INVESTIGATION OF MULTIWAVELENGTH FOR MULTI FREQUENCY RANGE OPTICAL LASER DRIVER

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This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Telecommunication Electronics) With Honours.

Faculty of Electronic and Computer Engineering

Universiti Teknikal Malaysia Melaka

June 2012

UNIVERSTI TEKNIKAL MALAYSIA MELAKA

FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN

PROJEK SARJANA MUDA II

Tajuk Projek : **INVESTIGATION OF MULTIWAVELENGTH FOR MULTI FREQUENCY RANGE OPTICAL LASER DRIVER**

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Prepared : NOOR AZILA BINTI AMAT PUADI.

Date : 15th JUNE 2012

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Prepared : MR FAUZI BIN ABDUL WAHAB.

Date : 15th JUNE 2012.

To my beloved mother and father,
my family, Mr Fauzi bin Hj Abd Wahab and all my friends…

ACKNOWLDGEMENT

Special thanks to Allah S.W.T for His gift because spare my life so that I can have and done my Projek Sarjana Muda 2 (PSM 2) and make this report. This report represents the so much effort of many people, all of whom have contributed in some way to make it as good as it can be. First of all I would like to take this opportunity to thanks my supervisor, Mr Fauzi bin Hj Abd Wahab, which always guide me and share his value knowledge with me to complete this project. He helped me very much on explaining and teaches me with full commitment and dedication in order for me to understand. His contributions and personal sacrifices are truly appreciated and will be well remembered.

On the other hand, I would like to express my appreciation to my friends especially my classmate who shares their knowledge with me. With assistances I am able to do research PSM 2 successfully and learning something that out of my league especially the mechanism part.

Lastly, I like to extend appreciated to my parents with support and all lovely family for their support and encouragement. Thank you.

ABSTRACT

This project is about investigation of multiwavelength for multifrequency range optical laser driver. Transmitter circuit consist light source such as LED and laser (pointer or diode). The laser light is considering as the output that need to be measured using power meter through fiber optic cable. From power meter we set the variation of wavelength and then obtained the value power of tern of dB, dBm and Watt. This project is to investigate and study the characteristic of light from laser or led with two inputs Vcc and frequency. The frequencies need to vary and are tested around 3 GHz and input voltage are fixed. Different value of frequencies will give different result and from there, analyzed the performance of the result, is it can be maintain and stabilizes the output voltage, current and power.

ABSTRAK

Projek ini adalah mengenai kajian multigelombang untuk multifrequenci pemandu laser optik pelbagai. Litar pemancar terdiri sumber cahaya seperti LED dan laser (penunjuk atau diod). Cahaya laser dianggap sebagai output (keluaran) yang perlu diukur menggunakan meter kuasa melalui kabel gentian optik. Dari meter kuasa kita menetapkan kepelbagaian panjang gelombang dan kemudian mendapat kuasa nilai dalam terma dB, dBm dan Watt. Projek ini adalah untuk menyiasat dan mengkaji ciri-ciri cahaya dari laser atau led dengan menyambungkan dengan dua input Vcc dan frekuenci. Frekuensi yang dipelbagaikan diuji sekitar 3 GHz dan voltan input adalah tetap. Nilai frekuensi yang berbeza akan memberikan hasil yang berbeza dan dari hasil, menganalisis karakter keputusan, sama ada ia boleh mengekalkan dan menstabilkan arus keluaran voltan, elektrik dan kuasa.

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LIST OF SYMBOLS AND ABBREVIATIONS

A	–	ampere
V	-	voltage
C	-	coulomb
cm	-	centimeter
F	-	farad
f	–	frequency
GHz	-	gigahertz
Hz	-	hertz
I/O	-	input/output
k	-	kilo
kHz	-	kilohertz
kΩ	-	kiloohm
M	-	Mega
MHz	-	MegaHertz
MΩ	-	Megaohm
mA	-	miliampere
mm	-	milimeter
m/s	-	Meter per seconds
cm	-	centimeter
W	-	Watt
dB	-	decibel
dBm	-	decibels of the measured power referenced to one milliwatt (mW)

CHAPTER 1

INTRODUCTION

This chapter will discuss about the introduction, objectives, scope and methodology of the project.

1.1 Introduction

Laser and laser driver have been widely used in engineering field over this past year. The process which makes lasers possible, Stimulated Emission, was proposed in 1917 by Albert Einstein. No one realized the incredible potential of this concept until the 1950's, when practical research was first performed on applying the theory of stimulated emission to making lasers. It wasn't until 1960 that the first true laser was made by Theodore Maimam, out of synthetic ruby. But before the build of laser (Light Amplification by the Stimulated Emission of Radiation), there was maser (microwave amplification by stimulated emission of radiation) that been invented by Charles Townes and Arthur Schawlow in 1954. Maser was created using ammonia gas and microwave radiation - the maser was invented before the (optical) laser. The technology is very close but does not use a visible light. The maser was used to amplify radio signals and as an ultrasensitive detector for space research. Then in 1958, Charles Townes and Arthur Schawlow theorized and published papers about a visible laser, an invention that would use infrared and/or visible spectrum light, however, they did not proceed with any research at the time. Nowadays, there are many applications that need laser to complete the process. But not all places use the same or type of laser. Even it used the same material of laser but it has different specification and parameters. So, to make laser operation are can be vary and adjust, laser driver need to be attached at laser device.

A typical optical communication system has three main components: a transmitter, a transmission medium, and a receiver. This basic structure of the system resembles conventional electronic communication systems. The difference is that optical communications use optical signals as a carrier of information instead of using electronic pulses to transmit information through copper wires. The transmitter is composed of optical sources such as a laser or a light emitting diode (LED) and driver circuits. Semiconductor lasers are currently the main light output source in high-speed applications. The laser driver circuit is one of the key components because it performs as the interface between the electronic devices and the optical devices and, as such, affects the performance of the entire optical communication

system. Its design, although simple in concept, is very challenging because of the difficulty of determining specifications that accommodate both large output current and operation at high-speed. To determine these design constraints a general understanding of the system into which the laser driver integrates is necessary.

In this project laser driver was designed that can adjust the operation of a laser of multi wavelength of (650nm – 1550nm) and multi frequency max RF range; (f≈3G Hz) with using the minimum voltage of 5-6V. The main objective is to design laser driver with light source and need of high current.

Nowadays many fields like engineering, medical and food use laser in their process. By developing this laser driver it can be used everywhere and without damage the component used because of the low power consumption. As example if we placed the laser driver at open location, the solar are used to help operate the laser driver and if been placed near the river, we can used turbine to operate the device.

Lasers are devices that produce intense beams of light which are monochromatic, coherent, and highly collimated. The wavelength (color) of laser light is extremely pure (monochromatic) when compared to other sources of light, and all of the photons (energy) that make up the laser beam have a fixed phase relationship (coherence) with respect to one another.

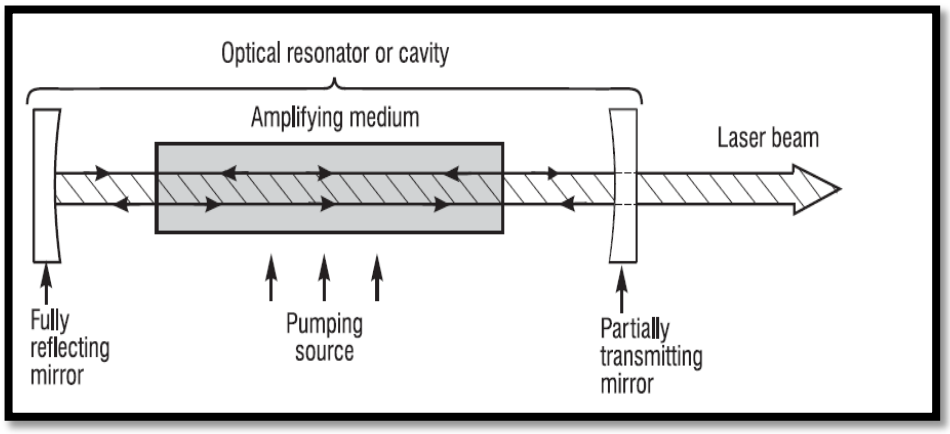

Figure 1.1: Basic Component of Laser [14]

Laser driver is a device that can adjust the operation of a laser of multi wavelength of (650nm – 1550nm) and multi frequency max RF range; (f≈3G Hz) with using the minimum voltage of 5-6V. The main objective is to design laser driver with light source (LED) and need of high current.

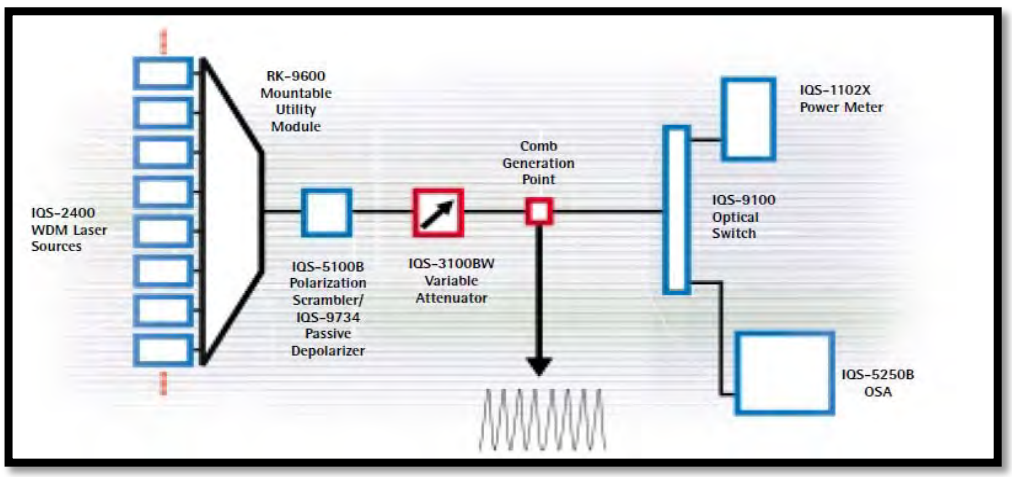

Figure 1.2: Multi Wavelength Laser [15]

1.2 Objective:

1. To investigate about the laser operation in different parameter.
2. To investigate laser driver with:

    a) Multi wavelength capability
    b) Multi frequency capability
    c) Low power consumption

1.3 Problem statement:

- To exist laser driver that are designed for specific range.
- For laser driver that drive with low voltage is very hard to achieve and to obtain output with multi-wavelength.
- Design a laser driver to obtain output multi-frequency signal width with that need to be featured with the above point requirement.

1.4 Scope of Project

1. Literature review of laser driver operation
2. Circuit simulation for laser driver
3. Analysis circuit to get simulation results by OptiSystem sofware
4. Construct the laser driver circuit
5. Testing the circuit
6. Verification- Compare the circuit with simulation and test the equipment by taking all the readings
7. Troubleshooting

1.5 Methodology

This project begins with the research of the proposed title. The result of that research is then discussed with the supervisor. Once the title of project was approved, the background of study for this project was explored as stated in the literature review.

OptiSystem was chosen as the software to design the laser driver. Then, the circuits' simulation was performed. In the other hand, the instruction programmed also being built for the interfacing part. After all the design is meet the requirement and specification, it may proceed with the hardware development.

If the hardware are completed the troubleshooting took part to resolve the problems faced and been experimental if the hardware result and similar and precise to the simulation. But for hardware part the project also can be trying using Protues software.

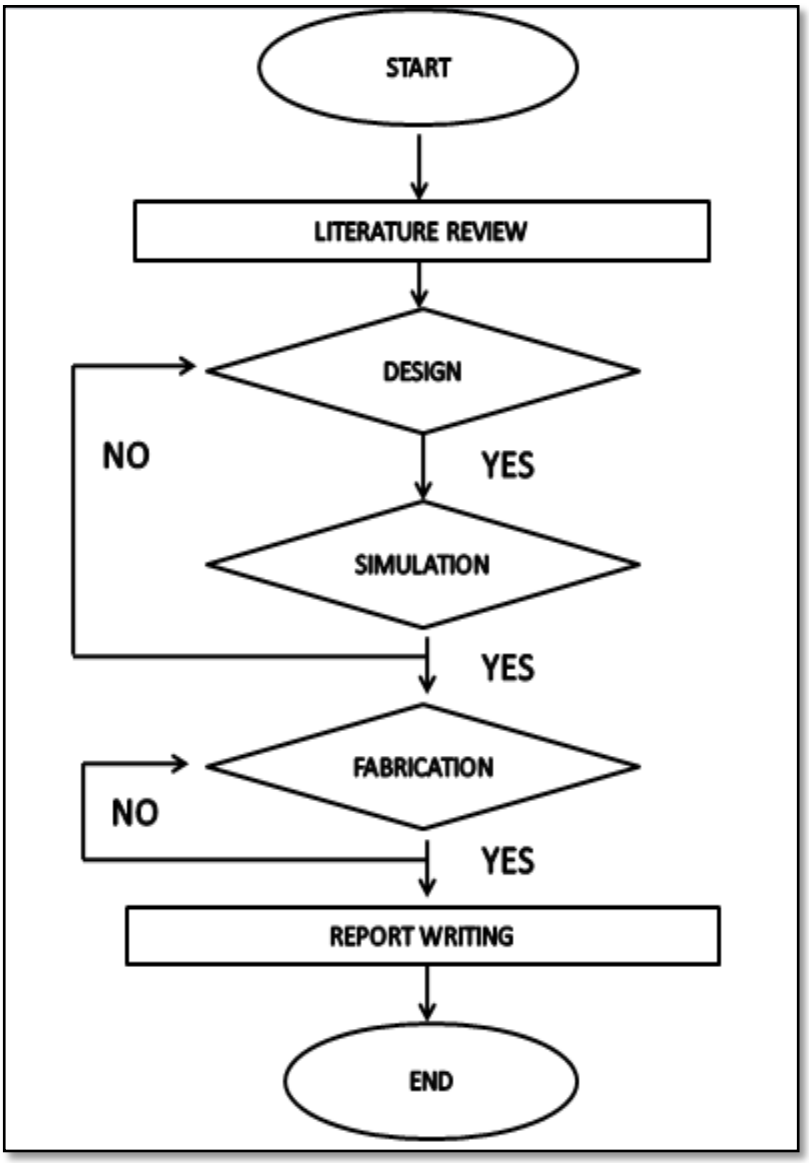

Figure 1.3: Project Flowchart