Department of Electrical and Electronic Engineering (EEE)
Bangladesh University of Engineering and Technology (BUET)

EEE 310: Communication Laboratory

EXPERIMENT NO: 2
FREQUENCY MODULATION BY VARACTOR MODULATOR AND FREQUENCY DEMODULATION BY FOSTER-SEELEY DETECTOR

Objective:
1) Demonstration of frequency modulation by Varactor modulator.
2) Demonstration of frequency demodulation by Foster-Seeley detector and effect of noise on its performance.

Equipment:
1) Anacom-2 module.
2) Power supply
3) Oscilloscope
4) Frequency meter

Procedure:
Part A: Frequency modulation by Varactor modulator:

1) Connect the Anacom-2 module to the appropriate power supply.
2) Ensure that the following initial conditions exists on the Anacom-2 module:
   a) All switched faults OFF.
   b) AMPLITUDE preset (in the MIXER/AMPLIFIER block) in fully clockwise position.
   c) VCO switch (in PLL block) in OFF position.
3) Turn on power to the ANACOM2 module.
4) Turn the AMPLITUDE PRESET (in the AUDIO OSCILATOR block) in fully clockwise (Max.) position and observe its output (at t.p 1) on oscilloscope. This is the modulating signal whose frequency (300 Hz to 3400 Hz) and amplitude can be varied by FREQUENCY PRESET and AMPLITUDE PRESET on the block.
   Leave the AMPLITUDE PRESET in fully counter clockwise (Min.) position for the time being.
5) Link the AUDIO OSCILLATOR output to the AUDIO INPUT of the MODULATOR CIRCUIT as shown in Fig. 3 and put the VARACTOR/VARACTOR switch in the VARACTOR position.
6) As like AUDIO block the amplitude of the FM carrier can be adjusted by the AMPLITUDE preset on the MIXER/AMPLIFIER block and the frequency (451 kHz to 458 kHz) can be varied by the CARRIER FREQUENCY preset on the VARACTOR MODULATOR block.
   In the VARACTOR MODULATOR block put the CARRIER FREQUENCY preset in its midway position and AMPLITUDE preset in fully clockwise position. Monitor the signal at t.p.34. It is the unmodulated carriers as the amplitude of the modulating signal is zero.
7) Turn the CARRIER FREQUENCY preset to its fully counter clockwise position-this corresponds to minimum base bias voltage. Monitor signal at t.p.34 (Oscillator output) and at t.p.21 (base bias voltage).

Now slowly turn the CARRIER FREQUENCY preset clockwise and record the oscillator frequency (with a frequency meter at t.p.34) for each 0.1 Volts intervals of the base voltage.

Plot the oscillator frequency Vs base bias voltage as shown in Fig.1.

8) If it is possible to change the base bias voltage with sinusoidal modulating signal a sinusoidal change in oscillator frequency can be obtained. Thus frequency modulation is performed with a VARACTOR modulator.

