PROJECT REPORT ON AC TRACK CIRCUIT

Submitted in partial fulfilment of the requirements

Of the Degree of

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Submitted by

Shaikh Aslam

Mohd Ali

Uzma Kadri

Guided By

Prof. Gulrez Bodle

DEPARTMENT OF ELECTRICAL ENGINEERING

ANJUMAN-I-ISLAM'S KALSEKAR TECHNICAL CAMPUS

SCHOOL OF ENGINEERING AND TECHNOLOGY

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SYNOPSIS OF THE PROJECT REPORT

NAME OF THE PROJECT: AC TRACK CIRCUIT

NAME OF THE STUDENTS AND ROLL NO:

SHAIKH ASLAM (12EE53)

MOHD ALI (13EE32)

UZMA KADRI (14EEDS13)

CLASS & BRANCH: BE ELECTRICAL ENGINEERING

NAME OF THE COLLEGE: ANJUMAN-I-ISLAM'S KALSEKAR TECHNICAL CAMPUS SCHOOL OF ENGINEERING AND TECHNOLOGY, NEW PANVEL

PROJECT GUIDE	HEAD OF THE DEPARTMENT
PRO. GULREZ BODLE	**PROF. SAYYED KALEEM**

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ABSTRACT

Track circuit is the fundamental method of train detection. The first track circuit, based on a DC technology, has been invented at the end of nineteenth. Over the years, the continuous technological development has enabled to realize track circuits in an increasingly performing way by using AC technology and modulations, but the basic principle for train detection is still the same.

An alternative approach is the Axle Counter system, which uses a “check-in/check-out” logic. By comparing the result for the axles counted in a block section with the result for those counted out, it is possible to know the status of the track section (free or occupied).

Track circuits contributes also for the vehicle’s speed control, since the electrical signals used for train detection can be exchanged between wayside and on-board for the transmission of speed commands. This can be realized through modulation of the track signal and is known as “coded track circuits”. Perhaps, no single invention in the history of the development of railway transportation has contributed more towards safety and dispatch in that field than the track circuit.

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CHAPTER 1

1.1 INTRODUCTION

Since the birth of railway signaling, train detection has been considered a primary need [1]. For this purpose, railway tracks are divided into blocks of varying length. Each block stands out from the adjacent ones by means of an insulated joint between rails and it permits the detection of the presence of a train. Track circuits operational principle is based on an electrical signal impressed between the two running rails. The presence of a train is detected by the electrical connection between the rails, provided by the wheels and the axles of the train (wheel-to-rail shunting).

However, this is not the only function that track circuits perform in a railway signaling system because the detection information is used also to control train speed and ensure safe operation, by means of the transmission of speed commands to wayside signaling devices and to the trains [2]. A common operational scenario can summarize the track circuit operation: if a train approach too close to the rear of the next train B, the locations information provided by the track circuits is used to command a speed reduction or a trip of the train A, avoiding a possible collision. The occupancy information of a block is used to control the operation of all trains nearby the occupied area. When a train is detected on a block, it causes a stop command for the block immediately behind the train. Depending upon the block lengths, the line speeds involved, and the number of available speed commands, the second block behind the train may have a command speed between zero and full line speed. The third block behind the train may have a commanded speed greater than or equal to the second block, and so on. In all cases, the blocks behind a train are signaled so that a train entering a block gets the sufficient braking distance [3] to enter the block at a speed not greater than the commanded speed. In the case of a zero-speed command, the train must be able to stop before approaching the end of the block.

1.2 BLOCK DIAGRAM OF AC TRACK CIRCUIT

1.2.1 Transmitter Section:

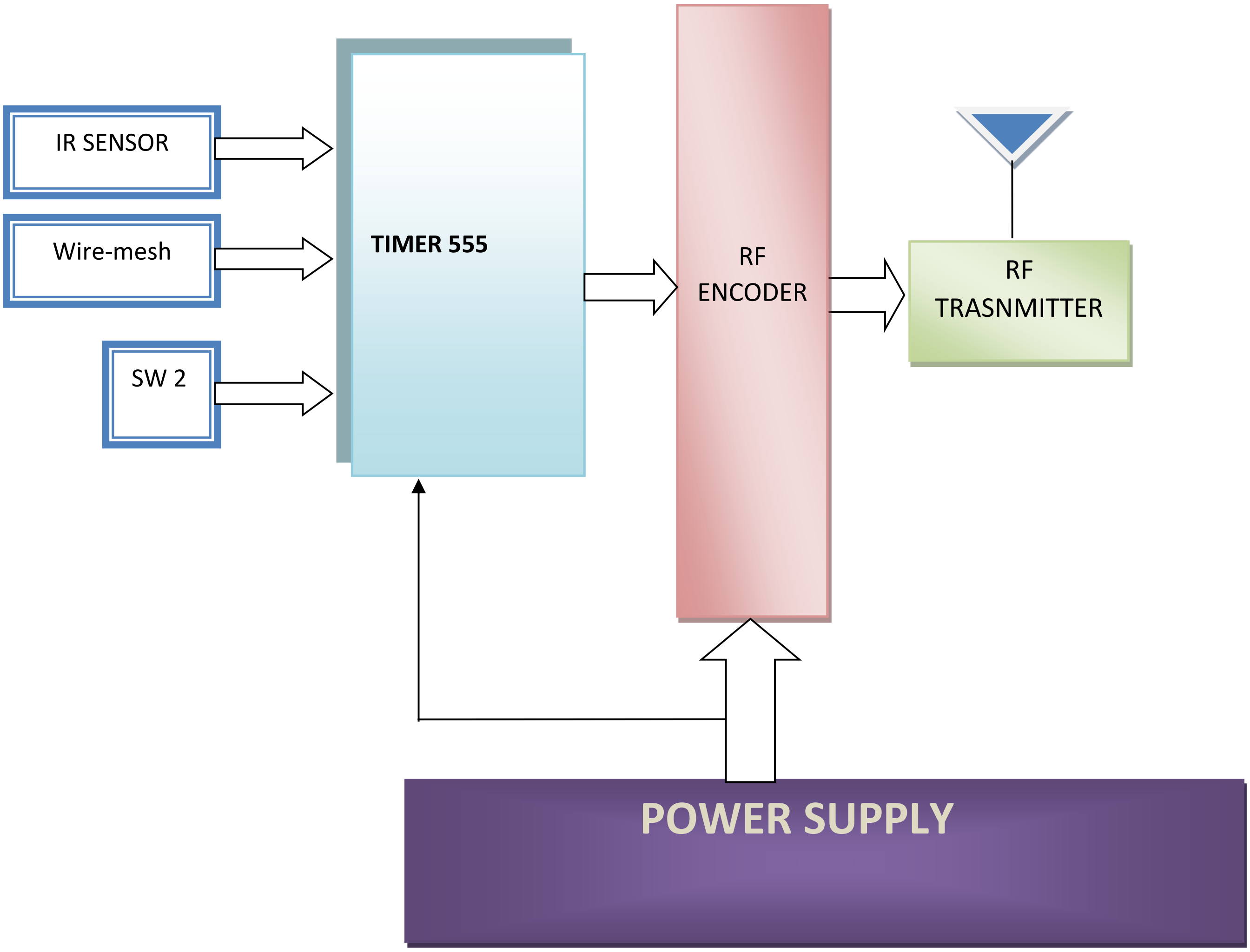


Fig. (1) Block Diagram of Transmitter.

1.2.2 Receiver Section:

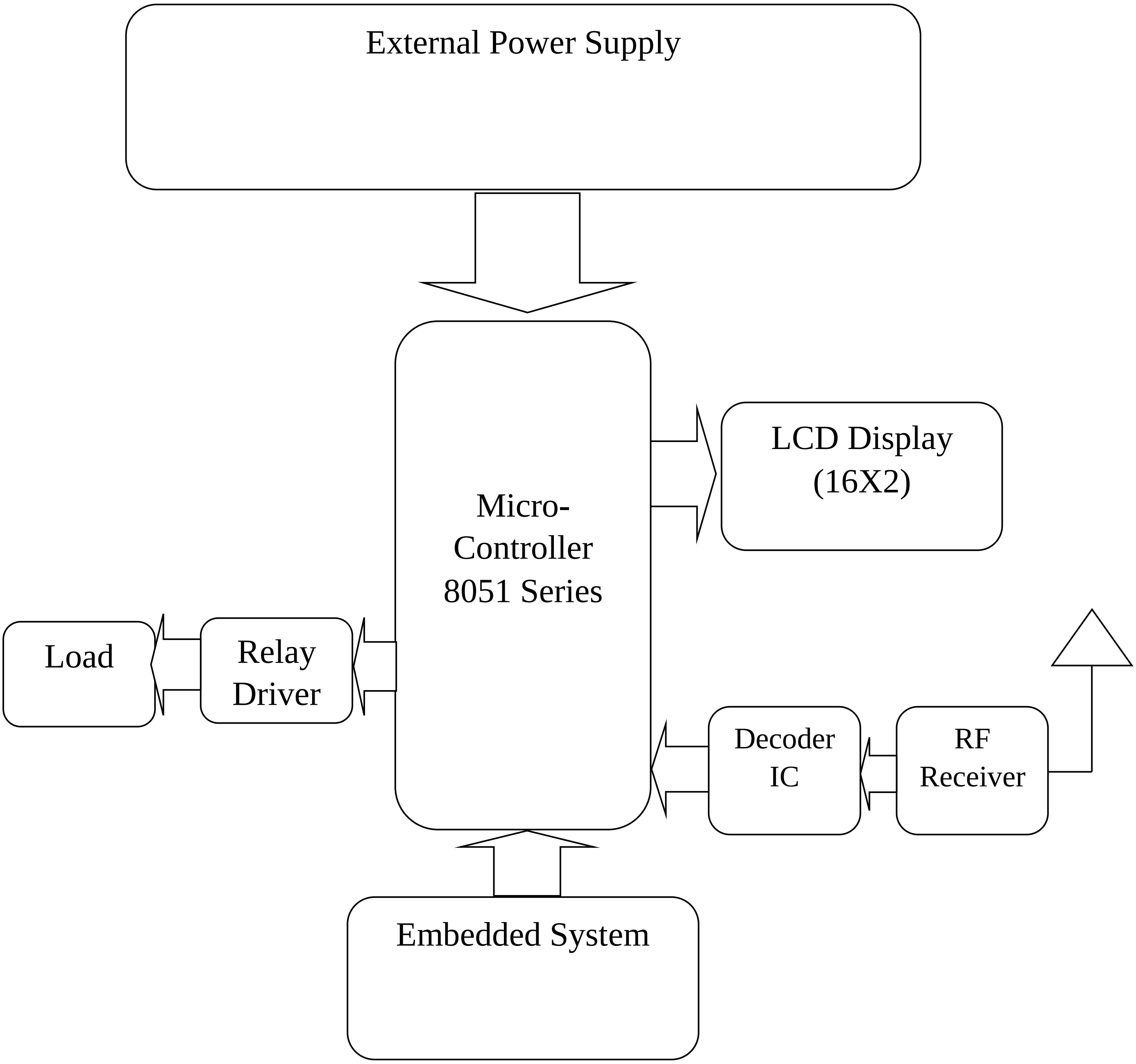


Fig. (2) Block Diagram of Receiver.

