Experiment 2
Schmitt Trigger, Astable Multivibrator

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1 Overview of the experiment

A Schmitt trigger is a comparator circuit with hysteresis implemented by applying positive feedback in an opamp. It is an active circuit which converts an analog input signal to a digital output signal.

An Astable Multivibrator or a Free Running Multivibrator is the multivibrator which has no stable states. Its output oscillates continuously between its two unstable states without the aid of external triggering.

In this experiment we have realized both the above mentioned circuits using opamp IC741. The connections have been made on a breadboard and waveforms have been observed on a DSO.

2 Schmitt Trigger

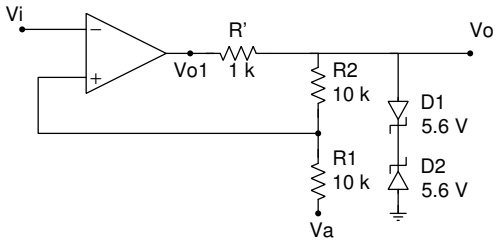
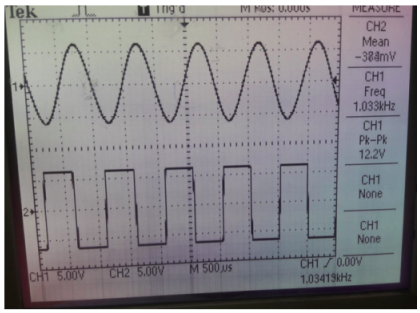


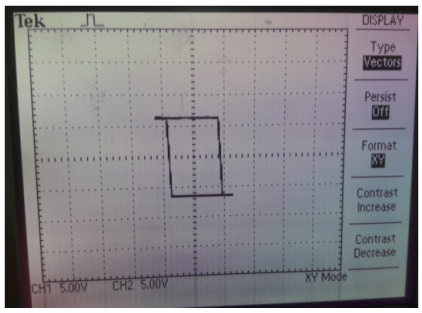
Figure 1: Schmitt Trigger

2.1 Observations for Va = 0 V

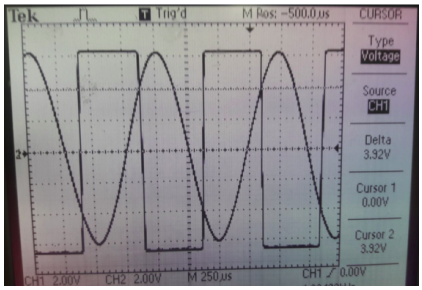
V_a=0 V, V_{in} = 12 V (pk-pk), 1 KHz



(a) Input and Output Waveform



(b) V_o vs V_i Plot



(c) Delta showing the value of V_T

Figure 2: Waveforms for V_a=0 V

2.1.1 Explanation

$$V_T = (\frac{R_1}{R_1 + R_2})V_O + (\frac{R_2}{R_1 + R_2}) \tag{1}$$

for $V_a = 0V$ and $V_O = \pm 5.6V \pm 0.7 = \pm 6.3V$

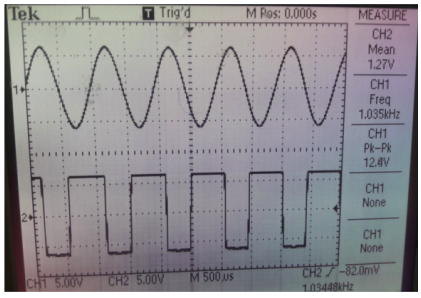
$$V_T = (\frac{10}{10 + 10})6.3 = 3.15V \tag{2}$$

Experimentally,delta comes out to be 3.92 V which is close to the theoretical value.

