UTM UNIVERSITI TEKNOLOGI MALAYSIA

Sekolah Pendidikan
Profesional dan
Pendidikan Berterusan
(SPACE)

JABATAN KEJURUTERAAN ELEKTRIK
PUSAT PENGAJIAN DIPLOMA (PPD), SPACE
UNIVERSITI TEKNOLOGI MALAYSIA
KUALA LUMPUR

DDPE 2701 ELECTRICAL ENGINEERING LABORATORY 2

(INSTRUMENTATION)

EXPERIMENT 1
THERMOCOUPLE TYPE K (CA)

Group members	**1.**
	2.
	3.
	4.
	5.
Lecturer	**:**
Date	**:**

No.	PO	CO	Student Marks	Marks
1	PO1	CO1		50
2	PO2	CO2		40
3	PO8	CO5		10
		Total Marks		/100

OBJECTIVE

1. Study the construction of a thermocouple.
2. Study the characteristic of a thermocouple.
3. Study the transduction principle of a thermocouple.

DESCRIPTION OF EXPERIMENTAL CIRCUITS AND EQUIPMENTS

A transduction circuit for the Type K(CA) thermocouple is shown in Figure 5-7. In Figure 5-6, it is found that the thermal emf vs temperature of Type K thermocouple is about 40 μ/°C. In order to produce an output of 100 mV/°C, the total voltage gain of 2500 is set by trimming the VR2. The output voltage of thermocouple is proportional to the temperature difference between the two junctions. The VR3 is used to set the K2 voltage to equal the product of the reference-junction temperature and the 10 mV reference voltage for the measured temperature output. The reference-voltage regulator consists of components R11, R12, VCR1, VR3, and U4. The VR1 is used for the adjustment of output offset.

