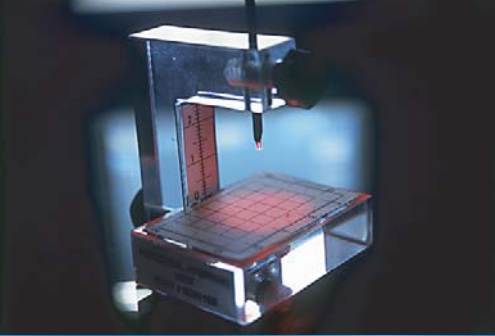


# BENCHMARK



## *OFS IV – Optical Fibre System*





Fibre optic training has assumed great importance in today's world of widespread fibre optic usage – whether in telecommunications or railways, industrial automation or aerospace... To this end, the Benchmark OFS IV Optical Fibre System provides fibre optic user organisations with a range of solutions for training their personnel in fibre optic concepts and practices.

The Benchmark OFS IV is designed to provide comprehensive training to students and all levels of scientific and technical personnel on fibre optic devices and digital communication systems. The laboratory spans fibre optics and related topics, including:

- Fibre optic device characteristics
- Principles of fibre optics and digital communications
- Fibre optic equipment
- Digital and analog fibre optic links

The OFS IV System can be used for demonstration, training, and experimentation, and can form the basis for student and research projects and prototypes.

## FOR ALL FIBRE OPTIC USERS

- Scientific/technical professionals in fibre optic user organisations
- R&D personnel in research/industry
- Students at B.S. & M.S. (EE) levels in technical institutions
- Technical Training Centres – telecom, railways, industries, educational training, etc.
- Students/researchers in physics
- Students in polytechnics and science colleges

## SINGLE-SOURCE SOLUTION FOR SETTING UP A FULL-FLEDGED, FIBRE OPTICS LABORATORY

- Ideal for structuring training courses in fibre optics and digital communications
- Designed to guide students through stages of fibre optics education – right up to building real-world systems
- Ideal for projects and prototype development

## FEATURES

- The Laboratory comprises compatible fibre optics equipment and components to conduct a series of structured experiments
- OFT- Optical Fibre and Digital Communications Trainer demonstrates integrated voice/data communication link, TDM and digital communication principles. It offers unlimited experimentation using on-kit circuitry and external interfaces, including an RS-232 add-on.
- Demonstration & Measurement of multimode fibre characteristics – Bending Losses, Attenuation, Pulse Broadening, Numerical Aperture, Clad mode stripping study.
- Individual LED, LASER, PD and APD Modules for device characteristics study. The characteristics modules cover forward, reverse & zero bias, leakage characteristics.
- Experimental OTDR: Integrate essential blocks of an OTDR and understand its principles of operation.
- Learn how to use an OTDR with fibre events
- Plastic and glass fibre links - for experimentation and as interface modules for other digital circuitry.
- Light Source with variable optical power output, continuous wave, external modulation, internal word and PRBS generation
- Power Meter calibrated at 650, 850 and 850, 1300 & 1550nm
- Specially designed component-insertion PCBs for link



construction – for repeated use by students

- Comprehensive lab manuals for individual modules. The manuals cover the theory and guide students through a series of experiments
- Optional Connectorisation and Splicing Kits – to provide students with hands-on experience in connectorisation and splicing of glass fibre
- Optional range of LEDs, detectors, fibres, connectors, adaptors & receptacles – for custom-development of links, and for study of fibre optic devices and fibre-handling
- Optional Single Mode Fiber Characteristics Study – Modes Observation, Normalized Frequency (V-number) calculation, Mode Field Diameter & NA Measurement.

## Device Characteristics Modules

Covers fibre optic devices performance under different bias conditions. The modules have appropriate monitoring points and circuit diagrams printed on top.

### ■ LED Module

The module covers the V-I, P-I characteristics and the conversion efficiency.

### ■ Photo Diode Module

The user works with a PIN photo diode under different bias conditions. (Zero, Forward and Reverse Bias). The module also covers quantum efficiency, responsivity and leakage characteristics of a PIN photo diode.

### ■ APD Module

The module covers characteristics of APD operation under Zero Bias and Reverse Bias. The user understands device performance under different bias conditions, plots the device characteristics and calculates the multiplication factor, quantum efficiency, responsivity.

### ■ LASER Diode Module (LD Module)

The module trains the user on device characteristics (P-I & V-I), Setting up of Free Space Line of Sight Link, effect of interferences & jamming of link by another source.

## OTDR Set Up

The OTDR set up trains the user on OTDR operation, at fraction of a commercial OTDR cost. The user configures the OTDR and works with several fibre events provided. The manual explains the concepts, the functionality of different blocks, different experiments and the commercial applications.

Modular fibre events with connector and adaptor at various distances are part of the lab to work with experimental OTDR. Other events can be added on request to capture the fibre bending effect, splice loss etc.

## OFT

Optical Fibre and Digital Communication Trainer

Used for demonstration, training and experimentation in basic and advanced concepts. It spans:

- Principles of fibre optic communications
- Multimode Fibre Characteristics – including NA, Attenuation & Bending Losses, EMI, and Pulse Broadening.
- Digital Communication Concepts like TDM, Voice Coding, Clock Recovery, Marker in TDM and False marker generation.
- Study of 64Kbps transmission concept which is common in serial communication systems like ISDN/E1/T1

## Fibre Optic Links

Plastic and Glass fibre links for experimentation and interfacing to other digital circuits:

- Plastic fibre analog link – 880nm, 2MHz
- Digital receiver for free space link – 5Mbps
- Multimode glass fibre digital link – 850nm, 2Mbps, 100m
- Single-mode glass fibre digital link – 1300nm, 34Mbps, 500m – optional

Specially designed PCBs are provided for plastic fibre analog and digital links. These come with self explanatory schematic diagram and observation points for study of links. The System consists of a completely assembled sample module and five sets of reusable PCBs (with sockets for component insertion).





## BENCHMARK OFS IV – LIST OF EXPERIMENTS:

### Multimode Plastic Fibre characteristics

- Measurement of Numerical Aperture
- Losses in Optical Fibre – Attenuation & Bending losses
- Electromagnetic Interference
- Pulse Broadening in FO Communication

### Multimode Glass Fibre Characteristics:

- Losses in Optical Fibre – Attenuation & Bending Loss
- Clad mode stripping study

### Laser Diode module

- Laser Diode P-I & V-I characteristics
- Line of Sight link (650nm)
- Live data – free space line of sight link with OFT

### Avalanche Photodiode Module

- APD at Zero Bias
- APD at Reverse Bias
- Multiplying effect of APD
- Leakage characteristics of APD

### LED Module

- LED Characteristics P – I & V – I

### PIN Photodiode Module

- PD at Reverse Bias (responsivity, quantum efficiency)
- PD at Forward Bias
- PD at Zero Bias
- Leakage characteristics of PD

### OTDR & Fibre Event Module

- Building blocks of OTDR – allows building an OTDR with essential components and studying its basic operations
- Study of optical fibre events using the constructed OTDR and standard OTDR's available

### Digital Communication concepts

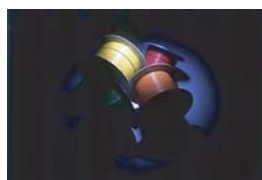
- Study of 64Kbps transmission concepts
- Time Division Multiplexing
- Manchester coding
- Marker in TDM and False marker generation
- PCM voice coding
- Asynchronous data transfer

### Fibre Optic Link Design and Analysis – Analog and Digital FO Digital link

- Multimode digital fibre link – Sensitivity and Power budget
- Bit Rate measurement and study of AC coupled digital link

### FO Analog link

- System study
- Bandwidth







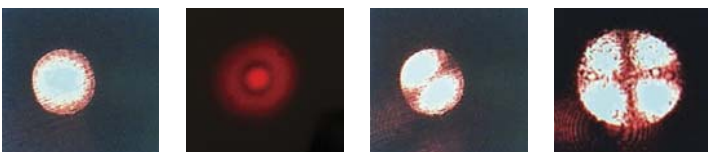
The Benchmark SMC Trainer provides a platform to show the propagating modes in a single mode fibre.

## OFS IV – OPTIONAL MODULES AND STANDALONES

### SMC -Single Mode Fibre Characteristics Training System

#### Features

- Enables comprehensive training on Single-mode fibre characteristics such as Normalized Frequency (V-number), Modes, cut off wavelength, Mode field diameter and Numerical aperture of a single mode fibre.
- Modes observation in two different single mode fibres having different cut off wavelengths
- Precision XYZ positioner for coupling the free space 650nm Laser light into Single-mode fibre.
- Specially designed Mechanical setup for Mode field diameter and NA measurement.
- Comprehensive lab manual



#### Experiments

- Normalized frequency (V-number) calculation and Modes observation in two different single mode fibres
- Mode field diameter and NA measurement

### Fibre Optic Components & Accessories

- Loose jacketed glass and plastic fibre, connectors, adaptors, receptacles,
- LEDs and detectors for 650, 850 & 1300nm operation
- Specially designed PCBs for glass fibre analog and digital links
- Patch cords

#### Experiments

- Mounting of LEDs and Detectors
- Link design & analysis for glass fibre

### Connectorisation & Splicing Kits

- Connectorisation kit for connectorising glass fibre with ST connectors
- UV and mechanical splicing kit for splicing multimode glass fibre

#### Experiments

- Connectorisation of optical fibre
  - Loss measurement
- Splicing of optical fibre
  - Loss Measurement

## POWER METERS & LIGHT SOURCES

### Fibre Optic Power Meter

Essential for measurement of fibre, splice and connector losses, characterisation of LEDs, Photodetectors, etc.

- Forms a powerful test-set with Fibre Optic Power Source
- Calibrated at 650 & 850nm, with large area Si photodetector
- Calibrated at 850, 1300 & 1550nm, with large area Ge photo-detector
- Universal adaptor with ST interface

### Fibre Optic Power Source

For testing and trouble-shooting fibre optic links, studying eye pattern of optical receivers, etc

- 850nm LED source module with ST interface
- Continuous wave output, external modulation, internal word & PRBS generation

## Optical Fibre System IV

	OFS IV
OFT – Optical Fibre Trainer	1
FOPS101 Handheld Fibre Optic Power Source 850nm	1
FOPM101 Handheld Fibre Optic Power Meter Si-650/850nm	1
FOTR110 2MHz Analog Plastic Fibre Link	1
FOTR300 2Mbps Digital Glass Fibre Link	1
Special PCB's – 1set Assembled & 5sets unassembled	1
FOSM600 LD Module	1
FORX200M Optical Receiver	1
FOSM100 850nm LED Module	1
FODM100 Si PD Module	1
FODM 200 Si APD Module	1
Experimental OTDR consisting of:	
FOSM U600 650nm LD Unit	Use FOSM600
FOTX 610 LD Modulator	1
FODM 200 Si APD Module	Use FODM200
X-Y positioner with rail	1
Coupler	1
Multimode fibre events (500m total)	1
Multimode Characteristics setup consisting of:	
Loose Jacketed Glass Fibre- 500m	1
ST-ST Multimode Glass Fibre patch cord	1
ST-ST Multimode Glass Fibre Reference patch cord	1
ST-ST Adaptors	1
Microscope	1
650nm LD Pointer	1
Mandrels 1set	1
Manuals (set)	1

## SMC Training System Add-on To OFS IV

- Single mode & multimode patchcords
  - SST-ST-PC-3-A – 1
  - SST-ST-PC-3-C – 1
  - ST-PC-3 – 1
- Rotation Stage with mounting post & XYZ positioner setup

### Options to OFS IV

FOTR1010 1550nm LD Module  
FOSM100 1300nm LED Module

FOPM102 Handheld Fibre Optic Power Meter  
Ge-850/1300/1550nm  
Connectorisation & Splicing Kit  
Fibre Optic Components & Accessories

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