Lab 2

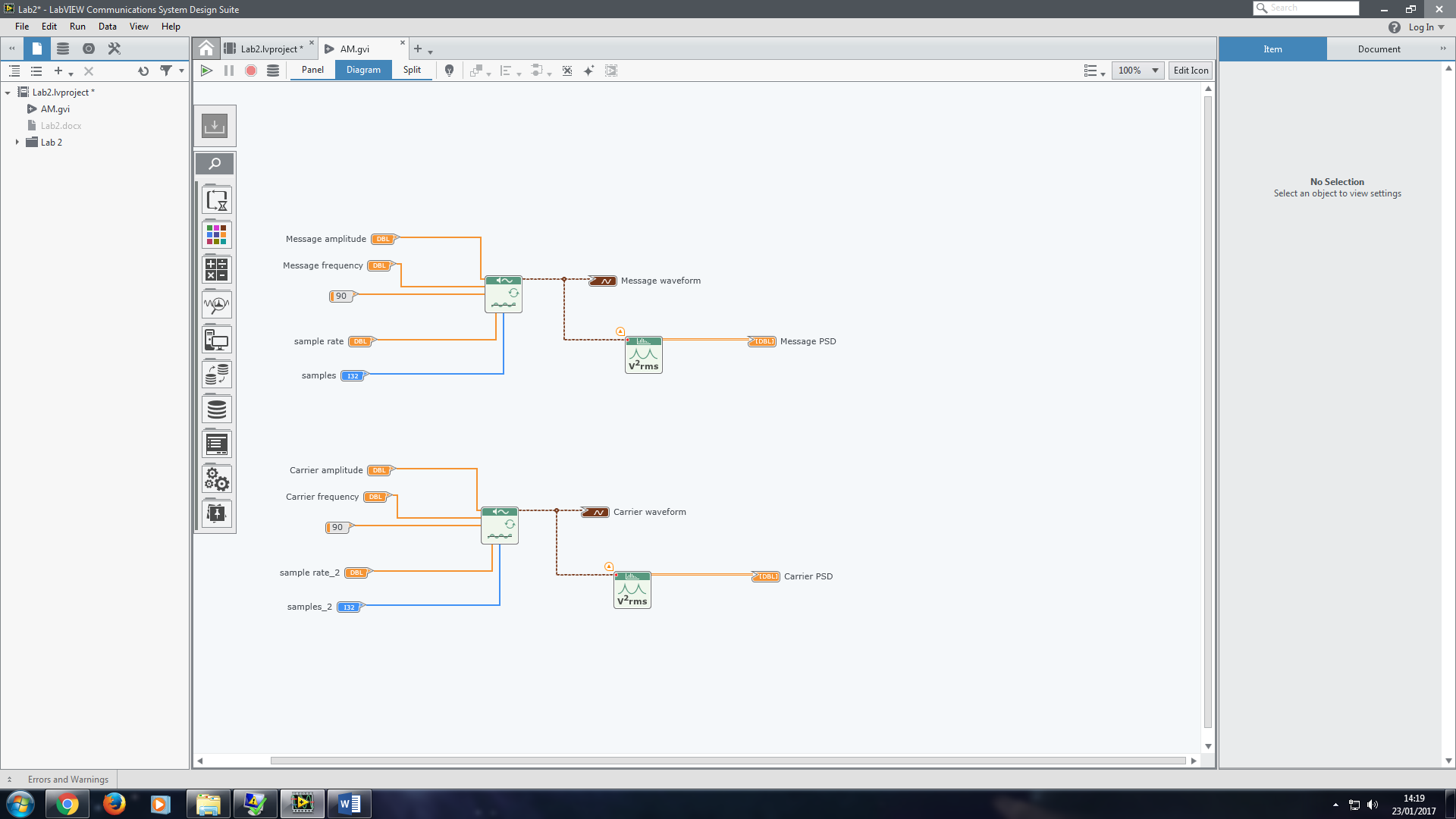
Ex1. AM Modulator

AM(Amplitude modulation) uses the basic relation:

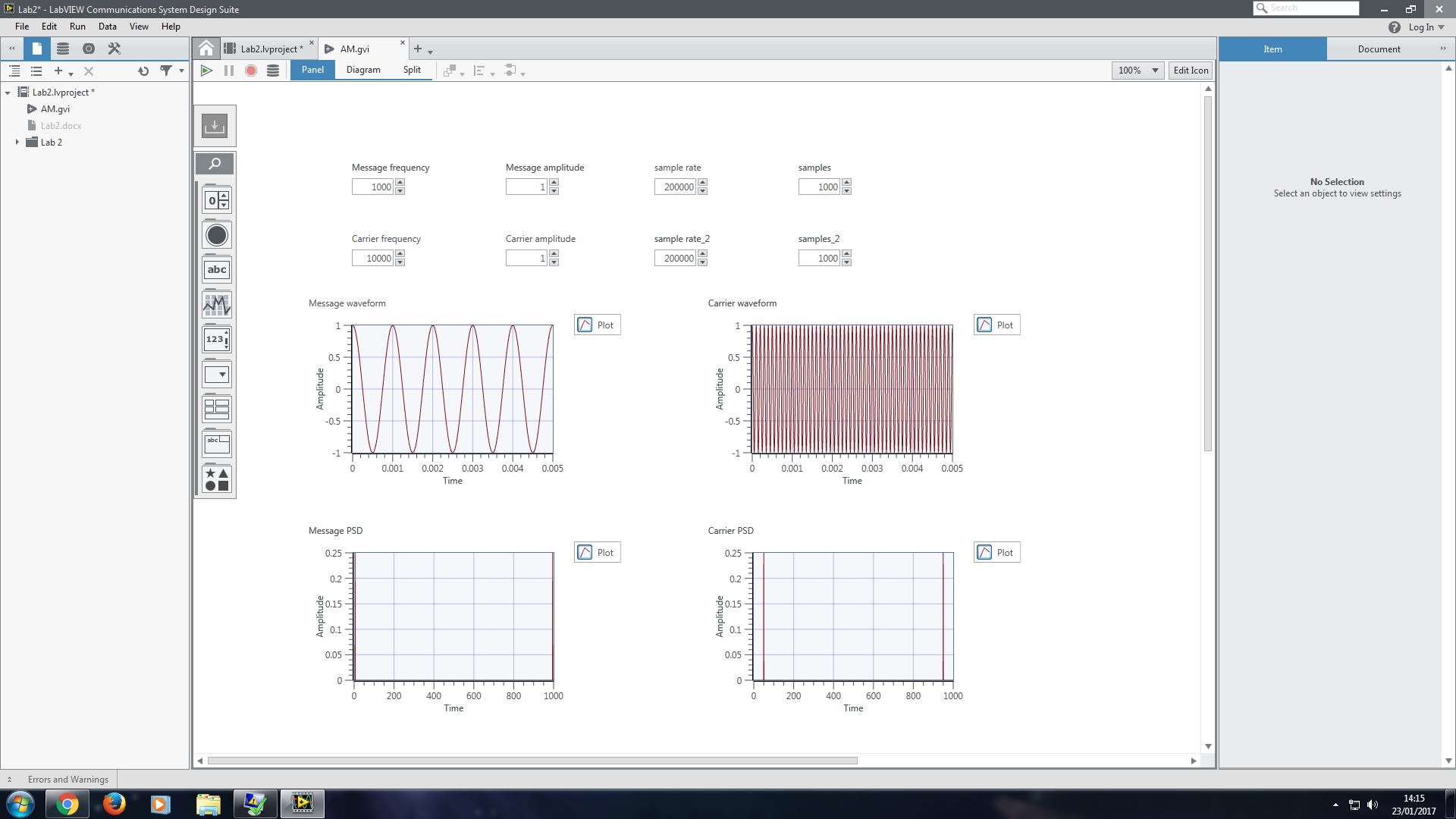
𝒔(𝒕) = [𝑨𝒄 + 𝑨𝒎𝐜𝐨𝐬(𝟐𝝅𝒇𝒎𝒕)]𝐜𝐨𝐬(𝟐𝝅𝒇𝒄𝒕)

Where fm is the frequency of message signal; fc is that of carrier signal.

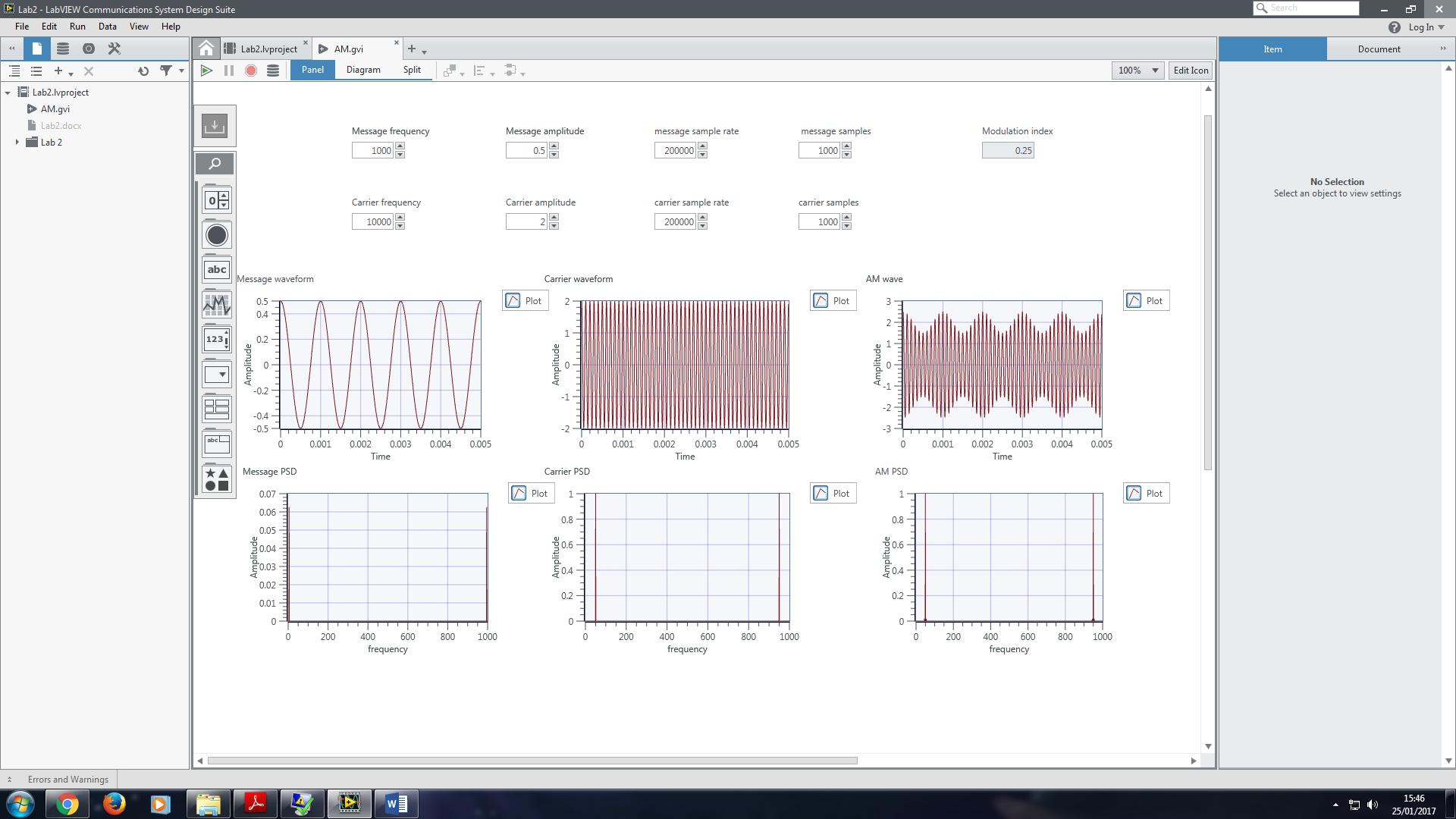
Ac and Am are amplitude of carrier and message signals.



