

Lab Work No. 2: PT100 Temperature Sensor

Lab Work Objectives

- 1) To familiarize students with electrical circuits.
- 2) To understand the operating principle of this type of sensor.
- 3) To study the characteristics of a PT100 temperature probe (sensor).
- 4) To determine the characteristics of a PT100 probe used as a temperature sensor.

Equipment

This laboratory work is carried out using Proteus simulation software. The sensor used is the RTD-PT100 available in the Proteus component library.

II.1 Introduction

Temperature is one of the most important physical quantities measured in industrial processes, energy systems, and scientific applications. Temperature sensors are used to measure temperature variations and convert them into electrical signals that can be processed by measurement and control systems.

The **PT100 is a Resistance Temperature Detector (RTD)** made of platinum. Its operating principle is based on the variation of the electrical resistance of platinum with temperature. The PT100 has a nominal resistance of (100Ω) at (0°C). As the temperature increases, its electrical resistance increases in a predictable manner, allowing temperature to be determined by measuring its resistance.

The relationship between resistance and temperature can be approximated by the following equation over a limited temperature range:

$$R(T) = R_0[1 + \alpha(T)]$$

Where:

- $R(T)$: Resistance of the PT100 sensor at temperature T , in ohms (Ω).
- $R_0 = 100 \Omega$: Resistance of the PT100 sensor at 0°C.
- $\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$: Temperature coefficient of platinum.
- T : Temperature in degrees Celsius ($^\circ\text{C}$).

For a PT100 sensor, the equation becomes: $R(T) = 100 \times (1 + 0.00385 \times T) \Omega$

For example, at 100°C: $R(100) = 100 \times (1 + 0.00385 \times 100) \Rightarrow R(100) = 138.5 \Omega$

This means that the resistance of the PT100 increases from 100 Ω at 0°C to approximately 138.5 Ω at 100°C.

In this laboratory work, the PT100 temperature sensor is studied using Proteus simulation software. The simulation allows students to observe the variation in the sensor's resistance as a function of temperature,

understand its operating principle, and investigate its main characteristics. A digital ohmmeter is used to measure the resistance corresponding to different temperature values.

This practical work helps students understand the behavior of resistive temperature sensors and the importance of accurate temperature measurement in instrumentation and measurement systems.

II.2 Experimental Procedure

Implement the circuit shown in the figure below using Proteus simulation software. The required components can be found in the Proteus component library by searching for the following keywords: RTD-PT100, Ohmmeter, and Digital Multimeter. Assemble the circuit according to the schematic diagram shown below.

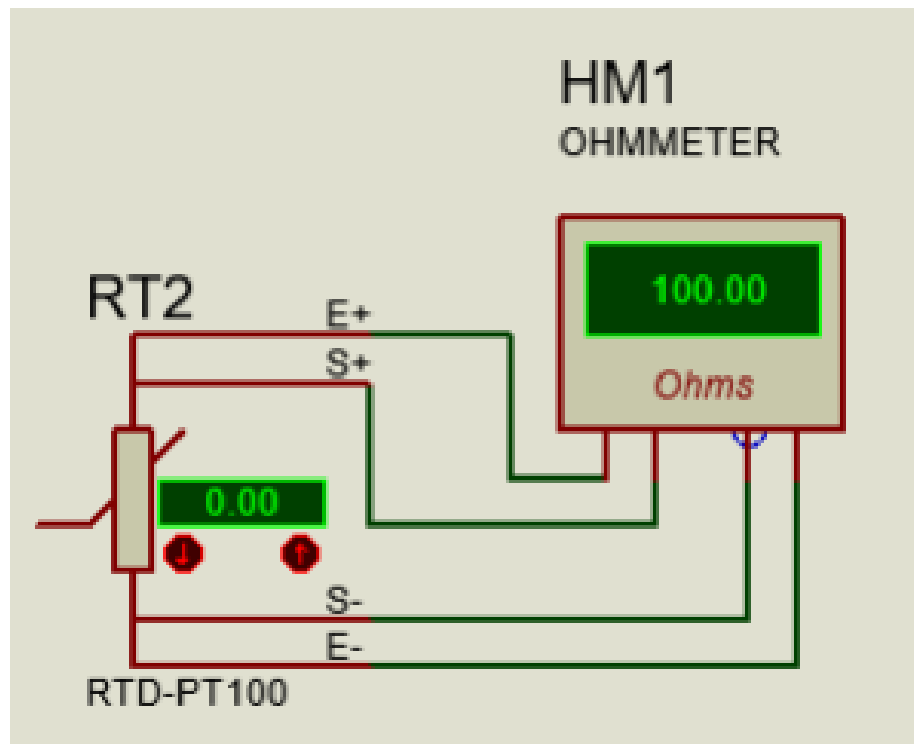


Figure II.1: PT100 Resistive Temperature Sensor Measurement Circuit.

