CIE 337 - Communication Theory and Systems

Project I

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Team Members:

Youssef Islam Elshabrawy 201-900-667

Amr Ahmed Elmasry 201-901-202

Ahmed Mohamed Ibrahem 201-902-227

مدينة زويل

ZEWAIL CITY

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Part A: Using Matlab

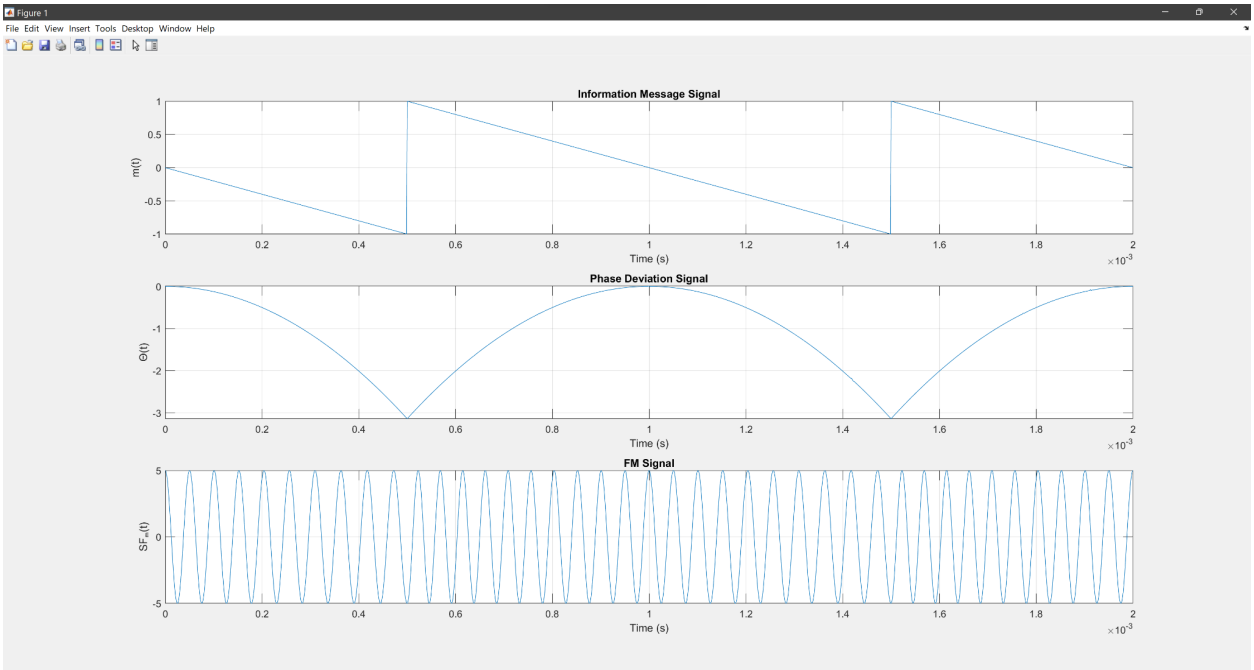

Figure 1: FM Signal (Kf= 2000)

As shown above, the message signal is modulated with a carrier frequency higher than its original frequency using FM (integrated message). Further, the modulated signal has a varying frequency that might not be shown in this figure, the change can be observed as we increase the number of samples (or the Kf as we will see later).

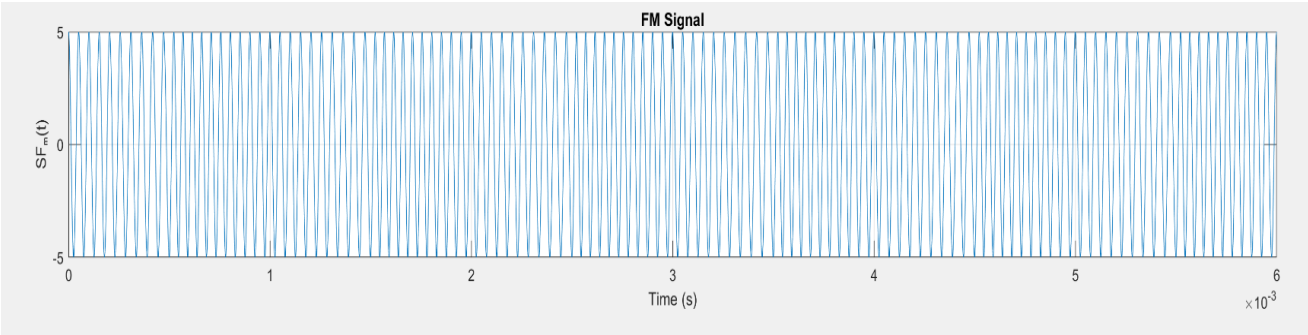

Figure 2: FM Signal (6 samples)

The Effect of Changing Kf

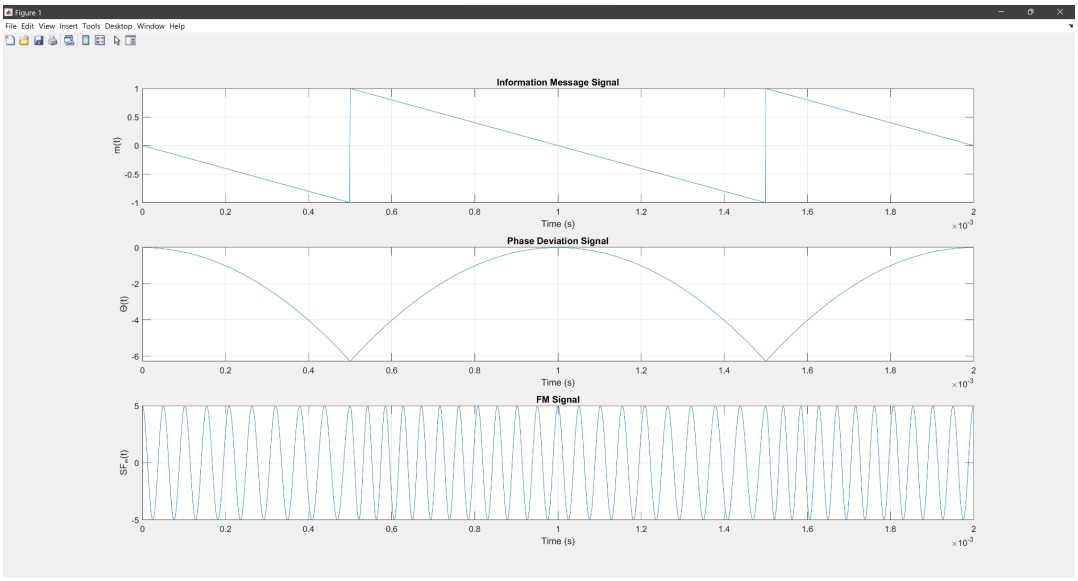

Figure 3: FM Signal (Kf= 4000)

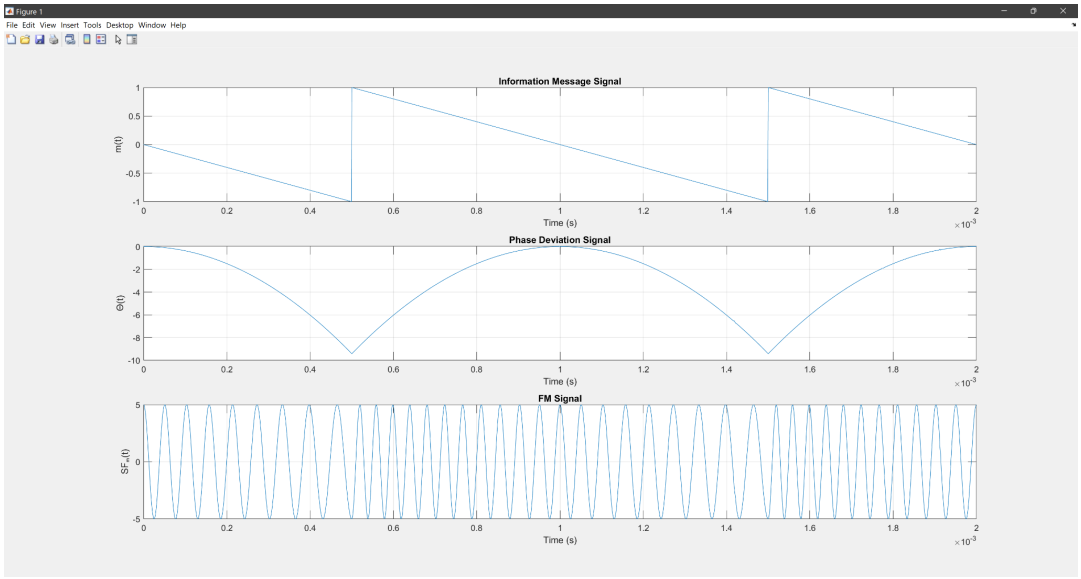

Figure 4: FM Signal (Kf= 6000)

The frequency deviation of the FM if proportional to Kf *(Dev = Kf * m(t))*, thus, as we increase the Kf, the deviation increases and the modulated signal's frequency change is more noticeable as observed above.