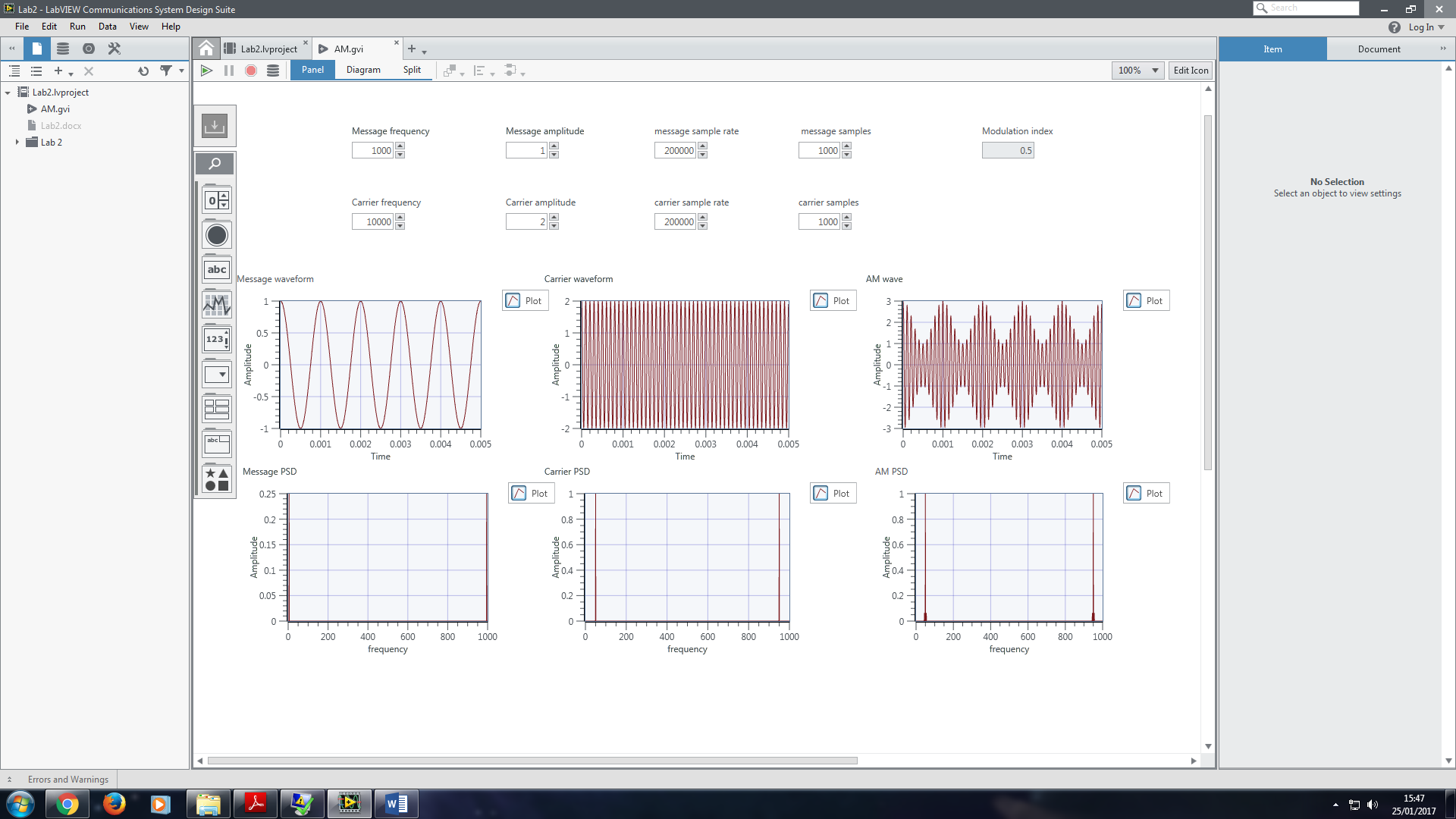
Obtain the waveforms of carrier and message signals and corresponding PSD.



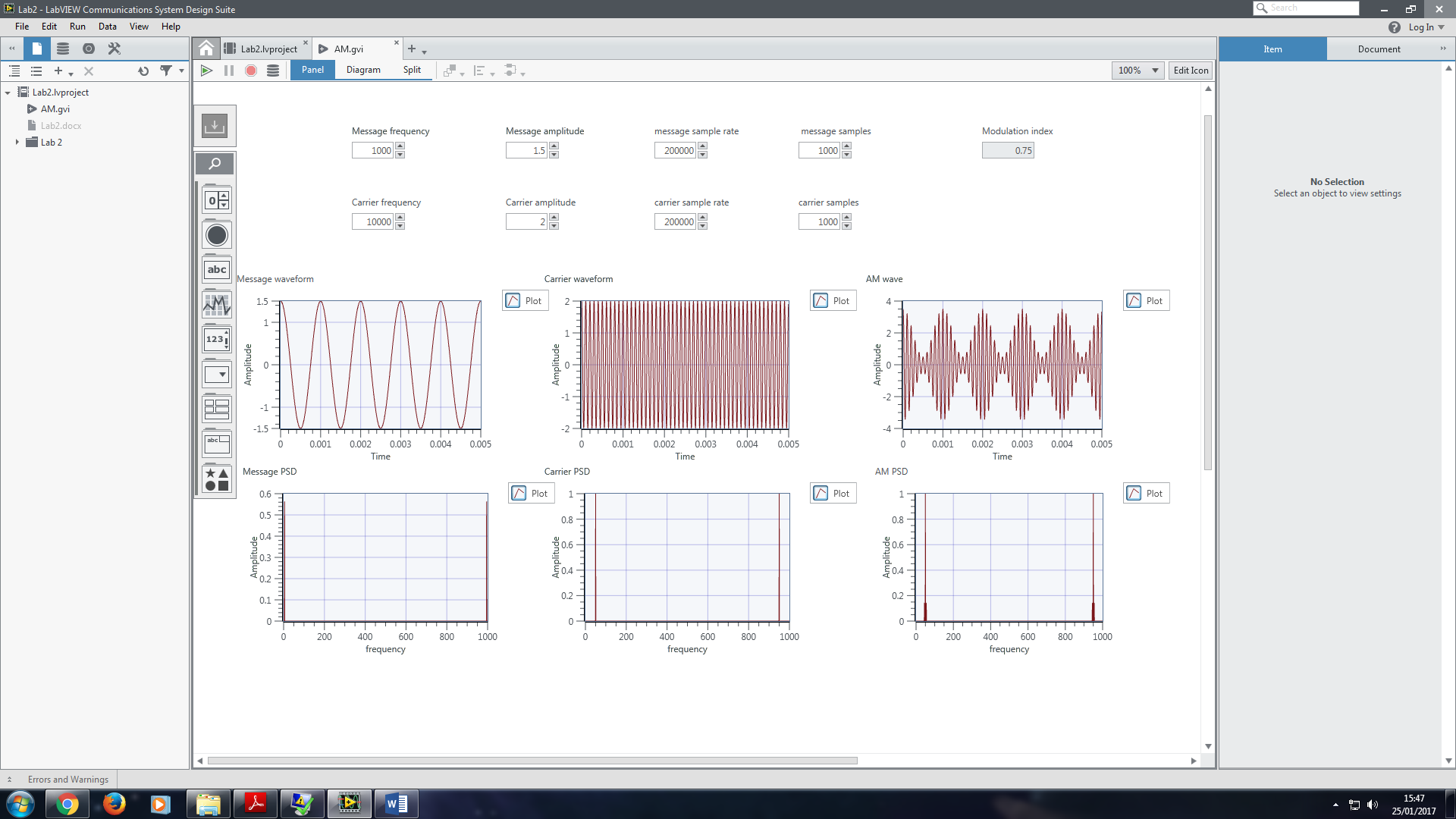
Obtain the AM waveform with modulation index 0.25.



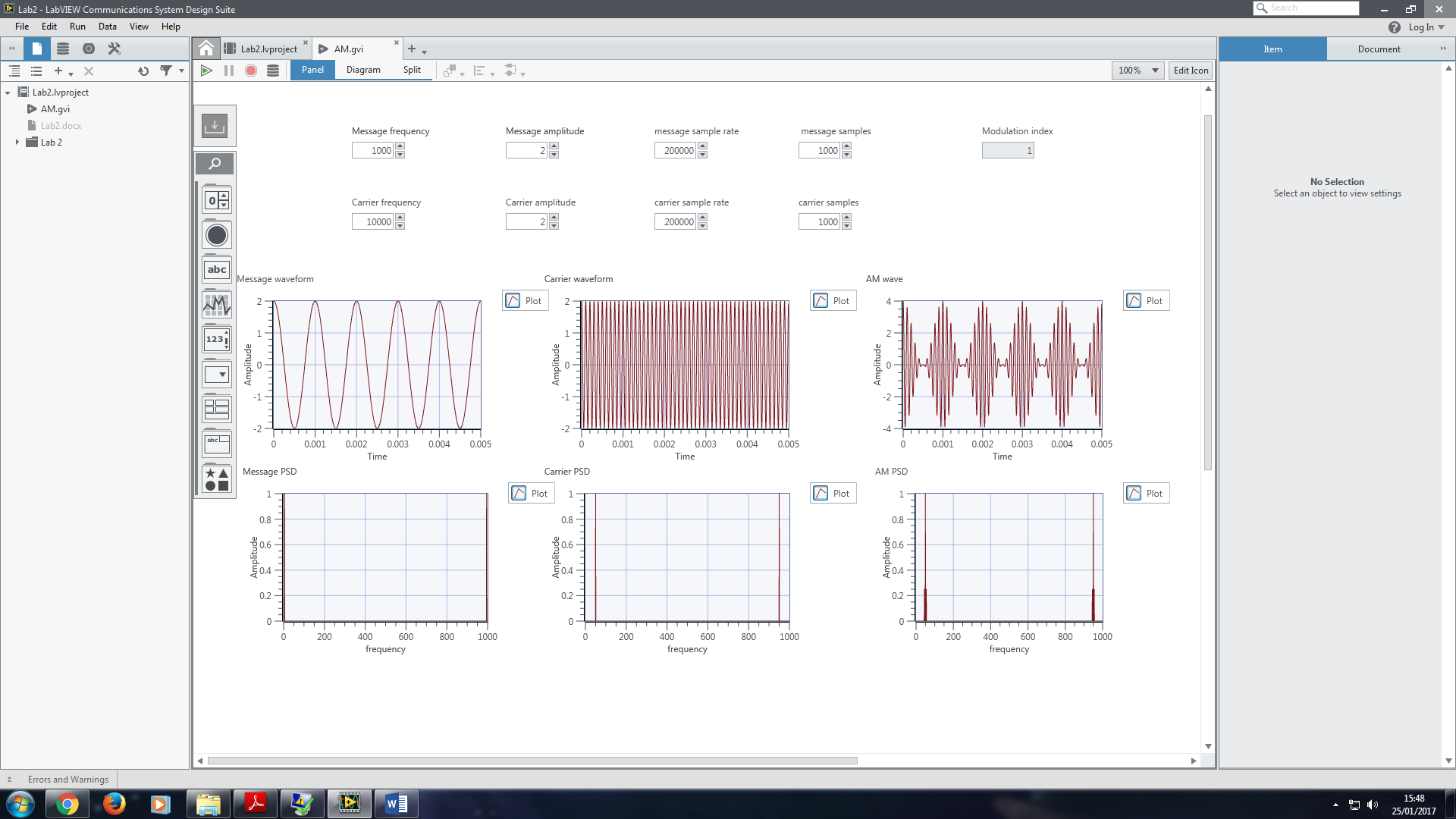
Obtain the AM waveform with modulation index 0.5.



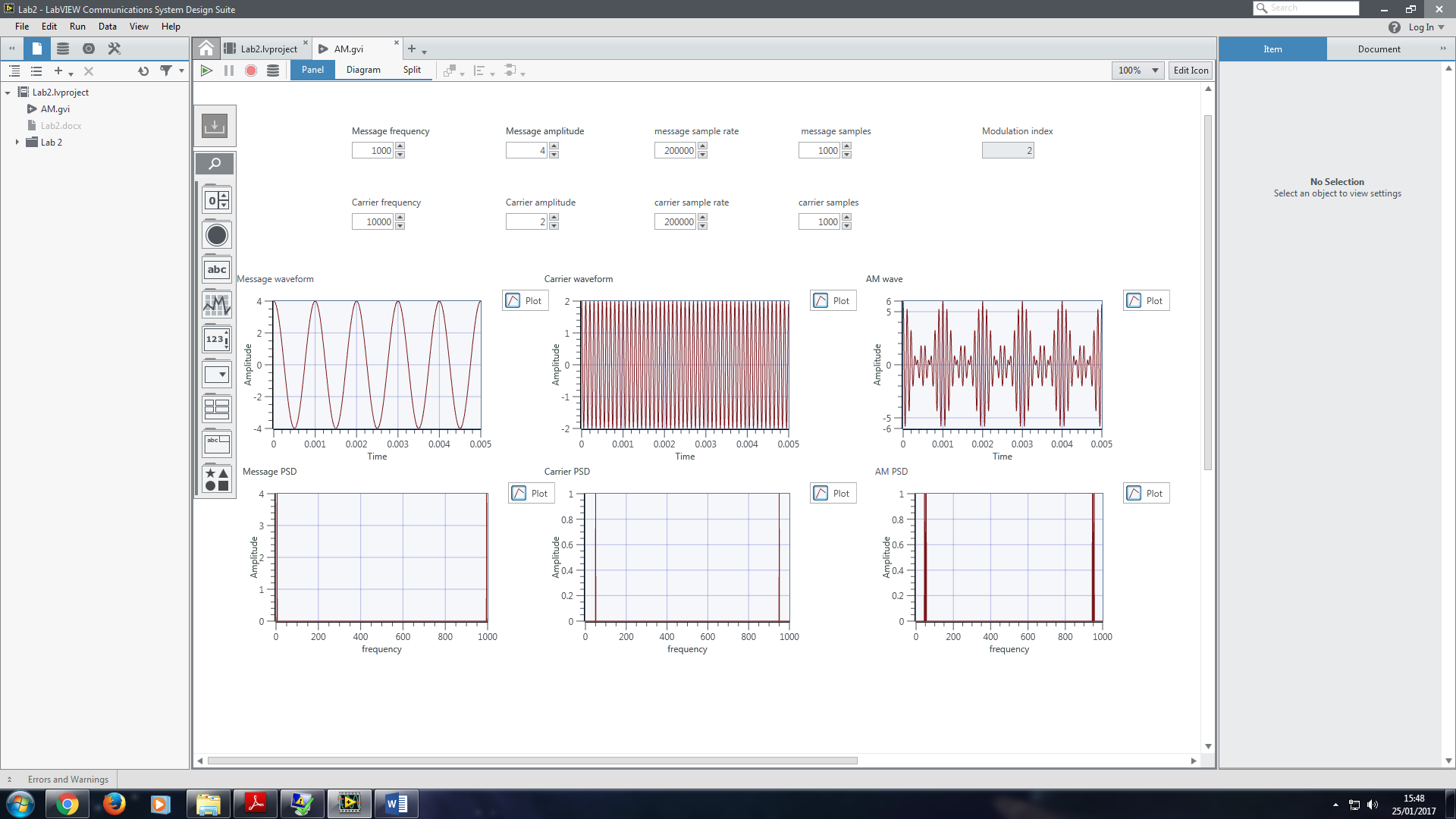
Obtain the AM waveform with modulation index 0.75.



Obtain the AM waveform with modulation index 1.

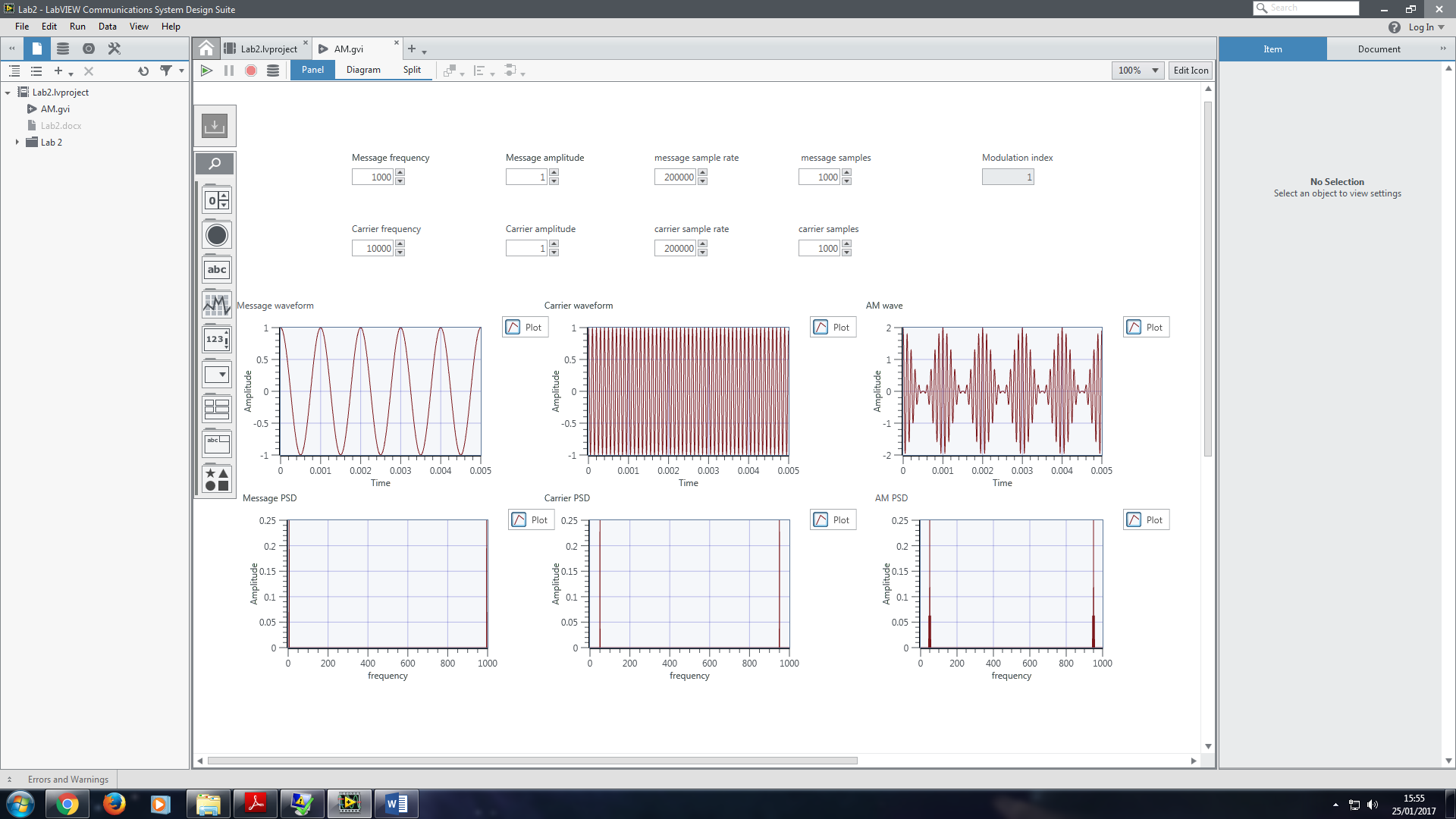


Obtain the AM waveform with modulation index 2.

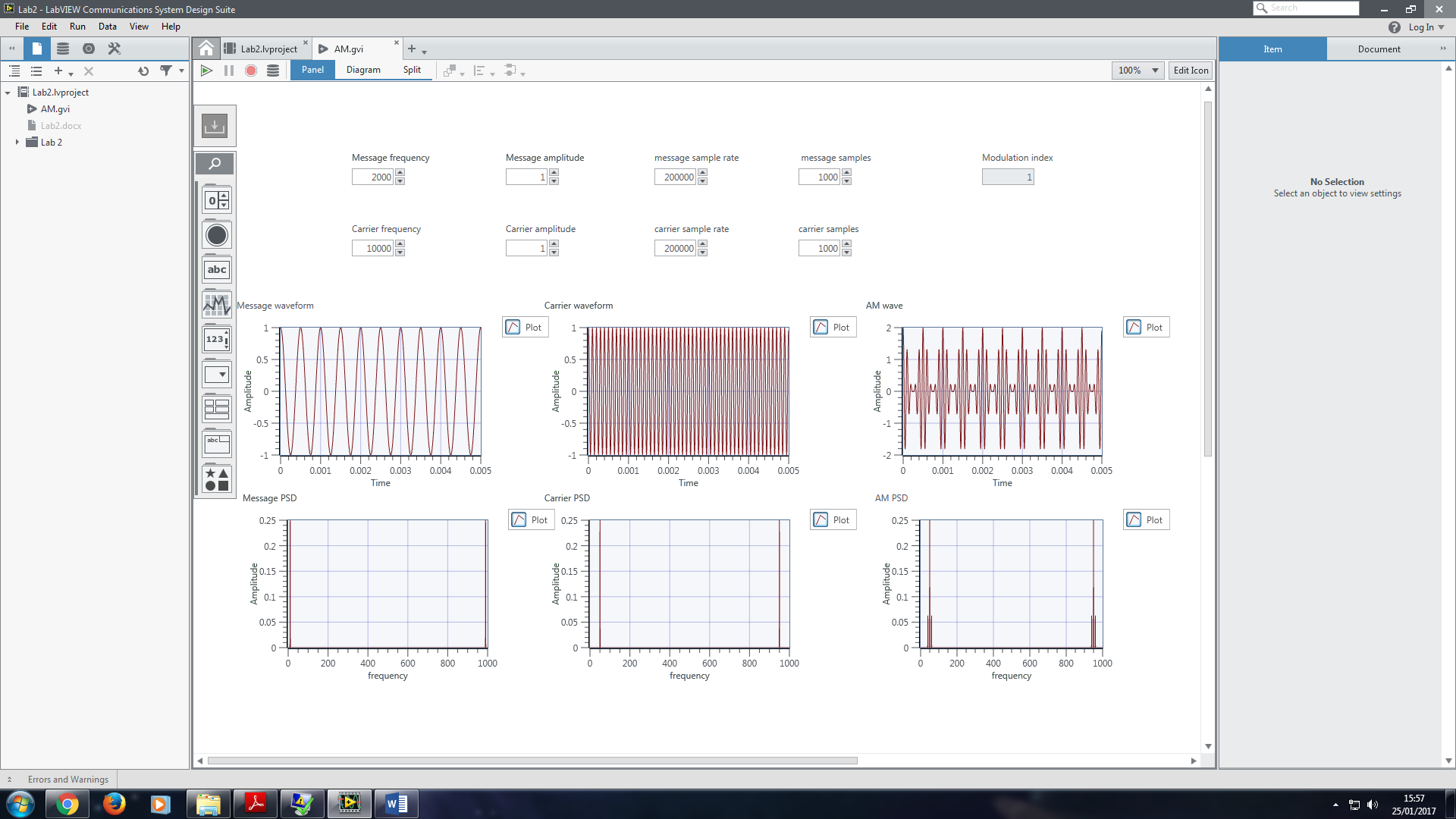


Observe the impact on AM with various frequency:

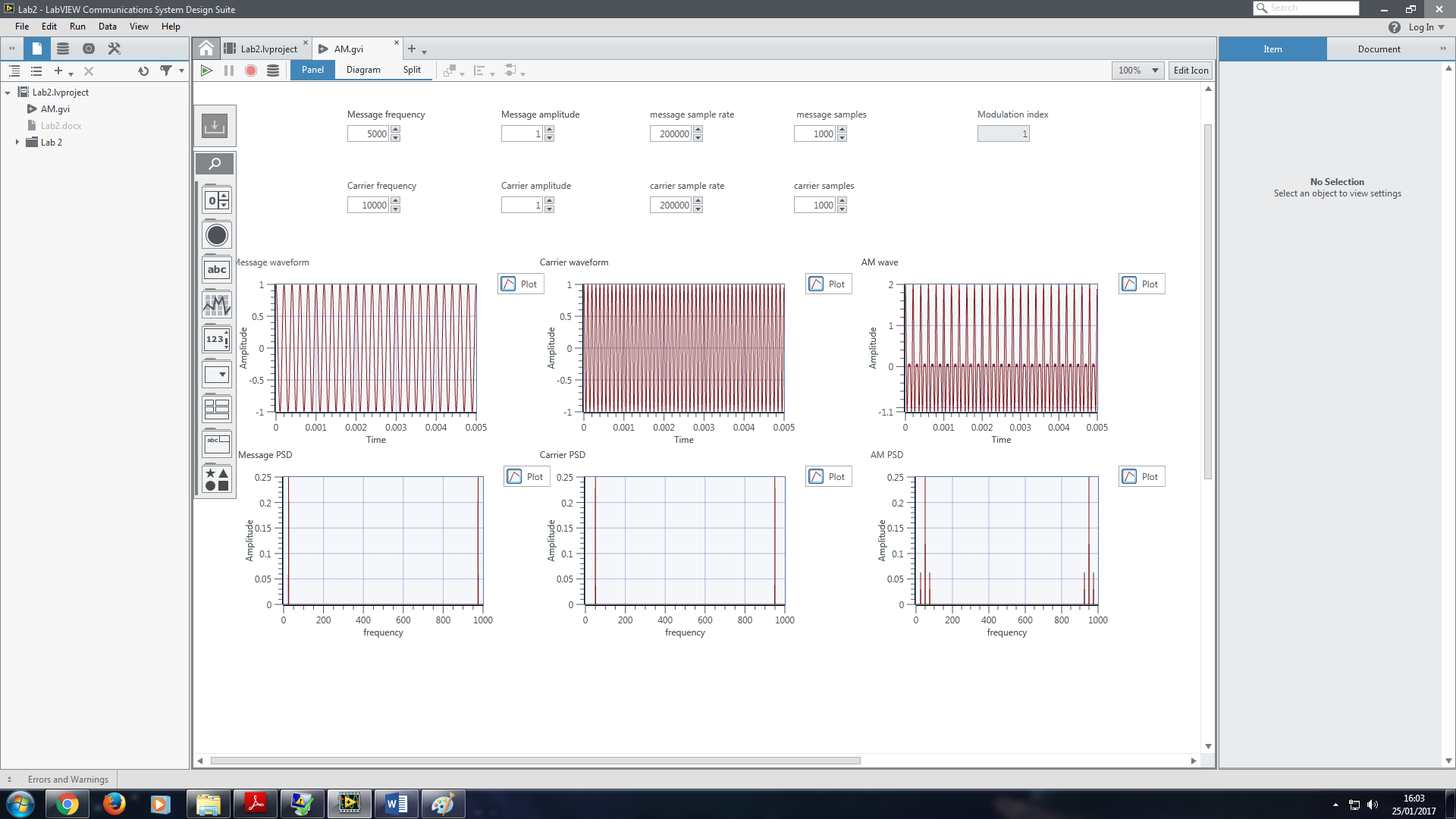
fm = 1000HZ



fm = 2000HZ

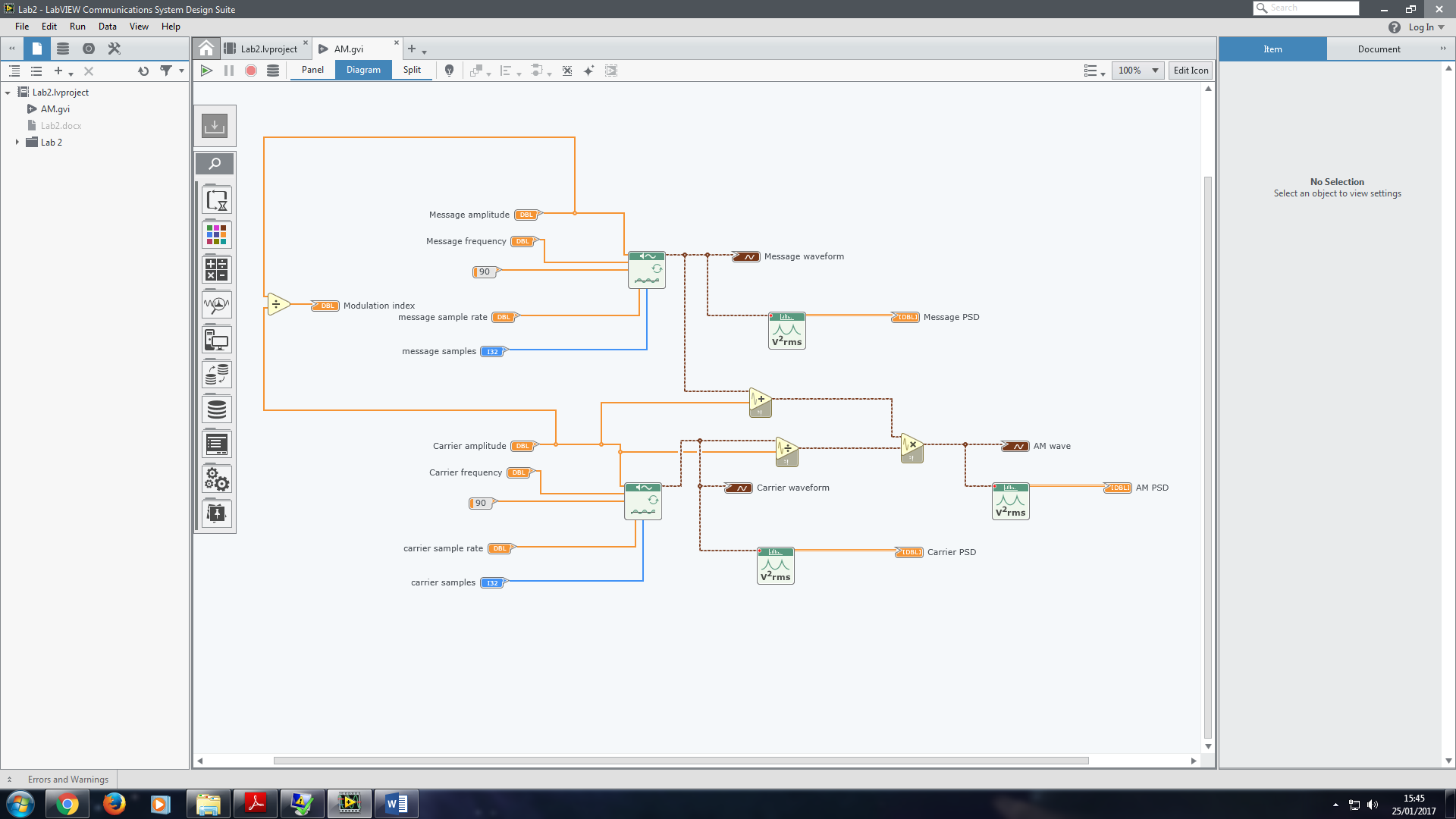


fm = 5000HZ



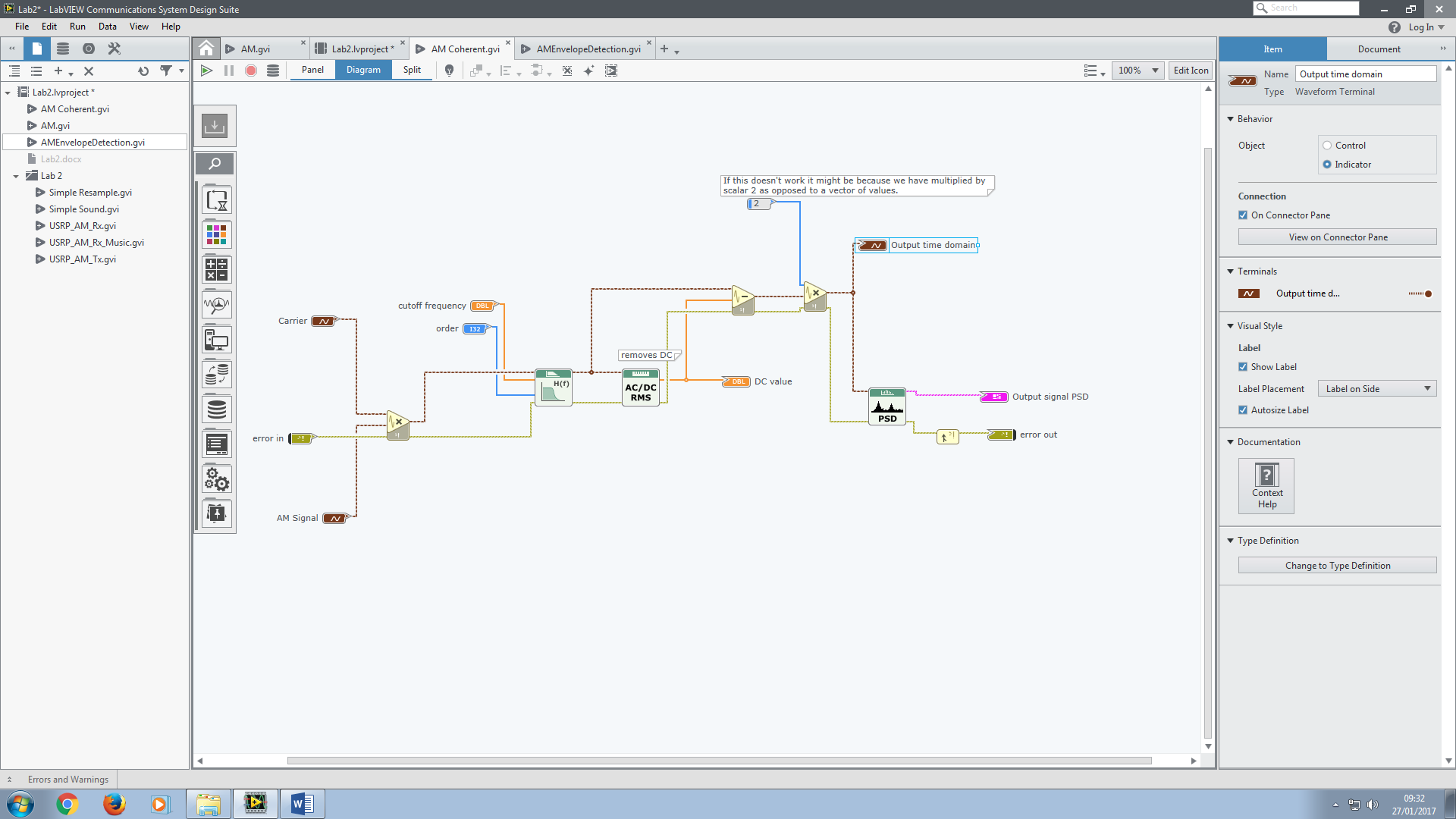
Question: what’s the influence on Am when we change the frequency of message wave?

Diagram of construction of AM:



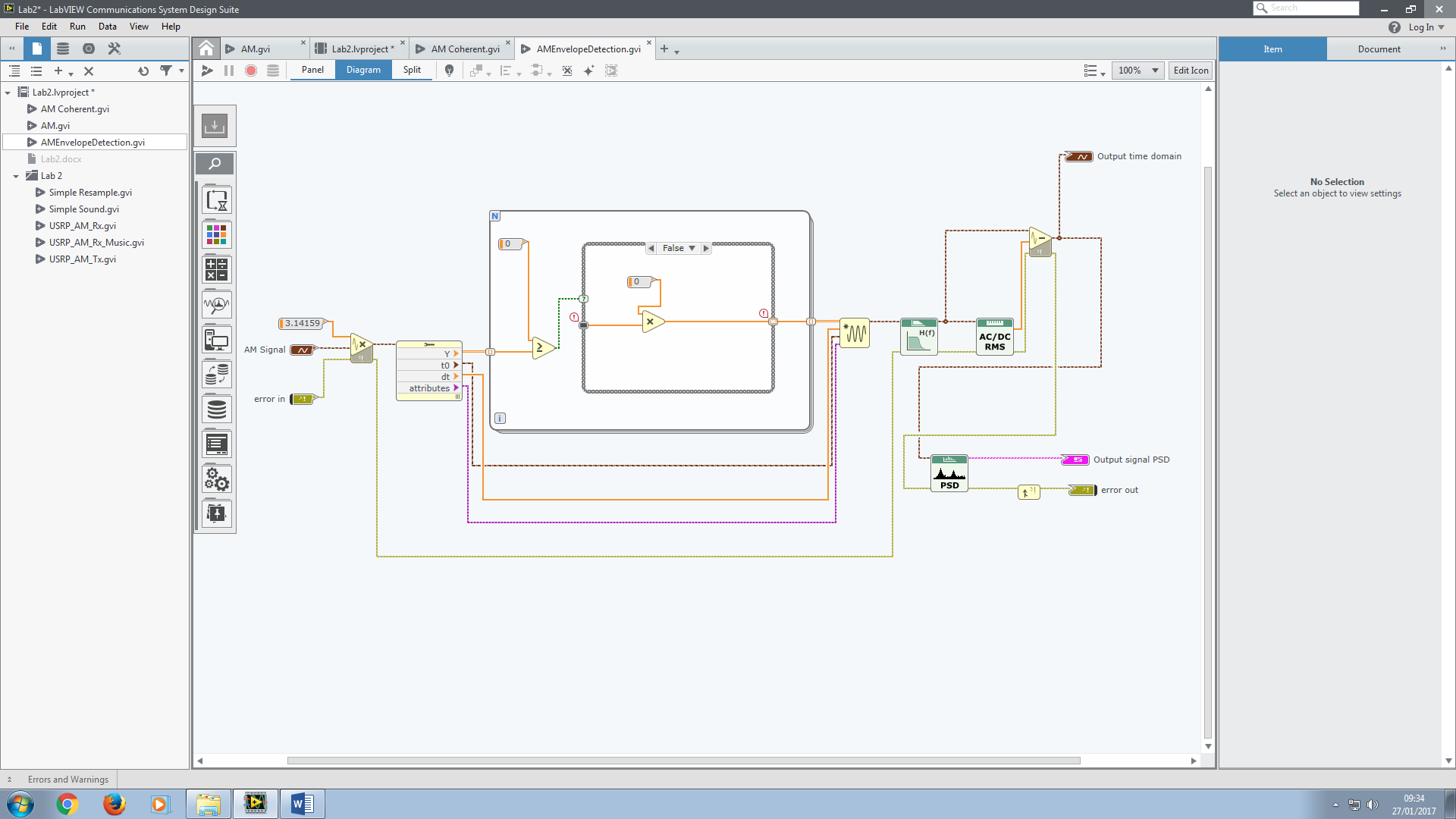
Ex.2 AM Demodulators

Part a: Coherent detection



Mathematical theory:

Part b envelope detection:

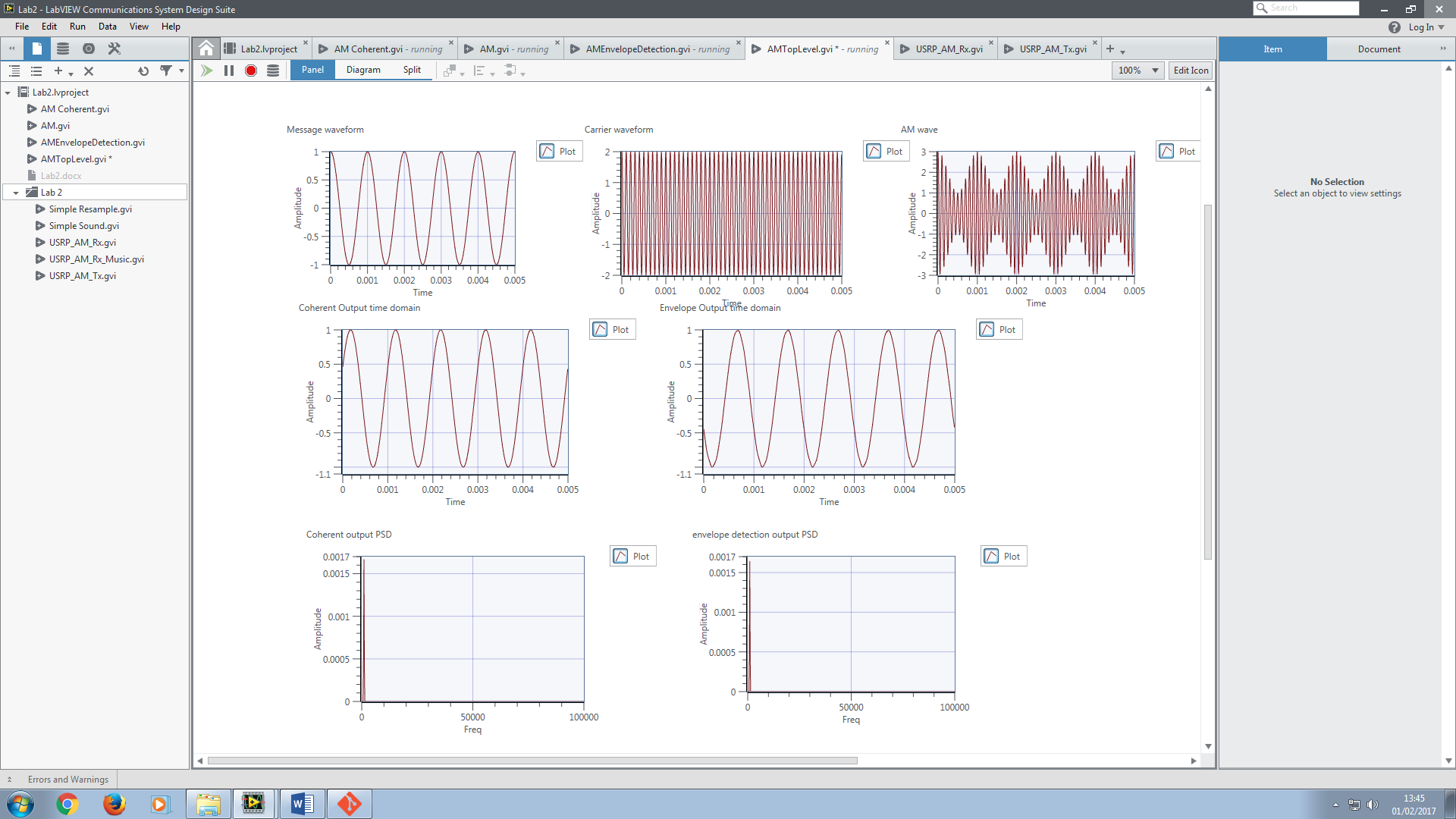


* Remove negative values
* Remove higher frequency components
* Remove DC components (introduced in first step?)

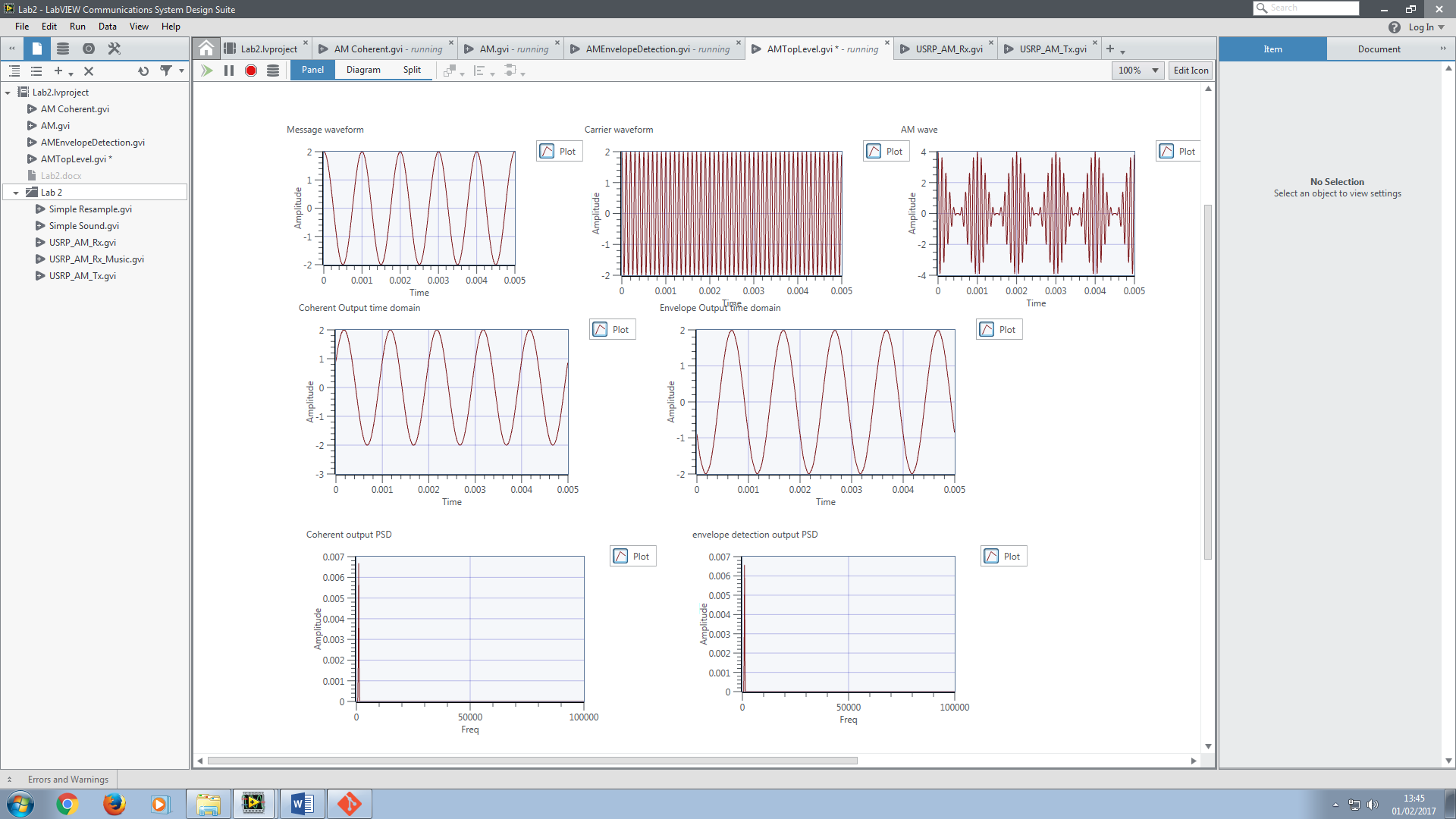
This will remove negative values and then it will remove the higher frequency components (can also be thought of as a capacitor which simply limits the rate of change of the voltage) and then it removes the DC to shift the AC signal back to 0.

Ex3.

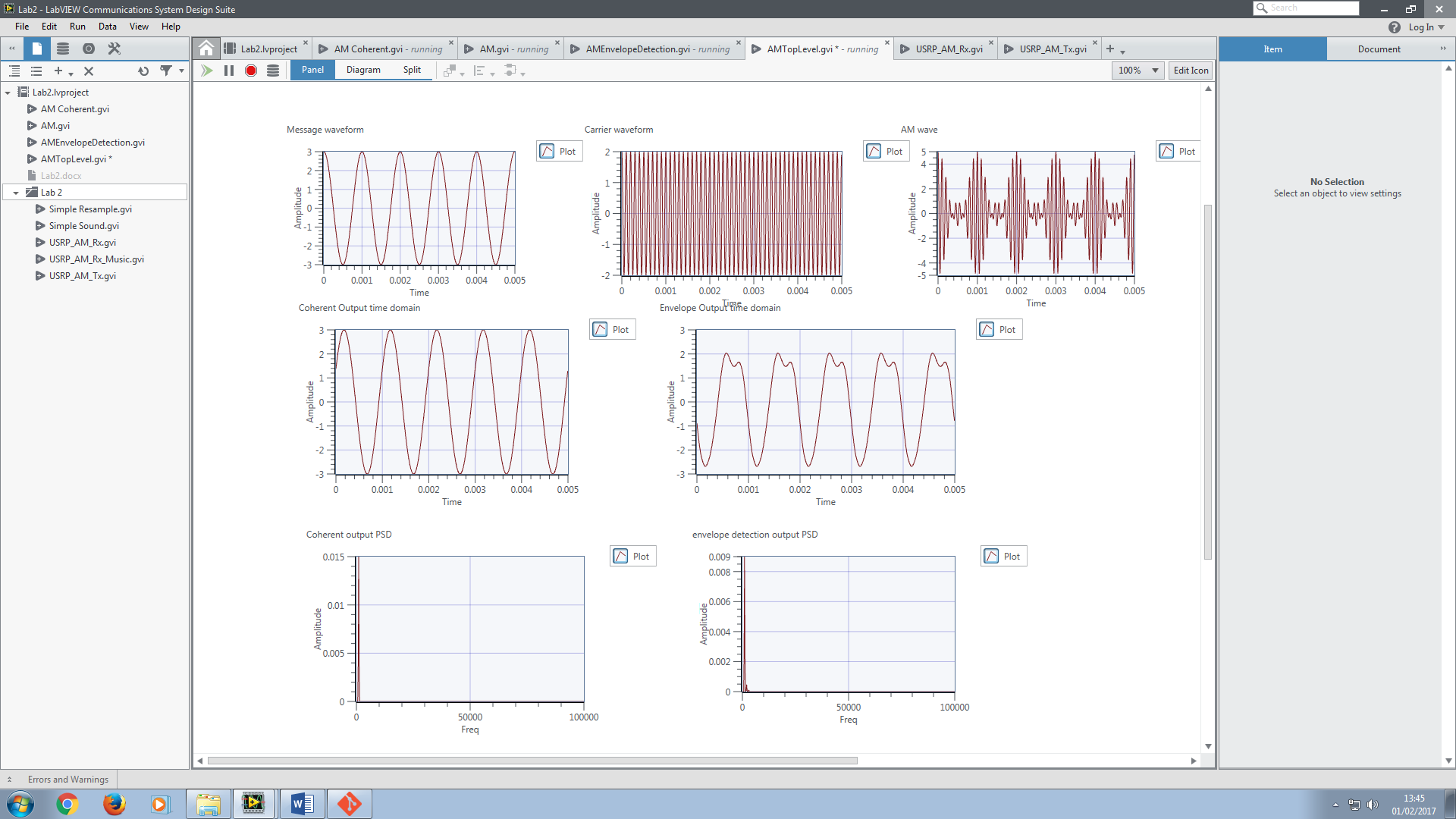
Waveform of envelope and coherent detection with message signal Amplitude from 1 to 4(message signal of Amplitude 1)



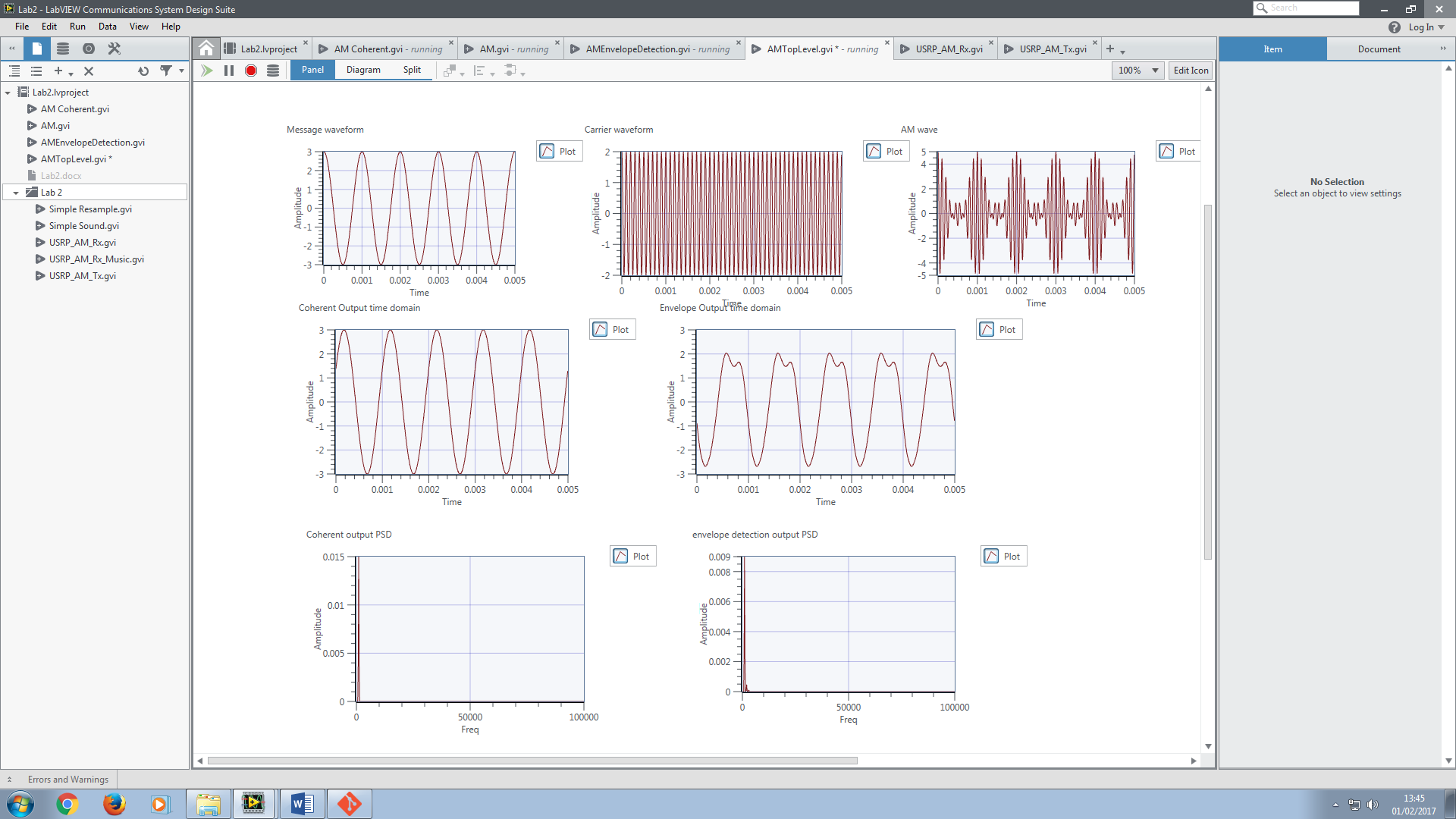
(message signal of Amplitude 2)



(message signal of Amplitude 3)



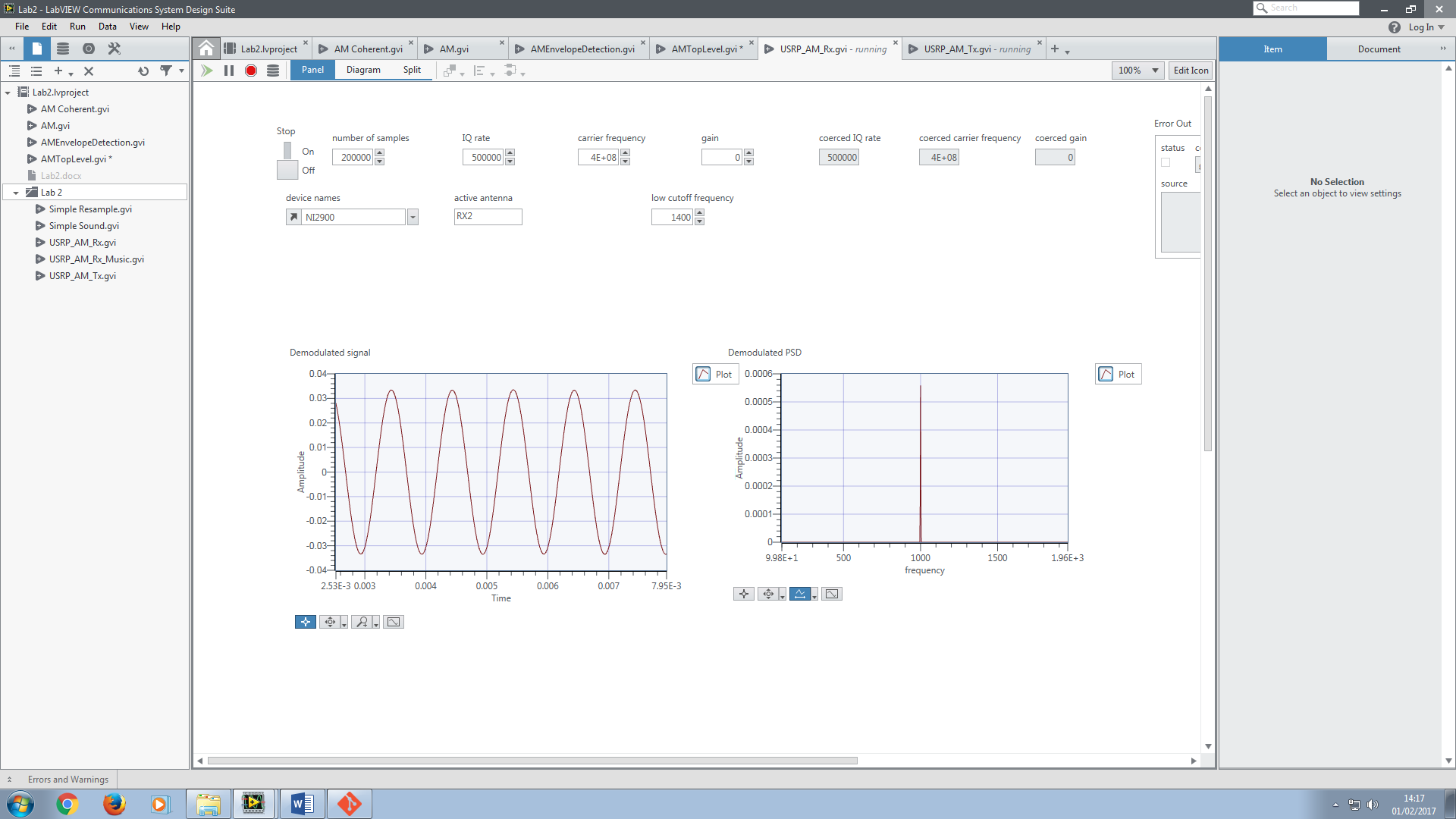
(message signal of Amplitude 4)



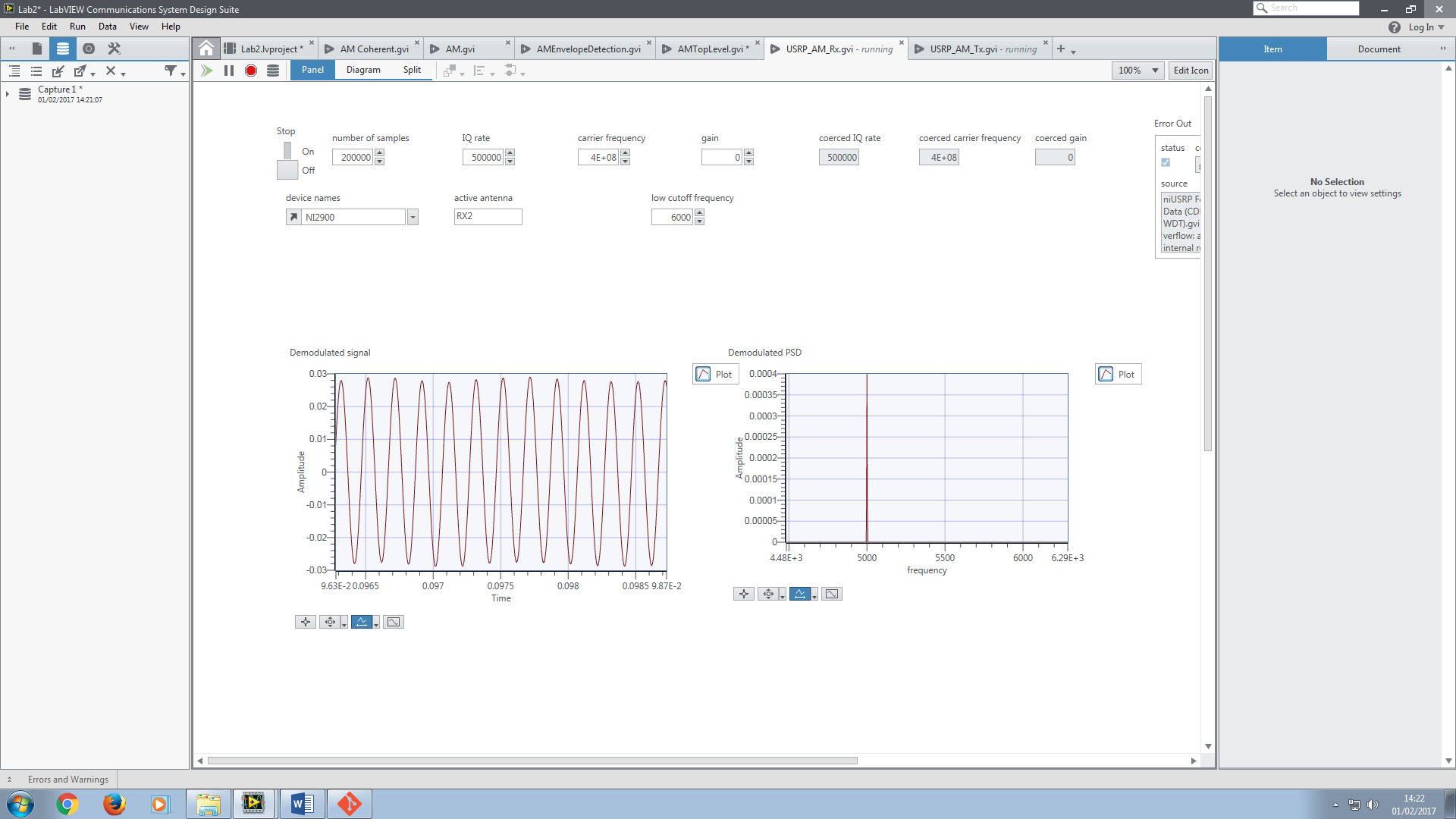
When we multiply the input signal by the transfer function (by applying an n-order filter) this will result in some phase shift according to the transfer function.

When the modular index > 1 the coherent detection does not work properly, however the envelope detection does work. The AM waveform does not have the envelope which has the same shape as the message signal when its amplitude is greater than the carrier.

Ex4.

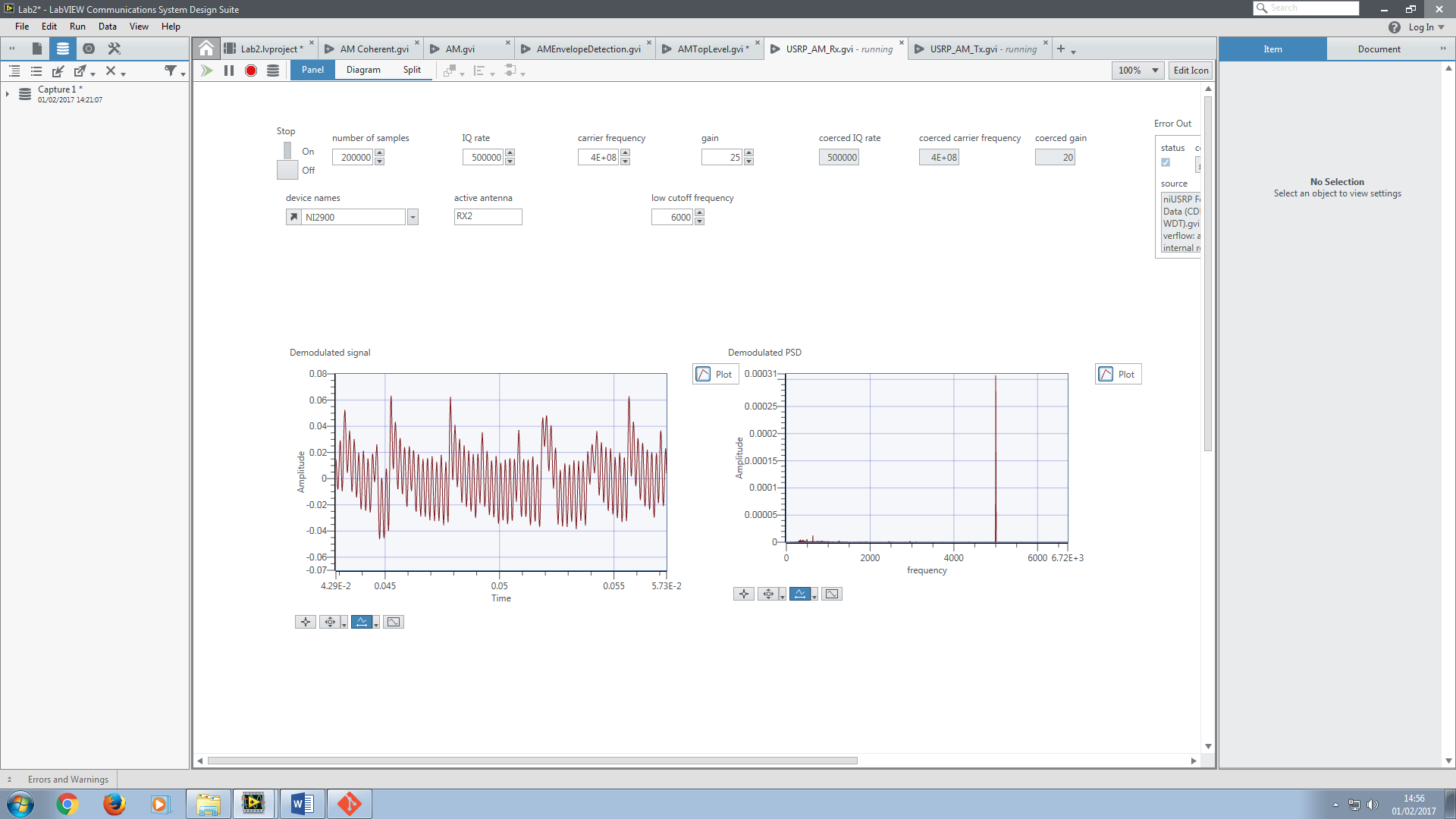


Sending a 5kHZ with cut-off frequency at 6kHZ

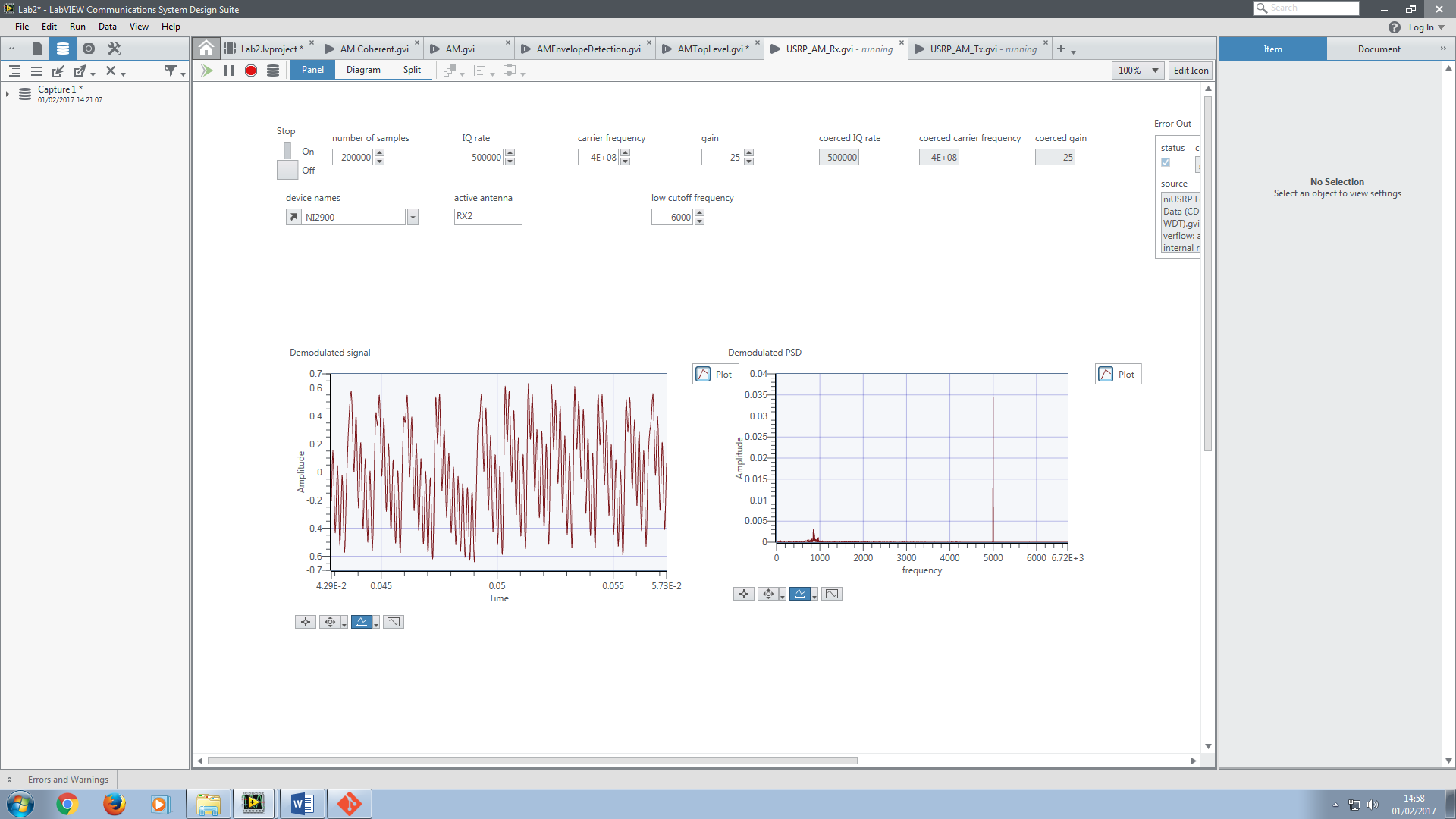


Noise observation:

With modulation index 0.1 and gain of 25dB



Modulation index of 0.5



Modulation index of 1.0



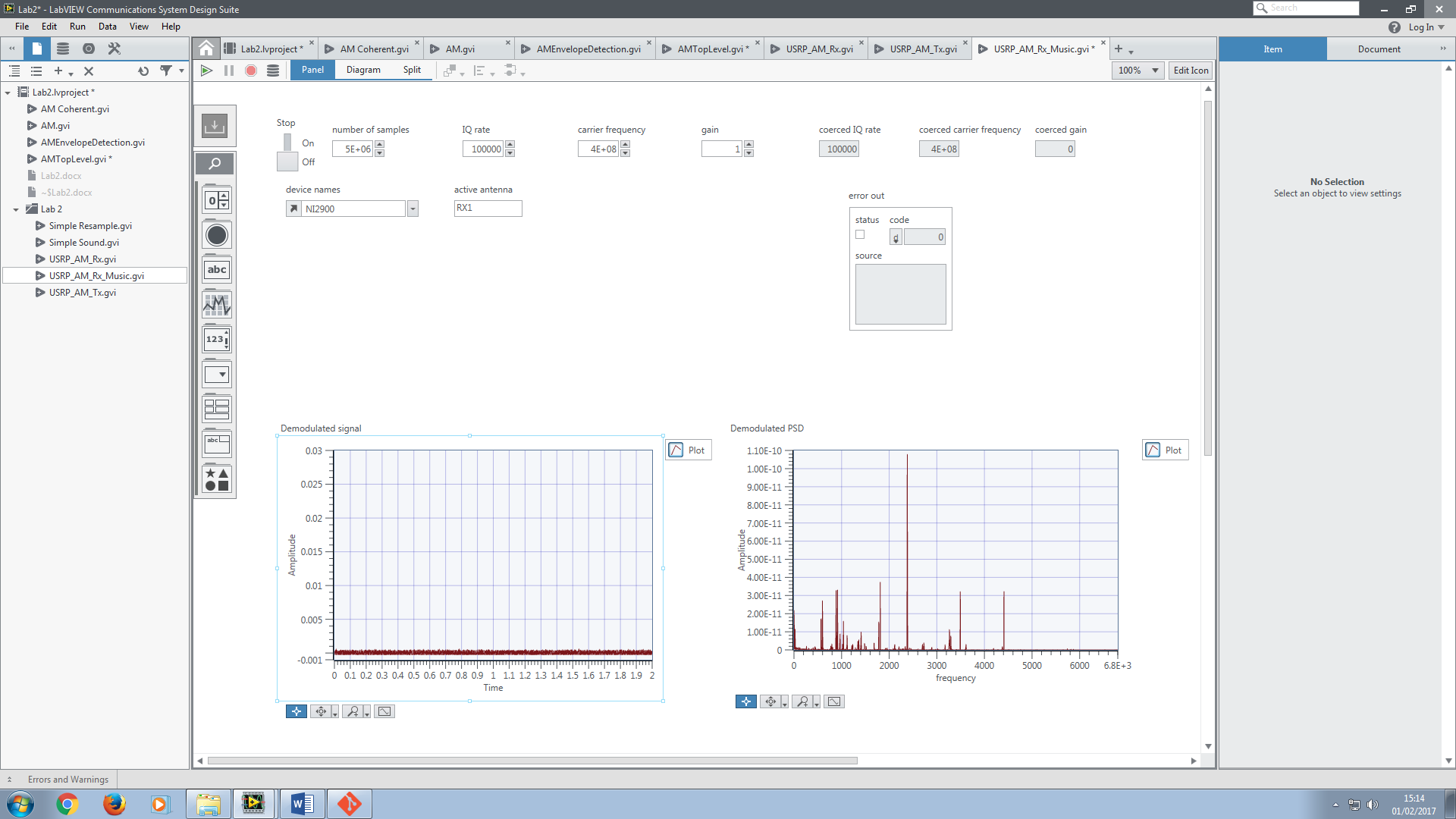
Modulation index of 5.0



Questions:

* The IQ rate: what is it?
* Why are we getting errors for transmitting/receiving the 5kHz signal?
* How do the gain and the modulation index affect the signal to noise ratio at the receiver?

Ex5.



AM channel is not playing sound therefore we do not hear anything but noise.