Design of 4-bit Servo Tracking type ADC

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Abstract—**A 4-bit servo tracking analog to digital converter is designed which can convert analog signal of amplitude ranging between 0 to VCC V. The input voltage VCC of the designed circuit is 1 V. 4 bit up down counter circuit is designed using verilog code in Makerchip. The Verilator converts the verilog code to c++. A 4 bit up-down counter model is created for simulation in NgSpice. The 4 bit up-down counter is used along with other SKY130 components like resistor and op-amps to design 4 bit servo tracking type ADC. The 4-bit digital input is converted to analog output using R-2R ladder type DAC.**

Keywords— op amp, DAC, ADC, 4 bit up-down counter

I. REFERENCE CIRCUIT DETAILS:

Fig 1 shows the circuit of servo tracking type ADC, the circuit contains up-down counter. The up-down counter counts up when the comparator output is HIGH and counts down when comparator output is low. The up-down counter output is in digital format, the output of up-down counter is fed to digital to analog converter which creates a staircase waveform. The staircase wave generated is within 1 LSB of the correct value, provided analog input changes slowly.

In a 4 bit synchronous up-down counter, if the comparator output is HIGH the counter counts up i.e., increase the initial 4-bit data by binary 1 after each cycle. If the comparator output is LOW, the counter counts down i.e., decrease the initial 4 bit by binary 1 after each cycle. Q0 is the LSB of 4 bit up-down counter output, Q3 is the MSB of 4 bit up-down counter output,

Fig 2: shows R-2R ladder type DAC. The Input 4-bit data is of form d1 d2 d3 d4 the data is converted to analog voltage Vo given by $(d_1 2^3 + d_2 2^2 + d_3 2^3 + d_4 2^4)$ (Rf/R)(Vr/2^4). The output wave form is staircase type. d_n is considered as 1 for voltage level V_r. d_n is considered as 0 for voltage level 0. (Rf/R) is decided as per gain requirement of circuit.
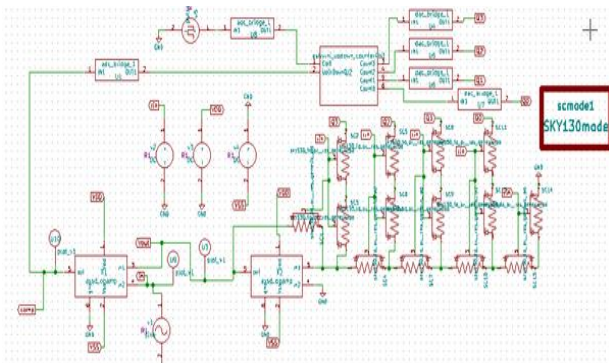
II. REFERENCE CIRCUIT DESIGN

Fig. 1.   Servo Tracking Analog to Digital converting circuit
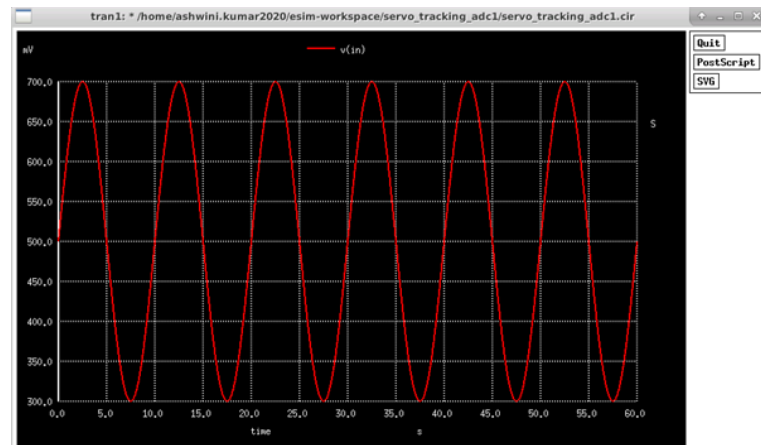
III. REFERENCE WAVEFORM
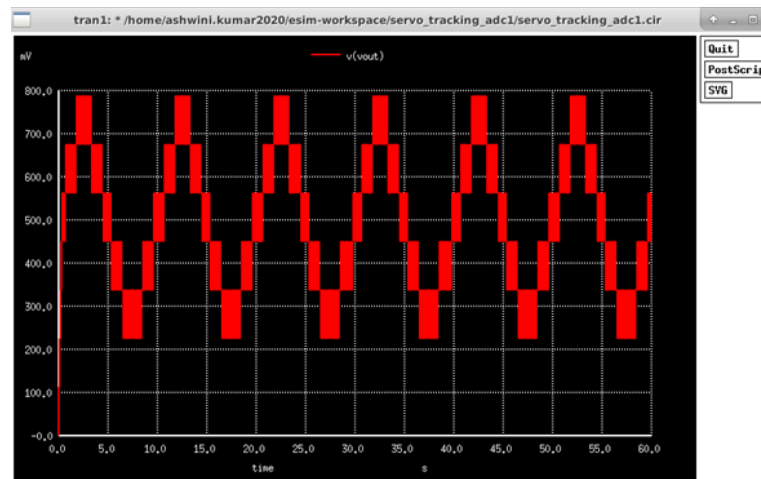

Fig. 2.   Input analog waveform is shown above

Fig. 3.   R-2R Digital to Analog Converter waveform output

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