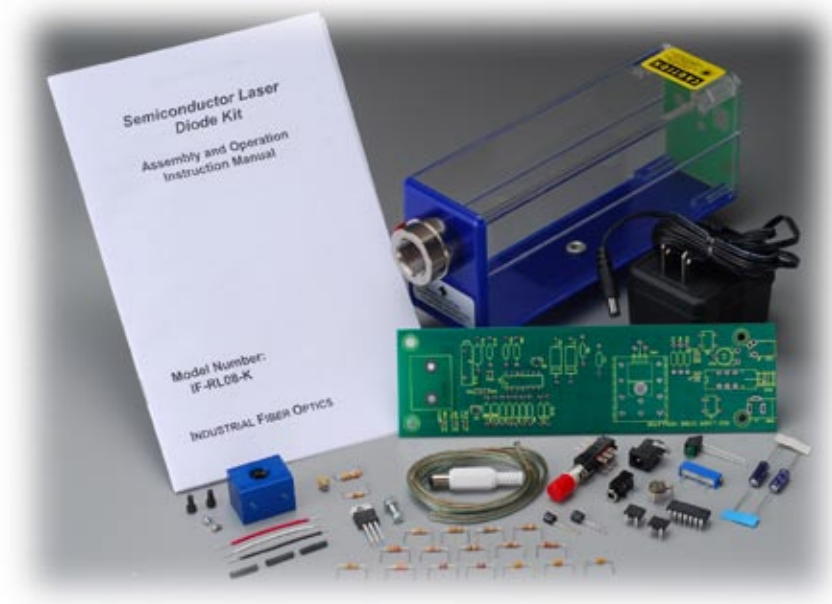
Diode Laser Kit

Operator's Manual



Model Number:
IF-RL08K

INDUSTRIAL FIBER OPTICS

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Printed in the United States of America

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INTRODUCTION

This manual provides information about the assembled Semiconductor Diode Laser Kit model number IF-RL08 K. *It contains all the information you need to operate this laser safely and knowledgeably, even if you are a novice to laser technology. Please read this manual carefully before operating the laser.*

Industrial Fiber Optics makes every effort to incorporate state-of-the-art technology, highest quality and dependability in its products. We constantly explore new ideas and products to best serve the rapidly expanding needs of industry and education. We encourage comments that you may have about our products, and we welcome the opportunity to discuss new ideas that may better serve your needs. For more information about our company and products refer to http// www.i-fiberoptics.com on the Worldwide Web.

Thank you for selecting this Industrial Fiber Optics product. We hope it meets your expectations and provides many hours of productive activity.

Sincerely,

The Industrial Fiber Optics Team

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LASER CLASSIFICATIONS

All manufacturers of lasers used in the United States must conform to regulations administered by the Center for Devices and Radiological Health (CDRH), a branch of the U.S. Department of Health and Human Services. CDRH categorizes lasers as follows:

Class	Description
I	A laser or laser system, which does not present a hazard to skin or eyes for any wavelength or exposure time. Exposure varies with wavelength. For ultraviolet, 2 to 4 µm exposures is less than from 8 nW to 8 µW. Visible light exposure varies from 4 µW to 200 µW, and for near-IR, the exposure is < 200 µW. Consult CDRH regulations for specific information.
II	Any visible laser with an output less than 1 mW of power. Warning label requirements – yellow caution label stating maximum output of 1 mW. Generally used as classroom lab lasers, supermarket scanners and laser pointers
IIIa	Any visible laser with an output over 1 mW of power with a maximum output of 5 mW of power. Warning label requirements – red danger label stating maximum output of 5 mW. Also used as classroom lab lasers, in holography, laser pointers, leveling instruments, measuring devices and alignment equipment.
IIIb	Any laser with an output over 5 mW of power with a maximum output of 500 mW of power and all invisible lasers with an output up to 400 mW. Warning label requirements – red danger label stating maximum output. These lasers also require a key switch for operation and a 3.5-second delay when the laser is turned on. Used in many of the same applications as the Class IIIa when more power is required.
IV	Any laser with an output over 500 mW of power. Warning label requirements – red danger label stating maximum output. These lasers are primarily used in industrial applications such as tooling, machining, cutting and welding. Most medical laser applications also require these high-powered lasers.

