AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH

Faculty of Engineering

Lab Report

Experiment # 05

Experiment Title: Study of Digital-to-Digital Conversion (Line Coding) Using MATLAB

Date of Perform:	Tuesday, September 19, 2023	**Date of Submission:**	16-12-2023
Course Title:	Data Communication Lab		
Course Code:	COE3103	**Section:**	G
Semester:	Fall 2023-24	**Degree Program:**	BSc in CSE
Course Teacher:	**Sadman Shahriar Alam**		

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FACULTY COMMENTS	**Marks Obtained**	
	Total Marks	

Table of Contents

1. Polar NRZ-L assuming bit rate is 4 kbps

Math

Nazmus Saadat ID = 21-45157-2

A	B	-	C	D	E	F	G	-	H
2	1	-	4	5	1	5	7	-	2

E (1) in binary: 0001
F (5) in binary: 0101
G (7) in binary: 0111

Code

```
clc
clear all
close all
bit_stream = [0 0 0 1 0 1 0 1 0 1 1 1];
no_bits = length(bit_stream);
bit_rate = 4000;
pulse_per_bit = 1;
pulse_duration = 1/((pulse_per_bit)*(bit_rate));
no_pulses = no_bits*pulse_per_bit;
samples_per_pulse = 500;
fs = (samples_per_pulse)/(pulse_duration);

t = 0:1/fs:(no_pulses)*(pulse_duration);

no_samples = length(t);
dig_sig = zeros(1,no_samples);
max_voltage = 10;
min_voltage = -10;
for i = 1:no_bits
    if bit_stream(i) == 0
        dig_sig(((i-1)*(samples_per_pulse)+1):i*(samples_per_pulse)) =
max_voltage*ones(1,samples_per_pulse);
    else
        dig_sig(((i-1)*(samples_per_pulse)+1):i*(samples_per_pulse)) =
min_voltage*ones(1,samples_per_pulse);
    end
end
plot(t,dig_sig,'linewidth',1.5)
grid on
xlabel('time')
ylabel('V')
ylim([(min_voltage - (max_voltage)*0.2)
(max_voltage+max_voltage*0.2)])
title(['POLAR NRZ-L '])
```

