

StingRay/BioRay Lasers

Operator's Manual

STINGRAY/BIORAY LASERS OPERATOR'S MANUAL





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PREFACE

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.



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 “Appendix A: Safety and Compliance”.

Safety Warnings

This section provides information about signal words and safety symbols that you need to know before you begin to use StingRay and BioRay lasers.

Signal Words

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

These signal words designate the degree or level of hazard when there is the risk of injury, as described in Table 1:

Preface Table-1. Signal Words





SIGNAL WORD	DESCRIPTION
DANGER	Indicates a hazardous situation that, if not avoided, WILL result in <i>death or serious injury</i> . This signal word is to be limited to the most extreme situations.
WARNING	Indicates a hazardous situation that, if not avoided, COULD result in <i>death or serious injury</i> .
CAUTION	Indicates a hazardous situation that, if not avoided, could result in <i>minor or moderate injury</i> .
NOTICE	Indicates information considered important, but not hazard-related. The signal word “NOTICE” is used when there is the <i>risk of property damage</i> .

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

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. The icons are intended to alert the operator as described in Table 2:

Preface Table-2. Safety Symbols

ICON	ALERTS THE OPERATOR TO...
	Important notes or instructions for operation and maintenance.
	Danger of exposure to hazardous visible and invisible laser radiation.
	Dangerous voltages when working with other equipment may be of sufficient magnitude to constitute a risk of electric shock.
	Danger of susceptibility to Electro-Static Discharge (ESD).

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 appropriate 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.

SECTION ONE: PRODUCT INTRODUCTION

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

For information about parts and accessories, see “Section Six: Parts and Accessories”.

- Features of the laser (this page)
- Precautions when using a laser (p. 1-2)
- Specifications (p. 1-3)

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 using 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 to improve 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 to create the line you need for measurement and profiling applications. Offering the same focus adjustment as BioRay, the StingRay allows a user to optimize the focus location for the best measurement resolution.
- **BioRay** is Coherent’s compact high-performance laser for Life Science applications with an elliptical beam output and 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 and 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 1-1. 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 1-1. 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_{DC}
 - NOTES: Recommend 12 V_{DC} for greatest efficiency. For lasers between 400 nm to 600 nm, the minimum operating voltage is 6 V_{DC}.
- ESD protection, over-temperature protection, and reverse polarity protection
- Optional fiber-ready version
- Health Monitor

Precautions When Using a Laser

Follow all safety instructions throughout this manual. Also read and understand all laser safety precautions in “Appendix A: 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 that 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.



DANGER!

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

For applications that require a Keyswitch and Interlock for protection from laser emissions, it is recommended that you use the StingRay/BioRay Remote, shown in Figure 1-2.



Figure 1-2. StingRay Remote — Interlock and Keyswitch

The Remote is available in a StingRay/BioRay Remote Kit (P/N 1231404) that includes all the required accessories, shown in Figure 1-3. This includes the Remote Power Supply and power cord, USB Cable, and a USB drive with Coherent Connection software.



Figure 1-3. StingRay/BioRay Remote Kit

In addition to safety features, the StingRay/BioRay Remote is a multi-functional interface that provides feedback, status, and control of the laser. The StingRay/BioRay Remote also provides interface to the laser for remote connection of power, modulation, and communication.

For more information about the features and functions of the Remote, see “StingRay/BioRay Remote” (p. 6-7).

Specifications

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

- Laser output specifications (p. 1-4)
- Electrical specifications (p. 1-4)
- Power requirements (p. 1-4)
- Operating environment (p. 1-5)
- Physical specifications (p. 1-5)

Each of these are described in the sections that follow.

Laser Output Specifications

Table 1-1 lists the laser output specifications for StingRay and BioRay lasers.

Table 1-1. Laser Output Specifications

DESCRIPTION	SPECIFICATION
Spatial Mode	TEM ₀₀ (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)	$<3 \text{ mrad}$
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)	$<5 \text{ minutes}$

Laser Electrical Specifications

Table 1-2 lists the electrical specifications for the StingRay and BioRay lasers.

Table 1-2. 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)	$< 280 \text{ mA}$
Power-on Delay (seconds)	5 seconds (if enabled)
Power Consumption (W)	$<5 \text{ W}$
ESD Protection	EN61326-1 (8 kV Air Discharge, 4 kV Contact Discharge)

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 operating voltage is 6 V_{DC} .

There are two different power supplies available:

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

The pin-out and wiring characteristics for StingRay and BioRay lasers vary by cable termination. See “Section Two: Set Up Equipment” for more information.

Operating Environment

StingRay and BioRay lasers are suitable for indoor and outdoor use and function normally when the specified operating conditions are met.



NOTICE!

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

Table 1-3 lists the environmental specifications for the StingRay and BioRay lasers.

Table 1-3. 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"> • 80% for temperatures up to 31°C • For temperatures above 31°C, the Relative Humidity decreases linearly from 80% to 50% (at 50°C).

Physical Specifications

This section provides 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/lasers/laser/laser-diode-modules/stingray-and-bioray-lasers>

StingRay and BioRay Lasers

Table 1-4 lists the physical specifications for standard StingRay and BioRay lasers.

Table 1-4. Physical Specifications

DESCRIPTION	VALUE
Weight (grams)	70 g
Diameter (mm)	19.1 mm
Material	Aluminum 6061 T6

Figure 1-4 shows the dimensions for standard StingRay and BioRay lasers:

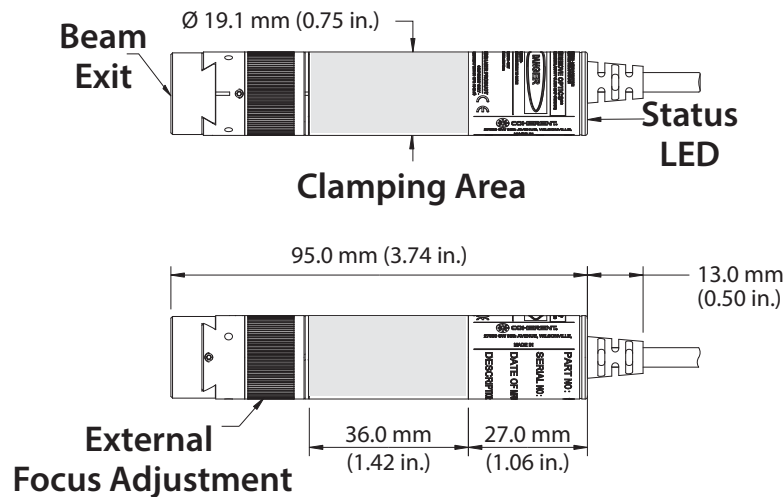


Figure 1-4. Dimensions of the Laser

StingRay or BioRay Laser in Mount

Figure 1-5 shows the dimensions for StingRay and BioRay lasers in a Mount:

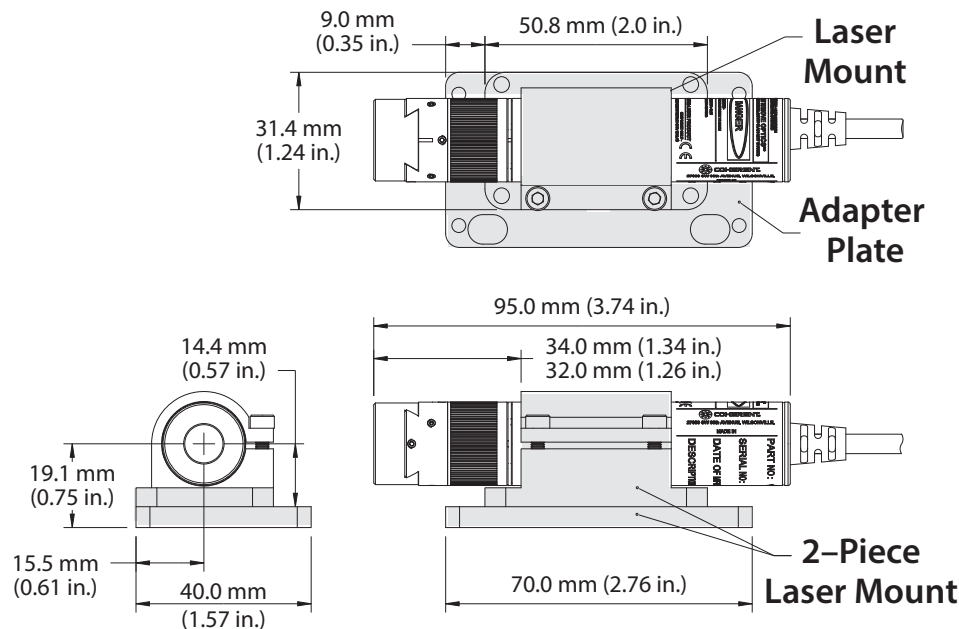


Figure 1-5. Dimensions — StingRay with Mount

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 1-6 shows the dimensions for a Compact Laser head (with a Separate Driver):

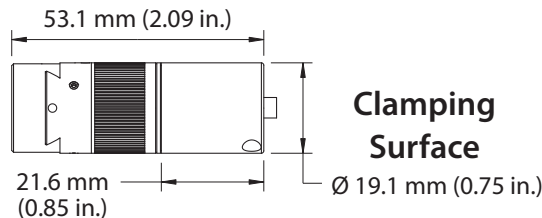


Figure 1-6. Dimensions — Compact Laser Head

BioRay FR (Fiber-Ready with SMA)

- Figure 1-7 shows the dimensions for a BioRay laser that is Fiber-Ready (FR) with a Sub-Miniature Adapter (SMA):

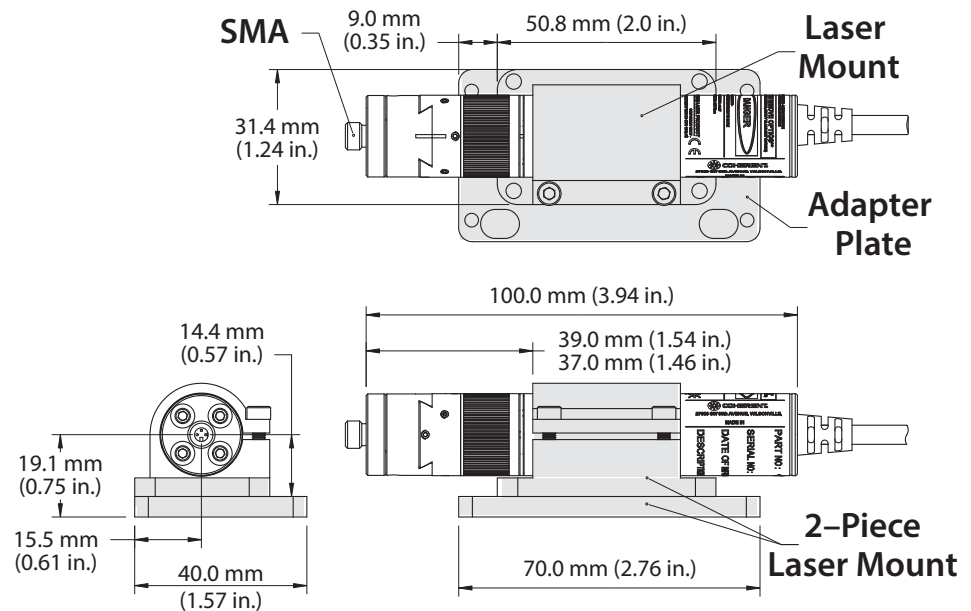


Figure 1-7. Dimensions — BioRay Laser (Fiber-Ready with SMA)

Additional Information

Go to “Section Two: Set Up Equipment” for instructions to set up equipment.

Go to “Section Four: Install and Run Software” for information about Coherent Connection Software, including installation instructions.

Go to “Section Five: Host Interface” for information about using host commands and queries with StingRay and BioRay lasers.

Go to “Section Six: Parts and Accessories” for descriptions of the Coherent parts and accessories available for StingRay and BioRay lasers.

For additional product information, go to the Coherent website:

<https://www.coherent.com/lasers/laser/stingray-and-bioray-lasers>

SECTION TWO: SET UP EQUIPMENT

This section provides information about ways to set up StingRay and BioRay lasers:

- Install a single laser (no Remote) (p. 2-5)
- Install a laser with a StingRay/BioRay Remote (p. 2-13)
- Change a StingRay Optical Head (SOH) (p. 2-18)
- Convert a BioRay laser to Fiber Ready (p. 2-19)

This section also describes the precautions you need to take against back reflection when working with lasers, as well as how to unpack and inspect parts before you begin set-up. The last section provides an example of how to build 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 may result in exposure to hazardous radiation.

Precautions for Laser Back Reflection

As you assemble and connect equipment, be aware of 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 any object in front of the laser and can result in instability, noise, or damage to the laser.



WARNING—LASER RADIATION!

Always wear correct laser safety eyewear and follow laser safety precautions when using the procedures to avoid eye or skin exposure to both DIRECT and SCATTERED radiation.

Read the section “Laser Back Reflection” (p. A-2) in its entirety and follow all recommended safety precautions. These guidelines are intended to prevent damage to persons or property, as well as prevent a decrease in the operating life of the laser.

Before You Begin

Before you begin set-up, first gather the necessary tools and equipment, then inspect the shipping box and unpack the contents.

Inspect the Shipping Box

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



NOTE!

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 another location or return to Coherent.

If you see any damage, document these discrepancies on the packing list. Also contact both the shipping carrier and either an authorized 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 “Appendix C: Service and Support” for more information.

Unpack the Components

Note that the product may be packaged in several smaller boxes inside the shipping box. As you unpack each part, place on a clean, dry surface.

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 handling a device during installation or use. Take necessary precautions or shielding to protect the system from Electrostatic Discharge (ESD). Otherwise, damage can occur to electronics.

To unpack the laser:

1. Open the shipping box and remove the box containing the laser.
2. Remove the printed documents from the box. Read and retain for future reference.
 - *Quick Start Guide*
 - Service Policy (instructions should you need to return the product)
 - Final Quality Control Report, which provides 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
 - Fan angle (for units with line generation optics)
 - Focus Distance
3. Also remove the USB flash drive.

4. Lift the inner packing material out of the box. Note how the laser is secured to the inner packing material by a plastic membrane, shown in Figure 2-1.



Figure 2-1. Laser Wrapped in Membrane



CAUTION:

Do not cut the high-density membrane secured around the laser. Cutting destroys the integrity of the packaging for any returns or future shipments. Instead, loosen the membrane by unfolding the bottom wings of the packaging.

5. Slide the laser out of the packaging and place it on a clean, flat surface.

Unpack the Power Supply

Unpack any Power Supply included in the shipment of parts and accessories.

To unpack the Power Supply:

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



Figure 2-2. Unpack the Power Supply

3. Carefully loosen the high-density membrane that is secured around the Power Supply and slide the Power Supply out. Place it on a clean, flat surface.
4. Lift the power cord out of the shipping box, if included in this shipment, and set it aside with the Power Supply.



NOTE:

Not all shipments of a Power Supply include a power cord. Power Cords are specific to the country of destination, and customers may need to supply their own power cord for the Power Supply.

Unpack a Remote Kit (Optional)

The StingRay/BioRay Remote Kit (P/N 1231404) is an option that you can order. The Remote Kit includes the items shown in Figure 2-3:

- Remote unit
- Power Supply and power cords
- USB Cable
- USB Flash Drive

See “Install a Laser with a Remote” (p. 2-13) for set-up instructions.



Figure 2-3. 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 2-4.



Figure 2-4. Unpack the Remote

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

Gather Tools and Equipment

The tools included with the shipment vary by the lasers and accessories ordered. Most shipments include a 0.9mm (0.035 in.) hex wrench (also referred to as hex key or an Allen wrench).

In addition, it is recommended that you gather the following supplies and any other tools to complete set-up. These are not included with the parts or accessories.

- A set of M6 or 1/4-20 screws used to attach the base plate onto an optical table or other flat surface
- A source for compressed clean, dry air or compressed nitrogen to clean off dust or particulates
- 2.5mm (0.098 in.) hex wrench

Install a Laser

This section describes how to set up and run the laser in Continuous Wave (CW) mode when not using the StingRay/BioRay Remote.



IMPORTANT!

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!*

To set up the laser, you'll need to:

- Mount the laser
- Connect power to the laser

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

Mount the Laser

StingRay and BioRay lasers contain a built-in temperature monitoring circuit. Should the laser become too hot, the unit is designed to temporarily shut down. Full laser operation resumes only after the laser returns to normal operating temperatures and power is cycled.

Proper mounting of the StingRay and BioRay lasers for heat dissipation is critical to lifetime and performance of the laser diode. Any laser above 20 mW should be mounted to provide proper thermal management.

An appropriate heat sink needs to make full radial contact with the clamping area. Coherent's Mounting Bracket is a heat sink specifically designed for StingRay and BioRay lasers that makes full radial contact and covers the entire clamping area. The recommended torque specification for the two M3 x 8 mm clamp screws used in the Coherent Heat Sink Mounting brackets is 70 in-oz.

Figure 2-5 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 operating region.



Figure 2-5. StingRay/BioRay Heat Sink Mounting Bracket



IMPORTANT!

Do NOT remove the product label from the laser. Doing so voids the warranty.

The bottom of the standard Heat Sink Mounting Bracket for StingRay and BioRay lasers is shown in Figure 2-6:



Figure 2-6. Heat Sink Mounting Bracket – Bottom View

The Mounting Bracket can also be placed on an optional Heat Sink Mount Adapter Plate (P/N 1222894), shown in Figure 2-7. The Adapter Plate has two (2) thru-holes for mounting to a Metric/Imperial Laser Table.



Figure 2-7. Adapter Plate – Bottom View



IMPORTANT!

Should you use a heat sink or mounting bracket that is not a Coherent part specifically designed for the StingRay and BioRay lasers, be aware that there may be issues with an over-temperature fault if that part is not properly designed to remove heat from the entire clamping surface area of the laser module.

To attach a mounting bracket to a laser:

1. Slide the laser (front end first) into the Heat Sink Mounting Bracket.
2. Position the laser so there is full accessibility to the focusing ring.
3. Using 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 achieved.

Figure 2-8 shows a laser mounted in a heat sink mounting bracket, attached to an Adapter plate.



Figure 2-8. Laser with Heat Sink on Mounting Bracket

V-block mounts are not recommended. This type of holding fixture does not adequately remove the heat load internal to the laser diode module, and should not be used. Figure 2-9 shows an example of a StingRay laser that is incorrectly mounted in a V-block.

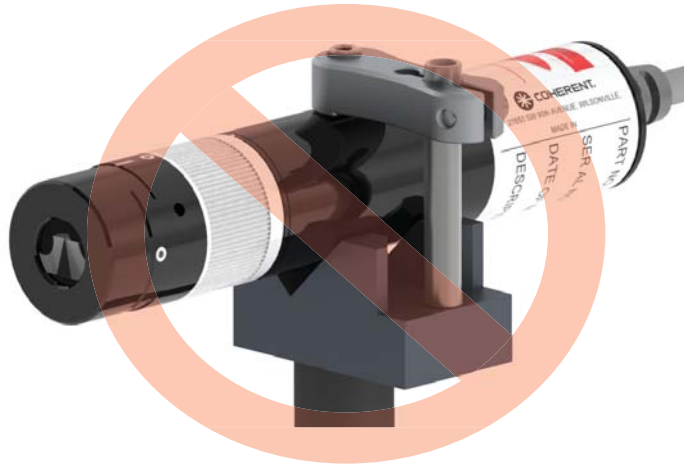


Figure 2-9. Wrong Way to Mount a Laser

Cable Assembly Connector Options

The StingRay and BioRay lasers can be used with a variety of connector options, shown in Figure 2-10. Each of these are described in more detail in “Connections to Lasers” (p. 6-14).

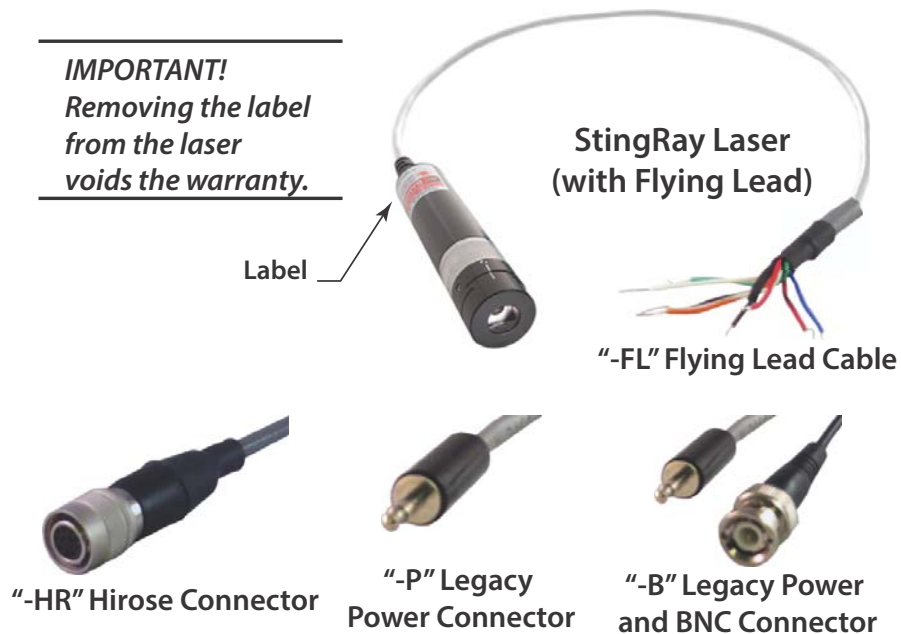


Figure 2-10. Connector Options for the Laser

Flying Leads

Flying Leads is a type of cable assembly termination. A Flying Leads cable configuration allows you the choice of such things as:

- Making solder wire connections
- Adding a connector of your choice
- Adding a Coherent connector (such as a two-pin power supply connector)

A Flying Leads cable can be wired for a variety of options, depending on the output power control to be used:

- 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 using lasers with either Analog or Digital Modulation.



