

Dedication

I dedicate this thesis to my parents, to my wife Dalia to my son Ahmed and to those whom I love.

A acknowledgments

To my supervisors, to the staff of laser institute, to the staff of Sudan Atomic Energy Commission (SAEC), to the staff of instrumentation center , to all those who had been of great help to me through my studies whatever kind of help.

I would like here to express my gratitude and appreciation for their aid and guidance.

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Abstract

In the recent years semiconductor laser substitute the others types of laser in many fields and that is due to it is simplicity and easy to use.

The main idea of this thesis is to design and construct of laser diode driver. Digital technique was used for driving the laser diode instead of the analogue traditional one. Digital technique offer the accuracy beside the tunability of the laser diodes, so with the same driver it is possible to drive different laser diodes which have different specification. The circuit was able to drive the laser diodes fall in the range form 1m watt to 1 watt power or that have wavelength range from infra red to ultra violet region. Replacing laser diode can be done just by some change in software with out need to touch any things in the hardware.

To achieve this goal an interface card was used beside the main driver circuit, which enables the personal computer (PC) to control the laser diode operating current and other parameters. One of the important parameters that affects the radiated output power of the laser diode is the

temperature .Through this design the PC is able to protect the radiated output power of the laser diode from fluctuating , all this can be done through what is known as closed loop control. In which the PC loads the diode laser with the suitable operating current and then waiting for the data coming from the feed back circuit to decide either to increase or decrease the operating current. Most of the laser diodes now days come with a photodiode attached with it. The photodiode represent the essential part in the feedback circuit, which give a good indication for the emitted power of the laser diode. The main objective of this design is to have a constant radiated power and to eliminate the negative affect of the increasing of the temperature.

الخلاصة

في الاونة الاخيرة حلت ثنائيات الليزر بديلا لكثير من انواع الليزرات فى كثير من التطبيقات الطبية والصناعية وغيرها وذلك لبساطتها وسهولة استعمالها و قلة تكلفتها مقارنة بالانواع الاخرى.

تقوم الفكرة الاساسية لهذا البحث على تصميم وبناء دائرة الكترونية تعمل كمشغل لثنائى الليزر. ولقد تم اتباع الطريقة الرقمية لتنفيذ هذا التصميم بدلا عن الطريقة التماثلية التقليدية. وتعتبر الطريقة الرقمية ذات ميزات عديدة اهمها الدقة مع امكانية التحول من ثنائى ليزر الى اخر مختلف عنه فى المواصفات .حيث يمكن للدائرة تشغيل ثنائيات الليزر التى تعطي قدرة تقع فى المدى ما بين 1ملى واط وواحد واط ولها طول موجى يقع فى المدى من الاشعة تحت الحمراء الى الاشعة فوق البنفسجية . التغيير من ثنائى ليزر الى اخر يتم دون الحاجة الى تعديل المكونات او قطع الالكترونية الموجودة بالدائرة وإنما يكون التعديل فقط بالبرمجيات المصاحبة للدائرة الالكترونية. ولتنفيذ هذه المهمة تم استعمال كرت موائمة مع الكمبيوتر الشخصي بالاضافة لدائرة المشغل الاساسية وذلك لتمكين الكمبيوتر من التحكم فى تيار التشغيل الخاص بالثنائى.

تعتبر درجة الحرارة من اهم العوامل المؤثرة فى الطاقة الاشعاعية الناتجة من الثنائي فعن طريق هذا التصميم يمكن للكمبيوتر حماية الليزر الناتج من التذبذبات التي تحدث نتيجة للتغيير الذى يحدث فى درجة الحرارة وذلك فى اطار ما يعرف بدورة التحكم المغلق. فى هذه المنظومة يتم ادخال تيار التشغيل الى الكمبيوتر عبر لوحة المفاتيح ومن ثم يقوم الكمبيوتر بتحميل التيار المعني عبر كرت الموائمة الى دائرة المشغل الرئيسية. يتم بعد ذلك استخدام تقنيات التغذية العكسية باستخدام محسس الليزر الذي ياتي كجزء اساسي من ثنائي الليزر. الوظيفة الاساسية لدائرة التغذية العكسية انها تغذي الكمبيوتر بما يفيد زيادة او نقصان الطاقة الناتجة من الثنائي ومن ثم يقوم الكمبيوتر بالتحكم فى تيار التشغيل بالزيادة او النقصان .وبهذا يكون الغرض الاساسي من هذا التصميم هو الحصول على طاقة اشعاعية ثابتة من ثنائي الليزر لا تتاثر بأرتفاع أوأنخفاض درجة الحرارة.

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