

ELECTRICAL AND ELECTRONICS WORKSHOP

LAB MANUAL FOR 1st YEAR

INDEX


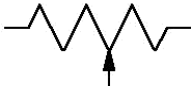
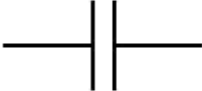
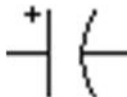


No	Date	Title	Sign	Remark
1		To Understand & Draw the symbols of various electronic devices.		
2		To identify resistors, capacitors using Different codes.		
3		Verification of Truth tables of Logic Gates (NAND, NOR, EX-OR, AND, OR, NOT).		
4		To study cathode ray oscilloscope and perform measurements.		
5		To study digital multimeter and perform testing of various components.		
6		To study function generator & Power Supply and perform measurements.		
7		To study soldering- de-soldering techniques.		
8		To study wiring diagram of ceiling Fan.		
9		How Fluorescent Lights Work.		
10		To study about stair case wiring two way switch.		
11		To Study Half – Wave Rectifier.		

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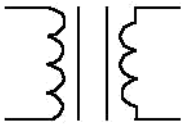
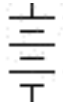


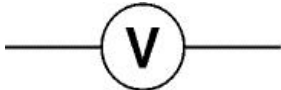



EXPERIMENT NO.: 1

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

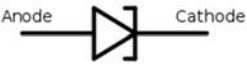
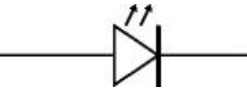
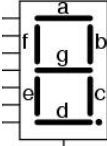
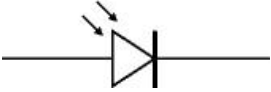
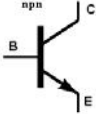
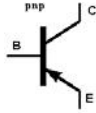
AIM: To Understand & Draw the symbols of various electronic devices.

Sr. No.	Device Name	Symbol
1.	Resistor	
2.	Variable resistor	
3.	Capacitor	
4.	Electrolyte (polarized) Capacitor	
5.	Variable capacitor	
6.	Inductor	

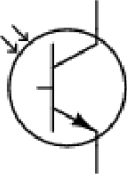
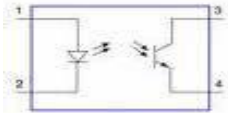






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7.	Transformer	
8.	DC power supply	
9.	Ground	
10.	AC supply	
11.	voltmeter	
12.	Current meter	
13.	CRO	
14.	ohm meter	








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15.	PN junction diode	
16.	Zener diode	
17.	Tunnel diode	
18.	Light Emitting diode(LED)	
19.	Seven segment display	
20.	Photo diode	
21.	nnp transistor	
22.	pnnp transistor	

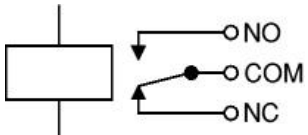


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23.	Photo transistor	
24.	Optocoupler	
25.	Thermistor	
26.	LDR(Light Dependent Resistor)	
27.	UJT(Uni Junction Transistor) n-type	
28.	UJT(Uni Junction Transistor) p-type	
29.	SCR(Silicon Controlled Rectifier)	
30.	DIAC	

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31.	TRIAC	
32.	n-channel JFET	
33.	p-channel JFET	
34.	n-channel depletion MOSFET	
35.	p-channel depletion MOSFET	
36.	n-channel enhance MOSFET	
37.	p-channel enhance MOSFET	

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38.	Relay	
39.	DC Supply	
40.	AC Supply	

CONCLUSION:


EXPERIMENT NO.: 2

Date:

AIM: To Identify resistors, capacitors using Different codes.

(a) To study different types of resistors and coding.

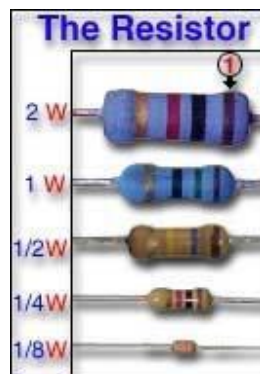
THEORY:

The resistor's function is to reduce the flow of electric current. This symbol  is used to indicate a resistor in a circuit diagram. Resistance value is designated in units called the "Ohm." A 1000 Ohm resistor is typically shown as 1K-Ohm (kilo Ohm), and 1000 K-Ohms is written as 1M-Ohm (Mega ohm).

There are two classes of resistors; **fixed resistors** and the **variable resistors**. They are also classified according to the material from which they are made. The typical resistor is made of either carbon film or metal film. There are other types as well, but these are the most common.

The resistance value of the resistor is not the only thing to consider when selecting a resistor for use in a circuit. The "tolerance" and the electric power ratings of the resistor are also important. The tolerance of a resistor denotes how close it is to the actual rated resistance value. For example, a $\pm 5\%$ tolerance would indicate a resistor that is within $\pm 5\%$ of the specified resistance value.

The power rating indicates how much power the resistor can safely tolerate. The maximum rated power of the resistor is specified in Watts. Power is calculated using the square of the current (I^2) x the resistance value (R) of the resistor. If the maximum rating of the resistor is exceeded, it will become extremely hot and even burn. Resistors in electronic circuits are typically rated 1/8W, 1/4W, 1/2W, 1W and 2W. 1/8W is almost always used in signal circuit applications. When powering a light emitting diode, a comparatively large current flow through the resistor, so you need to consider the power rating of the resistor you choose.



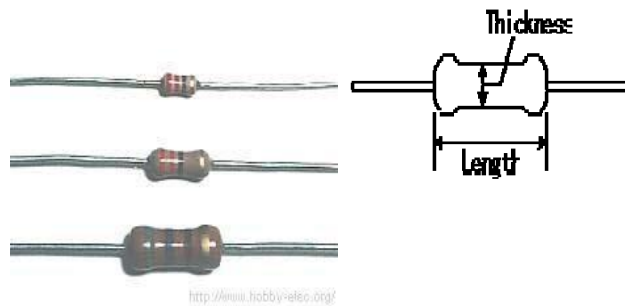
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Fixed Resistors:

A fixed resistor is one in which the value of its resistance cannot change. They are given below:

Carbon film resistors:

This is the most general purpose, cheap resistor. Usually the tolerance of the resistance value is $\pm 5\%$. Power ratings of $1/8W$, $1/4W$ and $1/2W$ are frequently used. Carbon film resistors have a disadvantage; they tend to be electrically noisy. Metal film resistors are recommended for use in analog circuits. The physical sizes of the different resistors are as follows.



Rough size		
Rating power (W)	Thickness (mm)	Length (mm)
1/8	2	3
1/4	2	6
1/2	3	9

Metal film resistors:

Metal film resistors are used when a higher tolerance (more accurate value) is needed. They are much more accurate in value than carbon film resistors. They have about $\pm 0.05\%$ tolerance. Resistors that are about $\pm 1\%$ are more than sufficient. Ni-Cr (Nichrome) seems to be used for the material of resistor. The metal film resistor is used for bridge circuits, filter circuits, and low-noise analog signal circuits.



<http://www.hobby-elect.org/>

From the top of the photograph

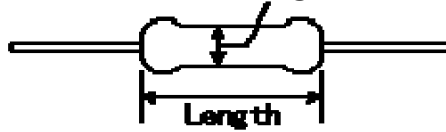
1/8W (tolerance $\pm 1\%$)

1/4W (tolerance $\pm 1\%$)

1W (tolerance $\pm 5\%$)

2W (tolerance $\pm 5\%$)

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Rough size

Rating power (W)	Thickness (mm)	Length (mm)
1/8	2	3
1/4	2	6
1	3.5	12
2	5	15

Variable Resistors:

There are two general ways in which variable resistors are used. One is the variable resistor which value is easily changed, like the volume adjustment of Radio. The other is semi-fixed resistor that is not meant to be adjusted by anyone but a technician. It is used to adjust the operating condition of the circuit by the technician. Semi-fixed resistors are used to compensate for the inaccuracies of the resistors, and to fine-tune a circuit. The rotation angle of the variable resistor is usually about 300 degrees. Some variable resistors must be turned many times to use the whole range of resistance they offer. This allows for very precise adjustments of their value. These are called "Potentiometers" or "Trimmer Potentiometers."



<http://www.hobby-elect.org/>

In the photograph to the left, the variable resistor typically used for volume controls can be seen on the far right. Its value is very easy to adjust.

The four resistors at the center of the photograph are the semi-fixed type. These ones are mounted on the printed circuit board.

The two resistors on the left are the trimmer potentiometers.

