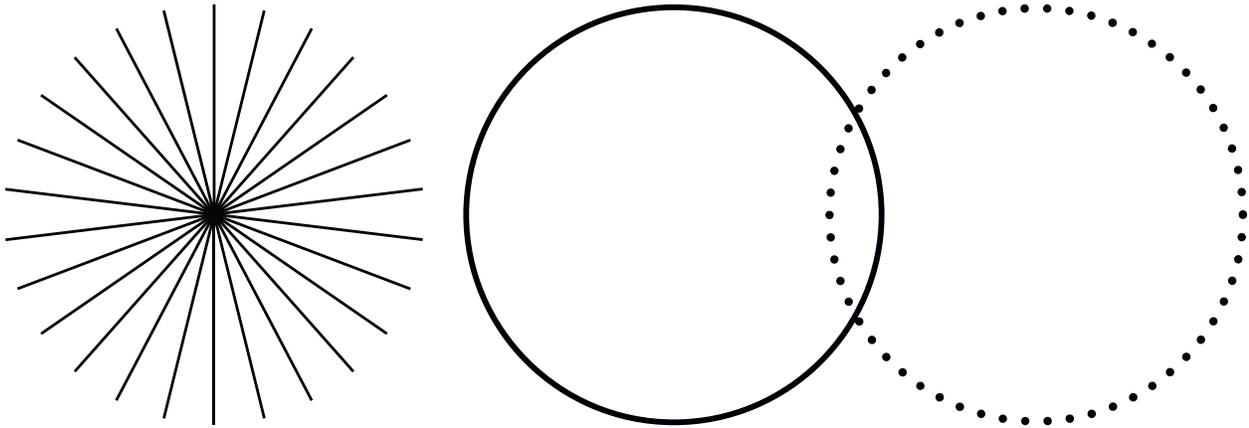


# StingRay/BioRay Lasers

Operator's Manual





**OPERATOR'S MANUAL**  
**STINGRAY/BIORAY LASERS**



27650 SW 95th Ave.  
Wilsonville, OR 97070 USA

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# 1 Introduction

## 1.1 Signal Words and Symbols in this Manual

This documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

Anyone setting up or operating StingRay and BioRay lasers must first read and understand how safety information is presented prior to beginning any tasks.



---

### **NOTICE**

This user information reported in this manual is in compliance with the following standards for Light-Emitting Products EN/IEC 60825-1 'Safety of laser products – Part 1: Equipment classification and requirements' and CDRH 21 CFR Title 21 Chapter 1, Sub-chapter J, Part 1040 'Performance standards for light-emitting products'.

---

Also see detailed information in 'Safety and Compliance' (p. 121).

### 1.1.1 Signal Words

Four signal words are used in this documentation: **DANGER**, **WARNING**, **CAUTION** and **NOTICE**.

The signal words **DANGER**, **WARNING** and **CAUTION** designate the degree or level of hazard when there is the risk of injury:

---

**DANGER!**

Indicates a hazardous situation that, if not prevented, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

---

---

**WARNING!**

Indicates a hazardous situation that, if not prevented, can result in death or serious injury.

---

---

**CAUTION!**

Indicates a hazardous situation that, if not prevented, can result in minor or moderate injury.

---

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

---

**NOTICE**

Indicates information considered important, but not hazard- related.

---

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

### 1.1.2

#### Symbols

The signal words **DANGER**, **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:



---

This symbol is intended to alert the operator to the presence of additional information.

---



---

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

---



---

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

---



---

This symbol is intended to alert the operator to the presence of dangerous voltages within the product enclosure that may be of sufficient magnitude to constitute a risk of electric shock.

---



---

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

---

## 1.2

## Preface

This manual contains user information for the StingRay/BioRay Lasers.



---

### **NOTICE**

Read this manual carefully before operating the laser for the first time. Failure to follow the instructions and safety precautions in this manual can result in serious injury or death. Special attention must be given to the material in 'Safety and Compliance' (p. 121), that describes the safety features built into the laser. Keep this manual with the product and in a safe location for future reference.

---



---

**DANGER!**

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

---

## 1.3 Export Control Laws

It is the policy of Coherent to comply strictly with export control laws of the United States of America (USA).

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

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

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

## 1.4 The Operator's Manual

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

---

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

---

### **1.4.1 Intended Audience**

The Operator's Manual is intended for all persons that are to work on or with the laser system. It assumes that the reader has received guidance from their company's laser safety officer on the safe operation of the laser system.

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

### **1.4.2 Availability and Use**

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

- Operation (including setting up, troubleshooting in the course of work, removal of production waste, care and disposal of consumables,
- Service (maintenance, inspection, repair)
- Transport



## 2 Laser Safety

This laser safety information must be reviewed thoroughly prior to operating the StingRay/BioRay Lasers system. Safety instructions presented throughout this manual must be followed carefully. See 'Safety and Compliance' (p. 121) for additional laser safety information and guidelines.

**Table 2-1. Laser Safety**

<b>Scope</b>	This user information is in compliance with the following standards for Light-Emitting Products IEC 60825-1 "Safety of laser products - Part 1: Equipment classification and requirements" and CDRH 21 CFR Title 21 Chapter 1, Subchapter J, Part 1040 "Performance standards for light-emitting products" except for conformance with IEC 60825-1 Ed. 3 and IEC 60601-2-22 Ed. 3.1, as described in Laser Notice No. 56, dated May 8, 2019.
<b>Hazards</b>	
<b>- Biological/Optical</b>	Exposure to laser radiation may damage the eyes or skin. Wear applicable laser safety eyewear for protection against the specific wavelengths and laser energy being generated. See 'Laser Optical Safety' (p. 122) for additional information/guidelines.
<b>- Electrical</b>	Laser uses AC and DC voltages that are potentially hazardous. The rules for electrical safety must be strictly followed. See 'Electrical Safety' (p. 131) for additional information/guidelines.
<b>- Chemical</b>	Contact of the laser beam with volatile or flammable substances, or released as a result of laser material processing.
<b>Laser Classification</b>	The StingRay/BioRay Lasers is classified as CDRH Class IIIb and IEC 60825-1 safety classification of 3b based on 21 CFR, Title 21 Chapter 1, Subchapter J, Part 1040 "Performance standards for light-emitting products". See 'Laser Safety Classification' (p. 126).
<b>Control Measures</b>	Laser incorporates protective housing, safety interlocks, remote interlock connector, key switch, laser emission indicators, beam attenuator, operator's controls, display, and manual reset mechanism in accordance with CFR 1040.10 (f)(6)/IEC 60825-1. See 'Precautions for Laser Safety' (p. 125) for additional information.
<b>Warning Labels</b>	Refer to Figure I-2 on page 130 for the location of all safety labels.



---

**WARNING!**

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

---

# 3 Description and Specifications

This section introduces StingRay and BioRay lasers, and includes information about the laser as follows.

For information about parts and accessories, see 'Parts and Accessories' (p. 117).

- 'Features of the Laser' (p. 9)
- 'Precautions When Laser is Used' (p. 11)
- 'Power is supplied to the StingRay/BioRay Remote through a 2 mm barrel connector, shown in the example in Figure 3-15. For locations other than North America, Coherent makes every effort to ship a power cord applicable to the location. The dimensions for the Power Supply for the StingRay/BioRay Remote (P/N 1105427) are shown in Figure 3-16.' (p. 20)

## 3.1 Features of the Laser

StingRay and BioRay lasers offer a high-performance laser in a compact module that measures only 19 mm in diameter.

With the modular design that uses the industries' premier laser diodes, StingRay and BioRay lasers deliver best-in-class performance. High-quality glass optics and sophisticated drive electronics deliver the power and control to your application. This improves signal-to-noise and measurement speed.

- **StingRay** is the highest performing top-hat-profile laser available that is offered in a variety of fan angles. This allows creation of the needed line for measurement and profiling applications. Offering the same focus adjustment as BioRay, the StingRay allows a user to get the best focus location for the best measurement resolution.
- **BioRay** is the Coherent compact high-performance laser for Life Science applications with an elliptical beam output. It also has a user-adjustable beam divergence (adjustable focus). With BioRay, the elliptical beam is easier to integrate into today's particle measuring systems. With RS-232 control, the laser power is adjustable. You can access on-board diagnostics for operating hours, diode current, output power, temperature, and more.

An example of the range of products for StingRay and BioRay lasers is shown in Figure 3-1. This includes (from left to right) a BioRay FR (Fiber Ready) in a mount, a StingRay in a mount, a StingRay laser, and StingRay SD (Separate Drive).



**Figure 3-1. StingRay and BioRay Lasers**

The features across the product families for StingRay and BioRay lasers include:

- Wavelengths from 405 nm to 830 nm
- Power up to 200 mW
- User-adjustable focus
- Pointing stability  $<10 \mu\text{rad}/^\circ\text{C}$
- Analog or digital modulation (optional at time of configuration)
- Microprocessor controlled
- On-board diagnostics monitor
- RS-232 control (optional for StingRay lasers at time of configuration; standard for BioRay lasers)
- Power supply range: 5 to 24  $V_{\text{DC}}$

NOTES: Recommend 12  $V_{\text{DC}}$  for greatest efficiency. For lasers between 400 nm to 600 nm, the minimum operating voltage is 6  $V_{\text{DC}}$ .

- ESD protection, over-temperature protection, and reverse polarity protection

- Optional fiber-ready version
- Health Monitor

## 3.2 Precautions When Laser is Used

Follow all safety instructions throughout this manual. Also read and understand all laser safety precautions in “Safety and Compliance”.

If you plan to use StingRay and BioRay lasers as standalone units, Class IIIb lasers require the installation of a safety mechanism. This prevents exposure to the laser light.

The laser light emitted by StingRay and BioRay lasers may be in the infrared area of the electromagnetic spectrum and may not be visible to the human eye.



---

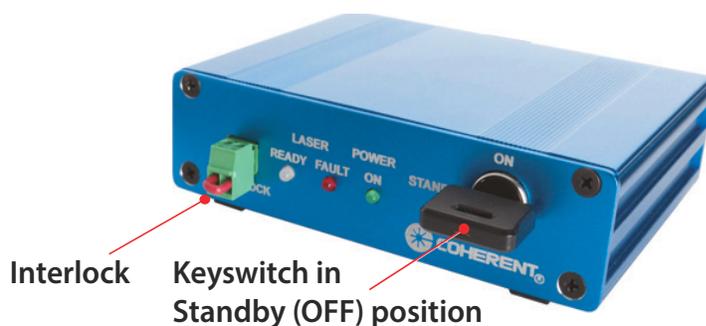
### **CAUTION!**

**Direct eye contact with the output beam from the StingRay and BioRay lasers can cause serious eye injury and possible blindness. Always prevent eye or skin exposure to both DIRECT and SCATTERED radiation. Wear applicable laser safety eyewear at all times when the laser is operational.**

---

## 3.3 StingRay/BioRay Remote

For applications that require a Keyswitch and Interlock for protection from laser emissions, it is recommended that to use the StingRay/BioRay Remote (P/N 1225414), shown in Figure 3-2.



**Figure 3-2. StingRay Remote – Interlock and Keyswitch**

The StingRay/BioRay Remote is a compact, multi-functional control box that lets users connect to a StingRay or BioRay laser terminated with a Hirose connector.

The Remote is available in a StingRay/BioRay Remote Kit (P/N 1231404) that includes all the required accessories, shown in Figure 3-3. This includes the Remote Power Supply and power cord, USB cable, and a USB drive with Coherent Connection software.



**Figure 3-3. StingRay/BioRay Remote Kit**

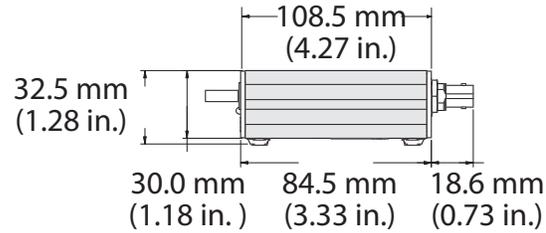
In addition to safety benefits, the StingRay/BioRay Remote supplies feedback, status, and laser control. The StingRay/BioRay Remote also supplies interface to the laser for remote connection of power, modulation, and communication.

Features include:

- Power to the laser through the Hirose connector
- Modulation to the laser via the BNC connector
- USB interface from the laser to a host PC for communications and control
- Visible indication of the laser status (Refer to 'LEDs on the Remote' (p. 86))

Modulation signal (0 to 5 V<sub>DC</sub>) through the BNC connector to the laser. Required only if the laser is ordered with modulation. Users must provide the modulation input voltage

Figure 3-4 shows the dimensions from a side view.



**Figure 3-4. Dimensions - StingRay/BioRay Remote**

See 'Install a Laser with a Remote' (p. 45) for more information.

### **3.3.1**

#### **Remote Front Panel**

The front panel of the StingRay/BioRay Remote includes a keyswitch, a remote interlock, and condition indicators.



**Figure 3-5. StingRay/BioRay Remote**



**NOTICE**

The CDRH Delay for the laser is set at the factory to ON or OFF. The default setting for the CDRH Delay is Enabled (ON). When the Delay is Enabled, the laser starts emission >5 seconds after power is applied.

Indicators on the front panel of the StingRay/BioRay Remote are shown in Figure 3-6.

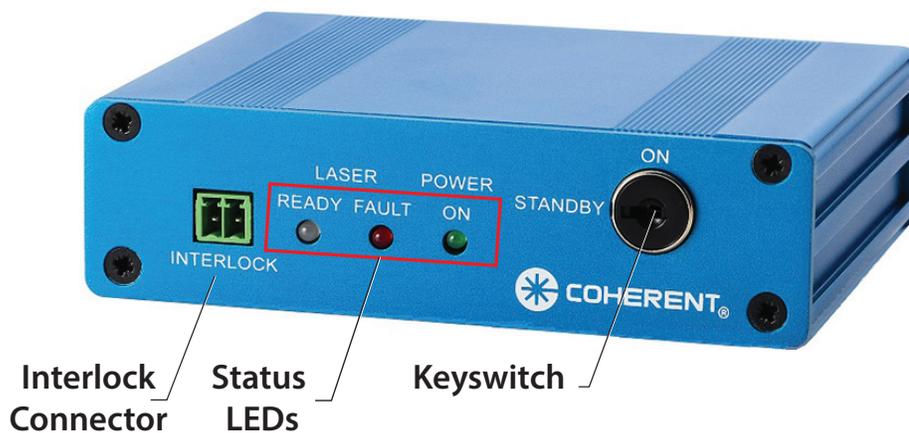


Figure 3-6. StingRay/BioRay Remote - Front Panel

### 3.3.1.1 Interlock Jumper

Figure 3-7 shows the Interlock Jumper on the front panel of the Remote:

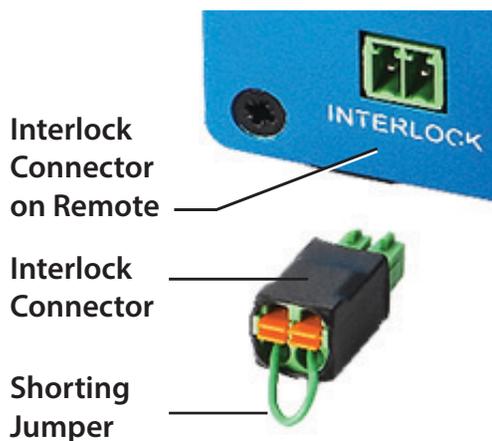


Figure 3-7. Interlock Jumper on the StingRay/BioRay Remote

This mechanical-style jumper is for CDRH interlock. The interlock has terminal style connections that permit connection to an external control device.

The 2-position Interlock Connector (P/N 1952267) is manufactured by Phoenix Contact (<https://www.phoenixcontact.com/>).

### **3.3.1.2 Remote Status LED Indicators**

Figure 3-8 shows the three Status LEDs that are located on the front panel of the StingRay/BioRay Remote. This example shows the Fault LED set to ON (light displays as red). For details about the colors displayed by the LEDs during operation of the laser, see 'LEDs on the Remote' (p. 86).



**Figure 3-8. LEDs on the Remote Front Panel**

### **3.3.1.3 Keyswitch**

The remote has an interlock circuit that must be closed for the laser to operate. It must have the interlock jumper plugged into it and the keyswitch turned to the ON position.

Figure 3-9 shows the keyswitch in the STANDBY and the ON positions.



**Figure 3-9. Keyswitch Positions**

- The 'ON' position is vertical.
- The 'Standby' or 'OFF' position is horizontal.

You can use the Interlock connector two ways:

- **For general use:** Attach the interlock connector with wire jumper (creating a short between the two pins) into the safety interlock. Turn the keyswitch to the ON (vertical) position for normal laser operation. After a short delay, light is emitted from the laser. The laser automatically shuts off if the shorted interlock jumper is removed.
- **For the interlock system:** When the interlock circuit is opened, the laser automatically is set to Off. For example, you can connect the two wires from the remote interlock plug to a door contact switch. In such an example, opening the door opens the Interlock circuit and automatically turns off the laser.

### 3.3.2 Remote Back Panel

The features on the back panel of the StingRay/BioRay Remote are shown in Figure 3-10. Each of these are shown in the subsections that follow.



**Figure 3-10. Back Panel on StingRay/BioRay Remote**

The back panel includes the following connectors:

- Power-In Connector
- BNC Connector
- Hirose Connector to Laser
- USB Connector

### 3.3.2.1 Power-In Connector

The Power In Connector is a 2mm Jack.

Figure 3-11 shows the Power-In connector on the StingRay/BioRay Remote.



**Figure 3-11. Power-In Connector – StingRay/BioRay Remote**

The input voltage for a StingRay/BioRay Remote is 12 V<sub>DC</sub>. For information about the Power Supply for the StingRay/BioRay Remote, see 'Power Supply for the StingRay/BioRay Remote' (p. 20).

The power supply for the StingRay/BioRay Remote (P/N 1105427) is included in the Remote Kit (P/N 1231404), or can be purchased separately from Coherent. Contact your Coherent Sales Representative or see 'Service and Support' (p. 149).

### 3.3.2.2 BNC Connector

The BNC connector supplies a path for the modulation signal to go from an external source to the laser while connected to the Remote.

Either an Analog or Digital signal can be applied to this connection. See 'Analog Modulation' (p. 90) for input requirements.

Figure 3-12 shows the BNC connector on the back of the StingRay/BioRay Remote.



**Figure 3-12. BNC Connector – StingRay/BioRay Remote**

For more information, see:

- 'Power Plug, Phono 3.5 mm' (p. 130) for a description of a cable with BNC connector, dimensions, and pin-outs
- 'Set Up and Connect the Remote' (p. 46) for an example that shows the use of a BNC connector

### **3.3.2.3 Hirose Connector to Laser**

The 'To Laser' connector on the Remote supplies a connection to a StingRay or BioRay laser. It uses a mating Hirose connector HR10-A-10R-12PB(72).

The 12-pin Hirose 'To Laser' receptacle is shown in Figure 3-13.



**Figure 3-13. Hirose Connector to Laser**

For pin-outs and details about a Hirose cable assembly, see 'Hirose Connector' (p. 128).

### **3.3.2.4 USB Connector**

Figure 3-14 shows the connector receptacle for a USB-to-Mini-B cable on the back panel of the Remote.



**Figure 3-14. USB Connector – StingRay/BioRay Remote**

The USB cable (P/N 1108906) included in the Remote Kit is a Type A-to-Type Mini B USB Cable with a Ferrite Core, and is 1.8 M in length.

With a USB cable, connect the computer to a StingRay/BioRay Remote and send commands refer to 'Host Interface' (p. 99). The commands go to the laser via the Remote, which changes the USB signal to RS-232.

The USB interface is available via a virtual COM port in the Coherent Connection software. For more information about set-up for RS-232, see 'Hirose Connector' (p. 128).

### 3.3.3 Specifications for the StingRay/BioRay Remote

Table 3-2 gives the specifications for an individual StingRay/BioRay Remote.

**Table 3-2. Specifications for Remote**

Parameter	Specification
StingRay/BioRay Remote Dimensions	84.5 mm x 108.5 mm x 30.0 mm
Laser-In connectors	One
Operating temperature range	10°C to 50°C
Storage temperature range	-20°C to 70°C
Storage humidity range (non-condensing)	30% to 95%
Interlock(s)	One keyswitch; one dual pin
Power input	12V ± 2 V <sub>DC</sub>
Mechanical expandability	No
Modulation capability <sup>a</sup>	Pass-through only; >1.5 k Ohms
Modulation connectors	One input: pass-through
Modulation connector style	BNC
Communications protocol to laser	RS-232
USB connector	Mini-B
Power-In connector	Kycon KLDX-SMT-0202-AP
Laser-In connector	Hirose 12-pin HR10A-10R-12PB(72)

a. The input modulation BNC is only a pass-through signal or connection, so the input impedance is the same as the modulation circuit inside the StingRay/BioRay laser module.

### 3.3.4 Power Supply for the StingRay/BioRay Remote

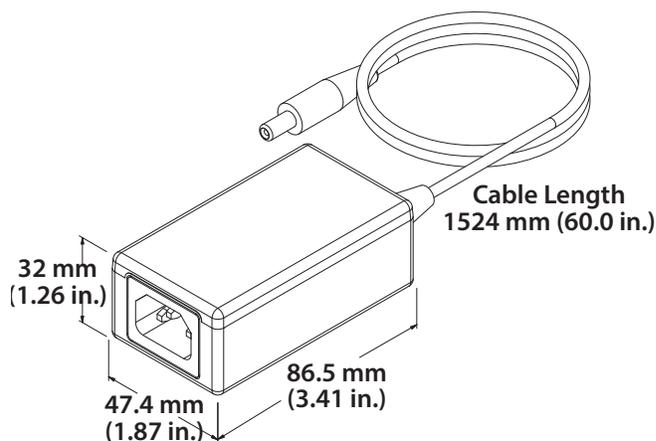
The Power Supply for the Remote is a different Power Supply than the one made for use with an individual laser with flying leads (see 'Flying Leads' (p. 126)).

Power is supplied to the StingRay/BioRay Remote through a 2 mm barrel connector, shown in the example in Figure 3-15. For locations other than



**Figure 3-15. Power Supply – StingRay/BioRay Remote**

North America, Coherent makes every effort to ship a power cord applicable to the location. The dimensions for the Power Supply for the StingRay/BioRay Remote (P/N 1105427) are shown in Figure 3-16.



**Figure 3-16. Dimensions – Power Supply – StingRay/BioRay Remote**

## 3.4 Laser Specifications

This section includes specifications for StingRay and BioRay lasers, including:

- 'Laser Output Specifications' (p. 21)
- 'Laser Electrical Specifications' (p. 21)
- 'Input Power Requirements' (p. 22)
- 'Operating Environment' (p. 22)
- 'Physical Specifications' (p. 23)

Each of these are shown in the sections that follow.

### 3.4.1 Laser Output Specifications

Table 3-3 gives the laser output specifications for StingRay and BioRay lasers.

**Table 3-3. Laser Output Specifications**

Description	Specification
Spatial Mode	TEM <sub>00</sub> (Single Transverse Electric Mode)
Pointing Stability over Temperature ( $\mu\text{rad}/^\circ\text{C}$ )	<10 $\mu\text{rad}/^\circ\text{C}$
Beam Angle (boresight) (mrad)	<3 mrad
RMS Noise (%) (20 Hz to 20 MHz)	<0.5%
Peak-to-Peak Noise (%) (20 Hz to 20 MHz)	<1%
Long Term Power Stability (%) (over 8 hours and $\pm 3^\circ\text{C}$ )	<2%
Warm-up Time (minutes)	<5 minutes

### 3.4.2 Laser Electrical Specifications

Table 3-4 gives the electrical specifications for the StingRay and BioRay lasers.

**Table 3-4. Laser Electrical Specifications**

Description	Value
Operating Voltage ( $V_{DC}$ )	+5 to +24 $V_{DC}$ (recommend 12 $V_{DC}$ for best efficiency) For lasers between 400 nm to 600 nm, the minimum operating voltage is 6 $V_{DC}$ .
Operating Current (mA) (maximum at 25°C)	< 200 mA
Power-on Delay (seconds)	5 seconds (if enabled)
Power Consumption (W)	<5 W
ESD Protection	EN61326-1 (8 kV Air Discharge, 4 kV Contact Discharge)

### 3.4.3 Input Power Requirements

StingRay and BioRay lasers utilize an auto-scaling input power feature. The laser regulates this input voltage to the operating requirement.

- Apply from 5 to 24  $V_{DC}$  to the system (recommended 12  $V_{DC}$  for the best operating efficiency).
- For lasers between 400 nm to 600 nm, the minimum voltage to operate is 6  $V_{DC}$ .

There are two different power supplies available:

- Coherent has a power supply (P/N 1232091) for lasers with cable assemblies that end with flying leads.
- A different power supply (P/N 1105427) must be used with the StingRay/BioRay Remote. This Power Supply is supplied with a StingRay/BioRay Remote Kit (P/N 1231404), or may be bought separately.

The pin-out and wiring qualities for StingRay and BioRay lasers vary by cable termination. See 'Cable Assembly Configuration and Connector Types' (p. 38) for more information.

### 3.4.4 Operating Environment

StingRay and BioRay lasers can be set up for indoor and outdoor use and function normally when the specified operating conditions are met.

**CAUTION!**

As with all semiconductor materials, prevent prolonged or repeated exposure to electrostatic charges or water droplets. All StingRay and BioRay lasers are made with basic ESD protection.

Table 3-5 gives the environmental specifications for the StingRay and BioRay lasers.

**Table 3-5. Environmental Specifications**

Description	Value
Operating Temperature	-10 to 50°C (Exception: 450 nm and 520 nm lasers at 10 to 40°C)
Non-Operating (Storage) Temperature	-20 to 60°C
Maximum Relative Humidity (RH)	<ul style="list-style-type: none"> <li>80% for temperatures up to 31°C</li> <li>For temperatures above 31°C, the Relative Humidity decreases linearly from 80% to 50% (at 50°C).</li> </ul>

### 3.4.5

#### Physical Specifications

This section includes physical specifications and dimensions for the following:

- StingRay and BioRay Lasers
- StingRay or BioRay Laser in Mount
- Compact Laser Head with Separate Driver
- BioRay FR — Fiber-Ready with Sub-Miniature Adapter (SMA)

For more detailed dimension and CAD drawings, see the Coherent website:

<https://www.coherent.com/resources>

#### 3.4.5.1

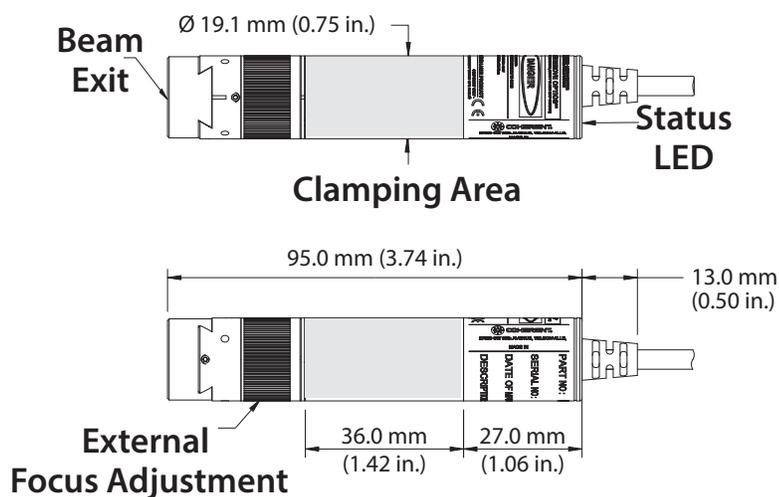
##### StingRay and BioRay Lasers

Table 3-6 gives the physical specifications for standard StingRay and BioRay lasers.

**Table 3-6. Physical Specifications**

Description	Value
Weight (grams)	70 g
Diameter (mm)	19.05 mm
Material	Aluminum 6061 T6

Figure 3-17 shows the dimensions for standard StingRay and BioRay lasers:



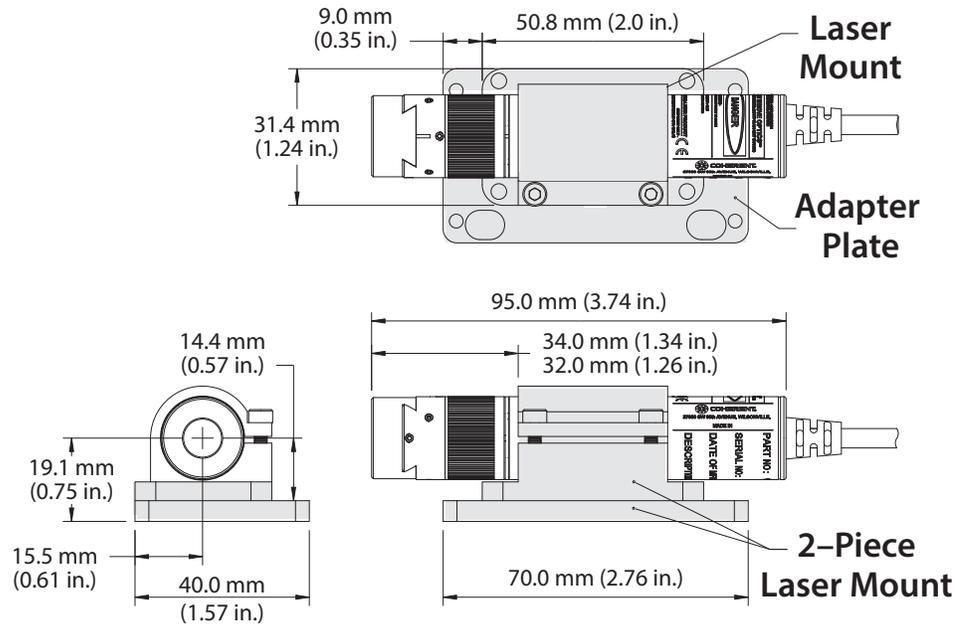
**Figure 3-17. Dimensions of the Laser**

### 3.4.5.2 StingRay or BioRay Laser in Mount

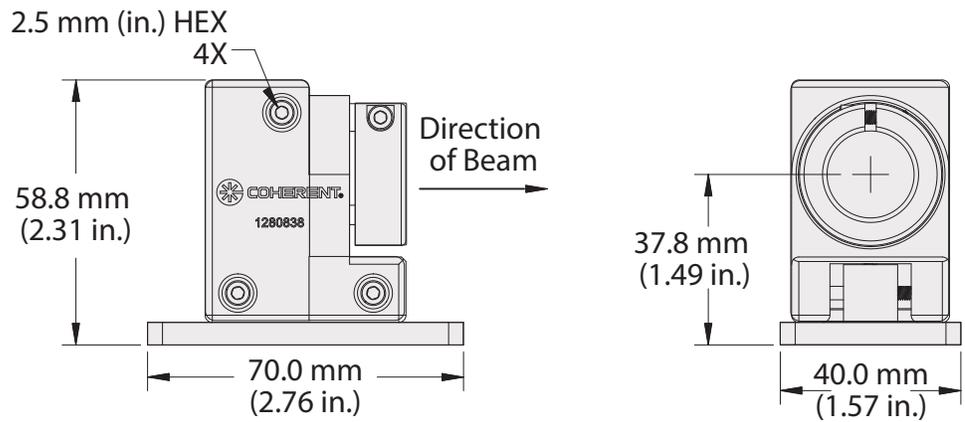
Figure 3-18 shows the dimensions for StingRay and BioRay lasers in a Mount attached to an adapter plate (sold separately):

The dimensions for the Multi-Axis Mount from the SIDE and FRONT Views are shown in Figure 3-19.

