

## LETI-52 Characteristics of Temperature Sensors & Measurement of Body Temperature



"Temperature" is an important thermal physical quantity. It is not only closely related to our living environment, but also plays an important role in scientific research and industrial production process where temperature sensing and control is widely required. Medically, temperature measurement is very important to the diagnosis of disease. Temperature sensors are made of materials such as metals and semiconductors based on their temperature-related properties.

This apparatus consists of a precise temperature control system, a constant-current source, a DC power supply, a digital voltmeter, an amplifier, and a set of temperature sensors including Pt100 thermocouple, NTC1K thermistor, PN-junction temperature sensor, and LM35 voltage-mode integrated temperature sensor.

The heating device of the apparatus adopts a high accuracy dry-well thermostatic furnace. The accuracy of temperature control is assured by a temperature control system P.I.D. The control accuracy is up to  $\pm 0.1\text{ }^{\circ}\text{C}$  at a preset temperature point and  $\pm 0.3\text{ }^{\circ}\text{C}$  for the entire temperature measurement range. Furthermore, using the internal setting of "UU" fine-tuning, temperature control accuracy can be up to  $\pm 0.1\text{ }^{\circ}\text{C}$  in the entire temperature range. The thermostatic block of the dry-well furnace is made of pure copper, which has excellent thermal conductivity that results in a very good temperature consistency for the four dry wells as well as the central dry well. Compared with a thermostatic tank, this kind of dry well is compact and does not need a blender. The power supply of the heater is DC 24V with current up to 2A (total power 48W). The time for heating the dry well furnace from room temperature to  $100\text{ }^{\circ}\text{C}$  is about 10 minutes. At the same time, in order to quickly repeat an experiment, the apparatus is equipped with a fan that can quickly reduce the temperature inside the dry well.

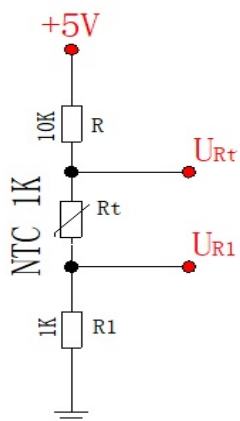
By using this apparatus, a series of experiments can be conducted, including the measurement of temperature properties of a thermistor NTC1K (negative temperature coefficient), a PN-junction temperature sensor and a voltage-mode integrated temperature sensor (LM35), and their applications on measuring human body temperature at different body parts.

## Specification

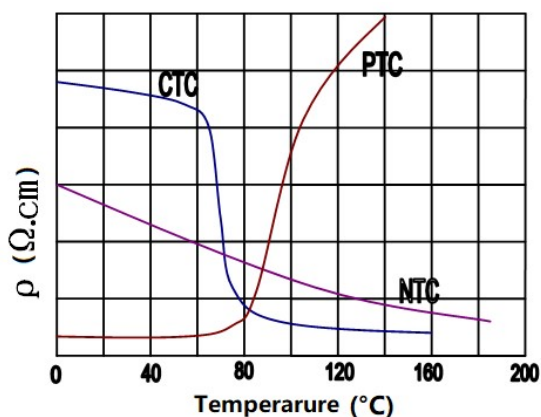
Description	Specifications
Voltage source	+5 V, 0.5 A
Digital voltmeter	0 ~ 2 V, resolution, 0.001V
Dry well heater	room temperature to 100 °C
Mercury thermometer	medical oral grade
Temperature controller	resolution: 0.1 °C
	stability: $\pm 0.1$ °C
	range: 0 ~ 100 °C
	accuracy: $\pm 3\%$ ( $\pm 0.5\%$ after calibration)
Power consumption	60 W

## Parts

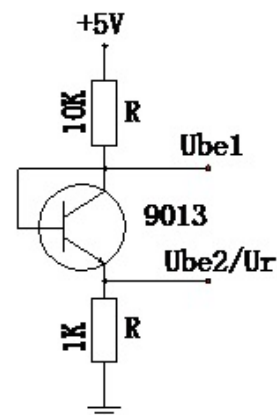
Description	Qty
Main unit	1
Temperature sensor	4 (Pt100, NTC1K, LM35, PN Junction)
Medical mercury thermometer	2
Jumper wire	4
Power cord	1
Experimental instruction manual	1



Measurement of thermal resistance



Temperature properties of 3 types of thermal resistances



Measurement of PN-junction temperature sensor