

Snubber Design Calculations For Flyback Transformer Converter

Design Inputs

This sheet is based on Fairchild Semiconductors'
Application note AN-4147 & reference design
EEIOL_2009NOV06_OPTO_AN_01

$V_{inMin} := 170V$	Minimum AC voltage
$V_{inMax} := 265V$	Maximum AC voltage
$L_{leak} := 3.0\mu H$	Leakage Inductance
$L_p := 255.0\mu H$	Primary Inductance
$N_p := 16$	Primary Turns
$N_s := 2.55$	Secondary Turns
$V_o := 30V$	Secondary Voltage
$\eta := 85\%$	Effeciency of Transformer
$D_{max} := 0.55$	Max Dutycycle
$P_o := 129W$	Output Power
$F_{sw} := 100KHz$	Switching Frequency
$\% \Delta V_{sn} := 10\%$	% Ripple of V_{sn} . Good Value Is 10 to 15%

Calculated Values

$\delta := \frac{N_p}{N_s}$	Primary to Secondary Turn Ratio
$\delta = 6.275$	
$V_{fly} := \delta \cdot V_o$	Calculate Flyback voltage also called as nV_o or V_f

$$V_{fly} = 188.235 \text{ V}$$

$$V_{sn} := 2.0 \cdot V_{fly}$$

Calculate Snubber Voltage. $V_{sn} = 2$ to 2.5 times of V_{fly}
Very small V_{sn} results in a severe loss in the snubber circuit

$$V_{sn} = 376.471 \text{ V}$$

$$V_{maxpk} := \sqrt{2} \cdot V_{inMax}$$

Calculate Peak voltage Max AC input

$$V_{maxpk} = 374.767 \text{ V}$$

$$V_{dsmax} := V_{maxpk} + V_{sn} + V_{fly}$$

Calculations for selection of mosfet

$$V_{dsmax} = 939 \text{ V}$$

V_{dsmax} will appear across the mosfet so choose one accordingly

$$I_{maxrms} := \frac{P_o}{\eta \cdot V_{inMin}}$$

Maximum Current RMS

$$I_{maxrms} = 0.893 \text{ A}$$

$$I_{maxpk} := I_{maxrms} \cdot \frac{2\sqrt{2}}{D_{max}}$$

Peak current when max rms current is flowing
Also this current (I_{maxpk}) is required for selection of mosfet

$$I_{maxpk} = 4.591 \text{ A}$$

Calculations For Selection of Secondary Diode

$$V_{rd} := V_o + \left(\frac{1}{\delta} \cdot V_{maxpk} \right)$$

$$V_{rd} = 90 \text{ V}$$

Minimum Peak inverse Voltage of Secondary rectifier diode

$$V_{maxavg} := \frac{2 \cdot \sqrt{2}}{\pi} \cdot V_{inMax}$$

$$V_{maxavg} = 238.584 \text{ V}$$

$$D_{\min} := \frac{V_o}{\left(\frac{1}{\delta} \cdot V_{\max \text{avg}} + V_o\right)}$$

Minimum Dutycycle

$$D_{\min} = 0.441$$

$$I_{rd} := \frac{2}{(1 - D_{\min})} \cdot \frac{P_o}{V_o}$$

$$I_{rd} = 15.385 \text{ A}$$

Peak Current Through Diode

Calculations For Finding Snubber Resistor And Capacitor

$$I_{dsn \text{maxpk}} := \frac{2\sqrt{2} \cdot P_o}{\eta \cdot D_{\min} \cdot V_{in \text{Max}}}$$

Peak current @ snubber diode when Vin is max

$$I_{dsn \text{maxpk}} = 3.673 \text{ A}$$

$$T_s := \frac{L_{\text{leak}} \cdot I_{dsn \text{maxpk}}}{V_{sn} - V_{fly}}$$

Time Required for Mosfet output capacitance to charge

$$T_s = 59 \cdot \text{ns}$$

$$P_{sn} := V_{sn} \cdot \frac{I_{dsn \text{maxpk}} \cdot T_s}{2} \cdot F_{sw}$$

$$P_{sn} = 4.047 \text{ W}$$

Powerloss @ snubber , Minimum Wattage of Rsn

$$R_{sn} := \frac{V_{sn}^2}{P_{sn}}$$

$$R_{sn} = 35.02 \cdot \text{k}\Omega$$

$$\Delta V_{sn} := V_{sn} \cdot \% \Delta V_{sn}$$

Snubber Ripple Voltage

$$\Delta V_{sn} = 37.647 \text{ V}$$

$$C_{sn} := \frac{V_{sn}}{\Delta V_{sn} \cdot R_{sn} \cdot F_{sw}}$$

$$C_{sn} = 3 \cdot \text{nF}$$

