SVR ENGINEERING COLLEGE

Approved by AICTE & Permanently Affiliated to JNTUA

Ayyalur metta, Nandyal – 518503.Website: www.svrec.ac.in

Department of Electronics and Communication Engineering

COMMUNICATION SYSTEMS LABORATORY

II B.TECH II SEM

2021-2022

STUDENT NAME	
ROLL NUMBER	
SECTION	

SVR ENGINEERING COLLEGE

Approved by AICTE & Permanently Affiliated to JNTUA

Ayyalur metta, Nandyal – 518503.Website: www.svrec.ac.in

Department of Electronics and Communication Engineering

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

ACADEMIC YEAR: 2021-2022

This is to certify that the bonafide record work done by Mr./Ms.________________ bearing *H*.T.No.______________ of II B.Tech- II Semester in the **Communication Systems Laboratory**

Faculty In-Charge **Head of the Department**

20A04402P			0	0	3	1.5
Pre-requisite	**NIL**	**Semester**	**IV**			

Course Objectives:

- To understand the basics of analog and digital modulation techniques.
- To integrate theory with experiments so that the students appreciate the knowledge gained fromthe theory course.
- To design and implement different modulation and demodulation techniques and theirapplications.
- To develop cognitive and behavioral skills for performance analysis of various modulation techniques.

Course Outcomes (CO):

CO1: Know about the usage of equipment/components/software tools used to conduct the experimentsin analog and digital modulation techniques.
CO2: Conduct the experiment based on the knowledge acquired in the theory about modulation and demodulation schemes to find the important metrics of the communication system experimentally.
CO3: Analyze the performance of a given modulation scheme to find the important metrics of thesystem theoretically.
CO4: Draw the relevant graphs between important metrics of the system from the observedmeasurements.
CO5: Compare the experimental results with that of theoretical ones and infer the conclusions.

List of Experiments:

Design the circuits and verify the following experiments taking minimum of six from each sectionshown below.

Section-A

1. AM Modulation and Demodulation
2. DSB-SC Modulation and Demodulation
3. Frquency Division Multiplexing
4. FM Modulation and Demodulation
5. Radio receiver measurements
6. PAM Modulation and Demodulation
7. PWM Modulation and Demodulation
8. PPM Modulation and Demodulation

Section-B

1. Sampling Theorem.
2. Time Division Multiplexing
3. Delta Modulation and Demodulation
4. PCM Modulation and Demodulation
5. BASK Modulation and Demodulation
6. BFSK Modulation and Demodulation
7. QPSK Modulation and Demodulation
8. DPSK Modulation and Demodulation

Note: Faculty members (who are handling the laboratory) are requested to instruct the students not touse readymade kits for conducting the experiments. They are advised to make the students work in the laboratory by constructing the circuits and analyzing them during the lab sessions.

ECE DEPT VISION & MISSION PEOs and PSOs

Vision

To produce highly skilled, creative and competitive Electronics and Communication Engineers to meet the emergingneeds of the society.

Mission

- Impart core knowledge and necessary skills in Electronics and Communication Engineering Through innovative teaching and learning.
- Inculcate critical thinking, ethics, lifelong learning and creativity needed for industry and society
- Cultivate the students with all-round competencies, for career, higher education and self-employability

I. PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

PEO1: Graduates apply their knowledge of mathematics and science to identify, analyze and solve problemsin the field of Electronics and develop sophisticated communication systems.

PEO2: Graduates embody a commitment to professional ethics, diversity and social awareness in theirprofessional career.

PEO3: Graduates exhibit a desire for life-long learning through technical training and Professional activities.

II. PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO1: Apply the fundamental concepts of electronics and communication engineering to design a variety of components and systems for applications including signal processing, image processing, communication, networking, embedded systems, VLSI and control system

PSO2: Select and apply cutting-edge engineering hardware and software tools to solve complex Electronics and Communication Engineering problems.

III. PROGRAMME OUTCOMES (PO'S)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and anengineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety,and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, andin multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects andin multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

IV. COURSE OBJECTIVES:

- To understand the basics of analog and digital modulation techniques.
- To integrate theory with experiments so that the students appreciate the knowledge gained from the theory course.
- To design and implement different modulation and demodulation techniques and their applications.
- To develop cognitive and behavioral skills for performance analysis of various modulation techniques.

V. COURSE OUTCOMES:

After the completion of the course students will be able to

Course Outcomes	Course Outcome statements	BTL
CO1	Recall the usage of equipment/components/software tools used to conduct the experiments in analog and digital modulation techniques	L1
CO2	Demonstrate the experiment based on the knowledge acquired in the theory about modulation and demodulation schemes to find the important metrics of the communication system experimentally	L2
CO3	Analyze the performance of a given modulation scheme to find the important metrics of the system theoretically.	L4
CO4	Illustrate the relevant graphs between important metrics of the system from the observed measurements	L2
CO5	Compare the experimental results with that of theoretical ones and infer the conclusions.	L2

VI. COURSE MAPPING WITH PO'S AND PEO'S:

CourseTitle	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Communication Systems Lab	3	3	2	3	2	2	2	1	2	1	2	2	3	3

VII. MAPPING OF COURSE OUTCOMES WITH PEO'S AND PO'S:

Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	2	2	1	1	2	1	2	2	3	2
CO2	3	2	3	2	2	2	1	1	2	1	2	2	3	2
CO3	3	3	3	2	2	2	1	1	2	1	1	2	3	2
CO4	2	2	3	2	2	2	2	1	2	1	2	2	3	2
CO5	3	3	3	2	2	2	1	1	2	1	3	2	3	2

LABORATORY INSTRUCTIONS

1. While entering the Laboratory, the students should follow the dress code. (Wear shoes and White apron,Female Students should tie their hair back).

2. The students should bring their observation book, record, calculator, necessary stationery items and graphsheets if any for the lab classes without which the students will not be allowed for doing the experiment.

3. All the Equipment and components should be handled with utmost care. Any breakage or damage will becharged.

4. If any damage or breakage is noticed, it should be reported to the concerned in charge immediately.

5. The theoretical calculations and the updated register values should be noted down in the observation bookand should be corrected by the lab in-charge on the same day of the laboratory session.

6. Each experiment should be written in the record note book only after getting signature from the lab in-charge in the observation notebook.

7. Record book must be submitted in the successive lab session after completion of experiment.

8. 100% attendance should be maintained for the laboratory classes.

Precautions.

1. Check the connections before giving the supply.
2. Observations should be done carefully.

1. AMPLITUDE MODULATION AND DEMODULATION

AIM

To perform the function amplitude modulation, perfect modulation &over modulation and also calculate modulation index.

APPARATUS

1. C.R.O (20MHZ)
2. Function generator (1MHZ).
3. Connecting chords &probes

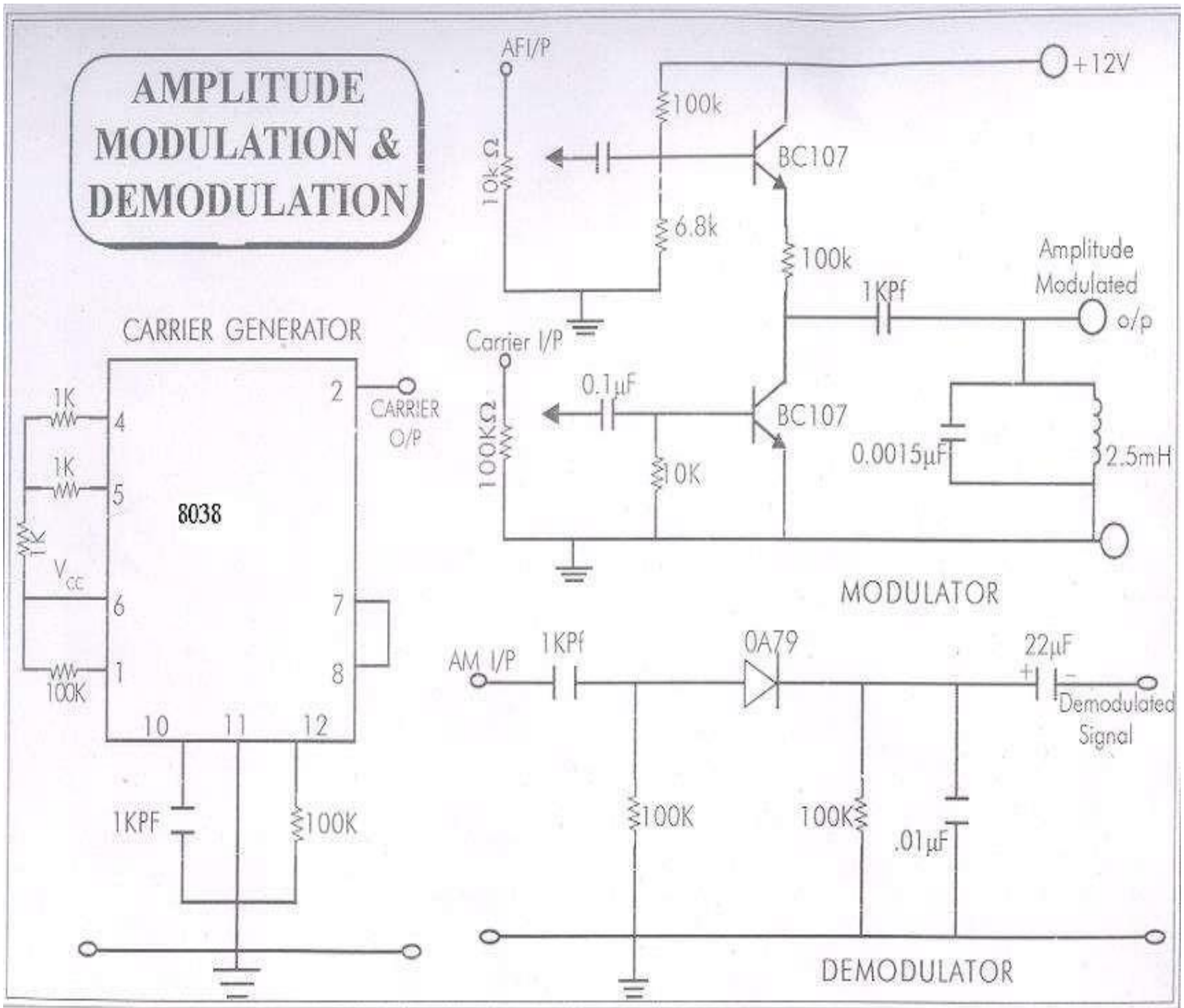
THEORY

Amplitude modulation is defined as the process in which the amplitude of the carrier wave c (t) is varied about a mean value, linearly with the base band signal. An AM wave may thus be described in the most general form, as a function of time as follows.

$S(t)=A_c\{1+K_a m(t)\} \cos(2\pi f c t)$

Where k_a-amplitude sensitive of the modulator
S(t)-modulated signal
A_c-carrier signal
M(t)-modulating signal
The amplitude of $k_a m(t)$ is always less than unity ,that is a $k_a m(t)<1$for all t.
It ensure that the function $1+k_a$ m(t) is always positive. When the amplitude sensitivity ka of the modulator is large enough to make k_a m(t)>1 for any carrier wave becomes over modulated ,resulting in carrier phase reversal whenever the factor $1+k_a m(t)$ crosses zero .the modulated wave then exhibits envelope distortion . the absolute maximum value of k_a m(t) multiplied by 100 is referred to as the percentage modulation.
Or percentage modulation = $vmax - vmin/vmax + vmin\ 100$
The carrier frequency $f_c$is much greater than the highest frequency component of the message signal m(t),that is f_c.>>w
Where w is the message bandwidth.
If the condition is not satisfied, and envelope cannot be visualized satisfactorily.
The trainer kit has a carrier generator, which can generate the carrier wave of 100 kHz when the trainer is switched on.
The circuit 's carrier generator ,modulator and demodulator are provided with the built in supplies, no supply connections are to be given externally.

CIRCUIT DIAGRAM:



PROCEDURE:

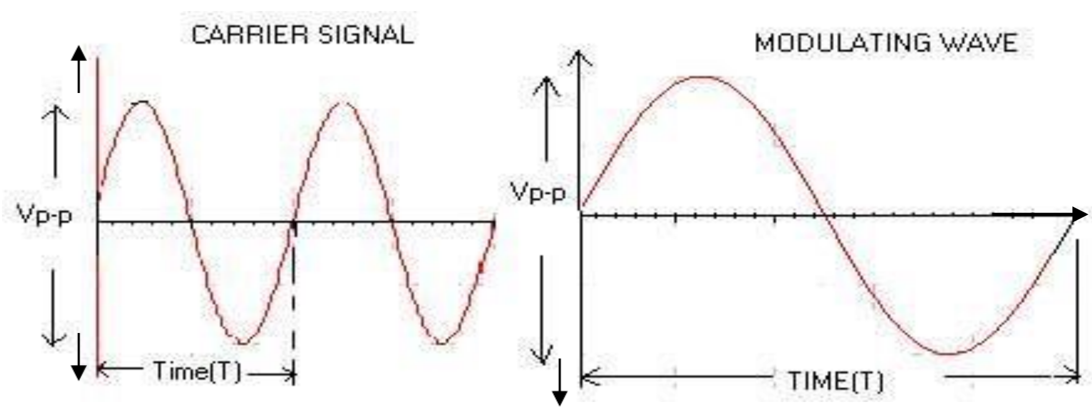
1. Switch on the trainer kit and check the O/P of the carrier generator on oscilloscope.
2. Connect around 1KHz with 2Volts .A.F signal at A.F I/P to the modulator circuit.
3. Connect the carrier signal at carrier I/P of the modulator circuit.
4. Observe the modulator output signal at AM O/p Spring by making necessary changes in A.F signal
5. Vary the modulating frequency and amplitude and observe the effects on the modulated waveform.
6. The depth of modulation can be varied using the variable knob provided at A.F input.
7. The percentage modulation can be calculated using the formula.

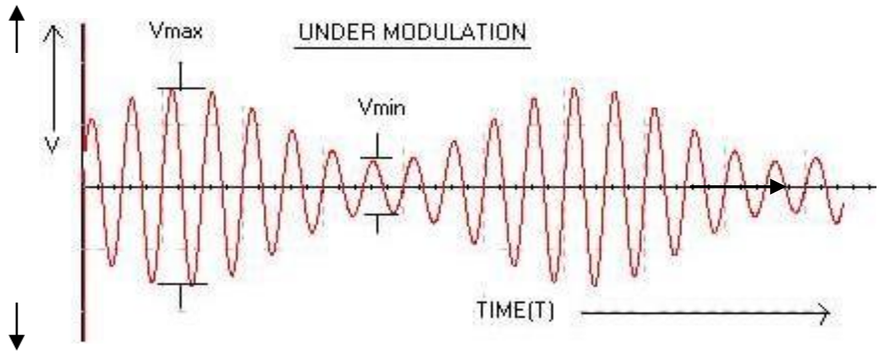
$$\text{Percentage modulation} = \frac{V_{max}-V_{min}}{V_{max}+V_{min}} \times 100$$

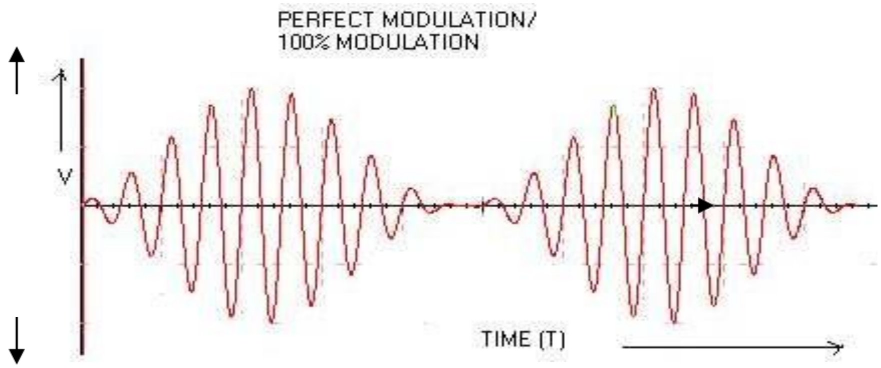
$$\text{Modulation factor} = \frac{V_{max}-V_{min}}{V_{max}+V_{min}}$$

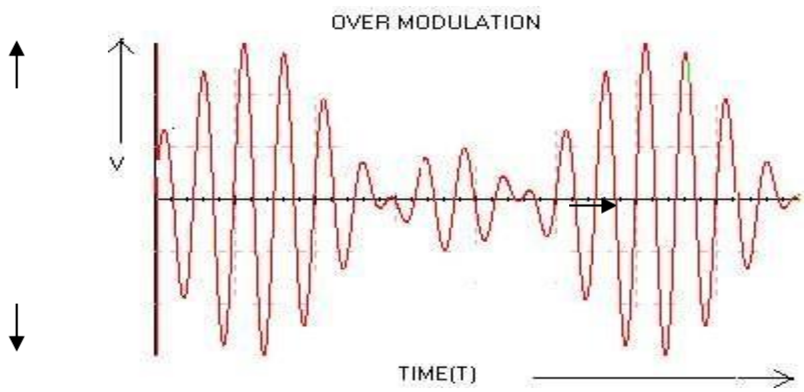
8. Connect the output of the modulator to the input of the demodulator circuit and observe the output.

