**Experiment No:**
**01 21UEC079**

## Aim

a) To generate Delta modulated and Demodulated signal.
b) Determine the conditions for slope overloading and step size.

## Apparatus Used

1. LM393 (Comparator) 4. LM741 7. 74LS74 (D Flip Flop) 10. Resistance 2. Capacitor 5. Connecting wires 8. Breadboard 11. DC Power Supply 3. DSO Probe 6. Function Generator 9. Digital Storage Oscilloscope

## Theory

Delta Modulation (DM) is a simplified PCM. In some type of signals, the neighboring samples are closely correlated with each other. Therefore, once a sample value is known this enables the determination of the following sample values most probably. Thus, instead of sending the real value of each sample at each time, differences (variances) between adjacent samples are sent in DM.
In DM, two-level quantizer and one-bit coding is used. Transmitted code pulses do not carry the data related to the message signal itself; instead they carry data regarding the differentials of the message function. The output of a delta modulator is a bit stream of samples at a relatively high rate, the value of each bit being determined according to whether the input message sample amplitude has increased or decreased relative to the previous sample.

Block Diagram of Delta Modulation and Demodulation

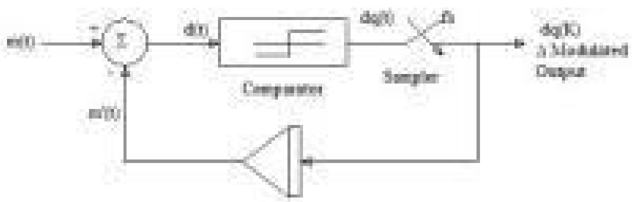


Figure: Delta Modulator

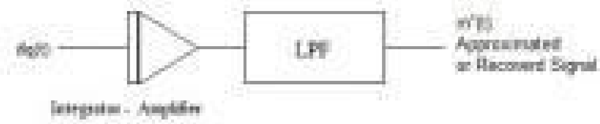


Figure: Delta Demodulator

Condition to avoid Slope overloading

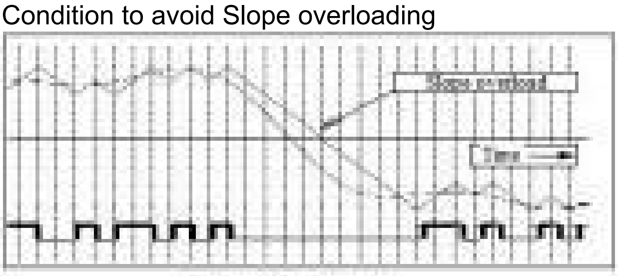


Figure: (a) Slope overload

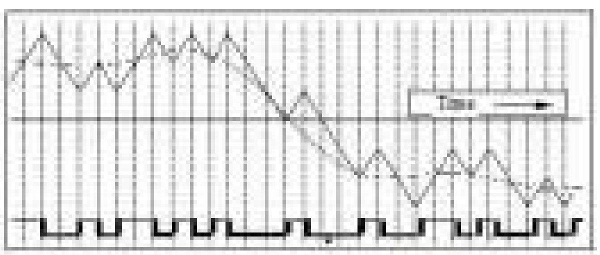


Figure: (b)Increased step size to reduce slope overload

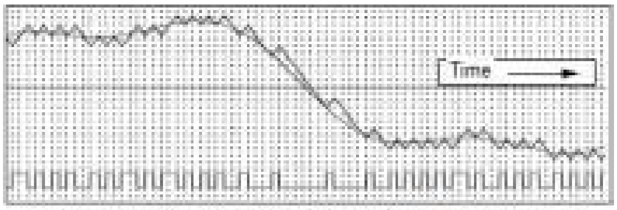



Figure: (c) increased sampling rate to reduce slope overload

This occurs when the sawtooth approximation cannot keep up with the rate-of-change of the input signal in the regions of greatest slope. The step size is reasonable for those sections of the sampled waveform of small slope, but the approximation is poor elsewhere. This is ‘slope overload’, due to too small a step. Slope overload is illustrated in Figure (a).

- To reduce the possibility of slope overload the step size can be increased (for the same sampling rate).This is illustrated in Figure (b). The sawtooth is better able to match the message in the regions of steep slope.
- An alternative method of slope overload reduction is to increase the sampling rate. This is illustrated in Figure (c), where the rate has been increased by a factor of 2.4 times, but the step is the same size as in Figure (a).

