LAB ASSIGNMENT No. 1

Characteristics of IC Temperature Sensor (LM 335)

Equipment Required:

ST2302with power supply cord

Multi Meter

Connecting cords

Connection diagram:

Temperature Transducers:

The most commonly used type of the entire sensor are those which detect Temperature or heat. These types of sensors vary from simple ON/OFF thermostatic devices which control a domestic hot water system to highly sensitive semiconductor types that can control complex process control plants. Temperature Sensors measure the amount of heat energy or even coldness within an object or system, and can "sense" or detect any physical change to that temperature.

There are many different types of Temperature Sensors available and all have different characteristics depending upon their actual application. Temperature sensors consist of two basic physical types:

Contact Types:

These types of temperature sensors are required to be in physical contact with the object being sensed and uses conduction to monitor changes in temperature. They can be used to detect solids, liquids or gases over a wide range of temperatures.

Non-contact Types:

These types of temperature sensors detect the Radiant Energy being transmitted from the object in the form of Infra-red radiation. They can be used with any solid or liquid that emits radiant energy. The two basic types of contact or even non-contact temperature sensors can also be sub-divided into the following three groups of sensors, Electro-mechanical, Resistive and Electronic.

LM 335:

The transducers RTD, thermistor and thermocouples have some significant limitations, e.g. thermocouples have a low output signal which varies none linearly with temperature. Also, they need some form of reference compensation. RTD's are more linear than thermocouple but the change in their resistance is very small even for large change in input temperatures i.e. they have low sensitivity. Thermistor has high sensitivity but they exhibit highly non-linear resistance temperature characteristics. For each of these transducers, electronic compensation circuits have to be used in order to overcome their shortcomings.

Also additional circuitry may be needed to increase their voltage or current output. Usually this additional electronics circuitry takes the form of monolithic integrated circuits. Thus it requires combining temperature sensing element with signal conditioning electronics to produce single monolithic IC package. The one used in ST2302 is LM 335.

This is an IC containing 16 transistors 9 resistance and 2 capacitors contained in a transistor type package. It provides an output of 10mV/° K, measurements of output voltage therefore indicate the temperature directly in degrees Kelvin e.g. at a temperature of 20°C (293 °K) the output voltage will be 2.93V.

An LM335 unit is mounted on the type K thermocouple panel, external to the heated closure and fitted in a heat sink together with another type K thermocouple. Its output is available at the REF socket. The output form this can be used as an indication of the ambient temperature outside the heated enclosure.

Circuit Diagram:

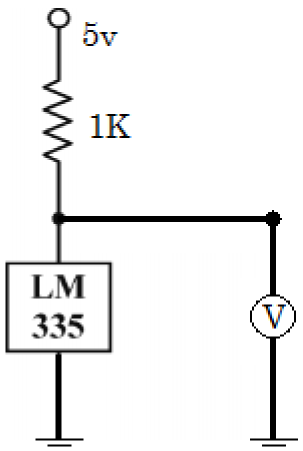
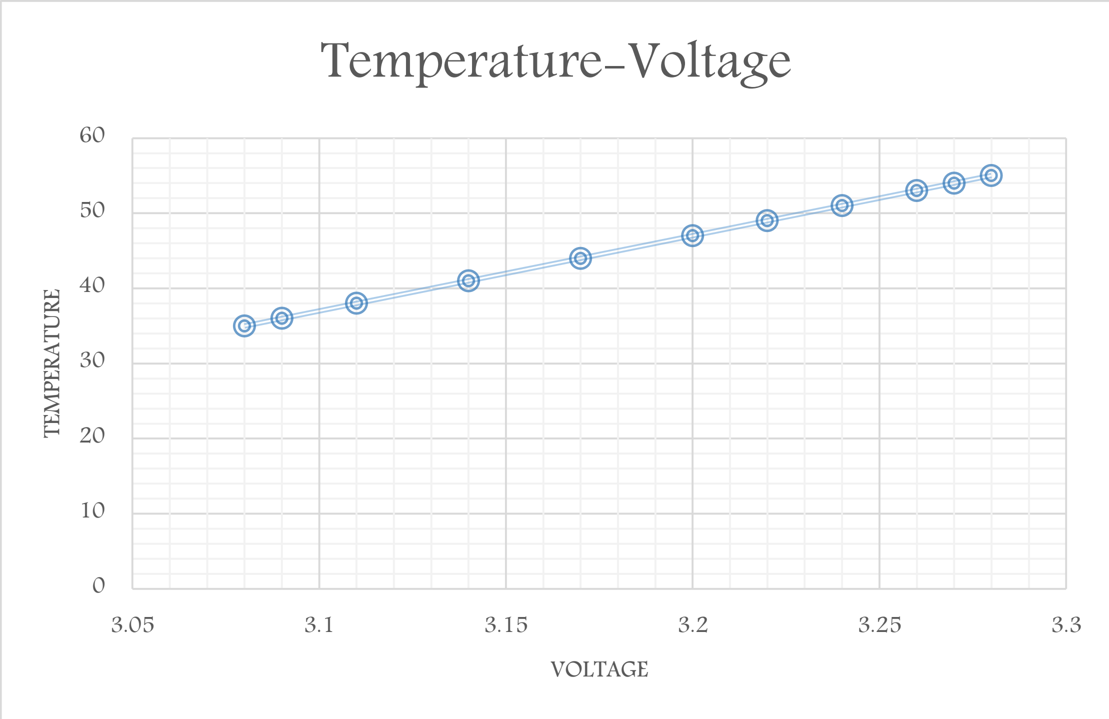
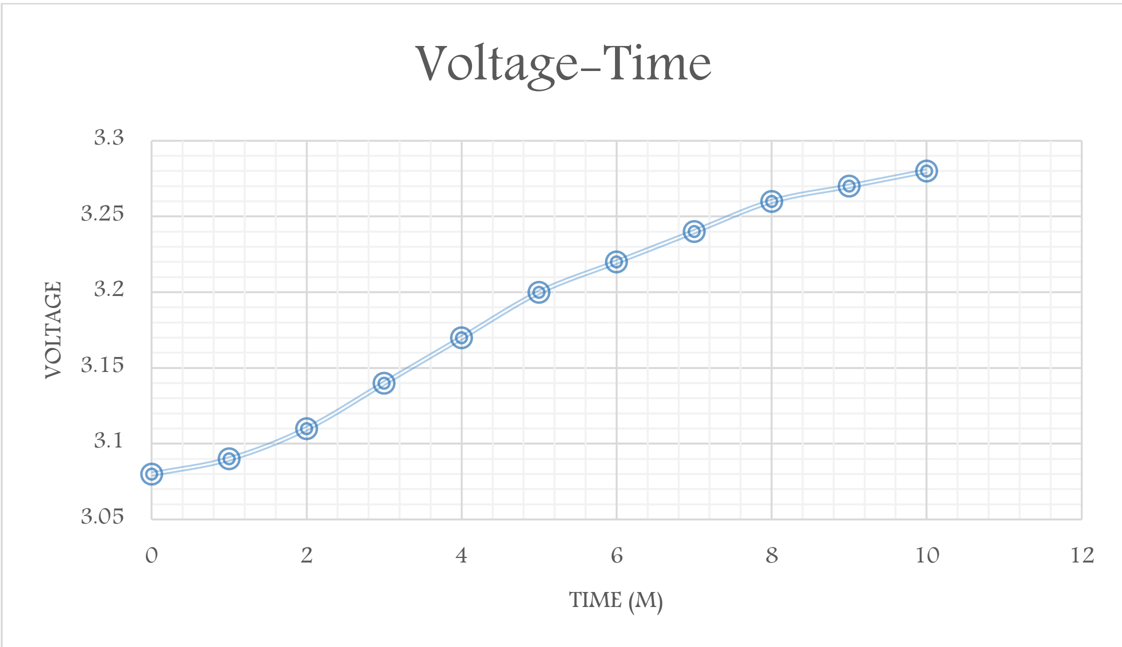


TABLE:

Time (min)		0	1	2	3	4	5	6	7	8	9	10
Voltage (v)		3.08	3.09	3.11	3.14	3.17	3.20	3.22	3.24	3.26	3.27	3.28
Temperature	^{0}C	308	309	311	314	317	320	322	324	326	327	328
	^{0}K	35	36	38	41	44	47	49	51	53	54	55

GRAPH:


Temperature-Voltage
TEMPERATURE
60
50
40
30
20
10
0
3.05
3.1
3.15
3.2
3.25
3.3
VOLTAGE


Voltage-Time
VOLTAGE
3.3
3.25
3.2
3.15
3.1
3.05
0
2
4
6
8
10
12
TIME (M)

LAB ASSIGNMENT No. 2

Characteristics of Platinum RTD

Equipment Required:

ST2302with power supply cord

Multi Meter

Connecting cords

Connection diagram:

Temperature Transducers:

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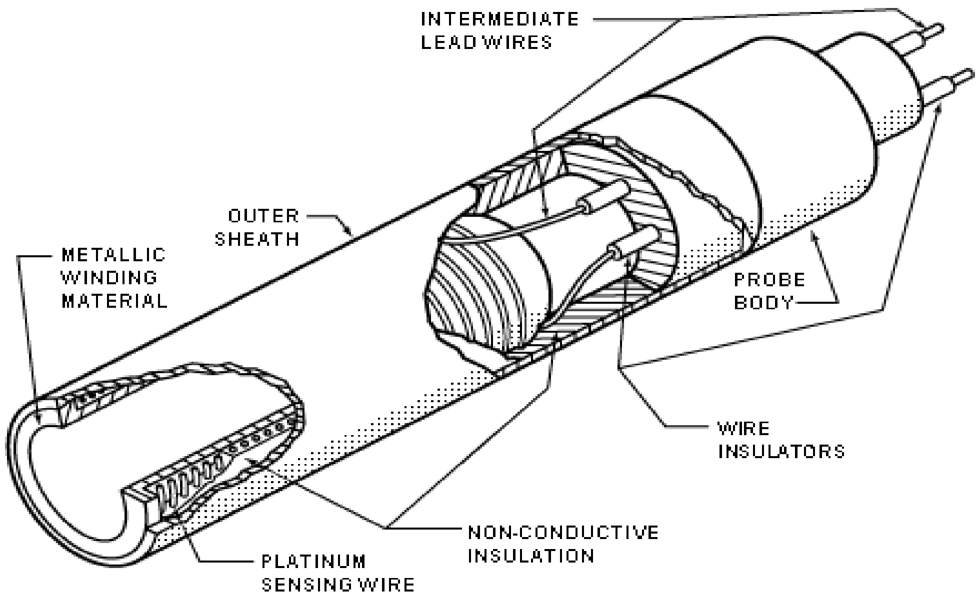
RTD:

The variation in resistance of a metal with variation in temperature is the basis of temperature measurement in a Platinum RTD. The metal generally used is platinum or tungsten. Platinum is especially suited for this purpose, as it can shows limited susceptibility to contamination. All metals produce a positive change in resistance with temperature. This of course is the main function of an RTD. This implies a metal with high value of resistance should be used for RTD's.

The requirements of a conductor material to be used in RTD's are:
The change in resistance of material per unit change in temperature should be as large as possible.
The material should have high value of resistance so that minimum volume of material is used for the construction of RTD.
The resistance of material should have continuous and stable relationship with temperature.

Resistance temperature detectors (RTDs), also called resistance thermometers, are temperature sensors that exploit the predictable change in electrical resistance of some materials with changing temperature.



