

**Faculty of Engineering & Technology Electrical & Computer Engineering Department**

**Communication Lab - ENEE4113**

**Experiment 5: Phase Modulation**

**Prelab #4**

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**Section**: 4

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# Software Prelab (Simulink MATLAB)

## Extract the message signal m(t) from s(t)

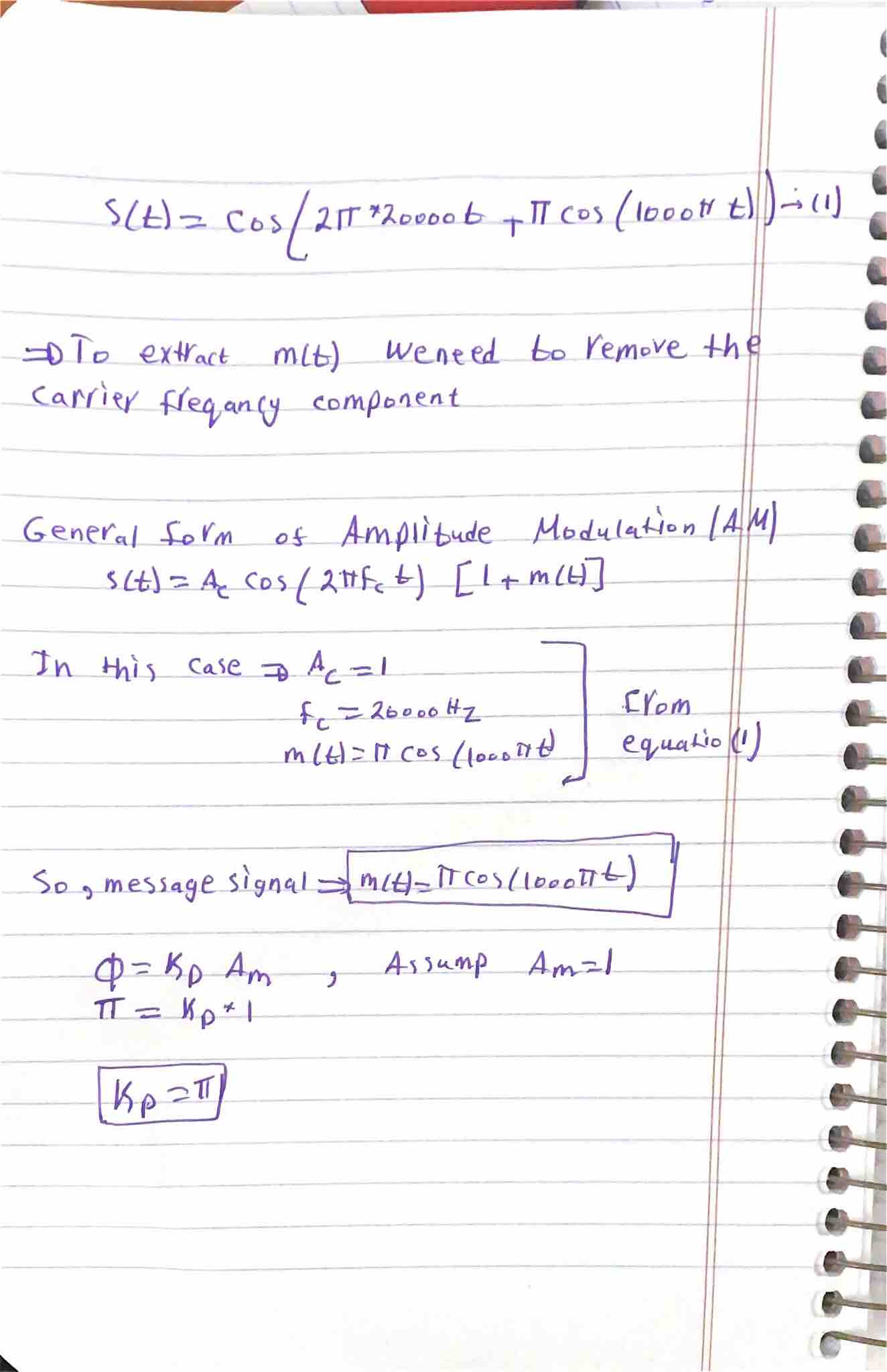


Figure 1: Steps to Extract the message signal m(t) from s(t)

## Plot 5 cycle from Message signal m(t) and s(t)

### Block Diagram

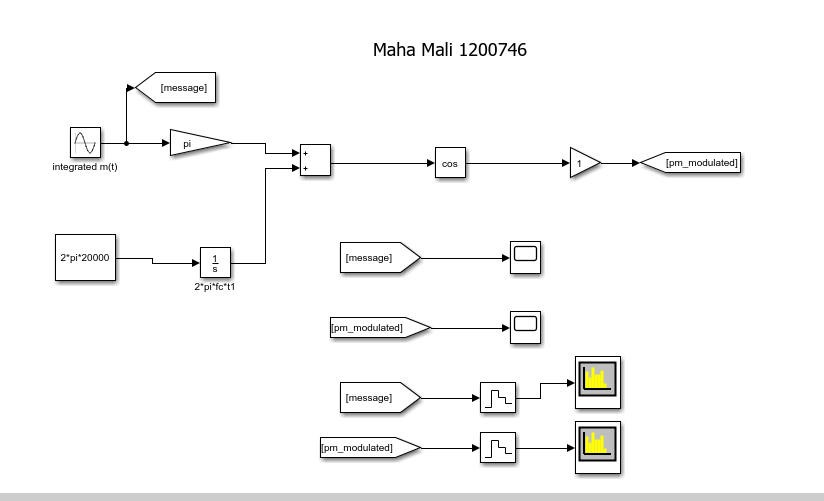


Figure 2: PM Modulation Block Diagram

### Message Signal

#### Time Domine



Figure 3: Message Signal in Time domine

From this graph we notice that we got the m(t) that we calculate it by hand with amplitude 1.

