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Control Prototype Excitation Laser Diodes Using Differencial Pair Transistor Configuration And Interface.

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Abstract: This paper describe the design and construction of a electronic prototype of system control power of laser diodes, specifically the design mainly on the laser diode whose wavelength is 532 nm and the beam is visble spectrum, and the use a photodiode in the same wavelengh. Mainly the power stability of the laser diode this based on the ***If*** current flowing through the photodiode, and likewise: If the transmission power of the laser diode increased o viceversa. The power control by the user will be monitored by an interface with a microcontroller together will be used to maintain the required power using the configuration Par Differential of the bipolar transistors. Finally to through this configuration we can power control of the diode laser, varying the voltage of one of the transistors of the array

Keywords: *- Control, Diode Laser, Excitation, Transistor.*

I. INTRODUCTION

The development of this work is considered based on the results obtained by using the photothermal techniques, to determine the response of certain materials to the emission of laser light modulated in amplitude that of different wavelengths at powers between 5 and 10mW.Also making use of a driver which uses a bipolar transistor and using a piezoelectric sensor response was observed in amplitude and phase with respect to frequency with an acceptable degree of stability [1], as demonstrated by the tests performed with this sensor, this images presented in the chapter on Design and Construction Prototype of this article. The specific purpose is presented in the article is the optical power control (excitation laser diode) using a configuration as shown in Figure 1 (a) and 1 (b).

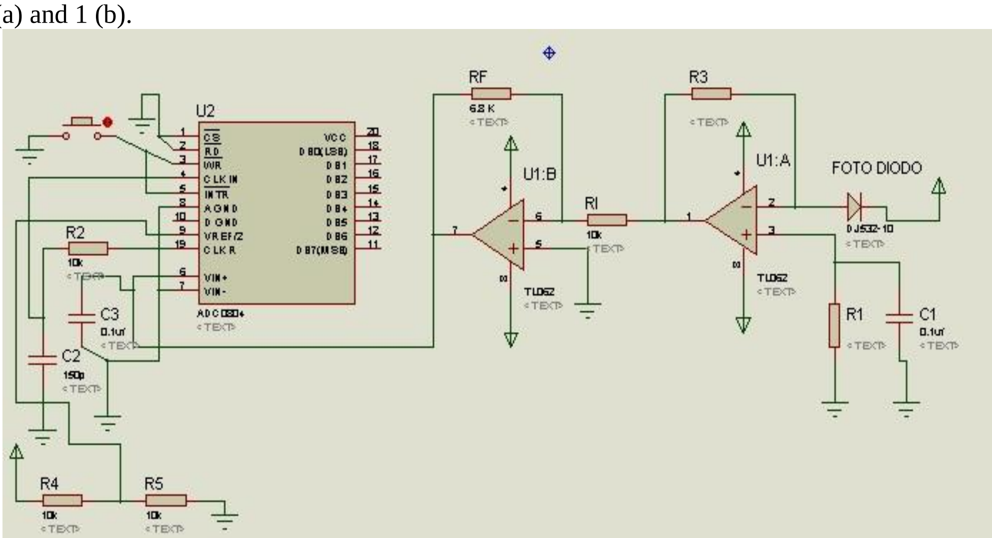

Figure 1 (a).Control of the optical power using the photo diode diagram.

The diagrams in Figures 1 (a) and 1 (b) are a simulation prototype to be developed for photothermal applications development, in this development used an analog to digital converter ADC0804 with intent to propose that new students entry into the engineering involved on this kind of development, and to visualize, understand the converter´s configuration with a practical method of successive approximation analog-to-digital conversion [2], among other things as the development of free software.

II. NON-DESTRUCTIVE TESTING

One of the main objectives of the development is considered and the prototype design and development of new materials evaluation to determine which kind of properties are necessary to characterize. The evaluations are common these materials prove in different tests to modify the form and composition, resulting in the production of new materials [3]. Nondestructive testing is any type of evaluation which is not permanently changes on physical, chemical, mechanical and dimensional properties of materials. The objective of these tests is to provide information about the characteristics of the materials.

In recent years there has been the development and consolidation of a number of experimental methods for the nondestructive characterization of thermo physical, optical and structural properties of matter, which are called photothermal techniques [4].

Derived from the importance of the analysis of the photothermal phenomena, the main objective of this work is focused on controlling the excitation laser diode and Beam splitter using the light beam division is performed to the photo diode and in turn to the sample to be analyzed .See Figure 2.

