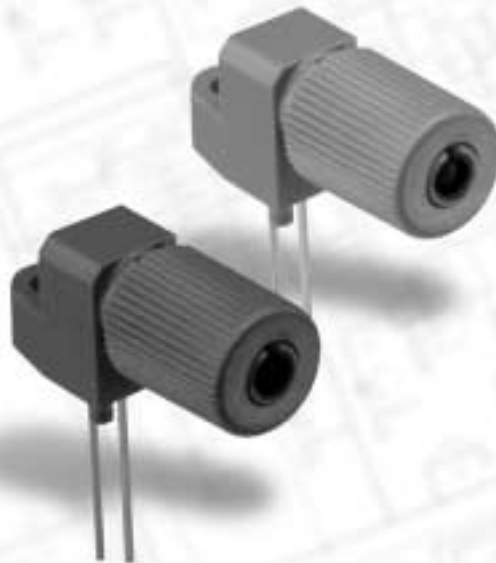


# Industrial Fiber Optics



## 2002 PRODUCT CATALOG

Scientech Technologies Pvt. Ltd.

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# Lasers!

Industrial Fiber Optics manufactures a broad line of lasers for educational use. They are well known industry-wide for their durability, simplicity and visual appeal. Our lasers range from inexpensive diode lasers to wide-bandwidth lasers capable of RF video transmission to the standby helium neon lasers. In 2002, we are proud to introduce a 5 milliwatt helium neon laser which renders our educational laser line the most comprehensive in the industry. Also in 2001 we expanded our product warranties on our lasers from 1-year to 2 or more years depending upon model.



Our complete line of lasers incorporates the Industrial Fiber Optics trademarks of solid dependability, the latest in proven electronic design and packaging. These lasers are packaged in our traditional brilliant, transparent, impact-resistant blue acrylic housings which add exceptional educational appeal and interest for all users. Specifications for all these lasers are found on the next four pages of this catalog.

## LASER SELECTION

Attempting to compare all the makes and models of lasers in today's market can be confusing. To help you make your best informed choice we have prepared the selection table below. It lists laser education applications and the best laser choice for a particular use. The top row lists all of our major laser product categories. In general, helium neon lasers are the preferred choice if you require long coherence length and wavelength stability for optical interferometric experiments. Diode lasers are the best choice for communications or fiber optic experiments.

Questions? Industrial Fiber Optics technical staff will be happy to help you select the correct laser for your specific needs. Monday through Friday, 8 a.m. to 5 p.m., Mountain Standard Time, call 480-804-1227, or e-mail to [info@i-fiberoptics.com](mailto:info@i-fiberoptics.com).

EXPERIMENTS/MODEL	IF-RL	IF-VL	IF-UL	IF-HN	IF-HNM
Refraction and reflection	\$	SS	SS	\$	SS
Lens	\$	SS	SS	\$	\$
Beam convergence and divergence	\$	SS	SS	\$	SS
Diffraction	<	<	<	\$	SS
Polarization	Linear	Linear	Linear	Random	Random
Holography	N/R	N/R	N/R	\$ <sup>1</sup>	SS <sup>1</sup>
Perimeter security	\$	SS	SS	\$	SS
Light shows	\$	SS	SS	\$	SS
Voice communications	\$	N/R	\$ Most versatile	N/S	\$
Baseband video transmission	N/S	\$	SS	N/S	N/S
RF video transmission	N/S	N/S	Best choice	N/S	N/S

\$ Best laser value for the application.

SS Laser is well suited to application, but other, lower priced, alternatives exist.

< Functional, but not best suited.

N/S Not suitable.

N/R Not recommended for first-time holography efforts although, with practice, acceptable holograms can be produced.

1 The higher the laser's power, the quicker the exposure.

# Helium Neon (He Ne) Lasers

Industrial Fiber Optics is pleased to announce the expansion of its dependable and versatile helium neon lasers to include the 5 mW powerhouse. Within our standard product line we offer modulated and unmodulated models to choose from with powers ranging from .5 to 3.5 milliwatts. These lasers have the same great features as our diode lasers. You will easily recognize this laser as it is packaged in a brilliant blue acrylic housing which is extremely durable and visually appealing to both industrial and educational users.

The helium neon laser with its narrow and stable wavelength stability and long coherence length is ideal for:

- Holography and interferometry
- AM/FM radio transmission
- Diffraction
- Single and double slit experiments

In addition, this laser can be used to conduct regular laser, optics and fiber optic experiments which demonstrate properties such as:

- Refraction
- Reflection
- Tyndall's light-guiding-in-water experiments
- Scattering of light
- Critical angle determination in materials
- Convergence and divergence of lenses
- Polarization of light
- Measurement of Brewster's angle

## CHARACTERISTICS

### OPERATING

Analog bandwidth.....600 Hz to 20 kHz  
 Temperature .....0 to 40°C

### OPTICAL

Wavelength.....632.8 nanometers  
 Polarization.....random  
 Mode.....TEM<sub>00</sub>  
 Beam diameter.....< 1 millimeter  
 Beam divergence.....< 2 milliradians

### STORAGE \*

Chassis dimensions .....5.8 × 7 × 36.7 cm  
 Weight......820 grams

\* Excluding 3.5 and 5.0 mW models



**Now 2-Year Warranty**

## FEATURES

- ◆ Hard-seal laser tube for long dependable life
- ◆ All solid-state electronic design
- ◆ Fool-proof mechanical beam stop
- ◆ Bright laser pilot light
- ◆ Impact-resistant, see-through, two-tone blue acrylic case
- ◆ Tamper-resistant screws for safety
- ◆ Threaded mounts for holding lenses, filters and diffraction gratings
- ◆ Tripod mount – 1/4 - 20 thread
- ◆ Rubber feet on chassis bottom for adhesion on slick lab surfaces
- ◆ Full-color operator's manual with safety information and common experiments
- ◆ Labeling and safety requirements compliant with U.S. CDRH regulations
- ◆ Standard 3.5 mm audio input jack (modulatable models)
- ◆ 110- and 220-VAC electrical voltage options
- ◆ 2-year warranty

## MODELS

STOCK No.*	CLASS <sup>1</sup>	MODULATABLE	POWER LEVEL
<b>IF-HN05</b>	II	No	.5 milliwatts
<b>IF-HN08</b>	II	No	.8 milliwatts
<b>IF-HN08M</b>	II	Yes <sup>2</sup>	.8 milliwatts
<b>IF-HN15M</b>	IIIa	Yes <sup>2</sup>	1.5 milliwatts
<b>IF-HN20</b>	IIIa	No	2.5 milliwatts
<b>IF-HN35</b>	IIIa	No	3.5 milliwatts
<b>IF-HN50</b>	IIIa	No	5.0 milliwatts

\* 220-VAC 50 Hz power adapters available upon request

1 Laser classifications as defined by the Center for Devices and Radiological Health

2 Electrical input is industry-standard 3.5 mm audio jack

# Diode Lasers

Industrial Fiber Optics offers two basic models of semiconductor diode lasers. Our RL series of diode lasers is ideal for conducting voice and audio optical transmission experiments as well as common laser and optical experiments. Electrical connections for the analog and digital inputs are the industry-standard, durable banana jacks. In addition, the analog input has a 3.5 mm audio jack for audio and microphone inputs. This laser is also the only product on the market which features an externally adjustable amplifier with a variable gain from 1 to 50, making it suitable for low-voltage microphone inputs and higher amplitude signals from AM/FM radios.

Industrial Fiber Optics' VL series lasers offer wider electrical modulation capabilities. They are suitable for video laser transmission and conducting standard voice and audio transmission experiments. Analog and digital inputs for these lasers are industry-standard RCA phono jacks.

## APPLICATIONS

- ▶ Voice and AM/FM radio transmission
- ▶ Video transmission (IF-VL only)
- ▶ Laser leveling experiments
- ▶ Light shows
- ▶ Bar code scanning
- ▶ Particle counting
- ▶ Refraction & reflection measurements
- ▶ Polarization experiments

## CHARACTERISTICS

Polarization .....	linear
Beam diameter .....	.2 millimeter
Beam divergence .....	.2 milliradians
Chassis dimensions .....	5.6 × 7.5 × 22 cm
Weight .....	400 grams
Operating temperature .....	0 to 40°C

## MODELS

STOCK NUMBER	CLASS <sup>1</sup>	WAVELENGTH (NANOMETERS)	DIGITAL BANDWIDTH	ANALOG BANDWIDTH	COMMENTS
<b>IF-RL08-635</b>	II	635	1-500 kHz	1-500 kHz	Alternative to conventional HeNe lasers
<b>IF-RL30-635</b>	IIIa	635	1-500 kHz	1-500 kHz	A very bright modulatable laser for long-distance requirements
<b>IF-RL30-670</b>	IIIa	670	1-500 kHz	1-500 kHz	An economical modulatable Class III laser
<b>IF-VL08-635</b>	II	635	1-20 MHz	1-10 MHz	Least expensive laser for transmitting video <sup>2</sup> signals
<b>IF-VL30-635</b>	IIIa	635	1-20 MHz	1-10 MHz	Brightest laser for transmitting digital and video <sup>2</sup> information

1 Laser classifications as defined by the Center for Devices and Radiological Health (CDRH)  
 2 Picture signals from color televisions, video cameras and camcorders



**Now 4-Year Warranty**

## FEATURES

- ◆ Semiconductor laser for long dependable life
- ◆ All solid-state electronic design
- ◆ Analog and digital modulation capabilities
- ◆ Variable gain on analog input
- ◆ Internal overdrive protection on inputs
- ◆ Fool-proof mechanical beam stop
- ◆ Linear polarized light beam
- ◆ Impact-resistant, see-through, two-tone blue acrylic case
- ◆ Tamper-resistant screws for safety
- ◆ Threaded mounts for holding lenses, filters and diffraction gratings
- ◆ Tripod mount – ¼ - 20 thread
- ◆ Rubber feet on chassis bottom for adhesion on slick lab surfaces
- ◆ Full-color operator's manual with safety information and common procedures
- ◆ Labeling and safety requirements compliant with U.S. CDRH regulations
- ◆ 110- and 220-VAC electrical voltage options
- ◆ 4-year warranty

*Operator's manual available on our Web site*

The *WBS Laser* is the ultimate educational laser and will be the last laser you'll need to purchase. Why? Because of its versatility which includes dual analog and digital input design, both with very wide electrical modulation capability. The analog input accommodates as low as 100 Hz for laser audio communication experiments to as high as 70 megahertz for simultaneous transmission of color video picture and sound. The digital input accepts all standard +5 logic levels for digital communications experiments. With such fantastic versatility, this one laser can perform all of the following dynamic optical communication demonstrations:

- Voice communication
- AM/FM radio transmission
- Video from camcorder
- RF video from VCR
- Digital line-of-sight computer links

In addition, this laser can be used to conduct regular laser, optics and fiber optic experiments which demonstrate properties such as:

- Refraction and reflection
- Light shows
- Tyndall's light-guiding-in-water experiments
- Speed of light measurement
- Critical angle determination in materials
- Convergence and divergence of lenses
- Polarization of light
- Measurement of Brewster's angle
- Perimeter security using laser beams

### CHARACTERISTICS

#### OPERATING

Analog bandwidth.....	100 to 70 MHz
Digital bandwidth.....	0 to 20 MHz
Temperature .....	-20 to 50°C

#### OPTICAL

Wavelength.....	635 nanometers
Polarization.....	linear
Output power.....	0.8 milliwatts
Beam diameter, max.....	3.2 millimeter
Beam divergence, max.....	2 milliradians

#### STORAGE

Weight.....	400 grams
Chassis dimensions.....	5.6 × 7.5 × 22 cm



Now 4-Year Warranty

### FEATURES

- ◆ Semiconductor lasing element and all solid-state electronic design for a long dependable life
- ◆ Bright 635 nanometer wavelength laser beam
- ◆ Standard RCA-type input jacks
- ◆ Electrical overdrive protection on all inputs
- ◆ High visibility, fool-proof mechanical beam stop
- ◆ Linear polarized light beam
- ◆ Tamper-resistant screws for safety
- ◆ Impact-resistant, see-through, two-tone blue acrylic case
- ◆ Threaded mount for holding lenses, filters and diffraction gratings
- ◆ Tripod mount – 1/4 - 20 thread
- ◆ Rubber feet on chassis bottom for adhesion on smooth surfaces
- ◆ Labeling and safety requirements compliant with U.S. CDRH regulations
- ◆ Full-color operator's manual with safety information and common experiments
- ◆ 110- and 220-VAC electrical voltage options
- ◆ 4-year warranty

As a special package offer, Industrial Fiber Optics will combine the *WBS Laser* with a free optical RF video receiver, interconnecting cables, power adapters and an instruction booklet for setting up a VCR-to-Laser-to-Receiver-to-TV link as a group package. To order, use:

**STOCK NUMBER IF-UL08-635X**

Industrial Fiber Optics also will offer the *WBS Laser* as a complete laser communication package with the items above, as well as a microphone, AM/FM radio, patch cords and an audio receiver. To order, use:

**STOCK NUMBER IF-UL08-635Y**

# Laser Ray Box

Compact and powerful, the Laser Ray Box produces five parallel and sharply defined light beams ideal for demonstrating optical ray analysis and viewing. Five side-by-side 1mW diode lasers 1.6 cm apart create beams that are 650 nm in wavelength for high visibility (readily seen even in a typical well-lit room). With its commanding visual effects, the Laser Ray Box will easily and dramatically demonstrate the following light behaviors when used with the appropriate lenses:

- Light bending due to refraction
- Refractive optics
- Reflections from mirrors
- Fresnel or “parasitic” reflections from non-coated optical elements
- Monochromatic character of laser light
- Total internal reflection

The bottom of the Laser Ray Box and included battery holder are magnetized for easy adherence to both horizontal and vertical metal surfaces such as steel white or chalk boards for classroom optical demonstrations.

