Pre-Lab 8:
BJT Amplifier Configuration

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ECEN 325 Section 514

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Calculation

Choose $V_{RE} = 1.1V$, $V_{CE,sat} \approx 0.35V$, $V_o = 1.2V$

$V_{cc} - V_o - V_{RE} - 0.35 \geq V_{RC} \geq V_o$

$5 - 1.2 - 1.1 - 0.35 \geq V_{RC} \geq 1.2 \Rightarrow 2.35V \geq V_{RC} \geq 1.2V$

$\Rightarrow V_{RC} = 2V$

Choose $\beta = 150$, $N = 20$, $R_i = 2.2K\Omega$

$$I_C \leq \frac{150}{2.2K} \frac{1}{\frac{20}{1.1+0.7} + \frac{20}{5-1.1-0.7} + \frac{25}{2}} = 2.28mA$$

$I_C = 1.3mA$

$$R_C = \frac{2V}{1.3mA} = 1.5\,K\Omega$$

$$R_E = \frac{1.1V}{1.3mA} = 846\,\Omega$$

$$R_{B1} = \frac{150(5-1.1-0.7)}{20 \cdot 1.3mA} = 18.46K\Omega$$

$$R_{B2} = \frac{150(1.1+0.7)}{20 \cdot 1.3mA} = 10.38\,K\Omega$$

$R_i = 18.46K \,||\, 10.38K \,||\, (150+1)(r_e + (846 \,||\, R_G))$ $\quad R_G = \frac{1.5K}{25} - r_e$

Choose $R_i = 2.2K\Omega$

$$2200 = \frac{6644.06\,(151)\left(r_e + \frac{846(60-r_e)}{846+60-r_e}\right)}{6644.06 + 151\left(r_e + \frac{846(60-r_e)}{846+60-r_e}\right)} = 1.003\times10^6\left(x + \right.$$

$r_e = -139.933, 221.716$ $\quad R_g = 199.933, -161.716$

② $R_{B1} = 18.46K\Omega$ $\quad R_E = 846$

$R_{B2} = 10.38K\Omega$

Find A_V, R_i, R_o

$$V_{RB2} = \frac{10.38K}{18.46K + 10.38K} \cdot 5 = 1.8V$$

$$V_{RE} = 1.8V - 0.7V = 1.1V$$

$$I_E = \frac{1.1V}{846} = 1.3mA$$

$$r_e = \frac{V_T}{I_E} = \frac{25mA}{1.3mA} = 19.2\Omega$$

$$R_o = \frac{846 \cdot 19.2}{846 + 19.2} = \boxed{18.77\Omega}$$

$$A_V = \frac{846}{19.2 + 846} = \boxed{0.978}$$

$$R_i = 18.46K \,||\, 10.38K \,||\, 151(19.2 + 846) = \boxed{6322.52\Omega}$$

③ Find A_V, R_i, R_o

$$R_o = \boxed{1.5K\Omega} = R_c$$

$$R_i = \frac{846 \cdot 19.2}{846 + 19.2} = \boxed{18.77\Omega}$$

$$A_V = \frac{1.5K}{19.2} = \boxed{78.125\Omega}$$

Simulation

(1)

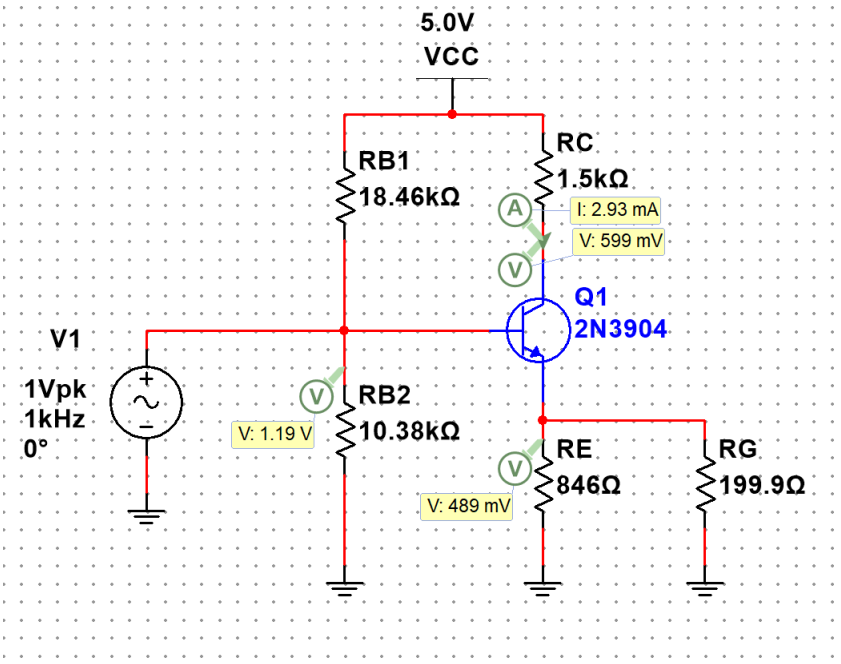

Figure 1: DC solution for Fig. 4(a)

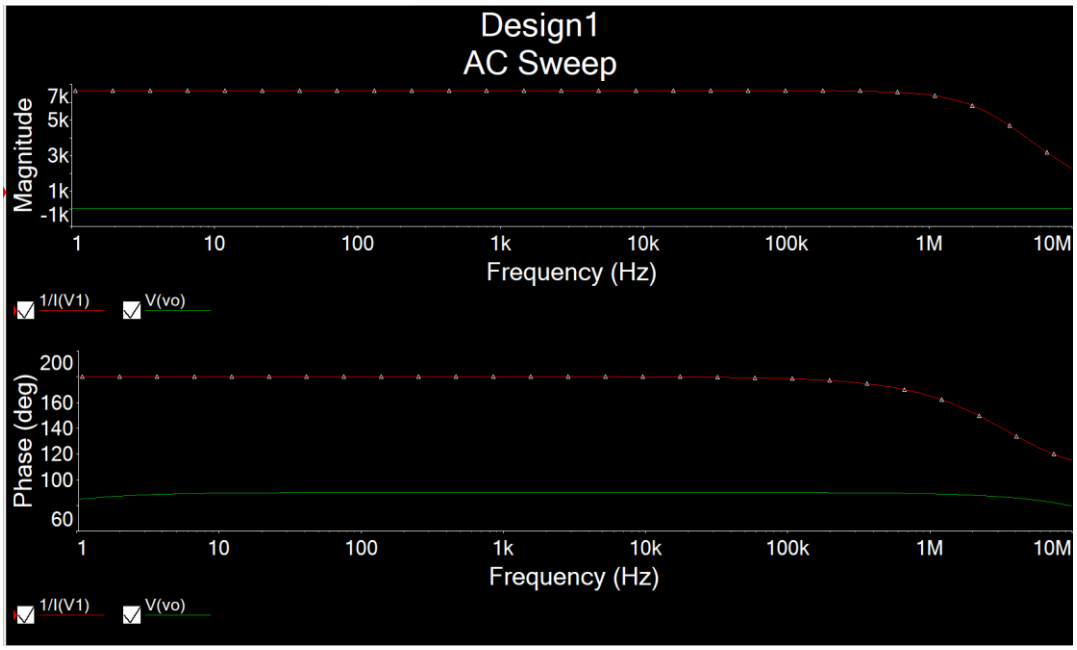

Figure 2: AC Simulation for Av, Ri and Ro for Fig. 4(a)