1.3 HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirement:-

- Step Down Transformer
- Bridge Rectifier
- Capacitors
- Regulator IC
- Micro-Controller
- IR Sensor
- Wire-mesh Sensor
- RF TX-RX Modules
- Encoder & Decoder IC
- LCD

Software Requirement:-

- Compiler:-Keil Compiler
- Language:-Embedded C

CHAPTER 2

2.1 IR SENSOR

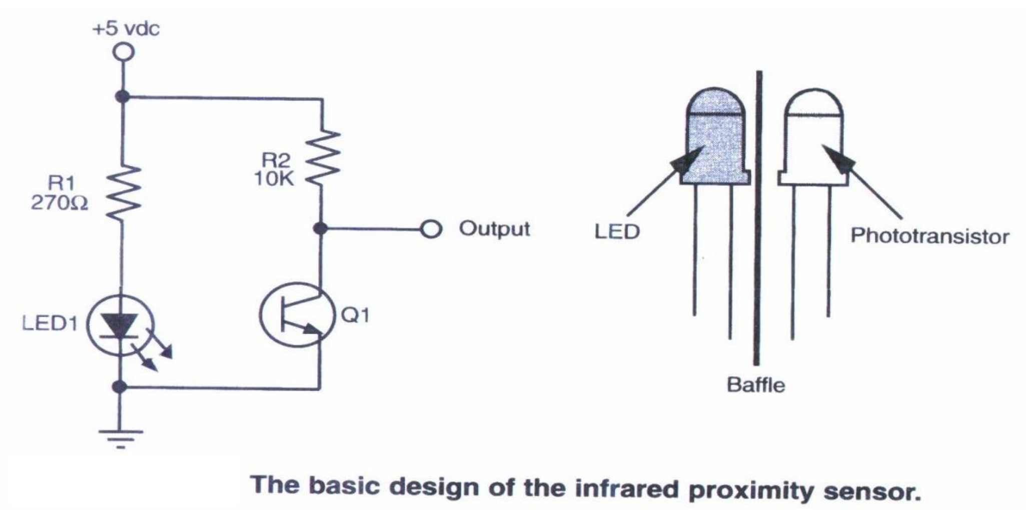


Fig. (3) Design of IR proximity sensor.

The photo depicts the schematics for an infrared sensor which allows you to detect an object's distance from the robot. The big picture problem is attach this infrared sensor on both wings of the aerial robot. Attaching these sensors on the wing tips will help the robot navigate through the halls of any building. This tutorial shows you how to construct and test one infrared sensor and takes approximately 3 hours to complete.

2.1.1 DESIGN OF INFRARED SENSOR CIRCUIT

2.1.1.1 Principle of operation of the I.R. L.E.D. and Phototransistor

A Photodiode is a p-n junction or p-i-n structure. When an infrared photon of sufficient energy strikes the diode, it excites an electron thereby creating a mobile electron and a positively charged electron hole. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in field of the depletion region, producing a photocurrent. Photodiodes can be used under either zero bias (photovoltaic mode) or reverse bias (photoconductive mode). Reverse bias induces only little current (known as saturation or back current) along its direction. But a more important effect of reverse bias is widening of the depletion layer (therefore expanding the reaction volume) and strengthening the photocurrent when infrared falls on it. There is a limit on the distance between I.R. L.E.D. and infrared sensor for the pair to operate in the desired manner. In our case distance is about 5mm.

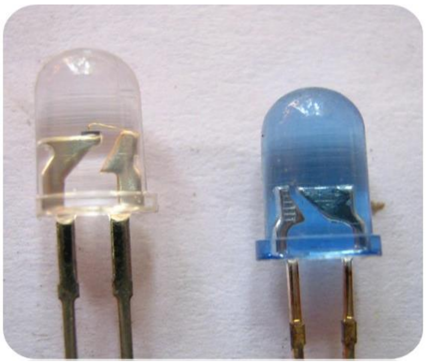


Fig. (4) IR LED

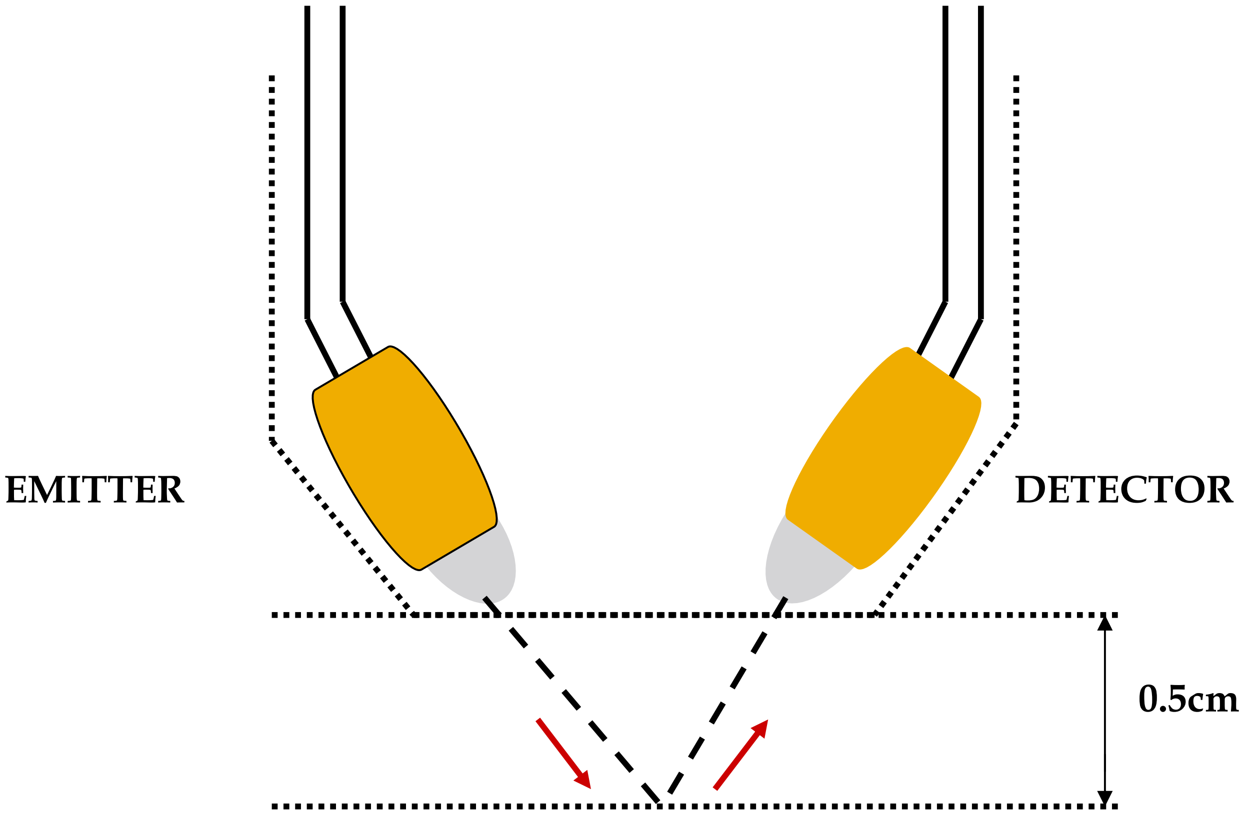


Fig. (5) Positioning of Sensors.

The resistance of the sensor decreases when IR (infrared) light falls on it. A good sensor will have near zero resistance in presence of light and a very large resistance in absence of light. Whether the sensors are Light Dependent Resistors, laser diode, Infrared Sensors, Ultrasonic Sensors or anything else, the outputs of the sensor modules are fed to the Non-inverting input of a comparator. The reference voltage of the comparator is fed to the inverting input of the comparator by a trim pot or a tuning device connected between the supply lines. LM339 is a comparator IC that digitizes the analog signal from the sensor array. Since the output of LM339 is TTL compatible it can be directly fed to the master microcontroller. The generalized connection diagram of Sensor Interfacing with microcontroller is shown below.

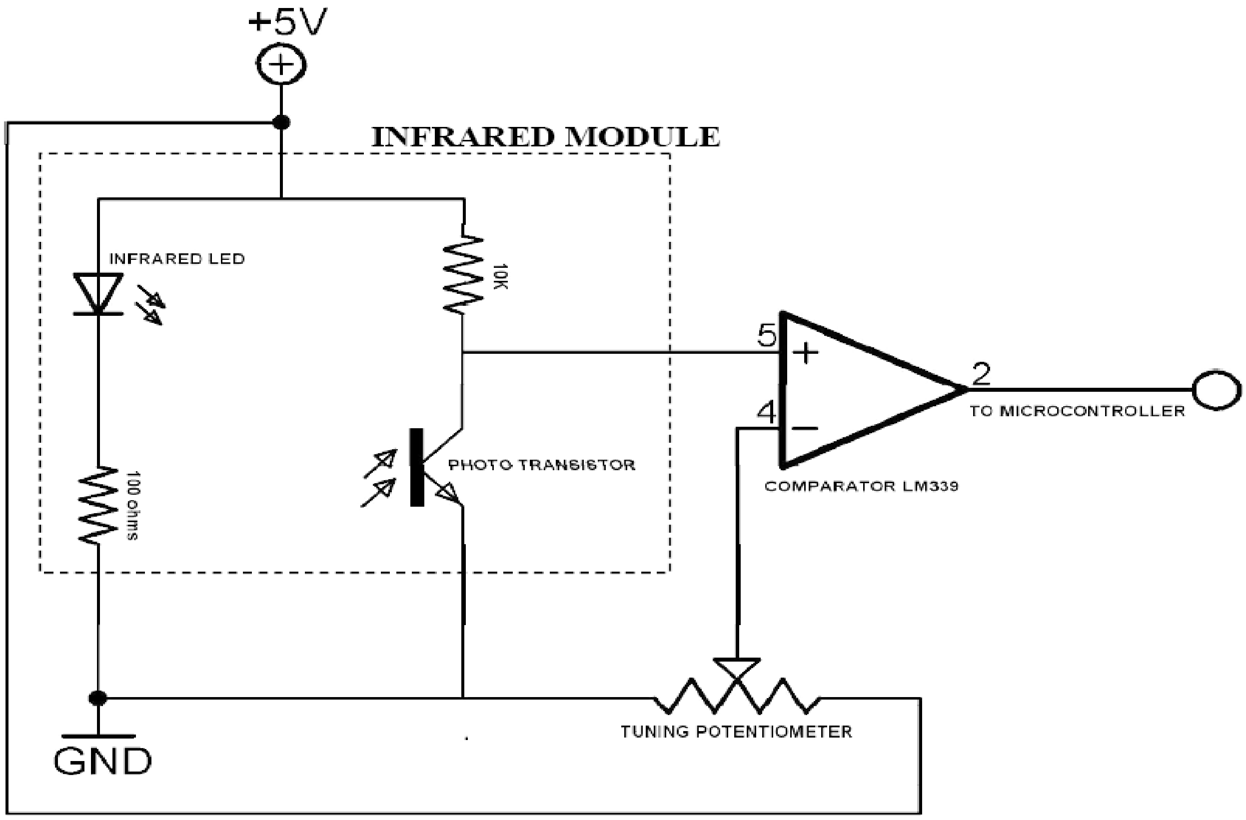


Fig. (6) Sensor Interfacing with Microcontroller.