Power is provided by 3 internal NiCd cells that are charged with VAC-to-DC power adapter provided.

**STOCK NUMBER**                      **IF-550**

(This device is rated as a Class II laser product by CDRH regulations because no single beam exceeds 1 mW of visible laser radiation or light.)



## CHARACTERISTICS

### OPERATING

Input voltage, max..... 5 volts  
Input current..... 150 milliamperes  
Temperature ..... 0 to 40°C

### OPTICAL

Wavelength..... 650 nanometers  
Polarization ..... linear  
Output power, max..... .95 milliwatts  
Beam diameter, max..... 2 millimeter  
Beam divergence, max ..... 2 milliradians

### STORAGE

Chassis dimensions ..... 11 × 6 × 2 cm  
Weight ..... 400 grams

## SMOKED LENS SET

High quality acrylic lenses allow the direct observation of refraction, Fresnel Reflections and internal reflection within the optical element itself. Best viewing is created with laser ray box although any laser, sunlight or ray box is suitable. Set includes four optical elements, each 20 mm thick.

- Double convex, 50 mm, focal length 50 mm
- Double convex, 76 mm, focal length 100 mm
- Right Angle Prism, 90/45/95, 70 mm on oblique side
- Rectangular Block, 70 mm × 28 mm

**Stock Number**                      **IF-551**



## LASER AUDIO TRANSMISSION PROJECT

Wow your students with a visual demonstration of sound being transmitted over light waves from a laser beam. Simple and easy to set up, this state-of-the-art equipment package is a breeze to use. Simply insert the microphone into the jack at the rear of the laser, plug in the VAC-to-DC power adapters and aim the laser beam at the audio receiver's optical detector. Then talk, sing, hum or create almost any imaginable sound into the microphone. Equipment set-up is less than five minutes and the sounds are sent across the room and recreated within nanoseconds.

Students will be amazed that somehow voices are electronically and optically relayed from one remote point to another and converted back into sounds – without benefit of a "hard connector" in-between.

The project's audio receiver features total solid state design, adjustable volume control, self-contained and durable surface-mount electronics design, 110 VAC operation, and impact-resistant enclosure. Inside the receiver are the sensitive optical semiconductor detector, amplifier, power conditioning electronics and 10 cm (4 in.) speaker.

Package includes a choice of diode or helium neon laser, audio receiver, high-sensitivity electronic microphone, instruction manuals and two 110-VAC-to-DC power adapters. Also included is 3 meters of fiber optic cable for demonstrating the light- and information-carrying abilities of optical fiber. Available with the general purpose .8 mW Class II Helium modulatable neon laser.

**Stock Number: IF-511**



With the smaller and highly linear .8 mW 635 nm Class II Diode Laser.

**Stock Number IF-512**

Specifications for Audio Receiver and stock number for purchase separately are shown on page 12.

## TYNDALL'S HISTORICAL EXPERIMENT – LASER STYLE

Recreate the historical experiment that demonstrated the fundamental concept that lead to transmitting light through optical fiber. In 1870, before the skeptical British Royal Society, Irish researcher John Tyndall successfully demonstrated how light could be guided in a stream of falling water. It was the first recorded observation of light being guided by "total internal reflection," and it still is a visually fascinating experiment today. Using modern components, demonstrate this basic principle of light's behavior when it enters a constricting optical channel. A visible-light laser with optical power of .5 mW or greater is required for use, but not included.



**Stock Number IF-514**



## DIGITAL PHOTOMETER

(Optical Power Meter)

A versatile and economical classroom tool for measuring power levels of laser beams, demodulating optical signals for audio applications and solar experiments. Photometers are essential equipment in any principles-of-technology or in-school research program. The battery power, portability and adjustable height detector of this model offer particular flexibility.

The photometer is powered by two standard 9-volt batteries and offers four digital measurement scales from 20 microwatts through 20 milliwatts. Output to two industry-standard banana jacks is a conditioned electrical voltage that is directly proportional to light incident upon the photodetector with a frequency range up to 10 kHz. (The analog output can be connected to a strip chart recorder for solar monitoring, to an oscilloscope for observing time-dependent optical signals or to an amplified speaker for voice transmission.) The photometer also will act as an audio receiver to demodulate laser signals, which are also output to the industry-standard banana jacks.

### FEATURES

- ◆ Large easy-to-read digital display
- ◆ Four measurement scales from 20 microwatts to 20 milliwatts
- ◆ Large active area detector
- ◆ Sensitive to visible and IR light
- ◆ Battery operation for portability (100-plus hours operation)
- ◆ Momentary switch for long battery life
- ◆ Adjustable detector height
- ◆ Impact resistant enclosure
- ◆ All solid state detector and electronic design

**STOCK NUMBER                      IF-PM**

OPTIONAL RANGE MODEL: 199  $\mu$ W, 1.999 mW, 19.99 mW, and 199.9 mW

**STOCK NUMBER                      IF-PM200**



*(Photometer comes complete with storage container, metal optical stand for the detector, instruction manual and batteries.)*

### CHARACTERISTICS

#### OPERATING

Input power .....	Two 9-volt batteries
Accuracy* .....	$\pm 10\%$
Ranges (4) .....	19.99 $\mu$ W, 199.9 $\mu$ W 1.999 mW, 19.99 mW
Temperature .....	10 to 30° C

#### OPTICAL

Detector active area .....	1 cm <sup>2</sup>
Wavelength sensitivity** .....	450 to 950 nanometers
Maximum optical input .....	100 milliwatts

#### STORAGE

Control/Display Unit .....	16 × 9.5 × 6.5 cm
Detector Assembly/Stand .....	16.5 × 5 cm
Weight .....	750 grams

\* Calibrated at 632.8 nanometers

\*\* Special response curve can be seen on our web site



## LASER SAFETY SIGNS

Readily visible warning signs are suggested by the FDA in any area where lasers may be operating. Be proactive in promoting safety. No lab area should be without proper warning signs.

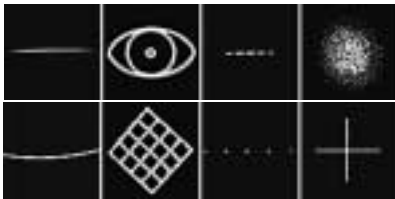
Sturdy laminated plastic signs for Class II and Class IIIa lasers measure 18 × 25 cm.

**Class II                      IF-140021**  
**Class IIIa                    IF-140020**

## LASER OPTICS KIT

This innovative collection of nine unique optical mounts offers endless possibilities for exploring the many aspects of modern optical technology. Each optic element is color-coded for ease of use and creates a distinctive beam or pattern effect. Elements screw onto a laser's standard optic mount ( $\frac{3}{4} \times 32$  inch thread) to:

- Conduct experiments utilizing geometric principles and optics
- Examine polarization of laser beams
- Investigate basic and advanced diffractive principles and optics
- View light traveling through optical fiber
- Create real-world problem-solving exercises using geometry and trigonometry



Each of the nine optical mounts in the kit is precisely machined from a solid aluminum billet and designed with a recess hole for totally enclosing the optical component for mechanical durability



*Kit contents: 16-page full-color illustrated manual, nine distinctive optic mounts, fiber optic cable, linear polarizing filter, padded snap-closure storage/carrying case. Laser not included.*

and stability. All optical mounts are protected with a brilliantly colored scratch-resistant anodizing. Each colored mount corresponds to the color codes described in the instruction manual. The 16-page full-color manual included contains step-by-step set-up instructions, actual photographs of images created with the optics mounts, explanations for each of the nine mounts, suggestions for labs and examples of real-world applications. In addition, four pages of technical references explain the basics of geometric and diffractive physics, polarization and fiber optics.

**STOCK NUMBER**      **IF-535**

## LASER POINTER



This smartly styled and handy pen-sized laser can be used both as a pointer and to conduct light experiments of all kinds. The pointer's adjustable lens can be focused to create the sharpest possible beam-point image (as small as 1 mm in diameter) over distances of nearly a half-mile. Focus simply by

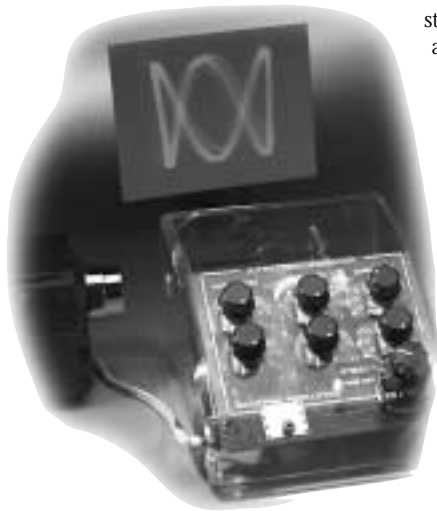
turning the gold ring at the front of the pointer. Comes with carrying case and batteries. Two-year warranty.

### CHARACTERISTICS

Class .....	IIIa
Power .....	< 5 mW
Wavelength .....	645 nanometers (twice as bright as 670 nm)
Range .....	2000 feet in darkness
Batteries .....	2 AAA

**Stock Number**      **IF-560**

## X-Y PATTERN GENERATOR



The X-Y Laser Pattern Generator is the creative educational vehicle to captivate student interest in the dynamic world of laser technology. When used with any laser, this device creates endless combinations of patterns and shapes, similar to those created for large and expensive laser light theatrical presentations.

### APPLICATIONS

- ▶ Create students' own laser light shows
- ▶ Dynamically contrast stereo and mono audio sounds
- ▶ Mimic the use of laser beams in cutting applications
- ▶ Meet the special lighting needs of small theaters
- ▶ Demonstrate laser beam control with motors and mirrors
- ▶ Create infinite numbers of "Lissajous" and quadrature patterns

The generator is housed in a see-through cool-blue acrylic case for easy viewing and alignment, and can be used in conjunction with any HeNe, diode or visible light laser. Laser light patterns can be generated with either the internal electronics or patched to an audio signal to create light images from sound.

*(Pattern Generator comes with control head, 110 VAC-to-12 VDC power adapter and operator's manual. An external lasing source is required.)*

**STOCK NUMBER**

**IF-XP**

## ROTATING BEAM SCANNER

Lasers are widely used in industrial leveling and commercial bar code scanning applications (in conjunction with rotating mirrors and motors). Now with the Rotating Beam Scanner and any visible-light producing laser, you can replicate an equipment configuration which uses laser technology in these applications. Your expenditure will be a tiny fraction of the cost of "industrial strength" models.

The Rotating Beam Scanner projects a straight "light" line from the laser beam by reflecting it off a rapidly spinning metal polygon. The scan pattern is 90 degrees in extent and is created by the 8-sided polygon mounted on the shaft of a precision ball-bearing motor. This polygon is the latest in optical fabrication technology, consisting of eight diamond-turned surfaces coated with a layer of high-reflectivity gold, just like those in the high-price range. The beam scanner has a low- and high-speed selection switch for versatility and is powered by any DC power source from 8 to 18 volts. Overall beam scanner dimensions are 11 x 9 x 9 cm.



*(Scanner comes complete and ready to use, including polygon and motor in a clear acrylic case, 110 VAC-to-DC power adapter and set-up/operating instructions.)*

**STOCK NUMBER**

**IF-BS**

## LASER BEAM STOP

An inexpensive apparatus for ensuring and practicing safe laser usage in the classroom. The apparatus acts as a diffuse surface to avoid any specular reflections.

One side is matte white for maximum visibility and the other side is matte black for maximum absorption. Applicable to all Class II, IIIa and IIIb laser beams. Acrylic base with rubber feet for stability and adhesion.



3 × 4 INCH UPRIGHT BEAM STOP **IF-LBS1**

## PHOTONICS WALL CHART

Our Photonics Wall Chart is the perfect visual aid for easily and accurately studying the characteristics of lasers, opto-electronics and light.



In four vibrant colors it portrays:

- The linear full-color visible spectrum
- Commercial laser emission spectra
- A chart of the complete photonic electromagnetic spectrum
- Photodetector spectrum detection ranges

Laminated in heavy plastic for durability, this is a superb complement to any science class or laser curriculum. Dimensions are 56 × 82.5 cm (22 × 32 in).

STOCK NUMBER **IF-PWC-L**

## FIBER OPTIC ROD

A specially formulated acrylic rod for demonstrating the basics of fiber optics when used with a visible light laser. To illustrate, merely align the end of the rod at an angle and watch the laser light rays "bouncing" down the acrylic cylinder. Ideal for inexpensive but dramatic demonstrations of Snell's Law in action.

STOCK NUMBER **IF-ACR**

## LIGHT RAY VIEWING KIT

The Light Ray Viewing Kit is a small "liquid laboratory." When used with any of our lasers it creates underwater light ray patterns and diagrams that constitute the basics of all introductory optical studies. In a complementary series of activities in the

accompanying instruction guide, students can observe, and more readily understand, principles and equations such as:

- Snell's Law
- Total internal reflection
- Equal angles of incidence and reflection
- Brewster's Angle
- Critical angle of light

Set-up for each experiment requires less than five minutes and costs only a few pennies. ("Just add water!") Project equipment includes impact-resistant observation tank; four ounces of scattering solution; first-surface mirror; stirring rod; ruler; protractor; and eight full-color instruction guides. Suitable for grades 6 and above.

