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DEPARTMENT OF
ELECTRONICS COMMUNICATION ENGINEERING

V SEMESTER - R 2013

EC6512 – COMMUNICATION SYSTEMS LABORATORY

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LABORATORY MANUAL

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DHANALAKSHMI

VISION

College of Engineering is committed to provide highly disciplined, conscientious enterprising professionals conforming to global stards through value based quality education training.

MISSION

- To provide competent technical manpower capable of meeting requirements of the industry
- To contribute to the promotion of Academic Excellence in pursuit of Technical Education at different levels
- To train the students to sell his brawn brain to the highest bidder but to never put a price tag on heart soul

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION

To impart professional education integrated with human values to the younger generation, so as to shape them as proficient dedicated engineers, capable of providing comprehensive solutions to the challenges in deploying technology for the service of humanity

MISSION

- To educate the students with the state-of-art technologies to meet the growing challenges of the electronics industry
- To carry out research through continuous interaction with research institutes industry, on advances in communication systems
- To provide the students with strong ground rules to facilitate them for systematic learning, innovation ethical practices

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PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Fundamentals

To provide students with a solid foundation in Mathematics, Science fundamentals of engineering, enabling them to apply, to find solutions for engineering problems use this knowledge to acquire higher education

2. Core Competence

To train the students in Electronics Communication technologies so that they apply their knowledge training to compare, to analyze various engineering industrial problems to find solutions

3. Breadth

To provide relevant training experience to bridge the gap between theory practice this enables them to find solutions for the real time problems in industry, to design products

4. Professionalism

To inculcate professional effective communication skills, leadership qualities team spirit in the students to make them multi-faceted personalities develop their ability to relate engineering issues to broader social context

5. Lifelong Learning/Ethics

To demonstrate practice ethical professional responsibilities in the industry society in the large, through commitment lifelong learning needed for successful professional career

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PROGRAMME OUTCOMES (POs)

a) To demonstrate apply knowledge of Mathematics, Science engineering fundamentals in Electronics Communication Engineering field

b) To design a component, a system or a process to meet the specific needs within the realistic constraints such as economics, environment, ethics, health, safety manufacturability

c) To demonstrate the competency to use software tools for computation, simulation testing of electronics communication engineering circuits

d) To identify, formulate solve electronic communication engineering problems

e) To demonstrate an ability to visualize work on laboratory multidisciplinary tasks

f) To function as a member or a leader in multidisciplinary activities

g) To communicate in verbal written form with fellow engineers society at large

h) To understand the impact of Electronics Communication Engineering in the society demonstrate awareness of contemporary issues commitment to give solutions exhibiting social responsibility

i) To demonstrate professional and ethical responsibilities

j) To exhibit confidence in self-education ability for lifelong learning

k) To participate succeed in competitive exams

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COURSE OBJECTIVES

To visualize the effects of sampling and TDM

- To Implement AM and FM modulation and demodulation
- To implement PCM and DM
- To implement FSK, PSK and DPSK schemes
- To implement Equalization algorithms
- To implement Error control coding schemes

LIST OF EXPERIMENTS

1. Signal Sampling and reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator and Demodulator
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Observation (simulation) of signal constellations of BPSK, QPSK and QAM
8. Line coding schemes
9. FSK, PSK and DPSK schemes (Simulation)
10. Error control coding schemes – Linear Block Codes (Simulation)
11. Communication link simulation
12. Equalization – Zero Forcing and LMS algorithms (simulation)

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COURSE OUTCOMES

Simulate end-to-end Communication Link

Demonstrate their knowledge in base b signaling schemes through implementation of FSK, PSK DPSK.

Apply various channel coding schemes and demonstrate their capabilities towards the improvement of the noise performance of communication system.

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CONTENTS

Sl. No.	Name of the Experiment	Page No.
CYCLE 1 - EXPERIMENTS		
1	Signal sampling reconstruction	7
2	Time division multiplexing	13
3	AM modulation demodulation	18
4	Frequency modulation demodulation	26
5	PCM modulation demodulation	33
6	Delta modulation demodulation	38
7	Line coding decoding techniques	45
CYCLE 2 – EXPERIMENTS		
8	Error control coding using MATLAB	51
9	Design of BPSK, QPSK, QAM using MATLAB	53
10	Design of FSK, PSK DPSK using MATLAB	55
11	Communication link simulation using MATLAB	57
12	Zero forcing LMS equalization algorithms using MATLAB	59
ADDITIONAL EXPERIMENTS BEYOND THE SYLLABUS		
13	Pulse amplitude modulation	61
14	Amplitude modulation demodulation using LabVIEW	64

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CYCLE 1 - EXPERIMENTS

Expt. No. 1 SIGNAL SAMPLING AND RECONSTRUCTION

Aim:

To study the process of sampling and reconstruction of signals using analog sampling trainer kit

Apparatus required:

1. Analog signal sampling and reconstruction trainer kit – 1 No.
2. Dual Power Supply – 1 No.
3. Patch cords – 6 Nos.
4. CRO (30 MHz) – 1 No.

Theory:

Sampling is defined as measuring the value of an information signal at predetermined time interval. The rate at which the signal is sampled is known as the sampling rate or sampling frequency. The types of sampling are natural sampling and flat top sampling.

A continuous time signal can be processed by processing its samples through a discrete time system. For reconstructing the continuous time signal from its discrete time samples without any error, the signal should be sampled at a sufficient rate that is determined by the sampling theorem.

Sampling theorem

If a signal is band limited and its samples are taken at sufficient rate than those samples uniquely specify the signal and the signal can be reconstructed from those samples. The condition in which this is possible is known as Nyquist sampling theorem.

A signal whose spectrum is band limited to D Hz $[X(f) = 0 \text{ for } |f| > D]$ can be reconstructed from its samples taken uniformly at a rate $fs > 2D$ samples/sec. The minimum sampling frequency is $fs = 2D$ Hz.

Reconstruction of Signals

The process of reconstructing a continuous time signal $x(t)$ from its samples is known as interpolation. In the sampling theorem a signal $x(t)$ band limited to D Hz can be reconstructed from its samples. This reconstruction is accomplished by passing the sampled signal through an ideal low pass filter of bandwidth D Hz.To recover $x(t)$ or $X(f)$, the sampled signal must be passed through an ideal low pass filter having bandwidth D Hz and gain T.

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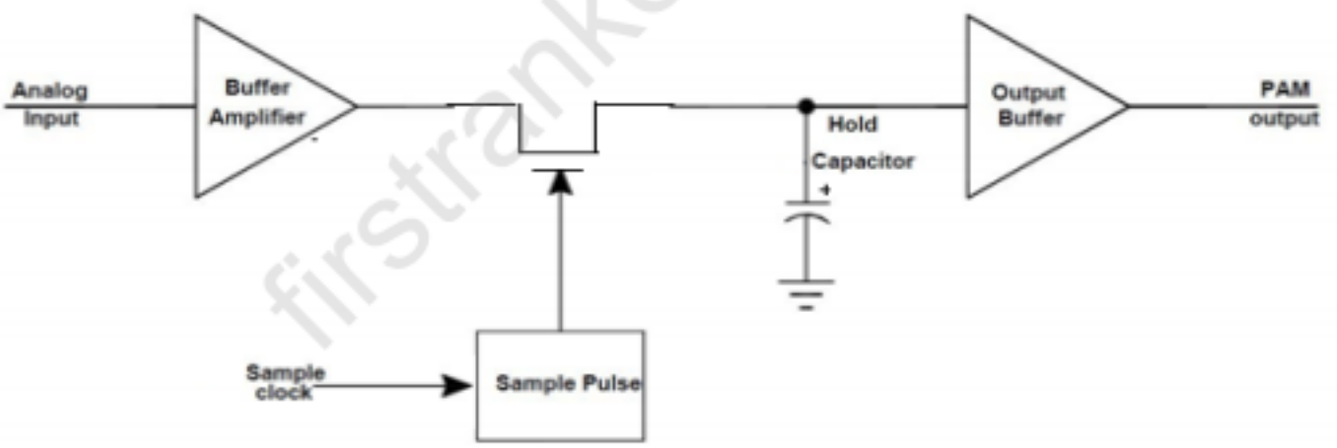
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Sample and hold circuit is used to operate on analog information in a time frame which is expedient. This circuit works by sampling a segment of the information holding it and then converts it into some readout or a form of control signal.

Procedure:

1. Assemble the sample and hold circuit with the desired components.
2. Give the input signal from the function generator.
3. Do not exceed the input signal above 10 volt.
4. Set the frequency of the input signal to 600 Hz.
5. Set the frequency of the sample signal to 5600 Hz.
6. Integrate the sampling inputs.

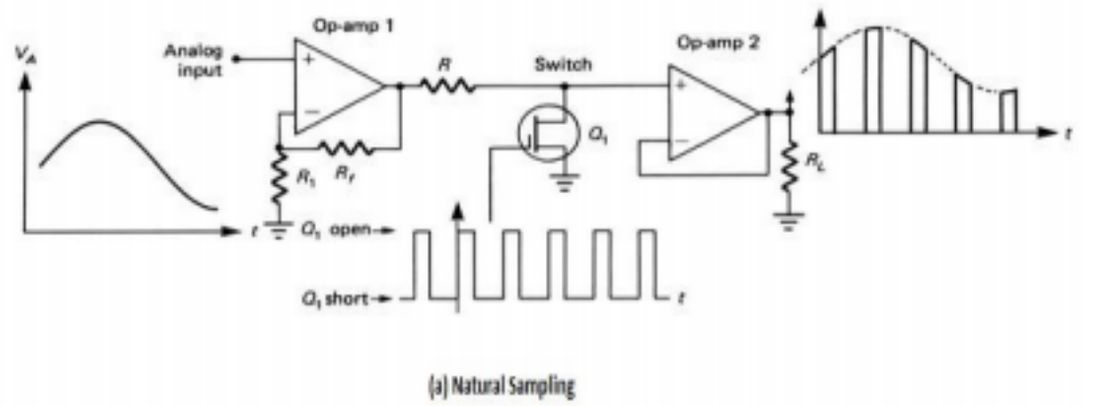
Circuit Diagram



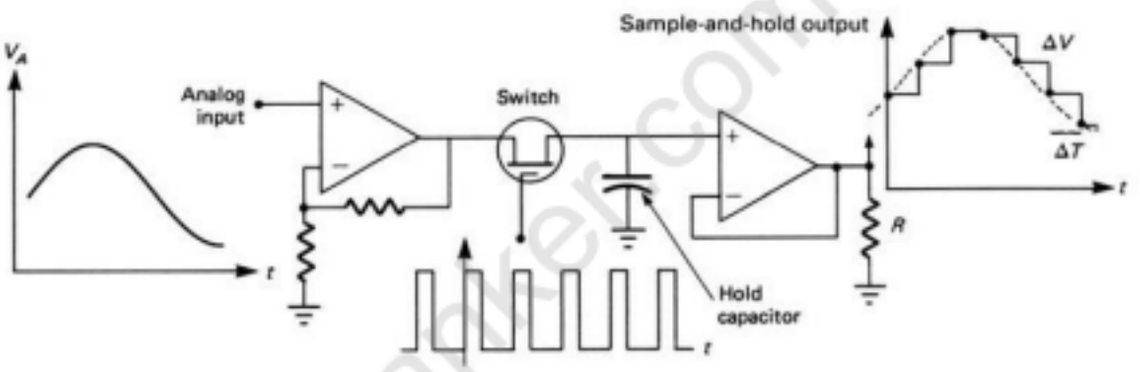
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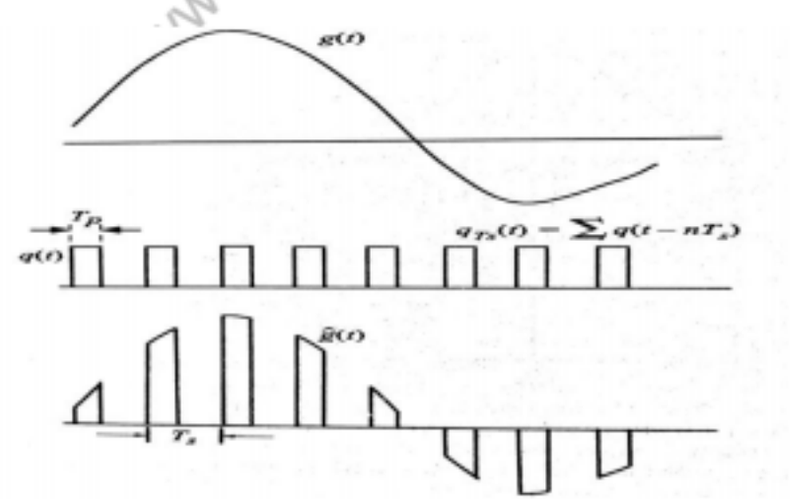
(a) Natural Sampling



(b) Flat Top Sampling

Natural Sampling and Flat Top Sampling Circuit Diagram

Model Graph:



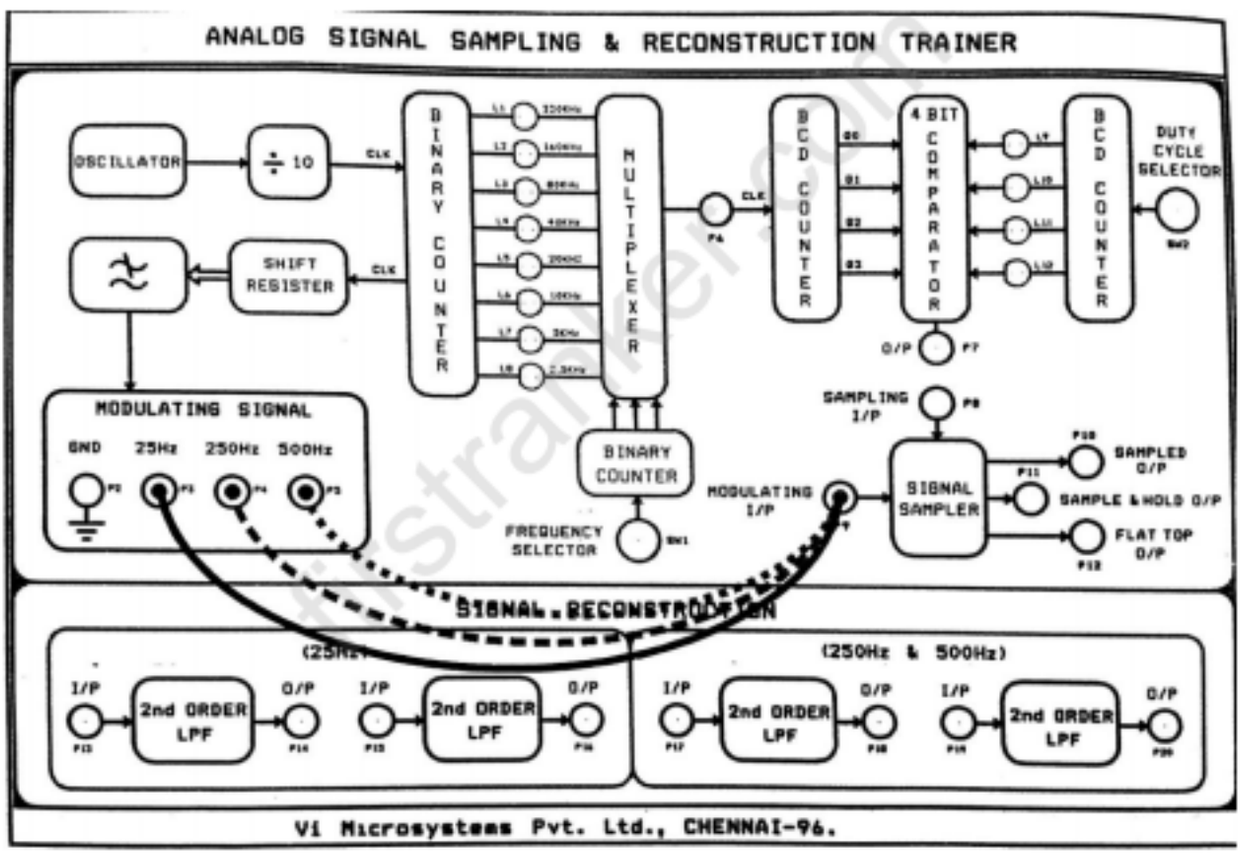
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Tabulation

Signal	Amplitude (V)	Time period (s)
Message signal		
Carrier signal		
Sampled output		

Analog signal sampling and reconstruction trainer kit



Result:

Thus the sampling and reconstruction of signal was studied and verified using sampling reconstruction trainer kit.