GENERAL

The Industrial Fiber Optics family of diode lasers utilizes the latest technology in miniaturization electronics and laser science — the same as used in long-distance fiber optic communication networks, CD players and bar code scanners. The technology incorporates semiconductor laser diodes —tiny electronic microchips that operate as lasers.

Semiconductor diode devices offer an important alternative to widely known and used helium-neon-gas (HeNe) lasers. Diode lasers are smaller, more efficient and offer direct digital and analog modulation capabilities previously unavailable. Exceptional versatility makes this semiconductor technology an essential component of modern science, physics and industrial technology curriculums.

The Industrial Fiber Optics family of lasers offers particular educational value in its ability to increase and reinforce learning via fascination. They also offer more options for internal application and types of modulation inputs. With these lasers, students will readily, enthusiastically learn about physical optics, fiber optics, light propagation, speed of light theory and measurement, laser communications and much more!

Table 1. Common abbreviations used in this manual.

Abbr	Long version	Scientific Notation
mW	milliwatts	1 x 10^{-3} Watts
µW	microwatts	1 x 10^{-6} Watts
nW	nanowatts	1 x 10^{-9} Watts
mm	millimeters	1 x 10^{-3} meters
µm	micrometers	1 x 10^{-6} meters
nm	nanometers	1 x 10^{-9} meters

OPERATIONAL INFORMATION

Electrical

All electrical controls are located at the rear of the laser chassis. A diagram of the rear view of the laser appears in Figure 1, with descriptions of each item.

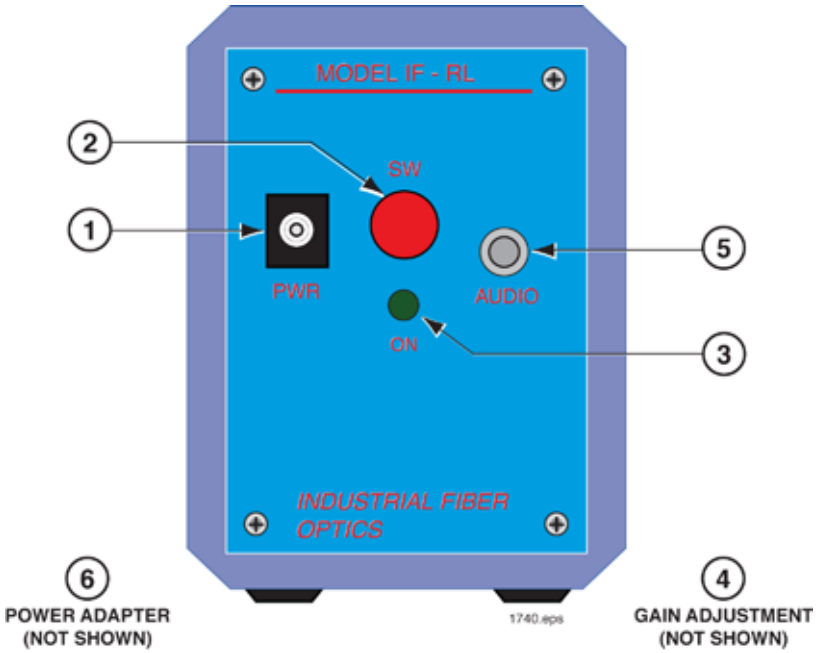

Figure 1. Rear view of laser showing electrical inputs and controls.

1. Power Jack (PWR)

All Industrial Fiber Optics lasers use a standard 2.1 mm DC power input jack to provide power to the laser. (An ON/OFF switch controls power from the jack to the electronic circuitry and lasing element.)

Power input to the laser must be applied from a low-voltage DC power source in the range of 10 to 15 volts, such as supplied with the laser. See Item 6 in this section for more information about the power adapter.

2. Switch (SW)

A push-button switch is located immediately to the right of the 2.1 mm power jack. It controls power from the 2.1 mm power jack to the electronic circuitry and lasing element. When the switch is closed it will be slightly depressed, compared to the open position, when the switch will be fully extended.