STOCK NUMBER **IF-548**  
 WITH .5 mW HELIUM NEON LASER **IF-549**  
 4 ADDIT'L OUNCES SCATTERING SOLUTION **IF-410055**



## LASER-TO-FIBER ADAPTER W/FIBER

With lasers and fiber optics classes frequently being taught together it is often desirable to direct light from a laser beam into an optical fiber. With this component, mating optical fibers to the standard optical mounts of many educational helium neon

(HeNe) and diode lasers (INDUSTRIAL FIBER OPTICS, Laser Master, Metrologic, Scientific Laser Connection) is easy. Threads on the fiber adapter are 32 threads per inch and 3/4-inch in diameter. Included: 1.5 meters of unjacketed 2000 μm core plastic fiber with factory-tooled and polished termination.

STOCK NUMBER **IF-LFA**

# Laser Receivers

## LASER AUDIO RECEIVER

Receiver for detecting light from any visible or infrared laser beam and converting modulated light signals to sound. Features:

- 110 VAC operation
- 100 mm (4 inch) internal speaker
- Adjustable volume control
- 100 to 15 kHz detection frequency range
- Dual channel



**STOCK NUMBER IF-513**

**RECEIVER, POWER ADAPTER & DYNAMIC MICROPHONE IF-LSL-2**

*Operator's manual available on our Web site*

## LASER SPEED OF LIGHT/RECEIVER PROJECT

*Operator's manual available on our Web site*



In the last few years, lasers have become invaluable tools in thousands of scientific, medical and communications applications. This project, in several individual experiments, demonstrates a laser's unique ability to perform a variety of tests with deceptive ease.

Included:

- Measuring the speed of light
- Transmitting and receiving audible signals using light as the transport medium
- Transmitting and detecting black-and-white video signals using light.

The modulated laser included with this kit can also be utilized for hundreds of other classroom and real-life projects. The instruction manual contains detailed instructions and diagrams that describe equipment set-up, as well as a historical journey into efforts to measure the speed of light. This is a great opportunity to learn not only about new technology, but also the very human history behind it.

*Included in the kit are a .8 mW diode laser; optical beam splitter; first-surface mirror; converging lens; optics mounts; microphone; electronic control/receiver box with 2-channel receiver and 1 MHz oscillator; 110 VAC-to-DC power adapter; optics table and step-by-step instruction book. Not included but required for operation are a modulated laser, video camera and monitor and a dual-channel 40 MHz oscilloscope. We will substitute 220 VAC adapters upon request.*

**COMPLETE KIT WITH LASER IF-546**  
**RECEIVER & ACCESSORIES IF-LSL-1**

**TWO-CHANNEL RECEIVER WITH POWER ADAPTER IF-LSL-SA1**  
(WILL REPLACE BATTERY POWERED METROLOGIC RECEIVERS)

## NTSC (COMPOSITE) VIDEO

Receiver for decoding IR and visible light beams to industry-standard NTSC video. Features:

- Internal automatic gain control
- Wide optical dynamic range
- 75  $\Omega$  output impedance
- Matched physically to IF-VL and IF-UL lasers
- See-through, impact-resistant blue acrylic case
- 110 VAC operation

**STOCK NUMBER IF-VR**



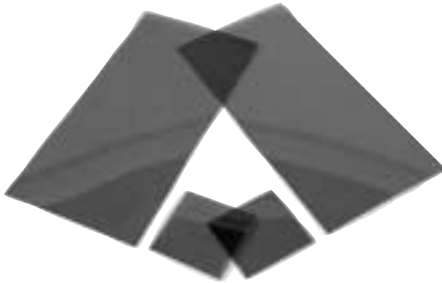
## RF VIDEO RECEIVER

Receiver for decoding IR and visible light beams to industry-standard NTSC video. Features:

- Wide optical dynamic range
- 75  $\Omega$  output impedance
- Matched physically to IF-UL laser
- See-through, impact-resistant blue acrylic case
- 110 VAC operation

**STOCK NUMBER IF-VR11**

## POLARIZING FILM



A general-purpose linear polarizing film for use with visible and near-infrared light. Thickness is .75 mm. Extinction ratio is greater than .01%. Useful for reducing glare, conducting optical experimentation and increasing contrast in sensors. Film is easily cut, punched or drilled and is resistant to heat, impact and abrasion.

SIZE (mm)	QUANTITY	STOCK NUMBER
50 × 50	2	<b>IF-PF1</b>
50 × 50	100	<b>IF-PF2</b>
100 × 200	2	<b>IF-PF3</b>
475 × 625	1	<b>IF-PF4</b>

## 1/4 WAVE OPTICAL RETARDER FILM

General purpose quarter wave optical retarder film; 92% transmission at 560 nm. Thickness is 0.25 mm. Useful for demonstrating circular and elliptical optical polarization as well as right and left hand polarization.

SIZE (mm)	QUANTITY	STOCK NUMBER
50 × 50	2	<b>IF-QW1</b>
100 × 200	2	<b>IF-QW3</b>

## 1/2 WAVE OPTICAL RETARDER FILM

General purpose half wave optical retarder film; 92% transmission at 560 nm. Thickness is 0.25 mm. Useful for demonstrating circular and elliptical optical polarization as well as right and left hand polarization.

SIZE (mm)	QUANTITY	STOCK NUMBER
50 × 50	2	<b>IF-QW1</b>
100 × 200	2	<b>IF-QW3</b>

## RGB FILTER SET

A set of three individual colored filters mounted in standard 35 mm slide holders. Ideal for use in optical transmission measurements, solar monitoring and exploration, attenuation of laser beams and demonstrations of laser light's monochromaticity. Set includes one red, blue and green filter.

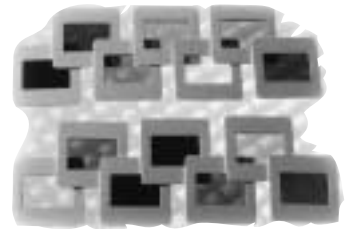


STOCK NUMBER

**IF-FS1**

## DELUXE FILTER SET

Contains 14 different colors of filter in 35 mm slide mounts. Colors are light blue, medium blue, daylight blue, dark blue, golden amber, medium green, light green, green-blue, light red, medium purple, orange, medium yellow, medium red and frost. All filters are individually mounted on plastic mounts as shown.



STOCK NUMBER

**IF-FS4**

## DIFFRACTION MOSAIC

The diffraction mosaic is a precision array of seven different slots/grids designed for use in performing laser double- and multiple-slit diffraction experiments. The mosaic contains four double-slits and three multiple-slit arrays on an opaque film with clear apertures. Double-slit separations range from 45 to 100 μm in width.

The gratings are 25, 50 and 100 lines/mm. The mosaic is inexpensive and is mounted in one easy-to-use 35 mm slide holder. Includes 12-page full-color guide for conducting and understanding light diffraction experiments.



STOCK NUMBER

**IF-508**

# Prisms, Lenses & Mirrors

## PRISM ASSORTMENT



Three assorted-size high-quality glass prisms. Excellent and for many optical experiments. Kits include right-angle, dove, equilateral and pentagonal prisms. No two assortments are identical.

STOCK NUMBER **IF-PA**

## EQUILATERAL PRISM 60°

Equilateral prisms have three equal 60° angles. They are ideal for demonstrating how a beam of light breaks into the colors of the spectrum. Made of optical glass. 25 × 50 mm in size.



STOCK NUMBER **IF-830095**

## LENS ASSORTMENT

An assortment of five high-quality glass lenses designed for optical experiments. Includes at least one each of double-concave, double-convex and concave-convex lens.

STOCK NUMBER **IF-LA**

## LENS CLASSPACK

Twenty-five assorted high-quality lenses suitable for conducting hundreds of experiments. Includes lenses from .25 to 1.00 inch in diameter. Package can include lens shapes in primary configurations such as plano-convex and plano-concave, double-convex, double concave. Ideal for graphically demonstrating basic principles of optics.

STOCK NUMBER **IF-LACP**

## INDEX OF REFRACTION BLOCK

Demonstrate how light is bent as it passes from air (low refractive index) into an acrylic block (higher refractive index). Specially formulated plastic highlights light beams as they bend and pass through. An inexpensive and dramatic way to visualize refractive indices, plus, this block can be used for critical angle reflection demonstrations. Can be used with any laser, light ray box or laser pointer. Unbreakable. 17 × 28 × 70 mm in size.



STOCK NUMBER **410225**

## MIRROR ASSORTMENT



Five assorted-size high-quality, multi-purpose first-surface, glass substrate mirrors excellent for many optical experiments. Mirror surfaces are protected with a removable film to prevent scratching during shipping.

STOCK NUMBER **IF-MA**

## UNBREAKABLE MIRRORS

An inexpensive solution to the problem of glass mirror breakage in classrooms. Substrate is acrylic with an aluminum coating for the reflecting surface. Ideal for younger students.



SIZE (IN)	STOCK NUMBER
2.5 × 3	<b>IF-AM1</b>
5 × 7	<b>IF-AM2</b>
10 × 12	<b>IF-AM3</b>

# Fiber Optic Demonstration System

The Fiber Optic Demonstration System is Industrial Fiber Optics' introductory fiber optic technology module. This tried and proven academic module comes complete and ready to use. All an instructor needs is a classroom and students. This curriculum recently has been revised and rewritten to include the very latest in the rapidly changing fiber technology field. Additions to the curriculum include:

- Fusion splicing techniques
- Fiber connector technology
- Optical power splitters
- Wavelength division multiplexing
- Fiber termination tools and procedures
- Fiber optic testing and test equipment

The curriculum is a full-color manual that is precisely formatted into 10 independent activities in 144 pages with more than 60 real-world illustrations and industry photos. An extensive list of references and a working glossary of fiber optic terms is included. Each activity includes:

- Historical and technical reading assignments
- Hands-on working experience and experiments with fiber optics and associated components
- Problem solving and student worksheets
- Team activities
- Homework and investigative research
- Web fiber optic tours and projects

Hands-on activities immerse students in the technological aspects of:

- Voice transmission over fiber
- Analog and digital data transmission
- Morse Code over fiber optics
- Optical fiber characterization
- Fiber sensors and applications
- Bending losses in optical fibers
- Optical fiber termination and polishing
- Attenuation in optical fiber

*(The Demonstration System is available in glass and plastic fiber models and comes complete with the following items: two fiber optic analog/digital transceivers, eight fiber lengths 1 to 10 meters, 40  $\mu\text{m}$  and 3  $\mu\text{m}$  polishing film, 110 VAC-to-12 VDC power adapters\*, color-coded electrical interconnecting leads, AM/FM radio, sensor reflection and indicator cards, two permanently bound student manuals, instructor's manual in a sturdy 3-ring binder with answer sheets.)*

*\*220 VAC adapters will be furnished upon request.*



## FEATURES

- ◆ Versatile curriculum format (metric and SAE dimensions)
- ◆ 10 comprehensive activities including lighting, sensor and communication fiber applications
- ◆ Full-color student and instructor manuals
- ◆ Solid-state, low profile, surface-mount transceivers capable of analog and digital operation
- ◆ Low-voltage transceiver operation
- ◆ Color-coded electrical connections
- ◆ Low-power LED technology for safety
- ◆ Instructor's manual includes color-coded answer sheets
- ◆ Suitable for grades 7 through 12

The glass version of this module utilizes industry-standard 62.5/125  $\mu\text{m}$  data communication fiber and high performance IR (infrared) LEDs with easy-to-use locking ST® fiber terminations (the same high quality components used by many standard data communications networks).

Curriculum  
available on our  
Web site

<b>STOCK NUMBER</b>	<b>IF-DS100G</b>
<b>STUDENT MANUALS</b>	<b>IF-120027</b>
<b>INSTRUCTOR'S MANUAL</b>	<b>IF-120026</b>

Our plastic fiber model utilizes inexpensive connector-less fiber design. The customized inter-connecting system with 1000  $\mu\text{m}$  plastic fiber and red visible LEDs is ideal for educational purposes.

<b>STOCK NUMBER</b>	<b>IF-DS100P</b>
<b>STUDENT MANUALS</b>	<b>IF-120255</b>
<b>INSTRUCTOR'S MANUAL</b>	<b>IF-120250</b>



# Fiber Optic Splicing & Connector Module



The Fiber Optic Connector and Splicing Module is a new and supplemental curriculum from Industrial Fiber Optics. It is written and designed to augment our best industry selling Fiber Optic Demonstration System training product. This new module is an ideal hands-on training curriculum for industrial technology and vocational education studies in two of the most sought after industry technical skills today – splicing a fiber optic cable and doing field installations of fiber optic connectors.

## FEATURES

- ◆ Comprehensive and challenging activities
- ◆ Complete self-contained curriculum
- ◆ Color-coded activity tabs
- ◆ Low cost per student
- ◆ Uses safe, large-core plastic fiber
- ◆ Full 4-color instructor and student manuals
- ◆ Step by step instructions
- ◆ Many graphic illustrations add clarity to instructions
- ◆ Removable and photocopyable sheets in the Instructor's Manual
- ◆ Stand-alone curriculum capability

The Fiber Optic Connector and Splicing Module is a 3-activity module with the following activities

- Equipment and Component Familiarization
- Methods for Installing a Fiber Connector
- Methods for Splicing Fiber Cable

Although this module was written as a supplemental curriculum for the Fiber Optic Demonstration System, it also can be used as a stand-alone instructional package. The module is fully compatible with both the plastic and glass versions of the Fiber Optic Demonstration System. (In addition, this module is also compatible with a product manufactured for Scientific Laser Connection, which is referred to as Module 2.)