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Outcome:

After completion of this experiment, the students will be able to understand the discretization process of continuous time signal.

Applications:

1. Analog-to-digital conversion (ADC)
2. Digital-to-analog conversion (DAC)
3. Storage, and transmission
4. Telephone and encrypted walkie-talkie (8000 Hz sample rate)
5. Wireless intercom and wireless microphone transmission (Audio Sampling)

Viva - voce

1. Define — Sampling Theorem
2. What is the necessary sufficient condition for sampling reconstruction of a signal?
3. Define — Nyquist rate
4. Define — Nyquist interval
5. What are the different types of sampling techniques?
6. What is the effect on sampled signal if $f_s < 2 f_m$?
7. Draw the amplitude spectrum of sampled signal if $f_s < 2 f_m$, $fs = 2 f_m$, $f_s > 2 f_m$.
8. What is aliasing effect in sampling? How to avoid it?
9. Why do we use pre-filtering in sampling?
10. What is reconstruction of sampling theorem?
11. What are the types of filters used in reconstruction?
12. Define — Sample Hold Circuits
13. Differentiate second order; fourth order and sixth order low pass filters in reconstruction process.
14. Explain the sampling reconstruction process.
15. What is the difference between discrete and digital signals?
16. Define — Digital Signal
17. What is the need for converting a continuous signal into a discrete signal?
18. Explain zero-order hold circuit.
19. How to convert an analog signal into a digital signal?
20. Differentiate flat top sampling from natural sampling.
21. Define — Natural Sampling

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Expt. No. 2 TIME DIVISION MULTIPLEXING

Aim:

To study the process of time division multiplexing of four signals using sampling trainer kit

Apparatus required:

1. TDM trainer kit – 1 No.
2. Dual Power Supply – 1 No.
3. Patch cords – 6 No.
4. CRO (30 MHz) – 1 No.

Theory:

Time Division Multiplexing (TDM) is a method of transmitting and receiving independent signals over a common signal path by means of synchronized switches at each end of the transmission line so that each signal appears on the line only a fraction of time in an alternating pattern.

Procedure:

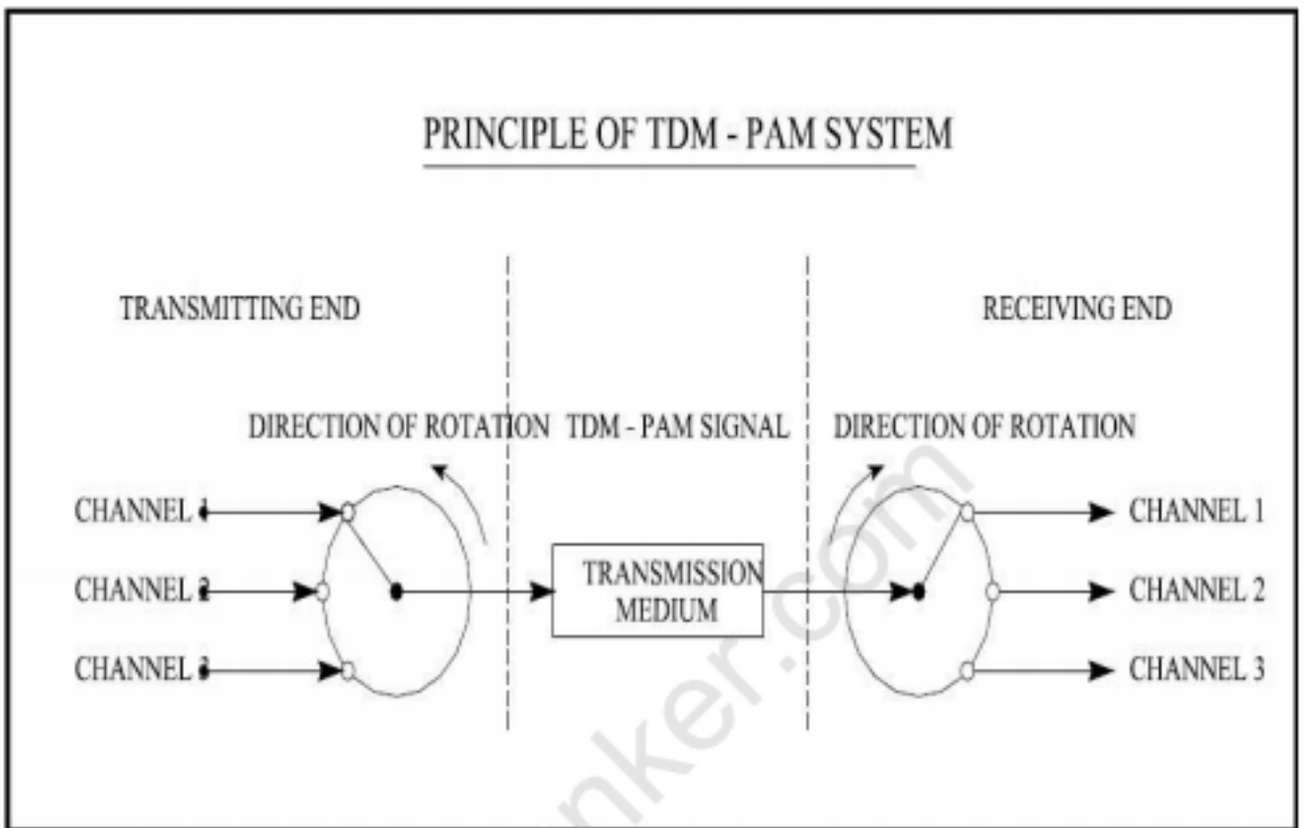
1. Switch ON the power supply.
2. Make initial settings on TDM Trainer kit as follows.
   (a) Set all sine wave voltages to 2V,
   (b) Make the wiring connections as in wiring diagram.
3. Display the multiplexed signal at test point T14 on channel 1 and 250Hz sine wave at test point T2 on channel 2 of oscilloscope.
4. Display the 500Hz sine wave at test point T3 on channel 2 in place of 250Hz, identify sampled version of this sine wave in TDM signal note down.
5. Observe 1 KHz 2 KHz waveforms at test point T4 T5 respectively on oscilloscope .
6. Display the TDM waveform (test point T14) on channel 1 channel synchronization signal (test point T13) on channel 2 of oscilloscope .
7. Display 250Hz sine wave at test point T2 on channel 1 and output sine wave at test point T16 on channel 2 of Oscilloscope.
8. Similarly, observe input output 500Hz, 1 KHz and 2 KHz sine waves on oscilloscope .

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Circuit Diagram

Time division multiplexing

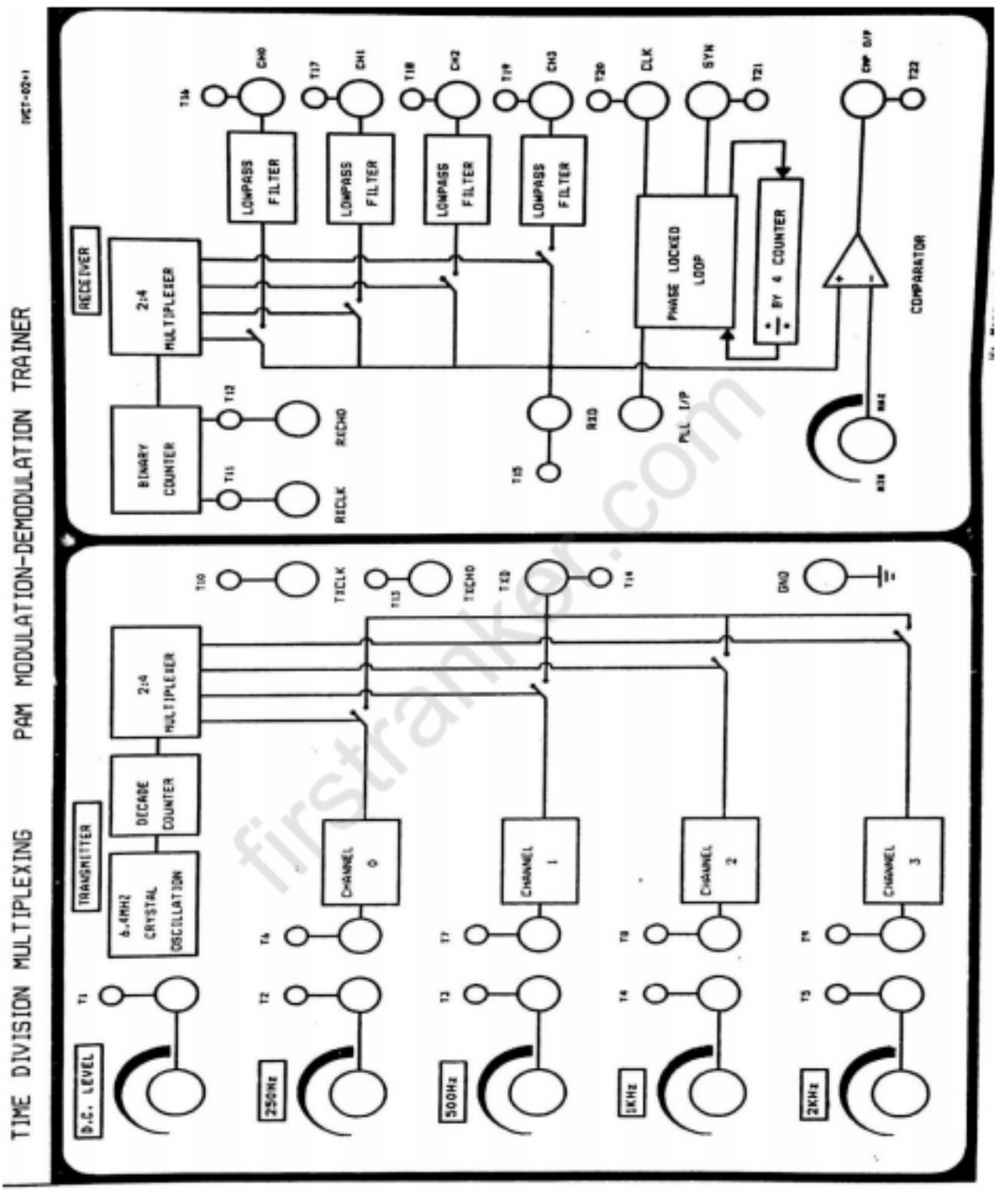


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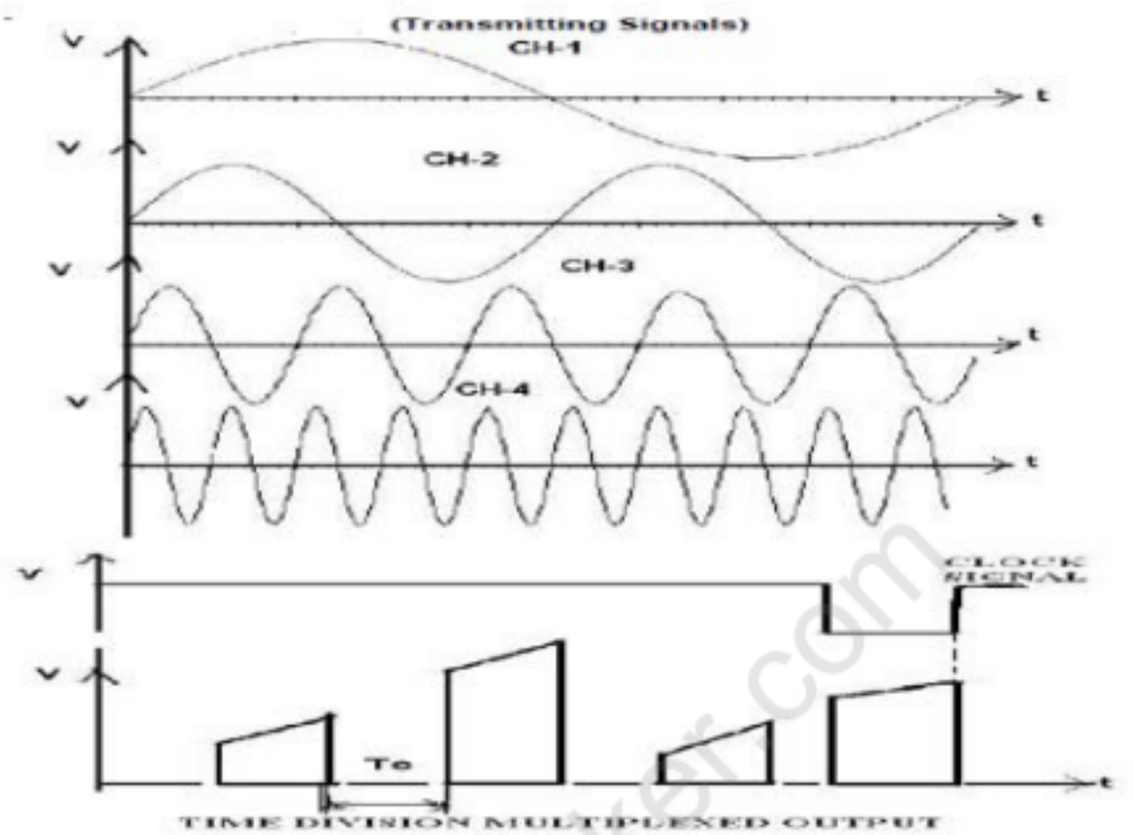
TDM Trainer Kit



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Model Graph:



Tabulation

Sl. No.	Signal	Amplitude (V)	Time period (s)
1.	Message signal 1		
2.	Message Signal 2		
3.	TDM signal		

Result:

Thus the TDM was studied the different types of signals are multiplexed using TDM Technique.

Outcomes:

After completion of this experiment the students will be able to understand the concept of multiplexing the signals.

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Applications:

1. The plesiochronous digital hierarchy (PDH) system, also known as the PCM system, for digital transmission of several telephone calls over the same four-wire copper cable (T-carrier or E-carrier) or fiber cable in the circuit switched digital telephone network
2. The synchronous digital hierarchy (SDH)/synchronous optical networking (SONET) network transmission standards that have replaced PDH.
3. The Basic Rate Interface and Primary Rate Interface for the Integrated Services Digital Network (ISDN).
4. The RIFF (WAV) audio standard interleaves left and right stereo signals on a per-sample basis
5. The GSM telephone system

Viva - voce

1.What is meant by multiplexing technique ?

2.What are the different types of multiplexers?

3. What is the transmission band width of a PAM/TDM signal?

4. What is the crosstalk effect in PAM/TDM system?

5. What are the advantages of TDM system?

6. Distinguish between TDM and FDM.

7. What is the value of Ts in TDM system?

8. What are the applications of TDM system? Give some example.

9. What is meant by signal overlapping?

10. Which type of modulation technique will be used in TDM?

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Expt. No. 3 AM MODULATION & DEMODULATION

Aim:

To transmit a modulating signal after amplitude modulation using AM transmitter receives the signal back after demodulating using AM receiver

Apparatus required:

.

1 Resistor – 4 No.

2 Capacitor – 1 No.

3 Diode – 2 No.

4 AM transmitter receiver trainer kit – 1 No.

5 CRO – 1 No.

6 Patch cards – 6 No.

Theory:

AMPLITUDE MODULATION

Amplitude Modulation is a process by which amplitude of the carrier signal is varied in accordance with the instantaneous value of the modulating signal, but frequency and phase of carrier wave remains constant.

