

**A MAJOR PROJECT REPORT ON**  
**STREET LIGHTS THAT GLOW ON DETECTING VEHICLE**  
**MOVEMENT**

*Submitted in partial fulfillment of the requirements  
For the award of the degree*

**BACHELOR OF TECHNOLOGY**

**IN**

**ELECTRONICS AND COMMUNICATION ENGINEERING**



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### **CERTIFICATE**

This is to certify that the project work titled “Development Of a Cell Phone Based Vehicle Remote Control System” that is being submitted by “N.SANTHOSH KUMAR (13E11A04C7), B.AKHIL KUMAR (13E11A0498), J.ROHITH (13E11A04C4)” is in partial fulfillment of the requirements for the award of BACHELOR OF TECHNOLOGY /DEGREE, is a record of Bonafide work under my/our guidance. The concept of this project work, in full or in parts, have neither been taken from any other source nor have been submitted to any other Institute or university for award of any degree or diploma and the same is certified.

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**HOD**

**This project work is satisfactory / unsatisfactory**

**Internal examiner**

**External examiner**

## **DECLARATION**

We, the undersigned, declare that the project entitled '**STREET LIGHTS THAT GLOW ON DETECTING VEHICLE MOVEMENT**', being submitted in partial fulfillment for the award of Bachelor of Engineering Degree in BHARAT ENGINEERING AND TECHNOLOGY, affiliated to JNTU University, is the work carried out by us.

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## **ABSTRACT**

- Generally, street lights are switched on for whole night and during the day, they are switched off. But during the night time, street lights are not necessary if there is no traffic. Saving of this energy is very important factor these days as energy resources are getting reduced day by day. Alternatives for natural resources are very less and our next generations may face lot of problems because of lack of these natural resources. This abstract describes about the circuit that switches the street lights on detecting vehicle movement and remains off after fixed time.

### **Principle behind this Circuit:**

The proposed system consists of At89S52 microcontroller, LDR, LED'S, RECEIVER and TRANSMITTER. This system controls the street lights using light dependent resistor. Street lights are switched on depending on the intensity of the Sun light on LDR. If the intensity of Sunlight on light dependent resistor is low, its resistance value is high. This value increases and becomes high when it is completely in dark. This resistance value decides when the street lights are required to switch ON. As the resistance value is maximum in the nights, this project comes into the play. The lights maintain minimum intensity without completely switching OFF. Whenever a vehicle comes between transmitter and receiver the signal between them is broken and it just indicates the microcontroller to switch on the street lights. Then lights are switched on to maximum intensity.

## **ACKNOWLEDGEMENT**

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mentioning of the people whose constant guidance and encouragement made it possible. We take pleasure in presenting before you, our project, which is result of studied blend of both research and knowledge.

We express our earnest gratitude to our internal guide, Assistant Professor BASVARAJ, Department of ECE, our project guide, for his constant support, encouragement and guidance. We are grateful for his cooperation and his valuable suggestions.

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# **1. INTRODUCTION TO EMBEDDED SYSTEMS**

## **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.

## SYSTEM DESIGN CALLS:

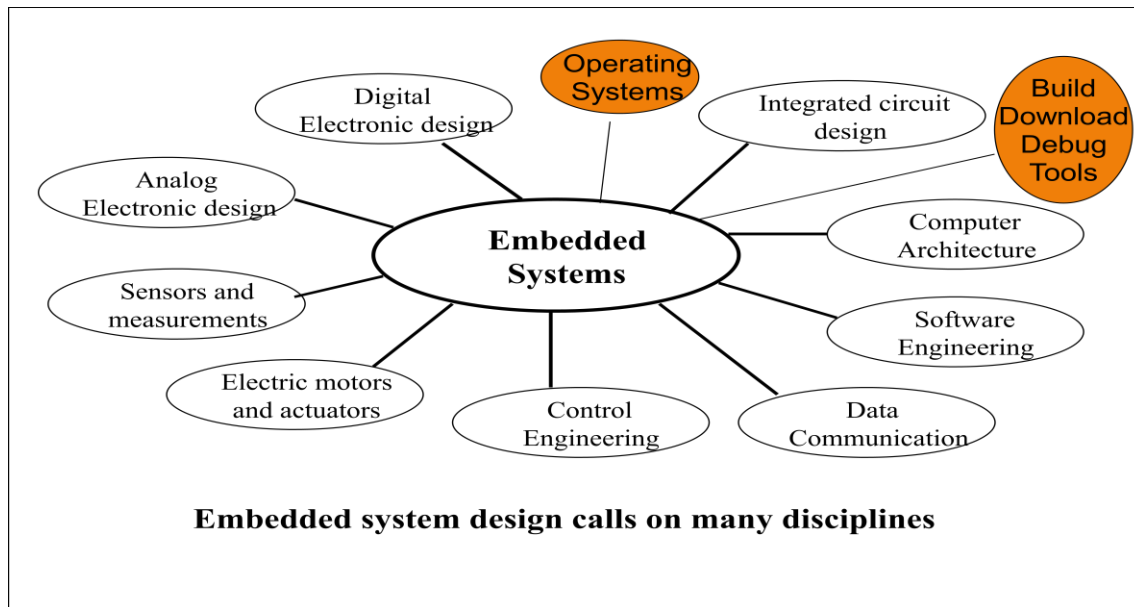


Fig:3.1(a) SYSTEM DESIGN CALLS

## EMBEDDED SYSTEM DESIGN CYCLE

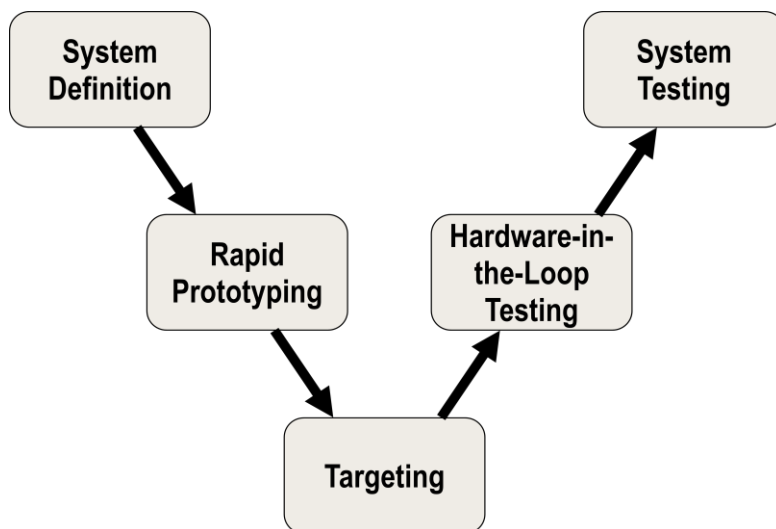


Figure 3.1(b) “V Diagram”

## 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.

## **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.

## **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

### **RTS CLASSIFICATION**

- Hard Real Time Systems
- Soft Real Time System

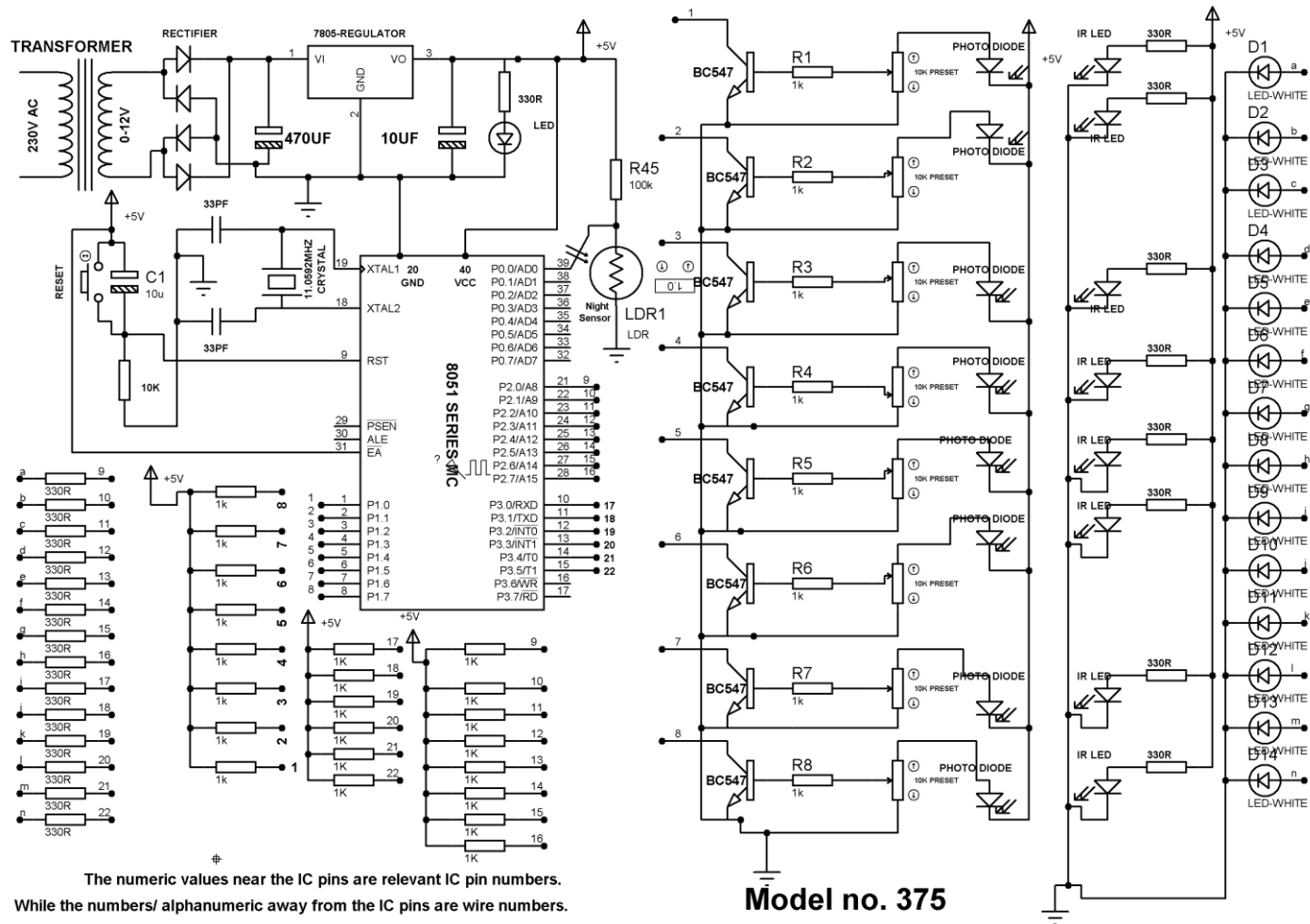
### **HARD REAL TIME SYSTEM**

- "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 constraints on "lateness" but still must operate very quickly and repeatably.

## 2. BLOCK DIAGRAM



### **3. HARDWARE REQUIREMENTS**

#### **HARDWARE COMPONENTS**

1. TRANSFORMER (230 – 12 V AC)
2. VOLTAGE REGULATOR (LM 7805)
3. RECTIFIER
4. FILTER
5. MICROCONTROLLER (AT89S52/AT89C51)
6. IR LED
7. PHOTODIODES
8. BC547
9. LED
10. 1N4007
11. RESISTORS
12. CAPACITORS

### **3.1 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 4.1: A TYPICAL TRANSFORMER

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

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

$$\text{TURNS RATIO} = (V_P / V_S) = (N_P / N_S)$$

Where,

$V_P$  = primary (input) voltage.