3. Pilot Light (PILOT)

Just below the Switch is the pilot light. It emits a green light when the switch is on and power is applied to the electronic circuitry and lasing element.

4. Gain Control (R14 - not shown)

The gain control feature of this laser increases its versatility, enabling it to modulate a greater variety of audio sources. The Gain control adjustment is made by adjusting the single-turn trim pot R14, located on the main amplifier printed wiring board near the switch and the 3.5 mm audio jack. It controls the gain of an internal electrical circuit that amplifies signals from the microphone (AUDIO) input. This feature is particularly useful for ensuring compatibility of the laser with low-level microphone signals as well as larger amplitude signals from cassette and CD and MP3 players.

The gain control adjustment is made by turning R14 with a non-conducting screwdriver. Starting with R14 turned fully counter-clockwise, the AUDIO signal input accepts voltage levels up to 50 mV peak before saturating the modulation range of the laser. When you have input signals less than 50 mV peak, you can turn R14 clockwise to increase the signal to the laser modulation circuitry. The laser can accept input signal levels even as low as <1 mV with R14 turned fully clockwise to increase the level 50 times. This allows for maximum laser modulation for improved output detection using a variety of laser receivers.

5. 3.5 mm Jack (AUDIO)

This is an industry-standard jack, commonly described as a 3.5 mm audio type. It is compatible with most remote microphones and, with patch-cord interconnections, to cassette, CD and MP3 players.

6. Power Adapter (not shown)

All Industrial Fiber Optics lasers sold in the United States come complete with a power adapter suitable for 60 Hz 110 VAC-to-VDC conversion. Most others come with 50 Hz 220 VAC-to-VDC power adapters. It is strongly recommended that the power adapter furnished with the laser be the only supply used.

If you must use another power supply, it must be one with voltage output between 10 to 15 volts DC, and minimum current capability of 150 milliamperes. Do not use a power supply which may generate or pass voltage spikes exceeding 36 volts.

BEAM CONTROLS

1. Optics Mount

The optics mount is a nickel-plated aluminum cylinder with internal diameter of 3/4 inches and with 32 threads per inch. The threads facilitate the use of this laser in many optical experiments using mounted lenses, polarizers and spatial filters, such as contained In Industrial Fiber Optics Laser Optics Kit P/N IF-535.

2. Beam Stop

The beam stop (also known as a beam attenuator) is required on lasers by federal regulations. When viewed from the rear of the laser, its handle protrudes from the right side of the optics mount. Its function is to mechanically block the laser beam when the handle is pushed downward. When the handle is pushed upward, the beam stop rotates and allows the laser beam to exit the lasing apparatus.

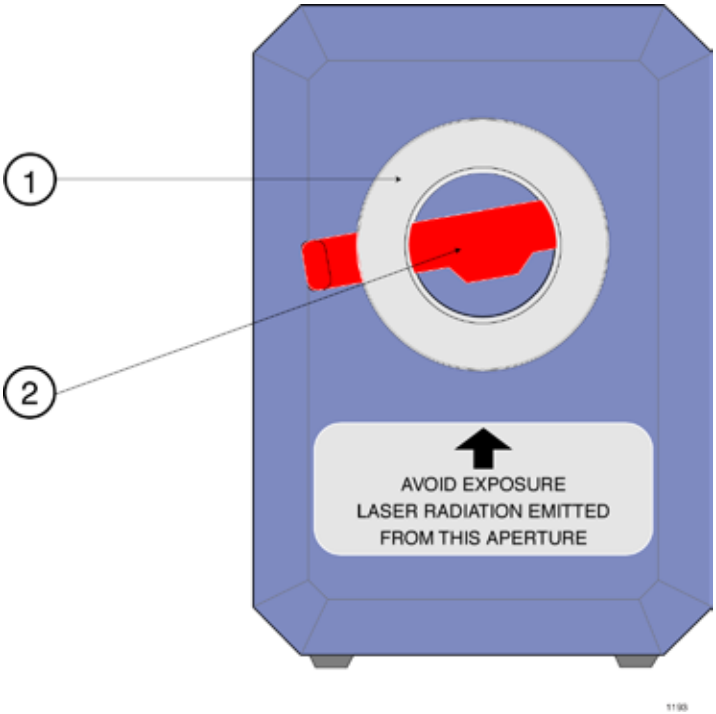

Figure 2. Front view of laser with beam stop blocking the laserbeam.

