# CHAPTER 10
# EDUCATIONS


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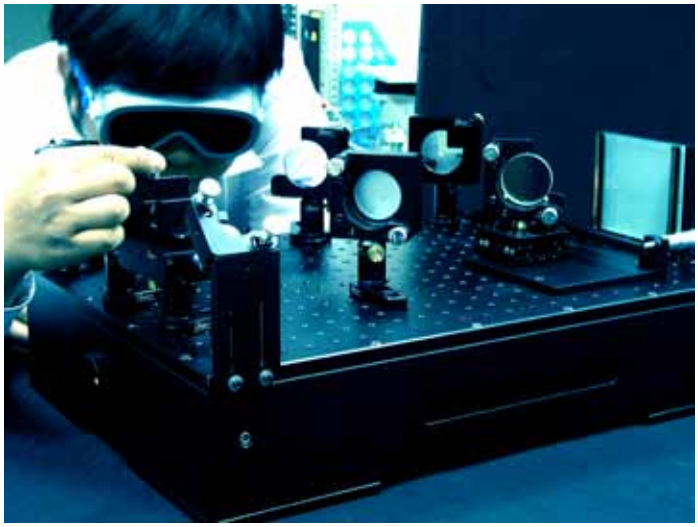
CHAPTER 10 EDUCATIONS

# UNIVERSAL INTERFEROMETER SYSTEM



This system can be set up as a Michelson, a Mach-Zander, and a Twyman-Green interferometer.

| GIM01 | Universal Inerferometer System | 1Set |
|---|---|---|
| | Includes | |
| 1 | Universal Optical Table, 400X600X120MM(M6-25MM) | 1 |
| | (With Concealed Laser Mount and Beam Steerer Mount) | |
| 2 | Precision Beam Splitter/Mirror Mounts φ50mm(100pitch) | 6 |
| 3 | Precision Spatial Filter(W/Micrometer) | 1 |
| | Travel(X.Y) ±2.0mm Z:13mm, Resolution 0.01mm | |
| 4 | Precision Pinhole,φ25mm(Low Power) | 1 |
| 5 | Microscope Objective 10X, Numerical Aperture:0.25 | 1 |
| 6 | Compensator,φ50.0mm, 1/10λ | 1 |
| 7 | Beam Splitter,φ50.0mm, 1/4λ | 2 |
| 8 | Mirror,φ50.0mm, 1/10λ | 3 |
| 9 | Mirror,φ25.0mm, 1/10λ | 3 |
| 10 | He-Ne Laser(Random Polarization) | 1 |
| | Min. Output Power: 2.0mW | |
| 11 | Precision Translation Stage | 1 |
| | Travel:±5mm, Resolution:<2μm | |
| 12 | Precision Mirror Mount,φ25mm(100pitch) | 1 |
| 13 | Plate Holder 100x125mm | 1 |
| 14 | Collimator Lens, φ50mm, F=100mm (BK 7) | 1 |
| 15 | Concave Mirror, φ50mm, F= -100 mm(BK 7) | 1 |
| 16 | Precision Prism Mounts Platform. Size 50x50mm(100pitch) | 1 |
| 17 | Prism 45° -90° -45° (Angles<30′) | 1 |
| 18 | Base Clamps,φ32x67mm | 6 |
| 19 | Posts & Holders,φ12mm L: 25mm | 6 |
| 20 | Screw Kit | 1 |

CHAPTER 10 EDUCATIONS

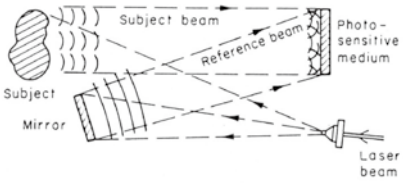
# INTRODUCTION TO HOLOGRAPHY

## Introduction to Holography

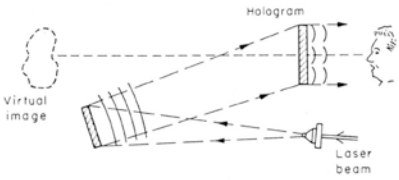
Holography is based on the recording of phase information of light wave. As shown below, the subject is shined with a coherent reference light, ex., a laser. The scattered light from the subject then interferes with the same reference light to form an interference pattern on the photo-sensitive plate, hologram. For a plane reference beam incident on the plate at an angle, the phase varies linearly along coordinates x. The plate is a square-law detector and records the interference pattern. In such way, the hologram records the complete information on the amplitude and phase of the scattered wave reaching the hologram.

