AUTO POWER CONTROL SYSTEM FROM FOUR TRANSFORMER

A

PROJECT REPORT

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Submitted by :

Abhishant kumar singh (1130433001)
Ankit dwivedi (1130433007)
Arun kumar singh (1130433011)
Neeraj tripathi (1110433049)
Seraj ahmad malik (1120433046)
Shashwat sen (1120433049)

Under The Supervision Of :

Mr. Shashikant
(Sr. Lecturer, Electrical Engineering, BBD University)

Department of Electrical Engineering
Babu Banarasi Das University,Lucknow

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<u>CERTIFICATE</u>

This is certify that the work contained in project entitled **"AUTO POWER SUPPLY CONTROL FROM FOUR TRANSFORMER",** which is submitted by **Abhishant Kumar Singh (1130433001), Ankit Dwivedi (1130433007), Arun Kumar Singh (1130433011), Neeraj Tripathi (1110433049), Seraj Ahmed Malik (1120433046), Shashwat Sen (1120433049),** in partial fulfillment of the requirement for the award of degree Bachelor of Technology in department of Electrical Engineering of Babu Banarasi das University, is a record of the candidates own work carried out by under my supervision. The matter embodied in this project work is original and not been submitted for the award of any other degree.

DATE –

Mr. Sashikant
Senior Lecturer
Department of Electrical Engineering
School of Engineering
Babu Banarasi Das university
Lucknow (U.P.)

Mr. V.K. Maurya
Assosiate Professor & Incharge
Department of Electrical Engineering
School of Engineering
Babu Banarasi Das university
Lucknow (U.P.)

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Abhishant kumar singh (1130433001)

Ankit dwivedi (1130433007)

Arun kumar singh (1130433011)

Neeraj tripathi (1110433049)

Seraj ahmad malik (1120433046)

Shashwat sen (1120433049)

ABSTRACT

The main objective of this project is to provide uninterrupted power supply to a load, by selecting the supply from any source out of 4 such as mains, generator, and inverter and solar automatically in the absence of any of the source. The demand for electricity is increasing every day and frequent power cuts is causing many problems in various areas like industries, hospitals and houses. An alternative arrangement for power source is a must.

In this project uses four switches to demonstrate the respective failure of that power supply. When any of the switches is pressed it shows the absence of that particular source, switches are connected to microcontroller as input signals. A microcontroller of 8051 family is used. The output of microcontroller is given to the relay driver IC, which switches appropriate relay to maintain uninterrupted supply to the load. The output shall be observed using a lamp drawing power supply from mains initially.

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CHAPTER-1

INTRODUCTION

Reliable and secure uninterruptible power supply is virtually all industrial operations. The reality, however, especially in most developing countries, is that energy resources are simply inadequate. Most manufacturing industries and firms have to contend with insecure and unreliable power supply coupled with its attendant negative impacts on productivity and cost of production. Unreliability in electric power supply has occasioned the proliferation of standby generators especially in developing countries.

However, the methods and equipment employed to effect power supply changeover remain fraught with challenges ranging from inefficiency to cost. Most industries still employ the manual method of power supply changeover, which is beset by a myriad of setbacks including: time wastage, strenuous operation, susceptibility to fire outbreak and high maintenance frequency.

This paper presents a Microcontroller-Based Automatic Transfer Switching System (MBATSS), which eliminates the challenges of a manual changeover system.

The quest for secure and reliable power supply remains a dream yet to be attained, especially in most developing countries. This is as a result of population growth, industrialisation and urbanization.

Nowadays, electrical power supply is one of the important elements in human being needs. The most of the human activities is dependent on electrical power supply. In other words, without electrical power supply, almost the whole of activities is become postponed or worse cancelled. For usage of daily routine, voltage supplied is within 240V ac. The need for power supply is paramount for the growth of a country, access to electricity as the basic form of energy supply to the masses is vital for the development of a nation’s economy.

CHAPTER-2

PROJECT OBJECTIVE

The main objective of this project is to provide uninterrupted power supply to a load, by selecting the supply from any source out of 4 such as mains, generator, and inverter and solar automatically in the absence of any of the source. The demand for electricity is increasing every day and frequent power cuts is causing many problems in various areas like industries, hospitals and houses. An alternative arrangement for power source is a must.

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2.1 Project Working:

When the supply from all the sources (Mains, Solar, Inverter and generator) are ready, first “Normally open” switch is pressed then the mains get failed and the supply automatically shifts to inverter. To proceed further, second normally open switch is pressed then the inverter get failed and supply is provided from solar and so on. Priority is assigned to each power source in the order of Mains, Inverter, Solar and Generator.

In case the mains power fails, the supply should automatically shift to Inverter but if Inverter also fails at the moment then the supply will automatically shift to next priority source. Figure below explains the working and construction of the Auto power supply from four different sources. As shown in the diagram the four sources are Mains, Inverter, solar and Generator, four “Normally open” switches are used to show the failure of each supply, four relays are used to provide protection at each respective output. This output can be used to drive any load such as a lamp or motor.

LEDs are used to display the source of supply. Other case is when the power switches from one source to another source, say Inverter fails and supply shifts to solar, if the mains come back then the supply will automatically reach back to mains power instead of switching to solar. At the output of microcontroller, each output port is connected to positive dc voltage. Relays are used in contact with the output port to provide switching at the output.

CHAPTER-3

BLOCK DIAGRAM

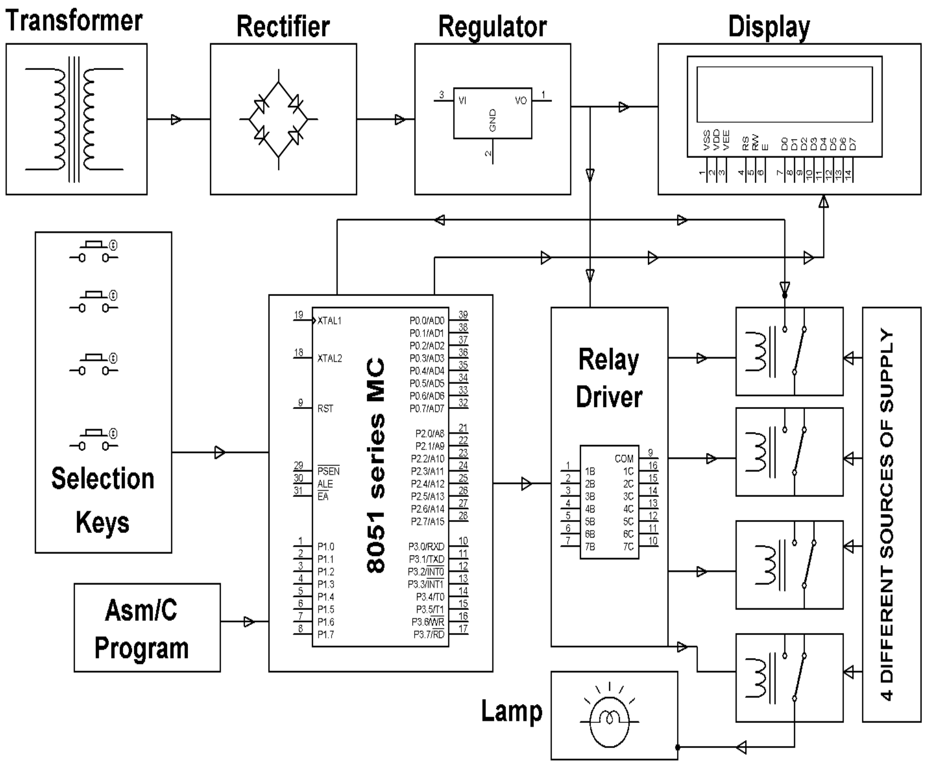

Fig3.1: Block Diagram

- power supply to the loadThe main scope of the project is to consume the power supply from mains, generator, and inverter and solar most effectively.
- The outline of the project is selection of supply from mains, generator, and inverter and solar automatically by using microcontroller

To give an uninterrupted

- POWER SUPPLY BLOCK
- MICROCONTROLLER (AT89S52/AT89C51)
- ULN2003
- RELAY

- LCD
- LED
- 1N4007
- RESISTORS & CAPACITORS

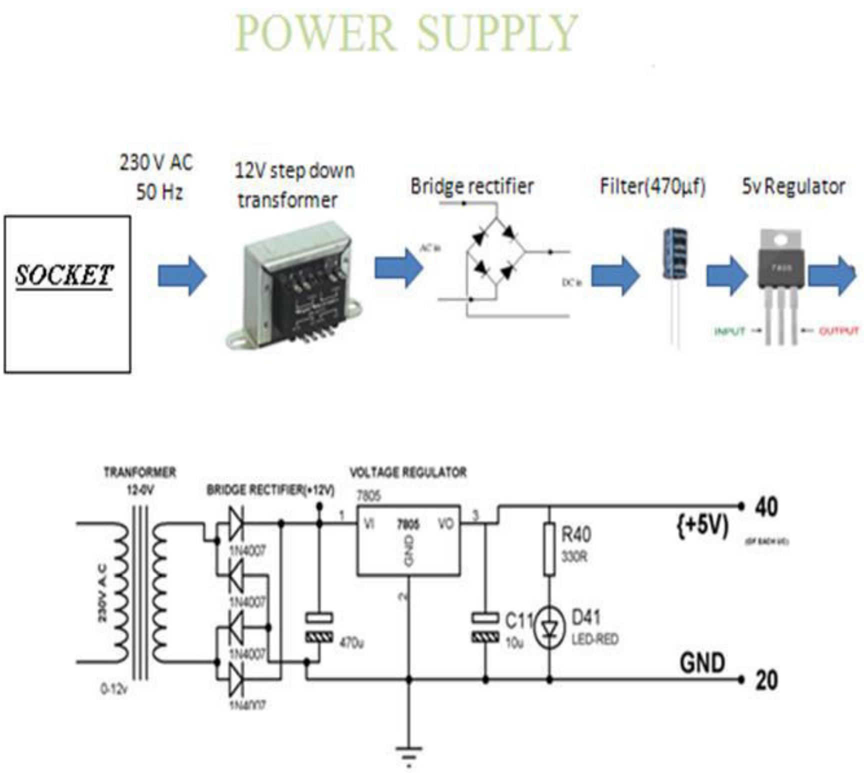

Fig: 3.2 Power Supply

The paper uses an arrangement where four different sources of supply are channelized to a load so as to have an uninterrupted operation of the load. As it is not practicable to get four sources of supply such as mains supply, generator supply, inverter supply and solar supply, we use relays only. The source of 230v mains supply is used and assumed as if being fed from four different sources by connecting all the four incoming sources in parallel as seen in the schematic circuit diagram.

The ac source to the lamp is connected to relay 1 to relay 2 to relay 3 and relay 4 by making the entire „NO" (normally open) contacts parallel and all the common contacts in parallel.

Four push button switches representing failure of corresponding supply such as mains, inverter, solar and generator respectively connected to port 3.4, 3.5, 3.6 and 3.7.The port pin‟s are pulled up with 10k resistor‟s for reliable operation of achieving high and low logic by the program.

It is so written that initially the relay driver IC ULN2003 pin number 1 gets a logic high from microcontroller port p0.1 that results in pin number 16 of the ULN 2003 going low to activate the relay 1 which results in the load i.e., lamps gets the supply through relay 1 „NO‟ contacts. While the push button meant for mains is pressed that represents failure of mains supply resulting in port p0.2 (pin number 37) going high along with ULN2003 pin 2 and port p0.1 (pin number 38) goes low and pin 16 of ULN2003 going high.

These results in pin number 15 of ULN2003 going low while pin number 16 goes high simultaneously. This causes relay 2 to switch „ON‟ that represents supply source from generator, thus the lamp gets supply now from the inverter in the event of mains fail. After that if both mains button and inverter buttons are pressed meaning both mains and inverter supply fail to the micro controller input that results in port 0.3 to go high at that time port 0.1 and 0.2 go to low.

Accordingly pin14 of ULN2003 goes low leaving pin16 and 15 to high such that the relay 3 is switched on while relay 1 and 2 remain in switched off condition. As the relay 3 corresponds to solar supply the lamp now gets the supply from solar.

If the solar push button is pressed along with the mains and inverter button that simulates failure of mains, inverter and solar resulting in microcontroller port no 0.4 going high leaving port 0.1, 0.2, 0.3 low which enables the ULN2003 pin no 13 to go low leaving pin no 16, 15, and 14 high such that relay 4 is switched ON that gets supply from the generator source.

If the generator button is pressed together with mains, inverter, solar simulating failure of all the supply sources results in port 0.4, port 0.1,0.2,and 0.3 which results in pin no 13 of the ULN2003 going high together with 16,15,14. Thus all the relays are off leaving no supply to the lamp. One 16 x 2 lines LCD is used to display the condition of the supply sources and the load.

CHAPTER-4

TRANSFORMER

A Transformer is an electrical device that takes electricity of one voltage and changes it into another voltage. In AC circuits, AC voltage, current and waveform can be transformed with the help of Transformers. Transformer plays an important role in electronic equipment. AC and DC voltage in Power supply equipment are almost achieved by transformer's transformation and commutation. Figure 1 shows the Transformer.

Basically, a Transformer changes electricity from high to low voltage or low to high voltage using two properties of electricity. In an electric circuit, there is magnetism around it. Second, whenever a magnetic field changes (by moving or by changing strength) a voltage is made.

Fig 4.1: Transformer

A Transformer takes in electricity at a higher voltage and lets it run through lots of coils wound around an iron core. ". A single-phase Transformer can operate to either increase or decrease the voltage applied to the primary winding.

Because the current is alternating, the magnetism in the core is also alternating. Also around the core is an output wire with fewer coils. The magnetism changing back and forth makes a current in the wire.

Having fewer coils means less voltage. When it is used to “decrease” the voltage on the secondary winding with respect to the primary it is called a Step-down Transformer. When a Transformer is used to “increase” the voltage on its secondary winding with respect to the primary, it is called a Step-up Transformer.

However, a third condition exists in which a transformer produces the same voltage on its secondary as is applied to its primary winding. In other words, its output is identical with respect to input.

This type of Transformer is called an “Impedance Transformer” and is mainly used for impedance matching or the isolation of adjoining electrical circuits.

Since the invention of the first constant-potential transformer in 1885, transformers have become essential for the transmission, distribution, and utilization of alternating current electrical energy.[3] A wide range of transformer designs is encountered in electronic and electric power.

4.1 Working of Transformer:

The working principle of Transformer is very simple. It depends upon Faraday’s law of electromagnetic induction. Actually, mutual induction between two or more winding is responsible for transformation action in an Electrical Transformer.According to Faraday’s laws of electromagnetic induction,

“Rate of change of flux linkage with respect to time is directly proportional to the induced EMF in a conductor or coil“.

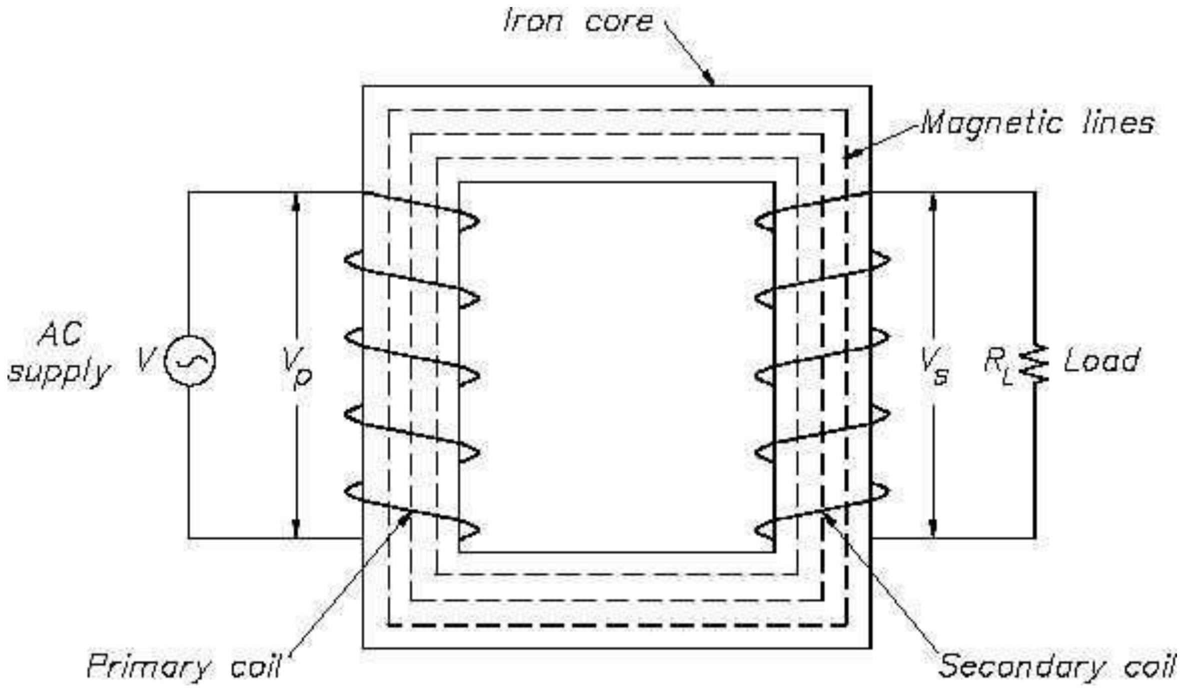

Fig4.2 : Transformer

When one winding which is supplied by an alternating electrical source as shown in figure 2. The alternating current through the winding produces a continually changing flux or alternating flux that surrounds the winding. If any other winding is brought nearer to the previous one, obviously some portion of this flux will link with the second. As this flux is continually changing in its amplitude and direction, there must be a change in flux linkage in the second winding or coil.