Temperature Increases Metal Resistance Increase

The resistance ideally varies linearly with temperature. Platinum or tungsten wire is wound on a former to give a resistance in the range of 10K ohms depending on application. Tungsten is reserved for high temperature application as it is brittle and extremely difficult to work.

To the first approximation, resistance variation with temperature is linear although more complex equations are used for greater accuracies. In fact standard calibration charts are available for different materials. The RTD used in ST2302 is of 100 Ohm at 0°C (Temperature coefficient = 0.385 ohms /°C).

The platinum RTD is connected in series with a high resistance to a DC supply and measure the voltage drop across it. Due to the small variation of resistance, the current drop across transducer will be directly proportional to its resistance.

The RTD consists of a thin film of platinum deposited on a ceramic substrate with gold contact-plates on each end. The platinum resistance temperature detector is a highly stable and accurate sensor. The resistance increases linearly at 0.385 Ohm/°C. To develop a voltage a suitable resistance should be connected between output and +5V and the wire-wound potentiometer is recommended. The RTD is located in the transparent plastic heating compartment.

RTD – sensitivity:

• Sensitivity is shown by the value αo

▫ Platinum – 0.004/ °C

▫ Nickel – 0.005/ °C

• Thus, for a 100Ω platinum RTD, a change of only 0.4 Ω would be expected if the temperature is changed by 1°C

RTD – response time

• Generally 0.5 to 5 seconds or more

•The slowness of response is due principally to the slowness of thermal conductivity in bringing the device into thermal equilibrium with its environment.

Circuit Diagram:

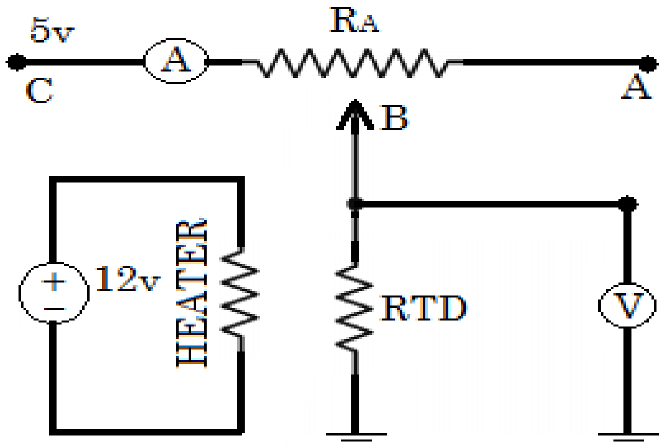
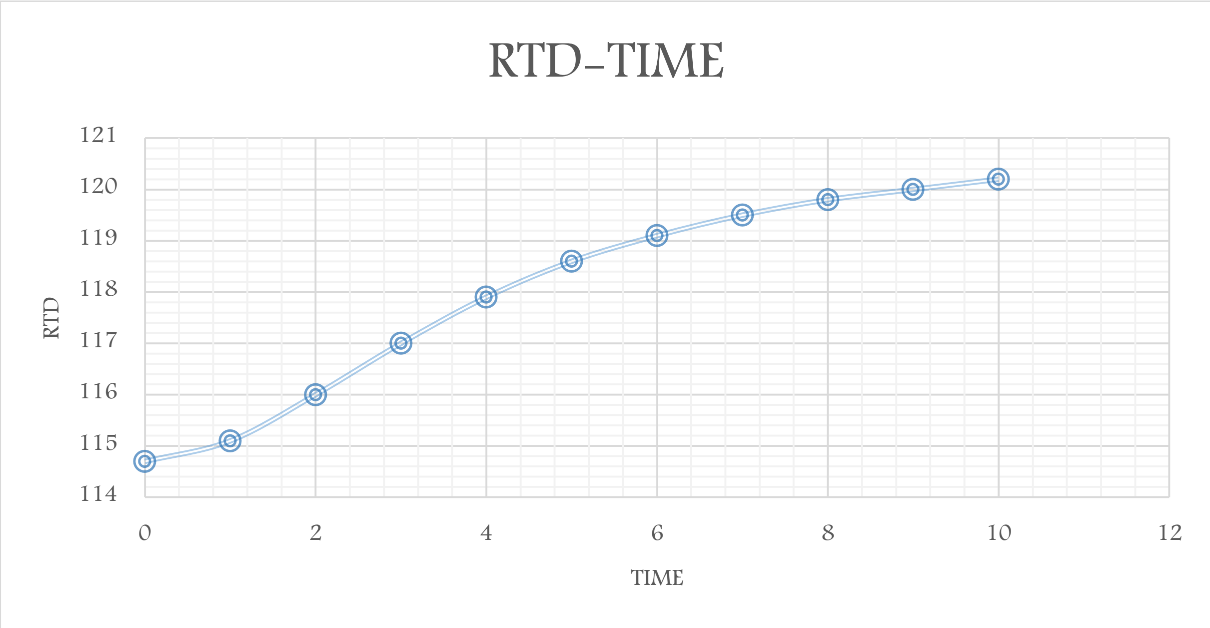
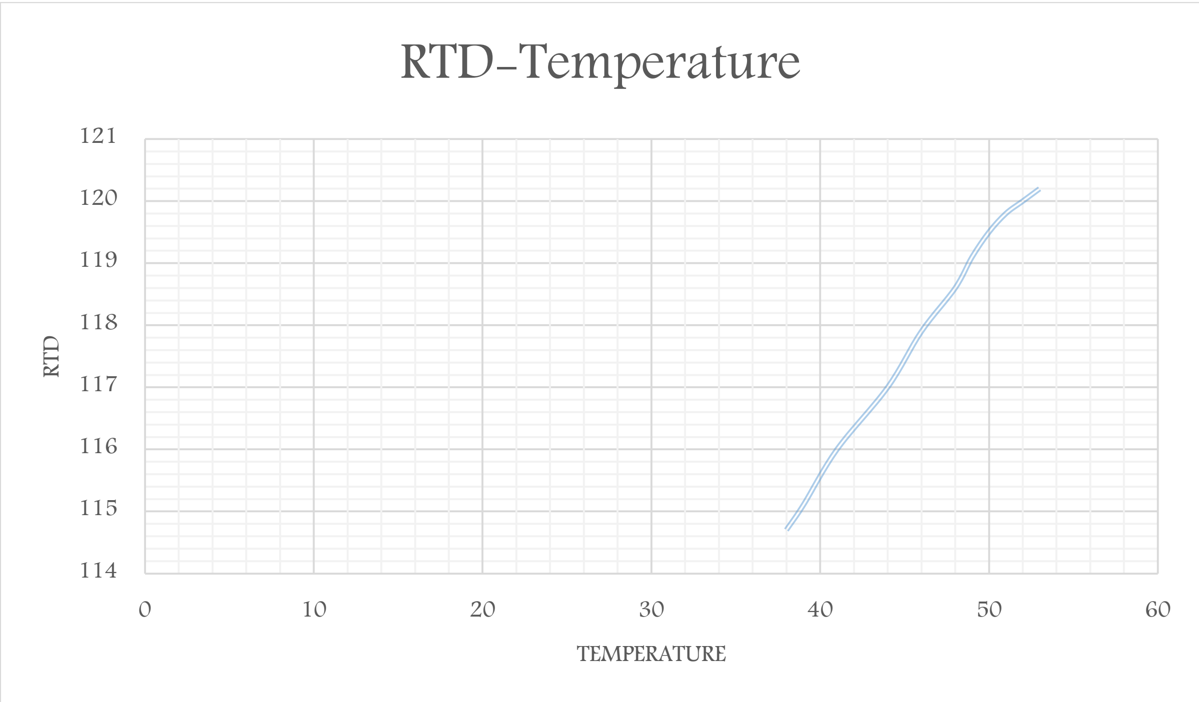


TABLE:

Time	R	Temperature	
Min	K Ω	°C	°K
0	114.7	38	311
1	115.1	39	312
2	116	41	314
3	117	44	317
4	117.9	46	319
5	118.6	48	321
6	119.1	49	322
7	119.5	50	323
8	119.8	51	324
9	120	52	325
10	120.2	53	326

GRAPH:


RTD-TIME
RTD
TIME
121
120
119
118
117
116
115
114
0
2
4
6
8
10
12


RTD-Temperature
RTD
TEMPERATURE
121
120
119
118
117
116
115
114
0
10
20
30
40
50
60

LAB ASSIGNMENT No. 3

Characteristics of NTC Thermistor

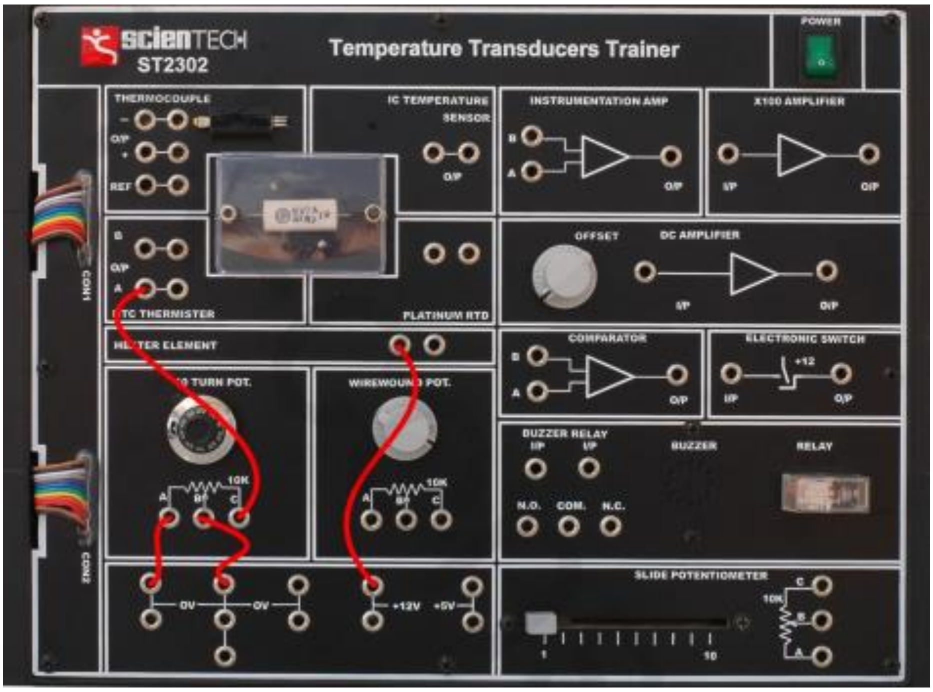
Equipment Required:

ST2302with power supply cord

Multi Meter

Connecting cords

Connection diagram:



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Thermistor:

Thermistor is a contraction of a term thermal resistor. Although positive temperature co-efficient of unit exhibit an increase in the value of resistance with increase in temperature are available, most Thermistor have a negative temperature coefficient i.e. their resistance decreases with increase in temperature. In some materials the resistance of Thermistor at room temperature may decrease as much as 6% for 1°C rise in temperature. This high sensitivity to temperature change make the Thermistor extremely well suited to precision temperature measurement, control & compensation.

Therefore, especially in lower temperatures range of -100°C to 300°C, or to detect very small changes in temperature which cannot be observed with an RTD or a thermocouple. Thermistor is composed of a sintered mixture of metallic oxides, such as Mn, Ni, Co, Cu, Fe, & U. Their resistance range from 0.5 Ω to 75MΩ and they are available in wide variety of shapes and sizes.

The resistance of the NTC Thermistor varies over a wide range for the temperature range available within the heated enclosure. If resistance readings are to be taken at regular interval of 1 minute, the readings must be obtained very quickly. The method selected connects the Thermistor in series with a calibrated resistance to the +5 supply.

