The Hashemite University

Faculty of Engineering

Department of Electrical Engineering

Experiment Number (7)

"PCM Receiver"

Name	Student's No.
Moslem Naji Nayef Othman	1733045

Date: 29/4/2021

➢ Objectives:

1) Outline the principles of a PCM receiver.
2) Describe the action of a Digital to Analog Converter. . Explain how the inforn1ation signals are recovered by demultiplexing and demodulating.
3) Investigate the importance of system timing in a PCM receiver.

➢ Equipment's:

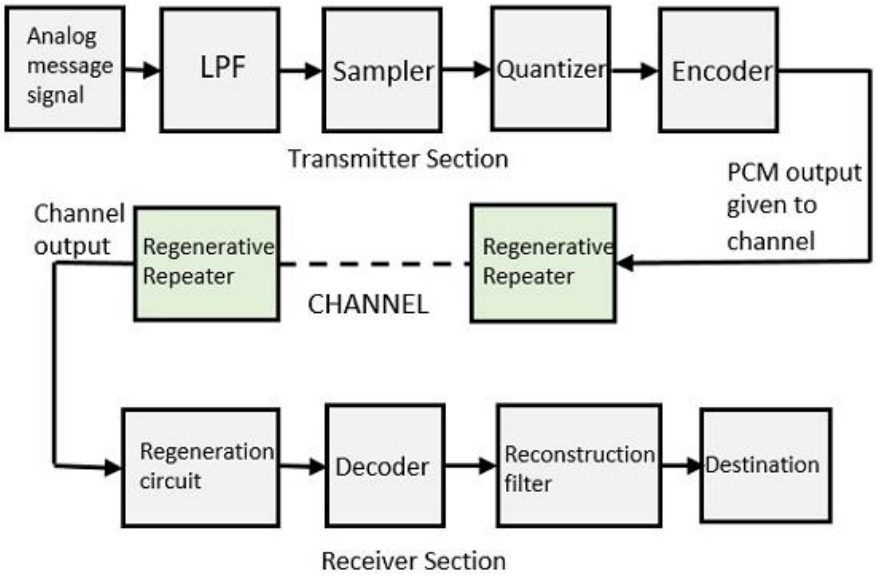
1) Trace Oscilloscope-Dual
2) DC Power Supply
3) MODICOM 3/1 Board
4) MODICOM 3/2 Board
5) DMM

➢ Theory:

Pulse Code 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.



Block Diagram of Pulse Code Modulation and Demodulation Process

Basic Elements of PCM Transmitter and Receiver:

- ✓ Low Pass Filter: This filter eliminates the high frequency components present in the input analog signal which is greater than the highest frequency of the message signal, to avoid aliasing of the message signal.
- ✓ Sampler: This is the technique which helps to collect the sample data at instantaneous values of message signal, so as to reconstruct the original signal. The sampling rate must be greater than twice the highest frequency component W of the message signal, in accordance with the sampling theorem.
- ✓ Quantizer: Quantizing is a process of reducing the excessive bits and confining the data. The sampled output when given to Quantizer, reduces the redundant bits and compresses the value.

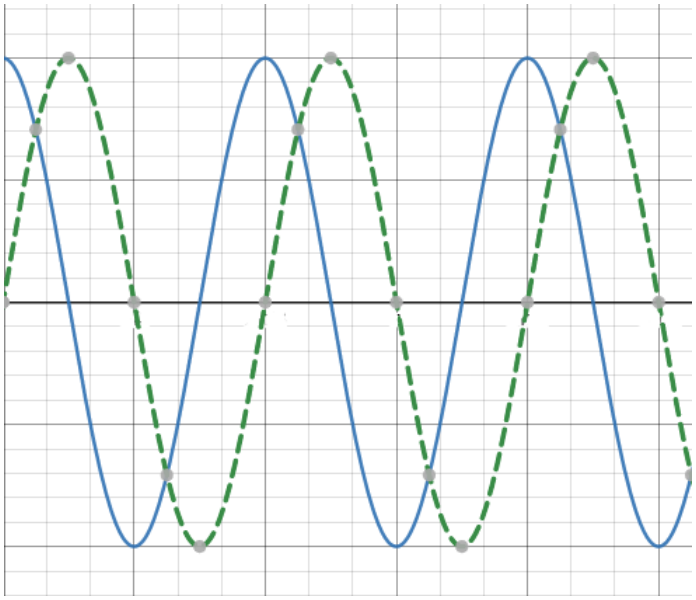
- ✓ Encoder: The digitization of analog signal is done by the encoder. It designates each quantized level by a binary code. The sampling done here is the sample-and-hold process. These three sections (LPF, Sampler, and Quantizer) will act as an analog to digital converter. Encoding minimizes the bandwidth used.
- ✓ Regenerative Repeater: This section increases the signal strength. The output of the channel also has one regenerative repeater circuit, to compensate the signal loss and reconstruct the signal, and also to increase its strength.
- ✓ Decoder: The decoder circuit decodes the pulse coded waveform to reproduce the original signal. This circuit acts as the demodulator.

- ✓ Reconstruction Filter:
  - After the digital-to-analog conversion is done by the regenerative circuit and the decoder, a low-pass filter is employed, called as the reconstruction filter to get back the original signal.
  - Hence, the Pulse Code Modulator circuit digitizes the given analog signal, codes it and samples it, and then transmits it in an analog form.
  - This whole process is repeated in a reverse pattern to obtain the original signal.

➢ Procedure:

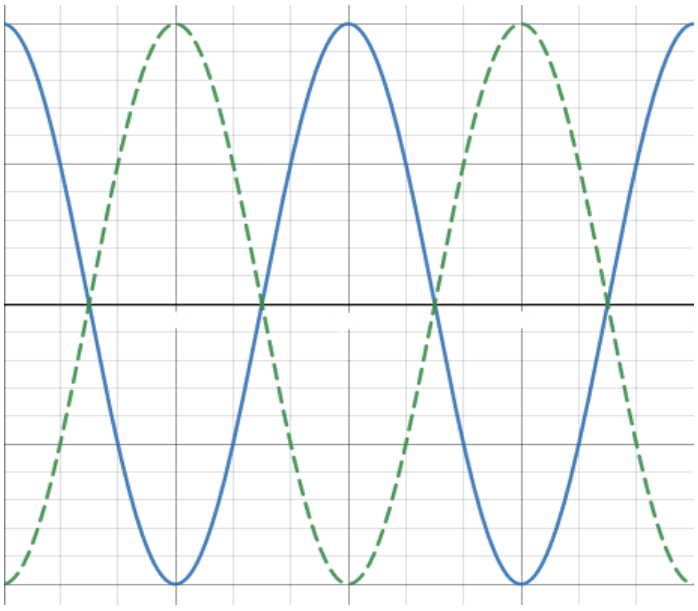
Part (1): Validation of Receiver Board Operation.

1) Investigation for the transmitted and the received signals for the 1KHz signal:



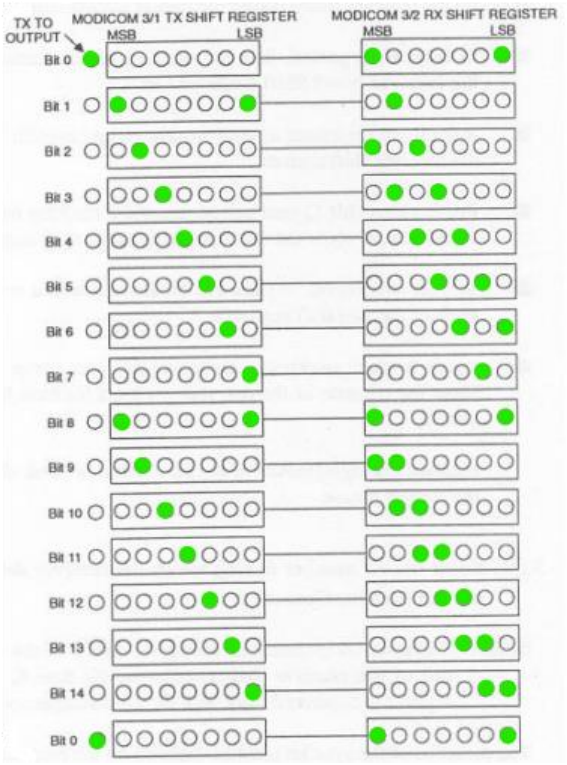
Tranmitted Signal. Received Signal.

2) Investigation for the transmitted and the received signals for the 2KHz signal:



Tranmitted Signal. Received Signal.

Part (2): Examination of Transmitter and Receiver Shift Registers.



Part (3): Digital to Analog Conversion.

Digital Code	Measured Voltage
1111111	+5
1110011	+4
1100110	+3
1011001	+2
1001101	+1
1000000	0
0110011	-1
0100110	-2
0011001	-3
0001100	-4
0000000	-5

➢ Conclusion:

1) There is phase shift (delay) the transmitted signal and the received signal and that phase shift is 90 degree for the 1KHz signal and 180 degree for the 2 KHz.
2) In the PCM receiver we have LPF since the message received have some noise and we want to get the original signal.
3) We can conclude from PCM that is increases the transmission bandwidth and the PCM system has more complexity than other systems.