## Connection Diagram

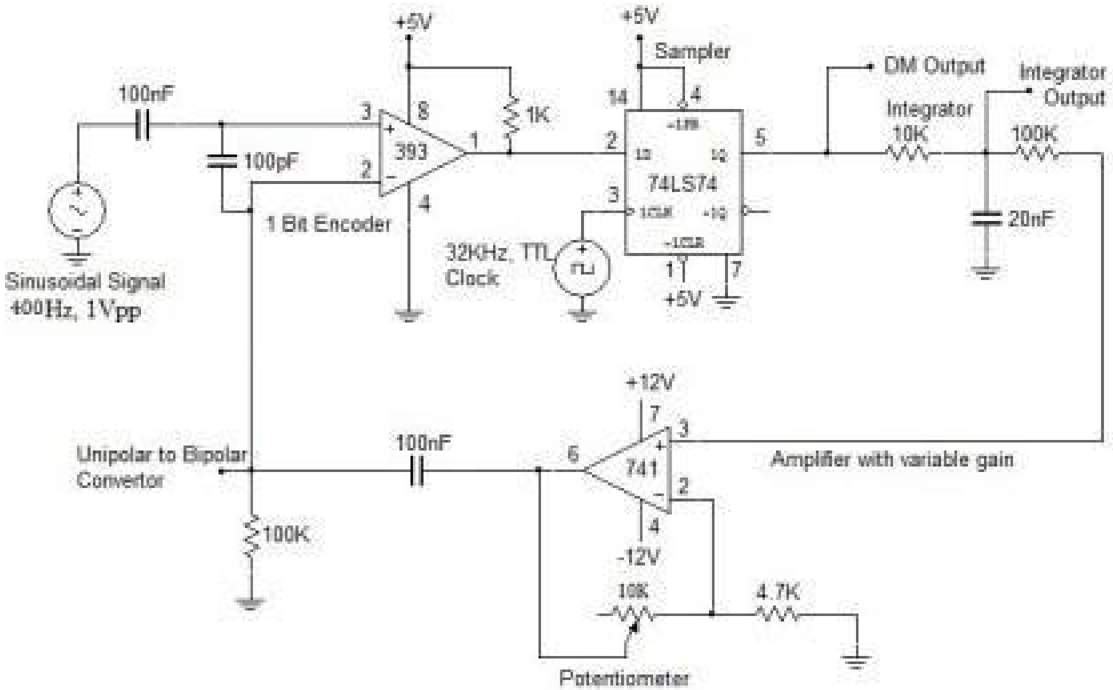



Figure 1: Delta modulation

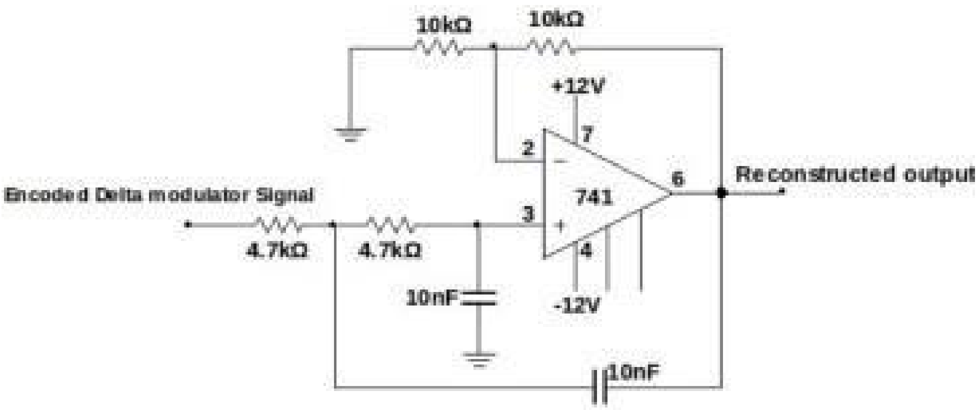
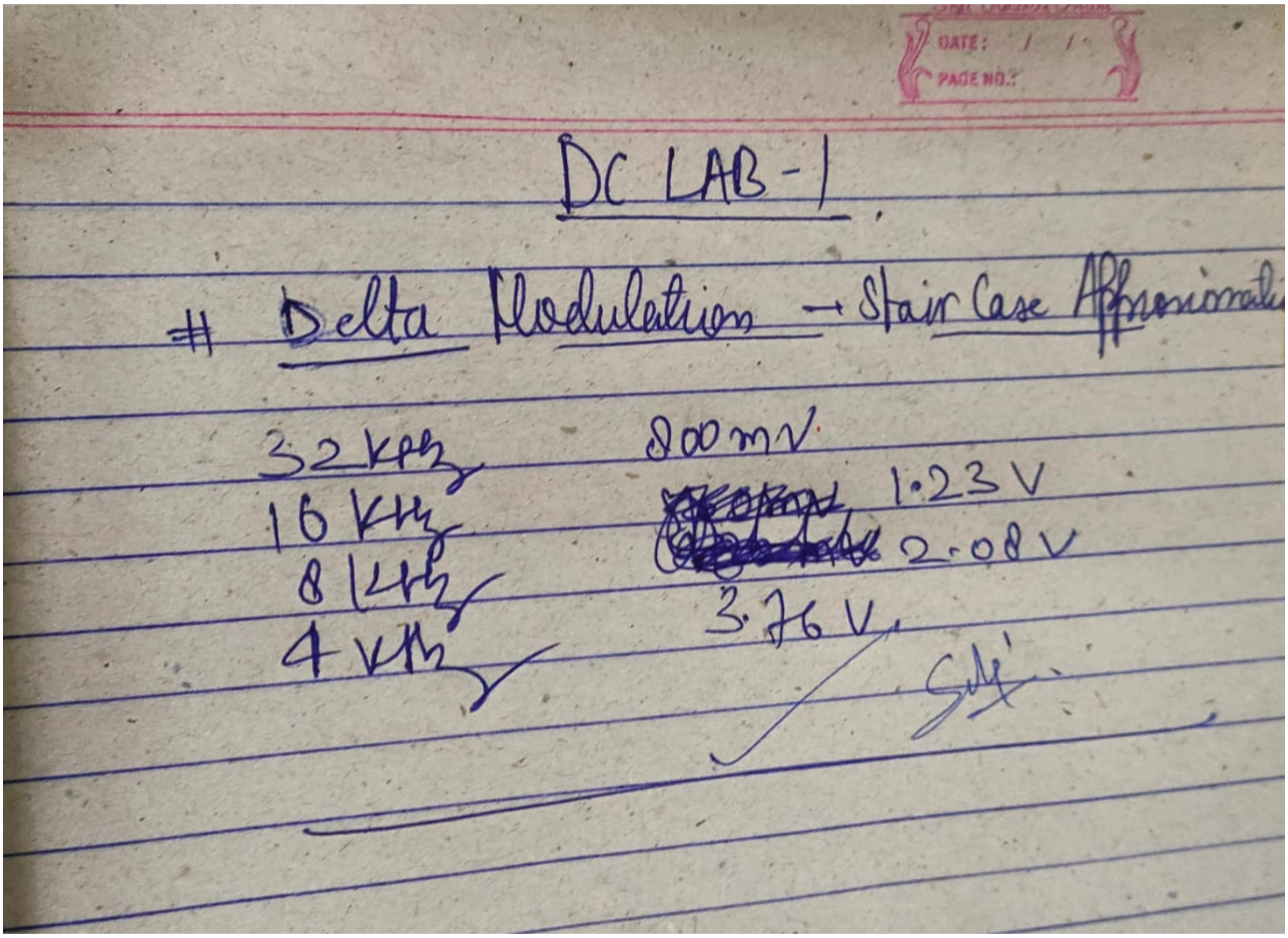



