# Lab-3

# Raj-202201403, Bhoomish-202201414

# Manthan-202201416, Rakshit-202201426

I/P Signal Type/Freq	Channel	Samplin g Freq	Sampled Outputs
Sine/ 500 Hz	Channel 1	-	RIGOL DS1102E DIGITAL OSCILLOSCOPE  RIGOL STOP  F 1.1-30  CH  CH2  MATIT  REP  CCH 1
Arbitrary /1.5 KHz	Channel 2	-	RIGOL STOP  RIGOL

Square /500 Hz	Channel 3	-	RIGOL DS1102E  SIGNAL OSCILISOOM  RIGOL STOP  SIGNAL  CHI  ANATH  ANTE SIGNAL  CHI  CHI  CHI  CHI  CHI  CHI  CHI  CH
Sine/ 500 Hz	Channel 1	8 KHz	RIGOL STOP  (G1498,255Hz)  (CH2-  (MATH-  CH2-  CH3-  CH3-

Sine/ 500 Hz	Channel 1	8 KHz	RIGOL STOP  T.8 1234 HF  TIME 200.042 010.00005
Arbitrary /1.5KHz	Channel 2	16 KHz	RIGOL STOP  1.320  1.32

Square/ 500 Hz	Channel 3	8 KHz	RIGOL STOP  GASO.ZTZ-II  CHI: 1.000 MIRR 1.000 Time 1.000ms 0-0.0000s  CH 2-0.0000s  CH 2-0.0000s  CH 2-0.0000s
Arbitrary /1.5KHz	Channel 4	8 KHz	RIGOL STOP  (6 9 76 5 5 3 Hz)  (1 1 1 0 0 Name 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

- Through this experiment, we learned how by varying the input signal frequencies, we see the effect on waveforms at each channel.
- By changing the sampling clock frequencies, we see sample-and-hold signals affect the quality of signal sampling.
- The more the samples, the better the signal integrity is maintained.

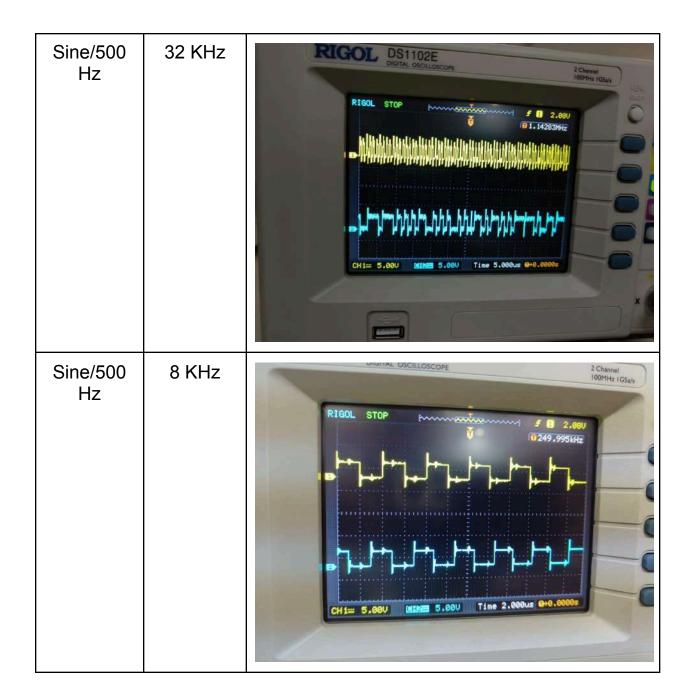
I/P Signal Type/Freq	Channel	Sampling Freq.	Sampled Output
Sine/ 500 Hz	Channel1	8 KHz	RIGOL DS1102E DIGITAL OSCILOSCOPE  2 Charinet 100thts (GSa)  RIBOL STOP (0/188,272Hz) (0/188,272Hz) (0/188,272Hz)
Arbitrary/ 500Hz	Channel2	8 KHz	RIGOL STOP

Square/ 500 Hz	Channel3	8 KHz	R160L STOP  G468.272-Hz  CH1== 1.000   Max.   2.090   Time 1.000ms   0+0.0000s   CH1=
Arbitrary /1.0KHz	Channel4	16 KHz	RIGOL STOP (#1.280) (
Sine/ 500 Hz	Channel1	8 KHz	RIGOL DS1102E DOGINAL PROPAGAGEGER  RIGOL STDP  GET. TREATM  GET. TREA