$V_S$  = secondary (output) voltage

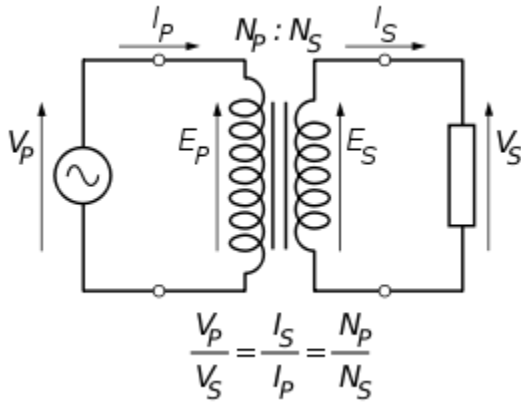
$N_P$  = number of turns on primary coil

$N_S$  = number of turns on secondary coil

$I_P$  = primary (input) current

$I_S$  = secondary (output) current.

## Ideal power equation



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

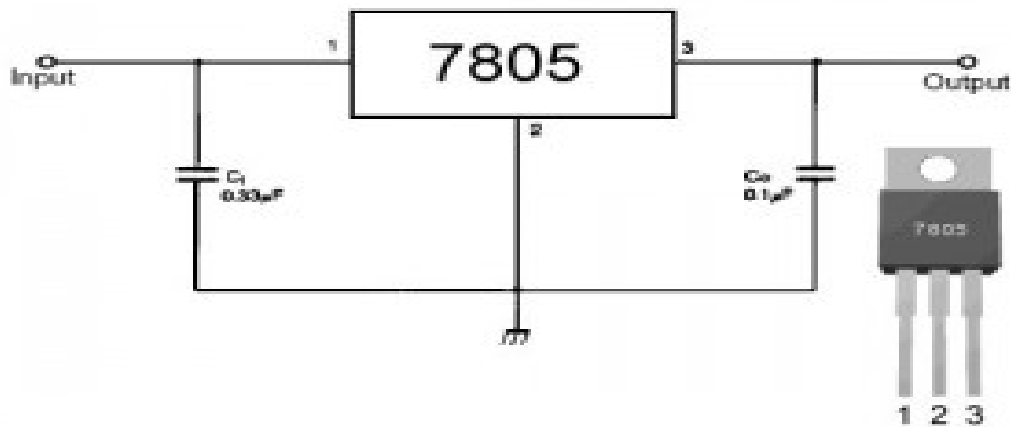


impedance of  $(N_p/N_s)^2 Z_s$ . This relationship is reciprocal, so that the impedance  $Z_p$  of the primary circuit appears to the secondary to be  $(N_s/N_p)^2 Z_p$ .

### **3.2 VOLTAGE REGULATOR 7805**

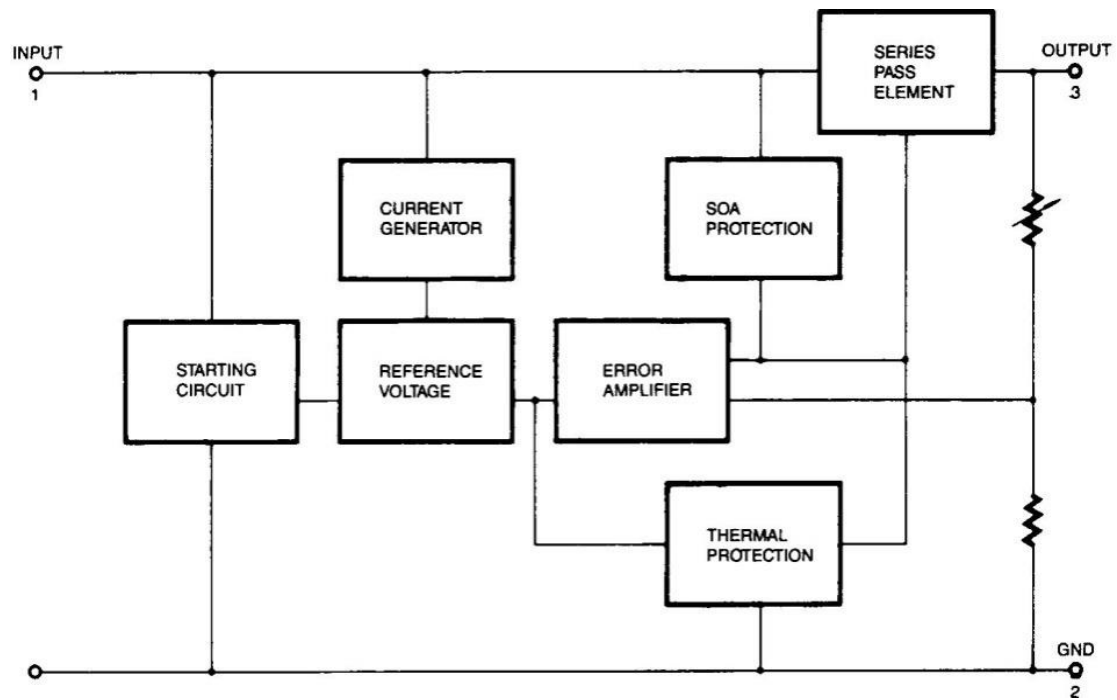
#### **Features**

- 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.



#### **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 4.2(a): BLOCK DIAGRAM OF VOLTAGE REGULATOR

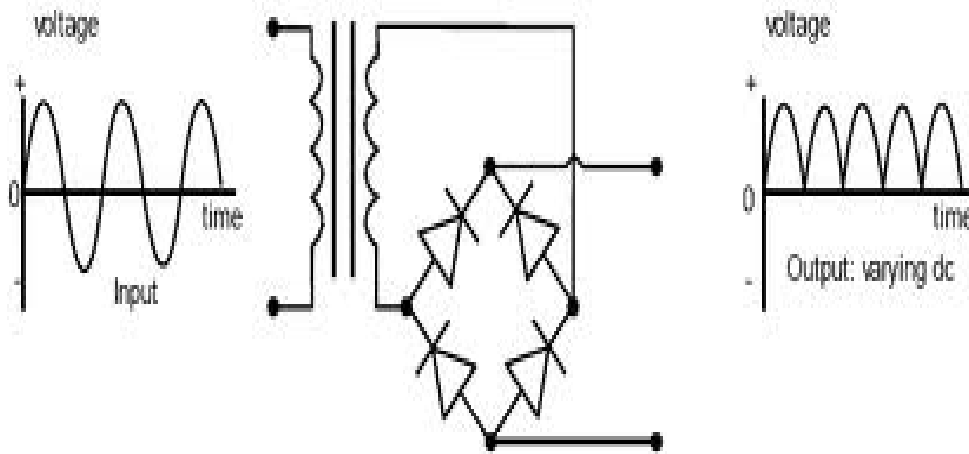
### Absolute Maximum Ratings

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

TABLE 4.2(b): RATINGS OF THE VOLTAGE REGULATOR

## 3.3 RECTIFIER

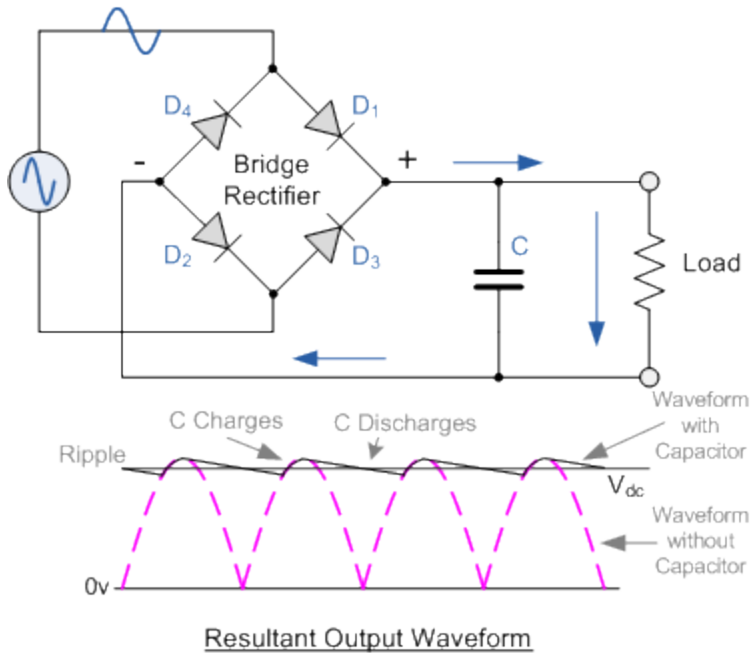
A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), current that flows in only one direction, a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of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



