Course: CPE435 - Prototyping Techniques

Group No: 5

Group Specification: 7VDC

Group Members

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DESIGN OF A TWO-STAGE CLASS A - CAPACITOR COUPLED RADIO FREQUENCY AMPLIFIER

① Design Assumptions

- Voltage Across terminal Collector V_{CE} must be half of the rail Voltage V_{cc}
- Voltage Across emitter V_E must be 10% of rail Voltage
  $V_E = 10\%$ of V_{cc}
- Voltage across the Collector resistor V_{RC} is 40% of rail Voltage

  $V_{RC} = 40\%$ of V_{cc}
- The Transistor is Biased in a linear region

② Component Calculations

(i) $V_{cc} = 7V$

(ii) $V_{CE} = 0.5 V_{cc} = 3.5 V$

$V_{CE1} = V_{CE2} = 3.5 V$

(iii) $V_{RC} = 0.4 V_{cc} = 0.4 \times 7 = \cancel{0.7V}$ $2.8 V$

(iv) $V_{RE1} = V_{RE2} = 0.1 V_{cc} = 0.7 V$,,

(v) $R_c = \frac{7 - 2.8}{10mA} = 0.42 k\Omega = \frac{V_{cc} - V_{RC}}{I_c}$

$I_c = 10mA$ $R_c = 0.42 k\Omega$,,

(vi) $R_E = \frac{V_E}{I_E} = \frac{V_E}{I_c + I_B} = ?$

$H_{FE} = 100$

$I_C = H_{FE} \times I_B$

$$I_B = \frac{10 \times 10^{-3}}{100} = 0.1 mA$$

$I_B = 0.1$

$$\therefore R_E = \frac{0.7}{(10+0.1) \times 10^{-3}} = 69.30\Omega$$

(vii) $V_{RB12} = V_{BE} + V_{BE1}$

V_{BE} (Silicon) $= 0.7V$

$V_{RB12} = 0.7 + 0.7 = 1.4V = V_{RB22}$

(viii) $I_{RB12} = I_{RB22} = 10 I_B = 10 \times 0.1 = 1 mA.$

(ix) $$R_{B12} = \frac{V_{RB12}}{I_{RB12}} = 1.4K\Omega$$

$R_{B22} = 1.4K\Omega$

(x) $V_{RB21} = V_{RB11} = 7 - 1.4 = 5.6V$

(xi) $I_{RB11} = I_B + I_{RB12}$

$= 0 + 0.1 + 1 = 1.1 mA$

(xii) $R_{B11} = R_{B21} = 5.6/1.1 = 5.09K\Omega$

(a) $C_{E1}, C_{E2}, C_{in}, C_{out}$

$$C_{E1} = \frac{1}{2\pi f X_C}$$

$$X_C = 1/2\pi f_C = R_E/10 = \frac{69.30}{10} = 6.930\,\Omega$$

$$f = 30 \times 10^6\ Hz$$

$$C_{E1} = \frac{1}{2\pi \times 30\times10^6 \times 6.930} = 0.765\,nF$$

$$C_{E1} = C_{E2} = 0.765\,nF$$

$$V_T = 26\,mV$$

$$r_e = V_T / I_C + I_B = \frac{26\times10^{-3}}{10.1\times10^{-3}} = 2.574\,\Omega$$

$$Z_{in} = (5.09\times10^3 \,//\, 1.4\times10^3 \,//\, 169.30) \times 100 \times 2.574$$

$$Z_{in} = 16.77\times10^3\,\Omega$$

$$C_{in1} = C_{in2} = \frac{1}{2\pi \times 30\times10^6 \times 16.77\times10^3}$$

$$C_{in1} = C_{in2} = 0.3163\,pF$$

$$C_{out} = \frac{1}{2\pi \times 30\times10^6 \times 0.42\times10^3} = 0.01263\,nF$$