

**Shri Ramdeobaba College of Engineering and Management,
Nagpur-13.**

**Department of Electronics Engineering
Analog and Digital Communication Engineering Lab [ENP357]**

Even Semester – 2023-24

Lab 03

Sampling Theorem

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Lab-03

✓ **Aim:** Verification of sampling theorem and analyze the effect of variation in

- Sampling frequency
- Duty cycle
- Order of the filter on recovered signal.

✓ **Apparatus:**

✓ **Theory:**

Carrier signal can be digital or analog but information signal will always be digital signal. A continuous time signal can be processed by processing its samples through a discrete time system.

For reconstructing the continuous time signal from its discrete time samples without any error, the signal should be sampled at a sufficient rate that is determined by the sampling theorem.

If a signal is band limited and its samples are taken at sufficient rate then those samples uniquely specify the signal and the signal can be reconstructed from those samples. The condition in which this is possible is known as Nyquist sampling theorem.

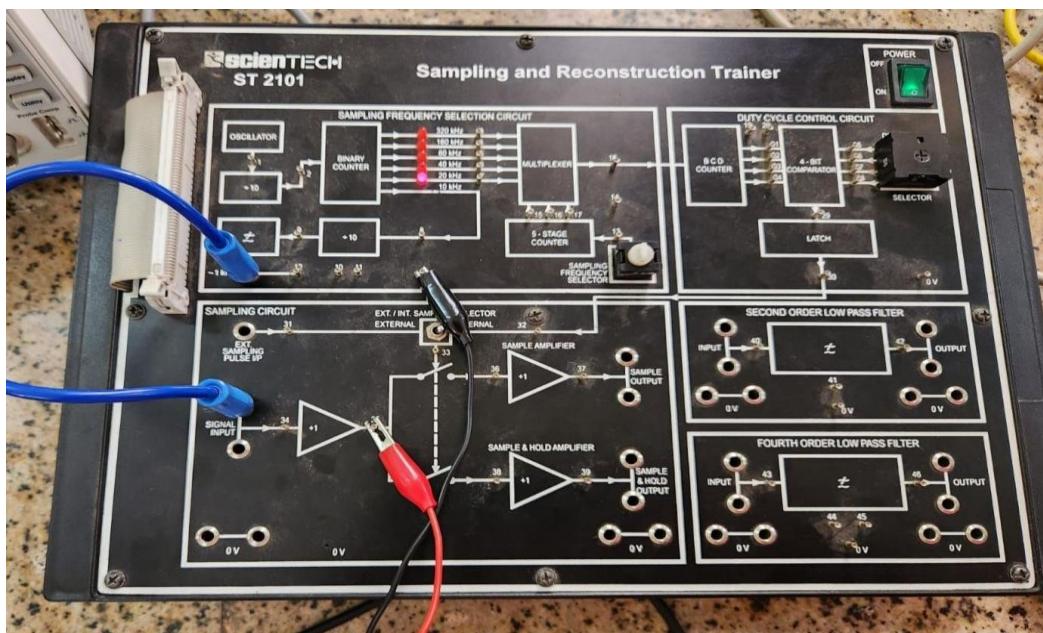
$f_s \Rightarrow 2 f_{\max}$ samples/sec

Sampling of signal is done by multiplication of carrier signal with information signal.

Flat-top sampling is a method where samples are taken at evenly spaced intervals with a specific duration. The duration of each sample is t and the sampling rate is $f_s = 1/T_s$.