The modulating carrier signal are given by

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

$$V_C(t) = V_C \sin\omega_c t$$

The modulation index is given by, $m_a = V_m / V_C$.

$$V_m = V_{max} - V_{min} \quad V_C = V_{max} + V_{min}$$

The amplitude of the modulated signal is given by,

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

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Where

V_m = maximum amplitude of modulating signal

V_C = maximum amplitude of carrier signal

V_{max} = maximum variation of AM signal

V_{min} = minimum variation of AM signal

Formula Used:

$M = (V_{max} - V_{min} / V_{max} + V_{min}) * 100$

Where, M = Modulation index

Vmax = Maximum peak amplitude

Vmin = Minimum peak amplitude

if

M < 1 Under modulation

M = 1 Critical modulation

M > 1 over modulation

Procedure:

1. Give the modulating signal input to the Amplitude modulator.
2. Increase the amplitude of the modulating signal to the required level.
3. Observe the amplitude and the time duration of the modulating signal using CRO.
4. Observe the amplitude modulated output from the output of amplitude modulator stage .
5. Calculate the modulation index

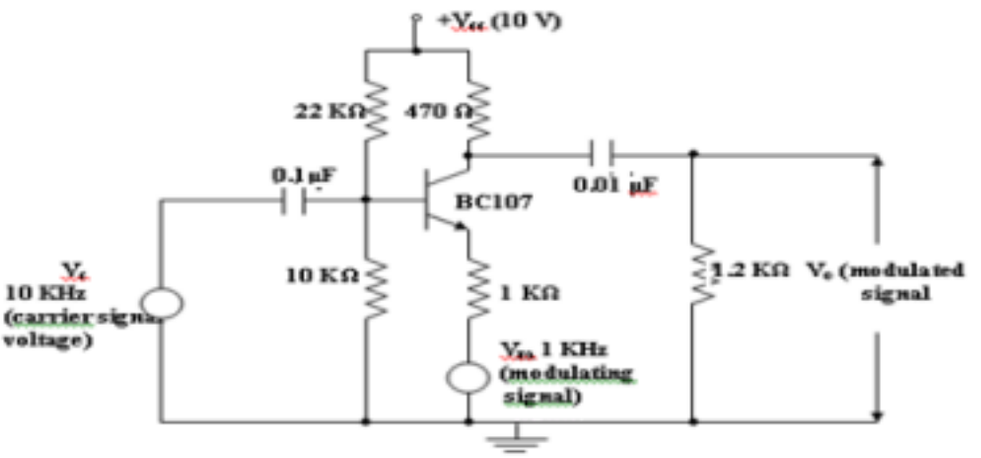
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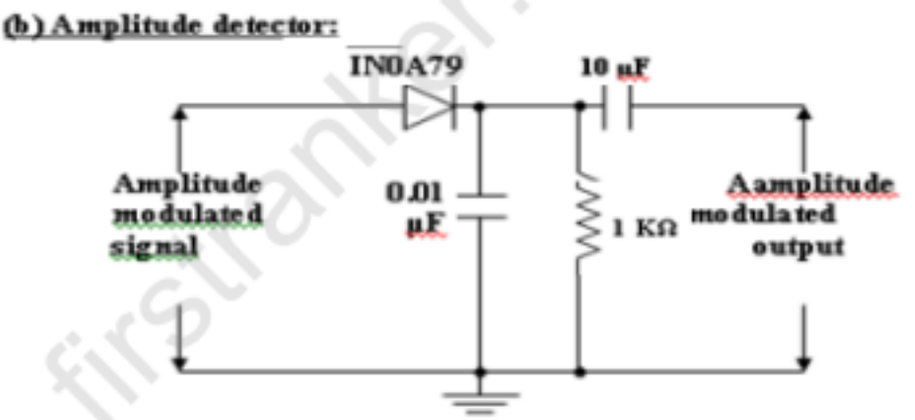
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Circuit Diagram

AM Modulation



AM Demodulation



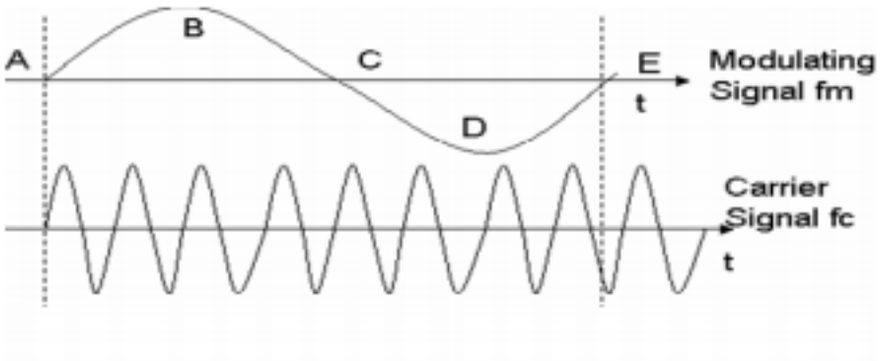
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Model Graph:

1. AM Waveform (Ring diode Transistor based AM Modulator)



AM Modulated wave

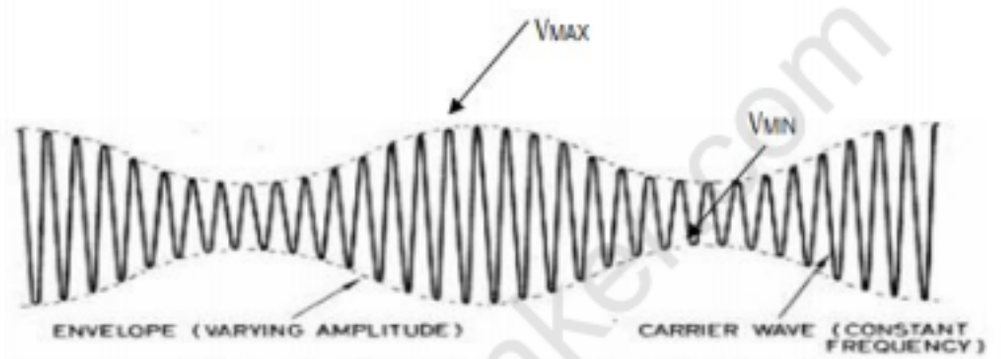
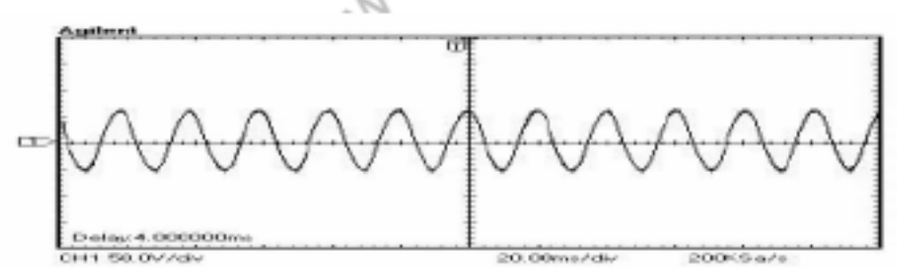
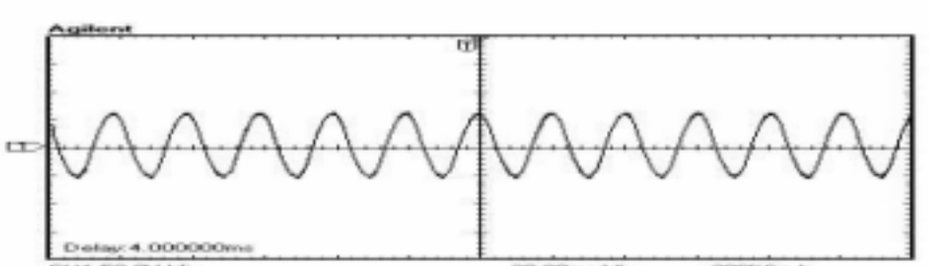


Figure 1 - Time domain of an AM signal

2. Envelope Detector Waveform (Modulating and Demodulated Signal)



Modulating Signal

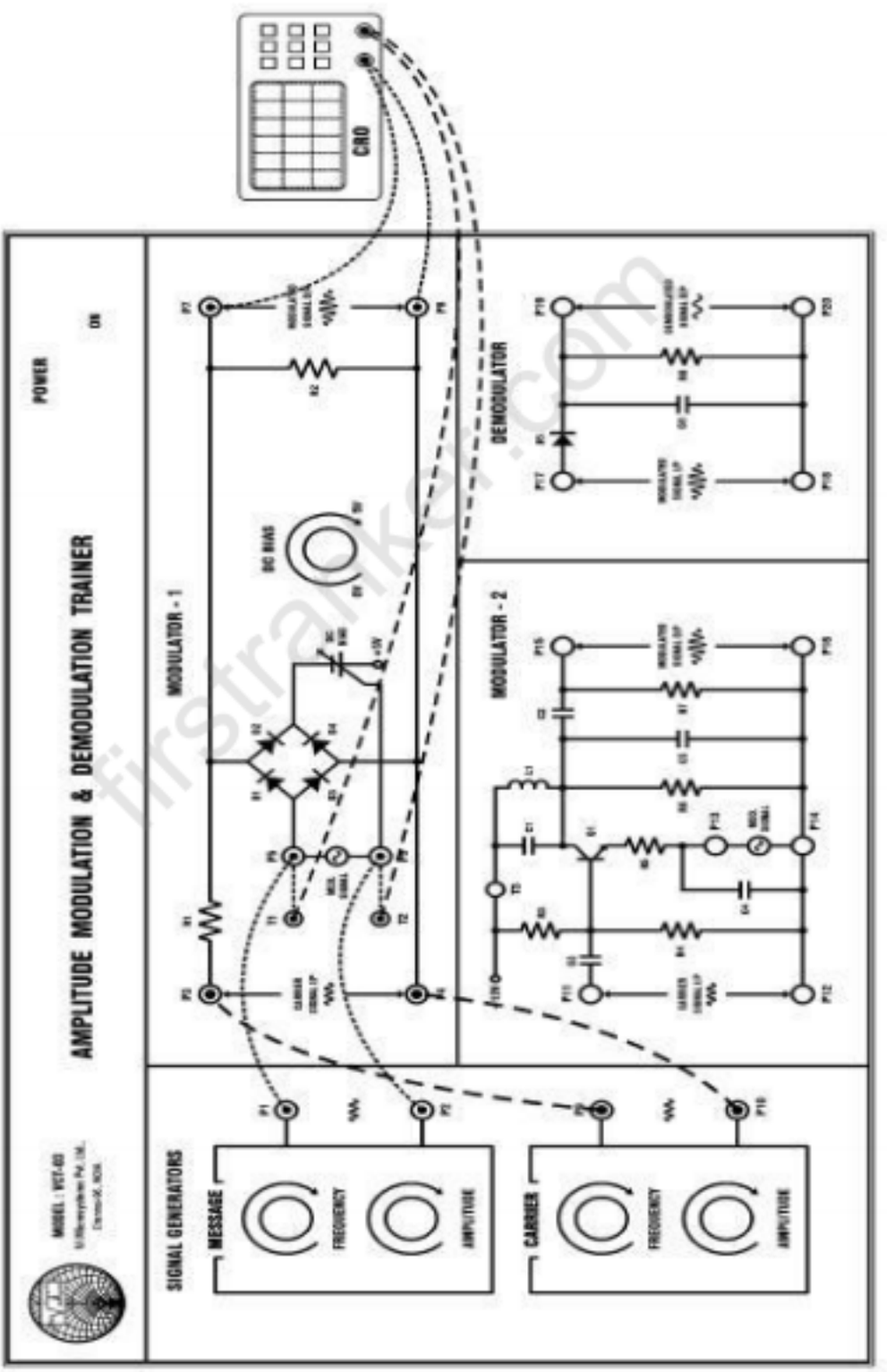


Demodulated signal

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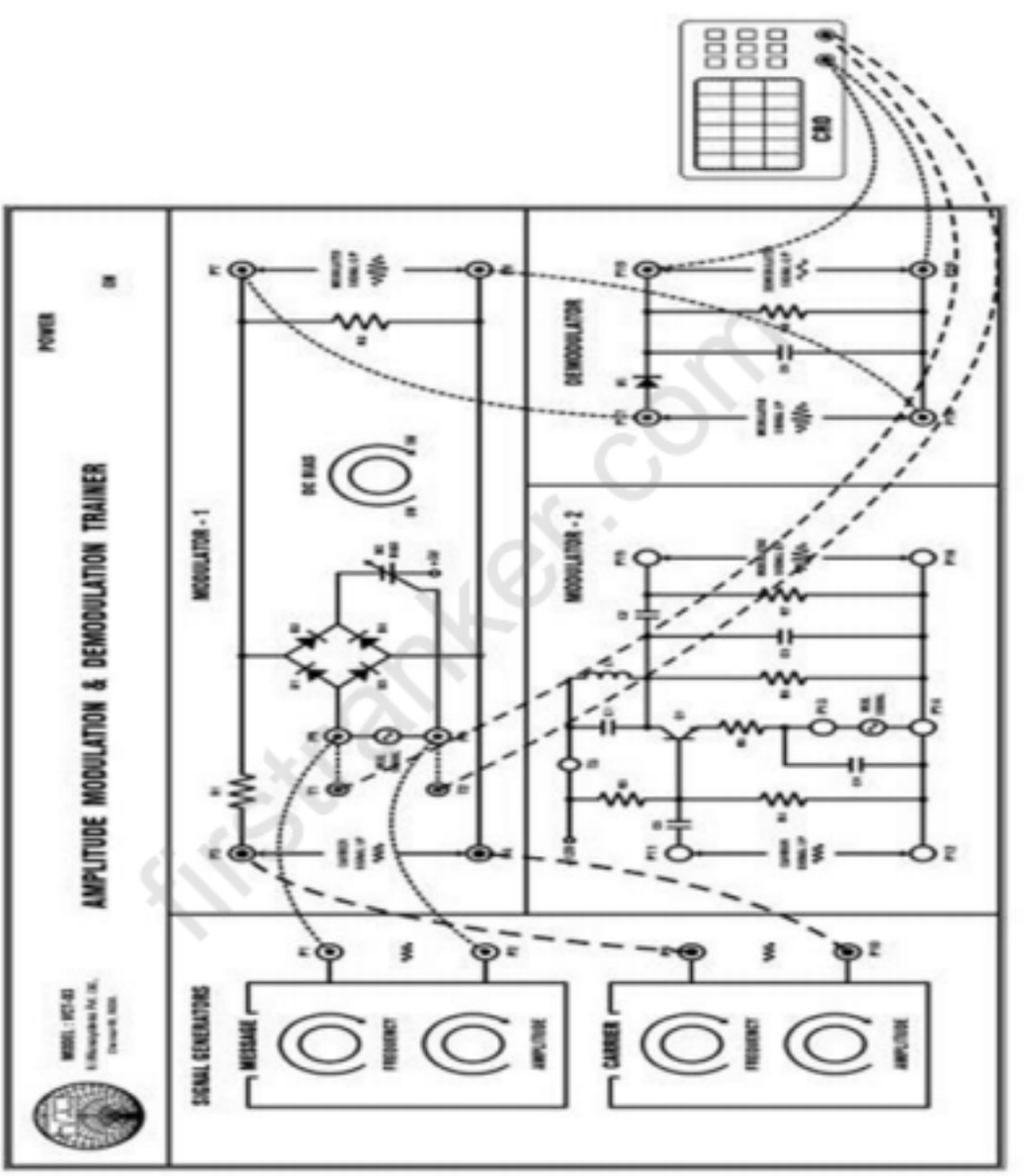
AM Modulation demodulation trainer kit



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AM Modulation and Demodulation trainer kit



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Tabulation

Signal	Amplitude (V)	Time Period (s)	Frequency (Hz)
Message			
Carrier			
Modulated			
Demodulated			

Result:

Thus the AM signal was transmitted using AM trainer kit the AM signal detected using AM detector kit.

Outcome:

After the completion of this experiment the students will be able to design construct the amplitude modulated demodulated wave.

Applications:

1. Commercial broadcasting of both audio and video signals
2. Two way mobile radio communication such as citizen band (CB) radio.
3. Facsimile transmission

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Viva - voce

1. What is modulation and demodulation?
2. Draw the phasor diagram of AM signal.
3. What is the degree of modulation?
4. Explain the need of modulation and demodulation?
5. What is analog modulation? State the various techniques.
6. Why frequency modulation is better than amplitude modulation?
7. Which type of modulation is used in TV transmission?
8. What is depth of modulation?
9. What are the different types of AM generation?
10. Define — Modulation Index
11. What are different types of analog modulation techniques?

