42.

OPERATING INSTRUCTIONS

DIFFERENT OSCILLATORS

SIBA INDIA

SATISH BROTHERS

4309/20,MARBLE HOUSE,PUNJABI MOHALLA
AMBALA CANTT 133 001

Ph. 2642617, 2645237. Fax: 0171-2645237

R - C, L - C, OSCILLATORS

Phase shift osc : An oscillator is a feedback amplifier in which part of output is fed back to the input via a feedback circuit. If the signal fed back is of proper magnitude and phase, the circuit produces alternating currents or voltages. To maintain proper oscillations the amplifier gain must be sufficient and both output and input must be in phase. In fixed frequency R - C sinusoidal oscillators the phase shift principal is used to create necessary phase reversal.

The Phase shift network: In fig 1, a R - C network is shown which has three identical R and C. each leg shifts the input signal 60°. It also attenuate the input signal by a factor of 1/ 96. Thus the three combination provide a phase shift of 180° with an attenuation about 1/ 29. If an amplifier A has voltage gain > 29, connected between the input and output with an additional phase shift of 180°, than the oscillation will be maintained. If the voltage gain is close to theoratical amplification value of 29, than the output will be sinusoidal but unstable. Due to three leg network these oscillators are used in fixed frequency applications. The fundamental frequency of phase shift network is,

$$f = \frac{1}{2\pi\sqrt{6}\ RC} = \frac{0.065}{RC} \text{ approx.}$$

f in Khz, taking R in K Ohm and C in uF.

The circuit : In fig 2 complete circuit of phase shift oscillator is shown, where Q1 is the amplifer with current series feedback applied through RE, C2 and VR1. The negative feedback in-crease the input impedance higher . The values of R2 , R1 is kept high not to disturb the phase shift network impedance.

Wein bridge osc : An oscillator is a feedback amplifier in which part of output is fed back to the input via a feedback circuit. If the signal fed back is of proper magnitude and phase, the circuit produces alternating currents or voltages. To maintain proper oscillations the amplifier gain must be sufficient and both output and input must be in phase. In variable frequency R - C sinusoidal oscillators the Wein's bridge oscillator is popular.

In fig 3, a wein bridge is shown (in box) as frequency selective network. The weins bridge consists two arms called shunt and series arm. The shunt arm has R and C parallel connected where the series arm has R and C in series. The other two arms are purly resistive. At particular frequency f, the wein network produce a phase relationship between input and output precisely 0^0 of $1/2\pi$ CR. At this center frequency the network has a voltage attenuation of 1/3. To compensate this attenuation the second arm consists two resistors R2,R4, having a ratio equal to R2 = 2R4. The center frequency f, of wein bridge is evaluated as,

$$f = \frac{1}{2\pi CR} \quad \text{approx}$$

Where C and R has similar values. The complete circuit of wein bridge is shown in fig 4.

<u>Hartley osc</u> : The Hartley oscillator is simplest type of oscillator used in RF applications. in these oscillators only one capacitor is used across one tapped inductor, where the tap point of inductor is connected with ground to forms L - C tuned circuit. The amount of feedback depends upon the coupling ratio L1 : L2. Generally these oscillators are used in variable frequency applications.

Ciruit description : In fig 5, shows the circuit of given Hartley's oscillator using a transistor as an amplifier biased through resistance RB and RE in base - emitter junction. Where the collector is connected with the supply through a resistance RC and L. The base is also connected to another portion of the coil through a capacitor CB. The portion of inductor L and CB forms the positive feedback loop.

