Faculty :	**FACULTY OF ELECTRICAL ENGINEERING**	
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SEEE 3732 / SKEE2752

INSTRUMENTATION LABORATORY
MEASUREMENT OF RTD

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PRELIMINARY EXERCISE (15 marks)

Important Note: You are required to do this exercise before the lab session.

1. Explain briefly what is RTD

(2 marks)

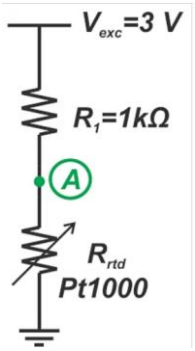
2. Sketch a circuit drawing to converts changes of temperature to voltage using RTD. Discuss briefly.

(4 marks)

3. Write an equation for the characteristic of RTD.

(2 marks)

4. Calculate the resistance of RTD for the circuit shown in Figure 1, if voltage at point A is 1.6V.



(2 marks)

Figure 1: RTD with the circuit voltage divider

5. Calculate the Resistance of RTD for the Figure 2, if
   a) V_A-V_B=0

(2 marks)

   b) V_A-V_B=0.2V,

(3 marks)

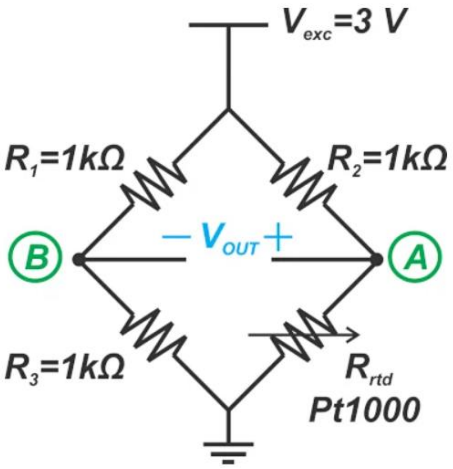


Figure 2: Wheatstone bridge to convert changes of resistance RTD to voltage

Objectives

- To gain practical experience measuring and analyzing Resistance Temperature detector (RTD) sensors.
- To compare the performance characteristics of each sensor
- To understand the principles behind how each sensor operates to convert into an electrical signal.

Equipment:

- RTD sensor; PT100 and PT1000
- Thermo meter
- Signal conditioning circuit
- Multimeter/DAQ system
- Power supply (if needed)
- Oscilloscope (optional, for signal visualization)

EXPERIMENT 1: Characteristic of PT100 and PT1000

Background

RTDs are resistive elements that change resistance over temperature. Because the change in resistance is well characterized, they are used to make precision temperature measurements, with capability of making measurements with accuracies of well under 0.1°C. RTDs are typically constructed from a length of wire wrapped around a ceramic or glass core. RTDs may also be constructed from thick film resistors plated onto a substrate. The wire or resistance is typically platinum but may also be made from nickel or copper.

The characteristic of RTD given by;
The temperature coefficient (α) is the slope of the platinum RTD between 0°C to 100°C. It is calculated as follows

$$\alpha = \frac{R_{100} - R_0}{100 \times R_0}$$

α = Temperature Coefficient
R_{100} = RTD resistance at 100°C
R_0 = RTD resistance at 0°C

Procedure

1. RTD is placed in a bath, then connect the RTD type PT 100 to the measurement circuit shown in Figure 3.
2. Record the changes of water temperature from minimum to miximum versus output resistances corresponding to each temperature.
3. Repeat step 1 and 2 for PT 1000. PT 100 and PT 1000, you can do PT 100 and PT 1000 simultaneously to save time during the heating of water.

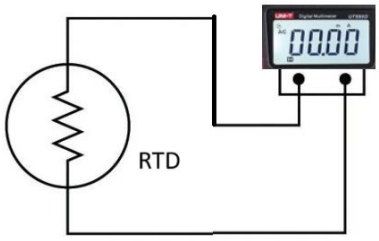


Figure 3

EXPERIMENT 2: RTD and Signal conditioning circuit

Background

External electronic devices are used to convert the resistance of sensor by passing a signal conditioning circuit to produce an electrical signal. For industrial application, the produced electrical signals are

a) voltage - typically 0V to 10V
b) current - typically 1 mA to 10 mA

Procedure

1) By using the Digiac 1750 or SU6808B/ ED6803B/CU6802 /OU6801, design a signal conditioning circuit to produce a voltage from minimum water temperature to a boiling water temperature. Example of circuit shown in Figure 4(a) and Figure 4(b).
2) If you are using amplifier in your signal conditioning circuit, make sure ***offset*** an amplifier before it used. Be careful for the amplifier used in circuit design and should not at saturated condition.
3) Connect RTD type PT100 to your signal conditioning circuit. Varies the temperature of water and measure the voltages output from temperature sensor and also from your signal conditioning circuit. Record all the results in appropriate table.
4) Repeat the experiment steps to observe the repeatibility, error and other terms of measurement and instrumentation.
5) Plot graphs voltage versus tempreature
6) Repeat the steps 1 to 5 this experiment using different RTD, (type PT1000)

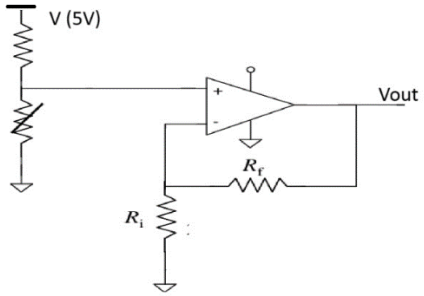


Figure 4(a): Voltage divider and amplifier

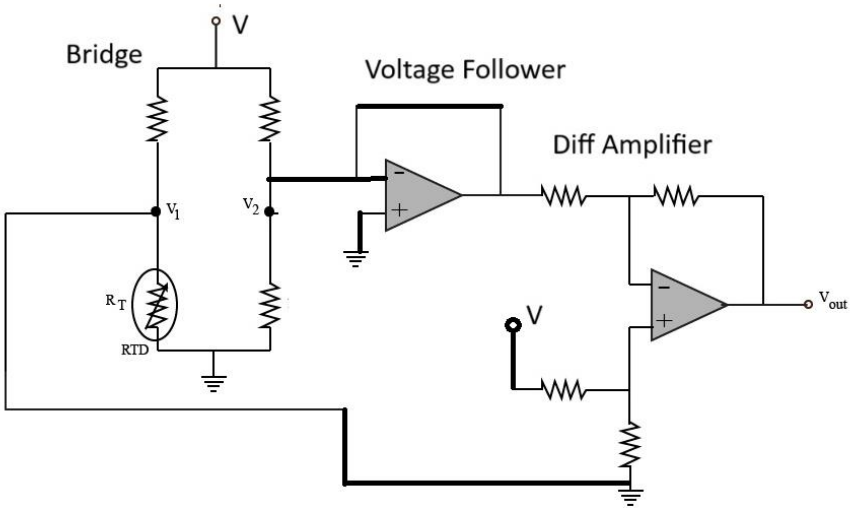


Figure 4 (b):Bridge, voltage follower, differential amplifier and amplifier

Discussion and general conclusion for every experiment 1, 2, 3 and 4.

1) Plot a graphs and calculate importanct parameter of your graph.
2) Using the obtained data, determine the characteristic of your experiments such as Sensitivity, response time, repeatability, stability, accuracy, resolution, linearity and any other measurement and instrumentation term.
3) Discuss error in measurement.