N. APERTURE field**—allows the user to select a numeric aperture (from a drop-down list) that best matches the user’s microscope.

**TAG fields (3)**—allows the user to select the three suffixes (from a drop-down list) to be added to the objective name to make it unique.

## Changing Wavelength Motor Position

To change the *InSight DeepSee* wavelength, either directly enter the new wavelength in the Target Wavelength box, or click the graph at the new wavelength value (see Figure 6-11). The red cross hair moves to the new value, and the Target wavelength and Actual wavelength change to the new value. The ACTUAL WAVELENGTH field updates as the *InSight DeepSee* changes its wavelength. Meanwhile, the *DeepSee* motor moves to the calibrated or interpolated position (shown by the ACTUAL MOTOR POS. field) according to the entry in the selected objective. Wavelengths beyond the objective’s minimum or maximum value is ignored.



**Figure 6-11** Upper section of Objectives tab

Change the motor position by entering a percentage value (percentage of full motor travel) in the MOTOR FINE TUNE field. The red cross-hair symbol moves along the vertical axis. Both the wavelength and the motor position entry fields have value range checks.

The blue lines show the interpolated soft limits. The motor position in the plot is clamped to within these limits except when the motor is homed.

### Calibration Points

Two indicators for a calibrated point exist in the table when:

- There is a black star above the ACTUAL FINE TUNE box (Figure 6-11).
- There is a little open circle on the objective curve.

**Note**



*If many adjacent points exist in the table, the curve appears thicker. If a point does not exist, the “Erase this Point” control is disabled.*

## Diagnostics Tab Display

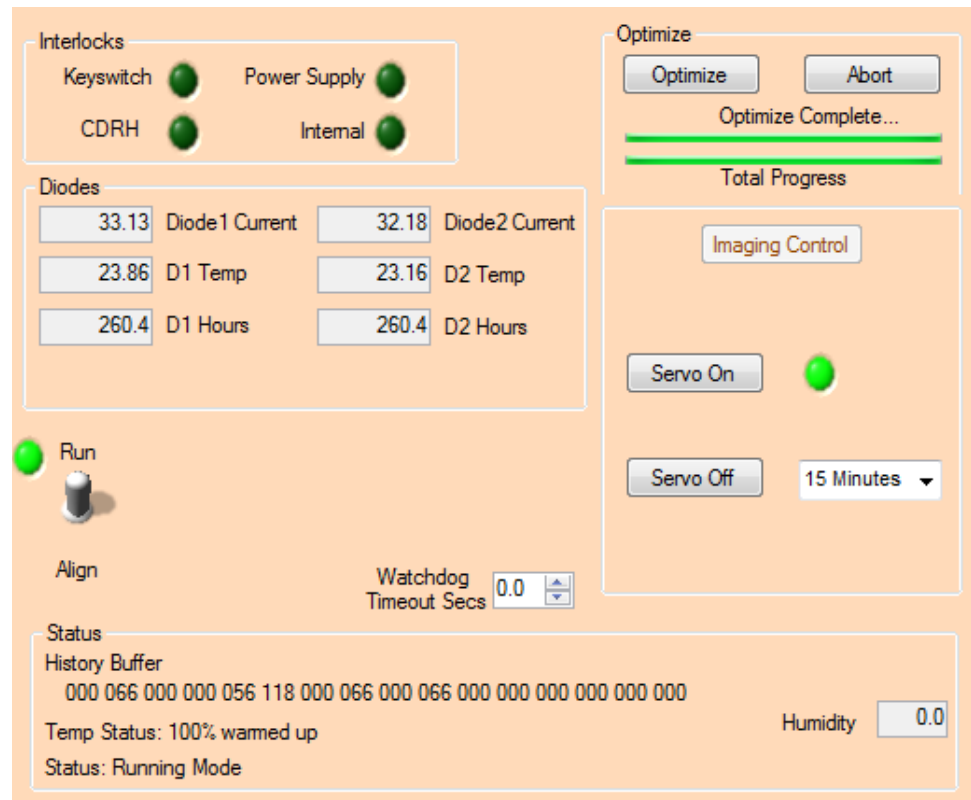
The Diagnostics tab shown in Figure 6-12 serves to give the user certain detailed operating information about the laser and allows the user to select specialized operating modes. Included is a control to initiate an optimization routine. The run/align switch allows the operator to select standard operation mode (run) or to alignment mode (align) where output power is reduced to allow the operator to align the laser beam to external optics.



Also included is the IMAGING CONTROL button, which allows the user to make extremely high resolution images by temporarily shutting off the automatic laser controls that actively adjust the laser.



*Although the output power of the laser is reduced in align mode (to approximately 200 mW), the beam IS NOT safe for your eyes! Always wear proper eye protection!*



**Figure 6-12** Diagnostics tab

**Interlocks**

**KEYSWITCH indicator (LED)**—when red, it indicates that the key is turned to the “off” (horizontal) position.

**CDRH indicator (LED)**—when red, it indicates that the user safety interlock on the back of the laser head is open.

**POWER SUPPLY indicator (LED)**—when red, it indicates that the power control cable from the power supply to laser head is loose or disconnected.

**INTERNAL indicator (LED)**—when red, it indicates that an internal interlock is open. Call your Spectra-Physics service representative.

**Optimize**

**OPTIMIZE button**—begins a multi-phase optimization routine when pressed. Use this routine if the laser power drops off from the nominal value.

This routine takes several minutes to complete. During the operation, progress is indicated by the green bars below the button. When finished, both bars are green and “complete” displays.

**ABORT button**—cancels the optimization routine immediately when pressed.

Unless there is a safety concern, always allow the laser to complete the optimization routine. Aborting the optimization routine may require the routine to be run at a later time to restore proper operation.

**Progress indicator bars**—display the progress of the optimization routine. The top bar shows the progress of each of the four phases, the bottom bar indicates total progress.

### **Diodes**

This section provides feedback regarding the condition of the two laser diodes.

**DIODE1 CURRENT monitor**—displays diode 1 current in Amps.

**DIODE1 TEMP monitor**—displays diode 1 temperature in degrees Celsius.

**DIODE1 HOURS monitor**—displays the accumulated hours of operation for diode 1.

**DIODE2 CURRENT monitor**—displays diode 2 current in Amps.

**DIODE2 TEMP monitor**—displays diode 2 temperature in degrees Celsius.

**DIODE2 HOURS monitor**—displays the accumulated hours of operation for diode 2.

**RUN/ALIGN switch**—allows the operator to set the laser to run or align mode of operation. Set this switch to “run” for normal system operation; set it to “align” to reduce output power to a level appropriate for aligning the laser beam to external optics.



*Although the output power of the laser is reduced in align mode (to approximately 200 mW), the beam IS NOT safe for your eyes! Always wear proper eye protection!*

---

**RUN/ALIGN indicator (green/yellow LED)**—is green when laser output is stable while in either run or alignment mode. It blinks yellow when the output is changing state.

**WATCHDOG TIMEOUT SECS field**—allows the operator to select the time period for resetting the watchdog counter. The watchdog counter is used to detect loss of communication between the host computer and the *InSight DeepSee* laser. If communication fails between these two units, the counter counts down to zero and shuts off the laser. Use the up/down buttons to set the time period in tenths of a second. A “0” setting turns off this function and allows the laser to remain on. A “0” setting should only be used for programming. For normal operation, communication with the laser must be maintained. The factory recommends a setting of 3 seconds for normal operation.

The value is returned to 3 seconds each time the GUI is started.

### **Imaging Control**

Use this button to take ultra high-resolution images with the *InSight*. Pressing this button displays three additional controls that allow the user to temporarily disable the servo systems that are typically operating to keep the *InSight* running at peak performance. When these servos are disabled, the laser operates without the chance of any change occurring to its output characteristics.

The servo off time is user selectable by choosing a time in the drop down box. Time intervals are in 15 minute increments with a maximum of 60 minutes. To ensure that the laser remains operating optimally, set the servo off time to the shortest time needed to take the high resolution image. If multiple images are to be taken with a time interval between each, set the off time for one image and then allow the servo to re-optimize the laser before disabling the servos for the next image.

**SERVO ON button**—restarts the laser servos immediately and stops the Servo Off counter.

**SERVO OFF button**—disables the servos and starts the servo off timer.

**Timer control**—allows the user to set the servo off timer to 15, 30, 45 or 60 minutes via a pull-down menu.

### Status

This area provides feedback about the system.

**HISTORY BUFFER display**—shows the last 16 “events,” which include system fault and status codes.

**TEMP STATUS monitor**—shows the warm-up status during start up (it mirrors the “Laser Ready” indication shown on the LCD screen on the front of the *IPS 300*). The system does not start until “100%” is displayed.

**HUMIDITY monitor**—shows the current humidity in the laser cavity. At 5% a warning is given to replace the filter cartridges. Refer to Chapter 6, “Operation,” for cartridge replacement instructions.

**STATUS monitor**—displays the operation status of the system.

## About Tab

The About tab shown in Figure 6-13 shows the GUI control software version as well as the system control software version. This information will likely be requested by Spectra-Physics service when assisting with any issues over the phone. Make note of it prior to contacting the factory.

**NOTE:** *Because of continuing efforts to improve and enhance the software, the information shown on your screen may not be the same as that shown below.*

GUI Software Version - 1.01.17

Main Control Software Version - 0180-0.01.60/ 175-1.00.15/TN00001003

**Figure 6-13** *About tab*



# CHAPTER 7: Maintenance and Diagnostics

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**Eyewear  
Required**



*The Spectra-Physics Insight™ DeepSee™ is a Class IV—High-Power Laser whose beam is, by definition, a safety and fire hazard. Take precautions to prevent accidental exposure to both direct and reflected beams. Diffuse as well as specular beam reflections can cause severe eye or skin damage. Always wear proper eye protection when working on the laser and follow the safety precautions in Chapter 2, “Laser Safety and Compliance.”*

**Note**



**Do not attempt repairs yourself while the system is still under warranty.** Instead, report all problems to Spectra-Physics for warranty repair. If you experience any problems with this system or any equipment purchased from Spectra-Physics, or if you are in need of technical information or support, contact Spectra-Physics. See Chapter 8, “Customer Service,” for a list of worldwide service centers you can call if you need help.

## Maintenance

The *InSight DeepSee* laser head requires no routine maintenance. Therefore, there is no reason to remove the outer cover from the laser head—there are no user-serviceable parts inside the laser! The cavity mirrors are optimally aligned and permanently fixed using special tooling at the factory. Realignment in the field is not necessary.

All components are cleaned to stringent standards prior to assembly and alignment at the factory. And when assembled, the inner cover is secured and sealed. This cover should only be removed by an authorized service engineer in an environment specifically designed for cleanliness, ideal humidity and temperature. *Removing the sealed cover in the field compromises the cleanliness of the intracavity space, degrades laser performance, and voids your warranty!*

Regular maintenance of the *InSight DeepSee* laser is limited to changing the coolant in the *ThermoRack 401* thermo-electric cooler (TEC) and cleaning or replacing the air filter and replacing the desiccant canisters in the *IPS-300* power supply. The procedures in the next section describe how to do this.