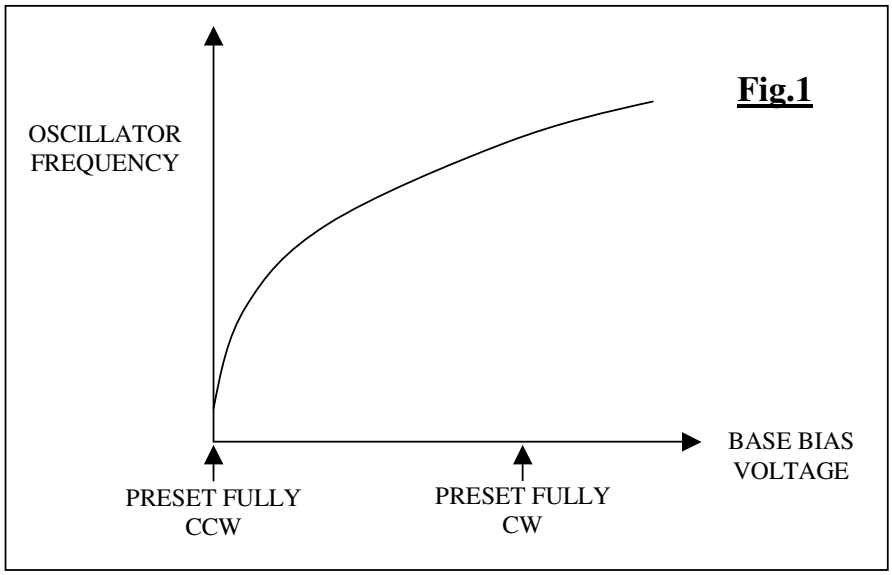

Fig.1

9) Now keeping the CARRIER FREQUENCY preset in fully CCW position observe the FM output at t.p.34. Now turn AMPLITUDE preset (in AUDIO OSCILLATOR block) to its fully clockwise position and note what
happens to the FM output.
Decrease amplitude of the modulating signal by turning AMPLITUDE preset (in AUDIO OSCILLATOR block) slowly CCW and observe the frequency deviation in the FM output.
10) Return the AMPLITUDE preset (in AUDIO OSCILLATOR block) to its fully CW position. Vary the frequency of the modulating signal by adjusting the FREQUENCY preset (in AUDIO OSCILLATOR block) and observe whether the FM output pattern changes or not.

The change in AUDIO OSCILLATOR frequency does not effect the amount of frequency deviation-it actually determines how many times per second the carrier deviates from its center position. But Oscilloscope can not show the rate of change of frequency deviation and for this reason it appears that the AUDIO OSCILLATOR frequency have no effect.

Now turn the CARRIER FREQUENCY preset slowly CW and observes the frequency deviation.

Part B: Frequency demodulation by Foster-Seeley detector:

1) Connect a signal generator having a sinusoidal output of amplitude 1V(p-p) and frequency 400 kHz to the INPUT socket of FOSTER-SEELEY DETECTOR block.
2) Now vary the frequency of the signal generator from about 430 kHz to 480kHz in 5 kHz steps and record the DC voltage at t.p.52 with the help of a multimeter for each step. Now plot the DC level against frequency. The curve should look like as shown in Fig.2:
3) Now disconnect the signal generator.

Adjust CARRIER FREQUENCY preset (in the VARACTOR MODULATOR block) to have carrier frequency of 450 kHz. Now modulate this carrier with a signal from the AUDIO OSCILLATOR and apply this modulated signal to the input of the FOSTER-SEELEY block as shown in Fig.3.

4) Now monitor the output of FOSTER-SEELEY block (at t.p.52) along with input audio signal (at t.p.14) at dual mode and compare the two signals. The signal should contain two components:
    a) A sine wave at the same frequency as the audio signal at t.p.14.
    b) A high frequency ripple component of small amplitude.