Figure 2: Delta Demodulation

## Observation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DC LAB - 1

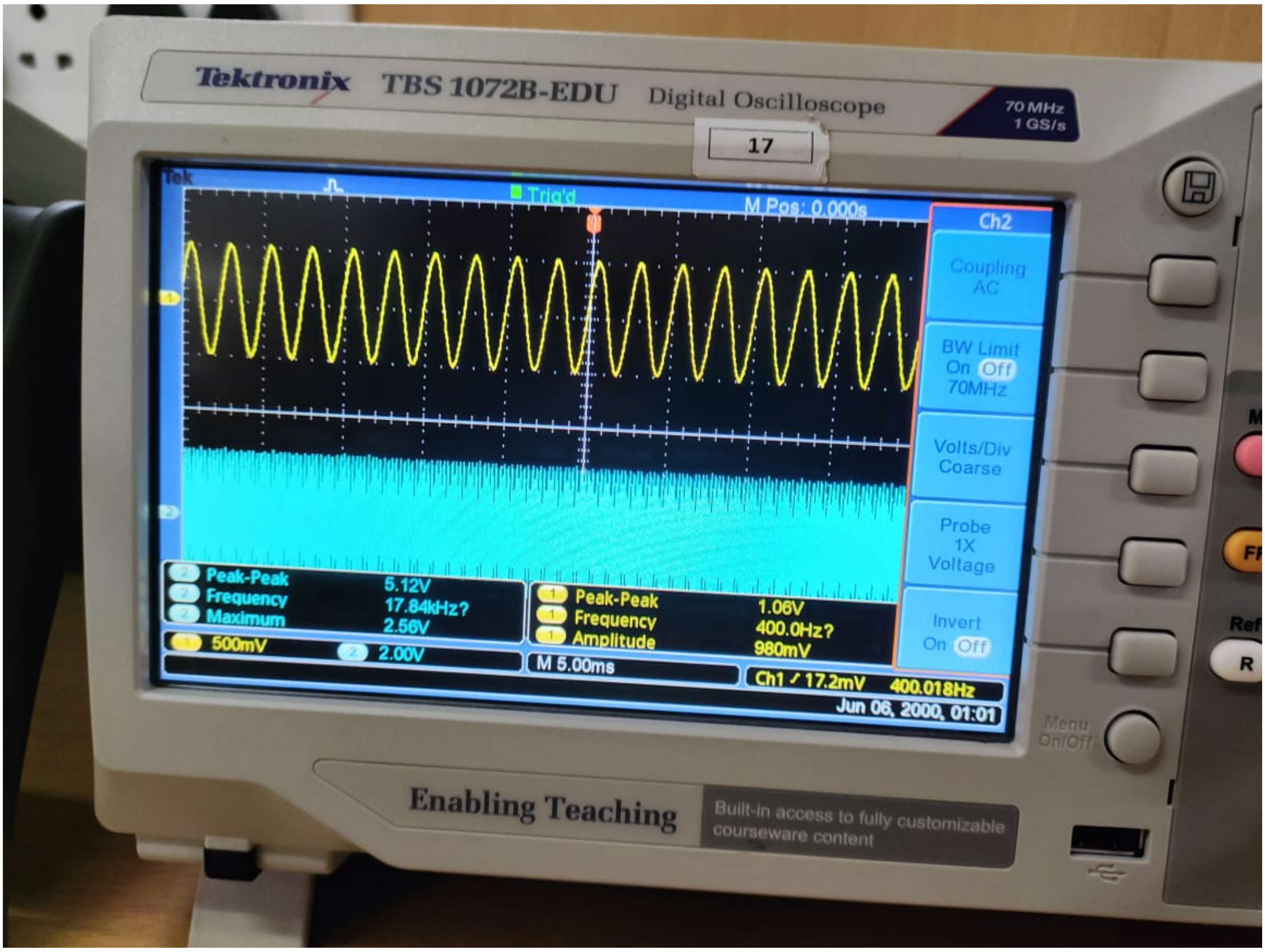
# Delta Modulation → Stair Case Approximation

