BJT Common-Emitter Design I

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DC Analysis Results

Table 1

2N3904 NPN BJT Characteristics	
Beta	Vbe
205.000	0.680

Table 2

DC Analysis Results					
Vc0 (V)	Ve0 (V)	Vceq (V)	Icq (mA)	Ie (mA)	Ib (mA)
3.725	0.290	3.435	1.3118	1.3182	0.0064

These DC measurements were taken using the bias resistor values that are listed below in Table 3.

Table 3

Bias Resistor Values Used	
R1	R2
47000.000	5200.000

Table 8.1 from the Lab manual with and without Emitter Bypass Capacitor

Table 4

Table 8.1: Voltage Gain Measurements			
RL	Vo-pp	Av with Ce	Av without Ce
0.1 Rc	0.045	20.704	2.309
Rc	0.194	108.261	10.015
10 Rc	0.292	187.350	15.026

Experimental Waveforms associated with Table 8.1

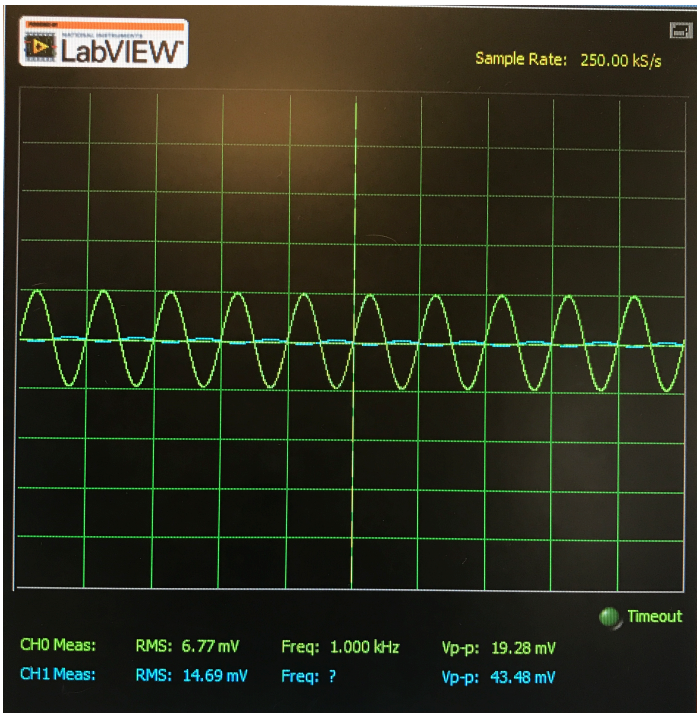

Figure 1: Waveform where RL=0.1RC without Ce

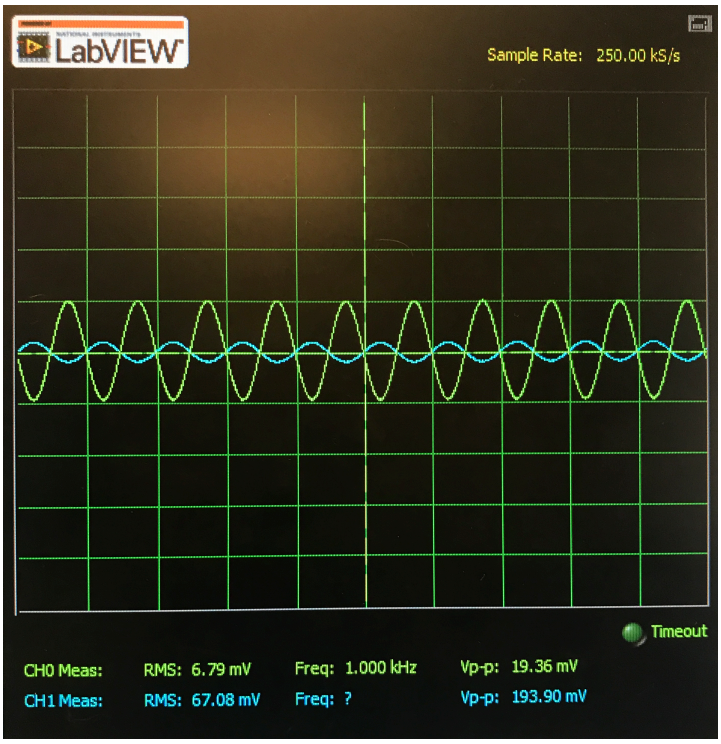

Figure 2: Waveform where RL=RC without Ce

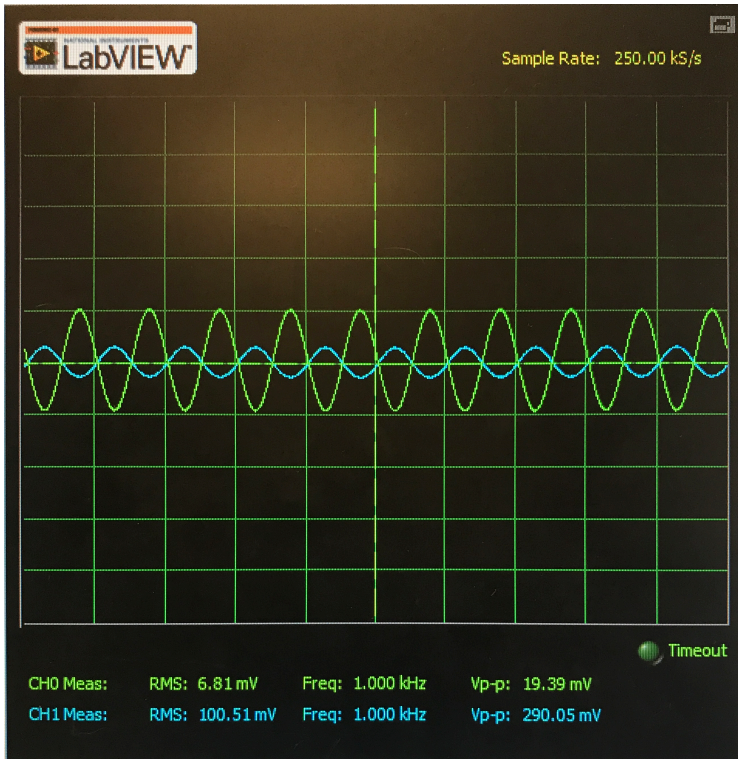

Figure 3: RL=10RC without Ce

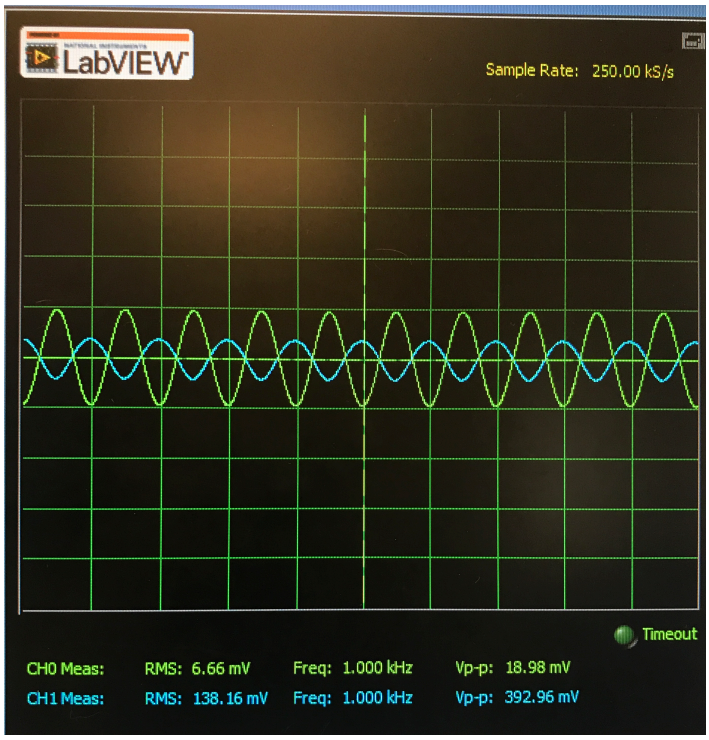

Figure 4: RL=0.1RC with Ce

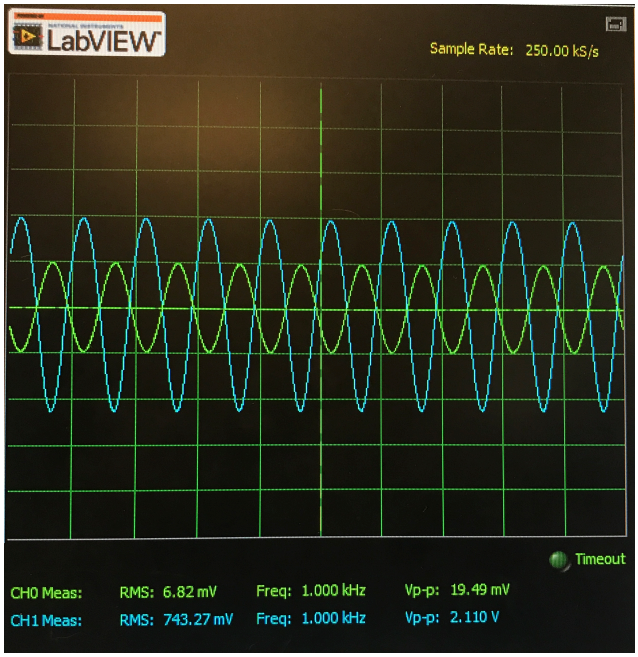

Figure 5: RL=RC with Ce

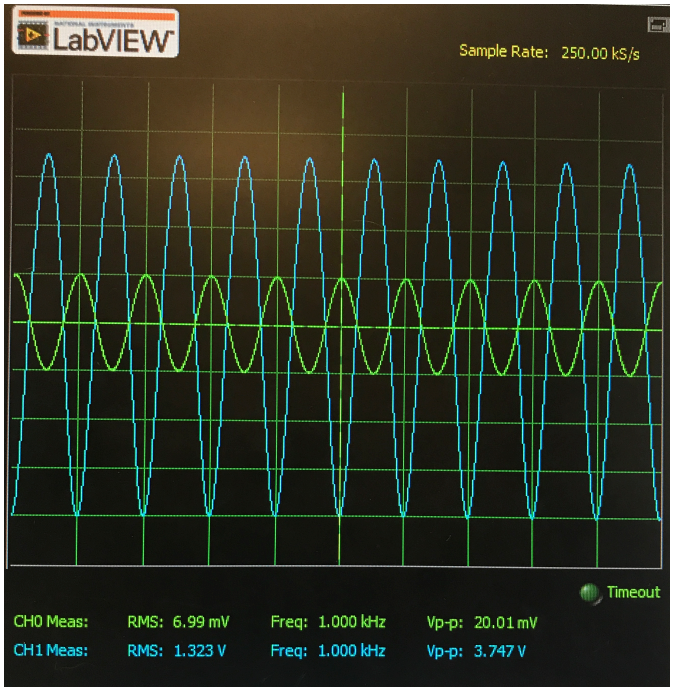

Figure 6: RL=10RC with Ce

Comparison of Table 8.1 and Experimental Results with Calculations and Simulations.

Calculated Design Specifications:

- $\beta = 205,\ V_{BE} = 0.68\ V$
- Emitter resistance has been calculated to be $R_E\ = 215.45\ \Omega \approx 220\ \Omega$
- $R_{ac} = 2585\ \Omega$ and $R_{dc} = 4935\ \Omega$
- $I_{CQ} = 1.330\ mA$ and $V_{CEQ} = 3.4375\ V$
- $h_{ie} = 4007.5\ \Omega$ and $h_{ib} = r_\pi = 19.55\ \Omega$
- $R_B = R_{Th} = 4817.5\ \Omega$
- $V_{BB} = V_{Th} = 1.024\ V$
- $R_2 = 5367\ \Omega$
- $R_1 = 47046\ \Omega$

Experimental Design Specifications:

- $\beta = 205,\ V_{BE} = 0.68\ V$
- Emitter resistance has been calculated to be $R_E\ = 220\ \Omega$
- $R_{ac} = 2585\ \Omega$ and $R_{dc} = 4935\ \Omega$
- $I_{CQ} = 1.3118\ mA$ and $V_{CEQ} = 3.435\ V$
- $h_{ie} = 4007.5\ \Omega$ and $h_{ib} = r_\pi = 19.55\ \Omega$
- $R_B = R_{Th} = 4682\ \Omega$
- $V_{BB} = V_{Th} = 1.024\ V$
- $R_2 = 5200\ \Omega$
- $R_1 = 47000\ \Omega$

Simulated Av values that would appear in Table 8.1:

Table 8.1 (Simulated): Voltage Gain Measurements w Vs=0.02Vpp			
RL	Vo-pp	Av with Ce	Av without Ce
0.1 Rc	0.034	19.8	1.7
Rc	0.192	103.4	9.6
10 Rc	0.328	175.6	16.4

The results in the table above show that the values are very similar to the experimental values in Table 8.1.

The differences in these values and the experimental values are almost nominal, however the sensitivity of the Q-point in our design is relatively sensitive, as the Q-point was pushed into saturation if a 5600 Ohm standard resistor is used instead of a 5200 Ohm standard resistor. When Vbe varies in my design, the Q-point has a relatively strong correlation with changes in Vbe. As seen in Table 8.1 and Table 8.1(Simulated), our experimental values of Av agree with our simulated values, which show that our experimental values are close to what would have been expected in the first place.