According to Faraday's law, there must be an EMF induced in the second. If the circuit of the later winding is closed, there must be an electric current flowing through it.

Now let us see the working of a Transformer in detail. The winding which takes electrical power from the source, is generally known as Primary winding of Transformer as shown in figure 2. The winding which gives the desired output voltage due to mutual induction in the transformer, is commonly known as Secondary winding of Transformer.

The difference in voltage between the Primary and the Secondary windings is achieved by changing the number of coil turns in the Primary winding compared to the number of coil turns on the Secondary winding.

As the Transformer is a linear device, a ratio is done between the number of turns of the primary coil divided by the number of turns of the secondary coil. This ratio, called the ratio of transformation, more commonly known as a Transformers “turns ratio”. This turn’s ratio value dictates the operation of the Transformer and the corresponding voltage available on the secondary winding.

If the Transformer’s ratio is 10:1, then if there are 2200 volts on the Primary winding there will be 220 volts on the Secondary winding. Then we can see that if the ratio between the number of turns changes the resulting.

4.2 Features of a Transformers 12-0-12 500mA:

Transformers are rated in Volt-amperes (VA), or in larger units of Kilo Volt Amperes (kVA). 12-0-12 means that the voltage or the potential difference between each of the end terminal of the secondary winding and the mid-point of the secondary winding of the Transformer is 12V.

And, between the two ends of the secondary winding, we will get 12 + 12 = 24V. 500mA means the current delivery capability of the secondary winding of the Transformer.

Normally it is said in VA. It would be 25 x 0.5 = 12VA. The ratings are based on the requirements of the loads that are to be connected to the Transformer.

It is a general purpose chassis mounting mains transformer. Transformer has 240 V primary windings and centre tapped secondary winding.

The transformer has flying colored insulated connecting leads (Approx 100 mm long). The Transformer act as step down transformer reducing AC - 240V to AC - 12V.

CHAPTER-5

MICROCONTROLLER

A microcontroller is a computer with most of the necessary support chips on-board. All computers have several things in common, namely:

- A central processing unit (CPU) that ‘executes’ programs.
- Some random-access memory (RAM) where it can store data that is variable.
- Some read only memory (ROM) where programs to be executed can be stored.
- Input and output (I/O) devices that enable communication to be established with the outside world i.e. connection to devices such as keyboard, mouse, monitors and other peripherals.

  There are a number of other common characteristics that define microcontrollers. If a computer matches a majority of these characteristics, then it can be classified as a ‘microcontroller’. Microcontrollers may be:
- ‘Embedded’ inside some other device (often a consumer product) so that they can control the features or actions of the product. Another name for a microcontroller is therefore an ‘embedded controller’.
- Dedicated to one task and run one specific program. The program is stored in ROM and generally does not change.
- A low-power device, a battery-operated microcontroller might consume as little as 50 milli-watts.
- A microcontroller may take an input from the device it is controlling and controls the device by sending signals to different components in the device.
- A microcontroller is often small and low cost. The components may be chosen to minimize size and to be as inexpensive as possible.

  However with advancement of the microcontroller systems various features have been included in the controllers but there three main building blocks which a system at-least should have to perform any task. They are:

▪ A processing unit (CPU)
▪ I/O PORTS for interaction with user or physical environment
▪ Memory elements (RAM/ROM/Flash/EEPROM)

- The PIC and AVR MCU brands represent two dominant architectures in the embedded design universe. With a combined 45 years' experience developing commercially available and cost-effective 8-bit MCUs, Microchip is the supplier of choice for many due to its strong legacy and history of innovation in 8-bit.
- Microchip's portfolio of 8-bit PIC and AVR MCUs is not only the industry's largest; the more than 1,200 MCUs offer class-leading flexibility and performance in areas of utmost importance to modern embedded designers.
- Increase system performance while reducing time-to-market
- Best-in-class EMI/EMC performance
- Graphical configuration of complex systems
- Microchip's desire for continuous improvement has led to several industry firsts that have moved embedded design forward.
- Recognizing the opportunity to eliminate componentry on our customers' PCBs, Microchip began offering the first general-purpose MCU family with commonly used analog modules.

The interrupts refer to a notification, communicated to the controller, by a hardware device or software, on receipt of which controller momentarily stops and responds to the interrupt. Whenever an interrupt occurs the controller completes the execution of the current instruction and starts the execution of an Interrupt Service Routine (ISR) or Interrupt Handler. ISR is a piece of code that tells the processor or controller what to do when the interrupt occurs. After the execution of ISR, controller returns back to the instruction it has jumped from (before the interrupt was received).

An application built around microcontrollers generally has the following structure. It takes input from devices like keypad, ADC etc; processes the input using certain algorithm; and generates an output which is either displayed using devices like seven segment, LCD or used further to operate other devices like motors etc. In such designs, controllers interact with the inbuilt devices like timers and other interfaced peripherals like sensors, serial port etc. The programmer needs to monitor their status regularly like whether the sensor is giving output.

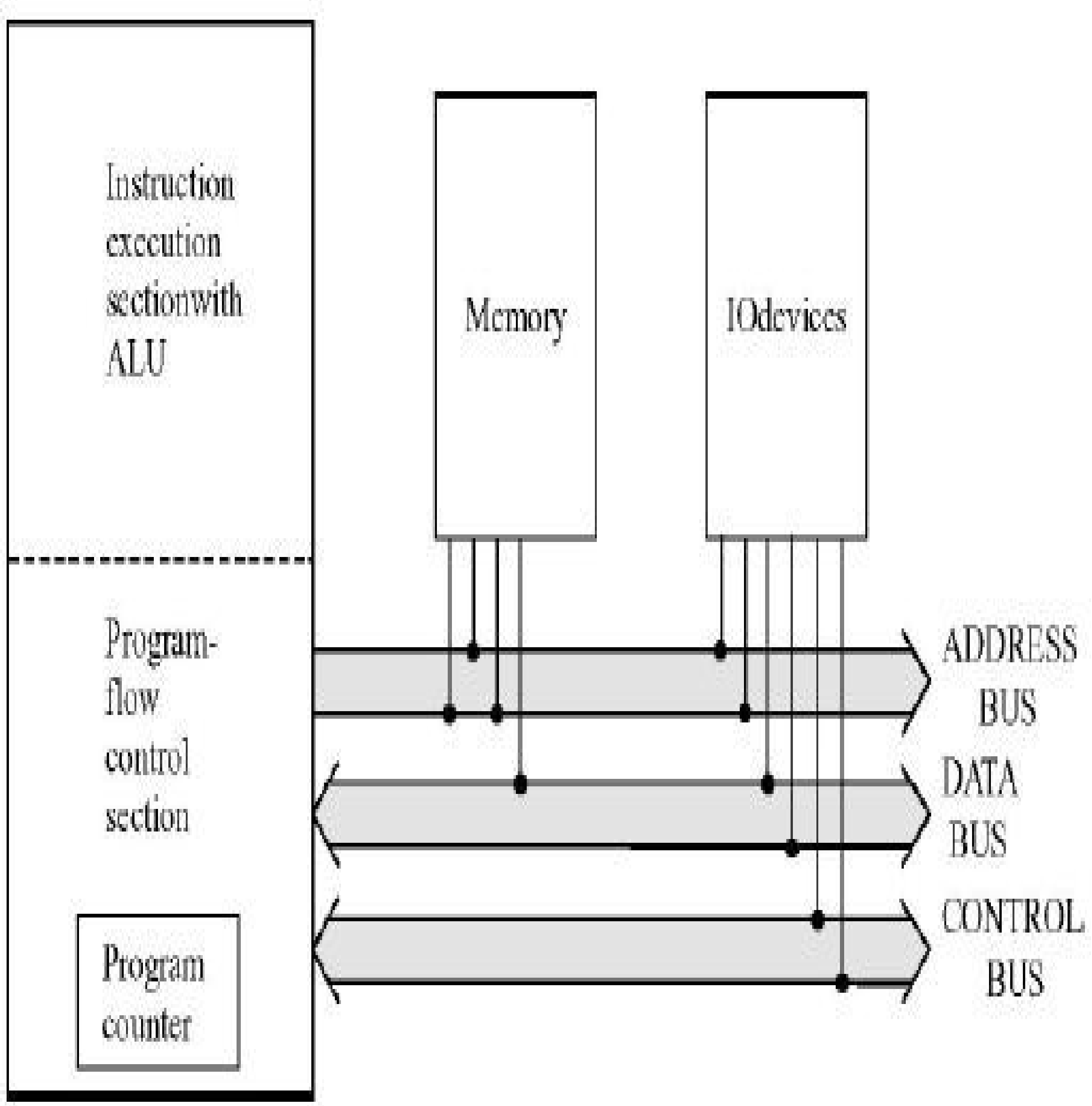

Fig 5.1: Basic element of microcontroller

5.1 Program-flow control section (PFCS). Its functions:

- Fetch the instruction and data from the memory or IO devices
- Control the processing operations for the fetched command or instruction.

- Microprocessor is an IC which has only the CPU inside them i.e. only the processing powers such as Intel's Pentium 1,2,3,4, CORE- 2 DUO, I3, I5 etc. These microprocessors don't have RAM, ROM, and other peripheral on the chip. A system designer has to add them externally to make them functional.

- Application of microprocessor includes Desktop PC's, Laptops, notepads etc. But this is not the case with Microcontrollers. Microcontroller has a CPU, in addition with a fixed amount of RAM, ROM and other peripherals all embedded on a single chip.

- At times it is also termed as a mini computer or a computer on a single chip. Today different manufacturers produce microcontrollers with a wide range of features available in different versions. Some manufacturers are ATMEL, Microchip, TI, Free-scale, Philips, Motorola etc.

- Microcontrollers are designed to perform specific tasks. Specific means applications where the relationship of input and output is defined. Depending on the input, some processing needs to be done and output is delivered. For example, keyboards, mouse, washing machine, digital cameras, pen-drive, remote, microwave, cars, bikes, telephone, mobiles, watches, etc. Since the applications are very specific, they need small resources like RAM, ROM, I/O ports etc and hence can be embedded on a single chip.

- This in turn reduces the size and the cost. Microprocessor find applications where tasks are unspecific like developing software, games, websites, photo editing, creating documents etc. In such cases the relationship between input and output is not defined.

- They need high amount of resources like RAM, ROM, I/O ports etc.

- The clock speed of the Microprocessor is quite high as compared to the microcontroller. Whereas the microcontrollers operate from a few MHz to 30 to 50 MHz, today's microprocessor operate above 1GHz as they perform complex tasks.

- Both of them whether a Micro-controller or the Micro-processor have their own features and application environment.

- Where the need is fulfilled using micro-controller no need to use micro-processor to make the system cost effective and user friendly(no need to interface external devices).However if the application is big consider using micro-processor to inhibit the constraints of memory etc.

5.2 CPU:

A CPU in a computer centrally fetches and processes the instructions. It processes the instructions for the arithmetic and logical operations, the bit manipulation and data transfer operations, the input and output operations, the program-flow control, program sequencing and the system supervising operations. The set of instructions that a CPU can process is defined by its specific instruction set. The instruction set is unique to each CPU.

5.2.1 Program-flow control section (PFCS). Its functions are to:

- Fetch the instruction and data from the memory or IO devices
- Control the processing operations for the fetched command or instruction

5.2.2 Instruction execution section (IES): It has the most important unit—the arithmetic logic unit (ALU).

- *Bus*

A bus is a set of wires (lines) in parallel to carry signals between two subsystems or subsections, which are activated in a system at an instance. Like address bus carries the data if the data is address. The address very important factor as if without address your letter cannot reach the destination or you cannot locate a position similar is the case with such system like from which address the input is to be taken and what address the data is being saved so that it can be retrieved later on and at what address the output is to fetched. This bus for carrying any address is called address bus. Similarly next bus is data bus which carry the actual data input by the user and the control carry the control signals regarding the operation as if the data is to be read or data is to be written and likewise many more. Each microcontroller has also these buses for the execution.

5.3 Program counter:

A program counter is a register in a computer processor that contains the address (location) of the instruction being executed at the current time. As each instruction gets fetched, the program counter increases its stored value by 1. After each instruction is fetched, the program counter points to the next instruction in the sequence. When the computer restarts or is reset, the program counter normally reverts to 0. In computing, a program is a specific set of ordered operations for a computer to perform.

5.4 ALU (Arithmetic and logic unit):

ALU is the part of a computer that performs all arithmetic computations, such as addition and multiplication, and all comparison operations. The ALU is one component of the CPU (central processing unit).

The ALU can perform:

- An addition or subtraction, multiplication or division, or a comparison
- A NOT operation or conversion from one form to another or an increment or decrement or transfer to a destination
- An AND, XOR, OR or other logical operation
- Other arithmetic or logical operation or bit-manipulation operation—like left shift, right shift, rotate left or rotate right as per the design and its capabilities.

5.5 MEMORY ELEMENTS:

Memory refers to the physical devices used to store programs (sequences of instructions) or data (e.g. program state information) on a temporary or permanent basis for use in a computer or other digital electronic device. The term primary memory is used for the information in physical systems which are fast (i.e. RAM), as a distinction from secondary memory, which are physical devices for program and data storage which are slow to access but offer higher memory capacity. Primary memory stored on secondary memory is called "virtual memory".

There are two main types of semiconductor memory: volatile and non-volatile. Examples of non-volatile memory are flash memory (sometimes used as secondary, sometimes primary computer memory) and ROM/PROM/EPROM/EEPROM memory (used for firmware such as boot programs). Examples of volatile memory are primary memory (typically dynamic RAM, DRAM), and fast CPU cache memory (typically static RAM, SRAM, which is fast but energy-consuming and offer lower memory capacity per area unit than DRAM).

- **RAM:** RAM stands for random access memory. This type of memory storage is temporary and volatile. You might have heard that if your system is working slowly you say that increase the RAM processing will increase. Let us understand in detail. Let us consider two cases to execute a task first the complete task is execute at one place(A), second the task is distributed in parts and the small tasks are executed at different places(A,B C)and finally assembled. It is clear the work will be finished in second case earlier. The A, B, C basically represent different address allocation for temporary processing. This is the case with RAM also if you increase the RAM the address basically increases for temporary processing so that no data has to wait for its turn. On major importance of the RAM is address allocations. However the storage is temporary every time u boot your system the data is lost but when you turn on the system The BIOS fetch number of addresses available in the RAM. This memory supports read as well as write operations both.

- **ROM:** ROM stands for Read Only Memory. This type of memory is one time writable and further read only. This is a non -volatile memory. This memory is basically used for writing the configuration files that how the system has to work etc that is the files which are not be changed again and again. So we can say this memory as setup memory containing files for system validations.

- **FLASH memory:** The example of the flash memory is your USB pen-drive. The advantages of this memory type are that it is non-volatile and supports maximum read and write cycles. The execution of this memory is also faster than other memory elements.

