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Experiment 5
PAM, PWM, PPM

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Aim.

- To study Pulse Amplitude Modulation and Demodulation (Sample, Sample & Hold and Flat Top)
- To study Pulse Position Modulation and Demodulation
- To study Pulse Width Modulation and Demodulation

Apparatus.

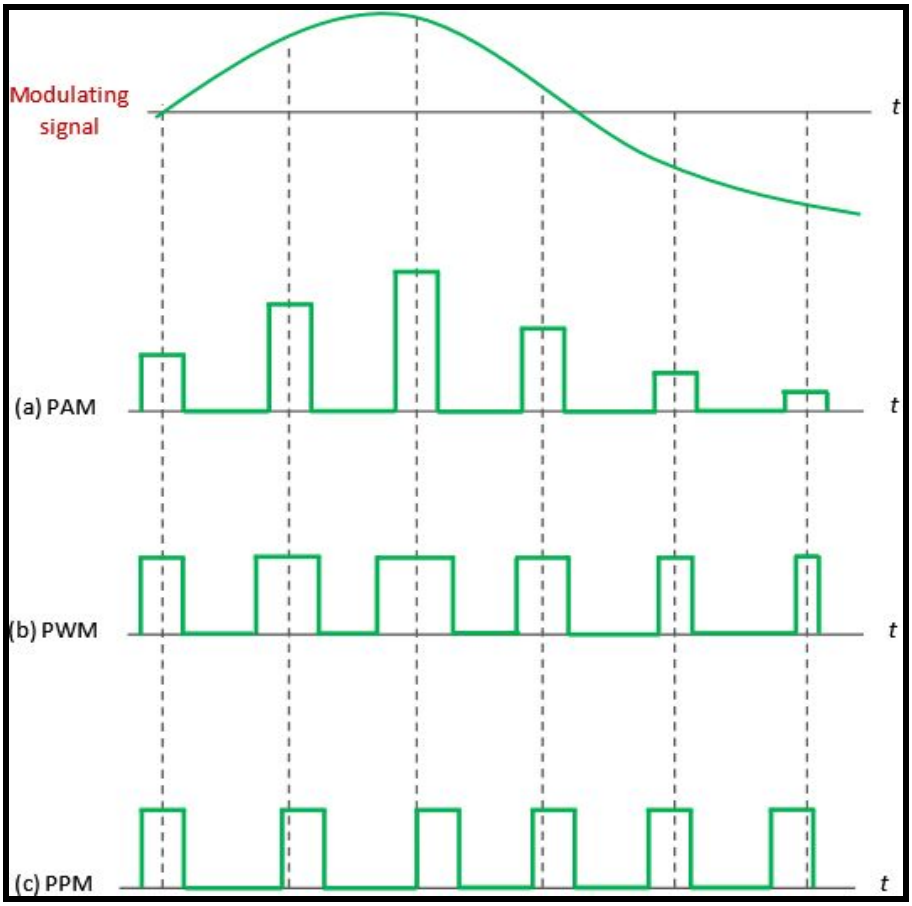
- Trainer board ST 2110
- Power supply
- Connecting Wires
- CRO
- Probes

Theory.

Pulse-amplitude modulation (PAM), is a form of signal modulation where the message information is encoded in the amplitude of a series of signal pulses. It is an analog pulse modulation scheme in which the amplitudes of a train of carrier pulses are varied according to the sample value of the message signal. Demodulation is performed by detecting the amplitude level of the carrier at every single period.

Pulse width modulation (PWM), or pulse-duration modulation (PDM), is a method of reducing the average power delivered by an electrical signal, by effectively chopping it up into discrete parts. The average value of voltage (and current) fed to the load is controlled by turning the switch between supply and load on and off at a fast rate. The longer the switch is on compared to the off periods, the higher the total power supplied to the load.

Pulse-position modulation (PPM) is a form of signal modulation in which M message bits are encoded by transmitting a single pulse in one of 2^M possible required time shifts.This is repeated every T seconds, such that the transmitted bit rate is M/T bits per second. It is primarily useful for optical communications systems, which tend to have little or no multipath interference.



PAM, PWM, PPM

Procedure.

PAM:

1. Connect the circuit as shown in Fig. 1
2. Output of Sine wave to Modulation Signal in PAM block keeping the switch in 1 kHz position
3. 8 kHz pulse output to Pulse IN
4. Switch On power supply.
5. Monitor the outputs at tp. 3, 4 and 5, these are natural, Sample and Hold flat top outputs respectively.

6. Observe the difference between the two outputs and try giving reasons behind them.
7. Try Varying the amplitude and frequency of sine wave by amplitude pot and frequency change over switch. Observe the effect on all the two outputs.
8. Also, try varying the frequency of pulse, by connecting the pulse input to the 4 frequencies available i.e. 8.16.32. 64 kHz in pulse output look.
9. For demodulation part Connect the sample output low pass filter input and Output of low pass filter to input of AC amplifier. Keep the gain pot in AC amplifier block in max position.
10. Follow the steps as of the modulation part.
11. Monitor the output of the AC amplifier. It should be a pure sine wave similar to input.
12. Similarly connect the sample and hold and flat top outputs to Low Pass Filter and see the demodulated waveform at the output of AC amplifier.

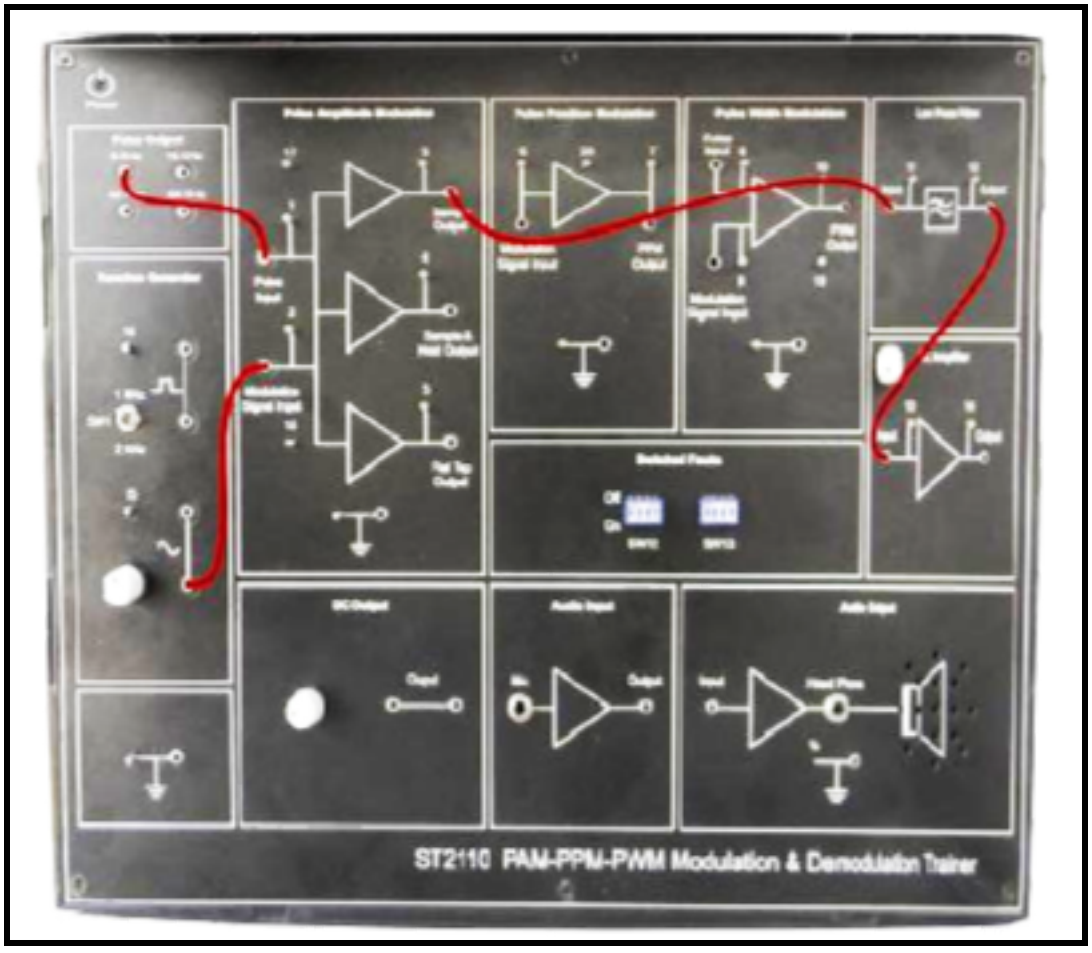


Fig. 1: PAM configuration

PPM:

1. Connect the circuit as shown in Fig. 2
2. Output of Sine wave to Modulation Signal in PPM block keeping the switch in 1 kHz position
3. 8 kHz pulse output to Pulse IN
4. Switch On power supply.
5. Observe the difference between the two outputs and try giving reasons behind them.
6. Try Varying the amplitude and frequency of sine wave by amplitude pot and frequency change over switch. Observe the effect on all the two outputs.
7. Also, try varying the frequency of pulse, by connecting the pulse input to the 4 frequencies available i.e. 8.16.32. 64 kHz in pulse output look.
8. For demodulation part Connect the sample output low pass filter input and Output of low pass filter to input of AC amplifier. Keep the gain pot in AC amplifier block in max position.
9. Follow the steps as of the modulation part.
10. Monitor the output of the AC amplifier. It should be a pure sine wave similar to input.

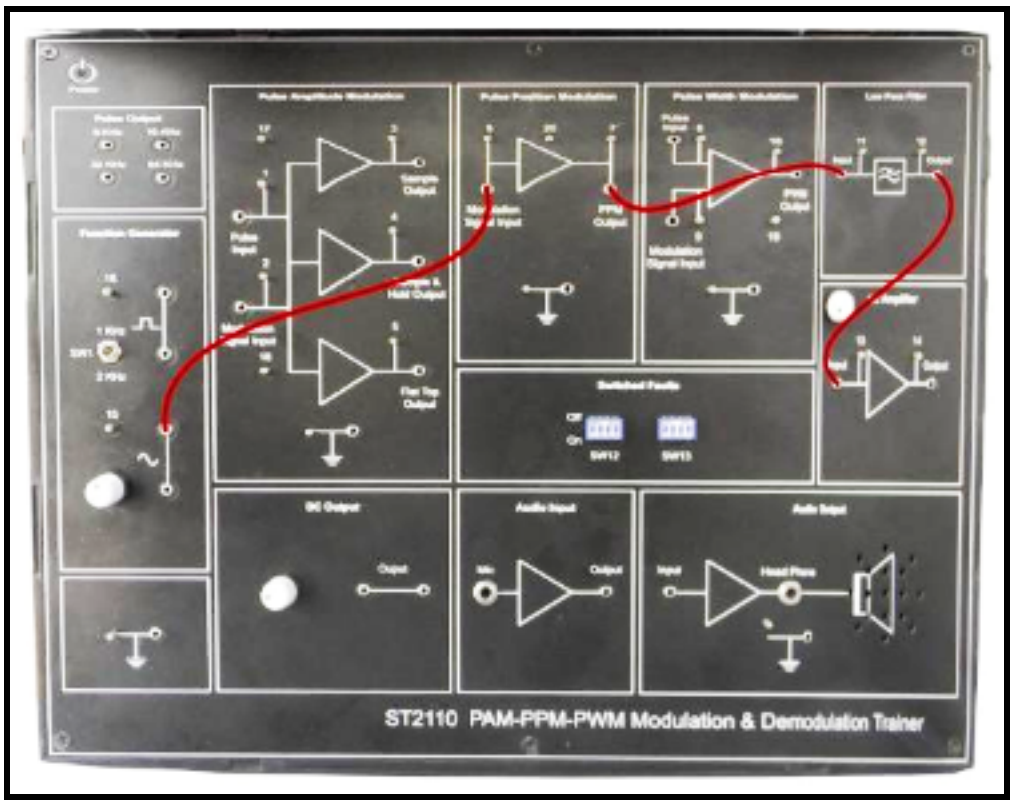


Fig. 2: PPM configuration

PWM:

1. Connect the circuit as shown in Fig. 3
2. Output of Sine wave to Modulation Signal in PWM block keeping the switch in 1 kHz position
3. 8 kHz pulse output to Pulse IN
4. Switch On power supply.
5. Observe the difference between the two outputs and try giving reasons behind them.
6. Try Varying the amplitude and frequency of sine wave by amplitude pot and frequency change over switch. Observe the effect on all the two outputs.
7. Also, try varying the frequency of pulse, by connecting the pulse input to the 4 frequencies available i.e. 8.16.32. 64 kHz in pulse output look.
8. For demodulation part Connect the sample output low pass filter input and Output of low pass filter to input of AC amplifier. Keep the gain pot in AC amplifier block in max position.
9. Follow the steps as of the modulation part.
10. Monitor the output of the AC amplifier. It should be a pure sine wave similar to input.

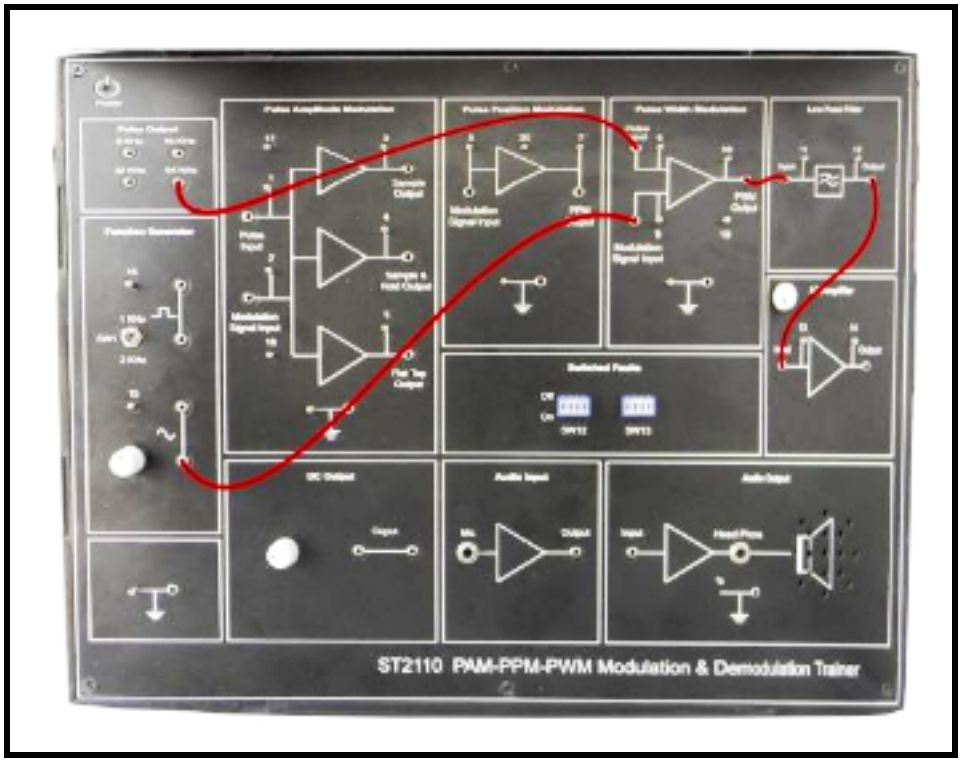
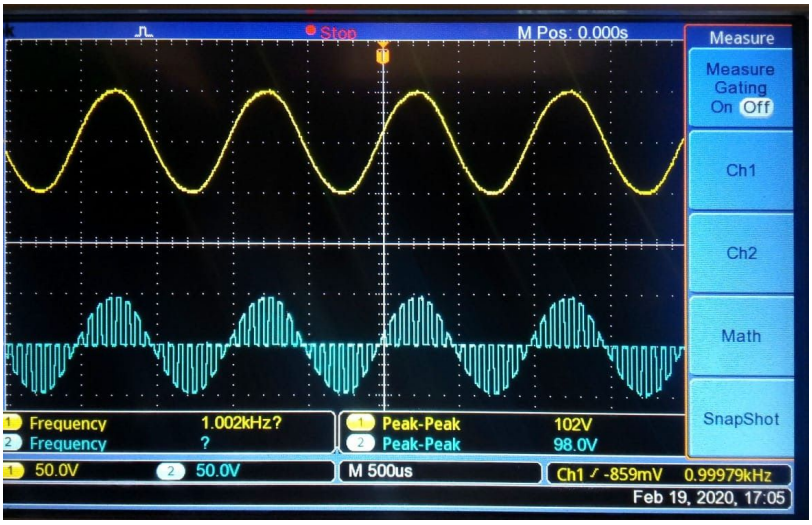


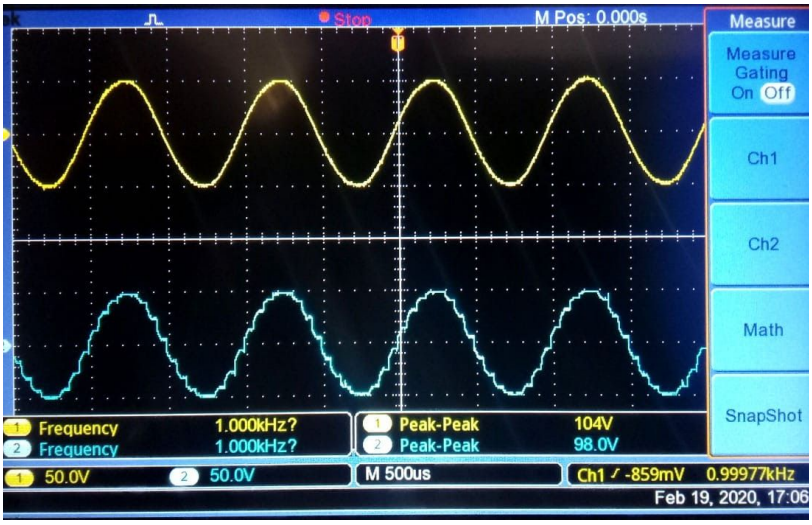
Fig. 3: PWM configuration

Observation.

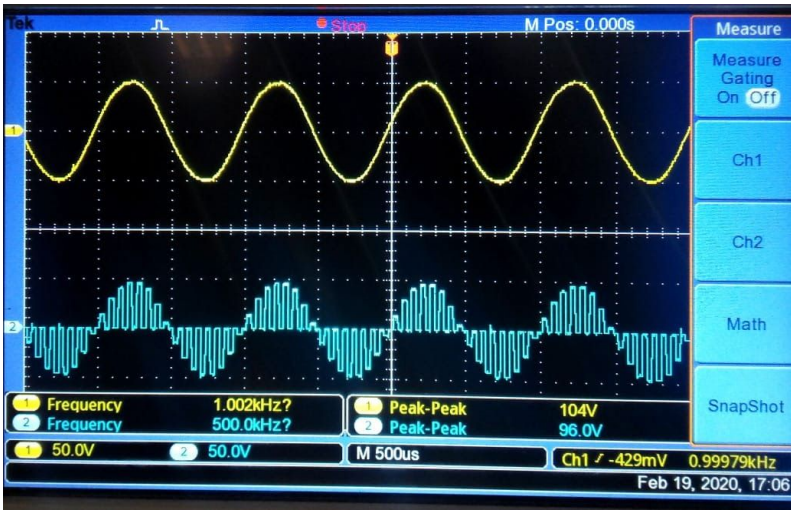
1. PAM



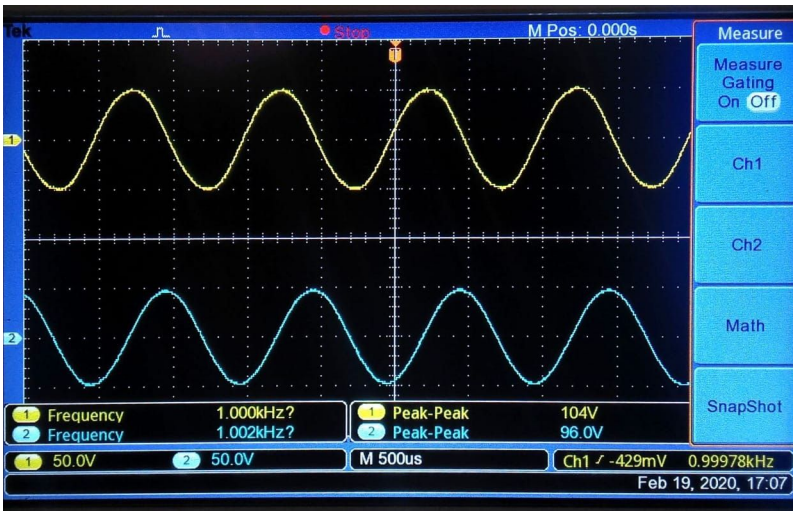
Message Signal and PAM Sample Signal



Message Signal and PAM Sample and Hold Signal

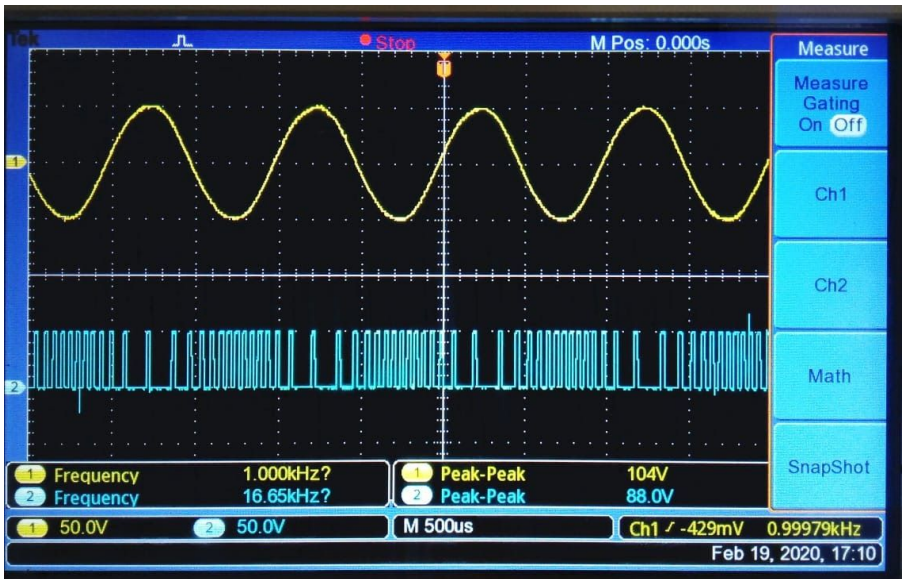


Message Signal and PAM Flat Top Signal

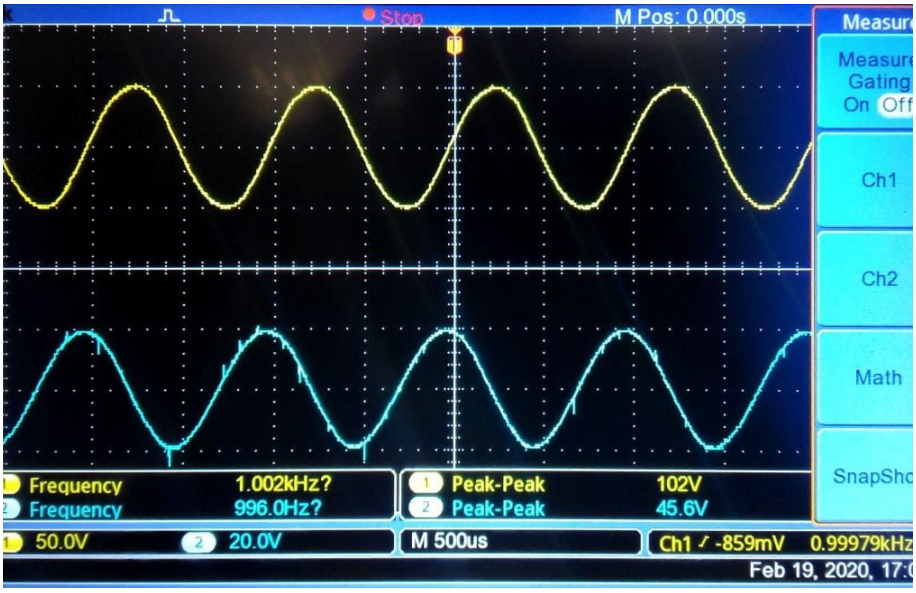


Message Signal with Reconstruction from PAM Flat Top Signal

2. PPM

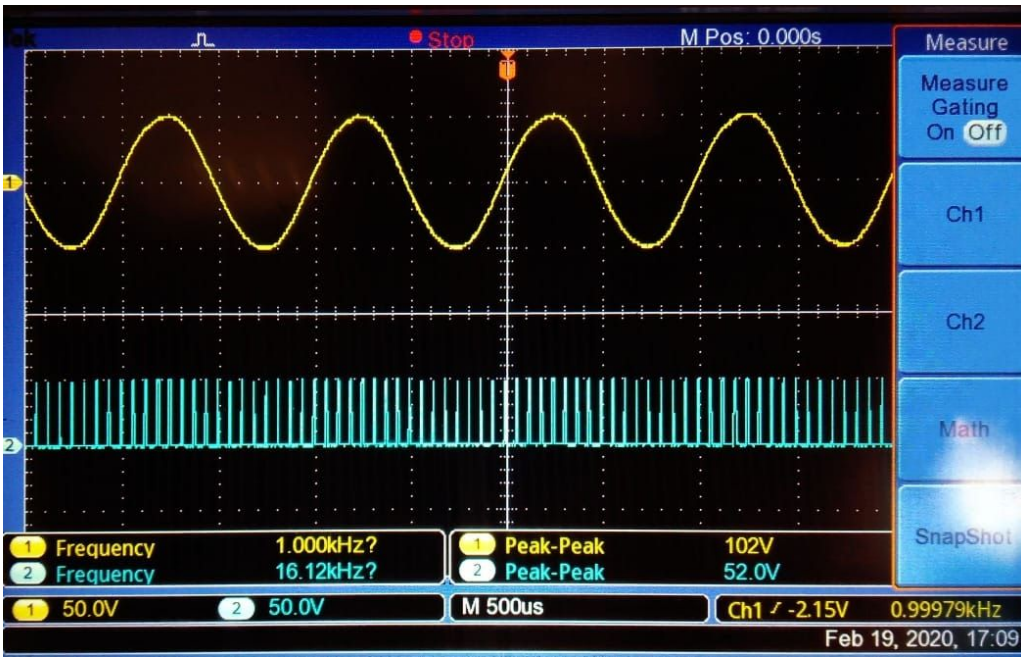


Message Signal and PPM Sample Signal

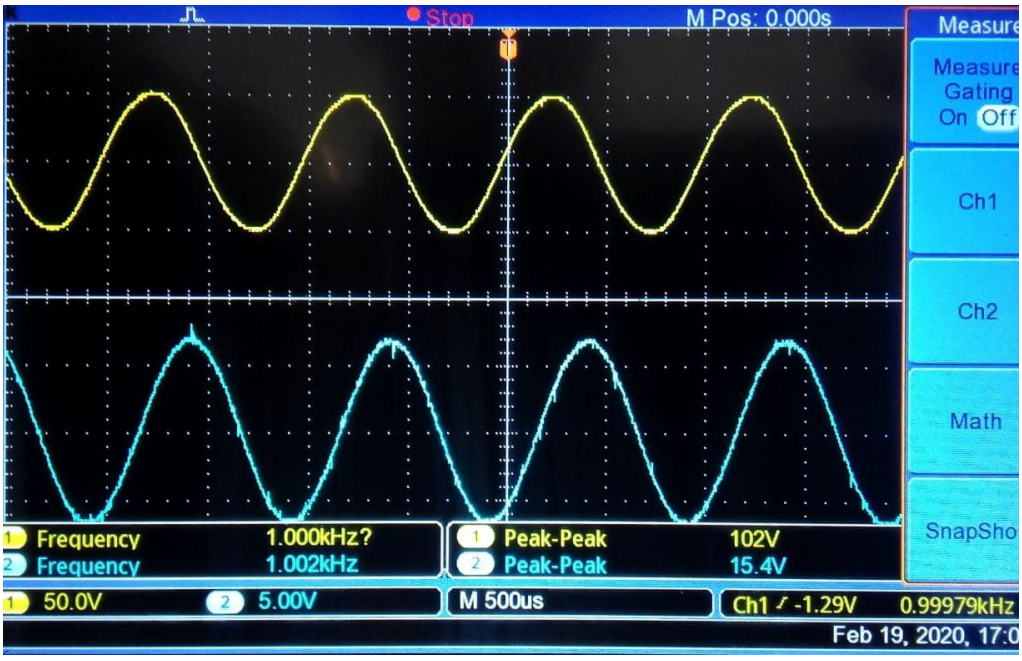


Message Signal with Reconstruction from PPM Signal

3. PWM

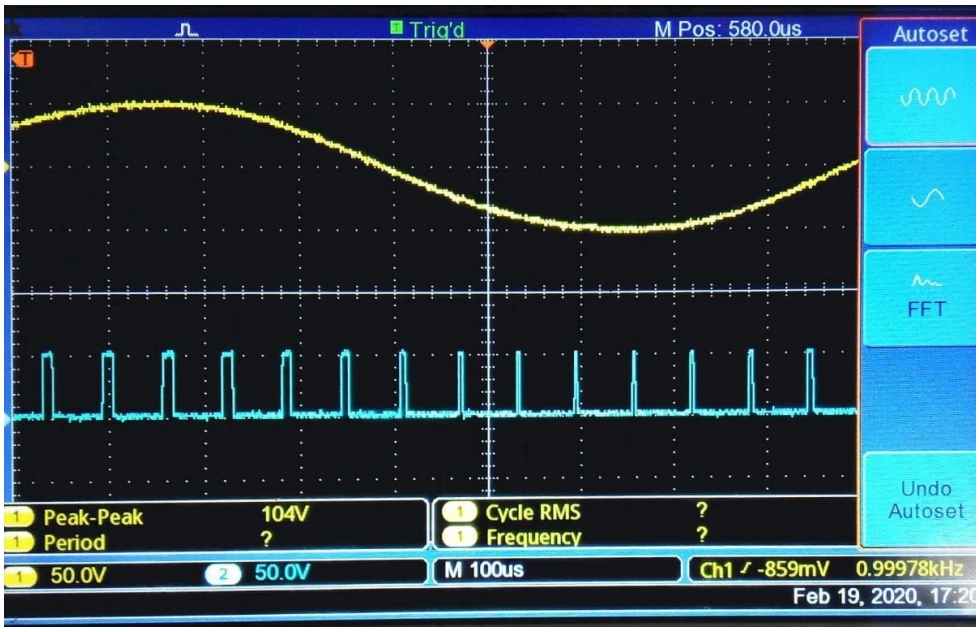


Message Signal and PWM Sample Signal

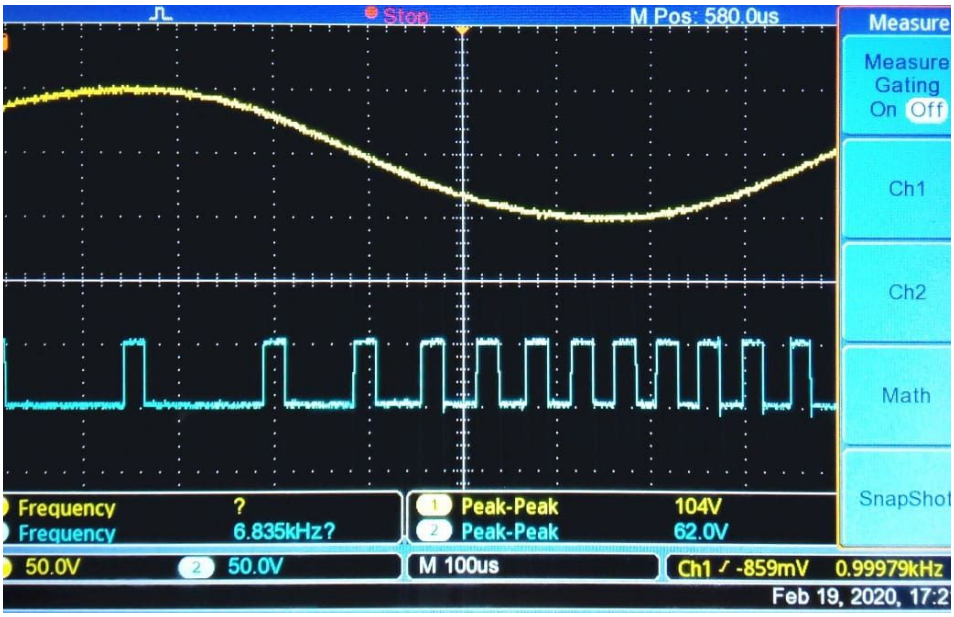


Message Signal with Reconstruction from PWM Signal

PWM vs PPM



Magnified View of PWM



Magnified View of PPM

Conclusion.

In this experiment we studied Pulse Amplitude Modulation, Pulse Width Modulation and Pulse Position Modulation by transmitting a sine wave as a message signal by modulating it. We also demodulated and reconstructed the original message signal and analysed the effectiveness and power efficiency of each modulation method.

Remarks.

Signature.