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12. What are the other names of message signal? What are the other names of carrier signal?
13. Write the equation of AM signal .Explain each parameter of the equation.
14. Define – Amplitude modulation
15. What is the range of Audio frequency signals? What is the range of Radio frequency signal?
16. What are the applications of Amplitude modulators?
17. How many generation methods are there to generate an AM wave? What are the methods of demodulation of an AM wave?
18. Explain the operation of diode detector circuit.
19. Write the formula for modulation index. Differentiate under, over perfect modulation in AM.
20. As the amplitude of message signal increases, modulation index increases or decreases?
21. Define – Single tone modulation
22. Draw the frequency spectrum of AM wave.
23. If modulation index is 100%, calculate the ratio of total power to carrier power of an AM wave.

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Expt. No. 4 FREQUENCY MODULATION & DEMODULATION

Aim:

To transmit a modulating signal after frequency modulation using FM transmitter receive the signal back after demodulating using FM receiver

Apparatus required:

.

1. Resistor – 4 No.
2. Capacitor – 1 No.
3. Diode – 2 No.
4. AM transmitter Receiver trainer kit – 1 No.
5. CRO – 1 No.
6. Patch cards – 6 No.

Theory:

Frequency modulation (FM) is a form of modulation that represents information as variations in the instantaneous frequency of a carrier wave. In analog applications, the carrier frequency is varied in direct proportion to changes in the amplitude of an input signal. Shifting the carrier frequency among a set of discrete values can represent digital data, a technique known as frequency-shift keying. FM is commonly used at VHF radio frequencies for high-fidelity broadcasts of music speech Normal TV sound is also broadcast using FM. A narrowband form is used for voice communications in commercial amateur radio settings. The type of FM used in broadcast is generally called wide-FM, or W-FM.

In two-way radio, narrow-fm (N-FM) is used to conserve bandwidth. In addition, it is used to send signals into space.

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FM is also used at intermediate frequencies by most analog VCR systems, including VHS, to record the luminance (black,white) portion of the video signal. FM is the only feasible method of recording video and retrieving video from magnetic tape without extreme distortion, as video signals have a very large range of frequency components — from a few hertz to several megahertz, it is too wide for equalizers to work with due to present of electronic noise below -60 dB. FM also keeps the tape at saturation level, therefore acts as a form of noise reduction, a simple limiter can mask variations in the playback output.The FM capture effect removes print-through pre-echo.

Procedure:

FM Modulator:

1. Switch ON the Power supply.
2. Connect the sine wave generator output to frequency modulator input.
3. Select the low frequency carrier (or) high frequency carrier.
4. Connect the CRO input to the frequency modulator output.
5. Vary the amplitude pot meter from minimum to maximum to find out the frequency deviation for FM.
6. Observe the frequency modulator output .

FM Demodulator:

A) PLL Detector

1. Connect frequency modulated output to the PLL detector input.
2. Now set the DPDT switch in low frequency mode.
3. Connect CRO input to PLL detector output.
4. Observe the Demodulated O/P compare with the original input.

B) Quadrature Detector

1. Connect the frequency modulated output to Quadrature detector input.
2. Now set the DPDT switch in high frequency mode.
3. Connect the CRO input to Quadrature detector output.
4. Observe the Demodulated O/P and compare with the original input.

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C) Phase Discriminator (Foster-Seeley detector)

1. Connect the frequency modulated output to Phase discriminator input.
2. Set the DPDT switch in high frequency mode.
3. Connect the CRO input to Phase discriminator output.
4. Observe the Demodulated O/P and then compare with the original input.

D) Ratio Detector

1. Connect the frequency modulated output to Ratio detector input.
2. Set the DPDT switch in high frequency mode.
3. Connect the CRO input to Ratio detector output.
4. Observe the Demodulated O/P and then compare with the original input.

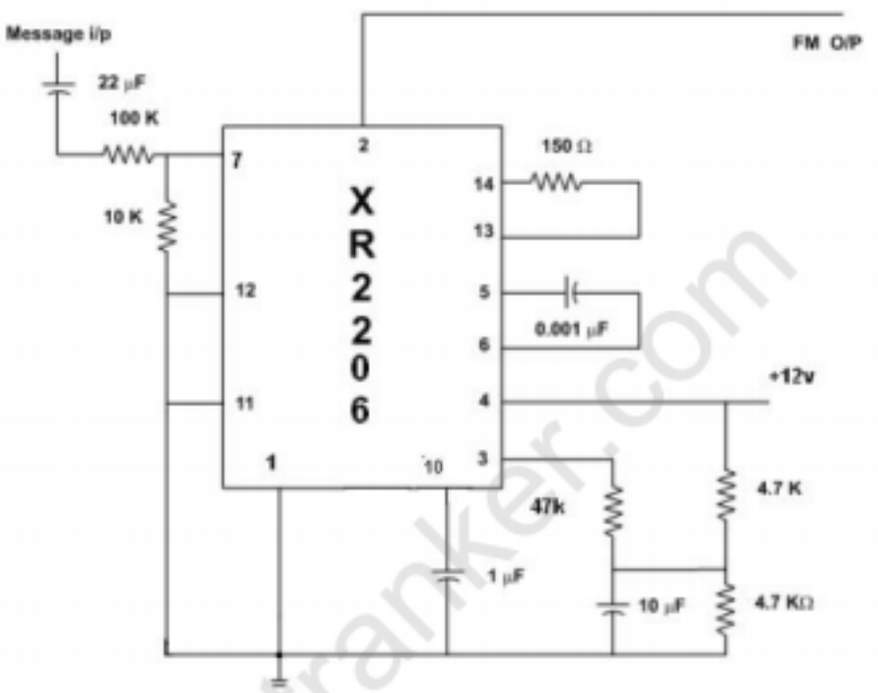
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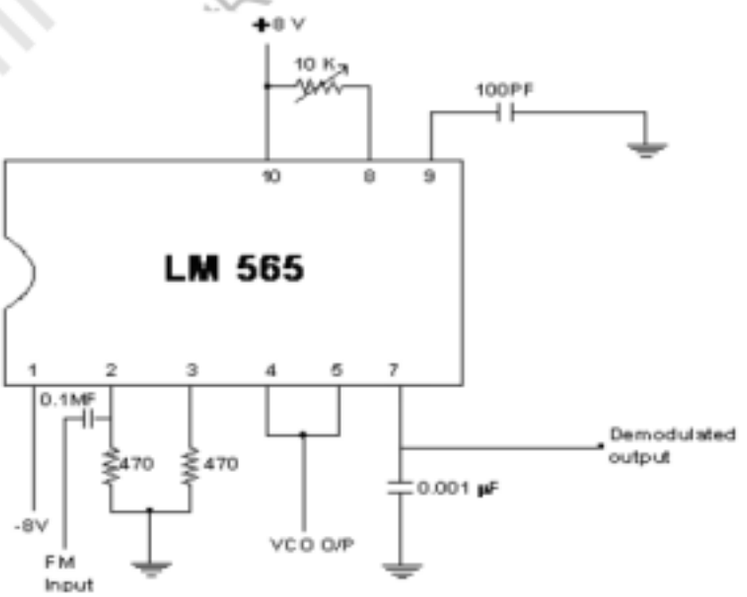
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Circuit Diagram

FM Modulator



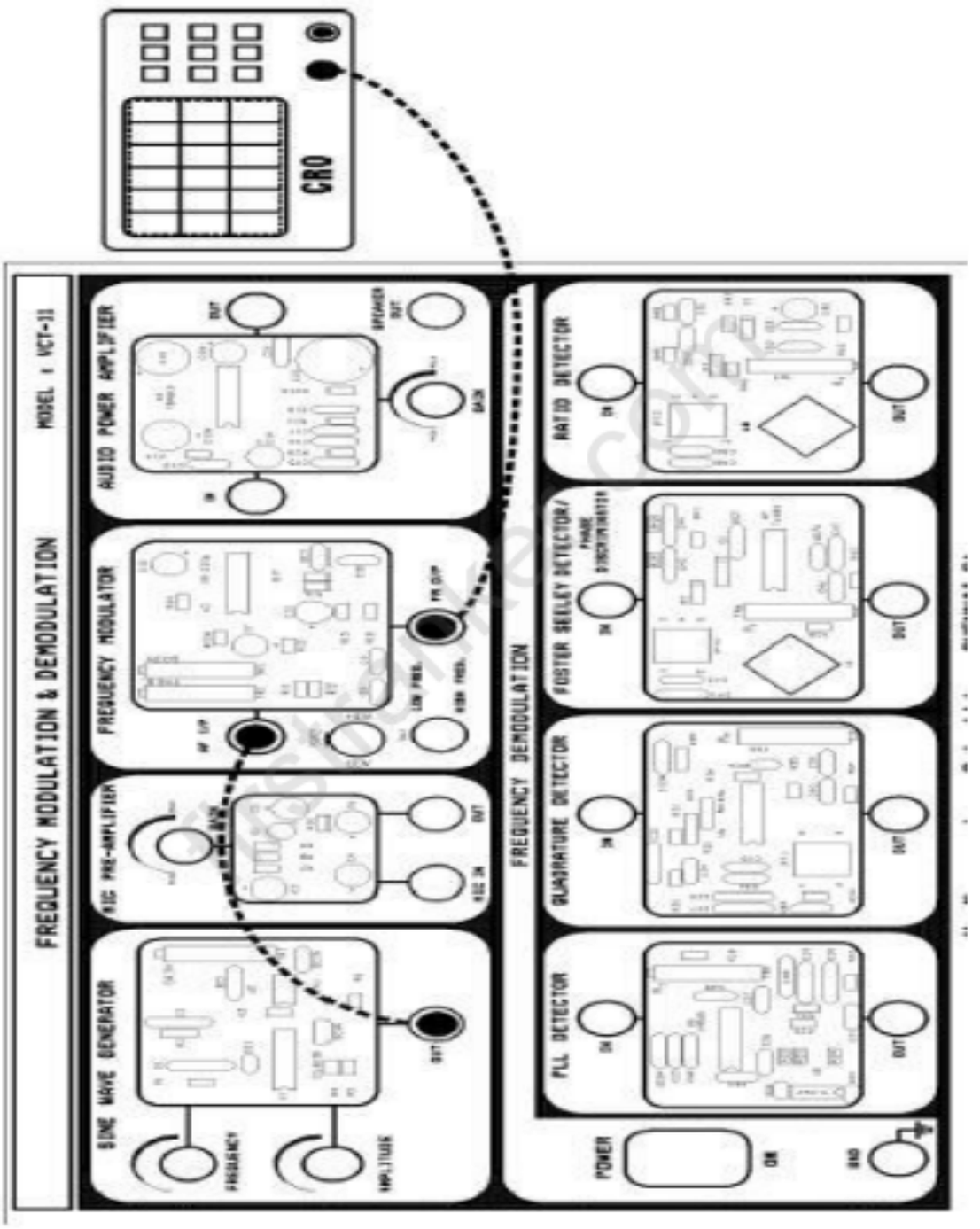
FM Demodulator



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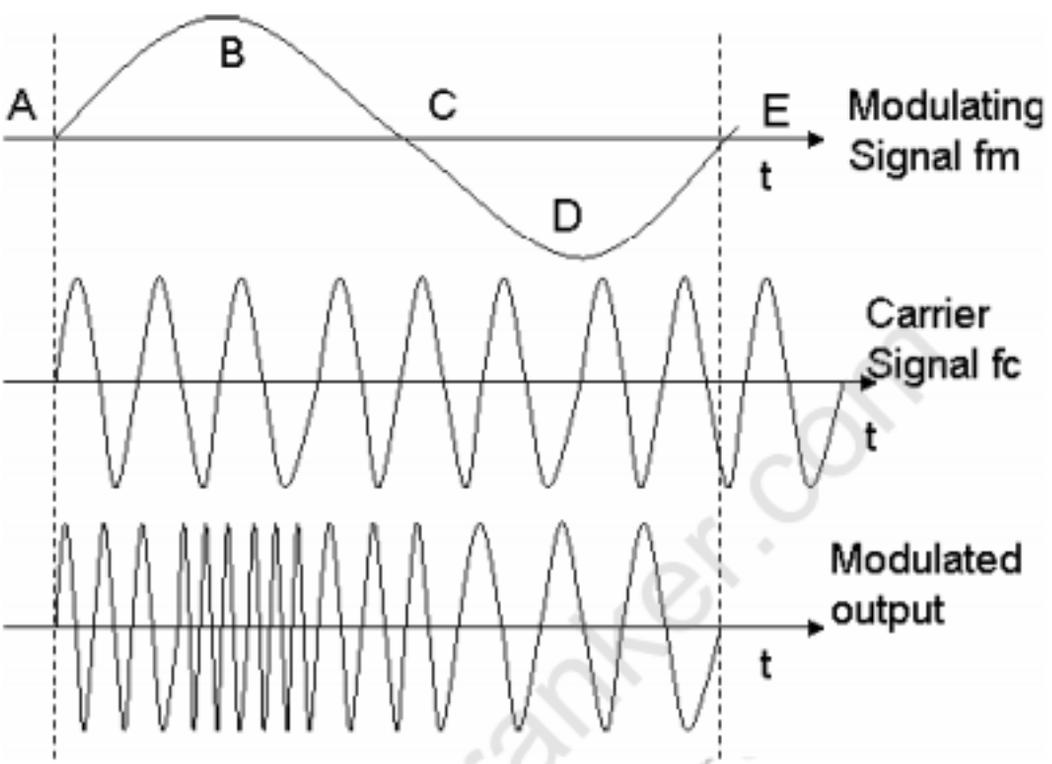
FM Modulation and Demodulation Trainer kit



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Model Graph:



Tabulation

Signal	Amplitude (V)	Time Period (s)	Frequency (Hz)
Message			
Carrier			
Modulated			
Demodulated			

Result:

Thus the FM Modulation and Demodulation is performed for the given message signal.

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Outcome:

After the completion of this experiment the students will be able to design and construct the frequency modulated and demodulated wave.

Applications:

1. Television sound transmission
2. Two way mobile radio
3. Cellular Radio
4. Microwave
5. Satellite Communication System

Viva - voce

1. Define — Frequency Modulation
2. How it is different from phase modulation?
3. Write equation of FM wave, explain each parameter in it.
4. Draw the amplitude spectrum of FM wave.
5. Give the Carson's rule in FM.
6. Define — Modulation Index
7. Differentiate between Narrow band FM from Wide band FM.
8. Draw message, carrier FM waves .
9. Explain the methods for generation of FM its demodulation.
10. How FM wave is different from PM wave?
11. Give the practical applications of FM.
12. State advantages and disadvantages of FM.
13. What is the range of speech signals?
14. What type of modulation is used in radios?
15. What type of modulation is used in voice signals?
16. Define — Phase Modulation
17. Draw the phasor diagram of FM signal.
18. What are the different types of FM generation?

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Expt. No. 5 PCM MODULATION & DEMODULATION

Aim:

To generate a PCM signal using PCM modulator detect the message signal from PCM signal by using PCM demodulator

Apparatus Required:

1. PCM trainer kit – 1 No.
2. CRO – 1 No.
3. Connecting probes – 4 No.

Theory:

Pulse code modulation is a process of converting an analog signal into digital. The voice or any data input is first sampled using a sampler (which is a simple switch) then quantized. Quantization is the process of converting a given signal amplitude to an equivalent binary number with fixed number of bits. This quantization can be either mid tread or mid raise it can be uniform or non-uniform based on the requirements. For example in speech signals, the higher amplitudes will be less frequent than the low amplitudes. So higher amplitudes are given less step size than the lower amplitudes thus quantization is performed non-uniformly. After quantization the signal is digital the bits are passed through a parallel to serial converter and then launched into the channel serially.

At the demodulator the received bits are first converted into parallel frames .Each frame is de-quantized to an equivalent analog value. This analog value is thus equivalent to a sampler output. This is the demodulated signal.

