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EXPERIMENT NO.-1

TITLE :- Generation and detection of FM modulation Signal.

AIM OF THE Experiment :- To study the generation and detection of FM modulated Signal.

Equipments / APPARATUS REQUIRED :

SI.No.	Name of the Equipment/ Component	Specifications/ Range	Quality
1.	FM transmitter and receiver kit		1
2.	Digital Storage Oscilloscope (DSO)		1
3.	Power Supply		1
4.	Patch Cords		As Per req.

THEORY :- The process, in which the frequency of the carrier is varied in accordance with the

instantaneous amplitude of the modul-
-ating signal, is called "frequency modulation". The fm signal is expressed as

$$S(t) = A_c \cos(2\pi f_c t + \beta \sin 2\pi f_m t)$$

where A_c is amplitude of the carrier frequency and β is the modulation index of the fm wave

PROCEDURE :-

1. The connections are given as per the block diagram.

2. Without input signal, note down the time period Tc of the output signal

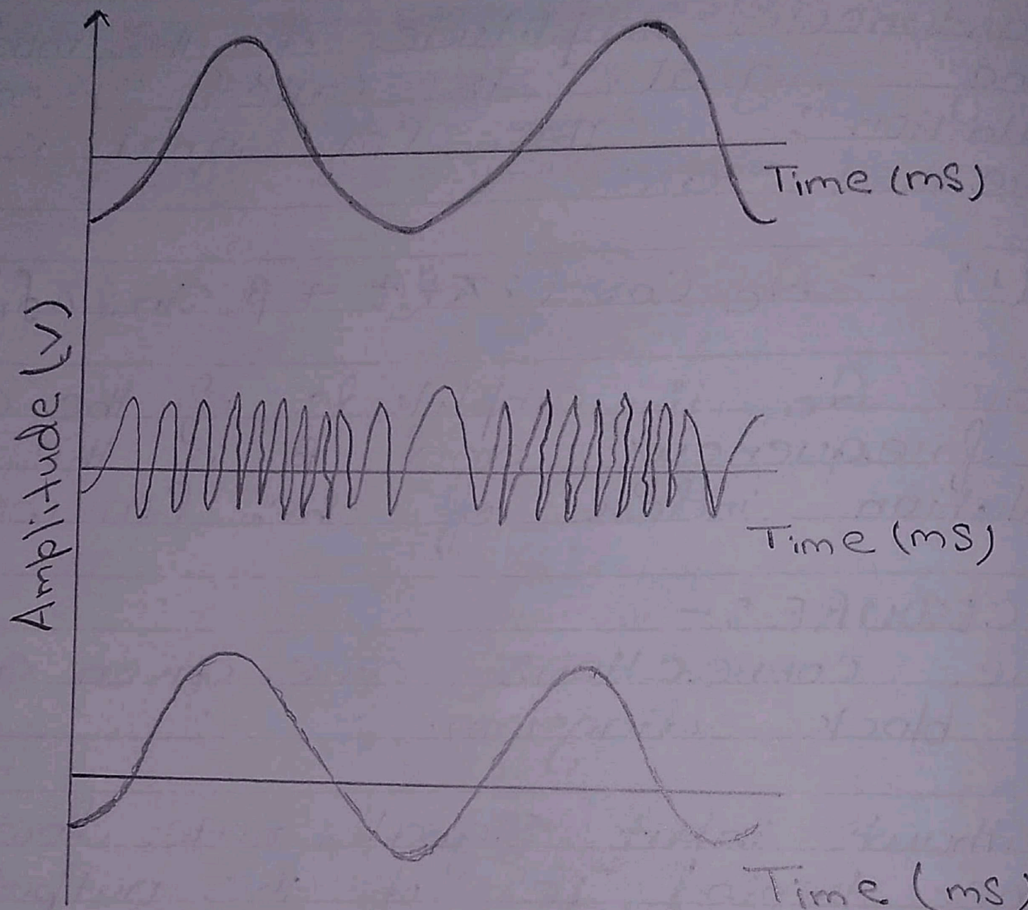
3. Set the input signal fm as 5 KHZ and 1 volt sinusoidal signal.

4. Observe the fm output waveform.

5. Note down the Tmin and Tmax from the output fm waveform.

6. Calculate fmax = 1/Tmin and fmin = 1/Tmax.

GRAPH :-



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7. Calculate frequency deviation $\Delta f = (f_{max} - f_{min})/2$

8. Calculate modulation index $m = \Delta f / f_m$

9. Take the print of the graph all wave-forms.

OBSERVATION :

Without input signal,

T_c = ... and f_c = ...

With input signal,

Amplitude	Tmin	fmax	Tmax	fmin	frequency deviation Δf

modulation index, β	

RESULTS : Frequency Modulation and Demodulation are verified in the kit and its waveforms are analysed.

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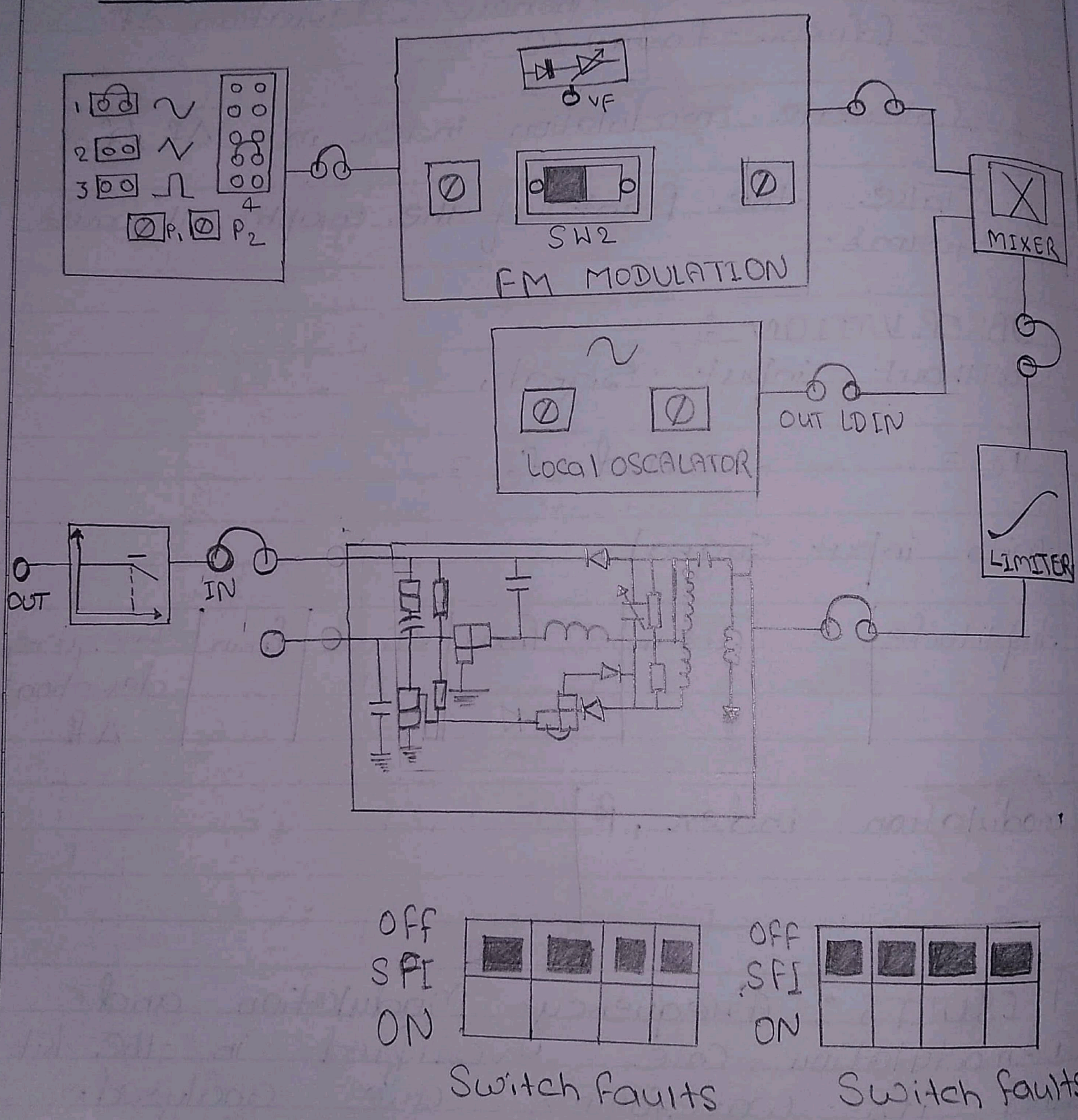
BLOCK DIAGRAM:



Block diagram of fm modulation and demodulation

Experiment No:-2

TITLE :- AM Superhetrodyne receiver.

AIM OF THE EXPERIMENT : To Study the AM Superhetrodyne receiver.

Sl.No.	Name of the Equipment/Component	Specifications/ Range	Quantity
1.	AM Superhetrodyne receiver kit		1
2.	Power Supply		1
3.	Connecting wire		As per req.
4.	Digital Storage		1
5.	Spectrum Analyzer		1
6.	Patch Cord		

THEORY :- The block diagram of a basic Superhetrodyne receiver is illustrated in fig 10.1. In a typical broadcast radio receiver, the input to the RF amplifier is obtained from the antenna tuning circuit as the station

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Selector dial changes the capacitance and therefore the resonant frequency of the LC tank circuit. The local oscillator frequency is adjusted simultaneously by varying a tuning capacitor that is also connected to the station selector dial. The local oscillator frequency is designed to change so that it is always a fixed value above the selected station frequency. Thus, if the RF tuner is centred at a frequency f_c, then

$$f_\omega = f_c + f_{IF}$$

Where f_{IF} is the amount that the local oscillator is above the carrier frequency selected. In most AM broadcast band radio receivers $f_{IF} = 455$ KHz, and in most FM receivers $f_{IF} = 10.7$ MHz. With the latest all digitally tuned radio receivers the basic techniques discussed above still apply. The RF amplifier can be tuned using an LC tank circuit with the capacitance component being a varactor diode which provides a voltage controlled capacitance and hence a voltage controlled resonant frequency. The local oscillator frequency can be obtained from a digitally programmable frequency synthesizer. The tuning voltage which drives the voltage controlled oscillator of the frequency synthesizer can also be used to tune the RF amplifier. In any case a digital word which corresponds to the desired station frequency can be used to set both the local oscillator and the R.F amplifier centre frequency.

