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PROJECT REPORT

ON

AUTO SELECTION OF ANY AVAILABLE PHASE IN A THREE PHASE SUPPLY SYSTEM

Project Report submitted in partial fulfillment of the degree of

BACHELOR OF ENGINEERING

BY

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REPORT OF PROJECT WORK

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Project topic entitled: AUTO SELECTION OF ANY AVAILABLE PHASES IN A THREE PHASE SUPPLY SYSTEM

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ABSTRACT

In today's modern world where the demand of the consumers for electricity requirement is going on day by day.

To achieve this ELECTRICAL POWER SYSTEM is the heart which continuously pumps the electricity from one end to other end by means of transmission and distribution system.

During this process if any of the phases of healthy phases runs out then the production process at that end gets hindered which leads to economic and productivity losses.

In our project we have shown by means of electrical and electronic components how auto selection can be done.

We will be showing it by means of various graphs indicating various electrical parameters.

We hope that our project would be successful and it would be adopted as well in the power system component

ACKNOWLEDGEMENT

We take this opportunity to express our deep and sense of gratitude to our guide PROF.GULREZ BODHLE for his valuable guidance and inspiration in spite of his busy schedule. He devoted himself in completing our task with the admirable excellence. We also thank our HOD PROF.SAYED KALEEM for cheerful encouragement and notable guidance.

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CHAPTER 1

1.1 BLOCK DIAGRAM

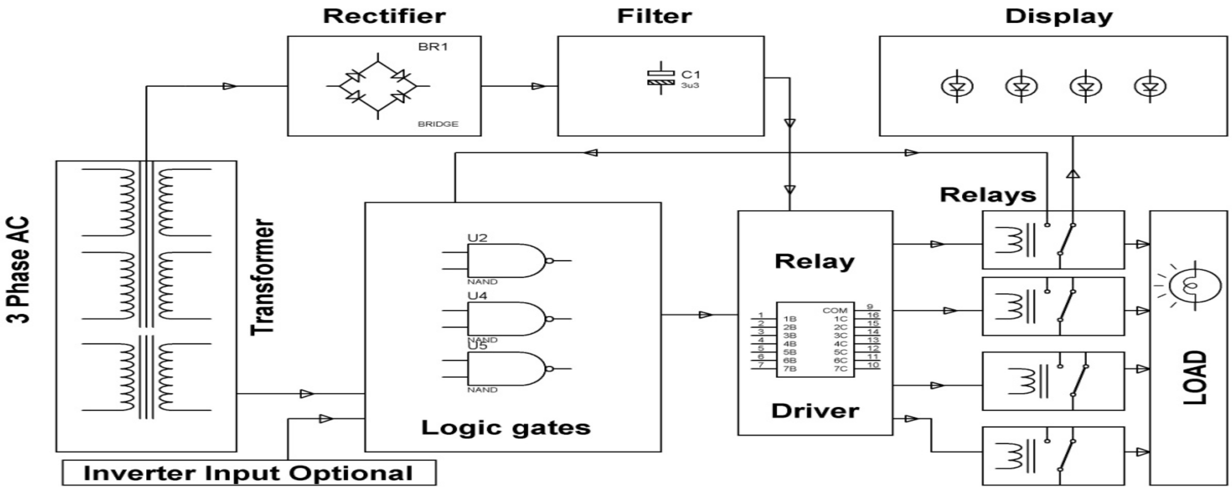


Fig 1.1 block diagram of supply system

1.1.1 HARDWARE REQUIREMENTS

HARDWARE COMPONENTS:

1. TRANSFORMER (230 – 12 V AC)
2. VOLTAGE REGULATOR (LM 7805)
3. FILTER
4. RELAY
5. ULN 2003
6. OPTO ISOLATOR
7. AND GATE IC 4081
8. INVERTER IC 4069
9. LED
10. 1N4007
11. RESISTOR
12. CAPACITOR

1.1.2 TRANSFORMER

Transformers convert AC electricity from one voltage to another with a little loss of power. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high voltage to a safer low voltage.

FIG 1.1 A typical transformer

The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils; instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core. Transformers waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down and current is stepped up.

The ratio of the number of turns on each coil, called the turn's ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

$$\text{TURNS RATIO} = (V_p / V_s) = (N_p / N_s)$$

Where,

V_p = primary (input) voltage.

V_s = secondary (output) voltage

N_p = number of turns on primary coil

N_s = number of turns on secondary coil

I_p = primary (input) current

I_s = secondary (output) current.

1.2 IDEAL POWER EQUATION

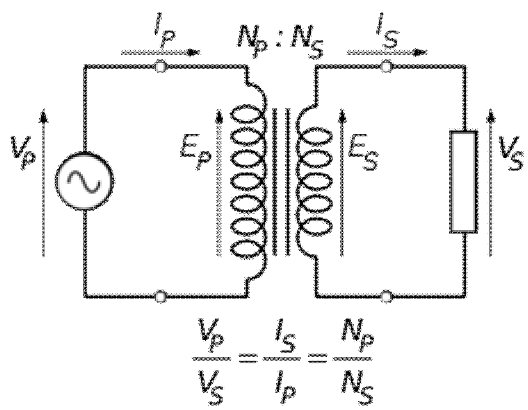


Fig:1.2 circuit diagram of transformer

The ideal transformer as a circuit element

If the secondary coil is attached to a load that allows current to flow, electrical power is transmitted from the primary circuit to the secondary circuit. Ideally, the transformer is perfectly efficient; all the incoming energy is transformed from the primary circuit to the magnetic field and into the secondary circuit. If this condition is met, the incoming electric power must equal the outgoing power:

$$P_{\mathrm{incoming}} = I_{\mathrm{p}} V_{\mathrm{p}} = P_{\mathrm{outgoing}} = I_{\mathrm{s}} V_{\mathrm{s}},$$

Giving the ideal transformer equation

$$\frac{V_{\mathrm{s}}}{V_{\mathrm{p}}} = \frac{N_{\mathrm{s}}}{N_{\mathrm{p}}} = \frac{I_{\mathrm{p}}}{I_{\mathrm{s}}}.$$

Transformers normally have high efficiency, so this formula is a reasonable approximation.

If the voltage is increased, then the current is decreased by the same factor. The impedance in one circuit is transformed by the *square* of the turns ratio. For example, if an impedance Z_s is attached across the terminals of the secondary coil, it appears to the primary circuit to have an impedance of $(N_p/N_s)^2 Z_s$. This relationship is reciprocal, so that the impedance Z_p of the primary circuit appears to the secondary to be $(N_s/N_p)^2 Z_p$.

1.3 VOLTAGE REGULATOR 7805

1.3.1 Features

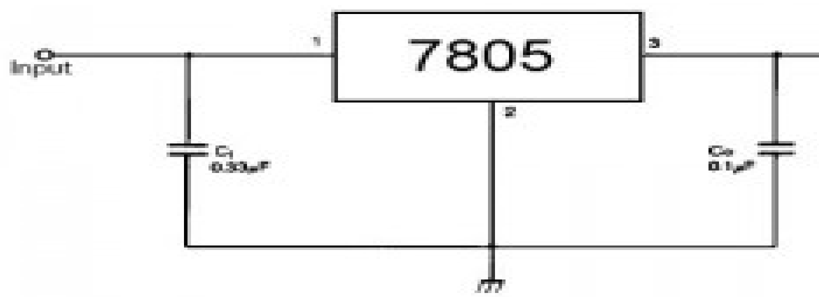
• Output Current up to 1A.

• Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V.

• Thermal Overload Protection.

• Short Circuit Protection.

• Output Transistor Safe Operating Area Protection.



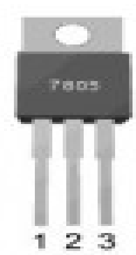


Fig:1.3.1(a) **Fig:1.3.1(b)**

Fig:1.3.1(a) Internal circuit diagramof 7805 **Fig:1.3.1(b) IC 7805**

1.3.2 Description

The LM78XX/LM78XXA series of three-terminal positive regulators are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a Wide range of applications. Each type employs internal current limiting, thermal shutdown and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output Current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

