Project title: Driver and controller for a thermoelectric cooler

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Abstract

This project is about analysis, simulation, design, and construction of a driver and controller for a thermoelectric cooler (TEC). The design is based on a TEC model and has been verified by SPICE simulation. The project includes hardware construction and testing of a prototype.

Key words
Thermoelectric, Stable temperature, TEC, SPICE model

Overview

Most of the solutions for maintaining a stable temperature work only in one direction – they can heat or cool the object, but not both. Obviously this is not the best solution for systems that need very accurate and stable temperature; for example, in laser technologies a 0.1˚C variation can prevent it from working properly.

The Thermoelectric cooling device (TEC) is based on the Peltier effect—passing a current through the TEC makes it colder on one side and hotter on the other. Moreover, if we change the direction of the current, it automatically changes the hot and the cold sides, so if we could control the current flow we could easily control the temperature of the object.

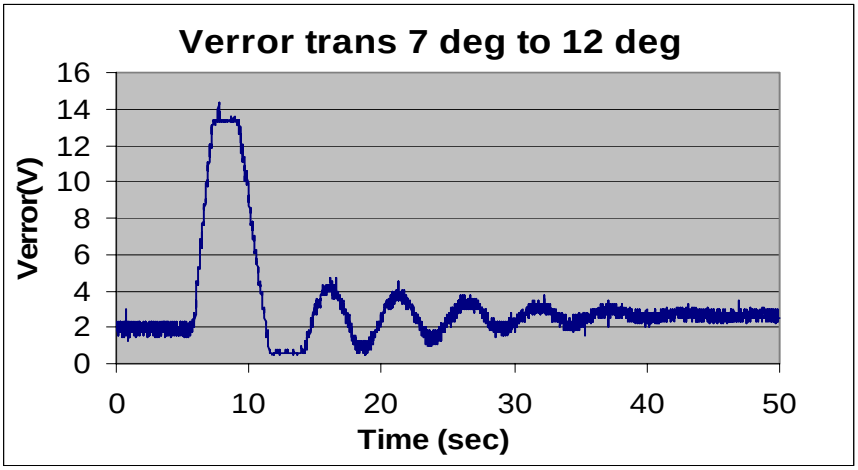
My system controls the direction of the current flow and, by using PWM, controls the power to the TEC. By using two PWM controllers, I can control each side (cooling/heating) of the PWM and by that, control the power.

The system decides if we need to heat or to cool the object and also looks for the amount of power that it will need in order to stay at a stable point, meaning a stable temperature not dependent on the environment.

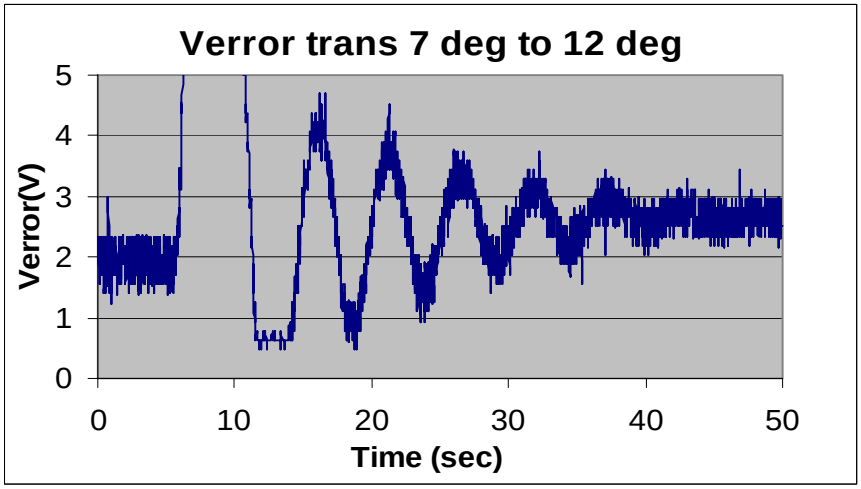
While designing the system I have used the SPICE model that was developed at the Department of Electrical and Computer Engineering at Ben-Gurion University, in order to design the system as a stable closed-loop reaction.

The results

Change the temperature of the load

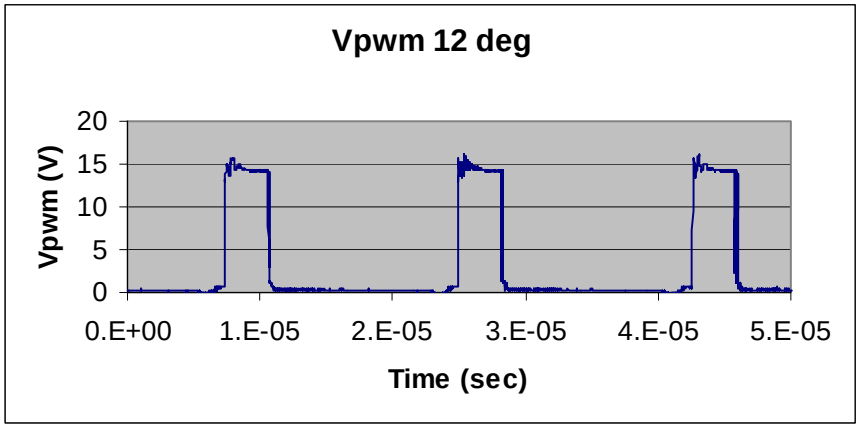


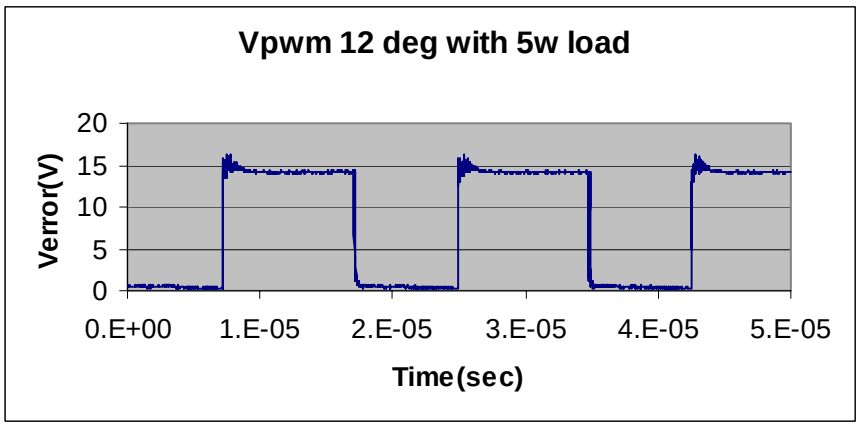
Full scale of Verror



Part scale of Verror

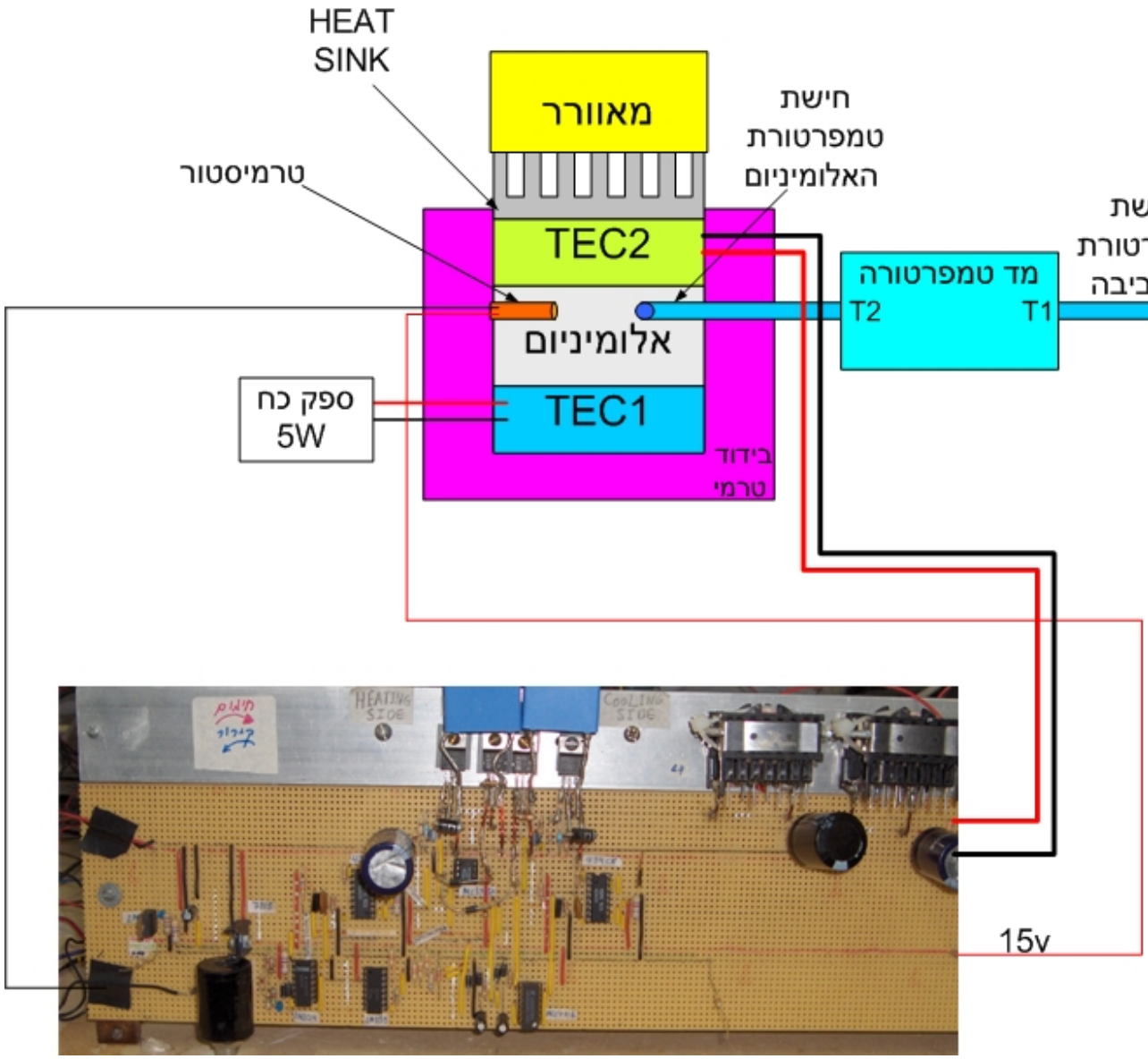
We can see how the system finds a new stable point of work. At a different level of Verror, which mean different pwm for the load.
With a change in the power of the load from 0 to 5w, the temperature of the load stays the same.





As we can see, the system finds a new PWM working point in order to “take out” the heat that enters the system from the load.

In order to maintain the same temperature, the system needs more power in creating the same temperature difference between the two sides of the TEC.


HEAT
SINK
מאוורר
חישת
טמפרטורת
האלומיניום
טרמיסטור
חישת
טמפרטורת
הסביבה
TEC2
מד טמפרטורה
T2
T1
אלומיניום
ספק כח
5W
TEC1
בידוד
טרמי
15v