EXPERIMENT NO-7

PULSE WIDTH MODULATION & DEMODULATION

1. To study of Pulse Width Modulation (PWM) and Demodulation Techniques.

AIM: To Study of Pulse Width Modulation & demodulation

APPARATUS:

1. PWM trainer kit
2. C.R.O(30MHz)
3. Patch Chords.
4. PC with windows(95/98/XP/NT/2000)
5. MATLAB Software with communication toolbox

THEORY:-

Pulse modulation is used to transmit analog information. In this system continuous wave forms are sampled at regular intervals. Information regarding the signal is transmitted only at the sampling times together with synchronizing signals.

At the receiving end, the original waveforms may be reconstituted from the information regarding the samples.

The pulse Width Modulation of the PTM is also called as the Pulse Duration Modulation (PDM) & less often Pulse length Modulation (PLM).

In pulse Width Modulation method, we have fixed and starting time of each pulse, but the width of each pulse is made proportional to the amplitude of the signal at that instant.

This method converts amplitude varying message signal into a square wave with constant amplitude and frequency, but which changes duty cycle to correspond to the strength of the message signal.

Pulse-Width modulation has the disadvantage, that its pulses are of varying width and therefore of varying power content. This means that the transmitter must be powerful enough to handle the maximum-width pulses. But PWM still works if synchronization between transmitter and receiver fails, whereas pulse-position modulation does not.

Pulse-Width modulation may be generated by applying trigger pulses to control the starting time of pulses from a mono stable multivibrator, and feeding in the signal to be sampled to control the duration of these pulses.

When the PWM signals arrive at its destination, the recovery circuit used to decode the original signal is a sample integrator (LPF).

CIRCUIT DESCRIPTION:-

Pulse & Modulating Signal Generator:-

A 4.096MHz clock is used to derive the modulating signal, which is generated by an oscillator circuit comprising a 4.096MHz crystal and three 74HC04(U9) inverter gates. This 4.096MHz clock is then divided down in frequency by a factor of 4096, by binary counter 74HC4040(U2), to produce 50% duty cycle, 1KHz square wave on pin no.1 of U4, and 2KHz square wave on pin no.15. the frequency is selectable by means of SW1. This goes to input of fourth order low pass filter U3 is used to produce sine wave from the square wave. The amplitude of this sine wave can be varied.

The square wave which is generated by the oscillator is buffered by inverter 74HC04, to produce 32KHz square wave at pin no.4 of the 74HC4040(U2). This pulse is given to the monostable multi to obtain the 16KHz and 32KHz square wave at the output which are selected by the frequency pot.

Modulation:-

The PWM circuit uses the 555 IC (U1) in monostable mode. The Modulating signal input is applied to pin no.5 of 555IC, and there Pulse input is applied to pin no.2.

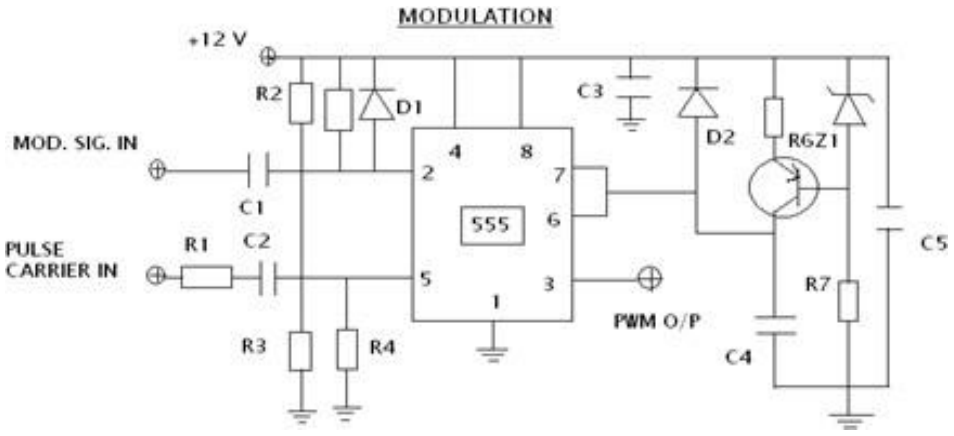
The output of PWM is taken at the pin no.3 of 555IC i.e., TP3.

Demodulation:-

The demodulation section comprises of a fourth order low pass filter and an AC amplifier. The TL074(U5) is used as a low pass filter and an AC amplifier. The output of the modulator is given as the input to the low pass filter.