CHAPTER 3

3.1 TRANSMITTER MODULE

The transmitter module is only 1/3 the size of a standard postage stamp, and can easily be placed inside a small plastic enclosure. The transmitter output is up to 8mW at 433.92 MHz with a range of approximately 400 foot (open area) outdoors. Indoors, the range is approximately 200 foot. The TWS-434 transmitter accepts both linear and digital inputs, can operate from 1.5 to 12 Volts-DC, and makes building a miniature hand-held RF transmitter very easy.

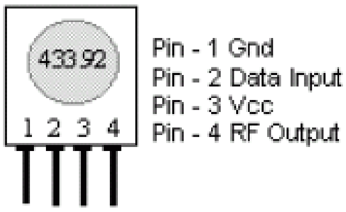


Fig. (7) Pin Diagram of Transmitter Module.

3.1.1 Features

- Frequency: 433.92 MHz
- 5 – 12V Single Supply Operational
- OOK / ASK Data Format
- Up to 9.6 kbps data rate
- 4 Pin compact size module
- + 5 dbm out put power (12V,Vcc)
- SAW based architect
- Vertical / Horizontal mount
- Directly connect to microcontroller
- Low Power Consumption suitable for battery operated devices
- Direct plug and use
- No external components required

- High performance SAW based Architecture with a maximum range of100 feet at 4800 bps data rate.
- Interface directly to Encoders and Microcontrollers with ease
- Can be directly in your PCB
- Right Angle Pin (Flat Out) is the standard in these modules
- Can be used with Fixed Code and Rolling Code Encoders or direct with Microcontrollers.

3.2 RECIEVER MODULE

The receiver also operates at 433.92MHz, and has a sensitivity of 3µV. The RWS-434 receiver operates from 4.5 to 5.5 volts-DC, and has both linear and digital outputs.

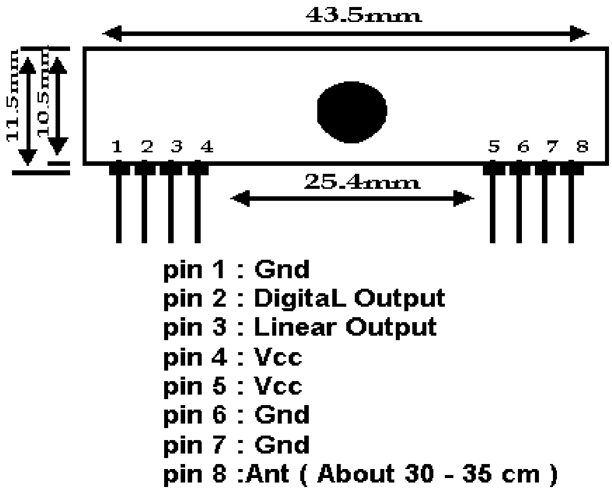


Fig. (8) Pin Diagram of Receiver Module.

3.2.1 Features

- Miniature Size
- Wide Operating Range
- Low Power Consumption
- Improved Data Transmission

- No Alignment Required
- No External Components PIN Configuration and Size
- Wide Range of Application
- Analogue and Digital Output

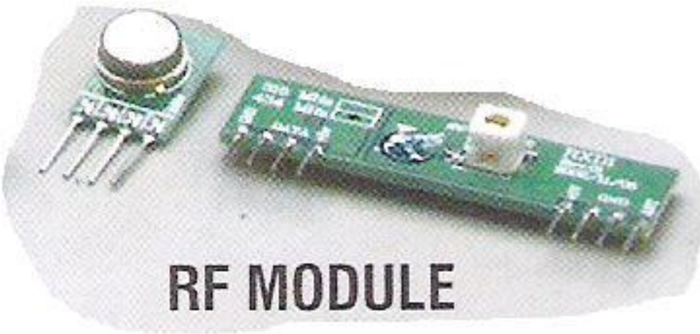


Fig. (9) Transmitter & Receiver module.

3.3 POWER SUPPLY

In this project circuits, sensors & motor are used which require +12V & +5V(DC)supply, to fulfill this requirement we have used following circuit of power supply which provides regulated +12V & +5V.(DC).

3.3.1 Working

As shown above Transformer (15V/1A) is used to down convert the AC upto 15V. 4 diodes (IN4007) are connected to secondary of transformer in bridge for rectifying AC into DC. Capacitor 1000 μf & 1μf are used as a filter red led shows that rectification and filtering is ok.

7812 IC is used as a 12V regulator it converts 15V into regulated +12V DC YELLOW led shows that output of 7812 is ok.

7805 IC is used as a 5V regulator it converts 12V into regulated +5V DC green led shows that output of 7805 is ok.

3.4 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. (10) 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.

$$\text{TURNS RATIO} = (Vp / Vs) = (Np / Ns) \qquad (1)$$

Where,

Vp = primary (input) voltage.

Vs = secondary (output) voltage

Np = number of turns on primary coil

Ns = number of turns on secondary coil

Is = secondary (output) current.

Ip = primary (input) current.

3.4.1 Ideal Power Equation

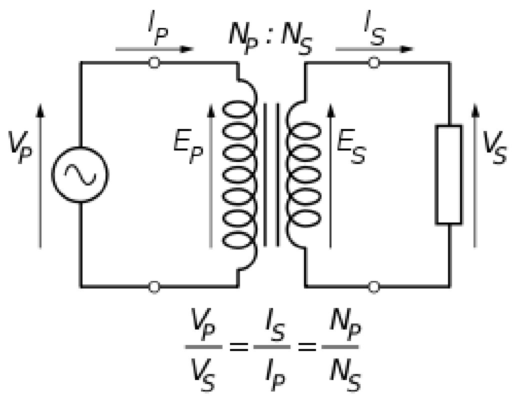


Fig. (11) The ideal transformer as a circuit element.

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:

$$P_{\text{incoming}} = I_p V_p = P_{\text{outgoing}} = I_s V_s, \qquad (2)$$

giving the ideal transformer equation,

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}. \qquad (3)$$

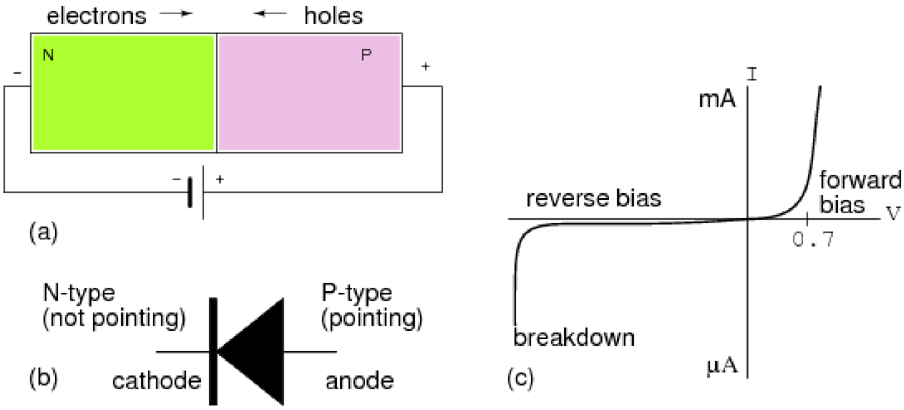
Transformers normally have high efficiency, so this formula is a reasonable approximation. If the voltage is increased, then the current is decreased by the same factor. The impedance in one circuit is transformed by the *square* of the turns ratio. For example, if an impedance Z_s is attached across 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 $(N_s/N_p)^2 Z_p$.

3.5 DIODE 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

Maximum forward voltage capacity.



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.

3.5.1 PN Junction Operation

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

3.5.2 Current flow in the N-type Material

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

3.5.3 Current flow in the P-type Material

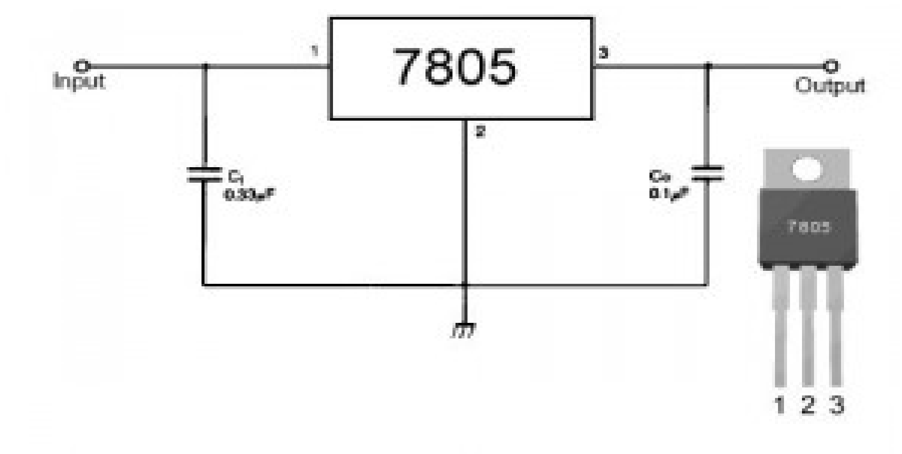
Current flow through the P-type material is illustrated. Conduction in the P material is by positive holes, instead of negative electrons. A hole moves from the positive terminal of the P material to the negative terminal. Electrons from the external circuit enter the negative terminal of the material and fill holes in the vicinity of this terminal. At the positive terminal, electrons are removed from the covalent bonds, thus creating new holes. This process continues as the steady stream of holes (hole current) moves toward the negative terminal.

CHAPTER 4

4.1 VOLTAGE REGULATOR 7805

4.1.1 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.



4.1.2 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.

