Daffodil International University (DIU)
Department of Electrical and Electronic Engineering

EEE 422: Measurement and Instrumentation Lab

EXPERIMENT NO: 08

NAME OF THE EXPERIMENT: INTRODUCTION TO ANALOG TO DIGITAL (A/D) AND DIGITAL TO ANALOG (D/A) CONVERSIONS.

Objective:
To study the operation of *Analog to Digital* and *Digital to Analog* converters and be familiar with the parameters which serve to describe the quality of performance of the converters.

Theory:

Digital to Analog Conversion:
D/A conversion is the process of taking a value represented in digital code (such as straight binary or BCD) and converting it to a voltage or current that is proportional to the digital value.

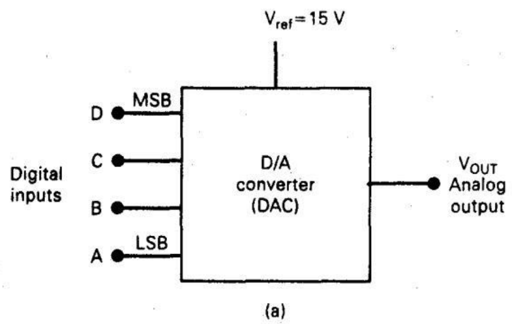


Fig. 1: DAC Module

Notice that there is an input for a voltage reference, V_{ref}. This input is used to determine the **full-scale output** or maximum value that the D/A converter can produce. The digital inputs D, B, C and A are usually derived from the output register of a digital system. For each input number, the D/A converter output voltage is a unique value. In fact, for this case, the analog output voltage V_{out} is equal in volts to the binary number. It could also have been twice the binary number or some other proportionality factor. The same idea would hold true if the D/A output were a current I_{out}.
In general, Analog output = K x digital input (10-1)
Where, K is the proportionality factor and is a constant value for a given DAC connected to a fixed reference voltage.

Resolution (Step Size)
Resolution of a D/A converter is defined as the smallest change that can occur in the analog output as a result of a change in the digital input.

Analog-To-Digital Conversion
An **analog-to-digital converter** takes an analog input voltage and after a certain amount of time produces a digital output code that represents the analog input. The A/D conversion

process is generally more complex and time consuming than the D/A process, and many different methods have been developed and used.

List of Equipment:

1. IC ADC0808
2. IC 741
3. Resistor: 10K(11 pcs.)
4. Trainer board
5. Oscilloscope
6. DMM

Circuit Diagram:

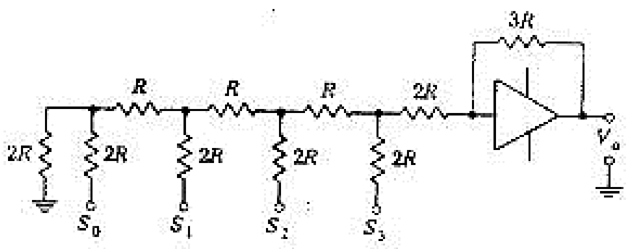


Figure 1

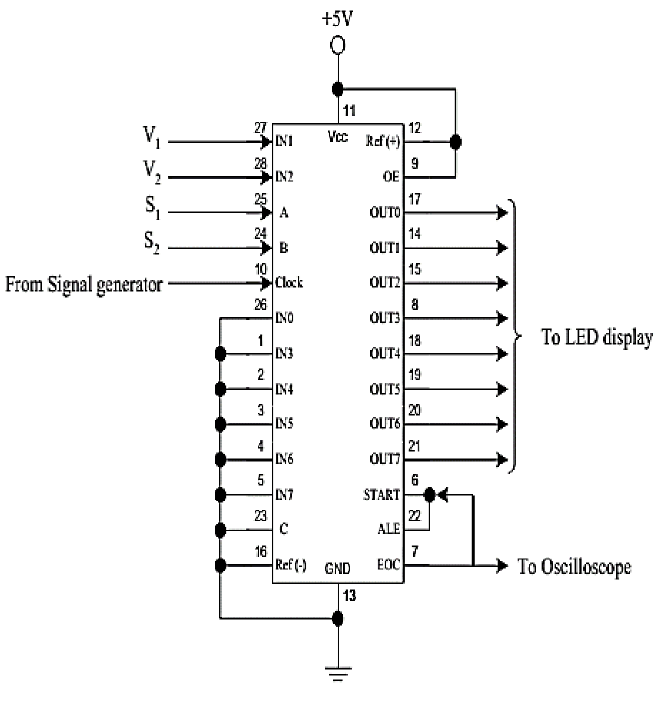
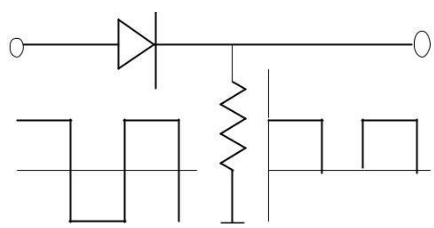


Figure 2

*Use TTL/Sync output from signal generator.
*If not available use the square wave output but use a rectifier (half wave) so that output clock is unipolar



C	B(S2)	A(S1)	Selection
0	**0**	**0**	**IN0**
0	**0**	**1**	**IN1**
0	**1**	**0**	**IN2**
0	**1**	**1**	**IN3**
1	**0**	**0**	**IN4**
1	**0**	**1**	**IN5**
1	**1**	**0**	**IN6**
1	**1**	**1**	**IN7**

Procedure:

1. Construct the circuit in figure-1 and fill up the following table:

S3	S2	S1	S0	V0
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

2. Construct the circuit as shown in figure2.

3. Apply 20 KHz TTL pulse from the signal generator to the clock input.

4. Connect S1 and S2 to the logic switches. Connect V1 and V2 with two different voltage sources.

5. Observe the multiplexing operation of the ADC by changing selection (CBA input) [V1=IN1;V2=IN2]

6. Fill up the following table for an input varying from 0V to 5V at IN0 select proper selection for that.

V1	OUT_7	OUT_6	OUT_5	OUT_4	OUT_3	OUT_2	OUT_1	OUT_0

7. Observe the EOC (end of conversion) signal in the oscilloscope. Compare it with the applied clock pulse. Determine the conversion time for a particular input voltage

Report:

1. Define quantization error.
2. Calculate resolution for both ADC and DAC and verify the obtained readings.
3. Discuss on different types of Analog to Digital converters.
4. Design an 8-bit DAC.

Change the connection in Fig.2, to allow an input signal that varies from -10V to +10V.