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AIM : Pulse Code Modulation and differential pulse Code modulation.

Pulse Code Modulation

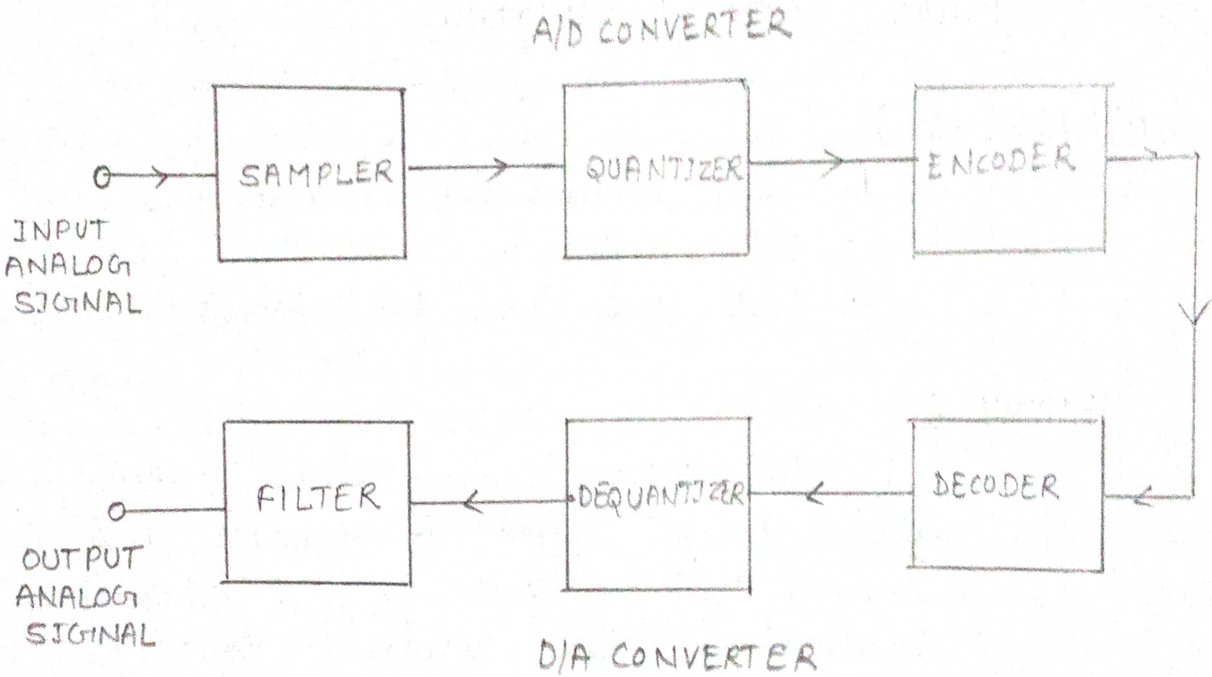
APPARATUS :

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

THEORY :

In the PCM Communication system, the input analog signal is sampled and these samples are subjected to the operation of quantization. the quantized samples are applied to an encoder. the encoder reponds to each such a sample by generation unique and identifiable binary pulse. the Combination of quantize and encoder is called analog to digital Converter. It accepts analog signal and replaces it with a successive code symbol, each symbol Consists of a train of pulses in which the each pulse represents a digit in arithmetic system.

Block Diagram:



When this digitally encoded signal arrives at the receiver, the first operation to be performed is separation of noise which has been added during transmission along the channel. It is possible because of quantization of the signal for each pulse interval; it has to determine which of many possible values has been received.

PROCEDURE :-

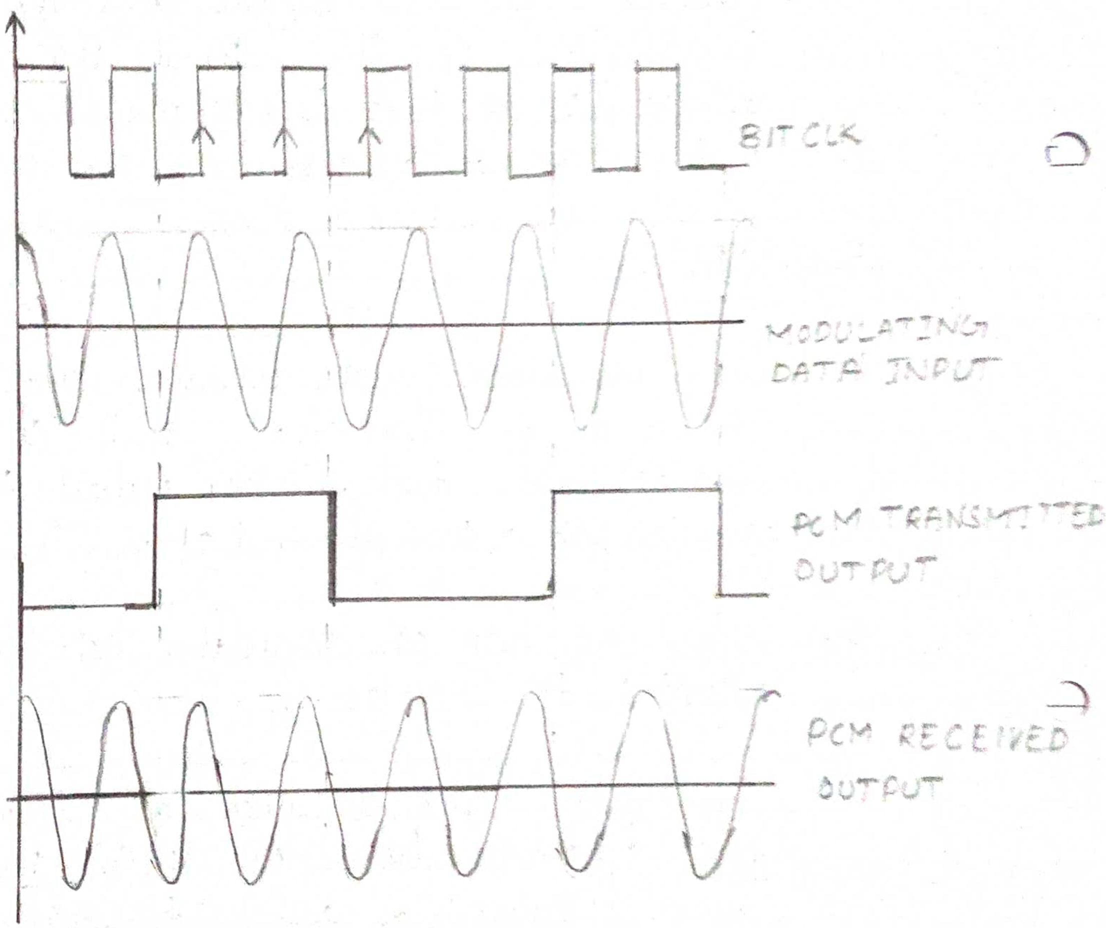
1. The two inputs of function generator are connected to Channel-0 and Channel-1 simultaneously that is DC_1 output to Channel-0 and DC_2 to Channel-1.

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

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

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

Output Waveform :



5. After connection is made the inputs channel 1 and channel 0 are noted. the sampled output of bit channels are taken by connecting DC1 output to channel 0 and DC2 output to channel -1.

6. The phase shift of a channel can be obtained by comparing the input and output of channels at the transmitter block.

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

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

Differential Pulse Code Modulation

APPARATUS :-

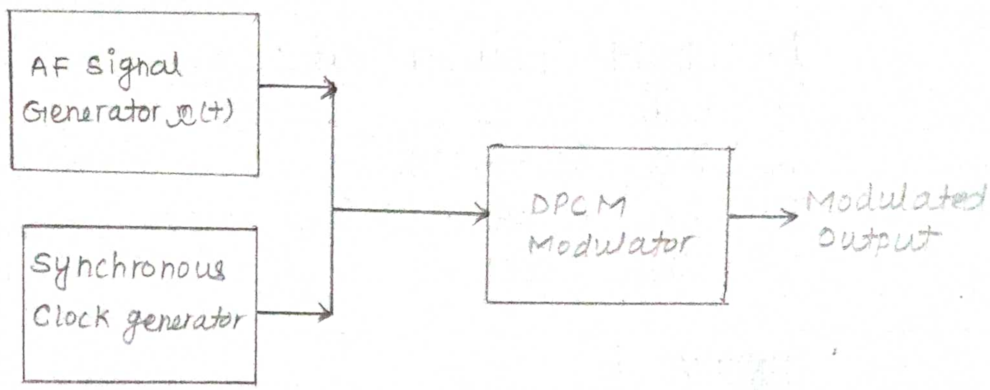
1. DPCM Trainer kit.
2. Path
3. CRO - (0-20 MHz)
4. AC Adapter (± 8V)
5. CRO Probes.

THEORY :-

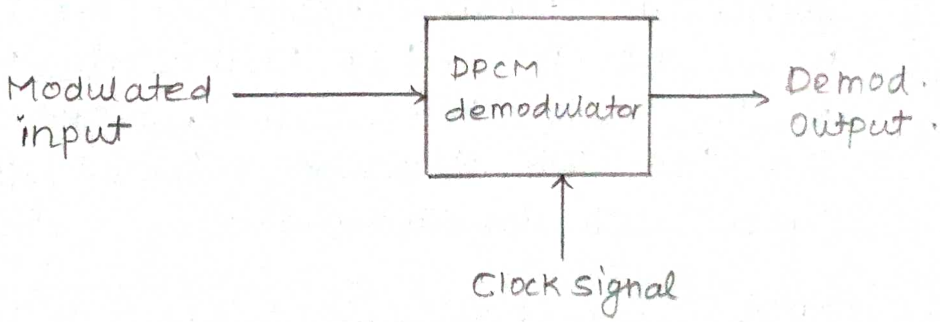
In Differential Pulse Code modulation (DPCM), instead of quantizing each sample, the difference between the two successive samples is quantized, encode, and transmitted as in the PCM. this particularly useful in the voice communication, because in this case two successive samples do not differ much in amplitude.

Thus, the difference signal is much less is amplitude than the actual sample and, hence, less number of quantization levels is needed. therefore, the number of bits per code is reduced, resulting in a reduced bit rate. thus, the band width required in this case is less than the one required in PCM.

DPCM MODULATOR :



DPCM DEMODULATOR :



The disadvantage of DPCM is that the modulator and demodulator circuits are more complicated than those in PCM.

PROCEDURE :-

1. Switch on the kit.

2. Apply the variable DC signal to the input terminals of DPCM modulator.

3. Observe the sampling signal output on CRO.

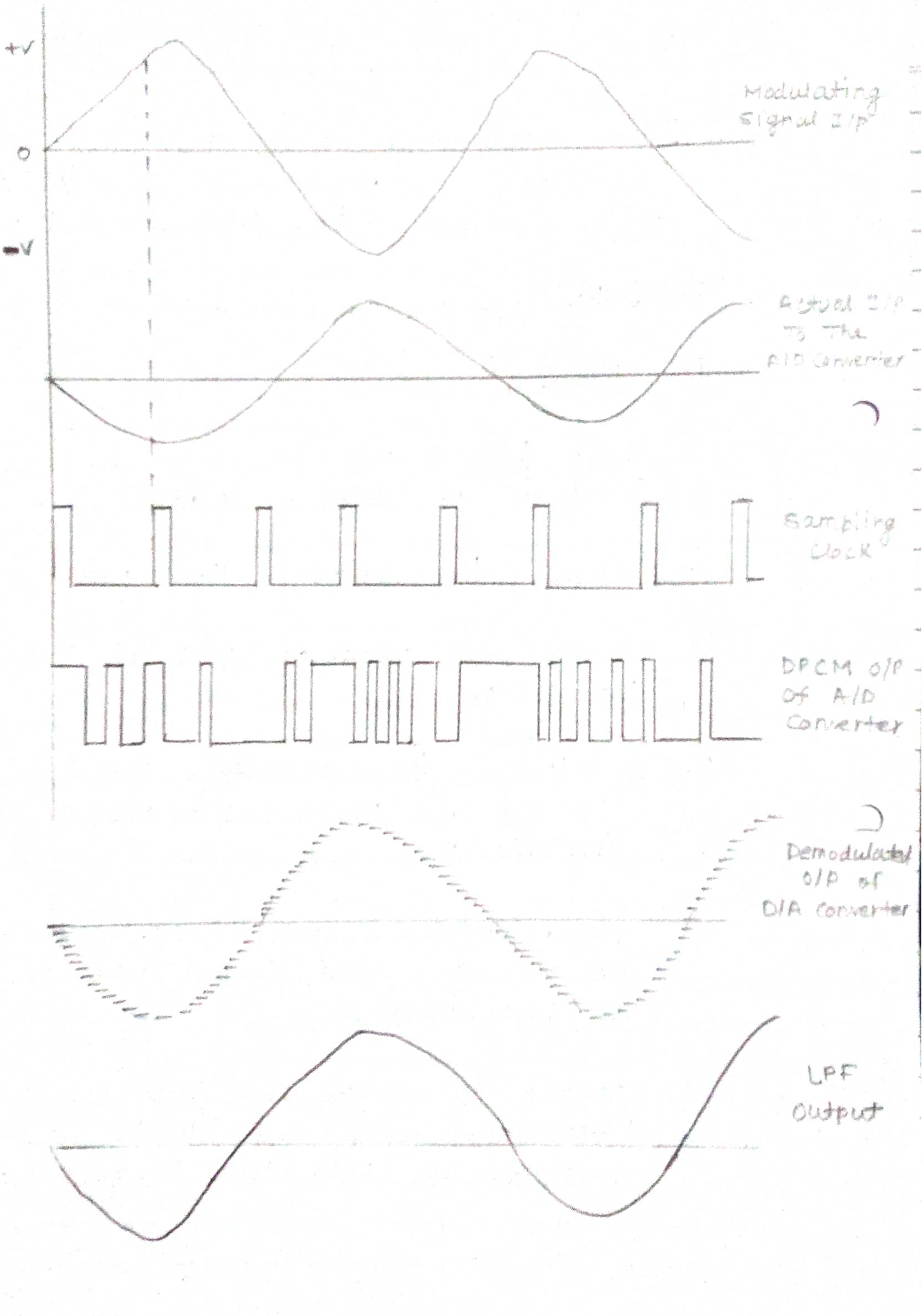
4. Observe the output of DPCM on the second channel of CRO.

5. By adjusting the DC voltage potentiometer we can get the DPCM output from 0000 0000 to 1111 1111.

6. Now, disconnect the DC voltage and apply AF oscillator output to the input of the DPCM modulator.

7. Observe the output of conditioning amplifier (differential output) and DPCM outputs in synchronization with the sampling signal.

Model Waveforms:



8. During demodulation, connect DPCM output to the input of demodulation and observe the output of Demodulator.

Observations :-

1. Amplitude of AF signal = ...
2. Frequency of AF signal = ...
3. Amplitude of Synchronous clock signal = ...
4. Frequency of synchronous clock signal = ...
5. Amplitude of DPCM Modulated signal = ...
6. Frequency of DPCM Modulated signal = ...
7. Amplitude of demodulated signal = ...
8. Frequency of demodulated output = ...

RESULT :-

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AIM : Delta Modulation and Adaptive Delta modulation.

APPARATUS :

1. Delta Modulation trainer
2. CRO
3. Connecting Wires.

THEORY :

DM uses a single bit PCM Code to achieve to achieve digital transmission of analog signal. With conventional PCM each Code is binary representation of both sign and magnitude of a Particular Sample. With DM, rather than transmitting a Coded representation of a Sample a single bit is transmitted, Which indicates Whether the sample is Smaller or larger than the previous sample. the algorithm for a delta modulation system is a simple one. if the Current Sample is Smaller than the Previous Sample then logic 0 is transmitted or logic 1 is transmitted if the Current Sample is larger than the Previous Sample. the input analog is Sampled and Converted to a PAM signal followed by Comparing it With the output of the DAC. the output of the DAC

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is equal to the regenerated magnitude of the previous sample which was stored in the up/down counter as a binary number. the up/down counter is incremented or decremented whether the previous sample is larger or smaller than the current sample. the up/down counter is clocked at a rate equal to the sample rate. so, the up/down counter is updated after each comparison.

PROCEDURE :

1. Switch on the experimental board.

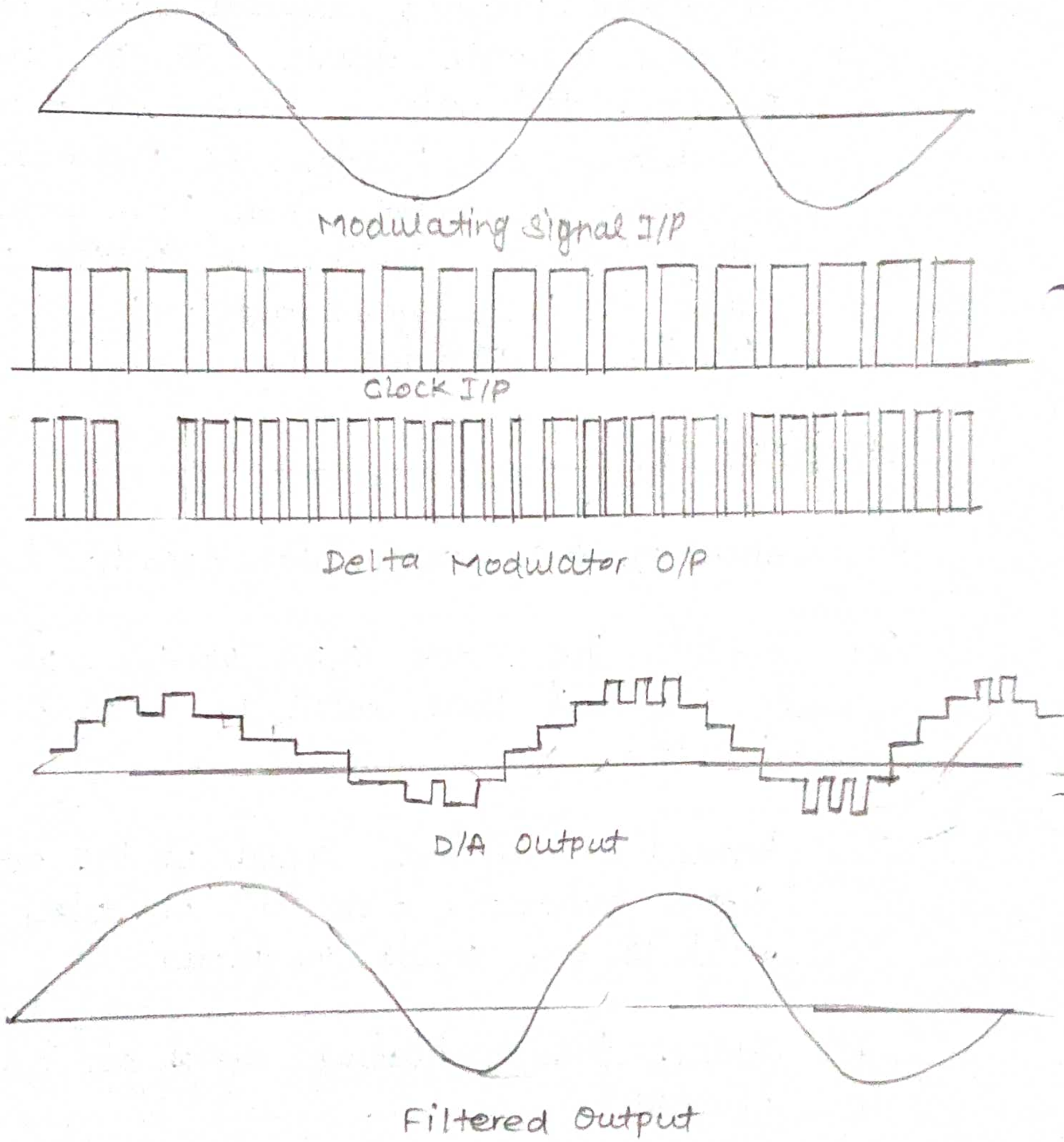
2. Connect the clock signal of Bit clock generator to the bit clock input of Delta modulator circuit.

3. Connect modulating signal of the modulating signal generator to the modulating signal input of the Delta modulator.

4. Observe the modulating signal on channel 1 of CRO.

5. Observe the Delta modulator output on channel 2 of CRO.

Expected Waveform:



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6. Connect the DM o/p of modulator to the DM I/P of Demodulator Circuit.

7. Connect the clock signal to the Bit clock I/P of Demodulator circuit.

8. Observe the demodulated o/p on channel 2 of CRO.

9. Connect the demodulated o/p to the filter input of demodulator circuit.

10. Observe the demodulated o/p with filter on CRO.

ADAPTIVE DELTA MODULATION

Setup requirement :

- TechBook Board 2803
- Power Supply
- DSO
- Test Probe

THEORY :

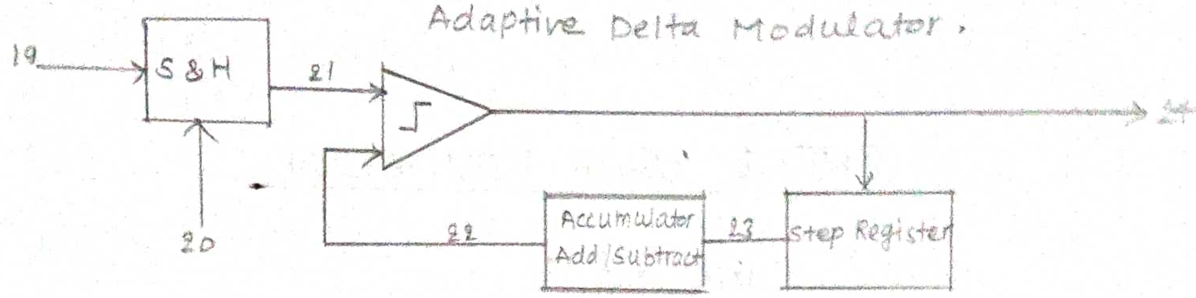
Delta modulation is an important modulation technique employed for data communication. Since, slope overload and granular noise are big problem in delta modulator, adaptive delta modulation became more important. In adaptive delta modulator, we optimize the step in such a way that mean square value of the quantization error of delta modulator can be minimized.

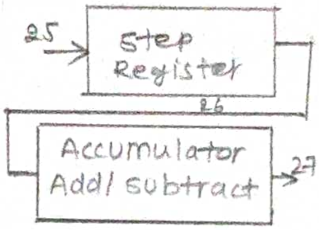
RESULT :

Thus the Adaptive delta modulation and demodulation were performed with lower slope overload and granular noise as compared to delta modulation. Accordingly, graphs are plotted as given in observation table.

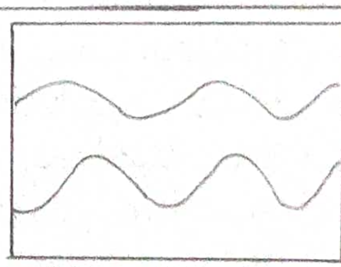
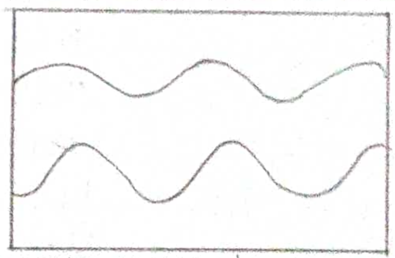
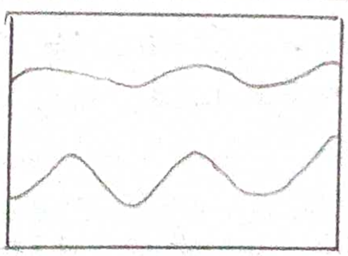
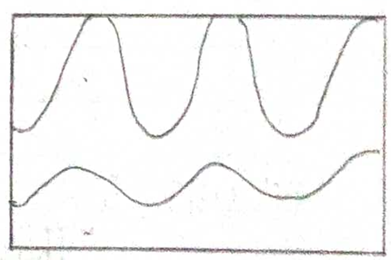
Block Diagram :

Adaptive Delta Modulator.





Observation Table :

Input signal frequency	Sampling frequency (KHz)	Modulated output	De- Modulated output
Sine/500 Hz	64		
Sine/500 Hz	128		

PRECAUTIONS :-

1. Switch off the experimental kit during making Connections.

2. Do not upload, delete or alter any software on the lab PC.

3. Use the DSO Carefully.

AIM :- Simulation of Band pass signal Transmission and Reception.

- Amplitude shift keying.
- Frequency shift keying.
- Phase shift keying.

Amplitude shift keying

Amplitude shift keying is a form of amplitude modulation that projects a digital data as variations in the amplitude of a Carrier Wave (Which is Particularly a High frequency Sinusoidal Wave). In an ASK system, binary symbol 1 is represented by transmitting Carrier Wave of fixed amplitude and fixed frequency for the bit duration T second, the binary symbol 0 will be represented by not transmitting any Wave for another bit duration T seconds.

In the examples MATLAB simulation of Amplitude Shift keying, the user is asked about the frequency of the Carrier Wave, binary message Periodic Pulse & the amplitude of the Waves (Considering both square message Wave & Carrier Wave have equal amplitude).

The MATLAB Code lets the user to plot 3 graphs, namely of the Carrier Wave (Sinusoid), The binary message pulse & the amplitude shift keyed wave.

MATLAB code FOR ASK :

```
Clc % for clearing the Command Window close
all % for closing all the Window except
Command Window.
Clear all % for deleting all the variables
from the memory.
fc = input ('Enter the freq of sine Wave
Carrier:');
fp = input ('Enter the freq of periodic
Binary pulse (Message):');
amp = input ('Enter the amplitude (for
Carrier & Binary pulse Message):');
t = 0:0.001:1; % for setting the
sampling interval.
c = amp.*sin (2*pi*fc*t); % for Generating
Carrier Sine Wave
subplot (3,1,1) % for Generating Carrier
Wave.
plot (t, c)
xlabel ('Time')
ylabel ('Amplitude')
title ('Carrier Wave')
```

```
m = amp/2 .* square (2*pi*fp*t) +
(amp/2); % for Generating square wave
message.
subplot (3,1,2) % for Plotting the
square Binary pulse (Message)
Plot (t,m)
xlabel ('Time')
ylabel ('Amplitude')
title ('Binary Message Pulses')
w = c.*m; % the shift keyed wave
subplot (3,1,3) % for Plotting the
Amplitude shift keyed wave.
Plot (t,w)
xlabel ('Time')
ylabel ('Amplitude')
title ('Amplitude shift keyed Signal')
```

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Frequency Shift Keying

Frequency Shift keying is a frequency Modulation scheme in which digital information is transmitted through Carrier frequency. the simplest FSK is binary FSK (BFSK). BFSK uses a pair of discrete frequencies to transmit binary (0s and 1s) information. If the number of symbols to transmit is more than 2, so we will just have to use as many carriers as the number of symbols.

The given example of MATLAB simulation of frequency shift keying, the user is asked about the frequency of the two carrier wave a message periodic pulse & the Amplitude of the waves (considering for square message wave & both carrier wave have equal amplitude). the frequency of the carrier wave change from f1 to f2 or vice versa whenever a zero is changed to 1 or vice-versa. the frequency will not change if in 2 successive time period there is no change in message bit value. The MATLAB below code lets the user to plot 4 graphs, namely 2 graph plot of the carrier waves (Sinusoid), the Binary Message pulse & The Modulated wave.

MATLAB Code FOR FSK

```
Clc % for clearing the Command Window
close all % for closing all the Window
except Command Window.
Clear all % for deleting all the variables
from the memory.
fc1 = input ('Enter the freq of 1st
Sine Wave Carrier :');
fc2 = input ('Enter the freq of 2nd Sine
Wave Carrier :');
fp = input ('Enter the freq of Periodic
Binary Pulse (Message ):');
amp = input ('Enter the amplitude (For
Both Carrier & Binary Pulse
Message):');
amp = amp/2 ;
t=0:0.001:1; % for setting the
Sampling interval
C1 = amp.*Sin(2*pi*fc1*t); % for
Generating 1st Carrier Sine Wave
C2 = amp.*sin (2*pi*fc2*t); % for
Generating 2nd Carrier Sine Wave
Subplot (4,1,1); % for Ploting the
Carrier Wave
Plot (t, C1)
xlabel ('Time')
ylabel ('Amplitude')
title ('Carrier 1 Wave')
```

Subplot (4,1,2) % for plotting The Carrier Wave
Plot (t, c2)
x label ('Time')
Y label ('Amplitude')
title ('Carrier 2 Wave')
m = amp. * square (2* pi * fp * t) + amp ; % for Generating Square Wave message.
Subplot (4,1,3) % for Plotting the Square Binary pulse (Message)
Plot (t, m)
xlabel 1 ('Time')
Ylabel 1 ('Amplitude')
title ('Binary Message Pulses')
for i = 0:1000 % here we are generating the modulated wave.

```
        if m(i+1)==0
            mm (i+1) = c2 (i+1);
        else
            mm (i+1) = c1 (i+1);
    end
end
```

Subplot (4,1,4) % for Plotting The Modulated Wave
Plot (t, mm)
X label ('Time')
Y label ('Amplitude')
title ('Modulated Wave')

Phase Shift Keying

Phase shift keying is a digital modulation technique that Projects data by modulating the Phase of reference signal (the Carrier Wave). Any digital modulation scheme uses a finite number of distinct signals to represent digital data. PSK uses a finite number of Phases, each assigned a unique Pattern of binary digits. usually, each Phase encodes an equal number of bits. Each Pattern of bits forms the symbol that is represented by the Particular phase. the demodulator, which is designed specifically for the symbol-set used by the modulator, determines the phase of the received signal and maps it back to the symbol it represents, thus recovering the original data.

In the example MATLAB Simulation of Phase shift keying, the the user is asked about the frequency of the Carrier Wave, Message Periodic Pulse & the Amplitude of the Waves (Considering both square message Wave & Carrier Wave have equal amplitude). The Phase of the Carrier Wave Will Change by 180 degree Whenever a zero is changed to 1 or vice-versa. The Phase Will not Change if in 2

Successive time Period there is no Change in message bit value. The MATLAB Code lets the user to plot 3 graphs, namely of the Carrier Wave (Sinusoid), the Binary Message Pulse & the Phase Shift Keyed Wave.

MATLAB Code for PSK

```
clc % for clearing the Command Window
close all % for Closing all the Window
except Command Window
Clear all % for deleting all the variables
from the memory.
t=0:.001:1; % for Setting the sampling
interval
fc = input ('Enter frequency of Carrier
Sine Wave:');
fm = input ('Enter Message frequency :');
amp = input ('Enter Carrier & Message
Amplitude (Assuming Both Equal):');
c = amp.* sin (2*pi fc*t); % Generating
Carrier Wave
Plot (t,c)
xlabel ('Time')
Ylabel ('Amplitude')
title ('Carrier')
m = square (2*pi*fm*t); % for plotting
Message signal.
```

```
subplot (3,1,2)
plot (t,m)
xlabel ('time')
ylabel ('amplitude')
title ('Message signal') % Sine wave
multiplied with square wave in order
to generate PSK.
x = c.*m;
subplot (3,1,3) % for plotting PSK (Phase
shift keyed) signal
plot (t,x)
xlabel ('t')
ylabel ('y')
title ('PSK')
```

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AIM :- Implementation of Amplitude shift Keying.

APPARATUS :-

1. ASK MODULATION & DEMODULATION Trainer kit.
2. CRO 30 MHz Dual channel.
3. Patch Chords.

THEORY :-

Modulation also allows different data streams to be transmitted over the same channel. this process is called as 'Multiplexing' & result in a considerable saving in bandwidth no of channels to be used. Also it increases the channel efficiency.

The variation of particular parameter variation of the carrier wave give rise to various modulation techniques. some of the basic modulation technique are described as under.

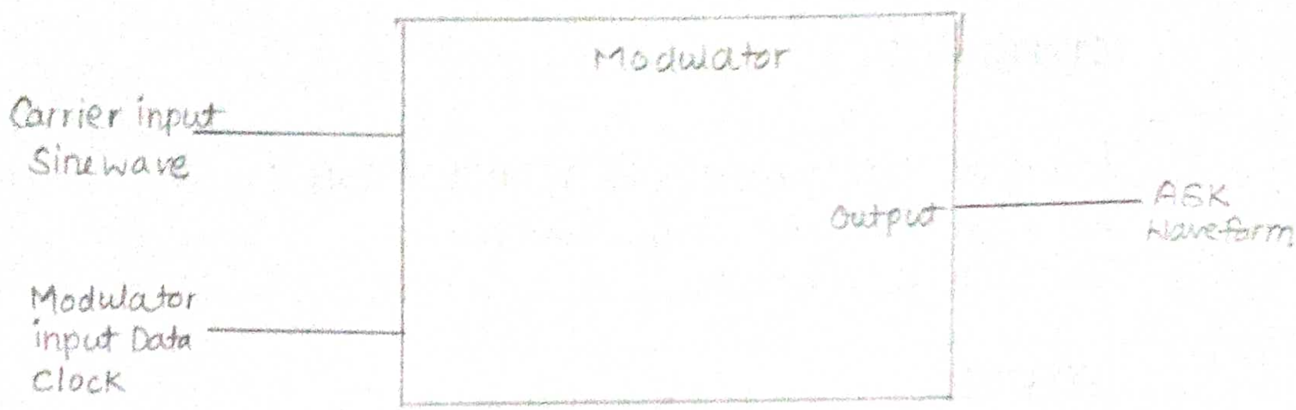
PROCEDURE :-

• Modulation :-

1. Connect the sinewave 500 KHz from the carrier generator TP1 to the carrier input of the modulator TP7.

Block Diagram :

AMPLITUDE SHIFT KEYING



Double-Balanced Modulator

2. And also Connect data Clock D1 i.e., modulation signal TP3 to the modulation input TP8.

3. Switch ON the power supply.

4. observe the output at TP9.

5. By varying the gain pot P3 observe the ASK output at TP10.

6. Adjusting the Carrier offset and modulation offset we can observe the ASK output.

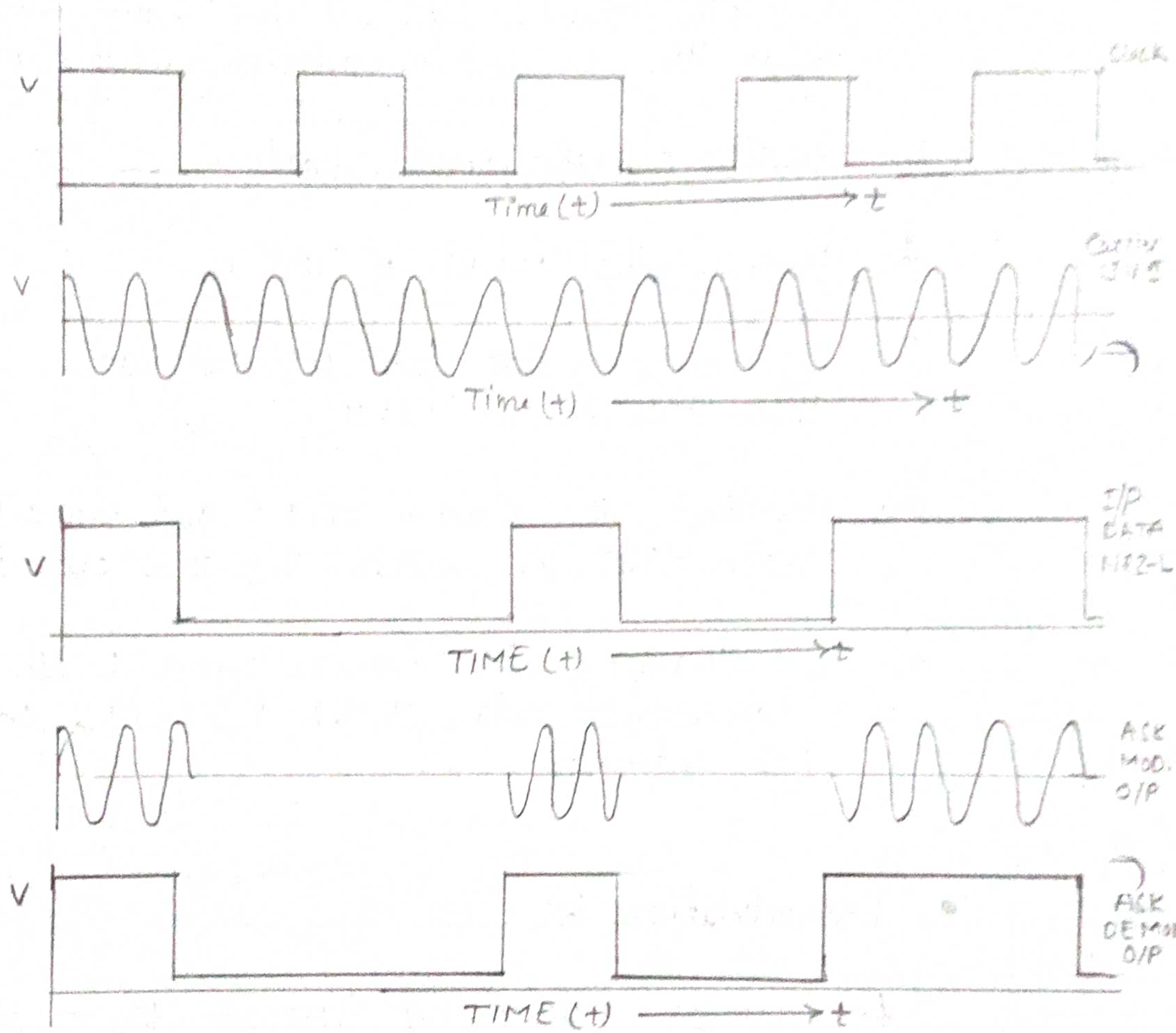
7. By Changing the Carrier signal 1 MHz and different data clocks D2, D3, D4 observe the output.

- Demodulation :-

1. Connect ASK output TP10 to the rectifier input TP12 and observe the wave form.

2. Now Connect rectifier output TP13 to the low pass filter input TP14 and observe the output at TP15.

Expected Waveforms:



3. CONNECT LPF output TP15 to the data squaring Circuit input TP16 and observe the demodulation output waveform at TP17.

4. By Changing the different data clocks and observe the demodulation output.

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AIM :- Implementation of frequency shift keying.

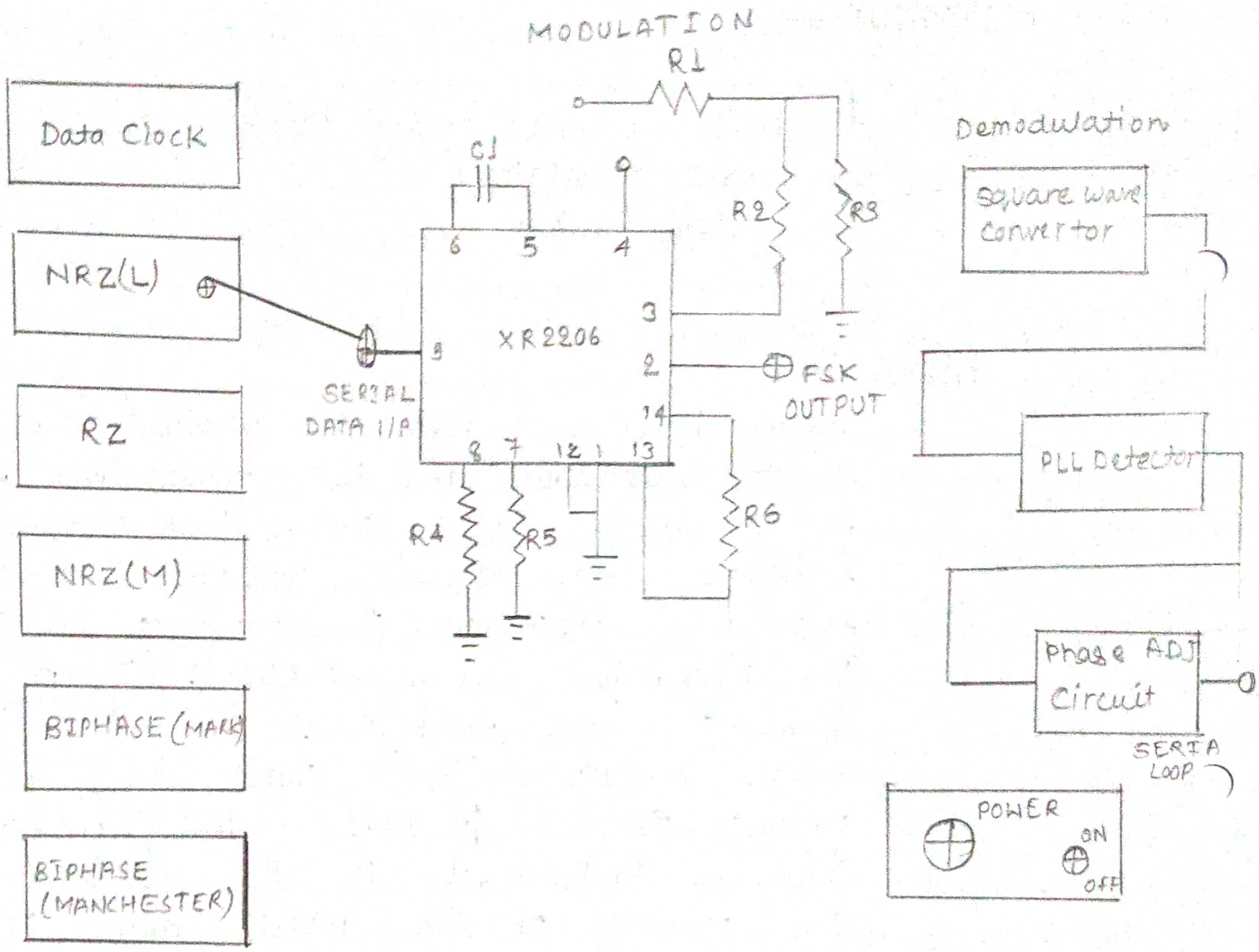
APPARATUS :-

1. frequency shift keying kit.
2. C.R.O (30 MHz)
3. Patch Cords.

THEORY :-

Binary FSK is a form of Constant-amplitude angle modulation and the modulating signal is a binary Pulse stream that varies between two discreate voltage levels but not Continuous changing analog signal. In FSK, the Carrier amplitude (Vc) remains Constant with modulation and the Carrier radian frequency (Wc) shifts by an amount equal to +W/2. the frequency shift is Proportional to the amplitude and polarity of the input binary signal. for example, a binary 1 could be +1 volt and a binary zero could be -1 volt producing frequency shift of + delta (W)/2 and - delta (W)/2 respectively. the rate at which the Carrier frequency shift is equal to the rate of change of the binary input signal Vm(t). thus the output Carrier frequency

Circuit Diagram :



deviates (shifts) between Wc + delta (W)/2 and Wc - delta (W)/2 at the rate equal to fm.

PROCEDURE :-

Modulation :-

1. Switch ON the Power supply.

2. Set the data selection switch ("DATA SELECTION") to the desired Code (say 11001100).

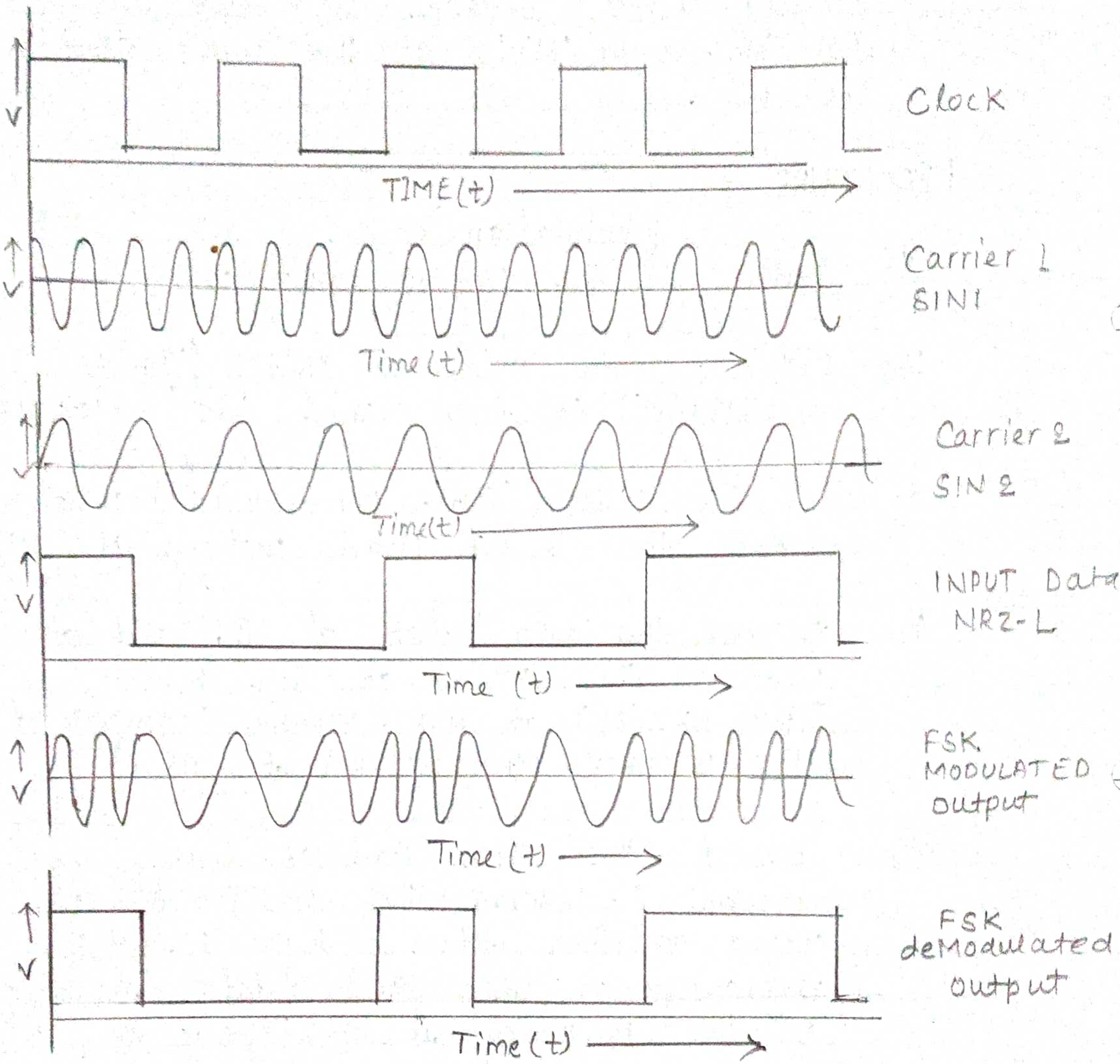
3. Set the switch (DATA ON - OFF) ON position. observe the 8 bit Word pattern at TP12.

4. Observe the data clock at TP1 and also observe the NRZ(L) at TP2, RZ at TP3, NRZ(M) at TP4, BIPHASE (MARK) at TP5, BIPHASE (MANCHESTER) at TP6.

5. Connect the patch Cord as shown in diagram 1. Observe the Corresponding FSK output at (When data is logic '1', the frequency is high and data is logic '0' the frequency is low) TP8.

6. Repeat the step 5 for other inputs. (like NRZ(M), RZ, BIPHASE) observe the Corresponding FSK outputs.

Expected Waveforms :



7. Now change the data selection and repeat the above steps 3 to 6 and observe the corresponding FSK outputs.

Demodulation :

1. Connect the patch cords as shown in diagram.

2. The incoming FSK input is observed at TP9.

3. The output of 'Square Wave Converter' is available at TP10. the serial data output is available at TP11.

4. Repeat the above steps 1, 2, 3 for other serial data inputs and observe the corresponding serial data outputs. These outputs are true replica of the orginal inputs.

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AIM :- Implementation of Phase shift keying.

APPARATUS :-

1. PSK Modulation And Demodulation Trainer.
2. 30MHz Dual Trace Oscilloscope.
3. Patch Chords.

THEORY :-

To transmit the digital data from one place to another, We have to choose the transmission medium. the simplest possible method to connect the transmitter to the receiver with a piece of Wire. This Work satisfactorily for short distances in some cases. But for long distance Communication & in situations like communication with the aircraft, ship, vehicle this is not feasible. Here We have to opt for the radio transmission.

It is not possible to send the digital data directly over the antenna because the antenna of practiced size works on very high frequencies, much higher than our data transmission rate.

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To able to transmit the data over antenna, we have to 'module' the signal i.e., phase, frequency or amplitude etc. is varied in accordance with the digital data. At receiver we separate the signal from digital information by the process of demodulation. After this process we are left with high frequency signal which we discard & the digital information, which we utilize.

PROCEDURE :-

1. Now switch ON the trainer and see that supply LED glows.

2. Observe the carrier output at TP1.

3. observe the data outputs (D_1, D_2, D_3, D_4).

4. Now the connect the carrier output TP1 to the carrier input of PSK modulator TP2 using patch chord (as shown in dig 1).

5. Connect the d1 to data input of PSK modulator TP3 (AS shown in dig 1).

6. observe the Phase shifted PSK output Waveform on CRO on Channel 1 and Corresponding data output on Channel 2.

7. Repeat the steps 4, 5, 6 for data outputs D2, D3, D4 and observe the PSK outputs.

8. Connect the PSK modulation output TP6 to the PSK input of demodulation TP4 (as shown in dig 2).

9. Connect the Carrier output TP1 to the Carrier input of PSK demodulation TP5. (As shown in dig 2).

10. Now, observe the PSK demodulated output at TP7 on CRO at Channel 1 and Corresponding data output on Channel 2.

11. the demodulated output is true replica of data output.

12. Repeat the steps 8 to 10 for other data outputs D2, D3, D4.

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AIM :- Time Division Multiplexing : PLL (CD 4046) based synch, clock and data extraction.

APPARATUS :-

1. Time Division multiplexing & demultiplexing trainer kit.
2. CRO (30 mhz).
3. Patch chords.

THEORY :-

The 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 input signals, all band limited by the input filters are sequentially sampled, the output of which is a PAM waveform containing samples of the input signals periodically interlaced in time. the samples from adjacent input message channels are separated by Ts/M, where M is the number of input channels. A set of M pulses consisting of one sample from each of the input channels is called a frame.

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

Besides the space diversity & frequency diversity is a method of sending multiple analog signals on a channel using "TIME DIVISION MULTIPLEXING & DEMULTIPLEXING" Technique.

PROCEDURE :-

Multiplexing :

1. Connect the circuit as shown in diagram.

2. Switch ON the power supply.

3. Set the amplitude of each modulating signal as 5V peak - peak.

4. Monitor the outputs at test point 5, 6, 7, 8. these are natural sampling PAM outputs.

5. observer the outputs varying the duty cycle pot (P5). the PAM outputs will varying with 10% to 50% duty cycle.

6. Try varying the amplitude of modulating signal corresponding each channel by using amplitude pots P1, P2, P3, P4. observe the effect on all outputs.

7. observe the TDM output at pin no. 13 (at TP9) of 4052. all the multiplexer channel are observed during the full period of the clock (1/32 KHz).

Demultiplexing & Low Pass filter :

1. Connect the circuit as shown in diagram 2.

2. observe the demultiplexed outputs at test point 13, 14, 15, 16 respectively.

3. observe by varying the duty cycle pot P5 and see the effect on the outputs.

4. observe the low pass filter outputs for each channel at test points 17, 18, 19, 20 and at sockets channels CH1, CH2, CH3, CH4. these signals are true replica of the inputs. these signals have lower amplitude.