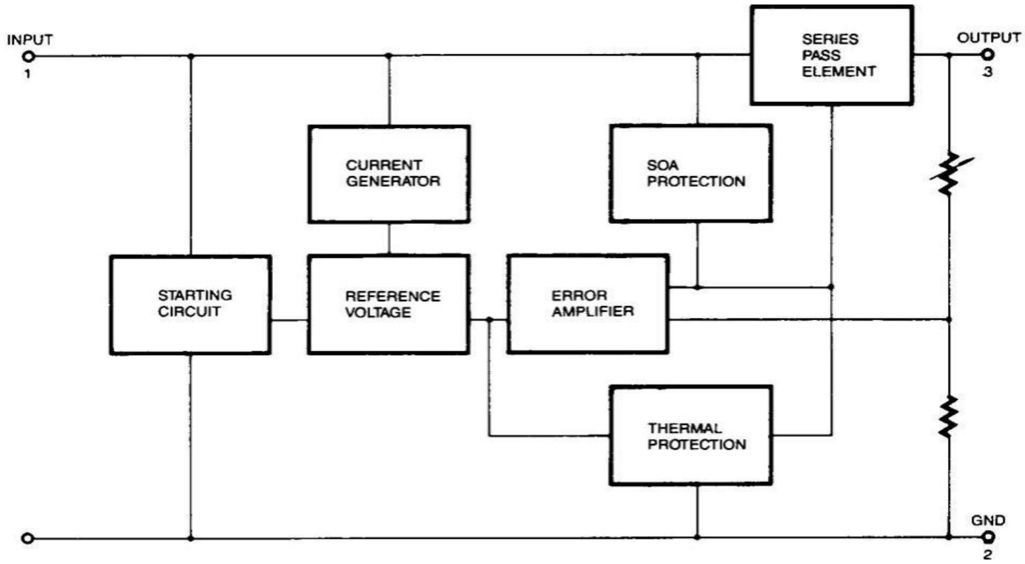


Fig. (12) Block Diagram of Voltage Regulator.

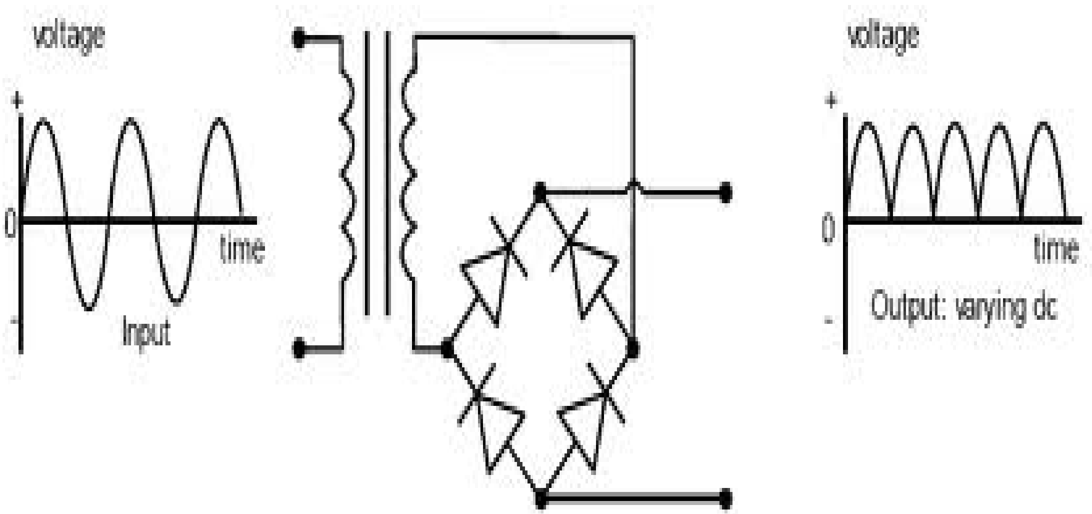
4.1.3 Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Input Voltage (for V_O = 5V to 18V) (for V_O = 24V)	V_I V_I	35 40	V V
Thermal Resistance Junction-Cases (TO-220)	$R_{\theta JC}$	5	°C/W
Thermal Resistance Junction-Air (TO-220)	$R_{\theta JA}$	65	°C/W
Operating Temperature Range (KA78XX/A/R)	T_{OPR}	0 ~ +125	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C

Table. (1) Ratings of the Voltage Regulator.

4.2 RECTIFIER

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), current that flows in only one direction, a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid state diodes, vacuum tube diodes, mercury arc valves, and other components. The output from the transformer is fed to the rectifier. It converts A.C. into pulsating D.C. The rectifier may be a half wave or a full wave rectifier. In this project, a bridge rectifier is used because of its merits like good stability and full wave rectification. In positive half cycle only two diodes (1 set of parallel diodes) will conduct, in negative half cycle remaining two diodes will conduct and they will conduct only in forward bias only.



4.3 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. Below figure can show how the capacitor charges and discharges.

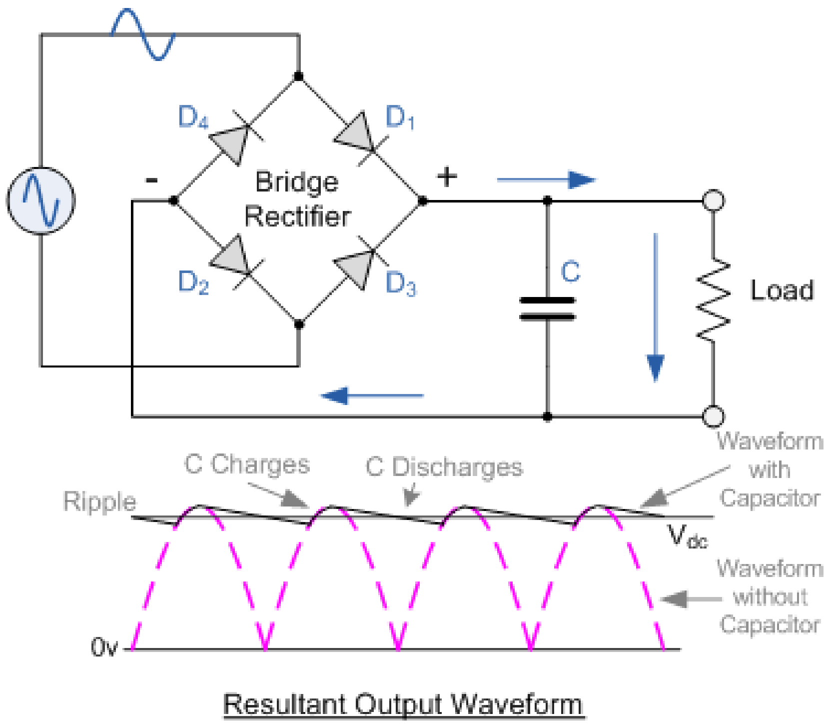


Fig. (13) Resultant Output Waveform.

4.4 RESISTORS

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:

$$V = IR \qquad (4)$$

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). 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.

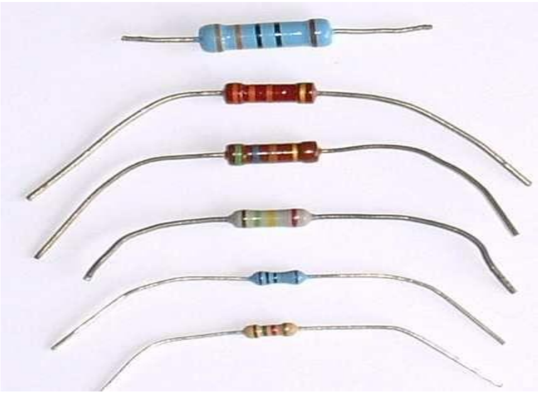


Fig. (14) Resistors.

A resistor is a two-terminal passive electronic 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:

$$I = \frac{V}{R} \tag{5}$$

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 behavior 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.

4.4.1 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), kilo ohm (1 kΩ = 10^{3} Ω), and mega ohm (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.

4.4.2 Variable Resistors

(a) 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.

(b) Potentiometers

A common element in electronic devices is a three-terminal resistor with a continuously adjustable tapping point controlled by rotation of a shaft or knob. These variable resistors are known as potentiometers when all three terminals are present, since they act as a continuously adjustable voltage divider. A common example is a volume control for a radio receiver.
Accurate, high-resolution panel-mounted potentiometers (or "pots") have resistance elements typically wire wound on a helical mandrel, although some include a conductive-plastic resistance coating over the wire to improve resolution. These typically offer ten turns of their shafts to cover their full range. They are usually set with dials that include a simple turns counter and a graduated dial. Electronic analog computers used them in quantity for setting coefficients, and delayed-sweep oscilloscopes of recent decades included one on their panels.

4.5 CAPACITORS

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.

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.

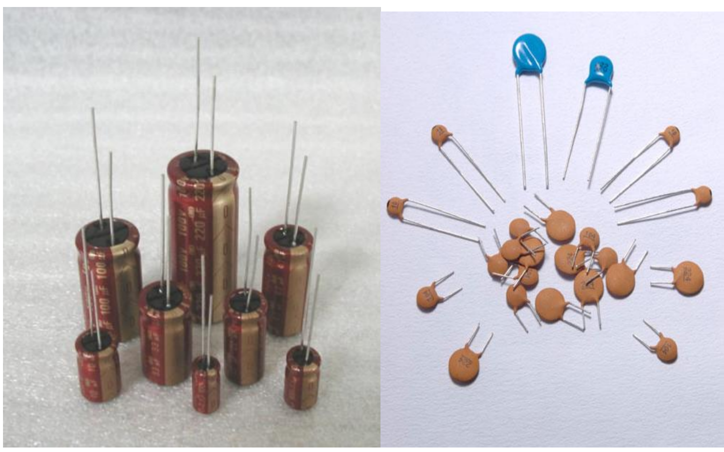


Fig. (15) Capacitors.

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 passive electronic 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.

4.5.1 Theory of Operation

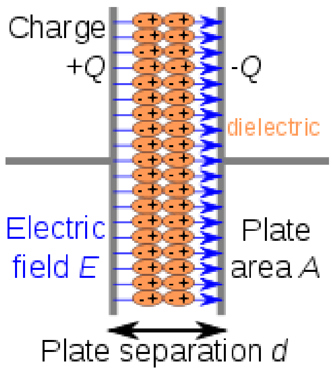


Fig. (16) Plate separation.

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

Fig. (17) 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 semiconductor depletion 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:

$$C = \frac{Q}{V} \qquad (6)$$

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

$$C = \frac{\mathrm{d}q}{\mathrm{d}v} \qquad (7)$$

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:

$$W = \int_{q=0}^{Q} V\,\mathrm{d}q = \int_{q=0}^{Q} \frac{q}{C}\,\mathrm{d}q = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}CV^2 = \frac{1}{2}VQ. \quad (8)$$

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 antiderivative, a constant of integration is added to represent the initial voltage v (t_0). This is the integral form of the capacitor equation,

$$v(t) = \frac{q(t)}{C} = \frac{1}{C}\int_{t_0}^{t} i(\tau)\,\mathrm{d}\tau + v(t_0) \quad (9)$$

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

$$i(t) = \frac{\mathrm{d}q(t)}{\mathrm{d}t} = C\frac{\mathrm{d}v(t)}{\mathrm{d}t} \quad (10)$$

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 5

5.1 LED

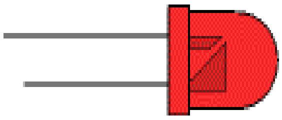


Fig. 18(a) Typical LED.

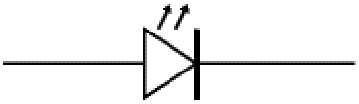


Fig 18(b) Circuit Symbol.

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.

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.

5.1.1 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.