#### Frequency Domine

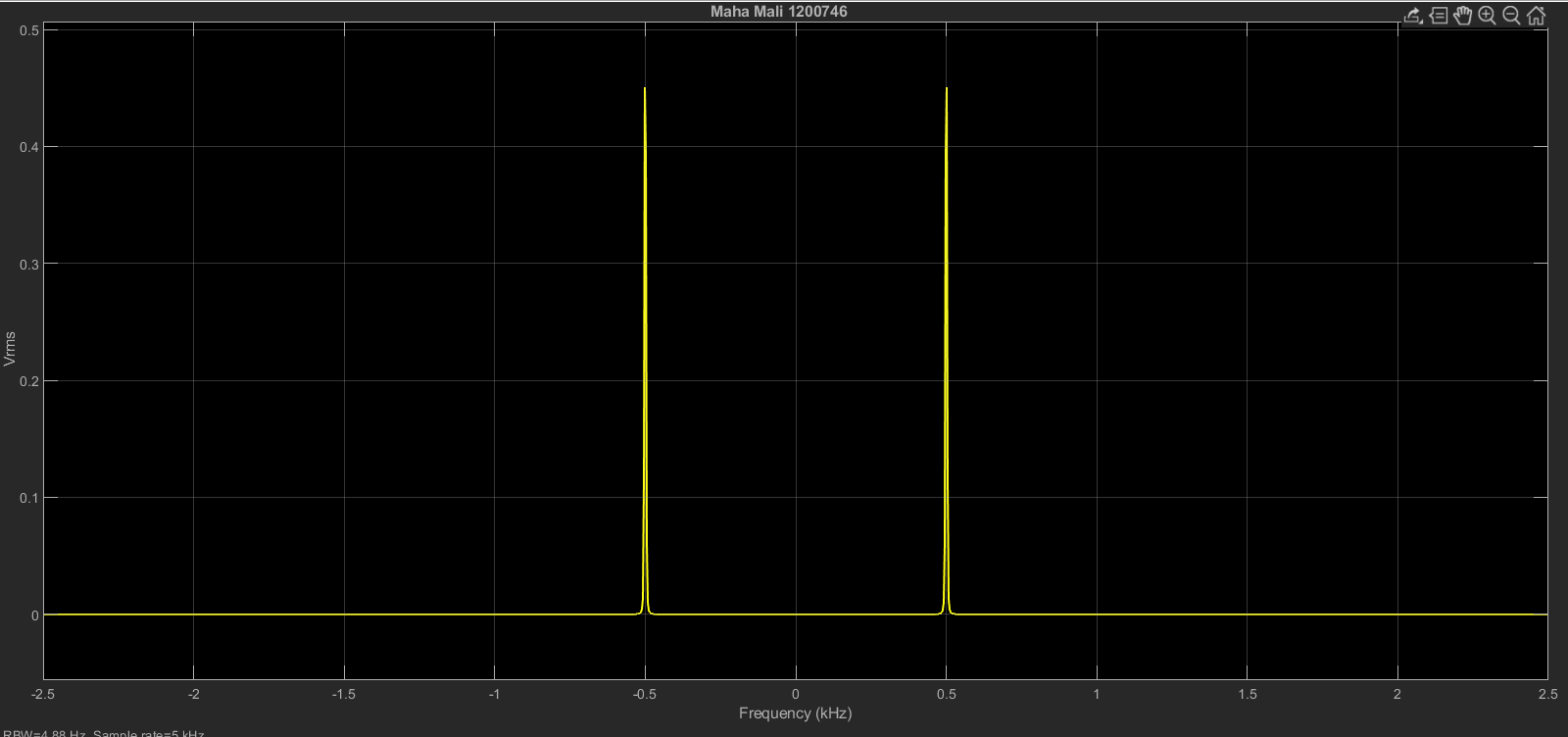


Figure 4: Frequency Domine

The figure 5 show that we have two delta one at 500 Hz, and another on -500 Hz , according the equation for m(f).