- **EPROM:** The EEPROM is a memory that user accessible memory. In all the other memory the user cannot manipulate any memory location. The EPROM is again a non-volatile memory and the data and address of this memory can be easily accessed by the user like the design of EVM. Every voting by the user changes the data of particular address in EPROM.

- **Cache memory:** Cache memory in the system is basically which maintain the communication between the processor and the memory elements at faster speed. A **cache memory** is a cache used by the central processing unit of a computer to reduce the average time to access memory. The cache is a smaller, faster memory which stores copies of the data from the most frequently used main memory locations. As long as most memory accesses are cached memory locations, the average latency of memory accesses will be closer to the cache latency than to the latency of main memory. This refer that randomly many time happening events are stored in the cache memory to be easily accessible.

  When the processor needs to read from or write to a location in main memory, it first checks whether a copy of that data is in the cache. If so, the processor immediately reads from or writes to the cache, which is much faster than reading from or writing to main memory.

  Most modern desktop and server CPUs have at least three independent caches: an **instruction cache** to speed up executable instruction fetch, a **data cache** to speed up data fetch and store, and a translation look aside buffer (TLB) used to speed up virtual-to-physical address translation for both executable instructions and data.

5.6 INPUT/OUTPUT PORTS:

To interact with the physical environment there are different input and output ports in every system like in PC we have VGA port to connect the monitor, USB port for flash memory connections and many more ports. Similarly every microcontroller has its input and output ports with different configurations depending on the architecture like only input, only output and bi-directional input output ports. The accessing of this port is referred as input output interface design for microcontrollers. These ports can also be categorized on the basis of type of microcontroller and different interface in built like analog input port, analog output port, digital input port ,digital output port, serial communication pins, timer execution pins etc.

5.7 UART Communication:

A UART (Universal Asynchronous Receiver/Transmitter) is the microchip with programming that controls a computer's interface to its attached serial devices. Specifically, it provides the computer with the RS-232C Data Terminal Equipment (DTE) interface so that it can "talk" to and exchange data with modems and other serial devices. As part of this interface, the UART also:

• Converts the bytes it receives from the computer along parallel circuits into a single serial bit stream for outbound transmission.

• On inbound transmission, converts the serial bit stream into the bytes that the computer handles.

• Adds a parity bit (if it's been selected) on outbound transmissions and checks the parity of incoming bytes (if selected) and discards the parity bit.

• Adds start and stop delineators on outbound and strips them from inbound transmissions.

• Handles interrupt from the keyboard and mouse (which are serial devices with special ports) .

• May handle other kinds of interrupt and device management that require coordinating the computer's speed of operation with device speeds.

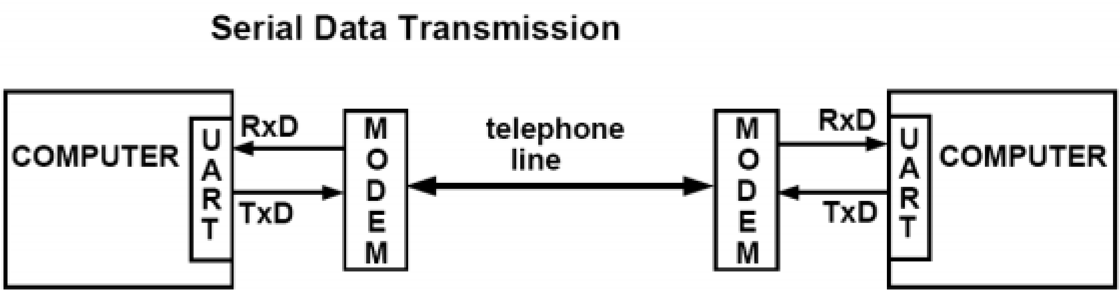

Fig 5.2: serial data transmission

This chip is inbuilt in some microcontroller and all its features are accessible through the controller programming. There are several others serial communications protocols in data can be transmitted serially like I^2C, SPI etc.

5.8 CLOCK GENERATORS:

The clock concept is found in all modern digital electronics, it is a simple circuit that will generate pulses of electricity at a very specific frequency. Those pulses will cadence all the events happening inside a microcontroller, those pulses will also assure the synchronization of the events between various components inside the microcontroller. For example, if the CPU is waiting for some result of mathematical operation from the ALU (Arithmetic and Logic Unit), it will be known – according to very specific protocol – when and where the resulting data will be delivered to the CPU. The synchronization of those two devices is maintained because they share the same clock.

The clock has another very important role which is to enable the microcontroller to count timing. Without a precise clock, it would be impossible to build a 'Real Time System', or any other device that relies on time measurements. It can be deduced that the precision of the timing of a microcontroller depends on the frequency of its clock.

In the 89S52 microcontroller, the clock can be fixed to different value by connecting a crystal to the pins 18 and 19. Those crystals are sold with the frequency written on them in Mega Hertz. The maximum operating frequency of the AT89S52 is 33 MHz, however other manufacturers like Philips built similar 8051 microcontrollers that can run at frequencies up to 120 MHz.

5.9 RESET/ RESTART BUTTON:

However the controller can be reset by putting off the power supply still button for reset or restart is configured in all the controller systems. When you put off the power supply the power to all interface design within the IC is cut-off every time that is not a better option and the logic being manipulated are retained to the original value.

However when you press the reset/restart button only the logics that have been manipulated are retained back but the power to devices is not cut. For example when you click restart button in computer the motherboard supply is not cut (the LED is still on).

5.10 ADC's and DAC are In MICROCONTROLLERS:

The major factors that determine the quality of performance of D/A and A/D converters are resolution, sampling rate, speed, and linearity. The resolution of a D/A circuit is the smallest change in the output analog signal. In an A/D system, the resolution is the smallest change in voltage that can be detected by the system and that can produce a change in the digital code. The resolution determines the total number of digital codes, or quantization levels, which will be recognized or produced by the circuit.

The resolution of a D/A or A/D IC is usually specified in terms of the bits in the digital code or in terms of the least significant bit (LSB) of the system. An n-bit code allows for 2n quantization levels, or 2n– 1 step between quantization levels.

As the number of bits increases, the step size between quantization levels decreases, therefore increasing the accuracy of the system when a conversion is made between an analog and digital signal.

The system resolution can be specified also as the voltage step size between quantization levels. For A/D circuits, the resolution is the smallest input voltage that is detected by the system.

The speed of a D/A or A/D converter is determined by the time it takes to perform the conversion process. For D/A converters, the speed is specified as the settling time. For A/D converters, the speed is specified as the conversion time. The settling time for D/A converters will vary with supply voltage and transition in the digital code; thus, it is specified in the data sheet with the appropriate conditions stated. A/D converters have a maximum sampling rate that limits the speed at which they can perform continuous conversions. The sampling rate is the number of times per second that the analog signal can be sampled and converted into a digital code. For proper ADC conversion, the minimum sampling rate must be at least two times the highest frequency of the analog signal being sampled.

5.11 INTERRUPTS:

In computing, an **interrupt** is an asynchronous signal indicating the need for attention or a synchronous event in software indicating the need for a change in execution.

A **hardware interrupt** causes the processor to save its state of execution and begin execution of an interrupt handler. **Software interrupts** are usually implemented as instructions in the instruction set, which cause a context switch to an interrupt handler similar to a hardware interrupt.

stops and responds to the interrupt. Whenever an interrupt occurs the controller completes the execution of the current instruction and starts the execution of an Interrupt Service Routine (ISR) or Interrupt Handler. ISR is a piece of code that tells the processor or controller what to do when the interrupt occurs. After the execution of ISR, controller returns back to the instruction it has jumped from (before the interrupt was received). The interrupts can be either hardware interrupts.

The interrupts refer to a notification, communicated to the controller, by a hardware device or software, on receipt of which controller momentarily stops and responds to the interrupt. Whenever an interrupt occurs the controller completes the execution of the current instruction and starts the execution of an Interrupt Service Routine (ISR) or Interrupt Handler. ISR is a piece of code that tells the processor or controller what to do when the interrupt occurs. After the execution of ISR, controller returns back to the instruction it has jumped from (before the interrupt was received).

5.12 Types of Microcontroller:

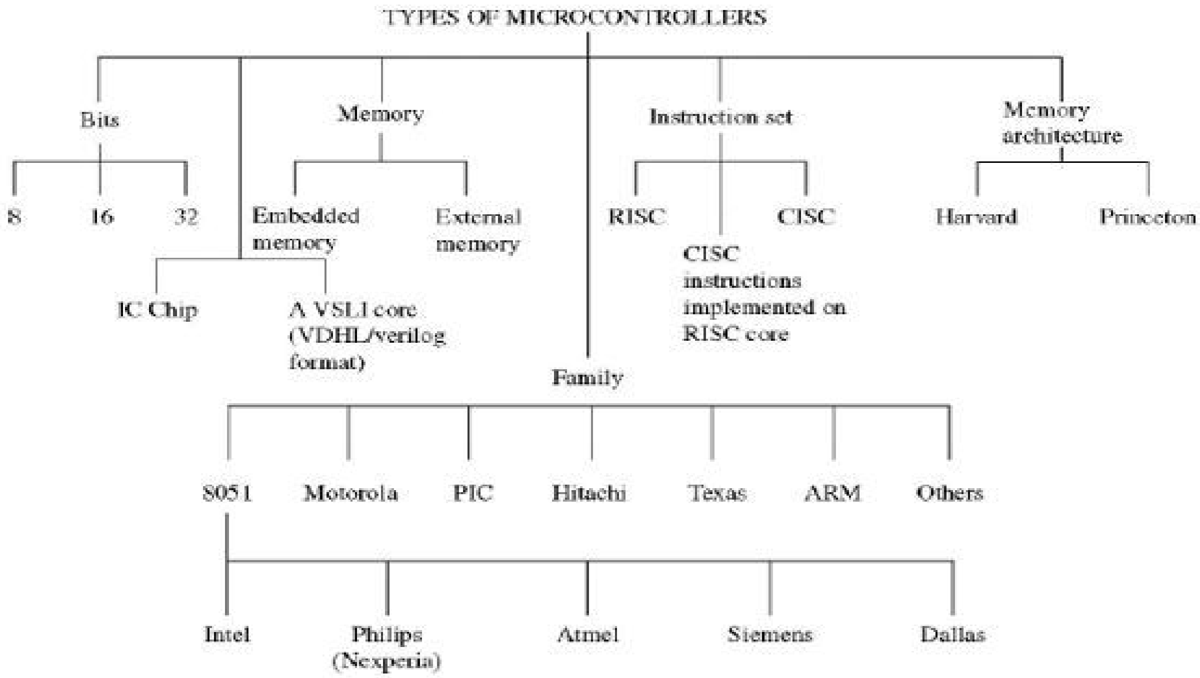

Fig5.3 : Types Of Microcontroller

5.12.1 The 8, 16 and 32-Bit Microcontrollers

- **8-bit microcontroller:** When internal bus in an MCU is 8-bit bus and the ALU performs the arithmetic and logic operations on a byte at an instruction, the MCU is 8-bit microcontroller. Examples of 8-bit MCUs are Intel 8031/8051, PIC1x and Motorola MC68HC11 families.

- **16-bit microcontroller:**

  When internal bus in an MCU is 16-bit bus and the ALU performs arithmetic and logic operations on the operand words of 16 bits at the instructions, the MCU is 16-bit microcontroller. Important 16-bit MCUs are extended 8051XA, PIC2x, Intel 8096 and Motorola MC68HC12 families. 16-bit MCU provides greater precision and performance as compared to the 8-bit MCU.

- **32-bit microcontroller:**

  When internal bus for the data transfer operations in an MCU is 32-bit bus and the ALU performs arithmetic and logic operations on operand words of 32 bits at the instructions, the MCU is 32-bit microcontroller. Important 32-bit

MCUs are Intel/Atmel 251 family, PIC3x, Motorola M683xx and ARM 7 or 9 or 11 processor-based microcontroller families.

These provide greater precision and performance compared to the 16-bit MCUs. They find applications in embedded computing systems for applications—mobile phones, MP3 audio systems, MPEG processing, image-processing-based products and aerospace systems, are the examples.

- **Embedded microcontroller:** When an embedded system has an MCU that has all the hardware and software units in a single unit, the MCU is called embedded microcontroller.

- **External memory microcontroller:** When an embedded system has an MCU that has all the hardware and software units present not as a single unit and has all or part of the memory unit externally interfaced using an interfacing circuit which is called the glue circuit, the MCU is called an external memory microcontroller.

5.13 CISC and RISC Architecture Microcontrollers:

- **Complicated Instruction Set Computer (CISC) architecture microcontroller:**

  When an MCU has an instruction set that supports many addressing modes for the arithmetic and logical instructions and when there are the memory accesses during the ALU operations and the data transfer instructions, the MCU is said to be possessing CISC-architecture.

  CISC provides flexibility in choosing various ways of performing the data transfer, arithmetic and other operations.

  For example, it is feasible to add contents of two registers or add the register and memory or add the bits at two memory addresses in a CISC.

  Instructions are of variable number of bytes in the CISC. These can take varying amounts of time interval for execution. An example is Intel 8096.

- **Reduced Instruction Set Computer (RISC) microcontroller:** When an MCU has an instruction set that supports a few addressing modes for the arithmetic and logical instructions and just a few (load, store, push and pop) instructions for the data transfer, the MCU is said to be of RISC architecture.

  RISC provides no flexibility in choosing the many different ways of performing the arithmetic and logic operations. These operations are performed after the load of operands in the registers, and the results of these operations are placed in registers. The register contents are later on stored in the memory. RISC implements each instruction in a single cycle using a distinct hardwired control.

  It uses a lesser amount of circuitry. It has less power dissipation. There is reduced instruction set.

  Instructions are of fixed number of bytes and take a fixed amount of time for execution.

  It has many registers. Therefore, operations can be performed using them.

  The need for external fetches from the memories is greatly reduced. (An external fetch is to be done by the CPU for an operand more frequently in the CISC).

  The RISC provides a higher performance in computing than the CISC. This is because little need of the external fetches, which takes a significant amount of processor time.

  High performance is also because of hardwired implementation of instructions.

  An example of RISC architecture is the ARM processor family-based MCU.

  These days most of the microprocessor and microcontroller designs are based on RISC core, because the CISC features can always be provided for programming with an appropriate on-chip compiler or internal circuit which translates the codes for the RISC core.

5.14 Harvard and Princeton Memory Architecture Microcontrollers:

- **Harvard memory architecture microcontroller:** When an MCU has a distinct memory address space for the program and data memory, the MCU has Harvard memory architecture in the processor.

The MCU has separate instructions, and hence separate control signal(s), for the data transfers from these two memories.

For example, 8051 has an address space between 0x0000 and 0xFFFF for the program memory bank and separate memory between 0x0000 and 0xFFFF for the data memory bank. (Bank saves the money, a memory bank saves the bytes during operations.)

- **Princeton memory architecture microcontroller:** When an MCU has a common memory address space usable for the program memory and data memory, the MCU has Princeton memory architecture in the processor.

  For example, 68HC11 has an address space between 0x0000 and 0xFFFF for the program memory codes and the same space between 0x0000 and 0xFFFF for the data bytes.

  It has no separate instructions, and hence no separate control signal(s) for data transfers from and to these two sets of memories. (Program and data can be stored on the same memory chip or unit within same address block.)

5.15 8051 family:

The **Intel MCS-51** (commonly referred to as **8051**) is Harvard architecture, single chip microcontroller (µC) series which was developed by Intel in 1980 for use in embedded systems.

[This family of microcontroller is digital in nature means these controllers understand only two logic level that is either 1(+5V) or 0 (0V). It can take only digital input and generate digital output.

8051 is a series of microcontroller in which architecture design is same with the different series controllers having certain advance features and different memory mappings for different memory elements. The 8051 is the basic controller of this series.

It consists of C-series (as ATC51 and many more), S-series (AT89S8253 and more) and many more controllers. For interfacing Analog you have to externally interface ADC's in these microcontrollers.

The execution speed is however is in micro-seconds but with reference to other microcontroller family.

5.15.1 AVR family: The **AVR** is a modified Harvard architecture 8-bit RISC single chip controller which was developed by Atmel in 1996. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time.

This family of microcontrollers can be directly used for digital and analog input and outputs. These microcontrollers have in-built ADC's and output PWM channels.

AVR is a series of microcontroller in which architecture design is same with the different series controllers having certain advance features and different memory mappings for different memory elements.