When the supply applied to the circuit the current flows in transistor through lower part of Lin such direction that an opposed current flow across upper portion of L. The capacitor C get charged to the voltage value appeared across the coil. As reistance of L is very much smaller for this sharp rise current, the mutual transfer of opposed current bias Q harder. This leads to saturation of Q, which ceased to accept no more current. Now C discharges across the lower portion of L and Q1, provide sharp falling current across upper portion of L in opposite direction as the discharge of C has reverse polarity.The voltage devloped across C provides regenerative action to sustained oscillations. The falling current across L pulls base of Q in reverse - bias, hence leads to cut - off. This prevent to flow of current in the circuit and cycle repeat again. The charge - discharge rate (frequency of oscillation) depends upon the value of C and L Smaller the values, higher the cycle hence higher the frequency. The frequency of oscillation is;

$$fo = \frac{1}{2\pi\sqrt{LC}}$$

where C is equal to C1.C2 / C1 + C2.

<u>Colpitt osc</u> : The colpitt oscillator is simplest type of oscillator used in RF applications. in these oscillators only one coil is used across two capacitors, where the joining point of capacitors is connected with ground to forms L - C tuned circuit. The amount of feedback depends upon the capacitance ratio c1 : c2. Generally these oscillators are used in fixed frequency applications.

Ciruit description : In fig 6, shows the circuit of given colpitt oscillator using a transistor as an amplifier biased through resistance RB and RE in base - emitter junction. Where the collector is connected with the supply through a resistance R and L. The base is also connected to another portion of the coil through a capacitor CB. The portion of capacitor C1 and CB forms the positive feedback loop. Emitter is bypassed through a small value capacitor CE, sufficient to exsists virtual ground for RF frequencies. Similarly the supply is also bypassed by CS which has very low reactance at high frequencies.

When the supply applied to the circuit the current flows in transistor through Lin such direction that an opposed current flow across c1 and c2. The capacitors get charged to the voltage value appeared across the coil. As reistance of L is very much smaller for this sharp rise current, the mutual transfer of opposed current bias Q harder. This leads to saturation of Q, which ceased to accept no more current. Now Cs discharges across the L provide sharp falling current across L in opposite direction as the discharge of C2 has reverse polarity.The voltage devloped across C2 provides regenerative action to sustained oscillations. The falling current across L pulls base of Q in reverse - bias, hence leads to cut - off. This prevent to flow of current in the circuit and cycle repeat again. The charge - discharge rate (frequency of oscillation) depends upon the value of C1 : C2. Smaller the values, higher the cycle hence higher the frequency. The frequency of oscillation is;

$$fo = \frac{1}{2\pi\sqrt{LC}}$$

where C is equal to C1.C2/ C1+C2, since both are in series.

Experiment procedure

Object : To verify the condition of oscillation in given phase shift R - C oscillator. To obtain sine wave output from it and observe the effect of gain control.

Other apparatus required : A general purpose cathode ray oscilloscope

1. Connect The circuit as shown in fig 2. Connect CRO across the Q1 output socket. Switch ON the power. Rotate VR1 to obtain oscillations.

2. Adjust CRO, Y amplitude and its sweep frequency to obtain stable waveforms. Observe the waveforms appeared upon CRO screen. Vary the VR1 and observe that the amplitude and purity of waveform is changed.

3. Adjust VR1 control to obtain clean sinusoidal waveform. Measure its period of oscillation and calculate the frequency as f = 1/ T.

4. Calculate the theoratical value of oscillation from the given network components. Compare it with the obtained result. A tolrence of 5% is adoptable due to componenet tolrence.

5. Connect the CRO at input of Q1. Measure the output at other side of network. It should be > 1/29 of output signal amplitude. Observe the phase between input - output. Is it 180^0 out of phase. It verify the principle of phase shift network.

Experiment procedure

Object : To verify the condition of oscillation in given Wein bridge R - C oscillator. To obtain sine wave output from it at different R - C and observe the effect of gain control.

Other apparatus required : A general purpose cathode ray oscilloscope, signal source.

1. Connect The circuit as shown in fig 4. Connect CRO across the Q2 output socket. Switch ON the power. Rotate VR 2 to obtain oscillations.

2. Adjust CRO, Y amplitude and its sweep frequency to obtain stable waveforms. Observe the waveforms appeared upon CRO screen. Vary the VR2 and observe that the amplitude and purity of waveform is changed.

