

ELG3331

Lab4: Binary and Decimal Numbers and Code Converters

Objective:

- To demonstrate the count sequence of binary number and the binary-coded decimal (BCD) representation.
- Design and build gray code to binary converter.
- Design and build BCD-to-7 segment converter.

Equipment and Components:

- SN 7493 4-bit ripple counter.
- Seven segment display.
- SN 7447 BCD-to-seven segment decoder.
- DC power supply.
- Digital multimeter.
- Function Generator.

Theory:

- BCD is a 4-bit binary code representing the decimal numbers 0 through 9. The binary numbers 1010 through 1111 are not used in BCD.

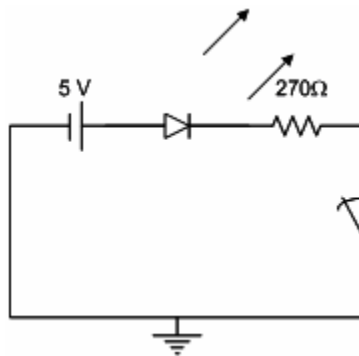
Decimal	BCD Outputs			
0	0	0	0	0
1	0	0	0	1
2	0	0	0	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

- The conversion from one code to another is common in digital systems. Sometimes the output of a system is used as the input to the other system. A conversion circuit is necessary between 2 systems if each system uses different codes for the same information.
- Gray code is one of the codes used in digital systems. It has the advantage over binary numbers that only one bit in the code word changes when going from one number to the next.

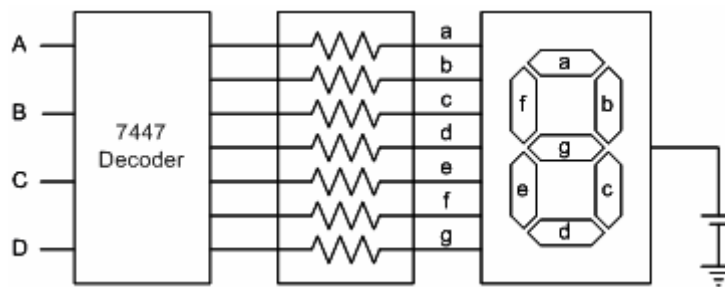
Decimal	Gray	Binary
0	0000	0000
1	0001	0001
2	0011	0010
3	0010	0011
4	0110	0100
5	0111	0101

6	0101	0110
7	0100	0111
8	1100	1000
9	1101	1001
10	1111	1010
11	1110	1011
12	1010	1100
13	1011	1101
14	1001	1110
15	1000	1111

- A light emitting Diode (LED) is a PN junction diode. When the diode is forward biased, a current flow through the junction and the light is emitted.



- A seven segment LED display contains 7 LEDs. Each LED is called a segment and they are identified as (a, b, c, d, e, f, g) segments.
- The display has 7 inputs each connected to an LED segment. All anodes of LEDs are tied together and joined to 5 volts (this type is called common anode type). A limiting resistance network must be used at the inputs to protect the 7-segment from overloading.
- BCD inputs are converted into 7 segment inputs (a, b, c, d, e, f, g) by using a decoder.
- A decoder is a combinational circuit that converts binary information from n input lines to a maximum of 2^n output lines. The input to the decoder is a BCD code and the outputs of the systems are the seven segments a, b, c, d, e, f, and g.



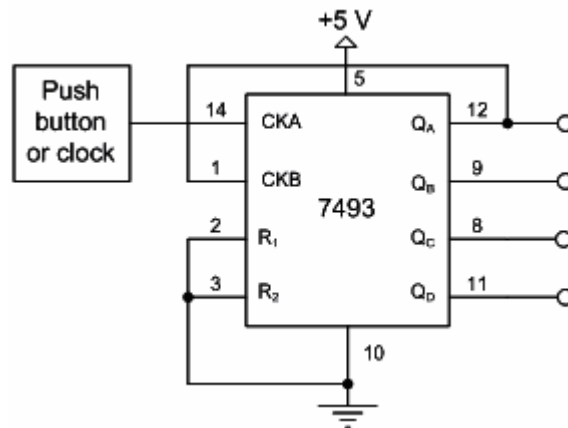
Note: In an actual 7-segment display the dot is on the left

Decimal	BCD				Outputs						
	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	0	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	0	1	1

Procedure:

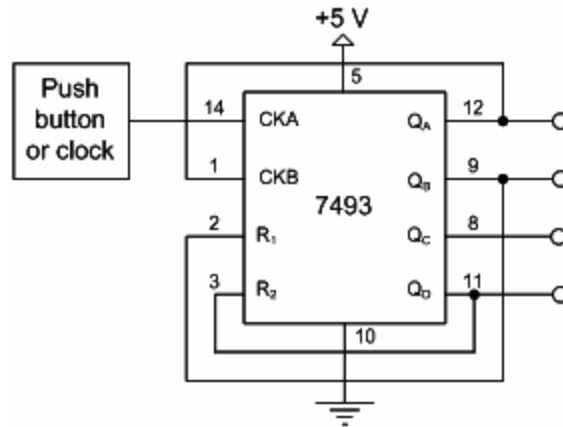
- **BINARY COUNT**

1. Connect the IC type 7493 as shown below. Pin 14 is connected to the push button switch.
2. Turn the power on. The 4-bit number in the output is incremented by one for every pulse generated by pushing the pulser button.
3. Disconnect the input of the counter at pin 14 from the push button and connect it to the FUNCTION GENERATOR (lead TTL).
4. Set frequency selector to 1 Hz. This will provide an automatic binary count.



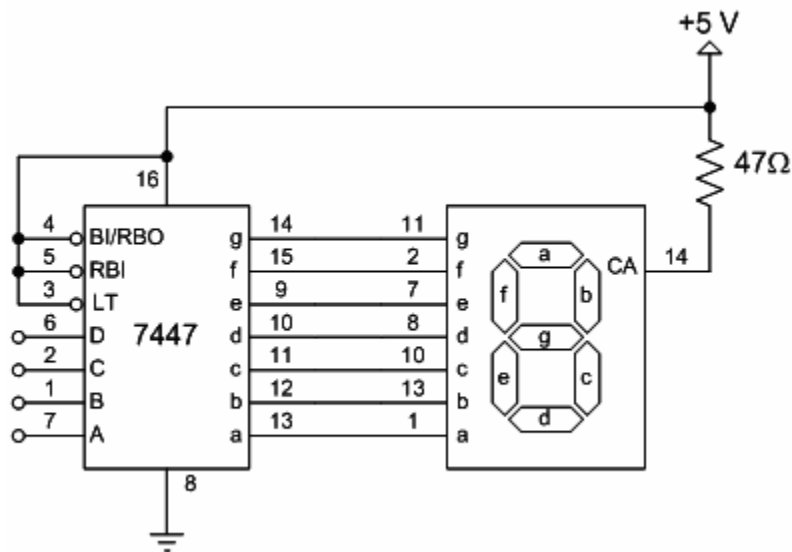
- **THE BCD COUNT**

5. Turn off the power switch.
6. Connect the IC type 7493 as shown below. Pin 14 is connected to the push button switch.
7. Turn the power on. The 4-bit number in the output is incremented by one for every pulse generated by pushing the pulser button following the sequence 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 1, 2, 3,
8. Disconnect the input of the counter at pin 14 from the push button and connect it to FUNCTION GENERATOR (lead TTL).
9. Set frequency selector to 1 Hz. This will provide an automatic binary count.



- **BCD-TO-SEVEN SEGMENT CONVERTER**

1. Turn off the power switch.
2. Connect the circuit as shown below. Pins 7,1,2,6 are connected to the push buttons.
3. Turn the power on. By applying BCD codes at the input, verify the displayed decimal digits for that given input.
4. Replace push buttons inputs by the BCD counter and observe displayed decimal digits.



Exercise:

- **GRAY CODE TO BINARY CONVERTER**

Design a combinational circuit with 4 inputs and 4 outputs that converts a four bit Gray code number into an equivalent four-bit Binary number.