Part B: Using Simulink

In this part, We use Simulink in conjunction with the Matlab workspace.

I) Sawtooth Signal

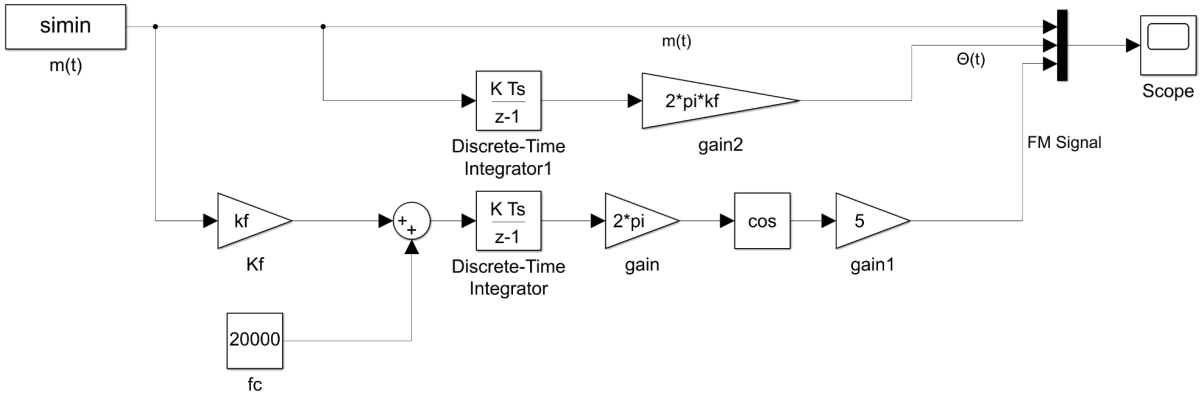

Figure 5: Circuit Diagram

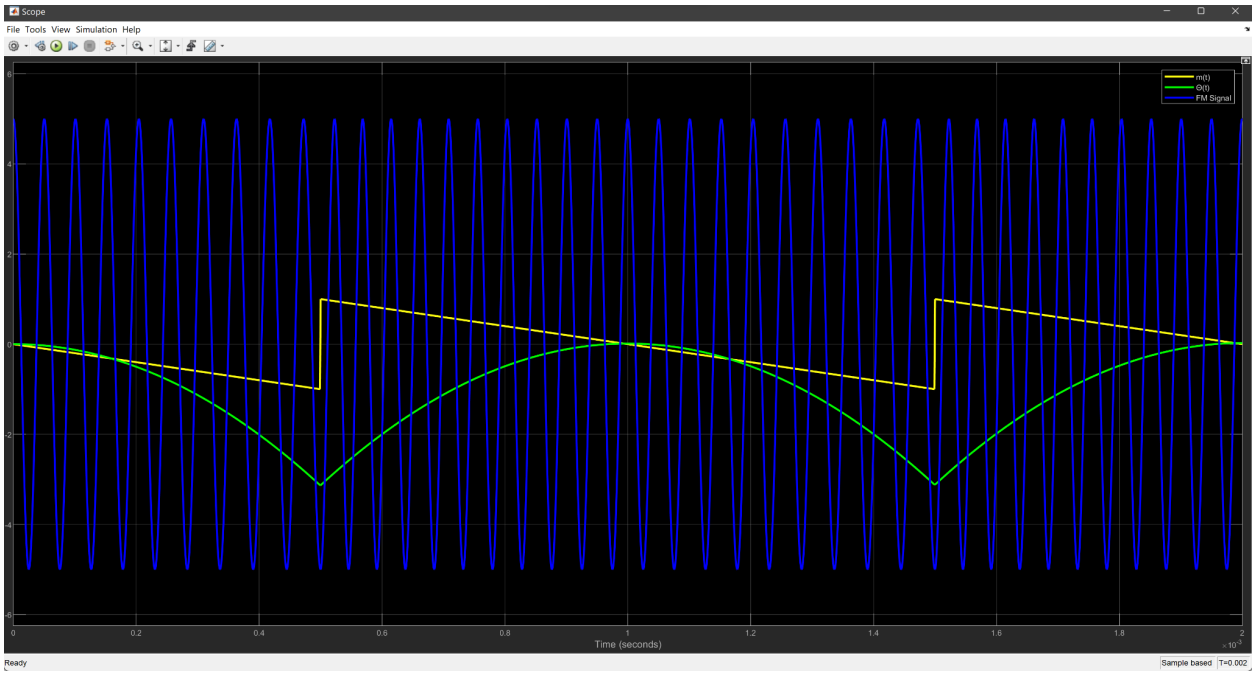

Figure 6: Scope output at Kf = 2000

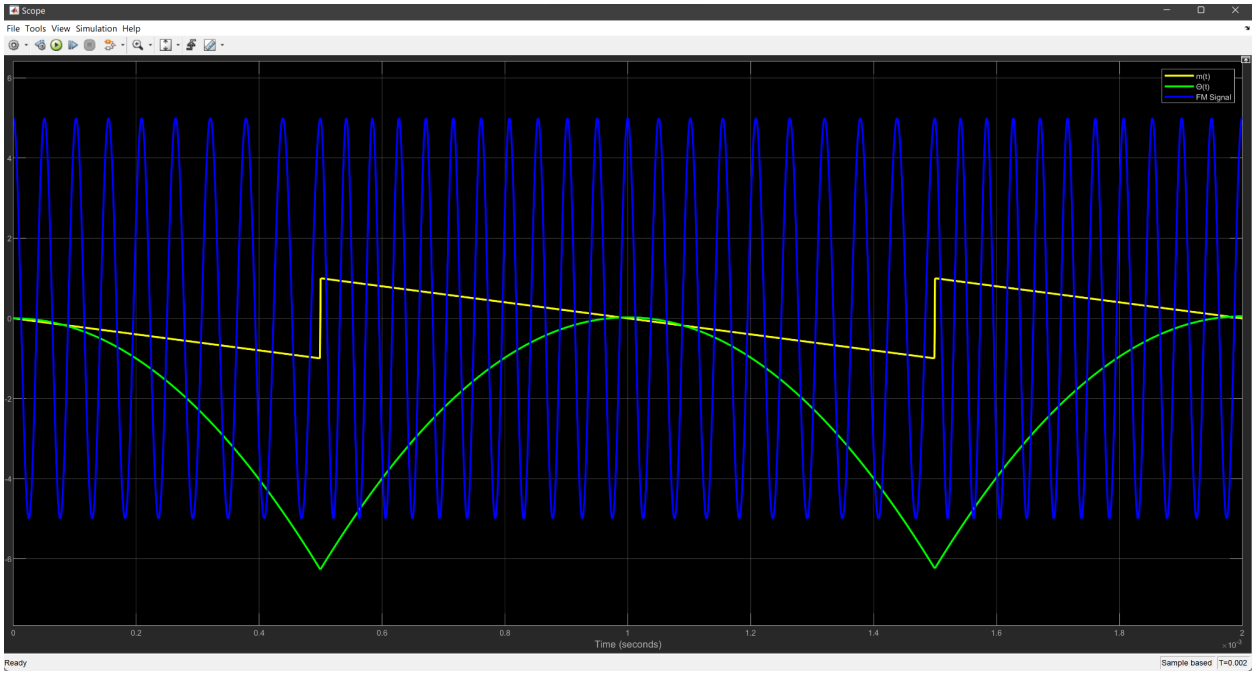

Figure 7: Scope output at Kf = 4000

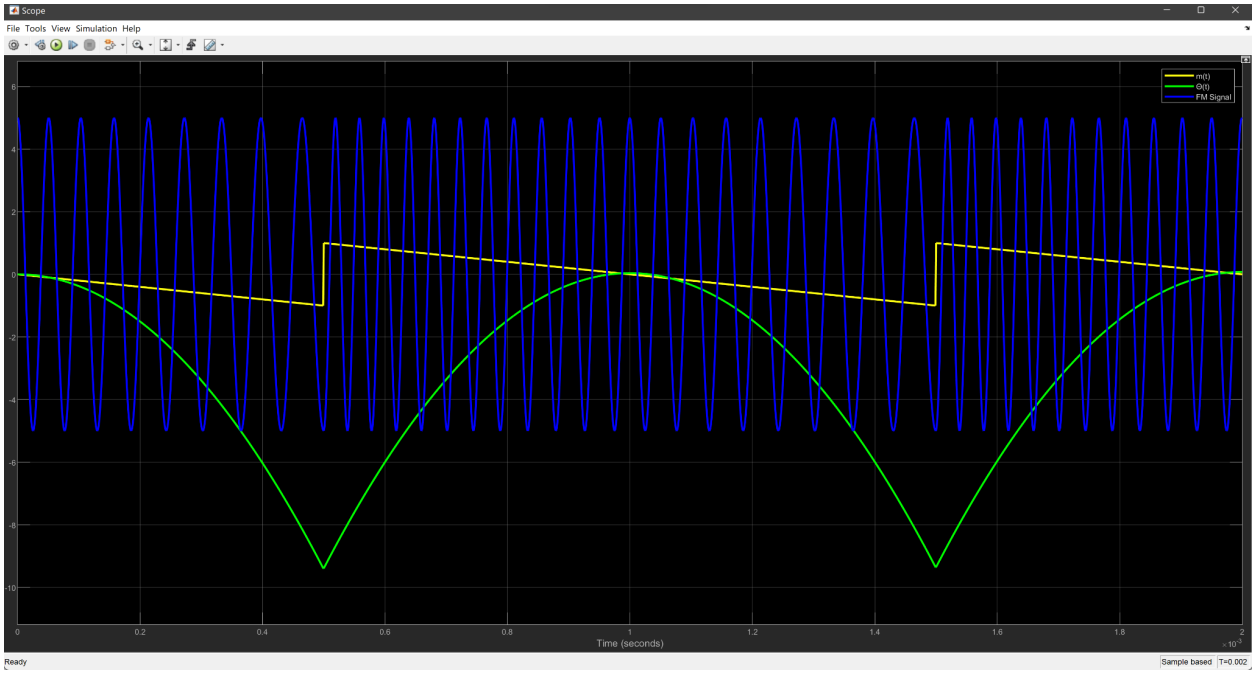

Figure 8: Scope output at Kf = 6000

Similarly, the simulink output produces the same FM signal in MATLAB implementation.

