Experiment No-1

AIM: Modulation various signals using AM on the trainer kit and observe waveforms.

APPARATUS REQUIRED:

S.NO	Name of the Equipment/ Component	Range	Quantity
1	AM/FM Transmitter kit - ACL 01/ACL-03	-	1
2	AM/FM Receiver kit - ACL 01/ACL-04	-	1
3	CRO	30MHz	1
4	Power supply	5V, ±12V	1
5	Patch chords	-	required

THEORY:

AMPLITUDE MODULATION THEORY: Modulation is defined as the process by which some characteristics of a carrier signal is varied in accordance with a modulating signal. The base band signal is referred to as the modulating signal and the output of the modulation process is called as the modulation signal.

The carrier frequency fc must be much greater than the highest frequency components f_m of the message signal m (t) i.e. $f_c >> f_m$.

The modulation index must be less than unity. If the modulation index is greater than unity, the carrier wave becomes over modulated. The modulating, carrier and modulated signals are given by

$$V_m(t) = V_m \sin\omega_m t \ ;$$

$$VC(t) = V_C \sin\omega_C t \ ;$$

$$V_{AM}(t) = V_C\ (1+m_a \sin\omega_m t) \sin\omega_C t$$

The modulation index is given by,

$$m_a = V_m / V_C.$$

$$Vm = Vmax – V_{min} \text{ and } V_C = Vmax + Vmin$$

The amplitude of the modulated signal is given by,

Where, Vm = maximum amplitude of modulating signal,

V_C = maximum amplitude of carrier signal,

Vmax = maximum variation of AM signal,

Vmin = minimum variation of AM signal

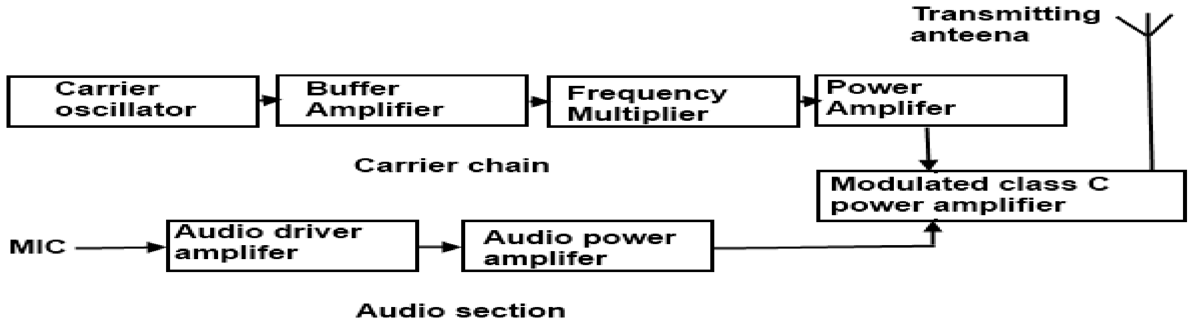


Figure (a) Block diagram of high level AM transmitter

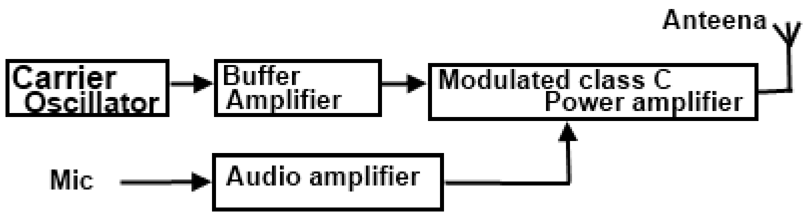
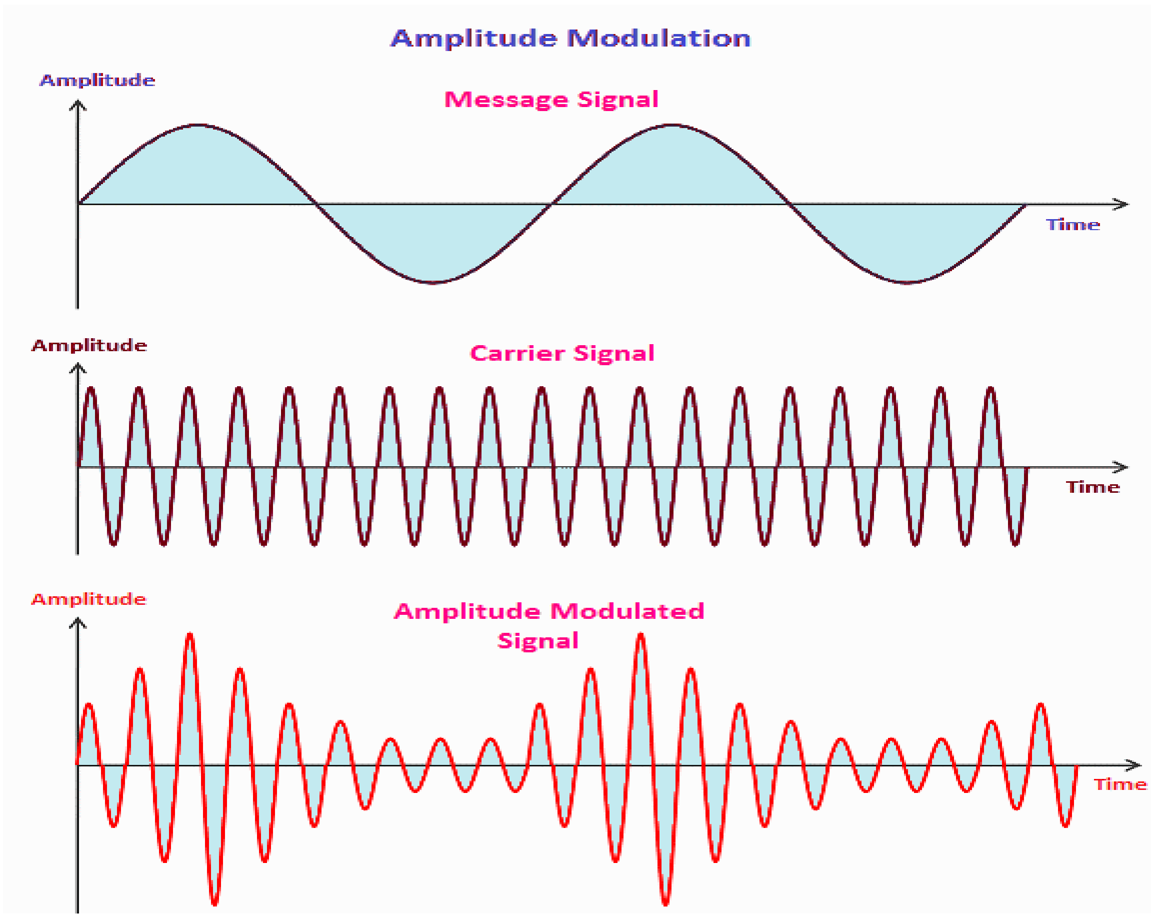


Figure (b) Block diagram of Low-level AM transmitter

GRAPH:



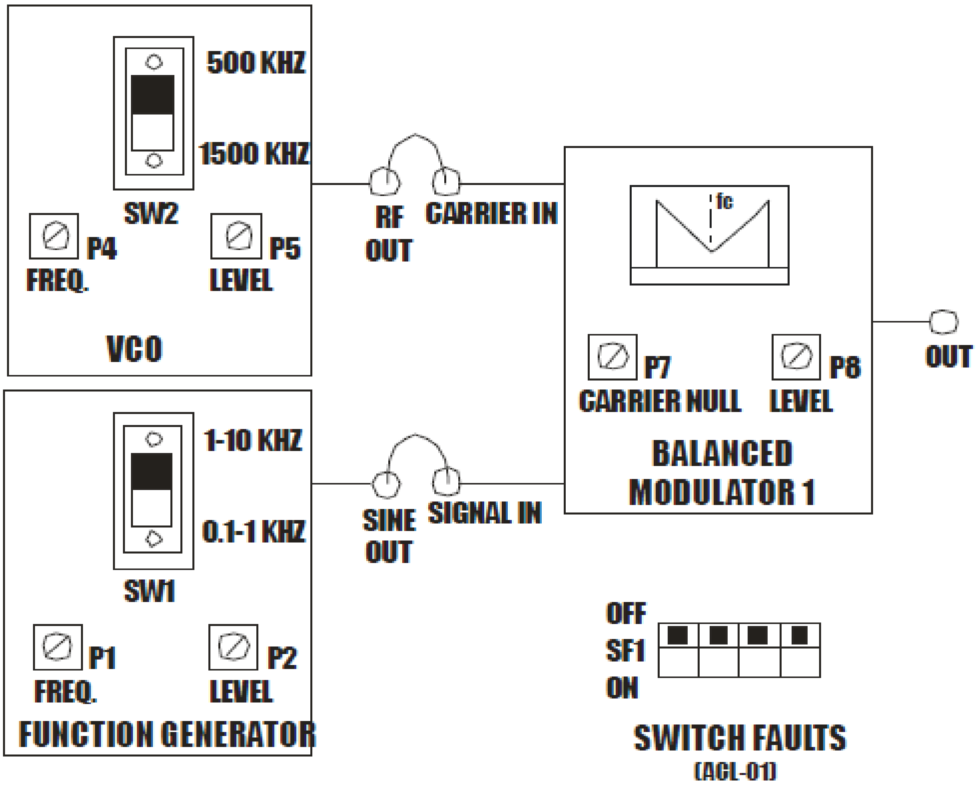


Figure: Block Diagram for AM Modulation

TABULATION:

AMPLITUDE MODULATION:

Parameter	Amplitude (V)	Time Period in seconds	Frequency in Hz
Message signal			
Carrier signal			
Modulated signal			

PROCEDURE:

AMPLITUDE MODULATION:

1. The circuit wiring is done as shown in diagram.

2. A modulating signal input given to the Amplitude modulator.

3. Now increase the amplitude of the modulating signal to the required level.

4. The amplitude and the time duration of the modulating signal are observed using CRO.

5. Finally the amplitude modulated output is observed from the output of amplitude modulator stage and the amplitude and time duration of the AM wave are noted down.

6. Calculate the modulation index by using the formula and verify them.

RESULT:

Experiment No-2

AIM: Modulation various signals using FM on the trainer kit and observe waveforms.

APPARATUS REQUIRED:

S.NO	Name of the Equipment/ Component	Range	Quantity
1	AM/FM Transmitter kit - ACL 01/ACL-03	-	1
2	AM/FM Receiver kit - ACL 01/ACL-04	-	1
3	CRO	30MHz	1
4	Power supply	5V, ±12V	1
5	Patch chords	-	required

FREQUENCY MODULATION THEORY:

Frequency modulation is a type of modulation in which the frequency of the high frequency (carrier) is varied in accordance with the instantaneous value of the modulating signal.

FREQUENCY MODULATION GENERATION: The circuits used to generate a frequency modulation must vary the frequency of a high frequency signal (carrier) as function of the amplitude of a low frequency signal (modulating signal). In practice there are two main methods used to generate FM.

DIRECT METHOD An oscilloscope is used in which the reactance of one of the elements of the resonant circuit depends on the modulating voltage. The most common device with variable reactance is the Varactor or Varicap, which is a particular diode which capacity varies as function of the reverse bias voltage. The frequency of the carrier is established with AFC circuits (Automated frequency control) or PLL (Phase locked loop).

INDIRECT METHOD: The FM is obtained in this case by a phase modulation, after the modulating signal has been integrated. In this phase modulator the carrier can be generated by a quartz oscillator, and so its frequency stabilization is easier. In the circuit used for the exercise, the frequency modulation is generated by a Hartley oscillator, which frequency is determined by a fixed inductance and by capacity (variable) supplied by varicap diodes.

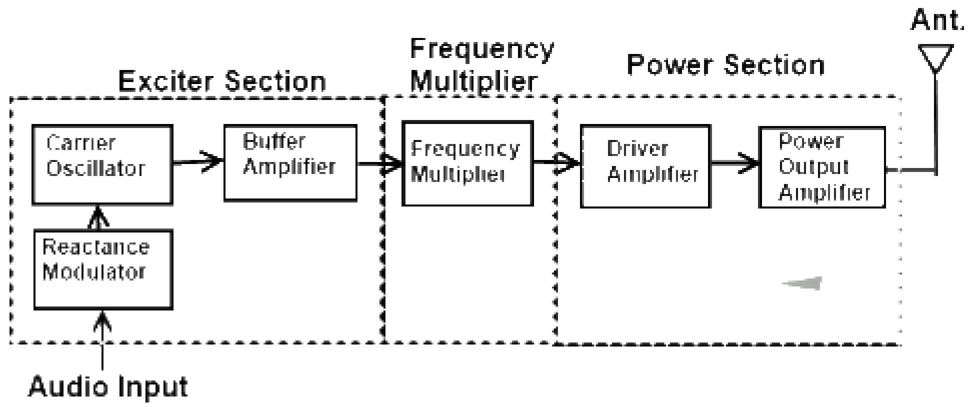
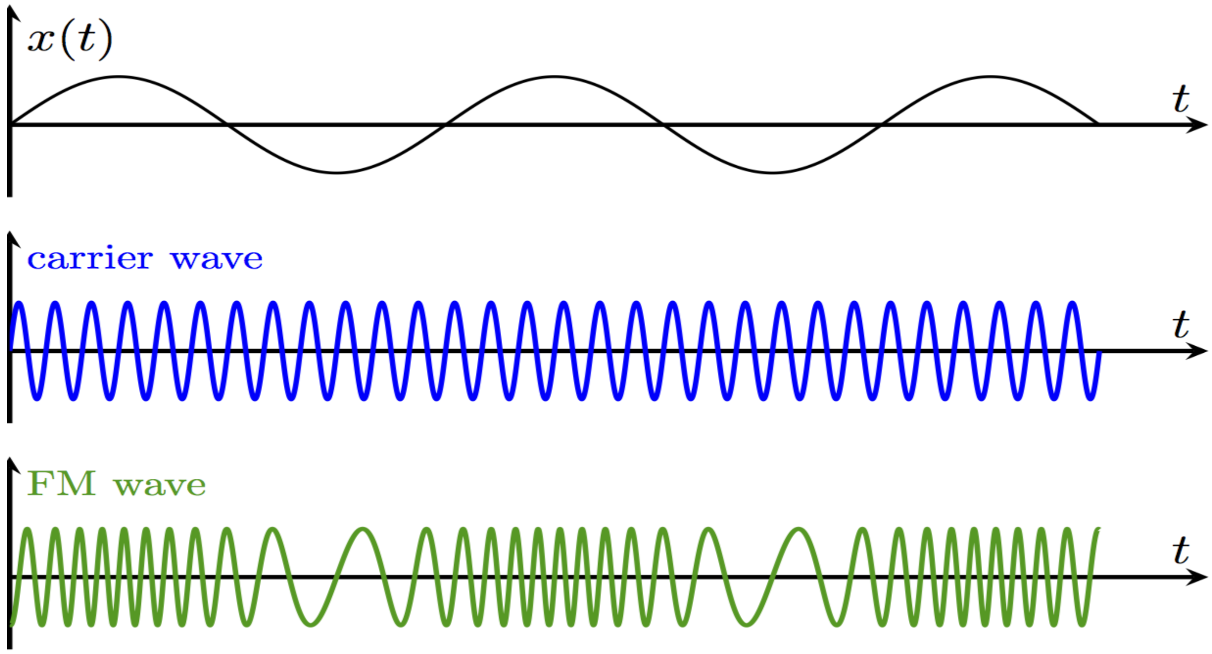


Figure: Block Diagram of FM.