EXPECTED WAVEFORMS:

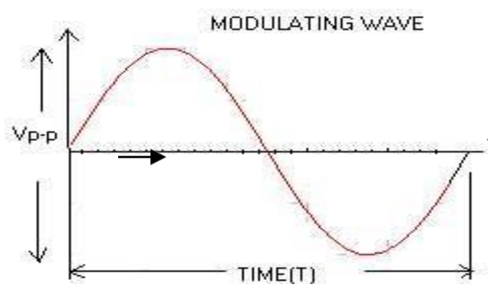








Demodulated signal



RESULT:

APPLICATIONS:

1. Tele communications.
2. TV Transmitters.

QUESTIONS:

1. Define AM and draw its spectrum?
2. Draw the phase representation of an amplitude modulated wave?
3. Give the significance of modulation index?
4. What is the different degree of modulation?
5 What are the limitations of square law modulator?
6. Compare linear and nonlinear modulators?
7. Compare base modulation and emitter modulation?
8 Explain how AM wave is detected?
9 Define detection process?
10. What are the different types of distortions that occur in an envelop detector? How can they be eliminated?

2.DSB-SC MODULATION AND DEMODULATION

AIM:

To perform the characteristics of the Balanced Modulator as a

1. Frequency Doubler
2. DSB-SC Generator.

APPARATUS:

1. Balanced modulator trainer kit

THEORY:

1. RF Generator:

Colpitts oscillator using FET is used here to generate RF signal of approximately 100 KHz Frequency to use as carrier signal in this experiment. Adjustments for Amplitude and Frequency are provided in panel for ease of operation.

2. AF Generator:

Low Frequency signal of approximately 5KHz is generated using OP-AMP based wein bridge oscillator. IC TL 084 is used as an active component; TL 084 is FET input general purpose quad OP-AMP integrated circuit. One of the OP-AMP has been used as amplifier to improve signal level. Facility is provided to change output voltage.

3. Regulated Power Supply:

This consists of bridge rectifier, capacitor filters and three terminal regulators to provide required dc voltage in the circuit i.e. +12v, -8v @ 150 ma each.

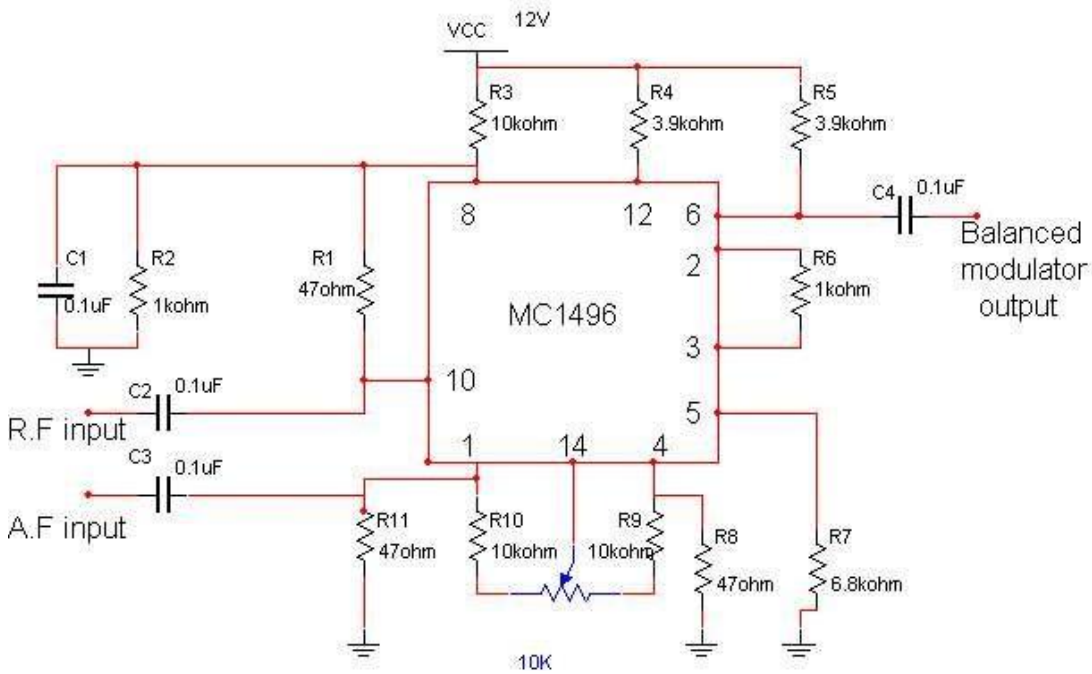
4. Modulator:

The IC MC 1496 is used as Modulator in this experiment. MC 1496 is a monolithic integrated circuit balanced modulator/Demodulator, is versatile and can be used up to 200 MHz.

Multiplier:

A balanced modulator is essentially a multiplier. The output of the MC 1496 balanced modulator is proportional to the product of the two input signals. If you apply the same sinusoidal signal to both inputs of a ballooned modulator, the output will be the square of the input signal AM-DSB/SC: If you use two sinusoidal signals with deferent frequencies at the two inputs of a balanced modulator (multiplier) you can produce AM-DSB/SC modulation. This is generally accomplished using a high- frequency “carrier” sinusoid and a lower frequency “modulation” waveform (such as an audio signal from microphone). The figure 1.1 is a plot of a DSB-SC waveform, this figure is the graph of a 100 KHz and a 5 KHz sinusoid multiplied together. Figure 1.2 shows the circuit that you will use for this experiment using MC 1496-balanced modulator/demodulator.

CIRCUIT DIAGRAM:



PROCEDURE:

(i)-Frequency Doubler

1. Connect the circuit as per the given circuit diagram.
2. Switch on the power to the trainer kit.
3. Apply a 5 KHz signal to both RF and AF inputs of 0.1V_{P-P}.
4. Measure the output signal frequency and amplitude by connecting the output to CRO.

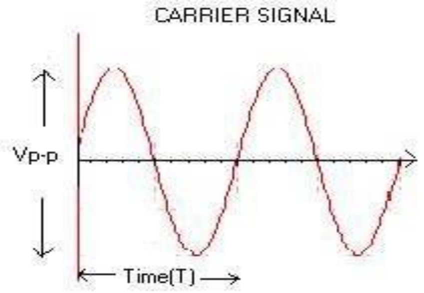
5. Repeat the steps 3 and 4 by changing the applied input signal frequency to 100KHZ and 500 KHz. And note down the output signals.

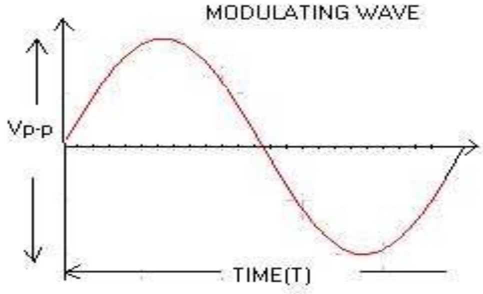
NOTE:- Amplitude decreases with increase in the applied input frequency.

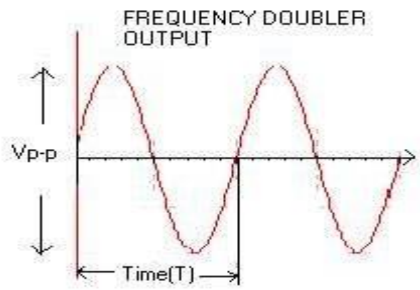
(ii)-Generation of DSB-SC

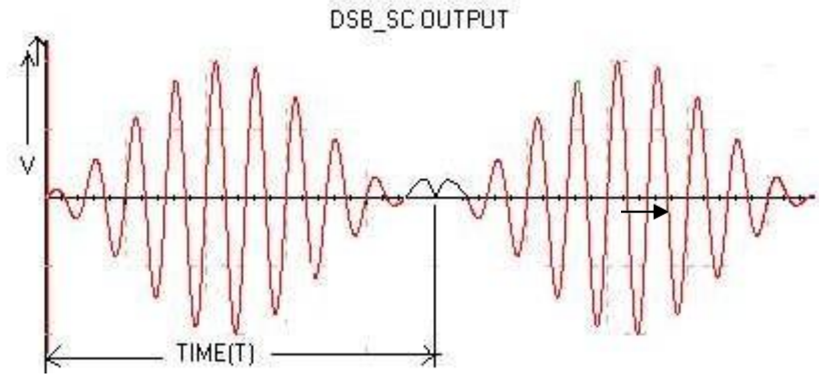
1. For the same circuit apply the modulating signal(AF) frequency in between 1Khz to 5Khz having 0.4 V_{P-P} and a carrier signal(RF) of 100KHz having a 0.1 V_{P-P} .
2. Adjust the RF carrier null potentiometer to observe a DSB-SC waveform at the output terminal on CRO and plot the same.
3. Repeat the above process by varying the amplitude and frequency of AF but RF maintained constant.
   NOTE:- Note down all the waveforms for the applied inputs and their respective outputs.

EXPECTED WAVEFORMS:









Note: In frequency doubling If the input time period is "T" after frequency doubling the time period should be halved. i.e., "T/2".

RESULT:

APPLICATIONS:

Tele communications.

TV Transmitters.

.

QUESTIONS:

1. What are the two ways of generating DSB_SC.
2. What are the applications of balanced modulator?
3. What are the advantages of suppressing the carrier?
4. What are the advantages of balanced modulator?
5. What are the advantages of Ring modulator?
6. Write the expression for the output voltage of a balanced modulator?

3. FRERQUENCY DIVISION MULTIPLEXING

Aim:

To construct the frequency division multiplexing and de multiplexing circuit and toverify its operation

Equipment / Components Required:

S. No	EQUIPMENT / COMPONENTS REQUIRED	Range	Quantity
1	Frequency Division Multiplexing and De multiplexing trainer Kit.	--------	1
2	C.R.O.	(0-20) MHz	1
3	Connecting wires.	-------	07

Theory

When several communications channels are between the two same point‟s significant economics may be realized by sending all the messages on one transmission facility a process called multiplexing. Applications of multiplexing range from the vital, if prosaic, telephone networks to the glamour of FM stereo and space probe telemetry system. There are two basic multiplexing techniques

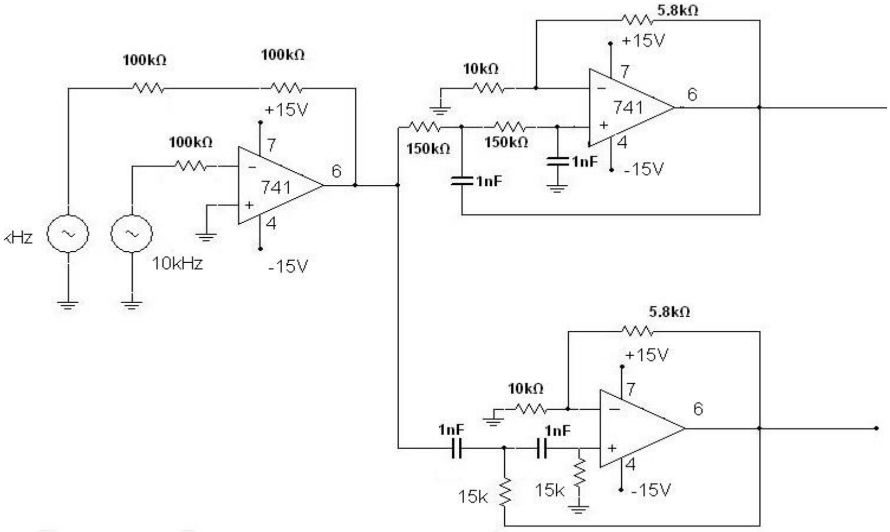
1. Frequency Division Multiplexing (FDM)
2. Time Division Multiplexing (TDM)

The principle of the frequency division multiplexing is that several input messages individually modulate the sub carrier‟s fc1, fc2, etc.after passing through LPFs to limit the message bandwidth. We show the sub carrier modulation as SSB, and it often is; but any of the CW modulation techniques could be employed or a Mixture of them. The modulated signals are then summoned to produce the base band signal with the spectrumXb9f), the designation "base band" is used here to indicate that the final carrier modulation has not yet taken place. The major practical problem of FDM is cross talks, the unwanted coupling of one message into another. Intelligible cross talk arises

Primarily because of non linearity's in the system, which cause 1 message signal to appear as modulation on sub carrier? Consequently, standard practice calls for negative

Feedback to minimize amplifier non linearity in FDM systems

Circuit Diagram:



Tabular Column

SIGNALS	Amplitude(V)	Time(ms)
Input 1		
Input 2		
Modulated input		
Demodulated output 1		
Demodulated output 2		

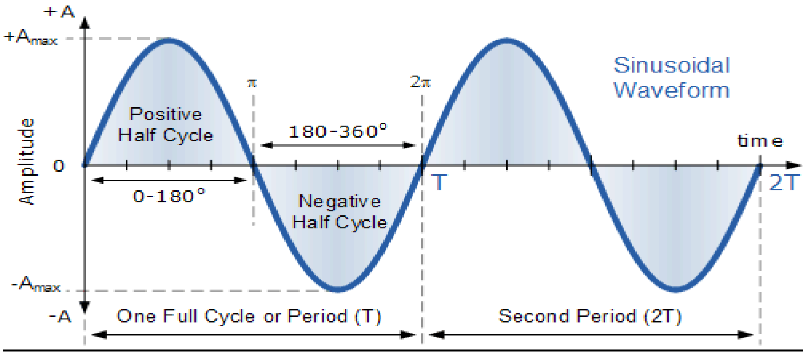
Procedure

1. Connections are given as per the CIRCUIT DIAGRAM.
2. The FSK signals are obtained with two different frequency pair with two different FSK generators.
3. The 2 signals are fed to op-amp which performs adder operation.
4. The filter is designed in such a way that low frequency signal is passed through the HPF.

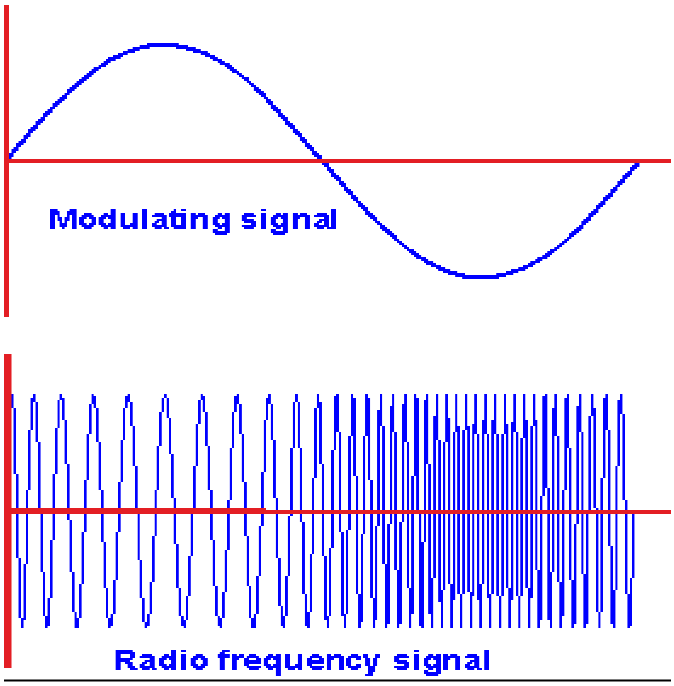
5.Fixed signal is obtained will be equal to the one signal obtained from FSK modulator.

Hardware Expected Waveforms:

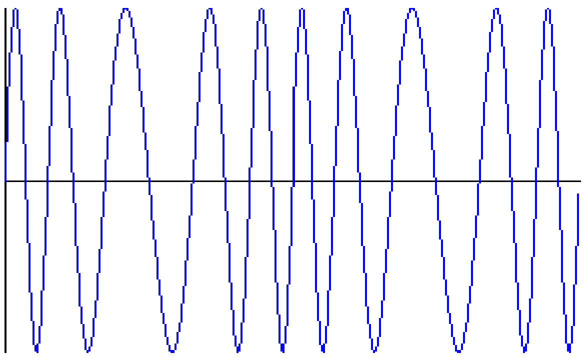
Message signal 1



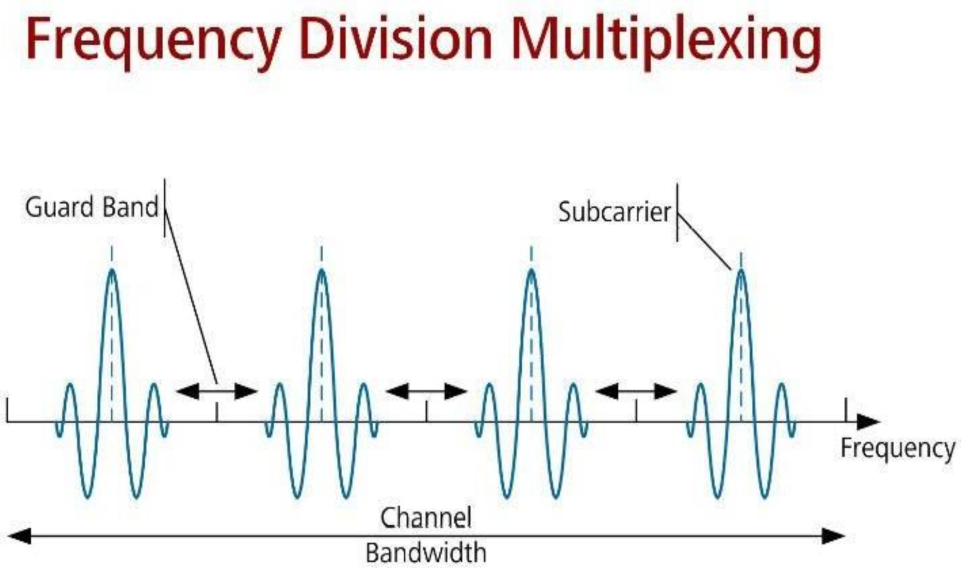
Message signal 2 and FM wave 1



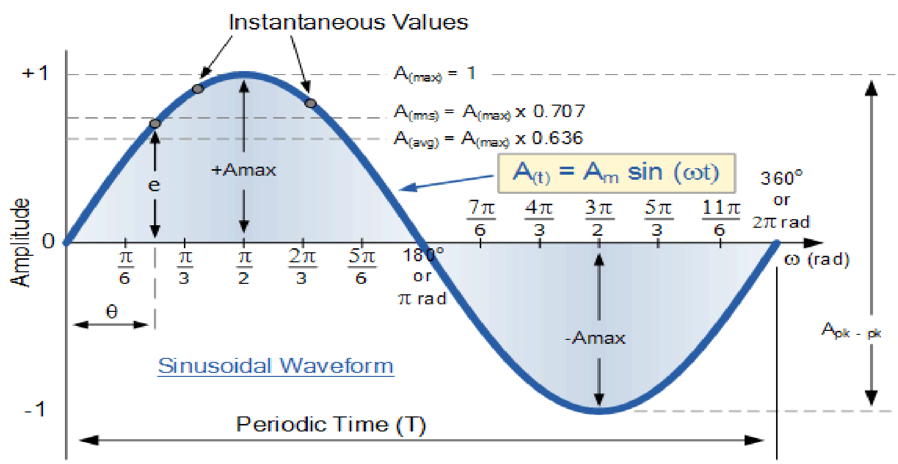
FM Wave 2

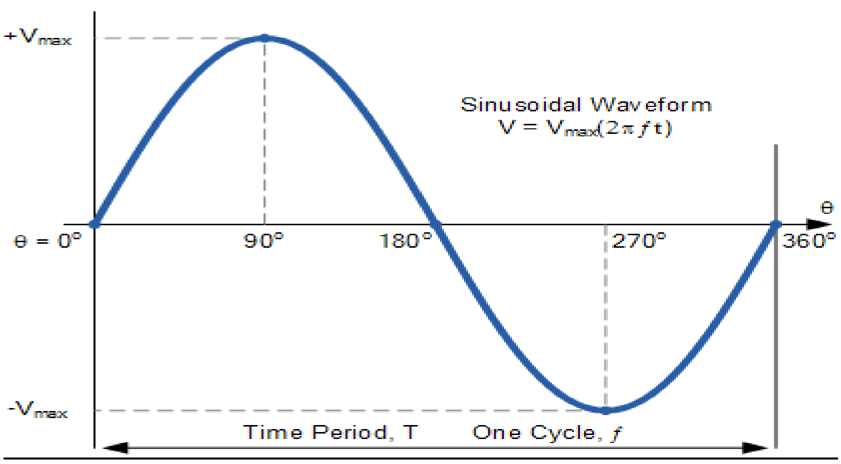


FDM Output



Demodulating Signals





Precautions

1. Check the connections before giving the supply

2. Observations should be done carefully

Pre Lab Question

1. Explain multiplexing?

2. Explain different types of multiplexing?

3. What are the advantages of multiplexing?

Lab Assignment

1. Observe FDM output at different channels?

2. Observe FDM output for 3 inputs using matlab code

Post Lab Questions

1. Explain Frequency-division multiplexing

2. Differentiate FDM & TDM

3. What is the BW of FDM

4. Explain FDM Generation

Result:

4. Frequency Modulation And Demodulation

Aim: 1. To generate frequency modulated signal and determine the modulation index and

bandwidth for various values of amplitude and frequency of modulating signal.

2. To demodulate a Frequency Modulated signal using FM detector.

Apparatus required:

Name of the Component/Equipment	Specifications/Range	Quantity
IC 566	Operating voltage –Max-24 Volts Operating current-Max.12.5 mA	1
IC 803 8	Power dissipation – 750mW Supply voltage - ±18V or 36V total	1
IC 565	Power dissipation -1400mw Supply voltage - ±12V	1
Resistors	15 K Ω, 10 K Ω, 1.8 K Ω, 39 K Ω, 560 Ω	1,2,1 2,2
Capacitors	470 pF, 0.1μF 100pF , 0.001μF	2, 1 1,1 each
CRO	100MHz	1
Function Generator	1MHz	2
Regulated Power Supply	0-30 v, 1A	1

Theory: The process, in which the frequency of the carrier is varied in accordance instantaneous amplitude of the modulating signal, is called "Frequency Modulation". The FM signal is expressed as

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

Where A_C is amplitude of the carrier signal, f_C is the carrier frequency

β is the modulation index of the FM wave

Circuit Diagrams:

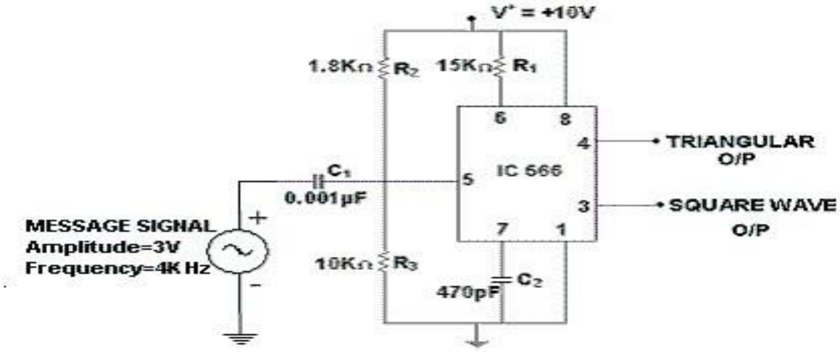


Fig.1. FM Modulator Using IC 566

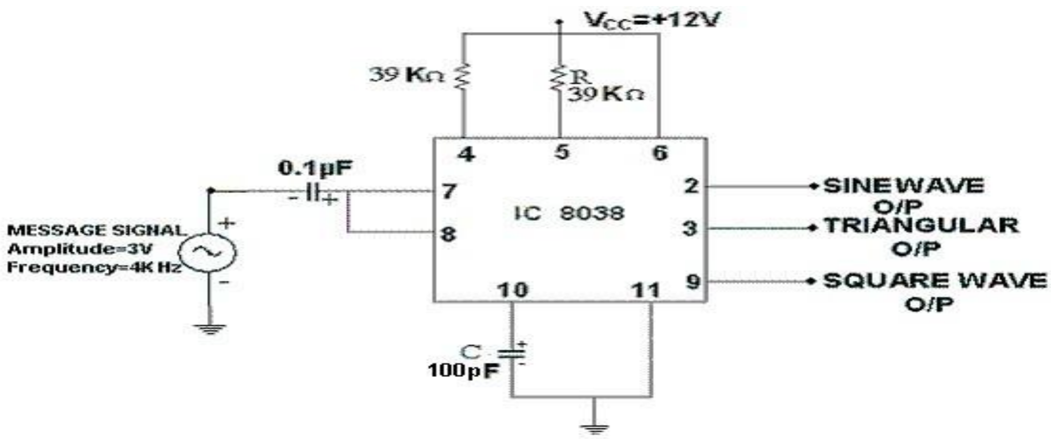


Fig.2. FM Modulator Circuit

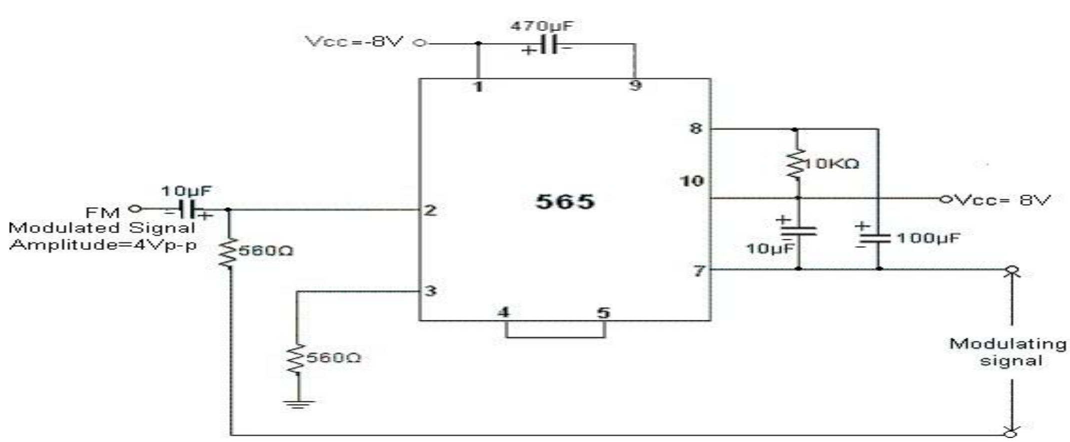


Fig.3. FM Demodulator Circuit

Procedure: Modulation:

1. The circuit is connected as per the circuit diagram shown in Fig.2(Fig.1 for IC 566)
2. Without giving modulating signal observe the carrier signal at pin no.2 (at pin no.3 for IC 566). Measure amplitude and frequency of the carrier signal. To obtain carrier signal of desired frequency, find value of R from f = 1/ (2ΠRC) taking C=100pF.
3. Apply the sinusoidal modulating signal of frequency 4KHz and amplitude 3Vp-p at pin no.7. (pin no.5 for IC 566)

   Now slowly increase the amplitude of modulating signal and measure f_{min} and maximum frequency deviation Δf at each step. Evaluate the modulating index ($m_f = \beta$) using $\Delta f / f_m$ where $\Delta f = |f_c - f_{min}|$. Calculate Band width. $BW = 2(\beta + 1)f_m = 2(\Delta f + f_m)$

4. Repeat step 4 by varying frequency of the modulating signal.

Demodulation:

Connections are made as per circuit diagram shown in Fig.3

Check the functioning of PLL (IC 565) by giving square wave to input and observing the output

Frequency of input signal is varied till input and output are locked.

Now modulated signal is fed as input and observe the demodulated signal (output) on CRO.

Draw the demodulated wave form.

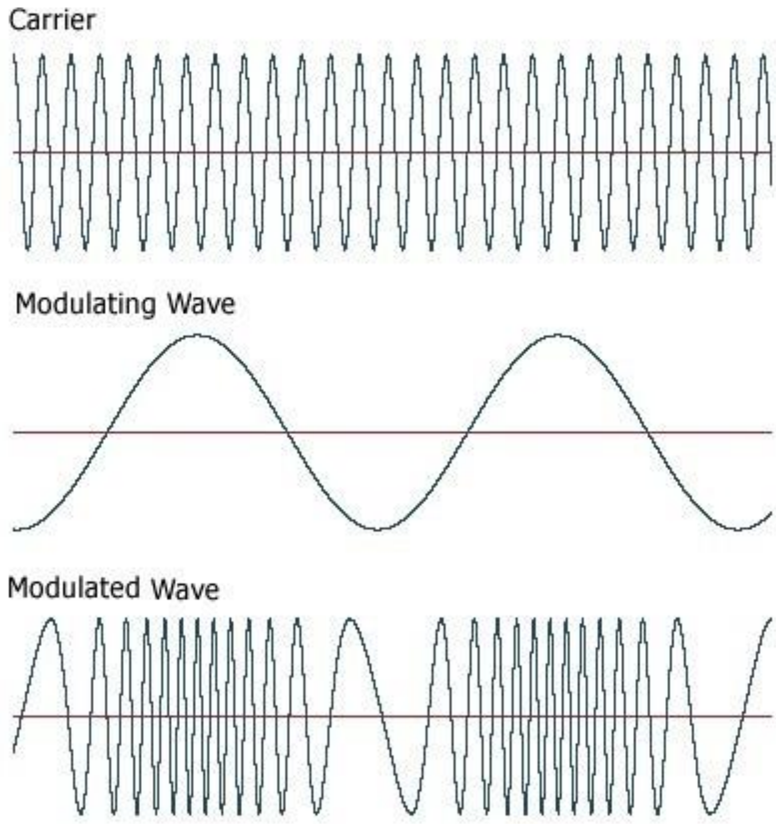
Table: 1 f_c = 45KHz

S.No.	f_m(KHz)	T_{max} (μsec)	f_{min}(KHz)	Δf(KHz)	β	BW (KHz)

Table 2: f_m = 4 KHz, f_c = 45 KHz

S.No.	A_m (Volts)	T (μsec)	f_{min}(KHz)	Δf (KHz)	β	BW(KHZ)

Waveforms:



Precautions:

1. Check the connections before giving the power supply
2. observations should be done carefully

VIVA QUESTION

1. How can be aliasing be avoided?
2. What is under sampling?
3. Define Nyquist rate?
4. What is sampling frequency?
5. What is modulating frequency?
6. What is sampling rate?

5.PULSE AMPLITUDE MODULATOR AND DE MODULATOR

AIM:

To set pulse amplitude modulator and de modulator circuits and to observe the wave forms

OBJECTIVES: After completing this experiment, students will be able to set up PAM modulator and demodulator circuits and identify the waveforms.

COMPONENTS AND EQUIPMENTS REQUIRED:

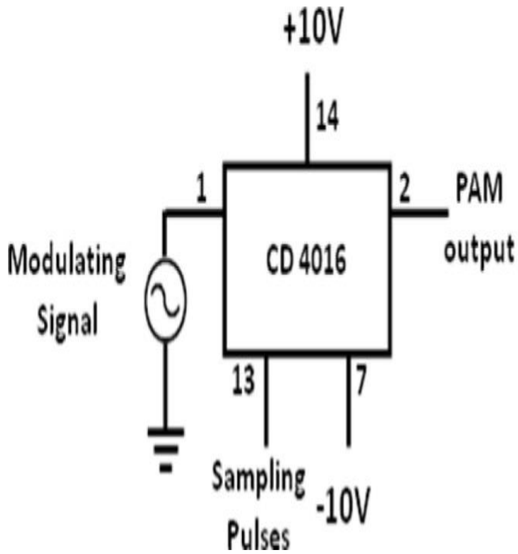
Sl. No.	Item & Specification	Quantity
1	Analog Switch CD 4016	1No.
2	Resistor- 1.5K	1No.
3	Capacitor- 1μF	1No.
4	Signal Generator	2Nos.
5	CRO	1No.
6	Bread Board	1No.
7	Power supply +/- 10V	1No.

THEORY:

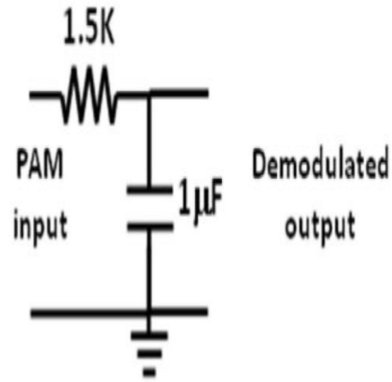
Pulse Amplitude Modulation (PAM) is the simplest pulse modulation scheme. In pulse amplitude modulation system the amplitude of a carrier pulse train is varied in accordance with the instantaneous level of the modulating signal.

The simplest form of the PAM modulator is an analog switch that is turned on and off at the RF carrier pulse rate. As the switch changes state, the modulating signal is connected and disconnected from the output. Thus the output PAM signal is a sampled version of the modulating signal. If the sampling frequency is sufficiently high (at least twice that of the highest modulating frequency), the original signal can be recovered at the receiver by simply passing it through a low pass filter having a cut-off frequency equal to the highest frequency in the modulating signal.

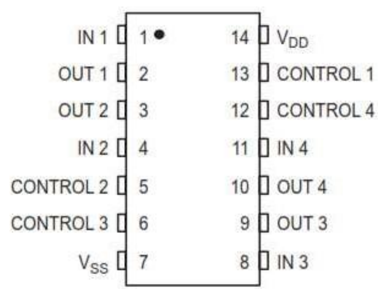
CIRCUIT DIAGRAM:



Modulator



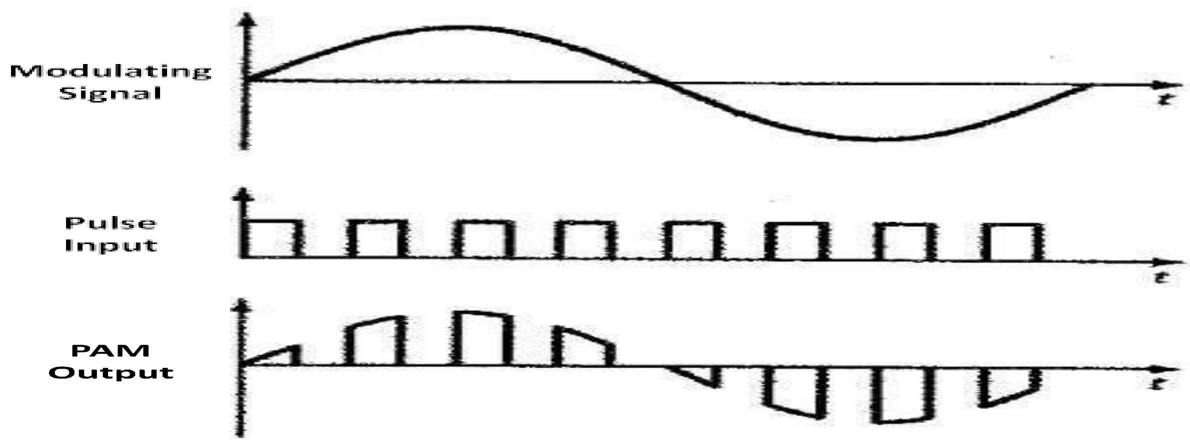
Demodulator



CD 4016 Pinout

WAVEFORMS:

observe the demodulated output on the other channel of the CRO. Plot the waveforms.



PROCEDURE:

1. Test all the components and probes.
2. Set up the modulator circuit using CD 4016 as shown in figure. Switch on the power supplies.
3. Feed 5Vpp, 100Hz modulating signal at IN 1 input and 5V, 1KHz square wave signal at Control 1 input of CD 4016.
4. Observe the PAM output signal at OUT 1 pin on one channel of the CRO.
5. Set up the demodulator circuit as shown in figure. Feed the PAM signal as the input and

RESULT:

Viva questions:

1. What is PAM practical circuit?

2. How the message can be recovered from PAM?

3. What are the objectives met by modulation?

4. What is analog and digital communication?

PULSE POSITION MODULATION & DEMODULATION

AIM: To set up pulse position (PPM) modulator and demodulator circuits and to observe and plot the waveforms.