MATLAB Simulation

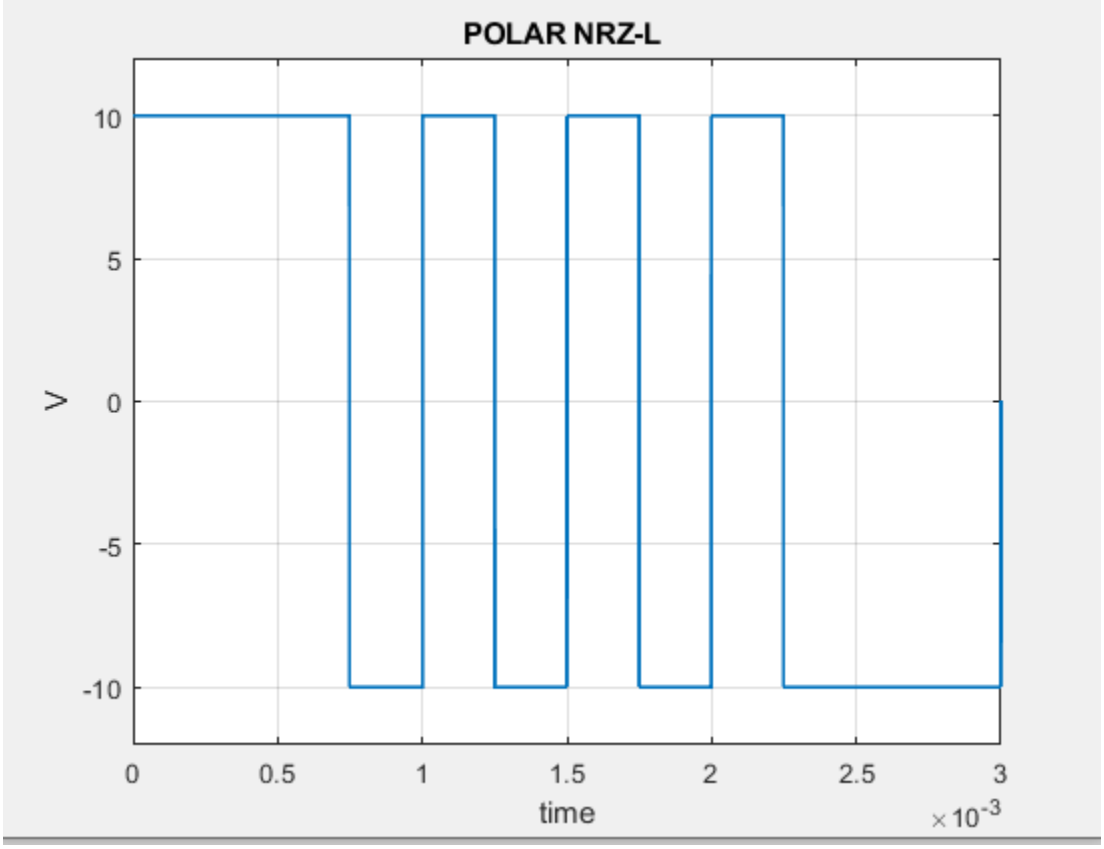

Figure 1: Signal Representation

2. Manchester assuming bit rate is 2 kbps

Nazmus Saadat ID = 21-45157-2

A	B	-	C	D	E	F	G		-	H
2	1	-	4	5	1	5	7		-	2

E (1) in binary: 0001
F (5) in binary: 0101
G (7) in binary: 0111

```
clc
clear all
close all
bit_stream = [0 0 0 1 0 1 0 1 0 1 1 1];
no_bits = length(bit_stream);
bit_rate = 2000;
pulse_per_bit = 2;
```

```
pulse_duration = 1/((pulse_per_bit)*(bit_rate));
no_pulses = no_bits*pulse_per_bit;
samples_per_pulse = 500;
fs = (samples_per_pulse)/(pulse_duration);
t = 0:1/fs:(no_pulses)*(pulse_duration);
no_samples = length(t);
dig_sig = zeros(1,no_samples);
max_voltage = +2;
min_voltage = -2;
non_inv_bit = 1;
last_state = max_voltage;
inv_last_state = min_voltage;
for i = 1:no_bits
    j = (i-1)*2;
    if bit_stream(i) == non_inv_bit
        dig_sig((j*(samples_per_pulse)+1):(j+1)*(samples_per_pulse)) =
last_state*ones(1,samples_per_pulse);
        dig_sig(((j+1)*(samples_per_pulse)+1):(j+2)*(samples_per_pulse)) =
inv_last_state*ones(1,samples_per_pulse);
        temp_cons = last_state;
        last_state = inv_last_state;
        inv_last_state = temp_cons;
    else
        dig_sig((j*(samples_per_pulse)+1):(j+1)*(samples_per_pulse)) =
inv_last_state*ones(1,samples_per_pulse);
        dig_sig(((j+1)*(samples_per_pulse)+1):(j+2)*(samples_per_pulse)) =
last_state*ones(1,samples_per_pulse);

    end
end
figure
plot(t,dig_sig,'linewidth',1.5)
grid on
xlabel('Time')
ylabel('Voltage')
ylim([(min_voltage - (max_voltage)*0.2)
(max_voltage+max_voltage*0.2)])
title(['Manchester'])
```

