

EXPERIMENT # 3

Phase Locked Loop PLL & Frequency Synthesizer

INTRODUCTION

A basic phase locked loop, PLL, consists of three basic elements:

- **Phase detector** compares the phase of two signals and generates a voltage according to the phase difference between the two signals.
- **Loop filter** filters the output from the phase comparator and removes any components of the signals of which the phase is being compared from the VCO line. It also governs many of the characteristics of the loop and its stability.
- **Voltage controlled oscillator (VCO)** generates the output radio frequency signal. Its frequency can be controlled and swung over the operational frequency band for the loop.

PLL are widely employed in radio, telecommunications, computers and other electronic applications. They can be used to demodulate a signal, recover a signal from a noisy communication channel, generate a stable frequency at multiples of an input frequency (**frequency synthesis**), or distribute precisely timed clock pulses in digital logic circuits such as microprocessors.

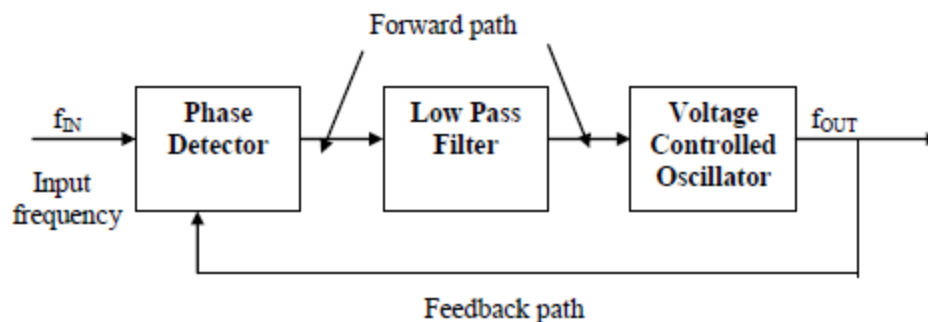


Figure 1: Block diagram of PLL.

Laboratory Procedure

1- Voltage Controlled Oscillator (VCO):

- Read the 4046 PLL data sheet to become familiar with pin arrangement.
- The free running frequency f_o is determined by the voltage of VCO in and the capacitor and resistors connected to pins C_{1A} , C_{1B} , R_1 and R_2 .
- Connect the circuit shown in Fig.2 with $R_1=10k$, $R_2=100k$ and $C_1=200pF$
- Vary the input voltage VCO in from 0 to 5 V at step of 0.5 V and record the frequency f_o of the output VCO out.

2- Frequency Synthesizer:

- Connect the circuit shown in Fig.3 using the counter 4024.
- Connect the TTL output of the signal generator to the input SIGN in. set the frequency to $f=1$ kHz.
- Measure the frequency at the output of the counter Q_0 , Q_1 , ..., Q_6 . Find their relation to f_o and the reference frequency.

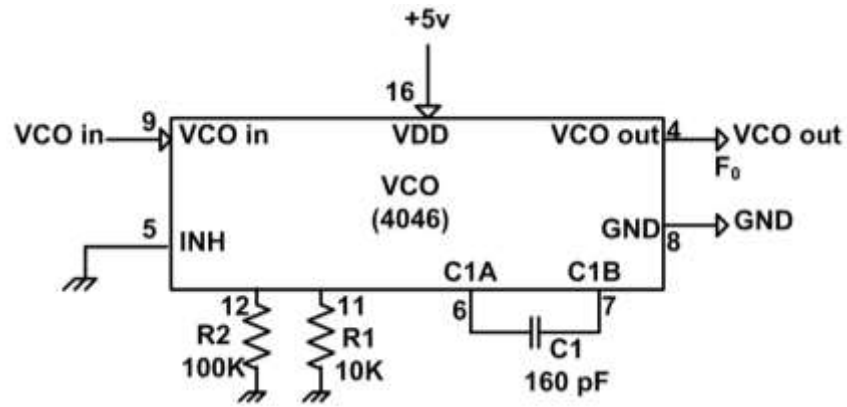


Figure 2. VCO.

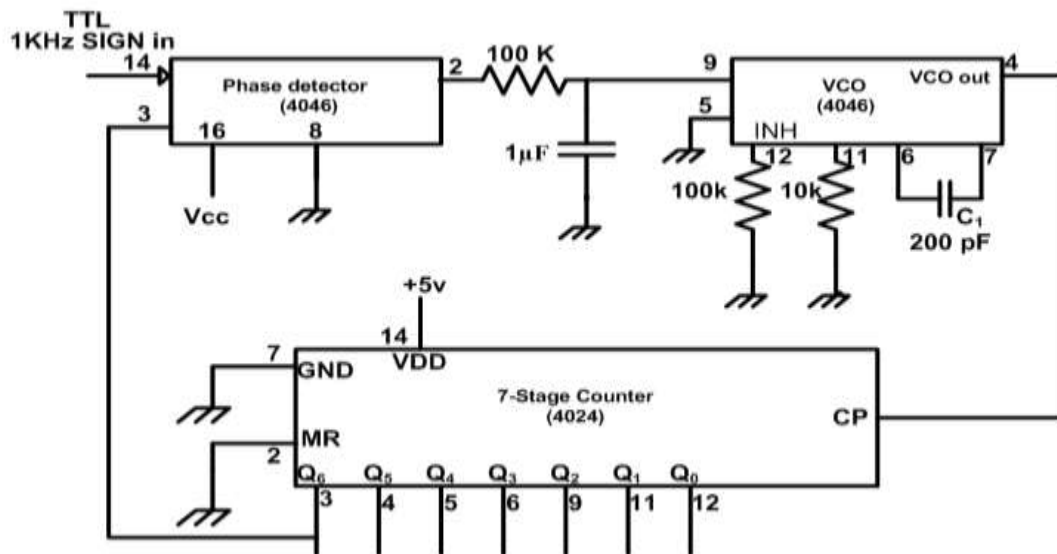


Figure 3. Frequency Synthesizer

Report:

- 1- Draw the recorded frequency f_0 vs. VCO in.
- 2- Discuss the operation of the circuit in Fig.3.
- 3- What is the impact of connecting the output Q₄ to the input of the phase detector?
- 3- How to get different group of frequencies at the outputs of the counter?