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EXPERIMENT-1

Objective :- To familiarize with electronic components and the usage of multimeter for the

i Measurement of resistance

ii Classification of capacitors and measurement of their capacitance

iii Diode testing

iv Transistor testing

Make voltage divider connection and verify its Thevenin Model using various arrangements of resistors.

Apparatus Required :-

(i) Plastic circuit Board (PCB)

ii Multimeter

iii Probe.

iv Capacitor probe

v. Connecting wires (vi) 12 V / 24 V DC Power Supply.

Theory :-

(i) Measurement of Resistance :- A resistor is a two-terminal electrical component that implement electric resistance as a circuit element. It opposes electric current by producing a voltage drop across its terminal in accordance with Ohm's law $R = V/I$ (for linear resistors)

The four coloured bands on the four resistors are used to indicate nominal values of their resistance and the permitted tolerance on the values, in ohms The first three bands (closest together) give the value of resistance in ohms (Ω). The band at the ~~end~~ first indicates the ~~1/~~ maximum significant digit(n_1).

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the second band indicates second digit (n_2). The third band indicates the no. of zeroes the following these two digits (n_3). Bands are colour coded as follows:-

Colour	Black	Brown	Red	Orange	Yellow	Green	Blue	Violet	Grey	White
Digit	0	1	2	3	4	5	6	7	8	9

Fourth band at the end indicates the tolerance. A red band means the resistor's value will be within ±2% of the stated value, gold ± 5%, silver ± 10% and absence of fourth band indicates ± 20% tolerance.

Identification of capacitors and measuring capacitors.

Small capacitors :-
Tantalum :- These are often coloured cylinders.
Mylar :- Yellow coloured cylinders made of long coils of metal foils separated by thin dielectrics.
Ceramics :- Disc shaped.

Diode Testing :- If potential ~~ties~~ diff. lies around 0.6 mv, then it is a Si diode, and if between 0.3-0.4 mv, then it is Ge diode.

Transistor ~~ror~~ testing :- Transistor is three terminal device with collector (C), Base (B), emitter (E). If multimeter ~~reads~~ display reading when the B is connected to anode

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then B is p-type and hence transistor is npn type.
If multimeter displays reading when B is connected to cathode, then B is n-type and transistor is pnp type.

Discussion :- (By Chelsi Rakeja / 16CS100131)

(i) In the board identify the circuit shown.
What is the resistance between terminals T_3 & T_7?
Measure the resistance and theory by verifying that the bottom ends of R_2 & R_3 are electrically joined.

(i) In fig(i),
Resistance between T_3 & T_7 = 9.14 kΩ (by multimeter)
Resistance between T_3 & T_7 by calculation

$$R_{eq} = R_1 + R_2 + R_3 = 4.89 + 2.4 + 2.34$$
$$= 9.63\ k\Omega$$

Hence bottom ends of R_2 and R_3 are electrically joined.

Q-2 Will the resistance b/w T_3 & T_7 differ if the ground points are instead actually connected to some point in planet earth?
No, because the potential ~~of cont~~ difference between two points is 0 as they are connected to same point to earth.

Q-3 Measure the applied voltage V_{T_3} at T_3. Verify that the voltage V_{T_4} at T_4 is given by

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$$V_{out} = V_{in} \times \frac{R_2}{R_1 + R_2}$$

Sol- In fig (iii)

$V_{in} = V_{T_3} = \cancel{12V}$ 12.12 V

By ~~~~ using multimeter, $V_{T_4} = 3.89$ V

By calculating,

$$V_{T_4} = \frac{12.12 (R_2)}{R_1 + R_2} = \frac{12.12V \times 2.4 k\Omega}{7.29 \; k\Omega} = 3.95 \; V$$

Q- What are Rin and Rout in fig (iv) ?

$R_{in} = R_1 + R_2 = 7.29 k\Omega$

$$R_{out} = R_1 \parallel R_2 = \frac{R_1 R_2}{R_1 + R_2} = \frac{4.89 \times 2.40 \; k\Omega}{7.29} = 1.609 \; k\Omega$$

Q. Calculate the voltage V_L and current I_L in fig (v) using Ohm's law.

(a) when $R_L = R_3$

$V_L = 2.29$ V (By multimeter)

$R_L = R_3 = 2.34$ kΩ

By calculation, $$V_L = \frac{V_{in}}{\left(\frac{R_2 R_L}{R_2 + R_L} + R_1\right)} \times \frac{R_2 R_L}{R_2 + R_L} = 2.34 \; V$$

$$I_L = \frac{V_L}{R_L} = 1 \; mA$$ (By calculation)

b $R_L = R_4 = 10.08$, $V_L = 3.37V$ (By multimeter)

Calculated V_L = $V_L = \frac{V_{in}}{\left(\frac{R_2 R_4}{R_2+R_4} + R_1\right)} \times \frac{R_2 R_4}{R_2 + R_4} = 3.4 V$

~~V_L=~~

$I_L = \frac{V_L}{R_L} = 1.754$ mA (by calculation)

(c) When $R_L = R_3 \parallel R_4 = 1.899 k\Omega$, $V_L = 2.10V$ (By multimeter)

$V_L = \frac{V_{in}}{\left(\frac{R_2 R_L}{R_2+R_L} + R_1\right)} \times \frac{R_2 R_L}{R_2 + R_L} = 12 \times .178$

$V_L = 2.14$ V (By calculation)

$I_L = \frac{V_L}{R_L} = 1.1268$ mA

II When capacitor is parallel to R_L,

a $R_L = R_3 \parallel C_b$

In steady state, capacitor act like an open terminal.
No current will from capacitor terminal.
$V_L = 2.29V$ (by multimeter) $V_L = 2.34V$ (calculated)

$I_L = 1mA$

b $R_L = R_4 \parallel C_b$

$V_L = 3.37V$ (By multimeter) $V_L = 3.4$ V (calculated)

$I_L = 1.754$ mA

~~c. $R_L = R$~~

~~$I_{R_L} = \frac{V_L}{R_L}$~~

iii ~~Make the conn~~ In fig(vii) by applying +12V between T_{18} & ground and -12V between T_{20} & ground. VA at T_{19} and compare with that given by $VA = (V_1 R_2 + V_2 R_1)/R_1 + R_2$

$\because$ $$\frac{V_1 - V_A}{R_1} = \frac{V_A - V_2}{R_2}$$

$$V_1 R_2 - V_A R_2 = V_A R_1 - V_2 R_1$$

$$V_A = \frac{V_1 R_2 + V_2 R_1}{R_1 + R_2} = \cancel{\frac{12(2.40) + (-12)(4.89)}{2.40 + 4.89}}$$

By using multimeter, $VA = -5.56$ V

By calculation, $V_A =$ ~~12.10 (2.4) - 12 12.19 (15.27 +~~ -

$$\cancel{V_A = \frac{12.10(15.27) - (11.95)(5.62)}{15.27 + 5.62} = 5.68\text{ V}}$$

$$V_A = \frac{12.10(5.62) - 11.95(15.27)}{15.27 + 5.62} = -5.479V$$

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DISCUSSION :

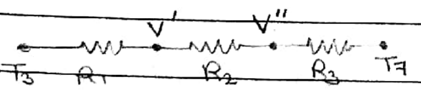
By,
Swastika Dutta
(16CS10060)

Resistances are characterised by the color bands. The value of resistances are measured by colour code and then with multimeter, the multimeter readings confirmed the measurement by color codes.

Capacitors are can be of various types, eg: metallic polyester film, ceramic, electrolytic, etc. Similarly, we also measured the capacitances of the capacitors ~~both~~ by code and confirmed it using the milimeter in capacitance measuring mode using capacitor probes.

In experiment (ii), R_2 and R_3 are joined by short-circuiting terminals T_3 and T_7. When the resistance between T_3 and T_7 is measured, we find it to be $R_{eq} = R_1 + R_2 + R_3$. which further proves they are in series.

No, the resistance between them will not change if they are connected to some other point on the earth as we measure the net voltage difference between the ~~ee~~ terminals.



$$V_7 - V_3 = (V_7 - V'') + (V'' - V') + (V' - V_{T_3})$$
$$= V_7 - V_3.$$

In experiment (iii) we measured V_L and I_L across the loads using both the multimeter and thevenin law. Hence, we showed that thevenin law holds true for this circuit.

In this experiment, we applied DC voltage $\Rightarrow \omega = 0$. Hence, impedance $= 1/\omega C = \infty$. Thus, it behaves like an open circuit and value of V_L remains same.

In second part of this experiment, we can apply Kirchoff's circuit law:

$$\frac{V_1 - V_A}{R_1} = \frac{V_A - V_2}{R_3}$$

$$\Rightarrow V_A = \frac{(V_1 \times R_2 + V_2 \times R_1)}{R_1 + R_2}$$

This was also verified by the readings of the multimeter.

Diodes are unilateral elements, i.e., they allow passage of electricity in only one direction — forward bias. The semiconductor used in the diodes can be measured using the cutoff voltages (0.6mV for SI and 0.3–0.4mV for Germanium).

It shows different resistances in different bias, and is generally used in forward bias. However special diodes, like zener diodes are used in backward bias.

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A junction transistor consists of base, emitter and collector. The base is sandwiched between the emitter and collector. They are broadly of two types - npn and pnp.

The base is identified by testing all voltages across combinations of volt terminals. It is the common point in the tests where there was voltage drop. Depending on the probe, we then find whether it is p-n-p or n-p-n.

- The collector and emitter is distinguished by finding voltage drop across each in forward bias, such that:

$|V_{BE}| > |V_{BC}|$.

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Discussion :-

By Chelsi Raheja
(16CS10013)

An electronic component is any basic discrete device or physical entity in an electronic system used to affect electrons or their associated fields. Electronic components have a number of electronic terminals which connect to create an electronic circuit with a particular function like an amplifier or oscillator.

Electronic components are classified as:

(i) Active
ii. Passive
iii Electromechanic

~~In th~~ This experiment comprises measurement of ~~resistances~~ value of resistors and capacitors which comes under active class of electronic components and also testing of diodes and transistors which comes under passive class of electronic components.

Multimeters :- It is an electronic ~~measuring~~ instrument which is used to measure circuit parameters like resistance, capacitance, voltage, diode tests, etc.

Value of resistances can be obtained experimentally by colour bands that are drawn on a resistors.

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which follows a code with some tolerance in that value. Resistances ~~and~~ are also measured by multimeter ~~which~~ by connecting them across two leads connected to multimeter.

By connecting resistance between ~~terminals~~ T_3 and T_7, we could verify that bottom ends of R_2 and R_3 are electrically joined as we could find that resistance between T_3 and T_7 ~~found~~ to be equal series resistances of R_1, R_2 and R_3.

Resistance between T_3 and T_7 does not differ because ~~they~~ ~~do~~ ~~so~~ ground points connected to some point of earth does not create ~~a~~ potential difference between two terminals as earth is assumed to be at 0 potential.

Experiment (III) contained calculation of voltage and current I_L using ohm's law and thereby comparing it with direct values of V_L measured by ~~a~~ multimeter which ~~a~~ comes out to be ~~abo~~ equal.

Capacitors are characterized by capacitance values and voltage ratings. Capacitors may belong to different families like ceramic, metallic, electrolytic, etc we measured capacitances by using multimeter and by ~~code~~ using a different kind of probes and also by using code.

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Capacitor reactance is given by $X_C = \frac{1}{wC}$ where

w is angular frequency of source voltage & C is the capacitance, but for a DC source that we used in this experiment characterized w=0 which implies X = ∞ Therefore, a capacitor worked as an open circuit, so when C_b is connected in parallel to R_L, value of V_L remained the same.

By applying 12 V across T_{18} and ground T_{19} and -12V across T_{20} and T_{19} ~~and~~ ground, we verified voltage between V_A and ground can be given by $V_A = (V_1R_2 + V_2R_1)/R_1+R_2$ by comparing it with value measured by using multimeter across $T_A(T_{19})$ and ground

Unilateral ~~characteristic~~ property of diode, allows flow of current in forward bias and voltage created across them can be used to find Semiconductor material which comes out to be 0.6 mV for silicon and 0.3-0.4 mV for Germanium)

A transistor is a three terminal device which can be a p-n-p or n-pn ~~by~~ which can be determined by using multimeter in diode-check position and forward bias diode drops |VBE|>|VBC| which help us to distinguish between collector and emitter terminals with base ~~is~~ sandwiched between them

Some diodes are used ~~as~~ in a reverse biased condition like zener diode to regulate voltage.

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