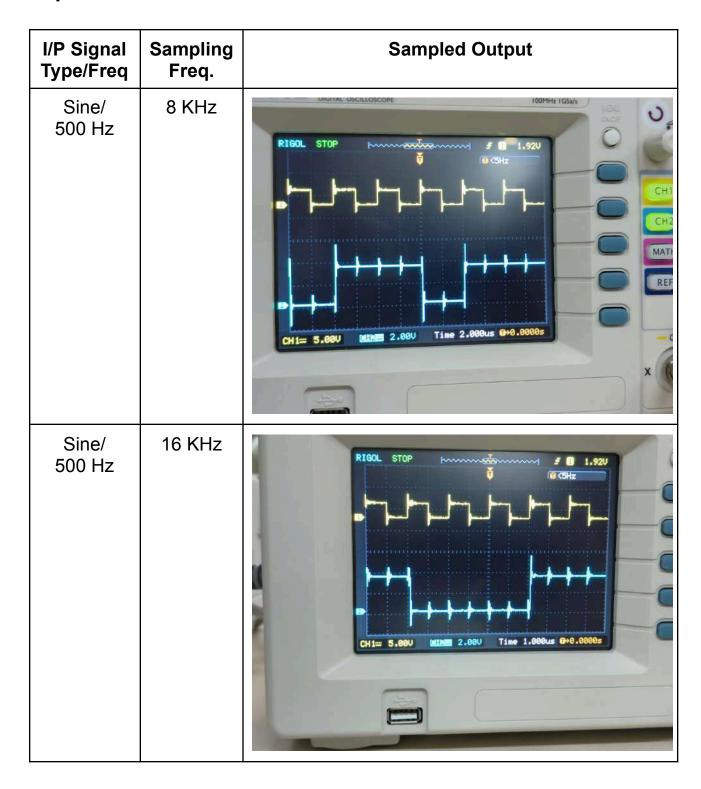
Sine/1.5 KHz	Channel2	8 KHz	RIGOL DS1102E DIGITAL OSCILOSCOPE  1 Charact 1007Hz 105ch 10
Sine/500 Hz	Channel3	8 KHz	RIGOL DS1102E STREET CONTINUES  STREET CONTINUES  STREET CONTINUES  CITY OF THE STREET CONTINUES

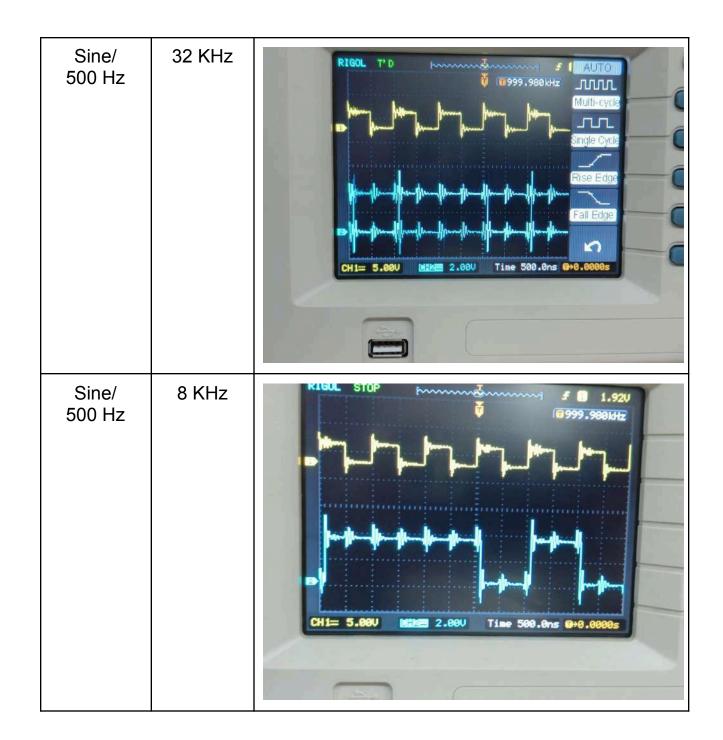
- Through this experiment, we learned how varying the line speed frequencies impacted the PCM clock and output signals.
- By adjusting line speed, we note changes in PCM output which demonstrates how line speed affects signal transmission in PCM.

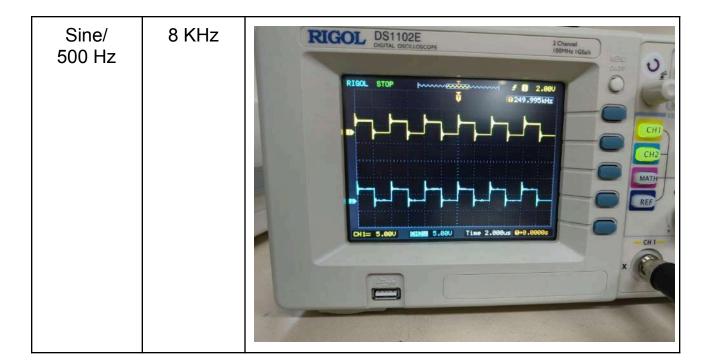
I/P Signal Type/Freq	Sampling Freq.	Sampled Output
Sine/500 Hz	8 KHz	RIGOL STOP    2 2.08U   1259.6591512  CH   5 5.08U   Time 10.60as 010.0000s
Sine/500 Hz	16 KHz	RIGOL STOP  (553-523H2)  (1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1



- Through this experiment, we observed the multiplexed output of a 33 bit frame, one bit of framing pulse.
- The framing pulse helped synchronize the frame for accurate transmission and reception.







- Through this experiment, we observed how 32 bit frame output after detecting the framing pulse.
- The framing pulse is essential for accurately identifying and synchronizing the 32 bit frame, ensuring that the data is correctly aligned and transmitted.

I/P Signal Type/Freq	Channel	Sampling Freq	Sampled Outputs
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Sine/ 500 Hz	Channel1	8 KHz	RIGOL DS1102E  SCHOOL DS1102E
Sine/ 500 Hz	Channel2	8 KHz	RIGOL DS1102E  SENS STATE OF S
Sine/ 500 Hz	Channel3	8 KHz	RIGOL DS1102E  LONG STATESHOOL  LINE STA

• Through this experiment, we observed how the demultiplexed output of a 4 channel PCM correctly separates and displays each channel's output at the designated test points, namely TP29, TP32, TP35, TP38.

I/P Signal Type/Freq	Channel	Samplin g Freq	Sampled Outputs
Sine/ 500 Hz	Channel1	8 KHz	R160L STOP  (6 11.6998H)  (7 1.520  (6 11.6998H)  (7 1.520  (8 1.520  (9 1.520  (9 1.520  (1 1.520  (1 1.520  (1 1.520  (1 1.6998)  (1 1.520  (1 1.6998)  (1 1.520  (1 1.6998)  (1 1.520  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.6998)  (1 1.690  (1 1.690  (1 1.6998)  (1 1.690  (1 1.690  (1 1.6998)  (1 1.690  (1 1
Sine/ 500 Hz	Channel1	8 KHz	RIGOL STOP 5 1.240 1.488.257Hz  CHI= 1.680 Nime 1.680 Time 1.000ms @10.0000s

Arbitrary/5 00 Hz	Channel2	8 KHz	RIGOL DS1102E District Coccocces  RIGOL STOP  G176.54595  CH2  LS00  CH2  LS00  CH3  LS00  CH1  CH2  CH1  CH1  CH1  CH1  CH1  CH1
Square/ 500 Hz	Channel3	8 KHz	RIGOL STOP
Arbitrary/5 00 Hz	Channel4	8 KHz	RIGOL DSTITUZE DIGITAL CSCULLOSCOPE  1.520  F 1.520  F 176.527Hz  CHIS 1.000  T 1 0.000  T 1 0.000

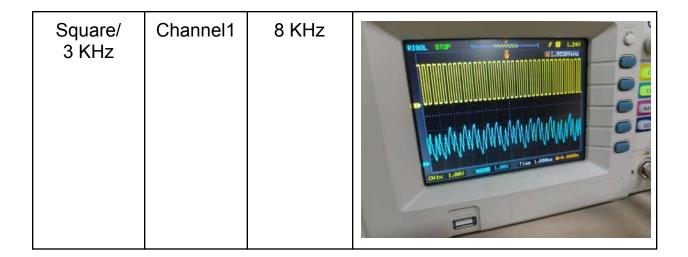
- Through this experiment, we learned how demodulated outputs of a 4 channel PCM system accurately recovered the original signal from the sampling process.
- This confirms that the TDM PCM system effectively demodulates the multiplexed signal and reconstructs the original channel signal.

