

7-Segment Displays

Using and driving 7-Segment displays

Riverside Raspberry Pi Meetup

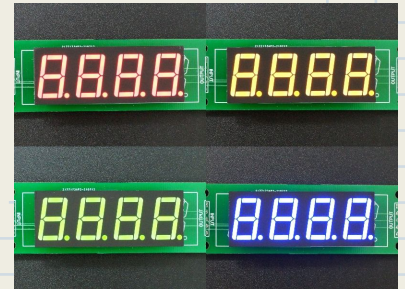
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What it is

7-Segment displays are usually just an array of LEDs arranged in a specific shape.

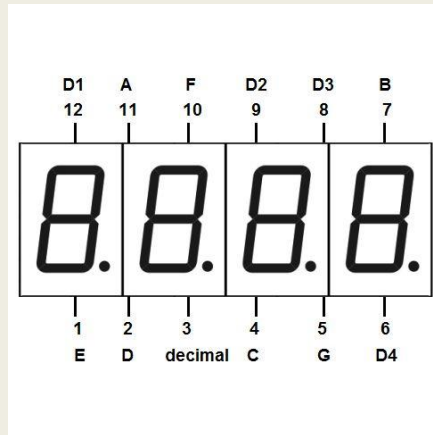
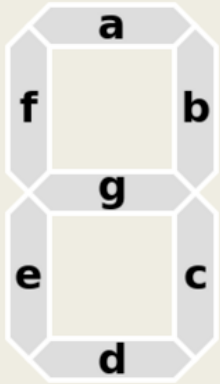
- 7 LEDs plus one decimal point
- Available in different colors just like regular LEDs
- Rules of using LEDs apply to 7-segment displays
- Display modules are available with a controller IC
- Available as single or multiple digits



How they work

Numbers are displayed by illuminating a specific combinations of LEDs

- Modules are common anode or common cathode
- Multi-digit modules have similar segments connected together



A 3x3 grid of 7-segment displays showing the digits 0 through 9. The digits are arranged as follows: Row 1: 0, 2, 3; Row 2: 4, 5, 6; Row 3: 7, 8, 9.

Digit Shown	Illuminated Segment (1 = illumination)						
	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

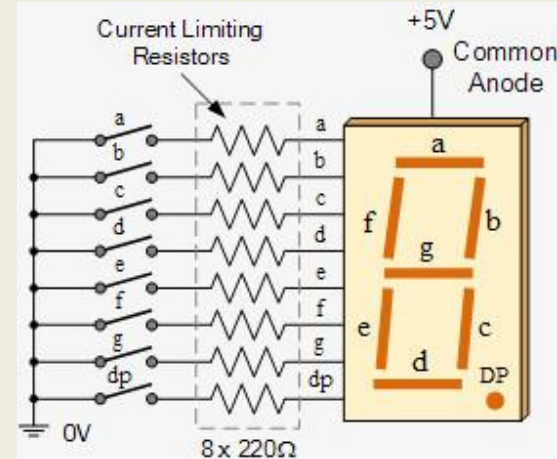
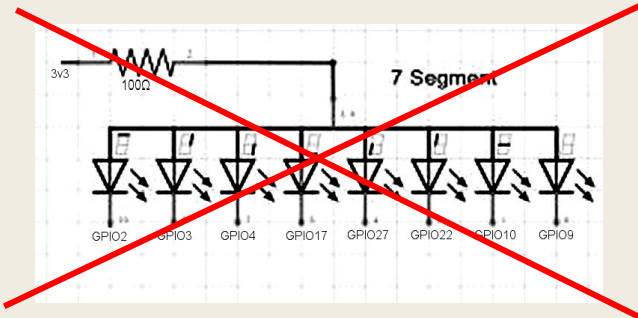
Power Requirements

7-Segment displays are powered just like a regular LED.

- They are current driven and that current must be controlled with a resistor

$$R = V / I \quad (\text{Example: } 5V / 20mA = 250\Omega \sim 220\Omega)$$

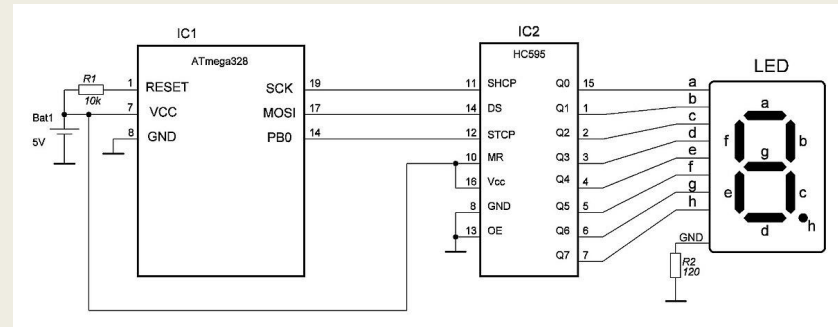
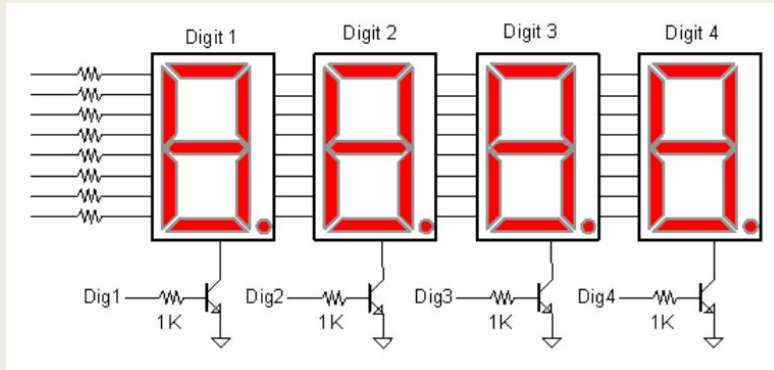
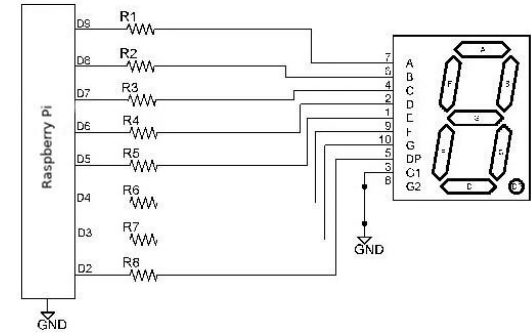
- Use a resistor for each segment instead of one resistor on the common



Control - GPIO

You can use GPIO ports to control the display

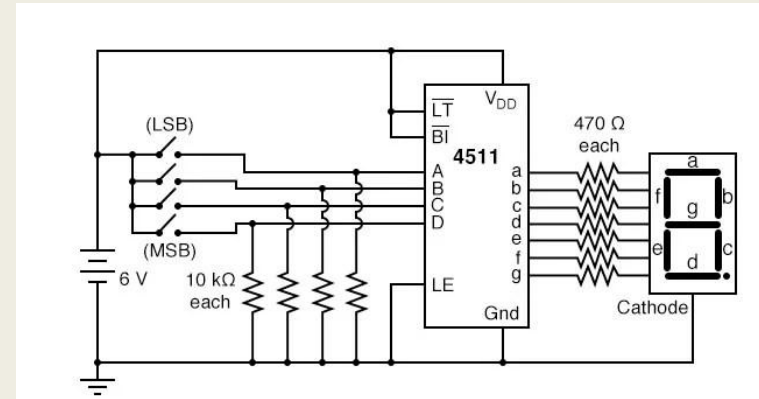
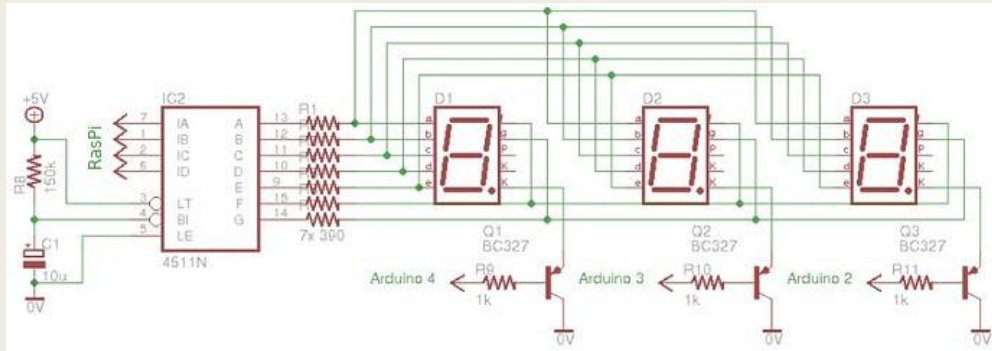
- Uses a lot of GPIO pins
- Controlling device has limited power output (might need to use transistors as buffers)
- Use shift registers to reduce pin count (74HC595)



Control - BCD to 7 Segment

You can use a BCD to 7-segment driver to control the display

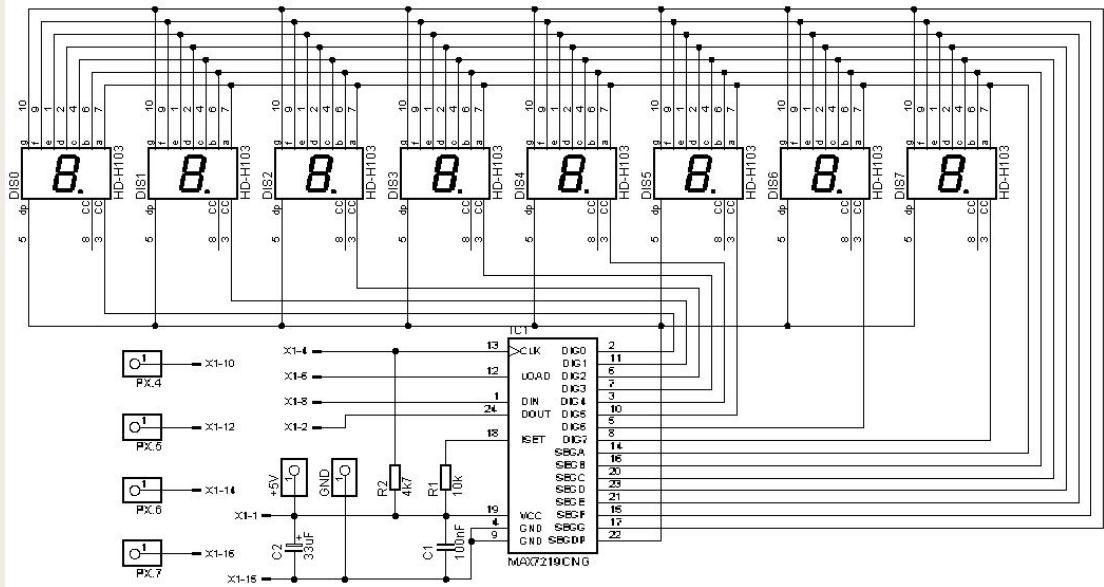
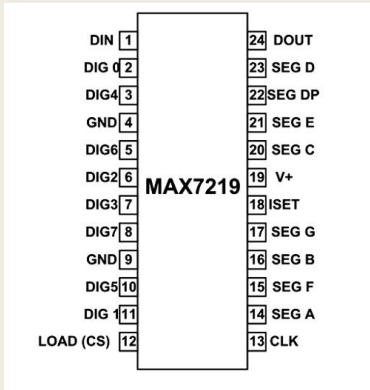
- Converts Binary-Coded-Decimal input to 7-segment numbers (CD4511)
- Needs only 4 GPIO pins
- Controlling device has limited power output (might need to use transistors as buffers)
- Can be multiplexed
- Provides buffered output



Control - MAX7219

You can use a BCD to 7-segment driver to control the display

- Designed for common cathode displays
- Controls 8 Digits
- Uses 4-wire SPI bus
- Provides buffered output
- ICs can be cascaded



Resources

- General Information:

<https://www.electronics-tutorials.ws/blog/7-segment-display-tutorial.html>

https://7seg.fandom.com/wiki/7-segment_display

- Example Projects

<http://hackaday.com/2013/11/21/7-segment-display-matrix-visualizes-more-than-numbers/>

<http://fortoffee.org.uk/raspberry-pi-delorean/>

<http://jeremyblythe.blogspot.com/2012/07/raspberry-pi-7-segment-displays.html>

- Data Sheets

<https://www.ti.com/lit/ds/symlink/cd4511b.pdf>

<https://datasheets.maximintegrated.com/en/ds/MAX7219-MAX7221.pdf>

<https://www.ti.com/lit/ds/symlink/sn74hc595.pdf>

- MAX7219 Software Drivers

<https://github.com/JennaSys/rpi-max7219>

<https://github.com/JennaSys/micropython-max7219>