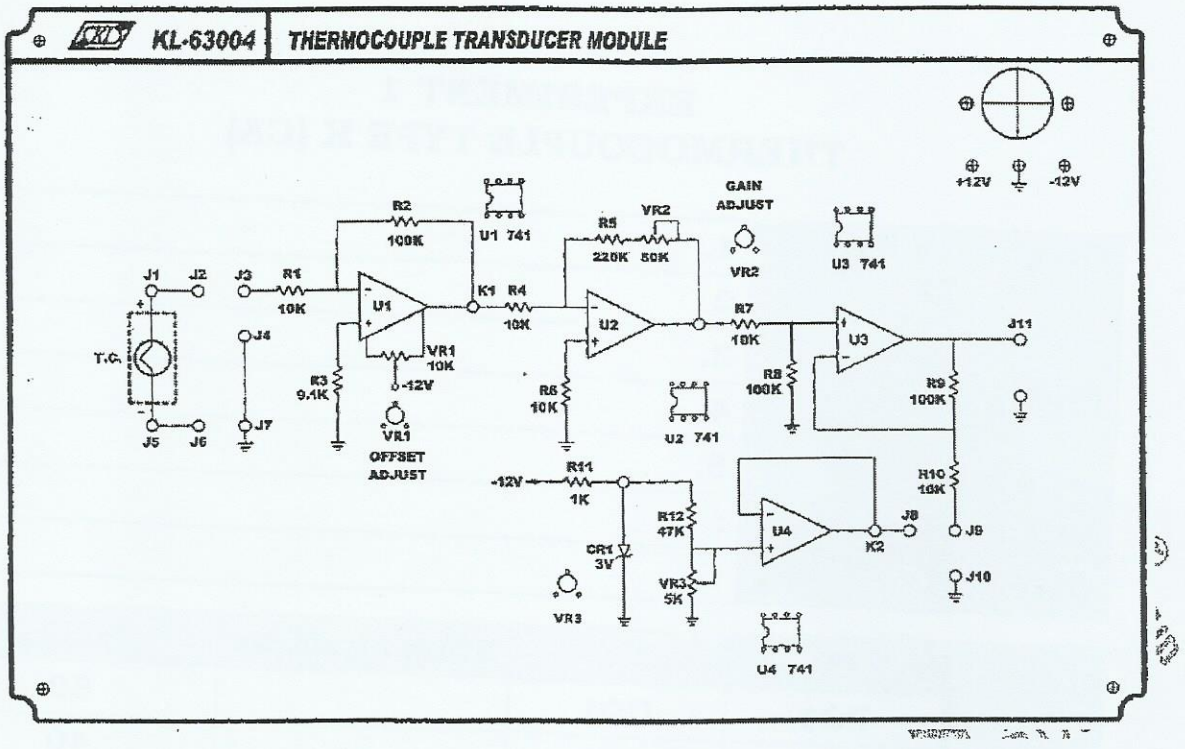


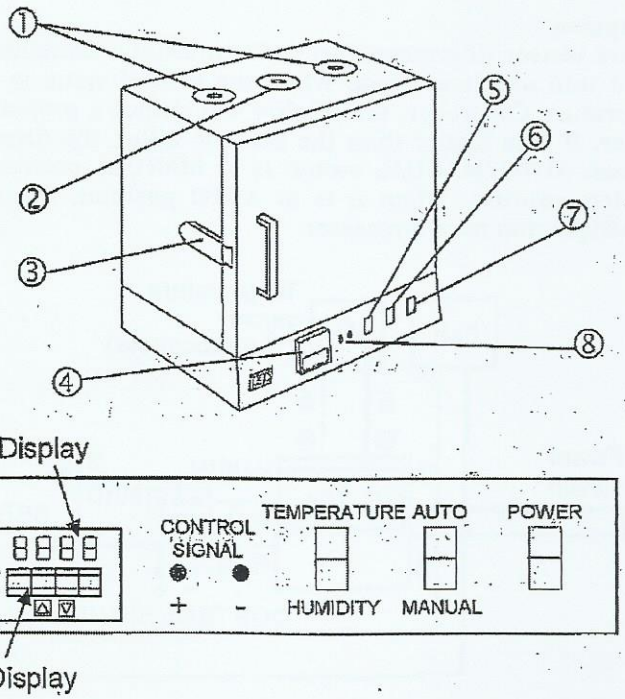
Figure 5-7 Thermocouple transducer circuit

KL-68001 Thermostatic Container

Overview

The KL-68001 Humidity & Temperature Load is a special thermostatic container. It provides appropriate operating environment for temperature sensors in control experiments. With convenient operation and simple interface, users can increase temperature and: humidity of air inside the container easily.

Specification



(1) Experiment Sensor Socket : Two sockets for AD590/PT-1 DO/HumidityTransducer sticks:

(2) Calibration Sensor Socket :

- A standard socket for the thermocouple transducer to measure temperature of the container.

(3) Door lock '

(4) SC-204 Temperature Controller :

- The upper display presents the temperature Value of measurement. The lower display presents setting value. The UP key ⍓ is use to increase the' setting value. The DOWN key ⍗ is used to decrease the setting value. The key ⍇ and ⍈ key have no function.

(5) HUMIDITY/TEMP Switch :

- Switch to HUMIDITY: 100W heater on.
- Switch to TEMP: Both 100W and 150W heaters on.

(6) AUTO/MANUAL Switch

- Switch to AUTO: Heater is controlled by CONTROL SIGNAL input.
- Switch to MANUAL: Heater is controlled by setting value on SC-204.

(7) POWER Switch

(8) CONTROL SIGNAL Input :

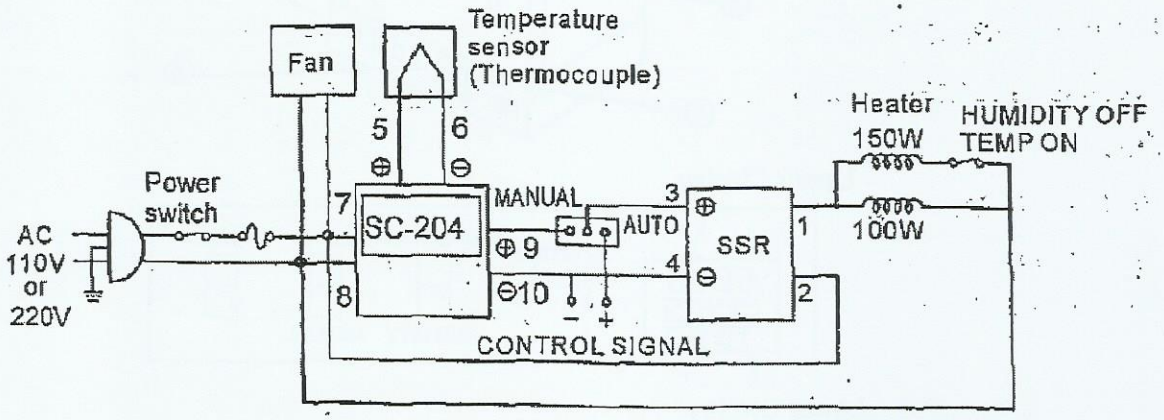
- When switch to AUTO position. The temperature inside KL-68001 is controlled by the DC voltage input to the CONTROL SIGNAL+ and - terminal.'