1.3.3 Internal Block Diagram

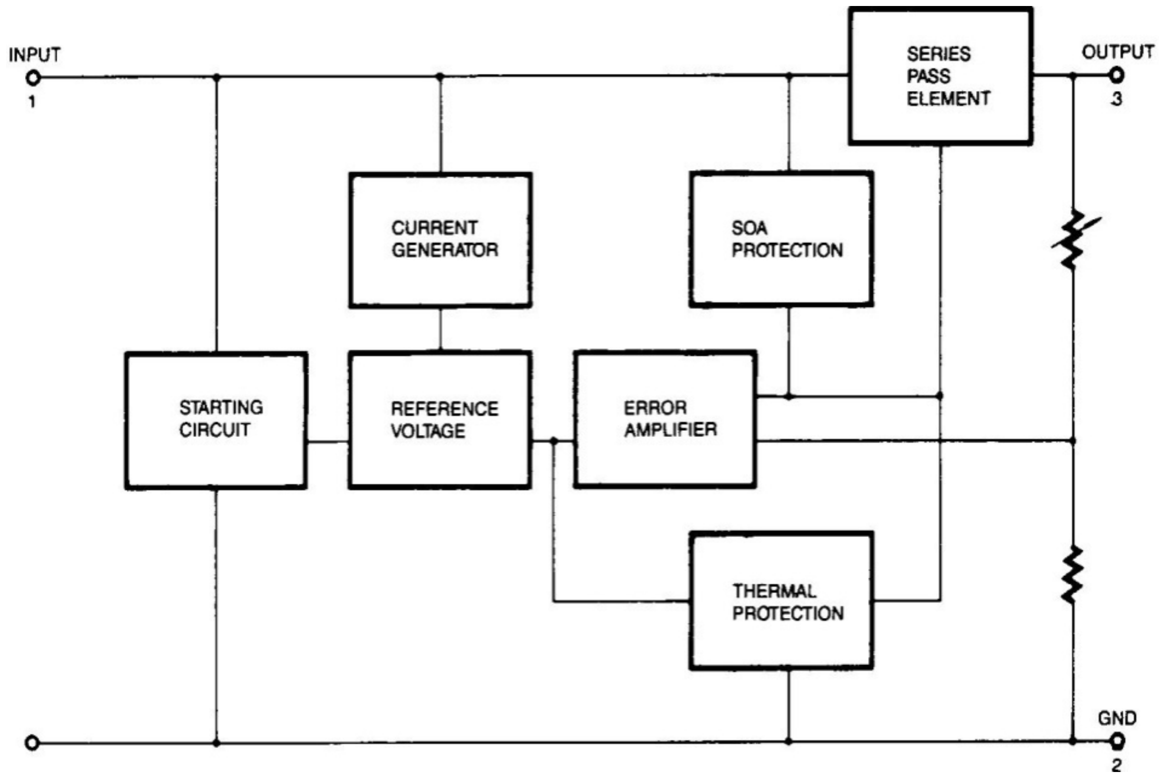


Fig:1.3.3(a): BLOCK DIAGRAM OF VOLTAGE REGULATOR

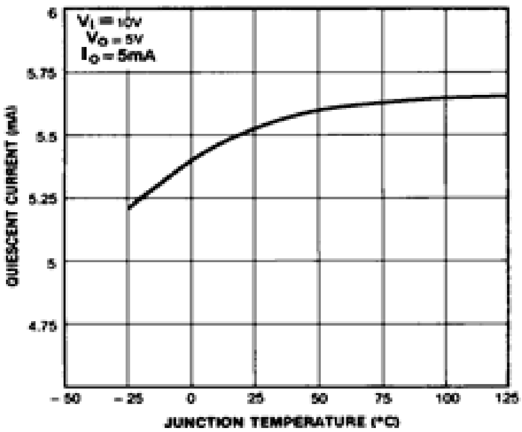


Figure 1. Quiescent Current

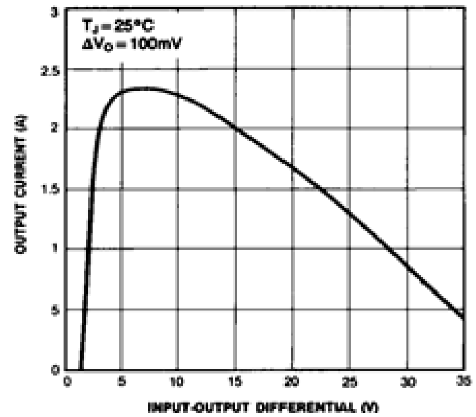


Figure 2. Peak Output Current

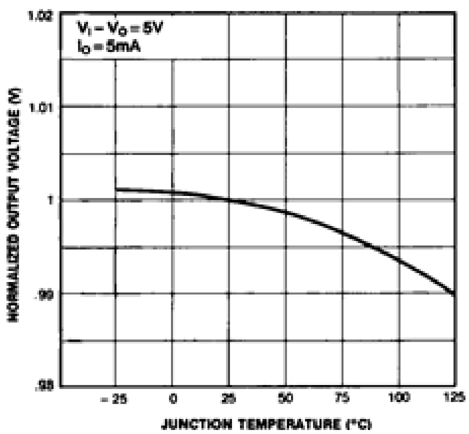


Figure 3. Output Voltage

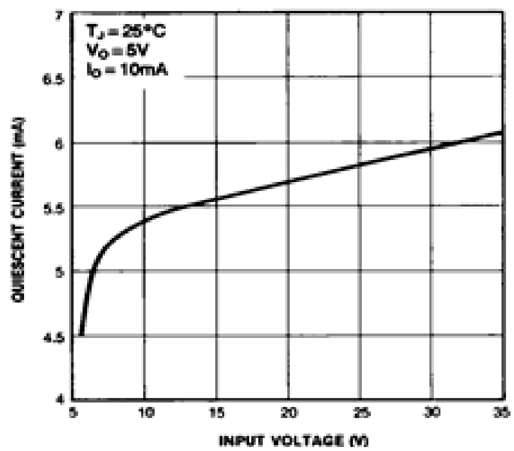


Figure 4. Quiescent Current

Fig: 1.3.2(b): Performance characteristic of voltage regulator

1.4 FILTER

Capacitive filter is used in this project. It removes the ripples from the output of rectifier and smoothens the D.C. Output received from this filter is constant until the mains voltage and load is maintained constant. However, if either of the two is varied, D.C. voltage received at this point changes. Therefore a regulator is applied at the output stage.

The simple capacitor filter is the most basic type of power supply filter. The use of this filter is very limited. It is sometimes used on extremely high-voltage, low-current power supplies for cathode-ray and similar electron tubes that require very little load current from the supply. This filter is also used in circuits where the power-supply ripple frequency is not critical and can be relatively high.

1.5 ULN2003

1.5.1 Relay driver:

ULN2003 is a high voltage and high current Darlington transistor array.

1.5.2 Description:

The ULN2003 is a monolithic high voltage and high current Darlington transistor arrays. It consists of seven NPN Darlington pairs that feature high-voltage outputs with common-cathode Clamp diode for switching inductive loads. The collector-current rating of a single Darlington pair is 500mA. The Darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED gas discharge), line drivers, and logic buffers.

The ULN2003 has a 2.7kW series base resistor for each Darlington pair for operation directly with TTL or 5V CMOS devices.

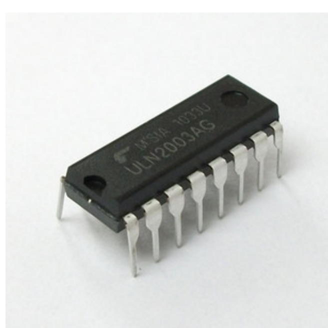


Fig:1.5.2: ULN 2003

1.5.3 Features:

- Pin no.:16
- Temperature, Operating Range:-20°C to +85°C
- Transistor Polarity: NPN
- Transistors, No. of:7
- Case Style:DIP-16
- Temp, Op. Min:-20°C
- Temp, Op. Max:85°C
- Base Number:2003
- Channels, No. of:7
- Current, Output Max:500mA
- Device Marking:ULN2003A
- IC Generic Number:2003
- Input Type: TTL, CMOS 5V
- Logic Function Number:2003
- Output Type: Open Collector
- Transistor Type: Power Darlington
- Voltage, Input Max:5V
- Voltage, Output Max:50V

