

**Product Group:** Vishay Foil Resistors

## Highly stable, low-noise current source for laser diode



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The Solid State Sciences department at the Ghent University, Belgium, developed a highly stable, low-noise current source to drive a conventional laser diode

**Industry/Application Area** Equipment requiring highly stable laserlight or current sourcing

**Products Used** VSMP2512 100R and 10R, 0.25%  
Accutrim™ 1280G trimming potentiometer

### The Challenge

The objective was to develop a highly stable, low-noise current source to drive a conventional (red) laser diode. Because the laser light was used to measure the Kerr effect at microwave frequencies, extreme stability was required (e.g. to avoid mode-hopping noise and get the laser diode in single longitudinal mode).

### The Solution

The choice for driver topology was straightforward, as sketched in Figure 1. Care had to be taken that the feedback resistor was connected using a Kelvin-connection, since the copper PCB trace has a higher temperature coefficient (TC) than the resistor. The voltage reference used was a MAX6350 from Maxim Integrated Products. The potentiometer was an Accutrim™ 1280G, also from VPG. The operational amplifiers are OP213s, which are specified to have an offset drift of  $0.2 \mu\text{V}/^\circ\text{C}$ . Under normal operation this would equate to around  $0.2 \text{ ppm}/^\circ\text{C}$ .

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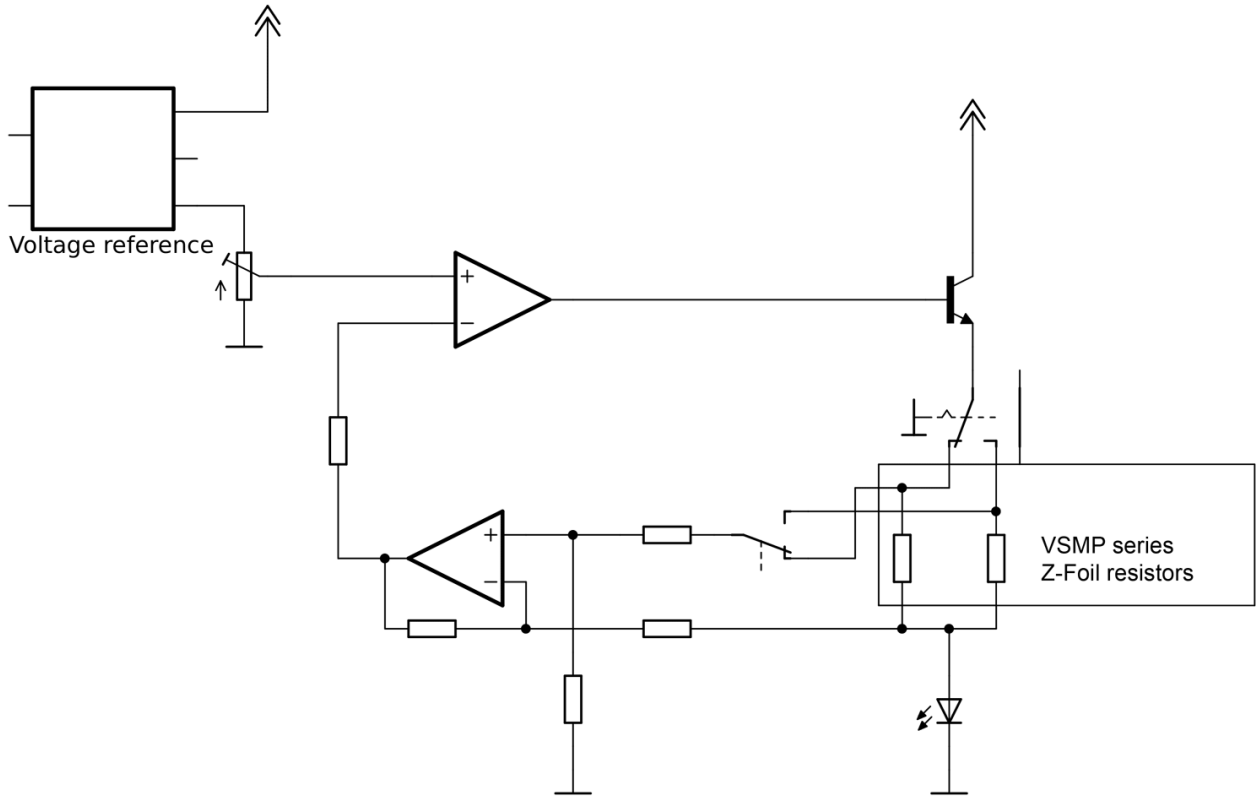


Figure 1: Schematic that was used for the current source

## The User Explains

The major sources of thermal drift would be the feedback resistors of the differential amplifier (10 ppm/°C for each resistor) and the voltage dividing potentiometer. Using anything other than VPG Z-Foil resistors would directly deteriorate the TC to unusable values.

