AUTOMATIC SUN TRACKING SYSTEM WITH PHOTO VOLTAIC PLATE TO THE IMPROVE THE EFFICIENCY OF SOLAR POWER GENERATION

ABSTRACT

In remote areas the sun is a cheap source of electricity because instead of hydraulic generators it uses solar cells to produce electricity. But the output of solar cells depends on the intensity of sunlight and the angle of incidence.

It means to get maximum efficiency; the solar panels must remain in front of the sun during the whole day. But due to the rotation of the earth, those panels can't maintain their position always in front of the sun. This problem results in a decrease of their efficiency. So to get a constant output, an automated system is to be required which should be capable to constantly rotate the solar panel.

Automatic sun tracking system with photo voltaic plate to improve the efficiency of solar power generation was helpful to solve the problem, mentioned above. It is completely automatic and keeps the panel in front of sun until that is visible. The unique feature of this system is that instead of taking the earth as its reference, it takes the sun as a guiding source. Its active sensors constantly monitor the sunlight and rotate the panel towards the direction where the intensity of sunlight is at maximum with the help of DC motor.

1. INTRODUCTION

The energy produced and radiated by the Sun; more specifically, the term refers to the Sun's energy that reaches the earth. Solar radiation, received in the form of electromagnetic waves, can be converted directly or indirectly into another form of energy, such as heat and electricity. Since the Sun expected to radiate at an essentially constant rate for a few billion years, it may be regarded as an inexhaustible source of useful energy. Among the various Non-Conventional sources of energy the solar energy schemes to hold out the greatest promise for the mankind. It is free, inexhaustible, and non-polluting. Solar power would eliminate most of the serious environmental problems associated with fossil fuel and Nuclear power. Energy from sun is received as electromagnetic waves of wavelengths between 0.2 to 0.4 μ.Solar energy reaching the top of the earth's atmosphere consists of about 8% Ultraviolet radiation (short wavelength less than 0.39 μ).4 6%visible lights (0.39 μ) to (0.78 μ) and 46% infrared radiation (longer wavelength more than 0.78 μ).

The utilization of solar energy is of great importance to our country as it lies in a tropical climate region where sunlight is abundant for a major part of the year. The target for power generation from Non-Conventional energy sources have been upgraded from 200MW to 600MW for light plan. The most promising and fast moving solar technology today is that of solar cells, flat metallic blue chips made of highly pure silicon that can convert sunlight into electricity. These photo-voltaic cells for a variety of applications such as:

1. Water pumps for irrigation and drinking water supplies.
2. Power supply for microwave repeater station.
3. Communication equipment, radio and television receivers.
4. Solar water heaters.
5. Solar refrigeration

2. LITERATURE SURVEY

Solar tracking system project had been widely employed by the other giant company like BP Solar, Yingli Green Energy, Kyocera, Q-Cells, Sanyo, Sharp Solar, Solar World, Sun Power, and Suntech. Now, many people use solar energy or photovoltaic energy as an alternative power because it's free and renewable. As we can see now, the payment charge for an electricity had been risen rapidly because the increasing of gas price.

Many researchers have tried to find the alternative energy to replace the gas. One of the alternative energy that we can use is photovoltaic energy. Photovoltaic energy is the most promising and popular form of solar energy. In solar photovoltaics', sunlight is actually converted into electricity.
This is very different from a conventional understanding of solar power as only a way of heating water. Photovoltaic, now the biggest usage of solar energy around the world, is briefly explained below:

Sunlight is made of photons, small particles of energy. These photons are absorbed by and pass through the material of a solar cell or solar photovoltaic panel. The photons 'agitate' the electrons found in the material of the photovoltaic cell. As they begin to move (or are dislodged), these are 'routed' into a current.

This, technically, is electricity the movement of electrons along a path. Solar panels made of silicon to convert sunlight into electricity. Solar photovoltaic are used in a number of ways, primarily to power homes that are inter-tied or interconnected with the grid. Wire conducts these electrons, either to batteries or to the regular electrical system of the house, to be used by appliances and other household electrical items. In many solar energy systems, the battery stores energy for later use. This is especially true when the sun is shining strongly.

Sun-synchronous navigation is related to moving the solar powered rover (robot) in such a way that its solar panel always points toward the sun and which results into maximum battery charging and hence the rover can work for long hours. The unique feature of this solar tracking system is that instead of taking the earth as its reference, it takes the sun as a guiding source. Its active sensors constantly monitor the sunlight and rotate the panel towards the direction where the intensity of sunlight is maximum. The light dependent resistor's do the job of sensing the change in the position of the Sun. The control circuit does the job of fetching the input from the sensor and gives command to the motor to run in order to tackle the change in the position of the sun. By using this system the additional energy generated is around 25% to 30% with very less consumption by the system itself. The paper gives the design and implementation of a fuzzy logic computer controlled sun tracking system to enhance the power output of photo voltaic solar panels.

The tracking system was driven by two permanent magnet DC motors to provide motion of the PV panels in two axis. The project describes the use of a microcontroller based design methodology of an automatic solar tracker. Light dependent resistors are used as the sensors of the solar tracker. The tracking system maximizes solar cell output by positioning a solar panel at the point of maximum light intensity. This paper describe the use of DC motors, special motors like stepper motors, servo motors, real time actuators, to operate moving parts of the solar tracker. The system was designed as the normal line of solar cell always move parallel to the rays of the sun. The Aim of this project is to develop and implement a prototype of two-axis solar tracking system based on a microcontroller. The parabolic reflector or parabolic dish is constructed around.

Two feed diameter to capture the sun's energy. The focus of the parabolic reflector is pointed to a small area to get extremely high temperature. The temperature at the focus of the parabolic reflector is measured with temperature probes. This auto-tracking system is controlled with two 12V, 6W DC gear box motors. The five light sensors (LDR) are used to track the sun and to start the operation (Day/Night operation). The paper adopts the PWM DC motor controller. It is capable of archiving the timeliness, reliability and stability of motor speed control, which is difficult to implement in traditional analog controller. The project concentrates on the design and control of dual axis orientation system for the photovoltaic solar panels. The orientation system calculations are based on astronomical data and the system is assumed to be valid for any region with small modifications. The system is designed to control the Altitude angle in the vertical plane as well as the Azimuth angle in the horizontal plane of the photovoltaic panel workspace.

And this system is expected to save more than 40% of the total energy of the panels by keeping the panel's face perpendicular to the sun. In the previous solutions, each tracking direction is controlled by using a Sun sensor made by a pair of phototransistors. The single matrix Sun sensor (MSS) controls both axes of the tracking system. The inspiration for the MSS is the antique solar clock. MSS comprises 8 photo resistors and a cylinder the difference between a shaded photo resistor cell and a lighted cell is recognized using an electronic circuit and corresponding output voltage signals are given to the DC motors which will move the array toward sun.

In order to improve the solar tracking accuracy, the author comes up with Combining program control and sensor control. Program control includes calendar-check tracking and the local longitude, latitude and time, to calculate the solar altitude and solar azimuth by SCM (single-chip microcomputer), servo motor is used to adjust the attitude of the solar panel. Sensor control is that sunray is detected by photoelectric detector and then the changed signal is transmitted to control step motor to adjust the attitude of the solar. The paper discusses the technology options, their current status and opportunities and challenges in developing solar thermal power plants in the context of India. The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change.

3. SOLAR SYSTEM

A **solar system** refers to a star and all the objects that travel in orbit around it. Our **solar system** consists of the sun - our star - eight planets and their natural satellites (such as our moon); dwarf planets; asteroids and comets. Our **solar system** is located in an outward spiral of the Milky Way galaxy.

1. The sun is one of the more than 100 billion stars in the giant spiral gallery called the Milky Way.
2. The sun is the center of the solar system. It means is about 740 times as much as that of all the plants combined.
3. The sun continuously gives off energy in several furs visible light gamma rays ,cosmic rays ,radio waves and plasma the sun generally ore in almost circular orbit around the galactic center at an average speed of about 250km per second.
4. The sun takes 250 million year to complete one revelation around the center their period is called a comic year.
5. He sun energy is generated by nuclear fusion in its interior it is calculated that the sun consumer about ten million tons of hydrogen energy second. At this rate it is expected to burn out its stack of hydrogen in about 5billio year and turn into re giant.

Solar layers:

Photo sphere is he slowing surface of the sun, which we see temperature 4,226 to 5,726 degree Celsius the gases that extend away from the photo sphere makes up the chromospheres which is about 2,500km thick. Chromospheres is called so because to the top the average temperature rises from 4,226 to 9,726 degree Celsius the chemosphere merges into the corona the out most region of the atmosphere corona is magnificently visible during eclipses the temperature of the corona, which extends for into space is about 2,700,0000 hot enough to emit ultraviolet and x-rays wavelength. The corona million f kilometer into space above the photo sphere and is very hot millions of degrees Celsius.

Through the rest of the sun, temperature of the sun, temperature drop as assess more away from the core. Outside the core is the convection zone. Here turbulent motion of gases transport the energy generated in the core towards the photosphere. The visible light is such as voltaic, indigo, blue, green, yellow and red. Super imposed on the spectrum are hundreds of dark lines called the Fran hoofers? The different that makes up the sun and their temperature.

Recent recherché using satellite have shown that the solar wind is made up of plasma that is inside gas mostly hydrogen and helium contains an equal number of proton and electron. Out flows out ward from the sun at suspension speed around 400m a second. Averagely this wind sweeps through the whole solar system to a distance of 40 as from the sun which coincides with the atmosphere lilts of the planting orient. When this eruption rolls out of theta Mosher of the many kilometers they are called solar plates. The sol players rolling an out as enormous aloud 20 to 40 times the size of the earth at speeds of the sun's the surface.

Solar activity has been observed to follows an 11 year cycle. Coming to the suns rotation, the solar wind travels in spiral and carries with it magnetic fields. The earth magnetic field the magnetosphere acts as a shield against the ever blowing solar wind sometimes price the magnetic shield and center the upper atmospheric where like the solar flares they causes aurora display.

The solar wind destroys the shape of the magnetosphere. The magnetosphere extends to a distance of 640000km above the earth 10 times the radius of the earth. On the part of the earth exposed to the sun the solar wind sweeps along the magnetospheres post-earth. On the other side of the earth the solar wind converges again and compress the magnetic field in to a plume or tail more like what it does to comet the tail thus of the earth.

Solar statics:

Distance from the earth	149.8 million kilometers
Absolute visual magnitude	4.75
Diameter	1,384,000km
Rotation as seen from the earth	
(At equator)	25.38 days
(Near the poles)	33 days
Chemical composition	
Hydrogen	71%
Helium	26.5%
Other elements	2.5%

Age 4.5 billion year approximately

Expected lifetime of natural star is 10 Billion year approximately

Mass	330,000×Earth mass

Solar energy:

Sun is the largest source of energy and biggest fusions reaction which supplies to the earth daily free or charge about 10,000 times energy needed by the world population it means that 8 days of sun energy falling on earth is equal to a total of all available source of energy into the world of period of one year.

India receives nearly 5.6kw/m^2 of solar energy as an average. Therefore solar energy can play an important role in the development of India power requirements. The sun gives out 3.7×10^{26} watts of energy into space out of earth interests only 5×10^{-10} part the solar energy output. The energy indicate by earth is equivalent to 1.7×10^{17}W. The energy emitted by the sun within three munities is equivalents to the solar radiation reaches earth as electromagnet waves of about 0.25to 3µ wavelength about half of this radiation is visible as light & the rest is infrared which account for heat.

Solar radiation is reduced in the atmospheric by clouds haze, dust, smog and fog the intensity of solar energy as sunny day in Indian is approximately 10^{12} KW/m^2 integrated daily average on a horizontal surface is 4.5KW/m^2.the monthly average solar energy in India is 50KJ/cm^{2}as per the record of metrology department of India. We require about 600KJ/cm^2/year giving a total incidence of India is approximately 60×10^{16} KWh/year.

The morphs rate of the world energy from the fact that in the use for one food calorie available at the table for human construction about 10 calories of industrial energy are consumed into production processing and distribution. Thus at the present alarming rate of energy consumption all the stored energy of the earth will last only foe a few decades.

Rapid depletion of fossils fuels and the threat of pollution of steep rise in oil prices fall brought about an upsurge of interest in solar energy. Solar energy has free attract characteristics, first the sun is essentially an infinite source of energy second this energy available at all nations and third this can amused with minimum determination effectors on the environ meant.

On the other hand the practical application of solar energy are not free problems solar energy is not available at night or driving pervious when local water conducting abscess the sun more over solar energy is diffused in its nature and is at a low potentate consequently. If solar energy is to be economically competitive with maximum effort to reduce the capital costs.

Heat gain from solar radiation:

The amount of heat flows due to solar radiation depends upon the following factors.

a. Altitude angle of the sun.
b. Clearness of the sky.
c. Position of the surface with respect of the sun's rays.
d. Absorptive of the surface.

The altitude angle of the sun, in turn, depends upon the altitude of the locality, season of year and hour of day.

The heat from solar radiation is two types:

1. **Direct radiation:**

It is the impinging of the sun's rays upon the surface of panel.

2. **Sky or diffuse radiation:**

It is received from moisture and dust particles in atmosphere which absorbs part of the energy of the sun's rays there by becoming heated to a temperature above that of the air. The sky radiation is received by surfaces which do not face the sun.

Heat gain from lighting equipment's:

The heat gain from lighting equipment depends upon the rating of lights in watts, use factor and allowance factor.

Q=total wattage of lights × use factor × allowance factor.

Use factor is the ratio of the actual wattage to the installed wattage. It is generally taken as unity. Allowance factor is generally used in case of fluorescent tubes to allow the power used by the ballast its value is usually taken as 1.25.

4. EMBEDDED SYSTEMS

4.1. INTRODUCTION TO EMBEDDED SYSTEM

4.1.1. What is embedded system?

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. An embedded system is a microcontroller-based, software driven, reliable, real-time control system, autonomous, or human or network interactive, operating on diverse physical variables and in diverse environments and sold into a competitive and cost conscious market.

An embedded system is not a computer system that is used primarily for processing, not a software system on PC or UNIX, not a traditional business or scientific application. High-end embedded & lower end embedded systems. High-end embedded system - Generally 32, 64 Bit.

Controllers used with OS. Examples Personal Digital Assistant and Mobile phones etc. . . .Lower end embedded systems - Generally 8,16 Bit Controllers used with an minimal operating systems and hardware layout designed for the specific purpose. Examples small controllers and devices in our everyday life like Washing machine, Microwave ovens where they are embedded in.

LANGUAGES USED:

- C
- C++
- Java
- Linux
- ADA

4.1.2. SYSTEM DESIGN CALLS:

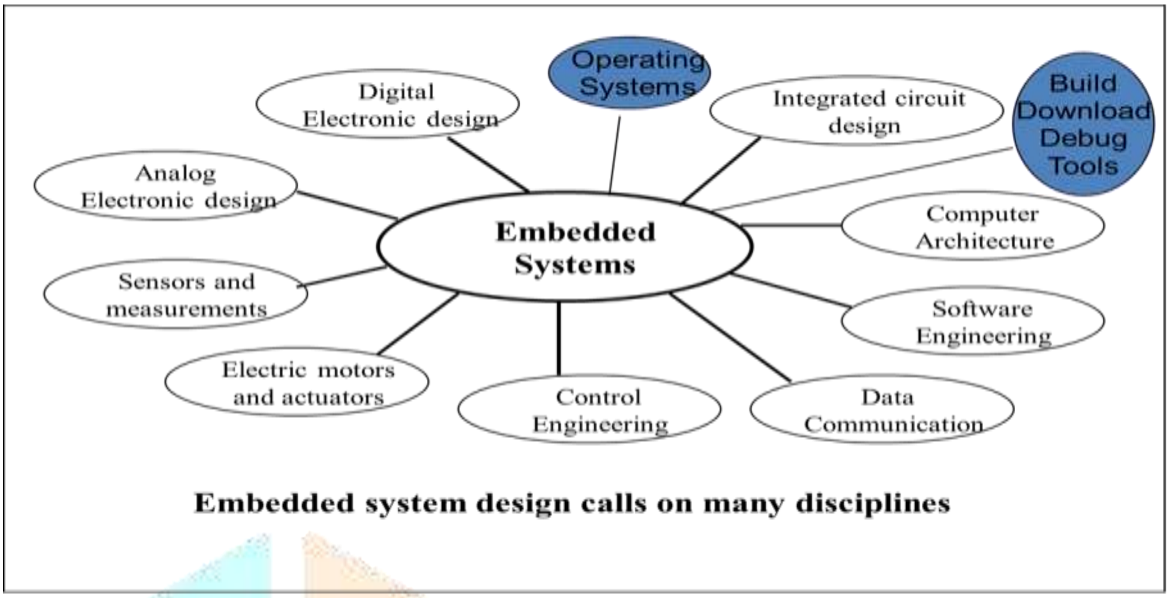


Figure 4(a): Embedded system design calls

4.1.3. EMBEDDED SYSTEM DESIGN CYCLE:

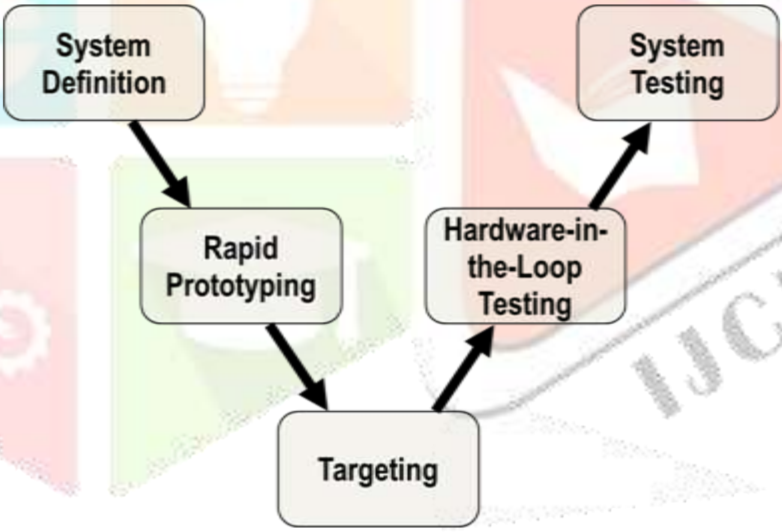


Figure 4(b) "V Diagram"

4.2. Characteristics of Embedded System:

An embedded system is any computer system hidden inside a product other than a computer.They will encounter a number of difficulties when writing embedded system software in addition to those we encounter when we write applications.

