Experiment 4

Voltage Controlled Oscillator

Objectives :

By the end of this experiment, the student should be able to:

1. Understand the operation of voltage controlled oscillator (VCO).
2. Apply VCO fine tuning.
3. Understand the VCO sensitivity and linear range of operation.

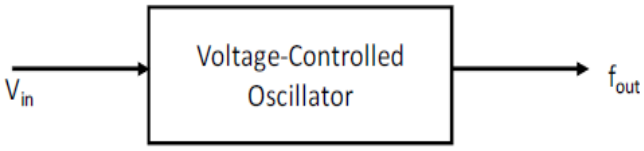
Introduction:

Voltage Controlled Oscillator (VCO):

Ideally, a voltage-controlled oscillator is a circuit whose output frequency is a linear function of its input voltage as shown in figure 1, mathematically:

$$\mathbf{f_{out} = f_o + K_{voc} \cdot V_{in}} \quad \text{.....(1)}$$

Where f_o is the frequency corresponding to Vin = 0, and K_{voc} represents the "**gain**" or "**sensitivity**" of the VCO (expressed in **Hz/V**).



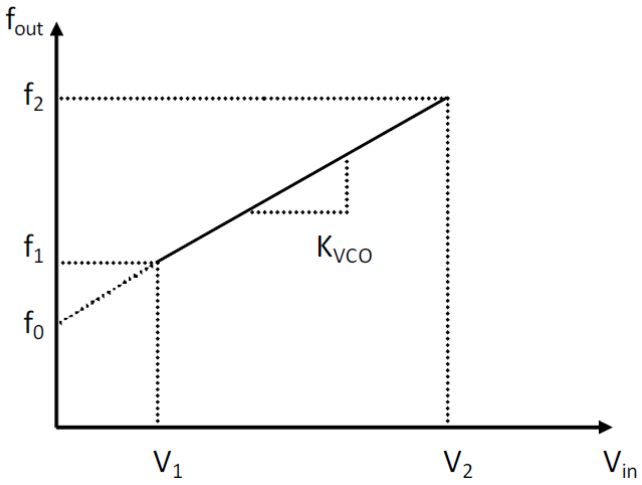


Figure 1. Basic VCO Characteristics

VCO Module:

The Voltage Controlled Oscillator module functions in two modes: either as a Voltage Controlled Oscillator with analog input voltage or as an FSK Generator with digital input. Both modes have two frequency ranges of operation (High and Low) which are selected by a range switch. The VCO frequency and input sensitivity can be controlled from the front panel.

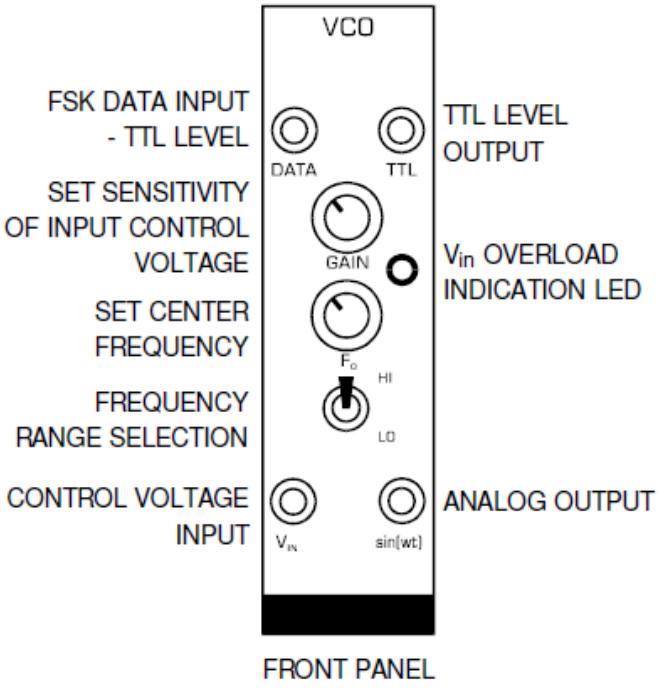


Figure2. VCO Module

Lab Work

This experiment has three parts. The first part studies sensitivity and the range of linear operation of the voltage controlled oscillator (**VCO**).

Modules:

The following plug in modules are needed to complete the experiment:
Audio Oscillator, VCO.

Procedure:

Part l. VCO Fine Tuning:

Fine tuning may be easily achieved by following these five steps:

1- Set the Variable DC module's output close to zero (use DMM).
2- Turn the Gain control of the VCO to zero, fully counter-clockwise.
3- Turn the Gain control up, clockwise, just a little (only a few degrees).
4- Set the VCO module's output frequency as close as possible to the frequency of interest. Use the frequency adjust knob, f_o. Use the frequency counter to measure the VCO's output frequency.
5- Finally, patch the Variable DC module's output to the VCO module's frequency control input, Vin, with a standard patching lead.

Note

Fine frequency control of the VCO module is now achieved by turning the Variable DC module's voltage control knob.

6- Switch VCO to high frequency mode then generate 80kHz sinusoidal signal and plot the output in your lab sheet
7- Switch VCO to low frequency mode then generate 10kHz sinusoidal signal and plot the output in your lab sheet.

Part ll: Sensitivity and Linearity of VCO

The output frequency of the VCO varies with the input voltage, Vin. The amount of variation (Hz/volt) can be controlled by the deviation sensitivity (Gain). Before generating a waveform it is required to set the deviation sensitivity to a value that ensures linearity of the VCO over the whole range of input amplitudes.

Note:

The **Deviation Sensitivity** can be set with the front panel **Gain** control.

1. Use the front panel ' $\mathbf{f_o}$' control to set the output frequency (sin ωt) close to 10 kHz.
2. Connect the Variable DC voltage to the input ($\mathbf{V_{in}}$) of the VCO.
3. Set the front panel Gain control to about **20%** of its fully clockwise rotation.

4. Vary the Variable DC from **-2** V to **+2** V in steps of **0.5** V and measure the output frequency.
5. Fill in the first the **Table 1** in the your Lab Sheet.
6. With the variable DC on its minimum value, set the GAIN control **(Sensitivity**) of the VCO to about **50%** (make sure that you do not overload the VCO, the LED should not light up).
7. Redo steps 4 and 5 and fill the **Table 2** in your lab sheet.
8. Plot the output frequency versus the input voltage for each setting.
9. Which of the above settings results in a more linear performance in the given range of $\mathbf{V_{in}}$?

Part III:

In this part we will examine the VCO output variation when the input is sinusoidal signal.

1. Using Audio Oscillator Generate 5khz sinusoidal signal .
2. Set the VCO Sensitivity about 20%.
3. Connect the output of the Audio Oscillator with the input of the VCO
4. Plot the input and output of VCO in your lab sheet.