$Vdc60 := 54\ V$ $\quad Vcs := 0.5\ V$ $\quad Rsense := 0.33\ \Omega$ $\quad Nr := 2$ $\quad Nps := 8$ $\quad Nsp := \frac{1}{Nps}$

$Vdc85 := 76\ V$ $\quad Vdc275 := 245\ V$ $\quad Vovp := 19\ V$

$Vout := 15\ V$ $\quad Vf := 0.5\ V$ $\quad Vdc400 := 400\ V$ $\quad \eta := 0.8$ $\quad Nsp = 0.125$

$Ipk := \frac{Vcs}{\frac{Rsense}{Nr}}$ $\quad Ipk = 3.03\ A$ $\quad Td := 580\ ns$ $\quad Tprop := 160\ ns$ $\quad Pout85 := 35.\ W$

$$Lp := \frac{2 \cdot Pout85}{(0.8 \cdot Ipk)^2 \cdot 75\ kHz \cdot \eta} \qquad Lp = \left(1.985 \cdot 10^{-4}\right)\ H$$

$Np := 40$ $\quad Ns := 5$

$Naux := 5$

For steady state 60vac max power is only 15v x 60mA. for start up ,need to charge 3500u cap to 15v

$$Freq_60 := \frac{1}{\left(Ipk \cdot Lp \cdot \left(\frac{1}{Vdc60} + \frac{1}{((Vout + Vf) \cdot Nps)}\right)\right) + Td}$$

$Freq_60 = 60.345\ kHz$

For steady state 60vac max power is only 15v x 2A. for start up, need to charge 3500u cap to 15v

$$Freq_85 := \frac{1}{\left(Ipk \cdot Lp \cdot \left(\frac{1}{Vdc85} + \frac{1}{((Vout + Vf) \cdot Nps)}\right)\right) + Td}$$

$Freq_85 = 74.925\ kHz$

For steady state 275vac max power is only 15v x 2A. for start up need to charge 3500u cap to 15v

$$Freq_275 := \frac{1}{\left(Ipk \cdot Lp \cdot \left(\frac{1}{Vdc275} + \frac{1}{((Vout + Vf) \cdot Nps)}\right)\right) + Td}$$

$Freq_275 = 126.796\ kHz$

For steady state 85vac max power is only 15v x 2A. for start up need to charge 3500u cap to 15v
.At 400v startup will not happen, but short ciruit can happen which can activate pulse by pulse I limit

$$Freq_400 := \frac{1}{\left(Ipk \cdot Lp \cdot \left(\frac{1}{Vdc400} + \frac{1}{((Vout + Vf) \cdot Nps)}\right)\right) + Td}$$

$Freq_400 = 144.192\ kHz$

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Power at Current limit

$Pout_60 := 0.5 \cdot Lp \cdot Ipk^2 \cdot Freq_60 \cdot \eta \qquad Pout_60 = 44.002\ W$

$Pout_85 := 0.5 \cdot Lp \cdot Ipk^2 \cdot Freq_85 \cdot \eta \qquad Pout_85 = 54.633\ W$

$Pout_275 := 0.5 \cdot Lp \cdot Ipk^2 \cdot Freq_275 \cdot \eta \qquad Pout_275 = 92.456\ W$

$Pout_400 := 0.5 \cdot Lp \cdot Ipk^2 \cdot Freq_400 \cdot \eta \qquad Pout_400 = 105.14\ W$

$$Freq_Comp := \frac{4}{\left(\sqrt{(4 \cdot Td) + \frac{2 \cdot Lp \cdot Pout_85 \cdot (Vout + Vf + (Nsp \cdot Vdc400))^2}{\eta \cdot Vdc400^2 \cdot (Vout + Vf)^2}} + \frac{\sqrt{2} \cdot Lp \cdot (Vout + Vf + (Nsp \cdot Vdc400)) \cdot \sqrt{\frac{Pout_85}{\eta \cdot Lp}}}{Vdc400 \cdot (Vout + Vf)}\right)^2}$$

$Freq_Comp = 243.654\ kHz$

$Ipk_60 := \sqrt{\frac{2 \cdot Pout_60}{\eta \cdot Lp \cdot Freq_60}} \qquad Ipk_60 = 3.03\ A$

$Ipk_85 := \sqrt{\frac{2 \cdot Pout_85}{\eta \cdot Lp \cdot Freq_85}} \qquad Ipk_85 = 3.03\ A$