1.5.4 PIN Diagram:

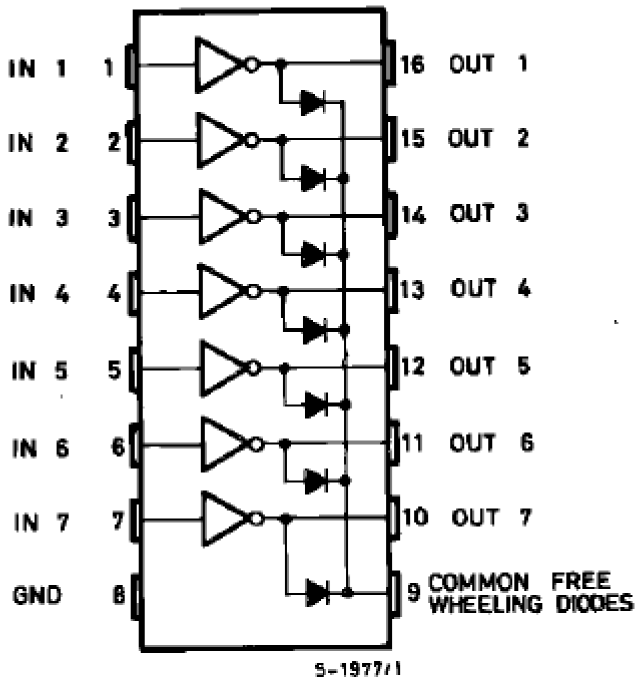


Fig:1.5.4(a) Pin diagram of ULN 2003

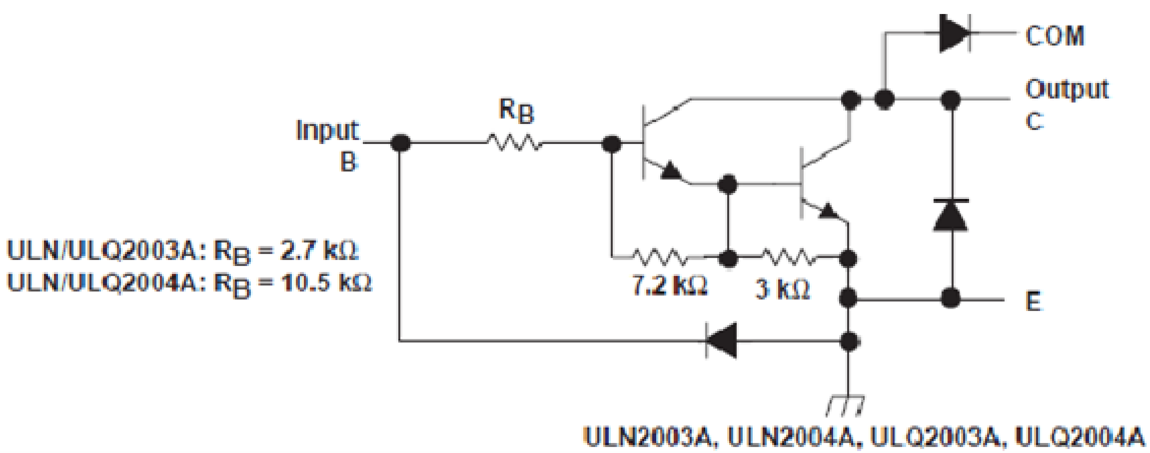


Fig:1.5.4(b) Schematics of Darlington's pair

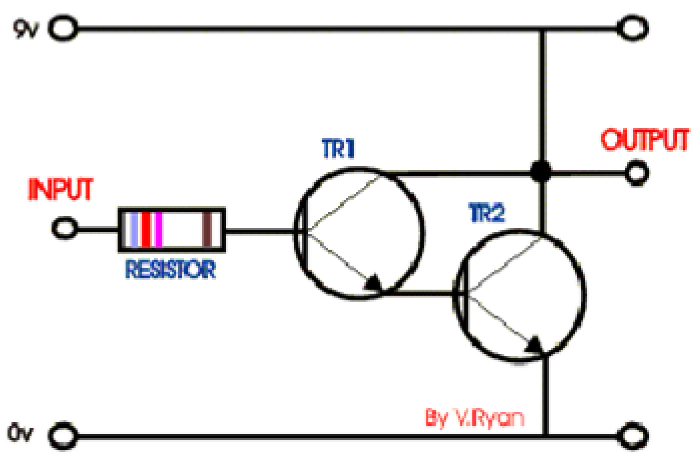


Fig:1.5.4(c) Darlington pair

Darlington pairs are back to back connection of two transistors with some source resistors and when they are arranged as shown in the circuit they are used to amplify weak signals. The amount by which the weak signal is amplified is called the 'GAIN'. .

1.5.5 Features of driver:

- Seven Darlington's per package
- Output currents500mA per driver(600mA peak)
- Integrated suppression diodes for inductive loads
- Outputs can be paralleled for high currents
- TTL/CMOS/PMOS/DTL compatible inputs.
- Inputs pinned opposite to outputs
- Simplified layout

Figure shows the Darlington pair connection of transistor. The circuit above is a 'Darlington Pair' driver. The first transistor's emitter feeds into the second transistor's base and as a result the input signal is amplified by the time it reaches the output. The important point to remember is that the Darlington Pair is made up of two transistors

* 500mA rated collector current (Single output).

* High-voltage outputs: 50V.

* Inputs compatible with various types of logic.

* Relay driver application.

1.6 RELAY

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.

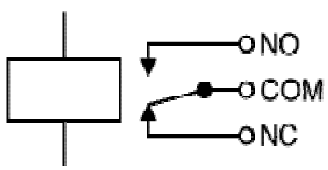


Fig:1.6(a)circuit diagram **Fig:1.6(b)Different types of realay**

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts as shown in the diagram.

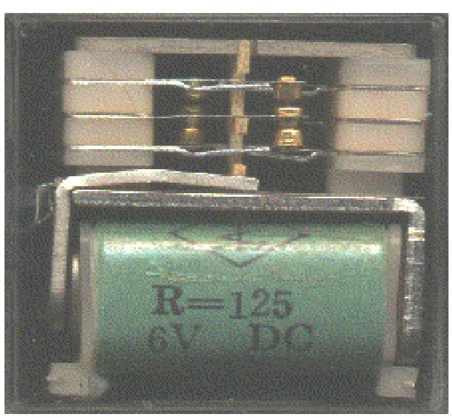


Fig:1.6(c) Relay showing coil and switch contacts

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. For further information about switch contacts and the terms used to describe them please see the page on switches.

Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay.

The supplier's catalogue should show you the relay's connections. The coil will be obvious and it may be connected either way round. Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit. To prevent damage you must connect a protection diode across the relay coil.

The figure shows a relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts.

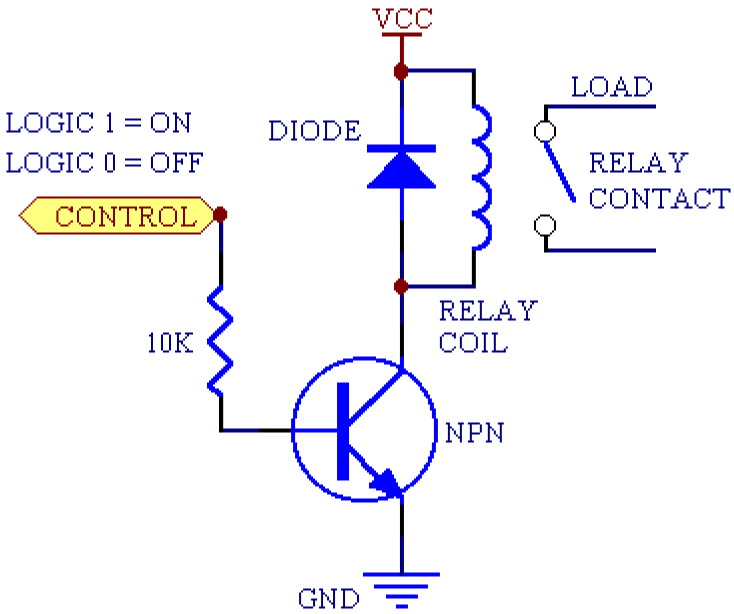


Fig:1.6(d)Relay under working conditions

There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.

The relay's switch connections are usually labelled COM, NC and NO:

- COM = Common, always connect to this; it is the moving part of the switch.
- NC = Normally Closed, COM is connected to this when the relay coil is off.
- NO = Normally Open, COM is connected to this when the relay coil is on.

1.7 APPLICATION OF RELAY

Relays are used to and for:

- Control a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers.
- Control a high-current circuit with a low-current signal, as in the starter solenoid of an automobile.
- Detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers.
- Time delay functions. Relays can be modified to delay opening or delay closing a set of contacts. A very short (a fraction of a second) delay would use a copper disk between the armature and moving blade assembly. Current flowing in the disk maintains magnetic field for a short time, lengthening release time. For a slightly longer (up to a minute) delay, a dashpot is used. A dashpot is a piston filled with fluid that is allowed to escape slowly. The time period can be varied by increasing or decreasing the flow rate. For longer time periods, a mechanical clockwork timer is installed.

1.8 OPTO ISOLATOR (MCT2E)

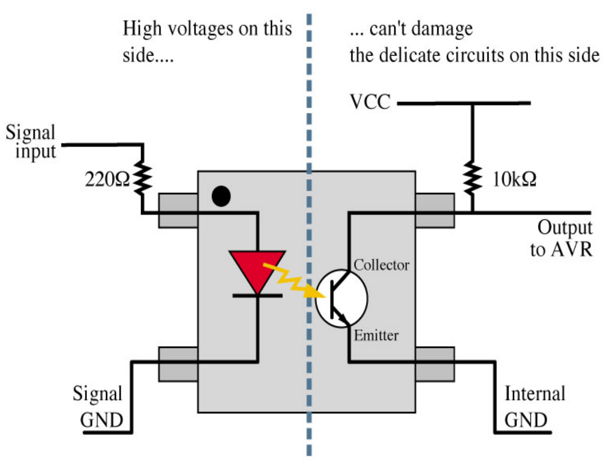


Fig:1.8(a) Internal circuit diagram

Fig1.8(b)Optoisolato (MCT2E)

Opto-isolators, or Opto-couplers, are made up of a light emitting device, and a light sensitive device, all wrapped up in one package, but with no electrical connection between the two, just a beam of light. The light emitter is nearly always an LED. The light sensitive device may be a photodiode, phototransistor, or more esoteric devices such as thyristors, triacs e.t.c.

A lot of electronic equipment nowadays is using optocoupler in the circuit. An optocoupler or sometimes refer to as optoisolator allows two circuits to exchange signals yet remain electrically isolated. This is usually accomplished by using light to relay the signal. The standard optocoupler circuits design uses a LED shining on a phototransistor-usually it is a npn transistor and not PNP. The signal is applied to the LED, which then shines on the transistor in the IC.

The light is proportional to the signal, so the signal is thus transferred to the phototransistor. Optocouplers may also comes in few module such as the SCR, photodiodes, TRIAC of other semiconductor switch as an output, and incandescent lamps, neon bulbs or other light source.

The optocoupler usually found in switch mode power supply circuit in many electronic equipment. It is connected in between the primary and secondary section of power supplies. The optocoupler application or function in the circuit is to:

1. Monitor high voltage
2. Output voltage sampling for regulation
3. System control micro for power ON/OFF
4. Ground isolation

If the optocoupler IC breakdown, it will cause the equipment to have low power, blink, no power, erratic power and even power shut down once switch on the equipment. Many technicians and engineers do not know that they can actually test the optocoupler with their analog multimeter. Most of them thought that there is no way of **testing** an IC with an analog meter.

This is the principle used in Opto−Triacs and opto−SCRs, which are readily available in Integrated circuit (I.C.) form, and do not need very complex circuitry to make them work. Simply provide a small pulse at the right time to the Light Emitting Diode in the package. The light produced by the LED activates the light sensitive properties of the Triac or Thyristor gate and the power is switched on. The isolation between the low power and high power circuits in these optically connected devices is typically several thousand volts.

1.8.1 Optoisolator characteristic :

Collector-emitter voltage

This is the maximum voltage that can be present from the collector to the emitter of the receiving phototransistor (when it is turned off – no light) before it may break-down.

Cree page distance

This is physically how far a spark would have to travel around the outside of the package to get from one side to the other. If the package has contaminants on it, solder flux, or dampness, then a lower-resistance path can be created for noise signals to travel along.