Each activity includes:

- Advance reading assignments
- Actual hands-on, step-by-step procedures for assembling components, then testing them for degree of technical performance. Discussions of applicability to real-world environments such as communications systems put the procedures in industry perspective.
- Assessment of the strengths and shortcomings of various components as system requirements change.
- Worksheets/quizzes that test students' knowledge as well as their ability to apply that knowledge to conceptual situations.
- Homework assignments (using Internet or library resources).

The comprehensive Instructor's Manual that comes with the module also includes answers to quiz and worksheet questions and a description of replacement parts, which are consumed or worn down in activities.

*(The Fiber Optic Connector and Splicing Module includes the following items: fiber inspection microscope, hot knife and stand, fiber optic crimping tool, Professional fiber cutter, titanium polishing puck, polishing slurry, Micro-strip fiber stripper, glass polishing plate, tool box, 2 ounces index-matching gel, 2000 grit sandpaper, 3 μm polishing film, 2 ST® mating sleeves, set of two interconnecting fibers, 4 ounces isopropyl alcohol, 2 Student manuals, 1 Instructor's manual, 15 2-meter lengths of 1000 μm-core plastic fiber, 15 fiber splices and 30 ST® fiber connectors)*

**STOCK NUMBER IF-505**

*2000 grit sandpaper, 3 μm polishing film, 15 2-meter lengths of 1000 μm-core plastic fiber, 15 fiber splices, and 30 ST® fiber connectors.*

**CONSUMABLES KIT IF-528**

# Fiber Optic Communications & Networking Module

The Fiber Optic Communications & Networking Module is Industrial Fiber Optics' newest fiber optic technology module. It's a 10-activity, intermediate-level product developed for teaching at a higher level than other modules, emphasizing fiber optic communications and networking technology. The curriculum addresses the most recent advances in the rapidly changing fiber communications and networking technology fields. Curriculum subjects include:

- Fundamentals of fiber optic technology
- Optical fiber manufacture
- Optical fiber construction: single- and multi-mode
- Dispersion and attenuation
- Fiber cable comparisons
- Generation III fiber connection technology
- Fusion splicing techniques
- Fiber couplers and optical power splitters
- Wavelength division multiplexing
- Fiber optic tools, testing and test equipment

The module curriculum guide is a comprehensive manual comprising 10 exciting activities, with technical reading assignments for each. Accompanying Fiber Optic Reference Guides contain 14 chapters with several hundred illustrations in 199 pages. An extensive list of references and a working glossary of fiber optic terms are included. Each activity features:

- Real-world applications
- Hands-on working experience and experiments with fiber optics and associated components
- Problem solving and student worksheets
- Homework assignments and investigative research
- Web fiber optic tours and projects

Hands-on experiments and networking activities include:

- Color picture and sound signals over fiber
- Optical fiber characterization
- Losses in optical fiber
- Fiber optic switching networks
- Optical and electrical multiplexing
- Fiber termination polishing and splicing
- Infrared light conversion
- Use of fiber optic couplers (splitters)



## FEATURES

- ◆ Versatile curriculum format (metric and SAE dimensions)
- ◆ 10 comprehensive and challenging activities
- ◆ Full-color student and instructor manuals
- ◆ Completely self-contained curriculum
- ◆ Curriculum pretest and post test
- ◆ Instructor's manual with color-coded answer sheets
- ◆ Solid-state, low profile, surface-mount transceivers with audio and video transmission capabilities
- ◆ Low-voltage transceiver operation with optical detection
- ◆ Multiplexed switching input/output transceiver
- ◆ Low-power LED technology for safety
- ◆ 3 transmit wavelength operation

*(The Communications and Networking Module shown above comes complete with three fiber optic wide-bandwidth video transceivers, 110 VAC- to-12 VDC power adapters\*, 15 2-meter 1000  $\mu$ m core plastic fibers, 15 fiber splices, 30 ST<sup>®</sup> fiber connectors, crimping tool for splices and connectors, 40  $\mu$ m and 3 mm polishing film, optical inspection scope, index-matching gel, DC motor, optical multiplexer, fiber cutter, polishing plate, polishing slurry, ST<sup>®</sup> barrel connector, 1  $\times$  2 fiber star coupler, 1, 3, and 10- meter fiber optic cables, fiber optic multi-meter, two dynamic micro-phones, two AM/FM radios, scale, infrared indicator card, coax cable, hot knife and stand, Micro-strip fiber stripper, four ounces isopropyl alcohol, photonics wall chart, two Fiber Reference Guides, two permanently bound student manuals and an instructor's manual in a sturdy 3-ring binder.) \*220 VAC adapters will be furnished upon request.*

Curriculum  
available on our  
Web site

**FIBER OPTIC COMMUNICATIONS  
& NETWORKING MODULE**  
**STUDENT MANUAL**  
**TEACHER'S MANUAL**  
**FIBER OPTIC VIDEO TRANSCEIVER**

**IF-527**  
**IF-120265**  
**IF-120260**  
**IF-529**

*15 2-meter 1000  $\mu$ m core plastic fibers, 15 fiber splices, 30 ST<sup>®</sup> fiber connectors, 40  $\mu$ m and 3 mm polishing film*

**CONSUMABLES KIT**

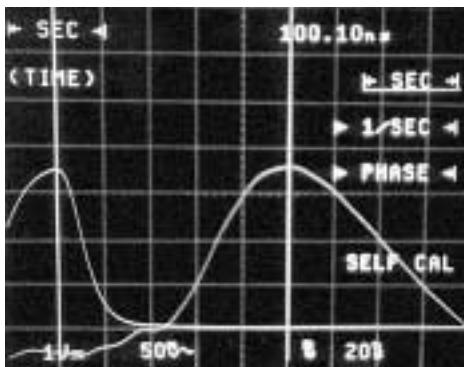
**IF-528**

# Speed of Light Apparatus

With Industrial Fiber Optics' Speed of Light Apparatus, measuring the speed of light is now easy and quite accurate. Such was not the case for many centuries. The famed Galileo – after he attempted to measure the speed of light with an unlikely arrangement of lanterns and flags on tall towers – decided that light must travel at infinite speed. Later, Armande Fizeau used an elaborate mechanism with mirrors, lens and a huge rotating cogwheel to determine if the speed of light was, in fact, not infinite. He got close. After many years we now know light does not travel at infinite speed, but rather 299, 792.4562 meters per second in a vacuum.

With the proper combination of electronics, electro-optics and fiber optics this once-difficult measurement is simple and can be conducted in any lab or classroom. All that's needed is a 60 × 100 cm table, 110 VAC electrical power, oscilloscope and the Speed of Light Apparatus.

To conduct this experiment, first apply 110 VAC power to the oscilloscope and Speed of Light Apparatus, then connect oscilloscope probes to apparatus test points. After calibration, the oscilloscope monitors the reference and delayed pulses, the time delay is measured and the speed of light calculated.



*A typical oscilloscope display depicts the reference signal and the delayed optical signal through optical fiber: (100 ns of delay through 20 meters of optical fiber.)*



An integral part of the Speed of Light Apparatus is an easily understood full-color, often lighthearted manual. It begins by tracing the early steps of technical pioneers in their quest to understand light. The manual also includes detailed step-by-step set-up and measurement instructions and examples with equations for calculating the speed of light. In addition, assembly instructions are included for those who purchase this as a kit.

## FEATURES

- ◆ All solid-state transmitter/receiver design
- ◆ Low-voltage electronics operation
- ◆ Fiber optic delay requires no optical alignment
- ◆ Safe, visible LED light source
- ◆ Quick set-up and measurement
- ◆ Impact-resistant, protective enclosure
- ◆ Rubber feet on chassis bottom for adhesion on smooth surfaces
- ◆ Contained light beam is ideal for small areas
- ◆ 28-page full-color manual with step-by step assembly, operation instructions and sample oscilloscope displays

*(The apparatus consists of an electronics circuit board in protective plastic enclosure, two fiber optic cables, test connections for all outputs and a 110 VAC-to-DC power adapter. The optical fibers terminate in simple cinch-collet connectors for easy assembly and efficient coupling. A 20 MHz oscilloscope is required.)* Adapters for 220 VAC will be furnished upon request.

**KIT VERSION**  
**ASSEMBLED VERSION**

**IF-SL-K**  
**IF-SL-A**

## INTERMEDIATE FIBER OPTIC CLASSROOM & LAB COURSE

An intermediate fiber optics curriculum, for vocational and trade schools, industrial arts and university levels. Courses can be tailored in length from 10 to 15 weeks. Recommended prerequisites: a basic understanding of electronics and mathematics. Course includes a text for classroom or lecture, lab course containing a comprehensive series of student experiments, and lab kit with all required components.

Part One of the classroom text places fiber optics into perspective as a transmission medium and describes its advantages over other media. Part Two examines fiber sources, detectors, and connectors, in contrast to the distinctly different characteristics of their electronic counterparts. Part Three explains in detail how fiber optic systems are designed and assembled. It covers link system design, installation, special fiber optic hardware, applications and equipment. (Hands-on experiments provided by Lab Course and Lab Kit are described on page 22.)



*(“Instructor’s Edition” contains the items pictured above, plus answer guides for text and lab manual, samples of different types of optical cable, image guides, LEDs and detectors.)*

**STOCK NUMBER IF-SC10**

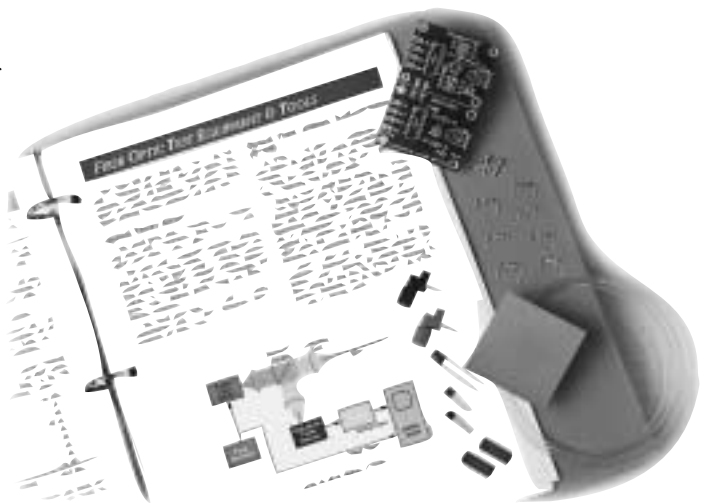
**INSTRUCTOR’S EDITION IF-SC10-INS**

## FIBER OPTIC MINICOURSE

A short course covering the basic concepts of fiber optic communications and industrial applications, intended as a supplement to other more general electronics classes. Class length is variable, to meet instructors’ time constraints: five to 10 1-hour periods, plus two 2-hour experimental sessions.

The course begins with “The History of Fiber Optics,” followed by sections describing fiber optic communications systems and their individual components. Also included are a list of additional reading references and a helpful fiber optic glossary. Experimental sessions involve students in assembling and testing a fully functional fiber optic *digital* communication link with separate transmitter and receiver modules.

Course comes complete with a full-color classroom manual and kit containing all required electronic components, including printed wiring boards, fiber optic LED, photodetector and cable. No prior fiber optics experience or special tools are needed for assembly and demonstration.



*(The “Instructor’s Edition” contains the items above, plus an additional reference book, answer guide, lecture file of figures and experiments, assortment of optical cable, image guides, LEDs and detectors.)*

**STOCK NUMBER IF-MC10**  
**INSTRUCTOR’S EDITION IF-MC10-INS**

# Fiber Optic Kits

## Just for Kids! - ADVENTURES IN FIBER OPTICS KIT

*Welcome to the fascinating world of fiber optic technology!*

Complete exciting fiber optic projects like these:



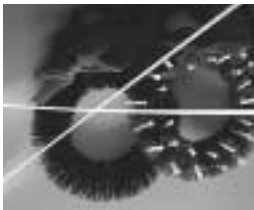
Image Magnifier



Lighted Constellation Map



Fiber Optic Wand



Fluorescent Holiday Wreath

Not long ago fiber optics was little more than a laboratory curiosity. Physicists and scientists in research labs were the only people doing much work in this field.

In the last 20 years all that has changed. From its obscure beginnings in the back of a lab, fiber optics has become an important and rapidly changing technology. It employs many of the world's brightest scientists and business people.

With this kit anyone can follow the exploits of famous experimenters such as Galileo, Franklin, Tyndall and Gould, begin to explore fiber optics starting with the very basics and learn more about the fascinating potential of fiber optical technology. Requires no electronics or optics experience.

The kit is suggested for ages 10 and above. It contains materials and an instruction manual to complete five unique projects and 20 exciting experiments such as:

- ▶ Bending a Light Guide
- ▶ Fluorescence
- ▶ Tyndall's Prestigious Light-in-Water Experiment
- ▶ Special Fiber Optic Lighting
- ▶ Art of Polishing Glass
- ▶ Making Your Own Image Conduit
- ▶ Creating a Holiday Ornament

*Kit items include penlight, rubber light hood, six different optical fiber types, Ulexite fiber optic rock, three coherent fiber optic components, color filters, lens, star/constellation map, polishing film and other miscellaneous components.*



*Instruction manual available on our Web site*

STOCK NUMBER

IF-E60

## OPTICAL VOICE LINK

This INDUSTRIAL FIBER OPTICS kit "favorite" may have earned more high grades and scholastic honors for student science projects than any other. For students and experimenters alike, the Optical Voice Link is the ideal introduction for an electronics hobbyist first learning about the marvels, mysteries and science of light transmission through optical fiber. There is something fascinating, indeed, about hearing your own voice, after it has been converted into light and then coupled into, through, and out of an optical fiber.

The Optical Voice Link is suitable for science projects; home projects for the hobbyist; short audio fiber optic curriculums for schools; inexpensive classroom demonstrations; hands-on industrial training; and voice transmission in critical electrical isolation applications.