### **3.4 FILTER**

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

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



### **3.5 MICROCONTROLLER AT89S52**

#### **Introduction:**

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

## Block Diagram of AT89S52:

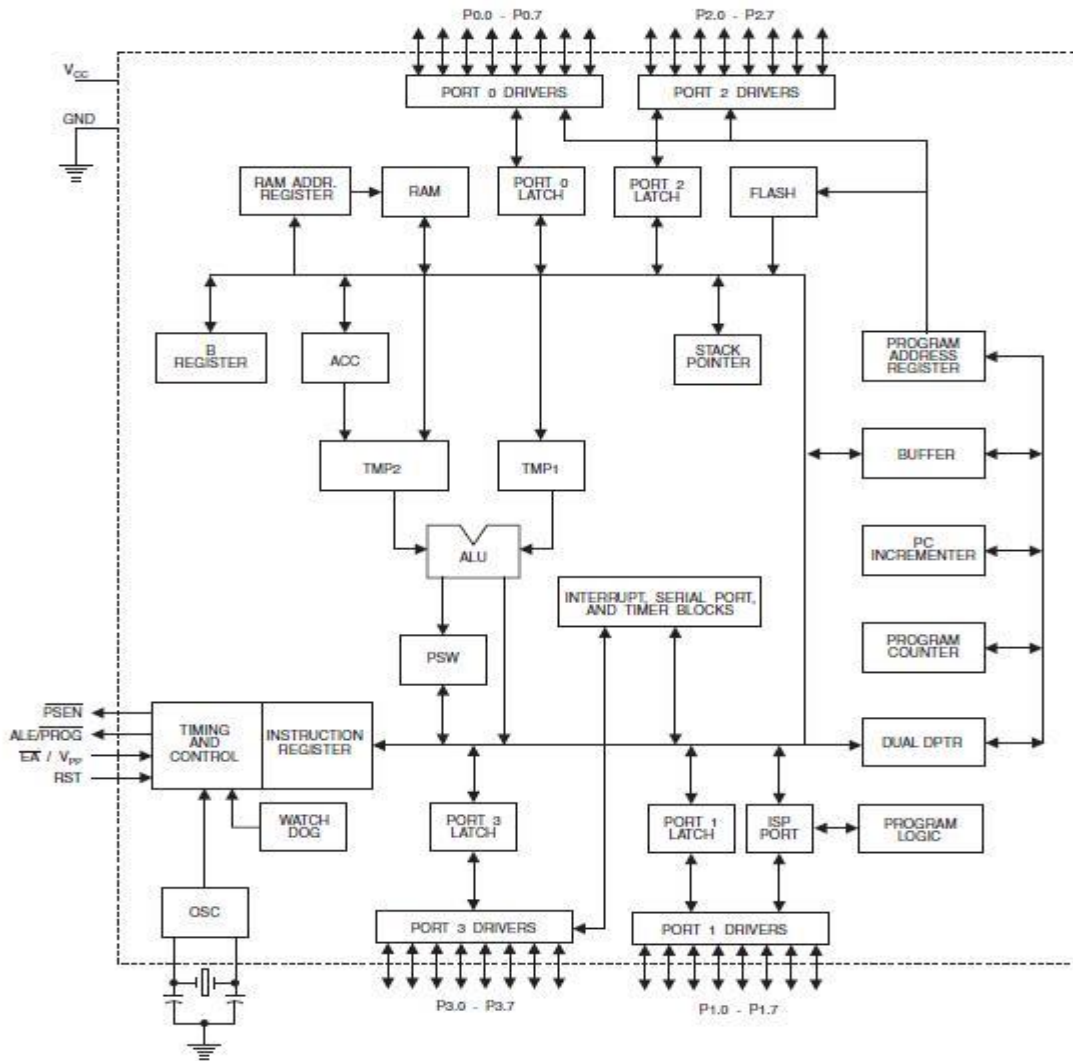


FIG 4.3(a): BLOCK DIAGRAM OF AT89S52

## Pin Configurations of AT89S52

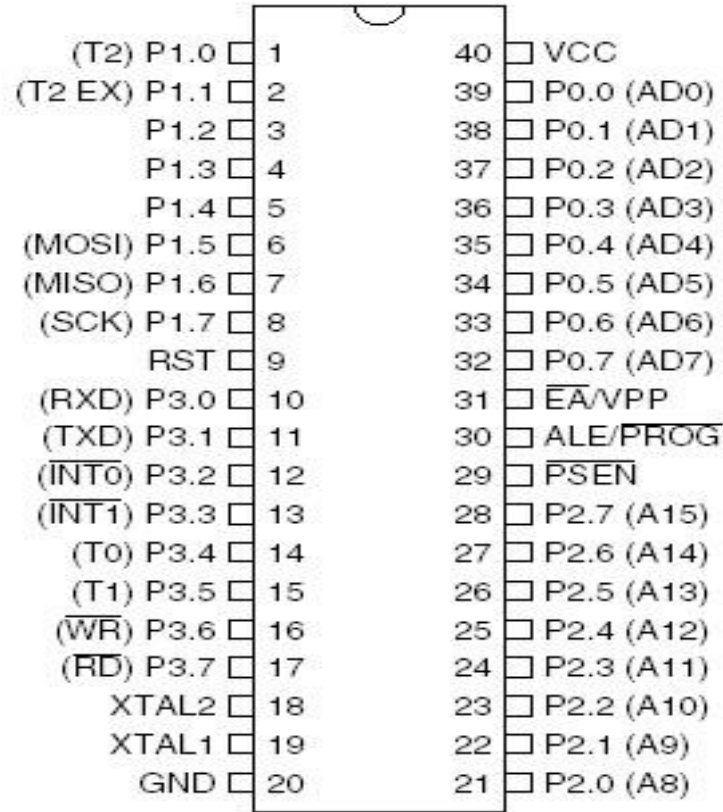


Figure taken from a datasheet provided by ATMEL™

FIG 4.3(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.

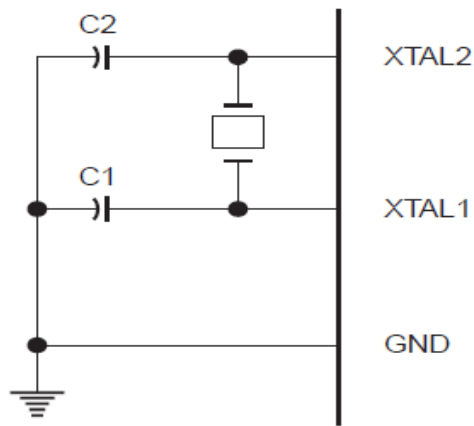


FIG 4.3(c): Oscillator Connections

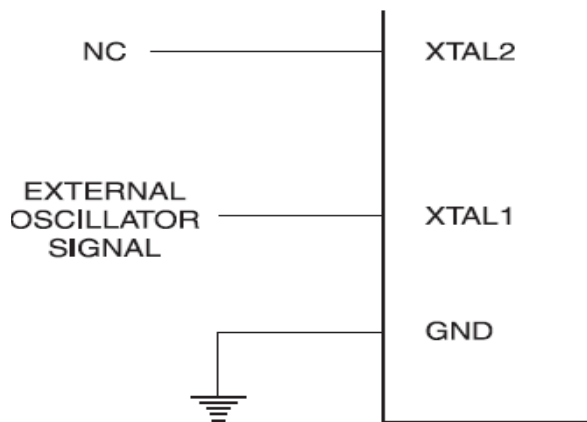


FIG 4.3(d): External Clock Drive Configuration

### **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.

## **3.6 IR LED**

An IR LED, also known as IR transmitter, is a special purpose LED that transmits infrared rays in the range of 760 nm wavelength. Such LEDs are usually made of gallium arsenide or aluminum gallium arsenide. They, along with IR receivers, are commonly used as sensors.

The appearance is same as a common LED. Since the human eye cannot see the infrared radiations, it is not possible for a person to identify whether the IR LED is working or not, unlike a common LED. To overcome this problem, the camera on a cell phone can be used. The camera can show us the IR rays being emanated from the IR LED in a circuit.



## Features

- Extra high radiant power
- low forward voltage
- suitable for high pulse current operation intensity
- high reliability

## Chip Materials

- Dice Material : GaAlAs/GaAs
- Lens Color : Water Clear

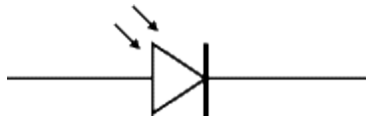
## Difference between white LED and IR LED

There are a couple key differences in the electrical characteristics of infrared LEDs versus visible light LEDs. Infrared LEDs have a lower forward voltage, and a higher rated current compared to visible LEDs. This is due to differences in the material properties of the junction. A typical drive current for an infrared LED can be as high as 50 milliamps, so dropping in a visible LED as a replacement for an infrared LED could be a problem with some circuit designs.

IR LEDs aren't rated in millicandelas, since their output isn't visible (and candelas measure light in a way weighted to the peak of the visible spectrum). They are usually rated in milliwatts, and conversions to candelas aren't especially meaningful.

## **3.7 PHOTODIODES**

A photodiode is a type of photo detector capable of converting light into either current or voltage, depending upon the mode of operation. Photodiodes are similar to regular semiconductor diodes except that they may be either exposed (to detect vacuum UV or X-rays) or packaged with a window or optical fibre connection to allow light to reach the sensitive part of the device. Many diodes designed for use specifically as a photodiode will also use a PIN junction rather than the typical PN junction.



## **Principle of operation**

A photodiode is a PN junction or PIN structure. When a photon of sufficient energy strikes the diode, it excites an electron, thereby creating a mobile electron and a positively charged electron hole. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in field of the depletion region. Thus holes move toward the anode, and electrons toward the cathode, and a photocurrent is produced.

## **Photovoltaic mode**

When used in zero bias or photovoltaic mode, the flow of photocurrent out of the device is restricted and a voltage builds up. The diode becomes forward biased and "dark current" begins to flow across the junction in the direction opposite to the photocurrent. This mode is responsible for the photovoltaic effect, which is the basis for solar cells—in fact, a solar cell is just a large area photodiode.

## **Photoconductive mode**

In this mode the diode is often reverse biased, dramatically reducing the response time at the expense of increased noise. This increases the width of the depletion layer, which decreases the junction's capacitance resulting in faster response times. The reverse bias induces only a small amount of current (known as saturation or back current) along its direction while the photocurrent remains virtually the same. The photocurrent is linearly proportional to the luminance

Although this mode is faster, the photoconductive mode tends to exhibit more electronic noise. The leakage current of a good PIN diode is so low ( $< 1\text{nA}$ ) that the Johnson–Nyquist noise of the load resistance in a typical circuit often dominates.

### **3.8 LED'S**

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 4.2.4(a): Typical LED

Fig 4.2.4(b): circuit symbol

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

#### **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.

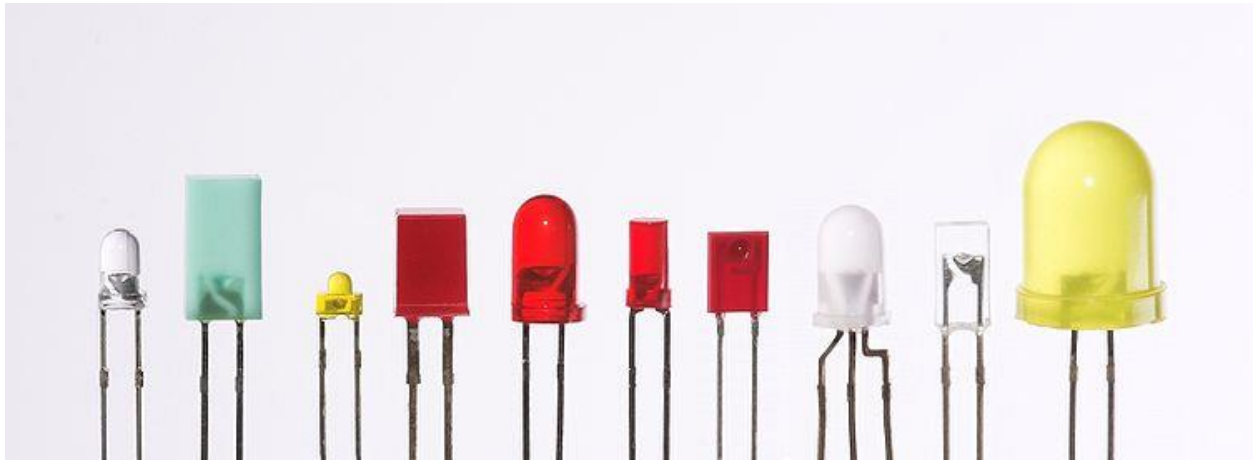


Fig 4.2.4(c) Different types of LED'S

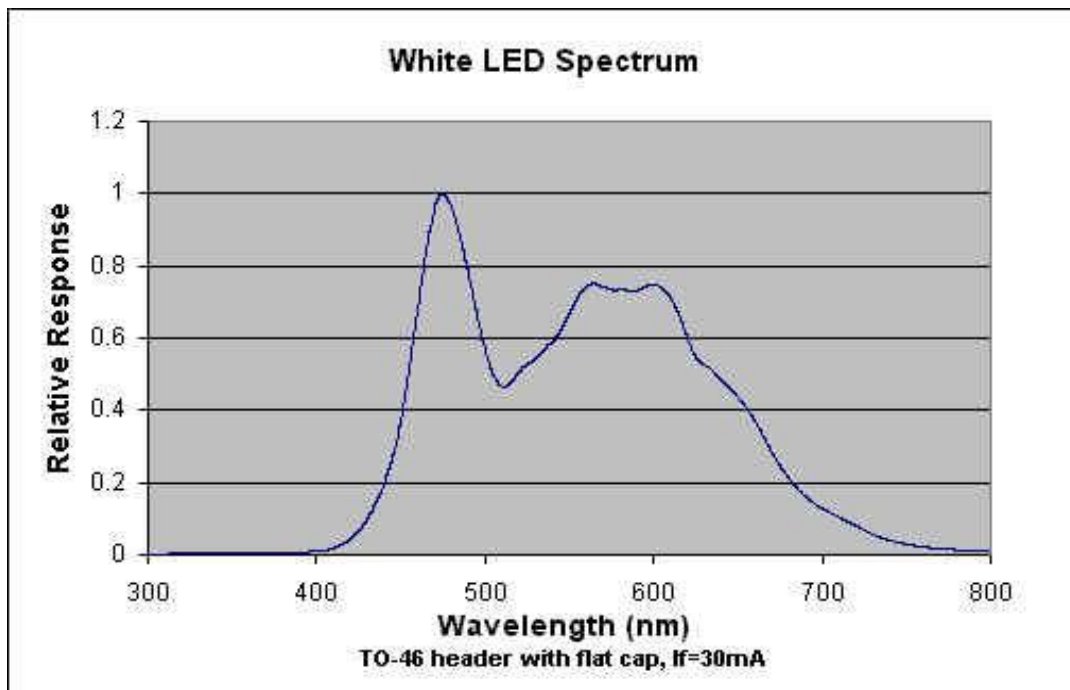
### **White LED'S**

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

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

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





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

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

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

## **Advantages of using LEDs**

- **Efficiency:**

LEDs produce more light per watt than incandescent bulbs; this is useful in battery powered or energy-saving devices.