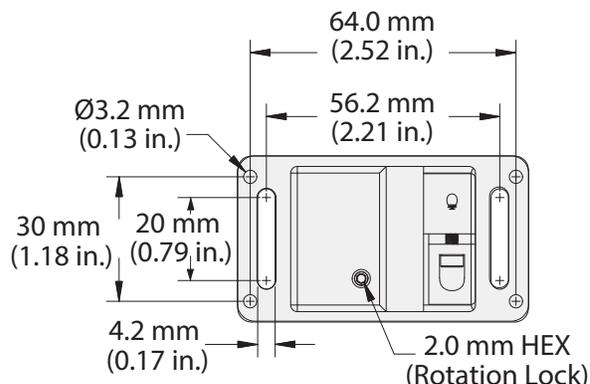
The dimensions for the Multi-Axis Mount from the top view are shown in Figure 3-20. Figure 3.4.5.2



**Figure 3-18. Dimensions – StingRay with Mount**



**Figure 3-19. Dimensions – Multi-Axis Mount – Side and Front Views**

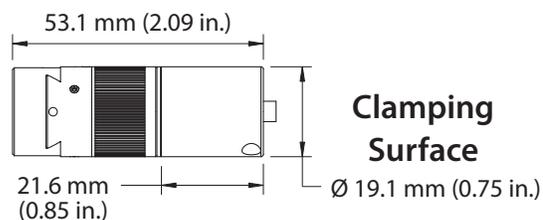


**Figure 3-20. Dimensions - Multi-Axis Mount – Top View**

### 3.4.5.3 Separate Driver, Compact Laser Head

For lasers with a Compact Laser Head with a Separate Driver (SD), select a cable length between the laser head and driver. This is available in 75 mm, 150 mm, 250 mm, or 500 mm lengths.

Figure 3-21 shows the dimensions for a Compact Laser head (with a Separate Driver):

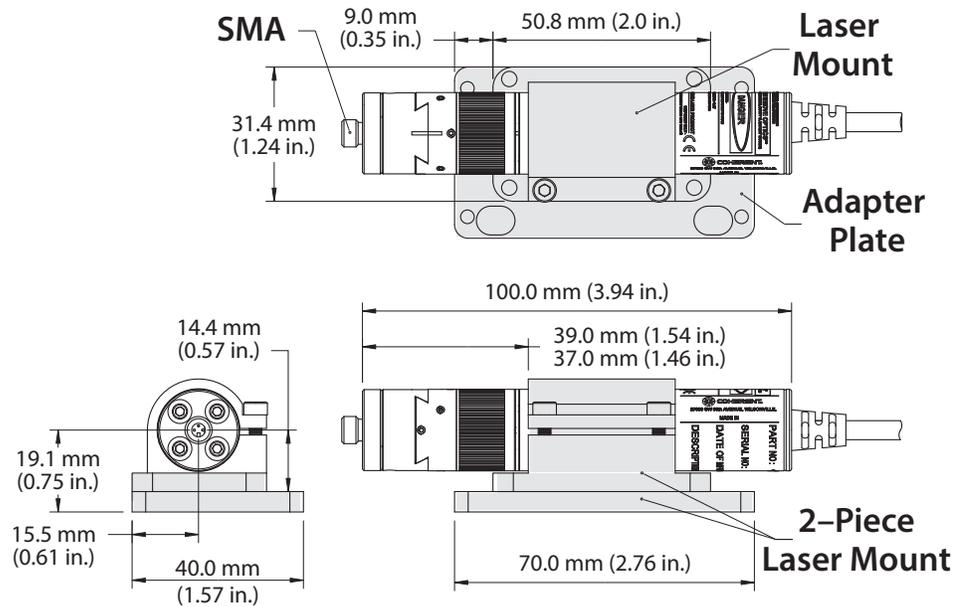


**Figure 3-21. Dimensions – Compact Laser Head**

### 3.4.5.4 BioRay FR (Fiber-Ready with SMA)

Figure 3-22 shows the dimensions for a BioRay laser that is Fiber-Ready (FR) with a Sub-Miniature Adapter (SMA).

For mount and adapter plate part numbers, refer to See 'Heat Sink Mounts' (p. 119).



**Figure 3-22. Dimensions – BioRay Laser (Fiber-Ready with SMA)**

## 3.5 Additional Information

Go to 'Set Up Equipment' (p. 29) for instructions to set up equipment.

Go to 'Install and Use Software' (p. 67) for information about Coherent Connection Software, that include installation instructions.

Go to 'Host Interface' (p. 99) for information about use of host commands and queries with StingRay and BioRay lasers.

Go to 'Parts and Accessories' (p. 117) for descriptions of the Coherent parts and accessories available for StingRay and BioRay lasers.

For more product information, go to the Coherent website:

<https://www.coherent.com/resources>



# 4 Set Up Equipment

This section supplies information about how to set up StingRay and BioRay lasers:

- 'Install a Laser' (p. 34)
- 'Install a Laser with a Remote' (p. 45)
- 'Change a StingRay Optical Head (SOH)' (p. 51)
- 'Change a Laser to Fiber-Ready (Optional)' (p. 53)

This section also gives the precautions necessary against back reflection when work is done with lasers. It also tells how to unpack and examine parts before you start set-up. The last section supplies an example of how to assemble an optional circuit to monitor the health of the laser.




---

## **WARNING!**

**Use of controls or adjustments or performance of procedures other than those specified in this manual can cause exposure to hazardous radiation.**

---

## 4.1 Precautions for Laser Back Reflection

As you assemble and connect equipment, know the potential damage caused by laser back reflection.

Back reflection (also referred to as retroreflection) occurs when a part of the laser beam is sent back into the laser's output aperture. Back reflection can be caused by an object in front of the laser. The result can be instability, noise, or damage to the laser.




---

## **WARNING!**

**Always wear correct laser safety eyewear and follow laser safety precautions when the procedures are used to prevent eye or skin exposure to DIRECT and SCATTERED radiation.**

---

Read the section 'Laser Back Reflection' (p. 123) in its entirety and follow all recommended safety precautions. These guidelines are intended to prevent damage to persons or property, and to prevent a decrease in the life of the laser.

#### 4.1.1 Before Start-up

Before you start set-up, first collect the necessary tools and equipment, then examine the shipping box and unpack the contents.

#### 4.1.2 Examine the Shipping Box

After you receive your order, immediately examine the shipping boxes for any indication of damage.



---

#### **NOTICE**

Retain the shipping box and all packaging materials for StingRay and BioRay lasers and accessories. These materials are required for safe transport if you later ship the equipment to a different location or back to Coherent.

---

If there is see any damage, record these problems on the pack list. Also contact the shipping carrier and either an approved Coherent representative or the Coherent Order Administration Department, as follows:

- Inside the USA: 1-(800)-367-7890
- Outside the USA: 1-(408)-764-4557

See 'Service and Support' (p. 149) for more information.

#### 4.1.3 Unpack the Components

The item can be packaged in more than one smaller boxes in the shipping box. As you unpack each part, put on a clean, dry surface.

##### 4.1.3.1 Unpack the Laser

The StingRay and BioRay lasers for your order are packaged separately from other components, such as the StingRay/BioRay Remote and any accessories.



---

**WARNING!**

The most common ESD damage occurs when a device is handled during installation or use. Use necessary precautions or shielding to prevent Electrostatic Discharge (ESD). If not, damage can occur to electronics.

---

*To unpack the laser:*

1. Open the shipping box and remove the box that contains the laser.
2. Remove the printed documents from the box. Read and keep to refer to later.
  - *Quick Start Guide*
  - *Service Policy* (instructions should you need to return the product)
  - *Final Quality Control Report*, which supplies data about the specifications unique to each laser.
    - Laser Safety Class (both CDRH and IEC)
    - Wavelength
    - Laser power (as measured without a L01 or CH optical head)
    - Diode current
    - Fan angle (for units with line generation optics)
    - Focus Distance
3. Also remove the USB flash drive.
4. Lift the inner pack material out of the box. Look at how the laser is attached to the inner pack material by a plastic material, shown in Figure 4-23.



**Figure 4-23. Laser in Pack Material**



---

**CAUTION!**

Do not cut the high-density material around the laser. Cuts decrease the integrity of the packaging for any returns or future shipments. As an alternative, loosen the material and unfold the bottom wings of the packaging.

---

5. Take the laser out of the packaging and put it on a clean, flat surface.

#### 4.1.3.2

#### Remove Power Supply out of from Package

Remove Power Supply included in the shipment of parts and accessories.out of package.

**To remove the Power Supply:**

1. Open the shipping box for the Power Supply.
2. Lift the Power Supply out of the box and put it on a flat, stable surface. Note how the Power Supply is attached to the inner pack material (see Figure 4-24):



**Figure 4-24. Power Supply in Pack Material**

3. Carefully loosen the high-density material that is put around the Power Supply and move the Power Supply out. Put it on a clean, flat surface.
4. Lift the power cord out of the shipping box, if included in this shipment. Set it with the Power Supply.

**NOTICE**

Not all shipments of a Power Supply include a power cord. Power Cords are specified by the country of destination. Customers frequently must supply their own power cord for the Power Supply.

**4.1.3.3****Remove Remote Kit from Package (Optional)**

The StingRay/BioRay Remote Kit (P/N 1231404) is an item that can be purchased. The Remote Kit includes the items shown in Figure 4-25:

- Remote control unit
- Power Supply and power cord
- USB Cable

See 'Install a Laser with a Remote' (p. 45) for set-up instructions.



**Figure 4-25. Contents of Remote Kit**

*To unpack a StingRay/BioRay Remote Kit:*

1. Open the shipping box and lift out the contents.
2. Lift the StingRay/BioRay Remote out of its box. The Remote is secured by a plastic membrane, shown in Figure 4-26.



**Figure 4-26. Unpack the Remote**

3. Carefully loosen the high-density membrane and slide the Remote out. Put it on a clean, flat surface.
4. Remove the any other parts from the shipping box and set aside.

## 4.2

### Install a Laser

This section shows how to set up and operate the laser in Continuous Wave (CW) mode when not the StingRay/BioRay Remote is not used.



---

#### **NOTICE**

**There are no user-serviceable components in the laser. DO NOT try to open the laser housing. If the enclosure is disassembled, the Warranty is void!**

---

To set up the laser, this must be done:

- Mount the laser
- Connect power to the laser

Instructions for each of these steps are supplied in the sections that follow.

## 4.2.1 Mount the Laser

StingRay and BioRay lasers contain a built-in temperature monitoring circuit. If the laser becomes too hot, the unit is made to temporarily stop. Full laser operation continues only after the operating temperature decreases below the upper limit and power is cycled.

Correct mount of the StingRay and BioRay lasers for heat dissipation is very important to lifetime and performance of the laser diode. Any laser above 20 mW must be installed on a mount to give correct thermal management.

An applicable heat sink is necessary to make full radial contact with the clamping area. Coherent's mount bracket is a heat sink specially created for StingRay and BioRay lasers that makes full radial contact and covers the full clamping area. The recommended torque specification for the two M3 x 8 mm clamp screws used in the Coherent Heat Sink mount brackets is 70 in-oz.

Figure 4-27 shows the Heat Sink Mounting Bracket (P/N 1222896) that covers the center section of the laser, which dissipates the heat load from the high-temperature region.



Figure 4-27. StingRay/BioRay Heat Sink Mount Bracket



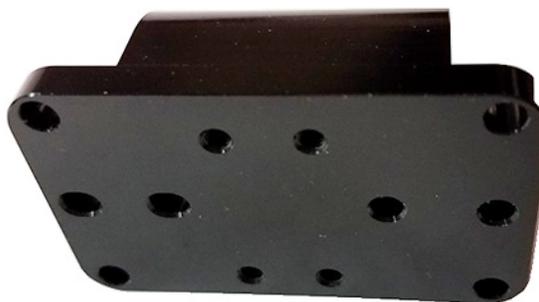
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### **NOTICE**

Do NOT remove the product label from the laser. To do this makes the warranty void.

---

The bottom of the standard Heat Sink Mounting Bracket for StingRay and BioRay lasers is shown in Figure 4-28:



**Figure 4-28. Heat Sink Mounting Bracket - Bottom View**

The Mounting Bracket can also be put on an optional Heat Sink Mount Adapter Plate (P/N 1222894), shown in Figure 4-29. The Adapter Plate has two (2) through-holes that are made to use 1/4-20 or M6 screws for mounting to an optical table.



**Figure 4-29. Adapter Plate - Bottom View**



---

**CAUTION!**

If a heat sink or mount bracket is used that is not a Coherent part specially made for the StingRay and BioRay lasers, be aware of the what follows. There can be issues with an over-temperature fault if that part is not correctly made to remove heat from the full clamping surface area of the laser module.

---

*To attach a mounting bracket to a laser:*

1. Move the laser (front end first) into the Heat Sink Mounting Bracket.
2. Put the laser in position so there is full accessibility to the focusing ring.
3. Use a 2.5mm hex wrench, tighten the clamp on the Heat Sink Mounting Bracket. Alternate between the two screws and apply an equal torque of 70 in-oz., alternating back and forth until the torque level is correct.

Figure 4-30 shows a laser installed in a heat sink mounting bracket, attached to an adapter plate.



**Figure 4-30. Laser with Heat Sink Mount on Adapter Plate**

V-block mounts are not recommended. They not correctly remove the heat load internal to the laser diode module, and must not be used. Figure 4-31 shows an example of a StingRay laser that is incorrectly installed in a V-block.

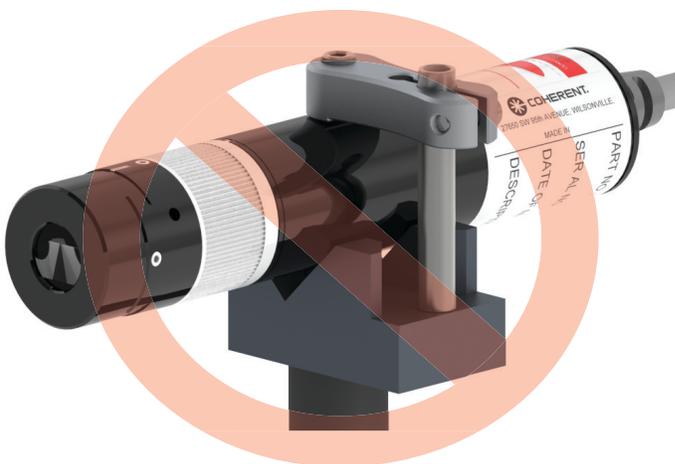


Figure 4-31. Wrong Way to Mount a Laser

## 4.2.2 Cable Assembly Configuration and Connector Types

The StingRay and BioRay lasers can be used with a variety of connector types, shown in Figure 4-32. Each of these are shown with more information in 'Connections to Lasers' (p. 126).

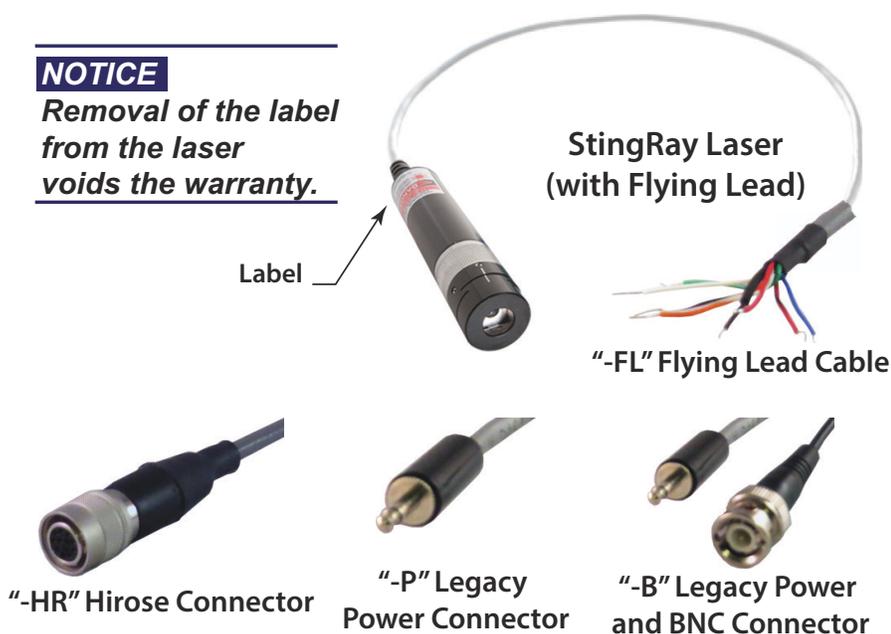


Figure 4-32. Connector types for the Laser

## 4.2.2.1

**Flying Leads**

Flying Leads is a type of cable assembly termination. A Flying Leads cable configuration gives the alternative of such things as:

- Make solder wire connections
- Add an alternative connector
- Add a Coherent connector (such as a two-pin power supply connector)

A Flying Leads cable wires can be attached for a variety of connection types, depending on the factory-configured Operating Mode:

- Continuous Wave (CW) configuration:
  - $V_{IN}$  (red wire)
  - $V_{IN}$  GND (black wire)
- Modulation configuration:
  - $V_{IN}$  (red wire)
  - $V_{IN}$  GND (black wire)
  - $V_{MOD}$  (blue wire)
  - $V_{MOD}$  GND (red/black wire)

The two  $V_{MOD}$  wires MUST be connected for correct operation when lasers are used with Analog or Digital Modulation.

**NOTICE**

**For lasers that operate Analog or Digital Modulation, the laser must be set up with the specified modulation at the factory before shipment.**

Table 4-7 shows the pin-outs and wiring signals for Flying Leads. Shaded areas show signals available when the RS-232 communications type is enabled.

**Table 4-7. Pin-Outs for Flying Lead Connector**

Pin	Signal	Wire color	Description
1	V <sub>IN</sub> GND	Black	Power Input Ground
2	V <sub>MOD</sub>	Blue	Modulation Input, 5 kOhm input impedance, 5 Volts maximum
3	V <sub>MOD</sub> GND	Red/Black	Modulation Input Ground
4	RS-232 RX	White	RS-232 Receive from computer *
5	RS-232 GND	White/Black	RS-232 signal Ground *
6	RS-232 TX	Orange	RS-232 Transmit to computer *
9	V <sub>IN</sub>	Red	Power Supply input for +5 to +24 V <sub>DC</sub> . The Minimum operating voltage for lasers between 400 nm to 520 nm is 6 V <sub>DC</sub> . Recommend 12 V <sub>DC</sub>
10	Fault (Open Output Signal)	Green	Open collector of a transistor 30V DC maximum, 100ma. Allows a wire junction, OR functionality with fault signals from other devices

\* For models with RS-232 option installed

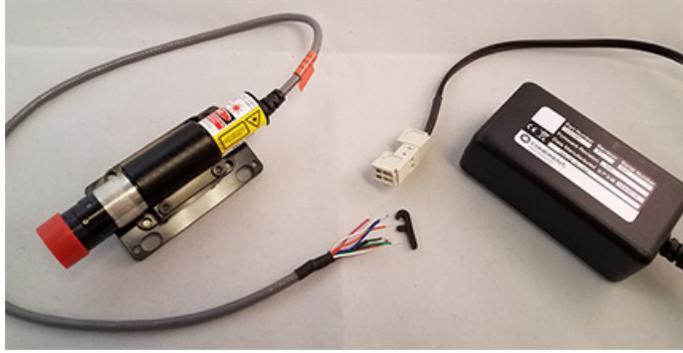
#### 4.2.2.1.1 Connect a Laser with Flying Leads to a Power Supply

To connect a StingRay laser with flying leads, simply apply proper DC voltage to V<sub>IN</sub> (red wire) and V<sub>IN</sub> GND (black wire). If the laser module is configured with modulation, a connection **MUST** be made to V<sub>MOD</sub> (blue wire) and V<sub>MOD</sub> GND (red/black wire) for correct operation.

The example used in these instructions includes the Power Supply (P/N 1232091) with a Terminal Block Connector. The Terminal Block Connector supplied with the Power Supply is made up of two parts:

- Connector, Terminal Block, Socket Terminal (Male), 3.5mm-pitch, 2-Way, 28-14AWG, Plug-in Type (WAGO #734-302 connector)
- Connector, Terminal Block, Plug-In Terminal (Female), 3.5mm-pitch, 2-Way, 28-14AWG, Plug-in Type (WAGO #734-102 connector)

Also included with the Power Supply is a small plastic Cage Clamp Connector Accessory tool in a shape like the letter 'F', as shown in Figure 4-33.



**Figure 4-33. Flying Leads Example – Connector to Power Supply**

Use this small clamp tool to open the connector block and insert wires, as shown in the following instructions.



**CAUTION!**

**Make sure that the unused leads don't come into contact with each other, ground, or a voltage source. Failure to isolate bare wire ends can cause signal shorts.**

*Connect Flying Lead wires to the Power Supply cable:*

1. Separate the terminal block connector into two pieces for ease of wiring, as shown in Figure 4-34.



**Figure 4-34. Sections of Terminal Block Connector**

Figure 4-35 shows the pins in the Connector:

- The Negative (-) opening of the terminal plug is on the side of the connector with text printed inside the square, as shown in this example.
  - The positive (+) opening of the terminal plug is on the side of the connector with a smooth surface and no text.
2. Separate the wires on the Flying Leads cable so the red ( $V_{IN}$ ) and black ( $V_{IN}$  GND) wires are exposed, as shown in Figure 4-36.

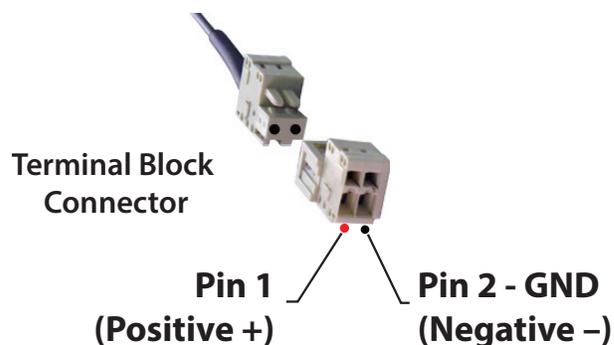


Figure 4-35. Pins in Terminal Block Connector

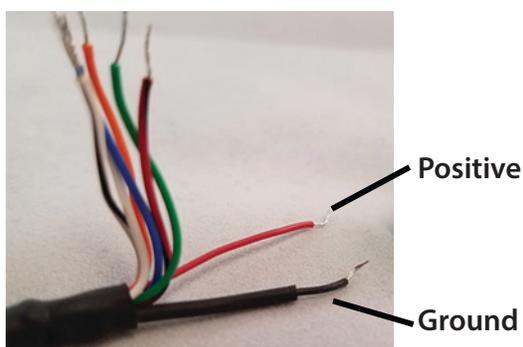


Figure 4-36. Separate Flying Leads Wires (Positive/Negative)



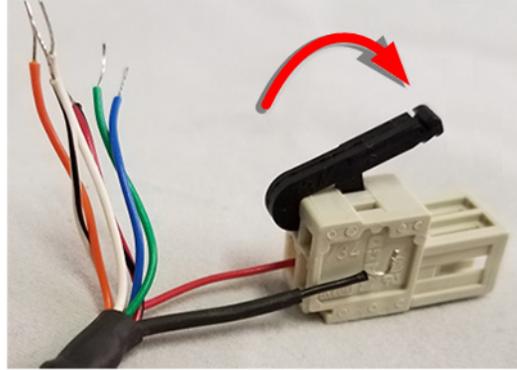
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**WARNING!**

Prevent damage to the unused wires so they don't have contact with each other, ground, or a voltage source. Failure to isolate bare wire ends can cause a short in signals.

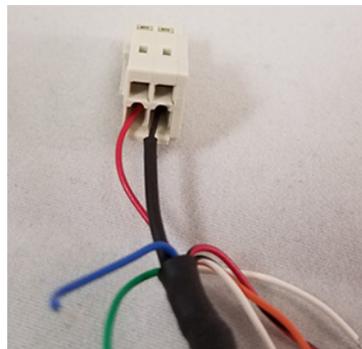
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3. Put the 'legs' of the clamp tool into the clamp spring tension release opening of the terminal plug, as shown in Figure 4-37. There is one opening on the front and one on the top.
4. Slowly push down on the clamp tool to release the spring clamp tension, which makes the opening available.
5. Put the red ( $V_{IN}$ ) wire into the opening of the terminal plug. Release the clamp tool so the tension of the clamp spring is applied on the wire. If it is not set correctly, do again until the wire is tightly in the clamp.
6. Insert the clamp tool into the clamp spring tension release opening of the terminal plug, and gently push down on the clamp tool until the spring clamp is opened.



**Figure 4-37. Use Clamp Tool to Open Plug for Wire**

7. Slide the Black ( $V_{IN}$  GND) wire into the Negative (-) opening of the Terminal Plug Connector.
8. Release the clamp tool so the tension of the clamp spring is applied on the wire. If it is not seated correctly, do it again until the wire is firmly clamped.
9. Make sure that the red and black wires are now securely inserted into the plug, as shown in Figure 4-38:



**Figure 4-38. Wires Fully Inserted into Terminal Plug**

10. Protect the unused leads from coming into contact with each other, ground or a voltage source.



---

**CAUTION!**

**Failure to isolate bare wire leads can short out signals.**

---

11. Slide the terminal plug now wired to the Flying Leads cable into the terminal plug for the Power Supply cable, as shown in Figure 4-39.



Figure 4-39. Connect Terminal Plug Ends

12. Connect all cables and apply power. A load must be applied to the modulation line for correct operation.



---

**NOTICE**

If the CDRH delay is not set up at the factory, the laser immediately starts emission when power is applied to the laser. Make sure that the use of all safety protocols when you operate this laser in this configuration.

---

### 4.2.3

#### Protective Dust Cap

The red plastic cap included with the laser is made to protect the laser from dust and other contaminants **during storage or when not in use**. Use the Dust Cap when the laser will not be used for an extended period of time.



---

**WARNING!**

Do not use the dust cap to block laser light. The heated material can contaminate the optical components in the laser.

---

When the laser is not in use, slide the cap onto the laser face, as shown in Figure 4-40,

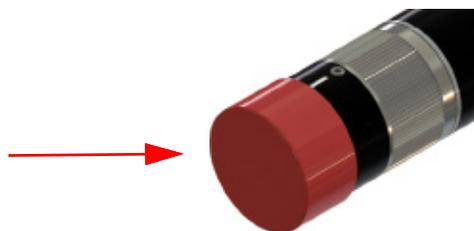


Figure 4-40. Dust Cap for Laser

## 4.3 Install a Laser with a Remote

This section shows how to set up a laser with a StingRay/BioRay Remote Kit. When the Remote Kit is used, you must order a laser separately.

### 4.3.1 Parts of the Remote Kit

The following parts are included in a StingRay/BioRay Remote Kit (P/N 1231404), shown in Figure 4-41.



**Figure 4-41. StingRay/BioRay Remote Kit**

You can also order each part separately.

- **StingRay/BioRay Remote** unit (P/N 1225414)
- **Power Supply** (P/N 1105427) for the remote (this is different than the power supply for an individual laser)
- A **USB Cable** (Type A to Type Mini B) is included with the Remote. This cable is also sold separately (P/N 1108906). Use this cable to connect the laser Remote to a computer (personal computer or laptop) so you can use the Coherent Connection software.

### 4.3.2 Set Up and Connect the Remote

The configuration used in this example requires the laser to be set up with a Hirose “-HR” connector. The cable from a StingRay laser terminated with a Hirose Connector is shown in Figure 4-42:



**Figure 4-42. StingRay Laser Terminated with a Hirose Connector**

See 'Hirose Connector' (p. 128) for pin-out assignments for the connector.



---

**NOTICE**

**This configuration of the laser with the Remote is NOT CDRH compliant for end-use applications.**

---

To set up the remote with a StingRay or BioRay laser:

1. Make sure the Interlock is in installed, as shown in Figure 4-43:



Interlock

Figure 4-43. Interlock Installed in Remote

You can use the Interlock connector two ways:

- **For general operation:** Put the interlock connector with wire jumper (creating a short between the two pins) into the safety interlock. Turn the keyswitch ON for normal laser operation. After a short delay, light is emitted from the laser. The laser automatically shuts off if the jack with a short circuit is removed.
- **To make an interlock system:** When the interlock circuit is opened, the laser automatically is set to off. For example, you can connect the two wires from the Remote interlock plug to a door contact switch.

2. Make sure that the keyswitch is in the Standby (OFF) position, as shown in Figure 4-44:



Keyswitch in Standby (OFF) position

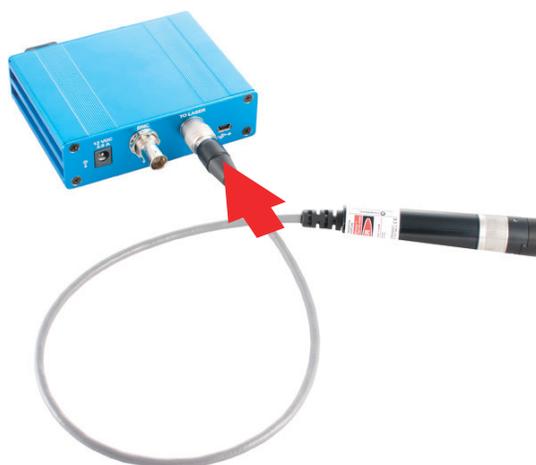
Figure 4-44. Keyswitch in Standby (OFF) on Remote

For BioRay (or StingRay laser with modulation), a voltage input signal must be applied to the BNC connector on the back of the remote. This is done to control the laser output power.



**Figure 4-45. Back Panel Power, BNC, Laser, and USB Connectors**

3. Attach the laser to the remote with the Hirose connector at the To Laser connector, as shown in Figure 4-46. (Optional) Connect the



**Figure 4-46. Connect Laser with Hirose Connector to Remote**

USB cable from the USB connector on the remote to a computer, as shown in Figure 4-47.

See 'Set Up a USB Connection' (p. 50) for information to set up the interface between the StingRay/BioRay and the host computer via the USB connector.

4. Connect the power supply to the remote at the 12VDC connector. Then connect the power cable into a power source (outlet), as shown in Figure 4-48.

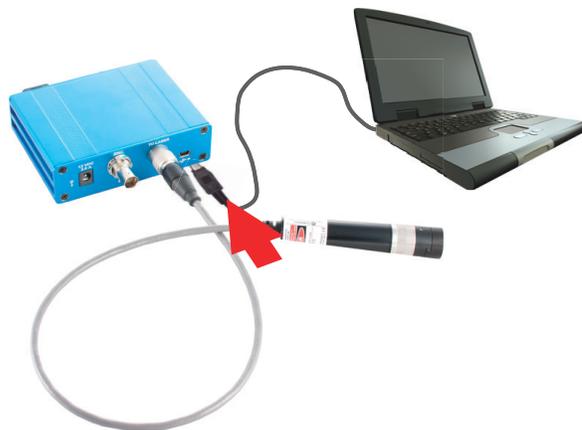


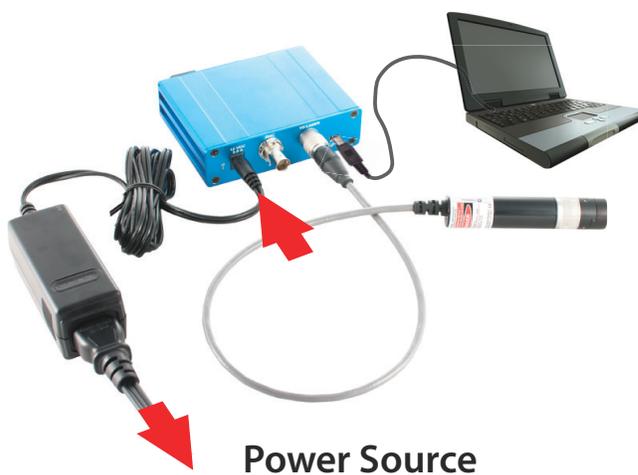
Figure 4-47. Connect USB to PC

---

**WARNING!**

Immediately after power is applied to the remote, the laser can emit light. Follow all safety precautions to prevent exposure to direct or indirect laser radiation.

---



Power Source

Figure 4-48. Connect Power Supply to Remote

5. Set the keyswitch to the ON position.

The laser gives emission in 5 seconds (a CDRH safety delay). If the StingRay model description contains an '-8' option, the CDRH delay was disabled at the factory, and laser emission starts immediately.