– ***Throughput***– Our system may need to handle a lot of data in a short period of time.

– ***Response***–Our system may need to react to events quickly.

– ***Testability***–Setting up equipment to test embedded software can be difficult.

– ***Debugability***–Without a screen or a keyboard, finding out what the software is doing wrong (other than not working) is a troublesome problem.

– ***Reliability***– embedded systems must be able to handle any situation without human intervention.

– ***Memory space***– Memory is limited on embedded systems, and you must make the software and the data fit into whatever memory exists.

– ***Program installation***– you will need special tools to get your software into embedded systems.

– ***Power consumption***– Portable systems must run on battery power, and the software in these systems must conserve power.
– ***Processor hogs***– computing that requires large amounts of CPU time can complicate the response problem.
– ***Cost*** – Reducing the cost of the hardware is a concern in many embedded system projects; software often operates on hardware that is barely adequate for the job.
• Embedded systems have a microprocessor/ microcontroller and a memory. Some have a serial port or a network connection. They usually do not have keyboards, screens or disk drives.

4.3. APPLICATIONS:

1) Military and aerospace embedded software applications.
2) Communication Applications.
3) Industrial automation and process control software.
4) Mastering the complexity of applications.
5) Reduction of product design time.
6) Real time processing of ever increasing amounts of data.
7) Intelligent, autonomous sensors.

4.4. CLASSIFICATION:

- Real Time Systems.
- RTS is one which has to respond to events within a specified deadline.
- A right answer after the dead line is a wrong answer.

4.5. RTS CLASSIFICATION:

- Hard Real Time Systems.
- Soft Real Time System.

HARD REAL TIME SYSTEM:

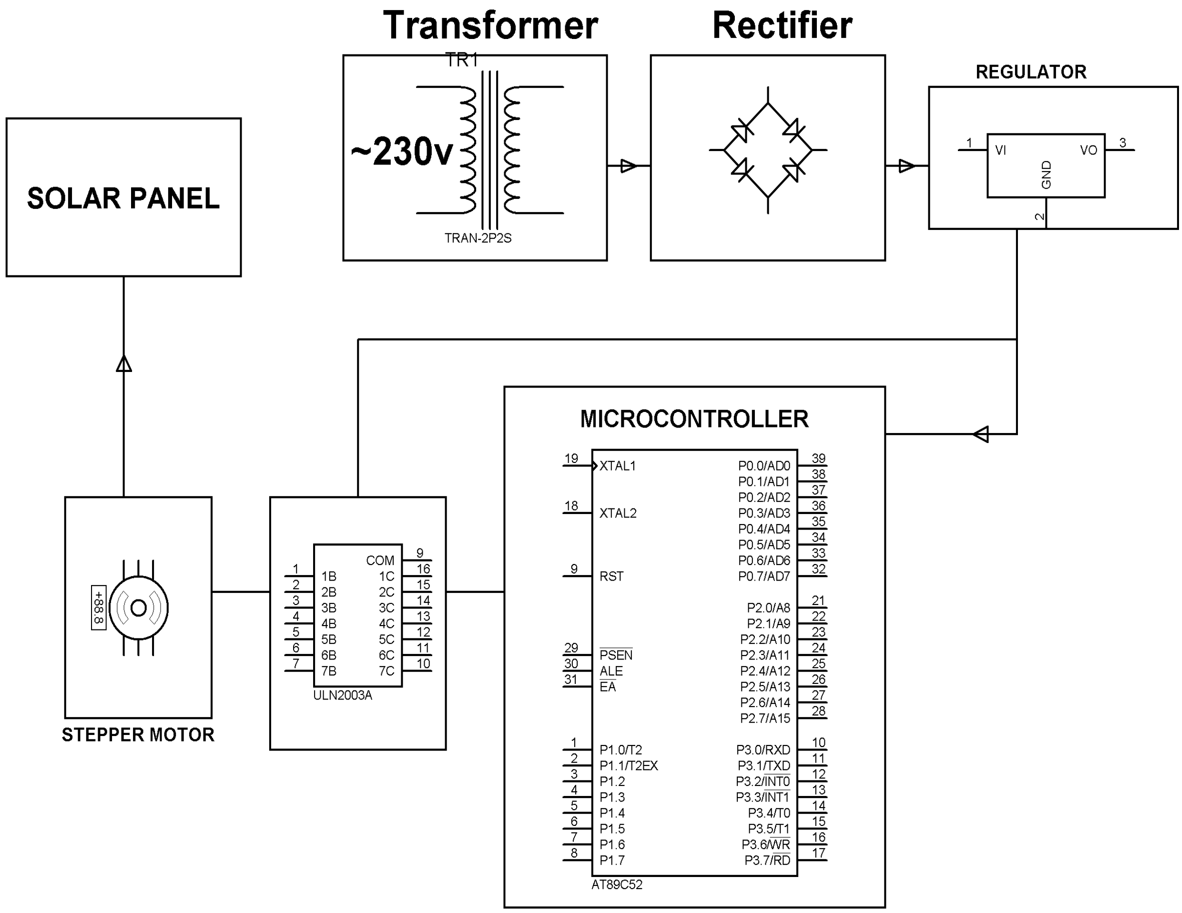
•"Hard" real-time systems have very narrow response time.
•Example: Nuclear power system, Cardiac pacemaker.

SOFT REAL TIME SYSTEM:

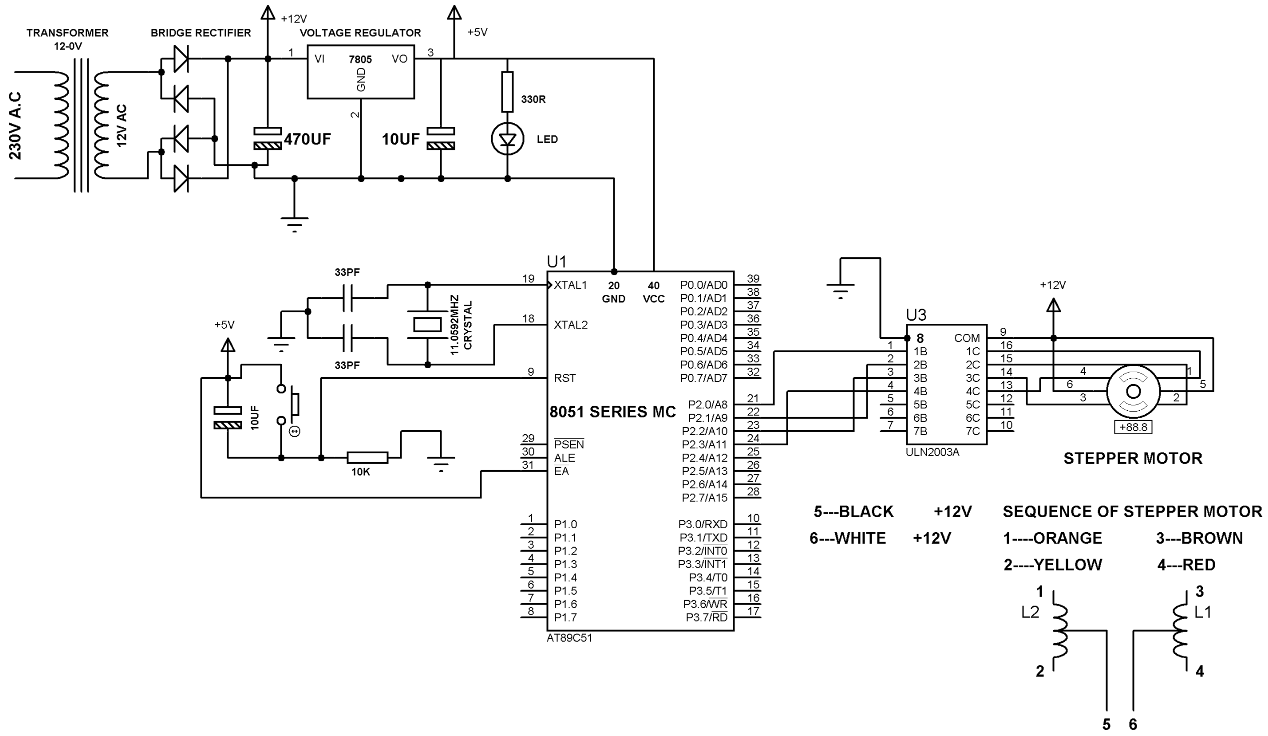
•"Soft" real-time systems have reduced constrains on "lateness" but still must operate very quickly and repeatable.
Example: Railway reservation system – takes a few extra seconds the data remains valid.

5. HARDWARE REQUIREMENTS

5.1. BLOCK DIAGRAM:



5.2. CIRCUIT DIAGRAM:



5.3. COMPONENTS:

5.3.1. MICROCONTROLLER:

In this project AT89S52 microcontroller is used. 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.

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.

5.3.1.1. Block Diagram of AT89S52:

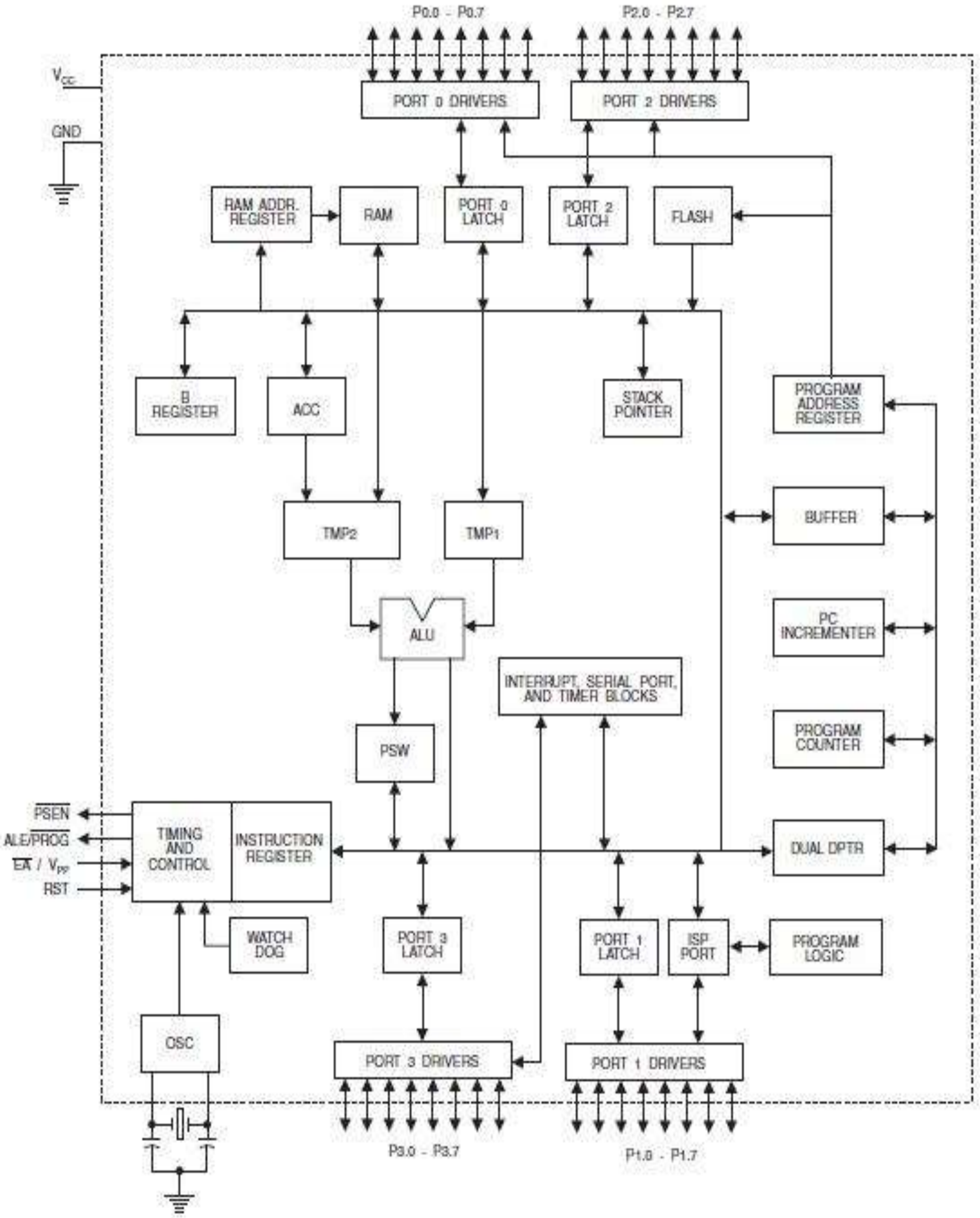


Fig 5.3(a): Block Diagram Of At89s52

5.3.1.2. Pin Configurations of AT89S52:

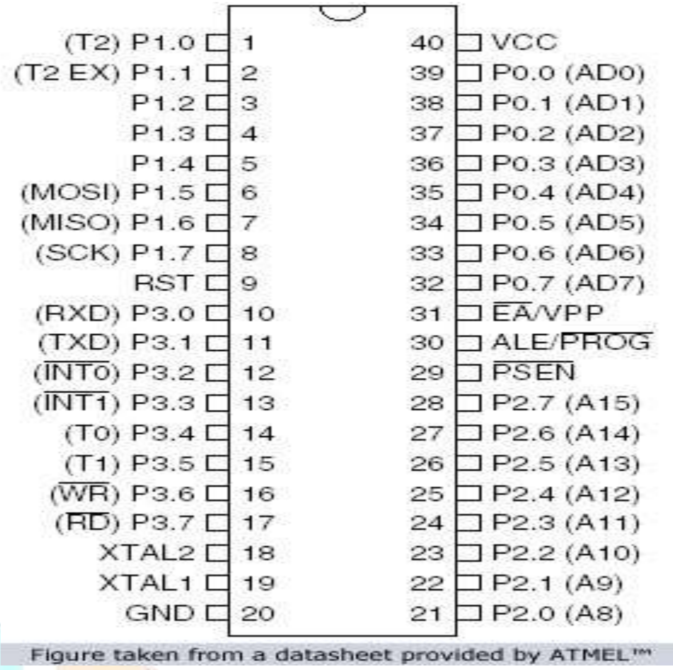


FIG 5.3(B): Pin Diagram Of AT89S52

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 uses 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 uses 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.

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.

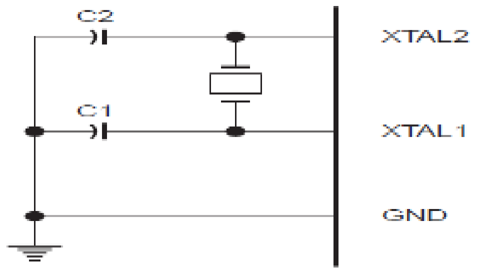


FIG 5.3(c): Oscillator Connections

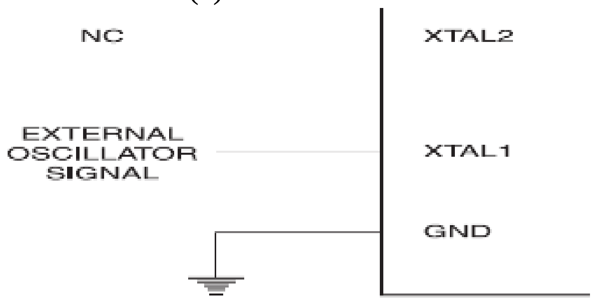


FIG 5.3(d): External Clock Drive Configuration

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.

5.3.2. 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 5.3.2: 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.

TURNS RATIO = (VP / Vs) = (Np / Ns)

Where,

VP = primary (input) voltage.

Vs = secondary (output) voltage.

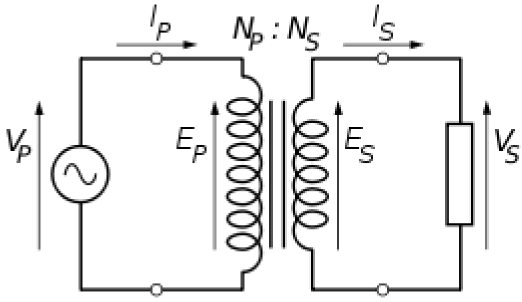
Np = number of turns on primary coil.

