Experiment No.3

To learn the various Baseband Transmission Scheme

Line Coding(Data Formats)

Problem Statement

Write a MATLAB code for Unipolar ,Polar and Bipolar signal for RZ,NRZ signal.

Line Coding:

- The analog waveforms are converted to digital signals by PCM,DM,ADM,DPCM etc. techniques.
- This digital data can be represented by different formats or waveforms.
- This waveforms are commonly known as digital data formats or their representation is called as line coding.

Line codes:

- A **line code** is the code used for data transmission of a digital signal over a transmission line.
- This process of coding is chosen so as to avoid overlap and distortion of signal such as inter-symbol interference.

Properties of Line Coding

- As the coding is done to make more bits transmit on a single signal, the bandwidth used is much reduced.
- For a given bandwidth, the power is efficiently used.
- The probability of error is much reduced.
- Error detection is done and the bipolar too has a correction capability.
- Power density is much favorable.
- The timing content is adequate.
- Long strings of **1s** and **0s** is avoided to maintain transparency.

Types of Line Coding

- There are 3 types of Line Coding
- Unipolar
- Polar
- Bi-polar

Unipolar Signaling

- In Unipolar format the waveform does have a single polarity. The waveform does have single polarity. The waveform can have +5V or +12 V when high.
- The waveform is simple ON-OFF.

- The presence of pulse represents a 1 and the absence of pulse represents a 0.

- There are two variations in Unipolar signaling −

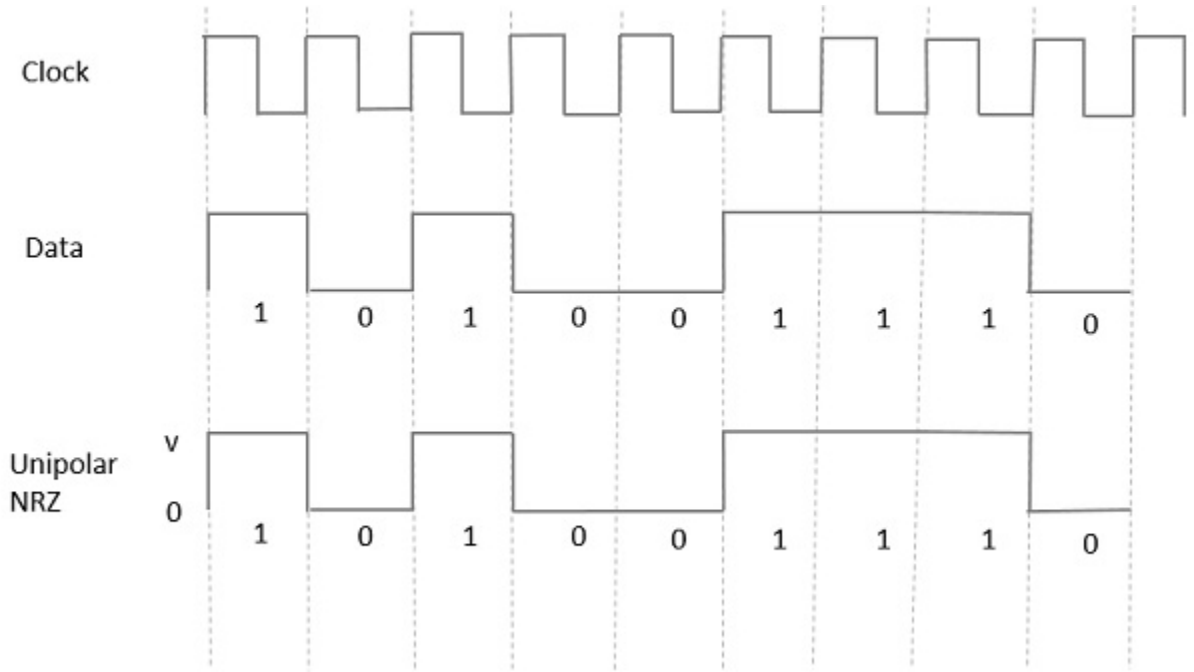
- Non Return to Zero NRZ
- Return to Zero RZ

Unipolar Non-Return to Zero NRZ

- In this type of unipolar signaling, a High in data is represented by a positive pulse called as Mark, which has a duration T0 equal to the symbol bit duration. A Low in data input has no pulse.

- The following figure clearly depicts this.

