DSP Quiz # 2

(1)

a) $x(t) = \sum_{n=1,3,5}^{\infty} \frac{4}{n\pi} \sin(2\pi n f_0 t)$

non zero coeff for $n = 1, 3, 5, 7 \ldots$

(2) yes the gibbs effect is observed because it is representing a discontinuous square wave using a finite sum of continuous funcs. The overshoot near the edges also visually the gibbs effect.

(3)

d) phase becomes a linearly decreasing function

e) 627.69 samples is what is showed but it should be 100 samples as what was introduced

f) noise distorts the phase especially where the magnitude is small, making the slope & group delay estimation inaccurate

(4) d) yes, you can see the harmonics at 100kHz, 300kHz & 500kHz

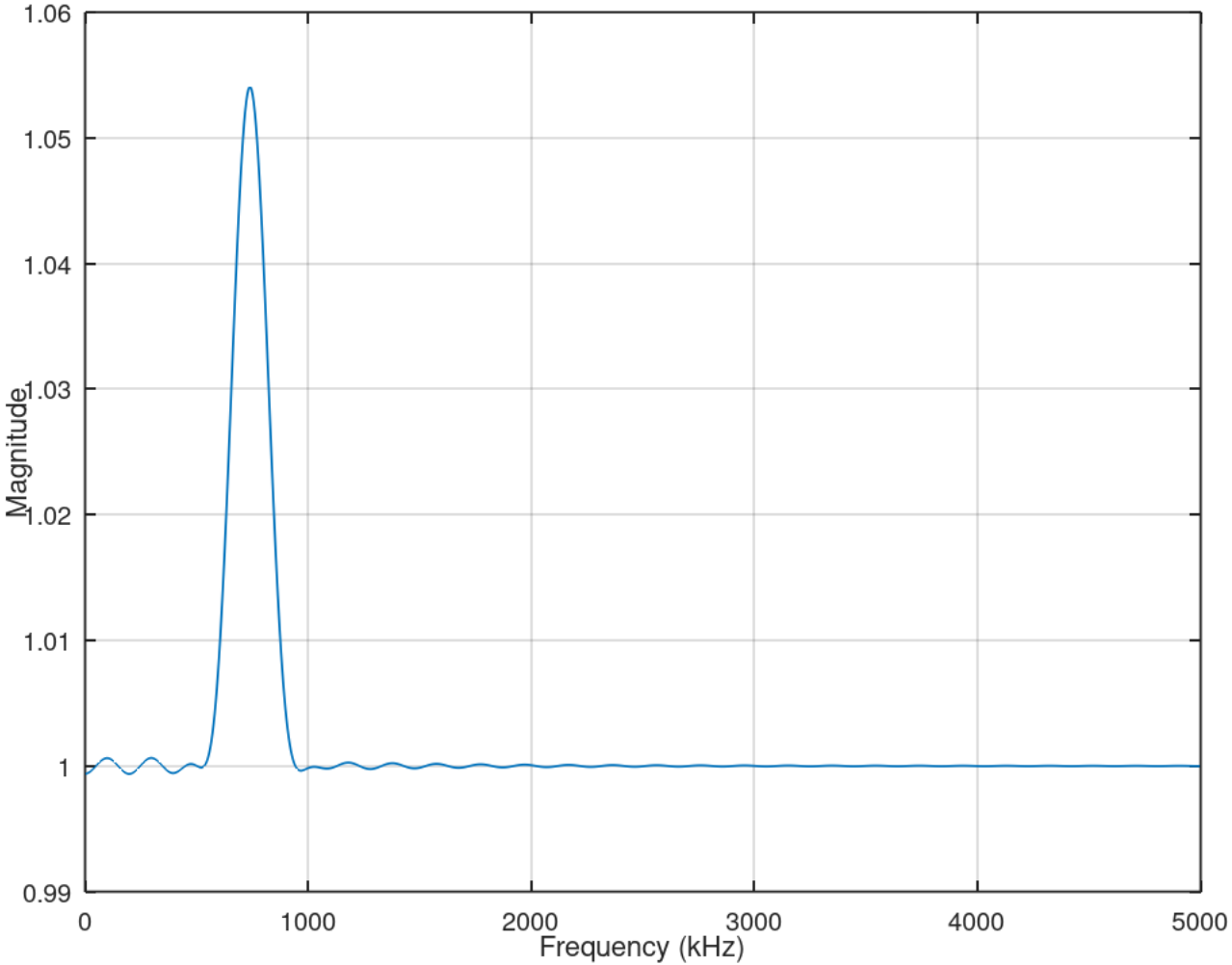
When the sine wave is clipped it becomes more square like and like the fourier it has many odd harmonics. The DFT also reveals additional harmonics

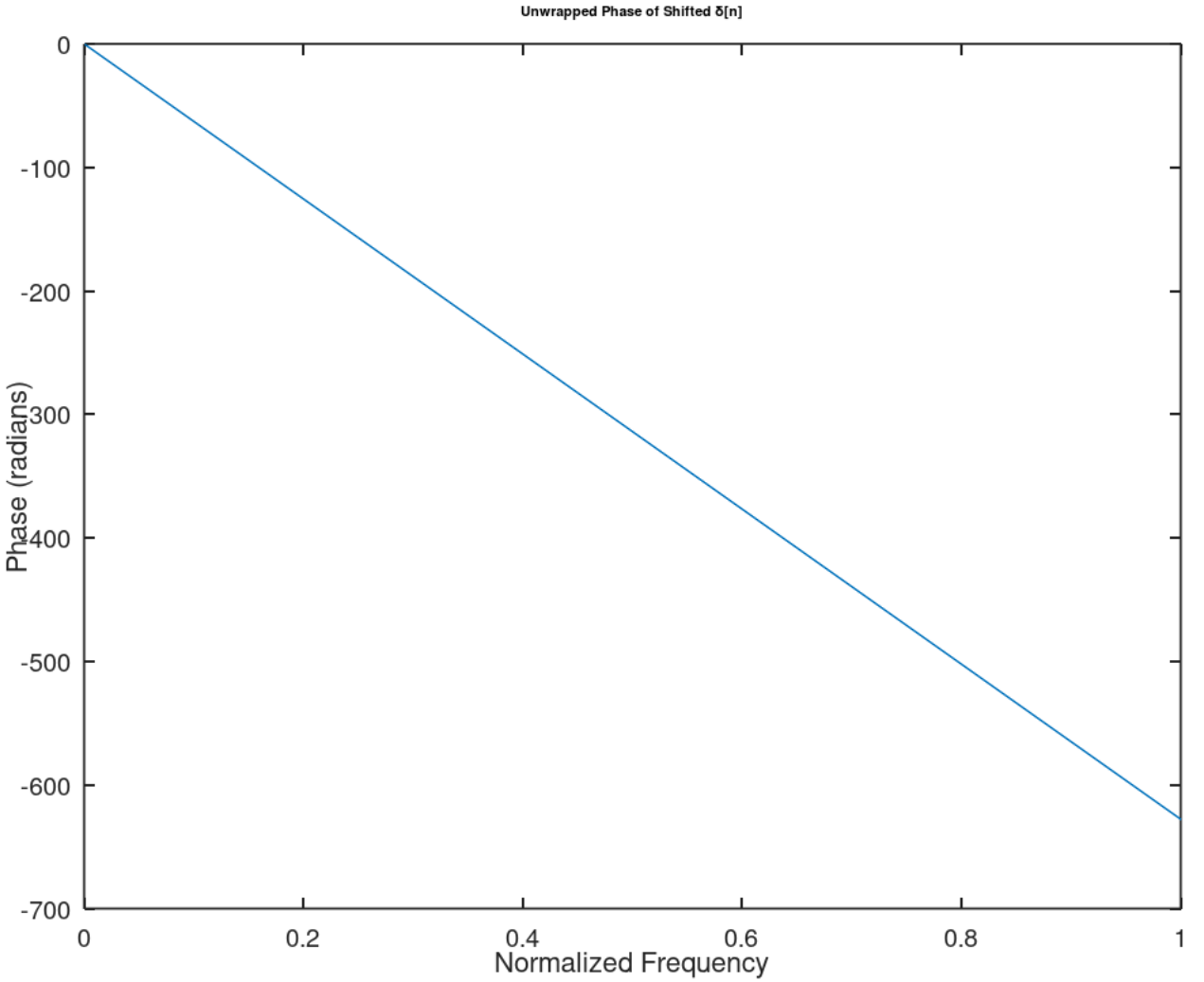
(8)

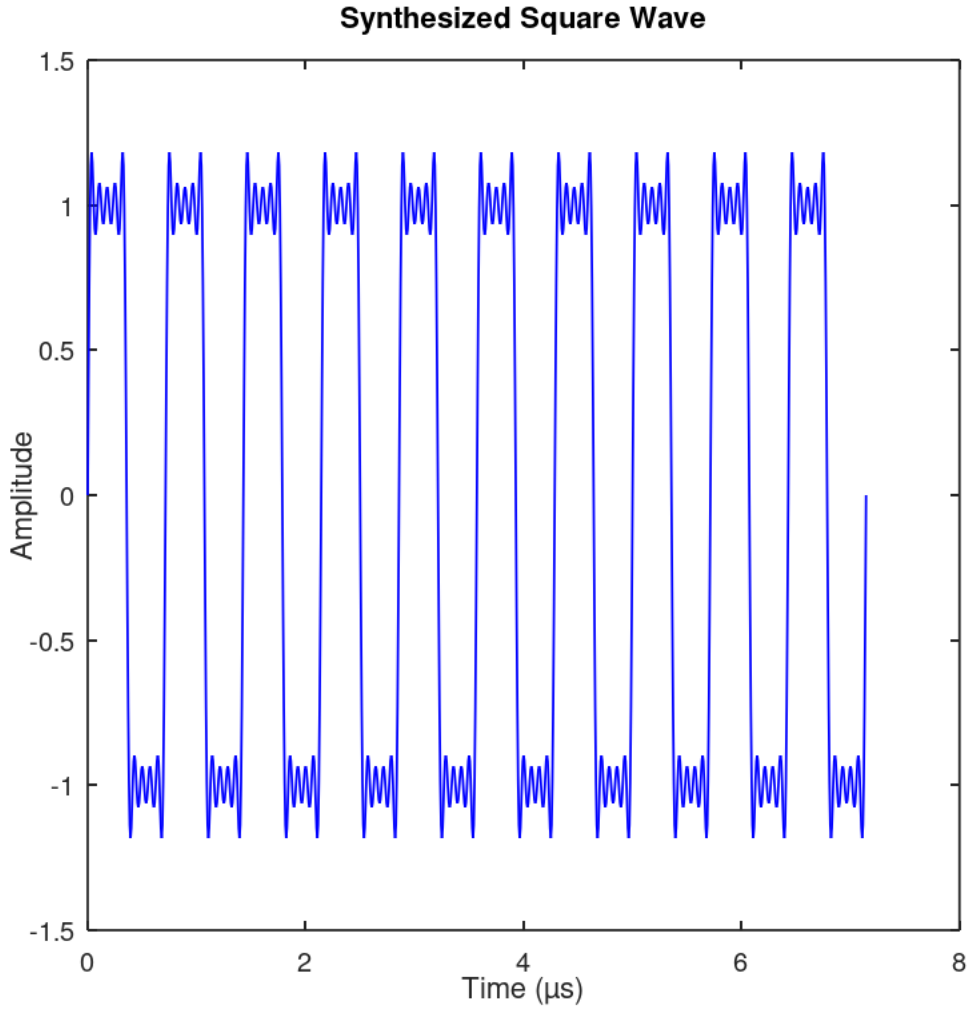
c) The results are non-linear

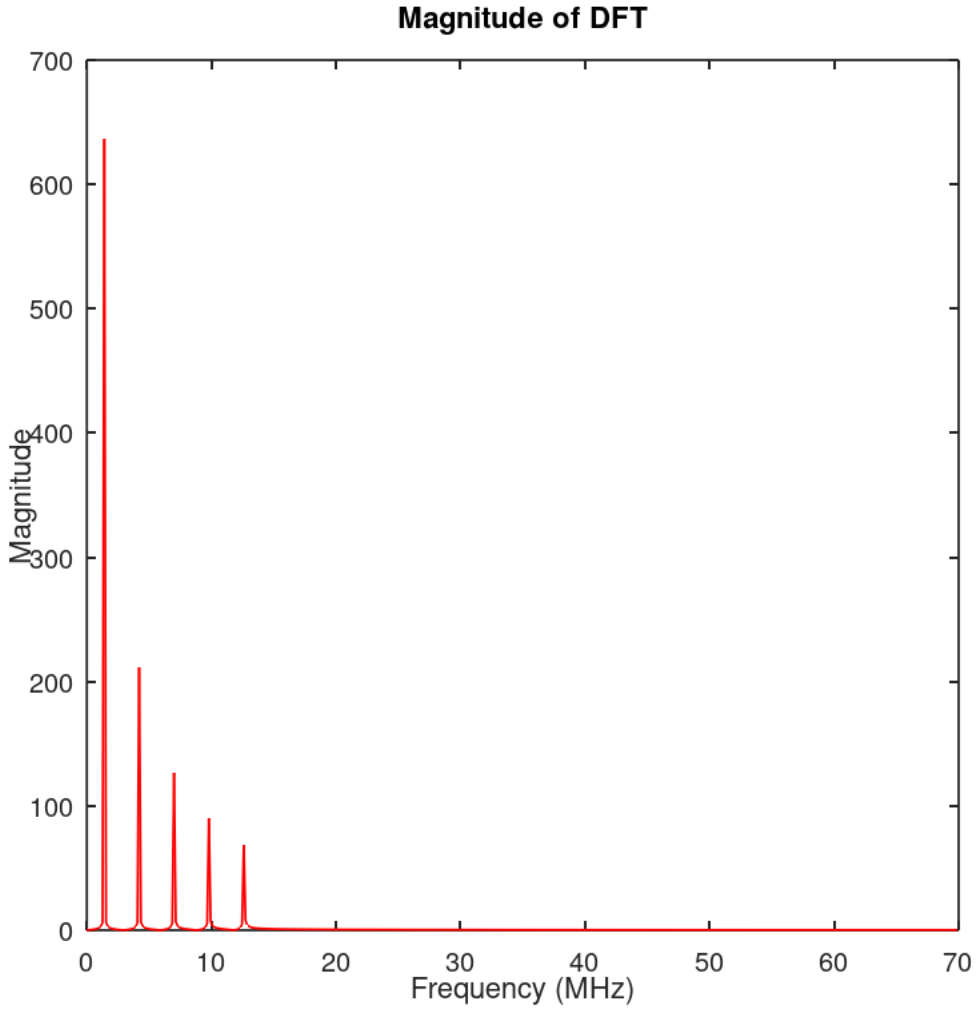
(9)

