

7 Segment Display Driver

ELECTRONICS123

Skill Level: Beginner

OVERVIEW

7 SEGMENT DISPLAY

A 7 segment display has found many uses to display decimal numbers ranging from 0—9 and other characters that may be created. The scope of this article will cover the 7 segment display used in conjunction with a driver IC (Integrated Circuit). The reason why a driver IC is commonly used with a 7 segment display is to display a relevant decimal number obtained from a binary code usually referred to as a BCD (Binary Coded Decimal) which will be discussed in further detail later on in the article, and to ease the use of a 7 segment display as it has 8 inputs (including the decimal point) and could prove frustrating to display a decimal number using 7 switches.

This BCD code will be fed into the driver on the 4Bit data inputs and will be logically analyzed inside of the IC to give the corresponding 7 outputs to display a decimal number.

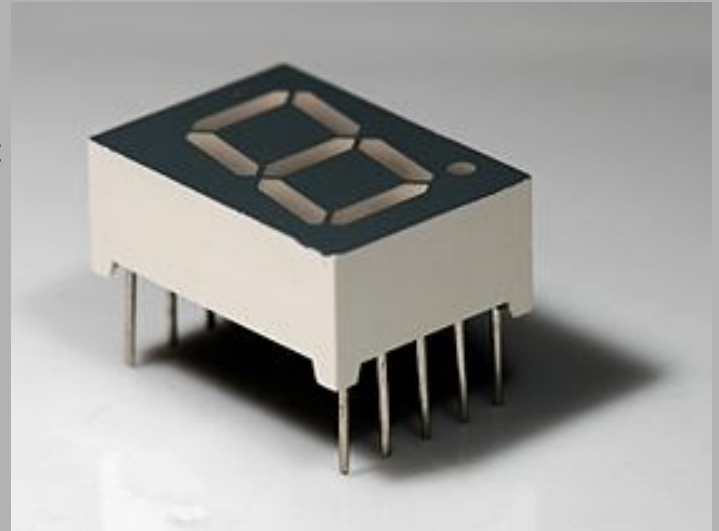


Figure 1: 7 Segment Display

Inside the 7 segment display are LED's for each segment that is visible in **figure1**. These LED's do not have any resistors connected to them to limit the current, thus we will need to implement our own. What size resistors should they be? It depends on the maximum current rating per segment which one can find in a data sheet as the example in **Figure2**.

Figure2 : Datasheet Example

Absolute Maximum Rating (Ta = 25°C)

PARAMETER	RED	AMBER	GREEN	BLUE	WHITE	UNITS
DC Forward Current Per Segment	30	30	25	30	20	mA
Peak Current Per Segment ⁽¹⁾	70	50	50	25	25	mA
Avg. Forward Current (Pulse Operation) Per Segment	30	30	25	25	25	mA
Derating Linear From 25°C Per Segment	0.3					mA/°C
Reverse Voltage ⁽²⁾	3					V
Operating Temperature	-25 to +85					°C
Storage Temperature	-30 to +85					°C

Using the information in **Figure2** we can determine the resistor size using Ohm's Law:

$$R = V / I$$

R = Resistance (Ω)

V = Voltage (V)

I = Current (A)

Lets use a 5V supply which is preferred for digital circuits and use the appropriate current rating for the display so focus on the " DC Forward Current Per Segment" row and select the display colour you have.

I will use 30mA and we will give it $\frac{2}{3}$ of the maximum rating, thus $(0.03 \text{ A} / 3) \times 2$ which yields 20mA, the reason is we do not want to run on the maximum rating as it could lower the life span of the device and put excessive current strain on the driver IC.

Our only unknown is resistance so we substitute the values into Ohm's law.

$$R = 5V / 0.02A$$

R = 250 Ω

V = 5 V

I = 0.02 A

TIP: If 250 Ω resistors cannot be obtained try using a higher value such as 270 Ω which we will use.

