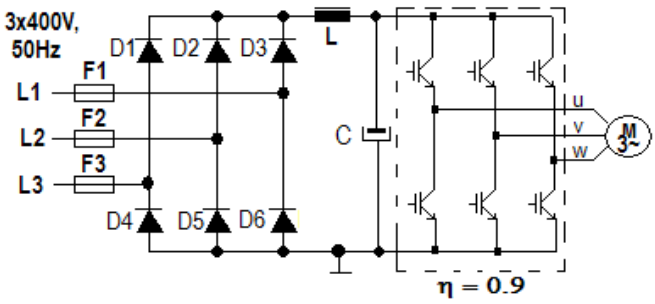
VISER- Master studije(elektrotehničko inženjerstvo)
REŠENJA ZADATAKA: Prvi kolokvijum iz predmeta PEEP 2018/2019 od 12.12.2018

1. ZADATAK: Trofazni AC/AC pretvarač na Slici 1 se koristi za frekventnu regulaciju elektromotora čiji su podaci: 380V, 50Hz, 175A, 1485 ob/min, η =92%, $cos\varphi$ = 0.85. Stepen iskorišćenja trofaznog tranzistorskog pretvarača je η_p =90%. Za ulazni ispravljač su na raspolaganju diodni moduli SKKD100 čiji su tehnički podaci dati u Prilogu 1.



Slika 1- Trofazni AC/AC pretvarač

(a) Projektovati LC filtar u DC međukolu ako je zahtevana talasnost DC napona ≤ 1% i talasnost DC struje ≤ 20% .
(b)Izračunati presek magnetnog kola prigušnice ako je širina vazdušnog procepa 3mm.
(c) Projektovati sistem hlađenja diodnog ispravljača za temperaturni opseg okoline -25ºC...+40ºC, ako se pretpostavi da su svi moduli montirani na istom hladnjaku. Na raspolaganju je hladnjak tipa P3 i ventilator SKF-3-230-1 čiji su tehnički podaci dati u Prilogu 2. Za tako izabrani sistem hlađenja odrediti temperaturu na kućištu modula i temperaturu hladnjaka.
(d) Izvršiti izbor ulaznih osigurača ako su na raspolaganju osigurači dati u Tabeli 1.

Tabela 1

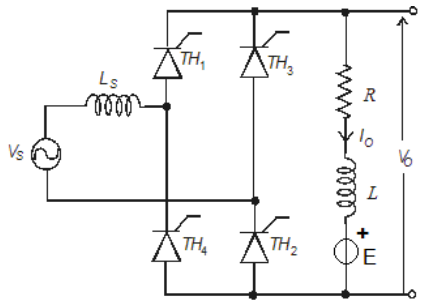
Osigurač	I^2t (A^2s)	I (A)	AC napon (V)	Vrsta prema brzini
Tip 1	8500	160	690	ultra brzi
Tip 2	2300	160	400	standardni
Tip 3	15500	200	690	ultrabrzi
Tip 4	10000	200	690	standardni
Tip 5	8000	200	440	standardni
Tip 6	30000	250	690	ultrabrzi
Tip 7	62000	315	690	ultrabrzi
Tip 8	2000	125	690	ultrabrzi

2. ZADATAK

Nacrtati električnu šemu monofaznog punotalasnog ispravljača sa C filtrom, koji je opterećen aktivnim opterećenjem. U zadatku je poznato: mrežni napon napajanja je 230V±10%, 50Hz. Opseg promene opterećenja, odnosno otpornosti na izlazu ispravljača 500Ω > R ≥ 5Ω. Podaci o korišćenim diodama su Vto=1V, rd=5mΩ.
(a) Proračunati vrednost kapacitivnosti filtarskog kondenzatora C tako da pri maksimalnom opterećenju na izlazu ispravljača, talasnost jednosmernog izlaznog napona bude manja od 5%. Za ovako izračunate vrednosti kapacitivnosti odrediti jednosmernu vrednost i talasnost izlaznog napona pri maksimalnom i minimalnom opterećenju.
(b) Kolika je maksimalna struja početnog punjenja kondenzatora C. Pretpostaviti da je za izabrani kondenzator ESR=50mΩ. Predložiti način za ograničenje struje početnnog punjenja na vrednost 30A.
(c) Izračunati efektivnu vrednost struje kondenzatora C i proceniti disipacione gubitke na njemu pri maksimalnom opterećenju na izlazu.

3. ZADATAK

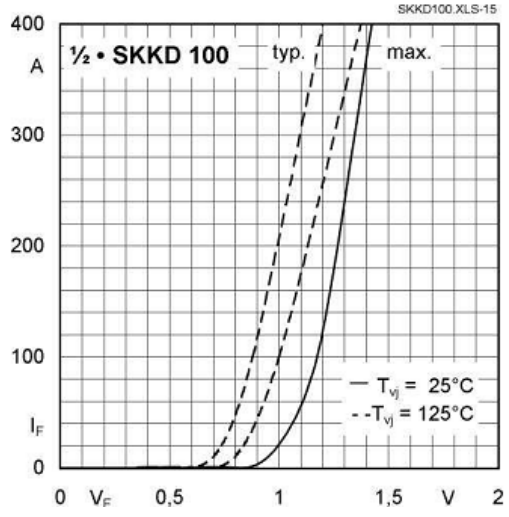
Za punoupravljivi tiristorski ispravljač za punjnje baterije napona E prikazan na slici je poznato: mrežni napon $v_s(t)=310\cdot\sin(100\pi t)$, R=0.1Ω, L_s=300μH, $L\rightarrow\infty$, E=110VDC. Ugao upravljanja tiristora se menja u opsegu 0º≤α<170º. Struja punjeja se održava na vrednosti Io=50A. Temperaturni opseg rada ispravljača 0ºC ...+45ºC.



Slika 2- Tiristorski punjač baterije

(a) Svi tiristori se montiraju na isti hladnjak. Termičke otpornosti tiristora iznose $R_{thj\text{-}c}$=0.18K/W, $R_{thc\text{-}s}$=0.1K/W. Električni parametri tiristora su Vto=1.2V, r_d=2mΩ. Maksimalna dozvoljena temperatura na Si spoju tiristora je 125ºC. Potrebno je odrediti termičku otpornost hladnjaka na koji su montirani tiristori.
(b) Za projektovani hlanjak odrediti temperature na kućištu tiristora i na površini hladnjaka

PRILOG 1-Karakteristike dioda

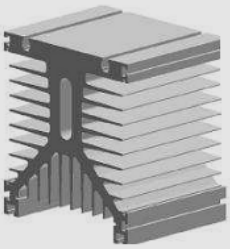


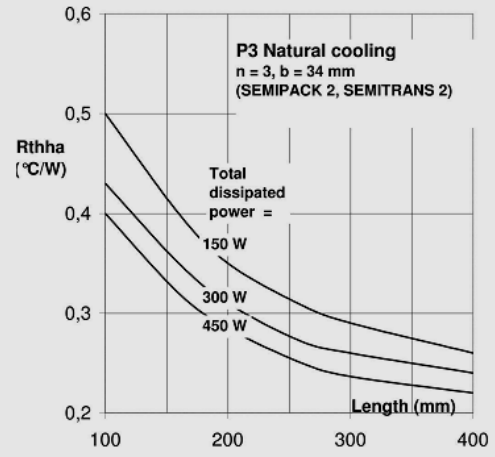
V_{RSM} V	V_{RRM} V	I_{FRMS} = 175 A (maximum value for continuous operation) I_{FAV} = 100 A (sin. 180; T_c = 85 °C)		
500	400	SKKD 100/04		
900	800	SKKD 100/08		
1300	1200	SKKD 100/12		
1500	1400	SKKD 100/14		
1700	1600	SKKD 100/16		
1900	1800	SKKD 100/18		

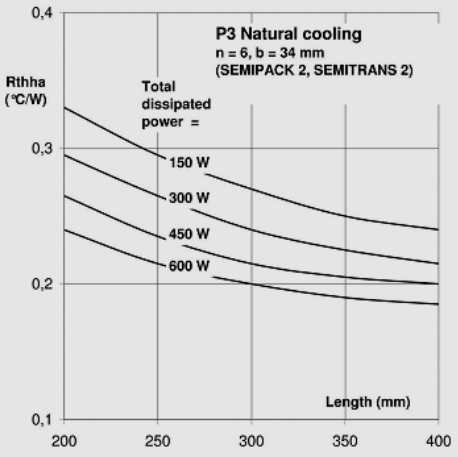
Symbol	Conditions	Values	Units
I_{FAV}	sin. 180; T_c = 85 (100) °C	100 (67)	A
I_D	P3/180; T_a = 45 °C; B2 / B6	73 / 91	A
	P3/180F; T_a = 35 °C; B2 / B6	150 / 190	A
I_{FSM}	T_{vj} = 25 °C; 10 ms	2500	A
	T_{vj} = 125 °C; 10 ms	2000	A
i^2t	T_{vj} = 25 °C; 8,3 ... 10 ms	31250	A^2s
	T_{vj} = 125 °C; 8,3 ... 10 ms	20000	A^2s
$R_{th(j-c)}$	per diode / per module	0,35 / 0,175	K/W
$R_{th(c-s)}$	per diode / per module	0,2 / 0,1	K/W
T_{vj}		- 40 ... + 125	°C
T_{stg}		- 40 ... + 125	°C

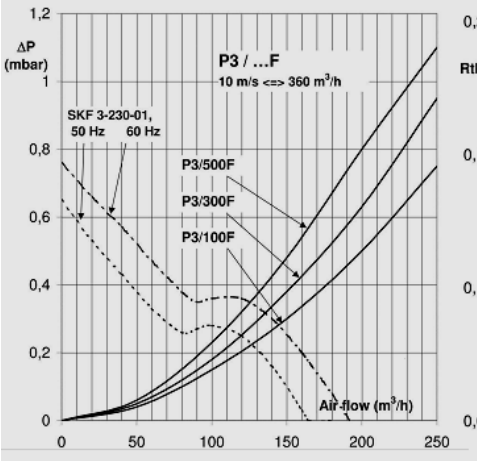
PRILOG 2- Karakteristike hladnjaka i ventilatora

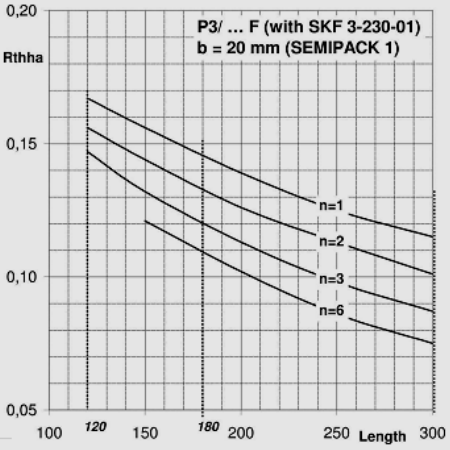
Standard lengths	n	b / d Ø mm	R_{thha} natural cooling K/W	R_{thha} with Fan SKF 3-230-01 K/W	w kg
P 3/120	1	20	0,55 (100W)	0,167	2,1
	3		0,43 (150W)	0,147	
P 3/180	2	20	0,39 (150W)	0,132	3,1
	3		0,36 (180W)	0,12	
	6		0,33 (200W)	0,108	
	1	34		0,144	
	3			0,118	
P 3/300	3	34		0,0847	5,3

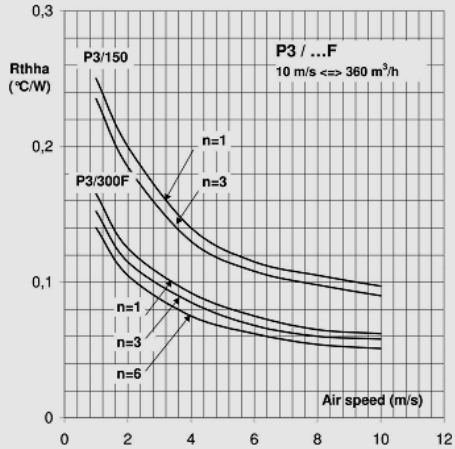




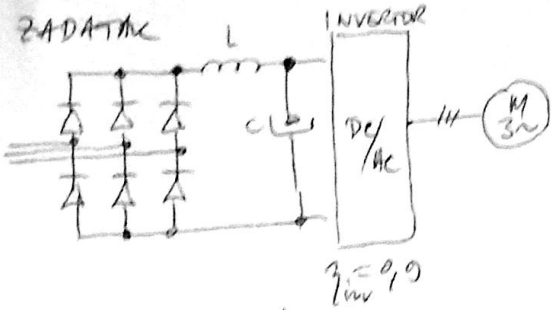








1 ZADATAK



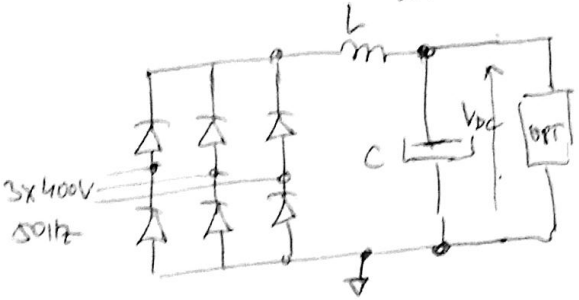
$\eta_{inv} = 0,9$

$P_{MOT} = P_{elMOT} \cdot \eta$

$P_{elMOT} = \sqrt{3} \cdot U_n \cdot I_n \cos\varphi_n$

$P_{elMOT} = \sqrt{3} \cdot 380 \cdot 175 \cdot 0,85 = 97,78\ kW$

$P_{ul\,inv} = \frac{P_{elMOT}}{\eta_{inv}} = \frac{97,78}{0,9} = 108,6\ kW$



$P_{opt} = 108,6\ kW$

$V_{DC} = \frac{3V_m}{\pi}$

$V_m = 400\sqrt{2}$

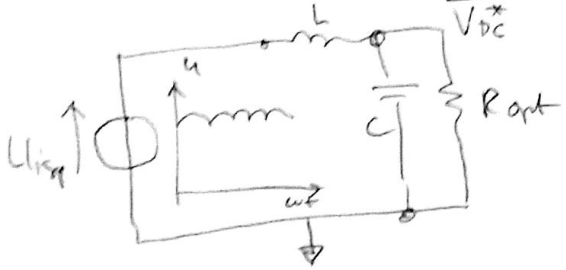
$V_{DC} = \frac{3 \cdot 400\sqrt{2}}{\pi} = 538,8V$

a) $2 \times 1,2V = 2,4V$ DC napon

Ako se uzme pad napona na diodama

$V_{DC}^* = 538,8 - 2,4 = 536,4V$

$R_{opt} = \frac{V_{DC}^*}{I_{DC}} = \frac{V_{DC}^*}{\frac{P_{opt}}{V_{DC}^*}} = \frac{V_{DC}^{*2}}{P_{opt}} = \frac{536,4^2 V}{108,6\ kW} = 2,65\Omega$

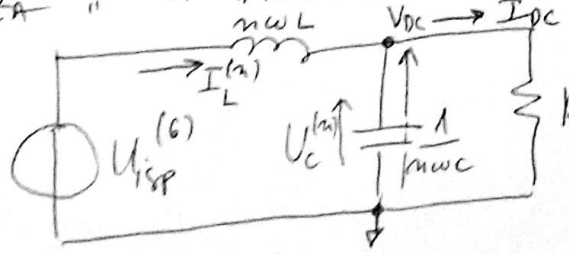


$U_{isp} = \frac{3V_m}{\pi} + \frac{6V_m}{35\pi}\cos 6\omega t - \frac{6V_m}{143\pi}\cos 12\omega t - \ldots$

$U_{isp} \approx V_{DC} + \frac{6V_m}{35\pi}\cos 6\omega t$

$V_{DC} = \frac{3V_m}{\pi}$ $\quad U_m^{(6)} = \frac{6V_m}{35\pi}$

Za "n" ti harmonik vrijedi:



$I_L^{(n)} = \frac{U_{isp}^{(n)}}{X_e^{(n)}} = \frac{U_{isp}^{(n)}}{n\omega L - \frac{1}{n\omega C}}$

$U_C^{(n)} = \frac{\frac{1}{n\omega C}}{n\omega L - \frac{1}{n\omega C}} \cdot U_{isp}^{(n)}$

$I_{Lm}^{(n)} = \frac{U_{isp\,m}^{(n)}}{X_{ekv}^{(n)}} \Rightarrow I_{Lm}^{(6)} = \frac{U_{isp\,m}^{(6)}}{X_{ekv}^{(6)}} = \frac{U_{isp\,m}^{(6)}}{n\omega L - \frac{1}{n\omega C}}$

$$\boxed{I_{Lm}^{(6)} = \frac{n\omega C}{n\omega^2 LC - 1} \cdot U_{isp\,m}^{(6)}}$$

$$\boxed{U_{Cm}^{(6)} = \frac{U_{isp\,m}^{(6)}}{n\omega^2 LC - 1}}$$

$V_{DC} = \frac{3V_m}{\pi}$ $\quad I_{DC} = \frac{3V_m}{\pi R}$ $\quad \Delta I_L^{(n)} = 2 I_{Lm}^{(n)}$

$\Delta I_L^{(n)} = \frac{2 \cdot n\omega C}{(n\omega)^2 LC - 1} \cdot U_{ispm}^{(n)}$ $\quad \Delta I_L^{(6)} = \frac{2 \cdot 6 \cdot \omega C}{(6\omega)^2 LC - 1}$

$$\boxed{\frac{\Delta I_L^{(n)}}{I_{DC}} = \frac{2U_{ispm}^{(n)} \cdot n\omega C}{(n\omega)^2 LC - 1} \cdot \frac{1}{\frac{3V_m}{\pi R}}}$$

$$\boxed{\frac{\Delta I_L^{(n)}}{I_{DC}} = \frac{2\pi R \cdot U_{ispm}^{(n)}}{3V_m} \cdot \frac{n\omega C}{(n\omega)^2 LC - 1}}$$ $\quad \frac{\Delta I_L^{(6)}}{I_{DC}} \le \delta_i$

$$\Delta U_C^{(n)} = 2U_{iscm}^{(n)} = \frac{2U_{ispm}^{(n)}}{(n\omega)^2 LC - 1}$$

$$\frac{\Delta V_C^{(n)}}{V_{DC}} = \frac{2U_{ispm}^{(n)}}{(n\omega)^2 LC - 1} \cdot \frac{1}{\frac{3V_m}{\pi}} = \frac{2\pi}{3V_m} \cdot \frac{U_{ispm}^{(n)}}{(n\omega)^2 LC - 1}$$

$$\boxed{\frac{\Delta V_C^{(n)}}{V_{DC}} = \frac{2\pi}{3V_m} \cdot \frac{U_{ispm}^{(n)}}{(n\omega)^2 LC - 1}} \le \delta_u$$

$$\frac{\delta_i}{\delta_u} = n\omega CR \Rightarrow C \ge \frac{1}{n\omega R} \cdot \frac{\delta_i}{\delta_u}$$

$$C \ge \frac{1}{n\omega R \cdot \left(\frac{\delta_u}{\delta_i}\right)}$$

$\delta_u \le 1\%$

$\delta_i \le 20\%$

$R_{ot} = R = 2{,}65\,\Omega$

$$C \ge \frac{1}{6 \cdot 314 \cdot 2{,}65 \cdot \frac{1}{20}} = 4005{,}93\,\mu F$$

usvojit ćemo $C^* = 4700\,\mu F$ za napon 800 V DC

[illegible]

$$L_{kr} = \frac{R}{105 \cdot \omega} = \frac{7{,}65}{105 \cdot 314} = 0{,}08\,mH$$

[illegible] $L \geq L_{kr}$

$$\frac{\Delta I_L^{(6)}}{I_{DC}} = U_{[illegible]}^{(6)} \cdot \frac{6\omega C^*}{(6\omega)^2 LC^* - 1} = \frac{2\pi R}{314} \cdot \frac{314}{35\pi} \cdot \frac{6\omega C^*}{(6\omega)^2 LC^* - 1} \leq 0{,}2$$

$$\frac{\Delta I_L^{(6)}}{I_{DC}} = \frac{4R}{35} \cdot \frac{6\omega C^*}{(6\omega)^2 LC^* - 1} \leq 0{,}2$$

$$(6\omega)^2 LC^* - 1 \geq \frac{4R}{35} \cdot \frac{6\omega C^*}{0{,}2} \Rightarrow LC^* \geq \left[\frac{4R}{35} \cdot \frac{6\omega C^*}{0{,}2} + 1\right] / (6\omega)^2$$

$$L \geq \frac{1}{(6\omega)^2 \cdot C^*} \cdot \left[\frac{4R}{35} \frac{6\omega C^*}{0{,}2} + 1\right]$$

$$L \geq \frac{4R}{35} \frac{6\omega C^*}{(6\omega)^2 \cdot C^*} \cdot \frac{1}{0{,}2} + \frac{1}{(6\omega)^2 C^*}$$

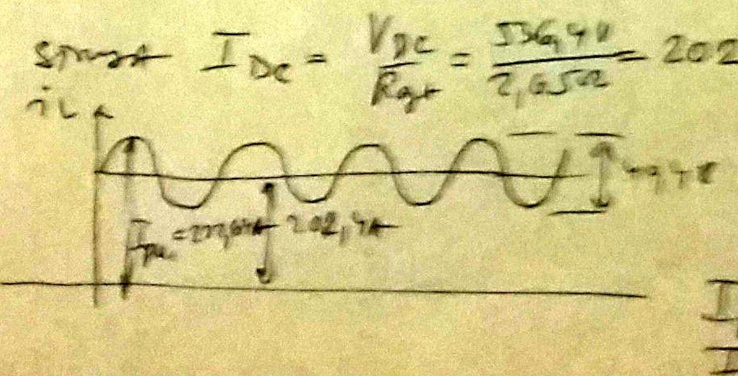
$$L \geq \frac{4R}{35} \cdot \frac{1}{6\omega} \cdot \frac{1}{0{,}2} + \frac{1}{(6\omega)^2 C^*}$$

$$L \geq \frac{4 \cdot 7{,}65}{35} \cdot \frac{1}{6 \cdot 314} \cdot \frac{1}{0{,}2} + \frac{1}{(6 \cdot 314)^2 \cdot 4{,}7 \cdot 10^{-3}}$$

$$L \geq 40{,}2\,mH + \frac{1}{16687{,}44} = 0{,}8\,mH + 0{,}06\,mH$$

$L \geq 0{,}806\,mH \rightarrow$ [illegible] $L^* = 1\,mH$

[illegible] $I_{DC} = \frac{V_{DC}}{R_{opt}} = \frac{536{,}4V}{2{,}65\Omega} = 202{,}4A$



$202 \cdot 202{,}4 = [illegible]$

$\Delta I_L = [illegible]$

$I_{pic} = 202{,}4 + [illegible]/2$

$I_{pic} = 222{,}64A$

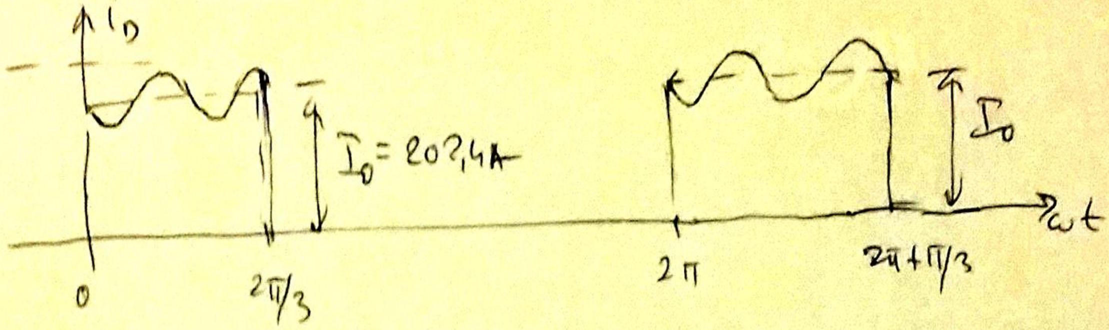
b) $V_\delta = \frac{L I_{pk}^2}{B_{max}^2} \cdot \mu_0$ $\quad \delta = 3mm$, $B_{max} = 1,5T$ $\quad V_\delta = 1m \cdot \frac{223,64^2}{1,5^2} \cdot 4\pi 10^{-7}$

$V_\delta = S_{Fe} \cdot \delta \quad V\delta = 27,67 cm^3$

$S_{Fe} = \frac{V\delta}{\delta} = \frac{27,67 cm^3}{0,3 cm} = 92,2 cm^2$

$S_{Fe} \geq 92,2 cm^2$

c) STRUJA DIODE



$I_{DSR} = \frac{I_0}{2\pi} \cdot \frac{2\pi}{3} = \frac{1}{3} I_0 = \frac{1}{3} I_{DC} = \frac{1}{3} \cdot 202,4 = 67,46A$

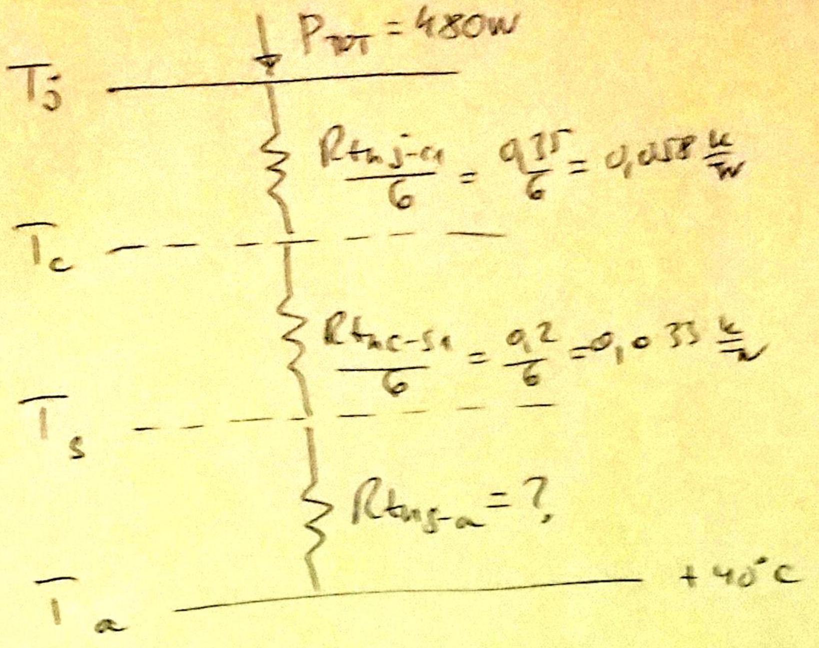
$I_{Deff} = \sqrt{I_0^2 \frac{1}{2\pi} \cdot \frac{2\pi}{3}} = \frac{I_0}{\sqrt{3}} = \frac{I_{DC}}{\sqrt{3}} = \frac{202,4}{1,73} = 117A$

SA GRAFIKA ZA DIODU $I_D = f(V_D)$ SE OČITAVA (PRI MAX temp. spoja) +125°C $V_{T0} = 0,9V$ $\quad r_d = \frac{1,4V - 1V}{380A - 100A} = \frac{0,4V}{280} = 1,42 m\Omega$

DISIPACIJA JEDNE DIODE

$P_{D1} = V_{T0} I_{DSR} + r_d \cdot I_{Deff}^2 = \underbrace{0,9 \cdot 67,46}_{60,7W} + \underbrace{1,42 \cdot 10^{-3} \cdot 117^2}_{19,43W} = 80,14W$

$\Sigma P_D = 6 \times 80W = 480W$ (UKUPNI DISIPACIONI GUBICI TROF. ISPRAVLJAČA)



$T_{jmax} = 125°C$

$T_{amax} = 40°C$

$$\frac{T_j - T_a}{\sum R_{th}} = P_{TOT}$$

$$T_j \leq T_{jmax} = 125°C$$

$$T_j = P_{TOT} \sum P_D + T_a$$

$$T_j = P_{TOT} \cdot \sum R_{th} + T_a \leq T_{jmax}$$

$$\sum R_{th} \leq \frac{T_{jmax} - T_a}{\sum P_D} = \frac{T_{jmax} - T_a}{P_{TOT}}$$

$$\sum R_{th} \leq \frac{125 - 40}{480} = 0,177 \frac{K}{W}$$

$$R_{thj-c_2} + R_{thc-s_2} + R_{ths-a} \leq 0,177 \frac{K}{W}$$

$$R_{thsa} \leq 0,177 - 0,058 - 0,033 \approx 0,09 \frac{K}{W}$$

ZA HLADNJAK P3 (PRILOG 2) SE ZAKLJUČUJE DA MORA DA SE KORISTI MEHANIČKO FORSIRANO HLAĐENJE, STOGA SE BIRA HLADNJAK TIPA P3/.... F.

ZA $n = 3$ (3 [illegible]) DOBIJA SE DA JE POTREBNA DUŽINA HLADNJAKA 290mm → USVAJA SE $L_{HL} = 300mm$. DAKLE USVOJENI HLADNJAK JE P3/300F.

ZA $n = 3$ I ZA P3/300F, UZ USLOV DA JE $R_{th} = 0,09 \frac{K}{W}$ SE DOBIJA DA JE BRZINA STRUJANJA VAZDUHA $v_{air} \approx 3,6$ m/s ŠTO ODGOVARA ZAPREMINSKOM PROTOKU $\approx 130 m^3/h$ (10 m/s → 360 $\frac{m^3}{h}$). SA KARAKTERISTIKE $\Delta P = f(Q_v)$ SE DOBIJA DA VENTILATOR SKF 3-230-01, 50Hz ZADOVOLJAVA OVAJ USLOV PRI ČEMU SE U PRESEČNOJ TAČKI KARAKTER. VENTILATORA I HLADNJAKA P3/300F IMA $\Delta P \approx 0,25$ mbar

TEMPERATURA HLADNJAKA:

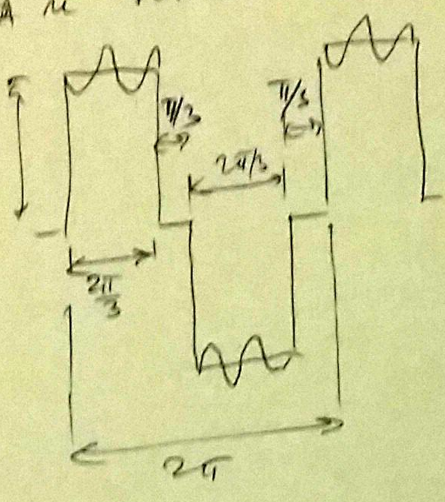
$$T_s = T_a + R_{th\,s-a} \cdot P_{TOT} = 40°C + 0{,}09 \cdot 460 = 81{,}4°C$$

TEMPERATURA KUĆIŠTA:

$$T_c = T_s + 0{,}033 \cdot 460 = 81{,}4°C + 15{,}18°C = 96{,}6°C$$

d) OSIGURAČ MORA DA BUDE MNOGO BRŽI

STRUJA U POVRATU



$$I_{Veff} = \sqrt{\frac{2 \cdot I_0^2 \cdot \frac{2\pi}{3}}{2\pi}}$$

$$I_{Veff} = \sqrt{\frac{2}{2\pi} \cdot I_0^2 \frac{2\pi}{3}} = \sqrt{\frac{4 I_0^2}{6}}$$

$$I_{Veff} = \sqrt{\frac{2}{3} I_0^2} = \sqrt{\frac{2}{3}} I_0$$

$$\boxed{I_{Veff} = 0{,}816 I_0 = 165A}$$

USVAJA SE OSIGURAČ ZA 200A

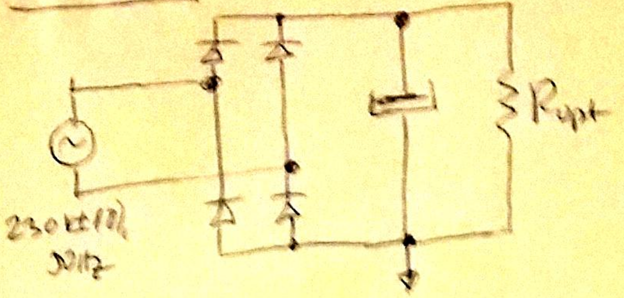
$$I^2t_{diode} \geq I^2t_{\text{mnogo brzog osig.}}$$

$$I^2t_D \approx 2 I^2 t_{MBO}$$

$$I^2t_{MBO} = \frac{1}{2} I^2t_{diode} = \frac{1}{2} 31250 = 15{,}6 \cdot 10^3 A^2 s$$

USVAJA SE TIP 3 $15500 A^2 s$, 200A, 690V

2 zadatak



$5\Omega \le R_{opt} \le 500\Omega$

$V_{\gamma D} \cong 1V$ $\quad \delta_r \le 5\%$

$r_d \cong 5m\Omega$

a) $\delta_r = \frac{\Delta V}{V_{DC}} = \frac{2}{4fRC-1} \le 0,05$ $\quad R = R_{min}$ (max opterećenje)

$4fRC - 1 \ge 40 \rightarrow 4fRC \ge 41$

$C \ge \frac{41}{4fR} = \frac{41}{4f \cdot R_{min}} = \frac{41}{4 \cdot 50 \cdot 5} = 0,041F$

$C \ge 41mF = 41000\mu F$

usvaja se $C^* = 47000\mu F$

obzirom da je napajanje 230V±10% za max napon na kondenz. se dobija $U_{Cmax} = 1,1 \cdot 230 \cdot \sqrt{2} = 356,73V$

za mrežni prenapon od 30% $\rightarrow U_C = 1,3 \cdot 356,73V = 463,75V$

usvaja se kondenzator 47000μF/500V

$$\Delta V_{max} = \frac{V_m^{max}}{2RC^*f} = \frac{V_m^{max}}{2R_{min} C^* \cdot f} = \frac{V_m^{max}}{2R_{min} C^* \cdot f} = \frac{356,73}{2 \cdot 5 \cdot 47m \cdot 50}$$

$\Delta V_{max} = 15V$ $\quad V_{DC}^{max} = V_m^{max} - \frac{\Delta V}{2} = 349,23V$

$\Delta V_{nom} = \frac{230\sqrt{2}}{2 \cdot 5 \cdot 47m \cdot 50} = 13,8V$ $\quad V_{DC}^{nom} = 230\sqrt{2} - 6,9 = 317,4V$

$\Delta V_{min} = \frac{0,9 \cdot 230\sqrt{2}}{2 \cdot 5 \cdot 47m \cdot 50} = 12,42V$ $\quad V_{DC}^{min} = 0,9 \cdot 230\sqrt{2} - 6,2 = 285,67$

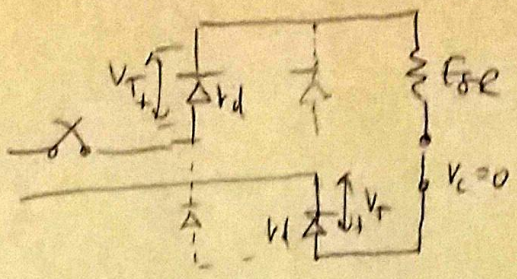
Pri min opterećenju $(R \rightarrow R_{max})$ tj. slučaj je $R_{opt}^{max} = 500\Omega$

$\Delta V'_{nom} = \frac{230\sqrt{2}}{2 \cdot 500 \cdot 47m \cdot 50} = 0,138V$ $\quad V_{DC} = 230\sqrt{2} - 0,138/2 \approx 230\sqrt{2}$ V

b) $ESR = 50m\Omega$

$V_{TO} \approx 1V$

$r_d = 50m\Omega$.



* MAX struja punjenja C se ima pri MAX. ULAZ. NAPONU

$$U_{ul}^{max} = 1{,}1 \cdot 230 \cdot \sqrt{2} = 356{,}73V$$

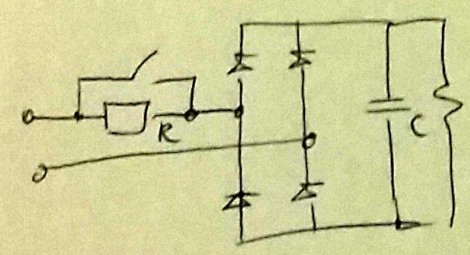
$$I_{punj} = \left(U_{ul}^{max} - 2V_{TO}\right) \Big/ \left(2r_d + ESR\right) = \frac{356{,}73 - 2 \cdot 1}{2 \cdot 5m\Omega + 50m\Omega}$$

$$I_{punjenja} = \frac{354{,}73\ V}{60m\Omega} = 5{,}91kA$$

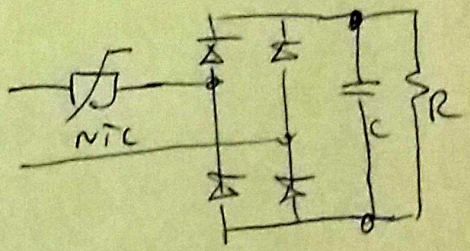
* Pri naponu 230V $U_{ul}^{max} = 230 \cdot \sqrt{2} = 324{,}3V$

$$I_{punjenja} = \frac{324{,}3 - 2 \cdot 1}{10m\Omega + 50m\Omega} = 5{,}37kA$$

* OGRANIČENJE STRUJE PUNJENJA OTPORNIKOM



(I)



(II)

I_{pp} - STRUJA POČETNOG PUNJENJA

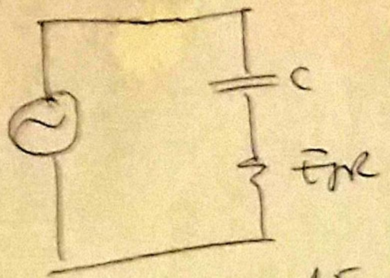
$R = R_{NTC} = ?$

$$I_{pp} = \frac{U_{ul}^{max} - 2V_{TO}}{R} \leq 30A$$

$$R_{NTC} = R \geq \frac{U_{ul}^{max} - 2V_{TO}}{I_{pp}} = \frac{356{,}73 - 2 \cdot 1}{30} = 11{,}82\Omega$$

Usvajamo $R_{NTC} = 12\Omega$

c) Izračunavanje ef. vrednosti struje za drugi harmonik



$$I_{eff}^{(2)} = \frac{\frac{\Delta V^{max}}{2\sqrt{2}}}{\sqrt{ESR^2 + \left(\frac{1}{2\omega C}\right)^2}}$$

$$I_{eff}^{(2)} = \frac{\frac{15}{2\sqrt{2}}}{\sqrt{\underbrace{(50\cdot 10^{-3})^2}_{0{,}0025} + \underbrace{\left(\frac{1}{2\pi\cdot 50\cdot 47m}\right)^2}_{\approx 0\ (0{,}0046)}}} = \frac{7{,}5/\sqrt{2}}{\sqrt{0{,}0025 + 0{,}0046}}$$

$$I_{eff}^{(2)} = \frac{7{,}5/\sqrt{2}}{0{,}08426} = 63{,}1\,A$$

$P_{DIS} = ESR\cdot\left[I_{eff}^{(2)}\right]^2 \approx 200W$ (ovo je velika snaga disipac.)

Vezivanjem 10 kondenzatora 4700 μF u paraleli dobijamo $\left(\frac{47000}{10} = 4700\,\mu F\right)$ da je disipacija drastično do mili'

$$I_{eff_1}^{(2)} = \frac{7{,}5/\sqrt{2}}{\left[\left(\underset{\downarrow\ 0}{5\,m\Omega/2}\right)^2 + \underbrace{\left(\frac{1}{2\pi\cdot 50\cdot 4{,}7m}\right)^2}_{0{,}46}\right]^{1/2}} = \frac{7{,}5/\sqrt{2}}{0{,}46} \approx 11{,}56\,A$$

$$P_{DIS_1} \approx ESR\cdot\left(I_{eff_1}^{(2)}\right)^2 = 0{,}05\cdot 11{,}56^2 = 6{,}7\,W$$

3 Transistore

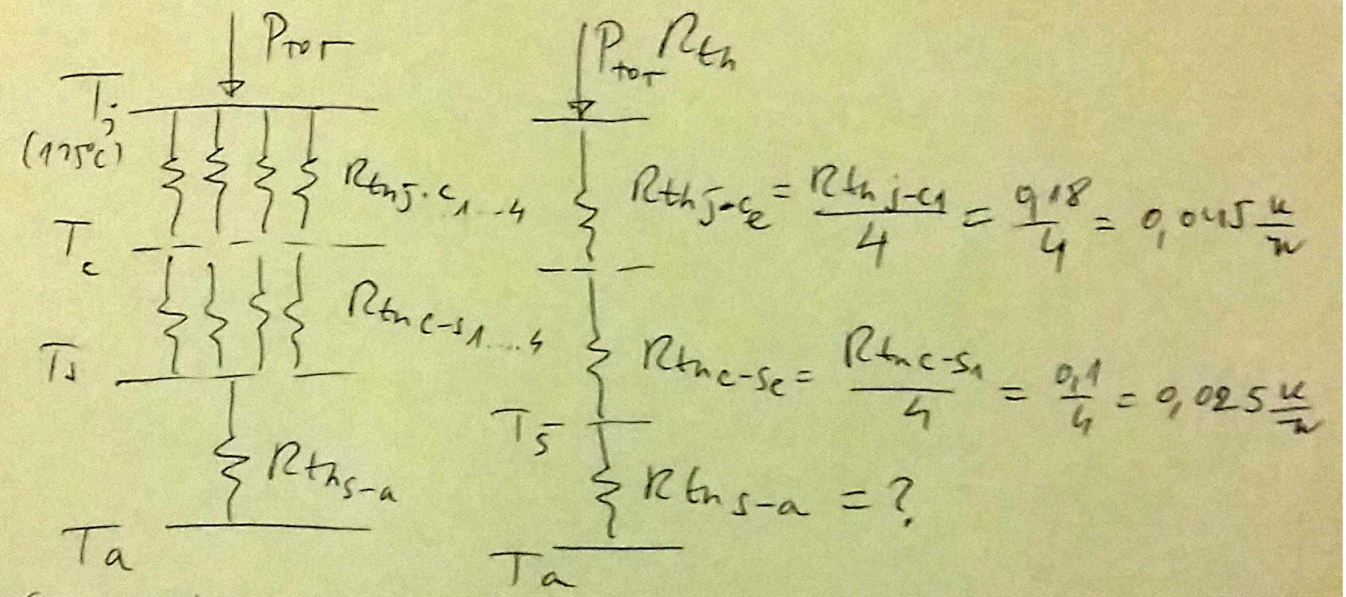
$I_0 = 50A$ $\quad I_{T\,dc} = \frac{I_0}{2} = 25A$