$Ipk_85_Comp := \sqrt{\frac{2 \cdot Pout_85}{\eta \cdot Lp \cdot Freq_Comp}} \qquad Ipk_85_Comp = 1.68\ A$

$Ipk_275 := \sqrt{\frac{2 \cdot Pout_275}{\eta \cdot Lp \cdot Freq_275}} \qquad Ipk_275 = 3.03\ A$

$Ipk_275_Comp := \sqrt{\frac{2 \cdot Pout_275}{\eta \cdot Lp \cdot Freq_Comp}} \qquad Ipk_275_Comp = 2.186\ A$

$$Ipk_400 := \sqrt{\frac{2 \cdot Pout_400}{\eta \cdot Lp \cdot Freq_275}} \qquad Ipk_400 = 3.231\ A$$

$$Ipk_400_Comp := \sqrt{\frac{2 \cdot Pout_400}{\eta \cdot Lp \cdot Freq_Comp}} \qquad Ipk_400_Comp = 2.331\ A$$

$$Ipk_60_Delayed := Ipk_60 + \frac{Vdc60}{Lp} \cdot Tprop \qquad Ipk_60_Delayed = 3.074\ A$$

$$Ipk_85_Delayed := Ipk_85 + \frac{Vdc85}{Lp} \cdot Tprop \qquad Ipk_85_Delayed = 3.092\ A$$

$$Ipk_275_Delayed := Ipk_275 + \frac{Vdc275}{Lp} \cdot Tprop \qquad Ipk_275_Delayed = 3.228\ A$$

$$Ipk_400_Delayed := Ipk_400 + \frac{Vdc400}{Lp} \cdot Tprop \qquad Ipk_400_Delayed = 3.554\ A$$

$$Vcs_60_Delayed := \frac{Rsense}{Nr} \cdot Ipk_60_Delayed \qquad Vcs_60_Delayed = 0.507\ V$$

$$Vcs_85_Delayed := \frac{Rsense}{Nr} \cdot Ipk_85_Delayed \qquad Vcs_85_Delayed = 0.51\ V$$

$$Vcs_275_Delayed := \frac{Rsense}{Nr} \cdot Ipk_275_Delayed \qquad Vcs_275_Delayed = 0.533\ V$$

$$Vcs_400_Delayed := \frac{Rsense}{Nr} \cdot Ipk_400_Delayed \qquad Vcs_400_Delayed = 0.586\ V$$

$$Vcs_cl_400 := \frac{Rsense}{Nr} \cdot \left(Ipk_400_Comp - \frac{Vdc400}{Lp} \cdot Tprop\right)$$

R1 Selected for 1mA< Iqr<4mA

$$Vcs_Offset := Vcs - Vcs_cl_400 \qquad Vcs_Offset = 0.169\ V \qquad Iqr := 2.39\ mA$$

$$Vaux := -1 \cdot \frac{Vdc400}{Naux} \qquad Vaux = -80\ V$$

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$$R1 := \left|\frac{Vaux}{Iqr}\right| \qquad R1 = 33.473\ k\Omega$$

$$Roffset := \frac{Vcs_Offset}{Iqr} \cdot 100 \qquad Roffset = 7.053\ k\Omega \qquad Rinternal := 6.6\ k\Omega$$

$$Rexternal := Roffset - Rinternal$$

$$Rexternal = 452.547\ \Omega$$

Extenal resistance

Output OV protection

$$Vovp := 3.0\ V \qquad Vaux_ovp := 19 \cdot 0.545\ V$$

$$R2 := Vovp \cdot \left(\frac{R1}{Vaux_ovp - Vovp}\right)$$

$$R2 = 13.653\ k\Omega \qquad Td = \left(5.8 \cdot 10^{-7}\right)\ s$$

$$Coss := 341\ pF \qquad Lp = \left(1.985 \cdot 10^{-4}\right)\ H$$

$$Td := \frac{\pi}{2} \cdot \sqrt{Lp \cdot Coss} \qquad Td = 408.69\ ns$$

$$RFF := \frac{R1 \cdot R2}{(R1 + R2)}$$

$$Cd := \frac{\frac{\pi}{2} \cdot \sqrt{Lp \cdot Coss}}{RFF} \qquad Cd = 0.042\ nF$$

$$Cdused := Cd - 20\ pF$$

$$Cdused = \left(2.214 \cdot 10^{-11}\right)\ F$$

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