

2016 International Electrical Engineering Congress, iEECON2016, 2-4 March 2016, Chiang Mai, Thailand

Development of laser driver for gauge block interferometer

Sakchai Chomkokard^a, Noparit Jinuntuya^a, Wiwat Wongkokua^{a*}

^a*Department of Physics, Faculty of Science, Kasetsart University, Bangkok 10900, Thailand*

Abstract

Gauge block plays an important role in dimensional metrology as a standard for calibration. There are several techniques to calibrate gauge block, one of which is an optical method, such as, Michelson interferometer. The interference pattern is recorded for gauge block comparison. The stability of light source is important for the calibration. In this work, we developed a reliable constant current control circuit of 7 mW laser diode for the gauge block interferometer with a closed-loop feedback temperature control, which utilized the advantage of an embedded system. A PID controller was used to maintain the temperature at 25.0 °C within ± 0.5 °C of uncertainty. We tested the system for 60 minutes by monitoring the stability of the laser wavelength. The results showed that the wavelength of the laser was unstable during the first 20 minutes before becoming constant at 655.525 nm.

© 2016 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the Organizing Committee of iEECON2016

Keywords: gauge block; laser driver; interferometer; PID controller

1. Introduction

In everyday life, the length measuring instruments are widely used. In general, range and accuracy are key factors to choose an instrument. The accuracy of instruments can be realized and verified by a calibration process. For basic calibration of length, gauge blocks supply standard values for direct calibration of instruments such as caliper and micrometer. Not only instruments have to be calibrated but also the gauge blocks. Gauge block interferometer is one of high accuracy method that utilizes the interference of laser for calibration. Hence, the laser source is an important part of the interferometer.

* Corresponding author. Tel.: +662-562-5555 ext 3671; fax: +662-9428029.
E-mail address: wiwat.w@ku.ac.th

Semiconductor laser diode has many advantages such as small in size, light, cheap and longest service life¹ in comparison to gaseous, liquid and other solid-state lasers. However, it also has a drawback in wavelength. The laser diode wavelength is affected by the unstable of temperature and current². For this reason, development of laser diode driver to stabilize wavelength is necessary to improve the performance of gauge block interferometer.

To regulate constant current, the driving circuit of the laser diode has to be stable and low noise. The operating point of the laser diode can be disturbed by noise. The instrument operational amplifier (op-amp) can solve the noise problem because the advantage of low power integrated circuit³. To control temperature of laser diode, proportional integral derivative (PID) method will be used instead of the standard proportional integral (PI) for flexible adjustment.

2. Materials and Methods

2.1. Constant Current Circuit Design

Schematic diagram of the constant current circuit can be shown in Fig. 1. The circuit consisted of two main op-amps. One was OP07; low input offset voltage and low noise, which was connected to the voltage control current at the non-inverting input pin. From this voltage controlled input, the current was adjusted to the designed level, and the output of this op-amp was connected to drive current on KPS42, the current control transistor. Another op-amp was INA121 which current level depended on its voltage gain (G) parameter. The current value can be calculated by

$$i_L = \frac{V_{in}}{GR_2} \quad (1)$$

where i_L is the current level of the laser diode and R_2 is the resistance between inverting and non-inverting inputs of INA121. With constant G , the current was adjusted by the voltage controlled input and the voltage regulator 7805 with the large capacitance output $C4$ (4700 μ F) leading to stable voltage then the constant current was achieved.

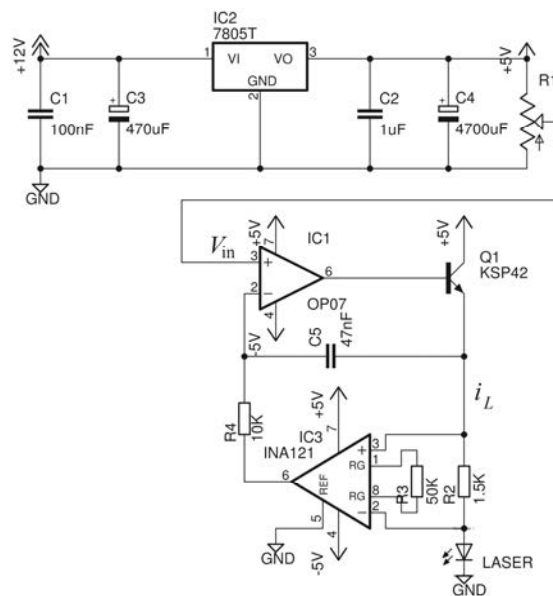


Fig. 1. Constant current circuit with voltage input adjusted current level, V_{in} , from the output of 7805

Download English Version:

<https://daneshyari.com/en/article/486913>

Download Persian Version:

<https://daneshyari.com/article/486913>

[Daneshyari.com](https://daneshyari.com)