Certificate

Name: Syeda Reeha Qusar Class: 4C7

Roll No: 14114802719 Exam No:

Institution _____

This is certified to be the bonafide work of the student in the _____ Laboratory during the academic year 20 / 20 .

No of practicals certified _____ out of _____ in the subject of _____

.....
Teacher In-charge

....
Examiner's Signature Principal

Date: ..... Institution Rubber Stamp

(N.B: The candidate is expected to retain his/her journal till he/she passes in the subject.)

INDEX

NAME : Syeda Reeha Quasar STD : 4C7 SEC : A ROLL NO.: 1412480279

S.No.	Name of the Experiment	Page No.	Date of Experiment	Date of Submission	Remarks
1	To generate signal sampling and reconstruction techniques.	1-4	18-03-2021		8.5 01/04/21
2.	To study Amplitude modulation and find the Modulation Index.	5-8	24-03-2021		
3.	To study generation and detection of SSBSC	9-13	07-04-2021		
4.	To study amplitude modulation and demodulation of AM wave.	12-14	21-04-2021		
5.	To study frequency modulation using Varactor modulation and reactance modulation.	15-17	12-05-2021		
6.	To study Pulse Amplitude modulation (PAM) using different sampling and hold methods and its demodulation	18-21	26-05-2021		
7.	To study PWM using different Sampling	22-24	09-06-2021		

INDEX

NAME : _____ STD : _____ SEC : _____ ROLL NO.: _____

S.No.	Name of the Experiment	Page No.	Date of Experiment	Date of Submission	Remarks
	methods and to study its demodulation				

Date 18-03-2021

Expt. No. 1 Page No. 1

Experiment - 1

Aim : To generate Signal Sampling and Reconstruction techniques

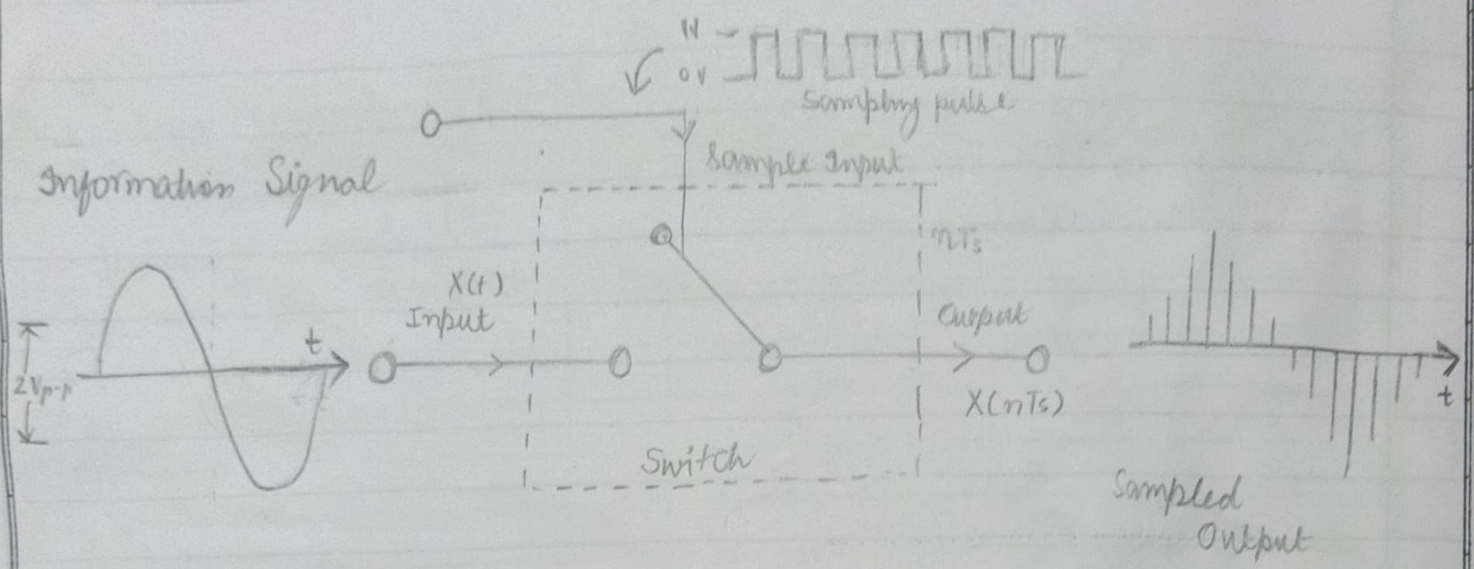
Objectives - Study of sampling and reconstruction of signal
Study the effect of sample/Hold circuitry on reconstructed signal
Comparison of frequency response of 4th order low pass filter

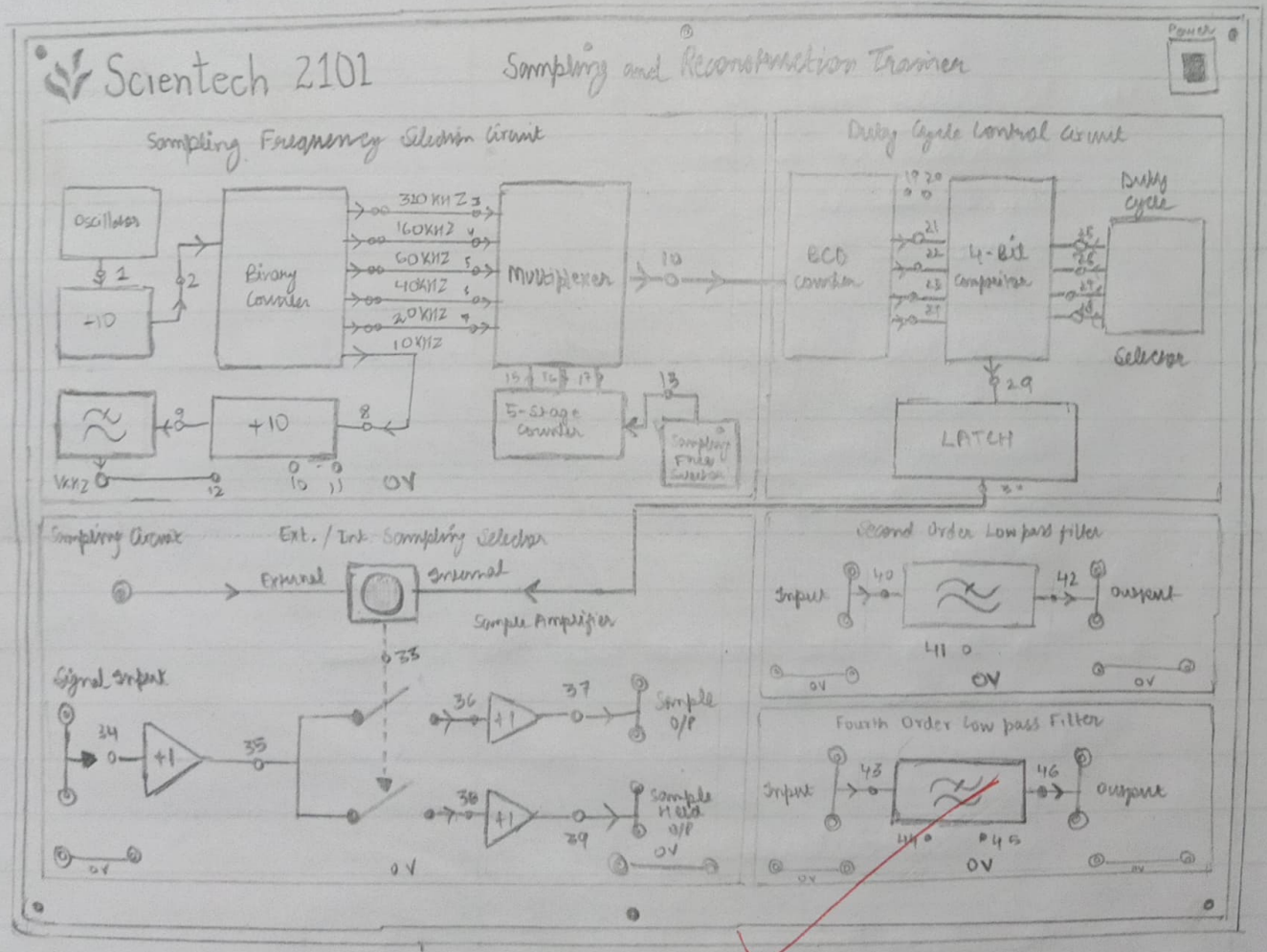
Equipments Required - Scientech 2101 with power cord
Oscilloscope with connecting probe
Connecting cords

Theory :
Signals we use in real world, such as our voice are called "analog" signal. To process these signals in digital communication we need to convert analog signals to digital signals.
Analog signals are continuous in time and amplitude while digital signal is discrete time signal and has both time and amplitude discrete
SAMPLING is the process to convert continuous time signal to discrete time signal. The value of signal is measured at certain intervals in time which are called as samples.
Sampling Theorem states that a continuous signal band limited to fm Hz, can be completely represented by and reconstructed from the samples taken at a rate greater than or equal to 2fm samples per sec. Minimum frequency is called "Nyquist Rate". Thus for faithful reconstruction of information signal from its samples it is necessary that the sampling rate $F_s > 2 \cdot F_{max}$ Hz

Teacher's Signature : _____

Sampling Circuit





If the information signal is sampled at a rate lower than that stated by Nyquist criterion, then there is overlap between information signal and side bands of harmonics. Thus the lower and higher frequency components get mixed and cause unwanted signals to appear at the demodulator output. This phenomenon is termed as Aliasing or Fold-over Distortion.

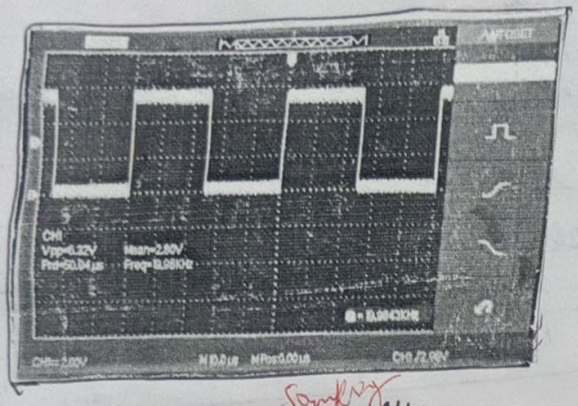
Procedure :

1. Duty cycle selector switch was set to 5 (50% duty cycle) and sampling selector switch was set to internal
2. 1KHz sine wave was given as input and Oscilloscope was used to observe the wave. Readings were taken at 320 and 20KHz sampling rates
3. For the respective sampling rates sample output waveforms were visualized
4. Sample input was connected to 4th order low pass filter and waves obtained were visualized for 320KHz and 20KHz sampling rates (sampling frequency was 1/10th of frequency indicated by LED illuminated)
5. We observed sample output lower frequencies introduced distortion which was caused as filter did not attenuate unwanted freq. component significantly
6. As we increased Duty cycle selector we observed linear relationship with amplitude
7. The output sample was connected to hold and sample and waveforms were observed. Also same outputs were passed from 4th order low pass filter and waves were visualized.
8. Outputs for different Duty cycles were observed too but there was no change in amplitude in the hold case.
9. Sample output was connected now to 2nd order low pass filter and difference b/w the waveforms of 4th and 2nd order were visualized
10. The outputs was observed by varying the duty cycle too and was done for hold and sample O/P also.

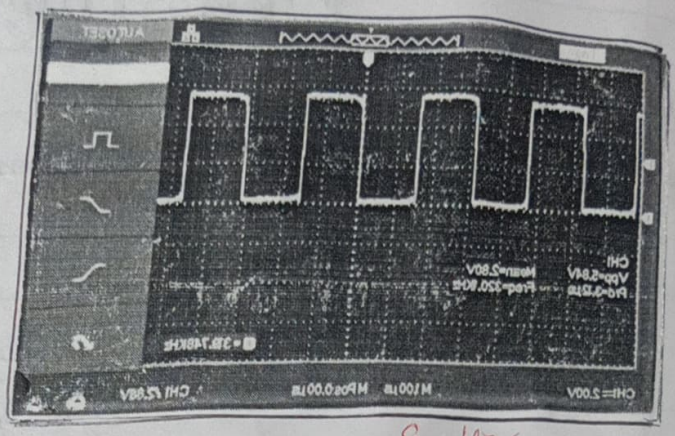
Teacher's Signature : _____

SIGNAL WAVE-FORM VISUALISATION/OUTPUTS

INPUT SIGNAL WAVEFORMS

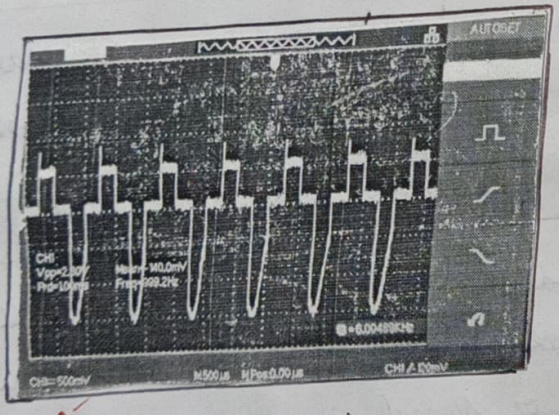


20KHz - Frequency



320 KHz - Frequency

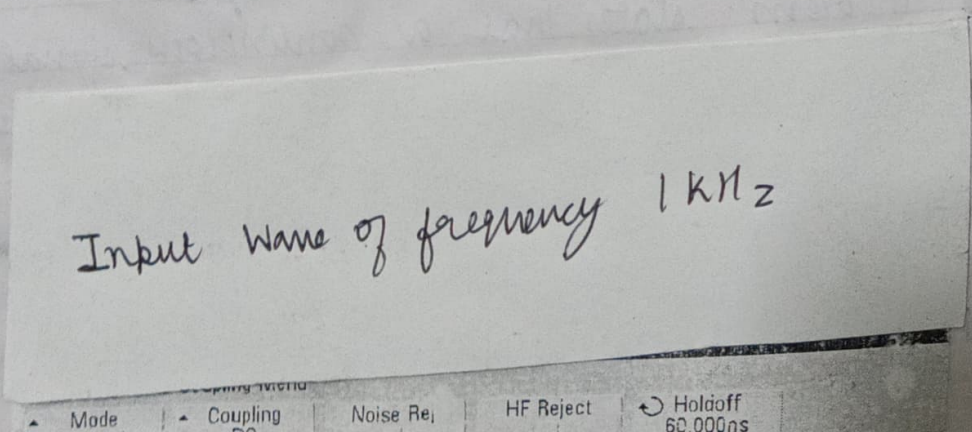
SAMPLE OUTPUT



Sampling wave of frequency 20KHz

Sample op of sampling wave frequency 320KHz

Input wave of frequency 1KHz



Result: It was observed from various cases that:
As sample frequency increases the output of sample port has more number of samples of applied signal
For transmitting the signal if a sample and hold amplifier is used just before the transmission channel, the signal suffered from ~~less~~ distortion as compared to when only sample amplifier was used.
As the order of LPF is increased at output, the recovered signal will be reconstructed more like transmitted signal
To further verify when sample amplifier or sample and hold amplifier was connected to II order LPF and this was I/P for IV order LPF. The obtained was the output for II order LPF.
Signal sampling was generated and various reconstruction techniques are verified and observed.

Viva Voice Questions

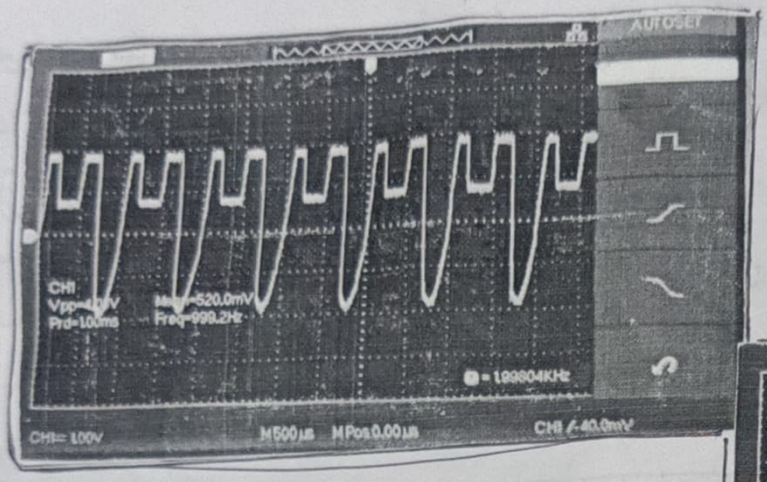
Ques1. What do you mean by sampling?
Ans To convert continuous time signal to discrete time signal, a process is used and this process is called Sampling.

Ques2. What is sampling theorem?
Ans The sampling theorem states that a signal can be exactly reproduced if it is sampled at a frequency F_s
where $F_s > 2.F_{max}$: F_{max} - maximum frequency in signal

Ques 3. What is Nyquist frequency?
Ans The frequence 2. F_{max} is called Nyquist sampling rate.

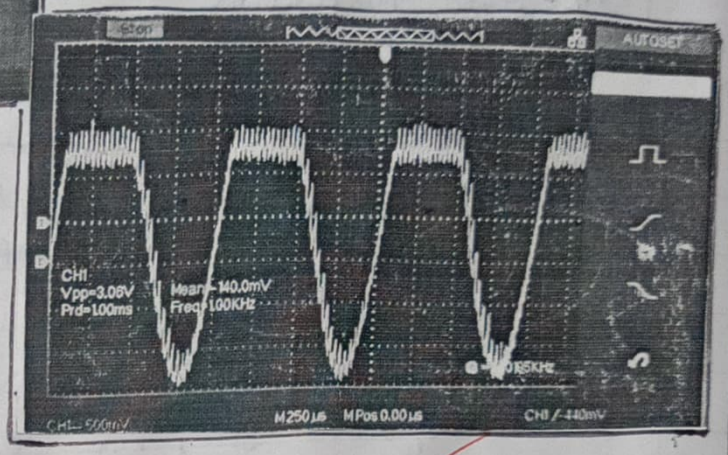
Teacher's Signature : _____

SAMPLE AND HOLD O/P

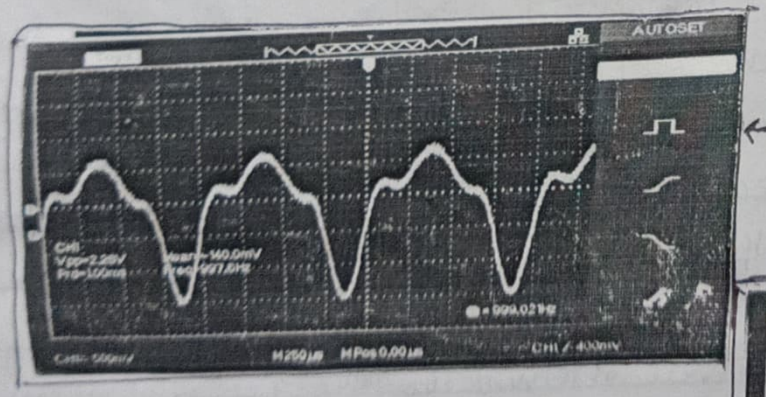


← Sample and hold O/P wave for sampling wave of frequency 20KHz

Sample and hold O/P for sampling wave of frequency 320KHz →

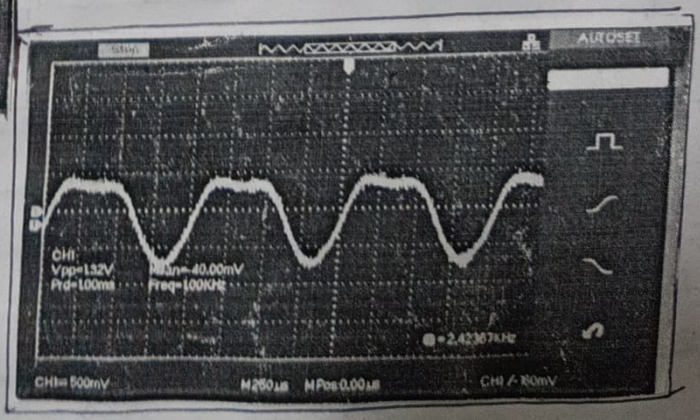


OUTPUT WAVE WHEN SAMPLE OUTPUT PASSED THROUGH 4th ORDER LOW-PASS FILTER



← for sampling wave of frequency 20 KHz

for Sampling wave of frequency 320KHz →



Half of this value f_{max} is sometimes called as Nyquist frequency.

Ans 4. List different sampling techniques?

Ans There are 3 types of sampling techniques:

1) Ideal sampling or Instantaneous sampling or Impulse sampling
2) Natural sampling
3) Flat top sampling

Ans 5. How aliasing is removed?

Ans Aliasing is removed by simple filtering out all high frequencies components before sampling.

Ans 6. What is under sampling?

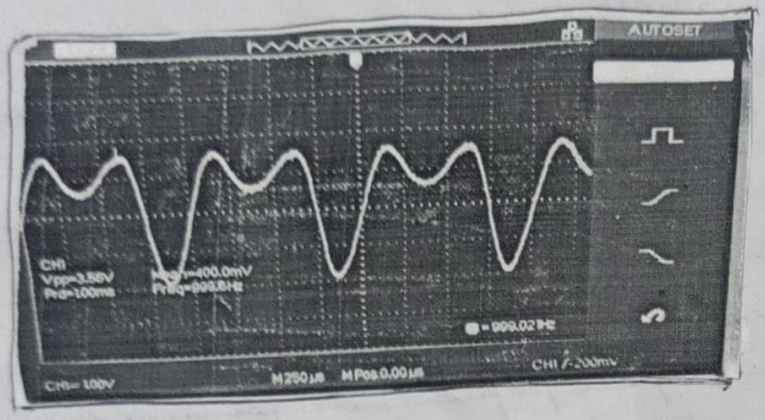
Ans When the sampling rate is lower than or equal to Nyquist rate, a condition defined as under sampling, it is impossible to rebuild the original signal according to sampling theorem.

E-5

08/04/21

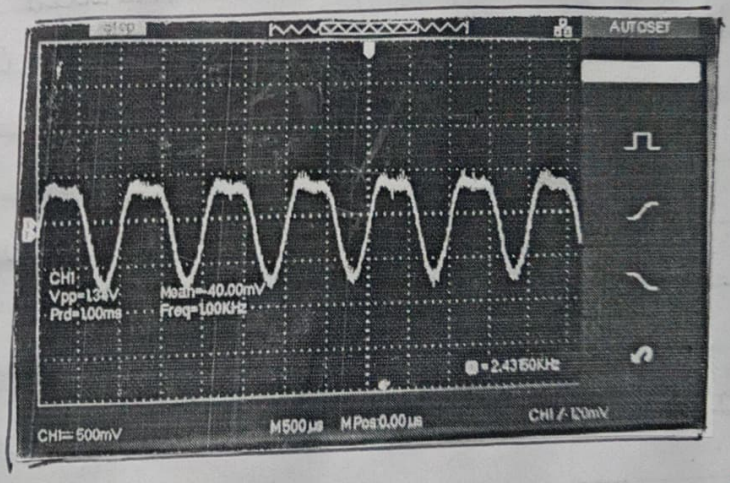
Teacher's Signature : _____

OUTPUT WAVE WHEN SAMPLE AND HOLD WAVE IS PASSED THROUGH 4TH ORDER LOW PASS FILTER



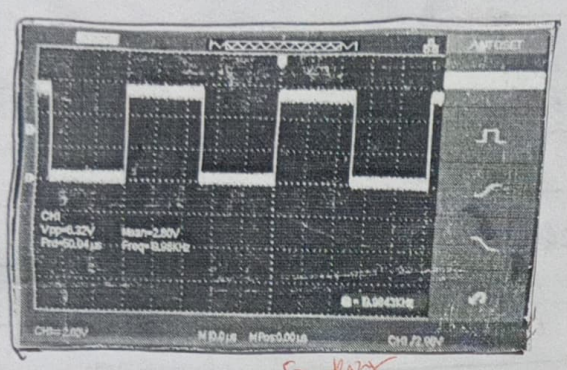
· when sampling wave of freqancy 20KHz is inputed

In case of sampling wave of frequency 320 KHz

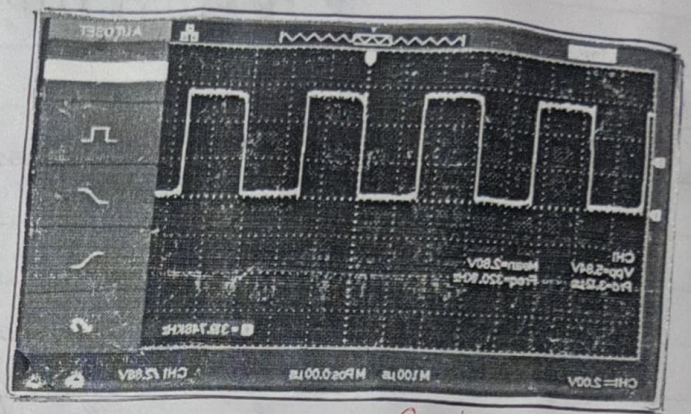


SIGNAL WAVE-FORM VISUALISATION/OUTPUTS

INPUT SIGNAL WAVEFORMS

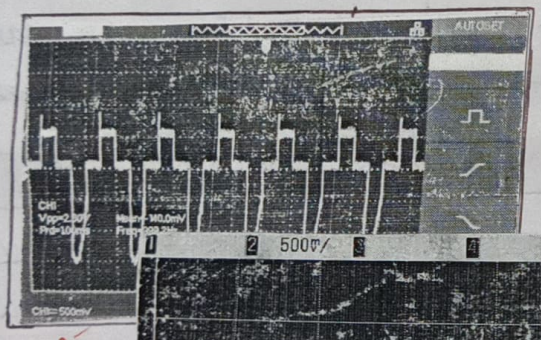


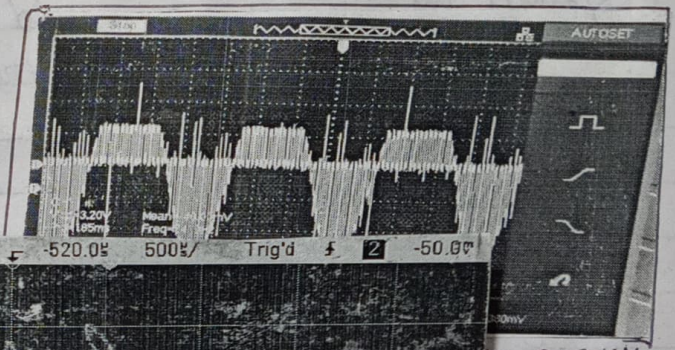
20KHZ - Frequency



320 KHz - Frequency

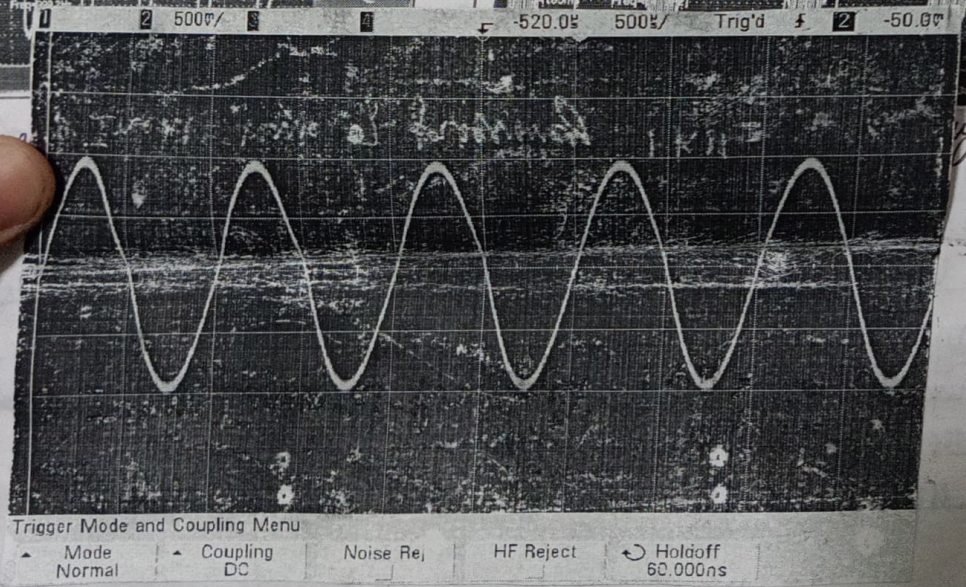
SAMPLE OUTPUT





Sampling wave of

y 320 KHz



Date _____

Expt. No. 2 Page No. 5

Experiment - 2

To study generation and detection of DSBSC

Aim: 1) Double sideband - Supressed Carrier AM Generation
2) Double sideband - Supressed Carrier AM Reception

equipments Required: → ST2201 and ST2202 with power supply cord
→ CRO with connecting probe
→ Connecting cords

Theory:

Double-sideband suppressed-carrier transmission (DSB-SC) is transmission in which frequencies produced by amplitude modulation (AM) are symmetrically spaced above and below the carrier frequencies and carrier level is reduced to the lowest practical level, ideally being completely suppressed. In DSB-SC modulation, unlike in AM, the wave carrier is not transmitted; thus much of the power is distributed between the sidebands, which implies an increase of the cover in DSB-SC, compared to AM, for the same power used.

DSB-SC is basically an amplitude modulation wave without the carrier, therefore reducing power waste, giving it a 100% efficiency. This is an increase compared to normal AM transmission (DSB), which has a maximum efficiency of 33.333% since 2/3 of the

Teacher's Signature: _____

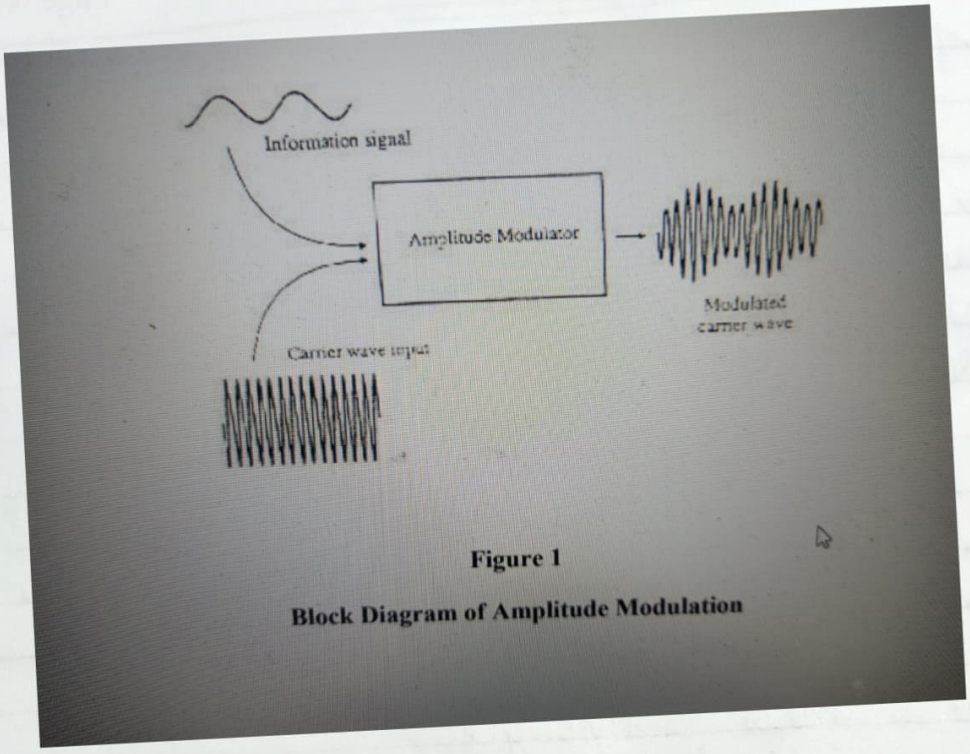


Figure 1

Block Diagram of Amplitude Modulation

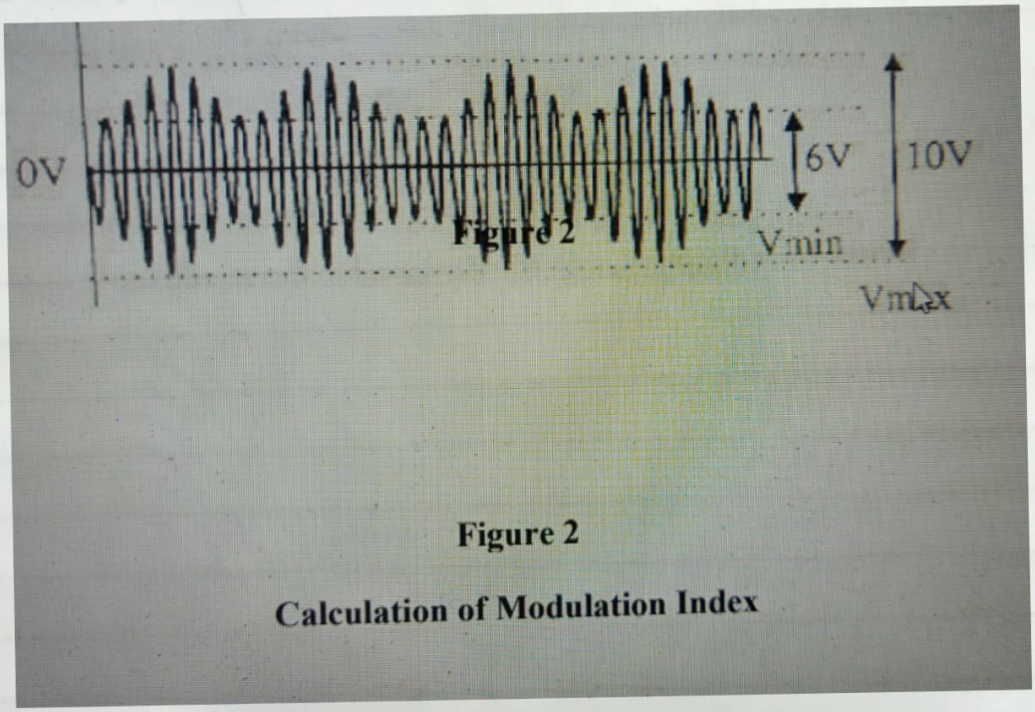


Figure 2

Calculation of Modulation Index

power is in carrier which carries no intelligence and each sideband carries the same information. Single Side Band (SSB) suppressed carrier is 100% efficient

GENERATION OF DSB-SC AM

DSB-SC is generated by a mixer. This consists of a message signal multiplied by a carrier signal. The mathematical representation of this process is shown below the product to sum trigonometric identity is used

$$\underbrace{V_m \cos(\omega_m t)}_{\text{message}} \times \underbrace{V_c \cos(\omega_c t)}_{\text{carrier}} = \underbrace{\frac{V_m V_c}{2}\left[\cos(\omega_m + \omega_c)t + \cos(\omega_m - \omega_c)t\right]}_{\text{modulated signal}}$$

Procedure:

1. Starting with audio switch in int position, mode switch in DSB position, Output amplifier gain potentiometer in full clockwise position, speaker in off position board ST2201 was turned ON.
2. Connect the CRO to trainer kit
3. Switch ON both CRO and kit. Select the switch on DSBSC position. All switches found off, Audio pin on
4. Adjust variable capacitator until we get demodulated output
5. Trace variable capacitator until we get demodulated I/p signal
6. Observe the o/p of SSB-SC modulated wave.
7. Makes ground level transmitter and receiver trainer's kit.
8. Insert the modulated signal o/p to receiver.

Teacher's Signature : _____

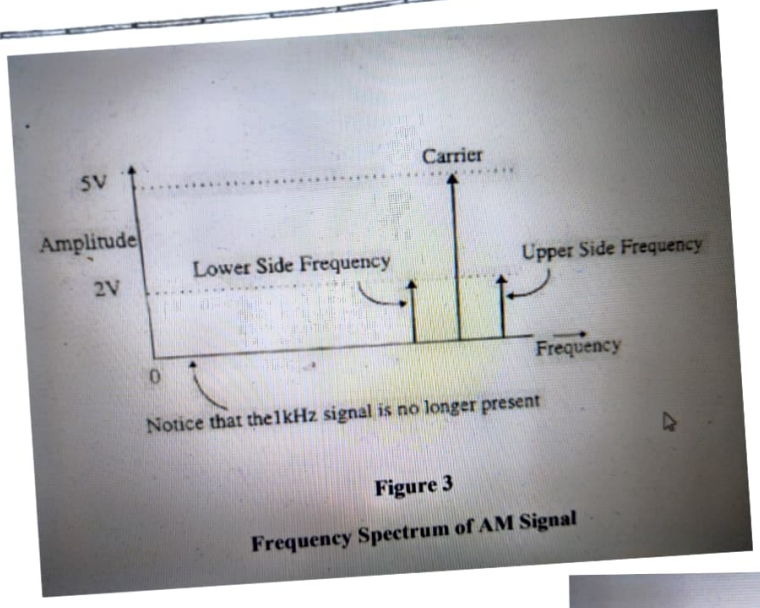


Figure 3

Frequency Spectrum of AM Signal

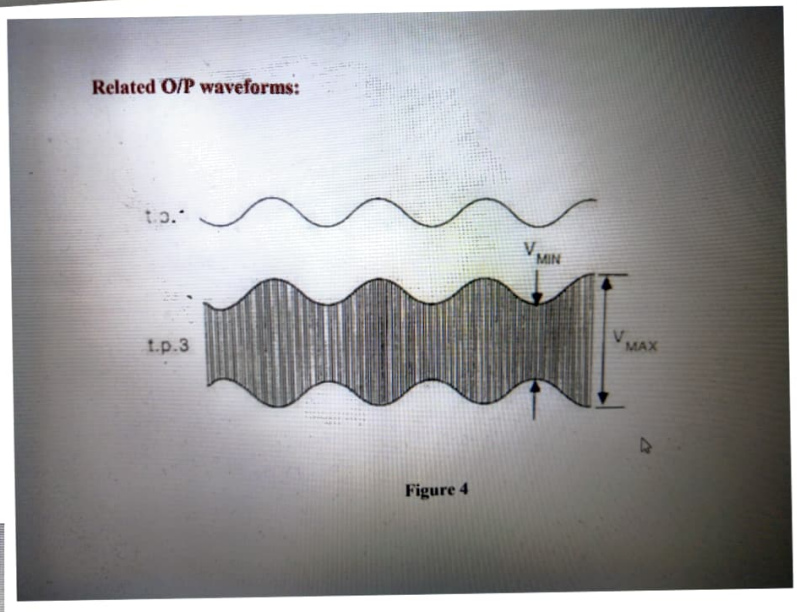


Figure 4

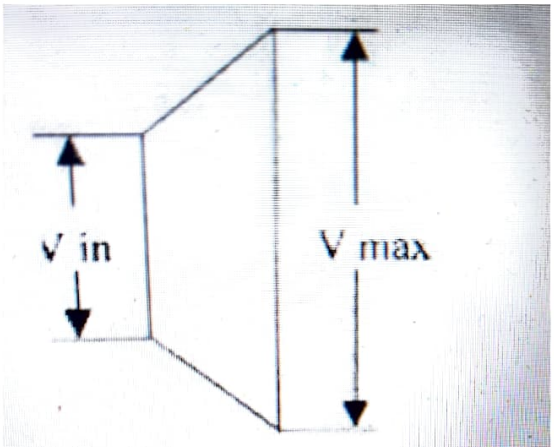


Figure 5

Trapezoidal Pattern

9. Adjust variable capacitor until you get demodulated O/P on CRO and trace the signal out

Result:
Carrier frequency of selected AM station is shifted down to 455 kHz and sideband of AM signal are more either side of 455 kHz
The signal at O/P of IF amplifier 2 (TP2) is composed of entirely of a 455 kHz carrier, and AM sidebands either side of it carrying the wanted audio information

Viva Questions

Ques 1. Define Amplitude Modulation

Ans Amplitude modulation is the type of modulation technique in which the amplitude of high frequency carrier wave is varried in accordance with the instantaneous amplitude of modulating signal.

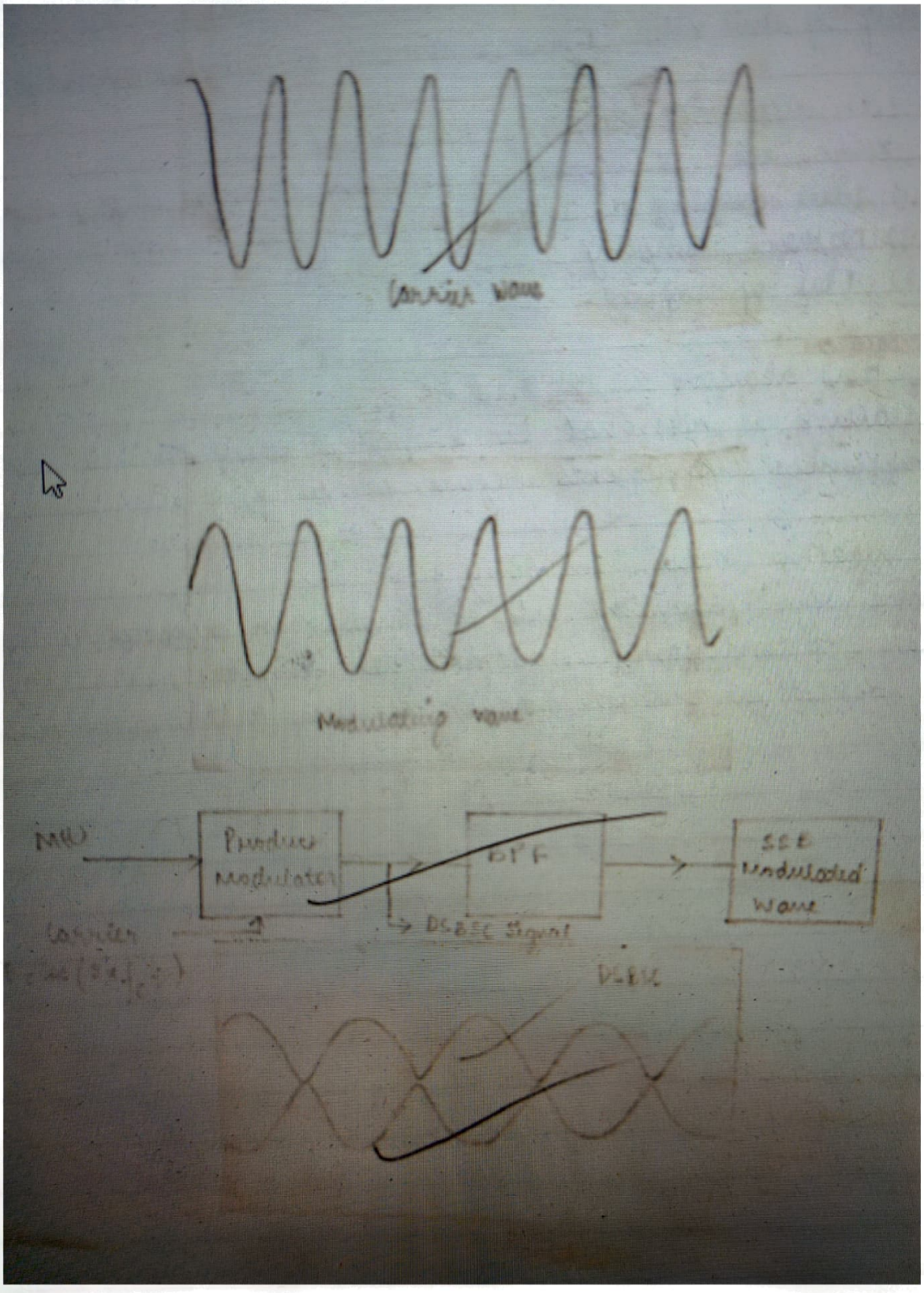
Ques 2. What is Modulation Index?

Ans Modulation Index is measure of the deapth of modulation It is a numerical Value between 0 and 1. Ideally it should be close to 1 or 1.

Ques 3. What is the range of commercial AM broadcast band?

Ans 535 kHz 1605 kHz (Medium Wave) 1.6 - 4.5 MHz (Short Wave), 4.5 - 11 MHz (Short Wave - II) and 11 - 25 MHz (Short Wave - III)

Teacher's Signature : _____


Pulse Modulator
DSBSC Signal
DSBSC

Date _____

Expt. No. _____ Page No. 8

Ques 4. Which kind of modulation is used in picture signals in Television broadcast ?

Ans VSB (Vestigial Sideband)

Teacher's Signature : _____

Date

Expt. No. 3

Page No. 9

Experiment - 3

Aim: To study generation and detection of SSBSC
1. Single Sideband AM Generation
2. Single sideband AM Reception

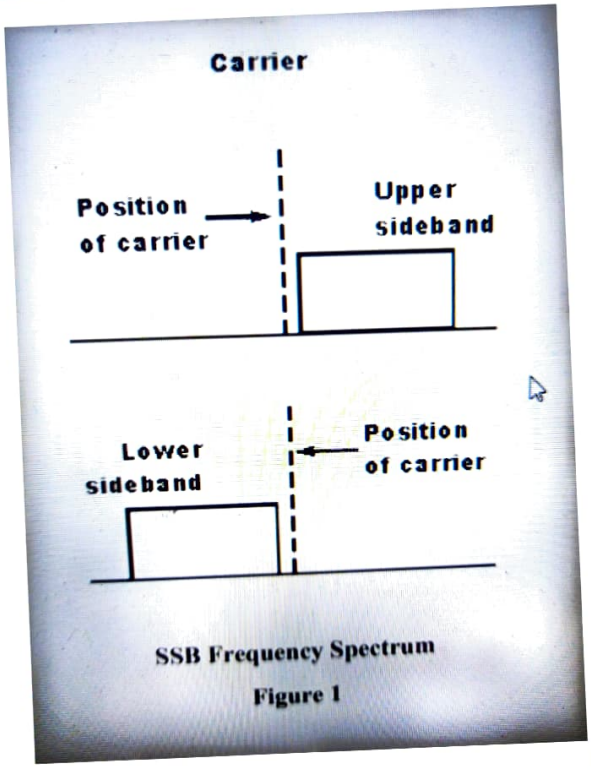
Apparatus Required: Transmitter, recievers, trace paper, connecting wires (connecting cords) ST 2201 and ST 2202 with power supply cords

Theory:
Modulating signal which contains no carrier wave and one side is called band suppressed modulation. In this type of modulation. One of two side bands is filtered by a suitable band filter.

Detection:
A modulating signal can be recovered from SSBSC signal by multiplying and receiving SSB-SC signal to the generated carrier.

Procedure:
1) Connect the CRO to the training kit and I/P frequency section and trainer kit section
2) Switch ON both CRO and trainer kit.
3) Select mode switch in SSB-SC function
4) All switch points are kept off.

Teacher's Signature: _____



SSB Frequency Spectrum

Figure 1

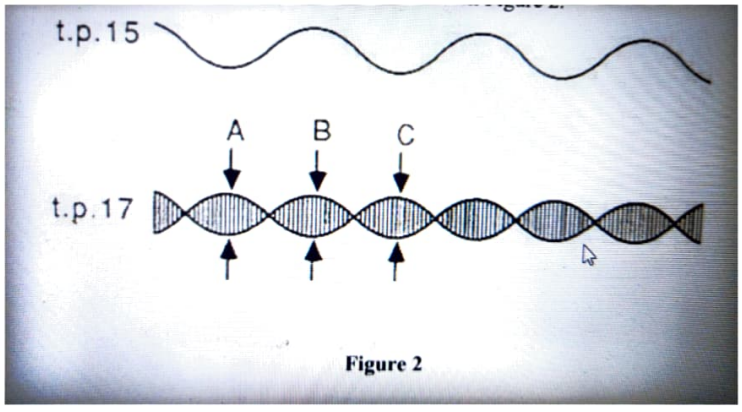


Figure 2

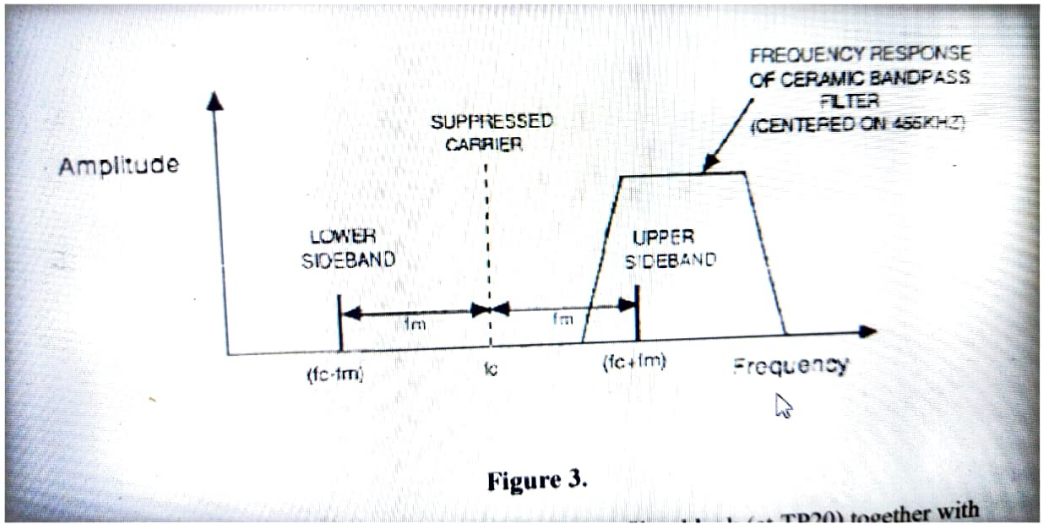


Figure 3.

TP20) together with

Date _____

Expt. No. _____ Page No. 10

5. Put audio i/p selection on IMT position.
6) Observe the o/p of SSBSC modulated wave
7) Make ground level transmission and receiver trainers
8) Input the modulating signal o/p to receiver
9) Adjust the variable capacitor until we get demodulated o/p
10) Trace out the modulated and demodulated signals

Result:
SB SC wave successfully generated and demodulated

Precautions:
i) Connections should be made tight and proper
ii) Don't switch 'ON' CRO before connecting wires.

Viva Questions

Ques 1. what is SSB?
Ans Single-Sideband Modulation (SSB) is a refinement of amplitude modulation that more efficiently uses electrical power and bandwidth. It is closely related to vestigial sideband modulation (VSB).

Ques 2. what is Hilbert Transform?
Ans Hilbert transform is an ideal phase shifter which shifts different frequency components present in the signal by $\pi/2$.

Ques 3. what are the advantages of SSB?

Teacher's Signature : _____

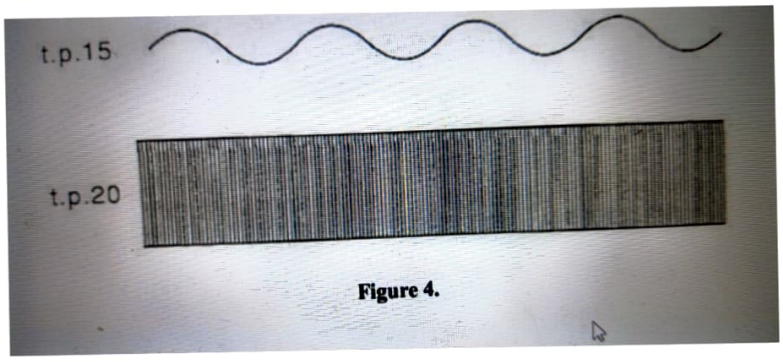
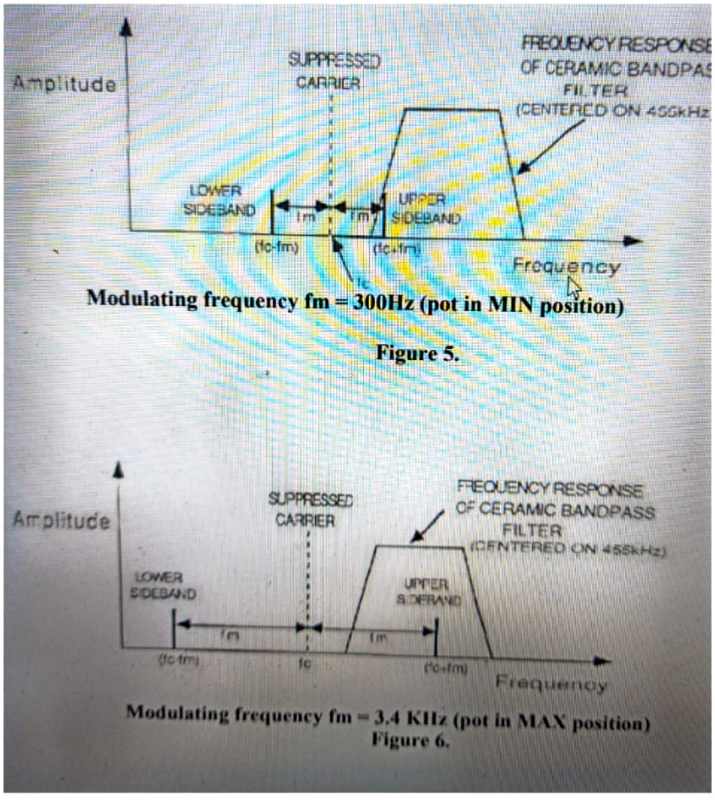


Figure 4.

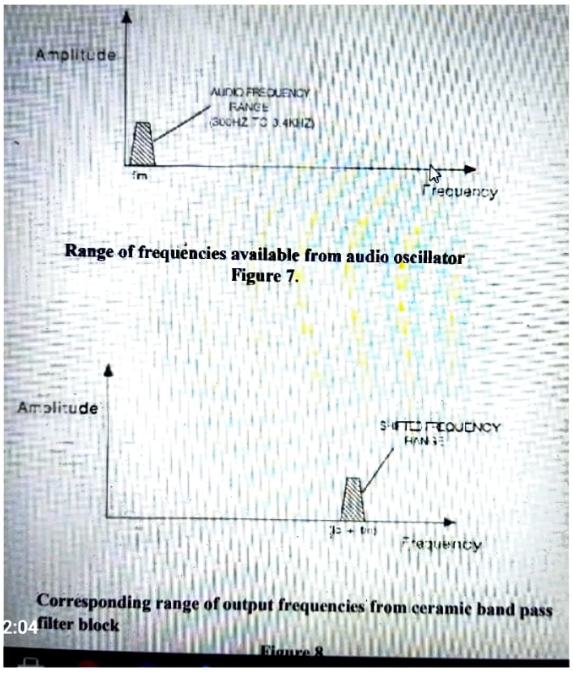


Modulating frequency fm = 300Hz (pot in MIN position)

Figure 5.

Modulating frequency fm = 3.4 KHz (pot in MAX position)

Figure 6.



Range of frequencies available from audio oscillator

Figure 7.

Corresponding range of output frequencies from ceramic band pass filter block

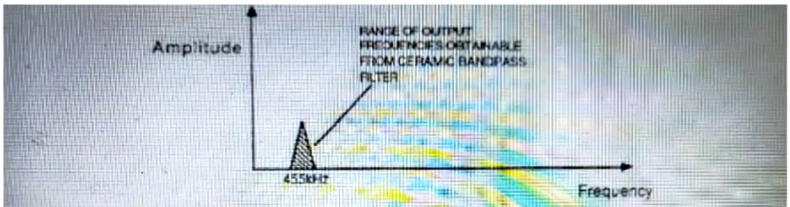
Figure 8

Ans Band width requirement of SSB is half as compared to DSB system.
SSB is a Power efficient scheme in which only 33% power is being utilized.

Ans 4. What are the application of SSB?

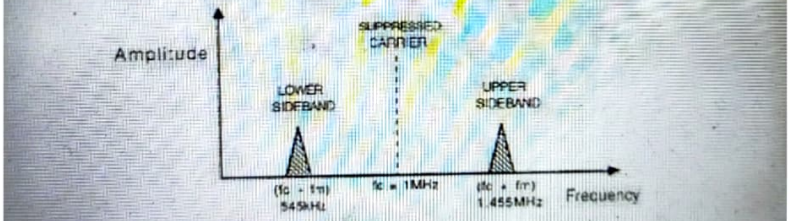
Ans SSB system is used in telemetry, land and air mobile communication, military communication, navigation and amateur radio. Most of these applications are point to point communication systems.

Teacher's Signature : _____



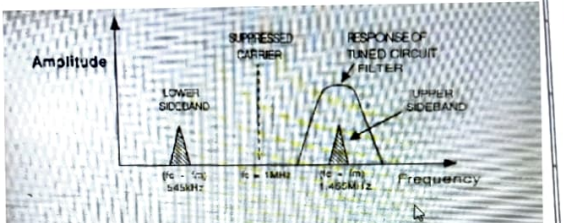
Spectrum of output from ceramic band pass filter block.

Figure 9.



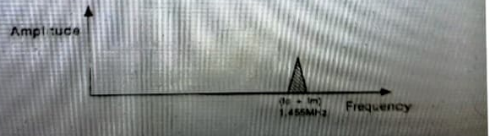
Spectrum obtained by modulating 1MHz carrier with output from ceramic band pass filter

Figure 10.



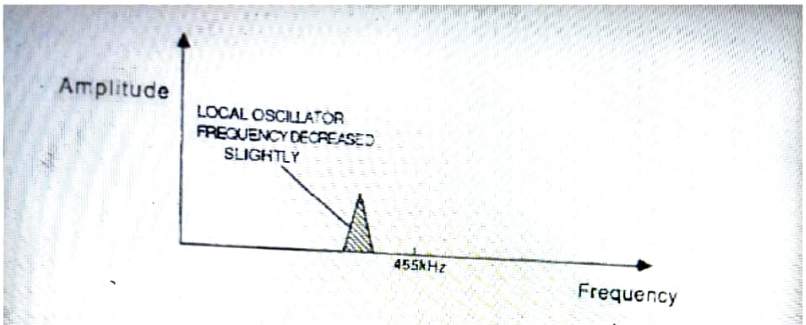
Rejection of lower side band with tuned circuit band pass filter.

Figure 11.



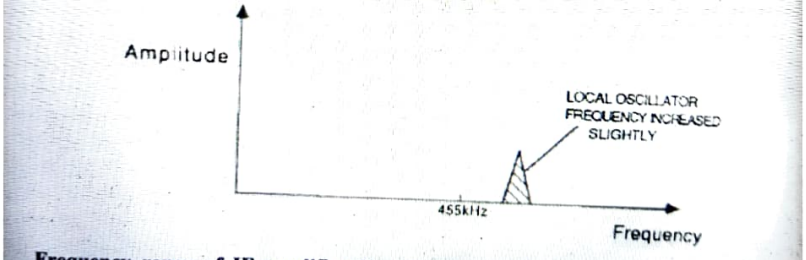
Final SSB output from balanced modulator and band pass filter circuit 2.

Figure 12



Frequency range of IF amplifier 2's output with slightly reduced local oscillator frequency

Figure 13.



Frequency range of IF amplifier 2's output with slightly increased local oscillator frequency.

Figure 14.

Date _____

Expt. No. 4.

Page No. 12

Experiment - 4

Aim: To study amplitude modulation and demodulation of AM wave

1. Double sideband Supressed Carrier AM Generation
2. Double sideband Carrier AM Reception

Equipments Required: ST 2201 and ST2202 with power cords, CRO with connecting probe, connecting cords

Theory:

The simplest form of modulation is Amplitude modulation. In AM, the modulation. In AM, the modulation voltage, whose frequency is variable lower than that of carrier signal. Carrier frequency is high while modulation frequency is low audio frequency.

AM is defined as a system of modulation in which the amplifier wave is varried in accordance with instantaneous amplitude of modulating signal.

Modulating Voltage $V_m(t) = V_m \sin W_m(t)$

Carrier voltage $V_c(t) = V_c \sin W_c(t)$

$V_L(t)$: Instantaneous voltage of Carrier wave

$A = V_m(t) + V_L$

$= V_c(t) + V_m \sin w_m(t)$

Teacher's Signature : _____

$$\underbrace{V_m \cos(\omega_m t)}_{\text{Message}} \times \underbrace{V_c \cos(\omega_c t)}_{\text{Carrier}} = \underbrace{\frac{V_m V_c}{2}\left[\cos((\omega_m + \omega_c)t) + \cos((\omega_m - \omega_c)t)\right]}_{\text{Modulated Signal}}$$

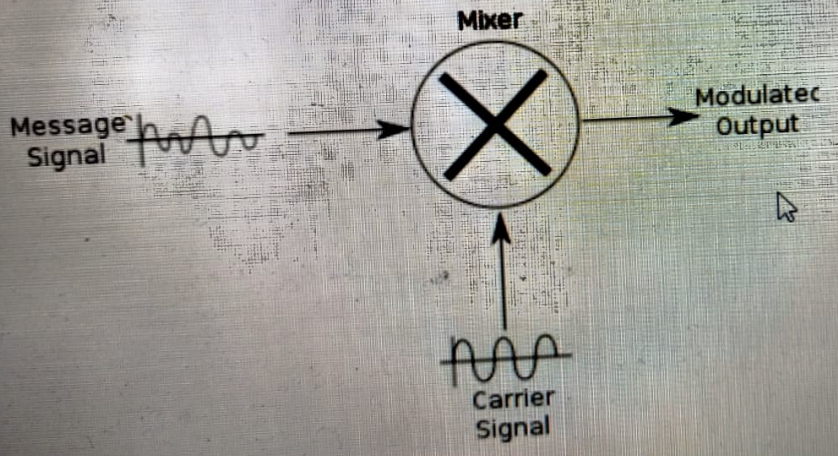


Figure 2

DSB-SC Modulator

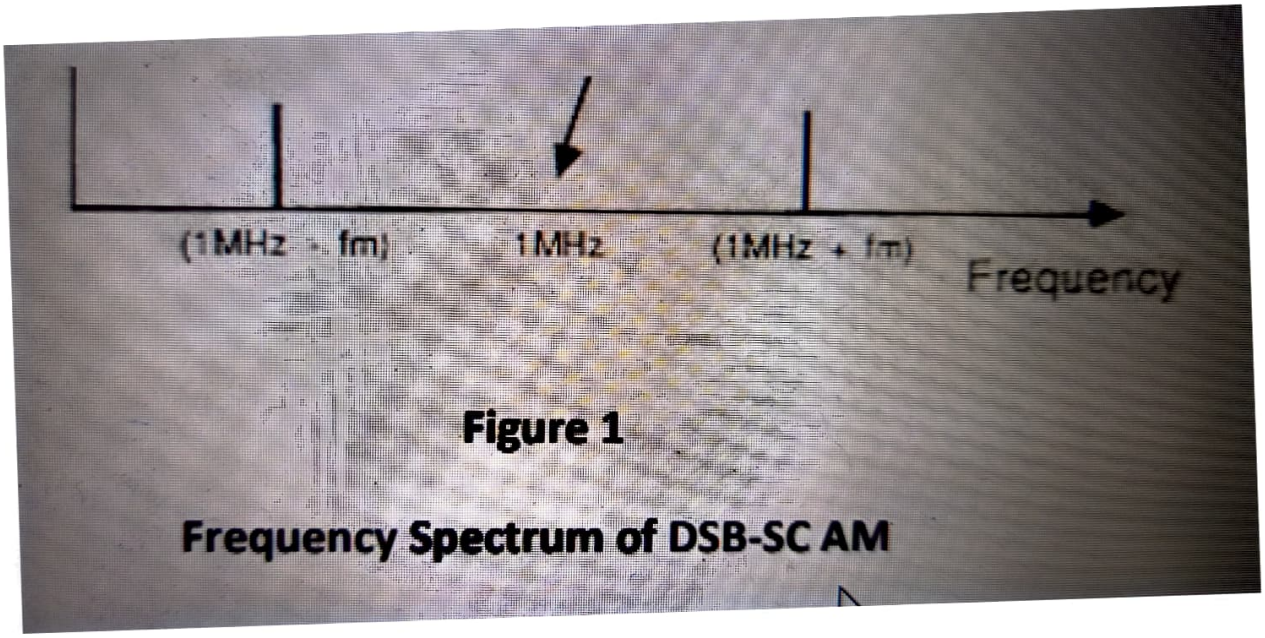


Figure 1

Frequency Spectrum of DSB-SC AM

Date _____

Expt. No. _____

Demodulation : The process of obtaining the baseband signal from the modulating signal with larger carrier frequency are detected by envelope detectors.

Envelope detectors employs ckt. that introduces the envelope detector of AM wave is baseband signal

Detectors → Square law detector
→ Envelope detector

Procedure :

1. Connect CRO with trainer kit
2. Switch ON both CRO and trainer's kit.
3. Select Mode Switch ON DSBSC position.
4. All switches faults are kept safe off.
5. Audio I/p switch are turned to ON position
6. Adjusted variable capacitor until we get the demodulated O/p.
7. Trace the modulated, demodulated and I/p signal

Precautions :

1) Connections must be proper and tight.
2) Do not switch ON CRO befor competing the circuit.

Teacher's Signature : _____

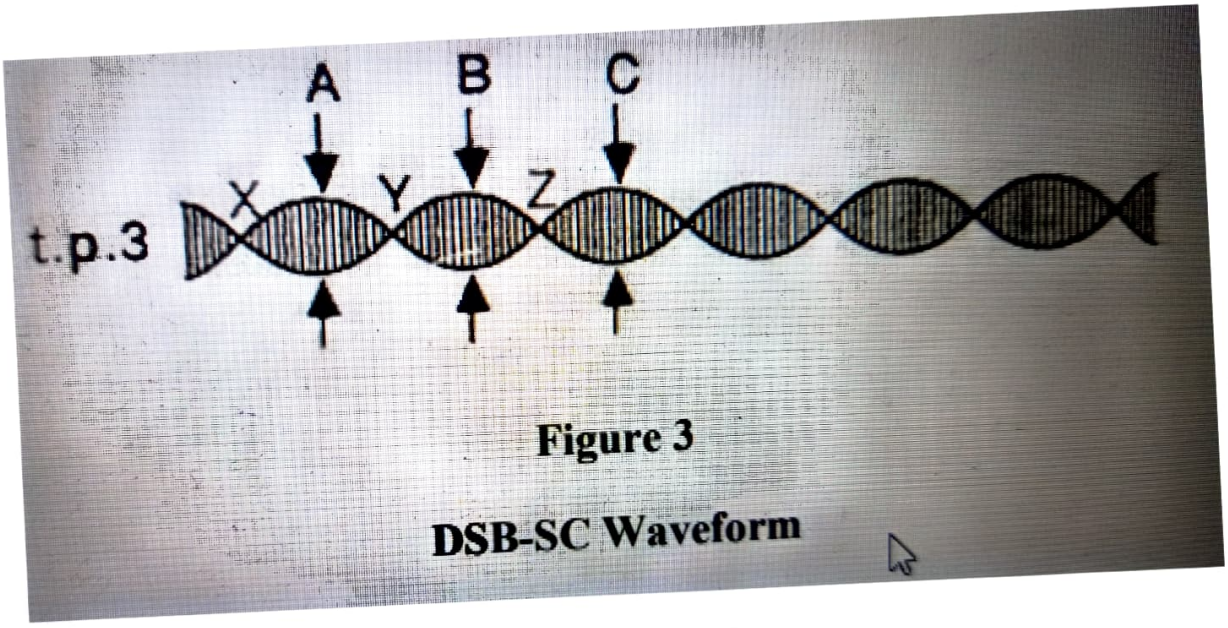


Figure 3

DSB-SC Waveform

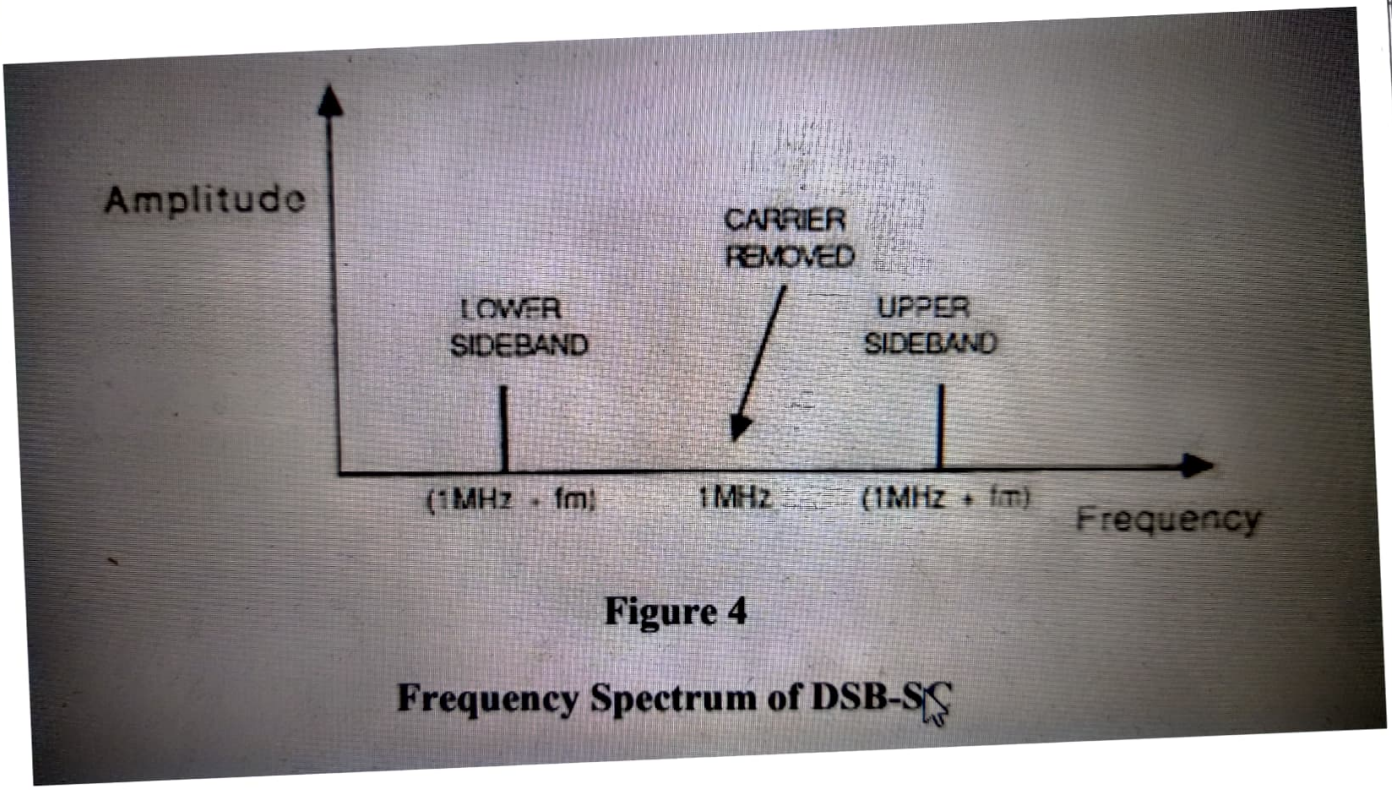


Figure 4

Frequency Spectrum of DSB-SC

Date

Expt. No.

Page No. 14

Viva Questions

Ques 1. Define DSB-SC.

Ans After modulation, the process of transmitting the sideband (USB & LSB) alone and suppressing the carrier is called as Double side band Suppressed carrier.

Ques 2. What are the disadvantages of DSB-FC?

Ans 1) Power wastage takes place
2) DSB FC is bandwidth inefficient system

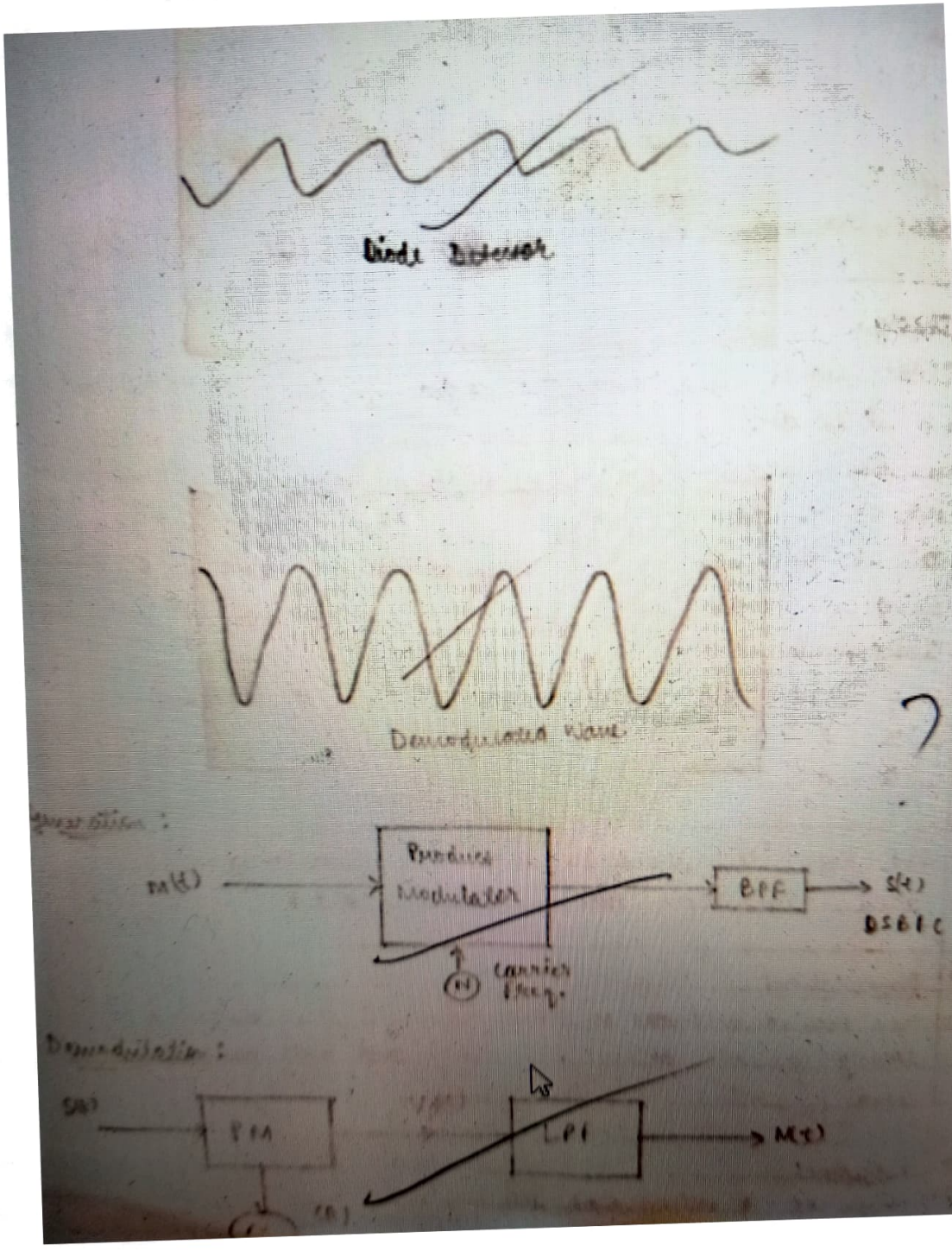
Ques 3 Define Coherent detection

Ans During Demodulation carrier is exactly coherent or synchronized in both the DSB-SC frequency and phase, with original carrier wave used to generate DSB-SC wave. This method of detection is called as Coherent detection or synchronous detection.

Ques 4. How will you generate DSBSC-AM?

Ans There are 2 ways of generating DSB SC
a) Balanced modulator
b) Ring modulator

Teacher's Signature :


Message signal
Demodulated wave
Product modulator
BPF
carrier freq.
PLL
LPF

Date _____

Expt. No. 5

Page No. 15

Experiment - 5

Aim :- To study frequency modulation by Varactor modulation

- To study frequency modulation using reactance modulation

Equipments required : ST2203 with power cord, CRO with connecting probe, connecting cords

Theory :

A varactor diode is a SC diode where junction capacitance varies similarly with applied bias. The varactor diode must be reverse biased. An oscillator circuit value frequency is calculated by modulating voltage is called Voltage Controlled Oscillator (VCO). The reactance of C is made large enough compared to R so the base band signal may be activated. The oscillator frequency will change with the change in varactor diode capacitance and FM wave is produced.

Reactance Modulation :

We are using phase locked loop detector for the demodulation of FM wave. The oscillator and tuned circuit provide the unmodulate carrier frequ-

Teacher's Signature : _____

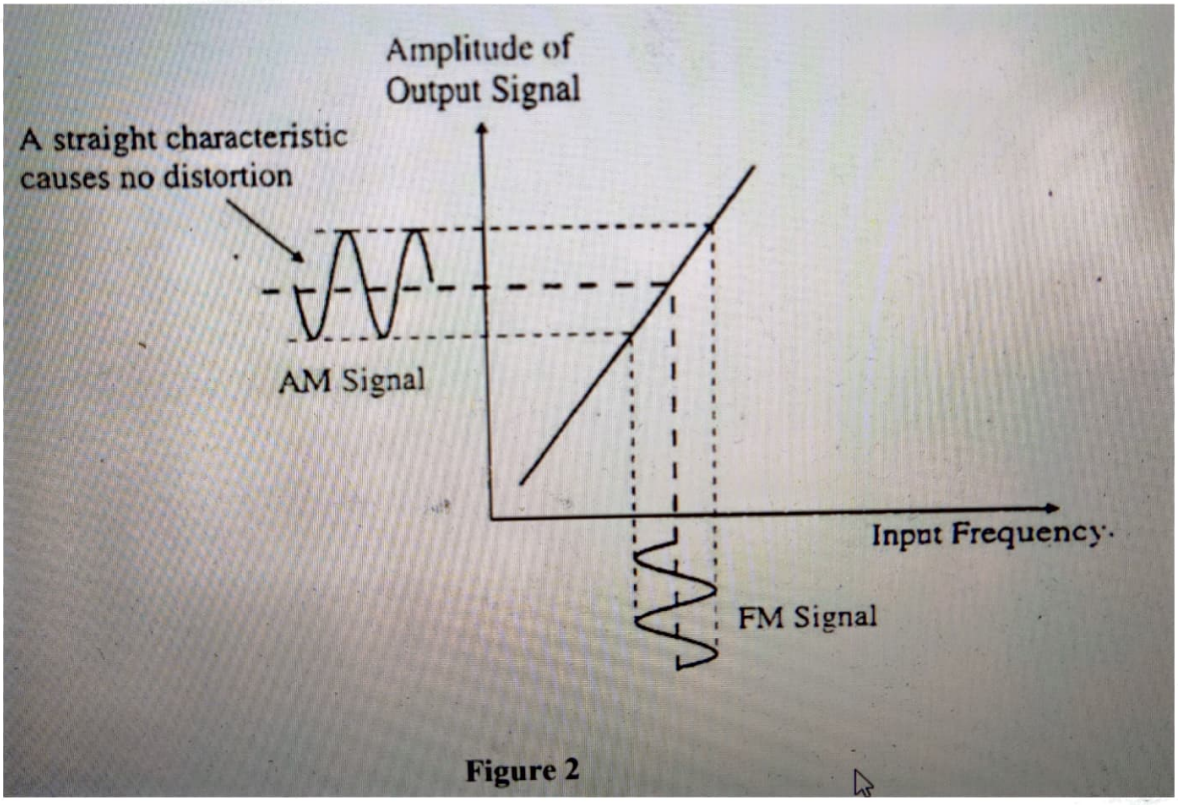
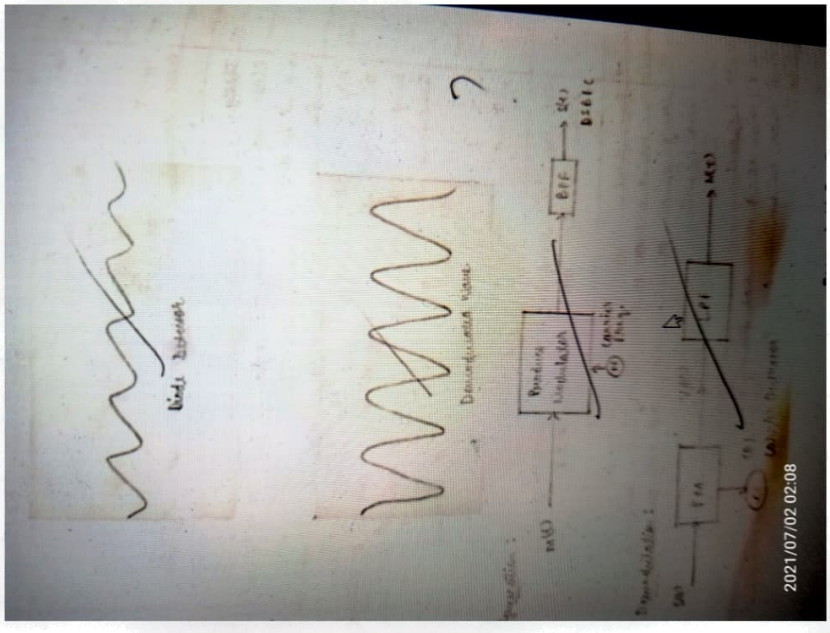

Amplitude of
Output Signal
A straight characteristic
causes no distortion
AM Signal
Input Frequency
FM Signal

Figure 2


2021/07/02 02:08

ency and this frequency is present on the collector of the transmitter. The capacitor and resistor provides 90° phase shift b/w the voltage and collector current. This makes the circuit as a capacitor. The changing information signal using applied base has the same effect as information signal using applied base has the same effect has changing the bias voltage applied to the transmitter and this would have the effect of increase and decrease value of capacitor

Procedure :

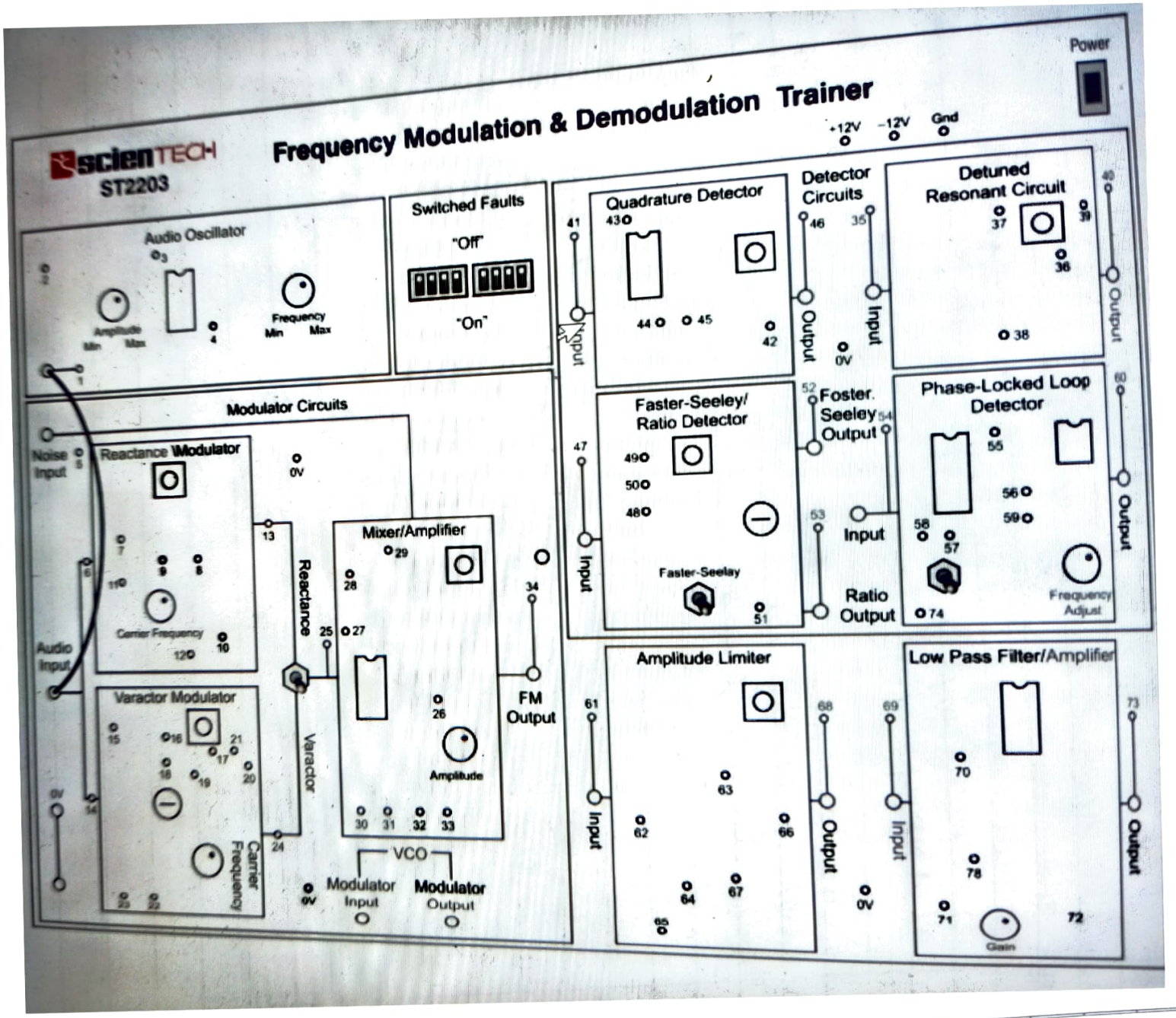
A) i) Connect the modulated wave to the phase locked loop detection
ii) Connect the O/p to PLL to the low pass filter trace out the demodulated wave from the O/p of LPF

B) i) Connect the modulated wave to the phase locked loop detector. This is done in order to obtain demodulated wave.
ii) Connect the O/P to PLL to LPF. Trace out the demodulated wave from O/p of LPF

Result :

The modulation wave signal obtained through varac-tor diode modulation is known as Baseband signal.

Teacher's Signature : _____


scienTECH
ST2203
Frequency Modulation & Demodulation Trainer
Power
+12V
-12V
Gnd
Audio Oscillator
Amplitude
Min
Max
Frequency
Min
Max
Switched Faults
"Off"
"On"
Quadrature Detector
Detector Circuits
Output
Input
0V
Detuned Resonant Circuit
Output
Modulator Circuits
Noise Input
Reactance Modulator
Carrier Frequency
Audio Input
Varactor Modulator
Varactor
Carrier Frequency
Reactance
Mixer/Amplifier
Amplitude
FM Output
VCO
Modulator Input
Modulator Output
Faster-Seeley/ Ratio Detector
Faster-Seelay
Foster. Seeley Output
Ratio Output
Phase-Locked Loop Detector
Frequency Adjust
Amplitude Limiter
Low Pass Filter/Amplifier
Gain

The modulated wave signal obtain through the reactance modulator is same as passband signal

Precautions :

i) Connect the circuit properly.
ii) Do not switch 'ON' the supply until circuit is complete.

VIVA QUESTIONS

Ques 1. What is frequency modulation (FM) ?

Ans Frequency modulation is the process of varying frequency of a periodic waveform, called carrier signal with respect to the frequency of modulating signal that typically contains information to be transmitted

Ques 2. What is use of varactor diode ?

Ans Tuning diode / varactor diode / variable capacitance / varicap diode / variable reactance diode is a diode that has a variable capacitance which is a function of voltage that is impressed on its terminals. Tuning / varactor diodes are operated reverse biased, and therefore no current flows.

Teacher's Signature : _____

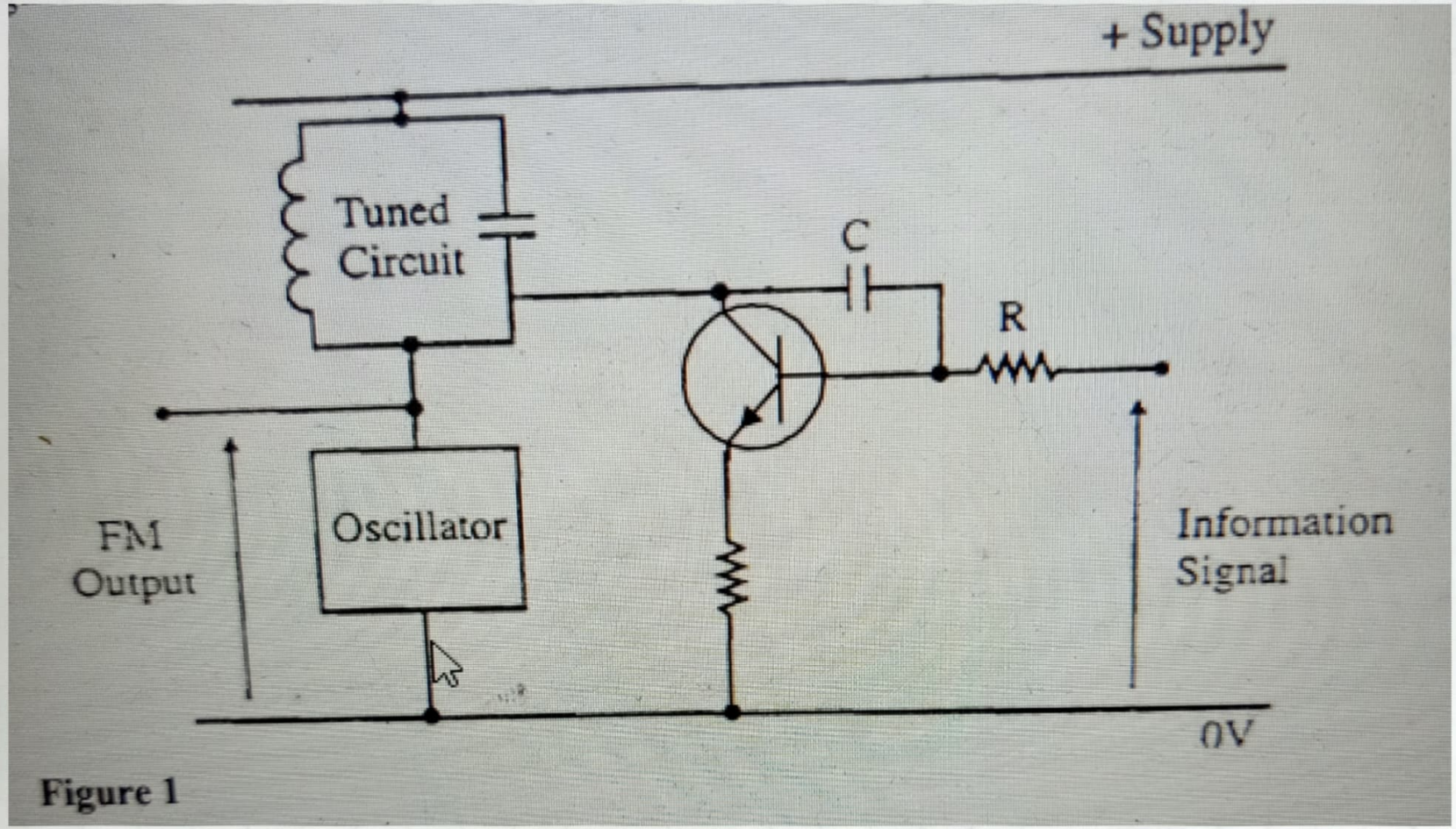

+ Supply
Tuned Circuit
C
R
Oscillator
FM Output
Information Signal
0V

Figure 1

Date _____

Expt. No. 6

Page No. 18

Experiment - 6

Aim : → Study of Pulse Amplitude Modulation using Natural and Flat top Sampling
→ Study of PAM using sample and Hold Sampling
→ Study of Pulse Amplitude modulation and Demodulation with sample and Hold and Flat top

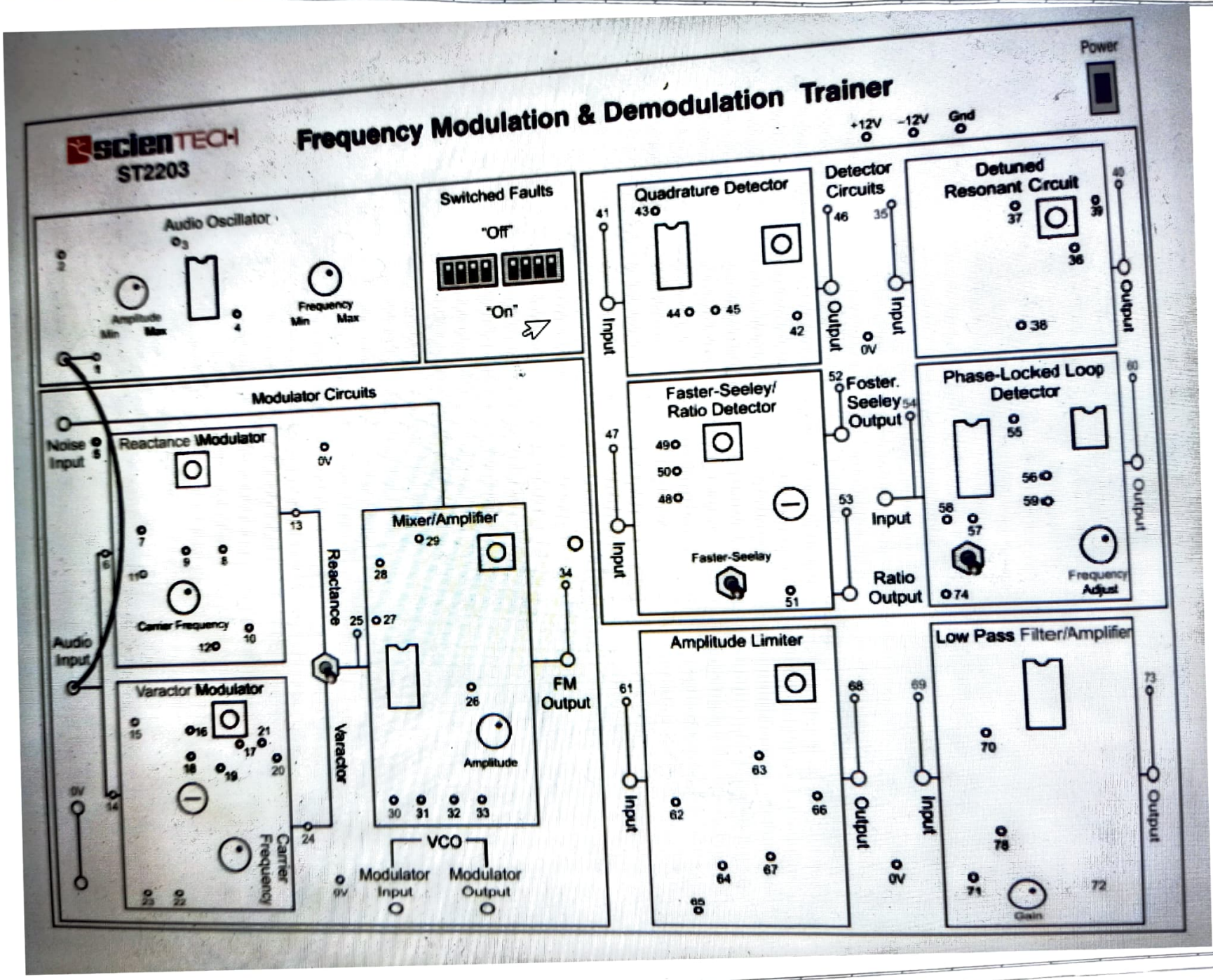
Equipment Required : ST2110 with power supply cord. CRO with connecting probes, connecting cords.

Theory :

Pulse modulation may be used to transmit information, such as continuous speech or data. It is a system in which continuous waveforms are sampled at regular intervals. Information regarding the signal is transmitted only at the sampling times, together with any synchronizing pulses that may be required. At the recieving end, the original waveforms may be reconstituted from the information regarding the samples, if these are taken frequently enough. Despite the fact that information about the signal is not supplied continuously, as in AM and FM, the resulting receiver output can have negligible distortion.

Pulse modulation may be subdivided broadly as

Teacher's Signature : _____


scienTECH
ST2203
Frequency Modulation & Demodulation Trainer
Power
+12V
-12V
Gnd
Audio Oscillator
Amplitude
Min
Max
Frequency
Min
Max
Switched Faults
"Off"
"On"
Quadrature Detector
Input
Output
0V
Detector Circuits
Input
Output
Detuned Resonant Circuit
Output
Modulator Circuits
Noise Input
Reactance Modulator
Carrier Frequency
Reactance
Varactor Modulator
Varactor
Carrier Frequency
Audio Input
Mixer/Amplifier
Amplitude
FM Output
VCO
Modulator Input
Modulator Output
Faster-Seeley/ Ratio Detector
Faster-Seeley
Foster. Seeley Output
Input
Ratio Output
Phase-Locked Loop Detector
Frequency Adjust
Amplitude Limiter
Input
Output
Input
Low Pass Filter/Amplifier
Output
Gain

analog and digital. In the former case, the indication of sample amplitude is the nearest variable while later case, a code, which indicates the sample amplitude to the nearest predetermined level, is sent. Pulse amplitude and pulse time modulation, to be treated next, are both analog

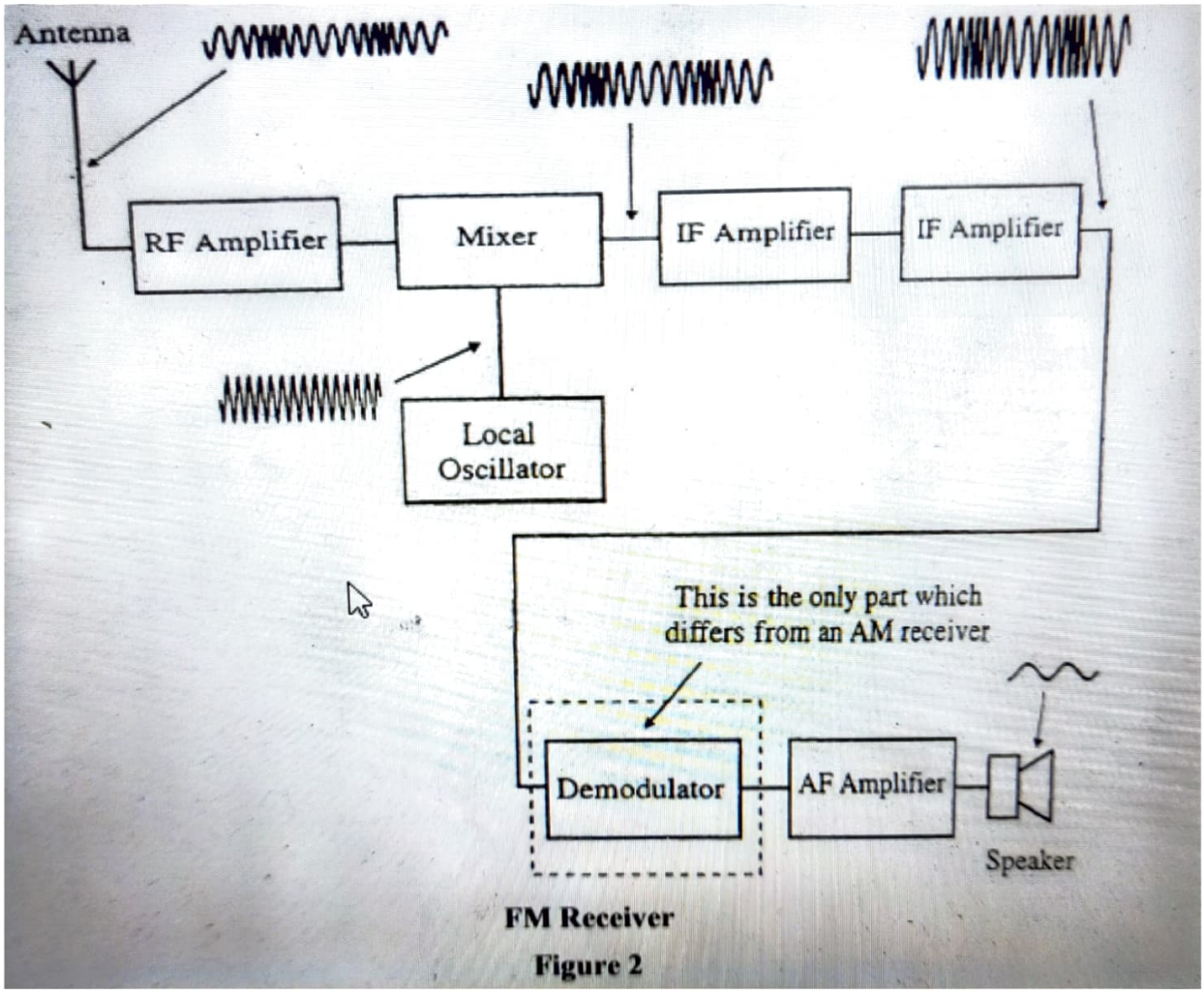
Procedure :

1. Connected the kit (as shown diagram) O/P to PAM block having switch at 1KHz
2. Monitor O/Ps of TP_3 and 5 having natural flat and O/Ps respectively.
3. Observed affect on O/P by varying reasons behind them. Then connected kit acc to diagram 2
4. Monitored O/P of sample and hold circuit at TP4.
5. Varied amplitude I/P wave frequency over 2KHz
6. Then at last connected the kit acc to ckt. diagram 3
7. All the O/P were monitored and traced.
8. Tried to locate fault and switch to different ones and demodulated waveform was obtained.

Precaution :

1. Connect the circuit properly.
2. Do not switch 'on' the ckt. before ensuring the wire connections.

Teacher's Signature : _____



FM Receiver

Figure 2

Date _____

Expt. No. _____ Page No. 20.

Viva! Questions

Ques 1. What is the pulse Amplitude modulation?

Ans. Pulse-amplitude modulation, is a form of signal modulation where the message information is encoded in the amplitude of a series of signal pulses. It is an analog pulse modulation scheme in which the amplitudes of a train of carrier pulses are varried according to the sample value of the message signal.

Ques 2. What is pulse signal?

Ans. In signal processing, the term pulse has the following meaning:
A rapid, transient change in the amplitude of a signal from a baseline value to a higher or lower value, followed by a rapid return to the baseline value.

Ques 3. What is a sample and hold circuit?

Ans. In electronics, a sample and hold (S/H, also "follow-and-hold") circuit is an analog device that samples (captures, grabs) the voltage of a continuously varying analog signal and holds (locks, freezes) its value at a constant level for a specified minimum period of time.

Teacher's Signature : _____

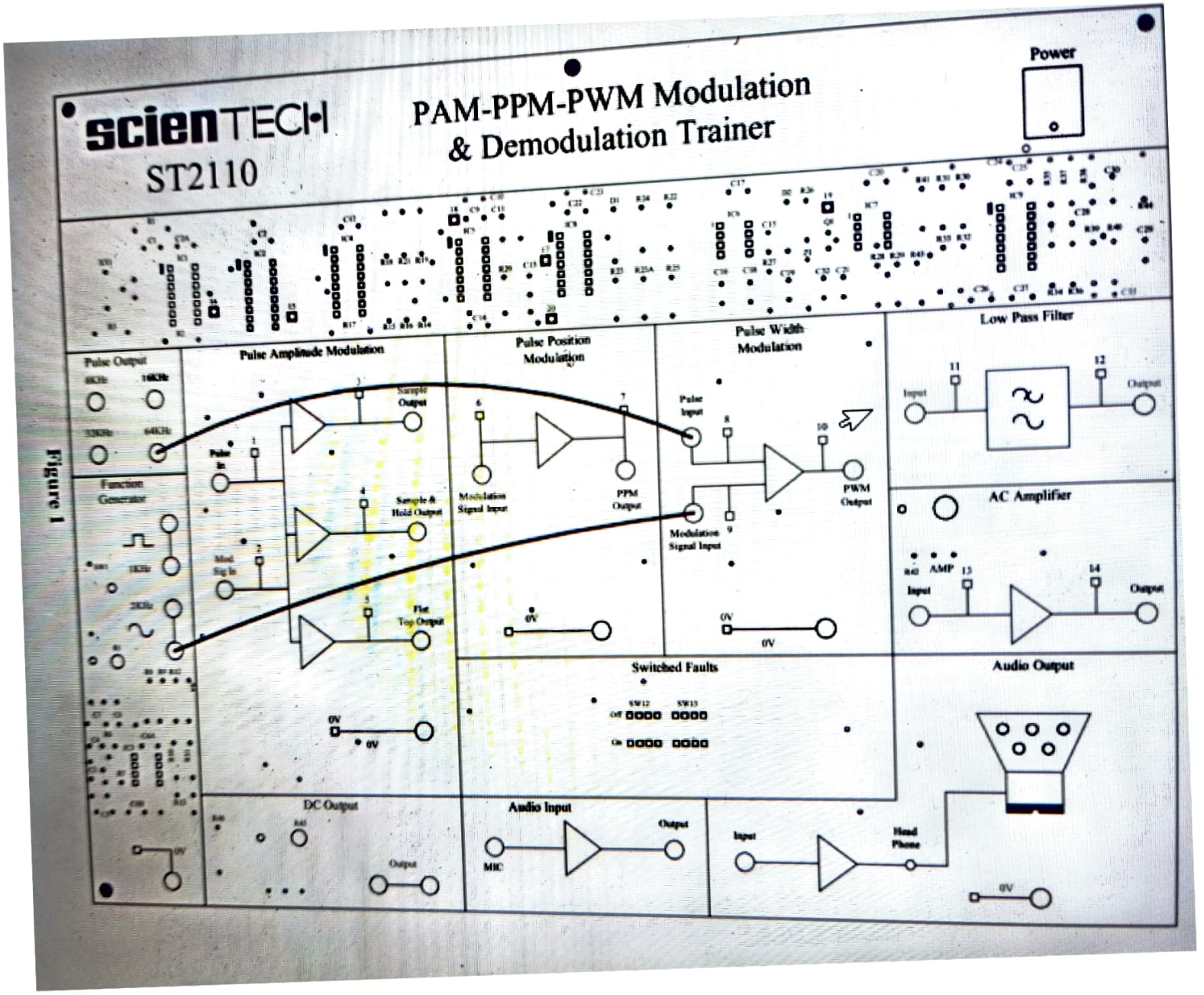

scientech
ST2110
PAM-PPM-PWM Modulation
& Demodulation Trainer
Power
Pulse Output
Pulse Amplitude Modulation
Pulse Position Modulation
Pulse Width Modulation
Low Pass Filter
Function Generator
Sample Output
Sample & Hold Output
Flat Top Output
Modulation Signal Input
PPM Output
Pulse Input
PWM Output
Input
Output
AC Amplifier
AMP
Switched Faults
Audio Output
DC Output
Audio Input
MIC
Head Phone
0V

Figure 1

Date _____

Expt. No. _____ Page No. 21

Ques 4. What is a holding circuit?

Ans The holding circuit interlock, is a normally open auxillary contact on magnetic starters or contactors. Used in three wire control schemes with momentary inputs. It closes when the coil is energised to form a holding circuit for the starter contactor after the "Start" button or input has been released.

Ques 5. What is zero order hold?

Ans The zero-order-hold (ZOH) is a mathematical model of the practical signal reconstruction done by a conventional digital-to-analog converter (DAC). That is, it describes the effect of converting a discrete time signal to continuous-time signal to a continuous-time signal by holding each sample value for one sample interval.

Teacher's Signature : _____

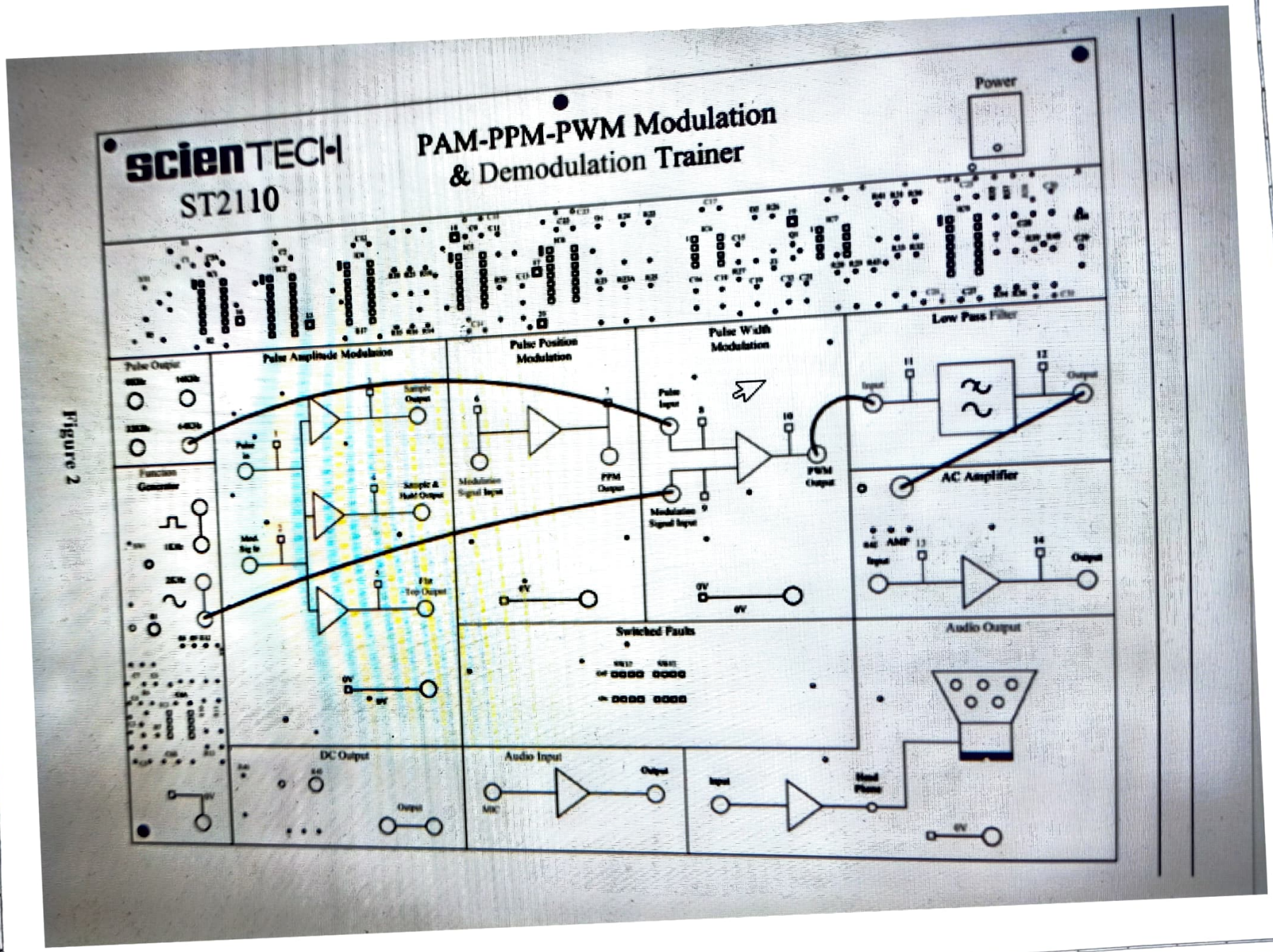

scienTECH
ST2110
PAM-PPM-PWM Modulation
& Demodulation Trainer
Power
Pulse Amplitude Modulation
Pulse Position Modulation
Pulse Width Modulation
Low Pass Filter
AC Amplifier
Switched Pauls
Audio Output
DC Output
Audio Input

Figure 2

Date _____

Expt. No. 7 Page No. 22

Experiment - 7

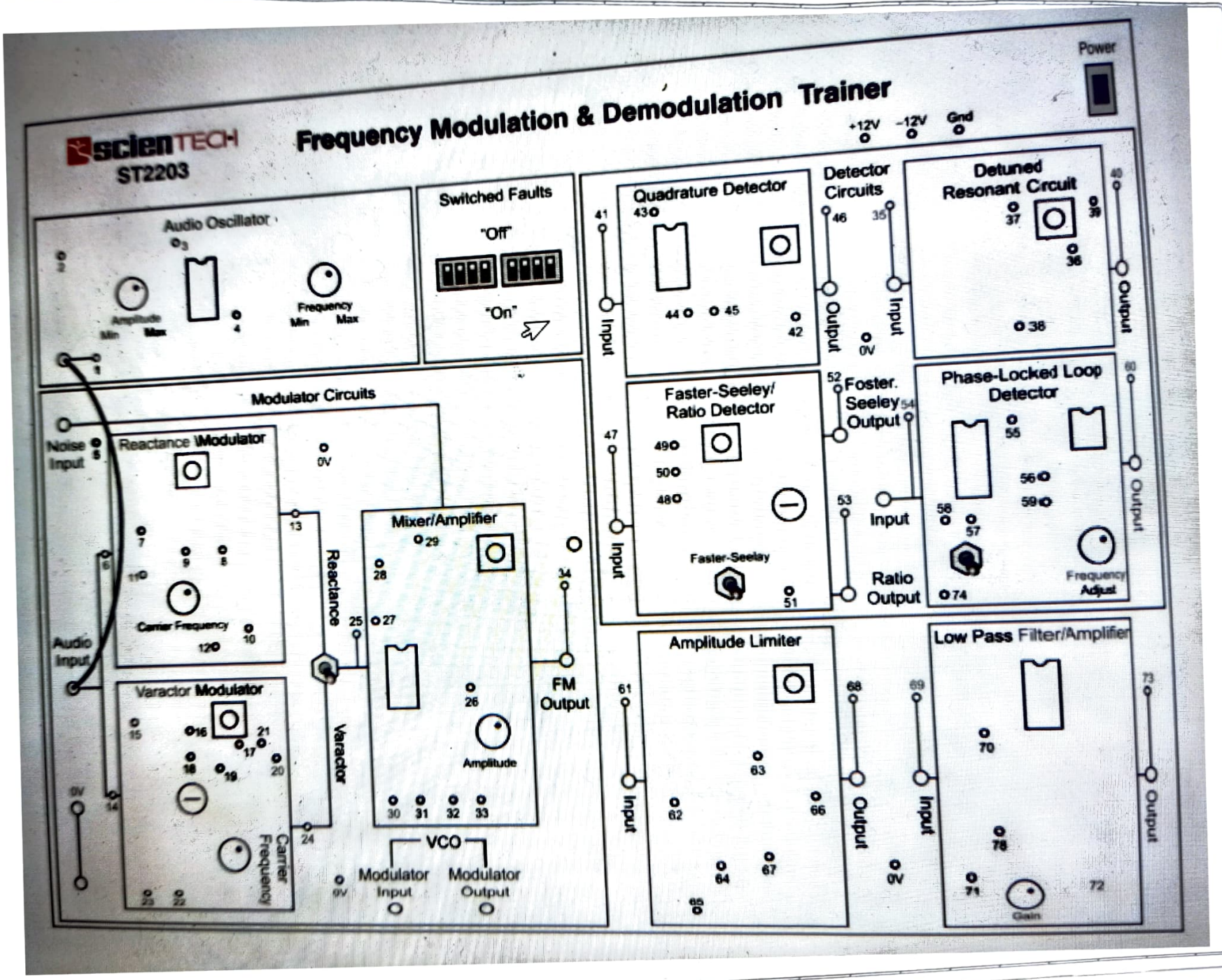
Aim: 1. Study of PWM using different Sampling Freqiency
2. Study of Pulse width Demodulation

Equipments Required: ST2110 with power cord,
CRO with connecting probes,
Connecting cords.

Theory:
Pulse width modulation (PWM) is a modulation technique that generates variable width pulse to represent the amplitude of an analog input signal. The output switching transistor is on more of the time for a high amplitude signal and off more of the time for a low amplitude signal.

Procedure:
1. Connected the circuit as diagram given & the connections were made.
2. Power supply was switched ON and amplitude was varied in sinewave and effect on pulse was observed.
3. Frequency of pulse was also varied to observe the variation of output PWM.

Teacher's Signature : _____


scienTECH
ST2203
Frequency Modulation & Demodulation Trainer
Power
+12V
-12V
Gnd
Audio Oscillator
Amplitude
Min
Max
Frequency
Min
Max
Switched Faults
"Off"
"On"
Quadrature Detector
Input
Output
0V
Detector Circuits
Input
Output
Detuned Resonant Circuit
Output
Modulator Circuits
Noise Input
Reactance Modulator
Carrier Frequency
Reactance
Varactor Modulator
Varactor
Carrier Frequency
Audio Input
Mixer/Amplifier
Amplitude
FM Output
VCO
Modulator Input
Modulator Output
Faster-Seeley/ Ratio Detector
Faster-Seelay
Foster. Seeley Output
Input
Ratio Output
Phase-Locked Loop Detector
Frequency Adjust
Amplitude Limiter
Input
Output
Input
Low Pass Filter/Amplifier
Output
Gain

Date _____

Expt. No. _____ Page No. 23

4. Circuit was switched off and reconnected as per the second ckt and modulations were observed. Output of PWM was passed as input to low pass filter.
5. Circuit was turned on and O/P of low pass filter and AC amplifier respectively to understand the demodulation of pulse width demodulation waveform.
6. Amplitude and frequency of sine wave was varied to observe the results

Result:

Learned about PWM and studied PWM with different sampling frequencies. Successful demodulation of Pulse width was also done.

Precautions:

1. Ensure the circuit connections before turning on the power supply.
2. Do not switch ON CRO before connections are complete.

Teacher's Signature : _____

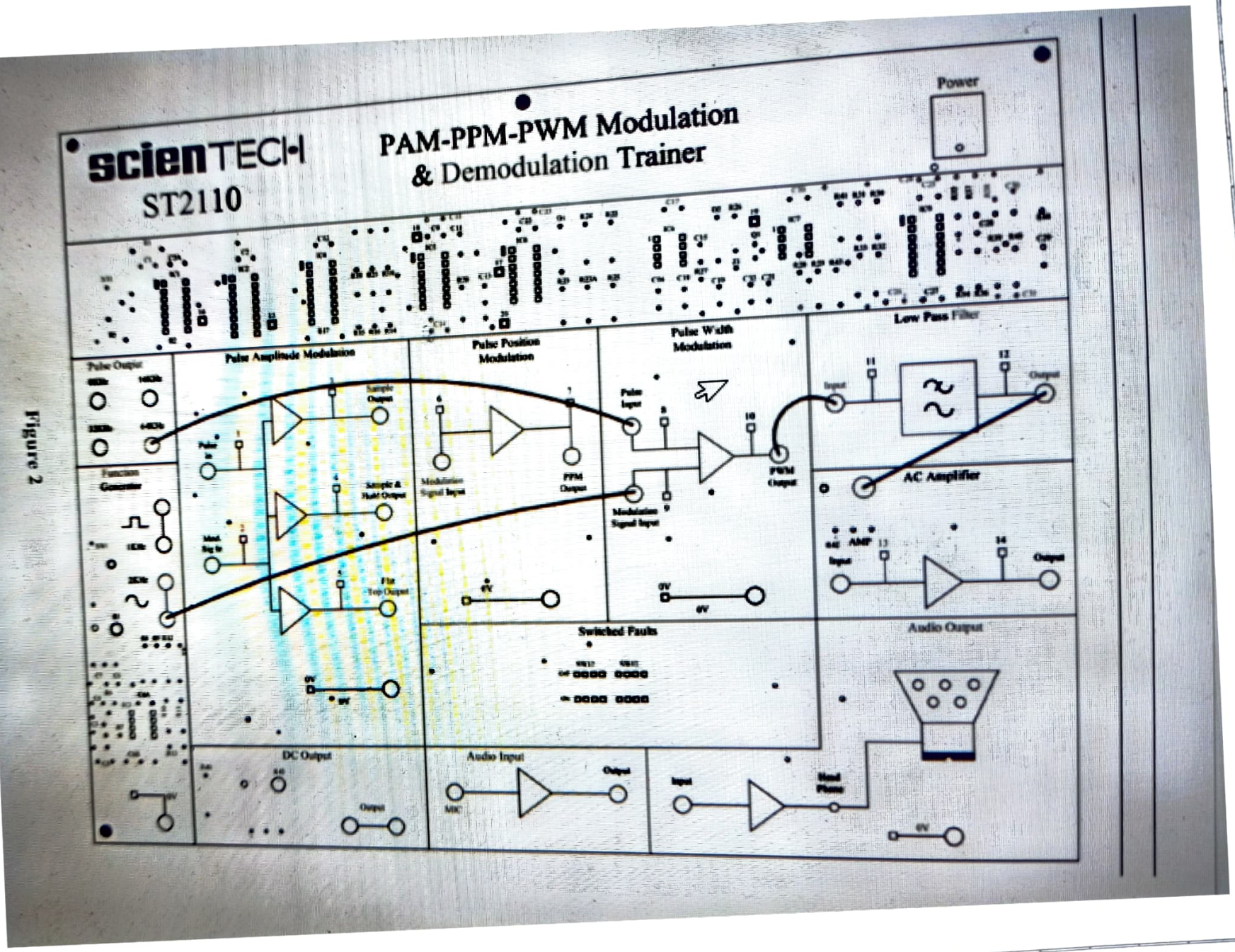

scienTECH
ST2110
PAM-PPM-PWM Modulation
& Demodulation Trainer
Power
Pulse Amplitude Modulation
Pulse Position Modulation
Pulse Width Modulation
Low Pass Filter
AC Amplifier
Switched Pauls
Audio Output
DC Output
Audio Input

Figure 2

Date _____

Expt. No. _____ Page No. 24

Viva Questions

Ques 1. What is the pulse amplitude modulation?

Ans Pulse-amplitude modulation where the message information is encoded in the amplitude of a series of signal pulses. It is an analog pulse modulation scheme in which amplitude of a train of carrier pulses are varied according to the instantaneous value of the message signal.

Ques 2. What is pulse signal?

Ans In signal processing, the term pulse has the following meanings:
A rapid change in the amplitude of a signal from a baseline value to a higher value, followed by a rapid return to the baseline value.

Ques 3. What is PWM duty cycle?

Ans Electrical motors typically use less than a 100% duty cycle. For example, if a motor runs for one out of 100 seconds, or 1/100 of the time, then its duty cycle is 1/100 or 1 percent. Pulse width modulation (PWM) is used in a variety of electronics situations, such as power delivery and voltage regulation.

Teacher's Signature : _____

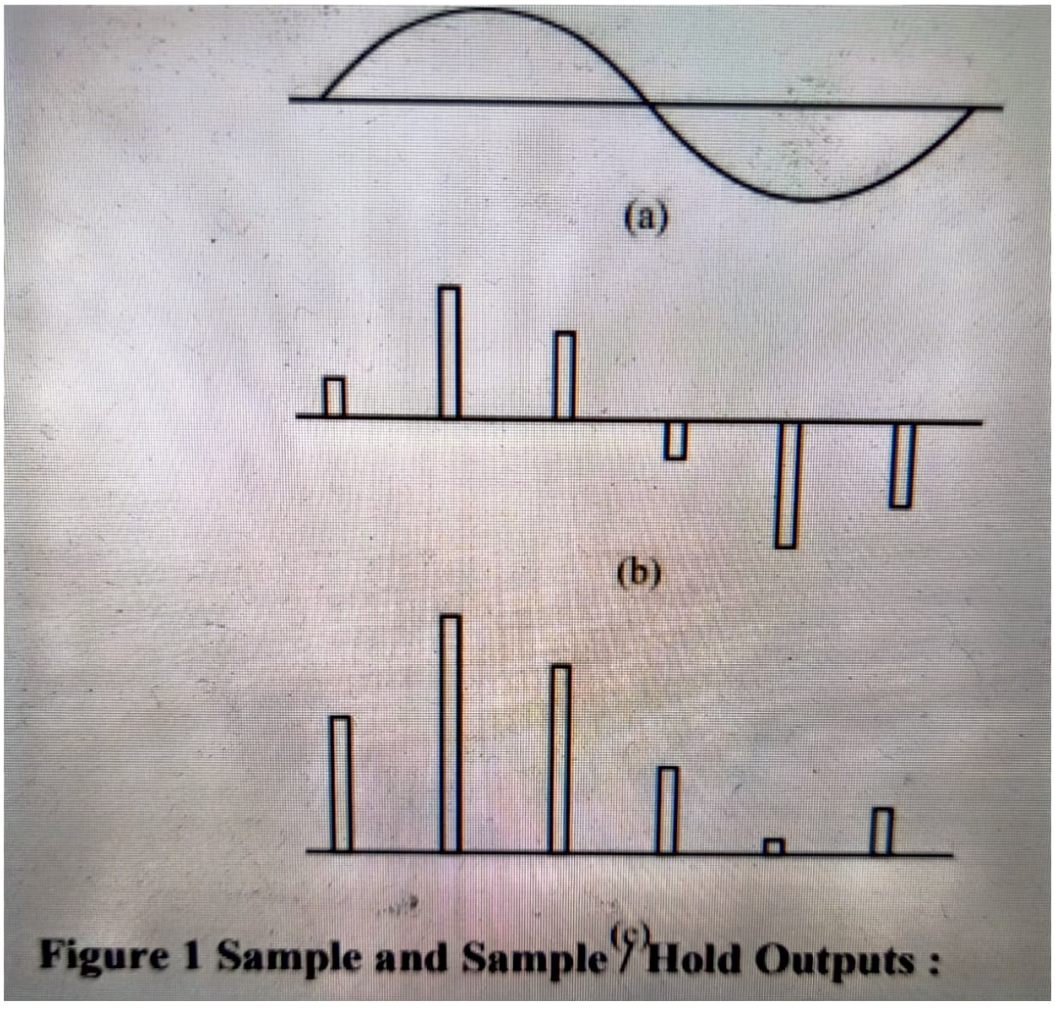
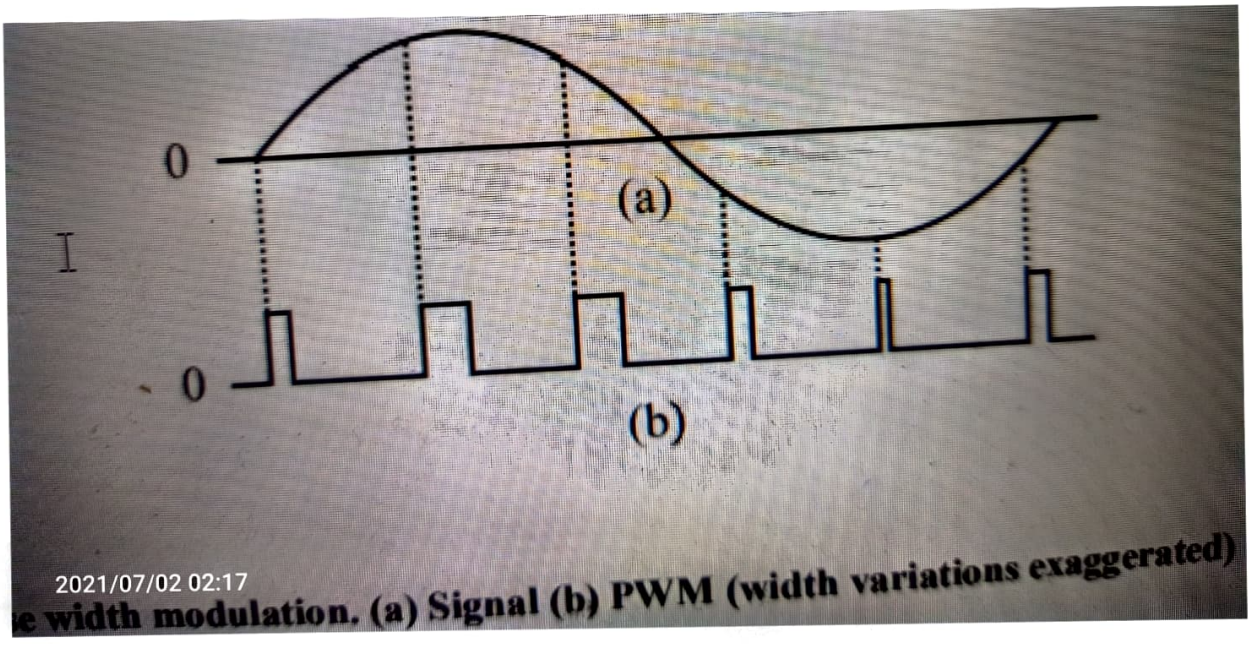


Figure 1 Sample and Sample / Hold Outputs :



2021/07/02 02:17

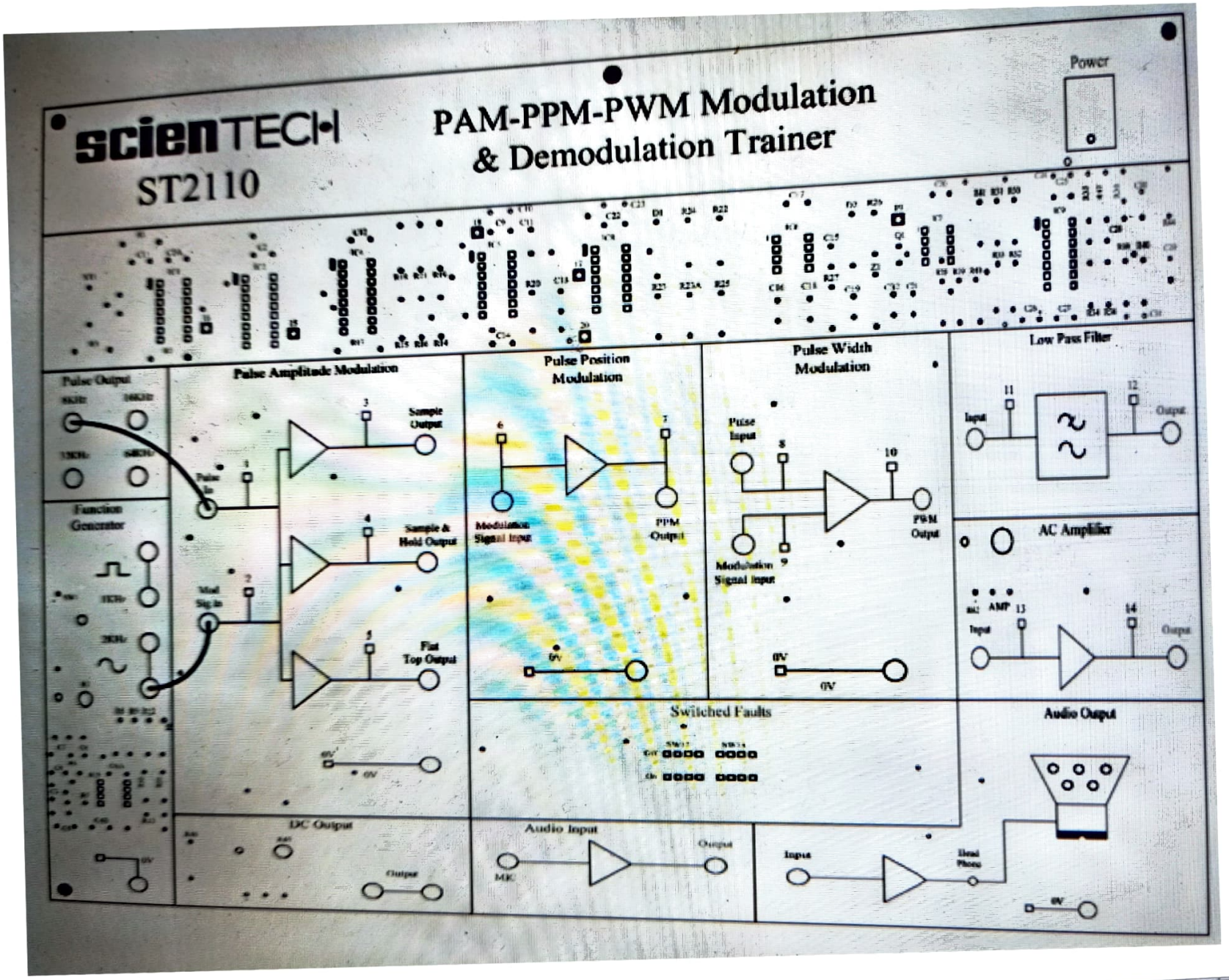
e width modulation. (a) Signal (b) PWM (width variations exaggerated)

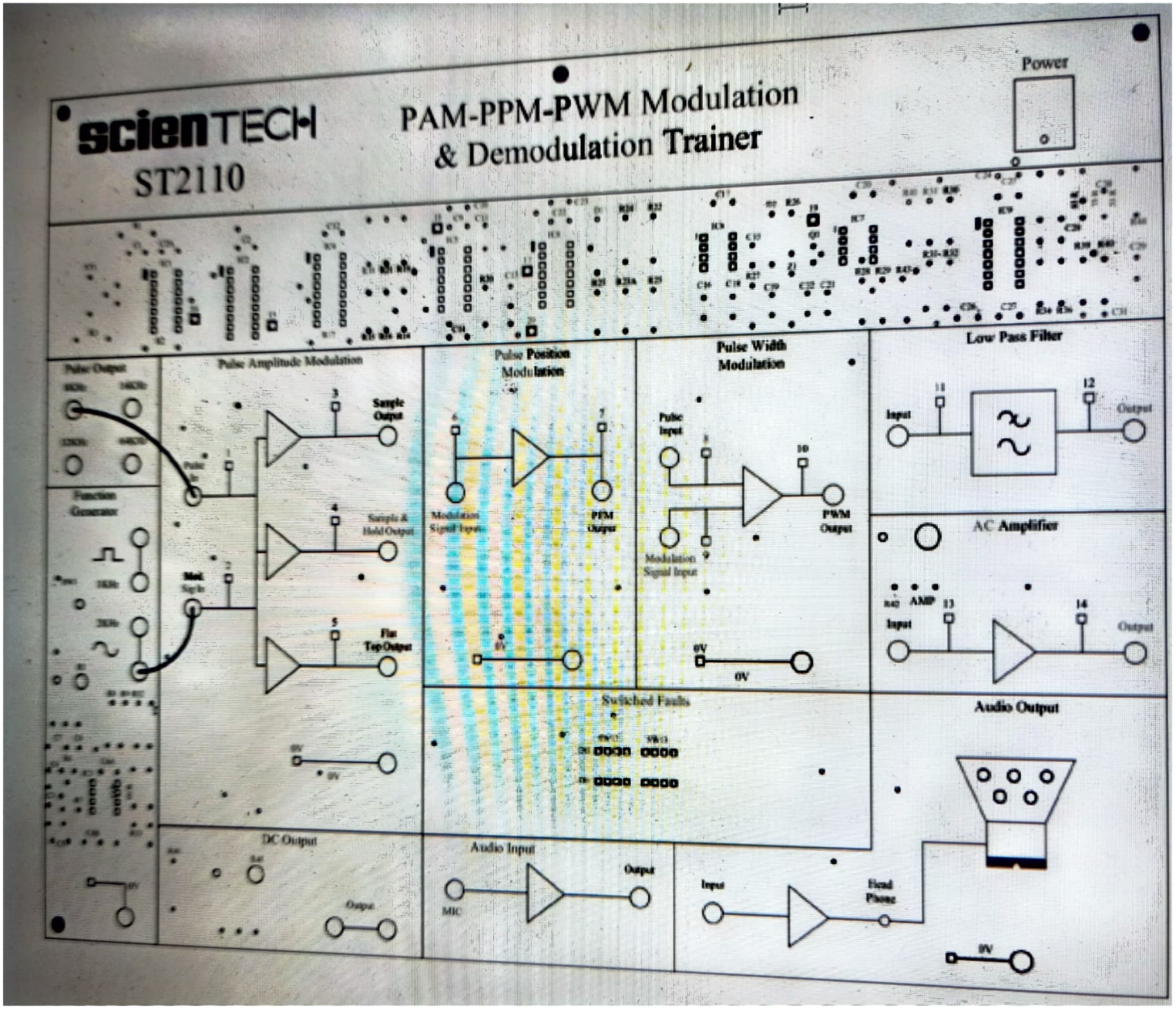
Ans Band width requirement of SSB is half as compared to DSB system.
SSB is a Power efficient scheme in which only 33% power is being utilized.

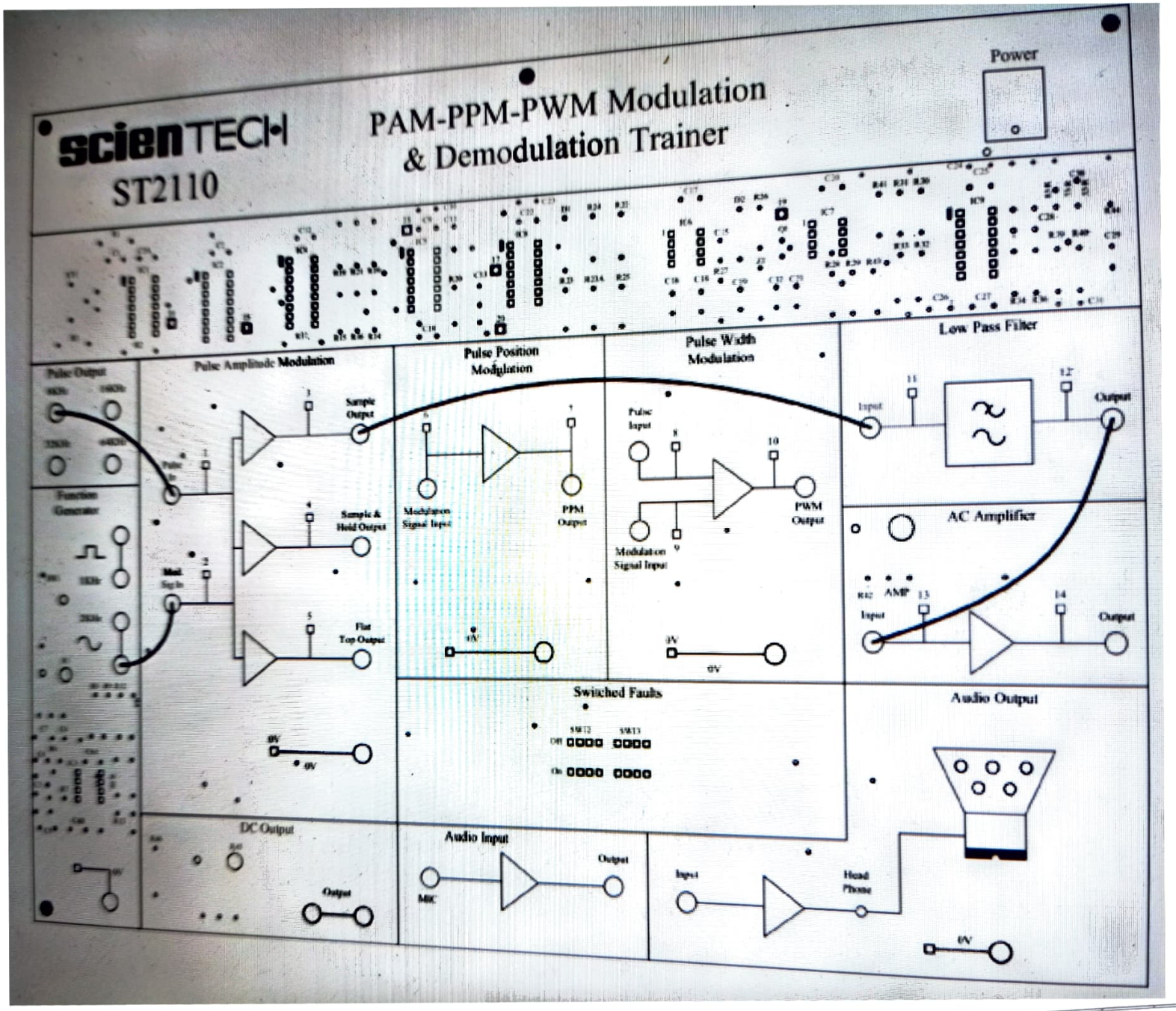
Ans 4. What are the application of SSB?

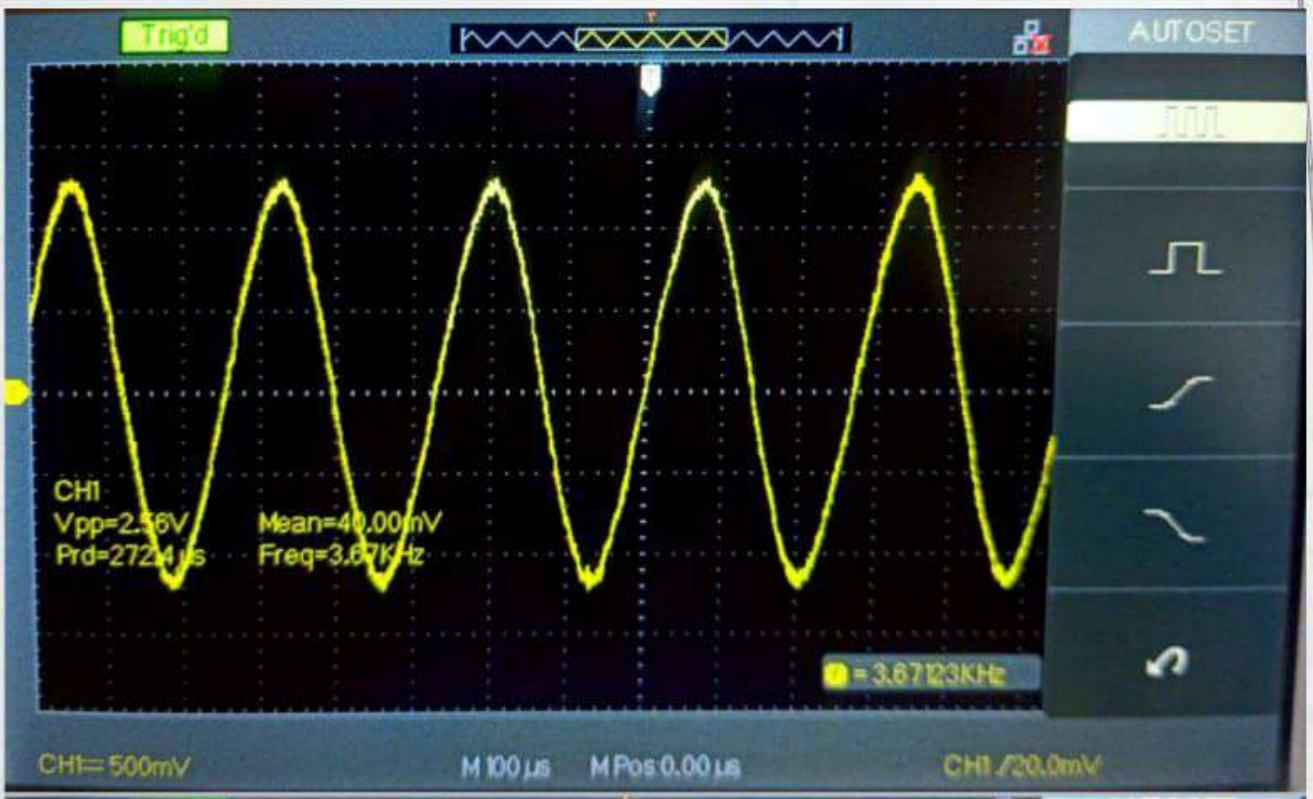
Ans SSB system is used in telemetry, land and air mobile communication, military communication, navigation and analog radio most of these application are point to point communication systems.

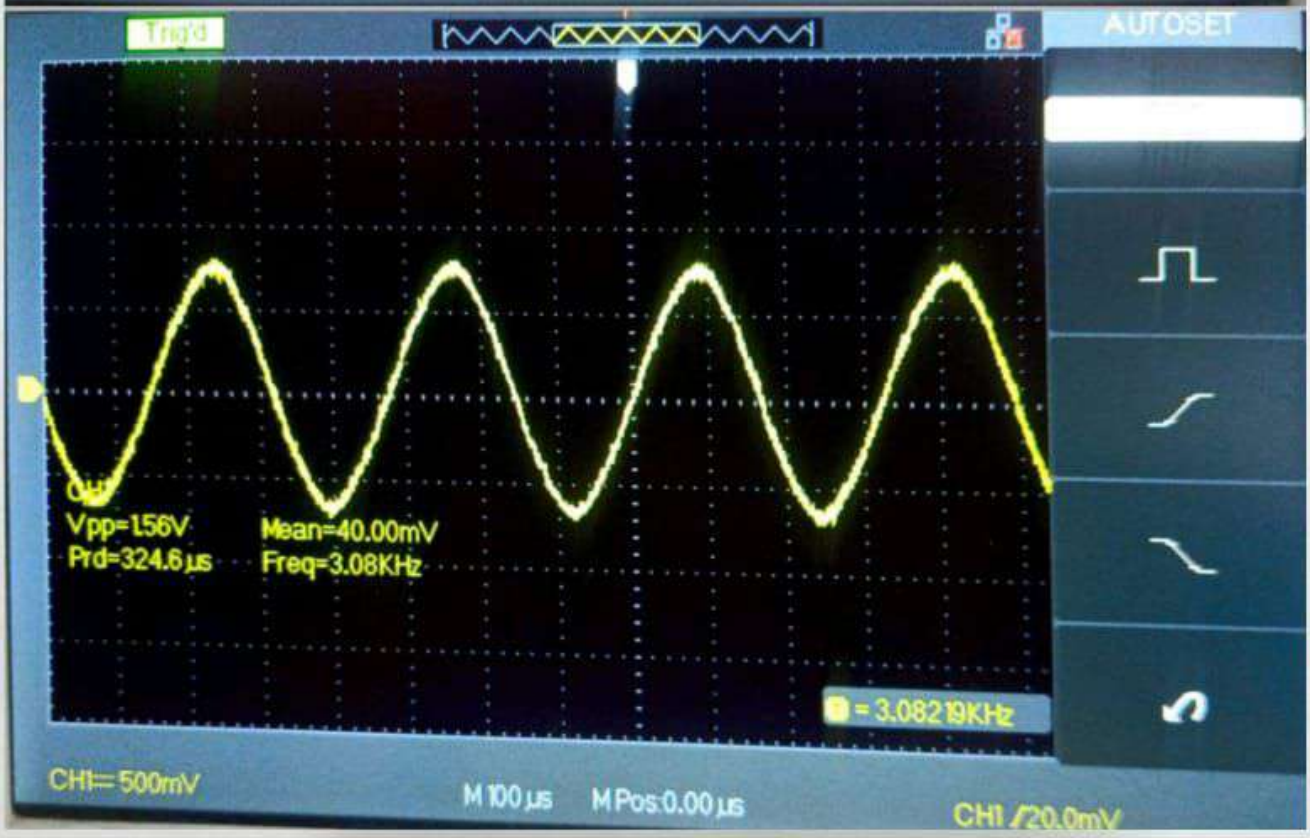
Teacher's Signature : _____

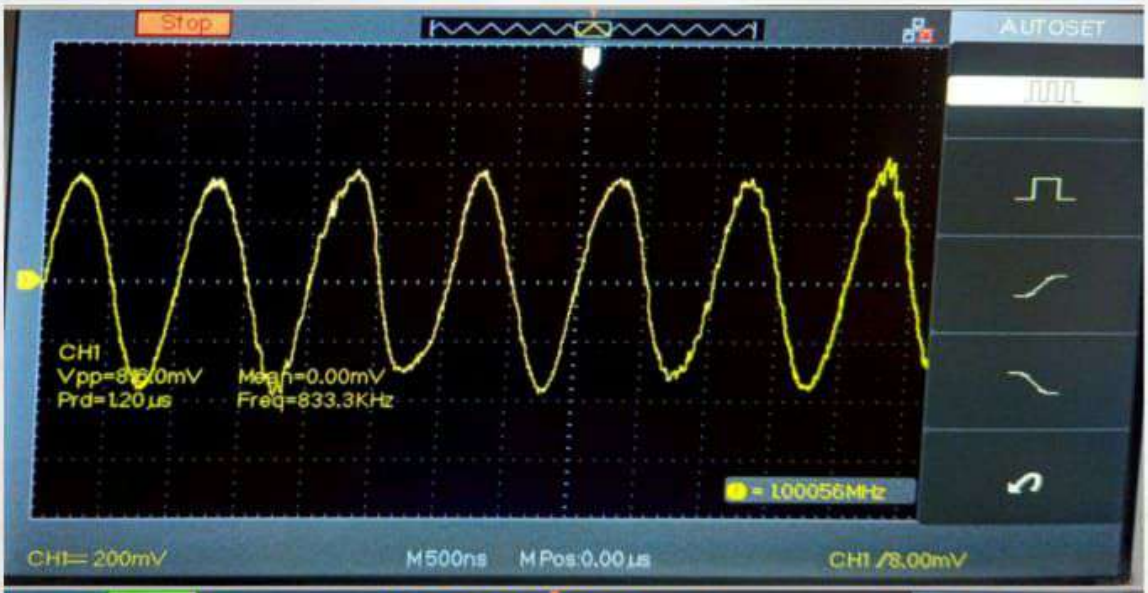

scienTECH
ST2110
PAM-PPM-PWM Modulation
& Demodulation Trainer
Power
Pulse Output
Pulse Amplitude Modulation
Sample Output
Sample & Hold Output
Flat Top Output
Pulse Position Modulation
Modulation Signal Input
PPM Output
Pulse Width Modulation
Pulse Input
Modulation Signal Input
PWM Output
Low Pass Filter
Input
Output
Function Generator
AC Amplifier
AMP
Input
Output
Switched Faults
Audio Output
DC Output
Audio Input
MIC
Output
Input
Head Phone

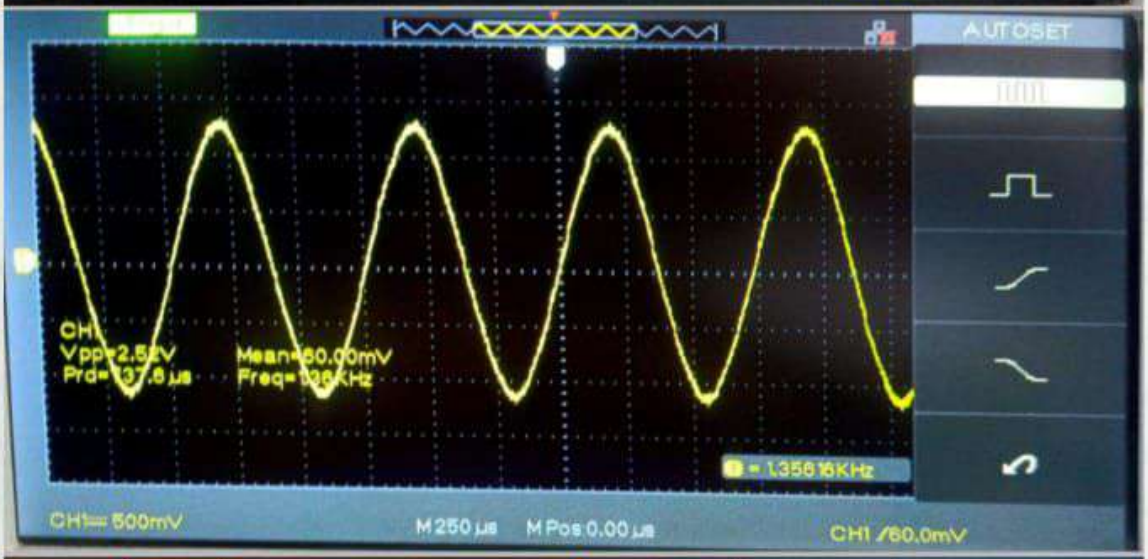

scienTECH
ST2110
PAM-PPM-PWM Modulation
& Demodulation Trainer
Power
Pulse Output
Pulse Amplitude Modulation
Sample Output
Sample & Hold Output
Flat Top Output
Pulse Position Modulation
Modulation Signal Input
PPM Output
Pulse Width Modulation
Pulse Input
Modulation Signal Input
PWM Output
0V
Low Pass Filter
Input
Output
Function Generator
AC Amplifier
AMP
Input
Output
Switched Faults
Audio Output
Head Phone
DC Output
Output
Audio Input
MIC
Output
Input
9V

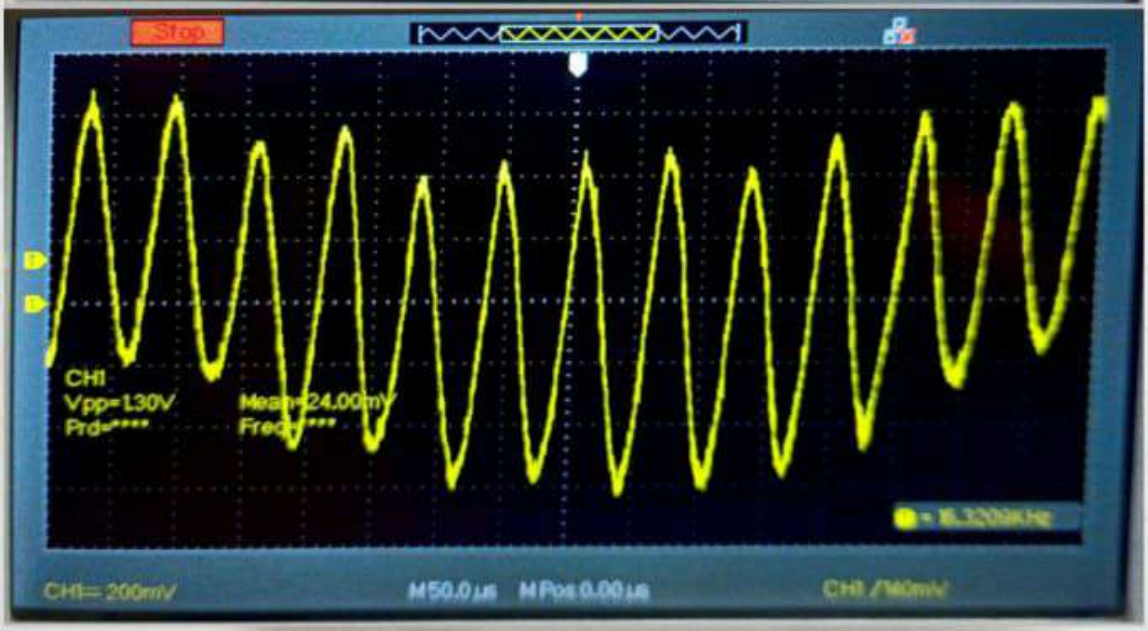

scienTECH
ST2110
PAM-PPM-PWM Modulation
& Demodulation Trainer
Power
Pulse Output
Pulse Amplitude Modulation
Sample Output
Sample & Hold Output
Flat Top Output
Pulse Position Modulation
Modulation Signal Input
PPM Output
Pulse Width Modulation
Pulse Input
Modulation Signal Input
PWM Output
Low Pass Filter
Input
Output
AC Amplifier
AMP
Input
Output
Function Generator
Switched Faults
Audio Output
Head Phone
DC Output
Audio Input
MIC
Output
0V

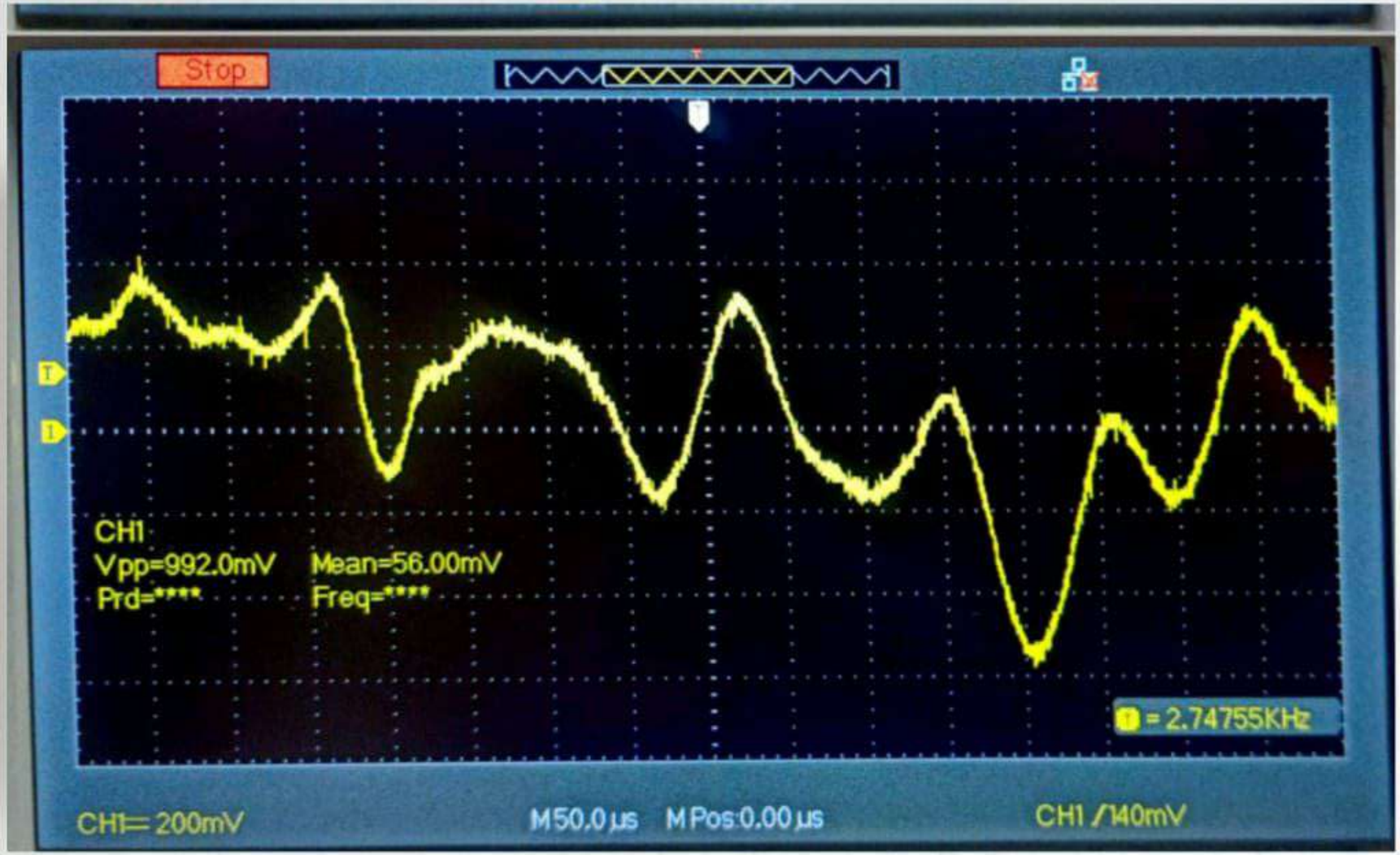

Trig'd
AUTOSET
CH1
Vpp=2.56V
Mean=40.00mV
Prd=272.4 µs
Freq=3.67KHz
= 3.67123KHz
CH1= 500mV
M 100 µs
MPos:0.00 µs
CH1 /20.0mV


Trig'd
AUTOSET
CH1
Vpp=1.56V
Mean=40.00mV
Prd=324.6 µs
Freq=3.08KHz
= 3.08219KHz
CH1= 500mV
M 100 µs
MPos:0.00 µs
CH1 /20.0mV


Stop
AUTOSET
CH1
Mean=0.00mV
Freq=833.3KHz
CH1 200mV
M500ns M Pos:0.00µs
CH1 /8.00mV


AUTOSET
CH1
Mean=60.00mV
CH1 500mV
M250µs M Pos:0.00µs
CH1 /60.0mV


Stop
CH1
Vpp=1.30V
M50.0µs M Pos:0.00µs


Stop
CH1
Vpp=992.0mV
Mean=56.00mV
Prd=****
Freq=****
1 = 2.74755KHz
CH1 200mV
M50.0µs MPos:0.00µs
CH1 /140mV