### FEATURES

- ◆ High-quality audio circuits
- ◆ On-board microphone
- ◆ Visible LED optimized to plastic optical fiber
- ◆ 9-volt battery operation
- ◆ Low stand-by current for long battery life
- ◆ High-quality multilayer PCBs
- ◆ Plastic optical fiber with simple terminations
- ◆ Extendable to 20 meters
- ◆ 32-page instruction booklet



*(Kit includes: printed wiring boards, switches, electronics, microphone, 8-ohm speaker, three meters of plastic fiber optic cable, and an uncomplicated tutorial and step-by-step assembly instruction manual. No prior fiber optics experience, special tools or training are needed to build, use and enjoy the multiple applications of this kit. Some experience with soldering is recommended for completion of the unassembled version.)*

*Instruction manual  
available on our  
Web site*

<b>UNASSEMBLED KIT</b>	<b>IF-OVL10-K</b>
<b>ASSEMBLED</b>	<b>IF-OVL10-A</b>
<b>DUPLEX KIT</b>	<b>IF-OVL20-K</b>
<b>ASSEMBLED DUPLEX</b>	<b>IF-OVL20-A</b>

## EDUCATIONAL COMMUNICATION KIT

This is our most popular kit, providing students the opportunity to examine fiber optic communication technology at its basics. It's a great hands-on educational product as well as an opportunity for the serious investigator/experimenter to explore fiber optic technology inexpensively. The Communication Kit is an easy-to-assemble, digital link for experimenting and beginner science projects. (This digital link also can be used to construct high-voltage isolation for telephones, modems and computers.)

### FEATURES

- ◆ Visible fiber optic source and detector
- ◆ Built-in oscillator for testing and demos
- ◆ TTL and CMOS logic-compatible inputs and outputs
- ◆ Low-voltage operation
- ◆ Utilizes plastic optical fiber with simple terminations
- ◆ 32-page comprehensive booklet covering assembly, schematics, experiments, fiber optic fundamentals and circuit operation.

Kit contains red LED and photodetector, one meter of optical fiber, printed wiring boards, polishing film, oscillator chip, electronic components and instruction booklet. Suitable for students in grades 9 and above.

*(We recommend some soldering experience for assembly.)*



**STOCK NUMBER**

**IF-E22**

# Fiber Optic Kits

## LAB COURSE AND LAB KIT

The Lab Course is a 68-page guide which contains nine fascinating fiber optics experiments. With the Lab Course, instructors can avoid having to create their own fiber optics or opto-electronics experiments and thus spend more time with their students. Do-it-yourself experimenters will learn valuable practical experience about fiber optics. Each of the nine experiments contains activities which use state-of-the-art opto-electronic components. Along with learning about unique fiber optics procedures, these activities later can be used in dealing with practical, real-world situations. Experiments begin with the basic physics and progress toward solutions for design and circuit problems.

### EXPERIMENTS

- Making a light guide
- Fiber optic cable transmission
- Characteristics of connectors and splices
- Index-matching procedures
- Speed of opto-electronic devices
- Fiber optic transmitter
- Receiver design
- Fiber termination techniques

Instruction Guide  
available on our  
Web site

**LAB MANUAL IF-LM**



Lab Kit contains all the fiber optic and electronic components required to complete the experiments in the Lab Course manual. (*Lab Kit contains optical light pipe, fiber optic cable, splices, connectors and polishing film, with LEDs, photodetectors, transmitter and receiver electronics. No special tools or training required.*)

**LAB MANUAL WITH LAB KIT IF-LMH**

Industrial Fiber Optics also has available a 26-page answer guide for the Lab Manual containing tables of typical experimental data derived in our labs, plus answers to all questions and homework assignments.

*Any instructor who uses the Lab Manual and Lab Kit can request a complimentary Answer Guide. Contact your distributor or our customer service department for details.*

**LAB MANUAL ANSWER GUIDE IF-LM-A**

## SCIENCE PROJECT KIT

Learn about fiber optics the easy way by experimenting and building fascinating, functional projects. No prior optical experience is needed. Our practical, 224-page text begins with easily grasped discussions about fiber optics fundamentals. Next are eight lab experiments and a final section with five intriguing projects, including "Getting Acquainted with a Light Pipe," "AM Fiber Optic Receiver," and "Fiber Optic Light-Pen Cable." Finished products such as an analog voice link and a light pen have many daily uses and applications to further study.

*(Kit includes all necessary fiber optic components, connectors and cable. Ideal for science projects in advanced junior high and high school classrooms.)*



**STOCK NUMBER IF-E33**

## FIBER OPTIC A/D KIT

An ideal kit for high school and technical instructors who require the ability to demonstrate analog and digital fiber optics communications principles with a single, economical product. When assembled, the kit provides a unique arrangement of dual-purpose analog and digital transmitter and receiver modules. The transmitter is a user-selectable design with an on-board microphone for an audio analog signal source and a built-in 15 Hz oscillator for digital signals. It also has input connections for external analog and CMOS-compatible signals. The receiver also incorporates a dual-purpose analog/digital design with a power amplifier driving a 10 cm speaker, digitized circuitry for signals and flashing LED. Unlike other fiber optic kits, this one requires no oscilloscope and is powered by two 9-volt batteries, eliminating the need for external power supplies. The kit includes:

- ◆ Transmitter and receiver printed wiring boards
- ◆ All required electronic circuit components
- ◆ Plastic fiber optic cable and connectors
- ◆ Complete instructions on how to assemble components and complete all projects.



The only accessories required but not included are a soldering iron, tools needed for assembly of the kit, and two 9-volt batteries. Economical for both individual students and group projects. A detailed component list can be found on the Industrial Fiber Optics web site.

**STOCK NUMBER**      **IF-545**

## LC CONNECTOR KIT

All components and complete instructions needed to forge two bulkhead connections for jacketed 1000  $\mu\text{m}$  core, plastic fiber. No polishing, adhesives or special tools required.

**STOCK NUMBER**      **IF-C-C10**

## EXPERIMENTER'S KIT

Our least expensive basic kit—ideal for designing experiments, original science projects and short-distance optical isolation applications.



Included are one meter of 1000  $\mu\text{m}$  plastic optical fiber, matched LED and photodetector (IF-E91A and IF-D92,

respectively) with integral fiber optic connectors, instructional

design information and application hints.

**STOCK NUMBER**      **IF-E10**

## DESIGNER'S KITS

A “creativity-friendly” kit for technicians, experimenters, scientists and enterprising students who are searching for a quick solution for prototypes or special-purpose interfaces requiring fiber optics capabilities. This very low-cost

“active link” requires a single +5-volt power supply and interfaces with all TTL/CMOS logic. It includes 10 meters of 1000  $\mu\text{m}$  plastic optical cable; efficient dry, non-polish connectors, bulkhead interfaces, and splices; integrated photodetector(s) and LED(s); and top-quality multi-layer printed wiring boards. Full instructions and technical data sheets complete the package. The operable range of both kits can be extended to 60 meters with additional cable purchased separately. Designer's Kits have been the basis of many fiber optics “brainstorms” and solutions.



**SIMPLEX KIT (SINGLE CHANNEL)**      **IF-SD11**  
**DUPLEX KIT (BI-DIRECTIONAL)**      **IF-DD11**



# Educational Fiber Components

## FIBER OPTIC DEMONSTRATOR SET



Demonstrate the basics of light transmission with two specially formulated Lucite bars – one curved and one straight. The two bars offered in this set are ideal for simply demonstrating how light is contained in optical fiber by total internal reflection. Light beams can be seen trapped and reflecting down the straight bar as well as around the bend in the curved bar. Both bars are  $1 \times 2 \times 23$  cm. Laser or laser beam box required to create light beams.

STOCK NUMBER **IF-547**

## FIBER ASSORTMENT KITS

An economical assortment of six different types of fibers that would be very costly if purchased individually. Assortment includes glass fibers, jacketed and unjacketed plastic fibers, multi-fiber light guides and coherent fiber bundles. An exceptional value!

STOCK NUMBER **IF-FGB**

Twelve different types of fibers and samples like those in the kit above, plus the addition of scintillating fibers, fiber optic "TV" stone and coherent light guides.

STOCK NUMBER **IF-FGB2**

## COHERENT LIGHT GUIDE



This versatile fiber optic component – only one inch long and  $\frac{1}{4}$ -inch square – contains thousands of small fibers fused together that transmit a coherent optical image from one end

to the other. Ideal for demonstrating the miniaturization of fiber optics and point-to-point image transfer capabilities of a coherent fiber optic bundles.

STOCK NUMBER **IF-CLG**

## OPTICAL SAMPLE KIT

A kit expressly created for teachers wanting to demonstrate fiber optics in classroom and anyone beginning to experiment or develop fiber optic products. Each kit contains an assortment of fiber core diameters and construction. Check them out – then decide which kit best suits your project needs. If in doubt...why not buy them both?!

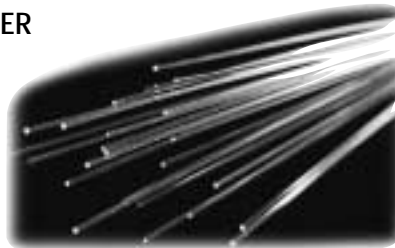
The **Optical Sample Kit** whose contents are listed below includes fibers and fiber lengths commonly used for illumination projects and model airplane, auto and railroad building.

STOCK NUMBER **IF-53883**

Jacketed		Unjacketed	
DIAMETER	LENGTH (m)	DIAMETER	LENGTH (m)
1000 $\mu\text{m}$ dia.	1.5 m	250 $\mu\text{m}$ dia.	1.5 m
1500 $\mu\text{m}$ dia.	.6 m	500 $\mu\text{m}$ dia.	.6 m
2000 $\mu\text{m}$ dia.	.6 m	750 $\mu\text{m}$ dia.	.6 m
16 $\times$ 265 $\mu\text{m}$ bndl	.3 m		
32 $\times$ 265 $\mu\text{m}$ bndl	.3 m		
48 $\times$ 265 $\mu\text{m}$ bndl	.3 m		
64 $\times$ 265 $\mu\text{m}$ bndl	.3 m		

## FLUORESCENT FIBER

Demonstrate the property of fluorescence and light guiding properties of optical fiber. Fiber is flexible and continues to fluoresce during bending. 1.5 mm diameter, 1.5 m lengths.



STOCK NUMBER (RED) **IF-810089**

STOCK NUMBER (GREEN) **IF-810089**

## MAGIC OPTIC ROCK (TV STONE)

Nature created its own fiber optic material long before scientists even dreamed of today's highly refined optical fiber.

It is a rare, naturally-occurring mineral called ulexite. The stones are composed of thousands of tiny, parallel, hairlike crystals that transfer an image just like the coherent faceplates and light guides described elsewhere in this catalog. Ulexite often is known by

the name of TV stone because of its image-transferring properties. Stones are approximately  $\frac{1}{2}$  inch (13 mm) thick and  $\frac{3}{4} \times \frac{3}{4}$  inches (19  $\times$  19 mm) across the face.



STOCK NUMBER **IF-C-FOR**

# Fiber Optic LEDs and Photodetectors

## DESCRIPTION

Industrial Fiber Optics produces an extensive line of low-cost, medium and high frequency fiber optic devices for use with plastic core fiber optic cable. This product family contains 18 different devices – 10 LEDs and eight photodetectors. Each device consists of a precision-molded PBT housing and cinch nut with an internal active element such as an LED or photodetector. The PBT housing holds the active element and optimizes the physical and optical connection between the optical fiber core and the active component. The cinch nut holds the fiber in place without requiring the expense and labor of a fiber connection or termination.

All devices in this product line are designed for use with industry-common “1.0 mm” or “1000  $\mu\text{m}$ ” core jacketed plastic fiber optic cable. The actual construction of a typical fiber cable is PMMA (poly-methyl methacrylate) core, thin flourinated polymer cladding layer and the jacket, which results in an overall diameter of 2.2 mm. Jacket material varies with application, with polyethylene the most common.

Compared to many of the other fiber optic LEDs and photodetectors on the market, Industrial Fiber Optics devices are unique because they require no fiber connector or ferrule, nor do they require a polishing procedure. No connector means reduced installation cost as a user. To prepare a fiber, simply cut the fiber squarely with our cutter shown on page 66.

On the following page is a quick-selection guide for choosing among our portfolio of devices. If you have special requirements not addressed in the list, please contact us. We will be happy to discuss your custom application needs.