Ns = number of turns on secondary coil.

Ip = primary (input) current.

Is = secondary (output) current.

Ideal power equation:



$$\frac{V_P}{V_S} = \frac{I_S}{I_P} = \frac{N_P}{N_S}$$

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:

$$P_{\text{incoming}} = I_p V_p = P_{\text{outgoing}} = I_s V_s,$$

Giving the ideal transformer equation:

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}.$$

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 turn's 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 $(N_s/N_p)^2 Z_p$.

5.3.3. VOLTAGE REGULATOR 7805:

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.

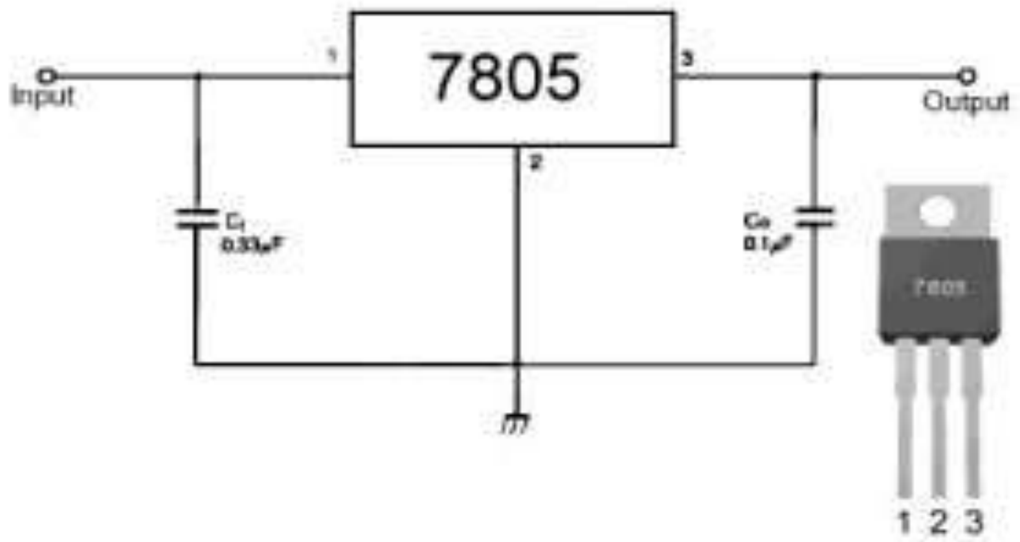


FIG 5.3.3 Voltage Regulator

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.

INTERNAL BLOCK DIAGRAM:

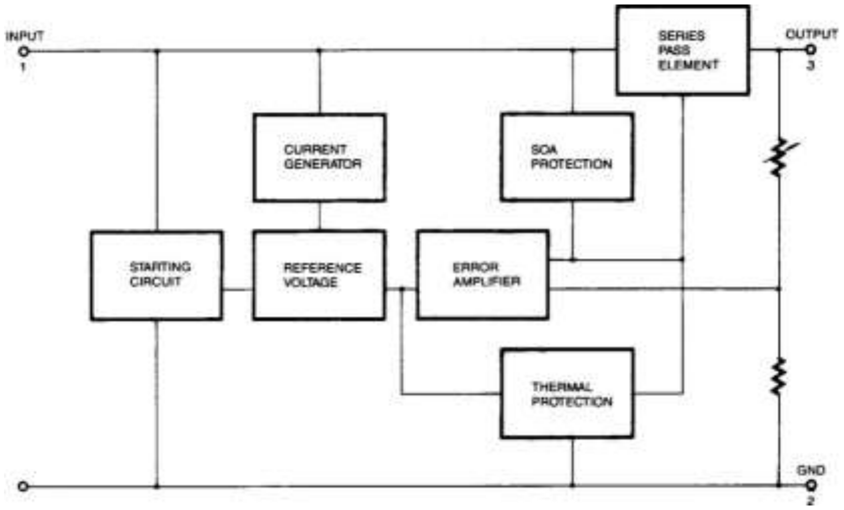
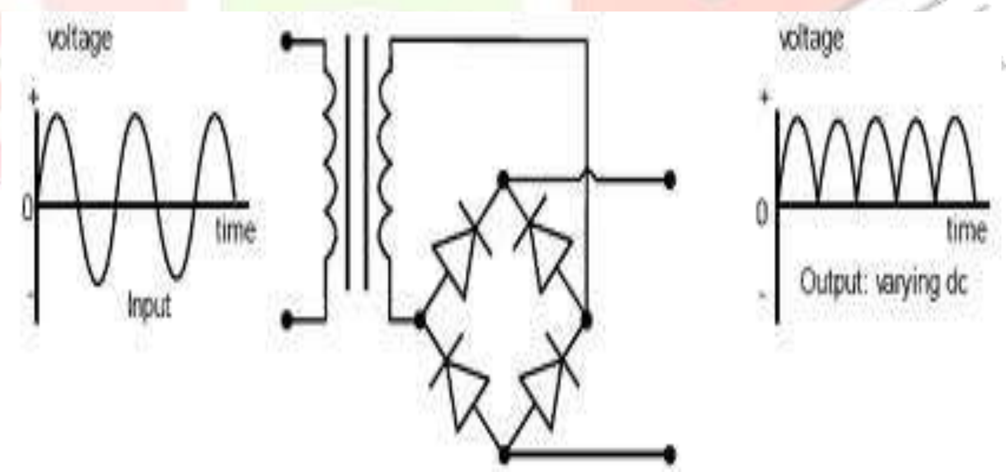


FIG 5.3.4(A): Block Diagram Of Voltage Regulator

5.3.4. RECTIFIER:

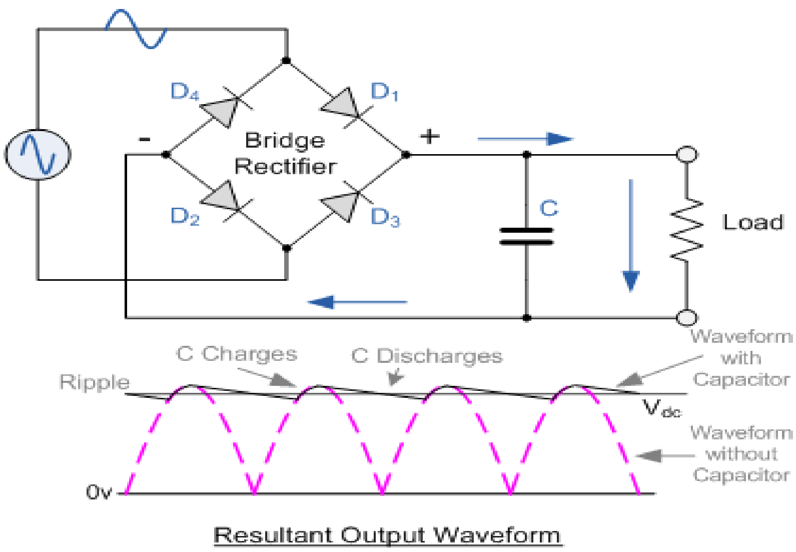
A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), current that flows in only one direction, a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid statediodes, 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 cycleonly 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.



5.3.5. 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.



5.3.6. STEPPER MOTOR:

A stepper motor (or step motor) is a brushless, synchronous electric motor that can divide a full rotation into a large number of steps. The motor's position can be controlled precisely without any feedback mechanism (see Open-loop controller), as long as the motor is carefully sized to the application. Stepper motors are similar to switched reluctance motors (which are very large stepping motors with a reduced pole count, and generally are closed-loop commutated.)

Fundamentals of operation:

Stepper motors operate differently from DC brush motors, which rotate when voltage is applied to their terminals. Stepper motors, on the other hand, effectively have multiple "toothed" electromagnets arranged around a central gear-shaped piece of iron. The electromagnets are energized by an external control circuit, such as a microcontroller. To make the motor shaft turn, first one electromagnet is given power, which makes the gear's teeth magnetically attracted to the electromagnet's teeth. When the gear's teeth are thus aligned to the first electromagnet, they are slightly offset from the next electromagnet. So when the next electromagnet is turned on and the first is turned off, the gear rotates slightly to align with the next one, and from there the process is repeated. Each of those slight rotations is called a "step", with an integer number of steps making a full rotation. In that way, the motor can be turned by a precise angle.

Stepper motor characteristics:

1. Stepper motors are constant power devices.
2. As motor speed increases, torque decreases. (Most motors exhibit maximum torque when stationary, however the torque of a motor when stationary 'holding torque' defines the ability of the motor to maintain a desired position while under external load).
3. The torque curve may be extended by using current limiting drivers and increasing the driving voltage (sometimes referred to as a 'chopper' circuit; there are several off the shelf driver chips capable of doing this in a simple manner).
4. Steppers exhibit more vibration than other motor types, as the discrete step tends to snap the rotor from one position to another (called a decent). The vibration makes stepper motors noisier than DC motors.
5. This vibration can become very bad at some speeds and can cause the motor to lose torque or lose direction. This is because the rotor is being held in a magnetic field which behaves like a spring. On each step the rotor overshoots and bounces back and forth, "ringing" at its resonant frequency. If the stepping frequency matches the resonant frequency then the ringing increases and the motor comes out of synchronism, resulting in positional error or a change in direction. At worst there is a total loss of control and holding torque so the motor is easily overcome by the load and spins almost freely.
6. The effect can be mitigated by accelerating quickly through the problem speeds range, physically damping (frictional damping) the system, or using a micro-stepping driver.

7. Motors with a greater number of phases also exhibit smoother operation than those with fewer phases (this can also be achieved through the use of a micro stepping drive).

Open-loop versus closed-loop commutation:

Steppers are generally commutated open loop, i.e. the driver has no feedback on where the rotor actually is. Stepper motor systems must thus generally be over engineered, especially if the load inertia is high, or there is widely varying load, so that there is no possibility that the motor will lose steps. This has often caused the system designer to consider the trade-offs between a closely sized but expensive servomechanism system and an oversized but relatively cheap stepper.

A new development in stepper control is to incorporate a rotor position feedback (e.g. an encoder or resolver), so that the commutation can be made optimal for torque generation according to actual rotor position. This turns the stepper motor into a high pole count brushless servo motor, with exceptional low speed torque and position resolution. An advance on this technique is to normally run the motor in open loop mode, and only enter closed loop mode if the rotor position error becomes too large — this will allow the system to avoid hunting or oscillating, a common servo problem.

Types:

There are three main types of stepper motors:

Permanent Magnet Stepper (can be subdivided in to 'tin-can' and 'hybrid', tin-can being a cheaper product, and hybrid with higher quality bearings, smaller step angle, higher power density)

1. Hybrid Synchronous Stepper
2. Variable Reluctance Stepper
3. Lavet type stepping motor

Permanent magnet motors use a permanent magnet (PM) in the rotor and operate on the attraction or repulsion between the rotor PM and the stator electromagnets. Variable reluctance (VR) motors have a plain iron rotor and operate based on the principle that minimum reluctance occurs with minimum gap, hence the rotor points are attracted toward the stator magnet poles. Hybrid stepper motors are named because they use a combination of PM and VR techniques to achieve maximum power in a small package size.

Two-phase stepper motors:

There are two basic winding arrangements for the electromagnetic coils in a two phase stepper motor: bipolar and unipolar.

Unipolar motors:

A unipolar stepper motor has two windings per phase, one for each direction of magnetic field. Since in this arrangement a magnetic pole can be reversed without switching the direction of current, the commutation circuit can be made very simple (e.g. a single transistor) for each winding. Typically, given a phase, one end of each winding is made common: giving three leads per phase and six leads for a typical two phase motor. Often, these two phase commons are internally joined, so the motor has only five leads.

A microcontroller or stepper motor controller can be used to activate the drive transistors in the right order, and this ease of operation makes unipolar motors popular with hobbyists; they are probably the cheapest way to get precise angular movements.

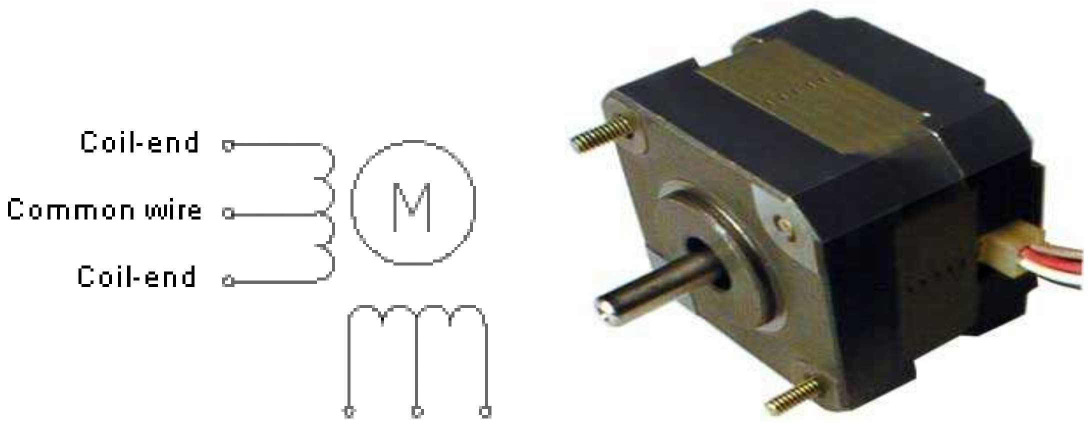


Fig5.3.5: Unipolar stepper motor coils

(For the experimenter, one way to distinguish common wire from a coil-end wire is by measuring the resistance. Resistance between common wire and coil-end wire is always half of what it is between coil-end and coil-end wires. This is because there is twice the length of coil between the ends and only half from centre (common wire) to the end.) A quick way to determine if the stepper motor is working is to short circuit every two pairs and try turning the shaft, whenever a higher than normal resistance is felt, it indicates that the circuit to the particular winding is closed and that the phase is working.

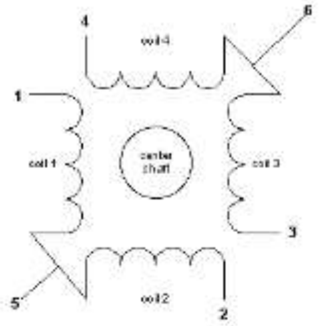
Bipolar motor:

Bipolar motors have a single winding per phase. The current in a winding needs to be reversed in order to reverse a magnetic pole, so the driving circuit must be more complicated, typically with an H-bridge arrangement (however there are several off the shelf driver chips available to make this a simple affair). There are two leads per phase, none are common.

Static friction effects using an H-bridge have been observed with certain drive topologies because windings are better utilized, they are more powerful than a uni-polar motor of the same weight. This is due to the physical space occupied by the windings. A uni-polar motor has twice the amount of wire in the same space, but only half used at any point in time, hence is 50% efficient (or approximately 70% of the torque output available). Though bipolar is more complicated to drive, the abundance of driver chip means this is much less difficult to achieve.

An 8-lead stepper is wound like a uni-polar stepper, but the leads are not joined to common internally to the motor. This kind of motor can be wired in several configurations:

- Uni-polar.
- Bipolar with series windings. This gives higher inductance but lower current per winding.
- Bipolar with parallel windings. This requires higher current but can perform better as the winding inductance is reduced.
- Bipolar with a single winding per phase. This method will run the motor on only half the available windings, which will reduce the available low speed torque but require less current.



Bipolar stepper motor coils

Applications:

Computer-controlled stepper motors are one of the most versatile forms of positioning systems. They are typically digitally controlled as part of an open loop system, and are simpler and more rugged than closed loopservo systems.

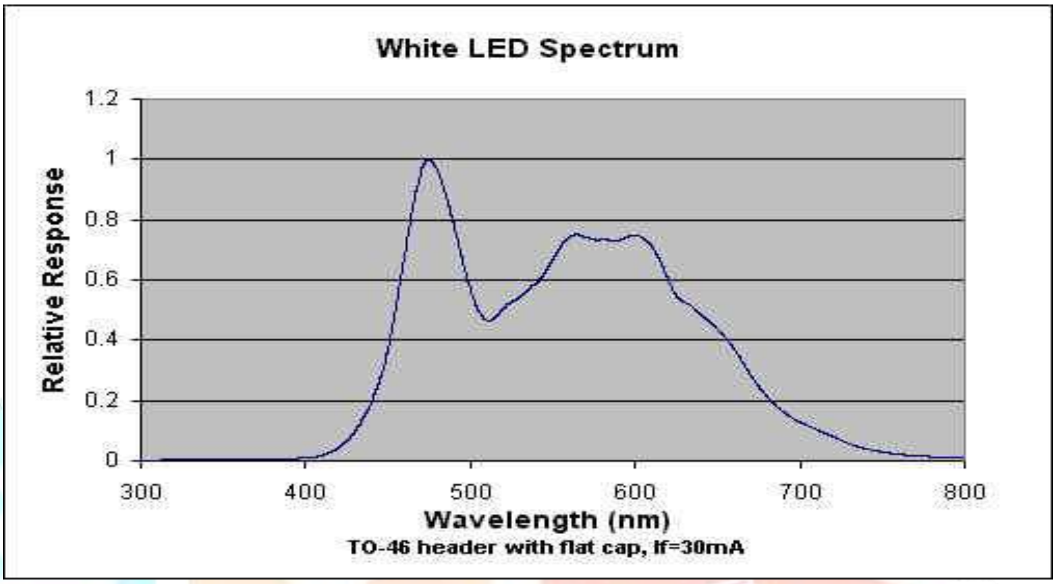
Industrial applications are in high speed pick and place equipment and multi-axis machine CNC machines often directly driving lead screws or ball screws. In the field of lasers and optics they are frequently used in precision positioning equipment such as linear actuators, linear stages, rotation stages, goniometers, and mirror mounts. Other uses are in packaging machinery, and positioning of valve pilot stages for fluid control systems.

Commercially, stepper motors are used in floppy disk drives, flatbed scanners, computer printers, plotters, slot machines, and many more devices.

5.3.7. 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.



1LEDs 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 mesmerism, 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.

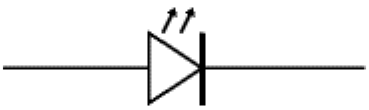


Fig 5.3.7(a): circuit symbol

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.

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.

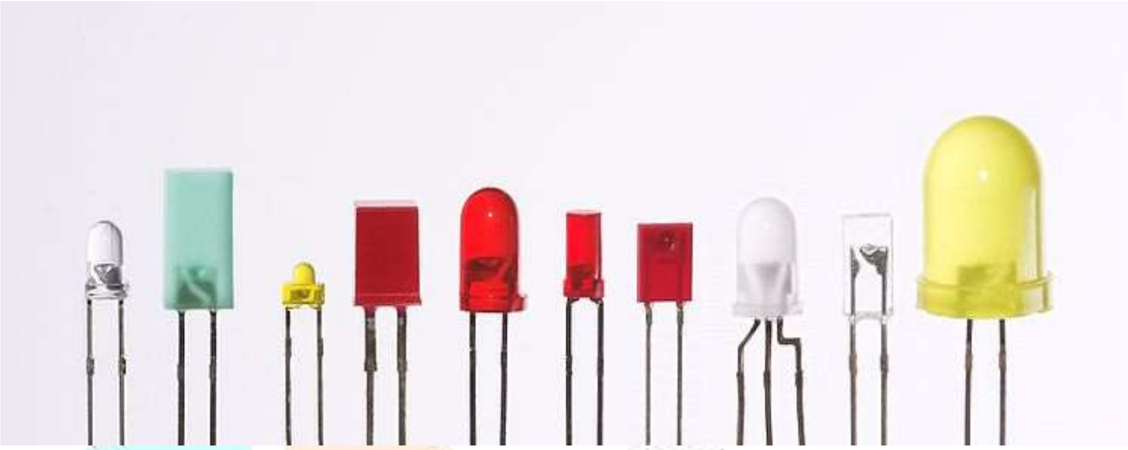


Fig 5.3.7 (b) Different types of LED'S

5.3.8. RELAY DRIVER-ULN2003:

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

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.

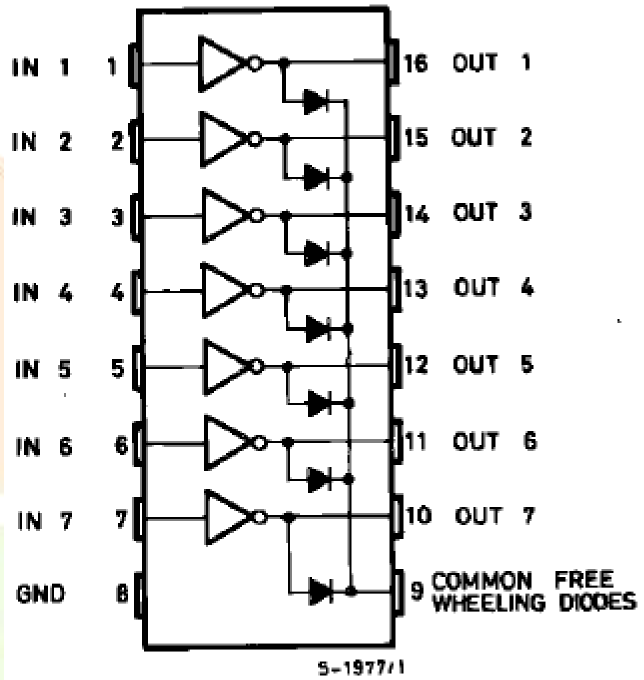
The ULN2003 has a 2.7kW series base resistor for each Darlington pair for operation directly with TTL or 5V CMOS devices.

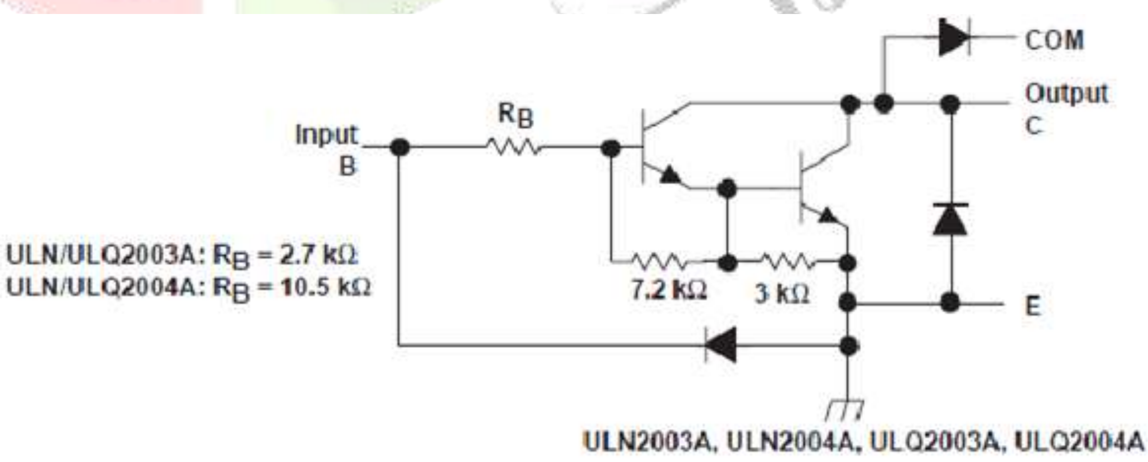
FIG 5.3.8: ULN 2003

•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

PIN Diagram:





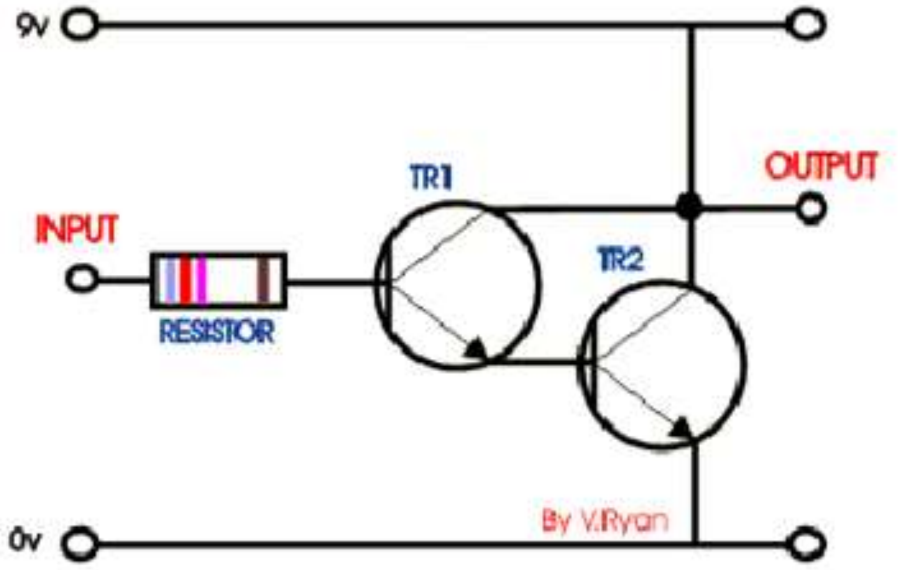


Fig5.3.7(c): Darlington pair

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'.

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.

FEATURES:

* 500mA rated collector current (Single output).
* High-voltage outputs: 50V.
* Inputs compatible with various types of logic.
* Relay driver application.

5.3.9. PUSH BUTTONS:

A push-button (also spelled pushbutton) or simply button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, though even many un-biased buttons (due to their physical nature) require a spring to return to their un-pushed state. Different people use different terms for the "pushing" of the button, such as press, depress, mash, and punch.

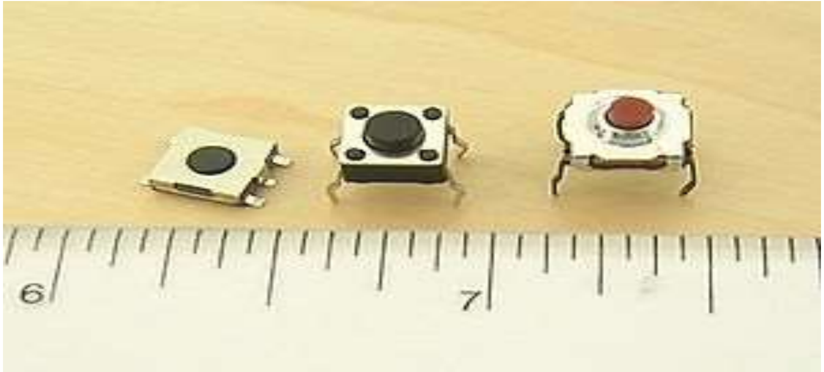


Fig 5.3.9(a) Push buttons

Uses:

In industrial and commercial applications push buttons can be linked together by a mechanical linkage so that the act of pushing one button causes the other button to be released. In this way, a stop button can "force" a start button to be released. This method of linkage is used in simple manual operations in which the machine or process have no electrical circuits for control.

Pushbuttons are often color-coded to associate them with their function so that the operator will not push the wrong button in error. Commonly used colors are red for stopping the machine or process and green for starting the machine or process.

Red pushbuttons can also have large heads (mushroom shaped) for easy operation and to facilitate the stopping of a machine. These pushbuttons are called emergency stop buttons and are mandated by the electrical code in many jurisdictions for increased safety. This large mushroom shape can also be found in buttons for use with operators who need to wear gloves for their work and could not actuate a regular flush-mounted push button. As an aid for operators and users in industrial or commercial applications, a pilot light is commonly added to draw the attention of the user and to provide feedback if the button is pushed. Typically this light is included into the center of the pushbutton and a lens replaces the pushbutton hard center disk.

The source of the energy to illuminate the light is not directly tied to the contacts on the back of the pushbutton but to the action the pushbutton controls. In this way a start button when pushed will cause the process or machine operation to be started and a secondary contact designed into the operation or process will close to turn on the pilot light and signify the action of pushing the button caused the resultant process or action to start.

In popular culture, the phrase "the button" refers to a (usually fictional) button that a military or government leader could press to launch nuclear weapons.

Push to ON button:

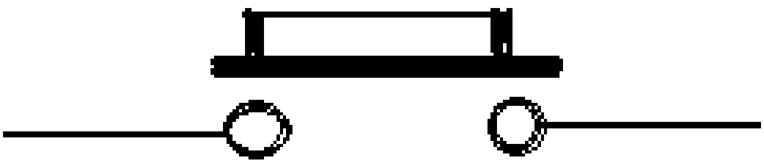
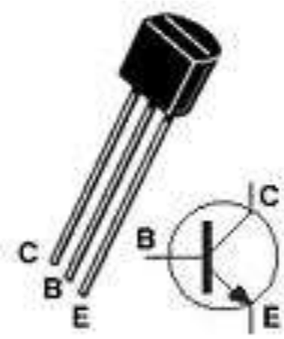


Fig. 5.3.9(b): push on button

Initially the two contacts of the button are open. When the button is pressed they become connected. This makes the switching operation using the push button.

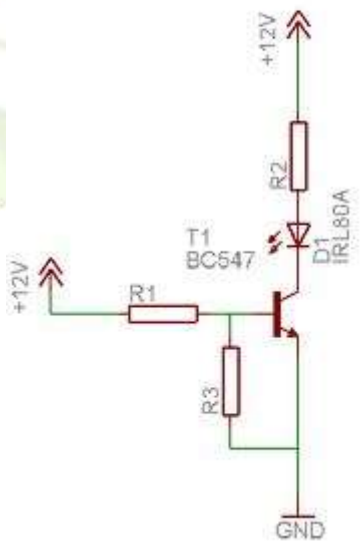
5.3.10. TRANSISTOR-BC547:

The BC547 transistor is an NPN Epitaxial Silicon Transistor. The BC547 transistor is a general-purpose transistor in small plastic packages. It is used in general-purpose switching and amplification BC847/BC547 series 45 V, 100 mA NPN general-purpose transistors.



BC 547 TRANSISTOR PINOUTS

The BC547 transistor is an NPN bipolar transistor, in which the letters "N" and "P" refer to the majority charge carriers inside the different regions of the transistor. Most bipolar transistors used today are NPN, because electron mobility is higher than whole mobility in semiconductors, allowing greater currents and faster operation. NPN transistors consist of a layer of P-doped semiconductor (the "base") between two N-doped layers. A small current entering the base in common-emitter mode is amplified in the collector output. In other terms, an NPN transistor is "on" when its base is pulled high relative to the emitter. The arrow in the NPN transistor symbol is on the emitter leg and points in the direction of the conventional current flow when the device is in forward active mode. One mnemonic device for identifying the symbol for the NPN transistor is "not pointing in." An NPN transistor can be considered as two diodes with a shared anode region. In typical operation, the emitter base junction is forward biased and the base collector junction is reverse biased. In an NPN transistor, for example, when a positive voltage is applied to the base emitter junction, the equilibrium between thermally generated carriers and the repelling electric field of the depletion region becomes unbalanced, allowing thermally excited electrons to inject into the base region. These electrons wander (or "diffuse") through the base from the region of high concentration near the emitter towards the region of low concentration near the collector. The electrons in the base are called minority carriers because the base is doped p-type which would make holes the majority carrier in the base.



Whenever base is high, then current starts flowing through base and emitter and after that only current will pass from collector to emitter. So that the LED which is connected to collector will glow to indicate that transistor is ON.

5.3.11. DIODE-1N4007:

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

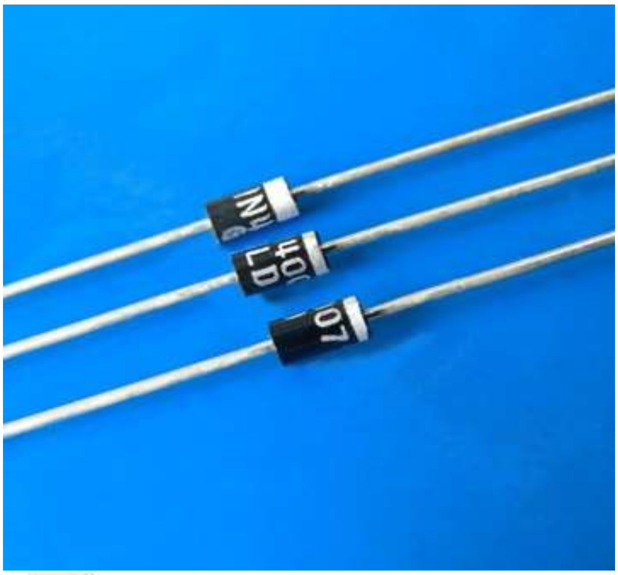


Fig: 1N4007 diodes

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.

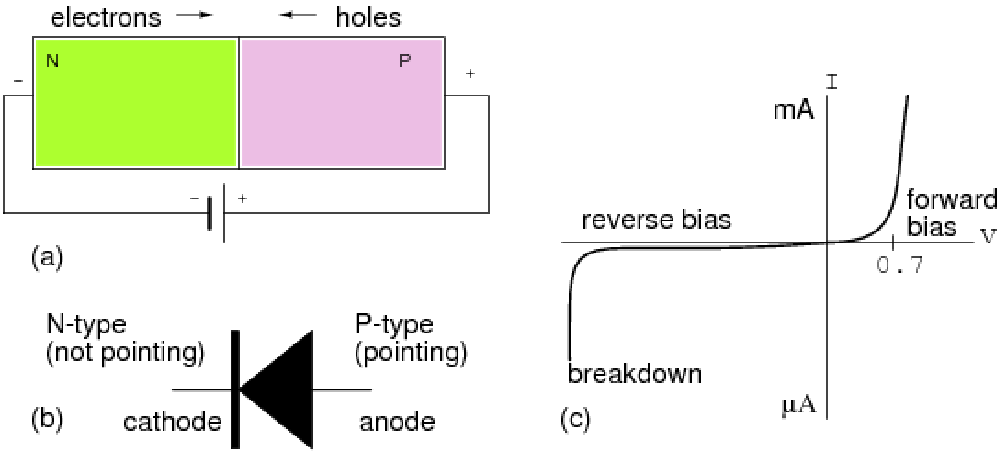


Fig:PN Junction diode

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.

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.

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

5.3.12. 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:

$$V = IR$$

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.

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:

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

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 ($1\ m\Omega = 10^{-3}\ \Omega$), kilohm ($1\ k\Omega = 10^{3}\ \Omega$), and megohm ($1\ M\Omega = 10^{6}\ \Omega$) 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.

Theory of operation:

Ohm's law:

The behaviour of an ideal resistor is dictated by the relationship specified in Ohm's law:

$$V = I \cdot R$$

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I) passing through it, where the constant of proportionality is the resistance (R).