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Other Resistors:

There is another type of resistor other than the carbon-film type and the metal film resistors. It is the **wirewound resistor**. A wirewound resistor is made of metal resistance wire, and because of this, they can be manufactured to precise values. Also, high-wattage resistors can be made by using a thick wire material. Wirewound resistors cannot be used for high-frequency circuits. Coils are used in high frequency circuits. Since a wirewound resistor is a wire wrapped around an insulator, it is also a coil. Using one could change the behavior of the circuit. Still another type of resistor is the **Ceramic resistor**. These are wirewound resistors in a ceramic case, strengthened with special cement. They have very high power ratings, from 1 or 2 watts to dozens of watts. These resistors can become extremely hot when used for high power applications, and this must be taken into account when designing the circuit. These devices can easily get hot enough to burn you if you touch one.



The photograph on the left is of wirewound resistors.

The upper one is 10W and is the length of 45 mm, 13 mm thickness.

The lower one is 50W and is the length of 75 mm, 29 mm thickness.

The upper one is has metal fittings attached. These devices are insulated with a ceramic coating.



The photograph on left is a ceramic (or cement) resistor of 5W and the height is of 9 mm, 9 mm depth, 22 mm width.

CDS Elements

Some components can change resistance value by changes in the amount of light hitting them. One type is the Cadmium Sulfide Photocell. (Cd) The more light that hits it, the smaller its resistance value becomes.



There are many types of these devices. They vary according to light sensitivity, size, resistance value etc.

Pictured at the left is a typical CDS photocell. Its diameter is 8 mm, 4 mm high, with a cylinder form. When bright light is hitting it, the value is about 200 ohms, and when in the dark, the resistance value is

about 2M ohms.

Thermistor (Thermally sensitive resistor):

The resistance value of the Thermistor changes according to temperature. This part is used as a temperature sensor. There are mainly three types of thermistor.



1. NTC(Negative Temperature Coefficient thermistor)

With this type, the resistance value decreases continuously as the temperature rises.

2. PTC(Positive Temperature Coefficient Thermistor)

With this type, the resistance value increases suddenly when the temperature rises above a specific point.

3.CTR(Critical Temperature Resister Thermistor)

With this type, the resistance value decreases suddenly when the temperature rises above a specific point.

NTC type is used for the temperature control.

RESISTOR CODINGS:

Colour Coding:

There are main two types of codes used for the identification of value of the resistor. The resistance value is displayed using **the color code** (the colored bars/the colored stripes), because the average resistor is too small to have the value printed on it with numbers.

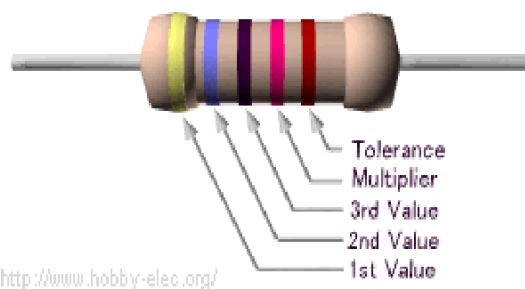


Example 1

(Brown=1),(Black=0),(Orange=3)

$$10 \times 10^3 = 10\text{k ohm}$$

Tolerance(Gold) = $\pm 5\%$



Color	Value	Multiplier	Tolerance (%)
Black	0	10	-
Brown	1	10	± 1
Red	2	10	± 2
Orange	3	10	± 0.05
Yellow	4	10	-
Green	5	10	± 0.5
Blue	6	10	± 0.25
Violet	7	10	± 0.1

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Example 2

(Yellow=4),(Violet=7),(Black=0),(Red=2)

$$470 \times 10^2 = 47\text{k ohm}$$

$$\text{Tolerance(Brown)} = \pm 1\%$$

Gray	8	10	-
White	9	10	-
Gold	-	10-1	± 5
Silver	-	10-2	± 10
None	-	-	± 20


Character Coding:

Characters are also used for coding the resistor. The characters used for coding are E, K, M, and R. When character comes in between two decimal numbers, it acts as a decimal point. The letter E indicates Ohms only, K indicates Kilo ohms and M indicates Mega ohms. e.g.

1. $2E5 = 2.5 \Omega$
 2. $3K9 = 3.9 K\Omega$
 3. $9M7 = 9.7 M\Omega$
 4. $23E = 23\Omega$
 5. $1K = 1 K\Omega$
 6. $2M = 2M\Omega$
 7. $22M3 = 22.3M\Omega$
 8. $R3 = 0.3 \Omega$
-

(b) To study different types of capacitors and coding.

THEORY:

The capacitor's function is to store electricity, or electrical energy. The capacitor also functions as a filter, passing alternating current (AC), and blocking direct current (DC). This symbol  is used to indicate a capacitor in a circuit diagram. The capacitor is constructed with two electrode plates facing each other, but separated by an insulator. When DC voltage is applied to the capacitor, *an electric charge* is stored on each electrode. While the capacitor is charging up, current flows. The current will stop flowing when the capacitor has fully charged.

The capacitor has an insulator (the dielectric) between 2 sheets of electrodes. Different kinds of capacitors use different materials for the dielectric.

Breakdown voltage:

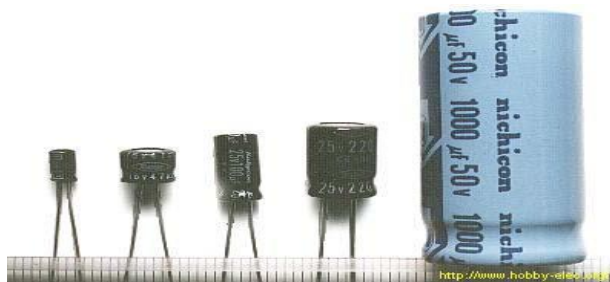
When using a capacitor, you must pay attention to the maximum voltage which can be used. This is the "breakdown voltage." The breakdown voltage depends on the kind of capacitor being used. You must be especially careful with electrolytic capacitors because the breakdown voltage is comparatively low. The breakdown voltage of electrolytic capacitors is displayed as Working Voltage. The breakdown voltage is the voltage that when exceeded will cause the dielectric (insulator) inside the capacitor to break down and conduct. When this happens, the failure can be catastrophic.

The different types of capacitors are given below:

Electrolytic Capacitors (Electrochemical type capacitors):

Aluminum is used for the electrodes by using a thin oxidization membrane. Large values of capacitance can be obtained in comparison with the size of the capacitor, because the dielectric used is very thin. The most important characteristic of electrolytic capacitors is that they have polarity. They have a positive and a negative electrode [Polarized]. This means that it is very important which way round they are connected. If the capacitor is subjected to voltage exceeding its working voltage, or if it is connected with incorrect polarity, it may burst. It is extremely dangerous, because it can quite literally explode. Make absolutely no mistakes. Generally,

in the circuit diagram, the positive side is indicated by a "+" (plus) symbol. Electrolytic capacitors range in value from about $1\mu\text{F}$ to thousands of μF . Mainly this type of capacitor is used as a ripple filter in a power supply circuit, or as a filter to bypass low frequency signals, etc. Because this type of capacitor is comparatively



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similar to the nature of a coil in construction, it isn't possible to use for high-frequency circuits. (It is said that the frequency characteristic is bad.)

The photograph on the left is an example of the different values of electrolytic capacitors in which the capacitance and voltage differ.

From the left to right:

1 μ F (50V) [diameter 5 mm, high 12 mm]

47 μ F (16V) [diameter 6 mm, high 5 mm]

100 μ F (25V) [diameter 5 mm, high 11 mm]

220 μ F (25V) [diameter 8 mm, high 12 mm]

1000 μ F (50V) [diameter 18 mm, high 40 mm]

The size of the capacitor sometimes depends on the manufacturer. So the sizes shown here are just examples.

In the photograph to the right, the mark indicating the negative lead of the component can be seen.

You need to pay attention to the polarity indication so as not to make a mistake when you assemble the circuit.



Tantalum Capacitors

Tantalum Capacitors are electrolytic capacitors that use a material called tantalum for the electrodes. Large values of capacitance similar to aluminum electrolytic capacitors can be obtained. Also, tantalum capacitors are superior to aluminum electrolytic capacitors in temperature and frequency characteristics. When tantalum powder is baked in order to solidify it, A crack forms inside. An electric charge can be stored on this crack. These capacitors have polarity as well. Usually, the "+" symbol is used to show the positive component lead. Do not make a mistake with the polarity on these types. Tantalum capacitors are a little bit more expensive than aluminum electrolytic capacitors. Capacitance can change with temperature as well as frequency, and these types are very stable. Therefore, tantalum capacitors are used for circuits which demand high stability in the capacitance

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values. Also, it is said to be common sense to use tantalum capacitors for analog signal systems, because the current-spike noise that occurs with aluminum electrolytic capacitors does not appear. Aluminum electrolytic capacitors are fine if you don't use them for circuits which need the high stability characteristics of tantalum capacitors.



The photograph on the left illustrates the tantalum capacitor. The capacitance values are as follows, from the left:

0.33 μF (35V)

0.47 μF (35V)

10 μF (35V)

The "+" symbol is used to show the positive lead of the component. It is written on the body.

Ceramic Capacitors

Ceramic capacitors are constructed with materials such as titanium acid barium used as the dielectric. Internally, these capacitors are not constructed as a coil, so they can be used in high frequency applications.