In the kit the analog signal is passed through a ADC (Analog to Digital Converter) and then the digital codeword is passed through a parallel to serial converter block. This is modulated PCM. This is taken by the Serial to Parallel converter and then through a DAC to get the demodulated signal. The clock is given to all these blocks for synchronization. The input signal can be either DC or AC according to the kit. The waveforms can be observed on a CRO for DC without problem. AC also can be observed but with poor resolution.

Procedure:

1. Power on the PCM kit.

2. Measure the frequency of sampling clock.

3. Apply the DC voltage as modulating signal.

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4. Connect the DC input to the ADC measure the voltage.

5. Connect the clock to the timing control circuit.

6. Note the binary work from LED display. The serial data through the channel can be observed in the CRO.

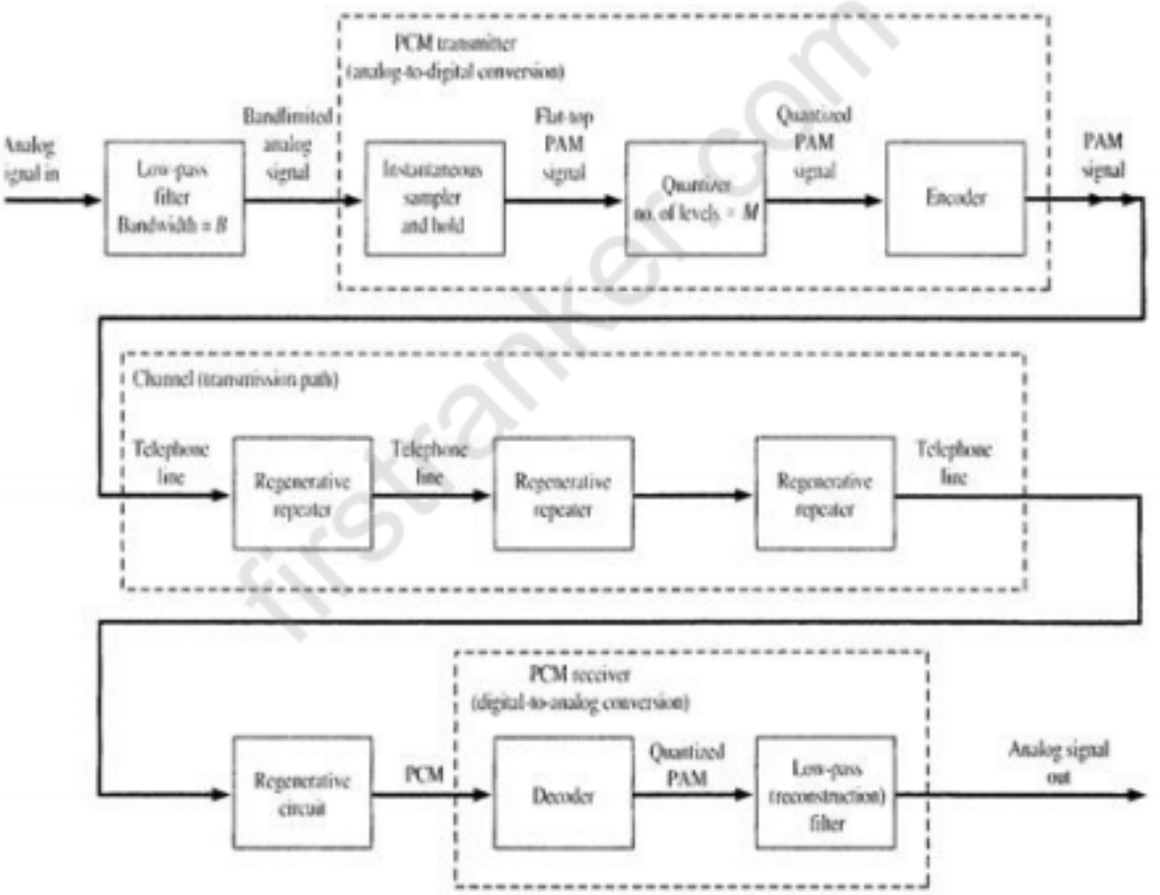
7. Also observe the binary word at the receiver end.

8. Now apply the AC modulating signal at the input.

9. Observe the waveform at the output of DAC.

10. Note the amplitude of the input voltage the codeword. Also note the value of the output voltage. Show the codeword graphically for a DC input.

Block diagram of PCM Transmission system

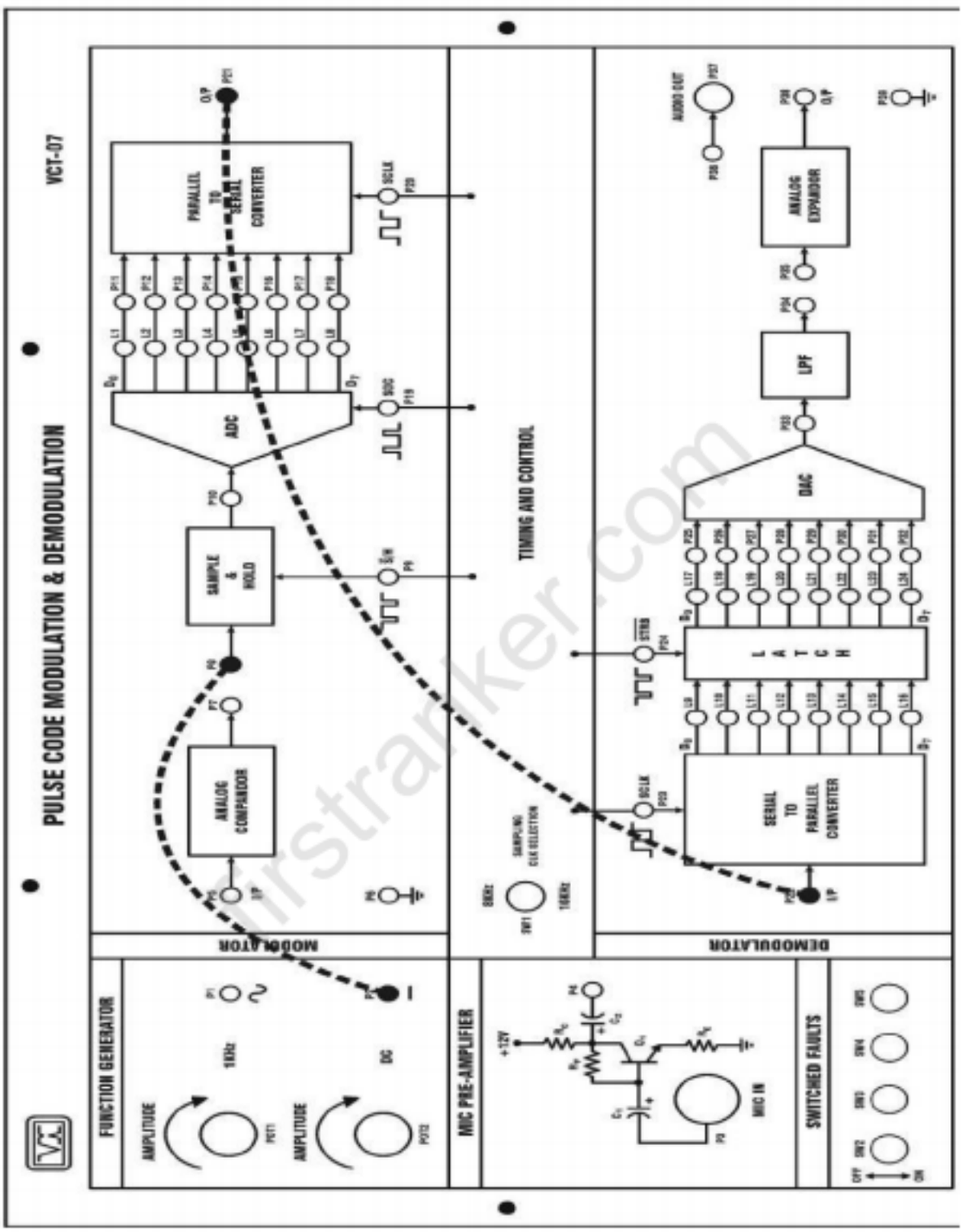


PCM Transmission System

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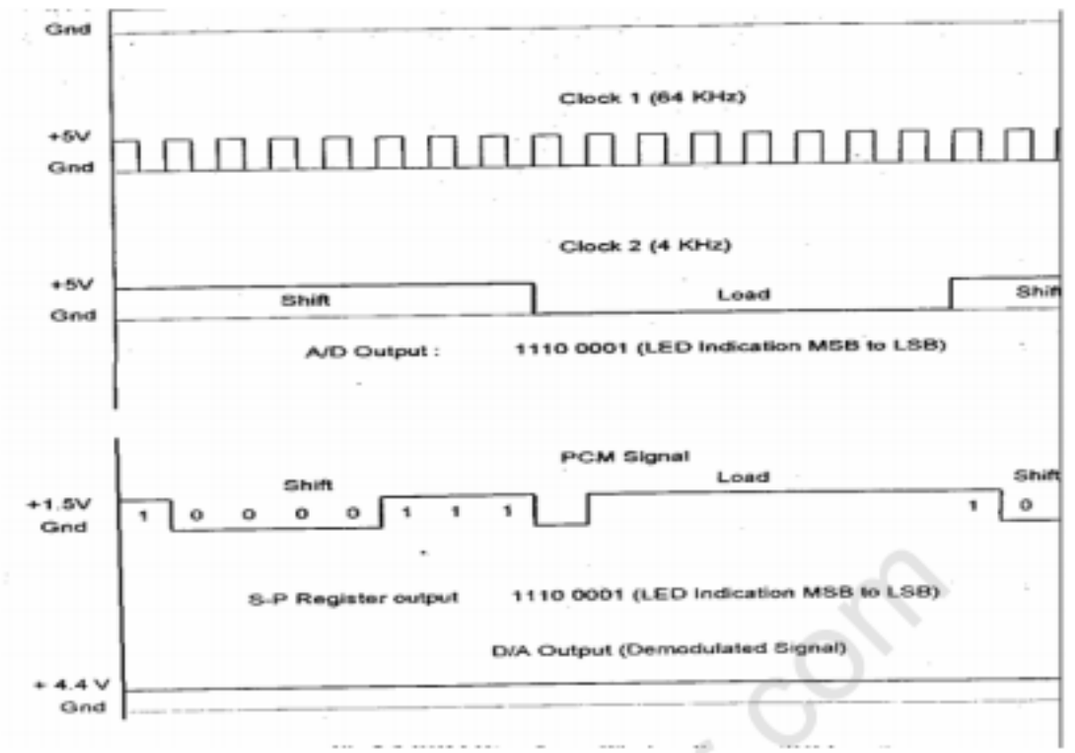
PCM Modulation and Demodulation Trainer kit



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Model Graph:



Tabulation

SIGNALS	AMPLITUDE (V)	TIME PERIOD (s)
DC Input		
Sampled Signal		
Clock Pulse		
PCM Output		
DC Output		

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Result:

Thus the PCM wave generated for the given DC or sinusoidal signals using Trainer.

Outcome:

After the completion of this experiment the students will be able to design and construct the pulse code modulated and demodulated wave.

Applications:

1. Military Applications.
2. The PCM is used in the satellite transmission system.

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3. It is used in space communication.
4. It is used in telephony.
5. The compact disc (CD) is a recent application of PCM.

Viva - voce

1. Define – Modulation
2. State sampling theorem
3. Define – Demodulation
4. Define – Pulse Code Modulation
5. What is aliasing effect?
6. What is quantization?
7. Define – Bit Rate
8. Define – Baud Rate
9. What are the advantages of PCM?
10. Define – Signal to Noise Ratio
11. What are the limitations of PCM?
12. What are the applications of PCM?
13. Define – Encoding
14. Define – Decoding
15. Define – Nyquist Rate
16. What is multiplexing?
17. What is de-multiplexing?
18. What are the types of pulse modulation?
19. What should be the minimum bandwidth required to transmit a PCM channel?
20. What is the value of signal to noise ratio in PCM?

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Expt. No. 6 DELTA MODULATION & DEMODULATION

Aim:

To transmit an analog message signal in its digital form and reconstruct back the original analog message signal at receiver by using Delta modulator

Apparatus required:

1. DM and ADM Trainer kit – 1 No.
2. CRO – 1 No.
3. Connecting probes – 4 No.

Theory:

Delta modulation is the DPCM technique of converting an analog message signal to a digital sequence. The difference signal between two successive samples is encoded into a single bit code. A present sample of the analog signal m(t) is compared with a previous sample , the difference output is level shifted, i.e. a positive level (corresponding to bit 1) is given if difference is positive and negative level (corresponding to bit 0) if it is negative. The comparison of samples is accomplished by converting the digital to analog form then comparing with the present sample. This is done using an Up counter DAC. The delta modulated signal is given to up counter then to a DAC. The analog input is given to OPAMP and LPF to obtain the demodulated output.

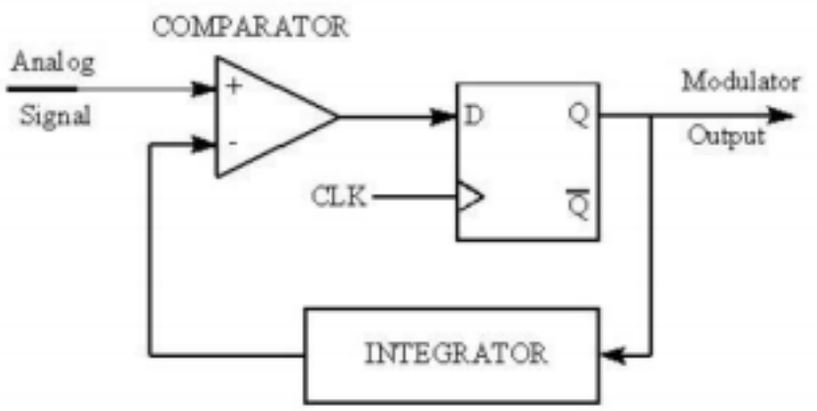
Procedure:

1. Switch on the kit. Connect the clock signal and the modulating input signal to the modulator block.
2. Observe the modulated signal in the CRO.
3. Connect the DM output to the demodulator circuit. Observe the demodulator output on the CRO.
4. Also observe the DAC output on the CRO.
5. Change the amplitude of the modulating signal.
6. Observe the DAC output. Notice the slope overload distortion.
7. Keep the tuning knob to minimize distortion.
8. Note this value of the amplitude. This is the minimum required value of the amplitude to overcome slope overload distortion.
9. Calculate the sampling frequency required for no slope overload distortion.
10. Compare the calculated measured values of the sampling frequency.