PROCEDURE :

To simulate a Superheterodyne receiver, you will need to construct the circuit shown in fig 10.1

1) Adjust the local oscillator (LO) sine wave source to about 500 mV peak-to-peak with a frequency of 955 KHz. With the Agilent Synthesized Sources getting the precise LO frequency needed to down-convert the RF signal, should be easy.

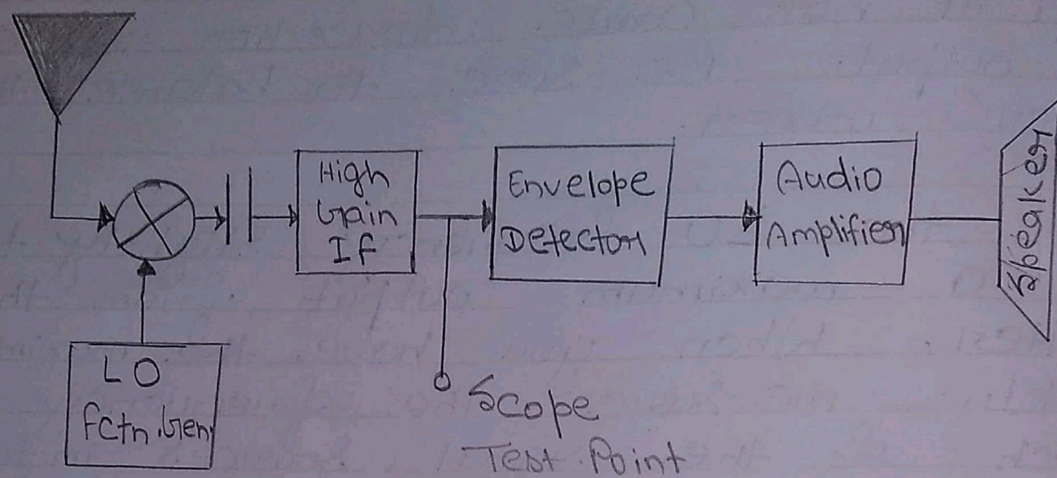
2. Adjust the AM modulator and/or function generators to obtain a 50%

modulated 500 KHz carrier at a level that will not cause distortion in the mixer output. Be sure to balance the receiver mixer.

3. Adjust the LO frequency slightly to obtain a maximum output from the IF filter. When you have the maximum, accurately measure the frequency of each of the signal sources into the mixer and calculate the centre frequency of the filter. When measuring the frequency of the modulated carrier, measure it with 50% modulation applied to it. Use the frequency counter to measure the carrier frequency. Do you know why the frequency counter can accurately measure a 50% modulated wave form?

4. With the oscilloscope triggered by the 5000 Hz modulation source, observe the input and output of the IF filter. Note that the envelope, or modulation, is the same for either signal. The output, however, should be a clean and undistorted modulated carrier at the IF. With the output of

Block Diagram:



the filter at a maximum, adjust the frequency control on the 5000 Hz source until you can clearly see the IF carrier waveform and thereby verify that the double frequency component is suppressed by the filter. Note: the modulation index of the AM signal at the output of the IF filter will change depending upon how the carrier and / or local oscillator frequencies are adjusted. This is due to the fact that 5000 Hz message sidebands get attenuated due to the narrow bandwidth of the IF filter.

5. Using a spectrum analyzer connected to the input and then to the mixer and filter, identify all the frequencies components of the superhetero-dyne system you have constructed. make a sketch of the spectrum at each of the locations you check.

RESULTS :- The AM superhetrodyne receiver was studied successfully.

Expt. No. ____ Date ____

EXPERIMENT NO:- 3

TITLE :- Generation and detection of PWM.

AIM OF THE EXPERIMENT : To study the generation and detection of pulse width modulation (PWM).

EQUIPMENTS / APPARATUS REQUIRED :

SI.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	PWM modulation and De.modulation trainer kit		1
2.	Digital Storage Oscilloscope (DSO)		1
3.	Power Supply		1
4.	Patch Cord		
5.	Connecting wires		As per req.

THEORY :-

Pulse time modulation is also known as Pulse Width Modulation or Pulse length modulation. In PWM, the samples of the

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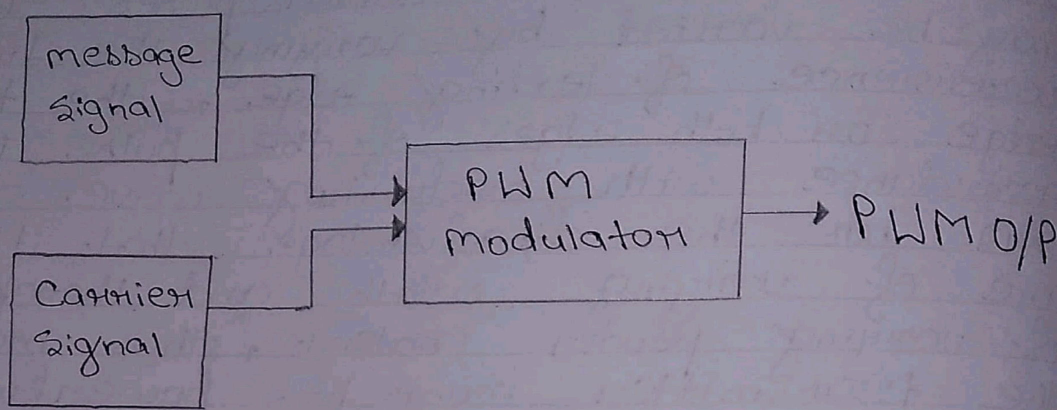
message signal are used to vary the duration of the individual pulses. Width may be varied by varying the time of occurrence of leading edge, the trailing edge or both edges of the pulse in accordance with modulating wave. The PWM has the disadvantage that its pulses are of varying width and therefore of varying power content, this means the transmitter must be powerful enough to handle the max. width pulses.

PROCEDURE :

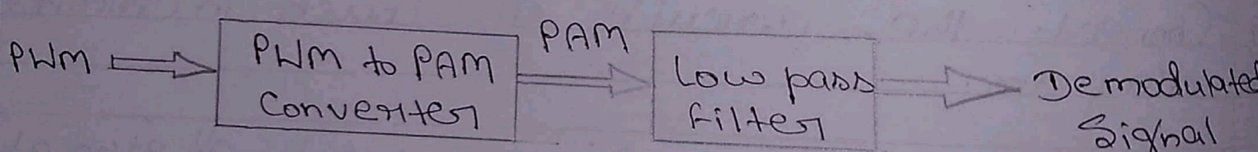
MODULATIONS:

1. Connect the circuit as shown in circuit diagram.
2. Set the carrier square wave of 3Vpp at 10 KHz.
3. Set the modulating signal of 1.5 Vpp, 1KHz.
4. Observe the PWM modulated output wave on DSO.
5. Plot the graph of the modulated signal, carrier signal and PWM modulated waveform

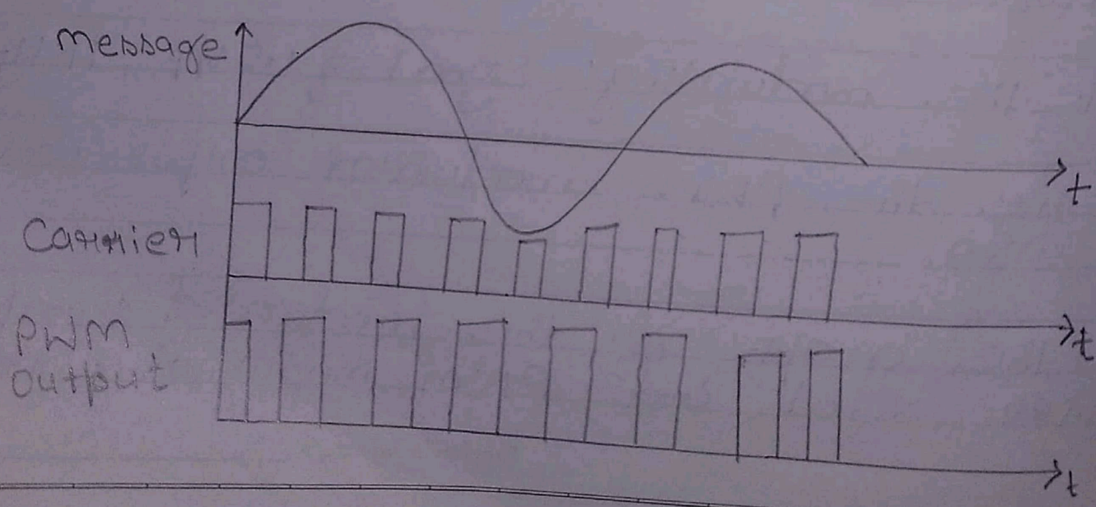
BLOCK DIAGRAM :-



Block diagram of PWM modulation



GRAPH:



DEMODULATIONS :-

1. Connect modulator circuit output to input of demodulated block of PWM demodulator.

2. Measure the amplitude and frequency of the demodulated signal from the DSO and verify with that of the modulating input.

3. Plot the demodulated waveform.

RESULTS :- The PWM circuit diagrams were set up and waveforms were verified.

EXPERIMENT NO:- 04

TITLE :- Generation and detection of PPM.