Typically, they are used in circuits which bypass high frequency signals to ground. These capacitors have the shape of a disk. Their capacitance is comparatively small. The capacitor on the left is a 100pF capacitor with a diameter of about 3 mm. The capacitor on the right side is printed with 103, so $10 \times 10^3 \text{ pF}$ becomes 0.01 μF . The diameter of the disk is about

6 mm. Ceramic capacitors have no polarity. Ceramic capacitors should not be used for analog circuits, because they can distort the signal.

Multilayer Ceramic Capacitors

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The multilayer ceramic capacitor has a many-layered dielectric. These capacitors are small in size, and have good temperature and frequency characteristics. Square wave signals  used in digital circuits can have a comparatively high frequency component included. This capacitor is used to bypass the high frequency to ground.

In the photograph, the capacitance of the component on the left is displayed as 104. So, the capacitance is $10 \times 10^4 \text{ pF} = 0.1 \text{ }\mu\text{F}$. The thickness is 2 mm, the height is 3 mm, and the width is 4 mm. The capacitor to the right has a capacitance of 103 ($10 \times 10^3 \text{ pF} = 0.01 \text{ }\mu\text{F}$). The height is 4 mm, the diameter of the round part is 2 mm. These capacitors are not polarized. That is, they have no polarity.



Variable Capacitors

Variable capacitors are used for adjustment etc. of frequency mainly.



On the left in the photograph is a "trimmer," which uses ceramic as the dielectric. Next to it on the right is one that uses polyester film for the dielectric.

The pictured components are meant to be mounted on a printed circuit board.

When adjusting the value of a variable capacitor, it is advisable to be careful. One of the component's leads is connected to the adjustment screw of the capacitor. This means that the value of the capacitor can be affected by the capacitance of the screwdriver in your hand. It is better to use a special screwdriver to adjust these components.

Pictured in the upper left photograph are variable capacitors with the following specifications:

Capacitance: 20pF (3pF - 27pF measured) [Thickness 6 mm, height 4.8 mm]

There are different colors, as well. Blue: 7pF (2 - 9), white: 10pF (3 - 15), green: 30pF (5 - 35), brown: 60pF (8 - 72). In the same photograph, the device on the right has the following specifications:

Capacitance: 30pF (5pF - 40pF measured) [The width (long) 6.8 mm, width (short) 4.9 mm, and the height 5 mm]

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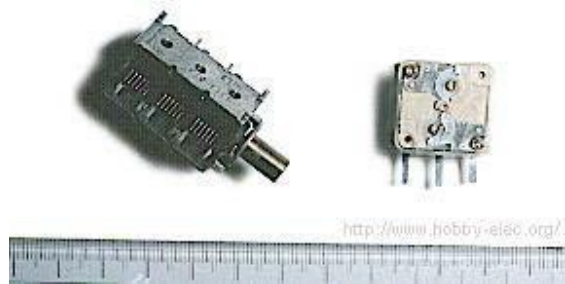
The components in the photograph on the right are used for radio tuners, etc. They are called "Varicons" but this may be only in Japan.

The variable capacitor on the left in the photograph, uses air as the dielectric. It combines three independent capacitors.

For each one, the capacitance changed 2pF - 18pF. When the adjustment axis is turned, the capacitance of all 3 capacitors change simultaneously.

Physically, the device has a depth of 29 mm, and 17 mm width and height. (Not including the adjustment rod.)

There are various kinds of variable capacitor, chosen in accordance with the purpose for which they are needed. The pictured components are very small.



To the right in the photograph is a variable capacitor using polyester film as the dielectric. Two independent capacitors are combined.

The capacitance of one side changes 12pF - 150pF, while the other side changes from 11pF - 70pF.

Physically, it has a depth of 11mm, and 20mm width and height. (Not including the adjustment rod.)

The pictured device also has a small trimmer built in to each capacitor to allow for precise adjustment up to 15pF.

CAPACITOR CODINGS:

The value of a capacitor (the capacitance), is designated in units called the Farad (F). The capacitance of a capacitor is generally very small, so units such as the microfarad (10^{-6} F), nanofarad (10^{-9} F), and picofarad (10^{-12} F) are used. The method used differs depending on the capacitor supplier. Also for different types of capacitors the coding is different. For example, on electrolytic capacitors the value is directly printed on the capacitor. For ceramic capacitor there are four types of codings.

(i) Using numbers, (ii) Using letters and numbers both, (iii) directly printed for μ F.

1. Coding using numbers:

A three-digit code is used to indicate the value of a capacitor. In the case that the value is displayed with the three-digit code, the 1st and 2nd digits from the left show the 1st figure and the 2nd figure, and the 3rd digit is a multiplier which determines how many zeros are to be added to the capacitance. Picofarad (pF) units are written this way.

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For example,

[103] indicates 10×10^3 , or $10,000\text{pF} = 10 \text{ nanofarad (nF)} = 0.01\text{microfarad } (\mu\text{F})$.

[224] indicates 22×10^4 or $220,000\text{pF} = 220\text{nF} = 0.22\mu\text{F}$.

Values under 100pF are displayed with 2 digits only. For example, 47 would be 47pF .

2. Coding using letters and numbers both:

When letter K comes in between two digits, it acts as a decimal point. Picofarad (pF) units are also written this way.

For example,

[3K3] indicates $3.3\text{k} = 3300 \text{ pF} = 3.3\text{nF}$.

[1k] indicates $1\text{k} = 1000\text{pF} = 1\text{nF}$,

[33k] indicates $33\text{k} = 33000\text{pF} = 33\text{nF}$.

3. Directly printed for microfarad:

If decimal dot is given in the code, directly consider the value in microfarad.

For example,

[0.1] indicates $0.1 \mu\text{F}$,

[0.22] indicates $0.22 \mu\text{F}$

[0.47] indicates $0.47 \mu\text{F}$

CONCLUSION:

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EXPERIMENT NO.: 3

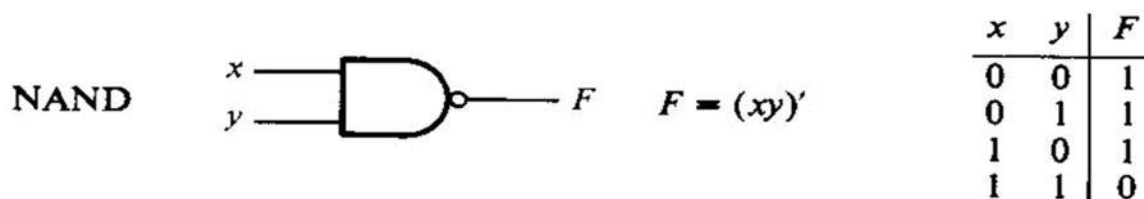
Date:

AIM: Verification of Truth tables of logic gates (NAND, NOR, EX-OR, AND, OR, NOT).

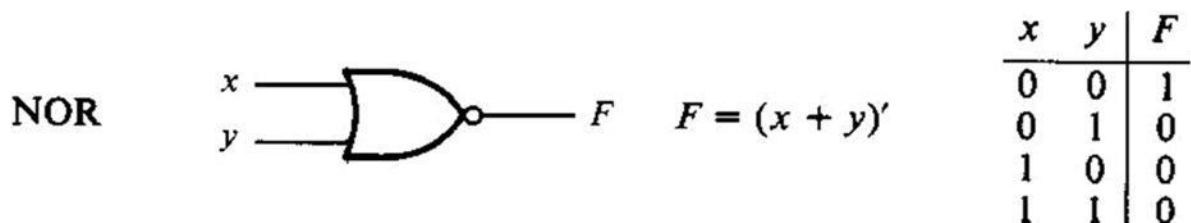
APPARATUS REQUIRED: Power Supply, Digital Trainer Kit, Connecting Lead (7400,7402,7404,7432,7408,7486)

BRIEF THEORY:

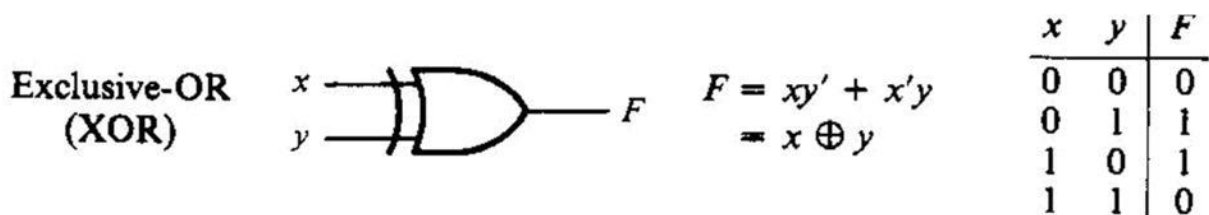
NAND GATE: The IC no. for NAND gate is 7400. The NOT-AND operation is known as NAND operation. If all inputs are 1 then output produced is 0. NAND gate is inverted AND gate.



