

## FIBRE OPTIC COMMUNICATIONS TRAINING SYSTEM

## EF-970-E

CLASS 1  
LASER PRODUCT



**TRANSMITTER MODULE**



**RECEIVER MODULE**

The **EF-970E** trainer is an innovative system designed for training, demonstration and experimentation with the Fibre Optics communication systems, the phenomenon related to light and the principles of transmission through Optical Fibres; as well as the latest tendencies like LASER and WDM (wavelength multiplexing).

- The equipment consists of:
- Emitter module, two independent channels with photo-emitters and LASER.
  - Receptor module with optical power measurements.
  - Accessories.
  - A set of Optic Fibres
  - Documentation.

### EMITTER KIT, CONSISTING OF TWO INDEPENDENT CHANNELS WITH LED AND LASER-PHOTOEMITTERS

#### 8 Inputs

The instrument possesses eight selectable inputs. The input signal may be selected, either channel 1 (CH 1) or channel 2 (CH 2), the same input may also be used for both channels.



- 1- LF generator: sinusoidal, triangular or square (internal) signal
- 2- DC analogue input (75  $\Omega$ ) (external)
- 3- AC analogue input (75  $\Omega$ ) (external)
- 4- Microphone (monophonic) (external)
- 5- Digital input (External)
- 6- Inverted digital input (External)
- 7- Digital input permanently on "1" (internal)
- 8- Digital switch "1" / "0", using the TL1 key (internal)

#### LF Generator (square, triangular, sinusoidal)

The LF generator possesses four control buttons to select the wave form (square, triangular or sinusoidal) and the frequency



#### Milliammeter

The emitter kit consists of a digital milliammeter showing the polarisation current flowing through the chosen photoemitter. The channel to be measured is selected with the "A METER CH1/CH2" button.



#### Channel 1 and 2

The emitter kit consists of 2 independent channels (channel 1 and channel 2) that enable signals to be transmitted from any optical input



and control the amplification of the input signal level. Includes channel overload or saturation indicator.

## FIBRE OPTIC COMMUNICATIONS TRAINING SYSTEM

## EF-970-E

### Optical outputs

The emitter kit has six cyclically selectable photoemitters. Two photoemitters may be activated at the same time for the WDM application.

The photoemitters have a protection circuit to limit optical power.



### Laser feedback

The nature of the LASER means that its optical power may be influenced by external factors such as temperature, ageing, etc.

The feedback circuit is able to maintain a stable and unalterable optical power no matter what the external conditions are.



The system can operate with the feedback circuit ON or OFF so to test its efficiency and the problems caused by its disconnection and/or malfunction.

## RECEIVER KIT WITH OPTICAL POWER METER

### Receiver

The receiver kit principally consists of two independent blocks (except for the input circuits: photodetectors and switches), one for the signal and the other for measuring.

The signal block contains two channels, also independent, one for receiving analogue signals and the other for digital signals.

The measuring block contains the power meter, enabling operation in four different modes: analogue, digital, 1 kHz and DC.

### Optical inputs

The receiver has four incorporated photodetectors and an external photodetector (optional) that connects to the "EXT. SENSOR" input by a coaxial cable (optional).



The signal block possesses a switch to select the type of coupling, DC or AC, applied to the first amplifier input and to the analogue channel output section.

The audio section consists of an independently-adjustable low-pass for regulating the level of the signal applied to the internal speaker or headphones.

### Digital channel signal block

The signal entering the digital channel follows a series of filtering and amplification processes for subsequent comparison with a reference level.



The amplitude of the channel output may be selected as either TTL level or RS-232 level.

### Optical power meter

This block performs the absolute or relative measurement of the received optical power. The optical meter possesses four measuring modes, selected by the user.

- ANALOG (monitoring mode)
- DIGITAL (monitoring mode)
- 1 kHz (precision mode, for measuring the 1 kHz component)
- DC (precision mode)

The resolution of the power meter in the monitoring modes is 0.1 dB, and 0.01 dB in the precision modes.



### Analogue channel signal block

The analogue channel has a gain of 40 dB, using two 20 dB amplifier stages.



## BASIC FIBRE OPTIC COMMUNICATIONS TRAINING SYSTEM

### EF-970

The **EF-970** FIBRE OPTIC COMMUNICATIONS TRAINING SYSTEM is a simplified version of the **EF-970-E**, including five photo-emitters and two photo-detectors. The rest of features are the same as those of the **EF-970 E**.  
If desired, the **EF-970** can be upgraded to the **EF-970 E** with the **OP-970-EU** option.



INCLUDED ACCESSORIES

### INCLUDED ACCESSORIES

Both **EF-970-E** and **EF-970** include the following accessories:

- 3 ST adapters for the photodetectors
- Cleaning elements for optical components
- 3 1-m pieces of optical fibre
- 1 1-m piece of optical fibre without protective covering
- 1 50-m optical fibre
- 2 ST-ST adapters
- 1 magnifying lens
- 1 microphone
- 1 headphones

### OPTIONS

#### OPT-970-01: Exercices kit

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>- 1 2-m piece of optical fibre</li> <li>- 1 2-m piece of optical fibre without protective covering</li> <li>- 1 set of modal filters (cylindrical hoops with various radiuses)</li> <li>- 2 clips for modal filters</li> <li>- 1 set of plaques for generating high-density microcurves</li> <li>- 1 set of plaques for generating low-density microcurves</li> <li>- 1 optical fibre arm</li> <li>- 2 fixed WDM devices</li> <li>- 1 fixed WDM device</li> <li>- 1 white light source (powered by two LR03 1.5 V alkaline batteries, not supplied)</li> <li>- 1 set of neutral optical filters</li> <li>- 1 universal bracket (# 1)</li> <li>- 1 universal bracket (# 2)</li> </ul> | <ul style="list-style-type: none"> <li>- 1 variable attenuator</li> <li>- 1 ST adapter for 650 nm filter photo-detectors</li> <li>- 1 ST adapter for 850 nm filter photo-detectors</li> <li>- 1 shutter (diaphragm)</li> <li>- 1 reflection sensor</li> <li>- 1 reflecting lamina</li> <li>- 1 U-sensor</li> <li>- 1 liquid container</li> <li>- 1 external photo-detector (1 mm Si PIN)</li> <li>- 1 measurement adapter (for external photo-detector)</li> <li>- 1 shielded connector cable for external photo-detector</li> <li>- 1 screwdriver</li> </ul> |
|---|---|