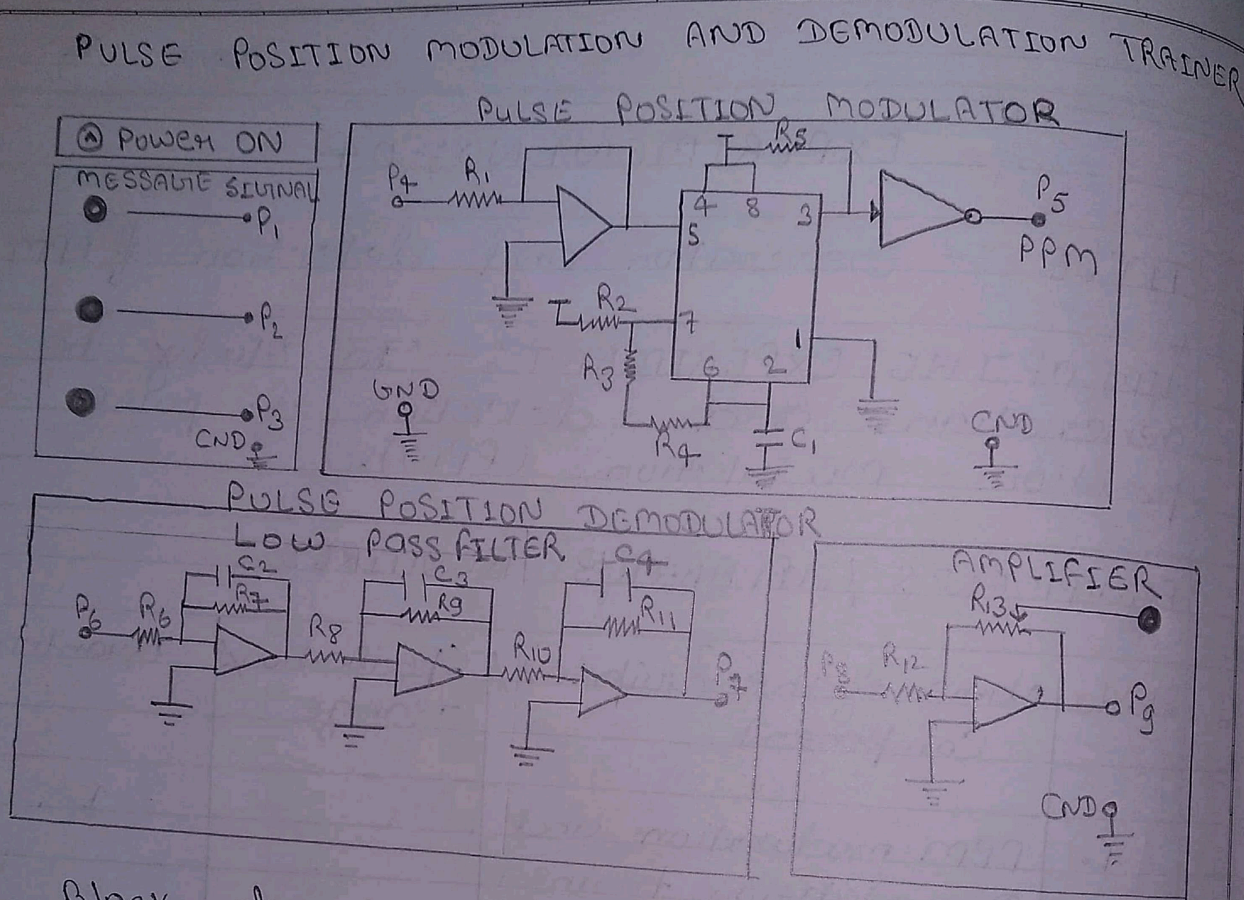
AIM OF THE EXPERIMENT :- To study the generation and detection of pulse position modulation (PPM).

EQUIPMENTS / APPARATUS REQUIRED :

Sl No.	Name of the Equipment/ Component	Specification/ Range	Quantity
1.	PPM modulation and Demodulation trainer kit		1
2.	Digital Storage Oscillos-cope (DSO)		1
3.	Power Supply		1
4.	Patch cord		
5.	Connecting wires		As per req

THEORY : In this type of modulation, the amplifier and width of the pulses is kept constant while the position of each pulse with reference to the position

PULSE POSITION MODULATION AND DEMODULATION TRAINER



Block diagram of PPM modulation and demodu-
-lation.

of a refrence pulse is changed according to the instantaneous sampled value of the modulating signal. It can be obteined by differentiating the PWM signal. It can also be obteined by feeding the PWM signal to the mono-stable multivibrator.

PROCEDURE:

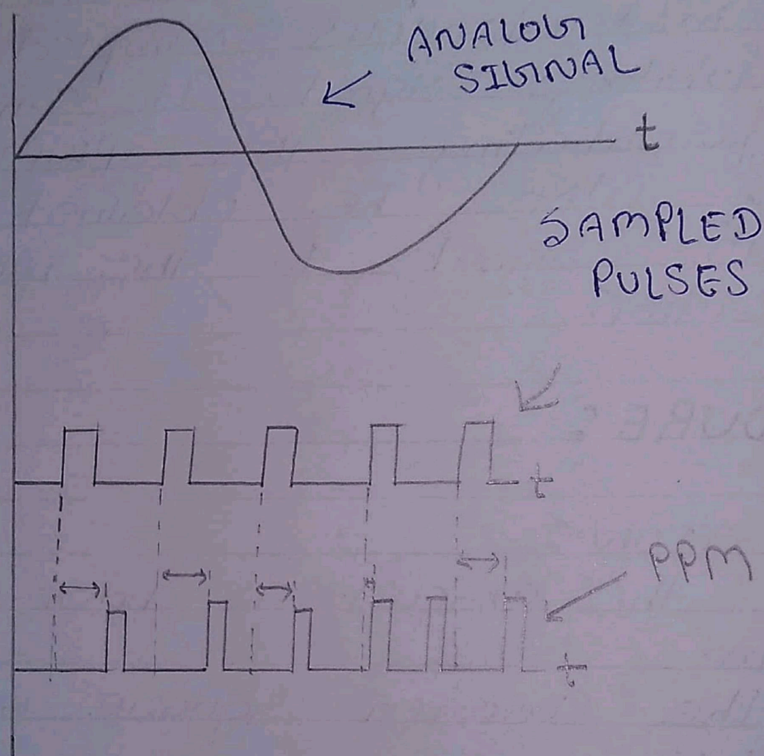
MODULATION:

1. Connect the circuit as shown in circuit diagram.
2. Set the carrier square wave of 3 Vpp at 10 KHz.
3. Set the modulating signal of 1.5 Vpp, 1KHz
4. Observe the PPM modulated output wave on DSO.
5. Plot the graph of the modulating signal carrier signal and PWM modulated waveforms.

DEMODULATION:

1. Connect modulator circuit output to input of demodulated signal block of PPM demodulator.

GRAPH



2. Measure the amplitude and frequency of the demodulated signal from the DSO and verify with that of the modula--ting input.

3. Plot the demodulated waveform.

RESULTS: The PPM circuit diagrams were set up and waveforms were verified.

EXPERIMENT NO :- 05

TITLE :- Generation and detection of PAM.

AIM OF THE EXPERIMENT :- To study the generation and detection of Pulse Amplitude modulation (PAM).

EQUIPMENTS / APPARATUS REQUIRED :

Sl. No	Name of the Equipment / Component	Specifications / Range	Quantity
1.	PAM modulation and Demodulation trainer kit		1
2.	Digital Storage Oscilloscope (DSO		1
3.	Power Supply		1
4.	Patch cord		1
5.	Connecting Wires		As per req.

THEORY : In PAM the amplitude of the individual pulses are varied according to the amplitude of the modulating signals. The PAM modulator and demo-

-dulator circuits are simple compared to other kind of modulation and demodulation techniques. There are two kinds of PAM one in which the pulses have the same polarity and the other in which the pulses can have both positive and negative polarity according to the amplitud-e of the modulating signal.

Pulse amplitude modulation is a scheme, which alters the amplitude of regularly spaced rectangular pulses in accordance with the instantaneous values of a continuous message signal.

A train of very short pulses of constant amplitude and fast repetition rate is chosen, the amplitude of these pulse is made to vary in accordance with that of a slower modulating signal the result is that of multiplying the train by the modulating signal the envelope of the pulse height corresponds to the modulating wave.

The demodulated PAM waves, the signal is passed through a low pass filter having a cut-off frequency equal to the highest frequency in the modulating signal. At the output of the filter is available the modulating signal along with the DC component.

PROCEDURE :

MODULATION :

1. Connect the circuit as shown in circuit diagram.

2. Set the carrier square wave of 3Vpp at 10 KHZ.

3. Set the modulating signal of 1.5 Vpp, 500 Hz.

4. Observe the PAM modulated output wave on DSO.

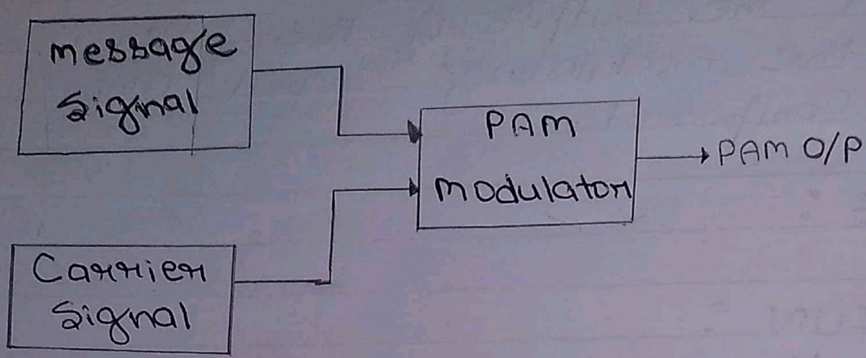
5. Plot the graph of the modulating signal, carrier signal and PAM modulated waveforms.

DEMODULATION :

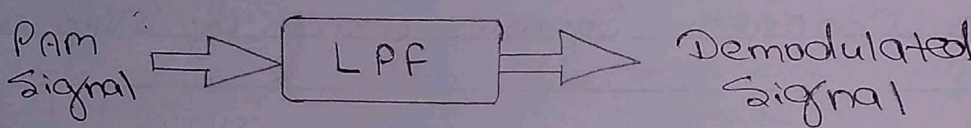
1. Connect modulator circuit output to RC filter circuit (LPF).

