School of Electrical and Electronic of Enginnering
eee 4474-01 : Experiments on Communication Networks
2조 2016142096 **조윤신**, 2017142043 **김재민**

Result Report Week 3

USPR(1) : Introduction, Labview, Spectogram

Experiment 1 : Python Visualization

Topic 1-1 : Python IQ Data Visualization

In this experiment, We used Python 'matplotlib.pyplot.specgram' fucntion for IQ data visualization.

```
(S,f,t)= plt.mlab.specgram(iq_signal, Fs=10e7, NFFT=64, noverlap=-14)
S=abs(S)
S=10*np.log10(S)
S= (((S-np.min(S)) / (np.max(S)-np.min(S))) * 255).astype(np.uint8)
S= S[::-1]
#y1 = label.iloc[DataIndex,1]
y1 = self.DirData[DataIndex]
self.data.append([S])
self.y.append([y1])
```

Figure 1: Pyhton spectrogram function

The paramenters used in this function are
Fs : The sampling freqeuncy used to calculate the Fourier frequencies.
NFFT : The number of data points used in each block for the FFT.
noverlap : The number of points of overlap between blocks.

Topic 1-2 : IQ Data Visualization Results

```
[Running] python -u "c:\Users\815ys\OneDrive\Yonsei\2022 2학기\2022-2 Team Project Management\2022-2
Network_Experiments\Experiment Results\02_USRP\week03\week3\Conv2Img.py"
Try Folder :  0
Folder Name in given IQ Signal file both ch there are # of files data : 123
Try Folder :  1
Folder Name in given IQ Signal file ch1 there are # of files data : 123
Try Folder :  2
Folder Name in given IQ Signal file ch2 there are # of files data : 125
Try Folder :  3
Folder Name in given IQ Signal file empty there are # of files data : 12
Total Data :  383
Data reading time spent :  0:01:15.031496

[Done] exited with code=0 in 81.31 seconds
```

Figure 2: IQ data visualization result

Using given IQ signal data, we could get 383 spectrogram images.

Experiment 2 : Labview Tutorial

Topic 2-1 : Transmitter Overview

Following figure is the transmitter Labview diagram.

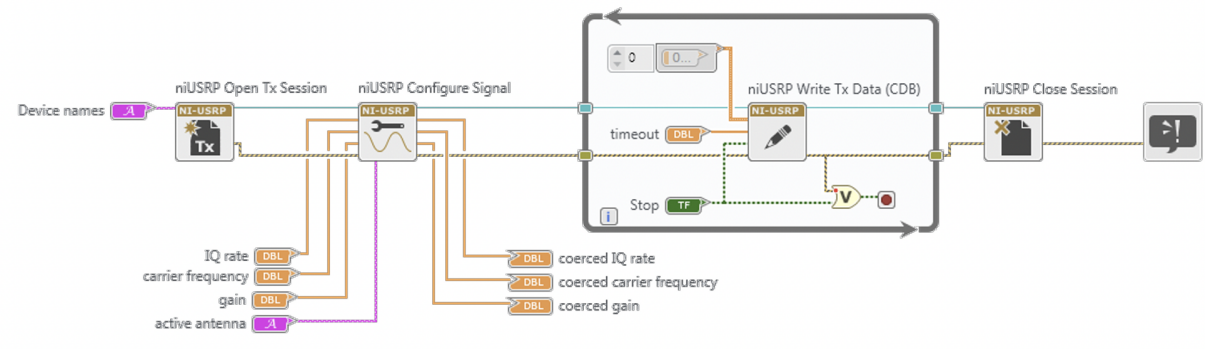

Figure 3: Transmitter Labview diagram

There are 4 main blocks regarding USRP transmitter
1. Open TX session : Turn on USRP and link the code to it.
2. Configure Signal : Configure signal parameters for USRP antenna (IQ rate, carrier frequency, gain, etc.)
3. Write TX data : Transmit data via USRP antenna
4. Close Session : Turn off USRP

Topic 2-2 : Basic Tutorial with Example Labview Code

Parameters

Parameter	Value
Number of Chirps	4
Chirp Direction	Up
Carrier Frequency	2.4G
IQ rate	4M