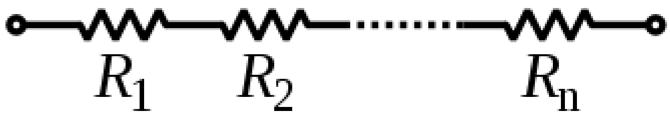
Equivalently, Ohm's law can be stated:

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

This formulation of Ohm's law states that, when a voltage (V) is present across a resistance (R), a current (I) will flow through the resistance. This is directly used in practical computations. For example, if a 300 ohm resistor is attached across the terminals of a 12 volt battery, then a current of 12 / 300 = 0.04 amperes (or 40 mill amperes) will flow through that resistor.

Series and parallel resistors:

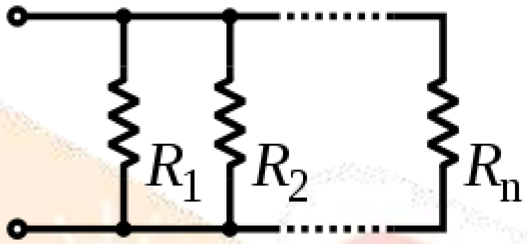
In a series configuration, the current through all of the resistors is the same, but the voltage across each resistor will be in proportion to its resistance. The potential difference (voltage) seen across the network is the sum of those voltages, thus the total resistance can be found as the sum of those resistances:



$$R_{eq} = R_1 + R_2 + \cdots + R_n$$

As a special case, the resistance of N resistors connected in series, each of the same resistance R, is given by NR.

Resistors in a parallel configuration are each subject to the same potential difference (voltage), however the currents through them add. The conductance of the resistors then add to determine the conductance of the network. Thus the equivalent resistance (R_{eq}) of the network can be computed:



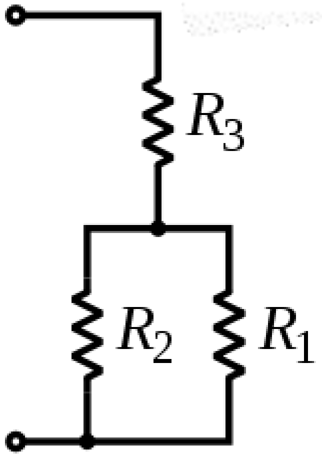
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}$$

The parallel equivalent resistance can be represented in equations by two vertical lines "||" (as in geometry) as a simplified notation. For the case of two resistors in parallel, this can be calculated using:

$$R_{eq} = R_1 \| R_2 = \frac{R_1 R_2}{R_1 + R_2}$$

As a special case, the resistance of N resistors connected in parallel, each of the same resistance R, is given by R/N.

A resistor network that is a combination of parallel and series connections can be broken up into smaller parts that are either one or the other. For instance,

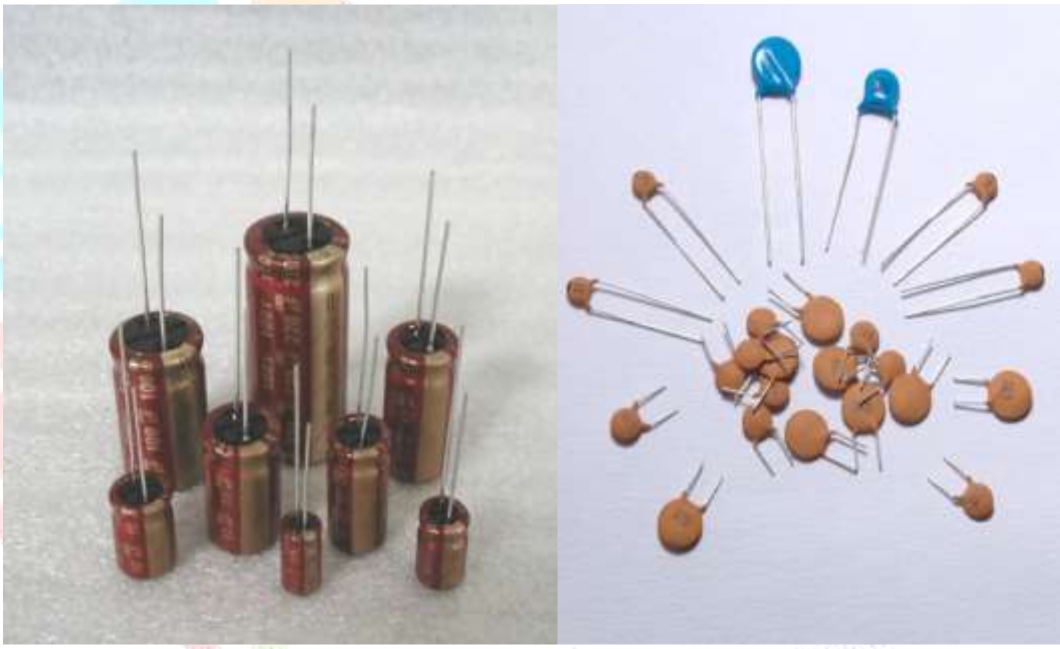


$$R_{eq} = (R_1 \| R_2) + R_3 = \frac{R_1 R_2}{R_1 + R_2} + R_3$$

However, some complex networks of resistors cannot be resolved in this manner, requiring more sophisticated circuit analysis. For instance, consider a cube, each edge of which has been replaced by a resistor. What then is the resistance that would be measured between two opposite vertices? In the case of 12 equivalent resistors, it can be shown that the corner-to-corner resistance is $\frac{5}{6}$ of the individual resistance. More generally, the Y-Δ transform, or matrix methods can be used to solve such a problem. One practical application of these relationships is that a non-standard value of resistance can generally be synthesized by connecting a number of standard values in series and/or parallel. This can also be used to obtain a resistance with a higher power rating than that of the individual resistors used. In the special case of N identical resistors all connected in series or all connected in parallel, the power rating of the individual resistors is thereby multiplied by N.

5.3.13. 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.

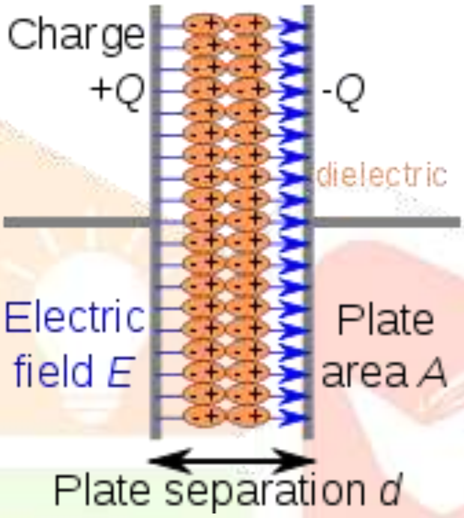
A capacitor (formerly known as condenser) is a device for storing electric charge. The forms of practical capacitors vary widely, but all contain at least two conductors separated by a non-conductor. Capacitors used as parts of electrical systems, for example, consist of metal foils separated by a layer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

Theory of operation:

Capacitance



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

5.3.14. PHOTOVOLTAIC CELLS/SOLAR CELLS:

How Solar Panels Work?

1. Rays of sunlight hit the solar panel (also known as a photovoltaic/ (PV) cells) and are absorbed by semi-conducting materials such as silicone.
2. Electrons are knocked loose from their atoms, which allow them to flow through the material to produce electricity. This process whereby light (photo) is converted into electricity (voltage) is called the photovoltaic (PV) effect.
3. An array of solar panels converts solar energy into DC (direct current) electricity.
4. The DC electricity then enters an inverter.
5. The inverter turns DC electricity into 120-volt AC (alternating current) electricity needed by home appliances.
6. The AC power enters the utility panel in the house.
7. The electricity (load) is then distributed to appliances or lights in the house.
8. When more solar energy is generated that what you're using - it can be stored in a battery as DC electricity. The battery will continue to supply your home with electricity in the event of a power blackout or at nighttime.

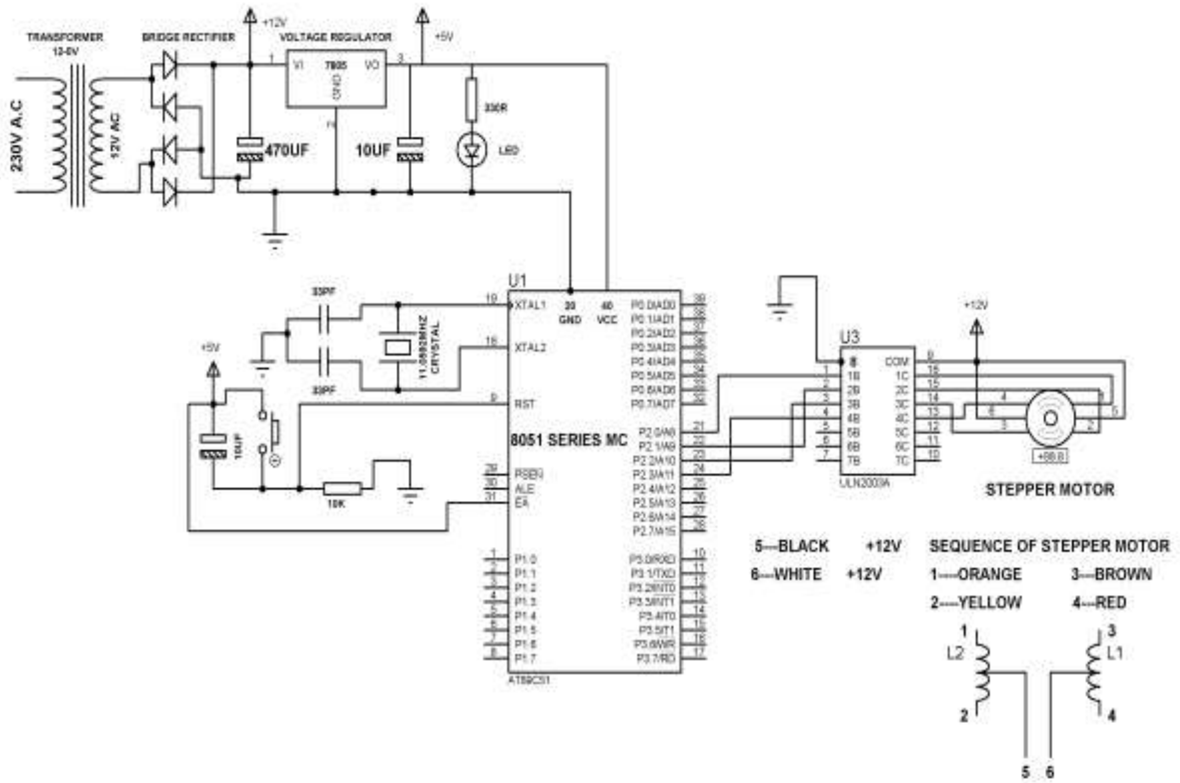
9. When the battery is full the excess electricity can be exported back into the utility grid, if your system is connected to it.

10. Utility supplied electricity can also be drawn from the grid when not enough solar energy is produced and no excess energy is stored in the battery, i.e. at night or on cloudy days.

11. The flow of electricity in and out of the utility grid is measured by a utility meter, which spins backwards (when you are producing more energy that you need) and forward (when you require additional electricity from the utility company). The two are offset ensuring that you only pay for the additional energy you use from the utility company. Any surplus energy is sold back to the utility company. This system is referred to as "net-metering".

- Solar Energy is measured in kilowatt-hour. 1 kilowatt = 1000 watts.
- 1 kilowatt-hour (kWh) = the amount of electricity required to burn a 100 watt light bulb for 10 hours.
- According to the US Department of Energy, an average American household used approximately 866-kilowatt hours per month in 1999 costing them $70.68.
- About 30% of our total energy consumption is used to heat water.

5.4 SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM EXPLANATION:

POWER SUPPLY:

The circuit uses standard power supply comprising of a step-down transformer from 230Vto 12V and 4 diodes forming a bridge rectifier that delivers pulsating dc which is then filtered by an electrolytic capacitor of about 470µF to 1000µF. The filtered dc being unregulated, IC LM7805 is used to get 5V DC constant at its pin no 3 irrespective of input DC varying from 7V to 15V. The input dc shall be varying in the event of input ac at 230volts section varies from 160V to 270V in the ratio of the transformer primary voltage V1 to secondary voltage V2 governed by the formula V1/V2=N1/N2. As N1/N2 i.e. no. of turns in the primary to the no. of turns in the secondary remains unchanged V2 is directly proportional to V1.Thus if the transformer delivers 12V at 220V input it will give 8.72V at 160V.Similarly at 270V it will give 14.72V.Thus the dc voltage at the input of the regulator changes from about 8V to 15V because of A.C voltage variation from 160V to 270V the regulator output will remain constant at 5V.

The regulated 5V DC is further filtered by a small electrolytic capacitor of 10µF for any noise so generated by the circuit. One LED is connected of this 5V point in series with a current limiting resistor of 330Ω to the ground i.e., negative voltage to indicate 5V power supply availability. The unregulated 12V point is used for other applications as and when required.

STANDARD CONNECTIONS TO 8051 SERIES MICRO CONTROLLER:

ATMEL series of 8051 family of micro controllers need certain standard connections. The actual number of the Microcontroller could be “89C51” , “89C52”, “89S51”, “89S52”, and as regards to 20 pin configuration a number of “89C2051”. The 4 set of I/O ports are used based on the project requirement. Every microcontroller requires a timing reference for its internal program execution therefore an oscillator needs to be functional with a desired frequency to obtain the timing reference as t =1/f.

A crystal ranging from 2 to 20 MHz is required to be used at its pin number 18 and 19 for the internal oscillator. It may be noted here the crystal is not to be understood as crystal oscillator it is just a crystal, while connected to the appropriate pin of the microcontroller it results in oscillator function inside the microcontroller. Typically 11.0592 MHz crystal is used in general for most of the circuits using 8051 series microcontroller. Two small value ceramic capacitors of 33pF each is used as a standard connection for the crystal as shown in the circuit diagram.

RESET:

Pin no 9 is provided with a re-set arrangement by a combination of an electrolytic capacitor and a register forming RC time constant. At the time of switch on, the capacitor gets charged, and it behaves as a full short circuit from the positive to the pin number 9. After the capacitor gets fully charged the current stops flowing and pin number 9 goes low which is pulled down by a 10k resistor to the ground. This arrangement of reset at pin 9 going high initially and then to logic 0 i.e., low helps the program execution to start from the beginning. In absence of this the program execution could have taken place arbitrarily anywhere from the program cycle. A pushbutton switch is connected across the capacitor so that at any given time as desired it can be pressed such that it discharges the capacitor and while released the capacitor starts charging again and then pin number 9 goes to high and then back to low, to enable the program execution from the beginning. This operation of high to low of the reset pin takes place in fraction of a second as decided by the time constant R and C.

For example: A 10µF capacitor and a 10kΩ resistor would render a 100ms time to pin number 9 from logic high to low, there after the pin number 9 remains low.

External Access (EA):

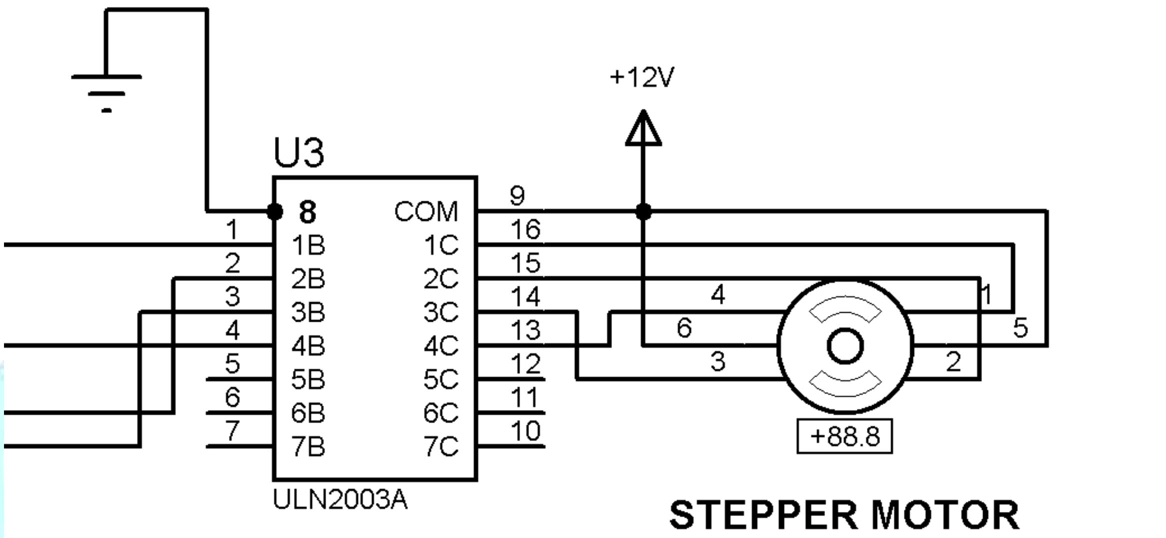
Pin no 31 of 40 pin 8051 microcontroller termed as EA¯ is required to be connected to 5V for accessing the program form the on-chip program memory. If it is connected to ground then the controller accesses the program from external memory. However as we are using the internal memory it is always connected to +5V.

