Date :
Experiment No : 7
Experiment Name : Study of pulse code modulation and demodulation

Theory :

When a digital signal undergoes Pulse Code Modulation, it converts the analog information into a binary sequence (1 and 0). Through the demodulation process, we can obtain the original analog signal. The figure below represents the output of the PCM signal with respect to the sine wave.
Pulse Code Modulation techniques are used to produce a series of numbers or digits in binary form. Hence this process is called digital modulation. The amplitude at that particular time of the signal sample is indicated by the binary codes.

In the PCM process, a sequence of coded pulses indicates the message signal. This message signal represents amplitude and time.

Pulse code modulations are of two types:

Differential pulse code modulation (DPCM)

Adaptive differential pulse code modulation (ADPCM)

Differential pulse-code modulation is a signal encoding process which adds functionalities based on the prediction of the samples of the signal. Adaptive differential pulse-code modulation is a technique in which the size of the quantization step is varied, to allow the further reduction of the required data bandwidth to a given signal-to-noise ratio.

The Pulse Code Modulation process is done through the following steps: Sampling ,Quantisation .Coding Block diagram of the Pulse Code Modulation process is as shown in the figure below.

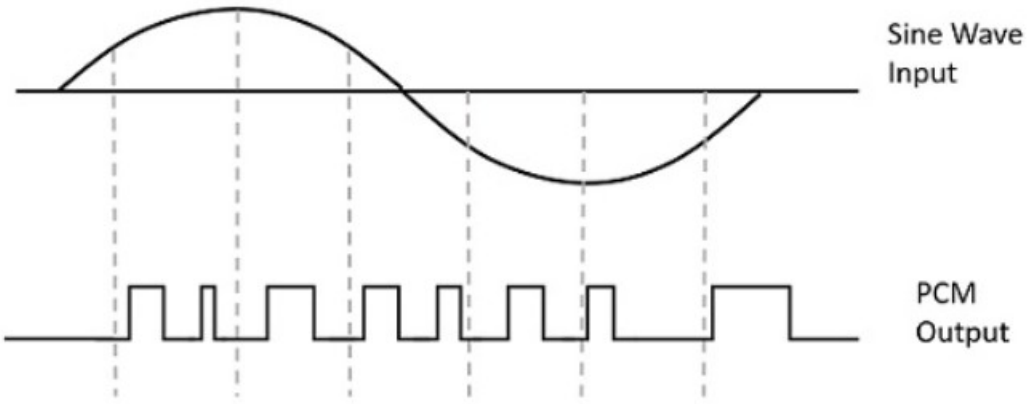


Figure 7.1 : Pulse code modulation

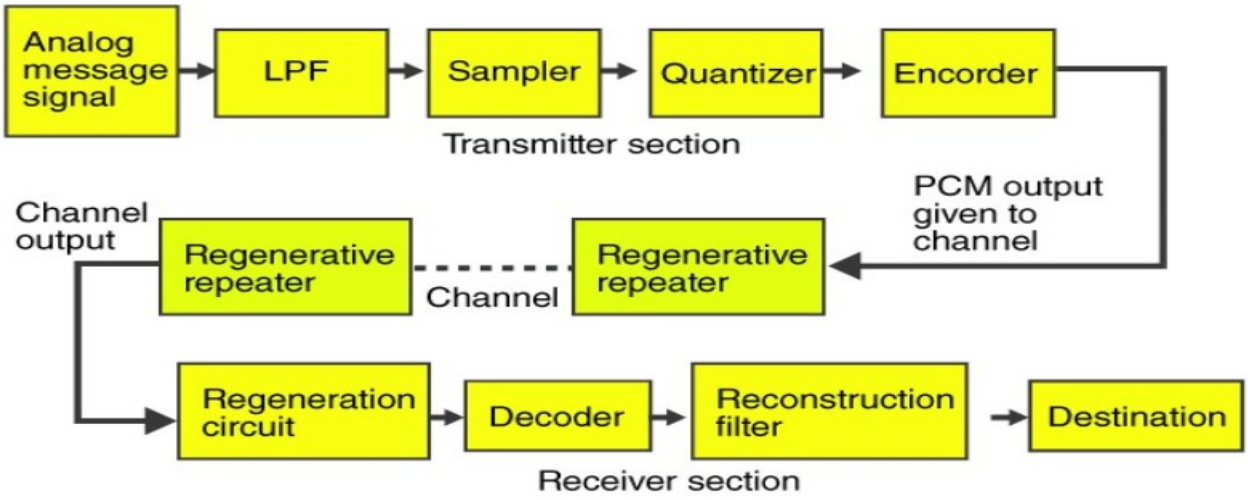


Figure 7.2 : Pulse code modulation technique