$$I_{T\,eff} = \frac{I_0}{\sqrt{2}} = \frac{50}{\sqrt{2}} = 35{,}46A$$

$$P_{dis_1} = V_{T0} \cdot I_{T\,dc} + r_d \cdot I_{T\,eff}^2$$

$$P_{dis_1} = 1{,}2 \cdot 25 + 2m \cdot 35{,}46^2 = 30W + 2{,}5W = 32{,}5W$$

$$\sum P_{dis} = P_{TT} = 4 \cdot P_{dis_1} = 4 \cdot 32{,}5W = 130W$$



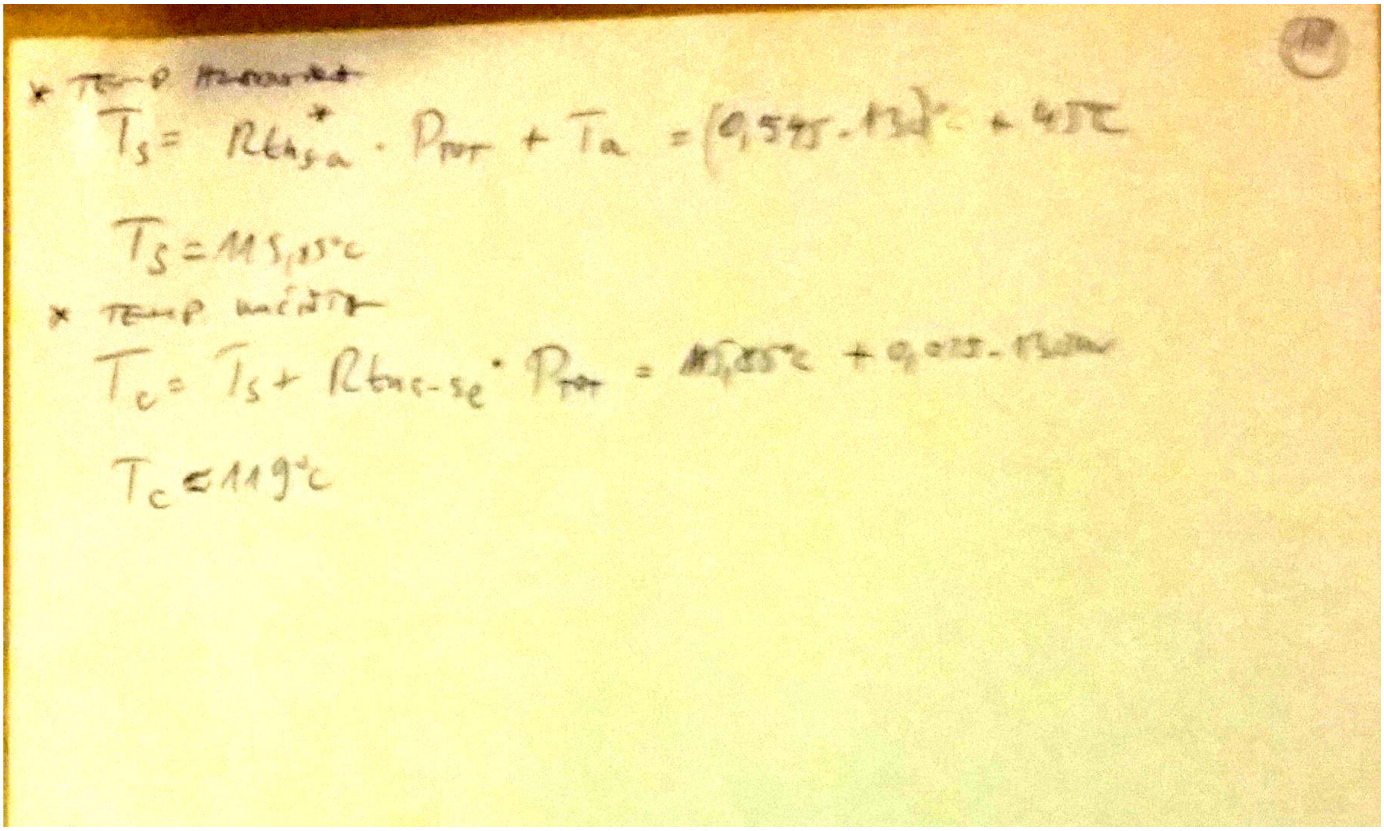
$$\frac{T_j - T_a}{\sum R_{th}} = P_{TOT} \qquad T_j \leq 125°C = T_{j\,max}$$

$$T_j = P_{TOT} \cdot \sum R_{th} + T_a = P_{TOT}\left(R_{thj-c} + R_{thc-s} + R_{ths-a}\right) + T_a \leq T_{j\,max} = 125°C$$

$$T_j = P_{TOT}\left(0{,}045 + 0{,}025 + R_{ths-a}\right) + T_a \leq T_{j\,max} = 125°C$$

$$R_{ths-a} \leq \frac{(125°C - 45°C)}{130W} - 0{,}045 - 0{,}025$$

$$R_{ths-a} \leq 0{,}545 \frac{K}{W}$$



U Beogradu 16.12.2018

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