Forward current

This is the current passing through the sending LED. Typically, an Opto-isolator will require about 5mA to turn the output transistor on.

Forward voltage

This is the voltage that is dropped across the LED when it is turned on. Most normal diodes drop about 0.7v, but with LEDs it is typically 1 – 2 volts.

Collector dark current

This is the current that can flow through the output phototransistor when it is turned off.

Collector-emitter saturation voltage

When the output transistor is fully turned on (saturated), this is the voltage there will be between the collector and emitter.

Isolation resistance

This is the resistance from a pin in the input side to a pin on the output side. It should be very high.

Response time

The rise and fall times are the times that the output voltage takes to get from zero to maximum. The rise time is very much dependant on the load resistor, since it is this that is pulling the output up. Therefore this value is always quoted with a fixed load resistance. Note however that the value, 100 Ohms, is much less than you are likely to use in practice. This is another of the manufacturer's attempts to make the product look better than it is!

Cutoff frequency

This is effectively the highest frequency of square wave that can be sent through the Opto-isolator. It is actually the frequency at which the output voltage is only swinging half the amplitude than at DC levels (-3Db = half). It is therefore linked with the rise and fall times.

Current Transfer Ratio (CTR)

This is the ratio of how much collector current in the output transistor that you get given a certain amount of forward current in the input side LED. It is affected by how close the LED and phototransistor are inside the device, how efficient they both are, and many other factors. In fact it is not a constant but varies wildly with LED forward current.

CHAPTER 2

2.1 AND GATES IC 4081

The 4081 is a member of the 4000 Series CMOS range, and contains four independent CMOS AND gates, each with two inputs. The pinout diagram, given on the right, is the standard two-input logic gate IC layout:

- Pin 7 is the negative supply
- Pin 14 is the positive supply
- Pins 1&2, 5&6, 8&9, 12&13 are gate inputs
- Pins 3, 4, 10, 11 are gate outputs

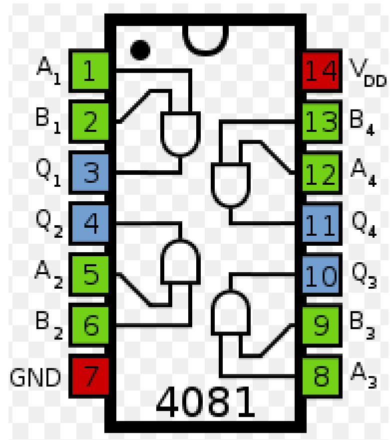


FIG: PINOUT

The truth table for one of the four gates is shown below.

Truth Table (One Gate)

A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

Table:1 AND Gate truth table

2.2 INVERTER IC 4069

- Medium-speed operation- tphl, tplh = 30ns (typ.) At 10v
- quiescent current specified to 20v for hcc device
- standardized symmetrical output characteristics
- 5v, 10v, and 15v parametric ratings input current of 100na at 18v and 25°c for hcc device
- 100% tested for quiescent current

2.3 DESCRIPTION

The **HCC4069UB** (extended temperature range) and **HCF4069UB** (intermediate temperature range) are monolithic integrated circuit, available in 14-lead dual in-line plastic or ceramic package and plastic micro package.

The **HCC/HCF4069UB** consists of six COS/MOS inverter circuits. This device is intended for all general purpose inverter applications where the medium-power TTL-drive and logic-level-conversion capabilities of circuits such as **HCC/HCF4049B** Hex Inverter/Buffers are not required.

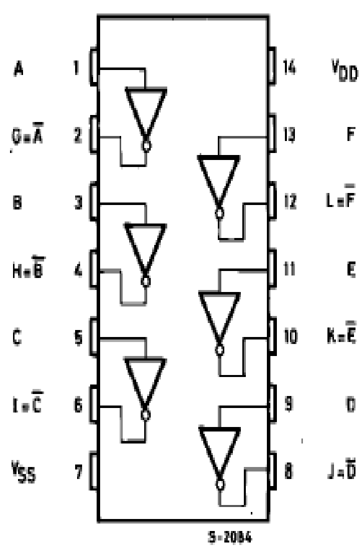


Fig:2.3 pin diagram of IC 4069

2.4 LED

Light Emitting Diodes (LED) have recently become available that are white and bright, so bright that they seriously compete with incandescent lamps in lighting applications. They are still pretty expensive as compared to a GOW lamp but draw much less current and project a fairly well focused beam.

The diode in the photo came with a neat little reflector that tends to sharpen the beam a little but doesn't seem to add much to the overall intensity.

When run within their ratings, they are more reliable than lamps as well. Red LEDs are now being used in automotive and truck tail lights and in red traffic signal lights. You will be able to detect them because they look like an array of point sources and they go on and off instantly as compared to conventional incandescent lamps.

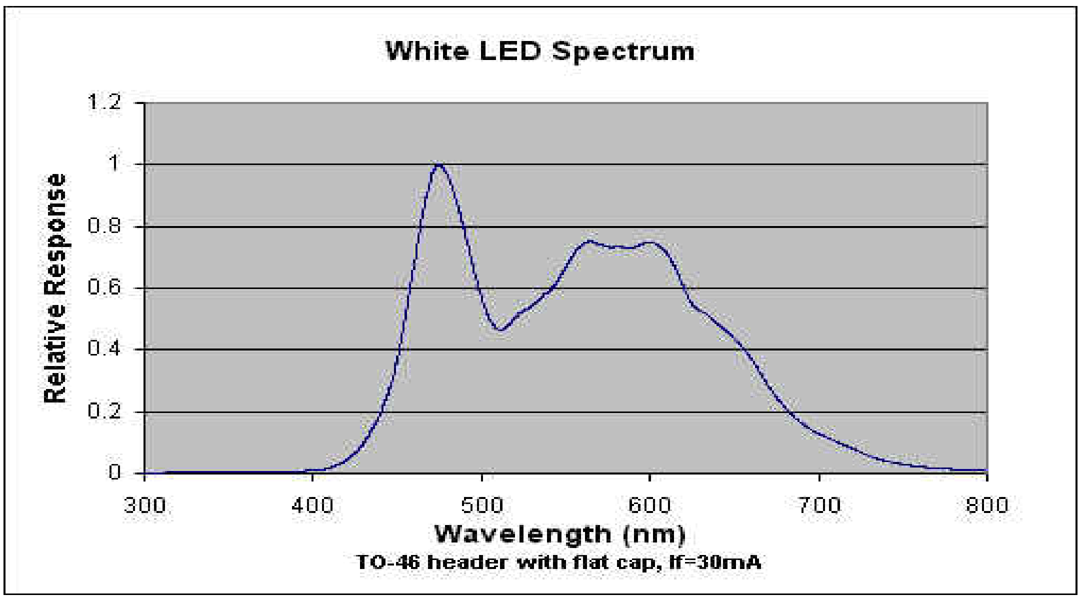


Fig:2.4(a) LED spectrum

LEDs are monochromatic (one color) devices. The color is determined by the band gap of the semiconductor used to make them. Red, green, yellow and blue LEDs are fairly common. White light contains all colors and cannot be directly created by a single LED. The most common form of "white" LED really isn't white. It is a Gallium Nitride blue LED coated with a phosphor that, when excited by the blue LED light, emits a broad range spectrum that in addition to the blue emission, makes a fairly white light.

There is a claim that these white LED's have a limited life. After 1000 hours or so of operation, they tend to yellow and dim to some extent. Running the LEDs at more than their rated current will certainly accelerate this process.

There are two primary ways of producing high intensity white-light using LED'S. One is to use individual LED'S that emit three primary colours—red, green, and blue—and then mix all the colours to form white light. The other is to use a phosphor material to convert monochromatic light from a blue or UV LED to broad-spectrum white light, much in the same way a fluorescent light bulb works. Due to metamerism, it is possible to have quite different spectra that appear white.

LEDs are semiconductor devices. Like transistors, and other diodes, LEDs are made out of silicon. What makes an LED give off light are the small amounts of chemical impurities that are added to the silicon, such as gallium, arsenide, indium, and nitride.

When current passes through the LED, it emits photons as a byproduct. Normal light bulbs produce light by heating a metal filament until it is white hot. LEDs produce photons directly and not via heat, they are far more efficient than incandescent bulbs.

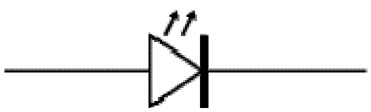


Fig 2.4(b): circuit symbol

Not long ago LEDs were only bright enough to be used as indicators on dashboards or electronic equipment. But recent advances have made LEDs bright enough to rival traditional lighting technologies. Modern LEDs can replace incandescent bulbs in almost any application.

2.4.1 Types of LED'S

LEDs are produced in an array of shapes and sizes. The 5 mm cylindrical package is the most common, estimated at 80% of world production. The color of the plastic lens is often the same as the actual color of light emitted, but not always. For instance, purple plastic is often used for infrared LEDs, and most blue devices have clear housings. There are also LEDs in extremely tiny packages, such as those found on blinkers and on cell phone keypads. The main types of LEDs are miniature, high power devices and custom designs such as alphanumeric or multi-color.

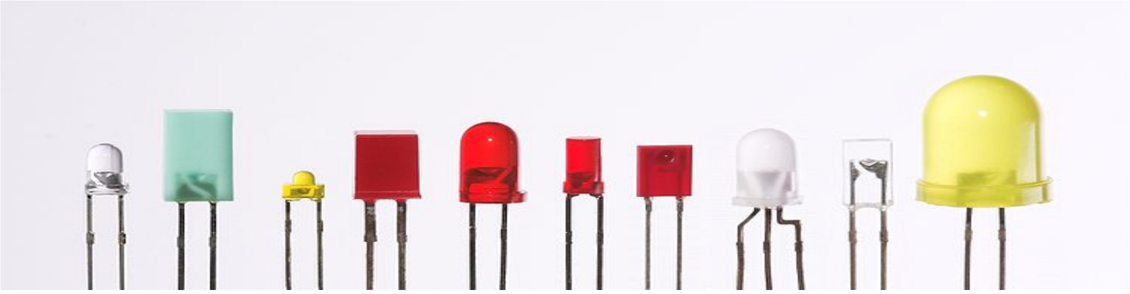


Fig 2.4(c) Different types of LED'S

2.5 IN4007

Diodes are used to convert AC into DC these are used as half wave rectifier or full wave rectifier. Three points must he kept in mind while using any type of diode.

1.Maximum forward current capacity

2.Maximum reverse voltage capacity

3.Maximum forward voltage capacity

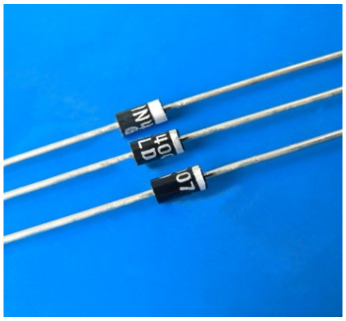


Fig:2.5(a) IN4007 diodes

The number and voltage capacity of some of the important diodes available in the market are as follows:

- Diodes of number IN4001, IN4002, IN4003, IN4004, IN4005, IN4006 and IN4007 have maximum reverse bias voltage capacity of 50V and maximum forward current capacity of 1 Amp.
- Diode of same capacities can be used in place of one another. Besides this diode of more capacity can be used in place of diode of low capacity but diode of low capacity cannot be used in place of diode of high capacity. For example, in place of IN4002; IN4001 or IN4007 can be used but IN4001 or IN4002 cannot be used in place of IN4007.The diode BY125made by

company BEL is equivalent of diode from IN4001 to IN4003. BY 126 is equivalent to diodes IN4004 to 4006 and BY 127 is equivalent to diode IN4007.

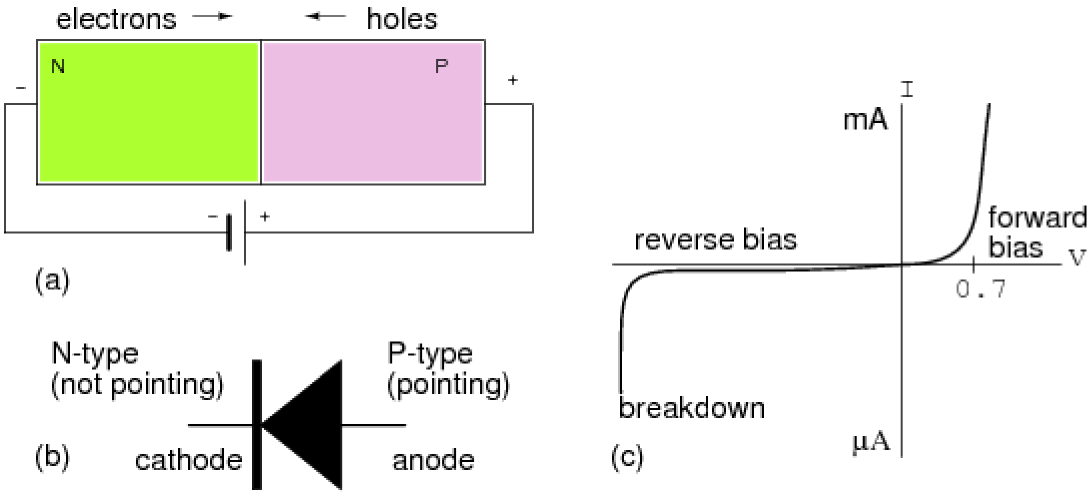


Fig:2.5(b) PN Junction diode

2.6 PN JUNCTION OPERATION

Now that you are familiar with P- and N-type materials, how these materials are joined together toform a diode, and the function of the diode, let us continue our discussion with the operation of the PNjunction. But before we can understand how the PN junction works, we must first consider current flow inthe materials that make up the junction and what happens initially within the junction when these twomaterials are joined together.

2.7 Current Flow in the N-Type Material

Conduction in the N-type semiconductor, or crystal, is similar to conduction in a copper wire. Thatis, with voltage applied across the material, electrons will move through the crystal just as current wouldflow in a copper wire. This is shown in figure 1-15. The positive potential of the battery will attract thefree electrons in the crystal. These electrons will leave the crystal and flow into the positive terminal ofthe battery. As an electron leaves the crystal, an electron from the negative terminal of the battery willenter the crystal, thus completing the current path. Therefore, the majority current carriers in the N-typematerial (electrons) are repelled by the negative side of the battery and move through the crystal towardthe positive side of the battery.

2.8 Current Flow in the P-Type Material

Current flow through the P-type material is illustrated. Conduction in the P material isby positive holes, instead of negative electrons. A hole moves from the positive terminal of the P materialto the negative terminal. Electrons from the external circuit enter the negative terminal of the material andfill holes in the vicinity of this terminal. At the positive terminal, electrons are removed from the covalentbonds, thus creating new holes. This process continues as the steady stream of holes (hole current) movestoward the negative terminal

2.9 RESISTORS

the A resistor is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current, that is, in accordance with Ohm's law:

$$V = IR$$

Resistors are used as part of electrical networks and electronic circuits. They are extremely commonplace in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel/chrome).

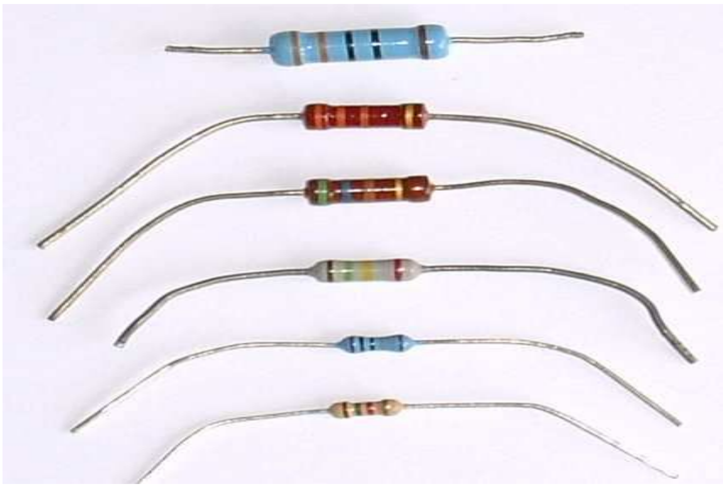


Fig2.9: Resistors

The primary characteristics of resistors are their resistance and the power they can dissipate. Other characteristics include temperature coefficient, noise, and inductance. Less well-known is critical resistance, the value below which power dissipation limits the maximum permitted current flow, and above which the limit is applied voltage. Critical resistance depends upon the materials constituting the resistor as well as its physical dimensions; it's determined by design.

Resistors can be integrated into hybrid and printed circuits, as well as integrated circuits. Size, and position of leads (or terminals) are relevant to equipment designers; resistors must be physically large enough not to overheat when dissipating their power.

A resistor is a two-terminalpassiveelectronic component which implements electrical resistance as a circuit element. When a voltage V is applied across the terminals of a resistor, a current I will flow through the resistor in direct proportion to that voltage. The reciprocal of the constant of proportionality is known as the resistance R, since, with a given voltage V, a larger value of R further "resists" the flow of current I as given by Ohm's law:

$$I = \frac{V}{R}$$

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel-chrome). Resistors are also implemented within integrated circuits, particularly analog devices, and can also be integrated into hybrid and printed circuits.

The electrical functionality of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than 9 orders of magnitude. When specifying that resistance in an electronic design, the required precision of the resistance may require attention to the manufacturing tolerance of the chosen resistor, according to its specific application. The temperature coefficient of the resistance may also be of concern in some precision applications. Practical resistors are also specified as having a maximum power rating which must exceed the anticipated power dissipation of that resistor in a particular circuit: this is mainly of concern in power electronics applications. Resistors with higher power ratings are physically larger and may require heat sinking. In a high voltage circuit, attention must sometimes be paid to the rated maximum working voltage of the resistor.

The series inductance of a practical resistor causes its behaviour to depart from ohms law; this specification can be important in some high-frequency applications for smaller values of resistance. In a low-noise amplifier or pre-amp the noise characteristics of a resistor may be an issue. The unwanted inductance, excess noise, and temperature coefficient are mainly dependent on the technology used in manufacturing the resistor. They are not normally specified individually for a particular family of resistors manufactured using a particular technology. A family of discrete resistors is also characterized according to its form factor, that is, the size of the device and position of its leads (or terminals) which is relevant in the practical manufacturing of circuits using them.

Units

The ohm (symbol: Ω) is the SI unit of electrical resistance, named after Georg Simon Ohm. An ohm is equivalent to a volt per ampere. Since resistors are specified and manufactured over a very large range of values, the derived units of milliohm (1 mΩ = 10^{-3} Ω), kilohm (1 kΩ = 10^{3} Ω), and megohm (1 MΩ = 10^{6} Ω) are also in common usage.

The reciprocal of resistance R is called conductance G = 1/R and is measured in Siemens (SI unit), sometimes referred to as a mho. Thus a Siemens is the reciprocal of an ohm: $S = \Omega^{-1}$. Although the concept of conductance is often used in circuit analysis, practical resistors are always specified in terms of their resistance (ohms) rather than conductance.

Resistor marking

Electronic color code

Most axial resistors use a pattern of coloured stripes to indicate resistance. Surface-mount resistors are marked numerically, if they are big enough to permit marking; more-recent small sizes are impractical to mark. Cases are usually tan, brown, blue, or green, though other colours are occasionally found such as dark red or dark gray.

Early 20th century resistors, essentially uninsulated, were dipped in paint to cover their entire body for colour coding. A second colour of paint was applied to one end of the element, and a colour dot (or band) in the middle provided the third digit. The rule was "body, tip, dot", providing two significant digits for value and the decimal multiplier, in that sequence. Default tolerance was ±20%. Closer-tolerance resistors had silver (±10%) or gold-coloured (±5%) paint on the other end.

Four-band resistors

Four-band identification is the most commonly used colour-coding scheme on resistors. It consists of four coloured bands that are painted around the body of the resistor. The first two bands encode the first two significant digits of the resistance value, the third is a power-of-ten multiplier or number-of-zeroes, and the fourth is the tolerance accuracy, or acceptable error, of the value. The first three bands are equally spaced along the resistor; the spacing to the fourth band is wider. Sometimes a fifth band identifies the thermal coefficient, but this must be distinguished from the true 5-color system, with 3 significant digits.

For example, green-blue-yellow-red is 56×10^4 Ω = 560 kΩ ± 2%. An easier description can be as followed: the first band, green, has a value of 5 and the second band, blue, has a value of 6, and is counted as 56. The third band, yellow, has a value of 10^4, which adds four 0's to the end, creating 560,000 Ω at ±2% tolerance accuracy. 560,000 Ω changes to 560 kΩ ±2% (as a kilo- is 10^3).

Each colour corresponds to a certain digit, progressing from darker to lighter colours, as shown in the chart below.

Color	1st band	2nd band	3rd band (multiplier)	4th band (tolerance)	Temp. Coefficient
Black	0	0	$\times10^0$		
Brown	1	1	$\times10^1$	±1% (F)	100 ppm
Red	2	2	$\times10^2$	±2% (G)	50 ppm
Orange	3	3	$\times10^3$		15 ppm
Yellow	4	4	$\times10^4$		25 ppm
Green	5	5	$\times10^5$	±0.5% (D)	
Blue	6	6	$\times10^6$	±0.25% (C)	
Violet	7	7	$\times10^7$	±0.1% (B)	
Gray	8	8	$\times10^8$	±0.05% (A)	
White	9	9	$\times10^9$		
Gold			$\times10^{-1}$	±5% (J)	
Silver			$\times10^{-2}$	±10% (K)	
None				±20% (M)	

There are many mnemonics for remembering these colours.

Preferred values

Early resistors were made in more or less arbitrary round numbers; a series might have 100, 125, 150, 200, 300, etc. Resistors as manufactured are subject to a certain percentage tolerance, and it makes sense to manufacture values that correlate with the tolerance, so that the actual value of a resistor overlaps slightly with its neighbours. Wider spacing leaves gaps; narrower spacing increases manufacturing and inventory costs to provide resistors that are more or less interchangeable.

A logical scheme is to produce resistors in a range of values which increase in a geometrical progression, so that each value is greater than its predecessor by a fixed multiplier or percentage, chosen to match the tolerance of the range. For example, for a tolerance of ±20% it makes sense to have each resistor about 1.5 times its predecessor, covering a decade in 6 values. In practice the factor used is 1.4678, giving values of 1.47, 2.15, 3.16, 4.64, 6.81, 10 for the 1-10 decade (a decade is a range increasing by a factor of 10; 0.1-1 and 10-100 are other examples); these are rounded in practice to 1.5, 2.2, 3.3, 4.7, 6.8, 10; followed, of course by 15, 22, 33, … and preceded by … 0.47, 0.68, 1. This scheme has been adopted as the E6 range of the IEC 60063 preferred number series. There are also E12, E24, E48, E96 and E192 ranges for components of ever tighter tolerance, with 12, 24, 96, and 192 different values within each decade. The actual values used are in the IEC 60063 lists of preferred numbers.

A resistor of 100 ohms ±20% would be expected to have a value between 80 and 120 ohms; its E6 neighbours are 68 (54-82) and 150 (120-180) ohms. A sensible spacing, E6 is used for ±20% components; E12 for ±10%; E24 for ±5%; E48 for ±2%, E96 for ±1%; E192 for ±0.5% or better. Resistors are manufactured in values from a few milliohms to about a gigaohm in IEC60063 ranges appropriate for their tolerance.

Earlier power wire-wound resistors, such as brown vitreous-enamelled types, however, were made with a different system of preferred values, such as some of those mentioned in the first sentence of this section.

5-band axial resistors

5-band identification is used for higher precision (lower tolerance) resistors (1%, 0.5%, 0.25%, 0.1%), to specify a third significant digit. The first three bands represent the significant digits, the fourth is the multiplier, and the fifth is the tolerance. Five-band resistors with a gold or silver 4th band are sometimes encountered, generally on older or specialized resistors. The 4th band is the tolerance and the 5th the temperature coefficient.

2.10 VARIABLE RESISTORS

2.10.1 Adjustable resistors

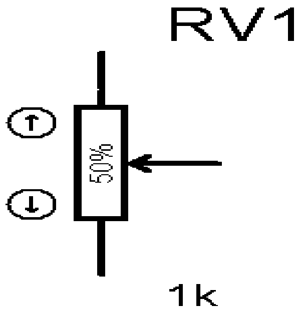
A resistor may have one or more fixed tapping points so that the resistance can be changed by moving the connecting wires to different terminals. Some wire wound power resistors have a tapping point that can slide along the resistance element, allowing a larger or smaller part of the resistance to be used.

Where continuous adjustment of the resistance value during operation of equipment is required, the sliding resistance tap can be connected to a knob accessible to an operator. Such a device is called a rheostat and has two terminals

2.10.2 Potentiometer

A potentiometer is a manually adjustable resistor. The way this device works is relatively simple. One terminal of the potentiometer is connected to a power source. Another is hooked up to ground (a point with no voltage or resistance and which serves as a neutral reference point), while the third terminal runs across a strip of resistive material. This resistive strip generally has a low resistance at one end; its resistance gradually increases to a maximum resistance at the other end. The third terminal serves as the connection between the power source and ground, and is usually interfaced to the user by means of a knob or lever. The user can adjust the position of the third terminal along the resistive strip in order to manually increase or decrease resistance. By controlling resistance, a potentiometer can determine how much current flow through a circuit. When used to regulate current, the potentiometer is limited by the maximum resistivity of the strip.

The power of this simple device is not to be underestimated. In most analog devices, a potentiometer is what establishes the levels of output. In a loud speaker, for example, a potentiometer directly adjusts volume; in a television monitor, it controls brightness.



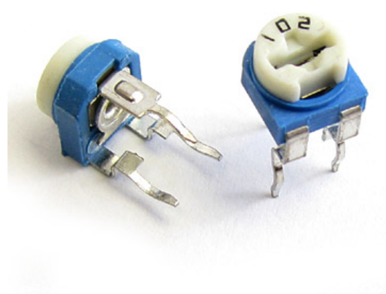


Fig:2.10.1(a) circuit diagram Fig:2.10.1(b) adjustable resistor

A potentiometer can also be used to control the potential difference, or voltage, across a circuit. The setup involved in utilizing a potentiometer for this purpose is a little bit more complicated. It involves two circuits: the first circuit consists of a cell and a resistor. At one end, the cell is connected in series to the second circuit, and at the other end it is connected to a potentiometer in parallel with the second circuit. The potentiometer in this arrangement drops the voltage by an amount equal to the ratio between the resistance allowed by the position of the third terminal and the highest possible resistivity of the strip. In other words, if the knob controlling the resistance is positioned at the exact halfway point on the resistive strip, then the output voltage will drop by exactly fifty percent, no matter how high the potentiometer's input voltage. Unlike with current regulation, voltage regulation is not limited by the maximum resistivity of the strip

2.11CAPACITORS

A capacitor or condenser is a passive electronic component consisting of a pair of conductors separated by a dielectric. When a voltage potential difference exists between the conductors, an electric field is present in the dielectric. This field stores energy and produces a mechanical force between the plates. The effect is greatest between wide, flat, parallel, narrowly separated conductors.

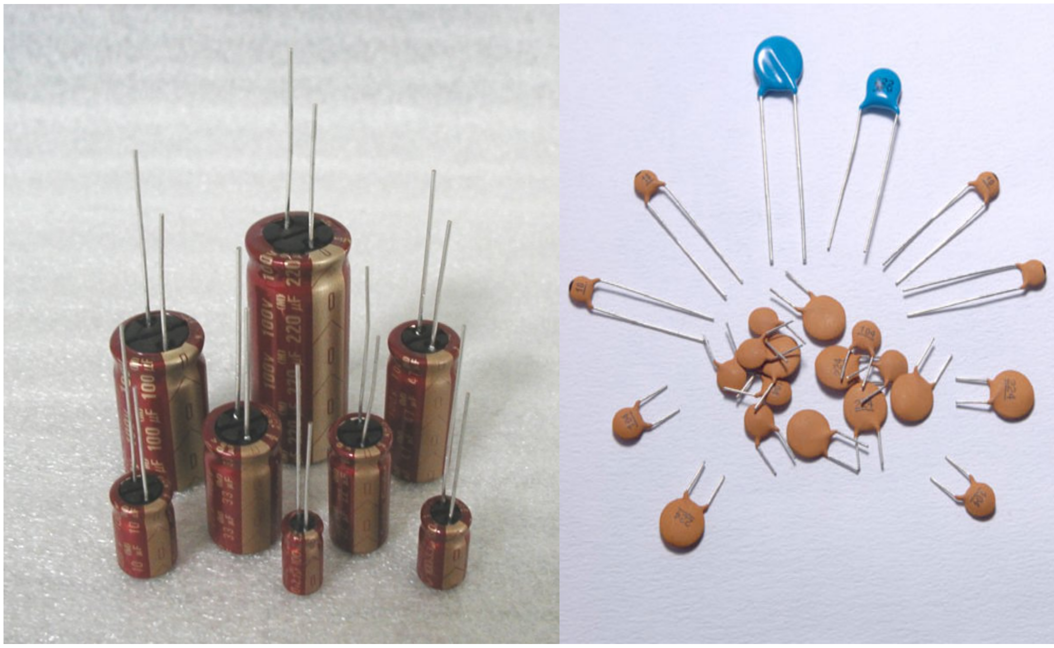


Fig:Types of capacitors

An ideal capacitor is characterized by a single constant value, capacitance, which is measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. In practice, the dielectric between the plates passes a small amount of leakage current. The conductors and leads introduce an equivalent series resistance and the dielectric has an electric field strength limit resulting in a breakdown voltage.

The properties of capacitors in a circuit may determine the resonant frequency and quality factor of a resonant circuit, power dissipation and operating frequency in a digital logic circuit, energy capacity in a high-power system, and many other important aspects.

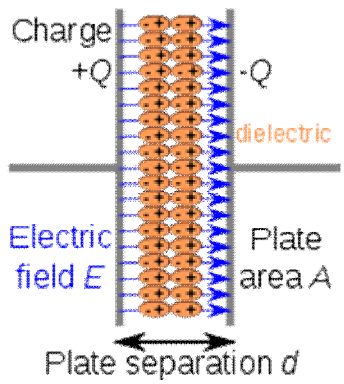
A capacitor (formerly known as condenser) is a device for storing electric charge. The forms of practical capacitors vary widely, but all contain at least two conductors separated by a non-conductor. Capacitors used as parts of electrical systems, for example, consist of metal foils separated by a layer of insulating film.

Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass, in filter networks, for smoothing the output of power supplies, in the resonant circuits that tune radios to particular frequencies and for many other purposes.

A capacitor is a passiveelectronic component consisting of a pair of conductors separated by a dielectric (insulator). When there is a potential difference (voltage) across the conductors, a static electric field develops in the dielectric that stores energy and produces a mechanical force between the conductors. An ideal capacitor is characterized by a single constant value, capacitance, measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them.

The capacitance is greatest when there is a narrow separation between large areas of conductor, hence capacitor conductors are often called "plates", referring to an early means of construction. In practice the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, resulting in a breakdown voltage, while the conductors and leads introduce an undesired inductance and resistance.

2.11.1 Theory of operation



Charge separation in a parallel-plate capacitor causes an internal electric field. A dielectric (orange) reduces the field and increases the capacitance.

A simple demonstration of a parallel-plate capacitor

A capacitor consists of two conductors separated by a non-conductive region. The non-conductive region is called the dielectric or sometimes the dielectric medium. In simpler terms, the dielectric is just an electrical insulator. Examples of dielectric mediums are glass, air, paper, vacuum, and even a semiconductordepletion region chemically identical to the conductors. A capacitor is assumed to be self-contained and isolated, with no net electric charge and no influence from any external electric field. The conductors thus hold equal and opposite charges on their facing surfaces, and the dielectric develops an electric field. In SI units, a capacitance of one farad means that one coulomb of charge on each conductor causes a voltage of one volt across the device.

The capacitor is a reasonably general model for electric fields within electric circuits. An ideal capacitor is wholly characterized by a constant capacitance C, defined as the ratio of charge ±Q on each conductor to the voltage V between them:

$$C = \frac{Q}{V}$$

Sometimes charge build-up affects the capacitor mechanically, causing its capacitance to vary. In this case, capacitance is defined in terms of incremental changes:

$$C = \frac{\mathrm{d}q}{\mathrm{d}v}$$

Energy storage

Work must be done by an external influence to "move" charge between the conductors in a capacitor. When the external influence is removed the charge separation persists in the electric field and energy is stored to be released when the charge is allowed to return to its equilibrium position. The work done in establishing the electric field, and hence the amount of energy stored, is given by:

$$W = \int_{q=0}^{Q} V \mathrm{d}q = \int_{q=0}^{Q} \frac{q}{C} \mathrm{d}q = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}CV^2 = \frac{1}{2}VQ.$$

Current-voltage relation

The current i(t) through any component in an electric circuit is defined as the rate of flow of a charge q(t) passing through it, but actual charges, electrons, cannot pass through the dielectric layer of a capacitor, rather an electron accumulates on the negative plate for each one that leaves the positive plate, resulting in an electron depletion and consequent positive charge on one electrode that is equal and opposite to the accumulated negative charge on the other. Thus the charge on the electrodes is equal to the integral of the current as well as proportional to the voltage as discussed above. As with any anti-derivative, a constant of integration is added to represent the initial voltage v (t_0). This is the integral form of the capacitor equation,

$$v(t) = \frac{q(t)}{C} = \frac{1}{C}\int_{t_0}^{t} i(\tau)\mathrm{d}\tau + v(t_0).$$

Taking the derivative of this, and multiplying by C, yields the derivative form,

$$i(t) = \frac{\mathrm{d}q(t)}{\mathrm{d}t} = C\frac{\mathrm{d}v(t)}{\mathrm{d}t}.$$

The dual of the capacitor is the inductor, which stores energy in the magnetic field rather than the electric field. Its current-voltage relation is obtained by exchanging current and voltage in the capacitor equations and replacing C with the inductance L.

CHAPTER 3

3.1OPTOCOUPLER

Opto coupler is a 6 pin IC. It is a combination of 1 LED and a transistor. Pin 6 of transistor is not generally used and when light falls on the Base-Emitter junction then it switches and pin5 goes to zero.

If input of the diode is zero and other end of diode is GND then the output is one.

- When logic zero is given as input then the light doesn't fall on transistor so it doesn't conduct which gives logic zero as output.
- When logic 1 is given as input then light falls on transistor so that it conducts, that makes transistor switched ON and it forms short circuit this makes the output is logic zero as collector of transistor is connected to ground.

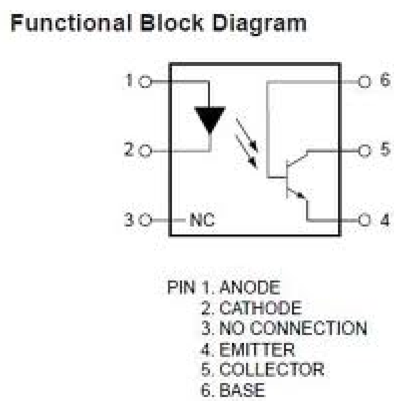


Fig:3.1functional block diagram

3.2ULN2003

ULN2003 is an IC which is used to interface relay with the microcontroller. Since the output of the micro controller is 5V and is not practicable to operate relay with that voltage. ULN2003 is nothing but a set of inverters, if logic high is given to the IC as input then its output will be logic low and vice-versa. Here in ULN2003 pin 1 to 7 are IC inputs and 10 to 16 are IC outputs.

For example let us operate a load using a relay which is interfaced with microcontroller by a ULN2003 IC.

Positive voltage i.e., 12V is given to 9^{th} pin of the ULN2003 IC and also to one end of the relay coil and the GND is connected to 8th pin. When microcontroller gives logic high to the

ULN2003, it gives an inverted output i.e., logic low which is connected to the other end of the relay coil. Due to this current flow through the coil which makes the relay ON and also the load is switched ON.

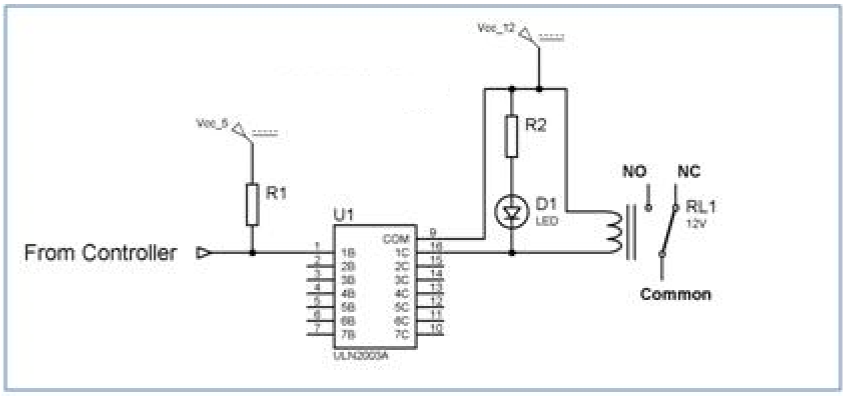


Fig:3.2 circuit diagram of ULN 2003

3.3 OPERATION

Three phase supply are given to three independent transformers connected in together with another transformers from receiving supply, an inverter , the secondary of the transformers are used to develop DC by half wave rectification and then deriving four number of opto isolators individually. The DC supply from all the three phases and inverter supply are combined and then fed to the regulator IC 7805 for the circuit operation power.