Heater Operation

1. Turn on the power.
2. Set the HUMIDITY/TEMP. switch at TEMP: position.
3. Set the AUTO/MANUAL switch at MANUAL position. The temperature inside KL-68001 is controlled by the setting value.
4. Set a centigrade value by UP& DOWN keys on SC-204.
5. Plug in the thermocouple transducer for measurement.
6. Wait for few minutes, the container is hearing and the temperature will be reached to the setting value.

Circuit Description

The temperature sensor (thermocouple) in Thermostatic Container senses the temperature value and converts it into a voltage form. When the sensed value is lower than the preset value on SCc204 Temperature Controller, the SC-204 will output a proportional signal to control SSR and drive the heater. If it is higher than the present value, the drive signal is absent, the heater is turned off. When AUTO/MANUAL switch is at MANUAL position, the SC-204 performs control operation for temperature. When it is at AUTO position, the closed-loop control operation is performed by single-chip microprocessor.



Circuit diagram

EQUIPMENT REQUIRED

1- Digital Multimeter (DMM)

2 - Type K (CA) Thermocouple

3 - KL-68001 Thermostatic Container

4 - Thermometer

5 - KL-63004 Thermocouple Transducer Module

6 – Ice cube and Ice container

Part A : Thermocouple characteristics

1. Using thermometer, measure the room temperature.

   Room temperature = ... °C.

2. Put the thermocouple in the **KL-68001** Thermostatic Container.
3. Switch **ON** the **KL-68001** Thermostatic Container. Set the **HUMIDITY/TEMP** switch to the **TEMP** position.
4. Set the **AUTO/MANUAL** switch to the **MANUAL** position and adjust the **UP key** ( ) to obtain the temperature at **80°C**.
5. Using the **DMM** (refer figure 1), measure and record the output for each temperature setting in Table 5-2.

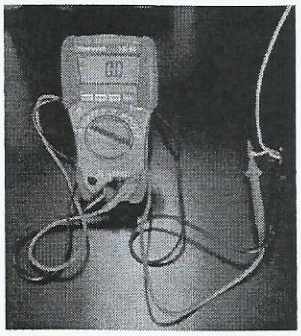


Figure 1

Temperature (°C)	30°	35°	40°	45°	50°	55°	60°	65°	70°
Output voltage (mV)									

Table 5-2

PO2	CO2	..... /10m

6. Measure and record the temperature of the ice water with the thermometer.

   Ice water temperature = ... °C

7. Reduce the **KL-68001** Thermostatic Container temperature by adjust the **DOWN** key ( ) to obtain the temperature at **30°C**.
8. **Soak** the cold junction thermocouple (the terminal connected with DMM) in the ice water (refer Figure 2)

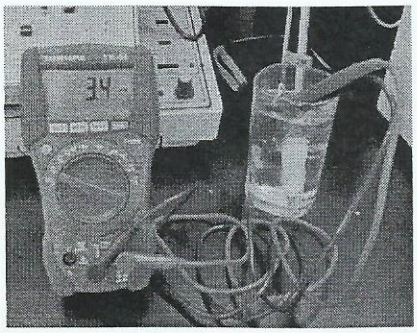


Figure 2

Measure and record the output voltage of thermocouple for each temperature setting in Table 5-3 (start record from 70°C to 30°C).

Temperature (°C)	70°	65°	60°	55°	50°	45°	40°	35°	30°
Output voltage (mV)									

Table 5-3

PO2	CO2	.....	/10m

9. Contruct the graph output voltage (mV) versus temperature (°C) using data in Table 5.2 and Table 5-3 on the same graph paper.

PO1	CO1	.....	/10m

10. Write your observations in Step 9.

.....