(Tried to find Av but couldn't appear on the graph)

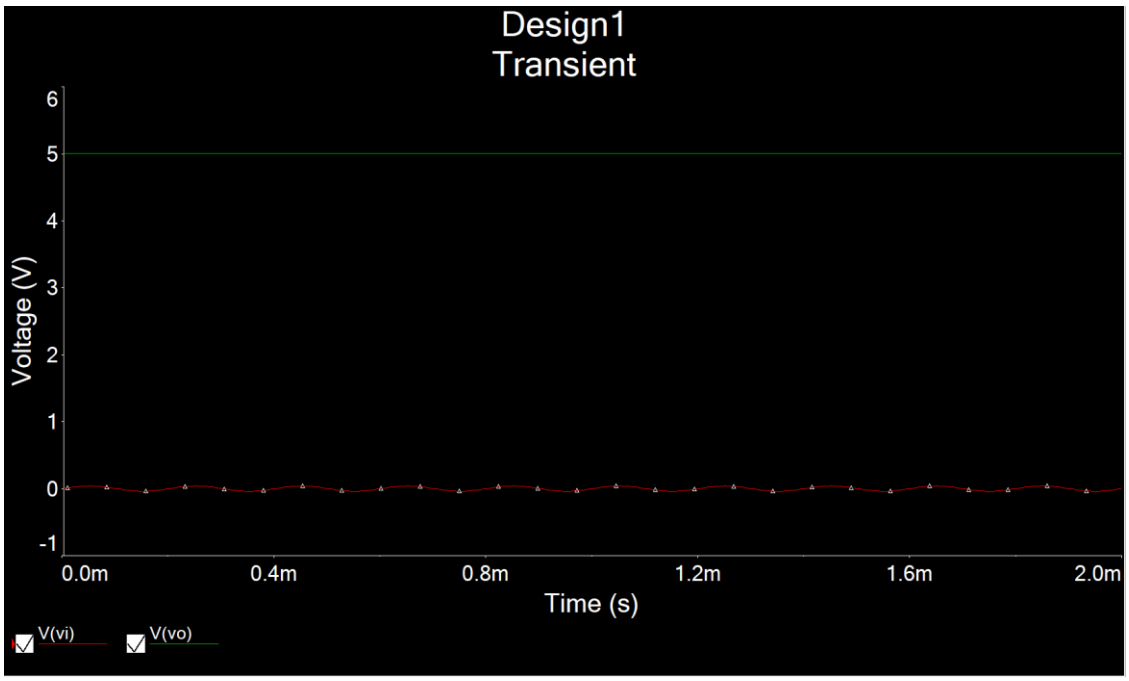

Figure 3: Time-domain Waveform for Fig. 4(a)

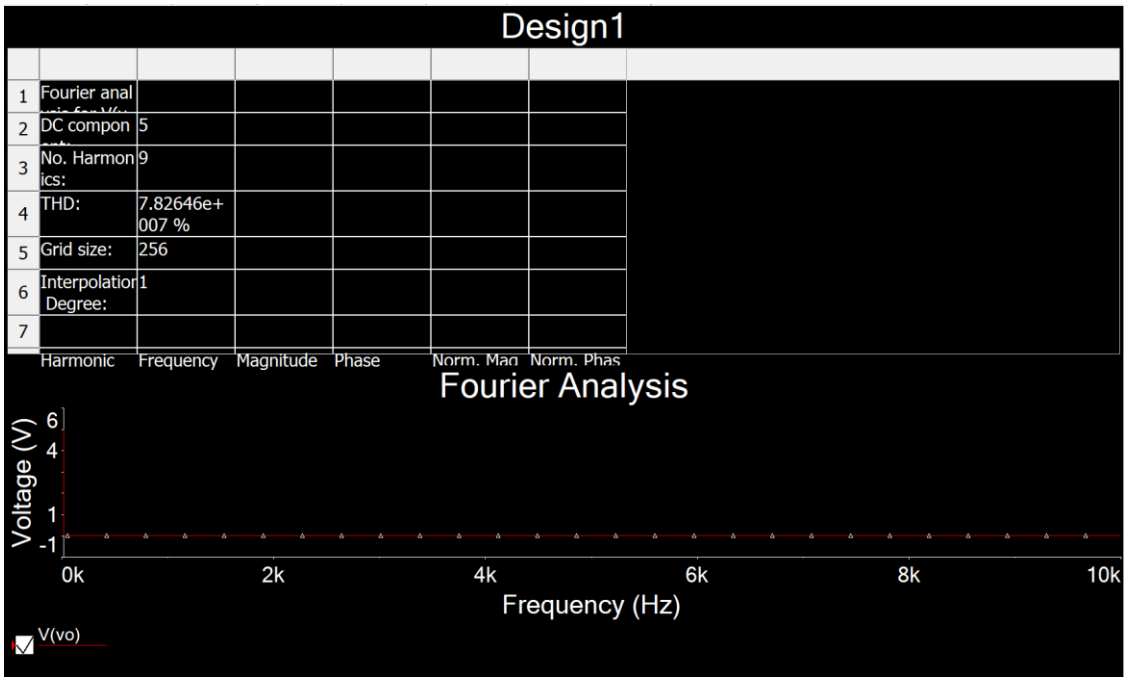

Figure 4: THD Waveform for Fig. 4(a)

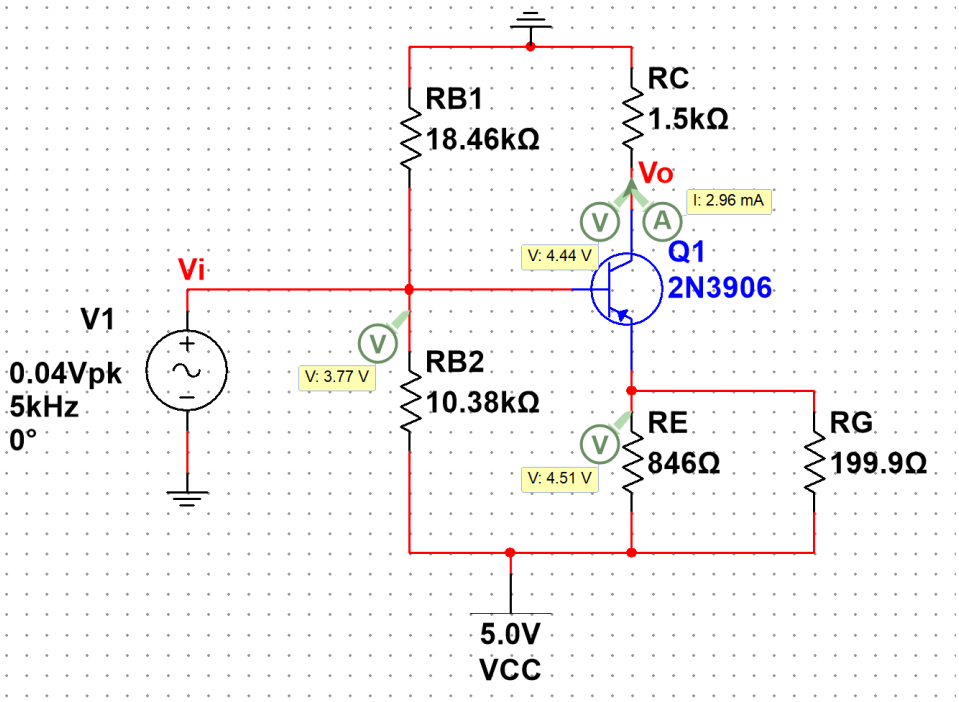

Figure 5: DC solution for Fig. 5(a)

