InSight® X3™ Laser System

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.

Spectra-Physics®

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Revision B

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Preface

About this Guide

This manual contains information needed to safely operate your *InSight® X3™* 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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Overview of this Guide

The *InSight X3 User’s Manual* includes the following sections:

- Chapter 1, “Introduction,” contains a brief description of the *InSight X3* 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 X3* 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 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 the *InSight X3* system 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 X3 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 X3* 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 X3* system.
- Appendix B, “Status Codes” lists the status codes.
- Appendix C, “Mode Locking and GVD Compensation,” describes mode locking, ultra-short pulse propagation, and dispersion (GVD) compensation.
- Appendix D, “Nalco MSDS,” 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 X3* laser.

Environmental Specifications

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.

Table 1-1 *Laser head environmental specifications*

Feature	Specification
Altitude	Up to 2000 m
Temperature, operating	20°C to 25°C
Relative humidity, operating	Maximum 75% noncondensing up to 25°C
Temperature, storage	15°C to 30°C
Relative humidity, storage	<65% for 15°C to 35°C
Cooled water temperature in closed-loop chiller	21°C typical [1]

1. 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.

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 their own expense.

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

CDRH Regulations

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

Warning Conventions

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.

Laser radiation is present.

Danger! 

Condition or action may present a hasard to personal safety.

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

Warning! 

Condition or action may cause damage to equipment.

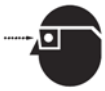
Warning!
ESD 

Action may cause electrostatic discharge and cause damage to equipment.

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.*

Standard Abbreviations

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	Ω
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^{12})	T
giga	(10^{9})	G
mega	(10^{6})	M
kilo	(10^{3})	k
deci	(10^{-1})	d
centi	(10^{-2})	c

Prefix	Power	Abbreviation
milli	(10^{-3})	m
micro	(10^{-6})	µ
nano	(10^{-9})	n
pico	(10^{-12})	p
femto	(10^{-15})	f
atto	(10^{-18})	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^{-15} second
GVD	group velocity dispersion
IR	infrared
ps	picosecond or 10^{-12} 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

InSight X3 Laser System

InSight® X3™ 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 X3* 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 X3* laser system comprises four main elements:

- *InSight X3* mode-locked laser head
- Rackmountable *IPS-300* power supply
- Rackmountable *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 X3* laser system. In the figure, *InSight X3* laser head is on the left. The *IPS-300* power supply and ThermoRack chiller are shown in the rack on the right.

Figure 1-1 *InSight X3 mode-locked laser system*

The *InSight X3* 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 diode 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 X3* laser system to supply chilled coolant to the laser head for cooling the laser diode.

Control Software

Special graphical user interface (GUI) control software is provided by Spectra-Physics for controlling the *InSight X3* system. This software comes preinstalled on a notebook computer optionally provided with the system. It is also provided on a 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 X3* 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.”

Patents

For patent information, please see www.newport.com/patents.

Specifications

Table 1-1 lists the optical performance specifications for the *InSight X3* laser system, Table 1-2 lists mechanical specifications, and Table 1-3 lists environmental specifications.

Table 1-1 *Optical specifications* [1, 2]

Output Characteristics	InSight X3 Specifications	Dual Option
Tuning Range	680 nm to 1300 nm	1045 nm (fixed)
Average Power [3]	>1.0 W at 700 nm >1.6 W at 800 nm >2.0 W at 900 nm >1.8 W at 1000 nm >1.6 W at 1100 nm >1.4 W at 1200 nm >1.0 W at 1300 nm	>2.0 W at 1045 nm
Pulse Width [4, 5]	< 120 fs	< 200 fs
Repetition Rate	80 MHz ±0.5 MHz	
Noise [4, 6]	<0.5%	
Stability [7]	< ±1%	
Spatial Mode	TEM_{00}, M^2 <1.2	
Polarization [4]	> 500:1 horizontal	
Beam Divergence, full angle [4]	< 1.5 mrad	
Beam Diameter at ($1/e^2$) [4]	< 1.1 ±0.2 mm	
Beam Roundness [4]	0.8–1.2	
Beam Pointing Stability	< 350 µrad full range	
Tuning Speed	>50 nm/sec full range	
Pre-compensation Dispersion Range [3] 700 nm 800 nm 1050 nm 1300 nm	 -12,000 fs^2 to -40,000 fs^2 0 fs^2 to -25,000 fs^2 0 fs^2 to -10,000 fs^2 -3000 fs^2 to -8,000 fs^2	 Optional 1045 nm: -15,000 fs^2 fixed

1. Due to our continuous improvement program, specifications may change without notice.
2. The *InSight X3* 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.
3. Specifications only apply to the wavelength noted.
4. Specification applies to 900 nm (tunable) or 1045 nm (fixed), respectively.
5. A $sech^2$ pulse shape is used to determine the pulse width as measured with a Newport PulseScout® autocorrelator.
6. Specification represents RMS noise measured in a 10 Hz to 10 MHz bandwidth.
7. Percent power drift in any 2-hour period with less than ±1°C temperature change after a 1-hour warm-up.

Table 1-2 *Mechanical/electrical specifications*

Feature	Specifications	
	English Units	**Metric Units**
Size		
InSight X3 Laser Head	19.76W x 35.83D x 7.25H in.	50.2W x 91.04D x 18.42H cm
IPS-300 Power Supply	19.0W x 17.9D × 6.9H in.	49.26W × 45.52D × 17.57H cm
ThermoRack 401 Chiller	19.0W x 20.0D × 6.9H in.	49.26W × 50.8D × 17.57H cm
Umbilical Length	10 ft.	3 m
Weight		
InSight X3 Laser Head	185 lb.	84 kg
IPS-300 Power Supply	28 lb.	13 kg
ThermoRack 401 Chiller	49.5 lb.	22.5 kg
Power Requirements		
IPS-300 Power Supply	100–120 V~/200–240 V~, 10 A/6 A max., 50/60 Hz	
ThermoRack 401 Chiller	100–240 Vac, 9 A max., 50/60 Hz	

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

Table 1-3 *Laser head environmental specifications*

Feature	Specification
Altitude	Up to 2000 m
Temperature, operating	20°C to 25°C
Relative humidity, operating	Maximum 75% noncondensing up to 25°C
Temperature, storage	15°C to 30°C
Relative humidity, storage	<65% for 15°C to 35°C
Cooled water temperature in closed-loop chiller	21°C typical [1]

1. 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.

Typical Tuning Curve

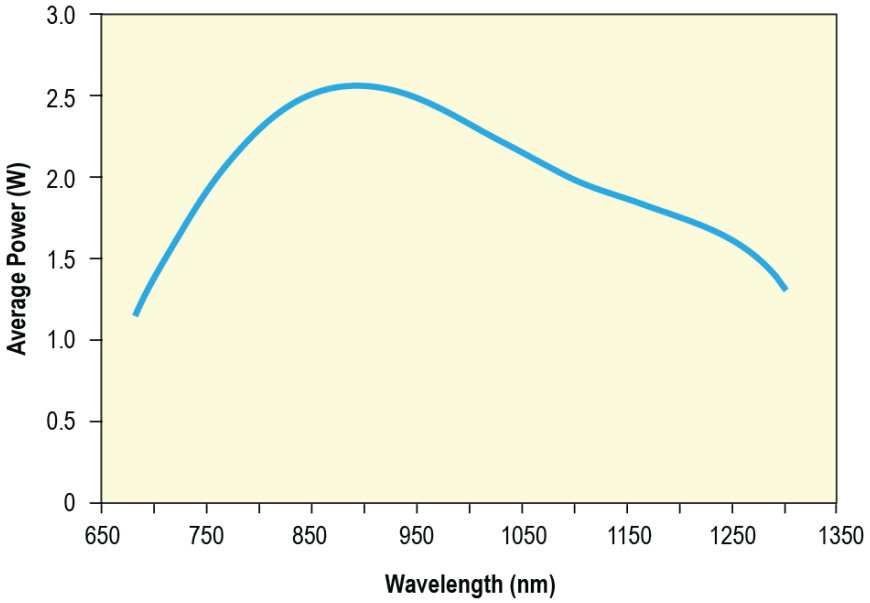


Figure 1-2 *Typical tuning curve*

Note *The curve in Figure 1-2 illustrates the typically measured performance; not a guaranteed or warranted specification.*

Outline Drawings

Laser Head

Figure 1-3 *Outline drawing, laser head top view*

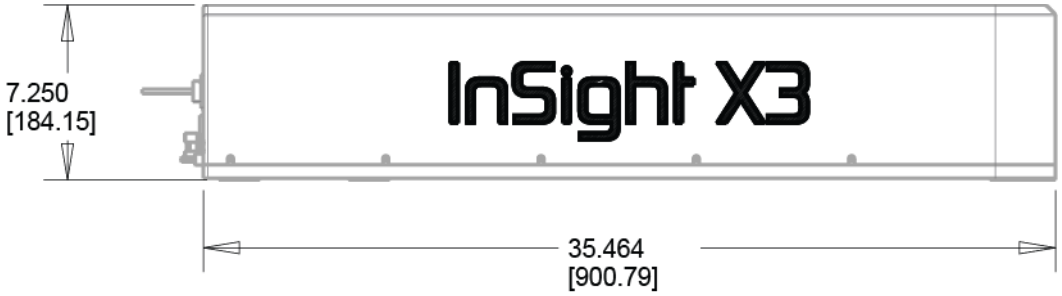


Figure 1-4 *Outline drawing, laser head, side view*

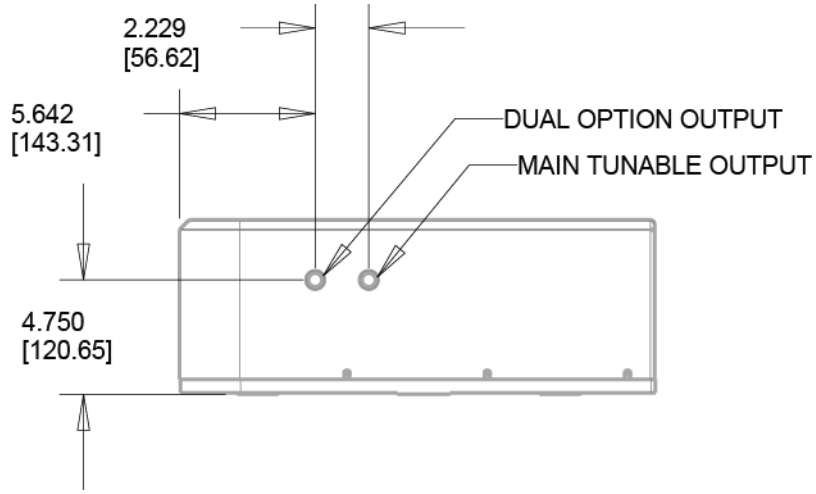


Figure 1-5 *Outline drawing, laser head, front view*

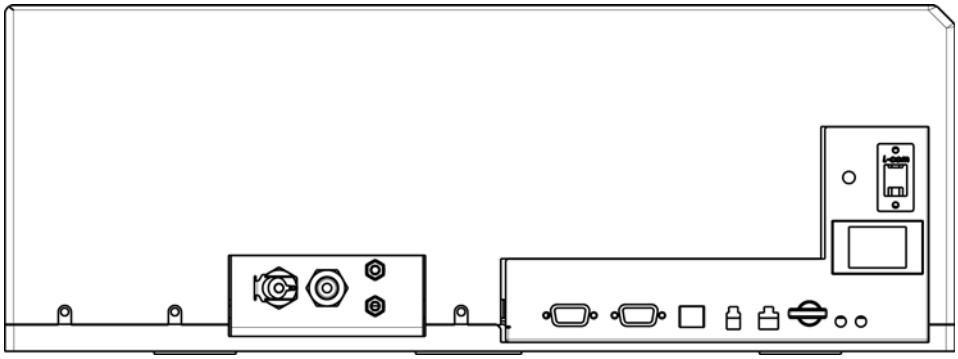


Figure 1-6 *Outline drawing, laser head, rear view*

Power Supply

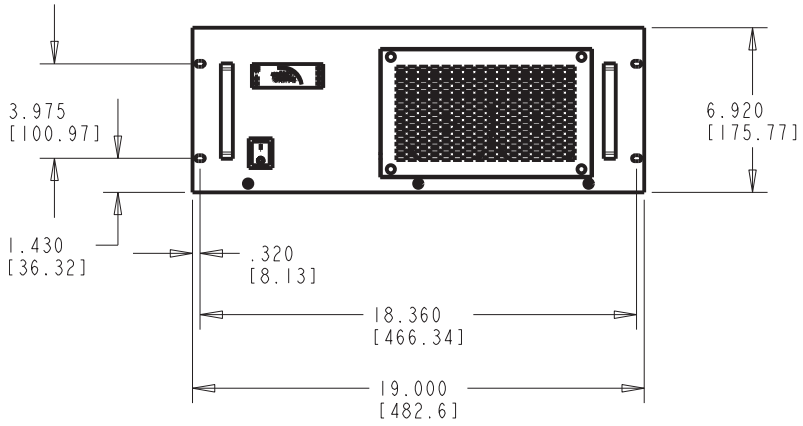


Figure 1-7 *Outline drawing, power supply, front view*

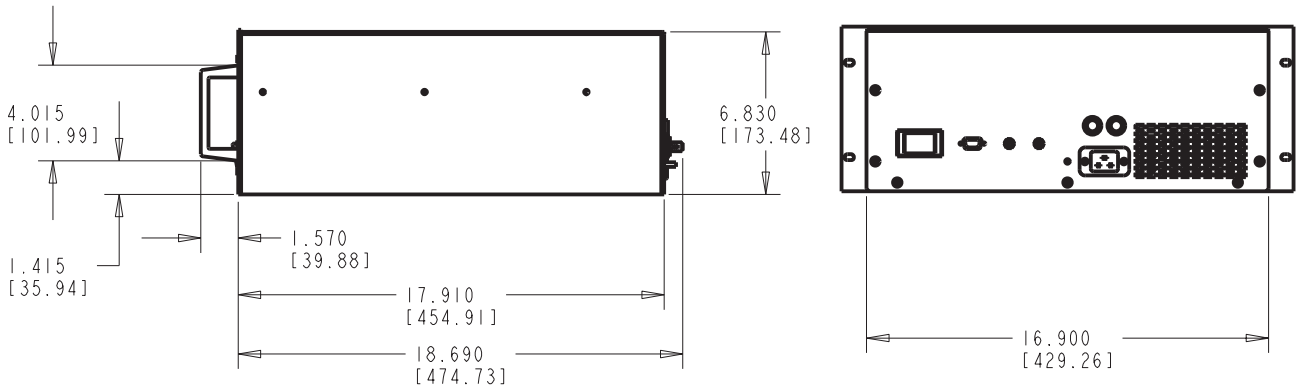


Figure 1-8 *Outline drawing, power supply, side (left) and rear (right) views*

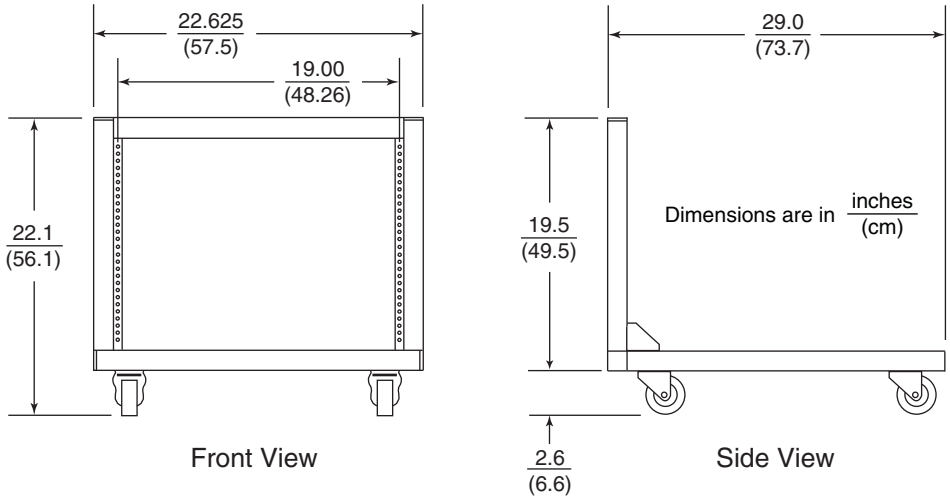


Figure 1-9 *Outline drawing, power supply and chiller rack*

Note *Refer to the chiller manual for chiller drawings.*

CHAPTER 2: Laser Safety and Compliance

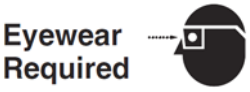
The *InSight® X3™* laser is a Class IV high-power laser and, as such, emits laser radiation that can permanently damage eyes and skin. This section contains information about these hazards and offers suggestions on safeguarding against them. Spectra-Physics recommends reading this chapter carefully, 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 X3* 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 the system, and refer to and Chapter 5, "Installation," for installation information.