- **Size:**

LEDs can be very small (smaller than 2 mm<sup>2</sup>) and are easily populated onto printed circuit boards.

- **On/Off time:**

LEDs light up very quickly. A typical red indicator LED will achieve full brightness in microseconds. LEDs used in communications devices can have even faster response times.

- **Cycling:**

LEDs are ideal for use in applications that are subject to frequent on-off cycling, unlike fluorescent lamps that burn out more quickly when cycled frequently, or HID lamps that require a long time before restarting.

- **Cool light:**

In contrast to most light sources, LEDs radiate very little heat in the form of IR that can cause damage to sensitive objects or fabrics. Wasted energy is dispersed as heat through the base of the LED.

- **Lifetime:**

LEDs can have a relatively long useful life. One report estimates 35,000 to 50,000 hours of useful life, though time to complete failure may be longer.

- **No Toxicity:**

LEDs do not contain mercury, unlike fluorescent lamps.

### **Disadvantages of using LEDs**

- **High price:**

LEDs are currently more expensive, price per lumen, on an initial capital cost basis, than most conventional lighting technologies.

- **Temperature dependence:**

LED performance largely depends on the ambient temperature of the operating environment. Over-driving the LED in high ambient temperatures may result in overheating of the LED package, eventually leading to device failure.

- **Voltage sensitivity:**

LEDs must be supplied with the voltage above the threshold and a current below the rating. This can involve series resistors or current-regulated power supplies.

- **Area light source:**

LEDs do not approximate a “point source” of light, but rather a lambertian distribution. So LEDs are difficult to use in applications requiring a spherical light field. LEDs are not capable of providing divergence below a few degrees. This is contrasted with lasers, which can produce beams with divergences of 0.2 degrees or less.

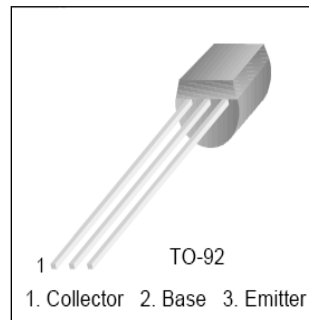
- **Blue Hazard:**

There is increasing concern that blue LEDs and cool-white LEDs are now capable of exceeding safe limits of the so-called blue-light hazard as defined in eye safety.

### **3.9BC547**

#### **TECHNICAL SPECIFICATIONS:**

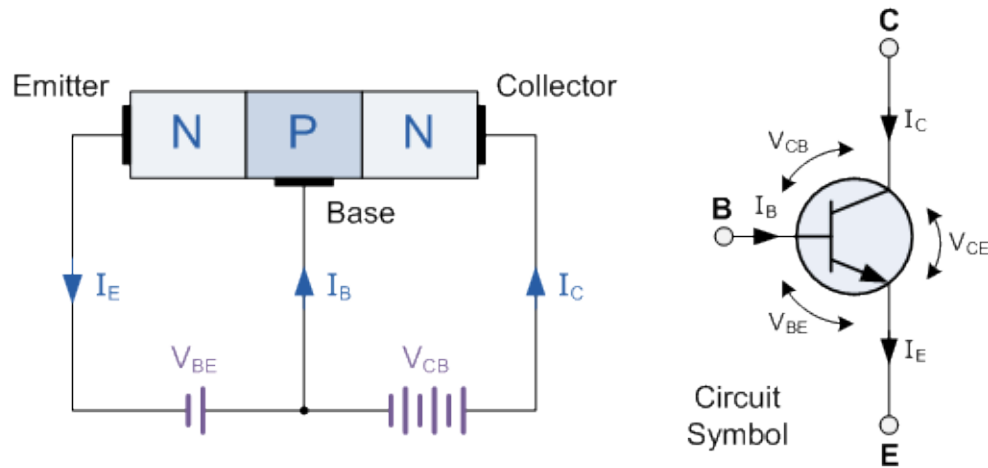
The BC547 transistor is an NPN Epitaxial Silicon Transistor. The BC547 transistor is a general-purpose transistor in small plastic packages. It is used in general-purpose switching and amplification BC847/BC547 series 45 V, 100 mA NPN general-purpose transistors.



**BC 547 TRANSISTOR PINOUTS**

We know that the transistor is a "CURRENT" operated device and that a large current ( $I_c$ ) flows freely through the device between the collector and the emitter terminals. However, this only happens when a small biasing current ( $I_b$ ) is flowing into the base terminal of the transistor thus allowing the base to act as a sort of current control input. The ratio of these two currents ( $I_c/I_b$ ) is called the DC Current Gain of the device and is given the symbol of  $h_{fe}$  or nowadays Beta, ( $\beta$ ). Beta has no units as it is a ratio. Also, the current gain from the emitter to the collector terminal,  $I_c/I_e$ , is called Alpha, ( $\alpha$ ), and is a function of the transistor itself. As the emitter current  $I_e$  is the product of a very small base current to a very large collector current the value of this parameter  $\alpha$  is very close to unity, and for a typical low-power signal transistor this value ranges from about 0.950 to 0.999.

## An NPN Transistor Configuration



### 3.101N4007

Diodes are used to convert AC into DC these are used as half wave rectifier or full wave rectifier. Three points must be 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 BY125 made 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.

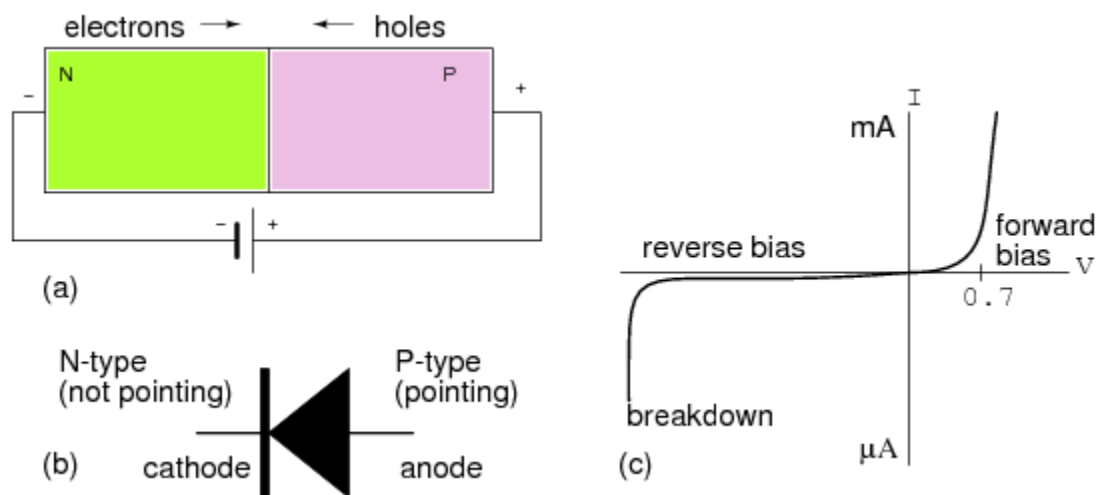


Fig:PN Junction diode

## **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.

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

## Units

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

## **VARIABLE RESISTORS**

### **Adjustable resistors**

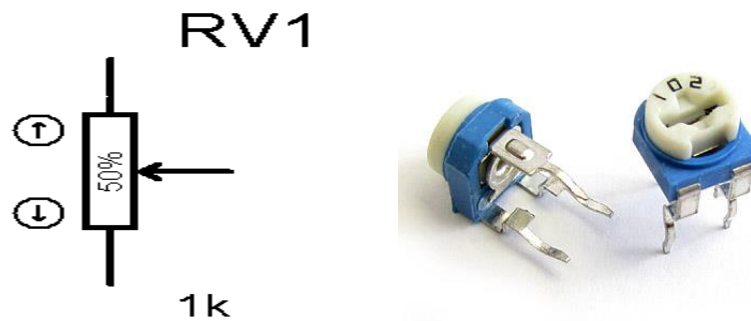
A resistor may have one or more fixed tapping points so that the resistance can be changed by moving the connecting wires to different terminals. Some wire wound power resistors have a tapping point that can slide along the resistance element, allowing a larger or smaller part of the resistance to be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

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

### **Potentiometer**

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

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



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

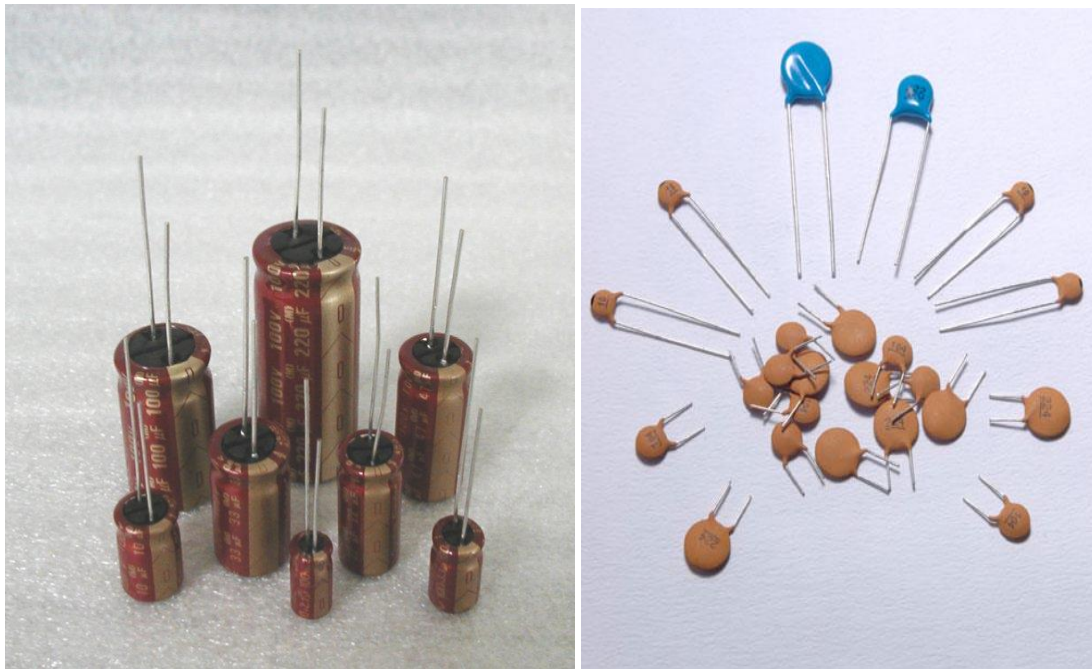
### **3.12 CAPACITORS**

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.