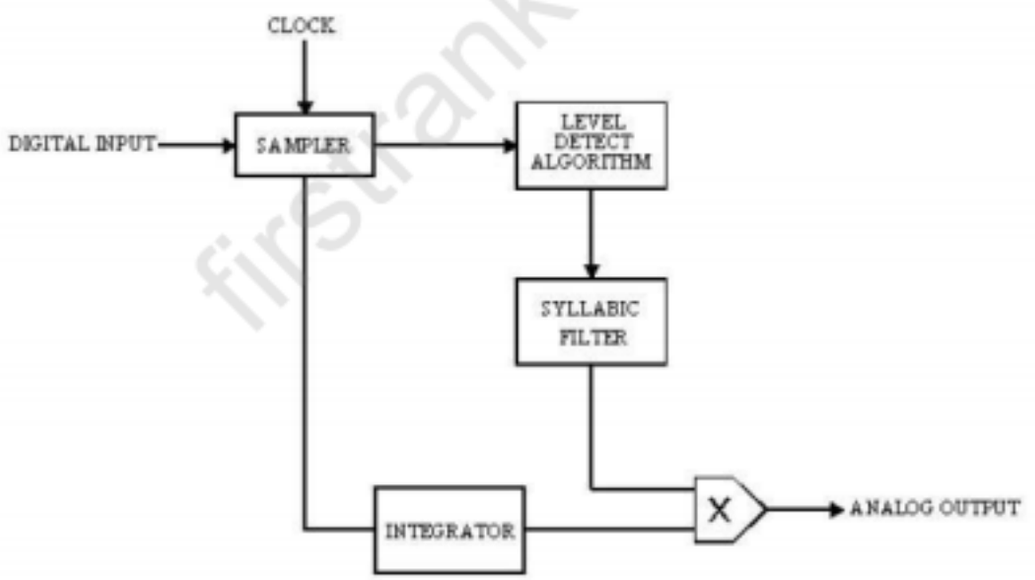
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Block Diagram Delta modulator and demodulator



Delta Modulator

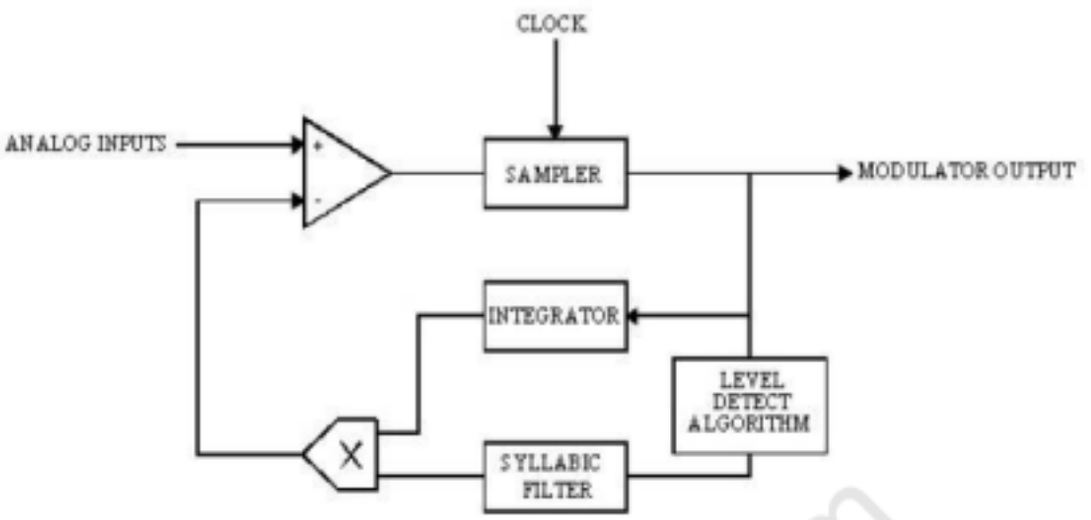


Delta Demodulator

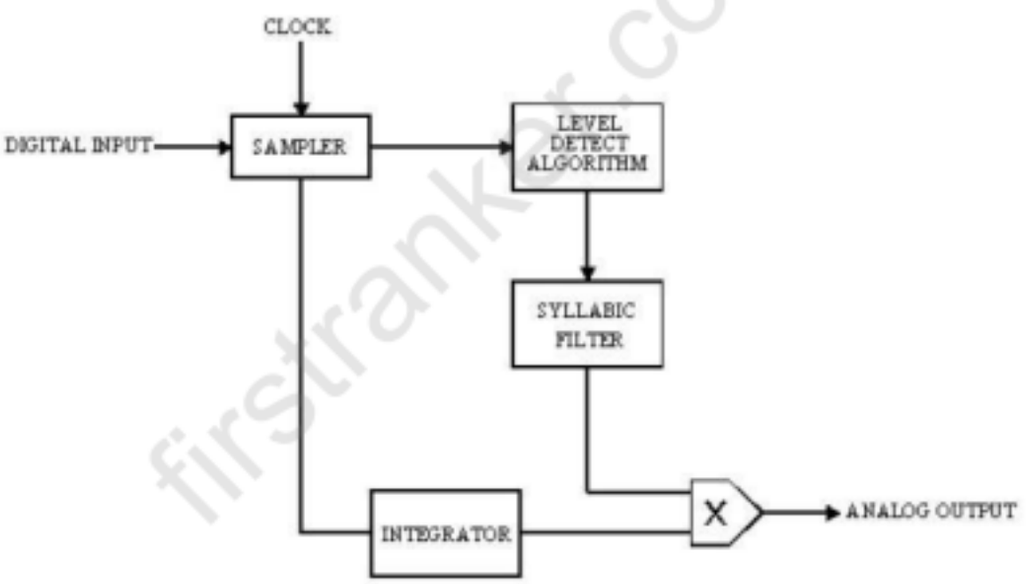
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Block diagram of Adaptive delta modulator and demodulator



Adaptive Delta Modulator



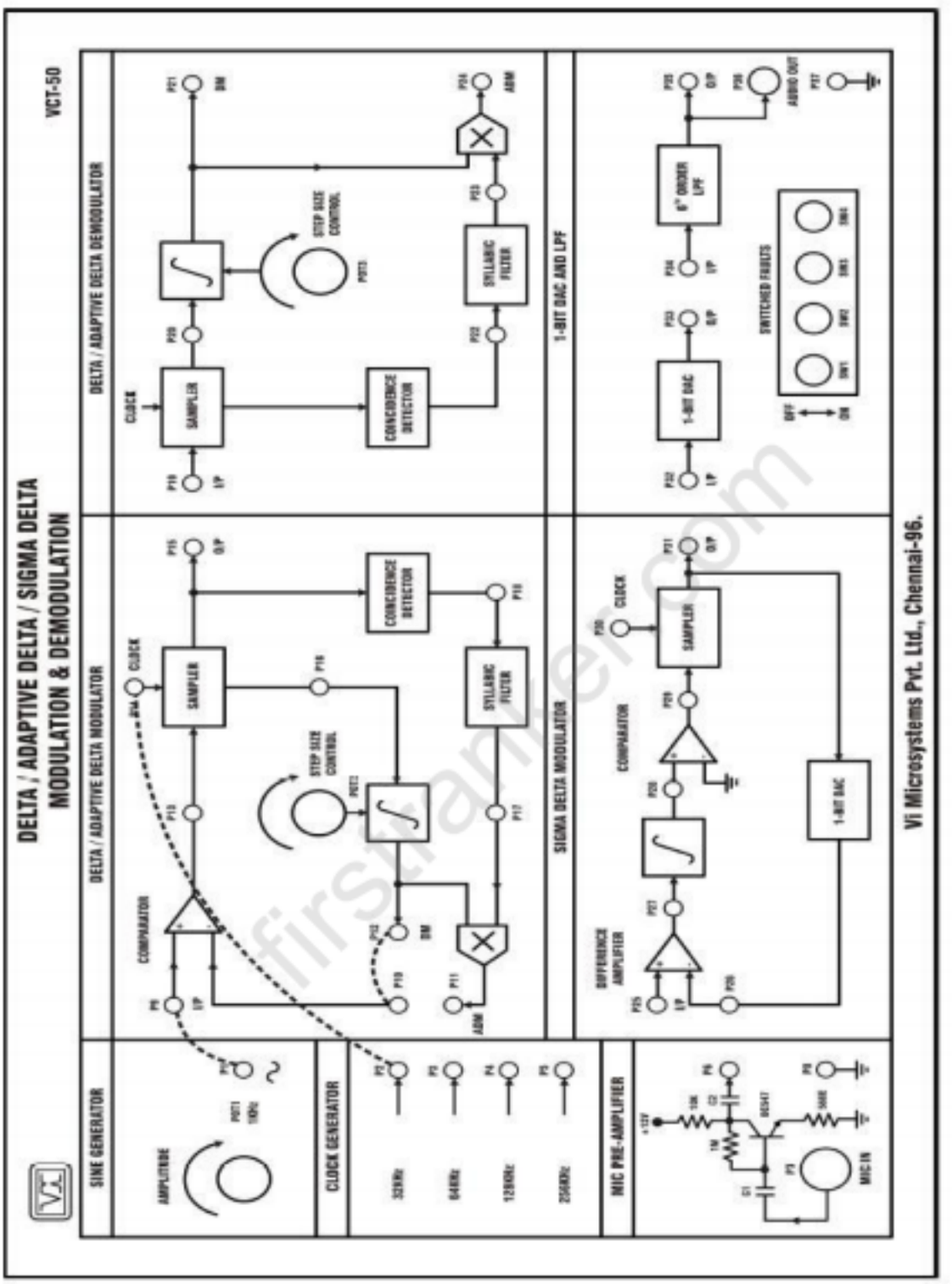
Adaptive Delta Demodulator

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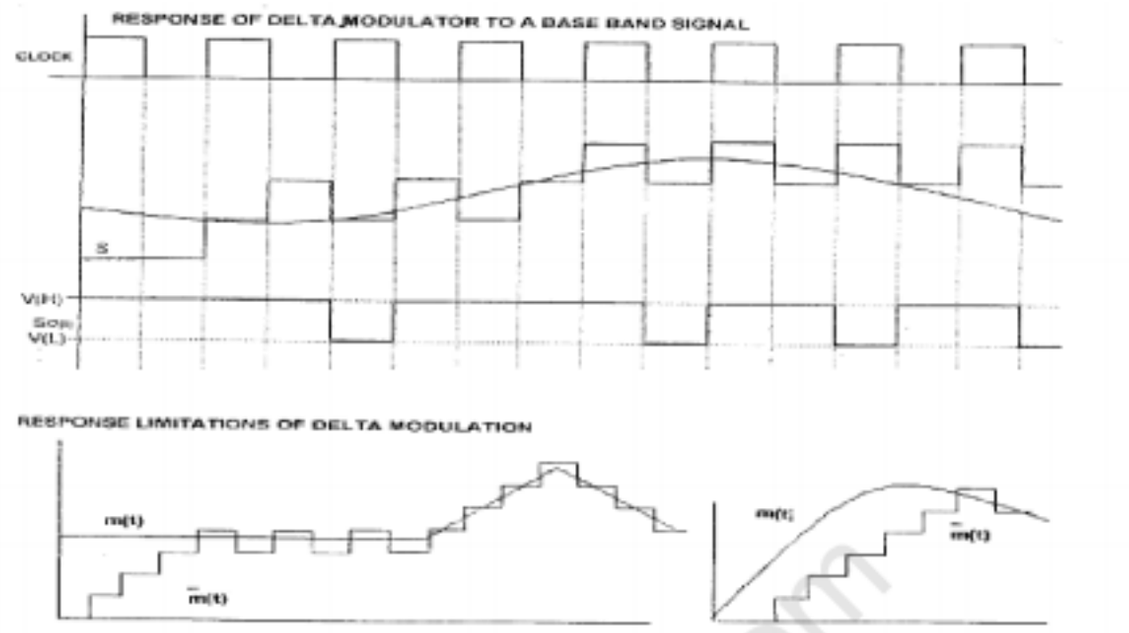
Delta Modulation and Adaptive Delta Modulator Trainer kit



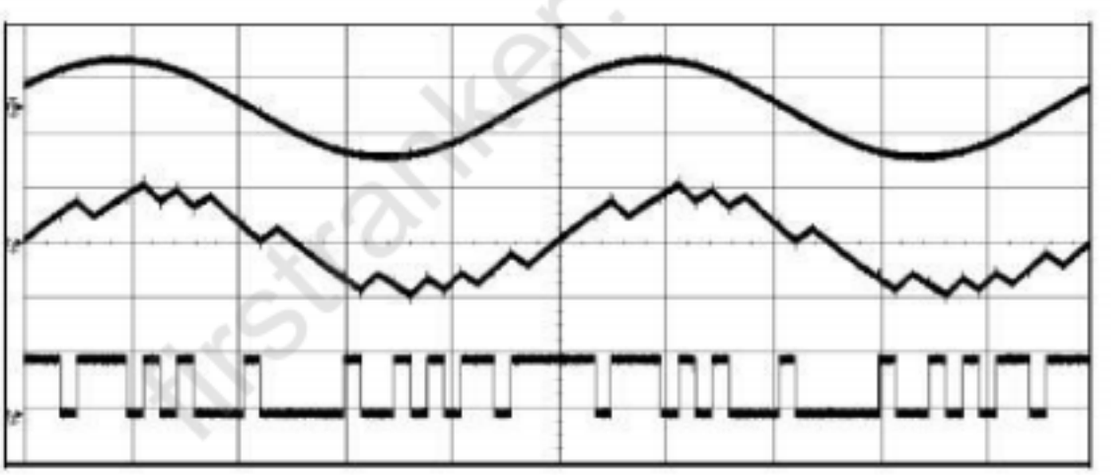
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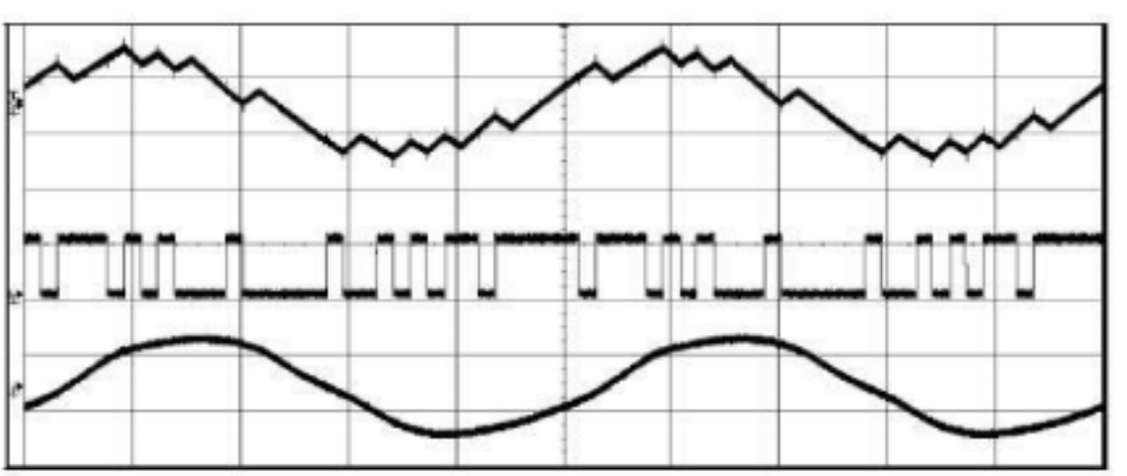
Model Graph:



For 32KHz clock frequency (Modulator)



For 32KHz clock frequency (Demodulator)



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Tabulation 1

For Delta Modulation

Sl. No.	Signal	Amplitude (V)	Time period (s)	Frequency (Hz)
1	Modulating Signal			
2	Carrier Signal			
3	Modulated Signal			
4	Demodulated Signal			

Tabulation 2

For Adaptive Delta Modulation

Sl. No.	Signal	Amplitude (V)	Time period (s)	Frequency (Hz)
1	Modulating Signal			
2	Carrier Signal			
3	Modulated Signal			
4	Demodulated Signal			

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Result:

Thus the output waveforms of Delta modulation and adaptive delta modulation circuit were observed.

Outcome:

After the completion of this experiment the students will be able to design and construct the delta modulation adaptive delta modulation circuit.

Applications:

1. Digital voice storage
2. Voice transmission

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3. Radio communication devices such TV remotes.
4. Delta Modulation was used by Satellite Business Systems or SBS
5. DM used in high resolution A/D and D/A converters.

Viva - voce

1. What is delta modulation?
2. What is adaptive delta modulation?
3. What are the advantages of adaptive delta modulation over delta modulation?
4. What is slope over load distortion?
5. What is granular noise effect?
6. What are the two limitations of delta modulation?
7. What is the function of integrator?
8. What is comparator?
9. What is companding?
10. What is the advantage of delta modulation over pulse modulation?
11. Distinguish between DPCM and DM.
12. What are the different types of digital modulation?
13. What is sampling rate?
14. Which kind of multiplexing used in digital communication?
15. Why is sample hold circuit used?
16. What are the advantages of digital transmission?
17. How is the performance corrupted in PCM?
18. What are the different types of multiplexing?
19. What is aliasing effect?
20. How to avoid aliasing effect?

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Expt. No. 7 LINE CODING DECODING TECHNIQUES

Aim:

To study different line coding techniques.