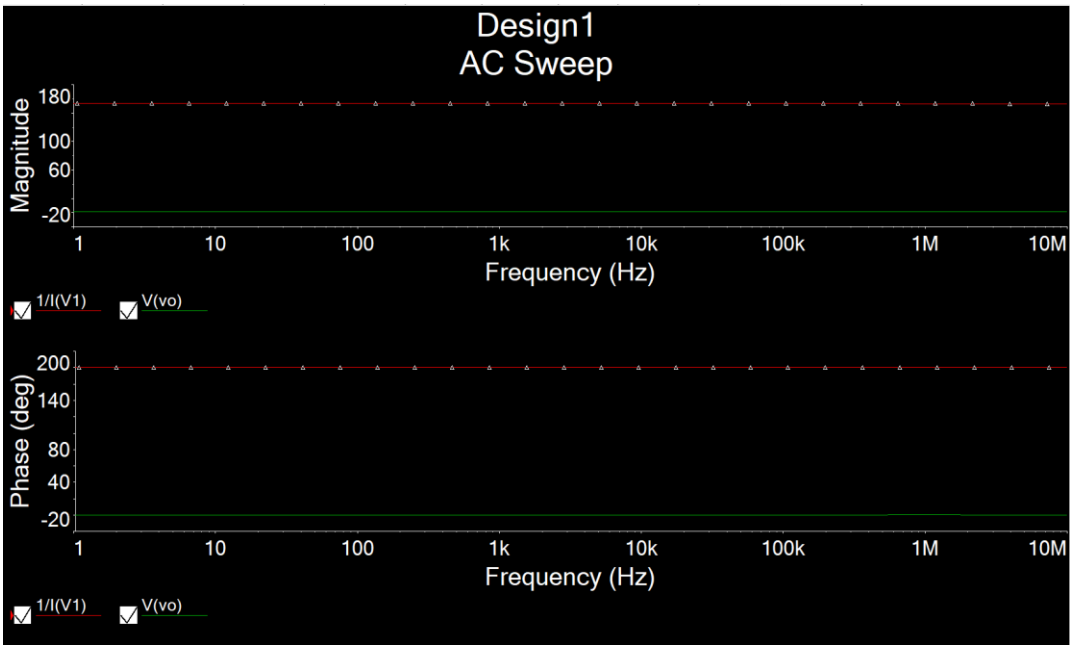

Figure 6: AC Simulation for Av, Ri and Ro for Fig. 5(a)

(Tried to find Av but couldn't appear on the graph)

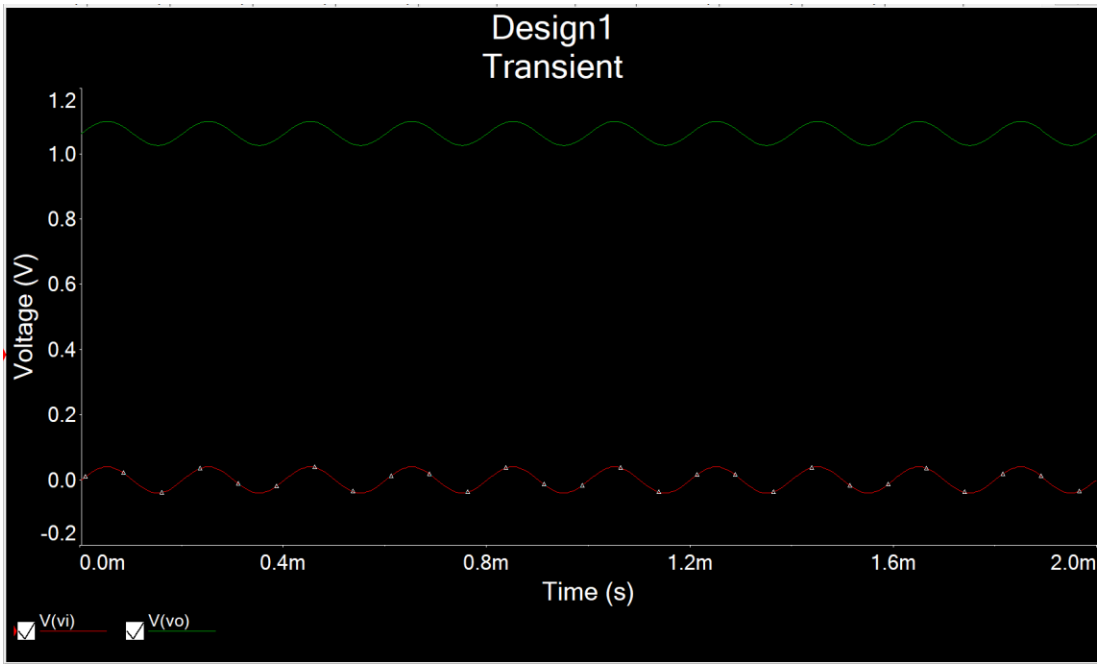

Figure 7: Time-domain Waveform for Fig. 5(a)

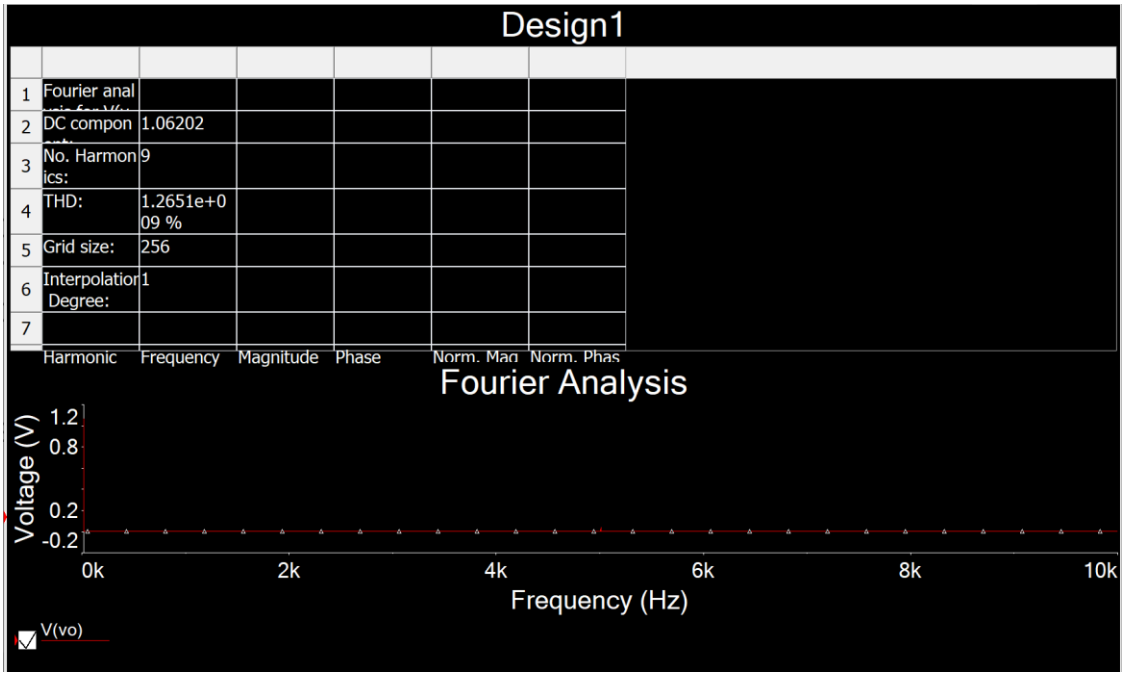

Figure 8: THD Waveform for Fig. 5(a)