I/P Signal Type/Freq	Channel	Sampling Freq	Sampled Outputs
Sine/ 500 Hz	Channel1	8 KHz	RIGOL STOP
Sine/1.5 KHz	Channel1	8 KHz	RIGOL STOP

Sine/1.5 KHz	Channel2	8 KHz	SIGNAL COCLUSIONS  SIGNAL COCCUSIONS  SIGNAL COCCUSIONS  SIGNAL COCCUSIONS  SIGNAL COCCUSIONS  SIGNAL COCCUSIONS  SIGNAL COCCUSIONS  SIGNAL COCUSIONS  SIGNAL COCCUSIONS  SIGNAL COCCUSI
Sine/1.5 KHz	Channel2	16 KHz	RIGOL DS1102E DSGTAL SPOLLOCOPE  1 CARROLL OFFICE 1.000  DS1102E DSGTAL SPOLLOCOPE  1 CARROLL OFFICE 1.000  DS1102E DS
Square/ 500 Hz	Channel3	8 KHz	RIGOL STOP

Sine/1.5 KHz	Channel3	8 KHz	RIGOL STOP  O I 1-0002194  CIT I 1-000 No. 1-000 Ties 200 . Rug GH-0.00001
Arbitrary/ 500 Hz	Channel4	8 KHz	RIGOL STOP  OCITAL COCKLESCOPE  OFFICE AND THE SERVICE CONTROL OF THE SERVICE CONTROL OFFICE CONTROL OFFI CONTROL
Square/ 500 Hz	Channel1	8 KHz	CHE 1.000 The Leave 0.0.000

Square/ 1 KHz	Channel1	8 KHz	RIGOL STOP # 1 1.200 (976, 5434)  CATE 1.000 Tim 1.000m (1.000m)
Square/ 1.5 KHz	Channel1	8 KHz	RIGOL STOP    I   STOP   I   STOP   S
Square/ 2 KHz	Channel1	8 KHz	RIGOL STOP    1.240     1.550     1.550



- Through this experiment, we observed how Low Pass Filter is used for the demodulated signals
- The filter smooths out the demodulated square wave due to its 5 kHz cutoff frequency.
- This confirms that LPF attenuates high frequency components and presents clear representation of demodulated signals.

#### **Matlab Experiment:**

#### **Matlab Code:**

```
s = sign(randn(1, 400)); % Generate 400 random bits
for a = [0,0.05,0.1,0.2]
x = s + a^* (s.*s); %input non - linear signal
Tau=64; % Define the symbol period
dataup=upsample(x, Tau); % Generate impulse train
yrz=conv(dataup,prz(Tau)); % Return to zero polar signal
yrz = yrz(1: end-Tau+1);
ynrz =conv(dataup, pnrz(Tau)); % Non-return to zero polar
ynrz =ynrz(1:end-Tau+1);
ysine=conv(dataup, psine(Tau)); % half sinusoid polar
ysine=ysine (1: end-Tau+1);
Td=4; % truncating raised cos ine to 4 periods
yrcos=conv(dataup , prcos(0.5,Td,Tau)); % rolloff factor = 0.5
yrcos =yrcos(2*Td*Tau:end- 2 *Td*Tau+1); % generating RC pulse train
eyel=eyediagram( yrz,2*Tau,Tau,Tau/2); title ('RZ eye - diagram');
eye2=eyediagram( ynrz,2*Tau,Tau,Tau/2); title ('NRZ eye-diagram');
eye3=eyediagram( ysine,2*Tau,Tau,Tau/2); title('Half-sine eye-diagram');
eve4
```

#### Pnrz.m

function pout=pnrz(T)
pout=ones(1, T);
end

#### Prz.m

function pout=prz(T)
pout=[zeros(1,T/4) ones(1,T/2) zeros(1,T/4)];
End

#### Psine.m

function pout=psine(T)
pout=sin(pi\*(0 : T- 1)/T);
end

#### Prcos.m

function y = prcos(rollfac, length, T)
span = length;
sps = T;
y = rcosdesign(rollfac, span, sps, 'normal');
end