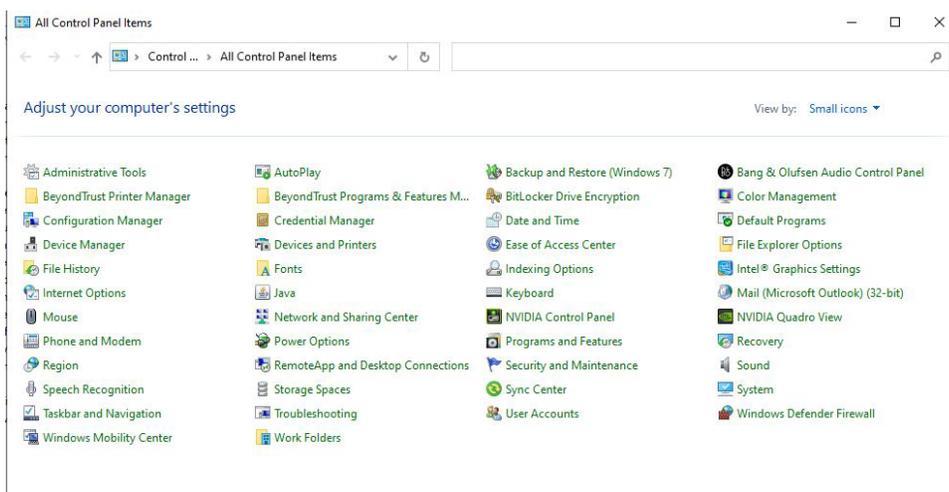


### 4.3.3 Set Up a USB Connection

The StingRay/BioRay laser has electronic circuitry that supplies the interface between the micro-controller and the USB port of a host computer.

The circuit changes logical high/low levels into the voltage levels necessary for the RS-232 protocol. You must enable Serial Communications in the StingRay/BioRay laser before communications between the laser and the host computer can occur.

Figure 4-49 shows the Windows Control Panel, as shown on a Windows 64-bit system.



**Figure 4-49. Windows Control Panel**

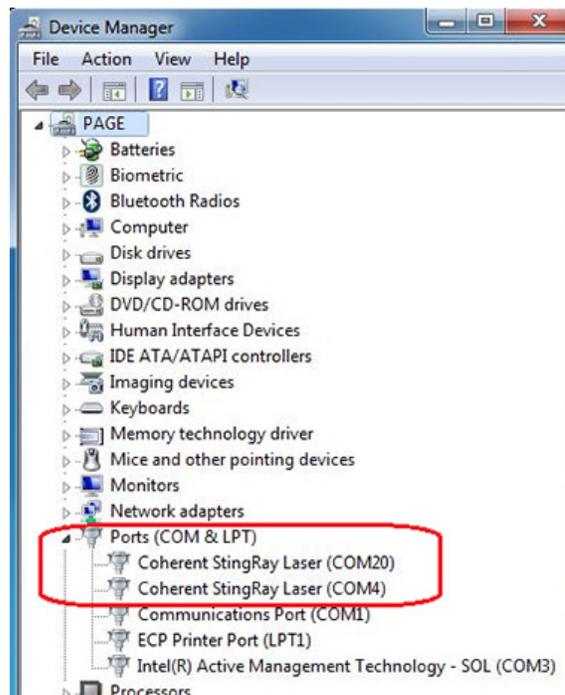
When a USB connection is made to a host computer, the laser is recognized as a COM port in the Windows Device Manager. The Device Manager automatically gives an available COM Port setting to the connected laser.

Multiple StingRay/BioRay connections can be made to a host computer through a USB interface. Each connection requires a dedicated COM Port assignment.

**NOTICE**

For some computers, a powered USB Hub (2.0 or higher) is required to connect multiple StingRay/BioRay lasers to a single USB connector on a host computer.

Figure 4-50 shows the Port assignments for two StingRay lasers. In this example, note the unique COM Port assignments assigned automatically to each individual laser.



**Figure 4-50. COM Port Assignment**

## 4.4 Change a StingRay Optical Head (SOH)

StingRay lasers are made to let a user to change the StingRay Optical Head (SOH). When done, one can examine more than one optical configuration and identify the best solution for a given application.

A selection of optical configurations are currently available; see 'Optical Configuration' (p. 143) for instruction. The StingRay Developer's Kit (P/N 1263022) also includes optical heads that support different of pattern configurations; examples are shown in Figure 4-51:

To change the optical head:



Figure 4-51. Optical Pattern Configurations

1. Use the 0.035-inch hex wrench (provided), and loosen the set screw shown in Figure 4-52.

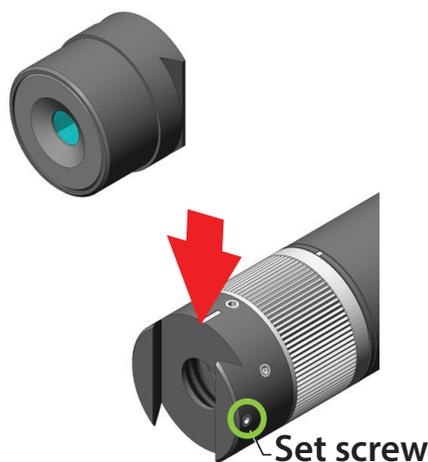


Figure 4-52. Change the Optical Head



---

**CAUTION!**

Operate with care to not unscrew the set screw too far, or it can fall out.

---

If necessary to replace the set screw, use these specifications:

Set Screw, Hex Socket Drive, 2-56 x 0.125inch L,  
Stainless Steel 316, Cup Point

2. Move the head off.
3. Replace with the selected head.
4. Balance the optical head. Move the head along the dovetail axis and monitor the supply of power change as the head moves.
5. Look at the 'balance' to make sure that the power is equal between the two sides.
6. Tighten the set screw to lock the optical head in position. Do not use a torque value of greater than 18 inch-ounces.

## 4.5 Change a Laser to Fiber-Ready (Optional)

If you have a StingRay or BioRay laser and want to change the laser to a Fiber-Ready version, follow the steps in this section. This section also shows the steps to adjust the Fiber-Ready accessory to maximize the coupling efficiency. This happens through a multi-mode fiber to maximize the output power through the fiber patch cord assembly.

A Fiber-Ready laser can be purchased as a complete, factory adjusted assembly as shown in Figure 4-53. A Fiber-Ready (FR) adapter can be purchased separately and installed onto a BioRay laser not originally set up in-factory.



**Figure 4-53. BioRay Fiber-Ready Laser**

This procedure includes two primary tasks:

- Install the Fiber-Ready (FR) adapter
- Get the best the coupling efficiency that results in the highest Output Power

### 4.5.1 Equipment, Tools, and Supplies

Before you start this procedure, collect the equipment that follows:

- Multi-mode fiber patch cord (must be purchased separately)
  - Minimum core size of 50  $\mu\text{m}$  (step or graded index)
  - Minimum NA of 0.2

See 'Summary of Part Numbers' (p. 133).

- Fiber-Ready (FR) adapter assembly (sold separately)
  - 1272906 FR Adapter for BioRay
  - 1275027 FR Adapter for BioRay with 640 nm Filter
  - 1278073 FR Adapter for BioRay with 488 nm Filter

The tools and supplies that follow are also necessary for this task:

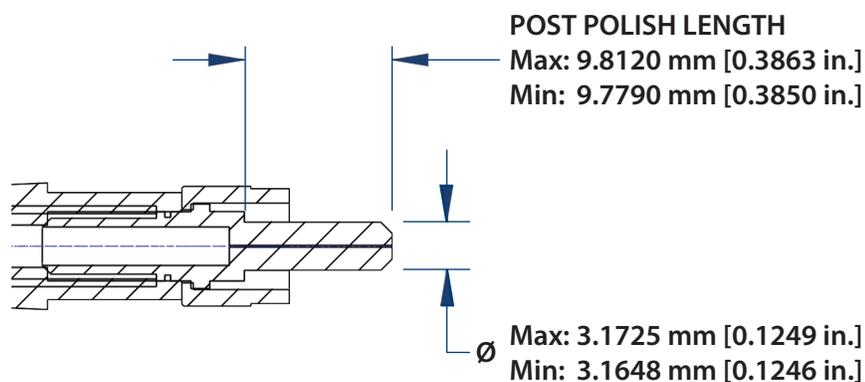
- Methanol or Isopropanol (spectroscopic grade or HPLC grade)
- Swabs (such as TexWipe TX759B)
- Gloves (such as TechNitrile from TechniGlove International)
- Torque driver (24 to 48 inch-ounces)
- 0.035-inch hex driver
- 0.05-inch hex driver
- 5/64-inch hex driver
- (optional) SMA Fiber Adapter Plate with External SM1 (1.035"-40) connector (Recommended model: Thorlabs SM1SMA)
- White target (to observe the exiting beam)

The equipment that follows is attached to the StingRay laser housing:

- Dovetail (mating mechanical front end of the laser module)

The equipment that follows is attached to a BioRay FR Adapter Assembly:

- An SMA 905 connector; tolerances are shown in Figure 4-54.



**Figure 4-54. SMA 905 Connector Tolerances**

It is also recommended that you have available a power meter with a photodiode sensor that has the wavelength and power of the StingRay or BioRay laser. Coherent recommends the PowerMax-USB UV/VIS Quantum Power Sensor (P/N 1168337). The requirements for the sensor are:

- Must be have sufficient speed to get the most coupling efficiency. Photodiodes are recommended.
- Must be have sufficient size to contain the diverging beam exiting the multi-mode fiber. See 'Get the Most Coupling Efficiency' (p. 57).

## 4.5.2 Install the Fiber-Ready (FR) Adapter

This section shows the steps to install a Fiber-Ready (FR) dovetail adapter.

1. Measure the maximum output power from the laser.  
If the photo-diode sensor has a result, decrease output power until it is less than the measurement range of the sensor. Do not decrease power more than about 80% of maximum output power of the laser.
2. Use the 0.035-inch hex driver, and install the FR dovetail assembly, as shown in Figure 4-55.

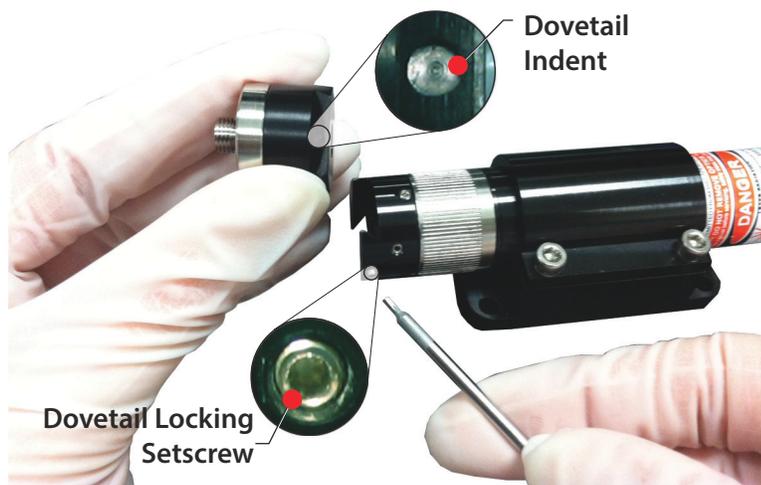


---

### **NOTICE**

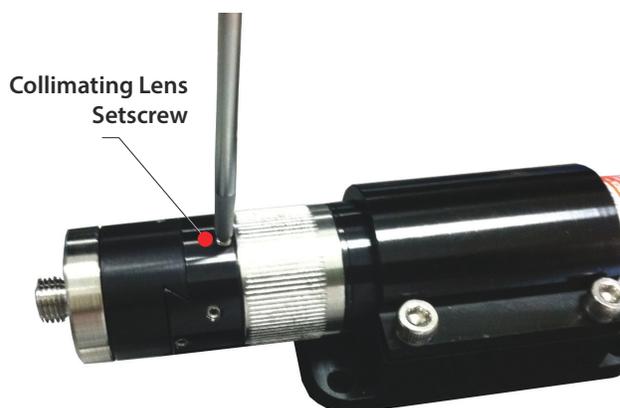
**Make sure that the indent on the dovetail is in alignment with the dovetail locking set screw on the laser.**

---



**Figure 4-55. Align FR Dovetail Adapter**

3. Torque the lock set screw to 24 inch-ounces.
4. Use the 0.035-inch hex driver, loosen the collimating lens set screw on the laser, as shown in Figure 4-56.



**Figure 4-56. Loosen Collimating Lens Set Screw**

5. Use the 5/64-inch hex driver, use minimal pressure to lightly seat the four screws holding the SMA mount to the dovetail, as shown in Figure 4-57.

The SMA mount is necessary to be able to move relative to the dovetail to peak coupling efficiency. Go to the next section for instructions.



**Figure 4-57. Set the SMA Mount**

### 4.5.3 Get the Most Coupling Efficiency

After the FR adapter is installed, follow the directions, below, to get the most the coupling efficiency.

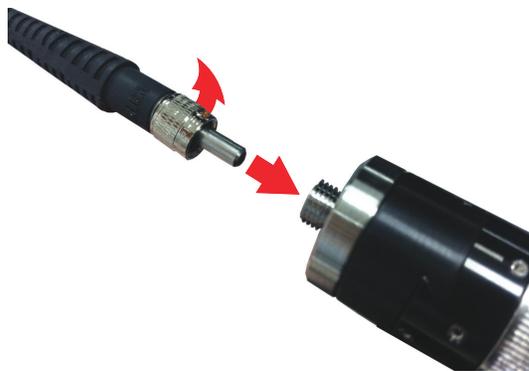
Practice is necessary to get maximum coupling efficiency in a fast manner. It is recommended that, for the first few times, continue slowly and carefully.

1. Apply methanol to a swab and clean the connector ferrule(s) on the fiber optic cable, as shown in Figure 4-58:



**Figure 4-58. Clean the Connector Ferrule**

2. Turn and attach the SMA connector into the laser FR adapter assembly, as shown in Figure 4-59:



**Figure 4-59. Insert SMA Connector into FR Adapter**

3. Set the exit end of the fiber in a clamp or holder to give safe protection to the output beam on the white target. Coherent recommends the PowerMax-USB UV/VIS Quantum Power Sensor (P/N 1168337).
4. Put the white target in less than two centimeters of the fiber tip to see the beam. Do this before you get the best coupling efficiency. Refer to Figure 4-60:



**Figure 4-60. Align White Target**

5. Set the laser to ON.
6. Align the light in the fiber core. Manually move the SMA mount relative to the dovetail. The result is a bright constant beam that shows on the white target.

**NOTICE**

Start the coupling procedure. Move the SMA mount with small movements. This usually helps reach the maximum coupling efficiency faster.

- If the result is NOT correct, continue with Step 6.
  - If the result IS correct, go to Step 7.
7. With the 0.05-inch hex driver, use the two alignment set screws to adjust the fiber ferrule laterally relative to the laser beam, as shown in Figure 4-61.



**Figure 4-61. Adjust the Fiber Ferrule**

8. Continue this adjustment until the output power exiting the fiber is increased to maximum (very bright) on the white target.
9. Put the photo-diode sensor in front of the exit end of the fiber cable, as shown in Figure 4-62.
10. Put the sensor close sufficiently to the photo-diode sensor until the beam has no clips, as shown in Figure 4-63.
11. Get the highest the power indication on the power meter. To do this:
- a.) Alternate and adjust the two alignment set screws.
  - b.) Adjust the focus ring.

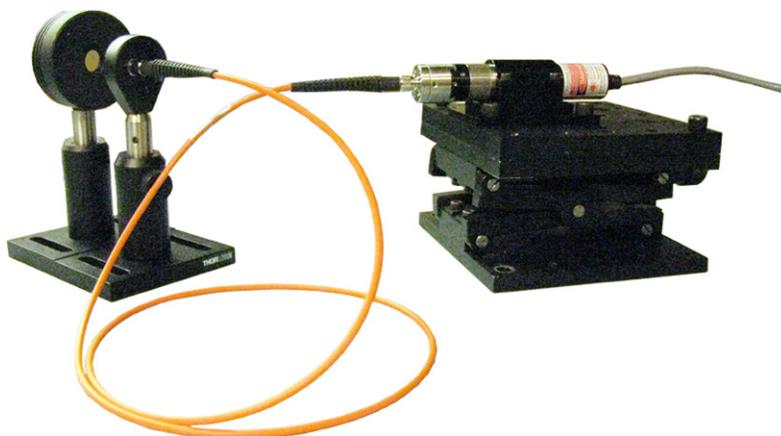


Figure 4-62. Place Photo-Diode Sensor

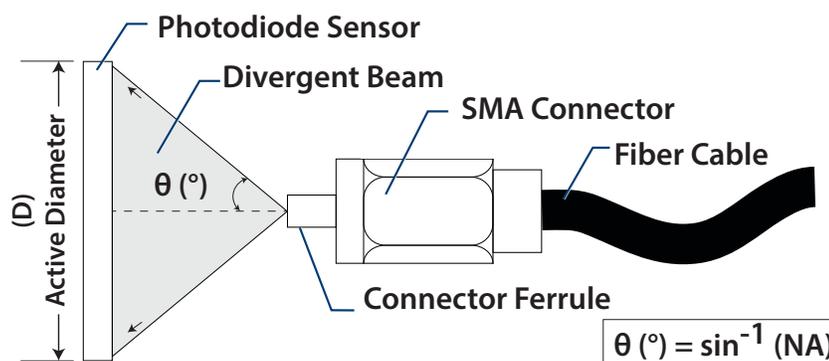


Figure 4-63. Sensor Placement for Divergent Beam

As a guideline, rotate the adjustment ring in the direction shown in Figure 4-64 to move the collimating lens closer to the laser diode.



Figure 4-64. Adjust the Collimating Lens

Typical coupling efficiencies can be gotten with a Multi-mode fiber patch cord. This examples uses a step index, 50 μm core fiber, 0.22 NA, SMA/ SMA, 1 meter (Coherent P/N 1278782):

$$CE (\%) = \frac{P_{\text{fiber}}}{P_{\text{laser}}} \times 100$$

Table 4-8 gives examples of coupling efficiencies. These coupling efficiencies are not always correct and must be used *only* as a guide.

**Table 4-8. Coupling Efficiencies**

Wavelength	Coupling Efficiency (%)
405 nm (50 mW)	72 to 75%
450 nm (50 mW)	72 to 75%
488 nm (20 mW)	72 to 78%
520 nm (50 mW)	77 to 80%
640 nm (40 mW)	80 to 83%

12. Torque the collimating lens set screw to 24 inch-ounces. This can decrease the power.
13. If necessary, get the best the coupling efficiency again. Use the 0.05-inch hex driver to adjust the two alignment set-screws.  
If the coupling efficiency decreases during the tightened:
  - a.) Loosen the four screws to let the two alignment set screws move the SMA connector mount that holds the fiber.
  - b.) Do Step 10 and Step 11 again until the output power is stable during the process.
14. Use the 5/64-inch hex driver, and small bit at a time tighten the four screws in the FR adapter assembly until they are tightened, as shown in Figure 4-65.



Figure 4-65. Tighten FR Adapter Assembly



---

**NOTICE**

Look at the output power during this full process. Note the greatest output power from the fiber.

---

15. Add alignment marks on the fiber body and the laser body, as shown in Figure 4-66. Use a felt-tip pen or a ballpoint pen on a small piece of tape. The alignment marks are used to re-align the fiber body with the laser body.

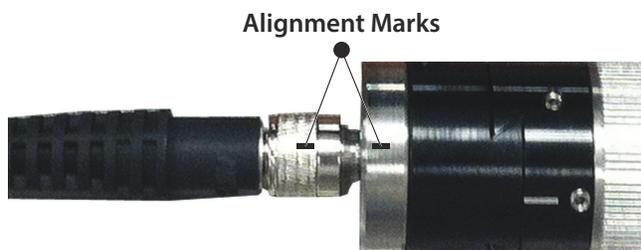


Figure 4-66. Add Alignment Marks

16. Set the laser to OFF and then remove the fiber cable.
17. Torque the four screws to 48 inch-ounces that attach the SMA connector mount and the FR dovetail, as shown in Figure 4-67.
18. Install the fiber cable again. Make sure the two alignment marks added in Step 12 are aligned.



**Figure 4-67. Torque the Set Screws**

19. Look at the output power—it must be between 3 to 5% of the indication given in Step 11. If the power has decreased:
  - a.) Loosen the four screws to let the two alignment set screws move the SMA connector mount that hold the fiber.
  - b.) Do steps Steps 10 through 16 again until the output power is between 3 to 5% of the indication you got in Step 11.

## 4.6 Set Up Health Monitor (Optional)

Another benefit is that users can monitor the health of the laser by with use of the applicable connection to the circuitry. An example is supplied in this section.

The Health Monitor is a firmware-controlled feature in StingRay and BioRay lasers that looks for a specified condition in the current versus optical power. This feature is available only on StingRay lasers set up with communications enabled ('-TX' mode) and is not available with Fast TTL configurations.

The Health Monitor is a term used for the Fault Output Circuit ability. The Fault output is simply an open collector of a transistor circuit. This lets the user connect or wire 'OR' logic capability with a fault signal from other devices by providing power and a load circuit to the Fault and Ground pins.

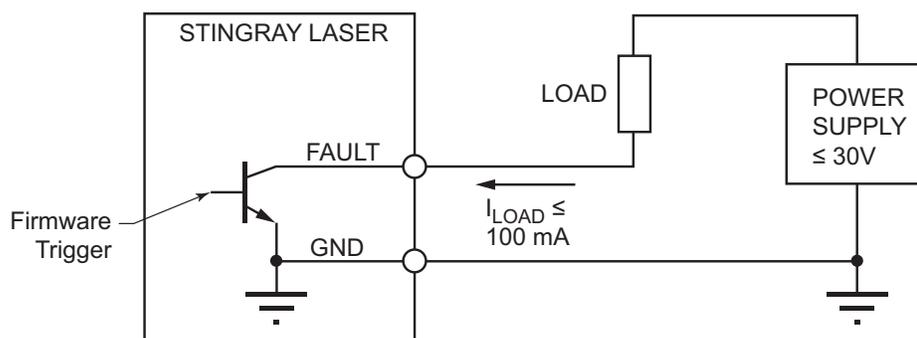
The user must connect circuitry with a visual indicator (such as an LED). When there is a trigger, the laser gives the user a visual indication and starts the open collector configuration of the monitor output.

Internal limits are related to the laser calibration. For example, if a 488-20mW laser is calibrated for 20mW output that needs 100mA, then this is the base current. The hard limits are set as a percentage change from this point.

Coherent calibrates the system to let there be a 30% over-current condition for the same output power (in this example, 130mA). This can be at 130% or lower. This depends on the rate of change of the current. When there is more than the limit in the system, the Health Monitor is started and the current limit is set at this point to the diode. The 30% or more increase in current starts the pulses of the rear panel red LED at 0.5Hz.

When the trigger occurs, the laser gives the user a visual indication and starts the open collector configuration of the monitor output.

- The output can accept a maximum of 30 volts and can drain the current to a maximum of 100 mA. The circuit is not allowed to have over current with a recoverable fuse.
- Connect the load between the voltage source and the open collector output, as shown in Figure 4-68.



**Figure 4-68. Health Monitor Connections**

The FAULT output is a current drain:

- Must have external power supply.
- The load circuit can be a LED, a relay, or something to set to on as a fault condition.
- The load circuit must have a current limiting resistor.
- The voltage drop over the load depends on the voltage of the external power supply and the current set by the current limiting resistor.

For example, with a standard industrial 240 V<sub>DC</sub> power supply and an LED as the Load with an LED current 20 mA, the resistor value is:

$$R_{LOAD} = (V_{POWER} - V_{LED} - 0.2V) / 20 \text{ mA}$$

Correct Operation is specified as:

- The Health Monitor started
- LED flashes red at 0.5 Hz. Refer to 'LED on the Laser' (p. 84).
- Output pulsing at 0.5 Hz

TP<sub>1</sub> is a point in time where the slope of the current changes by a set value to. This identifies a diode that goes into failure, as shown in Figure 4-69.

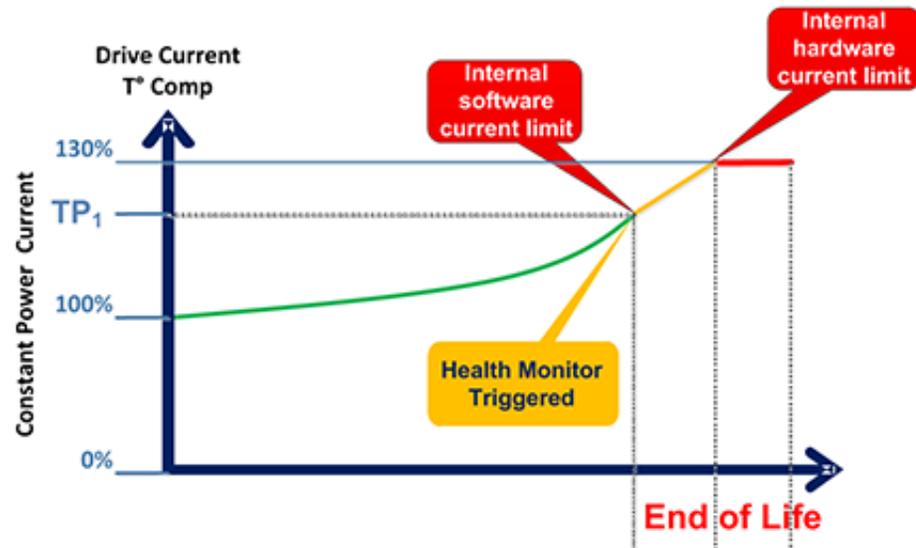


Figure 4-69. Health Monitor - Triggered

Figure 4-70 shows limits.

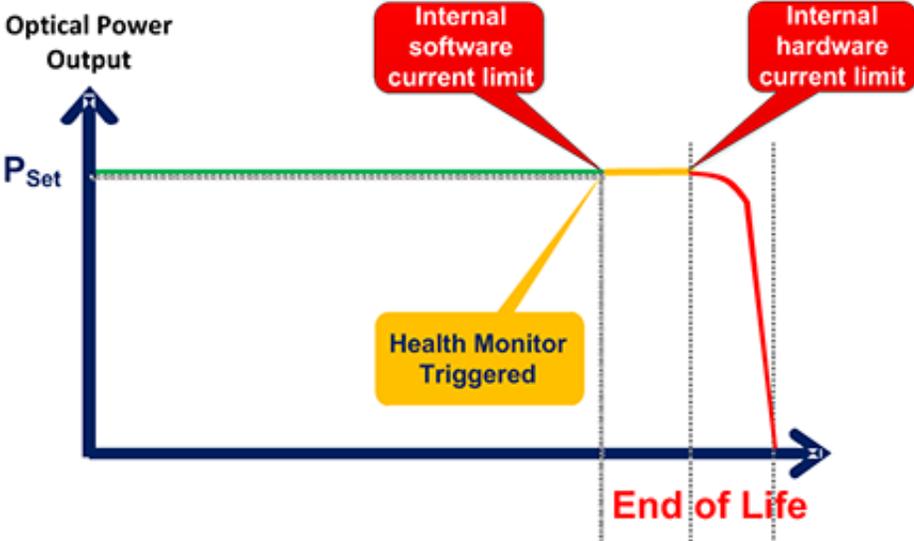


Figure 4-70. Health Monitor – End of Life

# 5 Install and Use Software

This section shows how to install and use the Coherent Connection software for the StingRay and BioRay lasers:

- Coherent Connection software overview
  - 'Compatibility' (p. 68)
  - 'System Requirements' (p. 68)
- 'Install Software' (p. 68)
- 'Overview of the Main Tabs' (p. 74)

For specified information about commands and queries that can also be used with StingRay and BioRay lasers, see 'Host Interface' (p. 99).

## 5.1 Software Overview

The Coherent Connection Software is an easy-to-use, flexible, and stable interface to control, poll, and set up a StingRay or BioRay laser. This applies only if the laser was purchased with the RS-232 communication option enabled.



---

### **NOTICE**

**RS-232 communication is configured at the factory and cannot be changed in the field.**

---

Through the Coherent Connection software, you can send signals and control different parameters directly through a USB connection with commands and queries; see 'Host Interface' (p. 99).

The software gives direct interface with the laser to monitor the performance of the laser system. Features can be different for different laser configurations and can include set power, report diode temperature, and report laser hours.

### 5.1.1 Compatibility

While used for other lasers like StingRay and BioRay lasers, Coherent Connection software is for these laser products: OBIS LX, OBIS LS, OBIS CORE LS, OBIS LG, OBIS XT, and OBIS CellX.

### 5.1.2 System Requirements

It is recommended that you use the most current and robust systems possible. Support is supplied on these operating systems:

- Windows v10 (32- and 64-bit)

The computer must have the these minimum requirements:

- CPU: 2.5 GHz or faster
- RAM: Minimum of 2 GB of RAM
- Available hard disk space: 10 GB
- USB 2.0 high-speed connection
- Display: 1280 x 1024 screen resolution
- Microsoft .NET Framework 4.0 or higher. If no version (or an older version) is found on the computer, then the installation program installs a new or updated version of Microsoft .NET Framework.

## 5.2 Install Software

This section shows how to install the Coherent Connection software.



---

#### **NOTICE**

**Follow the set-up procedure in the order in which it is shown. Failure to do that can cause errors.**

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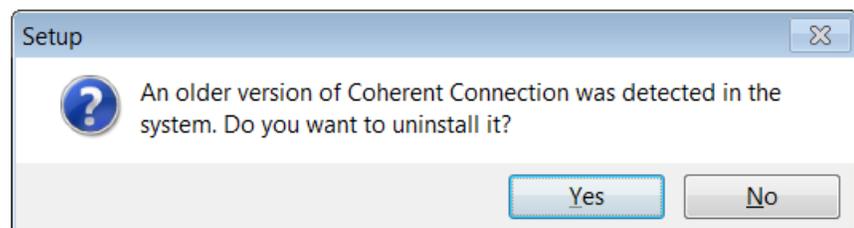
The correct order for system set-up is:

- Install the software, but **wait** to launch the software.

- AFTER the software is installed but BEFORE you open the installed program, connect the laser to the host computer. Use a USB connection.
- Run the Coherent Connection software on the host computer.

*To install software:*

1. Close all other software.
2. Download the current Coherent Connection software from the Coherent website, and unzip the files on the host computer. Download from [www.coherent.com/resources](http://www.coherent.com/resources).
3. Double-click this file to start the installation process. The last two digits show the number for the current software:  
**Coherent\_Connection\_Setup\_v5.0.1.xx**
4. If you had before installed the Coherent Connection software, the message in Figure 5-71 is shown. Click **Yes** to continue.



**Figure 5-71. Remove Old Software**

5. From the drop-down menu shown in Figure 5-72, select the language in which to show the software and then click **OK**.  
Available languages include English, Italian, French, German, Hebrew, and Japanese.  
Note that the language selection applies only to software setup instructions on-screen and not the Coherent Connection software function (English only).  
The Welcome screen like the one in Figure 5-73 is shown.
6. Read the instructions and then click **Next**. The License Agreement like the one in Figure 5-74 is shown.
7. Scroll down to read the agreement. Make note that the **Next** button is grayed out until you click the radio button to **Accept** the terms and conditions. When that is done, the button is started; click **Next**.
8. A window like the one in Figure 5-75 displays. Accept the selection, or browse to select the directory on the computer where you want to install the software, and click **Next**.

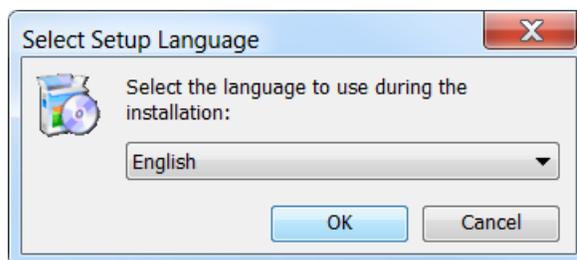


Figure 5-72. Select Language for Software



Figure 5-73. Welcome Screen for Installation

9. You can put an icon for the software on your desktop or for a Quick Launch (or both). As shown in Figure 5-76, click the applicable check box, and then click [Next](#).
10. The set-up utility is can now start to install Coherent Connection software on the computer. Review the location and icons, as shown in the example in Figure 5-77, and then click [Next](#).

A progress bar is shown, as shown in Figure 5-78.

11. After all files are prepared, click [Finish](#). The screen shown in Figure 5-79 closes and the software can be started.

The software and USB driver are now installed. If you selected a short-cut (icon) to be set up during installation, that now shows on the desktop of your computer (shown in Figure 5-80) and/or in the Quick Launch menu:

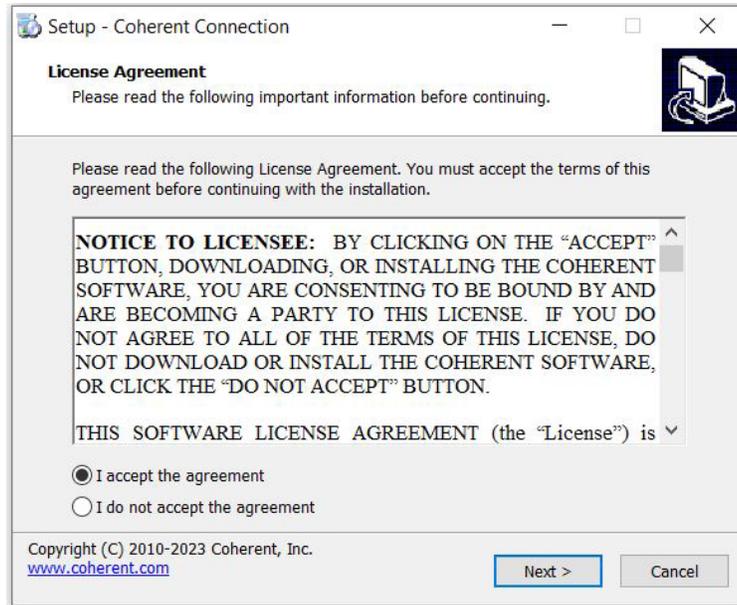


Figure 5-74. Coherent Connection License Agreement

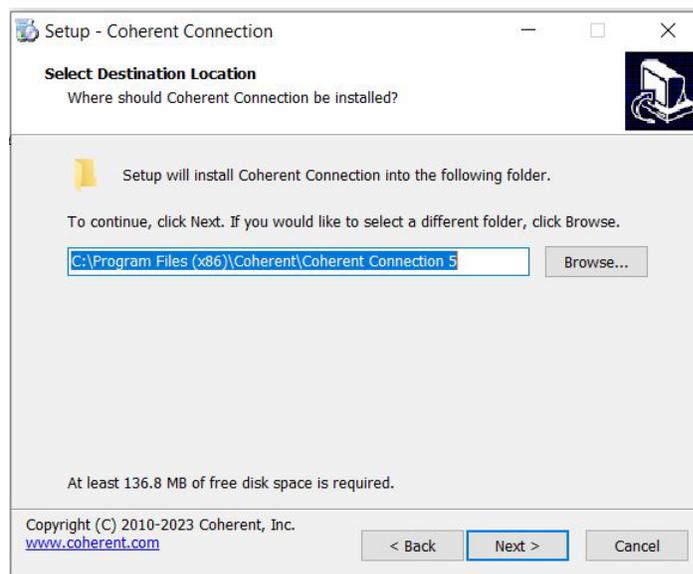
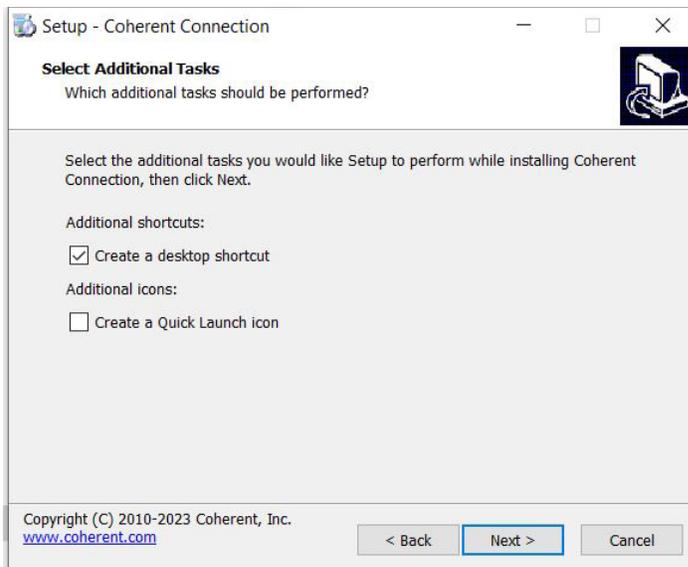
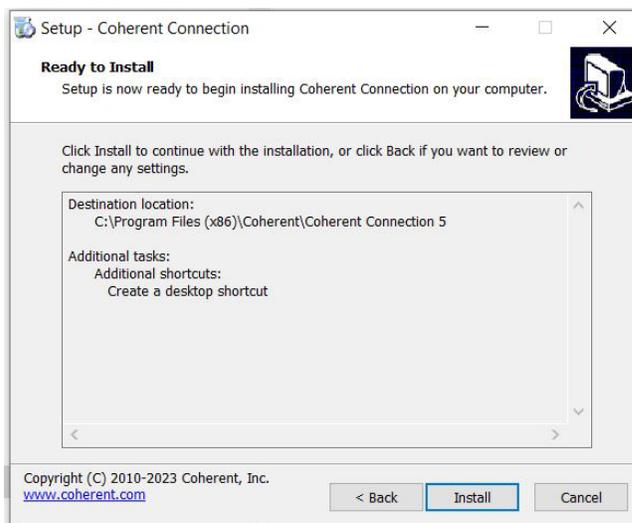


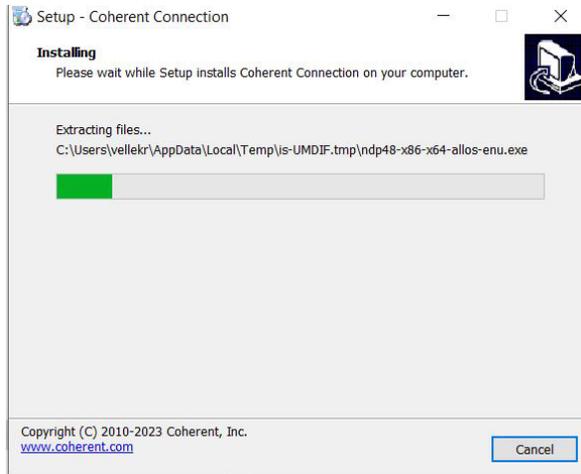
Figure 5-75. Select Directory to Install Software



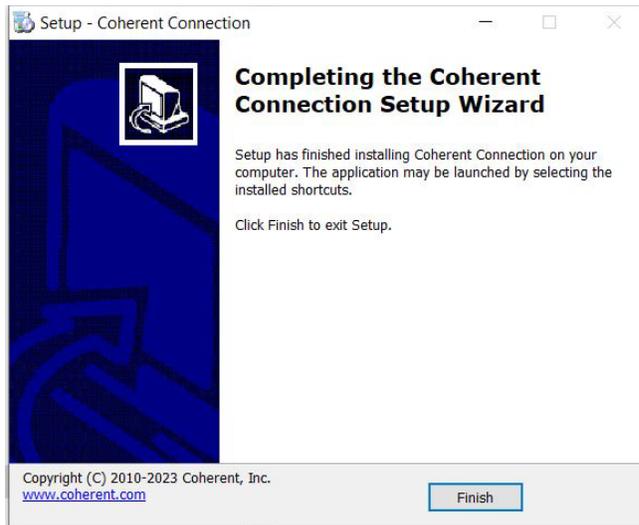
**Figure 5-76. Set Desktop or Quick Launch Icon**



**Figure 5-77. Verify Set-Up before Installation Starts**



**Figure 5-78. Progress of Installation**



**Figure 5-79. Finish the Software Installation**



**Figure 5-80. Desktop Icon for Coherent Connection Software**



---

**NOTICE**

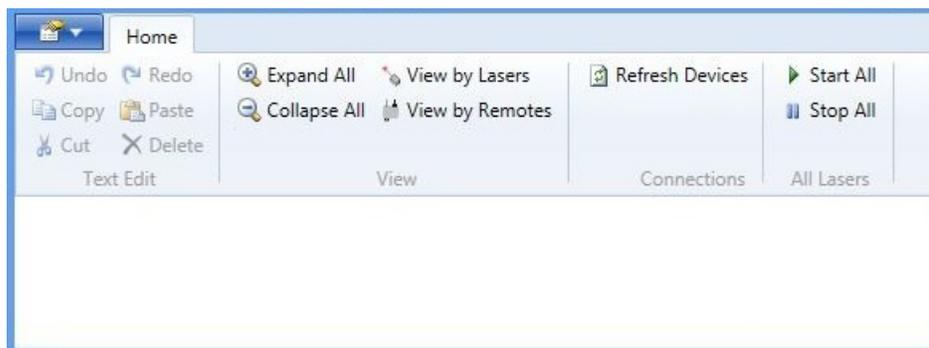
After installation, do NOT launch the software until you connect the laser or Remote.

---

## 5.3 Overview of the Main Tabs

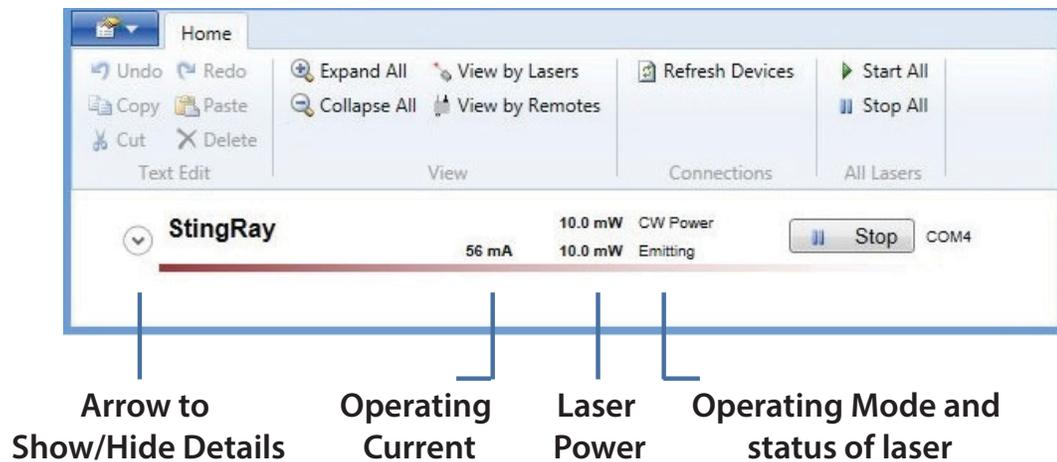
The illustrations in this section show each of the main tabs in the Coherent Connection Software.

When launching Coherent Connection without a laser connected to the host computer, or if the laser is not powered on, the main window shows an empty window, as shown in Figure 5-81.



**Figure 5-81. Coherent Connection Software – Main Screen (Empty)**

After you connect and set the power to the laser to On, the laser that is connected displays, as shown in Figure 5-82. This identifies the laser and shows top-level information only.



**Figure 5-82. Software – One Laser Connected**

You can show or hide information about each laser. You can expand information for all lasers, or only one at a time. Use the arrows adjacent to the laser name.

- To **show** more, click the **Down** arrow next to the necessary laser. This expands the window to show details about the laser selected.
- To **hide** more information, click the **Up** arrow adjacent to the necessary laser. This collapses the window to show only the top-level name of the laser selected.

If more than one StingRay or BioRay laser are connected, the window shows all lasers. Refer to Figure 5-83. This identifies each laser, but the window is not yet expanded to show detailed information.

When the information expands, a series of tabs display at the bottom of the Coherent Connection Software window:

- 'Information is given about each of these in the next sections. Operating Power Tab' (p. 76)
- 'Figure 5-87 shows both lasers emit a 100% Output Power level, at 10 mW and 50 mW, respectively.' (p. 78)
- 'Details Tab' (p. 79)
- 'Commands Tab' (p. 80)

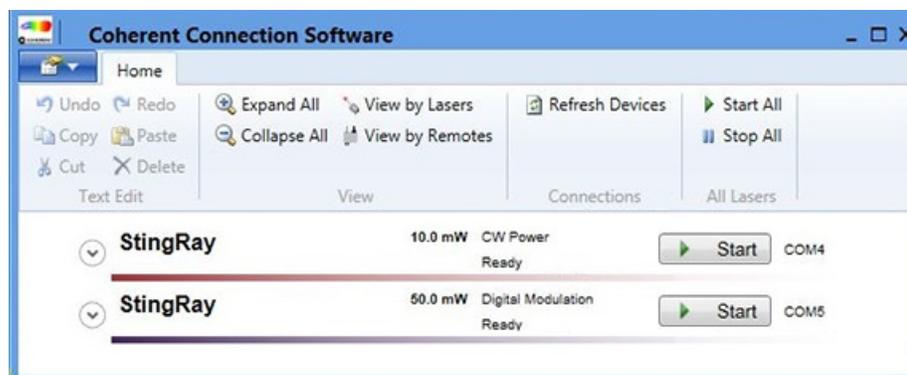


Figure 5-83. Software – Multiple Lasers Connected

- 'Remote Tab' (p. 82)

### 5.3.1

Information is given about each of these in the next sections. **Operating Power Tab**

Use the Operating Power tab to increase or decrease power levels, as well as pre-set power levels.



#### **NOTICE**

**Output Power can be changed in the software only for CW and Digital laser configurations. The Output Power CANNOT be changed through the software for lasers configured with Analog modulation.**

Figure 5-84 shows the Operating Power tab window expanded with information about a 100 mW laser in Continuous Wave (CW) Mode, can be but does not give light output.

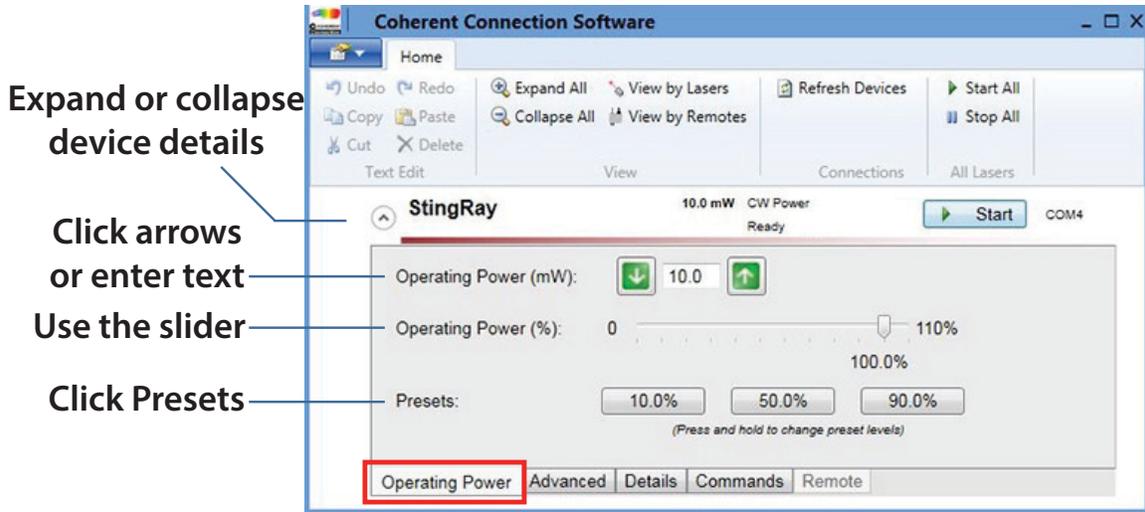
- Click the Start button to start laser output.

To edit the Operating Power (mW) level:

- Click the green DOWN-arrow button to decrease power levels by 1 mW for each click.
- Click the green UP-arrow button to increase power levels by 1 mW for each click.
- Enter text in the box between the arrows to give a specified power level.

To set power levels with the **Operating Power (%)** slider:

- Drag the slider to get the power level you want to use or to adjust the current power level.



**Figure 5-84. Software – Operating Power Tab**

- Click the left side of the slider to decrease power by 10%.
- Click the right side of the slider to increase power levels by 10%.

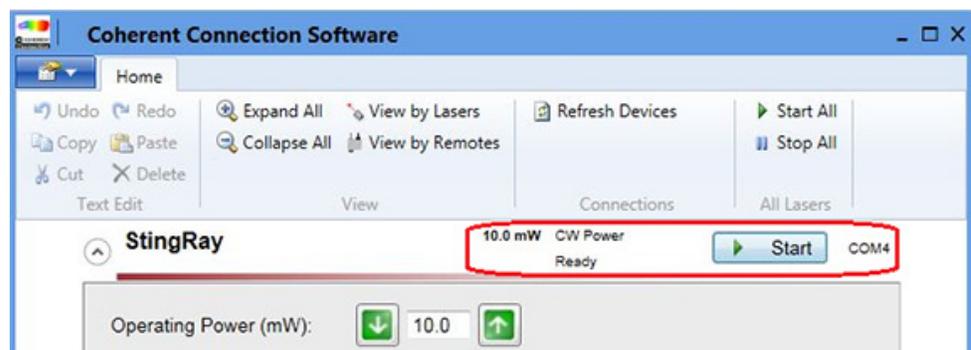
To select pre-set buttons:

- Press and hold the button in **Presets** to make the current power setting the new preset for that button.
- One click changes to 10, 50 or 90% (user-selectable)

Changes display immediately.

In the examples that follow, information in the window changes if the Operating Mode and status of the laser changes.

The example in Figure 5-85 shows a laser in Continuous Wave (CW) mode operation. Click the [Start](#) button and the laser immediately starts to give laser output.



**Figure 5-85. Example—CW Mode Emission**

If the CDRH delay was set up at the factory, there is a 5-second delay before the lasers start to give laser light output, as shown in Figure 5-86.

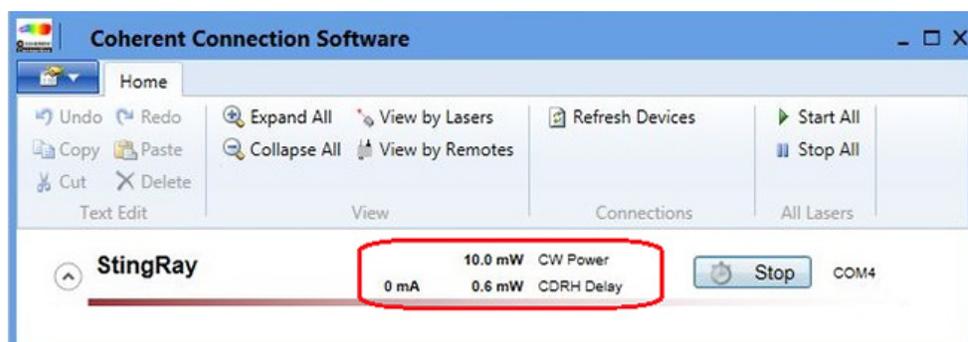


Figure 5-86. CDRH Delay Enabled

Figure 5-87 shows both lasers emit a 100% Output Power level, at 10 mW and 50 mW, respectively.

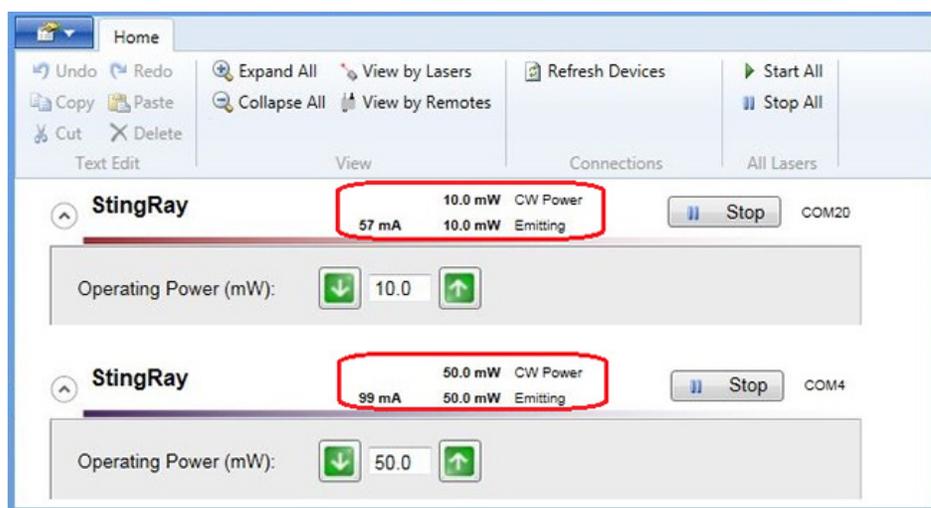
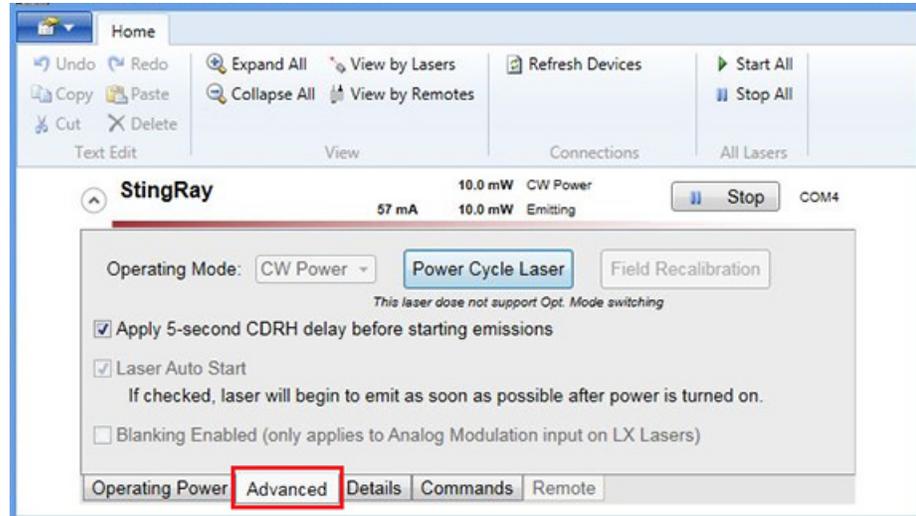


Figure 5-87. Laser Emitting at Full Output Power

### 5.3.2 Advanced Tab

Figure 5-88 shows the Advanced tab with use of a single laser.

This tab of the software shows the Operating Mode configured at the factory for each laser shown. Most of the possible selections shown on this tab are not available and are not applicable for StingRay or BioRay lasers. (Those options were intended for use with an OBIS laser product).



**Figure 5-88. Example— Advanced Tab**

Possible selections for StingRay/BioRay lasers include:

- Operating Mode  
The Operating Mode for each laser is set up at the factory for each laser and cannot be changed. See 'When there is power to the remote, the keyswitch is in the ON position, and the interlock is installed, the LASER READY indicator and the POWER ON indicator LEDs display green. Refer to Figure 6-96.' (p. 88) for more information.
- CDRH Delay  
The CDRH selection can be Enabled or Disabled with use of an RS-232 command ONLY if the communications selection (-TX) was enabled at the factory at the time the StingRay laser is purchased. This selection cannot be added or Enabled in the field.

These possible selections show as non-selectable. They do **not apply** to StingRay/BioRay lasers.

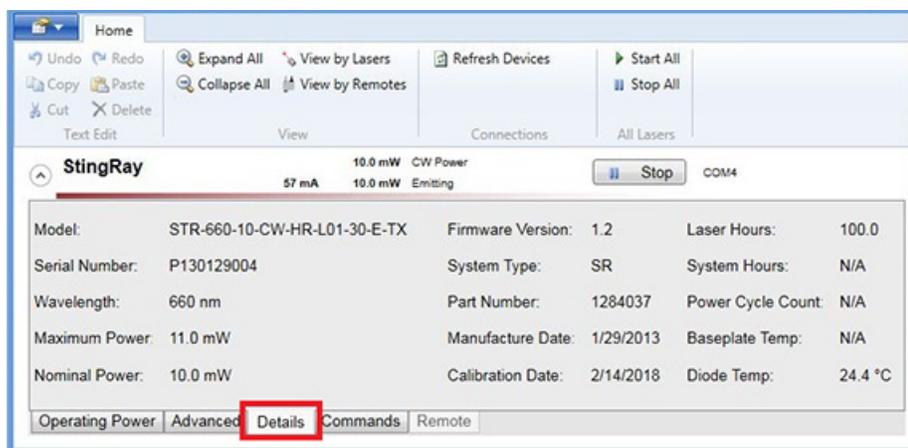
- Laser Auto Start
- Blanking Enabled
- Field Calibration

### 5.3.3

#### Details Tab

Figure 5-89 shows the Details tab. It shows the model, serial number, and other information that is specified for the laser selected. Users can select device information that use the ID command:

**SYSTEM:INF:USER** <user selected identification string>  
See 'Set/Query User-Defined ID' (p. 109) for more information.

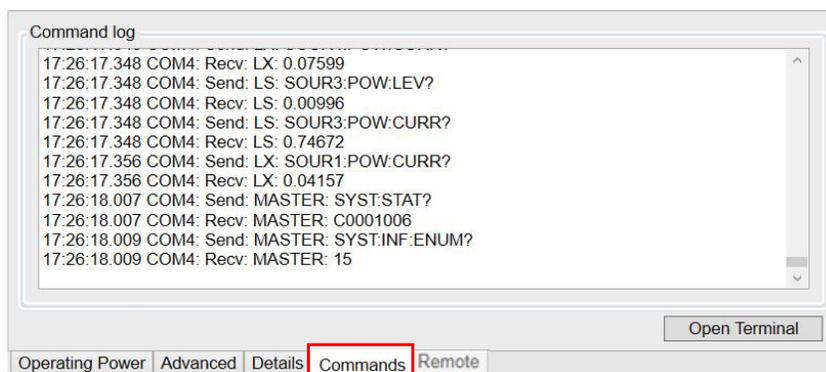


**Figure 5-89. Example—Details Tab**

When there is more than one laser shown in the window, it is possible to show or hide information for each laser. The same type of information is available for each laser.

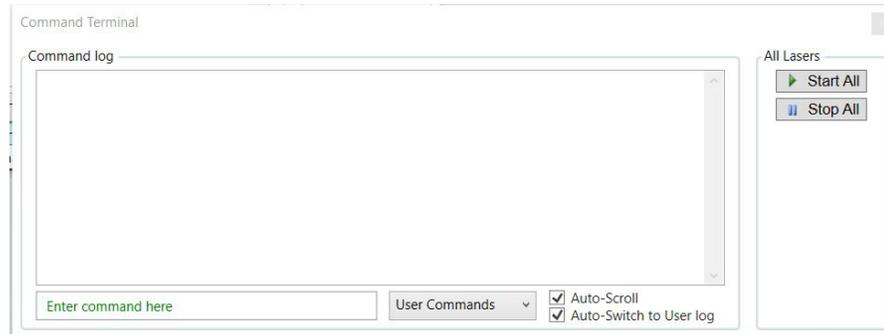
### 5.3.4 Commands Tab

The Commands tab shows the Command log with commands and responses sent to and received from an individual laser. Commands in use can be viewed or new commands can be entered.



**Figure 5-90. Coherent Connection—User Commands Tab**

- Click the **Open Terminal** button. The Command Terminal pop-up displays.



**Figure 5-91. Command Terminal - User Commands**

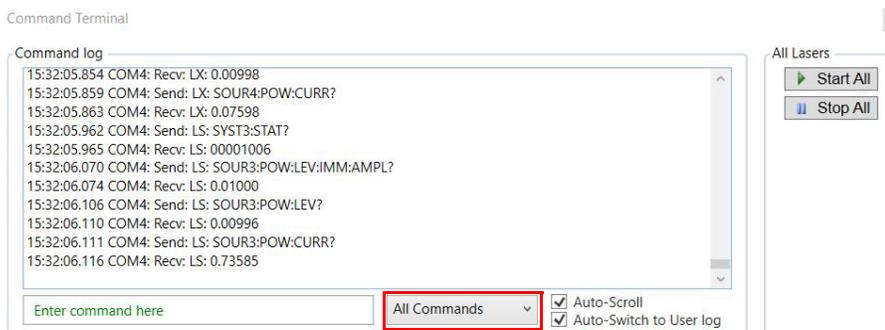
Notice the Auto-Scroll check box at the bottom of the Command Terminal screen. By default, Auto-Scroll is enabled at start-up.

- Deselect the **Auto Scroll** check box, then use the scroll bar at the side of the window to manually view the list of commands. The most recent command at the bottom of the list.
- Selection of the Auto-Scroll check box immediately starts rapid scrolling of the commands in use.

There is a User Commands selection. Click the **User Commands** drop-down and select the desired tab at the top of the window to show users commands that have been entered, or all commands in use.

For more information about commands and error messages, see 'Host Interface' (p. 99).

- **User Commands**, the first section displays, as shown in Figure 5-91. If no user commands have yet been used, the Command Log area is blank.
- To enter a command, click in the green field with label: **Enter command here**. The area changes to a text box. Type the command.
- Select **All Commands** in the drop-down to view all commands in use, as shown in the example in Figure 5-92.



**Figure 5-92. Command Terminal - All Commands**

### 5.3.5 Remote Tab

The Remote tab at the bottom of the main window is non-selectable and grayed when StingRay or BioRay are used. It is not available for use with a StingRay/BioRay Remote.

# 6 Operations

This section shows functions of the StingRay and BioRay lasers, that include:

- 'Operate the Laser with a Remote (Optional)' (p. 85)
- 'Operate the Laser with a Remote (Optional)' (p. 85)
- 'When there is power to the remote, the keyswitch is in the ON position, and the interlock is installed, the LASER READY indicator and the POWER ON indicator LEDs display green. Refer to Figure 6-96.' (p. 88)
- 'Focus the Laser' (p. 95)
- 'Clean Optics' (p. 97)

Refer to 'Safety and Compliance' (p. 121) to learn about required safety precautions when work is done with lasers.



---

**WARNING!**

**Use of controls, adjustments, or performance of procedures except as specified in this document can cause dangerous radiation exposure.**

---

## 6.1 Laser Operation

This section shows basic functions of a StingRay/BioRay laser.

### 6.1.1 Turn the Laser ON/OFF

To set the laser ON, do one of these:

- Apply power to the laser.  
(or)
- Turn the keyswitch on the Remote to the ON position.



---

**WARNING!**

**LASER RADIATION.** Immediately after power is supplied to the remote, the laser can give light. Follow all safety precautions to prevent exposure to direct or indirect laser radiation.

---

To set the laser to OFF, do one of these:

- Disconnect the power supply from the laser.  
(or)
- Turn the keyswitch on the remote to the STANDBY position.

### 6.1.2

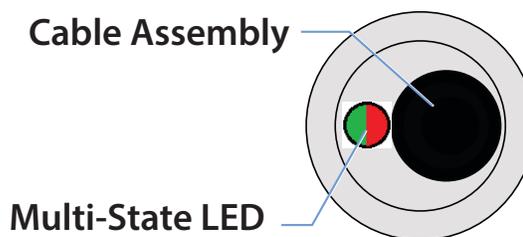
#### LED on the Laser

The laser includes an LED at the cable end of a StingRay or BioRay laser, as shown in Figure 6-93. This LED supplies status information about laser operation.



**Figure 6-93. Power-On LED**

This multi-state indicator LED can show more than one color at the back of the laser. See the example illustration in Figure 6-94.



