# Wrocław University of Science and Technology

## FUNDAMENTALS OF TELECOMMUNICATION LABORATORY REPORT

AM
Group 2
Instructor: Katarzyna Kunio
7:30 - Thursday

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# Introduction

In this lab session, we explore the principles of Amplitude Modulation (AM), focusing on the modulation and demodulation processes. Our goal is to understand how altering the amplitude of a carrier wave can effectively transmit information. Through hands-on experiments, we will characterize AM by examining the carrier and modulating signals and observing their combined output waveform. Additionally, we will analyze the AM signal spectrum, particularly noting the significance of the lower and upper sidebands. These exercises aim to bridge the gap between theoretical knowledge and practical application, deepening our comprehension of AM's role in telecommunications. By the end of this session, we anticipate a solid grasp of AM techniques, appreciating their utility and evolution in communication systems.

# Exercises

### 4.2

We connected a voltmeter to the power supply to verify it correctly provides +5V and -5V outputs.

| V+ | V- |
|---|---|
| 4.9963 | -5.0244 |

### 4.3

We connected the oscilloscope probe to both the output of the sine wave generator and the ground. By adjusting the knobs, we explored how the frequency and amplitude of the signal could be modified, gaining insights into the extent and control of the signal's characteristics.

| Freq. Min [Hz] | Freq. Max [kHz] | Amin[mV] | Amax[V] |
|---|---|---|---|
| 985.8 | 10.56 | 720 | 3.180 |

### 4.4

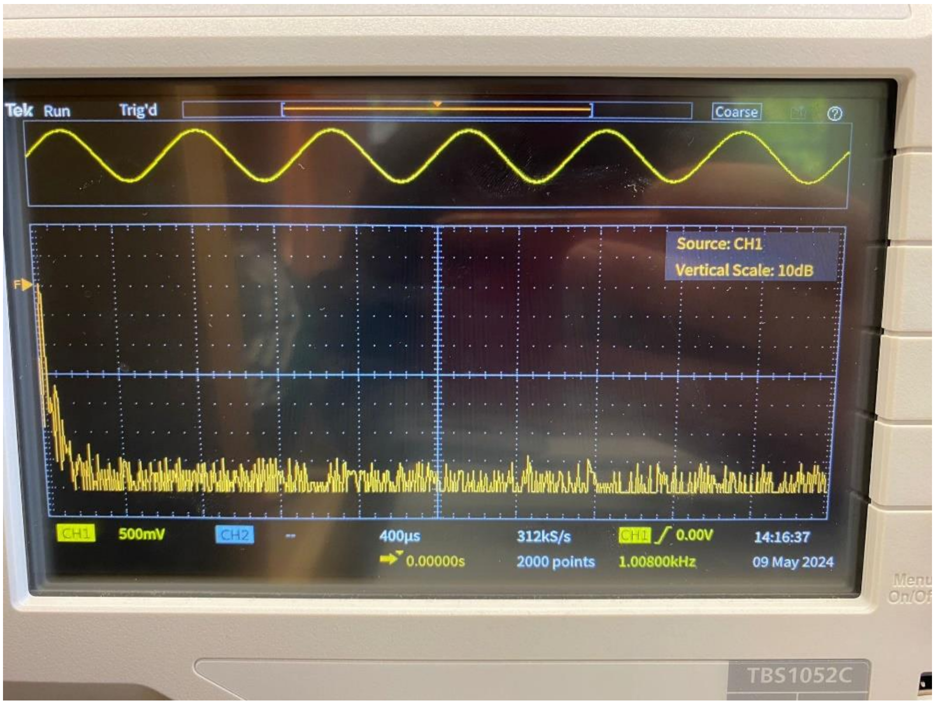
Following the previous procedure, we attached the oscilloscope probe to the output of the carrier generator and the ground. Using the control knobs, we adjusted the frequency and amplitude, documenting the available modifications to better comprehend the capabilities of the generator.

| Freq. Min [kHz] | Freq. Max [kHz] | Amin[mV] | Amax[V] |
|---|---|---|---|
| 10.28 | 625.4 | 17.2 | 5.2 |

