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Experiment - 1

Aim: To measure the frequency range of a sampling kit and its spectrum of the sampled output

Apparatus Required:

1] Sampling & Reconstruction kit
2] Oscilloscope
3] CRO probes.
4] BNC - crocodile cables
5] Jumper cables.

Theory:

The sampling theorem essentially says that a signal has to be sampled at least with twice the frequency of the original signal

Since signals and their respective speed can be easier expressed by frequencies most explanations of artifacts are based on their respective frequency domain

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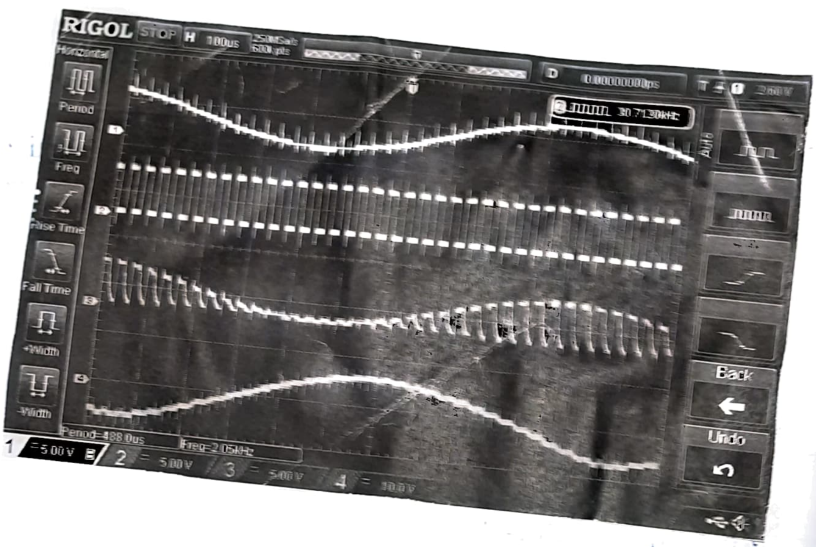

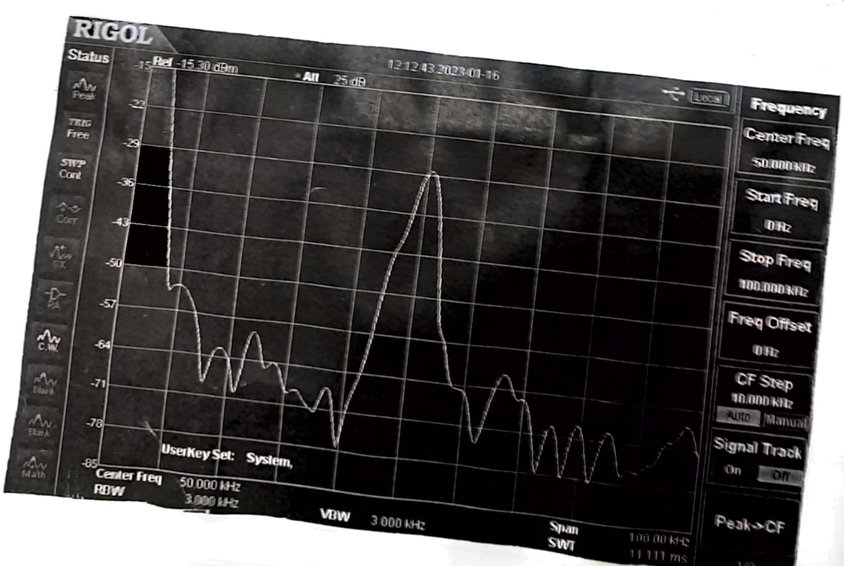

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Frequency spectrum
of frequencies con

Every electronic is
so if we increase th
same pt it will s
capacitive effect g
may stop function

Procedure:

*) Take a sampling and

*) Take the message sig
the frequency ge

*) Take the carrier sig
generator which
2 times of message

*) ~~Give the messag
to their respective~~
sampling kit wi

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Frequency spectrum of a signal is the range of frequencies contained by a signal

Every electronic is made up of RLC components so if we increase the testing frequencies then at same pt it will start to stop working as the capacitive effect gets overcome & the capacitance may stop functioning properly

Procedure:

* Take a sampling and reconstruction kit.
* Take the message signal as sine wave from the frequency generated
* Take the carrier signal from the frequency generator which is greater than or equal to 2 times of message signal
* Give the message signal and carrier signal to their respective block in the sampling kit using bnc to crocodile cables

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A) complete the connections in the kit using the jumper cables.

Conclusion:

we can conclude that every RC circuit has a fix range of operation in terms of frequency as we have seen that the sampling kit stops working after increasing the range from khz to mhz

every spectrum consists of multiple frequencies as we can see in the spectrum of the sampled signal.

Result: we have successfully completed the sampling theorem, range of the sampling kit and spectrum analyzation of sampled signal.

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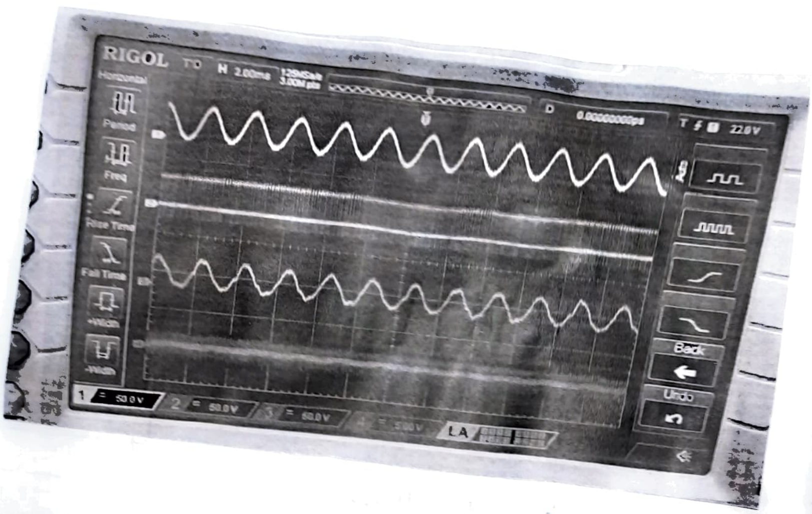

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Aim: Pulse code m
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none parity

Apparatus: ACT-04

Theory:

- The analog signa
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logic 2-chai sam
interleaning the
time slots.

- The crystal oscilla
6.4 mhz from
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before transmissi

- At the receiver sys
the ~~recovered~~ m
to demultiplexing
samples are given

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Experiment 2.

Aim. Pulse code modulation (PCM) of an analog signal, its sampling and multiplexing in none parity mode and the reconstruction of the signal

Apparatus: ACT-04 kit, jumper wires, crocodile wires

Theory:

- The analog signal or variable amplitude DC signal is fed to the input of the sampling logic & their samples and multiplexed by interleaving the property in their assigned time slots.

- The crystal oscillator generates a clock of 6.4 MHz from it the transmitter data and timing signals are derived. The multiplexed data is pulse code modulated before transmission

- At the receiver after the pulse code demodulation, the recovered multiplexed data is send to demultiplexing logic. The two demultiplexed samples are given to reconstruction unit

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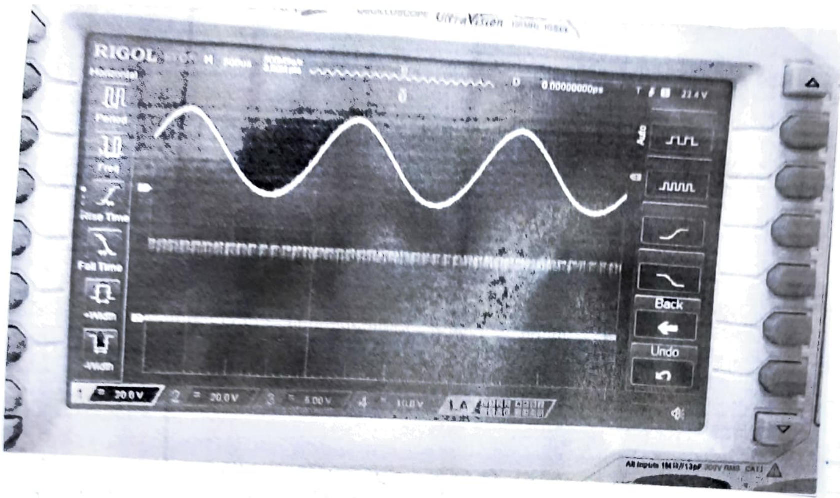

observation table:

V(volts)	IPH (0°)/mA	IPH (30°)/mA	IPH(60°)/mA	IPH(90°)/mA
16	0.9	0.3	0.5	0.2
14	0.66	0.37	0.34	0.19
12	0.59	0.47	0.27	0.17
10	0.48	0.38	0.22	0.13
8	0.38	0.3	0.17	0.10
6	0.27	0.22	0.12	0.07
4	0.18	0.14	0.07	0.04
2	0.09	0.07	0.04	0.02

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The reconstruction
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Procedure

- connect the AC s
- ensure that a
- make connection
diagram no 1
- set the speed s
- select parity
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- switched on the
- Take the obse
- repeat the abov
at the input o
- connect ground
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- observe the fo
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mA	IPn (90°) ...
	0.2
	0.19
	0.17
	0.13
	0.10
	0.03
	0.04
	0.02

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The reconstruction consisting of LPF's filter the high frequency components to recover the original signal at the receiver output.

Procedure

- connect the AC supply to the kit.
- ensure that all faults are in normal position
- make connection & settings as shown in block diagram no.1
- set the speed selection switch fast mode
- select parity selection switch to NONE mode on both the kits
- switch on the power.
- Take the observation as mentioned below.
- repeat the above experiment with original at the input of the channel CH0 & CH1
- connect ground points of both the kit with the help of patch chord provided during the all experiments
- observe the following waveforms in order for every setting & plot it on paper

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Conclusion:

- The sampling clock is 16KHz satisfying the Nyquist criteria for both 500 Hz (fs = 32fm) & 1000 Hz (fs = 16fm) inputs
- The multiplexed output shows the proper alignment of the samples to their respective time slots.
- The amplitude of samples at any one time is equal to the amplitude of sampled signal at the instant of time
- the sine waves are reconstructed without any distortion from the samples the sine waves can be observed to have good linearity
- the DC levels are also reconstructed without any distortion. The reconstruction ~~without~~ units are second order better worth low pass filter

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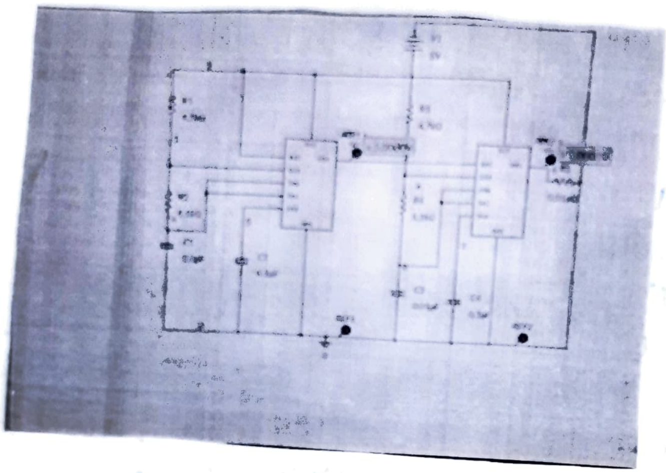

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Experiment 3.

Aim: To perform ASK modulation using IC 555

Apparatus: multisim online, bread board, 4 resistors, 4 capacitors, 1 oscilloscope, connecting wires

Theory: - ASK is a type of amplitude modulation which ~~reflects~~ represents the binary data in the form of variations in the amplitude of a signal

- Any modulated signal has a high freq. carrier, the binary signal when ASK modulated, gives a zero values for low input while it gives the carrier output for high input

- To find the process of obtaining this ASK modulation were the working of ASK modulation & demodulation is essential.

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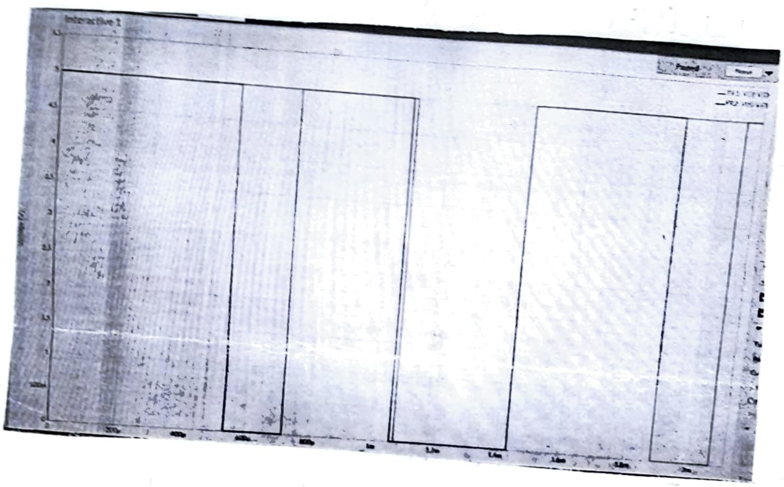

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Procedure:

- for breadb
1. Take a brea
2. Take the
procedu
3. check ou
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4. observe - t

For multisim
1. open the m
2. from the le
components
- 2 IC 555
- 4 resistors
- 4 capaci
3. connect t
as show
4. Run the

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Procedure:

- for breadbord & components.

① Take a breadboard & provide it vcc (5V) & ground

② Take the components mentioned in previous procedure & complete the circuit.

③ check output of each IC using CRO probes & oscilloscope

④ Observe the graph obtained

For multisim simulation

① open the multisim online software

② from the left toolbar drag & drop the following components :-

- 2 IC 555

- 4 resistors (2×5.1 k-Ω & 2×4.4 k-Ω)

- 4 capacitors (3 × 0.1 uF & 1×1nF)

③ connect the components & complete the circuit as shown as in diagram.

④ Run the simulation & check the o/p graph.

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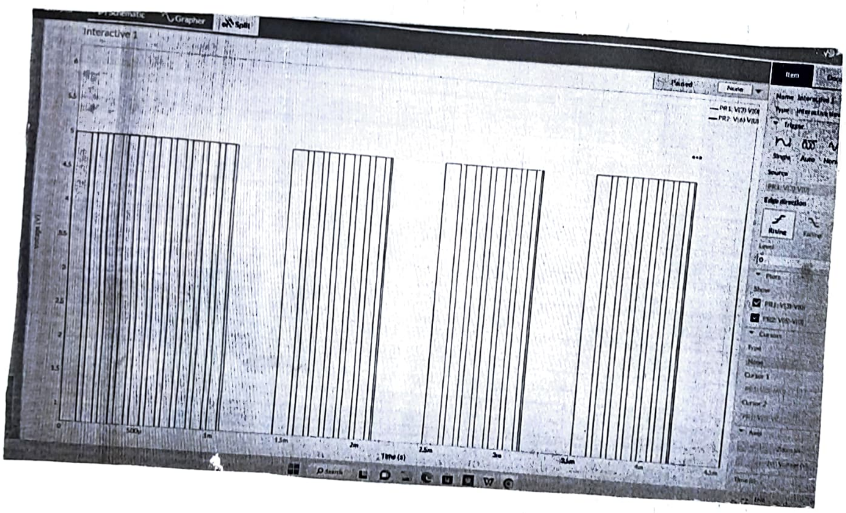

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Observation:

- The output obtained
wave

- The output obtained
high freq pulse
at previous pulse
off state of previous

Conclusion:

① Output obtained at
wave with equal

② The output after the
modulated and the
passed only when
signal is high on
signal when the

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Observation:

- The output obtained at first IC 555 is a pulse wave

- The output obtained at second IC555 is a high freq pulse train out on position of previous pulse wave & no pulses out off off state of previous pulse.

Conclusion:

1. Output obtained at first IC 555 is a pulse wave with equal on & off time

2. The output after the second IC is an ASK modulated and the high freq carrier is passed only when the pulse of previous signal is high ON & it stops the carrier signal when the pulse is low or off.

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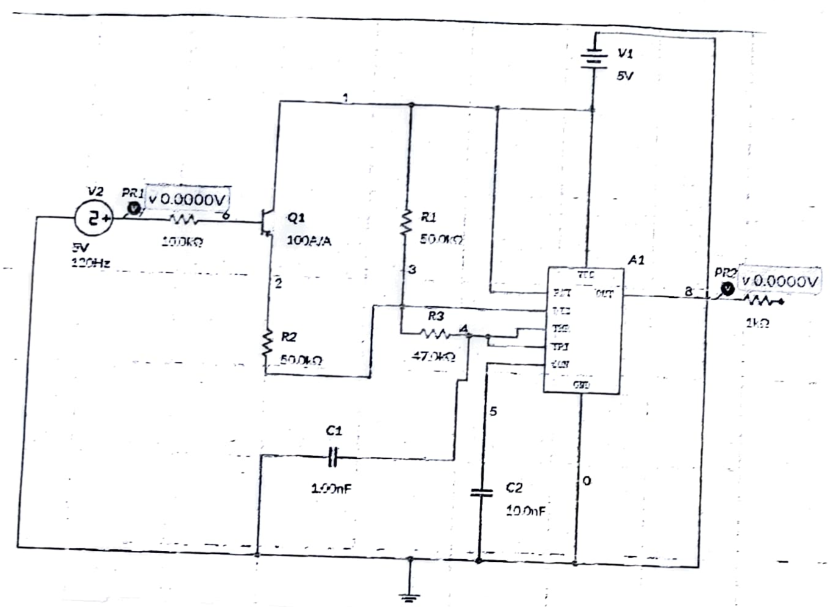

Name of Practical | Experiment

Aim: FSK modulation w

Apparatus required: 555 tim
Resistor

Theory:

- FSK means frequency sh
- It is used to transmit di
frequency carrier signal.
- Bit 1 is transmitted usi
transmitted using anot
Bit 1 (logic high
Bit 0 (logic low
- It is a signaling tech
of the carrier signal i
the incoming data or
- In digital data comm
frequency betn 2 p
binary code.
- A 555 timer is us
generate FSK signal for
one carrier and
another carrier

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Experiment-04.

Aim: FSK modulation using 555 timer IC

Apparatus required: 555 timer IC ; capacitor, potentio meter
Resistor, PNP transistor

Theory:

- FSK means frequency shift keying.
- It is used to transmit digital Data using high frequency carrier signal.
- Bit 1 is transmitted using one carrier signal & bit 0 is transmitted using another carrier signal like
  - Bit 1 (logic high) with freq f_{c1} $\boxed{f_{c1} > f_{c2}}$
  - Bit 0 (logic low) with freq f_{c2}
- It is a signaling technique in which the amplitude of the carrier signal is keyed or switched based on the incoming data or signal
- In digital data communication, shifting a carrier frequency between 2 preset frequencies transmits binary code.
- A 555 timer in astable mode can be used to generate FSK signal for data bit 1 it transmits one carrier and for data bit 0 it transmits another carrier

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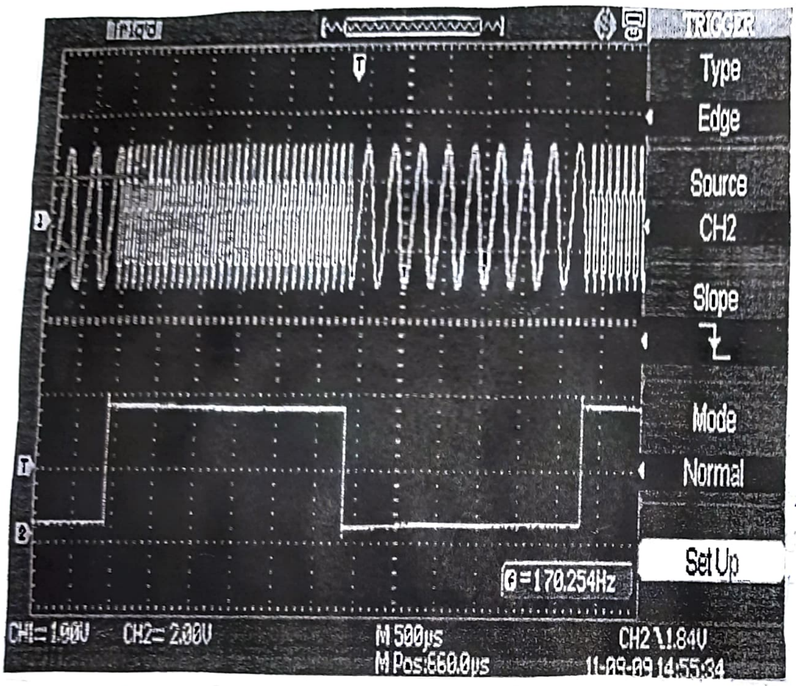

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- usually carrier freq…
  in single bit period
  transmitted

circuit set-up:

- The circuit can be b…
- on bread board, pla…
  necessary connections
- Next apply 5V to t…
  & connect o/p of p…

$$\boxed{f_D = \ldots}$$

Procedure:

- The circuit connecti…
- The free running …
  frequency or …
- the i/p square wave …
- The FSK waveform …
  plotted.
- observe the o/p …
  the second channe…

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- usually carrier freq are higher than data rate so in single bit period several cycles of carrier transmitted

circuit set-up:

- The circuit can be built on bread board.
- on bread board, place all the components & make necessary connections as shown in circuit diagram.
- Next apply 5V to the circuit through power supply & connect O/P of pulse generator & FSK output

$$\boxed{f_D = \frac{1.45}{(R_A R_C + 2 R_B)}}$$

Procedure:

- The circuit connections are made as shown in figure
- The free running frequency of the astable frequency or multivibrator is measured using CRO.
- the i/p square wave is given from the APO.
- The FSK waveform is noted from the CRO & plotted.
- observe the O/P of the FSK modulator in the second channel of the CRO.