2. Measure the amplitude and frequency of the demodulated signal from the DSO and verify with that of the modulating

BLOCK DIAGRAM

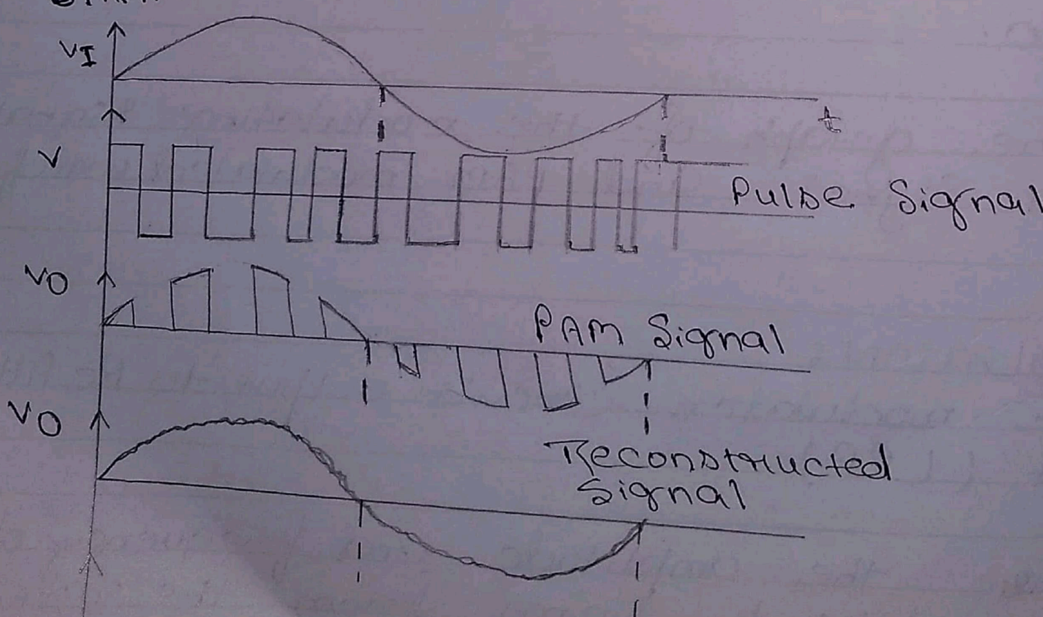


Block diagram of PAM modulation



Block diagram of PAM Demodulation

GRAPH :—



input.

3. Plot the demodulated waveform.

OBSERVATION :

MODULATION :

Modulating Signal				Carrier Signal			
Signal Type	Time Period	Frequency	Amplitude	Signal Type	Time Period	Frequency	Amplitude
Sine wave							

Modulated output

Signal Type	Amin	Amax	modulation Index
PAM			

Demodulation:

Demodulated Output

Signal Type	Time Period	Frequency	Amplitude

RESULTS :- Thus the pulse amplitude modulation and demodulation was performed and its corresponding waveforms are plotted.

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EXPERIMENT NO:- 06

PULSE CODE MODULATION & DEMODULATION

Aim :- To convert an analog signal into a pulse digital signal using PCM System and to convert the digital signal into analog signal using PCM demodulation system.

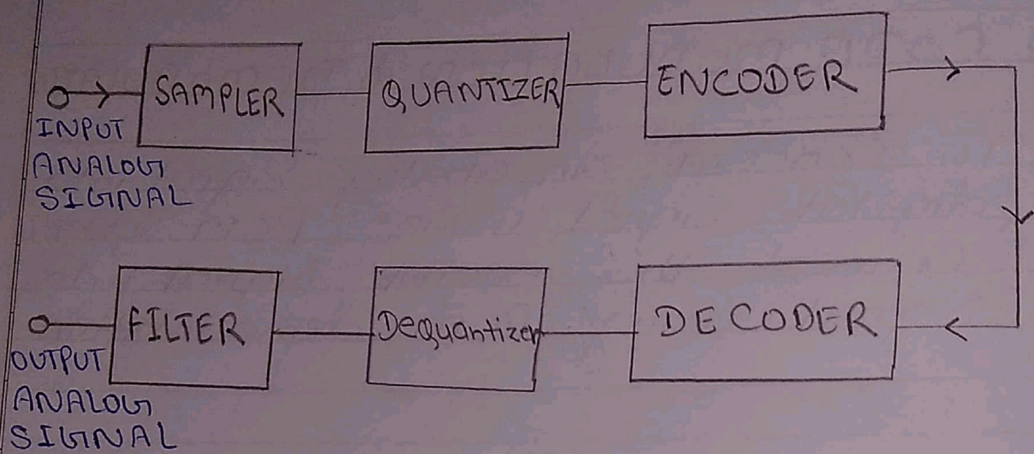
Apparatus:

1. PCM transmitter trainer.
2. PCM receiver trainer.
3. CRO and Connecting Wires.

Theory:

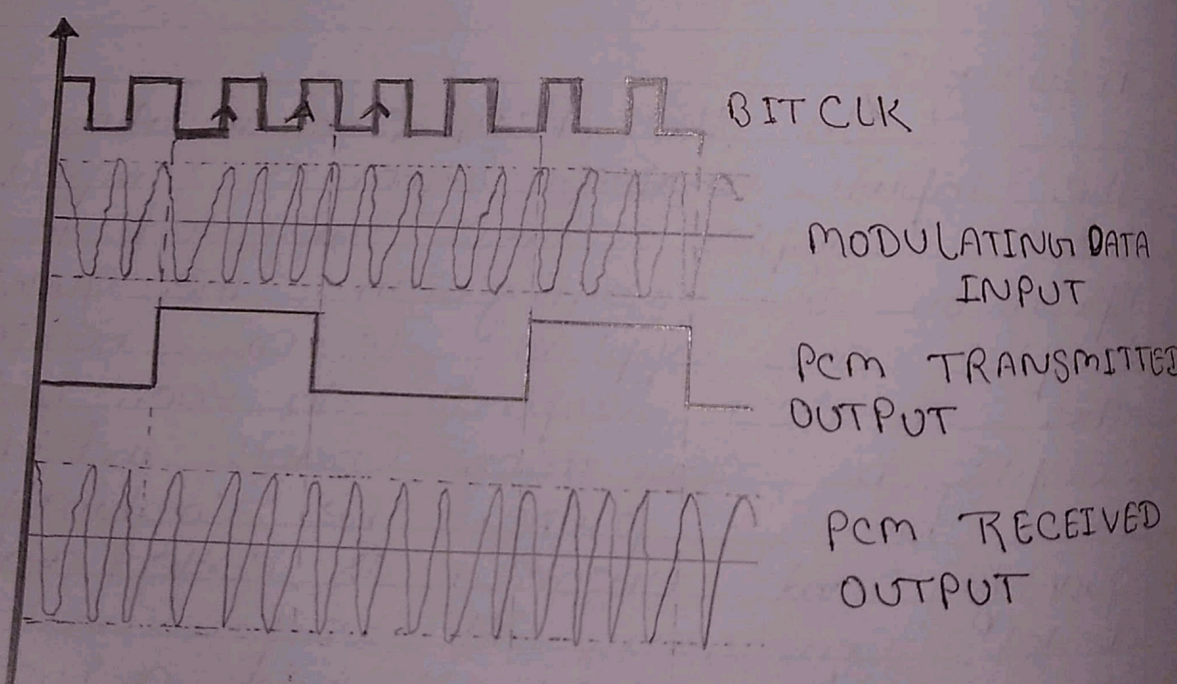
In the PCM communication system, the input analog signal is sampled and these samples are subjected to the operation of quantization. The quantized samples are applied to an encoder. The encoder responds to each such a sample by generation unique and identifi- -able binary pulse. The combination of quantize and encoder is called analog to digital converter. It accepts analog signal and replaces it with a successive code symbol, each symbol consists of a train of pulses in which the each

A/D CONVERTER



D/A CONVERTER

Output Waveform :



pulse interval. it has to determine which of many possible values has been received.

Procedure :-

1. The two inputs of function generator are Connected to channel-0 and channel-1 Simultaneously that is DC_1 output to channel -0 and DC_2 to channel -1.

2. With the help of oscillator DC_1 output is adjusted to 0 volts.

3. Transmitter and receiver are connected by the synchronization of clock pulses and by connecting ground transmitter to ground receiver.

4. The transmitter is connected to the input of receiver to go the original signal at the receiver output.

5. After connection is made the inputs channel 1 and output of bit channels are taken by connecting DC_1 output to channel 0 and DC_2 output to channel -1.

6. The phase shift of a channel can be noted down and input of receiver is

similar to that.

7. Thus the output of transmitter can be noted down and input of receiver is similar to that.

8. The receiver output signals are noted down at channel 0 and channel 1 of the receiver block.

Result: Hence, now to observe the operation of a pcm encoder and decoder To consider reason for using digital signal X-missions of analog signals.

EXPERIMENT NO:- 07

AIM :- To perform the AGC characteristics.

APPARATUS :

1. AGC trainer kit
2. Dual trace C.R.O (20MHz)
3. Digital frequency Counter or multimeter.
4. Patch Chords.

THEORY :

A Simple AGC is a system by means of which the overall gain of a radio receiver is varied automatically with the changing strength of the received Signal, to keep the output Substantially constent. A dc bias voltage, derived from the detector. The devices used in those stages are ones whose trans Conductance and hence gain depends on the applied bias voltage or current. It may be noted in passing that, for correct AGC operation, this relationship bet-ween applied bias and transconductar-nce need not to be strictly linear, as long as transConductance drops significantly with increased bias. All modern receivers are furnished with AGC, which enables tuning to stations of varying signal strengths without appreciable change in the size of the output signal thus AGC "irons out" input signal amplitude variations, and the gain control dose not have to be adjusted every time the receiver is tuned from one station to another, except when the change in signal strengths is enormous. In addition, AGC helps to smooth out the rapid fading which may occur with long-distance short-wave reception and prevents the overloading of the last IF amplifier which might otherwise have occurred.

