PulsAmplitudeMod_PAM -- Overview

Dr. Alex Noel Joseph Raj
Professor Embedded Division

Ms. Vijayalakshmi GV
Research Scholar

School of Electronics (SENSE)
Vellore Institute of Technology (VIT), Vellore, Tamilnadu (India)

Objectives:

At the end of performing this experiment, learners would be able to:

- Describe the concept of Pulse Amplitude Modulation
- Understand the working of PAM under different sampling conditions
- Identify the concept of envelope detection
- Demodulate the PAM signal

Equipment:

- Transistor SL100
- Signal generator
- Resistors
- Capacitor
- Digital Storage Oscilloscope & probes
- Connecting wires & Bread Board

Theory:

- Pulse Amplitude Modulation is a form of signal modulation where the message information is encoded in the amplitude of a series of signal pulses. The output is a series of pulses, the amplitude of which vary in proportion to the modulating signal. The samples are taken at regular interval of time.

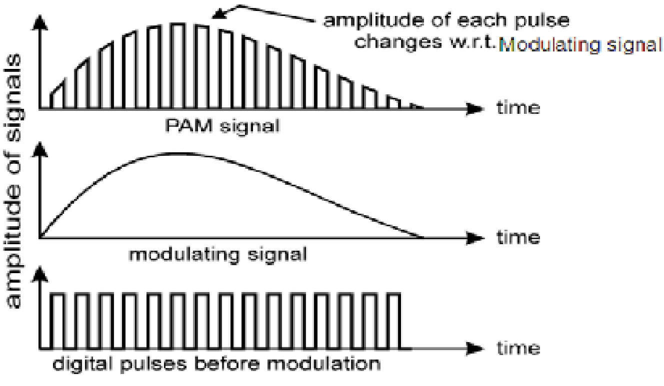


Figure (1): Pulse Amplitude Modulation

- Demodulation is performed by detecting the amplitude level of the carrier at every symbol period. If enough samples are taken, a reasonable approximation of the signal being sampled can be constructed at the receiving end.

Design:

Given the specifications

- Ic = ------ mA,
- hfe = -------,
- VCE sat = ------V,
- VBE sat = ------V and
- fm = ----------Hz

Design the biasing circuit

- To find Rc
  - Vm(t) = Ic x Rc + VCE sat   Where Vm(t) = Amplitude of the modulating signal

$$Rc = \frac{Vm(t) + DC\ shift - V_{CE\ sat}}{Ic}$$

- To find R_B

$$Vc(t) = I_B \times R_B + V_{BE\ sat}$$

Vc(t) = Amplitude of the carrier signal,

$$R_B = \frac{Vc(t) - V_{BE\ sat}}{I_B}$$

where $I_B = Ic/\ hfe$

- To design Filter/ envelope detector
  - Cut off frequency of the filter fo >> fm, choose fo = ------- Hz

    where   fo = 1/ 2πRC
  - Assume C = ------μF   and
  - find R , which is given by R = 1/ 2πfoC

Reference reading:

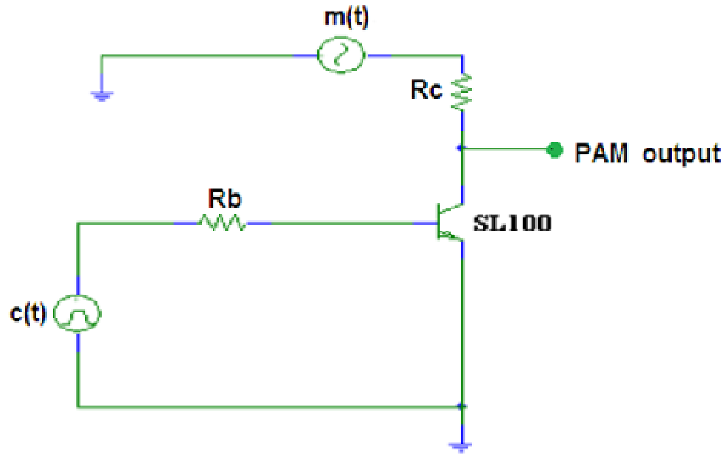
• Introduction to Analog and Digital Communication by Simon Haykin, 2e, Wiley.

PulsAmplitudeMod_PAM -- Procedures

Step 1

Circuit setup:

Build the following circuit to obtain the PAM signal



Circuit diagram of modulator

Step 2

Use a signal generator to generate:

- A sine wave modulating signal m(t) of
  - frequency fm (t) = 100 Hz and
  - amplitude Vm(t) = 5V(peak to peak) and a 3V DC Shift
- Square wave carrier signal c(t) of
  - frequency fc (t) = 5K Hz with
  - amplitude Vc(t) = 2V(peak to peak)

Step 3

- Apply the modulating signal m(t) and the carrier signal c(t) to the circuit as shown in Step1

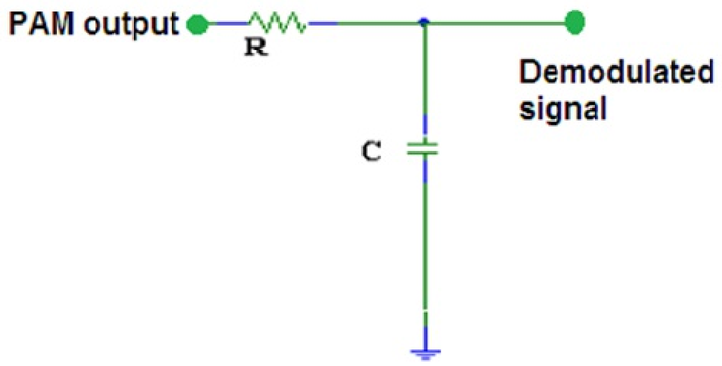
Step 4

- Connect the DSO probe – CH1 to the modulating signal and CH2 to the output and observe the PAM signal (variation in the amplitude of carrier wave with respect to the modulating signal).
- Take screenshot

Step 5

Circuit setup:

Build the demodulator circuit with the designed values



Step 6

- Apply the PAM output as input to the Demodulator circuit
- Connect the DSO probe – CH1 to the modulating signal and CH2 to the output of the demodulator circuit and observe the demodulated signal (take screenshot)

Step 7

- Repeat the Steps from 2 through 7 for
  - fc = 2fm
  - fc < 2fm
  - fc > 2fm

Step 8

Open-ended Question / Can you answer this?

What will be the result if:
1) We change the transistor to SK100?
2) We connect a diode(forward or reverse biased) before resistor in series with it in the demodulator circuit ?