The ATMEGA-8 is the basic controller of this series. It consists of ATMEGA-16, ATMEGA-32, ATMEGA-168 and many more controllers.

5.15.2 PIC Family: PIC is a family of modified Harvard architecture controllers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "**Peripheral Interface Controller**".

PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

They are also commonly used in educational programming as they often come with the easy to use 'PIC logicator' software. It has all the property For AVR Microcontroller but the execution speed is faster than the AVR microcontroller.

5.15.3 ARM family: ARM is the industry's leading provider of 32-bit embedded microprocessors, offering a wide range of processors based on a common architecture that deliver high performance, industry leading power efficiency and reduced system cost.

Combined with the broadest ecosystem in the industry with over 900 Partners delivering silicon, tools and software, the wide portfolio of more than 20 processors are able to meet every application challenge.

With more than 25 billion processors already created and in excess of 16 million shipped every day, ARM truly is The Architecture for the Digital World.

5.16 Additional factors:

- Cost when single chip and when MCU (micro-controller unit) interfaces to circuit with some features externally added.
- Major building hardware blocks and their cost and availability.
- Major building blocks of software, their cost and availability and required Hardware–software tradeoff.
- Ease of integration
- Availability of design team expertise
- Availability and cost of development software (compilers) and hardware tools
- Ease and availability of testing and debugging facilities
- Easy and reliable availability of the MCU, development tools and building blocks for hardware and software

Keeping these factors in mind the most common controller on which the student can work easily are 8051 family and AVR family of microcontrollers.

5.17 Application Senario Of Microcontroller:

All the improvements and changes made in the field of electronics over the past few decades, microcontroller technology might be the most satisfying. These remarkable devices are used in everything from microwave ovens and cars to televisions and computer printers. In fact, it would be difficult to put together a list of microcontroller uses without missing a few.

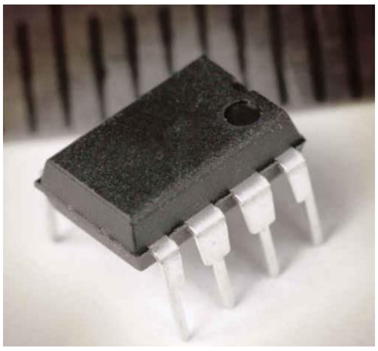

Fig5.4 : Senario of microcontroller

Some modern devices, such as cars and more complex machinery use multiple microcontrollers. If you have heard the terms “brain” or “computer” applied to the overall operation of a car’s engine, you have heard about the microcontroller that keeps most automobile systems in operation.

The best way to get a vision of a microcontroller is to think of it as a small computer. In fact, this tiny but important object has many of the same features and benefits of larger, more complex computers. They have a central processing unit (referred to as the CPU) in which the software programs work. Computers execute the programs to accomplish various tasks. Each computer has a storage device, such as a hard drive, a flash drive or a CD.

Information from this larger storage device is stored in part in the random-access memory. A microcontroller has all of these components in some form. It’s designed to be small and it’s designed to be specific to a certain task or use. They are also solid-state, integrated circuits.

This separates them from larger units such as a personal computer that can perform a number of different jobs for the user. Because they are so small, microcontrollers can be part of a larger device, such as the television, car or appliance mentioned earlier. They are programmed to control specific activity within that larger device. Their memory storage and programs are also very specific to the task at hand.

Most microcontrollers use very low amounts of electrical power and don’t have moving parts, large input devices such as a keyboard or big display screens. In some cases, the microcontroller shows that it is working by powering a small light-emitting diode (LED) or simply by the expected activity taking place.

One good example might be an entertainment center in the home. If a person operates the CD player, television set or other device by remote control a microcontroller (tiny computer) receives information from the remote control device and transfers that information to the right place within the larger electronic system. This same type of activity takes place in a car when the key is turned, when one of the accessories is switched etc. A microcontroller takes input from these points and takes the input on to the next step.

Smaller devices might use simpler microcontrollers that have been in efficient use for decades. In more complicated systems, the microcontroller might be a bit more powerful, yet still available at low cost and using very little electrical power to perform their tasks. While larger computer chips and storage drives might have millions of bytes of capability.

5.18 Important fact about the microcontroller:

What is a boot-loader: There are certain microcontrollers in which for running the program first you have to transfer a boot-loader to the microcontroller. Generally, when you want to program a microcontroller, you need a programmer for that particular microcontroller.

Apart from being expensive, it might have other disadvantages, like long programming times or too many interconnections between the micro and the programmer itself; some programmers are not capable of programming in circuit.

Many of these problems are addressed by a boot-loader. So, the boot-loader has to be programmed in the program memory of the microcontroller just once, using a conventional programmer.

After this, the microcontroller can be programmed without a programmer. Once in the microcontroller, the boot-loader is such programmed that each time after reset it starts running like any conventional program.

What it does however is different from a regular program. First of all, depending on what type of boot-loader it is, it starts "listening" for incoming bytes via a specific interface. For instance, a UART boot-loader will listen to the UART buffer of the micro, checking for incoming bytes.

If the bytes start arriving, the boot-loader will grab them and write them in the program memory in the sequence it receives them and at predefined locations. Once all bytes have been received, the boot-loader executes a jump at the start of the memory zone it has received and then the "normal" program starts running.**Programming or burning**: Burning means transfer of the code from PC to the microcontroller through different communication medium.

- Programming or burning a microcontroller means to transfer the program from the compiler to the memory of the microcontroller. A compiler is software which provides an environment to write, test and debug a program for the microcontroller.

The program for a microcontroller is generally written in C or assembly language. Finally the compiler generates a hex file which contains the machine language instruction understandable by a microcontroller.

It is the content of this hex file which is transferred to the memory of the microcontroller. Once a program is transferred or written in the memory of the microcontroller, it then works in accordance with the program.

- In order to program a microcontroller we need a device called a burner/programmer. A programmer is a hardware device with dedicated software which reads the content of the hex file stored on the PC or the laptop and transfers it to the microcontroller to be burned.
- It reads the data of the hex file by connecting itself to the PC via a serial or USB cable and transfers the data to the memory of the microcontroller to be programmed in accordance with the protocols as described by the manufacturer in the datasheet.
- The programmer and the compiler differ for microcontrollers from different companies. In some cases the compiler has programmer software inbuilt in it.

  You simply need to connect the programmer hardware and the microcontroller can be programmed from the compiler itself. Examples of some compiler are MIKRO-C, KEIL, AVR STUDIO, ARDUINO and many more.

5.19 Minimum Interface of a Microcontroller:

The minimum interface circuit of any microcontroller consists of at-least these things:

- Vcc (+5v) of the power source connected to the controller's Vcc
- Ground of the power source connected to the controller
- Reset connected according to the reset configuration to the reset pin of the controller
  - **CONFIGURATION 1**: The first configuration is that in which reset is done when the controller pin connected to Vcc when switch is pressed

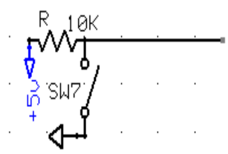

Fig5.5 : Configuration 1

- **CONFIGURATION 2** : The first configuration is that in which reset is done when the controller pin connected to Vcc when switch is pressed

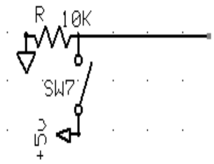

Fig5.6 : Configuration 2

- Crystal Oscillator of unique frequency on the crystal oscillator pin. To know about the pin configuration of a controller and crystal oscillator.

Electronic configurations describe each electron as moving independently in an orbital, in an average field created by all other orbitals. Mathematically, configurations are described by Slater determinants or configuration state functions.

According to the laws of quantum mechanics, for systems with only one electron, an energy is associated with each electron configuration and, upon certain conditions, electrons are able to move from one configuration to another by the emission or absorption of a quantum of energy, in the form of a photon.

Knowledge of the electron configuration of different atoms is useful in understanding the structure of the periodic table of elements. This is also useful for describing the chemical bonds that hold atoms together. In bulk materials, this same idea helps explain the peculiar properties of lasers and semiconductors.

CHAPTER-6

ASSESORIES

6.1 Adapter:

The adapters are the device that has inbuilt circuitry for converting the 230V AC in to desired DC like +5V adapter, +12V adapter, +9V adapter and many more. This consists of inbuilt circuit for HIGH AC to low voltage DC conversion.

Fig. 6.1 :Adapter

6.2 Dip Bases:

The case outlines of the plastic and ceramic Dual In-line Packages (DIPs) are nearly identical. The lead configuration consists of two rows of leads, both with 100 mil pitch. The plastic DIP is shown in Figure.

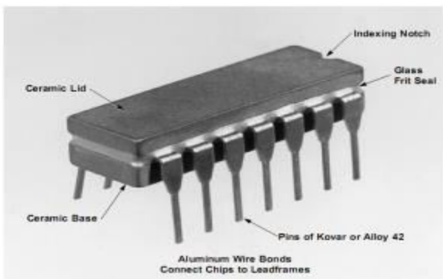

Fig 6.2 : Dip Bases

6.3 Power Jack:

Power Jack is basically a connector to connect the adapter output to the board directly. It has the proper connection designed to connect with the adapter a

well as out connection to connect the board. It has three terminals output 1 Vcc, 2 GND and 3 No connection.

Fig 6.3 : Power jack

6.4 Switches:

In electrical engineering, a **switch** is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another.

The most familiar form of switch is a manually operated electromechanical device with one or more sets of electrical contacts, which are connected to external circuits. Each set of contacts can be in

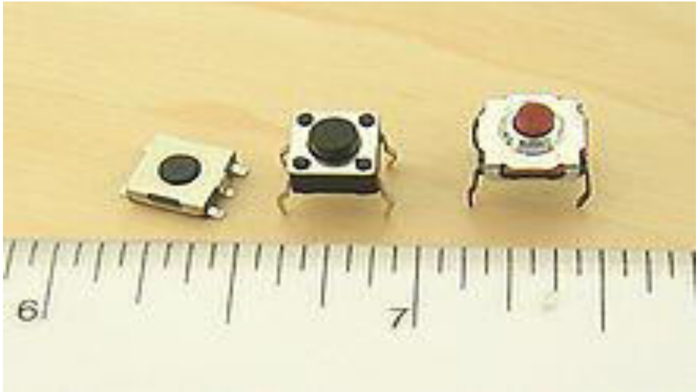

Fig6.4 : Switches

one of two states: either "closed" meaning the contacts are touching and electricity can flow between them, or "open", meaning the contacts are separated and the switch is non-conducting. The mechanism actuating the transition between these two states (open or closed) can be either a "*toggle*" (flip switch for continuous "on" or "off") or "*momentary*" (push-for "on" or push-for "off") type.

A switch may be directly manipulated by a human as a control signal to a system, such as a computer keyboard button, or to control power flow in a circuit, such as a light switch. Automatically operated switches can be used to control the motions of machines, for example, to indicate that a garage door has reached its full open position or that a machine tool is in a position to accept another work piece.

Switches may be operated by process variables such as pressure, temperature, flow, current, voltage, and force, acting as sensors in a process and used to automatically control a system.

For example, a thermostat is a temperature-operated switch used to control a heating process. A switch that is operated by another electrical circuit is called a relay.

Large switches may be remotely operated by a motor drive mechanism. Some switches are used to isolate electric power from a system, providing a visible point of isolation that can be padlocked if necessary to prevent accidental operation of a machine during maintenance, or to prevent electric shock.

An ideal switch would have no voltage drop when closed, and would have no limits on voltage or current rating. It would have zero rise time and fall time during state changes, and would change state without "bouncing" between on and off positions.

Practical switches fall short of this ideal; they have resistance, limits on the current and voltage they can handle, finite switching time, etc.

The ideal switch is often used in circuit analysis as it greatly simplifies the system of equations to be solved, however this can lead to a less accurate solution.

Theoretical treatment of the effects of non-ideal properties is required in the design of large networks of switches, as for example used in telephone exchanges.

6.5 There are varying types of switches:

6.5.1 Micro-switch: This is small switch for interconnection. It has 4 terminals with 2 in pair already connected .when you press the switch all four get connected.

Fig 6.5 : Micro switch

6.5.2 Power switch: This is 6 terminal switches for bidirectional connectivity on press.

Fig 6.6: switch

6.5.3 Toggle switch: A toggle switch is a class of electrical switches that are manually actuated by a mechanical lever, handle, or rocking mechanism. This is a two state switch that is not connected, and connected. It remains in the state till not forced again to change the state. This is a two state switch that is not connected, and connected. It remains in the state till not forced again to change the state.

Fig6.7 : toggle switch

6.5.4 DPDT switch: A DPDT switch is a class of electrical switches that are manually actuated by a mechanical rocking mechanism. This is a three state switch that is not connected, connected to one and connected to second. It remains in the state till forced in that particular state els4e goes to normal state.

Fig 6.8: DPDT

6.5.5 DIP SWITCHES: These are combination of multiple small switches in one package to put on/off multiple channels in circuitry.

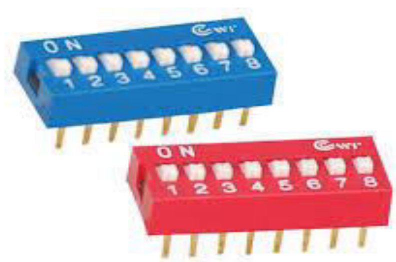

Fig 6.9: DIP

A DIP switch is a manual electric switch that is packaged with others in a group in a standard dual in-line package (DIP). The term may refer to each individual switch, or to the unit as a whole.

This type of switch is designed to be used on a printed circuit board along with other electronic components and is commonly used to customize the behavior of an electronic device for specific situations.

DIP switches are an alternative to jumper blocks. Their main advantages are that they are quicker to change and there are no parts to lose.

These are available in different configuration for example 8 pin configurations, 16 pin configuration and many more.

\6.6 Connectors:

Connectors are wire connection and interface to connect two different points. It has different configuration like 2- pin connector, 3 -pin connector, 4- pin connector and many more

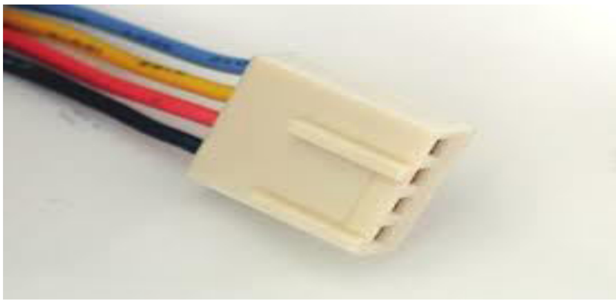

Figure 6.10 : connectors

6.7 Berge Strip:

Berge strip is also type of connector. It is of two types male or female. This is also used for making electrical connections to mount some components. The come in different packages and dimensions.

Depending upon the need they can be purchased. These are used for mounting certain modules, LCD etc.

Male connector: These have metallic rods for the connection

Fig 6.11 : Berge Strip

6.8 DC connectors:

A **DC connector** (or **DC plug**, for one common type of connector) is an electrical connector for supplying direct current (DC) power.Compared to domestic AC power plugs and sockets, DC connectors have many more standard types that are not interchangeable.

F

ig 6.12 : DC connectors

A switch may be directly manipulated by a human as a control signal to a system, such as a computer keyboard button, or to control power flow in a circuit, such as a light switch.

Automatically operated switches can be used to control the motions of machines, for example, to indicate that a garage door has reached its full open position or that a machine tool is in a position to accept another work piece.

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CHAPTER-7

AT89S8253

The microcontroller development effort resulted in the 8051 architecture, which was first introduced in 1980 and has gone on to be arguably the most popular micro controller architecture available.

The 8051 is a very complete microcontroller with a large amount of built in control store (ROM &EPROM) and RAM, enhanced I/O ports, and the ability to access external memory. The maximum clock frequency with an 8051 micro controller can execute instructions is 20MHZ.

Microcontroller is a true computer on chip. The design incorporates all of the features found in a microprocessor: CPU, ALU, PC, SP and registers. It also has the other features needed to, make complete computer: ROM, RAM, parallel I/O, serial I/O, counters and a clock circuit.

The 89C51/89C52/89C54/89C58 contains a non-volatile FLASH program memory that is parallel programmable. For devices that are serial programmable(In-System Programmable (ISP) and In-Application Programmable (IAP) with a boot loader)All three families are Single-Chip 8-bit Microcontrollers manufactured in advanced CMOS process and are Derivatives of the 80C51 microcontroller family.

