

6-3

①

$$I_a = a I_c = (6 \times 40) = 240 \text{ A}$$

$$k_a = \frac{PZ}{2\pi a} = \frac{(6)(48)(4)}{2\pi(6)} = 30,56$$

$$E_a = k_a \phi_p \omega_m = (30,56)(20 \times 10^{-3})(2\pi 1200/60) = 76,8 \text{ V}$$

$$P_{dev} = E_a I_a = (76,8)(240) = 18,432 \text{ W}$$

②

$$I_a = a I_c = (2 \times 40) = 80 \text{ A}$$

$$k_a = \frac{PZ}{2\pi a} = \frac{(6)(48)(4)}{2\pi(2)} = 91,67$$

$$E_a = k_a \phi_p \omega_m = (91,67)(20 \times 10^{-3})(2\pi 1200/60) = 230,4 \text{ V}$$

$$P_{dev} = E_a I_a = (230,4)(80) = 18,432 \text{ W}$$

6-7

$$(a) \quad I_t = \frac{P}{V_t} = \frac{50,000}{240} = 208.33 \text{ A}$$

$$(b) \quad I_f = \frac{V_t}{R_f} = \frac{240}{120} = 2 \text{ A}$$

$$(c) \quad I_a = I_t + I_f = 208.33 + 2 = 210.33 \text{ A}$$

$$(d) \quad E_a = V_t + R_a I_a + V_{BD} = 240 + (0.1)(210.33) + 2 = 263 \text{ V}$$

6-9

$$(a) \quad I_a = \frac{E_a - V_t}{R_a + R_s} = \frac{255 - 240}{0.2 + 0.1} = 50 \text{ A}$$

$$I_f = \frac{V_t}{R_f} = \frac{240}{200} = 1.2 \text{ A}$$

$$I_t = I_a - I_f = 50 - 1.2 = 48.8 \text{ A}$$

$$P_{out} = V_t I_t = (240)(48.8) = 11,712 \text{ W}$$

$$(b) \quad \frac{V_f - E_a}{R_a} + \frac{V_f}{R_f} + \frac{V_f - V_t}{R_s} = 0$$

$$V_f \left( \frac{1}{R_a} + \frac{1}{R_f} + \frac{1}{R_s} \right) = \frac{E_a}{R_a} + \frac{V_t}{R_s}$$

$$V_f = \frac{(E_a/R_a) + (V_t/R_s)}{\frac{1}{R_a} + \frac{1}{R_f} + \frac{1}{R_s}} = \frac{(255/0.2) + (240/0.1)}{\frac{1}{0.200} + \frac{1}{200} + \frac{1}{0.10}} = \frac{3675}{15.005}$$

$$= 244.918 \text{ V}$$

$$I_t = \frac{V_f - V_t}{R_s} = \frac{244.918 - 240}{0.1} = 49.184 \text{ A}$$

$$P_{out} = V_t I_t = (240)(49.184) = 11,804 \text{ W}$$

## 6-13

(a)  $E_a = 15 \text{ V}$    (b)  $I_f = 0$

(b)  $R_{\text{critical}} = \frac{150 - 50}{0.3 - 0.1} = 500 \Omega$

(c)  $R_{\text{ft}} = \frac{V_t}{I_f} = \frac{250}{0.75} = 333.33 \Omega$

$$R_{\text{pr}} = R_{\text{ft}} - R_f = 333.33 - 125 = 208.33 \Omega$$

(d)  $I_f = \frac{V_t}{R_f} = \frac{250}{125} = 2 \text{ A} \Rightarrow E_a = 330 \text{ V}$

$$\frac{E_{a1}}{E_{a0}} = \frac{E_{a1}}{330} = \frac{K_a \phi (2\pi n_1 / 60)}{K_a \phi (2\pi n_0 / 60)} = \frac{n_1}{n_0} = \frac{1500}{1750}$$

$$E_{a1} = \left( \frac{1500}{1750} \right) (330) = 282.86 \text{ V}$$

(e)  $\frac{E_{a2}}{330} = \frac{200}{330} = \frac{n_2}{1750}$

$$n_2 = \left( \frac{200}{330} \right) (1750) = 1061 \text{ rpm}$$