NOR GATE: The NOR gate has two or more input signals but only one output signal. IC 7402 is two I/P IC. The NOT- OR operation is known as NOR operation. If all the inputs are 0 then the O/P is 1. NOR gate is inverted OR gate.

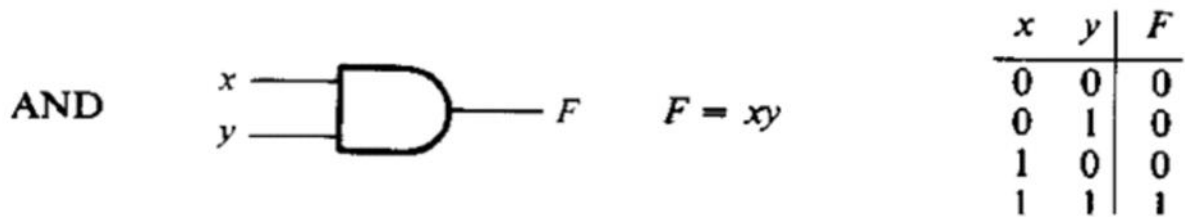


EX-OR GATE: The EX-OR gate can have two or more inputs but produce one output. 7486 is two input IC. EX-OR gate is not a basic operation & can be performed using basic gates.



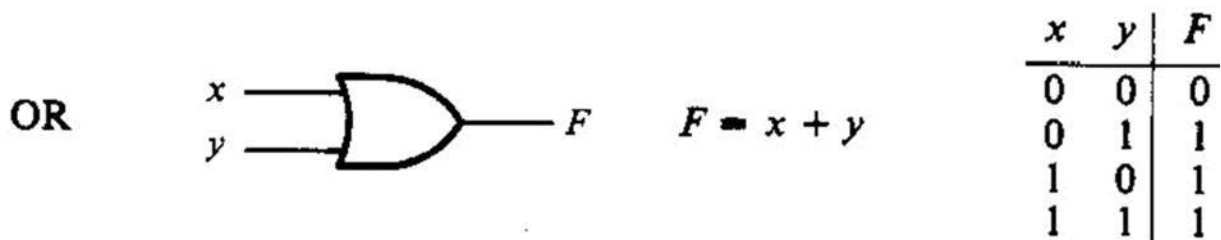
AND GATE The AND operation is defined as the output as one if and only if all the inputs are one. 7408 is the two Input AND gate IC. A&B are the Input Terminals & Y is the Output terminal.

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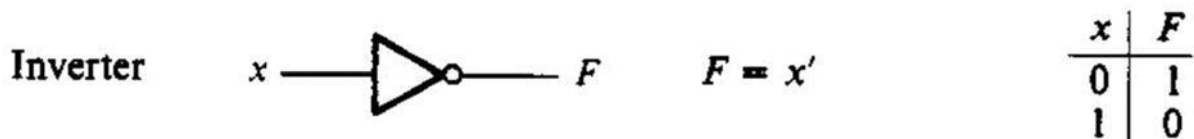


OR Gate: The OR operation is defined as the output as one if one or more than one inputs are one. 7432 is the two Input OR gate IC. A & B are the input terminals & Y is the Output terminal.

$$Y = A + B$$



NOT GATE: The NOT gate is also known as Inverter. It has one input (A) & one output (Y). IC No. is 7404. Its logical equation is, $Y = \text{NOT } A$ $Y = A'$



PROCEDURE:

- Fix the IC's on breadboard & give the input supply.
- Connect the +ve terminal of supply to pin 14 & -ve to pin 7.
- Give input at pin 1, 2 & take output from pin 3. It is same for all except NOT & NOR IC.
- For NOR, pin 1 is output & pin 2 & 3 are inputs.
- For NOT, pin 1 is input & pin 2 is output.
- Note the values of output for different combination of inputs & draw the TRUTH TABLE.

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OBSERVATION TABLE:

AND		OR		NOT		NOR		NAND		EX-OR	
I/P	O/P	I/P	O/P	I/P	O/P	I/P	O/P	I/P	O/P	I/P	O/P

RESULT: We have learnt all the gates ICs according to the IC pin diagram.

PRECAUTIONS:

- 1) Make the connections according to the IC pin diagram.
- 2) The connections should be tight.
- 3) The V_{cc} and ground should be applied carefully at the specified pin only.

CONCLUSION:

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EXPERIMENT NO.: 4

Date:

AIM: To study Cathode Ray Oscilloscope and perform measurements.

APPARATUS:

1. CRO
2. CRO probes

THEORY:



An oscilloscope is a test instrument which allows you to look at the 'shape' of electrical signals by displaying a graph of voltage against time on its screen. It is like a voltmeter with the valuable extra function of showing how the voltage varies with time.

The graph, usually called the trace, is drawn by a beam of electrons striking the phosphor coating of the screen making it emit light, usually green or blue. This is similar to the way a television picture is produced.

Oscilloscopes contain a vacuum tube with a cathode (negative electrode) at one end to emit electrons and an anode (positive electrode) to accelerate them so they move rapidly down the tube to the screen. This arrangement is called an electron gun. The tube also contains electrodes to deflect the electron beam up/down and left/right.

The electrons are called cathode rays because they are emitted by the cathode and this gives the oscilloscope its full name of cathode ray oscilloscope or CRO.

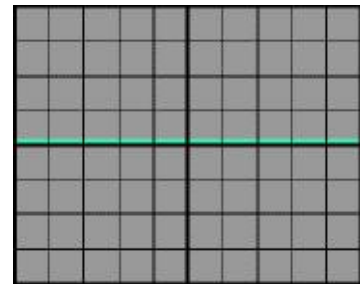
A dual trace oscilloscope can display two traces on the screen, allowing you to easily compare the input and output of an amplifier for example. It is well worth paying the modest extra cost to have this facility.

Setting up an oscilloscope

Oscilloscopes are complex instruments with many controls and they require some care to set up and use successfully. It is quite easy to 'lose' the trace off the screen if controls are set wrongly.

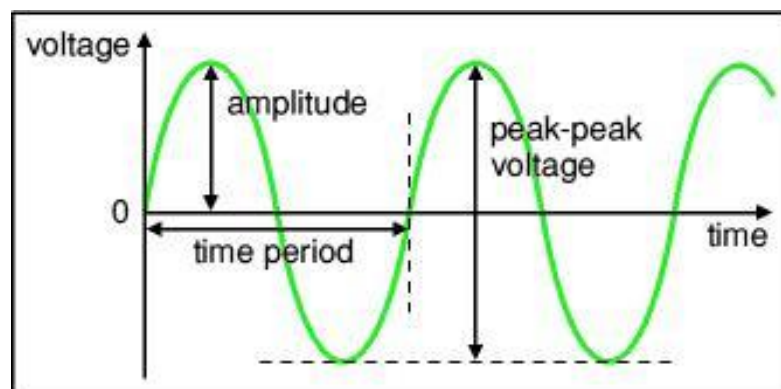
There is some variation in the arrangement and labeling of the many controls so the following instructions may need to be adapted for your instrument.

1. Switch on the oscilloscope to warm up (it takes a minute or two).
2. Do not connect the input lead at this stage.
3. Set the AC/GND/DC switch (by the Y INPUT) to DC.
4. Set the SWP/X-Y switch to SWP (sweep).
5. Set Trigger Level to AUTO.
6. Set Trigger Source to INT (internal, the y input).
7. Set the Y AMPLIFIER to 5V/cm (a moderate value).
8. Set the TIMEBASE to 10ms/cm (a moderate speed).
9. Turn the time base VARIABLE control to 1 or CAL.
10. Adjust Y SHIFT (up/down) and X SHIFT (left/right) to give a trace across the middle of the screen, like the picture.
11. Adjust INTENSITY (brightness) and FOCUS to give a bright, sharp trace.
12. The oscilloscope is now ready to use.



This is what you should see after setting up, when there is no input signal connected

Measuring voltage and time period



The trace on an oscilloscope screen is a **graph of voltage against time**. The shape of this graph is determined by the nature of the input signal.

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In addition to the properties labelled on the graph, there is frequency which is the number of cycles per second.

The diagram shows a **sine wave** but these properties apply to any signal with a constant shape.