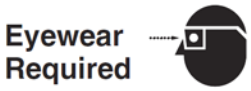
A factory-trained Service Engineer is required to complete the installation.

The InSight X3 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 X3 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 Optronics*, 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)*

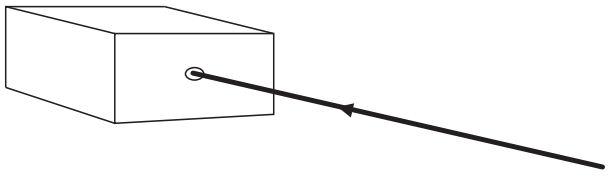


Figure 2-2 *Beam block*

Caution!

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

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[1] 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 X3* laser head emission indicator.

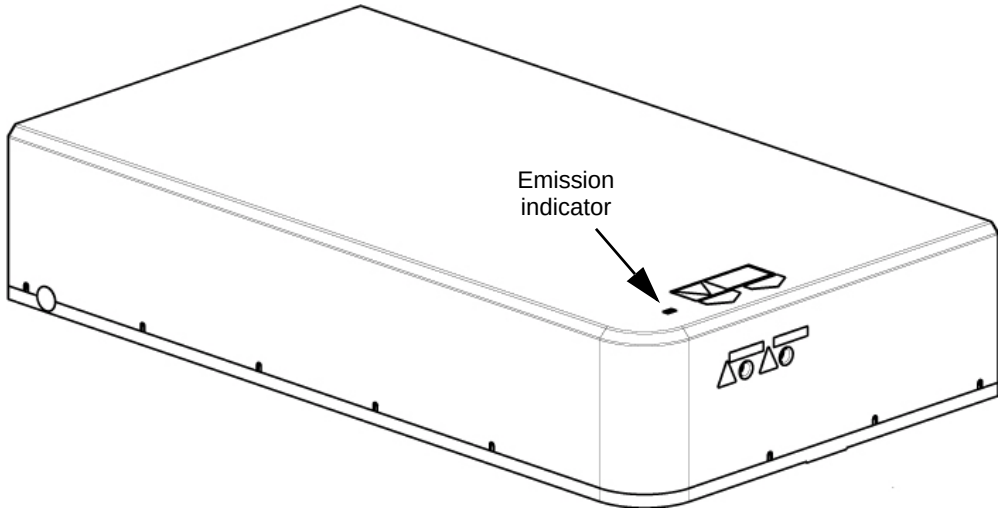


Figure 2-3 *Laser head emission indicator*

Emission Connector

The emission connector on the back of the *InSight X3* 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 opening 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.

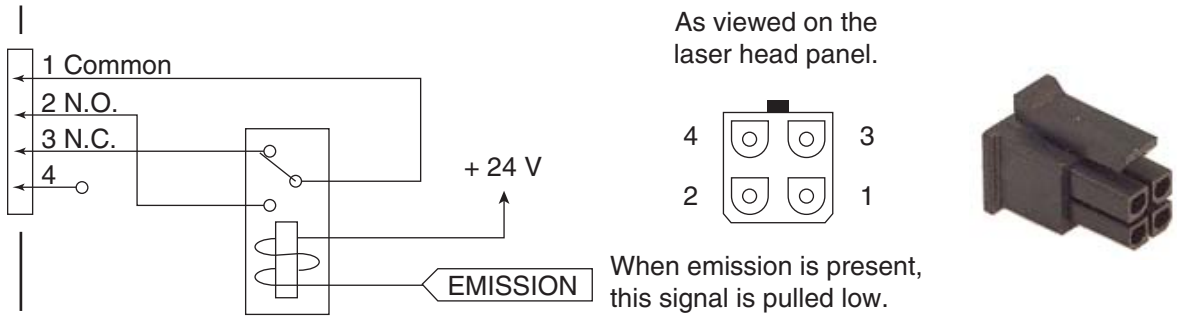


Figure 2-4 *EMISSION connector schematic*

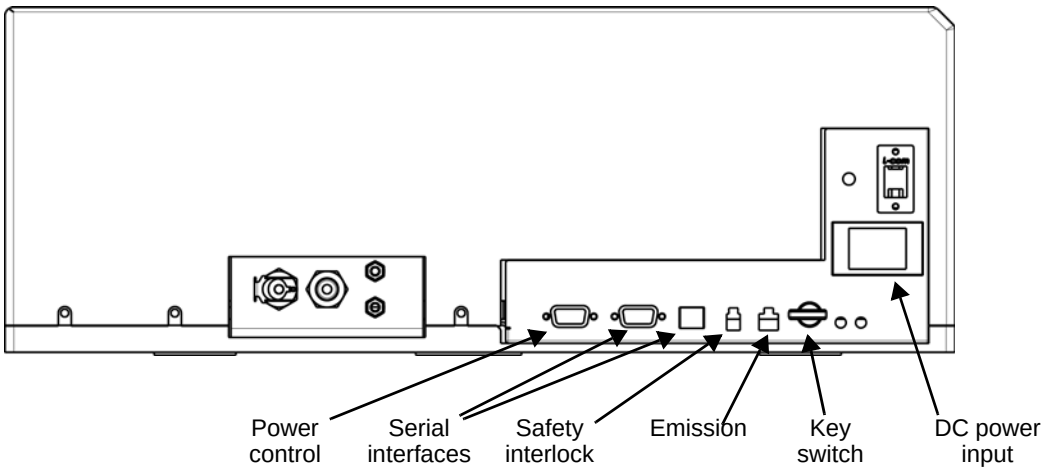


Figure 2-5 *Laser head safety devices*

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. The covers for both the laser head and laser power supply are secured with fasteners that require a tool to open. Only trained service personnel may remove these covers. 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 X3 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 X3* 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 laser diode to be energized if (a) the power supply AC power switch is also on and (b) an *ON* command is given.

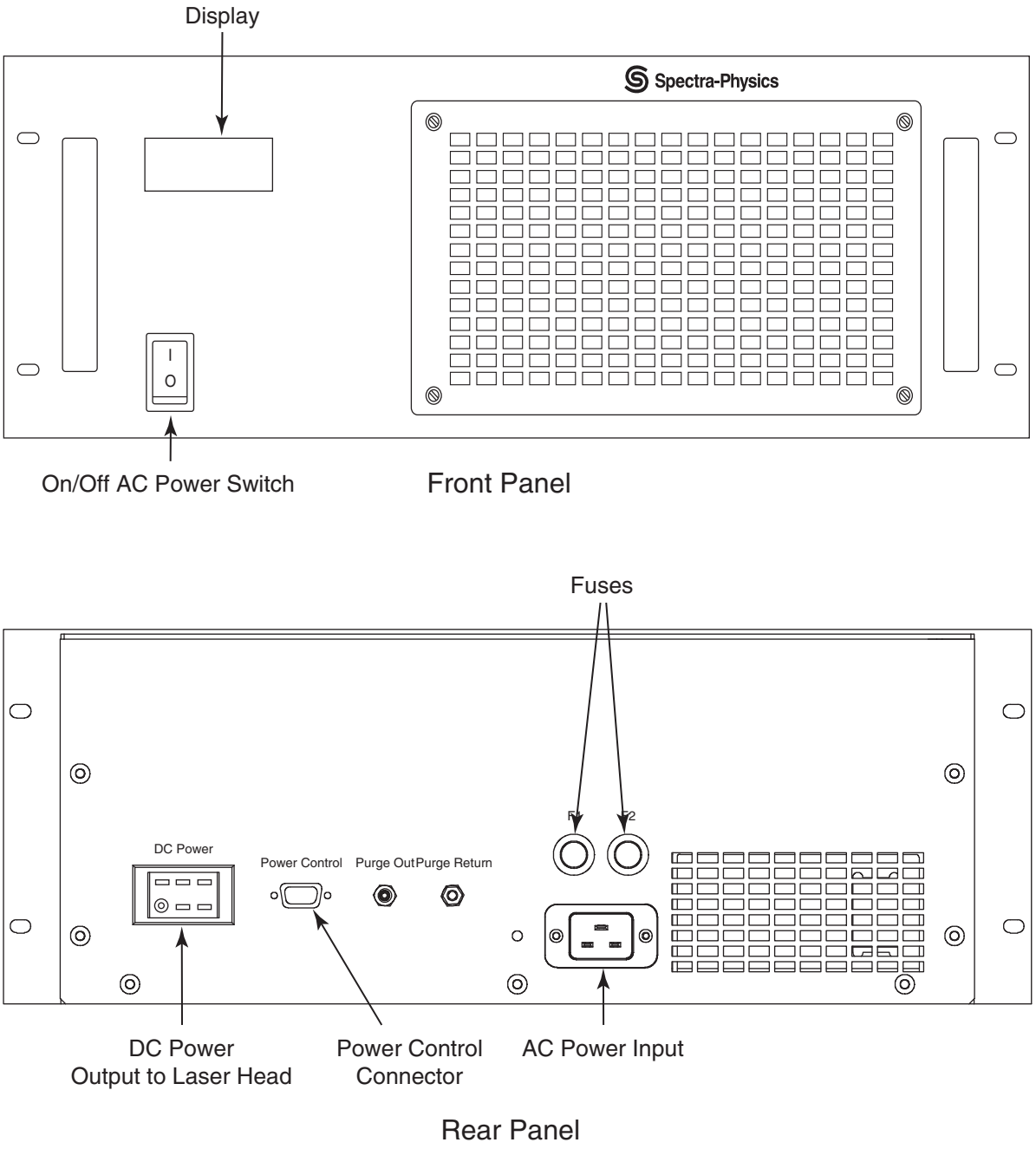


Figure 2-6 *Power supply safety devices*

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 tuning off the power to the diode laser. 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 X3* 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 that 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.[2]
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 in the GUI, 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.

CE/CDRH Radiation Control Drawings

NOTE: *The label numbers marked in the following figures are shown in Figure 2-11.*

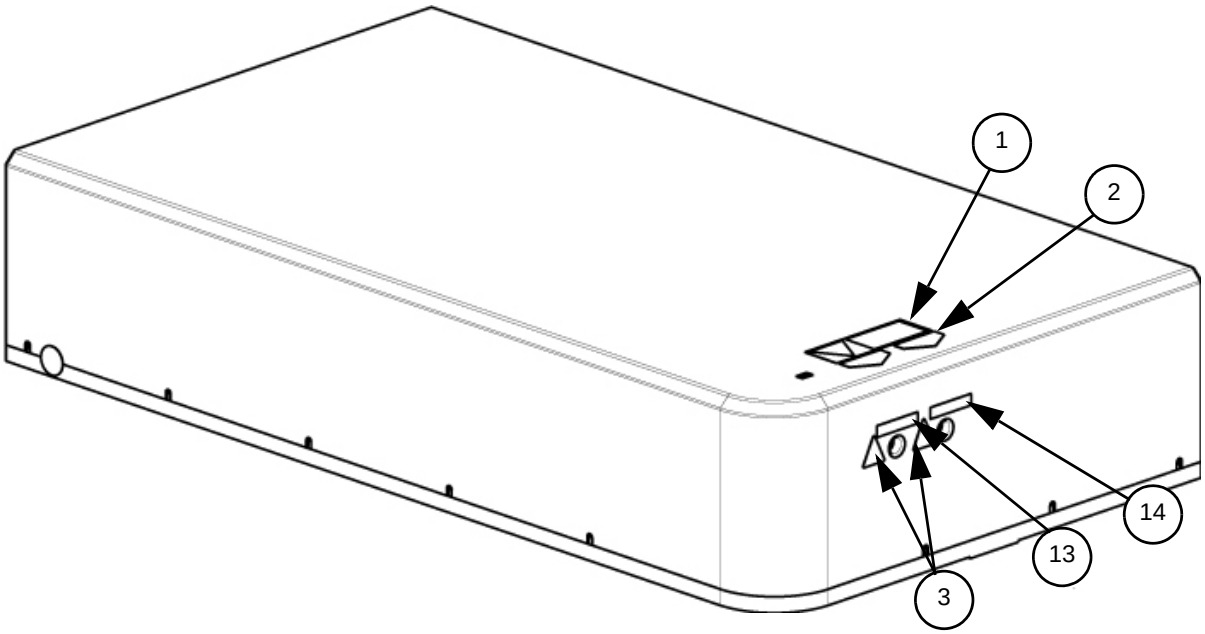


Figure 2-8 *CE/CDRH radiation control drawing, laser head, front/top view*

2. 0.39 µW for continuous-wave operation where output is limited to the 400 to 1400 nm range.