**Figure 6-94. Multi-State LED on Laser**

Table 6-9 shows the status is shown by the LED on the behind the laser:

**Table 6-9. LED Analog Output Status**

Condition	LED	Reset
Power OFF	OFF	—
Fault	Slow Red Flash at 5 times per second	Cycle power
Health Monitor	Slow Red Flash every two seconds	Reset automatically; see 'Set Up Health Monitor (Optional)' (p. 63).
Power ON	Steady Green ON	—

For information when Coherent Connection software is used to examine Fault Conditions, see 'Query System Fault' (p. 113).

## 6.2

### Operate the Laser with a Remote (Optional)

This section shows how to get the laser to operate when the laser remote is used. For laser modules set up with modulation, a correct modulation signal MUST be applied to the BNC connector on the rear panel of the remote. **NOTICE**

**The StingRay/BioRay Remote has an interlock circuit that must be closed for the laser to operate.**

To set the laser to ON with the Remote, attach the interlock jumper to the StingRay/BioRay Remote. It is used to make a circuit. Then turn the keyswitch to the ON position. For more information, see 'Set Up and Connect the Remote' (p. 46).

## 6.2.1 Remote Keyswitch

The keyswitch on the StingRay/BioRay Remote is as an ON/OFF switch for the laser. Table 6-10 shows the keyswitch position.

**Table 6-10. Keyswitch Position**

Position	Description
Standby	Standby = OFF When the key is in the Standby position, it is the same as having the laser set to OFF.
ON	As soon as power is applied to the remote and the keyswitch is toggled from the Standby (OFF) position to the ON position, the laser begins to emit after a default CDRH delay. If the StingRay model description contains an '-8' option, then CDRH delay is set to disabled by default.



---

**WARNING!**

**LASER RADIATION.** Prevent eye or skin exposure to **DIRECT** and **SCATTERED** radiation. Read and obey the recommended safety precautions in 'Laser Safety Hazards' (p. 121).

---

## 6.2.2 LEDs on the Remote

This section supplies information about the LED colors that show the operation condition of the StingRay/BioRay laser. Figure 6-95 shows the location of the LEDs.

---

**NOTICE**

**While the yellow LASER READY LED appears yellow in color when it is off, it is a bi-color LED that displays as either green or red when on.**

---



**Figure 6-95. LEDs on the Remote**

Table 6-11 shows the LEDs and shows the ON conditions for each:

**Table 6-11. Status of LEDs on the Remote**

Condition	LED	Description
Power to Laser	LASER READY	<ul style="list-style-type: none"> <li>LASER READY light displays only when the keyswitch is in the ON position and the laser has power for operation.</li> <li>When the keyswitch is in the ON position and the interlock jumper is removed, the LASER READY LED color changes from <b>GREEN</b> to <b>RED</b>.</li> </ul>
Laser Fault	LASER FAULT	LASER FAULT light is ON and flashes <b>RED</b> when there is a fault or an over-temperature condition in the laser.
Power to Remote	POWER ON	Laser displays <b>GREEN</b> light output when power is applied.

Table 6-12 shows the possible conditions of the Status LEDs on the Remote.

**Table 6-12. StingRay/BioRay Remote – LED Conditions**

Action	LASER READY	LASER FAULT	POWER ON
No power (no power supply connected)			
Power to Remote (power supply connected to remote)			<b>Stable ON</b>
Power to Laser (keyswitch on, laser emits) Refer to example, Figure 6-86.	<b>Stable ON</b>		<b>Stable ON</b>
Interlock disconnect	<b>Stable ON</b>		<b>Stable ON</b>

**Table 6-12. StingRay/BioRay Remote – LED Conditions (continued)**

Action	LASER READY	LASER FAULT	POWER ON
Interlock re-installed after disconnect (must toggle keyswitch to reset)			Stable ON
Fault	Stable ON	Flashes	Stable ON

When there is power to the remote, the keyswitch is in the ON position, and the interlock is installed, the LASER READY indicator and the POWER ON indicator LEDs display green. Refer to Figure 6-96.



**Figure 6-96. LED Indicators - Power to Laser, Keyswitch On, Laser Emits**

## 6.3 Modes of Operation



### **NOTICE**

The mode of operation is set up at the time the unit is made and cannot be reconfigured after it is shipped.

Modes of operation are used to modulate StingRay and BioRay lasers are:

- 'Continuous Wave (CW)' (p. 89)
- 'Analog Modulation' (p. 90):
  - Analog Modulation (A)
  - Reverse Analog Modulation (RA)
- 'Digital Modulation' (p. 92);

- Digital TTL(T) or Fast Digital TTL(FT) Modulation
- Reverse Digital TTL(RT) or Reverse Fast Digital TTL(RFT) Modulation

### 6.3.1 Continuous Wave (CW)

The Continuous Wave mode supplies:

- Laser on at full power
- Operations at constant power
- Adjustable laser output power and monitor power if RS-232 is enabled
- No requirements for modulation input

### 6.3.2 Signals for Modulation

Laser power can be modulated by operation of an external signal. A different selection must be done at the time the order is given.

Along with the  $V_{IN}$  (Power) and  $V_{IN}$  Ground lines, equipped lasers that have modulation enabled are controlled. They are controlled by connection of more lines to the modulation source:

- $V_{MOD}$  — Blue wire
- $V_{MOD}$  GND — Red/Black wire

---

**CAUTION**

**A StingRay or BioRay laser setup with Analog modulation must have both the VMOD input signal and the VMOD Ground line connected for correct operation.**

---

Supply an applicable voltage from the selected source (variable power supply, computer, manual potentiometer, pulse generator, and so on). Supply it to the  $V_{MOD}$  (Blue wire) and  $V_{MOD}$  GND (Red/Black wire).

As the voltage applied to the modulation input signal is changed, the output power of the laser also changes according to the modulation curve.

### 6.3.3 Analog Modulation

**Analog** modulation lets the laser output power to follow an analog input voltage. This feature is a waveform reproducing input signal to modulate the laser in frequency and adjust the output power through the amplitude.

Analog modulation uses an external DC voltage source to change the output power. The laser can be controlled with the Analog input to:

- Change the output power
- Apply modulation with an arbitrary waveform
- With a square wave of different voltage levels, can control the laser with different output power levels

---

#### **CAUTION**

**A StingRay or BioRay laser setup with Analog modulation must have both the VMOD input signal and the VMOD Ground line connected for correct operation.**

---

Analog selections include:

- Analog Modulation (A)
- Reverse Analog Modulation (RA)

#### 6.3.3.1 Analog Modulation (A)

The Analog Modulation (A) type supplies:

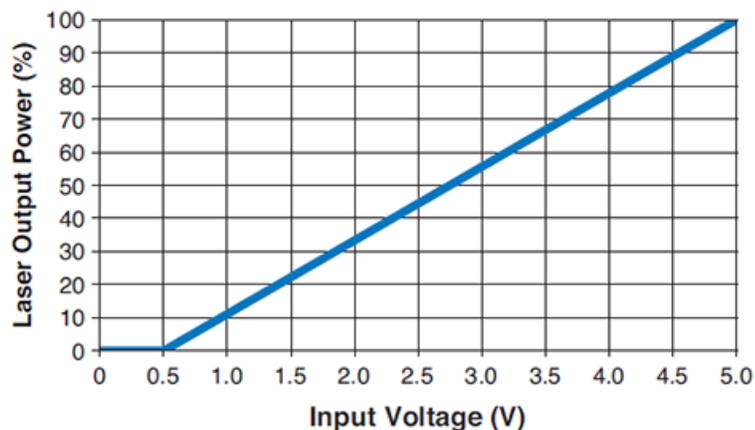
- Input  $V_{MOD} < 0.5V_{DC}$  = laser output power is off
- Input  $V_{MOD} = 5V_{DC}$  is 100% laser output power
- 0.5V to 5V is linear laser power control from an external voltage source

This selection can be used with a DC voltage input to simply change the output power. There is no adjustable output power through the RS-232.

- Maximum bandwidth of 500 KHz
- Rise time (10% to 90%) <1 msec

- Fall time (90% to 10%) <1 msec

Figure 6-97 illustrates Analog Modulation:



**Figure 6-97. Analog Modulation (A)**

### 6.3.3.2

#### Reverse Analog Modulation (RA)

The Reverse Analog Modulation (RA) type supplies:

- Input  $V_{MOD} \geq 4.5V_{DC}$  = laser output power is off
- Input  $V_{MOD} = 0V_{DC}$  is 100% laser output power
- 4.5V to 0V is linear laser power control from external voltage source

This selection can be used with a DC voltage input to simply change the output power. There is no adjustable output power through the RS-232.

- Maximum bandwidth of 500 KHz
- Rise time (10% to 90%) <1 msec
- Fall time (90% to 10%) <1 msec

Figure 6-98 illustrates Reverse Analog Modulation:

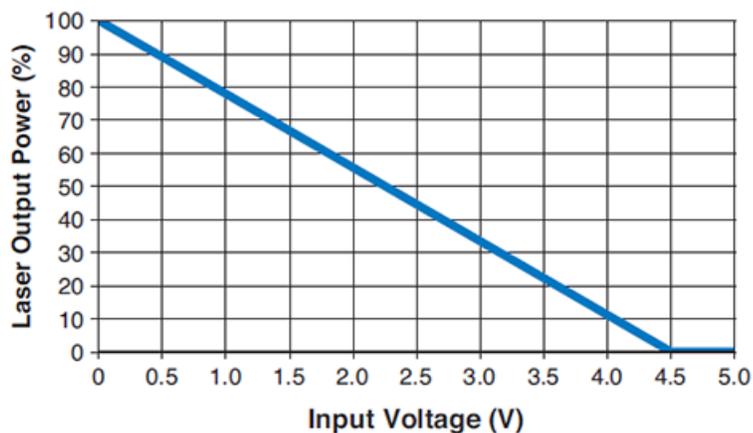


Figure 6-98. Reverse Analog Modulation (RA)



---

**NOTICE**

When the laser is set up for Analog Modulation, you must connect an Analog Modulation signal for correct operation.

---

### 6.3.4

#### Digital Modulation

StingRay and BioRay lasers can operate in Digital Modulation mode to control the laser output power. This is useful when it is necessary to have a laser come ON and OFF in a Digital mode.

The lasers can be modulated in Digital mode from minimum power to the Set Power. Adjust the Set Power with the Coherent Connection software (or host interface) to let the 'ON' level for Digital Modulation to be adjustable.

Power for the wavelength is controlled with the BNC connector on the Remote.

Digital Modulation offers the selections shown in this section:

- Digital TTL(T) or Fast Digital TTL(FT) Modulation
- Reverse Digital TTL(RT) or Reverse Fast Digital TTL(RFT) Modulation

### 6.3.4.1 Digital TTL(T) or Fast Digital TTL(FT) Modulation

Digital Modulation selections set the laser ON or OFF using a high- or low-input voltage level.

- Input 0 to 1  $V_{DC}$  = laser output power OFF
- Input 4 to 5  $V_{DC}$  = 100% laser output power ON

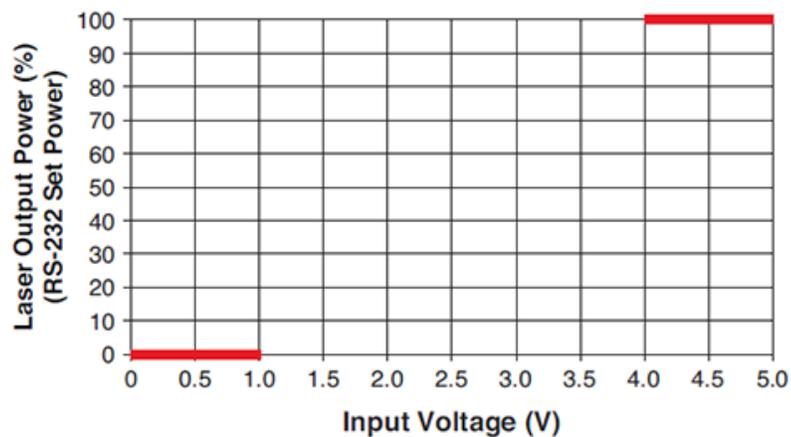
With RS-232 communications (TX) enabled, the output power level can be adjusted using Coherent Connection software.

Table 6-13 shows the differences between these two selections:

**Table 6-13. Digital or Fast Digital Modulation Values**

Selection	Function	Value
Digital TTL(T)	Maximum bandwidth	<b>100 KHz</b>
	Rise time (10% to 90%)	<b>&lt;1 msec</b>
	Fall time (90% to 10%)	<b>&lt;1 msec</b>
Fast Digital TTL(FT)	Maximum bandwidth	<b>2 MHz</b>
	Rise time (10% to 90%)	<b>&lt;150 nsec</b>
	Fall time (90% to 10%)	<b>&lt;150 nsec</b>

Figure 6-99 shows the use of Digital or Fast Digital Modulation:



**Figure 6-99. Digital or Fast Digital Modulation**

### 6.3.4.2 Reverse TTL(RT) or Reverse Fast TTL(RFT) Digital

The Reverse Digital Modulation TTL(RT) or Reverse Fast Digital TTL (RFT) selections provide:

- Input  $4V_{DC}$  to  $5V_{DC}$  is output power off
- Input  $0V_{DC}$  to  $1V_{DC}$  is 100% output power

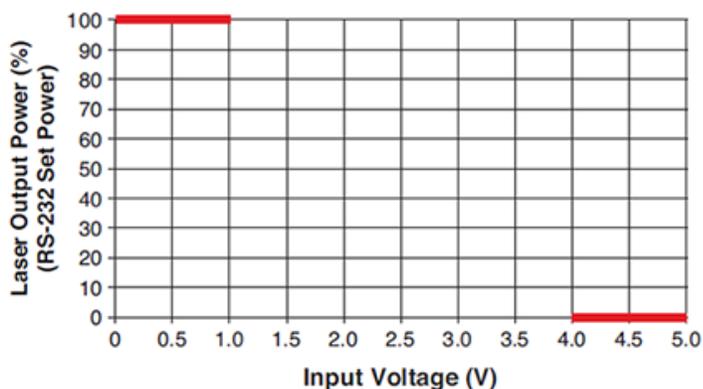
With RS-232 enabled, users can adjust the output power setting through software (for TX lasers only).

Table 6-14 shows the differences between these two selections:

**Table 6-14. Digital or Fast Digital Modulation Values**

Selection	Function	Value
Reverse Digital TTL(RT)	Maximum bandwidth	<b>100 KHz</b>
	Rise time (10% to 90%)	<b>&lt;1 msec</b>
	Fall time (90% to 10%)	<b>&lt;1 msec</b>
Reverse Fast Digital TTL(RFT)	Maximum bandwidth	<b>2 MHz</b>
	Rise time (10% to 90%)	<b>&lt;150 nsec</b>
	Fall time (90% to 10%)	<b>&lt;150 nsec</b>

Figure 6-100 shows the use of Reverse Digital or Reverse Fast Digital Modulation:



**Figure 6-100. Reverse Digital or Reverse Fast Digital Modulation**



---

**NOTICE**

When the laser is setup for Digital Modulation, you must connect an Digital Modulation signal for correct operation.

---

## 6.4

### Focus the Laser

The default focus distance for a StingRay laser, unless otherwise specified, is performed at a distance of 500 mm. BioRay lasers are set to 'collimated' at the factory.

All lasers are made so that the focusing lens cannot be removed. If an application is being used that requires accurate focusing and you want the laser to be pre-focused with a beam profiler, contact your sales person or see p. 149 for Coherent Support.



---

**WARNING!**

Use caution when operation or work is done near all laser products. Lasers are very concentrated light sources, some invisible to the eye. Never look directly at a raw laser beam. Never point a laser beam into your eyes or the eyes of another person—permanent damage to the retina can occur.

---

To focus lasers, use the following procedure:

1. Use the 0.035-inch hex wrench (provided), and loosen the screw for the focus lock. This is shown by a straight white line next to the screw. Refer to Figure 6-101.

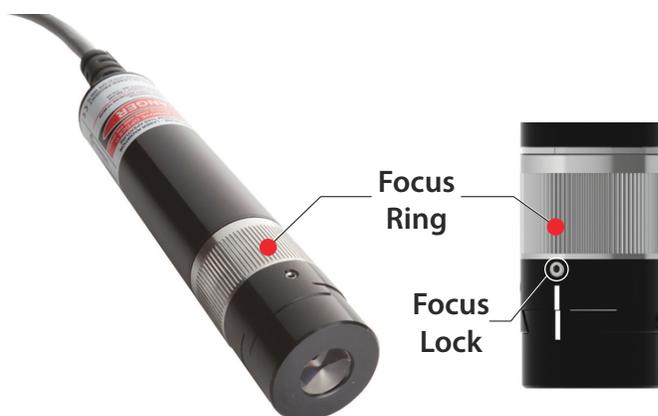


Figure 6-101. Focus Ring and Focus Lock



---

**CAUTION!**

**DO NOT** try to adjust any other screws!

- Three screws hold the orientation of the laser.
  - One screw is used to loosen the tension on the SOH optical head assembly when it is removed or changed.
- 

2. Hold the focus ring and turn the focus until it becomes the desired beam optical size at the working distance where you are the laser is used.
  3. Tighten the focus lock. Torque the lock set screw to 12 inch-ounces.
- 



---

**NOTICE**

**Do not over-tighten the set screw. Do not tighten to a torque level of more than 18 inch-ounces.**

---

For information to change the StingRay Optical Head (SOH), see 'Change a StingRay Optical Head (SOH)' (p. 51).

## 6.4.1 Clean Optics



---

**WARNING!**

**Before optics are cleaned, set the laser to OFF.**

---

After handling the laser, the laser pattern can become fuzzy or unclear. To improve the situation:

- Make sure that the image is focused. If it is not focused, follow the instructions in 'Focus the Laser' (p. 95).
- Make sure that the optics do not have contamination. If the optics have contamination, go to the next section.

### 6.4.1.1 Clean Contained Optics

If the optics have contamination, it is best to try and remove visible contamination. Blow dry air across the surface. Make sure the air used has no oil or moisture.

If this technique doesn't remove the contaminants, carefully clean the glass surface with a piece of lens tissue. Slightly dampen the tissue with methanol or IPA alcohol.



---

**CAUTION!**

**Clean with a wipe, gently to make sure that contamination does not scratch the lens.**

---

### 6.4.1.2 Clean Diffraction Gratings

Diffraction Optical Element (DOE) multi-line diffraction optics are obsolete. For technical questions about optical configuration, see how to contact Coherent See "Contact Product Support" (p. 152).



# 7 Host Interface

This section gives information about the host interface for the StingRay and BioRay lasers, including:

- Host command quick reference (this page)
- 'Message Considerations' (p. 102)
- Commands and Queries for
  - 'System Set-Up Commands and Queries' (p. 105)
  - 'Laser Information Commands and Queries' (p. 107)
  - 'Laser Operation Commands and Queries' (p. 110)
- 'Error Codes' (p. 114)

When a command is sent to the laser system, the parameter for the command is saved in internal continuous memory. Internal continuous memory has a logic cell life of ten thousand write cycles. The cell life sets the limits for repetitive commands sent to the laser system.

Storing in persistent memory applies only to commands and not to queries.

## 7.1 Host Command Quick Reference

This section gives all host commands and queries, and includes a brief description of each. For details about a specific command or query, refer to the page shown in the right column.

- To use commands and queries, the StingRay or BioRay laser must be set up with Communications Enabled (TX).
- To send a command to the laser, use the applicable value after the command with a space between the command and the value.
- To query the laser, add a question mark (?) at the end of the command.

The following tables provide a summary of host commands and queries used for StingRay and BioRay lasers. This includes commands and queries for:

- System set-up (Table 7-15)
- Laser information (Table 7-16)
- Laser operation (Table 7-17)

**Table 7-15. System Set-Up Commands and Queries**

Command/Query	Description	Page
*IDN?	Queries the identification string for the laser	5-6
SYST:CDRH	Enables or disables the CDRH laser emission 5-second delay	5-6
SYST:CDRH?	Queries the status of the CDRH laser emission delay	5-6
SYST:COMM:BAUD	Sets the serial communication baud rate	5-6
SYST:COMM:BAUD?	Queries the serial communication baud rate	
SYST:COMM:HAND	Toggles system SCPI handshaking	5-6
SYST:COMM:HAND?	Queries system SCPI handshaking	
SYST:COMM:PROM	Toggles the interactive command prompt	5-6
SYST:COMM:PROM?	Queries the interactive command prompt	

**Table 7-16. Laser Information**

Query	Description	Page
SYST:INF:MOD?	Retrieves the model name of the laser	5-7
SYST:INF:PNUM?	Retrieves the part number of the laser	5-8
SYST:INF:MDAT?	Retrieves the manufacture date of the device	5-8
SYST:INF:SNUM?	Retrieves the serial number of the laser	5-8
SYST:INF:FVER?	Retrieves the current firmware version	5-8
SYST:INF:WAV?	Retrieves the wavelength of the laser	5-8
SYST:DIOD:HOURL?	Queries the usage hours for the laser diode	5-8

**Table 7-16. Laser Information (continued)**

Query	Description	Page
SYST:INF:POW?	Retrieves the power rating of the laser	5-9
SYST:INF:USER	Enters and stores user-defined information (NOTE: there must be no space between the numeric parameter and the user information, as enclosed in the angle brackets)	5-9
SYST:INF:USER?	Queries user-defined information	

**Table 7-17. Laser Operation Commands and Queries**

Command/Query	Description	Page
SYST:STAT?	Queries the system status	5-10
SOUR:AM:STAT	Turns the laser ON or OFF	5-10
SOUR:AM:STAT?	Queries the current laser emission status	
SOUR:AM:SOUR?	Queries the current operating mode	5-10
SOUR:CURR:LEV?	Queries the operating current of the laser diode	5-10
SOUR:POW:LEV?	Returns the present output power of the laser	5-10
SOUR:POW:NOM?	Returns the nominal CW laser output power in Watts	5-10
SOUR:POW:LEV:IMM:AMPL	Sets laser power in Watts for CW power and Digital modulation modes	5-11
SOUR:POW:LEV:IMM:AMPL?	Queries laser output power in Watts for CW power and Digital modulation modes	
SOUR:TEMP:DIOD?	Queries diode temperature	5-11
SOUR:TEMP:INT?	Queries internal temperature	5-11
SOUR:TEMP:PROT:DIOD:LOW?	Queries laser diode low temperature limit (degrees Celsius)	5-11
SOUR:TEMP:PROT:DIOD:HIGH?	Queries laser diode high temperature limit (degrees Celsius)	
SYST:FAUL?	Queries current system faults	5-12

## 7.1.1 Short Forms for Commands/Queries

Following is a key that shows shortened forms used in commands and queries listed in this section:

SYST = SYSTem	POW = POWer
COMM = COMMunicate	STAT = STATus or STATe
HAND = HANDshaking	SOUR = SOURce
PROM = PROMpt	CURR = CURRent
INF = INFormation	LEV = LEVeI
MOD = MODel	NOM = NOMinal
PNUM = PNUMber (part number)	IMM = IMMEDIATE
MDAT = MDATe (manufacturing date)	AMPL = AMPLitude
SNUM = SNUMber (serial number)	TEMP = TEMPerature
FVER = FVERsion (firmware version)	INT = INTernal
WAV = WAVelength	FAUL = FAULT
DIOD = DIODe	

## 7.2 Message Considerations

This section includes additional information about various messages that may be is shown.

### 7.2.1 Message Completion Handshake

Standard Commands for Programmable Instrument (SCPI) message round-trip handshaking is implemented on every message sent by the laser firmware. The handshaking may be disabled using an SCPI command. Changes to a setting are saved in non-volatile memory.

This handshake serves several purposes—it includes:

1. An indication to the host/Remote that the message was received.
2. A synchronization mechanism to the host/Remote so it knows when a message has been processed to completion. When that occurs, a new message may be sent.
3. An indication to the host/Remote that errors that may have occurred.

The handshake is a short message string that is sent as the last action performed when handling a received message. The handshake string represents either an OK response or an error response if a received message raises an error condition.

**NOTE:** Quotation marks shown in the following examples are never to be included in the handshake string.

The OK response is formatted as "oK\r\n".

Error responses are formatted as "ERR<n>\r\n" where <n> represents the error code number. Negative numbers are permitted in the error string.

When handshaking is enabled, devices transmit one of the following handshake reply strings in response to each received command or query:

- Valid commands with valid data parameters replies with "oK\r\n"
- Valid queries with any optional valid data reply as explicitly defined elsewhere in this section, followed by "oK\r\n". For example, if querying the model name string, the laser transmits the model name string, followed by the "oK\r\n" string.
- Valid commands or queries which result in an error reply with "ERR<n>\r\n"
- Unrecognized or unsupported commands or queries reply with "ERR<n>\r\n"

The message completion handshake is not transmitted in response to a command that has been broadcast to all devices.

## **7.2.2 Message Terminators**

Messages between the laser and the host computer or Remote are comprised entirely of ASCII string characters; no binary messages are supported. All message strings passing through the host interface are terminated to signal the end of a message string.

The maximum message length supported is 255 bytes, which includes all terminating characters.

### **7.2.2.1 Messages Received by the Laser**

Messages received by the laser must be terminated by a carriage return (decimal 13).

A line feed (decimal 10) following the carriage return is ignored so messages may be terminated with a carriage return and line feed pair.

A command or query is considered incomplete without correct termination.

### **7.2.2.2 Messages Sent by the Laser**

All messages sent by the laser are terminated by a carriage return (decimal 13) and line feed (decimal 10) pair.

The maximum length of any message sent by the laser is limited to 255 bytes, including all terminating characters.

### **7.2.3 Message Syntax**

Syntax specified by the SCPI and IEEE 488.2 Standards is followed unless specified differently. Refer to the SCPI and IEEE 488.2 Standards for more information.

Notably, the base-10 numeric data format specification is used heavily in this document and covered in the IEEE 488.2 Standard. Unless otherwise specified, numeric data items referred to as NRf (IEEE flexible numeric representation) are interchangeable and may be represented in any of these formats:

- Integer values
- Non-scientific notation floating point values
- Scientific notation floating point values (uppercase E or lowercase e)

For example, the following data values are functionally equivalent:

- 31256
- 31256.0
- 3.1256E4
- 31.256E3
- +3.1256E+4

Unless otherwise specified, non-numeric data items (typically referred to as strings) are not quoted.

Devices interpret hexadecimal data using the following rules:

- Uppercase and lowercase are accepted ('FE' = 'fe')
- Leading zeros are required and accepted ('0A' = 'A')

- The data string may optionally be preceded by a '0x' or '0X' C hexadecimal notation idiom (0xD2C4 = D2C4)
- Following the optional "0x" prefix, the acceptable characters are from the list: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, f, A, B, C, D, E, and F

Enumerated values must match exactly, using the long form/short form comparison rules defined under the SCPI Standard.

Dates (manufacturing date, calibration date, and so on) use the `YYYYMMDD` format. Using this format, dates may be stored as ASCII strings or as numeric long integers and converted easily from one format to the other.

## 7.2.4 Command Prompt

Each device implements the ability to output a command prompt to support interactive operation by an operator typing commands in a terminal program. A command is specified to describe the command prompt behavior.

The command prompt is not transmitted in response to a command that has been broadcast to all devices.

## 7.3 System Set-Up Commands and Queries

This section shows commands and queries for setting controls for the laser.

### 7.3.1 Identification Query: \*IDN?

The SCPI Standard specifies a mandatory set of IEEE-488.2 common commands. All of these commands and queries start with an asterisk. Refer to the IEEE-488.2 specification for more detailed information about these commands.

Returns a device identification string that includes information about manufacturer name, model description, firmware version, and firmware release date.

<b>Query</b>	*IDN?
<b>Reply</b>	"Coherent, Inc" + "-" + <model name> + "-" + <firmware version> + "-" + <firmware date>

An example of the format is shown in the following example:

QUERY: \*IDN?

REPLY: Coherent, Inc - StingRay - STR-660-10-CW-HR-L01-30-E-TX -  
v1.2 - 20161202

A key to interpreting the reply string is as follows:

- The dash sign separates all fields within the reply string.
- The first field is always “Coherent, Inc”.
- The second field is the model name, which varies based on the laser.
- The third field is the firmware version number, having the format “V<major>.<minor><optional qualifier characters>”.
- The fourth field is the firmware date, having the form **YYMMDD**. The reply string is not quoted.

### 7.3.2 Set/Query CDRH Delay

The CDRH five-second laser emission delay is set at the factory to be enable or disabled. A Query returns the present CDRH setting in string format.

<b>Command</b>	SYST:CDRH ON OFF
<b>Query</b>	SYST:CDRH?
<b>Reply</b>	ON OFF




---

#### NOTICE!

Disabling the CDRH delay renders the StingRay or BioRay system non-CDRH compliant. Compliance is a responsibility of the customer.

---

### 7.3.3 Set/Query Baud Rate

Sets or queries the serial communication baud rate. The range is from 2400 ... 115,000; the default is 115200.

<b>Command</b>	SYST:COMM:BAUD <baud rate>
<b>Query</b>	SYST:COMM:BAUD?
<b>Reply</b>	115200

### 7.3.4 Set/Query Handshaking

Toggles the SCPI system handshaking control on and off. The setting is saved in persistent memory. The factory default is ON.

<b>Command</b>	SYST:COMM:HAND {ON OFF}
<b>Query</b>	SYST:COMM:HAND?
<b>Reply</b>	ON OFF

When enabled, the device responds to each received command or query by transmitting one of the handshaking strings shown under 'Message Completion Handshake' (p. 102).

This setting is stored in persistent memory so that it remains unchanged after a power ON/OFF cycle.

The handshaking reply is not transmitted in response to a command that has been broadcast to all devices, except by a Remote device.

### 7.3.5 Set/Query Command Prompt

Toggles the system command prompt on and off. The setting is saved in persistent memory. The factory default is OFF.

<b>Command</b>	SYST:COMM:PROM {ON OFF}
<b>Query</b>	SYST:COMM:PROM?
<b>Reply</b>	ON OFF

When enabled, the device outputs a command prompt after each reply string. The command prompt is preceded by a carriage return and line feed, and consists of a ">" character and a space character.

The command prompt is not transmitted in response to a command that has been broadcast to all devices, except by a Remote.

## 7.4 Laser Information Commands and Queries

The System Information command and queries allow a host to retrieve static information about the characteristics of the laser.

### 7.4.1 Query System Model Name

Retrieves the model name of the laser.

<b>Query</b>	SYST:INF:MOD?
<b>Reply</b>	<model name>

#### 7.4.2 Query System Part Number

Retrieves the manufacturer part number of the laser.

<b>Query</b>	SYST:INF:PNUM?
<b>Reply</b>	<manufacturer part number>

#### 7.4.3 Query System Manufacture Date

Retrieves the manufacture date of the device.

<b>Query</b>	SYST:INF:MDAT?
<b>Reply</b>	<manufacture date>

#### 7.4.4 Query System Serial Number

Retrieves the serial number of the laser.

<b>Query</b>	SYST:INF:SNUM?
<b>Reply</b>	<serial number>

#### 7.4.5 Query System Firmware Version

Retrieves the current firmware version from the laser firmware. The format of the returned firmware version number string is identical to that shown in the \*IDN? Query.

<b>Query</b>	SYST:INF:FVER?
<b>Reply</b>	<current firmware version>

#### 7.4.6 Query System Wavelength

Retrieves the actual wavelength (in nanometers) of the laser.

<b>Query</b>	SYST:INF:WAV?
<b>Reply</b>	<wavelength>

### 7.4.7 Query Diode Hours

Queries the number of hours the laser diode has operated. This is defined as the accumulation of time while the “Laser Enable” pin is asserted. The usage hours are saved to persistent memory every 15 minutes in the format x.xx.

<b>Query</b>	SYST:DIOD:HOURL?
<b>Reply</b>	<x.xx hours >

### 7.4.8 Query System Power Rating

Retrieves the power rating (in watts) of the laser. The power rating is minimum output power under a given set of operating conditions during the laser life. It is generally the same as nominal power.

<b>Query</b>	SYST:INF:POW?
<b>Reply</b>	<power>

### 7.4.9 Set/Query User-Defined ID

Enters and stores user-defined identification (persistent). Queries user-defined name..

<b>Command</b>	SYST:INF:USER {0,<character string>}
<b>Query</b>	SYST:INF:USER?
<b>Reply</b>	"STINGRAY" as default

The item stored at the location pointed to by the item number.

The information entered is stored in nonvolatile memory. The user can enter up to four items, with each comprised of up to 31 characters. The item number starts at zero.

This command is useful if you want to change the name or description of the laser. For example, if multiple lasers are connected, you can identify each by the location or project.

## 7.5 Laser Operation Commands and Queries

Operational commands and queries are used to configure and operate the laser from a Host or Remote. These commands and queries are available for user-level applications as well. System State commands allow a host to retrieve dynamic information about the current operational state of the laser.

### 7.5.1 Query System Status

Gets the system status code. The status code is returned in a string expressed in uppercase hexadecimal integer form. The 32-bit word represents a bit-mapped status indicator.

<b>Query</b>	SYST:STAT?
<b>Reply</b>	<status word>

Table 7-18 shows status code bit mapping. The 'Laser' column specifies the bit meaning when the status word is read from StingRay and BioRay lasers. The status word MSB is always unset.

**Table 7-18. Status Code Bit Definitions**

Bit	Mask	Bit Label	Laser
0	00000001	Laser Fault	Laser faults (see Table 7-19)
1	00000002	Laser Emission	Laser emission status
2	00000004	Laser Ready	Laser emission readiness status
3	00000008	Laser Standby	Laser standby mode status
4	00000010	CDRH Delay	Laser CDRH delay status
5	00000020	Laser Hardware Fault	Hardware-related faults

Unspecified bits are reserved and are zero. As an example, if the laser is set to ON, but emission is delayed because the CDRH 5-second delay was enabled at the factory, the system status query shows:

00000012 (Laser emission enabled but delayed by CDRH)

### 7.5.2 Set/Query Laser Enable

Turns the laser ON or OFF. When the laser is set to ON, true laser emission delays because of internal circuit stabilization logic and/or CDRH delays. Query shows the laser ON/OFF state in string format.

<b>Command</b>	SOUR:AM:STAT ON OFF
<b>Query</b>	SOUR:AM:STAT?
<b>Reply</b>	ON OFF

### 7.5.3 Query Laser Operating Mode

Queries the current operating mode of the laser.

<b>Query</b>	SOUR:AM:SOUR?
<b>Reply</b>	CWP ANALOG DIGITAL

The following mutually exclusive operating modes are available:

- CWP (continuous wave, constant power)
- ANALOG (CW with external analog modulation)
- DIGITAL (CW with external digital modulation)

The reply string represents the present laser operating mode, where CWP is not modulated externally and the other modes imply external modulation.

### 7.5.4 Query Operating Current of the Laser

Queries the operating current of the laser diode, measured in mA.

<b>Query</b>	SOUR:CURR:LEV?
<b>Reply</b>	<x .xxxxx>

### 7.5.5 Query System Output Power Level

Returns the present output power of the laser. The reply string is an NRf value representing the present laser output power, measured in watts.

<b>Query</b>	SOUR:POW:LEV?
<b>Reply</b>	<x.xxxxx>

### 7.5.6 Query CW Nominal Power

Returns the nominal CW laser output power. The reply string represents the nominal power value in watts.

<b>Query</b>	SOUR:POW:NOM?
<b>Reply</b>	<x.xxxxx>

### 7.5.7 Set/Query Laser Power Level

Sets or queries the laser output power for CW power and Digital modulation mode.



#### **NOTICE**

**When the power level is set, it does not set the laser to On.**

This command by itself does not enable laser emission. If laser emission has enabled before, this command changes the laser output power and the new setting is saved in continuous memory. Setting the power level to zero watts does not set the electrical power to the laser diode to off.

The reply string shows the present laser power level setting as an NRf value in Watts. <laser\_power> = (10% to 100% of nominal power).

<b>Command</b>	SOUR:POW:LEV:IMM:AMPL <value>
<b>Query</b>	SOUR:POW:LEV:IMM:AMPL?
<b>Reply</b>	<x.xxxxx>

### 7.5.8 Query Diode Temperature

Queries the temperature of the laser diode. The reply string shows the value in degrees Celsius.

<b>Query</b>	SOUR:TEMP:DIOD?
<b>Reply</b>	<x.x>

**NOTICE**

For Analog Modulation configurations, the Output power can NOT be set with a command. The output power must be changed by applying an input voltage to the  $V_{MOD}$  and  $V_{MOD}$  Ground input signals.

### 7.5.9 Query Internal Temperature

Queries the show internal temperature of the laser. The reply string shows the value in degrees Celsius.

<b>Query</b>	SOUR:TEMP:INT?
<b>Reply</b>	<x.x>

The internal temperature represents the temperature taken from a built-in temperature sensor of the microprocessor.

### 7.5.10 Query High Temperature Limit

Queries the high temperature limit of the laser diode. The reply string represents the value in degrees Celsius.

<b>Query</b>	SOUR:TEMP:PROT:DIOD:HIGH?
<b>Reply</b>	<x.x>

### 7.5.11 Query Low Temperature Limit

Queries the low temperature limit of the laser diode. The reply string represents the value in degrees Celsius.

<b>Query</b>	SOUR:TEMP:PROT:DIOD:LOW?
<b>Reply</b>	<x.x>

### 7.5.12 Query System Fault

Gets the system fault code. The fault code is returned in a string expressed in uppercase hexadecimal integer form. The 32-bit word represents a bit-mapped fault indicator.

<b>Query</b>	SYST:FAUL?
<b>Reply</b>	<fault word>

As an example, if the base plate and laser diode temperature limits are both exceeded, the system fault query returns:

00000020 Diode Over Current

The Most Significant Bit (MSB) of the code is always unset, as shown in Table 7-19 (fault code bit mapping).

**Table 7-19. Fault Code Bit Definitions**

Bit	Mask	Bit Label	Laser
1	00000002	Diode Temperature Fault	Diode temperature out of range
2	00000004	Internal Temperature Fault	Internal temperature out of range
3	00000000	N/A	N/A
4	00000010	I <sup>2</sup> C Error	I <sup>2</sup> C bus error
5	00000020	Over Current	Diode over current
6	00000040	Laser Checksum Error	Persistent memory checksum error
7 to 16	00000000	N/A	N/A
17	00020000	Watchdog (IWDG) Timer Reset	Firmware resumed from Watchdog reset
18	00000000	N/A	N/A
19	00080000	Diode End of Life	Laser diode reaches end of life

## 7.6 Error Codes

Table 7-20 shows the Error Codes and supplies information about the condition when each error code is issued:

**Table 7-20. Error Codes**

Code	Error	Issued When ...
-350	Queue Overflow	Error queue is full. Non-Queue overflow errors are replaced by Queue overflow errors when there is exactly one available storage location available in the error queue. No additional errors are added to the error queue if the error queue is full.
-310	System Error	Unexpected/unrecoverable hardware or software fault. Occurs when the device firmware detects an unexpected or unrecoverable error. This error condition includes unrecoverable hardware faults.

**Table 7-20. Error Codes (continued)**

<b>Code</b>	<b>Error</b>	<b>Issued When ...</b>
0	None	No error.
100	Unrecognized	The command or query is not recognized. Occurs when the device receives an unrecognized command or query. This is a generic syntax error for devices that cannot detect more specific errors.
101	Invalid Parameter	The command or query parameter is invalid. Occurs when an invalid parameter has been specified.
102	Data Error	Unrecognized command or data type was encountered. Occurs when command or data type is not recognized.



# 8 Parts and Accessories

This section shows the parts and accessories available for the StingRay and BioRay lasers, which includes:

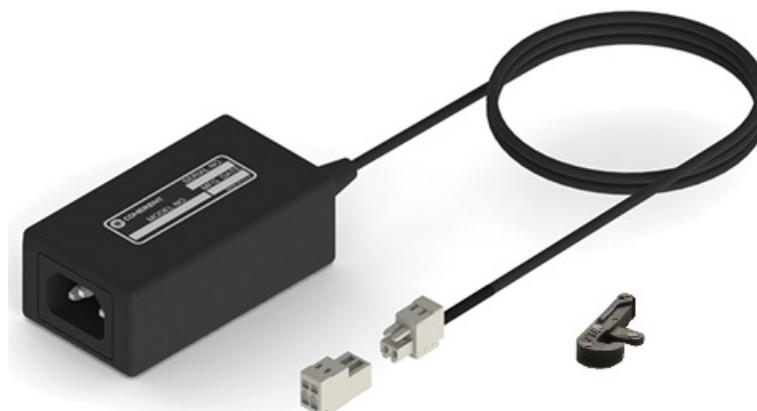
- 'Power Supply for Lasers with Flying Leads' (p. 117)
- 'Heat Sink Mounts' (p. 119)
  - 'Heat Sink Mount: Standard' (p. 119)
  - 'Heat Sink Mount: Separate Driver (SD)' (p. 120)
  - 'Heat Sink Mount Adapter Plate' (p. 121)
  - 'Multi-Axis Mount' (p. 123)
- 'StingRay/BioRay Remote Kit' (p. 124)
  - 'Stingray/BioRay Remote' (p. 124)
  - 'Connections to Lasers' (p. 126)
  - '(Optional) Mounting Brackets for Remote' (p. 125)
- 'Connections to Lasers' (p. 126)
  - 'Flying Leads' (p. 126)
  - 'Hirose Connector' (p. 128)
  - 'Power Plug, Phono 3.5 mm' (p. 130)
- 'Bandpass Filters' (p. 132)

These parts and accessories are specially made and selected for easy integration and to get the best performance of the StingRay and BioRay lasers. See 'Summary of Part Numbers' (p. 133) for part numbers to order.

For instructions about how to set up the various configurations of parts and accessories, see 'Set Up Equipment' (p. 29).

## 8.1 Power Supply for Lasers with Flying Leads

The Coherent Laser Power Supply (P/N 1232091) for StingRay and BioRay lasers is shown in Figure 8-102.

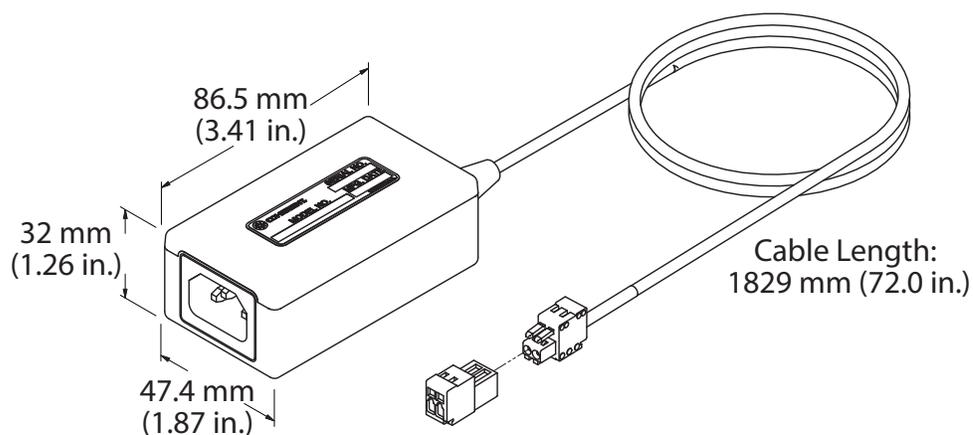


**Figure 8-102. Laser Power Supply**

The Terminal Block connector (socket and plug) and small accessory clamp tool are included with the Power Supply. For assembly instructions, see 'Set Up Equipment' (p. 29).

Note that a different power supply works with the StingRay/BioRay Remote (see p. 126). Only the North American power cord set (NEMA 5-15P to IEC-60230) is supplied. For other locations, customers must supply a power cord applicable for the outlet.

Figure 8-103 shows the dimensions for the Power Supply for StingRay lasers that are set up with a Flying Leads cable termination.



**Figure 8-103. Dimensions - Power Supply Set Up with Flying Leads Cable**

For instructions about how to wire the terminal block to the flying leads, see 'Connect a Laser with Flying Leads to a Power Supply' (p. 40).

## 8.2 Heat Sink Mounts

The options available to mount StingRay and BioRay lasers are shown in this section. These include:

- Heat Sink Mount (P/N 1222896) – Standard Configuration
- Heat Sink Mount (P/N 1264007) – Separate Driver
- Heat Sink Mount Adapter Plate (P/N 1222894)

### 8.2.1 Heat Sink Mount: Standard

This standard Heat Sink Mount is specially made to match the thermal management design in the family of StingRay and BioRay lasers. This clamp-type Heat Sink offers excellent thermal and pointing stability.

Figure 8-104 shows the standard Heat Sink Mount (P/N 1222896) for StingRay and BioRay lasers:

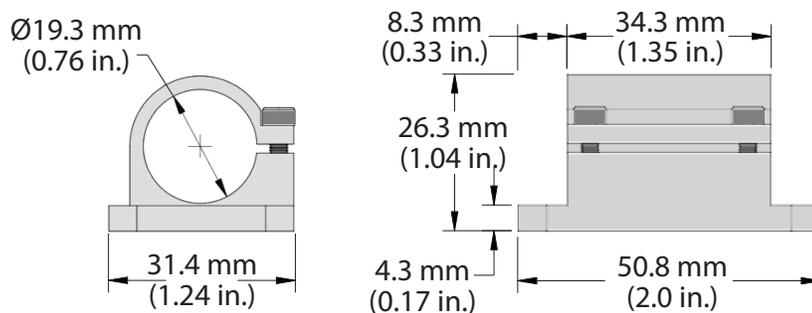


**Figure 8-104. Laser in a Standard Heat Sink Mount**

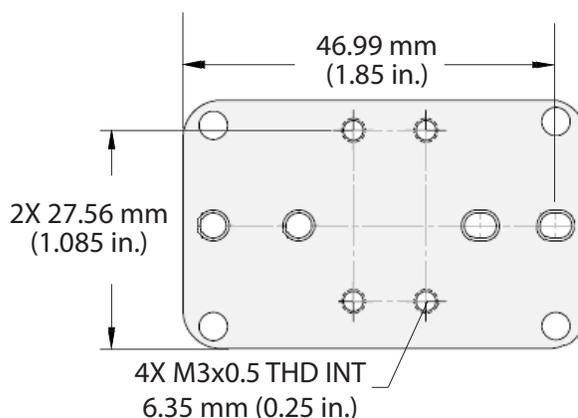
The mount includes 4 through-holes and 4 tapped holes, with a precision pin slot for easy and repeatable mounting. The recommended torque specification for the two M3 x 8 mm clamp screws is 70 in-oz.

Figure 8-105 shows the dimensions from the Side and Front views.

Figure 8-106 shows the dimensions of the standard Mount from the bottom.



**Figure 8-105. Dimensions - Standard Heat Sink Mount - Front and Side Views**



**Figure 8-106. Dimensions - Standard Heat Sink Mount - Bottom View**

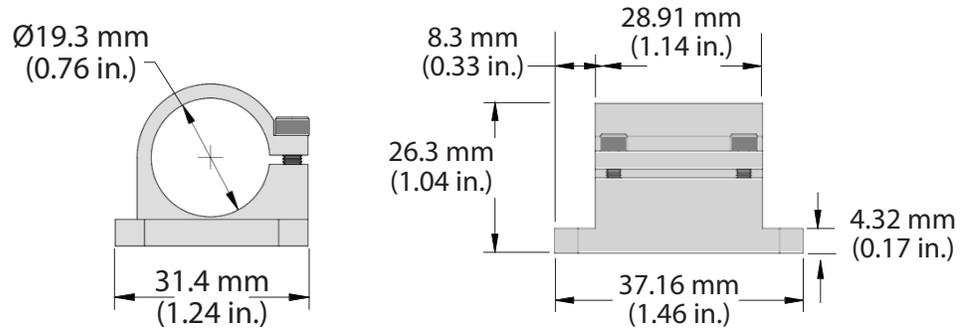
## 8.2.2 Heat Sink Mount: Separate Driver (SD)

A compact Heat Sink Mount (P/N 1264007) shown in Figure 8-107 is available. This mount is used when ordering a StingRay “Separate Driver (SD)” laser configuration.



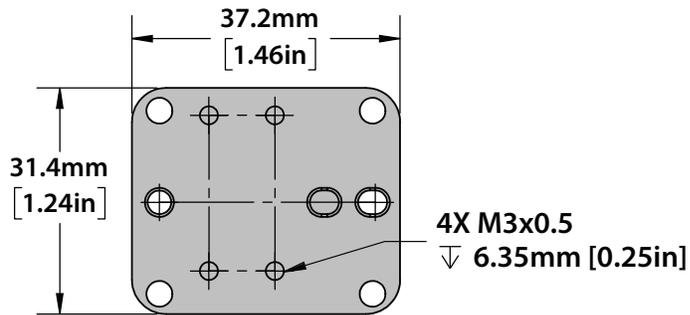
**Figure 8-107. SD or Compact Holding Heat Sink Mount**

Figure 8-108 shows the dimensions for the Separate Driver Heat Sink Mount from the side and front:



**Figure 8-108. Dimensions – SD or Compact Holding Heat Sink Mount – Side and Front**

Figure 8-109 shows the dimensions from the bottom for the SD Heat Sink Mount:



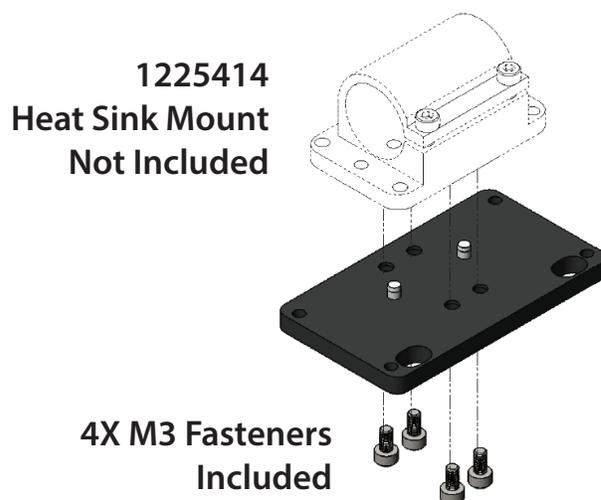
**Figure 8-109. Dimensions – SD or Compact Holding Heat Sink Mount – Bottom**

### 8.2.3 Heat Sink Mount Adapter Plate

This Adapter Plate for a Heat Sink Mount supplies quick and easy integration of the laser into applications.

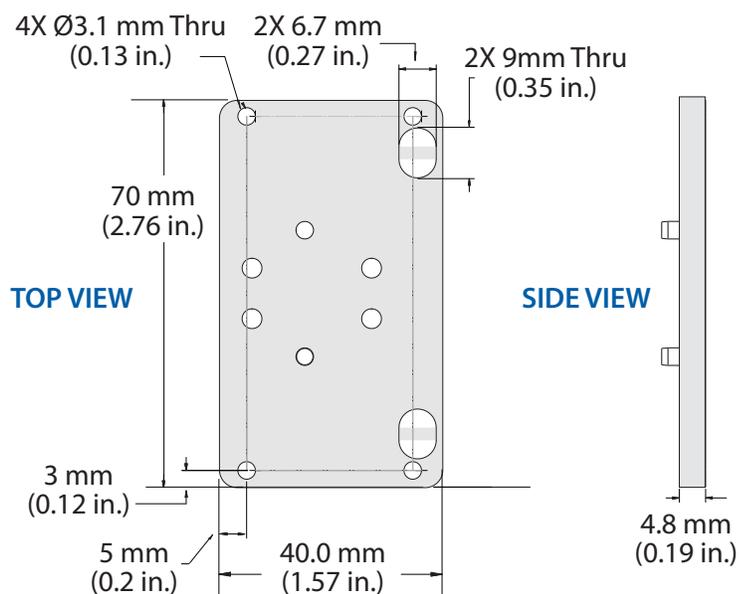
The Adapter Plate (P/N 1222894) for StingRay and BioRay lasers is shown in Figure 8-110. The Adapter Plate hole pattern allows the user to adapt the StingRay laser to the same mounting hole pattern as an OBIS LX/LS laser.

This Adapter Plate works with the StingRay/BioRay Heat Sink Mount (P/N 1222896) as well as the StingRay/BioRay Compact Mount (P/N 1264007). The location of the mounting screws through the bottom of the Adapter Plate may vary for each mount.



**Figure 8-110. Adapter Plate for Heat Sink Mount**

The dimensions for the Heat Sink Mount Adapter Plate are shown in Figure 8-111.



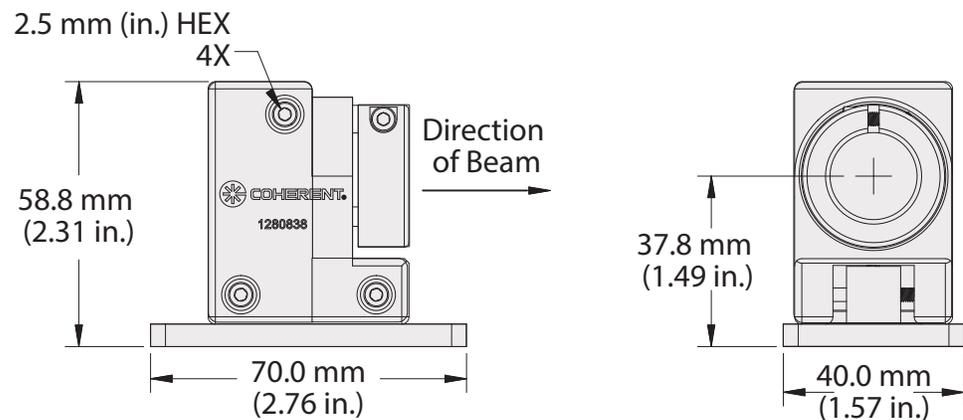
**Figure 8-111. Dimensions – Adapter Plate for Heat Sink Mount**

## 8.2.4 Multi-Axis Mount

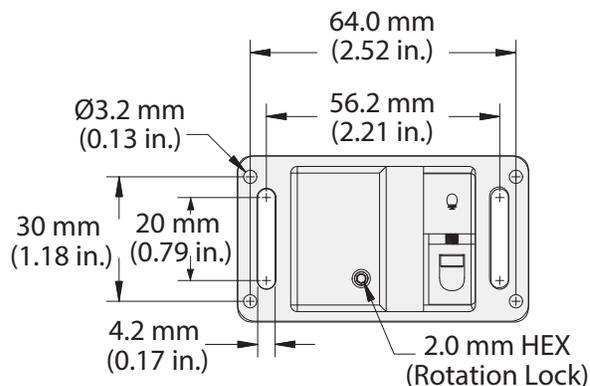
The Multi-Axis Mount (P/N 1280838) supplies the capability to precisely move or align the laser as it is installed into an instrument or application. This movement consists of:

- 360-degree rotation about the laser's mechanical axis
- X-axis translation, up to 6 mm
- Tilt about the X-axis up to 7 degrees

The Multi-Axis mount includes multiple mounting options that conform to a footprint for either a StingRay/BioRay standard or Separate Drive. This mount also allows for more general mounting with two machined slots for quick installation to the X-axis. Refer to dimensions in the figures below.



**Figure 8-112. Dimensions - Multi-Axis Mount - Side and Front Views**



**Figure 8-113. Dimensions – Multi-Axis Mount – Top View**

## 8.3 StingRay/BioRay Remote Kit

The StingRay/BioRay Remote Kit (P/N 1231404), shown in Figure 8-114, combines the following items into a single part number for one-step ordering:

- StingRay/BioRay Remote (P/N 1225414)
- StingRay/BioRay Remote Power Supply (P/N 1105427)
- USB Cable (P/N 1108906), 1.8 M Type A to Mini B

See 'Install a Laser with a Remote' (p. 45) for set-up instructions.

### 8.3.1 Stingray/BioRay Remote

The StingRay/BioRay Remote (P/N 1225414), shown in Figure 8-114, is a compact, multi-functional control box that lets users connect to a StingRay or BioRay laser terminated with a Hirose connector.

For more information, refer to 'StingRay/BioRay Remote' (p. 11).



**Figure 8-114. StingRay/BioRay Remote**

### 8.3.2 (Optional) Mounting Brackets for Remote

This section shows optional mounting flanges for the StingRay/BioRay Remote.

Available lengths for the brackets include either an 80 mm (3.15”) or 40 mm (1.57”) pair. Brackets are also available in various colors.

The dovetail mounting flanges slide into either the upper or lower slot on each side of the Remote, as shown in the example in Figure 8-115:



**Figure 8-115. Optional Mounting Brackets Added to Remote**

To install these third-party brackets, you must first remove either the front or the rear panel of the Remote so that you can slide the brackets into the slot.

Note that these parts are not available from Coherent but must be purchased directly from the third-party vendor (Box Enclosures & Assembly Services). See this link for more details:

<https://www.boxenclosures.com>

For questions or additional information, see 'Contact Product Support' (p. 152).

## 8.4 Connections to Lasers

StingRay and BioRay lasers can be set up with a cable that terminates in a variety of ways. Options include:

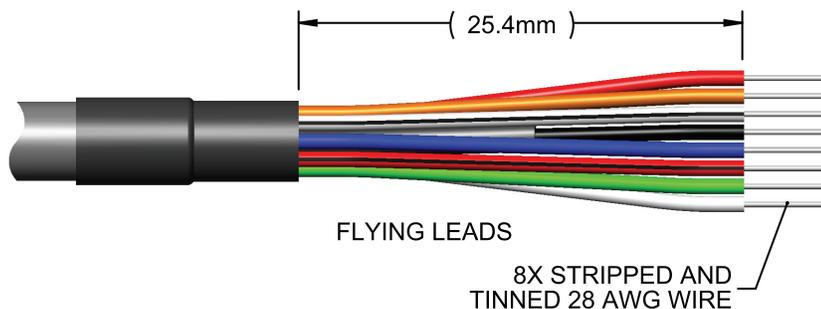
- Flying Leads
- Hirose Connector
- Power Plug, Phono 3.5 mm
- Power Plug, Phono 3.5 mm and BNC for Modulation

See 'Cable Termination and Connector Options' (p. 147) for a list of options for cable length that you can specify for each type of connector. Other options may be available. Contact your Coherent Sales Representative or Product Support for assistance.

### 8.4.1 Flying Leads

The flying leads cable configuration (P/N 1255499) supplies a convenient break-out of the I/O signals used by the family of StingRay and BioRay lasers.

Figure 8-116 shows the dimensions of a Flying Lead cable configuration.



**Figure 8-116. Dimensions – Flying Lead Connector**

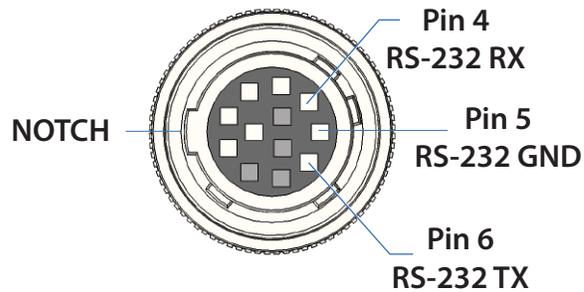
The Flying Leads quickly accesses signals from a StingRay laser. See 'Connect a Laser with Flying Leads to a Power Supply' (p. 40) for instructions to connect this cable.



**NOTICE**

Protect the unused leads from coming into contact with each other, ground, or a voltage source. Failure to isolate bare wire ends can short out signals.

Figure 8-117 shows the pins on the laser connector when it is enabled for RS-232 communications.



**Figure 8-117. Hirose Connector – RS-232 Pins**

Table 8-21 gives the RS-232 signal assignments and wire colors.

**Table 8-21. RS-232 Pin Assignments**

PIN	Assign-ment	Wire color	Description
4	RS-232 RX	White	RS-232 Receive from computer (Serial connector, Pin 3)
5	RS-232 GND	White/Black	RS-232 Ground (Serial connection, Pin 5)
6	RS-232 TX	Orange	RS-232 Transmit to Computer (Serial Connector, Pin 2)

Table 8-22 gives the communication settings for RS-232:

**Table 8-22. (Virtual COM Port) Communication Settings**

Setting	Description
Baud	115200
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	None

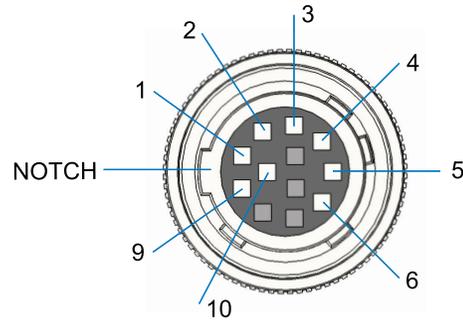
### 8.4.2 Hirose Connector

Figure 8-118 shows the dimensions for cable assembly with a 12-Pin Hirose Connector (P/N 1224516) that has a female connector HR10A-10P-12SC(73). The only cable length for the Hirose Connector cable assembly that can be specified with a StingRay/BioRay laser is a 1000 mm.



**Figure 8-118. Dimensions - Hirose Connector**

Figure 8-119 illustrates the pin layout for the 12-pin Hirose Adapter Connector to the laser.



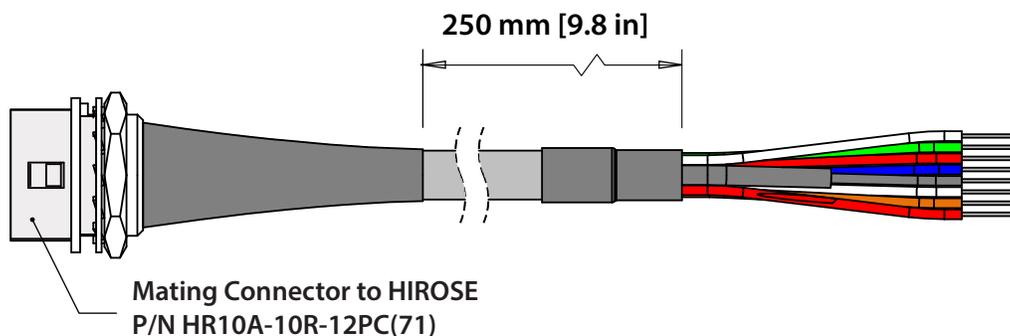
**Figure 8-119. Pin Diagram - Hirose Connector**

Table 8-23 gives the pin-outs for the 12-pin Hirose receptacle on the Remote (the 'To Laser' plug). Shaded areas in the Table represent signals available only when the RS-232 communications option is enabled.

**Table 8-23. Pin-Out Wiring List - Hirose Connector**

Pin	Signal	Wire Color
1	$V_{IN}$ GND	Black
2	$V_{MOD}$	Blue
3	$V_{MOD}$ GND	Red/Black
4	RS-232 RX	White
5	RS-232 GND	White/Black
6	RS-232 TX	Orange
9	$V_{IN}$	Red
10	Fault (Open Output Signal)	Green

When a StingRay laser uses a Hirose Connector, a mating cable assembly supplies access to connect to the laser. The Hirose-to-Flying Leads Cable Assembly (P/N 1229640) includes a male connector—Hirose HR10A-10R-12PC(71)—and flying leads, as shown in Figure 8-120. This Hirose-to-Flying Leads Cable Assembly is available only in a 250 mm length.

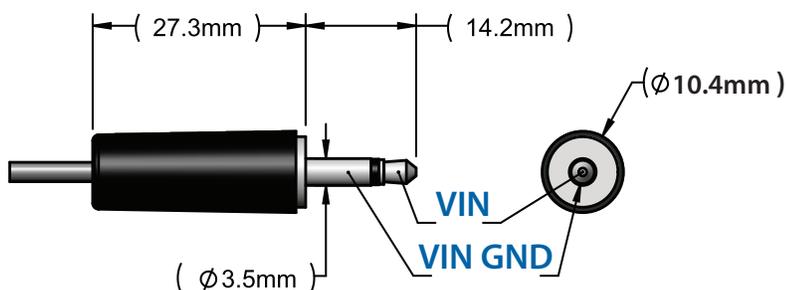


**Figure 8-120. Hirose-to-Flying Leads Cable Assembly**

### 8.4.3 Power Plug, Phono 3.5 mm

The Phono-style Power Plug connector is used only for Continuous Wave (CW) mode. The only cable length that can be specified is 500 mm. Note that this is a legacy connector and is typically not used for StingRay configurations unless replacing a SNF laser module.

Figure 8-121 gives the dimensions for a Phono 3.5 mm Power Plug.



**Figure 8-121. Dimensions – Phono Power Plug Connector**

Table 8-24 gives the only pin-outs available for this connector. There are no connections for any other signals.

**Table 8-24. Pin-Outs - Phono 3.5 mm Power Plug Connector**

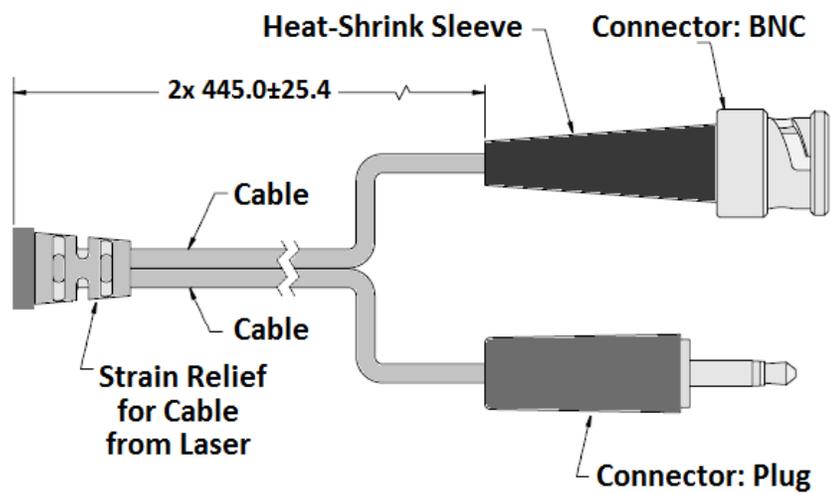
Plug	Signal
Tip	$V_{IN}$
Base	$V_{IN}$ GND, Shield

### 8.4.4 Power Plug, Phono 3.5 mm and BNC for Modulation

The Phono-style Power Plug and BNC connector is used when Modulation is specified for a laser.

The Phone Power Plug and BNC for modulation is a legacy connector configuration used with the discontinued SNF Laser product line. These connectors should be used only when replacing a legacy SNF laser module and mating power to the Power Plug is required.

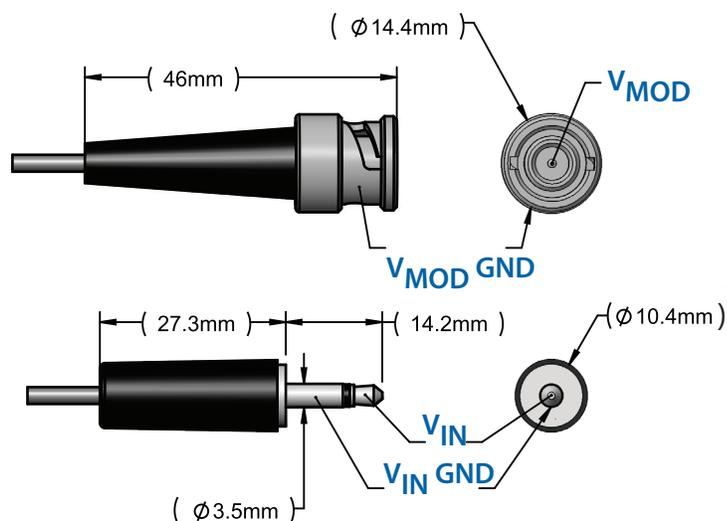
Figure 8-122 shows the cable layout of the Phono-style Power Plug with a BNC connector.



**Figure 8-122. Phono Power Plug with BNC Connector – Cable Layout**

Figure 8-123 gives the dimensions for each connector (the Phono 3.5 mm Power Plug and the BNC connector).

Table 8-25 gives the only pin-outs available for the 3.5 mm Phono Power Plug and BNC Connector. There are no connections for any other signals.



**Figure 8-123. Dimensions – Phono Power Plug with BNC Connector**

**Table 8-25. Pin-Outs – Phono 3.5 mm Power Plug with BNC Connector**

Pin	Plug	Signal
1	Phono Plug Tip	$V_{IN}$
8	Phono Plug Base	$V_{IN}$ GND, Shield
2	BNC Tip	$V_{MOD}$
5	BNC Base	$V_{MOD}$ GND

## 8.5 Bandpass Filters

Filters are used to improve contrast by allowing wavelengths within a certain range to be transmitted while blocking those outside of the band. This helps prevent the distortion of measurement signals.

Table 8-26 gives the bandpass filters that are available from Coherent for StingRay and BioRay lasers:

**Table 8-26. Coherent Bandpass Filters**

Image	Filter Name	P/N
	Bandpass Filter, 485 nm to 491 nm	1266767
	Bandpass Filter, 630 nm to 642 nm	1266768

## 8.6 Summary of Part Numbers

Table 8-27 summarizes the parts and accessories you can order for StingRay and BioRay lasers.

**Table 8-27. Parts and Accessories**

P/N	Description
1105427	Power Supply for the StingRay/BioRay Remote
1108906	USB Cable, Type A to Type Mini B, with Ferrite Core, 1.8 M
1222894	StingRay/BioRay Mount Adapter Plate
1222896	StingRay/BioRay Heat Sink Mount
1264007	StingRay/BioRay Separate Driver Heat Sink Mount
1280838	Multi-Axis Mount
1225414	StingRay/BioRay Remote
1229640	Cable Assembly, Accessory, 12-pin Hirose Connector
1231404	StingRay/BioRay Remote Kit (includes Power Supply for the Remote, USB Cable, USB drive for Coherent Connection software)
1232091	Power Supply for StingRay and BioRay lasers; for use only with flying leads
1263022	StingRay Developers Kit
1266767	Bandpass Filter, 485 nm to 491 nm
1266768	Bandpass Filter, 630 nm to 642 nm

**Table 8-27. Parts and Accessories (continued)**

<b>P/N</b>	<b>Description</b>
1278782	Multi-Mode Fiber Patch Cord, 50 $\mu\text{m}$ / 0.22NA, SMA/SMA, 1 m Length
1278783	Multi-Mode Fiber Patch Cord, 105 $\mu\text{m}$ / 0.22NA, SMA/SMA, 1 m Length

# 9 Troubleshooting

This section shows how to identify and resolve frequent issues you can occur when work is done with StingRay and BioRay lasers.

These symptoms are included in the checklists that follow:

- ‘There is no output power from the laser.’ (p. 136)
- ‘Laser output power is lower than expected.’ (p. 137)
- ‘Laser emissions stop after an initial period of time.’ (p. 138)
- ‘The software does not recognize the StingRay or BioRay laser.’ (p. 138)



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**NOTICE**

**StingRay and BioRay lasers are self-contained units. There are no necessary service and maintenance procedures, and no user-serviceable components in the laser. DO NOT try to open the laser housing. If the laser enclosure is disassembled, the Warranty is void!**

---

If the problem does not have a solution aid is needed, contact Coherent Technical Support; see ‘Service and Support’ (p. 149).

## 9.1 Symptom: No Output Power from the Laser

If there is no output power from the laser, perform the steps in Table 9-28 in the order shown:

**Table 9-28. No Output Power from the Laser**

To Do	Steps
[ ]	Cycle power to the laser OFF, then back ON.
[ ]	Examine the electrical connection of the $V_{IN}$ (Pin 9) red wire and $V_{IN}$ Ground (Pin 1) black wire. Make sure that there is a good connection.
[ ]	If laser is connected to a Remote, make sure that all are set as follows: <ul style="list-style-type: none"> <li>• The Hirose Connector is tightly attached.</li> <li>• The interlock jumper is tightly put in.</li> <li>• The keyswitch is in the ON position.</li> </ul>
[ ]	Examine the Operating Mode of the laser by use of Coherent Connection software or the Remote Query <b>SOUR:AM:SOUR?</b> to make sure the configuration and necessary connections are for correct operation. Communications (TX) must be set up before you can query the laser. If communications are not enabled, refer to the product label or the Final Quality Control Report to identify the Operating Mode of the laser.
[ ]	<ul style="list-style-type: none"> <li>• Analog Modulation: A connection to <math>V_{MOD}</math> (Pin 2) blue wire and <math>V_{MOD}</math> Ground (Pin 3) red/black wire is necessary. No connection to the modulation signals results in no or low Output Power.</li> </ul>
[ ]	<ul style="list-style-type: none"> <li>• Digital Modulation: A connection to the <math>V_{MOD}</math> (Pin 2) blue wire and the <math>V_{MOD}</math> Ground (Pin 3) red/black wire is necessary. No connection to the modulation signals and no correct input voltage given results in no Output Power.</li> </ul>
[ ]	<ul style="list-style-type: none"> <li>• Continuous (CW): A connection to the <math>V_{IN}</math> (Pin 9) red wire and the <math>V_{IN}</math> Ground (Pin 1) black wire is necessary.</li> </ul>
[ ]	If the laser is set up as CW or Digital Modulation, Examine the set power level of the laser. Use one or the other of Coherent Connection or the Remote Query <b>SOUR:POW:LEV:IMM:AMPL?</b> to make sure the set Output Power level is between nominal and 10% of nominal.
[ ]	Examine the LED on the rear panel of the laser. If the LED is red, there is a fault. Cycle the laser power by disconnecting and reconnecting the $V_{IN}$ (Pin 9) red wire, or by toggling the remote keyswitch. If the Fault signal stays after a power cycle, contact Coherent Product Support.
If any additional technical support is necessary, contact Coherent Product Support; see p. 149 for contact information.	

## 9.2

### Symptom: Low Output Power from the Laser

If output power from the laser is lower than expected, perform the steps listed in Table 9-29 in the order listed:

**Table 9-29. No Output Power from the Laser**

To Do	Steps
[ ]	Cycle power to the laser OFF, then back ON.
[ ]	Examine the electrical connection of the VIN (Pin 9, red wire) and VIN Ground (Pin 1, black wire) to make sure that a good connection.
[ ]	If laser is connected to a Remote, make sure that all are set as follows: <ul style="list-style-type: none"> <li>• The Hirose Connector is firmly attached.</li> <li>• The interlock jumper is firmly attached.</li> <li>• The keyswitch is in the ON position.</li> </ul>
[ ]	Check the operating mode of the laser by using Coherent Connection software or the Remote Query <b>SOUR:AM:SOUR?</b> to confirm configuration and required connections for correct operation. Communications (TX) must be set up to Query the laser. If communications are not enabled, refer to the product label or the Final Quality Control Report to identify the Operating Mode configuration of the laser.
[ ]	<ul style="list-style-type: none"> <li>• Analog Modulation: A connection to the <math>V_{MOD}</math> (Pin 2) blue wire and the <math>V_{MOD\ Ground}</math> (Pin 3) red/black wire is necessary. No connection to the modulation signals results in no or low Output Power.</li> </ul>
[ ]	<ul style="list-style-type: none"> <li>• Digital Modulation: A connection to the <math>V_{MOD}</math> (Pin 2) blue wire and the <math>V_{MOD\ Ground}</math> (Pin 3) red/black wire is necessary. No connection to the modulation signals and no valid input voltage provided results in no Output Power.</li> </ul>
[ ]	<ul style="list-style-type: none"> <li>• Continuous (CW): A connection to the <math>V_{IN}</math> (Pin 9) red wire and the <math>V_{IN\ Ground}</math> (Pin 1) black wire is necessary.</li> </ul>
[ ]	If the laser is set up as CW or Digital Modulation, examine the set power level of the laser with one or the other of Coherent Connection or the Remote Query <b>SOUR:POW:LEV:IMM:AMPL?</b> to make sure that the set Output Power level is between nominal and 10% of nominal.
[ ]	Make sure that the output power level of the laser with an external power meter that is calibrated and is applicable for the output power level of the laser. Coherent recommends the use of a PowerMax USB, UV/VIS Quantum power sensor, PS19Q, or almost the same.
For more technical support, contact Coherent Product Support; see 'Service and Support' (p. 149) for contact information.	

## 9.3 Symptom: Laser Emission Stops

If the laser emission stops after an initial period of time, do these steps in Table 9-30 in the order shown:

**Table 9-30. No Output Power from the Laser**

To Do	Steps
[ ]	Cycle power to the laser OFF, then back ON.
[ ]	Examine the electrical connection of the $V_{IN}$ (Pin 9) red wire and the $V_{IN}$ Ground (Pin 1) black wire to make sure a good connection.
[ ]	If laser is connected to a Remote, make sure that all are set as follows: <ul style="list-style-type: none"> <li>• The Hirose Connector is tightly attached.</li> <li>• The interlock jumper is tightly put in.</li> <li>• The keyswitch is in the ON position.</li> </ul>
[ ]	Examine that the laser is correctly installed in an adequate Heat Sink Mount that uses a radial clamp mount or almost the same. It should use the full clamp area of the laser to prevent overheat of the laser and a fault.
[ ]	Examine the internal temperature of the laser using Coherent Connection software or the Remote Query <code>SOUR:TEMP:INT?</code> to Examine internal temperature of laser. Communications (TX) must be set up to Query the laser. If communications are not enabled, refer to the product label or the Final Quality Control Report to identify the Operating Mode configuration of the laser.
[ ]	Examine the LED on the rear panel of the laser. If the LED is red, there is a fault. Cycle the laser power by disconnect and reconnecting $V_{IN}$ (Pin 9, red wire), or by toggle of the keyswitch on the Remote. If the Fault signal stays after a power cycle, contact Coherent Product Support.
For more technical support, contact Coherent Product Support; see 'Service and Support' (p. 149) for contact information.	

## 9.4 Symptom: Software Does Not Recognize Laser

If the Coherent Connection v5.0.x software does not recognize the StingRay or BioRay laser, perform the steps listed in Table 9-31 to resolve.

**Table 9-31. Software Does Not Recognize Laser**

<b>To Do</b>	<b>Steps</b>
[ ]	Go between STANDBY and OFF with the keyswitch position, and back to the ON position.
[ ]	Wait 1-2 seconds in each keyswitch position before the keys witch is moved to the next position.
For more technical support, contact Coherent Product Support; see 'Service and Support' (p. 149) for contact information.	



# Appendix I: Safety and Compliance

This section shows general requirements for safety for persons setting up or operating StingRay and BioRay laser, and includes information about:

- 'Laser Safety Hazards' (p. 121)
- 'Laser Safety Classification' (p. 126)
- 'Electrical Safety' (p. 131)

You must review these laser safety sections thoroughly BEFORE operating StingRay and BioRay laser, and carefully follow all safety instructions presented throughout this manual.

---

## **NOTICE**

**This user information is in compliance with the following standards for Light-Emitting Products IEC 60825-1 / EN 60825-1 “Safety of laser products - Part 1: Equipment classification and requirements” and CDRH 21 CFR Title 21 Chapter 1, Subchapter J, Part 1040 “Performance standards for light-emitting products”.**

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In addition, this section supplies information about compliance with standards and regulations, including:

- Compliance with standards and regulations (p. 132)
- Environmental compliance (p. 134)

The safety precautions included in this section are to be read and observed by anyone working with or near the laser. At all times, make sure that all personnel who operate, maintain or service the laser are protected from accidental or unnecessary exposure to laser radiation exceeding the accessible emission limits defined in the laser safety standards.

## I.1 Laser Safety Hazards

Hazards associated with lasers generally fall into the following categories:

- Biological hazards from exposure to laser radiation that may damage the eyes or skin

- Electrical hazards generated in the laser power supply or associated circuits
- Chemical hazards resulting from contact of the laser beam with volatile or flammable substances, or released as a result of laser material processing

The above list is not intended to be exhaustive. Anyone operating a laser must consider the interaction with its specific working environment to identify potential hazards. Hazards vary with the input angle and the laser beam.



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**WARNING!**

**Use of controls or adjustments or performance of procedures other than those specified in this manual may result in exposure to hazardous radiation. Always prevent eye or skin exposure to both DIRECT and SCATTERED radiation.**

---

### I.1.1

#### Laser Optical Safety

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

The safety precautions listed below are to be read and observed by anyone working with or near the laser. At all times, make sure that all personnel who operate, maintain or service the laser are protected from accidental or unnecessary exposure to laser radiation exceeding the accessible emission limits defined in the laser safety standards.



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**WARNING!**

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

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

Laser beams are powerful enough to burn skin, clothing, or combustible materials, even at some distance. They can ignite volatile substances such as alcohol, gasoline, ether, and other solvents, and can damage light-sensitive elements in video cameras, photomultipliers, and photodiodes. Follow the control measures listed in 'Precautions for Laser Safety' (p. 125).

### I.1.1.1

#### Laser Safety Eyewear

Always wear applicable laser safety eyewear for protection against the specific wavelengths and laser energy being generated.



---

**CAUTION!**

**Laser safety eyewear protects the user from accidental exposure to laser radiation by blocking light at the laser wavelengths. However, laser safety eyewear may also prevent the operator from seeing the beam or the beam spot. Exercise extreme caution even while wearing safety glasses.**

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The applicable eye protection can be calculated as defined in the 'EN 207 Personal eye protection equipment—Filters and eye-protectors against laser radiation (laser eye-protectors)', in other national or international standards (such as ANSI, ACGIH, or OSHA) or as defined in national safety requirements.

### I.1.2

#### Laser Back Reflection

Back reflection (also referred to as retroreflection) occurs when a part of the laser beam is sent back into the laser's exit aperture.

Back reflection can be caused by any object in front of the laser and can result in instability, noise, or damage to the laser. Damage from back reflection can be immediate, or it can be subtle and slowly decrease the service life of a laser.

A laser that shows symptoms—such as low output power, no output power, over-current, or high noise—indicates a possibility of back reflection to the laser.

Ideally 100% of the output power from the laser is used in the application and none of the light is scattered or sent back into the laser exit aperture. The amount of back reflection that can damage a laser diode changes from device to device. Sometimes a back reflection that is as low as 4% of the total beam power is sufficient to cause damage.

Indications that back reflections are causing permanent damage to the laser diode include:

- No output power
- Low output power
- Over-current of the laser diode

Back reflection can also cause the output power noise (RMS noise and Peak-to-Peak noise) to increase if the reflection interferes with the laser cavity or light-loop.

If you cannot adjust your application to decrease the back reflection of the laser light into the laser's exit aperture, add an optical isolator to protect the laser. Although the optical isolator adds cost and requires additional space, it can be an applicable safety factor to reduce noise and increase the life of the laser.

Be aware of every optical surface in front of the laser. All objects have the opportunity to create a back reflection. For example, the front surface and the back surface of the optic are a source of back reflection. If an object is positioned in front of the laser as a beam block, make sure that the object is not reflective and does not create a back reflection to the laser.

With any optic or object, the angle of incident can impact the optics performance or function. Review the specifications for each optical element to understand how much angle is acceptable.

- The closer the object is to the laser, the more angle is needed to direct the back reflection away from the laser exit aperture.
- The farther the object is away from the laser, the less angle is needed to direct the back reflection away from the laser exit aperture.



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**NOTICE**

**The Coherent product Warranty does not cover damages to the laser caused by customer usage. Take precautions with initial set-up to prevent damage to the laser. Prevent any condition where any part of the laser beam reflects back into the laser exit aperture.**

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### **I.1.3 Laser Ignition**

Laser beams are powerful enough to burn skin, clothing, or combustible materials, even at some distance. They can ignite volatile substances such as alcohol, gasoline, ether, and other solvents, and can damage light-sensitive elements in video cameras, photo-multipliers, and photo-diodes.

Follow the control measures listed in 'Precautions for Laser Safety' (p. 125).

### **I.1.4 Precautions for Laser Safety**

The following recommended precautions and guidelines to prevent damage to persons or property should always be observed. Laser beams can easily cause flesh burns or ignite clothing. These precautions also help to increase the operating life of the laser.

- Read and follow all safety precautions in the associated product manuals (whether Installation, Set-Up, Quick Start, Operator's or User Manuals).
- Set up the laser so that the beam height is either well below or well above eye level.
- Never look directly into the laser light source or at scattered laser light from any reflective surface, even when wearing laser safety eyewear. Never sight down the beam.
- Always wear applicable eyewear for protection against the specific wavelengths and laser energy being generated. See 'Laser Safety Eyewear' (p. 123) for more information.
- Watch where the reflections from objects are returning to make sure the reflections are not at or near the laser exit aperture. Change the objects to add an angle so the object is less reflective whenever possible. Add an optical isolator to those applications with laser exit aperture back reflections that cannot be corrected by angling the optics.
- Review any objects in front of the laser and make a note of which surfaces are a possible hazard for back reflections. Keep precautions in mind when moving objects that can create a back reflection in front of the laser.
- Do not wear watches, jewelry, or other objects that may reflect or scatter the laser beam.

- Block the beam before applying tools such as hex wrenches or ball drivers to external optics.
- Provide enclosures for beam paths whenever possible.
- Stay aware of the laser beam path, particularly when external optics are used to steer the beam.
- Use applicable energy-absorbing targets for beam blocking.
- Terminate the laser beam with a light-absorbing material. Laser light can remain collimated over long distances and therefore presents a potential hazard if not confined. It is good practice to operate the laser in an enclosed room.
- Decrease the power from any possible back reflections by starting the laser at lower output power—for example, 10% output power—before opening the laser shutter.
- Exercise extreme caution when using solvents in an area with any laser.
- Post laser warning signs in the area of the laser beam to alert those present.
- Limit access to the laser to trained and qualified users who are familiar with laser safety practices. When not in use, lasers should be shut down completely and made off-limits to unauthorized personnel.
- Advise all those working with or near the laser of these precautions.

## **I.2 Laser Safety Classification**

Governmental standards and requirements specify that the laser must be classified according to the output power or energy and the laser wavelength.

Based on those factors, the classification varies for different StingRay and BioRay laser.



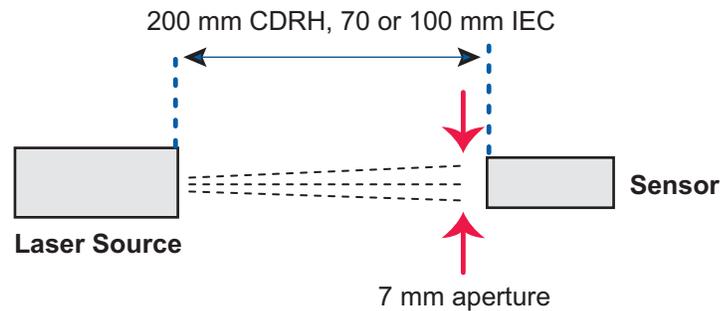
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### **NOTICE**

**A Final Quality Control Report is included with the laser you ordered that includes data about the Laser Class, Wavelength, Laser Power, Diode Current, and more. This information is specified for each device and should be your point of reference for all laser safety measures.**

---

Figure I-1 shows an example of the measurement distances from the laser's output aperture to the sensor.



**Figure I-1. Measurement Distance Set-Up for Laser Classification**

Table I-1 gives the possible Laser Safety Classifications for these lasers.

- For CDRH, the measurement is between the laser aperture and the sensor.
- For IEC, the measurement is between the apparent focal point and the sensor.

Maximum Power is the distance away from the laser source. For IEC regulations, wavelengths outside of those stated have different maximum power values. Distance reflects the distance for measuring power.

## I.2.1

### Maximum Accessible Radiation Level

NOTES:

- The 1 mW laser has a maximum set power of 0.95 mW.
- The 5 mW laser has a maximum set power of 4.75 mW.

A Final Quality Control Report included with the shipment of the laser you ordered. This report includes data about the following specifications unique to each laser.

- Laser Safety Class (both CDRH and IEC)
- Wavelength
- Laser power (as measured without a L01 or CH optical head)
- Diode current

**Table I-1. CDRH and IEC Classifications**

ORG	Class	Wavelength	Maximum Power	Distance
CDRH	II	400 to 710 nm	1 mW	200 mm
	IIIa	400 to 710 nm	5 mW	200 mm
	IIIb	400 to 710 nm	500 mW	200 mm
		or > 710 nm	500 mW	200 mm
IEC	2	400 to 700 nm	1 mW	70 mm
	3R	400 to 700 nm	5 mW	70 mm
	3B	400 to 700 nm	500 mW	70 mm

- Fan angle (for units with line generation optics)
- Focus Distance

You can use this information to determine the applicable Maximum Accessible Radiation Levels, as specified in IEC 60825-1.

## I.2.2

### Viewing Distance

A StingRay and BioRay laser produces optical power levels that are dangerous to the eyes and skin if exposed directly or indirectly.




---

#### **WARNING!**

**Operate this product with correct eye and skin protection at all times. Never view directly emitted or scattered radiation with unprotected eyes.**

---

When viewing the laser during operation, the operator must maintain the Nominal Ocular Hazard Distance (NOHD) between the laser or scatter radiation and the operator's eyes. The NOHD is based on the Maximum Permissible Exposure (MPE = 0.1 W/cm<sup>2</sup>) level for each power condition as specified in ANSI Z136.1 and IEC 60825-1.

The Final Quality Control Report included with the shipment of your laser specifies the following information unique to your laser. You can use this information to determine the applicable Maximum Accessible Radiation Levels.

- Class (both CDRH and IEC)
- Wavelength

- Laser power
- Diode current
- Fan angle (for units with line generation optics)
- Focus distance

You can use this information to determine the applicable Nominal Ocular Hazard zones, as specified in IEC 60825-1.

### I.2.3 Safety Interlocks

A safety interlock is not available on a standalone laser. There is no internal shutter in a StingRay and BioRay laser.

A safety interlock is part of the StingRay/BioRay Remote; see 'Interlock Jumper' (p. 14) for details.

The interlock should be defeated only for the purpose of maintenance and service by trained personnel aware of the hazards involved. Extreme caution must always be observed when operating the laser.

### I.2.4 Laser Safety Classification Labels

Safety labels on the product include warning labels indicating removable or displaceable protective housings, apertures through which laser radiation is emitted, and labels of certification and identification [21 CFR § 1040.10(g), 21 CFR § 1010.2, and 21 CFR § 1010.3/EN 60825-1/IEC 60825-1, Clause 7].

This section supplies examples of the safety labels under both the CDRH and IEC classifications.



---

#### **NOTICE**

**The applicable label for the power and wavelength class for each StingRay or BioRay laser is attached to the specific product you ordered.**

---

Figure I-2 shows the location of laser safety classification labels on a StingRay laser. Due to its compact size, the label is wrapped around the barrel of the laser.



Figure I-2. Example of Safety Labels Wrapped on Laser



**NOTICE**

Do not remove the label from the laser. Removing the label voids the warranty.

**I.2.4.1**

**IEC Labels**

StingRay and BioRay laser comply with IEC classification and fall in different safety classes, depending on output power and wavelength. Safety labels for StingRay and BioRay laser reflect IEC classifications, as shown in the examples in Figure I-3:

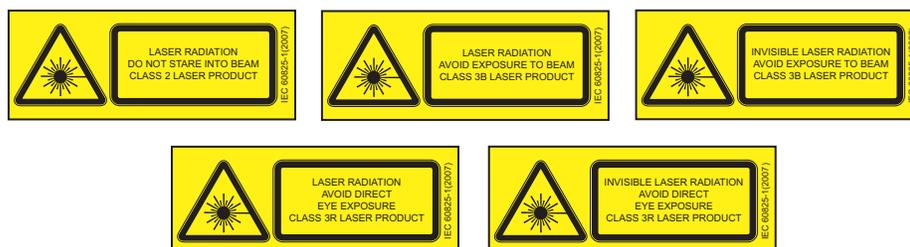


Figure I-3. Example of IEC Warning Labels

**I.2.4.2**

**CDRH Labels**

StingRay and BioRay laser comply with CDRH classification and fall in different safety classes based on output power and wavelength, as shown earlier. Safety labels for StingRay and BioRay laser reflect CDRH classifications, as shown in the examples in Figure I-4:

For information about labels for compliance with the China RoHS (Restriction of Hazardous Substances) Regulation, see 'The European Union RoHS Directive EN 50581:2012 restricts the use of certain hazardous substances in electrical and electronic equipment. Coherent is

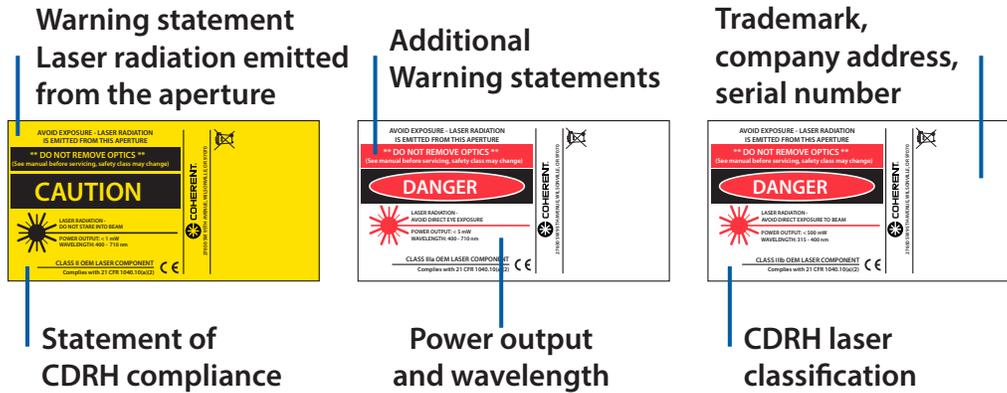


Figure I-4. Examples of CDRH Safety Labels

in compliance with this Directive and can provide RoHS certification upon request. Compliance of this laser with the EMC requirements is certified by the CE mark.’ (p. 134).

## I.3 Electrical Safety

### I.3.1 Electrostatic Discharge

The most common Electrostatic Discharge (ESD) damage occurs when handling a device during installation or use. Electrostatic charges easily collect on the human body, equipment, and facilities, and can discharge without detection. Dry air and carpet also create a higher potential for ESD.



#### **CAUTION!**

**Damage can occur to the electronics features of StingRay and BioRay laser from Electrostatic Discharge (ESD). Take precautions to prevent performance degradation or damage to the system.**

When mobile equipment (a cart or table) is used as an ESD-protected computer, connect it to ESD ground that meets ANSI/ESD S4.2 required limits for an ESD-protected computer ( $<1 \times 10^9$  ohms).

### I.3.2 Dangerous Voltage

StingRay and BioRay lasers do not have dangerous voltages.



---

**NOTICE**

**Do not disassemble the enclosure.  
There are no user-serviceable components in it.**

---

All units must be operated as assembled. The Warranty is canceled if the enclosure is disassembled.

## **I.4 Safety and Environmental Compliance**

This section shows compliance with various government requirements for safety, environmental regulations, and control law.

### **I.4.1 Laser Safety Standards**

Following are sources for information about laser safety standards, as well as safety equipment and training.

#### **I.4.1.1 Within the United States:**

The applicable United States Government laser safety requirements are contained in 21 CFR Title 21 Chapter 1, Subchapter J, Part 1040 (*“Performance standards for light-emitting products”*). The text of this federal standard is available from:

U.S. Food and Drug Administration  
Center for Devices and Radiological Health (CDRH)  
Document Mail Center – WO66-G609  
Sliver Spring, MD 20993-0002

Website: [www.fda.gov](http://www.fda.gov)

#### **I.4.1.2 Outside of the United States:**

For jurisdictions outside of the United States:

*Safety of laser products - Part 1: Equipment classification and requirements*

IEC 60825-1 / EN 60825-1

*Safety of laser products - Part 14: A user's guide*

IEC 60825-1 / EN 60825-1

*Safety Requirements For Electrical Equipment For Measurement, Control and Laboratory Use*  
IEC 61010-1 / EN 61010-1

### **I.4.1.3 Publications and Guidelines**

International Electrotechnical Commission (IEC)

[www.iec.ch](http://www.iec.ch)

Safety of laser products - Part 1: Equipment classification and requirements

BS EN 60825-1

British Standard Institute

[www.bsigroup.com](http://www.bsigroup.com)

*American National Standard for Safe Use of Lasers*

ANSI Z136 Series

American National Standards Institute (ANSI)

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

*A Guide for Control of Laser Hazards*

American Conference of Governmental and Industrial Hygienists (ACGIH)

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

*Laser Safety Guide*

Laser Institute of America

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

### **I.4.2 CE Marking**

The European Community requirements for product safety are specified in the Low-Voltage Directive (LVD) (published in 2014/35/EU).

This Directive requires that lasers comply with the standard EN 61010-1/ IEC 61010-1 “Safety Requirements For Electrical Equipment For Measurement, Control and Laboratory Use” and EN 60825-1/IEC 60825-1 “Safety of Laser Products”. Compliance with the European requirements is certified by CE Marking.

### **I.4.3 Electromagnetic Compatibility**

The primary issue for electromagnetic compatibility is to design covers, shielding, grounding, routing of electrical cable assemblies, and control elements with the correct safety features for a complete system.

Coherent products have been tested and shown to be compliant with the relevant requirements of the following directives for Electromagnetic Compatibility EN 61326-1\_Ed2:2013 (IEC 61326-1\_Ed2:2012) and EN 61000-3-2:2006.

## **I.4.4 Environmental Compliance**

This section gives information about compliance with different environmental regulatory directives to identify hazardous substances.

### **I.4.4.1 EU REACH**

Coherent products are classified as 'articles' according to EU REACH definition, as follows:

Article means an object which, during production, is given a special shape, surface or design that determines its function to a greater degree than its chemical composition. (REACH, Article 3(3))

Articles as defined by REACH regulations are exempt from registration as long as they are not intended to release a chemical substance. To the best of our knowledge, all Coherent product meet the definition of "article" according to REACH.

In addition, to the best of our knowledge, Coherent products do not contain any Substances of Very High Concern (SVHC) above the legally mandated thresholds included in the REACH SVHC list, which is updated every six months. The current SVHC list is available on-line at <https://echa.europa.eu/candidate-list-table>.

### **I.4.4.2 RoHS Compliance**

The European Union RoHS Directive EN 50581:2012 restricts the use of certain hazardous substances in electrical and electronic equipment. Coherent is in compliance with this Directive and can provide RoHS certification upon request. Compliance of this laser with the EMC requirements is certified by the CE mark.

### **I.4.4.3 China RoHS Compliance**

This section details compliance with the China RoHS (Restriction of Hazardous Substances) Regulation SJ/T 11364-2014.

This Regulation restricts the use of certain hazardous substances in electrical and electronic equipment. The China RoHS Regulation applies to the production, sale, and import of products into the Peoples Republic of China. Any hazardous substances in Coherent products are listed on the product label.

The China RoHS Regulation also requires that the date of manufacture be identified. This information is provided on the *Certificate of Calibration* shipped with each product.

部件名称 Part Name	有害物质 Hazardous Substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
印刷电路板组装 PCB Assembly	X	○	○	○	○	○
光学部件装配 Optic Assembly	X	○	○	○	○	○
组装二极管激光器 Laser Diode Assembly	X	○	○	○	○	○

本表格依据SJ/T 11364的规定编制  
 ○: 表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572规定的限量要求以下。  
 X: 表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572规定的限量要求。



Figure I-5. China ROHS Label

I.4.4.4

Waste Electrical and Electronic Equipment (WEEE, 2002)

The European Union Waste Electrical and Electronic Equipment (WEEE) Directive (2012/19/EU) is represented by a crossed-out garbage container label. The WEEE Directive applies to your product and any peripherals marked with this symbol.



Figure I-6. WEEE Label

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



**CAUTION**

Do not dispose of these products as unsorted municipal waste. Contact a local distributor for procedures for recycling this equipment.



# Appendix II: Laser Configurations

This appendix shows the options that can be ordered so you can identify the features and options unique to each laser.

StingRay and BioRay lasers are available in a broad range of wavelength, output power, and other options that can be configured for the requirements of your application. Not all combinations are possible; see the current Data Sheet or the Coherent website for options available.

<https://www.coherent.com/>

If you have questions or would like more information, please contact your Coherent Sales Representative.

## II.1 Information on Labels

Coherent assigns, manufactures, and warrants a part number that is unique to each StingRay or BioRay configuration. There is a label on the box for the laser, as well as a label on the laser itself.

### II.1.1 Product ID Label on Box

Figure II-1 shows the product ID Label for the laser placed on the end of the box:

The Product ID Label identifies the Product (StingRay, StingRay Optical Head, BioRay and so on), the unique part number, revision, and serial number assigned to each laser. This information (and more) is also listed in the Final Quality Control Report inserted in the box.



Figure II-1. Product ID Label on Box

## II.1.2 Laser Product Label

Figure II-2 shows an example of a product label attached to a laser.



Figure II-2. Product Identification on Laser Label

The key identification markings include the following:

- Part Number (PN)
- Serial Number (SN)
- Date of Manufacture (DM)
- Wavelength (WL)
- Power Rating (PW)
- 
- Options (see following breakdown of descriptions)

Figure II-3 shows an example of a StingRay laser with various options.

Table II-1 gives the options that were ordered for this example laser:

For a StingRay Optical Head (SOH), the model number is slightly different, as shown in the example in Figure II-4:

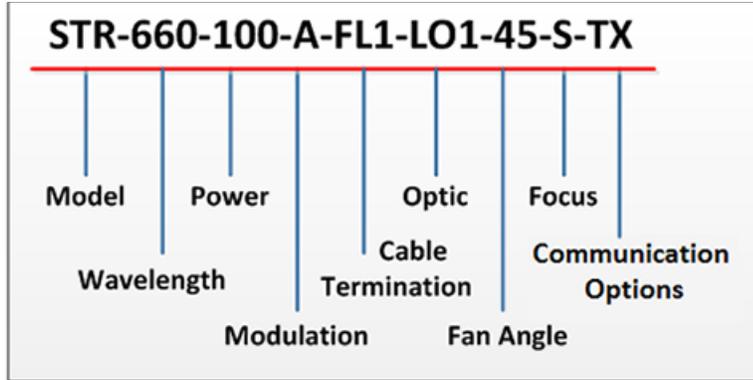


Figure II-3. Model Number Example – StingRay

Table II-1. Options on StingRay Laser Label

Identifier	Option Selected
Model	StingRay laser
Wavelength	660 nm wavelength
Power	100 mW
Modulation	Analog Modulation
Cable Termination	Flying Lead connector with a length of 250 mm
Optic	L01 – Single Line
Fan Angle	45° Fan Angle
Focus	Standard Focus
Communication Option	RS-232 communications enabled

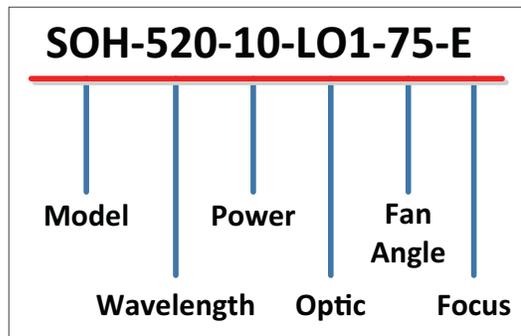


Figure II-4. Model Number Example – StingRay Optical Head

Table II-2 gives each of these options that were ordered for this example StingRay Optical Head:

**Table II-2. Options on StingRay Optical Head (SOH) Label**

Identifier	Option Selected
Model	StingRay Optical Head (SOH)
Wavelength	520 nm
Power	10 mW
Optic	Single-Line Optic
Fan Angle	75° Fan Angle
Focus	SOH Extended Focus

The sections that follow provide more details about the various options available.

## II.2 Laser Options

StingRay and BioRay lasers are available in a broad range of wavelength, output power, and other options that can be configured for the requirements of your application. Not all combinations are possible; see the current Data Sheet or the Coherent website for options available.

<https://www.coherent.com/resources>

If you have questions or would like more information, contact your Coherent Sales Representative.

The configuration for each laser is fixed and set at the factory. To change the configuration, users must return the unit for a service upgrade and assignment of a new part number. See "Service and Support" for details.



---

### **NOTICE**

**Settings for Operating Mode (CW, Analog, or Digital) and Communications (RS-232) cannot be enabled or disabled in the field.**

---

Lasers can be readily configured for applications using the following options. Refer to the StingRay Datasheet that provides a detailed eight-step configuration process, at:

<https://www.coherent.com/resources/>

- Wavelength and output power
- Operating mode (Continuous Wave (CW), Analog or Digital Modulation)
- Optical configuration
- Line fan angle (in degrees)
- Focus distance
- Communication option (RS-232); enabled only at time of manufacture
- Uniformity and straightness report for line configurations
- Type of connector and length of cable
- Power-on delay

Other options are listed below. Configurations can easily be customized at the factory for the requirements of your application. For more information, contact your Coherent Sales Representative.

- Custom focus distance
- Optional line data
- Safety Class (CDRH/IEC)
- Custom power setting
- Standard Drive electronics package
- Heat Sink Mount
- CDRH Timing Delay

## II.2.1 Laser Wavelength and Output Power

The wavelengths (nm) and output power (mW) currently available are listed in Table II-3. This list is subject to change as new lasers are added or made obsolete.

**Table II-3. Wavelength and Output Power Options**

Wavelengths/Power (nm)					
405-20	488-5	525-5	640-20	660-10	785-20
405-35	488-10	525-10	640-35	660-20	785-35
405-50	488-20	525-20	640-50	660-35	785-50
405-100	488-35	525-35	640-75	660-50	785-75
—	488-50	525-50	640-100	660-100	785-100
450-10	488-100	—	640-120	—	—
450-20	488-120	639-1	—	685-20	830-75
450-35	—	639-5	647-50	685-35	830-100
450-50	520-5	639-10	647-100	685-50	830-150
—	520-10	—	647-120	—	830-200
—	520-20	—	—	—	—
—	520-35	—	655-1	—	—
—	520-50	—	655-5	—	—

## II.2.2 Operating Modes: CW or Modulation

The model description defines all configuration details, including the singular Operating Mode. Settings for the Operating Mode cannot be enabled or disabled in the field.




---

### **NOTICE**

**Only one operating mode can be configured, and that configuration is fixed and set at the factory.**

---

The options for modulation are listed in Table II-4.

**Table II-4. Modulation Options**

Option	Description
CW	Continuous Wave
A	Analog
RA	Reverse Analog
T	Digital
RT	Reverse Digital
FT	Fast Digital
RFT	Reverse Fast Digital

### II.2.3 Optical Configuration

The options for beam shapes are listed in Table II-5. Beam shapes include line, crosshair, or dot (ellipse).

**Table II-5. Optic Options**

Line	Dot	Crosshair
L01 – Single Line	D01–XX Single Dot (Ellipse)	Crosshair (Limited Availability)
		CH10
		CH45

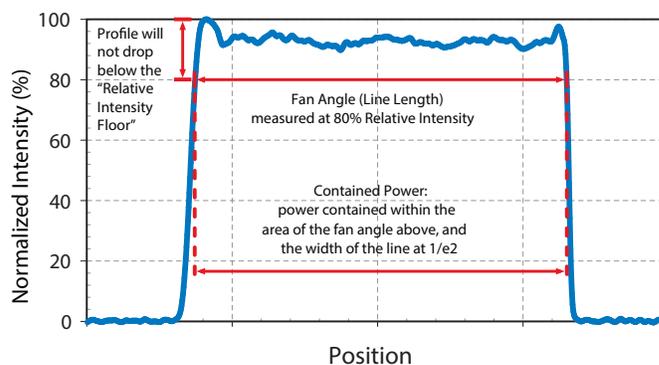
Diffractive Optical Element (DOE) multi-line diffraction optics are obsolete. For technical questions about optical configuration, see how to contact Coherent See “Contact Product Support” (p. 152).

The fan angle for Crosshair optics are limited in availability to certain laser configurations. Refer to p. 145.

### II.2.4 Line Length and Fan Angle

The line length is the length of the flat-top profile, measured at 80% relative intensity clip levels, as shown in Figure II-5.

The profile does not drop below the 'Relative Intensity Floor'.



**Figure II-5. Graph Showing Fan Angle**

Contained Power is the power contained within the area of the fan angle and the width of the line at  $1/e^2$ .

This option in the model description selects the fan angle (in degrees) that can be configured. Depending on wavelength and output power, the Fan Angle option may include those degrees listed in Table II-6:

**Table II-6. Fan Angle Options**

Fan Angles (in Degrees)	
1°	30°
5°	45°
10°	60°
15°	75°
20°	—

The fan angle for Cross-hair optics are limited in availability to the following laser configurations:

- 655mm–1mW and 655mm–10mW — 10° only
- 660mm–10mW — 10° or 45° only
- 660mm–20mW — 10° or 45° only

Some examples of fan angles are shown in Figure II-6:

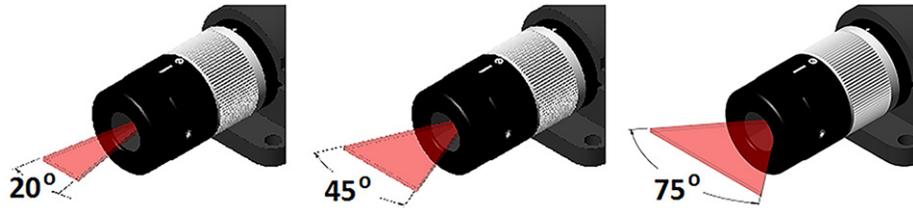


Figure II-6. Examples of Fan Angles

## II.2.5

### Focus

The adjustable focus feature is preset at the factory for StingRay lasers at a default setting of a 500 mm distance from the laser. Users can readjust and lock as needed.

Alternately, you can select a focus distance from 50 mm up to 2000 mm. The adjustable focus feature is set at the factory to your specified distance from the laser. Users can lock and readjust as needed. Choosing a focus distance of > 2000 mm is considered to be “collimated”.

The options for Focus are listed in Table II-7.

Table II-7. Focus Options Identified in Part Number

Option	Description
S	Standard Focus (fast axis, smaller Depth of Field)
E	Extended Focus (slow axis, larger Depth of Field)
Su	μFocus, Standard Focus (fast axis)
Eu	μFocus, Extended Focus (slow axis)

Table II-8 shows the items in the Focus options from Coherent that are included in the StingRay Developer’s Kit (P/N 1263022):

**Table II-8. StingRay Optical Heads (SOH) in the StingRay Developer's Kit**

Item	Description
1	30° Line, Standard Focus (Red)
2	30° Line, Extended Focus (Red)
3	30° Line, Standard Focus (Green)
4	30° Line, Extended Focus (Green)
5	60° Line, Standard Focus (Red)
6	60° Line, Extended Focus (Red)
7	3-Line, 30°, IA 1.5° Standard Focus (Red)

## II.2.6

### Communications

The options for RS-232 communications is reflected in the model description as shown in Table II-9:

**Table II-9. RS-232 Communications**

Option	Description
-XX	RS-232 Communications Disabled
-TX	RS-232 Communications Enabled




---

#### **NOTICE**

The communications configuration is fixed and set at the factory. Settings cannot be enabled or disabled in the field. To change the configuration, users must return the unit for a service upgrade and assignment of a new part number. See 'Service and Support' (p. 149) for information about how to contact Coherent.

---

For information about RS-232 Commands and Queries, see "Host Interface". For information about signals, see 'Hirose Connector' (p. 128).

## II.2.7 Other Configuration Options

Other optional values that can be specified are listed in Table II-10. The options listed comprise the last digits of a StingRay model number or model description. The options available may vary, depending on other choices selected.

**Table II-10. Other Configuration Options**

Option	Default	Code	Options
Custom Focus Distance	500 mm	-1	50 mm minimum to 2000 mm maximum, in 10 mm increments. Any value > 2000 mm is considered to be Collimated. The standard default focus of 500 mm does not obtain a non-standard focus designation.
Line Data	None	-2	Uniformity and Straightness Report
Custom Safety Class	Per Calibrated Nominal Power	-3	See "Safety and Compliance" for available options. The Class of Laser is listed in the Final Quality Control Report.
Custom Power	Nominal	-4	Enter value less than nominal in integer value, not less than 10% on the nominal output power.
Separate Driver	None	-5	SD = Separate Drive electronics.
Laser Mount	None	-7	Yes: Includes a Heat Sink Mount aligned with a StingRay laser.
CDRH Timing Delay	5-Second Delay Enabled	-8	CDRH Delay Disabled.
Fiber Ready	None	-9	Factory installs and adjusts a Fiber-Ready adapter.

## II.2.8 Cable Termination and Connector Options

The options for cable terminations for the laser are listed in Table II-11. Note that pin-outs vary by connector type.

**Table II-11. Cable Termination and Connector Options**

Option	Flying Lead or Connector Code	Specify Cable Length
Flying Leads	The default cable length is 500 mm and is simply an 'FL' code. Other lengths are designated as 'FLn'.	250 mm = FL1 500 mm = FL 1000 mm = FL3 1500 mm = FL4 2000 mm = FL5 2500 mm = FL6
Hirose Connector	HR	1000 mm = 3 (Only option available)
Power Plug	P	500 mm = 2 (Only option available)
Power & BNC	B	500 mm = 2 (Only option available)

# Appendix III: Service and Support

This section includes information about:

- How to request service
- Product shipping instructions
- How to contact Product Support

## III.1 Obtain Service

Customers may request service either when sending the laser for a service evaluation or for service under the Warranty.



---

### **NOTICE**

**There are no user-serviceable components inside the laser. DO NOT attempt to open the laser housing. *If the enclosure is disassembled, the Warranty is void!***

---

### III.1.1 Request for Service Evaluation

Any StingRay/BioRay laser returned for service evaluation must be the same configuration as originally purchased. The original configuration is linked to the Coherent part number assigned to that laser. (See 'Laser Configurations' (p. 137) for information about how to identify features of the laser by the Coherent model description.)

Any cable assemblies with non-standard connectors must be removed and replaced with the original cable assemblies before requesting an evaluation.

Figure III-1 shows a StingRay laser configured with a Flying Lead (FL) cable, and two examples of StingRay lasers with non-standard connectors.

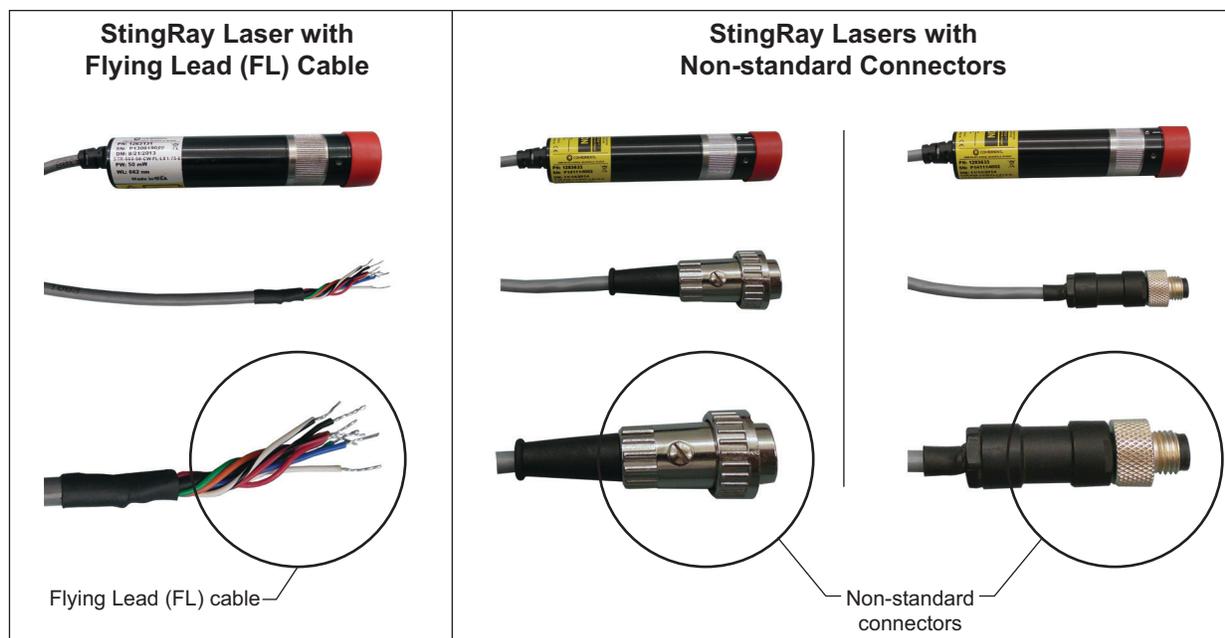


Figure III-1. Example – Non-Standard Connectors

### III.1.2 Request for Service Under Warranty

To obtain service under this Warranty, Customer must notify the Company of the defect before the expiration of the Warranty period and make suitable arrangements for the performance of service. The Company shall, in its sole discretion, determine whether to perform Warranty service at the Customer's facility, at the Company's facility, or at an authorized repair station.

If the Customer is directed by the Company to ship the product to the Company or a repair station, Customer shall:

- Package the product (to protect from damage during shipping) as instructed in 'Product Shipping Instructions' (p. 151).
- Ship it to the address specified by the Company, shipping prepaid. The customer shall pay the cost of shipping the Product back to the Company in conjunction with recalibration and recertification.
- The Company shall pay the cost of shipping the Product back to the Customer in conjunction with product failures within the first twelve (12) months of time of sale or during an extended 12-month or 24-month Warranty period.

Customers must include a Returned Material Authorization number (RMA) assigned by the Company on the outside of all shipping packages and containers. Items returned without an RMA number are subject to return to the sender. Detailed instructions are provided in the next section.

## III.2 Product Shipping Instructions

To ship a product to Coherent:

1. Contact Coherent Customer Service (see 'Contact Product Support' (p. 152)) to obtain a Return Material Authorization (RMA) number. Have the product serial number ready to provide.
2. Attach a tag to the product that includes the name and address of the owner, the person to contact, the serial number, and the RMA number you received from Coherent Customer Service. This tag should be packed **inside** the box.
3. Carefully insert the laser into the high-density membrane to secure it in the original packaging.
4. Use the original shipping and packaging materials, and pack all components of the product (power supply, cables, etc.). Carefully slide each part into the packing membrane in which it was originally shipped.



---

### **NOTICE**

**For service requests, also carefully package any non-standard hardware and return it with the laser, so the laser can be applicable evaluated.**

---

5. Make a secure seal on the shipping carton with shipping tape.
6. Make a note of the RMA number that was received from Coherent Customer Service on the **outside** shipping return label for the box.
7. Ship the product to the following address:

Coherent, Inc.  
Attn: RMA # \_\_\_\_\_  
27650 SW 95th Ave.  
Wilsonville, OR 97070  
USA

### **III.3 Contact Product Support**

Coherent supplies telephone and web-based technical assistance as a service to its customers and assumes no liability thereby for any injury or damage that may occur contemporaneous with such services.

Under no circumstances do these support services affect the terms of any Warranty agreement between Coherent and the buyer. Operation of any Coherent laser with any of its interlocks (or safety features) defeated is always at the operator's own risk.

Please be prepared to provide the following information to the Support Engineer who responds to your request:

- Model or part number of your unit
- Serial number of your unit
- A description of the problem
- Any corrective steps you may have attempted

For the latest Customer Service information, refer to the company website:

<https://www.coherent.com/support/>

#### **III.3.1 In the USA and North America**

For general technical support or to ship products from within the United States or North America, contact your local Coherent Service Representative, or contact Laser Systems and Measurement (LSM) Technical Support directly, either:

- By phone in North America: 1-(734)-456-3100 or 1-(800)-367-7890
- By e-mail: [customer.support@coherent.com](mailto:customer.support@coherent.com)

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

#### **III.3.2 International**

To view a list of contact names, telephone numbers, and addresses worldwide, visit our website:

<https://www.coherent.com/support/>

If you are located outside of North America, contact Laser Systems and Measurement (LSM) Technical Support directly, as follows:

Germany: +49-6071-968-0

Japan: +813-5635-7170



# Appendix IV: Warranty

StingRay and BioRay lasers have been designed to exhibit correct mechanical and temperature stability. These lasers are designed to be operated as assembled; there are no user-serviceable components in the laser or any accessories.



---

**NOTICE**

**DO NOT disassemble the enclosure for the laser or any device.**  
***The Warranty is void if the enclosure is disassembled!***

---

Should a product fail during the Warranty period, Coherent will, at its discretion, repair or replace the damaged unit. Repaired or replacement units will be covered for the remainder of the original equipment Warranty period.

This Warranty does not apply to units examined by Coherent that are found to have failed due to abuse, acts of nature, mishandling, alteration, improper installation, or negligence.

Coherent StingRay lasers are guaranteed to be free from material and manufacturing defects for a period of two years (24 months) from the date of shipment. The exception is any laser product that has a wavelength < 635 nm, which has a Warranty of one year (12 months).

## IV.1

### Conditions of Warranty

For warranty service requiring the return of any product to Coherent, the product must be returned to a service facility designated by Coherent. The Buyer is responsible for all shipping charges, taxes and duties.

Parts replaced under warranty shall become the property of Coherent and must be returned to Coherent, Inc., Santa Clara, or to a facility designated by Coherent. All laser systems must be carefully packed in a suitable shipping container(s).

Coherent does not assume responsibility for components broken in shipment due to improper packaging or handling. The Buyer is obligated to issue a purchase order for the value of the replaced parts and Coherent issues credit when the parts are received.

## **IV.2 Limitations of Warranty**

The foregoing warranty shall not apply to defects resulting from any of the following:

- Components and accessories manufactured by companies other than Coherent, which have separate warranties
- Improper or inadequate maintenance by the Buyer
- Buyer-supplied interfacing
- Operation outside the environmental specifications of the product
- Unauthorized modification or misuse
- Improper site preparation and maintenance
- Opening the housing

Coherent assumes no responsibility for customer-supplied material. The obligations of Coherent are limited to repairing or replacing, without charge, equipment which proves to be defective during the warranty period. Replacement sub-assemblies may contain reconditioned parts. Repaired or replaced parts are warranted for the duration of the original warranty period only. The warranty on parts purchased after expiration of system warranty is ninety (90) days. Our warranty does not cover damage due to misuse, negligence or accidents, or damage due to installations, repairs or adjustments not specifically authorized by Coherent.

Warranty applies only to the original purchaser at the initial installation point in the country of purchase, unless otherwise specified in the sales contract. Warranty is transferable to another location or to another customer only by special agreement which will include additional inspection or installation at the new site. Coherent disclaims any responsibility to provide product warranty, technical or service support to a customer that acquires products from someone other than Coherent or an authorized representative.

**THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED, AND DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL LOSS. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

### IV.3 Factory Warranty Period and Fee Schedule for StingRay/BioRay Lasers

Table IV-1 shows the factory warranty and evaluation fee options for StingRay and BioRay lasers. Outside of the Factory Warranty period

**Table IV-1. Factory Warranty Period and Fee Schedule for StingRay/BioRay Lasers**

Description	Factory Warranty	Evaluation Fee	Out of Warranty Repair
Wavelength 600nm and above	24 month or 6000h, whichever comes first	\$500	N/A
Wavelength 599nm and below	13 month or 3000h, whichever comes first	\$500	N/A

Coherent can provide evaluation of the product with fee, but no repairs.



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# Glossary

°C	Degrees Centigrade or Celsius
°F	Degrees Fahrenheit
Ω	Ohm(s)
μ	Micron(s)
μm	Micrometer(s) = 10 <sup>-6</sup> meters
μrad	Microradian(s) = 10 <sup>-6</sup> radians
μsec	Microsecond(s) = 10 <sup>-6</sup> seconds
1/e <sup>2</sup>	Beam diameter parameter = 0.13534
AC	Alternating current
Address	A unique one-byte identifier assigned to each device on the bus
Amp	Ampere(s)
APC	Angle physical contact
Application Protocol	A set of application defined commands and replies used to implement a system of cooperative devices
Automatic Send Data Control	An optional hardware feature that is useful to control enable/disable of transmit enable line of RS-485 transceiver
BNC	Type of connector
Broadcast Message	Message sent by a master device and received by all connected slave devices
BUSMGMT	Message is a bus management message
CCB	Coherent Connection Bus, a RS-485 communication bus
CDRH	Center for Devices and Radiological Health
cm	Centimeter(s)
CW	Continuous wave
DC	Direct current
DDL	Direct diode laser
Destination Address	Address of the recipient device for a message
DHCP	Dynamic Host Configuration Protocol. A protocol that provides a means to dynamically allocate IP addresses to computers on a local area network.
DLE	Data link escape
EOM	A two-byte sequence indicating the end of a message packet
ESD	Electrostatic discharge
ETX	End of message data
FC	Fiber-connector
FP	Fiber pigtail

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g	Gram(s) or earth's gravitational force (gravity)
GUI	Graphical user interface
HeNe	Helium neon
Hz	Hertz or cycles per second (frequency) (= 1/pulse period)
IEC	International Electrotechnical Commission
IR	Infrared (wavelength)
I/O	Input/output
kg	Kilogram(s) = $10^3$ grams
kHz	Kilohertz = $10^3$ hertz
kOhm	Kilohm(s) = $10^3$ ohms
LCD	Liquid crystal display
LED	Light emitting diode
LS version	OBIS Laser, based on optically pumped semiconductor laser (OPSL) technology
LX version	OBIS Laser, based on direct diode laser (DDL) technology
m	Meter(s) (length)
mA	Milliamp(s) = $10^{-3}$ Amperes
mAmp	Milliampere(s)
Master	Controlling device which manages bus direction, assigns device addresses, and generally the source for all application protocol command initiation
MHz	Megahertz = $10^6$ hertz
mm	Millimeter(s) = $10^{-3}$ meters
mrاد	Milliradian(s) = $10^{-3}$ radians (angle)
ms	Millisecond(s) = $10^{-3}$ seconds
mV	Millivolt(s)
MVP	Modulation and variable power
mW	Milliwatt(s) = $10^{-3}$ Watts (power)
NA	Numerical aperture
nm	Nanometer(s) = $10^{-9}$ meters (wavelength)
N·m	Newton meter
NOHD	Nominal Ocular Hazard Distance
OBIS Remote	A dedicated Coherent device that serves as a communication gateway to a single laser and provides a CDRH-compliant keyswitch and interlock capabilities.
OEM	Original equipment manufacturer
OPSL	Optically-pumped semiconductor laser
oz·in.	Ounce inches
PIP	Port Identification Pin, a signal pin located on the cable connecting the slave device to the CCB
PPS	Pulses per second
rms	Root mean square (effective value of a sinusoidal wave)
RMA	Return material authorization

SCPI	Standard commands for programmable instruments. This standard, developed by Hewlett-Packard, complements <a href="#">IEEE 488</a> and is promoted by the <a href="#">SCPI Consortium</a> .
SDR	Shrunk delta ribbon. This connector type is used on the back panel of the OBIS Laser for the full-feature I/O cable.
Slave	Device which receives and interprets messages and responds as required
SOM	A two-byte sequence indicating the start of a message packet
Source Address	Address of the device transmitting a message
Standard Message	Message sent from the master device to a specific slave device address
SRCCCB	Message originated from CCB stack
SRCCONT	Message originated from master device (controller)
STX	Start of message data
System Protocol	A set of predefined bus management commands and responses used by CCB protocol stacks for set-up and management of the bus
TEC	Thermoelectric cooler
TEM	Transverse electromagnetic mode (cross-sectional laser beam mode)
TTL	Transistor-transistor logic
UART	Universal asynchronous receiver/transmitter
UFC	Ultra-flat contact
UV	Ultraviolet
V	Volt(s)
VAC	Volts, alternating current
VDC	Volts, direct current
W	Watt(s) (power)







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**INNOVATIONS THAT RESONATE**



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