8051-MICROCONTROLLER APPLICATIONS: PERIPHERALS AND INPUT OUTPUT WITH 8051 MICROCONTROLLER

SUB TOPICS:-

1. MICROCONTROLLERS APPLICATIONS
2. PERIPHERALS & I/O DEVICES

8051-MICROCONTROLLER APPLICATIONS

- **Industrial Automation:** The 8051 microcontroller is commonly used in industrial automation applications such as controlling conveyor belts, temperature control, and process control.

- **Robotics:** The 8051 microcontroller can be used to control various aspects of robots, including motion control, obstacle avoidance, and navigation.

- **Security Systems:** The 8051 microcontroller can be used in security systems such as access control systems, alarm systems, and surveillance systems.

- **Automotive Electronics:** The 8051 microcontroller can be used in automotive electronics applications such as engine management systems, fuel injection systems, and anti-lock brake systems.

- **Medical Devices:** The 8051 microcontroller is used in medical devices such as blood glucose monitors, heart rate monitors, and infusion pumps.

- **Consumer Electronics:** The 8051 microcontroller is used in a wide range of consumer electronics products, including remote controls, gaming consoles, and home automation systems.

- **Communication Systems:** The 8051 microcontroller can be used in communication systems such as modems, routers, and wireless transceivers.

- **Power Electronics:** The 8051 microcontroller is used in power electronics applications such as battery management systems and power supplies.

- Overall, the 8051 microcontroller has found widespread use in a diverse range of applications, owing to its versatility, affordability, and ease of use.

INDUSTRIAL AUTOMATION

- The 8051 microcontroller is widely used in industrial automation applications due to its high performance, low power consumption, and small size. Here are some of the ways in which the 8051 microcontroller is used in industrial automation:

- **Programmable Logic Controllers (PLCs):** PLCs are widely used in industrial automation for controlling machinery and processes. The 8051 microcontroller can be used as the core of a PLC system, allowing it to perform various functions such as monitoring sensors, controlling actuators, and communicating with other systems.

- **Temperature Control:** The 8051 microcontroller can be used to control the temperature of industrial processes by interfacing with temperature sensors and controlling heating or cooling systems.

- **Process Control:** The 8051 microcontroller can be used to control various industrial processes such as mixing, filling, and packaging by interfacing with sensors and controlling actuators.

- **Motor Control:** The 8051 microcontroller can be used to control the speed and direction of motors in industrial machinery, such as conveyor belts and pumps.

- **Monitoring and Data Logging:** The 8051 microcontroller can be used to monitor various parameters such as temperature, pressure, and flow rates and log this data for later analysis.

- **Human Machine Interface (HMI):** The 8051 microcontroller can be used as the core of a human-machine interface (HMI) system, allowing operators to monitor and control industrial processes through a graphical user interface.

- Overall, the 8051 microcontroller is a versatile and reliable choice for industrial automation applications, making it a popular choice among engineers and manufacturers.

ROBOTICS

- **Motion Control:** The 8051 microcontroller can be used to control the motion of robots, such as controlling the movement of robotic arms or mobile robots.

- **Sensing and Perception:** The 8051 microcontroller can be used to interface with sensors such as ultrasonic sensors, infrared sensors, and vision systems, allowing robots to perceive their surroundings.

- **Navigation and Localization:** The 8051 microcontroller can be used to process sensor data and control the movement of robots to navigate and localize themselves in an environment.

- **Control of Grippers and Actuators:** The 8051 microcontroller can be used to control the movement of grippers and other actuators in robotic systems.

- **Human-Machine Interface (HMI):** The 8051 microcontroller can be used to provide a user interface for controlling robotic systems, such as through a remote control or a graphical user interface.

- **Communication:** The 8051 microcontroller can be used to communicate with other systems and devices, such as wireless communication systems or other robots.

- Overall, the 8051 microcontroller is a versatile and reliable choice for controlling various aspects of robotics, making it a popular choice among roboticists and researchers.

