New Products

A Compact Erbium Doped Fiber Amplifier with Fast Transient Control

1. INTRODUCTION

Conventionally, high-capacity, point-to-point transmissions have been realized by the implementation of wavelength division multiplexing (WDM) systems in telecommunications trunk lines. Recently, however, such technologies as optical add drop multiplexing (OADM) and photonic cross connect (PXC) have been developed to realize the ring and mesh configuration of optical networks, thereby aiming at implementing transparent photonic networks without resort to using opto-electric conversion. Such a configuration is expected not only to improve the efficiency and reliability of transmission but also to offer more flexible services as well as to reduce the costs of investment and maintenance. Because, in such systems, dynamical switching of optical signals with arbitrary wavelengths are effected at each node, erbium doped fiber amplifiers (EDFA) employed are required to give unconventional fast response to the transient conditions. Moreover, because equipment space in the terminal offices is limited, it is essential to improve the mounting density of transmission equipment, and this raises an increasing need for compact EDFAs.

Against this background, we have developed a compact EDFA with fast transient control measuring 70 × 90 × 15 mm, the maximum compactness in the same industry. The product will be presented below.

2. FEATURES

The EDFA developed here consists of a pumping laser module and a variable optical attenuator, enabling high-performance operation with a saturated output power of not less than 17 dBm and a variable gain range of not less than 10 dB. The optics comprise a small diameter erbium doped fiber (EDF) with reduced length due to high concentration doping and downsized optical components such as compact isolator. In addition, the small package measuring 70 × 90 × 15 mm has been realized thanks to the two-stage layout for the control circuit. See Photo 1. It is possible to externally change the control mode and to monitor alarms through RS232 serial communication. The control modes include automatic gain control (AGC), automatic level control (ALC), and automatic current control (ACC), allowing the user to select a suitable mode depending on applications.

Photo 1 **Compact size erbium doped fiber amplifier with fast transient control.**

3. TRANSIENT RESPONSE CHARACTERISTICS OF EDFA

When an EDFA is not fast enough in responding to changes in the number of input channels, the output signal level shows transient fluctuations causing degradation in transmission quality in terms of bit error rate (BER) and so on. In order to maintain constant the gain for the surviving channels, it is essential to effect fast control of the pumping laser diode. Performance indexes to represent such transient response include the following three items, and the developed EDFA is satisfactory in terms of these indexes. See Table 1 and Figure 1.

1) Gain excursion
2) Settling time
3) Gain error

Table 1 **Transient response performance (at P_{out}: 17 dBm, Gain: 23 dB).**

Event type	Gain excursion	Settling time	Gain error
15 dB Add	0.4 dB	122 µs	0.36 dB
15 dB Drop	1.2 dB	118 µs	0.36 dB

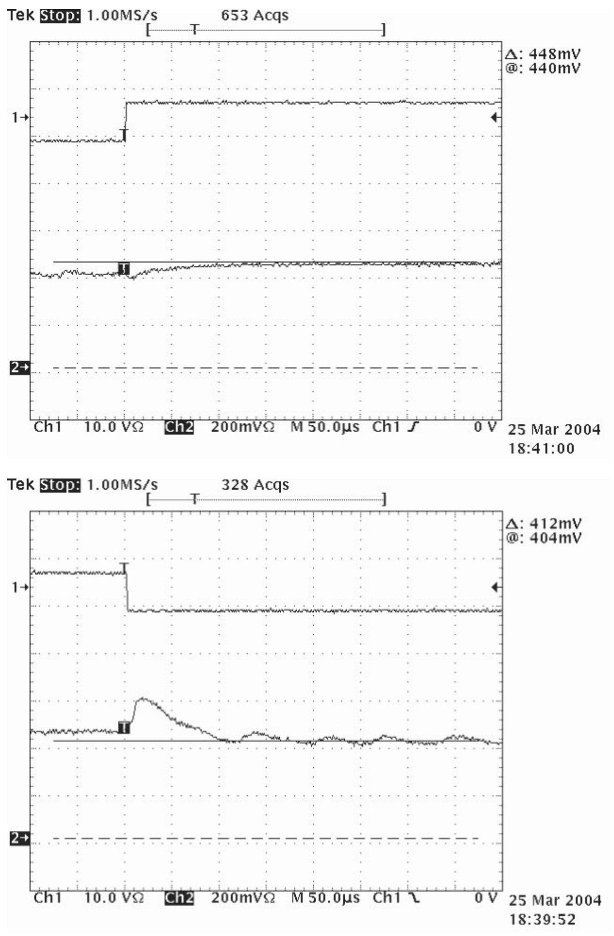

Figure 1 Measured transient response (Left: add, Right: drop).

Table 2 General characteristics of the EDFA.

Item	Specification	Note
Wavelength	C band	1530∼1564 nm
Output power	≥ 17 dBm	P_{in}=−13∼−3 dBm
Variable gain range	≥ 10 dB	
Gain excursion	≤ 1.5 dB	1⇔32 ch (15 dB add/drop)
Transient settling time	≤ 200 µs	1⇔32 ch (15 dB add/drop)
Return loss	≤ −40 dB	

4. CONCLUSION

Table 2 shows the general characteristics of the EDFA developed here. It is hoped that the product will find wide applications, making contribution to the development of photonic network.

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GLOSSARY

WDM: Wavelength Division Multiplexing
A transmission technology which enables increasing the transmission capacity of optical fibers by several to several tens times. More specifically, optical signals of slightly different wavelength are multiplexed and the multiplexed signal is propagated along a single optical fiber.

OADM: Optical Add-Drop Multiplexer
When installed at the nodes in a ring network, this optical multiplexer can add and/or drop some of the optical channels that are multiplexed by WDM.

PXC: Photonic Crossconnect
This system makes it possible to separate the optical signals transmitted from multiple fibers at the respective demultiplexers and allocate them by channel to output fibers.

EDFA: Erbium Doped Fiber Amplifier
An optical amplifier using erbium-doped fiber (EDF) pumped by a laser diode. It takes advantage of the fact that the gain band of erbium coincides with the signal wavelength band of 1.55 µm generally used for optical transmission, and that EDF is highly compatible with ordinary transmission optical fibers.