For each reading the variable resistance is adjusted until the voltage at the junction of the Thermistor and resistance is half of the supply voltage. For this setting there will be the same voltage drop across the Thermistor and the resistance and since the same current flows in each their resistance must be equal. Hence, the value of the resistance read from the calibrated resistance scale is the same as the resistance of the Thermistor.

Thermistor

• Semiconductor resistance sensors

• Unlike metals, Thermistor respond negatively to temperature and their coefficient of resistance is of the order of 10 times higher than that of platinum or copper.

• Temperature semiconductor resistance

Circuit Diagram:

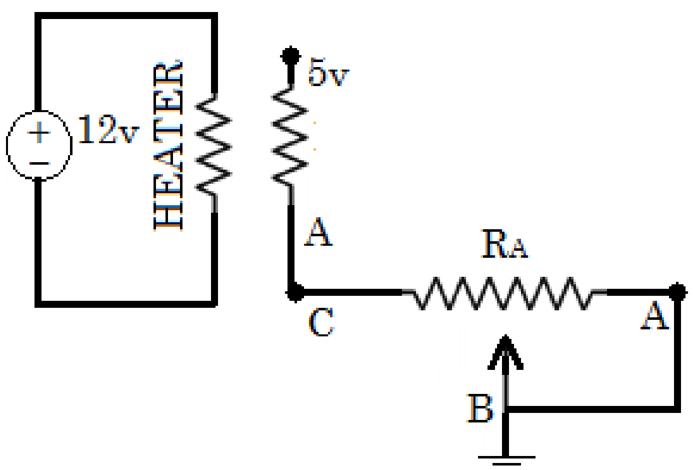
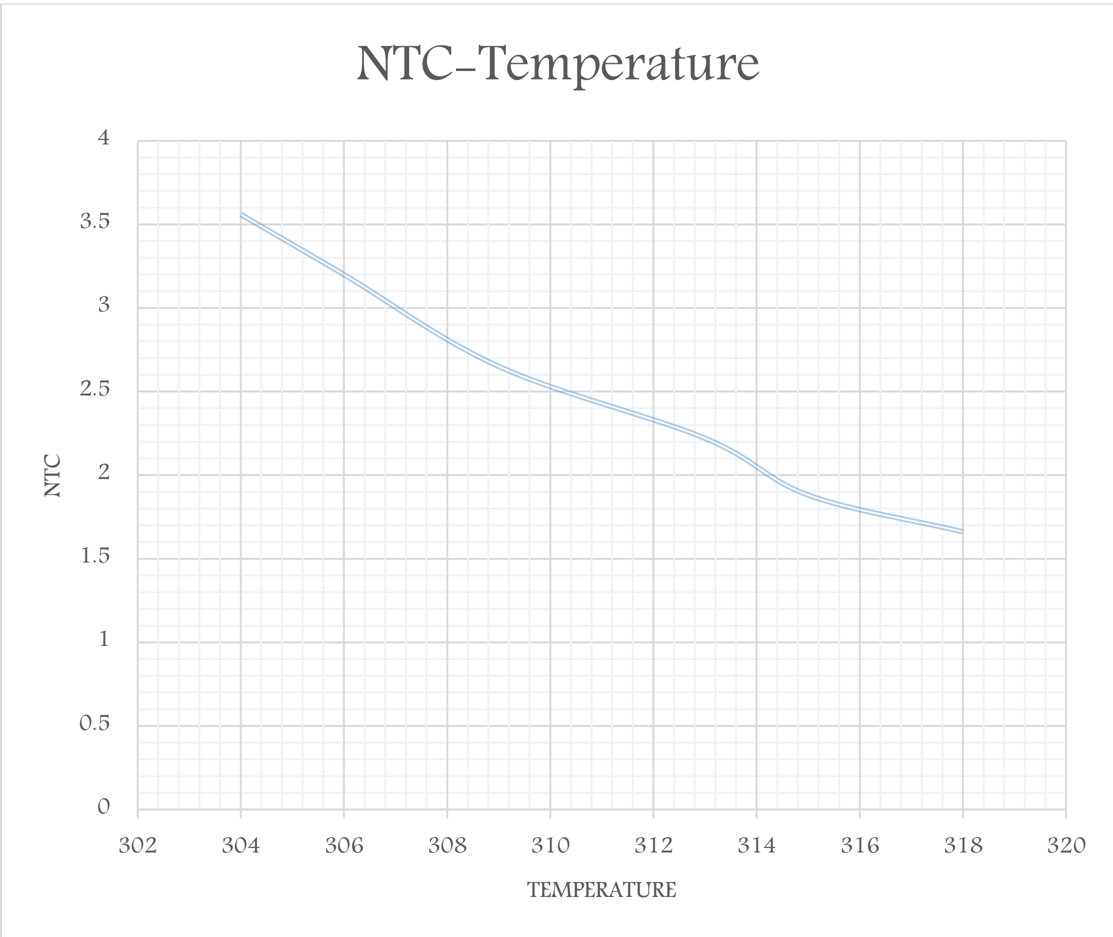


TABLE:

Time	Temperature		R_{DIAL}	RTH=1K+R_{DIAL}
min	°C	°K	KΩ	KΩ
0	31	304	2.56	3.56
1	33	306	2.2	3.2
2	36	309	1.65	2.65
3	40	313	1.22	2.22
4	42	315	0.88	1.88
5	45	318	0.66	1.66

GRAPH:



LAB ASSIGNMENT No. 4

Characteristics of NTC Bridge circuit

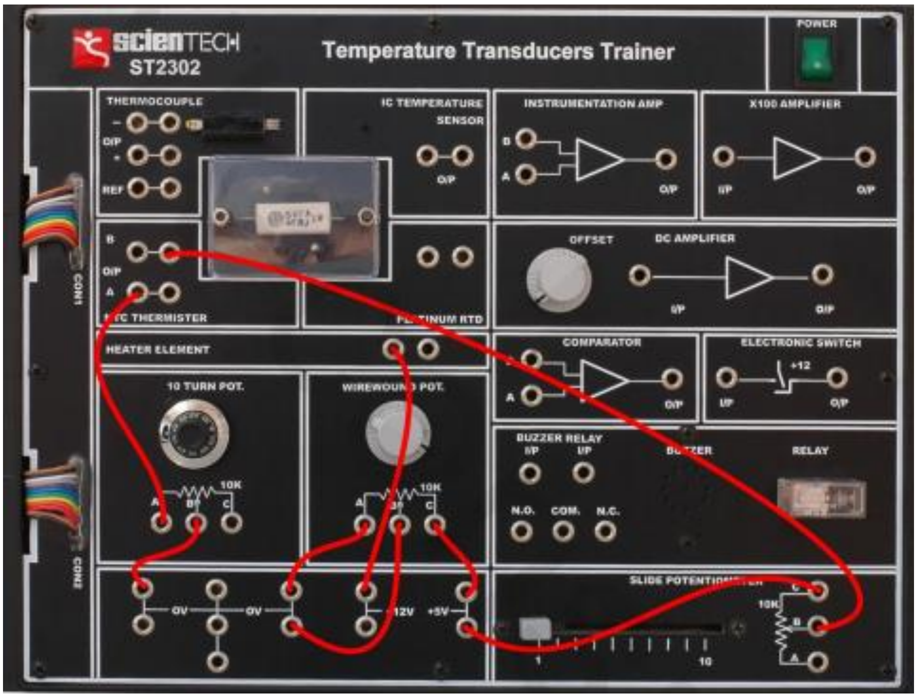
Equipment Required:

ST2302with power supply cord

Multi Meter

Connecting cords

Connection diagram:



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Circuit Diagram:

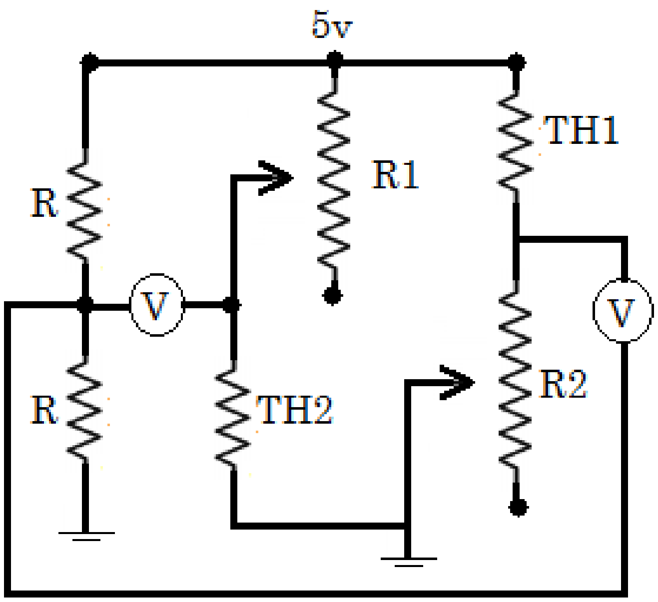
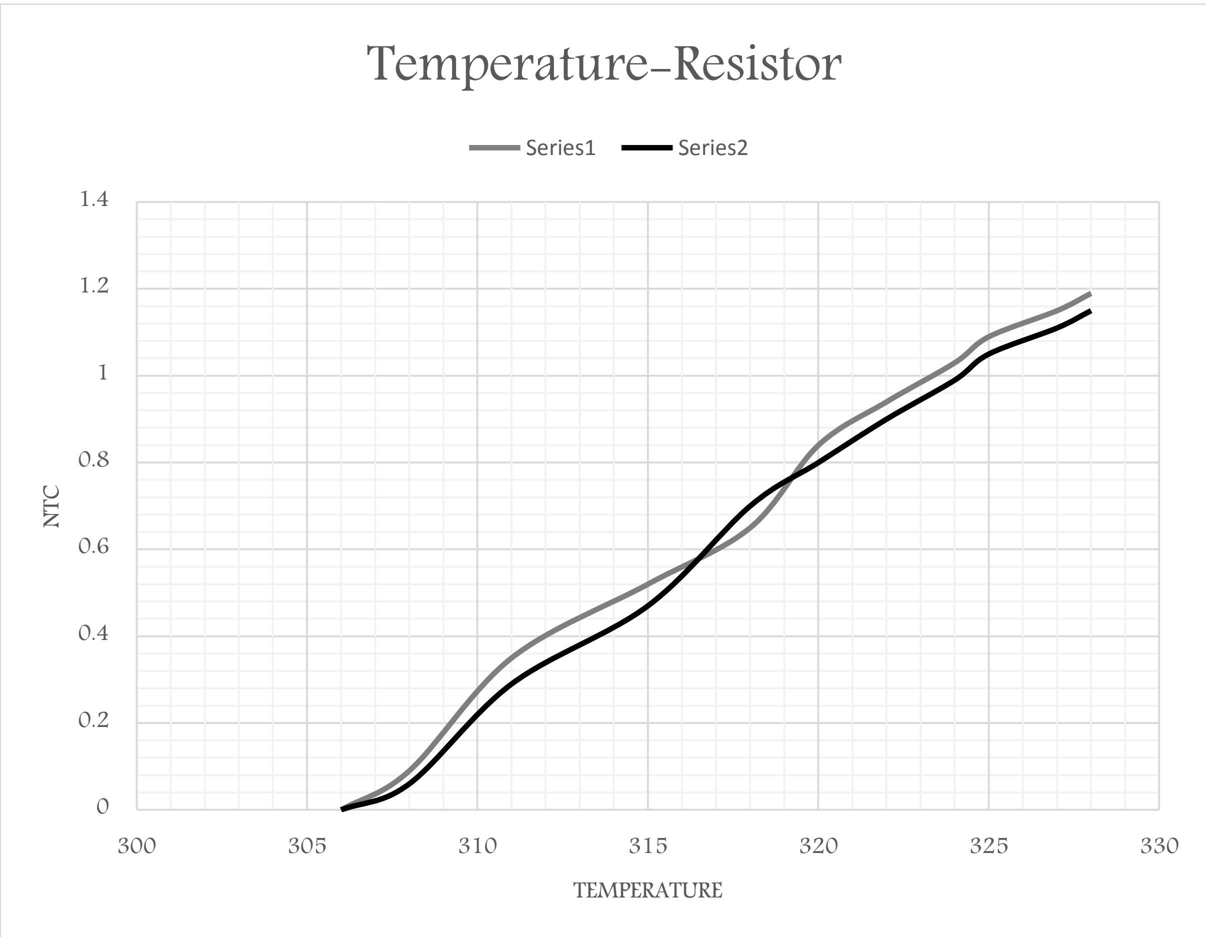