SPECIFICATIONS

Caution:
Using controls, making adjustments, or performing procedures other than those specified herein may result in hazardous radiation exposure.

Table 3. Laser specifications.

Parameter	Value	Units
Operating		
Input voltage	10 to 15	Volts
Input current	60 to 125	milliamperes
Temperature	0 to 50	° C
Optical		
Polarization	Linear	
Wavelength	635	nm
Output power	0.80	mW
Beam diameter	4.0	mm
Beam divergence, max	1.0	milliradians
Electrical		
Analog modulation	10 to 500	kHz
Storage		
Dimensions	5.6 x 7.5 x 19.5	cm
Weight	400	grams
Temperature	-20 to 50	° C

MODELS AND LASER CLASSIFICATIONS

Table 4. CDRH classifications for laser models.

Laser Model	Classification	Typical power levels
IF-RL08 K	CLASS II	.75 to .90 mW
IF-RL08-635	CLASS II	.75 to .90 mW
IF-RL30-635	CLASS IIIa	2.8 to 3.2 mW

Table 5. Metric prefixes and their meanings.

Prefix	Symbol	Multiple
tera	T	10^{12} (trillion)
giga	G	10^{9} (billion)
mega	M	10^{6} (million)
kilo	k	10^{3} (thousand
hecto	h	10^{2} (hundred
deca	da	10^{1} (ten)
deci	d	10^{-1} (tenth)
centi	c	10^{-2} (hundredth)
milli	m	10^{-3} (thousandth)
micro	μ	10^{-6} (millionth)
nano	n	10^{-9} (billionth)
pico	p	10^{-12} (trillionth)
femto	f	10^{-15} (quadrillionth)

SAFETY

Optical

All lasers addressed by this manual emit a visible beam of red light. No infrared, ultra-violet, x-ray or other non-visible radiation is emitted from these products.

This low-power laser cannot be used to burn, cut or drill. Even so, you should use caution, because the beam is concentrated. It could become focused to a pinpoint within the human eye. **Never look directly into the laser beam or stare at its bright reflections — just as you should avoid staring at the sun or other very bright light sources.**

Review the "Rules for Laser Safety" on the back cover of this booklet.

Electrical

Included with this laser is a UL-approved VAC-to-VDC adapter for VAC operation. The adapter converts common lab/household voltage to low DC voltage suitable for laser use. Always plug the adapter into a grounded circuit.

This laser is particularly safe because it operates at low wattage and low current levels. However, as when using any electrical device, you must take certain safety precautions:

- Do not touch (or short-circuit) the connection point at which incoming power from the adapter enters the laser housing, as this could damage the power supply.
- Do not operate the laser outside its enclosure. Accidentally touching the circuitry against a conducting surface could result in a short circuit that might damage circuit components or the laser diode. Operating the laser without the required safety labeling and beam stop also violates federal safety regulations.

LASER REGULATIONS

The U.S. Department of Health, Education and Welfare regulates and classifies all laser products sold in the United States. For more information about compliance with federal laser performance standards and regulations, please refer to the Center for Devices and Radiological Health (CDRH) Regulation 21, parts 1040.10 and 1040.11, Code of Federal Regulations.

Specific labeling is required by Federal Regulations on all laser products. **For your safety and that of others, do not remove any of the labels.**

Classifications

All lasers described by this manual fall within the limitations of Class II and Class IIIa of CDRH standards. All lasers covered by this manual will exhibit a label located on the top, rear of the laser chassis as shown in Figure 7.

Class II lasers may not exceed 1 milliwatt (1 mW) of output power, and must contain a pilot light and a beam attenuator. An example of the "warning logotype" label used for Class II lasers is shown in Figure 4.

Figure 4. Warning logotype label for Class II lasers.

Class IIIa lasers have an output power limitation between 1 and 5 milliwatts, and require a pilot light and a beam attenuator. The "warning logotype" label required for this classification of laser is shown in Figure 5.

Figure 5. Warning logotype label for Class IIIa lasers.