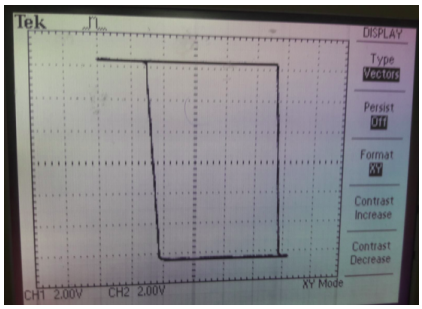
$$A_v = \frac{V_{out}}{V_1 - V_2} = \frac{R_4}{R_3}(1 + \frac{2R_2}{R_1}) \tag{3}$$

2.2 Observations for Va = 3 V

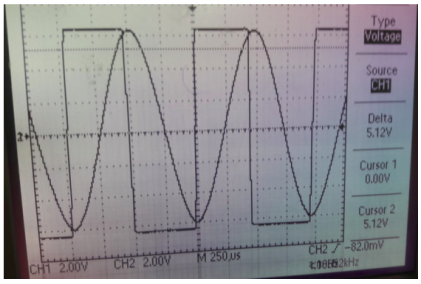
Va = 3 V, Vin = 12 V (pk-pk), 1 KHz



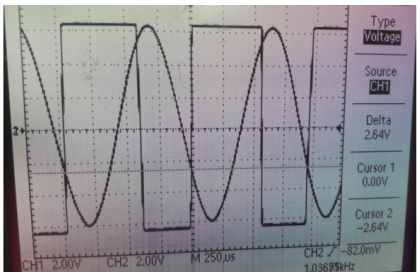
(a) Input and Output Waveform



(b) V_o vs V_i Plot



(c) Cursor 2 showing the value of V_{TH}



(d) Cursor 2 showing the value of V_{TL}

Figure 3: Waveforms for V_a=3 V

2.2.1 Explanation

$$V_T = (\frac{R_1}{R_1 + R_2})V_O + (\frac{R_2}{R_1 + R_2})V_a \tag{4}$$

for V_a= 0 V and V_O=$\pm 5.6V \pm 0.7 = \pm 6.3V$

So,we get V_{TH}=4.6 V and V_{TL}=-1.65 V

The experimental values are very close to the theoretically calculated values.

3 Astable Multivibrator

Output waveform when potentiometer is close to 10 kΩ

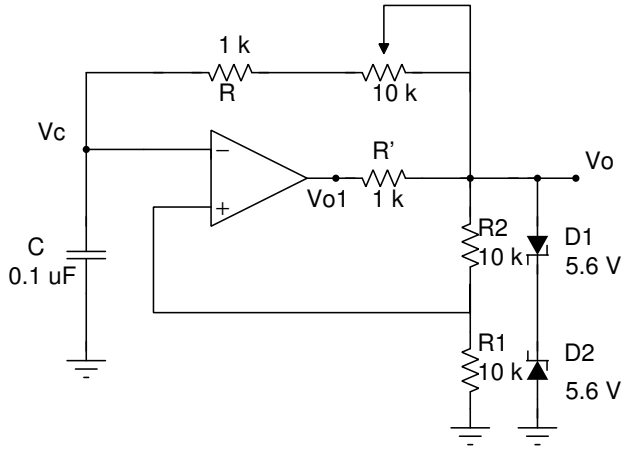


Figure 4: Astable Multivibrator

3.1 Observations

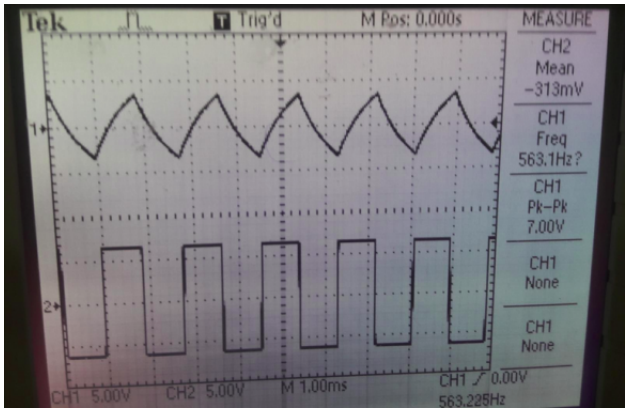


Figure 5: Output waveform when resistance of the potentiometer is close to 10 kΩ

Potentiometer Value(kΩ)	Theoretical Value(Hz)	Experimental Frequency(Hz)
10	413	563.1
0	4.55 k	5.14 k

Table 1: Observation table for Astable Multivibrator

3.2 Explanation

When potentiometer value is close to 0 Ω, the frequency is very high, thus, the pulse width reduces and the capacitor doesn't get time to charge. Hence we see a distortion in the waveform.