INFERENCE: Learned the usage of 555 timer as a pulse width modulator.

COMPONENTS AND EQUIPMENTS REQUIRED:

Modulator

Sl. No.	Item & Specification	Quantity
1	IC 555	2Nos.
2	Resistor- 4.7K,10K, 1.2K	
3	Capacitor- 10µF, 0.01µF 0.1µF, 0.001µF	1No. each 2Nos.
4	Diode 1N 4001	2Nos.
5	CRO	1No.
6	Signal Generator	1Nos.
7	Bread Board	1No.
8	Power Supply 10V	1No.
9	Wires and connectors	

DEMODULATOR:

Sl. No.	Item & Specification	
1	IC 741, IC LM324	
2	Resistor-1.5K, 47K, 15K, 100K 1K,10Ω	1No. each 2Nos.
3	Capacitor 10μF 1μF	1No. 2Nos.
4	CRO	1No.
5	Bread Board	1No.
6	Power Supply 10V, +/- 15V	1No.each
7	Wires and connectors	

THEORY:

Pulse Position Modulation (PPM) is one of the pulse modulation schemes where the relative position of the pulses in a carrier pulse train is made proportional to the instantaneous value of the modulating signal.

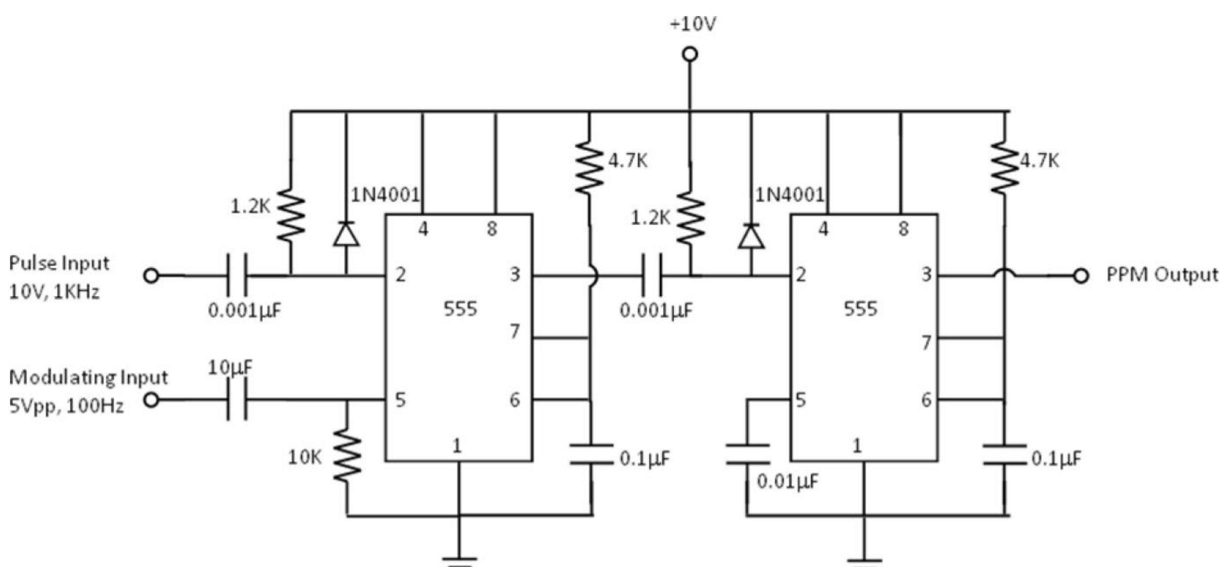
A pulse position modulator made up of IC 555 is shown in figure. Both the 555s are working in monostable mode. The first monostabe generates a PWM signal and this PWM output is used as the trigger input of the second monostable. Since the monastable triggers at the trailing edge of the PWM signal, the position of the resulting pulses will have position shift compared to the input pulse train.

The PPM demodulator is set up using an Op Amp SR flip flop, an integrator and a low pass filter. The flip flop is set by the carrier pulses and reset by the PPM pulses. The resulting output is a PWM signal. This PWM signal is then demodulated using the integrator-low pass filter combination.

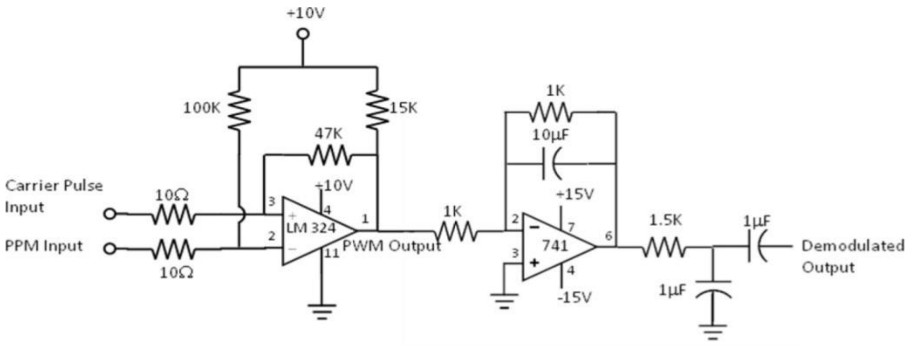
PROCEDURE:

1. Test all the components and probes.
2. Set up the circuit as shown in the figure on the bread board. Switch on the power supplies.
3. Feed the 10Vpp, 1KHz, 0.2 duty cycle carrier pulse train and the 5Vpp, 100Hz modulating signal (Sine wave) at the trigger and control inputs of the first 555 respectively.
4. Make sure that the PWM signal is available at pin 3 of the first 555. Vary the amplitude of the modulating signal to get a proper PWM output if needed.
5. Observe the waveforms of the input pulse train, modulating input, PWM output and PPM output on the CRO.
6. Observe the following waveforms in pairs on both the channels of the CRO; a) Modulating input and PWM output b) PWM output and PPM output c) Modulating input and PPM output
7. Plot the waveforms.
   Set up the demodulator circuit as shown in figure. Switch on the power supply.
   Feed the PPM signal input and the carrier pulse input as shown in figure. Observe the waveforms at various points on CRO and plot.

CIRCUIT DIAGRAM:

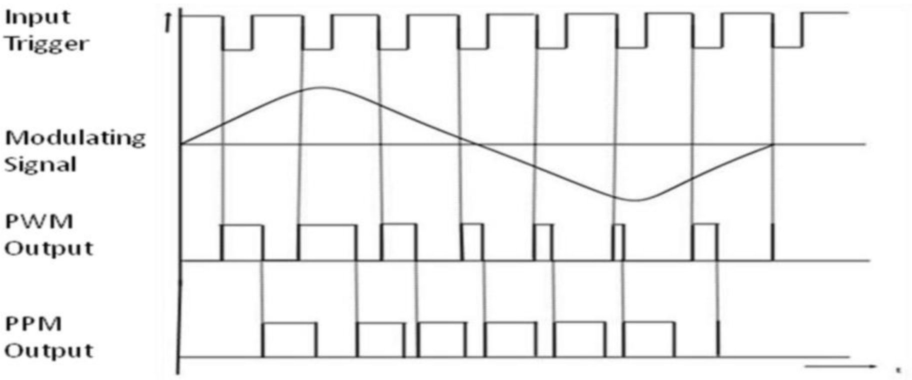


Modulator



Demodulator

WAVEFRM:



INFERENCE: Studied the usage of 555 timer as PPM modulator.

RESULT:

VIVAQUESTIONS

1. What is objective met modulation?

2. What is analog and digital communication?

3. What is analog communication?

4. Is communication a system?

PULSE WIDTH MODULATION &DEMODULATION

Aim: To generate the pulse width modulated and demodulated signals

Apparatus required:

Name of the Apparatus	Specifications/Range	Quantity
Resistors	1.2kΩ, 1.5 kΩ, 8.2 kΩ	1,1,2
Capacitors	0.0 1 μF, 1 μF	2,2
Diode	0A79	1
CRO	0-30, MHz	1
Function Generator	1MHz	1
RPS	0-30v,1A	1
IC 555	Operating tem :SE 555 -55°C to 125°C NE 555 0° to 70°C Supply voltage :+5V to +18V Timing :µSec to Hours Sink current :200mA Temperature stability :50 PPM/°C change in temp or 0-005% /°C.	1
CRO Probes	--	1

Theory:

Pulse Time Modulation is also known as Pulse Width Modulation or Pulse Length Modulation. In PWM, the samples of the 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. It is also called Pulse Duration Modulation.

Circuit Diagram:

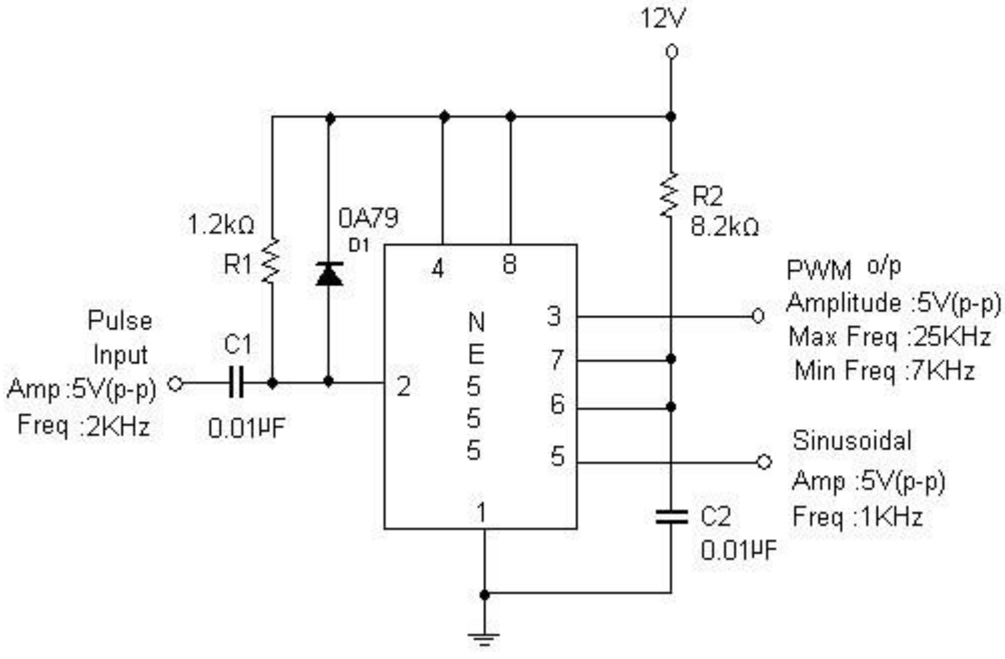


Fig: 1 Pulse Width Modulation Circuit

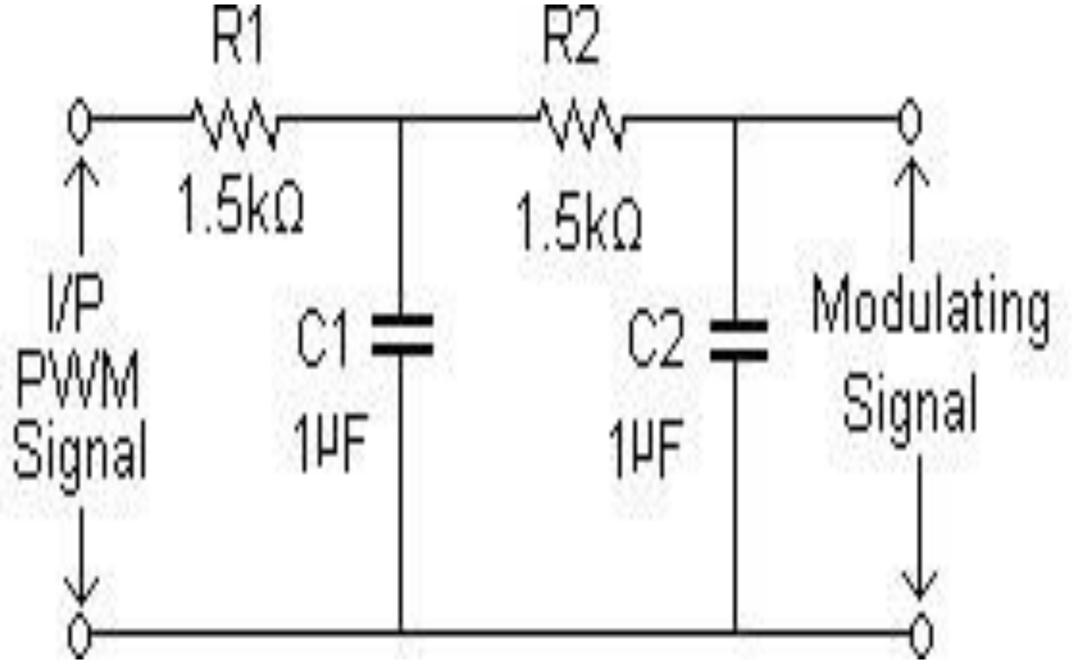


Fig: 2 Demodulation Circuit

Procedure:

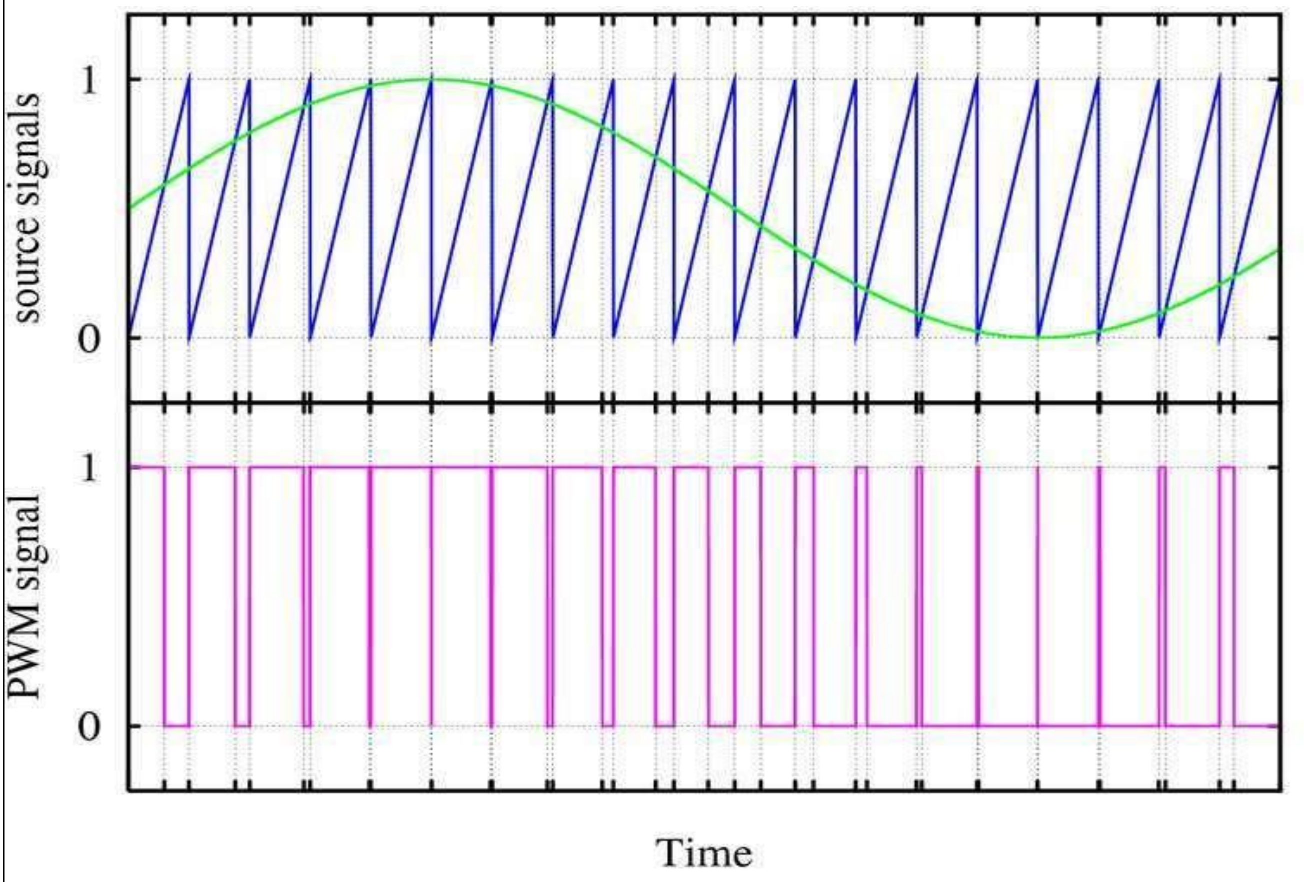
1. Connect the circuit as per circuit diagram shown in fig 1.
2. Apply a trigger signal (Pulse wave) of frequency 2 KHz with amplitude of 5v (p-p).
3. Observe the sample signal at the pin3.
4. Apply the ac signal at the pin 5 and vary the amplitude.

Note that as the control voltage is varied output pulse width is also varied.

6. Observe that the pulse width increases during positive slope condition & decreases under negative slope condition. Pulse width will be maximum at the +ve peak and minimum at the –ve peak of sinusoidal waveform. Record the observations.
7. Feed PWM waveform to the circuit of Fig.2 and observe the resulting demodulated waveform.

Observations:

S.No.	Control voltage (V_{P-P})	Output pulse width (m sec)



RESULT :

VIVA QUESTION:

1. Define Pam And Write Down Its Drawbacks?

2. How Can Be Aliasing Be Avoided? ..

.

3 .State The Advantages Of Super Heterodyning?

...

3. What Do You Mean By Fm And Classify Fm? ...

5 .What Do You Mean By Nyquist Rate? ...

6 What Is Amplitude Modulation? .

..

7. What Is Modulation?

4. VERIFICATION OF SAMPLING THEOREM

AIM:

To observe the number of samples by applying the modulating signal with frequency 500Hz and 1KHz with clock frequency 20KHz.