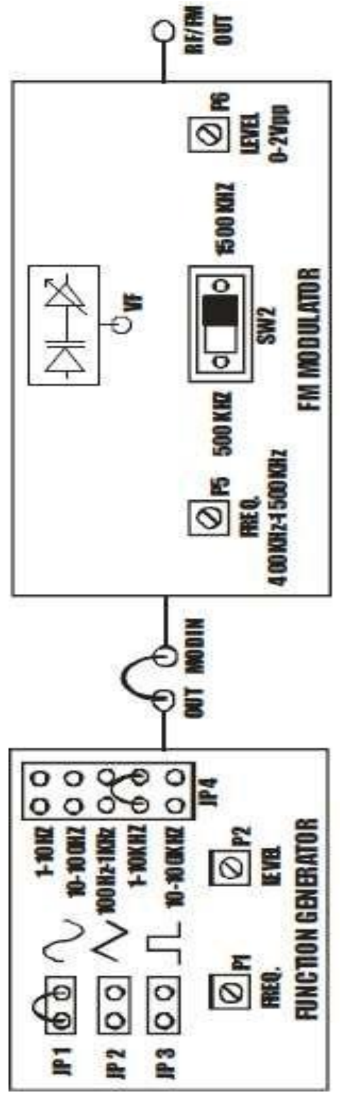


Figure: Block Diagram for FM modulation

TABULATION:

FREQUENCY MODULATION:

Parameter	Amplitude (V)	Time Period in seconds	Frequency in Hz
Message signal			
Carrier signal			
Modulated signal			

PROCEDURE:

FREQUENCY MODULATION:

1.Connect the power supply with proper polarity to the kit. While connecting this ensures that the Power supply is OFF.

2. Switch on the power supply and carry out the following pre-setting as shown in-circuit Diagram.

3. In the FM modulator set the level about 2Vpp and frequency knob to the minimum and switch on 1500 KHz.

RESULTS:

Experiment No-3

AIM: Demodulation various signals using AM on the trainer kit and observe waveforms.

APPARATUS REQUIRED:

- Modules ACL-AD.
- Power supply.
- 20MHz Oscilloscope.
- Connecting Links.
- Frequency counter.

DEMODULATION THEORY: Demodulation is the reverse process of modulation. The detector circuit is employed to separate the carrier wave and eliminate the side bands. Since the envelope of an AM wave has the same shape as the message, independent of the carrier frequency and phase, demodulation can be accomplished by extracting envelope. The depth of modulation at the detector output greater than unity and circuit impedance is less than circuit load ($R_l > Z_m$) results in clipping of negative peaks of modulating signal. It is called "negative clipping ".

TABULATION:

AMPLITUDE DEMODULATION:

Parameter	Amplitude (V)	Time Period in seconds	Frequency in Hz
Message signal			
Carrier signal			
Modulated signal			
Demodulation signal			

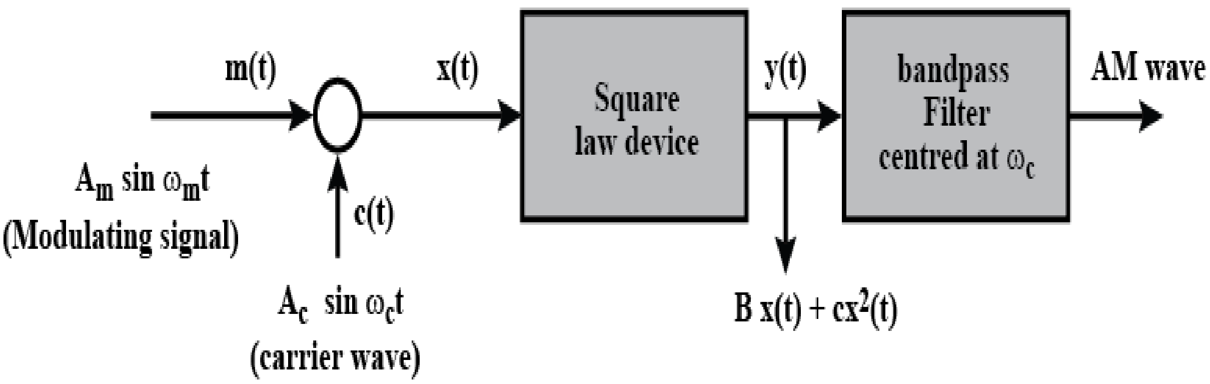
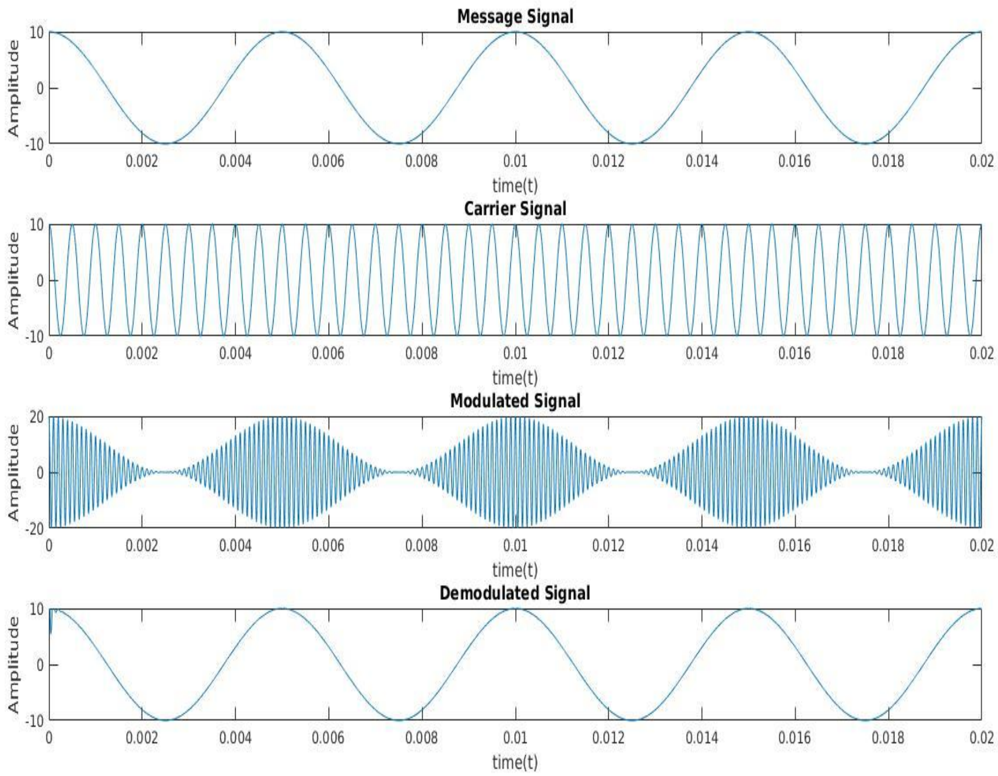


Figure: Block Diagram of AM.