Apparatus required:

1. Line coding and decoding trainer kit – 1 No.
2. Patch cords – 6 No.
3. CRO – 1 No.

Theory:

Line coding refers to the process of representing the bit stream (**1**"s and **0**"s) in the form of voltage or current variations optimally tuned for the specific properties of the physical channel being used. The selection of a proper line code can help in many ways. One possibility is to aid in clock recovery at the receiver. A clock signal is recovered by observing transitions in the received bit sequence, if enough transitions exist, a good recovery of the clock is guaranteed, the signal is said to be self-clocking. Another advantage is to get rid of DC shifts. The DC component in a line code is called the bias or the DC coefficient. Unfortunately, most long-distance communication channels cannot transport a DC component. This is why most line codes try to eliminate the DC component before being transmitted on the channel. Such codes are called DC balanced, zero-DC, zero-bias, or DC equalized. Some common types of line encoding in common-use nowadays are unipolar, polar, bipolar, Manchester, MLT-3 Duo binary encoding.

Unipolar (Unipolar **NRZ** and Unipolar **RZ**):

Unipolar is the simplest line coding scheme. It has the advantage of being compatible with TTL logic. Unipolar coding uses a positive rectangular pulse $p(t)$ to represent binary **1**, the absence of a pulse (i.e., zero voltage) to represent a binary **0**. Two possibilities for the pulse $p(t)$ exist3: Non-Return-to-Zero (NRZ) rectangular pulse Return-to-Zero (RZ) rectangular pulse. The difference between Unipolar NRZ Unipolar RZ codes is that the rectangular pulse in NRZ stays at a positive value (e.g., +5V) for the full duration of the logic **1** bit, while the pule in RZ drops from +5V to 0V in the middle of the bit time.

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Procedure:

1. Connect the PRBS (test point P5) to various line coding formats. Obtain the coded output as per the requirement.

2. Connect coded signal test point to corresponding decoding test point as inputs.

3. Set the SW1 as per the requirement.

4. Set the potentiometer P1 in minimum position.

5. Switch ON the power supply. Press the switch SW2 once.

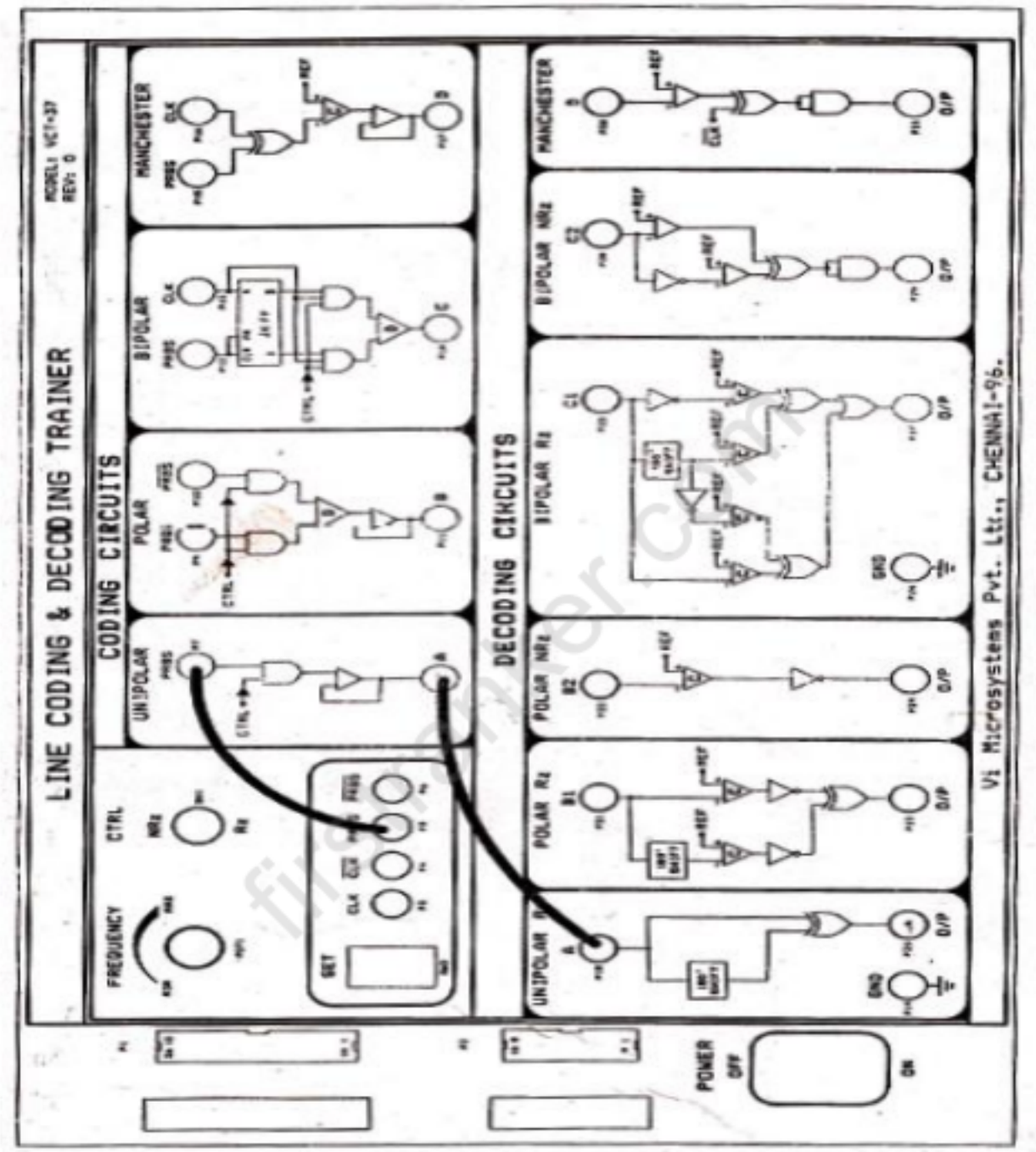
6. Display the encoded signal on one channel of CRO and decoded signal on second channel of CRO.

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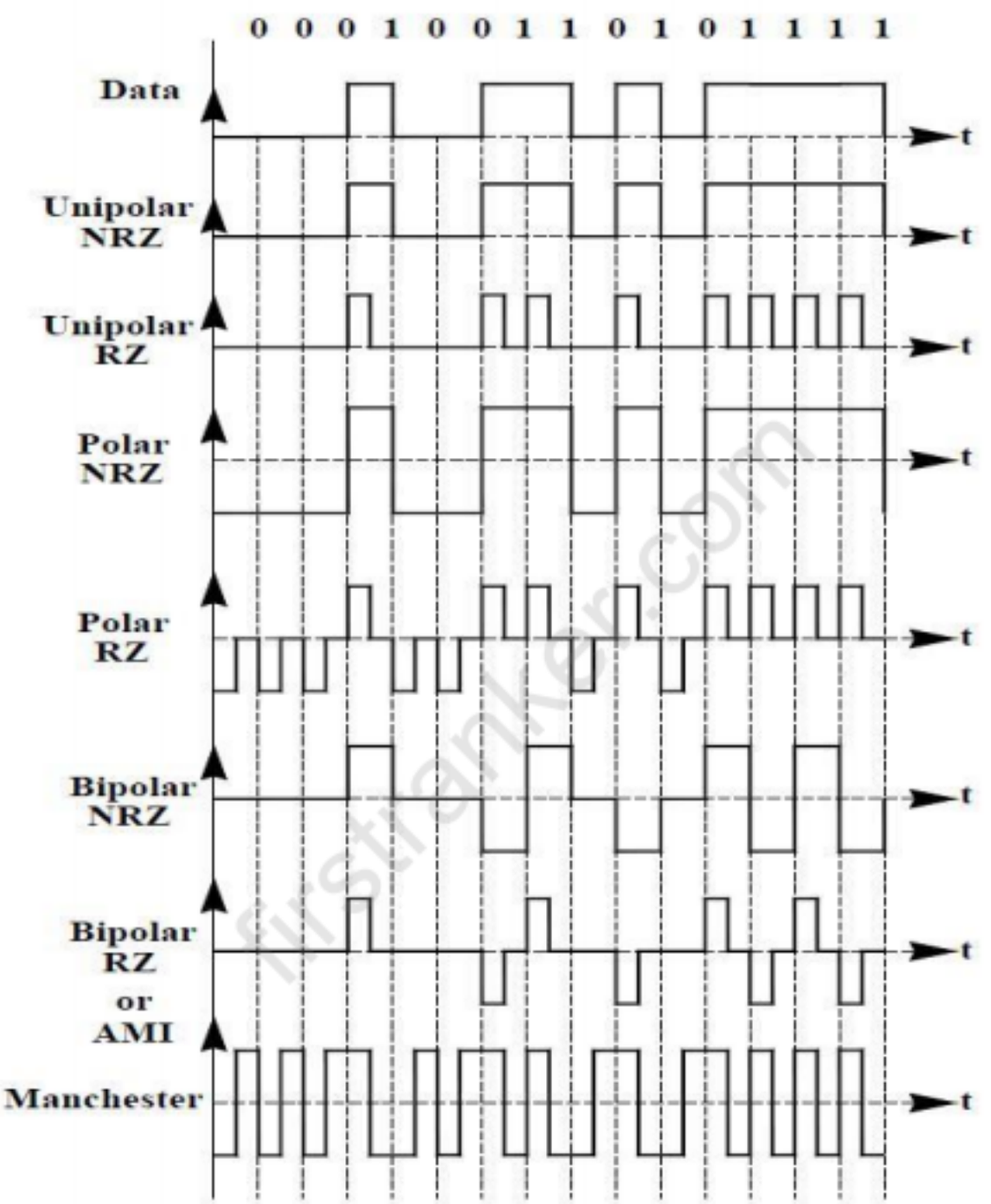
Line coding decoding trainer kit



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Model Graph:



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Tabulation

Sl. No.	Type of Coding	AMPLITUDE (V)	Time period (s)
1.	Unipolar data(NZ NRZ)		
2.	Unipolar data (NRZ RZ)		
3.	Bipolar Data(NRZ AMI)		
4.	Manchester		

Result:

Thus the different line coding techniques was studied and verified.

Outcome:

After the completion of this experiment the students will be able to understand implement the different line coding schemes.

Applications:

1. DC balance
2. embedded clock applications
3. computing applications
4. Manchester codes are commonly used for local area networks
5. Bipolar codes are commonly used for local area networks

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Viva - voce

1. What is line coding?
2. Define – Polar Encoding
3. Define – Unipolar Encoding
4. Define – Bipolar Encoding
5. Define – Manchester Encoding
6. What are the two function of fast frequency hopping?
7. What is return to zero?
8. What is Non-return to zero?
9. What is the difference between source coding and line coding?
10. What are the properties of line coding?
11. What is the effect of inter symbol interference?
12. How ISI can be reduced?
13. Define – Encoding
14. Define – Decoding
15. Define – Nyquist Rate
16. Draw the NRZ and RZ code for the digital data 10110001.
17. Define – Equalization
18. What is PRBS?
19. Write the Boolean expression for X-NOR gate.
20. Define – Digital demodulation

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CYCLE 2 – EXPERIMENTS

Expt. No.8 ERROR CONTROL CODING USING MATLAB

Aim:

To write a program in MATLAB for error control coding techniques

Software required:

PC with MATLAB version 7.0 software installed

Procedure:

1. Open the MATLAB software by double clicking its icon.
2. MATLAB logo will appear after few moments comon prompt will appear.
3. Go to the file menu select a new M – file.(File _New_M-file) 0r in the left h corner a blank white paper icon will be there. Click it once.
4. A blank M –file will appear with a title 'untitiled'.
5. Now start typing your program. After completing, save the M-file with appropriate name. To execute the program press F5 or go to debug menu select run.
6. After execution output will appear in the common window. If there is an error then with an alarm, type of error will appear in red colour.
7. Rectify the error if any go to debug menu select run.

Result:

Thus the error control coding techniques are executed using MATLAB programs.

Outcome:

After the completion of this experiment the students will be able to simulate the different error control coding schemes using MATLAB.

Applications :

1. Deep space communication
2. Satellite communication
3. Data transmission
4. Data storage
5. Mobile communication
6. File transfer
7. digital audio/video transmission.

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Viva - voce

1. What is the need for error control coding?
2. What is meant by linear code?
3. What is meant by cyclic code?
4. Name some error control coding techniques.
5. Name the code which is used only for error detection.

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Expt. No. 9 DESIGN OF BPSK, QPSK, QAM USING MATLAB

Aim:

To write a program in MATLAB for design of BPSK, QPSK and QAM

Software required:

PC with MATLAB version 7.0 software installed

Procedure:

1. Open the MATLAB software by double clicking its icon.
2. MATLAB logo will appear after few moments command prompt will appear.
3. Go to the file menu select a new M – file.(File _New_M-file) 0r in the left h corner a blank white paper icon will be there. Click it once.
4. A blank M –file will appear with a title 'untitled'.
5. Now start typing your program. After completing, save the M-file with appropriate name. To execute the program press F5 or go to debug menu select run.
6. After execution output will appear in the command window. If there is an error then with an alarm, type of error will appear in red colour.
7. Rectify the error, if any go to debug menu select run.

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Result:

Thus the BPSK, QPSK and QAM were simulated using MATLAB.

Outcome:

After the completion of this experiment the students will be able to simulate the various modulation schemes such as BPSK, QPSK and QAM using MATLAB.

Applications:

QPSK

1. Data transmission, mainly radio transmissions.
2. RTTY means radio teletype transmissions from amateur radio up to WiFi transmissions or Zigbees

QAM

1. Radio communications and data delivery applications.

Viva - voce

1. What is a correlator?
2. Define – Constellation Diagram
3. What is BPSK ? Mention its significance.
4. Give the expression for bandwidth of BPSK scheme.
5. What is QPSK mention its significance?
6. Give the expression for bandwidth of QPSK scheme.
7. Draw the constellation diagram of QPSK.
8. What is QAM ?
9. Give the expression for bandwidth of QAM scheme.
10. What are the blocks in BPSK receiver?
11. What is the function of a decision device?
12. Draw the constellation diagram of QAM.
13. What are the types of QPSK?
14. What is the significance of Q-channel I channel in QPSK modulator?
15. What is the minimum bandwidth requirement of QPSK?
16. Draw the output phase versus time relationship for a QPSK modulator.
17. Compare OQPSK with QPSK.
18. Identify the error in the matlab command Sin 3.
19. Draw the constellation diagram of QPSK.
20. Give the applications of QPSK modulation scheme.

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Expt. No. 10 DESIGN OF FSK, PSK, DPSK USING MATLAB

Aim:

To write a program in MATLAB for design of FSK, PSK and DPSK

Software required:

PC with MATLAB version 7.0 software installed

Procedure:

1. Open the MATLAB software by double clicking its icon.
2. MATLAB logo will appear after few moments command prompt will appear.
3. Go to the file menu select a new M – file.(File _New_M-file) 0r in the left h corner a blank white paper icon will be there. Click it once.
4. A blank M –file will appear with a title 'untitled'.
5. Now start typing your program. After completing, save the M-file with appropriate name. To execute the program press F5 or go to debug menu select run.
6. After execution output will appear in the command window. If there is an error then with an alarm, type of error will appear in red colour.
7. Rectify the error if any go to debug menu select run.

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Result:

Thus the FSK, PSK and DPSK were simulated using MATLAB.

Outcome:

After the completion of this experiment the students will be able to simulate the various modulation schemes such as FSK, PSK and DPSK using MATLAB.

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Applications:

ASK:

1. ASK is used to transmit digital data over optical fiber

PSK:

1. over voice lines
2. in high-freq. radio transmissions.

Viva - voce

1. What is FSK? Mention its significance.
2. What is PSK? Mention its significance.
3. What is DPSK? Mention its significance.
4. What are the applications of DPSK?
5. Give the equation for average probability of symbol error for DPSK.
6. List the operations performed in DPSK transmitter.
7. Compare DPSK with QPSK modulation scheme.
8. What is differential encoding technique?
9. Why do we make 180 degree phase shift in PSK why not 90 or 270?
10. What is the function of a decision device?
11. What is RZ?
12. What is NRZ?
13. What is Manchester encoding?
14. Sketch the FSK waveform for the input a) 1010110 b) 1100101
15. Define modulation index.
16. Write a MATLAB program for generating PN sequence.
17. Differentiate coherent with non-coherent FSK.
18. Give the expression for bandwidth of FSK scheme.
19. What is the difference between PSK and FSK?
20. What is the major advantage of coherent PSK over coherent ASK?

