EXPERIMENT 3: CARRIER GENERATION

INTRODUCTION:

Modulation is the process of placing information onto a *carrier* frequency. The carrier is nothing more than a radio-frequency (RF) sine wave whose characteristics are modified in one of three ways (amplitude, frequency, or phase) in order to convey the information. In this experiment, an RF oscillator will be constructed as the first stage of an AM broadcast transmitter.

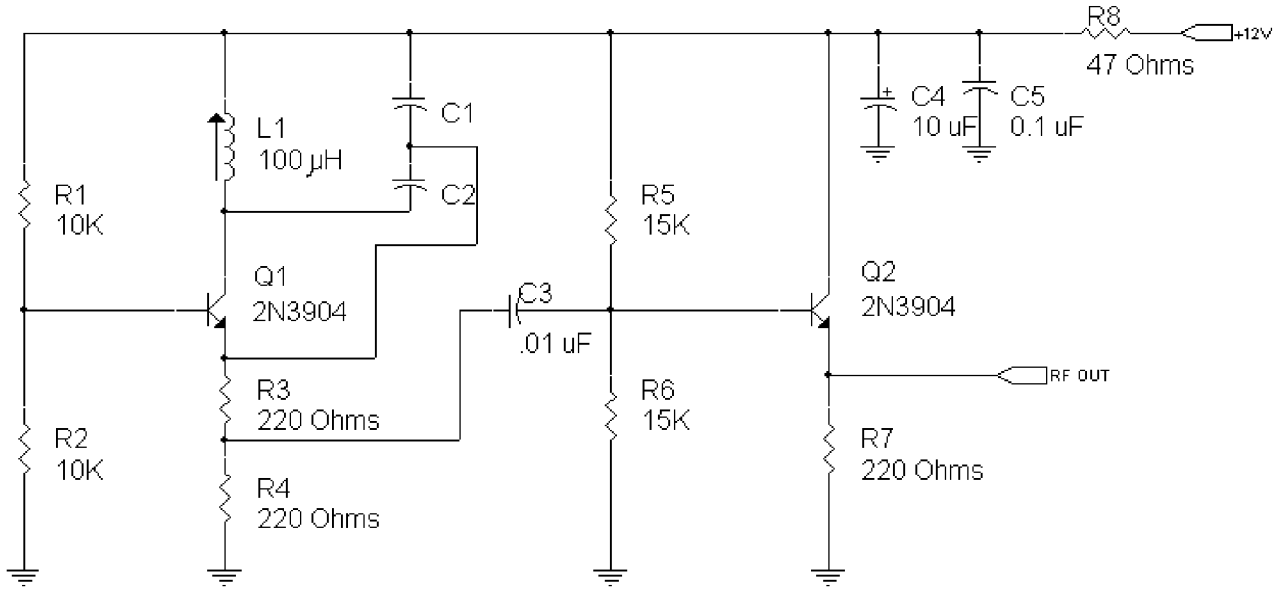

Figure 1 Oscillator and Buffer Amplifier

THEORY OF OPERATION:

An oscillator is a circuit that converts DC energy into AC. At radio frequencies, either an LC resonant circuit or a quartz crystal can be used to control the frequency. A quartz crystal provides the highest stability, but can only operate on one frequency without the use of special techniques (frequency synthesis).

In the circuit of figure 1, Q_1 is configured as a Colpitts oscillator. L_1 and the series combination of C_1 and C_2 set the operating frequency and control the amount of positive feedback. R_1,R_2, R_3, and R_4 serve to provide DC bias to Q_1.

An oscillator needs to see a constant load impedance or it will "drift" (change frequency unexpectedly.) That's the purpose of Q_2, the *buffer amplifier*. Q_2 is an untuned emitter-follower which will present a light load on the oscillator. There is no voltage gain provided by Q_2, but there is a small power gain. The signal at the output of Q_2 is suitable for driving a higher-power stage such as a modulator or power amplifier.

In RF circuitry, special attention must be given to power supply filtering in order to prevent undesired feedback. R_8, C_4, and C_5 form the power supply filter.

LABORATORY PROCEDURE:

0. Use only 10:1 probes in the 10X position to measure RF waveforms!

1. Build the circuit of Figure 1. Compute the value for C_1 and C_2 assuming that F_c=750 KHz. (C_1 and C_2 should be equal values).

2. Apply power to the circuit. The RF output voltage at the emitter of Q2 should be at least 1 V p-p; if not, there is some sort of trouble in the unit. If there is trouble, apply the three basic steps of troubleshooting:

   a) Visual inspection
   b) Check Power Supply
   c) Check Inputs and Outputs

3. By tuning L_1, we can control the carrier frequency. What are the minimum and maximum frequencies this oscillator will produce? Display these in your report, and compute the effective L_1 inductances at minimum/maximum frequency.

   Note: Use only the plastic tuning tool to adjust L_1. The ferrite coil core is easily broken. Use of a metal tool will detune the oscillator.

4. Perform final alignment of the unit to 750 KHz frequency. Record the waveforms at the following test points (Use the waveform capture and printing capability of the digital storage oscilloscope):

   a) Junction of R_3 and R_4
   b) Q_1 collector
   c) Q_2 emitter

   Make sure each waveform is clearly titled and labeled.

REPORT CONTENTS

The following should be in the design portion of your report:

1. The calculation for C_1 and C_2.
2. The minimum and maximum oscillation frequencies.
3. The effective inductance of L_1 at the minimum/maximum oscillation frequencies.