Colour Bands: RED, VIOLET, BROWN

DRIVER IC

The driver IC we will use is the 74LS47. This driver can only be used with Common Anode displays, Common Cathode drivers are also available but will not work on a Common Anode display.

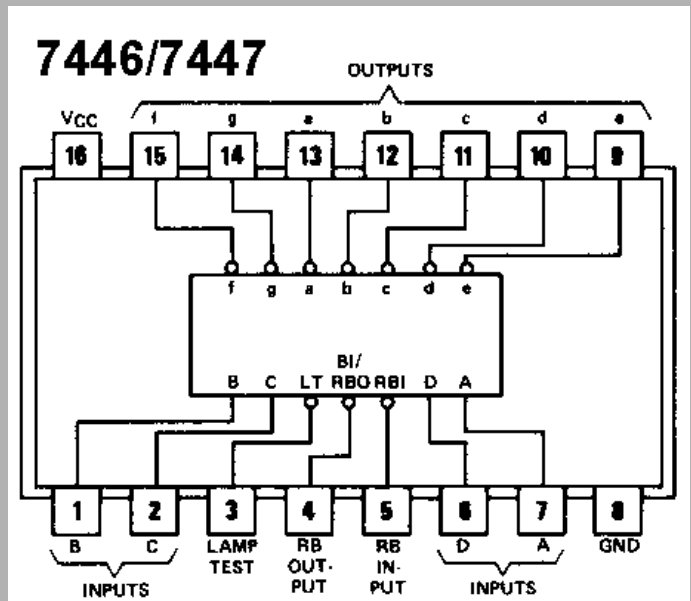


Figure3: 74LS47 Driver IC and Pin out

The 74LS47 Driver has an active low output represented by the little circles from a to f in the internal image of **Figure3**. Active low means that the current will sink into the IC when an output is active. This suggests that a Common Anode display is used as the LED's are essentially connected to the +5V point and then connected through the resistors to the outputs of the Driver IC.

PIN DEFINITIONS:

- Pins(1, 2, 6, 7) are the data input pins this is where the BCD code will be applied, a logic 1 = 2V to 5V and a logic 0 = 0v to 0.8V
- Pins(9, 10, 11, 12, 13, 14, 15) are the active low outputs which will be connected to the resistor's which will connect to the 7 Segment Display .
- Pin(3) Lamp Test, used to test all the segments by turning them on, this pin is

also active low, so should be connected to ground to enable it, in this experiment we will tie it to +5V as we do not want to enable it.

- Pin(4) RBO used to blank screens when they have been cascaded together.

RBO = Ripple Blanking Output Active Low.

- Pin(5) BI used to blank the screen.

BI = Blanking Input Active Low.

- Pins(16, 8) Power pins, 16 = +5V and 8 = GND.

BCD TRUTH TABLE

Decimal	DATA INPUTS			
	D (MSB)	C	B	A (LSB)
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

In the BCD truth table the decimal ranges from 0 to 15 for a 4Bit Data input. The problem that arises is that the 7 segment display can only accommodate decimal values 0—9, so 10—15 will display other images on the display.

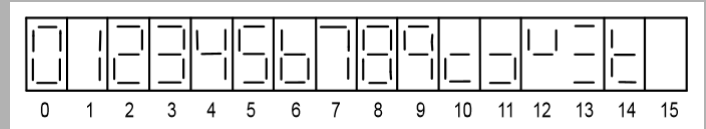


Figure4: 7 Segment outputs 0—15

Note that in the truth table there's labels (LSB) and (MSB), LSB stands for Least Significant Bit and MSB stands for Most Significant Bit, LSB will be taken as your first Bit and MSB will be the last bit as follows:

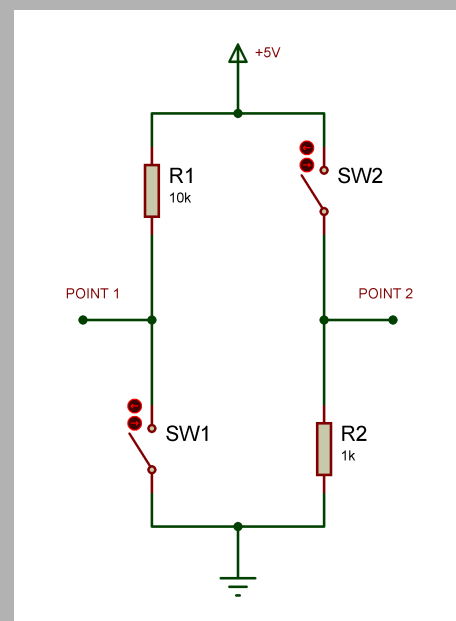
(LSB) A = Bit₀

B = Bit₁

C = Bit₂

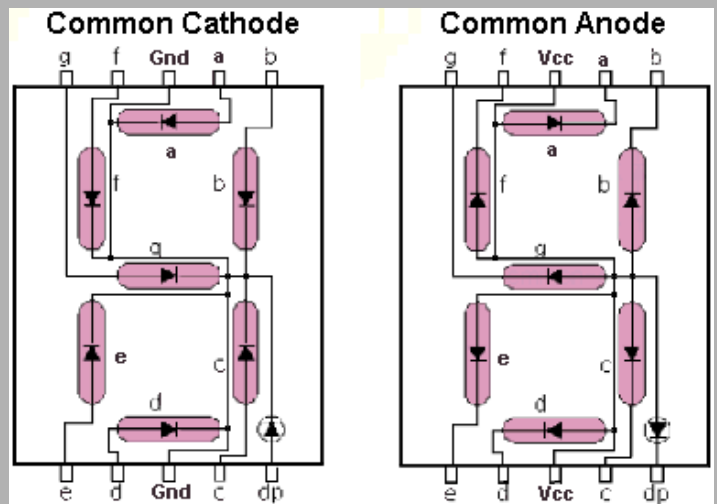
(MSB) D = Bit₃

The 4Bit input will be created using a 4 pin DIP switch to supply +5V or 0V to represent logic 1 and 0 respectively. The switch will be implemented in one of two configurations to prevent a floating voltage on the input pins which would corrupt our output.

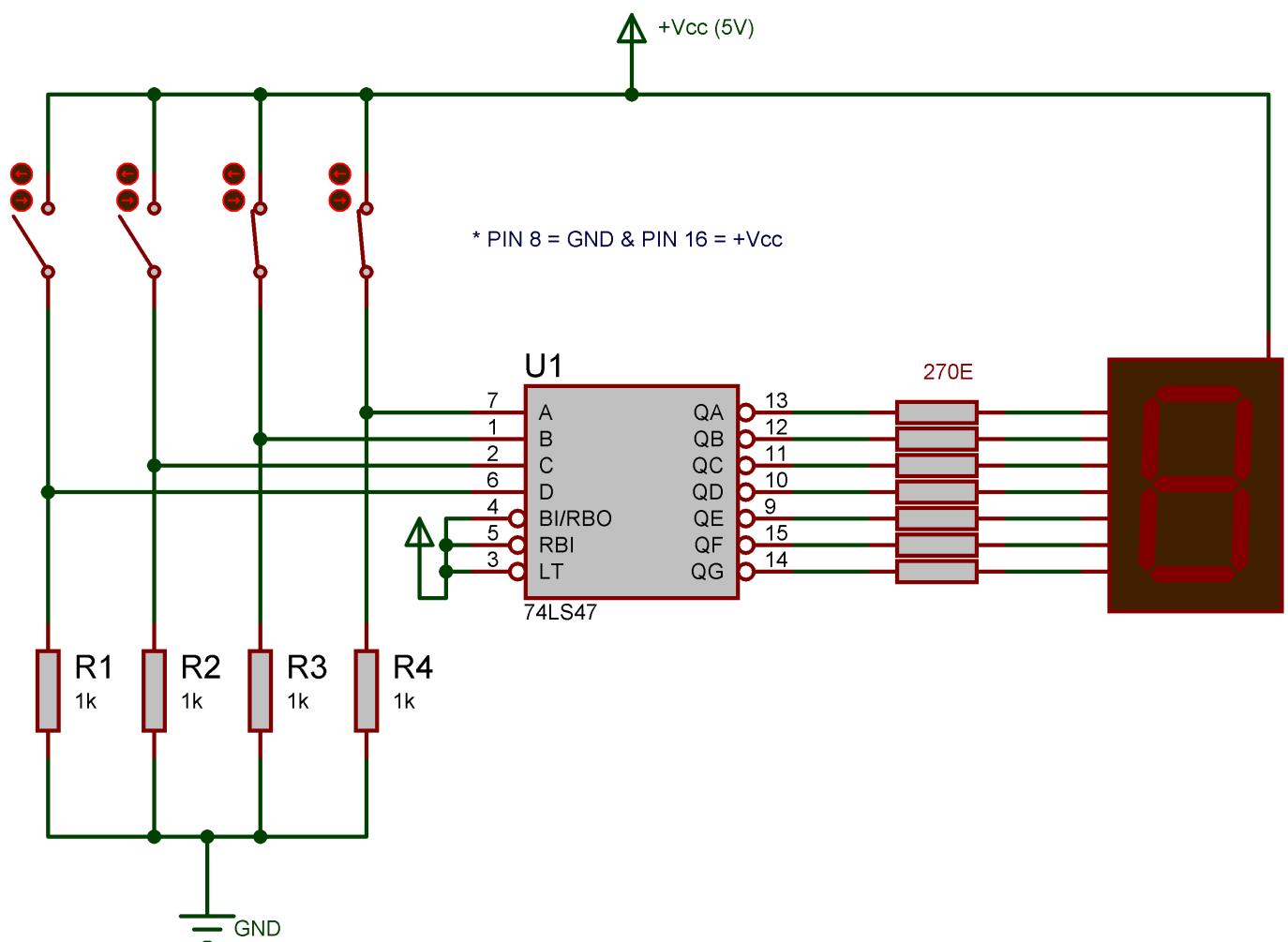


In the above figure point 1 will produce a logic 1 when the switch is open and point 2 will produce a logic 1 when the switch is closed. Either of these switch configurations can be used. We will use the second configuration as, switch on = logic 1.

Connect the circuit as the schematic diagram indicates. The 7 Segment Display pin out is represented in the image to the right. Use the Common Anode display as it's the only one that will work with the 74LS47 Driver IC.



7 SEGMENT DISPLAY DRIVER SCHEMATIC



TROUBLE SHOOTING

Once the circuit has been constructed and any problems arise they could often be solved by a few simple checks as listed:

- **Nothings turning on:**

Set the DIP switch to different values if its set as 1111 (Decimal value 15 in binary) the display driver blanks the display, if problems persist make sure all the 7 segment display power pins are connected to +5V and that the IC has +5V on pin 16 and GND on pin 8.

- **Screen displaying non relevant information:**

Make sure the 7 segment display resistors are not shorting with each other and that the pins are connected to the right pins on the driver IC.

- **All segments are on and doesn't change:**

If all 7 segments are on it is most likely the Blanking input pin that is not connected to +5V to disable it.

- **Binary input doesn't correspond to decimal number displayed:**

Check the switch layout, your LSB will be pin A and MSB will be pin D on the driver IC, make sure all input bits are to the correct input on the IC. Possible shorts between any connection's, if built on a bread board keep an eye on the output resistors, as they are commonly shorted with each other.

PARTS LIST

ELECTRONICS 123 Stock codes:

Quantity	Description	Stock Code
1x	74LS47 Driver IC	AA574
1x	7 Segment	AA027
4x	1 k Ω 1/4 Watt	DB056
7x	270 Ω 1/4 Watt	DB049
1x	4 Way DIP	DB682