## Chiller Maintenance Tips

1. Check the coolant level regularly and check immediately if the screen reads “Low water level.” If low flow or significant contamination occurs, check the coolant filter.
2. From time to time, it is necessary to check the level of the *Nalco 460-PCCL104* coolant in the reservoir, or even change it if the chiller has been stored for a long period. Refer to the chiller’s user manual for instructions.
3. Clean the exterior of the chiller with a soft cloth. *Never use abrasive or solvent-based cleaners.*
4. Clean the air intake and exhausts periodically using a vacuum.
5. Do not immerse the chiller! Wetting the exterior of the chiller can cause an extreme shock hazard.

---

**Warning!**



***Always disconnect line power before performing any service on the unit.***

- 
6. If you have any questions or concerns about the chiller, call Spectra-Physics Customer Service at (800) 456-2552.

## Chiller Coolant

From time to time it is necessary to check the level of the coolant and periodically change it. Refer to the chiller user’s manual for instructions on filling the chiller reservoir and for changing the fluid. The part number for the *Nalco* coolant is listed in Table 7-1 on page 10.

---

**Warning!**



***Always fill and maintain the chiller reservoir with Nalco 460-PCCL104 liquid corrosion inhibitor. Do not use deionized water.***

---

Appendix D contains the material safety data sheet (MSDS) for the *Nalco* product. Make sure you follow the safety measures listed in this document when transporting and using the *Nalco* product. The service representative installing your system fills the chiller the first time and instructs you on its use. After the initial installation, if you have any questions regarding the use of this product, contact your Spectra-Physics service representative. Address and telephone numbers are listed at the end of Chapter 8, “Customer Service.”

## Chiller Filter

This section describes the procedure to clean the mesh filter from the chiller water filter. Spectra-Physics recommends performing this procedure once per year.

1. Close the GUI, and choose the shut down option.
2. Turn off the power supply.
3. Turn off the chiller.
4. Disconnect the hose with the filter attached from the chiller and the laser head.



**Figure 7-1** *Hose with filter attached*

5. With the filter assembly over a bucket, unscrew the filter assembly bottom (Figure 7-2).



**Figure 7-2** *Unscrew filter assembly bottom*

6. Rinse the mesh filter under water.
7. If needed, wash the mesh in the ultrasonic cleaner.
8. Replace the mesh filter into the filter assembly (Figure 7-3).



**Figure 7-3** Replace filter into assembly

9. Screw the filter assembly back together.
10. Plug the hose back into the chiller and laser head (Figure 7-4).



**Figure 7-4** Plug hose back into chiller

11. Turn on the chiller, and check for leaks.
12. Turn on the power supply.

## Changing the Desiccant Cartridges

The desiccant cartridges are located behind the ventilated panel on the front of the power supply. By pumping air through them, clean dry air is provided to keep the laser operating properly. It is important that they are maintained regularly, to ensure proper laser operation.



The cartridges contain blue desiccant that turns pink when it is consumed. A visual indication of cartridge state can be gained by looking at the cartridge color through the grill. If the cartridges appear pink, they need replacement soon. Check the humidity level on the diagnostics tab and replace the cartridge when the humidity increases above 5%.

---

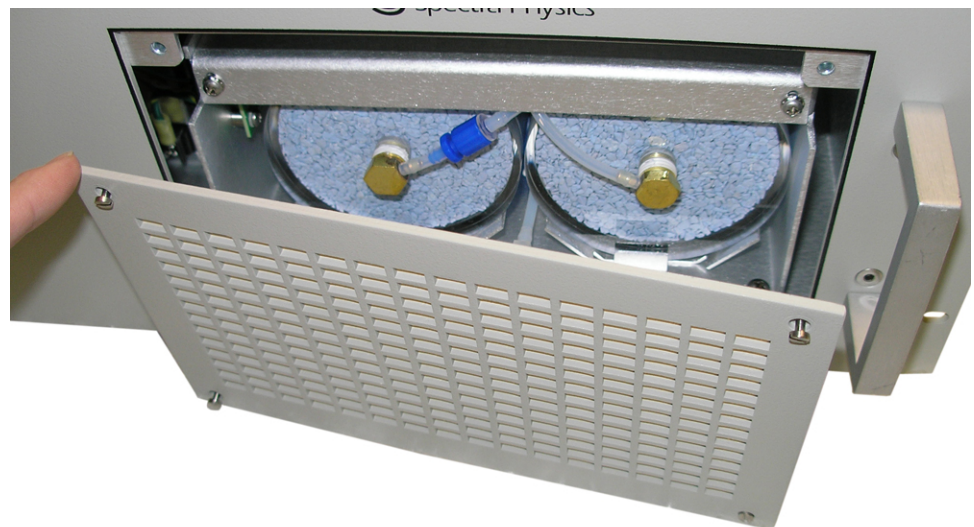
**Warning!**

**Always** disconnect line power before performing any service on the unit.

---

Remove and replace the desiccant cartridge set when the Info panel HUMIDITY indicator on the Diagnostics tab display shows that the humidity inside the laser cavity has reached 5% or more. Table 7-1 on page 10 lists the part numbers. The following procedure describes how to remove an expired cartridge set and install a new one.

1. Turn off the power supply and disconnect the power cord.
2. From the front of the power supply, loosen the four captured screws from the corners of the right-hand grill, and remove the grill as shown in Figure 7-5.



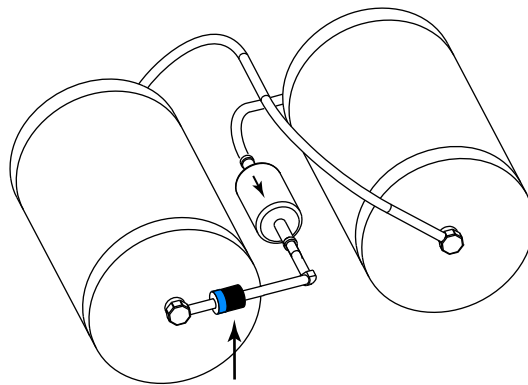
**Figure 7-5** Removing grill that covers filter assembly

3. Remove the two Phillips screws holding the cartridge retaining bracket as shown in Figure 7-6.



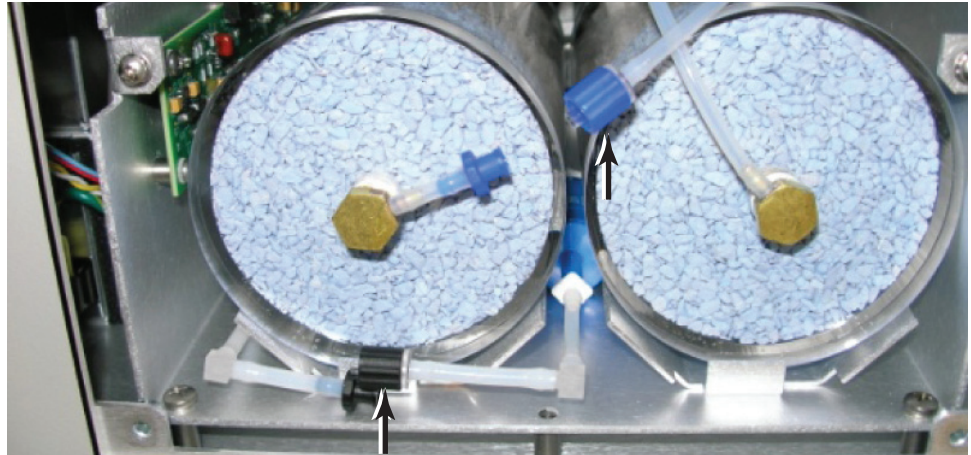
**Figure 7-6** Removing retaining bracket

The two cartridges and the little blue filter are replaced as a unit. To keep the filters dry during shipment and storage, the new cartridge set comes preassembled and with the blue and black couplers shown in Figure 7-7 connected together. After the new assembly is installed, disconnect the couplers and reconnect them as shown in Figure 7-8.



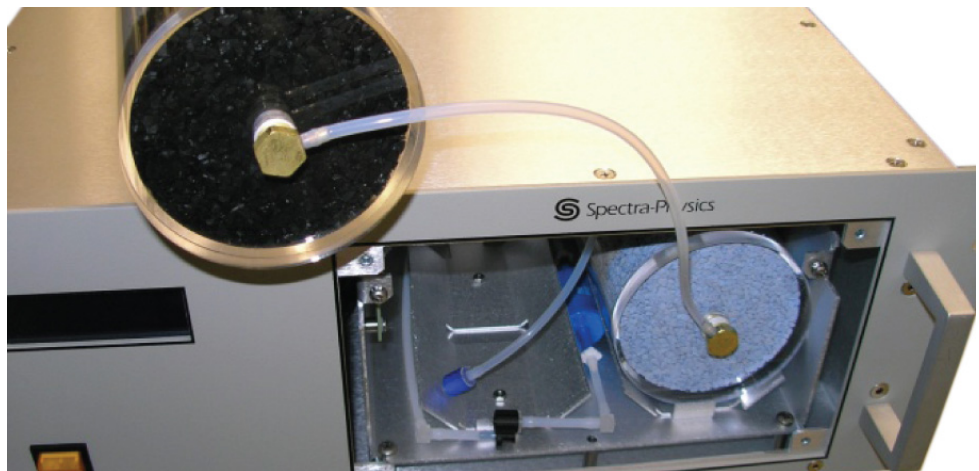
**Figure 7-7** Blue and black couplers

4. Disconnect the blue and black hose couplers shown in Figure 7-8 by twisting the connectors counter-clockwise and pulling them apart.



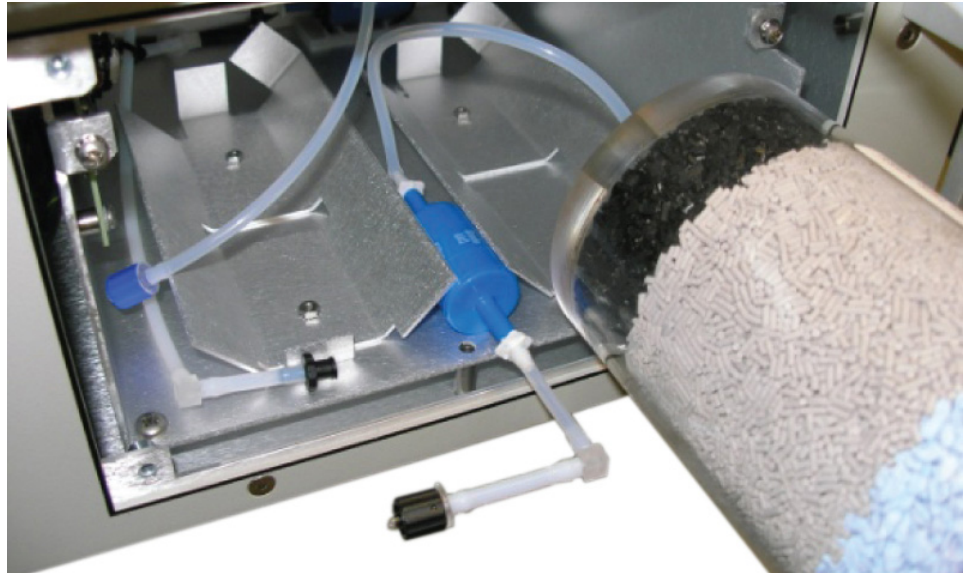
**Figure 7-8** Disconnect blue and black couplers

5. Slide out the left canister, invert it and place it on top of the power supply as shown in Figure 7-9.



**Figure 7-9** Place canister on power supply

6. Slide out the blue particle filter cartridge and the right filter canister as shown in Figure 7-10. (Angle the canister slightly to the center to clear the sheet metal.)