.....

.....

PO1	CO1	.....	/10m

Part B : Transduction circuit

1. Set the Thermocouple Transducer Module **KL-63004** on the Trainer **KL-61001A**. Remove Type K (CA) Thermocouple from KL68001 module.
2. Connect Type K(CA) thermocouple to the connectors **J1** and **J5**.
   (Notice the correct polarities : **Red to J1 and Black to J5**)
3. Switch **ON** the Thermocouple Transducer Module KL-63004 (at the back right).
4. Connect **J3** to **J4** and **J9** to **J10**.
5. Measure **voltage at K1** and adjust the **VR1** to obtain voltage at **K1 ≈ 0 V** (offset).

6. Remove the connection between **J3** and **J4**.
7. Connect **J2** to **J3** and **J6** to **J7**.
8. Put the thermocouple in the **KL-68001** Thermostatic Container and set the temperature to **35°C** (adjust **UP** key (⏏)). Measure the output voltage of thermocouple (**J1** to **J5**).
9. Measure and record the output voltage (**J11** to **GND**) and calculate the total voltage gain.

Step 8 : Output voltage of thermocouple (J1 to J5) = ... mV

Step 9 : Output voltage (J11 to GND) = ... V

Total voltage gain = Output voltage / Output voltage of thermocouple

PO1	CO1	.....	/5m

10. Setting the **KL-68001** Thermostatic container temperature by press the **UP** key (⏏) to obtain the temperature at **80°C**.
11. Measure and record the voltage at **J11** for each temperature setting in Table 5-4.

Temperature (°C)	35°	40°	45°	50°	55°	60°	65°	70°
Output voltage (V)								

Table 5-4

PO2	CO2	.....	/10m

12. Contruct the output characteristic curve (emf Vs temperature) of the transducer circuit using data in Table 5-4.

PO1	CO1	.....	/5m

Calculate the overall system sensitivity from the equation:

System sensitivity = [change in thermocouple output reading] / [change in temperature]

PO1	CO1	.....	/5m

13. Using the **DMM,** measure the temperature (ambient temperature) at cold connection at **J1** (refer Figure 3).

Ta = ...°C.

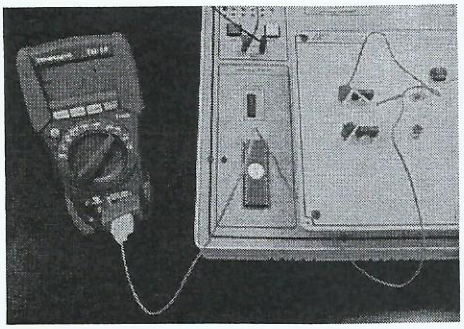


Figure 3

14. Review the curve in Step 13 and estimate the temperature = ... °C when voltage at J11 = 0 V

15. Compare this temperature to the Ta in Step 13.

Write your comment

.....

.....

.....

PO1	CO1	.....	/10m

CONCLUSION

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PO1	CO1	.....	/10m

Guideline for ethic rubric:

ETHIC AND PROFESSIONAL MORAL (100 marks)					
Scale :	**1 (5marks)**	**2 (10marks)**	**3 (15marks)**	**4 (20marks)**	**5 (25marks)**
Criteria ✓ **Understand the economic, environmental and socio-cultural impacts of professional practice**	**Very Poor**	**Poor**	**Moderate**	**Good**	**Excellent**
A. Professional Practice (Punctuality/Follow the Rules)	Tidak menepati/ Tidak Mematuhi	Kurang menepati/ Kurang mematuhi	Adakala menepati / Adakala mematuhi	Menepati / Mematuhi	Sentiasa menepati / Sentiasa mematuhi
B. Ethical Behavior (Trustworthy / Respectfulness)	Tidak mengamalkan	Kurang mengamalkan	Adakala mengamalkan	Mengamalkan	Sentiasa mengamalkan
C. Social Cultural (Racial Harmony)	Tidak mengamalkan	Kurang mengamalkan	Adakala mengamalkan	Mengamalkan	Sentiasa mengamalkan
D. Sahsiah Rupa Diri	Tidak menepati	Kurang menepati	Adakala menepati	Menepati	Sentiasa menepati

PO8	**CO5**	.....	**/10m**