In the PCM process, it is possible to digitise all forms of analog data, including music, telemetry, voice, full-motion video. To obtain a pulse code modulated waveform from an analog waveform at the transmitter end and to convert the message signal into the binary form, a process known as quantisation is used.

At the receiver end of the pulse code circuit, demodulation takes place, and the signal is converted into pulses with the same quantum levels.

Pulse coded Demodulation :

Pulse Code Demodulation will be doing the same modulation process in reverse. Demodulation starts with the decoding process, during transmission the PCM signal will be affected by noise interference. So, before the PCM signal sends to the PCM demodulator, we have to recover the signal to the original level for that we are using a comparator. The PCM signal is a series pulse wave signal, but for demodulation, we need a wave to be parallel.

By using a serial to parallel converter the series pulse wave signal will be converted into a parallel digital signal. After that the signal will pass through the n-bits decoder, it should be a Digital to Analog converter. Decoder recovers the original quantization values of the digital signal. This quantization value also includes a lot of high-frequency harmonics with original audio signals. For avoiding unnecessary signals we utilize a low-pass filter at the final part.

Required Apparatus :

1. Pulse code Modulation Transmitter kit

2. Pulse coded demodulation receiver kit

3. Oscilloscope

4. Probe

5. Wire

Circuit Diagram :

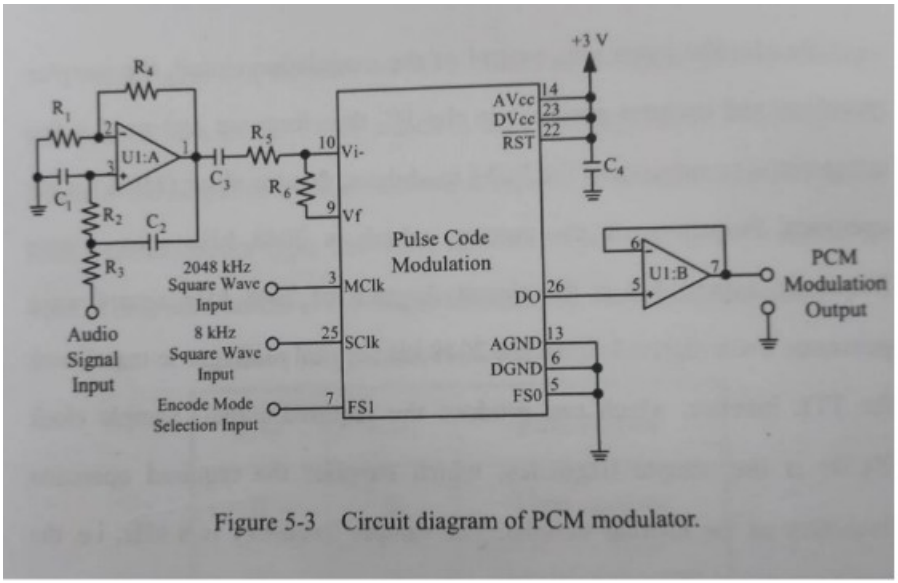


Figure 5-3 Circuit diagram of PCM modulator.

Figure 7.3 : PCM Modulation circuit

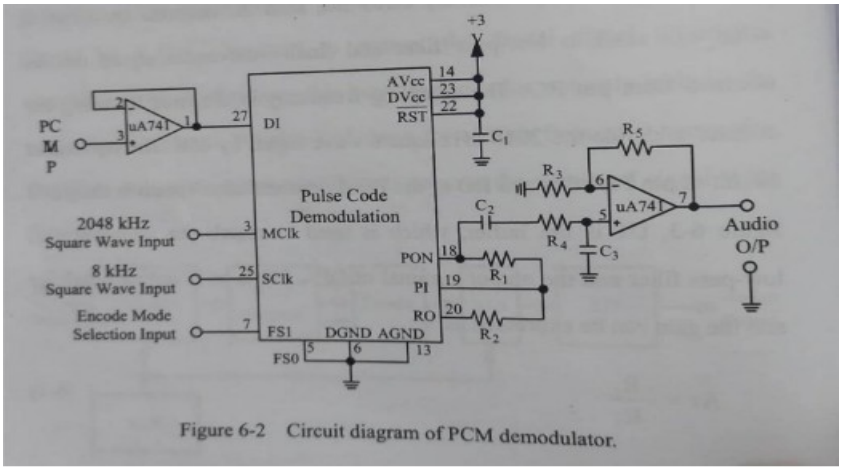


Figure 6-2 Circuit diagram of PCM demodulator.

Figure 7.4 : PCM Demodulation circuit

Input Wave shape :

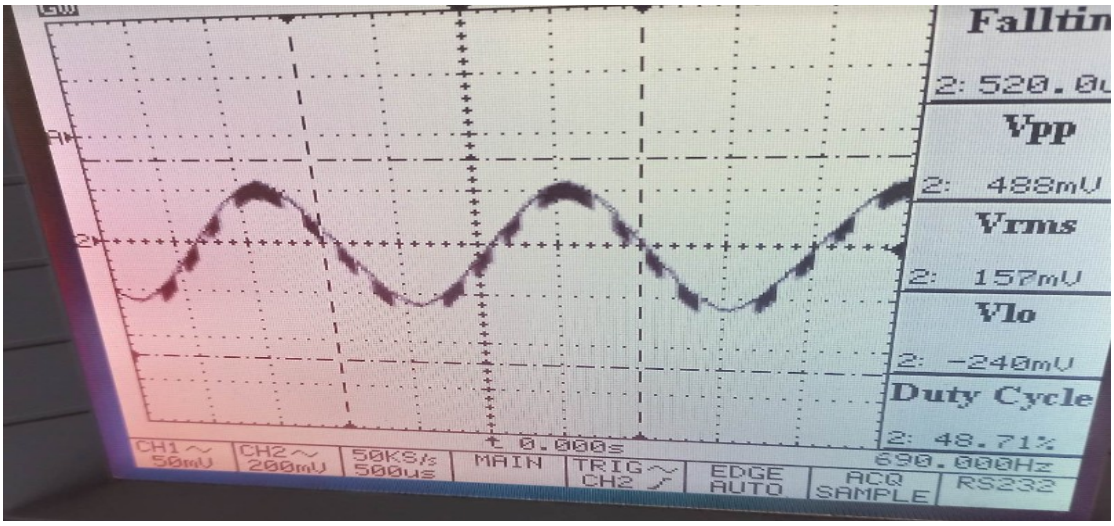


Figure 7.5 : Input message signal

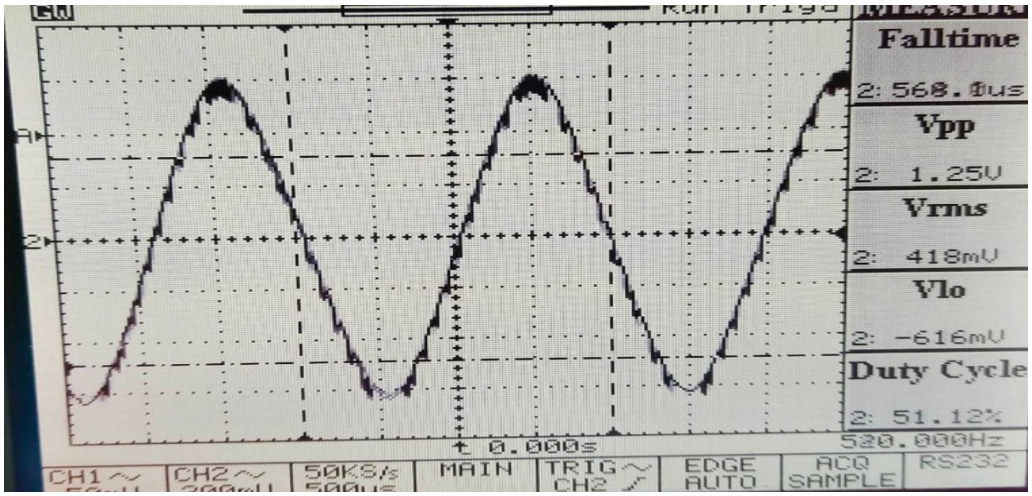


Figure 7.6 : Output waveshape of Tp1

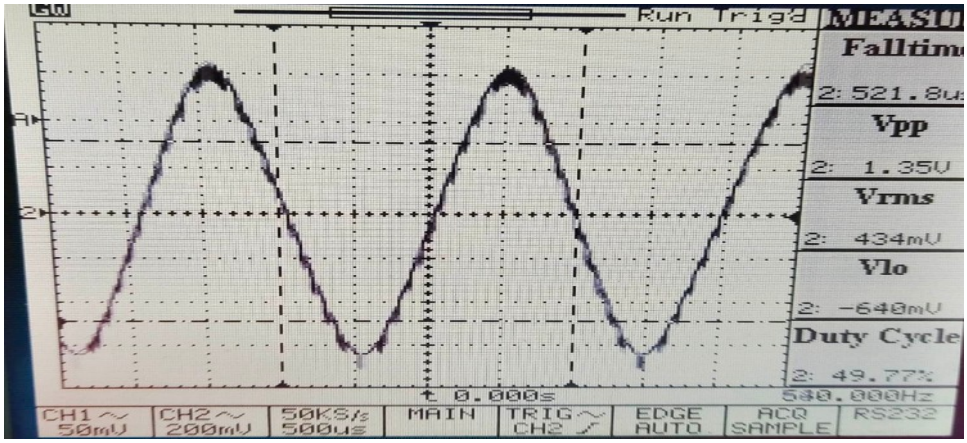


Figure 7.7 : Output wavshape of Tp2

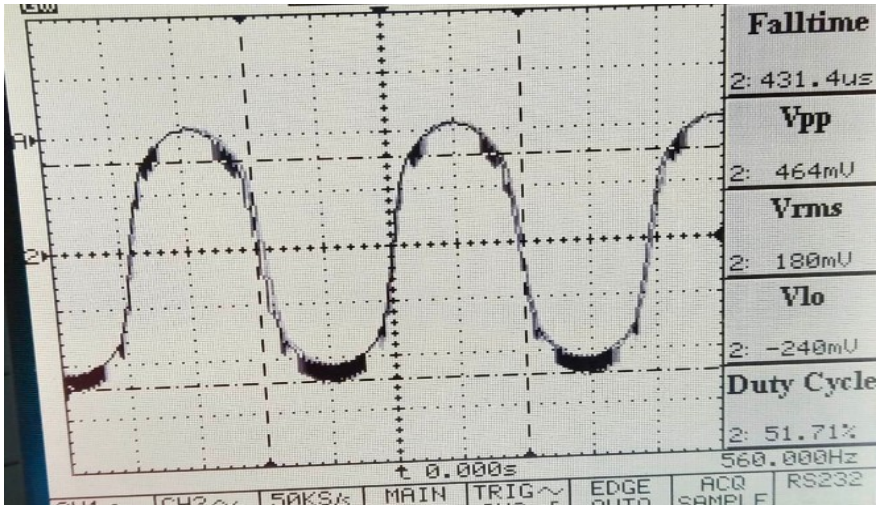


Figure 7.8 : Output waveshape of Tp3

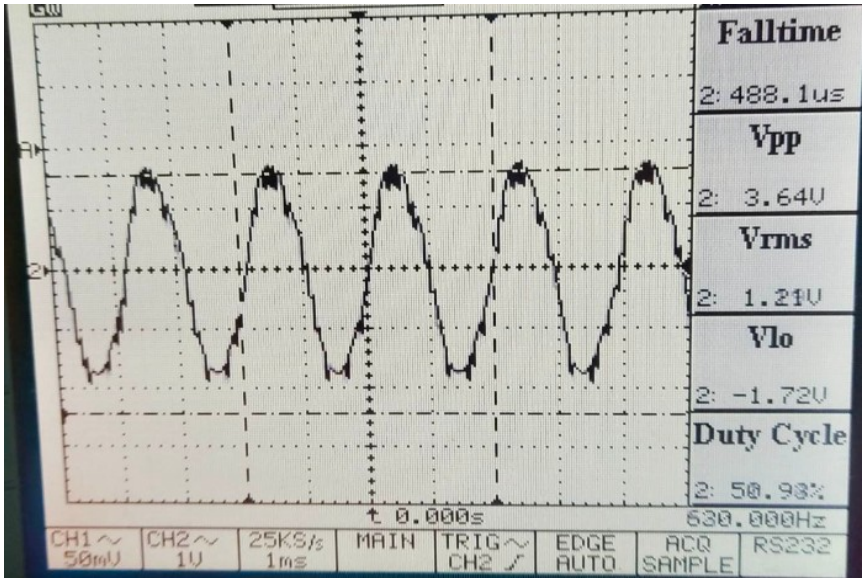


Figure 7.9 : Output waveshape

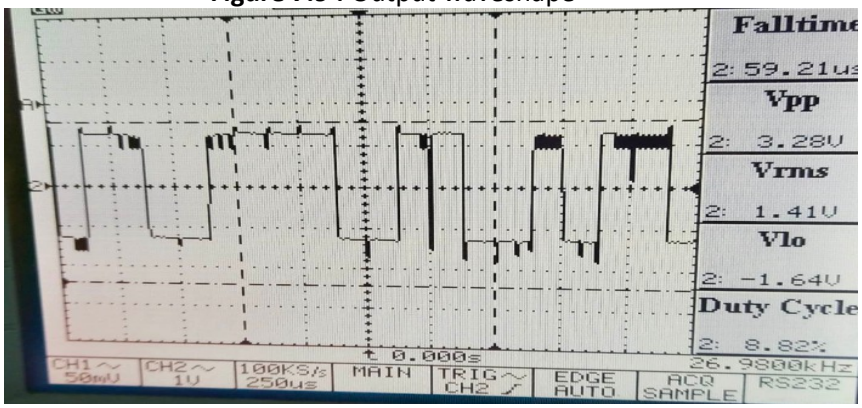


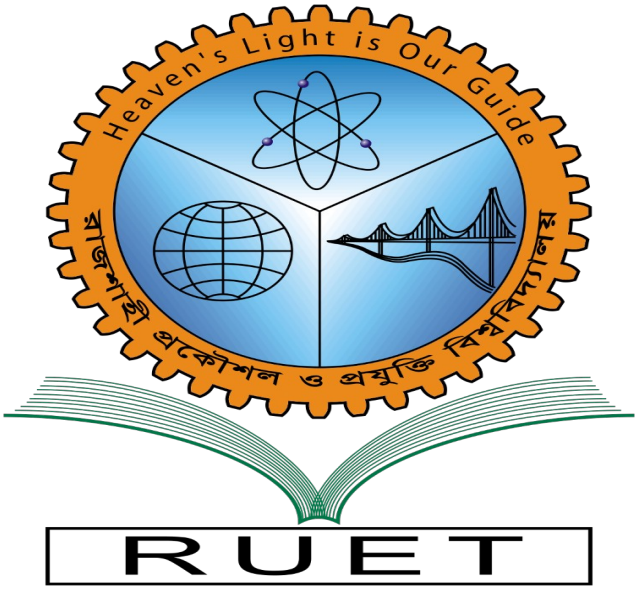
Figure 7.10: Output waveshape of PCM

Discussion :

Here in this experiment we give a message signal input to a low pass filter. Then it passes to a sampler then quantizer then to encoder. Then we demodulate the waveshape. Pulse Code Demodulation will be doing the same modulation process in reverse. By using a serial to parallel converter the series pulse wave signal will be converted into a parallel digital signal. After that the signal will pass through the n-bits decoder, it should be a Digital to Analog converter. Decoder recovers the original quantization values of the digital signal. This quantization value also includes a lot of high-frequency harmonics with original audio signals.

Conclusion :

The waveshape in the oscilloscope matches exactly with the theoritical concept. But the waveshape was not hundred percent clear. The reason behind it is the noise in the process.



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