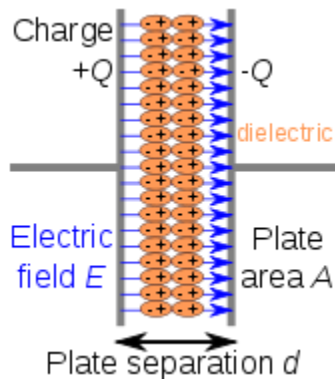
A capacitor is a passive electronic component consisting of a pair of conductors separated by a dielectric (insulator). When there is a potential difference (voltage) across the conductors, a static electric field develops in the dielectric that stores energy and produces a mechanical force between the conductors. An ideal capacitor is characterized by a single constant value,

capacitance, measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them.

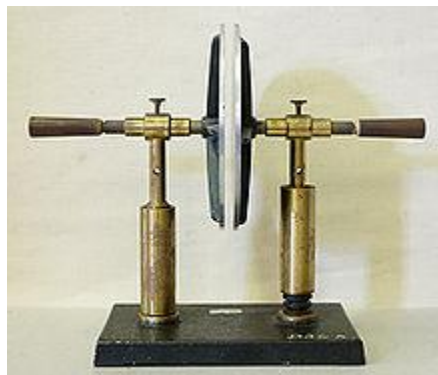
The capacitance is greatest when there is a narrow separation between large areas of conductor, hence capacitor conductors are often called "plates", referring to an early means of construction. In practice the dielectric between the plates passes a small amount of leakage current and also has an electric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

## 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 simple demonstration of a parallel-plate capacitor

A capacitor consists of two conductors separated by a non-conductive region. The non-conductive region is called the dielectric or sometimes the dielectric medium. In simpler terms,

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

The capacitor is a reasonably general model for electric fields within electric circuits. An ideal capacitor is wholly characterized by a constant capacitance  $C$ , defined as the ratio of charge  $\pm Q$  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:

$$C = \frac{dq}{dv}$$

### **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:

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

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

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

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

$$i(t) = \frac{dq(t)}{dt} = C \frac{dv(t)}{dt}$$

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.

## **4. SOFTWARE REQUIREMENTS**

### **4.1 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  $\mu$ Vision 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.

### **4.2 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. Now as compilers translate source code into object code, which is unique for each type of computer, many compilers are available for the same language.

### **4.3 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.

### **4.4 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.

## **4.5 Building an Application in $\mu$ Vision2**

To build (compile, assemble, and link) an application in  $\mu$ Vision2, you must:

1. Select Project -(forexample,166\EXAMPLES\HELLO\HELLO.UV2).
2. Select Project - Rebuild all target files or Build target. $\mu$ Vision2 compiles, assembles, and links the files in your project.

## **4.6 Creating Your Own Application in $\mu$ Vision2**

To create a new project in  $\mu$ Vision2, you must:

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

## **4.7 Debugging an Application in $\mu$ Vision2**

To debug an application created using  $\mu$ Vision2, 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.

## **4.8 Starting $\mu$ Vision2 and Creating a Project**

$\mu$ Vision2 is a standard Windows application and started by clicking on the program icon. To create a new project file select from the  $\mu$ Vision2 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.  $\mu$ Vision2 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.

## **4.9 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  $\mu$ Vision2 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.

## **4.10 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,  $\mu$ Vision2 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  $\mu$ Vision2 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.  $\mu$ Vision2 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.

## 4.11 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.

## 4.12 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.

## 4.13 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.

## 4.14 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.

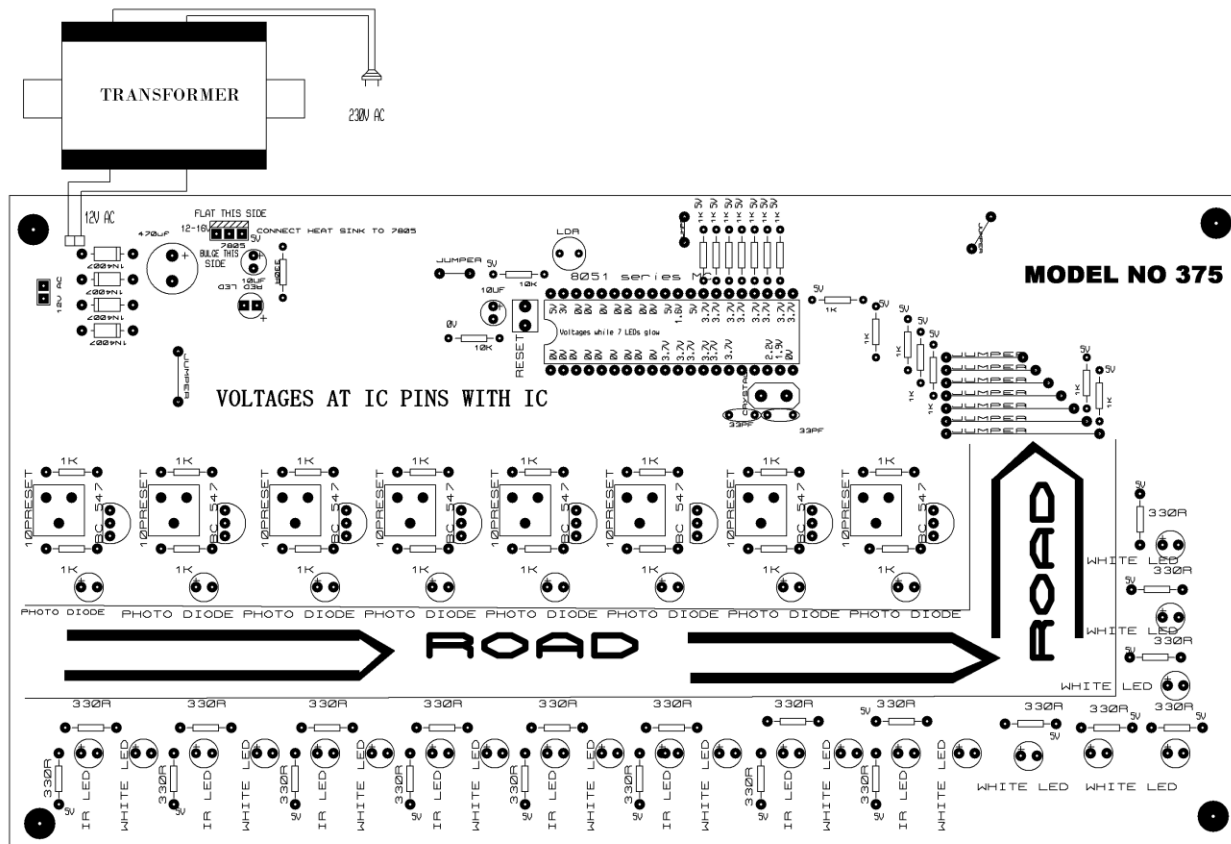
The Keil  $\mu$ Vision Debugger accurately simulates on-chip peripherals (I<sup>2</sup>C, CAN, UART, SPI, Interrupts, I/O Ports, A/D Converter, D/A Converter, and PWM Modules) of your 8051 device. Simulation helps you understand hardware configurations and avoids time wasted on setup problems. Additionally,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

## 4.15 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.

## 5. SCHEMATIC DIAGRAM



## 5.1 SCHEMATIC EXPLANATION

## POWER SUPPLY

The circuit uses standard power supply comprising of a step-down transformer from 230V to 12V and 4 diodes forming a bridge rectifier that delivers pulsating dc which is then filtered by an electrolytic capacitor of about 470 $\mu$ F to 1000 $\mu$ F. 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 10 $\mu$ F for any noise so generated by the circuit. One LED is connected of this 5V point in series with a current limiting resistor of 330 $\Omega$  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 an reset 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 10 $\mu$ F capacitor and a 10k $\Omega$  resistor would render a 100ms time to pin number 9 from logic high to low, there after the pin number 9 remains low.

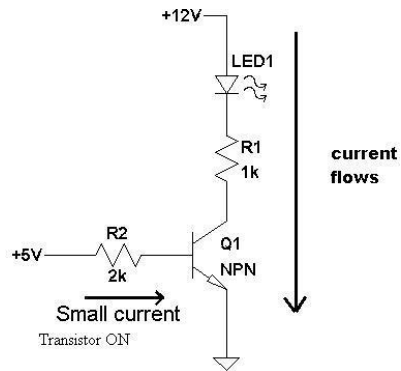
## **External Access(EA):**

Pin no 31 of 40 pin 8051 microcontroller termed as EA<sup>-</sup> is required to be connected to 5V for accessing the program from 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.

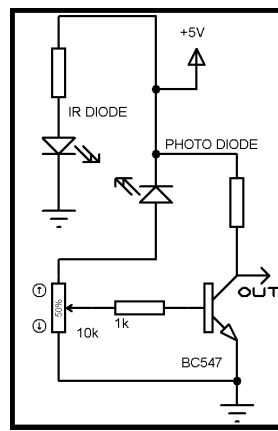
## **BRIEF DESCRIPTION OF TRANSISOR ACTING AS SWITCH**

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. Whenever base is high, then current

starts flowing through base and emitter and after that only current will pass from collector to emitter.



### **BRIEF DESCRIPTION OF IR & PHOTO DIODE SENSING SWITCH**



IR diode is connected through a resistance to the dc supply. A photo diode is connected in reverse biased condition through a potential divider of a 10k variable resistance and 1k in series to the base of the transistor. While the IR rays fall on the reverse biased photo diode it conducts

that causes a voltage at the base of the transistor. The transistor then works like a switch while the collector goes to ground. Once the IR rays are obstructed the driving voltage is not available to the transistor thus its collector goes high. This low to high logic can be used for the microcontroller input for any action as per the program.

## **OPERATION EXPLANATION**

### **Microcontroller and connections:**

The microcontroller used is AT89S52. The 40th pin of the IC is given a 5v power supply. Pins 18 & 19 of the IC are used to connect crystal to the microcontroller. Pin 9 of the IC is the reset pin which is connected to a mechanical switch. Using the mechanical switch we can externally restart the whole project. The pin 31 of the IC is driven HIGH to show that port0 and port2 are being used for data transfer. Pin 39 of the IC is connected to another switch. The function the switch is to toggle the circuit between the two modes.

All the ports of this microcontroller can be used for both inputs and outputs. In our project we are using port 1 as input port and port 2 and port 3 as output ports. 20th pin of the microcontroller is connected to ground. The inputs to the port1 are from the highway model sensors via transistor switches. The outputs from port2 and port3 are given to the streetlights present in the highway model. Since we want an output of 14 LEDs, pins from entire port2 and first six pins of port3 are being used. The port0.0 pin is used to switch the output from dark mode to dim mode.