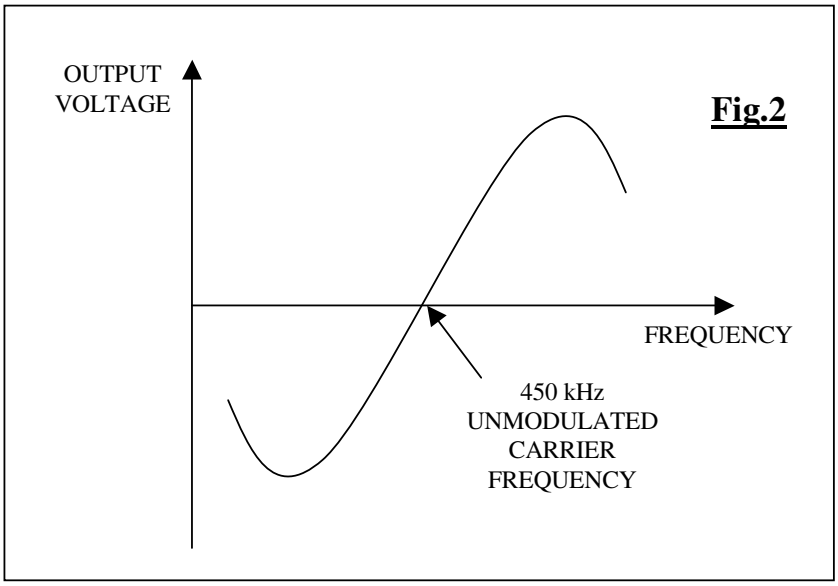

Fig.2

5) To remove the high frequency ripple apply the signal at t.p.52 to the LOW PASS FILTER/AMPLIFIER block. Now observe the signal at the output of the LOW PASS FILTER at t.p.73.
6) We will now investigate the effect of noise on the system. For this put the AMPLITUDE preset in its MAX position and the FREQUENCY preset in its MIN position in the AUDIO OSCILLATOR block. Adjust the signal generator for a sinusoidal output of amplitude 100 mV (p-p), and frequency 2kHz, which will be used as noise input.
   Connect this signal to the NOISE INPUT socket in ANACOM2's MODULATOR CIRCUIT block and monitor the noise input (at t.p.5) and the FM output (at t.p.34). The FM signal will be amplitude modulated by the 'noise' input in addition to be frequency modulated by the audio input.
7) Monitor the audio modulating signal (at t.p.14) and the output of the LOW PASS FILTER block (at t.p.73). A considerable amount of 'ripple' may be seen (at t.p.73) at the frequency of the 'noise' input. This is because the FOSTER-SEELEY DETECTOR is sensitive to amplitude variations in the incoming FM signal.
8) To reduce the amplitude variation connect the AMPLITUDE LIMITER as shown in Fig.4 and observe the signal at AMPLITUDE LIMITER output (at t.p.68) and at LOW PASS FILTER output (at t.p.73).

   Compare the final output with and without AMPLITUDE LIMITER.

Report:

1) Describe the principle of operation of the VARACTOR MODULATOR and the FOSTER-SEELEY DETECTOR.
2) Show all the observations with necessary wave shapes in your report and describe them.