SECURITY SYSTEMS

- The 8051 microcontroller is widely used in security systems due to its low power consumption, small size, and cost-effectiveness. Here are some of the ways in which the 8051 microcontroller is used in security systems:

- **Access Control Systems:** The 8051 microcontroller can be used to control access to buildings, rooms, and other areas by interfacing with various sensors and actuators.

- **Alarm Systems:** The 8051 microcontroller can be used to monitor various parameters such as motion, temperature, and sound and trigger an alarm if any abnormal activity is detected.

- **Video Surveillance Systems:** The 8051 microcontroller can be used to control video surveillance systems, including controlling cameras, recording video, and processing video data.

- **Biometric Systems:** The 8051 microcontroller can be used to interface with various biometric sensors, such as fingerprint sensors and facial recognition systems, to authenticate users and grant access to secure areas.

- **Home Automation Security Systems:** The 8051 microcontroller can be used in home automation systems to monitor and control security devices such as door locks, window sensors, and security cameras.

- **Wireless Security Systems:** The 8051 microcontroller can be used in wireless security systems to control and communicate with various devices, such as sensors and actuators.

- Overall, the 8051 microcontroller is a versatile and reliable choice for security systems, making it a popular choice among security system manufacturers and integrators.

MEDICAL DEVICES

- The 8051 microcontroller is widely used in medical devices due to its low power consumption, small size, and cost-effectiveness. Here are some of the ways in which the 8051 microcontroller is used in medical devices:

- **Patient Monitoring Systems:** The 8051 microcontroller can be used in patient monitoring systems to measure various parameters such as heart rate, blood pressure, and temperature and display this data to healthcare professionals.

- **Drug Delivery Systems:** The 8051 microcontroller can be used in drug delivery systems to control the dosage and timing of medication delivery.

- **Medical Imaging Systems:** The 8051 microcontroller can be used in medical imaging systems to process image data from various imaging modalities such as X-rays and ultrasound.

- **Prosthetic Devices:** The 8051 microcontroller can be used in prosthetic devices to control the movement and feedback of prosthetic limbs.

- **Blood Glucose Monitors:** The 8051 microcontroller can be used in blood glucose monitors to measure and display blood glucose levels in diabetic patients.

- **Electrocardiogram (ECG) Machines:** The 8051 microcontroller can be used in ECG machines to measure and display the electrical activity of the heart.

- Overall, the 8051 microcontroller is a versatile and reliable choice for medical devices, making it a popular choice among medical device manufacturers and researchers.

PERIPHERALS OF 8051 MICROCONTROLLER

- The 8051 microcontroller is a versatile microcontroller that can interface with a wide range of peripherals. Here are some of the most commonly used peripherals of the 8051 microcontroller:

- **Timers/Counters:** The 8051 microcontroller has two 16-bit timers/counters that can be used for timing and counting events.

- **Interrupts:** The 8051 microcontroller has five interrupt sources that can be used to interrupt the main program for time-critical tasks.

- **Serial Communication:** The 8051 microcontroller has a built-in UART (Universal Asynchronous Receiver/Transmitter) that can be used for serial communication with other devices.

- **Analog-to-Digital Converter (ADC):** The 8051 microcontroller can interface with an external ADC to convert analog signals to digital signals.

- **Digital-to-Analog Converter (DAC):** The 8051 microcontroller can interface with an external DAC to convert digital signals to analog signals.

- **External Memory:** The 8051 microcontroller can interface with external memory devices, such as RAM and ROM, to expand its memory capacity.

- **LCD Display:** The 8051 microcontroller can interface with an LCD (Liquid Crystal Display) to display data and messages.

- **Keypad:** The 8051 microcontroller can interface with a keypad to receive user input.

- **Interrupt Controller:** The 8051 microcontroller can interface with an external interrupt controller to handle multiple interrupt sources.

- **Real-Time Clock:** The 8051 microcontroller can interface with a real-time clock to keep track of time and date.

INPUT & OUTPUT OF 8051

- Input: The 8051 microcontroller has four ports (P0, P1, P2, and P3) that can be configured as input ports. These ports can be used to receive data from external devices such as sensors, switches, and keypads. When a pin on a port is configured as an input, the 8051 can read the logic level on the pin (high or low) and use it to control the program flow.

- Output: The 8051 microcontroller also has four ports (P0, P1, P2, and P3) that can be configured as output ports. These ports can be used to send data to external devices such as LEDs, motors, and relays. When a pin on a port is configured as an output, the 8051 can set the logic level on the pin (high or low) to control the device connected to the pin.

- In addition to the general-purpose input/output (GPIO) ports, the 8051 microcontroller also has several special-purpose peripherals that can be used for input and output. These peripherals include:

- **Timers/Counters:** The timers/counters can be used to count external events or generate output waveforms.

- **Interrupts:** The 8051 can be configured to trigger an interrupt when a specific event occurs, such as the arrival of data on a serial port or a change in the logic level on an input pin.

- **Serial Communication:** The 8051 has a built-in UART (Universal Asynchronous Receiver/Transmitter) that can be used for serial communication with other devices.

- **Analog-to-Digital Converter (ADC):** The 8051 can interface with an external ADC to convert analog signals to digital signals.

- **Digital-to-Analog Converter (DAC):** The 8051 can interface with an external DAC to convert digital signals to analog signals.

- Overall, the 8051 microcontroller is highly flexible in terms of input and output, and can be configured to interface with a wide range of external devices.

SEVEN SEGMENT INTERFACING

- A Seven segment display is the most basic electronic display. It consists of eight LEDs which are associated in a sequence manner so as to display digits from 0 to 9 when proper combinations of LEDs are switched on.

- A 7-segment display uses seven LEDs to display digits from 0 to 9 and the 8th LED is used for dot. A typical seven segment looks likes as shown in figure below.
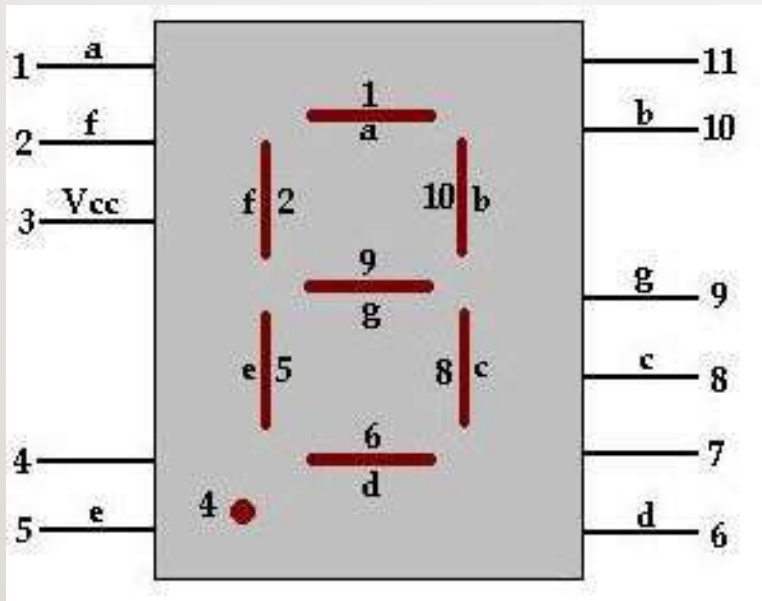
The 7-segment displays are used in a number of systems to display the numeric information. They can display one digit at a time. Thus the number of segments used depends on the number of digits to display. Here the digits 0 to 9 are displayed continuously at a predefined time delay.

The 7-segment displays are available in two configurations which are common anode and common cathode. Here common anode configuration is used because output current of the microcontroller is not sufficient enough to drive the LEDs. The 7-segment display works on negative logic, we have to provide logic 0 to the corresponding pin to make on LED glow.

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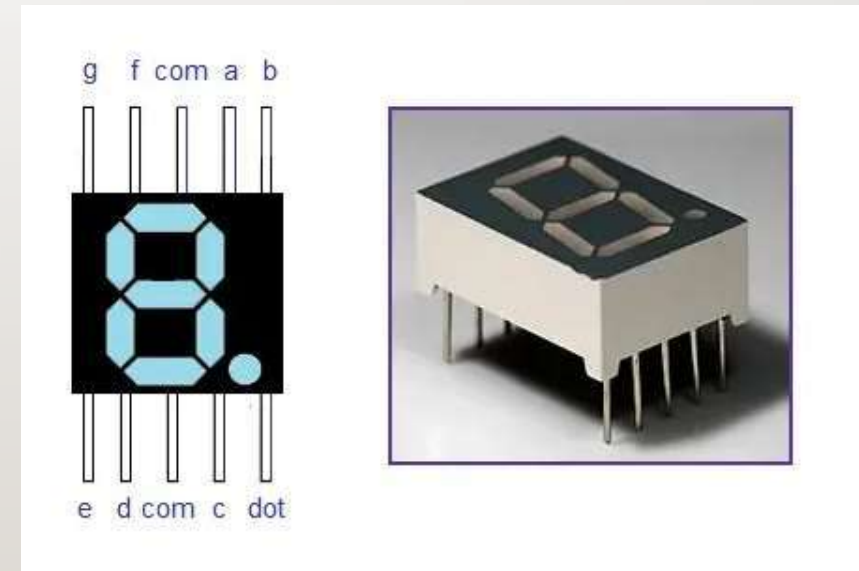
Types of Seven segment displays

- As mentioned in previous paragraphs, seven segment displays come up with two different configurations. They are the common anode and a common cathode.
- One pin each from each segment is connected to a common terminal. According to the pins which are connected to the common terminal, the seven segment display is categorized as a common anode and common cathode.

Common Cathode 7-segment display

As the name indicates, its cathode is connected to a common terminal. Below is the schematic diagram to indicate its common cathode structure. It should be connected to the ground while operating the display. If a high voltage is given to the anode, then it will turn on the corresponding segment.


Common Cathode Terminal

a b c d e f g dp

Connect these pins to source to enable each segment
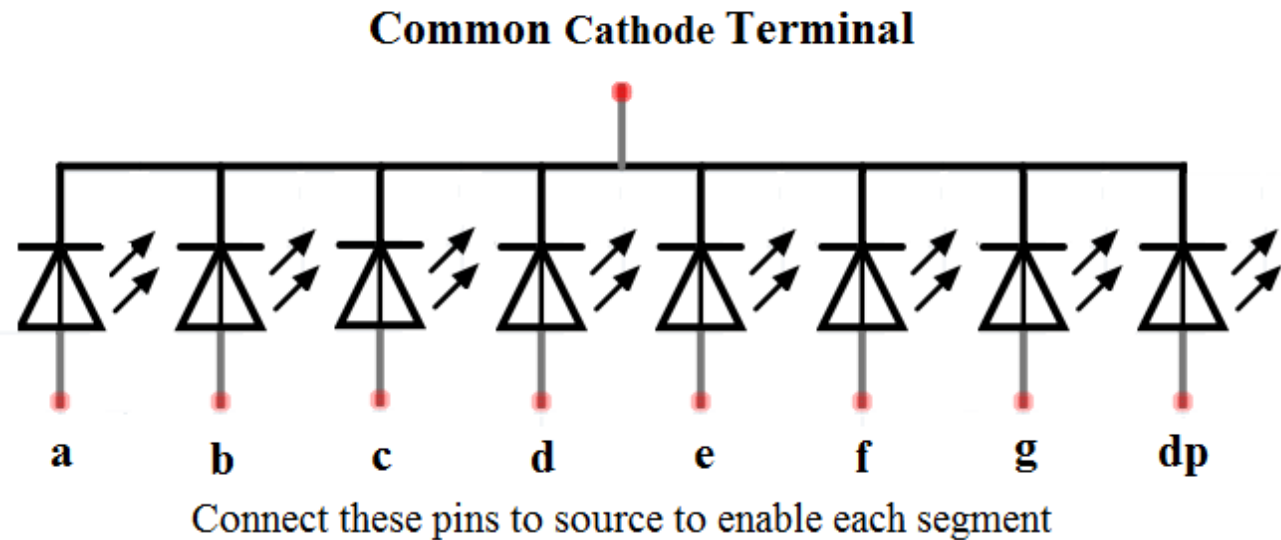
Common Cathode
7 Segment Display
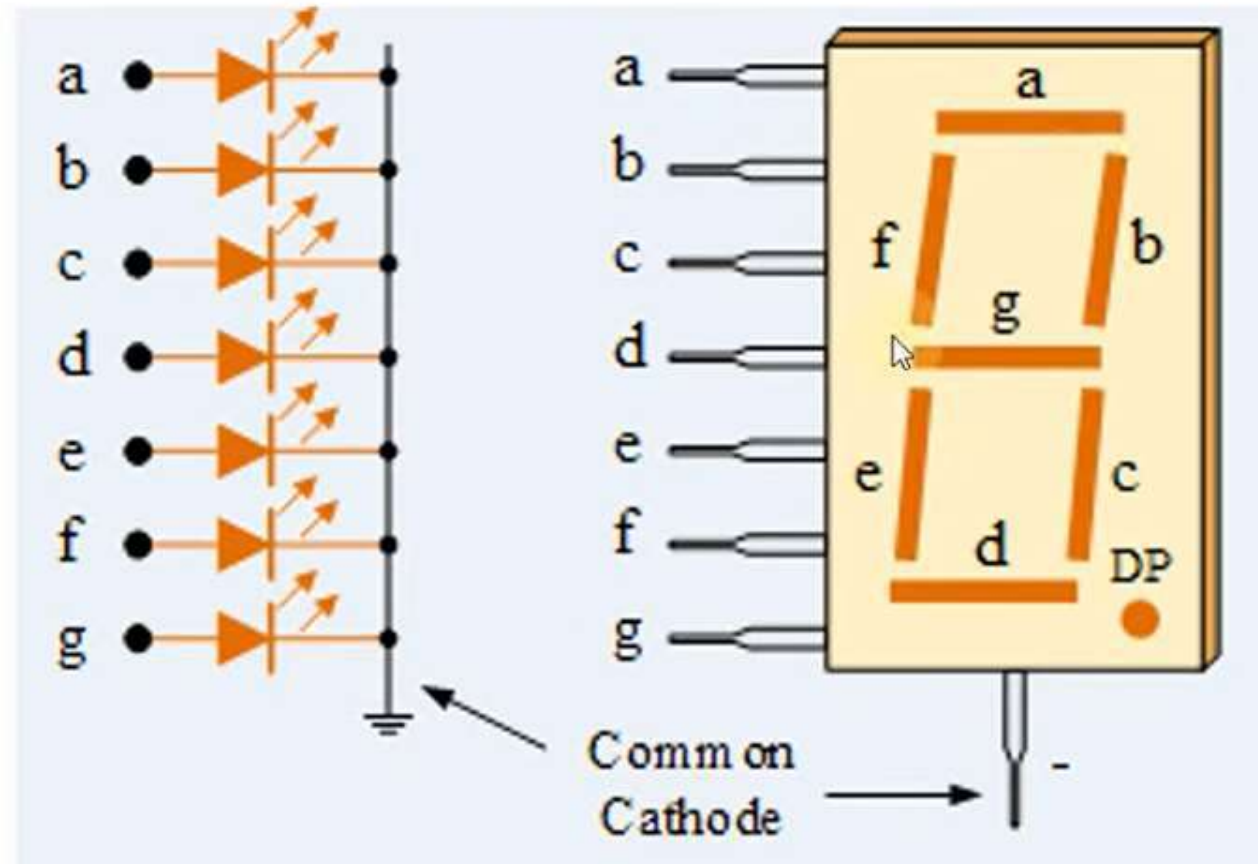
Common Anode 7-segment display

In this type, the anode is common. It should be connected to a high voltage (to the supply through a resistor to limit current). In order to turn on a particular segment, a ground level voltage is given to the corresponding pin. Since logic circuits can sink more current than they can source, common anode connection is used most widely.

Common Anode Terminal

a   b   c   d   e   f   g   dp
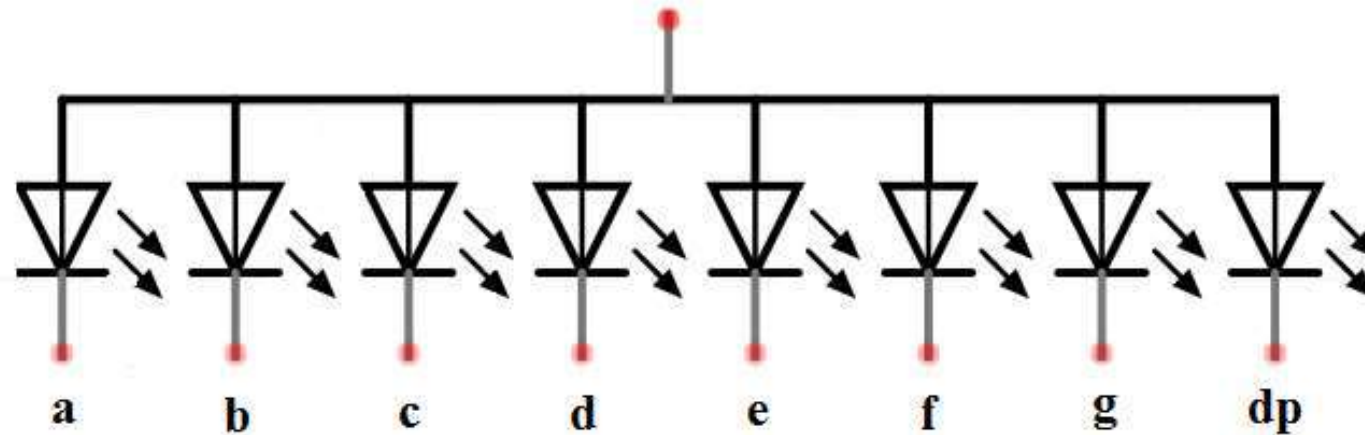
Ground these pins to enable each segment

Common Anode
# 7 Segment Display
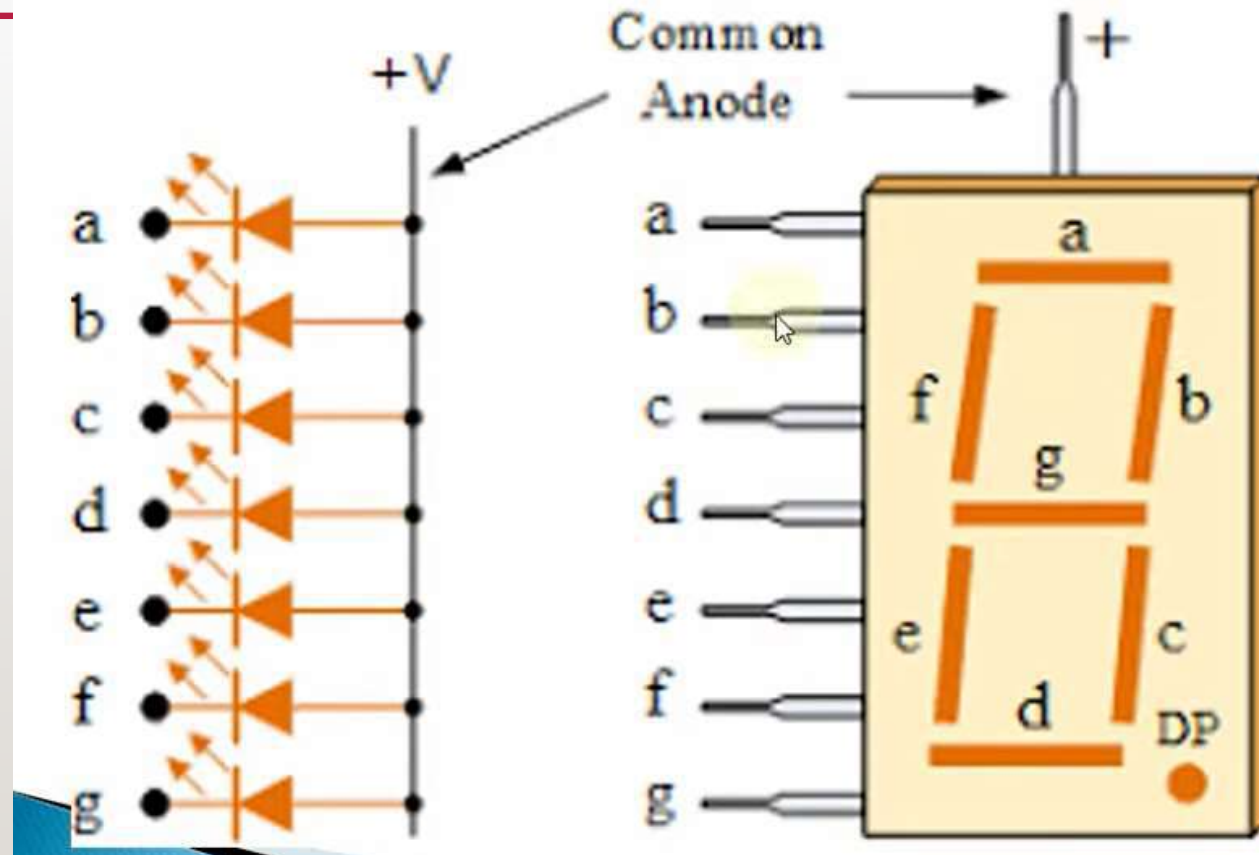
Digit Drive Pattern.

•   Digit drive pattern of a seven segment LED display is simply the different logic combinations of its terminals **'a' to 'h'** in order to display different digits and characters. The common digit drive patterns (0 to 9) of a seven segment display are shown in the table below.

Display codes are the voltages to be applied to the segments to display a number. It is in the order of segments ABCDEFG(DP), total 8 bits. For example, below is the common cathode display code of '0' with decimal point OFF.

LSB	A	B	C	D	E	F	G	DP	MSB
	1	1	1	1	1	1	0	0	

Below is a table with display codes of all the digits with decimal point OFF.

Numbers	Common Cathode		Common Anode	
	(DP)GFEDCBA	HEX Code	(DP)GFEDCBA	HEX Code
0	00111111	0x3F	11000000	0xC0
1	00000110	0x06	11111001	0xF9
2	01011011	0x5B	10100100	0xA4
3	01001111	0x4F	10110000	0xB0
4	01100110	0x66	10011001	0x99
5	01101101	0x6D	10010010	0x92
6	011111101	0x7D	10000010	0x82
7	00000111	0x07	11111000	0xF8
8	01111111	0x7F	10000000	0x80
9	01101111	0x6F	10010000	0x90
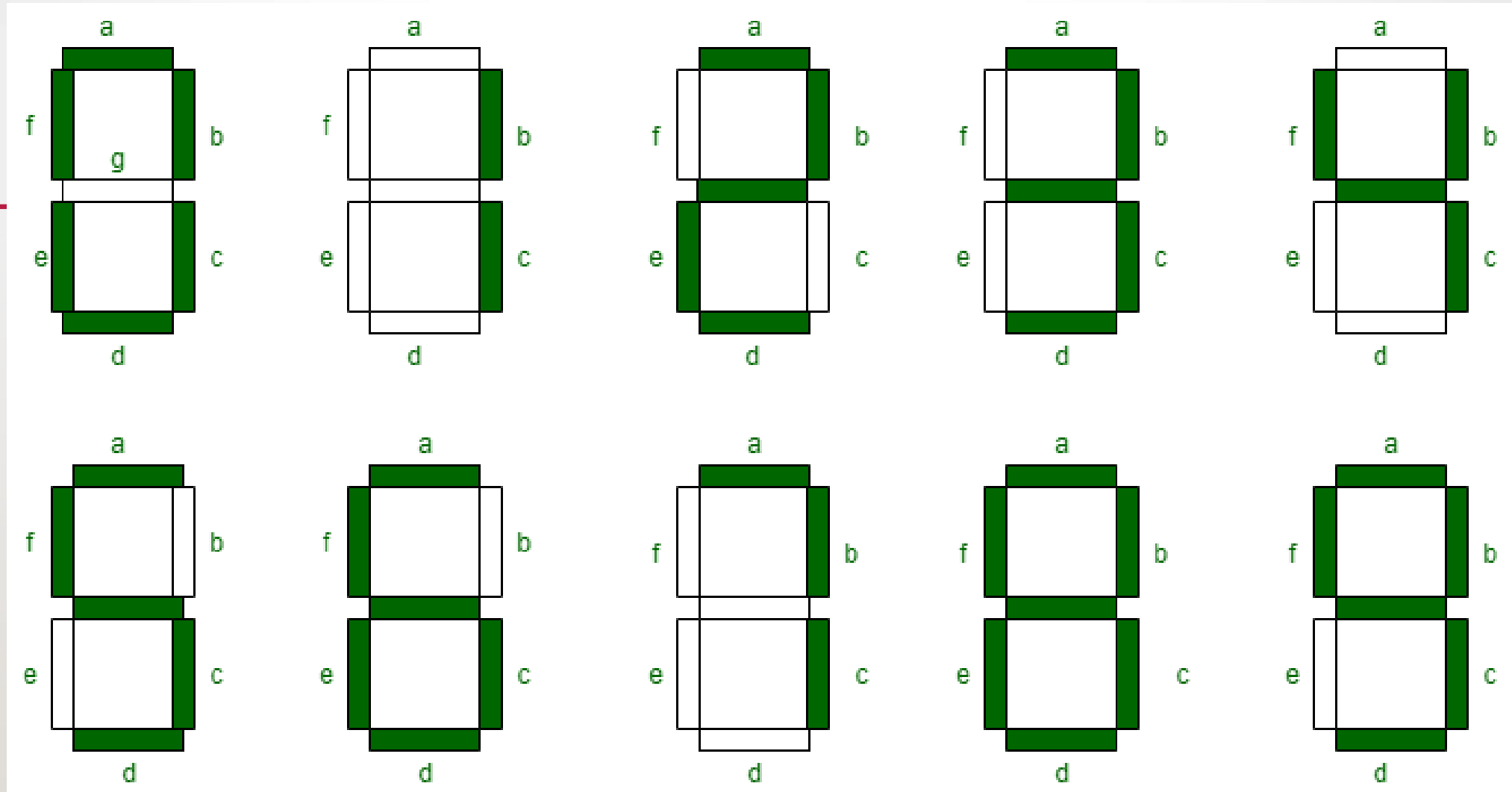
Digit	A	B	C	D	E	F	G
0	1	1	1	1	1	1	0
1	0	1	1	0	0	0	0
2	1	1	0	1	1	0	1
3	1	1	1	1	0	0	1
4	0	1	1	0	0	1	1
5	1	0	1	1	0	1	1
6	1	0	1	1	1	1	1
7	1	1	1	0	0	0	0