Universiti Malaysia PAHANG
Engineering • Technology • Creativity

Faculty of Electrical & Electronics Engineering
BEE3413 Principles of Communication Systems

LAB 1

Mapping CO, PO:
CO 04: Use and apply modern computational techniques and tools to measure the parameters for analog and digital communication system.
PO 05: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations.

Learning Outcomes:

By the end of the experiment, students should be able to:

- Investigate the process of amplitude modulation
- Understand the theory and apply the concept of AM modulation

Equipment needed:

- Waveform generator 33521A
- Digital oscilloscope DSO-X3024A
- RF signal Generator N9310A 9kHz to 3GHz
- Spectrum analyzer N9320B 9KHz to 3GHz

Project Task:

You are a group of telecommunication engineers working in R&D department at Radio Technology Sdn. Bhd. Your team is in charge of developing a new AM radio transmitter/receiver. The new AM radio will be using this carrier signal:

$$v_c(t) = 2mv \sin[2\pi(50x10^3)t]V \qquad \text{equation (1)}$$

You are required to investigate the effect of percentage of modulation (depth of modulation) to the AM system. Your investigation must include the effect of varying percentage of modulation to the envelope: its shape, its V_{max}, and V_{min}. You must also investigate the effect of different percentage of modulation in terms of AM signal power. Use the sets of instructions below to guide you. Given the information signal frequency f_m is set at 5 kHz.

Instructions:

1. Setup your waveform generator and digital storage oscilloscope with an appropriate cable and value. Save all the displayed waveform in oscilloscope (use your own USB flash drive). Report your analysis and discussion based on the result obtained during experiment.

2. You are required to generate an AM signal based on *equation (1)*. Use modulation index, m = 1 (100% modulation). Determine:
   (i) The information signal and carrier signal equation.
   (ii) The modulated signal equation.
   (iii) V_{max} and V_{min} value.
   (iv) Verify your experiments result with theoretical calculations.

3. Repeat step 2, with modulation index ranging from 50, 75 and 100 %. Discuss your findings in your report.

4. Setup your RF signal generator and spectrum analyzer with an appropriate cable. Save all the displayed figures in the spectrum analyzer.
   (a) Set up the value of AM modulation as per (2) experiment. Based on the result displayed:
      (i) Determine the power (dBm) in each sidebands and carrier.
      (ii) Determine the bandwidth for the signal.

5. Prepare a short report in IEEE format of your findings. No plagiarism is allowed.

Lab 1 Task: Appendix

Part A

Lesson 1 (Digital Oscilloscope & Waveform Generator).

1) **Waveform Generator 33500B SERIES**

   a) Press Channel 1.
   b) Press waveform>sine.
   c) Press parameter>Channel 1 Parameters> Press Frequency= 50kHz, Press Amplitude 2mV
   d) Press Modulate> CH1 Modulate>Press Type AM>Press AM Depth = 100%>Press more 1 of 2> Press AM frequency 5 kHz> Press DSSC ON>Press Modulate ON>
   e) Press Channel 1> output ON.

2) **Oscilloscope DSO-X 3024A**

   a) Press Auto Scale> Press Default setup.
   b) Rotate the knob just above channel 1.
   c) For modulate the AM signal>Press> turn on> single.
   d) For modified antenna frequency. Push Tune Horizontal.
   e) Press trigger>back. For tuning purposes.
   f) For save result. Press Save/Recall.

Lesson 2 (RF Signal Generator + Spectrum Analyzer)

1) **RF Signal Generator N9310A**

   a) Press Frequency> setup the value of fc = 50 kHz.
   b) AM Depth = Modulation Index = 100%
   c) Press Amplitude> 2mV
   d) Press AM >
   e) Set rate = information signal frequency, f_m = 5 kHz. AM ï ON & RF ON.

2) **Spectrum analyzer N9320B**

   a) Press SPAN > full span.
   b) Press Preset /System>Preset> Press Center Frequency> 50 kHz.
   c) Press start frequency> suitable value to see fc-fm (50 kHz ï 5 kHz) = 45 kHz, value can be in the range of 35 kHz - 40 kHz.

d) Press stop frequency> suitable value to see fc+fm (50 kHz + 5 kHz) =55 kHz, value can be in the range of 60 kHz-65 kHz.
e) Press Marker- to mark the point of desired signals. For Spectrum Analyzer, students can select up to 12 markers.