The Proteus circuit consists of the following components:

- 1) Platinum temperature sensor (PT100): It senses the heat transferred from the power transistor through the panel. The temperature is controlled using the temperature controller, which operates over a range of 0 to 100°C.
- 2) Digital ohmmeter: It is used to measure and display the resistance of the platinum PT100 sensor.

The PT100 parameters must be configured in the following window. Set Temperature Set-point to 10°C and Actual Temperature to 0°C, as shown in the following figure.

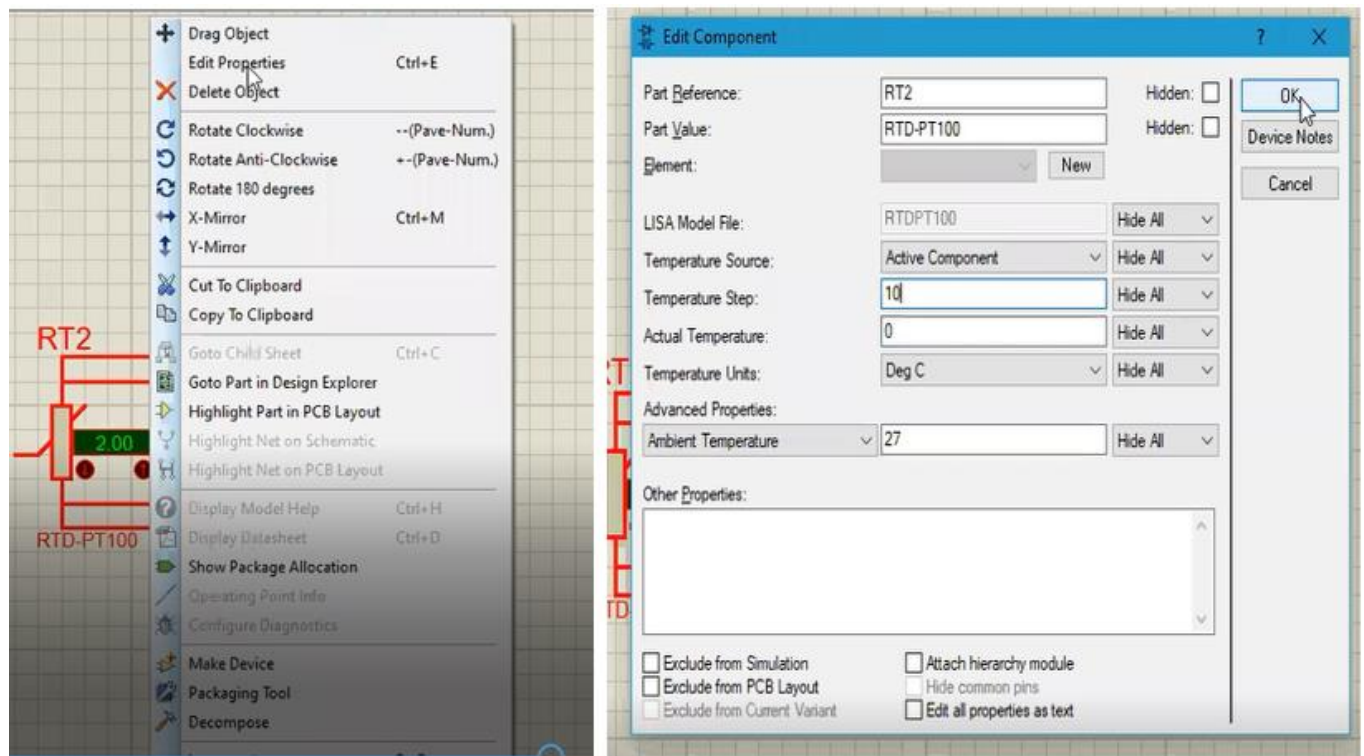


Figure II.2: Parameter Settings for the PT100 Temperature Measurement Circuit.

Complete the following table and answer the questions below:

Temperature Displayed by the PT100 (°C)	Measured Resistance R (Ω)

Table II.1: Measurement Results of the PT100 Circuit.

II.3 Questions

1. What does RTD-PT100 mean?

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2. What is the difference between a PT100 sensor and a PT100 probe:

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3. Is the PT100 sensor active or passive? Justify your answer.....

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4. What is the operating principle of the PT100 sensor?.....

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6. What conclusion can you draw?