### **Circuit working:**

The highway model consists of 14 led's as streetlights and 8 pairs of photodiodes-IR diodes used as sensors, variable resistors and transistors which acts as switch as explained above.

The IR diodes are placed on one side of the road and photodiodes are placed on the other side of the road, directly facing the IR diodes.

Consider the case when there is no vehicle on the highway. In this case, the IR radiation emitted from the IR diode directly falls on the photodiode which is exactly opposite to it. This causes the photodiode to fall in conduction state. This implies that photodiode conducts and current passes through it. The current passes through the photodiode and goes through the variable resistor and the base-emitter region of the transistor. This in turn connects the collector of the transistor to the emitter. From the circuit diagram we can see that emitter is connected to ground which implies that the collector also goes to the ground. The collector region of the transistor is connected to the port 1 (input port) which in turn goes to ground i.e., logic ZERO. So, to summarize we can say that, when there is no vehicle on the highway, then all the inputs to the microcontroller port 1 is ZERO.

Consider the case when a vehicle obstructs the IR radiation path. In this case, IR radiation is blocked and hence it does not fall on the photodiode. This in turn implies that photodiode doesn't conduct. Hence there is no current flowing through this first transistor. So, the collector is at HIGH state. Let us assume that the first Photodiode-IR diode pair IR path is obstructed. This leads to a transition from ZERO to HIGH at P1.0 pin.

The microcontroller is programmed in such a way that, whenever the pin P1.0 goes high, then a window of seven led lights ahead from the vehicle glows. In other words, the respective pins of port 2 and port 3 go HIGH. This process goes on i.e., as the vehicle moves forward, the street lights ahead of it glows and the trailing lights goes back to its original off state.

There are two basic modes of operation,

1. Transition of streetlights from dim to bright state.
2. Transition of streetlights from dark to bright state.

1. In the first mode of operation, initially when the vehicle is not sensed, all the streetlights will be in dim state. This is achieved by use of pulse width modulation technique through the program stored in the microcontroller. When a vehicle is not present on the highway, then the streetlights are made to glow for about 1ms and then for 100ms they are switched off. Thus, we get streetlights with less brightness. When a vehicle is sensed, all the streetlights are illuminated for 1ms and the window of streetlights are illuminated for 100ms. Thus we have a PWM wave of 99% duty cycle for those seven led's.

2. In the second mode of operation, when the vehicle is not present, all the streetlights will be in dark state. When a vehicle is sensed then the window of streetlights is illuminated in front of the vehicle.

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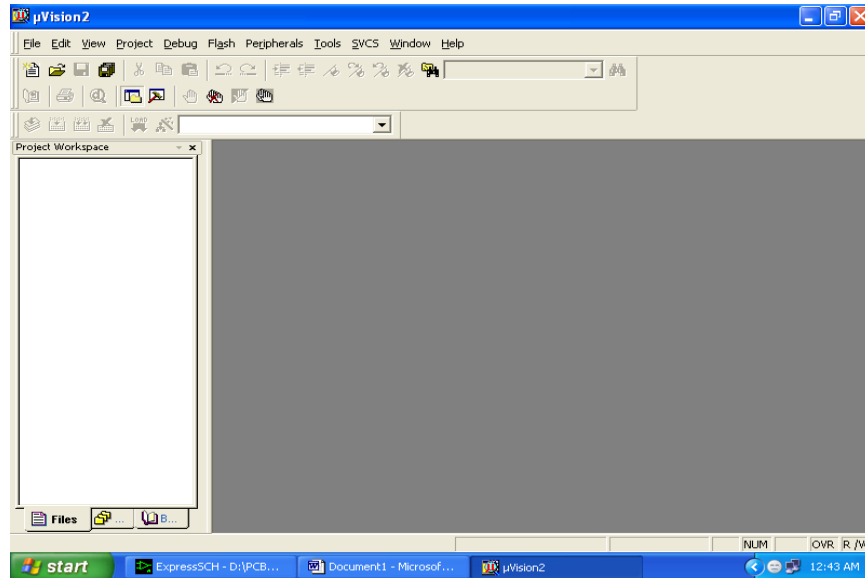
## 7. BILL OF MATERIALS

<u>COMPONENT NAME</u>	<u>QUANTITY</u>
<b><u>Resistors</u></b>	
330R	23
10K 1	
1K	31
100K	1
10K PRESET	8
<b><u>Capacitors</u></b>	
470uF/35V	1
10uF/63V	2
33pF Ceramic	2
<b><u>Integrated Circuits</u></b>	
7805	1
AT89S52	1
<b><u>IC Bases</u></b>	
40-PIN BASE 1	
<b><u>Transistors</u></b>	
BC547	8
<b><u>Diodes</u></b>	
1N4007	4
PHOTODIODE	8
<b><u>Miscellaneous</u></b>	
CRYSTAL 11.0592MHz	1
LED-RED	1
LED-WHITE	14
LED-SPACERS	14
IR-LED	8
POWER CORD	1
TRANSFORMER 0-12V	1
2 PIN PUSH BUTTON	1
LDR	1
HEAT SINK	1
SCREW NUT FOR HEAT-SINK	1
MALE BURGE 2-PIN	1
FEMALE BURGE 2-PIN	1(For Transformer)
ASSEMBLED PCB (WORKING)	1
PLAIN PCB	1
ZERO BOARD	1
SOLDERING IRON	1
CUTTER	1
MULTIMETER	1
SCREW DRIVER	1
SOLDERING LED (50 gm)	
CONNECTING WIRE	
RIBBON WIRE FOR ZEROBOARD	
CD	1

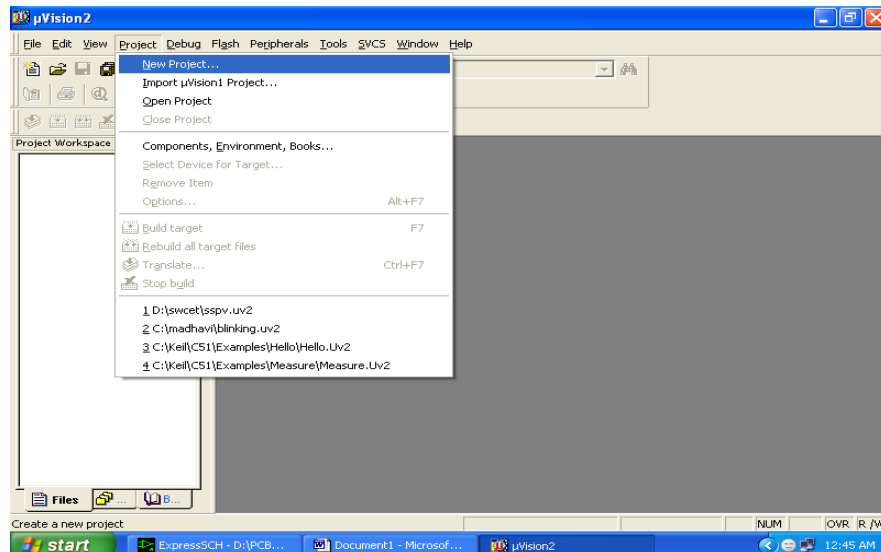
## 8. CODING

### 8.1 COMPILER

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

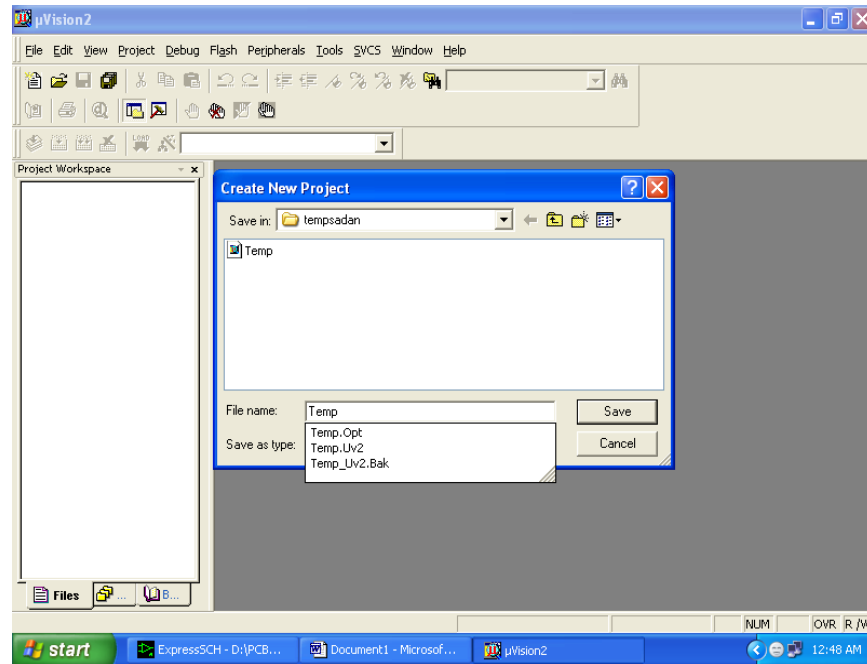


3. Click on the Project menu from the title bar
4. Then Click on New Project

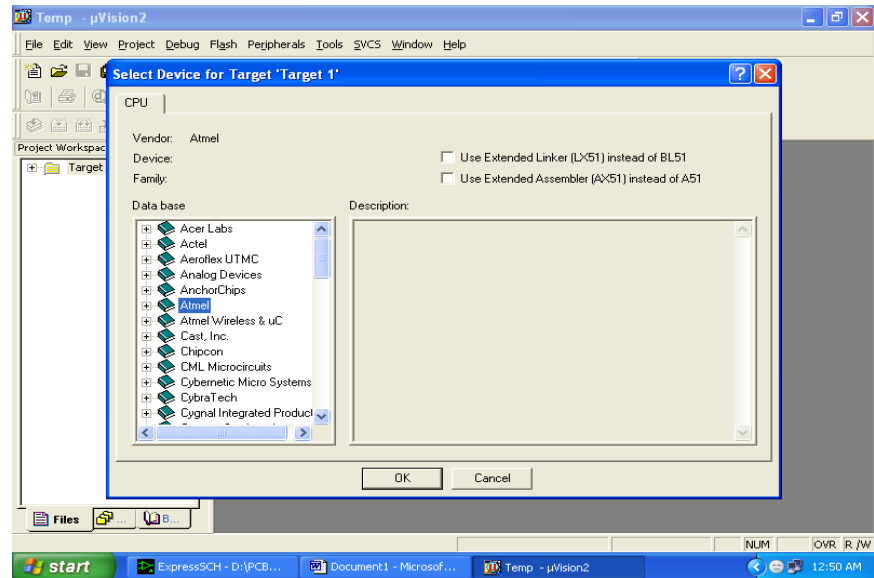




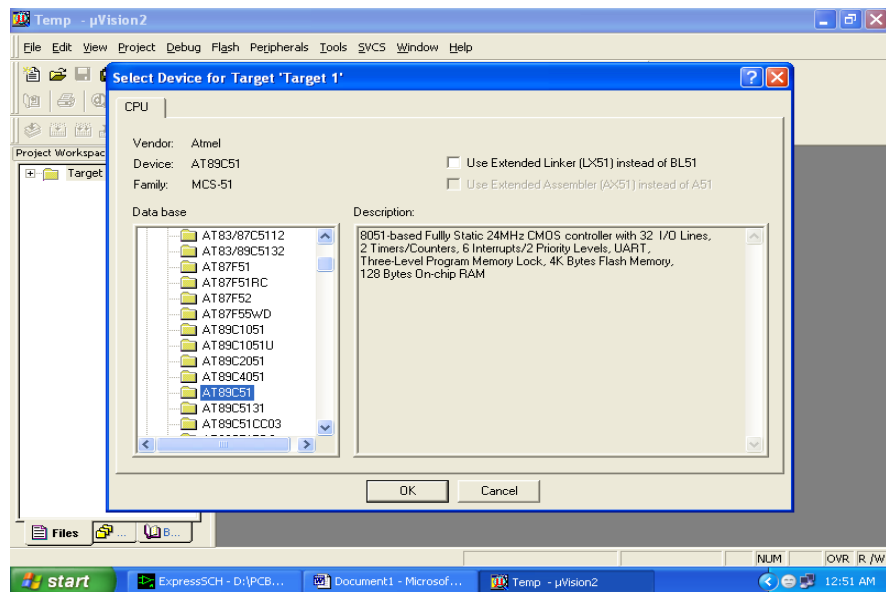
5. Save the Project by typing suitable project name with no extension in u r own folder sited in either C:\ or D:\