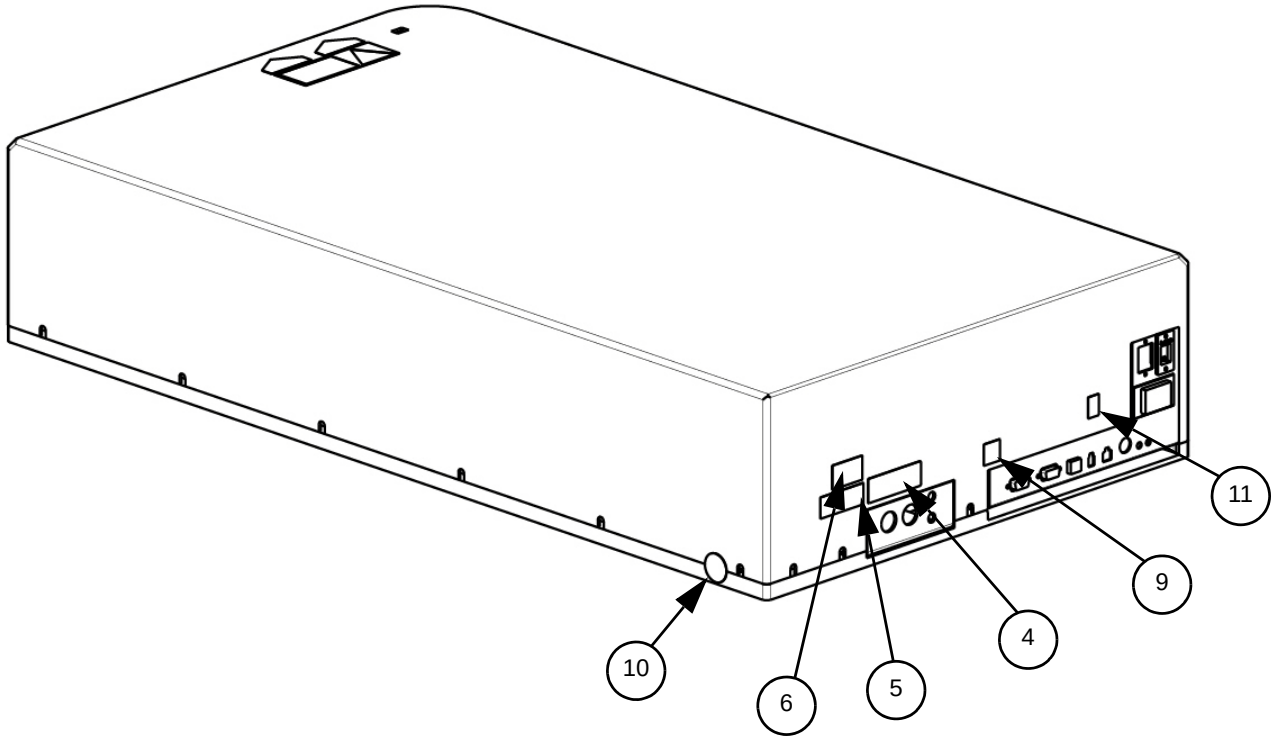


Figure 2-9 *CE/CDRH radiation control drawing, laser head, rear view*

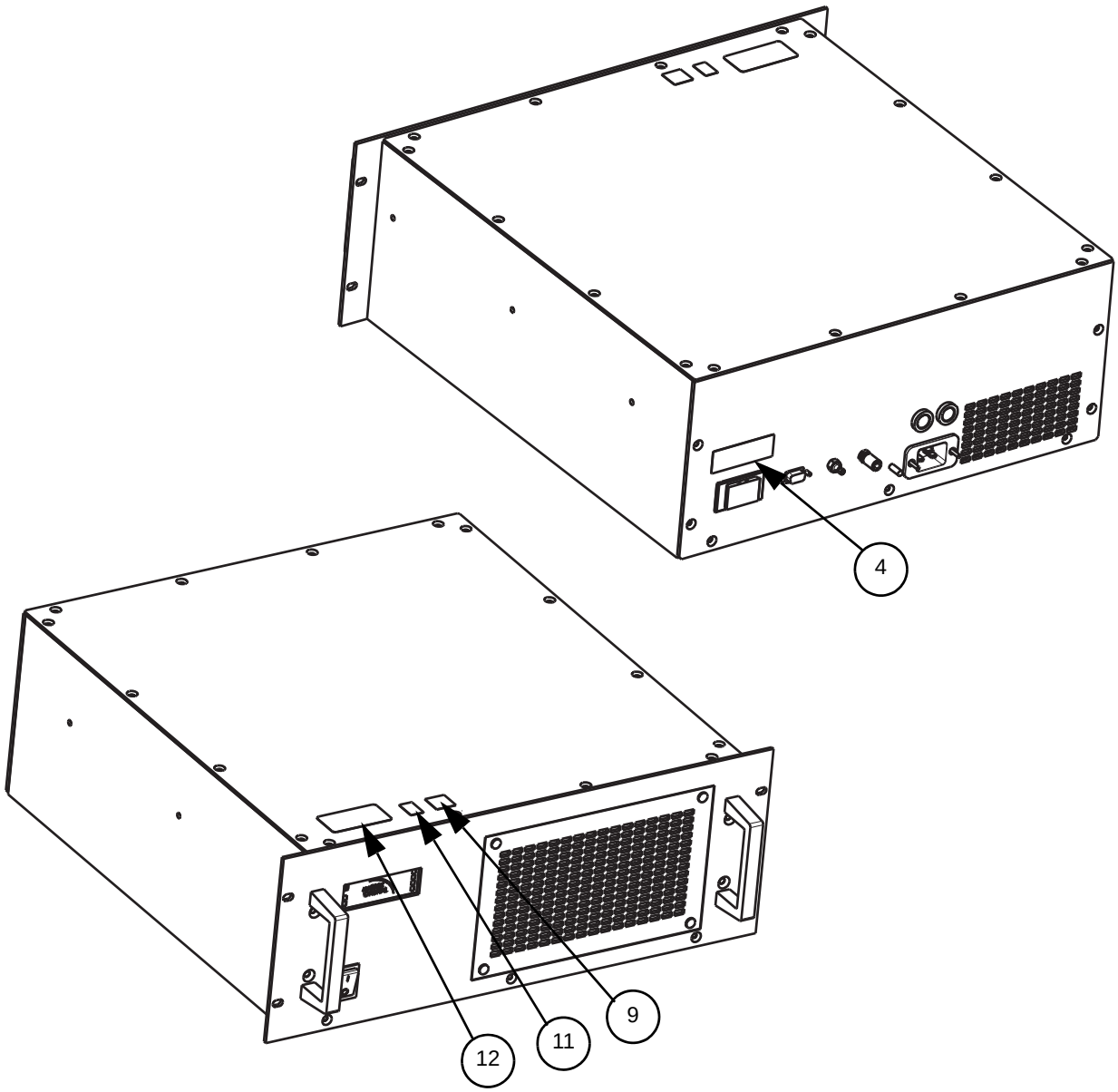


Figure 2-10 *CE/CDRH radiation control drawing, IPS-300 power supply*

CE/CDRH Warning Labels

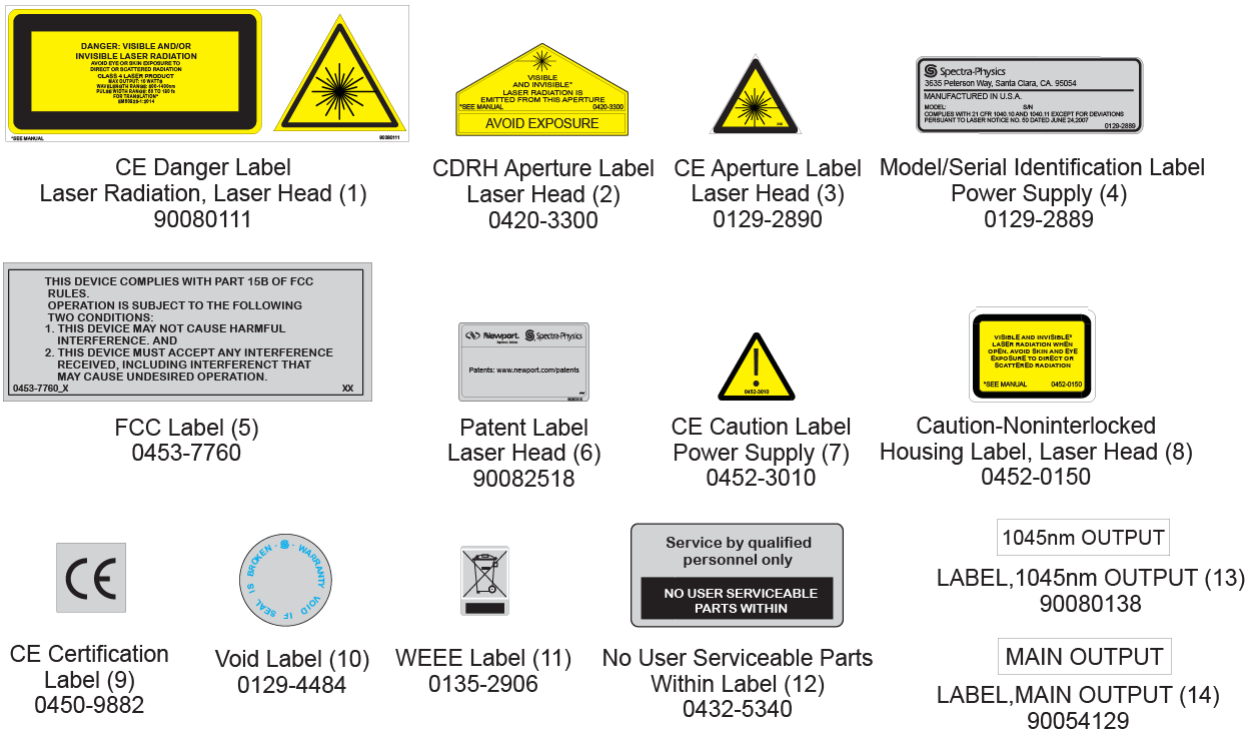


Figure 2-11 *CE/CDRH warning labels*

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 in Figure 2-11.

Table 2-1 *Label translations*

Label	French	German	Spanish	Dutch
CE Danger 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:10 W. Longueur d'onde 500 -1400 nm. Durée d'impulsion: 60- 180 fs. EN60825-1:2014.	Austritt von sichtbarer und/oder unsichtbarer Laserstrahlung. Augenund Hautkontakt mit direkter Strahlung oder Streustrahlung vermeiden. Laser Klasse IV. Maximale Ausgangsleistung 10 W. Wellenlänge 500 -1400 nm Pulsbreite 60- 180 fs. EN60825-1:2014.	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 10 W. Longitud de onda: 500 -1400 nm. Longitud de pulso: 60- 180 fs. EN60825-1:2014.	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: 10 W. Golflengtebereik: 500 -1400 nm. Pulsdurr bereik: 60- 180 fs. EN60825-1:2014. Zie de gebruikershandleiding voor vertaling van dit label.

Table 2-1 *Label translations (Continued)*

Label	French	German	Spanish	Dutch
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!
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 blootsteling 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,

MKS Instruments, Inc.
Spectra-Physics Lasers
3635 Peterson Way
Santa Clara, CA 95054
United States of America

Declare under sole responsibility that the:

InSight X3 and InSight X3 Dual Family of Ultrafast Lasers

Manufactured after April 11, 2017

Meet the intent of the EMC Directive 2014/30/EC for Electromagnetic Compatibility, 2014/35/EU for the Low Voltage Directive, and Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment. Compliance was demonstrated to the following specifications as listed in the official *Journal of the European Communities*:

EMC Directive 2014/30/EC

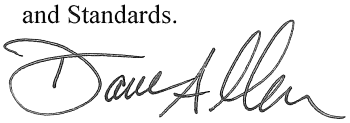
EN 55011:2009+A1: 2010 (EMC)-Generic Standards- Emissions Standard for Industrial Environments
EN 61000-6-4:2007+A1: 2011 (EMC)-Generic Standards- Emissions Standard for Industrial
EN 61000-3-2:2014 (EMC)- Limit for Harmonic Current
EN 61000-3-3:2013 (EMC)-Limitation of Voltage Changes, Voltage Fluctuations and Flicker
EN 61000-6-2: 2005+AC:2005 Generic Standards- (EMC) Immunity Standard for Industrial Environments
EN 61000-4-2:2009 (EMC)-Testing and Measurement Techniques Electrostatic Discharge
EN 61000-4-3:2011 (EMC)-Testing & Measurement Techniques - Radiated, Radio-Frequency, Electromagnetic Field
EN 61000-4-4:2012 (EMC)-Testing & Measurement Techniques - Electrical Fast Transient/Burst
EN 61000-4-5:2006 (EMC)-Testing & Measurement Techniques - Surge
EN 61000-4-6:2009 (EMC)-Testing & Measurement Techniques - Conducted Disturbances, induced by Radio-Frequency Fields
EN 61000-4-8:2010 (EMC)- Testing & Measurement Techniques - Power Frequency Magnetic Field
EN 61000-4-11:2004 (EMC)-Testing & Measurement Techniques - Voltage Dips, Short Interruptions & Voltage Variations

Low Voltage Directive 2014/35/EU

EN 61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory use General Requirements
EN 60825-1: 2014: Part 1: Safety of Laster Products – Equipment Classification, Requirements and Users Guide

RoHS II Directive 2011/65/EU

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



Dave Allen
Senior Vice-President / General Manager
MKS Instruments, Inc.
Spectra-Physics Lasers

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, 11th 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 NW
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/

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 Varembé, P.O. Box 131
1211 Geneva 20
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, Suite 8
Belmont, CA 94002
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.laserfocusworld.com/

Photonics Spectra Buyer's Guide
Photonics Media/Laurin Publishing Co., Inc.
100 West St.
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 describes the user controls, indicators and connections of the *InSight® X3™* laser system. It is divided into three sections: the *InSight X3* laser head, the *IPS-300* power supply, and the connector interface descriptions. (Chapter 6, "Operation," explains how to use the included *InSight X3* 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

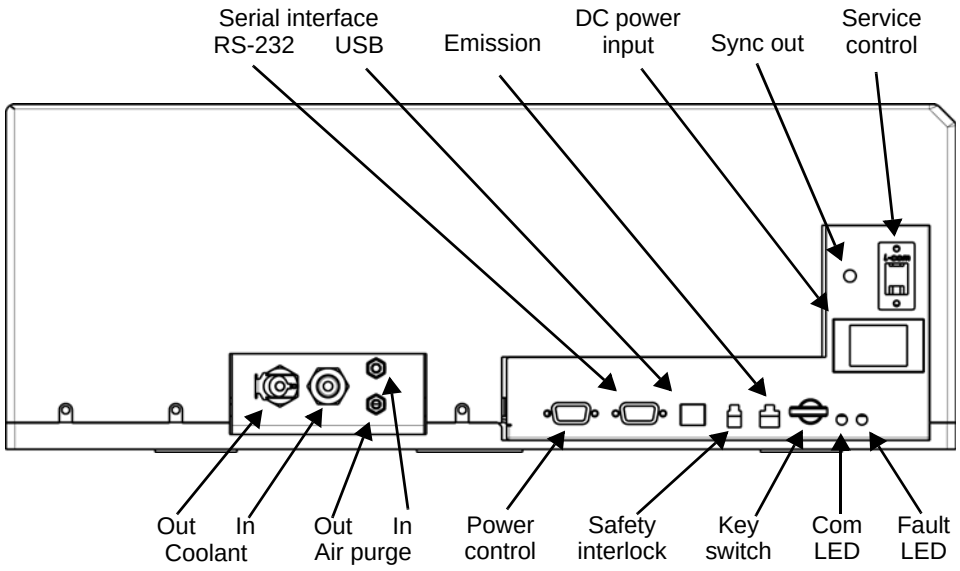


Figure 3-1 *Laser head rear panel controls, indicators, and connectors*

Controls

Laser enable interlock keyswitch—Provides interlock safety to prevent unauthorized personnel from using the *InSight X3* 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 laser 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 turning on 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)—Illuminates steadily while the laser boots up (about 2 minutes). It then blinks slowly at 0.5 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)—Remains off when no fault exists and blinks slowly at 0.5 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 Diagnostics tab status display (Figure 6-13, under History Buffer) for error codes, and to Chapter 7, "Maintenance and Diagnostics," for information on resolving this issue.

Connections

Service connector (Ethernet)—For use only by Spectra-Physics service personnel.

Power Input connector—Provides connection for the high-current DC power from the *IPS-300* power supply. Power is provided to the laser diode 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's outer jacket and pull the hose free.

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 the laser head control circuits.

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)—Operates 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 X3* 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—Operates 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 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 X3* 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"). 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*

Sync Out connector (SMA)—Typically connected to a frequency counter or to a 50 Ω oscilloscope input for monitoring the laser head photodiode signal. Runs at the 80 +/-0.5 MHz repetition rate of the laser. A typical waveform is shown in Figure 3-4. The signal amplitude shown is approximate 600 mV peak-to-peak.

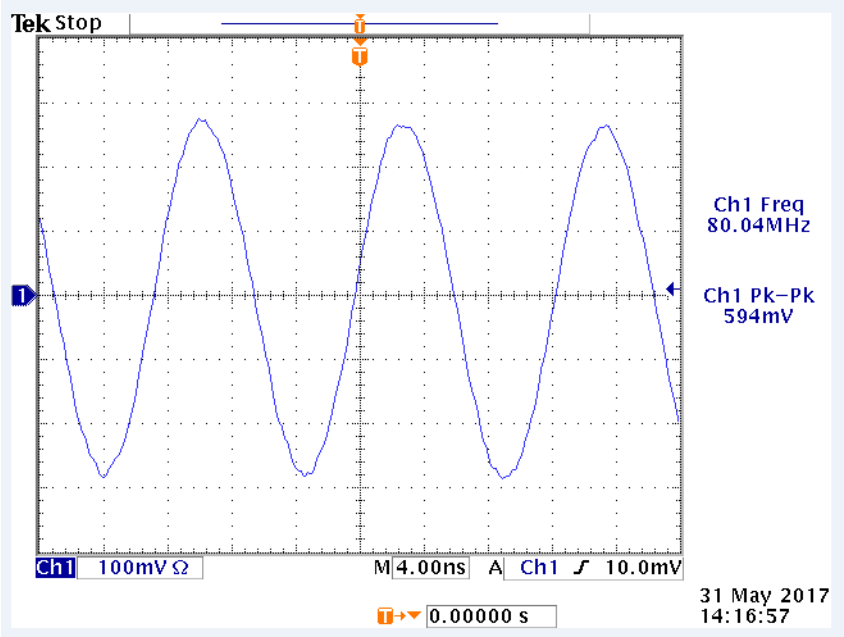


Figure 3-4 *Typical waveform*

IPS-300 Power Supply

The *IPS-300* power supply is air-cooled. It provides high-current DC power to the laser diode in the *InSight X3* 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

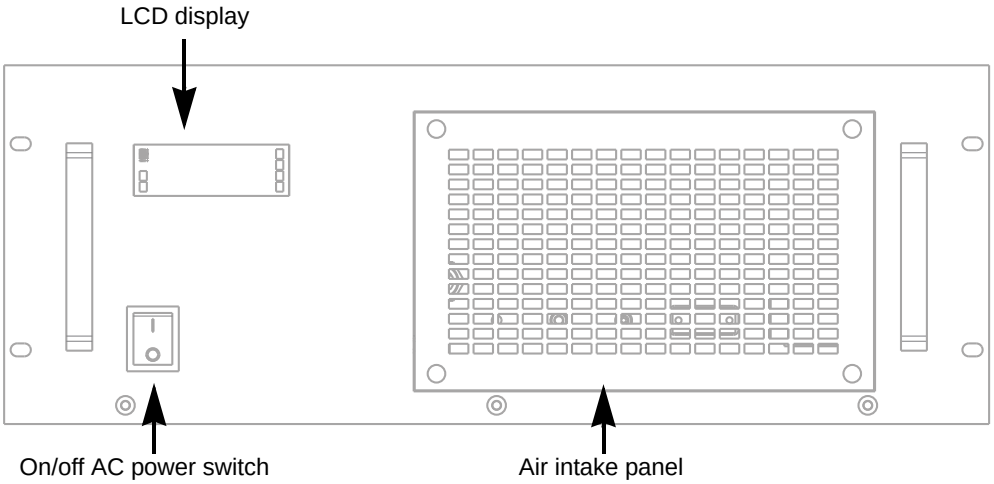


Figure 3-5 *Power supply front panel*

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 they occur. 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 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 panel—Allows cooling air to be drawn into the power supply. The heated exhaust air is then vented from the rear panel (see Chapter 7, "Maintenance and Diagnostics").