Ⅱ) Sine Wave

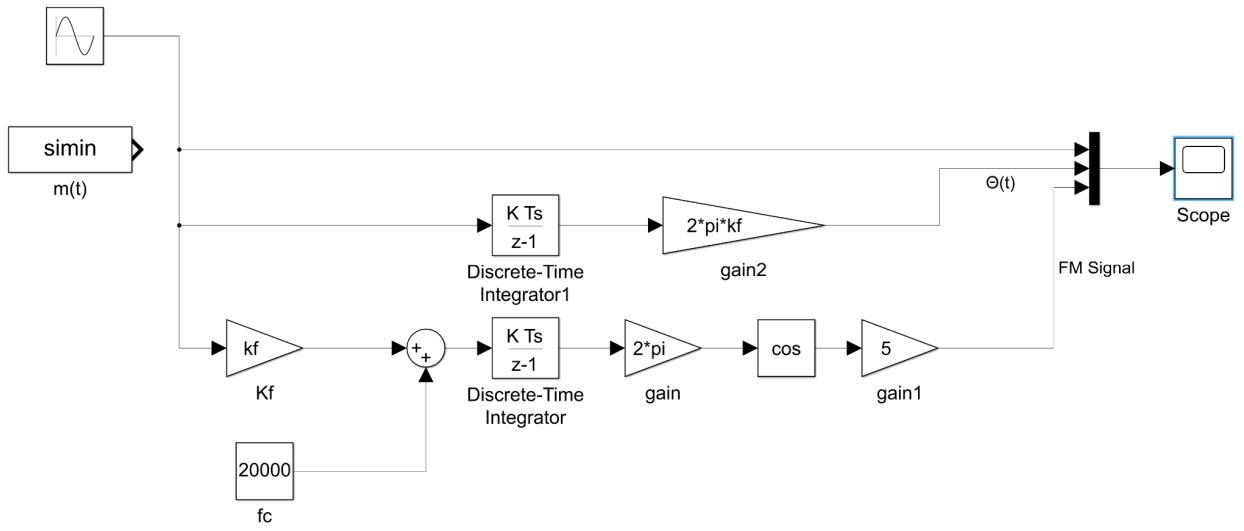

Figure 9: Circuit Diagram

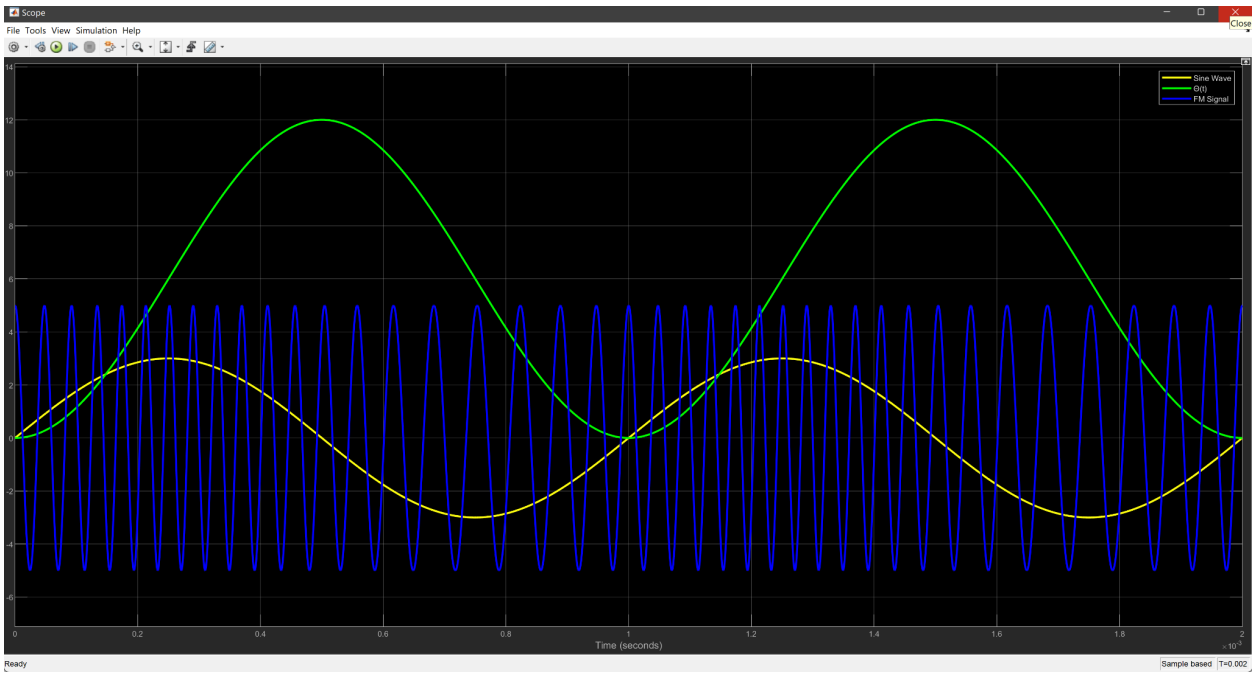

Figure 10: Scope output at Kf = 2000

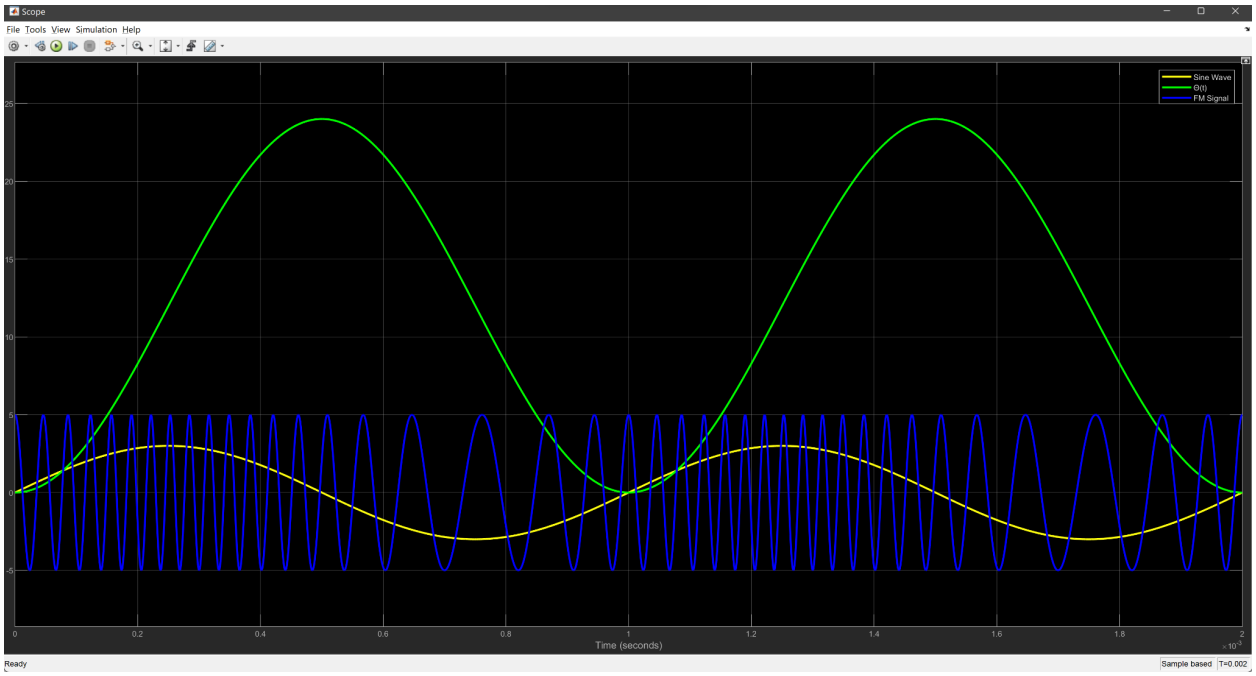

Figure 11: Scope output at Kf = 4000