3. Adjust VR2 control to obtain clean sinusoidal waveform. Measure its period of oscillation and calculate the frequency as $f = 1/T$. Note the values of R and C selected.

4. Calculate the theoratical value of oscillation from the given network components. Compare it with the obtained result. A tolrence of 5% is adoptable due to componenet tolrence. Change the value of R, and C. Adjust VR2 to obtain clean sine wave and compute theoratical value of fo. Tabulate the value of R and C with fo.

R	C	fo

5. Select any R - C combination. Adjust the VR2 to obtain oscillation. Now connect CRO at the input of network (Q1) . Measure the output / input signal with its phase. The input should be near 1/3 of output amplitude with 0^0 phase. It verify the Wein's principle.

Experiment procedure

Object : To verify the condition of oscillation in given Hartley oscillator.

Other apparatus required : A general purpose cathode ray oscilloscope, absorption wave meter or better a digital frequency counter upto 10 Mhz.

1. Connect The circuit as shown in fig 5. Connect CRO across the RF output sockets. Keep C (variable capacitor) in middle. Switch ON the power.

2. Adjust CRO, Y amplitude and its sweep frequency to obtain stable waveforms. Observe the waveform appeared upon CRO screen. Connect a frequency counter in place of CRO and measure the frequency of oscillation.

3. Disconnect the patch lead connected between tap of L and +12V.Observe that the oscillations stops. Connect the patch lead again and observe that the oscillations restored. This situation can be confirm by measuring base voltage which will fall when oscillations restored. Revert the connection between +12 to 2 and 1 with 3. Note the oscillation does not start. Revert back connections as before.

Estimate the value of L as;

$$L \text{ in } H = \left[\frac{1}{2\pi f}\right]^2 \div C,$$ where f in Mhz and C in pF.

The given L is 4.8 mH approx, where C1,C2 are 1n each (1000pF).

Experiment procedure

Object: To verify the condition of oscillation in given Colpitt oscillator.

Other apparatus required: A general purpose cathode ray oscilloscope, absorption wave meter or better a digital frequency counter upto 10 Mhz.

1. Connect The circuit as shown in fig 6. Connect CRO across the RF output sockets. Switch ON the power. Switch on S.
2. Adjust CRO, Y amplitude and its sweep frequency to obtain stable waveforms. Observe the waveforms appeared upon CRO screen.
3. Disconnect the patch lead connected between joining point of C1, C2 and GND.Observe that the oscillations stops. Connect the patch lead again observe that the oscillations restored.
4. Connect Frequency counter across the RF output sockets. If wave meter is used than place it nearly coil L mounted upon the panel. Keep it's distance constant from the L throughout the experiment. Note the frequency of oscillations