This kit consists of wired circuitry of:

1. RF Generator.
2. AF Generator.
3. Regulated Power Supply
4. AM Modulator
5. Demodulator (Simple diode detector) and AGC Circuit

DEVICE DESCRIPTION:

1. RF GENERATOR:

Colpitts oscillator using FET is used here to generate RF signal of 455KHz

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frequency to use as carrier signal in this Experiment. Adjustments for amplitude and frequency are provided on panel for ease of operation.

2. AF Generator :

Low frequency signal of approximately 1 KHZ is generated using OP-AMP based wein bridge oscillator, required amplification and adjustable attenuation are provided.

3. Regulated Power Supply :

This consists of bridge rectifier, capacitor filters and three terminal regulators to provide required DC voltages in the circuit i.e. +12V, −12V, +6V @ 150 mA each.

4. AM Modulator :

Modulator section illustrates the circuit of modulating amplifier employing a transistor (BC 107) as an active device in common emitter amplifier mode. R1 and R2 establishes a quiescent forward bias for the transistor. The modulating signal is fed at the emitter section causes the bias to increase or decrease in

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accordance with the modulating Signal. R4 is emitter resistance and C3 is by pass capacitor for carrier. Thus the carrier signal applied at the base gets amplified more when the amplitude of the modulating signal is at its maximum and less when the signal by the modulating signal output is amplitude-modulated signal. C2 couples the modulated signal to output of the modulator.

5. Detector And AGC Stage:
This circuit incorporates two-stage amplifier, diode detector and AGC circuit.

a. 1st IF Amplifier:
Q2 (BF495C) acts as 1st IF Amplifier. The base of Q2 is connected through R5 (68 KΩ) to the detector output. R6 (100 E) and C4 (47n) is decoupling filter for +B line. The base potential depends on R4 (220K) base biasing resistor and the detector current supplied by R5. The detector current is proportional to the signal strength received. This controls the bias of Q2 (BF 495 C) automatically to the signal received. This is called A.G.C. C6 (4.7/16) is used

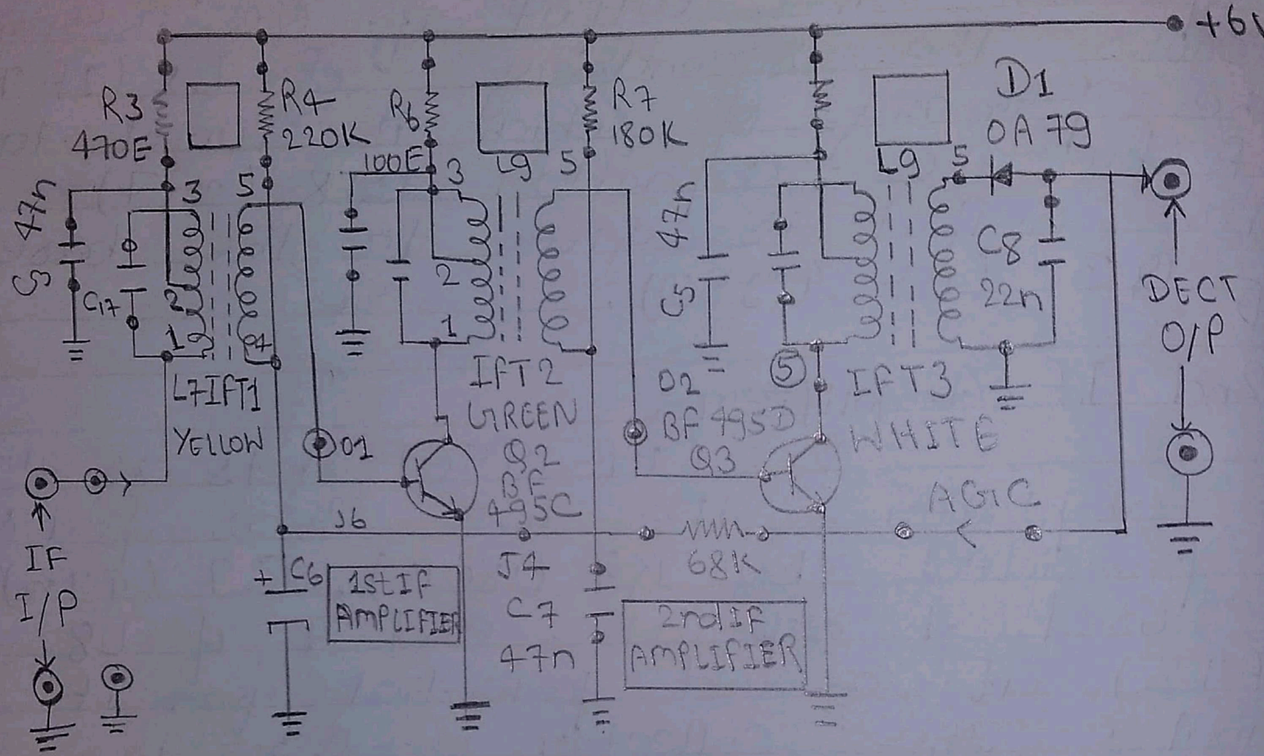
as base bias and AGC decoupling capacitor. The output of Q2 is available across the secondary of L8 (IF T2), the primary of which is tuned to IF by the Capacitor C18 (2n7). This output is given to the base of Q3 (BF 495D).

b. 2nd IF Amplifier:

Q3 (BF 195C) acts as 2nd IF amplifier. The base bias for Q3 is provided by R7 (180K), C7 (47n) is used to keep the end 4 of L8 (IFT2) at ground potential for IF signal. The collector of Q3 is connected to the L9 (IF T3). L9 contains 200 pf capacitor inside across the primary. The output of Q3 is available across the secondary of L9, the primary of which is tuned by the internal 200pf capacitor. R8 (220E), C8 (47n) consists the decoupling circuit for the collector supply of Q3. The output of Q3 is coupled to detector diode DI (OA 79).

c. Detector:

modulated IF signal from the secon-dary of L9 (IF T3) is fed to the


+6V
R3
470E
R4
220K
R6
100E
R7
180K
D1
OA 79
47n
C3
C17
L7IFT1
YELLOW
IFT2
GREEN
L9
IFT3
WHITE
C5
C8
22n
DECT
O/P
IF
I/P
Q1
Q2
BF
495C
Q3
BF 495D
J6
J4
C6
C7
47n
68K
AGC
1st IF
AMPLIFIER
2nd IF
AMPLIFIER

detector diode D1. D1 rectifies the modulated IF signal & IF component of modulated signal is filtered by C8 (22n), R9 (680E0 & C14 (22n). R9 is the detector load resistor. The detected signal (AF signal) is given to the volume control P2 (10K log) though maximum audio output - limiting resistor r21 (10K). It is also given to AGC circuit made of R5 (68K) and C6 (a. 7/16).

d. AGC

The sound received from the LS will depend on the strength of the signals received at the antenna. The strength of the received signals can vary widely due to fading. This will cause variations in sound which can be annoying. Moreover, the strength of signals can also be too large in close vicinity of MW transmitters causing overloading of the 2nd IF amplifier.

Automatic gain control (AGC) is used to minimize the variations in sound with changes in signal strength & to prevent overloading.

The operation of AGC depends on the fact that the gain obtained from any transistor depend on its collector current & becomes less when the collector current is reduced to cut off (or increased to saturation

For AGC, DC voltage obtained from the detection of IF signal & is applied to the 1st amplifier transistor base in such a way that an increase in this voltages reduces the gain of the transistor. The result is that when the strength of the incoming signal increases, the DC voltage also increase and this tends to reduce the gain of the amplifier thus not permitting the output to change much. Here R5 (68k) & C6 (4.7/16) performs this function. C6 (4.7/16) is the AGC decoupling capacitor to by pass any AF signals and keep the bias steady

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VI. PROCEDURE :

1. As the circuit is already wired you just have to trace the circuit according to the circuit diagram given above.

2. Connect the trainer to the mains and switch on the power supply.

3. measures the output voltages of the regulated power supply circuit i.e. +12V and -12V, +6 @ 150 ma.

4. Observe outputs of Rf and Af signal generator using CRO, note that Rf voltage is approximately 50m Vpp of 455 KHz frequency and Af voltage is 5Vpp of KHZ frequency.

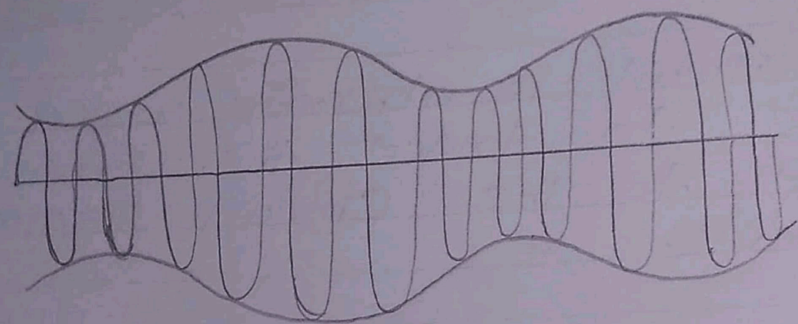
5. Now vary the amplitude of Af signal and observe the Am wave at output, note the percentege of modulation for different values of Af signal.

% modulation = (B - A) / (B+A) x100

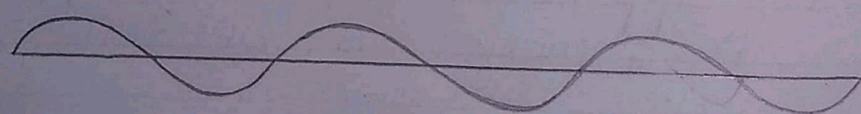
6. Now adjust the amplitude modulation index to 30% by varying

EXPECTED WAVEFORMS:

Af modulated RF Input.



Detected Output With AGC:



the amplitudes of RF & AF Signals Simultaneously.