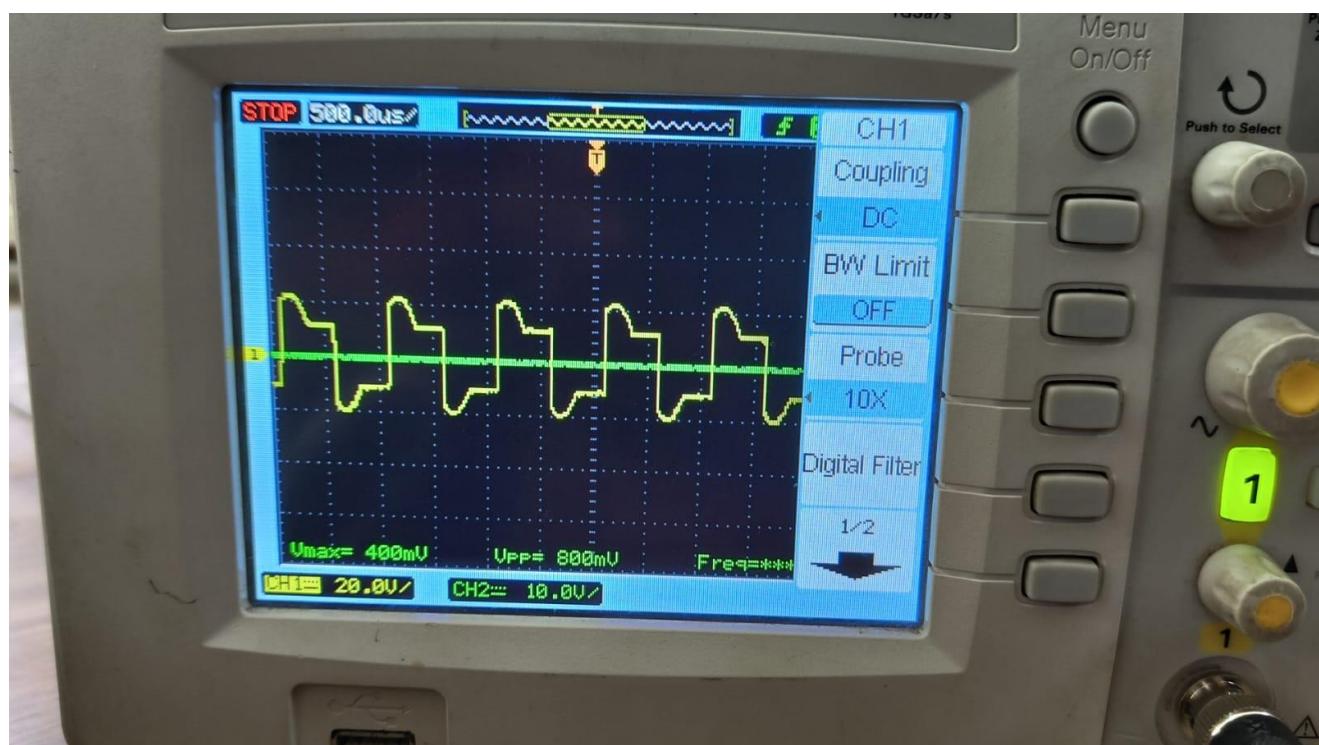
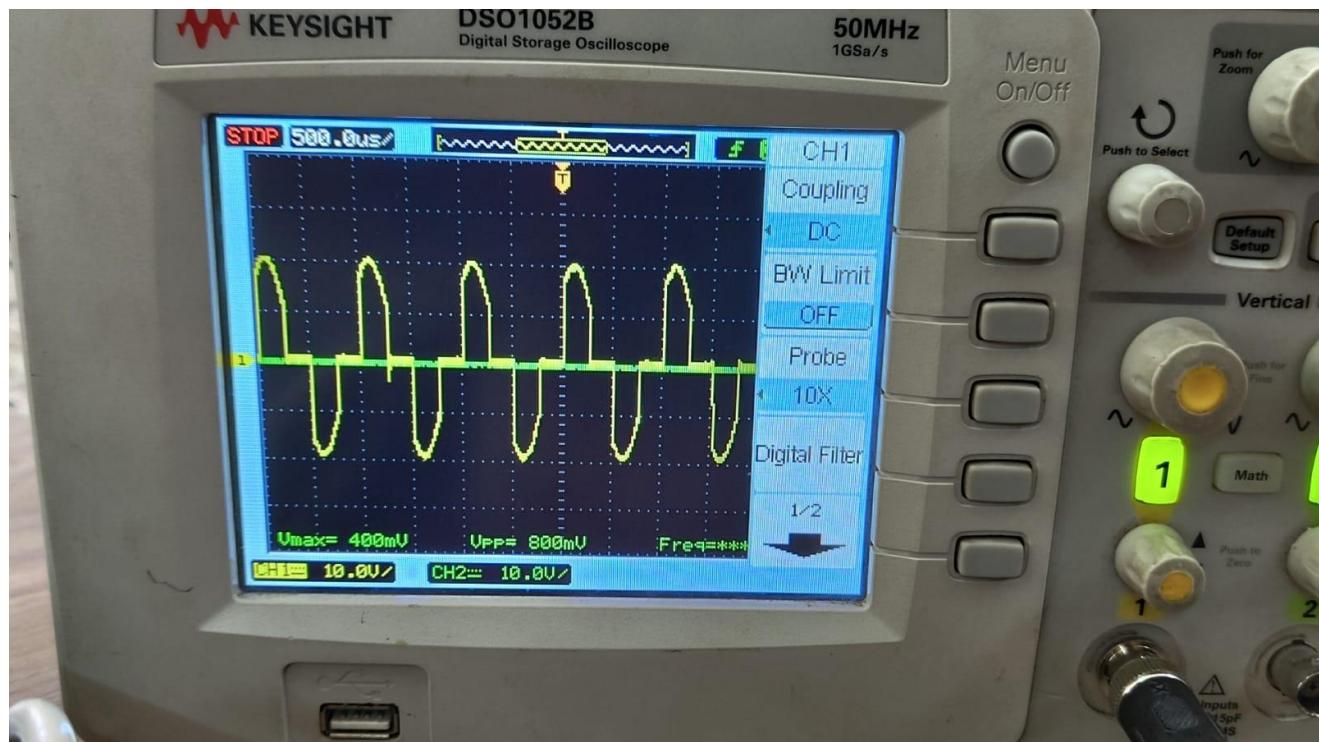
Therefore, $T_s = 1/f_s$. Sample and hold circuit is used for the generation of the sampled signal to attain flat top sampling.

✓ **Circuit Diagram:**

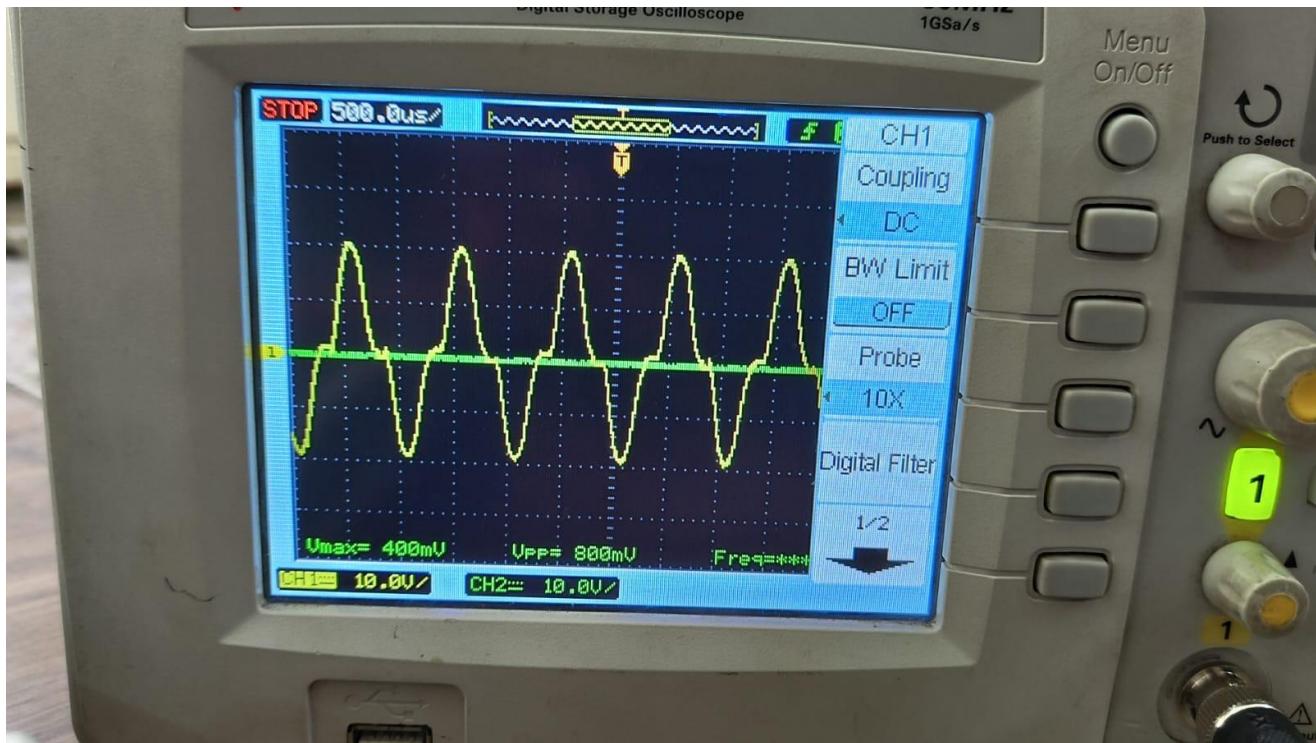


✓ Output Waveform:

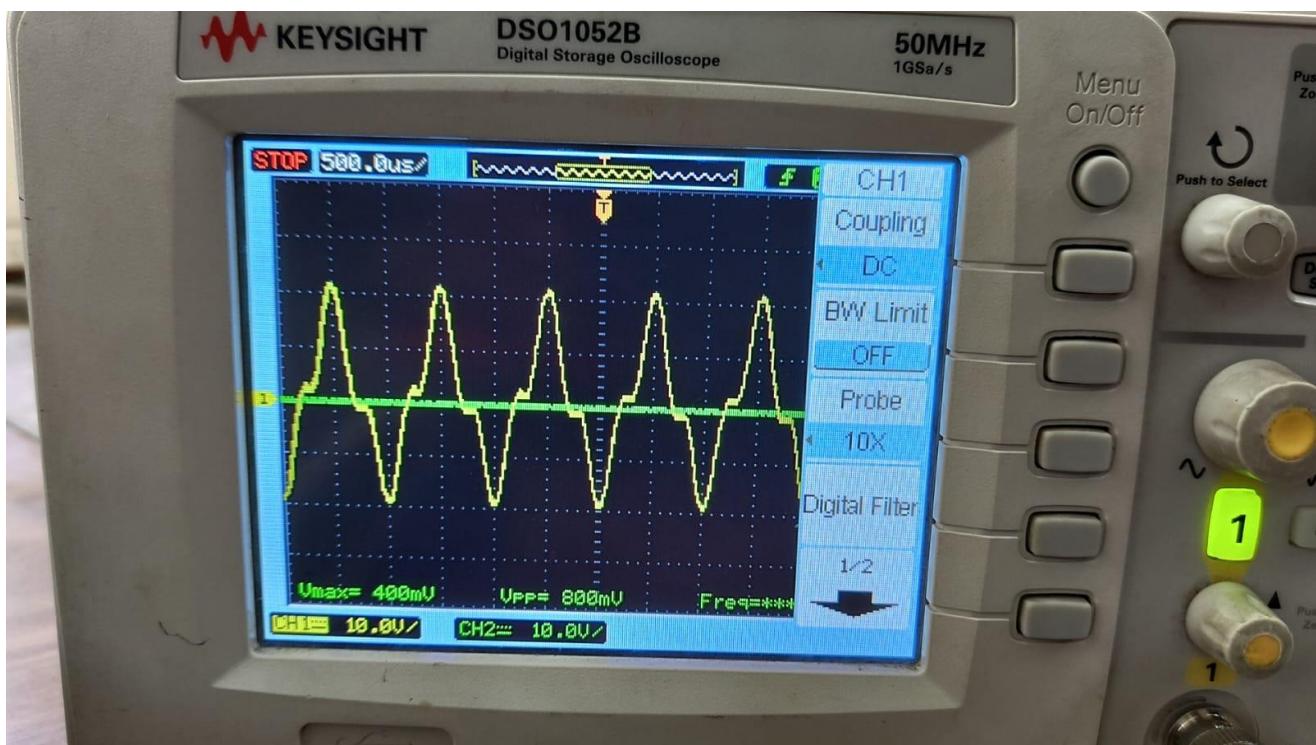
At 20 KHz:



20 KHz Sample Hold

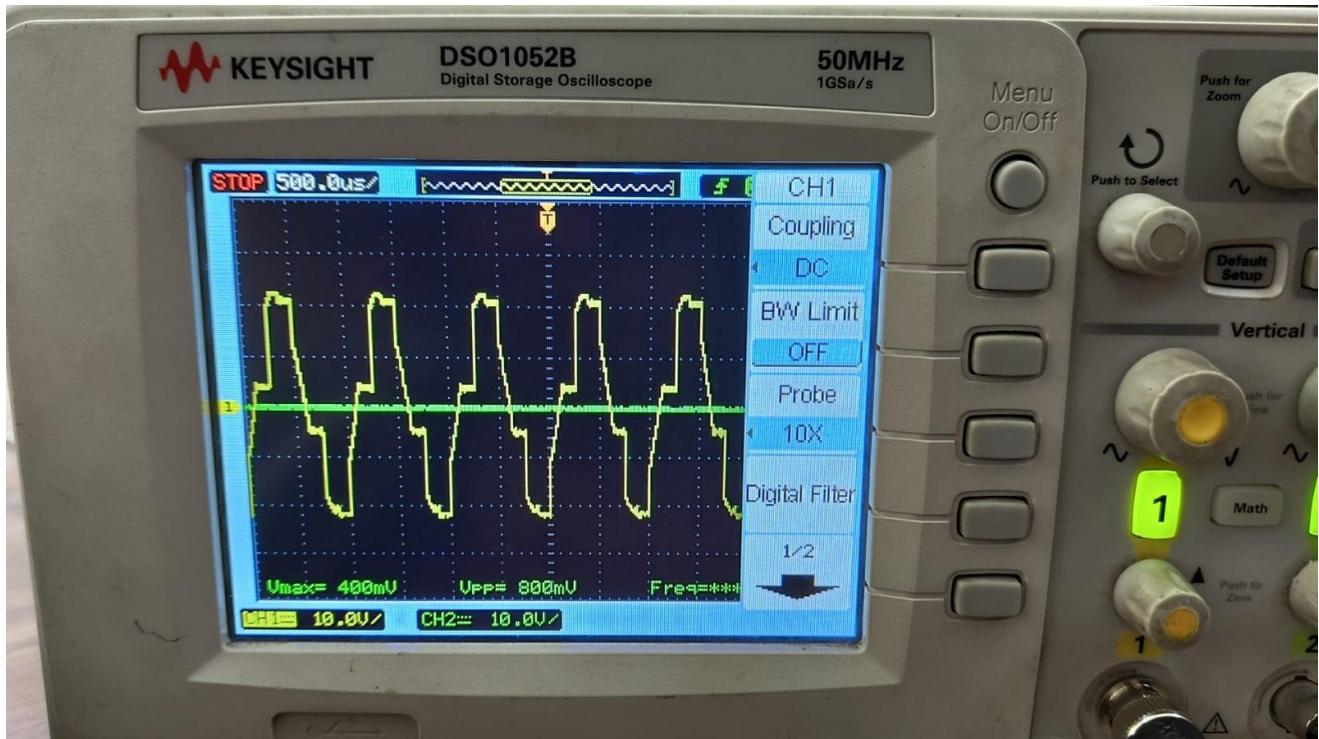
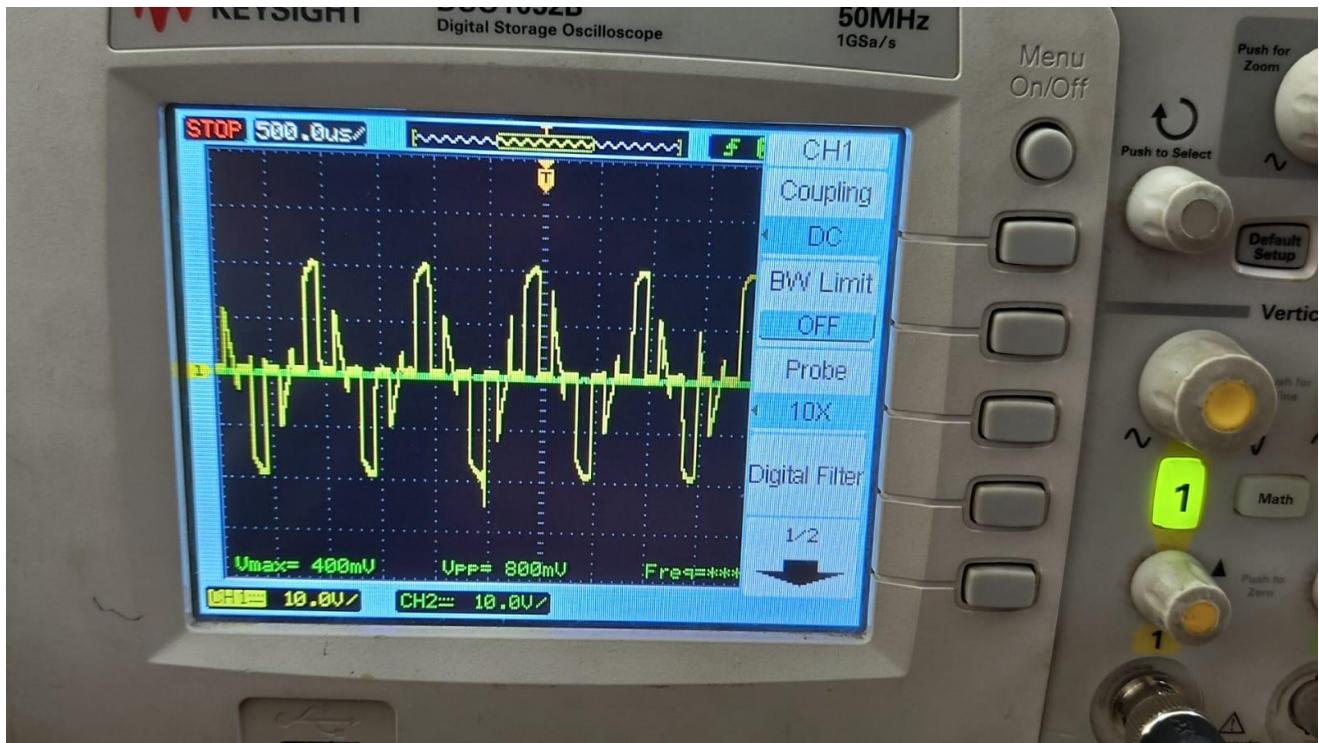


2nd order low pass

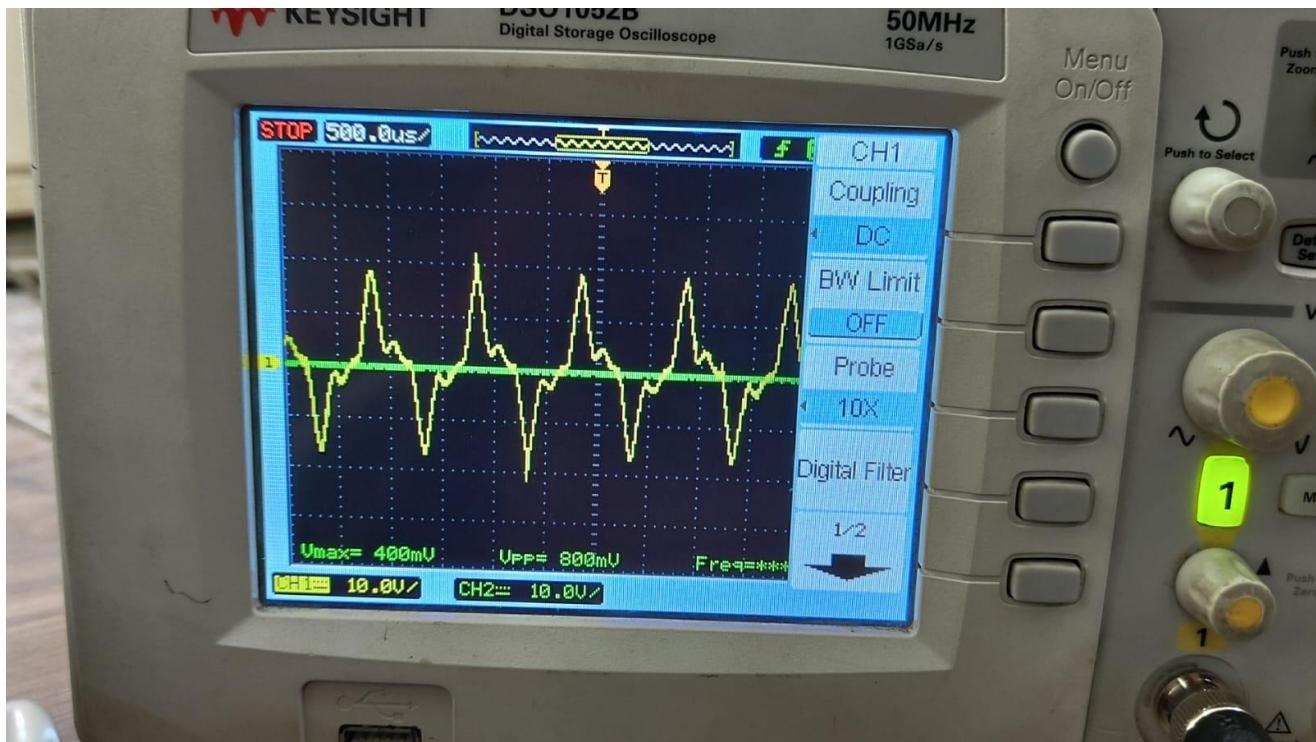


4th order low pass

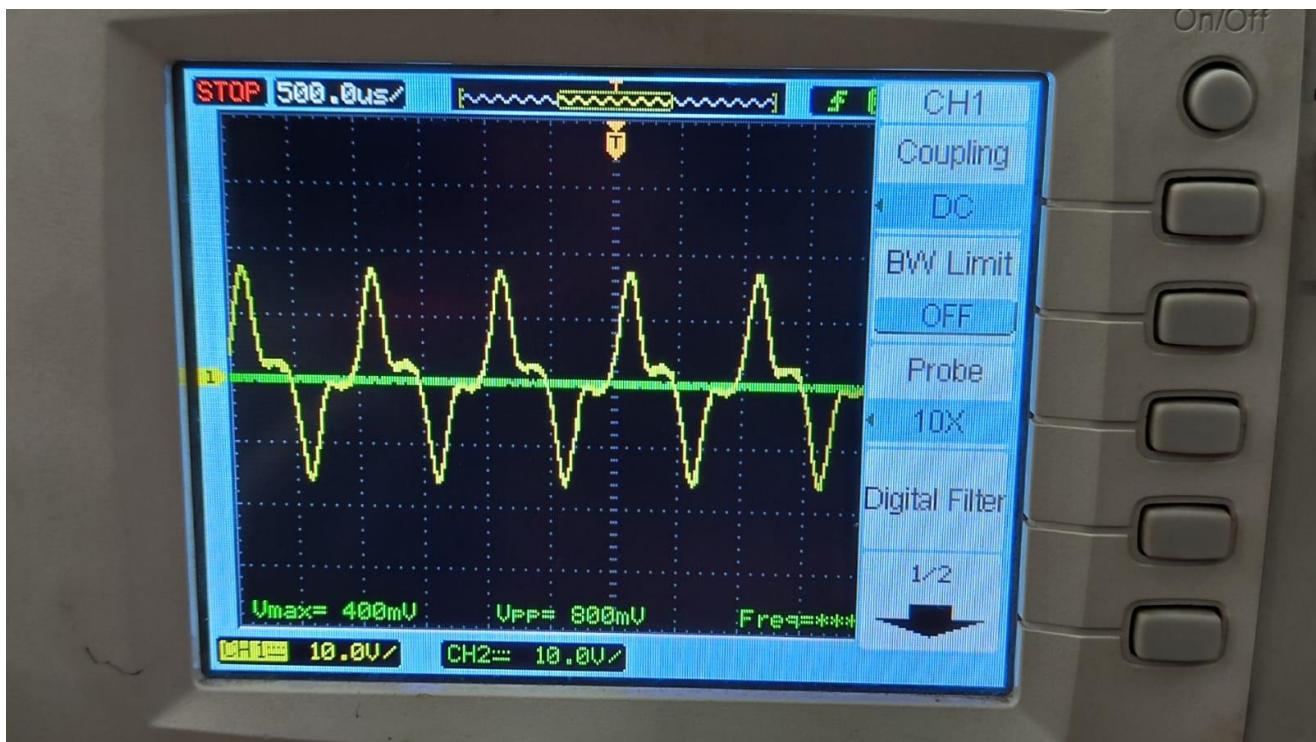
At 40 KHz:



40KHz Sample Hold

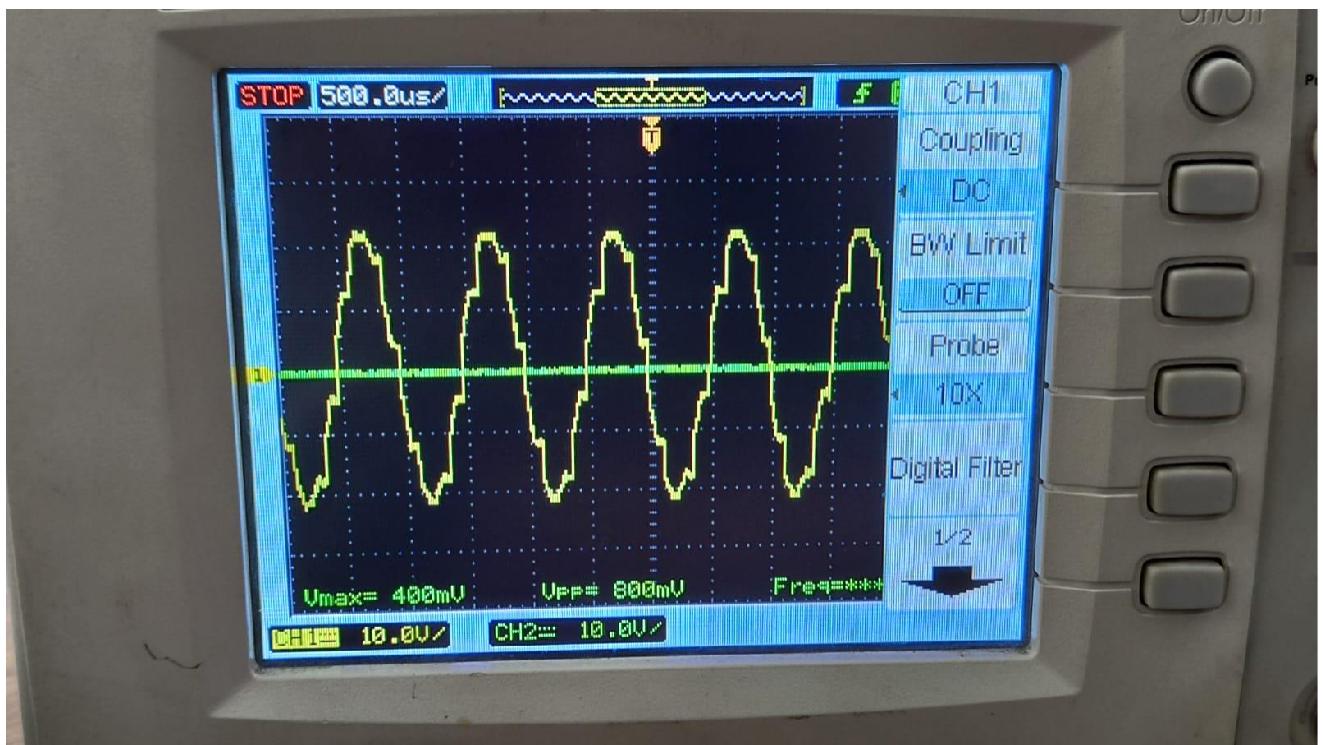
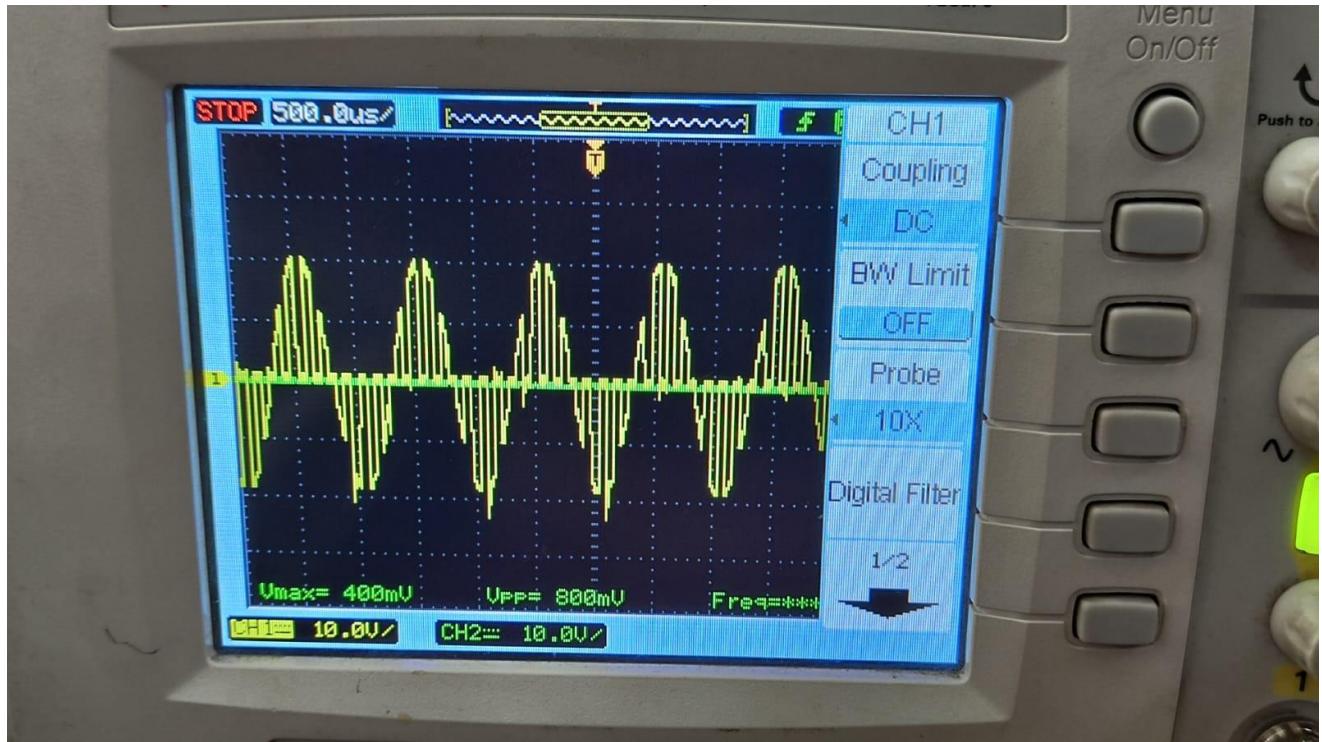


2nd order low pass

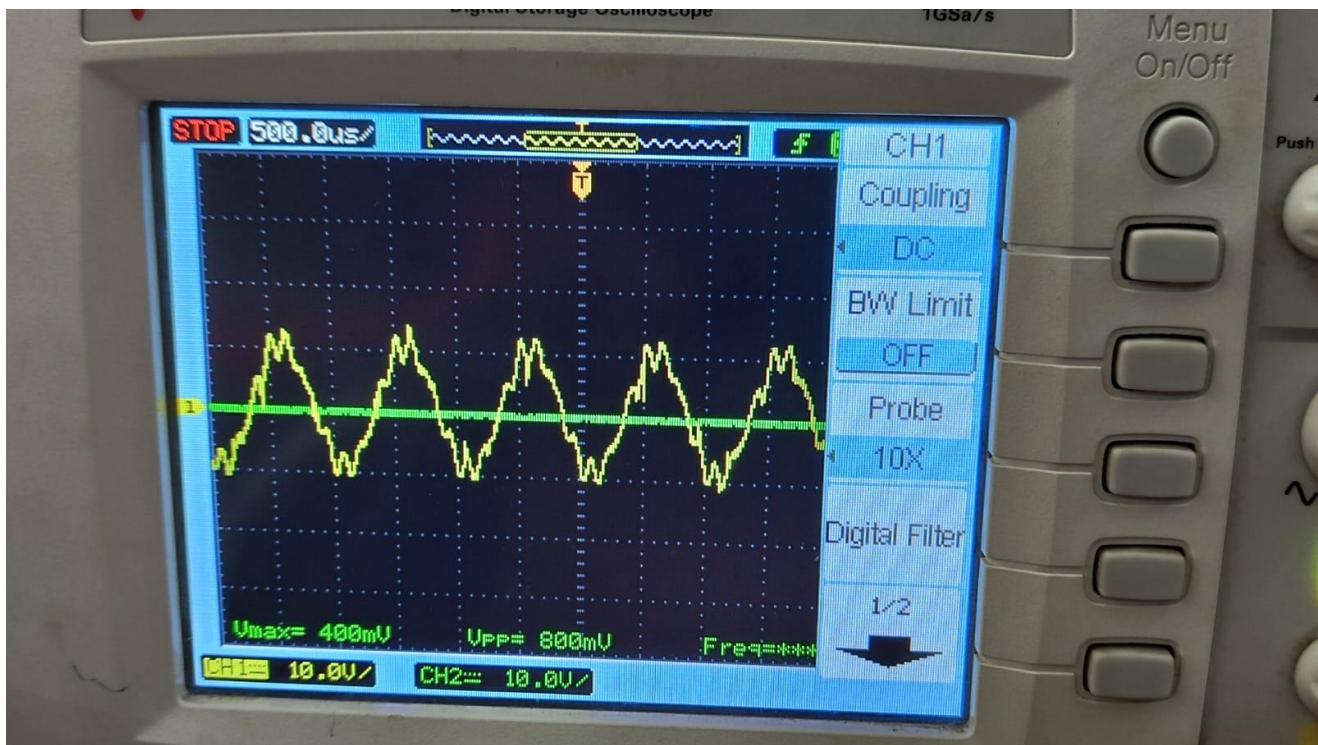


4th Order low pass

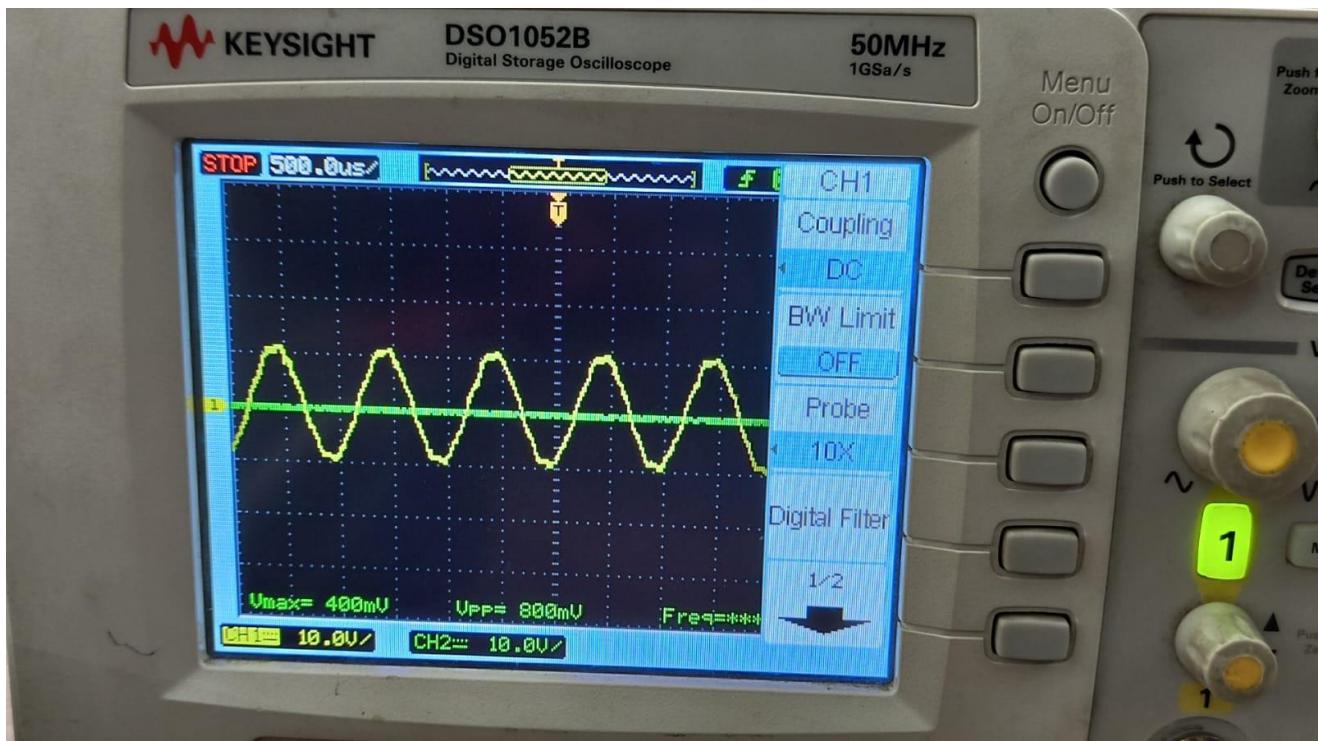
At 80 KHz:



80 KHz Sample Hold



2nd Order low pass



4th order low pass

✓ **Conclusion:**

In this experiment, we have observed output samples by increasing sampling rate and also demodulated this samples by a low pas filter of different orders and obtained original signal back.