EECE 3071L Electronics Laboratory II Spring, 2015

Session 2
Project 3: Emitter-Coupled Oscillator

Objective

To investigate the design and operation of an emitter-coupled astable multivibrator for 50 MHz operation.

Background

The basic emitter-coupled multivibrator consists of two bipolar junction transistors and a single timing capacitor. A key feature of this circuit is that the switching transistors are not driven into saturation during operation. Therefore, high frequency oscillations can be obtained with this circuit.

This type of circuit is the basic building block in high-speed ECL (emitter-coupled-logic) oscillators such as the MC1658. It can also be used as a voltage-controlled oscillator.

Specifications

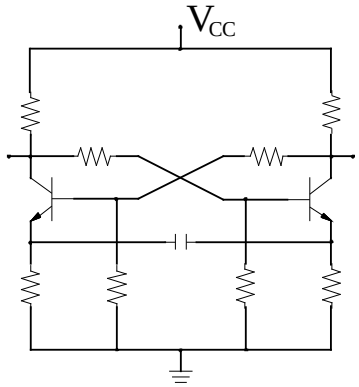
power supply	24 V(can be single-ended or split)
output signal amplitude	2V(p-p)
maximum frequency	50 MHz
average I_C of switching transistor	_____assigned by lab tech

Instructions

1. Identify the transient current loop in the symmetric emitter-coupled oscillator circuit and derive the equation for the frequency of oscillation.
2. Calculate values for all the resistors in the primitive circuit (A or B) to produce the average operating current in each switching BJT of __ mA and an output signal amplitude of $2V_{pp}$.
3. Use MATLAB to plot the frequency of oscillation [over the range $[0.1 < f < 50$ MHz] as function of the timing capacitor value in the absence and in the presence of a parasitic capacitance of 5 pF.
4. Verify your circuit design with SPICE using transistor characteristics obtained from the curve tracer (compare these with the manufacturer's models in SPICE).
5. Build and test the primitive circuit. Record the output voltage waveforms at one of the outputs and at the corresponding timing capacitor terminal with respect to ground at the discrete frequencies 0.1, 1.0, 10 and 50 MHz (or the maximum frequency possible). Output waveforms are valid only if $V_{PP} > 2.0$ volts.
6. From your results determine the timing capacitor value for maximum frequency of oscillation and check this by testing.
7. Repeat the design procedure [steps 1 through 3] for the current-sourced/follower-cross-coupled version of the oscillator circuit (B) and simulate it with SPICE using measured (and spec-sheet) transistor data.
8. Plot the measured frequency of oscillation versus timing capacitor values for the advanced circuit and determine the resistor and capacitor values required for 50 MHz operation. The biasing resistor values may need to be adjusted but the average operating current must be maintained at the assigned value.
7. Build and test your final version for 50 MHz operation and record all output and timing capacitor waveforms. Record the maximum measured frequency of oscillation if 50 MHz oscillation is not obtained and describe what additional changes would need to be made to get 50 MHz.

Basic Circuits:

A. Primitive symmetric circuit



B. Advanced symmetric circuit