**Figure 7-10** Slide cartridge

7. Open the box with the new filter cartridges and carefully remove the cartridges.
8. Install the filter assembly by reversing Steps 4. through 6. Make sure you slide the blue particle filter into place below the filter brackets.
9. Disconnect the blue and black connectors from each other and attach each to their mating colored connections by pushing inward and twisting clockwise.
10. Replace the canister retaining bar. Be careful not to pinch any tubing under the bar.
11. Replace the filter grill.
12. Reconnect the line cord.
13. Start the power supply and chiller, and verify that the humidity level drops below 5% within an hour.

This completes this procedure.

## Diagnostics

### Preliminary Verification

---

**Warning!**



*The chiller and power supply must both be either on or off. Do not run the power supply or chiller without the other component for more than a few minutes.*

---

Verify the chiller temperature is set to 21°C.

## Troubleshooting Guide

The troubleshooting guide below is for use by the user. It is provided to assist in isolating some of the problems that might arise while using the *InSight DeepSee* laser system. Under no circumstances should the user attempt any repair of the laser. Hazardous voltages and high levels of laser radiation are present inside this system. Opening the laser could expose you to these dangers. Also, any repair attempt voids the factory warranty. For information concerning the repair of this unit by Spectra-Physics, call your local service representative. A list of world-wide service centers is included at the end of Chapter 7, “Maintenance and Diagnostics.” Before calling, note the software revision number of your system. It can be found on the Info menu by scrolling to the bottom of the list of specifications displayed on the screen.

### Symptom: The controller screen does not light up.

Possible Causes	Corrective Action
Power is not available to the system.	If the power supply fan is off: a. Verify that the power cord is plugged in. b. Verify that the power supply fuses are not blown.
Power supply has failed.	Call your Spectra-Physics service representative.

### Symptom: Low output power

Possible Causes	Corrective Action
The system needs calibration.	Press the OPTIMIZE button on the Diagnostics tab.
Diode(s) may have degraded.	Call your Spectra-Physics service representative.
Possible Causes	Corrective Action
The chiller is not turned on or there is poor or no coolant flow.	Verify that the chiller is turned on and its reservoir is full. Make sure all the coolant fittings are connected. Check the chiller's filter screen at the pump and clean it if necessary. Refer to the chiller user's manual.

### Symptom: High optical noise

Possible Causes	Corrective Action
The system needs calibration.	Press the OPTIMIZE button on the Diagnostics tab.
The chiller is not turned on or there is poor or no coolant flow.	Verify that the chiller is turned on and its reservoir is full. Make sure all the coolant fittings are connected. Check the chiller's filter screen at the pump and clean it if necessary. Refer to the chiller user's manual.

### Symptom: Long-term stability/beam pointing is poor.

Possible Causes	Corrective Action
The laser head is not properly mounted.	If the laser head appears to be mounted incorrectly, contact your service representative.
The routing mirrors are not installed correctly.	If routing mirrors are used as part of the beam delivery setup, ensure that they are assembled and locked down correctly.

### Warning!



*The chiller and power supply must both be either on or off. Do not run the power supply or chiller without the other component for more than a few minutes.*

# Replacement Parts

**Table 7-1** *Field replaceable units*

Description	Part Number
Nalco 460-PCCL104 liquid corrosion inhibitor (coolant), 1 gal.	1607-0546
Purge Filter Cartridge Assembly	90016698
<i>InSight</i> Laser Head Shipping Crate	90044279
<i>IPS-300</i> Power Supply/Chiller Shipping Crate w/ shipping boxes	90044281
<i>ThermoRack 401</i> Chiller	90043423
<i>ThermoRack 401</i> Chiller Filter	90062975
Hose Assembly, <i>ThermoRack 401</i> , Drain Hose	90044272
Fuse Kit for <i>IPS300</i> Power Supply	90055570
Fuse for <i>IPS-300</i> Power Supply, 15 A, 80 V, FKS ATO Blade	90048981
Fuse for <i>IPS-300</i> Power Supply, 10 A, 80 V, FKS ATO Blade	90048982
Fuse for <i>IPS-300</i> Power Supply, 7.5 A, 80 V, FKS ATO Blade	90048983
Fuse for <i>IPS-300</i> Power Supply, 3 A, 80 V, FKS ATO Blade	90048984
Fuse Kit for <i>ThermoRack 401</i> Chiller	90055702
Fuse for <i>ThermoRack 401</i> Chiller, 15 A, 100 V, 5 x 20 mm	90055700
Fuse for <i>ThermoRack 401</i> Chiller, 10 A, 220 V, 5 x 20 mm	90055701
Hose Assembly, 10 ft. long, 2 fittings	90044049
Manual, User, <i>InSight</i> (this document)	90044047
USB Flash Drive with GUI Software and USB Driver	90055290

# CHAPTER 8: Customer Service

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At Spectra-Physics, we take pride in the durability of our products. We place considerable emphasis on controlled manufacturing methods and quality control throughout the manufacturing process. Nevertheless, even the finest precision instruments need occasional service. We feel our instruments have favorable service records compared to competitive products, and we hope to demonstrate, in the long run, that we provide excellent service to our customers in two ways. First, by providing the best equipment for the money, and second, by offering service facilities that restore your instrument to working condition in a timely manner.

Spectra-Physics maintains major service centers in the United States, Europe and Japan. Additionally, there are field service offices in major United States cities. When calling for service inside the United States, dial our toll-free number: **1 (800) 456-2552**. To phone for service in other countries, refer to the Service Centers listing located at the end of this section.

Order replacement parts directly from Spectra-Physics. For ordering or shipping instructions, or for assistance of any kind, contact your nearest sales office or service center. You need your instrument model and serial numbers available when you call. Our office or service center promptly supplies service data or shipping instructions.

To order optional items or other system components, or for general sales assistance, dial **1 (800) SPL-LASER** in the United States, or **877-835-9620** from anywhere else.

## Warranty

This warranty supplements the warranty contained in the specific sales order. In the event of a conflict between documents, the terms and conditions of the sales order shall prevail.

The *Insight™ DeepSee™* laser is protected by a 12-month warranty. All mechanical, electronic, optical parts and assemblies are unconditionally warranted to be free of defects in workmanship and material for the warranty period.

Liability under this warranty is limited to repairing, replacing or giving credit for the purchase price of any equipment that proves defective during the warranty period, provided prior authorization for such return has been given by an authorized representative of Spectra-Physics.

Warranty repairs or replacement equipment is warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced equipment.

This warranty does not apply to any instrument or component not manufactured by Spectra-Physics. When products manufactured by others are included in Spectra-Physics equipment, the original manufacturer's warranty is extended to

Spectra-Physics customers. When products manufactured by others are used in conjunction with Spectra-Physics equipment, this warranty is extended only to the equipment manufactured by Spectra-Physics.

Spectra-Physics will provide at its expense all parts and labor and one-way return shipping of the defective part or instrument (if required).

This warranty does not apply to equipment or components that, upon inspection by Spectra-Physics, discloses to be defective or unworkable due to abuse, mishandling, misuse, alteration, negligence, improper installation, unauthorized modification, damage in transit or other causes beyond Spectra-Physics' control.

The above warranty is valid for units purchased and used in the United States only. Products with foreign destinations are subject to a warranty surcharge.

## Instrument Repair

If service for your laser is required, call your Spectra-Physics service representative and a Spectra-Physics service engineer will be sent to remove and package the laser for return shipment to the company. If the laser is out of warranty, a purchase order is needed to cover this service call.

## Service Centers

**Table 8-1** Service centers

Location	Contact Details
Belgium	Telephone: 0800-11 257 Fax: 0800-11 302 Email: <a href="mailto:belgium@newport.com">belgium@newport.com</a>
China	Newport Corporation Beijing Representative Office Room 2305, Building B, Tri-Tower No. 66 Zhongguancun East Road Beijing 100080 P. R. China Telephone: (86) 10-6267-0065 Fax: (86) 10-267-2342
France	MICRO-CONTRÔLE Spectra-Physics S.A. Zone Industrielle 45340 Beaune-la-Rolande France Telephone: +33-2-38-40-50-00 E-mail: <a href="mailto:france@newport-fr.com">france@newport-fr.com</a>



**Table 8-1** Service centers (Continued)

Location	Contact Details
Germany and Export Countries (includes all European and Middle Eastern countries not listed here)	Newport Spectra-Physics GmbH Guerickeweg 7 D-64291 Darmstadt, Germany  Telephone: +49-(0) 06151-708-0 Fax: +49-(0) 06151-708-217 E-mail: <a href="mailto:verkauf@newport-de.com">verkauf@newport-de.com</a>
Japan (East)	Spectra-Physics K.K. 4-6-1 Nakameguro Meguro-Ku Tokyo 153-0061, Japan  Telephone: +81-3-3794-5511 Fax: +81-3-3794-5510 E-mail: <a href="mailto:spectra-physics@splasers.co.jp">spectra-physics@splasers.co.jp</a> Web site: <a href="http://www.spectra-physics.jp">www.spectra-physics.jp</a>
Japan (West)	Spectra-Physics K.K. Nishi-honmachi Solar Building 3-1-43 Nishi-honmachi Nishi-ku Osaka 550-0005, Japan  Telephone: +81-6-4390-6770 Fax: +81-6-4390-2760 E-mail: <a href="mailto:spectra-physics@splasers.co.jp">spectra-physics@splasers.co.jp</a> Web site: <a href="http://www.spectra-physics.jp">www.spectra-physics.jp</a>
Netherlands	Newport Spectra-Physics B.V. Vechtensteinlaan 12-16 3555 XS Utrecht Netherlands  Telephone: 0900 555 5678 Fax: 0900 555 5679 E-mail: <a href="mailto:netherlands@newport-de.com">netherlands@newport-de.com</a>
Singapore	Newport Opto-Electronics Technologies (Singapore) Private Ltd. 10 Ang Mo Kio Street 65 02-11 TechPoint Singapore 569059  Telephone: (65) 6664 0400 Fax: (65) 6664 0401 E-mail: <a href="mailto:sales.sg@newport.com">sales.sg@newport.com</a>