32 KHz 800 mV
16 KHz ~~[illegible]~~ 1.23 V
8 KHz ~~[illegible]~~ 2.08 V
4 KHz 3.76 V.

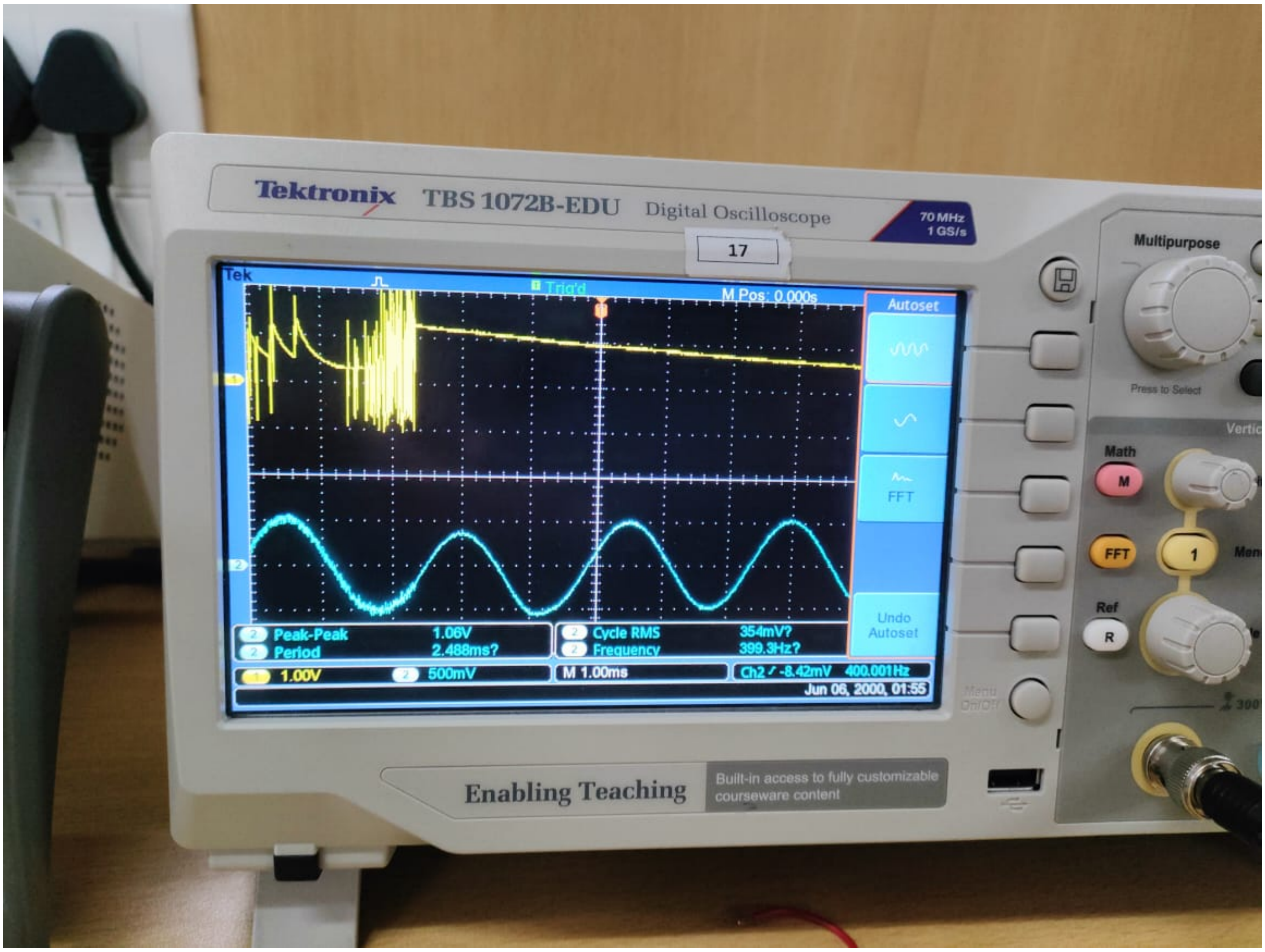
| S.No | Sampling Frequency | Step Size(Volt) |
|---|---|---|
| 1 | 32*KHz* | *- 560 mV* |
| 2 | 16*KHz* | *- 1.00 mV* |
| 3 | 8*KHz* | *- 2.09V* |
| 4 | 4*KHz* | *- 3.2 V* |

Table 1: Observation Table

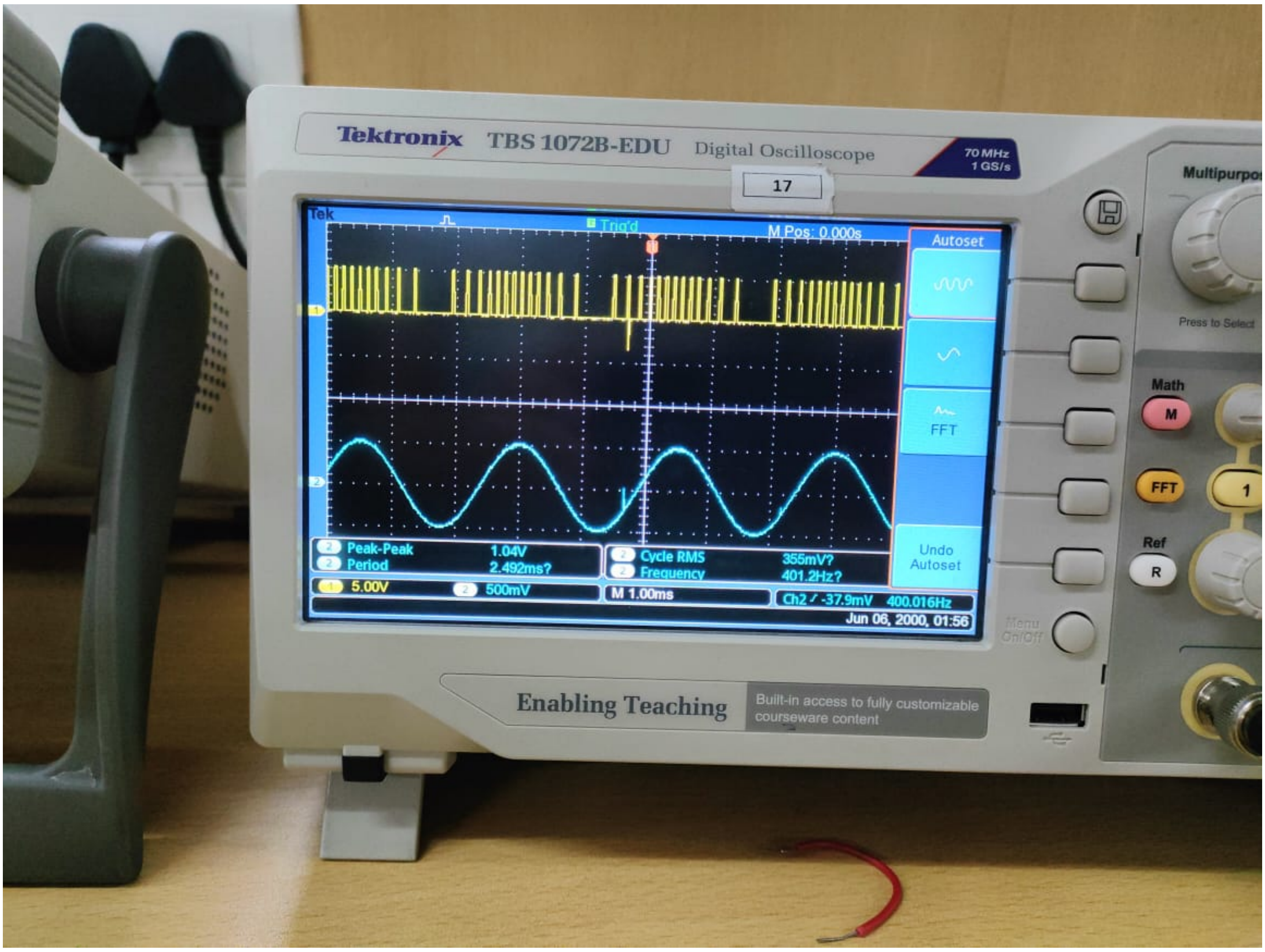
## Analysis of Results



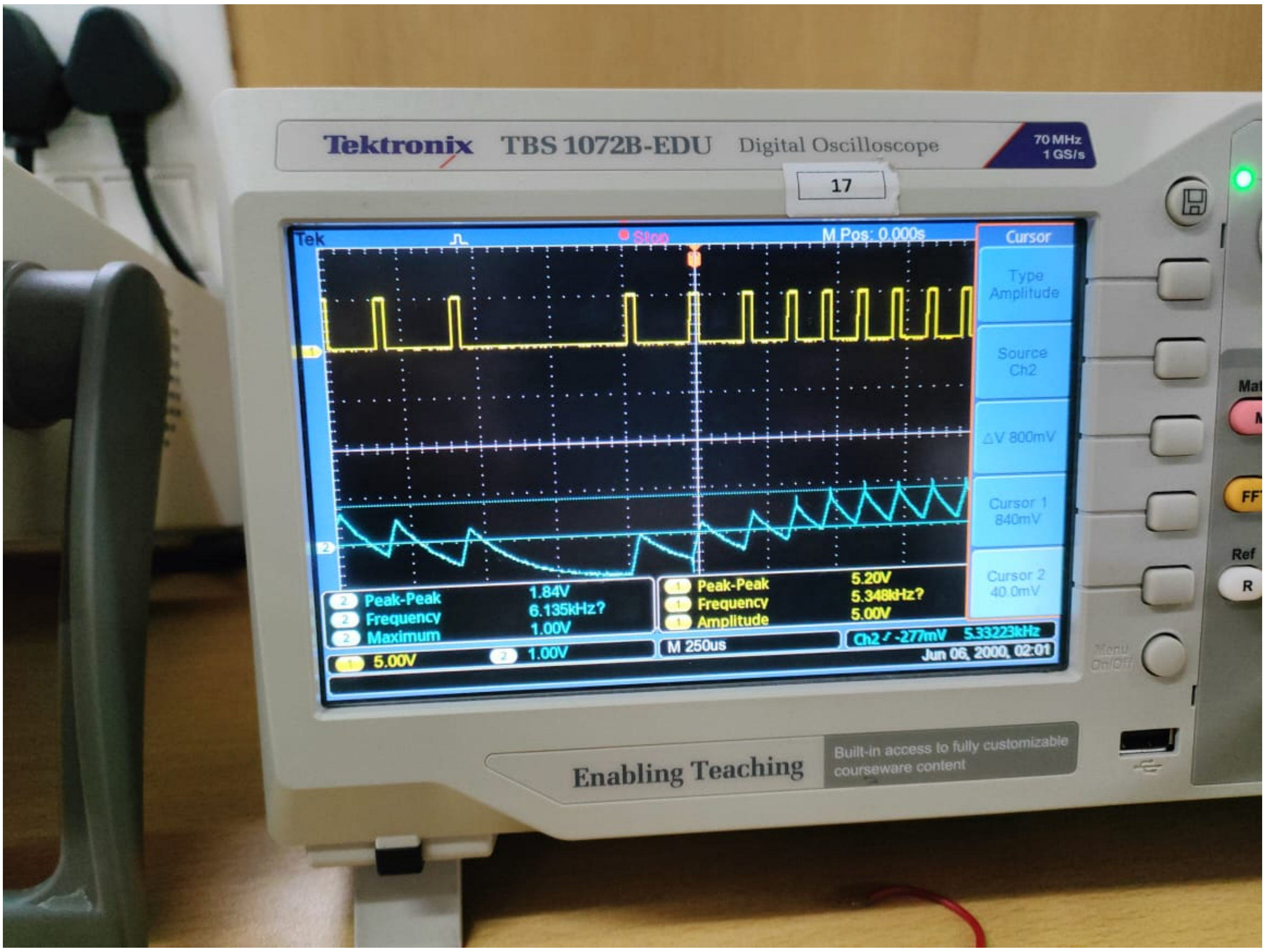

Input signals (Sine wave and clock pulse)



