

无线通信实验在线开放课程

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广东省教学质量工程建设项目







Lab 2: Pre-Labs and AM

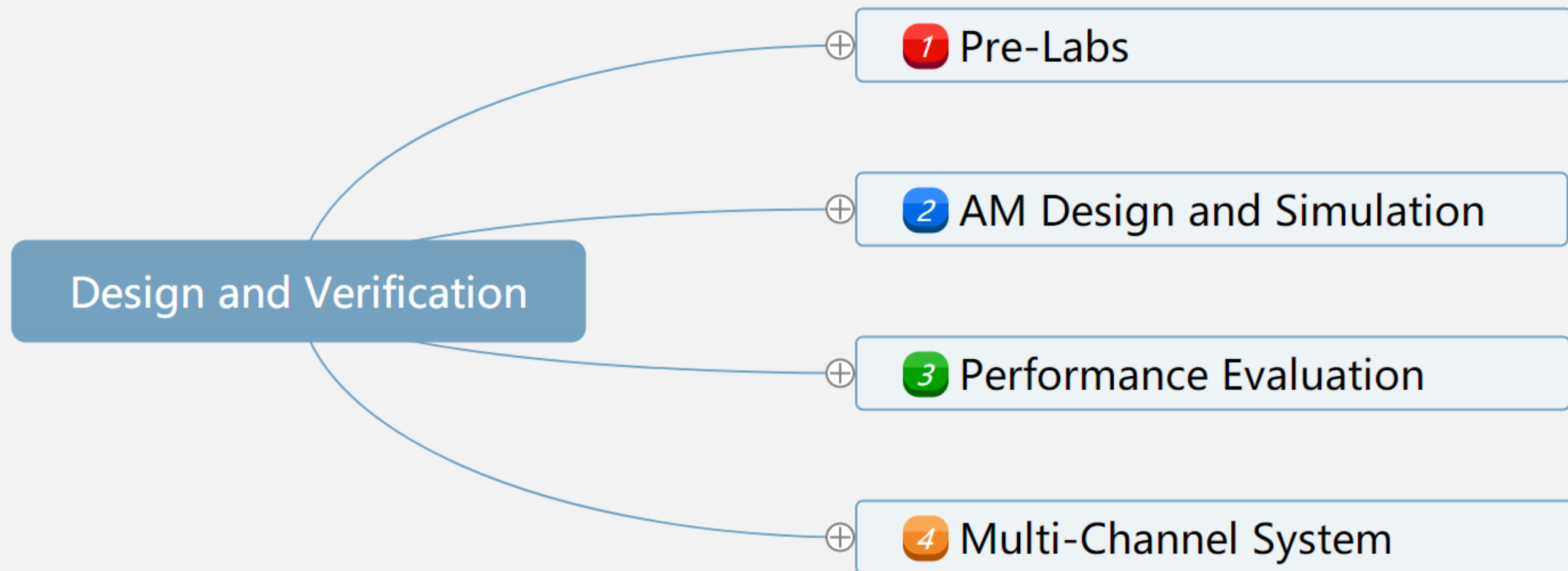
(Basic)

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Rethinking and Redesign

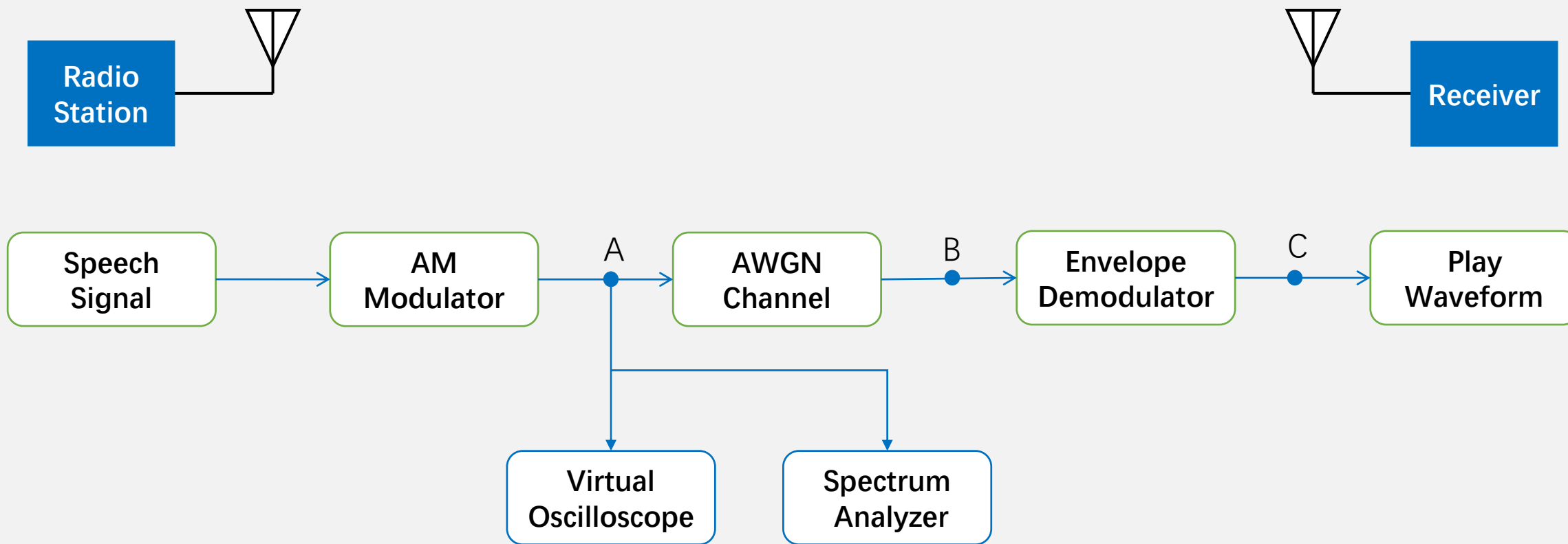




Demo: Amplitude Modulation



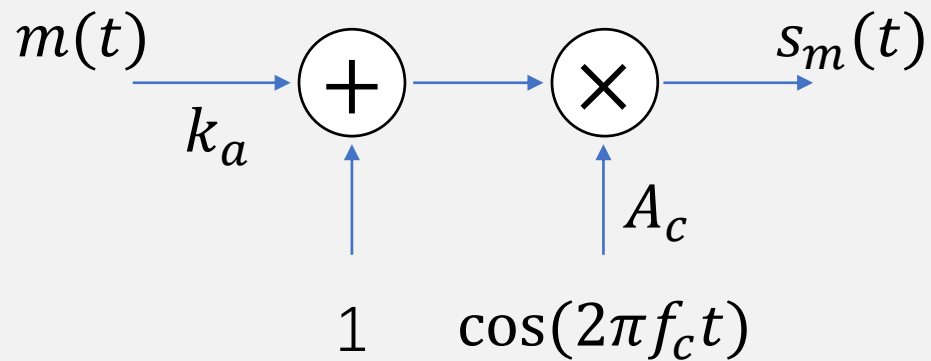
Simulation Model of AM System





Pre-Lab: AM Mathematical Model

Modulator

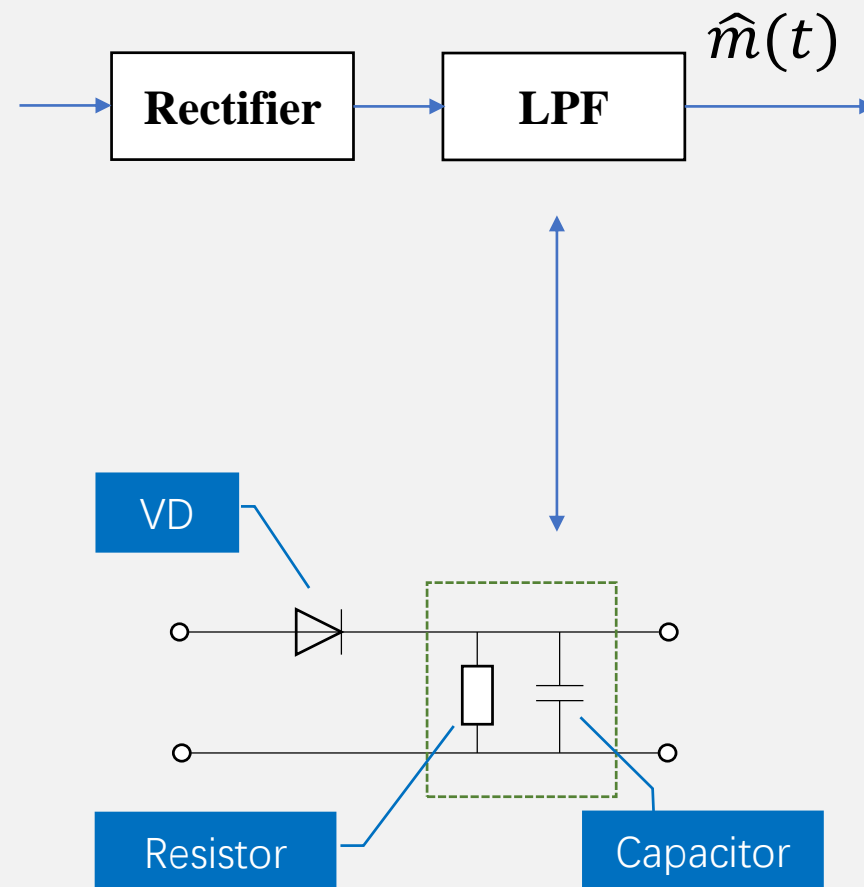


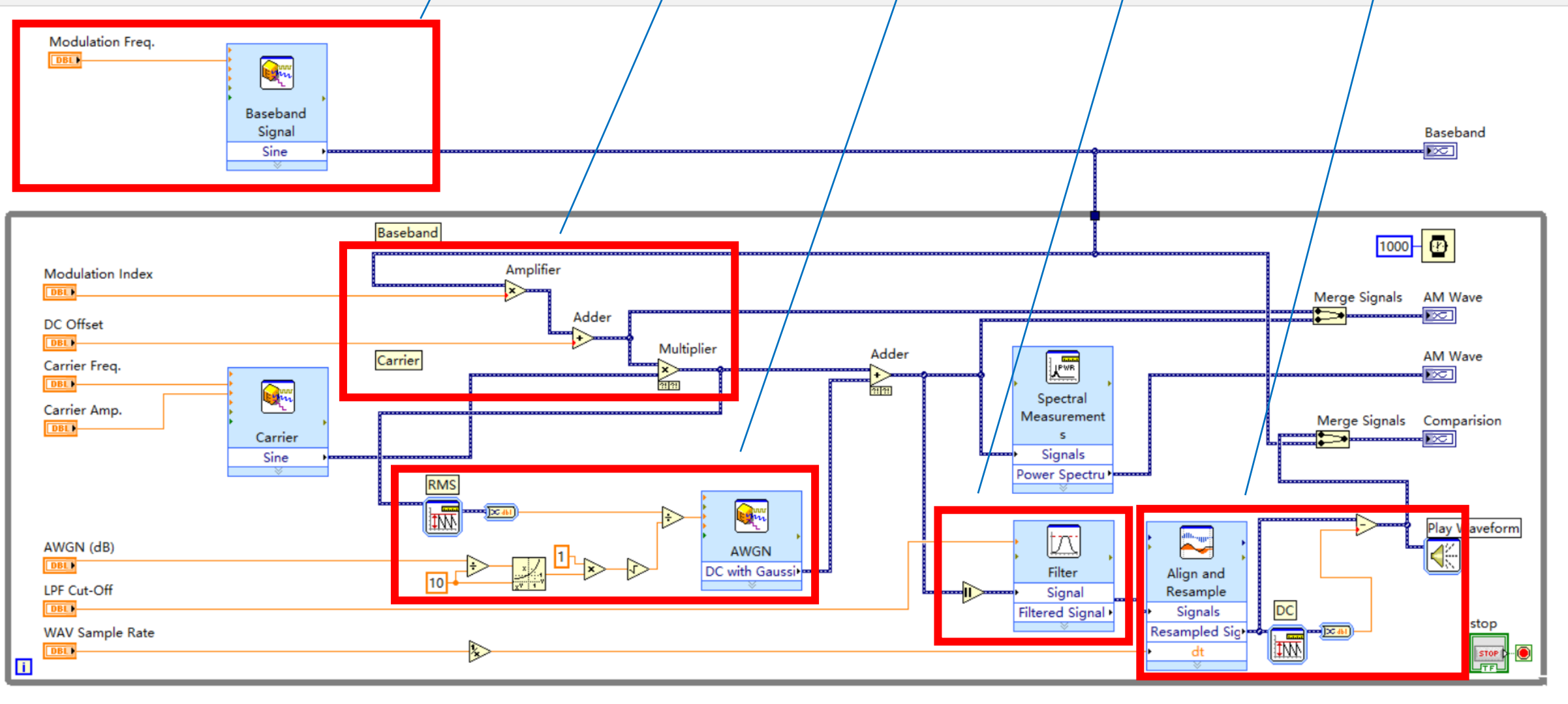
$$s_m(t) = A_c (1 + k_a m(t)) \cos(2\pi f_c t)$$

Labels in the diagram:

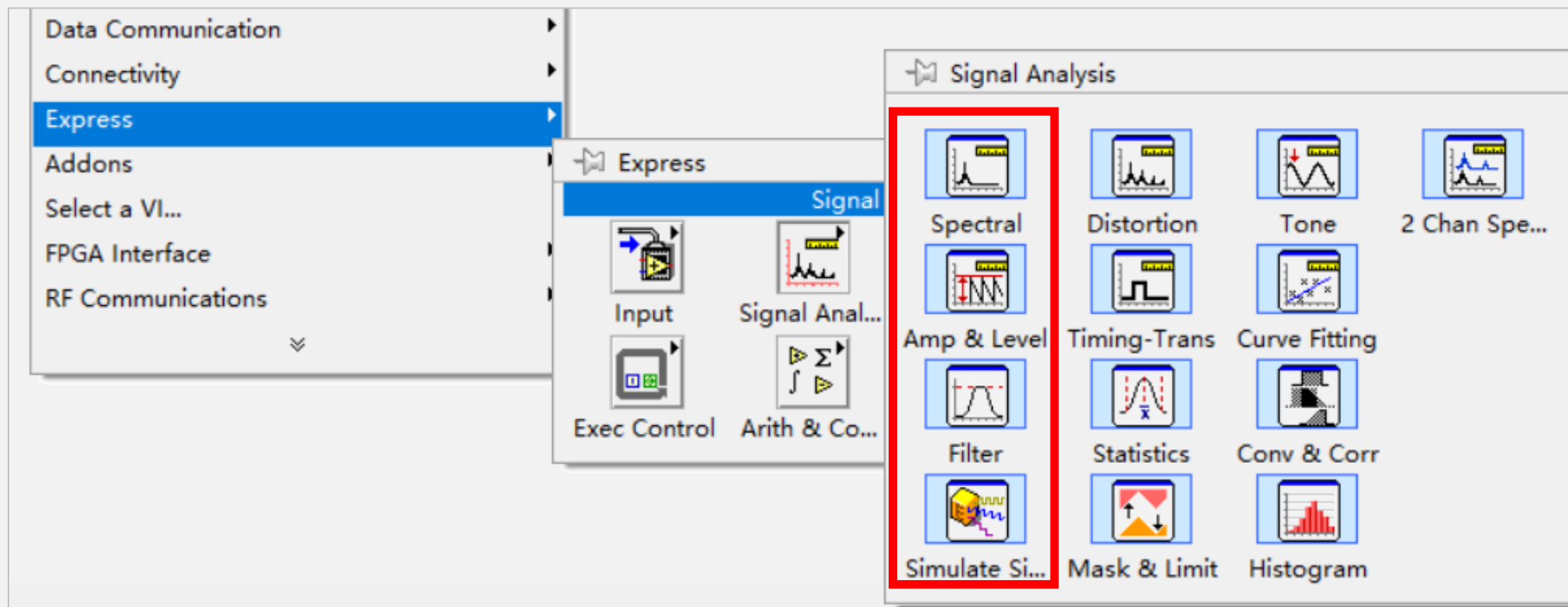
- Sensitivity** points to k_a .
- Carrier** points to $\cos(2\pi f_c t)$.
- Baseband** points to $m(t)$.

Demodulator





Blocks for Programming





Exercise: Amplitude Modulation

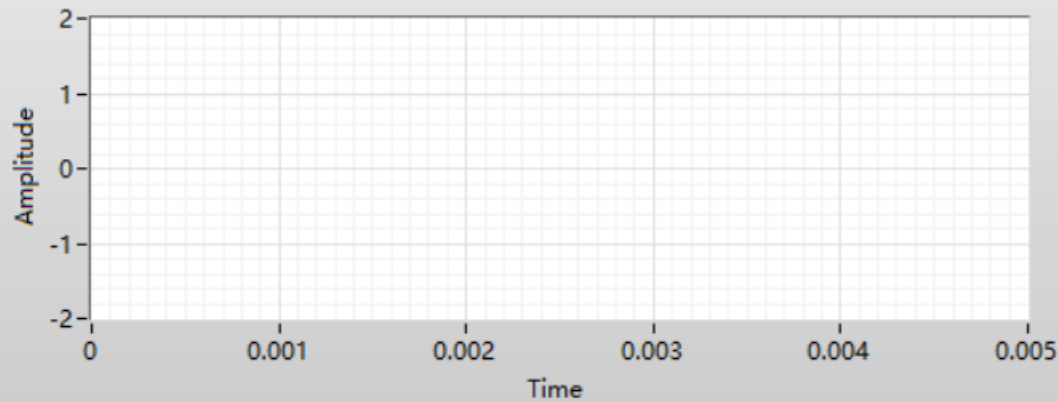
Amplitude Modulation

AM Wave

Upper Envelope

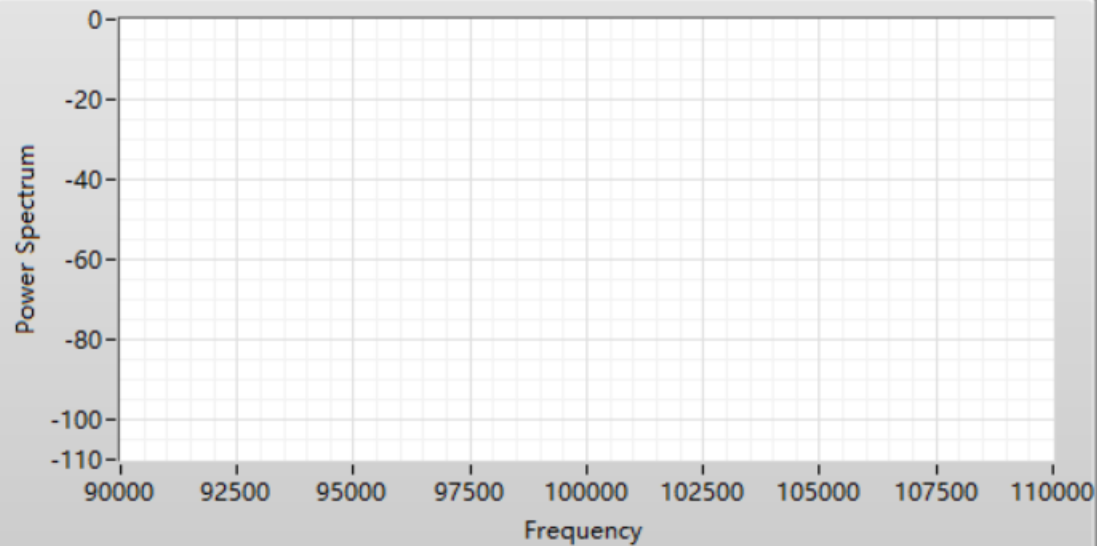


Modulated Signal



AM FFT

Sine (Power Spectrum)



Carrier Amp.

1

Carrier Freq.

100000

DC Offset

1

Mod. Freq.

2000

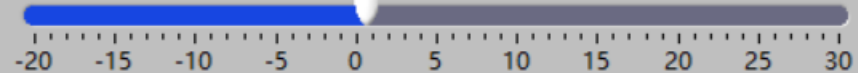
LPF Cut-Off

10000

WAV Sample Rate

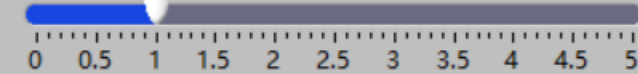
44100

AWGN (dB)



0.6

Modulation Index

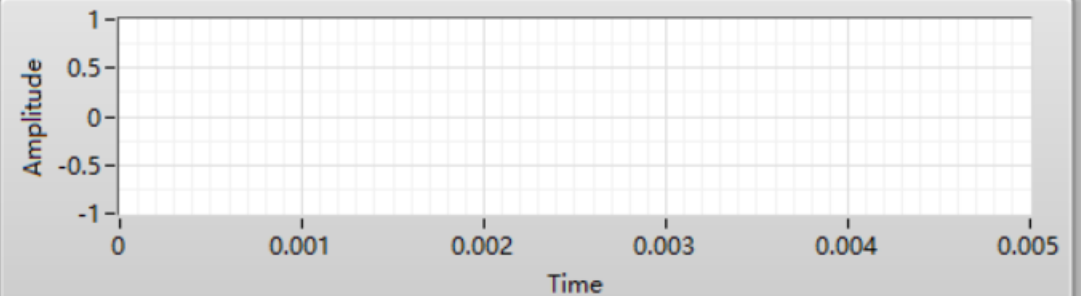


1

stop

STOP

Baseband

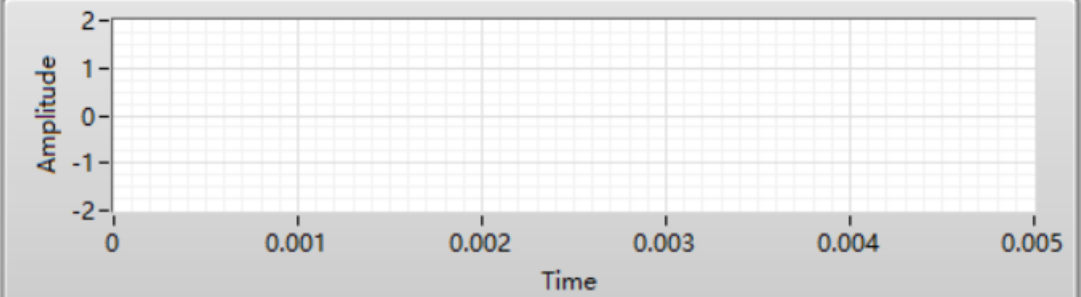


Comparison

Sine (Resampled)



Baseband Signal

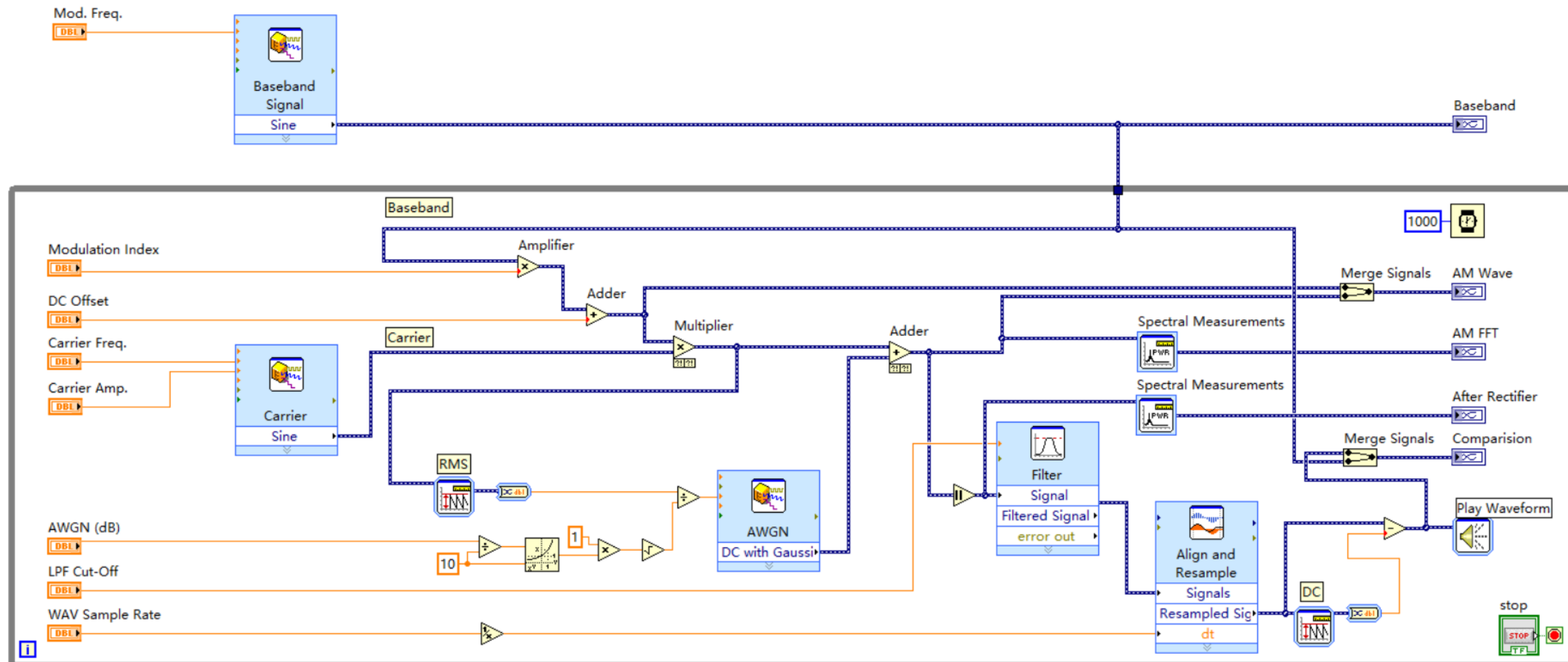


AM Modulation Demo (Baseband-Sine).vi Block Diagram

File Edit View Project Operate Tools Window Help

18pt Application Font

Search



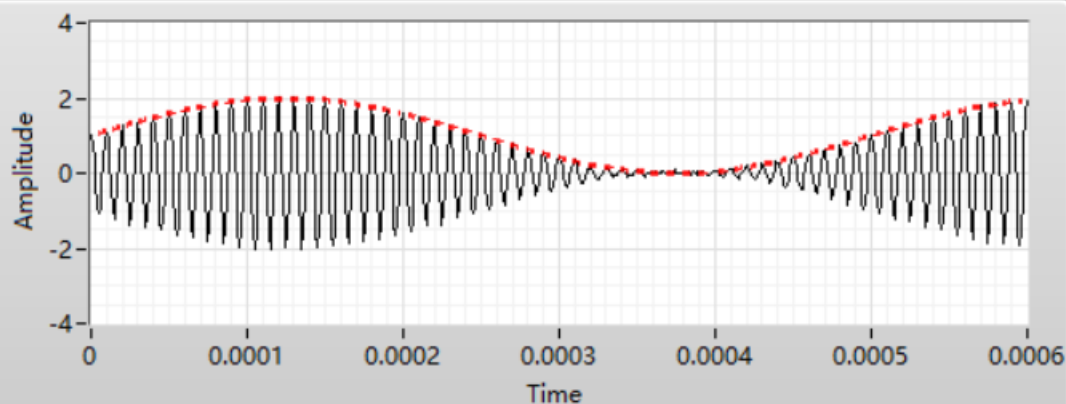
Amplitude Modulation

AM Wave

Upper Envelope

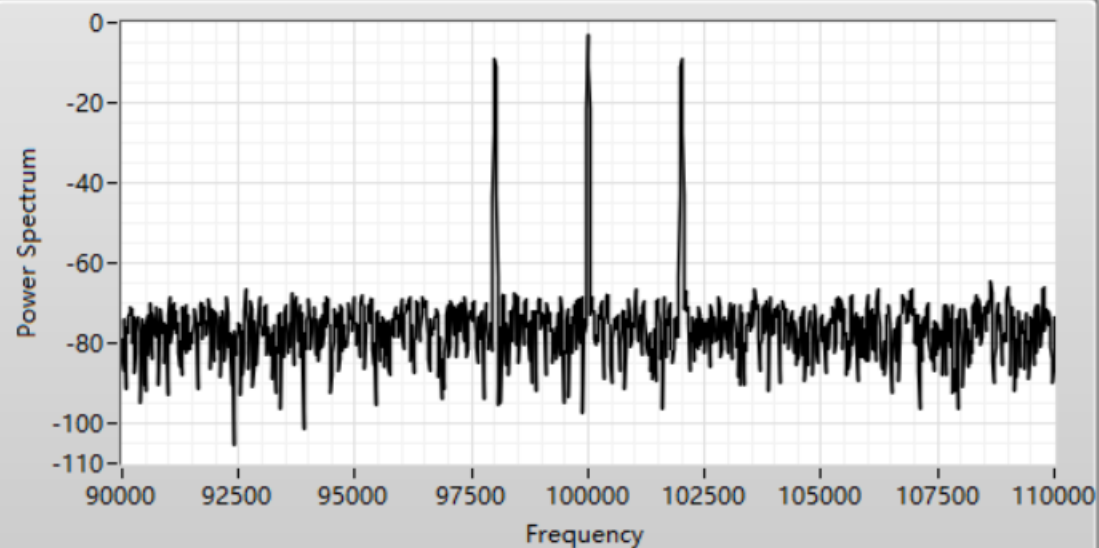


Modulated Signal



AM Power Spectrum

Sine (Power Spectrum)



Carrier Amp.

1

Carrier Freq.

100000

DC Offset

1

Mod. Freq.

2000

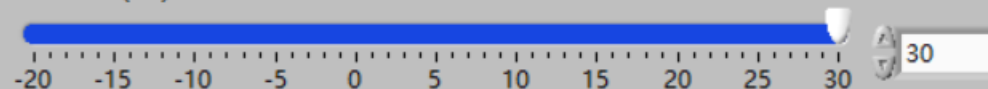
LPF Cut-Off

10000

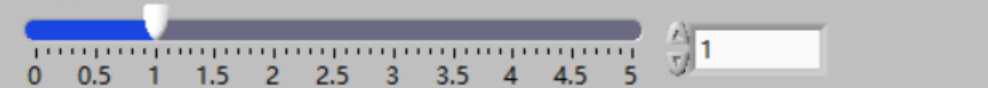
WAV Sample Rate

44100

AWGN (dB)



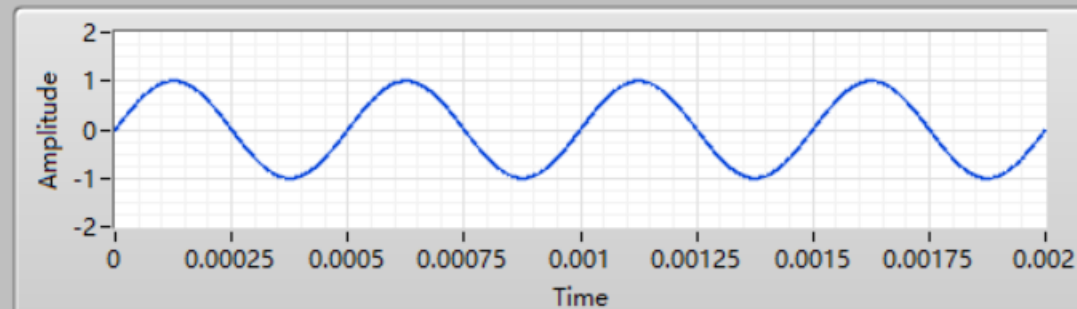
Modulation Index



stop

STOP

Baseband

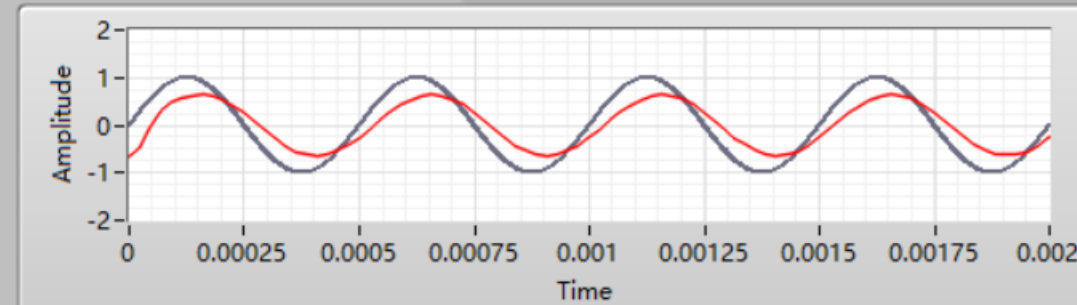


Comparison

Sine (Resampled)



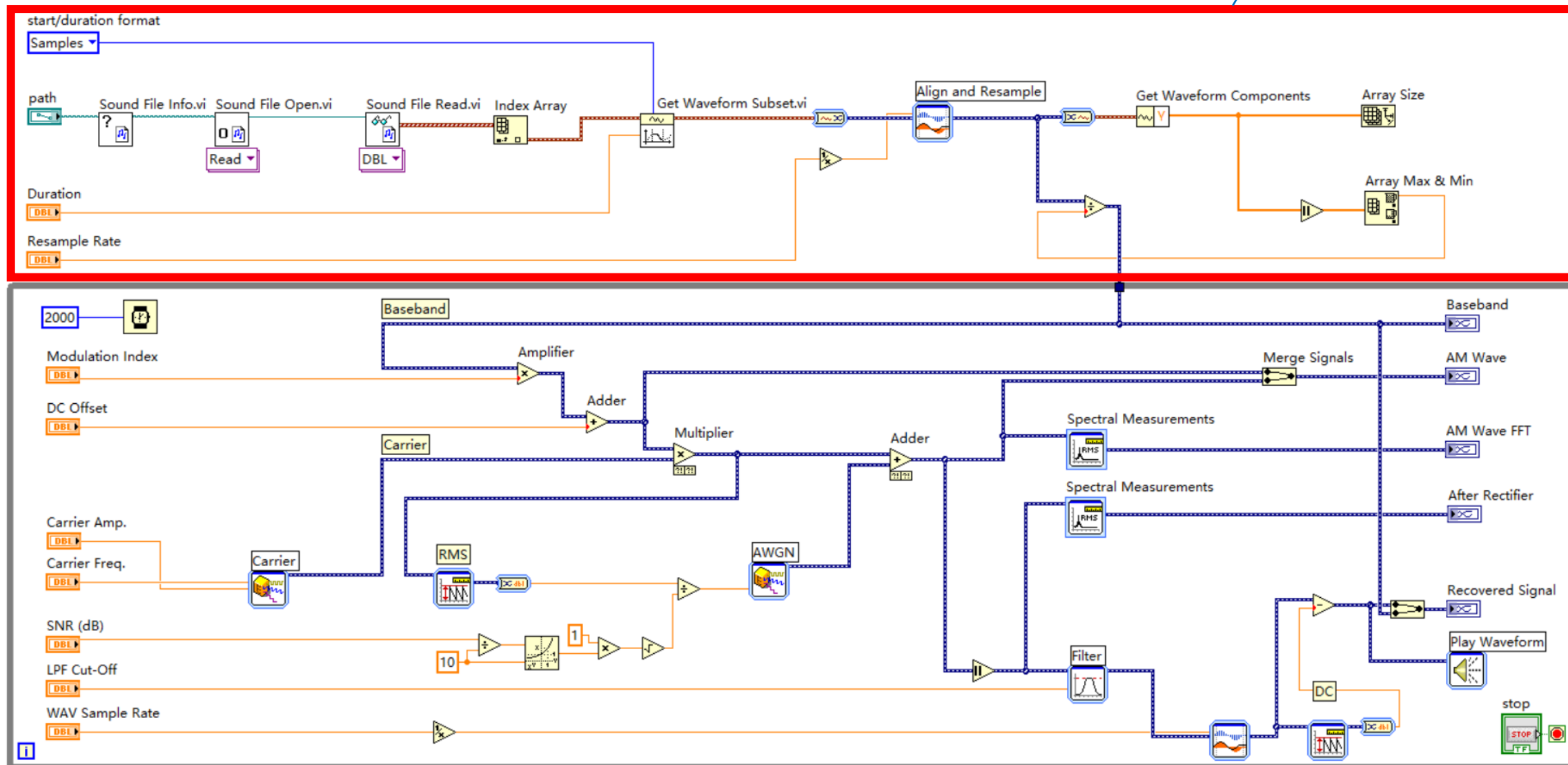
Baseband Signal



AM Modulation Demo (Baseband-Music).vi Block Diagram

File Edit View Project Operate Tools Window Help

Baseband





Exercise: Sound File Read

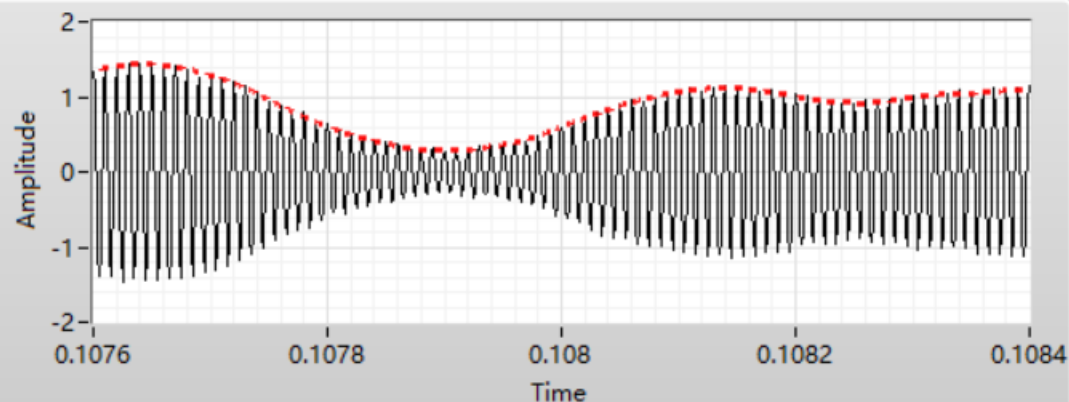
Amplitude Modulation

AM Wave

Upper Envelope

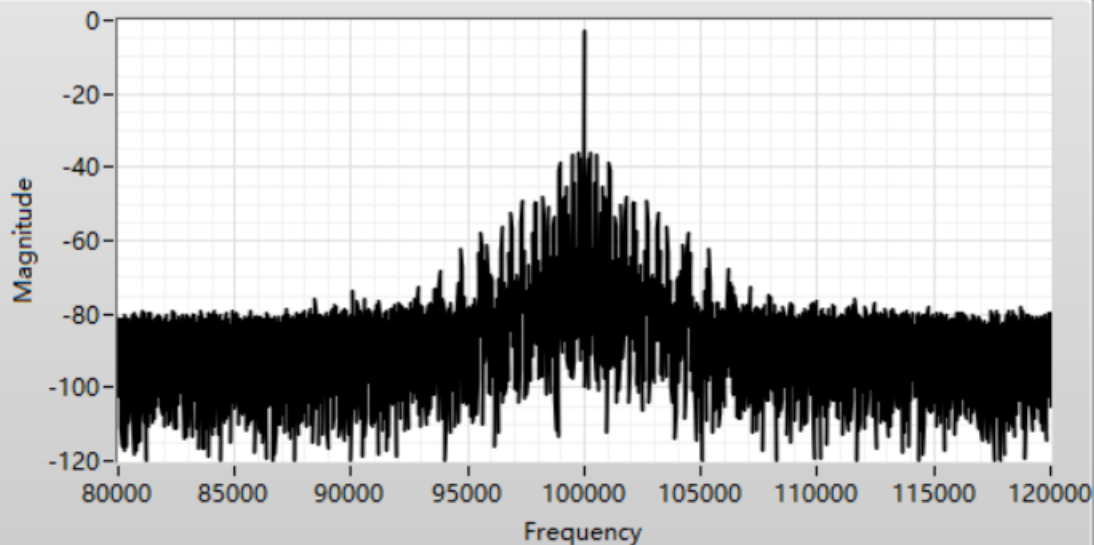


Modulated Signal



AM Wave FFT

Modulated Signal (FFT - (RMS))



path

D:\File\mozart.wav

Duration

44101

WAV Sample Rate

44100

Carrier Amp.

1

Carrier Freq.

100000

DC Offset

1

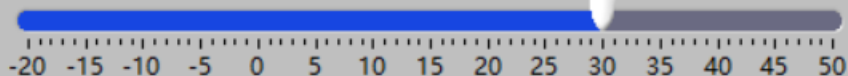
Resample Rate

1000000

LPF Cut-Off

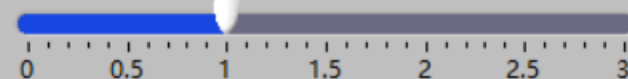
10000

SNR (dB)



30

Modulation Index

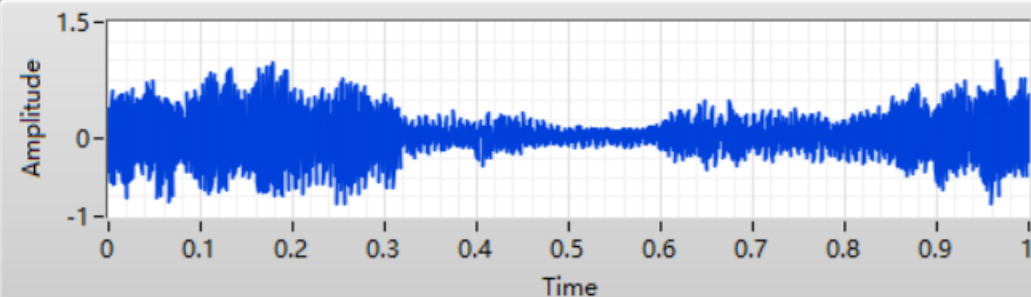


1

stop

STOP

Baseband

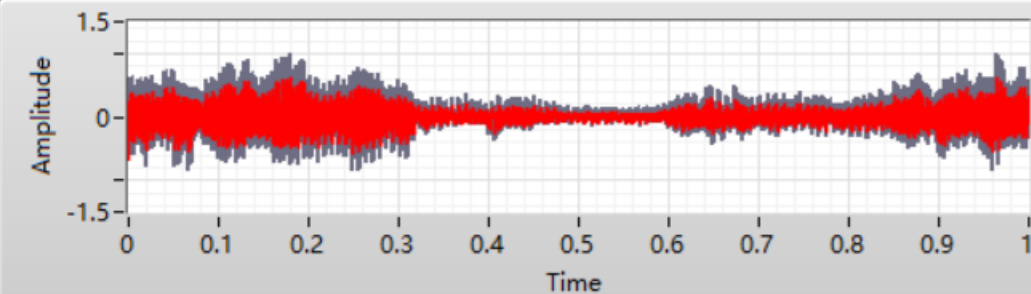


Recovered Signal

Recovered Signal



Baseband Signal

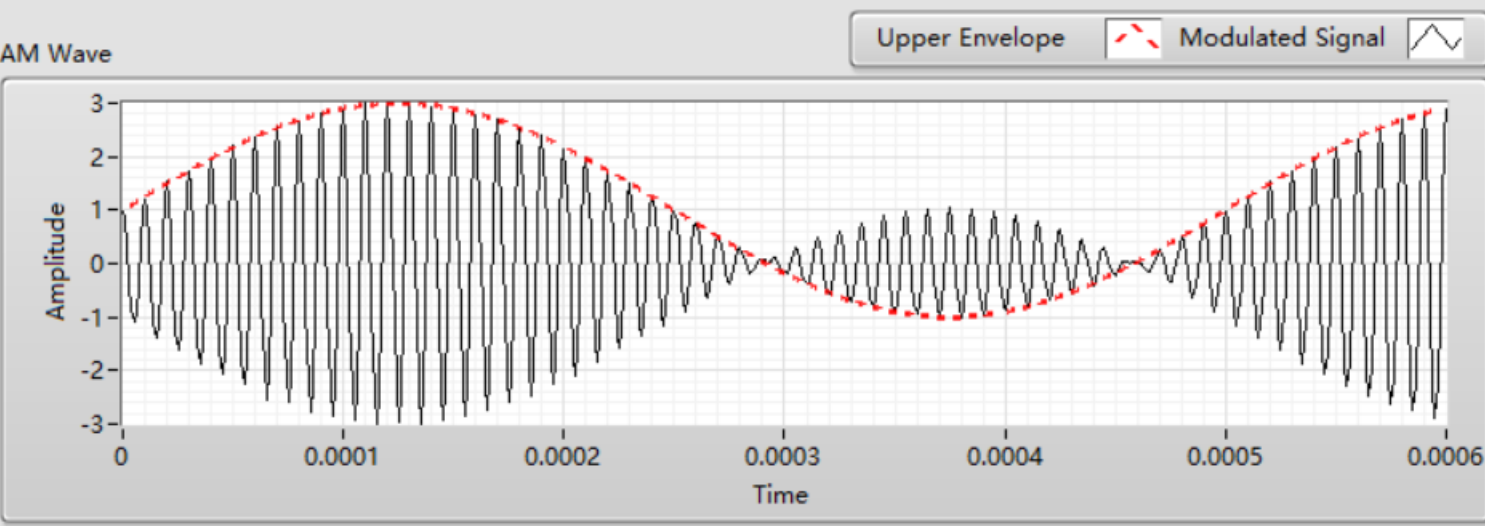




Demo: Performance Evaluation

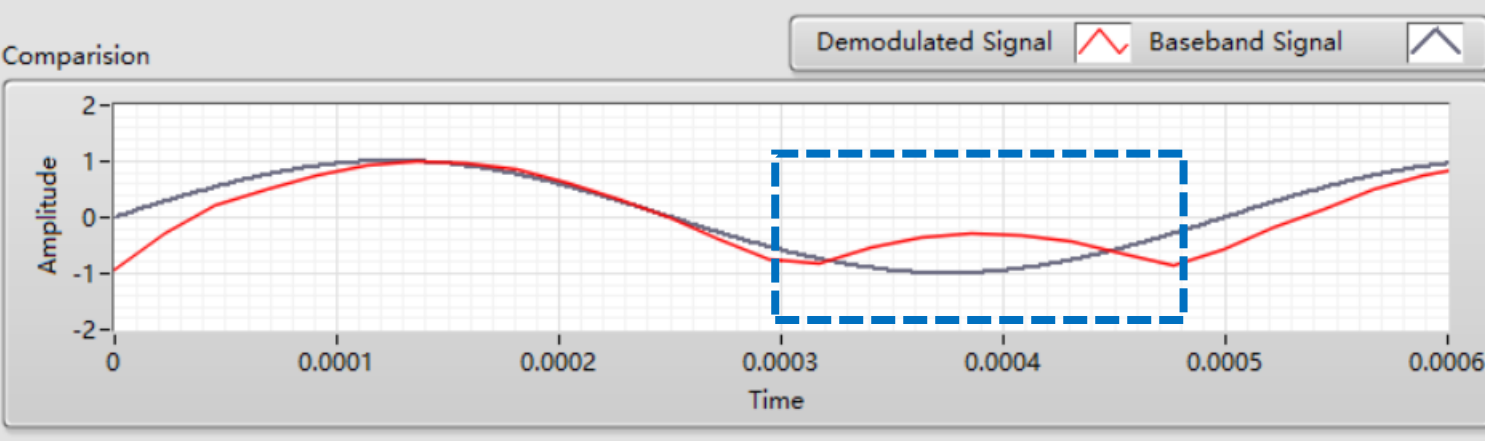


Performance Evaluation-Over modulation



Modulation Index: 2

SNR(dB): 30 dB



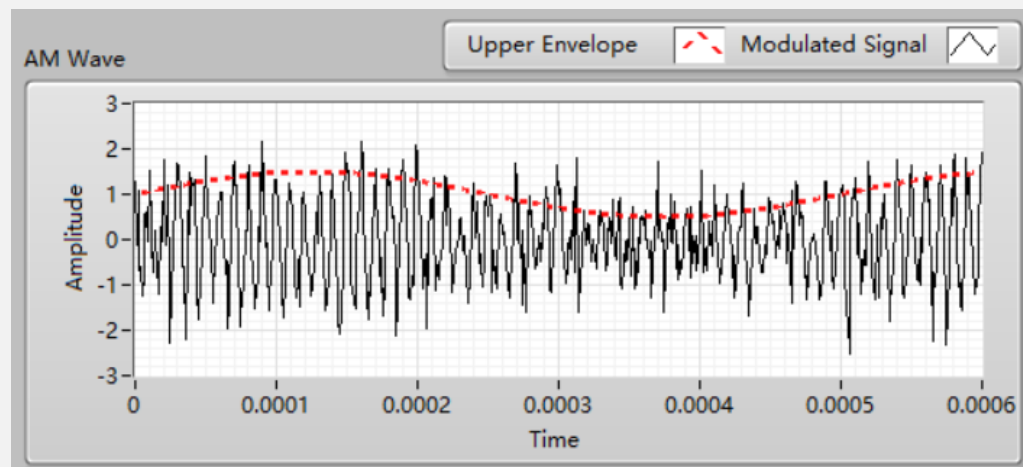
LPF Cutoff Frequency:
10 kHz



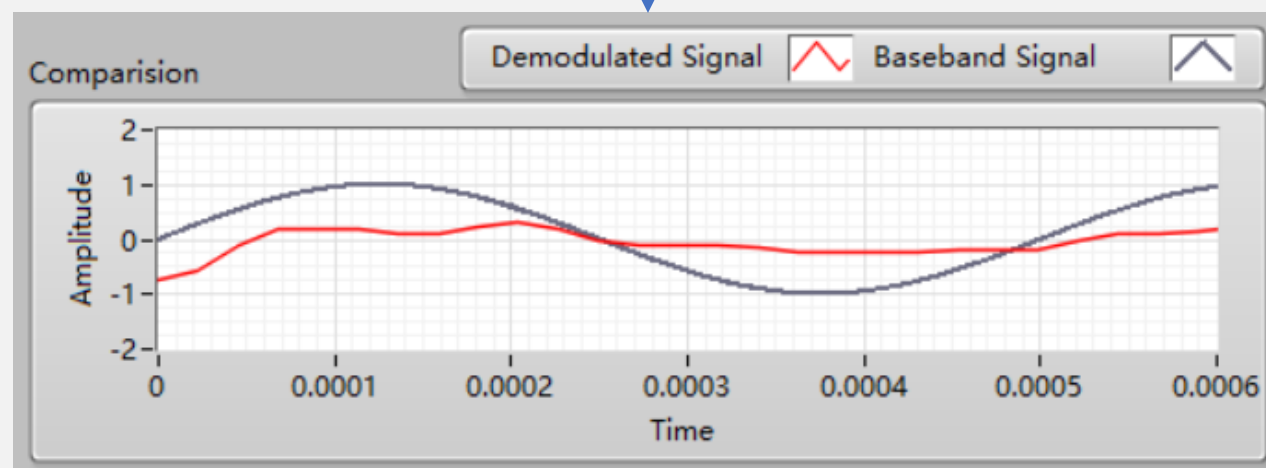
Demo: Performance Evaluation



Performance Evaluation-AWGN



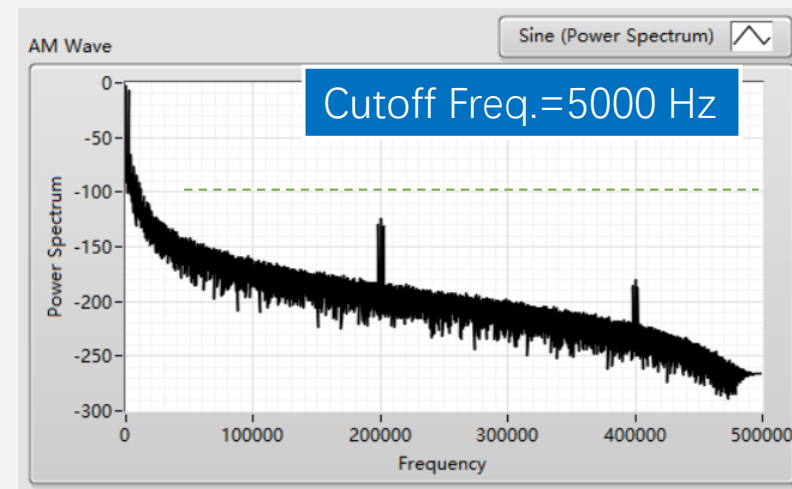
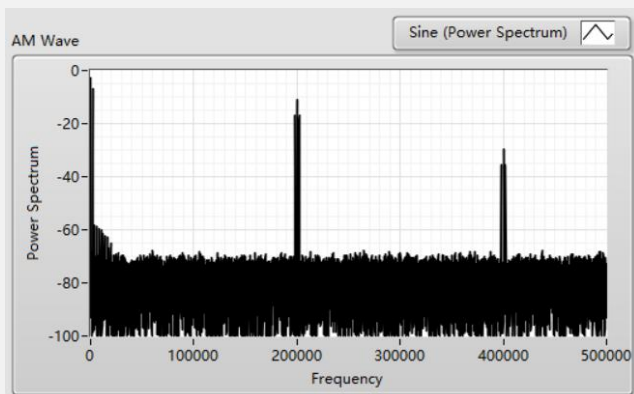
SNR(dB): 0 dB





Demo: Performance Evaluation

Performance Evaluation-Cutoff Frequency



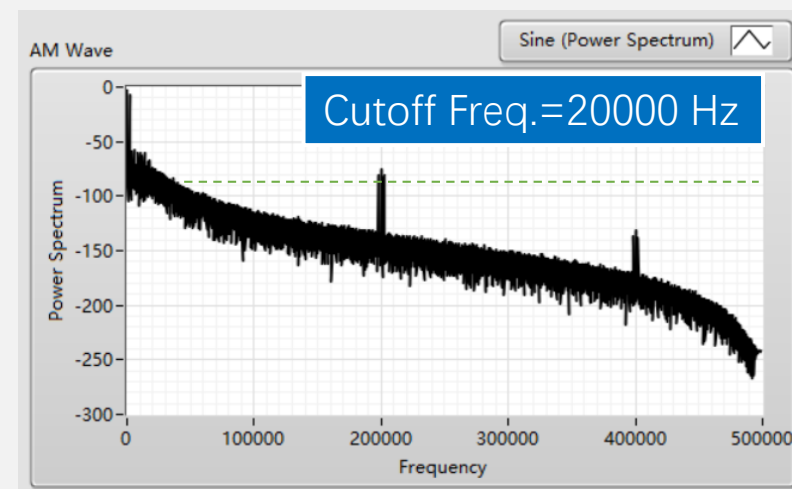
☒ Infinite impulse response (IIR) filter

Topology

Butterworth

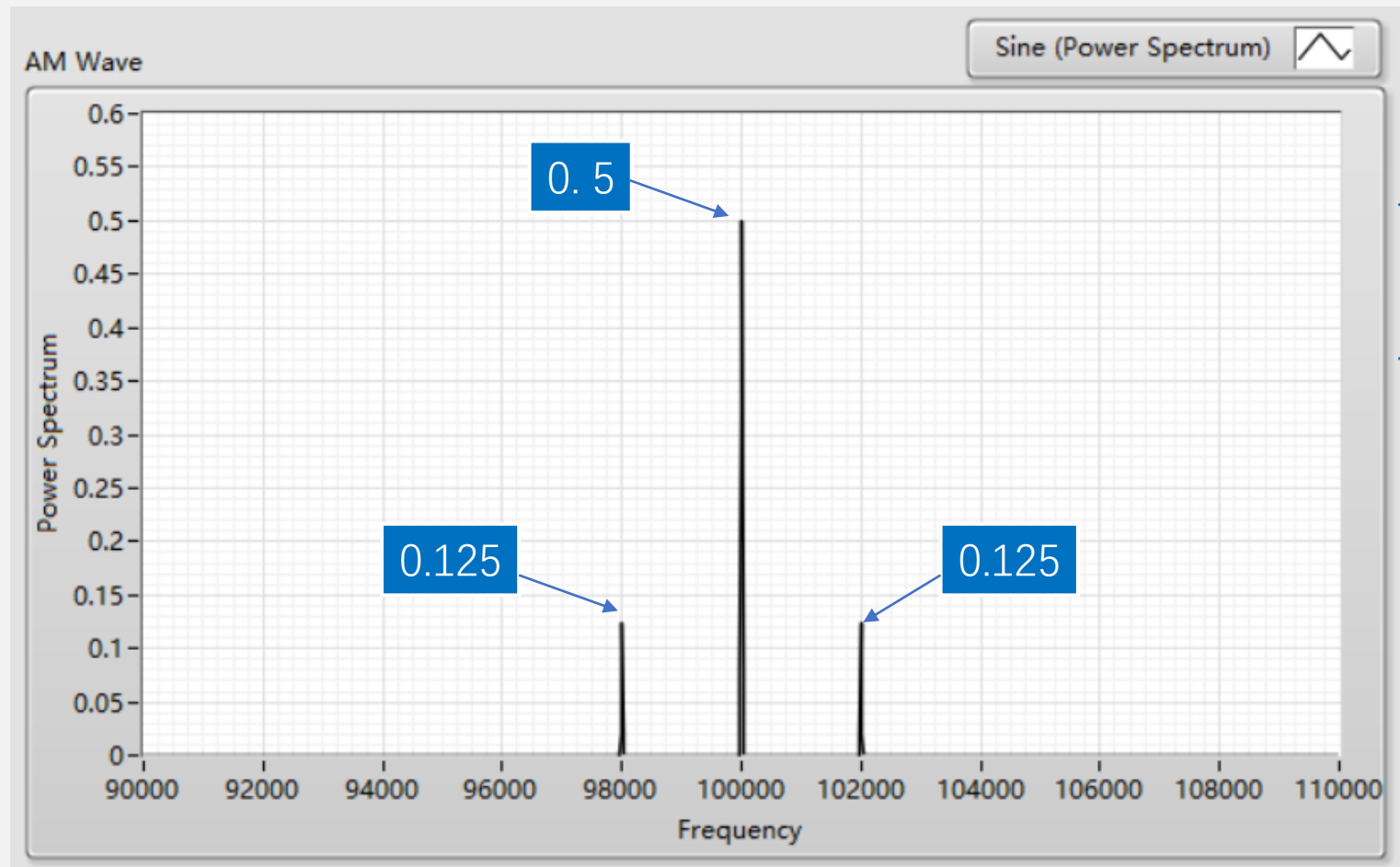
Order

3





Performance Evaluation-Power and Spectrum



Power Efficiency $\leq 1/3$

Bandwidth=4000Hz



- Question ?