7. Connect AM output to the input of AGC and also to the CRO Channel-1.

8. Connect AGC link to the feedback network through OA79 diode

9. Now Connect CRO channel-2 at output. The detected audio signal of 1KHZ will be observed.

10. Calculate the voltage gain by measuring the amplitude of output signal (Vo) waveform, using formula A = Vo/Vi.

11. Now vary input level of 455 KHZ IF signal and observe detected 1 KHZ audio signal with and without AGC link. The output will be distorted when AGC link removed i.e. there is no AGC action.

12. This explains AGC effect in Radio Circuit.

RESULT :- Hence, to perform the AGC characteristics.

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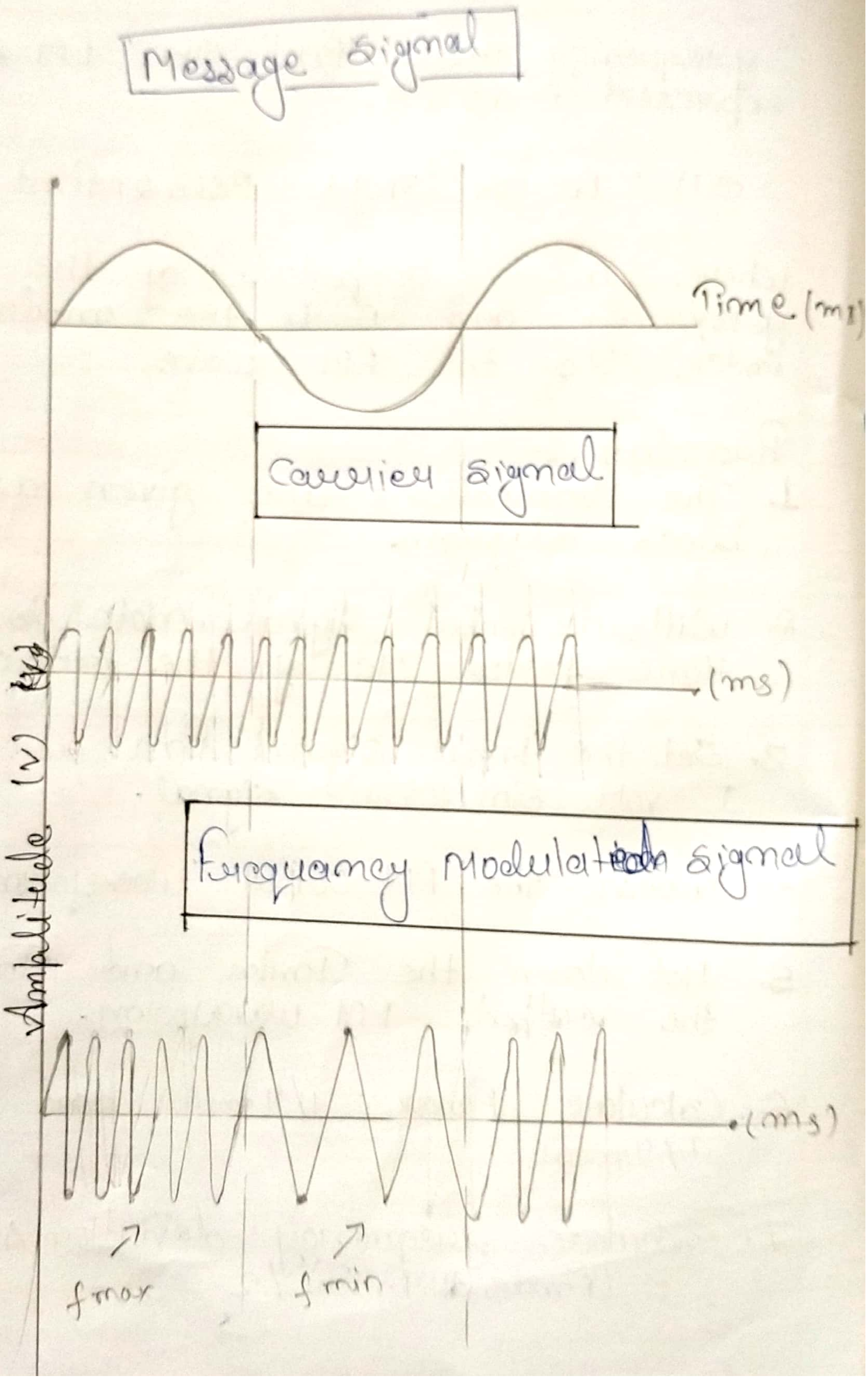
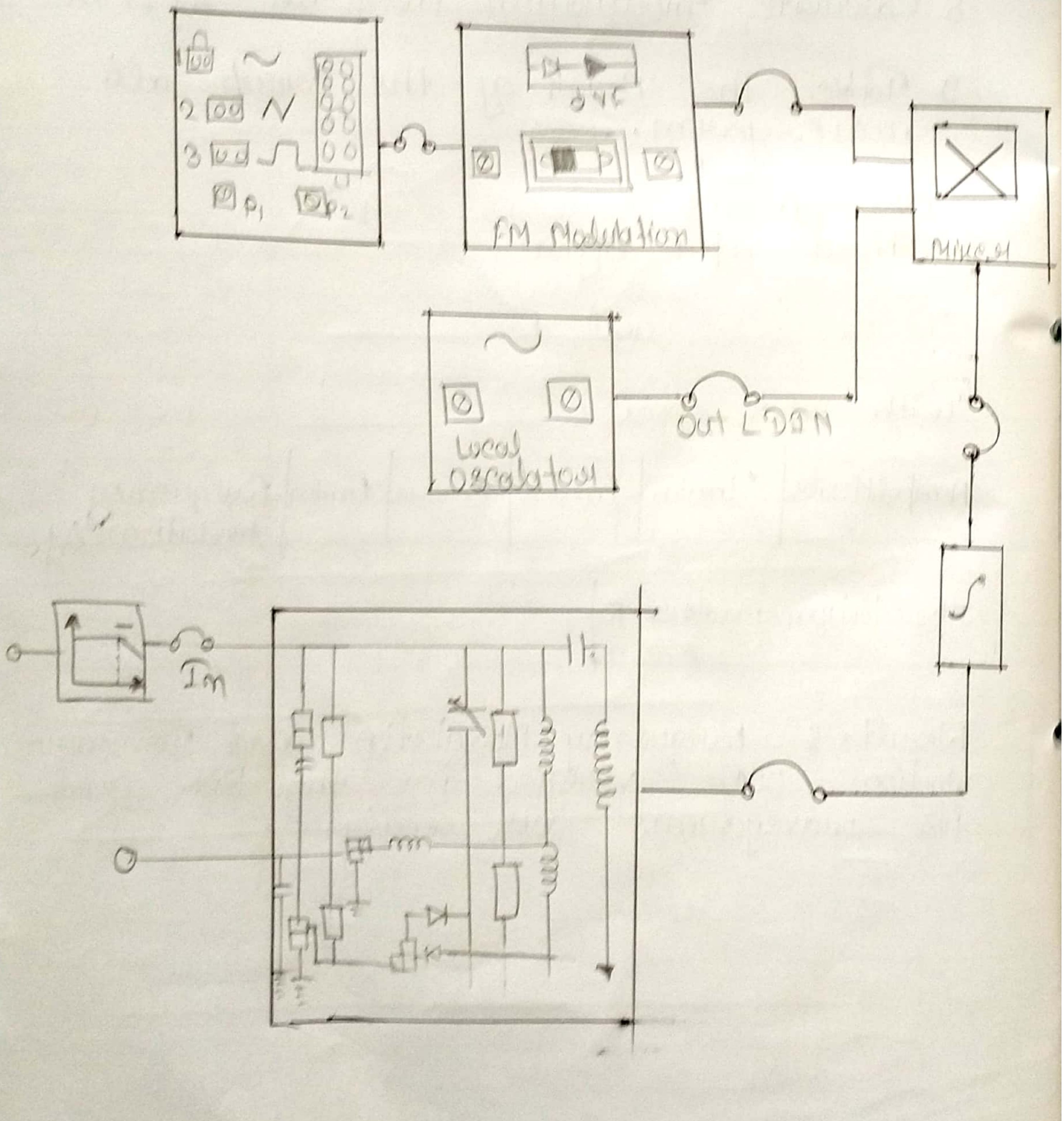
Graph


Message Signal
Time (ms)
Carrier signal
(ms)
Amplitude (V)
Frequancy Modulation signal
(ms)
fmax
fmin