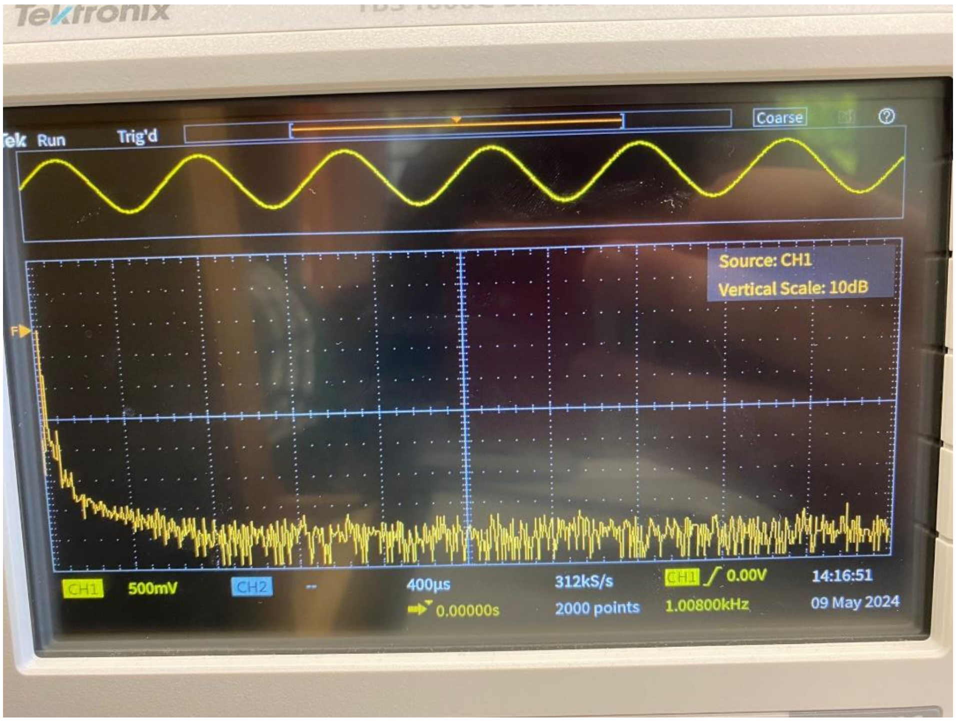
### 4.5

We configured the sine wave generator to a frequency of 1 kHz and an amplitude of 3 Vpp. Using the oscilloscope, we analyzed the waveform in both the time and frequency domains, experimenting with various window settings to observe their effects on the spectrum analysis.

