Laboratory 2: Voltage-Controlled Oscillator

1 Objectives

1. Understand the basic concepts of VCOs.
2. Analyze the frequency response of a sine wave VCO.

1.1 MC1648 VCO

In this experiment, we will study the operation of a voltage-controlled oscillator (VCO) based on the MC1648 IC. The MC1648 is a high-speed differential oscillator whose output frequency depends on an external tuning voltage applied to a varactor diode.

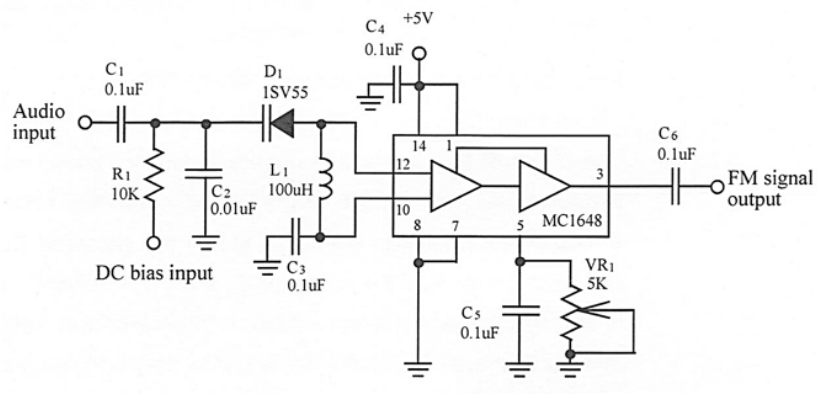

Figure 1: MC1648 based VCO

- **DC Control Voltage Input:** A DC voltage is applied at the input terminal. This voltage is fed to a varactor diode (D_1), which acts as a voltage-dependent capacitor.
- **Tuned Circuit (L_1, C_2, D_1):** Together with the inductor L_1 and capacitor C_2, the varactor forms a resonant LC tank circuit. As the DC control voltage changes, the capacitance of D_1 varies, shifting the resonant frequency of the oscillator.
- **MC1648 Oscillator Core:** The MC1648 amplifies and sustains oscillations at the frequency determined by the LC network. By changing the input DC voltage, the output frequency can be controlled.
- **Frequency Adjustment:** The variable resistor VR_1 allows manual tuning of the VCO's center frequency.
- **Output:** The generated signal is available at the output terminal through the coupling capacitor C_6.

2 Experiments

Note : The laboratory report must be submitted at the end of the session.

Required Equipment

1) KL-92001 Module, 2) KL-93004 Module, 3) Oscilloscope.

Experiment 1

1. Locate the MC1648 in the FM modulator circuit on the KL-93004 module. Insert jumper J2 to select inductor $L_1 = 100\,\mu$H.
2. Insert jumper J1 to select $V_{in} = 5\,$V. With this voltage, the output frequency will be the center frequency.
3. Observe the output using an oscilloscope. Adjust VR1 until a sinusoidal signal is obtained. Then, record the frequency value and sketch the output signal.
4. Using the spectrum analyzer, observe and record the output spectrum.
5. Remove jumper J1.
6. Connect a DC voltage of +2V to input (I/P2). Observe the output and record the output frequency.
7. Repeat this step for other DC voltage values, noting them in the following table.

V (V)	2	3	4	5	6	7	8	9	10	11	12	13	14
f (Hz)													

Table 1: Output Frequencies for Varying DC Input Voltages

8. Using the results from the table, plot the frequency as a function of the DC voltage.

Experiment 2

9. Insert jumper J3 to select inductor L_2.
10. Repeat steps 2 to 7 from Experiment 1.

Discussion

1. Calculate the sensitivity, then write the transfer function expressions for the two VCOs.
2. Comment on the results obtained. Is this VCO linear?
3. What conclusions can be drawn ?