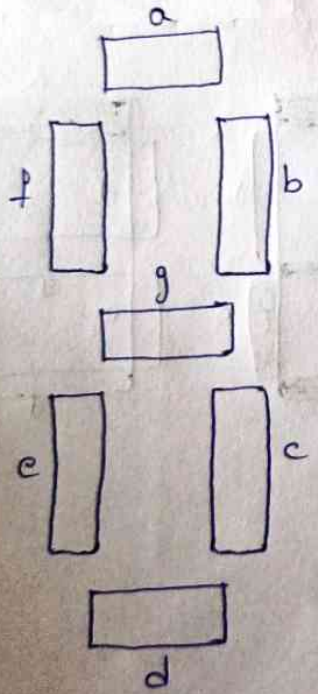
Unit-4 Display Instruments

Display devices are used to display the characters, symbols and outputs on them ex: LED's, LCD screens etc. Seven segment displays are mostly used display instruments.

- Seven Segment Displays -

Light Emitting Diode (LED) is the most widely used semiconductor which emits either visible light or invisible IR light when forward biased.

- These are output devices that provides a way to display information in the form of text, decimals, images which is an alternative to the more complex dot matrix displays.



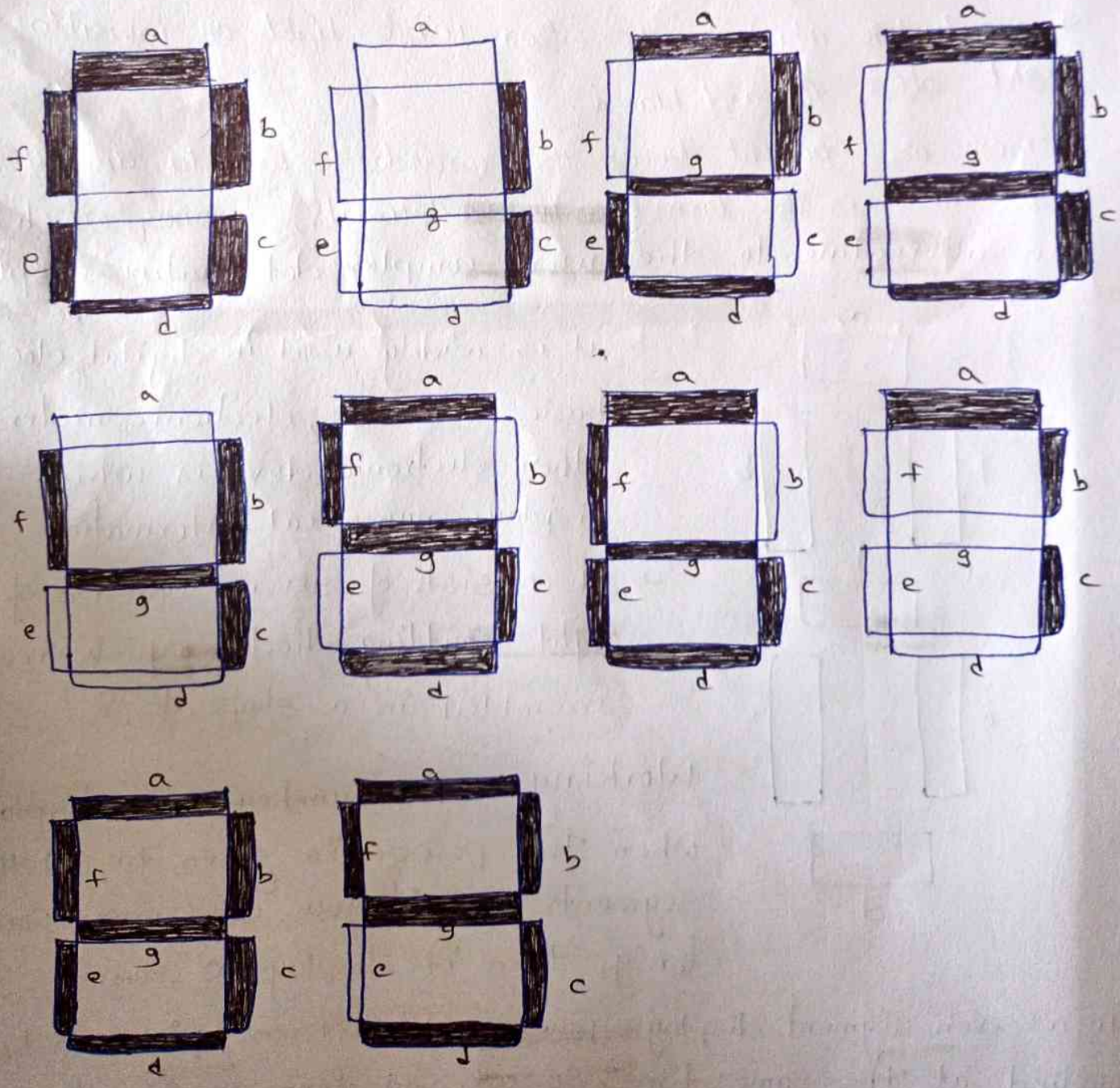
→ It is widely used in digital clocks basic calculators, electronic meters & other electronic devices which displays numerical information

→ It consists of seven segments of light emitting dioder which are assembled in a shape of 8.

Working :- The number 8 is displayed when the power is given to all the segments and if you disconnect power for 'g', then it displays '0' (zero).

In a seven segment display, power at different pins can be applied at the same time, so we can form combinations of display numerical from 0 to 9. Since seven segment displays can't form alphabets like X & Z, so it can not be used for the alphabet and they can be used only for displaying decimal

numerical magnitudes. However, seven segment displays can form alphabets A, B, C, D, E and F, so they can also be used for representing. each display unit is usually has a dot point (DP). The display point could be located either towards the right of the display pattern. This type of pattern can be used to display numerals from 0 to 9 and letters from to f hexadecimal digits.



Truth Table -

Digits (0 to 9) are produced based on the truth table.

Decimal Digit	Individual segments Illuminated						
	a	b	c	d	e	f	g
0	1	1	1	1	1	1	0
1	0	1	1	0	0	0	0
2	1	1	0	1	1	0	1
3	1	1	1	1	0	0	1
4	0	1	1	0	0	1	1
5	1	0	1	1	0	1	1
6	1	0	1	1	1	1	1
7	1	1	1	0	0	0	0
8	1	1	1	1	1	1	1
9	1	1	1	1	0	1	1

so for each boolean expression for each decimal digit the respective LED's will be on or OFF.

- Seven segment displays must be controlled by other external devices like micro controlless which are useful to communicate with external devices like switches, keypads and memory.

⇒ Types of seven segment Displays -

There are two types of SSD's an there

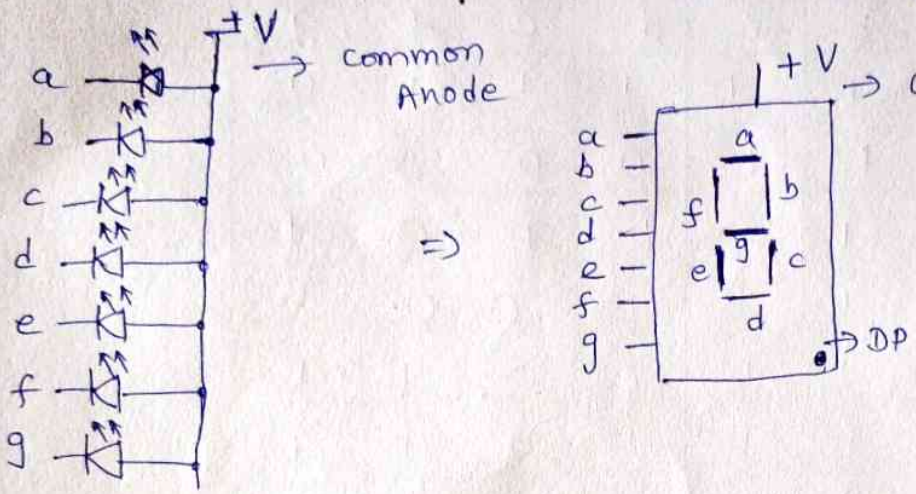
→ Common Anode (CA) type SSD

→ Common cathode (CC) type SSD.

→ common Anode (CA) seven segment Display -

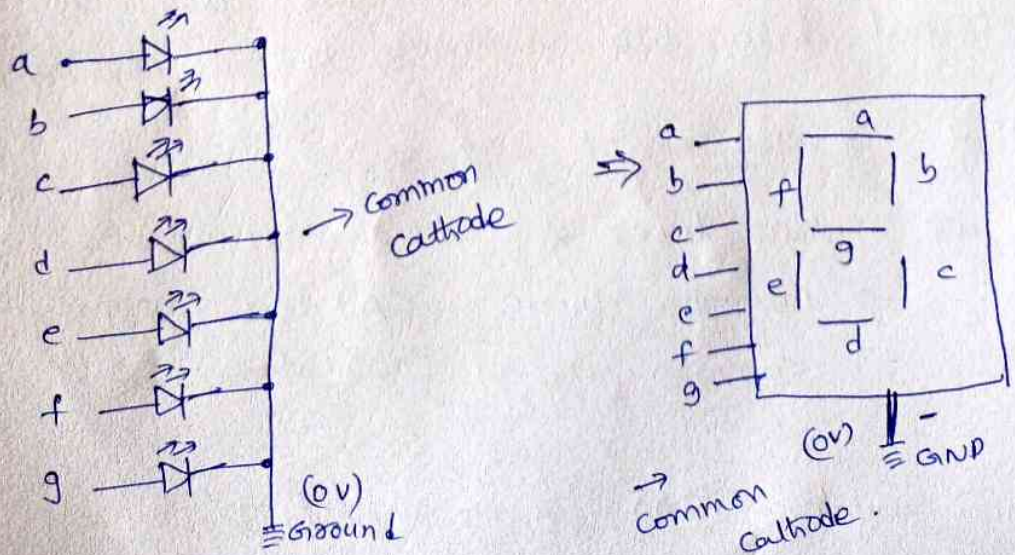
In this type of seven segment LED display, the anode terminals of all the LED segments are connected together

to logic 1. (higher voltage level), and the logic 0 (lower voltage level) is used through a current limiting resistor to individual cathode terminals of LED segments.



2) common cathode (CC) seven segment display -

- In this type of seven segment LED display, the cathode terminal of all LED segments are connected together to logic '0' (lower voltage level.
- The logic 1 (higher voltage level) is applied through a current limiting resistor to forward bias the individual LED segments at their anode terminals.



Applications of seven segment LED displays -

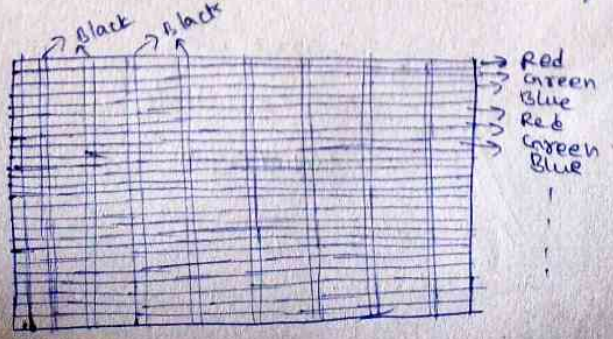
- → digital watches and clocks
- → calculators
- → microwaves
- → Remote controls
- → speedometers
- → vehicle odometers
- → clock radios. etc.

Note - common Anode Seven Segment LED displays are more popular than common cathode seven segment display because logic circuit can sink higher current as compared to the other.

⇒ **Liquid crystal Display - (LCD)**

LCD stands for liquid crystal Display. It is a flat panel display technology mostly used in TV's and computers & mobiles

- LCD's are completely different from old CRT's.
- In LCD's it consists of millions of pixels made of crystal and arranged in a rectangular grid.
- It has back lights which provide light to each pixel.
- Each pixel has a Red, Green and Blue (RGB) sub-pixel that can be turned ON / OFF.
- when all the sub-pixels are turned off, then it's black and when all the sub-pixels are turned ON, then it's white.



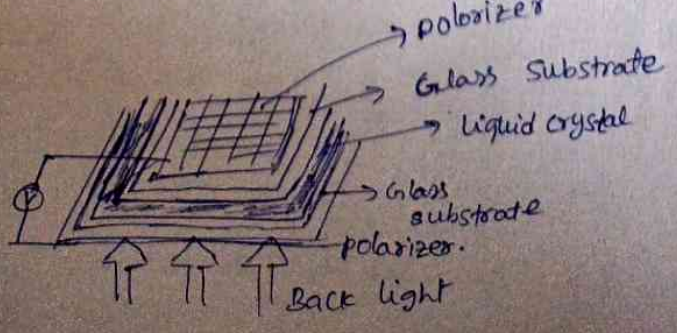
- LCD is a combination of two states of matter, the solid and the liquid.
- The solid part is crystal and the liquid.
- When solid and the liquid together make the visible image.
- LCD consists of two layers, which are two polarized panels.
  ⇒ filters and electrodes
- LCD screen works by blocking the light rather than emitting the light.

⇒ There are two types of pixel grids in LCD.

① Active matrix Grid - new technology
② passive matrix Grid - old technology

Passive matrix Grid - It uses a grid of vertical and horizontal conductors comprised of Indium Tin oxide to create an image.
- Each pixel is controlled by an intersection of two conductors.
- It represents the off-state of LCD i.e the pixel is OFF.

Active matrix Grid - It uses thin-film transistors that are arranged in a matrix on a glass surface.
- To control the voltage tiny switching transistors and capacitors are used at each pixel location.
- The active pixel is called so because it has the ability to control individual pixels and switch them quickly.



Advantages of LCD's

1) LCDs operate at low voltages (1 - 15 V)
2) current requirement is small (0.1 μA/cm²)
3) power requirement is small (1 μW/cm)
4) LCD's are thinner and lighter as compared to other displays.

Limitations of LCD's

1) LCD's are slow devices, they turn ON time and turn-OFF time is more (in milli seconds range)
2) Life time of LCD's is limited due to chemical degeneration.
3) Temperature range is limited (from 0°c to 60° c).
4) requires additional light source (Back light).
5) LCD's need an AC drive. (AC energy).

comparision between LED and LCD displays -

S.No	property	LCD	LED
1.	material	Liquid (organic) crystal	Solid (GaAs, GaP)
2.	power supply	AC ($10V_{p-p}$, 50Hz)	DC (1-2 V)
3.	Cost	low	High
4.	switching time	slow ON → 1ms OFF → 10ms	fast. < 1ns
5.	operating Temperature	Restricted, 10-30°c	wide 0-70°c
6.	luminosity	to be illuminated	self illuminated, so, visible in dark.
7	size	larger, typical height of each character is 10-30 mm.	smaller, each diode about 0.4 mm². typical height of each character is 7 mm.

Applications of LCD modules -

LCD modules have now replaced CRTs and LED screens. CRTs use more power, heavier and larger.

As compared to LED screens, LCD has less power consumption because it operates on the basic principle of blocking light rather radiating it.

LCD screens can be interfaced simply with
→ PIC micro controllers
→ 8051 μC
→ Arduino
→ AT mega 16 etc.

Advantages of LCD modules -

LCD modules are preferred over multi-segment LED's and SSD's because
→ These are inexpensive.
→ Simply programmable
→ Animations are possible.
→ can display custom or special characters.
→ power consumption is less.
→ operating voltage is low

~~Applications~~ -

Disadvantages of LCD modules -

→ module occupies a large area.
→ these are considered as slow devices. so they are less accurate.
→ life span is less.
→ They have a limited viewing angle.
→ can be operated in limited temperature range.
→ visibity of the image depends on luminosity.