## APPLICATIONS

- Local Area Networks (LANs)
- Electric Cars
- PC-to-Peripheral Data Link
- Digitized Video
- Robotics Communications
- Household Appliances
- Motor Control Triggering
- Optical Networks
- Medical Instruments
- Automotive Electronics
- Audio Systems
- Electronic Games
- Educational Projects
- Reduction of Lightning and Voltage Transient Susceptibility
- Intra-Systems Links: Board-to-Board, Rack-to-Rack

## FEATURES

- ◆ Mates with Standard, 1000  $\mu\text{m}$  Core, Plastic Fiber Cable
- ◆ Requires No Optical Design
- ◆ Internal Micro-Lens for Efficient Coupling
- ◆ Inexpensive Plastic Connector Housing
- ◆ Connector-Less Interface
- ◆ Interference-Free Transmission from Light-Tight Housing
- ◆ Simple Fiber Termination and Connection
- ◆ Rugged Screw Attachment

# Component Selection Guide

## LEDs

STOCK NUMBER	$\lambda$ (nm)	$\Delta\lambda$ (nm)	$P_{i\ min}^1$ ( $\mu$ W)	$t_r^2$	$t_f^2$	DISTANCE (m)	GENERAL COMMENTS OR APPLICATION
<b>IF-E91A</b>	950	40	100	1.0 $\mu$ s	1.0 $\mu$ s	< 10	Lowest cost device in portfolio for short distance applications
<b>IF-E91B</b>	880	80	75	.5 $\mu$ s	.5 $\mu$ s	< 15	Higher data rates/slightly longer operating distance
<b>IF-E91D*</b>	870	30	200	7 ns	7 ns	< 10	Lowest cost high electrical bandwidth device
<b>IF-E92A</b>	430	65	25	.5 $\mu$ s	.5 $\mu$ s	< 50	Blue light for sensor applications in a convenient package
<b>IF-E92B</b>	470	25	75	.6 $\mu$ s	.6 $\mu$ s	< 50	Blue light for sensor applications in a convenient package
<b>IF-E93</b>	530	50	95	3.5 ns	16 ns	< 150	Longest distance, since PMMA fiber has very low attenuation at 530 nm
<b>IF-E96</b>	660	20	125	.1 $\mu$ s	.1 $\mu$ s	< 75	Lowest cost visible red LED device in portfolio
<b>IF-E97</b>	660	40	250	.5 $\mu$ s	.5 $\mu$ s	< 100	High power red LED for low data rates
<b>IF-E98</b>	650	20	200	8 ns	8 ns	< 65 <sup>4</sup>	High power, fast electrical switching times for 50 Mbps applications
<b>IF-E99</b>	650	10	700	3.5 ns	3.5 ns	< 100 <sup>5</sup>	Very high power device for 100 Mbps LAN applications

<sup>1</sup> Optical power measured from the end of a 1 mm core plastic fiber 1 m long, NA=.47 and LED IF =20 mA.

<sup>2</sup> Rise time and fall times are measured from the 10% to 90% and 90% to 10% points.

<sup>3</sup> Exact operating distance is dependent upon the photodetector selected and in some cases the electrical bandwidth of accompanying circuits. These distances are to be used for relative distance comparisons.

<sup>4</sup> Distance when mated with the IF-D97 photologic detector.

<sup>5</sup> When matched with the IF-D98 photologic detector.

## PHOTODETECTORS

STOCK NUMBER	TYPE	$t_r^1$	$t_f^1$	$t_d$	RESPON-SIVITY <sup>2</sup>	THRESHOLD <sup>3</sup>	GENERAL COMMENTS OR APPLICATION
<b>IF-D91</b>	Diode	5 ns	5 ns	N/A	1.2 $\mu$ A/ $\mu$ W	N/A	Highest electrical bandwidth device suitable for analog/digital applications
<b>IF-D92</b>	Transistor	20 $\mu$ s	20 $\mu$ s	N/A	50 $\mu$ A/ $\mu$ W	N/A	Lowest cost, simplest to use photodetector
<b>IF-D93</b>	Darlington	5 ms	2.5 ms	N/A	200 $\mu$ A/ $\mu$ W	N/A	Highest responsivity linear detector in portfolio
<b>IF-D95</b>	Logic	70 ns	70 ns	8.0 $\mu$ s	N/A	1.0 $\mu$ W -30 dBm	Totem-pole output device for data rates up to 150 kbps
<b>IF-D95OC</b>	Logic	.1 $\mu$ s	.1 $\mu$ s	8.0 $\mu$ s	N/A	1.0 $\mu$ W -30 dBm	Identical to IF-D95T only with open collector output
<b>IF-D96</b>	Logic			65 ns	N/A	3.5 $\mu$ W -24.5 dBm	Open-collector output device for data rates up to 5 Mbps
<b>IF-D97</b>	Logic	7 ns	7 ns	12 ns	N/A	17 $\mu$ W -17.5 dBm	Totem-pole output device for data rates up to 55 Mbps
<b>IF-D98</b>	Logic	3.5 ns	3.5 ns	6 ns	N/A	6.3 $\mu$ W -22 dBm	Device suitable for data rates up to 155 Mbps <sup>5</sup>

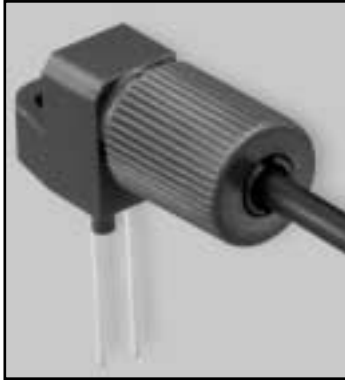
<sup>1</sup> Rise times and fall times are measured from the 10% to 90% and 90% to 10% points, respectively.

<sup>2</sup> Optical power measured from polished end of 1000  $\mu$ m plastic optical fiber connected to Helium Neon laser producing radiation at 632.8 nm in wavelength.

<sup>3</sup>  $\lambda$ =660 nm.

<sup>4</sup> Threshold is the optical power that the photologic switches from a low to high, or from high to low.

<sup>5</sup> This device has internal gain control circuitry that makes it unsuitable for applications under 4 Mbps.



## DESCRIPTION

The IF-D91 is a high-speed photodiode detector housed in a “connector-less” style plastic fiber optic package. Optical response of the IF-D91 extends from 400 to 1100 nm, making it compatible with a wide range of visible and near-infrared LED and laser diode sources. This includes 650 nm visible red LEDs used for optimum transmission in PMMA plastic optic fiber. The detector package features an internal micro-lens and a precision-molded PBT housing to ensure efficient optical coupling into standard 1000 μm core plastic fiber cable.

## APPLICATION HIGHLIGHTS

The fast response times of the IF-D91 make it suitable for high-speed digital data links. When used with an appropriate LED or laser diode source the IF-D91 is capable of 100 Mbps data rates. The IF-D91 also can be used in analog video links with bandwidths up to 70 MHz. The integrated design of the IF-D91 provides simple, cost-effective implementation in a variety of analog and digital applications.

## APPLICATIONS

- ▶ High-Speed Digital Data Links
- ▶ Local Area Networks
- ▶ Motor Controller Triggering
- ▶ Video Links
- ▶ Medical Instruments
- ▶ Automotive Electronics
- ▶ Robotics Communications
- ▶ EMC/EMI Signal Isolation
- ▶ Fiber Optic Modems

## FEATURES

- ◆ Fast Rise and Fall Times
- ◆ Mates with Standard 1000 μm Core Jacketed Plastic Fiber Optic Cable
- ◆ No Optical Design Required
- ◆ Inexpensive Plastic Connector Housing
- ◆ Internal Micro-Lens for Efficient Optical Coupling
- ◆ Connector-Less Fiber Termination
- ◆ Light-Tight Housing provides Interference Free Transmission

## MAXIMUM RATINGS

(T<sub>A</sub> = 25°C)

Operating and Storage Temperature Range (T <sub>OP</sub> , T <sub>STG</sub> ).....	-40° to 85°C
Junction Temperature (T <sub>J</sub> ) .....	85°C
Soldering Temperature (2 mm from case bottom) (T <sub>S</sub> ) t ≤ 5 s.....	240°C
Power Dissipation (P <sub>TOT</sub> ) T <sub>A</sub> = 25°C .....	100 mW
De-rate Above 25°C .....	1.33 mW/°C

## CHARACTERISTICS (T<sub>A</sub> = 25°C)

Parameter	Symbol	Min	Typ	Max	Unit
Wavelength for Maximum Photosensitivity	λ <sub>PEAK</sub>	-	880	-	nm
Spectral Bandwidth (S=10% of S <sub>MAX</sub> )	Δλ	400	-	1100	nm
Rise and Fall Times (10% to 90% and 90% to 10%) (R <sub>L</sub> = 50 Ω, V <sub>R</sub> = 20 V, λ = 850 nm)	t <sub>r</sub> , t <sub>f</sub>	-	5	-	ns
Total Capacitance	C <sub>T</sub>	-	4	-	pF
Responsivity min. @ 880 nm	R	-	.4	-	μA/μW
@ 632 nm		-	.2	-	μA/μW
Reverse Dark Current (V <sub>R</sub> = 30 volts, E <sub>F</sub> = 0)	I <sub>D</sub>	-	-	60	nA
Reverse Breakdown Voltage	V <sub>(BR)R</sub>	60	-	-	V
Forward Voltage	V <sub>f</sub>	-	1.2	-	V

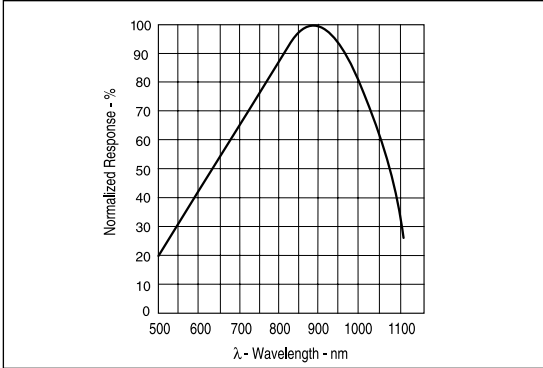


FIGURE 1. Typical detector response versus wavelength.

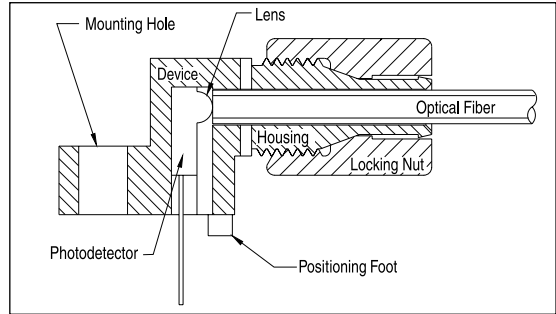


FIGURE 3. Cross-section of fiber optic device.

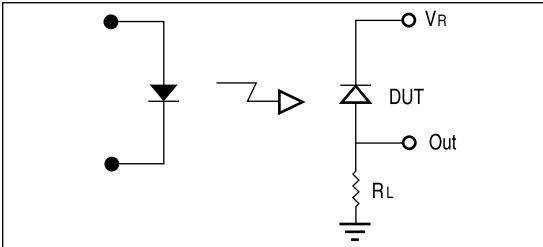


FIGURE 2. Circuit diagram for measuring rise and fall times.

## FIBER TERMINATION INSTRUCTIONS

1. Cut off the ends of the optical fiber with a single-edge razor blade or sharp knife. Try to obtain a precise 90-degree angle (square).
2. Insert the fiber through the locking nut and into the connector until the core tip seats against the internal micro-lens.
3. Screw the connector locking nut down to a snug fit, locking the fiber in place.

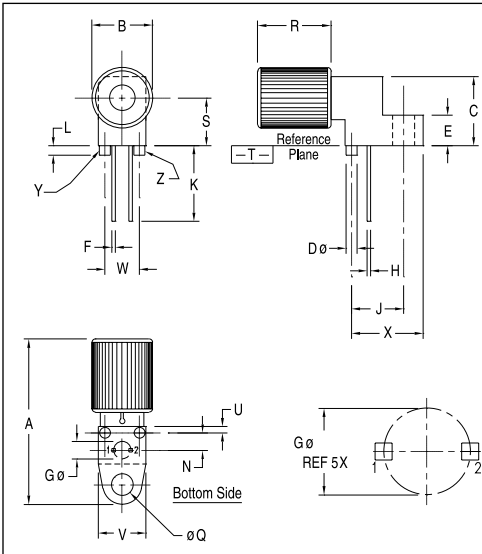


FIGURE 4. Case outline.

Notes:

1. Y AND Z ARE DATUM DIMENSIONS AND T IS A DATUM SURFACE.
2. POSITIONAL TOLERANCE FOR D  $\phi$  (2 PL):  
 $\phi 0.25(0.010) \text{ (M) | T | Y (M) | Z (M) }$
3. POSITIONAL TOLERANCE FOR F DIM (2 PL):  
 $\phi 0.25(0.010) \text{ (M) | T | Y (M) | Z (M) }$
4. POSITIONAL TOLERANCE FOR H DIM (2 PL):  
 $\phi 0.25(0.010) \text{ (M) | T | Y (M) | Z (M) }$
5. POSITIONAL TOLERANCE FOR Q  $\phi$ :  
 $\phi 0.25(0.010) \text{ (M) | T | Y (M) | Z (M) }$
6. POSITIONAL TOLERANCE FOR B:  
 $\phi 0.25(0.010) \text{ (M) | T }$
7. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
8. CONTROLLING DIMENSION: INCH

PACKAGE IDENTIFICATION:

- Black housing w/ Orange dot
- PIN 1. Anode
- PIN 2. Cathode

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	23.24	25.27	.915	.995
B	8.64	9.14	.340	.360
C	9.91	10.41	.390	.410
D	1.52	1.63	.060	.064
E	4.19	4.70	.165	.185
F	0.43	0.58	.017	.023
G	2.54 BSC		.100 BSC	
H	0.43	0.58	.017	.023
J	7.62 BSC		.300 BSC	
K	10.35	11.87	.408	.468
L	1.14	1.65	.045	.065
N	2.54 BSC		.100 BSC	
Q	.305	3.30	.120	.130
R	10.48	10.99	.413	.433
S	6.98 BSC		.275 BSC	
U	0.83	1.06	.032	.042
V	6.86	7.11	.270	.280
W	5.08 BSC		.200 BSC	
X	10.10	10.68	.397	.427



## DESCRIPTION

The IF-D92 is a high-sensitivity phototransistor detector housed in a “connector-less” style plastic fiber optic package. Optical response of the IF-D92 extends from 400 to 1100 nm, making it compatible with a wide range of visible and near-infrared LEDs and laser diode sources. This includes 650 nm visible red LEDs used for optimum transmission in PMMA plastic optic fiber. The detector package features an internal micro-lens and a precision-molded PBT housing to ensure efficient optical coupling into standard 1000  $\mu\text{m}$  core plastic fiber cable.