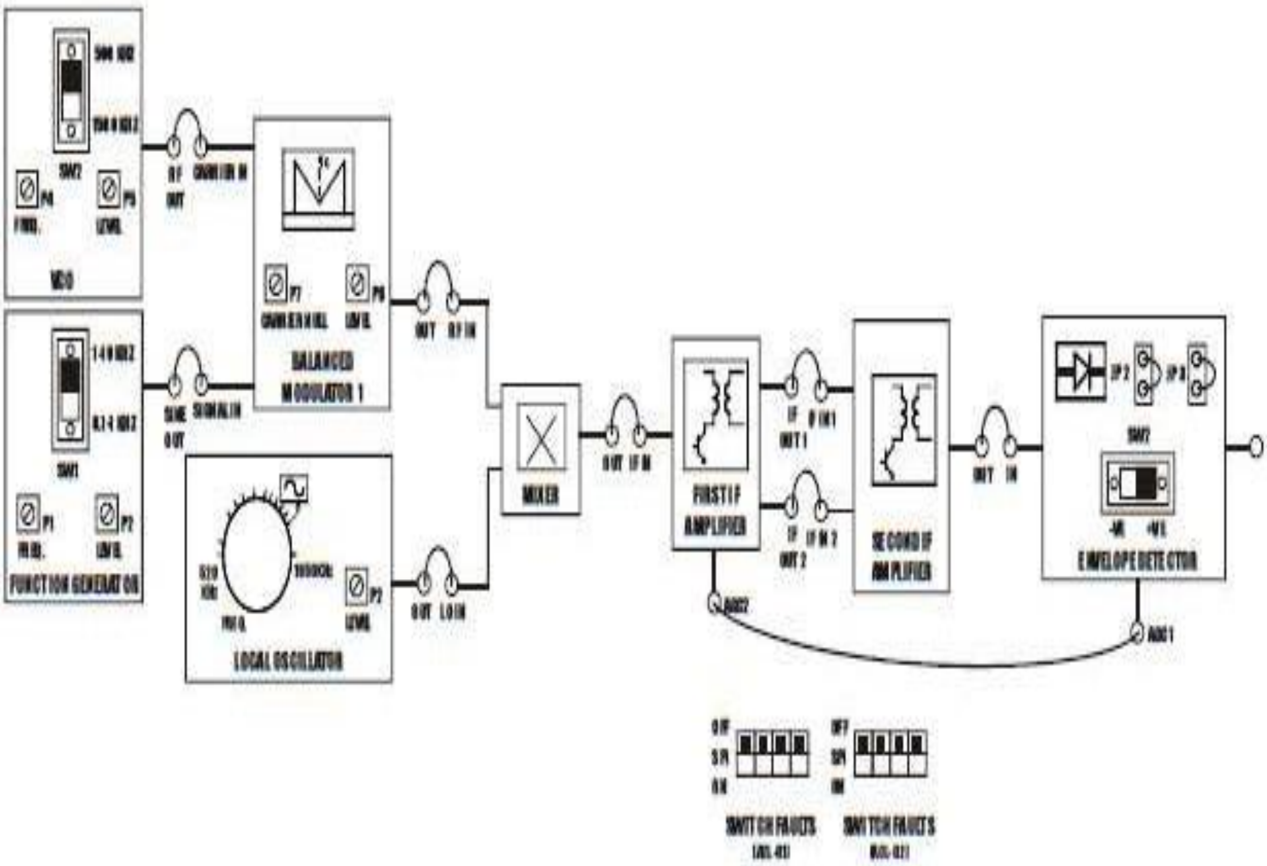


Figure: Block Diagram for AM Demodulation

PROCEDURE:

1. The circuit wiring is done as shown in diagram

2. A modulating signal input given to the Amplitude modulator

3. Now increase the amplitude of the modulating signal to the required level.

4. The amplitude and the time duration of the modulating signal are observed using CRO.

5. Finally the amplitude modulated output is observed from the output of amplitude modulator stage and the amplitude and time duration of the AM wave are noted down.

6. The final demodulated signal is viewed using CRO at the output of audio power amplifier stage. Also, the amplitude and time duration of the demodulated wave are noted down.

RESULT:

Experiment No-4

AIM: Demodulation various signals using FM on the trainer kit and observe waveforms.

APPARATUS REQUIRED:

- ACL-FD Kits.
- Power supply.
- Oscilloscope.
- Volt meter.
- Frequency meter.
- Connecting Links.

FREQUENCY MODULATION THEORY:

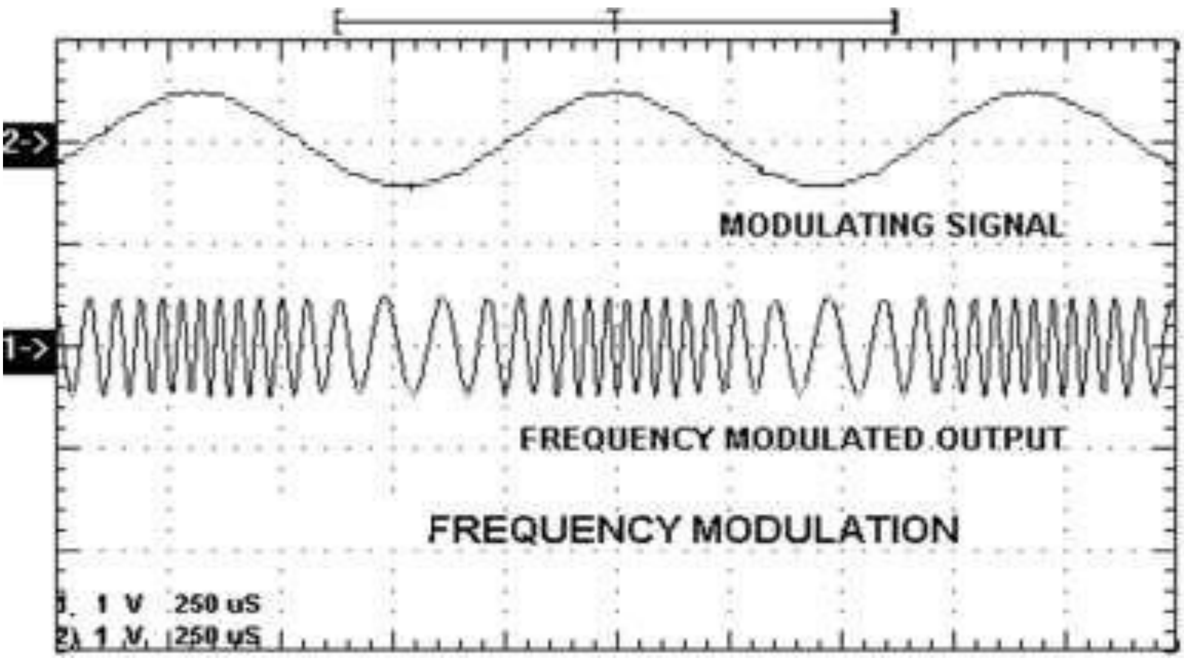
The demodulation process of FM waves is exactly opposite to that of the frequency modulation. After demodulation, we get the original modulating signal at the demodulation output.