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sExpt. No. 11 COMMUNICATION LINK SIMULATION USING MATLAB

Aim:

To simulate the basic communication link using mat lab

Software required:

PC with MATLAB version 7.0 software installed

Procedure:

1. Open the MATLAB software by double clicking its icon.
2. MATLAB logo will appear after few moments command prompt will appear.
3. Go to the file menu select a new M – file.(File _New_M-file) 0r in the left h corner a blank white paper icon will be there. Click it once.
4. A blank M –file will appear with a title 'untitled'.
5. Now start typing your program. After completing, save the M-file with appropriate name. To execute the program press F5 or go to debug menu select run.
6. After execution output will appear in the command window. If there is an error then with an alarm, type of error will appear in red colour.
7. Rectify the error if any go to debug menu select run.

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Result:

Thus the communication link simulation was designed using MATLAB.

Outcome:

After the completion of this experiment the students will be able to simulate and design the communication link using MATLAB.

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Viva - voce

1. Give examples for digital modulation techniques.
2. What is meant by pass-b transmission?
3. What is meant by base-b transmission?
4. What is the meaning for error pattern?
5. Differentiate systematic from non-systematic coding.

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Expt. No. 12 ZERO FORCING LMS EQUALIZATION ALGORITHMS USING MATLAB

Aim:

To write a program in MATLAB for design of zero forcing LMS algorithms

Software required:

PC with MATLAB version 7.0 software installed

Procedure:

1. Open the MATLAB software by double clicking its icon.
2. MATLAB logo will appear after few moments command prompt will appear.
3. Go to the file menu select a new M – file.(File _New_M-file) 0r in the left h corner a blank white paper icon will be there. Click it once.
4. A blank M –file will appear with a title 'untitled'.
5. Now start typing your program. After completing, save the M-file with appropriate name. To execute the program press F5 or go to debug menu select run.
6. After execution output will appear in the command window. If there is an error then with an alarm, type of error will appear in red colour.
7. Rectify the error if any go to debug menu select run.

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Result:

Thus the equalization of zero forcing LMS algorithms was simulated using MATLAB.

Outcome:

After the completion of this experiment the students will be able to implement the various algorithms using MATLAB.

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Viva - voce

1. Define – Equalization
2. What is meant by zero forcing algorithms?
3. Define – LMS Algorithm
4. What is meant by pass-b transmission?
5. What is meant by base-b transmission?
6. What is the meaning for error pattern?

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ADDITIONAL EXPERIMENTS BEYOND THE SYLLABUS

Expt. No. 13 PULSE AMPLITUDE MODULATION

Aim:

To study the Pulse Amplitude Modulation technique and observe the output waveform

Apparatus required:

Sl. No.	Name of the Apparatus	Range	Quantity
1	Function generator	0-3 MHz	1
2	Diode	1N4007	2
3	Resistors,	3.3 kΩ	2
4	Bread Board		1
5	Power supply	(0-30) V	1
6	CRO	30 MHz	1
7	Probe		few
8	Connecting Wires		few

Procedure:

1. Measure the amplitude of each pulse, no. of pulses in one cycle, frequency of pulses.
2. Vary the modulating input signal observe its effect on the output.
3. Observe compare the output waveform with input waveform/
4. See the input and output that are same in frequency, amplitude phase.
5. Draw the waveform of the modulating signal, sampling signal, pulse amplitude a modulated signal.

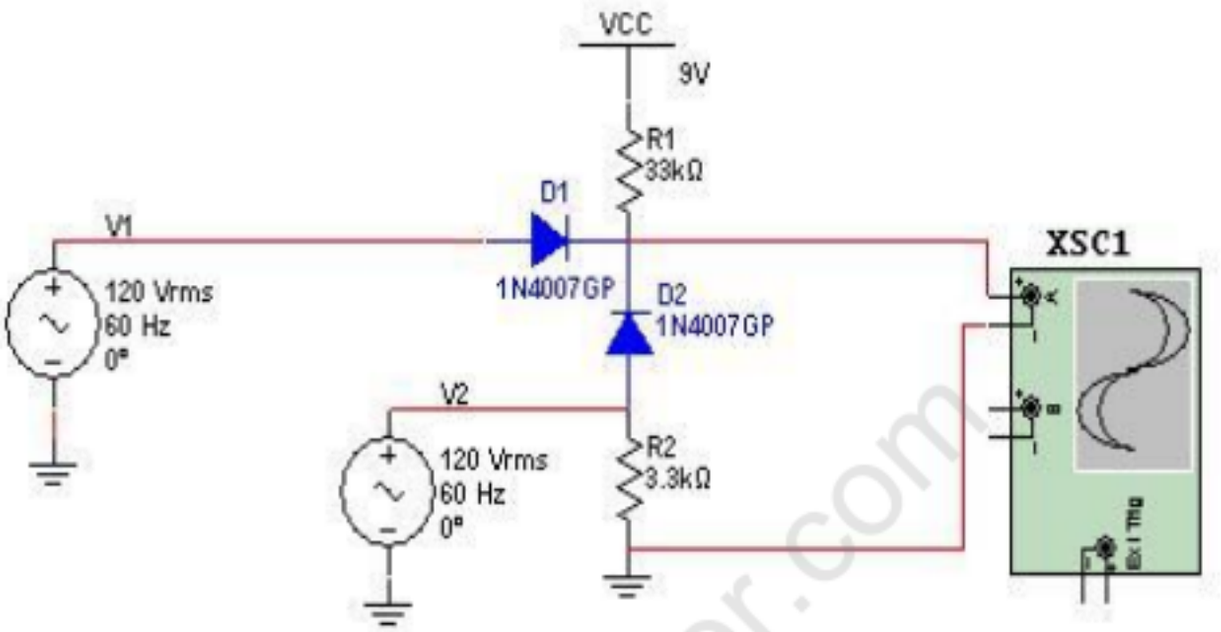
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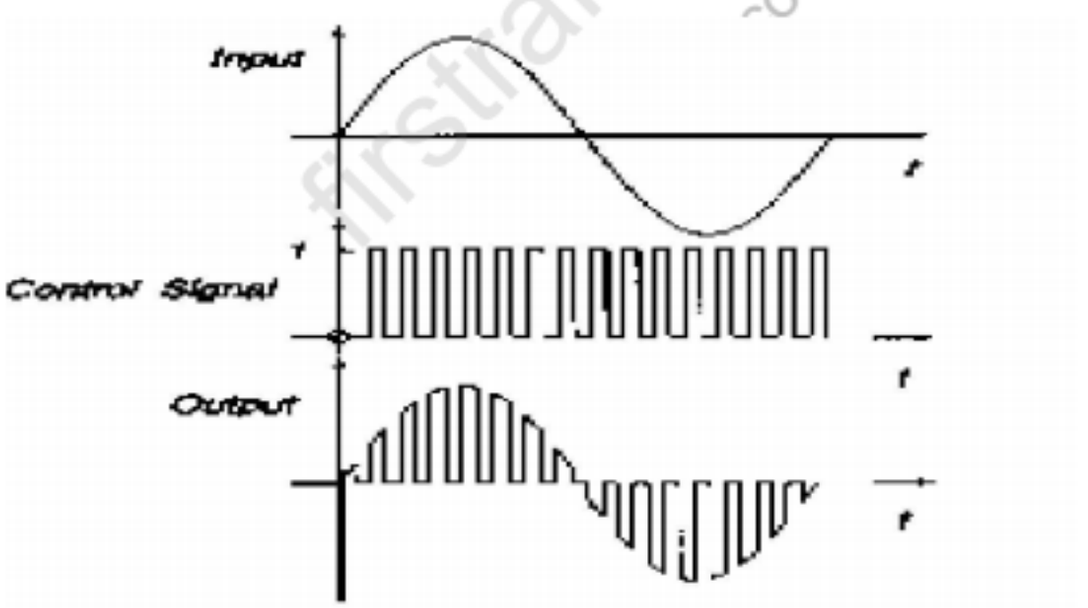
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Circuit Diagram

Pulse amplitude modulation



Model Graph:



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Tabulation

Signal	Amplitude (V)	Time Period (s)
Message		
Carrier		
PAM wave		
Demodulated		

Result:

Thus the pulse amplitude modulation (PAM) output waveform was generated.

Outcome:

After the completion of this experiment the students will be able to design and construct the PAM modulated wave.

Viva – voce

1. What is PAM?
2. Differentiate PAM from PCM.
3. Write the application of PAM.
4. Draw the PAM signal.
5. Compare PAM, PPM and PWM.
6. What are the advantage of PAM and PWM?
7. What is the advantage of PPM over PWM and PAM?
8. What is Pulse position modulation?
9. Mention the applications of PAM.
10. What are the disadvantages of PAM?
11. What is PWM or Pulse length modulation or pulse duration modulation?
12. Define — Pulse Modulation

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Expt. No. 14 AMPLITUDE MODULATION DEMODULATION USING Lab VIEW

Aim:

To generate amplitude modulated wave using NI LabVIEW demodulate the AM wave using envelope detector

Apparatus required:

1. Windows XP or Later Version
2. LabVIEW Software

Procedure:

Amplitude Modulation:

1. Select the controls which are used for AM transmitter place it on Block Diagram.
2. Select the carrier message signal from function palette (Right click on Block Diagram→ Signal Processing→Wave form Generation → Simulate signal) drag to block diagram. Select the parameters such as frequency, amplitude sampling frequency for the Amplitude Modulation as listed in Table: Front panel configurations for Amplitude Modulation.
3. Select the required Numeric controls used in the circuit from the block diagram (Right click on Block Diagram→ Programming→ Numeric) connect as shown in figure: Circuit diagram for Amplitude Modulation.
4. Select the waveform graphs to display the input output waveforms (Right click on Front Panel → Modern→ Graph→ Waveform Graph) place those waveform Graphs on Front panel connect it as shown in figure: Circuit diagram for Amplitude Modulation.
5. Run the circuit; observe the output signal for the corresponding Input (Message Carrier) signal.

Configurations on Front panel:

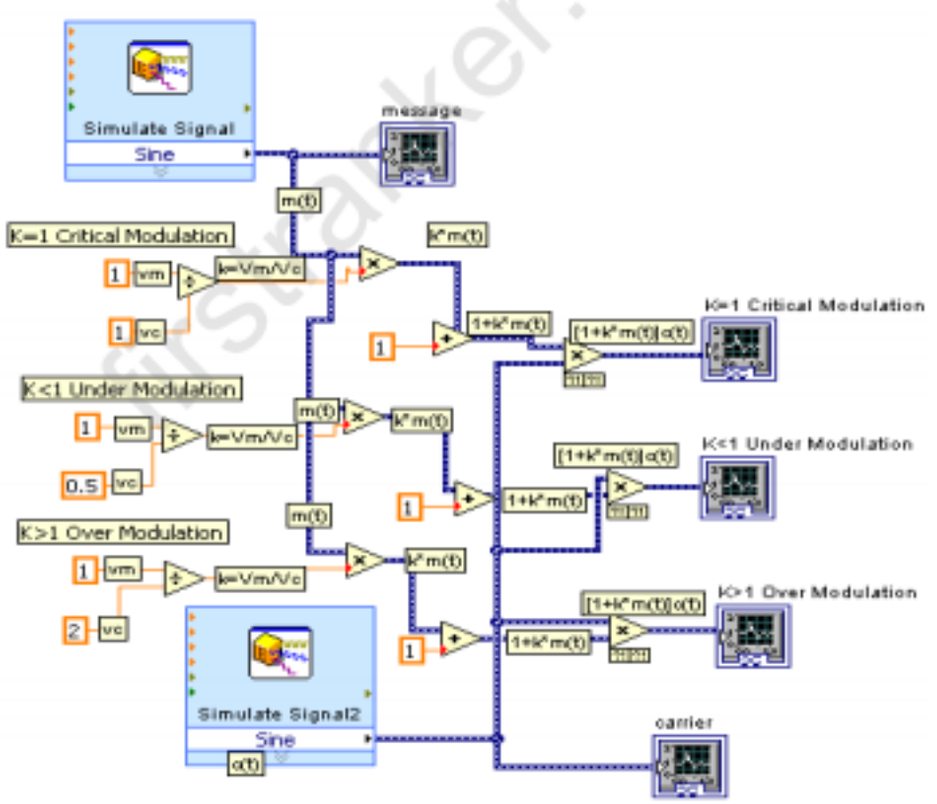
1. Disable the Auto scale option for both X Y axis on each waveform graph(By making right click on waveform graph) which is used in Front panel.
2. Select the X axis scale (0 to 0.03) Y axis scale (-1 to +1) as required to view the waveform graph properly on the Front panel.

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Front panel configurations for Amplitude Modulation

Parameter	Message Signal	Carrier Signal
Signal Type	Sine	Sine
Frequency	100 Hz	1000 Hz
Amplitude	1	0.5
Phase	0	0
Offset	0	0
Sampling Rate	10000 Hz	10000 Hz
Number of Samples	1000(Automatic)	1000(Automatic)
Timing	Run as fast as possible	Run as fast as possible
Timestamps	Relative	Relative



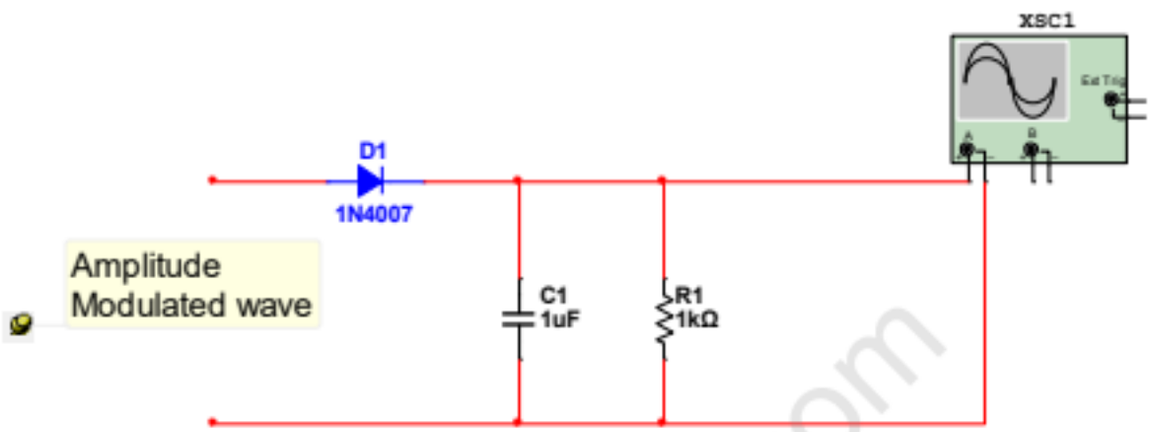
Amplitude modulation using labVIEW

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Amplitude Demodulation:

1. Connect the circuit in external kit as shown in Figure Demodulator of AM wave with Envelope Detector.
2. Apply the modulated signal input from LabVIEW software to external hardware kit.
3. Verify the message signal after demodulating using the envelope detector circuit.



Demodulator of AM wave with Envelope Detector using labVIEW

Result:

Thus the simulation of amplitude modulation and demodulation using NI LabVIEW was performed.

Outcome:

After the completion of this experiment the students will be able to simulate the AM modulated wave and demodulated wave using LabVIEW.

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Viva - voce

1. What is LabVIEW?
2. Define — Amplitude Modulation
3. Draw the phasor diagram of AM signal.
4. What is depth of modulation?
5. Draw the frequency spectrum of amplitude modulation.

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List of Projects

1. Vehicle Tracking System
2. Accident Identification System
3. Wireless Camera Position System
4. Remote Home Security System
5. Wireless Voting Machine
6. Wireless Security System
7. Video Signal Transmitter
8. Audio Signal Transmitter
9. Remote Controlled Dish Antenna
10. Wireless Home Appliances Controller

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