IMPORTANT!

For lasers that use Analog or Digital Modulation, the laser must be configured with the specified modulation at the factory prior to shipment.

Table 2-1 describes the pin-outs and wiring signals for Flying Leads. Shaded areas represent signals available when the RS-232 communications option is enabled.

Table 2-1. Pin-Outs for Flying Lead Connector

PIN	SIGNAL	WIRE COLOR	DESCRIPTION
1	V_{IN} GND	Black	Power Input Ground
2	V_{MOD}	Blue	Modulation Input, 5 kOhm input impedance, 5 Volts maximum
3	V_{MOD} 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_{IN}	Red	Power Supply input for +5 to +24 V_{DC} . The Minimum operating voltage for lasers between 400 nm to 520 nm is 6 V_{DC} . Recommend 12 V_{DC}
10	Fault (Open Output Signal)	Green	Open collector of a transistor that allows a wire junction, OR functionality with fault signals from other devices

Wire a Laser with Flying Leads to a Power Supply

To connect a StingRay laser with flying leads, you will need the laser with an attached cable terminating in Flying Leads.

The example used in these instructions includes the Power Supply (P/N 1232091) with a Terminal Block Connector. The Terminal Block Connector provided 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 shaped like the letter “F”, as shown in Figure 2-11.



Figure 2-11. Flying Leads Example — Connector to Power Supply

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



IMPORTANT!

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

To wire Flying Leads to the cable to the Power Supply:

1. Separate the terminal block connector into two pieces for ease of wiring, as shown in Figure 2-12.



Figure 2-12. Sections of Terminal Block Connector

Figure 2-13 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.

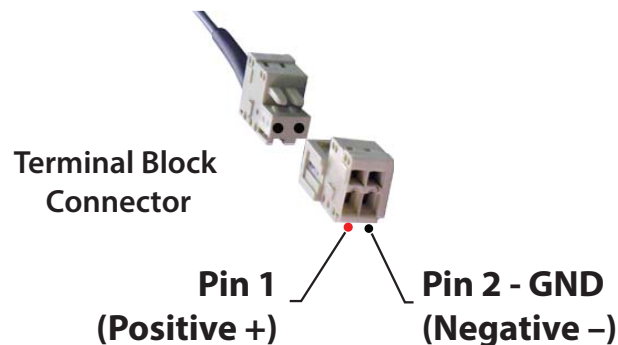


Figure 2-13. Pins in Terminal Block Connector

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 2-14.

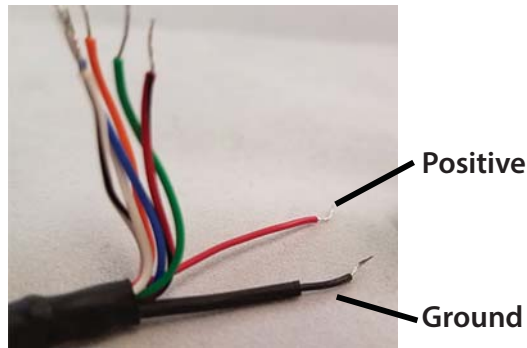


Figure 2-14. Separate Flying Leads Wires (Positive/Negative)



IMPORTANT!

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

3. Insert the “legs” of the clamp tool into the clamp spring tension release opening of the terminal plug, as shown in Figure 2-15. There is one opening on the front and one on the top.

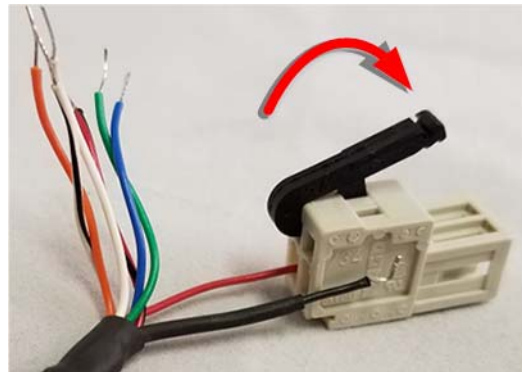


Figure 2-15. Use Clamp Tool to Open Plug for Wire

4. Slowly push down on the clamp tool to release the spring clamp tension, which exposes the opening.
5. Slide the red (V_{IN}) wire into the opening of the terminal plug and release the clamp tool so the tension of the clamp spring is applied on the wire. If it is not seated corrected, repeat until the wire is firmly clamped.
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.
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 corrected, repeat until the wire is firmly clamped.
9. The red and black wires should now be securely inserted into the plug, as shown in Figure 2-16:

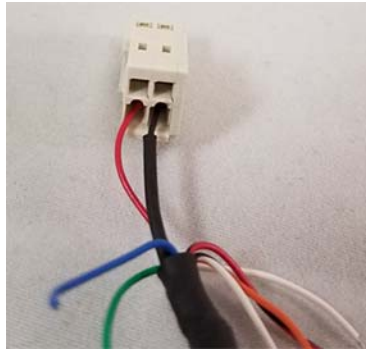


Figure 2-16. Wires Fully Inserted into Terminal Plug

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



CAUTION!

Failure to isolate bare wire leads could 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 2-17.



Figure 2-17. Connect Terminal Plug Ends

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



NOTE:

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

Protective Dust Cap

The vinyl cap included with the laser is designed 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 could 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 2-18,

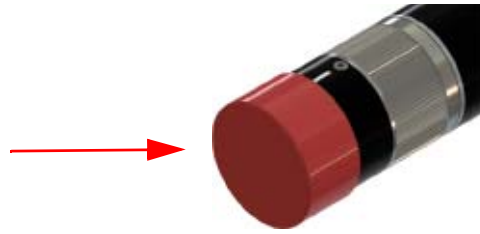


Figure 2-18. Dust Cap for Laser

Install a Laser with a Remote

This section describes how to set up a laser using a StingRay/BioRay Remote Kit. When using the Remote Kit, you must order a laser separately.

Parts of the Remote Kit

The following parts are included in a StingRay/BioRay Remote Kit (P/N 1231404), shown in Figure 2-19.



Figure 2-19. 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.
- **USB Flash Drive** (P/N 1258561)

Set Up and Connect the Remote

The configuration used in this example requires the laser to be configured with a Hirose “-HR” connector. The cable from a StingRay laser terminated with a Hirose Connector is shown in Figure 2-20:



Figure 2-20. StingRay Laser Terminated with a Hirose Connector

See “Hirose Connector” (p. 6-15) for pin-out assignments for a Hirose connector.



NOTE:

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. Ensure the Interlock is in place, as shown in Figure 2-21:



Interlock

Figure 2-21. Interlock Inserted in Remote

You can use the Interlock connector two ways:

- **For general use:** Plug 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 shorted jack is removed.
 - **To create an interlock system:** When the interlock circuit is opened, the laser automatically shuts off. For example, you can connect the two wires from the Remote interlock plug to a door contact switch.
2. Ensure that the keyswitch is in the Standby (OFF) position, as shown in Figure 2-22:



Keyswitch in Standby (OFF) position

Figure 2-22. Keyswitch in Standby (OFF) on Remote

3. Plug in the laser to the Remote using the mating Hirose connector, as shown in Figure 2-23.

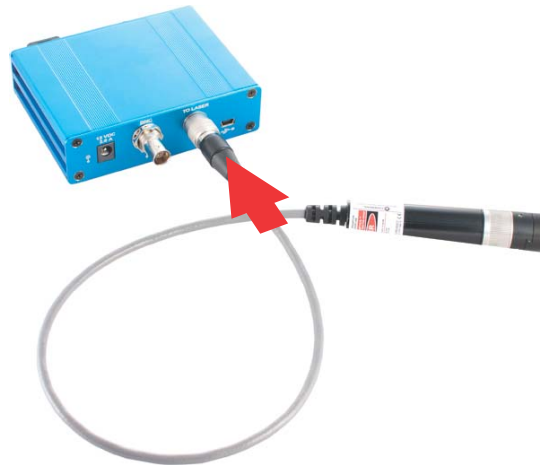


Figure 2-23. Connect Laser with Hirose Connector to Remote

4. (Optional) Connect the USB cable from the Remote to a computer, as shown in Figure 2-24.

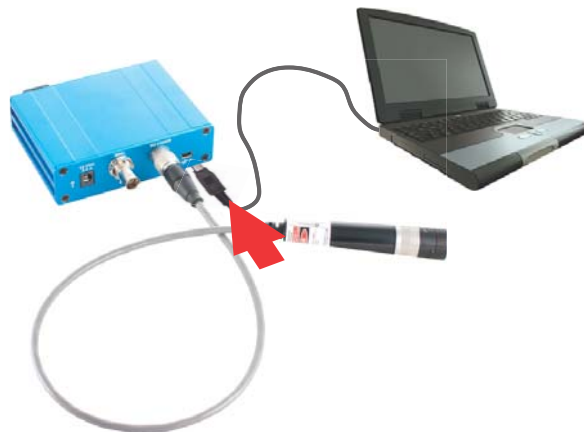


Figure 2-24. Connect USB to PC

See “Set Up a USB Connection” (p. 2-16) for information about setting up the interface between the StingRay/BioRay and the host computer via the USB connector.

5. Connect the Power Supply to the Remote, and then the power cable into a power source (outlet), as shown in Figure 2-25:

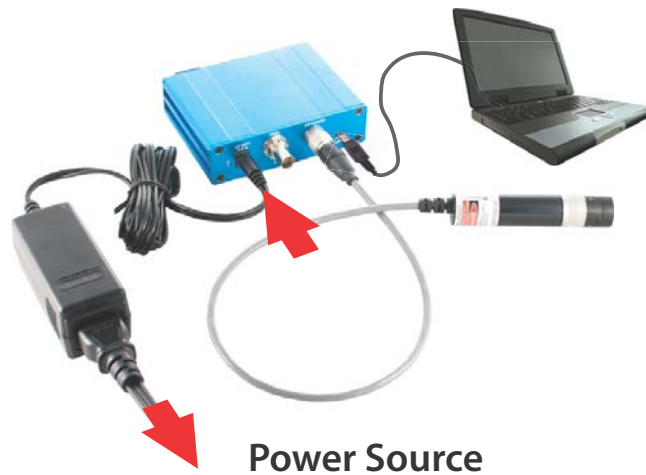


Figure 2-25. Connect Power Supply to Remote

6. Turn the keyswitch to the ON position.

The laser emits 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 begins immediately.



WARNING—LASER RADIATION!

Immediately after power is applied to the remote, the laser may be emitting light. Follow all safety precautions to avoid exposure to direct or indirect laser radiation.

Set Up a USB Connection

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

The circuit converts logical high/low levels into the required voltage levels required by 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 2-26 shows the Windows Control Panel, as displayed on a Windows v7 64-bit system.

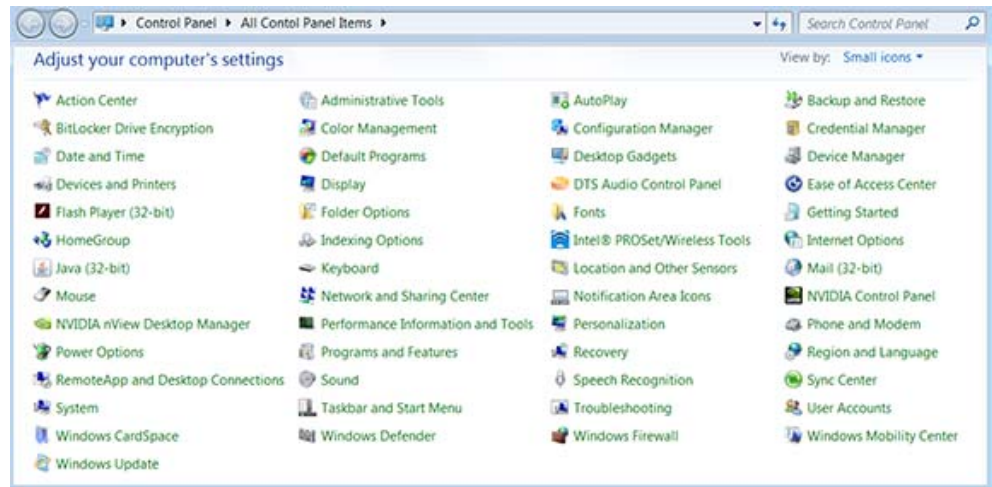


Figure 2-26. Windows Control Panel

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 assigns 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.



NOTE:

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 2-27 shows the Port assignments for two StingRay lasers. In this example, note the unique COM Port assignments assigned automatically to each individual laser.

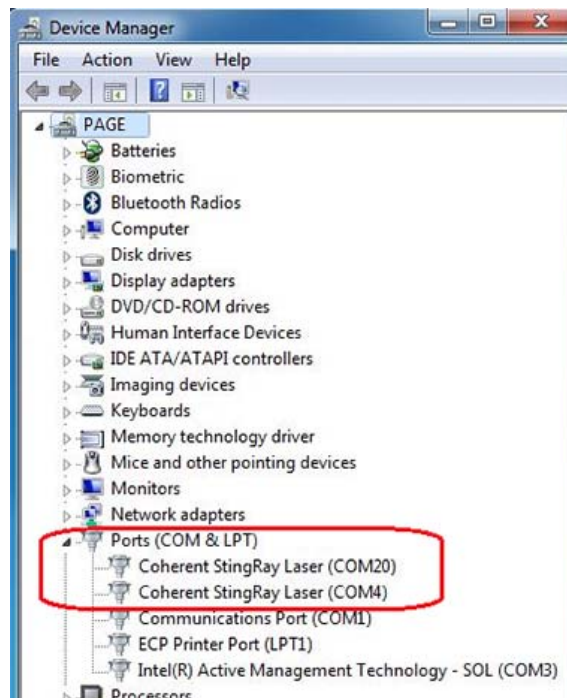


Figure 2-27. COM Port Assignment

Change a StingRay Optical Head (SOH)

StingRay lasers are designed to allow a user to change the StingRay Optical Head (SOH). By doing so, you can evaluate multiple optical configurations and identify the best solution for a given application.

A selection of optical configurations are currently available; see “Optical Configuration” (p. B-5) for details. The StingRay Developer's Kit (P/N 1263022) also includes a variety of optical heads that supports a variety of pattern configurations; some examples are shown in Figure 2-28:



Figure 2-28. Optical Pattern Configurations

To change the optical head:

1. Using the 0.035 hex wrench (provided), loosen the set screw shown in Figure 2-29.

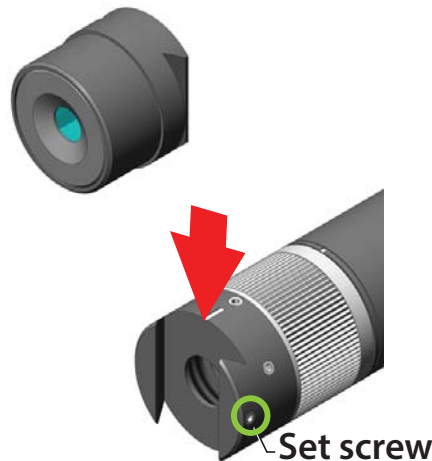


Figure 2-29. Change the Optical Head



CAUTION:

Take care to not unscrew the set screw too far, or it could fall out.

If you need to replace the set screw, purchase using these specifications:

Set Screw, Hex Socket Drive, 2-56 x 0.09375" (3.32") L,
Stainless Steel 316, Cup Point

2. Slide the head off.
3. Replace with the selected head.
4. Balance the optical head by moving the head along the dovetail axis and watching the power distribution change as the head moves.
5. Visually optimize the “balance” to make sure that the power is evenly distributed between the two sides.
6. Tighten the set screw to lock the optical head in place. Do not exceed a torque of 18 inch-ounces.

Convert a Laser to Fiber-Ready (Optional)

If you have a StingRay or BioRay laser and want to convert the laser to a Fiber-Ready version, follow the steps in this section. This section also describes the steps to adjust the converted laser to maximize output power.

A Fiber-Ready laser can be ordered as an accessory, a field replacement, or purchased from Coherent already configured. Figure 2-30 shows a BioRay Fiber-Ready laser.



Figure 2-30. BioRay Fiber-Ready Laser

This procedure includes two major tasks:

- Install the Fiber-Ready (FR) adapter
- Optimize the coupling efficiency

Equipment, Tools, and Supplies

Before you begin this procedure, gather the following equipment:

- Multi-mode fiber patch cord (must be purchased separately)
 - Minimum core size of 50 μm (step or graded index)
 - Minimum NA of 0.2

See “Summary of Part Numbers” (p. 6-19) for recommended multi-mode fiber Patch Cords.

- Fiber-Ready (FR) adapter assembly (sold separately)

The following tools and supplies are also required 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 following equipment is already attached to the StingRay laser housing:

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

The following is already attached to a BioRay FR Adapter Assembly:

- An SMA 905 connector; tolerances are illustrated in Figure 2-31.

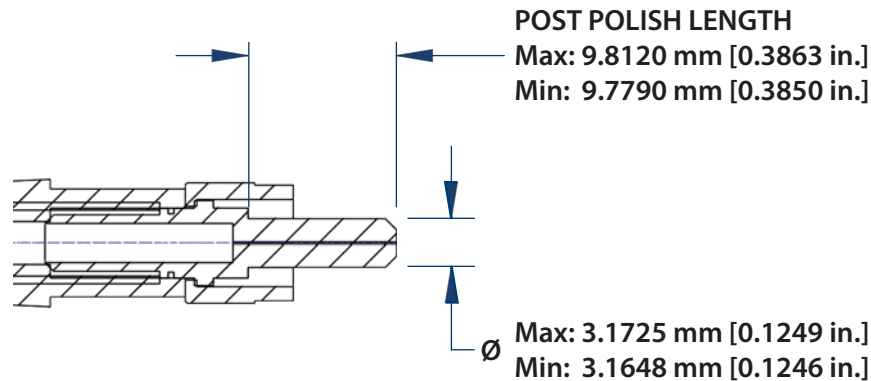


Figure 2-31. SMA 905 Connector Tolerances

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

- Must be fast enough to peak the coupling efficiency. Photodiodes are recommended.
- Must be large enough to contain the diverging beam exiting the multi-mode fiber. See “Optimize the Coupling Efficiency” (p. 2-22).

Install the Fiber-Ready (FR) Adapter

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

1. Measure the maximum output power from the laser.

If the photo-diode sensor saturates, reduce the output power until it falls within the measurement range of the sensor. Do not reduce power more than about 80% of maximum output power of the laser.

2. Using the 0.035-inch hex driver, install the FR dovetail assembly, as shown in Figure 2-32.



IMPORTANT!

Ensure that the indent on the dovetail is in alignment with the dovetail locking set screw on the laser.

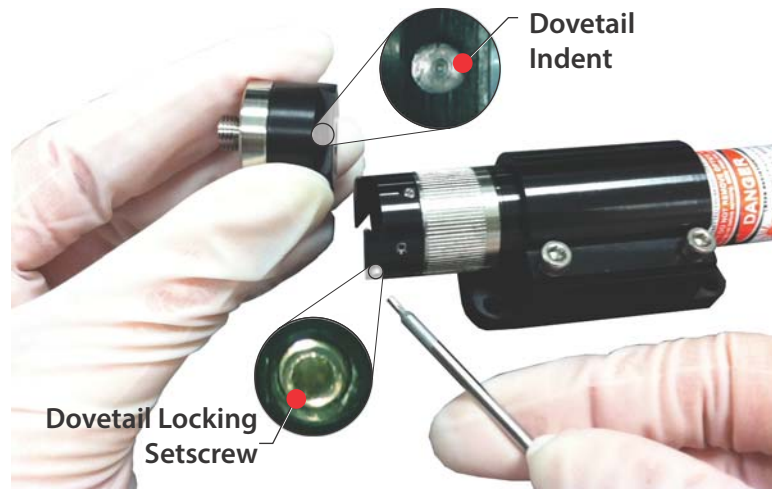


Figure 2-32. Align FR Dovetail Adapter

3. Torque the locking set screw to 24 inch-ounces.
4. Using the 0.035-inch hex driver, loosen the collimating lens set screw on the laser, as shown in Figure 2-33.

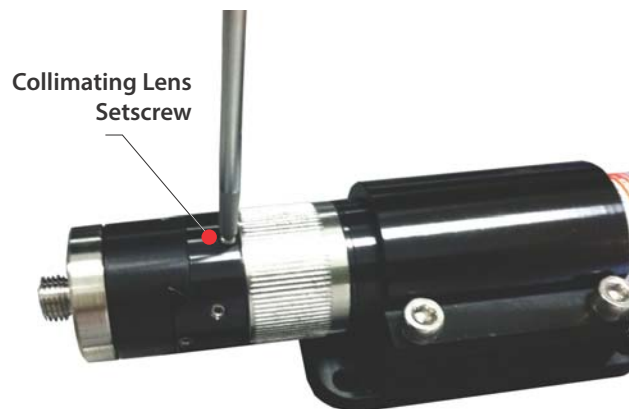


Figure 2-33. Loosen Collimating Lens Set Screw

5. Using 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 2-34.



Figure 2-34. Set the SMA Mount

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

Optimize the Coupling Efficiency

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

This step takes practice to obtain maximum coupling efficiency in a fast and efficient manner. It is recommended that, for the first few times, proceed slowly and carefully.