FM demodulator or detector is basically a frequency to amplitude converter. It is expected to convert the frequency variations in FM wave at its input into amplitude variations at its output to recover the original modulating signal.

TABULATION:

FREQUENCY DEMODULATION:

Parameter	Amplitude (V)	Time Period in seconds	Frequency in Hz
Message signal			
Carrier signal			
Modulated signal			
Demodulation signal			



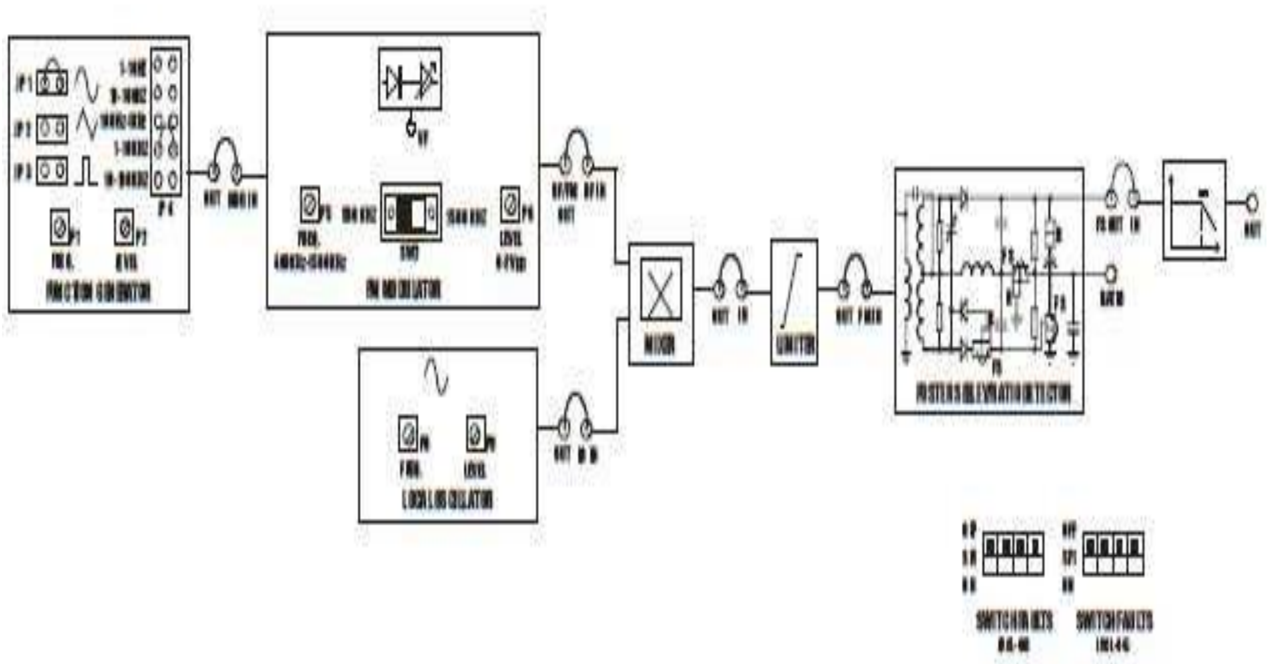


Figure: Block Diagram for FM Demodulation.

PROCEDURE:

1. Connect the power supply with proper polarity to the kit. While connecting this ensures that the Power supply is OFF.

2. Switch on the power supply and carry out the following pre-setting as shown in circuit Diagram.

3. In the FM modulator set the level about 2Vpp and frequency knob to the minimum and switch on 1500 KHz. Observe the FM modulated waveform from the RF/FM output of the FM modulator measure frequency deviation and modulation index of FM.

5. For demodulation switch on the demodulator and carry out the following demodulation connection as shown in circuit diagram.

6. Observe the demodulated waveform and plot the graph.

RESULT:

Experiment No-5

AIM: To verify Pulse Amplitude Modulation. And Demodulation.

EQUIPMENTS:

- Experimenter kit DCL-08.
- Connecting Chords
- Power supply
- 20 MHz Dual trace oscilloscope

THEORY: In Pulse Amplitude Modulation, the signal is sampled at regular intervals and the amplitude of each sample is made proportional to the amplitude of the signal at that instant of sampling. This amplitude of each sample is hold for the sample duration to make pulses flat top. The Pulse Amplitude Demodulator consists of Active Low Pass Butterworth filter. It filters out the sampling frequency and their harmonics from the modulated signal and recovers the base band by integrated action.