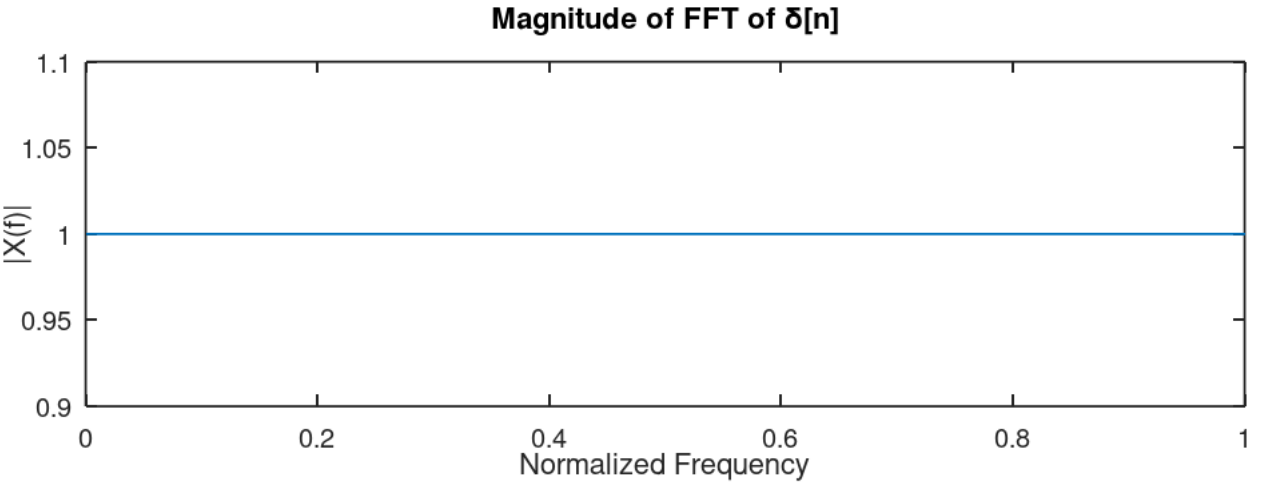
note: not sure if figure is meant to look like that, but it is extremely neat

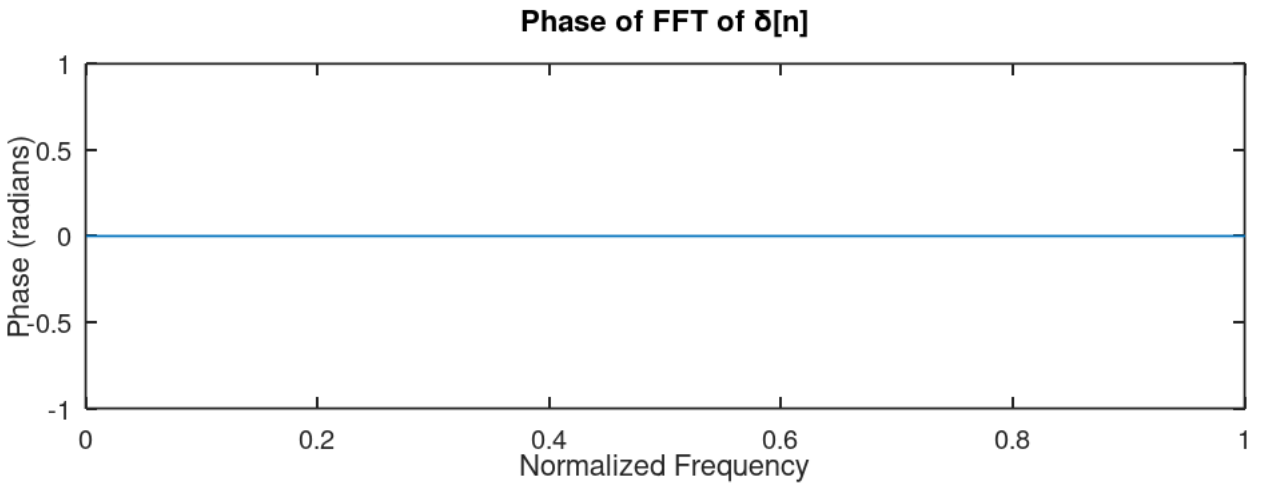

1.06
1.05
1.04
1.03
1.02
1.01
1
0.99
Magnitude
0
1000
2000
3000
4000
5000
Frequency (kHz)