1. Apply methanol to a swab and clean the connector ferrule(s) on the fiber optic cable, as shown in Figure 2-35:



Figure 2-35. Clean the Connector Ferrule

2. Screw the SMA connector into the laser FR adapter assembly, as shown in Figure 2-36:

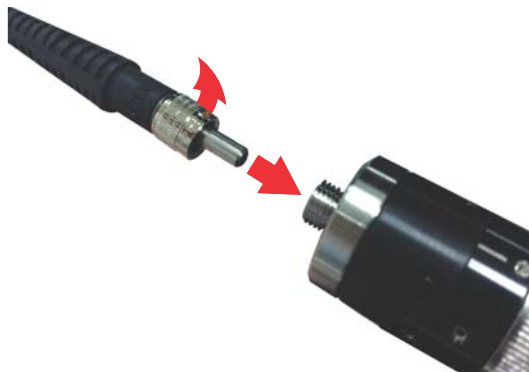


Figure 2-36. Insert SMA Connector into FR Adapter

3. Secure the exit end of the fiber in a clamp or holder to safely project the output beam on the white target. Coherent recommends the PowerMax-USB UV/VIS Quantum Power Sensor (P/N 1168337).
4. Place the white target within two centimeters of the fiber tip to see the faint beam before optimizing the coupling efficiency, as shown in Figure 2-37:



Figure 2-37. Align White Target

5. Turn ON the laser.
6. Couple the light in the fiber core by manually moving the SMA mount relative to the dovetail. The result is a bright uniform beam appearing on the white target.



IMPORTANT!

Start the coupling procedure by moving the SMA mount by hand in small movements. This usually helps reach the maximum coupling efficiency faster.

- If this step is NOT successful, continue with Step 6.
 - If this step IS successful, 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 2-38.



Figure 2-38. Adjust the Fiber Ferrule

8. Continue this adjustment until the output power exiting the fiber is peaked (that is, very bright) on the white target.
9. Place the photo-diode sensor in front of the exit end of the fiber cable, as shown in Figure 2-39.

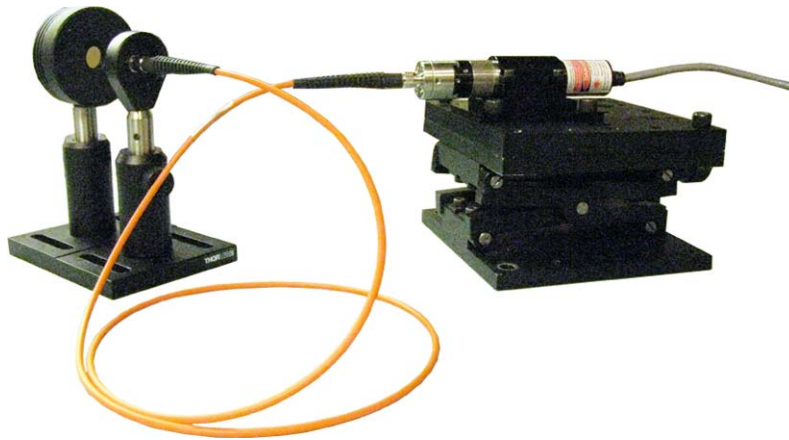


Figure 2-39. Place Photo-Diode Sensor

10. Position the sensor close enough to the photo-diode sensor so that the divergent beam is not clipped, as shown in Figure 2-40.

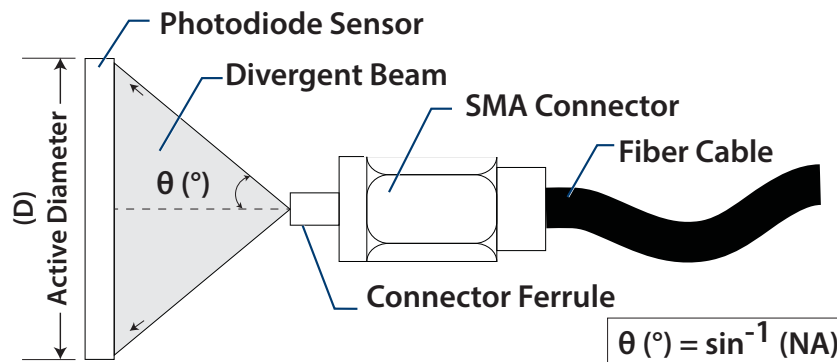


Figure 2-40. Sensor Placement for Divergent Beam

11. Peak (maximize) the power reading on the power meter. To do this:
 - a.) Alternately adjust the two alignment set screws.
 - b.) Adjust the focus ring.

As a guideline, rotating the adjustment ring in the direction shown in Figure 2-41 moves the collimating lens closer to the laser diode.



Figure 2-41. Adjust the Collimating Lens

Typical coupling efficiencies can be obtained 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 2-2 lists examples of coupling efficiencies. These coupling efficiencies are not guaranteed and should be used *only* as guidelines.

Table 2-2. 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 drop the power.
13. If necessary, optimize the coupling efficiency again by using the 0.05-inch hex driver to adjust the two alignment set-screws.

If the coupling efficiency decreases during the tightening process:

- a.) Loosen the four screws to permit the two alignment set screws to move the SMA connector mount holding the fiber.
 - b.) Repeat Steps 10 and 11 until the output power is stable throughout the process.
14. Using the 5/64-inch hex driver, incrementally tighten the four screws in the FR adapter assembly until they are firmly tightened, as shown in Figure 2-42.



Figure 2-42. Tighten FR Adapter Assembly



IMPORTANT!

Monitor the output power during this entire process. Note the maximized output power from the fiber.

15. Add alignment marks on the fiber body and the laser body as shown in Figure 2-43. Use a felt-tip marker or a ballpoint pen on a small piece of tape. The alignment marks are used to realign the fiber body with the laser body.

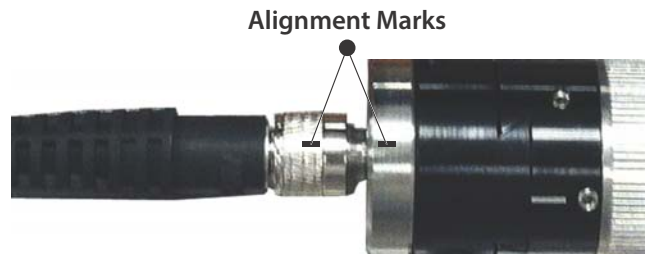


Figure 2-43. Add Alignment Marks

16. Turn OFF the laser and 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 2-44.



Figure 2-44. Torque the Set Screws

18. Install the fiber cable again, making sure the two alignment marks added in Step 12 are lined up.
19. Check the output power—it must be within 3 to 5% of the reading you took in Step 11. If the power has decreased:
 - a.) Loosen the four screws to permit the two alignment set screws to move the SMA connector mount holding the fiber.
 - b.) Repeat steps Steps 10 through 16 until the output power is within 3 to 5% of the reading you took in Step 11.

Set Up Health Monitor (Optional)

In addition to standard features, users can monitor the health of the laser by building the appropriate connection to the circuitry. An example is provided 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 configured 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 capability. The Fault output is simply an open collector of a transistor circuit. This allows the user to 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 the event triggers, the laser gives the user a visual indication and activates the open collector configuration of the monitor output.

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

Coherent calibrates the system to allow for a 30% over-current condition for the same output power (in this example, 130mA). This could be at 130% or lower, depending on the rate of change of the current. When that limit is exceeded in the system, the Health Monitor is activated and the current is limited at this point to the diode. The 30% or more increase in current starts the pulsing of the back panel red LED at 0.5Hz.

When the event triggers, the laser gives the user a visual indication and activates 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 protected from over current through the use of a recoverable fuse.
- Connect the load between the voltage source and the open collector output, as shown in Figure 2-45.

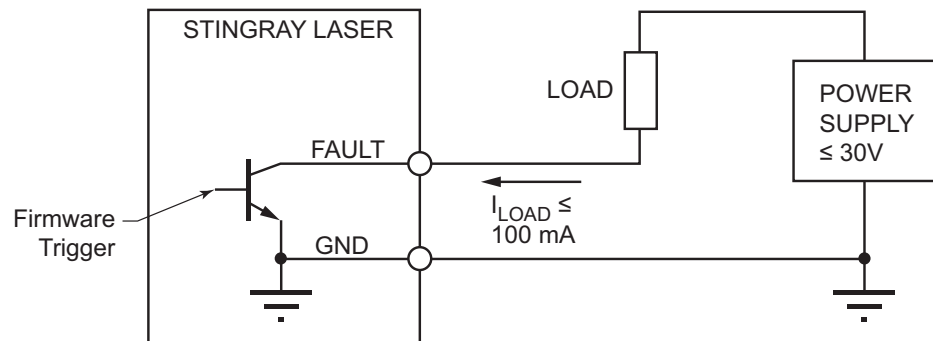


Figure 2-45. Health Monitor Connections

The FAULT output is a current drain:

- Requires external power supply.
- The load circuit can be a LED, a relay, or something to turn 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_{DC} power supply and an LED as the Load with an LED current 20 mA, the resistor value is:

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

Normal Operation is defined as:

- The Health Monitor activated
- LED flashes red at 0.5 Hz
- Output pulsing at 0.5 Hz

TP₁ is a point in time where the slope of the current changes by a fixed factor to identify a diode going into failure, as shown in Figure 2-46.

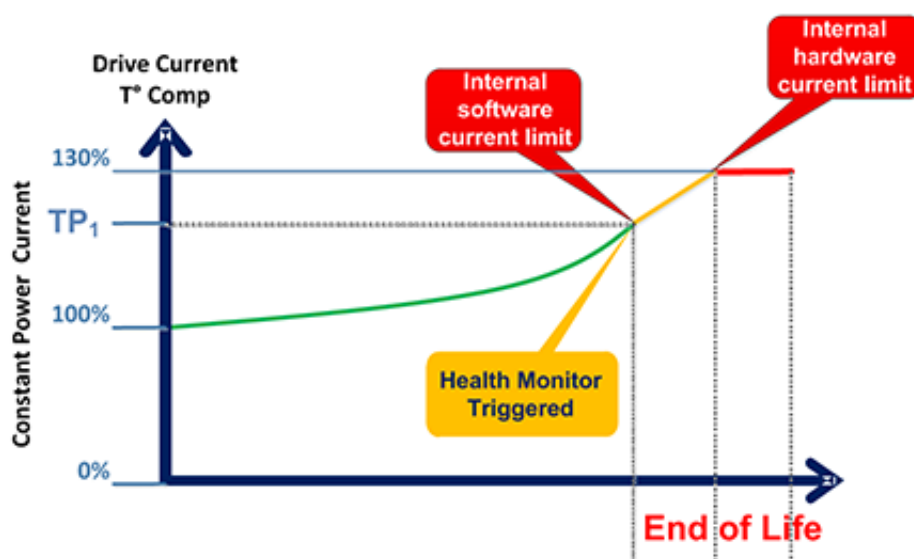


Figure 2-46. Health Monitor – Triggered

Figure 2-47 shows limits reached.

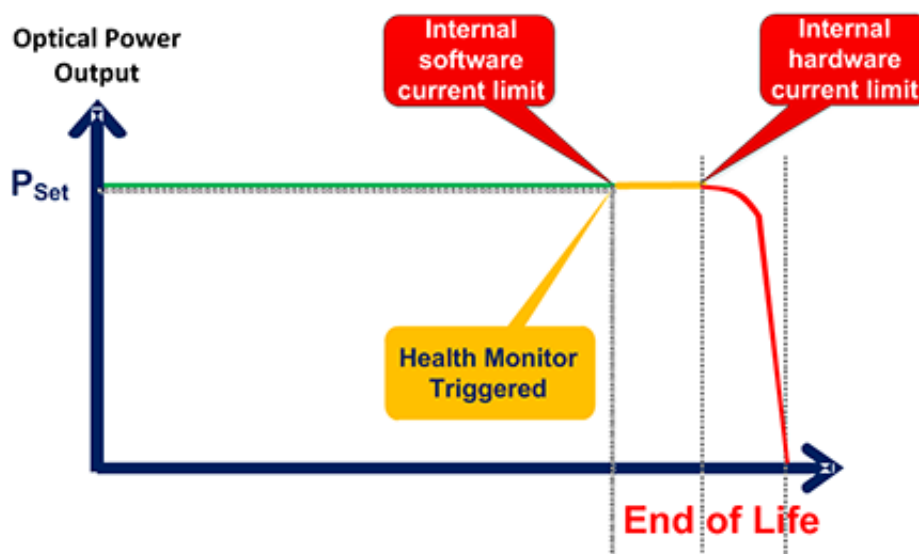


Figure 2-47. Health Monitor – End of Life

SECTION THREE: OPERATIONS

This section describes functions of the StingRay and BioRay lasers, including:

- Single laser operation (p. 3-2)
- Using a laser with the Remote (p. 3-2)
- Modes of operation (p. 3-4)
- Focus the laser (p. 3-9)
- Cleaning optics (p. 3-10)

Refer to “Appendix A: Safety and Compliance” to learn about required safety precautions when working with lasers.



WARNING!

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

Laser Operation

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

Turn the Laser ON/OFF

To turn the laser ON, either:

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



WARNING—LASER RADIATION!

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

To turn the laser OFF, either:

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

LED on the Laser

The laser includes an LED at the cable end of a StingRay or BioRay laser, as shown in Figure 3-1. This LED provides status information about operating of the laser.



Figure 3-1. Power-On LED

This multi-state LED can display more than one color at the end of the laser, as shown in the illustration in Figure 3-2:

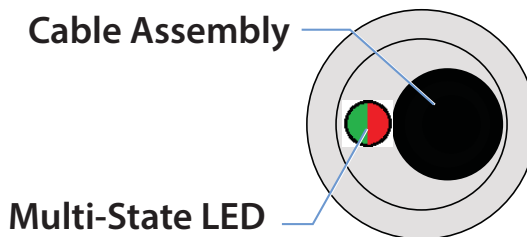


Figure 3-2. Multi-State LED on Laser

Table 3-1 lists the status displayed by the LED on the back of the laser:

Table 3-1. LED Analog Output Status

CONDITION	LED	RESET
Power OFF	OFF	—
Fault	Fast Flashing @ 5 Hz	Cycle power
Health Monitor	Slow Flashing @ 0.5 Hz	Reset automatically; see “Set Up Health Monitor (Optional)” (p. 2-26).
Power ON	ON	—

For information when using Coherent Connection software to check on Fault Conditions, see “Query System Fault” (p. 5-11).

Operating the Laser Using a Remote (Optional)

Using the StingRay/BioRay Remote is not required to operate the laser.



NOTE:

In this example, the laser is NOT CDRH-compliant for end-use applications.

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

To turn the laser ON using the Remote, plug the interlock jumper into the StingRay/BioRay Remote and turn the keyswitch to the ON position. For more information, see “Set Up and Connect the Remote” (p. 2-14).

Remote Keyswitch

The keyswitch on the StingRay/BioRay Remote acts as an ON/OFF switch for the laser. Table 3-2 describes the keyswitch position.

Table 3-2. Keyswitch Position

POSITION	DESCRIPTION
Standby	Standby = OFF When the key position is in the Standby position, it is the same as having the laser turned 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 immediately begins emitting.



WARNING—LASER RADIATION!

Avoid eye or skin exposure to both DIRECT and SCATTERED radiation. Read and following the recommended safety precautions in “Laser Safety Hazards”.

LEDs on the Remote

This section provides details about the LED colors that show the operating status of the StingRay/BioRay laser. Figure 3-3 shows the location of the LEDs.



Figure 3-3. LEDs on the Remote

Table 3-3 describes the LEDs and lists the ON conditions for each:

Table 3-3. Status of LEDs on the Remote

CONDITION	LED	DESCRIPTION
Power to Laser	YELLOW = Laser Ready	<ul style="list-style-type: none"> Light illuminates only when the keyswitch is in the ON position and the laser is powered for use. When the keyswitch is in the ON position and the interlock jumper is removed, the Laser Ready LED turns from Green to Red.
Laser Fault	RED = Laser Fault	Light is ON when there is a fault or an over-temperature condition in the laser.
Power to Remote	GREEN = Power ON	Laser is emitting when power is applied.

Table 3-4 lists the possible states of the Status LEDs on the Remote.

Table 3-4. StingRay/BioRay Remote — LED States

ACTION	READY	FAULT	ON
No power			
Power to Remote			Steady ON
Power to Laser	Steady ON		Steady ON
Interlock disconnect	Steady ON		Steady ON
Interlock reapplied after disconnect (must toggle keyswitch to reset)			Steady ON
Fault	Steady ON	Flashing	Steady ON

Modes of Operation



NOTE:

The mode of operation is configured at the time the unit is manufactured.

Following are operating modes used to modulate StingRay and BioRay lasers:

- Continuous Wave (CW)
- Analog Modulation:
 - Analog Modulation (A)
 - Reverse Analog Modulation (RA)
- Digital Modulation
 - Digital TTL(T) or Fast Digital TTL(FT) Modulation
 - Reverse Digital TTL(RT) or Reverse Fast Digital TTL(RFT) Modulation

Continuous Wave

The Continuous Wave (CW) option provides:

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

Signals for Modulation

Laser power can be modulated by using an external signal. A different option must be selected at the time the order is placed.

In addition to the V_{IN} (Power) and V_{IN} Ground lines, lasers equipped with modulation enabled are controlled by connecting these additional lines to the modulation source:

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

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

As you vary the voltage applied to the modulation input signal, the output power of the laser also varies according to the modulation curve.

Analog Modulation

Analog modulation allows the laser output power to track an analog input voltage. This feature is a waveform reproducing input signal to modulate the laser in frequency and adjust the output power via 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:

- Vary the output power
- Modulate with an arbitrary waveform
- With a square wave of different voltage levels, be able to control the laser with different output power levels

BioRay lasers are shipped as Analog Modulation as a standard configuration.

Any StingRay or BioRay laser configured with Analog modulation **must** have both the V_{MOD} input signal and the V_{MOD} Ground line connected for proper operation.

Analog options include:

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

Analog Modulation (A)

The Analog Modulation (A) option provides:

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

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

Figure 3-4 illustrates Analog Modulation:

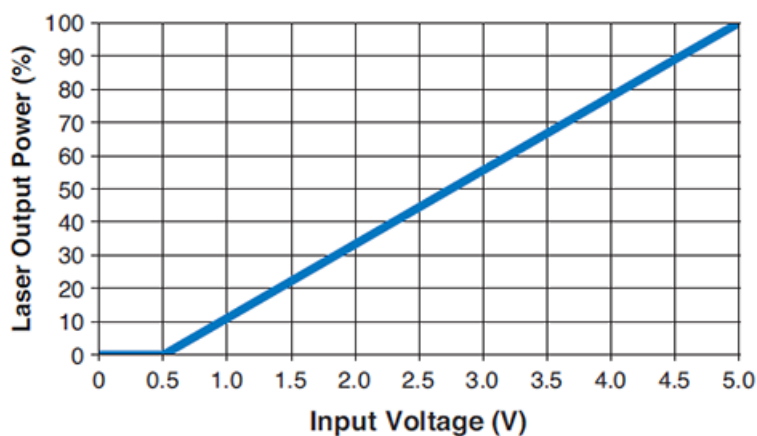


Figure 3-4. Analog Modulation (A)

Reverse Analog Modulation (RA)

The Reverse Analog Modulation (RA) option provides:

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

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

Figure 3-5 illustrates Reverse Analog Modulation:

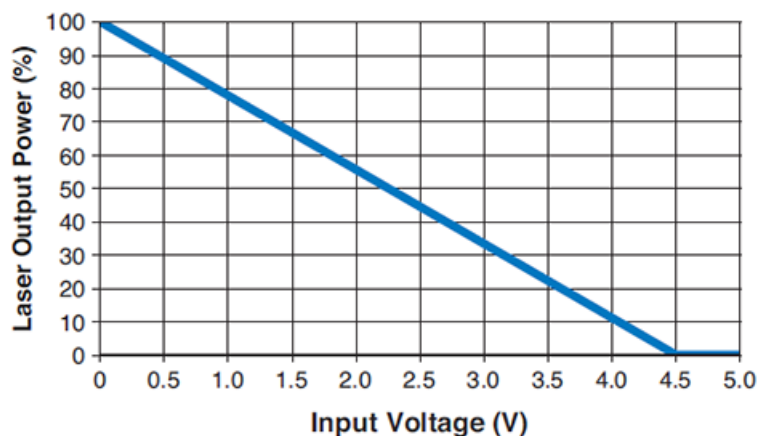


Figure 3-5. Reverse Analog Modulation (RA)



NOTE:

When the laser is configured for Analog Modulation, you must connect an Analog Modulation signal for proper operation.

Digital Modulation

StingRay and BioRay lasers can operate in Digital Modulation mode to control the laser output power. This is useful in applications that require a laser to turn 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 using the Coherent Connection software (or host interface) to allow the "ON" level for Digital Modulation to be adjustable.