MATLAB Simulation

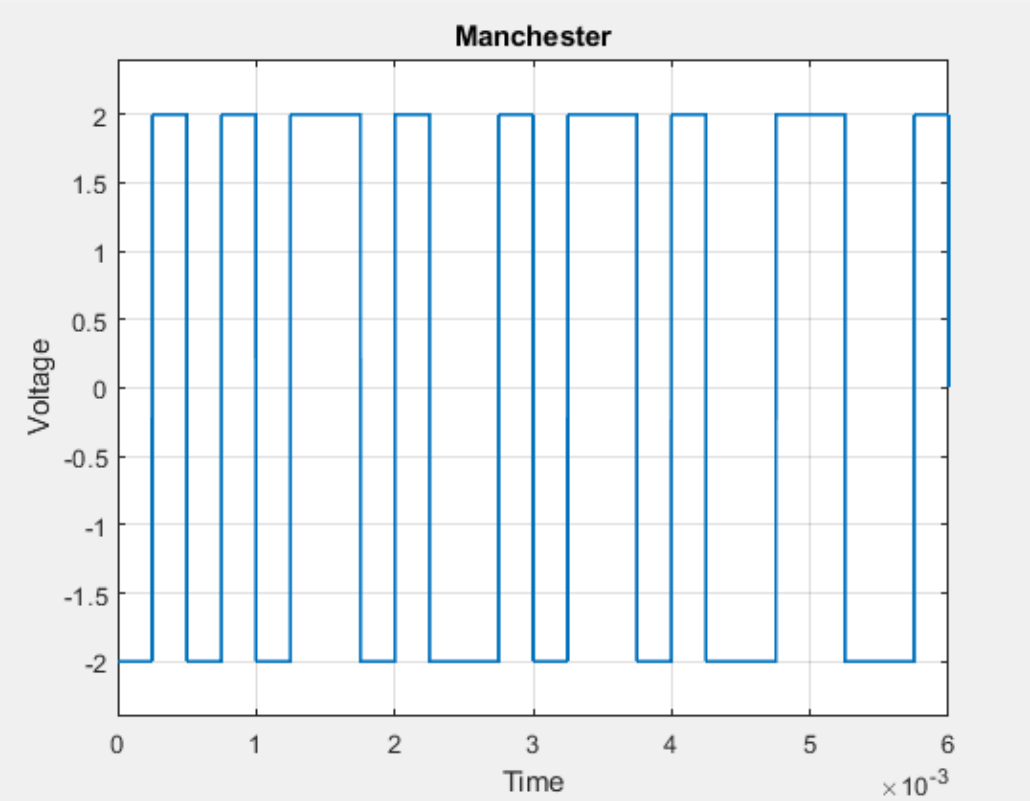

Figure 2: Signal Representation

3. AMI assuming bit rate is 5 kbps.

Nazmus Saadat ID = 21-45157-2

A	B	-	C	D	E	F	G	-	H
2	1	-	4	5	1	5	7	-	2

E (1) in binary: 0001
F (5) in binary: 0101
G (7) in binary: 0111

```
clc
clear all
close all

bit_stream = [0 0 0 1 0 1 0 1 0 1 1 1];
no_bits = length(bit_stream);
bit_rate = 5000;
pulse_per_bit = 1;
pulse_duration = 1 / (pulse_per_bit * bit_rate);
```

```
no_pulses = no_bits * pulse_per_bit;
samples_per_pulse = 500;
fs = samples_per_pulse / pulse_duration;
t = 0:1/fs:(no_pulses) * pulse_duration;

no_samples = length(t);
dig_sig = zeros(1, no_samples);
last_level = 1;
invert_state = 0;

for i = 1:no_bits
    if bit_stream(i) == 1
        last_level = -last_level;
        dig_sig(((i - 1) * samples_per_pulse + 1):i * (samples_per_pulse)) = last_level *
ones(1, samples_per_pulse);
        invert_state = last_level;
    else
        dig_sig(((i - 1) * samples_per_pulse + 1):i * (samples_per_pulse)) = 0;
    end
end

plot(t, dig_sig, 'linewidth', 1.5)
grid on
xlabel('Time ')
ylabel('Voltage')
ylim([-1.2 1.2])
title(['AMI'])

set(gca, 'XTick', 0:pulse_duration:(no_pulses * pulse_duration));
set(gca, 'YTick', [-1 0 1]);
```

