Instituto Politécnico Nacional

Ingeniería en Sistemas Computacionales

Laboratorio de Instrumentación

Práctica N° 5 Acondicionamiento de termopar tipo K.

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Objective

The student will implement the signal conditioning of a K type thermocouple considering its main characteristics and a specific measurement range.

Equipment employed

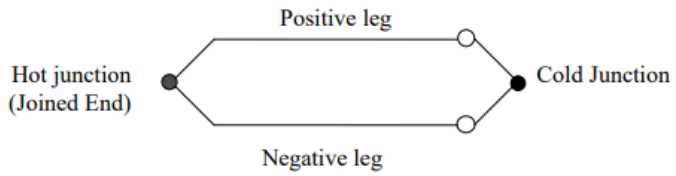
- Computer
- Software tool for electronic circuit simulation (Multisim or PROTEUS).
- Internet connection.

Introduction

What is a thermocouple type K ?

First we are going to introduce what is a thermocouple, in 1821 Thomas Seebeck identified that by joining the ends of two metals of different materials, where each junction had a different temperature, a current was created. This phenomenon is called the Seebeck effect and is the basis of thermocouples.

Therefore a thermocouple is a type of temperature sensor that is manufactured by joining two different metals at one end. The former is called a hot junction and the latter a cold junction.On the other hand, it is important to mention that the voltage it produces is very small and is measured in mV.



All thermocouples have a corresponding color code according to the ANSI standard.

Metal based thermocouples are classified as E, J, K, T and N, but in this practice we will focus on the k type whose characteristics are mentioned below.

The type K thermocouple refers to any temperature sensor with a positive leg of Chromel and a negative leg of Alumel (nickel, 5% aluminum and silicon). It is recommended when there are oxidizing and completely inert environments and it should not be used in sulfurous atmospheres, in a vacuum or in oxygen-poor environments.The temperature range for Type K is -200 to 1260°C and its wire is primarily available in two color codes: yellow and red per ANSI/ASTM E230 or green and white per IEC 60584.

How does a thermocouple work?

The basic design of a thermocouple involves two dissimilar metal wires, each with different electrical properties at different temperatures. The two metals are in contact touching, twisted, or welded at one end; this is the measuring point. At the other end is the connection point, so called because it connects to the voltage reader. When the temperature changes at the measuring point, so does the electron density of each metal wire. This varying electron density is the voltage, which is measured at the connection point.

the type k thermocouple has a positive conductor of niquel-chrome and a negative conductor of niquel-aluminium. This is one of the cheapest and most common of all thermocouples, but is less precise than others.

Development

1. Construction of the signal conditioning circuit

In the circuit simulation software tool, assemble the circuit in Figure 1 using a K-type thermocouple and the appropriate amplifier circuits to operate with the configuration shown, then determine the measurement range and sensitivity of the sensor based on the voltage values to be measured.

Note that the temperature measured by the sensor must be gradually modified until the circuit delivers an output voltage ranging from 0 to 5 V.

Therefore, the value of the temperature measured by the sensor must be adjusted until the output voltmeter indicates the 0 V and 5 V levels for the lower and upper limit of the measurement.

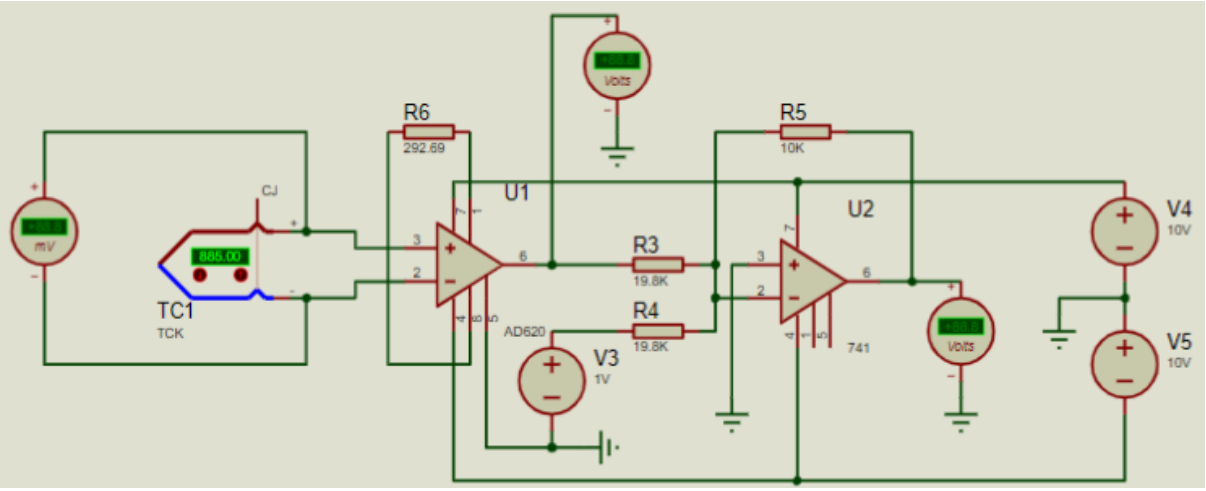


Figure 1.

The sensitivity value will be obtained based on the minimum and maximum values of the voltage delivered by the sensor, within the measuring range, which will be measured with the voltmeter connected to the thermocouple output. Record your results in Table 1.

Vout (V)	**Range (°C)**	**Vsensor (mV)**
0	**Lim. inf.** = -207	-5.99
5	**Lim. sup.** = 1303	52.5

Table 1. Measurement range

The sensitivity value can be calculated using the following equation

$$S = \frac{V_{sensor(L.S.)} - V_{sensor(L.I.)}}{Alcance}$$

$$S = \frac{52.5x10^{-3}-(-5.99x10^{-3})}{1303-(-207)} = 0.0000387$$

Questionnaire

1. What is the working principle of a thermocouple?
   The Seebeck, Peltier and Thompson effect.
2. List some applications for a thermocouple.

- Household appliances, where thermistors are not enough.
- Manufacture of food and beverages.
- Manufacturing and testing of pharmaceutical and medical supplies

3. What are the main characteristics of a type K thermocouple?
   a. The range between -200 C° to 1250 C°
   b. Composition of Niquel-Chrome and Niquel-Aluminium
   c. Colors: Positive-Yellow, Negative-Red
4. What is the usefulness of the color code for thermocouples?

The color code is used to recognize the type of thermocouple, the material of fabrication and specific properties.

Conclusions

This practice was simple, the only thing that seemed curious to us is that the output voltage was negative, and it was interesting to note that for 5v a very large amount of temperature is necessary

References

https://www.pyromation.com/Downloads/Doc/Training_TC_Theory.pdf
https://www.omega.com/en-us/resources/k-type-thermocouples
https://blog.wika.us/products/temperature-products/how-do-thermocouples-work/
https://dewesoft.com/es/daq/temperatura-medicion-termopar-sensores#applications
https://jemartermometria.com/blog-de-jemar-termometria/identifica-el-codigo-de-colores-para-termopares