German Jordanian University

Department of Communication Engineering

Digital Communication Systems Lab

CME 313-Lab

Experiment 2

Pulse Modulation

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Experiment 1Experiment 2

Sampling and Pulse Modulation

Objectives:

By the end of this experiment, the student should be able to:

1. Implement a simple system of PWM and PPM.

Introduction

Pulse Modulation:

We can conclude that, instead of transmitting the complete signal in analog form we need to transmit only a discrete number of samples. In pulse modulation, these discrete samples are used to vary a parameter of a pulse waveform; we may vary the amplitude, width or position of pulses in proportion to the sample values of the signal.

Accordingly we have three types of pulse modulation, which are:

1- Pulse Amplitude Modulation (PAM).
2- Pulse Width Modulation (PWM) or Pulse-Duration Modulation (PDM).
3- Pulse Position Modulation (PPM).

Pulse Amplitude Modulation

Pulse amplitude modulation is used in sampling process.In the pulse amplitude modulation, the message signal is sampled at regular periodic or time intervals and this each sample is made proportional to the magnitude of the message signal. These sample pulses can be transmitted directly using wired media or we can use a carrier signal for transmitting through wireless

Pulse Width Modulation

If the widths of the pulses are varying in accordance with the modulating signal it is called pulse width modulation. In Pulse width modulation, the amplitude of the pulses is constant. Generation of PWM the input modulating signal is given to non - inverting terminal of op-amp .the op-amp now compares with both the input signals. The output of the comparator is high only when instantaneous value of input modulating signal is grater then that of saw tooth waveform. When sawtooth waveform voltage is grater then input modulating signal at that instant the output of the comparator remains zero i.e. in negative saturation. Thus output of comparator is PWM signal.

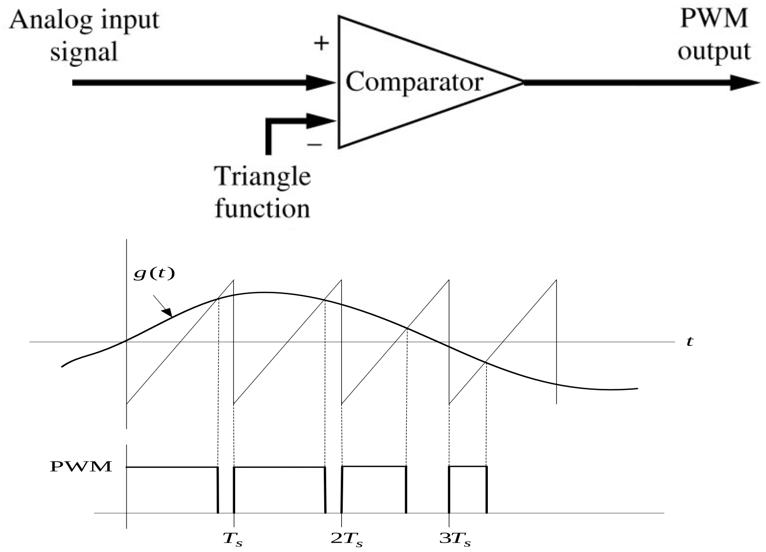

Figure1. PWM Generation.

Pulse Position Modulation:

In PPM the amplitude and width of the pulse is kept constant inthe system. The position of each pulseis variedby each instantaneous sampled value of the modulating wave. PPM has the advantage of requiringconstant transmitter power since the pulses are of constant amplitude and duration. PPM may be obtained from PWM, in which the position of PWM pulses are position modulated. Thus these pulses will have time displacement proportional to the instantaneous value of the signal voltage.Figure7. shows how PPM can be generated from PWM with trailing-edge modulation. The width-modulation pulses are inverted and differentiated, changing the modulated edge into position-modulated positive spikes. With a little reshaping these spikes become the desired PPM.