MATLAB Simulation

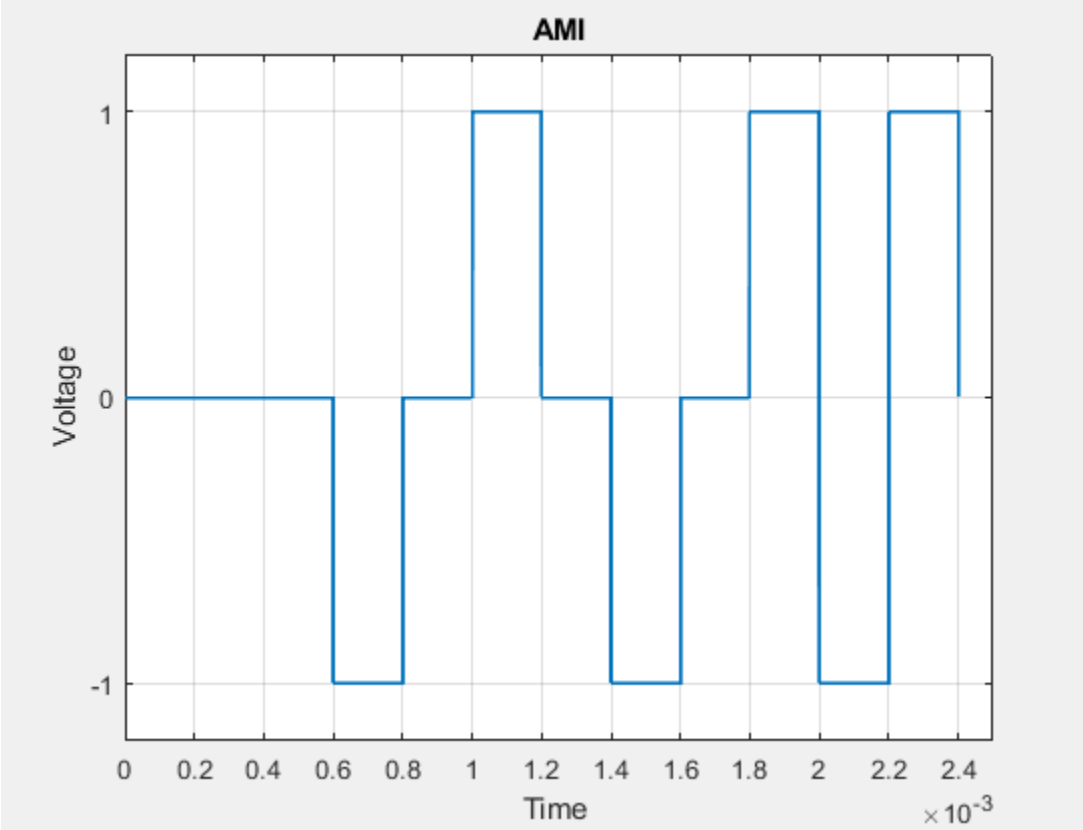

Figure 3: Signal Representation

4. MLT-3 assuming bit rate is 10 kbps

Nazmus Saadat ID = 21-45157-2

A	B	-	C	D	E	F	G	-	H
2	1	-	4	5	1	5	7	-	2

E (1) in binary: 0001
F (5) in binary: 0101
G (7) in binary: 0111

```
clc
clear all
close all

bit_stream = [0 0 0 1 0 1 0 1 0 1 1 1];
no_bits = length(bit_stream);
bit_rate = 10000;
pulse_per_bit = 1;
```

```
pulse_duration = 1 / (pulse_per_bit * bit_rate);
no_pulses = no_bits * pulse_per_bit;
samples_per_pulse = 500;
fs = samples_per_pulse / pulse_duration;

t = 0:1/fs:(no_pulses) * pulse_duration;

no_samples = length(t);
dig_sig = zeros(1, no_samples);
last_non_zero_level = -1;
last_level = 0;

for i = 1:no_bits
    if bit_stream(i) == 0
        dig_sig(((i - 1) * samples_per_pulse + 1):i * (samples_per_pulse)) = last_level *
ones(1, samples_per_pulse); % No change for '0' bit