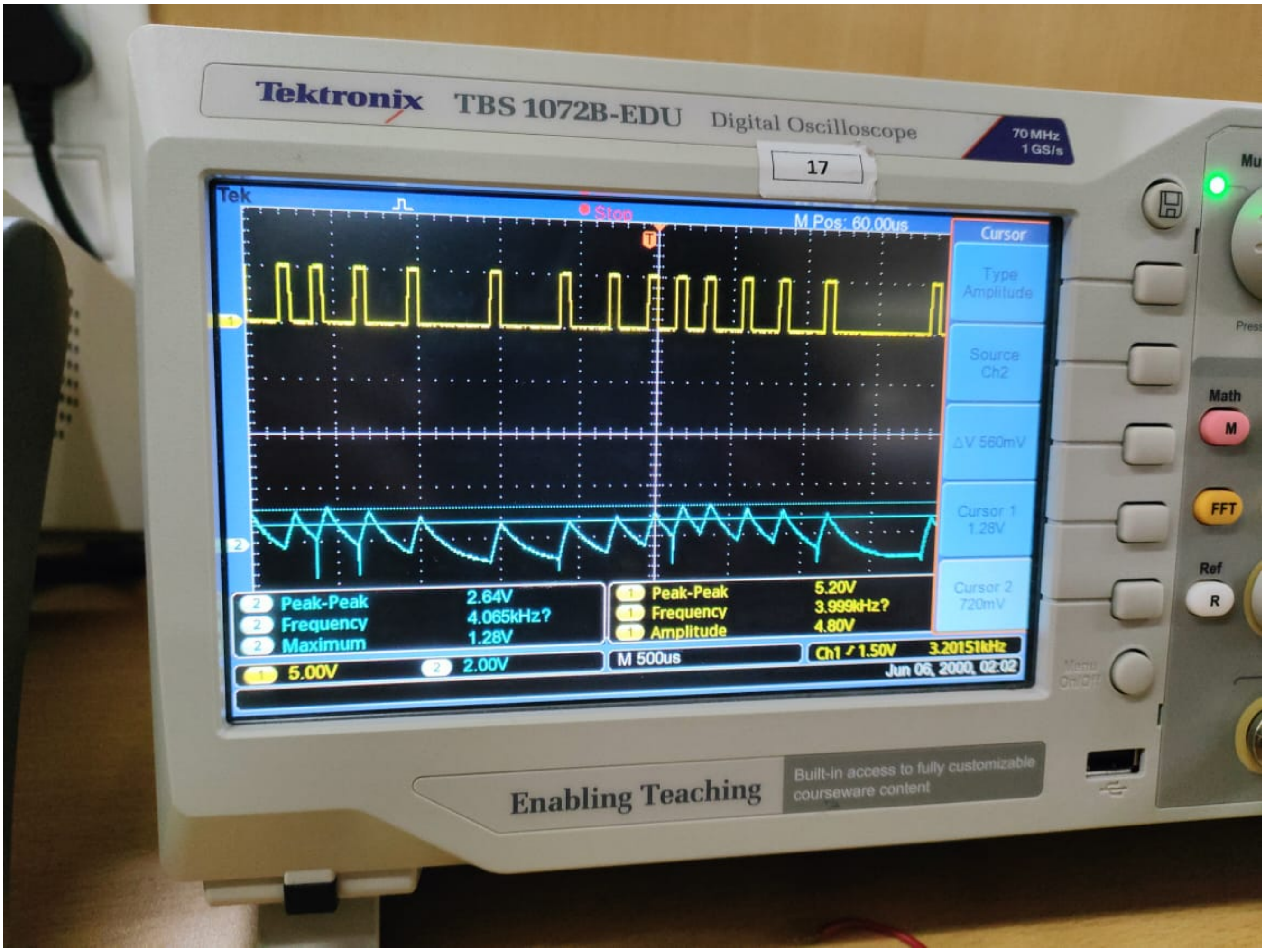

Message signal and Comparator input (IC 393 pin2 and pin3)