Equipment required: -

Sampling theorem trainer kit.

Function generator

CRO

BNC cablePatch cards

Theory: -

The sampling process is usually described in the time domain as such it is as operation that is basic to digital signal processing and digital communications. Though use of the sampling process an analog signal is converted into a corresponding sequence of samples that are usually spaces uniformly is time clearly for such a procedure to have practical utility it is necessary that we choose the sampling rate properly so that the sequence of samples uniquely defines the original signal this is the senesce of the sampling theorem.

Consider an arbitrary signal x (t) of finite energy which is specified for all time suppose that we sample the signal x (t) instantaneously and at a uniform rate, once every t_s seconds consequently we obtain an infinite sequence of samples spaced t_s seconds apart and denoted by {x (nt_s)}. T_s are the sampling period and its reciprocal fs=1/ts is the sampling rate. This ideal form of sampling is called instantaneous sampling. Xs (t) =

Where Xs (t) is the ideal sampled signal

We may state the sampling theorem for strictly band limited signals of finite energy is two equivalent parts, which apply to the transmitter and receiver of a pulse modulation system.

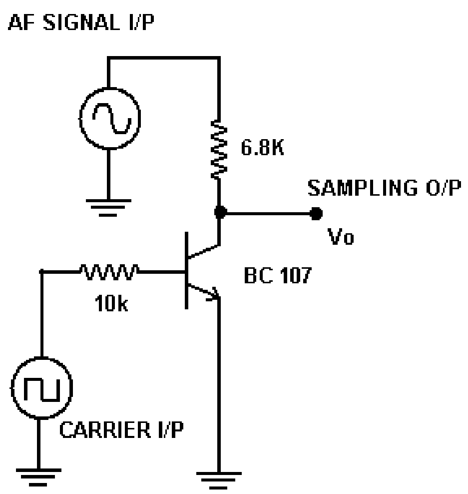
Time domain statement: -

A band limited signal of finite energy and finite duration, which has no frequency components higher than fm Hz is completely described by specifying the values of the signal at instants of time serrated by 1/2fm, seconds.

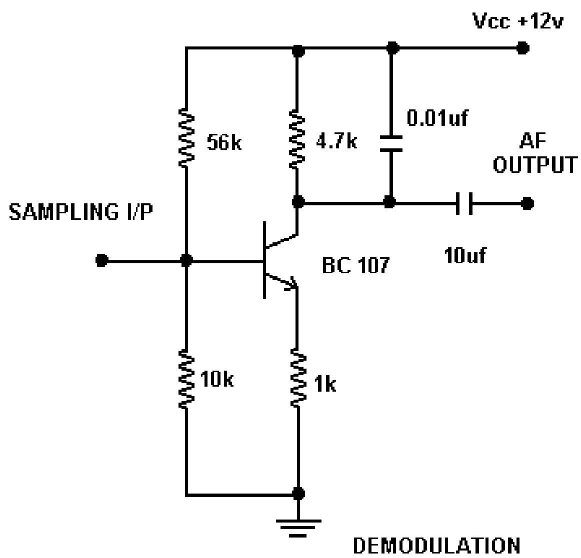
Frequency domain statement: -

A band-limited signal of finite energy, which has no frequency components higher than f_m Hz, may be completely recovered form, knowledge of its samples taken at the rate of $2f_m$ samples per second. The sampling rate of $2f_m$ samples per second for a signal bandwidth of f_m Hz is called the Nyquist rate and its reciprocal of $1/2f_m$ is called the Nyquist interval. This equation provides an interpolation formula for reconstructing the original signal x (t) form the sequence of samples values x $(n/2f_m)$, with the sine function since (2fmt) playing the role of an interpolation function each sample is multiplied by a delayed version of the interpolation function and all resulting waveforms are added to obtain x (t).

CIRCUIT DIAGRAM

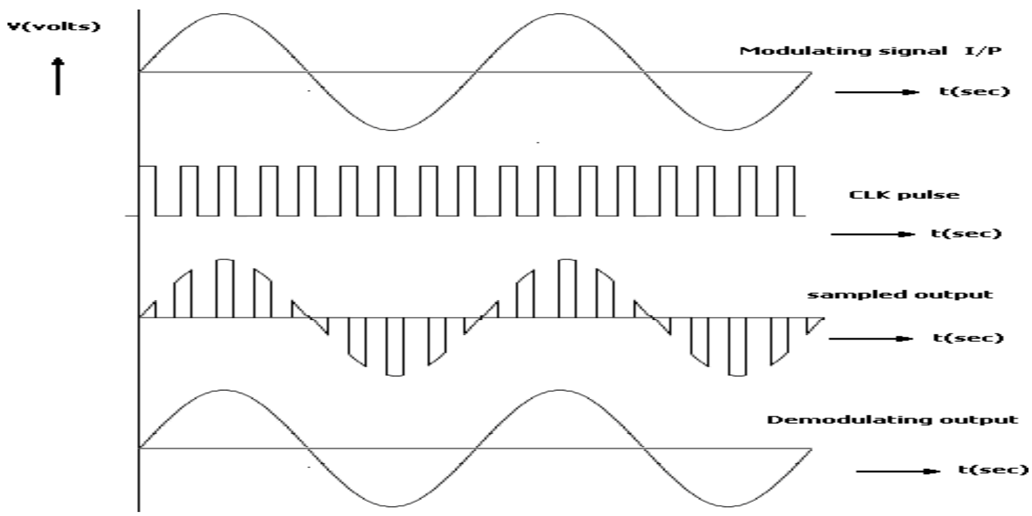


MODULATION



DEMODULATION

MODEL GRAPH



Procedure: -

1. Connect the circuit as per the circuit diagram.
2. Apply a modulating signal of frequency 1 kHz and a clock pulse of frequency18KHz
3. Observe the sampled waveform on CRO and find the number of samplesobtained.
4. Compare it with theoretical value and verify it draw the waveform of thesampled signal.

Results: -

Applications:

The sampling theorem is usually formulated for functions of a single variable. Consequently, the theorem is directly applicable to time-dependent signals and is normally formulated in that context. However, the sampling theorem can be extended in a straightforward way to functions of arbitrarily many variables.

VIVA

Define sampling theorem.

What is sampling?

Define band limited signals?

What is aliasing effect?

TIME DIVISION MULTIPLEXER AND DEMULTIPLEXER

AIM:

To set up Time Division Multiplexer and Demultiplexer circuits and to observe the waveforms.

OBJECTIVES: After completing this experiment, the students will be able to a) Set up TDM multiplexer and demultiplexer circuits.

COMPONENTS AND EQUIPMENTS REQUIRED:

Sl. No.	Item & Specification	Quantity
1	Transistor- SL100, SK100	1No. each
2	Resistor - 1K 10K	7Nos. 4Nos.
3	Capacitor 1μF	2No.
4	IC 741	1No.
5	Signal Generator	3Nos.
6	CRO	1No.
7	Power Supply - +/- 15V	1No.
8	Bread Board	1No.
9	Wires and probes	

THEORY:

Time Division Multiplexing (TDM) is widely used in digital communication networks to transmit multiple signals simultaneously through the same channel. Different signals are transmitted in a time shared manner. Each signal is allotted a fixed time slot and a sample of the corresponding signal is transmitted during that period. After one sample each of all the signals is sent, the time slot is given back to the first signal and this process repeats.

TDM Multiplexer

A simple TDM multiplexer circuit using an NPN-PNP transistor pair and an Op amp is shown in figure. The transistors work as switches and the Op amp works as an adder. The signals to be sent are fed to the collectors of the two transistors. The switching signal is applied to the bases the transistors. During the ON time of the switching signal, the NPN transistor is ON and the PNP transistor is OFF. Signal 1 alone is connected to the adder input and reaches the output. During OFF time of the switching signal, the NPN transistor is OFF and the PNP transistor is ON. Signal 2 alone is connected to the adder input and reaches the output. Thus the two signals reach the output one after the other as the switching signal changes state. The resulting signal is a time division multiplexed one. The on-off period of the switching signal decides the time slot.

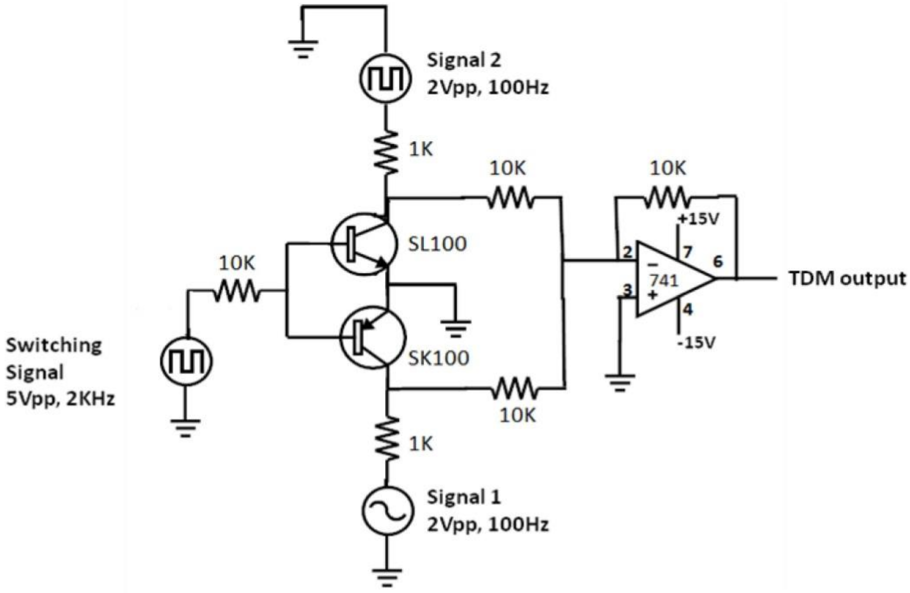
TDM Demultiplexer

In the demodulator circuit the two transistors act as switches. They connect the input TDM signal to the respective outputs alternately as the switching signal changes state. A square wave signal with the same phase and frequency as the one used at the TDM modulator is used as the switching signal. During the ON time of the switching signal, the NPN transistor is ON and the PNP transistor is OFF. TDM input is now connected to signal 1 output. During the OFF time of the switching signal, the NPN transistor is OFF and the PNP transistor is ON. TDM input is now connected to signal 2 output. The RC networks act as low pass filters.

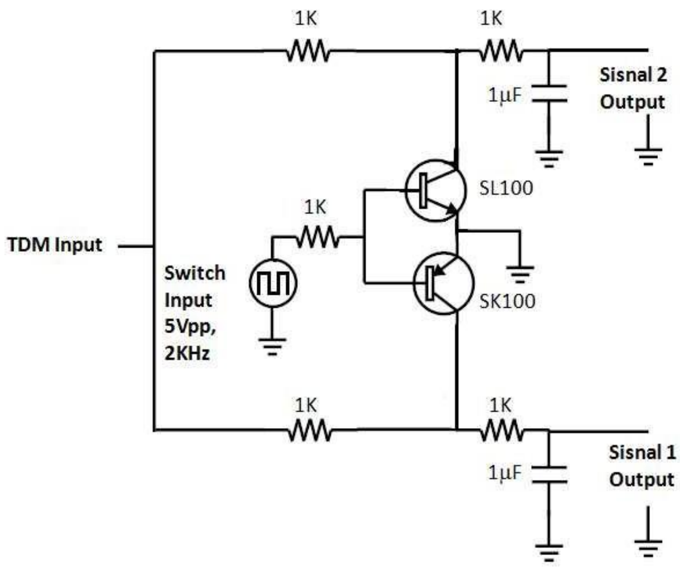
PROCEDURE:

1. Test all the components and probes.
2. Set up the circuits on the bread board as shown in figure.
3. Connect 5Vpp, 2KHz square wave signal as the switching input.
4. Connect 2Vpp, 100Hz sine wave as signal 1 and 2Vpp, 100Hz square wave as signal 2.
5. Observe the TDM output on CRO and plot the waveforms.
6. Feed this TDM output to the input of the demultiplexer. Use the same square wave signal used at the modulator as the switching signal.
7. Observe signal 1 and signal 2 outputs of the demultiplexer on CRO.
8. Plot the waveforms.

CIRCUIT DIAGRAM:

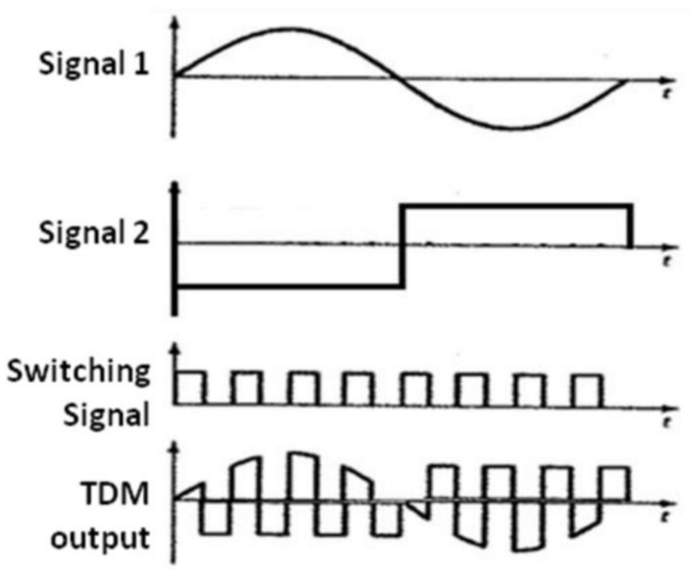


TDM Multiplexer



TDM Demultiplexer

WAVEFORM:



RESULT:

VIVA QUESTIONS:

1. What is TDM used for?
2. What is TDM signal?
3. What are the types of TDM?
4. What is the basic principle of TDM?

PULSE CODE MODULATION & DEMODULATION

AIM: To set up a PCM modulator and observe the waveforms.

OBJECTIVES: After completing this experiment, the students will be able to a) Set up a PCM modulator and to generate a PCM encoded output for a given analog input.

COMPONENTS AND EQUIPMENTS REQUIRED:

Sl. No.	Item & Specification	Quantity
1	Resistor - 2.2K 1K	7Nos. 3Nos.
2	IC CD4016, LM324, 7493, 7400	1No.each
3	Signal Generator	3Nos.
4	CRO	1No.
5	Power Supply - +5V	1No.
6	Bread Board	1No.
7	Wires and probes	

THEORY:

Pulse Code Modulation is a digital modulation technique by which an analog signal is converted to an equivalent sequence of binary codes. The analog signal is first sampled at regular intervals and these samples are then quantized to predefined levels. An analog to digital convertor converts these quantized symbols to their corresponding binary codes.

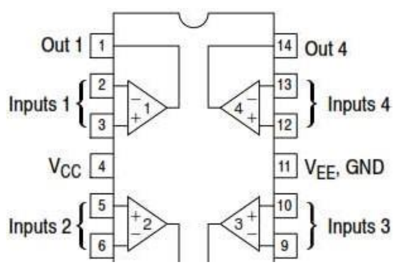
In the circuit an analog switch is used to sample the input signal. These samples are compared to the output of a DAC circuit which is initially zero. So the comparator output goes 'high' and strobes the clock input to the counter. This signal also disables the reset inputs of the counter. The counter starts to count up. An R-2R ladder DAC simultaneously converts the counter output to its equivalent analog value. When the DAC output goes above the input sample, the comparator output switches to 'low' and cuts off the clock input from the counter. The reset inputs are also enabled causing the counter output to reset. When the next sample reaches the comparator input the whole process starts over again.

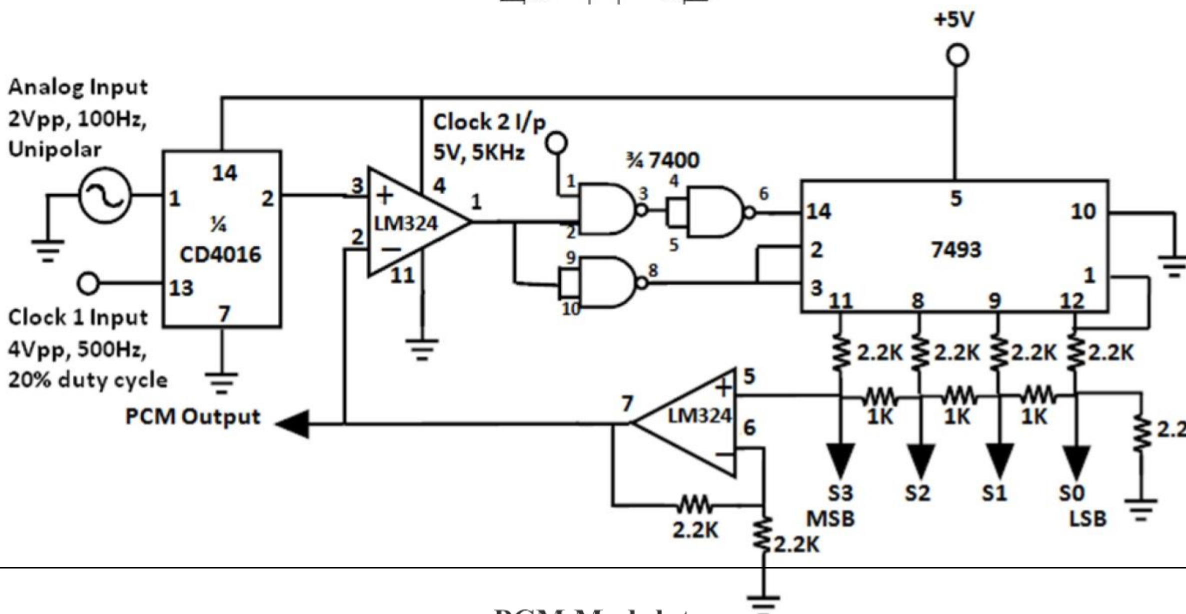
1. Test all the components and probes.
2. Set up the circuit as shown in figure on a bread board.
3. Feed 2Vpp, 100Hz unipolar sine wave as the analog input (Set dc level at 2V to obtain a signal that varies between +1V and +3V). Make sure that the input peak voltage never exceeds the peak DAC output.

