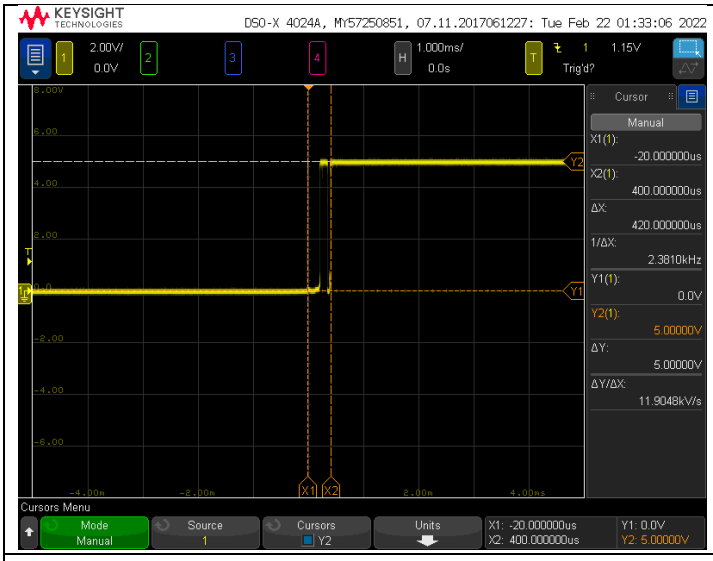
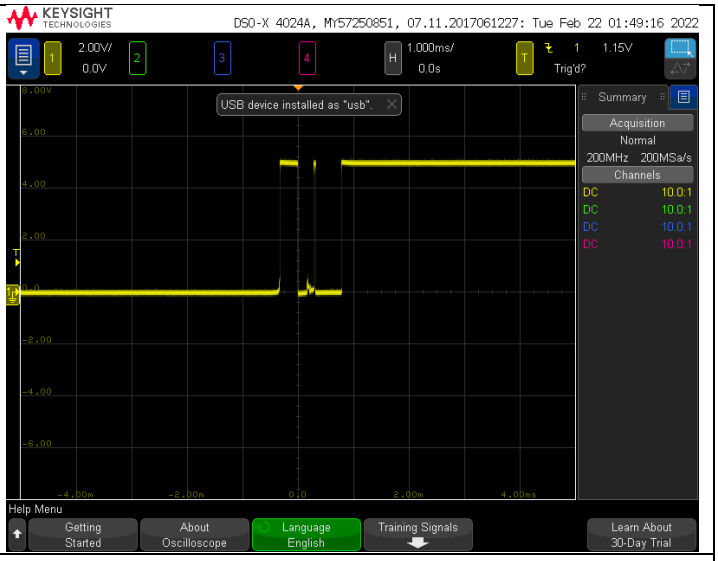
Lab 16: Crystal and Debounce circuit **- Rishab Shah** **02/27/2022**

A) **Debounce Circuit:**

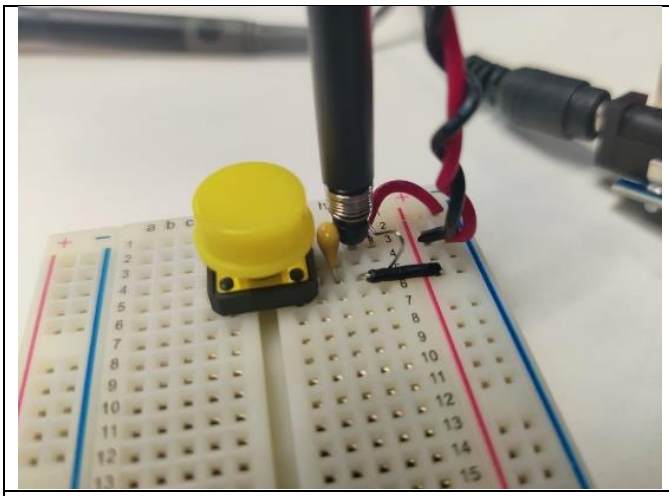
No Decoupling capacitor:

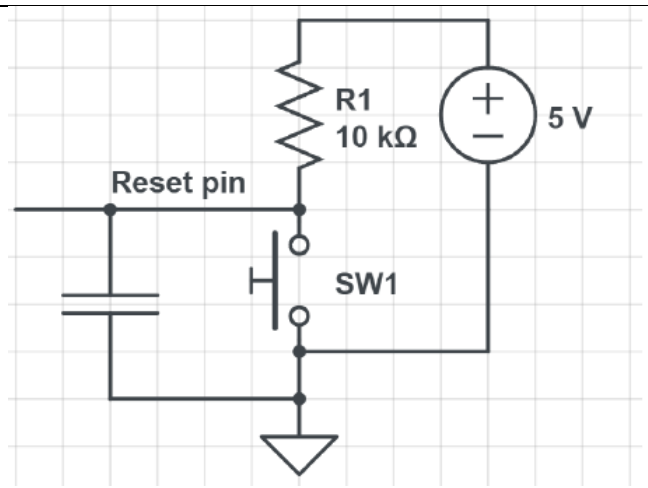




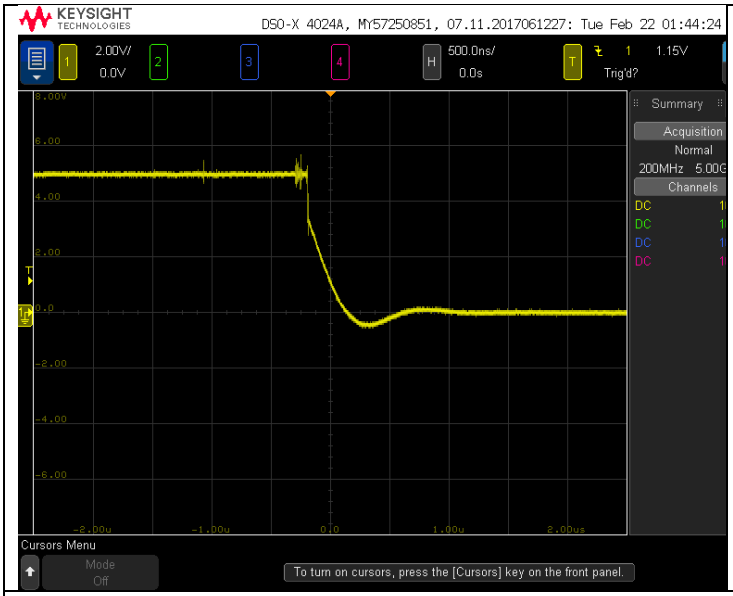
The signal switches frequently between Logic level high and low when there is no capacitor connected.
Even if the trigger is set for falling edge, it looks like the trigger is for rising edge.

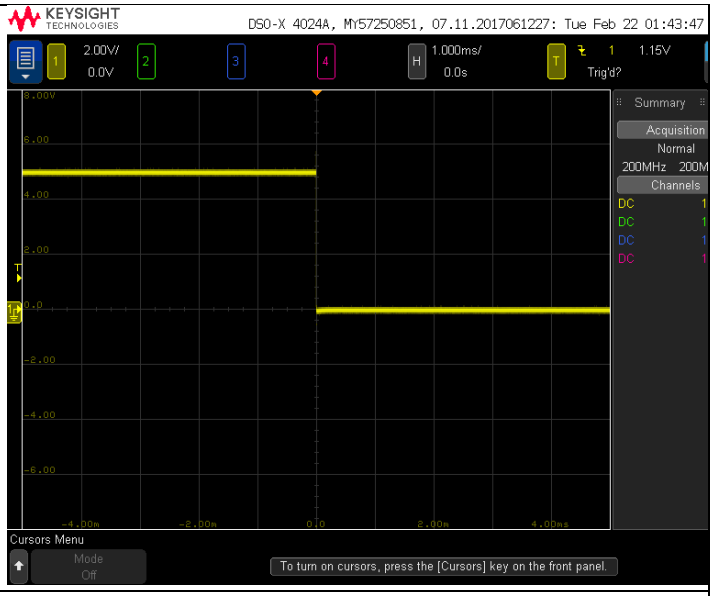
Decoupling capacitor:





An image of debounce circuit for a switch button with 1uF capacitor.

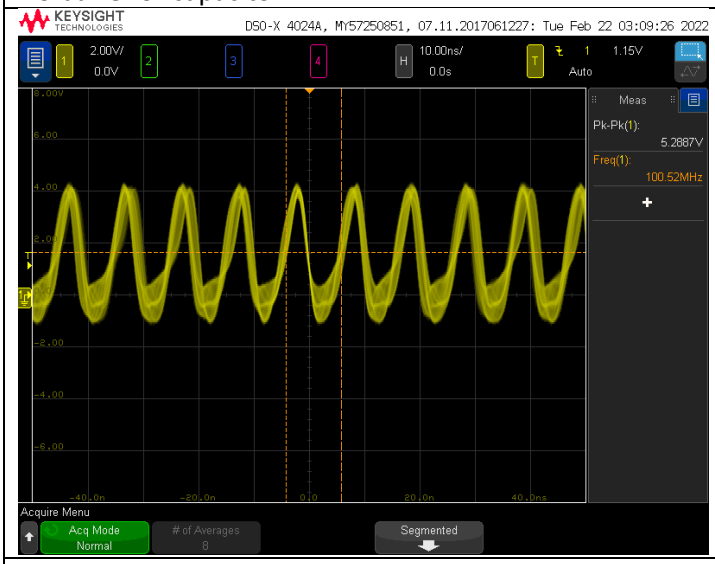
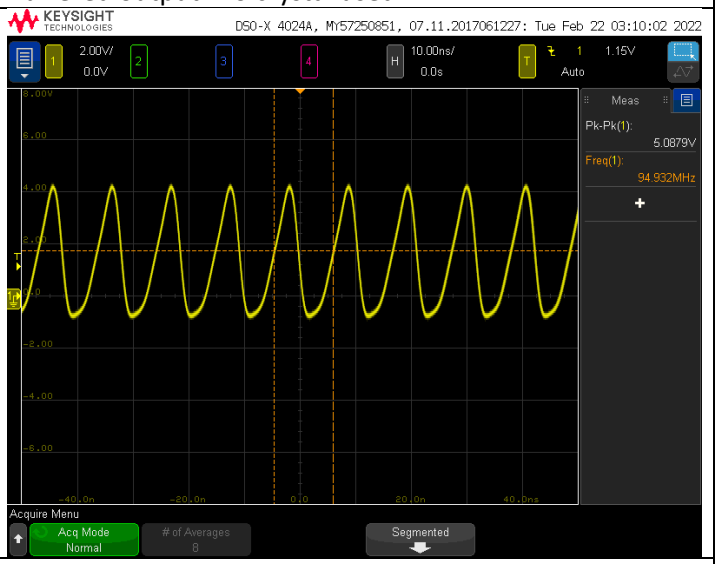




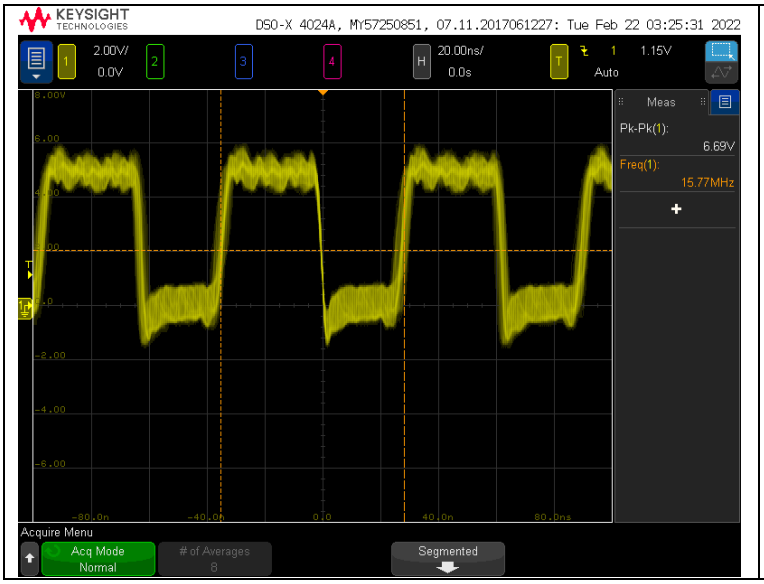
The image shows that addition of a capacitor does not cause the signal to toggle due to the inherent nature of capacitor rise and fall time. This is necessary especially when RESET circuit is involved typically to an MCU, Sensors.

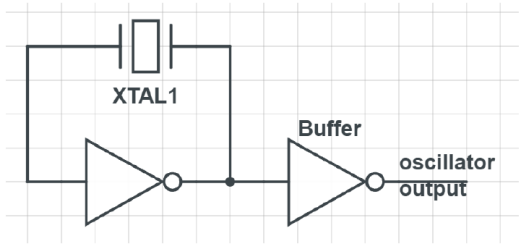
B) **Crystal Circuit:**

No capacitor connected, No crystal used: Plain buffered circuit to generate oscillations.

No buffer or capacitor.	Buffered output. No crystal used.
	
Non-buffered output has noise. No clear transitions present. No crystal used.	Buffered output gives a clean waveform. A propogation delay is also added with buffer.

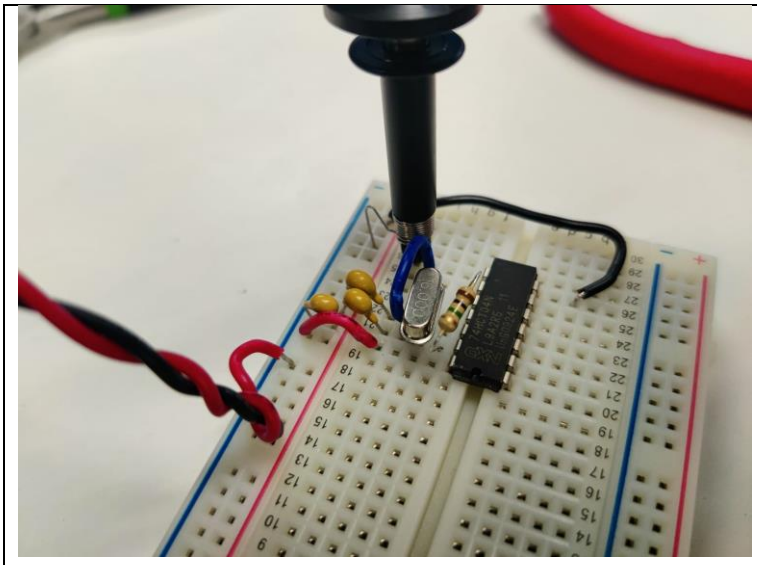
Crystal added to the circuit

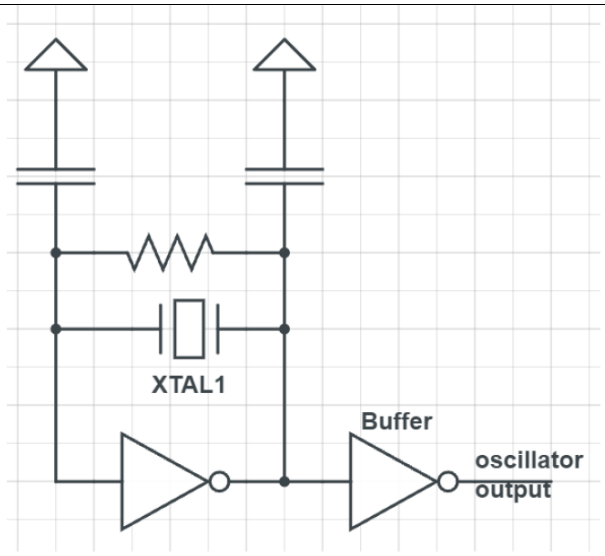




Only crystal along with buffer circuit is used.

Crystal and resistor added to the circuit along with filter capacitors:





1) **10K resistor output:**

	
Output taken before buffered stage.	Output taken after buffered stage. More stable square waveform. It occurs due to usage of capacitors which provide sufficient time for signal to toggle between low and high.

2) **1 M Ohm resistor output**

	
Output taken before buffered stage.	Output taken after buffered stage. More stable square waveform. It occurs due to usage of capacitors which provide sufficient time for signal to toggle between low and high.

Conclusion:

1. Always use a buffered circuit as it is not clear what would the impedance connected will be. A buffered gives a better response.
2. The resistor value is insignificant. It just helps to create oscillations by acting a catalyst.
3. Usage of a capacitor and crystal along with buffered output helps to generate stable square wave oscillations as well as desired frequency.