The subject wave can be reconstructed by illuminating the hologram with the same reference beam as in the hologram-forming state.

The diffraction of light by the interference pattern in the hologram reconstructs the original light wave. The original light wave corresponding to the virtual image, travels at right angles to the hologram plane. The recording and reconstruction processes are complete, i.e., the phase information contained in a light wave u(x, y) is not lost.




Hologram forming

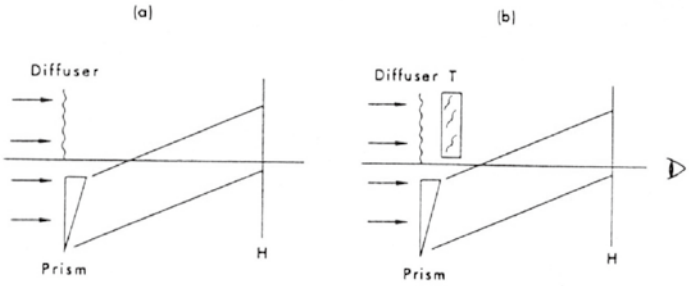



Reconstruction of original light wave

## Applications of holography

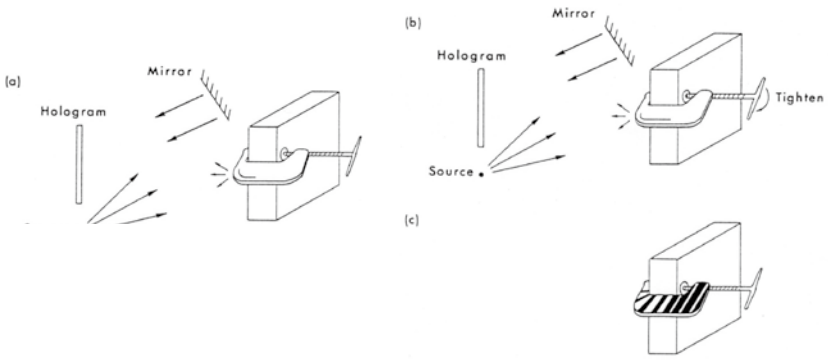
- Holographic interferometer

A hologram of a diffuser is recorded, (a). The hologram is placed exactly in its original position so that both the reconstructed and actual object wave are superposed. When the test plate T is inserted, any optical inhomogeneities will distort the actual object wave so that interference fringes appear, (b).



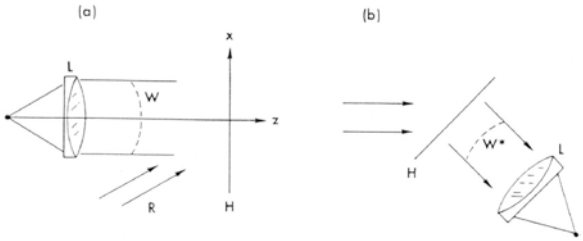

- Holographic strain interferometry

A hologram is recorded of an object, (a). The hologram is replaced in its exact original position and the object is strained, (b). Light from the strained object passes directly through the hologram and interferes with the reconstructed wave of the unstrained object, (c).



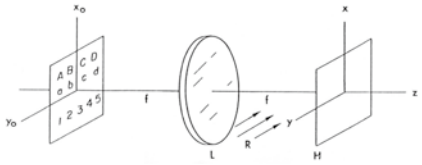
• Holographic correction of lens aberrations.

Recording the aberration, (a). The hologram produces a wave that is phase conjugate to the aberrated wave. When the lens L images this wave, the errors will cancel, (b).