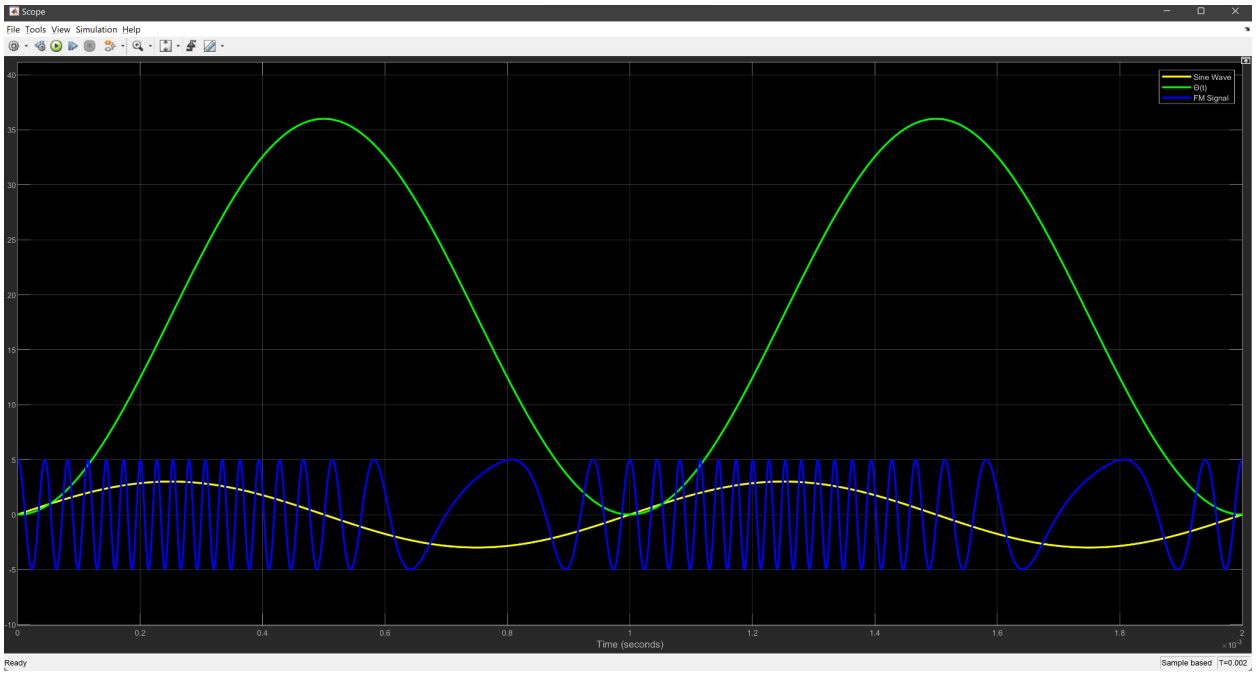

Figure 12: Scope output at Kf = 6000

Ⅲ) Blocks Parameters

1) Simin: m(t), and time vectors from the workspace

2) Gain: From figure 5: circuit diagram, the gain of each gain block is written inside the block.