## APPLICATION HIGHLIGHTS

The IF-D92 is suitable for digital data links at rates up to 25 kbps. Analog bandwidths greater than 15 kHz are possible making the IF-D92 usable for high frequency audio transmission. Phototransistor operation provides high internal gain – reducing the amount of post amplification required in many circuits. The integrated design of the IF-D92 makes it a simple, cost-effective solution in a variety of analog and digital applications.

## APPLICATIONS

- ▶ Low-Speed Digital Data Links
- ▶ Motor Controller Triggering
- ▶ Audio Links
- ▶ Medical Instruments
- ▶ Automotive Electronics
- ▶ Robotics Communications
- ▶ EMC/EMI Signal Isolation
- ▶ Electronic Games
- ▶ Process Control

## FEATURES

- ◆ High Optical Sensitivity
- ◆ Mates with Standard 1000  $\mu\text{m}$  Core Jacketed Plastic Fiber Optic Cable
- ◆ No Optical Design Required
- ◆ Inexpensive but Rugged Plastic Connector Housing
- ◆ Internal Micro-Lens for Efficient Optical Coupling
- ◆ Connector-Less Fiber Termination
- ◆ Light-Tight Housing provides Interference Free Transmission

## MAXIMUM RATINGS

( $T_A = 25^\circ\text{C}$ )

Operating and Storage Temperature Range ( $T_{OP}, T_{STC}$ ).....	-40° to 85° C
Junction Temperature ( $T_J$ ) .....	85° C
Soldering Temperature (2 mm from case bottom) ( $T_S$ ) $t \leq 5$ s.....	240° C
Collector Emitter Voltage ( $V_{CEO}$ )....	30 V
Emitter Collector Voltage ( $V_{ECO}$ ) .....	5 V
Collector Current ( $I_C$ ).....	50 mA
Collector Peak Current ( $I_{CM}$ ) $t = 1$ ms .....	100 mA
Power Dissipation ( $P_{TOT}$ ) $T_A = 25^\circ\text{C}$ .....	100 mW
De-rate Above 25° C .....	1.33 mW/°C

## CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )

Parameter	Symbol	Min	Typ	Max	Unit
Wavelength for Maximum Photosensitivity	$\lambda_{PEAK}$	-	870	-	nm
Spectral Bandwidth (S=10% of $S_{MAX}$ )	$\Delta\lambda$	400	-	1100	nm
Switching Times (10% to 90% and 90% to 10%) ( $R_L=1$ k $\Omega$ , $I_C=1.0$ mA, $V_{CE}=5$ V, $\lambda=950$ nm)	$t_r, t_f$	-	20	-	$\mu\text{s}$
Responsivity min. @ 880 nm @ 632 nm	R	-	100	-	$\mu\text{A}/\mu\text{W}$ $\mu\text{A}/\mu\text{W}$
Collector Dark Current ( $V_{CE}=15$ volts)	$I_{CEO}$	-	-	100	nA
Breakdown Voltage ( $I_C=100$ $\mu\text{A}$ )	$BV_{CEO}$	30	-	-	V
Breakdown Voltage ( $I_C=100$ $\mu\text{A}$ )	$BV_{ECO}$	5	-	-	V
Saturation Voltage ( $I_C=250$ $\mu\text{A}$ , $H=100$ $\mu\text{W}$ )	$V_{CE sat}$	-	0.15	-	V

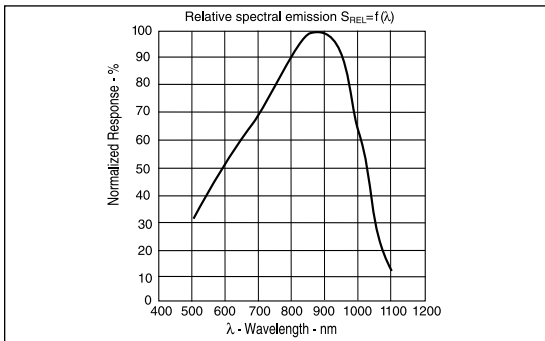


FIGURE 1. Typical detector response versus wavelength.

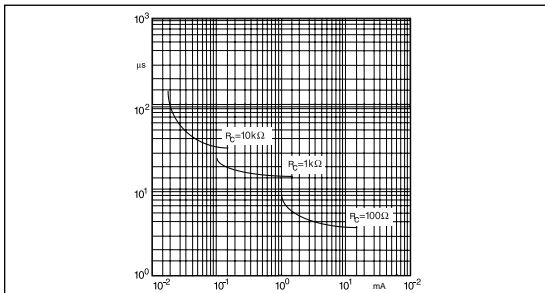


FIGURE 2. Rise and fall times of phototransistor.

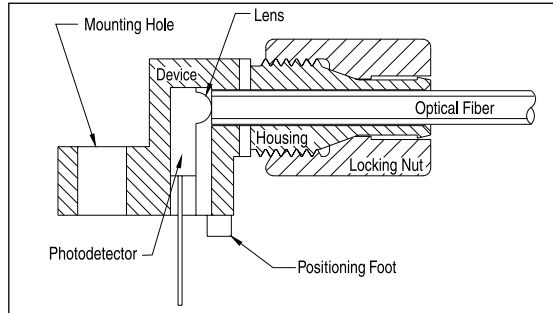


FIGURE 3. Cross-section of fiber optic device.

**FIBER TERMINATION INSTRUCTIONS**

1. Cut off the ends of the optical fiber with a single-edge razor blade or sharp knife. Try to obtain a precise 90-degree angle (square).
2. Insert the fiber through the locking nut and into the connector until the core tip seats against the internal micro-lens.
3. Screw the connector locking nut down to a snug fit, locking the fiber in place.

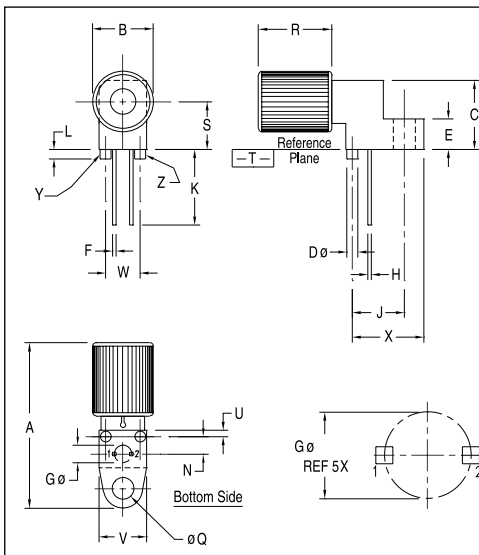


FIGURE 4. Case outline.

**Notes:**

1. Y AND Z ARE DATUM DIMENSIONS AND T IS A DATUM SURFACE.
2. POSITIONAL TOLERANCE FOR D  $\phi$  (2 PL):  
 $\phi 0.25(0.010) \text{ M } | T | Y \text{ M } | Z \text{ M}$
3. POSITIONAL TOLERANCE FOR F DIM (2 PL):  
 $\phi 0.25(0.010) \text{ M } | T | Y \text{ M } | Z \text{ M}$
4. POSITIONAL TOLERANCE FOR H DIM (2 PL):  
 $\phi 0.25(0.010) \text{ M } | T | Y \text{ M } | Z \text{ M}$
5. POSITIONAL TOLERANCE FOR Q  $\phi$ :  
 $\phi 0.25(0.010) \text{ M } | T | Y \text{ M } | Z \text{ M}$
6. POSITIONAL TOLERANCE FOR B:  
 $\phi 0.25(0.010) \text{ M } | T$
7. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
8. CONTROLLING DIMENSION: INCH

**PACKAGE IDENTIFICATION:**

- Black housing w/ White dot
- PIN 1. Emitter
- PIN 2. Collector

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	23.24	25.27	.915	.995
B	8.64	9.14	.340	.360
C	9.91	10.41	.390	.410
D	1.52	1.63	.060	.064
E	4.19	4.70	.165	.185
F	0.43	0.58	.017	.023
G	2.54 BSC		.100 BSC	
H	0.43	0.58	.017	.023
J	7.62 BSC		.300 BSC	
K	10.35	11.87	.408	.468
L	1.14	1.65	.045	.065
N	2.54 BSC		.100 BSC	
Q	.305	3.30	.120	.130
R	10.48	10.99	.413	.433
S	6.98 BSC		.275 BSC	
U	0.83	1.06	.032	.042
V	6.86	7.11	.270	.280
W	5.08 BSC		.200 BSC	
X	10.10	10.68	.397	.427

# Plastic Optical Fiber

## BARE/UNJACKETED FIBER

This versatile fiber is particularly well suited to low-cost simple illumination and demonstration applications such as illuminated maps, lights for model railroads/airplanes, holiday lighting/ornaments and embroidering into fabric. Fiber core is polymethyl methacrylate (PMMA) with 10 μm fluorinated polymer cladding layer. Available on page 62 by the meter.



GRADE	PRODUCT CODE	FIBER DIA. (μm)	OPER TEMP. (°C)	ATTEN. (dB/m)	FIBER NA	LENGTH PER SPOOL (m)	STOCK NUMBER	COMMENTS
ESKA® COMMERCIAL	CK-10	250	-55~+70	<0.20*	0.50	12,000	<b>810038</b>	.010" dia.
	CK-20	500	-55~+70	<0.20*	0.50	6000	<b>810035</b>	.020" dia.
	CK-30	750	-55~+70	<0.20*	0.50	2700	<b>810040</b>	.030" dia.
	CK-40	1000	-55~+70	<0.20*	0.50	1500	<b>810045</b>	.040" dia.
	CK-60	1500	-40~+70	<0.20*	0.50	700	<b>810050</b>	.060" dia.
	CK-80	2000	-55~+70	<0.20*	0.50	250	<b>810055</b>	.080" dia.
	CK-120	3000	-55~+70	<0.20*	0.50	150	<b>810060</b>	.120" dia.

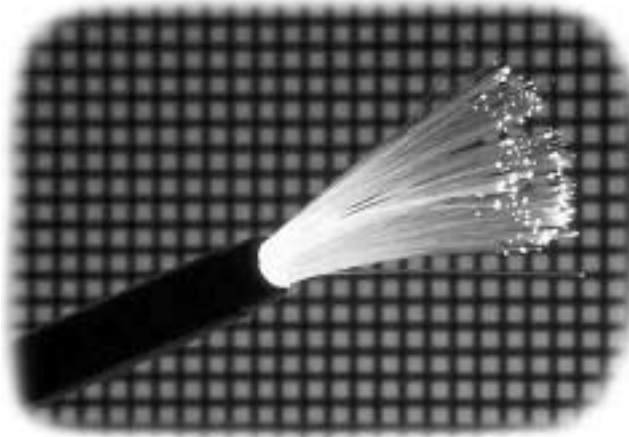
\* Attenuation measured at room temperature with 1000 μm diameter fiber with 650 nm collimated light

## OPTICAL PROPERTIES

GRADE	REFRACTIVE INDEX CORE	REFRACTIVE INDEX CLADDING	NA	ACCEPTANCE ANGLE
COMMERCIAL	1.492	1.402	.51	60°



## MULTIFIBER LIGHT GUIDE



A “large caliber” flexible bundle of many unjacketed fibers – especially useful for exotic illumination and demonstration purposes. Used instead of a large single fiber core because of smaller bend radius. Optical fiber strands are 245  $\mu\text{m}$  diameter poly-methyl methacrylate (PMMA) core with 10  $\mu\text{m}$  cladding layer of fluorinated polymer. Available by the meter or in 500-meter spools.

GRADE	PRODUCT CODE	FIBER DIA. ( $\mu\text{m}$ ) × NUMBERS	JACKET MAT'L/COLOR	JACKET DIA. (mm)	OPER TEMP. (°C)	ATTEN. (dB/m)	FIBER NA	TENSILE STRENGTH (kg)	LENGTH PER SPOOL (m)	STOCK NUMBER
SUPER ESKA®	SH1016	265 × 16	PE (BLK)	2.2±0.07	-55~+70	<0.65**	0.51	10	500	<b>810210</b>
	SH1032	265 × 32	PE (BLK)	2.8±0.1	-55~+70	<0.65**	0.51	20	500	<b>810216</b>
	SH1048	265 × 48	PE (BLK)	3.0±0.1	-55~+70	<0.65**	0.51	27	500	<b>810220</b>
	SH1064	265 × 64	PE (BLK)	3.3±0.07	-55~+70	<0.65**	0.51	36	500	<b>810225</b>

PE: Polyethylene

\*\* Measured at room temperature with collimated non-filtered tungsten-halogen light

### OPTICAL PROPERTIES

GRADE	REFRACTIVE INDEX CORE	REFRACTIVE INDEX CLADDING	NA	ACCEPTANCE ANGLE
SUPER ESKA®	1.492	1.402	.51	60°

# Optical Fiber

Industrial Fiber Optics sells the most popular fibers by the meter as well in spools. Part numbers are listed below for purchasing fiber by the meter.

