Digital Sine-Wave Generator Using D Flip-Flop

Circuit Simulation done by:

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Theory:

A D-type flip-flop is a clocked flip-flop which has two stable states. A D-type flip-flop operates with a delay in input by one clock cycle. Thus, by cascading many D-type flip-flops delay circuits can be created, which are used in many applications.

The Q output always takes on the state of the D input at the moment of a rising clock edge (or falling edge if the clock input is active low). It is called the D flip-flop for this reason, since the output takes the value of the D input or Data input, and Delays it by one clock count. To build a walking-ring counter, connect the Q output of one stage to the D input of the next stage and so on down the line.

At the last stage use the complementary Q output to feed back to the D input of the first stage. If we use a Six-stage register and start with 000000, one clocking gives us 100000 since the Q output of the last stage was a "l" and gets passed on to the first stage. Continuous clocking gives us 110000, 111000, 111100, 111110 and 111111. The output Q is now 0. The next clocking gives us 011111, 001111, 000111, 000011, 000001 and finally 000000. Thus, repeating the Twelve-step sequence we shall close the series. The length of our sequence is twelve or twice the number of stages.

Converting this sequence by using a digital to analog converter, we will get a sine wave. Pure sinusoidal waveform is obtained with a help of a capacitor after the DAC.

Circuit Diagram:

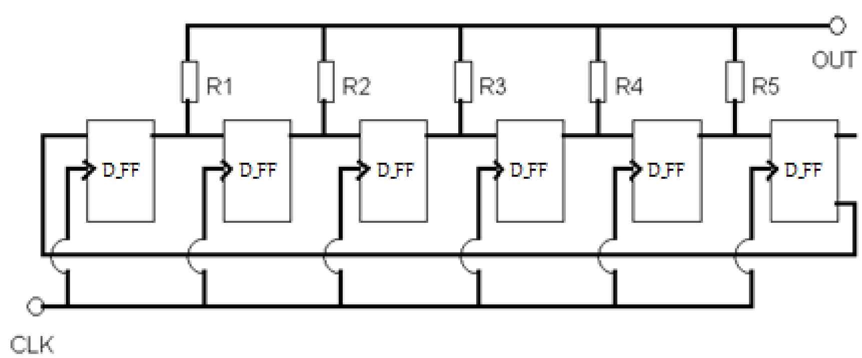

Fig 1: Circuit diagram of Digital Sine wave Generator using D Flip-Flop.

Model Graph:

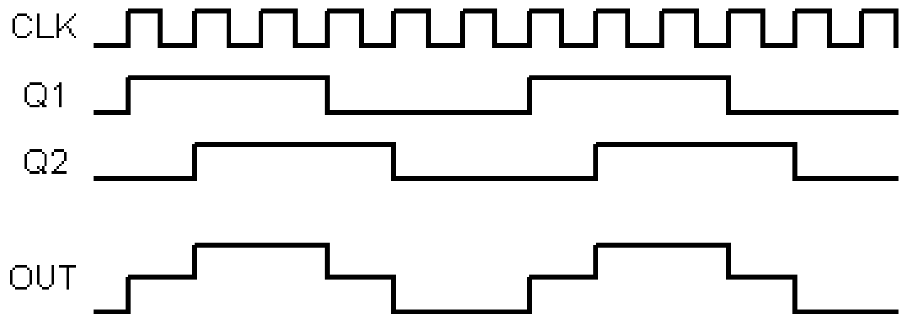

Fig 2: Model Graph of a Digital Sine-wave Generator

Schematic Diagram:

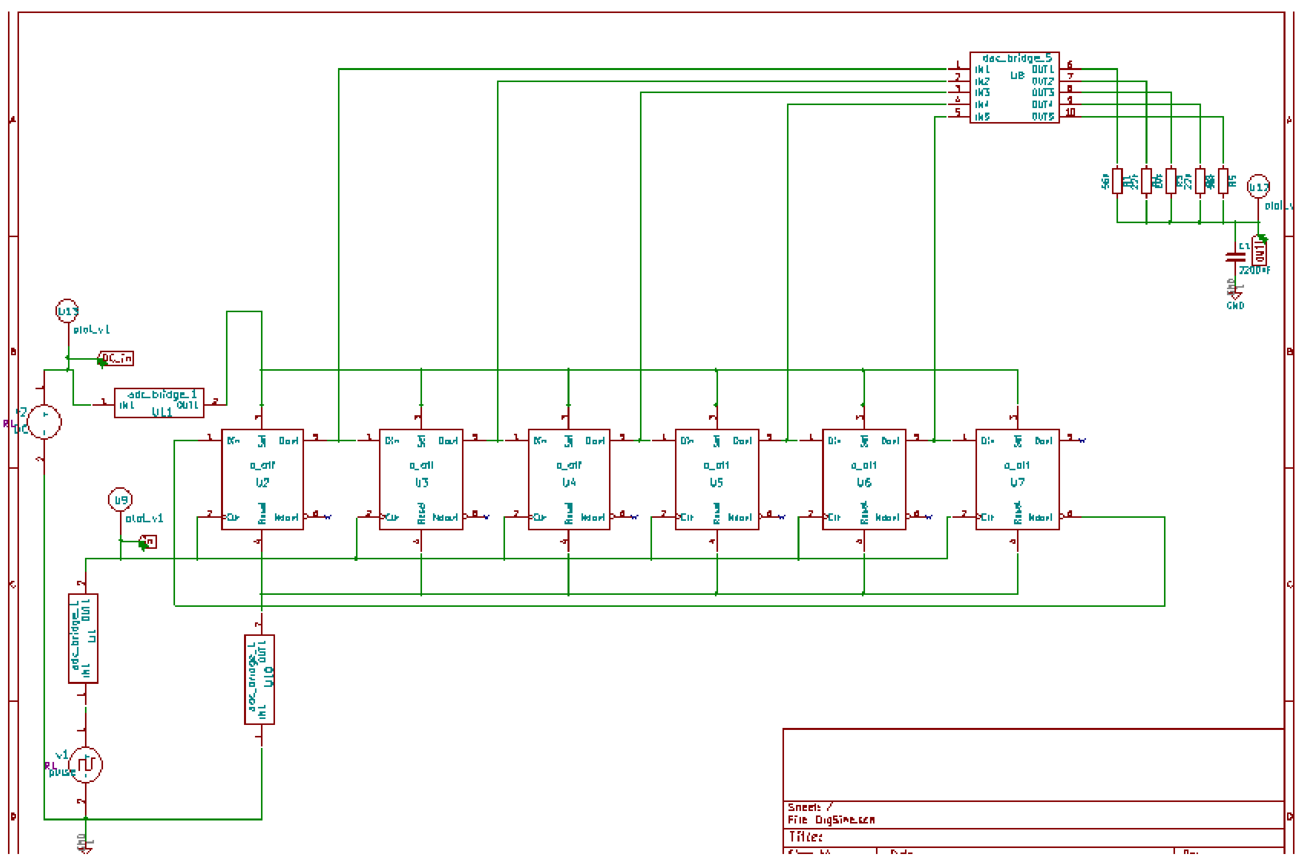

Fig 3: Schematic diagram of Digital Sine wave Generator using D Flip-Flop.

Simulation:

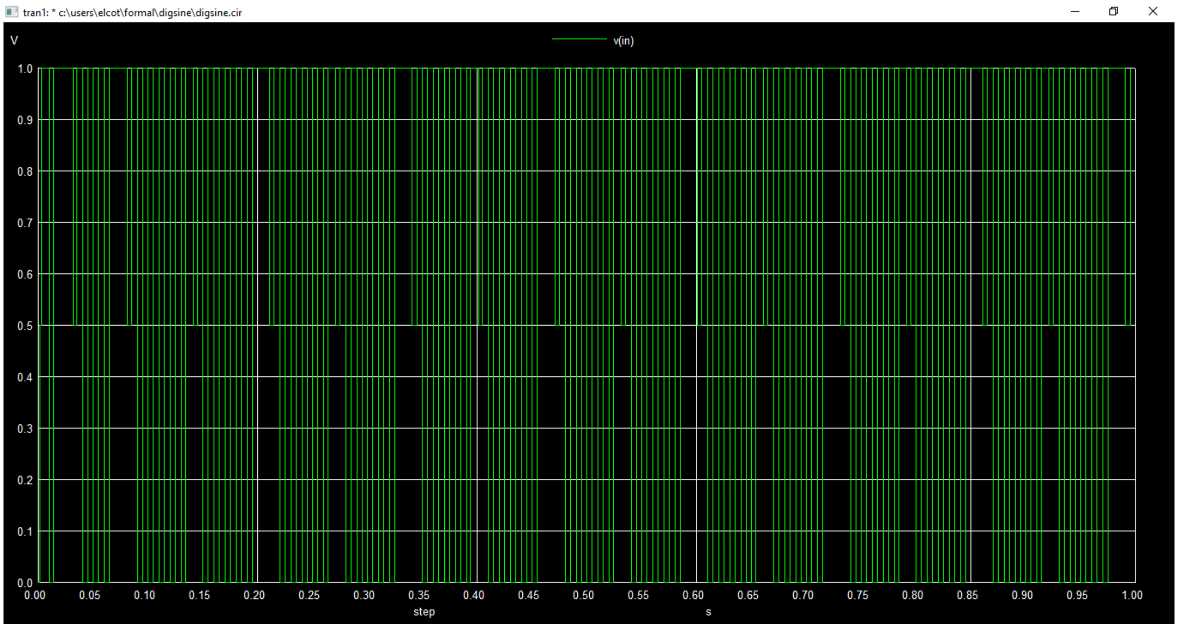

Fig 4: Ngspice plot for Input Pulse

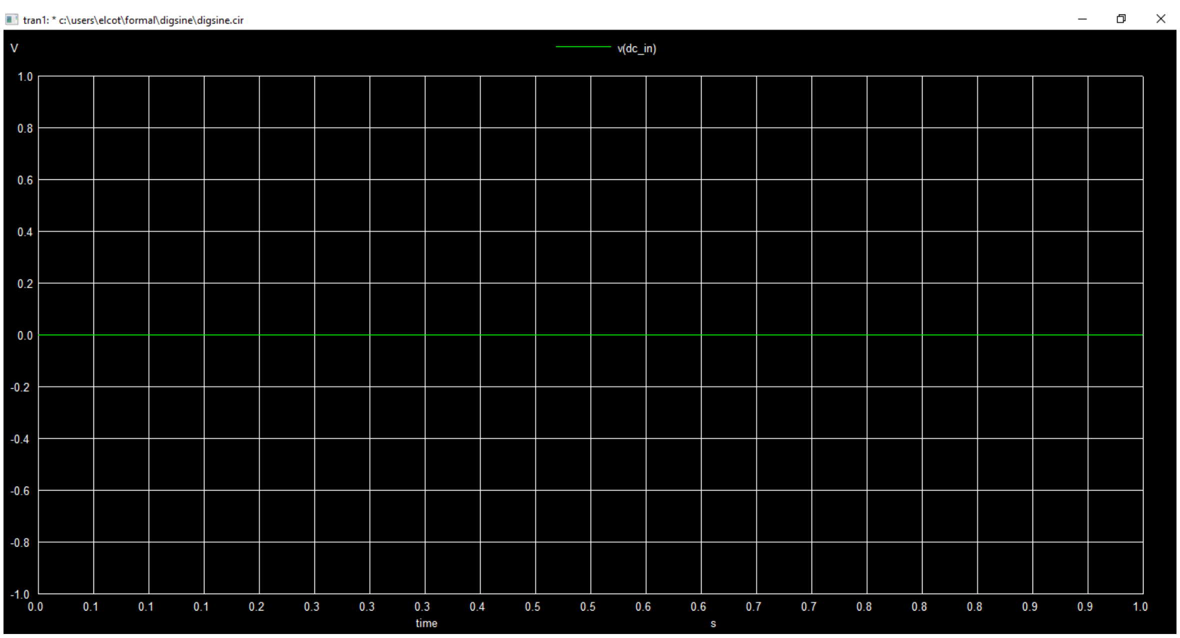

Fig 5: Ngspice plot for DC Input

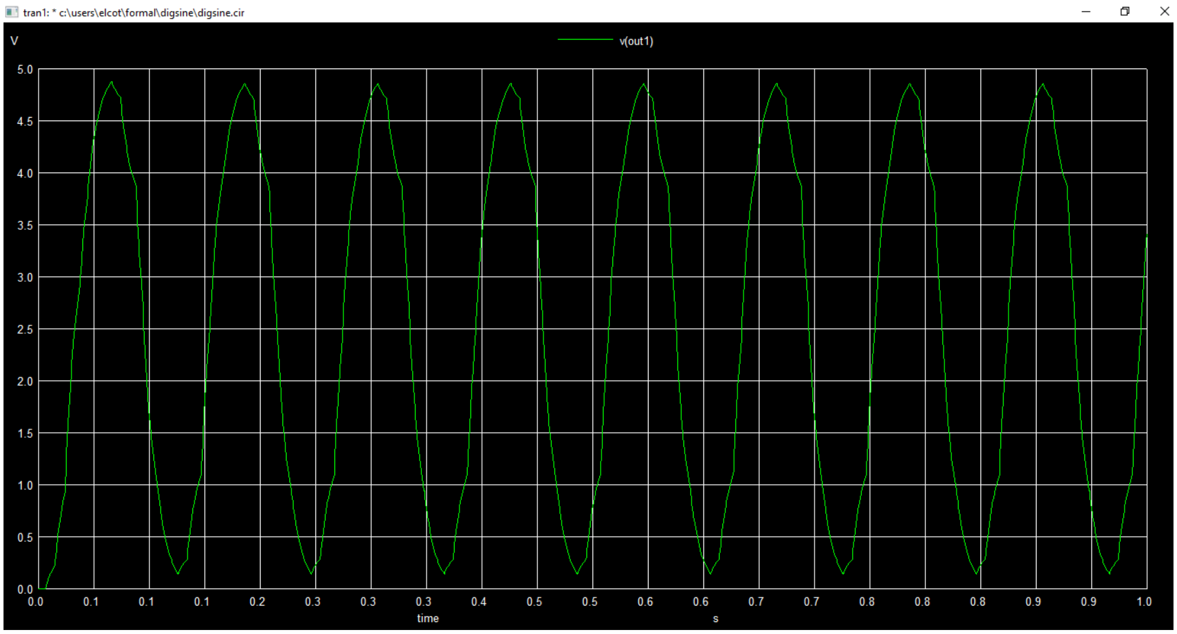

Fig 6: Ngspice plot for Output waveform

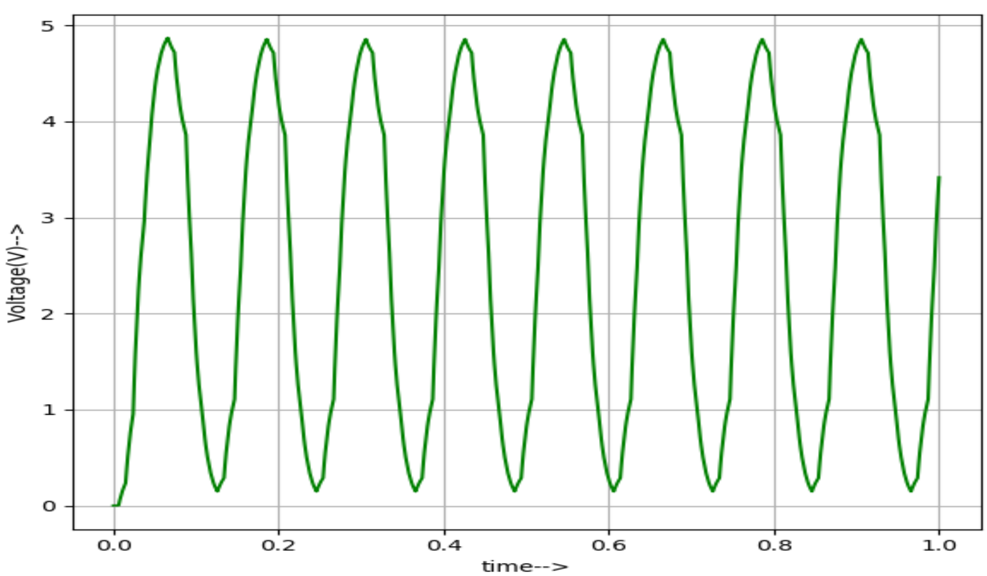

Fig 7: Python plot for Output waveform

Reference:

http://www.physics.udel.edu/~nowak/phys645/Basic_CMOS_Circuits.htm