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

Digital Modulation offers the following options, described in this section:

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

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

Digital Modulation options turn 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 3-5 lists the differences between these two options:

Table 3-5. Digital or Fast Digital Modulation Values

OPTION	FUNCTION	VALUE
Digital TTL(T)	Maximum bandwidth	100 KHz
	Rise time (10% to 90%)	<1 msec
	Fall time (90% to 10%)	<1 msec
Fast Digital TTL(FT)	Maximum bandwidth	2 MHz
	Rise time (10% to 90%)	<150 nsec
	Fall time (90% to 10%)	<150 nsec

Figure 3-6 illustrates the use of Digital or Fast Digital Modulation:

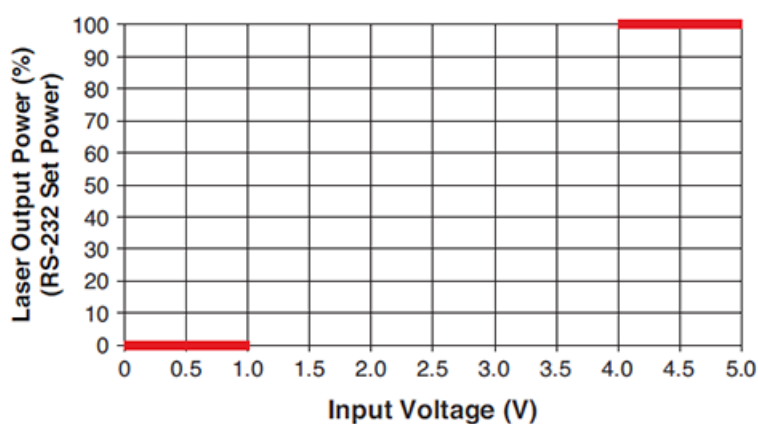


Figure 3-6. Digital or Fast Digital Modulation

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

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

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

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

Table 3-6 lists the differences between these two options:

Table 3-6. Digital or Fast Digital Modulation Values

OPTION	FUNCTION	VALUE
Reverse Digital TTL(RT)	Maximum bandwidth	100 KHz
	Rise time (10% to 90%)	<1 msec
	Fall time (90% to 10%)	<1 msec
Reverse Fast Digital TTL(RFT)	Maximum bandwidth	2 MHz
	Rise time (10% to 90%)	<150 nsec
	Fall time (90% to 10%)	<150 nsec

Figure 3-7 illustrates the use of Reverse Digital or Reverse Fast Digital Modulation:

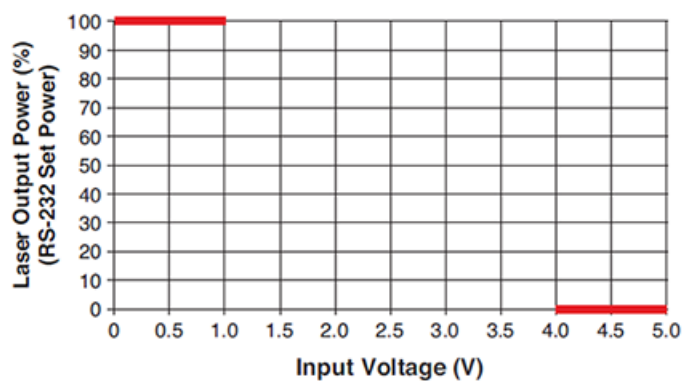


Figure 3-7. Reverse Digital or Reverse Fast Digital Modulation



NOTE:

When the laser is configured for Digital Modulation, you must connect an Digital Modulation signal for proper operation.

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 designed so that the focusing lens cannot be removed. If you have a application that requires accurate focusing and you want the laser to be pre-focused using a beam profiler, contact your sales person or see p. C-1 for Coherent Support.



WARNING!

Use caution when operating or working 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. Using the 0.035 hex wrench (provided), loosen the screw for the focus lock. This is identified by a straight white line under the screw, as shown in Figure 3-8.

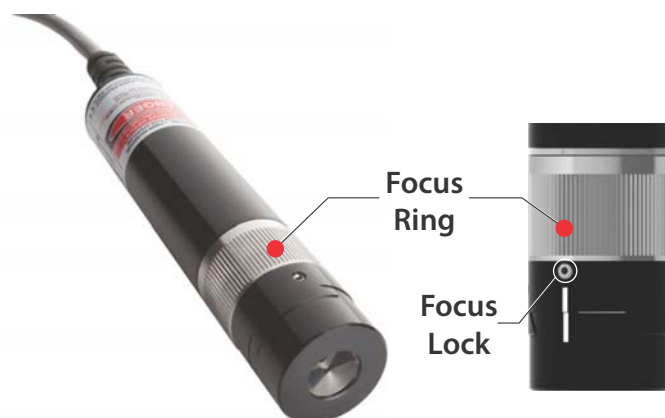


Figure 3-8. Focus Ring and Focus Lock



CAUTION!

DO NOT attempt 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. Grasp the focus ring and rotate the focus until it reaches the desired beam optical size at the working distance where you are using the laser.
 3. Tighten the focus lock. Torque the locking set screw to 12 inch-ounces.
-



CAUTION!

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

For information about changing the StingRay Optical Head (SOH), see “Change a StingRay Optical Head (SOH)” (p. 2-18).

Clean Optics



IMPORTANT!

Before you begin to clean optics, turn the laser OFF.

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

- Confirm that the image is focused. If it is not focused, follow the instructions in “Focus the Laser” (p. 3-9).
- Verify that the optics are not contaminated. If the optics are contaminated, go to the next section.

Clean Contained Optics



IMPORTANT!

Wipe gently to ensure that contamination does not scratch the lens.

If the optics are contaminated, it is best to try and remove visible contamination by blowing dry air across the surface. Make sure the air used is free of any oil or moisture.

If this technique fails to remove the contaminants, gently wipe the glass surface with a piece of lens tissue that has been slightly dampened with methanol or IPA alcohol.

Clean Diffraction Gratings



CAUTION!

Do not touch the laser with any cleaning products other than a sterile jet of nitrogen or air to clean a diffraction grating!

All lasers projecting a pattern other than a dot, a single line, or a crosshair have a diffraction grating.

If your laser has a diffraction grating, use *only* a sterile jet of nitrogen or air to clean the surface of the grating.

SECTION FOUR: INSTALL AND RUN SOFTWARE

This section describes how to install and run the Coherent Connection software for the StingRay and BioRay lasers:

- Coherent Connection software
 - Compatibility (p. 4-1)
 - System requirements (p. 4-1)
- Install software (p. 4-2)
- Overview of software tabs (p. 4-6)

For detailed information about commands and queries that can also be used with StingRay and BioRay lasers, see “Section Five: Host Interface”.

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 ordered with the RS-232 communication option enabled.



NOTE: RS-232 communications is configured at the factory and cannot be changed in the field.

Through the Coherent Connection software, you can communicate and control various parameters directly through a USB connection using commands and queries; see “Section Five: Host Interface” (p. 5-1).

The software allows direct interface with the laser to monitor the performance of the laser system. Depending on the laser configuration, features may include setting power, reporting diode temperature, and reporting laser hours.

Compatibility

In addition to StingRay and BioRay lasers, Coherent Connection software supports the following laser products: OBIS LX, OBIS LS, OBIS CORE LS, OBIS LG, and OBIS CellX.

System Requirements

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

- Windows v7, v8, and v10 (32- and 64-bit)
- Windows XP with Service Pack 3

NOTE: Functions are supported for backwards compatibility, with no automatic checks for software updates.

In addition, the computer must meet the following minimum requirements:

- CPU: 2.5 GHz or faster processor
- RAM: Minimum of 2 GB of RAM
- Available hard disk space: 10 GB
- USB 2.0 high-speed port
- 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.

Install Software

This section describes how to install the Coherent Connection software.



IMPORTANT!

Follow the set-up procedure in the order in which it is presented. Failure to do so may result in errors.

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 through a USB connection.
- Run the Coherent Connection software on the host computer.

To install software:

1. Close all other applications.
2. Download the Coherent Connection 4 software from the Coherent website, and unzip the files on the host computer.
http://cohrdownloads.blob.core.windows.net/file/Coherent_Connection_4.zip
3. Double-click the following file to start the installation process. The last two digits represent the number for the current software build:

Coherent_Connection_Setup_v4.0.0.xx

4. If you had previously installed the Coherent Connection software, the message shown in Figure 4-1 is displayed. Click [Yes](#) to proceed.

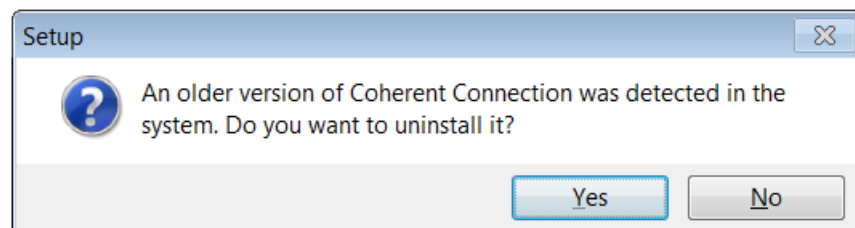


Figure 4-1. Uninstall Old Version of Software

5. From the drop-down menu shown in Figure 4-2, select the language in which to display the software and click [OK](#).

Available languages include English, Italian, French, German, Hebrew, and Japanese.

Note that the language selection applies only to software set-up instructions on-screen and not the Coherent Connection software itself (English only).

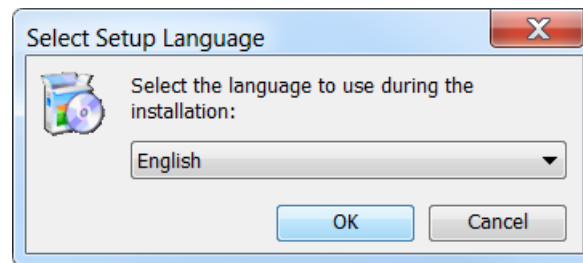


Figure 4-2. Select Language for Software

The Welcome screen shown in Figure 4-3 is displayed.



Figure 4-3. Welcome Screen for Installation

6. Read the instructions, then click [Next](#). The License Agreement shown in Figure 4-4 is displayed.

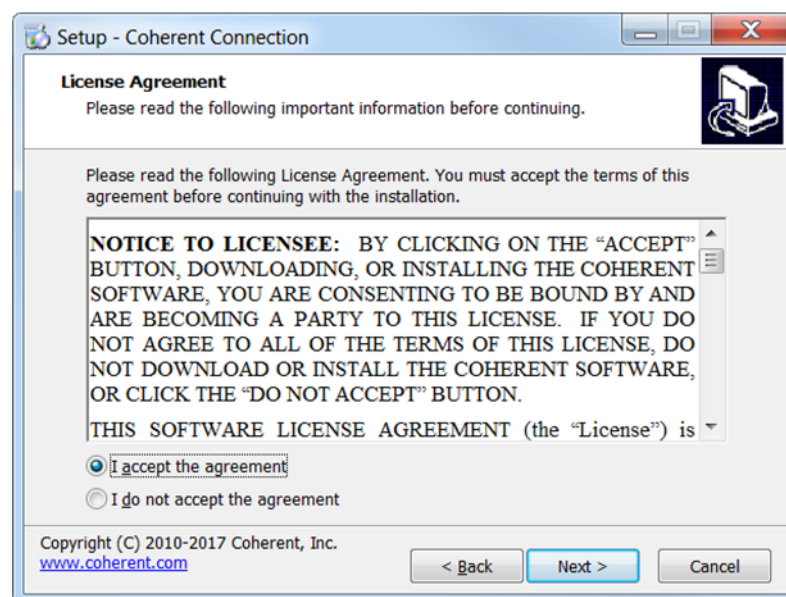


Figure 4-4. Coherent Connection 4 License Agreement

7. Scroll down to read the agreement. Note that the [Next](#) button is grayed out until you click the radio button to **Accept** the terms and conditions. When you do that, the button is activated; click [Next](#).
8. The window shown in Figure 4-5 is displayed. Accept the selection, or browse to select the directory on the computer where you want to install the software, and click [Next](#).

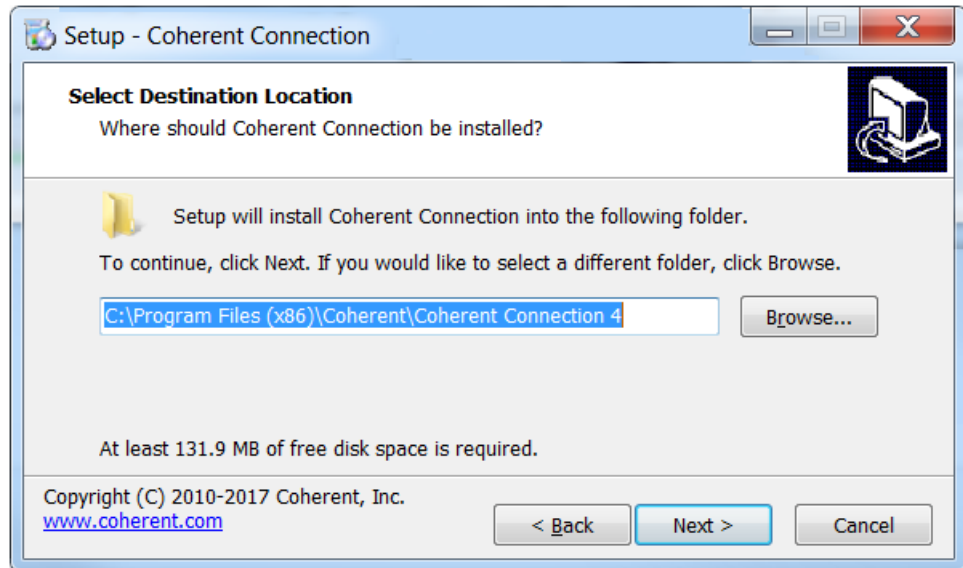


Figure 4-5. Select Directory to Install Software

9. You can create an icon for the software either on your desktop or for a Quick Launch (or both). As shown in Figure 4-6, click the appropriate check box, and then click [Next](#).

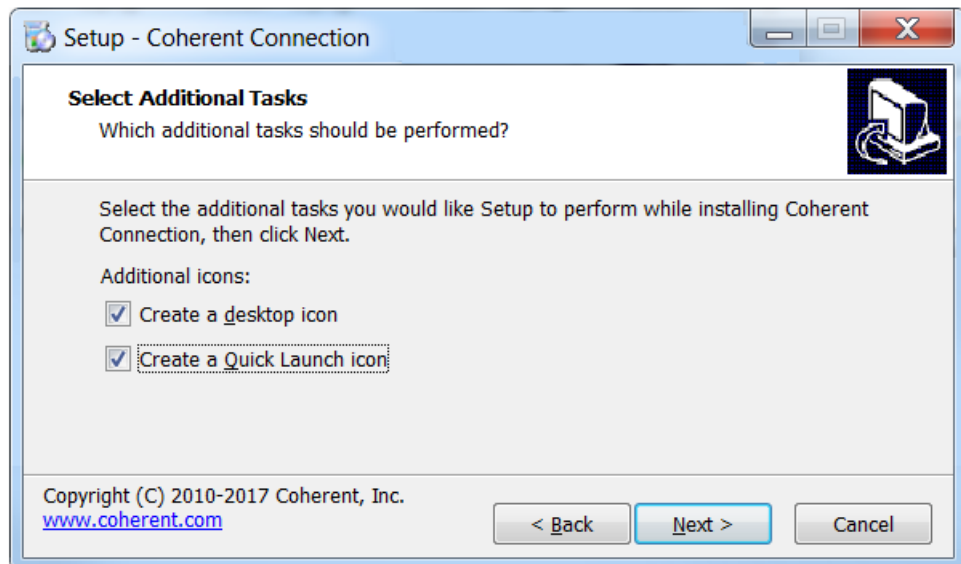


Figure 4-6. Set Desktop or Quick Launch Icon

10. The set-up utility is now ready to begin installing Coherent Connection 4 software on your computer. Review the location and icons, as shown in the example in Figure 4-7, and then click [Next](#).

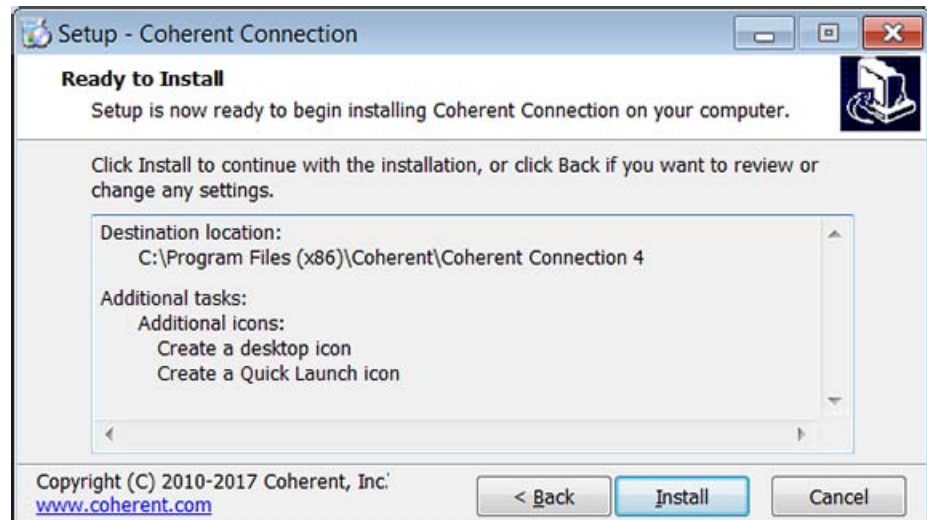


Figure 4-7. Review Set-Up before Installation Begins

A progress bar is displayed, as shown in Figure 4-8.

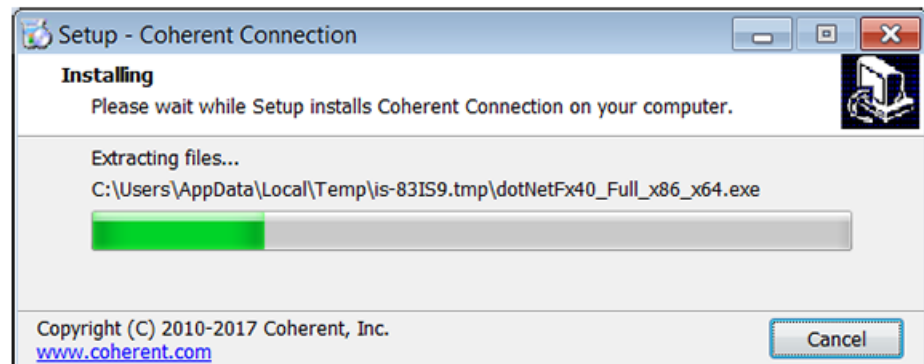


Figure 4-8. Progress of Installation

11. After all files are extracted, click [Finish](#). The screen shown in Figure 4-9 closes and the software is ready to be launched.

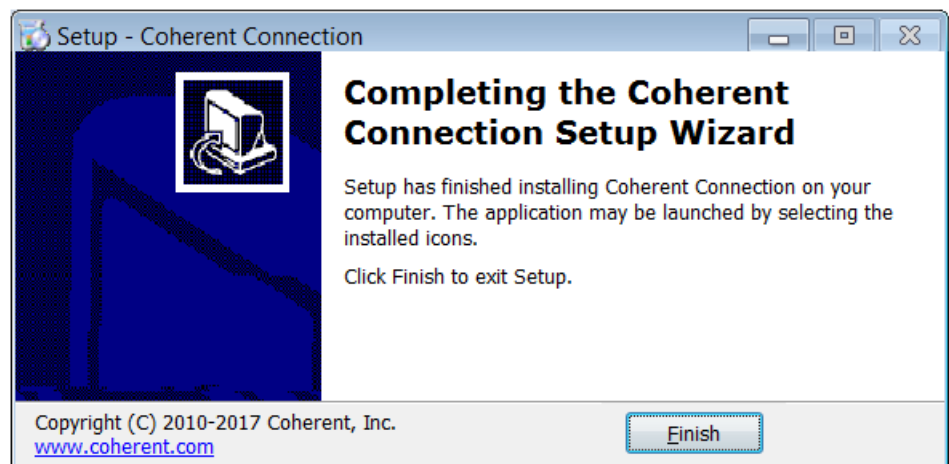


Figure 4-9. Finish the Software Installation

The software and USB driver are now installed. If you selected a short-cut (icon) to be set up during installation, that is now displayed on the desktop of your computer (shown in Figure 4-10) and/or in the Quick Launch menu:



Figure 4-10. Desktop Icon for Coherent Connection 4 Software



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

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 displays an empty window, as shown in Figure 4-11.

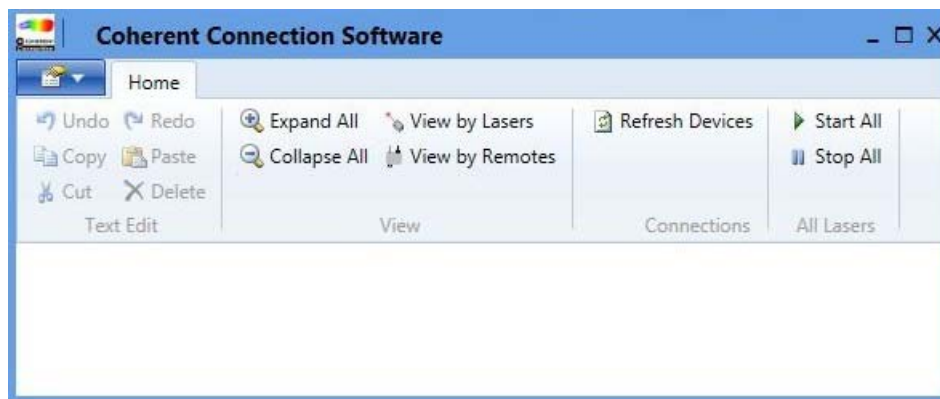


Figure 4-11. Coherent Connection Software – Main Screen (Empty)

After you connect and turn on power to the laser, the window lists the laser that is connected, as shown in Figure 4-12. This identifies the laser and shows top-level information only.