Rear Panel

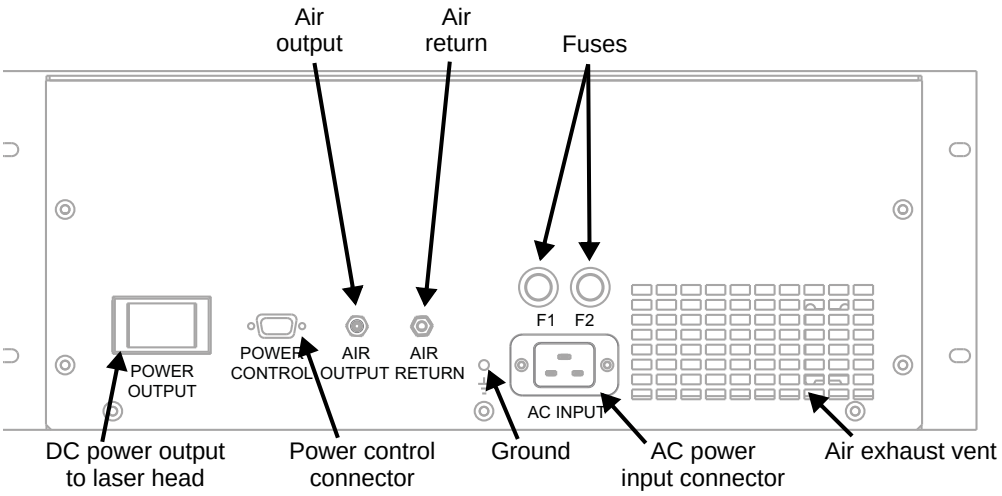


Figure 3-6 *Power supply rear panel*

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 diode 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 Output connector—Provides connection for the "clean" air hose that delivers clean, dry air to the lower **Air Return** port on the *InSight X3* 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 Return air connector—Provides attachment for the return line from the upper **Air Output** 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—Holds the two line fuses. Refer to the table below for fuse type and size.

AC Input	Frequency	Fuses F1, F2	Caution
100–120V~, 10A 200–240V~, 6A	50–60 Hz	T 12A 250V 326 Series 3AB Slo-Blo fuse	Double pole/ neutral fusing

AC Input power connector—Provides connection for primary AC input power. Power supply inlet connector is IEC C20-style (Schurter #4798.9000). Use a cord consistent with the current and voltage specifications printed on the rear of the unit. Provide at least 6 inches of clearance (for air flow).

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 X3* 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.

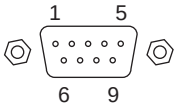


Figure 3-7 *9-pin RS-232 port*

Table 3-1 *RS-232 port connections*

	Computer or Terminal			***InSight X3*** **Laser Head**	
RS-232-C Signal Name	**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.

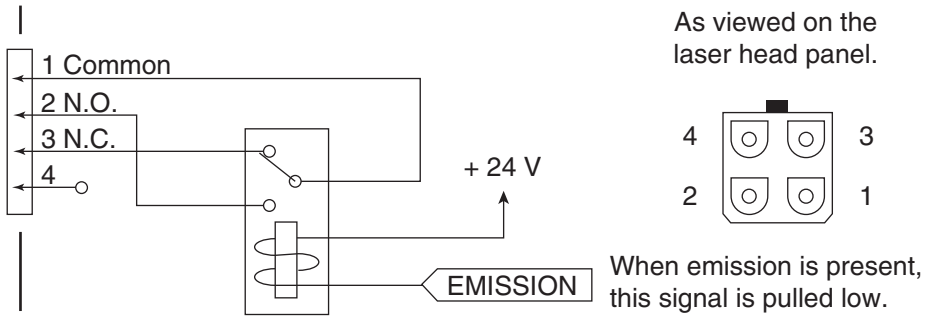


Figure 3-8 *Laser head emission connector and circuit*

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 3-9 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 laser immediately.

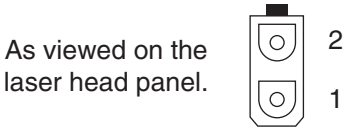


Figure 3-9 *Laser head interlock connector*

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.*

CHAPTER 4: Receiving and Inspecting

Inspecting the Shipment

Your *InSight® X3™* 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 X3* 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 system is packaged in the event the factory instructs you to open the crates 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 laser head is immediately visible (Figure 4-3). 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 (middle layer)*

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 a 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's 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 there is no apparent damage to the laser or the laser cover, 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 4-4.

Figure 4-4 *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 4-5. 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 4-5 *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 there is no apparent damage to the boxes and rack, 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 4-6) then open the inner bag (Figure 4-7).

Figure 4-6 *Power supply box shown open with center foam piece removed*

Figure 4-7 *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 the photos 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 4-8, left).

Figure 4-8 *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 4-8, 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 the photos 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 X3* 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

System Installation

A Spectra-Physics service engineer will install your *InSight® X3™* laser system. *Do NOT install it yourself.*

Site Considerations

Warning!  *All InSight X3 systems are initially installed by Spectra-Physics as part of the purchase agreement. Relocating an InSight X3 system after installation requires a service call to Spectra-Physics. An InSight X3 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.*

Warning!  *Personal injury and product impairment can occur if this product is used in a manner not specified by the manufacturer. Misuse voids warranty.*

This chapter assumes that you have already inspected the shipping crates (and contents if instructed to do so) for damage upon receiving the system (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 X3* 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 X3* 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 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 1/4-20 or M6 threaded mounting holes; see Figure 1-3 for mounting hole locations
- 100–120 V~/200–240 V~, 50/60 Hz electrical service for the *IPS-300* power supply and the *ThermoRack 401* chiller

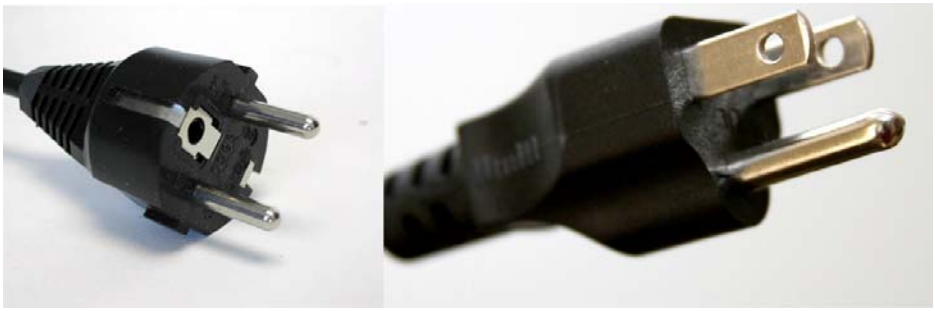


Figure 5-1 *Electrical plugs*

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

Only use a power cord with adequate rating. The connection to the power supply inlet connector is the mains disconnect. Keep the area around the back of the power supply clear so that you can pull the main cord if needed. This requirement is independent of the 6 in. (15 cm) clearance requirement for cooling of power supply.

Both the power supply and chiller are air cooled and rackmounted, 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 the containers 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 assure adequate protection.

Chiller Requirements

A *ThermoRack 401* chiller is provided with the *InSight X3* 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, “Nalco MSDS,” 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 laser is 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 command language described in Appendix A, “Programming Guide.”

The GUI control software is preinstalled on new systems from Spectra-Physics. To install the software on a different system the software and USB driver are provided on a USB flash drive (located in the accessory kit). The following two sub-sections provide directions for installing the software.

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
- 4 GB RAM
- 20 MB available disk space for installation
- 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 7, 8, or 10 operating system

Installing the USB Driver

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

1. Place the USB flash drive into a spare USB port.
2. Browse to the `INSIGHTX3 GUI/MANUAL(90082279_1)` folder on the USB drive and open it.
3. Double-click the Preinstaller icon.
   The following window opens:

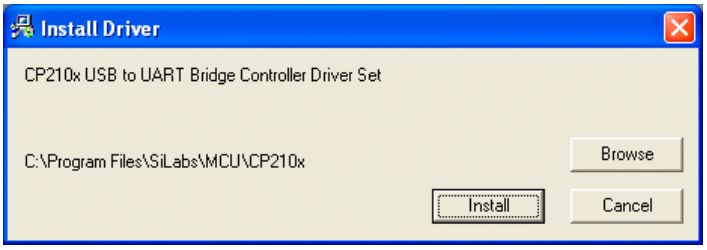


Figure 5-2 *Install screen*

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, click **OK**.

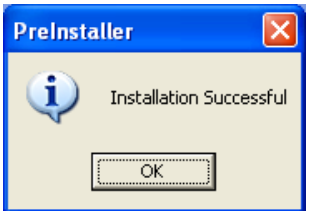


Figure 5-3 *Installation Successful message*

7. Attach the USB cable between the laser head and the control computer, then turn on the chiller and the 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 USB driver software.

Installing the 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 they install 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 USB flash drive in a spare USB port. Double-click `Setup.exe` and follow any prompts that appear during installation.

The software creates the folder `C:\Program Files\Spectra-Physics\InSight X3` 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 X3* icon on the desktop and in the Start menu under the `Spectra-Physics` folder.

When you are ready to start operation, double-click the icon on the desktop or in the Start menu to start the control software.

This completes the installation of the GUI control software.

CHAPTER 6: Operation

This chapter describes the operation of the *InSight® X3™* laser system, including system notices.

Read Chapter 2, “Laser Safety and Compliance,” before turning on the *InSight X3* system.

Danger! 

The InSight X3 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 X3 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.

There are no controls to adjust or optics to change inside the *InSight X3* laser head. *The laser head should never be opened.*

The *InSight X3* system can 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.” 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, “Programming Guide,” 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 X3* 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 Objectives tab of the GUI control software (see “Objectives Tab”) provides a user interface that allows the operator to create and modify objective settings to compensate for external dispersion of *InSight X3* 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 their equipment, and that table is displayed on the controller screen. When the *InSight X3* 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. The operator can create, modify, calibrate, and delete objective tables.

The operator can change the *InSight X3* 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 X3* wavelength is changed, the *DeepSee* component 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 table from a list of stored objectives or create a new one with new calibration data. The operator can create a new objective table 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), the operator can create each objective table, then modify, save, erase, or replace it. A total of 200 objective tables 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 X3* laser. For example, the objective table for a wavelength range of 680 to 1300 nm, is 620 points (one for each 1 nm change). The operator calibrates 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 operator saves the table 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 6-9) 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 interpolation. 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

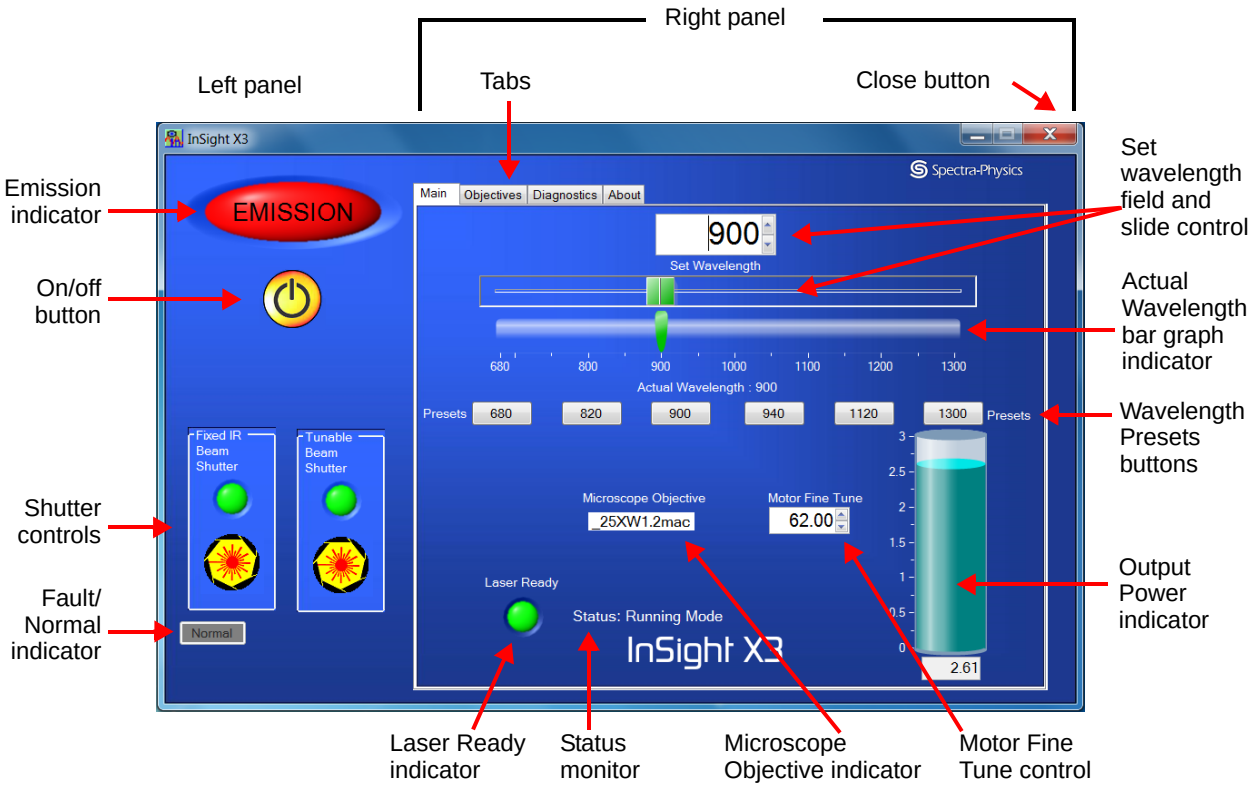


Figure 6-1 *User interface overview, showing Main tab*

Operating the *InSight X3* system using the supplied GUI control software is easy. 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 displays laser output power, shutter position, and laser/controller communication.

There are three other tab displays: Objectives, Diagnostics, and About. These tabs and their functions are described on the next several pages.

To exit the control program, click the close button (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 close button brings up the shutdown options shown in Figure 6-2.

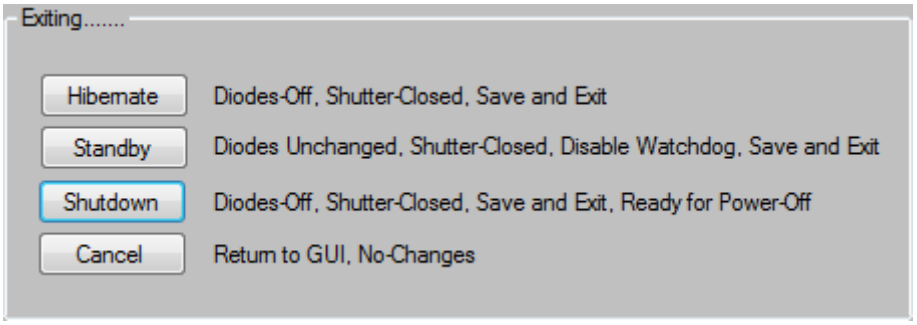


Figure 6-2 *GUI shutdown choices*

Hibernate—This is the default day-to-day operating mode. Shuts off the laser diode, 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 diode. It closes the shutters and disables 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 diode is operating, simply opening the shutter results in laser emission. DO NOT leave the laser unattended in this mode.

Shutdown—Turns the laser off completely. This options shuts off the diode, 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 supply.*

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 close button to exit.

The Left Panel

Figure 6-3 shows the left portion of the Main panel. This panel is always displayed no matter which tab is open. 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 1045 nm second output and, thus, a second shutter, is shown on the right.