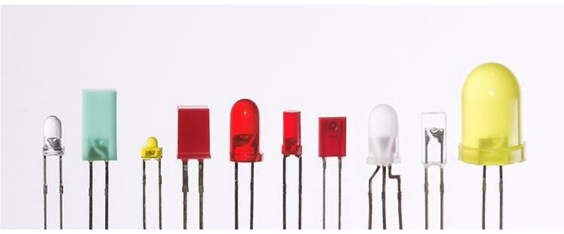


Fig. (19) Different Types of LED's.

5.1.2 Colors and Materials of LED's

Conventional LED'S are made from a variety of inorganic semiconductor materials, the following table shows the available colors with wavelength range, voltage drop and material.

5.1.3 White LED's

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.

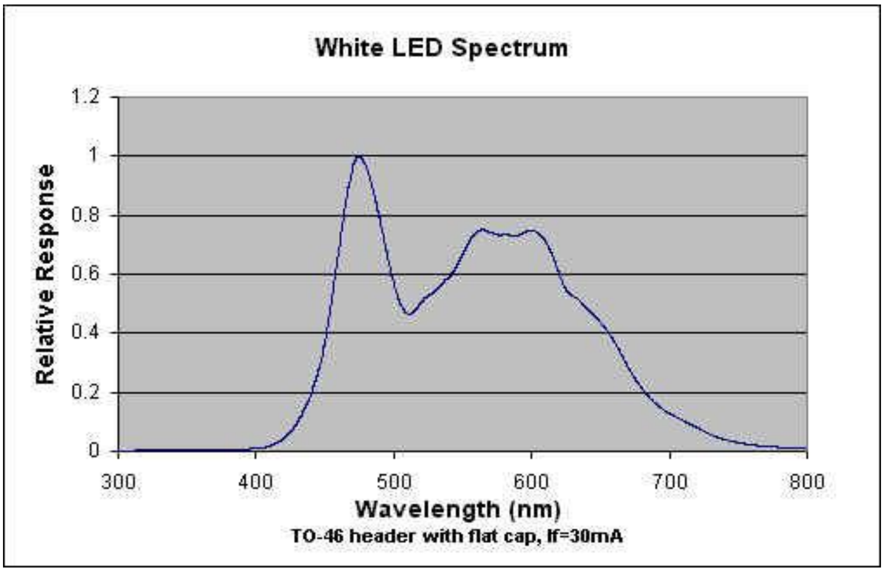


Fig. (20) White LED Spectrum.

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 colors red, green, and blue and then mix all the colors 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.

5.2 POWER RELAY

Fig. (21) Power Relay.

The type of power relay we are using is called Miniature Power PCB Relay T7N/T7N-WG SPDT TYPE with specification 12v/7amp.

5.2.1 Working

Notice in the above diagram that a relay uses an electromagnet. This is a device consisting of a coil of wire wrapped around an iron core. When electricity is applied to the coil of wire it becomes magnetic, hence the term electromagnet. The A B and C terminals are an SPDT switch controlled by the electromagnet. When electricity is applied to V1 and V2, the electromagnet acts upon the SPDT switch so that the B and C terminals are connected. When the electricity is disconnected, then the A and C terminals are connected. It is important to note that the electromagnet is magnetically linked to the switch but the two are NOT linked electrically.

5.2.2 Relay Contact Types

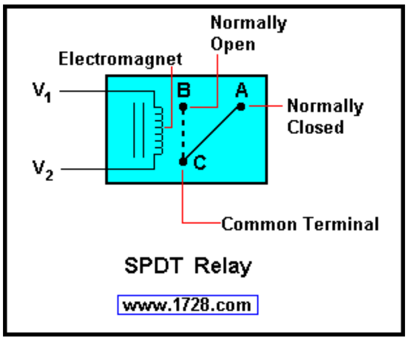


Fig. (22) SPDT Relay.

As well as the standard descriptions of Normally Open, (NO) and Normally Closed, (NC) used to describe how the relays contacts are connected, relay contact arrangements can also be classed by their actions. Electrical relays can be made up of one or more individual switch contacts with each "contact" being referred to as a "pole". Each one of these contacts or poles can be connected or "thrown" together by energizing the relays coil and this gives rise to the description of the contact types as being:

SPST - Single Pole Single Throw

SPDT - Single Pole Double Throw

DPST - Double Pole Single Throw

DPDT - Double Pole Double Throw

with the action of the contacts being described as "Make" (M) or "Break" (B). Then a simple relay with one set of contacts as shown above can have a contact description of:

"Single Pole Double Throw - (Break before Make)", or SPDT - (B-M).

Examples of just some of the more common contact types for relays in circuit or schematic diagrams is given below but there are many more possible configurations.

Relay Contact Configurations

Where,

- C is the Common terminal
- NO is the Normally Open contact
- NC is the Normally Closed contact

One final point to remember, it is not advisable to connect relay contacts in parallel to handle higher load currents. For example, never attempt to supply a 10A load with two relays in parallel that have 5A contact ratings each as the relay contacts never close or open at exactly the same instant of time, so one relay contact is always overloaded.

While relays can be used to allow low power electronic or computer type circuits to switch a relatively high currents or voltages both "ON" or "OFF". Never mix different load voltages through adjacent contacts within the same relay such as for example, high voltage AC (240v) and low voltage DC (12v), always use sperate relays for safety.

One of the more important parts of any relay is the coil. This converts electrical current into an electromagnetic flux which is used to operate the relays contacts. The main problem with relay coils is that they are "highly inductive loads" as they are made from coils of wire. Any coil of wire has an impedance value made up of resistance (R) and inductance (L) in series (RL Series Circuit).

As the current flows through the coil a self induced magnetic field is generated around it. When the current in the coil is turned "OFF", a large back emf (electromotive force) voltage is produced as the magnetic flux collapses within the coil (transformer theory). This induced reverse voltage value may be very high in comparison to the switching voltage, and may damage any semiconductor device such as a transistor, FET or microcontroller used to operate the relay coil.

5.3 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. (23) Relays.

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.

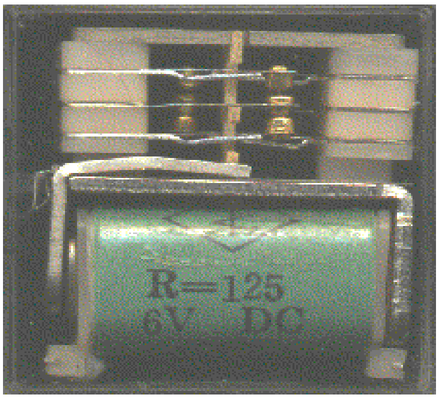


Fig. (24) Relay showing coil and switch contacts.

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.

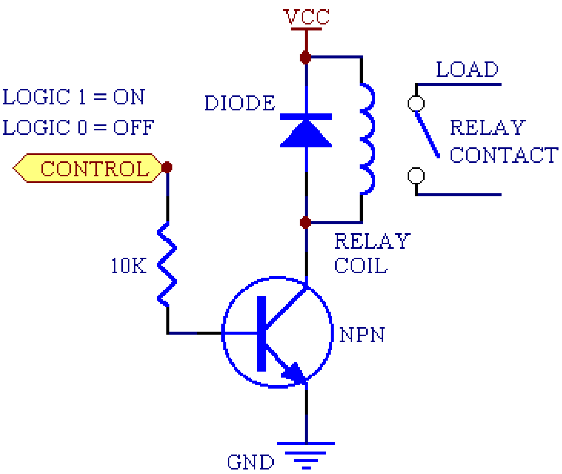
The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required 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.



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.

5.3.1 Application of Relays

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.

5.4 ENCODER AND DECODER

5.4.1 Encoder

IC HT12E is used as encoder. Four bits (D0- D3) are given as data at the data pins (10-13). The 4 bit data connected at the pins 10 to 13 are in parallel order. Another 1 bit taken from pin D4 is used for transmission enable signal and is connected at pin no 14.

The 4 bit parallel data is converted into serial form internally by the encoder and the serial 4 data is obtained at pin no 17. This serial data is further given to the transmitter module.

The external 51k ohm resistor connected at the pins 15 and 16 is used to generate oscillations in the encoder. So the 4 bit serial data is fed to the transmitter module at the same frequency. An LED is connected at pin 15 indicating valid transmission.

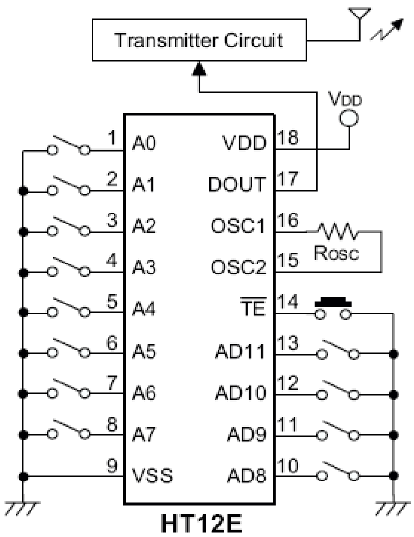


Fig. (25) Pin Diagram of IC HT12E.

Features

- Operating voltage
- 2.4V~5V for the HT12A
- 2.4V~12V for the HT12E
- Low power and high noise immunity CMOS technology
- Low standby current: 0.1_A (typ.) at VDD=5V

- HT12A with a 38kHz carrier for infrared transmission medium
- Minimum transmission word
- Four words for the HT12E
- One word for the HT12A
- Built-in oscillator needs only 5% resistor
- Data code has positive polarity
- Minimal external components
- Pair with Holtek s 2^{12} series of decoders

5.4.2 Decoder

The serial data received at data in pin i.e. pin no 14 is internally converted in parallel form and the 4 bit data available at the 4 data out pins of the decoder is similar to the status of data at data in pins of the encoder.

When the encoder address given is all zeros i.e. A0-A7 bits of encoder IC is 0 is selected. This gives 4 bit parallel output which is given to motor driver circuitry which controls the robotic finger.

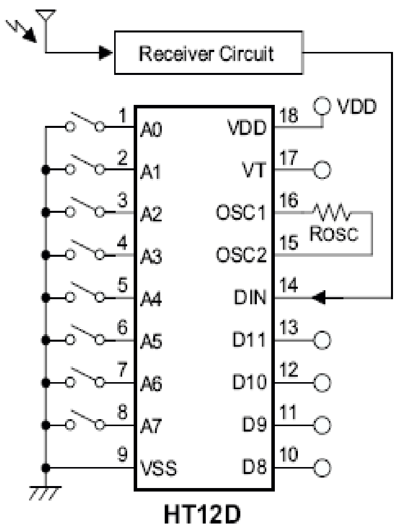


Fig. (26) Pin Diagram of IC HT12D.

Features

- Operating voltage: 2.4V~12V
- Low power and high noise immunity CMOS
- technology
- Low standby current
- Capable of decoding 12 bits of information
- Pair with Holteks
- series of encoders
- Binary address setting
- Received codes are checked 3 times
- Address/Data number combination
- HT12D: 8 address bits and 4 data bits
- HT12F: 12 address bits only
- Built-in oscillator needs only 5% resistor
- Valid transmission indicator
- Easy interface with an RF or an infrared
- Transmission medium
- Minimal external components.

