The Hashemite University

Faculty of Engineering

Department of Electrical Engineering

Experiment Number (6)

“PCM Transmitter”

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Objectives:

1) Summarize the principles of a PAM system.
2) Describe how an analog signal can be converted to a serial transmission of digital pulses.
3) Describe the quantization process and the cause of quantization noise.
4) Explain the need for frame synchronization in a PCM ~ transmitter.

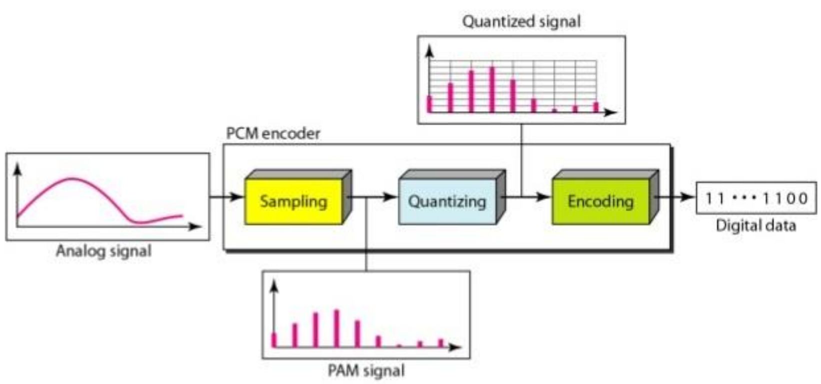
Equipment's:

1) Trace oscilloscope-Dual
2) DC power Supply
3) MODICOM 3/1 Board
4) DMM

Theory:

What is the PCM?

PCM (Pulse Code Modulation) is A digital technique that involves sampling an analog signal at regular intervals and coding the measured amplitude into a series of binary values, which are transmitted by modulation of a pulsed, or intermittent, carrier. It is the standard technique in telecommunications transmission.



Block Diagram of PCM

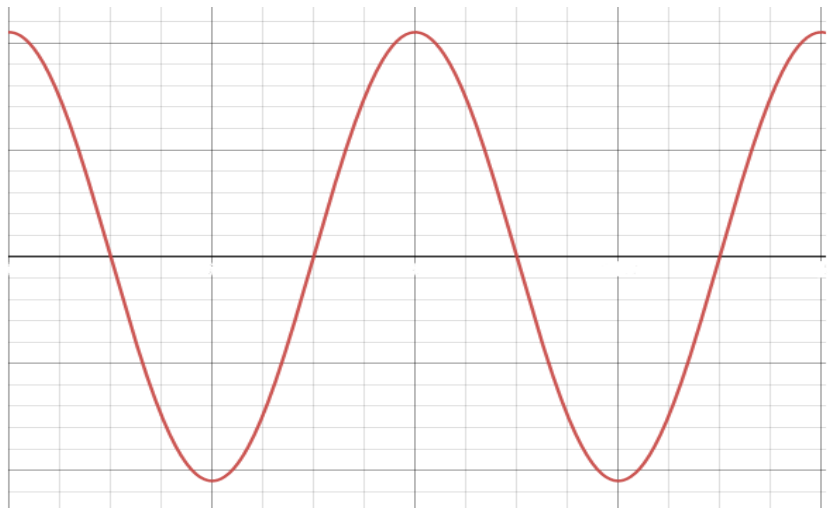
Basic Elements of PCM Transmitter:

- ✓ 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.

➢ Procedure:

Part (a): Investigation of Sampling.

1) Measure the frequency and amplitude with the oscilloscope, by placing a probe on test point 10 of MODICOM 3/1.

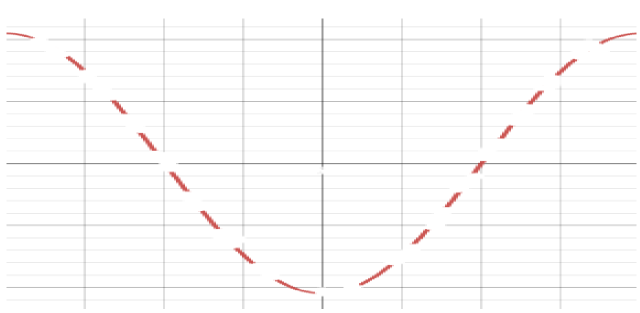


Freq.= 1KHz, Amp.=10.5V

2) Monitor TP5 on MODICOM 3/1 using the oscilloscope and measure the frequency. (This is the frequency at which the analog signal will be sampled).

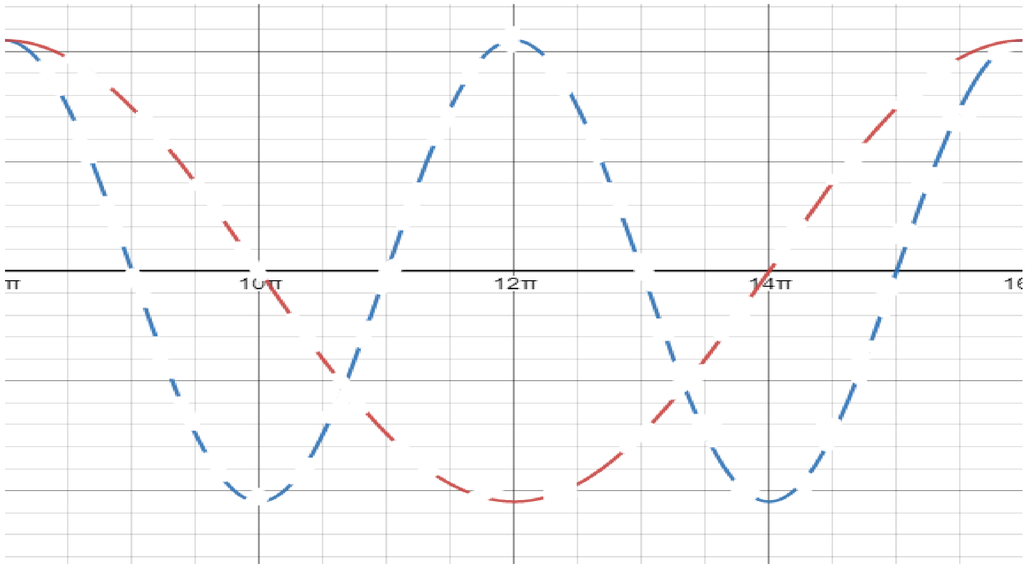
frequency signal is 16KHz.

3) Sketch the waveforms at tpl0 and tp15 (both on the same time scale).



Sampling Freq.=16KHz

Part (b): Investigation of Time Division Multiplexing.

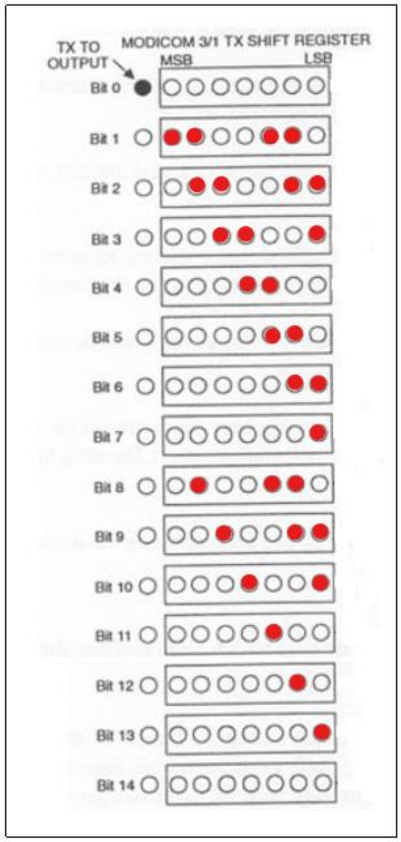


Part (c): Investigation of Quantization.

DC INPUT	D6	D5	D4	D3	D2	D1	D0
MAX	1	1	1	1	1	1	1
+5V	1	1	1	1	1	1	1
+4V	1	1	1	0	0	1	1
+3V	1	1	0	0	1	1	0
+2V	1	0	1	1	0	0	1
+1V	1	0	0	1	1	0	1
0V	1	0	0	0	0	0	0
-1V	0	1	1	0	0	1	0
-2V	0	1	0	0	1	1	0
-3V	0	0	1	1	0	0	1
-4V	0	0	0	1	1	0	0
-5V	0	0	0	0	0	0	0
-MAX	0	0	0	0	0	0	0

Part (d): Parallel to Serial Conversion.

After performing all the procedure, fill the following table:



Part (e): Timing Frame.

It is consist of 15 bits and the data appearing at the transmitter's in the middle of each transmitter clock cycle, is as follows:

Bit 0: The bit that is reserved from the Sync to the output.

Bit 1-7: These bits carry 7-bit data word, and it is representing channel 1.

Timeslot 0: It is the time interval during which the sample (Bit 1-7) is transmitted.

Bits 8-14: These bits carry another 7-bit data word, and it is representing channel 2.

Timeslot 1: It is the time interval during which the sample (Bit 8-14) is transmitted.

➢ Conclusion:

1) The phase shift between the two control signals is almost half of the time period.
2) We can send the bits to the receiver by using shift right register.
3) PCM have efficient SNR and bandwidth trade off and It provides secure data transmission.
4) In PCM we need large bandwidth is required for transmission.