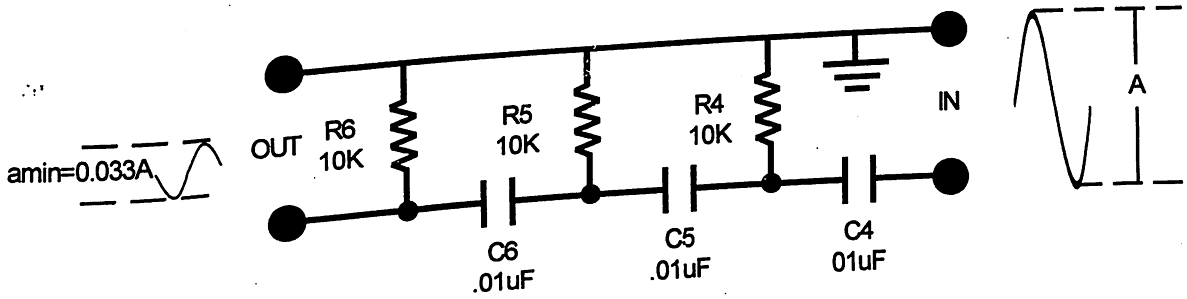

FIG 1. The Phase shift R - C network

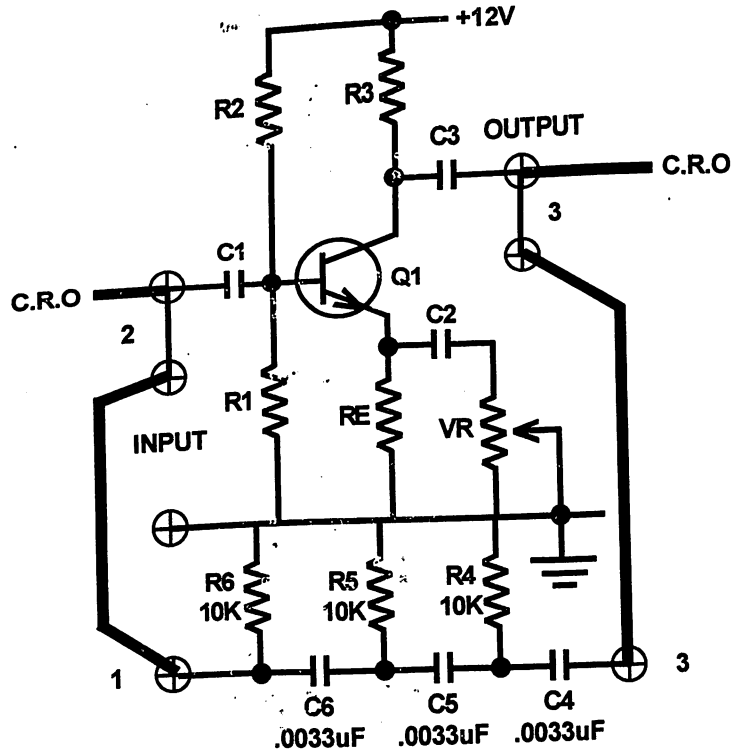

FIG 2. The Phase shift R - C network connections for experiment

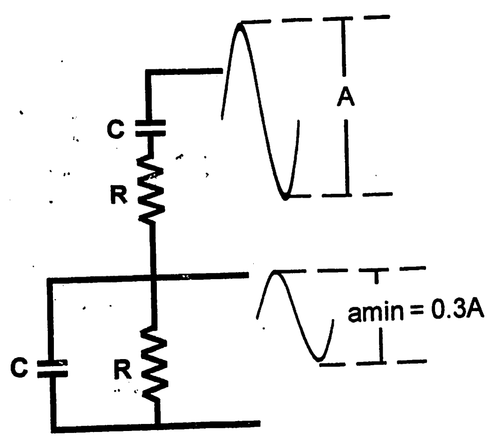

FIG 3. The Wein frequency network

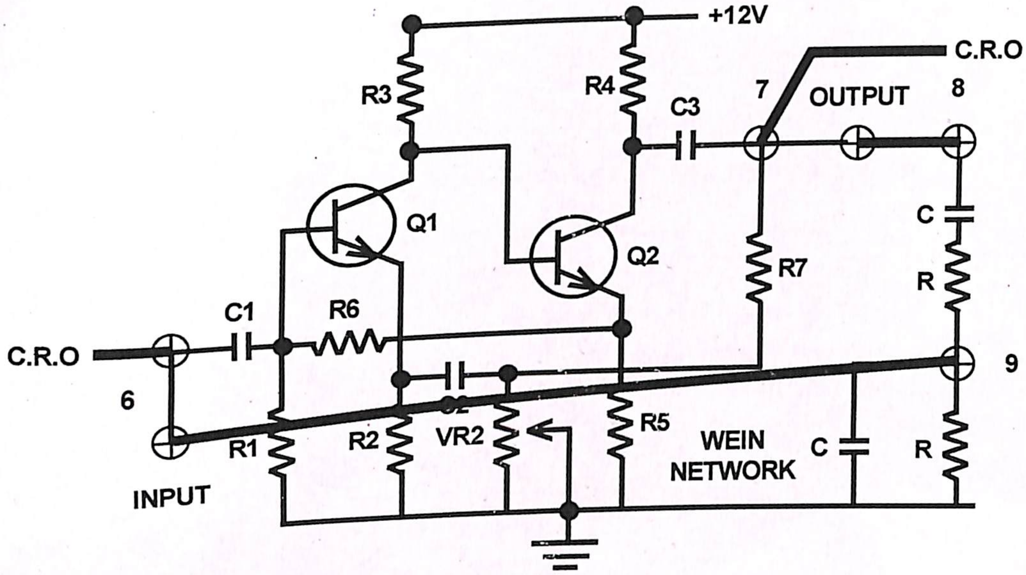