- **Amplitude** is the maximum voltage reached by the signal.
It is measured in **volts, V**.
- **Peak voltage** is another name for amplitude.
- **Peak-peak voltage** is twice the peak voltage (amplitude). When reading an oscilloscope trace it is usual to measure peak-peak voltage.
- **Time period** is the time taken for the signal to complete one cycle.
It is measured in **seconds (s)**, but time periods tend to be short so **milliseconds (ms)** and **microseconds (µs)** are often used. $1\text{ms} = 0.001\text{s}$ and $1\mu\text{s} = 0.000001\text{s}$.
- **Frequency** is the number of cycles per second.
It is measured in **hertz (Hz)**, but frequencies tend to be high so **kilohertz (kHz)** and **megahertz (MHz)** are often used. $1\text{kHz} = 1000\text{Hz}$ and $1\text{MHz} = 1000000\text{Hz}$.

$$\text{Frequency} = \frac{1}{\text{Time Period}} \quad \text{and} \quad \text{Time Period} = \frac{1}{\text{Frequency}}$$

Voltage

Voltage is shown on the **vertical y-axis** and the scale is determined by the Y AMPLIFIER (VOLTS/CM) control. Usually **peak-peak voltage** is measured because it can be read correctly even if the position of 0V is not known. The **amplitude** is half the peak-peak voltage.

If you wish to read the amplitude voltage directly you must check the position of 0V (normally halfway up the screen): move the AC/GND/DC switch to GND (0V) and use Y-SHIFT (up/down) to adjust the position of the trace if necessary, switch back to DC afterwards so you can see the signal again.

$$\text{Voltage} = \text{distance in cm} \times \text{volts/cm}$$

Time period

Time is shown on the **horizontal x-axis** and the scale is determined by the TIMEBASE (TIME/CM) control. The **time period** (often just called **period**) is the time for one cycle of the signal. The **frequency** is the number of cycles per second, $\text{frequency} = 1/\text{time period}$

Ensure that the variable timebase control is set to 1 or CAL (calibrated) before attempting to take a time reading.

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Time = distance in cm \times time/cm

Precautions

- An oscilloscope should be handled gently to protect its fragile (and expensive) vacuum tube.
- Oscilloscopes use high voltages to create the electron beam and these remain for some time after switching off - for your own safety do not attempt to examine the inside of an oscilloscope.

CONCLUSION:

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EXPERIMENT NO.: 5

Date:

AIM: To study digital multimeter and perform testing of various components.

APPARATUS:

3. digital multimeter
4. resistors
5. diode
6. P-n-p and n-p-n transistors.

Typical Voltage/Current Test

Voltmeters are usually connected across a circuit. You can perform two types of tests with a voltmeter. If you connect it from the positive terminal of a component to ground, you will read the amount of voltage there is to operate the component. It will usually read 0 volts or full voltage. If you test a component that is supposed to have 12 volts, but there is 0 volts, there is an open in the circuit. This is where you will have to trace back until you locate the open.

Using digital multimeter, we can measure voltage across any electronic component. We have to connect the multimeter probes across that component. We can measure ac or dc voltage. The switch position must be kept at particular position to ensure correct readings. To measure ac voltage/current, the switch should be kept on V~ / A~ range. Same way, to measure dc voltage/current, the switch should be kept on V- / A- range.

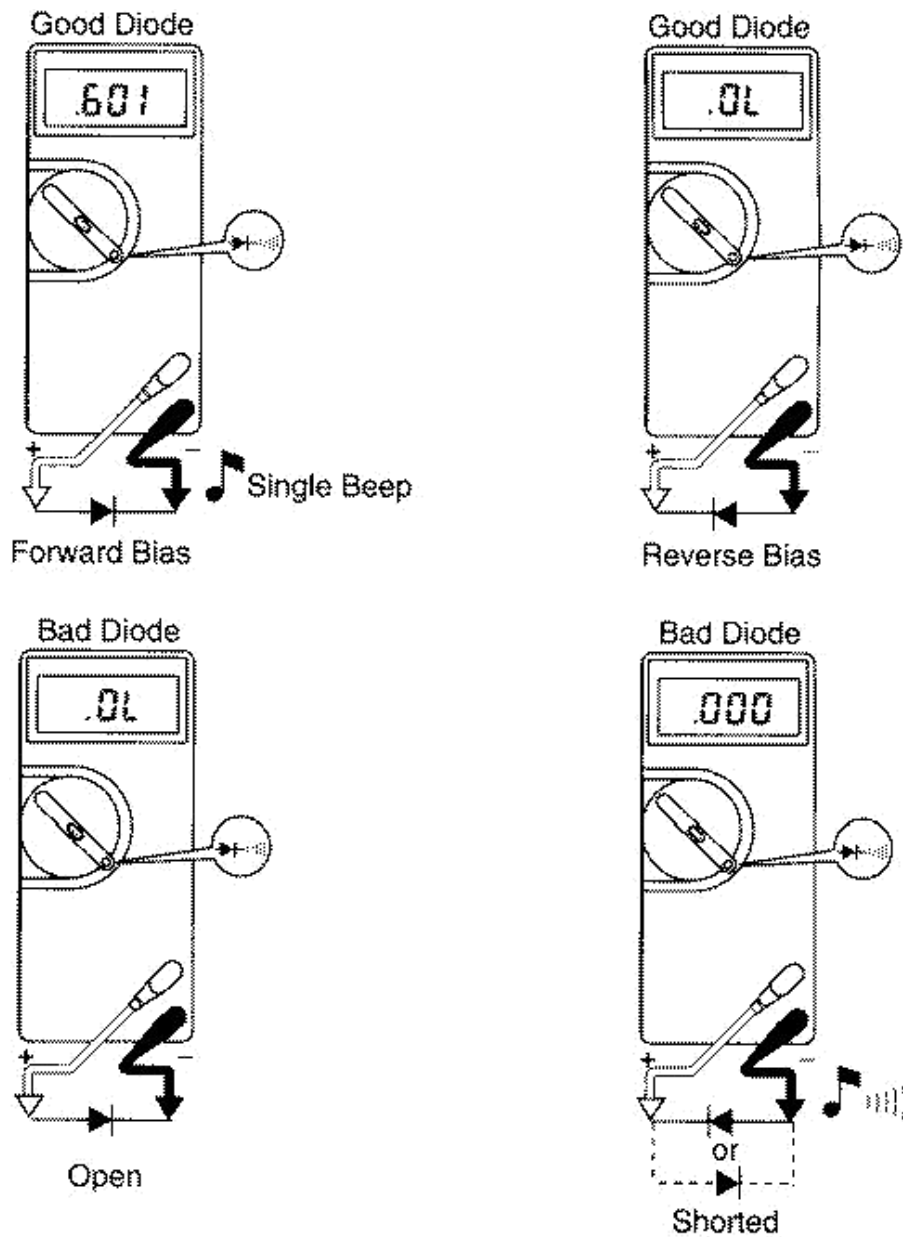
Typical Resistance Test

Another useful function of the DMM is the ohmmeter. An ohmmeter measures the electrical resistance of a circuit. The switch should be kept on Ω range. If you have no resistance in a circuit, the ohmmeter will read 0. If you have an open in a circuit, it will read infinite.

An ohmmeter uses its own battery to conduct a resistance test. Therefore there must be no power in the circuit being tested or the ohmmeter will become damaged.

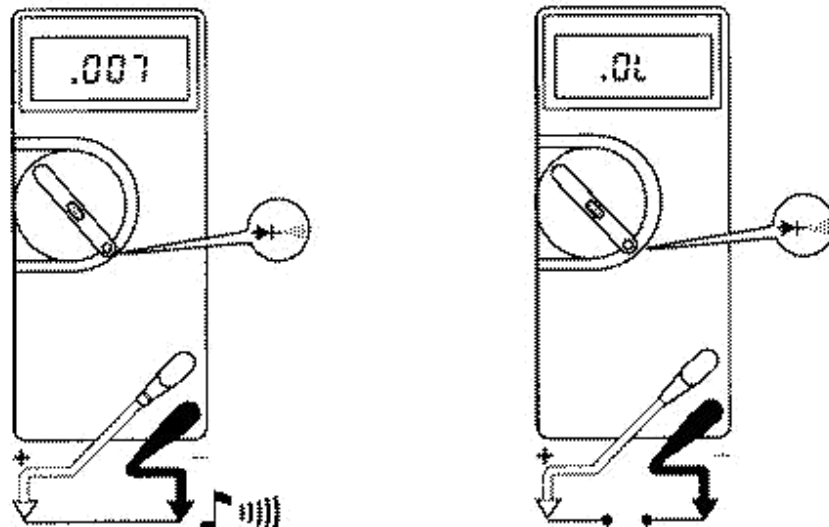
When you test a component you put the red lead on the positive side and the black lead on the negative side. Current from the battery will flow through the component and the meter will determine the resistance by how much the voltage drops. If the component has an open the meter will flash "1.000" or "OL" to show an open or infinite resistance. A reading of 0 ohms indicates that there is no resistance in the component and it is shorted. If a component is supposed to have 1,000 ohms of resistance and a test shows it has 100 ohms of resistance, which indicates a short. If it reads infinite, then it is open.

Testing Diode



On a (digital) DMM, there will usually be a diode test mode. Using this, a silicon diode should read between .5 to .8 V in the forward direction and open in reverse. For a germanium diode, it will be lower, perhaps .2 to .4 V or so in the forward direction. Using the normal resistance ranges - any of them - will usually show open for any semiconductor junction since the meter does not apply enough voltage to reach the value of the forward drop. Note, however, that a defective diode may indeed indicate a resistance lower than infinity especially on the highest ohms range. So, any reading of this sort would be an indication of a bad device but the opposite is not guaranteed.

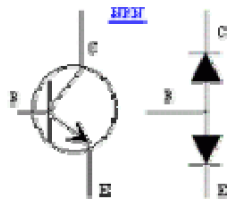
Continuity test



This mode is used to check if two points are electrically connected. It is often used to verify connectors. If continuity exists (resistance less than 210 ohms), the beeper sounds continuously.

Testing bipolar transistors

The assumption made when testing **transistors** is that a transistor is just a pair of connected diodes. Therefore it can be tested for shorts, opens or leakage with a simple digital multimeter.



To test a bipolar transistor with a digital multimeter, take it out of circuit and make the following measurements using the diode test mode:

- Connect the red (positive) lead to the base of the transistor. Connect the black (negative) lead to the emitter. A good NPN transistor will read a **junction drop voltage** of 0.4V to 0.9V. A good PNP transistor will read **open**.
- Leave the red meter lead on the base and move the black meter lead to the collector - the reading should be *almost the same as the previous test*, open for PNP and a *slightly lower voltage drop* for NPN transistors.
- Reverse the meter leads and repeat the test. This time, connect the black meter lead to the base of the transistor and the red lead to the emitter. A good PNP transistor will read a **junction drop voltage** of 0.4V to 0.9V. A good NPN transistor will read **open**.

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- Leave the black meter lead on the base and move the red lead to the collector - the reading should be *almost the same as the previous test*, open for NPN and a *slightly lower voltage drop* for PNP transistors.
- Place one meter lead on the collector, the other on the emitter, then reverse. Both tests should read **open** for both NPN and PNP transistors.

If you read a short circuit (zero ohms or a voltage drop of zero) between two leads, or the transistor fails any of the tests described above, it is bad and must be replaced.

If you get readings that do not make sense, try to compare them with measurements done on a good transistor of the same type.

Identifying the leads and polarity of unknown bipolar transistors

The type (**PNP** or **NPN**) and the **lead arrangement** of unmarked transistors can be determined easily using a digital or analog multimeter, if the transistor is seen as a pair of connected diodes. The collector and emitter can be identified knowing the fact that the doping for the B-E junction is always much higher than for the B-C junction, therefore, the forward voltage drop will be slightly higher. This will show up as a couple of millivolts difference on a digital multimeter's diode test scale or a slightly higher resistance on an analog VoltOhmMeter.

First *make the a few measurements between various leads*. Soon you'll identify a lead (the **Base**) that will show a forward voltage drop (on DMMs) combined with two other leads (the Emitter and Collector). Now that the Base is identified, observe carefully the voltage drops across B-E and B-C. The **B-C** junction will have a slightly less voltage drop.

If you arrived at this point, you already know the **polarity** of the transistor under test. If the negative lead (black lead connected to the COM on most digital multimeters) is placed on the Base when measuring the B-C and B -E voltage drops - you have a **PNP transistor**. Similarly - if the positive meter lead is placed on the base, you have a **NPN transistor**.

CONCLUSION:

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EXPERIMENT NO.: 6

Date:

AIM: To study function generator & Power Supply and perform measurements.

APPARATUS:

7. function generator
8. CRO probes

THEORY:

A function generator is a device that can produce various patterns of voltage at a variety of frequencies and amplitudes. It is used to test the response of circuits to common input signals. The electrical leads from the device are attached to the ground and signal input terminals of the device under test.

Most function generators allow the user to choose the shape of the output from a small number of options.

- Square wave - The signal goes directly from high to low voltage.
- Sine wave - The signal curves like a sinusoid from high to low voltage.
- Triangle wave - The signal goes from high to low voltage at a fixed rate.

The amplitude control on a function generator varies the voltage difference between the high and low voltage of the output signal.

The direct current (DC) offset control on a function generator varies the average voltage of a signal relative to the ground.

The frequency control of a function generator controls the rate at which output signal oscillates. On some function generators, the frequency control is a combination of different controls. One set of controls chooses the broad frequency range (order of magnitude) and the other selects the precise frequency. This allows the function generator to handle the enormous variation in frequency scale needed for signals.

The duty cycle of a signal refers to the ratio of high voltage to low voltage time in a square wave signal.

Using a function generator

After powering on the function generator, the output signal needs to be configured to the desired shape. Typically, this means connecting the signal and ground leads to an oscilloscope to check the controls. Adjust the function generator until the output signal is correct, then attach the signal and ground leads from the function generator to the input and ground of the device under test. For some applications, the negative lead of the function generator should attach to a negative input of the device, but usually attaching to ground is sufficient.

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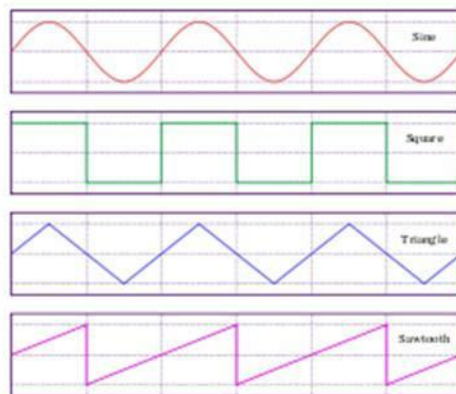
FUNCTION GENERATOR



A simple analog function generator, circa 1990



A DDS function generator



Sine, square, triangle, and sawtooth waveforms

A **function generator** is usually a piece of electronic test equipment or software used to generate different types of electrical waveforms over a wide range of frequencies. Some of the most

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common waveforms produced by the function generator are the sine, square, triangular and sawtooth shapes. These waveforms can be either repetitive or single-shot (which requires an internal or external trigger source). Integrated circuits used to generate waveforms may also be described as function generator ICs.

Although function generators cover both audio and RF frequencies, they are usually not suitable for applications that need low distortion or stable frequency signals. When those traits are required, other signal generators would be more appropriate.

Some function generators can be phase -locked to an external signal source (which may be a frequency reference) or another function generator.

Function generators are used in the development, test and repair of electronic equipment. For example, they may be used as a signal source to test amplifiers or to introduce an error signal into a control loop.

Working

Simple function generators usually generate triangular waveform whose frequency can be controlled smoothly as well as in steps. This triangular wave is used as the basis for all of its other outputs. The triangular wave is generated by repeatedly charging and discharging a capacitor from a constant current source. This produces a linearly ascending or descending voltage ramp. As the output voltage reaches upper and lower limits, the charging and discharging is reversed using a comparator, producing the linear triangle wave. By varying the current and the size of the capacitor, different frequencies may be obtained. Saw tooth waves can be produced by charging the capacitor slowly, using a current, but using a diode over the current source to discharge quickly

- the polarity of the diode changes the polarity of the resulting saw tooth, i.e. slow rise and fast fall, or fast rise and slow fall.

A 50% cycle square is easily obtained by noting whether the capacitor is being charged or discharged, which is reflected in the current switching comparator output. Other duty cycles (theoretically from 0% to 100%) can be obtained by using a comparator and the saw tooth or triangle signal. Most function generators also contain a non-linear diode shaping that can convert the triangle wave into a reasonably accurate sine wave by rounding off the corners of the triangle wave in a process similar to clipping in audio systems.

A typical function generator can provide frequencies up to 20 MHz RF generators for higher frequencies are not function generators in the strict sense since they typically produce pure or modulated sine signals only.

Function generators, like most signal generators, may also contain an attenuator, various means of modulating the output waveform, and often the ability to automatically and repetitively "sweep" the frequency of the output waveform (by means of a voltage-controlled oscillator) between two operator-determined limits. This capability makes it very easy to evaluate the frequency response of a given electronic circuit.

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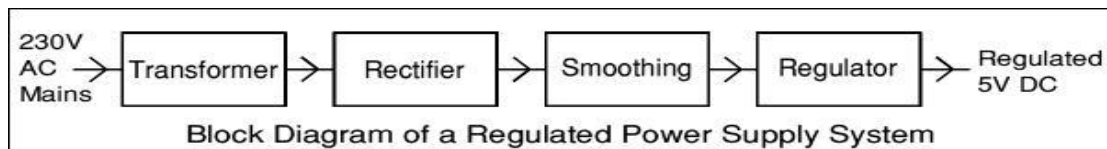
Some function generators can also generate white or pink noise.

More advanced function generators are called arbitrary waveform generators (AWG). They use direct digital synthesis (DDS) techniques to generate any waveform that can be described by a table of amplitudes.

POWER SUPPLY

There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronics circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function.