Figure 6-3 *Left panel: standard system showing a fault (left), IR option system (right)*

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

On/Off button—Turns the laser diode 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 diode is energized. Click the button again to turn the laser diode off immediately.

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

Fixed IR beam shutter control—Opens and closes the fixed IR beam shutter on the 1045 nm option, which provides IR output from a second output port. To open the shutter, click the aperture icon and hold it down until the icon opens (turns yellow, about 3 to 5 seconds). To close the shutter, click the aperture icon again and this shutter closes immediately (turns black), blocking the IR laser beam. The aperture icon also closes.

Tunable beam shutter control—Opens and closes the tunable beam shutter. To open the shutter, click the aperture icon and hold the button down until the icon opens (turns yellow, about 3 to 5 seconds). To close the shutter, click the aperture icon again and the shutter closes immediately, blocking the laser beam. The aperture icon also closes (turns black). Closing this shutter does NOT automatically close the fixed IR beam shutter (if present).

Fault indicator—Appears gray and displays *Normal* when there is no fault, and turns yellow and displays *Fault* when a fault occurs. When there is a fault, 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. Select a tab by clicking it, and the controls on that tab are shown. The Main tab is shown in Figure 6-4.

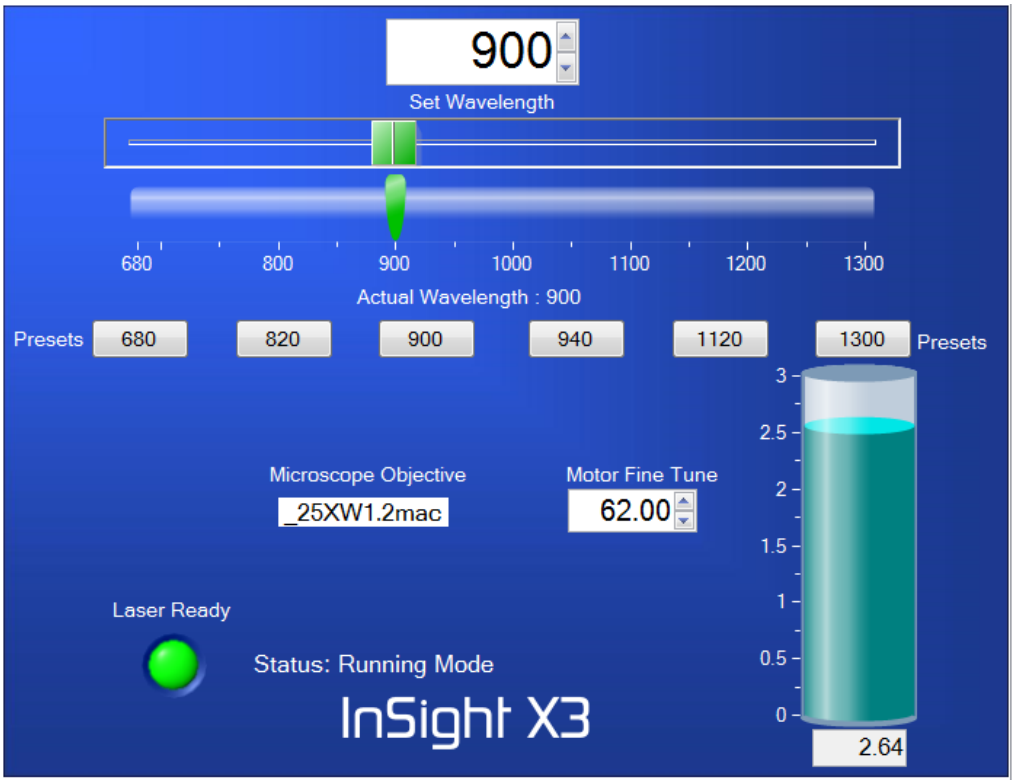


Figure 6-4 *Right panel, Main tab*

Turning On the System

Warning! *The chiller must **always** be on when the IPS-300 power supply is on, even if the diode laser is 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 the power supply's AC power switch to ON.
   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 display *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.”

Note *If the system doesn’t turn on, wait 5 to 10 minutes and try again.*

5. Turn on the host computer and start the GUI control program.
6. The program looks for the *InSight X3* system and, when found, displays the Main tab display shown in Figure 6-5.

   Note that turning the key to the enable (vertical) position allows the diode laser 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 (vertical) position, the FAULT LED on the laser head is on.

Danger! Laser Radiation

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

7. Wait until the status line (seen at the bottom center of the screen) says *Ready* before turning on the laser. Then 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 6-5) 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 diode is energized.) Although the emission light is on and the laser diode is on, no light is emitted until the shutter is opened in Step 9.

Figure 6-5 *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 tunable beam 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 aperture icon until the icon opens (turns yellow, about 3 seconds).

   When the shutter opens, laser emission is present.

   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 6-4 to ensure trouble-free operation.*

1. To temporarily block laser output without turning off the laser, click the red and yellow tunable beam shutter or fixed IR beam shutter aperture icon (Figure 6-6).

   The shutter closes, emission is blocked, and the aperture icon closes (turns black). However, the emission lights remain on to warn of possible emission (the laser diode is still on).

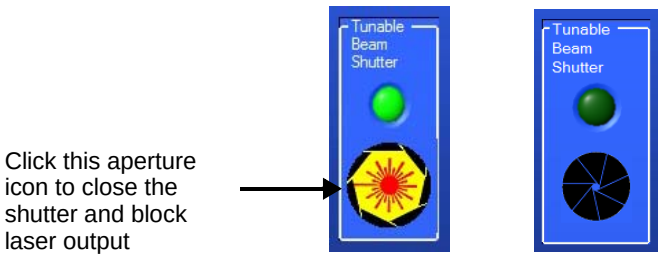


Figure 6-6 *Emission on (left); emission off and shutter closed (right)*

To resume operation, open the shutter again by clicking the appropriate aperture 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. When you wish to turn off the computer for the day, click the close button (red X) to exit the control program, then select Hibernate, Standby, or Shutdown to set the off mode (refer to Figure 6-2 and the shutdown option descriptions below the figure).
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.

Warning! 

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

This is the preferred off mode for day-to-day operation or any time a quick startup is preferred.

If the laser is not to be used for an extended period of time, shut down the GUI as described in “Operating the System Using the GUI Control Software,” then turn off the power supply, then turn off the chiller.

This completes the turn off sequence.

Main Tab

The Main tab (Figure 6-7) appears on program startup (it appears right after the Communication Setup menu is displayed). The screen is large and easily seen from a distance, and serves as both a monitor and an input screen.

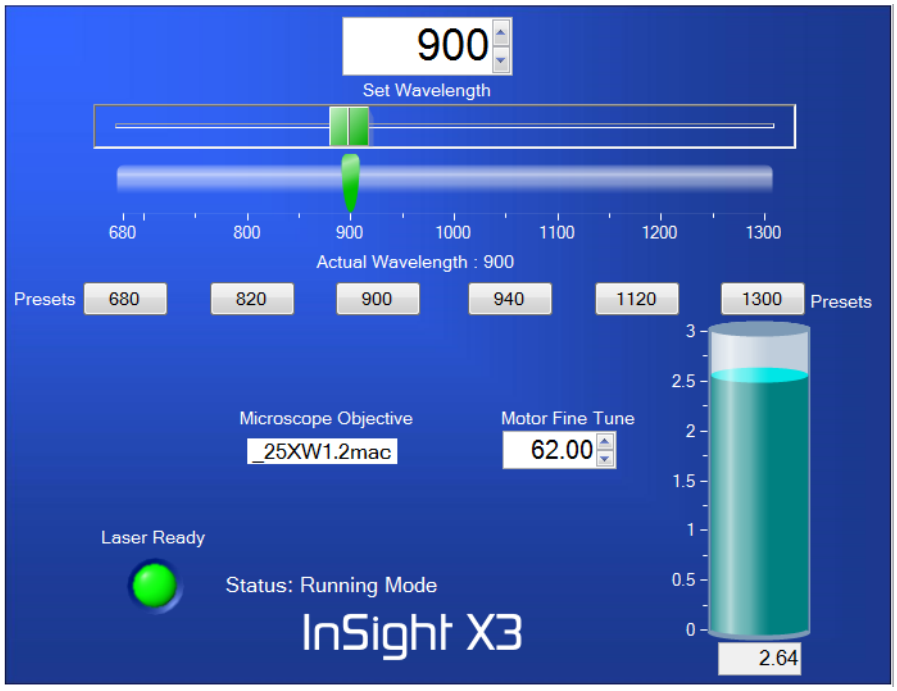


Figure 6-7 *Main tab display*

The control features 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 Wavelength** 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—Allow the user to quickly change the wavelength to a preset value by pressing one of the six buttons. The buttons are programed 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 Objectives 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 Objectives tab (see Figure 6-9).

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 only 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—Illuminates in 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

The Objectives tab (Figure 6-8) allows the user to modify and create different objective tables. This section describes the function of each control and display. Refer to “Objective Tables” for an explanation of objective tables and how to create and use them.

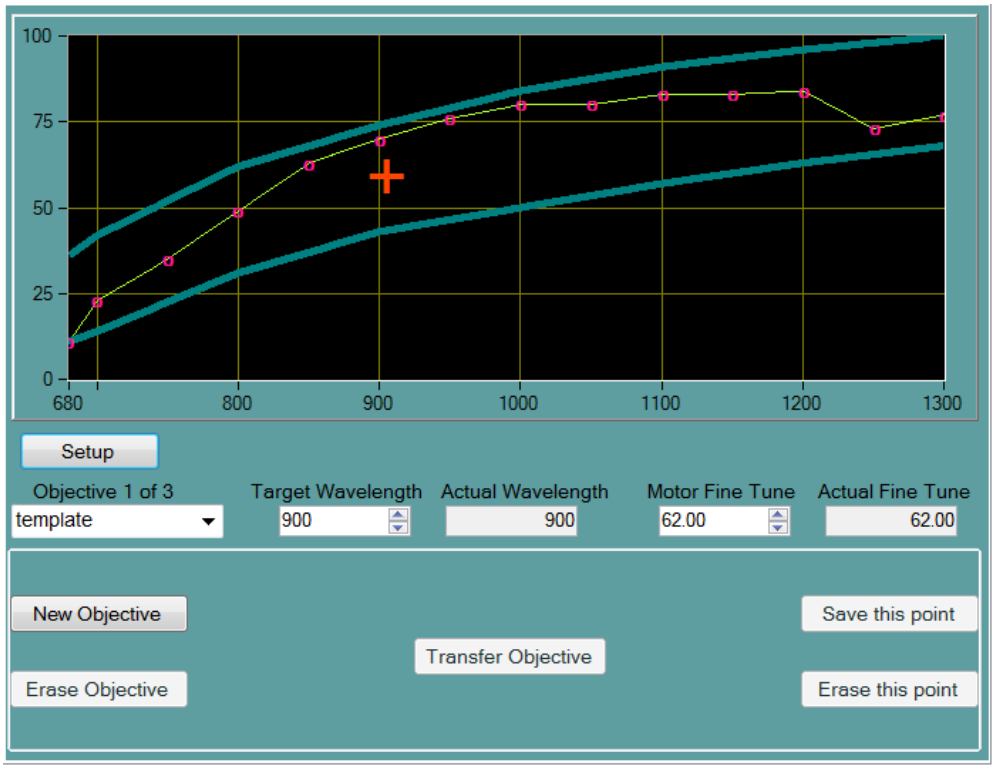


Figure 6-8 *Objectives tab display*

The Objectives tab display has two sections.

The upper section (Figure 6-9) 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 X3* wavelength and the *DeepSee* motor position

To open the lower section (Figure 6-10), press and hold the **Setup** button for several seconds. The lower section 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” for information on how to change motor position for a particular wavelength, and to “Calibration Points” for information on creating calibration points.

The Upper Section

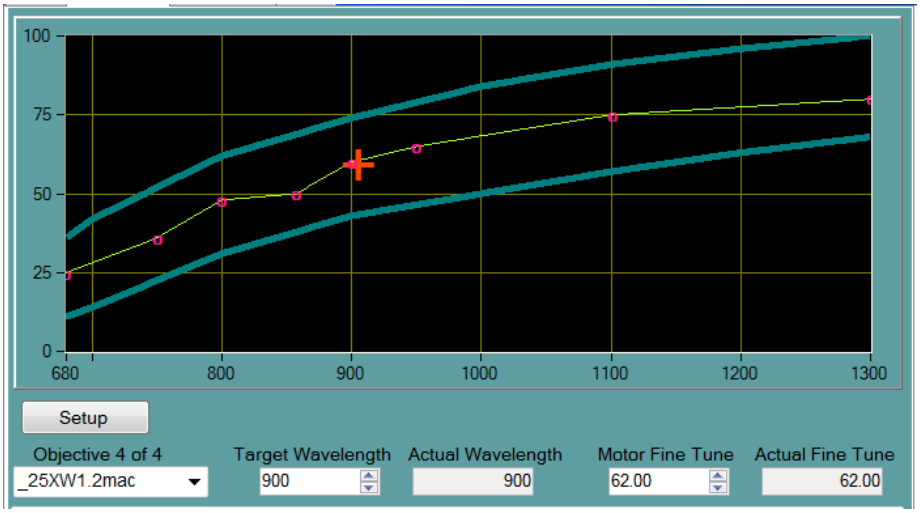


Figure 6-9 *Upper section of the Objectives tab*

X-Y Plot—Shows the *DeepSee* motor position vs. the *InSight X3* 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 6-10), which is used to create, save, and delete objective tables and to create, save, and delete points that define objective tables.

Objective field—Provides 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 X3* wavelength.

Actual Wavelength monitor—Shows the current *InSight X3* 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 6-10 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 X3* to the control computer and vice versa. Figure 6-11 shows the lower section after the **New Objective** button has been pushed.

Figure 6-10 *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 6-11 on page 6-15).

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 X3* 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 6-11.

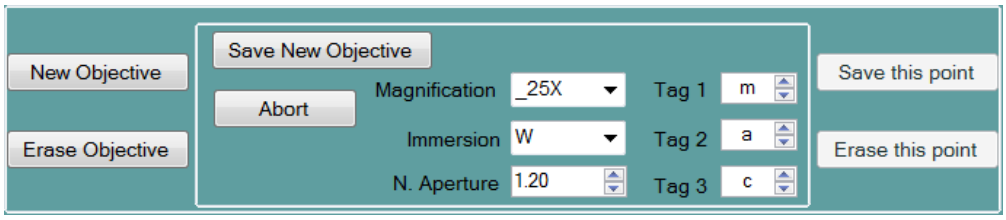


Figure 6-11 *New Objective panel*

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 or overwrite the currently named objective file. (Refer to "Commands and Queries" on page A-2 for the objective name syntax.)

Up to 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	40 x
4 x	50 x
5 x	60 x
10 x	63 x
15 x	93 x
20 x	100 x
25 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 X3* wavelength, either directly enter the new wavelength in the **Target Wavelength** box, or click the graph at the new wavelength value (see Figure 6-12). 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 X3* changes its wavelength. Meanwhile, the *DeepSee* motor moves to the calibrated or interpolated position (shown by the **Actual Fine Tune** field) according to the entry in the selected objective. Wavelengths beyond the objective's minimum or maximum value are ignored.

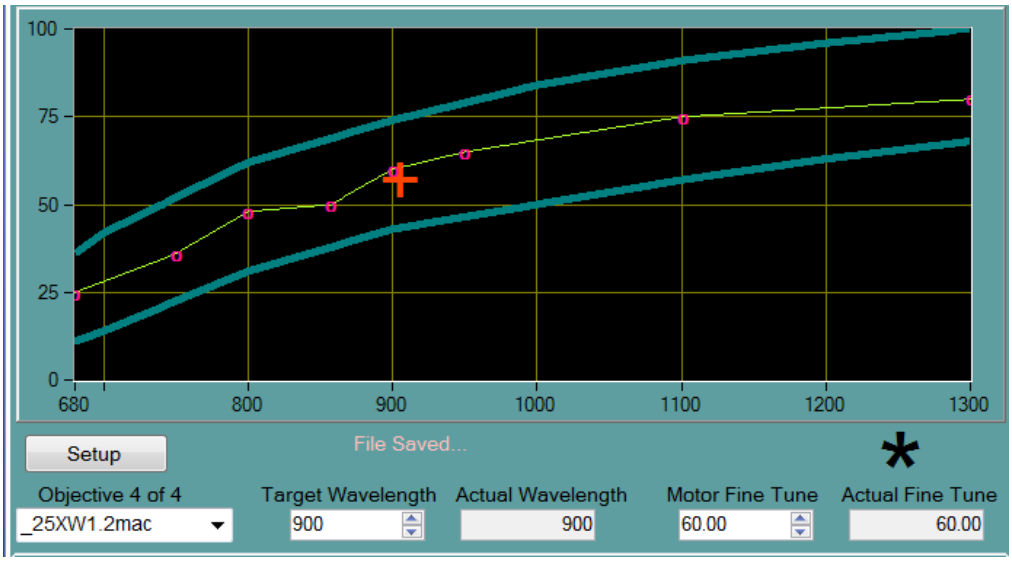


Figure 6-12 *Upper section of Objectives tab*

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 asterisk above the **Actual Fine Tune** box (Figure 6-12).
- 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** button is disabled.*

Diagnostics Tab

The Diagnostics tab (Figure 6-13) provides 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 about 200 mW), the beam is NOT safe for your eyes! Always wear proper eye protection!

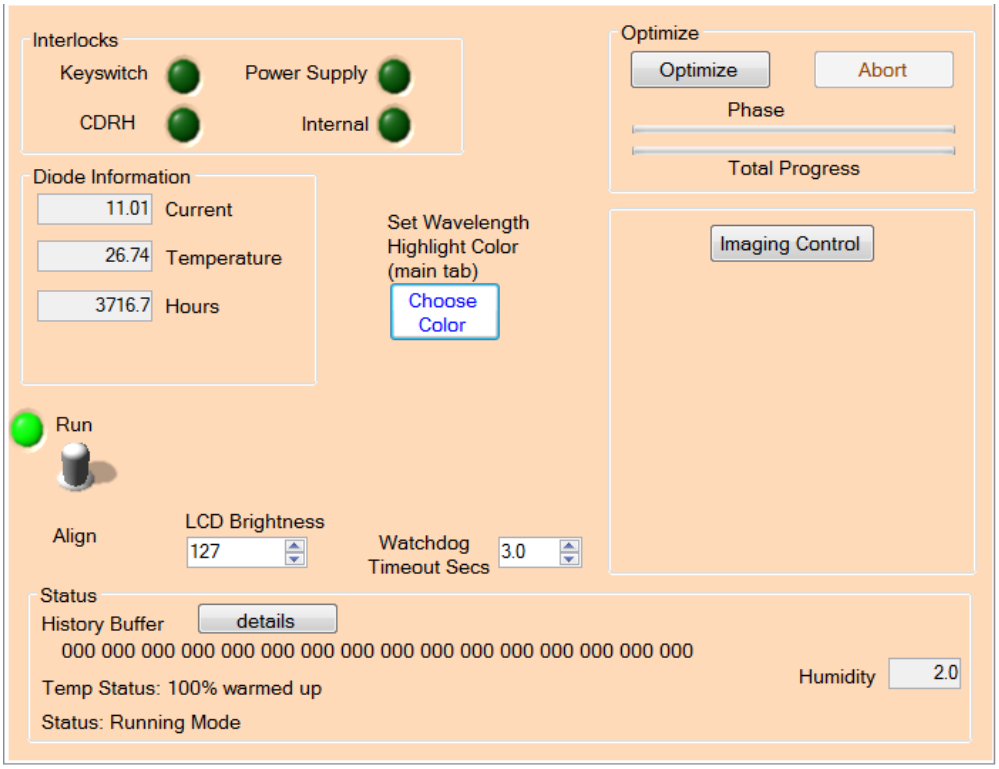


Figure 6-13 *Diagnostics tab*

Interlocks

Keyswitch indicator (LED)—When red, indicates that the key is turned to the off (horizontal) position.

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

Power Supply indicator (LED)—When red, indicates that the power control cable from the power supply to laser head is loose or disconnected.

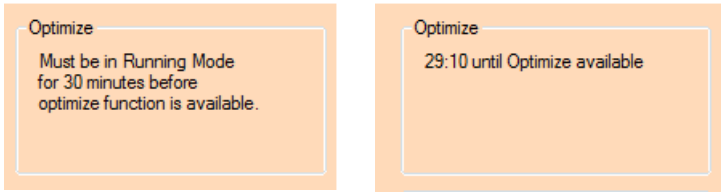
Internal indicator (LED)—When red, indicates that an internal interlock is open. Call your Spectra-Physics service representative.

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, the button is grayed out and progress is indicated by the green bars below the button. When finished, both bars are green and *Optimize Complete* appears above the bars.

The **Optimize** button becomes available 30 minutes after the InSight X3 has initialized. It displays a timer counting down to when it is available, as shown below.



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—Displays the progress of the optimization routine. The top bar shows the progress of each of the four phases, and the bottom bar indicates total progress.

Diode Information

This section provides feedback regarding the condition of the laser diode.

Current monitor—Diode current in Amps

Temperature monitor—Diode temperature in degrees Celsius

Hours monitor—Accumulated hours of operation for diode

Set Wavelength Highlight Color—Allows the operator to change the color of the wavelength displayed in the Main tab when a wavelength change is requested. The default color is red.

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 about 200 mW), the beam is NOT safe for your eyes! Always wear proper eye protection!

Run/Align indicator (green/yellow LED)—Illuminates in green when laser output is stable while in either run or alignment mode. This LED blinks yellow when the output is changing state.

LCD Brightness—Allows adjustment of the brightness of the LCD display on the power supply.

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 X3* laser. If communication fails between these two units, the counter counts down to 0 and shuts off the laser. Use the up/down arrow buttons to set the time period in tenths of a second. A setting of 0 turns off this function and allows the laser to remain on. The 0 setting should be used only in special circumstances. 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 the **Imaging Control** 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 user can select a servo off time using the drop-down menu next to the **Servo Off** button. 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 servo immediately and stops the servo off counter.

Servo Off button—Disables the servo and starts the servo off timer.

Timer control—Allows the user to set the servo off timer to 15, 30, 45, or 60 minutes using the drop-down menu.

Status

This area provides feedback about the system.

History Buffer display—Shows the last 16 events, including 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 cannot be started until *100% warmed up* is displayed.

Humidity monitor—Shows the current humidity in the laser cavity. At 10% 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 6-14 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.

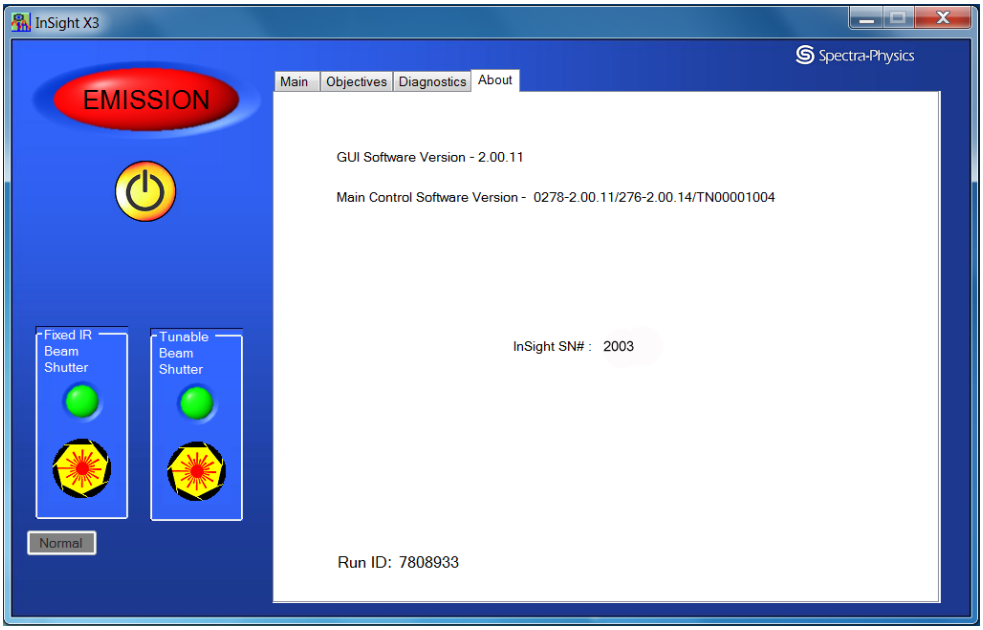


Figure 6-14 *About tab*

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 in the figure.*

CHAPTER 7: Maintenance and Diagnostics

The Spectra-Physics InSight® X3™ 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 X3* laser head itself 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. 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 X3* laser is limited to changing the coolant in the *ThermoRack 401* chiller, and cleaning or replacing the air filter and replacing the purge unit in the *IPS-300* power supply.

The purge unit in the *IPS-300* is not user serviceable. The part number for the 2200-HT purge unit is list in Table 7-3. Please contact your Spectra-Physics service representative to schedule a visit to replace the unit.

The procedures in the next section describe how to do these tasks. Recommended maintenance intervals for the *InSight X3* systems are listed in the table below.

Table 7-1 *Maintenance task intervals*

Recommended Maintenance	Frequency	Notes
Purge air tubes	Inspect weekly	Replace if the tubes become damage or contaminated.
Chiller hoses	Inspect weekly	Replace the chiller hoses if leaking or other damage occurs.
Cables and cords	Inspect weekly	Replace cables and cords if damaged.
Change Nalco coolant in the *ThermoRack 401* chiller	Every 6 months or as necessary	Refer to the chiller user's manual for instructions. The part number for the Nalco coolant is listed in Table 7-3.
Clean the mesh filter from the chiller water filter	Every year	See instructions in the section "Chiller Filter."
Replace the 2200-HT purge unit in the *IPS-300* power supply	Every 2 years or if the humidity level exceeds 10% as noted on the diagnostics tab of the *InSight X3* GUI (Figure 6-13)	Not user serviceable, please contact your Spectra-Physics service representative.

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. Use a vacuum to clean the air intake and exhausts periodically.
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.*

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.

Spectra-Physics recommends replacing the coolant **at least every 6 months**.

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 7-3 on page 7.

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).

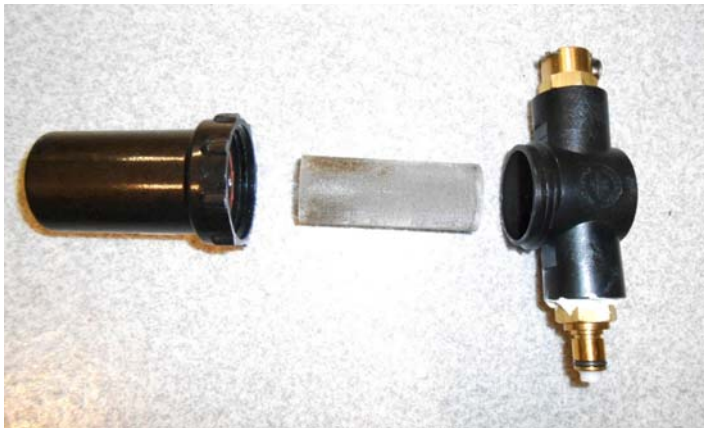


Figure 7-3 *Replace filter in assembly*

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

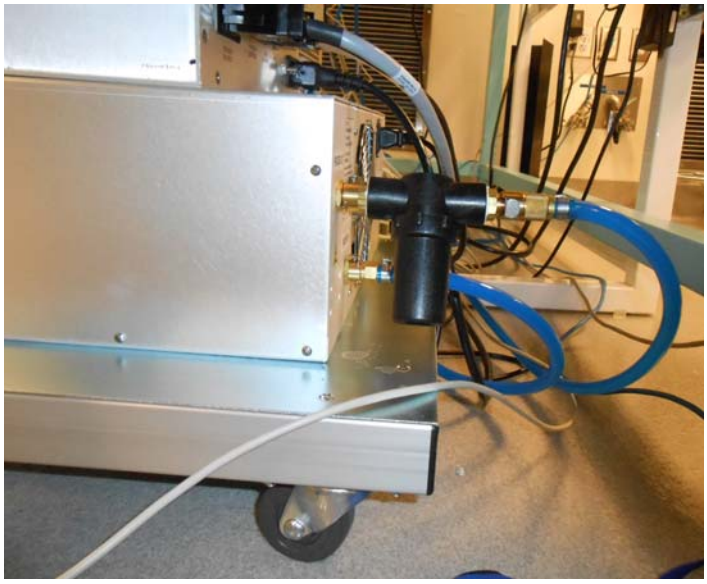


Figure 7-4 *Plug hose back into chiller*

11. Turn on the chiller, and check for leaks.

12. Turn on the power supply.

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 X3* 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, found on the About tab.

Table 7-2 *Troubleshooting issues and corrective actions*

Possible Causes	Corrective Action
Symptom: The controller screen does not light up.	
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.	
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.
The system needs calibration.	Press the **Optimize** button on the Diagnostics tab.
Diode may have degraded.	Call your Spectra-Physics service representative.
Symptom: High optical noise.	
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.
The system needs calibration.	Press the **Optimize** button on the Diagnostics tab.
Symptom: Long-term stability/beam pointing is poor.	
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 7-3 *Field replaceable units*

Description	Part Number
Nalco 460-PCCL104 liquid corrosion inhibitor (coolant), 1 gal.	1607-0546
2200HT-ETN purge cartridge replacement (requires return of customer purge)	2200HT-ETN
InSight laser head shipping crate	90044050
IPS-300 power supply/chiller shipping crate w/ shipping boxes	90044281
ThermoRack 401 chiller	90060831
ThermoRack 401 chiller filter	90062975
Hose assembly, *ThermoRack 401,* drain hose	90044272
Fuse Kit for *IPS-300* power supply	90055570
Fuse for *IPS-300* power supply, 15 A, 80 V, FKS ATO blade	90048981
Fuse for *IPS-300* power supply, 10 A, 80 V, FKS ATO blade	90048982
Fuse for *IPS-300* power supply, 7.5 A, 80 V, FKS ATO blade	90048983
Fuse for *IPS-300* power supply, 3 A, 80 V, FKS ATO blade	90048984
Fuse kit for *ThermoRack 401* chiller	90055702
Fuse for *ThermoRack 401* chiller, 15 A, 100 V, 5 x 20 mm	90055700
Fuse for *ThermoRack 401* chiller, 10 A, 220 V, 5 x 20 mm	90055701
Hose assembly, 10 ft. long, 2 fittings	90041685
USB flash drive with GUI software and USB driver	90083932

CHAPTER 8: Customer Service

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® X3™* laser system is protected by a 12-month warranty. All mechanical, electronic, and 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
Austria	Spectra-Physics - High Q Laser Feldgut 9 Rankweil A-6830 Austria Tel: +43 5522 82646 Fax: +43 5522 82646 800 Email: office@highqlaser.at Spectra-Physics Vienna Fernkorngasse 10 1100 Vienna Austria Tel: +43 1 503 70 02 0 Fax: +43 1 503 70 02 99

Table 8-1 *Service centers (Continued)*

Location	Contact Details
China (Mainland)	Beijing Newport Spectra-Physics Technologies Co.,Ltd Room 2305 Building B Tri-Tower No. 66 Zhong Guan Cun East Road Beijing 100080 P.R.China Tel: +86-10-6267-0065 Fax: +86-10-6267-2342 Email: zhenyi.yao@spectra-physics.com.cn
China (Hong Kong)	A & P Instrument Co., Ltd Room 68,1/F Sino Industrial Plaza 9 Kai Cheung Road Kowloon Bay, Kowloon Hong Kong China Tel: +852-2755-6578 Fax: +852-2755-4549 Email: andy@anp.com.hk
Germany and Export Countries (includes all European and Middle Eastern countries not listed here)	Newport Spectra-Physics - Darmstadt Guerickeweg 7 D-64291 Darmstadt Germany Tel: +49-(0) 6151-708-0 Fax: +49-(0) 6151-79102 Email: germany@newport.com Spectra-Physics - Stahnsdorf Ruhlsdorfer Str. 95 Stahnsdorf 14532 Germany Tel: +49-3329-6387-0 Fax: +49-3329-638733
Japan (East)	Spectra-Physics K.K. HF Nakameguro Building 4-6-1 Nakameguro Meguro-Ku Tokyo 153-0061 Japan Tel: +81-3-3794-5511 Fax: +81-3-3794-5510 Email: spectra-physics@splasers.co.jp Website: www.spectra-physics.jp

Table 8-1 *Service centers (Continued)*

Location	Contact Details
Japan (West)	Spectra-Physics K.K. Nishi-Honmachi Solar Building, 3-1-43 Nishi-Honmachi, Nishi-ku Osaka 550-0005 Japan Tel: +81-6-4390-6770 Fax: +81-6-4390-2760 Email: spectra-physics@splasers.co.jp Website: www.spectra-physics.jp
Korea (Republic of)	Spectra-Physics Korea Applications Lab Pyungchon Smart Bay A-801 Beolmal-ro 123, Dongan-gu, Anyang-si Gyeonggi-do 431-804 Korea (Republic of) Tel: +82-0-31-8069-2401 Fax: +82-0-31-8069-2402 Email: korea@spectra-physics.com Laser Spectronix Byucksan Digital Valley 6-406 481-4, Gasan-dong Geumcheon-Gu Seoul 153-704 Korea (Republic of) Tel: +82-2-2627-3123 Fax: +82-2-2627-3120 Email: laser@laser.co.kr
Singapore	Newport Opto-Electronics Technologies Private Ltd 10 Ang Mo Kio Street 65 02-11 TechPoint Singapore 569059 Republic of Singapore Tel: +65-6664-0400 Fax: +65-6664-0401 Email: sales.sg@newport.com

Table 8-1 *Service centers (Continued)*

Location	Contact Details
Taiwan	Newport Taiwan 11F, No. 35, Sec. 3 Minquan E. Rd. Taipei 104 Taiwan R.O.C. Tel: +886-2-2508-4977 Fax: +886-2-2508-0367 Email: sales@newport.com.tw
United Kingdom	Newport Spectra-Physics Ltd Unit 7, Library Avenue, Harwell Oxford Didcot, Oxfordshire, OX11 OSG UK Tel: +44 (0) 1235 432 710 Fax: +44 (0) 1235 821 045 Email: uk@newport.com
United States and Export Countries (includes all non-European or Middle Eastern countries not listed here)	Spectra-Physics Headquarters 3635 Peterson Way Santa Clara, CA 95054 United States Office Tel: +1 408-980-4300 Toll-Free Phone - Sales: +1 800-775-5273 Toll-Free Phone - Service: +1 800-456-2552 Office Fax: +1 408-980-6921 Email: service@spectra-physics.com Website: www.spectra-physics.com

APPENDIX A: Programming Guide

Command/Query/Response Format

In the interest of standardization, the serial commands and queries used on the *InSight*® *X3*™ system follow the Standardized Commands for Programmable Instruments (SCPI) protocol. 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 laser 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 laser 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 laser 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, the following commands are equivalent:

  READ:PLAS:DIOD1:CURR?
  READ:PLAS:DIODE1:CURR?
  READ:PLASER:DIODE1:CURRENT?

  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 X3* 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?* and then 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 X3* laser. A detailed description of this list with examples follows in the next section.

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 — *Turn On Pump Laser*

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 — *Turn Off Pump Laser*

Turns off the pump diode laser, 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? — *Open/Close Fixed IR Beam Shutter*

NOTE: *This command/query only applies when the 1045 nm option is installed.*

- *IRSHUTter 1* opens the fixed IR beam shutter.
- *IRSHUTter 0* closes the fixed IR beam shutter.
- *IRSHUTter?* reads and returns the last fixed IR beam shutter command sent.

To determine the actual shutter status, use the **STB?* command. When issuing **STB?* 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? — *Set/Query LCD Brightness*

Sets the power supply LCD screen back illumination brightness level. When set, the system remembers the user's set point any time the power supply is cycled.

MODE RUN
MODE ALIGN
MODE? — *Set/Query Operating Mode*

Sets the system mode as follows:

- *MODE RUN* sets the laser to standard operating mode.
- *MODE ALIGN* sets the laser to low power so that it is easier and safer to align the optical beam through a microscope. Note that 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? — *Query History Buffer*

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, "Status Codes," contains a list of status and fault codes.

READ:HUMidity? — *Query Humidity*

Returns the relative humidity (in percent) of the laser cavity. The humidity should be kept below 5%. If humidity rises above this value, replace the purge unit (contact Spectra-Physics service personnel).

READ:PCTWarmedup? — *Query Warm-up Time*

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? — *Query Diode Current*

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

READ:PLASer:DIODe1:TEMPerature? — *Query Diode Temperature*

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

READ:PLASer:DIODe1:HOURS? — *Query Diode Hours*

Returns the accumulated hours that the diode pump laser has been operating. A typical response might be 37.5<LF>.

READ:POWer? — *Query Power*

Returns the laser 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:SERVOTIME? — *Query Servo On/Off Time*

When the servo is off (**STB* bit 5 is cleared), this is the number of seconds remaining before the servo is automatically turned on.

When the servo is on (**STB?* bit 5 is set), this is the number of seconds remaining before *SERVO 0* is accepted.

READ:WAVelength? — *Query Wavelength*

Returns the 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 — *Save Variables*

Saves the 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.

SERVO <n> — *Turn Servo On/Off*
SERVO? — *Query Servo*

Turns the servo on or off. The query gets the last commanded servo state.

- *SERVO 1*
  - Turns the servo on immediately.
  - When the servo is on, bit 5 of the status bits (**STB?*) is set.

  NOTE: *Sending either the WAVelength command or the ON command also turns on the servo.*
- *SERVO 0*
  - Turns the servo off.
  - This command is ignored if *READ:SERVOTIME?* is nonzero.
  - This command is ignored unless the laser is in state 50.
  - When the servo is off, bit 5 of the status bits (**STB?*) is cleared.
- *SERVO?* gets the last commanded servo state (1 or 0).

SERVOTIME? — *Set Servo Off Time*

Sets the number of seconds for the servo to be off after issuing *SERVO 0* command. Values above 3600 (60 minutes) are clamped to 3600 seconds. The *SERVOTIME* command must be issued before turning the servo off.

SHUTDOWN — *Shut Down System*

Never turn off the power switch before exiting the laser GUI or using RS-232/USB commands to shut down the laser.

Refer to "Turning Off the System" for a detailed explanation of how to shut down the laser safely.

Turns off the main power to the laser. In addition to saving all internal variables (see the *SAVE* command), this command 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? — *Open/Close/Query Tunable Beam Shutter*

Opens or closes the tunable beam shutter.

- *SHUTter 1* opens the tunable beam shutter.
- *SHUTter 0* closes the tunable beam shutter.
- *SHUTter?* reads and returns the last shutter command sent.

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

TIMer:WATChdog n — *Set Timer*

Sets the number of seconds for the software watchdog timer. A value of 0 disables the software watchdog timer. If the laser 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? — *Set/Query Wavelength*

Sets the wavelength to 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? — *Query Min/Max Wavelength*

Returns the maximum or minimum values for the *WAVelength* command. Examples:

← WAVelength:MAX? <CR>
→ 1300 <LF>
← WAVelength:MIN? <CR>
→ 680 <LF>

**IDN?* — *Query Laser Identification String*

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

Spectra-Physics, InSight DeepSee, 2017/, 0278-2.00.12/276-2.00.14/TN00001005

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? Query Status Byte

Returns an integer 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	Name	Interpretation
0	0x00000001	Emission	The laser diode is 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 *Mai Tai.* In the *InSight X3 system*, 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	Tunable beam shutter	1 = The tunable beam shutter is open (sensed position).
3	0x00000008	Fixed IR beam shutter	1 = The fixed IR beam shutter is open (sensed position). **NOTE:** *On systems purchased without the optional dual beam output, this bit is always set to 1.*
4	0x00000010	reserved	Reserved
5	0x00000020	Servo on	1 = Servo is on (see “SERVO” command on page A-6).
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:AHIStory?* (page A-4) to see what is causing the warning.

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

Bit Number	Bit Mask	Name	Interpretation
15	0x00008000	fault	1 = The system is currently detecting a fault condition. *InSight* immediately turns off the laser diode. Use *READ:AHIStory?* 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. The laser system 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 – Laser 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? — *Query Motor Position Limit*

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 *X3* lower soft limit value

CONTrol:SLMAX? *Query Max Motor Position Limit*

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 *X3* higher soft limit value

CONTrol:MTRMOV nn.nn (Range 0 to 100)
CONTrol:MTRMOV? *Set/Query Motor Position*

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? *Query Motor Position*

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 (as could be learned from the *CONTrol:SLMIN?* query), 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 RS-232 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 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® X3™* 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 along with a short description are also shown on the LCD display on the front panel of the *IPS-300* power supply, as shown in Table B-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.
Critical Fault—Laser turns off and cannot be restarted without cycling AC mains power.

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 the 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 therm. shorted	A diode laser thermistor short has been detected.	Contact Spectra-Physics.
89	Fault	Diode therm. open	A diode laser thermistor open has been detected.	Contact Spectra-Physics.
90	Fault	Diode is too hot	Diode laser temperature ≥ 35°C (shutdown condition).	Check the coolant connections.
91	Warning	Diode is warm	Diode laser temperature ≥ 32°C (shutdown condition).	Check the 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
92	Warning	Diode is too cold	Diode laser temperature ≤ 17°C.	Check the chiller status and coolant connections.
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 *IPS-300.*
120	Fault	Keyswitch interlock	The keyswitch is in the OFF position.	Turn the keyswitch to the enable (vertical) position.
130	Warning	High humidity	The purge component is no longer removing enough moisture from the system.	Change the purge cartridge when convenient.
482	Fault	Low FSec Osc Power	The oscillator output is below spec (during turn-on sequence).	Contact Spectra-Physics.
483	Fault	Low FTO Power	Laser turn on failed.	Try a different wavelength. Contact Spectra-Physics.
484	Fault	Low FSec Osc Power	The oscillator output is below spec (during normal operation).	Contact Spectra-Physics.
520	Critical Fault	Motion Control Error Comm. Failure	Motion control error	Contact Spectra-Physics.
522	Critical Fault	Motion Control Error Home Sensor Failure	Motion control error	Contact Spectra-Physics.
524	Critical Fault	Motion Control Error Motor Fault	Motion control error	Contact Spectra-Physics.
543	Critical Fault	Temp Ctrl Error	Temperature control error	Contact Spectra-Physics.
550	Critical Fault	Type 1 memory error	Type 1 memory error	Contact Spectra-Physics.
551	Critical Fault	Type 2 memory error	Type 2 memory error	Contact Spectra-Physics.
552	Critical Fault	Type 3 memory error	Type 3 memory error	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.

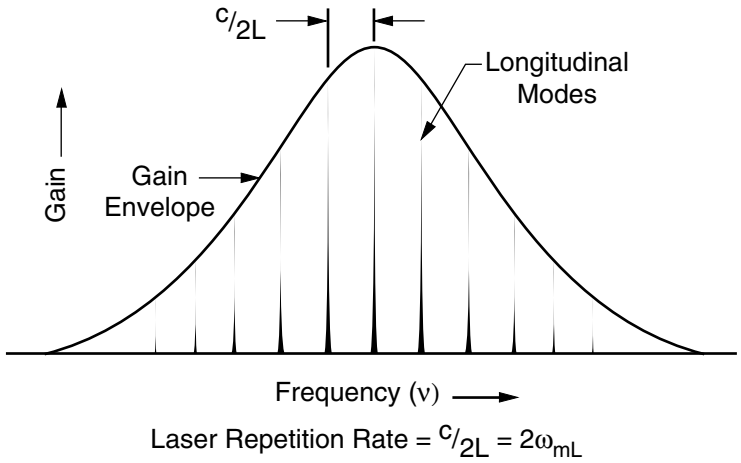


Figure C-1 *Amplitude and frequency of longitudinal modes in mode-locked laser*

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® X3™* laser, the resulting frequency is around 80 MHz (see Figure C-2). In the figure, L is cavity length and c is light velocity.

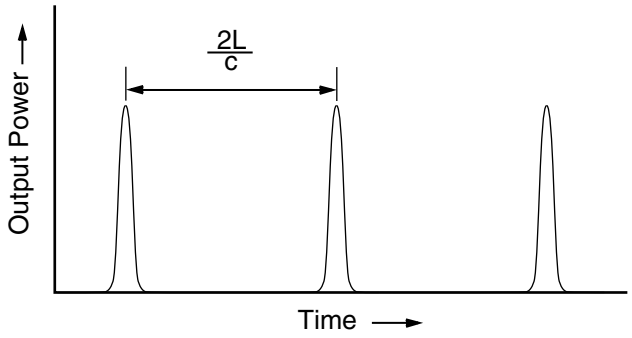


Figure C-2 *Typical output of mode-locked laser*

The *InSight X3* laser system takes advantage of mode locking, making it capable of generating a series of pulses with less than 120 fs duration.

Group Velocity Dispersion (GVD)

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 though the optically transparent media with a unique velocity (refer to Figure C-3).

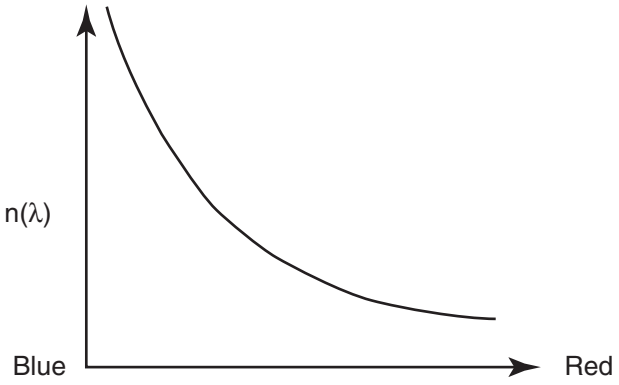


Figure C-3 *Typical wavelength dependence of refractive index of material*

Group velocity dispersion (GVD) comes into effect when a group of wavelengths pass though 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.

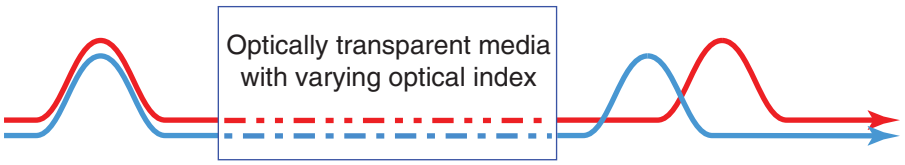


Figure C-4 *Typical pulse spreading due to GVD*

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 X3* 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 X3* laser 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 X3* laser 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 X3* laser 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 X3* laser generates this precompensation.

The *DeepSee* component allows the precompensated *InSight X3* 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.

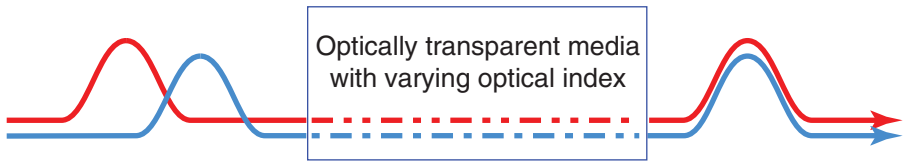


Figure C-5 *System with precompensation providing shortest pulse at sample*

This makes the *InSight X3* laser particularly well suited for applications requiring the shortest possible pulse at the sample location, such as in vivo microscopic florescence imaging.

With the *InSight X3* laser, Spectra-Physics introduces a completely automated, user-friendly, compact dispersion compensation system. The *DeepSee* component provides high negative GVD values, a large dynamic range for dispersion compensation, high throughput and excellent pointing stability. Refer to Chapter 6, “Operation,” for further details.

APPENDIX D: Nalco MSDS

This section contains the material safety data sheet (MSDS) supplied by the Nalco Company for the algaecide and cleaner used in the *ThermoRack 401* chiller. This appendix includes an MSDS for each of the following products:

- Nalco 460-PCCL104 algaecide (7 pages)
- Nalco 460-CCL2567 cleaner (9 pages)

The MSDS for the algaecide begins on the next page, followed by the MSDS for the cleaner. Please read this information before handling or disposing of the chemicals or any cooling water containing them.

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.

Warning! 

This information does not pertain to, and may not be appropriate for, larger quantities of the chemical than those described. Nalco products are intended for use by personnel with sufficient technical skill and qualification to use the materials correctly and understand the risks in handling any potentially hazardous chemical.

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	Nalco 460-PCCL104
Other means of identification	:	Not applicable.
Restrictions on use	:	Refer to available product literature or ask your local Sales Representative for restrictions on use and dose limits.
Company	:	Nalco Company 1601 W. Diehl Road Naperville, Illinois 60563-1198 USA TEL: (630)305-1000
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	01/22/2015

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Not a hazardous substance or mixture.