Service Centers

**Table 8-1** Service centers (Continued)

Location	Contact Details
Taiwan	<p>Newport Corporation                      11F, No. 35, Sec. 3, Minquan E. Rd.                      Taipei 10476, Taiwan (R.O.C.)</p> <p>Telephone: +886-2-2508-4977</p> <p>Fax: +886-2-2508-0367</p> <p>E-mail: <a href="mailto:sales@newport.com.tw">sales@newport.com.tw</a></p>
United Kingdom	<p>Newport Spectra-Physics Ltd-Registered Office                      Unit 7, Library Avenue                      Harwell Science and Innovation Campus, Didcot.                      Oxfordshire, OX11 0SG</p> <p>Telephone: +44 1235 432710</p> <p>Fax: +44 1235 821045</p> <p>E-mail: <a href="mailto:sales@newport.com.uk">sales@newport.com.uk</a></p>
United States and Export Countries (includes all non-European or Middle Eastern countries not listed here)	<p>Newport Spectra-Physics                      3635 Peterson Way                      Santa Clara, CA 95054-2809</p> <p>Telephone: (800) 456-2552 (Service) or                      (800) SPL-LASER (Sales) or                      (800) 775-5273 (Sales) or                      (408) 980-4300 (Operator)</p> <p>Fax: (408) 980-6921</p> <p>E-mail: <a href="mailto:service@spectra-physics.com">service@spectra-physics.com</a>  <a href="mailto:sales@spectra-physics.com">sales@spectra-physics.com</a></p> <p>Website: <a href="http://www.spectra-physics.com">www.spectra-physics.com</a></p>

# APPENDIX A: Programming Guide

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## Command/Query/Response Format

In the interest of standardization, the serial commands and queries used on the *InSight™ DeepSee™* follow the SCPI protocol (Standardized Commands for Programmable Instruments). This protocol was developed with the user in mind so that all commands are easily readable by the user. The following rules apply:

- All commands and responses are in ASCII format.
- Commands to the *InSight DeepSee* system are terminated by an ASCII carriage return, line feed, or both.  
In this document, a carriage return is indicated by <CR> and a line feed by <LF>.
- All responses from the *InSight DeepSee* system are terminated by an ASCII line feed character.
- All queries end with a question mark (?). If a query has no command associated with it, it is preceded with READ.
- The *InSight DeepSee* system does not generate any signals on the RS-232 or USB interface (i.e., it does not respond) unless a query is received first.
- Parameters are separated from commands by spaces.
- Commands have both a “short” and “long” form.

The long form is the completely written command. The short form is derived from the long form by dropping every character after the fourth character. If the fourth character is a vowel, a three-letter form is used. The only exceptions to this pattern are OFF and ON.

Example:

Long form: SHUTTER 1

Short form: SHUT 1

In the examples in this document, the long form of the command is used with the short form portion of it written in capital letters (e.g., SHUTter 1) and, when contained within text, the entire command is in lower case.

- Several commands have variations or sub-commands which are separated by a colon (:). Short and long forms of the various commands and sub-commands may be freely mixed. For example, all of the following are equivalent:

READ:PLAS:DIOD1:CURR?

READ:PLASER:DIODE1:CURRENT?

READ:PLAS:DIODE1:CURR?

However, for consistency and readability, it is best to choose one form and stay with it throughout.

## Typical Command Usage

The control flow of an *InSight DeepSee* program might look like this:

1. Turn on the system, then wait approximately 120 seconds for the computers to initialize.
2. Begin issuing a series of READ:PCTWarmedup? queries and wait for the laser to return “100” to indicate the system is fully warmed up.
3. Set the output wavelength to 800 nm by issuing the WAVelength 800 command.
4. Check the operational readiness by issuing \*STB? Interpret the state bits of the numerical response to determine if the state is ready (State 25).
5. Turn on the laser by issuing the ON command.
6. Issue \*STB? every 1 second until the response state indicates RUN (State 50).
7. Open the shutter by issuing the SHUTter 1 command.

## Commands and Queries

### Quick Reference

The following is a list of the commands and queries used by the *InSight DeepSee*. A detailed description of this list with examples follows in the next section.

ON	page A-3
OFF	page A-3
IRSHUTter	page A-4
IRSHUTter?	page A-4
LCD:BRIGtness	page A-4
MODE RUN	page A-4
MODE ALIGN	page A-4
MODE?	page A-4
READ:AHIStory?	page A-4
READ:HUM?	page A-4
READ:PCTWarmedup?	page A-5
READ:PLASer:DIODE(n):CURRent?	page A-5
READ:PLASer:DIODE(n):TEMPerature?	page A-5
READ:PLASer:DIODE(n):HOURS	page A-5
READ:POWER?	page A-5
READ:WAVelength?	page A-5
SAVe	page A-6
SHUTDOWN	page A-6

SHUTter (n)	page A-6
SHUTter?	page A-6
TIMer:WATChdog (n)	page A-6
WAVelength (nnn)	page A-7
WAVelength?	page A-7
WAVelength:min?	page A-7
WAVelength:max?	page A-7
*IDN?	page A-7
*STB?	page A-7

## Full Description

This section explains the commands and queries in detail. The form of the command is followed by the form of the associated query, which is followed by an explanation of each.

---

### ON

---

Turns on the pump laser.

**NOTE:** *The shutter is not automatically opened when the ON command is issued.*

The response to this command depends on whether or not the system is warmed up. Use the READ:PCTWarmedup? query to determine the progress of the warm-up cycle. When the response to this query reaches 100, the laser can be started. While the response is 0 to 99, the ON command is simply ignored.

If the response to READ:PCTWarmedup? is...	The response to ON is...
0 to 99	The ON command is ignored.
100	The laser diode drive currents ramp to full power.

---

### OFF

---

Turns off the pump diode lasers, but the oven temperatures are maintained for a quick warm-up time. To turn off the laser system entirely, refer to the SHUTDOWN command.

**NOTE:** *The shutter is closed when the OFF command is issued.*

---

***IRSHUTter n (1, 0)***  
***IRSHUTter?***

---

**NOTE:** *This command/query only applies when the 1040 nm option is installed.*

IRSHUTter 1 opens the IR shutter.

IRSHUTter 0 closes the IR shutter.

IRSHUTter? Reads and returns the last IR shutter command sent.

To determine the actual shutter status, use \*STB?. When issuing the \*STB? command to determine shutter position, it is normal for the system to return 0 for approximately 1 second after issuing the IRSHUTter 1 command or, likewise, to return 1 after issuing the IRSHUTter 0 command.

---

***LCD:BRIGhtness n (50, 255)***  
***LCD:BRIGhtness?***

---

This command sets the power supply LCD screen back illumination brightness level. The default value of 255 is restored any time the power supply is cycled.

---

***MODE RUN***  
***MODE ALIGN***  
***MODE?***

---

Sets the system mode as follows.

**MODE RUN**—sets the *InSight DeepSee* to standard operating mode.

**MODE ALIGN**—sets the *InSight DeepSee* to low power so that it is easier and safer to align the optical beam through a microscope. Note: The laser does not necessarily meet mode quality or divergence specifications at the low power.

**MODE?**—returns the current mode of operation, either RUN or ALIGN.

---

***READ:AHIStory?***

---

Returns the contents of the history buffer (16 numeric codes) that indicate the various conditions of the system since the last power-on condition. The history buffer lists the most recent status codes first. Appendix B contains a list of status and fault codes.

---

***READ:HUMidity?***

---

Returns the relative humidity (in percent) of the *InSight DeepSee* laser cavity. The humidity should be kept below 5%. If humidity rises above this value, replace the purge filter cartridge (refer to Chapter 6, “Operation”).

---

**READ:PCTWarmedup?**

---

Returns the status of system warm-up as a percent of the predicted total time. The system responds with a value similar to 050<LF>. When the response is 100<LF>, the laser can be turned on.

---

**READ:PLASer:DIODe1:CURRent?**  
**READ:PLASer:DIODe2:CURRent?**

---

Returns the actual current (in Amps) of the specified pump diode laser (1 or 2). A typical response might be 14.3<LF>.

---

**READ:PLASer:DIODe1:TEMPerature?**  
**READ:PLASer:DIODe2:TEMPerature?**

---

Returns the actual temperature (in °C) of the specified pump diode laser (1 or 2). A typical response might be 20.5<LF>.

---

**READ:PLASer:DIODe1:HOURS?**  
**READ:PLASer:DIODe2:HOURS?**

---

Returns the accumulated hours that the specified diode pump laser (1 or 2) has been operating. A typical response might be 37.5<LF>.

---

**READ:POWer?**

---

Returns *InSight DeepSee* output power (in Watts). A typical response might be 1.5<LF> (this reading is for reference only—use a calibrated power meter for critical measurements).

---

**READ:WAVelength?**

---

Returns the *InSight DeepSee* actual wavelength (in nanometers). The returned value may not match the commanded wavelength until the system has finished moving to the newly commanded wavelength. A typical response might be 900<LF>.

---

## SAVe

---

Saves the *InSight DeepSee* variables and continues laser operation, unlike the SHUTDOWN command, which saves these variables and turns off the system. The following string is returned when the variables have been saved:

“Saving...completed.”

---

## SHUTDOWN

---



**Caution!**



*Never turn off the power switch before exiting the laser GUI or using RS232/USB commands to shutdown the laser.*

*Refer to Chapter 6, “Operation,” for a detailed explanation of how to shut down the laser safely.*

Use this command when you want to turn off the mains power to the *InSight DeepSee*. In addition to saving all internal variables (see the SAVE command), it does some extra preparation for the loss of power.

The following string is returned when the variables have been saved and the system is shutting down:

“Shutting down...completed.”

**NOTE:** *After this command is given, you **must** cycle the power off and on to begin using the laser again.*

---

## SHUTter N (1, 0) SHUTter?

---

SHUTter 1 opens the main shutter.

SHUTter 0 closes the main shutter.

SHUTter? Reads and returns the last shutter command sent.

To determine the actual shutter status, use \*STB?. It is normal for \*STB? to return an incorrect shutter status for approximately 1 second after issuing the SHUTter 1 command.

---

## TIMer:WATChdog n

---

Sets the number of seconds for the software watchdog timer. A value of zero disables the software watchdog timer. If the *InSight DeepSee* does not receive a valid command (or Query) every *n* seconds, the pump laser is turned off and shutters are closed. A recommended value of 3 seconds should be used. Do not disable the timer except for programing support.



---

**WAVelength nnn (in nm)**  
**WAVelength?**

---

Sets the *InSight DeepSee* wavelength between 680 and 1300 nm. Values out of this range are ignored. The query returns the most recent value of the WAVelength command. Use it to verify that the command was properly received. A typical response might be 900<LF>.

---

**WAVelength:MAX?**  
**WAVelength:MIN?**

---

These queries return the maximum and minimum values for the WAVelength command. Examples:

```
← wav:max? <CR>
→ 1300 <LF>
← wave:min? <CR>
→ 680 <LF>
```

---

**\*IDN?**

---

Returns a system identification string that contains four fields separated by commas such as:

```
“Spectra-Physics, InSight DeepSee, xxxx,
0180-0.01.60/175-1.00.15/TN00001003”
```

This string provides the laser manufacturer, model name, serial number and the revision numbers of the software versions used on the laser. Make note of this string should you have to discuss any problems with the factory.

---

**\*STB?**

---

Returns a hex value that corresponds to a 32-bit binary number. Some binary bit locations correspond to the status of individual components, while others give general status information. This allows immediate analysis of the laser status. See Table A-1.