5.5 MICROCONTROLLER

We are using micro controller **PIC 16F877.** It is one of the most commonly used microcontroller especially in automotive, industrial, appliances and consumer applications.

5.5.1 High Performance RISC CPU

Only 35 single-word instructions to learn

• All single-cycle instructions except for program branches, which are two-cycle

• Operating speed: DC – 20 MHz clock input DC – 200 ns instruction cycle

• Up to 8K x 14 words of Flash Program Memory, Up to 368 x 8 bytes of Data Memory (RAM), Up to 256 x 8 bytes of EEPROM Data Memory.

• Pinout compatible to other 28-pin or 40/44-pin PIC16CXXX and PIC16FXXX microcontrollers.

5.5.2 Peripheral Features

Timer0: 8-bit timer/counter with 8-bit prescaler.

• Timer1: 16-bit timer/counter with prescaler, can be incremented during Sleep via external crystal/clock.

• Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler.

• Two Capture, Compare, PWM modules - Capture is 16-bit, max. resolution is 12.5 ns.

- Compare is 16-bit, max. resolution is 200 ns - PWM max. resolution is 10-bit

• Synchronous Serial Port (SSP) with SP (Master mode) and I2C™ (Master/Slave)

• Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address

Detection • Parallel Slave Port (PSP) – 8 bits wide with external RD, WR and CS controls (40/44-pin only)

• Brown-out detection circuitry for Brown-out Reset (BOR)

5.5.3 Analog Features

• 10-bit, up to 8-channel Analog-to-Digital Converter (A/D)

• Brown-out Reset (BOR)

• Analog Comparator module with:

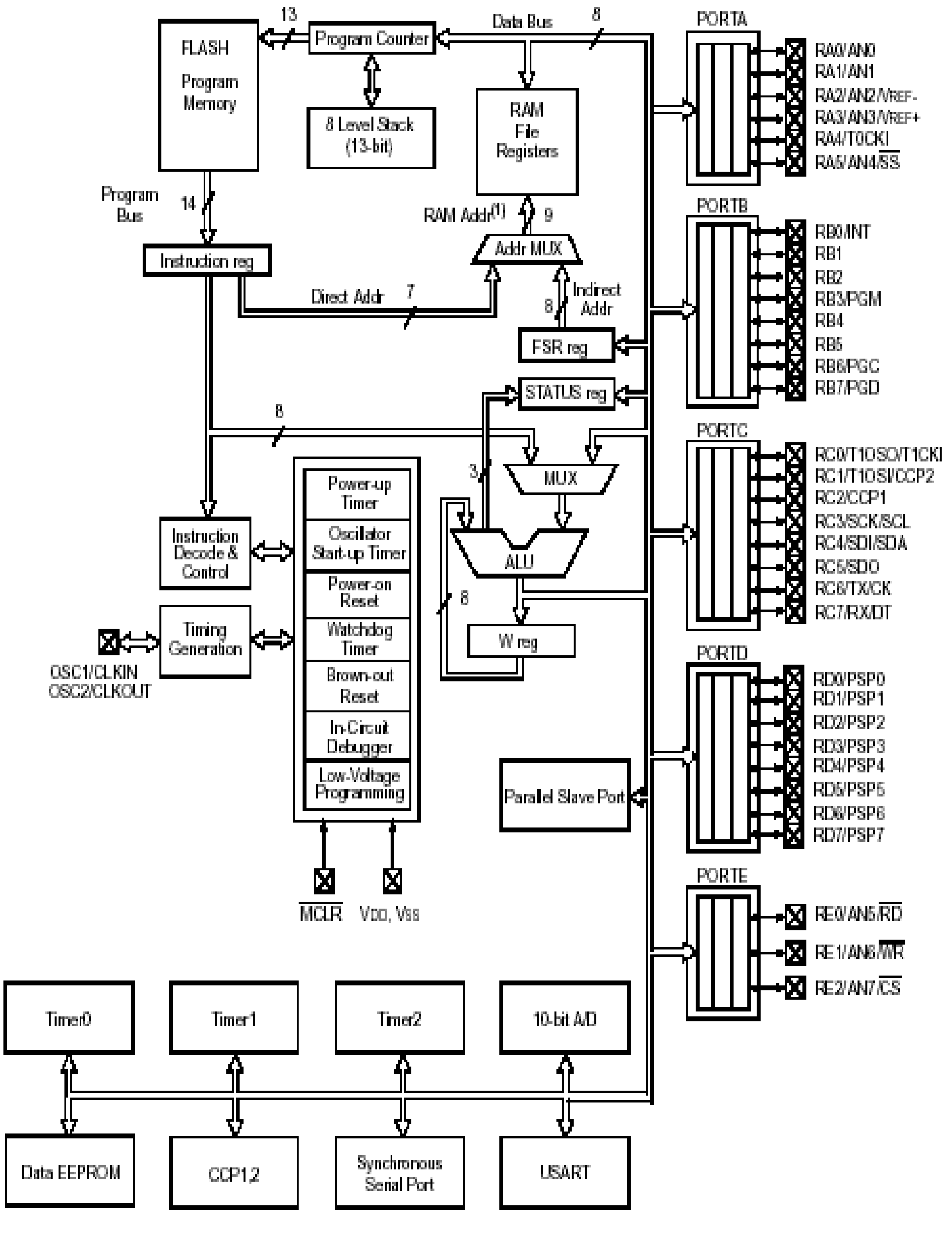
- Two analog comparators

- Programmable on-chip voltage reference (VREF) module

- Programmable input multiplexing from device inputs and internal voltage reference

- Comparator outputs are externally accessible.

Device	Program FLASH	Data Memory	Data EEPROM
PIC16F874	4K	192 Bytes	128 Bytes
PIC16F877	8K	368 Bytes	256 Bytes



Note 1: Higher order bits are from the STATUS register.

Fig. (27) Block Diagram of PIC 16F877.

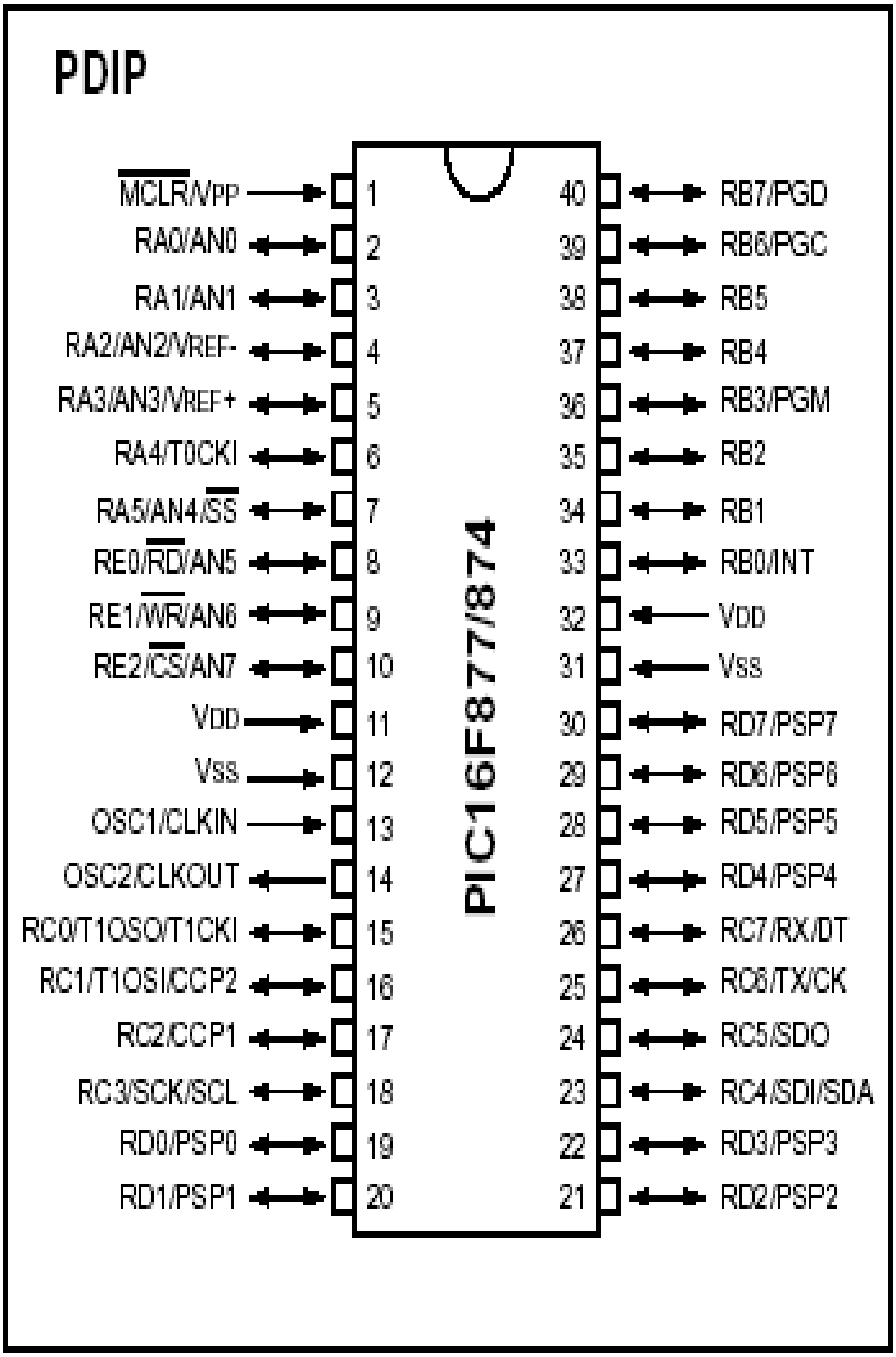


Fig. (28) Pin Diagram of PIC16F877.

CHAPTER 6

6.1 SOFTWARE REQUIREMENTS

6.1.1 Introduction To Keil Micro Vision (IDE)

Keil an ARM Company makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, evaluation boards, and emulators for ARM7/ARM9/Cortex-M3, XC16x/C16x/ST10, 251, and 8051 MCU families.

Keil development tools for the 8051 Microcontroller Architecture support every level of software developer from the professional applications engineer to the student just learning about embedded software development. When starting a new project, simply select the microcontroller you use from the Device Database and the µVision IDE sets all compiler, assembler, linker, and memory options for you.

Keil is a cross compiler. So first we have to understand the concept of compilers and cross compilers. After then we shall learn how to work with keil.

6.1.2 Concept Of Compiler

Compilers are programs used to convert a High Level Language to object code. Desktop compilers produce an output object code for the underlying microprocessor, but not for other microprocessors. I.E the programs written in one of the HLL like 'C' will compile the code to run on the system for a particular processor like x86 (underlying microprocessor in the computer). For example compilers for Dos platform is different from the Compilers for Unix platform So if one wants to define a compiler then compiler is a program that translates source code into object code.

