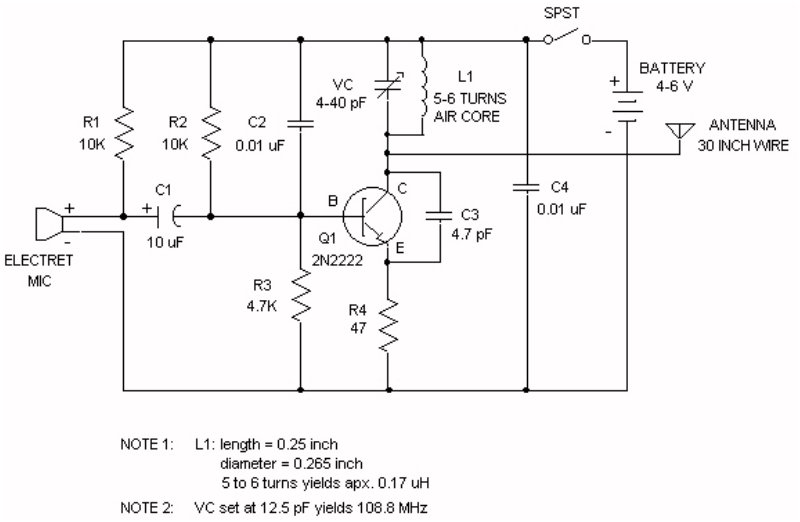
Appendix A: Transistor Analysis for the FM Transmitter

Reference: *The ARRL Handbook* 73rd Edition, 1996 ISBN 0-87259-173-5 pp. 8.24-8.25

The 2N2222A NPN transistor's maximum power $P_{\max}$ is 0.5 Watts. Power dictates transmission range and exceeding this maximum will overheat and destroy the transistor. Recall that power is calculated as

$$P = I_c V_{ce}$$

Here, I_c is the transistor collector current and V_{ce} is the transistor collector and emitter voltage.



In the schematic, the collector voltage V_c is the 6 Volt battery and is related to the emitter voltage V_e as

$$V_{ce} = V_c - V_e = 6 - V_e$$

Bipolar transistors like the 2N2222A have a 0.7 Volt difference between V_e and the base voltage V_b

$$V_b - V_e = 0.7 \text{Volts}$$

The schematic shows that V_b results from a voltage divider created by the two resistors R_2 and R_3. Calculating, one has

$$V_b = \frac{6R_3}{R_2+R_3} = \frac{6 \cdot 4.7\ k\Omega}{10+4.7\ k\Omega} = 1.92 \text{ Volts}$$

Consequently, the emitter voltage and emitter current become

$$V_e = 1.92 - 0.7 = 1.22 \text{ Volts}$$

$$I_e = \frac{V_e}{R_4} = \frac{1.22\ V}{47\ \Omega} = 25.96 \text{ mA}$$

From the schematic, the emitter and collector currents are approximately equal. As such the power now can be calculated. Since $V_{ce} = 6 - 1.22 = 4.78$ Volts the resulting power of the wireless transmitter is

$$P = I_c V_{ce} = 25.96\ mA\ \cdot 4.78\ V\ =\ 124\ mW$$