**Table A-1** Status byte (\*STB) details

Bit Number	Bit Mask		Interpretation
0	0x00000001	Emission	The laser diodes are energized. Laser emission is possible if the shutter(s) is (are) open.
1	0x00000002	Pulsing	1 = "pulsing" The name PULSING is used for compatibility with <i>Mai Tai</i> . In the <i>InSight DeepSee</i> , this bit indicates that the laser has either: a) Reached the RUN state and can be used to take data. or b) Reached the ALIGN state and can be used to align the optical system.
2	0x00000004	Main shutter	1 = The main shutter is open (sensed position).
3	0x00000008	IR shutter	1 = The IR shutter is open (sensed position).
4	0x00000010	reserved	Reserved
5	0x00000020	Servo on	1 = Servo is on (see "SERVO n" command).
6 to 8	0x000001C0	reserved	Reserved
9	0x00000200	User interlock	1 = The user interlock (CDRH interlock) is open; laser is forced off.
10	0x00000400	Keyswitch	1 = The safety keyswitch interlock is open; laser is forced off.
11	0x00000800	Power supply	1 = The power supply interlock is open; laser is forced off.
12	0x00001000	Internal	1 = The internal interlock is open; laser is forced off.
13	0x00002000	reserved	Reserved
14	0x00004000	Warning	1 = The system is currently detecting a warning condition. The laser continues to operate, but it is best to resolve the issue at your earliest convenience.  Use READ:HISTORY? to see what is causing the warning.
15	0x00008000	fault	1 = The system is currently detecting a fault condition. <i>InSight</i> immediately turns off the laser diodes. Use READ:HISTORY? to see what is causing the fault.  Note: The fault condition may clear itself when the laser turns itself off. If so, the fault bit clears.
16 to 22	0x007F0000	State	After masking, shift right 16 bits and interpret as a number with a value from 0 to 127 (see Table A-2).  Most state numbers are not specifically assigned, but several ranges can be described and three specific values (25, 50, and 60) are guaranteed not to change.
23 to 31	0xFF800000	reserved	Reserved

Bits 16 to 22 of the \*STB command, taken in aggregate, provide a value that indicates the laser state. Those values are shown in Table A-2.

**Table A-2** State definitions

Value	Interpretation
0 to 24	Initializing
25	READY to turn on (i.e., the laser is fully warmed up. <i>InSight DeepSee</i> still does not turn on if there is an error condition such as an open interlock.)
26 to 49	Turning on and/or optimizing
50	RUN – <i>InSight DeepSee</i> is operational (see bit 1)
51 to 59	Moving to align mode
60	ALIGN mode (see bit 1)
61 to 69	Exiting align mode
70 to 127	Reserved

## DeepSee Commands

---

### **CONTrol:SLMIN?**

---

Reads the soft limit value of the lowest available motor position at the current wavelength. This query returns a value between 0 and 100. Commanding a motor position smaller than the CONTrol:SLMIN value moves the motor to the CONTrol:SLMIN value.

Example:

```

<CONT:SLMIN?<CR>
→19.39                DeepSee lower soft limit value
    
```

---

### **CONTrol:SLMAX?**

---

Reads the soft limit value of the highest available motor position at the current wavelength. This query returns a value between 0 and 100. Commanding a motor position larger than the CONTrol:SLMAX value moves the motor to the CONTrol:SLMAX value.

Example:

```

<CONT:SLMAX?<CR>
→98.00                DeepSee higher soft limit value
    
```

---

**CONTRol:MTRMOV nn.nn (Range 0 to 100)**  
**CONTRol:MTRMOV?**


---

This command writes the motor position as a number between 0 and 100 and moves the motor to this position. The number is an absolute value. If the motor position is below the minimum soft limit or above the maximum soft limit for the current wavelength, the motor moves to the soft limit and stop, though CONTRol:MTRMOV? still returns the commanded value. The range of permitted motor positions changes with wavelength.

The query reads and returns the most recent value of the CONTRol:MTRMOV command, i.e. a number between 0 and 100. Use it to verify that the commanded value was properly received.

Example:

```
<CONT:MTRMOV 002?<CR>      Moves the DeepSee motor 0.02 units.
```

---

**CONTRol:DSMPOSITION?**


---

This query reads and returns the **actual** *DeepSee* motor position. The returned value may not match the commanded motor position (see the command CONTRol:MTRMOV) if:

- The motor has not finished moving.
- OR
- The command value is less than or more than the soft-limit values.

Even after the system has finished moving to the commanded motor position, it is possible for there to be a difference between the commanded position and the actual position of up to 0.01.

For example:

If the motor starts at count 70 (the response to CONTRol:DSMPOSITION?) and the command is sent to move the motor to 20 (CONTRol:MTRMOV 20.00), and then the command CONTRol:DSMPOSITION? is immediately sent, the system responds *not* with 20, but with some value between 70 and 20, i.e., a number that represents actual motor position at that instant.

Let's say it returns 52. If CONTRol:DSMPOSITION? is continuously sent, the value for motor position continues to approach 20 for each successive command sent.

However, if the lower soft-limit is set higher than 20, say at 40 (using the command CONTRol:SLMIN), the response to the command CONTRol:DSMPOSITION? is 40 when the motor has stopped moving, because this is as far as the motor can travel due to the soft-limit. This is the actual motor position.

**NOTE:** *If the command CONTRol:MTRMOV? is sent, a response of 20 is returned, because this is the command value that was entered.*

## Using the RS-232 and USB Serial Ports

The RS-232 port can be used to run a control program written by the operator. The USB port is used when the GUI control software is used, but it can also be used by the operator.

---

**Warning!**



**DO NOT USE** the RS232 interface while the USB interface is in use.

---

Do not operate any remote software when the laser is being controlled by the factory GUI. Use only one control interface at a time.

### Pinout/Wiring for RS-232

The *InSight DeepSee* RS-232 port accepts a standard 9-pin D-sub male/female extension cable for hookup. Only three of the pins are actually used:

**Table A-3** RS-232 pin assignments

Pin Number	Use
2	Transmit data (InSight out)
3	Receive data (InSight in)
5	Signal ground

### Communications Parameters for RS-232

Computer communications for each port used must be set to:

- 8 data bits
- no parity
- one stop bit
- baud rate 9600

**NOTE:** Do not use the hardware protocol setting in your communications software.

### Using the USB Port

This is a standard USB 2.0 port. The port automatically recognizes the control computer if the USB driver software (provided with the system) has been installed on the computer prior to use. For proper operation, the supplied driver must be installed. This port is used as a virtual COM port with the BAUD rate set to 115200. The Spectra-Physics service representative who installs your system will also install the USB driver.



# APPENDIX B: Status Codes

## Status Codes

Table B-1 lists the status codes and messages that can be produced by the *Insight™ DeepSee™* laser system. Most are self-explanatory and many errors can be corrected by the user.

In the event the error cannot be corrected or the action required to correct the error is not known, contact your Spectra-Physics service representative. However, before you call, write down the code and its description.

The READ:AHIS? command reports the most recent 16 codes from the system, with the most recent code listed first. These codes are also shown on the LCD display on the front panel of the *IPS-300* power supply, as indicated by the line numbers given in Table C-1.

The status types shown in the table below are:

**Status**—System is functioning normally

**Warning**—System is functioning normally, but user action is suggested.

**Fault**—Laser diodes turn off and the shutter closes. User action is required.

**Table B-1** Status codes reported by the READ:AHIS? command

Status Code (line 2)	Type	LCD Displays (line 3 and line 4)	Description	Action Required
0	Status	Normal display	No notices are displayed.	No action is required
56	Fault	HW watchdog expired	A hardware time-out has occurred.	If problem continues, contact Spectra-Physics.
66	Fault	SW watchdog expired	A software time-out has occurred.	Restore computer communications. Consider increasing the timeout time using the Timer: Watchdog command.
88	Fault	Diode thermistor shorted	A diode laser thermistor short has been detected.	Contact Spectra-Physics
89	Fault	Diode thermistor open	A diode laser thermistor open has been detected.	Contact Spectra-Physics
90	Fault	Diodes are too hot	Diode laser temperature $\geq 50^{\circ}\text{C}$ . (shutdown condition)	Check coolant connections.
91	Warning	Diodes are warm	Diode laser temperature $\geq 45^{\circ}\text{C}$ . (shutdown condition)	Check coolant connections.
92	Fault	Diodes are too cold	Diode laser temperature $\leq 5^{\circ}\text{C}$ .	Check chiller status and coolant connections.

**Table B-1** Status codes reported by the READ:AHIS? command (Continued)

Status Code (line 2)	Type	LCD Displays (line 3 and line 4)	Description	Action Required
117	Fault	Internal interlock	An internal interlock has opened.	Contact Spectra-Physics
118	Fault	CDRH interlock	The CDRH interlock is open.	Check the interlock connector.
119	Fault	Pwr supply interlock	The power supply interlock is open.	Check the cable to the <i>IPS-300</i> .
120	Fault	Key switch interlock	The keyswitch is in the OFF position.	Turn the keyswitch to the enable (vertical) position.
129	Fault	Very high humidity	The purge component is no longer removing moisture from the system.	Change the purge cartridge.
130	Warning	High humidity	The purge component is no longer removing enough moisture from the system.	Change the purge cartridge when convenient
476	Warning	Chiller temp warning	The coolant temperature is nearing the range limit of operation.	Check the chiller temperature setpoint.
477	Fault	Chiller temp fault	The coolant temperature is outside the range limit of operation.	Check the chiller temperature setpoint.
478	Fault	Chiller water low	Coolant level low	Check chiller coolant level.
479	Fault	Chiller COM fault	Communication with the chiller has been lost.	Check the cable from the <i>InSight</i> to the chiller.
480	Fault	Chiller fault	The chiller is not working.	Contact Spectra-Physics
481	Fault	Slow Diode Ramp	Laser turn on failed.	Contact Spectra-Physics
482	Fault	Low FSec Osc Power	Oscillator output is below spec.	Contact Spectra-Physics
483	Fault	Low FTO Power	Laser turn on failed.	Try a different wavelength. Contact Spectra-Physics



# APPENDIX C: Mode Locking and GVD Compensation

---

This appendix provides a brief discussion of mode locking. Also included is a description of group velocity dispersion (GVD).

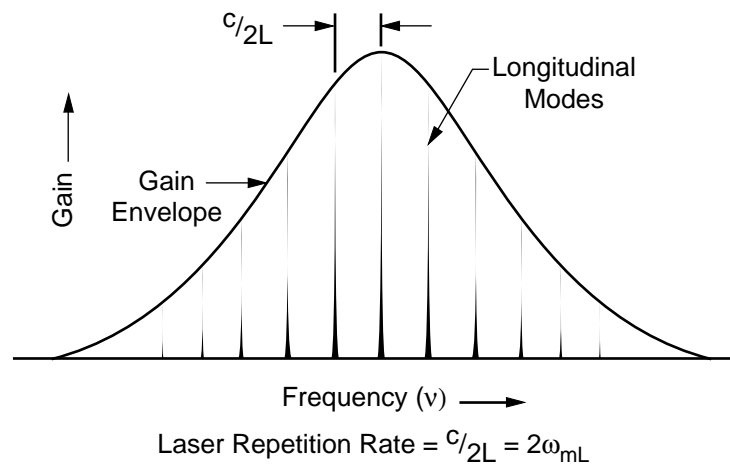
## Mode Locking

Mode locking is the process by which a laser system can generate extremely short pulses and correspondingly high peak powers without significantly changing the average power out of the laser.