TABLE:

Time	Temperature	NTC1	NTC2
0	306	0	0
1	308	0.09	0.06
2	311	0.35	0.29
3	315	0.52	0.47
4	318	0.65	0.7
5	320	0.84	0.8
6	322	0.94	0.9
7	324	1.03	0.99
8	325	1.09	1.05
9	327	1.15	1.11
10	328	1.19	1.15

GRAPH:



LAB ASSIGNMENT No. 5

Perform and verify Operation & Principle of Thermocouple

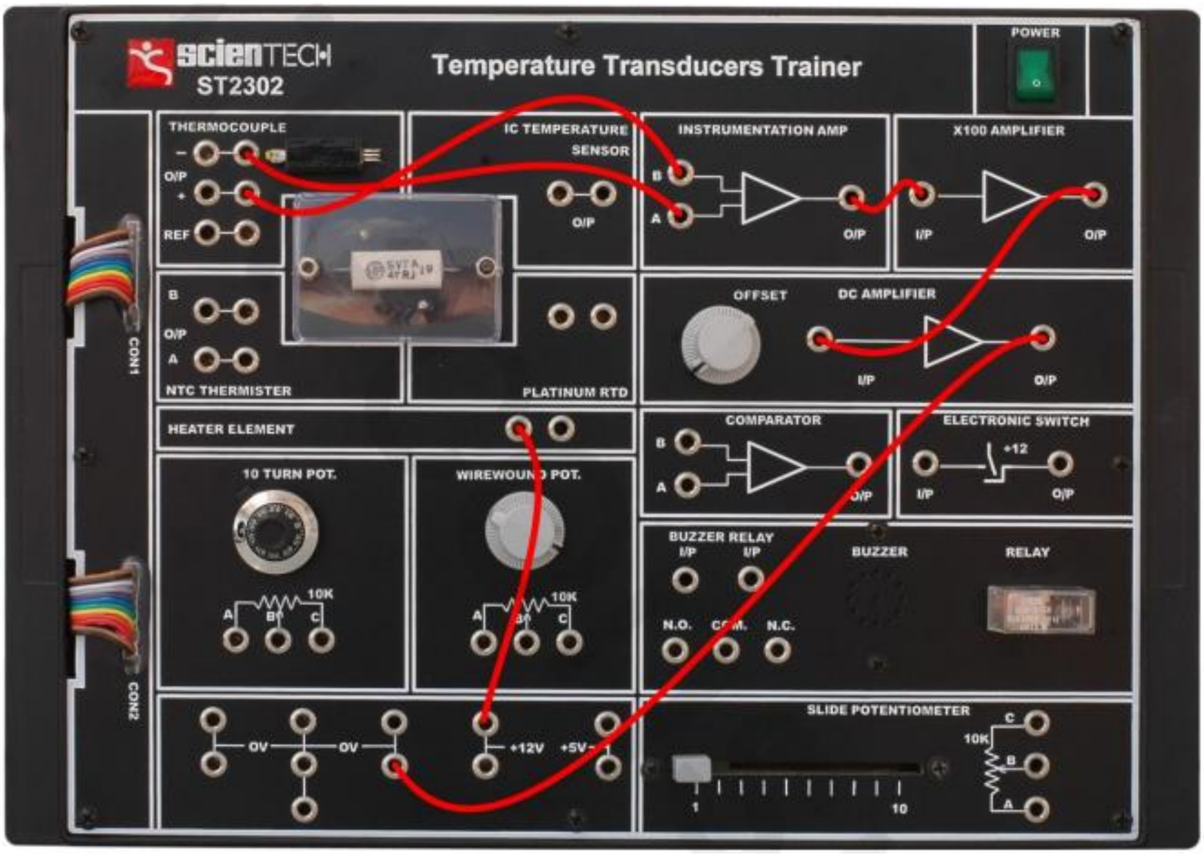
Equipment Required:

ST2302with power supply cord

Multi Meter

Connecting cords

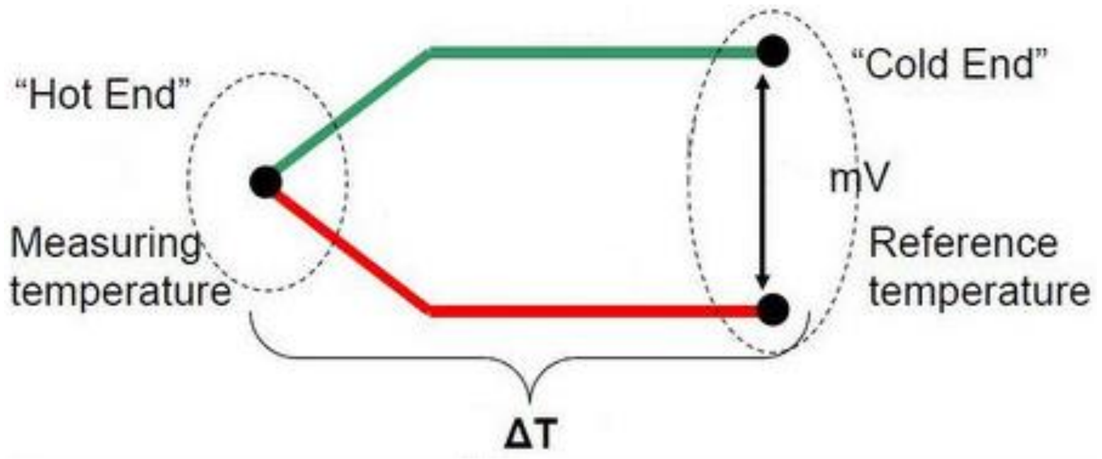
Connection diagram:



Thermocouple:

The Thermocouple is the most commonly used type of all the temperature sensing devices due to its simplicity , ease of use and their speed of response to changes in temperature, due mainly to their small size.

Thermocouples also have the widest temperature range of all the temperature sensing devices from below -200°C to well over 2000°C. It basically consists of two junctions of dissimilar metals, such as copper and constantan that are welded or crimped together. One junction is kept at a constant temperature called the reference (Cold) junction, while the other the measuring (Hot) junction is used as the temperature sensor and this is shown below.



The principle of operation is that the junction of the two dissimilar metals produces a "thermo-electric" effect that produces a constant potential difference of only a few millivolts (mV) between and which changes as the temperature changes. If both the junctions are at the same temperature the potential difference across the two junctions is zero in other words, no voltage output. However, when the junctions are connected within a circuit and are both at different temperatures a voltage output will be detected relative to the difference in temperature between the two junctions. This voltage output will increase with temperature until the junction's peak voltage level is reached and this is determined by the characteristics of the two metals used.

Thermocouples can be made from a variety of different materials enabling extreme temperatures of between -200°C to over +2000°C to be measured. With such a large choice of materials and temperature range, internationally accepted standards have been developed complete with thermocouple Colour codes to allow the user to choose the correct thermocouple sensor for a particular application.

Circuit Diagram:

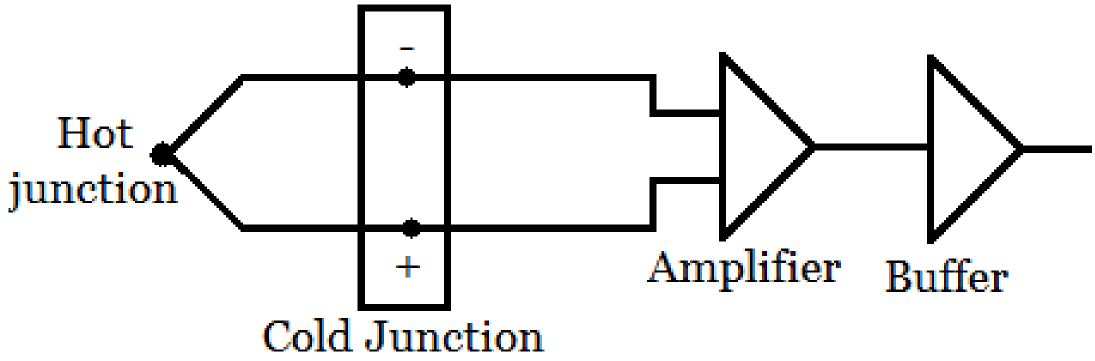
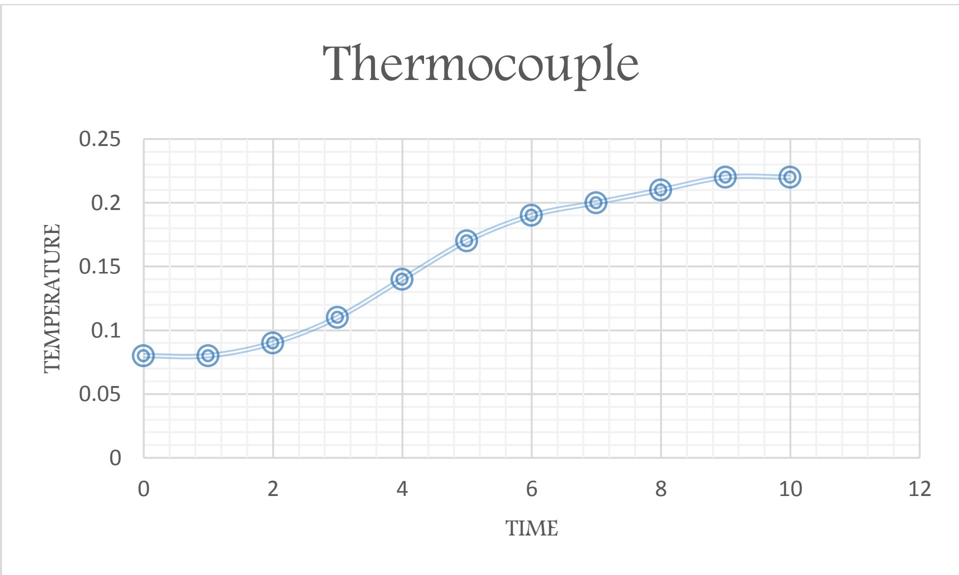


Table:

Voltage (V)	Time (Minutes)	Temperature Hot Junction (°C)	Temperature Cold Junction (°C)	Temperature Difference (°C)
0.18	0	3.18	3.10	0.08
0.42	1	3.18	3.10	0.08
0.46	2	3.19	3.10	0.09
0.49	3	3.21	3.10	0.11
0.52	4	3.24	3.10	0.14
0.55	5	3.27	3.10	0.17
0.57	6	3.29	3.10	0.19
0.59	7	3.31	3.11	0.20
0.60	8	3.32	3.11	0.21
0.61	9	3.33	3.11	0.22
0.61	10	3.34	3.12	0.22

Graph:



LAB ASSIGNMENT No. 6

Perform and verify Operation & Principle of Alarm system by NTC

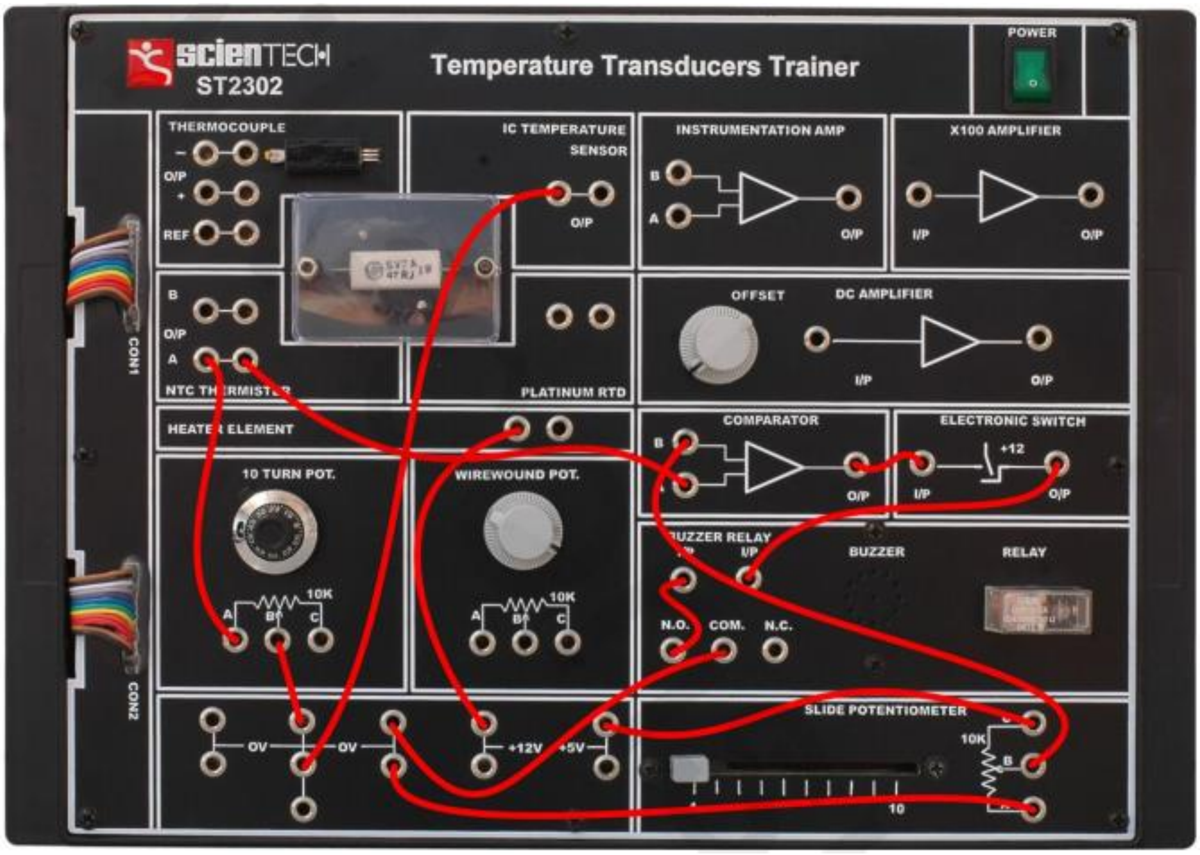
Equipment Required:

ST2302with power supply cord

Multi Meter

Connecting cords

Connection diagram:



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Temperature ALARM:

A temperature alarm circuit can be designed by replacing the bridge detection meter in the above circuit with a sufficiently sensitive relay. The alarm set point will be determined by the values of the fixed resistors. The selection of the relay and thermistor/resistor values are critical to the design of the temperature alarm circuit. The bridge output is sufficiently small below the alarm set point which is determined by the fixed resistor legs of the bridge circuit. At a sufficiently high temperature, the thermistor resistance would be reduced causing an imbalance in the circuit and sufficient current to activate the relay.

Temperature was one of the first physical parameters to be measured in the process field and has been sensed in just about every way imaginable over the years. At one time or another, just about every physical property that changes with respect to temperature has been used as a basis for this measurement. Over the last few years, the development of low cost, small controllers and associated electronics circuitry has allowed for the cost effective measurement and control of temperature that was not possible before. NTC thermistor elements, either alone or as part of temperature sensing assembly, are being utilized more and more where the need to sense or control temperature is needed.

NTC thermistors offer designers many advantages over other type of sensing technologies including the highest sensitivity to temperature changes, high signal to noise ratio, simple operation as well as being low cost. Formerly, the nonlinear resistance versus temperature characteristic was problematic in analog sensing circuits. Today, however, with the advent of digital electronic controls the translation is handled via equations in software or lookup tables. The reliability, performance and longevity of the NTC thermistor as well as its other inherent characteristics has made it the temperature sensing element of choice where precise measurement and control of temperature are necessary.
NTC thermistor applications make use of the characteristics inherent in their composition. Applications are generally broken up into two separate categories that utilize different characteristics of the NTC thermistor.

Circuit Diagram:

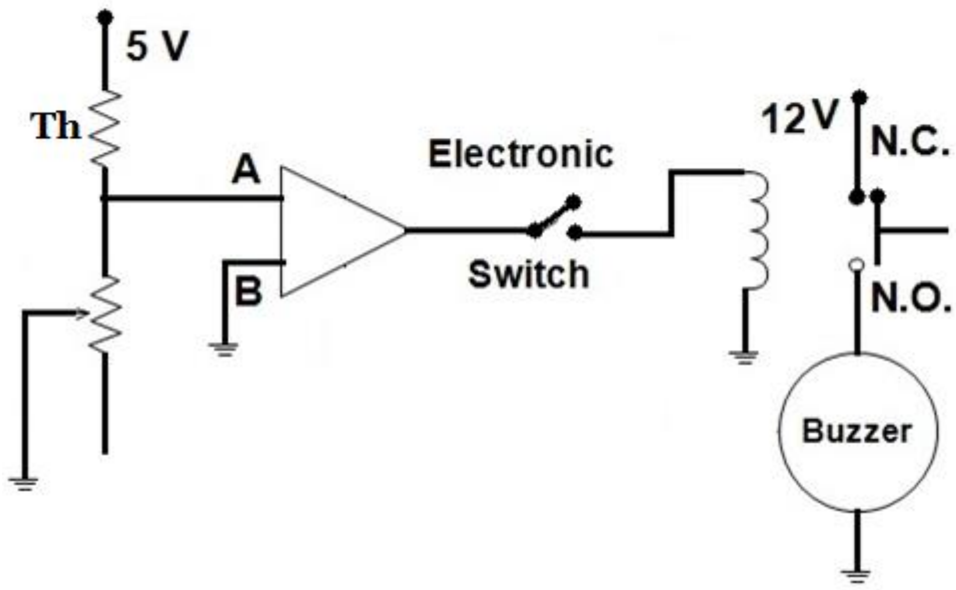


Table:

Sr. No.	Time (Minutes)	Sensor Output (°C)	I.C. Voltage (V)	I.C. Temperature (K)
1	0	41	3.14	314
2	1	42	3.15	315
3	2	45	3.18	318
4	3	48	3.21	321

LAB ASSIGNMENT No. 7

Perform and verify Operation & Principle of Alarm system by 2 NTC

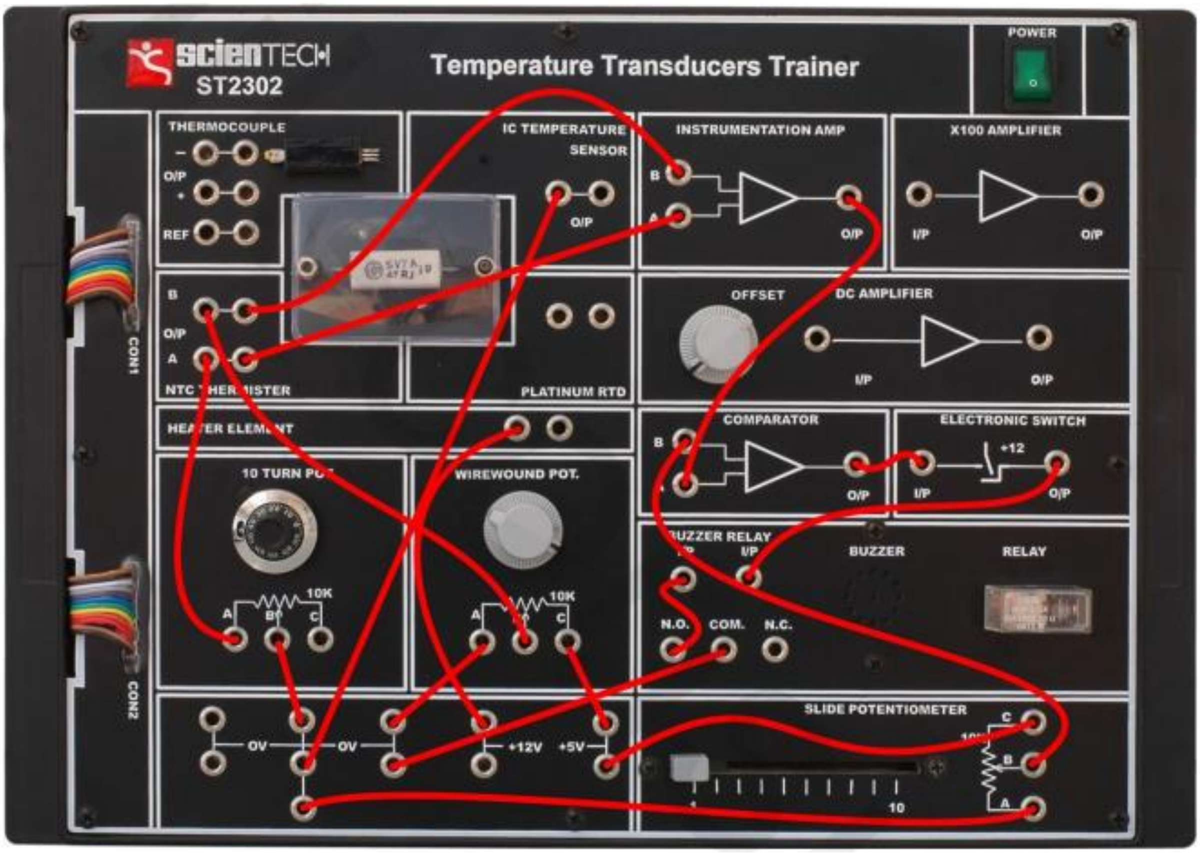
Equipment Required:

ST2302with power supply cord

Multi Meter

Connecting cords

Connection diagram:



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Temperature was one of the first physical parameters to be measured in the process field and has been sensed in just about every way imaginable over the years. At one time or another, just about every physical property that changes with respect to temperature has been used as a basis for this measurement. Over the last few years, the development of low cost, small controllers and associated electronics circuitry has allowed for the cost effective measurement and control of temperature that was not possible before. NTC thermistor elements, either alone or as part of temperature sensing assembly, are being utilized more and more where the need to sense or control temperature is needed.

NTC thermistors offer designers many advantages over other type of sensing technologies including the highest sensitivity to temperature changes, high signal to noise ratio, simple operation as well as being low cost. Formerly, the nonlinear resistance versus temperature characteristic was problematic in analog sensing circuits. Today, however, with the advent of digital electronic controls the translation is handled via equations in software or lookup tables. The reliability, performance and longevity of the NTC thermistor as well as its other inherent characteristics has made it the temperature sensing element of choice where precise measurement and control of temperature are necessary.