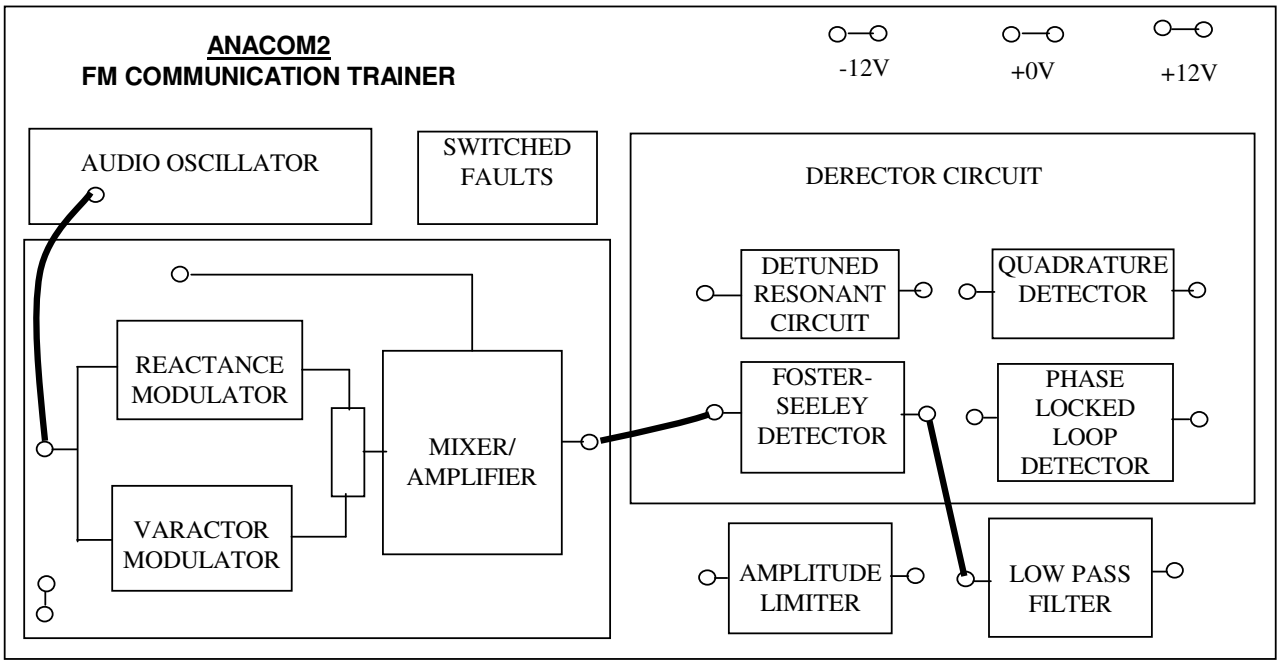

Fig.3

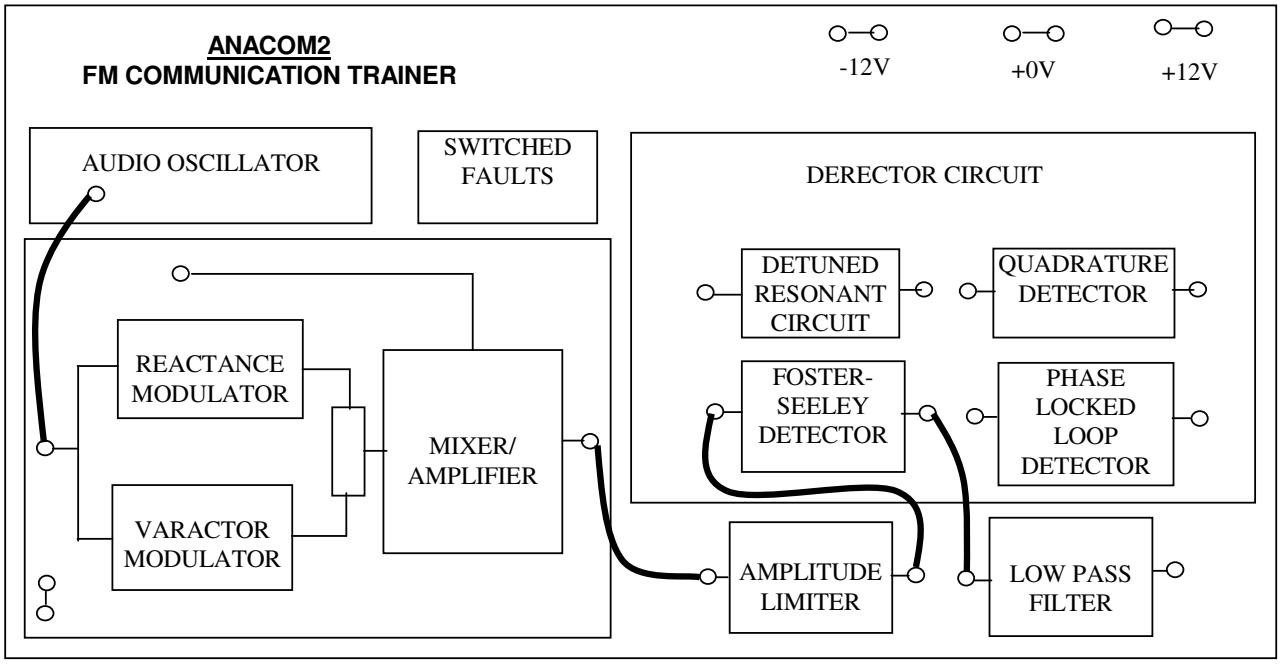

Fig.4