The compiler derives its name from the way it works, looking at the entire piece of source code and collecting and reorganizing the instruction. See there is a bit little difference between compiler and an interpreter. Interpreter just interprets whole program at a time while compiler analyses and execute each line of source code in succession, without looking at the entire program produced by compilers run much faster than the same programs executed by an interpreter. However compilers require some time before an executable program emerges. Now as compilers translate source code into object code, which is unique for each type of computer, many compilers are available for the same language.

6.1.3 Concept of C Cross Compiler

A cross compiler is similar to the compilers but we write a program for the target processor (like 8051 and its derivatives) on the host processors (like computer of x86). It means being in one environment you are writing a code for another environment is called cross development. And the compiler used for cross development is called cross compiler. So the definition of cross compiler is a compiler that runs on one computer but produces object code for a different type of computer.

6.1.4 Keil C Cross Compiler

Keil is a German based Software development company. It provides several development tools like

- IDE (Integrated Development environment)
- Project Manager
- Simulator
- Debugger
- C Cross Compiler, Cross Assembler, Locator/Linker

The Keil ARM tool kit includes three main tools, assembler, compiler and linker. An assembler is used to assemble the ARM assembly program. A compiler is used to compile the C source code into an object file. A linker is used to create an absolute object module suitable for our in-circuit emulator.

6.1.5 Building an Application in µVision2

To build (compile, assemble, and link) an application in µVision2, you must:

1. Select Project -(forexample,166\EXAMPLES\HELLO\HELLO.UV2).
2. Select Project - Rebuild all target files or Build target.µVision2 compiles, assembles, and links the files in your project.

6.1.6 Creating Your Own Application in µVision2

To create a new project in µVision2, you must:

1. Select Project - New Project.
2. Select a directory and enter the name of the project file.
3. Select Project - Select Device and select an 8051, 251, or C16x/ST10 device from the Device Database™.
4. Create source files to add to the project.
5. Select Project - Targets, Groups, Files. Add/Files, select Source Group1, and add the source files to the project.
6. Select Project - Options and set the tool options. Note when you select the target device from the Device Database™ all special options are set automatically. You typically only need to configure the memory map of your target hardware. Default memory model settings are optimal for most applications.
7. Select Project - Rebuild all target files or Build target.

6.1.7 Debugging an Application in µVision2

To debug an application created using µVision2, you must:

1. Select Debug - Start/Stop Debug Session.
2. Use the Step toolbar buttons to single-step through your program. You may enter G, main in the Output Window to execute to the main C function.
3. Open the Serial Window using the Serial #1 button on the toolbar.

Debug your program using standard options like Step, Go, Break, and so on.

6.1.8 Starting µVision2 and Creating a Project

µVision2 is a standard Windows application and started by clicking on the program icon. To create a new project file select from the µVision2 menu Project – New Project…. This opens a standard Windows dialog that asks you for the new project file name. We suggest that you use a separate folder for each project. You can simply use the icon Create New Folder in this dialog to get a new empty folder. Then select this folder and enter the file name for the new project, i.e. Project1. µVision2 creates a new project file with the name PROJECT1.UV2 which contains a default target and file group name. You can see these names in the Project.

6.1.9 Window – Files.

Now use from the menu Project – Select Device for Target and select a CPU for your project. The Select Device dialog box shows the µVision2 device data base. Just select the microcontroller you use. We are using for our examples the Philips 80C51RD+ CPU. This selection sets necessary tool Options for the 80C51RD+ device and simplifies in this way the tool Configuration.

6.1.10 Building Projects and Creating a HEX Files

Typical, the tool settings under Options – Target are all you need to start a new application. You may translate all source files and line the application with a click on the Build Target toolbar icon. When you build an application with syntax errors, µVision2 will display errors and warning messages in the Output Window – Build page. A double click on a message line opens the source file on the correct location in a µVision2 editor window. Once you have successfully generated your application you can start debugging.

After you have tested your application, it is required to create an Intel HEX file to download the software into an EPROM programmer or simulator. µVision2 creates HEX files with each build process when Create HEX files under Options for Target – Output is enabled. You may start your PROM programming utility after the make process when you specify the program under the option Run User Program #1.

6.1.11 CPU Simulation

µVision2 simulates up to 16 Mbytes of memory from which areas can be mapped for read, write, or code execution access. The µVision2 simulator traps

and reports illegal memory accesses. In addition to memory mapping, the simulator also provides support for the integrated peripherals of the various 8051 derivatives. The on-chip peripherals of the CPU you have selected are configured from the Device.

6.1.12 Database selection

You have made when you create your project target. Refer to page 58 for more Information about selecting a device. You may select and display the on-chip peripheral components using the Debug menu. You can also change the aspects of each peripheral using the controls in the dialog boxes.

6.1.13 Start Debugging

You start the debug mode of µVision2 with the Debug – Start/Stop Debug
Session Command. Depending on the Options for Target – Debug Configuration, µVision2 will load the application program and run the startup code µVision2 saves the editor screen layout and restores the screen layout of the last debug session. If the program execution stops, µVision2 opens an editor window with the source text or shows CPU instructions in the disassembly window. The next executable statement is marked with a yellow arrow. During debugging, most editor features are still available.

For example, you can use the find command or correct program errors. Program source text of your application is shown in the same windows. The µVision2 debug mode differs from the edit mode in the following aspects:

The "Debug Menu and Debug Commands" described on page 28 are available. The additional debug windows are discussed in the following.

The project structure or tool parameters cannot be modified. All build commands are disabled.

6.1.14 Disassembly Window

The Disassembly window shows your target program as mixed source and assembly program or just assembly code. A trace history of previously executed instructions may be displayed with Debug – View Trace Records. To enable the trace history, set Debug – Enable/Disable Trace Recording.

If you select the Disassembly Window as the active window all program step commands work on CPU instruction level rather than program source lines. You can select a text line and set or modify code breakpoints using toolbar buttons or the context menu commands.

You may use the dialog Debug – Inline Assembly… to modify the CPU instructions. That allows you to correct mistakes or to make temporary changes to the target program you are debugging.

Numerous example programs are included to help you get started with the most popular embedded 8051 devices.

The Keil µVision Debugger accurately simulates on-chip peripherals (I^2C, CAN, UART, SPI, Interrupts, I/O Ports, A/D Converter, D/A Converter, and PWM Modules) of your 8051 device. Simulation helps you understand hardware configurations and avoids time wasted on setup problems. Additionally, with simulation, you can write and test applications before target hardware is available.

6.2 EMBEDDED C

Use of embedded processors in passenger cars, mobile phones, medical equipment, aerospace systems and defense systems is widespread, and even everyday domestic appliances such as dish washers, televisions, washing machines and video recorders now include at least one such device. Because most embedded projects have severe cost constraints, they tend to use low-cost processors like the 8051 family of devices considered in this book. These popular chips have very limited resources available most such devices have around 256 bytes (not megabytes!) of RAM, and the available processor power is around 1000 times less than that of a desktop processor. As a result, developing embedded software presents significant new challenges, even for experienced desktop programmers. If you have some programming experience - in C, C++ or Java - then this book and its accompanying CD will help make your move to the embedded world as quick and painless as possible.

CHAPTER 7

7.1 MICROCONTROLLER AT89S52

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density non volatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non volatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.

7.1.1 Features

• Compatible with MCS®-51 Products

• 8K Bytes of In-System Programmable (ISP) Flash Memory

– Endurance: 10,000 Write/Erase Cycles

• 4.0V to 5.5V Operating Range

• Fully Static Operation: 0 Hz to 33 MHz

• Three-level Program Memory Lock

• 256 x 8-bit Internal RAM

• 32 Programmable I/O Lines

• Three 16-bit Timer/Counters

• Eight Interrupt Sources

• Full Duplex UART Serial Channel

• Low-power Idle and Power-down Modes

• Interrupt Recovery from Power-down Mode

• Watchdog Timer

• Dual Data Pointer

• Power-off Flag

• Fast Programming Time

• Flexible ISP Programming (Byte and Page Mode)

• Green (Pb/Halide-free) Packaging Option

7.1.2 Block Diagram

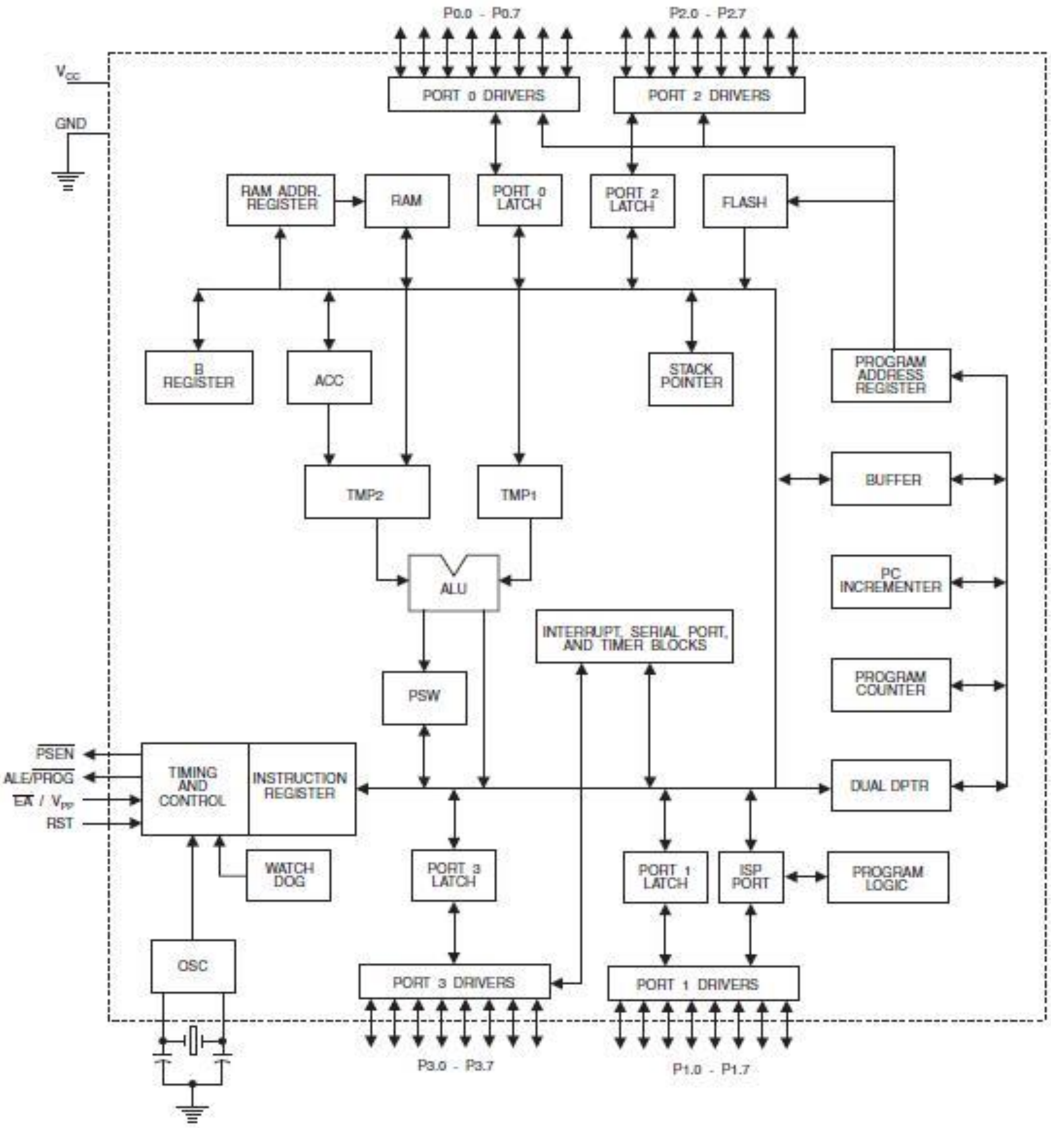


Fig. (29) Block Diagram of AT89S52

7.1.3 Pin Configuration of AT89S52

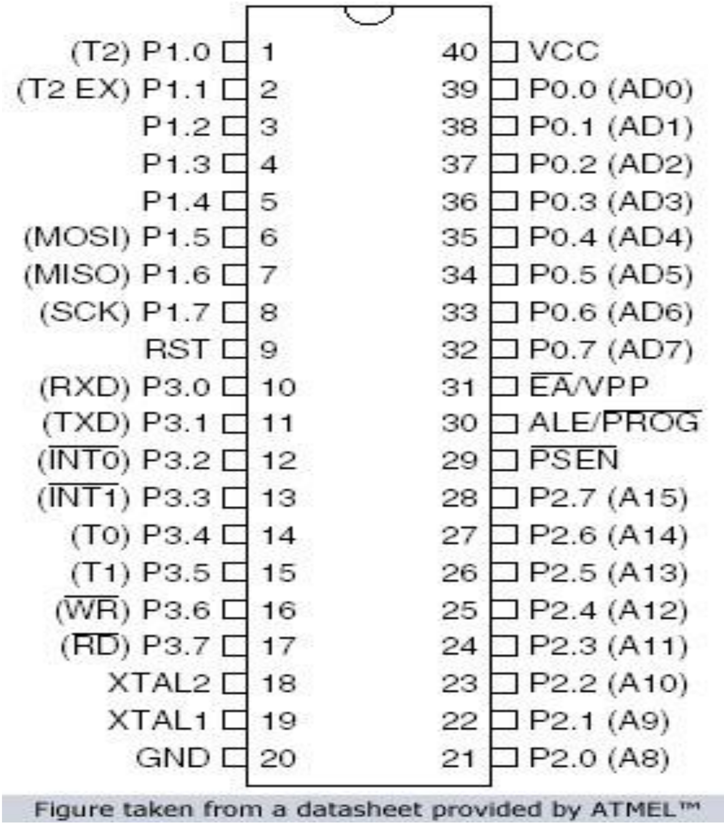


Fig. (30) Pin Diagram of AT89S52

Pin Description:

VCC:

Supply voltage.

GND:

Ground.

Port 0:

Port 0 is an 8-bit open drain bidirectional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs. Port 0 can also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. External pull-ups are required during program verification.

Port 1:

Port 1 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. In addition, P1.0 and P1.1 can be configured to be the timer/counter 2 external count input (P1.0/T2) and the timer/counter 2 trigger input (P1.1/T2EX).

Port 2:

Port 2 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @ DPTR). In this application, Port 2 uses strong internal pull-ups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register.

Port 3:

Port 3 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups.

RST:

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device. This pin drives high for 98 oscillator periods after the Watchdog times out. The DISRTO bit in SFR AUXR (address 8EH) can be used to disable this feature. In the default state of bit DISRTO, the RESET HIGH out feature is enabled.

ALE/PROG:

Address Latch Enable (ALE) is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming.

In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external data memory.

PSEN:

Program Store Enable (PSEN) is the read strobe to external program memory. When the AT89S52 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP:

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming.

XTAL1:

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2:

Output from the inverting oscillator amplifier.

7.1.4 Oscillator Characteristics:

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier which can be configured for use as an on-chip oscillator, as shown in Figure 1. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven as shown in Figure 6.2. There are no requirements on the duty cycle of the external clock signal, since the input to the internal clocking circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high and low time specifications must be observed.

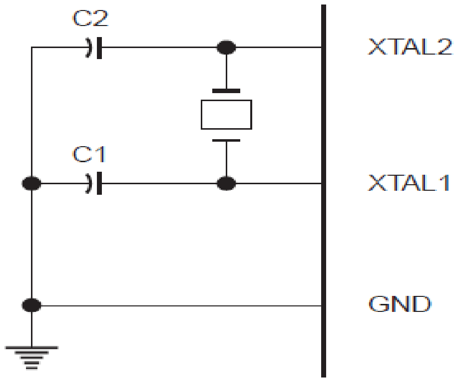


Fig. (31) Oscillator Connections.

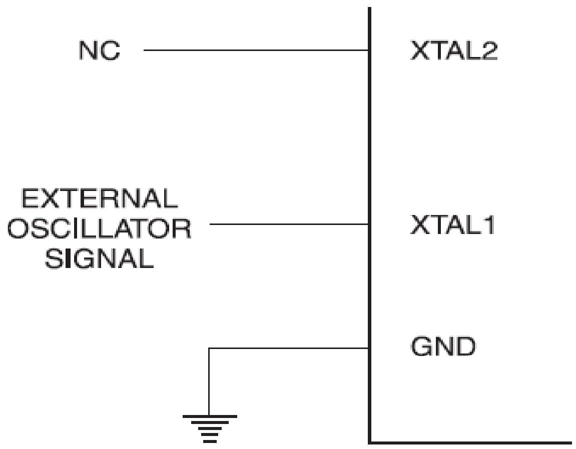


Fig. (32) External Clock Drive Configuration.

Idle Mode

In idle mode, the CPU puts itself to sleep while all the on chip peripherals remain active. The mode is invoked by software. The content of the on-chip RAM and all the special functions registers remain unchanged during this mode. The idle mode can be terminated by any enabled interrupt or by a hardware reset.

Power down Mode

In the power down mode the oscillator is stopped, and the instruction that invokes power down is the last instruction executed. The on-chip RAM and Special Function Registers retain their values until the power down mode is terminated. The only exit from power down is a hardware reset. Reset redefines the SFRs but does not change the on-chip RAM. The reset should not be activated before VCC is restored to its normal operating level and must be held active long enough to allow the oscillator to restart and stabilize.

7.2 LCD DISPLAY

Various display device such as seven segment display. LCD display, etc can be interfaced with microcontroller to read the output directly. In our project we use a two line LCD display with 16 characters each.

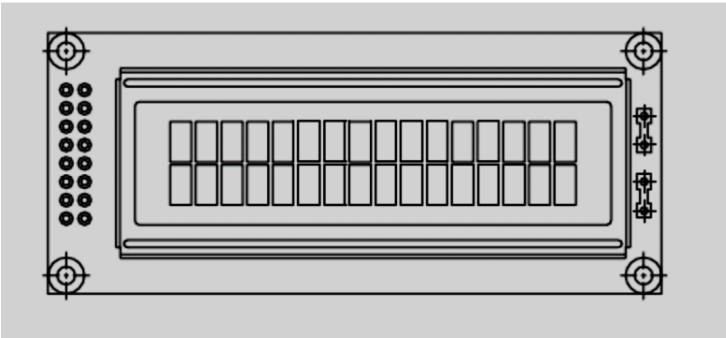


Fig. (33) LCD Display.

7.2.1 Features

- 5 x 8 dots with cursor
- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply
- RS232 compatible serial interface (2400 & 9600 baud selectable)
- Externally selectable serial polarities (Inverted & Non-Inverted)
- Serially controllable contrast and backlight levels
- 8 user programmable custom characters
- 16 Byte serial receive buffer.

7.2.2 Pin Diagram

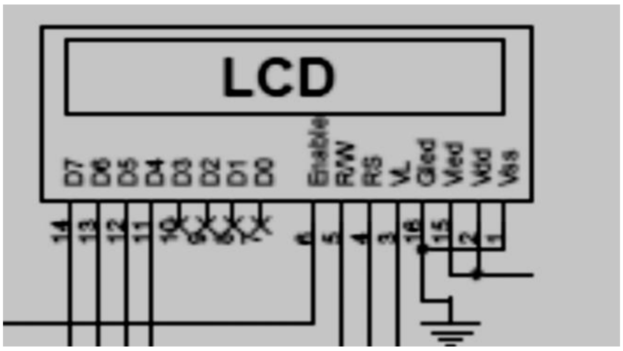


Fig. (34) LCD Pin Diagram.

PIN NAME	PIN NO	DESCRIPTION
VSS	1	Gnd
VDD	2	+3V – +5V
V0	3	Contrast adjustment
RS	4	Register select signal
R/W	5	Read write signal
E	6	Enable signal
DB0	7	Data bus line
DB1	8	Data bus line
DB2	9	Data bus line
DB3	10	Data bus line
DB4	11	Data bus line
DB5	12	Data bus line
DB6	13	Data bus line
DB7	14	Data bus line
A/VEE	15	Negative voltage output
K	16	Power supply for B/L

Table (2). Pin Diagram Description

7.3 BUZZER

Buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows.

It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise). Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC-connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8-ohm speaker. Nowadays, it is more popular to use a ceramic-based piezoelectric sounder like a Son alert which makes a high-pitched tone. Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.

In game shows it is also known as a "lockout system," because when one person signals ("buzzes in"), all others are locked out from signaling. Several game shows have large buzzer buttons which are identified as "plungers".

The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep.

Some systems, such as the one used on *Jeopardy!*, make no noise at all, instead using light. Another example is the buzzer at the end of each stage in Sasuke, Kunoichi, and Viking. These buzzers do not make a sound or turn on a light; instead, they stop a nearby digital clock, briefly fire two smoke cannons on each side of the stage exit, and open the exit. However, at the end of the Heartbreaker in Viking, the buzzer is replaced with a sword that, when removed, causes two contacts to touch, closing the circuit and causing the latter two actions above to occur.

CHAPTER 8

8.1 CONCLUSION

Already at an early stage it was found necessary to be able to ensure, automatically and absolutely reliably, that a track section was free from trains. Track circuit was the first to be developed and it is the fundamental method of train detection, and while there has been experimentation with other methods over the years it remains the more reliable. As described there are several types of track circuits, but the detection principle is similar for each.

Perhaps, no single invention in the history of the development of railway transportation has contributed more towards safety and dispatch in that field than the track circuit. By this invention, simple in itself, the foundation has been obtained for the development of practically every one of the intricate systems of railway block signaling in use today wherein the train is under all conditions continuously active in maintaining its own protection.

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AC TRACK CIRCUIT

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