GHS Label element

Precautionary Statements : **Prevention:**
Wash hands thoroughly after handling.
Response:
Specific measures: consult SDS Section 4.
Storage:
Store in accordance with local regulations.

Other hazards : None known.

Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

Pure substance/mixture : Mixture

No hazardous ingredients

Section: 4. FIRST AID MEASURES

In case of eye contact	:	Rinse with plenty of water. Get medical attention if symptoms occur.
In case of skin contact	:	Wash off with soap and plenty of water. Get medical attention if symptoms occur.
If swallowed	:	Rinse mouth. Get medical attention if symptoms occur.
If inhaled	:	Get medical attention if symptoms occur.
Protection of first-aiders	:	In event of emergency assess the danger before taking action. Do not put yourself at risk of injury. If in doubt, contact emergency responders.Use personal protective equipment as required.

Notes to physician	:	Treat symptomatically.
Most important symptoms and effects, both acute and delayed	:	See Section 11 for more detailed information on health effects and symptoms.

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	:	None known.
Specific hazards during firefighting	:	Not flammable or combustible.
Hazardous combustion products	:	Decomposition products may include the following materials: Carbon oxides nitrogen oxides (NOx) Sulphur oxides Oxides of phosphorus
Special protective equipment for firefighters	:	Use personal protective equipment.
Specific extinguishing methods	:	Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Refer to protective measures listed in sections 7 and 8.
Environmental precautions	:	No special environmental precautions required.
Methods and materials for containment and cleaning up	:	Stop leak if safe to do so. Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). For large spills, dike spilled material or otherwise contain material to ensure runoff does not reach a waterway. Flush away traces with water.

Section: 7. HANDLING AND STORAGE

Advice on safe handling	:	For personal protection see section 8. Wash hands after handling.
Conditions for safe storage	:	Keep out of reach of children. Keep container tightly closed. Store in suitable labeled containers.
Suitable material	:	Keep in properly labelled containers.
Unsuitable material	:	The following compatibility data is suggested based on similar product data and/or industry experience: Compatibility with Plastic Materials can vary; we therefore recommend that compatibility is tested prior to use.

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Contains no substances with occupational exposure limit values.

Engineering measures	:	Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Personal protective equipment

Eye protection	:	Safety glasses
Hand protection	:	Wear protective gloves. Standard glove type. Gloves should be discarded and replaced if there is any indication of degradation or chemical breakthrough.
Skin protection	:	Wear suitable protective clothing.
Respiratory protection	:	No personal respiratory protective equipment normally required.
Hygiene measures	:	Wash hands before breaks and immediately after handling the product.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Liquid
Colour	:	Pink
Odour	:	No data available.
Flash point	:	does not flash
pH	:	9 - 10, 100 %
Odour Threshold	:	no data available
Melting point/freezing point	:	no data available
Initial boiling point and boiling range	:	no data available
Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	no data available
Relative vapour density	:	no data available
Relative density	:	1.0 (25 °C)
Density	:	no data available
Water solubility	:	completely soluble
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available

Auto-ignition temperature	:	no data available
Thermal decomposition temperature	:	no data available
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	no data available
VOC	:	no data available

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	No dangerous reaction known under conditions of normal use.
Conditions to avoid	:	Extremes of temperature
Incompatible materials	:	None known
Hazardous decomposition products	:	Decomposition products may include the following materials: Carbon oxides nitrogen oxides (NOx) Sulphur oxides Oxides of phosphorus

Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Inhalation, Eye contact, Skin contact

Potential Health Effects

Eyes	:	Health injuries are not known or expected under normal use.
Skin	:	Health injuries are not known or expected under normal use.
Ingestion	:	Health injuries are not known or expected under normal use.
Inhalation	:	Health injuries are not known or expected under normal use.
Chronic Exposure	:	Health injuries are not known or expected under normal use.

Experience with human exposure

Eye contact	:	No symptoms known or expected.
Skin contact	:	No symptoms known or expected.
Inhalation	:	No symptoms known or expected.

Toxicity

Product

Acute oral toxicity	:	Acute toxicity estimate : > 5,000 mg/kg
Acute inhalation toxicity	:	no data available

Acute dermal toxicity	:	no data available
Skin corrosion/irritation	:	no data available
Serious eye damage/eye irritation	:	no data available
Respiratory or skin sensitization	:	no data available
Carcinogenicity	:	no data available
Reproductive effects	:	no data available
Germ cell mutagenicity	:	no data available
Teratogenicity	:	no data available
STOT - single exposure	:	no data available
STOT - repeated exposure	:	no data available
Aspiration toxicity	:	no data available

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Environmental Effects : This product has no known ecotoxicological effects.

Persistence and degradability

no data available

Mobility

no data available

Bioaccumulative potential

no data available

Other information

no data available

Section: 13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it is not a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261, since it does not have the characteristics of Subpart C, nor is it listed under Subpart D.

Disposal methods	:	Where possible recycling is preferred to disposal or incineration. If recycling is not practicable, dispose of in compliance with local regulations. Dispose of wastes in an approved waste disposal facility.
Disposal considerations	:	Dispose of as unused product. Empty containers should be

taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

Land transport (DOT)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Air transport (IATA)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Sea transport (IMDG/IMO)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Section: 15. REGULATORY INFORMATION

EPCRA - Emergency Planning and Community Right-to-Know Act

CERCLA Reportable Quantity

This material does not contain any components with a CERCLA RQ.

SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 311/312 Hazards : No SARA Hazards

SARA 302 : No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 : This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

California Prop 65

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

INTERNATIONAL CHEMICAL CONTROL LAWS :

TOXIC SUBSTANCES CONTROL ACT (TSCA)

The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA)

The substance(s) in this preparation are included in or exempted from the Domestic Substance List (DSL).

AUSTRALIA
All substances in this product comply with the National Industrial Chemicals Notification & Assessment Scheme (NICNAS).

CHINA
All substances in this product comply with the Provisions on the Environmental Administration of New Chemical Substances and are listed on or exempt from the Inventory of Existing Chemical Substances China (IECSC).

EUROPE
The substances in this preparation have been reviewed for compliance with the EINECS or ELINCS inventories.

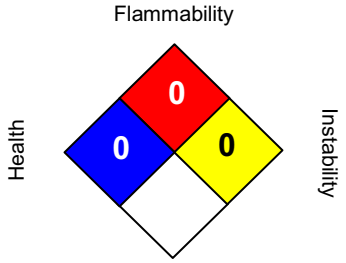
JAPAN
All substances in this product comply with the Law Regulating the Manufacture and Importation Of Chemical Substances and are listed on the Existing and New Chemical Substances list (ENCS).

KOREA
All substances in this product comply with the Toxic Chemical Control Law (TCCL) and are listed on the Existing Chemicals List (ECL)

PHILIPPINES
All substances in this product comply with the Republic Act 6969 (RA 6969) and are listed on the Philippines Inventory of Chemicals & Chemical Substances (PICCS).

Section: 16. OTHER INFORMATION

NFPA:



Special hazard.

HMIS III:

HEALTH	0
FLAMMABILITY	0
PHYSICAL HAZARD	0

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Revision Date	:	01/22/2015
Version Number	:	1.0
Prepared By	:	Regulatory Affairs

REVISED INFORMATION: Significant changes to regulatory or health information for this revision is indicated by a bar in the left-hand margin of the SDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.
For additional copies of an MSDS visit www.nalco.com and request access.

SAFETY DATA SHEET

460-CCL2567 Cleaning Solution,CCLS,2567

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	460-CCL2567 Cleaning Solution,CCLS,2567
Other means of identification	:	Not applicable.
Restrictions on use	:	Refer to available product literature or ask your local Sales Representative for restrictions on use and dose limits.
Company	:	Nalco Company 1601 W. Diehl Road Naperville, Illinois 60563-1198 USA TEL: (630)305-1000
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	01/27/2015

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Skin corrosion	:	Category 1A
Serious eye damage/eye irritation	:	Category 1

GHS Label element

Hazard pictograms :

Signal Word : Danger

Hazard Statements : Causes severe skin burns and eye damage.

Precautionary Statements :

Prevention:
Wash skin thoroughly after handling. Wear protective gloves/ protective clothing/ eye protection/ face protection.
Response:
IF SWALLOWED: rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician. Wash contaminated clothing before reuse.
Storage:
Store locked up.
Disposal:
Dispose of contents/ container to an approved waste disposal plant.

Other hazards : None known.

Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

No hazardous ingredients

Section: 4. FIRST AID MEASURES

In case of eye contact	:	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.
In case of skin contact	:	Wash off immediately with plenty of water for at least 15 minutes. Use a mild soap if available. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
If swallowed	:	Rinse mouth with water. Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Get medical attention immediately.
If inhaled	:	Remove to fresh air. Treat symptomatically. Get medical attention if symptoms occur.
Protection of first-aiders	:	In event of emergency assess the danger before taking action. Do not put yourself at risk of injury. If in doubt, contact emergency responders.Use personal protective equipment as required.
Notes to physician	:	Treat symptomatically.
Most important symptoms and effects, both acute and delayed	:	See Section 11 for more detailed information on health effects and symptoms.

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	:	None known.
Specific hazards during firefighting	:	Not flammable or combustible.
Hazardous combustion products	:	Decomposition products may include the following materials: Carbon oxides nitrogen oxides (NOx) Sulphur oxides Oxides of phosphorus
Special protective equipment for firefighters	:	Use personal protective equipment.
Specific extinguishing methods	:	Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations. In the event of fire and/or explosion do not breathe fumes.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures : Ensure adequate ventilation. Keep people away from and upwind of spill/leak. Avoid inhalation, ingestion and contact with skin and eyes. When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Ensure clean-up is conducted by trained personnel only. Refer to protective measures listed in sections 7 and 8.

Environmental precautions : Do not allow contact with soil, surface or ground water.

Methods and materials for containment and cleaning up : Stop leak if safe to do so. Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). For large spills, dike spilled material or otherwise contain material to ensure runoff does not reach a waterway. Flush away traces with water.

Section: 7. HANDLING AND STORAGE

Advice on safe handling : Do not ingest. Do not breathe dust/fume/gas/mist/vapours/spray. Do not get in eyes, on skin, or on clothing. Wash hands thoroughly after handling. Use only with adequate ventilation.

Conditions for safe storage : Do not store near acids. Keep out of reach of children. Keep container tightly closed. Store in suitable labeled containers.

Suitable material : Keep in properly labelled containers.

Unsuitable material : not determined

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Form of exposure	Permissible concentration	Basis
2-Butoxyethanol	111-76-2	TWA	20 ppm	ACGIH
		TWA	5 ppm 24 mg/m3	NIOSH REL
		TWA	50 ppm 240 mg/m3	OSHA Z1

Engineering measures : Effective exhaust ventilation system Maintain air concentrations below occupational exposure standards.

Personal protective equipment

Eye protection : Safety goggles
Face-shield

Hand protection : Wear the following personal protective equipment:
Standard glove type.
Gloves should be discarded and replaced if there is any indication of degradation or chemical breakthrough.

Skin protection	:	Personal protective equipment comprising: suitable protective gloves, safety goggles and protective clothing
Respiratory protection	:	When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.
Hygiene measures	:	Handle in accordance with good industrial hygiene and safety practice. Remove and wash contaminated clothing before re-use. Wash face, hands and any exposed skin thoroughly after handling. Provide suitable facilities for quick drenching or flushing of the eyes and body in case of contact or splash hazard.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Liquid
Colour	:	Clear
Odour	:	None
Flash point	:	does not flash
pH	:	12.6, 100 %
Odour Threshold	:	no data available
Melting point/freezing point	:	no data available
Initial boiling point and boiling range	:	no data available
Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	no data available
Relative vapour density	:	no data available
Relative density	:	1.0 (25 °C)
Density	:	no data available
Water solubility	:	completely soluble
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition temperature	:	no data available
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	no data available
VOC	:	no data available

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions.

Possibility of hazardous reactions	:	No dangerous reaction known under conditions of normal use.
Conditions to avoid	:	None known.
Incompatible materials	:	None known
Hazardous decomposition products	:	Decomposition products may include the following materials: Carbon oxides nitrogen oxides (NOx) Sulphur oxides Oxides of phosphorus

Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Inhalation, Eye contact, Skin contact

Potential Health Effects

Eyes	:	Causes serious eye damage.
Skin	:	Causes severe skin burns.
Ingestion	:	Causes digestive tract burns.
Inhalation	:	May cause nose, throat, and lung irritation.
Chronic Exposure	:	Health injuries are not known or expected under normal use.

Experience with human exposure

Eye contact	:	Redness, Pain, Corrosion
Skin contact	:	Redness, Pain, Corrosion
Ingestion	:	Corrosion, Abdominal pain
Inhalation	:	Respiratory irritation, Cough

Toxicity

Product

Acute oral toxicity	:	no data available
Acute inhalation toxicity	:	no data available
Acute dermal toxicity	:	no data available
Skin corrosion/irritation	:	no data available
Serious eye damage/eye irritation	:	no data available
Respiratory or skin sensitization	:	no data available

Carcinogenicity

IARC	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
OSHA	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.
NTP	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

Reproductive effects	:	no data available
Germ cell mutagenicity	:	no data available
Teratogenicity	:	no data available
STOT - single exposure	:	no data available
STOT - repeated exposure	:	no data available
Aspiration toxicity	:	no data available

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Environmental Effects : This product has no known ecotoxicological effects.

Persistence and degradability

Chemical Oxygen Demand (COD): 6,500 mg/l

Biochemical Oxygen Demand (BOD):

Incubation Period	Value	Test Descriptor
5 d	1,500 mg/l	Product

Mobility

no data available

Bioaccumulative potential

no data available

Other information

no data available

Section: 13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it could meet the criteria of a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Before disposal, it should be determined if the waste meets the criteria of a hazardous waste.

Hazardous Waste:	:	D002
Disposal methods	:	Where possible recycling is preferred to disposal or incineration. If recycling is not practicable, dispose of in compliance with local regulations. Dispose of wastes in an approved waste disposal facility.
Disposal considerations	:	Dispose of as unused product. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

Land transport (DOT)

Proper shipping name	:	PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Air transport (IATA)

Proper shipping name	:	PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Sea transport (IMDG/IMO)

Proper shipping name	:	PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Section: 15. REGULATORY INFORMATION

EPCRA - Emergency Planning and Community Right-to-Know Act

CERCLA Reportable Quantity

This material does not contain any components with a CERCLA RQ.

SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 311/312 Hazards	:	Acute Health Hazard
SARA 302	:	No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.
SARA 313	:	This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

California Prop 65

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

INTERNATIONAL CHEMICAL CONTROL LAWS :

TOXIC SUBSTANCES CONTROL ACT (TSCA)
The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA)
The substance(s) in this preparation are included in or exempted from the Domestic Substance List (DSL).

AUSTRALIA
All substances in this product comply with the National Industrial Chemicals Notification & Assessment Scheme (NICNAS).

CHINA
All substances in this product comply with the Provisions on the Environmental Administration of New Chemical Substances and are listed on or exempt from the Inventory of Existing Chemical Substances China (IECSC).

EUROPE
The substances in this preparation have been reviewed for compliance with the EINECS or ELINCS inventories.

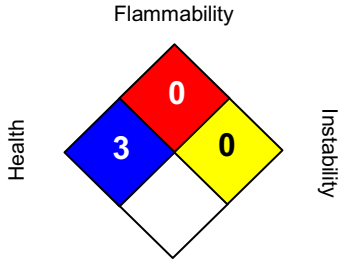
JAPAN
All substances in this product comply with the Law Regulating the Manufacture and Importation Of Chemical Substances and are listed on the Existing and New Chemical Substances list (ENCS).

KOREA
All substances in this product comply with the Toxic Chemical Control Law (TCCL) and are listed on the Existing Chemicals List (ECL)

PHILIPPINES
All substances in this product comply with the Republic Act 6969 (RA 6969) and are listed on the Philippines Inventory of Chemicals & Chemical Substances (PICCS).

Section: 16. OTHER INFORMATION

NFPA:



HMIS III:

HEALTH	3
FLAMMABILITY	0
PHYSICAL HAZARD	0

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Revision Date	:	01/27/2015
Version Number	:	1.0
Prepared By	:	Regulatory Affairs

REVISED INFORMATION: Significant changes to regulatory or health information for this revision is indicated by a bar in the left-hand margin of the SDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.
For additional copies of an MSDS visit www.nalco.com and request access.

Log/Notes

Report Form for Problems and Solutions

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 _____

_____

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_____

_____

_____

Suggested Solution(s) _____

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