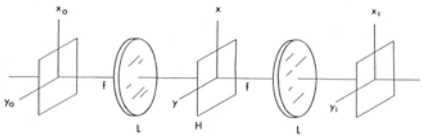



• Holographic character recognition

The master hologram consists of a large number of Fourier transform holograms of a set of characters to be stored.



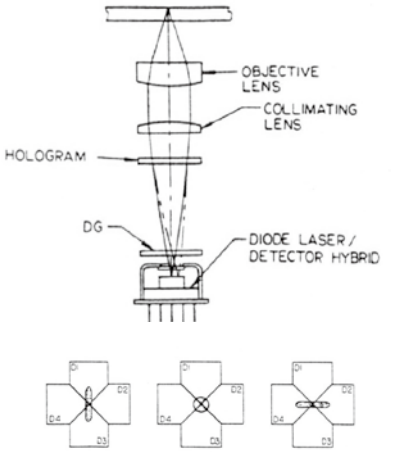

The completed hologram is replaced as indicated below. When an unknown character is placed in the window in the x-y plane, the lens L produces its Fourier transform at the hologram. A second lens L produces a Fourier transform of this product in the xi-yi plane, and therefore the cross-correlations of the unknown character and all of the stored characters are displayed in this plane.




A bright spot will appear in the xi-yi plane when the unknown character is correlated with a stored character of similar shape.

• Optical pick head

The spatial frequency of the hologram is designed to diffract the returned light to the center of the detector. The hologram also serves as a cylindrical lens introduces astigmatism to the returned beam. The focusing condition of the laser beam on the disk surface can be detected from the signal generated by the astigmatic beam on the detector.




When the spot is in focus, the beam on the detector is round. If the point of focus is above or below the disk's surface, the beam on the detector is either a vertical elliptical beam or a horizontal elliptical beam. The focus error is then simply given by (D1+D3)-(D2+D4).

• Photographic emulsions

High-resolution photographic plates and films are the most widely employed recording materials for holographic interferometry because of their relatively high sensitivity.

• Photothermoplastics

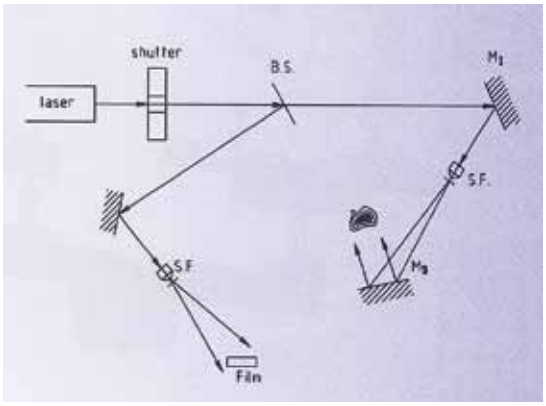
A hologram can also be recorded in a multiplayer structure consisting of a glass or Mylar substrate coated with a thin, transparent, conducting layer of indium oxide, a photoconductor, and a thermoplastic. Photothermoplastics have a reasonably high sensitivity and yield a thin phase hologram with good diffraction. They have the advantage that they can be processed rapidly in situ; in addition, with a glass substrate, the hologram can be erased by heating the substrate, and the material reused.

## Holographic Recording Materials

• Photorefractive(PR) crystals

PR crystals feature excellent resolution, readout efficiency, reversibility, storage capacity, and sensitivity. They are highly flexible, being useful in both read/write and read-only systems. The advantages include the improvement of techniques for hologram fixing, the storage of many thick holograms at different angles within the same volume of a crystal, and electronic means for storage and readout enhancement.