PROCEDURE:

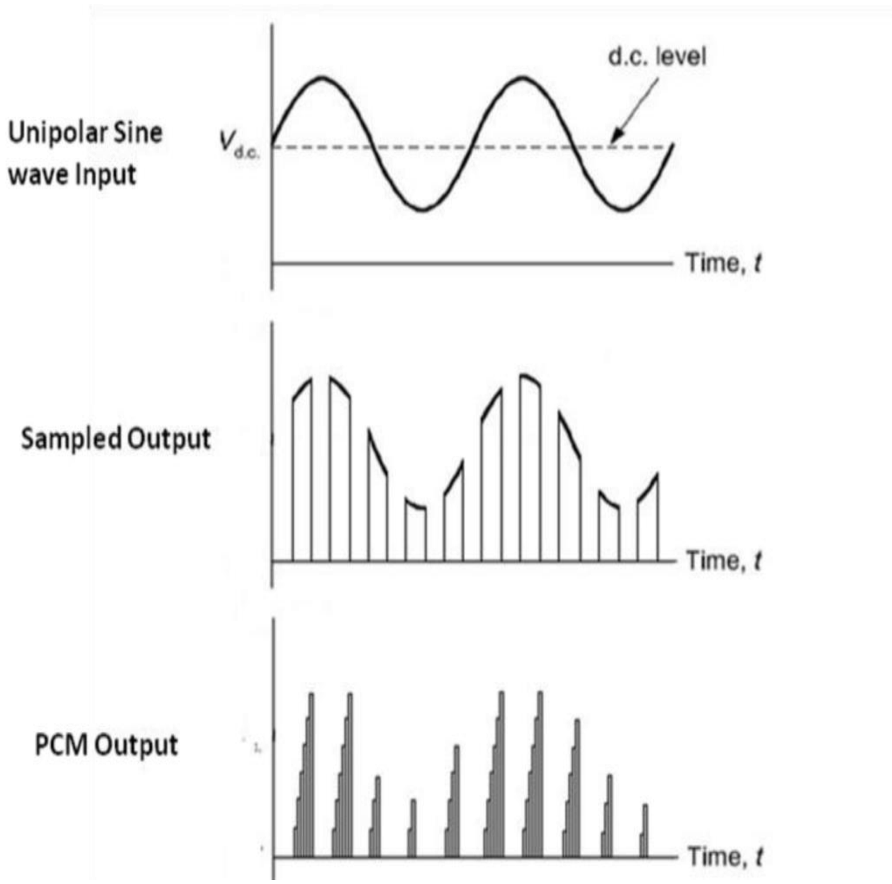
4. Use the dc offset knob on the function generator to add dc offset to make unipolar sine wave.
5. Use 4Vpp, 500Hz square wave with 20% duty cycle as sampling clock (clock 1) and 5V, 5KHz square wave as the clock input of the counter (clock 2).
6. Observe the input sine wave, sampled output and the PCM output (DAC output; staircase waveform) on CRO. Vary the analog input and clock 1 input amplitudes to obtain the optimum result, if needed.
7. Plot the waveforms.
8. The binary output can be checked by giving discrete dc input voltages (less than 5V).

CIRCUIT DIAGRAM:





WAVEFORM:


d.c. level
Unipolar Sine wave Input
$V_{d.c.}$
Time, t
Sampled Output
Time, t
PCM Output
Time, t

RESULT:

VIVA QUESTION

1. How does Pulse Code Modulation work?

2. What are the steps of Pulse Code Modulation?

3. What is electronic electronic communication?

4.What are the main features of receiver?

ASK MODULATOR AND DEMODULATOR

AIM:

To set up ASK modulator and demodulator circuits and to observe the waveforms.

OBJECTIVES:

After completing this experiment the students will be able to a) Set up ASK modulator and demodulator circuits and b) Identify ASK waveform.

COMPONENTS AND EQUIPMENTS REQUIRED:

Sl. No.	Item & Specification	Quantity
1	Transistor- BC 107	1No.
2	Resistor- 4.7K, 10K, 2.2K, 1K 10K pot	1No. each 1No.
3	Capacitor- 0.01μF	1No.
4	Diode- 1N 4001	1No.
5	Zener Diode - 5Z1	2Nos.
6	IC 741	1No.
7	Signal Generator	2Nos.
8	CRO	1No.
9	Power Supply - +/- 15V, 5V	1No. each
10	Bread Board	1No.
11	Wires and probes	

THEORY:

Amplitude Shift Keying (ASK) is a digital modulation scheme where the binary data is transmitted using a carrier signal with two different amplitude levels. For binary 0 and 1, the carrier switches between these two levels. In its simplest form, a carrier is sent during one input and no carrier is sent during the other. This kind of modulation scheme is called on-off keying.

A simple ASK modulator circuit is shown in figure. Here a sinusoidal high frequency carrier signal is sent for logic ‘0’ (-5V) and no carrier is sent for logic ‘1’ (+5V). The transistor works as a switch closes when the input (base) voltage is +5V (logic ‘1’) and shorts the output. When the input voltage is -5V (logic ‘0’), the switch opens and the carrier signal is directly connected to the output.

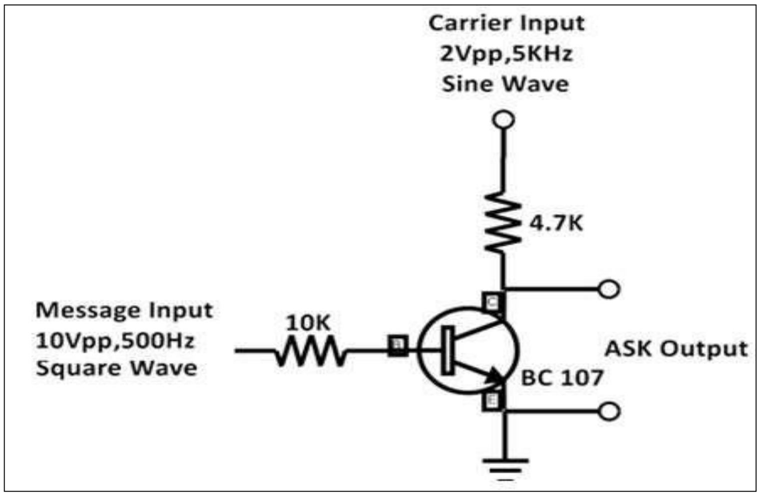
The demodulator circuit consists of an envelope detector and a comparator. The diode D selects the positive half cycle of the ASK input. The envelop detector formed by 2.2K resistor and 0.01uF capacitor detects the data out of the ASK input. The Op Amp comparator and the zener diode amplitude limiter convert this detected signal to its original logic levels. The 10K potentiometer may be varied to set suitable reference voltage for the comparator.

PROCEDURE:

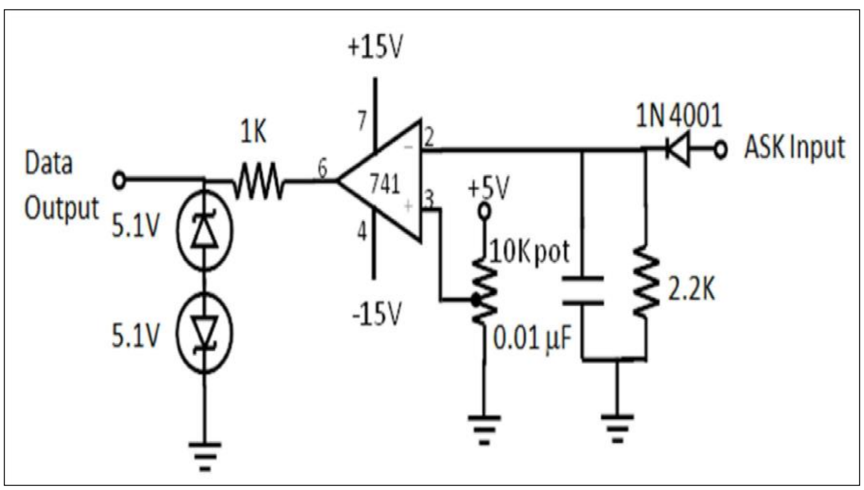
2. Set up the circuits as shown in figure on the bread board.
3. Feed 10Vpp, 500Hz square wave as the message/data input and 2Vpp, 5KHz sine wave as the carrier input.
4. Observe both the message input and ASK output simultaneously on CRO and plot.
5. Apply the ASK output of the modulator to the demodulator input.
6. Observe both the ASK input and the demodulated output simultaneously on CRO. Adjust the reference voltage of the comparator if needed.
7. Plot the waveforms.

1. Test all the components, bread board and probes.

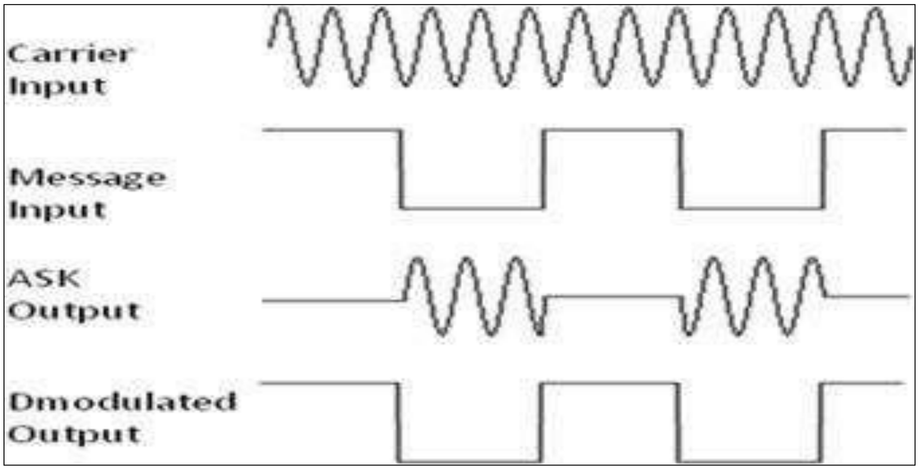
CIRCUIT DIAGRAM:



ASK Modulator



WAVEFORMS:



RESULT:

VIVA QUESTION

1. What is modulation VIVA?

2. What are the objectives met by modulation?

3. What are the different digital modulation techniques?

4. What are the types of digital communication?

FREQUENCY SHIFT KEYING

AIM:

To set up FSK modulator and demodulator circuits and to observe the waveforms.

OBJECTIVES:

After completing this experiment, the students will be able to a) Set up FSK modulator and demodulator circuits and b) Identify FSK waveform.

COMPONENTS AND EQUIPMENTS REQUIRED:

Sl. No.	Item & Specification	Quantity
	0.02μF	
1	0.047μF, 0.001μF IC LM311 Transistor- BC 177	1No.
2	Resistor- 47K, 47K pot, 10K pot 10K	1No. each 7Nos.
3	Capacitor- 0.01μF	3Nos. 4Nos. 1No.each
4		1No.
5	IC 555, IC 565	1No. each
6	Signal Generator	1Nos.
7	CRO	1No.
8	Power Supply - +/- 5V	1No.
9	Bread Board	1No.
10	Wires and probes	

THEORY:

Frequency Shift Keying (FSK) is a digital modulation scheme where the digital data is transmitted using a high frequency carrier signal. For logic '0' and '1' the carrier signal switches between two preset frequencies, hence the name FSK.

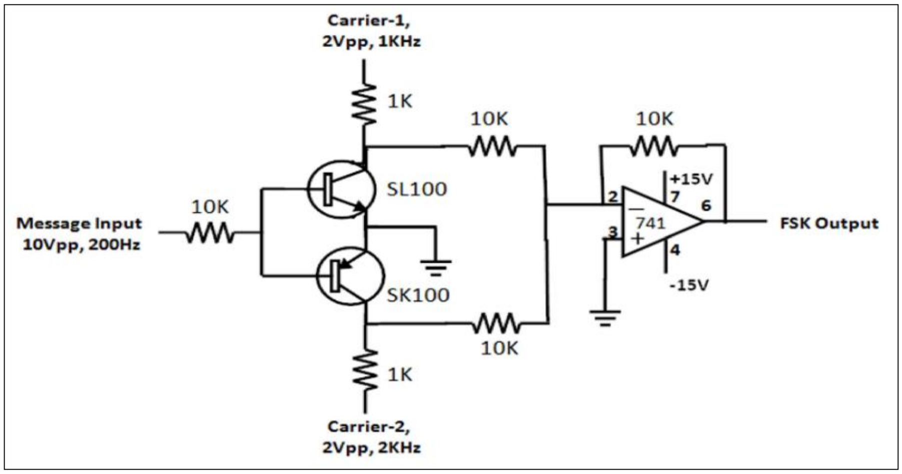
For logic '1' transistor SK100 is OFF and SL 100 is ON and vice versa, at any one time one frequency will be the output of the op-amp. Thus the output signal switches between the two preset frequencies for logic '0' and logic '1'. The resulting signal is FSK modulated.

PROCEDURE:

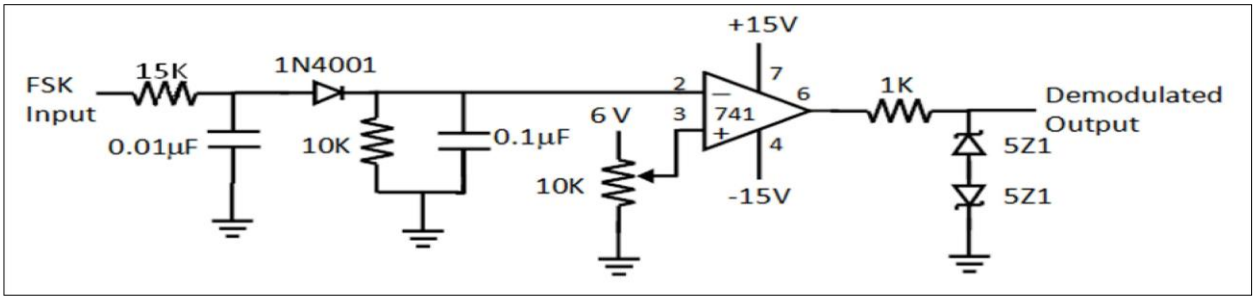
1. Test all the components and probes.
2. Set up the FSK modulator and demodulator circuits on the bread board. Switch on the power supplies.
3. Feed 5V, 100Hz (10Vpp, 100Hz) square wave as the data input. Vary the pot R_C to adjust the output frequencies if needed.
4. Observe both the input and output waveforms on CRO and plot. The waveform of the FSK output will be rectangular in nature for 555 modulator.

Apply the FSK output of the modulator to the input of the demodulator, and observe the output. Vary the 10K pot to get the PLL locked with the input signal. Plot the waveforms.

CIRCUIT DIAGRAM:

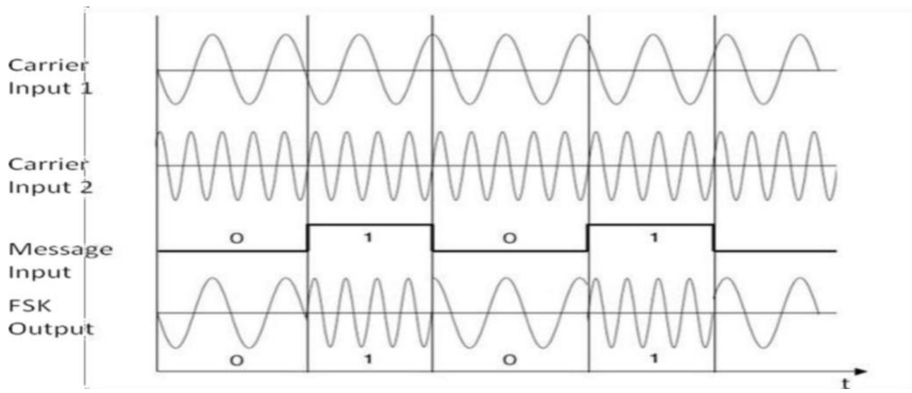


FSK Modulator



FSK DEMODULATION

WAVEFORM:



RESULT

VIVA QUESTION

What is electronic electronic communication?

What is the difference between analog and digital communication?

What are the different digital modulation techniques?

What are the types of digital communication?

QPSK GENERATION AND DETECTION

AIM: To study modulation and demodulation of QPSK and sketch the relevant waveforms**.**

APPRATUS:

1. QPSK Trainer Kit
2. Dual Trace oscilloscope
3. Digital Millimeter
4. C.R.O(30MHz)
5. Patch chords.

THEORY:

The Quadrature Phase Shift Keying QPSKQPSK is a variation of BPSK, and it is also a Double Side Band Suppressed Carrier DSBSCDSBSC modulation scheme, which sends two bits of digital information at a time, called as bigits.Instead of the conversion of digital bits into a series of digital stream, it converts them into bit pairs. This decreases the data bit rate to half, which allows space for the other users

BLOCK DIAGRAM: QPSK MODULATOR & DEMODULATOR

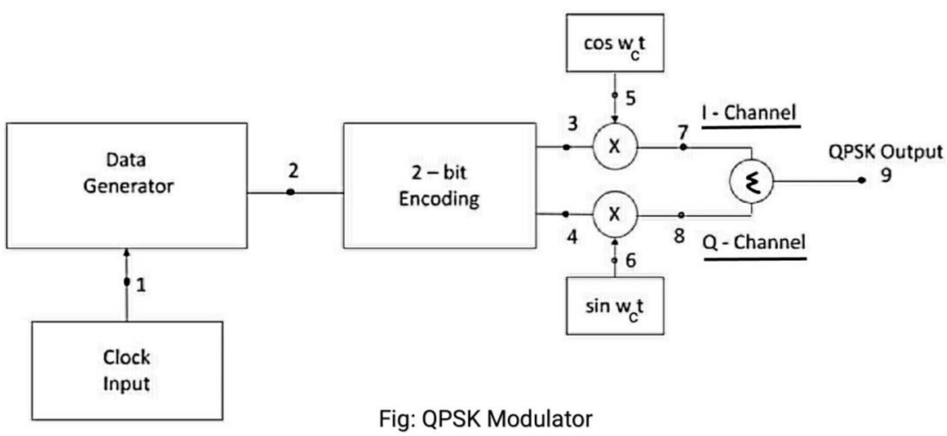


Fig: QPSK Modulator

PROCEDURE:

1. Connect and switch on the power supply.
2. QPSK is selected by default and LEDs of corresponding technique will glow.
3. Select the bit pattern using push button i.e. 8 bit or 16 bit or 32 bit or 64 bit. Observe bit pattern onTP-2.
4. Select data rate using push button i.e. 2 KHz or 4 KHz or 8 KHz 16 KHz.