3) Discrete-Time integrator

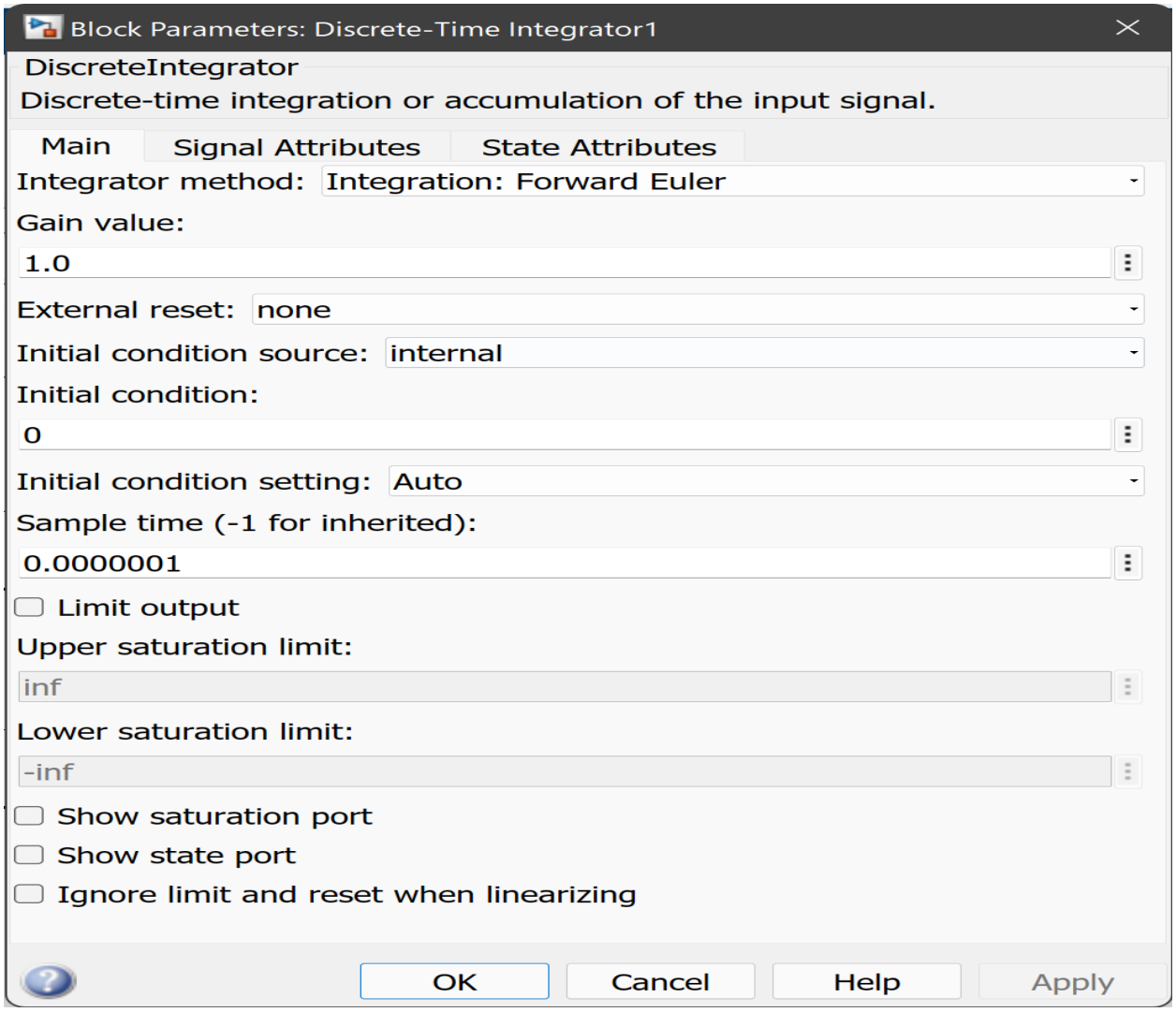

Figure 13: Discrete-Time integrator block parameters

4) Sine Wave

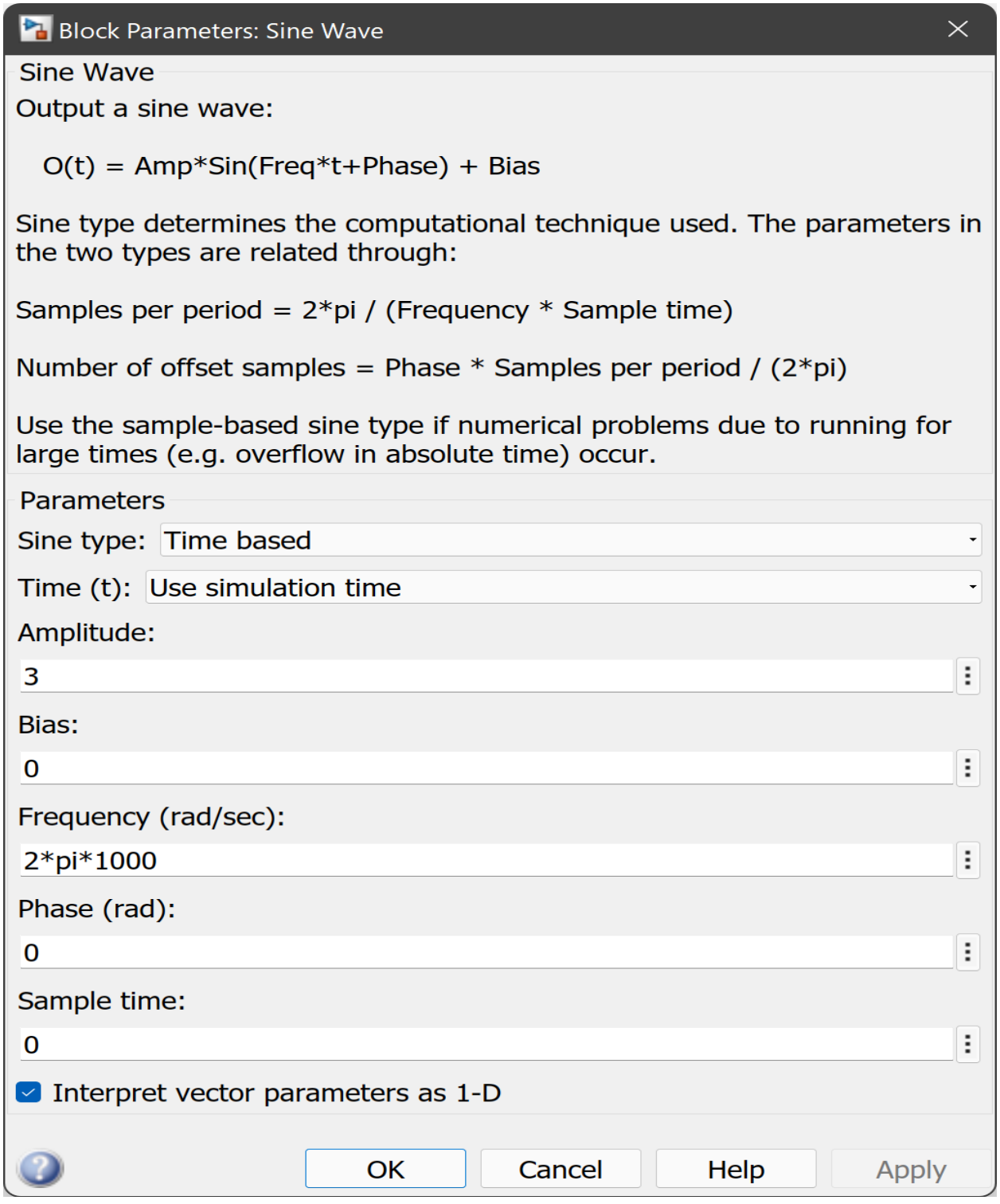

Figure 14: Sine Wave block parameters

Part C: Using Simulink Toolbox

By using the FM Modulator block from Communications toolbox, We verify our findings from Part B.

I) Sawtooth Signal

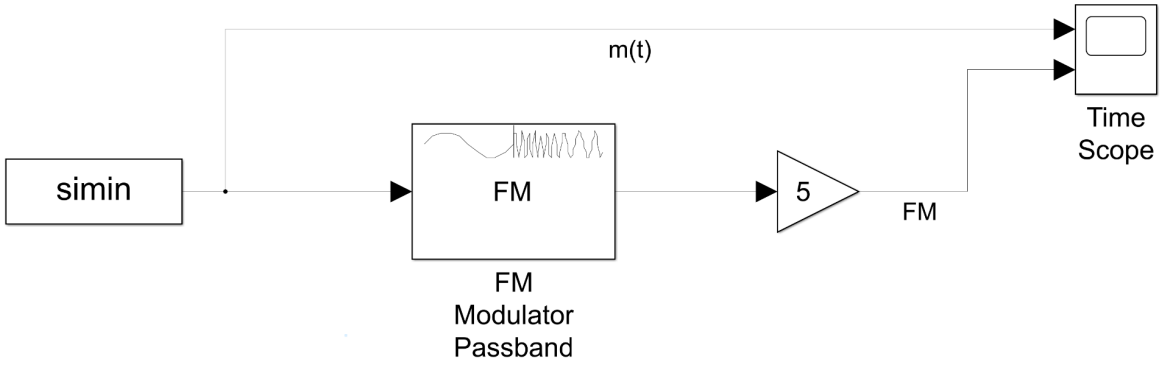

Figure 15: Circuit Diagram

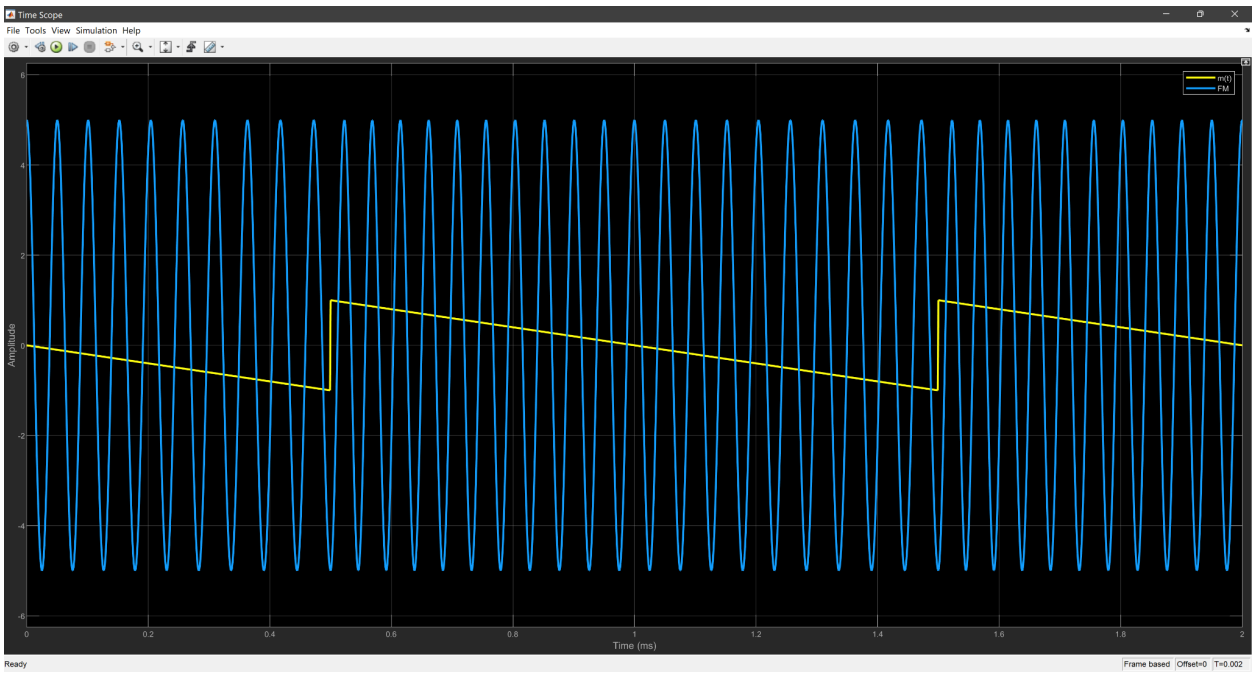

Figure 16: Scope output at Kf = 2000

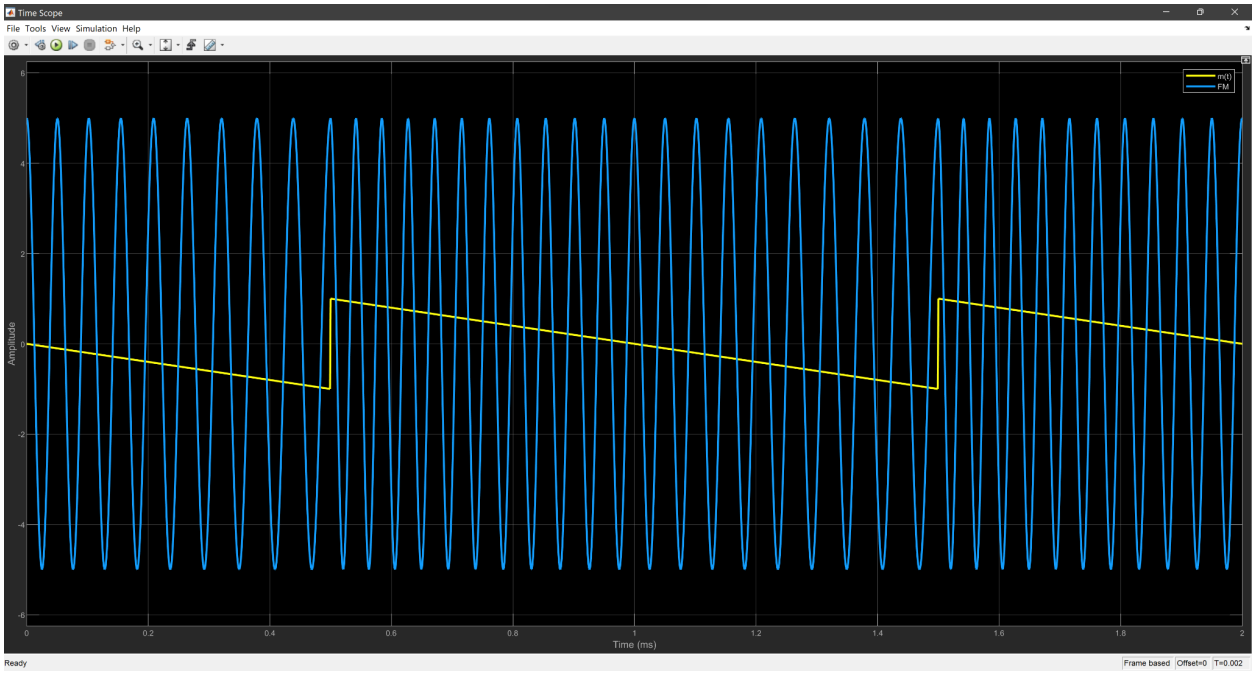

Figure 17: Scope output at Kf = 4000

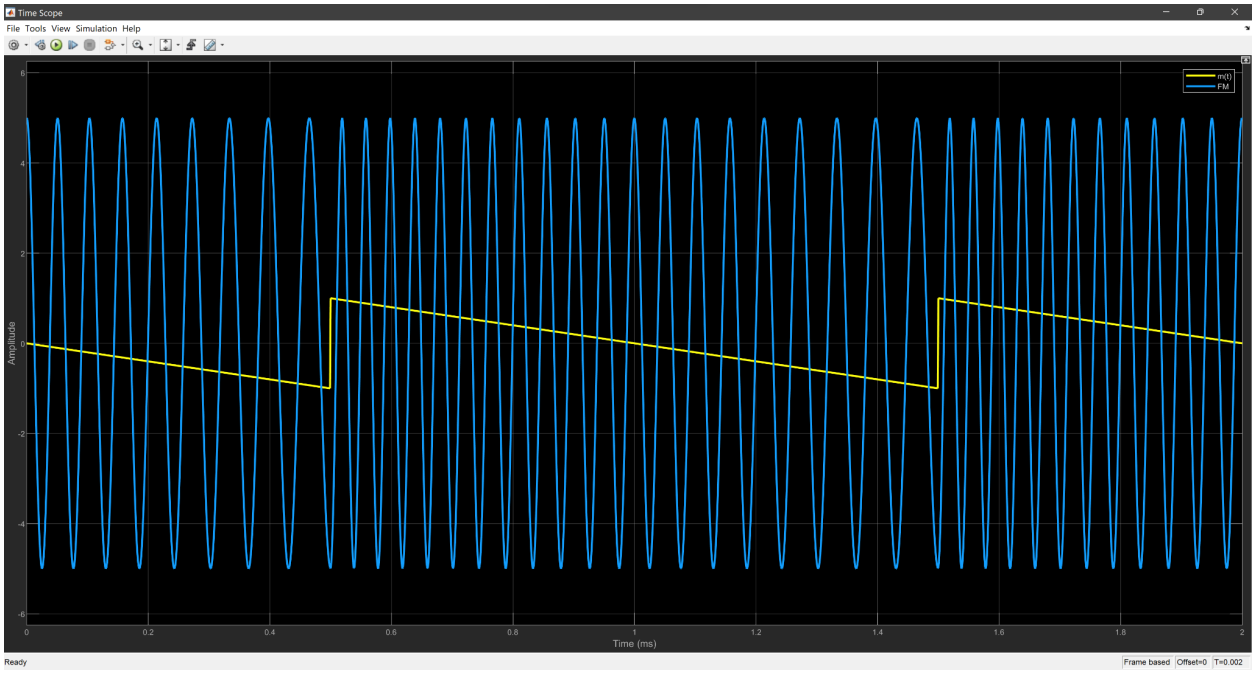

Figure 18: Scope output at Kf = 6000

The outputs are identical to part 2 as expected.

Ⅱ) Sine Wave

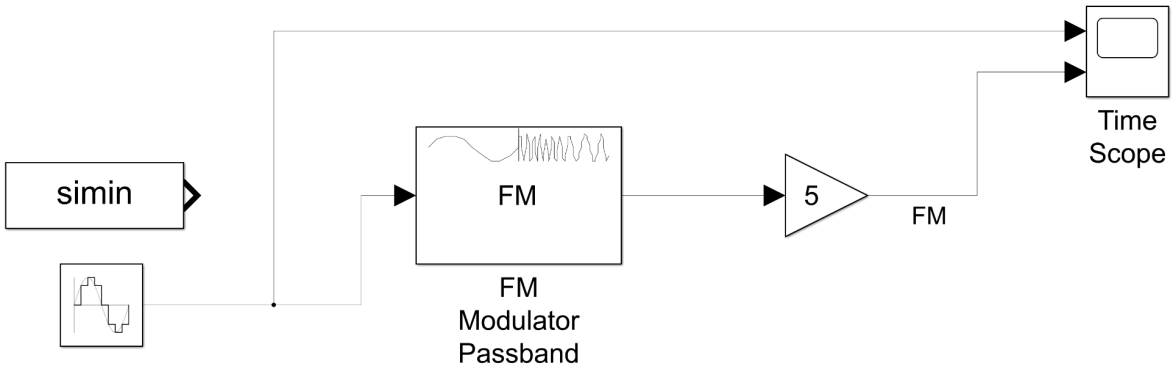

Figure 19: Circuit Diagram

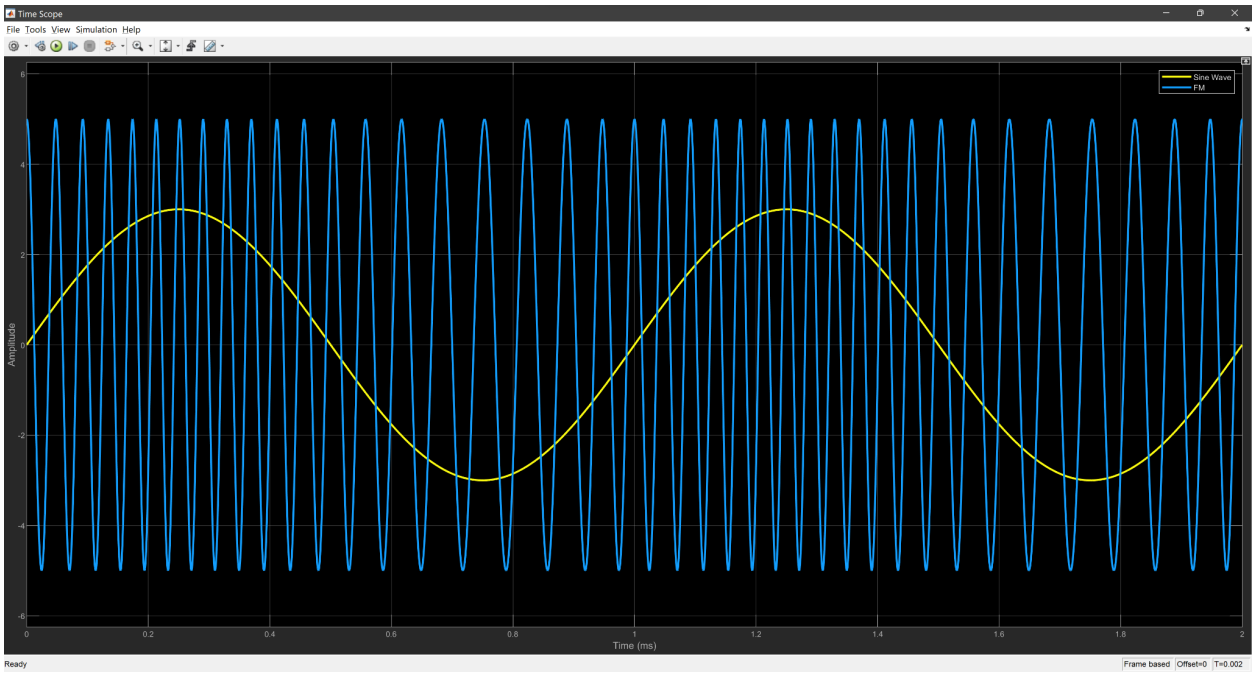

Figure 20: Scope output at Kf = 2000

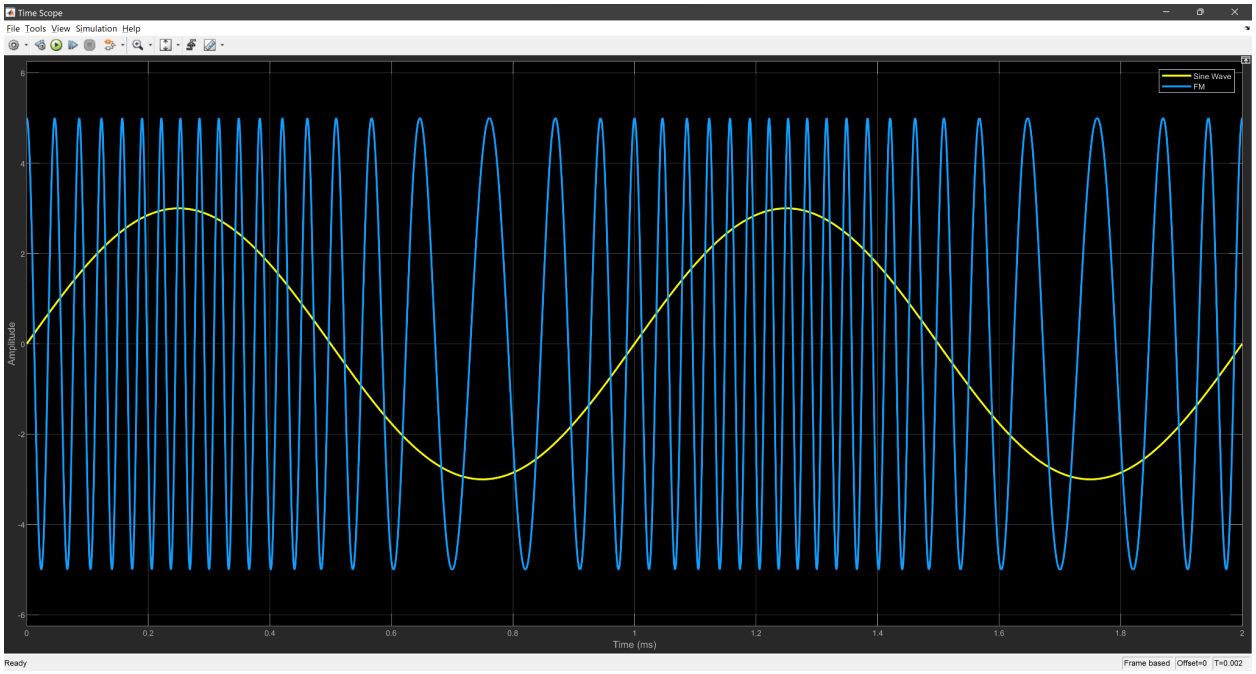

Figure 21: Scope output at Kf = 4000

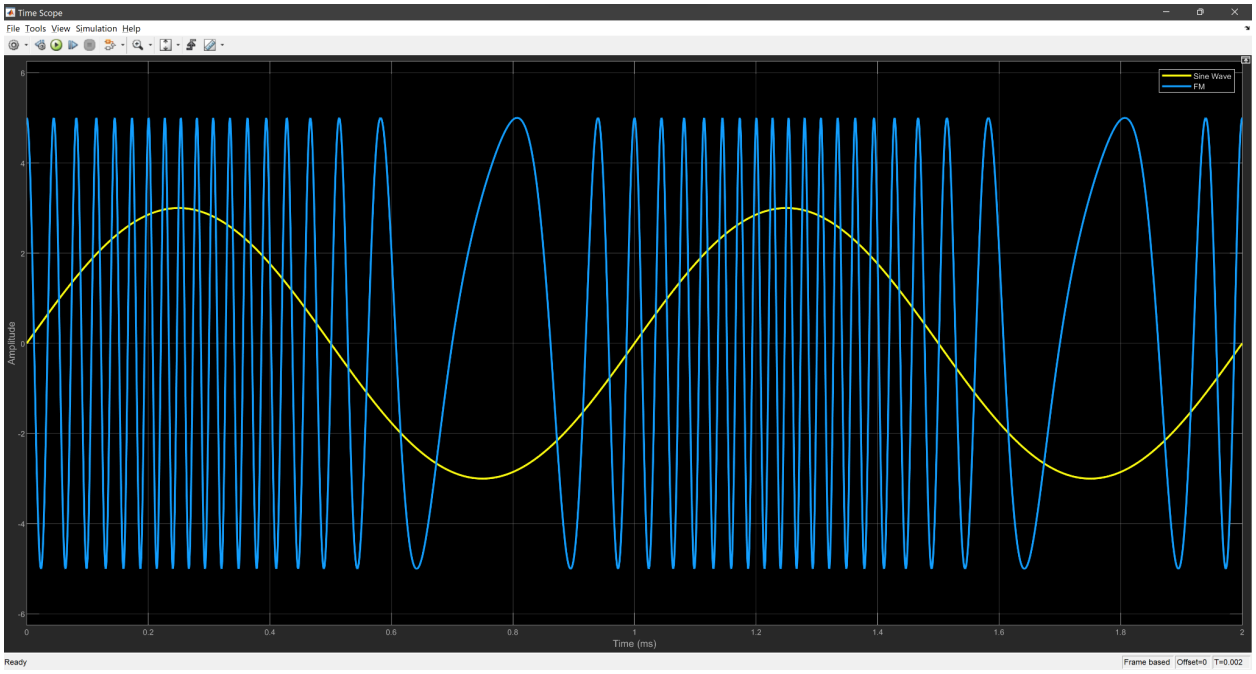

Figure 22: Scope output at Kf = 6000