(2)

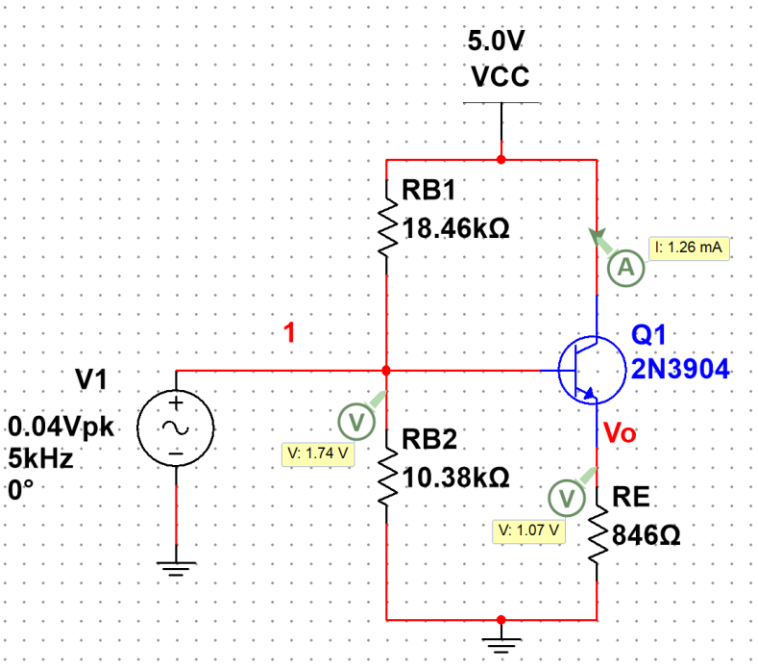

Figure 9: DC solution for Fig. 6(a)

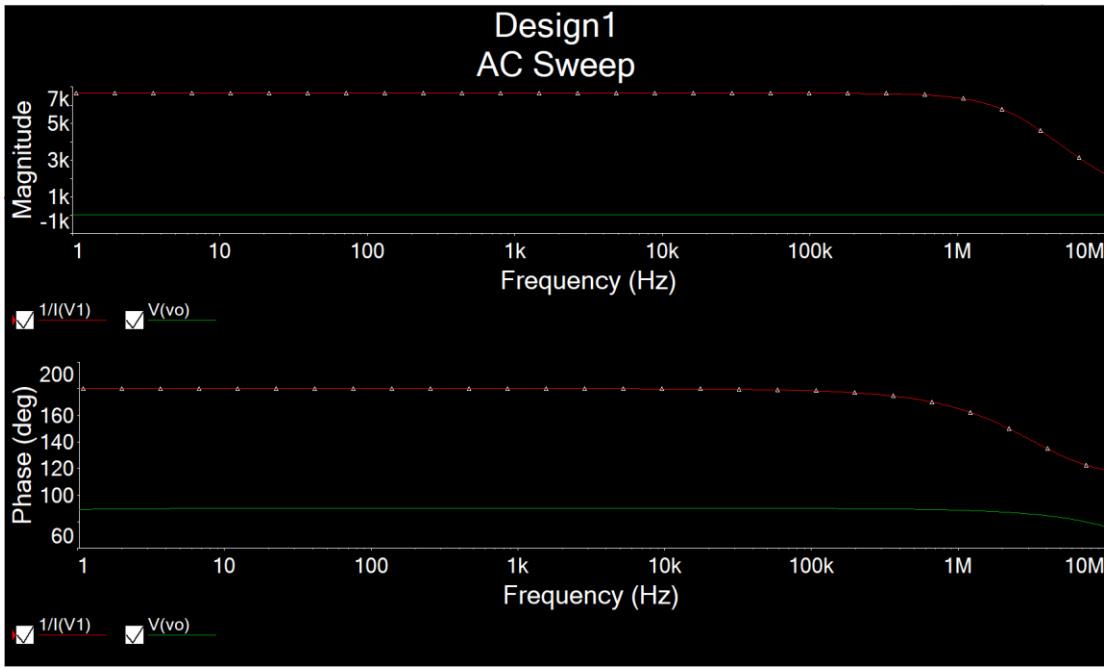

Figure 10: AC Simulation for Av, Ri and Ro for Fig. 6(a)

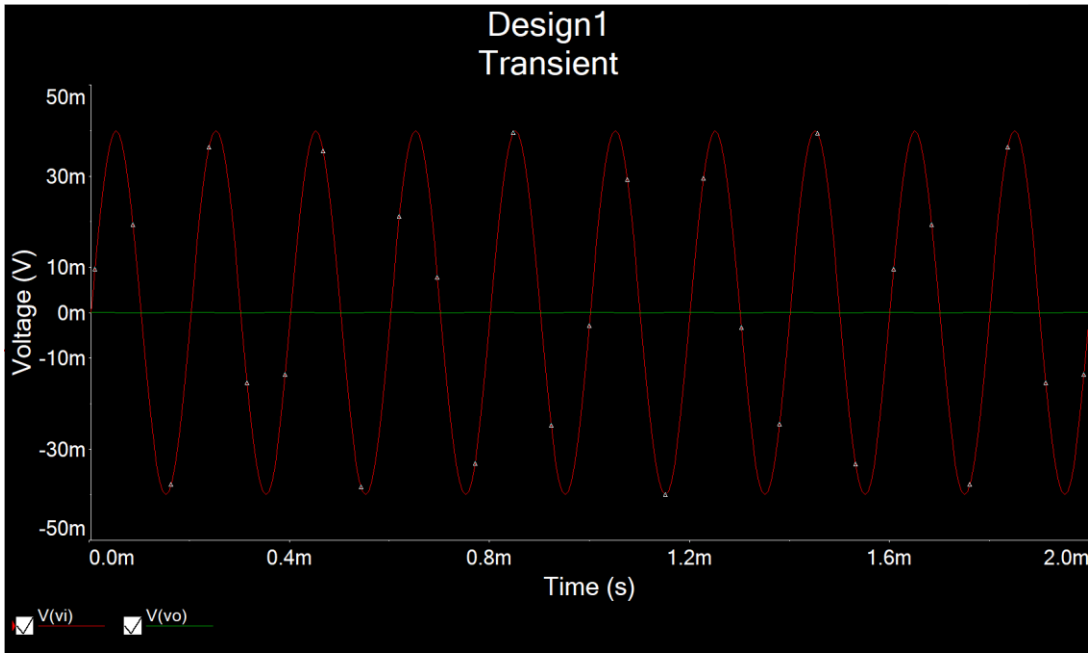

Figure 11: Time-domain Waveform for Fig. 6(a)

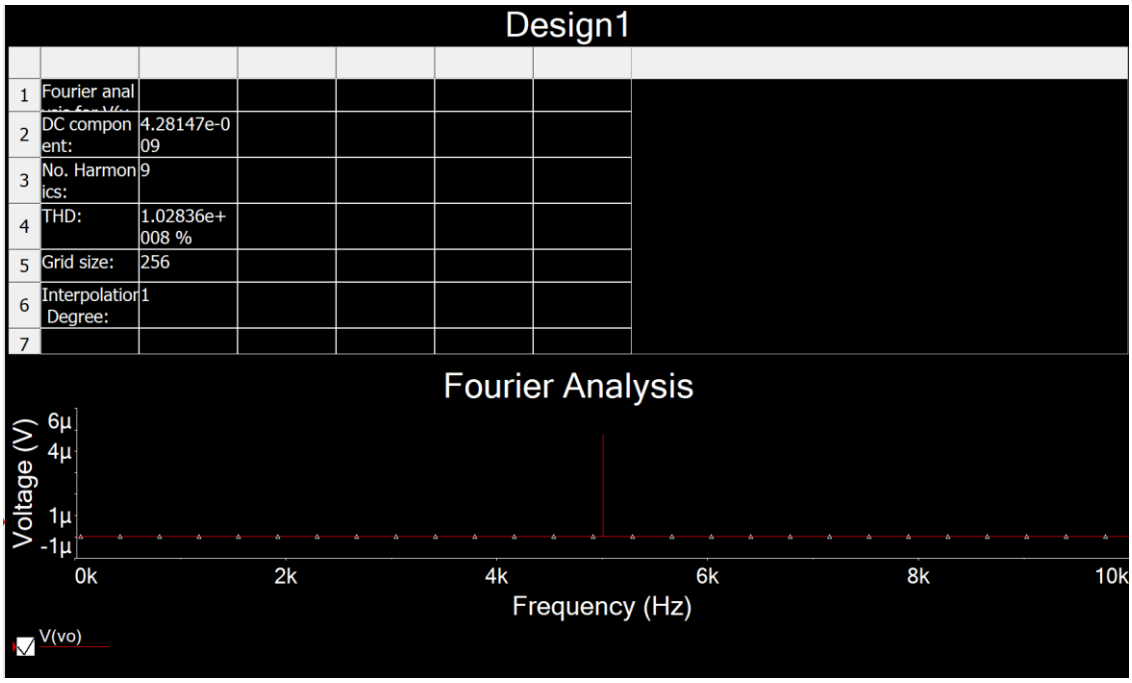

Figure 12: THD Waveform for Fig. 6(a)

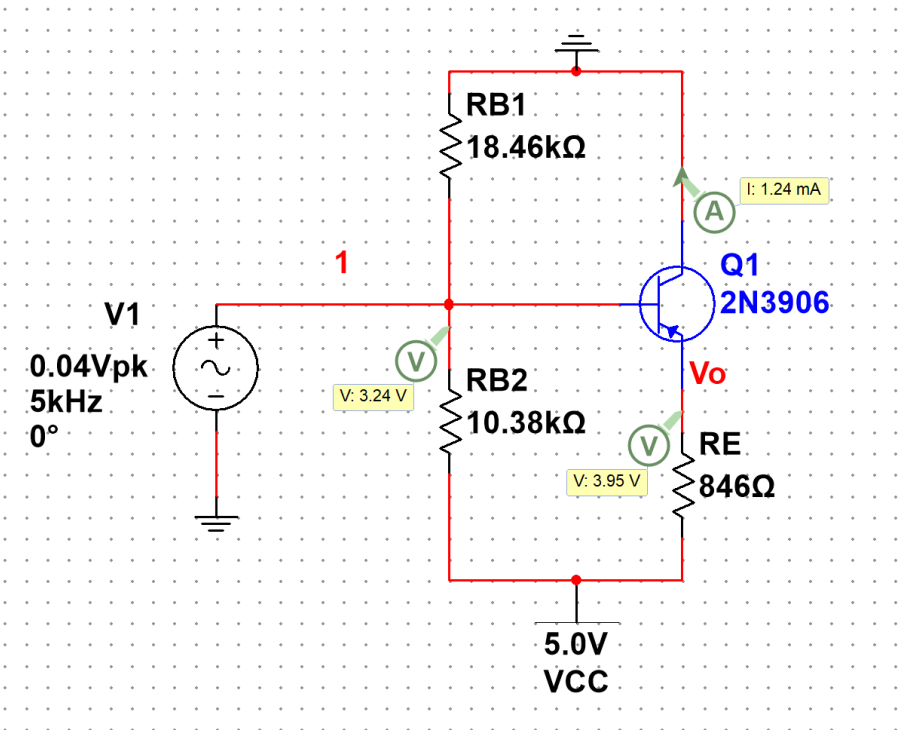

Figure 13: DC solution for Fig. 7(a)

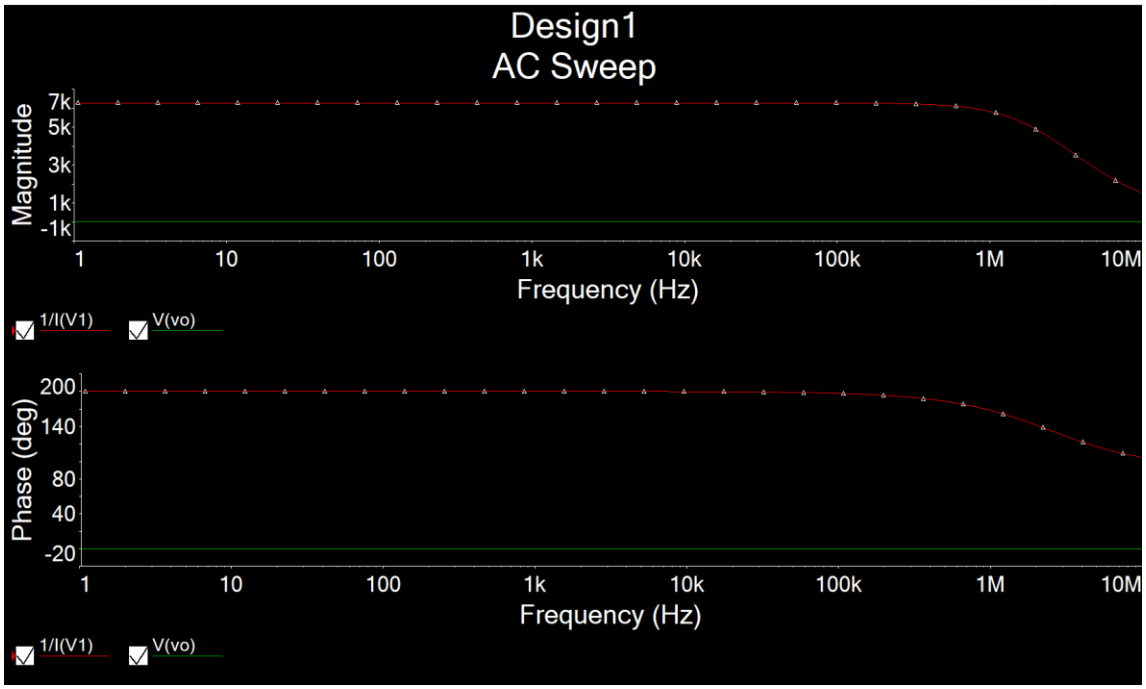

Figure 14: AC Simulation for Av, Ri and Ro for Fig. 7(a)

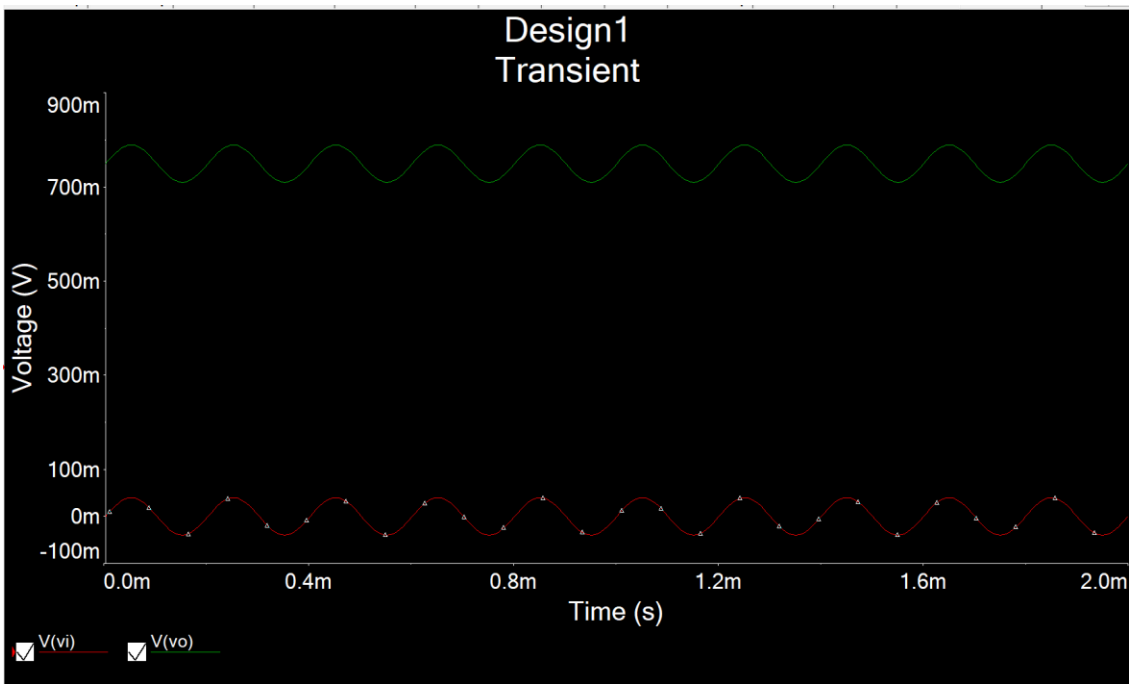

Figure 15: Time-domain Waveform for Fig. 7(a)

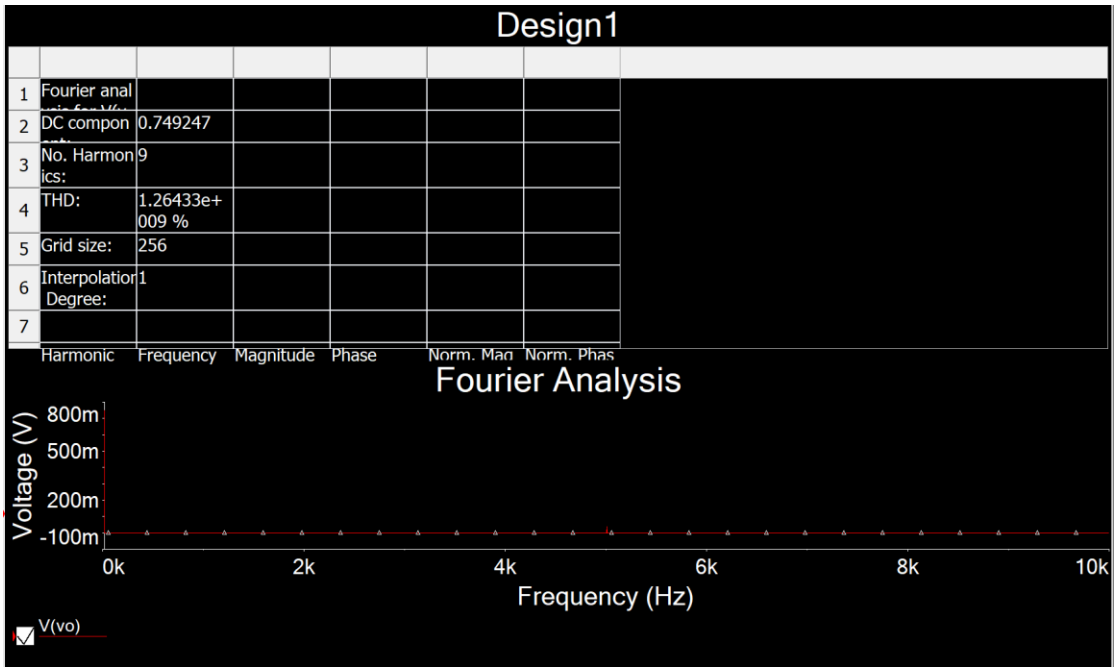

Figure 16: THD Waveform for Fig. 7(a)

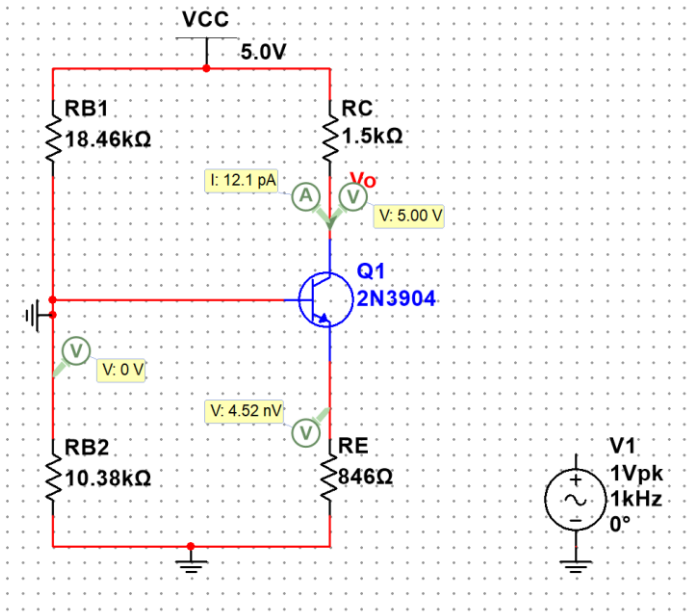

Figure 17: DC solution for Fig. 8(a)

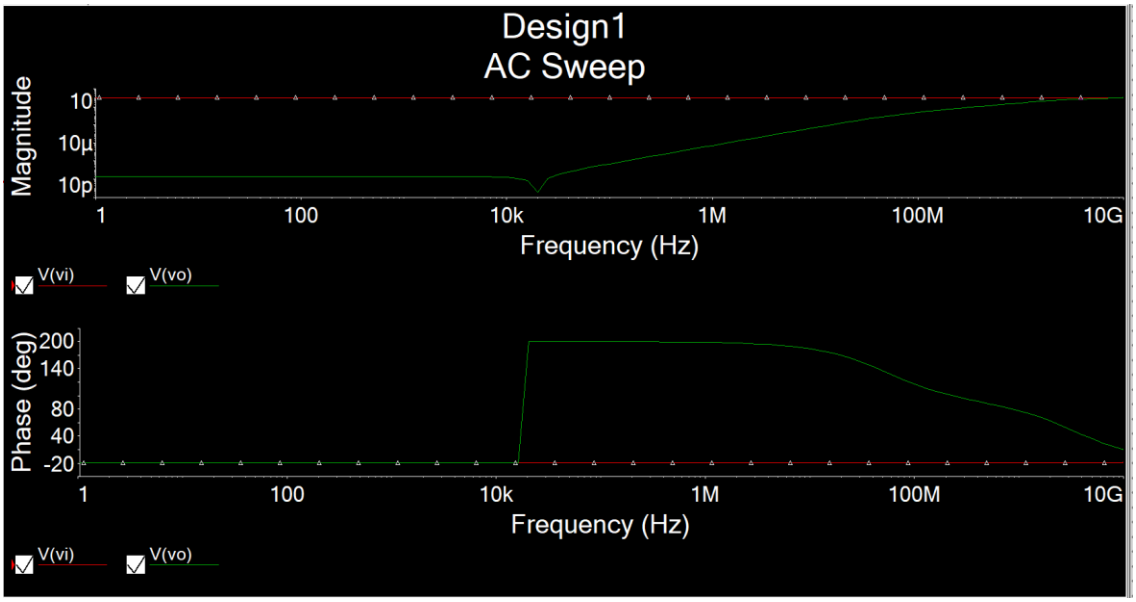

Figure 18: AC Simulation for Av, Ri and Ro for Fig. 8(a)

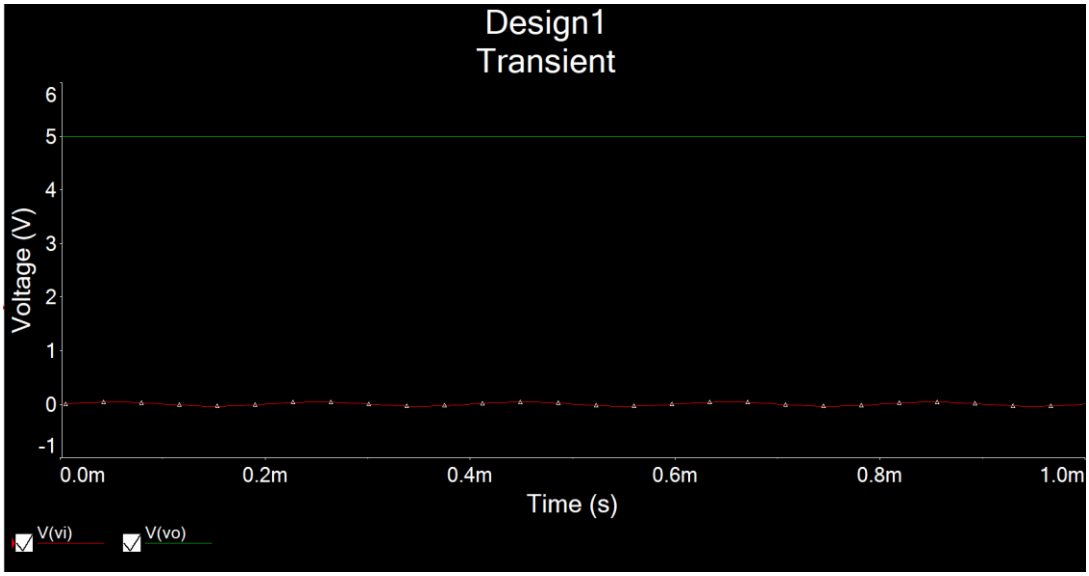

Figure 19: Time-domain Waveform for Fig. 8(a)

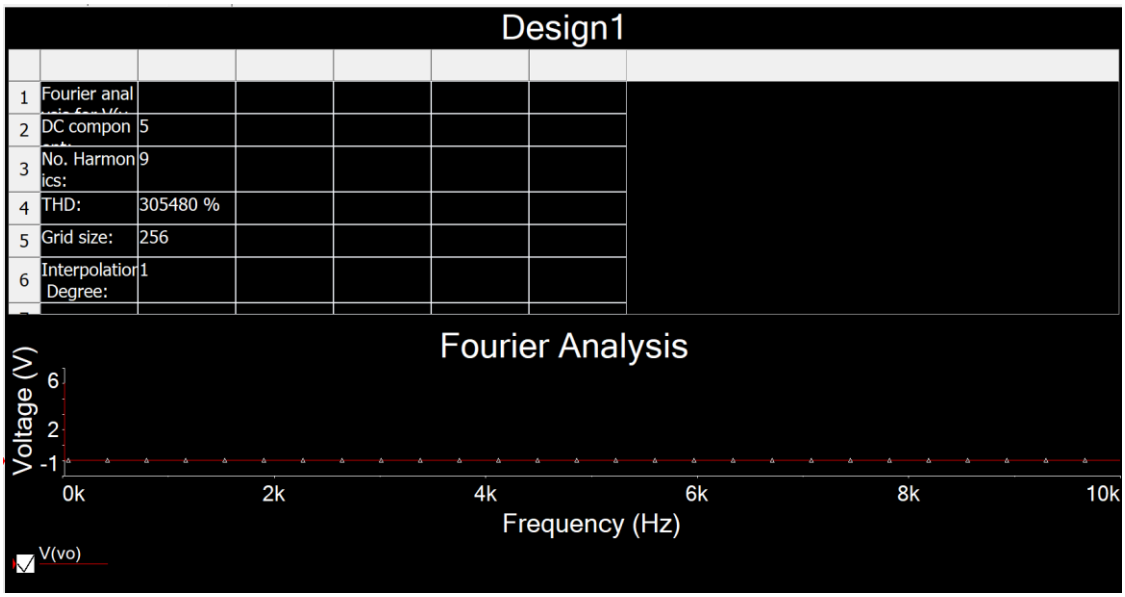

Figure 20: THD Waveform for Fig. 8(a)

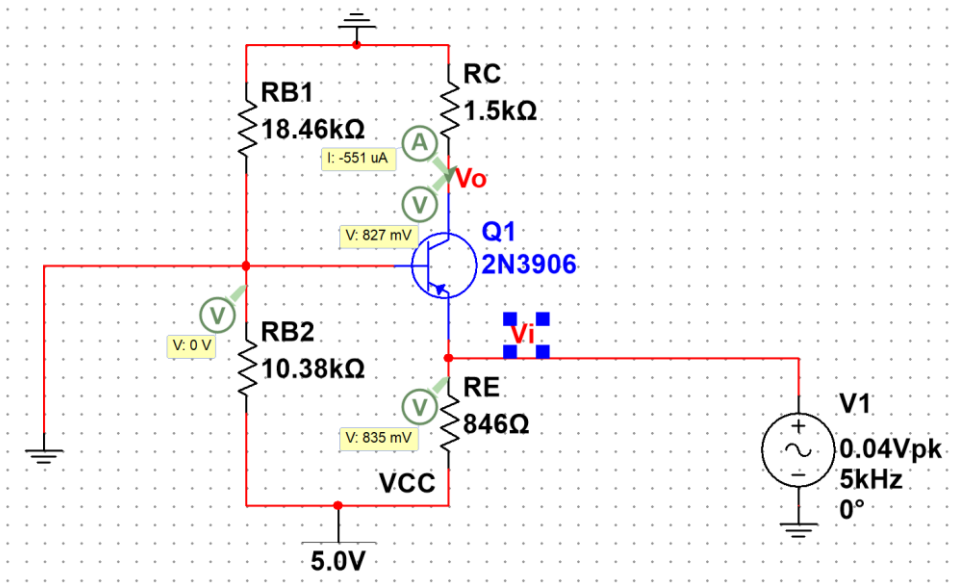

Figure 21: DC solution for Fig. 9(a)

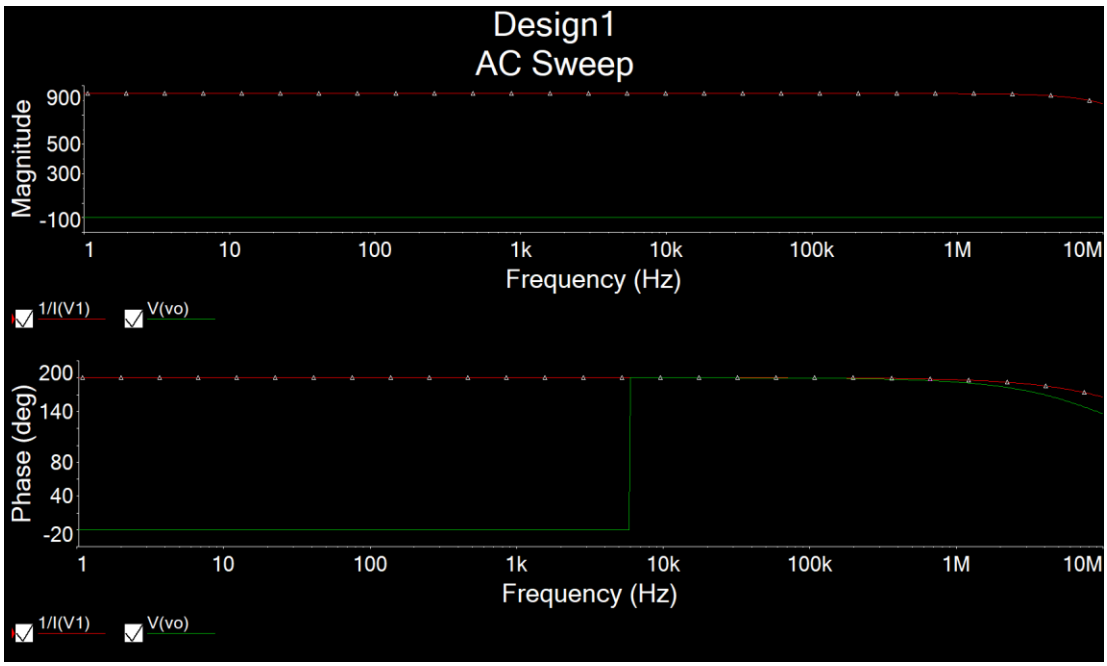

Figure 22: AC Simulation for Av, Ri and Ro for Fig. 9(a)

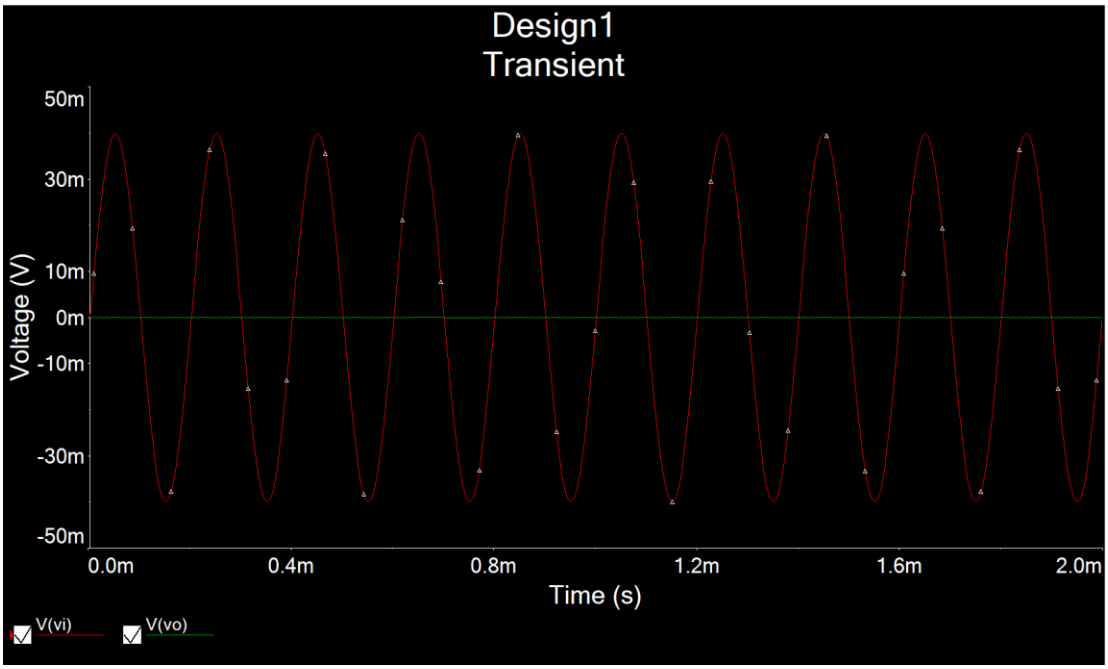

Figure 23: Time-domain Waveform for Fig. 9(a)

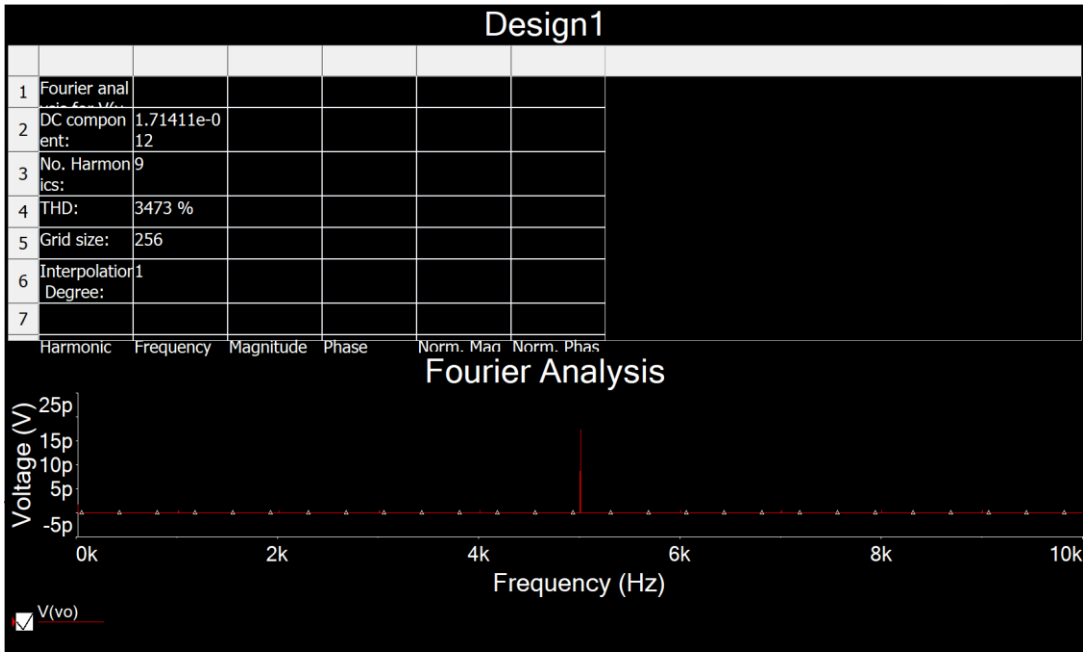

Figure 24: THD Waveform for Fig. 9(a)