    else
        if last_level ~= 0
            last_level=0;
            dig_sig(((i - 1) * samples_per_pulse + 1):i * (samples_per_pulse)) =
last_level * ones(1, samples_per_pulse); % Set amplitude to 0 for '1'
        else
            if last_level == 0
                last_non_zero_level = -last_non_zero_level;
                dig_sig(((i - 1) * samples_per_pulse + 1):i * (samples_per_pulse)) =
last_non_zero_level * ones(1, samples_per_pulse);
                last_level = last_non_zero_level;
            else

            end
        end
    end
end

plot(t, dig_sig, 'linewidth', 1.5)
grid on
xlabel('Time')
ylabel('Voltage')
ylim([-1.2 1.2])
title(['MLT-3'])

set(gca, 'XTick', 0:pulse_duration:(no_pulses * pulse_duration));
set(gca, 'YTick', [-1 0 1]);
```

MATLAB Simulation

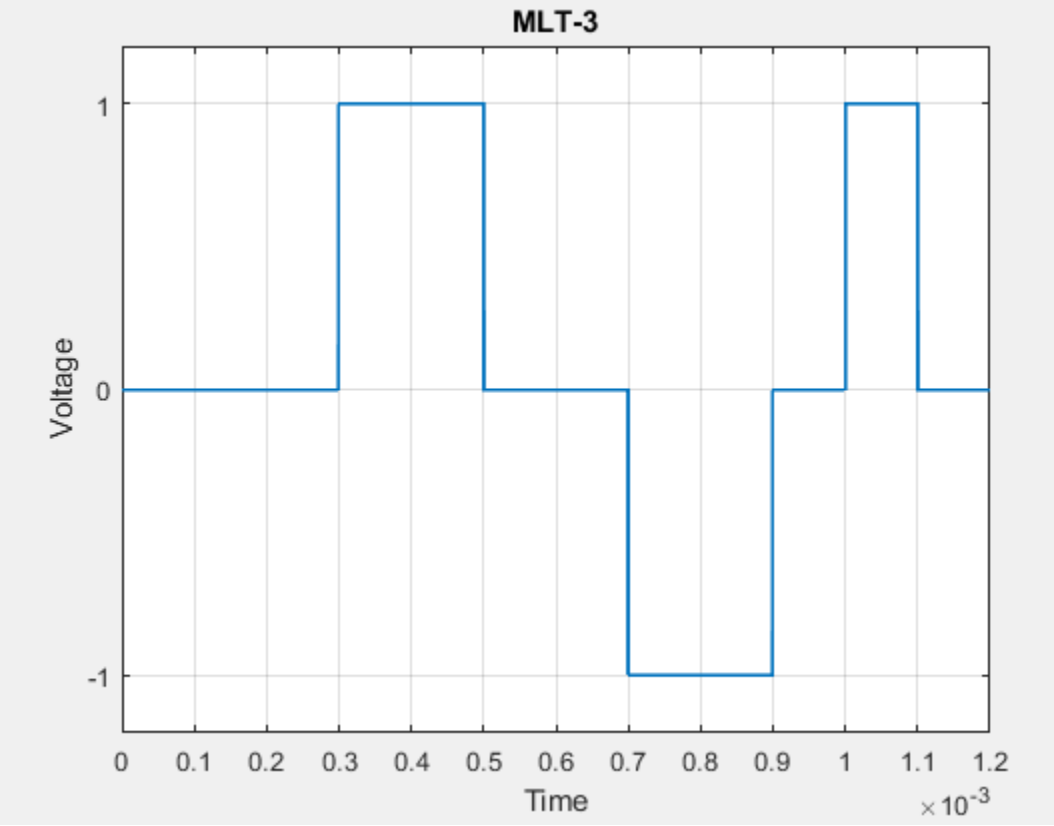

Figure 4: Signal Representation