## JACKETED COMMUNICATION FIBER

GRADE	PRODUCT CODE	FIBER DIA. (mm) × NUM.	JACKET MAT'L/ COLOR	JACKET DIA. (mm)	OPER TEMP. (C°)	ATTEN. (dB/m)	FIBER NA	TENSILE STREN. (kg)	LENGTH PER SPOOL (m)	STOCK NUMBER	COMMENTS
SUPER ESKA®	SH2001	1.0 × .5	PE (BLK)	1.0±0.07	-55~+70	<0.22*	0.51	2	1000	N/A	
	SH3001	1.0 × .75	PE (BLK)	2.2±0.07	-55~+70	<0.20*	0.51	5	1000	N/A	
	SH4001	1.0 × 1	PE (BLK)	2.2±0.07	-55~+70	<0.20*	0.5	9	500	<b>IF-C-E1000</b>	
	SH6001	1.5 × 1	PE (BLK)	3.0±0.15	-55~+70	<0.20*	0.5	16	500	<b>IF-C-E1500</b>	
	SH8001	2.0 × 1	PE (BLK)	3.0±0.15	-55~+70	<0.20*	0.5	29	500	<b>IF-C-E2000</b>	
	SH4002	1.0 × 2	PE (BLK)	A. 2.2±0.07 B. 4.4±0.1	-55~+70	<0.20*	0.5	14	500	<b>IF-C-D1000</b>	Duplex
ESKA PREMIER®	GH4001	1.0 × 1	PE (BLK)	2.2±0.07	-55~+85	≤.16	.51	8	500	N/A	
	GHV4001	1.0 × 1	PVC (GRAY)	2.2±0.07	-55~+85	≤.16	.51	7	500	<b>810110</b>	UL rated
	GH4002	1.0 × 2	PE (BLK)	A. 2.2±0.07 B. 4.4±0.1	-55~+85	≤.16	.51	14	500	N/A	Duplex
HEAT RESISTANT <sup>1</sup>	DH4001	1.0 × 2	XPE (BLK)	2.2±0.07	-55~+115	<0.3*	0.54	14	500	N/A	
HEAT RESISTANT <sup>2</sup>	FH4001	1.0 × 1	XPE (BLK)	2.2±0.07	-55~+125	<0.7*	0.75	14	500	N/A	
ESKA MEGA®	MH4001	1.0 × 1	PE (BLK)	2.2±0.07	-40~+85	≤.14	.3	-	500	N/A	

## MULTIFIBER LIGHT GUIDE

GRADE	PRODUCT CODE	FIBER DIA. (µm) × NUMBERS	JACKET MAT'L/ COLOR	JACKET DIA. (mm)	OPER TEMP. (C°)	ATTEN. (dB/m)	FIBER NA	TENSILE STRENGTH (kg)	LENGTH PER SPOOL (m)	STOCK NUMBER
SUPER ESKA®	SH1016	265 × 16	PE (BLK)	2.2±0.07	-55~+70	<0.65**	0.51	10	500	<b>IF-C-LG16</b>
	SH1032	265 × 32	PE (BLK)	2.8±0.1	-55~+70	<0.65**	0.51	20	500	<b>IF-C-LG32</b>
	SH1048	265 × 48	PE (BLK)	3.0±0.1	-55~+70	<0.65**	0.51	27	500	<b>IF-C-LG48</b>
	SH1064	265 × 64	PE (BLK)	3.3±0.07	-55~+70	<0.65**	0.51	36	500	<b>IF-C-LG64</b>

## BARE / UNJACKETED FIBER

GRADE	PRODUCT CODE	FIBER DIA. (µm)	OPER TEMP. (C°)	ATTEN. (dB/m)	FIBER NA	LENGTH PER SPOOL (m)	STOCK NUMBER	COMMENTS
ESKA® COMMERCIAL	CK-10	250	-55~+70	<0.20*	0.50	12,000	<b>IF-C-U250</b>	.010" dia.
	CK-20	500	-55~+70	<0.20*	0.50	6000	<b>IF-C-U500</b>	.020" dia.
	CK-30	750	-55~+70	<0.20*	0.50	2700	<b>IF-C-U750</b>	.030" dia.
	CK-40	1000	-55~+70	<0.20*	0.50	1500	<b>IF-C-U1000</b>	.040" dia.
	CK-60	1500	-40~+70	<0.20*	0.50	700	<b>IF-C-U1500</b>	.060" dia.
	CK-80	2000	-55~+70	<0.20*	0.50	250	<b>IF-C-U2000</b>	.080" dia.
	CK-120	3000	-55~+70	<0.20*	0.50	150	<b>IF-C-U3000</b>	.120" dia.

## SCINTILLATING /FLUORESCENT FIBERS

Scintillating and fluorescent fibers appear visually the same, but they act differently when exposed to high energy particles. Scintillating fibers are made with fiber core doped with special materials to produce photons in the visible range when high energy particles pass through the core material.

Applications for scintillating fibers include:

- Calorimeters
- Cosmic ray telescopes
- Flow cells
- Neutron imaging
- Particle discrimination

Although fluorescent fiber looks the same to the human eye, it does not absorb high energy particles such as gamma rays. These fibers are sometimes called “wavelength shifters” because they absorb short wavelength energy, such as ultraviolet or blue, and emit it in a longer wavelength region. The optical energy (light) emitted is narrow-wavelength, vivid and bright.

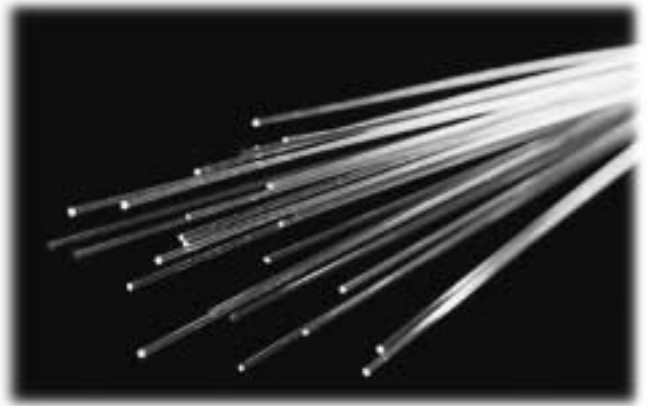
Optical fibers produce these brilliant colors from their cores, which contain material selected to produce desired fluorescent and optical characteristics.

Applications for these fibers include:

- Sights for rifles, shotguns and bows
- Decorative displays

This optical fiber is easily cut and can be finished like other plastic fiber. Standard stock items are listed below – available in red, green, amber and blue fluorescent colors. (Other fiber colors and diameters such as orange, yellow, .25, 1.0, 1.5, 2 and 3 mm in diameter are available upon special request.)

The optical core of this fiber can be either polystyrene (which is lower cost) or acrylic (higher cost but with more resistance to UV light for outdoor applications).



### POLYSTYRENE

COLOR	DIAMETER	INVENTORY <sup>†</sup>	WAVELENGTH nm <sup>1</sup>	STOCK NUMBER
Red	.5 mm	stock	635	<b>IF-810065</b>
Green	.5 mm	stock	490	<b>IF-810070</b>
Blue	.5 mm	stock	435	<b>IF-810075</b>
Amber	.5 mm	spec. order	540 <sup>2</sup>	<b>IF-810076</b>
Red	.75 mm	stock	635	<b>IF-810091</b>
Green	.75 mm	stock	490	<b>IF-810092</b>
Amber	.75 mm	stock	540 <sup>2</sup>	<b>IF-810098</b>
Red	1 mm	stock	635	<b>IF-810087</b>
Green	1 mm	stock	490	<b>IF-810082</b>
Amber	1 mm	stock	540 <sup>2</sup>	<b>IF-810083</b>
Red	1.5 mm	stock	635	<b>IF-810088</b>
Green	1.5 mm	stock	490	<b>IF-810089</b>
Amber	1.5 mm	spec. order	540 <sup>2</sup>	<b>IF-810000</b>
Red	2 mm	spec. order	635	<b>IF-810093</b>
Green	2 mm	spec. order	490	<b>IF-810094</b>
Amber	2 mm	spec. order	540 <sup>2</sup>	<b>IF-810095</b>
Red	2.5 mm	spec. order	635	<b>IF-810096</b>
Green	2.5 mm	spec. order	490	<b>IF-810097</b>

### ACRYLIC

COLOR	DIAMETER	INVENTORY <sup>†</sup>	WAVELENGTH nm <sup>1</sup>	STOCK NUMBER
Red	1 mm	stock	615	<b>IF-810085</b>
Green	1 mm	stock	515	<b>IF-810080</b>

<sup>1</sup> Emission peak

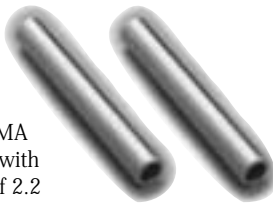
<sup>2</sup> Two spectral peaks. 540 & 575 nm

<sup>†</sup> Standard length 1.52 m. Continuous lengths available by special order.

# Fiber Optic Connectors

## FIBER SPLICE

This fiber splice is a permanent crimp-type splice for all jacketed 1.0 mm PMMA core fiber optic cable with an outside diameter of 2.2 mm. Overall length of the splice is 25.4 mm. Crimps to fiber with a .128 hex crimping die and tool (crimping tool on page 67). Can be used with or without index-matching gel.



**STOCK NUMBER** IF-420090  
**INDEX MATCHING GEL** IF-400010

## ST® ACTIVE DEVICE MOUNT



Low-profile ST device mount for multi-mode plastic or glass fiber cable. Accepts TO-18, TO-46 and TO-52 active device package styles. Body is nickel plated, die-cast zinc for EMI/RFI shielding and protecting sensitive electro-optical components. Mounts to PCB with two 2-26 SAE screws.

**STOCK NUMBER** 820050

® ST is a registered trademark of AT&T.

## DNP COMPONENTS

AMP dry, non-polish (DNP) optical fiber terminations and device mounts are a proven line of products very popular for use with 1000 µm jacketed simplex and duplex plastic fiber. Listed below are the most commonly used DNP components in the AMP line for replacement components that are stocked for our IF-LMH and IF-SD11 products and for OEM use.

DESCRIPTION	STOCK NO.
Single-position plug assembly	<b>228087-1</b>
Dual-position plug assembly	<b>228088-1</b>
Single-position bulkhead receptacle	<b>228042-1</b>
Dual-position bulkhead receptacle	<b>228045-1</b>
Device mount	<b>228043-1</b>
Device mount	<b>228709-1</b>
Retention clip	<b>228046-1</b>

## FIBER OPTIC CONNECTOR

This multi-purpose connector is an expansion of our highly successful LED and photodetector product designs for jacketed 1 mm core plastic fiber. It utilizes the same cinch nuts, alignment principles and no-fuss fiber terminations to quickly handle the three most common requirements for joining two fiber lengths:



- Replacing damaged fiber segments
- Combining two different fiber lengths
- Bulkhead or patch panel connections

To join two fibers, cut the fiber ends at a 90-degree angle, insert each into the connector and tighten the cinch nuts. Device features an 8-1 mm threaded flange, 9 mm long for bulkhead or panel connections.

**STOCK NUMBER** IF-C-S1

## ST® STYLE CONNECTOR

Designed specifically for the installer who demands fast and easy assembly, top optical performance and low cost. The durable connector has metal housing with hard stainless alloy ferrule and polishes quickly. The connector's rear design crimps directly on the cable jacket, eliminating cable pull-away from the connector. The ST® connector is supplied with a 3 mm boot.



FERRULE	FIBER SIZE	TYPICAL LOSS	STOCK NO.
Stainless	1 mm	.5 dB	<b>IF-C-ST</b>

® ST is a registered trademark of AT&T.

## PMMA FIBER EPOXY

Bonding to the unique structure of PMMA plastic fiber core is difficult, so a special epoxy is called for. Industrial Fiber Optics has prepared a special epoxy that adheres well to the fluoropolymer cladding and to all jacket materials, plus does not embrittle the PMMA fiber core. Our epoxy comes in 4 gram A-packs which allows mixing to be done inside a 2-part pouch.

**STOCK NUMBER** IF-400005

## FIBER OPTIC TEST SET

A versatile and rugged fiber optic test instrument specifically designed for use with plastic optical fiber. It features capabilities for:

- Performing fiber continuity checks
- Measuring fiber output power
- Calibrating and screening detectors
- Measuring LED power
- Measuring fiber attenuation

*Operator's manual  
available on our  
Web site*

The Fiber Optic Test Set uses a silicon photodetector to measure optical power, which is calibrated at the two most commonly used wavelengths in plastic fiber – 660 (red) and 850 (infrared) nanometers. Optical power upon the photodetector is displayed in an easy-to-read 3½ LCD display that can be set in four different power ranges: 20 µW, 200 µW, 2 mW and 20 mW. The test set includes a 660 nm LED for fiber attenuation measurements, activated by a separate switch with automatic turn-off circuitry to save battery life.

The detector and LED are both housed in industry-standard ST® female input connectors. The connectors permit measurements with any plastic fiber in an ST® male connector or connector-less fiber with an outer diameter of 2.5 mm or less.

This meter is inexpensive enough for classroom budgets, yet offers the range, features and durability required for industrial applications.



*The Test Set comes with two 9-volt batteries, sturdy storage container, test cable and easy-to-read full-color instruction manual.*

**STOCK NUMBER**

**IF-FOM**

## FIBER OPTIC TOOL KIT

This recent addition to our product line meets a simple, yet long-neglected need for POF. In a compact and easily stored kit, you'll find all the tools you need to work with all plastic optical fibers and termination types:

- Jacketed and unjacketed
- Diameters ranging from .25 to 3 mm
- Single strands or multi-fiber bundles
- Polishing, simple cutting or hot knife terminations
- Connector-less or connectorized

*Kit contains fiber optic stripper, hot knife, professional fiber cutter, water dispenser, glass polishing plate, 2000 grit and 3 µm polishing film, replacement blades, ST® fiber polishing puck, rugged storage container and full-color procedure guide.*



*Operator's manual  
available on our  
Web site*

**STOCK NUMBER**

**IF-TK4**