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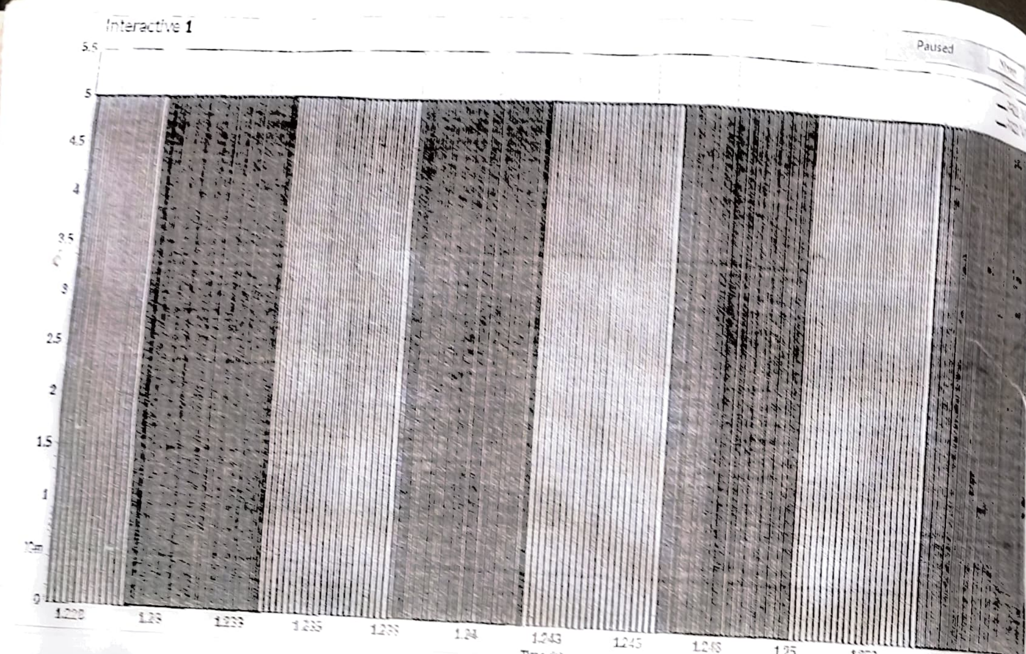

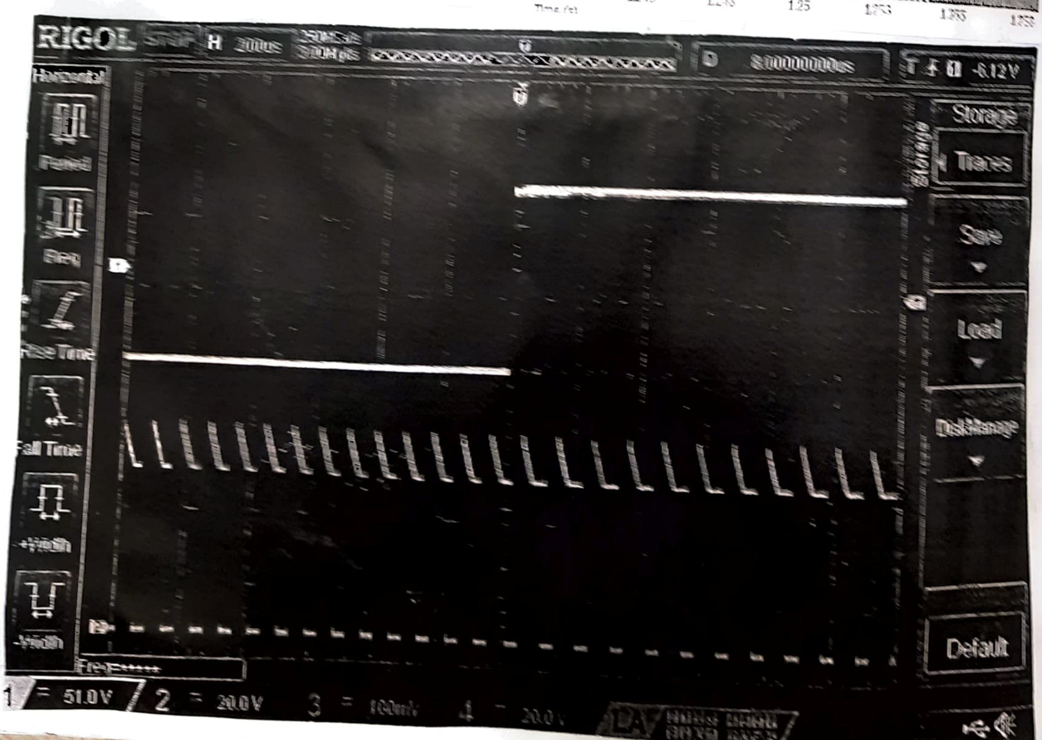

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conclusion :

from this exp
frequency of
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Result:

Hence we
modulator
board & si

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Conclusion:

from this experiment we can conclude that the frequency of the ON pulse of the ip signal is greater than the frequency of the less than or off pulse of the input

$$f_{c1} > f_{c22}$$
(ON) (off)

Result:

Hence we generated the frequency shift-key modulator using 555 timer IC in bread board & simulation

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lab-5

Aim: To perform PSK (phase shift key) modulation using 5 terminal op-amp.

Apparatus: (1) Bread Board (2) 5 Terminal op-amp. (3) NPN transistor (4) oscilloscope (5) connecting wires (6) Resistor (10k-Ω, 1k-Ω) (7) Multisim online software

Theory:

- PSK is a digital modulation technique
- The phase of the carrier signal is changed by varying the sine & cosine inputs
- Widely used for wireless LAN networks, bio-metrics
- PSK is of 2 types. depending on the phases, the signal gets shifted
- Binary phase shift (BPSK) is also called as 2 phase PSK or phase reversal keying the sine wave carrier takes 2 phase reversal - 0° or 180°
- Quadrature phase-shift keying (QPSK) the sine wave takes ~~two~~ four phase reversal such as as 0°, 90°, 180 & 270°

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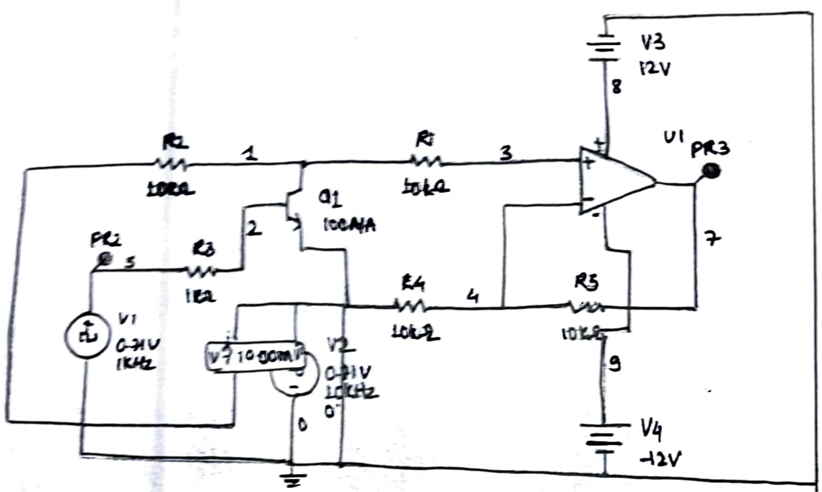

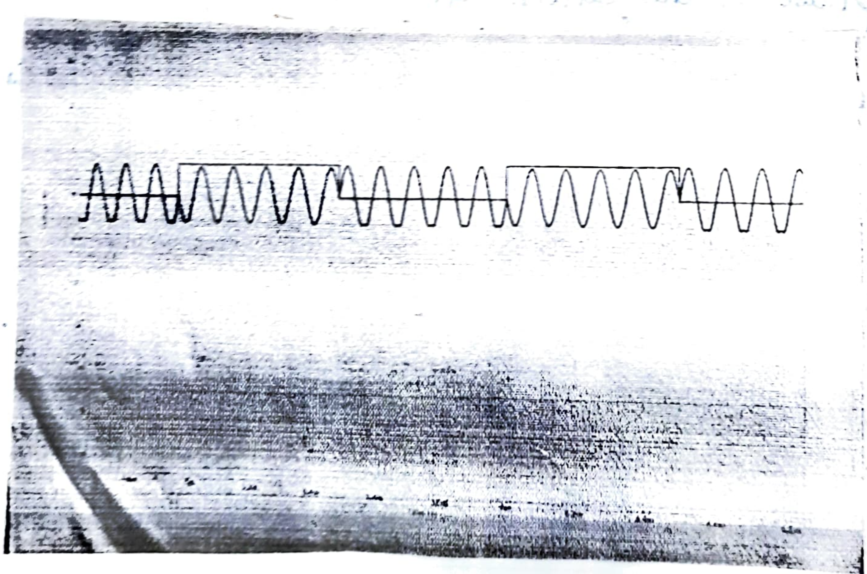

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Procedure:

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① Take a Bread B
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② Take the com
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③ check the
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Procedure:

Breadboard circuit

1. Take a BreadBoard and provide Vcc (5V) and ground.
2. Take the components & complete the circuits as shown in diagram
3. check the o/p of op-amp using CRO probes and oscilloscope
4. observe the graphs

Multisim software:

- Open the multisim software
- from the left tool kit box drag & drop the following components op-amp, NPN transistor 10kΩ resistor x 4, 1kΩ resistor, powersupply & ground
- connect the component & complete the circuit as shown in diagram
- run the simulation & check the graph.

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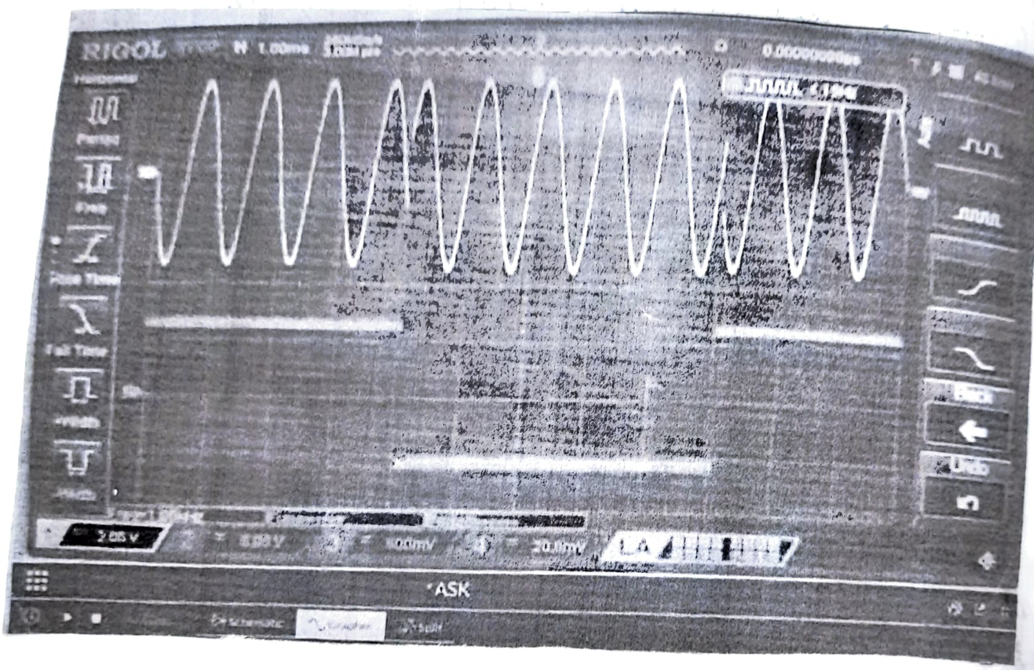

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Result:

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- observation:
- The phase of wave shifts at each leading & trailing edge of the pulse.
- The phase reverses from 0° to 180° & vice versa
- The Take balance modulator multiply the two signal at i/p
- for a zero binary i/p the phase will be 0°
- for a high i/p the phase reversal is of 180°

Result:
- we have successfully completed the PSK modulation using op-amp.
- we have executed the circuit on multisim as well as physically on breadboard using the components.
- we have successfully observed the graph of PSK modulation

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Lab-6.

- Aim: To perform DPCM modulation and demodulation using Matlab simulink.

- Apparatus Required: Matlab simulink

- Theory: → Differential Pulse code Modulation (DPCM) is a technique of analog to digital conversion.

→ This technique samples the analog signal then quantizes the difference b/w sampled values & its predicted value

→ then encodes the signal to form a digital value

Principle of DPCM is

- If the redundancy is reduced, then the overall bitrate will decrease.

- The number of bits required to Transmit one sample will reduce.

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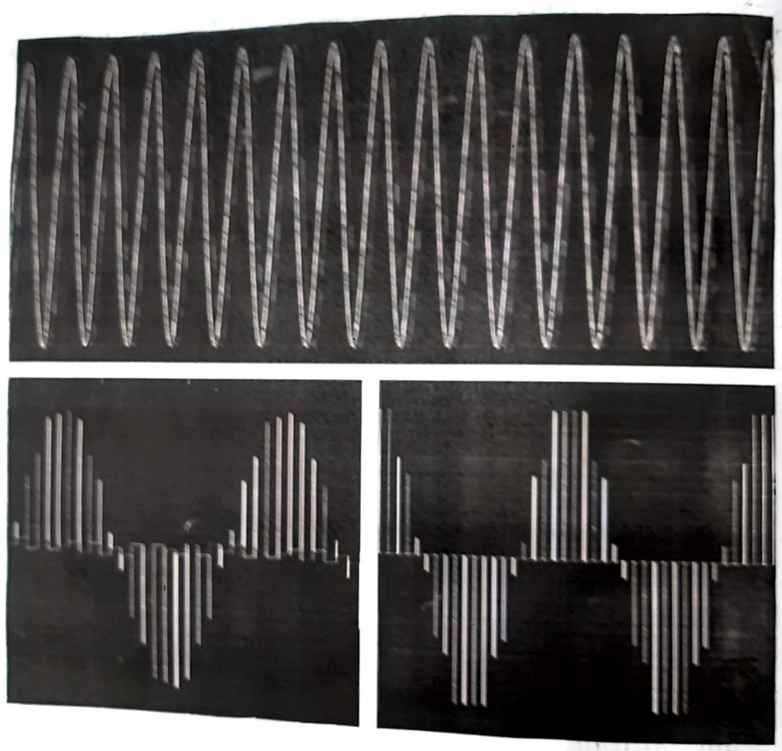

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- It works on the principle of prediction.
- value of present sample is predicted from the previous samples.
- efficient for lossless compression & implementation of lossless medical image compression

→ **Procedure:**

1. open Matlab Application.
2. open simulink from the ribbon.
3. create a blank model
4. from the block library, add the following blocks:

1. pulse generator (period = 1/400)
2. sine wave (amplitude = 3, freq = 2*pi*20)
3. sample & hold
4. Quantizer (interval = 0.1)
5. Delay (delay length = 1) x2.
6. Add (1 x +-1 2x +4)
7. uniform encoder (peak = 3, bits = 16)
8. uniform Decoder (Peak = 3, bits = 16)
9. Analog filter design (filter order = 16, edge freq = 2*pi*40)
10. Scope

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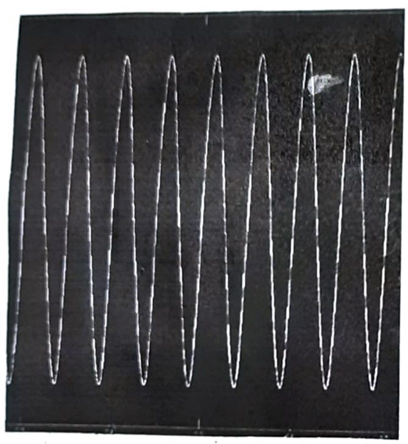 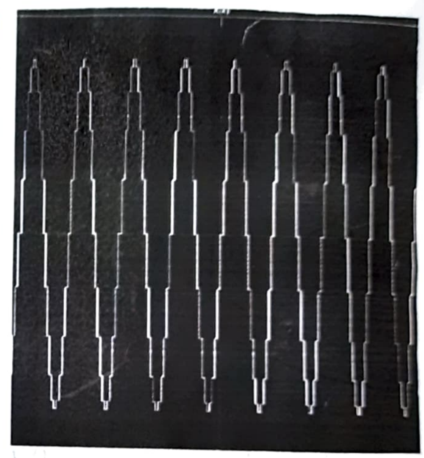

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7. Run the
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- Observation
- Fig 2 is
- Fig3
- Fig4
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- Conclusion
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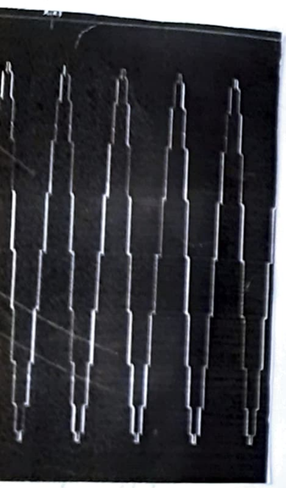

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(5) Do the connections as shown.
(6) Set scope time = 1
(7) Run the simulation
(8) Check the graph from scope.

→ Observation:

- Fig 2 is o/p of sine wave
- Fig3 is o/p of sample & hold
- Fig4 is o/p of error signal.
- Fig 5 is o/p of DPCM modulated signal after quantizer & uniform encoder
- Fig 6 is o/p of DPCM demodulate signal along with initial sine wave

→ Conclusion:

(1) Error signal in fig 4 is calculated using the present signal along with previous signal in the prediction filter block

(2) The DPCM demodulated is almost same as message signal

- error is reduced
- No. of bits required is reduced.

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Result:

- Successfully completed the DPCM modulation & Demodulation.

- Observed their o/p graphs using simulink

```
%% Delta Modulation (DM)
%delta modulation = 1-bit differential pulse code modulation (DPCM)
predictor = [0 1]; % y(k)=x(k-1)
%partition = [-1:.1:.9];codebook = [-1:.1:1];
step=0.2; %SFs>=2pifA
partition = [0];
codebook = [-1*step step]; %DM quantizer
t = [0:pi/20:2*pi];
x = 1.1*sin(2*pi*0.1*t); % Original signal, a sine wave
%t = [0:0.1:2*pi];x = 4*sin(t);
%x=exp(-1/3*t);
%x = sawtooth(3*t); % Original signal
% Quantize x(t) using DPCM.
encodedx = dpcmenco(x,codebook,partition,predictor);
% Try to recover x from the modulated signal.
decodedx = dpcmdeco(encodedx,codebook,predictor);
distor = sum((x-decodedx).^2)/length(x) % Mean square error
% plots
figure,
subplot(3,1,1);
plot(t,x);
xlabel('time');
title('original signal');
subplot(3,1,2);
stairs(t,10*codebook(encodedx+1),'--');
xlabel('time');
title('DM output');
subplot(3,1,3);
plot(t,x);
hold;
stairs(t,decodedx);
grid;
xlabel('time');
title('received signal');
```

Name of Practical | 1(

Aim: To perform delt

Apparatus: Matlab s

Theory: - Delta mod
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- In delta
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Name of Practical lab 7.

Aim: To perform delta modulation using Matlab.

Apparatus: Matlab simulink

Theory: - Delta modulation is a form of pulse modulation where a sample value is represented as single bit.

- This is almost similar to differential PCM. as the transmitted bit is only one per sample just to indicate whether present sample is larger or smaller of the previous one.
- In delta modulation two level quantizer & one-bit coding is used.
- Transmitted code pulse do not carry the data related to message signal itself, instead they carry data regarding differentials of message function
- The o/p of delta modulation is a bit stream of samples of a relatively high rate, the value of each bit being determined has increased or decreased

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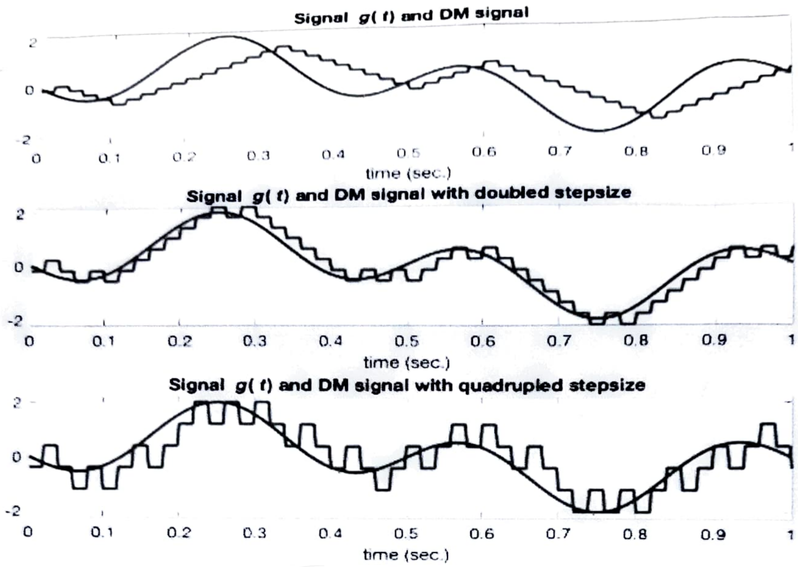
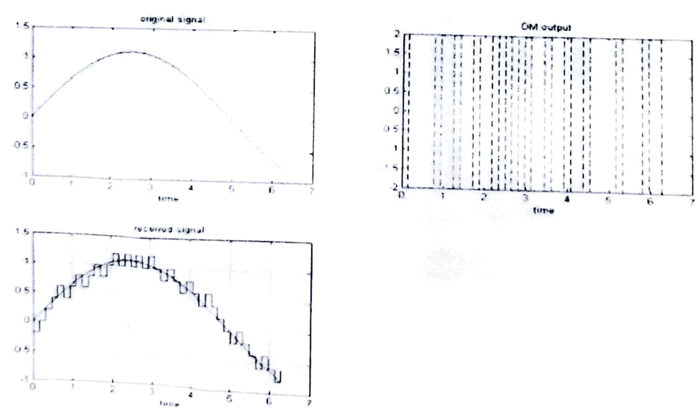

Signal g(t) and DM signal
time (sec.)
Signal g(t) and DM signal with doubled stepsize
time (sec.)
Signal g(t) and DM signal with quadrupled stepsize
time (sec.)

- Wave Forms:


original signal
DM output
received signal
time

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Slope overload:

- This distortion arises because of large dynamic range of the i/p signal
- The rate of rise of i/p signal x(t) is so high that the staircase signal can not approximate it, the step size 'Δ' becomes too small for staircase signal u(t) to follow the step segment of x(t).
- Hence there is a large error between the staircase approximated signal & the original i/p signal x(t). known as slope overload ~~distortion~~ distortion.
- To reduce this error a large step size is required, when slope of x(t) is high.
- This can be achieved using Adaptive Delta Mod^n.

Granular Noise:

Granular noise occurs when the step size is too large compared to small variation in the i/p signal

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Observation:

- Hence we observed on increasing the step size the granular noise increases.
- On decreasing the step size granular noise decreases
- Similarly on decreasing step size slope overload distortion increases.
- On increasing step size slope overload distortion decreases.

Result: Hence we have performed delta modn with slope overload distortion + granular noise using matlab code..

Parth
11/04/23

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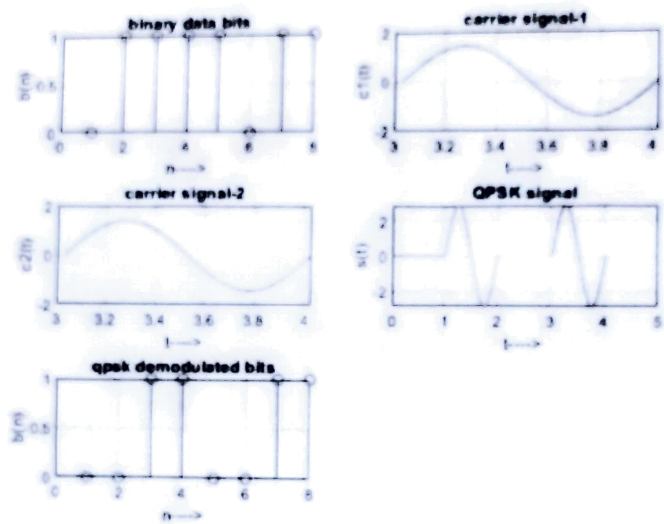
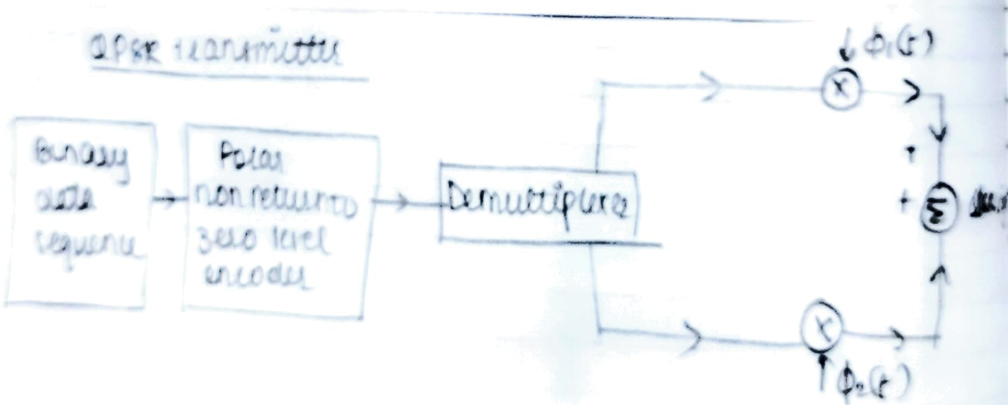
fig: when phase difference is same



QPSK transmitter



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Aim: To

Apparatus

Theory:-

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Name of Practical lab-8.

Aim: To perform Quadrature Phase shift keying

Apparatus: Matlab

Theory:- QPSK is a variation of BPSK, and it is also a double side band suppressed carrier DSBSC modulation scheme, which sends two bits of digital informations, called as digits

- 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.

* QPSK modulator:

- It uses a bit-splitter, two multipliers with local oscillator, a 2bit serial to parallel converter & a summer circuit

At the modulator's input, the message signal's even bits and odd bits are separated by the bits splitter and are multiplied with the same carrier to generate odd BPSK (called PSKI) & even BPSK (PSKQ)

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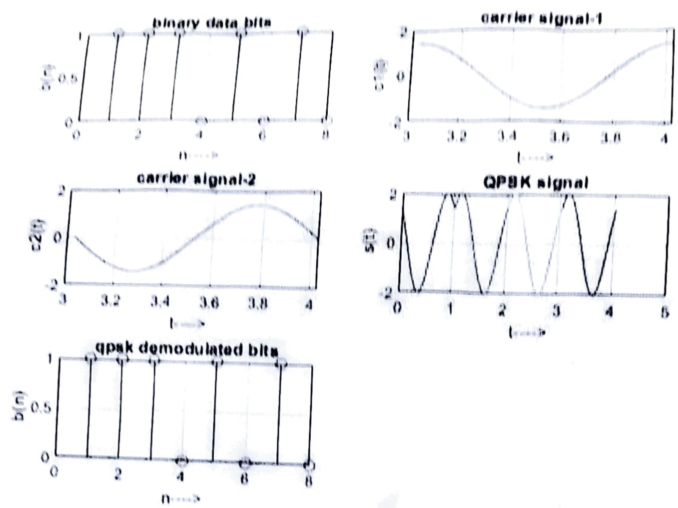
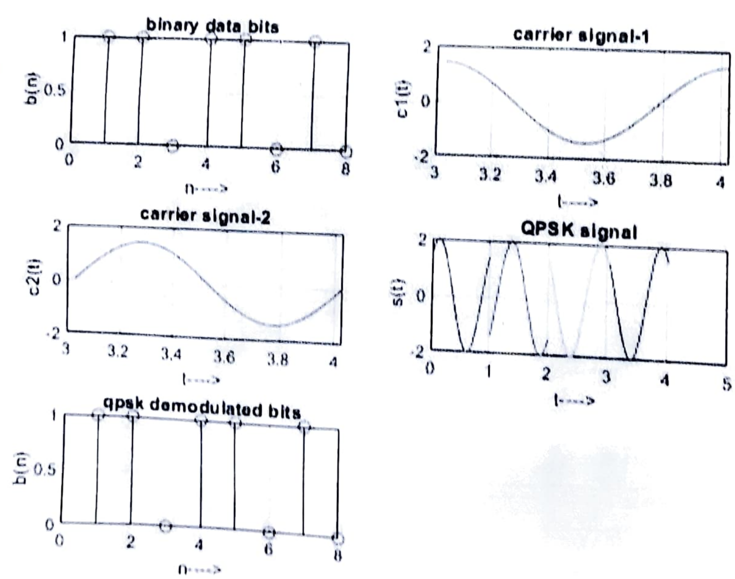


optimised output



phase difference of π/4

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* QPSK Demodulator:

- The QPSK demodulator uses two product demodulator circuit with local oscillator, two band pass filter, two integer circuits, and a 2 bit parallel to serial converter.
- The two product detectors at the ip of demodulator simultaneously demodulate the two BPSK signals.
- The pair of bits are recovered here from the original data. These signals after processing are passed to the parallel serial converter.

Conclusion:

Hence QPSK has been successfully performed using matlab.

Result: QPSK modulation transmits 2 bits per symbol as compared to BPSK & has a Bandwidth efficiency twice as that of BPSK. Hence it is also called Double sideband suppressed carrier frequency

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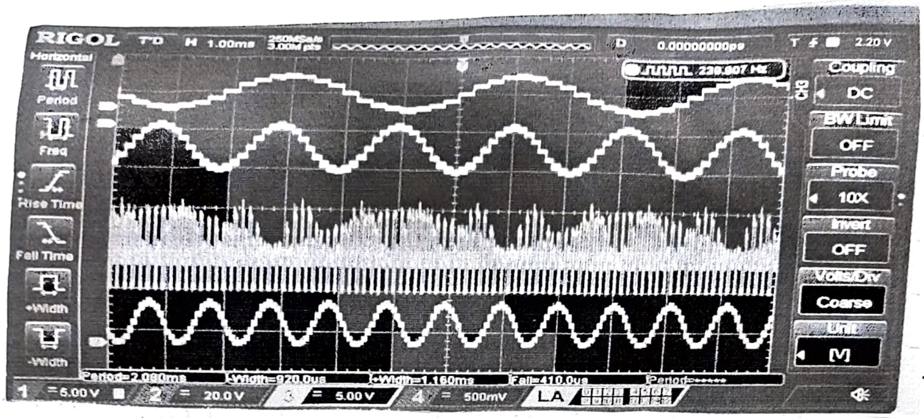

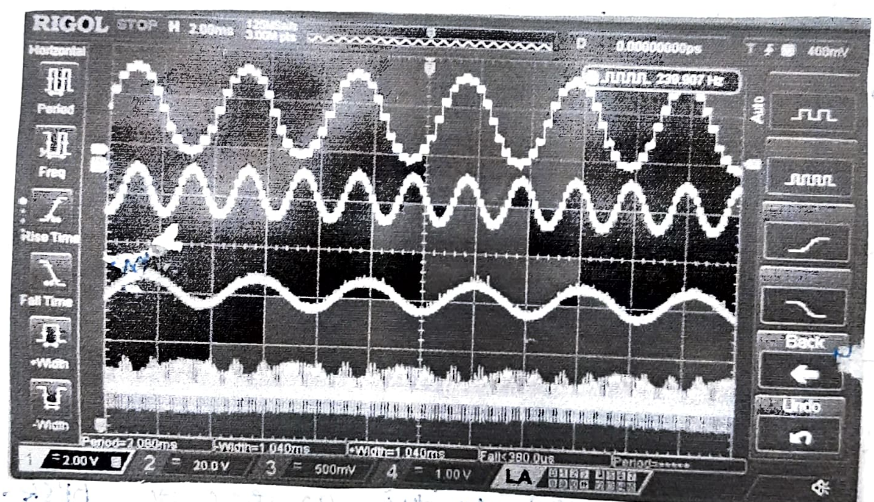

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Name of Practical lab - 9

Aim: Time division multiplexing & demultiplexing

Apparatus: · TDM & demultiplexing kit
· CRO ·
· connecting wires
· probes ·

Theory:

- TDM is used for transmitting several analog message signals over a communication channel by dividing the time frame into slots, one slot for each message signal.
- The four ip signals, all band limited by the ip filters are sequentially sampled, the op of which is a PAM waveform containing samples of the input signal periodically interlaced in time
- The samples from adjacent ip msg channels are separated by T_s/M; M → no. of ip channels.
- A set of M pulse consisting of one sample from each of M ip channels is called a frame

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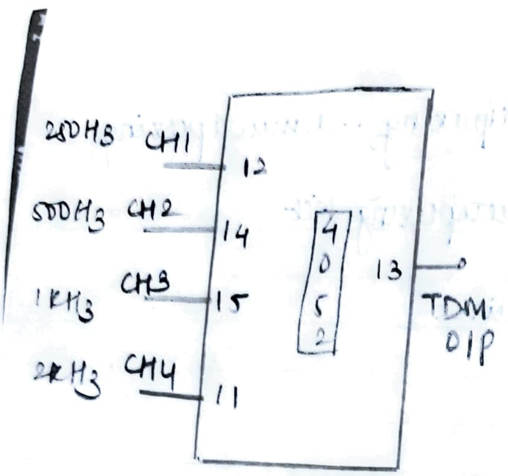
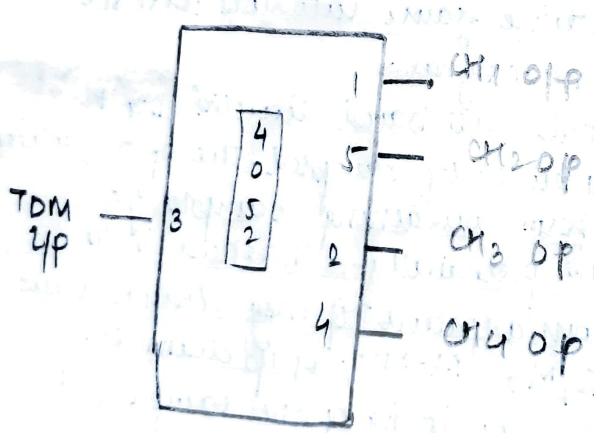


Multiplexer



Demultiplexer

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- At the se
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- There are
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Procedure:
Multiplexe
1. Connect t
2. switch on
3. set the a
as 5V p
4. monitor
are n
5. Observe
6. All the
during

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- At the receiver the samples from individual channels are separated by carefully synchronizing and are a critical part TDM.
- The samples from each channel are filtered to reproduce the original msg signal.
- There are two levels of synchronization
- Frame synchronization is necessary to establish when each group of samples begins & end synchronization is necessary to properly separate the samples within each frame.

Procedure:

Multiplexing

1. Connect the circuit as shown in diagrams
2. Switch on the power supply.
3. Set the amplitude of each modulating signal as 5V peak-peak.
4. Monitor the o/ps at test points 5,6,7,8. these are natural sampling PAM o/ps.
5. Observe TDM o/ps.
6. All the multiplexer channel are observed during the full period of clock.

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Demultiplexing & low Pass filter

- connect the circuit as shown as diagram 2
- observe the demultiplexed o/ps.
- observe the low pass filter o/ps for each channel and at socket channels CH 1 CH 2 CH 3 CH 4.
- These signals are true replica of the i/ps.
- These signals have lower amplitude

Result:

we have successfully performed Time division multiplexing & demultiplexing

Precautions:

1. check connections before giving power supply
2. Observations should be done carefully
3. connect the circuit properly
4. Apply the voltage wherever required
5. do not apply stress on the components

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