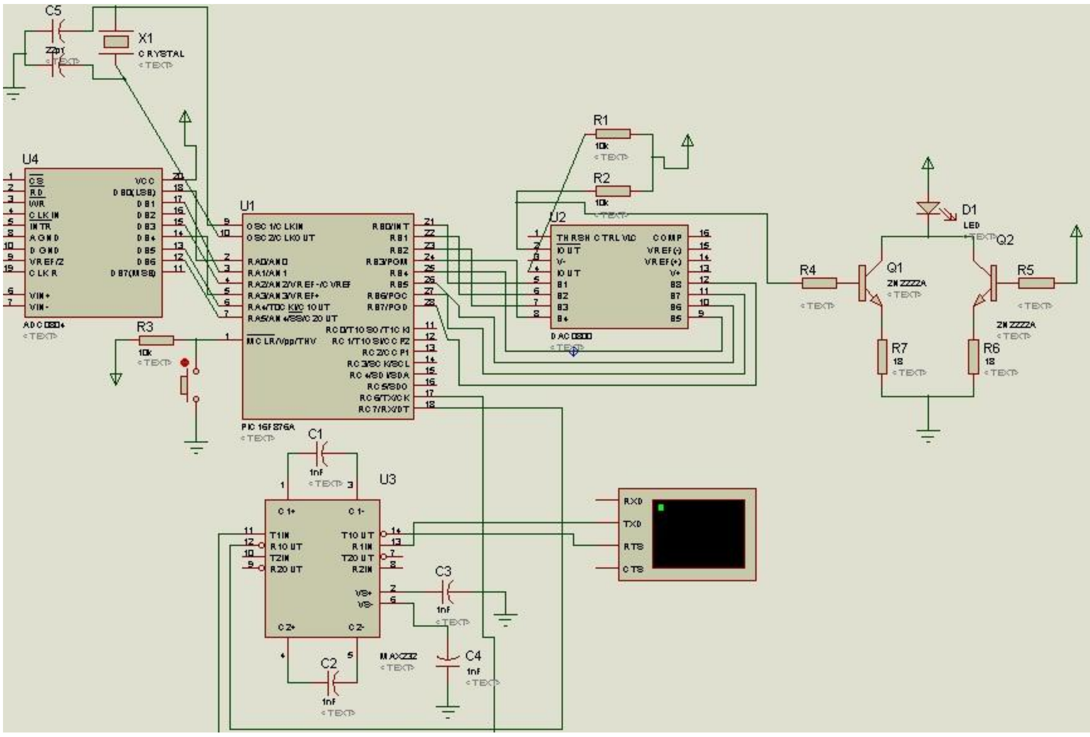

Figure 1 (b). Optical power control as a function of voltage applied to the differential pair diagram.

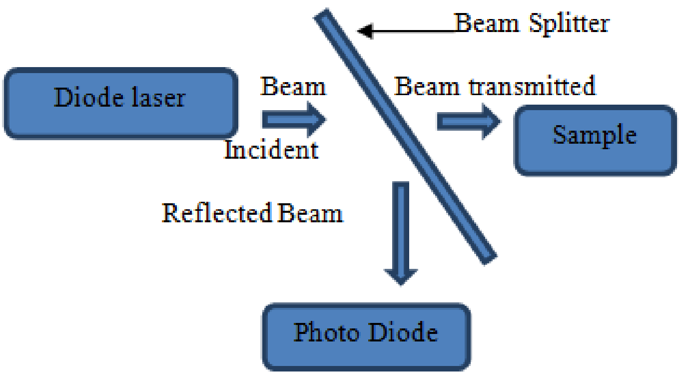

Figure 2. Experimental setup for nondestructive testing

III. DESIGN AND ANALYSIS OF PROTOTYPE

Design and construction Electronic Prototype was developed according to the following parameters;

1. Power Laser Diode
2. Operating Temperature.
3. Wavelength.
4. Operating current.
5. Operating Voltage.

In our case we chose the laser diode DJ532-10, one of the most important for controlling excitation laser characteristics is the current, in this case the diode reaches its operating area to 157mA.

This is because depending of the electrical characteristics of laser photodiode, and as the design of the differential pair with bipolar transistors 2N2222A was developed the following analysis;

First we have the current "If" flowing through the photodiode is increased if the transmission power of the laser diode is increased in the case of the first output voltage operational. U1:A (TL062)depends by the current "If" flowing through the photodiode and the feedback resistance, display the equation 1:

$$V_{sal} = -RI_f \qquad (1)$$

If R would have to be very large output voltage would be given by Equation 2:

$$V_{sal} = -\left[R_1\left(1+\frac{R_2}{R_3}\right)+R_2\right]I_f \qquad (2)$$

But we can make the value of the output voltage with the resistance to the positive input of the operational configuration current to voltage.

Also occupy the operational U1: B (TL062) with this configuration because the inverter output voltage is negative first operational.

The feedback resistor"Rf" of operational inverters configured on 6.8K as this value is obtained for the voltage range between 0 and 3V.At this early stage we can use an analog-digital converter (ADC0804) with a resolution of 8 bits. The configuration of this permit that the reference voltage is selected using a voltage divider and the sampling frequency too, which will be used by default settings uses this converter (150pF and10k).

For the PIC16F876 microcontroller was programmed using visual programming PIC microcontrollers. This receiving the digital equivalent of the value obtained from the ADC0804 voltage by operational sending by U1: B (TL062), and is send to the PC, the microcontroller USART setting for this operation.

When the interface receives the data by the generated virtual COM port RS232-USB adapter. It is shown in the interface developed in the Java programming language as shown in Figure 3. Importantly, using the interface can choose the intensity of optical power while monitoring the intensity of the optical power emitted by the laser diode and photodiode together with said optical power is regulated.

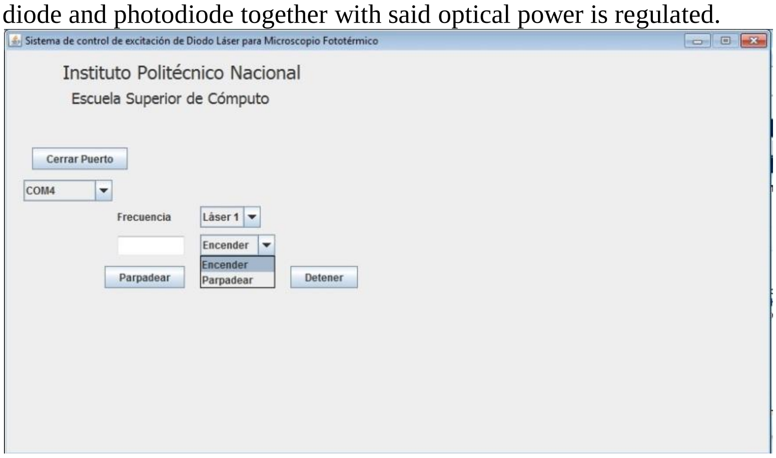

Figure 3. Interface for controlling excitation of 532nm laser diode

Finally, it is required an analog digital converter DAC0800, for the voltage to regulate the current "ID" flowing through the laser diode, so then the design is described for regulating the current in the laser diode;

For emitter current one has to;

$$\begin{aligned} I_{E1} &= I_{B1} + I_{C1} \\ \text{Sabemos que} &: I_{C1} = \beta I_{B1} \\ &= I_{B1} + \beta I_{B1} \\ I_{E1} &= (1+\beta) I_{B1} \end{aligned} \qquad (3)$$

Where in the term β Beta is the Transistor 2N2222A.

$$-V_{B1} + R_{B1} I_{B1} + V_{BE} + R_{E1} I_{E1} = 0 \qquad (4)$$

Whereas in equation 3, the emitter current I_{E1} is defined in terms of the base current I_{B1} and manifold I_{C1}, And substitute this we have equation 4 that the current of the base I_{B1} of the first transistor is defined as shown in Equation 5.

$$I_{B1} = \frac{V_{B1} - V_{BE}}{R_{B1} + R_{E1}(\beta + 1)} \qquad (5)$$

Given that the Base Resistance R_{B1} is unknown, we can substitute in equation 5, being expressed R_{B1} terms as shown in equation 6, substituting the values in each term of Equation 6.

$$R_{B1} = \frac{5V - 0.7V - (201)(\frac{100\ mA}{200})(18\,\Omega)}{\frac{100\ mA}{200}} = \frac{2.491\ V}{0.5\,mA} = 4.982\ K\Omega \approx 4.7\,K\Omega \qquad (6)$$

Current base I_{B1} is expressed by beta, and the collector current I_{C1} as indicated in Equation 7.

$$I_{B1} = \frac{I_{C1}}{\beta} = \frac{100\ mA}{200} \qquad (7)$$

In the case of the second transistor, the equation representing the branch of the voltage drops is expressed as shown in Equation 8.

$$-V_{CC} + V_D + V_{CE} + R_{E1} I_{E1} = 0 \qquad (8)$$

Figure A symmetry in the configuration of the transistors Q1 and Q2 is observed, as well as having the same value of resistance in the emitter R_{E2}, so we can get the value of R_{B2}, from equation 9.

$$R_{B2} = \frac{5V - 0.7V - (201)(\frac{57\ mA}{200})(18\,\Omega)}{\frac{57\ mA}{200}} = \frac{3.26\,V}{0.285\ mA} = 11.4\,K\Omega \approx 12\ K\Omega \qquad (9)$$

Importantly, for the current I_{B2} is considered sufficient;

$$I_{B2} = \frac{I_{C2}}{\beta} = \frac{57\ mA}{200} = 0.285\ mA \qquad (10)$$

IV. OBTAINED AND EXPECTED RESULTS

In Figure 4 the system is presented in amplitude modulation laser diodes for applications photothermals, also you can choose the oscillation frequency control for laser diodes, it is clear that in this article only the design and simulation of this is shown new phase of the project is to control excitation of a laser diode to regulate the optical intensity of this to be used in photothermal techniques in specific use with a photothermal microscope [5].

In figure 5 the stability curve presenting the driver when the laser diode is modulated in amplitude is shown. Also we can see the behavior of the driver in amplitude and phase with respect to frequency.

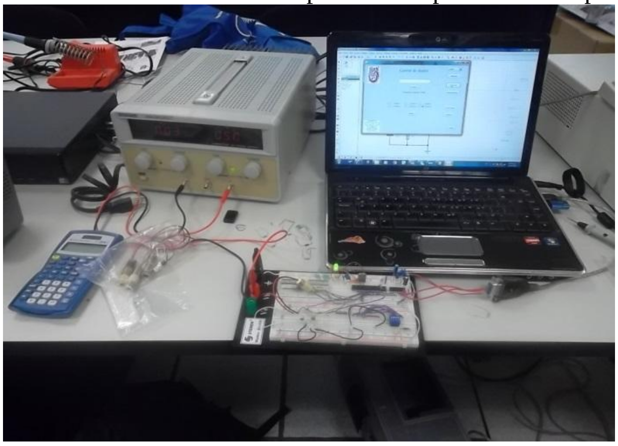

Figure 4. Interface and control circuit diode laser excitation.

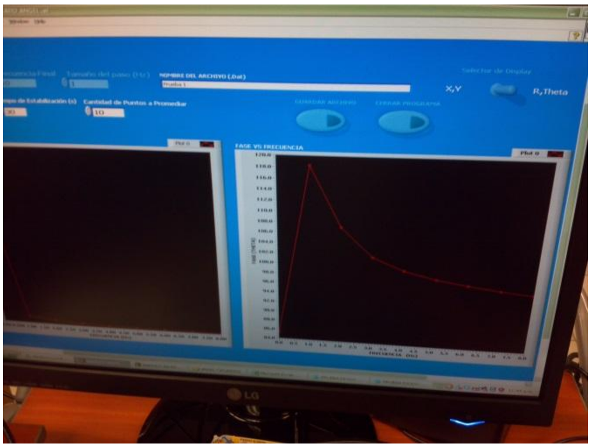

Figure 5.Driver for modulation and excitation laser diode.

V. CONCLUSIONS

We conclude that the design of electronic prototype is calculated and analyzed in terms of the electrical characteristics of both the laser diode and the photodiode, adjusting to changes in voltage due to the increase of temperature in the laser diode device, it is important to note that with calculation development may involve changes in current through the effects of temperature for the case study would be minimal because the optical powers with which we work are within ranges of 5 to 10mW.

Another situation that is important to discuss is the development of free software with improvements to the design view- controller can have a reliable interface on their performance. Note that most institutions use software interfaces for owner, this situation creates that developments are only valid in the environment for businesses that generate this product.

Finally we can say that polarizing inversely photodiode can get a current when excited by light emitted by the laser diode, this would be faster if a switching device will be used as it does iC-HK and iC -WK, this would benefit speed changes in optical intensity of the laser diode.

REFERENCES

[1] E. Kannatey-Asibu, Principles of laser materials processing, John Wiley & Sons, 2009, p. 174.

[2] Bueno Gimeo, Enrique." Diseño de un Convertidor Analógico-Digital de Aproximaciones Sucecivas de bajo consumo y area reducida. Austria microsystems. Universidad Politécnica de Valencia.

[3] J.Baggio,J.M. Rainsant, C D`hose P. Lalande, O.Musseau. J.L. Leray" Comparison of Laser Diode Response to Pulsed Elcetrical and Radiactive Excitations". IEEE Transaction on nuclear science, vol.43, no.6, december 1996.

[4] Plimmer, M.D.; du Colombier, D. Iraqui Houssani, N." Apparatus to measure adsorption of condensable solvents on technical surfaces by photothermal deflection".Review of Scientific Instruments. Vol. 83. Issue:11.IEEE.

[5] V ; Chirtoc, M. ; Wubbenhorst, M.R. ; de Wit, J.H.W." Photothermal imaging of localized delamination between organic coatings and metallic substrates using a scanning photopyroelectric microscope" Journal of Applied Physics Vol.93, Issue:4. IEEE.