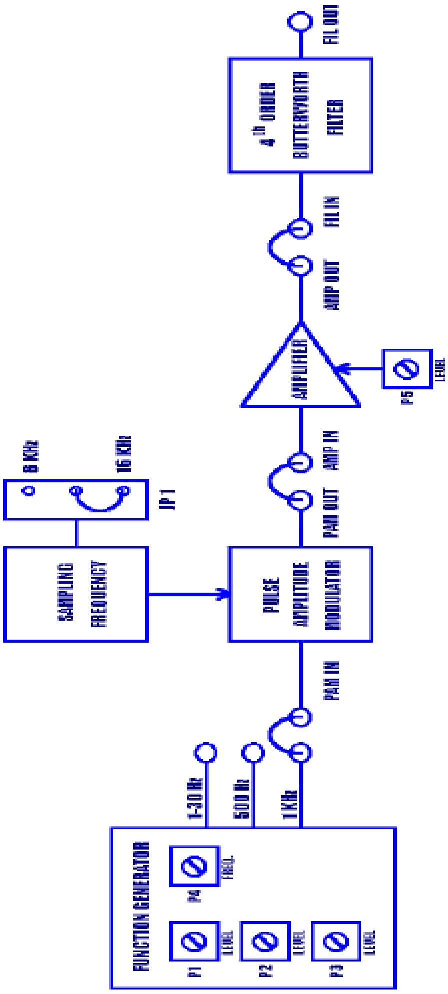
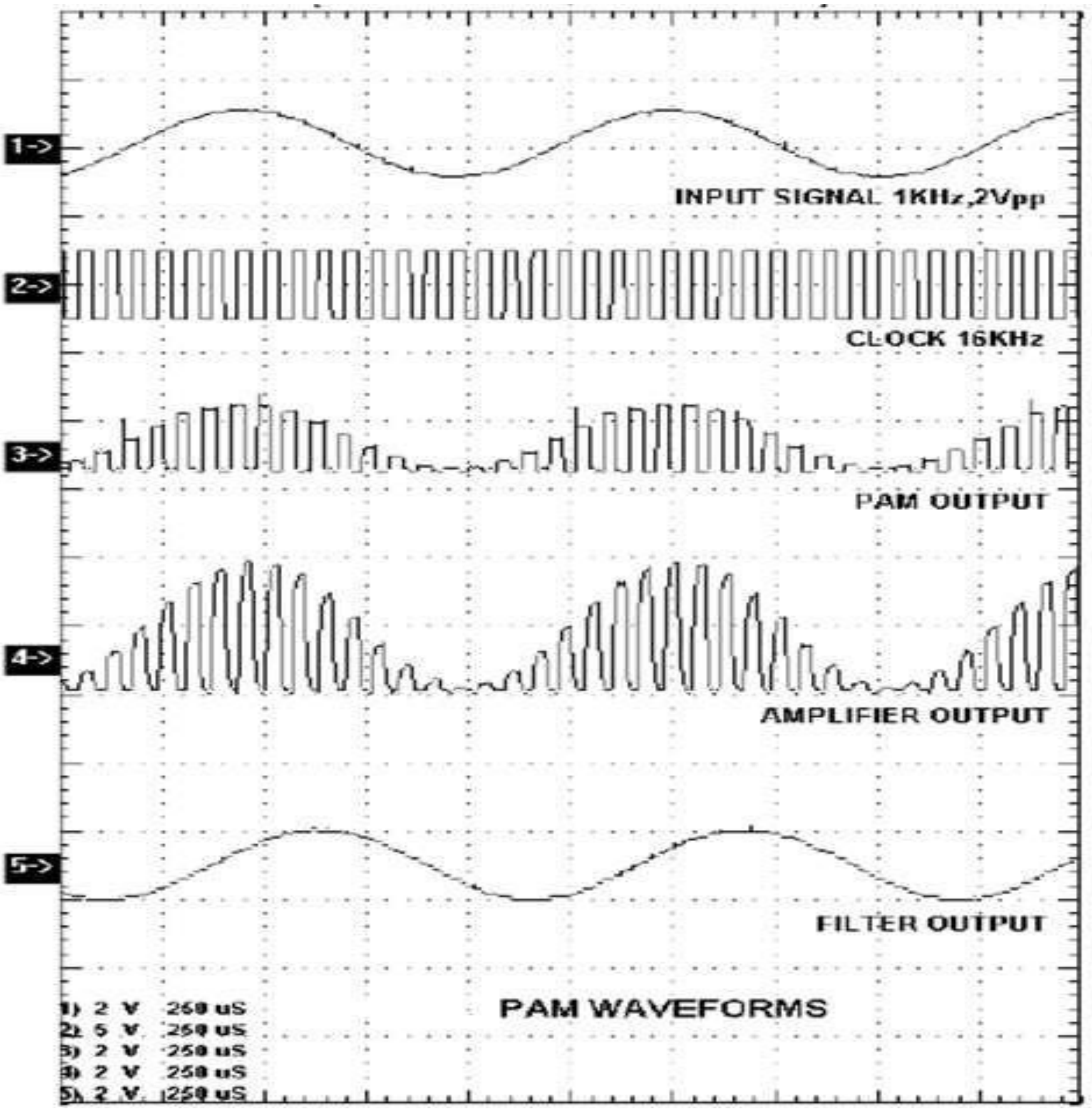


Figure: Block Diagram for Pulse Amplitude Modulation.



PROCEDURE:

1.Connect the Power Supply with proper polarity to the kit DCL-08 and switch it on.

2.Select 16 KHz sampling frequency by jumper JP1.

3.Connect the 1 KHz, 2Vp-p sine wave signal generated onboard to PAM IN Post.

4.Observe the Pulse Amplitude Modulation output at PAM OUT Post.

5.Short the following posts with the Connecting chords provided as shown in block diagram.

PAM OUT and AMP IN

AMP OUT and FIL IN.

6.Keep the amplifier gain control potentiometer P5 to maximum completely clockwise.
7.Observe the Pulse Amplitude Demodulated signal at FIL OUT, which is same as the input signal.

8. Repeat the experiment for different input signal and sampling frequencies

RESULT:

Experiment No-6

AIM To verify Pulse Width Modulation and Demodulation.

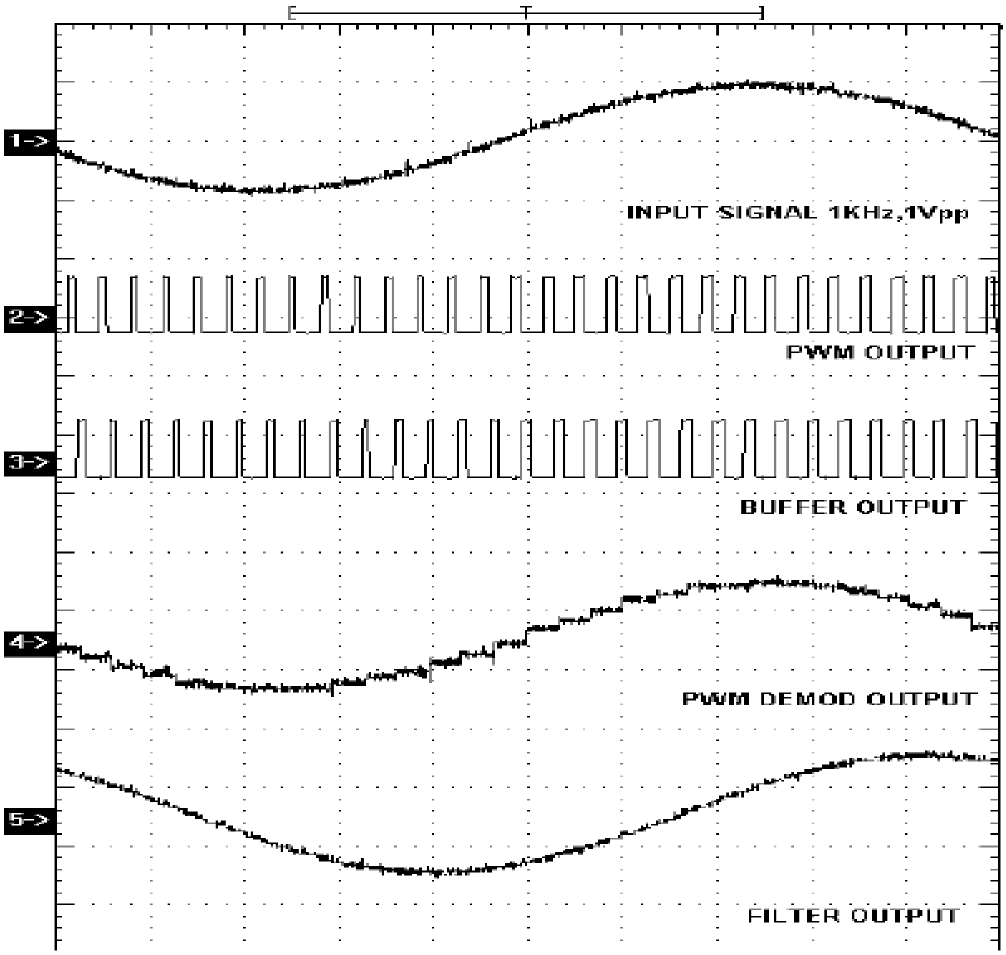
EQUIPMENTS

- Experimenter kit DCL-08.
- Connecting Chords Power supply.
- 20 MHz Dual trace oscilloscope.

THEORY

Pulse Width Modulation: This technique of modulation controls the variation of duty cycle of the square wave (With some fundamental frequency) according to the input modulating signal. Here the amplitude variation of the modulation signal is reflected in the ON period variation of square wave. Hence, it is a technique of V to T conversion.

