Md Saiful Islam Sajol Matriculation no. 30042836

Task 2a:

To open the source circuit we draw circuit like below. The below circuit will show the given signal both in time domain and frequency domain

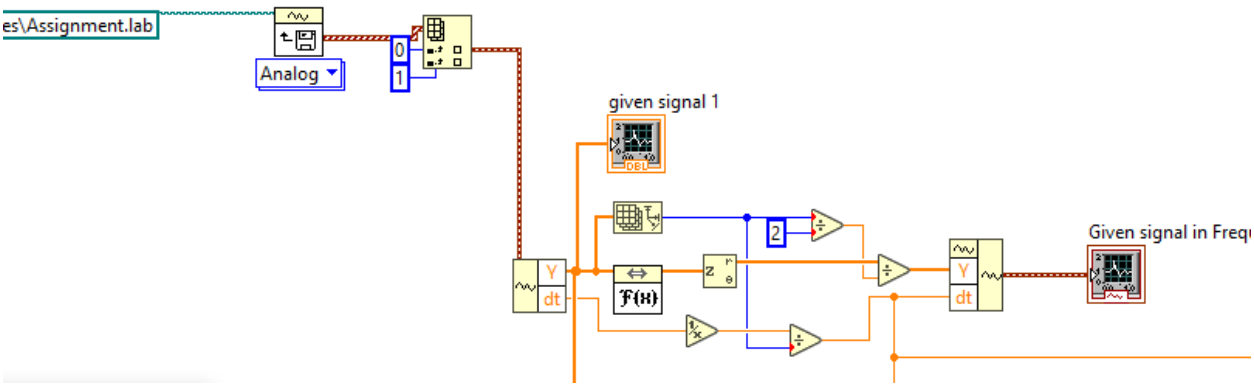


Figure 1

If we show this in Front panel we will get two waveforms like figure 2 and figure 3.

Figure 2 provides time domain information and figure 3 gives frequency domain information.