Aperture Labels

Federal regulations also require that the laser emission aperture/port be labeled. A graphic representation of that label is shown in Figure 6. Location of this label is shown in Figure 2.

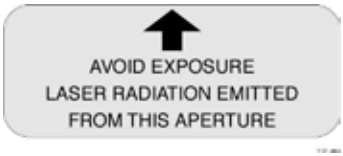

Figure 6. Beam aperture label.

Additional References

For more information about lasers and laser standards, contact your local U.S. Department of Health and Human Services office, or write to the agency's headquarters at 1390 Piccard Dr., Rockville, MD 20850.

For U.S. guidelines on laser classifications and health standards, refer to the American National Standards Institute (ANSI) specifications governing lasers and laser safety. The guidelines are published by the Laser Institute of America, 12424 Research Parkway, Suite 130, Orlando, FL 32826.

Figure 7. Top view of laser showing the location of the "warning logotype" label for a Class IIIa laser.

OPERATING PROCEDURES

Non-Modulation or CW Operation

1. Review the laser safety steps on the back cover of this manual.
2. Point the laser toward a wall or other dull non-reflecting surface.
3. Push the beam stop handle downward to its closed position.
4. Make sure the laser's ON/OFF switch (SW) is in its OFF position. (The push button should be in its extended position.)
5. Plug the 110* VAC-to-DC power adapter (provided with the laser) into an AC wall outlet.

> **Important!**
> If you must use a power adapter other than the one supplied with this laser, check the section entitled Operational Information in this manual to ensure the power adapter's voltage and current levels are within recommended specifications.

6. Plug the cord from the power adapter into the power jack (PWR) located on the rear of the laser.
7. Depress the ON/OFF switch (SW) on the control panel of the laser until it clicks into the ON position. (The switch should be slightly depressed.)
8. The pilot light (green LED) just to left and below the ON/OFF switch should now be lit, showing that the laser is on.
9. Push the beam stop handle upward, to its open position.
10. Observe the red beam striking the wall, or other surface, in the direction which the laser is pointed.

* 220 VAC for most customers outside of North America

USING LASER WITH A MICROPHONE

1. Complete Steps 1 through 10 on page 13.
2. Push the beam stop to its closed position, and make sure the laser's ON/OFF switch is OFF. (The button should be extended and the pilot light no longer illuminated.)
3. Plug the 3.5 mm plug on the end of the microphone cord into the 3.5 mm audio jack.
4. Point the laser toward a wall or other non-reflecting dull surface.
5. Set up your laser receiver, referring to its manual for operating procedures.
6. Press the ON/OFF switch (SW) on the control panel of the laser. The laser now should be on, as indicated by the pilot light.
7. Rotate the beam stop handle upward, to its open position.
8. Target the laser beam on the light detector found on the laser receiver.
9. Position the receiver or laser as needed, so the laser light beam strikes the center of the receiver detector.
10. If a high-pitched squeal is produced by the laser receiver and speaker, reduce the volume at the receiver.
11. Speak into the microphone. If you cannot hear yourself, bring the microphone closer to your mouth and/or increase laser receiver volume.
12 A single-turn trim pot, R14 can be adjusted to raise or lower the gain of the modulating amplifier circuit to better match the output of your microphone or other audio source. For more information about the gain control, see the section entitled Operational Information in this manual.

Your laser and receiver should now be functioning as a free-space optical voice link. You should be hearing your voice or music from the audio receiver.

Figure 8. Class IIIa laser and laser beam aligned with an Industrial Fiber Optics' audio laser receiver for demodulation of the laser beam's modulated signal and producing sound waves.

TROUBLESHOOTING

No Pilot Light

- Is the laser's ON/OFF switch in the ON position?
- Is the 110 (220) VAC-to-VDC power adapter plugged into the laser and an appropriate wall outlet or extension cord?
- Is there power to the wall outlet?

No Laser Light Output

- Is the ON/OFF switch in the ON position?
- Is the 110 (220) VAC-to-VDC power adapter plugged into the laser and an appropriate wall outlet or extension cord?
- Is there power to the wall outlet?
- Is the pilot light on?
- Is the mechanical beam stop in its open position?

No Modulation from Receiver

- Is the laser beam positioned properly so its beam strikes the receiver detector?
- Are input signals to the laser of sufficient amplitude?
- Slowly move the receiver detector out of the path of the laser beam while continuously monitoring receiver operation. (This will desensitize the receiver in case the receiver is too sensitive for this laser.)
- Check the troubleshooting section in your laser receiver manual.

Do not attempt to troubleshoot the laser beyond the steps listed above. If all your connections are correct, and you are confident that power is being supplied to the laser and any input devices, please return the laser for appropriate inspection/servicing to Industrial Fiber Optics, as described in the section entitled SERVICE AND MAINTENANCE.

SERVICE AND MAINTENANCE

Once assembled and tested, periodic operation, maintenance and service of this laser are not required.

In the unlikely event this laser malfunctions and you wish to have it repaired, please do the following:

- In writing, describe the problem, person to contact, phone number, and return address.
- Carefully pack the laser, power adapter, manual and written description in a strong box with sufficient packing material to prevent damage in shipment.
- Ship the package to:

INDUSTRIAL FIBER OPTICS
1725 WEST 1ST STREET
TEMPE, AZ 85281-7622

WARRANTY

This kit was carefully inspected before leaving the factory. If any components were damaged in shipping, Industrial Fiber Optics will repair or replace them at its discretion. Since soldering and incorrect assembly of this kit can damage electrical components, no warranty can be made after assembly has begun. If any electrical parts become damaged, replacements may be obtained from most radio/electronics supply shops, or from Industrial Fiber Optics. Refer to the parts list of the assembly manual for part numbers.

Note: This kit contains a laser diode which can be damaged if operated at excess power levels. A calibrated optical power meter is crucial for proper adjustment of this device.

Industrial Fiber Optics recognizes that responsible service to our customers is the basis of our continued operation. If problems occur during the assembly, adjustment or operation of the laser you are encouraged to contact us for assistance. If necessary the laser can be shipped to us for evaluation and possible repair. Typical repair costs range from $50 - $125 plus return shipping costs, and repairs usually take two to three weeks to complete. Any necessary repairs will not be started until written authorization has been received from the customer.

When returning items for analysis and possible repair, please do the following:

- In a letter, describe the problem, person to contact, phone number and return address.
- Pack the laser, power adapter, manual and letter carefully in a strong box with adequate packing material, to prevent damage in shipment.
- Ship the package to:

INDUSTRIAL FIBER OPTICS
1725 WEST 1ST STREET
TEMPE, AZ 85281-7622

SHIPMENT DAMAGE CLAIMS

If damage to an Industrial Fiber Optics product should occur during shipping, it is imperative that it be reported immediately, both to the carrier and the distributor or salesperson from whom the item was purchased. DO NOT CONTACT INDUSTRIAL FIBER OPTICS.

Time is of the essence because damage claims submitted more than five days after delivery may not be honored. If shipping damage has occurred during shipment, please do the following:

- Make a note of the carrier company, the name of the carrier employee, the date and the time of the delivery.
- Keep all packing material.
- In writing, describe the nature of damage to the product.
- In cases of severe damage, do not attempt to use the product (including attaching it to a power source).
- Notify the carrier immediately of any damaged product.
- Notify the distributor from whom the purchase was made.

NOTES:

NOTES:

Rules for Laser Safety

- Lasers produce a very intense beam of light. Treat them with respect. Most educational lasers have an output of less than 3 milliwatts, and will not harm the skin.
- Never look into the laser aperture while the laser is turned on! PERMANENT EYE DAMAGE COULD RESULT.
- Never stare into the oncoming beam. Never use magnifiers (such as binoculars or telescopes) to look at the beam as it travels – or when it strikes a surface.
- Never point a laser at anyone's eyes or face, no matter how far away they are.
- When using a laser in the classroom or laboratory, always use a beam stop, or project the beam to areas, which people won't enter or pass through.
- Never leave a laser unattended while it is turned on – and always unplug it when it's not actually being used.
- Remove all shiny objects from the area in which you will be working. This includes rings, watches, metal bands, tools, and glass. Reflections from the beam can be nearly as intense as the beam itself.
- Never disassemble or try to adjust the laser's internal components. Electric shock could result.