Laser RF Video Receiver

Product Specifications
Operating Instructions
Warranty Information

Model Number:

IF-VR2

INDUSTRIAL FIBER OPTICS

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Revision - C

Printed in the United States of America

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INTRODUCTION

*This manual provides information about Industrial Fiber Optics Laser Video Receiver number **IF-VR2**. The receiver is designed for use with our innovative **WBS Laser**—the first educational laser that will transmit color video with sound, and function as a voice transmission laser as well. This manual contains all the information you need to operate the receiver with a laser safely and knowledgeably, even if you are a novice to laser technology. Please read the manual carefully before operating the laser.*

As soon as you receive this laser receiver, inspect it and the shipping container for damage. If any damage is found, immediately refer to the section of this manual entitled Shipment Damage Claims.

*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 complete listing of products refer to **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

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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 exposure 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

Discoveries in laser and photonics technology have created a booming industry. In the last few years, they have brought the world many technological advances and a standard of living inconceivable a hundred years ago. Examples of how lasers have indirectly affected our lives include the distinctive red bar code scanners, which have improved cost accounting at supermarkets; repair of memory chips in computers to reduce costs; three-dimensional color holograms on credit cards to improve security; and automobile manufacturing sheet metal cutters for reduced waste and increased speed. Direct examples of how laser and photonics technology have affected our everyday lives include use of fiber optics to continue lowering cost of long-distance telephone calls; in surgical procedures to reduce blood loss and trauma, and to promote quicker recovery; and use of lasers in computer printers for quick, high-quality printouts.

From a historical perspective, the creative ideas behind modern-day lasers could be said to have started with scientist Gordon Gould's handwritten notes in 1957. Actual demonstration of the first working laser—a pulsed ruby laser—was performed by Theodore Maiman on May 16, 1960. Soon other scientists also demonstrated the ruby laser, then began research on lasers which used different materials (such as gases) as their active lasing element. The most prominent gas laser which emerged was the helium neon, or "HeNe" laser, which many of you may have used.

Much earlier, in 1907, researcher H. J. Round had found that the semiconductor material silicon carbide produced light when subjected to an electrical field. Building on that discovery, by the 1950s many of the world's leading scientists were involved in research involving semiconductor materials and the creation of the transistor. Thus it is not surprising, with some of the brightest people in the world working in the laser and semiconductor fields, that somebody would create a laser from semiconductor materials. In the fall of 1962, several different companies succeeded in producing working semiconductor lasers. Although these devices had to be cooled to 77 degrees Kelvin and produced very short high-current pulses for very short times, indeed they were working lasers.

The success of early semiconductor lasers diodes soon led to creation of the modern marvel known as the semiconductor laser diode. Diode lasers are smaller, more efficient, and superior in nearly every aspect to any other device when it comes to communications or data technology applications. These microchip systems are the smallest and most widely used lasers in the world. Industrial Fiber Optics utilizes the latest technology in miniature electronics and laser science in creating the WBS Laser, which you will use to transmit picture and sound over one beam with this *Video RF Receiver*. Read on to learn more about the receiver and to set up the laser video demonstration.

OPERATIONAL INFORMATION

Electrical

All electrical controls are located at the rear of the laser receiver chassis. A diagram of the rear view of the laser receiver appears in **Figure 1**. Following are descriptions of each item identified in **Figure 1**:

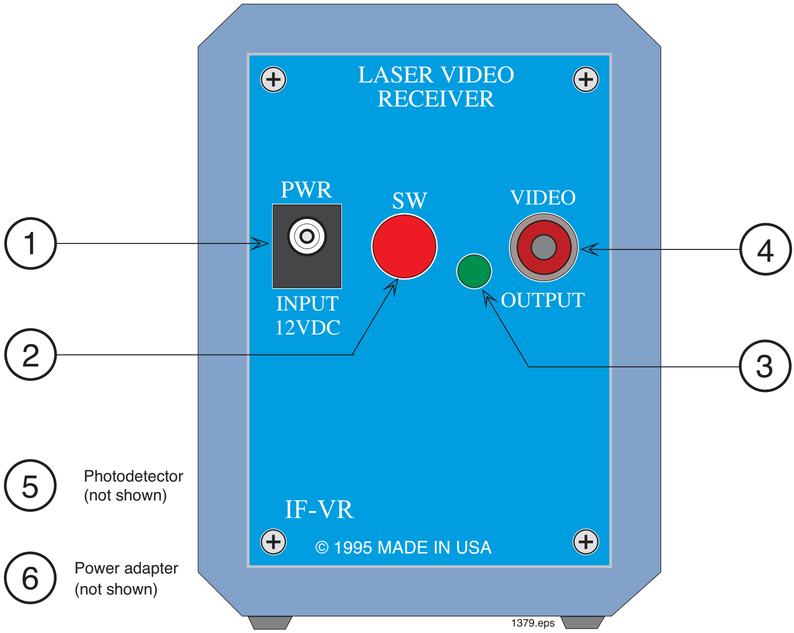

Figure 1. Rear view of Laser Video Receiver showing electrical inputs and controls.

1. Power Jack (PWR)

Industrial Fiber Optics Laser Video Receiver IF-VRII uses a standard 2.1 mm DC power input jack to provide power to the receiver. (An ON/OFF switch controls power from the jack to the electronic circuitry and photodetector.)

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

2. Switch (SW)

A push-button switch is located directly to the right of the 2.1 mm power jack. It controls power from the jack to the internal electronic circuitry. When the switch is closed (ON) it will be slightly depressed, and fully extended when it is open (OFF).

3. Pilot light (PILOT)

To the right of the switch is an indicator or pilot. It emits a green light when the switch is turned on and electrical power is applied to the electronic circuitry.

4. Video Output

The video jack is located to the right of the power jack, switch and indicator light. It is an industry-standard Type F connector.

The inner portion of the Type F jack is the signal connection, and the outer chrome-like portion establishes the common ground required between the receiver and the TV. The maximum analog voltage the receiver can produce without distortion is 200 millivolts peak-to-peak. Internally this output is AC coupled.

The receiver can reproduce a wide range of signals from low frequency audio to high frequency RF (radio frequency). Examples of compatible signal sources to drive the companion laser include dynamic microphones, composite video outputs from television or VCRs, and modulated RF signals from VCRs or cable converter boxes.

5. Photodetector (not shown)

The active detection element is a silicon photodiode, which converts the coded information on the laser beam to an electrical signal. The detector is located inside the receiver chassis about 1.5 cm (5/8 of an inch) from the front. If you look through the translucent blue enclosure, the detector is a two-lead component extending vertically from the printed wiring board. Printed near the detector will be the letters "D1".

To decode the information on laser beams it is necessary to adjust the receiver or laser so the beam strikes the center of this detector. The red plastic in the front of the laser receiver reduces the effects of ambient light.

6. Power adapter (not shown)

All Industrial Fiber Optics products sold in the United States come complete with a power adapter suitable for 60 Hz 120 VAC-to-VDC conversion. When shipped to international regions that are on a 50 Hz 220 VAC power grid, Industrial Fiber Optics will supply 220 VAC to 110 VAC step down transformers to be used in conjunction with the 110 VAC adapters. It is strongly recommended that the power adapter furnished with the laser be the only supply used.

If you use another power supply, it **must** be one with voltage output between 10 to 15 volts DC and minimum current capability of 100 milliamperes. *Do not use a power supply which may generate spikes exceeding 36 volts.*

Specifications

Specifications for laser receiver part number **IF-VRII.**

Table 1. Laser RF Video Receiver Specifications.

Parameter	Value
Operating	
Input voltage	10 to 15 volts
Input current	30 to 50 milliamperes
Temperature	0 to 40° C
Optical	
Polarization	No effect
Spectral bandwidth (20% of max)	500 - 1050 nanometers
Electrical	
Analog modulation, 3 dB1	100 Hz - 70 MHz
Analog output, max.	200 mV peak-to-peak
Storage	
Dimensions	5.6 x 7.5 x 14 cm
Weight (with power adapter)	570 grams
Temperature	-20 to 50° C

1 Lower frequency receivers suitable for audio or voice transmission experiments are available for purchase from Industrial Fiber Optics.

SAFETY

Optical

The Laser RF Video Receiver does not emit optical light or radiation that is hazardous to health. The Industrial Fiber Optics *WBS Laser* with which the receiver is used is a low-power Class II or Class IIIa laser which is very safe for classroom and general laboratory use. These low-power lasers 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.***

If this is your first experience using any laser, review the ***Rules for Laser Safety*** on the back cover of this booklet.