Block Diagram: Modulation and De-modulation



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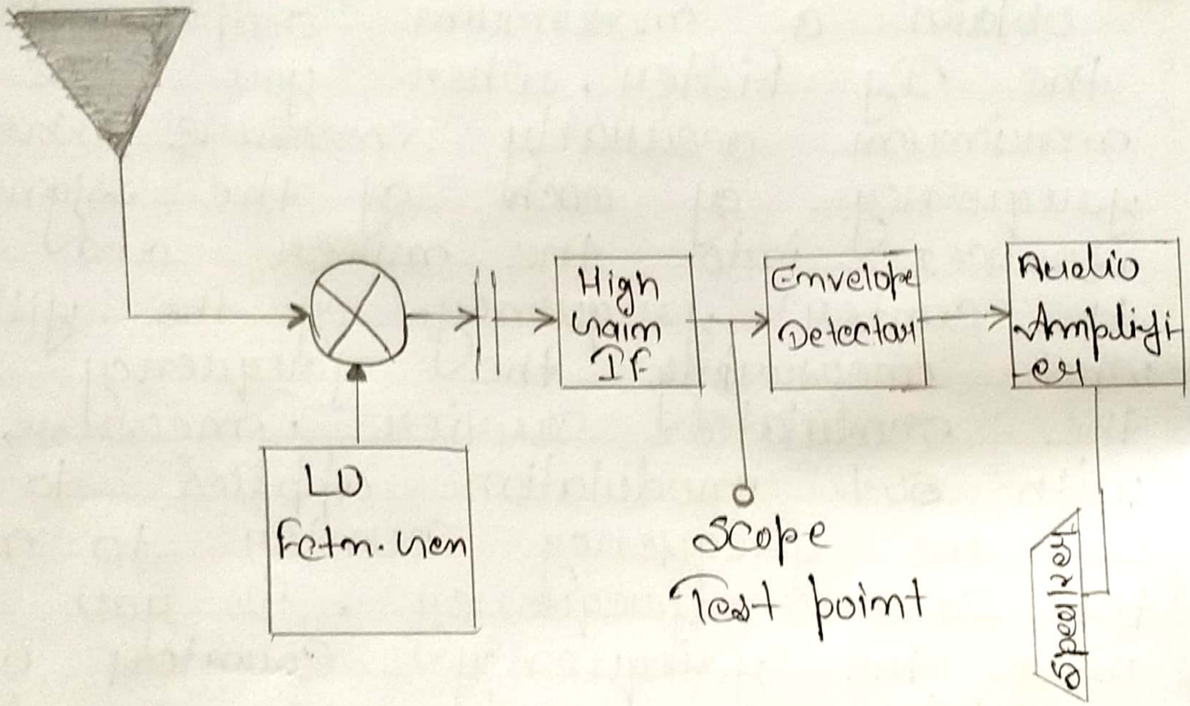
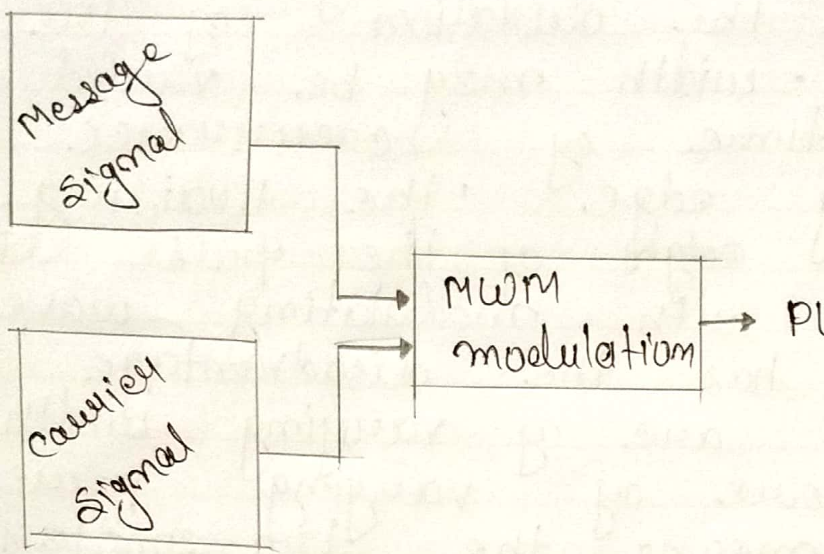
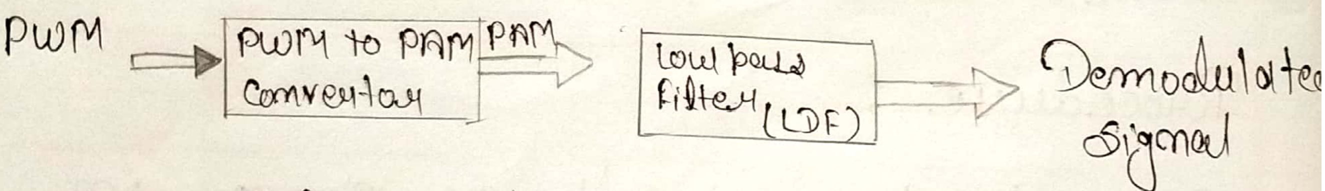
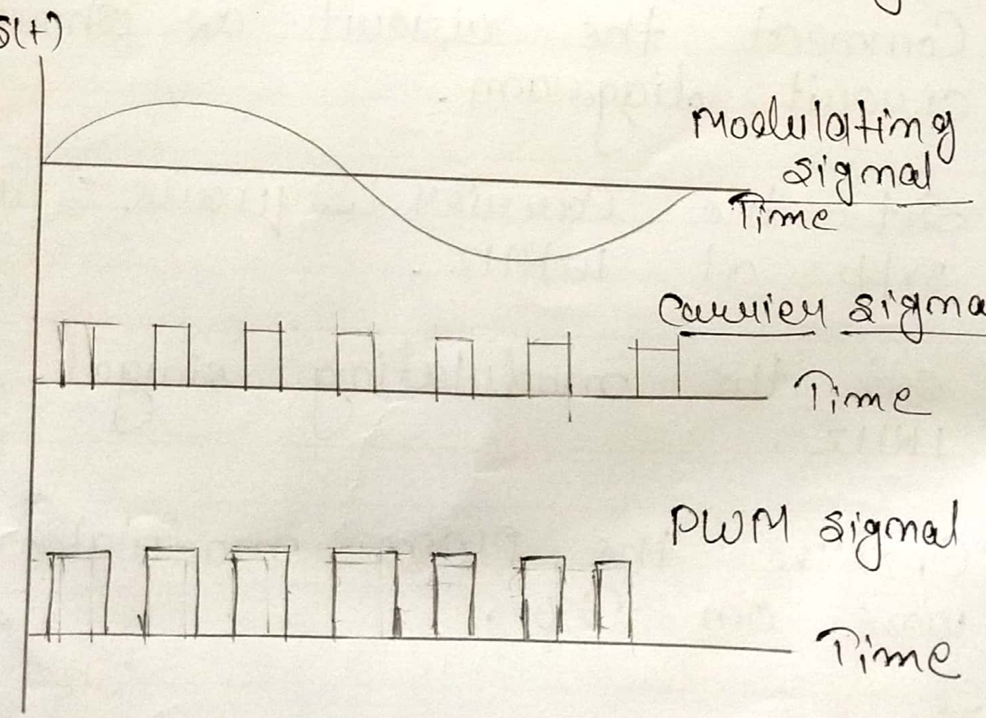
Block Diagram :-