All the devices have the same instruction set as the 80C51.

L293D is a motor driver. As its name suggests it can drive a motor (normally DC motors up-to certain range). Since the output voltage of 8051 is limited to 5V only thus motors with higher required voltage need some drivers to provide them their desired input voltage.

7.1 Features :

- 8K Bytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 33 MHz

The AT89s8253 is a low power, high performance CMOS 8-bit micro computer with 8K bytes of flash programmable and erasable read only memory(PEROM).The device is manufactured using Atmel's high density nonvolatile memory technology and is compatible with the industry standard 80c51 and 80C52 instruction set and pin out.

The on-chip flash allows the program memory to be reprogrammed in system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with flash on a monolithic chip, the Atmel AT89s8253 is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications. The main advantages of 89s8253 over 8051 are:

- Software Compatibility
- Program Compatibility
- Maximum erase cycle
- The 8051 is the name of a big family of microcontrollers. The device which we are going to use along this tutorial is the 'AT89S8253'which is a typical 8051 microcontroller manufactured by Atmel™. Note that this part doesn't aim to explain the functioning of the different components of a 89S52 microcontroller, but rather to give you a general idea of the

7.2 Architecture of AT89S8353

- organization of the chip and the available features, which shall be explained in detail along this tutorial.
- The block diagram provided by Atmel™ in their datasheet showing the architecture the AT89S8253 device can seem very complicated, and since we are going to use the C high level language to program it, a simpler architecture can be represented as the figure.

- Compatible with 8051 family.
- 12Kb of Flash Memory for storing programs.
  - Program is loaded via SPI System (Serial Peripheral Interface).
  - Program may be loaded/erased up to 1000 times.
- 2Kb of EEPROM Memory.
- Power supply voltage: 4-6V.
- Operating clock frequency: 0-24MHz.
- 256 bytes of internal RAM for storing variables.

- 32 input/output pins.
- Three 16-bit timers/counters.
- 9 interrupt sources.
- 2 additional power saving modes (low-power idle and power-down mode).
- Programmable UART serial communication.
- Programmable watchdog timer.
- Three-level program memory lock

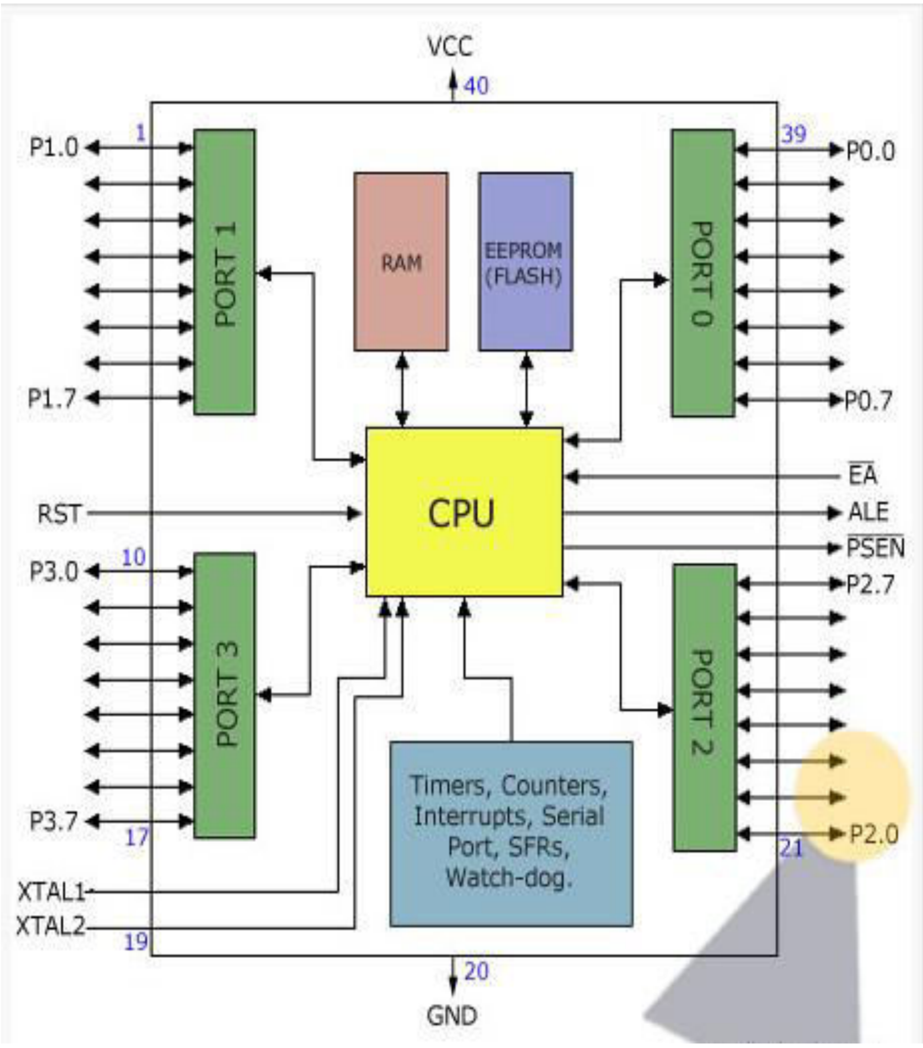

Fig 7.1 : Architecture of AT89S8253

7.3 Typical resistor:

You can also notice two different memory types: RAM and EEPROM.

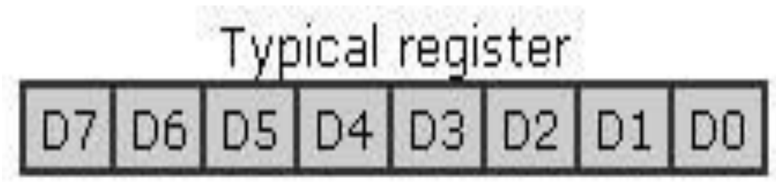

Fig 7.2 : Typical resistor

Shortly, RAM is used to store variable during program execution, while the EEPROM memory is used to store the program itself, that’s why it is often referred to as the ‘program memory’. The memory organization will be discussed in below:

In a memory each register has a specific address which is used by the processor to read and write from specific memory location.

7.4 Pin diagram & description:

The AT89S8253 is a low-power, high-performance CMOS 8-bit microcontroller with 12K bytes of In-System Programmable (ISP) Flash program memory and 2K bytes of EEPROM data memory.

The device is manufactured using Atmel’s high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pinout.

The on-chip downloadable Flash allows the program memory to be reprogrammed in-system through an SPI serial interface or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with downloadable Flash on a monolithic chip, the Atmel AT89S8253 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

The AT89S8253 provides the following standard features: 12K bytes of In-System Programmable Flash, 2K bytes of EEPROM, 256 bytes of RAM, 32

I/O lines, programmable watchdog timer,two data pointers, three 16-bit timer/counters, a six-vector, four-level interrupt architecture.

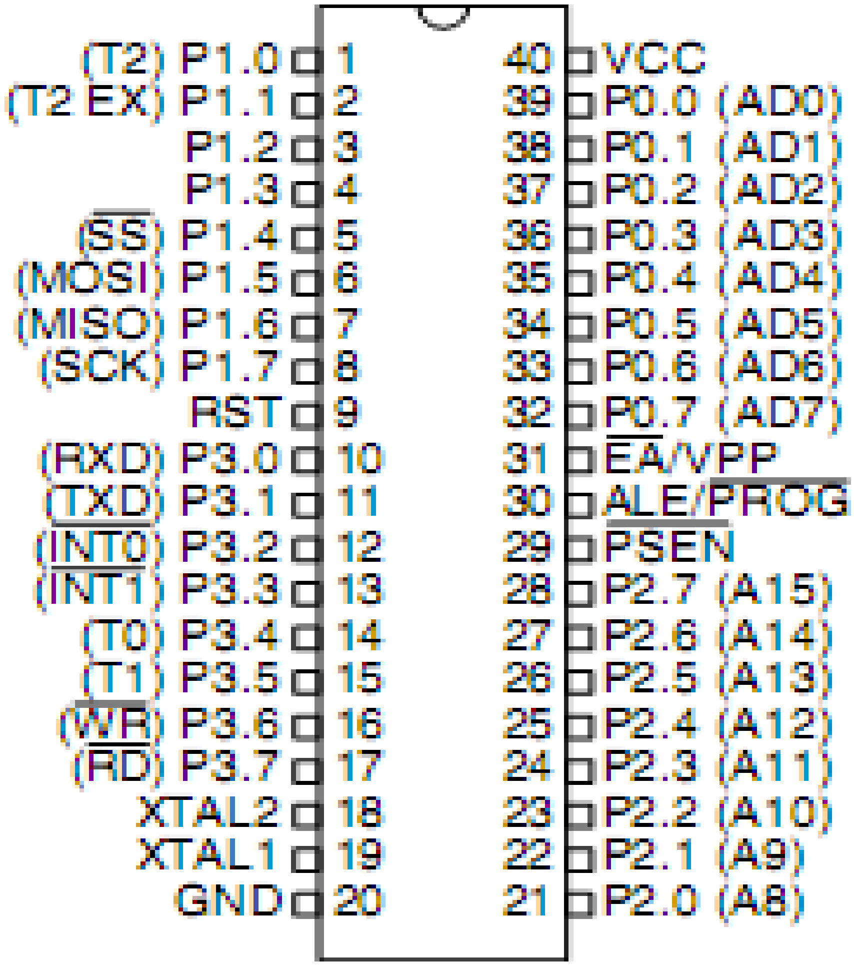

Fig 7.3 : AT89S8253 PIN DIAGRAM

7.5 Oscillator: Pins XTAL1 and XTAL2 are used for connecting a quartz crystal for the internal oscillator. Crystal Frequency-10 MHz

7.6 External Access (EA): The 8051 family members, all come with on-chip ROM to store the program. In such case, EA pin is connected to Vcc. To indicate that the code is stored in external ROM, EA pin must be connected to ground.

7.7 Pin Description:

- **VCC**

Supply voltage (all packages except 42-PDIP).

- **GND**

Ground (all packages except 42-PDIP; for 42-PDIP GND connects only the logic core and the embedded program/data memories).

- **VDD**

Supply voltage for the 42-PDIP which connects only the logic core and the embedded program/ data memories.

- **PWRVDD**

Supply voltage for the 42-PDIP which connects only the I/O Pad Drivers. The application board must connect both VDD and PWRVDD to the board supply voltage.

- **PWRGND**

Ground for the 42-PDIP which connects only the I/O Pad Drivers. PWRGND and GND are weakly connected through the common silicon substrate, but not through any metal links. The application board **must** connect both GND and PWRGND to the board ground.

- **Port 0**

Port 0 is an 8-bit open drain bi-directional I/O port. As an output port, each pin can sink six 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 bi-directional I/O port with internal pull-ups. The Port 1 output buffers can
sink/source six TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the weak
internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being
pulled low will source current (IIL,150 μA typical) because of the weak internal pull-ups.

Port Pin Alternate Functions
P1.0 T2 (external count input to Timer/Counter 2), clock-out
P1.1 T2EX (Timer/Counter 2 capture/reload trigger and direction control)
P1.4 SS (Slave port select input)
P1.5 MOSI (Master data output, slave data input pin for SPI channel)
P1.6 MISO (Master data input, slave data output pin for SPI channel)
P1.7 SCK (Master clock output, slave clock input pin for SPI channel)

- **Port 2**

Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 2 output buffers can sink/source six TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the weak internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL,150 μA typical) because of the weak internal pull-ups.

Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @ DPTR). In this application, Port 2 uses strong internal pull-ups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register.
Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

- **Port 3**

Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffers can sink/source six TTL inputs. When 1s are written to Port 3 pins, they are pulled high by the weak internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL,150 μA typical) because of the weak internal pull-ups.

Port 3 receives some control signals for Flash programming and verification.Port 3 also serves the functions of various special features of the AT89S8253, as shown below.

Port Pin Alternate Functions

P3.0 RXD (serial input port)
P3.1 TXD (serial output port)
P3.2 INT0 (external interrupt 0)(1)
P3.3 INT1 (external interrupt 1)(1)
P3.4 T0 (timer 0 external input)
P3.5 T1 (timer 1 external input)
P3.6 WR (external data memory write strobe)
P3.7 RD (external data memory read strobe)

Note: 1. All pins in ports 1 and 2 and almost all pins in port 3 (the exceptions are P3.2 INT0 and P3.3 INT1) have their inputs disabled in the Power-down mode.

Port pins P3.2 (INT0) and P3.3 (INT1) are active even in Power-down mode (to be able to sense an interrupt request to exit the Power-down mode) and as such still have their weak internal pull-ups turned on.

- **RST**

Reset input. A high on this pin for at least two machine cycles while the oscillator is running resets the device.

- **ALE/PROG**

Address Latch Enable. ALE/PROG is an output pulse for latching the low byte of the address (on its falling edge) 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.

If desired, ALE operation can be disabled by setting bit 0 of the AUXR SFR at location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

- **PSEN**

Program Store Enable. PSEN is the read strobe to external program memory (active low). When the AT89S8253 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access.

- **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 when 12-volt programming is selected.

- **<u>XTAL1</u>**

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

- **<u>XTAL2</u>**

Output from the inverting oscillator amplifier. XTAL2 should not drive a board.

<u>7.8 ATS89S8253 Block Diagram:</u>

4. Block Diagram

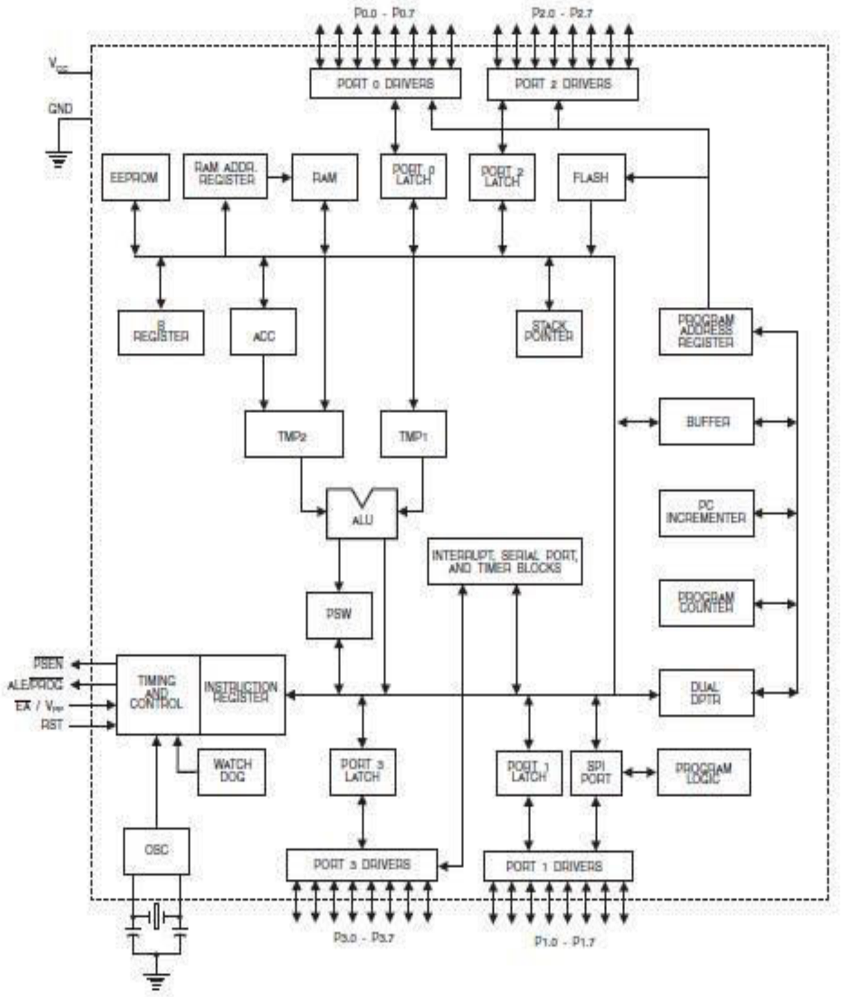

Fig 7.4 :ATS89S8253 Block Diagram:

7.9 Code:

```
void main() {
Lcd_Init(); // Initialize LCD
Lcd_Cmd(LCD_CLEAR); // Clear display
Lcd_Cmd(LCD_CURSOR_OFF); // Cursor off
lcd_out (1,1,"Phase changer");
while (1) // infinite loop
{
if (p1_1) // if electricity is comming in phase 1
{
p0=0x01; // switch on the first relay
lcd_out (2,1,"Phase 1");
while (p1_1); // wait till the electricity is comming in phase 1
}
if ((p1_2)&&(p1_1)) // if electricity is comming in phase 2
{
p0=0x02; // switch on the second relay
lcd_out (2,1,"Phase 2");
while ((p1_2)&&~(p1_1)); // wait till the electricity is comming in
phase 2
}
if ((p1_3)&&(p1_2)&&(p1_1)) // if electricity is comming in phase 3
{
p0=0x04; // switch on the third relay
lcd_out (2,1,"Phase 3");
while ((p1_3)&&(p1_2)&&(p1_1)); // wait till the electricity is comming
in phase 3
}
if ((p1_4)&&(p1_3)&&(p1_2)&&(p1_1)) // if electricity is comming in
phase 4
{
p0=0x08; // switch on the third relay
lcd_out (2,1,"Phase 4");
while ((p1_4)&&(p1_3)&&(p1_2)&&(p1_1)); // wait till the electricity is
comming in phase 3
}
if ((p1_1) && (p1_2) && (p1_3)&&(p1_4)) // if electricity is not comming
in any phase
{
lcd_out (2,1,"No Phase");
p0=0x00; // switch off all the relays
}
}
}
```

7.10 Special Function Registers:

A map of the on-chip memory area called the Special Function Register (SFR).