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

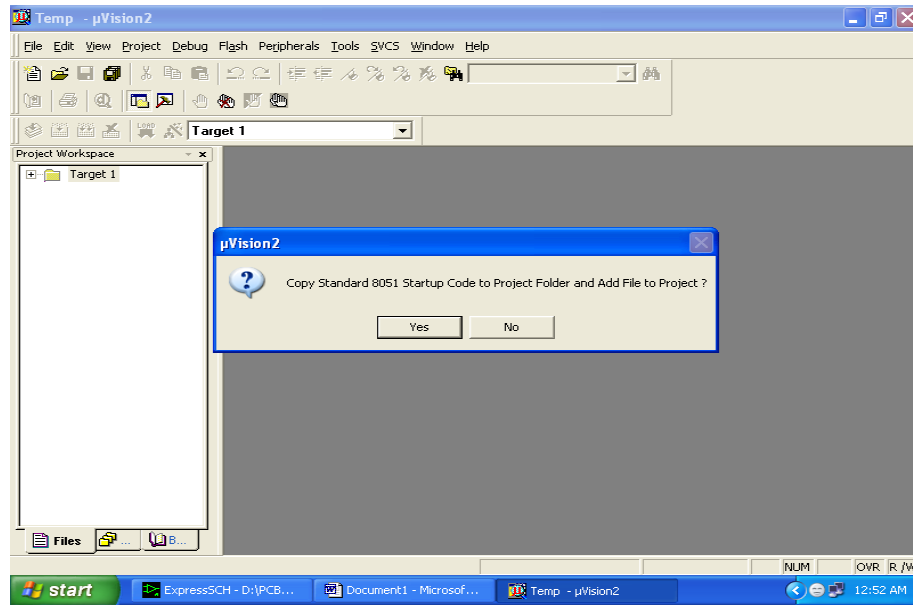


9. Select AT89C51 as shown below

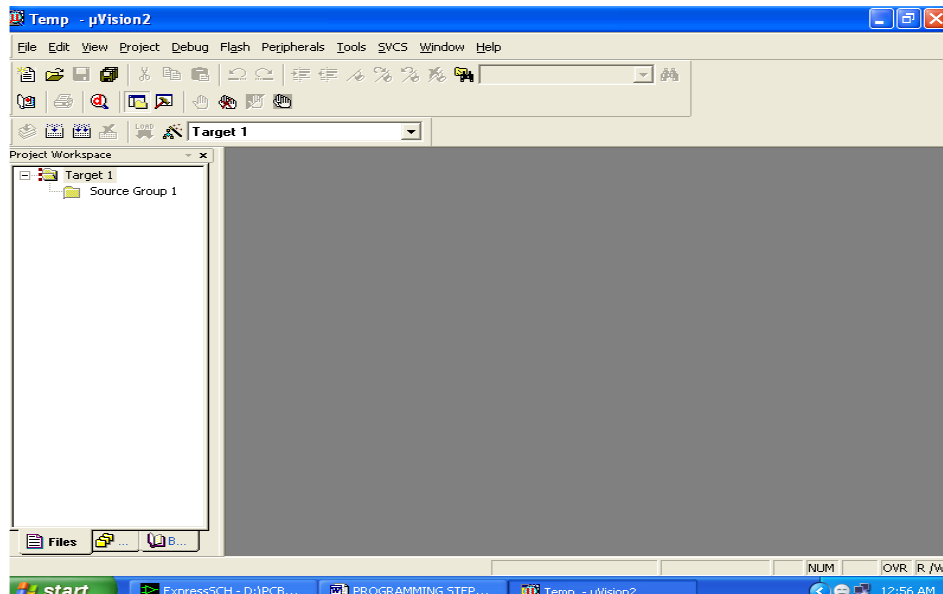


10. Then Click on “OK”

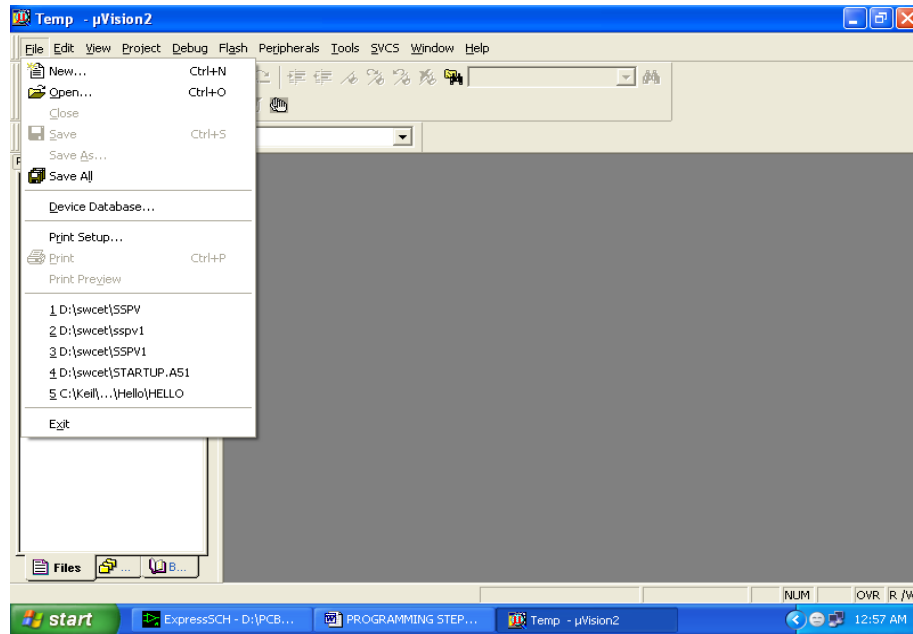
11. The Following fig will appear



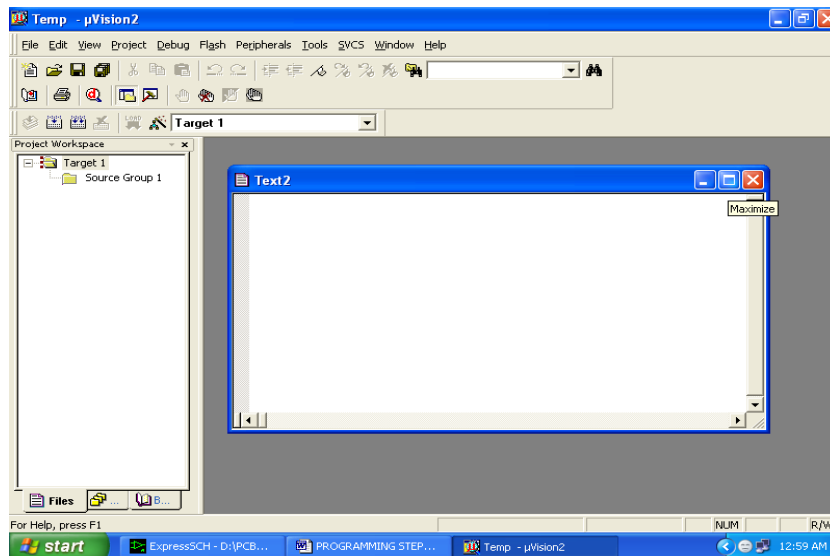
12. Then Click either YES or NO.....mostly “NO”.
13. Now your project is ready to USE.
14. Now double click on the Target1, you would get another option “Source group 1” as shown in next page.



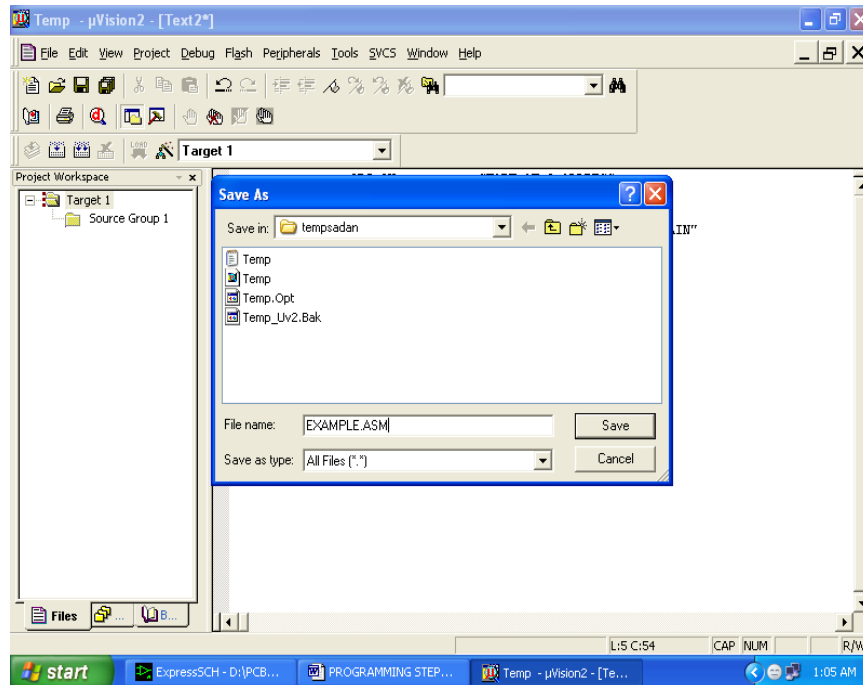
15. Click on the file option from menu bar and select “new”.