Optical fibre arm



Variable optical attenuator



Variable WDM device

#### OP-970-02: Connection kit

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>- 1 tool for removing the protective covering from optical fibre</li> <li>- 1 ST crimping tool</li> <li>- 1 polishing disk</li> <li>- 1 set of abrasive laminas</li> </ul> | <ul style="list-style-type: none"> <li>- 1 elastic polishing pad</li> <li>- 1 rigid pad</li> <li>- 1 liquid container</li> <li>- 1 10- m optical fibre cable</li> <li>- 10 ST connectors</li> </ul> |
|---|---|

#### OP-970-03: Microscope

- 1 Universal Microscope (ST, FC, SC) x 100

#### OP-970-EU: Extension kit for basic fibre optic communications training system (Factory assembly)

- Upgrades the basic Fibre Optics Trainer (EF-970) to the same characteristics as the **EF-970-E**
  - Photo-emitter 1300 nm Led
  - 1 mm InGaAs PIN photo-detector
  - 0.1 mm Ge APD (variable internal gain photo-detector)



# FIBRE OPTIC COMMUNICATIONS TRAINING SYSTEM SPECIFICATIONS

## Emitter module

The emitter kit for the simultaneous transmission of two independent channels of up to 10 MHz consists of the following blocks:

### Inputs

- Analogue (separate DC and AC)
- Functions generator (internal)
- Microphone
- Digital (with possibility of inversion)

### Emitter stage

- Channel 1
- Channel 2, with actionable laser feedback

### Amperimeter, for adjusting photoemitter polarisation current

### Photoemitters

526 nm Led, 590 nm Led, 660 nm Led, 850 nm Led, 1300 nm Led, 650 nm Laser

### Fault simulator

## RECEIVER MODULE

### Photo-detectors

- 1mm Si PIN
- 1mm InGaAs PIN
- 0.1 mm Ge APD (variable internal gain photodetector)
- 2.5 mm Si PIN

### Precision measurements channels

- 1 kHz, to prevent influence from external optical sources
- Very low DC noise, for very precise measurements

### Receptor stages (with variable inverse polarisation)

- Analogue channel
- Digital channel

### Optical power meter (dBm and mW) with absolute and relative measurements

### Outputs

- Analogue (high or low impedance)
- Digital (TTL or RS-232)
- Speaker (internal) and headphones

### Fault simulator

## CD-ROM supplied documentation

- User's Manual
- Training Manual

## Partial list of exercises

### EF-970

- Measuring optical power (suggested **EF-970-E**)
- Measuring the attenuation of an optical fibre. Insertion losses method (suggested **EF-970-E**)
- Measuring the attenuation of an optical fibre
- Spectral dependence of the attenuation of an optical fibre
- Influence of ambient light
- Connecting optical fibre using ST-ST adapters
- Measuring repeatability
- Measuring the P/I characteristics of photoemitters
- Measuring the optical stability of photo-emitters

- Measuring the V/I characteristics of photo-emitters
- Frequency characteristics of photo-emitter modulation
- Spectral dependence of photo-detectors (suggested **EF-970-E**)
- Bandwidth of photo-detectors
- Transmission of analogue signals
- Transmission of audio signals
- Transmission of video signals
- Transmission of digital signals
- RS-232 transmission using optical fibres

### EF-970-E

- Optical power measurement
- Measuring the attenuation of an optical fibre. Insertion losses method (suggested **EF-970-E**)
- Measuring the attenuation of an optical fibre
- Spectral dependence of the attenuation of an optical fibre
- Influence of ambient light
- Connecting optical fibre using ST-ST adapters
- Measuring repeatability
- Measuring the P/I characteristics of photo-emitters
- Measuring the optical stability of photo-emitters
- Measuring the V/I characteristics of photo-emitters
- Frequency characteristics of photo-emitter modulation
- Spectral dependence of photo-detectors (suggested **EF-970-E**)
- Inverse voltage in photo-detectors
- Bandwidth of photo-detectors
- Transmission of analogue signals
- Transmission of audio signals
- Transmission of video signals
- Transmission of digital signals
- RS-232 transmission by optical fibres

### OP-970-01 Exercices kit

- Sensitivity of optical fibre to curvature (Macrocurves)
- Sensitivity of optical fibre to microcurvature
- Radiation characteristics of optical fibre. Measuring numeric aperture
- Measuring sliding in optical fibre connections
- Characteristics of a fixed WDM device
- Characteristics of a variable WDM device
- Measurements with neutral optical fibres
- Measuring insertion loss by the variable optical attenuator
- WDM: multiplexation and demultiplexation
- WDM system
- WDM transmission
- Transmission sensor
- Reflection sensor
- Liquid level sensor
- Spectral dependence insertion loss by the variable optical attenuator (**EF-970-E** needed)
- Comparing noise characteristics between PIN and APD photo-detectors (**EF-970-E** needed)

### OP-970-02 Connection kit

- Connections with the optical fibre connector tool kit **EF-970** or **EF-970-E**

### OP-970-03 Microscope

- Recommended even to use with **OP-970-02**