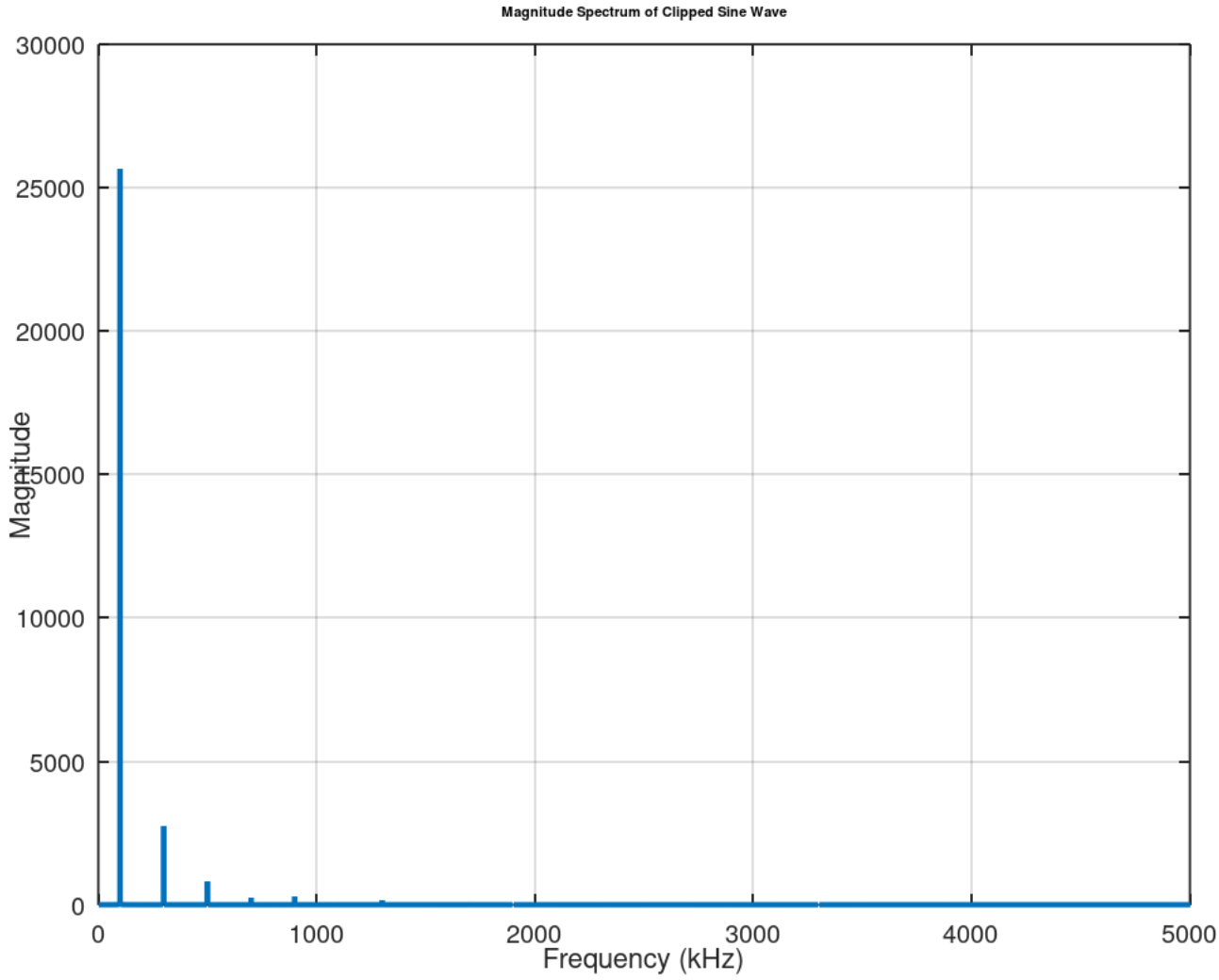

Unwrapped Phase of Shifted δ[n]
0
-100
-200
-300
-400
-500
-600
-700
Phase (radians)
0
0.2
0.4
0.6
0.8
1
Normalized Frequency

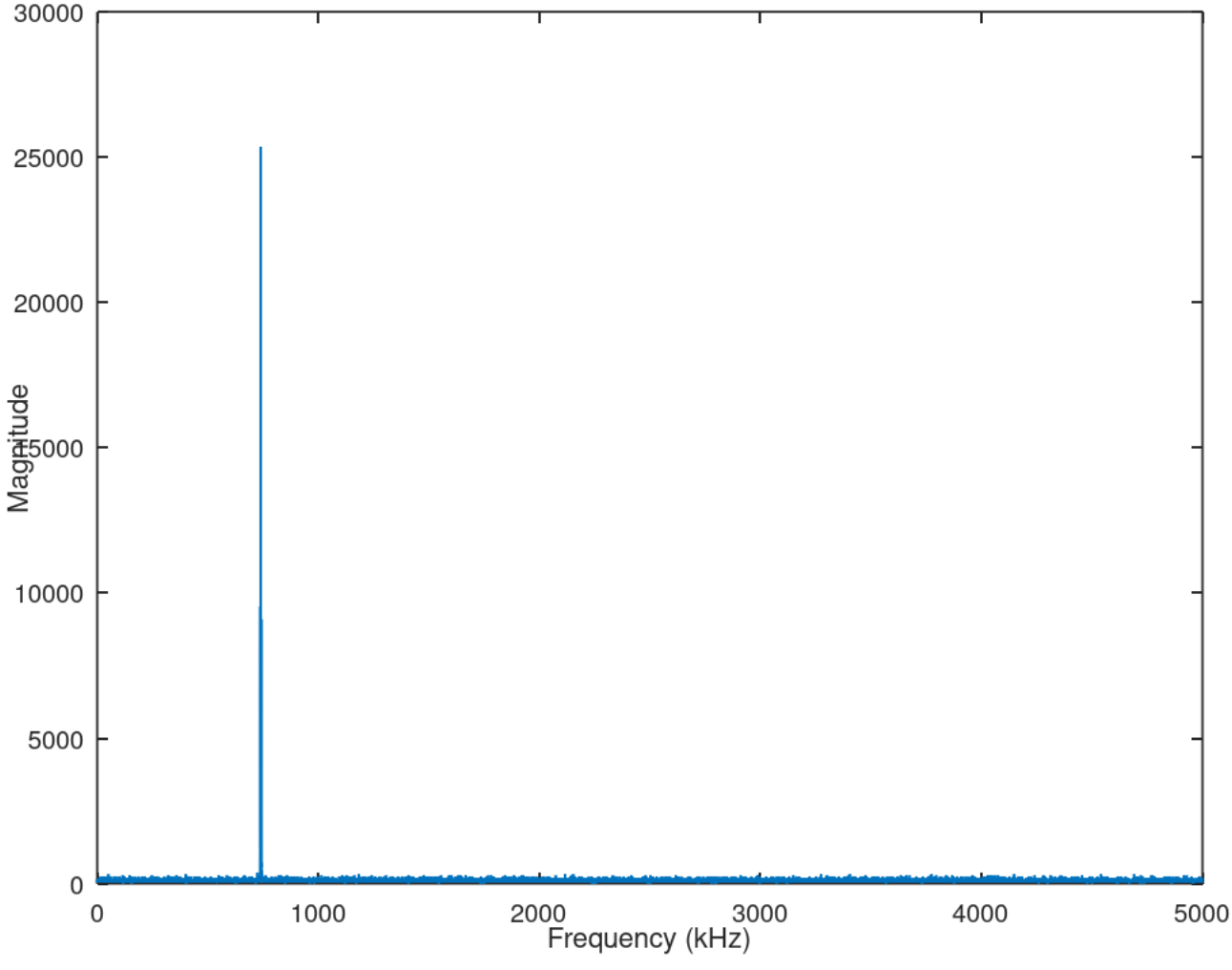

Synthesized Square Wave
Amplitude
Time (μs)
1.5
1
0.5
0
-0.5
-1
-1.5
0
2
4
6
8

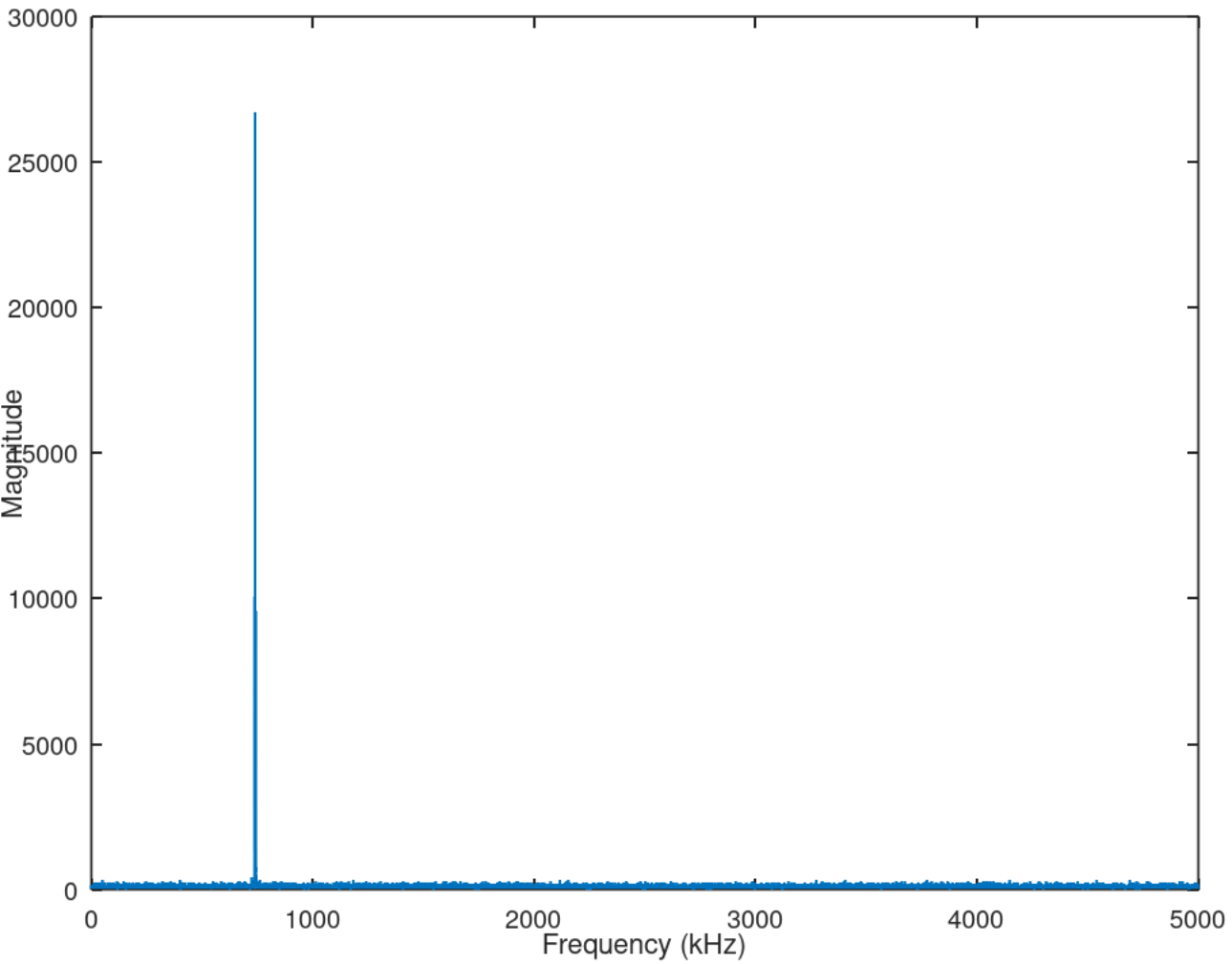

Magnitude of DFT
Magnitude
Frequency (MHz)
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70

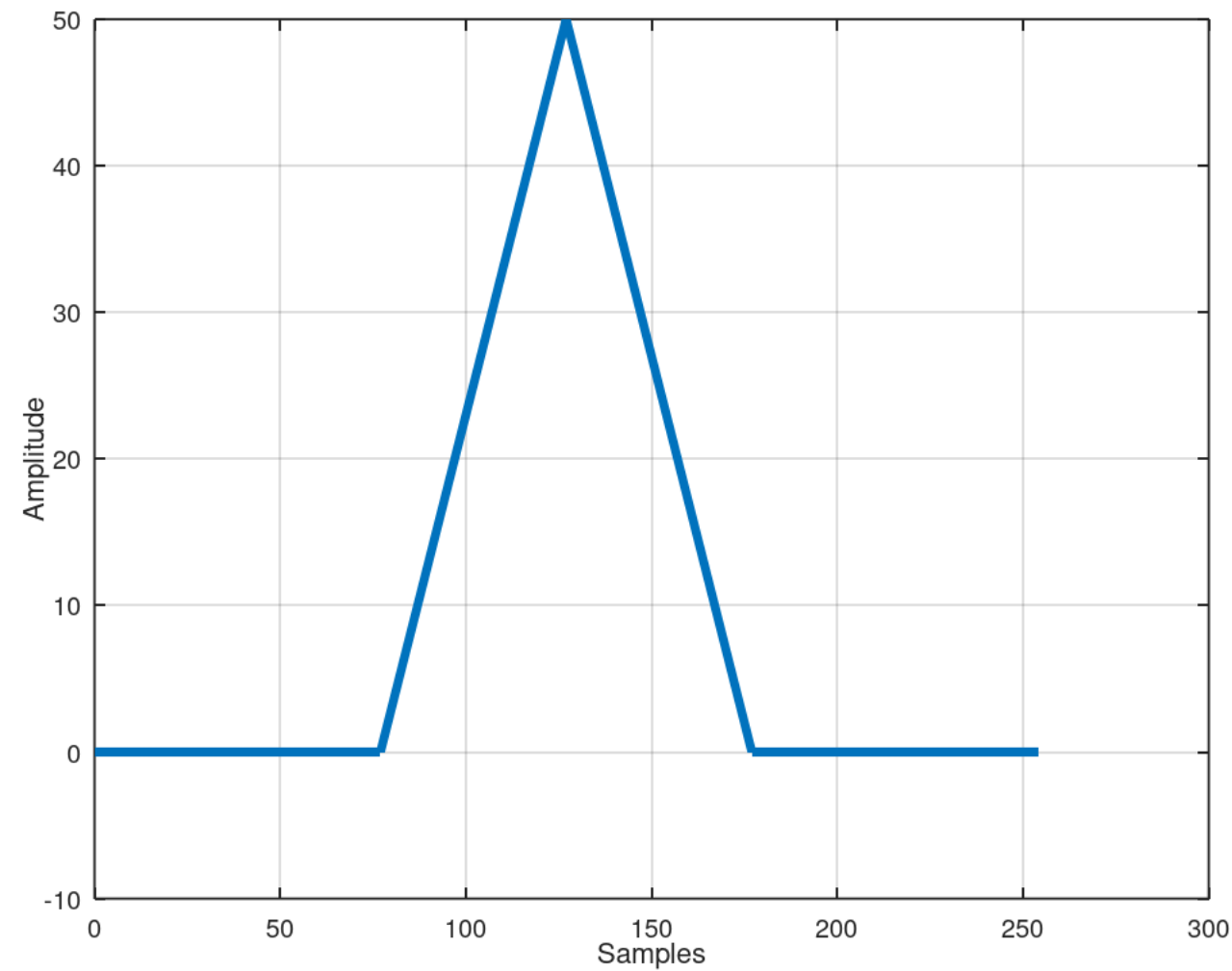

Magnitude of FFT of δ[n]
1.1
1.05
1
0.95
0.9
|X(f)|
0
0.2
0.4
0.6
0.8
1
Normalized Frequency

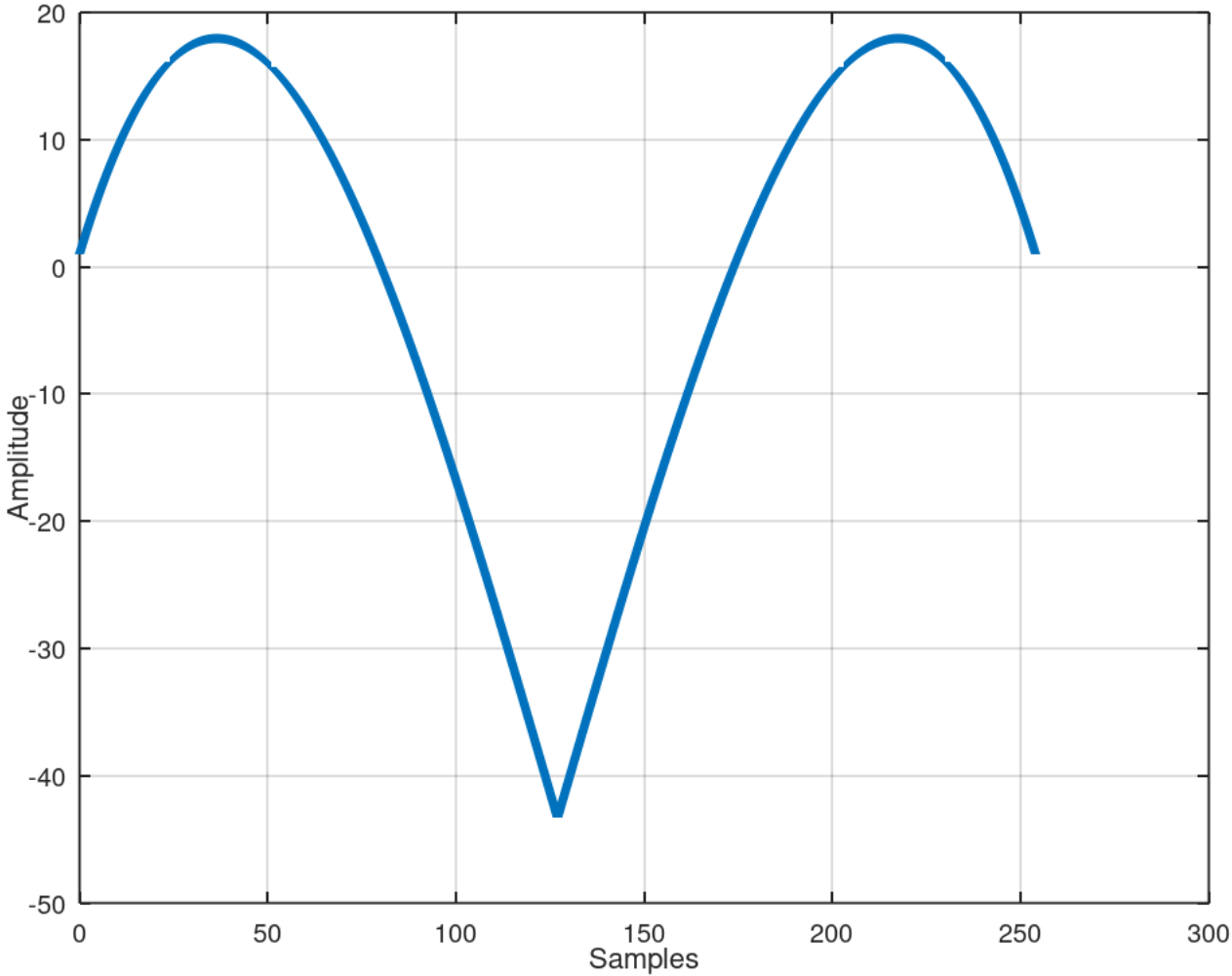

Phase of FFT of δ[n]
1
0.5
0
-0.5
-1
Phase (radians)
0
0.2
0.4
0.6
0.8
1
Normalized Frequency

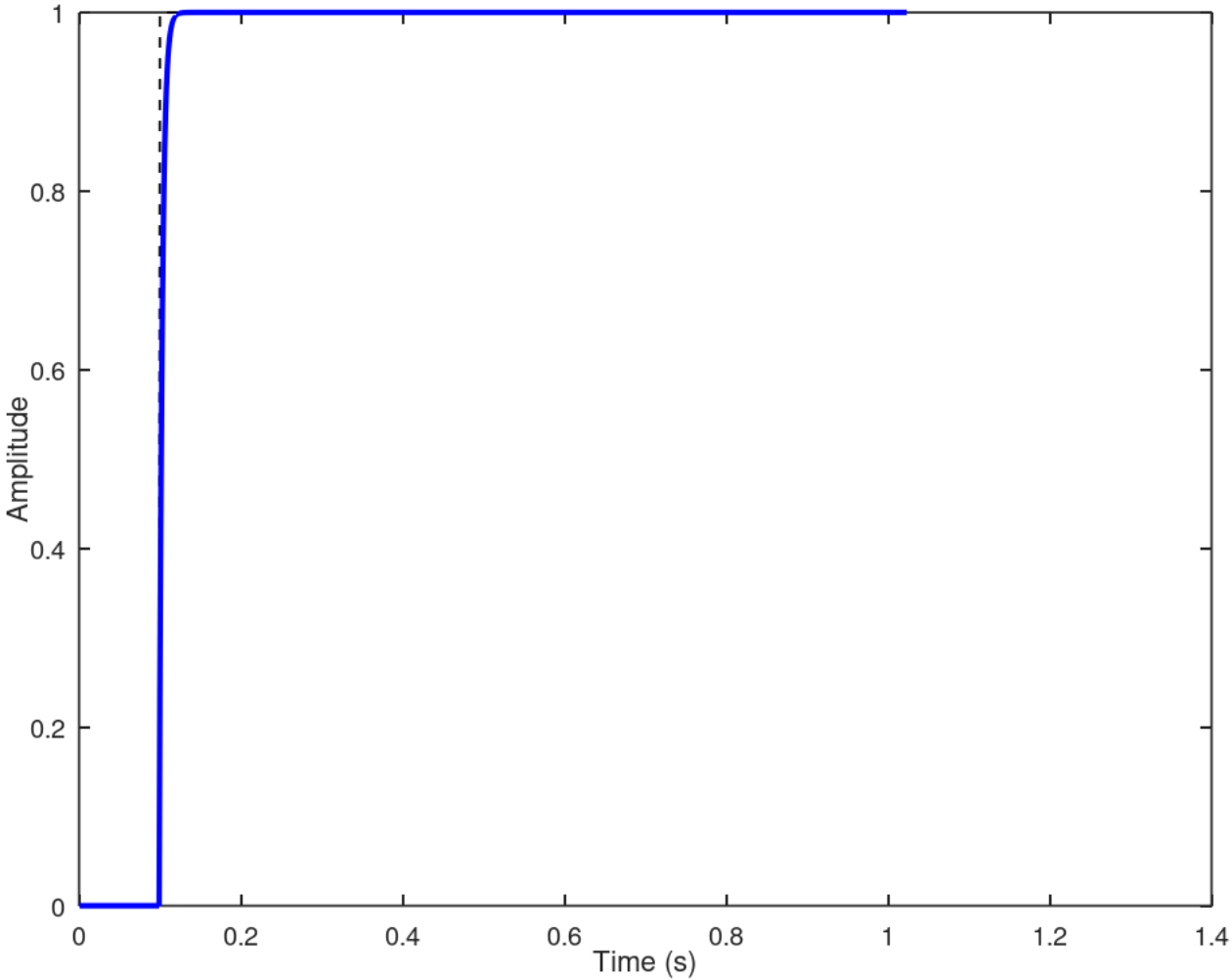

Magnitude Spectrum of Clipped Sine Wave
30000
25000
20000
15000
10000
5000
0
Magnitude
0
1000
2000
3000
4000
5000
Frequency (kHz)

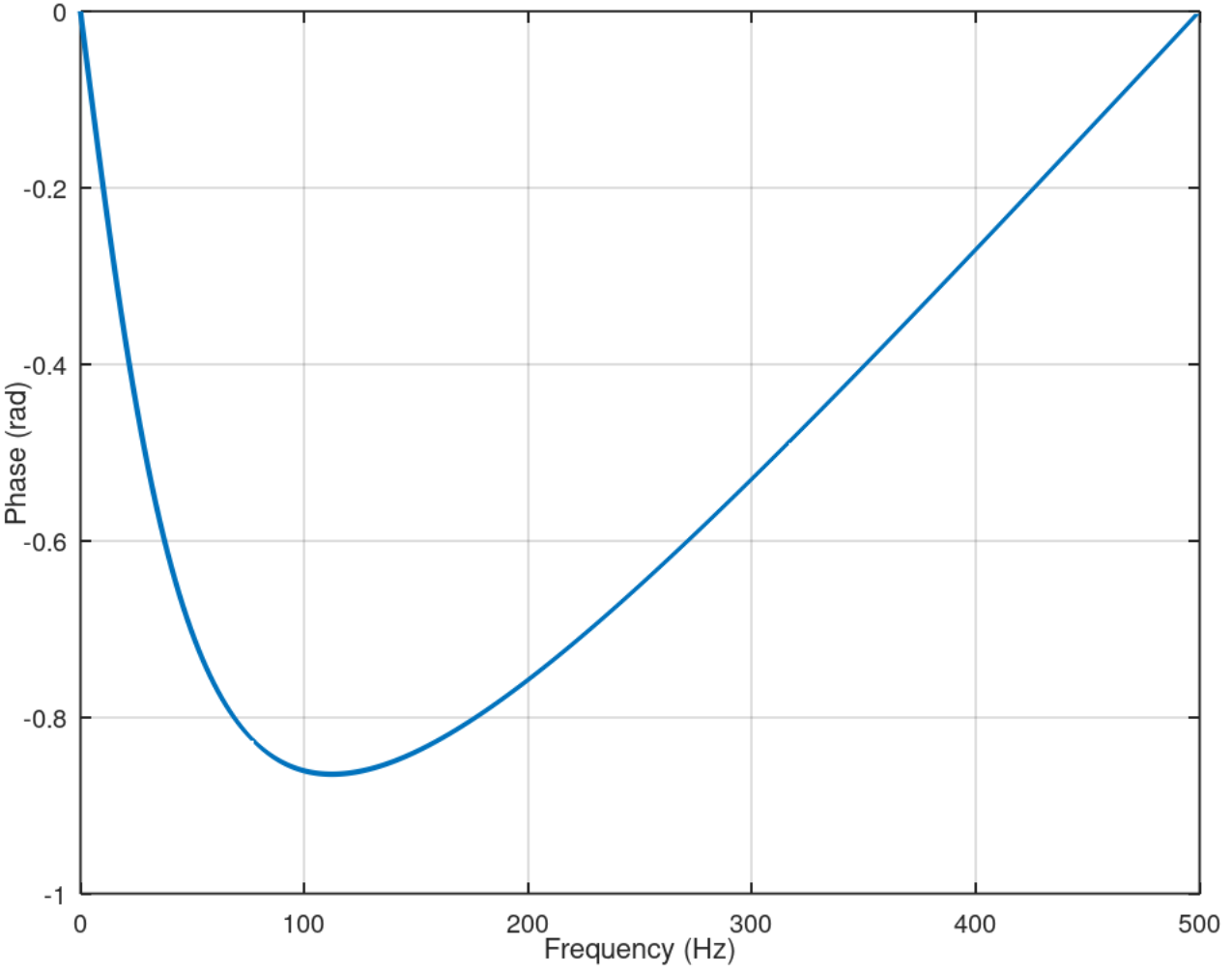

30000
25000
20000
15000
10000
5000
0
Magnitude
0
1000
2000
3000
4000
5000
Frequency (kHz)

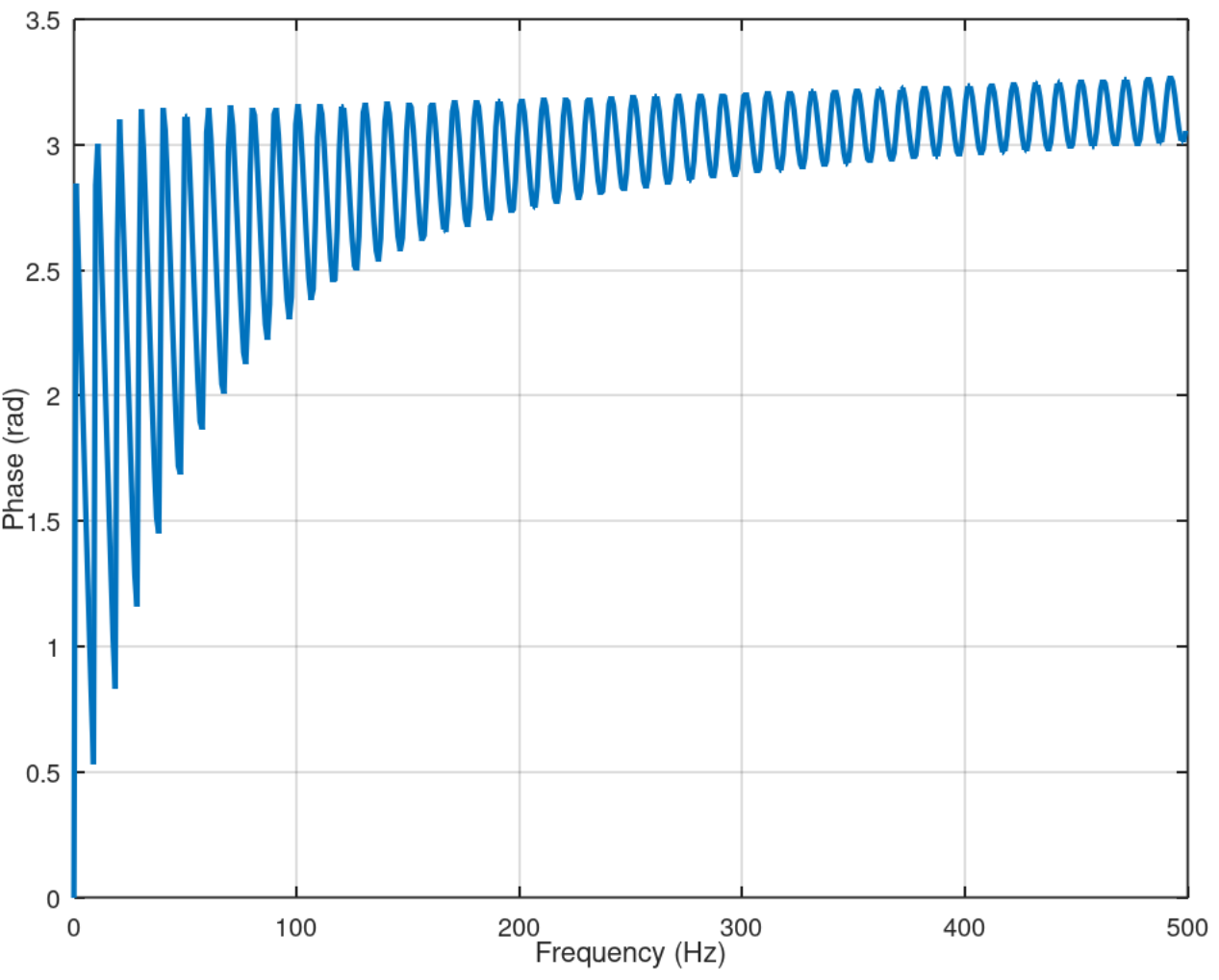

30000
25000
20000
15000
10000
5000
0
Magnitude
0
1000
2000
3000
4000
5000
Frequency (kHz)

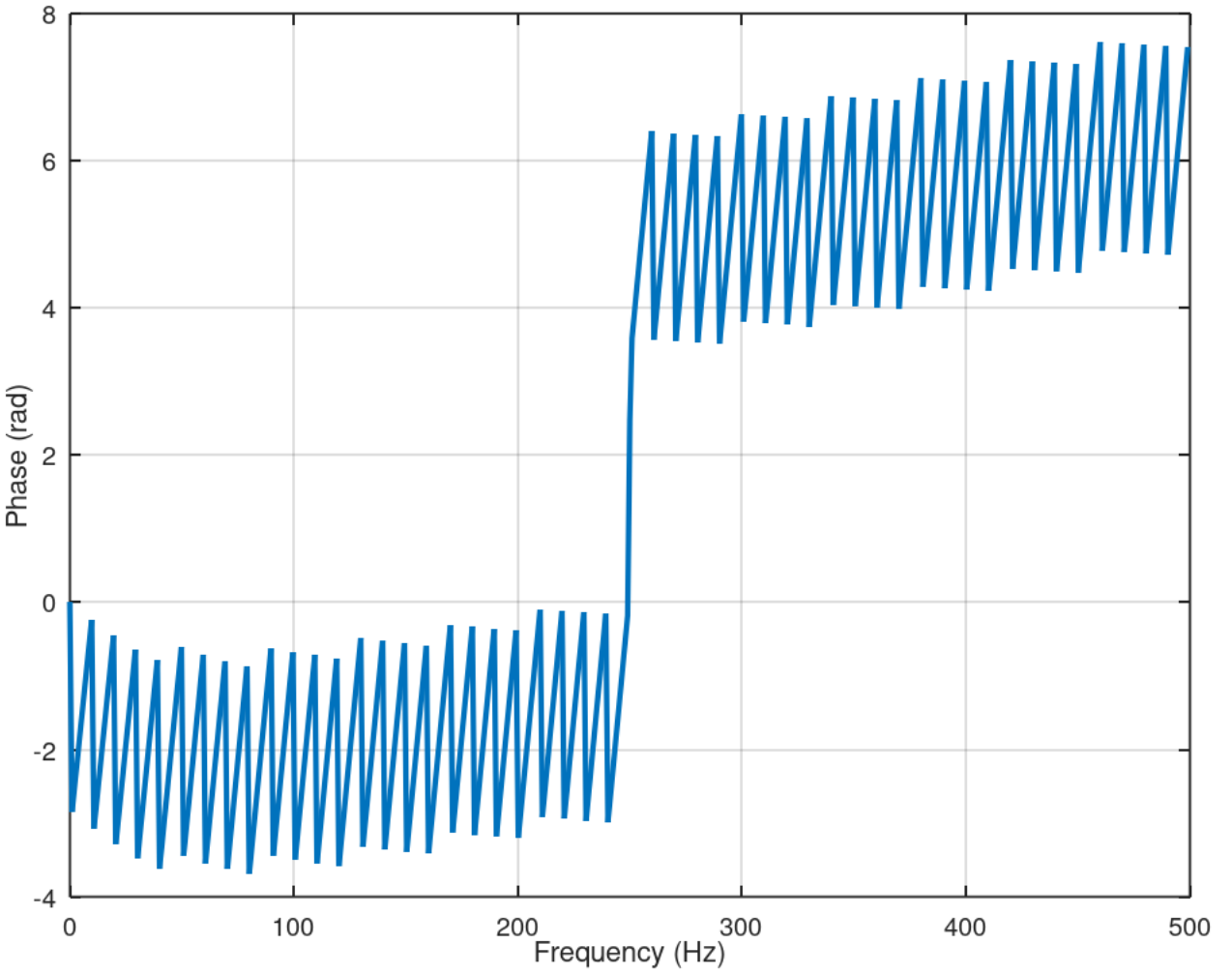

50
40
30
20
10
0
-10
Amplitude
0
50
100
150
200
250
300
Samples


20
10
0
-10
-20
-30
-40
-50
Amplitude
0
50
100
150
200
250
300
Samples


1
0.8
0.6
0.4
0.2
0
Amplitude
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Time (s)


0
-0.2
-0.4
-0.6
-0.8
-1
Phase (rad)
0
100
200
300
400
500
Frequency (Hz)


3.5
3
2.5
2
1.5
1
0.5
0
Phase (rad)
0
100
200
300
400
500
Frequency (Hz)


8
6
4
2
0
-2
-4
Phase (rad)
0
100
200
300
400
500
Frequency (Hz)