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

- To **show** details, click the Down arrow beside the desired laser. This expands the window to show details about the laser selected.
- To **hide** details, click the Up arrow beside the desired laser. This collapses the window to show only the top-level name of the laser selected.

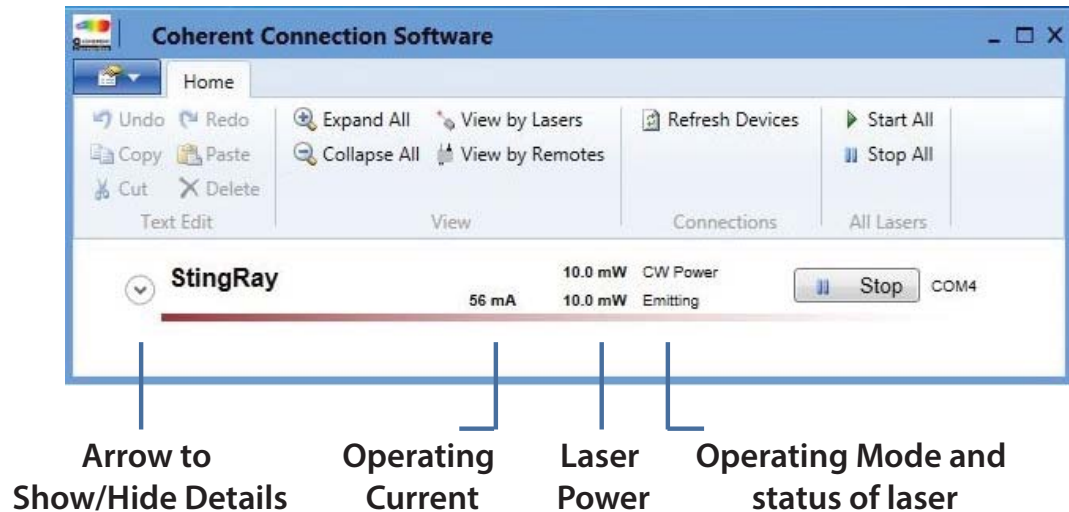


Figure 4-12. Software – One Laser Connected

If you connect more than one StingRay or BioRay laser, the window lists all lasers, as shown in Figure 4-13. This identifies each laser, but the window is not yet expanded to show detailed information.

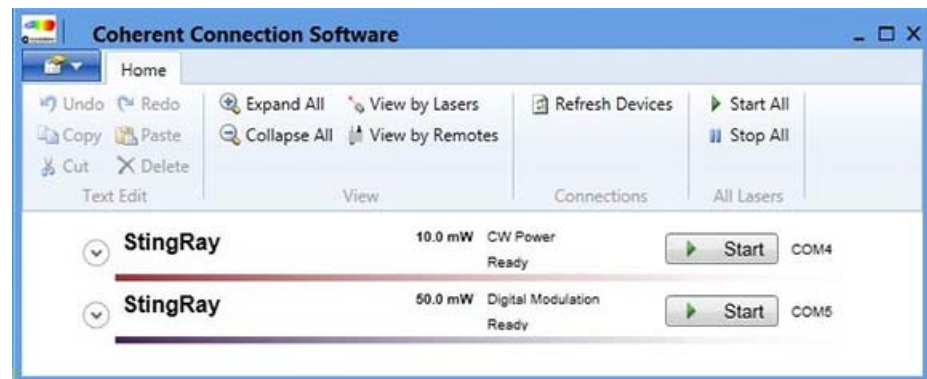


Figure 4-13. Software – Multiple Lasers Connected

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

- Operating Power tab
- Advanced tab
- Details tab
- Commands tab
- Remote tab

Each of these are described in the sections that follow.

Operating Power Tab

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



NOTE:

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 4-14 shows the Operating Power tab window expanded with details about a 100 mW laser in Continuous Wave (CW) Mode, ready but not emitting.

Click the [Start](#) button to begin emitting.

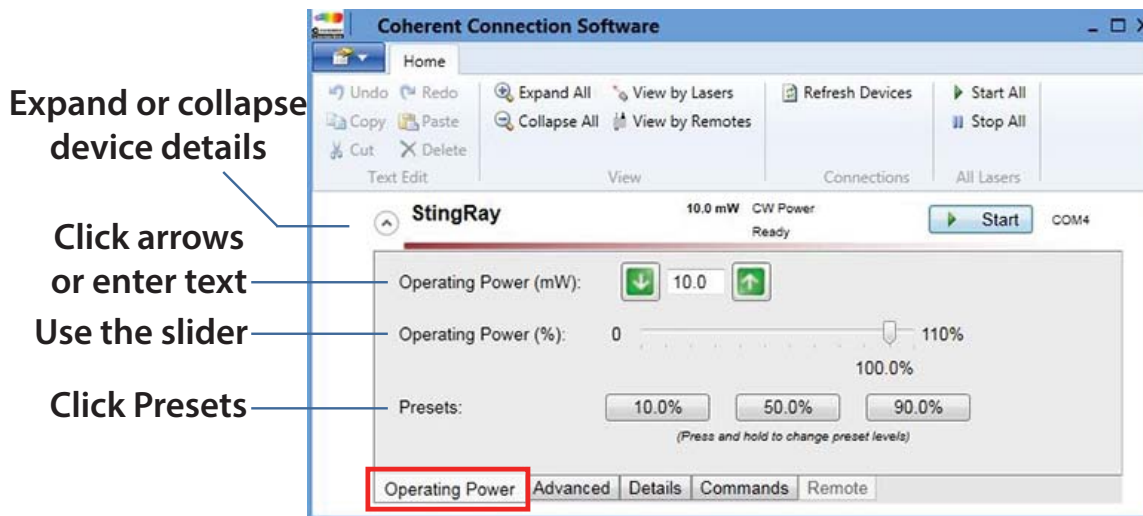


Figure 4-14. Software – Operating Power Tab

To edit the Operating Power (mW) level:

- Click the green DOWN-arrow button to decrease power levels by 1 mW per click.
- Click the green UP-arrow button to increase power levels by 1 mW per click.
- Enter text in the box between the arrows to specify the power level.

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

- Drag the slider until you reach the power level you want to use or to adjust the current power level.
- Click the left side of the Operating Power 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 to make the current power setting the new preset for that particular button.
- One click changes to 10, 50 or 100% (user-selectable)

Changes take effect immediately.

In the following examples, details in the windows change depending on the Operating Mode and status of the laser.

The example in Figure 4-15 shows a laser operating in Continuous Wave (CW) mode. Click the [Start](#) button and the laser immediately begins emitting.

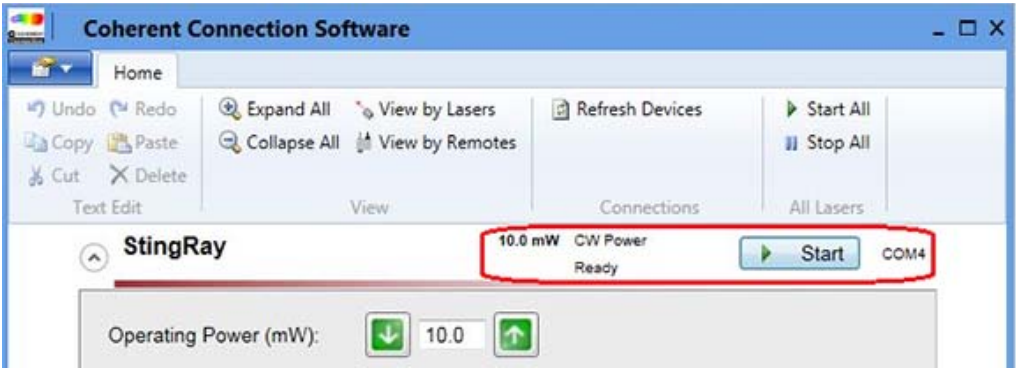


Figure 4-15. Example—CW Mode Emitting

If the CDRH delay was configured at the factory, there is a 5-second delay before the lasers start emitting, as shown in Figure 4-16.

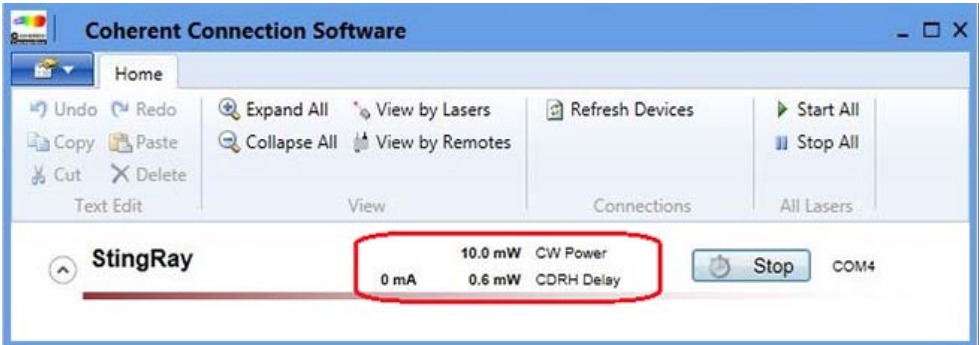


Figure 4-16. CDRH Delay Enabled

Figure 4-17 shows both lasers emitting a 100% Output Power level, at 10 mW and 50 mW respectively.

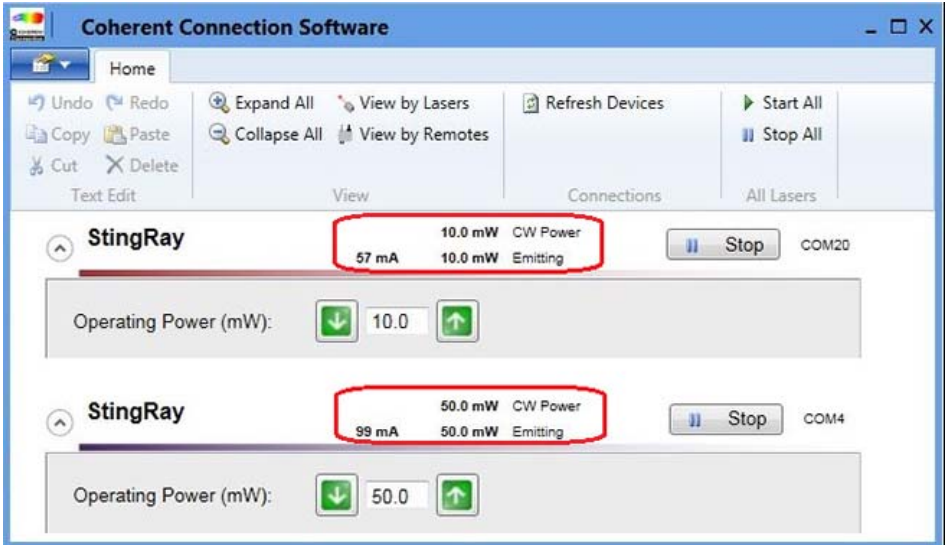


Figure 4-17. Laser Emitting at Full Output Power

Advanced Tab

Figure 4-18 shows the Advanced tab that lists a single laser.

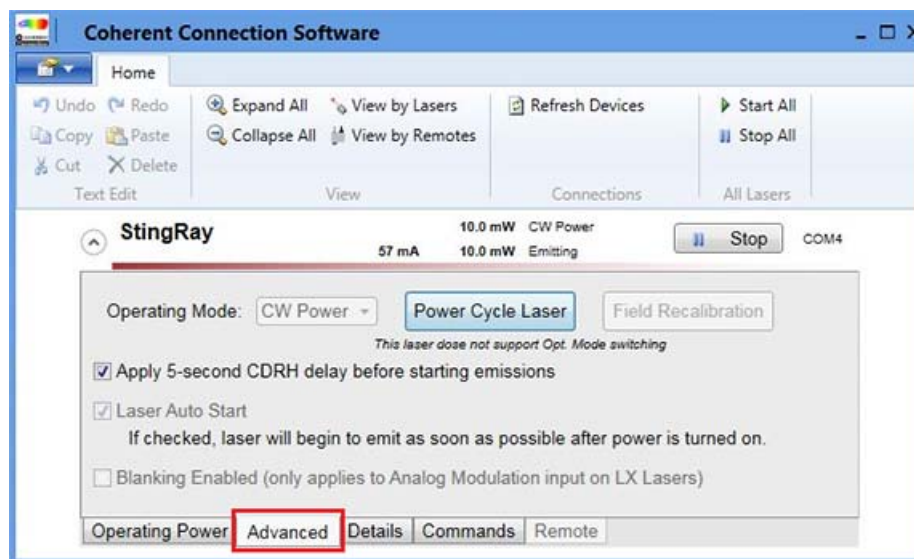


Figure 4-18. Example— Advanced Tab

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

Options for StingRay/BioRay lasers include:

- Operating Mode

The Operating Mode for each laser is configured at the factory for each laser and cannot be changed. See “Modes of Operation” (p. 3-4) for more information.
- CDRH Delay

The CDRH option can be Enabled or Disabled using an RS-232 command ONLY if the communications option (-TX) was enabled at the factory at the time the StingRay laser is ordered. This option cannot be added or Enabled in the field.

The following options are grayed out. They do not apply to StingRay/BioRay lasers.

- Laser Auto Start
- Blanking Enabled
- Field Calibration

Details Tab

Figure 4-19 shows the Details tab, where you can view the model, serial number, and other information that is specific to the laser currently selected. Users can select device information using the ID command `SYSTEM:INF:USER <user selected identification string>`; see p. 5-8 for more information.

When there are multiple lasers listed in the window, you can show or hide information for each individual laser. The same type of information is available for each laser.

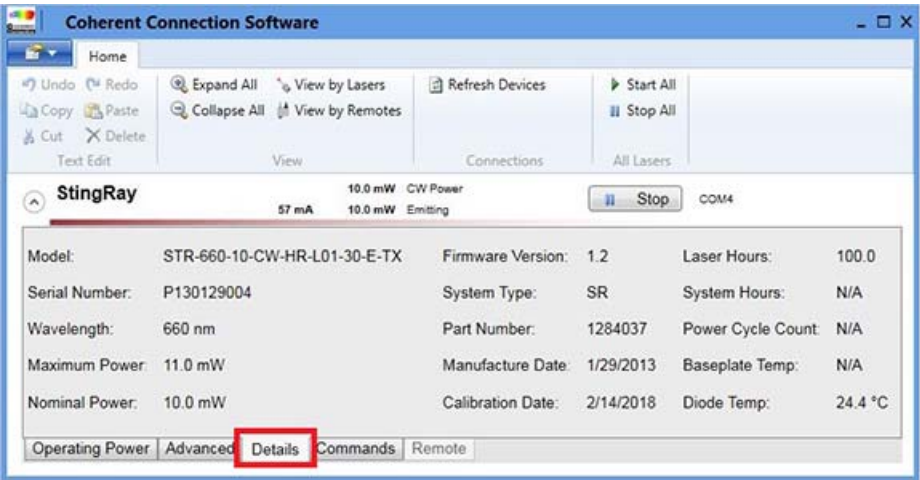


Figure 4-19. Example—Details Tab

Commands Tab

Figure 4-20 shows the Commands tab. Enter commands or queries in the space near the bottom of the window.

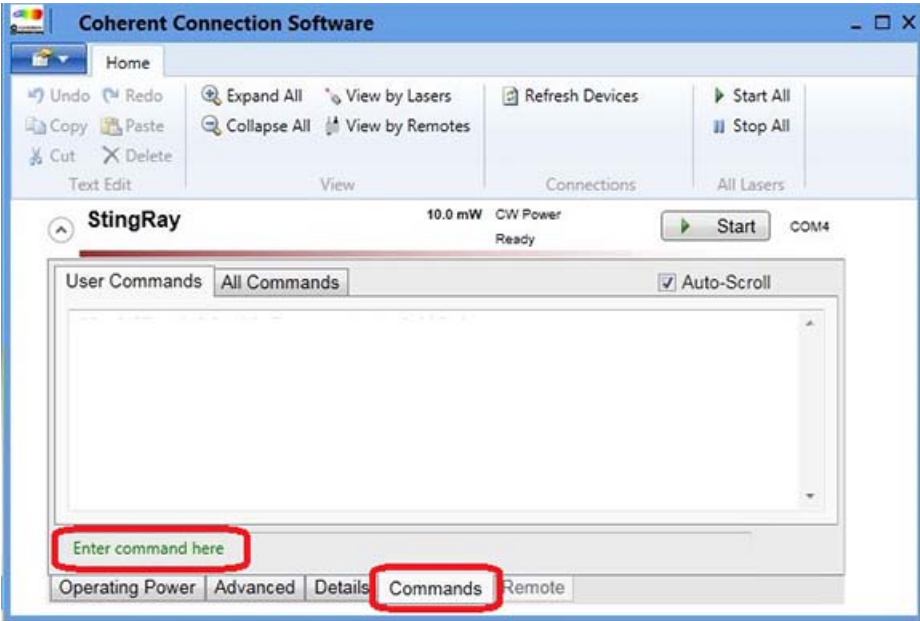


Figure 4-20. Example—Commands Tab

View commands sent to control the laser, as well as responses received from the laser, in the center section of the window, as shown in Figure 4-21:

For more information about commands and error messages, see “Section Five: Host Interface” (p. 5-1).

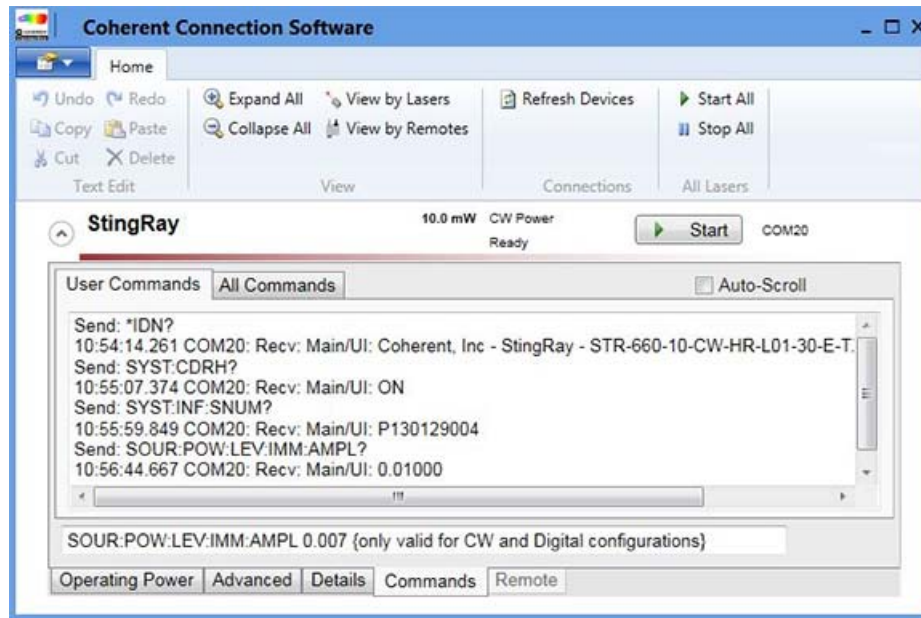


Figure 4-21. Example—Commands Running

Remote Tab

The Remote Tab is grayed out. This option is not available for use with a StingRay/BioRay Remote.

SECTION FIVE: HOST INTERFACE

This section describes host interface for the StingRay and BioRay lasers, including:

- Host command quick reference (this page)
- Message considerations (p. 5-3)
- Commands and Queries for
 - System Set-Up (p. 5-5)
 - Laser System Information (p. 5-7)
 - Laser Operations (p. 5-9)
- Error codes (p. 5-12)

When a command is sent to the laser system, the parameter for the command is stored in internal persistent memory. Internal persistent 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.

Host Command Quick Reference

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

- To use commands and queries, the StingRay or BioRay laser must be configured with Communications Enabled (TX).
- To send a command to the laser, use the appropriate 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 5-1)
- Laser information (Table 5-2)
- Laser operation (Table 5-3)

Table 5-1. System Set-Up Commands and Queries

COMMAND/QUERY	DESCRIPTION	PAGE
*IDN?	Queries the identification string for the laser	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 5-2. Laser Information Commands and Queries

COMMAND/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
SYST:INF:POW?	Retrieves the power rating of the laser	5-9
SYST:INF:USER	Enters and stores user-defined information	5-9
SYST:INF:USER?	Queries user-defined information	

Table 5-3. 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:CURRE: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

Table 5-3. Laser Operation Commands and Queries (continued)

COMMAND/QUERY	DESCRIPTION	PAGE
SOUR:TEMP:PROT:DIOD:LOW?	Queries laser diode low temperature limit (degrees Celsius)	5-11
SOUR:TEMP:PROT:DIOD:HIG?	Queries laser diode high temperature limit (degrees Celsius)	
SYST:FAUL?	Queries current system faults	5-12

Short Forms for Commands/Queries

Following is a key that describes 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 = LEVel
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	

Message Considerations

This section provides additional information about various messages that may be displayed.