# HOLOGRAPHIC IMAGE SYSTEM

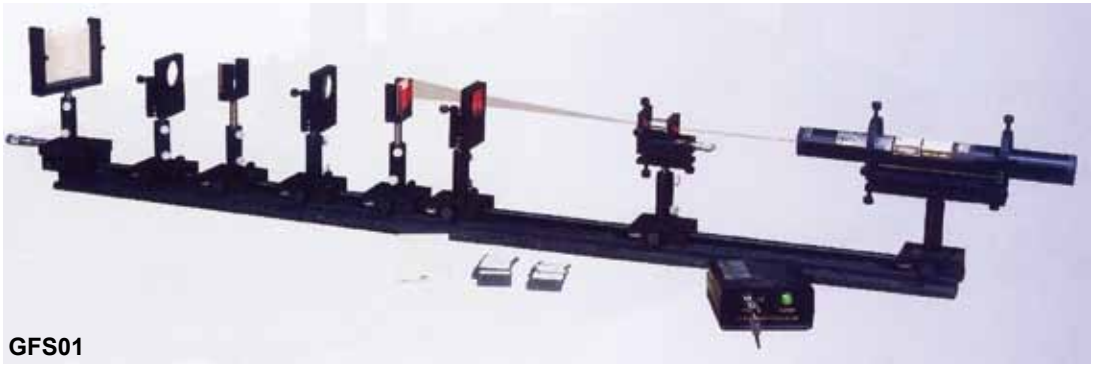



This system is a one-step transmission image-plane holographic system. It can be expanded to a two-step transmission image-plane system, a rainbow holographic system, or a two-beam reflection holographic system.

| GHS01 | Holographic Image System | 1Set |
|---|---|---|
| | Includes | |
| 1 | Holographic Film 90x240mm Plate (24Pcs/box) For Red Laser | 1 |
| 2 | Chemical (Developer, Fixer, Developing Container) | 1 |
| 3 | He-Ne Laser(Random) | 1 |
| | Min. Output Power: 5.0mW/10mW, 35mW(Option) | |
| 4 | Precision Laser Mount | 1 |
| | Max,φ60.0mm(100 pitch) | |
| 5 | Precision Beam Splitter/Mirror Mounts,φ50mm(100Pitch) | 6 |
| 6 | Precision Spatial Filter (W/Micrometer) | 2 |
| | Travel (X.Y)±2.0mm. Resolution 0.01mm | |
| 7 | Precision Pinhole,φ10μm (Low Power) | 1 |
| 8 | Precision Pinhole,φ25μm (Low Power) | 1 |
| 9 | Microscope Objectives, 10X | 1 |
| 10 | Microscope Objectives, 20X | 1 |
| 11 | Mirror,φ50mm, 1/10λ | 4 |
| 12 | Beamsplitter,φ50mm, 1/4λ (R : T=50% : 50%) | 2 |
| 13 | Plate Holder, 100x125mm | 1 |
| 14 | Magnetic Bases | 10 |
| 15 | Posts & Holders,φ12mm. A 75mm | 10 |
| 16 | Sliding Base Plate, 76mmx51mmx9mm | 1 |
| 17 | Power Meter, 0.01μW~20mW | 1 |
| 18 | Mechanical Shutter(Electrical Shutter is Optional) | 1 |
| 19 | Variable N.D. Filter w/Mount | 1 |
| 20 | Screw Kit | option |
| 21 | Cutter for holographic plate | 1 |

CHAPTER 10 EDUCATIONS

# EDUCATIONS FOURIER OPTICS SYSTEM



GFS01

A tutorial system for Fourier Optics experiments, including Fresnel and Fraunhofer diffraction, spatial filtering, relay imaging, etc.

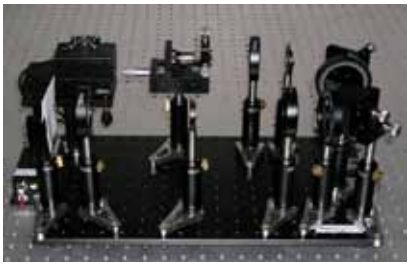
| GFS01 | Fourier Optics System | 1Set |
|---|---|---|
| | Includes | |
| 1 | He-Ne Laser, 5.0mW(Random Polarization) | 1 |
| 2 | Precision Laser Mounts | |
| | Max. Dia,φ60.0mm(100pitch) | 1 |
| 3 | Precision Spatial Filter (W/Micrometer) | 1 |
| | Travel (X.Y)±2.0mm. Resolution 0.01mm | |
| 4 | Microscope Objectives,10X | 1 |
| 5 | Precision Pinhole,φ25μm (Low Power) | 1 |
| 6 | Adjustable Lens Holders, 5-75mm | 3 |
| 7 | Plate Holder, 100x125mm | 1 |
| 8 | Plate Holder, 50x50mm | 2 |
| 9 | Posts & Holders,φ12mm.A 75mm | 6 |
| 10 | Optical Bench, L 2.0m | 1 |
| 11 | Carrier With Translation Stages | 7 |
| | Travel 10.0mm(W/100Pitch Screw) | |
| 12 | Carrier, 77.0x88.0mm | 1 |
| 13 | Precision Translation Stage (W/Micrometer) | 4 |
| | Travel 25.0mm, Resolution : 0.01 mm | |
| 14 | Collimator Lens ,φ50mm, F 100mm | 1 |
| 15 | Fourier Lenses,φ50mm, F 300mm | 2 |
| 16 | Fourier Translation Plates(25 slides/set) | 1 |
| 17 | Screw Kit | 1 |