Modulation:

5. Observe the input bit pattern at TP-2 by varying bit pattern using respective pushbutton.
6. Observe the data rate at TP-1 by varying data rate using respective pushbutton.

7. Observe the Two- bit encoding i.e. I-Channel (TP-3) and Q-Channel (TP-4).
8. Observe carrier signal i.e. cosine wave (TP-5) and sine wave (TP-6). Frequency of carrier signal will change with respect to data rate.
9. Observe I-Channel (TP-7) and Q-Channel (TP-8) modulated signal.
10. Observe QPSK modulated signal atTP-9.

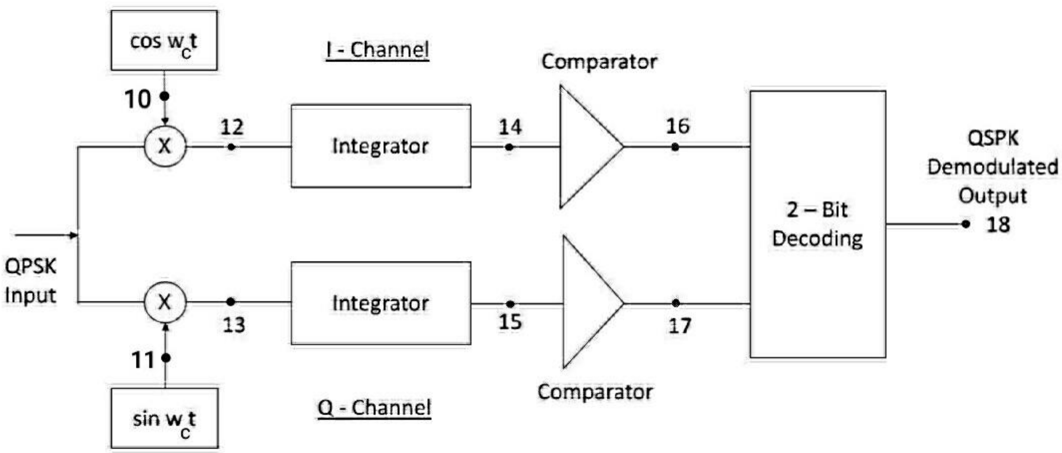


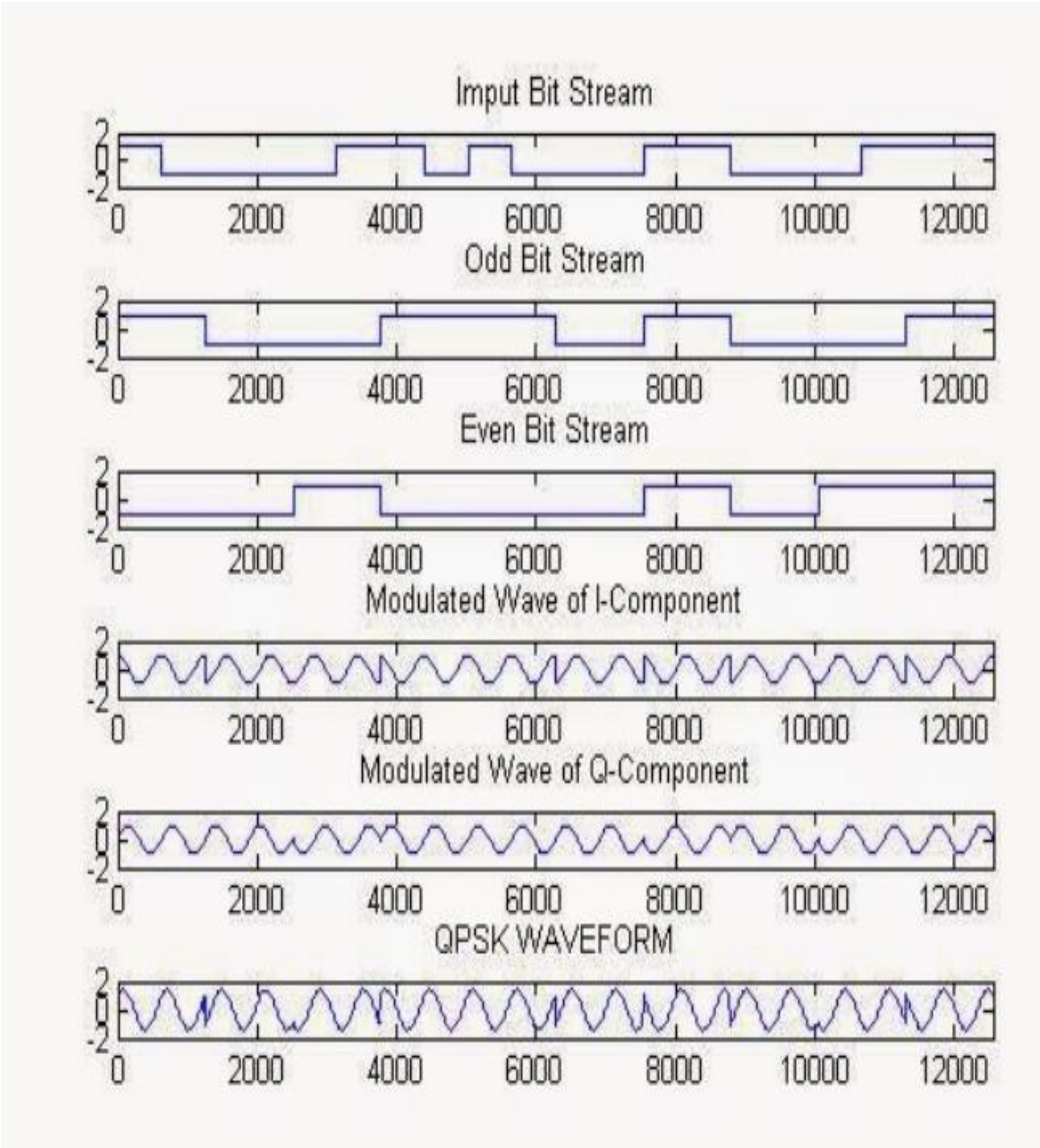
Fig: QPSK Demodulator

Demodulation:

11. Apply the QPSK modulated output to the demodulator input.
12. Observe the multiplied signal of QPSK and carrier signal, cosine at TP-12 and also observe the multiplied signal of QPSK and carrier signal, sine atTP-13.
13. Observe the integrated output at I-channel (TP-14) and Q-channel(TP-15)

Input Bits	**Phase of QPSK signal**	**Co –ordinates of message signal**	
		S1	**S2**
10	**π/4**		
00	**3π/4**		
01	**5π/4**		
11	**7π/4**		

EXPECTED WAVE FORMS:



RESULT:

VIVA QUESTION

Why QPSK is called quadrature shift keying?

What is PSK used for?

What is DC PSK?

What is the advantage of PSK?

DIFFERENTIAL PHASE SHIFT KEYING

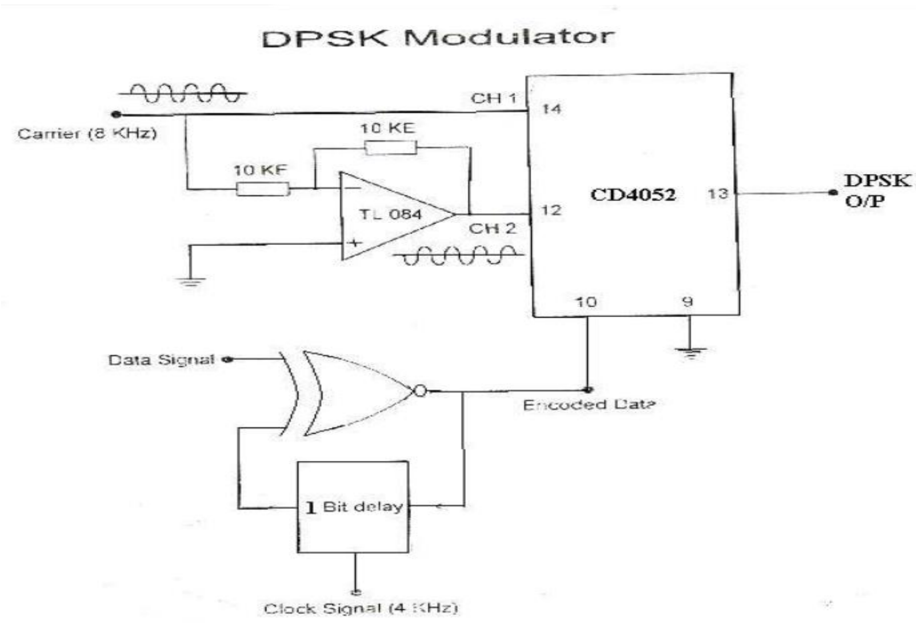
AIM:

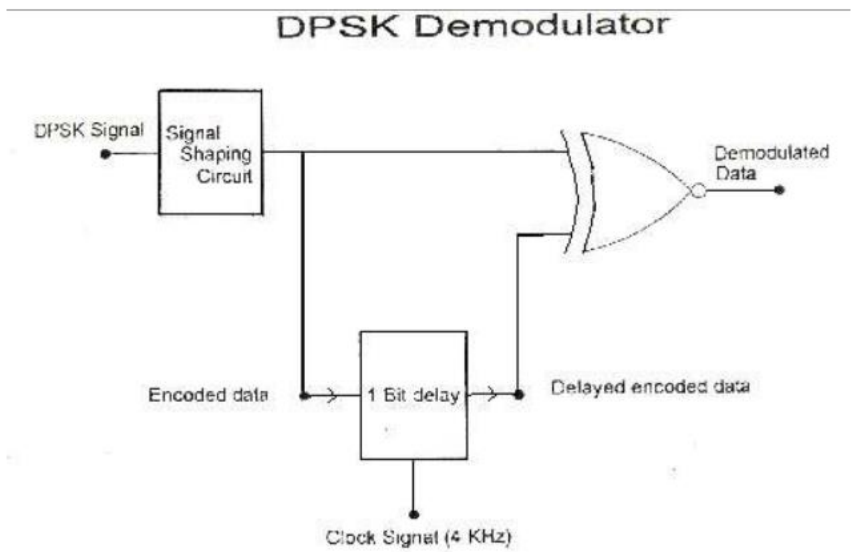
Study the characteristics of differential phase shift keying

APPRATUS:

1. DPSK Trainer Kit
2. Dual Trace oscilloscope
3. Digital Multimeter
4. C.R.O(30MHz)
5. Patch chords.
6. PC with windows(95/98/XP/NT/2000)
7. MATLAB Software with communication toolbox

BLOCK DIAGRAM:





PROCEDURE: MODULATOR

1. Connect carrier signal to carrier input of the PSK Modulator.

2. Connect data signal from data input of the X-NOR gate.

3. Keep CRO in dual mode.

4. Connect CH1 input of the CRO to data signal and CH2 input to the encoded data (which is nothing but the output of the X-NOR gate)

5. Observe the encoded data with respect to data input. The encoded data will be in a given sequence.

6. Actual data signal : 10101101001010110100

7. Encoded data signal : 01100011011001110010

8. Now connect CH2 input of the CRO to the DPSK output and CH1 input to the encoded data. Observe the input and output waveforms and plot the same.

9. Compare the plotted waveforms with the given waveforms in fig: 1.3

10. Note: Observe and plot the waveforms after perfect triggering. Better to keep the encoded data more than 4 cycles for perfect triggering.

DEMODULATOR

1. Connect DPSK signal to the input of the signal shaping circuit from DPSK transmitter with the help of coaxial cable (supplied with trainer).

2. Connect clock from the transmitter (i.e. DPSK Modulator) to clock input of the 1 bit delay circuit using coaxial cable.

3. Keep CRO in dual mode. Connect CH1 input to the encoded data (at modulator) and CH2 input to the encoded data (at demodulator).

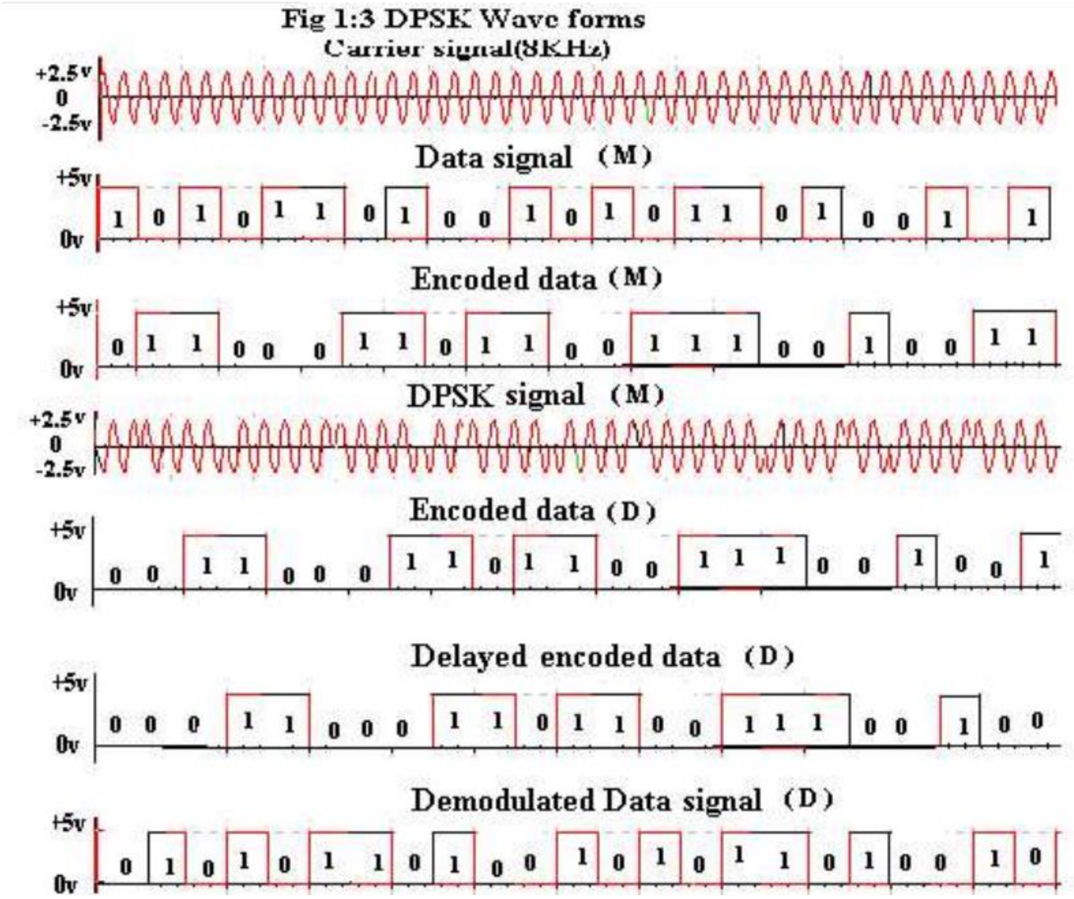
4. Observe and plot both the waveforms and compare it with the given waveforms. You will notice that both the signals are same with one bit delay.

5. Keep CRO in dual mode. Connect CH1 input to the data signal (at modulator) and CH2 input to the output of the demodulator.

6. Observe and plot both the waveforms and compare it with the given waveforms. You will notice that both the signals are same with one bit delay.

Disconnect clock from transmitter and connect to local oscillator clock (i.e., clock generator output from De Modulator) with remaining setup as it is. Observe demodulator output and compare it with the previous output. This signal is little bit distorted. This is because lack of synchronization between clock at modulator and clock at demodulator. You can get further perfection in output waveform by adjusting the locally generated clock frequency by varying potentiometer.

EXPECTED WAVEFORMS:



RESULT:

VIVA QUESTIONS:

What is the principle of DPSK?

What is the main advantage of DPSK?

What is the bandwidth of DPSK signal?

How synchronization problem is avoided in DPSK?

How many phases does DPSK Mcq have?