NTC thermistor applications make use of the characteristics inherent in their composition. Applications are generally broken up into two separate categories that utilize different characteristics of the NTC thermistor.

Circuit Diagram:

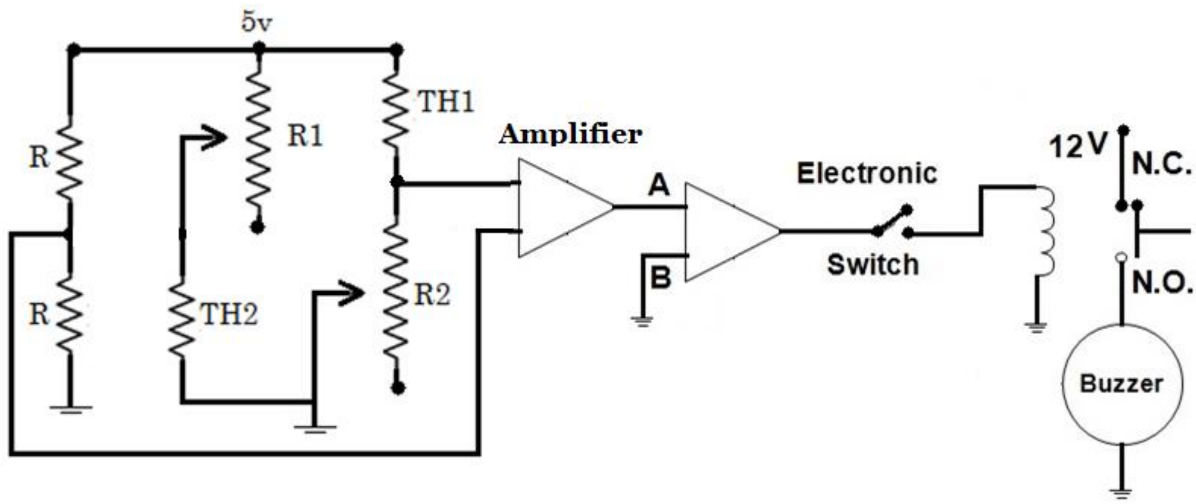


Table:

Sr. No.	Time (Minutes)	Sensor Output (°C)	I.C. Voltage (V)	I.C. Temperature (K)
1	0	41	3.14	314
2	1	42	3.15	315
3	2	45	3.18	318
4	3	48	3.21	321

LAB ASSIGNMENT No. 8

Perform and verify Operation & Principle of Strain Gauge Resistance Potentiometer

Equipment Required:

Trainer with Power supply cord

Multi Meter

Connecting cords

Strain gauge:

A strain gauge is a device used to measure strain on an object. Invented by Edward E. Simmons and Arthur C. Ruge in 1938, the most common type of strain gauge consists of an insulating flexible backing which supports a metallic foil pattern. The gauge is attached to the object by a suitable adhesive, such as cyanoacrylate. As the object is deformed, the foil is deformed, causing its electrical resistance to change. This resistance change, usually measured using a Wheatstone bridge, is related to the strain by the quantity known as the gauge factor. The gauge factor is defined as: Where is the change in resistance caused by strain, is the resistance of the unreformed gauge, and is strain.

Wheatstone bridge:

A Wheatstone bridge is an electrical circuit used to measure an unknown electrical resistance by balancing two legs of a bridge circuit, one leg of which includes the unknown component. Its operation is similar to the original potentiometer. It was invented by Samuel Hunter Christie in 1833 and improved and popularized by Sir Charles Wheatstone in 1843. One of the Wheatstone bridge's initial uses was for the purpose of soils analysis and comparison.

Operation of Wheatstone bridge:

In the below figure, is the unknown resistance to be measured. , and are resistors of known resistance and the resistance of is adjustable. If the ratio of the two resistances in the known leg is equal to the ratio of the two in the unknown leg , then the voltage between the two midpoints (B and D) will be zero and no current will flow through the galvanometer . If the bridge is unbalanced, the direction of the current indicates whether is too high or too low. is varied until there is no current through the galvanometer, which then reads zero.

Detecting zero current with a galvanometer can be done to extremely high accuracy. Therefore, if , and are known to high precision, then can be measured to high precision. Very small changes in disrupt the balance and are readily detected.

At the point of balance, the ratio of

$$\frac{R_2}{R_1} = \frac{R_x}{R_3}$$

$$\Rightarrow R_x = \frac{R_2}{R_1} \cdot R_3$$

Circuit Diagram:

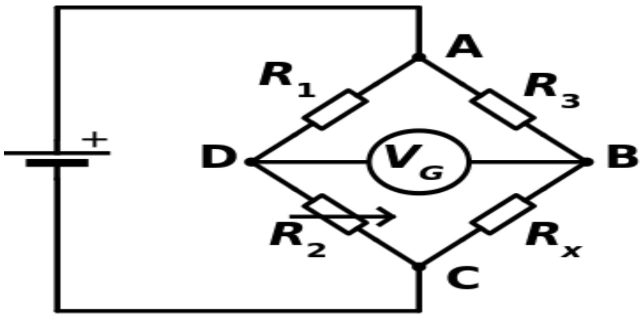
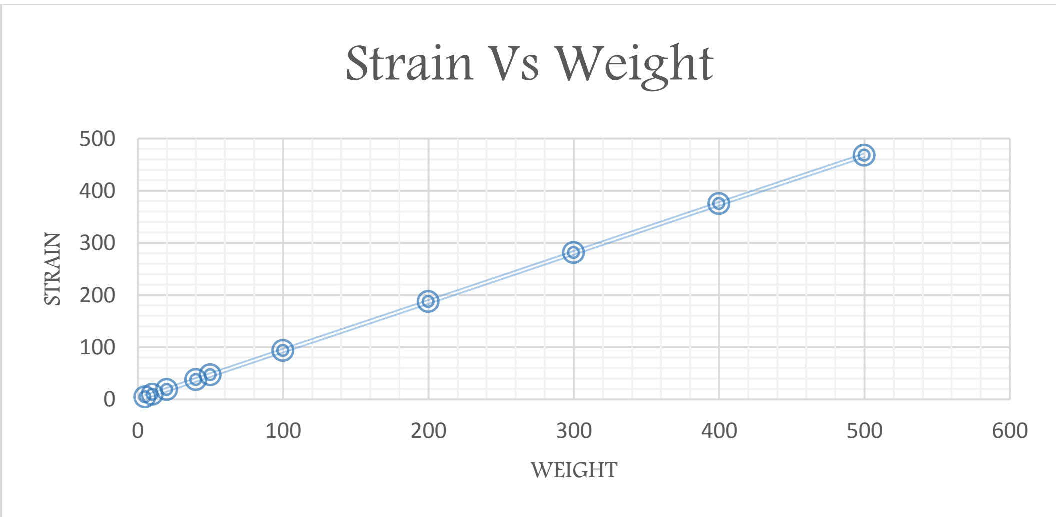


Table:

Sr. No.	Weight (grams)	The Strain (e×10^{-6})	Display (e×10^{-6})
1	5	4.68	2
2	10	9.37	4
3	20	18.7	8
4	40	37.5	17
5	50	46.8	18
6	100	93.7	39
7	200	187	80
8	300	281	121
9	400	375	163
10	500	468	203

Graph:



LAB ASSIGNMENT No. 9

Perform and verify Operation & Principle of Optical Transducer

Equipment Required:

ST 2301 with Power supply cord
Multi Meter
Connecting cords

Optical Transducers :

The ST2301 Optical Transducers Trainer deals with 4 different types of Optical
Transducers viz.

1. Photovoltaic Cell,
2. Photoconductive Cell,
3. PIN Photodiode,
4. Phototransistor.

Photonic transducers convert light energy into a proportional electrical output. The transduction mechanisms made use of in different t y pes of photonic transducers include photo-emissive effect, photoconductive effect, photovoltaic effect and pyro electric effect.

Accruing to the photo emissive effect, electrons are emitted from surface of a material on absorption of light energy in the form of photons. When the energy of an impinging photon is greater that the work function of the material, the photon liberates an electron wit h a kinetic energy equal to the difference between the photonic energy and the work function. This effect is used in vacuum and gas filled phototubes where photons impinging on a photocathode liberate electrons which are attracted towards the anode due to anode - cathode electric field, thus producing anode current proportional to light energy . The famous photomultiplier tube is based on photoemission and has provision for photo current multiplication.

In the photoconductive transducers, the input photon energy creates electron hole pairs, then increasing the number of available charge carriers and the conductivity of the semiconductor material of which they are made. They are made by depositing a thin film of Cadmium sulfide, Lead sulfide or lead solenoid on a ceramic substrate. Cadmium sulfide devices respond in the visible region, matching the response of a human eye. Lead sulfide & Lead solenoid detectors respond in 1 to 3 mm & 1 to6mm respectively.

Photovoltaic detectors are PN function based detectors. These junction t y pe photo detectors more appropriately called photodiodes can also be operated in the photoconductive mode. In t he photovoltaic modes, the impinging photons generate electron-hole pairs in the depletion range. The electrons and holes respectively move towards N-side and P-side under the influence of the depletion field, leading to accumulation of charges on the two sides and consequently an open circuit voltage or a short circuit current that is proportional to light energy input.

In case of pyro-electric detectors the light radiation falling on the detector changes the temperature of the material. The changes in temperature are accompanied by changes in electrical polarization. The changing electrical polarization is sensed as an electrical signal. The light radiation needs to be chopped to provide a changing temperature pattern for the pyro-electric detector to work.

Circuit Diagram:

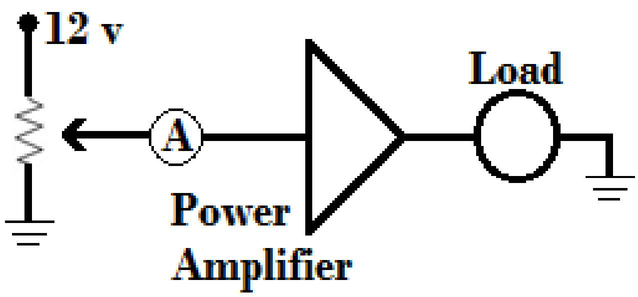
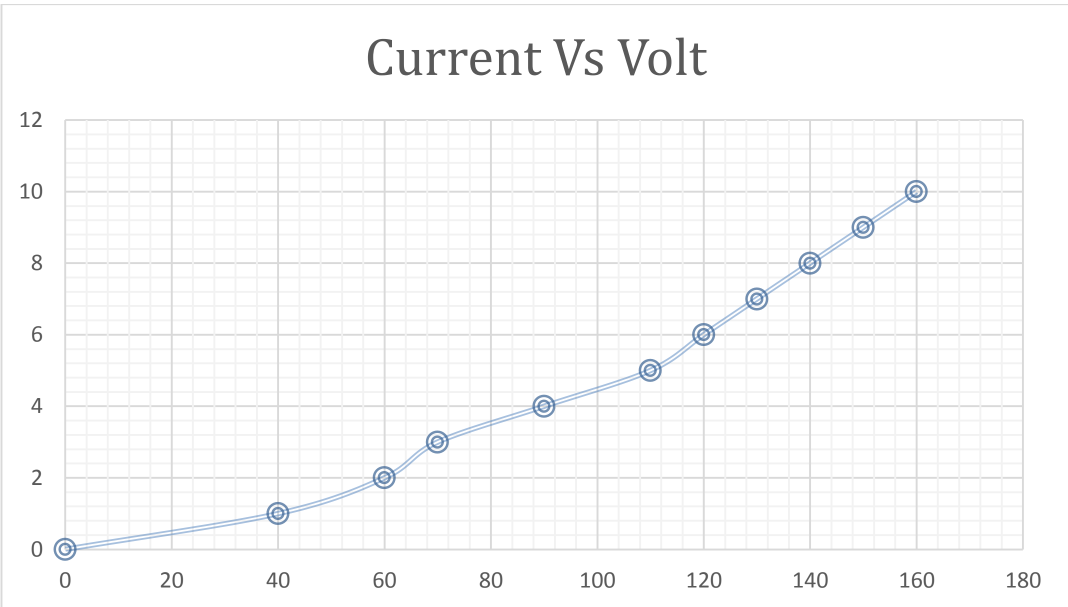