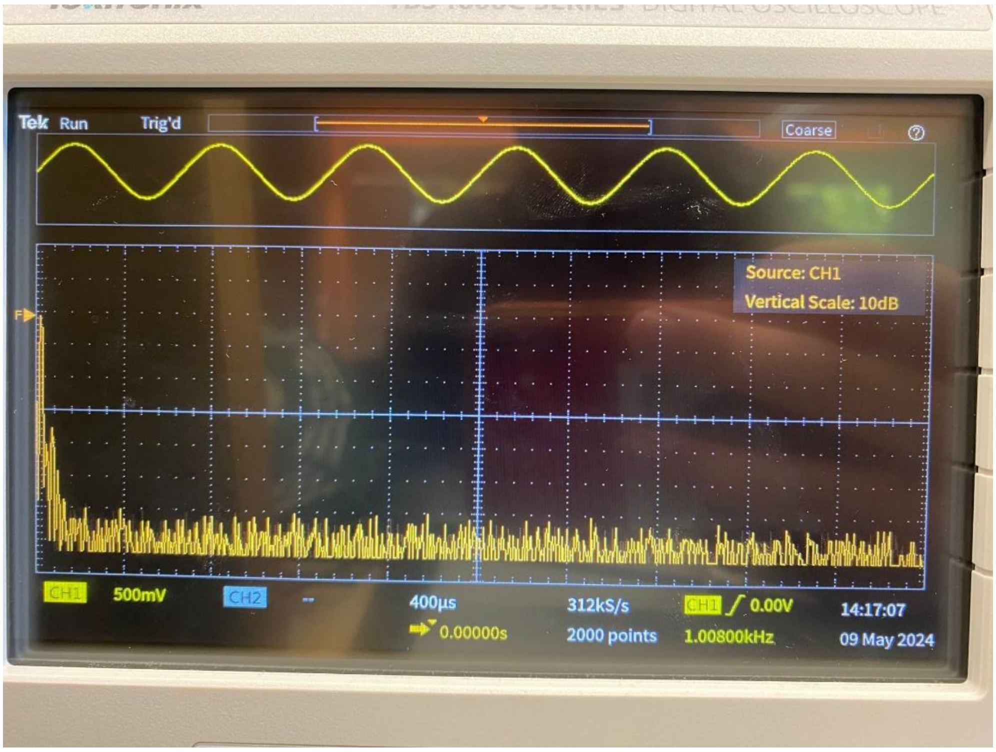
### Hanning



**Rectangular**

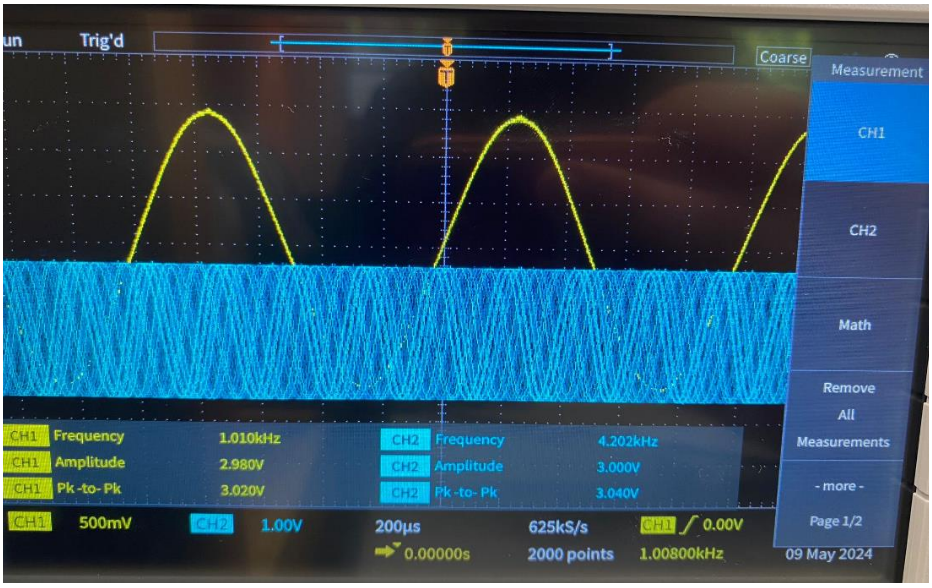



**Hamming (Flattop was not working for us, it was discussed with the proffessor to add Hamming instead of Flattop)**



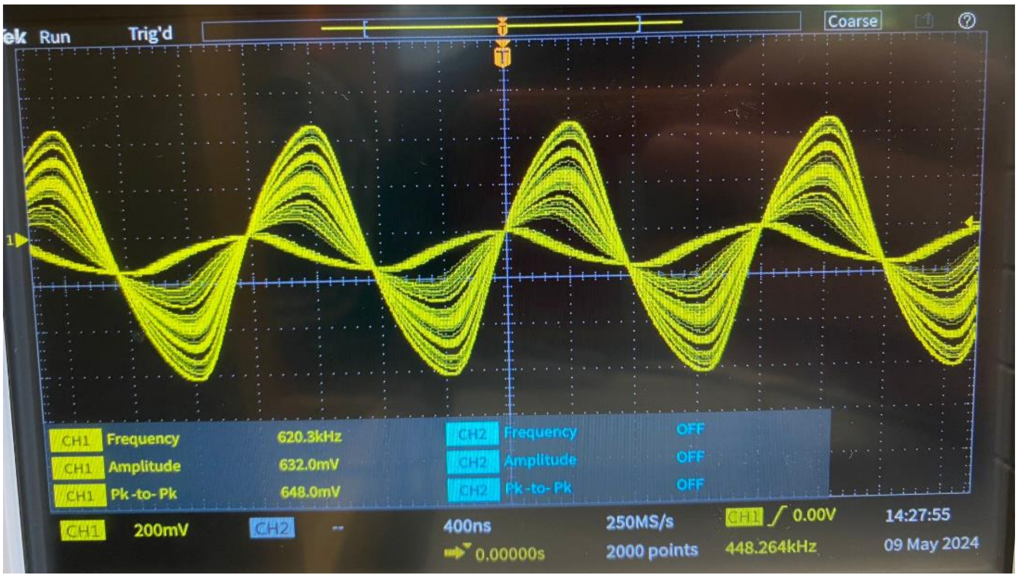
## 4.6

We set the carrier generator to a frequency of 500 kHz and an amplitude of 3 Vpp, noting that the maximum frequency was 4 kHz. We then used the oscilloscope to observe the resulting waveform in the time domain and conducted a spectral analysis in the frequency domain to gain a deeper understanding of the carrier's characteristics.



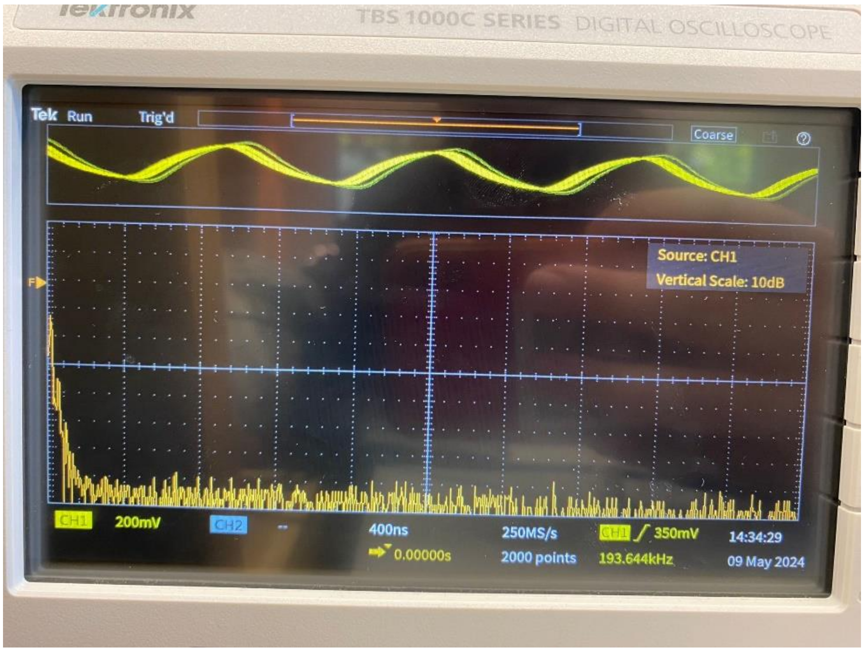

## 4.7

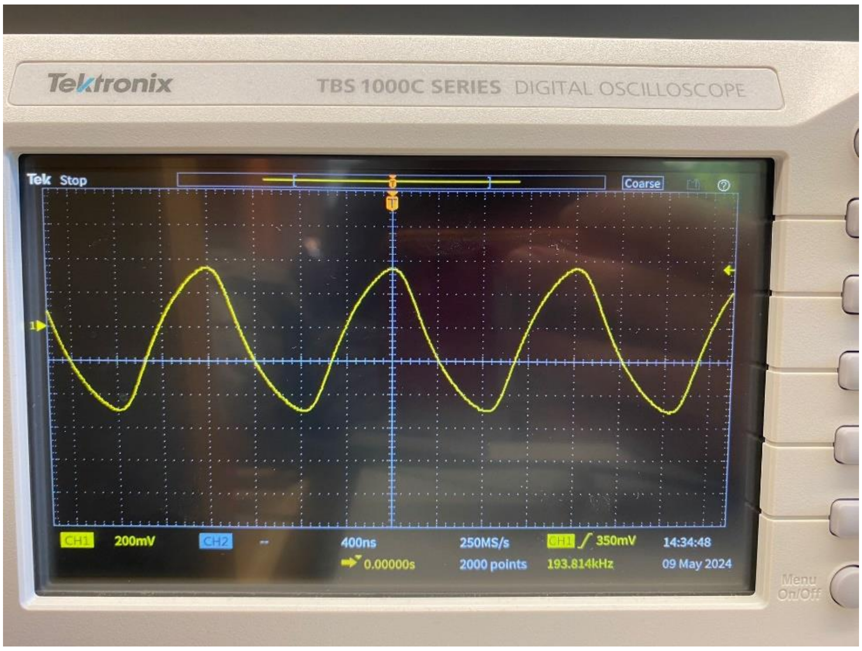
We connected both the sine wave generator and the carrier generator to the modulator input. Using the oscilloscope, we observed how the two waves interact and combine to create a modulated signal.

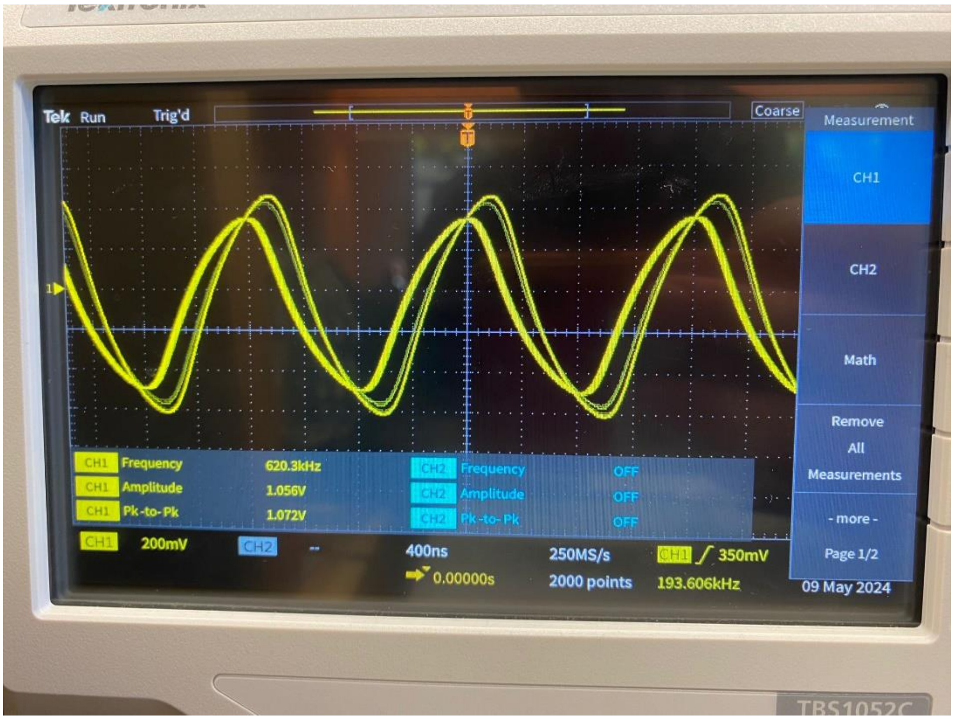


## 4.8

We redirected the oscilloscope's second channel to monitor the output from the modulator. We analyzed the modulated signal in the time domain and examined its spectrum in the frequency domain, observing the characteristics of the resulting waveform.