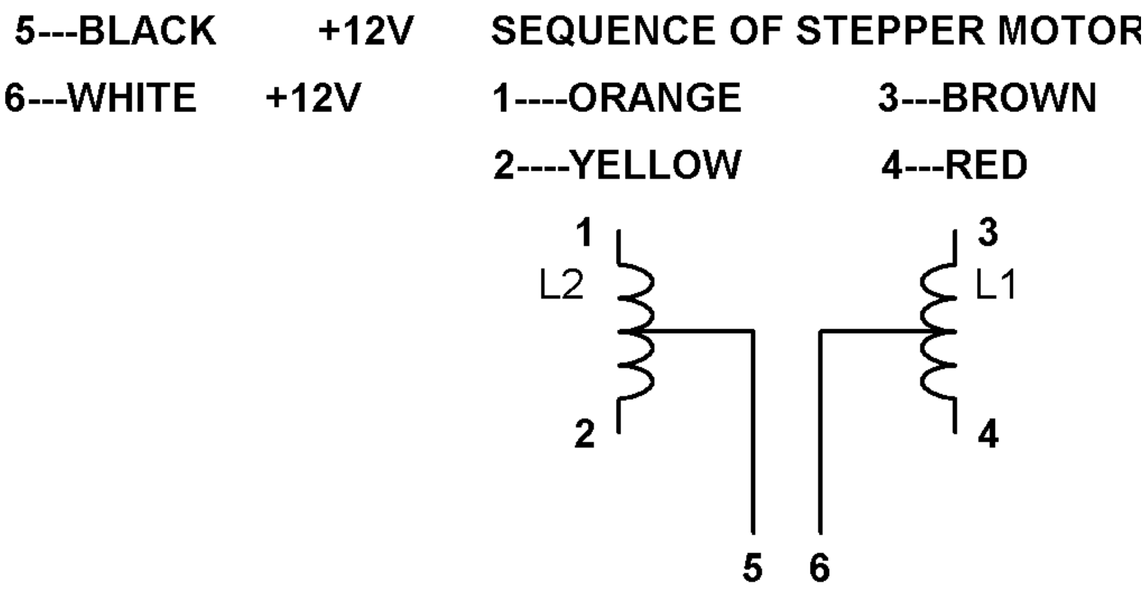
5.5 OPERATION EXPLANATION

CONNECTIONS:

The output of power supply which is connected to the 40th pin of microcontroller and ground is connected to its 20th pin. Pins 2.0 to 2.3 of port3 of microcontroller are connected to pins1, 2, 3, and 4 of ULN2003. Pins 13, 14, 15, 16 of ULN2003 are given to stepper motor and solar panel is connected to stepper motor.

WORKING:





The stepper motor is interfaced to the MC through driver IC ULN2003.Out of 6 connections from the stepper motor four (1,2,3,4) are fed from the output of ULN2003 while the other two (5&6) are fed directly to positive supply. The stepper motor shaft rotates in steps while each coil is energized in sequence of 1,2,3,4 by the logic low provided by the ULN 2003 while the common point (5&6) of the four coils are connected to the positive supply. Sun raises in the morning at 6 AM and sunset at 6PM.so in this 12 hours' time period sun rotates 180^0.For demonstration purpose the program was so written that the stepper motor completes an 180^0 rotation in appropriate number of steps with each step in 5 sec interval. After completing 180^0 the solar panel comes to starting position directly much faster such that it is ready for repeating the cycle from next day morning... A low power solar panel is mounted on to the shaft of the stepper motor such that the phase of the solar panel faces the sun in 90^0 incidences throughout the day. The projects uses a dummy solar panel as the tracking is to be understood properly and not the functioning of the solar panel.

LAYOUT DIAGRAM

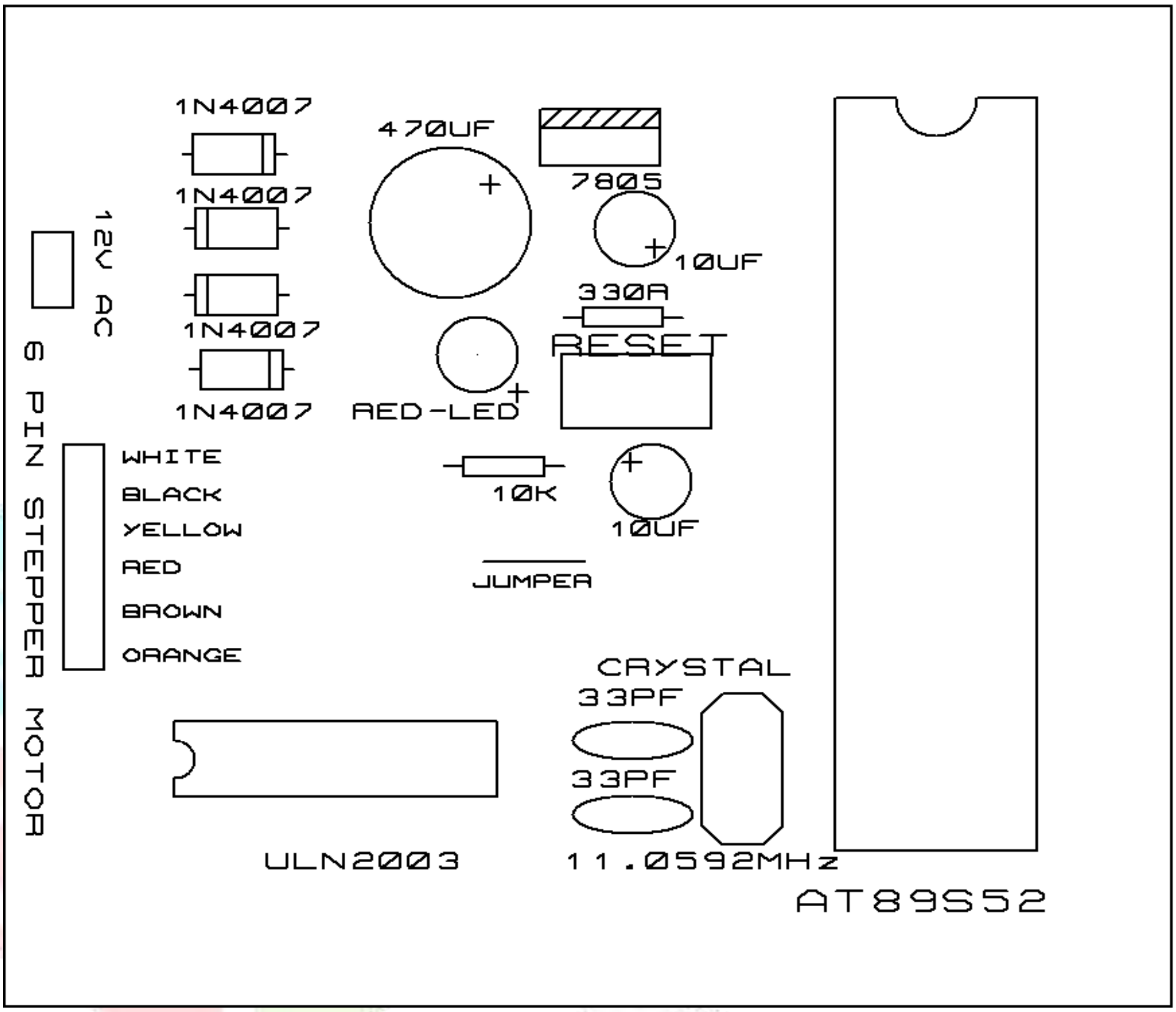


Fig.5.5: Layout Diagram

6. SOFTWARE REQUIREMENTS

6.1 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.

6.2 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.

The advantage of interpreters is that they can execute a program immediately. Secondly programs produced by compilers run much faster than the same programs executed by an interpreter. However compilers require some time before an executable program emerges.

6.3 CONCEPT OF 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.

6.4 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.

6.5 Building an Application in µVision2:

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

1. Select Project - (for example, 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.

6.6 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, and 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.

6.7 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.

6.8 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.

6.9 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.

6.10 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.

6.11 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.

6.12 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.

6.13 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.

6.14 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.

6.15 EMBEDDED C:

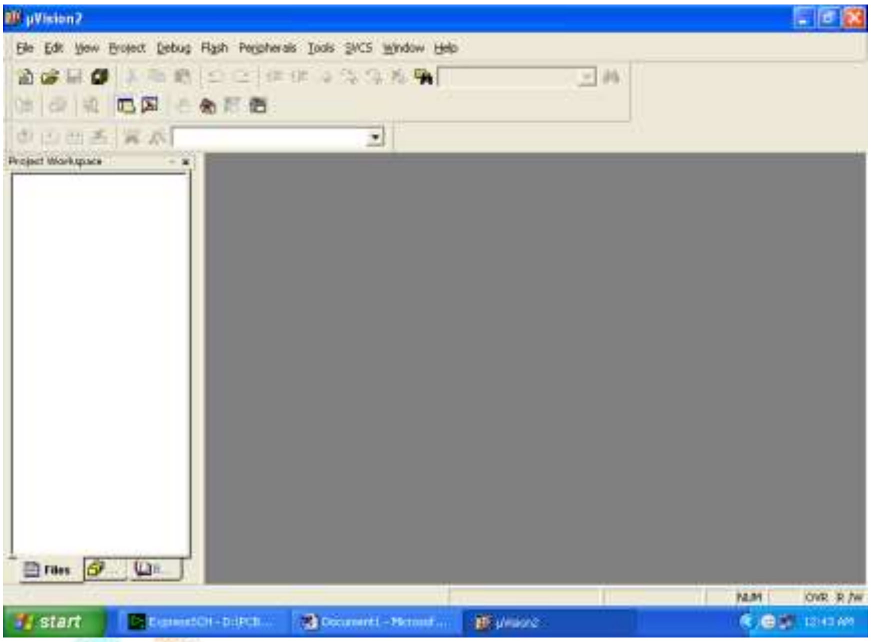
Use of embedded processors in passenger cars, mobile phones, medical equipment, aerospace systems and defense systems is widespread, and even everyday domestic appliances such as dish washers, televisions, washing machines and video recorders now include at least one such device.

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.

7. CODING

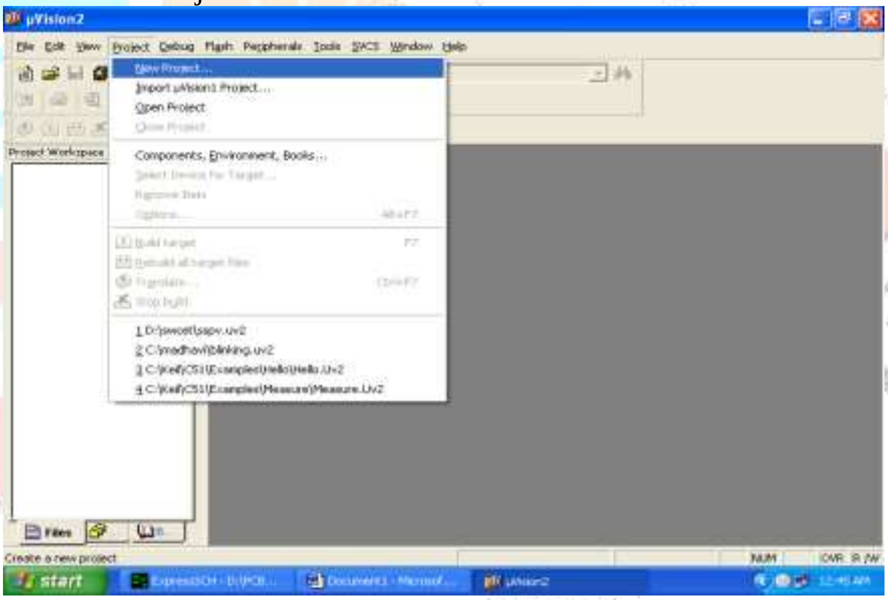
7.1 COMPILER:

1. Click on the Keil Vision Icon on Desktop
2. The following fig will appear

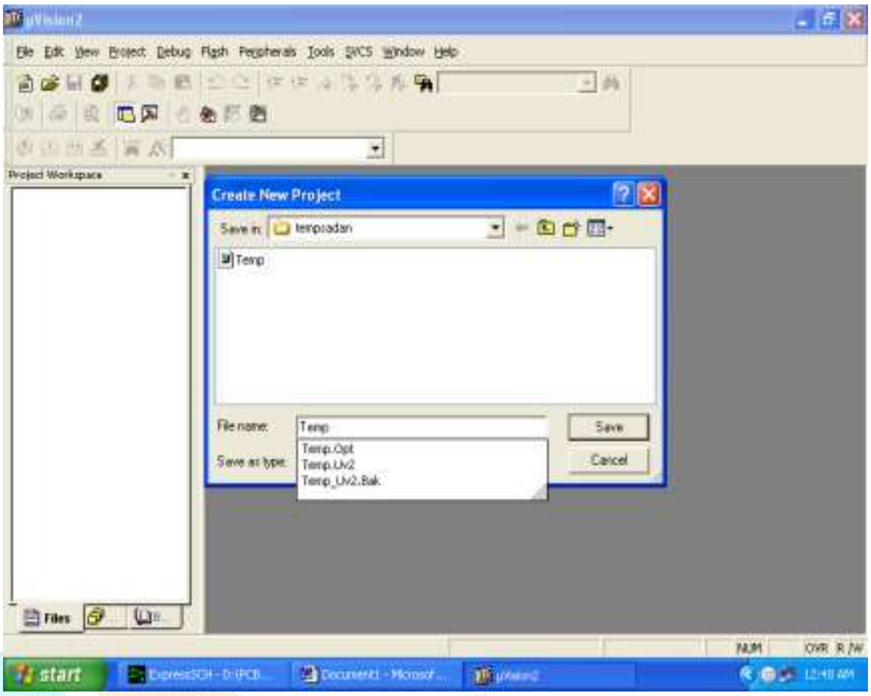


3. Click on the Project menu from the title bar

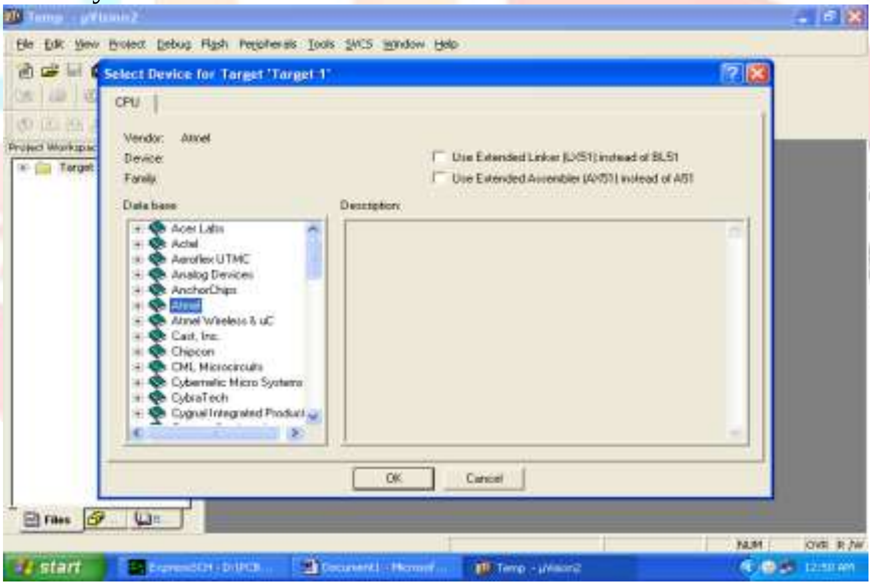
4. Then Click on New Project



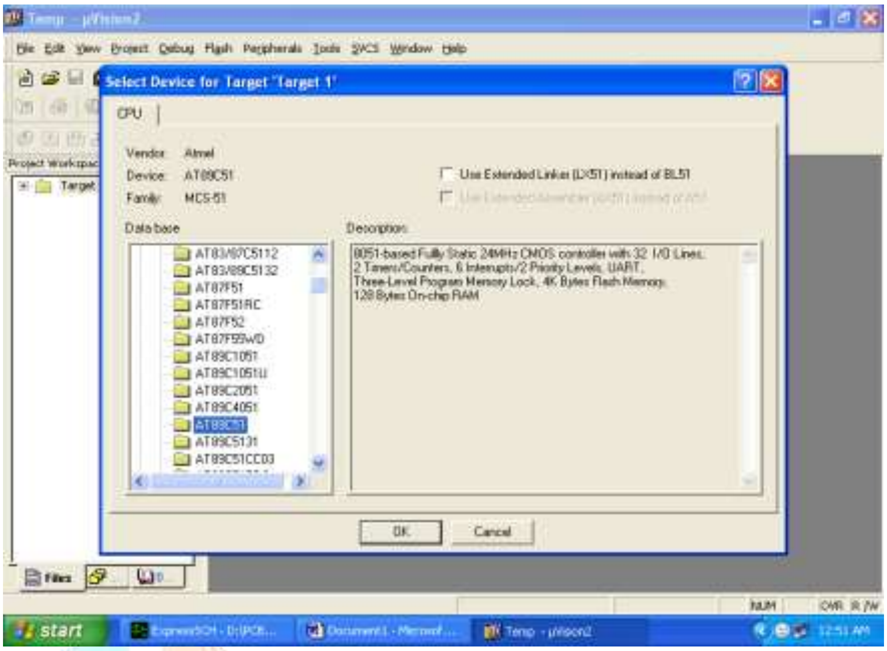
5. Save the Project by typing suitable project name with no extension in u r own folder sited in either C:\ or D:\