Two different resistors were used to get two different tuning areas. The 10 Ω resistor would give an upper current limit of 100 mA, the 100 Ω resistor only 10 mA. This allows current in the lower range to be set more accurately, without excessive self-heating in the high current range.

The design and construction were verified using a standard LED as the load. The current through the LED and the setpoint voltage were monitored as a function of the temperature. To this end, the PCB (see Figure 2 for the first prototype) of the current source was encased in a heating mantle to gently and slowly warm it up.

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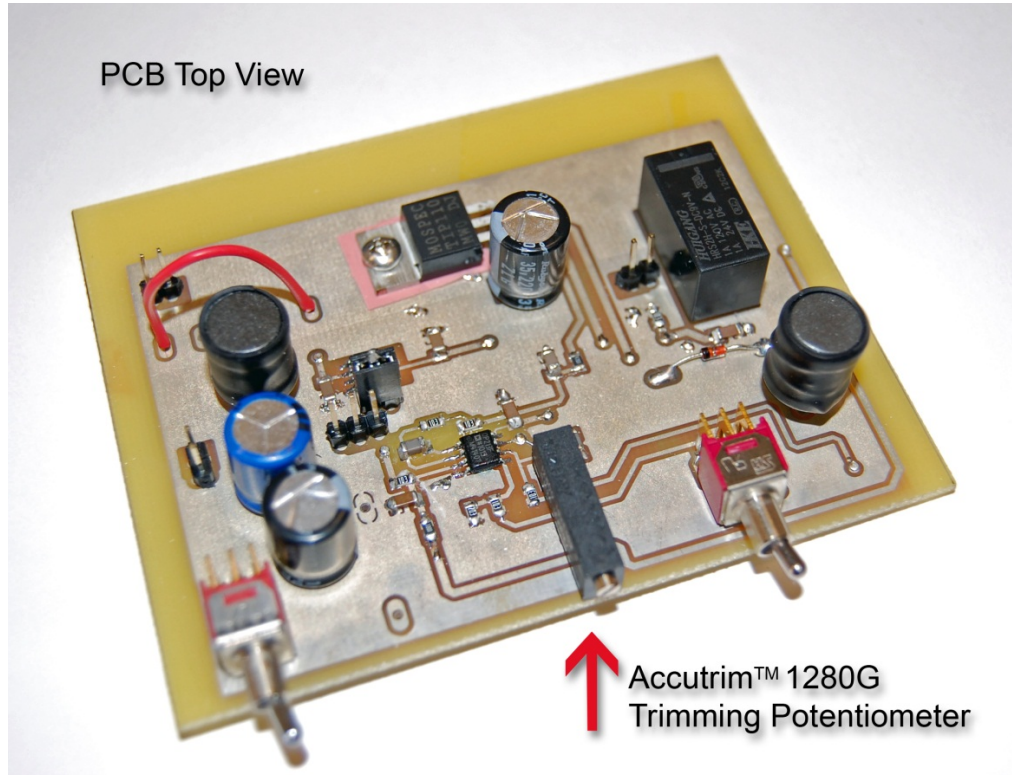
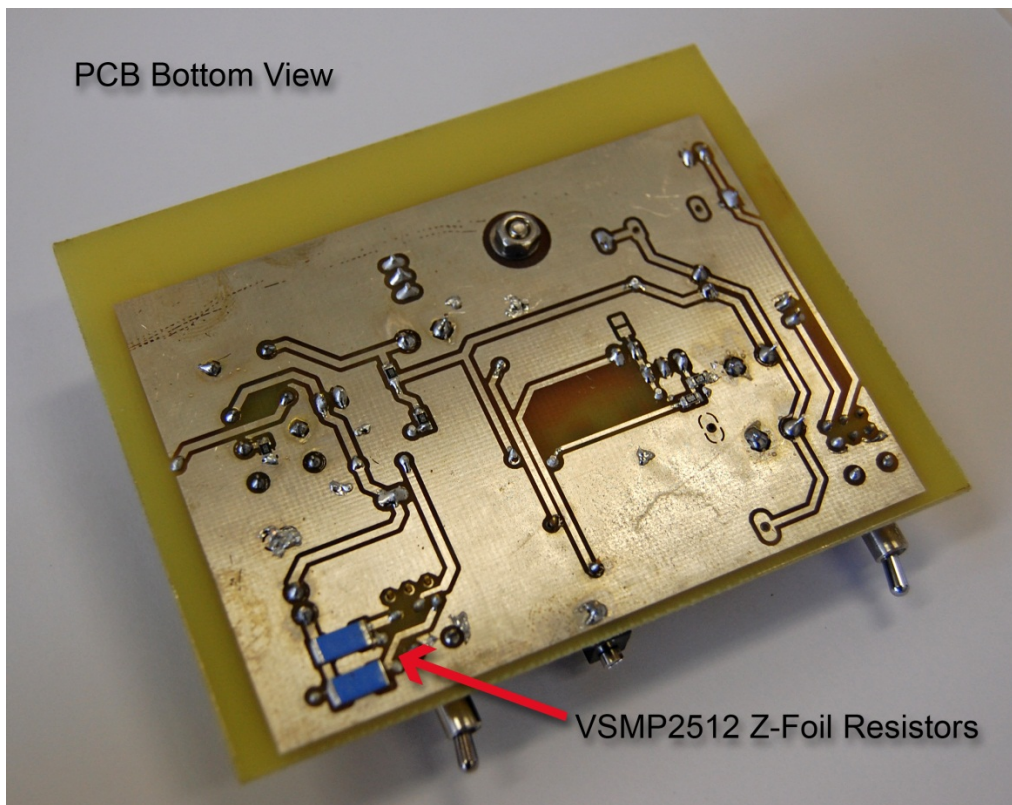


Figure 2 Photograph of the first prototype



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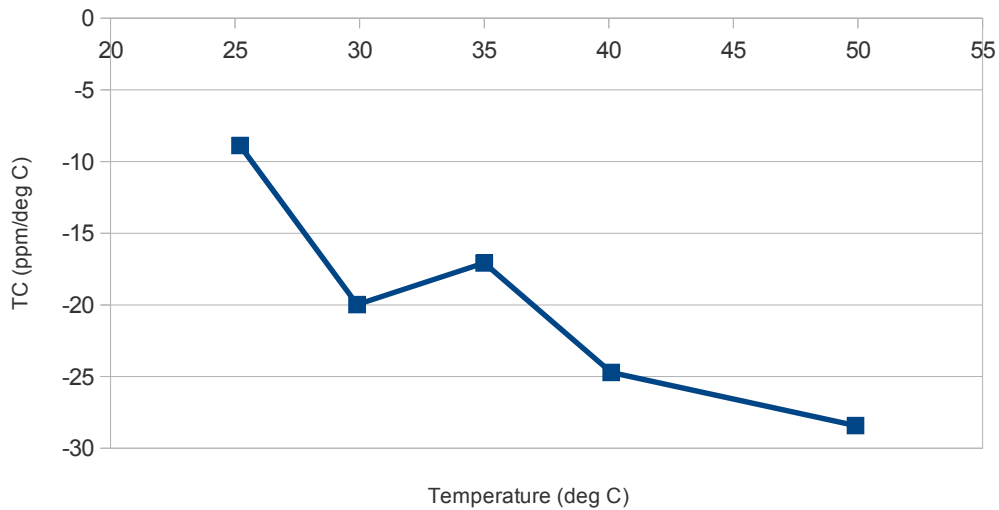


Figure 3: The evolution of the temperature coefficient as a function of the temperature

Figure 3 depicts the change in the output current as a function of temperature (relative to the temperature difference, i.e. ppm/°C); thus it represents the sum of all the factors that contribute to the TC of the entire circuit. The Z- Foil resistors inherently feature low TCR (Temperature Coefficient of Resistance). Using standard resistors would add to the accumulated TC of the circuit, with severe deterioration as a result. Even resistors with a TCR of 10 ppm/°C would double the resulting TC at room temperature.

***“VPG Z-Foil resistors are unique in enabling low drift current sensing. Their extremely low temperature coefficient enables the low drift current sources necessary for stable diode lasers.”***

**Acknowledgment** – the VSMP samples were provided by UHP Resistors Inc; Vishay Foil Resistors' (VFR) authorized precision center located in California, which ensured fast delivery of small quantities of Bulk Metal® Foil resistors with any value/tolerance combination. Shipping small quantities in five days or less, the precision centers trim each resistor to the precise value ordered giving the designers the exact resistor they need in the shortest time possible.

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