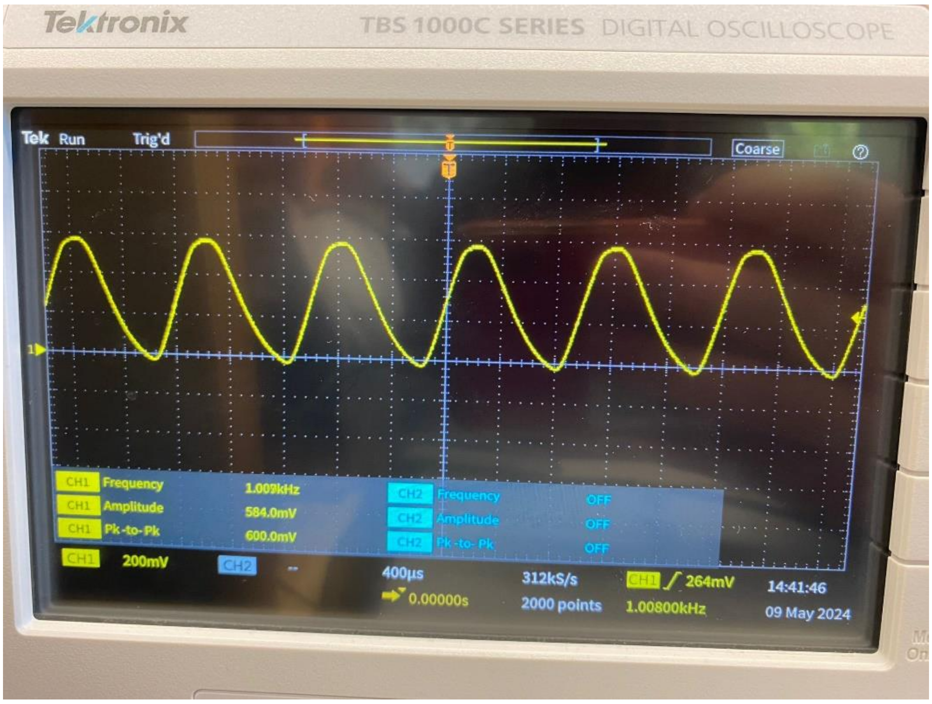




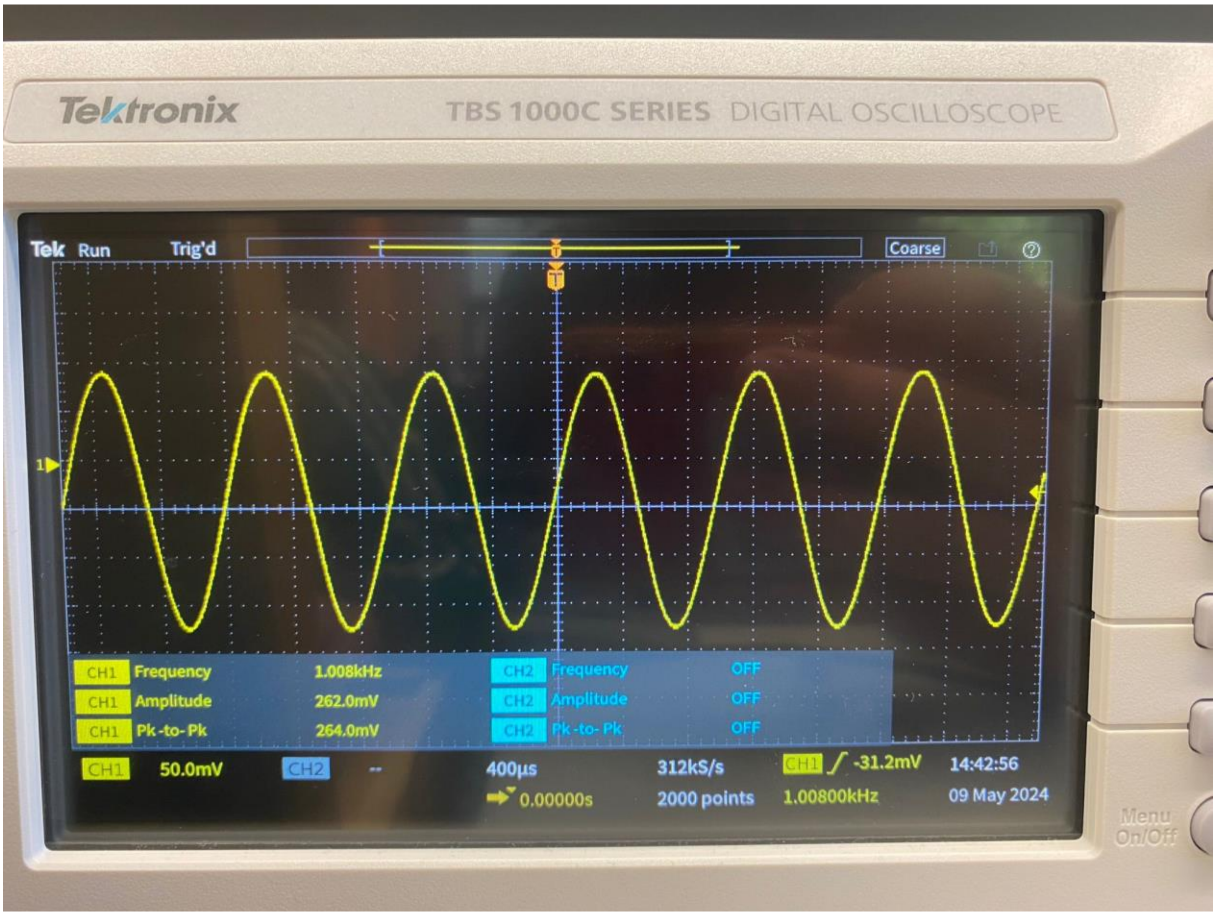

## 4.9

We linked the modulator output to the diode detector output and employed the oscilloscope to observe the demodulation process. We focused on the changes and characteristics of the extracted signal to better understand the demodulation effects.



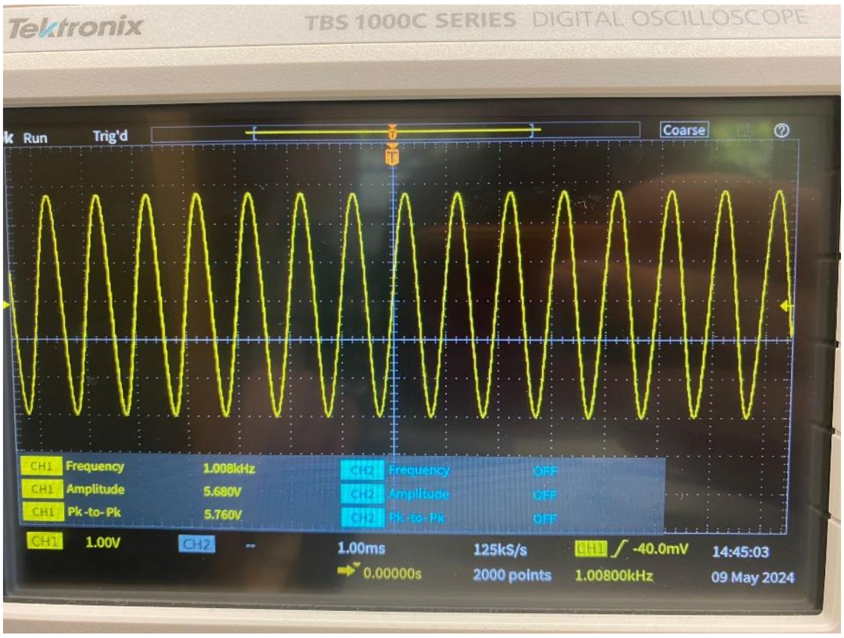
## 4.10

We’ve connected the modulator output to the demodulator input and observe the demodulator output signal.



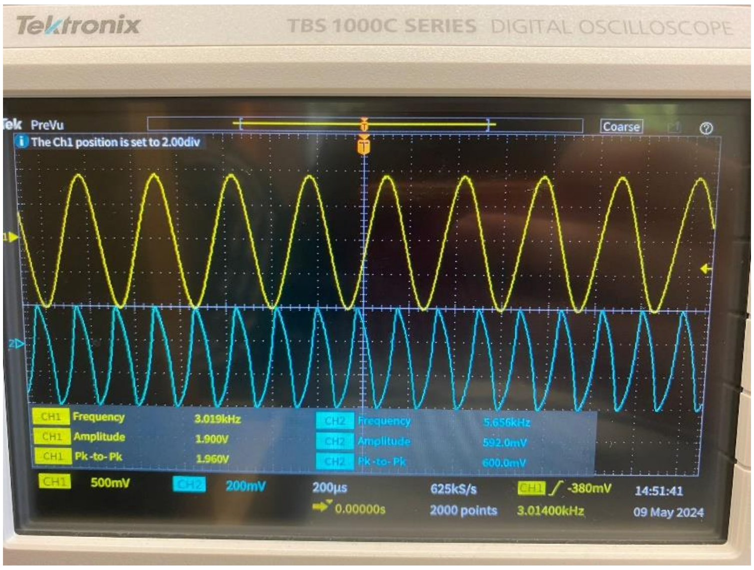

## 4.11

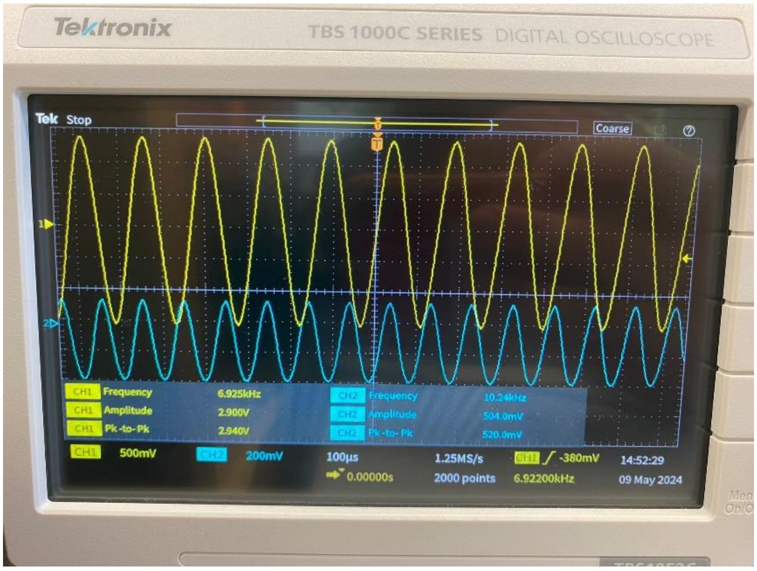
We’ve connected the demodulator output with the audio amplifier input (Fig. 14) and observe the signal.

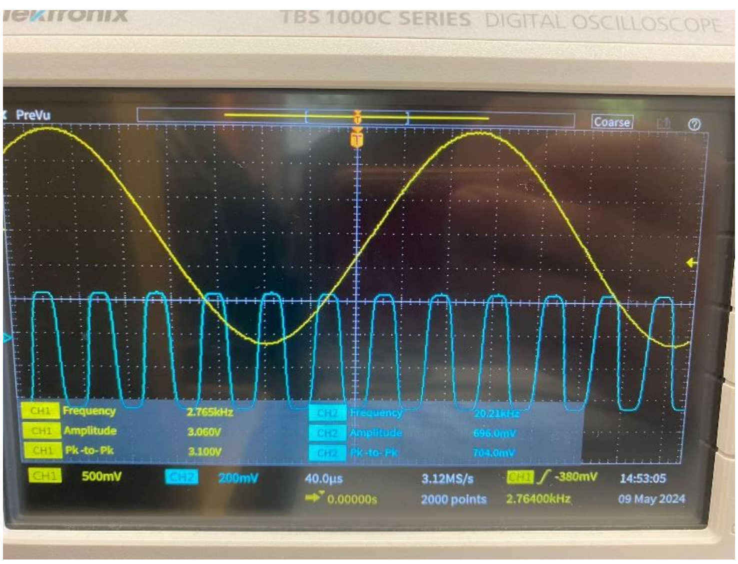


## 4.12

We attached the first oscilloscope probe to the output of the sine wave generator and the second probe to the modulator output. By adjusting the amplitude and frequency settings, we observed the resultant changes in the waveform, exploring how these adjustments influenced the characteristics of the modulated signal.

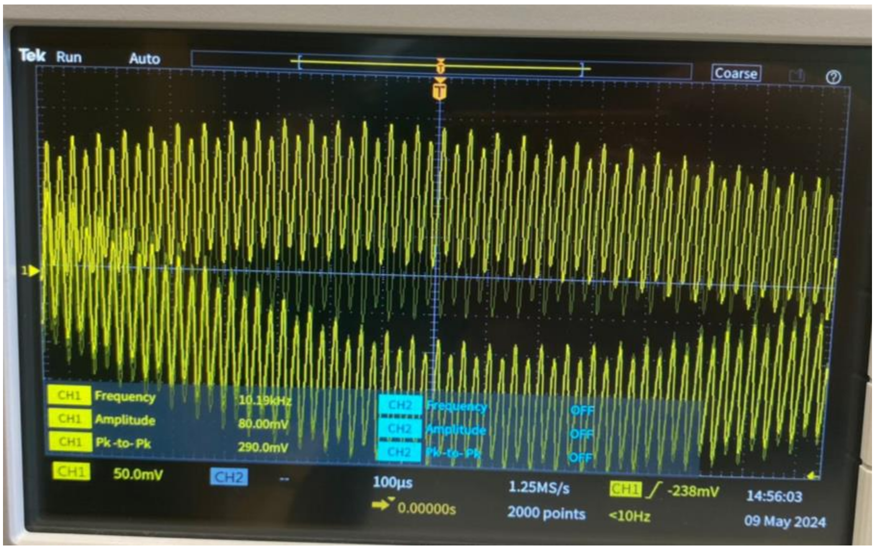


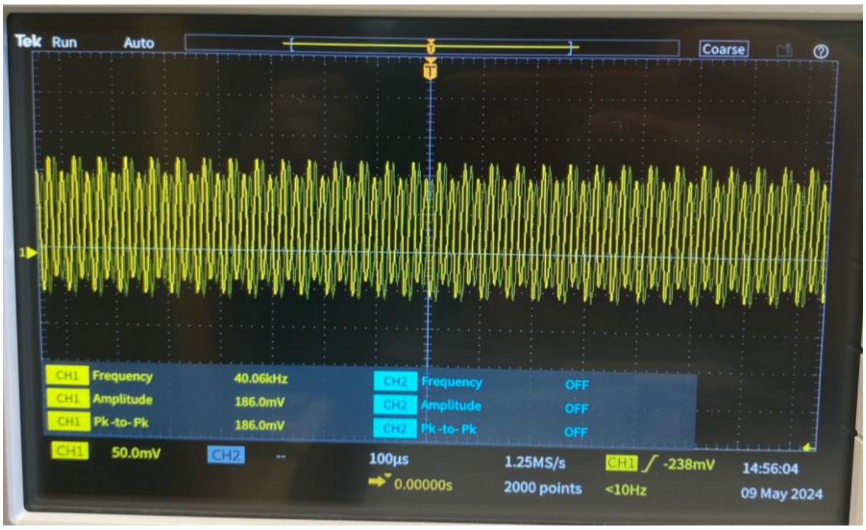



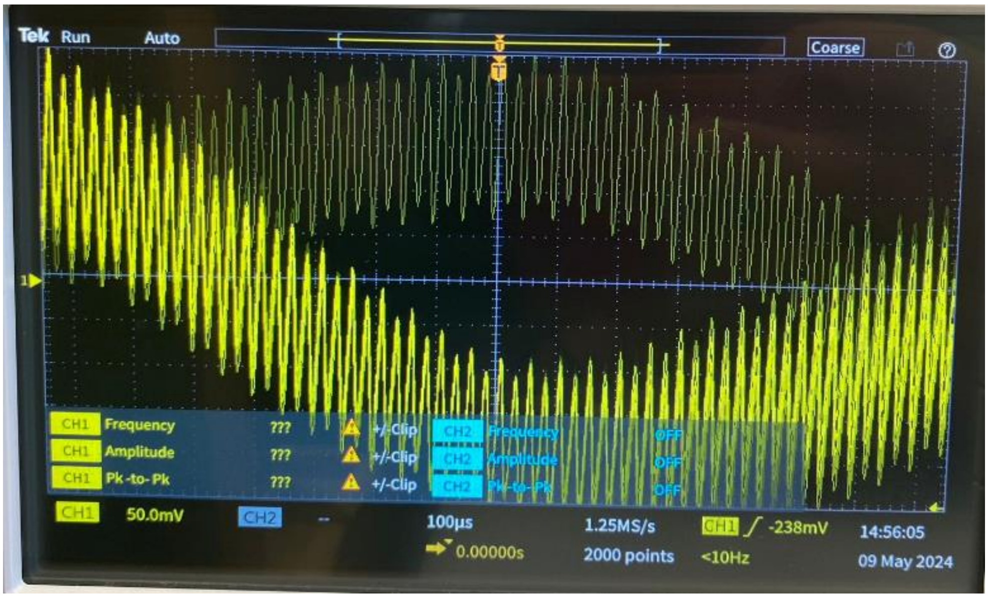



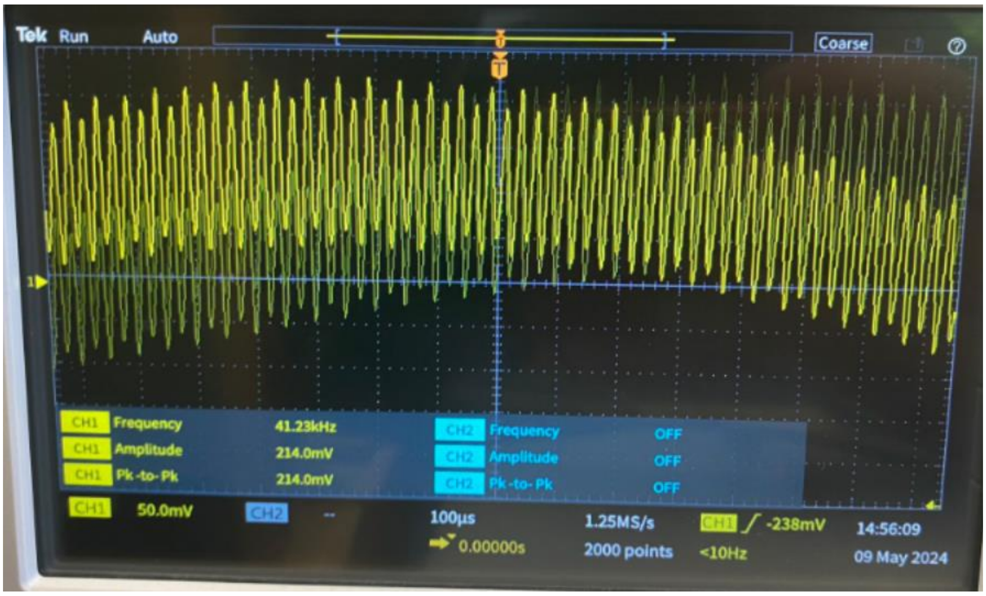
## 4.13-4.14

We connected a microphone as outlined in the provided diagram and began speaking into it. Using the oscilloscope, we monitored the waveform to analyze how the audio signal from the microphone underwent modulation. This step illustrated the real-time processing and modulation of live audio signals, emphasizing the practical use of AM in voice communication transmission.






# Conclusion

Throughout this laboratory session on Amplitude Modulation (AM), we gained practical insights into the modulation and demodulation processes, essential for understanding various telecommunication applications. We explored different settings and manipulations of the sine wave and carrier generators, which solidified our grasp of AM's impact on signal transmission. The exercises demonstrated AM's sensitivity to noise and its limitations in sound quality and frequency response, which are crucial factors in its application in radio and communication technologies. Overall, this lab reinforced the foundational theory of AM through hands-on experiments, highlighting its practical implications and historical significance in telecommunications.