The low pass filter output is obviously less and it is feed to the AC amplifier which comprises of a single op amp and whose output is amplified.

CIRCUIT DIAGRAM:



PROCEDURE:

Modulation:-

1. Connect the circuit as shown in the diagram 1.
    a. The output of the modulating signal generator is connected to the modulating signal input TP2 keeping the frequency switch in 1KHz position, and amplitude knob to max position
    b. 16KHz pulse output (by varying the frequency pot (put it min position) in pulse generator block) from pulse generator to pulse input(TP1).
2. Switch ON the power supply.
3. Observe the output of pulse width modulation block at TP3.(By varying the amplitude pot).
4. Vary the modulating signal generator frequency by switching the frequency selector switch to 2 KHz.
5. Now, again observe the PWM output at TP3.(By varying the amplitude pot).
6. Repeat the above steps (3 to 5) for the pulse frequency of 32KHz(by varying the frequency pot(put it in max position) in pulse generator block).
7. Switch OFF the power supply.

Demodulation:-

8. Connect the circuit as shown in diagram 2.

a. The output of the modulating signal generator is connected to the modulating signal input TP2 keeping the frequency switch in 1KHz position, and amplitude knob to max

position.

b. 16KHz pulse output (put frequency pot minimum) from pulse generator block to pulse input TP1.

c. PWM output to LPF input.

d. LPF output to AC amplifier input.

9. Switch ON the power supply.

10. Observe the output of low pass filter and AC amplifier respectively at TP6 & TP8. The output will be the true replica of the input.

11. Now vary the position of the switch in modulating signal generator to 2 KHz and observe the outputs at TP6 & TP8.

12. Repeat the steps 10& 11 for pulse frequency 32 KHz (By varying the frequency pot (put in max). in pulse generator block). Observe the output waveforms.

13. Switch OFF the power supply.

EXPECTED WAVEFORMS

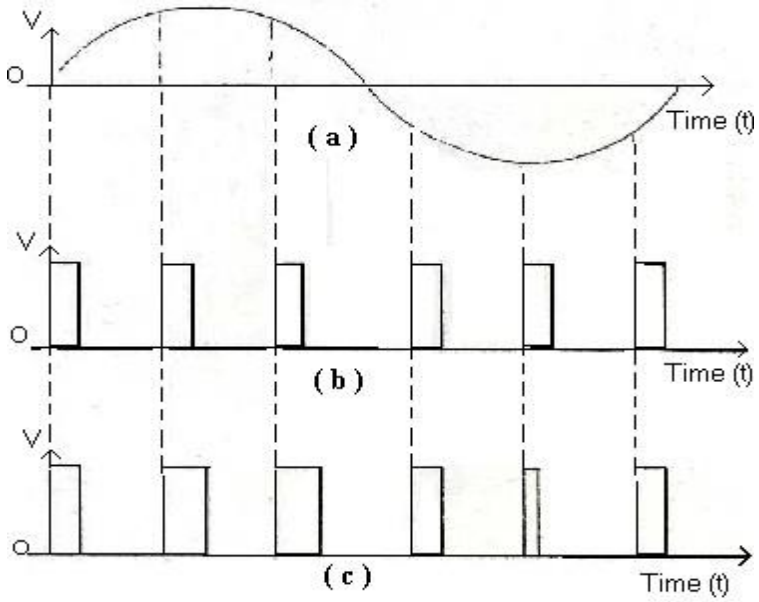


Fig (2) PULSE WIDTH MODULATION
(a) Signal
(b) Unmodulated pulses
(c) PWM

RESULT:

QUESTIONS

1. An audio signal consists of frequencies in the range of 100Hz to 5.5KHz.What is the

minimum frequency at which it should be sampled in order to transmit it through pulse modulation?

2. Draw a TDM signal which is handling three different signals using PWM?

3. What do you infer from the frequency spectrum of a PWM signal?

4. Clock frequency in a PWM system is 2.5 kHz and modulating signal frequency is 500Hzhowmany pulses per cycle of signal occur in PWM output? Draw the PWM signal?

5. Why should the curve for pulse width Vs modulating voltage be linear?

6. What is the other name for PWM?

7. What is the disadvantage of PWM?

8. Will PWM work if the synchronization between Tx and Rx fails?

9. Why integrator is required in demodulation of PWM?

10. What kind of conversion is done in PWM generation?