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Department of ELECTRONICS

III B.Sc. VI – Semester

Electronics Paper-7B

Consumer Electronics

(Study Material)

Name of the Student : ______________________

Roll Number : ______________________

Group : ______________________

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Dr. B. R. AMBEDKAR UNIVERSITY-SRIKAKULAM
B.Sc. ELECTRONICS SYLLABUS
STRUCTURE UNDER CHOICE BASED CREDITS SYSTEM
REVIEWED SYLLUBUS w.e.f. 2020-21

III B.Sc. SEMESTER-VI

Elective Paper – 7(B): CONSUMER ELECTRONICS

UNIT-1: MICROWAVE OVENS

Microwaves (Range used in Microwaves Ovens) – Microwave Oven block diagram – LCD timer with alarm – Single-chip Controllers – Types of Microwave Oven – Wiring and Safety instructions – Care and Cleaning.

UNIT-2: WASHING MACHINES

Electronic controller for washing machines – Washing machine hardware and software – Types of washing machines – Fuzzy logic washing machines - Features of washing machines.

UNIT-3: AIR CONDITIONERS AND REFRIGERATORS

Air conditioning – Components of air conditioning systems– All water air conditioning systems – All air-air conditioning system – Unitary and central air conditioning systems – Split air conditioners.

UINT-4 HOME/OFFICE DIGITAL DEVICES:

Facsimile machine – Xerographic copier – Calculators – Structure of calculator – Internal Organization of a calculators – Servicing electronic calculators – Digital clocks – Block diagram of digital clock.

UINT-5 DIGITAL ACCESS DEVICES

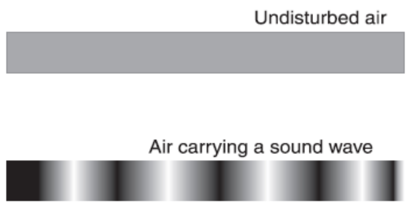
Digital computer – Internet access – Online ticket reservation – Functions and networks – Barcode Scanner and decoder – Electronic Fund Transfer – Automated Teller Machines(ATMs) – Set-Top boxes – Digital cable TV – video on demand.

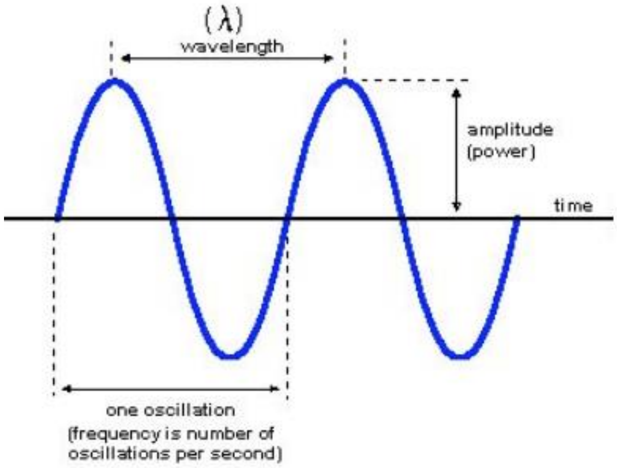
UNIT-1: MICROWAVE OVENS

1.1 BASIC TERMINOLOGY AND DEFINITIONS

Wave:

A wave is a disturbance in a medium that carries energy without a net movement of particles.





There are some basic descriptors of a wave.

(a) **Wavelength** is the distance between an identical part of the wave.

(b) **Amplitude** is maximum displacement from the neutral position. This represents the energy of the wave. Greater amplitude carries greater energy.

$$\text{frequency} = \left(\frac{1}{\text{wavelength}}\right) * \text{speed of light}$$

$$\nu = \left(\frac{1}{\lambda}\right) * c$$

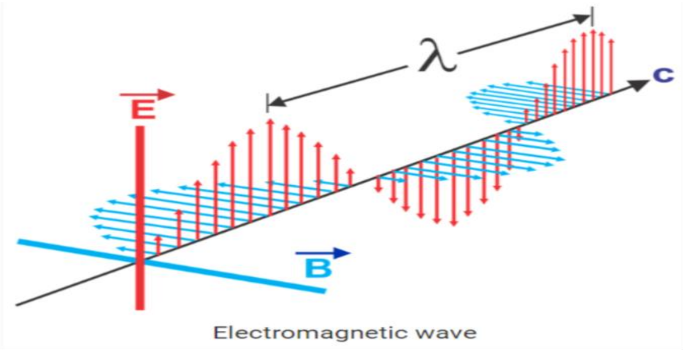
$$\nu\lambda = c$$

(c)Time Period is defined as the time taken to complete one cycle of a wave, it is denoted by T and is a reciprocal of frequency.

$$T = 1/f \text{ sec.}$$

1.2 ELECTROMAGNETIC WAVES

These waves are the disturbance that does not need any object medium for propagation and can easily travel through the vacuum. They are produced due to various magnetic and electric fields. The periodic changes that take place in magnetic electric fields and therefore known as Electromagnetic Wave



1.3 ELECTROMAGNETIC SPECTRUM

The electromagnetic (EM) spectrum is the range of all types of EM radiation. Radiation is energy that travels and spreads out as it goes – the visible light that comes from a lamp in your house and the radio waves that come from a radio station are two types of electromagnetic radiation. The other types of EM radiation that make up the electromagnetic spectrum are microwaves, infrared light, ultraviolet light, X-rays and gamma-rays.

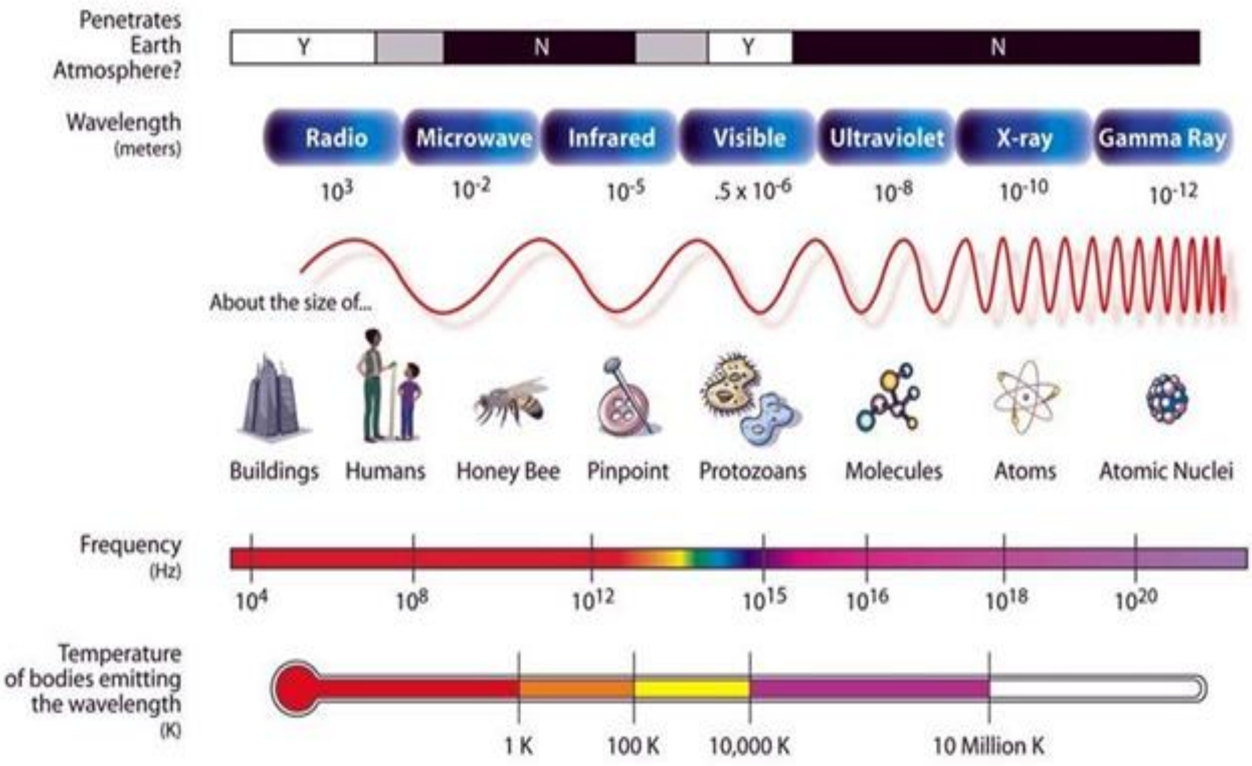


Fig. 1.1 Electromagnetic Spectrum

1.4 MICROWAVES (RANGE USED IN MICROWAVE OVEN)

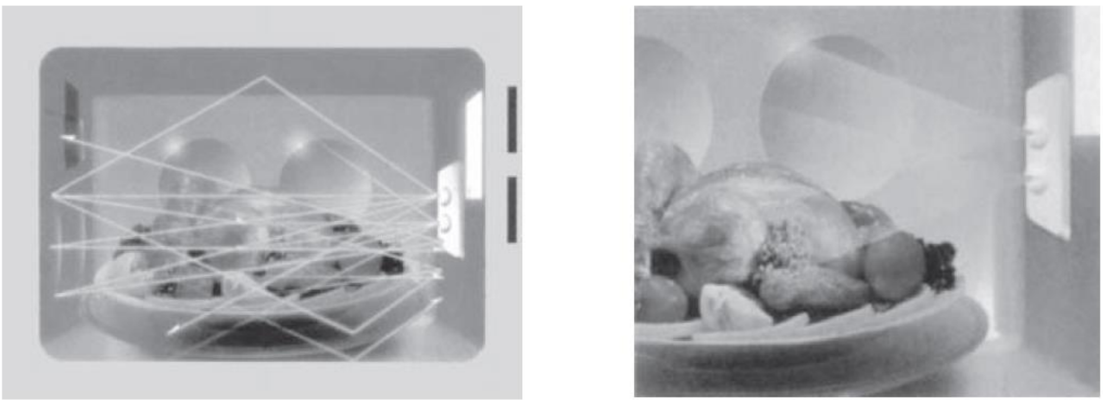
A microwave is a signal that has a wavelength of one foot (30.5 cm) or less. This converts to a frequency of 984 MHz, so all frequencies above 1000 MHz (1 GHz) are considered microwaves. The frequencies immediately below this border are considered ultra-high frequencies. The upper end of the microwave range contains the light frequencies, about 1015 MHz.

Normally microwaves spread outwards as they travel through the atmosphere and disappear without effect. The *microwave oven* uses microwaves of frequency 2.4 GHz (12.5 cm wavelength) to cook food. Microwave ovens have a *magnetron* usually concealed in the roof of the oven, specifically designed to make use of the energy in the microwaves. Electricity applied to the magnetron tube is used to create *microwave energy*.

Microwaves enter the cooking area through openings inside the oven. A turntable or tray is located at the bottom of the oven. Microwaves cannot pass through the metal walls of the oven, but they can penetrate such materials as glass, porcelain and paper, the materials out of which microwave-safe cookware is constructed. Microwaves do not heat cookware, though cooking vessels will eventually get hot from the heat generated by the food.

4 concave reflectors are located on the left and back sides to concentrate the microwave energy on the food. In state-of-art microwave ovens, the wave reflector system (WRS) and dual-wave emission system (DES), Fig. 1.2, ensure that the food is always uniformly cooked.

Microwaves reflect off the metal components in the oven (such as the interior walls and the fine screen on the oven door). These metal parts prevent the escape of microwave energy. All microwave activity remains inside the oven. When the door is opened or the oven is switched off, the production of microwaves stops instantly.



(a) (b)

Fig. 1.2 (a) The wave reflector system (WRS) (b) The dual-wave emission system (DES)

Properties of Microwaves

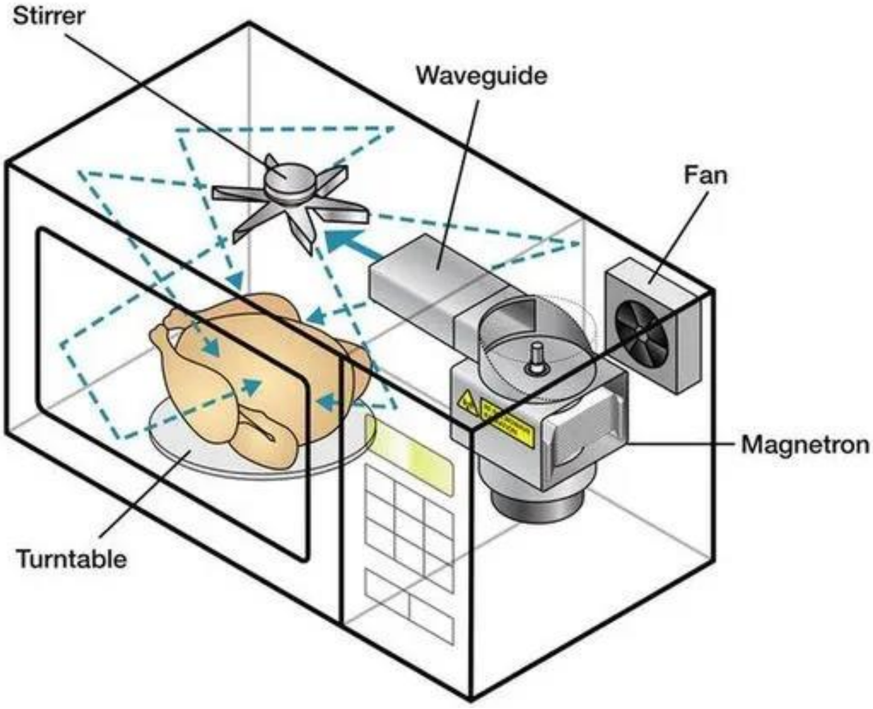
Following are the main properties of Microwaves.

- Microwaves are the waves that radiate electromagnetic energy with shorter wavelength.
- Microwaves are not reflected by Ionosphere.
- Microwaves travel in a straight line and are reflected by the conducting surfaces.
- Microwaves are easily attenuated within shorter distances.
- Microwave currents can flow through a thin layer of a cable.

Advantages of Microwaves

- Supports larger bandwidth and hence more information is transmitted. For this reason, microwaves are used for point-to-point communications.
- Higher data rates are transmitted as the bandwidth is more.
- Antenna size gets reduced, as the frequencies are higher.
- Low power consumption as the signals are of higher frequencies.
- Satellite communications with high capacities are possible.
- Low-cost miniature microwave components can be developed.
- Effective spectrum usage with wide variety of applications in all available frequency ranges of operation.

1.5 MICROWAVE OVEN BLOCK DIAGRAM



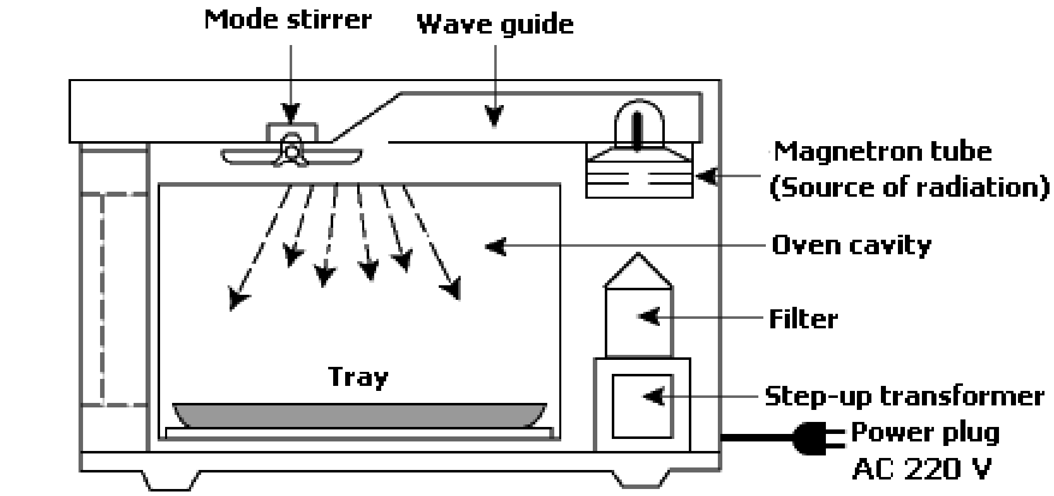


Fig. 1.3 Microwave oven schematic representation

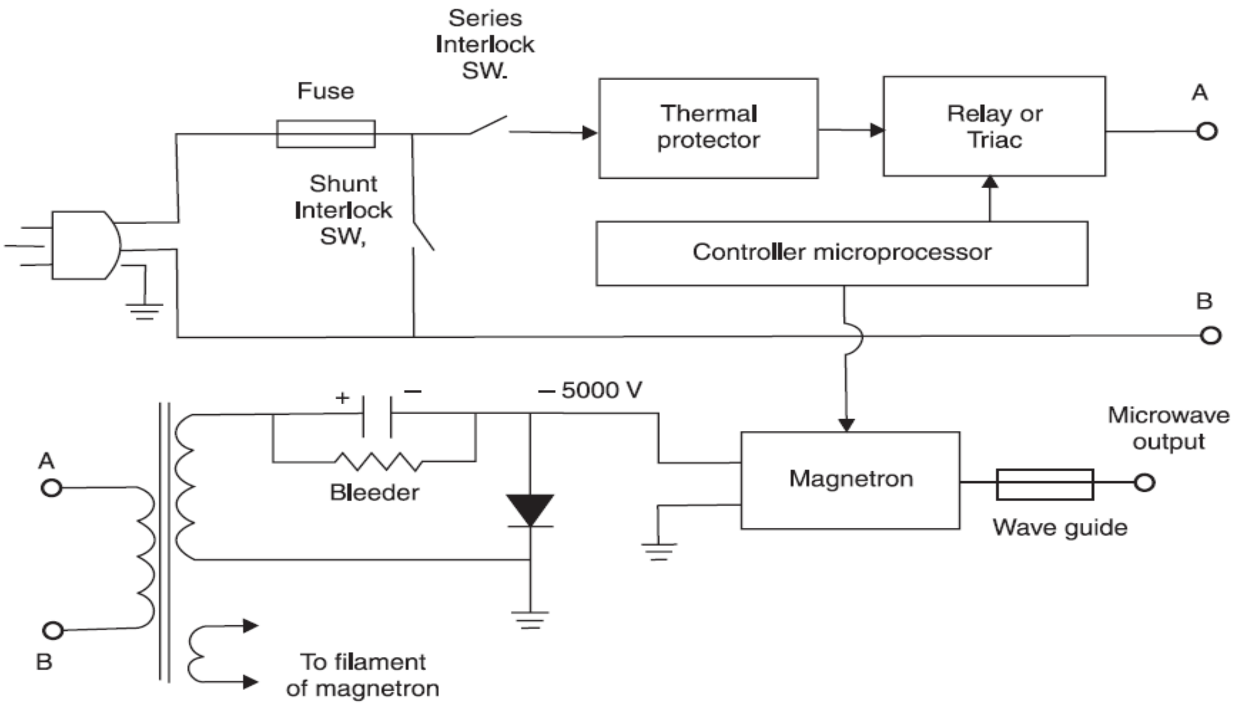


Fig. 1.4 Functional block diagram of a microwave oven

1. The block diagram of a microwave oven is given in Fig. 1.4. The mains plug and socket are three-pin earthing type. The fast blow ceramic fuse is of 15 A, 250 V.
2. Interlock switches are linked with the oven door. Power will be applied to the mains transformer only when the oven door is closed.

3. At least one interlock switch is in series with the transformer primary, hence even a spot of dirt in the relay or TRIAC, cannot turn the oven on when the door is open.
4. There is yet another interlock across the power supply line. It normally remains open. If the door alignment is not correct it will be activated, putting a short circuit (crowbar) across the line and making the fuse to melt. Thus, the microwave oven is a fail-safe device.
5. The voltage induced in the secondary winding is about 2000 V (rms) at 250 mA for normal domestic ovens. The transformer also has a tertiary winding for the magnetron filament.
6. The high voltage return circuit is fastened directly to the chassis through the transformer frame. A half-wave doubler configuration is used for the rectifier, with a peak inverse voltage of about 12000 V. One end of the diode is connected to the chassis.
7. The bleeder capacitor (1 μF) should always be discharged before touching anything inside when the cover is removed. The high value bleeder resistor is slow to discharge; further it may be open.
8. The thermal protector is a thermistor. The primary current decreases when the temperature rises abnormally. It senses the temperature of the magnetron as it is bolted to the magnetron case and is so connected electrically that its resistance comes in series with the primary circuit.
9. The controller is a microprocessor chip with a clock. It is activated by key-pad switches and sets the cooking time. It senses the temperature and moisture, sets the power levels and runs the display.
10. There are three power levels. For HIGH the microwave generator remains on continuously; for MEDIUM it remains on for 10 seconds and off for 10 seconds; for LOW it remains on for 5 seconds and off for 15 seconds. The controller activates the microwave generator using either a relay or a TRIAC.

1.6 LCD TIMER WITH ALARM

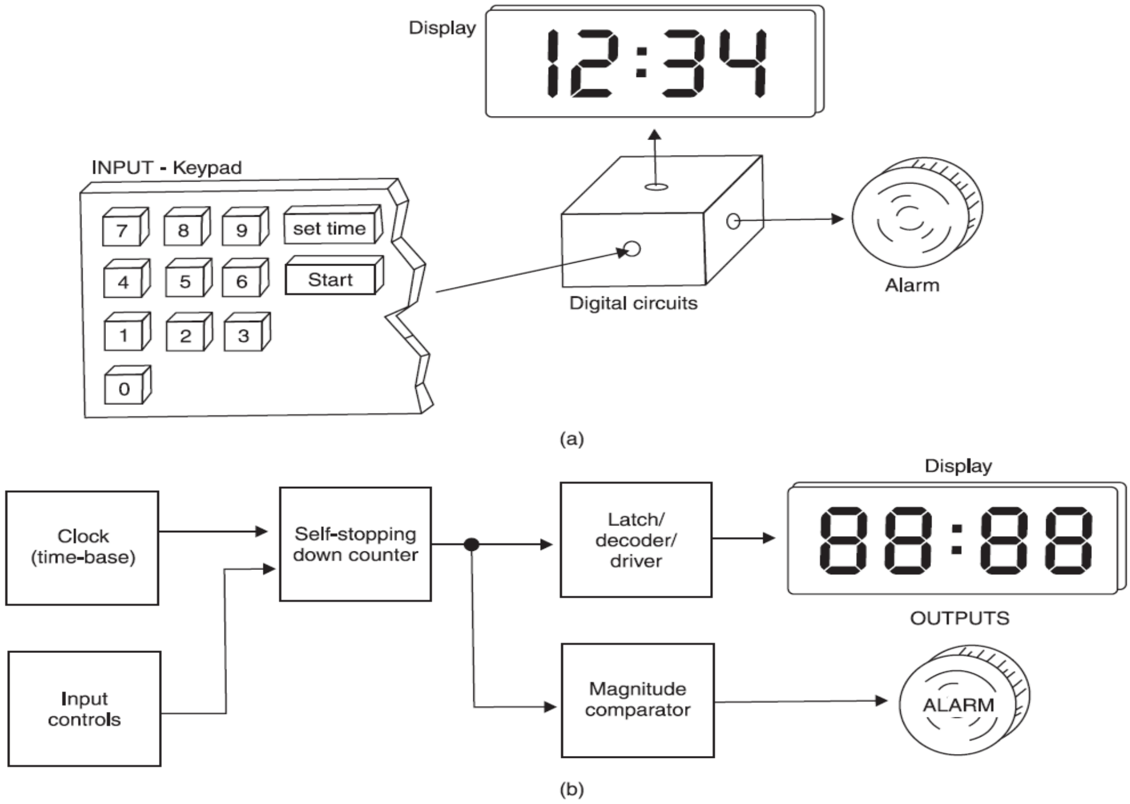


Fig. 1.5 Digital timer system (a) Concept sketch of timer with alarm (b) Simple block diagram of timer with alarm

Most microwave ovens feature at least one timer with an alarm. Older appliances used mechanical timers, but modern microwave ovens feature electronic timers using digital circuitry. The concept of a timer is sketched in Fig. 1.5. In this system, the keypad is the input and both the digital display and alarm buzzer are the output devices. The processing and storage of data occur within the digital circuits block in Fig. 1.5(a).

A somewhat more detailed block diagram of a digital timer is shown in Fig. 1.5(b). The digital circuits block has been subdivided into four blocks. They are the time-base clock, the self-stopping down counter, the latch/decoder/driver, and the magnitude comparator. The input controls block presets the time held in the down counter. The time base is a stable multivibrator which generates a known frequency. In this case, the signal is a 1 Hz square wave. The accuracy of the entire timer depends on the accuracy of the time-base clock. Activating the start input control causes the down counter to decrement. Each lower number is latched and decoded by the latch/decoder/driver. This block also drives the display.

1.7 SINGLE-CHIP CONTROLLERS

1. Microcomputers can perform a wide variety of tasks in a wide range of applications depending on the software (programs) they are running.
2. There is a more specialized type of microcomputer call a microcontroller which is not a general-purpose computer. Rather, it is designed to be used as a dedicated or embedded controller which helps monitor and control the operation of a machine, a piece of equipment, or a process.
3. Microcontrollers are microcomputers because they use a microprocessor chip as the CPU, but they are much smaller than general-purpose microcomputers because the input/output devices they normally use are much smaller.
4. In fact, some of the input/output devices—as well as memory— are usually right on the same chip as the microprocessor. These single-chip microcontrollers are employed in a wide variety of control applications such as: appliance control, VCRs, automated teller machines, photocopiers, automobile ignition systems, antilock brakes, medical instrumentation, and much more.
5. A very typical application of an embedded microprocessor is a microwave oven control system. A block diagram of such a system is shown in Fig. 1.6.

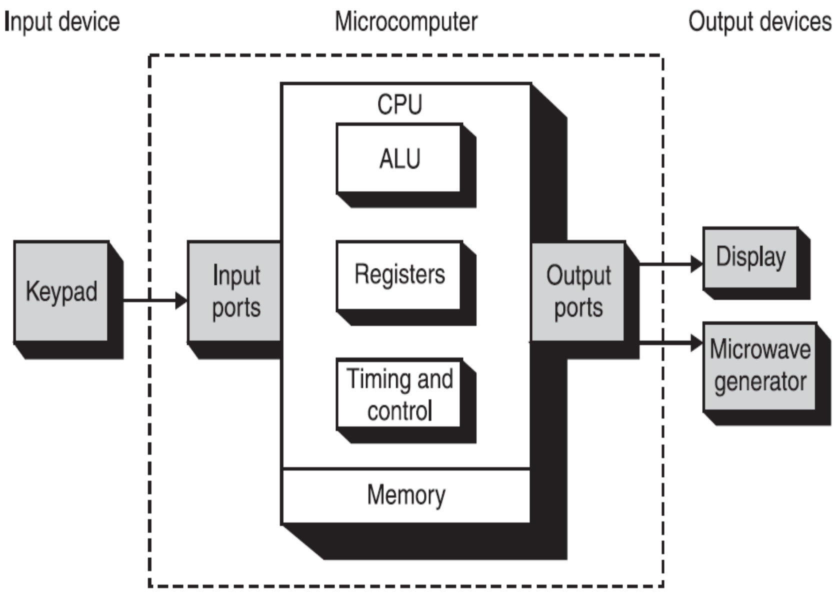


Fig. 1.6 Single-chip microcontroller block diagram

6. If we were to try to analyze all of the machine language instructions needed to program an actual microwave oven, you would find it very large. Our goal here is to understand

how a simple part of a program works and give you a partial view of what the program does to control the system.

7. In the example of Table 1.1 only a portion of a program is shown in a simplified form that you will find easy to understand. Its purpose is to determine if a non-zero value has been placed in the accumulator.
8. The value in the accumulator represents the number of seconds that the microwave should cook the food. If a non-zero value is in A, it displays the number of seconds on an output port and counts down in 1 second interval until it reaches 0. It then continues with the rest of the program.
9. The program starts executing at address 0000 when power is first applied, which resets the system. The instruction that is generally stored at the reset address is a jump instruction that sends the microcontroller to the main program.
10. The main program in this case starts at 0100, where it makes a decision either to jump immediately to the rest of the program at 010A or to execute the instructions from 0102–0109. In either case, it eventually executes the rest of the program from 010A until it is told to jump back to 0100 and do it all over again.

Table 1.1 Sample Machine-Language Program

Memory Address (Hex)	Memory Contents (Hex)	Assembly Language	Description
0000	02	LJMP 0100H	JUMP to start of program
0001	01		
0002	00		
0100	60	JZ 010AH	Should we cook the food?
0101	08		
0102	F5	MOV P1, A	Display cook time on port 1
0103	90		
0104	12	LCALL 1_SEC_DELAY	Waste one sec
0105	28		
0106	55		
0107	14	DEC A	Subtract one sec from time
0108	70	JNZ 0102H	Is the food done?
0109	F8		
010A	*****This is where the rest of the program continues.*****		

1.8 TYPES OF MICROWAVE OVEN

There are three types of microwave ovens: **Solo, Grill, and Convection**. Solo microwaves are considered basic or entry level, Grill microwaves are considered the next step up, and Convection microwaves are at the top.

Solo Microwave Ovens

1. A solo microwave is a basic/ entry level microwave designed to reheat food and beverages, cook noodles, and defrost frozen foods. Solo microwaves use electromagnetic radiation to cook food and drinks.
2. Solo microwave ovens can be used in both commercial and domestic kitchens. Solo microwaves are the cheapest of the three microwaves listed in this post. These microwaves can be seen just about anywhere including office break rooms, small apartments, and restaurant kitchens.
3. Oven capacity is the amount of cooking space inside your microwave. Oven capacity is measured by multiplying the length, width, and height. This calculation, known as the cubic foot plays an important role in the cost of the microwave.
4. The oven capacity of solo microwaves ranges from 0.5 – 2.5 cubic feet. For reference, 0.5 cubic feet is a little more than a gallon of milk, which is not big enough to cook most things.

Grill Microwave Ovens

1. A grill microwave is a microwave that gives families the grill taste without needing to fire up an outdoor grill. A grill microwave oven can do everything a solo microwave can do plus grill pizza, chicken, and fish. Grill microwaves grill food with a special grill heater and additional accessories. These special grilling coils allow food to be grilled, toasted, and roasted.
2. This model has a combination of microwave and conventional ovens called the combo mode of cooking where the food automatically cooks by means of microwaves and then crisps by the conventional method, Fig. 1.7.
3. The oven capacity for grill microwaves is a little smaller than solo microwaves. The oven capacity for grill microwaves ranges between 1 and 2.5 cubic feet.

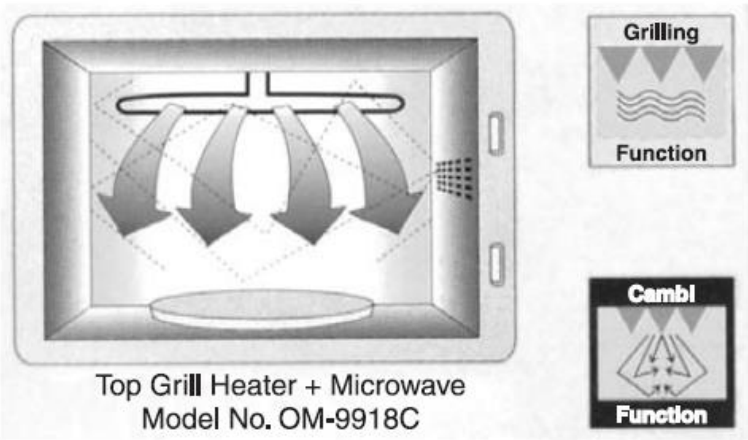


Fig. 1.7 In combo mode of cooking, the microwave along with the grill can be used simultaneously to cook faster for perfect browning and crispy texture.

<u>Convection Microwave Ovens</u>

1. Convection microwave ovens include all of the cooking options of solo and grill microwaves and have the ability to bake foods.
2. The convection microwave uses a different heater and fan combination to cook all of the foods listed plus more.
3. Convection microwaves are by far the most expensive of the three microwave types.
4. The oven capacity for convection microwaves is similar to the sizes of grill microwaves. Convection microwaves range from 1 cubic foot to over 2.0 cubic feet of cooking space.

Fig. 1.8 Different types of microwaves with their cooking ability

1.9 WIRING INSTRUCTIONS

The wires in this mains cord are colored in accordance with the following code.

Green: Earth

Black: Neutral

Red: Live

1. As the colours of the wires of the main cord of this appliance may not correspond with the coloured marking identifying the terminals in your plug, proceed as follows: The wire which is coloured green must be connected to the terminal in the plug which is marked with the 'E' or by the earth symbol or green.
2. The wire which is coloured black must be connected to the terminal which is marked with the letter 'N' or coloured black.
3. The wire which is coloured red must be connected to terminal which is marked with the letter 'L' or coloured red.
4. Ensure proper wiring of the socket which should be of 15 Amps capacity. Line terminals should confirm to the above.

Warning: This appliance must be earthed properly.

1.10 SAFETY INSTRUCTIONS

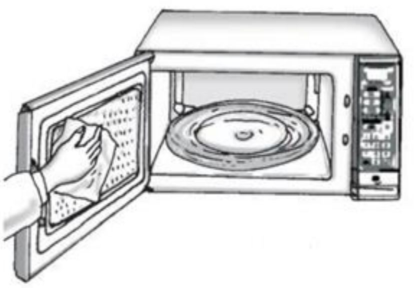
Listed below are certain rules to follow and safeguards to assure best performance from this oven:

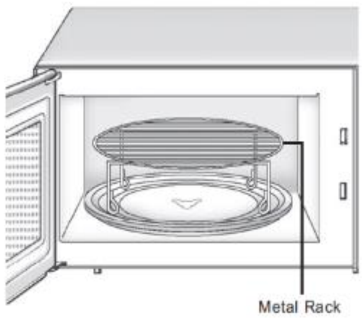
1. Do not use the oven for drying clothes, paper or any other nonfood item.
2. Do not use the oven without food items, this could damage the oven and may cause smoke emission.
3. Do not use the oven for storage of papers, cookbook, cookware, etc.
4. Do not operate the oven without glass tray. Be sure it is properly placed on the rotating base.
5. Ensure removal of caps or lids prior to cooking when you cook food sealed in bottles.
6. Do not put foreign material between the oven surface and door which could result in excessive leakage of harmful microwave energy.
7. Do not use recycled paper products for cooking. They may contain impurities which could cause sparks and/or fires when used during cooking.

8. Do not pop popcorn longer than the manufacturer's directions (popping time is generally below 3 minutes). Longer cooking does not yield more popped corn; it can cause fire. Also, the cooking tray can become too hot to handle or may break.
9. Should the microwave oven emit smoke indicating a fire, keep the oven door shut, switch the appliance off and disconnect the mains cord from the outlet.
10. Always test the temperature of food or drink which has been heated in a microwave oven before serving, especially to children or elderly people. This is important because things which have been heated in a microwave oven keep on getting hotter even though the microwave oven cooking has stopped.

1.11 CARE AND CLEANING

Wipe the oven inside and outside with a soft cloth and mild detergent solution. Then rinse and wipe dry. This should be done on a weekly basis—more often if needed. Never use rough powders. The inside oven top can be gently wiped in place. Excessive oil spatters on the inside top will be difficult to remove if left for many days. Wipe spatters with a wet paper towel especially after cooking chicken or bacon. For best performance and safety, the inner door panel and the oven front frame should be free of food or grease build-up. Wipe both often with a mild detergent. Then rinse and wipe dry. Never use rough powders or pads.





METAL RACK CARE:

(i) The metal rack may get hot during cooking.

Pot holders may be needed to remove Rack after cooking.

(ii) Remove metal rack from oven when not being used for whole meal cooking.

(iii) Do not use browning dishes on metal rack.

(iv) Do not run the oven empty with the metal rack in it.

(v) Do not use foil or metal containers on the metal rack.

UNIT-2: WASHING MACHINES

2.1 ELECTRONIC CONTROLLER FOR WASHING MACHINES

The task here is simply to identify the input and output devices used in electronic washing machines and to construct a block diagram showing their connections to the controller.

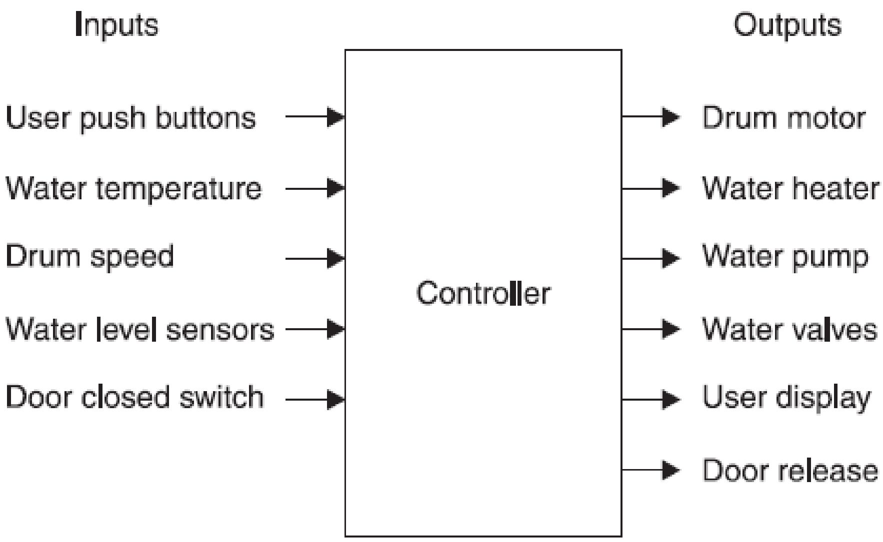


Fig. 2.1 Inputs and outputs in an electronic washing machine

Inputs to Controller:

1. The user push buttons are used to give the timing and type of washing to be done by the washing machine.
2. Water temperature is measured by the controller through a temperature sensor, based the sensor value either the temperature of the water is controlled (either increased or decreased) by enabling the water heater.
3. Drum speed is continuously monitored by the controller to provide proper washing to clothes, different speeds are used for different type of washing and types of clothes.
4. Water level is measured through a sensor.
5. Door closed switch gives the information about whether the door is properly closed or not.

Outputs from Controller:

The outputs from the controller are used to control various output devices.

1. One output signal is connected to drum motor either to increase or decrease the speed of the drum.

2. Water heater signal is used to increase or decrease the water temperature based on the input signal water temperature.
3. Water pump and water valves are used to release the excess water in the machine based on the input signal water level sensor value.
4. Used display indicates the timing information.
5. Door release signal controls the door of the machine.

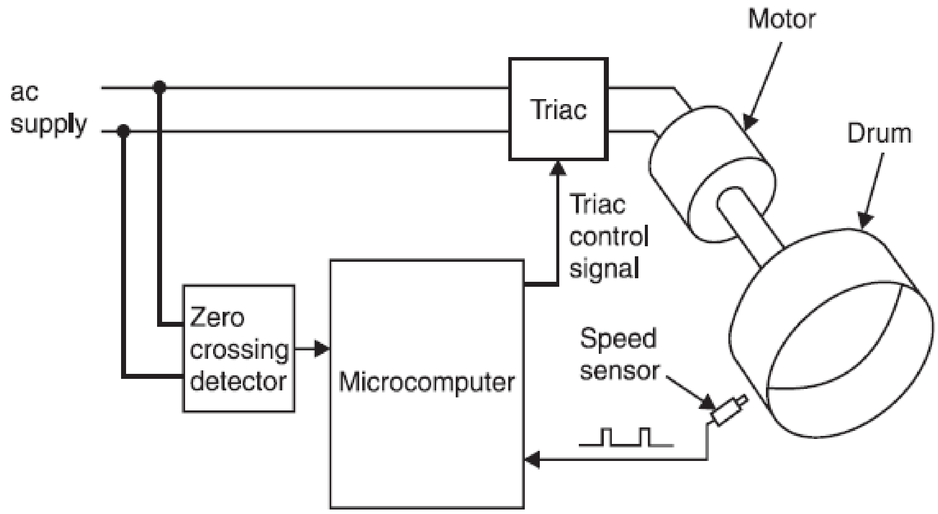


Fig. 2.2 Washing machine Model

At various stages of the washing cycle the drum is required to rotate at different speeds. These include:

1. A low speed of about 30 revolutions per minute (rpm) while clothes are washed.
2. An intermediate speed of about 90 rpm while the water is pumped out.
3. A high speed of either 500 or 1000 rpm to spin dry the clothes.

Let's consider how the microcomputer should control the speed of the motor.

1. The speed of the motor will be controlled by the power dissipated in it. The simplest way of speed control is to use a TRIAC.

2. The power could be controlled by some form of electronic circuitry, but the hardware requirement can be reduced if the microcomputer controls the power directly by firing the TRIAC at an appropriate time during its cycle. To do this the controller must detect the zero crossing of the ac supply.
3. One of the simplest methods of speed measurement is to use a counting technique illustrated in Fig. 2.3. It uses a fixed inductive sensor to produce a pulse each time it is

passed by a magnet which rotates with the drum. This produces one pulse per revolution of the drum which can be used to determine its speed.

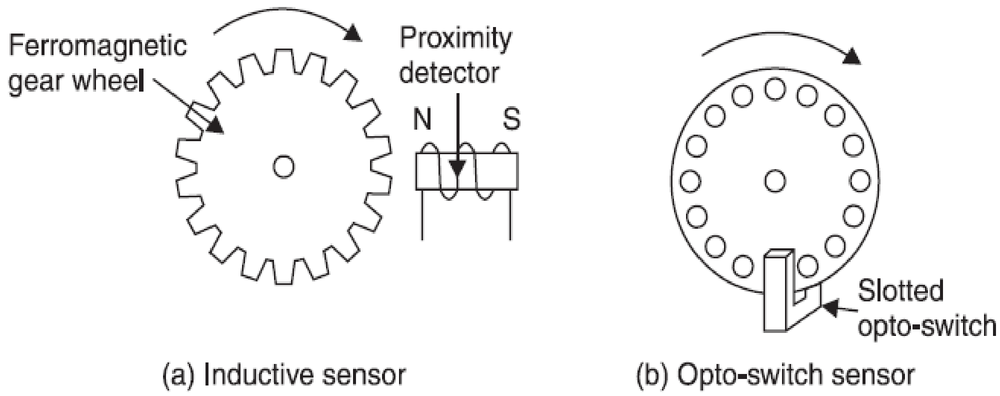


Fig. 2.3 Displacement sensors using counting

4. At any time in the washing cycle the program determines at what speed the drum should rotate. From a knowledge of the required speed and the actual speed as obtained above, the controller can determine whether to increase or decrease the power dissipated in the motor.
5. The motor power is determined by the timing of the TRIAC firing pulse. If the TRIAC is fired at the beginning of each half of mains cycle it will remain on for the remainder of the half cycle and the motor will operate at full power.
6. The longer the processor waits before firing the TRIAC, the less will be the motor power. The processor thus varies the delay time with respect to the zero-crossing point of the mains by an appropriate amount to increase or decrease the power in the motor as determined by the difference between the actual and required speeds.

2.2 WASHING MACHINE HARDWARE

A system is an assembly of components united by some form of regulated interaction to form an organized whole.

We will examine a microcomputer system, a washing machine control as an example. The input peripherals consist of (Fig. 2.4).

1. temperature sensor which senses the washing water temperature. (The analog/digital converter changes the analog values to binary numbers).
2. safety cut-out switch.
3. keyboard for program selection.
4. water level gauge.
5. motor for washing drum.
6. power switches for motor, heater, etc.
7. heater for washing water.
8. water inlet valve.
9. water suction pump.
10. control lamps and indicators.

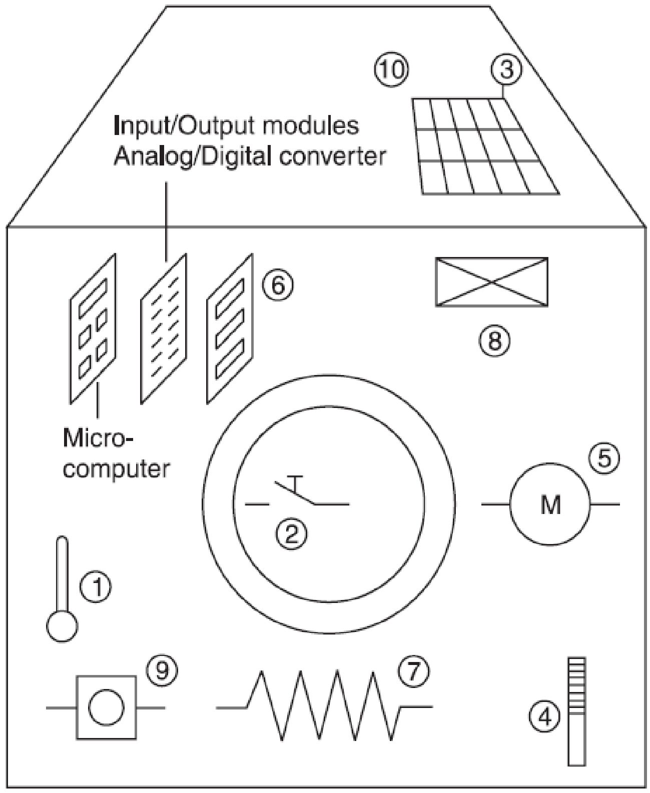


Fig. 2.4 Washing machine hardware

The units listed above i.e., the washing machine as well as its mechanical components, electrical units and electronic components are known as hardware.

2.3 WASHING CYCLE

1. The push-button keyboard enables the desired program to be selected.
2. The control—the microcomputer— checks firstly that the safety cut-out is in the ON position. The water is then admitted (valve opened) and the water level is constantly monitored.
3. When the required quantity of water has been provided the valve closes.
4. The water temperature is measured and the heater is switched until the water reaches the required temperature.
5. In the meantime, the washing powder is admitted from a container and the hardness of water is noted, at the same time the drum motor is switched on so that the dirty washing is evenly moved through the water.
6. After the required time has elapsed, according to the selected program, the motor is switched to high-speed spinning and the suction pump is switched on to remove the washing water and the rinsing water to waste.
7. At the end of the washing cycle the machine switches off and provides a signal to indicate this.

2.4 HARDWARE AND SOFTWARE DEVELOPMENT

We will now examine how a system is developed. The example used for this is, of course, a simple washing machine control. The development will follow the broad pattern shown in Fig. 2.5.

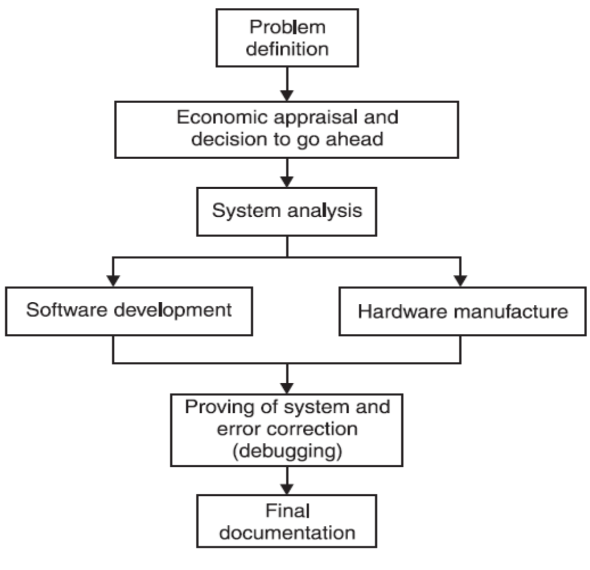


Fig. 2.5 Developing the system for washing machine control

1. The problem definition is based on the requirements of the specification. It is a means of determining what a system's performance is capable of and what is required from it.
2. The decision to go ahead with the developments of a system is governed by economic appraisal and technical feasibility of the plan.
3. To establish these criteria the required operating speed, memory storage capacity and costs of the component parts of the system must be determined.
4. Subsequently the structure of the problem is analyzed and the final production costs deduced.
5. There are two alternative approaches for hardware development. On one hand, a universal system may be considered which has not been designed to cope with any one specific problem. On the other hand, a specially designed system may be decided upon in which the components used are specially selected for their suitability to deal with the problem under consideration.
6. For software development a detailed program sequence plan must first be established. This is then written in the appropriate code and fed into a computer or into a development system.
7. The program is then translated into the language required by the machine and a simulation of the operation sequence is carried out.
8. Any errors found in the program are corrected (this is known as debugging) and the software is then available for use.
9. After the hardware and software has been developed the system is tested. An examination is carried out to determine whether the system can satisfy all the demands which may be put upon it, i.e. "Can the machine perform every function which may be required from it?"

2.5 TYPES OF WASHING MACHINES

Washing machines are mainly of three types, namely washer, semi-automatic and automatic. Washers are single tub machines that only wash. Since washers don't have the facilities for drying the clothes, these cost less than semi-automatic and fully automatic machines.

In semi-automatic machine, Fig. 2.6, the controls are not fully automatic and manual intervention is required.

In fully automatic machines, Fig. 2.7, no manual intervention is required during the washing process.

Fig. 2.6 A typical semi-automatic washing machine (top loading)

Fig. 2.7 A typical fully-automatic washing machine (top loading)

1. For automatic machines, programs have to be selected and set by the user prior to the start of washing cycle.
2. Sensors sense the wash load and decide the program ideal for washing the clothes, water level, time required to wash, number of rinses and spins, type of fabric etc.
3. Although washer dryer (semi-automatic) machines don't operate with the efficiency of standalone washing machines, they offer enormous space saving.
4. However, you have to drain all the soap water before drying.
5. Also, you can't wash and dry at the same time and the drying performance is inferior to that of standalone machines. But then washer-dryers cost less and allow you to wash and dry your clothes without having to reset the machines.

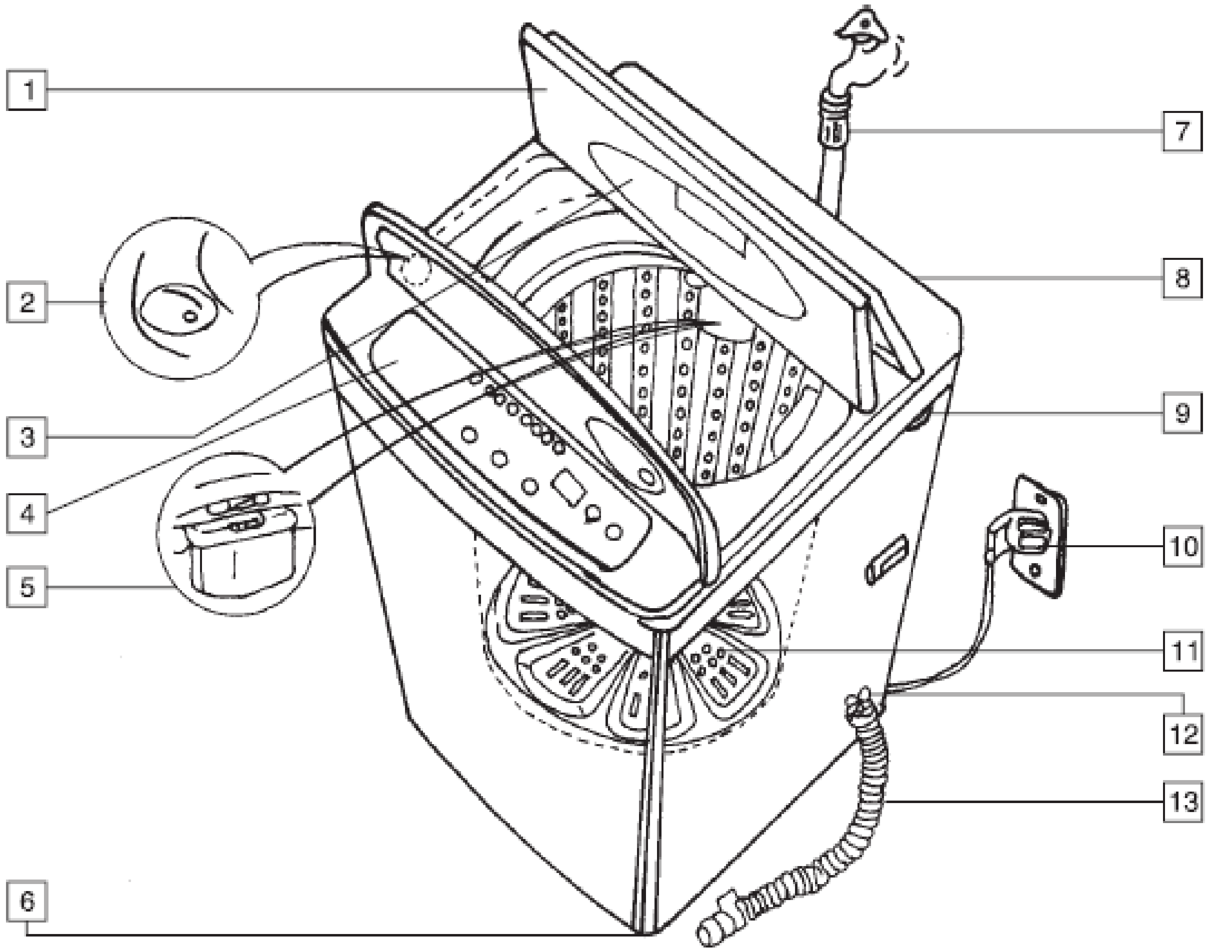
2.6 FUZZY LOGIC WASHING MACHINES

1. Fuzzy logic washing machines are gaining popularity. These machines offer the advantages of performance productivity, simplicity, and less cost.
2. Sensors continually monitor varying conditions inside the machine and accordingly adjust operations for the best wash results.

3. Typically, fuzzy logic controls the washing process, water intake, water temperature, wash time, rinse performance and spin speed. This optimizes the life span of the washing machine.
4. More sophisticated washing machines weigh the load (so you can't overload the washing machine), advise on the required amount of detergent, assess cloth material type and water hardness, and check whether the detergent is in powder or liquid form. Some machines even learn from past experience, memorizing programs and adjusting them to minimize running costs.
5. Machines with fuzzy logic microprocessors can be updated as and when a new technology or program comes up. Several models of internet-enabled washing machines have been launched. These machines will allow downloading of new programs and remote fault diagnosis over the direct internet connection.
6. Most fuzzy logic machines feature one-touch control. Equipped with energy saving features, these machines consume less power, and are worth paying extra for if you wash full loads more than three times a week. In-built sensors monitor the washing process and make corrections to produce the best washing results.
7. In some machines a tangle sensor senses where the clothes are tangled and takes corrective action by adjusting the water current, so the clothes don't tangle further and are cleaned better.
8. High-end machines have a suds-free system including a pressure sensor to detect extra suds in washing if you have used a large amount of detergent.
9. These machines cost more than regular models. The foam suppression feature detects whether too much foam is present during wash and accordingly it either reduces the agitation or adds an extra rinse.
10. Fuzzy logic checks for the extent of dirt and grease, the amount of soap and water to add, direction of spin and so on. The machine rebalances washing load to ensure correct spinning. Else it reduces spinning speed if an imbalance is detected.

2.7 FEATURES OF WASHING MACHINE

The controls and features of a typical top loading washing machine are shown in Fig. 2.8. The controls of a typical front-loading washing machine are given in Fig. 2.9.



1. **Lid**
2. **Bleach inlet**
3. **Transparent window**
   You can see the laundry being washed through this window.
4. **Front control panel**
   Open the panel lid, and then choose the function you want to use.
5. **Softener case**
6. **Adjustable legs**
   Adjust the length of the legs when installing the washer.
7. **Water supply hose**
8. **Lint filter**
   Lint will collect in the lint filter pouch during washing.
9. **Drain hose hook**
10. **Power cord**
11. **Pulsator**
12. **Drain hose clamp**
13. **Drain hose**

Fig. 2.8 The controls and features of a typical top loading washing machine

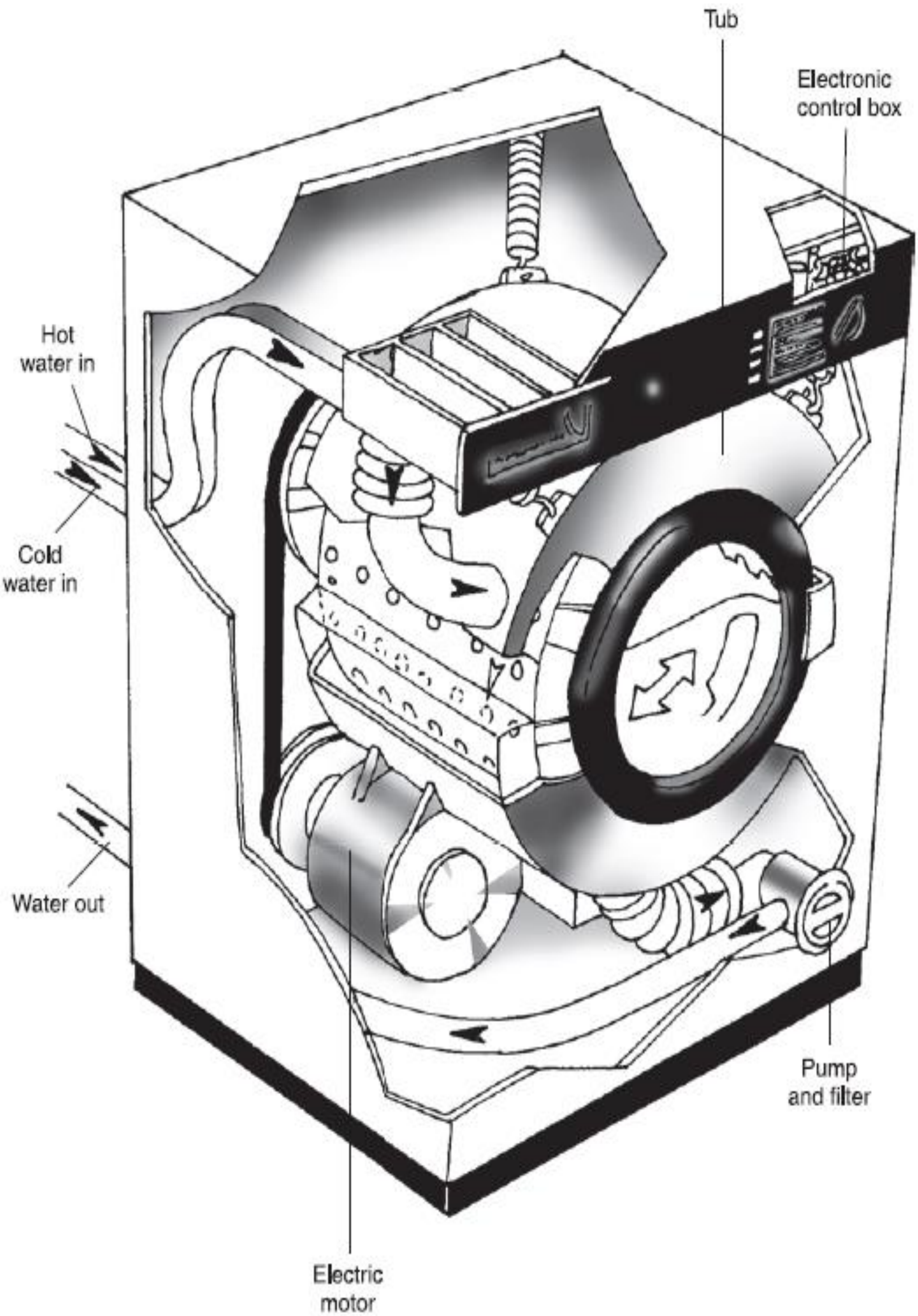


Fig. 2.9 The controls of a typical front-loading washing machine

1. Capacity: The capacity of a washing machine is expressed in terms of the wash load, which in turn depends on the type of fabric. It is expressed in kg. The maximum load for the washer is the amount that will move freely in the wash tub. Indicative range of weights of some commonly washed clothes is given in Table 2.1.

Clothes	Approximate *weights*
Shirt	200 gm – 300 gm
Trousers	350 gm – 500 gm
Pyjama	300 gm – 400 gm
Kurta	200 gm – 300 gm
Lungi	200 gm – 300 gm
Vests	75 gm – 100 gm
Salwar Suit	350 gm – 500 gm
Frocks-Baby	200 gm – 300 gm
Frocks-Girl	350 gm – 450 gm
Skirt	200 gm – 300 gm
Sweater	500 gm – 800 gm
Bedsheet Double	1000 gm – 1200 gm
Bedsheet Single	400 gm – 600 gm
Towel large	700 gm – 1000 gm

2. Wash programs: High-end washing machines feature different wash programs to suit different types of clothes. The program includes regular for normal wash, gentle for delicate clothes and tough/hard for rugged clothes. In addition, you are able to select the temperature of wash and the number of runs for better cleaning. This is important for clothes that require different temperatures.

3. Spin Speed: The higher the spin speed, the dryer the clothes at the end of the washing cycle and hence the shorter the drying time in the tumbler dryer. Thus, a high spin speed results in less washing time. Some machines spin at more than 1000 rpm, some machines spin as fast as 7000 rpm during drying cycle.

4. Washing Technique: In some machines a pulsator disk (Fig. 2.10) at the bottom, circulates water upwards in large circles while rotating, providing better and gentler cleaning of clothes.

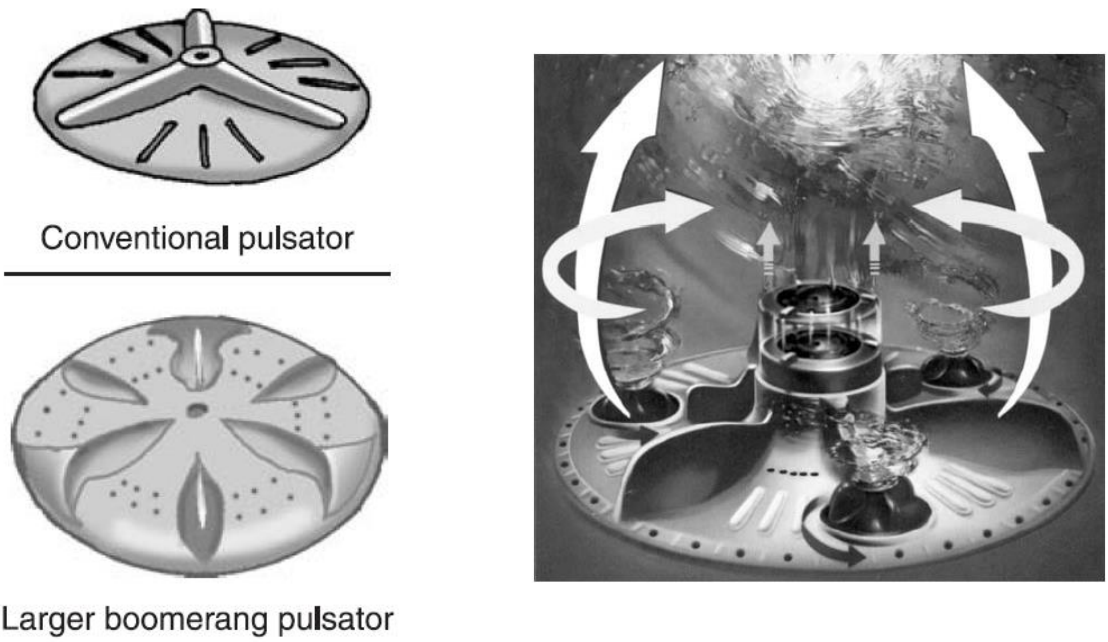


Fig. 2.10 Pulsator disk

5.Loading the machine: Top loaders (Fig. 2.8) allow you to easily remove clothes, without having to bend even during power failure. These are compact and require normal detergents. You can add clothes even during the wash cycle. The larger the porthole, the more convenient the loading and unloading. Most top loading machines have an agitator.

Front loaders (Fig. 2.9) are usually more expensive than top loaders as these incorporate large and heavy motors and suspensions. However, these machines consume less water and dry clothes much faster, thereby reducing energy bill.

6. Automation: On fully-automated washing machines you don't need to wet your hands, just put in the wash load, turn the machine on and wait for it to finish washing and drying. Automatic machines require a dedicated running water supply from a tap. A single tub carries out all the actions. The washing machine does wash, rinsing and drying and beeps when it is through with all the tasks.

UNIT-3: AIR CONDITIONERS AND REFRIGERATORS

3.1 AIR CONDITIONING

Air conditioning is the process of treating air in an internal environment to establish and maintain required standards of temperature, humidity, cleanliness, and motion. This is how each of these conditions is controlled:

1. **Temperature:** Air temperature is controlled by heating or cooling the air. Cooling technically means the removal of heat, in contrast to heating, the addition of heat.
2. **Humidity:** Air humidity, the water vapour content of the air, is controlled by adding (humidification) or removing (dehumidification) water vapour from the air.
3. **Cleanliness:** Air cleanliness or air quality is controlled by either filtration, the removal of undesirable contaminants using filters or other devices or by ventilation, the introduction of outside air into the space which dilutes the concentration of contaminants. Often both filtration and ventilation are used in an installation.
4. **Motion:** Air motion refers to air velocity and to where the air is distributed. It is controlled by appropriate air distributing equipment.

Sound control can be considered an auxiliary function of an air conditioning system even though the system itself may be the cause of the problem. The air conditioning equipment may produce excessive noise requiring additional sound attenuating (reducing) devices as part of the equipment.

The above description does not imply that every HVAC (heating, ventilation and air conditioning) system regulates all of the conditions described.

1. A hot water or steam heating system consisting of a boiler, piping, and radiation devices (and perhaps a pump) only controls air temperature and only during the heating season. These types of systems are common in many individual homes (residences), apartment houses, and industrial buildings.
2. A warm air system, consisting of a furnace, ducts, and air outlet registers, also controls air temperature in winter only. However, by the addition of a humidifier in the ducts, it may also control humidity in winter. Warm air systems are popular in residences.
3. Some residences have combination of air heating and air-cooling equipment that provides control of temperature and humidity in both winter and summer. Some degree of control of air quality and motion is provided in air-type heating and cooling systems.

Air conditioning systems used for newer commercial and institutional buildings and luxury apartment houses usually provide year-round control of most or all of the air conditions described. For this reason, it is becoming increasingly popular to call complete HVAC systems environmental control systems.

Most air conditioning systems are used for either human comfort or for process control. Air conditioning enhances our comfort. Certain ranges of air temperature, humidity, cleanliness, and motion are comfortable; others are not.

Air conditioning is also used to provide conditions that some processes require. For example, textile printing, and photographic processing facilities as well as computer rooms and medical facilities, require certain air temperature and humidity for successful operation.

3.2 COMPONENTS OF AIR CONDITIONING SYSTEMS

Heat always travels from a warmer to a cooler area. In winter, there is a continual heat loss from within a building to the outdoors. If the air in the building is to be maintained at a comfortable temperature, heat must be continually supplied to the air in the rooms. The equipment that furnishes the heat required is called a heating system.

In summer heat continually enters the building from the outside. In order to maintain the room air at a comfortable temperature, this excess heat must be continually removed from the room. The equipment that removes the excess heat is called a cooling system.

An air conditioning system may provide heating, cooling, or both. Its size and complexity may range from a single space heater or window unit for a small room to a huge system for a building complex. Most heating and cooling systems must have the following basic components:

1. A heating source that adds heat to a fluid (air, water, or steam).
2. A cooling source that removes heat from a fluid (air or water).
3. A distribution system (a network of ducts or piping) to carry the fluid to the rooms to be heated or cooled.
4. Equipment (fans or pumps) for moving the air or water.
5. Devices (e.g., radiation) for transferring heat between the fluid and the room.

3.3 ALL-WATER AIR CONDITIONING SYSTEMS

A typical hydronic (all water) heating system is shown in Fig. 3.1. Water is heated at the heat source (1) usually a hot water boiler. The heated water is circulated by a pump (2) and travels to each room through piping (3) and enters a terminal unit (4). The room air is heated by bringing it into contact with the terminal unit. Since the water loses some of its heat to the rooms, it must return to the heat source to be reheated.

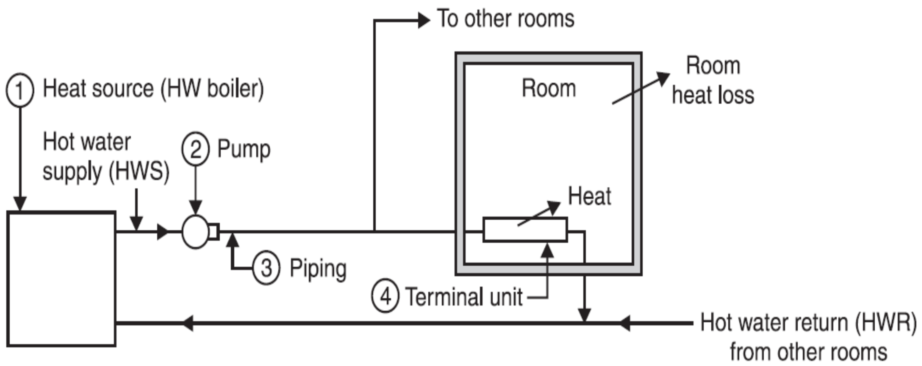


Fig. 3.1 Arrangement of basic components of a (hydronic) hot water heating system

If steam is used in a heating system, the components still work in the same manner, with the exception that a pump is not necessary to move the steam; the pressure of steam accomplishes this. However, when the steam cools at the terminal unit, it condenses into water and may require a condensate pump to return the water to the boiler.

A hydronic cooling system Fig. 3.2, functions in a similar manner to the hydronic heating system. Water is cooled in refrigeration equipment called a water chiller (1). The chilled water is circulated by a pump (2) and travels to each room through piping (3) and enters a terminal unit (4). The warmer room air loses its heat to the cold water in the terminal unit. Since the water is now warmed, it must return to the water chiller to be recooled.

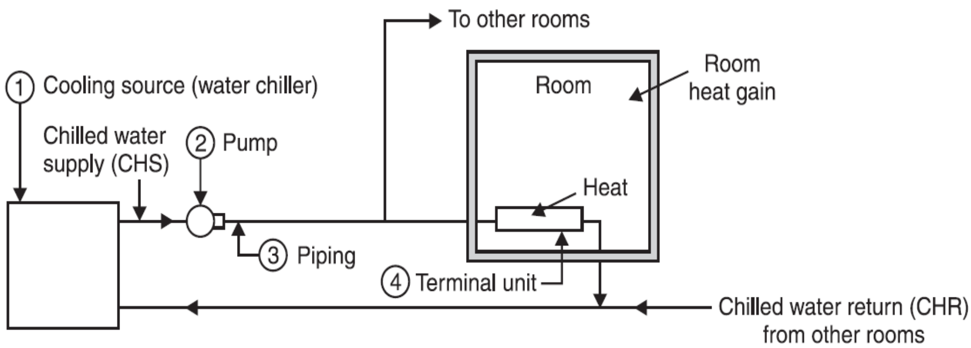


Fig. 3.2 Arrangement of basic components of a (hydronic) chilled water-cooling system

Hydronic systems are popular for HVAC systems that require both heating and cooling. This is because it is possible to use the same piping system for both by connecting a hot water boiler and water chiller in parallel, Fig. 3.3, using each when needed.

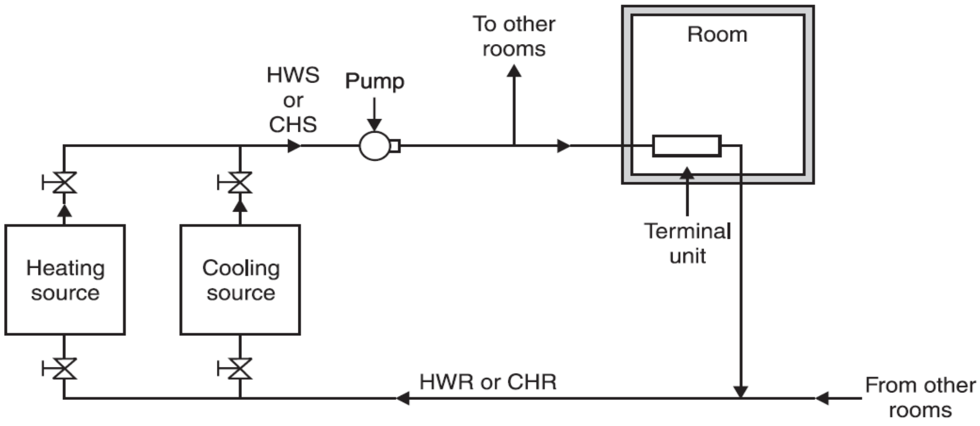


Fig. 3.3 Arrangement of basic components of a hydronic heating and cooling system

3.4 ALL-AIR AIR CONDITIONING SYSTEMS

All-air systems use air to heat or cool rooms. They may also have the added capability of controlling humidity and furnishing outdoor ventilation, which hydronic systems cannot do.

A typical all-air heating and cooling system is shown in Fig. 3.4. Air is heated at the heat source (1), such as a furnace. It may also be a coil circulating hot water, or steam, heated by a boiler. The heated air is circulated by a fan (2) and travels to each room through supply air ducts (3). The supply air enters the room through outlets called air diffusers or registers (4) that are designed to provide proper air distribution in the room. When the warmed supply air enters the room, the room is heated. A humidifier (10) may also be included to maintain a comfortable room humidity in winter.

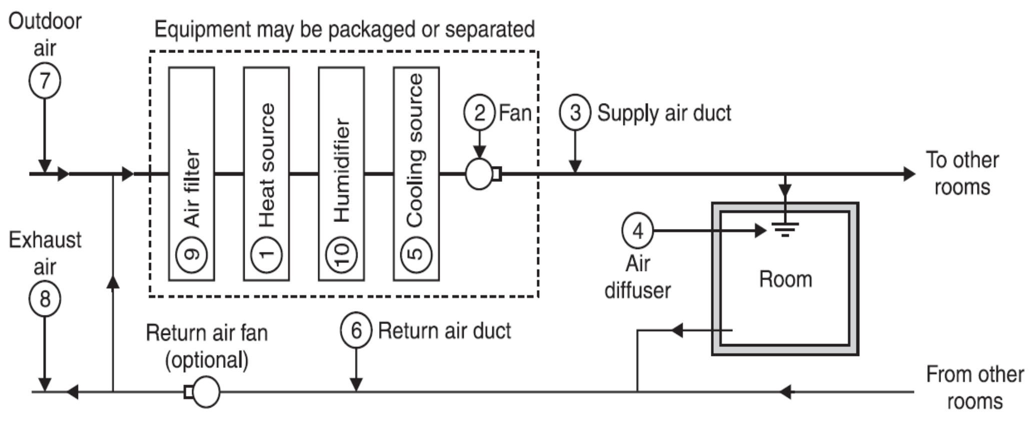


Fig. 3.4 Arrangement of basic components of an all-air heating and cooling system

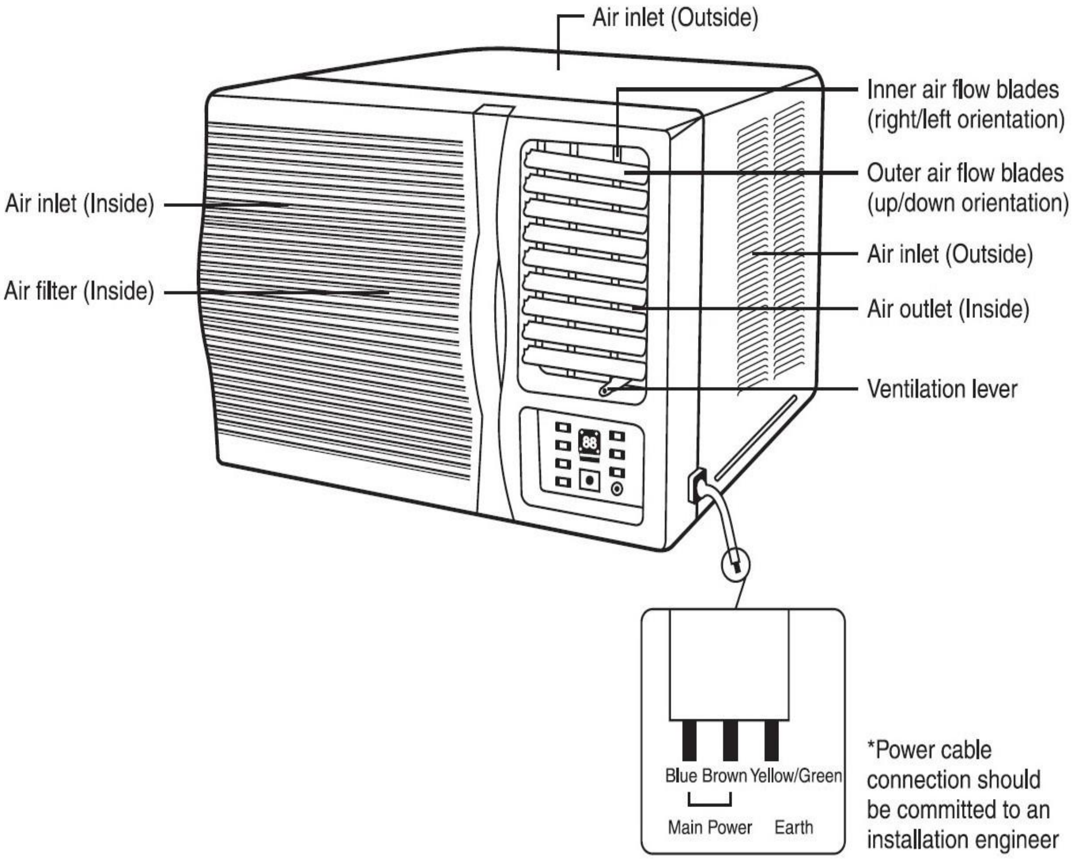
In summer, air is cooled when it flows over a cooling source (5), usually a coil of tubing containing a fluid cooled by refrigeration equipments. When the cooled supply air enters the room, the room is cooled.

Because a room's size is fixed, the same volume of air that enters the room must also exit. This is usually accomplished by return air ducts (6). The air is then heated or cooled again and recirculated. An outdoor air intake duct (7) may be provided for introducing fresh outdoor air for increased air quality. Similarly, the same volume of air must be exhausted (8). Provision may be made for cleaning the air with air filters (9) and for humidifying the air (10).

3.5 UNITARY AND CENTRAL AIR CONDITIONING SYSTEMS

A unitary or package air conditioning system uses equipment where most or all of the basic components have been assembled in the factory e.g., room air conditioner (Fig. 3.5).

A central or built-up air conditioning system uses equipment centrally located in mechanical equipment rooms. Each piece of equipment is installed separately and connected on the job, rather than manufactured as a package.



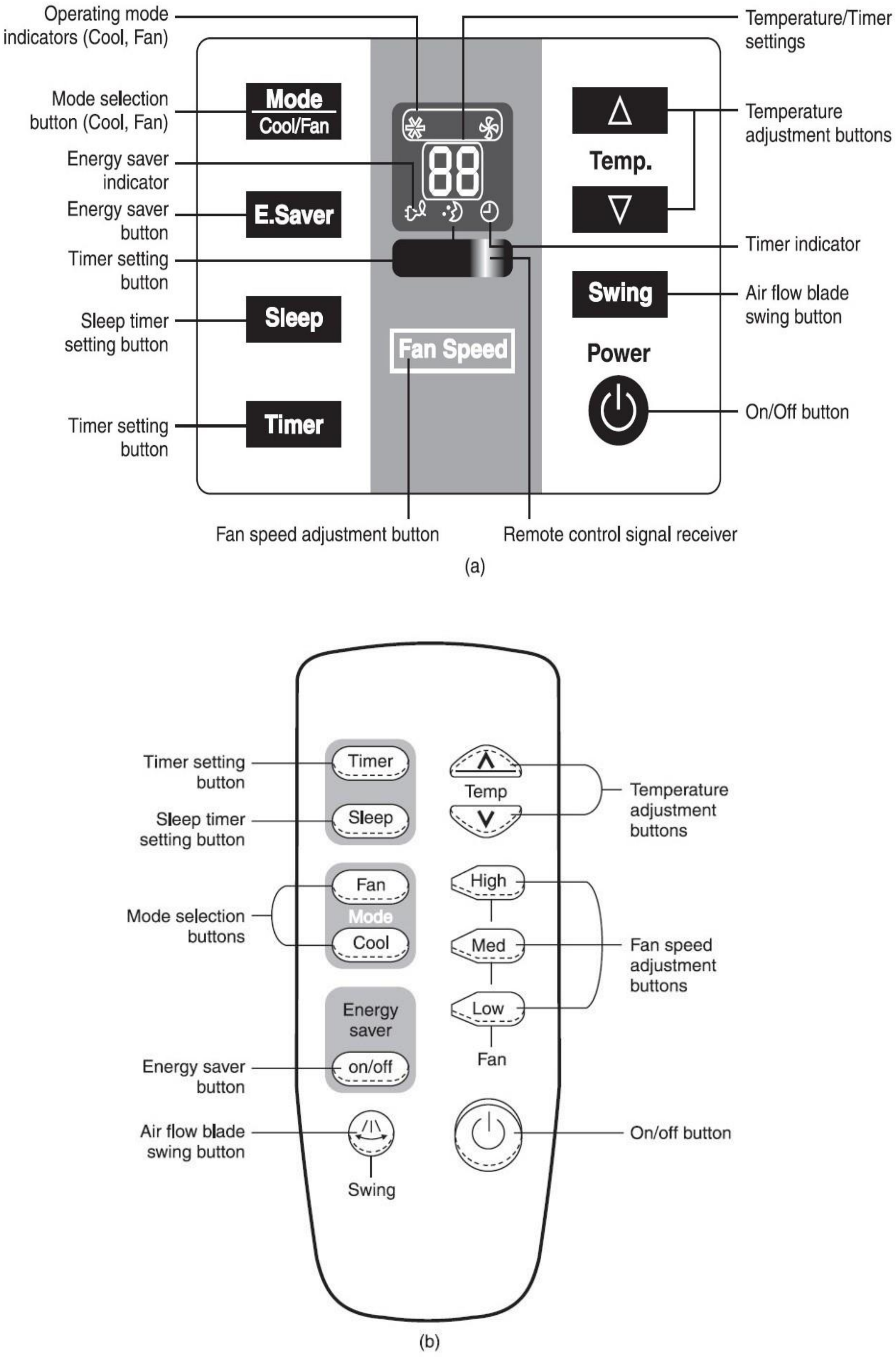


Fig. 3.5 (a) A unitary window type room air conditioner Control and features and (b) a typical remote control

3.6 SPLIT AIR CONDITIONERS

In split units the indoor and outdoor sections of the room air conditioner are separated out into two casings or units. The indoor unit, Fig. 3.5, consists of the evaporator coil, evaporator blower with its own separate motor, capillary tube, control panel, air filter, supply and return grills, etc. It is installed inside the room to be conditioned. It can be ceiling suspended, wall mounted, or kept on the floor as a console unit and is generally known as fan coil unit.

The outdoor unit has the other parts of the system like the compressor, air-cooled condenser, condenser fan and its own motor, installed outside. The liquid and suction lines of the system have to be laid at site after the outdoor and indoor units are installed in position. The distance between the indoor and outdoor units has to be as small as possible. As this distance increases, the pressure drops in the suction and liquid lines also increases, resulting in reduction of the unit capacity.

Since the compressor (inside the outdoor unit) is remotely installed from the room to be air conditioned, the noise level will be appreciably lower than in the case of a room air conditioner. This is the advantage and the reason for opting for the split.

UINT-4 HOME/OFFICE DIGITAL DEVICES

4.1 FACSIMILE (FAX) MACHINE

(I) Definition and Block diagram:

1. A facsimile machine, a device that can send or receive pictures and text over a telephone line. Fax machines work by digitizing an image -- dividing it into a grid of dots. Each dot is either on or off, depending on whether it is black or white.
2. Electronically, each dot is represented by a bit that has a value of either 0 (off) or 1 (on). In this way, the fax machine translates a picture into a series of zeros and ones (called a bit map) that can be transmitted like normal computer data.
3. On the receiving side, a fax machine reads the incoming data, translates the zeros and ones back into dots, and reprints the picture.
4. Fig. 4.1 shows the block diagram of a typical facsimile machine. When data is read from an input document it is first compressed and then modulated on to an audio-frequency carrier prior to being coupled to the line. The receive path is the reverse of this.

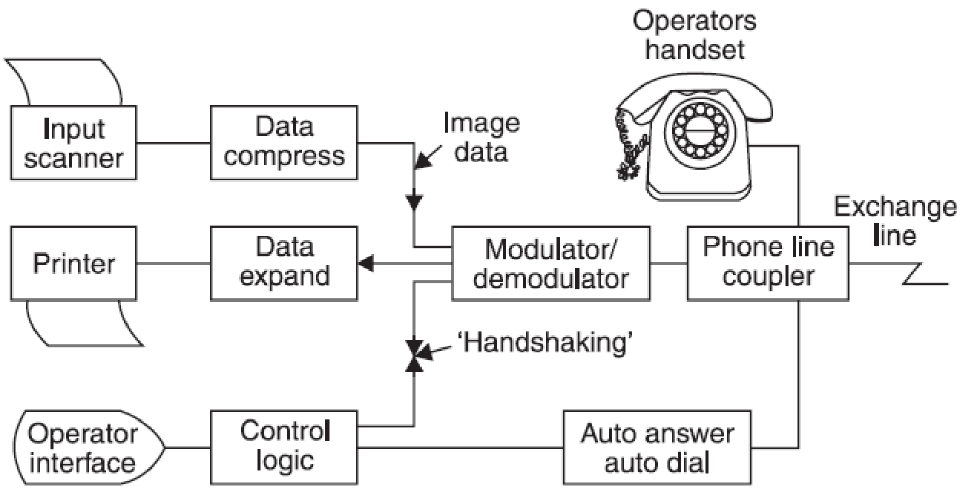


Fig. 4.1 Block diagram of a typical facsimile machine

(II) Basic Fax Machine Operations:

Essentially, a fax machine scans original documents, converts the scanned images into electrical signals, and transmits them over telephone lines to a receiving fax machine. The receiving fax machine in turn converts the received signals back into the graphical images of the original document and prints them. The basic fax machine operations for transmitting a page are presented in Fig. 4.2.

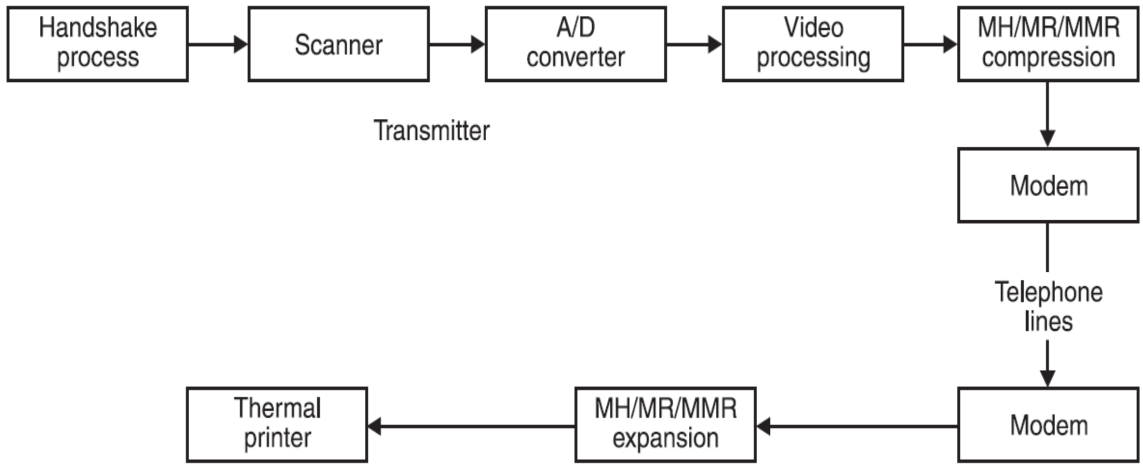


Fig. 4.2 Basic fax machine operations

(a) The handshake process : The sending and receiving fax-modems set up the transmission protocols, transmission speed, and other settings between them in a handshake process. If one modem cannot transmit at the highest speed of the other, both modems agree to fall back to the next highest speed at which both modems can transmit on the line.

(b) At the transmitting end :

1. **Scanning :** The images on the page are scanned and transformed into analog signals to begin the transmission process. A photosensor array of 1728 tiny sensors for A4 paper size targets very small picture elements (pixels) on a line of page, one sensor per pixel, resulting in 1728 (or 2048) bits per line. The array determines whether each pixel is black or white and accordingly generates a strong or weak electronic signal for that pixel.
2. **A/D Conversion :** The scanner signals are converted from analog to digital with typically from one to six bits per pixel. After image processing is complete, one bit per pixel is produced.
3. **Video Processing :** The processing of the scanner data can be done on the analog scanner signal, the digital data, or both. It accommodates for the shading, distortions, and other aspects of the original image so that reproduction can be as accurate as possible.
4. Other video processing techniques include automatic background correction, automatic contrast control, edge enhancement and MTF (modulation transfer function) correction.

These can be performed in one or two dimensions. Images may also be reduced or enlarged.

5. **Compressing the digital signals :** The data compression operation can reduce the picture information by a factor of from 5 to 20, depending on the characteristics of the image. This operation generates code words containing the pixel information in compressed digital signals.
6. **Modulation :** The compressed digital signals are modulated by the modem into analog signals (a tone series) that can be sent over regular telephone lines. Group 3 fax machines are half duplex and can either send or receive at any time.
7. **Transmission:** The analog signals are then transmitted over the phone lines from the sending modem to the receiving modem.

(c) At the receiving end :

1. **Demodulation :** A modem demodulates or decodes the received analog tone signals regenerating the digital signals (bit streams) sent.
2. **Decompression :** The next step is to expand the digital signals and reconstruct the page's images into black-and-white pixels which represent the pixels of the page's image.
3. **Thermal printing:** The thermal printer converts the expanded bit stream into a copy of the original page. The printer's wires are spaced 203 to the inch, touching the temperature-sensitive recording paper. For black marking, the wires heat up when high current passes through them. The wires go from non-marking (white) to marking (black) temperature, and back again in a few milliseconds.
4. **Resolution :** Standard resolution is 203 lines per inch across and 98 lines per inch down the page. Fine resolution requires twice the number of lines (196 lines per inch) down the page. Most group 3 fax machines include a high-resolution option.

4.2 CALCULATORS

4.2 (a) Structure of A Calculator:

1. A calculator is really a special purpose computer containing a number of fixed program routines which may be initiated by entering such commands as +, –, ×,÷.

2. Numerical data are entered for the programs to operate on. Since the calculator is essentially a special kind of computer, it has a similar internal structure. This structure is illustrated in Fig. 4.3.

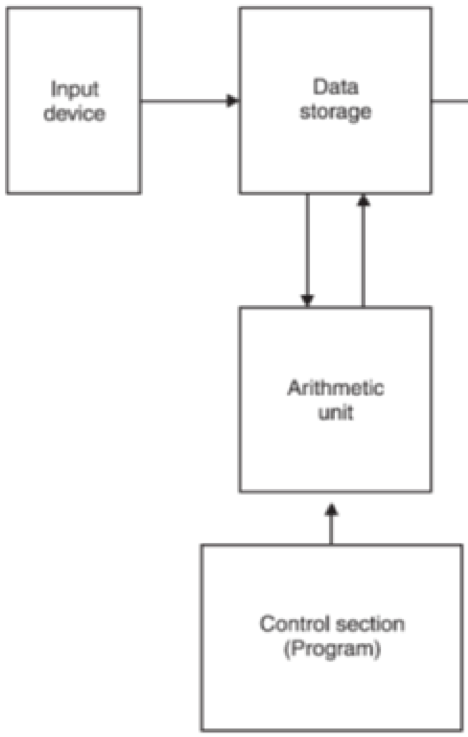


Fig. 4.3 Basic calculator structure

Input Devices : The most common, input device to a calculator is keyboard. This is merely a group of key switches, each representing a digit or an operation, which will be understood by the calculator when a key is depressed. Each key, when depressed, causes a binary code to be generated and passed to the processing section of the calculator. There is a unique code for each key so that the processor can decode it and know how to handle the information.

Data Storage : When data is entered into the calculator it must be stored so that it can later be operated by the processor or arithmetic unit. The data storage area is generally made up of register stages.

The Arithmetic Unit : The arithmetic unit, as its name implies, performs arithmetic operations on the data in the storage registers. It consists of an adder circuit, or an adder/subtractor, typically resembling the serial or parallel adders. A single-bit storage register is usually included so that the carry condition from a previous operation may be remembered.

<u>Output Devices :</u> The most common output devices used with calculators are printers or luminous displays. A printer has the obvious advantage of giving a permanent record of the data, this being typically a strip of paper containing ten to fifteen digits per line of print. Luminous displays, Fig. 4.4, have the advantages of lower power consumption, so important for small calculators and fast response time. Data from the storage registers is output to the display device under control of the calculator. The binary codes representing the numbers have to be decoded by suitable logic circuits so that the required digit is displayed after it has been read out from the store.

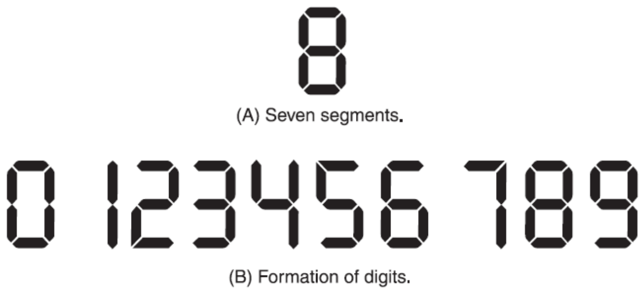


Fig. 4.4 Seven segment display

<u>The Control Section :</u> The control section contains the programs which govern the operations to be performed on data in order to produce the answer to the required problem. The program consists of many binary coded instructions held in a read only memory (ROM). The instructions are read from this program memory sequentially and decoded to perform the required control functions. Such control functions include selecting the appropriate register data and routing it to the adder, sending data back to the register, outputting data to the display, selecting an add or subtract mode for the adder, examining the carry bit and many more.

4.2 (b) Internal Organization of Calculator:

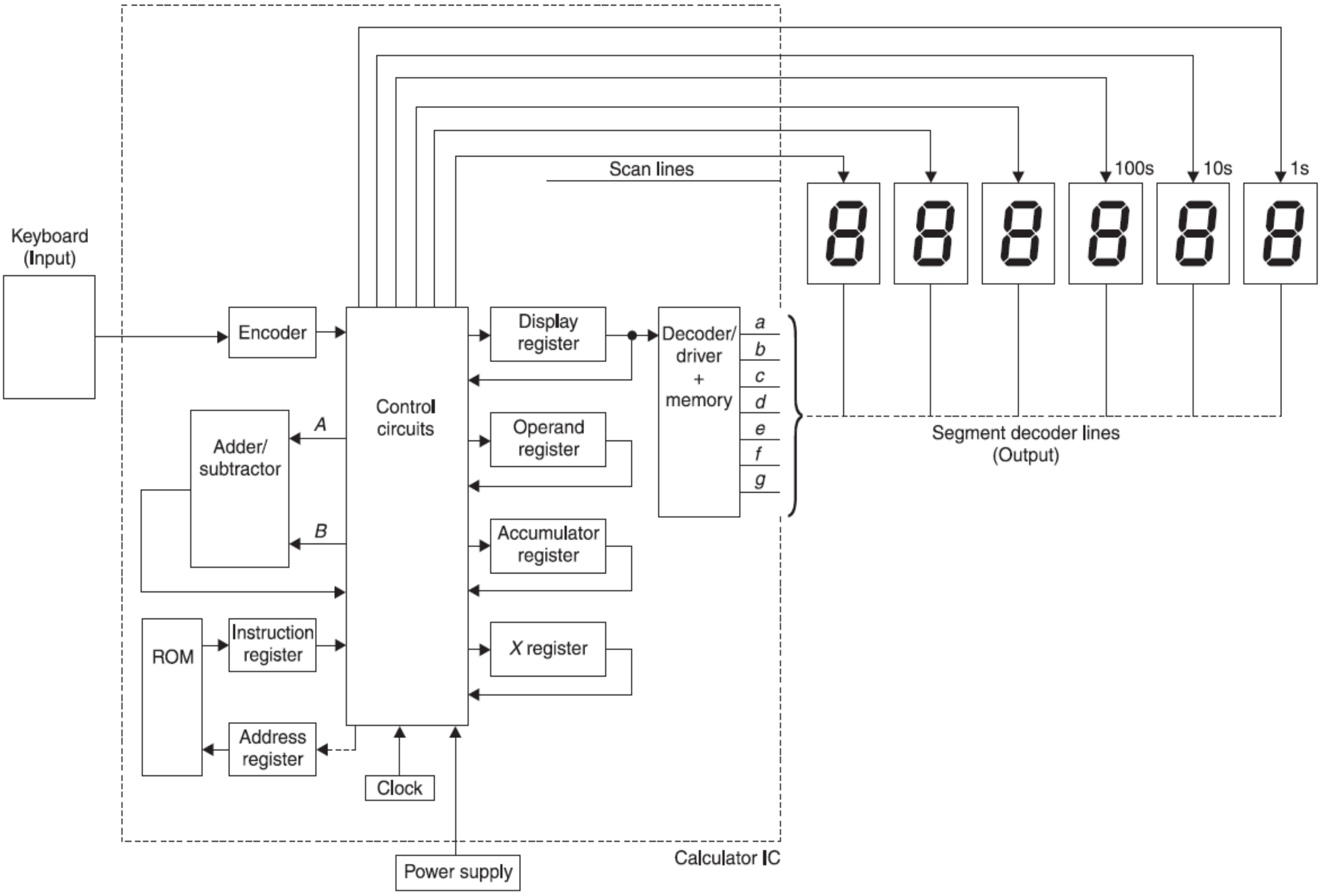


Fig. 4.5 Internal organization of a calculator

1. The diagram in Fig. 4.5 will help us figure out how a calculator works. Figure 4.5 shows three components : the keyboard, the seven-segment displays and the power supply. These parts are the only functional ones not contained in the single LSI IC in most calculators.
2. The keyboard is obviously the input device. The keyboard contains simple normally open switches. The decimal display is the output. The readout unit in Fig. 4.5 contains only six seven-segment displays. The power supply is a battery supply in most inexpensive hand-held calculators. Many modern calculators use solar cells as their power supply. CMOS ICs and LCD make this supply feasible.
3. The calculator chip (the IC) is divided into several functional subsystems as shown in Fig. 4.5. The heart of the system is the adder/subtractor subsystem. The clock subsystem pulses all parts of the system at a constant frequency. The clock frequency is fairly high

ranging from 25 to 500 kHz. When the calculator is turned on, the clock runs constantly and the circuit is idle until a command comes from the keyboard.

4. Suppose we add 2 + 3 with this calculator. As we press the 2 on the keyboard, the encoder translates 2 to a BCD 0010. The 0010 is directed to the display register by the control circuitry and is stored in the display register. This information is also applied to the seven-segment decoder and lines a, b, d, e, and g are activated. The first (Is display) seven-segment display shows a 2 when the scan line pulses that unit briefly.
5. Next, we press + on the keyboard, this operation is transferred to and stored in code form in an extra register (X register).
6. Now we press 3 on the keyboard. The encoder translates the 3 to a BCD 0011. The 0011 is transferred to the display register by the controller and is passed to the display decoder/driver which also places a 3 on the display.
7. Meanwhile, the controller has moved the 0010 (decimal 2) to the operand register. Now we press = key. The controller checks the X register to see what to do. The X register says to add the BCD numbers in the operand and display registers. The controller applies the contents of the display and operand registers to the adder inputs. The results of the addition get collected in the accumulator register. The result of the addition is a BCD 0101. The controller routes the answer to the display register, shown in the readout as 5.

4.2 (c) Servicing Electronic Calculators:

1. To service a defective calculator, you will need a pencil-type soldering iron (30 to 40 watts at about 700°F), small screwdrivers, solder remover, sharp knife, diagonal cutters, and needle-nose pliers. A volt ohm multimeter and oscilloscope are the only necessary pieces of test equipments.
2. A few general procedures will save lots of time and reduce the chance of damaging additional components in an already defective machine. First, give the machine a careful visual inspection. Burned or bubbly resistors, blown electrolytic capacitors, solder bridges, and other obvious malfunctions can usually be quickly found and corrected.
3. If the problem involves a destroyed component, never install a replacement part until the cause of the problem is found and corrected. Never use a replacement component of less quality than the original one.

4. Next, although it may be necessary to turn on a calculator to find the symptoms of a problem, never leave a malfunctioning machine on longer than necessary.
5. Finally, if a thorough visual inspection fails to reveal the problem, begin troubleshooting at the point of the improper indication and work backward, checking each associated component. If more than one problem exists, begin with the simplest since it frequently leads to the major trouble spot.

4.3 DIGITAL CLOCK

An interesting and common use of counters is for frequency division. An example of a simple system using a frequency divider is shown in Fig. 4.6. This system is the basis for an electric clock. The 60 Hz input frequency formed into a square wave is divided by 60, and output will be one pulse per second (1 Hz). This is a second's timer.

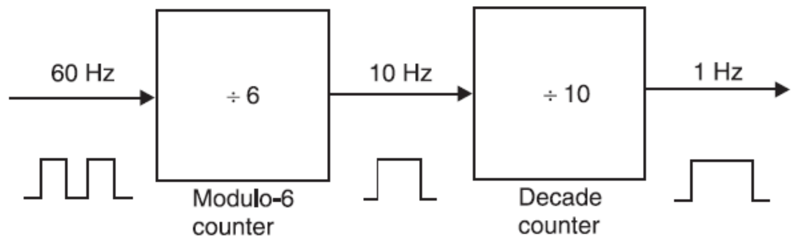


Fig. 4.6 Practical divide-by-60 circuit used as a 1-second timer

4.3 (a) Block Diagram of a Digital Clock:

Various counters are the heart of a digital clock system. Figure 4.7 (a) is a simple block diagram of a digital clock system. Many clocks use 60 Hz as their input or frequency standard. This frequency is divided into seconds, minutes and hours by the frequency divider section of the clock. The one-per-second, one-per minute and one-per-hour pulses are then counted and stored in the count accumulator section of the clock.

The stored contents of the count accumulators (seconds, minutes, hours) are then decoded and the correct time is shown on the output time displays. The digital clock has the typical elements of a digital system. The input is the 60 Hz alternating current. The processing takes place in the frequency divider, count accumulator, and decoder sections. Storage takes place in the count accumulators. The control section is illustrated by the time-set control, as shown in Fig. 4.7 (a). The output section is the digital time display. All systems consist of logic gates, flip-flops, and subsystems.

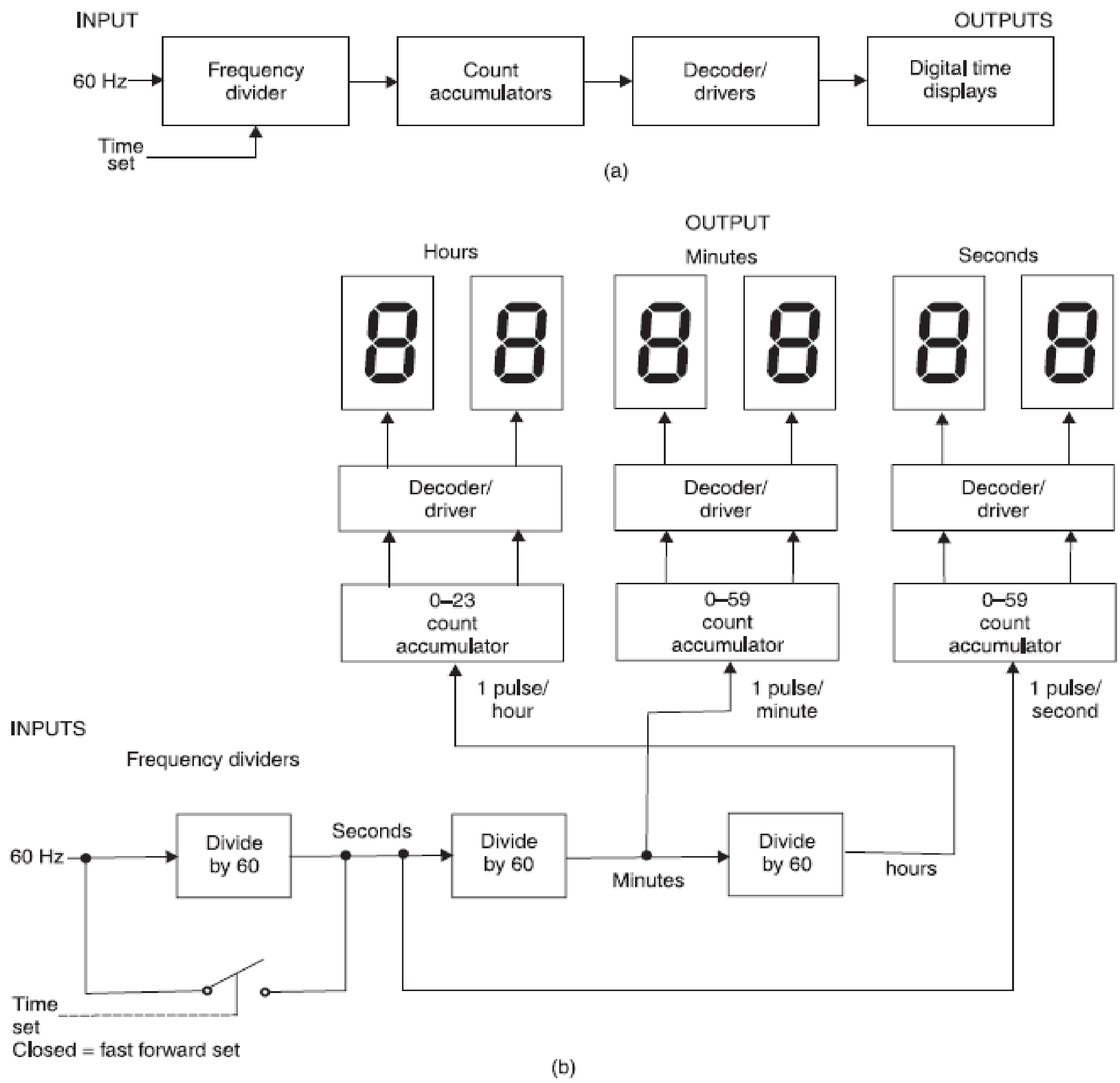


Fig. 4.7 (a) Simplified block diagram of a digital clock
(c) More detailed block diagram of digital clock

The diagram in Fig. 4.7 (b) illustrates how subsystems are organized to display time in hours, minutes, and seconds. This is a more detailed diagram of a digital clock. The input is still a 60 Hz signal. The 60 Hz may be from the low voltage secondary coil of a transformer. The 60 Hz is divided by 60 by the first frequency divider. The output of the first divide-by-60 circuit is 1 pulse per second. The 1 pulse per second is fed into an up counter that counts from 00 through 59 and then resets to 00. The seconds counters are then decoded and displayed on the 2 seven-segment LED displays at the upper right, Fig. 4.7 (b).

Consider the middle frequency-divider circuit in Fig. 4.7 (b). The input to this divide-by-60 circuit is 1 pulse per second, the output is 1 pulse per minute. The 1 pulse per minute output is transferred into the 0 to 59 minutes counter. This up counter keeps track of the number of minutes from 00 through 59 and then resets to 00. The output of the minutes counter accumulator is decoded and displayed on the two 7-segment LEDs at the top center, Fig. 4.7(b). Now for the divide-by-60 circuit on the right in Fig. 4.7 (b).

The input to this frequency divider is 1 pulse per minute. The output of this circuit is 1 pulse per hour. The 1 pulse per hour output is transferred to the hours counter on the left. These hours count accumulator keeps track of the number of hours from 0 to 23. The output of the hours count accumulator is decoded and transferred to the 2 seven-segment LED displays at the upper left, Fig. 4.7 (b). This is a 24-h digital clock. It easily could be converted to a 12-h clock by changing the 0 to 23 count accumulators to a 1 to 12 counter. For setting the time, a time-set control has been added to the digital clock in Fig. 4.7 (b).

When the switch is closed (a logic gate may be used) the display counts forward at a fast rate. This enables you to set the time quickly. The switch bypasses the first divide-by-60 frequency divider so that the clock moves forward at 60 times its normal rate. An even faster fast-forward set could be used by bypassing both the first and the second divide by-60 circuits. The latter technique is common in digital clocks.

4.4 XEROGRAPHIC COPIER

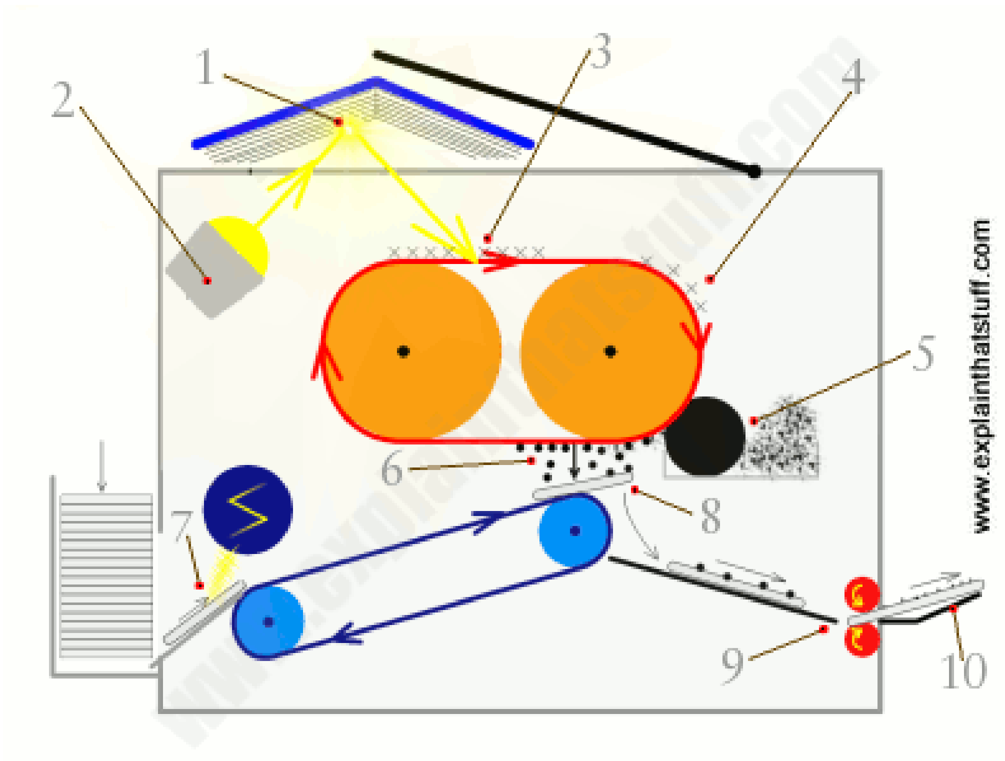


Fig. 4.8 Block diagram of cerographic copier machine

1. You place the document you want to copy upside down on the glass
2. An extremely bright light scans across the document. Much more light reflects off the white areas (where there is no ink) than off the black, inked areas.
3. An "electrical shadow" of the page forms on the photoconductor. The photoconductor in a photocopier is a rotating conveyor belt coated with a chemical called selenium.
4. As the belt rotates, it carries the electrical shadow around with it.
5. An ink drum touching the belt coats it with tiny particles of powdered ink (toner).
6. The toner has been given an electrical charge, so it sticks to the electrical shadow and makes an inked image of the original page on the belt.
7. A sheet of paper from a hopper on the other side of the copier feeds up toward the first belt on another conveyor belt. As it moves along, the paper is given a strong electrical charge.
8. When the paper moves near the upper belt, its strong charge attracts the charged toner particles away from the belt. The image is rapidly transferred from the belt onto the paper.
9. The inked paper passes through two hot rollers (the fuser unit). The heat and pressure from the rollers fuse the toner particles permanently onto the paper.
10. The final copy emerges from the side of the copier. Thanks to the fuser unit, the paper is still warm. It may still have enough static electric charge to stick to your pullover. Try it (but make sure the ink is dry first).

UINT-5 DIGITAL ACCESS DEVICES

5.1 DIGITAL COMPUTER

Computer: A computer is a combination of hardware and software resources which integrate together and provides various functionalities to the user. Hardware are the physical components of a computer like the processor, memory devices, monitor, keyboard etc. while software is the set of programs or instructions that are required by the hardware resources to function properly.

Digital Computer: A digital computer can be defined as a programmable machine which reads the binary data passed as instructions, processes this binary data, and displays a calculated digital output. Therefore, Digital computers are those that work on the digital data.

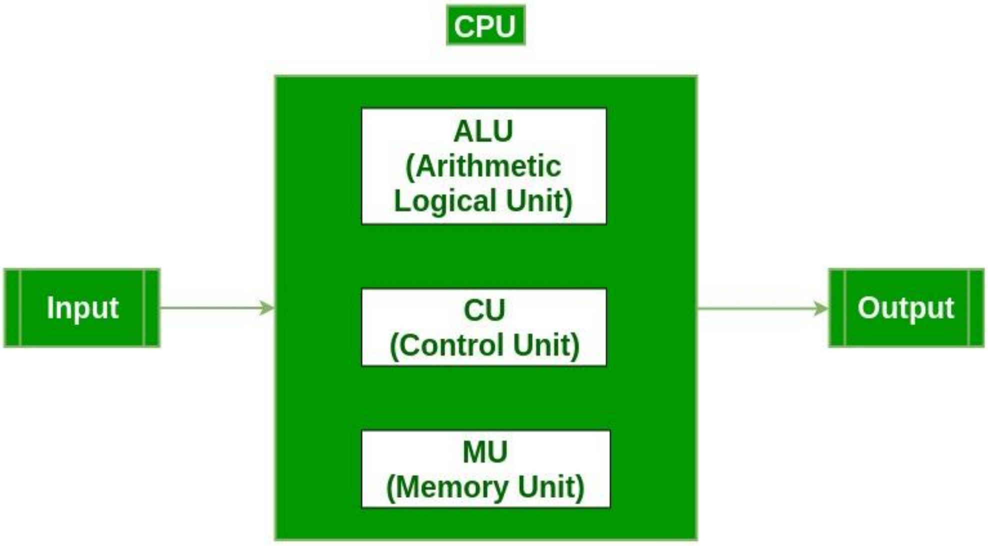


Fig 5.1 Details of Functional Components of a Digital Computer

Input Unit : The input unit consists of input devices that are attached to the computer. These devices take input and convert it into binary language that the computer understands. Some of the common input devices are keyboard, mouse, joystick, scanner etc.

Central Processing Unit (CPU) : Once the information is entered into the computer by the input device, the processor processes it. The CPU is called the brain of the computer because it is the control center of the computer. It first fetches instructions from memory and then interprets them so as to know what is to be done. If required, data is fetched from memory or input device. Thereafter CPU executes or performs the required computation and then either stores the output or displays on the output device. The CPU has three main components which are responsible for different functions – Arithmetic Logic Unit (ALU), Control Unit (CU) and Memory registers.

Arithmetic and Logic Unit (ALU) : The ALU, as its name suggests performs mathematical calculations and takes logical decisions. Arithmetic calculations include addition, subtraction, multiplication and division. Logical decisions involve comparison of two data items to see which one is larger or smaller or equal.

Control Unit : The Control unit coordinates and controls the data flow in and out of CPU and also controls all the operations of ALU, memory registers and also input/output units. It is also responsible for carrying out all the instructions stored in the program. It decodes the fetched instruction, interprets it and sends control signals to input/output devices until the required operation is done properly by ALU and memory.

Memory Registers : A register is a temporary unit of memory in the CPU. These are used to store the data which is directly used by the processor. Registers can be of different sizes(16-bit, 32-bit, 64-bit and so on) and each register inside the CPU has a specific function like storing data, storing an instruction, storing address of a location in memory etc. The user registers can be used by an assembly language programmer for storing operands, intermediate results etc. Accumulator (ACC) is the main register in the ALU and contains one of the operands of an operation to be performed in the ALU.

Memory : Memory attached to the CPU is used for storage of data and instructions and is called internal memory. The internal memory is divided into many storage locations, each of which can store data or instructions. Each memory location is of the same size and has an address. With the help of the address, the computer can read any memory location easily without having to search the entire memory. when a program is executed, its data is copied to the internal memory, and is stored in the memory till the end of the execution. The internal memory is also called the Primary memory or Main memory. This memory is also called as RAM, i.e., Random-Access Memory. The time of access of data is independent of its location in memory, therefore this memory is also called Random Access memory (RAM).

Output Unit : The output unit consists of output devices that are attached with the computer. It converts the binary data coming from CPU to human understandable form. The common output devices are monitor, printer, plotter etc.

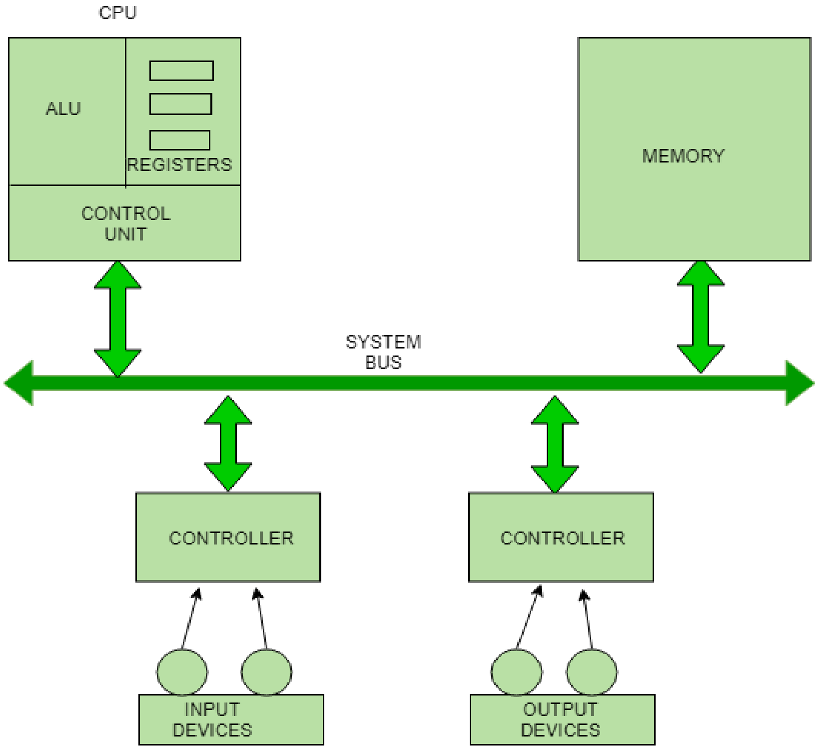


Fig 5.2 Interconnection between Functional Components

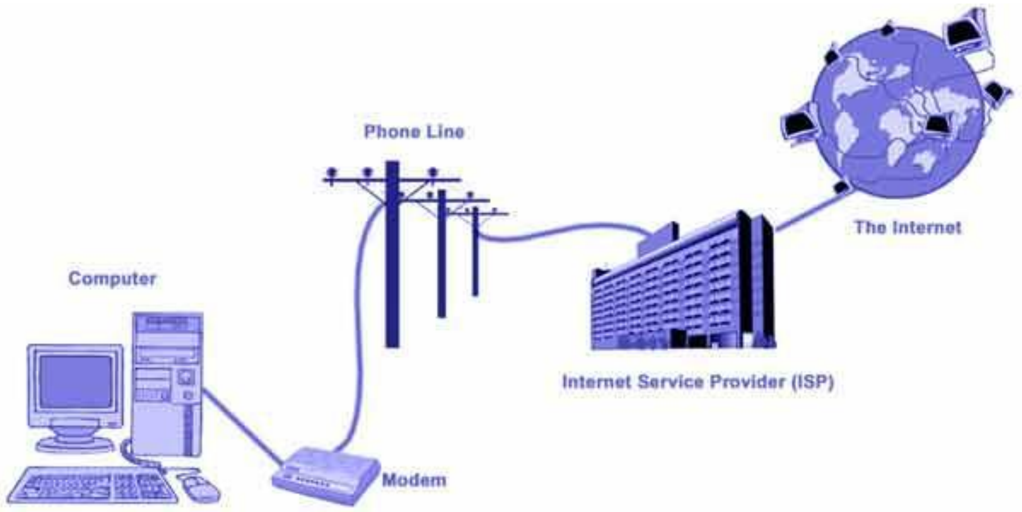
5.2 INTERNET ACCESS

1. A global network connecting millions of computers. More than 100 countries are linked into exchanges of data, news and opinions. The Internet links computer networks all over the world so that users can share resources and communicate with each other.
2. Internet access is the ability of individuals and organizations to connect to the Internet using computer terminals, computers, and other devices; and to access services such as email and the World Wide Web.
3. Internet access is sold by Internet service providers (ISPs) delivering connectivity at a wide range of data transfer rates via various networking technologies.
4. To gain access to the internet, the user has to register to any Internet Service Provider (ISP).