FIG 4. The Wein bridge oscillator connections for experiment

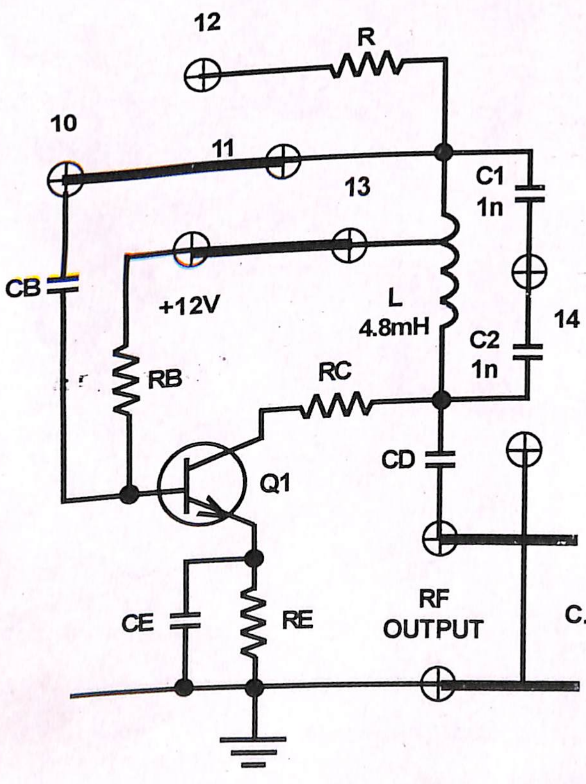

FIG 5. The Hartley oscillator

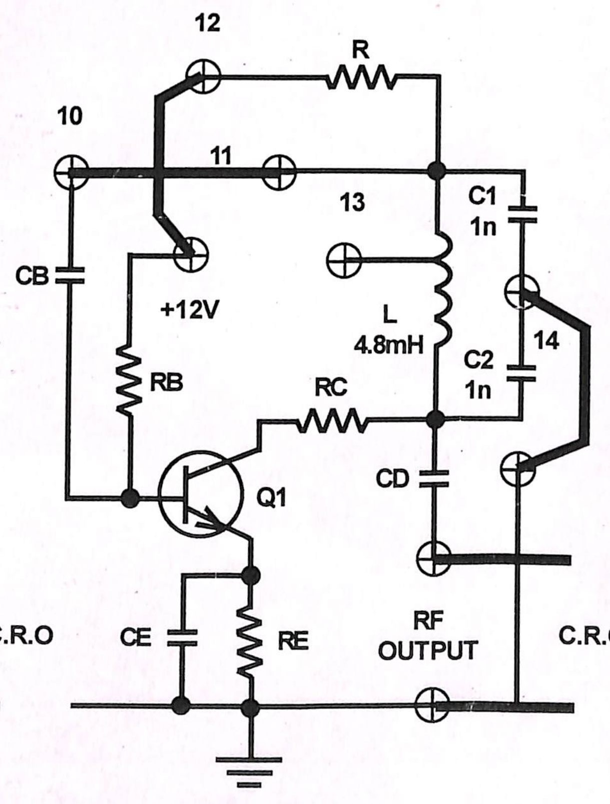

FIG 6. The colpitt oscillator

The Hartley and colpitts oscillator connections for experiment