**Advanced Fourier Optics System**


**The FX15/5F FOURIER TRANSFORM SYSTEM** meets the needs of the experimentalist on a very limited budget with a unique combination of hardware and software for a wide variety of applications. Economically priced, it is complemented by a Manual of 16 Articles/Experiment with test data and illustrations including Fourier Transform photos obtained with these lenses.

**CONTAINS** 1 Collimator and 2 Fourier lenses: 7.6cm diameter, f/5:
32 lines/mm resolution and λ/8 wavefront accuracy over central 3.8 cm aperture: lenses assembled in cells tapped for easy mounting. Pinhole spatial filter with 40X objective lens and 10μ removable, magnetically- held pinhole: will accept standard microscope objective lenses: micrometer drives provide smooth, precise, displacement of lens along stainless steel dual rails, and 63-page Text/Manual.

# LIQUID CRYSTAL DISPLAY EDUATION KIT




## Applications

- Computer generated holography.
- Hybrid Compute-Controlled Optical Correlator for Multiple Target Recognition.
- Optical-data processing/Liquid-Crystal television spatial light modulator.
- Acousto-optic space integration correlator.
- Color encoding of holographic interfero metric fringe patterns with white-light pro cessing.
- Coherent optical implementation of gener alized two-dimensional transforms.

## Features:

1. Including foundation experiment for light and three subjects of optical experiment
2. Each subject includes several test items for practical training and verifying
3. This system could be practiced in prop er sequence in experiment course
4. Each of them includes manual specify ing physics principle and experiment steps
5. Simplified designs for easy assembling and operating
6. Module designs for all kinds of educa tion purpose and experiment

| SLM-EK | Liquid Crystal Display Education Kit | 1Set |
|---|---|---|
| | Includes | |
| 1 | DPSS Green Laser,30.0mW | 1 |
| 2 | Precision Laser Mounts(100pitch) | 1 |
| 3 | Precision Spatial Filter (W/Micrometer) | 1 |
| | Travel (X.Y)±2.0mm. Resolution 0.01mm | |
| 4 | Microscope Objectives,10X | 1 |
| 5 | Precision Pinhole,φ25μm (Low Power) | 1 |
| 6 | Precision Mirror | 2 |
| 7 | Precision Mirror Mount(100 pitch) | 2 |
| 8 | Iris | 2 |
| 9 | Collimator Lens, φ50mm, F 100mm | 1 |
| 10 | Plano-convex Lens φ50mm, F 200mm | 1 |
| 11 | Plano-convex Lens φ50mm, F 300mm | 1 |
| 12 | Plano-convex Lens φ50mm, F 400mm | 1 |
| 13 | Expanding Lens φ50mm, F -100mm | 1 |
| 14 | Polarizer | 2 |
| 15 | Polarizer Mount | 2 |
| 16 | Plate Holder, 50x50mm | 1 |
| 17 | Spatial Light Modulator | 1 |
| 18 | Lens Holder | 3 |
| 19 | Posts & Holders,φ12mm.A 75mm | 13 |
| 20 | Base Clamp | 13 |
| 21 | Photo Detector | 1 |
| 22 | Electricity Meter | 1 |
| 23 | Optical Breadboard (250 x 450 x 10 mm) | 1 |
| 24 | Laser Safety Eyewear | 1 |
| 25 | Screw Kit | 1 |
| 26 | Manual | 1 |
| 27 | Digital to Analog converter | 1 |
| 28 | Suit Case | 1 |

