



Lösungen

Thema: Elektrische Leistung – Seite 1

1. a) $R = \frac{U}{I} = \frac{12 \text{ V}}{6,25 \text{ A}} = 1,92 \Omega$ b) $P = U \cdot I = 12 \text{ V} \cdot 6,25 \text{ A} = 75 \text{ W}$

2. a) $I = \frac{P}{U} = \frac{40 \text{ W}}{230 \text{ V}} = 0,174 \text{ A};$ $R = \frac{U}{I} = \frac{230 \text{ V}}{0,174 \text{ A}} = 1320 \Omega$

b) $I = \frac{P}{U} = \frac{60 \text{ W}}{230 \text{ V}} = 0,261 \text{ A};$ $R = \frac{U}{I} = \frac{230 \text{ V}}{0,261 \text{ A}} = 881 \Omega$

c) $I = \frac{P}{U} = \frac{100 \text{ W}}{230 \text{ V}} = 0,435 \text{ A};$ $R = \frac{U}{I} = \frac{230 \text{ V}}{0,435 \text{ A}} = 529 \Omega$

3. $R = \frac{U^2}{P_{220}} = \frac{(220 \text{ V})^2}{1000 \Omega} = 48,4 \Omega; \quad P_{230} = \frac{(230 \text{ V})^2}{48,4 \Omega} = 1093 \text{ W}$

4. a) $P = I^2 \cdot R = (0,007 \text{ A})^2 \cdot 2150 \Omega = 0,105 \text{ W} = 105 \text{ mW}$
 b) $U = R \cdot I = 2150 \Omega \cdot 0,01 \text{ A} = 21,5 \text{ V}$

5. Wertetabellen für $I = \frac{P}{U}$:

$P = 1000 \text{ mW}:$

U in V	20	30	40	50	80
I in mA	50	33	25	20	12,5

$P = 500 \text{ mW}:$

U in V	10	15	20	25	40
I in mA	50	33	25	20	12,5

$P = 250 \text{ mW}:$

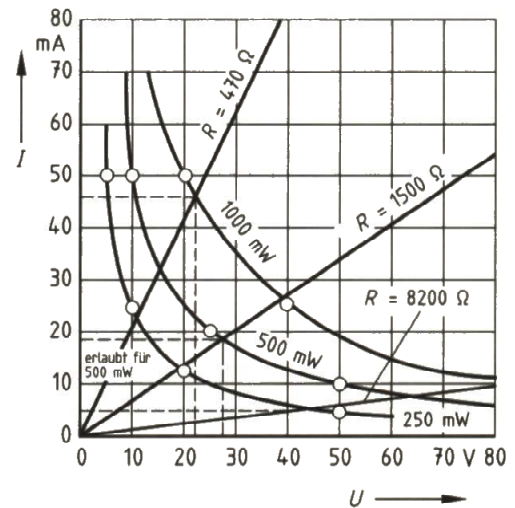
U in V	5	10	20	50
I in mA	50	25	12,5	5

Abgelesen aus Zeichnung für:

a) 500 mW und $R = 1,5 \text{ k}\Omega$: $U = 28 \text{ V}; I = 18 \text{ mA}$

b) 1000 mW und $R = 470 \Omega$: $U = 22 \text{ V}; I = 46 \text{ mA}$

c) 250 mW und $R = 8,2 \text{ k}\Omega$: $U = 45 \text{ V}; I = 5 \text{ mA}$



zu 63/5.

6. a) $U = U_2 = I_2 \cdot R_2 = 4 \text{ mA} \cdot 8,2 \text{ k}\Omega = 32,8 \text{ V}$

b) $I_3 = \frac{U}{R_3 + R_4} = \frac{32,8 \text{ V}}{10 \text{ k}\Omega + 1,5 \text{ k}\Omega} = 2,85 \text{ mA}$

c) $\frac{1}{R} = \frac{1}{5,6 \text{ k}\Omega} + \frac{1}{8,2 \text{ k}\Omega} + \frac{1}{11,5 \text{ k}\Omega} = 0,387 \frac{1}{\text{k}\Omega} \Rightarrow R = 2,58 \text{ k}\Omega$

$P = \frac{U^2}{R} = \frac{(32,8 \text{ V})^2}{2,58 \text{ k}\Omega} = 0,417 \text{ W} \approx 0,42 \text{ W}$

7. a) $U_2 = U_3 = I_2 \cdot R_2 = 9,9 \text{ mA} \cdot 270 \Omega = 2,67 \text{ V}$

$I_3 = \frac{U_3}{R_3} = \frac{2,67 \text{ V}}{150 \Omega} = 0,0178 \text{ A} = 17,8 \text{ mA}$

$I_4 = I_2 + I_3 = 9,9 \text{ mA} + 17,8 \text{ mA} = 27,7 \text{ mA}$

$U_4 = R_4 \cdot I_4 = 120 \Omega \cdot 27,7 \text{ mA} = 3,32 \text{ V}; \quad I_5 = \frac{U_5}{R_5} = \frac{U_2 + U_4}{R_5} = \frac{5,99 \text{ V}}{180 \Omega} = 33,3 \text{ mA}$

$I = I_1 = I_4 + I_5 = 27,7 \text{ mA} + 33,3 \text{ mA} = 61 \text{ mA}$

$U_1 = I_1 \cdot R_1 = 61 \text{ mA} \cdot 100 \Omega = 6,1 \text{ V}; \quad U = U_1 + U_5 = 6,1 \text{ V} + 6,00 \text{ V} = 12,1 \text{ V}$



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b) $P_1 = U_1 \cdot I_1 = 6,1 \text{ V} \cdot 61 \text{ mA} = 373 \text{ mW}$

$P_2 = 2,67 \text{ V} \cdot 9,9 \text{ mA} = 26,4 \text{ mW}; \quad P_3 = 2,67 \text{ V} \cdot 17,8 \text{ mA} = 47,5 \text{ mW}$

$P_4 = 3,32 \text{ V} \cdot 27,7 \text{ mA} = 92,0 \text{ mW}; \quad P_5 = 6,0 \text{ V} \cdot 33,1 \text{ mA} \approx 200 \text{ mW}$

c) Normwerte für R_1 : 0,5 W; R_2 : 0,05 W; R_3 : 0,05 W; R_4 : 0,125 W; R_5 : 0,25 W

8. a) $P = U \cdot I \Rightarrow I = \frac{P}{U} = \frac{700 \text{ W}}{230 \text{ V}} = 3,04 \text{ A}$

b) $R = \frac{U}{I} = \frac{230 \text{ V}}{3,04 \text{ A}} = 75,6 \Omega$

c) $U_{\text{unter}} = 230 \text{ V} \cdot 0,95 = 218,5 \text{ V}; \quad P = \frac{U^2}{R} = \frac{(218,5 \text{ V})^2}{75,6 \Omega} = 632 \text{ W}$

$P_{\%} = \frac{632 \text{ W} \cdot 100\%}{700 \text{ W}} = 90,3\% \Rightarrow \text{Er gibt } 100\% - 90,3\% = 9,7\% \text{ weniger Leistung ab.}$

9. a) $A = \frac{\pi \cdot d^2}{4} = \frac{\pi \cdot (0,5 \text{ mm})^2}{4} = 0,1963 \text{ mm}^2; \quad R = \frac{\rho \cdot l}{A} = \frac{1,45 \Omega \cdot \text{mm}^2 \cdot 20,5 \text{ m}}{\text{m} \cdot 0,1963 \text{ mm}^2} = 151,4 \Omega$

$P = \frac{U^2}{R} \Rightarrow U = \sqrt{R \cdot P} = \sqrt{151,4 \Omega \cdot 2000 \text{ W}} = 550 \text{ V}; \quad \text{b) } I = \frac{U}{R} = \frac{550 \text{ V}}{151,4 \Omega} = 3,63 \text{ A}$

10. a) $P = \frac{U^2}{R}; \quad U = \sqrt{P \cdot R} = \sqrt{5 \text{ W} \cdot 47 \Omega} = \sqrt{235 \text{ V}} = 15,3 \text{ V}; \quad I = \sqrt{\frac{P}{R}} = \sqrt{\frac{5 \text{ W}}{47 \Omega}} = 330 \text{ mA}$

b) $U = \sqrt{1 \text{ W} \cdot 330 \Omega} = \sqrt{330 \text{ V}} = 18,2 \text{ V}; \quad I = \sqrt{\frac{1 \text{ W}}{330 \Omega}} = 55 \text{ mA}$

c) $U = \sqrt{0,125 \text{ W} \cdot 15000 \Omega} = \sqrt{1875 \text{ V}} = 43,3 \text{ V}; \quad I = \sqrt{\frac{0,125 \text{ W}}{15 \text{ k}\Omega}} = 2,83 \text{ mA}$

d) $U = \sqrt{0,125 \text{ W} \cdot 0,1 \text{ M}\Omega} = \sqrt{0,0125 \text{ kV}} = 0,112 \text{ kV} = 112 \text{ V}; \quad I = \sqrt{\frac{0,125 \text{ W}}{100 \text{ k}\Omega}} = 1,12 \text{ mA}$

e) $U = \sqrt{0,5 \text{ W} \cdot 4,7 \text{ M}\Omega} = \sqrt{2,35 \text{ kV}} = 1,53 \text{ kV} = 1530 \text{ V}; \quad I = \sqrt{\frac{0,5 \text{ W}}{4,7 \text{ M}\Omega}} = 0,326 \text{ mA}$

f) $U = \sqrt{0,25 \text{ W} \cdot 5600 \Omega} = \sqrt{1400 \text{ V}} = 37,4 \text{ V}; \quad I = \sqrt{\frac{0,25 \text{ W}}{5 \text{ k}\Omega}} = 6,68 \text{ mA}$

11. a) R_1 und R_2 in Reihe an 400 V: $P = 18 \text{ kW}$

b) $R_1 + R_2 = \frac{U^2}{P} = \frac{(400 \text{ V})^2}{18000 \text{ W}} = 8,89 \Omega$

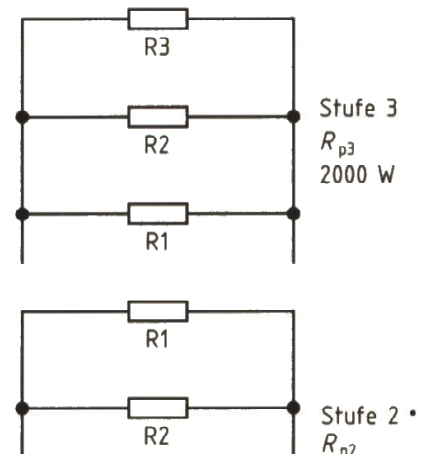
R_1 allein an 400 V: $P = 18 \text{ kW} \cdot 1,25 = 22,5 \text{ kW}$

$R_1 = \frac{(400 \text{ V})^2}{22500 \text{ W}} = 7,11 \Omega; \quad R_2 = 8,89 \Omega - 7,11 \Omega = 1,78 \Omega$

$R_1 + R_2 + R_3$ an 400 V: $P = 18 \text{ kW} \cdot 0,85 = 15,3 \text{ kW};$

$R_1 + R_2 + R_3 = \frac{(400 \text{ V})^2}{15300 \text{ W}} = 10,46 \Omega$

$R_3 = 10,46 \Omega - 8,89 \Omega = 1,57 \Omega$



zu 12.



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12. a) Stufe 3: $I = \frac{P}{U} = \frac{2000 \text{ W}}{230 \text{ V}} = 8,70 \text{ A}$

Stufe 1●: $I = \frac{P}{U} = \frac{450 \text{ W}}{230 \text{ V}} = 1,96 \text{ A}$

Stufe 1: $I = \frac{P}{U} = \frac{305 \text{ W}}{230 \text{ V}} = 1,33 \text{ A}$

Widerstände:

Stufe 3: $R_{p3} = \frac{U^2}{P} = \frac{(230 \text{ V})^2}{2000 \text{ W}} = 26,5 \Omega$

Stufe 1●: $R_2 = \frac{U^2}{P} = \frac{(230 \text{ V})^2}{450 \text{ W}} = 118 \Omega$

Stufe 1: $R_{1+2} = \frac{U^2}{P} = \frac{(230 \text{ V})^2}{305 \text{ W}} = 173 \Omega$

$R_1 = R_{1+2} - R_2 = 173 \Omega - 118 \Omega = 55 \Omega$

$\frac{1}{R_3} = \frac{1}{R_{p3}} - \frac{1}{R_1} - \frac{1}{R_2} = \frac{1}{26,5 \Omega} - \frac{1}{55 \Omega} - \frac{1}{118 \Omega} = 0,01108 \frac{1}{\Omega}; R_3 = 90,3 \Omega$

Stufe ●: $R_{1+2+3} = R_1 + R_2 + R_3 = 55 \Omega + 118 \Omega + 90,3 \Omega = 263,3 \Omega$

$I = \frac{U}{R_{1+2+3}} = \frac{230 \text{ V}}{263,3 \Omega} = 0,874 \text{ A}$

Stufe 2: $I = \frac{U}{R_1} = \frac{230 \text{ V}}{55 \Omega} = 4,18 \text{ A}$

Stufe 2●: $R_{p2} = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{55 \Omega \cdot 118 \Omega}{55 \Omega + 118 \Omega} = 37,5 \Omega; I = \frac{U}{R} = \frac{230 \text{ V}}{37,5 \Omega} = 6,13 \text{ A}$

$I_{\bullet} = 0,874 \text{ A}; I_1 = 1,33 \text{ A}; I_{1\bullet} = 1,96 \text{ A}; I_2 = 4,18 \text{ A}; I_{2\bullet} = 6,13 \text{ A}; I_3 = 9,09 \text{ A}$

b) Stufe ●: $P = U \cdot I_{\bullet} = 230 \text{ V} \cdot 0,874 \text{ A} = 201 \text{ W}$

Stufe 2: $P = 230 \text{ V} \cdot 4,18 \text{ A} = 961 \text{ W}$

Stufe 2●: $P = 230 \text{ V} \cdot 6,13 \text{ A} = 1410 \text{ W}$