For example a 5V regulated supply:



Each of the blocks is described in more detail below:

- Transformer - steps down high voltage AC mains to low voltage AC.
- Rectifier - converts AC to DC, but the DC output is varying.
- Smoothing - smoothes the DC from varying greatly to a small ripple.
- Regulator - eliminates ripple by setting DC output to a fixed voltage. s

CONCLUSION:

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EXPERIMENT NO.: 7

Date:

AIM: To study Soldering and de-soldering techniques.

APPARATUS:

1. Solder Iron
2. Solder wire
3. De-soldering pump
4. Flux
5. PCB
6. Different electronic components

THEORY:

Introduction: Soldering is the act of unifying two pieces of similar or dissimilar metals by an alloy called Solder, the melting point of which is lower than that of the metal to be united. When two surfaces of the metal are soldered together, the solder penetrates pores of the metal and it makes firm grip with permanent electrical continuity and strength.

Solder: The soldering material or solder usually employed for the purpose of joining together two or more metals at temperature below their melting point and is a fusible alloy consisting essentially of lead and tin. Solder is an alloy (mixture) of tin and lead, typically 60% tin and 40% lead. It melts at a temperature of about 200°C. Coating a surface with solder is called 'tinning' because of the tin content of solder. Solder for electronics use contains tiny cores of flux, like the wires inside a mains flex.

Flux: When a metal is heated in free air, it is immediately affected by oxygen. A layer of oxide is formed over the surface which is a hindrance during soldering. This layer of oxide can be removed using chemical compounds called fluxes. They are deoxidizing agents and are used to keep the surface clean from oxide, increase the fluidity of the solder and help the joints to adhere perfectly. The melting temperature of the flux is always less than that of the solder used.

Soldering Techniques: Soldering techniques can be broadly classified in two groups:

1. Iron soldering or Manual soldering
2. Mass soldering or Automatic soldering

Manual soldering requires solder iron, solder wire, flux and electronic components. Solder irons are available in different temperature ranges, and available with ratings of 6 W, 12 W, 25 W, 35 W, 100 W, 150 W etc. Selection of the solder iron depends on the use.

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SOLDERING:

1. Take one PCB, solder iron, solder wire and electronic components and give supply to solder iron.
2. Place the iron at the angle of 45 degree, with the tip touching as many elements of the joints as possible.
3. Place the solder wire near the iron and let it flow. Pass it around the joints.
4. Remove the iron and let the solder flow in the area from where the iron has been removed.
5. When the solder has successfully flowed in the lead and track, take the solder away and then remove the iron.

DESOLDERING:

To de-solder means to remove a joint or re-position a wire or component. There are two ways to remove the solder:

1. With a de-soldering pump (solder sucker)

1. Set the pump by pushing the spring-loaded plunger down until it locks.
2. Apply both the pump nozzle and the tip of your soldering iron to the joint.
3. Wait a second or two for the solder to melt.
4. Then press the button on the pump to release the plunger and suck the molten solder into the tool.
5. Repeat if necessary to remove as much solder as possible.
6. The pump will need emptying occasionally by unscrewing the nozzle.

2. with solder remover wick (copper braid)

1. Apply both the end of the wick and the tip of your soldering iron to the joint.
2. As the solder melts most of it will flow onto the wick, away from the joint.
3. Remove the wick first, then the soldering iron.
4. Cut off and discard the end of the wick coated with solder.

After removing most of the solder from the joint(s) we can remove the wire or component lead straight away (allow a few seconds for it to cool). If the joint will not come apart easily apply your soldering iron to melt the remaining traces of solder at the same time as pulling the joint apart.

CONCLUSION:

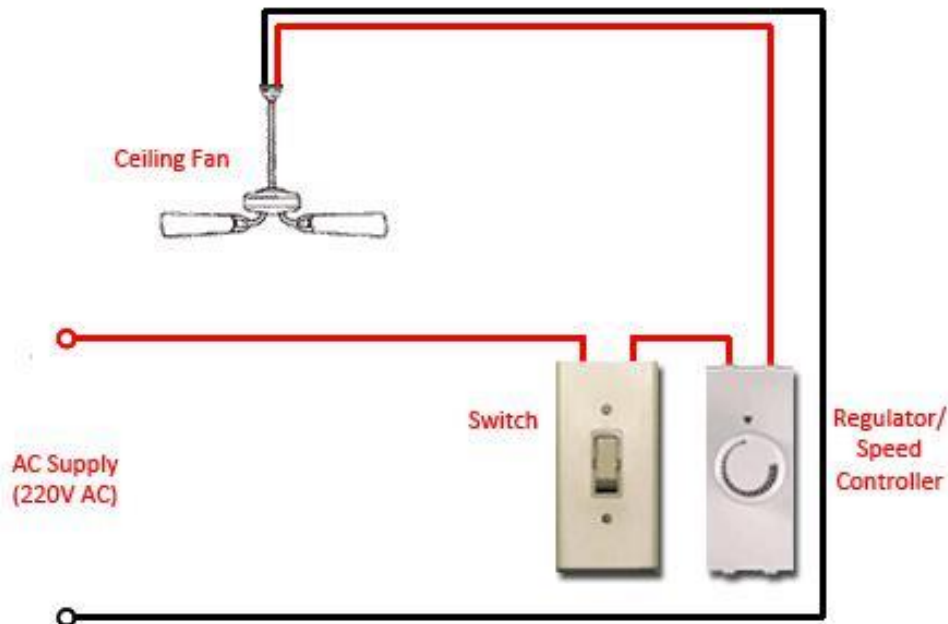
EXPERIMENT NO.: 8

Date:

AIM: To study Wiring diagram of ceiling Fan

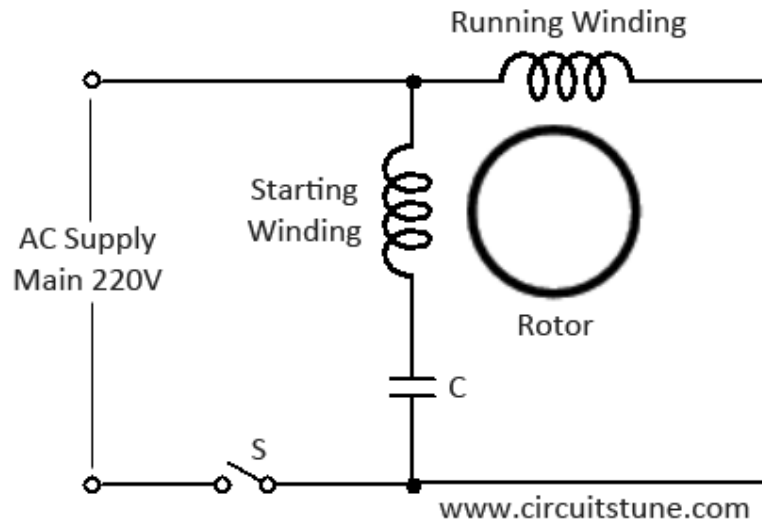
Simple Wiring diagram of ceiling Fan

This is a simple illustrated *circuit diagram of ceiling fan*. To be noted that the wiring diagram is for AC 220V single phase line with single phase ceiling fan motor. Here a simple SPST switch is used to supply power or not to the fan motor and a Regulator is used to controlling the fan speed. Though it is very simple, but one thing to be noted that **Switch** and **Regulator** should be connected with the phase line of main power, not neutral.



Capacitor connection diagram of ceiling fan

Ceiling fan has a “capacitor start motor” in its inside. AC single phase capacitor start motor has two winding; one is starting winding and another is running winding.



Ceiling fan capacitor connection diagram

As it is a **capacitor start-capacitor run** type motor; there a capacitor is used in series with **Starting Winding**, It defines the direction of rotation. It is an electrolytic capacitor.

Sometimes you may have faced this type of question...

1. Why ceiling fan rotating in reverse?
2. What makes a ceiling fan run backwards?

Two of this question sounds the same; the answer of the both question is “If capacitor is connected with **running winding/main coil** instead of **starting winding/auxiliary coil** then the direction of rotation will changed. That’s mean if you want **to change the direction of rotation of the fan, just connect the capacitor with other winding.**

CONCLUSION:

EXPERIMENT NO.: 9

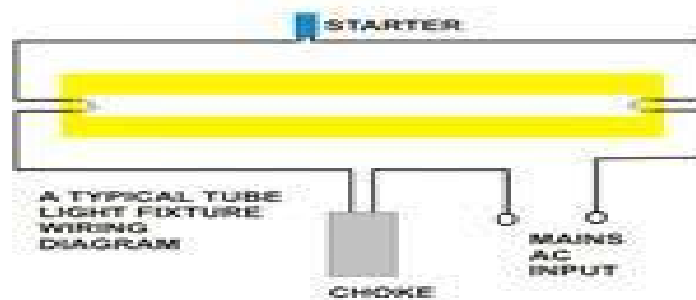
Date:

AIM: How Fluorescent Lights Work

- **What's Inside a Fluorescent Tube Light?**

- A fluorescent lamp basically consists of a long glass gas discharge tube. Its inner surface is coated with phosphorous and is filled with an inert gas, generally argon, with a trace of mercury.
- The tube is then finally sealed at low pressure with two filament electrodes each at its both ends.
- These electrode filaments are used to preheat the tube and initiate a rapid conduction of electrons between the two end electrodes. The process initially requires a relatively high amount of power.
 - The bombardment of these electrons on the inner phosphorous coating is instantly transformed into a visible bright light, when we ultimately find the tube glowing brightly.
 - Once the conduction of electrons between the electrodes is complete, no more heating of the filaments is required and whole system works at a much lower current.