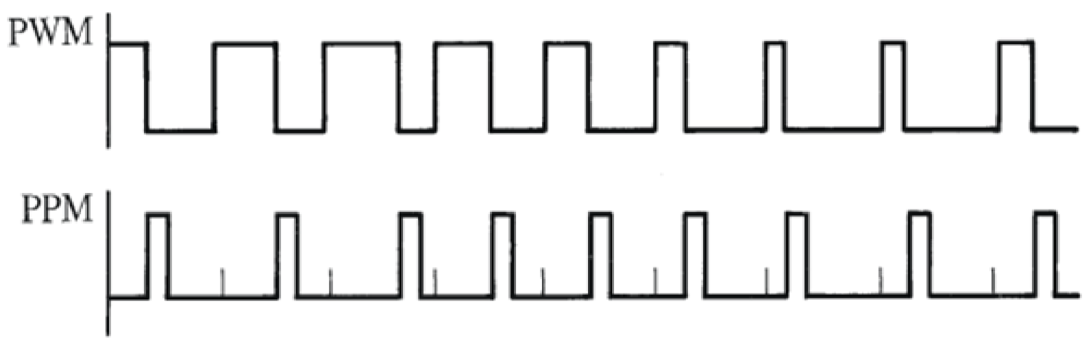

Figure.2 PWM and PPM Waveforms

The following figure contains summary of pulse modulation types:

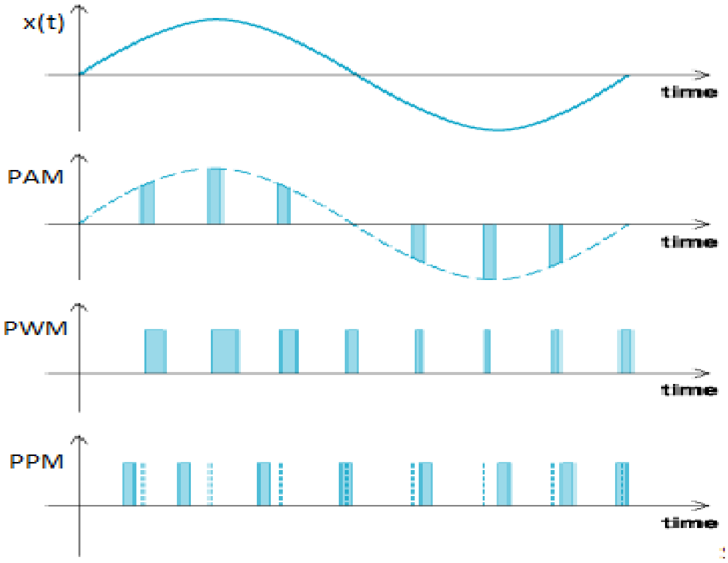

Figure3. Pulse modulation types

Lab Work

Modules

The following plug in modules are needed for this experiment:
Audio Oscillator, TPG, Dual Analog switch, Tunable LPF, Adder, Utilities.

