Experiment No.4
AM Detection and AGC

Complete Experiment No. 4 Pre-Lab Before Beginning Experiment

Include all measured data in a report to your lab instructor. The report is a discussion of your results following the guidelines given at the end of the experiment. You may add additional comments as desired. Be sure to discuss how your results differed from the results you expected from the pre-lab.

Part A: AM Detection

Objective: To observe AM demodulation using a diode and to determine the proper filter capacitor to recover the modulation signal

1) The circuit shown uses an MPF102 N-channel JFET tuned transistor amplifier to amplify and a signal diode to demodulate the AM signal. It is important to get the pin locations for the FET (drain, source, gate) properly connected. The gate to channel (drain, source) is a p-n diode junction and a large reverse bias could damage the junction. Make sure to use a signal diode and not a rectifier diode.
2) Set the function generator for a 50 kHz sinewave with amplitude of 500 mV p-p. Select the AM function by pressing Shift AM and you should see AM displayed on the front panel screen. The default modulation waveform is sinewave. Press the Shift Freq key to set the modulating frequency to 1 kHz. Press Shift Level to set the modulation depth to 80%. Observe the function generator output and verify that it is an 80% modulated AM wave with a carrier frequency of 50 kHz and a modulation frequency of 1 kHz.

3) To verify sine wave modulation press Shift and then the Menu button and the display should read A:Mod Menu. Press ⏽ (down arrow) once to enter Mod Menu. The display should read 1: AM Shape. Enter this option by pressing ⏽ and you should see Sine.

4) Connect the circuit shown in the figure below. Use a MPF102 transistor. The MPF102 is an N-channel JFET. It is important to get the pin locations (drain, source, gate) properly connected. The gate to channel (drain, source) is a p-n diode junction and a large reverse bias could damage the junction.

5) Connect the function generator to the circuit. The terminals marked AGC are left open for now. Adjust the potentiometer for zero ohms and measure the DC FET source current. This should be the maximum FET bias current. Readjust the potentiometer to get half of the maximum current. This sets the operating point for the transistor in the middle of the active region of the JFET transfer curve.
6) Adjust the generator frequency a small amount to get the maximum AM signal at point A. Observe the detector output waveform at point B. You should see the negative half of the AM waveform due to the half-wave rectification provided by the diode. Notice that the 1 kHz modulating signal is visible as a line connecting the negative peaks of the waveform. This line is called the envelope of the waveform. A sweep rate of 100 µs/div should be best for viewing both the envelope and the carrier signal.

7) One at a time, add the following filter capacitors in parallel with the resistor from point B to ground: 470 pF, 0.001 µF, 0.002 µF, 0.005 µF and 0.01 µF. Observe the output waveform each time.

Part B: Automatic Gain Control

Objective: To investigate the operation of automatic gain control and to learn how it can be implemented

1) Change the filter capacitor to the value in your judgment that gave you the optimum demodulated information signal. Connect a jumper wire between the two terminals marked AGC. This enables the automatic gain control function of the amplifier.

2) Measure the peak-to-peak voltage at point A for each of the following function generator peak to peak input voltages: 100 mV, 500 mV, 1V, 2V, 3V, 4V and 5V. Be consistent in measuring the peak-to-peak voltages. Use either the maximum of the peaks, the minimum of the peaks (troughs) or the average of the peaks (carrier p-p level). For the same input voltages, measure the peak-to-peak modulation signal voltage at point B and also the DC gate to source voltage.

3) On the same graph plot the amplifier voltage gain, the voltage level at point B and the DC gate to source voltage vs. function generator input voltage. The voltage
gain is defined as the voltage at point A divided by the function generator voltage. Note that the gate to source voltage is negative.

Submit a discussion of results to your lab instructor following the guidelines below. Include all measured data. Be sure to discuss how your results differed from the results expected from the pre-lab.

Part A:
Discuss the trade-offs in selecting filter capacitors for AM demodulation.

Part B:
Discuss the need for AGC in receivers and how AGC is accomplished in circuits.