### Modulated signal s(t)

#### Time Domine

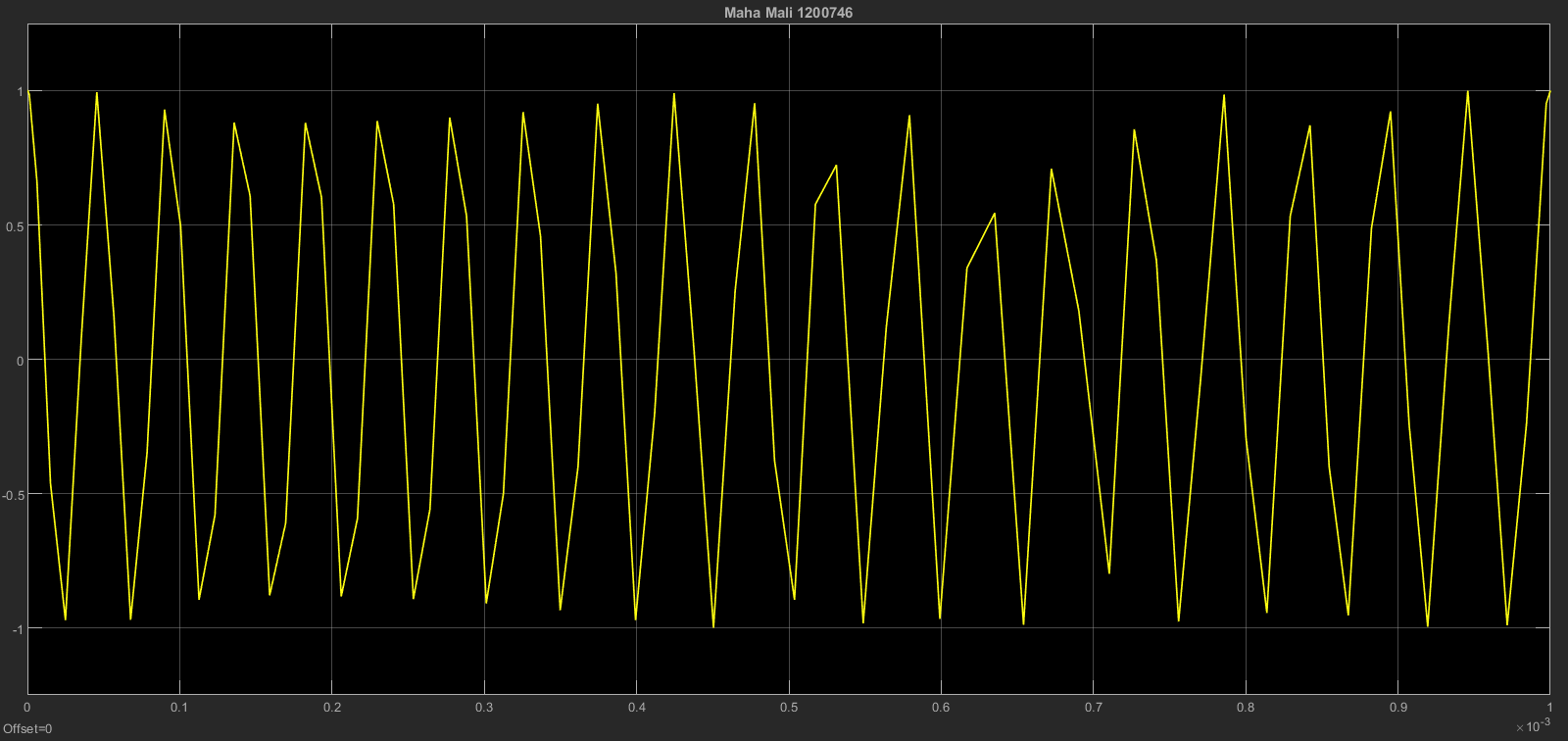


Figure 5: Modulated signal In Time Domine

#### Frequency Domine

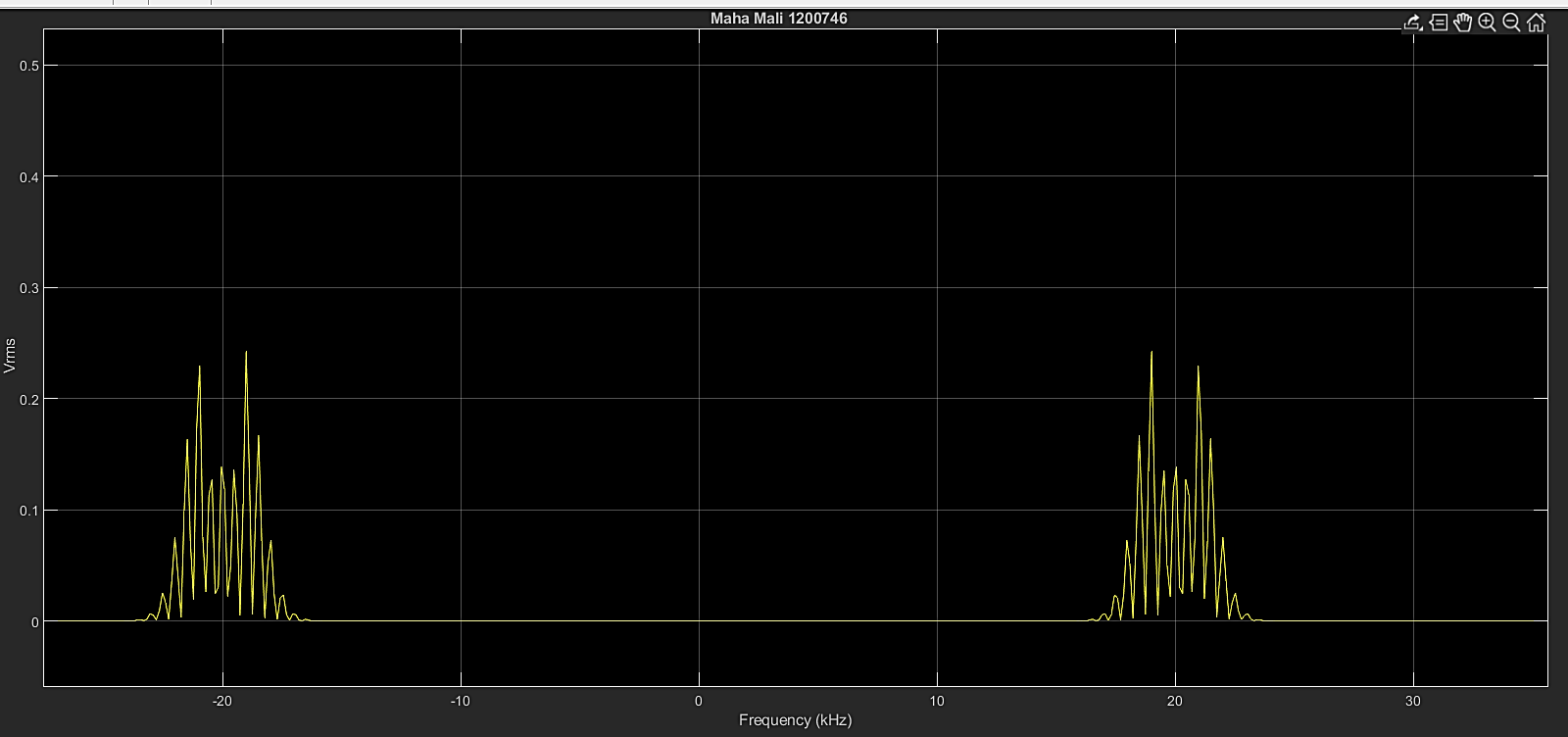


Figure : Modulated signal in frequency Domine

## Differentiate s(t) with respect to t and plot ds(t)/dt

### By Hand Solution

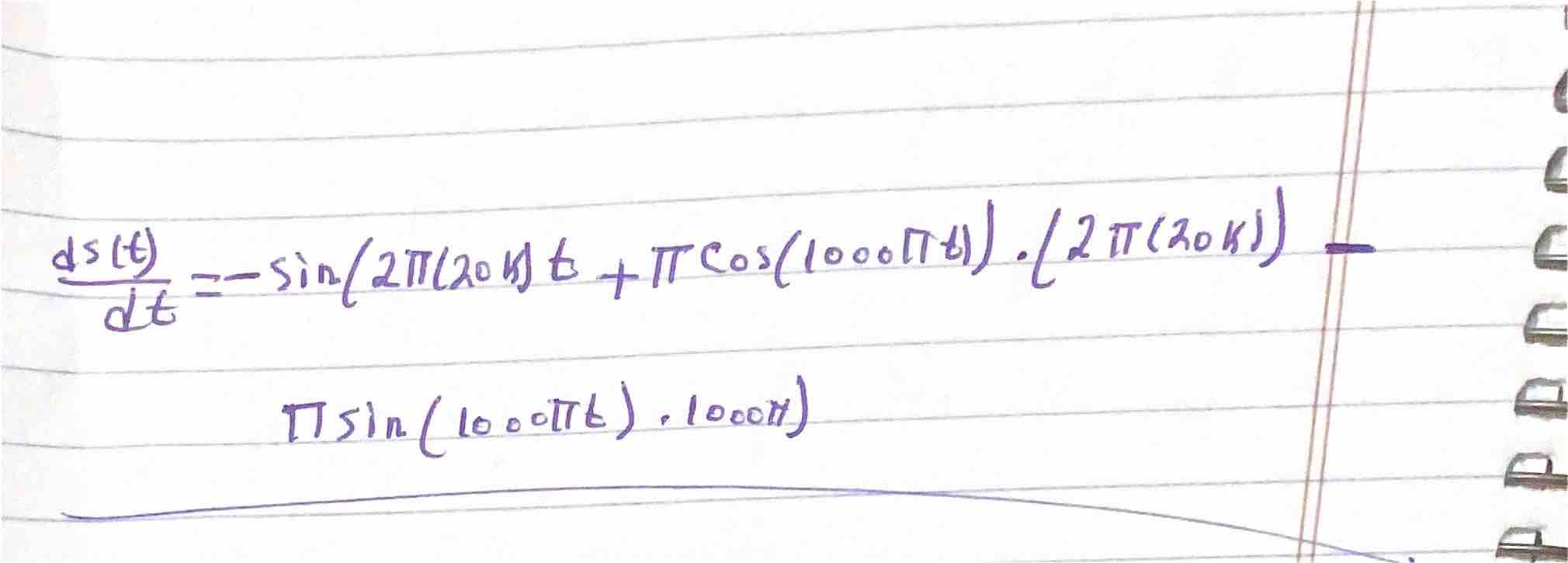


Figure 7: Differentiate s(t)

### Using Simulink

#### Block Diagram

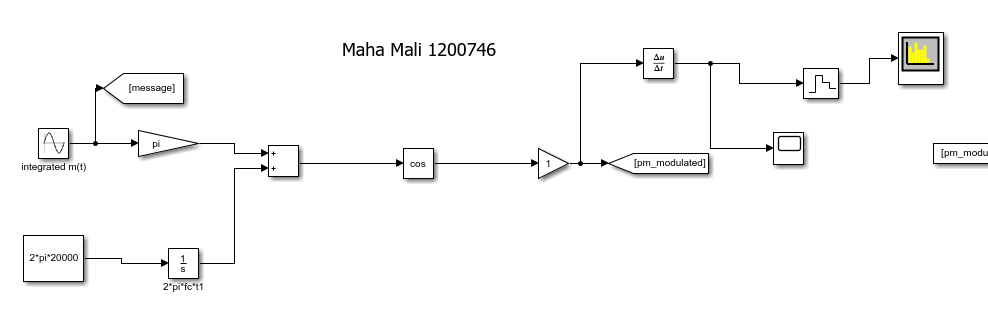
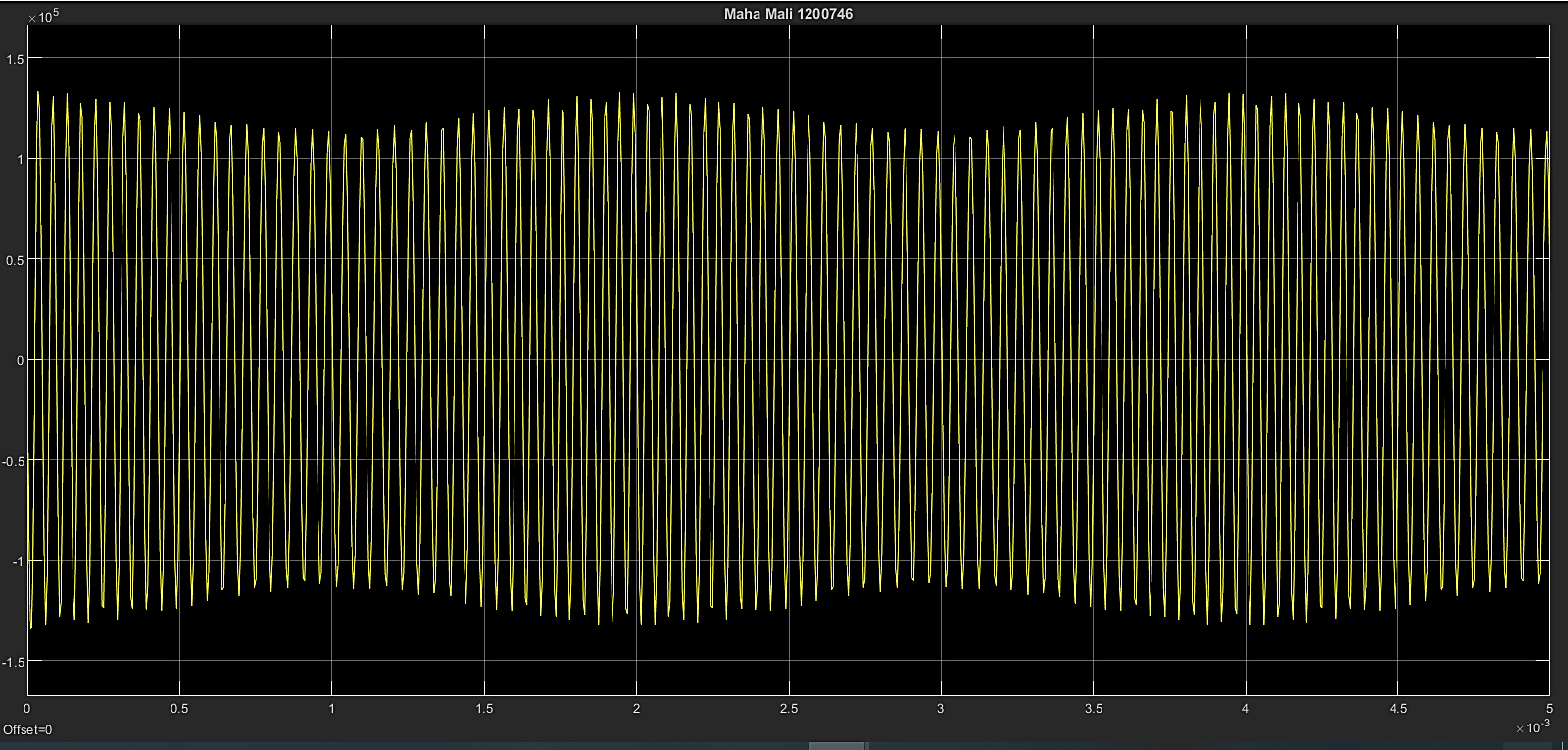


Figure 8: Block Diagram to Differentiate s(t)

#### Time domine

Figure 9: Differentiate s(t) in time domine



##### Frequency domine

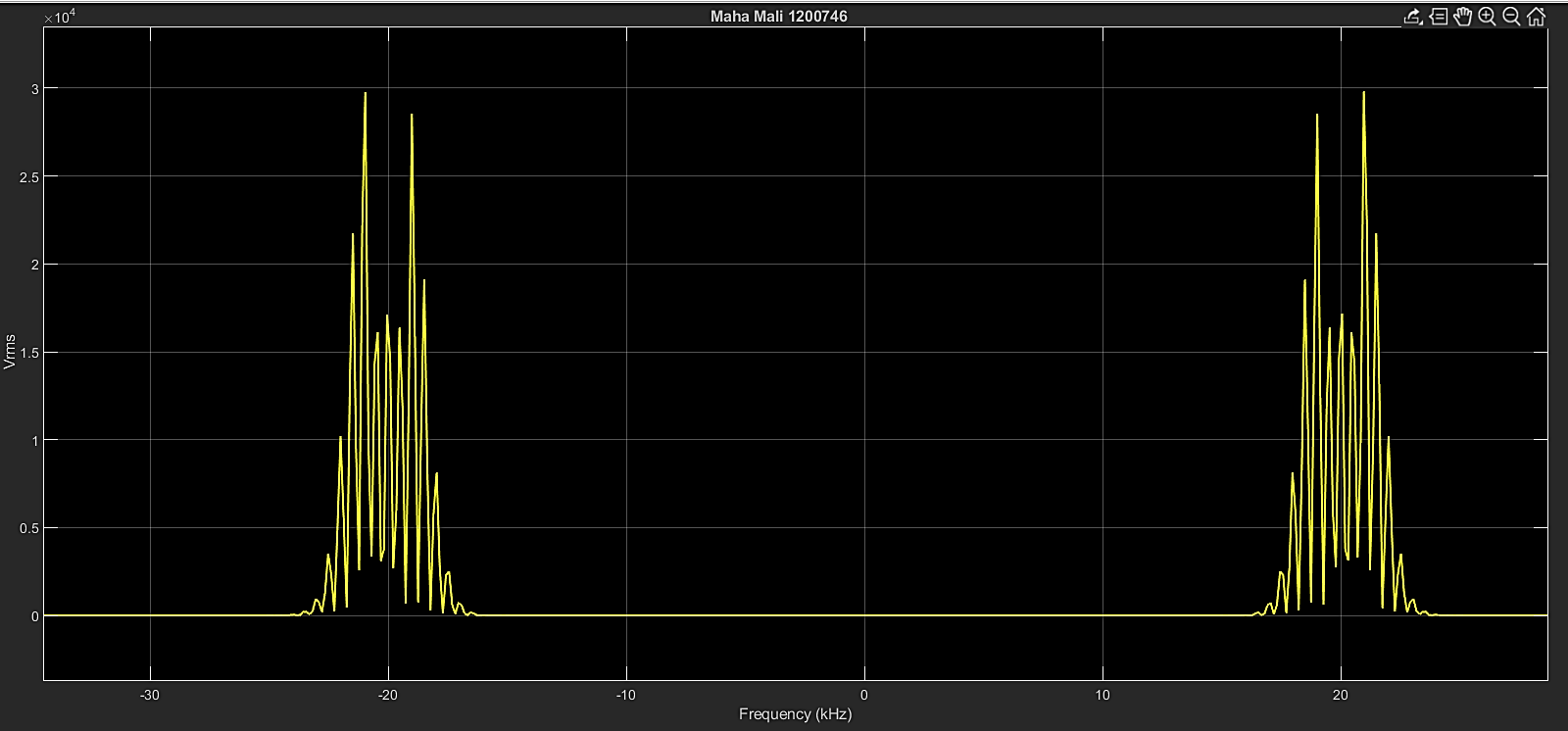


Figure 10: Differentiate s(t) in frequency domine

Differentiating the phase-modulated waveform s(t) = cos (2\*pi\*20000t+pi\*cos(1000\*pi\*t)) with respect to time yields a signal with amplitude variations linked to the frequency of the message signal. This transformation resembles amplitude modulation (AM), where the message signal modulates the carrier's amplitude. The resulting signal takes on AM-like characteristics due to the changing amplitudes associated with the message frequency, demonstrating the interconnected nature of different modulation techniques within the context of signal processing.

## Apply ds(t)/dt to an ideal envelope detector

### By Hand Solution

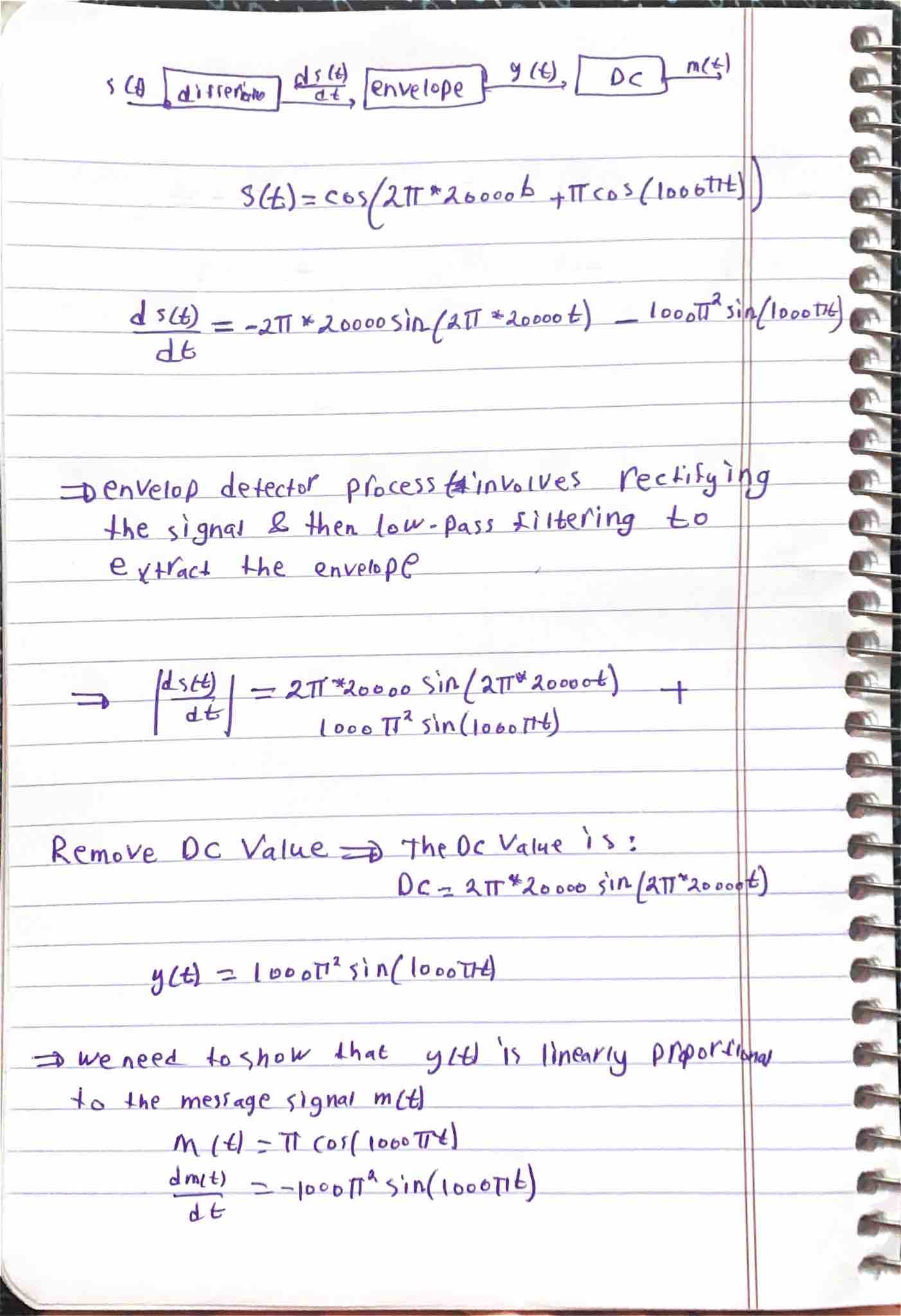


Figure 11: Apply ds(t)/dt to an ideal envelope detector

## Extract message signal by using phase-locked loop (PLL)

### Block Diagram

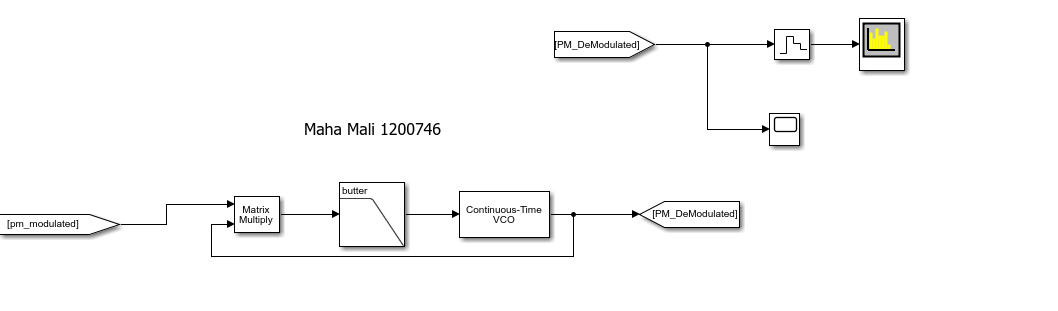


Figure 12: PM Demodulation by PLL Block Diagram

### In time Domine

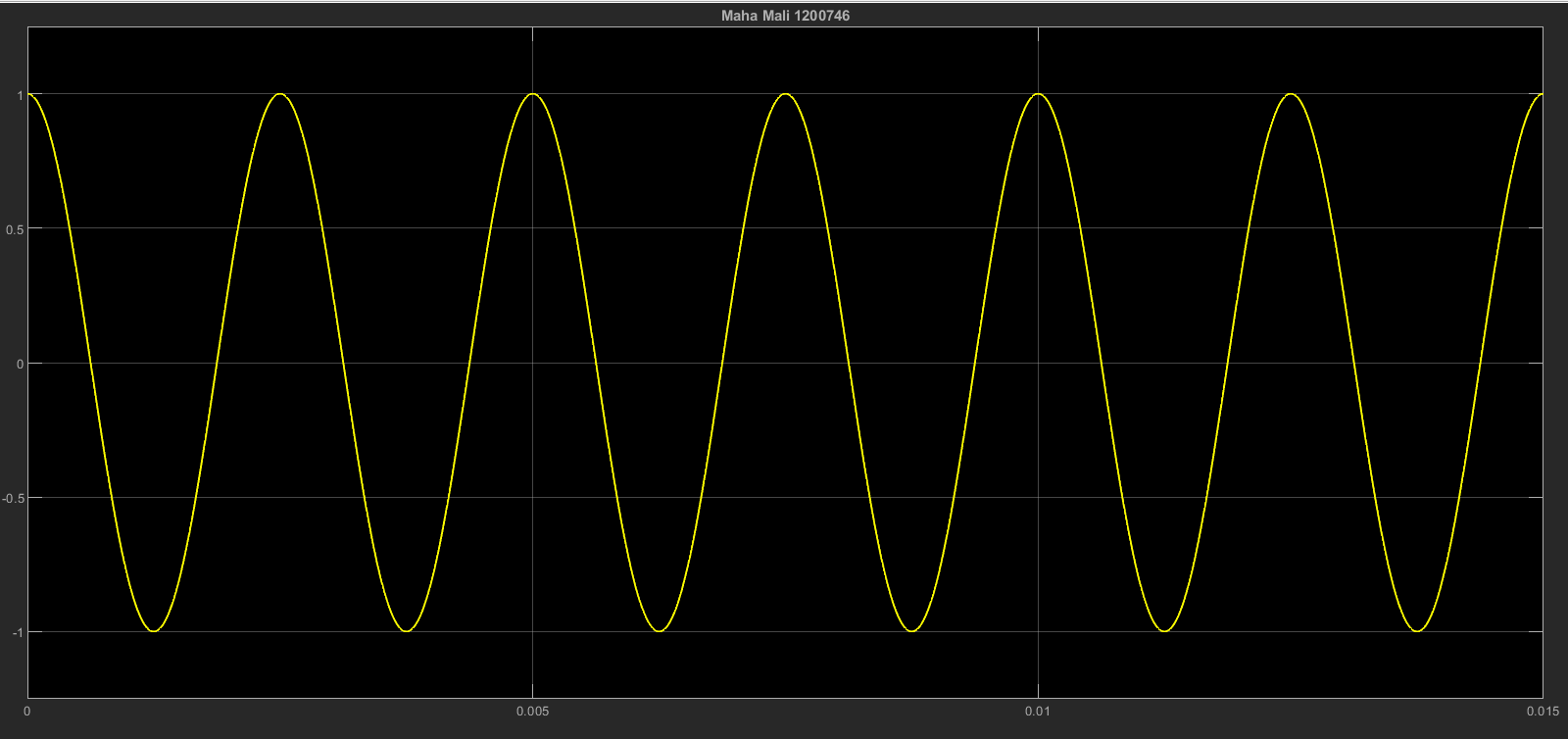


Figure 13: Demodulated signal in time domine

The figure 13 shows the amplitude of the demodulated signal has the same amplitude of message signal which is 1.

### In frequency Domine

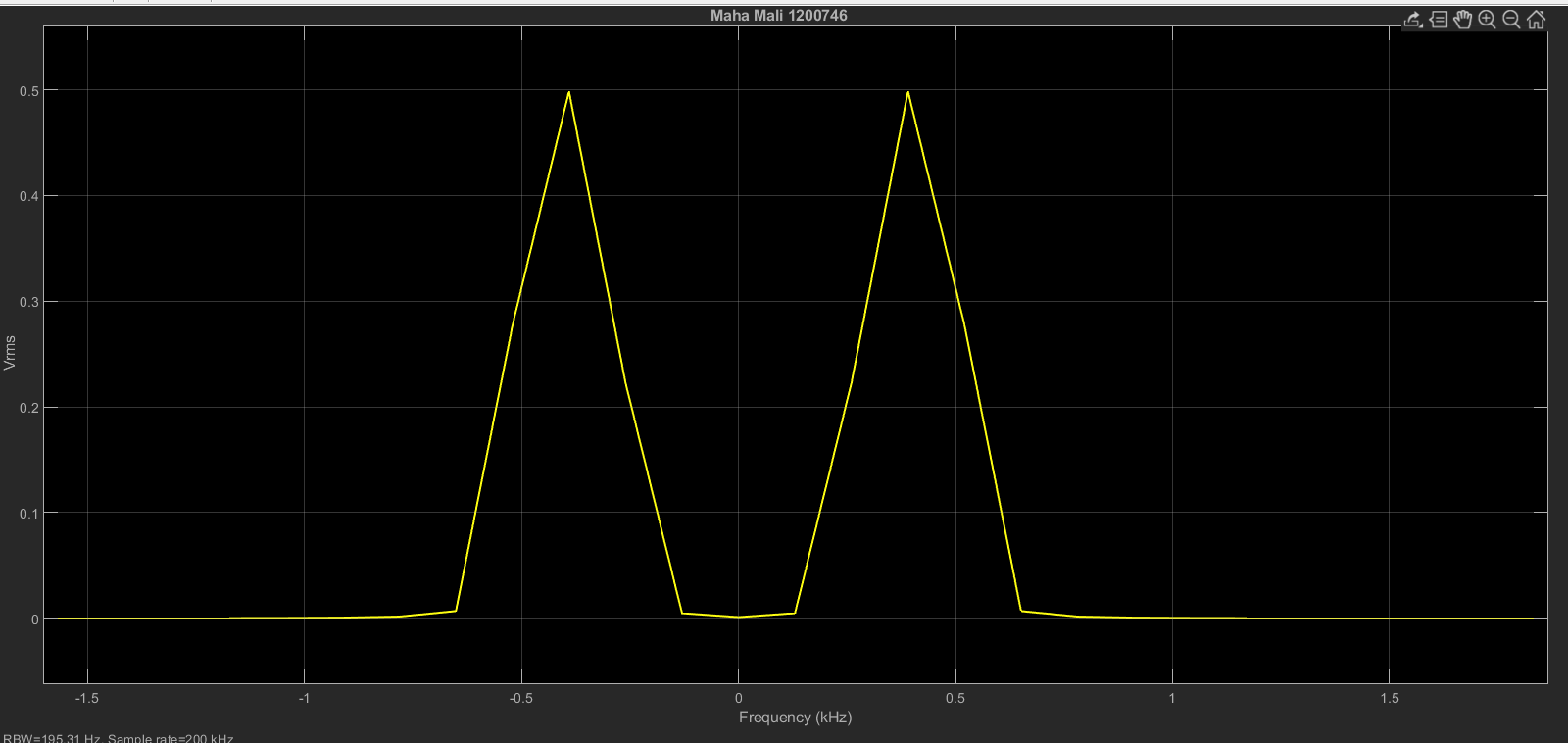


Figure 14: Demodulated signal in frequency domine

The figure show that the demodulated signal has the same frequency of message signal which is 500 Hz.

## Extract the message signal by using the envelop detector

### Block Diagram

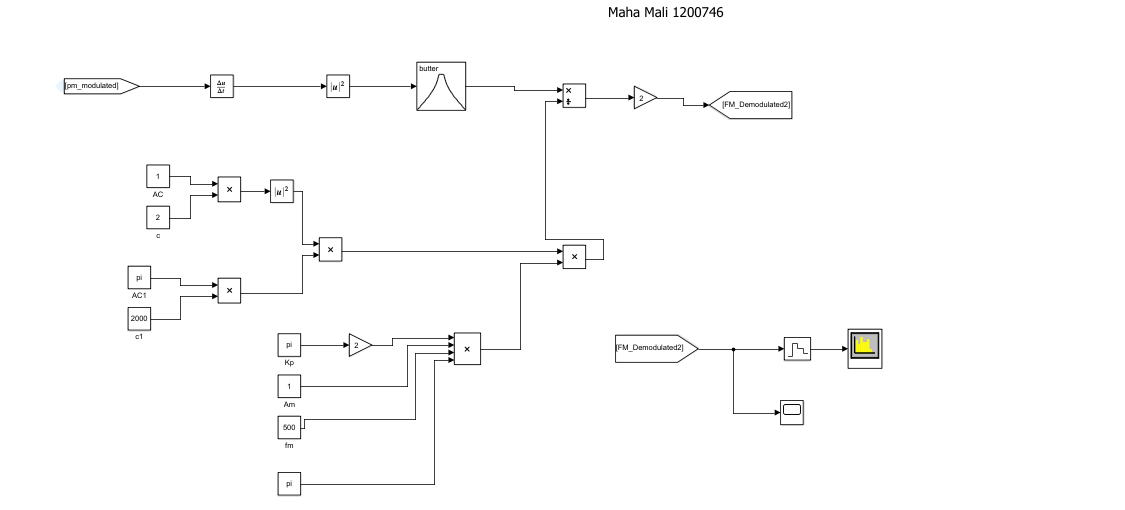


Figure 15: PM Demodulation by using the envelop detector Block Diagram

### In Time Domine

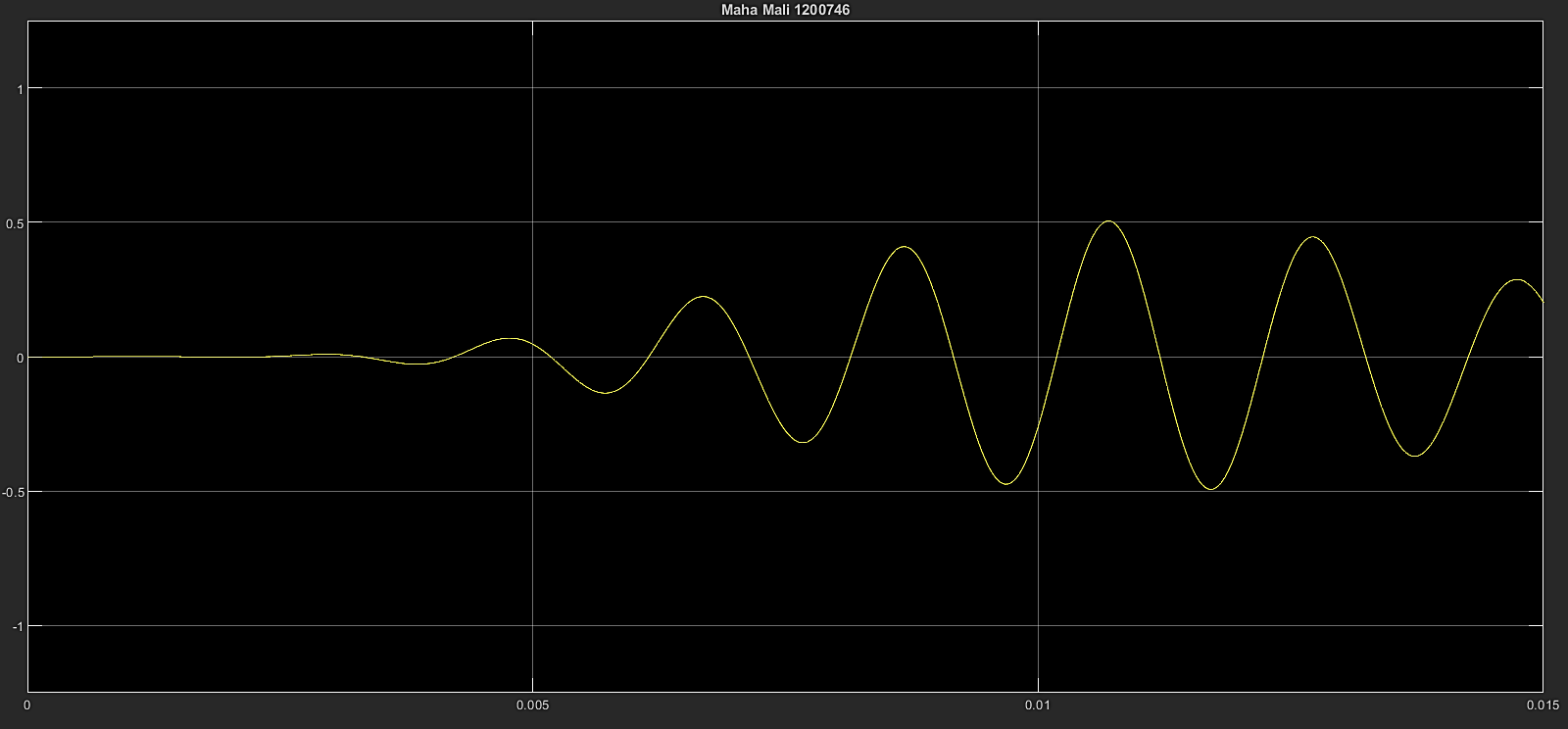


Figure 16: Demodulated signal in time domine

### In frequency Domine

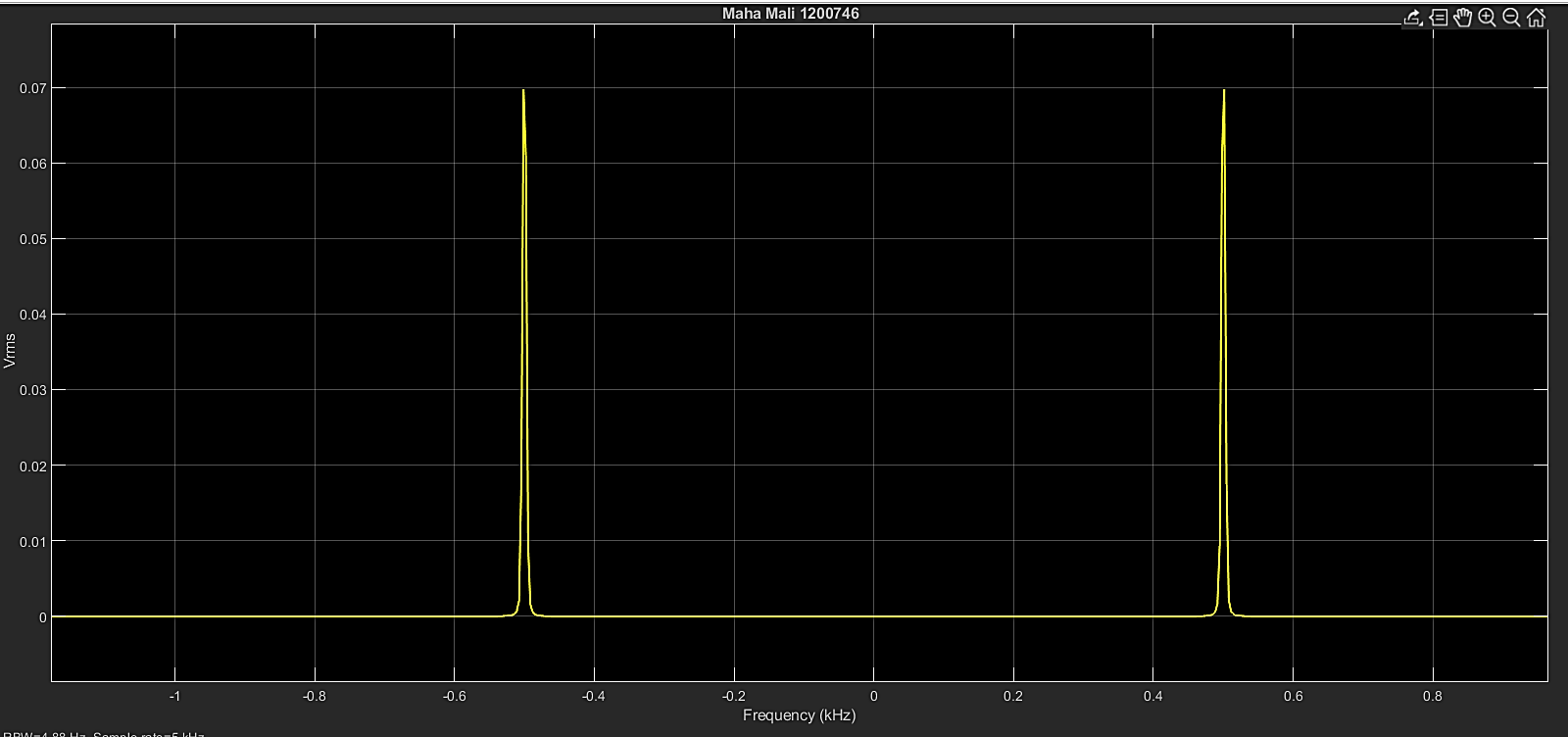


Figure 17: Demodulated signal in time domine

The figure show that the demodulated signal has the same frequency of message signal which is 500 Hz.