Pulse Width Demodulation: The input signal is Pulse Width Modulated, so the ON time of the signal is changing according to the modulating signal. In this demodulation technique during the ON time of PWM signal one counter is enabled. At the end of ON time, counter gives a particular count, which directly corresponds to the amplitude of input signal. Then this count is fed to a DAC. The output of DAC corresponds to the amplitude of input signal. Thus train of varying pulse widths gives varying count values and accordingly DAC give outputs, which is directly proportional to amplitude of input signal. This is then filtered to get original signal. Thus at the output we get the original modulating signal extracted from PWM wave.



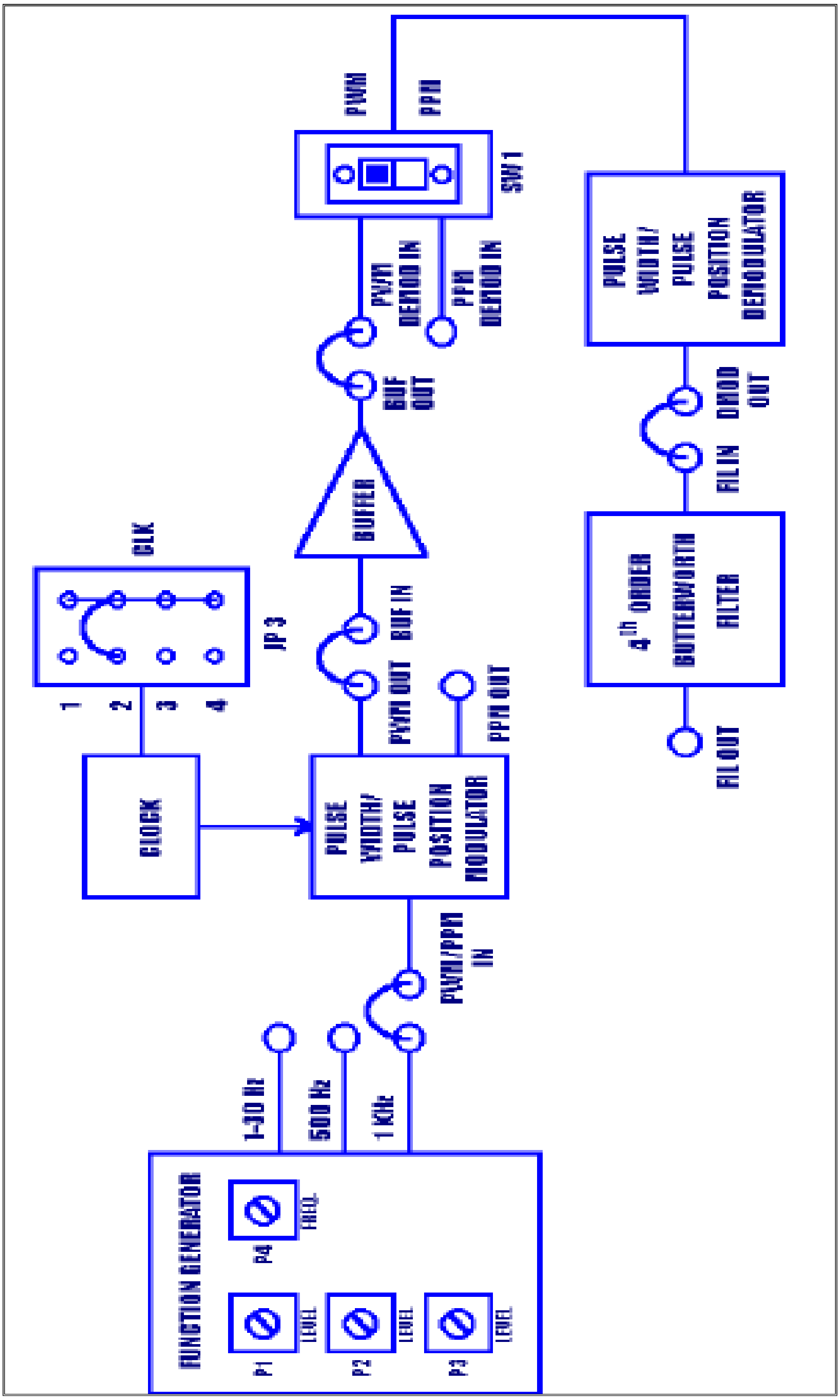


Figure: Block Diagram for Pulse Width Modulation and Demodulation.

PROCEDURE

1. Connect the Power Supply with proper polarity to the kit DCL-08 and switch it on. DCL-08: PAM / PWM / PPM MODULATION & DEMODULATION KIT
2. Put jumper JP3 to 2nd position.
3. Select 1KHZ 1v-pp sine wave signal generated onboard.
4. Connect this signal to PWM/PPM IN. Observe the Pulse Width Modulated output at PWM OUT post. Note that since the sampling frequency is high, only blurred band in waveform will be observed due to persistence of vision. In absence of input signal only square wave of fundamental frequency and fixed on time will be observed and no width variation are present. To observe the variation in pulse width, apply 1-30Hz sine wave signal to PWM/PPM IN post. Vary the frequency from 1-30 Hz.
5. hort the following posts with the Connecting chords provided as shown in block diagram for demodulation section. PWM OUT and BUF IN BUF OUT and PWM DMOD IN DMOD OUT and FIL IN.
6. Observe the Pulse Width Demodulated output at FIL OUT.

RESULT:

Experiment No-7

AIM To verify Pulse Position Modulation and Demodulation.