Table 1: Experiment 2 parameter values

Experiment Result

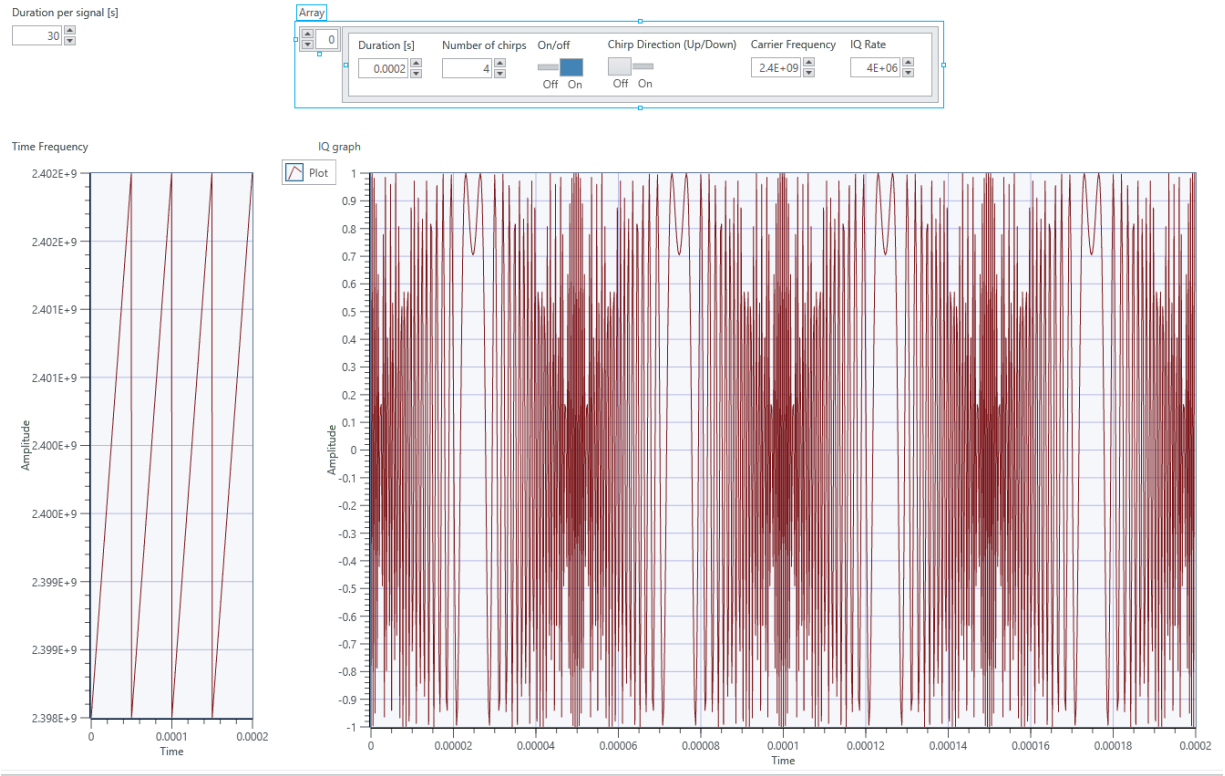

Figure 4: Experiment 2 result

Experiment 3 : Changing parameter values

Topic 3-1 : Number of Chirps

Parameters

Parameter	Value
Number of Chirps	2
Chirp Direction	Up
Carrier Frequency	2.4G
IQ rate	4M

