Circuit Simulation Project

https://esim.fossee.in/circuit-simulation-project

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Title of the circuit: Gray Code to Binary Code conversion

Theory/ Description:

The Gray code is a non-weighted code, and is not suitable for arithmetic operations. It is not a BCD code, it is a cyclic code because of successive code words in this code differ in 1 bit position only i.e., a unit distance code. It is also a reflective code.

Gray Code to Binary Code Conversion:

If n-bit Gray Code number is represented by G_n, G_{n-1}, …, G_1, and its equivalent binary code by B_n, B_{n-1}, …, B_1 where B_n and G_n are the MSBs. The binary code bits are obtained from the Gray code bits as follows:

$$B_n = G_n$$

$$B_{n-1} = B_n \oplus G_{n-1}$$

$$B_{n-2} = B_{n-1} \oplus G_{n-2}$$

$$\vdots \; \vdots \; \vdots$$

$$B_1 = B_2 \oplus G_1$$

where $\oplus$ is the Exclusive OR (XOR) operation.

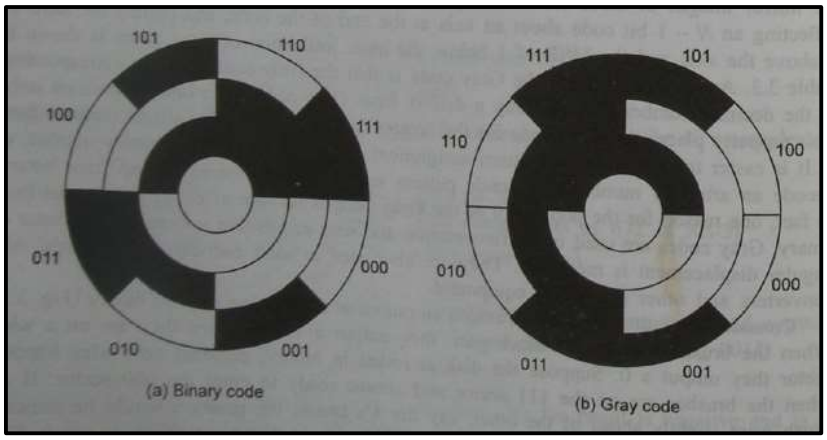


Fig 1 – Binary code and Gray Code Relation [2]

The truth table for the Gray Code to Binary Code conversion is:

Table 1 – Truth Table

G_2	G_1	G_0	B_2	B_1	B_0
0	0	0	0	0	0
0	0	1	0	0	1
0	1	1	0	1	0
0	1	0	0	1	1
1	1	0	1	0	0
1	1	1	1	0	1
1	0	1	1	1	0
1	0	0	1	1	1

The procedure to convert Gray code to Binary Code is as follow:

1. The MSB of the binary number is the same as the MSB of the Gray code number.
2. Add the MSB of the binary to the next bit of Gray Code, i.e., XOR it. Recording the sum and ignore the carry.
3. Add the 2nd bit of the binary to the 3rd bit of the Gray code, the 3rd bit of the binary to the 4th bit of the Gray code and so on.
4. Continue this till all the Gray bits are exhausted. The sequence of bits that has been written down is the binary equivalent of the Gray code number.

The Gray code is used in a few specific applications. The main applications include being used in analog to digital converters, as well as being used for error correction in digital communication. Gray code is used to minimize errors in converting analog signals to digital signals.

Circuit Diagram(s):

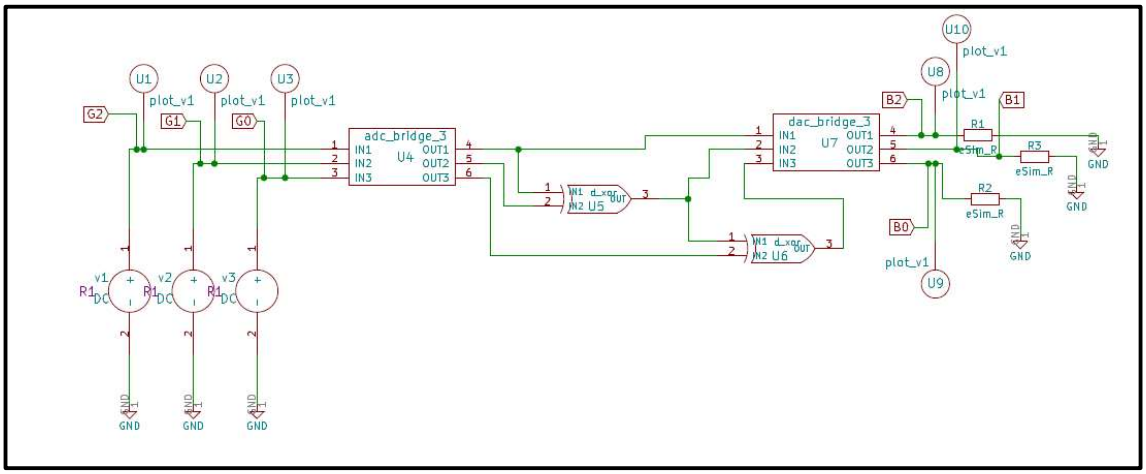


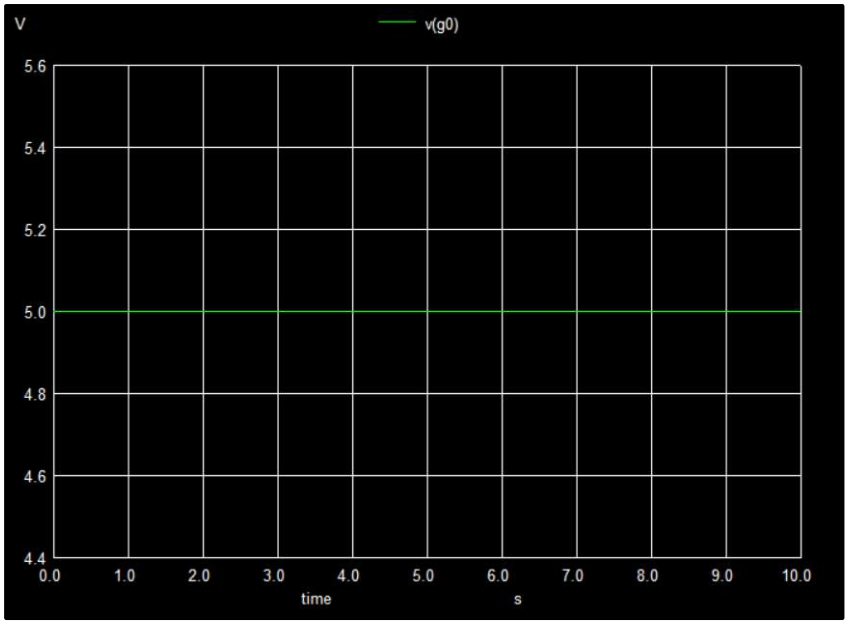
Fig. 2 – Circuit diagram of Gray code to Binary code conversion

Results (Input, Output waveforms and/or Multimeter readings):

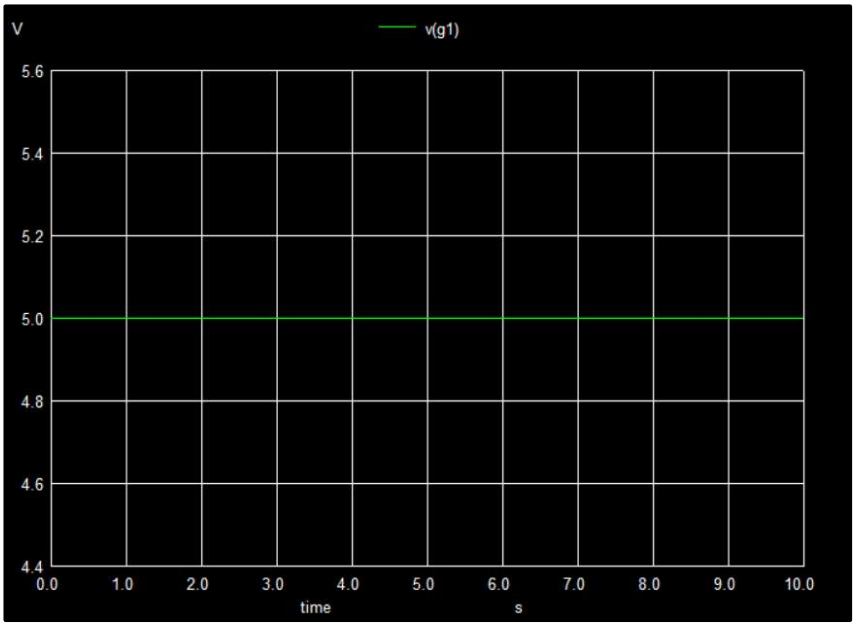
For input – 111 the output should be 101 which can be observed and verified from the following plots.

Inputs: G0|G1|G2 = 111 (each 5V)

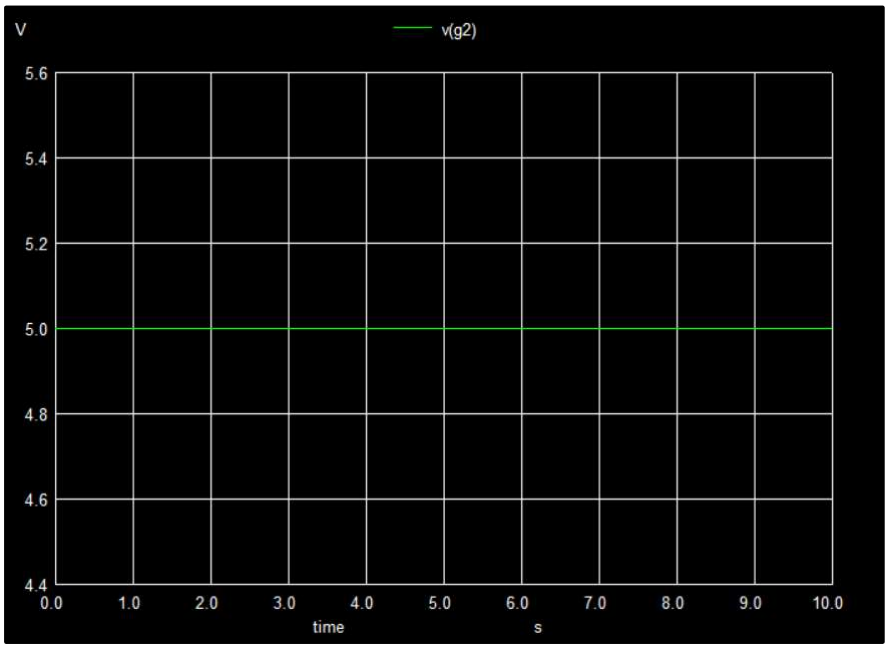
1. G0 bit input



2. G1 bit input

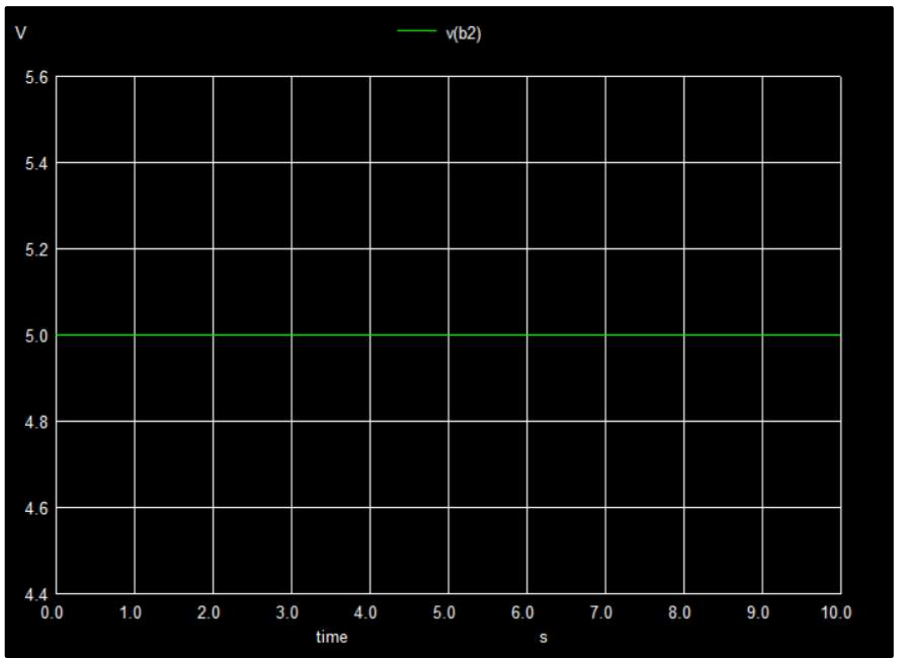


3. G2 bit input

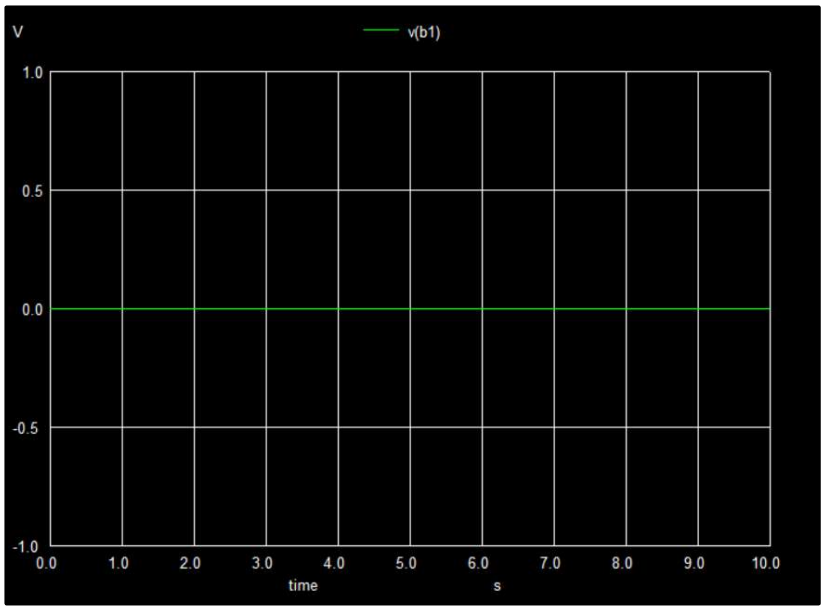


Outputs: B2|B1|B0 = 101

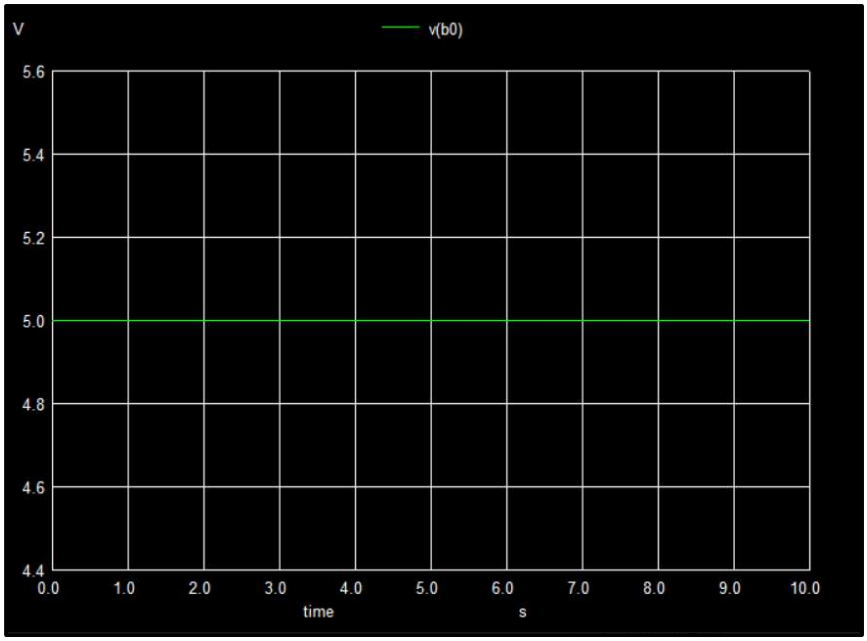
1. B2 bit output



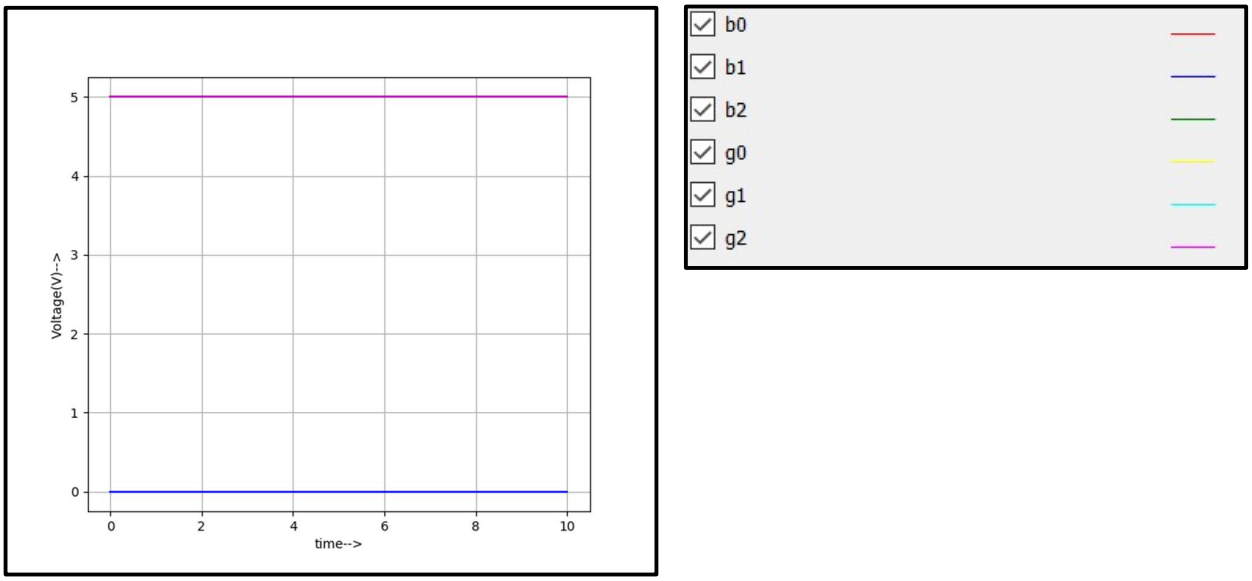
2. Output B1



3. Output – B0



Python Plot:



Source/Reference(s):

1. https://www.electrical4u.com/binary-to-gray-code-converter-and-grey-to-binary-code-converter/
2. Book - Digital Circuits by Anand Kumar