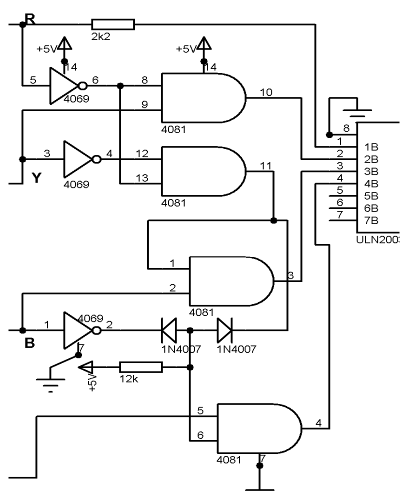


Fig 3.3 IC 7805 circuit diagram

One hex inverter CD4069 is used in combination with a quad AND CD4081 the output of which are fed to relay driver IC ULN2003 to operate relays for specific phase. While all the three phases R,Y,B are available the dc for R is directly given to ULN2003 pin number 1 such that the relay connected to pin 16 is operated and the load draws power from the R phase. The relays connected to pin number 15 and 14 of ULN2003 are held high as their corresponding input pin 2 and 3 are held low. This is because while R is high, pin 8 of 4081 is low through the inverter .Pin number 9 of 4081 is high since Y is available. Thus pin number 10 of 4081 provides low logic to ULN2003 pin number 2 to force the relay remain in OFF connected to pin number 15. The output of 4081 at pin number 11 is also low because of Y availability. Also since B is available pin number 2 of 4081 is held high while its pin number 1is held low because it is connected to pin number 11.Thus pin number 3 of 4081 is held low resulting in pin number 3 of ULN2003 also low and its pin number 14 remaining high ,hence the corresponding relay is OFF. When the R phase is missing the relay R stops and relay connected to pin number 15 is ON as per similar logic and load is supplied from Y phase. While Y phase is missing the relay 15 switches off and relay 14 switches ON similarly and the load is supplied from B phase. While B phase is available driving pin number 6 of 4081 low because of left side diode 4007 being forward biased .So the output pin 4 of 4069 remains low, forcing pin 13 of ULN2003 as high keeping the corresponding relay OFF. While all the three phases fail, 4069 pin 6 is held high because of pull up resistor and both the diodes in reverse biased condition. Hence the last AND gate can be used if an inverter is used such that while all the three phases fail it can supply power to the load. The relays connected drive the load with interlocking logic from the NO/NC contact of additional relays for handling the load.

CHAPTER 4

4.1 LAYOUT DIAGRAM

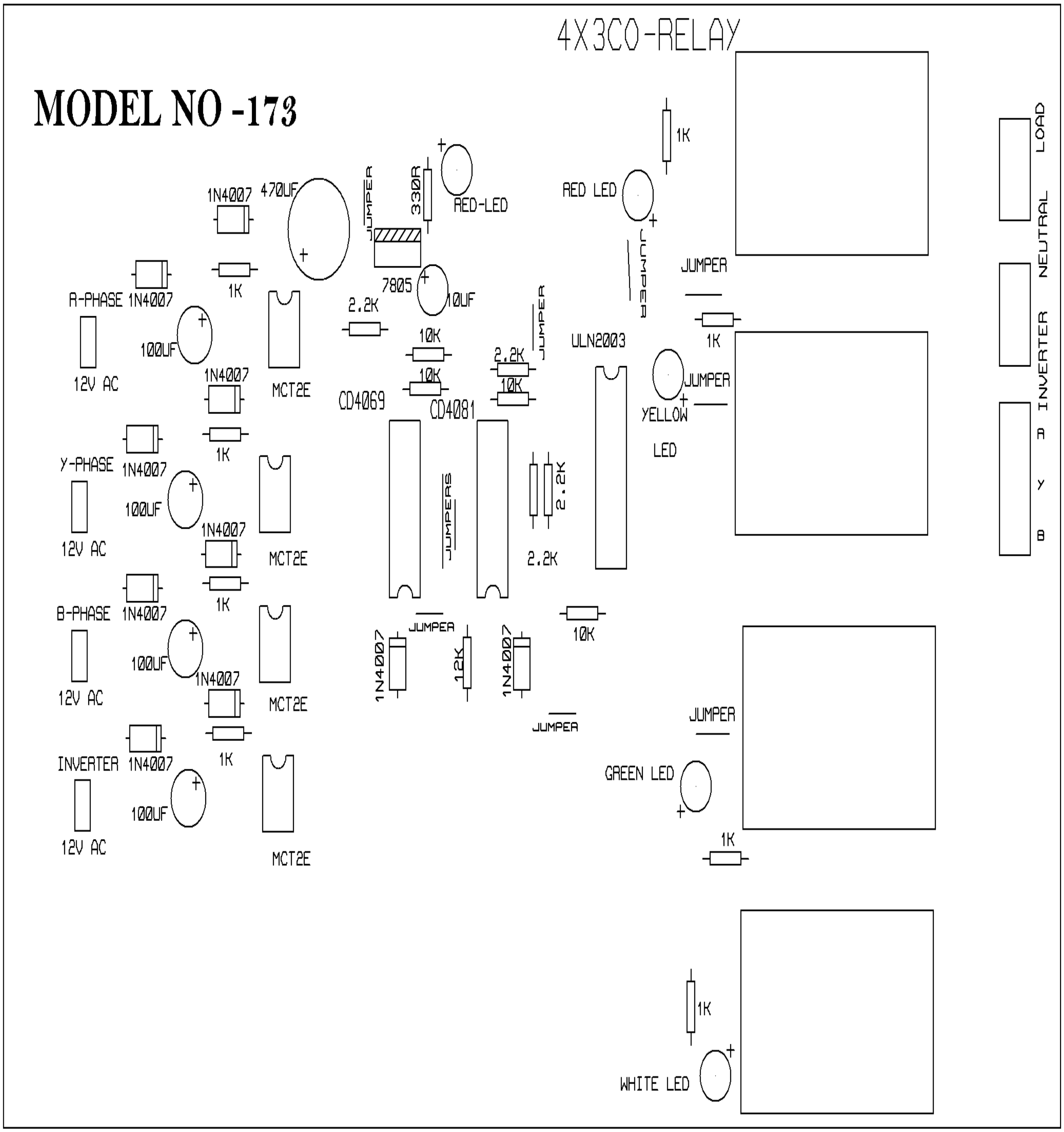


Fig.4.1: Layout Diagram

4.2 LIST OF MATERIALS

Component Name	Quantity
Resistors	
1K	8
330R	1
2.2K	4
12K	1
10K	4
Capacitors	
100uF/35V	4
470uF/35V	1
10uF/63V	1
Integrated Circuits	
MCT 2E	4
7805	1
4069	1
4081	1
ULN2003	1
IC BASES	
14 PIN BASE	2
16 PIN BASE	1
06 PIN BASE	4
Diodes	
1N4007	10
Miscellaneous	
LED-RED	2
LED- YELLOW	1
LED- GREEN	1
LED- WHITE	1
TRANSFORMER 0-12V	3
3C/O RELAY	4
PCB CONNECTOR 3-PIN	1
PCB CONNECTOR 2-PIN	2
AC CONNECTOR 4-PIN	1
MALE BURGE 2-PIN	4
FEMALE BURGE 2-PIN (For Transformers)	4
LAMP	1
LAMP HOLDER	1
RYB-N WIRE CONNECTING WIRE	
COPPER WIRE FOR LOAD	
PLAIN PCB	1
ZERO BOARD	1
ASSEMBLED PCB(WORKING)	1
SOLDERING IRON	1
CUTTER	1
MULTIMETER	1
SCREW DRIVER	1
SOLDERING LED (50 gm)	
CONNECTING WIRE	
RIBBON WIRE FOR ZEROBOARD	

Table :2 list of materials

CHAPTER 5

5.1CONTINUITY TEST:

In electronics, a continuity test is the checking of an electric circuit to see if current flows (that it is in fact a complete circuit). A continuity test is performed by placing a small voltage (wired in series with an LED or noise-producing component such as a piezoelectric speaker) across the chosen path. If electron flow is inhibited by broken conductors, damaged components, or excessive resistance, the circuit is "open".

Devices that can be used to perform continuity tests include multi meters which measure current and specialized continuity testers which are cheaper, more basic devices, generally with a simple light bulb that lights up when current flows.

An important application is the continuity test of a bundle of wires so as to find the two ends belonging to a particular one of these wires; there will be a negligible resistance between the "right" ends, and only between the "right" ends.

This test is the performed just after the hardware soldering and configuration has been completed. This test aims at finding any electrical open paths in the circuit after the soldering. Many a times, the electrical continuity in the circuit is lost due to improper soldering, wrong and rough handling of the PCB, improper usage of the soldering iron, component failures and presence of bugs in the circuit diagram. We use a multi meter to perform this test. We keep the multi meter in buzzer mode and connect the ground terminal of the multi meter to the ground. We connect both the terminals across the path that needs to be checked. If there is continuation then you will hear the beep sound.

5.2 POWER ON TEST:

This test is performed to check whether the voltage at different terminals is according to the requirement or not. We take a multi meter and put it in voltage mode, and measure voltage at different points in circuit to make sure we are getting required voltage at those particular points. First we apply less voltage and check whether the capacitors are getting charged, it is indicated by the lamp which is connected in series with supply and circuit. Initially lamp should glow fully because initially when capacitors are not charged they act as short circuit and due to the flow of short circuit current the series lamp glows, and when capacitors get gradually charged they act as open circuit, in this condition the series lamp stops glowing. If it happens then we can conclude that the circuit is working properly.

CHAPTER 6

6.1 FUTURE SCOPE

This system can be useful for many industrial as well as for domestic purposes Suppose if fault occurs during healthy operation of a relay. This circuit can be used for swithiching of phase from any two healthy phase for smooth and continous operartion of appliances which will not produce any effect in production processes in industries and in domestic household processes

6.2 CONCLUSION

Our project describes how it is possible to automatically select and switch between unhealthy to healthy phases using electrical and electronic circuit using relay and drives

Electrical phases are vulnerable to faults and disturbances which in turn makes our production and industrial operation into a stop which is directly proportional to economic losses

During such conditions our project come into picture and helps a lot in industries and hospitals

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