- **How do Fluorescent Lights Function?**



We have all seen a tube light fixture consisting of a large heavy square "choke" or "ballast" and a small cylindrical "starter." Let's try to understand how the whole system works. Please refer to the circuit diagram on the right as you read the following points:

- The choke is in fact a large inductor. It consists of a long copper winding over iron laminations.
 - An inductor by nature always has a tendency to throw back the stored current in it, every time the power through it is switched OFF. This principle of the choke is exploited in lighting a fluorescent tube light.
 - When an AC voltage is applied to a tube light fixture, the voltage passes through the choke, the starter, and the filaments of the tube.
 - The filaments light up and instantly warm up the tube. The starter holds the current for a moment and then releases to break the circuit.
 - This forces the choke to "kick back" its stored current, which again passes through the filaments and ignites the tube light.
 - If the tube does not sufficiently charge up, subsequent kicks are delivered by the choke due to rapid switching of the starter, so that finally the tube strikes.
-

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- After this the choke only acts like a low impedance current limiter to the tube as long as the light is kept illuminated.

A common problem associated with these types of fixtures is humming or buzzing. Wonder why your fluorescent lights hum? The answer lies in the loosely fitted choke on to the fixture which vibrates in accordance with the 50 or 60 hertz frequency of our AC mains and creates a humming sort of noise. Tightening the choke's screws may instantly eliminate the problem.

The working principle of today's modern electronic ballasts is to avoid the use of starters for the preheating purpose. They are also very light in weight. These inhibit the initial flickering of the tube light as normally seen in the ordinary tube fixtures by changing the frequency of the mains power to a much higher 20,000 hertz or more. Moreover, electronic ballasts are very energy efficient.

CONCLUSION:

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EXPERIMENT NO.: 10

Date:

AIM: To study about stair case wiring two way switch.

Apparatus:

1. Kit Kat fuse: 1Nos. 5 Amps
2. Single pole switch: 2 Nos. , 5 Amps
3. Lamp holders: 2 Nos. , 5 Amps
4. Lamps: 2 Nos.
5. Battens, Nails, Clips, CTS wire, Fuse wire.
6. Round wooden block: 04 Nos
7. Square wooden block: 01 Nos.

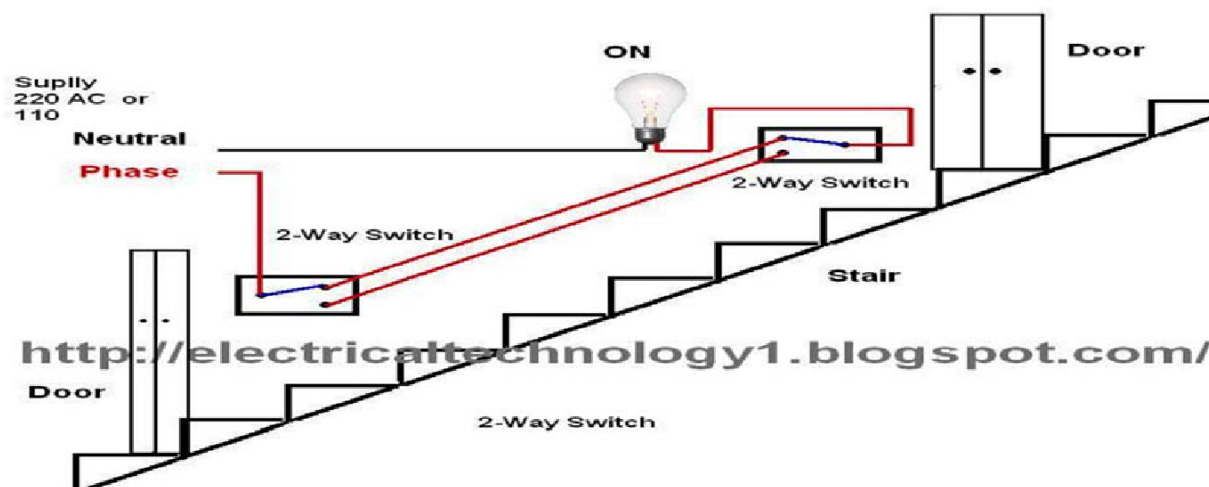
Theory:

This is the staircase wiring circuit diagram. Here we can control a bulb from two different places by using two, 2-way switches.

Now consider this circuit diagram. In this case you can see that circuit is complete and bulb is ON. Suppose you want to OFF bulb from the upper switch at top of stair, simply Switch OFF the switch then circuit will break and the bulb will be OFF. You can switch ON the bulb again to switch ON this Switch. In other words you can OFF and ON bulb from upper switch at the top of stair. Obviously; you can do same from the upper and bottom switch, so let's see how we can do that from that switch at the bottom of stair.

Now return to circuit again in the pic, In this case you can see that circuit is complete and bulb is ON. Suppose you want to OFF the bulb from the lower switch at bottom of stair. Simply OFF the switch, then again circuit will break and the bulb will be OFF. You can switch ON the bulb again to switch ON this Switch

EEW LAB MANUAL



Stair case wiring circuit diagram, OR How to control a lamp from two places by two ,2-way switches?

CONCLUSION:

EXPERIMENT NO.: 11

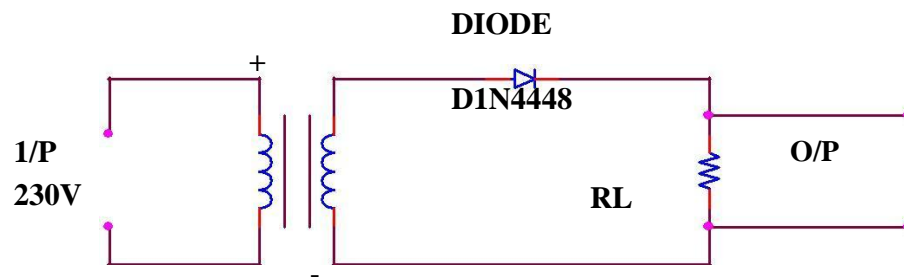
Date:

AIM: To Study Half – Wave Rectifier.

APPARATUS REQUIRED: Power supply, rectifier kit, CRO, Connecting Leads.

BRIEF THEORY: Rectification is a process of conversion of AC to DC. In half-wave rectifier, only one diode is used. During +ve half Cycle the diode is forward biased &, it conducts current through the load resistor R. During –ve half cycle diode is reverse biased Hence, no current flow through the circuit. Only +ve half cycle appears across the load, whereas, the –ve half Cycle is suppressed.

CIRCUIT DIGRAM:

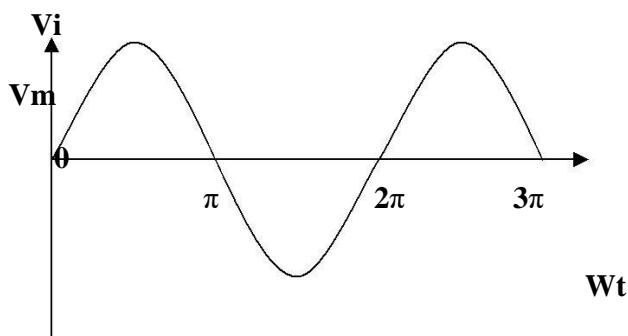


PROCEDURE:

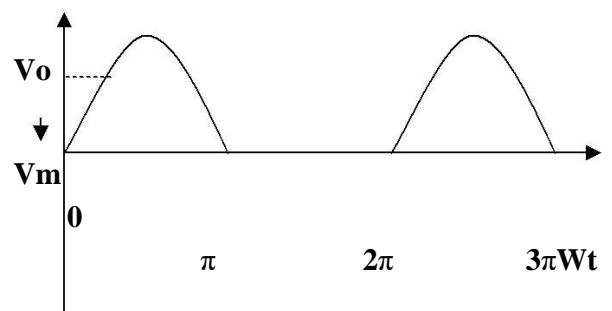
1. Connect the ckt. as shown in fig.
2. Supply the input AC signal to the circuit.
3. Output signal is obtained on CRO which shows the DC(pulsating output).
4. Draw the wave form.

WAVE FORM:

Input wave



Output wave



EEW LAB MANUAL

RESULT: Input and output waveform of half wave rectifier is as shown

PRECAUTIONS:

1. Connection should be proper & tight.
2. Switch 'ON' the supply after completing the circuit.
3. Note down the input & output wave accurately.

CONCLUSION:
