FIG 1

Simulate the circuit of Fig.1 using a run time of 50ms. Set the voltage across Co to -12V. Be careful of polarity.

Under Plot click on User Defined axes and
Set the X axis to (49.9ms:50ms.)
Set the Y axis to (-8V:16V)
Plot and copy the waveforms V(J1:d), V(J1:g), V(J1:s)

Set the Xaxis to (48ms:50ms)
Set the Y axis to (4V:20V)
Plot and copy V(J2:d).

Under X axis settings
Click on Fourier
Set the X axis to (47KKHz:53KHz)
Set the Y axis to (0V:6V)
Plot and copy the spectrum of V(J2:d)
Choose R in the circuit of Fig.1 so that the collector current of Q2 is 20ua. Neglect base currents. The transistors are matched. Check your result using Spice with 2N2222 transistors.

\[ I_{C2} = I_{C1} \exp(-I_{C2}R/V_t) \]
\[ 20 \text{ua} = 200 \text{ua} \exp(-20 \text{ua}R/27 \text{mv}) \]

\[ 20 \text{ua} \times R = \ln(10) = 2.3 \quad R = 2.3(1.3K) = 3.11K \]

\[ R = 3.11K \]

Determine the collector current of Q2 in Fig.1 if R=500 ohms.

\[ I_{C2} = \frac{V_t}{R} \ln\left(\frac{I_{C1}}{I_{C2}}\right) \]
\[ I_{C2} = \frac{(27 \text{mv}/500)\ln(200 \text{ua}/I_{C2})}{(54 \text{ua})\ln(200 \text{ua}/I_{C2})} \]

\[ I_{C2} \approx 54.0 \text{ua} \rightarrow 70.7 \text{ua} \quad 0.5(70.7+54)/2 = 63.4 \]
\[ 63.4 \text{ua} \rightarrow 62.0 \text{ua} \quad 0.5(63.4+62.0) = 67.7 \]
\[ 62.7 \text{ua} \rightarrow 62.6 \text{ua} \]

\[ I_{C2} = 62.6 \text{ua} \]