Types of Internet connection:

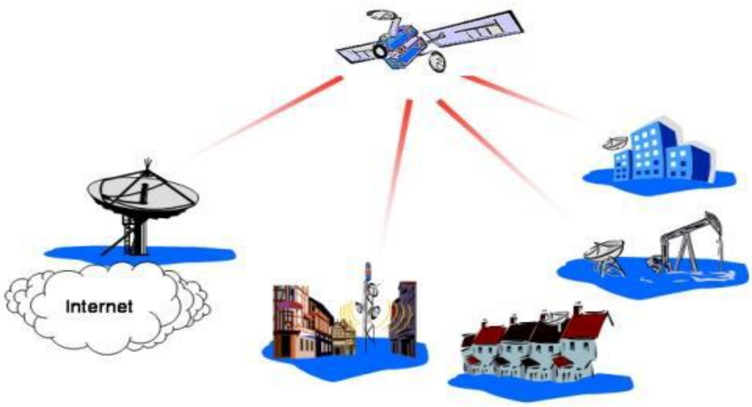
1. Dial-up
2. Integrated services digital network
3. Asymmetric Digital Subscriber Line
4. Wireless Internet Connections
5. Internet over Satellite

Dial-up: Slower than other type of connection, connects through existing phone lines using dial-up modem, Cheapest, must “dial-up” to connect to Internet and disconnect when done. Cannot use Internet and phone line at the same time.



Internet over Satellite:

Broadband–faster than dial-up, but data is delayed, Connects via satellites, Can be affected by rain and snow, Does not require phone lines and cables, Can be use anywhere around the world.



Choosing Internet Service Provider:

Below are some things to consider as you research ISPs:

1. Speed
2. Price
3. Ease of Installation

4. Service Record
5. Technical Support
6. Contract Terms

Internet Usages:

1. Communication
2. Send and receive emails
3. Download files
4. Post your opinion to a news group
5. Chatting
6. Surf the world wide web
7. Business
8. Shopping
9. Entertainment

5.3 ONLINE TICKET RESERVATION

Airline reservation system Objectives:

There are three main objectives in designing a reservation system.

1. To improve the service given to passengers and potential passengers.
2. To save staff in sales offices and control offices where reservations are processed and space on aircraft controlled.
3. To improve the load factor on flights.

Functions of an airline reservation system:

Function 1. Giving flight information to distant sales points, and especially answering requests about what seats are available.

Function 2. Centralized inventory control of seats booked and canceled at distant locations. This has been done without passengers' names being used, but to be done efficiently these are needed to eliminate duplicate bookings and invalid cancelations.

Function 3. Mechanization of passenger files. These have previously been maintained manually in the sales offices. To keep them in the files of the distant computer and maintain them in a real-time manner, using the facilities needed for the preceding functions, will give major labor cost savings and improve the service given to passengers.

Function 4. Waiting list, reconfirmation, checking ticket time limits and other operations concerned with manipulation of the passenger files.

Function 5. Provision of special facilities for the passenger such as renting a car or booking hotels in distinct location, providing a wheel chair, facilities for pets and so on.

Function 6. Passenger check-in at airports. Details of passengers are sent to the airport check-in details.

Function 7. Cargo reservation may also be controlled by the system and the weight and approximate volume of cargo used in the load and trim calculations.

5.4 BAR CODE SCANNER AND DECODER

Bar Codes:

A bar code, Fig. 5.3, is a rectangular block of black and white lines often seen printed on cans of food, books and many other items. It is a method of coding consumer products by combinations of bars of varying thicknesses representing characters and numerals. The black lines and white spaces tell a computer what the item is and how much the item costs. The various codes, Universal Product Code (UPC), and others are designed to be read by optical wands or stationery in-counter readers.

Fig. 5.3 Bar Code

Bar Code Scanner and Decoder:

A bar-code system is made up to two parts : the printer and the scanner/decoder. Printers are available to print labels or to print directly on products such as card board boxes and packages. The ink must contrast with the background so that the symbols can be easily read by the scanner. The second part of the system consists of a scanner that reads the code symbols and a decoder that interprets the code.

Optical scanners, also referred to as digital scanners or bar-code readers, are special optical devices which scan patterns of incident light and generate analog/digital signals which are functions of the incident light synchronized with the scan, the primary purpose being to generate or read digital representation of printed or written data.

The scanners can be hand-held (portable) or stationary, such as the readers in a grocery store. The basic parts of the scanner are shown in Fig. 5.4.

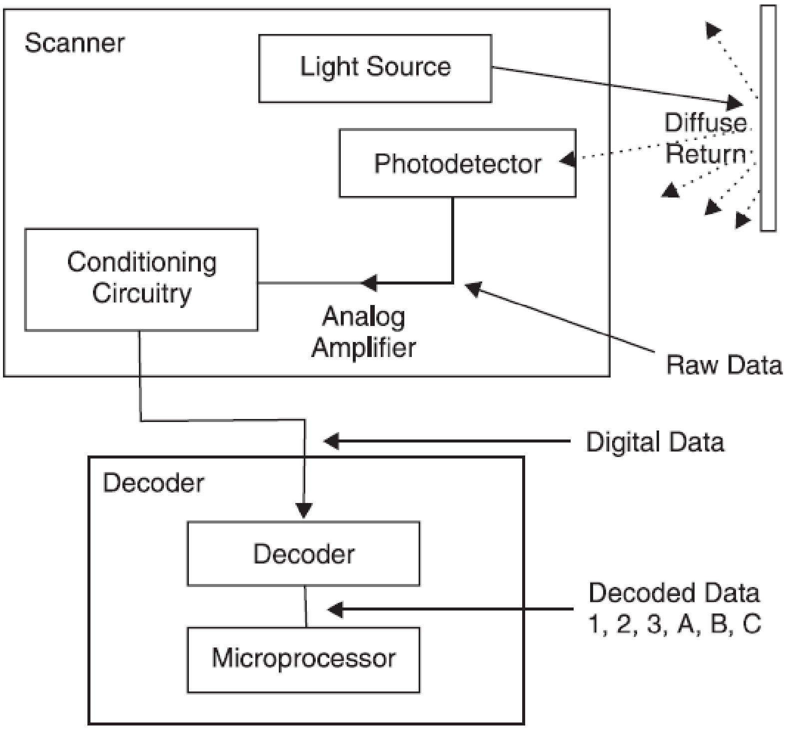


Fig. 5.4 Block diagram of a bar-code scanner and decoder

In this figure you can see the block diagram that shows a light source focused on the bar code. This light must be reflected back to the photodetector part of the scanner. Since the reflected light diffuses (spreads out), the window that receives the reflected light must be aligned correctly so that the scanner can read the code. After the signal is received it is amplified, conditioned, and then passed to the decoder section of the system. The decoder uses a microprocessor to decode the data and compare them to data in the database. The decoded data can be stored or displayed so that the humans using the system can read the data.

5.5 AUTOMATED TELLER MACHINES (ATMs)

Electronic Fund Transfer:

It has been more than 40 years since computers were first used in banking. In these years, more and more of the operation of banks and of many other financial organizations have become dependent on computers. Under the constant pressure to improve service and efficiency and to reduce costs.

The birth of electronic funds transfer and automated teller machines have given rise to 24-hour banking and a greater variety of services for the custom. This method uses a computer to transfer debits and credits with the help of electronic pulses, which are carried through wire either to a magnetic disk or tape. This method is used to replace checks which have become very expensive to process. The electronic funds transfer system functions are shown in Fig. 5.5.

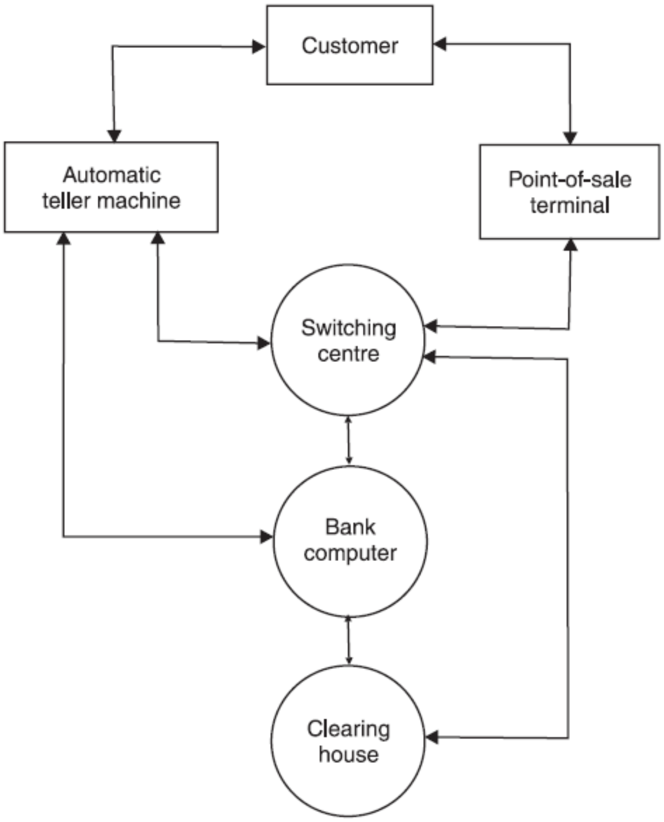


Fig. 5.5 Electronic funds transfer system

A customer brings his or her bank card with a personal identification number to either a point-of sale terminal or an automated teller machine, depending on the type of transaction.

Point of sale terminal:

The point-of-sale terminal processes transactions that occur over and over again, such as deposits of pay checks or payments of monthly bills. The point-of-sale terminal may be anything from an ordinary telephone to a high-speed electronic cash register. Many retail stores have these for such things as payroll or accounts receivable. A point-of-sale terminal allows the customer to pay for goods purchased with automated account debits.

AUTOMATED TELLER MACHINE (ATMs):

Using a bank card at an appropriate automated teller machine (ATM), the customer can withdraw money; pay money into one or more accounts; transfer funds between accounts; get a current balance; order a statement, new cheque book, or bank card and so on. Since their introduction, ATMs have proved exceedingly popular; they take less time to operate than standing in a queue in a bank lobby, they are available when the bank is closed, and they are often located in areas where you would not normally expect a bank to operate, such as shopping malls, airports, railway stations, and office buildings.

The basic operation of a single bank ATM is fairly straight forward. When the customer inserts a card, the ATM reads off the magnetic strip the cardholder’s account number and personal identification number. Once this has been checked, the ATM establishes a connection via a telephone line to the bank computer that holds the relevant account. A regional switching center and the regional automated clearing house may also come into play if the banks are not the same. When the cardholder responds by, for example, requesting to withdraw a certain sum from the account, the ATM passes the request to the computer, which checks if sufficient funds are available and if so, authorizes the payment.

Parts of an ATM include:

Card Reader: This reads account information that is stored on a magnetic strip, the one that you always see on credit and debit cards. The data retrieved is passed on to a host processor, which in turn is able to interpret the information and retrieve the customer’s account information.

Keypad: This allows customers to input the information they need to give. It lets them input their personal identification or pin code, select what type of transaction they want to make, and generally communicate with the ATM software.

Display screen: Like any computer, this allows customers to see each step of the process or transaction they are doing.

Speaker: This allows the customer to hear when keys are being pressed on the keypad, but it may also allow for additional voice features on certain ATMs.

Receipt printer: Although much of the process of an ATM is digital, printed receipts are requested by many or most ATM customers. This ATM part makes this possible.

Cash dispenser: The main purpose of an ATM is for a customer to acquire cash, so of course this is the most important part. The cash dispenser is a pivotal part and a part that is highly sophisticated.

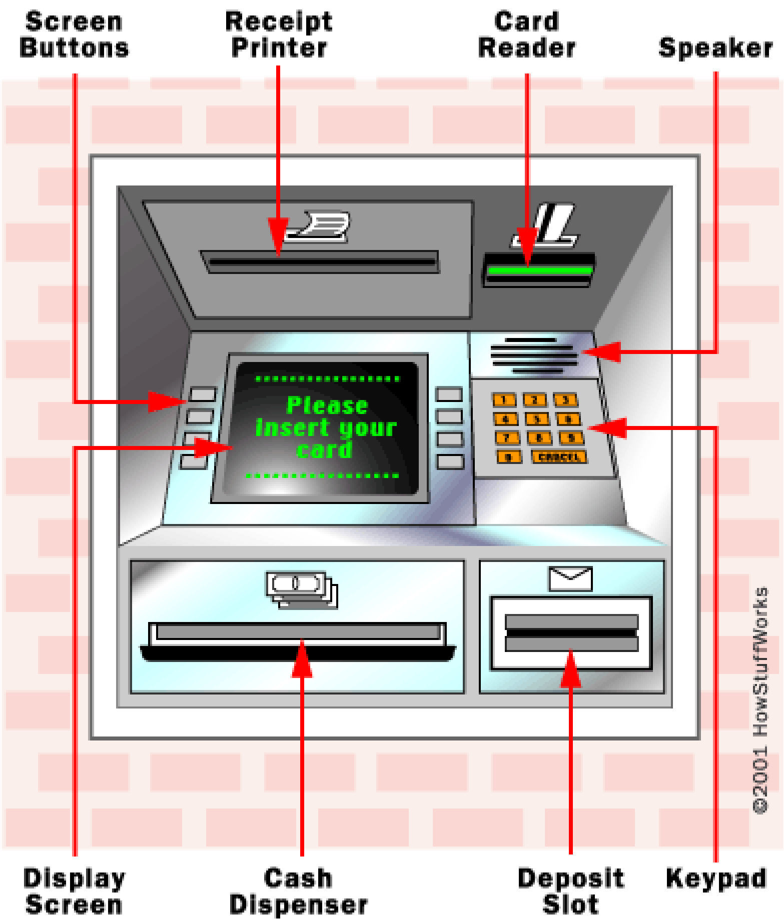


Fig. 5.6 Parts of an ATM machine

5.6 SET TOP BOXES

Cable TV set-top boxes are interfaces between televisions, satellite TV, and cable TV networks for access to television and other services. At the most basic level, they are tuners. Cable and satellite TV operators remotely administer filters and traps in set-top boxes to allow subscribers access to basic cable TV or premium channels. The set-top box also has a security function. It scrambles and unscrambles TV signals and also has links to billing systems for information on which channels to allow the subscriber to receive. Credit information is also stored in some set-top boxes. Digital set-top boxes are available to take advantage of the two-way capability of digital cable TV and satellite TV. These capabilities include :

● Advanced digital security so that the security is placed on a card in the set-top box that can be installed separately. If a consumer buys a set-top box from a retailer, the cable TV provider can install the security feature on the card. (Because security is proprietary to each provider, it is not available in retail outlets.)

● Advanced programming with 30 days' worth of programming information.

● Embedded modems that will enable televisions to be used as computers for internet access. For example, someone watching a football game will be able to view statistics from the internet in a window of the television. The set-top box will also include infrared links to keyboards and computer mice.

● Compression so that 6 to 12 compressed digital TV signals can be carried in the same amount of frequency as one analog TV signal. The set-top box converts digital cable TV or satellite TV into analog signals compatible with analog television. It also can be built directly into digital televisions when the industry agrees on standards compatible with digital cable TV. Some of these extra channels can be used for interactive games for which subscribers will be charged extra on their monthly cable bills.

● Computer operating systems, software and possibly a hard disc for programming guides and potential new services such as picture-in-picture for viewing statistics while watching sports programs.

● An Ethernet plug on the back of the set-top box so that computers or home routers can be connected to the set-top box. A set-top box can be used to send caller ID to the television screen. For this to work, subscribers must get their telephone service from their cable TV provider.

● Video on demand so callers do not have to place a separate telephone call to order a premium movie. The movie can be ordered from the set-top box.

● Open platform standards so consumers can purchase set-top boxes from a variety of retailers and know they will work with all cable systems.

DIGITAL CABLE TV:

Digital Cable TV has the following advantages :

(i) TV image resolution is improved. There is less interference from noise to create snow and shadows.

(ii) Stereo sound in the form of digital radio can be provided.

(iii) Less bandwidth is used per television station and movie sent to subscribers. Providers can put 10 to 12 channels instead of 1 into each 6-megahertz channel of capacity.

(iv) The extra capacity is a particular benefit for operators that supply internet access and voice telephony as well as cable TV.

(v) In the future, digital TV could be used for electronic commerce although to date this has not happened. In Europe, where fewer people than in the United States have computers, expectations for commerce via set-top boxes and digital cable TV have not been met.

(vi) Operators can download very popular movies in advance to all set-top boxes and only play them for eligible subscribers, thus improving infrastructure peak-rate utilization. If there is a cable outage, the movies have already been downloaded and the provider still receives revenue for the movies.