6. Then Click on save button above.
7. Select the component for u r project. I.e. Atmel……
8. Click on the + Symbol beside of Atmel

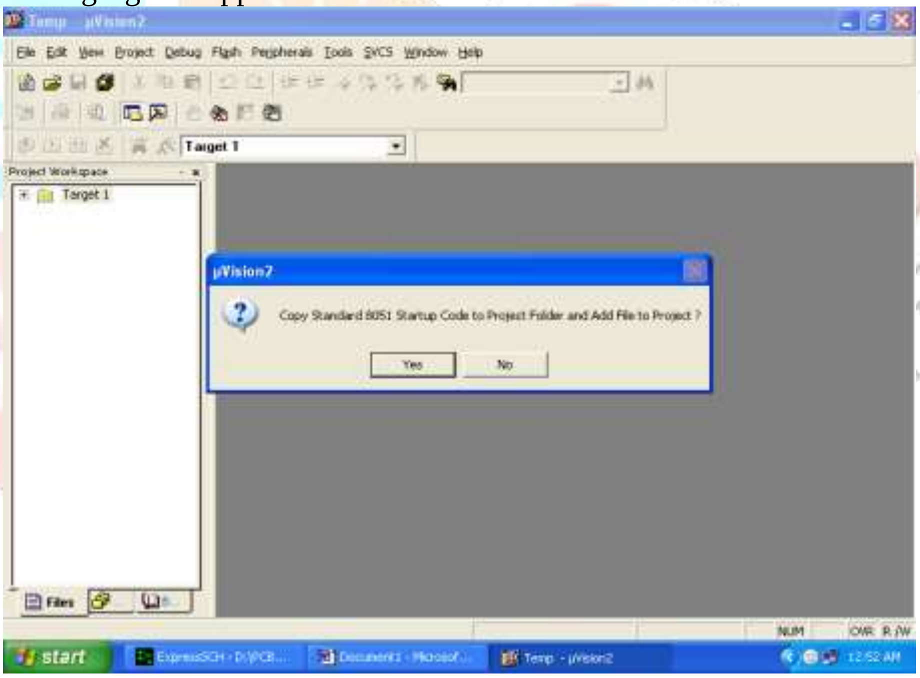


9. Select AT89C51 as shown below



10. Then Click on "OK"

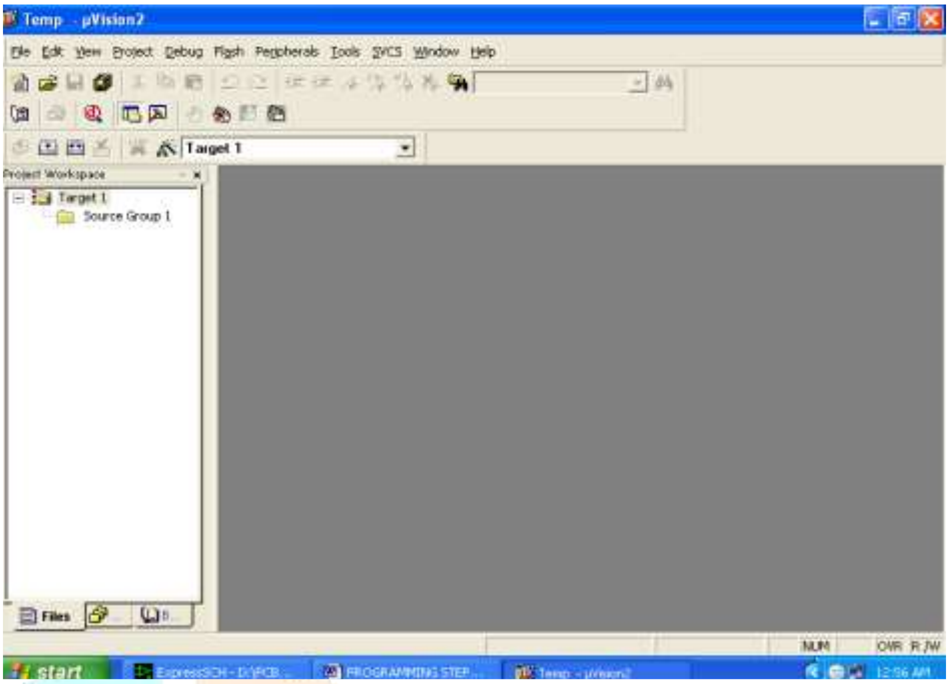
11. The Following fig will appear



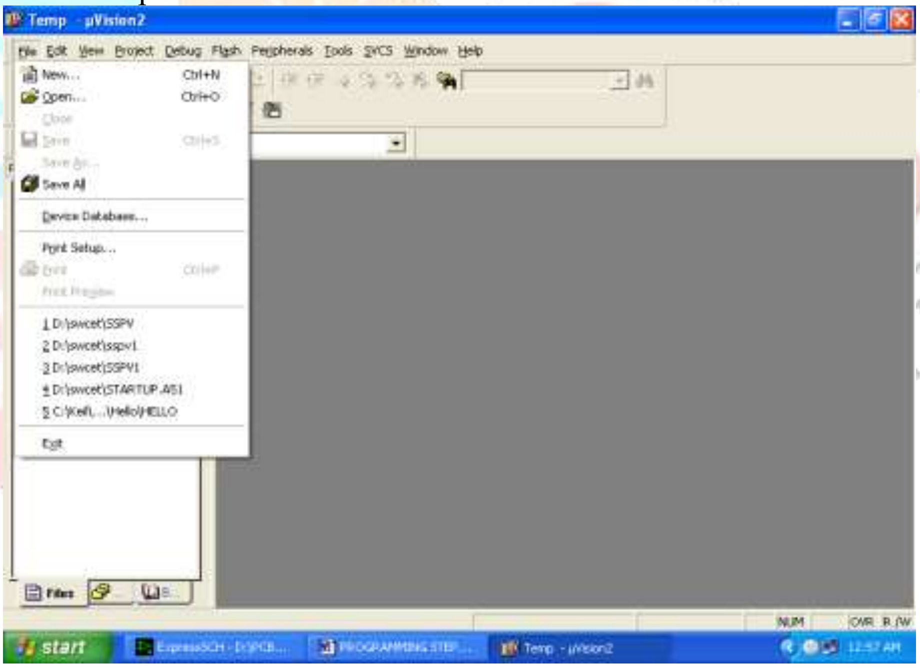
12. Then Click either YES or NO………mostly "NO".

13. Now your project is ready to USE.

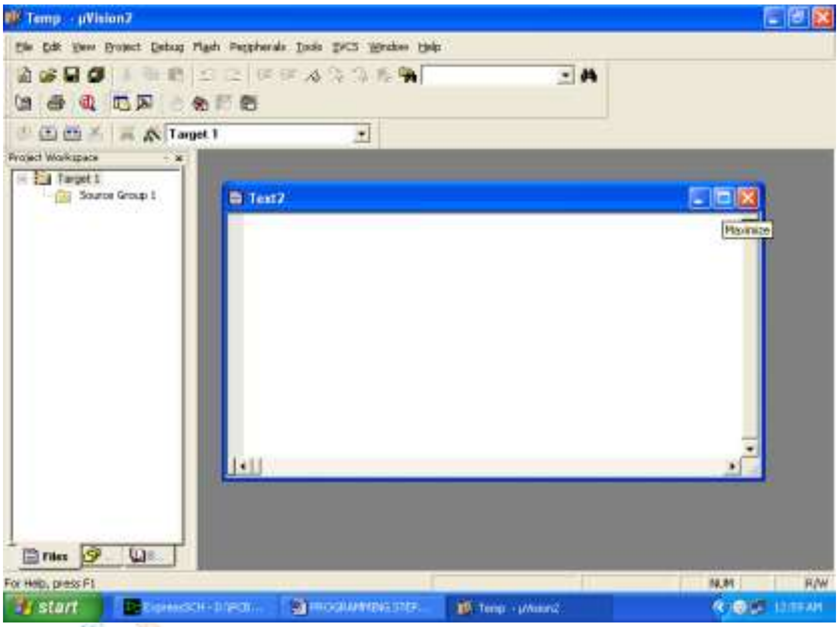
14. Now double click on the Target1, you would get another option "Source group 1" as shown in next page.



15. Click on the file option from menu bar and select “new”.

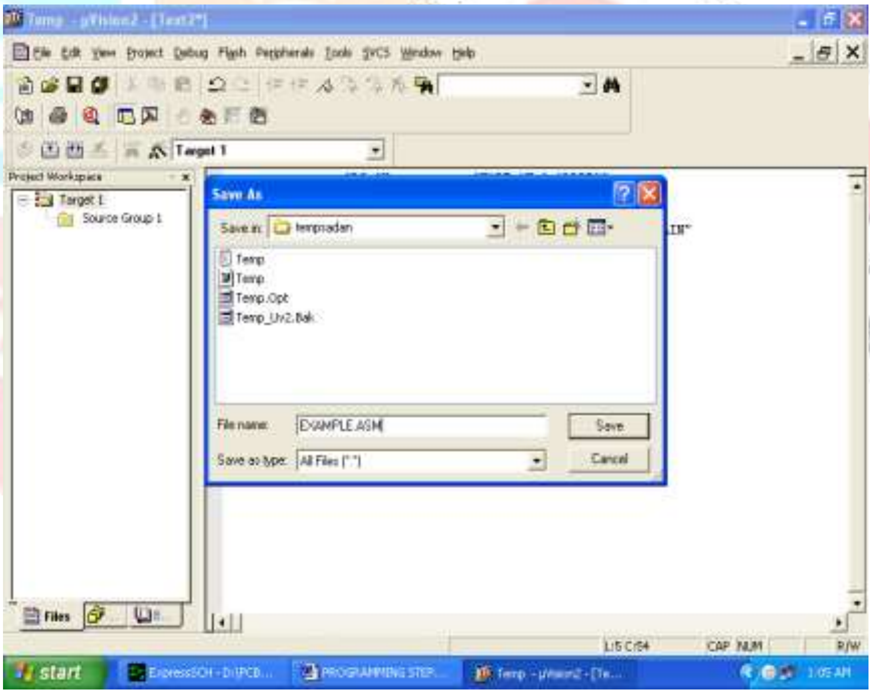


16. The next screen will be as shown in next page, and just maximize it by double clicking on its blue boarder.

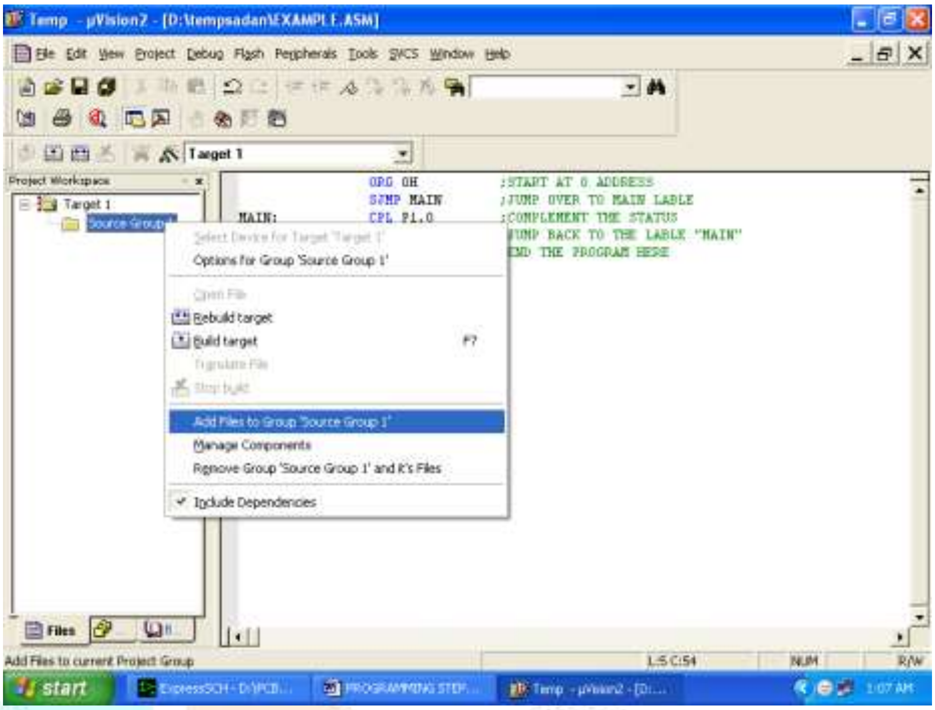


17. Now start writing program in either in "EMBEDDED C" or "ASM".

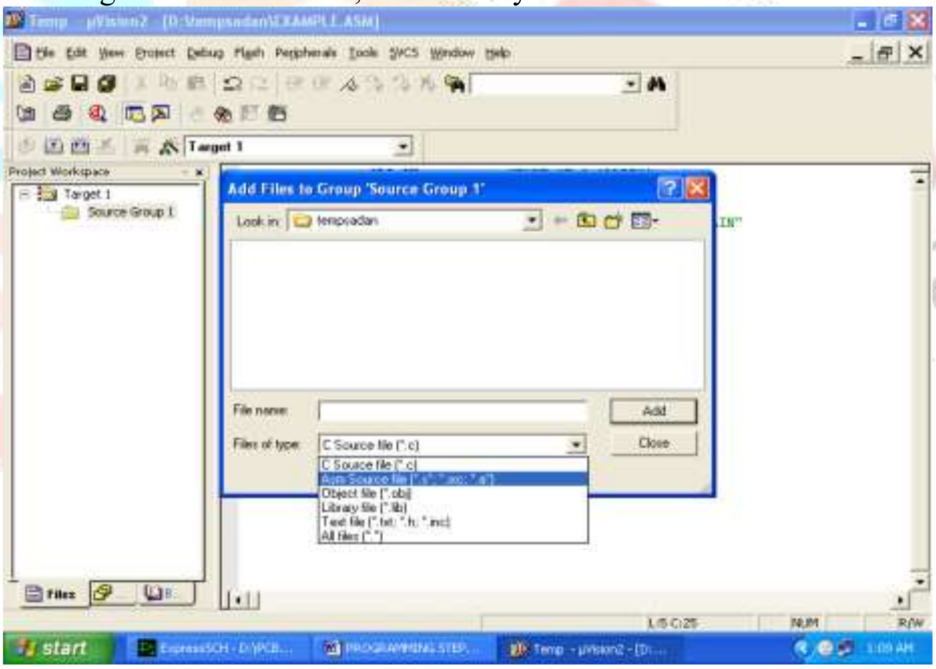
18. For a program written in Assembly, then save it with extension ". Asm" and for "EMBEDDED C" based program save it with extension " .C"



19. Now right click on Source group 1 and click on "Add files to Group Source".



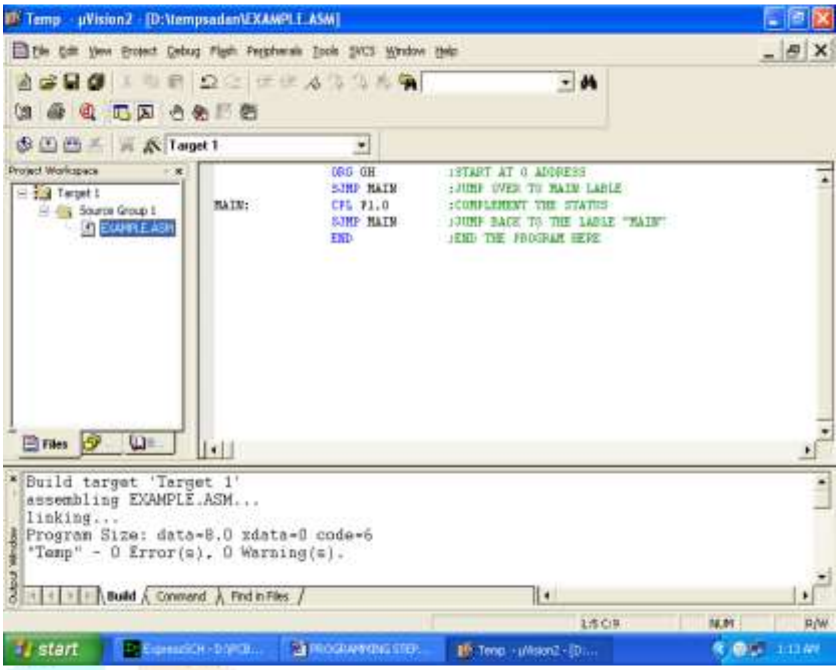
20. Now you will get another window, on which by default "EMBEDDED C" files will appear.