Table 2: Experiment 3-1 parameter values

Experiment Result

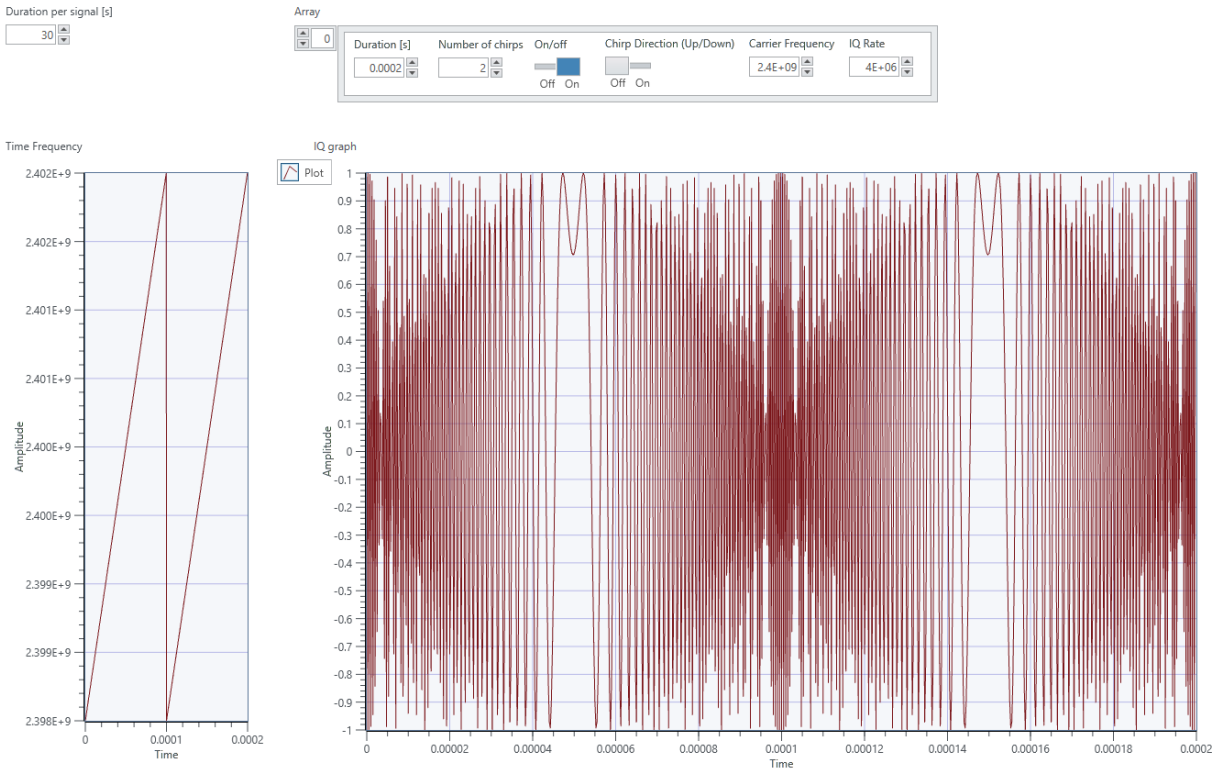

Figure 5: Experiment 3-1 result

Discussion

Compared to example of Experiment 2, we changed the number of chirps from 4 to 2. A chirp is a signal that the frequency increases or decreases with time. As we can see in both Time-Frequency graph and IQ graph, the number of chirps changed from 4 to 2.

Topic 3-2 : Chirps Direction

Parameters

Parameter	Value
Number of Chirps	4
Chirp Direction	Down
Carrier Frequency	2.4G
IQ rate	4M