BEYOND THE SYLLABAS

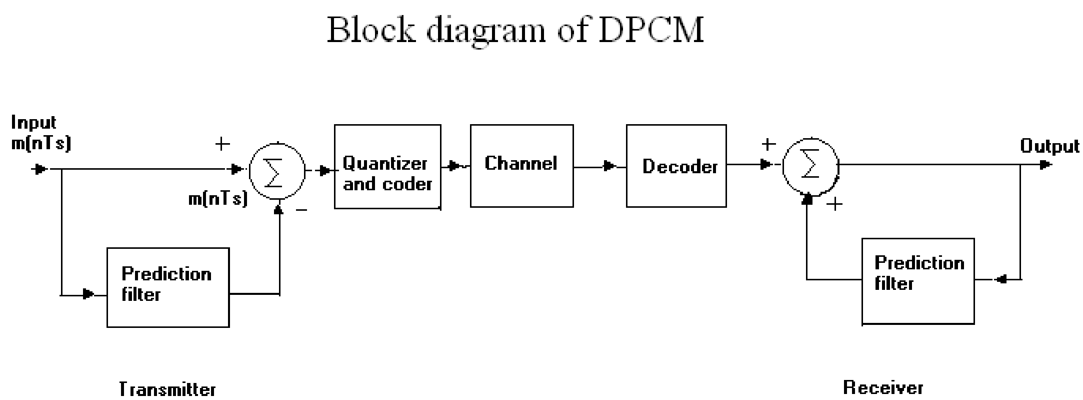
DIFFERENTIAL PULSE CODE MODULATION AND DEMODULATION

AIM: To Study & understand the operation of the DPCM

APPARATUS:

1. DPCM Modulator trainer
2. DPCM Demodulator trainer
3. Storage Oscilloscope
4. Digital MULTIMETER
5. 2 No's of co- axial cables (standard accessories with trainer)
6. Patch chords
7.

BLOCK DIAGRAM:



THEORY:

Differential PCM is quite similar to ordinary PCM. However, each word in this system indicates the difference in amplitude, positive or negative, between this sample and the previous sample. Thus the relative value of each sample is indicated rather than, the absolute value as in normal PCM.

This unique system consists of

I. DPCM Modulator

1. Regulated power supply
2. Audio Frequency signal generator
3. Prediction Filter

4. Sample & Hold circuit
5. A/D Converter
6. Parallel –Serial Shift register
7. Clock generator / Timing circuit
8. DC source

II. DPCM Demodulator

1. Regulated Power Supply
2. Serial-Parallel Shift registers.
3. D/A converter.
4. Clock generator
5. Timing circuit
6. Passive low pass filter

PROCEDURE:

1. Study the theory of operation thoroughly.
2. Connect the trainer (Modulator) to the mains and switch on the power supply.
3. Observe the output of the AF generator using CRO, it should be Sine wave of 400 Hz frequency with 3V pp amplitude.
4. Verify the output of the DC source with millimeter/scope; output should vary 0 to +290mV.
5. Observe the output of the Clock generator using CRO, they should be 64 KHz and 8 KHz frequency of square with 5 Vpp amplitude.
6. Connect the trainer (De Modulator) to the mains and switch on the power supply.
7. Observe the output of the Clock generator using CRO ; it should be 64KHz square wave with amplitude of 5 pp.

DPCM Operation (with DC input):

Modulation:

8. Keep CRO in dual mode. Connect one channel to 8 KHz signal (one which is Connected to the Shift register) and another channel to the DPCM output.
9. Observe the DPCM output with respect to the 8 KHz signal and sketch the Wave forms.

Demodulation:

10. Connect DPCM signal to the demodulator (S-P register) from the DPCM modulator with the help of coaxial cable (supplied with the trainer).
11. Connect clock signal (64KHz) from the transmitter to the receiver using coaxial cable.
12. Connect transmitter clock to the timing circuit.
13. Observe and note down the S-P shift register output data and compare it with the transmitted data (i.e output A/D converter at transmitter) notice that the output of the S-P shift register is following the A/D converter output in the modulator.
14. Observe D/A converter output (demodulated output) using multimeter/scope and compare it with the original signal and can observe that there is no loss in information in process of conversion and transmission.

DPCM Operation (with AC input):

Modulation:

15. Connect AC signal of $3V_{PP}$ amplitude to positive terminal of the summer circuit.

Note: The output of the prediction filter is connected to the negative terminal of the summer circuit and can observe the waveforms at the test points provided on the board.

16. The output of the summer is internally connected to the sample and hold circuit
17. Keep CRO in dual mode. Connect one channel to the AF signal and another channel to the Sample and Hold output. Observe and sketch the sample & hold output
18. Connect the Sample and Hold output to the A/D converter and observe the DPCM output using oscilloscope.
19. Observe DPCM output by varying AF signal voltage.

Demodulation:

20. Connect DPCM signal to the demodulator input (S-P shift register) from the DPCM modulator with the help of coaxial cable (supplied with trainer).
21. Connect clock signal (64KHz) from the transmitter to the receiver using coaxial cable.
22. Connect transmitter clock to the timing circuit.
23. Keep CRO in dual mode. Connect one channel to the sample & hold output and another channel to the D/A converter output ..
24. Observe and sketch the D/A output
25. Connect D/A output to the LPF input and observe the output of the LPF.
26. Observe the wave form at the output of the summer circuit.
27. Disconnect clock from transmitter and connect to the local oscillator(i.e., clock generator output from De Modulator) with remaining setup as it is. Observe D/A output

and compare it with the previous result. This signal is little bit distorted in shape. This is because lack of synchronization between clock at transmitter and clock at receiver

EXPECTED WAVEFORMS:

Draw the wave forms for the given DC input (190mV)corresponding binary data wave form, and for AC input draw sample and hold waveform then D/A converter o/p and then reconstructed AC signal

DPCM way form / timing diagram DC input

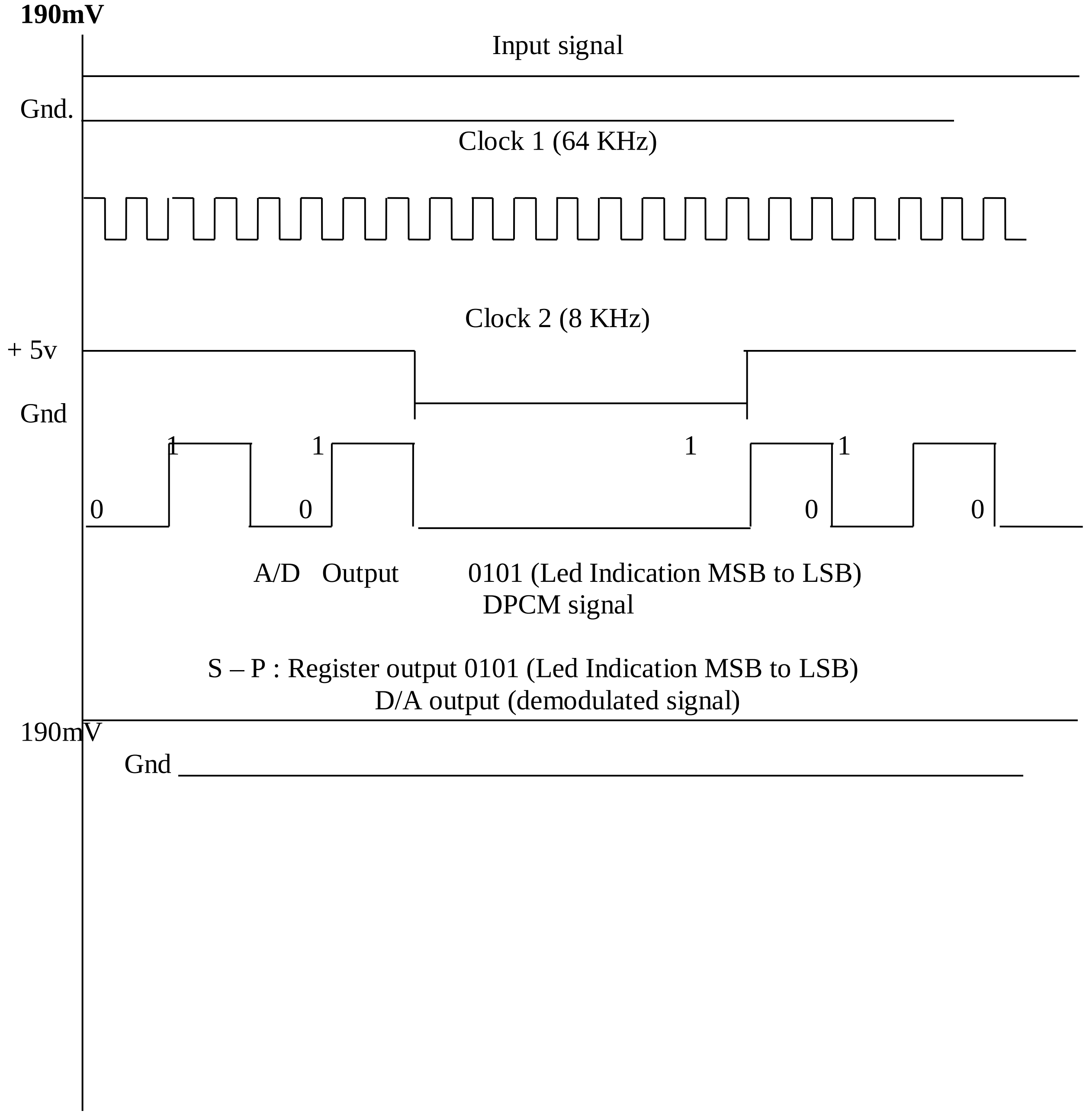


TABLE1

Example for complete DPSK operation(witharbitrarybitas0)

Message signal(to be transmitted)	0	1	1	0	0	
Encoded data(differential data)	0	1	1	1	0	1
Transmitted signal phase	180	0	0	0	180	0
Received signal phase	180	0	0	0	180	0
Message signal(demodulated)		0	1	1	0	0

__OBSERVATIONS: **DPCM with AC input**

	Amplitude	Time period
AC Input		
Prediction Filter Output		
Sample and Hold Output		
Clock -1 output		
DPCM Output		

Demodulation:

	Amplitude	Time period
DPCM Input		
D/A Converter Output		
LPF Output		
Demodulation Output		
Prediction Filter output		

RESULT:

VIVAQUESTIONS:-

1 What is PSK?

2 What is the

3 disadvantage of PSK?

4 3What is BPSK?

4 How BPSK is generate

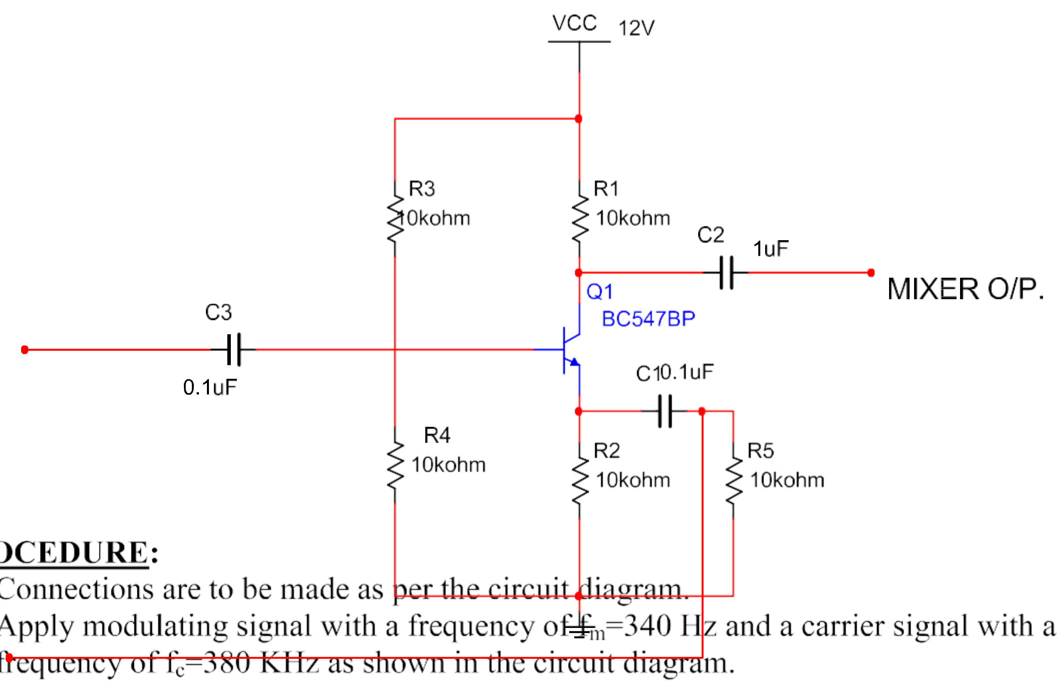
f=380 KHz

3.A) MIXER CHARACTERISTICS

AIM: To verify the characteristics of the mixer.

APPARATUS: Transistor BC-547, Resistors 10K-5,
Capacitors 0.1µf-2, 1µf-1.

CIRCUIT DIAGRAM:



MIXER CIRCUIT

PROCEDURE:

1. Connections are to be made as per the circuit diagram.
2. Apply modulating signal with a frequency of f_m=340 Hz and a carrier signal with a frequency of f_c=380 KHz as shown in the circuit diagram.
3. Now observe the output across the collector.
4. This output signal is having a frequency which is equal to sum of modulating & carrier signal frequencies i.e., f_c+f_m.

OBSERVATIONS:

Frequency of signal-1 f_m=………….. Hz.
Frequency of signal-2 f_c=…………... Hz.
Frequency of output signal = …………Hz.

EXPECTED GRAPH:

RESULT:

3.B) PRE-EMPHASIS AND DE-EMPHASIS

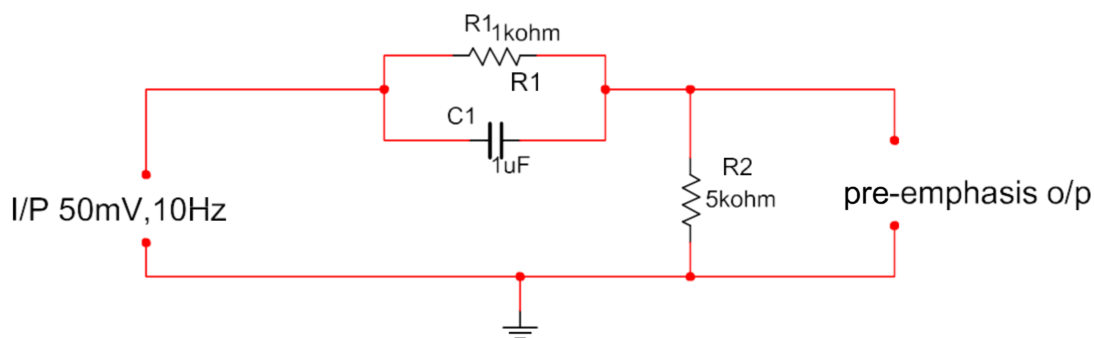
AIM:

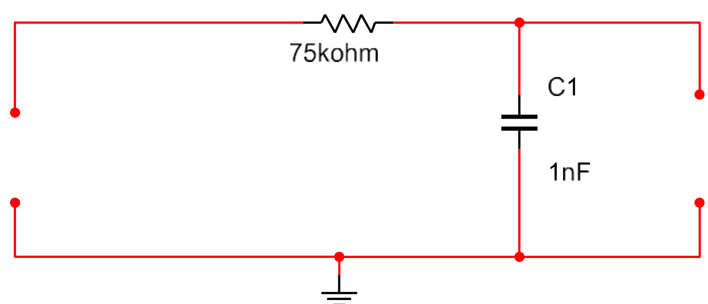
1.To boost the high frequency signal.
2.To avoid the noise of the FM with respect to high frequency signal.
3.To get the original signal.
4.To verify the results graphically.

APPARATUS:

- Resistors 33k -1,10k -2, Capacitors 470-1, DCB-1, Inductance DLB-11 , Transistor BC 107-1,Function Generator.,CRO with probes.RPS,Connecting wires.
-

CIRCUIT DIAGRAM:





DE-EMPHASIS CIRCUIT

PROCEDURE:

PRE-EMPHASIS:

1. Connections are to be made as per the circuit diagram.
2. 50 mv input is to be given and the output is observed varying the frequency.

3. By calculating the time constant of the circuit the corresponding frequency is calculated.
4. Exactly at the break down frequency the out put is observed.

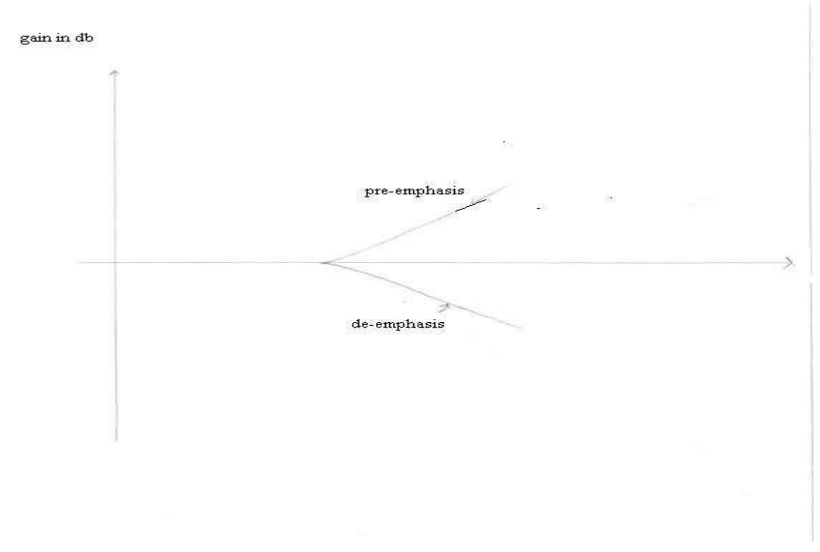
DE-EMPHASIS:

1. Connections are to be made as per the circuit diagram.
2. The pre-emphasis output is given as input to the de-emphasis circuit.
3. The gradual decay in gain is occurred.
4. Exactly at the break down frequency the output value is calculated and is compared with the theoretical value.

OBSERVATIONS:

S.NO:	FREQUENCY	PRE-EMPHASIS		DE-EMPHASIS	
		0UTPUT(V)	GAIN(dB)	OUTPUT(V)	GAIN(dB)

EXPECTED GRAPHS:



RESULT:

VIVA QUESTION

1. What is the role of pre-emphasis and de-emphasis?

2. Which circuit is used for de-emphasis?

3. Why pre-emphasis is required?

4. Why pre-emphasis is done after modulation?