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Development of a small size of Erbium doped optical fiber amplifier

Keiichi Hara Shigeru Shikii Shusei Aoki Yasuaki Tamura Hiroshi Takano

Optohub. Co., Ltd, 305 Live Tower, 7-6-8 Bessho, Minami-Ku Saitama-City, Japan

Phone: +81-48-844-8541, Fax: +81-48-844-8902, Email: hara@optohub.com

Abstract: We have developed a small size of 45x70x12 mm and +18dBm high output power erbium doped optical fiber amplifier module with two pump lasers and a control electronics circuit.

1. Introduction

Erbium doped optical fiber amplifiers (EDFAs) have been penetrated optical communication systems in the past 10 years. Multi-channel EDFAs have provided dramatically progress of optical communication systems, especially long haul terrestrial systems and undersea systems. Single channel EDFAs are applied to metro optical communication systems and CATV systems as well. Recently the metro systems are migrating from 1 or 2.5Gb/s to 10Gb/s. The 1 or 2.5 Gb/s systems can reach to around 80km without optical amplifiers. However the 10Gb/s systems require optical amplifier(s) to reach more than several 10km. Then recently developments of 40Gb/s commercial systems have been started. The 40Gb/s systems also require single channel optical amplifiers for transmitter and/or receiver sides. Of course for CATV systems single channel EDFAs are required as well. The multi-source agreement (MSA) type of EDFAs module, whose size is 70x90x12 mm, has been already expand to mainly for single channel applications. The MSA compliant EDFA module does not have control electronics, but the MSA size of EDFA modules with control electronics have been developed and provided by several vendors. Then according to requirement of smaller-sized transmission equipment, smaller-size EDFA module is required as well, and around half MSA sized EDFA module has been already developed and started to provide [1]- [5]. As for the half sized EDFA modules, however the characteristics and/or functions are restricted due to very small size. For example the output power is limited to around +15dBm and some EDFA modules do not have input power monitoring or control electronics.

In this paper, we describe a high output power of +18dBm and small size of half MSA size (45x70x12 mm) EDFA module incorporating two uncooled pump LDs and control electronics with full function.

2. Er doped optical fiber amplifier design and characteristics

The schematic diagram of the half size EDFA module configuration is shown in Fig.1. The EDFA module incorporates two pump LDs for bidirectional pumping scheme, small size hybrid optical components and a control electronics circuit. We develop the hybrid optical components shown at inside of dash line in Fig. 1, which incorporate a tap coupler, a photo detector, an optical isolator and WDM coupler for signal and pump. The size of hybrid optical component is 15x8.5x6mm. The functions of the control electronics are "automatic constant output signal power control", "input and output signal power monitors and degradation alarms", "pump

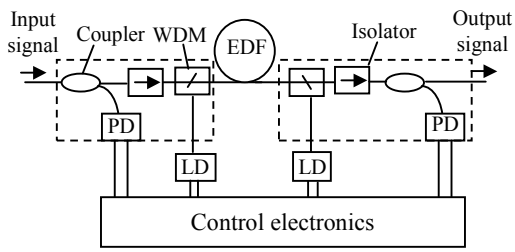

Fig. 1 Schematic diagram of the EDFA module

LD current alarm", "EDFA module case temperature alarm" and" RS232 serial communication". The RS232 interface functions are "set of output signal power", "set of alarms threshold" and "read of monitor parameters values". The electronics circuit consists of analog circuit for drive of LDs and a general-purpose microprocessor for monitors, alarms and RS232 communication. Those configuration and functions of the half MSA size EDFA module are same as a conventional MSA size EDFA module. For the package type of pump LDs uncooled mini-DIL and coaxial type are available, and for wavelengths of pump 980nm and 1480nm are available. Only in the case of bidirectional pump by using two 980nm LDs the remnant pump power should be paid attention because the remnant pump power come into the opposite side LD and may damages LD chip and make LD spectrum or power unstable. As for the EDF, conventional Si-EDF is adapted and the length is around 3m.We evaluate the half size EDFA module with 980nm forward pump of 150mW and 1480nm backward pump of 70mW, the output signal power of +18dBm is obtained at 0dBm the input signal power. The other characteristics and functions are shown in table 1. Fig. 2 shows the photograph of the half size EDFA module.

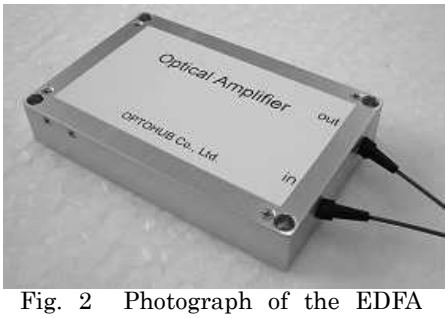

Fig. 2 Photograph of the EDFA module (Size: 45×70×12mm)

Table 1 Characteristics of the half MSA size EDFA module with 980nm forward and 1480nm backward pump

Parameter	Characteristics	Note
Number of pump LD	2	Uncooled type
Pump wavelength	980nm and 1480nm	980nm forward and 1480nm backward pumping
Signal wavelength	1530nm-1565nm	
Output signal power	+18dBm	At 0dBm input signal power
Noise figure	5dB	
Power supply	3.3V or 5V	
Size	45×70×12mm	
Alarm functions	Loss of input signal, Loss of output signal, LD current alarm, EDFA case temperature alarm	
Monitor functions	Input and output signal power, LD current, EDFA case temperature	
Control functions	Constant output signal power control, Pump LD on/off	
Serial communication interface	Set of output signal power and alarms threshold, read of monitor parameters	RS-232

3. Conclusion

We have developed the half MSA size of EDFA module, which incorporate two uncooled pump LDs for high output power of +18dBm, full function of input and output monitors and alarms enough for single channel applications, and control electronics with RS232 serial communication interface.

References

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