Table 3: Experiment 3-2 parameter values

Experiment Result

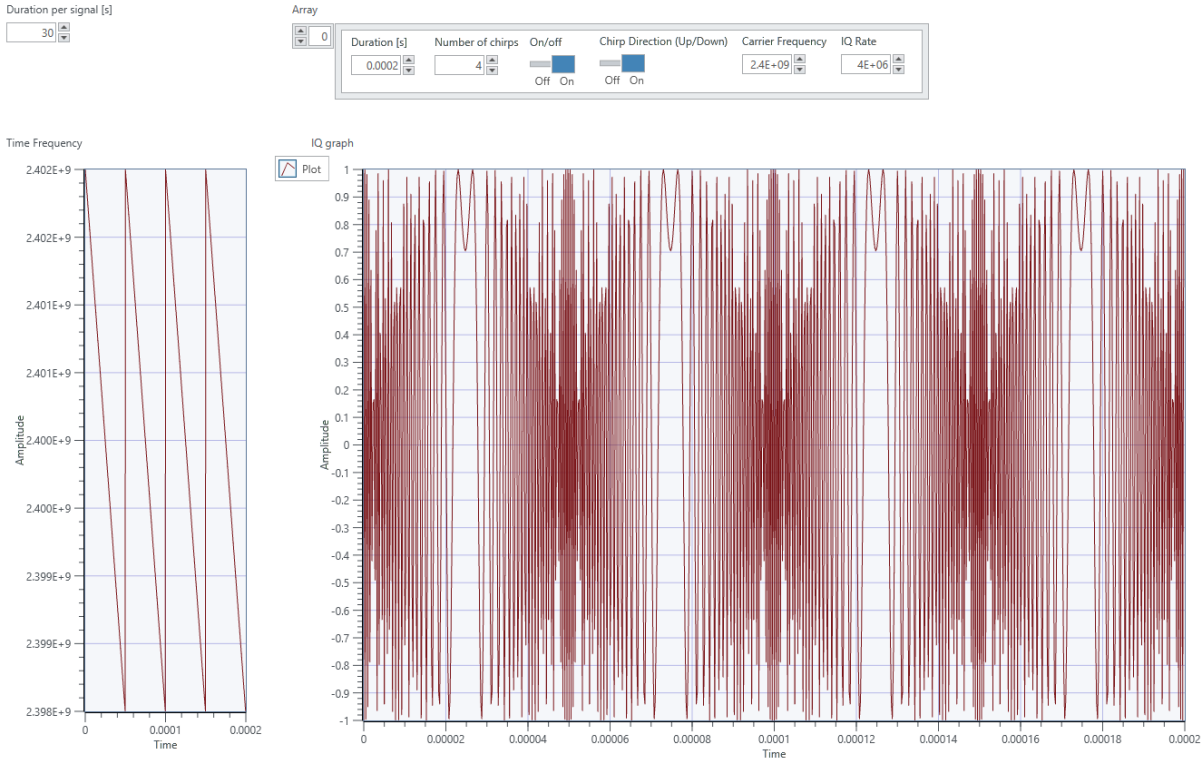

Figure 6: Experiment 3-2 result

Discussion

Compared to example of Experiment 2, we changed the chirp direction from ‘Up’ to ‘Down’. As we can see in Time-Frequency graph, the frequency of chirps is increasing linearly in Experiment 2, but it is decreasing linearly in this experiment. However, IQ graphs are the same.

Topic 3-3 : Carrier Frequency

Parameters

Parameter	Value
Number of Chirps	4
Chirp Direction	Up
Carrier Frequency	2.39G
IQ rate	4M

Table 4: Experiment 3-3-1 parameter values

Experiment Result

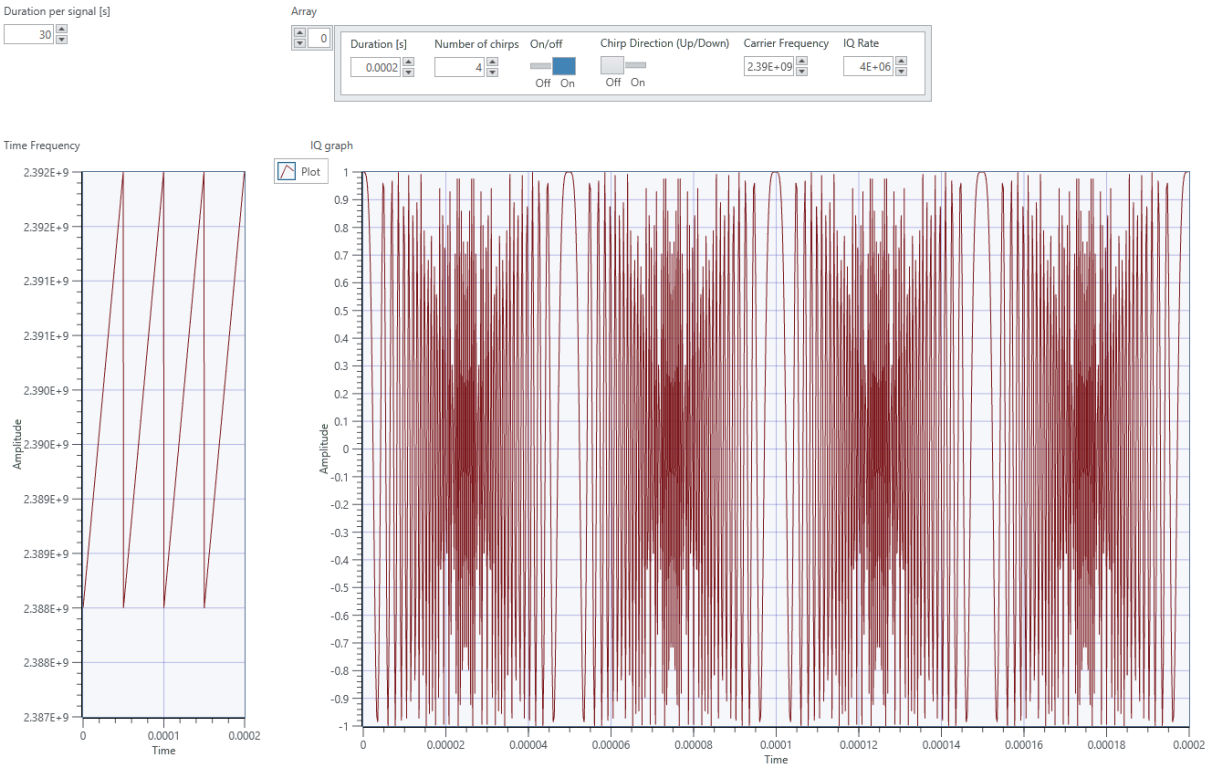

Figure 7: Experiment 3-3-1 result

Parameters

Parameter	Value
Number of Chirps	4
Chirp Direction	Up
Carrier Frequency	2.41G
IQ rate	4M

Table 5: Experiment 3-3-2 parameter values

Experiment Result

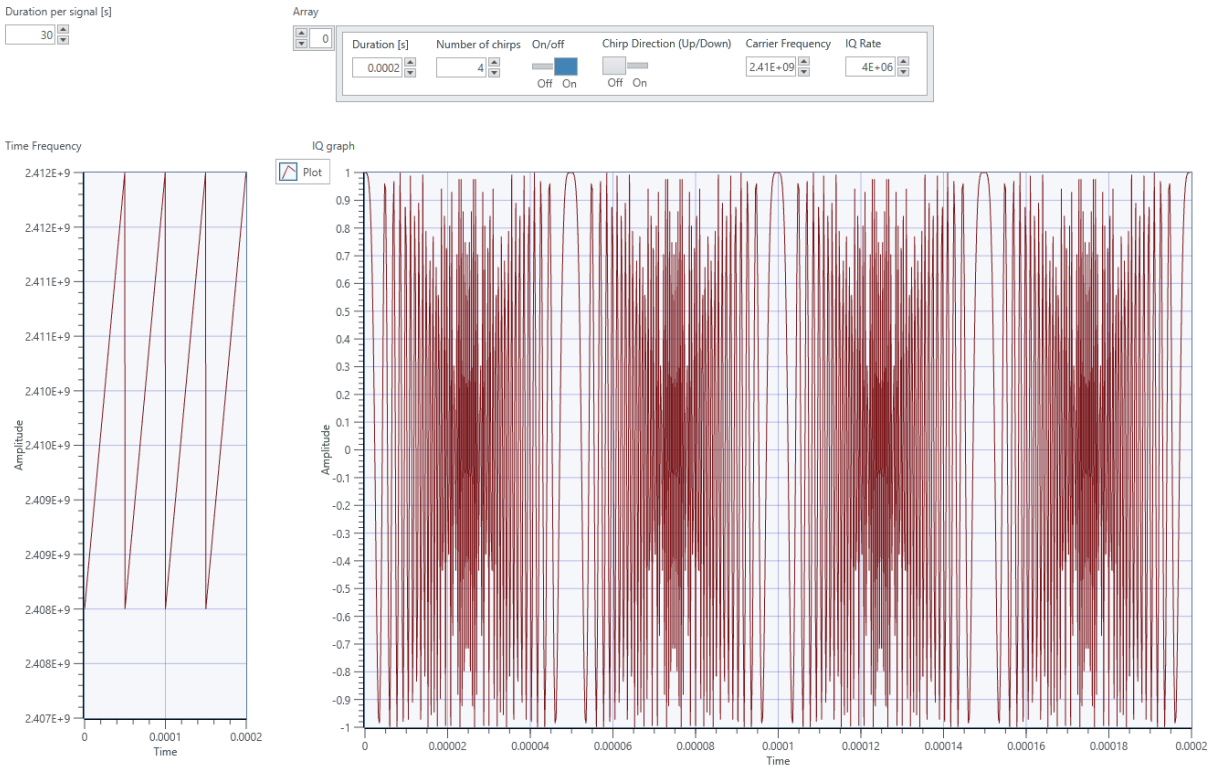

Figure 8: Experiment 3-3-2 result

Discussion

Compared to example of Experiment 2, we changed the carrier frequency from 2.4G to 2.39G and 2.41G. As we can see in Time-Frequency graph, the carrier frequency is located in the center of the chirp's frequency range. So, the chirp's frequency range shifts as the carrier frequency changes. Since the frequency difference is too small, we can't find difference between IQ graphs.

Topic 3-4 : IQ rate

Parameters

Parameter	Value
Number of Chirps	4
Chirp Direction	Up
Carrier Frequency	2.4G
IQ rate	8M

Table 6: Experiment 3-4-1 parameter values

Experiment Result

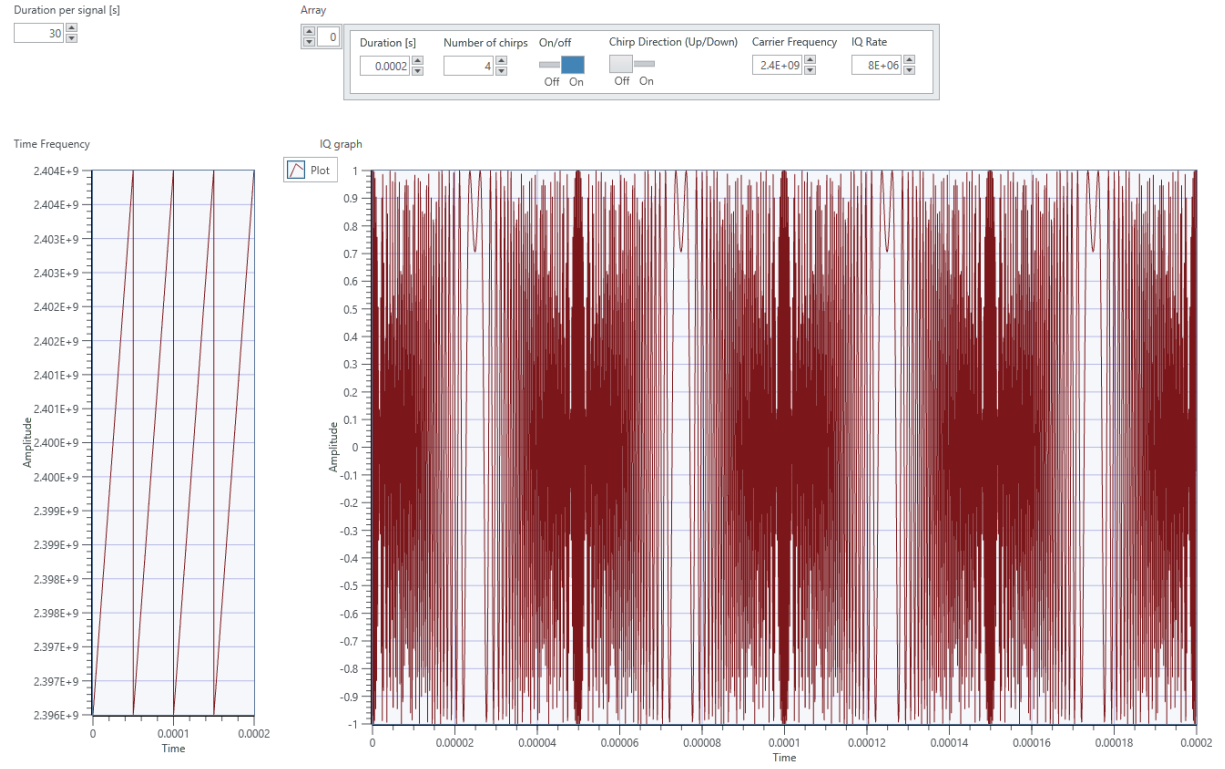

Figure 9: Experiment 3-4-1 result

Parameters

Parameter	Value
Number of Chirps	4
Chirp Direction	Up
Carrier Frequency	2.4G
IQ rate	12M

Table 7: Experiment 3-4-2 parameter values

Experiment Result

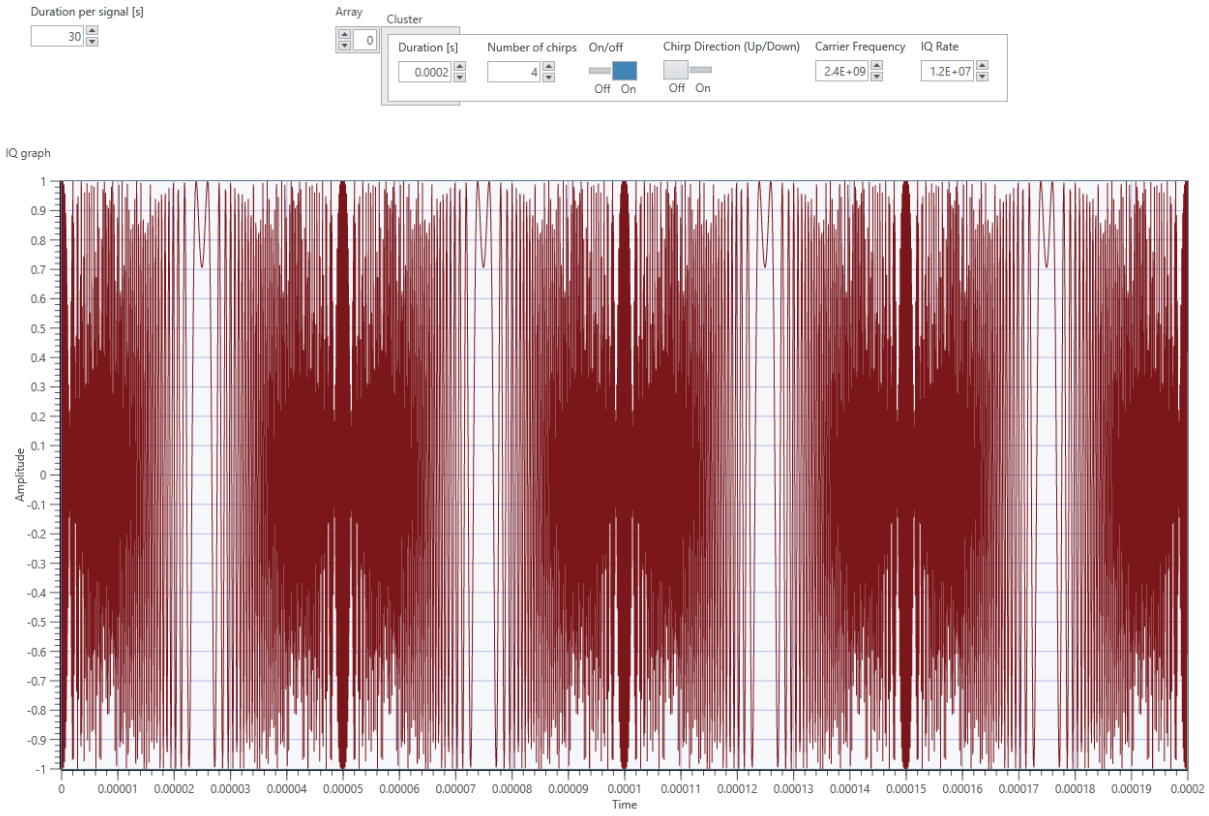

Figure 10: Experiment 3-4-2 result

Discussion

Compared to example of Experiment 2, we changed the IQ rate from 4M to 8M and 12M. As we can see in Time-Frequency graph, the IQ rate is equal to chirp's frequency range. So, the chirp's frequency range increases as the IQ rate increases. Also, IQ graph is denser on time axis as the IQ rate increases.