Unipolar NRZ



Advantages

The advantages of Unipolar NRZ are −

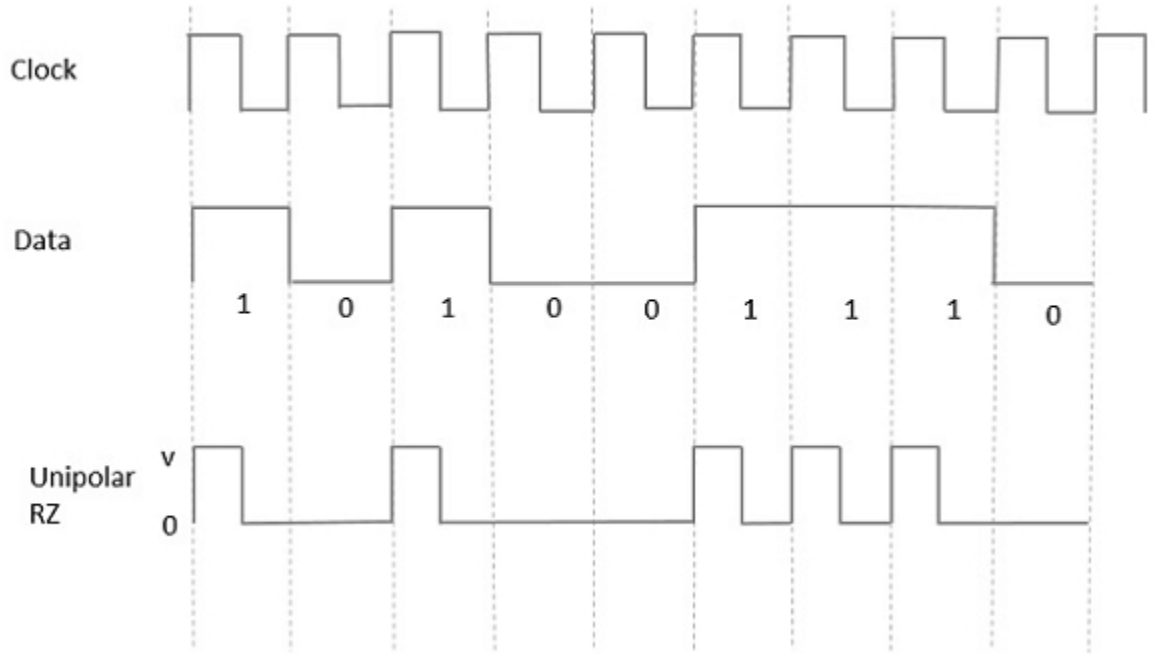
- It is simple.
- A lesser bandwidth is required.

Unipolar Return to Zero RZ

- In this type of unipolar signaling, a High in data, though represented by a Mark pulse, its duration T0 is less than the symbol bit duration. Half of the bit duration remains high but it immediately returns to zero and shows the absence of pulse during the remaining half of the bit duration.

- It is clearly understood with the help of the following figure.

Unipolar RZ Waveform:



Advantages and disadvantages:

- The advantages of Unipolar RZ are −

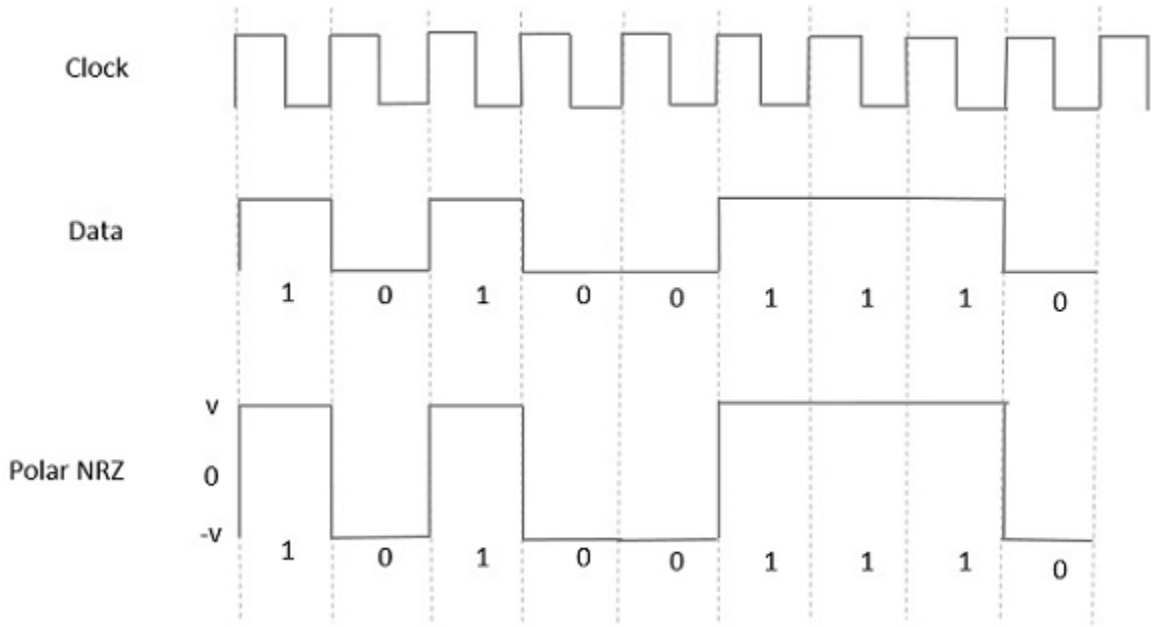
- It is simple.
- The spectral line present at the symbol rate can be used as a clock.

Polar Signaling

- There are two methods of Polar Signaling. They are –

- Polar NRZ
- Polar RZ
- Polar NRZ
- In this type of Polar signaling, a High in data is represented by a positive pulse, while a Low in data is represented by a negative pulse. The following figure depicts this well.

Polar NRZ waveform:



Advantages and disadvantages:

- The advantages of Polar NRZ are −

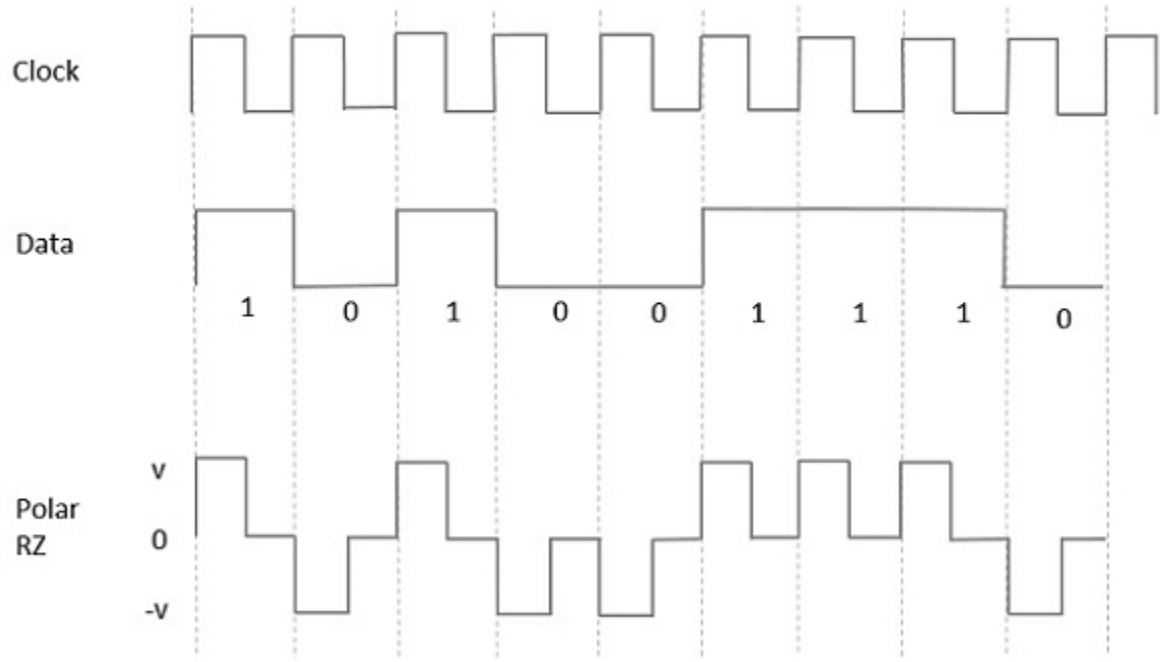
- It is simple.
- No low-frequency components are present.

Polar RZ

- In this type of Polar signaling, a High in data, though represented by a Mark pulse, its duration T0 is less than the symbol bit duration. Half of the bit duration remains high but it immediately returns to zero and shows the absence of pulse during the remaining half of the bit duration.

- However, for a Low input, a negative pulse represents the data, and the zero level remains same for the other half of the bit duration. The following figure depicts this clearly.

Polar RZ waveform:



Advantages

- The advantages of Polar RZ are −
- It is simple.
- No low-frequency components are present.

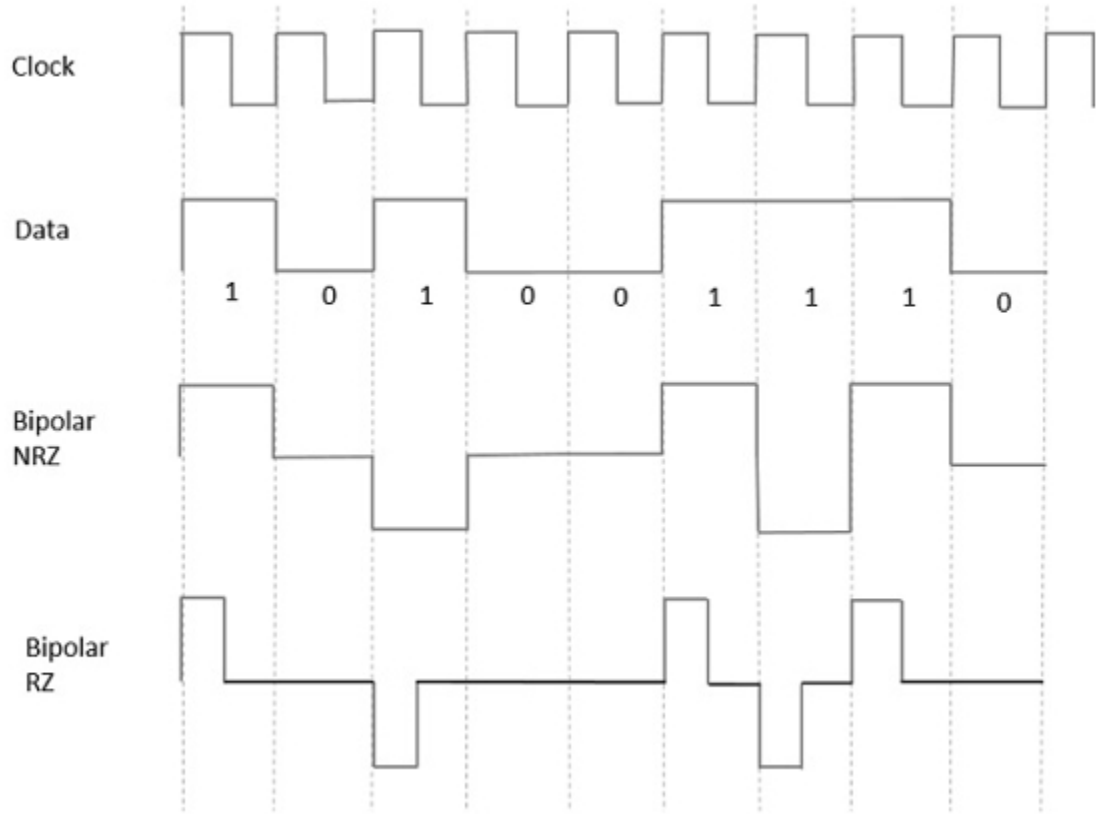
Bipolar Signaling

- This is an encoding technique which has three voltage levels namely +, - and 0. Such a signal is called as duo-binary signal.

- An example of this type is Alternate Mark Inversion AMI. For a 1, the voltage level gets a transition from + to – or from – to +, having alternate 1s to be of equal polarity. A 0 will have a zero voltage level.

- Even in this method, we have two types.
- Bipolar NRZ
- Bipolar RZ
- From the models so far discussed, we have learnt the difference between NRZ and RZ. It just goes in the same way here too. The following figure clearly depicts this.

Bipolar NRZ and Bipolar RZ waveform:

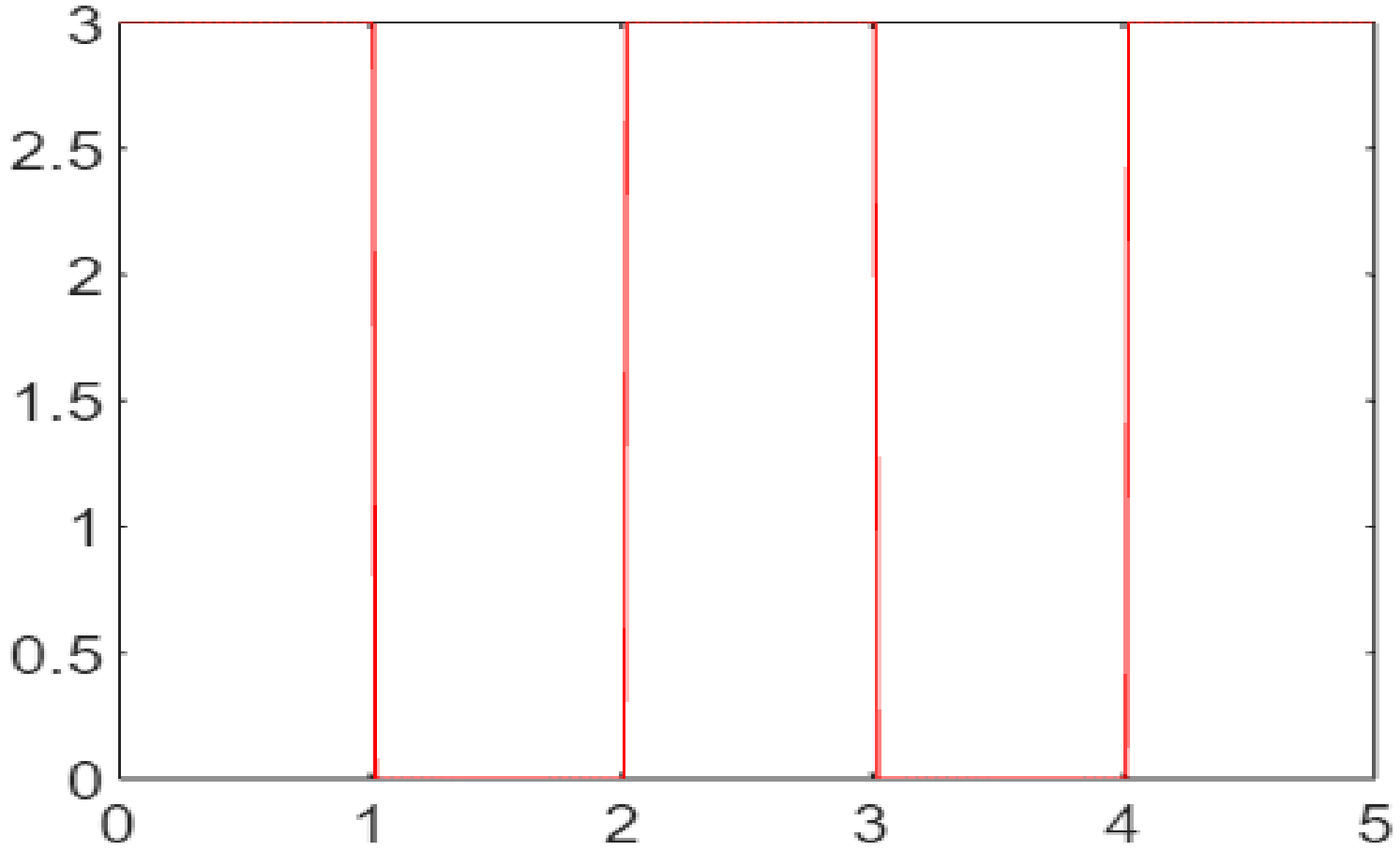


- The above figure has both the Bipolar NRZ and RZ waveforms. The pulse duration and symbol bit duration are equal in NRZ type, while the pulse duration is half of the symbol bit duration in RZ type.
- Advantages
- It is simple.
- No low-frequency components are present.
- Occupies low bandwidth than unipolar and polar NRZ schemes.
- This technique is suitable for transmission over AC coupled lines, as signal drooping doesn’t occur here.
- A single error detection capability is present in this.