Electrical

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

This laser receiver 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 receiver housing, as this could damage the power supply.

- Do not open the laser receiver housing under any circumstances, as this will expose you to unshielded electrical connections, violating federal government regulations and voiding the product warranty.

OPERATING PROCEDURES

Radio and TV signals use electromagnetic energy that travels at the speed of light. They are broadcast in the radio frequency portion of the electromagnetic spectrum which has a limited capacity for individual signal channels, whether over the air or through cable. By using the light frequency portion of the electromagnetic spectrum, we can greatly increase the amount of TV signals that cable systems can deliver. The following activity will show how clearly radio-frequency based television signals can be carried on a light beam.

Equipment Needed

- WBS Video Laser; IFO part number IF-UL08-635
- 120-VAC to 12-VDC power adapters (2)
- Type F video coax cables (2)
- Female-to-Female Type F adapter (1)
- Laser Video Receiver; IFO part number IF-VRII
- Television with Type F RF input jack*
- Video tape player (or VCR) with Type F RF output jack*

* Not included in this product

Procedure A. Setting up the TV and VCR

In this procedure, we will describe specific steps to hook up the VCR to the television. Because VCRs and televisions vary, it is possible these steps may need to be altered to accommodate your particular situation.

1. Choose a flat, level table approximately 90 × 240 cm (3 × 8 feet) in size as your work area for this exercise.

2. Assemble all items from the **"Equipment Needed"** list at your work area.

3. Connect the power cords for the VCR and the television to 120-VAC outlets.

4. Find the RF "OUTPUT" jack on the VCR and insert one end of the first video coax cable. (Note: The name varies on VCRs, but it's the jack that sends RF-based video signal to the television tuner). The Type F connection on the end of the coax cable can be either a press-on or a screw-on type. Connect one end of the other video coax cable to the RF "INPUT" (tuner) jack on the television. Join the opposite ends of the cables with the female-to-female Type F adapter.

5. Turn on the VCR and television. Change the tuner setting on the television to channel 3 or 4, whichever is unused in your broadcast area. Find the VCR switch that selects the channel for the RF output, usually located in the rear near the "OUTPUT" connector. Set it to the same channel as the television, either 3 or 4. (Whatever names are used on your particular equipment, the key is to have the television tuned to the same channel as the VCR output.)

6. Insert any video tape into the VCR and start it playing. (You may also use the built-in tuner if available to receive a television station.)

7. Make certain the television set is displaying the video and playing the audio signal properly before proceeding to the next procedure. If it is not, check the volume control, signal switch positions and cable connections.

8. When a signal is being received, leave the signal switch positions on the VCR and television as you set them, then stop the playback on the video tape (if used) and turn the VCR and television off. Disconnect the video cables from the female-to-female Type F adapter.

Procedure B. Making the laser transmit video

In this procedure, you will transmit a television signal from the VCR to the television over a light or laser beam. First, you will need to place the WBS Laser and Laser RF Video Receiver in the video signal path as outlined by the following steps:

1. Position the VCR, laser, Laser Video Receiver and television on the table top as shown in **Figure 2**.

2. Connect the Type F connector on the end of the coax cable originating at the VCR and connect it to the VIDEO INPUT jack of the WBS Laser.

Figure 2. Equipment setup for transmitting video signals by light.

3. Connect the Type F end of the video adapter cable attached to the television set to the OUTPUT jack of the Laser Video Receiver.

4. Check the laser to ensure the laser beam shutter is closed.

5. Plug one end of a 120-VAC to 12-VDC power adapter into the WBS Laser, and the other end into a 120-VAC electrical outlet.

6. Plug one end of the second 120-VAC to 12-VDC power adapter into the Laser Video Receiver and plug the other end into a 120-VAC electrical outlet.

7. Switch the Laser Video Receiver on by pressing on the switch at the rear of the chassis. The green indicator just to the right of the switch should light when the laser is powered.

8. Turn on the VCR and start playback of the tape, or use the built in tuner to receive a television station as in **Procedure A**.