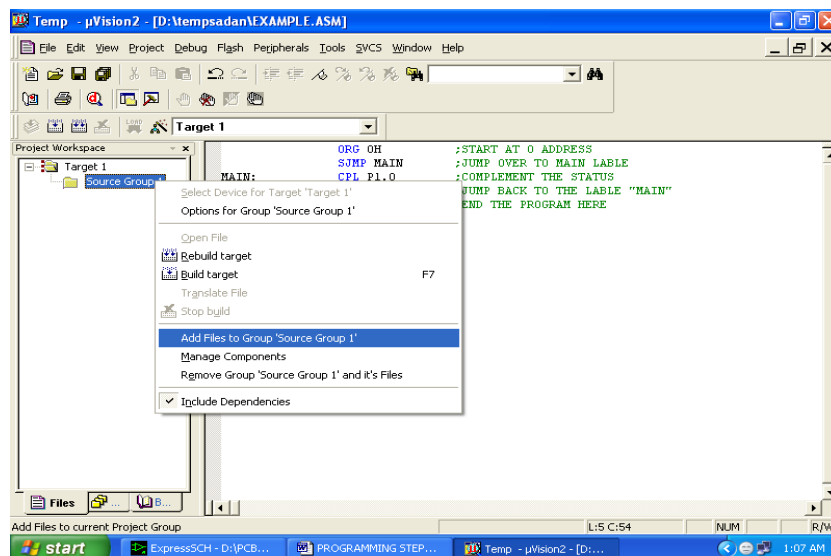
16. The next screen will be as shown in next page, and just maximize it by double clicking on its blue boarder.



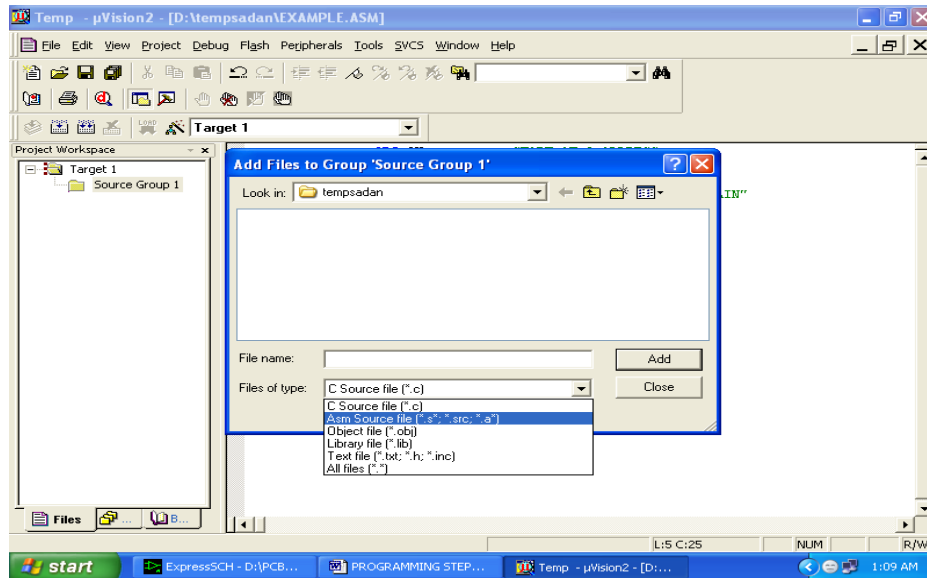
17. Now start writing program in either in “EMBEDDED C” or “ASM”.
18. For a program written in Assembly, then save it with extension “. asm” and for “EMBEDDED C” based program save it with extension “.C”



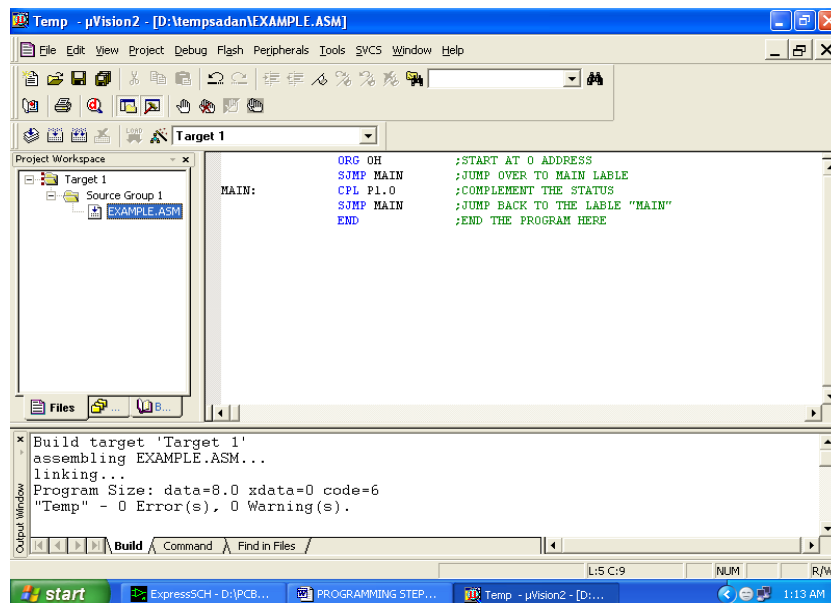
19. Now right click on Source group 1 and click on “Add files to Group Source”.



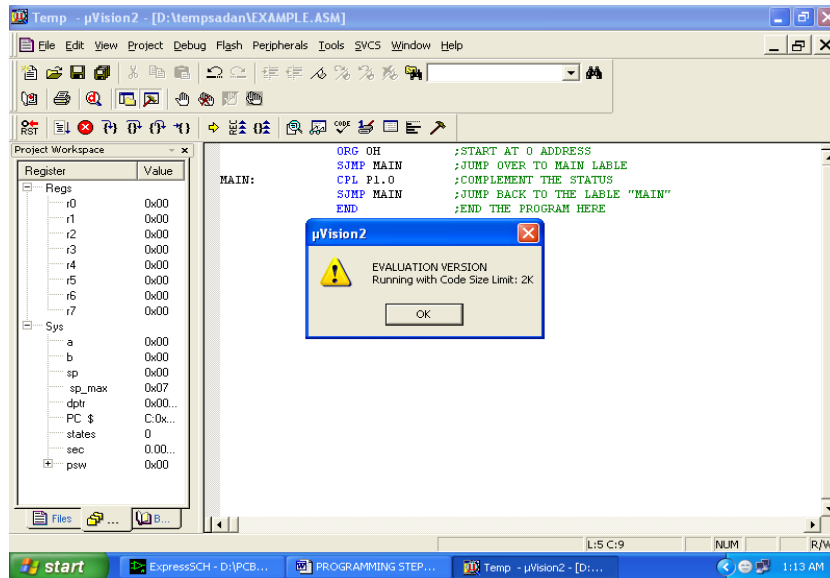
20. Now you will get another window, on which by default “EMBEDDED C” files will appear.



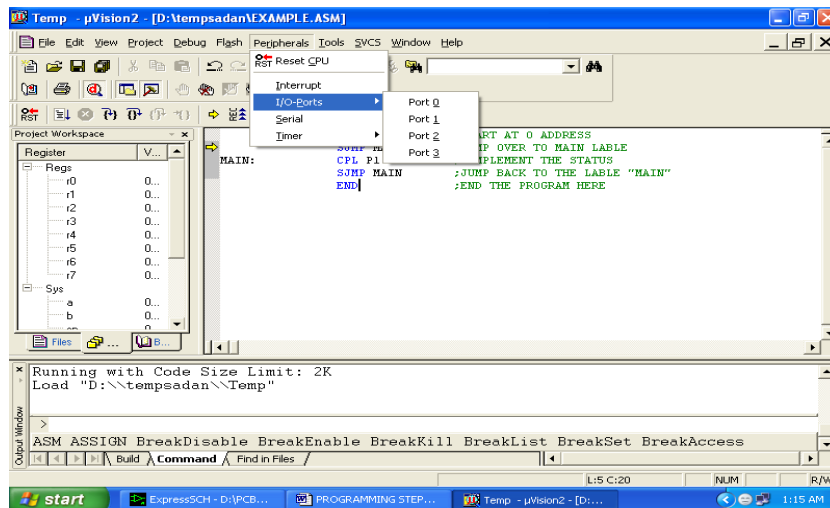
21. Now select as per your file extension given while saving the file.
22. Click only one time on option “ADD”.
23. Now Press function key F7 to compile. Any error will appear if so happen.



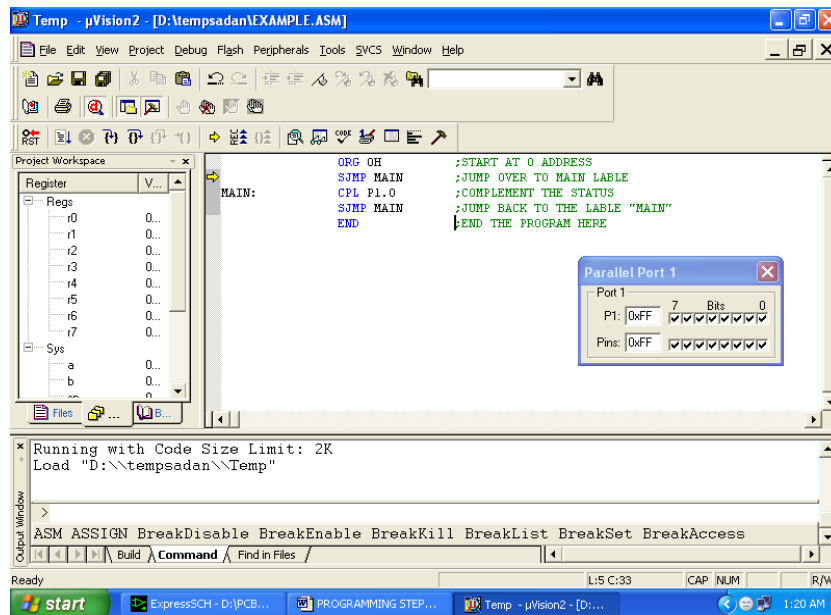
24. If the file contains no error, then press Control+F5 simultaneously.
25. The new window is as follows



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.



## **9. HARDWARE TESTING**

### **9.1 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.

## 9.2 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' 40<sup>th</sup> pin.

Hence we check for the voltage level at 40<sup>th</sup> 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.

In this power on test we also check for the sensors i.e., as we know from the circuit explanation that when there is no vehicle on the highway, then the input to the microcontroller is logic ZERO. This can be tested by checking the voltage level at pot1 pins. Consider the second case when the vehicle obstructs the IR path, then we should get a high at port1 pin. This can be checked using the multi meter.

## **10. RESULTS**

This project presents STREET LIGHTS and it is designed in such a way that it glows when vehicle is detected and implemented with Atmel series AT89S52 microcontroller in embedded system domain. Experimental work has been carried out carefully and efficient utilization of current is achieved.

## **11. CONCLUSION**

This project of **STREET LIGHTS THAT GLOW ON DETECTING VEHICLE MOVEMENT** is a cost effective, practical, ecofriendly and the safest way to save energy. It clearly tackles the two problems that world is facing today, saving of energy and also disposal of incandescent lamps, very efficiently. According to statistical data we can save more than 40 % of electrical energy that is now consumed by the highways. Initial cost and maintenance can be the drawbacks of this project. With the advances in technology and good resource planning the cost of the project can be cut down and also with the use of good equipment the maintenance can also be reduced in terms of periodic checks. The LEDs have long life, emit cool light, do not have any toxic material and can be used for fast switching. For these reasons our project presents far more advantages which can overshadow the present limitations. Keeping in view the long term benefits and the initial cost would never be a problem as the investment return time is very less.

The project has scope in various other applications like for providing lighting in industries, campuses and parking lots of huge shopping malls. This can also be used for surveillance in corporate campuses and industries.

## **12.BIBLIOGRAPHY**

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2. ATMEL 89S52 Data Sheets.

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