Block Daigram of PWM Modulation

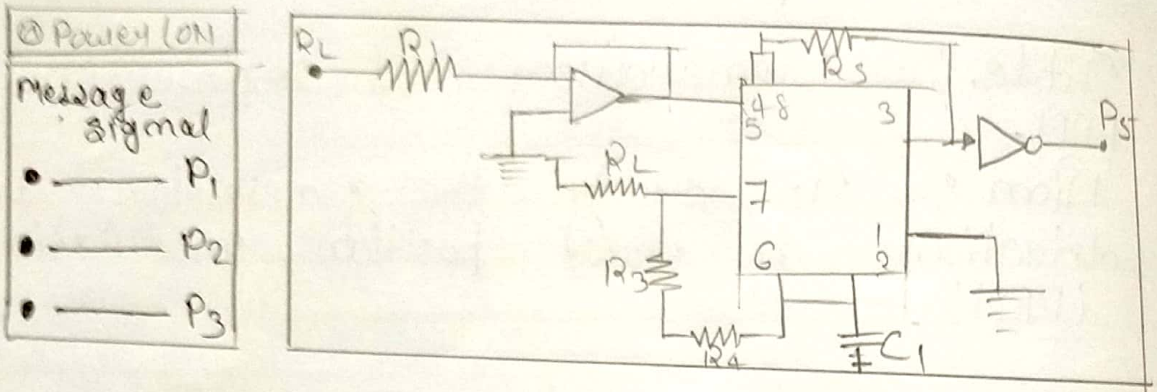






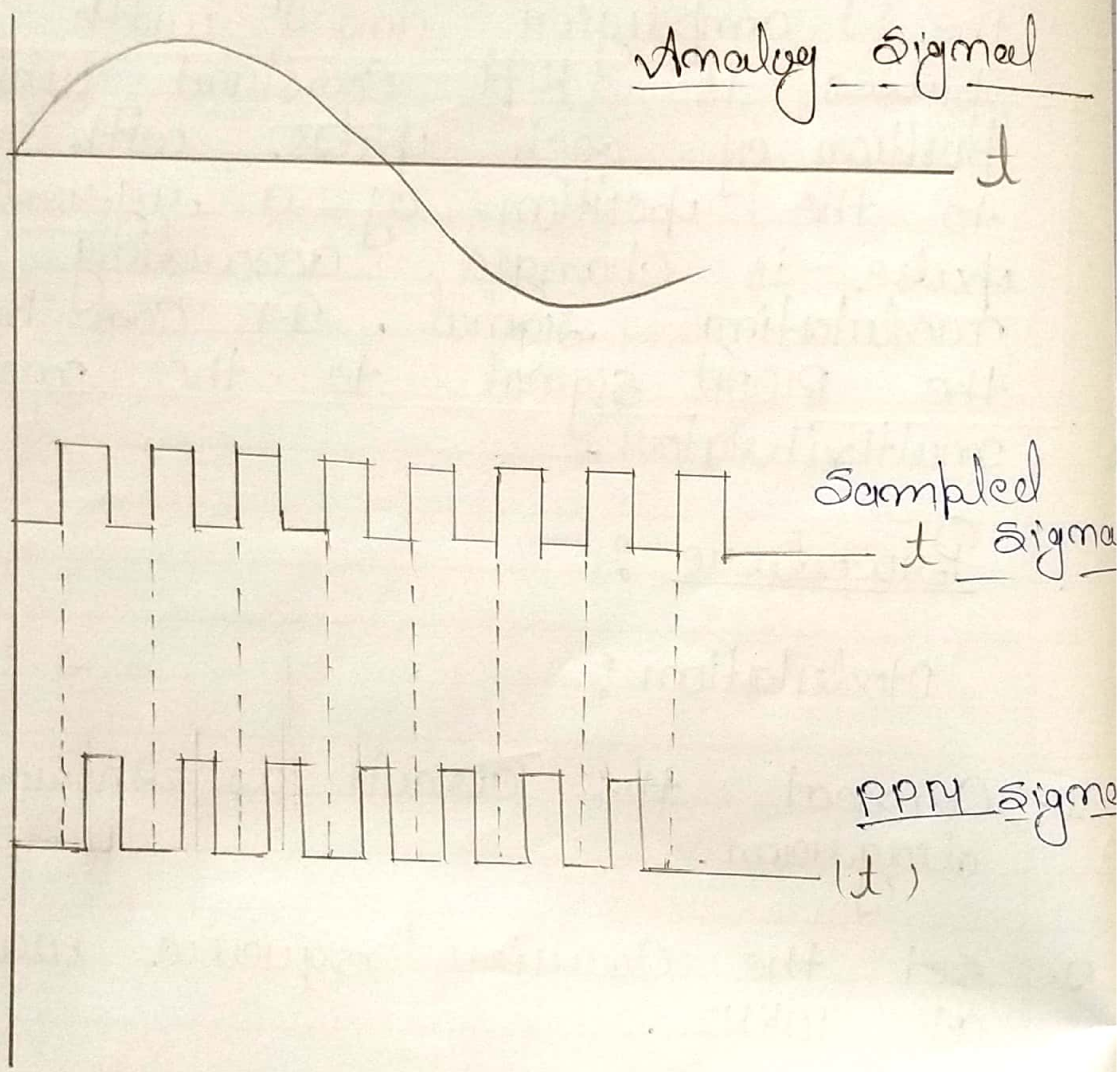
Scanned with CamScanner

PPM and De-Modulation Trainer

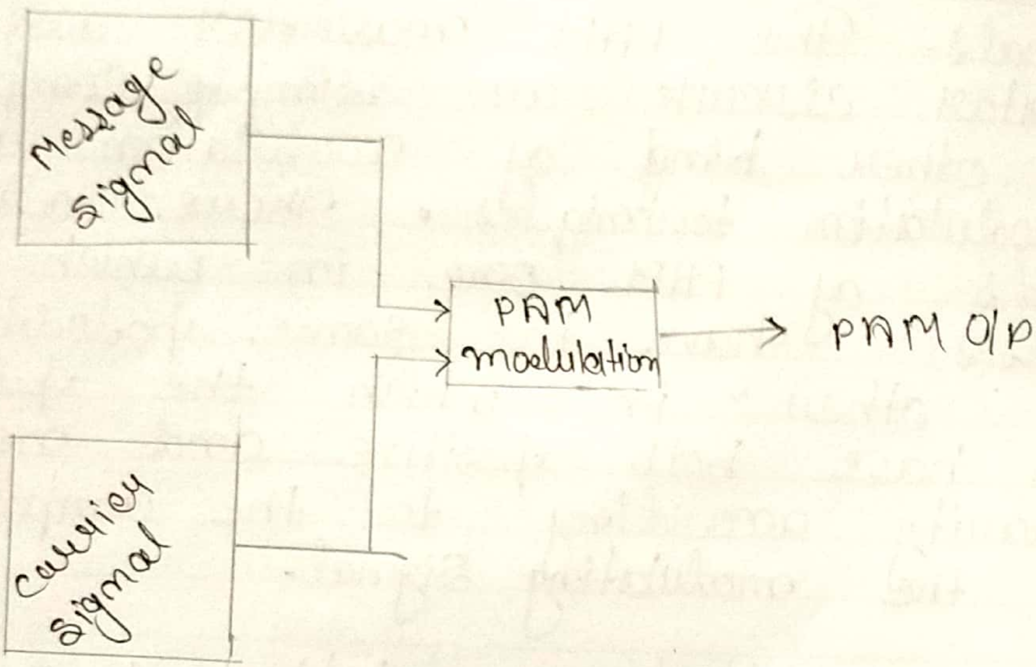


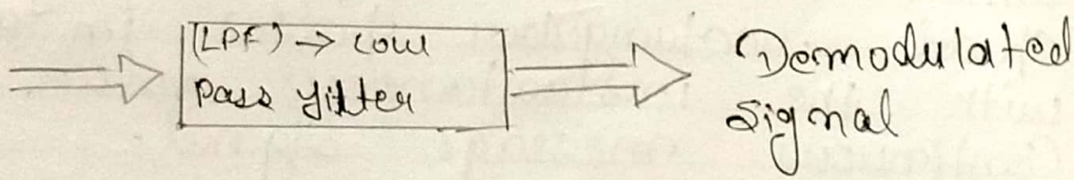
Scanned with CamScanner

Graph

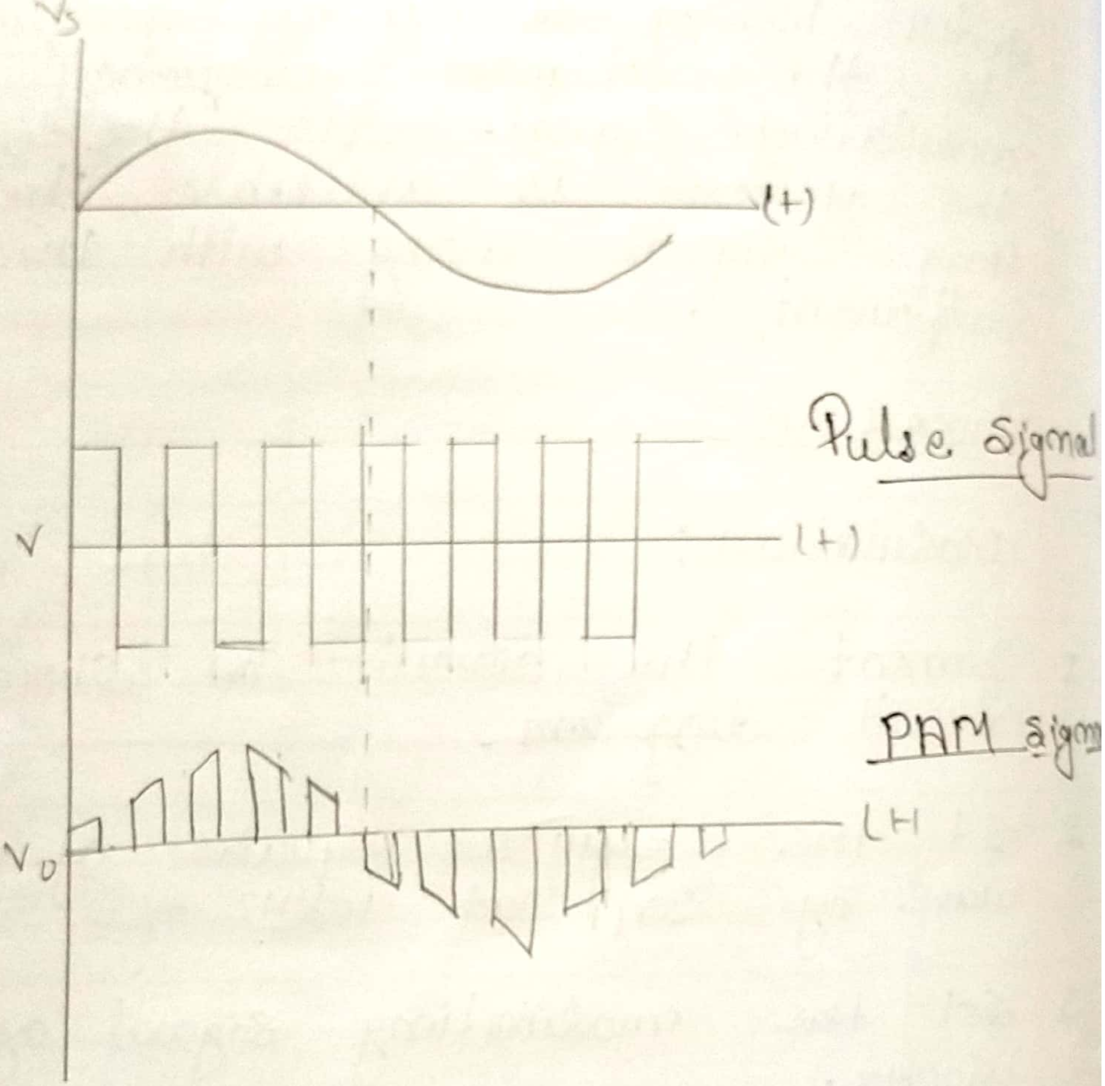


Block Daigram of PAM. Mod.

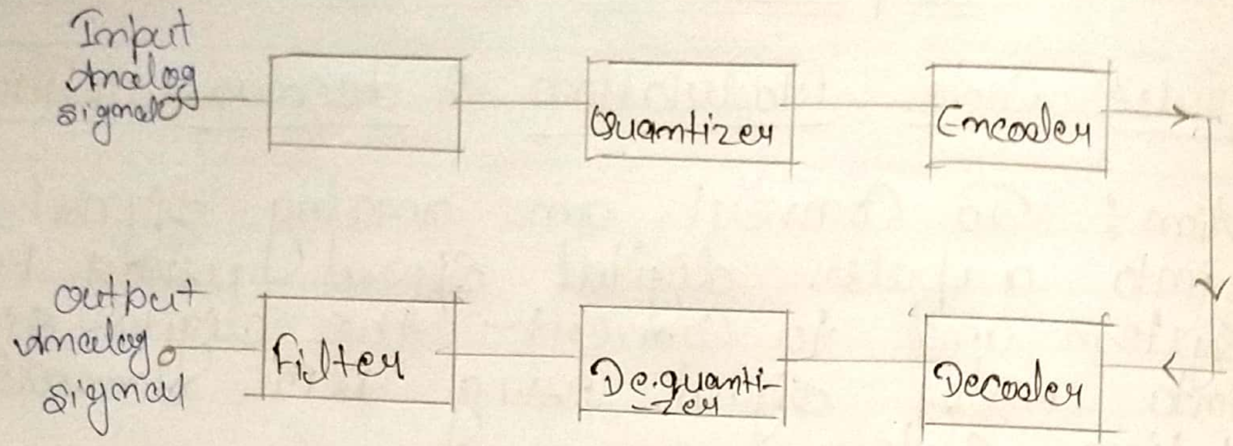




Graph



A/D Converter



D/A Converter