|  |  |
| --- | --- |
| A picture containing electronics  Description generated with high confidence  Seven-Segment DISPLAY  Design and Implement a 7SD | Shady Boukhary, Brice Allard, Tommas Johnson  Logic Design 3023 |

The seven-segment display (7SD) consists of 7 LEDs arranged in a triangular fashion like the number 8. Every LED, or a segment, forms a part of a numerical digit when illuminated, whether it being a Decimal or a Hex digit. Moreover, the LED pins are labelled from a through g with each letter representing one LED or segment. Each of the decimal digits can be generated on the display by forward biasing – applying voltage across the diode in a way that the diode would allow the current to flow – the pins of the LEDs in a specific order. Consequently, some segments of the display will be dimmer than others, creating shapes. Every LED has two pins, a Cathode and an Anode. Therefore, this produces two types of 7SD displays called Common Cathode (CC) and Common Anode (CA), which is the more common one. The difference between the two is that the CC illuminates individual segments by applying high voltage – logical 1, while the CA illuminates them by applying low voltage – logical 0. To come up with a truth table for the seven-segment display, one needs to understand how to illuminate the segments to generate the digits first. To illuminate the display to generate the digit 0, 6 out of the 7 segments need to be illuminated. Particularly, the segments corresponding to the a, b, c, d, e, and f pins. The afore-mentioned pins would generate the numerical digit 0 by illuminating the segments that would resemble its shape. Applying the same logic to the rest of the numerical digits, one can deduce that in order to generate the numbers 1 through 9, the following display segments (LEDs) need to be illuminated respectively: b and c corresponding to 1; a, b, d, and e corresponding to 2; a, b, c, d, and g corresponding to 3; b, c, f, and g corresponding to 4; a, c, d, f, and g corresponding to 5; a, c, d, e, f, and g corresponding to 6; a, b, and c corresponding to 7; a, b, c, d, e, f, and g corresponding to 8 since all the LEDs need to be illuminated to represent 8; a, b, c, f, and g corresponding to 9. Moreover, to prevent damage to the LEDs, a resistor should be used. Typically, each LED segment can draw about 15 mA. Therefore, on a typical 5V circuit, a 200 Ohm resistor is needed by applying Ohm’s law on the circuit: where V is the voltage in Volts *(V)*, R is the resistance in Ohms *(Ω)*, and I is the current in Amperes *(A).* To get the resistance needed, we calculate . The truth table for a Common Anode 7-segment display derived using the above logic is presented in the next page in Figure 1.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Decimal or Hex Digit | Individual LEDs (Segments) Illuminated | | | | | | |
| A | B | C | D | E | F | G |
| 0 *(0000)* | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 *(0001)* | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 2 *(0010)* | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 3 *(0011)* | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| 4 *(0100)* | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 5 *(0101)* | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 6 *(0110)* | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 7 *(0111)* | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 8 *(1000)* | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 *(1001)* | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| A *(1010)* | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| B *(1011)* | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| C *(1100)* | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| D *(1101)* | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| E *(1110)* | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| F *(1111)* | 0 | 1 | 1 | 1 | 0 | 0 | 0 |

*Fig. 1: Truth Table for a Common Anode (CA) 7-Segment Display with all possible values.*