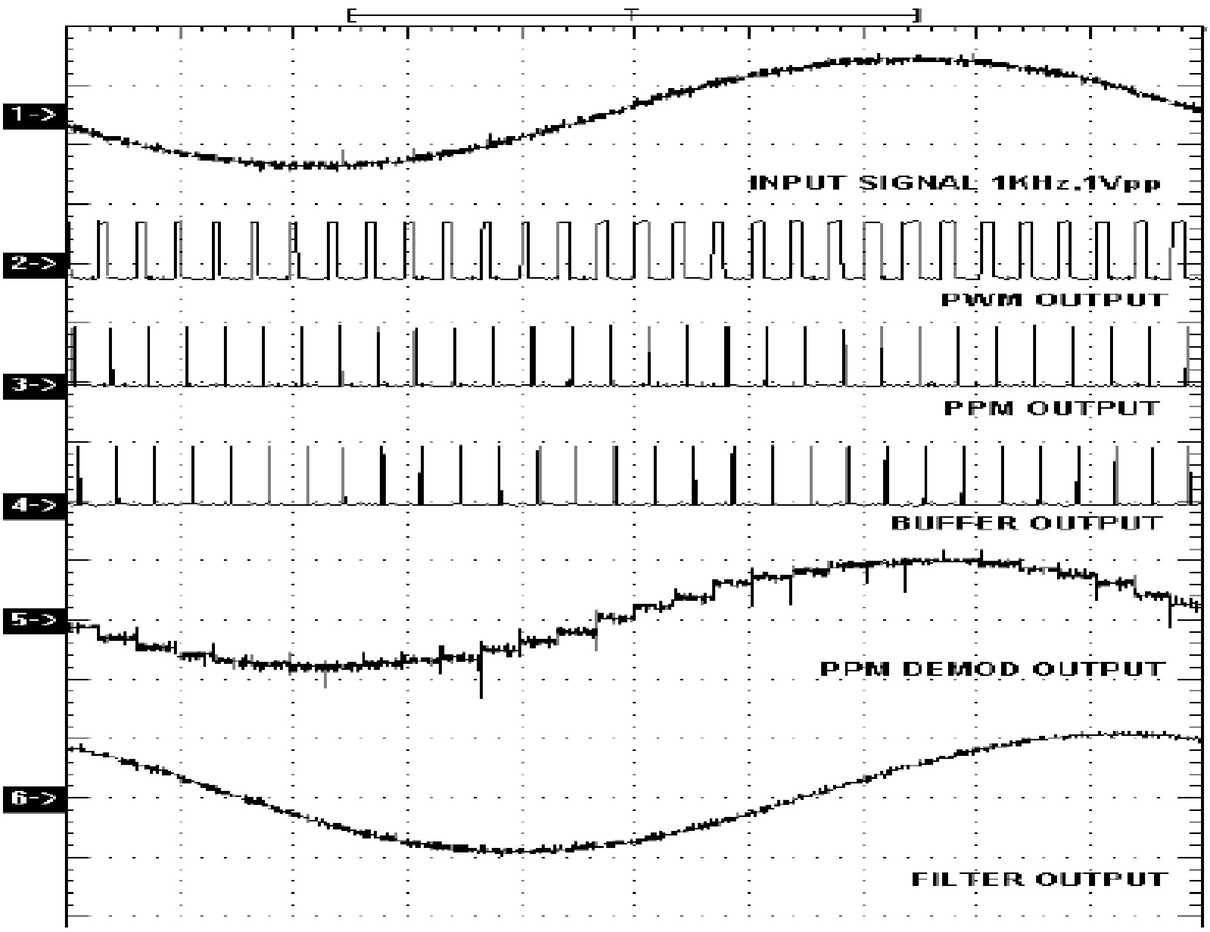
EQUIPMENTS

- Experimenter kit DCL-08.
- Connecting Chords Power supply 20 MHz
- Dual trace oscilloscope

THEORY: The position of the TTL pulse is changed on time scale according to the variation of input modulating signal amplitude, Width of the pulses and Amplitude of the pulses remain same.

Demodulation

This pulse position modulated signal is converted into PWM pulse form using Monosatable multivibrator. This signal is then demodulated using the same technique of PWM demodulation. In this demodulation technique during the ON time of PWM signal one counter is enabled. At the end of ON time, counter gives a particular count, which directly corresponds to the amplitude of input signal. Then this count is fed to a DAC. The output of DAC corresponds to the amplitude of input signal. Thus train of varying pulse widths gives varying count values and accordingly DAC gives outputs, which is directly proportional to amplitude of input signal. This is then filtered to get original signal. Thus at the output we get the original modulating signal extracted from PWM wave.



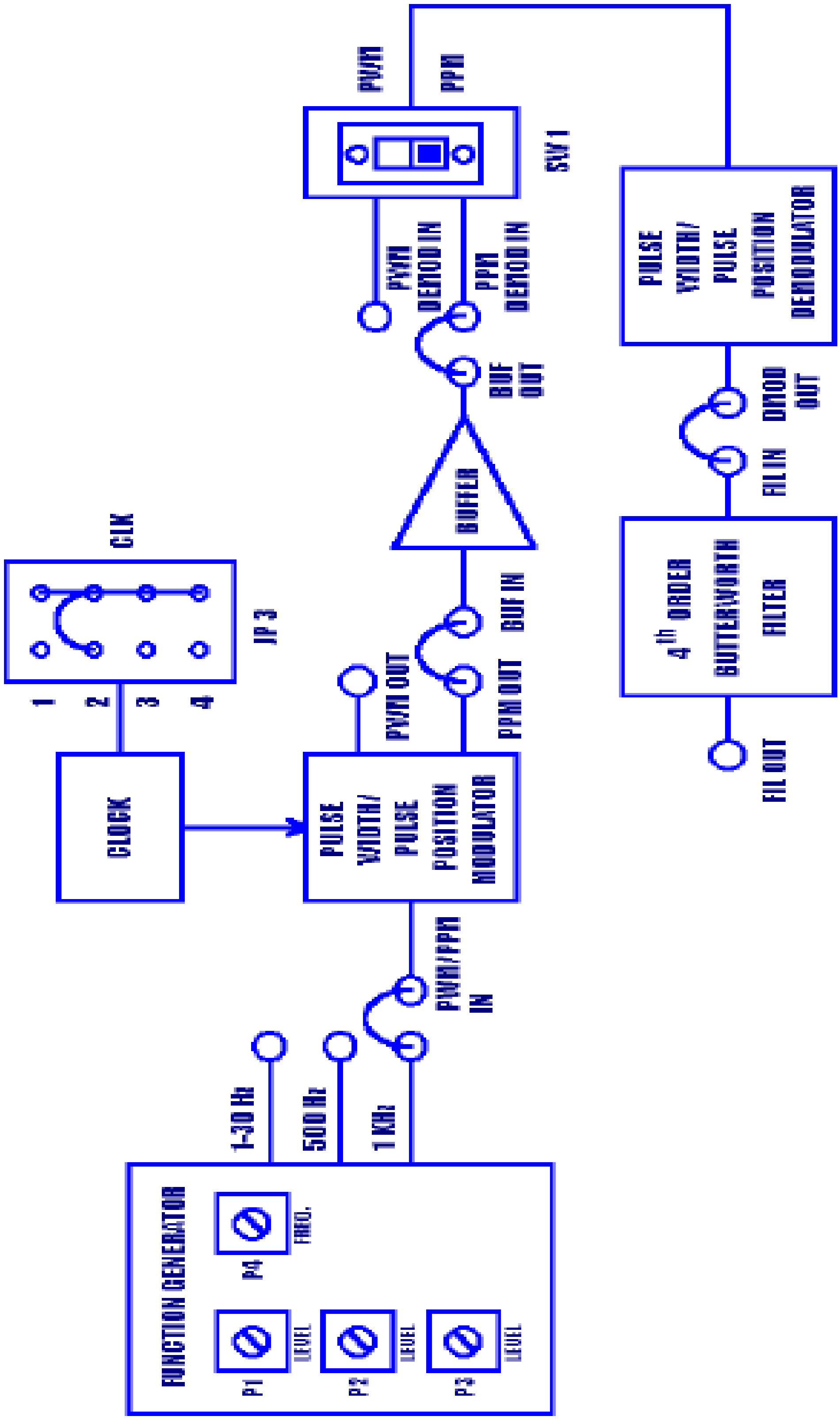


Figure: Block Diagram for Pulse Position Modulation and Demodulation.

PROCEDURE

1. Connect the Power Supply with proper polarity to the kit DCL-08 and switch it on.
2. Put jumper JP3 to 2nd position.
3. Select1KHZ, 1v-pp sine wave signal generated onboard.
4. Connect the selected signal to the PWM/PPM IN.
5. Observe the Pulse Position Modulated output at PPM OUT post with shifted position on time scale. Please note amplitude and width of pulse are same and there is shift in position which is proportional to input Analog signal.
6. To observe the variation in pulse positions, apply 1-30Hz sine wave signal to PWM/PPM IN post vary the frequency from 1-30 Hz and observe the signal on oscilloscope in dual for posts PPM OUT and PWM OUT simultaneously.
7. Then short the following posts with the link provided as shown in block diagram for Demodulation section. PPM OUT and BUFIN BUFOUT and PPM DMOD IN DMOD OUT and FIL IN
8. Observe the Pulse Position Demodulated signal at FIL OUT.
9. Repeat the experiment at different input signal and different sampling frequencies.

RESULT: