

## ERBIUM DOPED FIBER AMPLIFIER AND FIBER LASER TRAINING KIT



- ✓ Comprehensive teaching & training manual
- ✓ Rack mounted components
- ✓ Eye safe connectors
- ✓ Competitive pricing

The aim of this educational kit is to familiarize students with optical components for Telecommunications (Laser diodes, optical fibers, isolators...). We propose a kit containing a laser diode pump, a multiplexer and an erbium doped fiber. With different components (attenuators, coupler, DFB laser, Bragg gratings...), it is possible to study :

- the erbium doped fiber amplifier
- the superfluorescent source
- the linear and ring laser

### COMPONENTS INCLUDED

1 Pump laser @ 980 nm, 80 mW	3 Optical attenuators (5, 10 and 20 dB)
1 Erbium doped fiber (saturation power : 10 dBm, gain : >30 dB)	1 Gold mirrored fiber end
1 DFB laser diode @ 1550 nm, 1 mW	1 Optical isolator
1 Fiber optic coupler 90/10	1 Fiber Bragg grating
2 980/1550 nm multiplexers	1 Detector : InGaAs photodiode
	9 Patchcords E2000/APC Diamond connectors

### PRACTICAL EXPERIMENTS

#### AMPLIFIER :

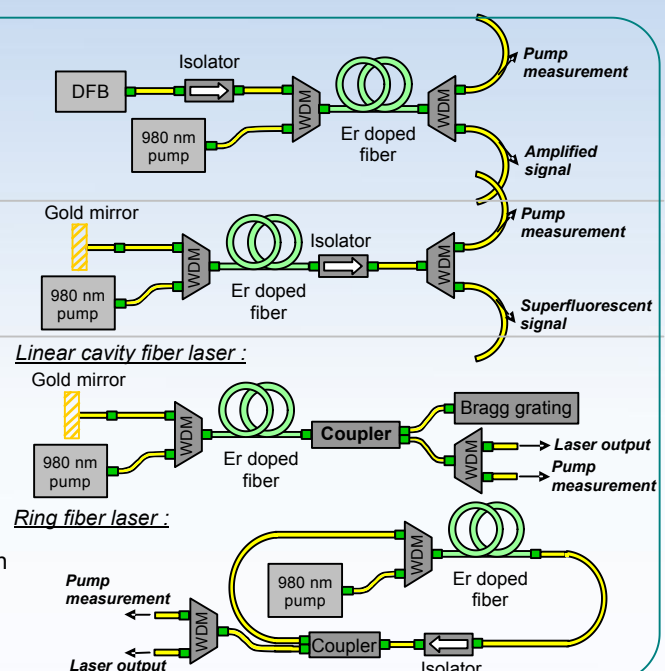
Transmitted pump  
Gain of the amplifier for different input signal levels  
Saturation power measurement  
Observation of the optical spectrum of an amplified signal

#### SUPERFLUORESCENT SOURCE :

Output power measurement  
Residual pump power measurement  
Evolution of the optical spectrum with pump power

#### FIBER LASERS :

Output power  
Laser optical spectrum for different pump power  
Bi and uni directional ring laser behaviour  
Observation of the fiber laser onset  
Measurement of the frequency of the relaxation oscillations  
Comparison of the laser onset with the field life time  
Observation of the laser behaviour for high pump modulation (2T, 3T periodic behaviour and chaotic behaviour).



## OPTICAL AMPLIFICATION :

Erbium Doped Fiber Amplifiers (EDFA) have revolutionized Telecommunications. They allow an amplification of 30 dB of optical signal without any bandwidth limitation, on a 40 nm band, centred at 1550 nm. Consequently, fiber optics Telecommunications systems can be upgraded only by changing the emitter and receiver systems. Their wide amplification band also enables the development of WDM transmission, with a capacity of up to 1 Tbits/s. Amplifiers are now the key elements of optical Telecommunications.

**i.d.i.l. Fibres Optiques** has developed a laboratory kit

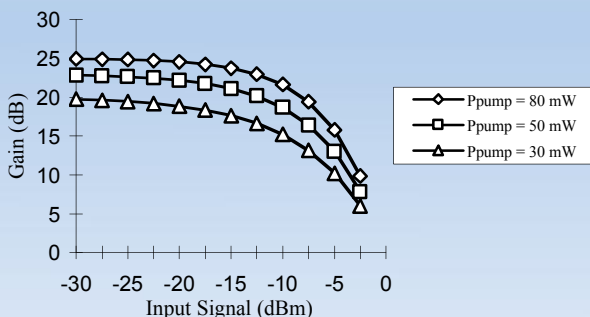
allowing a complete study of Erbium Doped Fiber Amplifiers (EDFA). Starting with the basic physical phenomena, this kit is suitable for the complete influence of many parameters such as the pump power, the input signal level on EDFA performances (ASE noise, saturation power, gain, etc...).

The kit is complete, with different components including an optical isolator, a 1550 nm DFB laser, three attenuators, a fiber Bragg grating... The documentation explains in detail the fabrication and performance of all these components. It also contains various lecture notes and practical exercises.

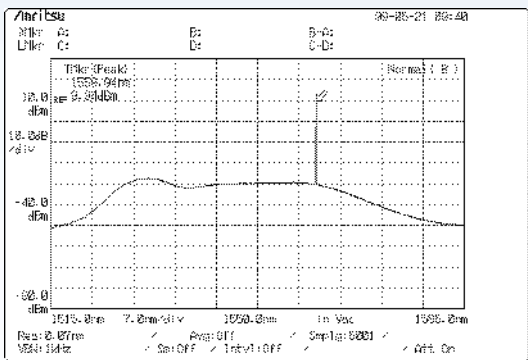
## PRACTICAL DEMONSTRATION :

With the EDFA kit, students can make a complete investigation of the basics of optical amplification, by characterizing the EDFA key parameters. Here are a few examples:

- amplifier gain measurement, in relation to the input signal
- saturation power measurement, in relation to the optical pump power.



The use of an optical spectrum analyser allows a complete study of an EDFA, by observing the evolution of fluorescence spectra for different configurations and pump power, for instance, the high wavelengths shift for a low pump power. Of course, the gain measurements are simplified.



## ERBIUM DOPED FIBER LASERS :

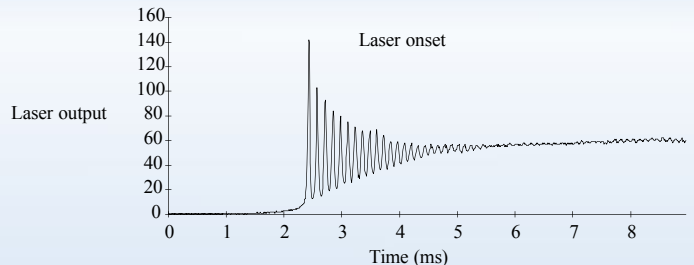
Thanks to the modular presentation of the kit, it is possible to realize many types of sources :

- superfluorescent source (ASE source)
- linear cavity fiber laser
- ring cavity fiber laser.

Pump modulation allows the study of the laser onset :

- the constant fluorescent level start-up
- the relaxation oscillations.

The observation of the various spectra enables a complete understanding of laser behaviour (fluorescence decay, saturation effects, gain or loss dependence of the working wavelength...)



## ENCLOSED DOCUMENTATION :

The documentation of the kit is really complete. It contains, a detailed description of the components, and many experimental examples.

Experimental part :

- Introduction
- Description of components
- Laser safety
- Experiments : gain, saturation power, noise characteristics, ASE noise, superfluorescent source, linear and ring lasers.

## THEORETICAL LECTURE NOTES :

- Introduction
- Theory of atoms
- Optical amplification
- Pumping mechanisms
- Amplifier noise
- Erbium doped fiber amplifiers
- Erbium doped fiber lasers