1 Abstract

During this experiment, I will produce a periodic wave form(A clock signal) using schmitt trigger SN74HC14, which will be later fed into a counter IC CD74HC163E.
I am doing this so I have a clock signal as future projects may require a bit pattern on $\boldsymbol{N}$ channels. But this can wait till next week.
In this report there is only part 1 of this project which is to get a clock signal fron IC SN74HC14.

2 AIM

1. To produce a clock signal using schmitt trigger SN74HC14.
2. To answer the following questions:
   - What is the purpose of the first schmitt trigger?
   - What is the purpose of the second schmitt trigger?
   - What is the purpose of the resistor and capacitor in the circuit?
3. and finally comparing the measured oscillation time with the RC time constant.

3 APPARATUS

1. Schmitt trigger SN74HC14
2. Resistor (1k and 5k Ω)
3. Capacitor (1 nF)
4. breadboard
5. picoscope
6. And other basic electronic components.

4 circuit diagram

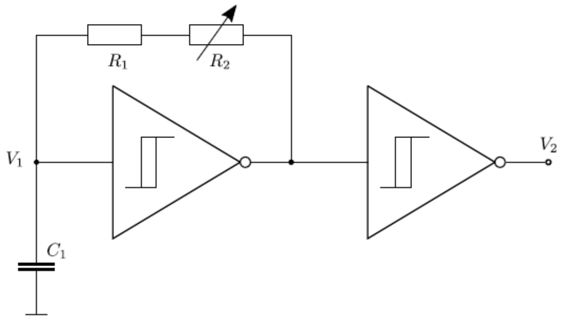

Figure 1: oscillator using two inverting schmitt trigger

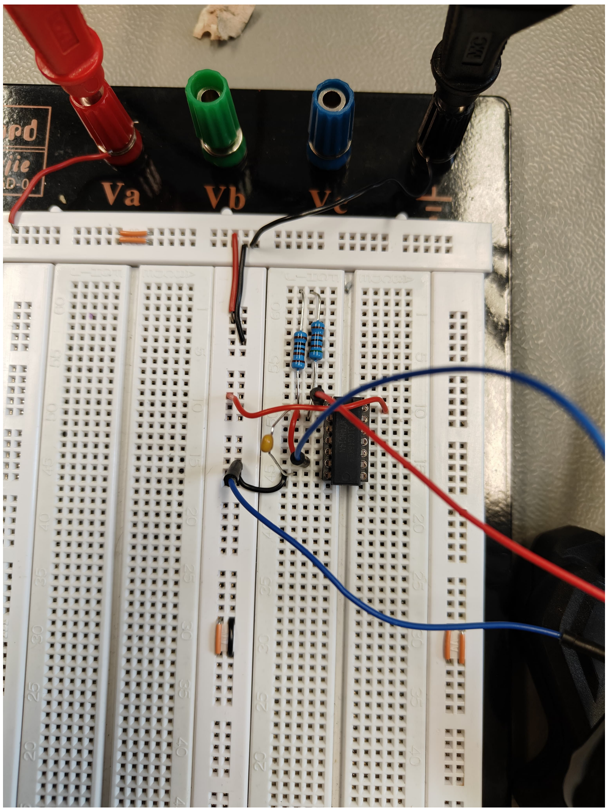

Figure 2: Circuit assembly on breadboard

We measure V_1 and V_2 using picoscope utilizing channels A and B.

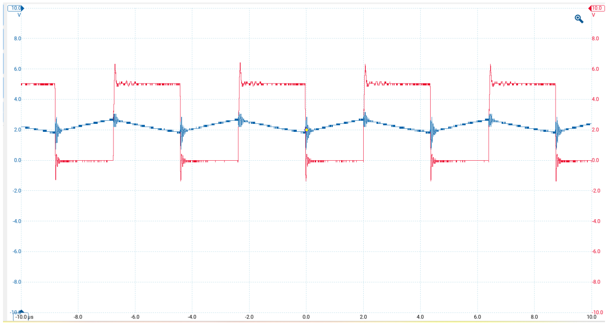

Figure 3: Oscilloscope measurement of V_1 and V_2

5 Discussion

Now to answer the questions from the aim:
1. The first inverting schmitt trigger is the core of the oscillation. It creates the feedback condition necessary for the capacitor to charge and discharge, thus generating the oscillation.

2. The second inverting schmitt trigger is used to clean up the signal. It ensures that the output is a clean square wave, free from noise and glitches. It is also used as a buffer, preventing any load from affecting the timing or stability of the oscillator.

3.Capacitor charges and discharges during each cycle of the oscillation. The resistor and capacitor together determine the time constant of the circuit, which in turn determines the frequency of the oscillation. The time constant is given by $\tau = (R_1 + R_2) \cdot C$, where R_1 and R_2 is the resistance and C is the capacitance.
And both the resistors form a path from the output of the first Schmitt trigger back to the capacitor — this feedback is what enables oscillation.
As one of the resistor is variable resistor (potentiometer), it allows tuning the frequency of the oscillator by adjusting the effective resistance.

$$\tau = (R_1 + R_2) \cdot C \tag{1}$$

This equation basically tells us that time constant is higher if the resistance and capacitance is higher.

4. Thw theoretical time constant is nearly 6 μs and the measured time constant is 4.4 μs.
The difference is due to some internal capacitance and resistance of the IC and other components used in the circuit.

6 Conclusion

In this project, I have successfully produced a clock signal using a Schmitt trigger SN74HC14.
The circuit was built on a breadboard and the output was measured using a picoscope.
The theoretical time constant was calculated to be 6 μs, while the measured time constant was 4.4 μs.
This difference can be attributed to the internal capacitance and resistance of the IC and other components used in the circuit.