Note that not all of the addresses are occupied, and unoccupied addresses may not be implemented on the chip.
Read accesses to these addresses will generally return random data, and write accesses will have an indeterminate effect.
User software should not write 1s to these unlisted locations, since they may be used in future products to invoke new features.
In that case, the reset or inactive values of the new bits.

7.11 SPI Registers:

Control and status bits for the Serial Peripheral Interface are contained in registers SPCR and SPSR The SPI data bits are contained in the SPDR register.
In normal SPI mode, writing the SPI data register during serial data transfer sets the Write Collision bit (WCOL) in the SPSR register. In enhanced SPI mode, the SPDR is also write double-buffered because WCOL works as a Write Buffer Full Flag instead of being a collision flag. The values in SPDR are not changed by Reset.

7.12 Interrupt Registers:

The global interrupt enable bit and the individual interrupt enable bits are in the IE register.
In addition, the individual interrupt enable bit for the SPI is in the SPCR register. Four priorities can be set for each of the six interrupt sources in the IP and IPH registers.
IPH bits have the same functions as IP bits, except IPH has higher priority than IP. By using IPH in conjunction with IP, a priority level of 0, 1, 2, or 3 may be set for each interrupt. always be 0.

7.13 Dual Data Pointer Registers:

To facilitate accessing both internal EEPROM and external data memory, two banks of 16-bit Data Pointer Registers are provided: DP0 at SFR address locations 82H - 83H and DP1 at 84H- 85H. Bit DPS = 0 in SFR EECON selects DP0 and DPS = 1 selects DP1.

The user should ALWAYS initialize the DPS bit to the appropriate value before accessing the respective Data Pointer Register.

7.14 Power Off Flag:

The Power Off Flag (POF), located at bit_4 (PCON.4) in the PCON SFR. POF, is set to “1” during power up.
It can be set and reset under software control and is not affected by RESET.

7.15 Data Memory – EEPROM and RAM:

The AT89S8253 implements 2K bytes of on-chip EEPROM for data storage and 256 bytes ofRAM.
The upper 128 bytes of RAM occupy a parallel space to the Special Function Registers.

That means the upper 128 bytes have the same addresses as the SFR space but are physically separate from SFR space.
When an instruction accesses an internal location above address7FH, the address mode used in the instruction specifies whether the CPU accesses the upper
128 bytes of RAM or the SFR space.

Instructions that use direct addressing access the SFR space.
For example, the following direct addressing instruction accesses the SFR at location
0A0H (which is P2).
MOV 0A0H, #data
Instructions that use indirect addressing access the upper 128 bytes of RAM. For example, the following indirect addressing instruction, where R0 contains 0A0H, accesses the data byte at address 0A0H, rather than P2 (whose address is 0A0H).
MOV @R0, #data.

Note that stack operations are examples of indirect addressing, so the upper 128 bytes of data RAM are available as stack space.
The on-chip EEPROM data memory is selected by setting the EEMEN bit in the EECON register at SFR address location 96H.
The EEPROM address range is from 000H to 7FFH. MOVX
instructions are used to access the EEPROM. To access off-chip data memory with the MOVX instructions, the EEMEN bit needs to be set to “0”.
During program execution mode (using the MOVX instruction) there is an auto-erase capability at the byte level.

This means that the user can update or modify a single EEPROM byte location
in real-time without affecting any other bytes.
The EEMWE bit in the EECON register needs to be set to “1” before any byte location in the EEPROM can be written. User software should reset EEMWE bit to “0” if no further EEPROM write is required.

EEPROM write cycles in the serial programming mode are self-timed and typically
take 4 ms. The progress of EEPROM write can be monitored by reading the RDY/BSY bit (read-only) in SFR EECON. RDY/BSY = 0 means programming is still in progress and RDY/BSY
= 1 means an EEPROM write cycle is completed and another write cycle can be initiated.

Bit EELD in EECON controls whether the next MOVX instruction will only load the write buffer of the EEPROM or will actually start the programming cycle. By setting EELD, only load will occur.

Before the last MOVX in a given page of 32 bytes, EELD should be cleared so that after the last MOVX the entire page will be programmed at the same time. This way, 32 bytes will only require 4 ms of programming time instead of 128 ms required in single byte programming.
In addition, during EEPROM programming, an attempted read from the EEPROM will fetch the byte being written with the MSB complemented. Once the write cycle is completed, true data are valid at all bit locations.

7.16 Memory Control Register:

The EECON register contains control bits for the 2K bytes of on-chip data EEPROM. It also contains
the control bit for the dual data pointer.

7.17 Memory Burn-out Protection:

The AT89S8253 has an on-chip Brown-out Detection (BOD) circuit for monitoring the VCC level during operation by comparing it to a fixed trigger level of nominally 2.2V (2.4V max).

The purpose of the BOD is to ensure that if VCC fails or dips, the Flash or EEPROM memories cannot be erased/written at voltages too low for programming. At powerup the VCC level must pass the BOD threshold before execution starts. When VCC decreases to a value below the trigger level, the WRTINH bit in EECON is activated and futher programming of the Flash/EEPROM is restricted.

When VCC increases above the trigger level, the BOD delay counter blocks programming until after the timeout period has expired in approximately 2 ms. The BOD does not reset the system. To protect the system from errors induced by incorrect execution at lower voltages an external BOD circuit may be required.

7.18 Features:

• Compatible with MCS®51 Products
• 12K Bytes of In-System Programmable (ISP) Flash Program Memory
– SPI Serial Interface for Program Downloading
– Endurance: 10,000 Write/Erase Cycles
• 2K Bytes EEPROM Data Memory
– Endurance: 100,000 Write/Erase Cycles
• 64-byte User Signature Array
• 2.7V to 5.5V Operating Range
• Fully Static Operation: 0 Hz to 24 MHz (in x1 and x2 Modes)
• Three-level Program Memory Lock
• 256 x 8-bit Internal RAM

• 32 Programmable I/O Lines
• Three 16-bit Timer/Counters
• Nine Interrupt Sources
• Enhanced UART Serial Port with Framing Error Detection and Automatic Address Recognition
• Enhanced SPI (Double Write/Read Buffered) Serial Interface
• Low-power Idle and Power-down Modes
• Interrupt Recovery from Power-down Mode
• Programmable Watchdog Timer
• Dual Data Pointer
• Power-off Flag
• Flexible ISP Programming (Byte and Page Modes)
– Page Mode: 64 Bytes/Page for Code Memory, 32 Bytes/Page for Data Memory
• Four-level Enhanced Interrupt Controller
• Programmable and Fuseable x2 Clock Option
• Internal Power-on Reset
• 42-pin PDIP Package Option for Reduced EM

PSEN: PSEN stands for Program Store Enable. This is an output pin and is connected to OE pin of ROM

Port 0: Port 0 is an 8-bit open drain bi-directional 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 lower order address/data bus during accesses to external program and data memory.

The AT89S8253 is a low-power, high-performance CMOS 8-bit microcontroller with 12K bytes of In-System Programmable (ISP) Flash program memory and 2K bytes of EEPROM data memory.
The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pinout.
The on-chip downloadable Flash allows the program memory to be reprogrammed in-system through an SPI serial interface or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with downloadable Flash on a monolithic chip, the Atmel AT89S8253.

CHAPTER-8

CAPACITOR

The function of capacitors is to store electricity, or electrical energy. The capacitor also functions as filter, passing AC, and blocking DC. The capacitor is constructed with two electrode plates separated by insulator. They are also used in timing circuits because it takes time for a capacitor to fill with charge. They can be used to smooth varying DC supplies by acting as reservoir of charge.

The capacitor's function is to store electricity, or electrical energy. The capacitor also functions as a filter, passing alternating current (AC), and blocking direct current (DC). This symbol (⊣⊢)is used to indicate a capacitor in a circuit diagram. The capacitor is constructed with two electrode plates facing each other but separated by an insulator.

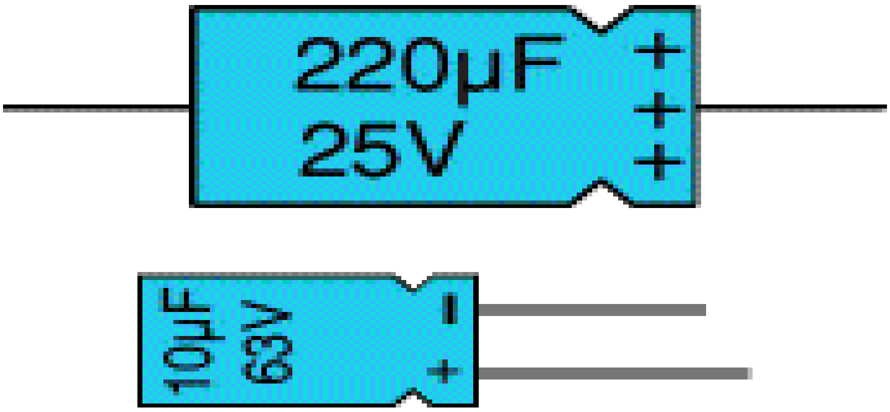

Fig 8.1 : Capacitor

These are the capacitors having polarity. Basically these are of larger values than 1uf. For example below is the diagram of capacitor of 220 microfarad and having breakdown voltage 25V.

When DC voltage is applied to the capacitor, an electric charge is stored on each electrode. While the capacitor is charging up, current flows. The current will stop flowing when the capacitor has fully charged.

Commercial capacitors are generally classified according to the dielectric. The most used are mica, paper, electrolytic and ceramic capacitors. Electrolytic capacitors use a molecular thin oxide film as the dielectric resulting in large capacitance values. There is no required polarity, since either side can be the most positive plate, except for electrolytic capacitors. These are marked to indicate which side must be positive to maintain the internal electrolytic action that produces the dielectric required to form the capacitance. It should be noted that the polarity of the charging source determines the polarity of the changing source determines the polarity of the capacitor voltage.

8.1 ACTUAL CAPACITANCE:

This is a measure of a capacitor's ability to store charge. A large capacitance means that more charge can be stored. It is measured in farad, F. 1F is very large, so prefixes are used to show the smaller values.

Three prefixes are used, u (micron), n (Nano), and p (Pico).

1uf=10^{-6} f

1nf=10^{-9} f

1pf=10^{-12} f

Sometimes, a three-digit code is used to indicate the value of a capacitor. There are two ways in which the capacitance can be written one uses letters and numbers, the other uses only numbers. In either case, there are only three characters used. [10n] and [103] denote the same value of capacitance. The method used differs depending on the capacitor supplier. In the case that the value is displayed with the three-digit code, the 1st and 2nd digits from the left show the 1st figure and the 2nd figure, and the 3rd digit is a multiplier which determines how many zeros are to be added to the capacitance. Pico farad (pF) units are written this way.

For example, when the code is [103], it indicates 10 x 103, or 10,000pF = 10 nano-farad (nF) = 0.01 microfarad (µF).

If the code happened to be [224], it would be 22 x 104 = or 220,000pF = 220nF = 0.22µF.

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

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

8.2 Breakdown Voltage:

When using a capacitor, you must pay attention to the maximum voltage which can be used.

This is the "breakdown voltage." The breakdown voltage depends on the kind of capacitor being used.

You must be especially careful with electrolytic capacitors because the breakdown voltage is comparatively low.

8.3 TYPES OF CAPACITORS

There are various types of capacitors available in the market. Some of them are as follows:

- Mica Capacitor
- Paper Capacitor
- Ceramic Capacitor
- Variable Capacitor
- Electrolytic Capacitor
- Tantalum Capacitor
- Film Capacitor

Here we used only two types of capacitor i.e. ceramic capacitor & electrolytic capacitor.

1. Polarized capacitors
2. Un-polarized capacitors

1.Polarized capacitors

These are the capacitors having polarity. Basically these are of larger values than 1uf. For example below is the diagram of capacitor of 220 microfarad and having breakdown voltage 25V.

Electrolytic capacitors are polarized and they must be connected the correct way round, at least one of their leads will be marked + or -. They are not damaged by heat when soldering. There are two designs of electrolytic capacitors; axial where the leads are attached to each end (220µF in picture) and radial where both leads are at the same end (10µF in picture).

Radial capacitors tend to be a little smaller and they stand upright on the circuit board.

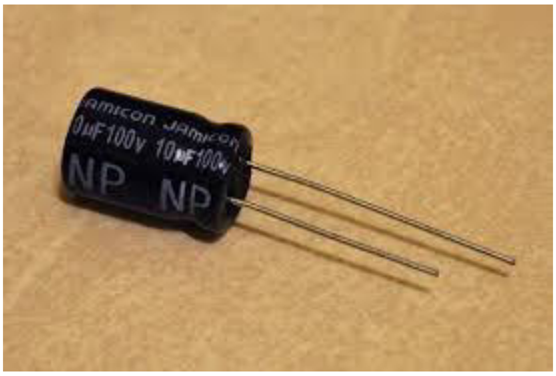

Fig 8.2 : Polrized Capacitor

It is easy to find the value of electrolytic capacitors because they are clearly printed with their capacitance and voltage rating. The voltage rating can be quite low (6V for example) and it should always be checked when selecting an electrolytic capacitor. If the project parts list does not specify a voltage, choose a capacitor with a rating which is greater than the project's power supply voltage. 25V is a sensible minimum for most battery circuits.

3. Unpolrized Capacitor

Small value capacitors are un-polarized and may be connected either way round. They are not damaged by heat when soldering, except for one unusual type (polystyrene).

They have high voltage ratings of at least 50V, usually 250V or so. It can be difficult to find the values of these small capacitors because there are many types of them and several different labeling systems.

Polarized capacitors are the electrolytic type or tandalium type.

There are two types of non polarized capacitors. The plastic foil that are nonpolarized by nature and electrolytic nonpolarized capacitors that are actually two capacitors in series (back to back) so that the result is nonpolarized with half the capacitance.

Polarized capacitors have large leakage current if the voltage is inverted. Nonpolarized capacitors are needed at AC applications in series or in parallel with the signal (or power). Examples are speaker crossover filters and power factor correction networks. In both applications a large voltage AC signal is applied accross the capacitors. If polarized types were used the leakage current would distort the signal and overheat the capacitor and potentially destroy it.

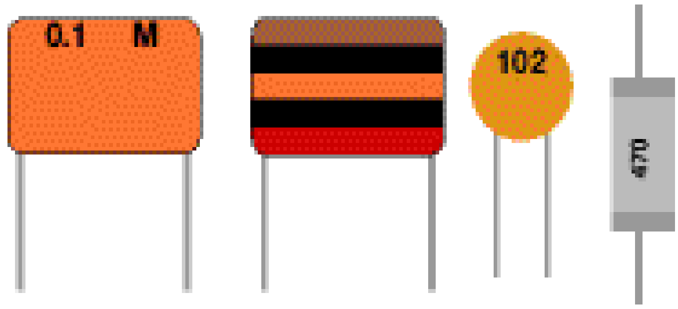

Fig 8.3 : Un – Polrized Capacitor

4.Electrolytic capacitors:

Electrolytic capacitors are polarized and they must be connected the correct way round, at least one of their leads will be marked + or -. They are not damaged by heat when soldering.

Small value capacitors are un-polarized and may be connected either way round. They are not damaged by heat when soldering, except for one unusual type (polystyrene).

They have high voltage ratings of at least 50V, usually 250V or so. It can be difficult to find the values of these small capacitors because there are many types of them and several different labeling systems.

Fig 8.4 : Electrolytic capacitors

All electrolytic capacitors (e-caps) are polarized capacitors whose anode (+) is made of a particular metal on which an insulating oxide layer formed by anodization, acting as the dielectric of the electrolytic capacitor. A non-solid or solid electrolyte which covers the surface of the oxide layer in principle serves as the second electrode (cathode) (-) of the capacitor.

Due to their very thin dielectric oxide layer and enlarged anode surface, electrolytic capacitors have—based on the volume—a much higher capacitance-voltage (CV) product compared to ceramic capacitors or film capacitors, but a much smaller CV value than electrochemical supercapacitors.

The large capacitance of electrolytic capacitors makes them particularly suitable for passing or bypassing low-frequency signals up to some mega-hertz and for storing large amounts of energy. They are widely used for decoupling or noise filtering in power supplies and DC link circuits for variable-frequency drives, for coupling signals between amplifier stages, and storing energy as in a flashlamp.

Many small value capacitors have their value printed but without a multiplier, so you need to use experience to work out what the multiplier should be.

2.Variable capacitors :

Variable capacitors are mostly used in radio tuning circuits and they are sometimes called 'tuning capacitors'.

They have very small capacitance values, typically between 100pF and 500pF (100pF= 0.0001µF).

Fig 8.5 :Variable capacitor

Many variable capacitors have very short spindles which are not suitable for the standard knobs used for variable resistors and rotary switches. It would be wise to check that a suitable knob is available before ordering a variable capacitor.

One way of making capacitors is to use the two poly-silicon layers in our process. We create a parallel plate capacitor with poly1 and poly2 ("electrode") forming the two parallel sides.

The silicon dioxide between the two poly layers is thin enough to yield good capacitance values per unit area.

This is called a poly-poly capacitor.

The other way would be to use the gate oxide and actually build a transistor whose gate area (W x L) would actually give us the capacitance.

These are called MOS capacitors, and they only work properly when the transistor is strongly inverted or depleted.

Otherwise, the capacitance can vary with the voltage across it.

A capacitor is used to store electrons (electricity) for use in a circuit.

Capacitors are made up of two conductive materials separated by a dielectric. The dielectric material varies.

Paper, plastic, oil, ceramic, resin or epoxy and air are all materials used as a dielectric in a capacitor.

A homemade electrolytic capacitor is one where the dielectric is a very, very thin layer of aluminum oxide (see the diagram on the right.) In fact, even though the negative plate is labelled as the grey metal strip, the electrolyte is conductive and really counts as part of the negative plate too.

Since the dielectric is very thin, the capacitance is relatively high, 60 to 500 microfarads.

At least it's high compared to most homemade capacitors plastic or the sides of a jar as the dielectric, 600 picofarad.

CHAPTER-9

CRYSTAL OSCILLATOR

A crystal oscillator is an electronic circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits designed around them were called "crystal oscillators".

Fig 9.1 :crystal oscillator

A crystal oscillator is an electronic circuit that produces electrical oscillations at a particular designed frequency determined by the physical characteristics of one or more crystals, generally of quartz, positioned in the circuit feedback loop. A piezoelectric effect causes a crystal such as

quartz to vibrate and resonate at a particular frequency. The quartz crystal naturally oscillates at a particular frequency, its fundamental frequency that can be hundreds of megahertz. The crystal oscillator is generally used in various forms such as a frequency generator, a frequency modulator and a frequency converter. The crystal oscillator utilizes crystal having excellent piezoelectric characteristics, in which crystal functions as a stable mechanical vibrator. There are many types of crystal oscillators. One of them is a crystal oscillator employing an inverting amplifier including a CMOS (complementary metal oxide semiconductor) circuit, and used, for example, as a reference signal source of a PLL (phase-pocked poop) circuit of a mobile phone. Crystal oscillator circuits using crystal have a number of advantages in actual application since crystals show high frequency stability and stable temperature characteristic as well as excellent processing ability.

An electronic circuit or electronic device that is used to generate periodically oscillating electronic signal is called as an electronic oscillator. The electronic signal produced by an oscillator is typically a sine wave or square wave. An electronic oscillator converts the direct current signal into an alternating current signal. The radio and television transmitters are broad casted using the signals generated by oscillators. The electronic beep sounds and video game sounds are generated by the oscillator signals. These oscillators generate signals using the principle of oscillation.

There are different types of oscillator electronic circuits such as Linear oscillators – Hartley oscillator, Phase-shift oscillator, Armstrong oscillator, Clapp oscillator, Colpitts oscillator, and so on, Relaxation oscillators – Royer oscillator, Ring oscillator, Multivibrator, and so on, and Voltage Controlled Oscillator (VCO). In this article, let us discuss in detail about Crystal oscillator like what is crystal oscillator, crystal oscillator circuit, working, and use of crystal oscillator in electronic circuits.

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9.1Crystal Oscillator Used In Microcontroller:

A microcontroller is disclosed that includes a crystal oscillator circuit that is programmable to provide multiple different levels of start-up current. In the present embodiment, the crystal oscillator circuit includes logic devices for receiving programming indicating one of a plurality of different start-up current levels and a resistor chain.

The logic devices are coupled to the resistor chain for controlling the resistance of the oscillator circuit such that, upon receiving programming indicating a particular start-up current level, the crystal oscillator circuit generates a corresponding start-up current. In addition, the crystal oscillator circuit includes provision for selecting one of a plurality of different levels of capacitance.

Furthermore, the crystal oscillator circuit includes a gate pass that includes circuitry for assuring predetermined start-up conditions are met. A feedback loop that includes an amplifier provides for steady-state operations that have low power consumption.

9.2 Applications:

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers.

Virtually all microprocessors, micro-controllers, PICs and CPU's generally operate using a QUARTZ CRYSTAL OSCILLATOR as its frequency determining device to generate their clock waveform because as we already know, crystal oscillators provide the highest accuracy and frequency stability compared to resistor-capacitor(RC), inductor-capacitor (LC) oscillators.

Today, product designn engineers often do not find themselves designing oscillators because the oscillator circuitry is provided on the device. However, the circuitry is not complete. Selection of the crystal and external capacitors have been left to the product design engineer. If the incorrect crystal and external capacitors are selected, it can lead to a product that does not operate properly, fails prematurely, or will not operate over the intended temperature range. For product success it is important that the designer understand how an oscillator operates in order to select the correct crystal. Selection of a crystal appears deceivingly simple. Take for example the case of a microcontroller. The first step is to determine the frequency of operation which is typically one of several standard values that can be selected from a catalog, distributor, or crystal manufacturer.

CHAPTER-10

DIODE BRIDGE

A diode bridge is an arrangement of four (or more) diodes in a bridge circuit configuration that provides the same polarity of output for either polarity of input.

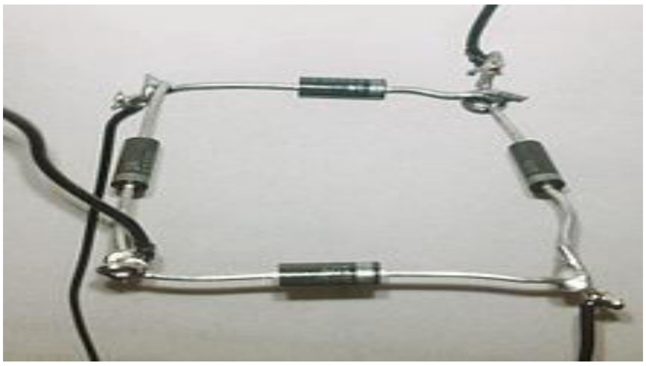

Fig 10.1 : Diode bridge

When used in its most common application, for conversion of an alternating current (AC) input into a direct current (DC) output, it is known as a bridge rectifier.

A bridge rectifier provides full-wave rectification from a two-wire AC input, resulting in lower cost and weight as compared to a rectifier with a 3-wire input from a transformer with a center-tapped secondary winding.

The essential feature of a diode bridge is that the polarity of the output is the same regardless of the polarity at the input. The diode bridge circuit is also known as the Graetz circuit after its inventor, physicist Leo Graetz.

While this method may be suitable for low power applications it is unsuitable to applications which need a “steady and smooth” DC supply voltage. One method to improve on this is to use every half-cycle of the input voltage instead of every other half-cycle. The circuit which allows us to do this is called a Full Wave Rectifier.

Like the half wave circuit, a full wave rectifier circuit produces an output voltage or current which is purely DC or has some specified DC component. Full wave rectifiers have some fundamental advantages over their half wave rectifier counterparts. The average (DC) output voltage is higher than for half wave, the output of the full wave rectifier has much less ripple than that of the half wave rectifier producing a smoother output waveform.

In a Full Wave Rectifier circuit two diodes are now used, one for each half of the cycle. A multiple winding transformer is used whose secondary winding is split equally into two halves with a common centre tapped connection, (C). This configuration results in each diode conducting in turn when its anode terminal is positive with respect to the transformer centre point C producing an output during both half-cycles, twice that for the half wave rectifier so it is 100% efficient as shown below.

The full wave rectifier circuit consists of two power diodes connected to a single load resistance (RL) with each diode taking it in turn to supply current to the load. When point A of the transformer is positive with respect to point C, diode D1 conducts in the forward direction as indicated by the arrows.

When point B is positive (in the negative half of the cycle) with respect to point C, diode D2 conducts in the forward direction and the current flowing through resistor R is in the same direction for both half-cycles. As the output voltage across the resistor R is the phasor sum of the two waveforms combined, this type of full wave rectifier circuit is also known as a “bi-phase” circuit.

As the spaces between each half-wave developed by each diode is now being filled in by the other diode the average DC output voltage across the load resistor is now double that of the single half-wave rectifier circuit and is about 0.637Vmax of the peak voltage, assuming no losses.

The peak voltage of the output waveform is the same as before for the half-wave rectifier provided each half of the transformer windings have the same rms voltage value. To obtain a different DC voltage output different transformer ratios can be used. The main disadvantage of this type of full wave rectifier circuit is that a larger transformer for a given power output is required with two separate but identical secondary windings making this type of full wave rectifying circuit costly compared to the “Full Wave Bridge Rectifier” circuit equivalent.

10.1 The Full Wave Bridge Rectifier:

Another type of circuit that produces the same output waveform as the full wave rectifier circuit above, is that of the Full Wave Bridge Rectifier. This type of single phase rectifier uses four individual rectifying diodes connected in a closed loop "bridge" configuration to produce the desired output. The main advantage of this bridge circuit is that it does not require a special centre tapped transformer, thereby reducing its size and cost.

10.2 Basic Operation Of Full Wave Bridge Rectifier:

1. According to the conventional model of current flow originally established by Benjamin Franklin and still followed by most engineers today, current is assumed to flow through electrical conductors from the positive to the negative pole. In actuality, free electrons in a conductor nearly always flow from the negative to the positive pole. In the vast majority of applications, however, the actual direction of current flow is irrelevant. Therefore, in the discussion below the conventional model is retained.

2. In the diagrams below, when the input connected to the left corner of the diamond is positive, and the input connected to the right corner is negative, current flows from the upper supply terminal to the right along the red (positive) path to the output, and returns to the lower supply terminal via the blue (negative) path.

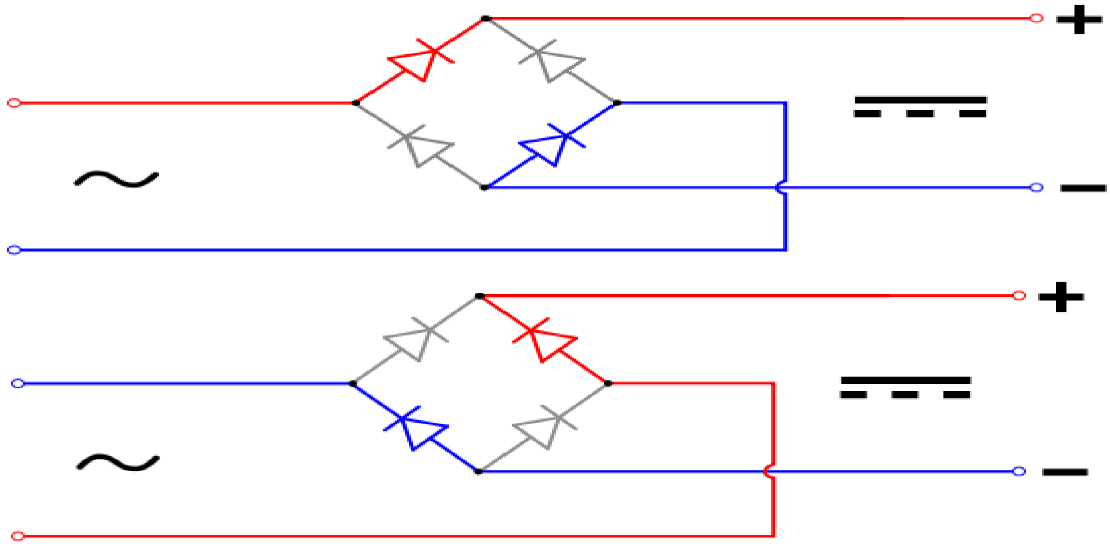

Fig 10.2 : Basic operation of bridge diode

4. In each case, the upper right output remains positive and lower right output negative. Since this is true whether the input is AC or DC, this circuit not only produces a DC output from an AC input, it can also provide what is sometimes called "reverse polarity protection".

A **diode bridge** is an arrangement of four (or more) diodes in a bridge circuit configuration that provides the same polarity of output for either polarity of input.

When used in its most common application, for conversion of an alternating current (AC) input into a direct current (DC) output, it is known as a **bridge rectifier**. A bridge rectifier provides full-wave rectification from a two-wire AC input, resulting in lower cost and weight as compared to a rectifier with a 3-wire input from a transformer with a center-tapped secondary winding.[1]

The essential feature of a diode bridge is that the polarity of the output is the same regardless of the polarity at the input. The diode bridge circuit was invented by Polish electrotechnician Karol Pollar.

The four diodes labelled D1 to D4 are arranged in "series pairs" with only two diodes conducting current during each half cycle. During the positive half cycle of the supply, diodes D1 and D2 conduct in series while diodes D3 and D4 are reverse biased and the current flows through the load.

During the negative half cycle of the supply, diodes D3 and D4 conduct in series, but diodes D1 and D2 switch "OFF" as they are now reverse biased. The current flowing through the load is the same direction as before.

As the current flowing through the load is unidirectional, so the voltage developed across the load is also unidirectional the same as for the previous two diode full-wave rectifier, therefore the average DC voltage across the load is 0.637Vmax.

CHAPTER-11

EXPRESS PCB

A PCB layout is required to place components on the PCB so that the component area can be minimized and the components can be placed in an efficient manner. The components can be placed in two ways, either manually or by software. The manual procedure is quiet cumbersome and is very inefficient. The other method is by the use of computer software. This method is advantageous as it saves time and valuable copper area. There are various software's available for this purpose like-

- Express PCB
- Pad2pad
- Protel PCB
- PCB design

Many of them are loaded with auto routing and auto placement facility. The software that we have used here is **EXPRESS PCB.** This software has a good interface, easy editing options and a wide range of components.

11.1 P.C.B.:

Express PCB is a very easy to use Windows application for laying out printed circuit boards. There are two parts to Express PCB, Express SCH for drawing schematics and Express PCB for designing circuit boards. Thesoftware can be downloaded.

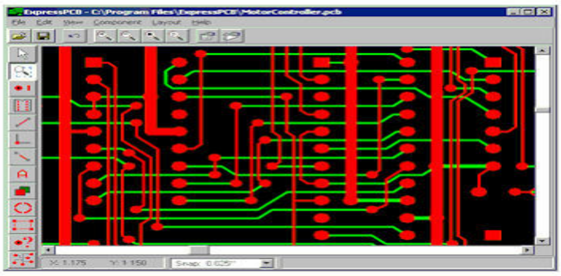

Fig 11.1 : PCB

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. Components (e.g. capacitors, resistors or active devices) are generally soldered on the PCB. Advanced PCBs may contain components embedded in the substrate.

PCBs can be single sided (one copper layer), double sided (two copper layers) or

FR-4 glass epoxy is the primary insulating substrate. A basic building block of the PCB is an FR-4 panel with a thin layer of copper foil laminated to one or both sides. In multi-layer boards multiple layers of material are laminated together.

Printed circuit boards are used in all but the simplest electronic products. Alternatives to PCBs include wire wrap and point-to-point construction. PCBs require the additional design effort to lay out the circuit, but manufacturing and assembly can be automated. Manufacturing circuits with PCBs is cheaper and faster than with other wiring methods as components are mounted and wired with one single part.

A minimal PCB with a single component used for easier prototyping is called a breakout board.

When the board has no embedded components it is more correctly called a printed wiring board (PWB) or etched wiring board. However, the term printed wiring board has fallen into disuse. A PCB populated with electronic components is called a printed circuit assembly (PCA), printed circuit board assembly or PCB assembly (PCBA). The IPC preferred term for assembled boards is circuit card assembly (CCA).

CHAPTER-12

LED & LCD

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting.

Appearing as practical electronic components early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

Fig 12.1 : LED

When a light-emitting diode is forward-biased (switched on), electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.

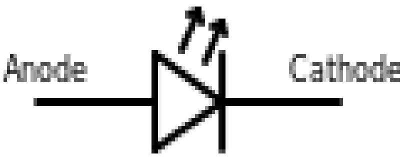

Fig 12.2 : Light emitting diode

This effect is called electro luminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor.

A LED is often small in area (less than 1 mm2), and integrated optical components may be used to shape its radiation pattern. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching.

LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output.

CHAPTER-13

RESISTANCE

There is always some resistance in every circuit.

• A circuit is always made up of some wire, so there will be some resistance there.

• Even the battery has parts that offer resistance to the flow of electrons.

• The only circuits that come near to zero resistance are superconductors.

• This resistance that is from the parts of the circuit itself (especially the battery) is called **internal resistance**.

• This internal resistance is usually drawn into a circuit diagram (*schematic*) as shown in Figure 27.

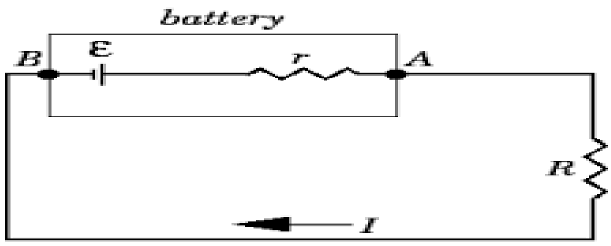

Fig 13.1 : Internal resistance

• Notice the squiggly line just before the positive terminal of the battery? That's to show the internal resistance of the circuit.

• That symbol, drawn any other place in the circuit, represents an actual resistor placed in the circuit.

• A resistor is a device found in circuits that has a certain amount of resistance. Why would you ever want to add resistance to a circuit by using a resistor.

Resistance is the opposition that a substance offers to the flow of electric current. It is represented by the uppercase letter R.

The standard unit of resistance is the ohm, sometimes written out as a word, and sometimes symbolized by the uppercase Greek letter omega: Greek letter omega.

In general, when the applied voltage is held constant, the current in a direct-current (DC) electrical circuit is inversely proportional to the resistance. If the resistance is doubled, the current is cut in half; if the resistance is halved, the current is doubled.

This rule also holds true for most low-frequency alternating-current (AC) systems, such as household utility circuits.

In some AC circuits, especially at high frequencies, the situation is more complex because some components in these systems can store and release energy, as well as dissipating or converting it.

The electrical resistance per unit length, area, or volume of a substance is known as resistivity.

Resistivity figures are often specified for copper and aluminum wire, in ohms per kilometer.

Opposition to AC, but not to DC, is a property known as reactance. In an AC circuit, the resistance and reactance combine vectorially to yield impedance.

Resistance is the opposition that a substance offers to the flow of electric current. It is represented by the uppercase letter R. The standard unit of resistance is the ohm, sometimes written out as a word, and sometimes symbolized by the uppercase Greek letter omega: Greek letter omega

When an electric current of one ampere passes through a component across which a potential difference (voltage) of one volt exists, then the resistance of that component is one ohm. (For more discussion of the relationship among current, resistance and voltage, see Ohm's law.).

CHAPTER-14

ULN2803

The eight NPN Darlington connected transistors in this family of arrays are ideally suited for interfacing between low logic level digital circuitry (such as TTL, CMOS or PMOS/NMOS) and the higher current/voltage requirements of lamps, relays

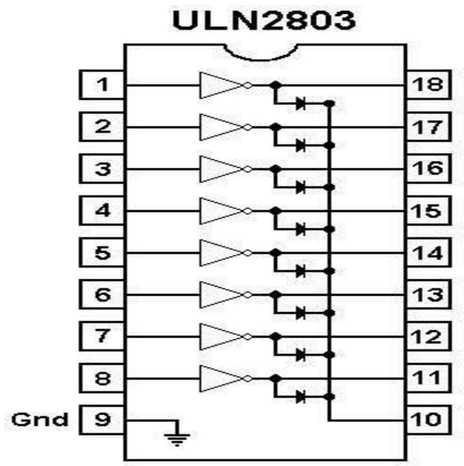

Fig 14.1 : ULN2803

printer hammers or other similar loads for a broad range of computer, industrial, and consumer applications.

All devices feature open–collector outputs and freewheeling clamp diodes for transient Suppression.

The ULN2803 is designed to be compatible with

standard TTL families while the ULN2804 is optimized for 6 to 15 volt high level CMOS or PMOS.

is two transistors connected together so that the current amplified by the first is amplified further by the second transistor. The overall current gain is equal to the two individual gain multiplied together: Darlington pair current gain, HFE = hfe1* hfe2 (hfe1 and hfe2 are the gains of the individual transistors).

This gives the Darlington pair a very high current gain, such as10000, so that only a tiny base current is required to make the pair switch on. A Darlington pair behaves like a single transistor with a very high.

In electronics, the Darlington transistor (often called a Darlington pair) is a compound structure consisting of two bipolar transistors (either integrated or separated devices) connected in such a way that the current amplified by the first transistor is amplified further by the second one.[1] This configuration gives a much higher current gain than each transistor taken separately and, in the case of integrated devices, can take less space than two individual transistors because they can use a shared collector. Integrated Darlington pairs come packaged singly in transistor-like packages or as an array of devices (usually eight) in an integrated circuit.

The Darlington configuration was invented by Bell Laboratories engineer Sidney Darlington in 1953. He patented the invention of having two or three transistors on a single chip sharing a collector.

A Darlington pair behaves like a single transistor with a high current gain (approximately the product of the gains of the two transistors). In fact, integrated devices have three leads (B, C, and E), broadly equivalent to those of a standard transistor.

Most of the Chips operates with low level signals such as TTL, CMOS, PMOS, NMOS which operates at the range of (0-5)v and are incapable to drive high power inductive loads. However this chip takes low level input signals (TTL) and use that to switch/turn off the higher voltage loads that is connected to the output side.

The ULN2803 IC consists of eight NPN Darlington pair which provides the proper current amplification required by the loads. We all know that the transistors are used to amplify the current but here Darlington transistor pairs are used inside the IC to make the required amplification.

A Darlignton pair is two transistors that act as a single transistor providing high current gain. In this pair the current amplified by the first transistor is further amplified by the next transistor providing high current to the output terminal.

When no base voltage is applied that when is no signal is given to the input pins of the IC , there will be no base current and transistor remains in off state. When high logic is fed to the input both the transistors begin to conduct providing a path to ground for the external load that the output is connected. Thus when an input is applied corresponding output pin drops down to zero there by enabling the load connected to complete its path.

The ULN2803A device is a 50 V, 500 mA Darlington transistor array. The device consists of eight NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of each Darlington pair is 500 mA. The Darlington pairs may be connected in parallel for higher current capability.

CHAPTER-15

VOLTAGE REGULATOR

A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components.

Depending on the design, it may be used to regulate one or more AC or DC voltages.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements.

In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. The maximum current they can pass also rates them.

Fig 15.1 : Voltage regulator

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A simple voltage/current regulator can be made from a resistor in series with a diode (or series of diodes). Due to the logarithmic shape of diode V-I curves, the voltage across the diode changes only slightly due to changes in current drawn or changes in the input. When precise voltage control and efficiency are not important, this design may be fine.

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15.1 3 Terminal 1 A Positive Voltage Regulator:

- 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

A simple voltage/current regulator can be made from a resistor in series with a diode (or series of diodes). Due to the logarithmic shape of diode V-I curves, the voltage across the diode changes only slightly due to changes in current drawn or changes in the input. When precise voltage control and efficiency are not important, this design may be fine.

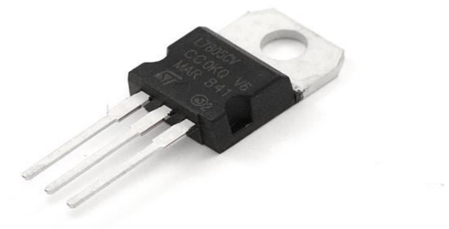

Fig 15.2 : 3 Terminal Voltage Regulator

Feedback voltage regulators operate by comparing the actual output voltage to some fixed reference voltage. Any difference is amplified and used to control the regulation element in such a way as to reduce the voltage error. This forms a negative feedback control loop; increasing the open-loop gain tends to increase regulation accuracy but reduce stability. (Stability is avoidance of oscillation, or ringing, during step changes.) There will also be a trade-off between stability and the speed of the response to changes. If the output voltage is too low (perhaps due to input voltage reducing or load current increasing), the regulation element is commanded, up to a point, to produce a higher output voltage–by dropping less of the input voltage (for linear series regulators and buck switching regulators), or to draw input current for longer periods (boost-type switching regulators); if the output voltage is too high, the regulation element will normally be commanded to produce a lower voltage. However, many regulators have over-current protection, so that they will entirely stop sourcing current (or limit the current in some way) if the output current is too high, and some regulators may also shut down if the input voltage is outside a given range (see also: crowbar circuits).

The KA78XX/KA78XXA series of three-terminal positive regulator 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 shut down 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.

The 78xx (sometimes LM78xx) is a family of self-contained fixed linear voltage regulator integrated circuits. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost. For ICs within the family, the xx is replaced with two digits, indicating the output voltage (for example, the 7805 has a 5 volt output, while the 7812 produces 12 volts). The 78xx line is positive voltage regulators: they produce a voltage that is positive relative to a common ground. There is a related line of 79xx devices which are complementary negative voltage regulators. 78xx and 79xx ICs can be used in combination to provide positive and negative supply voltages in the same circuit.

15.2 Pin Architecture:

7805, It is a voltage regulator the 78 indicates a positive regulator the 05 indicates the voltage output. At 1 amp if adequate heats sink is provided. Never fear it has thermal protection to shut it down only if the internal heating exceeds the safety zone. It will not destroy itself by removing or reducing the load it will come- back alive after cooling.

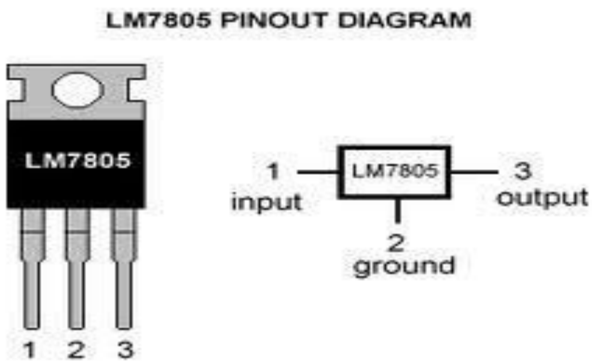

Fig15.3 : LM7805 Pinout Diagram

NOTE: Every voltage regulator has minimum voltage threshold and Maximum voltage threshold.

The minimum threshold input voltage is the should be greater than the output voltage of the regulator like for 7805 it should be greater than +5V. Similarly, the maximum threshold input is also defined for the regulator till which the voltages can be regulated to give the desired output else due to excessive heat the regulator can destroy since beside the regulated voltage the remaining voltage goes as heat loss.

So the regulators have heat sink also. Always refer the datasheet for maximum thresholds.

Try to put the input voltage minimum as per the requirement like if you require 5 V then put the source of 6V or 9V so that minimum heat is dissipated.

15.3 Internal Block Diagram:

Internal Block Digram

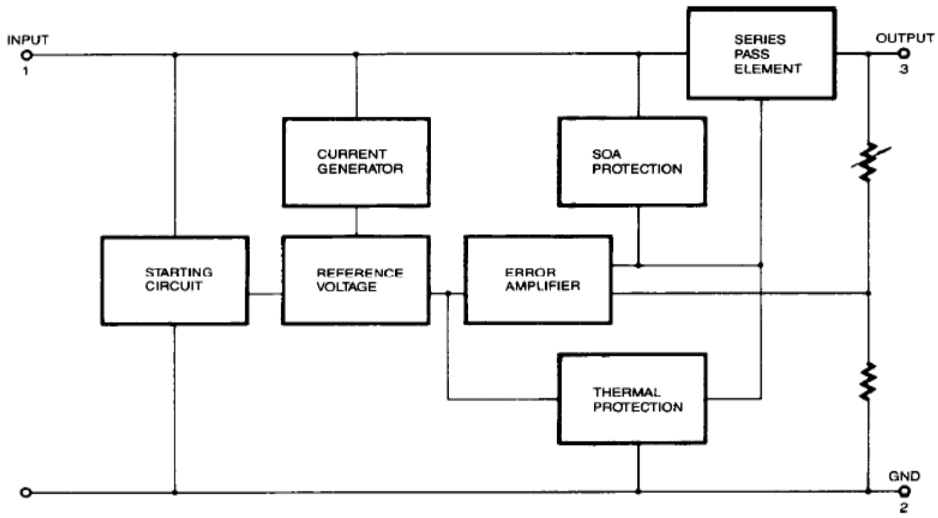

Fig 15.4 : Internal Block Diagram Of LM 7805 Voltage Regulator

Featurs In Details

- Output current in Excess of 1.0 A
- No external component required
- Internal thermal overload protection
- Internal short circuit current limiting
- Output transistor safe-area compensation
- Output voltage offered in 2% and 4% tolerance
- Available I n surface mount D2PAK and standard 3-lead transistor packages
- Previous commercial temperature range has been extended

CHAPTER-16

APPLICATIONS

- The demand for electricity is increasing every day and frequent power cuts is causing many problems in various areas like industries, hospitals and houses. An alternative arrangement for power source is a must.
- The project can be further enhanced by using other sources like wind power also and then taking into consideration for using the best possible power whose tariff remains lowest at that moment.
- Power supply can be control in:- 1) industries 2)Hospitals 3)Schools 4)Multiplexes 5)Banks etc.
- 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.
- We can implement GSM technology to inform the technician from which source power supply is coming.
- This setup can be further enhanced by using other sources like wind power and also by taking into consideration the best possible alternative power source whose tariff remains lowest at any given time.
- When power goes to off then the sources to be switched for take supply at the output load but this method can auto switched without any physical interrupt.
- Like industries frequent power supply cut create a huge amount of loss and the total energy not to be used as some loss of energy to be exist so it can save them.
- Now a days every domestic use of energy to be take from different sources

  And then it is perfect for switching supply of energy.

CHAPTER-17

CONCLUSION

We conclude that main objective of this project is to develop an “AUTO POWER SUPPLY CONTROL FROM 4 DIFFERENT TRANSFORMER TO ENSURE NO BREAK POWER”.

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.

The major aim of this no break power supply project is to supply continuous energy supply to a load, by picking the supply from any spring out of the four like – generator, mains, inverter and solar robotically in the lack of any of the spring.

The demand for power is raising day by day and regular electricity cuts are grounds to a lot of troubles in a range of areas such as- houses, hospitals and industries. A substitute arrangement for electricity supply is a must.

The no break power supply can in addition be improved by means of other springs such as wind speed power also and then taking into thought for bring into play the best feasible power whose duty maintains low at that point of time.

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