Part I: Pulse-Width Modulation

1. Construct the TIMS model of the sampler and reconstruction filter as shown in below **Figure 4.**

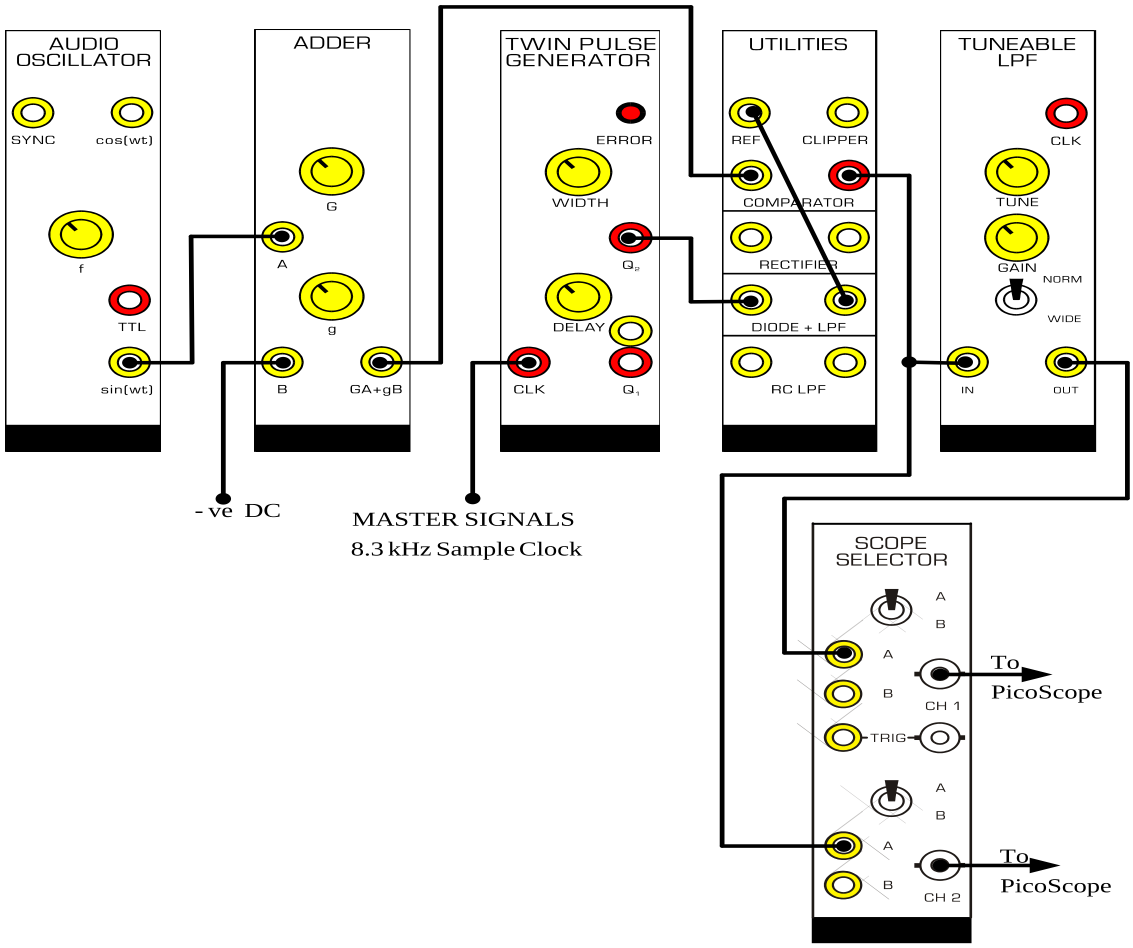

Figure4. The TIMS model of **PWM**

2. Set the VARIABLE DC to deliver -1.5 V.
3. Set the frequency of Audio Oscillator to 300 HZ.
4. Set the amplitude of the information signal from 5 volts by changing the gains **"G"**
5. Set the WIDTH and DELAY of TWIN PULSE GENERATOR at the middle position, and set on-board SW1 to TWIN mode.

- **Save the signal at the output of the COMPARATOR.**
- **What type of signal you can see at the output of the COMPARATOR?**

6. Increase and decrease the level of the DC voltage.

- **What effect has the DC voltage at the output of the COMPARATOR? Explain your answer in details.**

7. Reset the DC voltage to -1.5V.

- **What signal you have at the output of the TUNEABLE LPF? What do you conclude from this signal?**

Part II: Pulse-Position Modulation

1. Construct the TIMS model of the sampler and reconstruction filter as shown in below **Figure 5.**

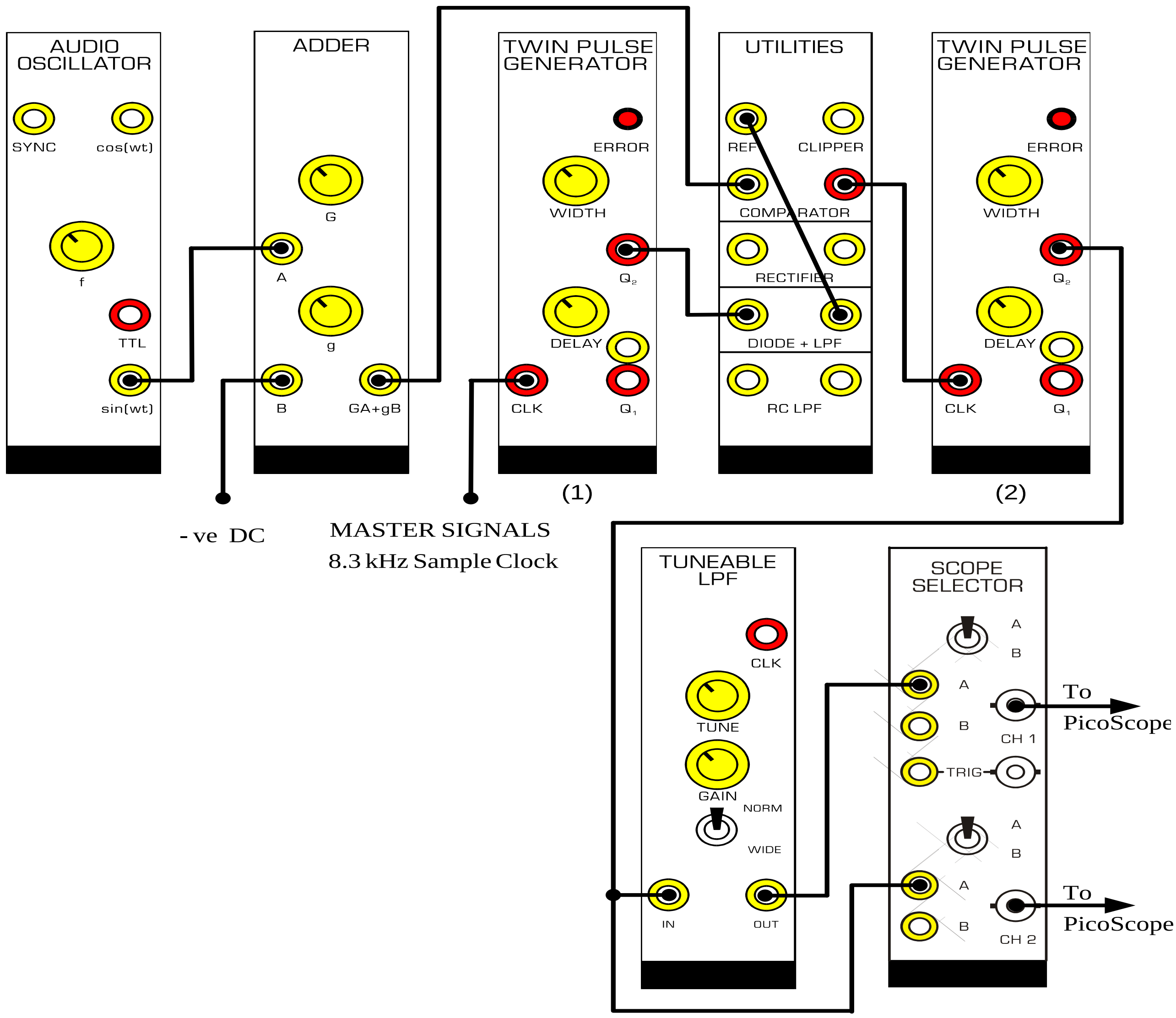

Figure.5. The TIMS model of **PPM**

2. Set WIDTH and DELAY of the second TWIN PULSE GENERATOR in middle.

- **Save and print the signal at the output of the second TWIN PULSE GENERATOR.**
- **What type of signal you get at step 3?**

3. Increase and decrease the level of the DC voltage.

- **What effect has the DC voltage at the above signal? Explain your answer in details.**

4. Rest the DC voltage to -1.5V.

- **What signal you have at the output of LPF? What do you conclude from this signal?**