Ⅲ) Blocks Parameters

1) Simin: m(t), and time vectors from the workspace

2) Gain: 5

3) FM Modulator Passband

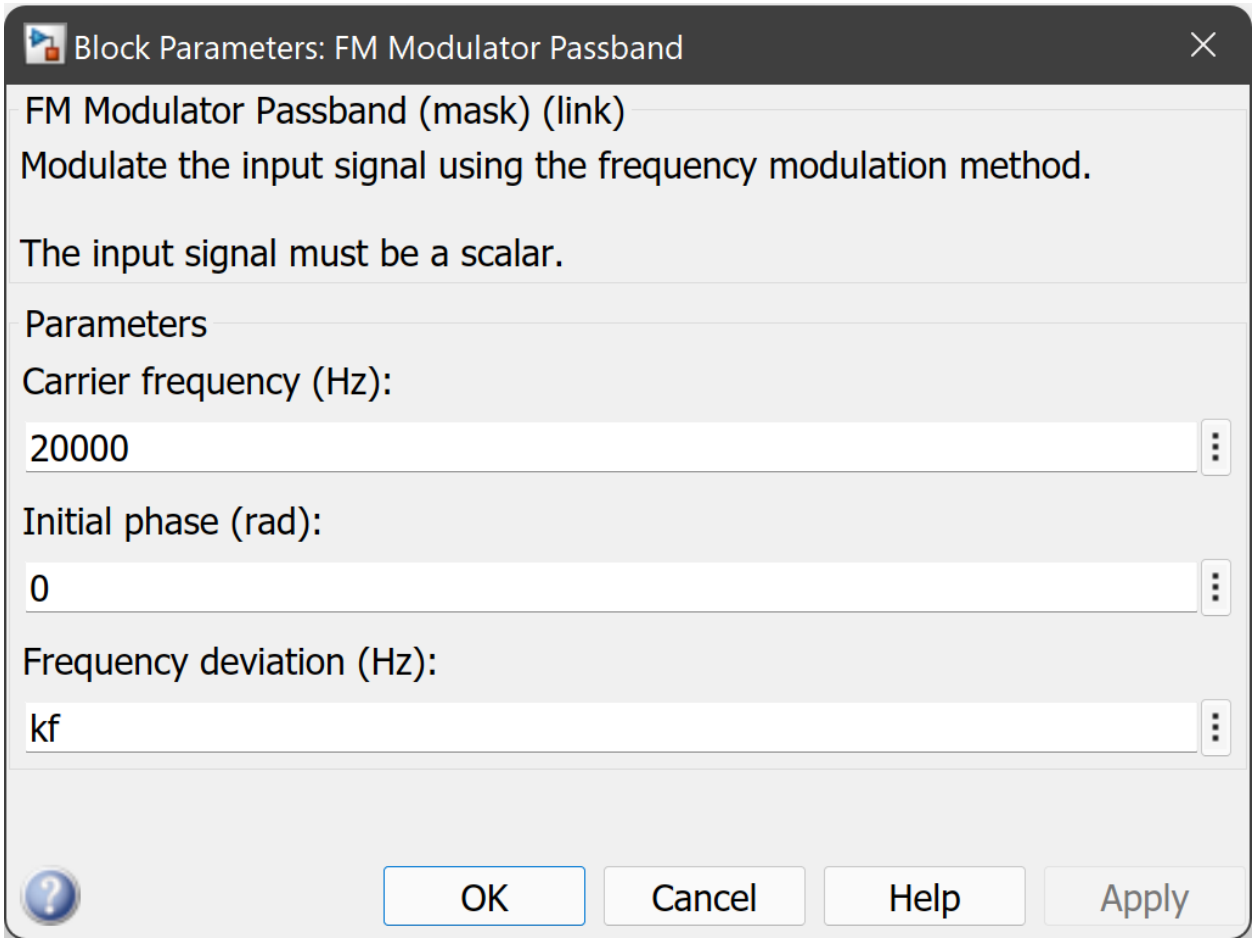

Figure 23: FM Modulator Passband block parameters

4) Sine Wave

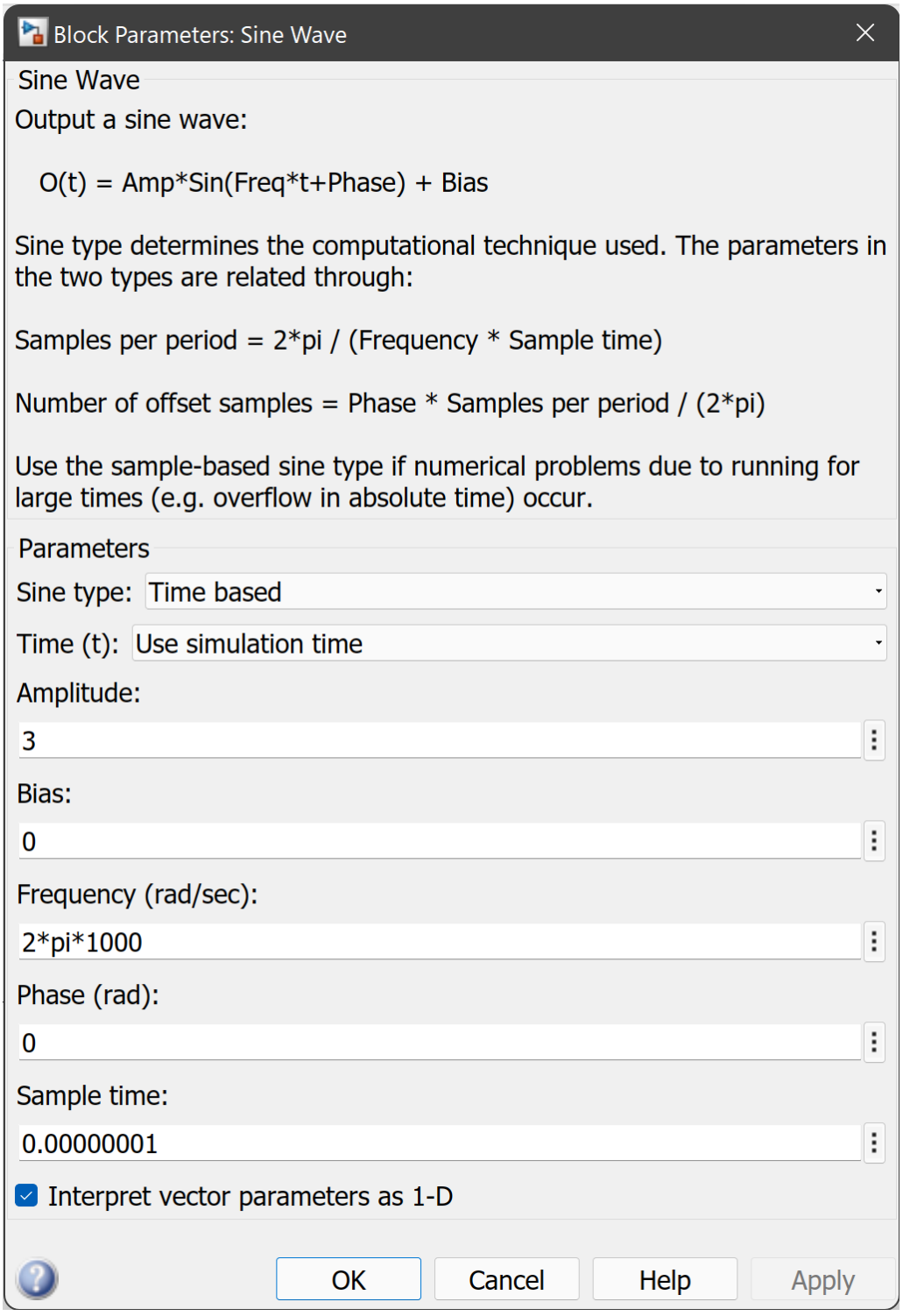

Figure 24: Sine Wave block parameters