Programs: Electrical & Computer Engineering

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| Course Number | **ELE635** |
| Course Title | **Communication Systems** |
| Semester/Year | **Winter 2019** |
| Instructor | **Ngok-Wa Ma** |

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| **Lab Report No.** | **2** |

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| --- | --- |
| Report Title | **Amplitude Modulation and Demodulation** |

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| --- | --- |
| Section No. | **10** |
| Group No. | **01** |
| Submission Date | **12/03/19** |
| Due Date | **12/03/19** |

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# **A1**

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# **A2**

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504.90Hz 
Freq(2): 
9.99kHz 
Pk.Pk(2): 
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# **B1 Table 1.1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **M(t)** VPP | **AMAX** mV | **AMIN** mV | **α** mV | **β** mV | **S** mVrms | **C** mVrms | **SdB** dBV | **CdB** dBV |
| 2 | 183 | 79.8 | 118.3 | 297.5 | 16.59 | 68.23 | -35 | -23.125 |
| 4 | 169 | 93.10 | 134 | 274 | 13.7 | 69.1 | -36.5 | -22.5 |
| 6 | 188 | 75.90 | 89.1 | 313 | 19.4 | 69.1 | -34.37 | -22.5 |
| 8 | 211 | 55.125 | 49.2 | 355.7 | 26.01 | 69.1 | -31.2 | -23.5 |
| 10 | 230 | 36.50 | 10 | 390.9 | 31.9 | 69.1 | -29.5 | -23.5 |
| 12 | 248 | 47.90 | 39 | 434 | 31.9 | 69.1 | - | - |
| 14 | 262 | 59.60 | 39 | 458 | 31.9 | 69.1 | - | - |
| 16 | 262 | 55.12 | 39 | 458 | 31.9 | 69.1 | - | - |

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Y2 16.589mV 

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Freq(l): 
1 .0002kHz 
Freq(2): 
1.4286kHz 
Pk-Pk(2): 
298mv 
Measurement Menu 
ource 
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**Table 1.2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **M(t)** VPP | **Method 1 μ** | **Method 2 μ** | **Method 3 μ** | **Method 4 μ** |
| 2 | 0.3920 | 0.4310 | 0.4863 | -12.2826 |
| 4 | 0.2890 | 0.3431 | 0.3965 | -14.0551 |
| 6 | 0.4240 | 0.5568 | 0.5615 | -11.0335 |
| 8 | 0.5940 | 0.7570 | 0.7528 | -8.4867 |
| 10 | 0.7260 | 0.9501 | 0.9233 | -6.7137 |
| 12 | 0.6760 | 0.8351 | 0.9233 | -6.7137 |
| 14 | 0.6290 | 0.8431 | 0.9233 | -6.7137 |
| 16 | 0.6520 | 0.8431 | 0.9233 | -6.7137 |

# **B2**

All the methods for calculating the modulation index are applicable for the specified usage. The efficiency of each method, however, is different and therefore brings produces varying accuracies. The methods implemented in the 3rd and the 4th calculations, respectively, are not quite accurate as the values can be clobbered due to the height of the peaks, as is witnessed in the plots. This is the case for both Vrms case and dBV case. The other two methods offer multiple values of measurements for further calculation to produce more accurate results.

# **B3: Table 1.3**

|  |  |  |  |
| --- | --- | --- | --- |
| **M(t)** VPP | **PS** W | **PC**  W | **Efficiency** % |
| 2 | 0.0086 | 0.0007 | 7.1585 |
| 4 | 0.0086 | 0.0004 | 4.0242 |
| 6 | 0.0087 | 0.0008 | 8.2754 |
| 8 | 0.0089 | 0.0015 | 14.6419 |
| 10 | 0.0089 | 0.0023 | 20.8607 |
| 12 | 0.0082 | 0.0036 | 30.5634 |
| 14 | 0.0129 | 0.0026 | 16.5305 |
| 16 | 0.0126 | 0.0027 | 17.5458 |

# **B4**

To use an envelope detector for these purposes, then: [Ac + Am] > 0.

The minimum value of Am will be evaluated at:

To maximize power efficiency, then the amplitude for the messenger signal must be as high as possible. Therefore, the amplitude for the messenger signal to use would be 0.1.

# **C1**

This proves that no matter what the carrier amplitude is, the radio stations can broadcast a signal with a μ+ of 125%

# **C2**

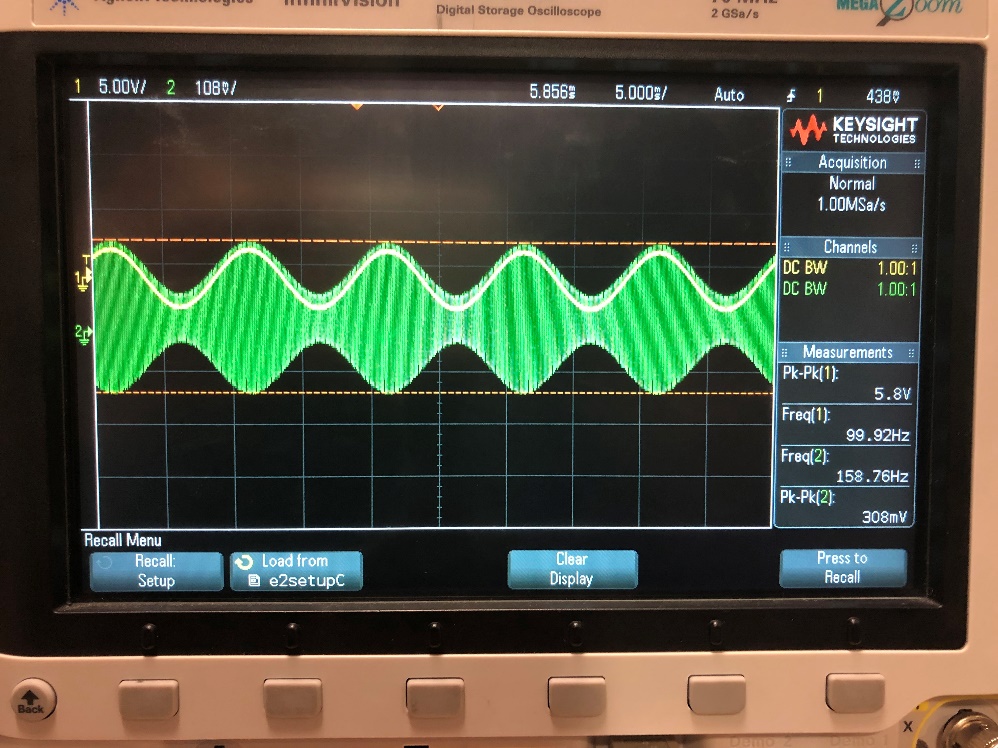
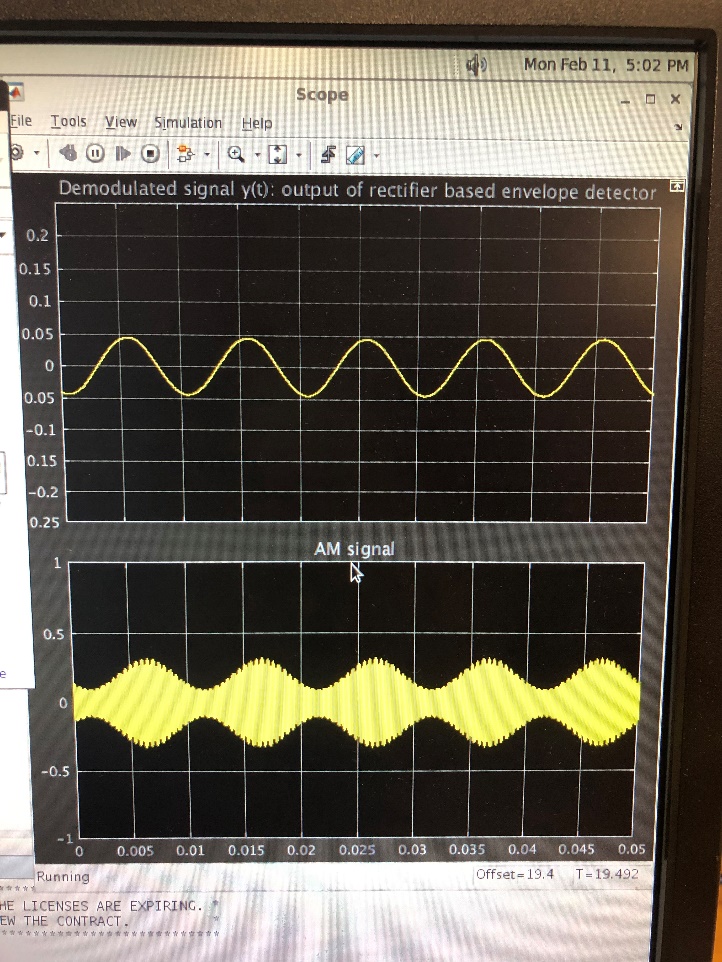
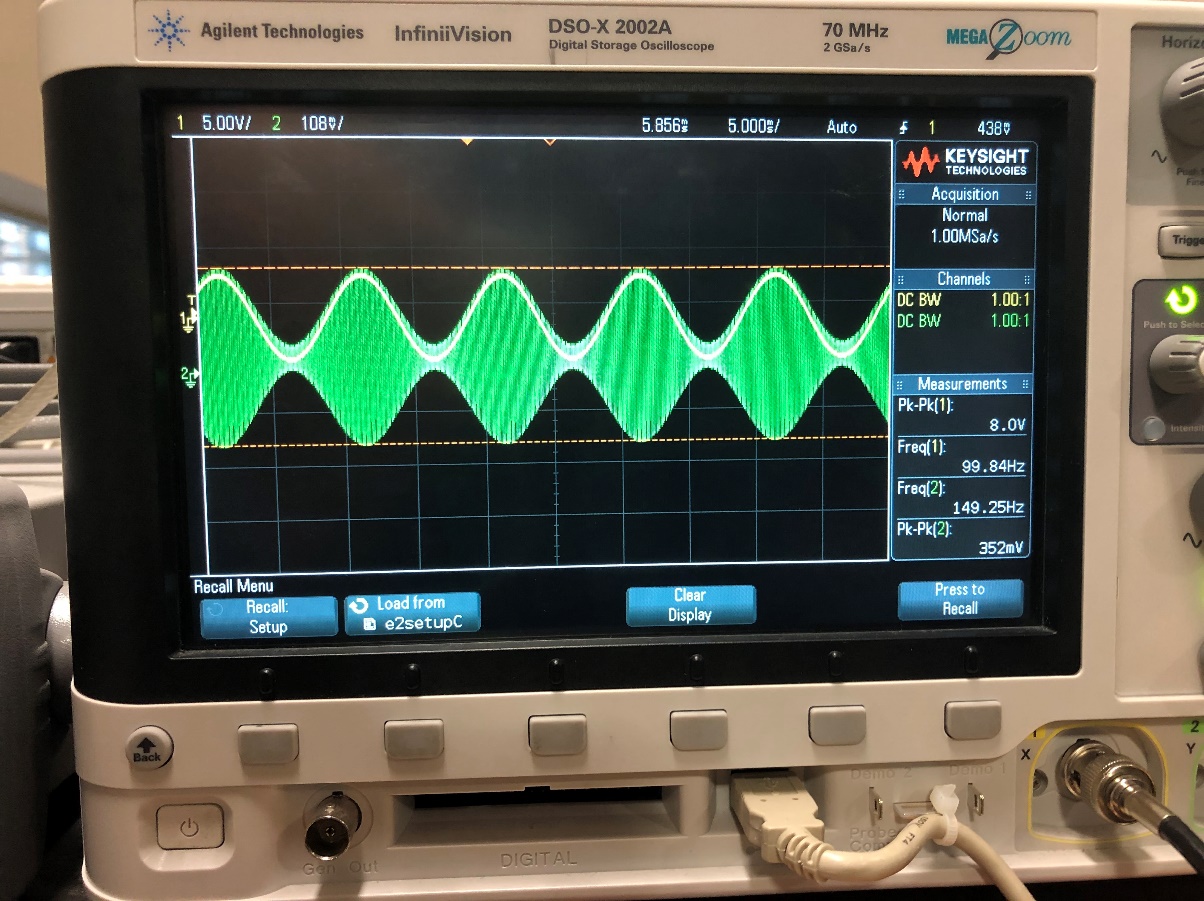
The Envelop Detector Rectifier is able to reproduce the signal with lesser components and can be implemented to serve the purpose of creating cheap radio receivers for AM signal.

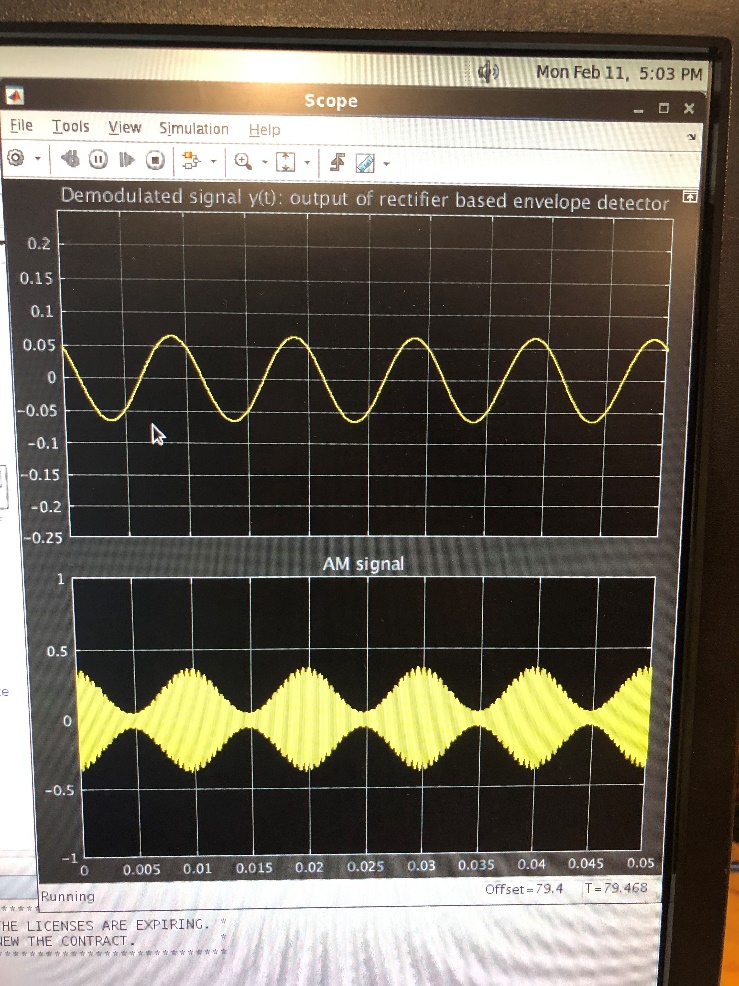
# **C3**

Regardless of the modulation index, the coherent detector demodulated the modulated signal. Any signal, that is not over-modulated, can be demodulated by the envelope detector. Therefore, the coherent detector is more than effective demodulation method.

# **C4**

The Phase Locked Loop seems to adjust the carrier frequency, as is observed from the calculations. The oscillator will suppress any signal that is not an ideal frequency.

**Rectifier Based Envelope Detector**



# **Hilbert Transform Based Envelope Detector**

# **Envelope and Coherent**