CHAPTER 10 EDUCATIONS

# FIBER OPTICS COMMUNICATIONS & NETWORKING MODULE

The Fiber Optic Communications & Networking Module is Industrial Fiber Optic technology module. It's a 10-activity, intermediate-level product developed for teaching the very latest in state-of-the-art 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 multimode
- Dispersion and attenuation
- Fiber cable comparisons
- Generation Ⅲ fiber connection technology
- Fusion splicing techniques
- Fiber couplers and 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 nvestigative 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 couplers

## FECTURES

- 10 comprehensive and challenging activities
- 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 safely
- 3 wavelength operation

(The Communications and Networking Module shown above comes complete with three fiber optic wide bandwidth analog/digital transceivers, 110 VAC to 12 VDC power adapters, assorted pre-connectorized plastic and glass fibers, 252 meter 1000 µm core plastic fibers, 25 fiber splices, 50 fiber optic retention clips, 50 ST fiber connectors, crimping tool for splices and connectors, 40 µm and 3 mm polishing film, optical inspection scope, index-matching gel, DC motor, fiber optic switch, two optical multiplexers, fiber cutter, polishing plate,

polishing liquid, fiber optic test set, dynamic microphone, AM/FM radio, scale, infrared indicator card, coax cable, photonics and electromagnetic wall charts, two Fiber Optic Reference Guides, two permanently bound student manuals and an instructor's manual in a sturdy 3-ring binder with answer sheets.)

| | |
|---|---|
| **FIBER OPTIC COMMUNICATIONS & NETWORK MODULE** | **IF-527** |
| **STUDENT MANUAL FOR IF-527** | **IF-120265** |
| **TEACHER'S MANUAL FOR IF-527** | **IF-120260** |

25.2-meter 1000 µm core plastic fibers, 25 fiber splices, 50 fiber optic retention clips, 50 ST fiber connectors, 40 µm and 3 mm polishing film

| | |
|---|---|
| **CONSUMABLES KIT** | **IF-528** |

# FIBER OPTICS DEMONSTRATION SYSTEM

The Fiber Optic Demonstration System is Industrial Fiber Optics state-of-the-art fiber optic technology module. This tried and proven academic module comes complete and ready to use. All and 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 inc 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 manual 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 assl gnments
- Hands-on working experience and experiments with fiber optics and as sociated components
- Problem solving and student work sheets
- Team activities
- Homework and investigative research
- Web fiber optic tours and projects

Hand-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 µm and 3 µm 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 (SAE and metric dimensions)
- 10 comprehensive activities
- including lighting, sensor and commu nication fiber applications
- 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 manuals with color-coded answer sheets
- Suitable for grades 7 through 12

The glass version of this module utilizes industry standard 62.5/125 µm data communication fiber and high performance IR (infrared) LEDs with easy-to-use locking ST, fiber terminations (the same high quality components use by many standard data communications networks.)

| | |
|---|---|
| **STOCK NUMBER** | **IF-DS100G** |
| **STUDENT MANUALS** | **IF-120027** |
| **INSTRUCTOR'S MANUAL** | **IF-120026** |

Our plastic fiber model utilizes inexpensive connector-less fiber design. The customized inter-connecting system with 100 µm plastic fiber and red visible LEDs is ideal for educational purposes. (This model is distributed exclusively by Scientific Laser Connection in the United States.)

| | |
|---|---|
| **STOCK NUMBER** | **IF-DS100P** |
| **STUDENT MANUALS** | **IF-120255** |
| **INSTRUCTOR'S MANUAL** | **IF-120250** |

CHAPTER 10 EDUCATIONS

# INFORMATION TRANSMITTED KILS

## SPEED OF LIGHT MEASUREMENT / RECEIVER KIT

For years after lasers were invented they usually were considered only a novelty. People often commented, after seeing a laser beam for the first time, “Pretty. But what’s it good for?” This kit makes the mist of your modulated laser to demonstrate functions such as:

- Transmitting /receiving an audio signal
- Speed of light measurement
- B/W video receiver transmission /detection

The principle employed in this kit to measure the speed of light is similar to that used by Newcomb in 1880 and Michelson in 1924. In operation, the laser beam is split into two portions. Your instruction manual contains detailed instructions and diagrams describing equipment set-up, as well as historical journey into efforts to measure the speed of light. This is a great opportunity to learn not only about technology, but also the very human history behind it. Included in the kit are an optical beam splitter, first-surface mirror, two converging lenses, optics mounts, microphone, electronic control box with 2-channel receiver and 1MHz oscillator, 110VAC-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 40MHz oscilloscope,We will furnish 220 VAC adapters upon requesr.

| | |
|---|---|
| **RECEIVER & POWER ADAPTER** | **IF-LSL-SA1** |
| **RECEVER, POWER ADAPTER & MICORPHONE** | **IF-LSL-2** |
| **COMPLETE KIT** | **IF-LSL-1** |

## LASER VIDEO KIT

Industrial Fiber Optics manufactures laser receivers specially designed to decode information transmitted via laser beams, then convert that information to electrical or audible forms. With so many lasers on the market today, determining which receiver you should purchase fir a particular application can be frustrating. For your convenience we created the following table to aid in your selection. (The receiver in the photo is the same size as the IF-VR or IF-VR2.)

| APPLICATION | SUGGESTED STOCK NO. | COMPONENT COMPATABILITY | COMMENTS |
|---|---|---|---|
| Audio or Voice | IF-LSL-SA1 | Suitable for use with any diode or helium neon laser made by the following companies :Elanco,Fisher Scientific, Heath Kit, Industrial Fiber Optics(IFO), Meredith Instruments, Mertologic and Scientific Laser Connection(SLC) | This receiver is sold with a dynamic microphone as Part NO. IF-LSL-2. The microphone is suitable for use with all IFO and SLC diode lasers. |
| Laser Speed of Light | IF-LSL-SA1 | Replacement for Metrologic’s Laser Speed of Light/Audio Kit Pat No.45-720 | 110 VAC operation - no more dead batteries |
| Video | IF-VR | Can be used with any Industrial Fiber Optics or Scientific Laser Connection video laser | Used for TV video output from RCA jacks |
| RF Video | IF-VRII | For use with Industrial Fiber Optics’ WBS laser only(Part No.IF-UL-08-635) | Used with the IFO WBS laser for reception of TV picture and sound over a single channel |

# BUILD-A-LASER KIT

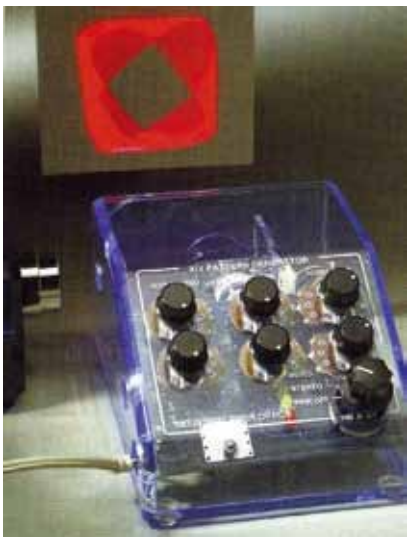
Metrologic invites you to build your own helium-neon laser. In this kit, you'll find everything you need, including schematics and step-by-step assembly instruction. This low-cost laser can be assembled in two or three hours. It is ideal for the student laboratory, classroom demonstrations, laser shows and holography instruction.

The Kit contains:

- Long-lasting, hard-seal helium-neon laser tube
- Print circuit board
- Durable aluminum housing
- All components
- Mounting hardware
- Schematic and instructions
- Model: ML801

0.5mW
Build-A-Laser Kit
class II

## X-Y Pattern Generator



**Model: IF-XYP**

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

### Applications

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

The generator in 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.)