

Physics Assignment

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Problem Statement

A radio can tune over the frequency range of a portion of the MW broadcast band: (800 kHz to 1200 kHz). If its LC circuit has an effective inductance (L) and a variable capacitor with capacitance (C), what must be the range of C ?

Solution

To find the range of the variable capacitor (C) for a radio tuning over the frequency range of the MW broadcast band with an effective inductance (L), we can use the formula for the resonant frequency (f) of an LC circuit:

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

For this problem, we can rearrange the formula to solve for C :

$$C = \frac{1}{(2\pi f)^2 L}$$

Given the frequency range of 800 kHz to 1200 kHz, we can find the range of C by substituting these values into the formula:

$$C_1 = \frac{1}{(2\pi \times 800 \times 10^3)^2 \times L} \approx 198.1 \text{ pF}$$

$$C_2 = \frac{1}{(2\pi \times 1200 \times 10^3)^2 \times L} \approx 88.04 \text{ pF}$$

So, the variable capacitor should have a frequency range between 198.1pF and 88.04pF.

Table 1: Input Parameters given in the question

Symbol	Value	Description
L	$200\mu H$	Inductance of the circuit
f_{\min}	800 kHz	Minimum operating frequency
f_{\max}	1200 kHz	Maximum operating frequency
C_1	$\frac{1}{(2\pi \times 800 \times 10^3)^2 \times 200 \times 10^{-6}} \approx 198.1 \text{ pF}$	Maximum capacitance value
C_2	$\frac{1}{(2\pi \times 1200 \times 10^3)^2 \times 200 \times 10^{-6}} \approx 88.04 \text{ pF}$	Minimum capacitance value

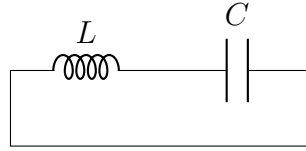


Figure 1: LC Circuit Diagram (Time Domain)

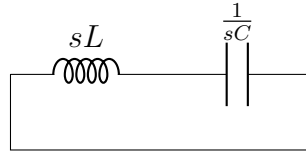


Figure 2: LC Circuit Diagram (s Domain)