9. Turn the television on.

10. Switch the WBS Laser on, then open the laser beam shutter.

11. Position the laser as required so that the laser beam strikes the photodiode inside the Video Laser Receiver. See Item 5 in the section titled “OPERATIONAL INFORMATION” to visually locate the photodiode.

12. You should see the visual portion and hear the sound of the VCR source signal on the television as in **Procedure A**.

13. Experiment by varying the alignment of the laser beam with the receiver photodiode while observing the television screen, and by playing different video tapes.

14. Close the laser beam shutter and turn the laser off.

In the procedure above, the electrical signal from the VCR was used to modulate (vary) the optical power of the laser beam. The information content (picture and sound on an RF carrier) from the VCR was carried by the laser light energy to the video receiver. At the receiver, the laser beam was detected and reproduced in an electrical form for use by the television tuner.

Summary

Congratulations on completing a successful demonstration of transmitting a television signal over a laser beam. With modern technology, this equipment made a once-difficult, or even impossible, experiment look easy. You might ask yourself, "Why go to the trouble of transmitting TV images with lasers and fiber optics?" Most people already get excellent TV reception using conventional cable, antennas and satellite dishes, right?

The big advantage to using light lasers and fiber optics is their ability to carry many times more audio and video information than conventional radio frequency methods. For example the highest microwaves are about 10 Gigahertz in frequency, whereas light is in the frequency range of one million Gigahertz. This much higher bandwidth opens up the opportunity for much higher communication rates than available with our current radio frequency methods. Our world grows by millions of people each year, and natural resources have been feeling the strain of human consumption for a long time. The technology which drives laser and fiber optics developments is a dramatic example of how we can do more with less—and make life a little easier for a crowded planet.

Table 3. 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)

TROUBLESHOOTING

No indicator light on receiver

- Is the ON/OFF switch in the ON position?
- Is the 120 (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 picture visible on the screen

- Is the laser beam positioned properly so it strikes the center of the receiver detector?
- Is there an electrical connection between the VCR and Laser?
- Is there an electrical connection between the Laser Receiver and TV?
- Are you using an Industrial Fiber Optics WBS Laser?
- Slowly move the receiver photodetector out of the path of the laser beam while continuously monitoring receiver operation. This will desensitize the receiver in case it is too sensitive for this laser [i.e., the receiver element is being saturated by laser light].

Grainy or Snowy Picture Visible on TV Screen

- Is the laser beam positioned properly so it hits the center of the receiver photodetector?
- Electrical connections between the VCR and laser may not be secure. Press in firmly on electrical plugs.
- Electrical connections between the laser receiver and TV may not be not secure. Press in firmly on electrical plugs.
- Slowly move the receiver photodetector in and out of the path of the laser beam while continuously monitoring receiver operation. This will desensitize the receiver in case its receiving element is being saturated by the laser.

Do **not** attempt to troubleshoot the laser receiver 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 receiver to Industrial Fiber Optics for appropriate inspection/servicing, as described in the section entitled **SERVICE AND MAINTENANCE**.

SERVICE AND MAINTENANCE

Periodic maintenance and service of this laser receiver is not required. The warranty will be voided if entry has been made to the laser receiver's housing and/or screws have been removed.

In the unlikely event, the receiver 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 receiver, power adapter, manual and written description in a stout 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
USA

WARRANTY

Industrial Fiber Optics laser receivers are warranted against defects in materials and workmanship for 1 year. The warranty will be voided if the laser components have been damaged or mishandled by the buyer, including entry to the laser housing and/or removal of screws.

Industrial Fiber Optics' warranty liability is limited to repair or replacement of any defective unit at the company's facilities, and does not include attendant or consequential damages. Repair or replacement may be made only after failure analysis at the factory. Authorized warranty repairs are made at no charge, and are guaranteed for the balance of the original warranty.

Industrial Fiber Optics will pay the return freight and insurance charges for warranty repair within the continental United States by United Parcel Service or Parcel Post. Any other delivery means must be paid for by the customer.

The costs of return shipments for products no longer under warranty must be paid by the customer. If an item is not under warranty, repairs will not be undertaken until the cost of such repairs has been approved, in writing, by the customer. Typical repair costs range from $20 - $75 and usually take two to three weeks to complete.

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 receiver, 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
USA

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 to the carrier more than five days after delivery may not be honored. If 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.

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.