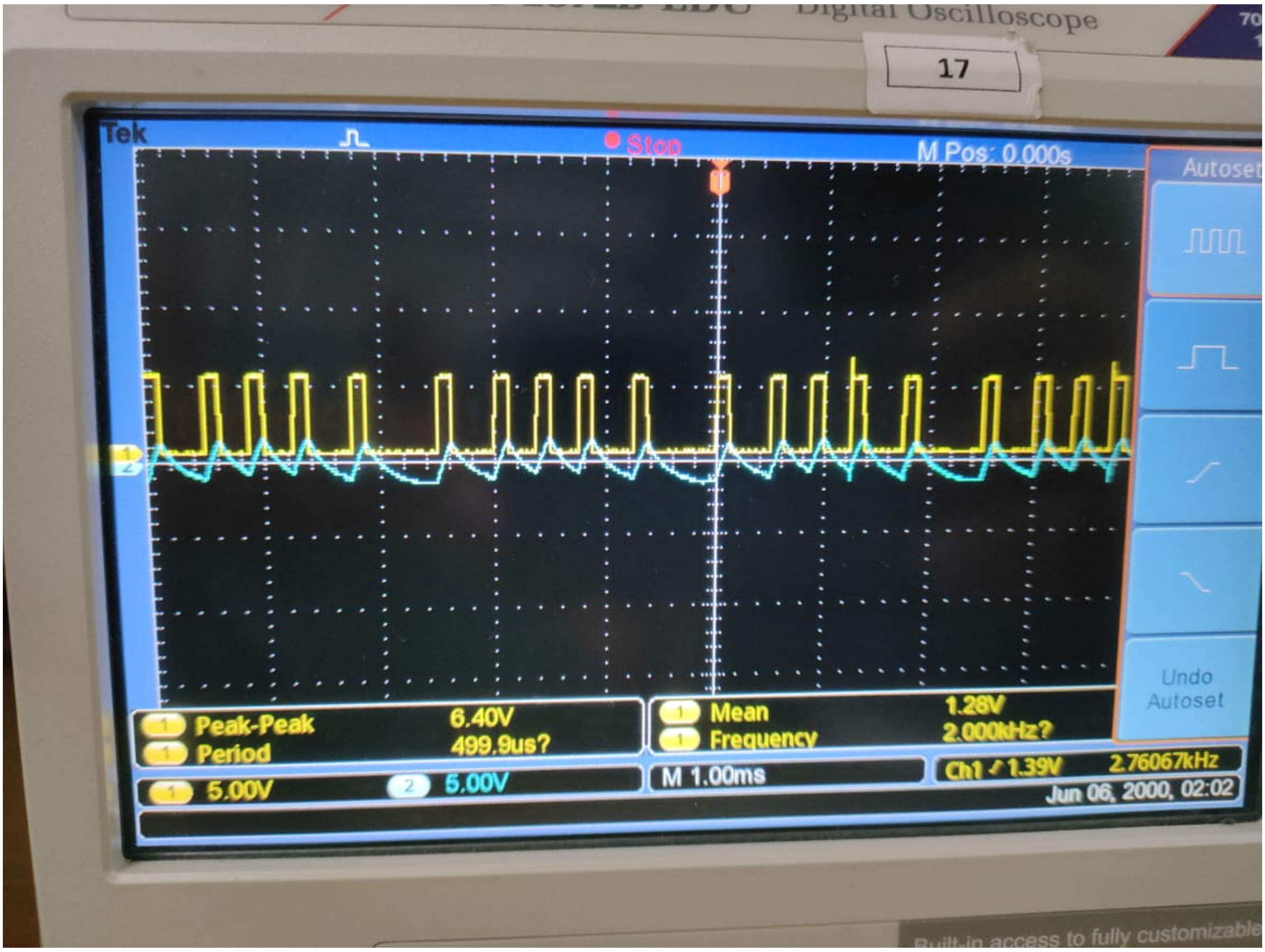

Message signal and Delta modulation output



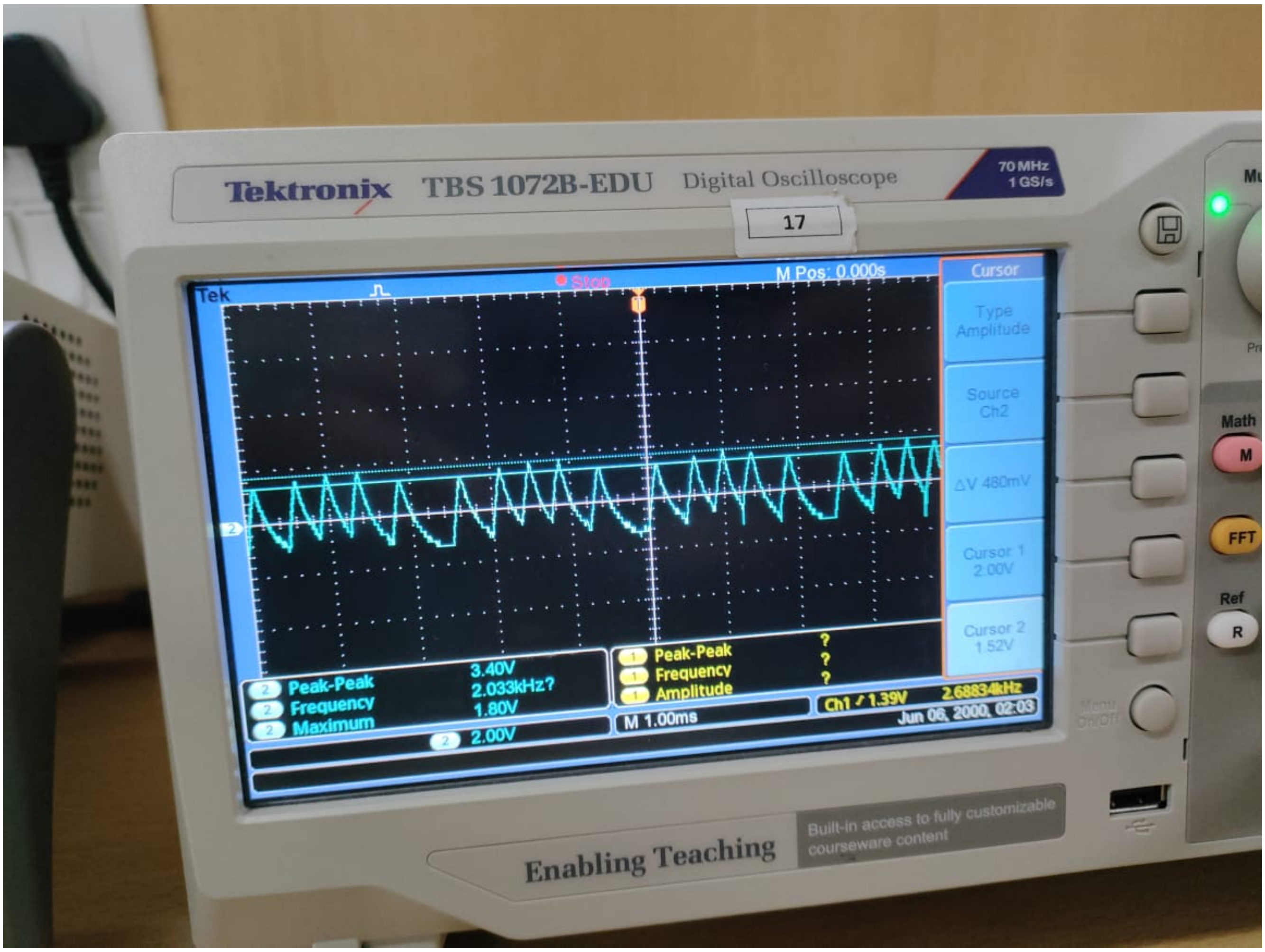

Unipolar to bipolar point output at 32 kHz

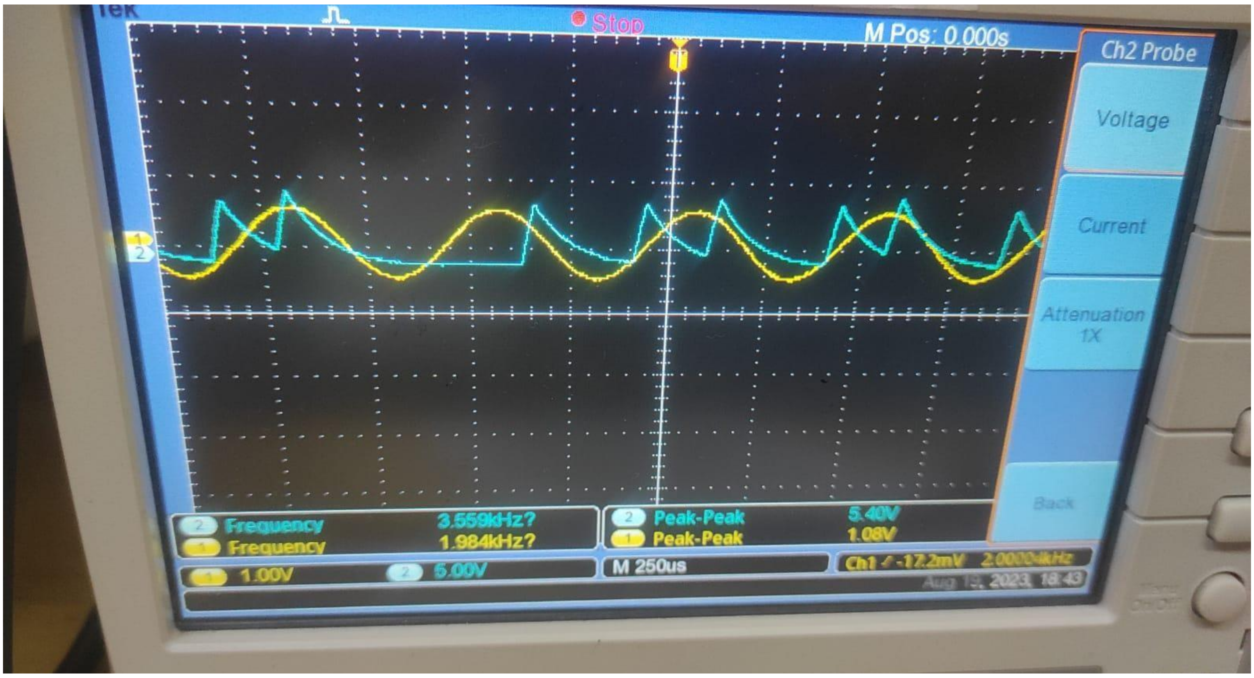



Unipolar to bipolar point output at 16 kHz

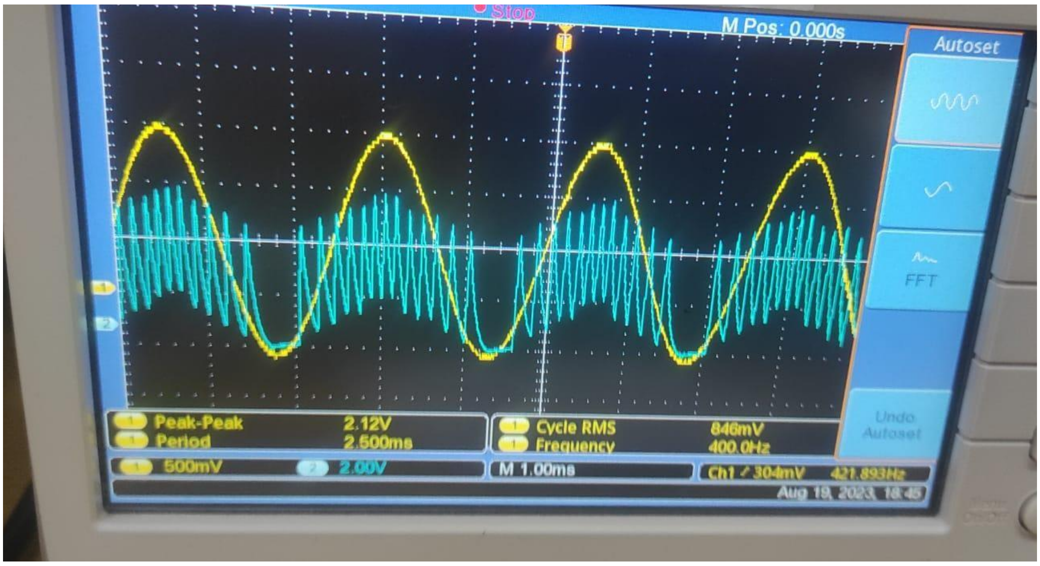



Unipolar to bipolar point output at 8 kHz

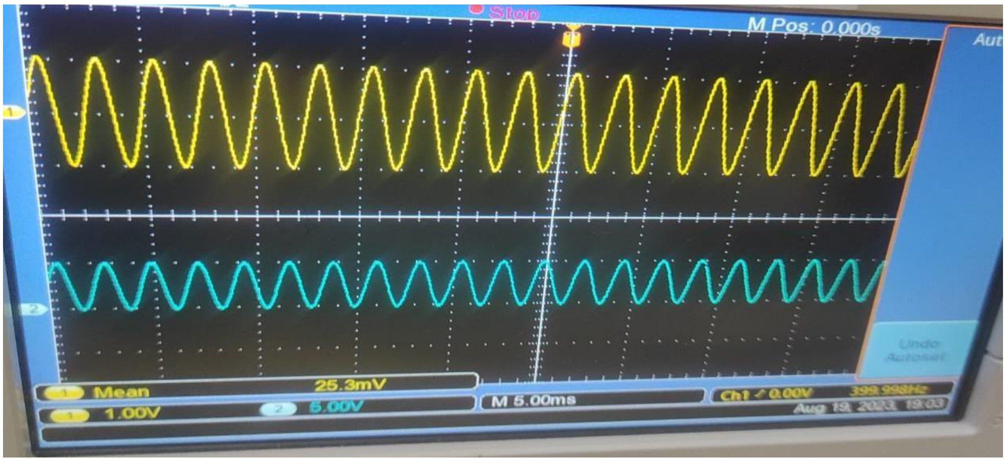

Tektronix
TBS 1072B-EDU
Digital Oscilloscope
70 MHz
1 GS/s
17
Tek
Stop
M Pos: 0.000s
Cursor
Type
Amplitude
Source
Ch2
ΔV 480mV
Cursor 1
2.00V
Cursor 2
1.52V
Peak-Peak 3.40V
Frequency 2.033kHz?
Maximum 1.80V
2.00V
Peak-Peak ?
Frequency ?
Amplitude ?
M 1.00ms
Ch1 1.39V 2.68834kHz
Jun 06, 2000, 02:03
Math
M
FFT
Ref
R
Enabling Teaching
Built-in access to fully customizable courseware content




Slope overloading when Frequency varies




Slope overloading when Amplitude varies




Input message signal and demodulated output

**Conclusion**

1. We get to know the conversion of continuous signal to discrete.
2. We get to learn about slope overloading.
3. We get to use various ICs and their implementation.

**Precautions**

1. Check the connections before switching on the kit.
2. Connections should be done properly.