Experiment No.: 03

1 AIM

1. Using a differential amplifier create an analog signal multiplier to produce amplitude modulated signals. (μ = 0.3, 0.5 and 1)
2. Analyze the effect of modulation index on modulation efficiency.
3. Design an envelope detector to demodulated the AM wave.

2 Apparatus Used

1. Function Generator
2. Digital signal oscilloscope
3. Opamp-741 IC & PN diode
4. Breadboard & Connecting wires
5. Resistors & Capacitors
6. DC power supply

3 Theory

3.1 Circuit Operation

The circuit diagram of the Amplitude Modulator is shown in Figure 1. The message signal, a pure tone of ($50Hz$) is applied at the modulating input. Obtain the sinusoidal carrier from the function generator. Use a carrier frequency of $1-4000Hz$, adjust the amplitude to about : $0.5-2V$ peak-to-peak. Observe the generated amplitude modulated signal. Envelope detector is a commonly used demodulator for the AM signals. The detector circuit is shown in Figure 2. Use suitable values of R and C. Sketch the demodulated signal for under modulation, perfect modulation and over modulation.

3.2 AM Modulator

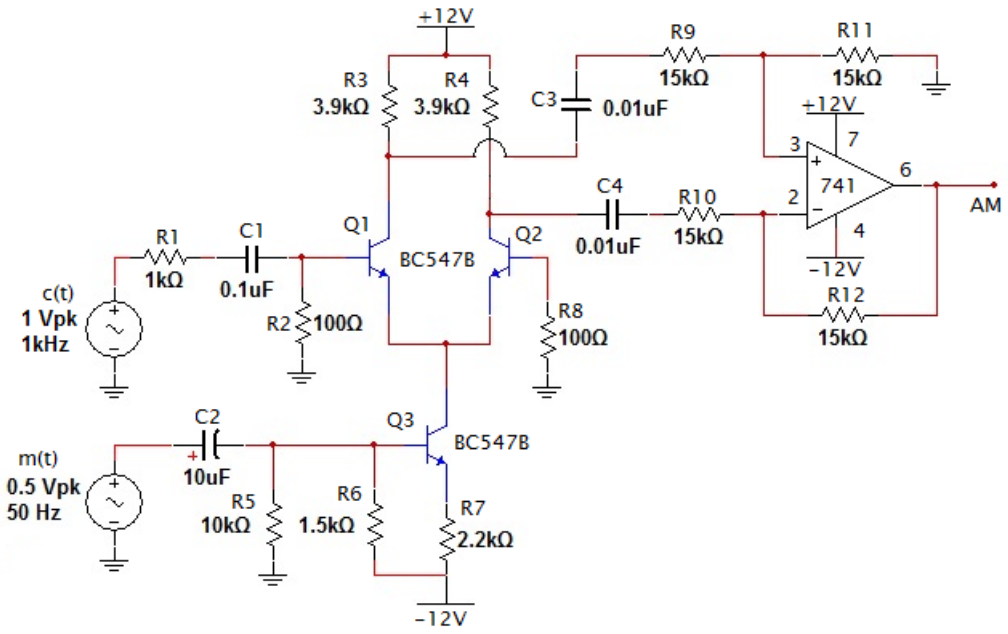


Figure 1: Amplitude modulation

3.3 Envelope Detector

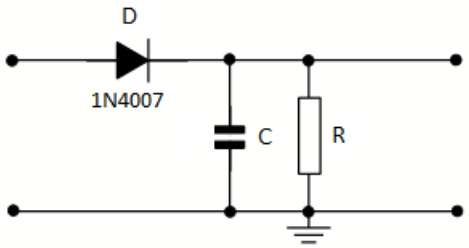
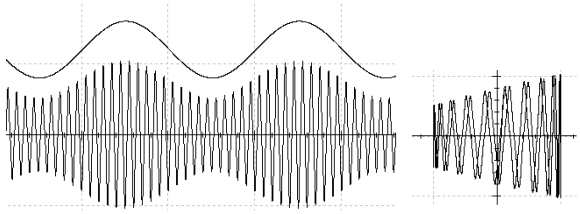


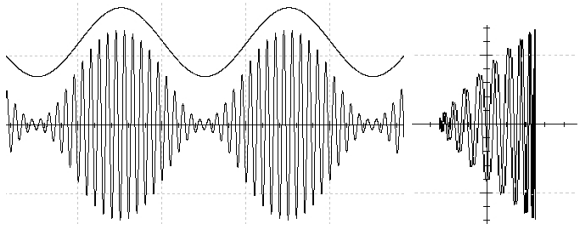
Figure 2: Envelope Detector

4 Procedure

1. Observe the AM output signal. Neatly sketch it. Vary the modulating signal amplitude and note the waveform for different modulation index. Modulation index $\mu = \frac{m_p}{A} = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$, where m_p is the peak value of modulating signal and A is the carrier amplitude, V_{max} and V_{min} are maximum and minimum values of the envelope. (Also observe the over modulation case)



(a) Modulated signal (b) XY mode



(c) Modulated signal (d) XY mode

Figure 3: Amplitude Modulation with $\mu = 0.3$ and $\mu = 1$

2. On DSO observe the modulating signal and modulated signal in time domain. Utilize XY mode of DSO to see the trapezoidal pattern as shown in the Figure 3. Analyze various cases of modulation and effect of modulation index on trapezoidal pattern. This pattern provides an idea about the input-output linearity of the modulator.

3. Calculate the efficiency of the modulation in each case. Use DSO to calculate the carrier power and the message signal power. Compare your results with the theoretical values. Efficiency is defined as $\eta\% = \frac{P_s}{P_s + P_c} \times 100$, where P_s is the side-band power and P_c is the carrier power.

4. For the envelope detector, find the values of R and C and demodulate the AM signal.

5. The Output from this detector will contain a high-frequency component also, how would you reduce it?

5 Observation

Table 1: AM Modulator

S. No.	m_p	A	$\mu_{th.}$	$\eta_{th.}$	V_{max}	V_{min}	$\mu_{pr.}$	P_c	Total Side Band Power	$\eta_{pr.}$
1.			0.3							
2.			0.5							
3.			1							

6 Analysis of Results

Calculations/Display/plot/typical graph Write/Plot Your Own.

7 Conclusions

Write Your Own.

Precautions

1. Check the connections before switching on the kit.
2. Connections should be done properly.
3. Observation should be taken properly.

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