MATLAB Code

```
n=[1,0,1,0,1]; % Number of binary data inputs
for b = 1:length(n)
if n(b)==1;
a(b)=3;
else
a(b)=0;
end
end
i=1; % Index value is start from 1 in MATLAB. So variable i is used to index the input(n)
t=0:0.01:length(n); % Time axis begin from 0 to length of n (5)
for j=1:length(t) % j=1 means it indicates the first value of t
if t(j)<=i;
y(j)=a(i);
else
y(j)=a(i);
i=i+1;
end
end
% plotting
plot(t,y,'r')
```

NRZ Uni Polar signal output waveform



Generation of pulses:

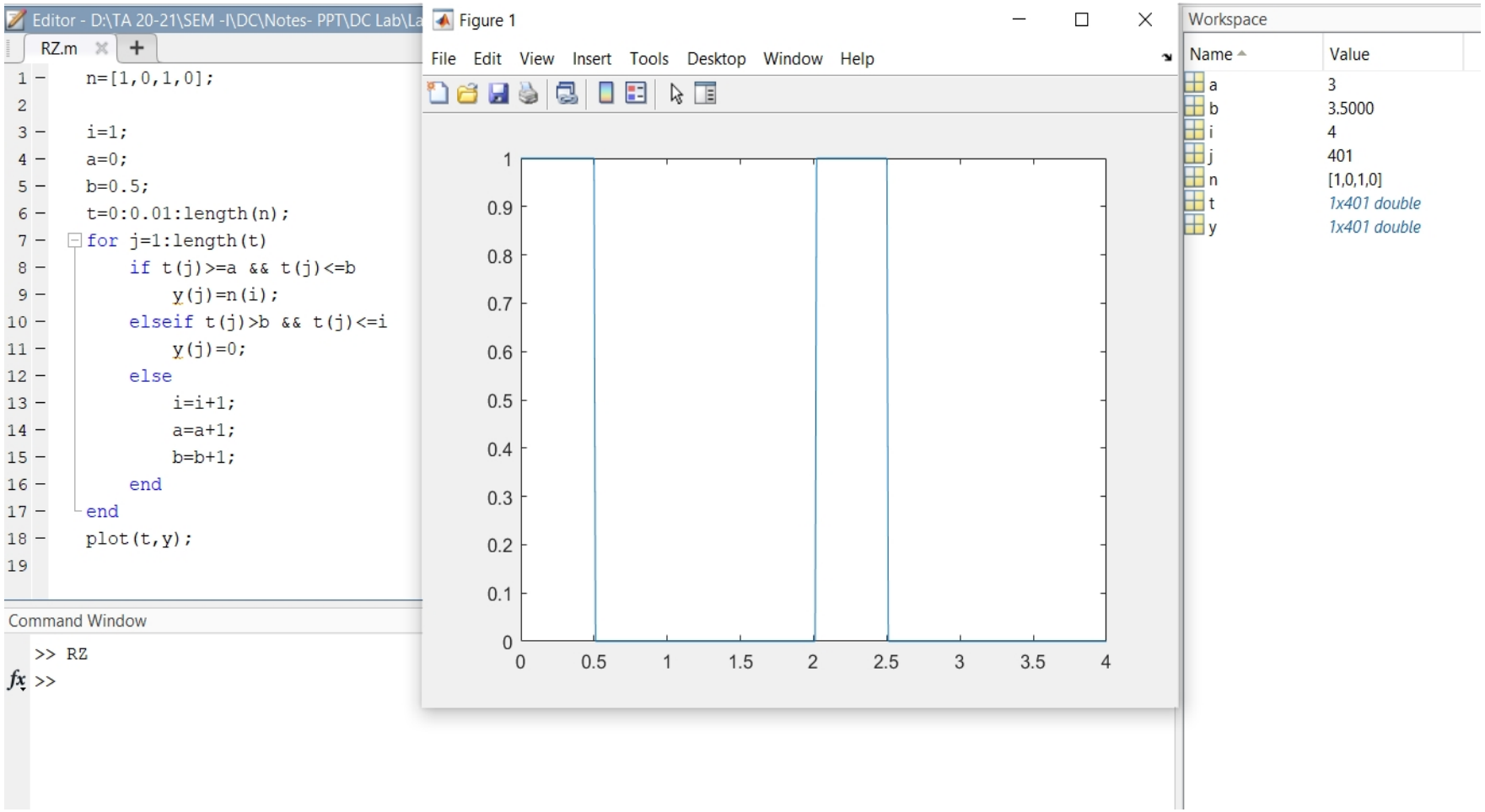
```
n =[1,0,1,0];
T=
a_h=3
A_c=0
A_l=-3

o/p=[]
for j=1:length(n)
If n(j)==1
o/p=[o/p,a_h,a_l] Else
o/p=[o/p,a_l]
End
End
Stairs(o/p)
```

RZ (Unipolar):

Logic for Unipolar waveform is same as previous.

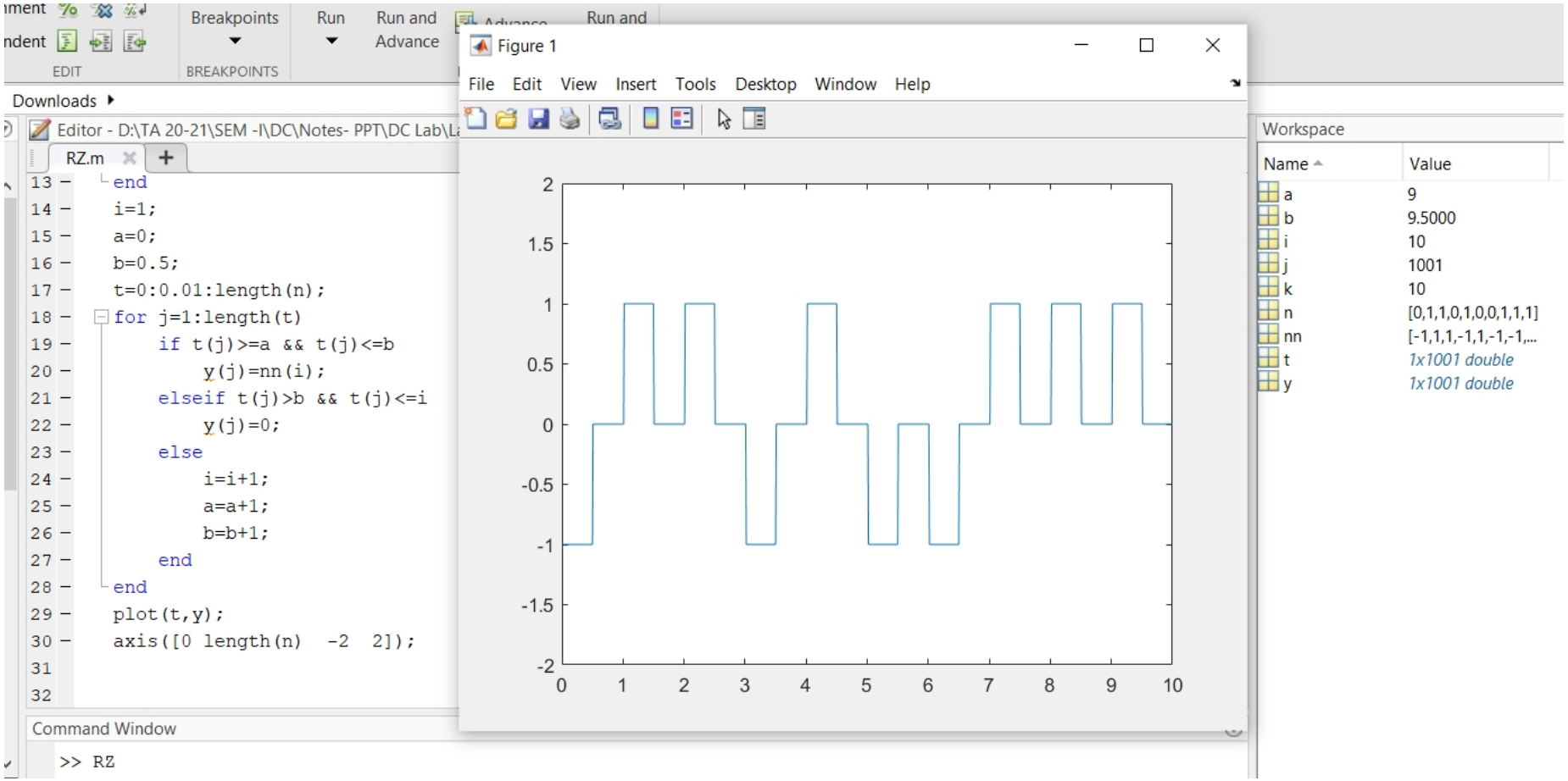
For RZ only duration of pulse is changed.(Half of the time interval is considered)



RZ (polar):

Logic for polar waveform is same as previous.

For RZ only duration of pulse is changed.(Half of the time interval is considered)



References:

[1]https://www.tutorialspoint.com/digital_communication/digital_communication_line_codes.htm

[2] www.youtube.com

Thank you