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 provides:

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.

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.

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 proper termination.

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.

Message Syntax

Syntax specified by the SCPI and IEEE 488.2 Standards is followed unless otherwise specified. 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 **YYMMDD** 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.

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.

System Set-Up Commands and Queries

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

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.

QUERY	*IDN?
REPLY	“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 YYYYMMDD. The reply string is not quoted.

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.

QUERY	SYST:CDRH?
REPLY	ON OFF

Set/Query Baud Rate

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

COMMAND	SYST:COMM:BAUD <baud rate>
QUERY	SYST:COMM:BAUD?
REPLY	115200

Set/Query Handshaking

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

COMMAND	SYST:COMM:HAND {ON OFF}
QUERY	SYST:COMM:HAND?
REPLY	ON OFF

When enabled, the device responds to each received command or query by transmitting one of the handshaking strings described under “Message Completion Handshake” (p. 5-3).

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.

Set/Query Command Prompt

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

COMMAND	SYST:COMM:PROM {ON OFF}
QUERY	SYST:COMM:PROM?
REPLY	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.

Laser Information Commands and Queries

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

Query System Model Name

Retrieves the model name of the laser.

QUERY	SYST:INF:MOD?
REPLY	<model name>

Query System Part Number

Retrieves the manufacturer part number of the laser.

QUERY	SYST:INF:PNUM?
REPLY	<manufacturer part number>

Query System Manufacture Date

Retrieves the manufacture date of the device.

QUERY	SYST:INF:MDAT?
REPLY	<manufacture date>

Query System Serial Number

Retrieves the serial number of the laser.

QUERY	SYST:INF:SNUM?
REPLY	<serial number>

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 described in the *IDN? Query.

QUERY	SYST:INF:FVER?
REPLY	<current firmware version>

Query System Wavelength

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

QUERY	SYST:INF:WAV?
REPLY	<wavelength>

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.

QUERY	SYST:DIOD:HOURL?
REPLY	<x.xx hours >

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.

QUERY	SYST:INF:POW?
REPLY	<power>

Set/Query User-Defined ID

Enters and stores user-defined identification or any other information the user wants to store for the device. <index> = (0, 3). <item> = (0, 31 characters)

COMMAND	SYST:INF:USER <text string>, <item>
QUERY	SYST:INF:USER? <text string>
REPLY	<text string up to 31 characters>

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 could identify each by the location or project.

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.

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.

QUERY	SYST:STAT?
REPLY	<status word>

Table 5-4 describes 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 5-4. Status Code Bit Definitions

BIT	MASK	BIT LABEL	LASER
0	00000001	Laser Fault	Laser faults (see Table 5-5)
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 turned ON, but emission is delayed because the CDRH 5-second delay was enabled at the factory, the system status query returns:

00000012 (Laser emission enabled but delayed by CDRH)

Set/Query Laser Enable

Turns the laser ON or OFF. When turning the laser ON, actual laser emission may be delayed due to internal circuit stabilization logic and/or CDRH delays. Query returns the present laser ON/OFF state in string format.

COMMAND	SOUR:AM:STAT ON OFF
QUERY	SOUR:AM:STAT?
REPLY	ON OFF

Query Laser Operating Mode

Queries the current operating mode of the laser.

QUERY	SOUR:AM:SOUR?
REPLY	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.

Query Operating Current of the Laser

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

QUERY	SOUR:CURR:LEV?
REPLY	<x.xxxxx>

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.

QUERY	SOUR:POW:LEV?
REPLY	<x.xxxxx>

Query CW Nominal Power

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

QUERY	SOUR:POW:NOM?
REPLY	<x.xxxxx>

Set/Query Laser Power Level

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



IMPORTANT!

Setting the power level does not turn the laser on.

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

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

COMMAND	SOUR:POW:LEV:IMM:AMPL <value>
QUERY	SOUR:POW:LEV:IMM:AMPL?
REPLY	<x.xxxxx>

Query Diode Temperature

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

QUERY	SOUR:TEMP:DIOD?
REPLY	<x.x>



NOTE:

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

Query Internal Temperature

Queries the present internal temperature of the laser. The reply string represents the value in degrees Celsius.

QUERY	SOUR:TEMP:INT?
REPLY	<x.x>

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

Query High Temperature Limit

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

QUERY	SOUR:TEMP:PROT:DIOD:HIG?
REPLY	<x.x>

Query Low Temperature Limit

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

QUERY	SOUR:TEMP:PROT:DIOD:LOW?
REPLY	<x.x>

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.

QUERY	SYST:FAUL?
REPLY	<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 described in Table 5-5 (fault code bit mapping).

Table 5-5. 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 ² C Error	I ² 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

Error Codes

Table 5-6 lists the Error Codes and provides information about the condition under which each error code is issued:

Table 5-6. 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.
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.

SECTION SIX: PARTS AND ACCESSORIES

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

- Laser Power Supply (p. 6-1)
- Mounting Brackets (p. 6-2)
 - Heat Sink Mount: Standard (p. 6-3)
 - Heat Sink Mount: Separate Driver (p. 6-4)
 - Heat Sink Mount Adapter Plate (p. 6-4)
 - Multi-Axis Mount (p. 6-5)
- StingRay/BioRay Remote Kit (p. 6-6)
 - StingRay/BioRay Remote (p. 6-7)
 - StingRay/BioRay Remote Power Supply (p. 6-13)
 - (Optional) Third-party Mounting Brackets (p. 6-12)
- Connectors (p. 6-14)
 - Flying Leads (p. 6-14)
 - Hirose Connector (p. 6-15)
 - Legacy Phono-style Power Plug Options (p. 6-16)
- Filters (p. 6-18)

These parts and accessories are specifically designed and selected for easy integration and to optimize performance of the StingRay and BioRay lasers. See ““Summary of Part Numbers” (p. 6-19)” for part numbers to order.

For instructions about how to set up the various configurations of parts and accessories, see “Section Three: Set Up Equipment”.

Power Supply for Lasers with Flying Leads

The Coherent Laser Power Supply (P/N 1232091) for StingRay and BioRay lasers is shown in Figure 6-1.



Figure 6-1. 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 p. 2-9.

Note that a different power supply works with the StingRay/BioRay Remote (see p. 6-13). Only the North American power cord set (NEMA 5-15P to IEC-60230) is supplied. For other locations, customers must supply a power cord appropriate for the outlet.

Figure 6-2 shows the dimensions for the Power Supply for StingRay lasers that are configured with a Flying Leads cable termination.

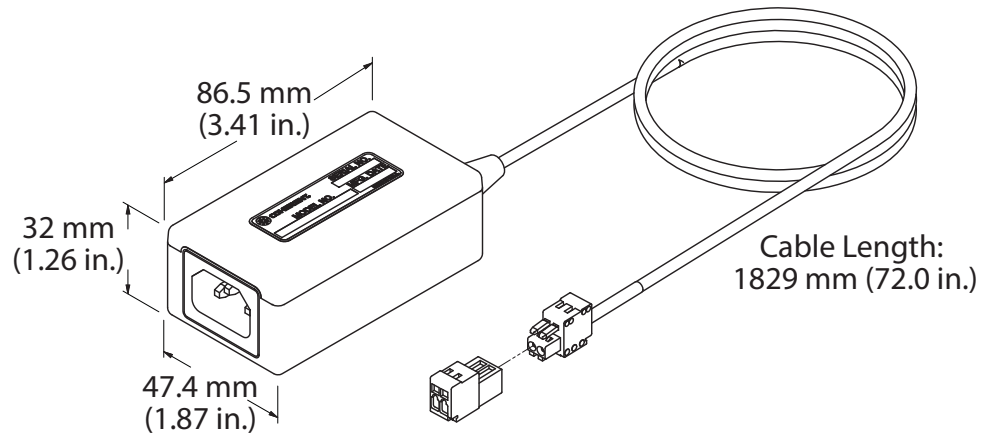


Figure 6-2. Dimensions – Power Supply Configured with Flying Leads Cable

The pin-outs for the terminal block on the power supply connector are shown in Figure 6-3:

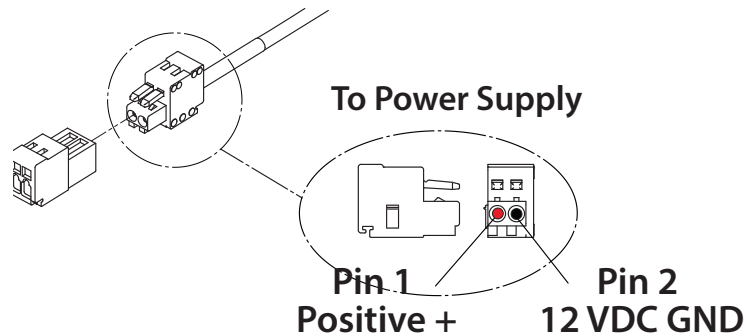


Figure 6-3. Pin Connector for Individual Laser Power Supply

For instructions about how to wire the terminal block to the flying leads, see “Wire a Laser with Flying Leads to a Power Supply” (p. 2-9).

Mounting Brackets

The options available to mount StingRay and BioRay lasers are described 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)

Heat Sink Mount: Standard

This standard Heat Sink Mount is specifically designed 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 6-4 shows the standard Heat Sink Mount (P/N 1222896) for StingRay and BioRay lasers:



Figure 6-4. Laser in a Standard Heat Sink Mount

The mount includes 4 thru-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 6-5 shows the dimensions from the Side and Front views.

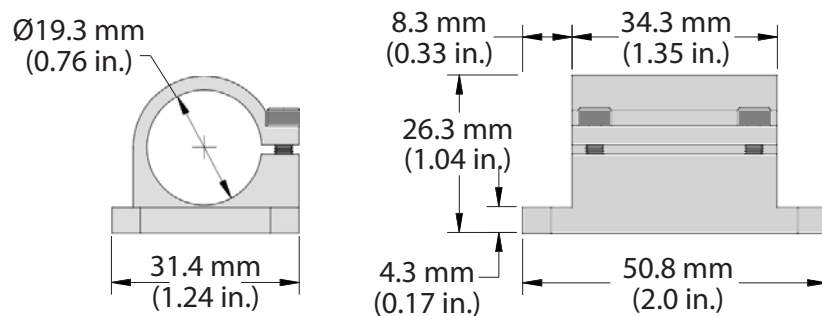


Figure 6-5. Dimensions – Standard Heat Sink Mount – Front and Side Views

Figure 6-6 shows the dimensions of the standard Mount from the bottom.

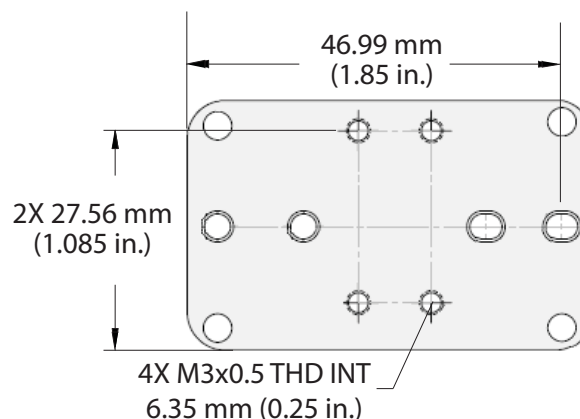


Figure 6-6. Dimensions – Standard Heat Sink Mount – Bottom View

Heat Sink Mount: Separate Driver (SD)

A compact Heat Sink Mount (P/N 1264007) shown in Figure 6-7 is available. This mount is used when ordering a StingRay "Separate Driver (SD)" laser configuration.



Figure 6-7. SD or Compact Holding Heat Sink Mount

Figure 6-8 shows the dimensions for the Separate Driver Heat Sink Mount from the side and front:

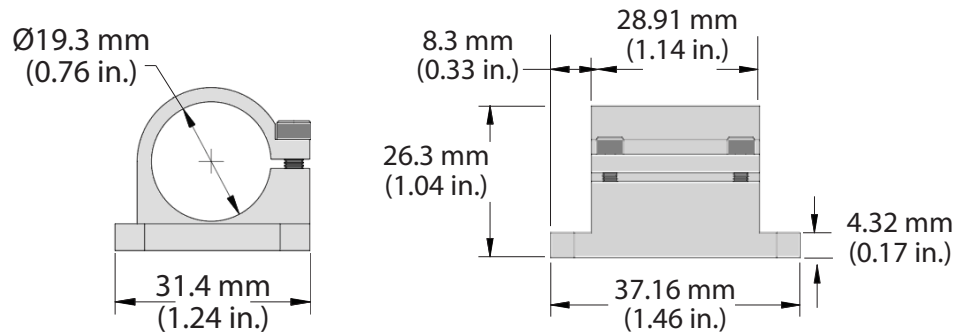


Figure 6-8. Dimensions – SD or Compact Holding Heat Sink Mount – Side and Front

Figure 6-9 shows the dimensions from the bottom for the SD Heat Sink Mount:

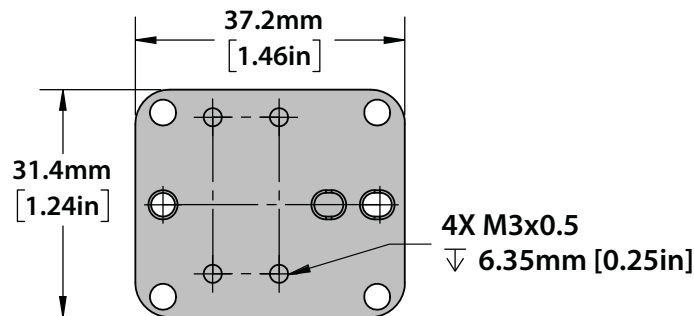


Figure 6-9. Dimensions – SD or Compact Holding Heat Sink Mount – Bottom

Heat Sink Mount Adapter Plate

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

The Adapter Plate (P/N 1222894) for StingRay and BioRay lasers is shown in Figure 6-10. 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.

1225414
Heat Sink Mount
Not Included

4X M3 Fasteners
Included

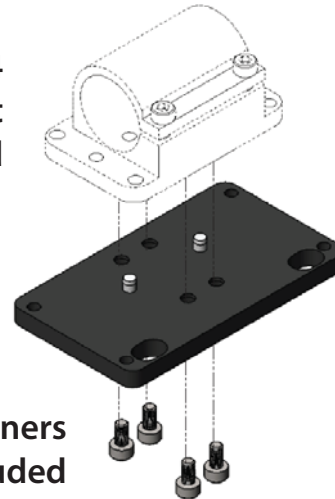


Figure 6-10. Adapter Plate for Heat Sink Mount

The dimensions for the Heat Sink Mount Adapter Plate are shown in Figure 6-11.

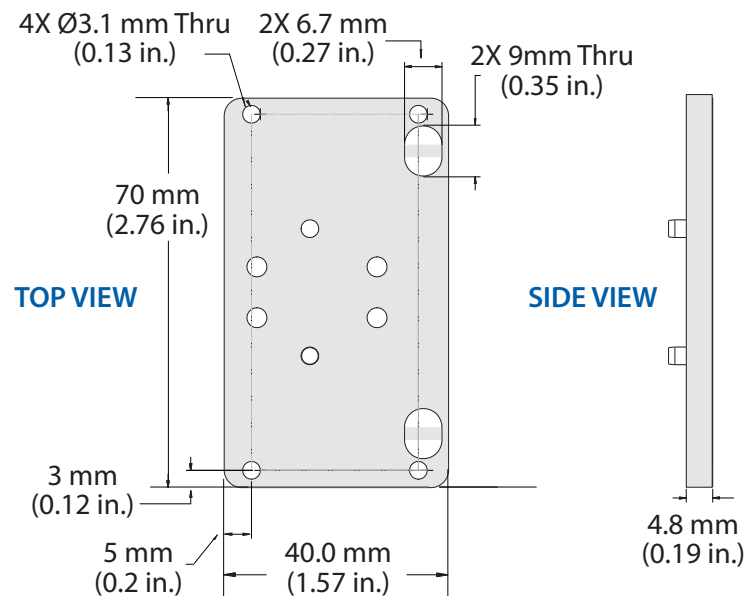


Figure 6-11. Dimensions – Adapter Plate for Heat Sink Mount

Multi-Axis Mount

The Multi-Axis Mount (P/N 1280838) provides 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 provides 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 using two machined slots for quick installation to the X-axis.

The dimensions for the Multi-Axis Mount from the SIDE and FRONT Views are shown in Figure 6-12.

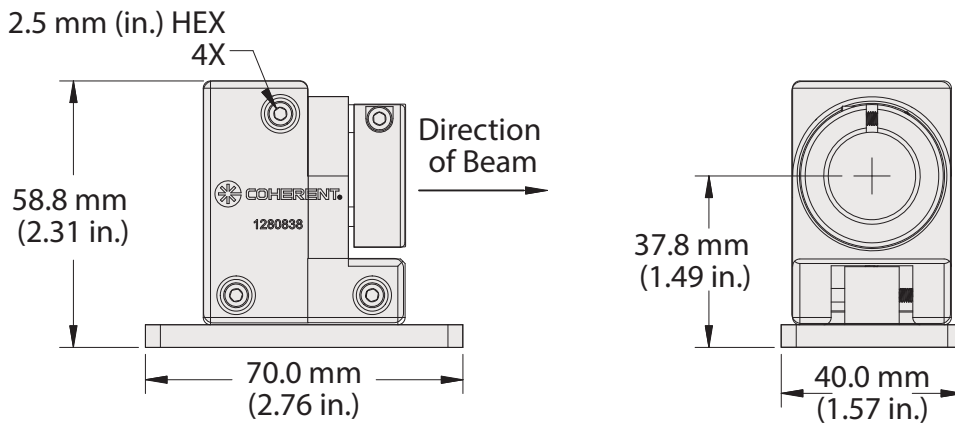


Figure 6-12. Dimensions – Multi-Axis Mount – Side and Front Views

The dimensions for the Multi-Axis Mount from the top view are shown in Figure 6-13.

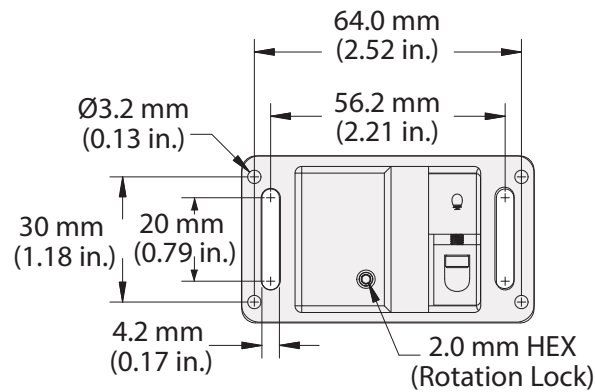


Figure 6-13. Dimensions – Multi-Axis Mount — Top View

StingRay/BioRay Remote Kit

The StingRay/BioRay Remote Kit (P/N 1231404), shown in Figure 6-14, 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
- USB Flash Drive with Coherent Connection control software (P/N 1258561)

See “Install a Laser with a Remote” (p. 2-13) for set-up instructions.



Figure 6-14. Contents of Remote Kit

StingRay/BioRay Remote

The StingRay/BioRay Remote (P/N 1225414), shown in Figure 6-15, is a compact, multi-functional control box that lets you connect to a StingRay or BioRay laser terminated with a Hirose connector.



Figure 6-15. StingRay/BioRay Remote

This interface provides safety features as well as feedback, status, and control of the laser to comply with end-use applications. The Remote also provides an interface to the laser for power, modulation, and communications. 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
- Modulation signal (0 to 5 V_{DC}) through the BNC connector to the laser. Required only if the laser is ordered with modulation. Users must provide the modulation input voltage.

See “Connections to Lasers” (p. 6-14) for more information.

Figure 6-16 shows the dimensions from a side view.

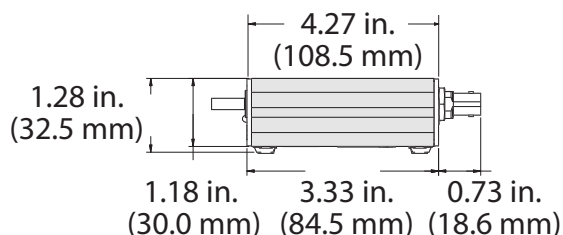


Figure 6-16. Dimensions – StingRay/BioRay Remote

Front Panel

The front panel of the StingRay/BioRay Remote includes a keyswitch, a remote interlock, and an emission indicator.



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 6-17.

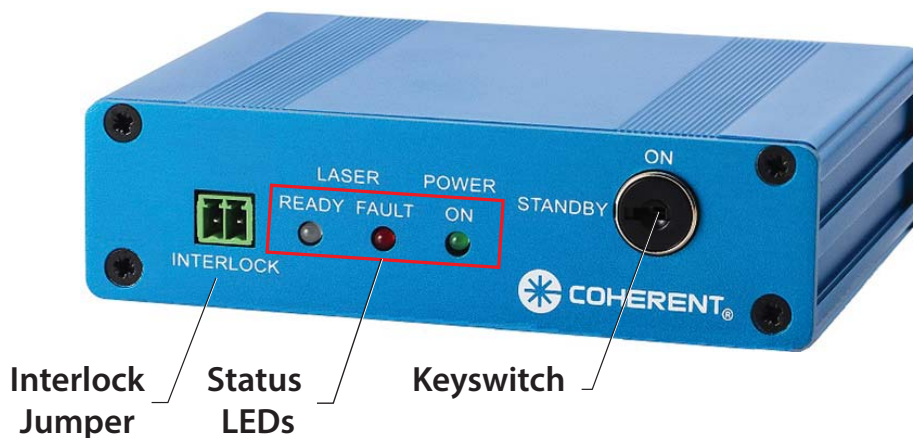


Figure 6-17. StingRay/BioRay Remote – Front Panel

Interlock Jumper

Figure 6-18 shows the Interlock Jumper on the front panel of the 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/>).

Status LED Indicators

Figure 6-19 shows the three Status LEDs that are located on the front panel of the StingRay/BioRay Remote. This example shows the Fault LED turned ON (illuminated as red). For details about the colors displayed by the LEDs during operation of the laser, see “LED on the Laser” (p. 3-2).

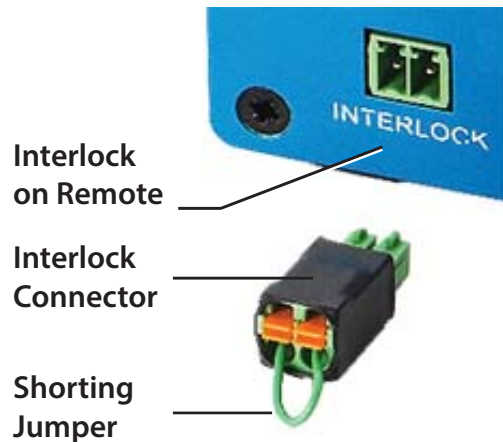


Figure 6-18. Interlock Jumper on the StingRay/BioRay Remote



Figure 6-19. LEDs on the Remote Front Panel

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 6-20 shows the keyswitch in the STANDBY and the ON positions.



Figure 6-20. 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:** Plug 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 shuts 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.

Back Panel

The features on the back panel of the StingRay/BioRay Remote are shown in Figure 6-21. Each of these are described in the subsections that follow.

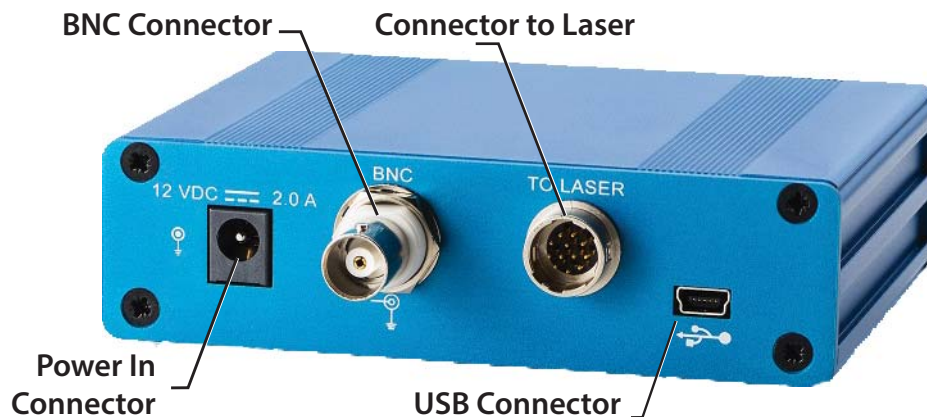


Figure 6-21. Back Panel on StingRay/BioRay Remote

The back panel includes the following connectors:

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

Power-In Connector

The Power In Connector is a 2mm Jack.

Figure 6-22 shows the Power-In connector on the StingRay/BioRay Remote.



Figure 6-22. Power-In Connector – StingRay/BioRay Remote

The input voltage for a StingRay/BioRay Remote is 12 V_{DC}. For information about the Power Supply for the StingRay/BioRay Remote, see p. 6-13.

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 “Appendix D: Coherent Service and Support”.

BNC Connector

The BNC connector provides a path for the modulation signal to pass 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. 3-5) for input requirements.

Figure 6-23 shows the BNC connector on the back of the StingRay/BioRay Remote.



Figure 6-23. BNC Connector – StingRay/BioRay Remote

For more information, see:

- “Power Plug, Phono 3.5 mm and BNC for Modulation” (p. 6-17) for a description of a cable with BNC connector, dimensions, and pin-outs
- “Set Up and Connect the Remote” (p. 2-14) for an example showing the use of a BNC connector

Hirose Connector to Laser

The “To Laser” connector on the Remote provides for a connection to a StingRay or BioRay laser using a mating Hirose connector HR10-A-10R-12PB(72).

The 12-pin Hirose “To Laser” receptacle is shown in Figure 6-24.



Figure 6-24. Hirose Connector to Laser

For pin-outs and details about a Hirose cable assembly, see p. 6-15.

USB Connector

Figure 6-25 shows the connector receptacle for a USB-to-Mini-B cable on the back panel of the Remote.



Figure 6-25. 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 (described in “Section Five: Host Interface”). The commands pass 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. 6-15).

Specifications for the StingRay/BioRay Remote

Table 6-1 lists the specifications for an individual StingRay/BioRay Remote.

Table 6-1. 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 \pm 2 V _{DC}
Mechanical expandability	No
Modulation capability ^a	Pass-through only; >1.5 kOhms
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.

(Optional) Mounting Brackets for Remote

This section describes 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 6-26:



Figure 6-26. 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/product-category/bex-series-anodized-extruded-aluminum-enclosures/bex-series-2/>

For questions or additional information, see “Contact Product Support” (p. C-3).

Power Supply for the StingRay/BioRay Remote

The Power Supply for the Remote is a different Power Supply than the one designed for use with an individual laser with flying leads (see p. 6-1).

Power is supplied to the StingRay/BioRay Remote through a 2 mm barrel connector, shown in the example in Figure 6-27. For locations other than North America,



Figure 6-27. Power Supply – StingRay/BioRay Remote

Coherent makes every effort to ship a power cord appropriate to the location.

The dimensions for the Power Supply for the StingRay/BioRay Remote (P/N 1105427) are shown in Figure 6-28.

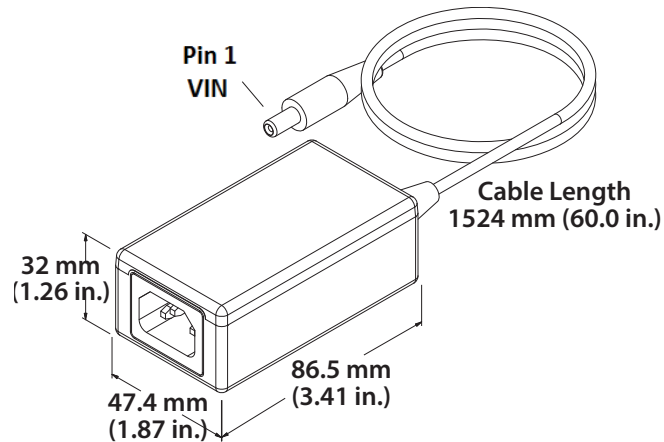


Figure 6-28. Dimensions – Power Supply – StingRay/BioRay Remote

Connections to Lasers

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

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

See “Cable Termination and Connector Options” (p. B-8) 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.

Flying Leads

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

Figure 6-29 shows the dimensions of a Flying Lead cable configuration.

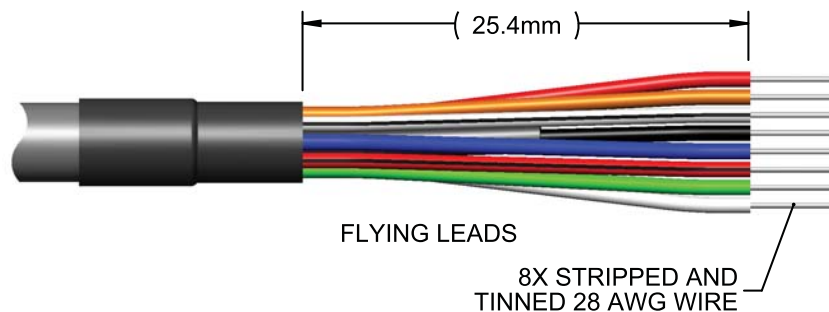


Figure 6-29. Dimensions — Flying Lead Connector

The Flying Leads quickly accesses signals from a StingRay laser. See “Wire a Laser with Flying Leads to a Power Supply” (p. 2-9) for instructions to connect this cable.



IMPORTANT!

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

Figure 6-30 shows the pins on the laser connector when it is enabled for RS-232 communications.

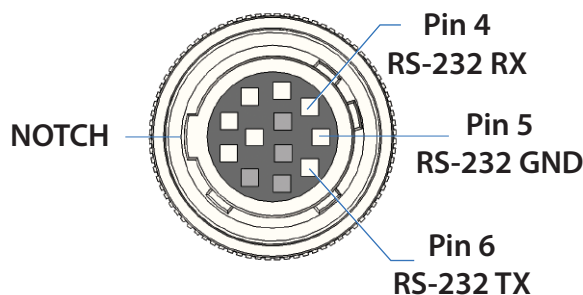


Figure 6-30. Hirose Connector — RS-232 Pins

Table 6-2 lists the RS-232 signal assignments and wire colors.

Table 6-2. RS-232 Pin Assignments

PIN	ASSIGNMENT	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 6-3 lists the communication settings for RS-232:

Table 6-3. (Virtual COM Port) Communication Settings

SETTING	DESCRIPTION
Baud	115200
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	None

Hirose Connector

Figure 6-31 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.

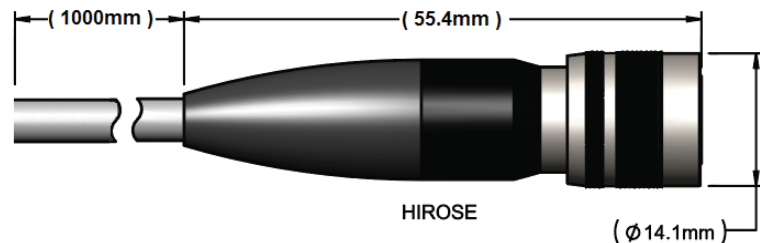


Figure 6-31. Dimensions – Hirose Connector

Figure 6-32 illustrates the pin layout for the 12-pin Hirose Adapter Connector to the laser.

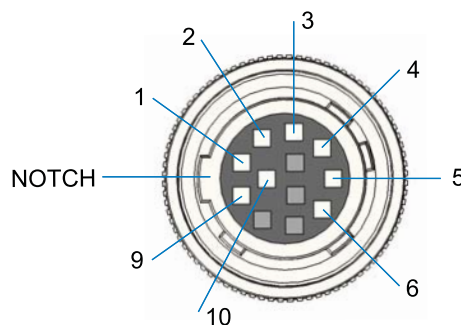


Figure 6-32. Pin Diagram – Hirose Connector

Table 6-4 lists 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 6-4. 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 provides 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 6-33. This Hirose-to-Flying Leads Cable Assembly is available only in a 250 mm length.

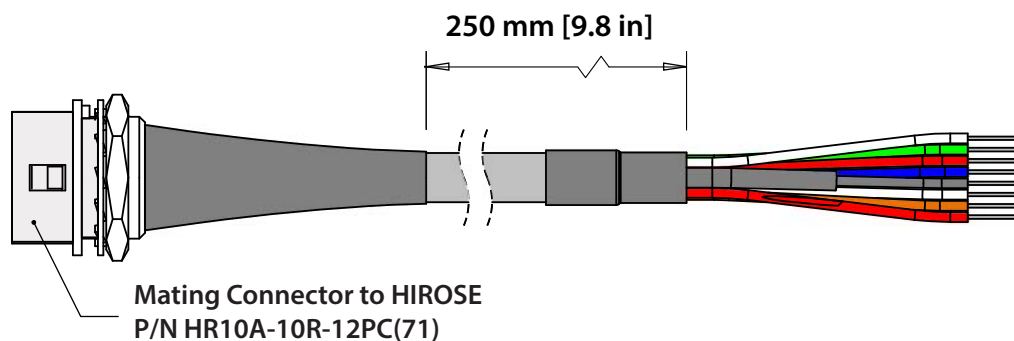


Figure 6-33. Hirose-to-Flying Leads Cable Assembly

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 6-34 lists the dimensions for a Phono 3.5 mm Power Plug.

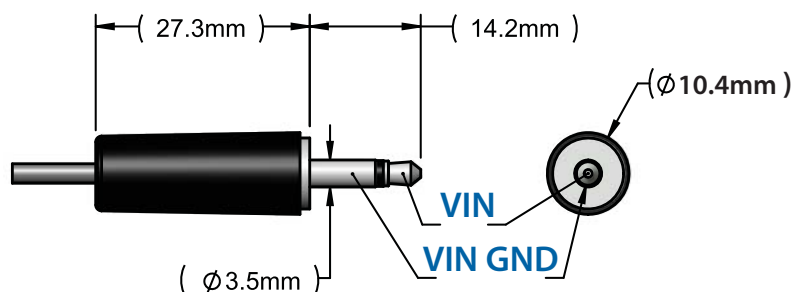


Figure 6-34. Dimensions — Phono Power Plug Connector

Table 6-5 lists the only pin-outs available for this connector. There are no connections for any other signals.

Table 6-5. Pin-Outs – Phono 3.5 mm Power Plug Connector

PLUG	SIGNAL
Tip	V_{IN}
Base	V_{IN} GND, Shield

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 6-35 shows the cable layout of the Phono-style Power Plug with a BNC connector.

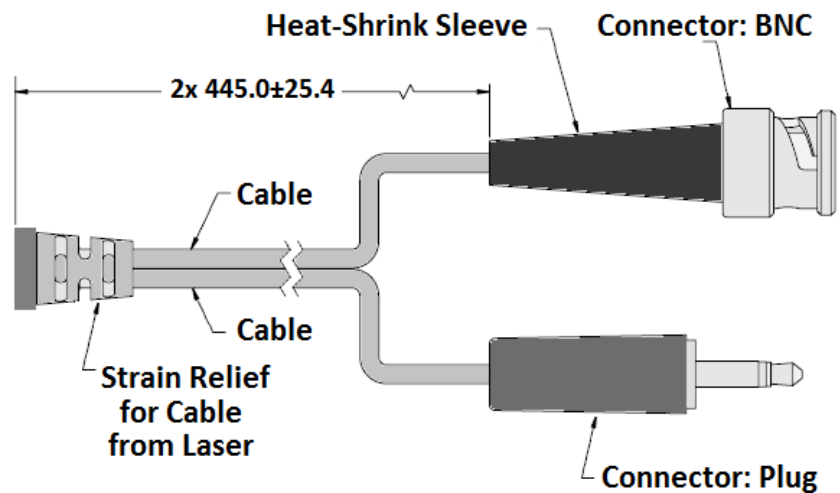


Figure 6-35. Phono Power Plug with BNC Connector — Cable Layout

Figure 6-36 lists the dimensions for each connector (the Phono 3.5 mm Power Plug and the BNC connector).

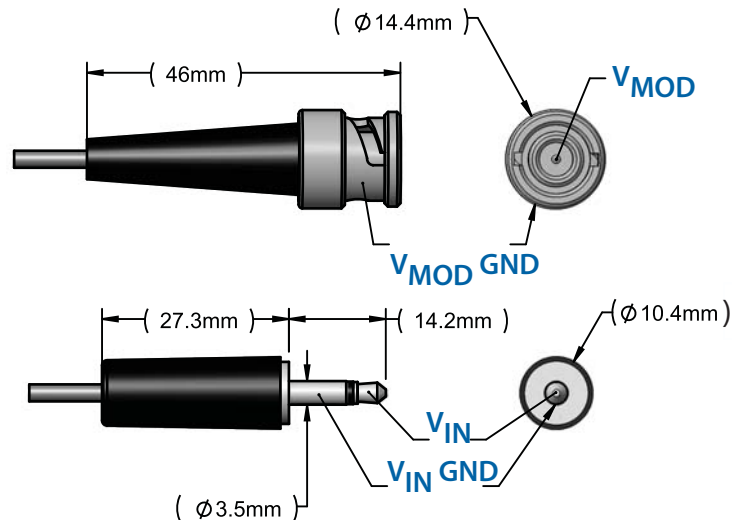


Figure 6-36. Dimensions — Phono Power Plug with BNC Connector

Table 6-6 lists the only pin-outs available for the 3.5 mm Phono Power Plug and BNC Connector. There are no connections for any other signals.

Table 6-6. 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

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 6-7 lists the bandpass filters that are available from Coherent for StingRay and BioRay lasers:

Table 6-7. Coherent Bandpass Filters

IMAGE	FILTER NAME	P/N
	Bandpass Filter, 485 nm to 491 nm	1266767
	Bandpass Filter, 630 nm to 642 nm	1266768

Summary of Part Numbers

Table 6-8 summarizes the parts and accessories you can order for StingRay and BioRay lasers.

Table 6-8. 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
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
1264007	StingRay/BioRay Separate Driver Heat Sink Mount
1266767	Bandpass Filter, 485 nm to 491 nm
1266768	Bandpass Filter, 630 nm to 642 nm
1278782	Multi-Mode Fiber Patch Cord, 50 μm / 0.22NA, SMA/SMA, 1 m Length
1278783	Multi-Mode Fiber Patch Cord, 105 μm / 0.22NA, SMA/SMA, 1 m Length
1280838	Multi-Axis Mount

SECTION SEVEN: TROUBLESHOOTING

This section describes how to identify and resolve common issues you may encounter when working with StingRay and BioRay lasers.

The following common symptoms are described in the checklists that follow:

- There is no output power from the laser. (p. 7-2)
- Laser output power is lower than expected. (p. 7-3)
- Laser emissions stop after an initial period of time. (p. 7-4)
- The software does not recognize the StingRay or BioRay laser. (p. 7-4)



IMPORTANT!

StingRay and BioRay lasers are self-contained units. There are no required service and maintenance procedures, and no user-serviceable components inside the laser. DO NOT attempt to open the laser housing.

If the laser enclosure is disassembled, the Warranty is void!

If you cannot solve the problem or need assistance, contact Coherent Technical Support; see “Appendix C: Service and Support” (p. C-1).

Symptom: No Output Power from the Laser

If there is no output power from the laser, perform the steps in Table 7-1 in the order listed:

Table 7-1. No Output Power from the Laser

To Do	STEPS
	Cycle power to the laser OFF, then back ON.
	Check the electrical connection of the V_{IN} (Pin 9) red wire and V_{IN} Ground (Pin 1) black wire to ensure a good connection.
	If laser is connected to a Remote, ensure that all are set as follows: <ul style="list-style-type: none"> • The Hirose Connector is firmly attached.Pin • The interlock jumper is firmly inserted. • The keyswitch is in the ON position.
	Check the Operating Mode of the laser by using either Coherent Connection 4.x software or the Remote Query SOUR:AM:SOUR? to confirm the configuration and required connections for proper operation. Communications (TX) must be configured 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"> • Analog Modulation: Requires connection to V_{MOD} (Pin 2) blue wire and V_{MOD} Ground (Pin 3) red/black wire. No connection to the modulation signals results in no or low Output Power.
	<ul style="list-style-type: none"> • Digital Modulation: Requires connection to the V_{MOD} (Pin 2) blue wire and the V_{MOD} Ground (Pin 3) red/black wire. No connection to the modulation signals and no valid input voltage provided results in no Output Power.
	<ul style="list-style-type: none"> • Continuous (CW): Requires connection to the V_{IN} (Pin 9) red wire and the V_{IN} Ground (Pin 1) black wire.
	If the laser is configured as CW or Digital Modulation, check the set power level of the laser using either Coherent Connection or the Remote Query SOUR:POW:LEV:IMM:AMPL? to ensure the set Output Power level is between nominal and 10% of nominal.
	Check the LED on the back 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 keyswitch on the Remote. If the Fault signal remains after a power cycle, contact Coherent Product Support.
Should you need any additional technical support, contact Coherent Product Support; see p. C-1 for contact information.	

Symptom: Low Output Power from the Laser

If output power from the laser is lower than expected, perform the steps listed in Table 7-2 in the order listed:

Table 7-2. No Output Power from the Laser

To Do	STEPS
	Cycle power to the laser OFF, then back ON.
	Check the electrical connection of the VIN (Pin 9, red wire) and VIN Ground (Pin 1, black wire) to ensure a good connection.
	If laser is connected to a Remote, ensure that all are set as follows: <ul style="list-style-type: none"> • The Hirose Connector is firmly attached.Pin • The interlock jumper is firmly inserted. • The keyswitch is in the ON position.
	Check the operating mode of the laser by using either Coherent Connection 4.x software or the Remote Query SOUR:AM:SOUR? to confirm configuration and required connections for proper operation. Communications (TX) must be configured 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"> • Analog Modulation: Requires connection to the V_{MOD} (Pin 2) blue wire and the V_{MOD} Ground (Pin 3) red/black wire. No connection to the modulation signals results in no or low Output Power.
	<ul style="list-style-type: none"> • Digital Modulation: Requires connection to the V_{MOD} (Pin 2) blue wire and the V_{MOD} Ground (Pin 3) red/black wire. No connection to the modulation signals and no valid input voltage provided results in no Output Power.
	<ul style="list-style-type: none"> • Continuous (CW): Requires connection to the V_{IN} (Pin 9) red wire and the V_{IN} Ground (Pin 1) black wire.
	If the laser is configured as CW or Digital Modulation, check the set power level of the laser using either Coherent Connection or the Remote Query SOUR:POW:LEV:IMM:AMPL? to ensure the set Output Power level is between nominal and 10% of nominal.
	Confirm the output power level of the laser using an external power meter that is calibrated and is appropriate for the output power level of the laser. Coherent recommends using a PowerMax USB, UV/VIS Quantum power sensor, PS19Q, or similar.
Should you need any additional technical support, contact Coherent Product Support; see p. C-1 for contact information.	

Symptom: Laser Emission Stops

If the laser emission stops after an initial period of time, perform the steps listed in Table 7-3 in the order listed:

Table 7-3. No Output Power from the Laser

To Do	STEPS
	Cycle power to the laser OFF, then back ON.
	Check the electrical connection of the V _{IN} (Pin 9) red wire and the V _{IN} Ground (Pin 1) black wire to ensure a good connection.
	If laser is connected to a Remote, ensure that all are set as follows: <ul style="list-style-type: none"> • The Hirose Connector is firmly attached.Pin • The interlock jumper is firmly inserted. • The keyswitch is in the ON position.
	Check that the laser is properly mounted in an adequate Heat Sink Mount implementing a radially clamp mount or similar using all of the clamping area of the laser to prevent overheating of the laser and a fault.
	Check the internal temperature of the laser by using either Coherent Connection 4.x software or the Remote Query SOUR:TEMP:INT? to check internal temperature of laser. Communications (TX) must be configured 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.
	Check the LED on the back panel of the laser. If the LED is red, there is a fault. Cycle the laser power by disconnecting and reconnecting V _{IN} (Pin 9, red wire), or by toggling the keyswitch on the Remote. If the Fault signal remains after a power cycle, contact Coherent Product Support.
Should you need any additional technical support, contact Coherent Product Support; see p. C-1 for contact information.	

Symptom: Software Does Not Recognize Laser

If the Coherent Connection v4.0.x software does not recognize the StingRay or BioRay laser, perform the steps listed in Table 7-4 to resolve.

Table 7-4. Software Does Not Recognize Laser

To Do	STEPS
	Toggle the keyswitch from the ON position to the STANDBY position, and back to the ON position.
	Allow 1-2 seconds in each keyswitch position before moving the keyswitch to the next position.
Should you need any additional technical support, contact Coherent Product Support; see p. C-1 for contact information.	

APPENDIX A: SAFETY AND COMPLIANCE

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

- “Laser Safety Hazards” (p. A-1)
- “Laser Classification” (p. A-5)
- “Electrical Safety” (p. A-8)

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

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*”.

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

- Compliance with standards and regulations (p. A-8)
- Environmental compliance (p. A-10)

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

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.



WARNING—LASER RADIATION!

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

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, ensure that all personnel who operate, maintain or service the laser are protected from accidental or unnecessary exposure to laser radiation exceeding the accessible emission limits defined in the laser safety standards.



WARNING!

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

The greatest concern when using a laser is eye safety. In addition to the main beam, there are often many smaller beams present at various angles near 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. A-4).

Laser Safety Eyewear

Always wear appropriate 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.

The appropriate 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.

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 appropriate 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, ensure 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.



NOTICE:

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

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. A-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 appropriate eyewear for protection against the specific wavelengths and laser energy being generated. See "Laser Safety Eyewear" (p. A-2) 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.
- Avoid wearing 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 appropriate 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.

Laser 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 lasers. StingRay and BioRay lasers typically have an output power between 20 mW and 200 mW—generally have a CDRH safety laser classification of IIIb and an IEC safety classification of 3B.



IMPORTANT!

A Final Quality Control Report is included with the laser you ordered that provides 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 A-1 shows an example of the measurement distances from the laser's output aperture to the sensor.

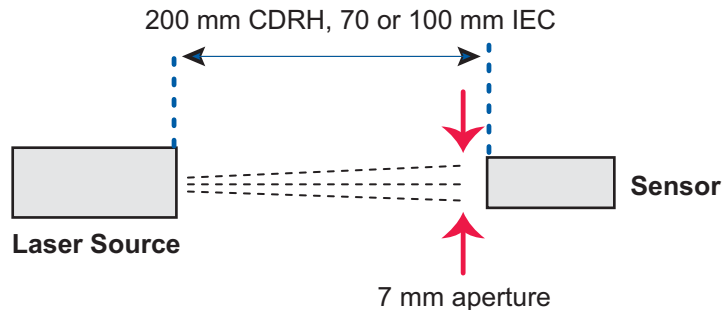


Figure A-1. Measurement Distance Set-Up for Laser Classification

Table A-A-1 lists 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.

Table A-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

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.

Maximum Accessible Radiation Level

A Final Quality Control Report included with the shipment of the laser you ordered. This report provides 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
- Fan angle (for units with line generation optics)
- Focus Distance

You can use this information to determine the appropriate Maximum Accessible Radiation Levels, as specified in IEC 60825-1.

Viewing Distance

A StingRay and BioRay lasers produces optical power levels that are dangerous to the eyes and skin if exposed directly or indirectly.



WARNING!

Operate this product with proper 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^2) 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 appropriate 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 appropriate Nominal Ocular Hazard zones, as specified in IEC 60825-1.

Safety Interlocks

A safety interlock is not available on a standalone laser. There is no internal shutter in StingRay and BioRay lasers.

A safety interlock is part of the StingRay/BioRay Remote; see p. 6-8 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.

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 provides examples of the safety labels under both the CDRH and IEC classifications.



NOTE:

The appropriate label for the power and wavelength class for each StingRay or BioRay laser is attached to the specific product you ordered.

Figure A-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 A-2. Example of Safety Labels Wrapped on Laser



IMPORTANT!

Do not remove the label from the laser. Removing the label voids the warranty.

IEC Labels

StingRay and BioRay lasers comply with IEC classification and fall in different safety classes, depending on output power and wavelength. Safety labels for StingRay and BioRay lasers reflect IEC classifications, as shown in the examples in Figure A-3:

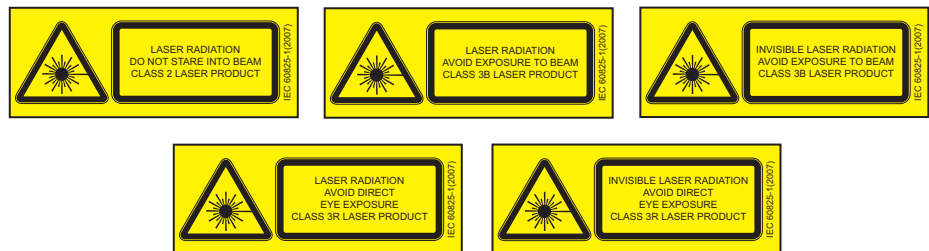


Figure A-3. Example of IEC Warning Labels

CDRH Labels

StingRay and BioRay lasers comply with CDRH classification and fall in different safety classes based on output power and wavelength, as described earlier. Safety labels for StingRay and BioRay lasers reflect CDRH classifications, as shown in the examples in Figure A-4:

For information about labels for compliance with the China RoHS (Restriction of Hazardous Substances) Regulation, see p. A-10.

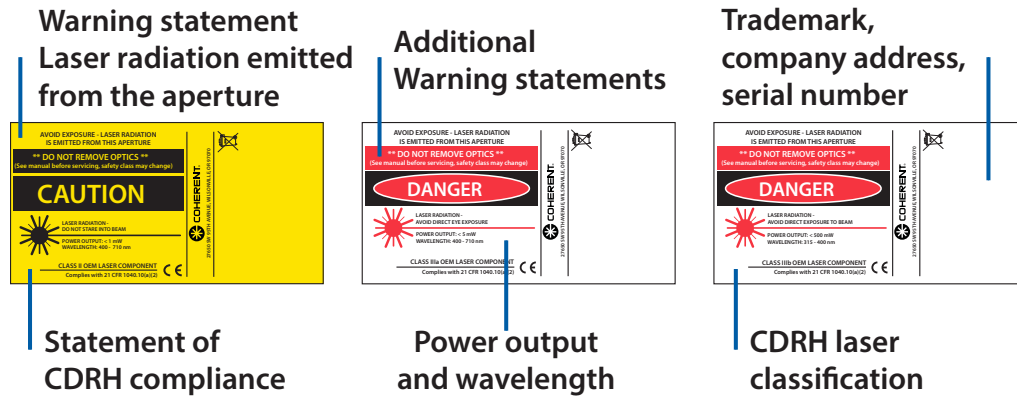


Figure A-4. Examples of CDRH Safety Labels

Electrical Safety

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 lasers 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).

Compliance

This section describes compliance with various government requirements for safety, environmental regulations, and control law.

Laser Safety Standards

Following are sources for information about laser safety standards, as well as safety equipment and training.

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

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

Publications and Guidelines

International Electrotechnical Commission (IEC)

www.iec.ch

Safety of laser products - Part 1: Equipment classification and requirements
BS EN 60825-1

British Standard Institute

www.bsigroup.com

American National Standard for Safe Use of Lasers

ANSI Z136 Series

American National Standards Institute (ANSI)

www.ansi.org

A Guide for Control of Laser Hazards

American Conference of Governmental
and Industrial Hygienists (ACGIH)

www.acgih.org

Laser Safety Guide

Laser Institute of America

www.lia.org

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.

Electromagnetic Compatibility

The primary issue for electromagnetic compatibility is to design covers, shielding, grounding, routing of electrical cable assemblies, and control elements with the proper 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.

Environmental Compliance

This section describes compliance with various environmental regulatory directives to identify hazardous substances.

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>.

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.

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.

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.

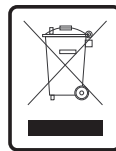


Figure A-5. WEEE Label

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

Do not dispose of these products as unsorted municipal waste. Contact your local distributor for procedures for recycling this equipment.



APPENDIX B: LASER CONFIGURATIONS

This Appendix describes 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/lasers/laser/machine-vision-structured-light-lasers/stingray-and-bioray-lasers>

If you have questions or would like more information, please contact your Coherent Sales Representative.

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.

Product ID Label on Box

Figure B-1 shows the product ID Label for the laser placed on the end of the box:



Figure B-1. Product ID Label on 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.

Laser Product Label

Figure B-2 shows an example of a product label attached to a laser.



Figure B-2. Product Identification on Laser Label

The key identification markings include the following:

- Part Number (PN)
- Serial Number (SN)
- Date of Manufacture (DM)
- Options (see following breakdown of descriptions)
- Power Rating (PW)
- Wavelength (WL)

Figure B-3 shows an example of a StingRay laser with various options.

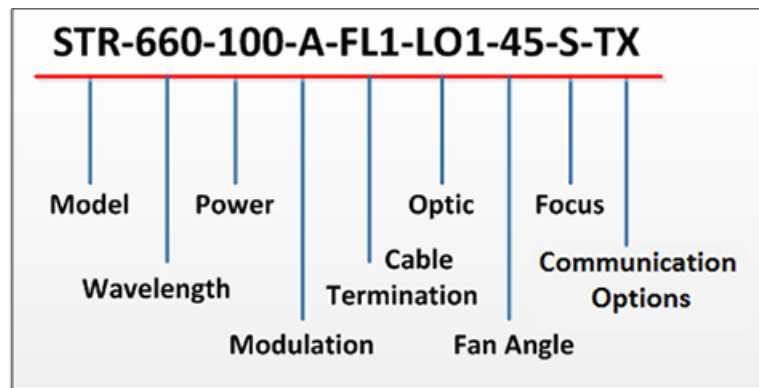


Figure B-3. Model Number Example – StingRay

Table B-1 lists the options that were ordered for this example laser:

Table B-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

For a StingRay Optical Head (SOH), the model number is slightly different, as shown in the example in Figure B-4:

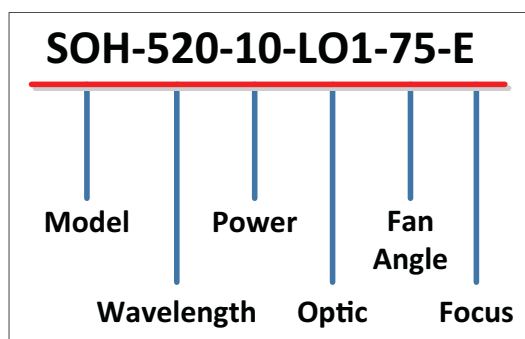


Figure B-4. Model Number Example – StingRay Optical Head

Table B-2 lists each of these options that were ordered for this example StingRay Optical Head:

Table B-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.

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/lasers/laser/machine-vision-structured-light-lasers/stingray-and-bioray-lasers>

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 “Appendix C: Service and Support” for details.



IMPORTANT!

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 your application using the following options.

- 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 SD
- Heat Sink Mount
- CDRH Timing Delay

Laser Wavelength and Output Power

The wavelengths (nm) and output power (mW) currently available are listed in Table B-3. This list is subject to change as new lasers are added or made obsolete.

Table B-3. Wavelength and Output Power Options

WAVELENGTHS/POWER					
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	—	—

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.



IMPORTANT!

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 B-4.

Table B-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

Optical Configuration

The options for beam shapes are listed in Table B-5. Beam shapes include line, crosshair, or dot (ellipse).

Table B-5. Optic Options

LINE	DOT	CROSSHAIR
L01 – Single Line	D01–XX Single Dot (Ellipse)	Crosshair (Limited Availability)
		CH10
		CH45

Diffraction Optical Element (DOE) multi-line diffraction optics are obsolete. For technical questions about optical configuration, see how to contact Coherent (“Appendix C: Service and Support”).

The fan angle for Crosshair optics are limited in availability to certain laser configurations; see p. B-5.

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 B-5.

The profile does not drop below the “Relative Intensity Floor”.

Contained Power is the power contained within the area of the fan angle and the width of the line at $1/e^2$.

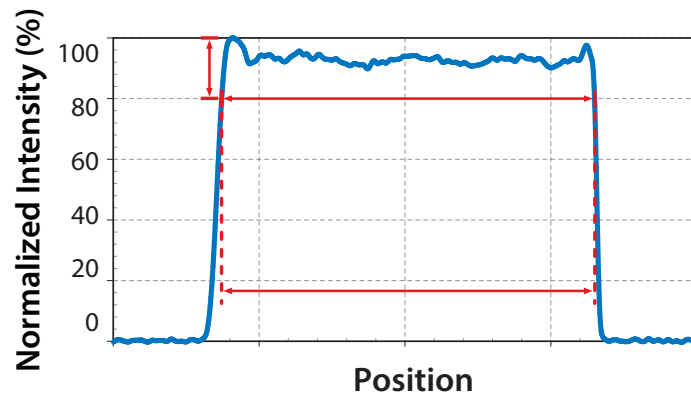


Figure B-5. Graph Showing Fan Angle

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 B-6:

Table B-6. Fan Angle Options

FAN ANGLES (IN DEGREES)	
1°	30°
5°	45°
10°	60°
15°	75°
20°	—

The fan angle for Crosshair 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 B-6:

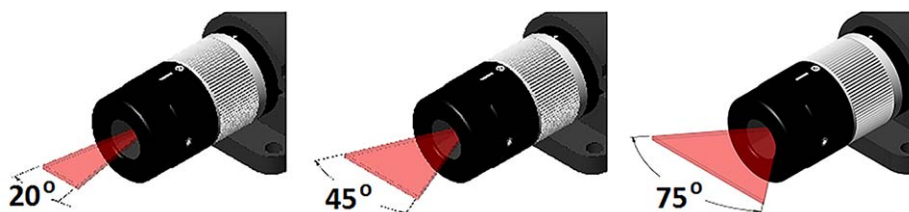


Figure B-6. Examples of Fan Angles

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 B-7.

Table B-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 B-8 lists the items in the Focus options from Coherent that are included in the StingRay Developer's Kit (P/N 1263022):

Table B-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)

Communications

The options for RS-232 communications is reflected in the model description as shown in Table B-9:

Table B-9. RS-232 Communications

OPTION	DESCRIPTION
-XX	RS-232 Communications Disabled
-TX	RS-232 Communications Enabled



IMPORTANT!

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 “Appendix C: Service and Support” for information about how to contact Coherent.

For information about RS-232 Commands and Queries, see “Section Five: Host Interface”. For information about signals, see “Hirose Connector” (p. 6-15).

Other Configuration Options

Other optional values that can be specified are listed in Table B-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 B-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 “Appendix A: 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.

Cable Termination and Connector Options

The options for cable terminations for the laser are listed in Table B-11. Note that pin-outs vary by connector type.

Table B-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 “FL <i>n</i> ”.	250 mm = FL1 500 mm = FL 1000 mm = FL3 1500 mm = FL4 2000 mm = FL5 2500 mm = FL6
Hirose	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 C: SERVICE AND SUPPORT

This section provides information about:

- Obtaining service
- Product shipping instructions
- How to contact Product Support

Obtaining Service

Customers may request service either when sending the laser for a service evaluation or for service under the Warranty.



IMPORTANT!

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!*

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 “Appendix B: Laser Configurations” (p. B-1) 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 C-1 shows a StingRay laser configured with a Flying Lead (FL) cable, and two examples of StingRay lasers with non-standard connectors.

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”.
- 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.

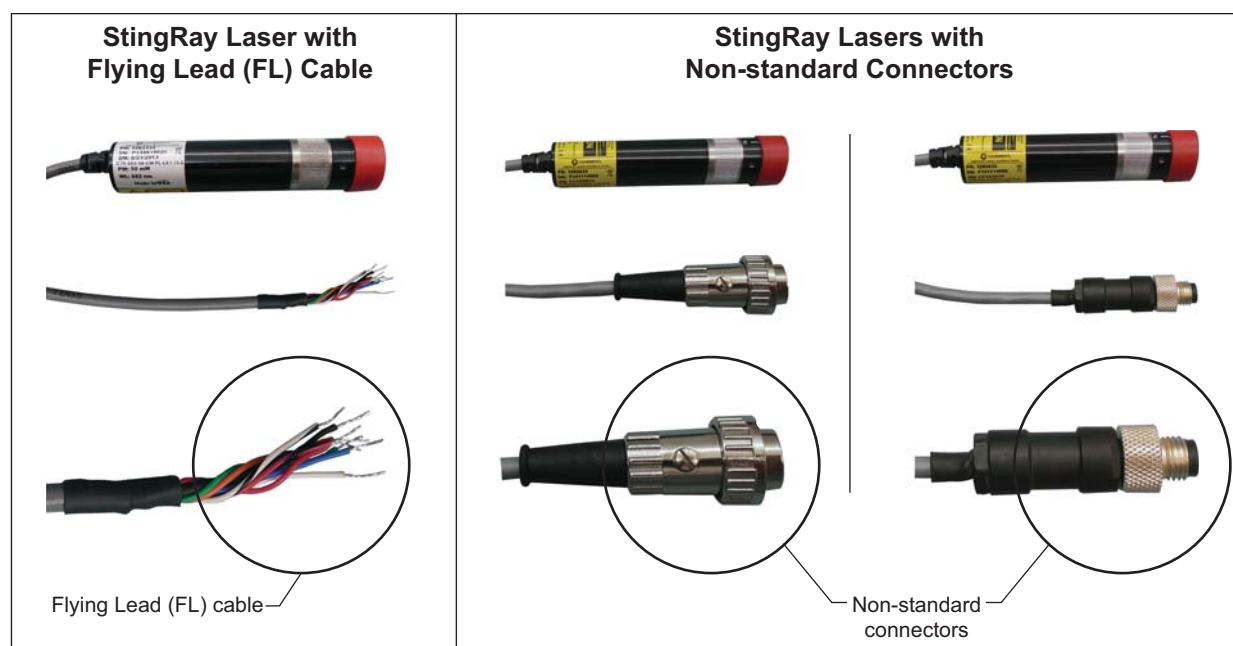


Figure C-1. Example — Non-Standard Connectors

- 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.

You 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.

Product Shipping Instructions

To ship a product to Coherent:

1. Contact Coherent Customer Service (see “Contact Product Support” in the next section) to obtain a Return Material Authorization (RMA) number.
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. Using the original shipping and packaging materials, pack all components of the product (Power Supply, cables, and so on). Carefully slide each part into the packing membrane in which it was originally shipped.



IMPORTANT!

For service requests, also carefully package any non-standard hardware and return it with the laser, so the laser can be appropriately evaluated.

5. Seal the shipping carton securely with shipping tape.

6. Make a note of the RMA number you 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

Contact Product Support

Coherent provides telephone and web-based technical assistance as a service to its customers and assumes no liability thereby for any injury or damage that may occur contemporaneous with such services.

Under no circumstances do these support services affect the terms of any Warranty agreement between Coherent and the buyer. Operation of any Coherent laser with any of its interlocks (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/>

In the USA and North America

If you are shipping products from within the United States or North America, contact LMC Technical Support directly, either:

- By phone in North America: 1-(800) 343-4912 or 1-(408)-767-4042
- By e-mail: LSMservice@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.

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 in Europe, contact LMC Technical Support directly, as follows:

- Germany: +49-6071-968-0
- Japan: +813-5635-8680

For Coherent general Technical Support, contact your local Coherent Service Representative, or contact us as follows:

- By phone: 1-(408)-764-4557 or 1-(800)-367-7890
- By e-mail: Product.Support@coherent.com

APPENDIX D: WARRANTY

StingRay and BioRay lasers have been designed to exhibit proper 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.



IMPORTANT!

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).

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.

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.



StingRay/BioRay Operator's Manual

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