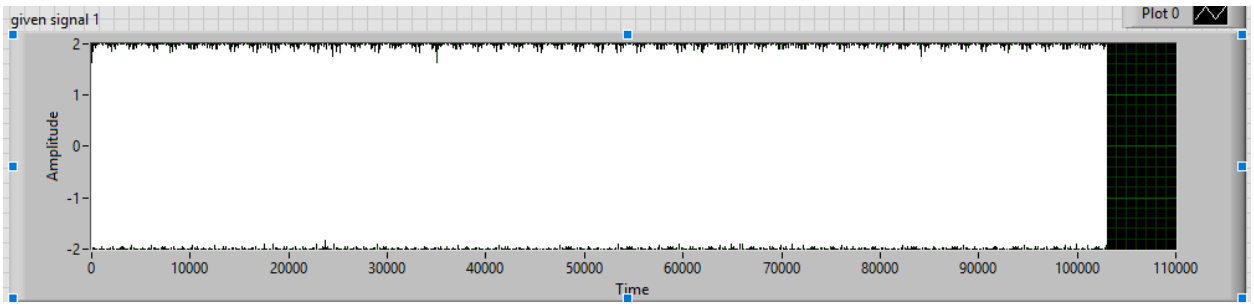


Figure 2

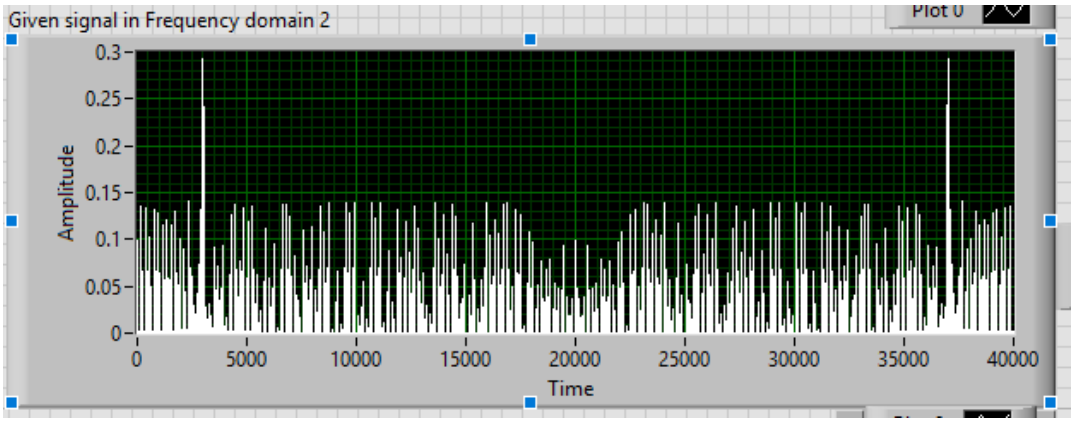
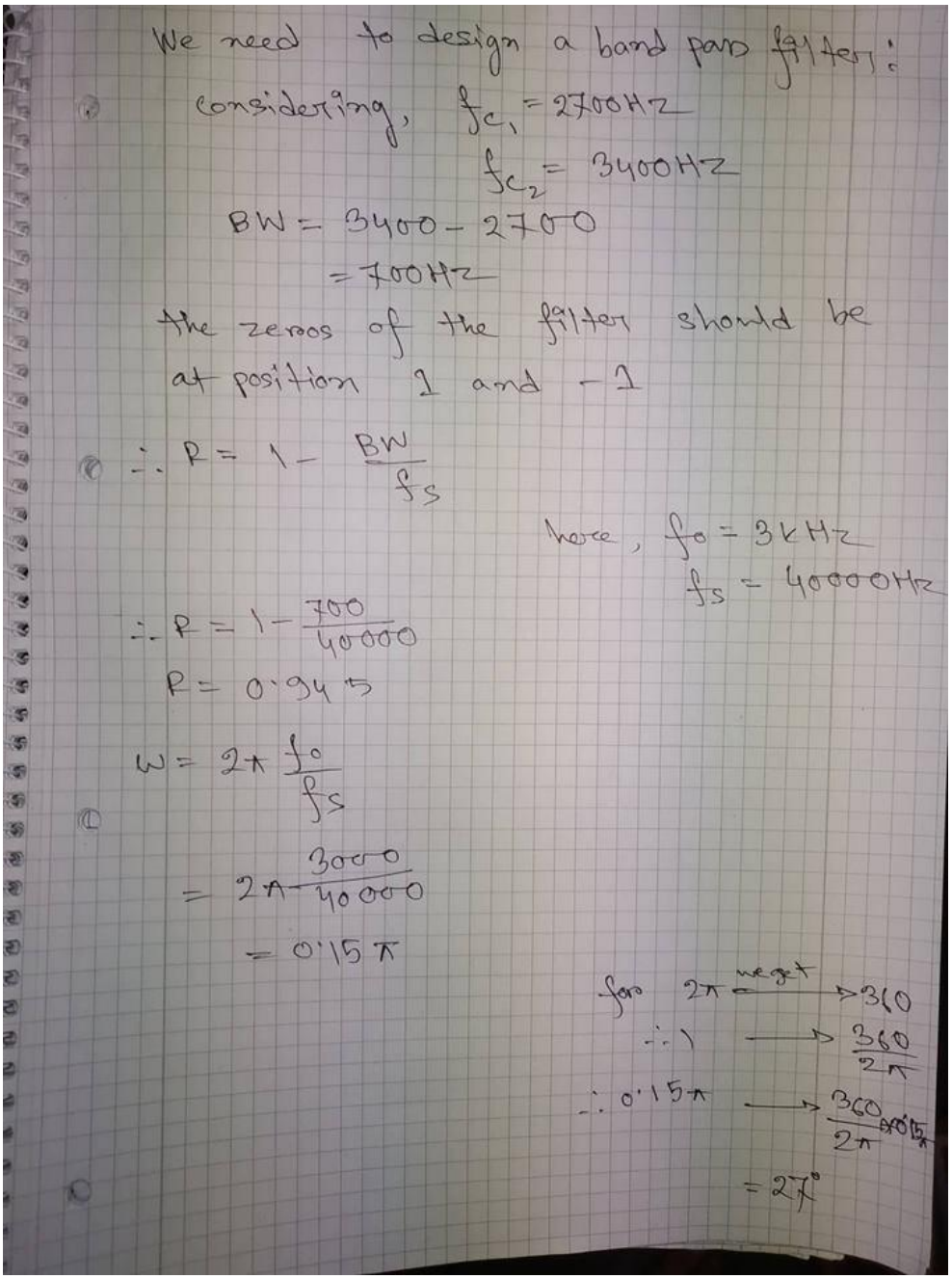


Figure 3

Task 2 b :

Analyzing Figure 3 we get that the message frequency is in 3000Hz bandwidth that we need to extract. a BPSK modulated signal has to be demodulated and decoded. The sample frequency of the signal is 40KHz and the signal is modulated using a 3KHz carrier signal. Two dominant phases are available in the BPSK modulated signal. The 180° shift of phase codes a '1' and the 0° of phase codes a '0'. To extract the message signal a bandpass filter is used.

Task 2c:



$e^{jw} = \cos w + j \sin w \qquad w = 27°$

$P_1 = Re^{jw}$

$= 0.945 (\cos 27° + j \sin 27°)$

$= 0.842 + 0.429j = 0.945 \angle 27$

$P_2 = Re^{-jw}$

$= 0.945 (\cos 27° - j \sin 27°)$

$= 0.842 - 0.429j = 0.945 \angle -27$

So, the ~~denomination~~ should be,

$(z - 0.945\angle 27)(z - 0.945\angle -27)$

$\Rightarrow z^2 - z\,0.945\angle -27 - z\,0.945\angle 27 + (0.945)^2$

$\Rightarrow z^2 - z\{0.842 - 0.429j + 0.842 + 0.429j\} + 0.893$

$\Rightarrow z^2 - z\{1.684\} + 0.893$

$\Rightarrow z^2 - 1.684z + 0.893$

Reverse coefficients; forward coefficient

$a_0 = \sout{0.893}\ 1$ and $b_0 = 1$

$a_1 = -1.684$ $b_1 = 0$

$a_2 = 0.893$ $b_2 = -1$

$$H(z) = \frac{(z-1)(z+1)}{(z - Re^{jw})(z - Re^{-jw})}$$

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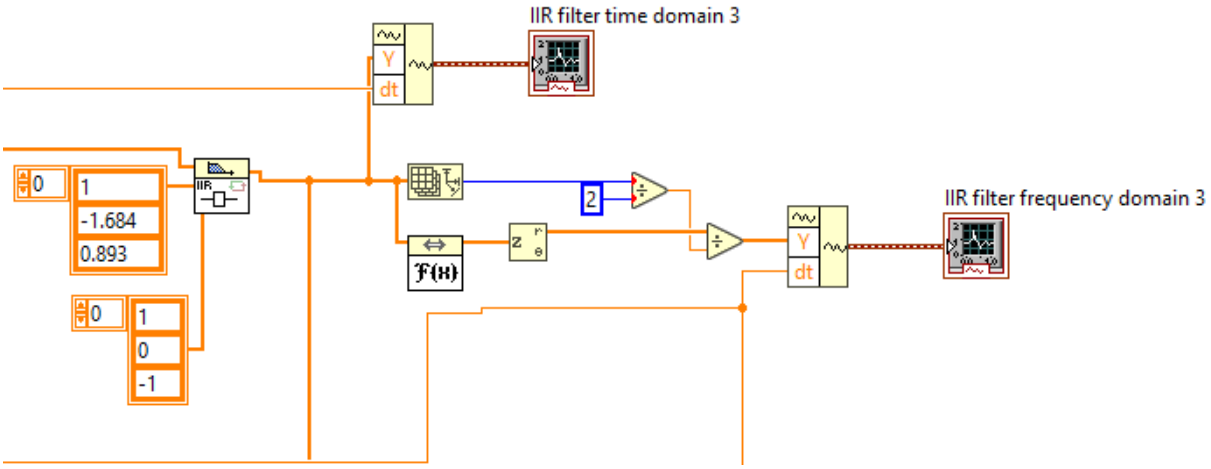
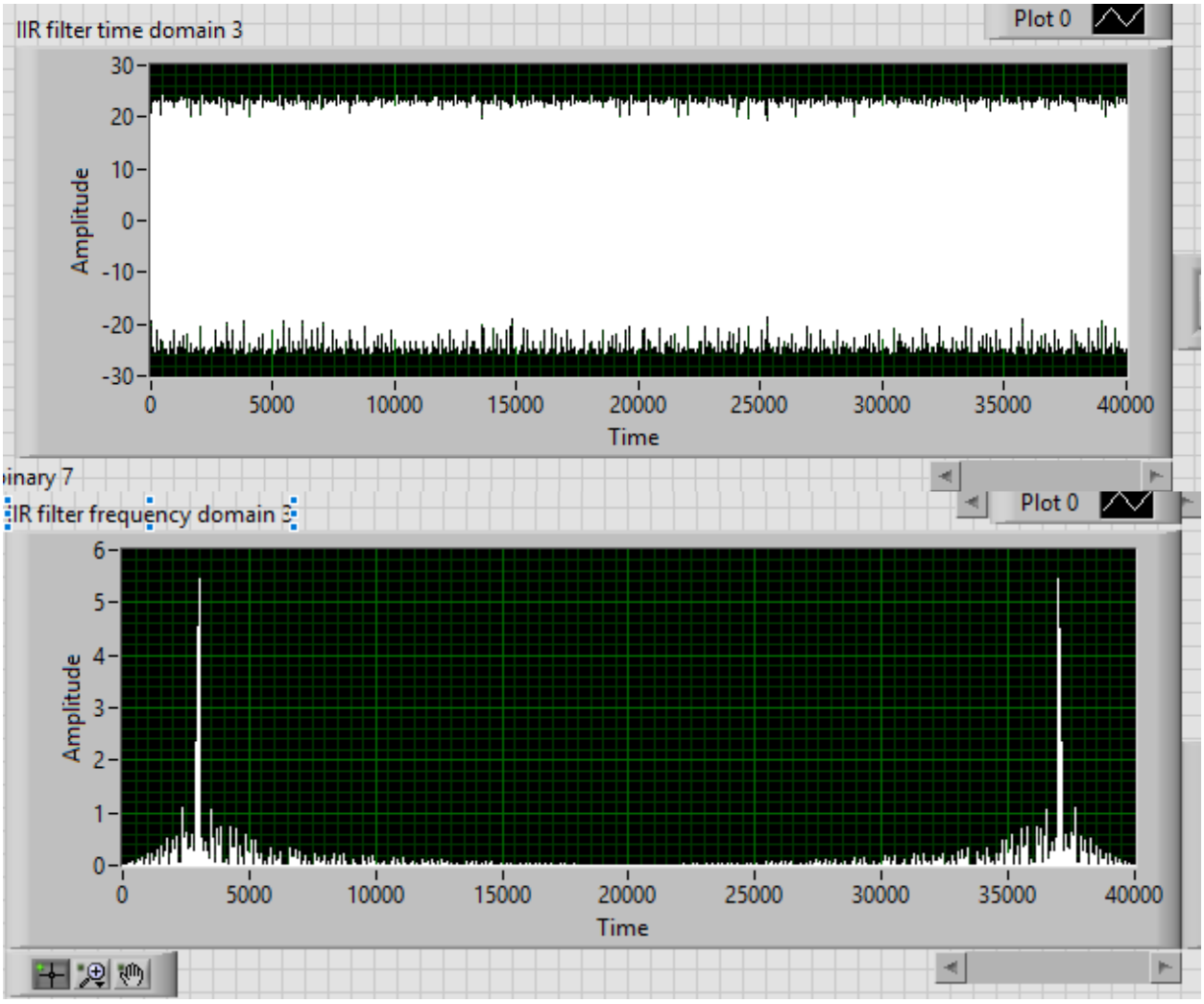
Task 2d:

The manually calculated coefficients Is applied as reverse and forward coefficients to the building block.



Task 2e:



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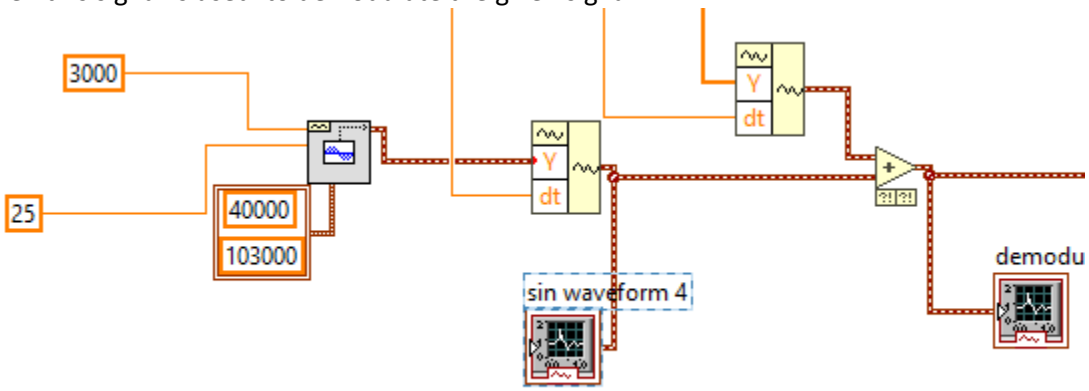
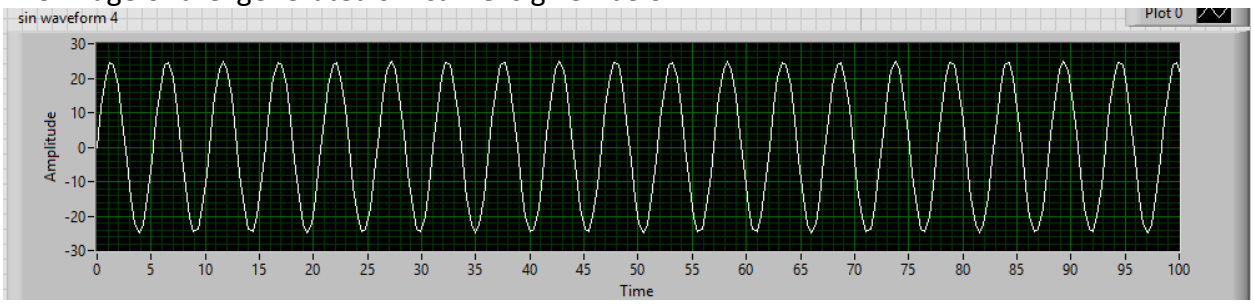
Task 2f:

Generating a carrier clock using a sine wave with the same frequency as the modulated signal. Then this signal is used to demodulate the given signal.

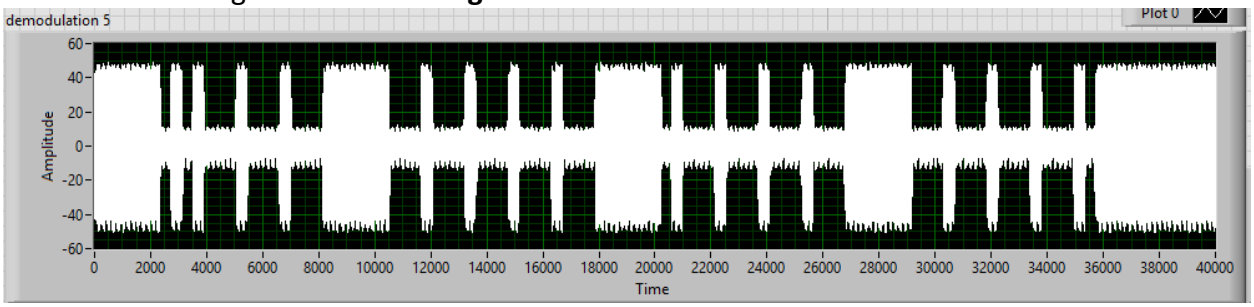


Frequency of the signal is 3kHz
Amplitude 25
Sampling frequency 40KHz

The image of the generated **sin curve** is given below



Then the following **demodulated signal** is found



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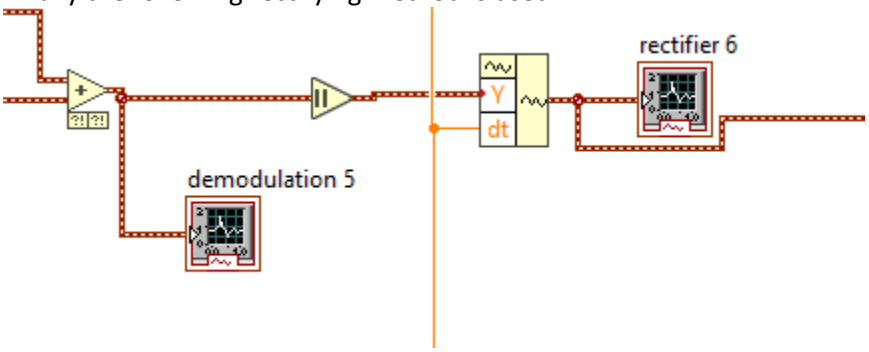
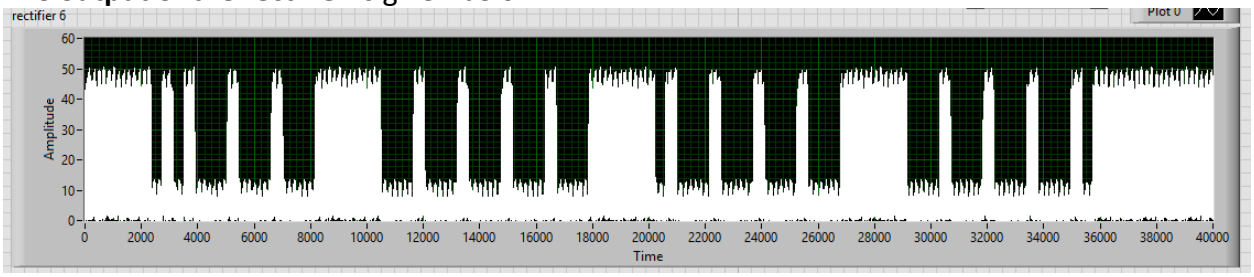
Task 2g:

Finally the following rectifying method is used.

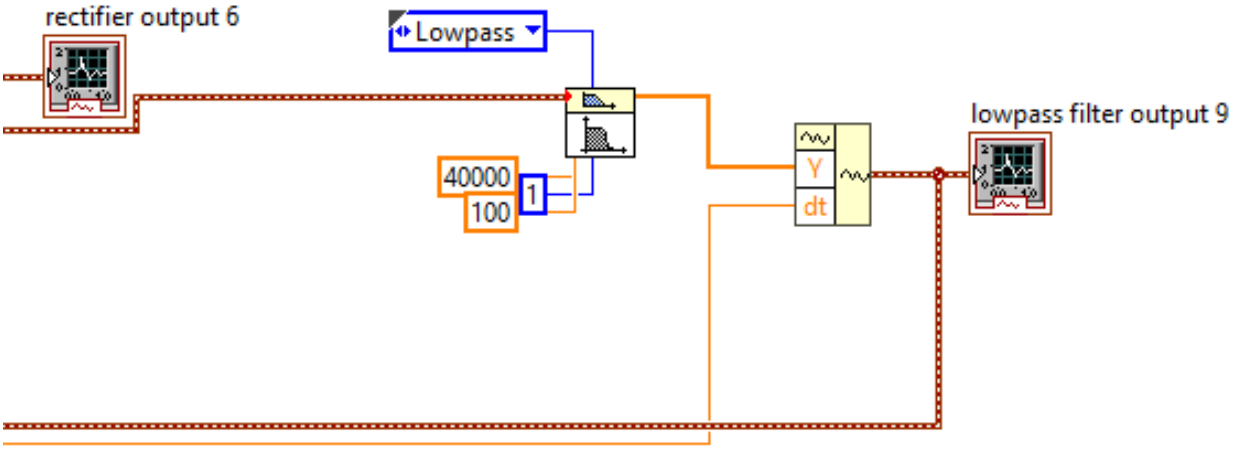


The **output of the rectifier** is given below:



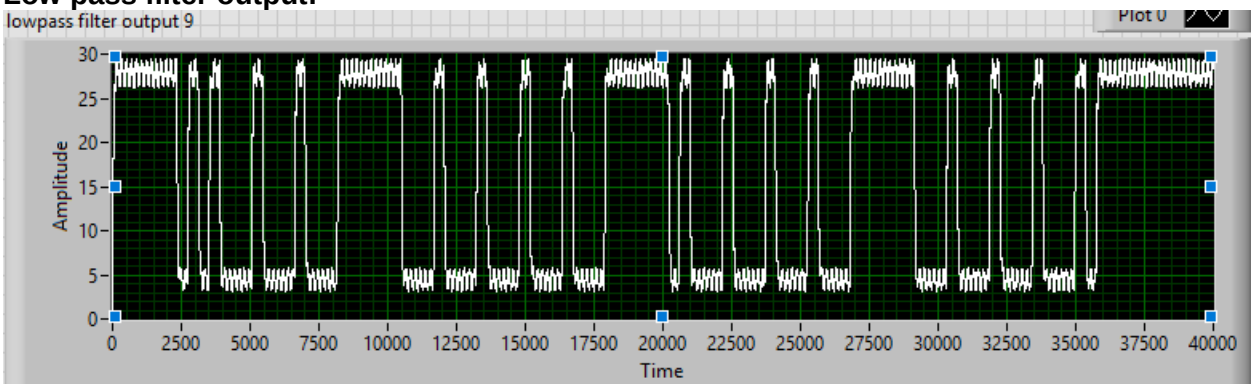
Task 2h:

In order to reconstruct the Morse signal, a **low pass filter** is used
Here first order filter is used
Low cut of frequency =100Hz
Sampling frequency 40000Hz

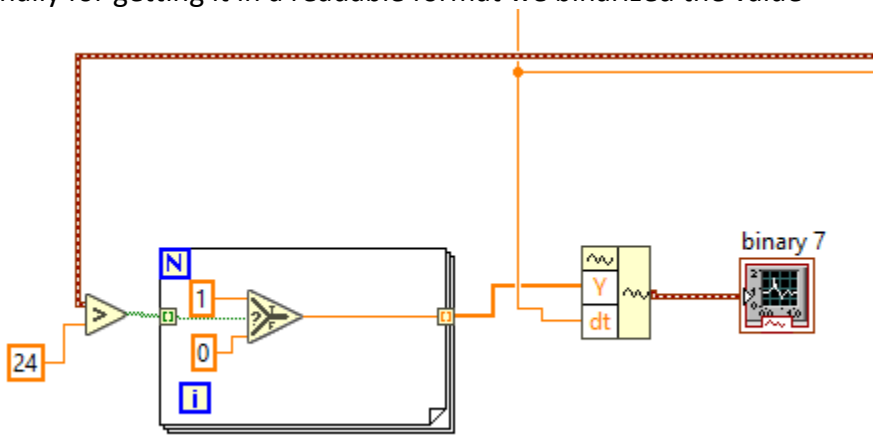


Then we get the following output.

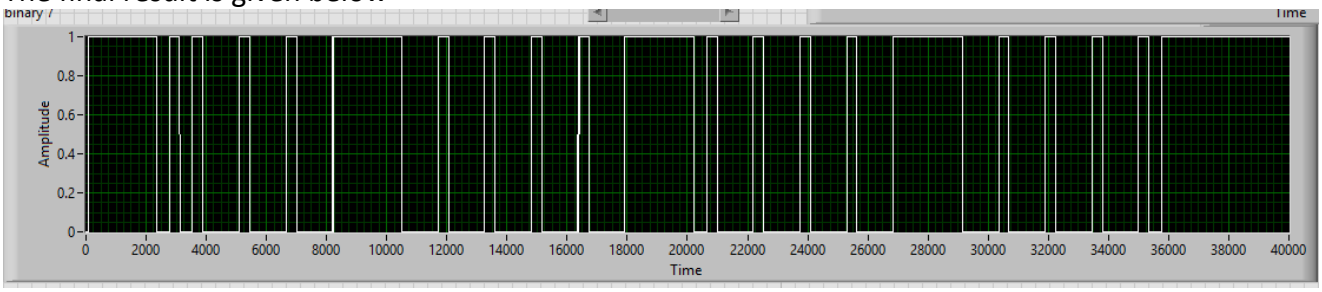
Low pass filter output:



Finally for getting it in a readable format we binarized the value



The final result is given below



Comparing this result with international morse code

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Task 2 i:

International Morse Code

1. A dash is equal to three dots.
2. The space between parts of the same letter is equal to one dot.
3. The space between two letters is equal to three dots.
4. The space between two words is equal to seven dots.

A	● ▬	U	● ● ▬
B	▬ ● ● ●	V	● ● ● ▬
C	▬ ● ▬ ●	W	● ▬ ▬
D	▬ ● ●	X	▬ ● ● ▬
E	●	Y	▬ ● ▬ ▬
F	● ● ▬ ●	Z	▬ ▬ ● ●
G	▬ ▬ ●		
H	● ● ● ●		
I	● ●		
J	● ▬ ▬ ▬		
K	▬ ● ▬	1	● ▬ ▬ ▬ ▬
L	● ▬ ● ●	2	● ● ▬ ▬ ▬
M	▬ ▬	3	● ● ● ▬ ▬
N	▬ ●	4	● ● ● ● ▬
O	▬ ▬ ▬	5	● ● ● ● ●
P	● ▬ ▬ ●	6	▬ ● ● ● ●
Q	▬ ▬ ● ▬	7	▬ ▬ ● ● ●
R	● ▬ ●	8	▬ ▬ ▬ ● ●
S	● ● ●	9	▬ ▬ ▬ ▬ ●
T	▬	0	▬ ▬ ▬ ▬ ▬

Which means :