STUDY ON THE PERFORMANCE CHARACTERISTICS OF ERBIUM-DOPED FIBER AMPLIFIER FOR C AND L-BAND

This thesis is presented in fulfilment of the condition for the award of the

Bachelor (Hons) in Electrical Engineering

UNIVERSITI TEKNOLOGI MARA

MOHAMED ARSHAAD SOBRATTEE
Faculty of Electrical Engineering
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR

ACKNOWLEDGEMENT

First and foremost, thank God for giving me spiritual, intellectual and physical strength to complete this project.

My gratitude goes to my supervisor for final year project 1 & 2 (EEE690) Pn.Mas Izyani Md Ali for her precious advice and guidance.

A special thank goes to my family and friends for their never-ending support in all aspect.

Lastly, I would like to thank all people who have helped me directly or indirectly in completing this project.

ABSTRACT

In this project, the performance characteristics of Erbium-doped fibre amplifier (EDFA) in C-band (1520- 1555nm) and L-band (1560- 1610nm) are theoretically investigated. Several configurations were designed in order to determine these characteristics. The components involved in the set-up configurations are assembled and simulated using a software called OptiSystem.

The first configuration designed was used to determine the optimum length of EDF in both C and L-band. For the L-band, the optimum length of EDF was found to be 10m and for C-band, the optimum length was observed to be in the range from 4m to 8m.

The most suitable pumping scheme for EDFA was determined with the help of three configurations. These configurations are namely forward, backward and bi-directional pumping architecture. From the results obtained from simulation of these configurations, it was found that bi-directional exhibits the highest signal gain as well as appropriate noise figure (NF) value, which falls in the acceptable range for EDFA which is 6 to 8dB [6].

Finally, a single-pass configuration using bi-directional pumping was designed to analyse the performance characteristics of EDFA. The performance characteristics include usable input power (P_{in}), signal gain (in dB), NF (in dB) and the pump power at which gain saturation start to occur. The usable P_{in} was found to be in the range from -20dBm to -8dBm. At input signal power of -20dBm, a maximum signal gain of 39.55dB is obtained at 1530nm. Moreover, the noise figure recorded is less than 6.78dB within the wavelength region from 1520 to 1610nm. Lastly, gain saturation starts at 30mW of pump power for C-band using both 980nm and 1480nm.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.0 BACKGROUND OF STUDY

In today's world, the use of fibre optic has outrun the use of electrical cable (copper wires) in the communication sector. This is due to the numerous advantages that fibre optic has over copper wires; one of it is that optical fibres provide much less attenuation and interference than copper wires. This is the reason why many telecommunication companies use optical fibre to transmit telephone signals, Internet communication and cable television signals [2].

Modern fibre-optic communication systems generally include an optical transmitter to convert an electrical signal into an optical signal to send into the optical fibre, a cable containing bundles of multiple optical fibres that is routed through underground conduits and buildings, multiple kinds of amplifiers, and an optical receiver to recover the signal as an electrical signal [2].

To overcome the attenuation or the loss in strength of the transmitted signals, the use of optical amplifiers is very useful, helpful and is strictly recommended. Erbium-doped Fibre Amplifier amplifies the optical signal directly without having to convert the signal into the electrical domain. It is made by doping a length of fibre with the rare-earth mineral erbium, and pumping it with light from a laser with a shorter wavelength than the communications signal, typically 980 nm [2].

In this project, the performance of Erbium-doped fibre amplifier for C and L-band is investigated. The range of input wavelength used is 1520 to 1610nm which covers both the C and L-band together with 980nm pump laser.