Mode locking occurs when a periodic loss mechanism is introduced to a laser resonator, and the loss period is set to match the laser cavity round trip time of the laser light.

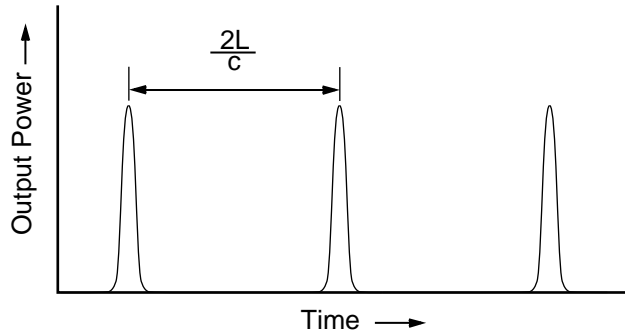
The laser pulses when the cavity loss is at a minimum. The resulting temporal pulse is then narrowed on each successive round trip through the loss mechanism and other nonlinear effects within the laser.

This results in the phase of all the optical frequencies, or longitudinal modes, being locked together.



**Figure C-1** Amplitude and frequency of longitudinal modes in mode-locked laser

This produces a series of ultra-short laser pulses at a frequency of  $c/2L$ , where  $L$  is the laser cavity length. In the *InSight DeepSee* laser, the resulting frequency is around 80 MHz (see Figure C-2). In the figure,  $L$  is cavity length and  $c$  is light velocity.

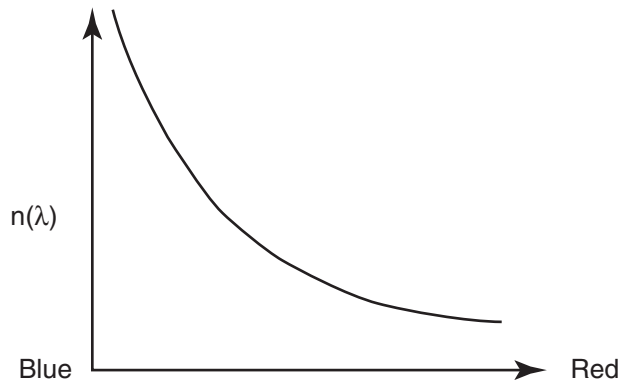


**Figure C-2** Typical output of mode-locked laser

The *InSight DeepSee* takes advantage of this characteristic of lasers to deliver a laser system capable of generating a series of pulses with less than 120 fs duration.\*

## Group Velocity Dispersion

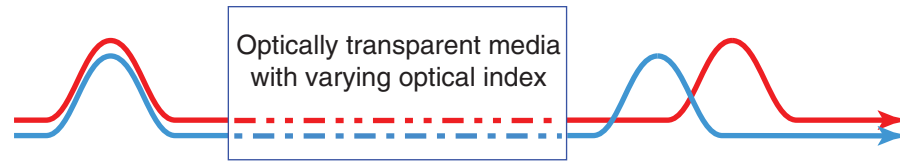
The optical index of a material is a ratio of the velocity of light in a vacuum to the velocity of light in the material. Most materials have an optical index that varies with wavelength. That is, light at any given wavelength travels through the optically transparent media with a unique velocity (refer to Figure C-3).



**Figure C-3** Typical wavelength dependence of refractive index of material

Group velocity dispersion (GVD) comes into effect when a group of wavelengths pass through an optically transparent medium with a varying optical index. Each color component of the wavelengths takes a different time to pass through the material due to the different optical index it experiences. The characteristic of a material to yield this mismatch in time is known as GVD.

This can be visualized by imagining a pulse composed of a red and blue wavelength entering a length of optical material at the same time. The red wavelength experiences less delay than the blue wavelength, and so the red pulse would exit the material first. The overlapped pulses that entered the material would exit as two distinct pulses in time, with the red one first.



**Figure C-4** Typical pulse spreading due to GVD

GVD is present in all optically transparent materials other than a perfect vacuum. The amount of GVD varies with the material. In practice, the GVD of some materials, such as air, is typically small enough to be ignored.

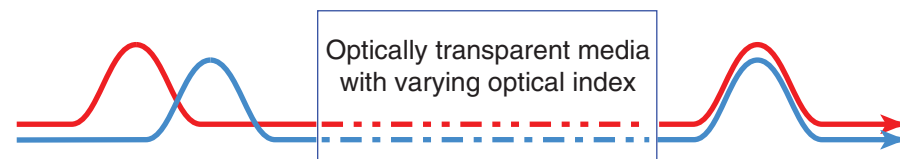
The pulses from the *InSight DeepSee* laser are not composed of a single wavelength. They are made up of a band of wavelengths, the width of which is referred to as the bandwidth of the laser. The tunable oscillator within the *InSight DeepSee* has been carefully designed to ensure that the effects of GVD in the laser are minimized for all operating wavelengths. Therefore, the pulses leaving the tunable oscillator show very little residual dispersion.

Most applications for *InSight DeepSee* require the beam to pass through other optical components, such as lenses, beam splitters or microscope objectives. Each of the components exhibit GVD. Even dielectrically coated reflecting mirrors exhibit some GVD.

If sufficient GVD is encountered in the optical path, the band of wavelengths that make up the pulse become spread in time, or “chirped,” resulting in a broader effective pulse width. For many applications, this spreading of the wavelengths limits the usefulness of very short optical pulses.

In order to cancel the effect of dispersive optical components introduced by the user, the *InSight DeepSee* uses a patented scheme to precompensate the dispersion. That is, it delays the red wavelength components more than the blue wavelength components. The *DeepSee* portion of the *InSight DeepSee* laser generates this precompensation.

*DeepSee* allows the precompensated *InSight DeepSee* beam to pass through a user’s optical components, and exit the last optic with the dispersion canceled out (see Figure C-5). A wide range of optical dispersion can be compensated for with this technique.



**Figure C-5** System with precompensation providing shortest pulse at sample

This makes the *InSight DeepSee* particularly well suited for applications requiring the shortest possible pulse at the sample location, such as in vivo microscopic fluorescence imaging.

With the *InSight DeepSee* component, Spectra-Physics introduces a completely automated, user-friendly, compact dispersion compensation system. *DeepSee* provides high negative GVD values, a large dynamic range for dispersion compensation, high throughput and excellent pointing stability. Refer to Chapter 5, “Operation,” for further details.

# APPENDIX D: MSDS Data Sheets

---

This section contains copies of material safety data sheets (MSDS) that are supplied by our vendors and which cover the various chemicals and compounds used in the *InSight* laser system, e.g., the compounds used in the *Nalco* coolant in the *ThermoRack 401* chiller.

---

**Danger!**

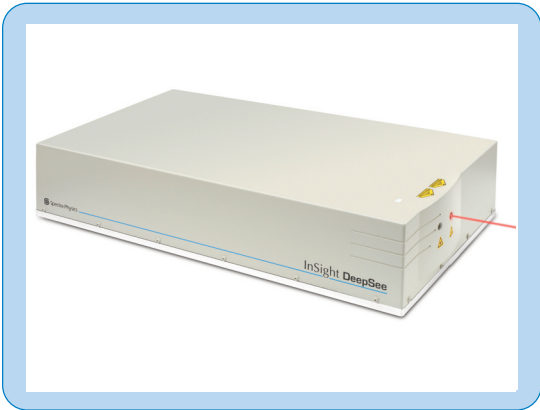


*Read the MSDS carefully before handling or disposing of the Nalco coolant. They may contain hazardous chemicals. Spectra-Physics has not independently determined the accuracy of the MSDS, which are developed by the manufacturer of each chemical; therefore, we do not warrant the information contained therein. Dispose of the Nalco coolant properly as indicated on the appropriate data sheet, and refer to your local environmental regulations regarding disposal. For further information, contact the chemical manufacturer at the address listed on each sheet.*

---

# InSight™ DeepSee™

ULTRAFAST LASER SYSTEM FOR MULTIPHOTON IMAGING



## The InSight DeepSee Advantage

- Broadest tuning range: 680 nm to 1300 nm for deepest imaging
- Short pulse width and highest peak power for maximum fluorescence
- Integrated DeepSee™ to deliver short pulses to the sample
- Ideal beam characteristics optimized for multiphoton imaging
- Fully automated, turn-key system
- Dual wavelength option for uncaging, CARS and multi-modal imaging

## APPLICATIONS

- Multiphoton microscopy
- Multimodal imaging including CARS and SHG
- Time-resolved photoluminescence
- Non-linear spectroscopy
- Optical computed tomography
- Surface second harmonic generation
- Terahertz imaging
- Semiconductor metrology

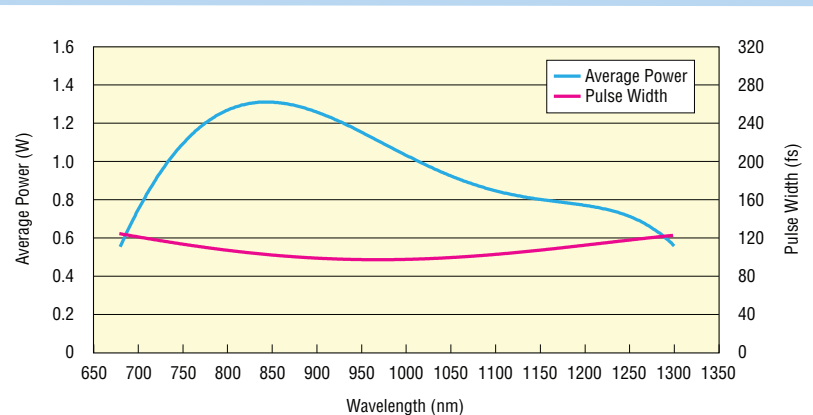
 Spectra-Physics  
A Newport Corporation Brand

Spectra-Physics introduces InSight™ DeepSee™, an extraordinary new ultrafast laser system that takes multiphoton imaging to new depths. Based on patented technology<sup>2</sup>, the InSight DeepSee delivers nearly double the tuning range of existing ultrafast lasers and provides seamless access to long infrared wavelengths for deepest in vivo imaging. Robust and fully automated, InSight DeepSee provides easy-to-use, hands-off operation, freeing users to focus on their critical research.

InSight DeepSee features an unprecedented 680 nm to 1300 nm continuous tuning from a single source, short 100 fs pulse widths and highest peak power levels into the infrared where imaging penetration depth is maximized. Spectra-Physics' integrated patented DeepSee, the industry standard dispersion pre-compensator, delivers the short pulses through a microscope to the sample for maximum fluorescence. InSight DeepSee also has exceptional beam pointing stability, beam quality and output power stability, making it ideal for microscopy.

A dual wavelength option with a second output beam complementing the main tunable output is available for advanced imaging techniques including uncaging, CARS imaging and multimodal imaging. This fully automated ultrafast laser can be seamlessly tuned with the click of a mouse to any wavelength within seconds at speeds over 50 nm/sec. InSight DeepSee is designed, built and tested to our highest quality standards for reliable hands-free operation.

## Typical Tuning Curve and Pulse Width<sup>1</sup>



1. Typically measured performance; not a guaranteed or warranted specification.

2. The automated dispersion compensation technology in this product is protected by US patent number 7,962,046.

# InSight™ DeepSee™

## Specifications<sup>1, 9</sup>

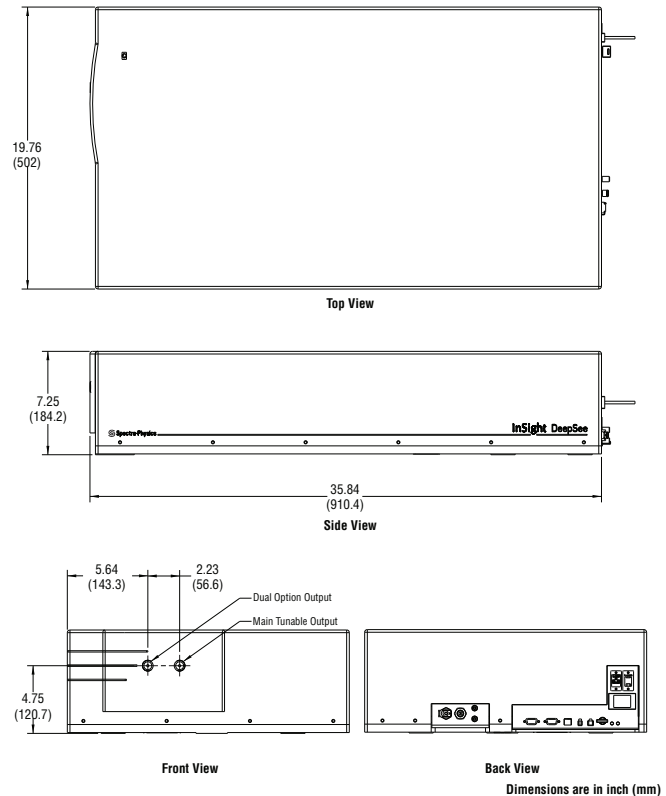
Output Characteristics	InSight DeepSee
Tuning Range	680 nm–1300 nm
Average Power <sup>2</sup>	600 mW at 700 nm 1.0 W at 900 nm 800 mW at 1000 nm 600 mW at 1200 nm 500 mW at 1300 nm
Dual Option <sup>3</sup>	500 mW at 1041 nm
Pulse Width <sup>4, 7</sup>	<120 fs
Repetition Rate	80 MHz ±1 MHz
Noise <sup>4, 5</sup>	<0.5%
Stability <sup>6</sup>	<±1%
Spatial Mode <sup>4</sup>	TEM <sub>00</sub> , M <sup>2</sup> <1.2
Polarization <sup>4</sup>	>500:1 horizontal
Beam Divergence, full angle <sup>4</sup>	<1.5 mrad
Beam Diameter (1/e <sup>2</sup> ) <sup>4</sup>	1.1 ±0.2 mm
Beam Roundness <sup>4</sup>	0.8–1.2
Beam Pointing Stability	<350 μrad full range
Tuning Speed	>50 nm/sec full range
Dispersion Range <sup>2</sup>	680 nm: -12,000 fs <sup>2</sup> to -40,000 fs <sup>2</sup> 800 nm: 0 fs <sup>2</sup> to -25,000 fs <sup>2</sup> 1050 nm: 0 fs <sup>2</sup> to -10,000 fs <sup>2</sup> 1300 nm: -3,000 fs <sup>2</sup> to -8,000 fs <sup>2</sup>

### Environmental Requirements

Altitude	Up to 2000 m
Temperature, Operating	20–25°C
Relative Humidity, Operating	Maximum 75% non-condensing up to 25°C
Temperature, Storage	15–35°C
Relative Humidity, Storage	<65% for 15–35°C
Cooled Water Temperature in Closed-loop Chiller	20°C typical <sup>8</sup>

- Due to our continuous improvement program, specifications may change without notice
- Specifications only apply to the wavelength noted
- When configured with the Dual Option, average power specifications are reduced by 10%. Contact factory for additional specifications with this option.
- Specification applies to 900 nm only
- Specification represents rms noise measured in a 10 Hz to 10 MHz bandwidth
- Percent power drift in any 2-hour period with less than ±1°C temperature change after a 1-hour warm up

## InSight DeepSee Dimensions



- A sech<sup>2</sup> pulse shape is used to determine the pulse width as measured with a Newport PulseScout<sup>®</sup> autocorrelator
- Avoid obstructing the air exhaust grills which will result in the recirculation of hot exhaust air. Cooling air enters through the front panel and exits through the rear fan apertures.
- 9. The InSight DeepSee is a Class IV – High-Power Laser, whose beam is, by definition, a safety and fire hazard. Take precautions to prevent exposure to direct and reflected beams. Diffuse as well as specular reflections can cause severe skin or eye damage.**



A Newport Corporation Brand

3635 Peterson Way, Santa Clara, CA 95054, USA

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Germany / Austria / Switzerland	+49-(0)6151-708-0	germany@newport.com

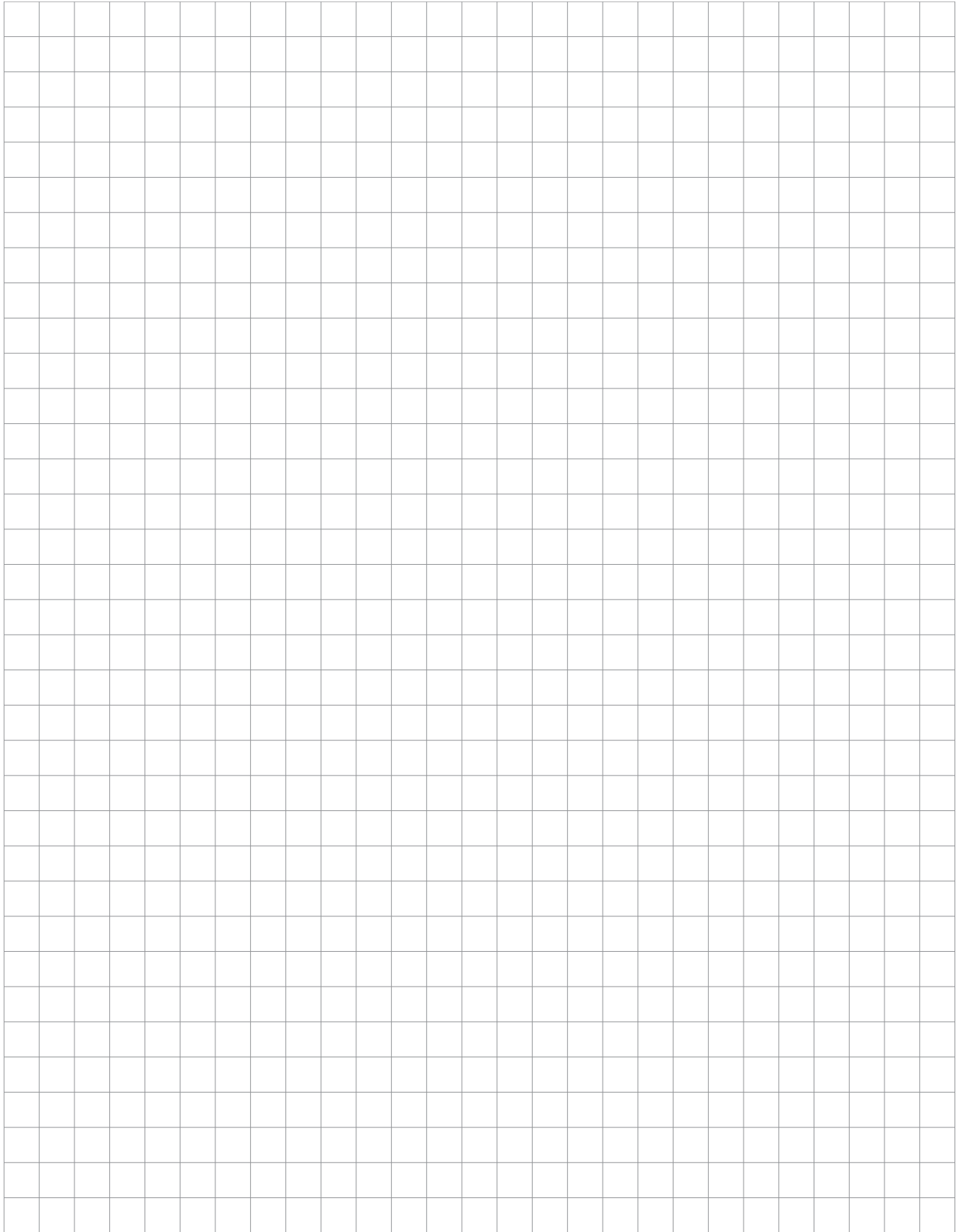
Newport Corporation, Irvine and Santa Clara, California and Franklin, Massachusetts; Evry and Beaune-La-Rolande, France; Stahnsdorf, Germany and Wuxi, China have all been certified compliant with ISO 9001 by the British Standards Institution.

