Digital To Analog Conversion

Hersh Samdani (EP22B027)

Introduction:

A DAC(Digital-to-analog converter) converts digital signals into analog signals. They are commonly used in music players, televisions, mobile phones and the like to convert digital data streams to analog audio/video signals.
This is useful for a large variety of physical devices that generate output signals of the analog or continuous variety. Any processing done on this data though, is mostly done using digital methods and the processed signal has to be converted back to the analog form.

Experiment:

Apparatus:

In this experiment, we use:

- DAC0800 - Digital to Analog Converter
- IC7943 - Binary Counter
- Breadboard, wires resistors, capacitors, LEDs
- Oscilloscope
- Function Generator
- Power Source

Experiment:

The experiment is split broadly into two parts:

1. We first set up an 8 bit counter using two binary counters.
2. We can check its output using LEDs.
3. The 8 bit counter is connected to the 8 bit DAC.
4. The output of the DAC is connected to the oscilloscope and we observe the sawtooth wave form.

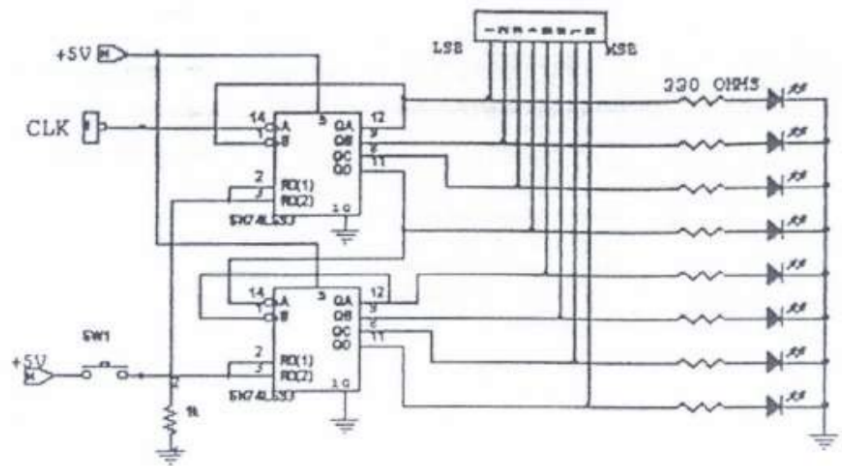

Figure 1: High level circuit overview

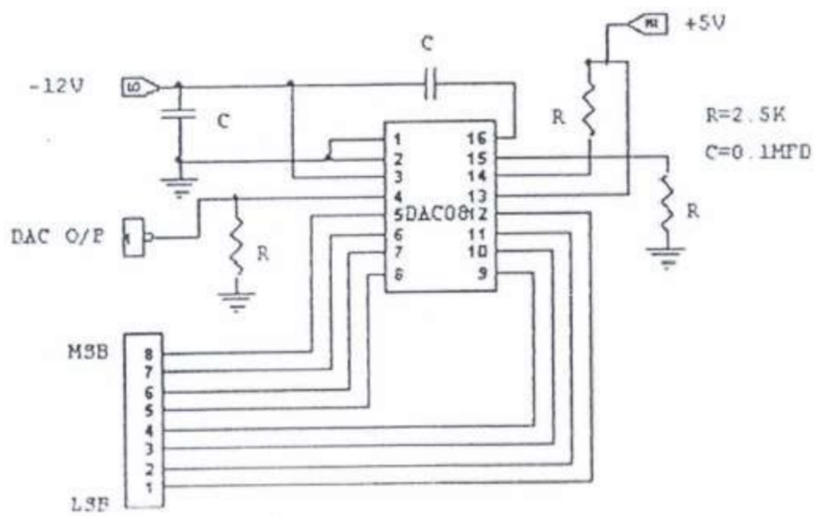

Figure 2: Wiring of the DAC circuit

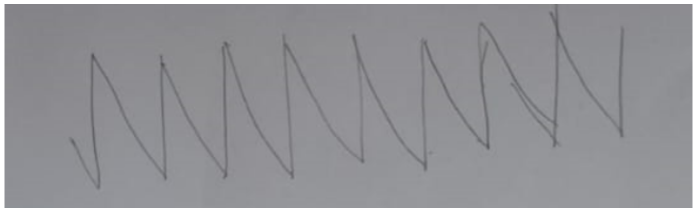

Figure 3: Observed Sawtooth Plot

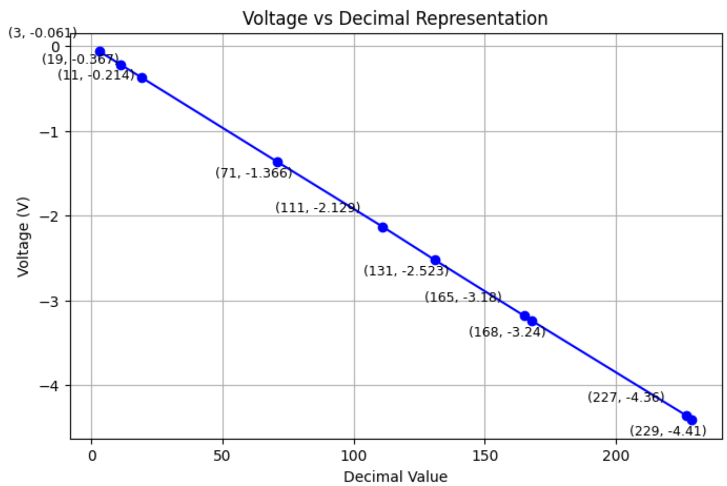

Figure 4: Plot of Voltage vs Decimal Value

Observations:

We observe Figure. 3 with a clock frequency of 1 KHz and the frequency of the sawtooth itself is 7.81 Hz.

Bits	Voltage(V)
00000011	-0.061
00001011	-0.214
00010011	-0.367
01000111	-1.366
01101111	-2.129
10000011	-2.523
10100101	-3.18
10101000	-3.24
11100011	-4.36
11100101	-4.41

From the slope of the plot we can tell that the resolution is about 0.025V/bit and the zero error (or the y-intercept) is about 0.01V.

Results

1. The 8-bit binary counter functions as expected and we can change the frequency to change the counting speed.
2. We are able to generate a sawtooth waveform.
3. The graph of the output DAC voltage vs. the input code is linear, confirming that the output voltage is equal to the reference voltage multiplied by the decimal value of the input code divided by 2^n.
4. Resolution ≈ 0.025 V
5. Zero error ≈ 0.01 V

Discussion and Sources of Error

- In certain applications, the zero error of ≈ 0.01V should be considered.
- We may get errors in readings due to inaccuracies in the DAC output due to power supply fluctuations.
- Parasitic capacitances can affect the waveform, causing distorted readings.
- Circuit components such as resistances and capacitors are not exactly their specified value which could also give slight errors.
- While doing the experiment, we initially thought we were not getting a sawtooth output because we were zoomed in to the waveform, but the output is clearly visible on zooming out,