21. Now select as per your file extension given while saving the file.

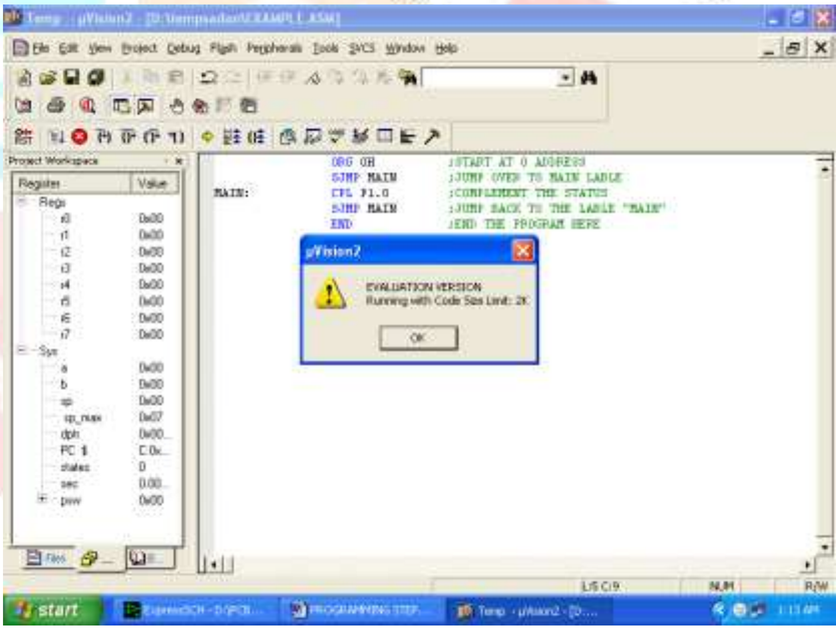
22. Click only one time on option "**ADD**".

23. Now Press function key F7 to compile. Any error will appear if so happen.



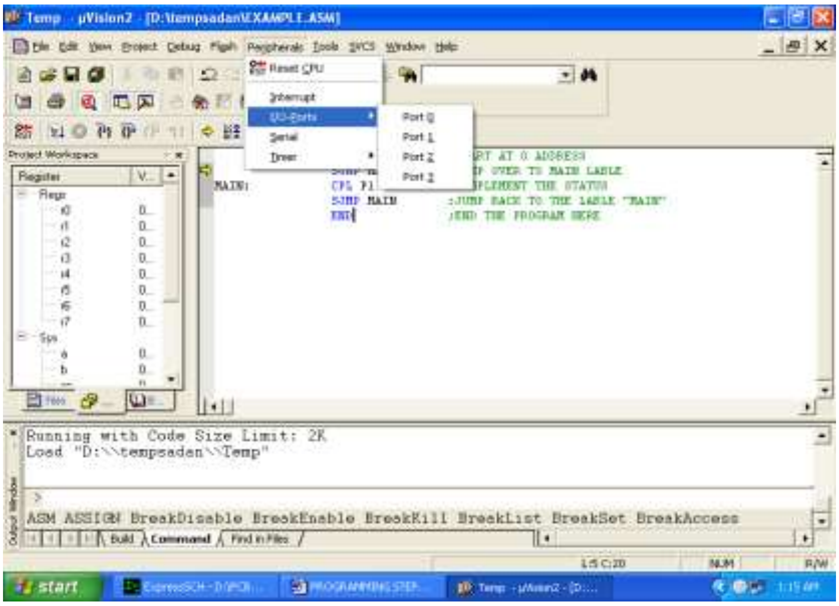
24. If the file contains no error, then press Control+F5 simultaneously.

25. The new window is as follows.

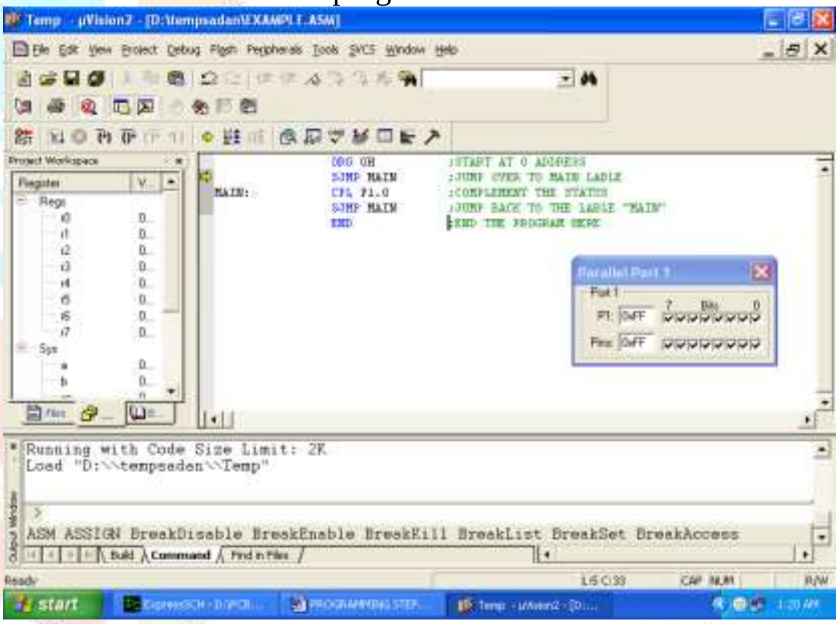


26. Then Click "OK".

27. Now click on the Peripherals from menu bar, and check your required port as shown in fig below.



28. Drag the port a side and click in the program file.



29. Now keep Pressing function key "F11" slowly and observe.

30. You are running your program successfully.

7.2 SOURCE

```
#include<reg52.h>


sbit    RED     = P2^0;
sbit    BROWN           = P2^1;
sbit    YELLOW          = P2^2;
sbit    ORANGE          = P2^3;

unsigned char   i,j;

void delay_5sec();
void delay_2sec();
void delay_1sec();
void main()
{
P0 = 0x00;                              //make port0 as both input & output port
YELLOW          = 0;                    //clear the pin
BROWN           = 0;                    //clear the pin
RED     = 0;                    //clear the pin
ORANGE          = 0;                    //clear the pin
delay_5sec();                   //delay for 5 seconds
while(1)
{
for(j=0;j<6;j++)
{

YELLOW          = 1;            //set  port pin
BROWN           = 0;            //clear port pin
RED     = 0;            //clear port pin
ORANGE          = 0;            //clear port pin

delay_1sec();           //delay for 1 second

YELLOW          = 0;            //clear port pin
BROWN           = 0;            //clear port pin
RED     = 0;            //clear port pin
ORANGE          = 0;            //clear port pin

delay_5sec();           //delay for 5 seconds

YELLOW          = 0;            //clear port pin
BROWN           = 1;            //set port pin
```

CODE

```
RED      =0;              //clear port pin
ORANGE          =0;              //clear port pin

delay_1sec();             //delay for 1 second

YELLOW          =0;              //clear port pin
BROWN           =0;              //clear port pin
RED      =0;              //clear port pin
ORANGE          =0;              //clear port pin

delay_5sec();             //delay for 5 seconds

YELLOW          =0;              //clear port pin
BROWN           =0;              //clear port pin
RED      =1;              //set port pin
ORANGE          =0;              //clear port pin

delay_1sec();             //delay for 1 second

YELLOW          =0;              //clear port pin
BROWN           =0;              //clear port pin
RED      =0;              //clear port pin
ORANGE          =0;              //clear port pin

delay_5sec();             //delay for 5 seconds

YELLOW          =0;              //clear port pin
BROWN           =0;              //clear port pin
RED      =0;              //clear port pin
ORANGE          =1;              //set port pin

delay_1sec();             //delay for 1 second

YELLOW          =0;              //clear port pin
BROWN           =0;              //clear port pin
RED      =0;              //clear port pin
ORANGE          =0;              //clear port pin

delay_5sec();             //delay for 5 seconds
}
for(j=0;j<6;j++)
{
```

```
ORANGE = 1;          //set port pin
RED = 0;                     //clear port pin
BROWN = 0;           //clear port pin
YELLOW = 0;          //clear port pin

delay_2sec();         //delay for 2 seconds

ORANGE = 0;          //clear port pin
RED = 1;                     //set port pin
BROWN = 0;           //clear port pin
YELLOW = 0;          //clear port pin

delay_2sec();         //delay for 2 seconds

ORANGE = 0;          //clear port pin
RED = 0;                     //clear port pin
BROWN = 1;           //set port pin
YELLOW = 0;          //clear port pin

delay_2sec();         //delay for 2 seconds

ORANGE = 0;          //clear port pin
RED = 0;                     //clear port pin
BROWN = 0;           //clear port pin
YELLOW = 1;          //set port pin

delay_2sec();         //delay for 2 seconds

}
delay_5sec();         //delay for 5 seconds
delay_5sec();         //delay for 5 seconds


}
}

void delay_5sec()
{
unsigned int i;

for(i=0;i<100;i++)
{
```

```
TMOD = 0X01;            //select timer 0 in mode1
TH0 = 0X4B;             //load TH0 value
TL0 = 0XFD;             //loadTL0 value
TR0 = 1;                        //start timer0
while(TF0 == 0);                //wait here till the timer0 overflows
TF0 = 0;                //clear timer0 overflow flag
TR0 = 0;                        //stop timer0
}
}
void delay_2sec()
{
unsigned int i;

for(i=0;i<20;i++)
{
TMOD = 0X01;            //select timer 0 in mode1
TH0 = 0X4B;             //load TH0 value
TL0 = 0XFD;             //loadTL0 value
TR0 = 1;                        //start timer0
while(TF0 == 0);                //wait here till the timer0 overflows
TF0 = 0;                //clear timer0 overflow flag
TR0 = 0;                        //stop timer0
}
}
void delay_1sec()
{
unsigned int i;

for(i=0;i<4;i++)
{
TMOD = 0X01;            //select timer 0 in mode1
TH0 = 0X4B;             //load TH0 value
TL0 = 0XFD;             //loadTL0 value
TR0 = 1;                        //start timer0
while(TF0 == 0);                //wait here till the timer0 overflows
TF0 = 0;                //clear timer0 overflow flag
TR0 = 0;                        //stop timer0
}
}
```

8. HARDWARE TESTING

8.1 CONTINUITY 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.

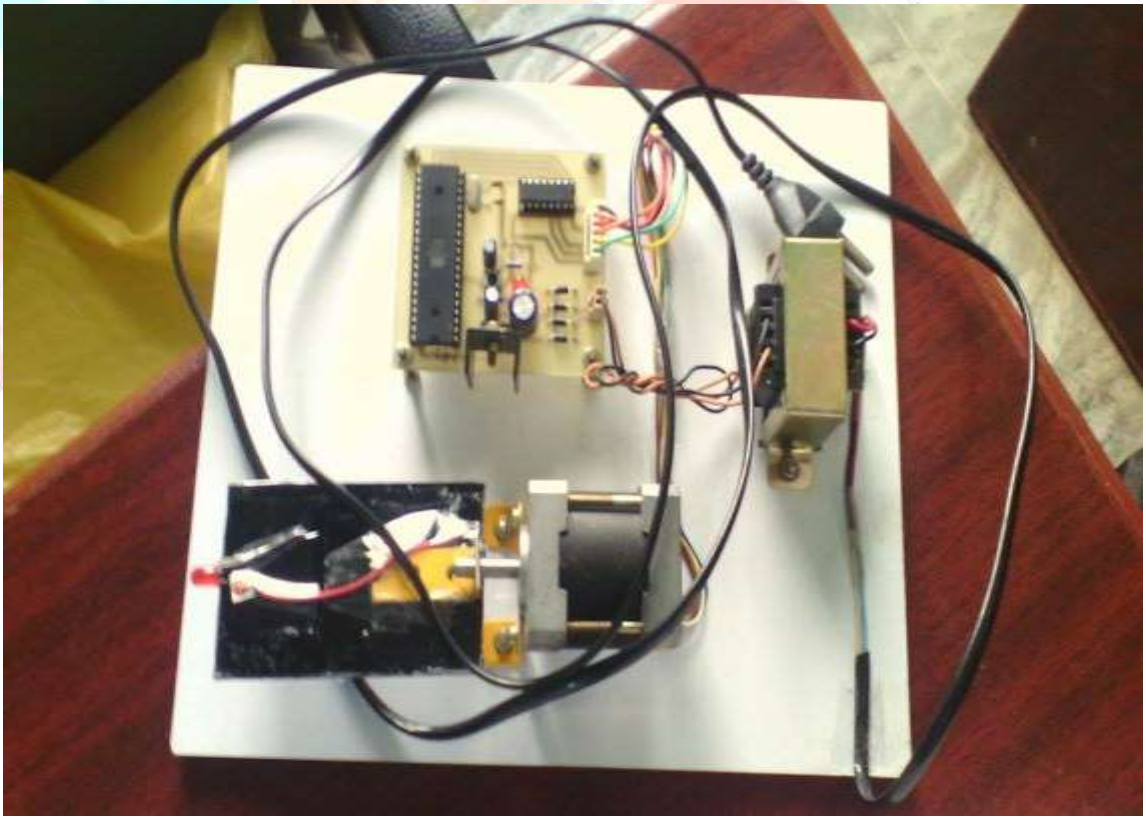
This test is the performed just after the hardware soldering and configuration has been completed. This test aims at finding any electrical open paths in the circuit after the soldering. Many a times, the electrical continuity in the circuit is lost due to improper soldering, wrong and rough handling 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.

8.2 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. Remember that this test is performed without microcontroller. Firstly, we check the output of the transformer, whether we get the required 12 v AC voltage.

Then we apply this voltage to the power supply circuit. Note that we do this test without microcontroller because if there is any excessive voltage, this may lead to damaging the controller. We check for the input to the voltage regulator i.e., are we getting an input of 12v and an output of 5v. This 5v output is given to the microcontrollers' 40th pin. Hence we check for the voltage level at 40th pin. Similarly, we check for the other terminals for the required voltage. In this way we can assure that the voltage at all the terminals is as per the requirement.

PROTOTYPE KIT:



8.2 Prototype kit

8.3 CALCULATION:

The values are taken from NASA data

Surface temperature of the sun=5600 K,

The distance from the earth=15×10^{10}m,
The diameter of the sun=1.4810^{9}m,
The earth diameter with in sun diameter=12.8×10^{6}m,
The energy loss through atmosphere=85%,
Energy radiated by the sun=$Q_s=E\times b\times A\times T^4$
Where,
E=1,
b=block body radiation co-efficient=$5.67\times10^{-8}W/m^2$
T=surface temperature=5600 K,
A=surface area=$4\times\pi r^2$
$Q_s=E\times b\times A\times T^4$
$=1\times (5.67\times10^{-8}) \times 4\pi\times (0.7\times10^{9})^2 \times5600^4$
$=3.43\times10^{26}$ W
Radiation energy received by the earth (Q_e) =Q_s/A_m
Where,
A_m=mean surface area between sun and earth
$=4\pi\times (15\times10^{10})^2$
There fore
$Q_e =3.43\times10^{26}/ (4\pi\times (15\times10^{10})^2)$
$=1.23\times10^{3}W/m^2$
Direct radiation reaching the earth= $(1-(85/100)) \times1.23\times10^3$
E_{rd} =181.952 W/m^2
Area of photo voltaic plate =0.01512×0.02268
=$0.03375m^2$
Energy received by plate without sun tracking system $E = E_{rd} \times A \cos\theta$
=181.952×0.03375(cos 35)
=5.030 W

Energy received by plate with sun tracking system:
Since the angle of solar rays to vertical plate is $\theta=0^0$
There fore
$E=E_{rd}\times A \cos\theta$
$=181.95\times0.03375\times\cos\theta$
=6.1408 W
Increase in power received by plate=6.1408-5.030
=1.1108 W
Increase in efficiency= (1.1108/5.030)×100
=22%

Advantages:

1. Generating up to 100% Hot water free.
2. Safe, clean and simple.
3. Raise the value of your home.
4. Saving up to 1 tone of CO_2 per year.
5. 20 year panel warranty.
6. 35^+ year life expectancy.
7. Non dependable.
8. No transmission and distribution losses.
9. No fossil fuels.
10. Eco friendly.
11. Low operating and maintenance cost.

Applications:

1. Street light applications without using normal power supplies.
2. Signaling system.

3. In remote areas implementing a small power system unit at each home.
4. Using this system to getting hot water

CONCLUSION

The project "AUTOMATIC SUN TRACKING SYSTEM WITH PHOTO VOLTAIC PLATE TO IMPROVE THE EFFICIENCY OF SOLAR POWER GENERATION" has been successfully designed and tested. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

The Automatic Sun Tracking System has an extensive range of solar energy systems with advanced design capabilities and world leading manufacturing; suitable for a wide range of uses, from heating swimming pools and homes to larger commercial installations such as sports stadiums and industrial complexes.

Finally we conclude that AUTOMATIC SUN TRACKING SYSTEM WITH PHOTO VOLTAIC PLATE TO IMPROVE THE EFFICIENCY OF SOLAR POWER GENERATION is an emerging field and there efficiency is increased up to 22%.

REFERENCES

The 8051 Micro controller and Embedded Systems
- MAHUMMAD ALI MAZIDIJANCICE GILLISPIE MAZIDI

The 8051 Micro controller Architecture,
Programming & Applications
- KENNETH J.AYALA

Electronic Components
- D.V.PRASAD

An Introduction to Power plant technology
- G.D.RAI

A C**ourse in Power plant engineering**
- ARORA&DOMAKUNDWAR

Power plant Technology
- M.M.EL_ WAKIL

A course in heat and Mass Transfer
- ARORA&DOMAKUNDWAR

Essential of Heat Transfer
- CHRISTOPHER ALONG

Heat and Mass Transfer
- D.S. KUMAR

A journal of Electronics today
- Feb 2010 Vol 42

MANORAMA year book – 2009

A text book of Refrigeration & Air conditioning
- ARORA&DOMAKUNDWAR

References on the Web:
www.national.com
www.atmel.com
www.microsoftsearch.com
www.geocities.com