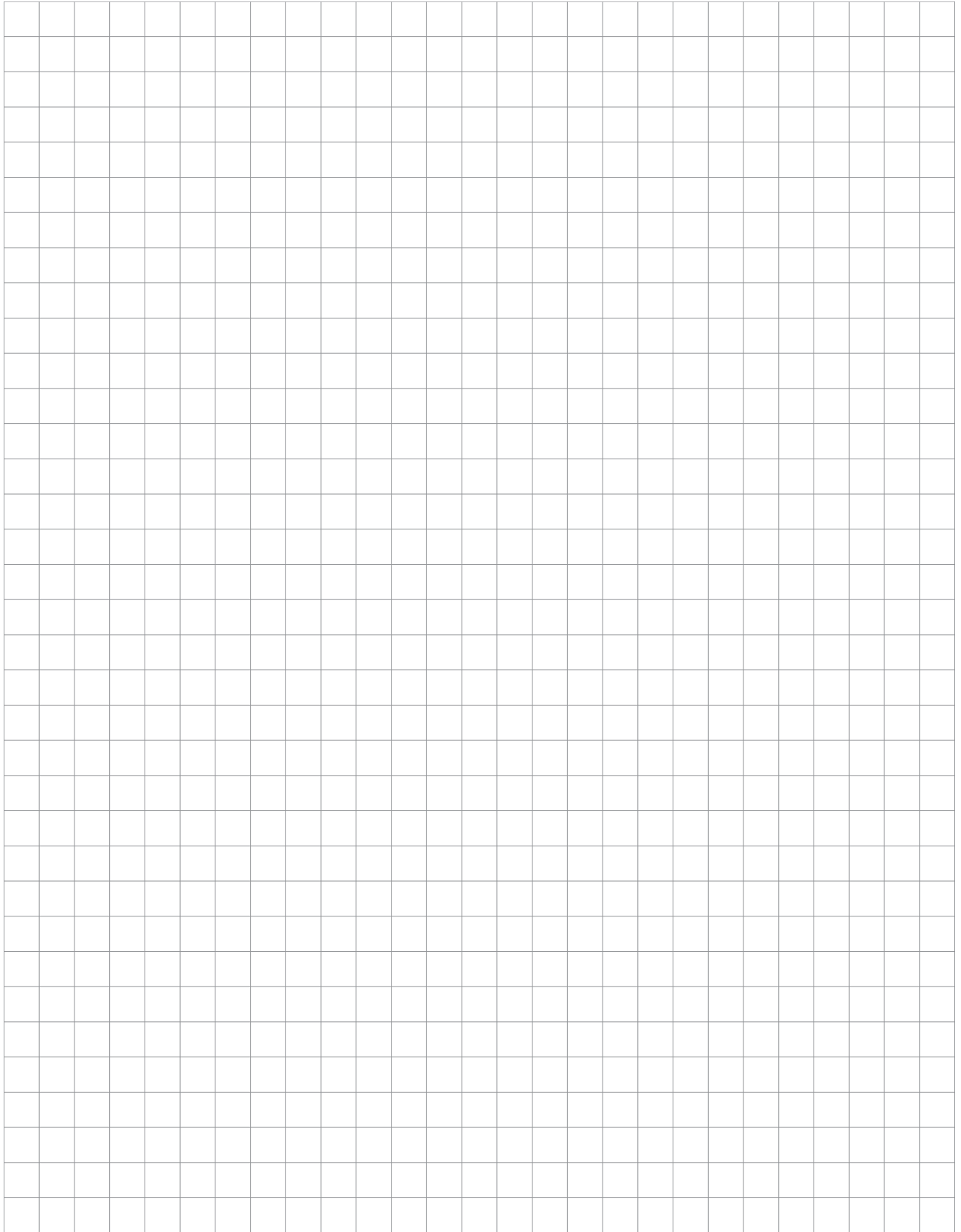
Newport Corporation, Global Headquarters PHONE: 1-800-222-6440 1-949-863-3144  
1791 Deere Avenue, Irvine, CA 92606, USA EMAIL: sales@newport.com  
Complete listings for all global office locations are available online at [www.newport.com/contact](http://www.newport.com/contact)

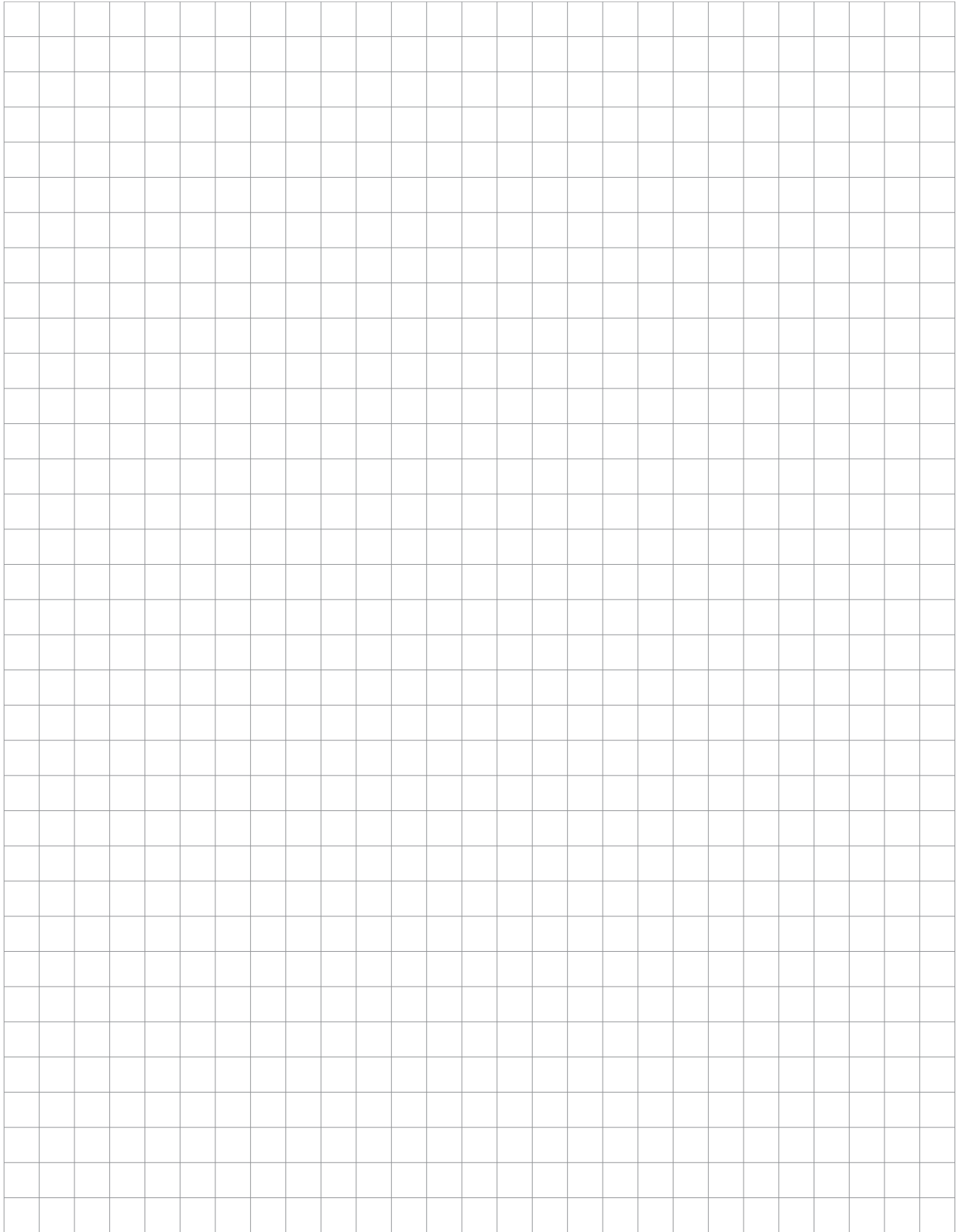




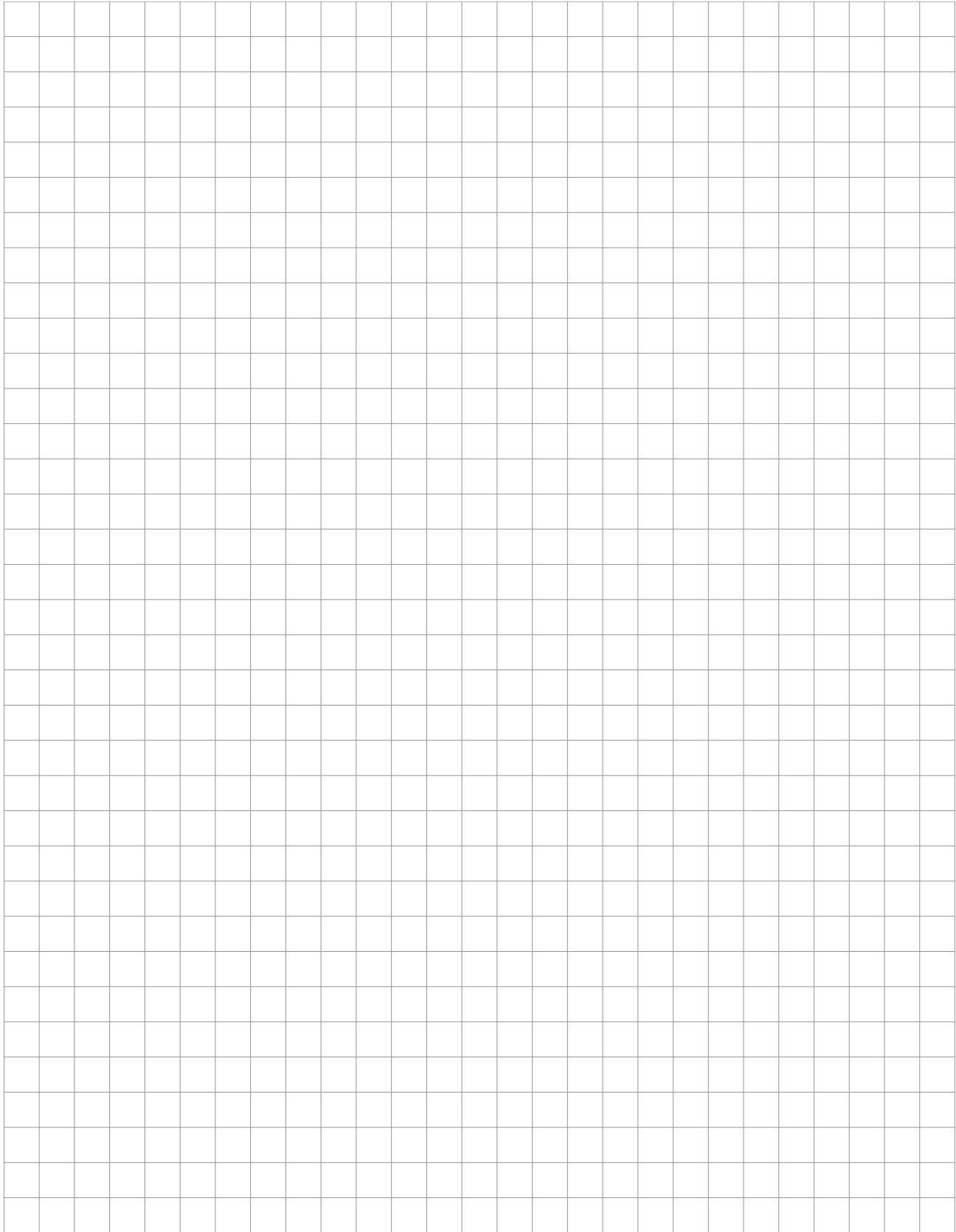












# Report Form for Problems and Solutions

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We have provided this form to encourage you to tell us about any difficulties you have experienced in either using your Spectra-Physics instrument or its manual—problems that did not require a formal call or letter to our service or marketing departments, but that you feel should be remedied. We are always interested in improving our products and manuals and we appreciate all suggestions. Thank you!

Send all instrument-related questions to:

Spectra-Physics  
A Newport Corporation Brand  
Service Manager  
3635 Peterson Way  
Santa Clara, CA 95054  
FAX: (408) 980-3584

Send all manual-related questions to:

Spectra-Physics  
A Newport Corporation Brand  
Senior Director Product Marketing  
3635 Peterson Way  
Santa Clara, CA 95054  
FAX: (408) 980-7101

**From:**

Name \_\_\_\_\_

Company or Institution \_\_\_\_\_

Department \_\_\_\_\_

Address \_\_\_\_\_

Instrument Model Number \_\_\_\_\_ Serial Number \_\_\_\_\_

**Problem** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Suggested Solution(s)** \_\_\_\_\_

\_\_\_\_\_

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