Table:

Sr. No.	Applied Voltage(V)	Current (mA)	Power (mW)	Resistance (Ω)
1	0	0	0	0
2	1	40	40	25
3	2	60	120	33.33
4	3	70	210	37.5
5	4	90	360	44.44
6	5	110	550	45.45
7	6	120	720	50
8	7	130	910	53.85
9	8	140	1120	57.14
10	9	150	1350	60
11	10	160	1600	62.5

Graph:



LAB ASSIGNMENT No. 10

Study the comparison between Lamp v/s Photovoltaic Cell Voltage

Equipment Required:

ST 2301 with Power supply cord
Multi Meter
Connecting cords

Optical Transducer:

An incandescent light bulb, incandescent lamp or incandescent light globe is an electric light which produces light with a wire filament heated to a high temperature by an electric current passing through it, until it glows see Incandescence. The hot filament is protected from oxidation with a glass or quartz bulb that is filled with inert gas or evacuated. In a halogen lamp, filament evaporation is prevented by a chemical process that redeposit metal vapor onto the filament, extending its life. The light bulb is supplied with electrical current by feed-through terminals or wires embedded in the glass. Most bulbs are used in a socket which provides mechanical support and electrical connections.

Incandescent bulbs are manufactured in a wide range of sizes, light output, and voltage ratings, from 1.5 volts to about 300 volts. They require no external regulating equipment, have low manufacturing costs, and work equally well on either alternating current or direct current. As a result, the incandescent lamp is widely used in household and commercial lighting, for portable lighting such as table lamps, car headlamps, and flashlights, and for decorative and advertising lighting.

Photovoltaic Cell

A solar cell, or photovoltaic cell, is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect. It is a form of photoelectric cell, defined as a device whose electrical characteristics, such as current, voltage, or resistance, vary when exposed to light.

Solar cells are described as being photovoltaic irrespective of whether the source is sunlight or an artificial light. They are used as a photo detector (for example infrared detectors), detecting light or other electromagnetic radiation near the visible range, or measuring light intensity.

The operation of a photovoltaic (PV) cell requires 3 basic attributes:

- The absorption of light, generating either electron-hole pairs or excitons.
- The separation of charge carriers of opposite types.
- The separate extraction of those carriers to an external circuit.

Circuit Diagram:

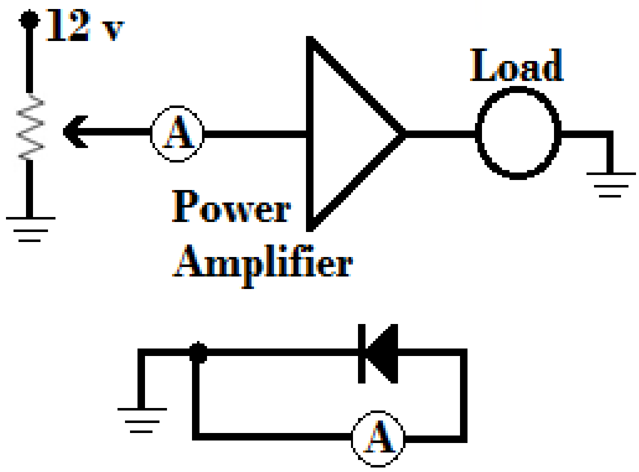
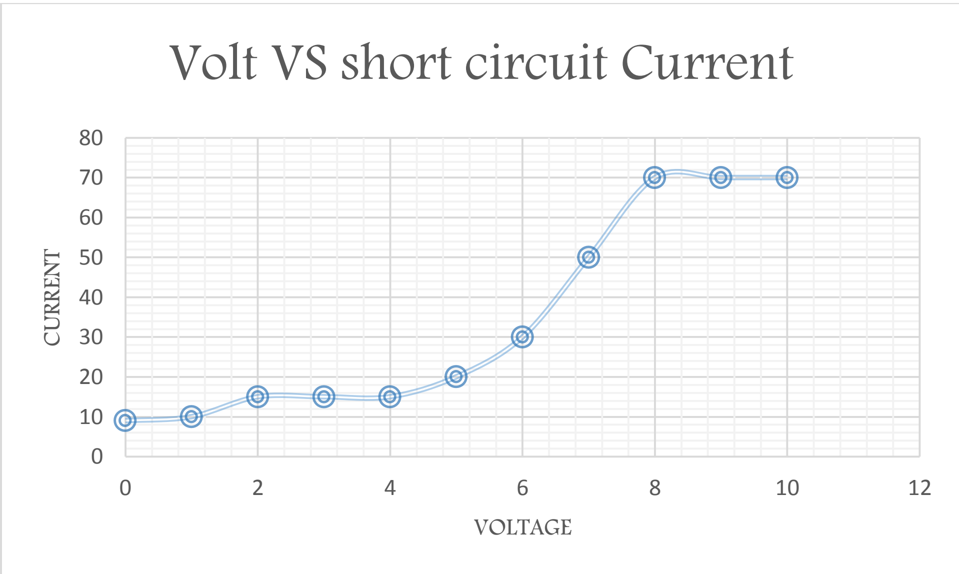


Table:

Sr. No.	Lamp Voltage	Short Circuit Current (μA)	Open Circuit Output Voltage (V)
1	0	9	1.71
2	1	10	1.72
3	2	15	1.72
4	3	15	1.73
5	4	15	1.75
6	5	20	1.80
7	6	30	1.89
8	7	50	1.95
9	8	70	2.01
10	9	70	2.06
11	10	70	2.08

Graph:



LAB ASSIGNMENT No. 11

Study the comparison between Lamp v/s Photo Conductive Cell

Equipment Required:

ST 2301 with Power supply cord

Multi Meter

Connecting cords

Optical Transducer:

An incandescent light bulb, incandescent lamp or incandescent light globe is an electric light which produces light with a wire filament heated to a high temperature by an electric current passing through it, until it glows see Incandescence. The hot filament is protected from oxidation with a glass or quartz bulb that is filled with inert gas or evacuated. In a halogen lamp, filament evaporation is prevented by a chemical process that redeposit metal vapor onto the filament, extending its life. The light bulb is supplied with electrical current by feed-through terminals or wires embedded in the glass. Most bulbs are used in a socket which provides mechanical support and electrical connections.

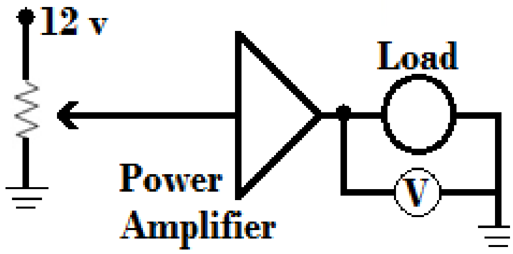
Incandescent bulbs are manufactured in a wide range of sizes, light output, and voltage ratings, from 1.5 volts to about 300 volts. They require no external regulating equipment, have low manufacturing costs, and work equally well on either alternating current or direct current. As a result, the incandescent lamp is widely used in household and commercial lighting, for portable lighting such as table lamps, car headlamps, and flashlights, and for decorative and advertising lighting.

Photoconductivity:

Photoconductivity is an optical and electrical phenomenon in which a material becomes more electrically conductive due to the absorption of electromagnetic radiation such as visible light, ultraviolet light, infrared light, or gamma radiation.

When light is absorbed by a material such as a semiconductor, the number of free electrons and electron holes increases and raises its electrical conductivity. To cause excitation, the light that strikes the semiconductor must have enough energy to raise electrons across the band gap, or to excite the impurities within the band gap. When a bias voltage and a load resistor are used in series with the semiconductor, a voltage drop across the load resistors can be measured when the change in electrical conductivity of the material varies the current flowing through the circuit.

Circuit Diagram:



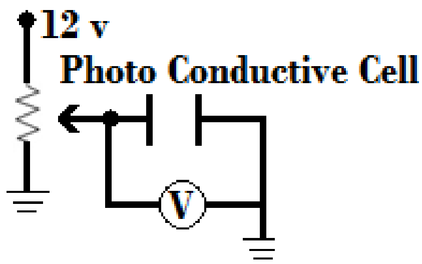
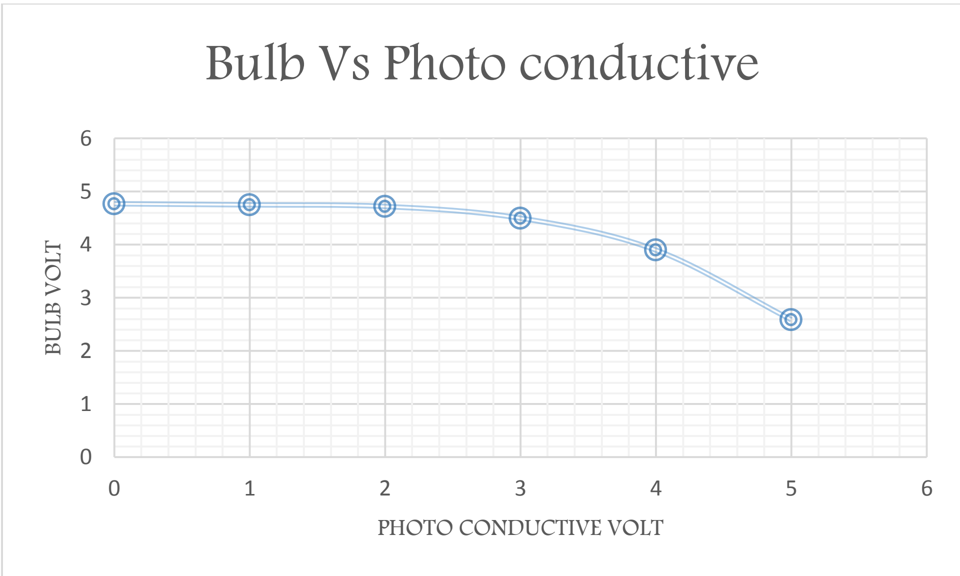


Table:

Sr. No.	Filament bulb voltage (V)	Photoconductive cell voltage (V)
1	0	4.77
2	1	4.75
3	2	4.72
4	3	4.50
5	4	3.90
6	5	2.59

Graph:



LAB ASSIGNMENT No. 12

Study the Input / Output Characteristics of LVDT

Equipment Required:

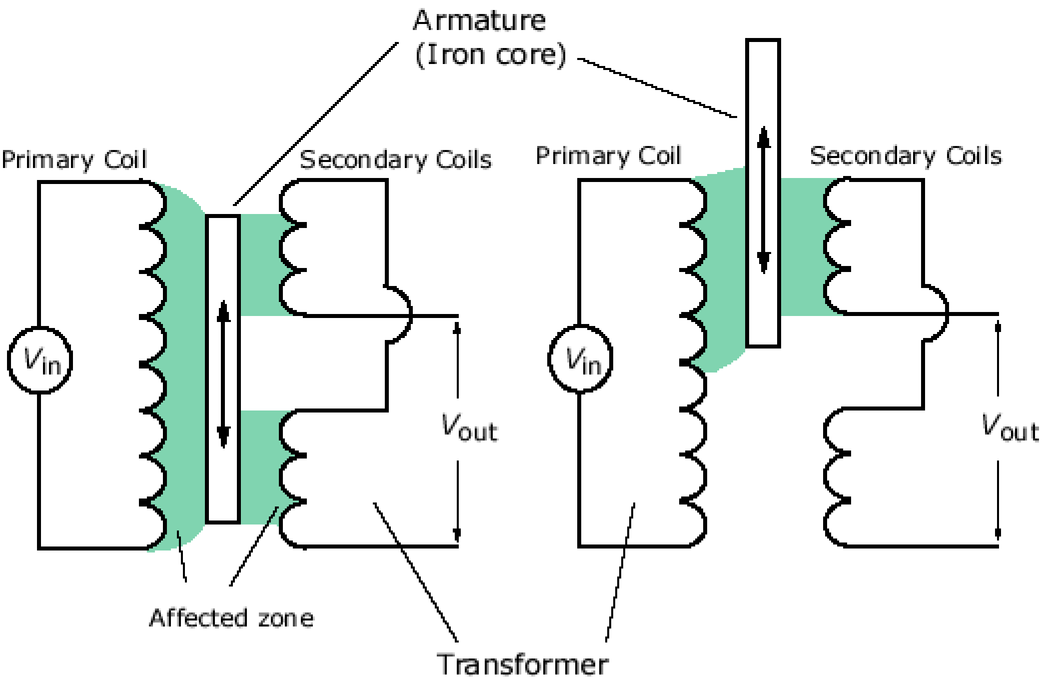
ST 2301 with Power supply cord
Multi Meter
Connecting cords

LVDT (Linear Variable Differential Transformer)

LVDT stands for Linear Variable Differential Transformer. It is most widely used inductive transducer that converts input displacement to an electrical signal. It consists of single primary winding and two secondary windings having equal number of turns and placed identically on either side of the primary winding. A movable soft iron core is placed inside a former upon which the windings are wound.

The primary is excited by an A.C voltage of frequency 50Hz to 20 KHz. The secondary are connected in series opposing when the core is placed in the null position and the output voltage is zero as equal voltages induced in the secondary cancel each other. LVDT primary, secondary windings are connected such that applied voltage on primary and induced voltage on secondary are 180° phase opposition as shown in the figure.

If the core is moved to the left of null position more flux will link S1 than that of S2. A resultant voltage (Es1 - Es2) which is in phase with primary voltage will appear across the output. If the core is moved to the right of null position, the resultant voltage (Es1 - Es2) is 180° out of phase with primary voltage which will be the output. Thus the output voltage is a measure of displacement.


Armature
(Iron core)
Primary Coil
Secondary Coils
Primary Coil
Secondary Coils
Vin
Vout
Vin
Vout
Affected zone
Transformer

Graph:

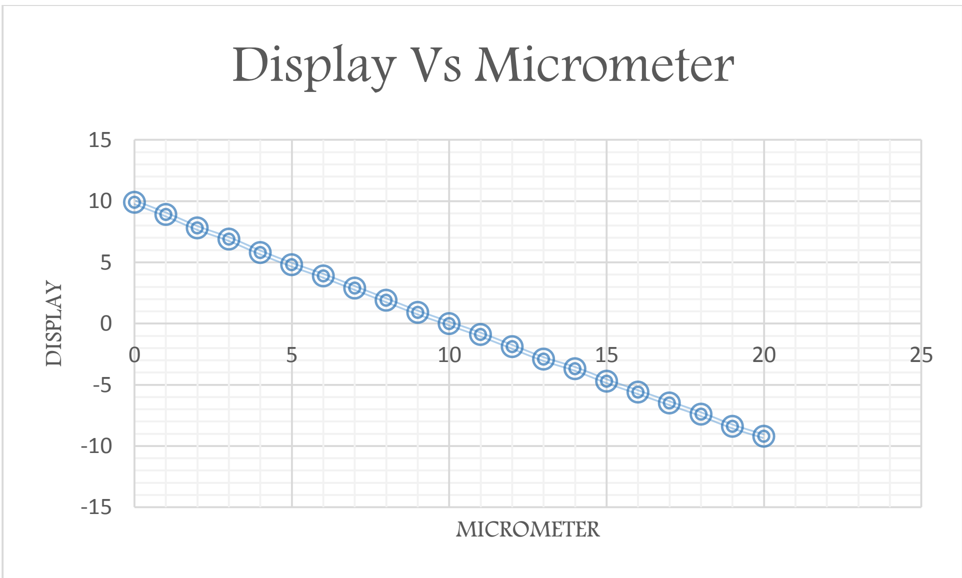

Display Vs Micrometer
DISPLAY
MICROMETER
15
10
5
0
-5
-10
-15
0
5
10
15
20
25

Table:

Sr. No.	Displacement by Micrometer (mm)	Display Reading (mm)
1	0	9.9
2	1	8.9
3	2	7.8
4	3	6.9
5	4	5.8
6	5	4.8
7	6	3.9
8	7	2.9
9	8	1.9
10	9	0.9
11	10	0
12	11	-0.9
13	12	-1.9
14	13	-2.9
15	14	-3.7
16	15	-4.7
17	16	-5.6
18	17	-6.5
19	18	-7.4
20	19	-8.4
21	20	-9.2

LAB ASSIGNMENT No. 13

Study the Linear Range of Operation of LVDT

Equipment Required:

ST 2301 with Power supply cord

Multi Meter

Connecting cords

LVDT (Linear Variable Differential Transformer)

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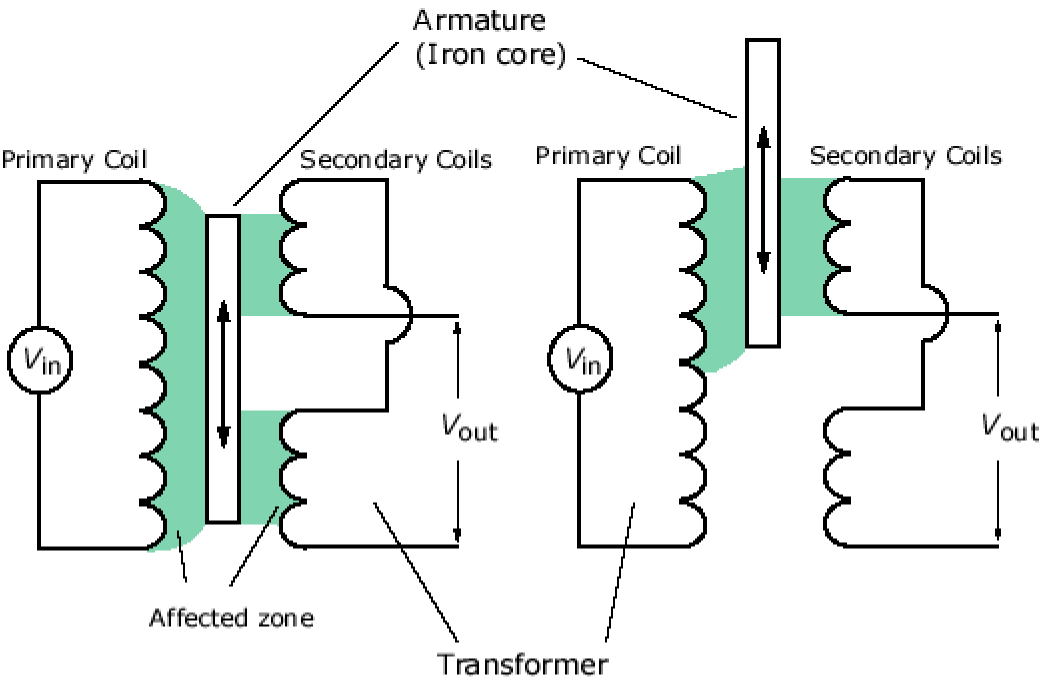
Armature
(Iron core)
Primary Coil
Secondary Coils
Primary Coil
Secondary Coils
Vin
Vout
Vin
Vout
Affected zone
Transformer

Graph:

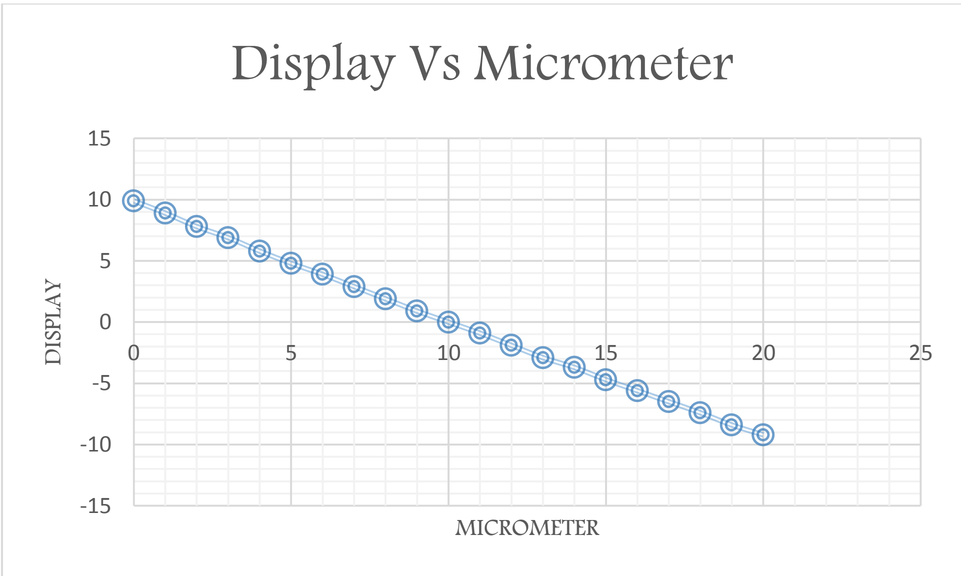
Display Vs Micrometer
15
10
5
0
-5
-10
-15
DISPLAY
0
5
10
15
20
25
MICROMETER

Table:

Sr. No.	Displacement by Micrometer (mm)	Display Reading (mm)
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3	2	7.8
4	3	6.9
5	4	5.8
6	5	4.8
7	6	3.9
8	7	2.9
9	8	1.9
10	9	0.9
11	10	0
12	11	-0.9
13	12	-1.9
14	13	-2.9
15	14	-3.7
16	15	-4.7
17	16	-5.6
18	17	-6.5
19	18	-7.4
20	19	-8.4
21	20	-9.2

LAB ASSIGNMENT No. 14

Study the Operation and Principle of Optically Controlled Switching System

Equipment Required:

ST 2301 with Power supply cord

Multi Meter

Connecting cords

Optical Transducer:

An incandescent light bulb, incandescent lamp or incandescent light globe is an electric light which produces light with a wire filament heated to a high temperature by an electric current passing through it, until it glows see Incandescence. The hot filament is protected from oxidation with a glass or quartz bulb that is filled with inert gas or evacuated. In a halogen lamp, filament evaporation is prevented by a chemical process that redeposit metal vapor onto the filament, extending its life. The light bulb is supplied with electrical current by feed-through terminals or wires embedded in the glass. Most bulbs are used in a socket which provides mechanical support and electrical connections.

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Circuit Diagram: