

## ***Electrical Parameters***

$V_{acmin} := 90$	VrmsMinimum AC Input Voltage
$V_{acmax} := 264$	Vrms Maximum AC Input Voltage
$F_{acMainsMin} := 47Hz$	Minimum AC Mains Frequency
$i := V_{acmin} .. V_{acmax}$	
$V_{brfd} := 0.9V$	Forward voltage drop of the diode in the input bridge rectifier
$V_{ac_i} := i \cdot 1V$	ACInput Voltage Range
$V_{pkmin} := V_{ac_{V_{acmin}}} \cdot \sqrt{2} - 2 \cdot V_{brfd}$	Peak Rectified voltage at the Vac min point
$V_{pkmin} = 125.479 V$	
$V_{pkmax} := V_{ac_{V_{acmax}}} \cdot \sqrt{2} - 2 \cdot V_{brfd}$	Peak Rectified voltage at the Vac max point
$V_{pkmax} = 371.552 V$	
$V_{o1} := 32V$	Output Voltage
$I_{o1} := 2.656A$	Output Current
$V_{fd1} := 0.95V$	Forward Voltage drop of the output rectifier
$V_{o2} := 12V$	Output Voltage
$I_{o2} := 0.04A$	Output Current
$V_{fd2} := 1.2V$	Forward Voltage drop of the output rectifier
$C_{bulk} := 120\mu F$	Nominal input bulk capacitance
$TolC_{bulk} := 20\%$	
$thold := 4ms$	Minimum Holdup requirements
$\tan\delta := 0.24$	Tan Delta of the Bulk Capacitor
$V_{brownout} := 68V$	Bulk Cap DC Voltage the brownout protection circuit trips in
$\eta := 85\%$	Expected PSU efficiency

$$PF := 0.55$$

**Expected Power Factor**

$$Vacnom := 115V$$

**Nominal AC Line voltage to consider the holdup time with**

$$DutyCycle := 65\%$$

**Max Primary side duty cycle at peak power**

$$Fsw := 70KHz$$

**Switching Frequency**

$$Leakage\% := 1.2\%$$

**Target ratio of Leakage Inductance to Primary Inductance**

$$Kcoupling := \sqrt{1 - Leakage\%}$$

**Transformer Coupling Factor**

$$Kcoupling = 0.994$$

$$Po := Vo1 \cdot Io1 + Vo2 \cdot Io2$$

**Output Power**

$$Po = 85.472 \text{ W}$$

$$Pin := \frac{Po}{\eta}$$

**Estimated Input Power**

$$Pin = 100.555 \text{ W}$$

### ***Core Parameters EE2525 A-Core JPP-4***

$$Ac := 0.518 \text{ cm}^2$$

**Core cross sectional winding area**

$$MPL := 5.78 \text{ cm}$$

**Magnetic Path Length from core data sheet**

$$MLT := 4.8 \text{ cm}$$

**Mean Length per Turn from bobbin data sheet**

$$Volfe := 2.994 \text{ cm}^3$$

**Core Fe Volume**

$$CoreWid := 2.51 \text{ cm}$$

**Core Width**

$$CoreLen := 2.505 \text{ cm}$$

**Core Length**

$$CoreHt := 0.72 \text{ cm}$$

**Core Height**

$$WindowWidth := 1.79 \text{ cm}$$

**Winding Window Width**

$$WindowHt := 0.5325 \text{ cm}$$

**Window Winding Height (B-φC)/2**

$$\mu := 2300$$

**Core Permeability**

Window Area

$$Wa := WindowWidth \cdot WindowHt$$

$$Wa = 0.953 \cdot \text{cm}^2$$

$$\text{BobbinWidth} := \text{WindowWidth} - 2.2\text{mm}$$

Use this equation or enter from bobbin mfg data sheet. Use 2.2mm when using tripple insulated wire and 8.2mm when using margin tape.

$$\text{BobbinWidth} = 1.57 \cdot \text{cm}$$

$$A_p := W_a \cdot A_c$$

$$A_p = 0.494 \cdot \text{cm}^4$$

Power Handling ability of the core

$$A_t := 2 \cdot \text{CoreLen} \cdot \text{CoreWid} + 2 \cdot \text{CoreLen} \cdot \text{CoreHt} + 2 \cdot \text{CoreWid} \cdot \text{CoreHt}$$

$$A_t = 19.797 \cdot \text{cm}^2$$

Surface Area for heat dissipation

For EE/ER style transformers use the above but substitute for Core Height the following:  
CoreHt+2\*WindowHt

### Constants

$$K_i := 0.0388$$

Gap Loss Coefficient

$$K_u := 0.32$$

Window utilization factor use 40% for most cases

$$K_f := 4$$

Waveform coefficient use 4 for a square wave or 4.4 for a sinewave

$$\text{offset} := 0.72\text{V}$$

Used on the bulk cap below

$$\text{offset}_{115} := \text{offset} \cdot \frac{V_{acnom}}{V_{acmin} \cdot 1\text{V}}$$

New Offset for operation at 115V

### Bulk Capacitor Calculations

$$C_{bulkmin} := \frac{2 \cdot \text{Pin} \cdot \text{thold}}{\left( V_{acnom} \cdot \sqrt{2} - 2 \cdot V_{brfd} \right)^2 - V_{brownout}^2}$$

Choose CBulk > than this value

$$C_{bulk} = 120 \cdot \mu\text{F}$$

$$C_{esr} := \frac{\tan \delta}{2 \cdot \pi \cdot 2 \cdot \text{FacMainsMin} \cdot C_{bulk} \cdot (1 - \text{TolCbulk})}$$

$$C_{esr} = 4.233 \, \Omega$$

$$V_{BulkMin} := V_{pkmin} - \left[ \left( \frac{C_{esr}}{25 \Omega} \right)^2 \cdot 1 \text{ V} + \text{offset} \right] \cdot \frac{P_{in}}{1 \text{ W}} \cdot \left[ \frac{100 \mu\text{F}}{C_{bulk} \cdot (1 - \text{TolCbulk})} \right]$$

$$V_{BulkMin} = 47.06 \text{ V}$$

Minimum Bulk Cap Voltage at Min Line and Frequency

$$V_{acNomPk} := V_{acnom} \cdot \sqrt{2} - 2 \cdot V_{brfd}$$

$$V_{NomBulk} := V_{acNomPk} - \left[ \left( \frac{C_{esr}}{25 \Omega} \right)^2 \cdot 1 \text{ V} + \text{offset} \right] \cdot \frac{P_{in}}{1 \text{ W}} \cdot \left( \frac{100 \mu\text{F}}{C_{bulk}} \right)$$

$$V_{NomBulk} = 81.34 \text{ V}$$

### ***Transformer Calculations***

$$I_{dc} := \frac{P_{in}}{V_{BulkMin} \cdot \text{DutyCycle}}$$

Primary Side Square wave current

$$I_{dc} = 3.287 \text{ A}$$

$$\Delta \beta_m := 0.37 \text{ T}$$

**Peak Operating Flux Density for the transformer Tesla**

$$\Delta I\% := 43\%$$

**Primary Side % of IDC for Lp slope**

$$\Delta I := \Delta I\% \cdot I_{dc} \quad \Delta I = 1.414 \text{ A}$$

**Slope defined by the primary inductance 200% is TM/DC**

$$I_{pk} := I_{dc} + \frac{\Delta I}{2}$$

Peak Current through the primary side transformer

$$I_{pk} = 3.994 \text{ A}$$

$$T_{sw} := \frac{1}{F_{sw}}$$

Switching Period

$$T_{on} := T_{sw} \cdot \text{DutyCycle}$$

On Time for the converter

$$T_{on} = 9.286 \cdot \mu\text{s}$$

$$T_{off} := T_{sw} - T_{on}$$

$$L_p := \frac{V_{BulkMin} \cdot T_{on}}{\Delta I}$$

Required Primary Inductance

$$L_p = 309.143 \cdot \mu\text{H}$$

Primary Side Inductance

$$L_k := L_p \cdot \text{Leakage\%}$$

Leakage Inductance

$$L_k = 3.71 \cdot \mu\text{H}$$

$$L_m := L_p - L_k$$

Magnetizing Inductance

$$L_m = 305.433 \cdot \mu\text{H}$$

$$N_p := \frac{I_{pk} \cdot L_p}{\Delta \beta_m \cdot A_c} = 64.423$$

Adjust  $\Delta I$  and  $\Delta \beta_m$  above to get a whole number

$$N_p = 64.423$$

$$l_g := 1.4\text{mm}$$

Adjust  $l_g$  (Core Gap) until  $L_{gapped} = L_p$

$$FFlux := 1 + \frac{l_g}{\sqrt{A_c}} \cdot \ln\left(\frac{2 \cdot \text{WindowWidth}}{l_g}\right)$$

Fringing Flux Caused by gapping the core

$$FFlux = 1.631$$

$$L_{gapped} := \frac{\left(0.4 \frac{\text{H}}{\text{m}} \cdot \pi \cdot 10^{-6}\right) \cdot N_p^2 \cdot FFlux \cdot A_c}{l_g + \frac{MPL}{\mu}}$$

$$L_{gapped} = 309.102 \cdot \mu\text{H}$$

This needs to equal  $L_p$

$$L_p = 309.143 \cdot \mu\text{H}$$

$$B_{max} := \frac{0.4 \frac{\text{H}}{\text{m}} \cdot \pi \cdot N_p \cdot FFlux \cdot (I_{pk}) \cdot 10^{-6}}{l_g + \frac{MPL}{\mu}}$$

Double Check this against your input requirement

$$B_{max} = 0.37 \text{ T}$$

$$\beta_{ac} := \frac{0.4 \frac{\text{H}}{\text{m}} \cdot \pi \cdot N_p \cdot FFlux \cdot \left(\frac{\Delta I}{2}\right) \cdot 10^{-6}}{l_g + \frac{MPL}{\mu}}$$

$$\beta_{ac} = 0.065 \text{ T}$$

AC Component

$$\beta_{dc} := B_{max} - \beta_{ac}$$

DC component

$$\beta_{dc} = 0.304 \cdot \text{T}$$

$$\text{Energy} := \frac{L_p \cdot I_{pk}^2}{2}$$

Energy in W-S

$$\text{Energy} = 2.466 \times 10^{-3} \text{ J}$$

Available energy storage in the gap

$$\text{Energy} \cdot F_{sw} = 172.607 \text{ W}$$

Max Power available at that frequency and inductance

$$ALe := \frac{Lp}{Np^2 \cdot 10^{-3}}$$

Effective ALe gapped uH/1000 turns

$$ALe = 74.486 \cdot \mu H$$

$$H := \frac{0.4 \cdot \pi \cdot Np \cdot Ipk}{MPL}$$

Oersteds

$$H = 55.942 \cdot \frac{A}{cm}$$

Check this against data sheet curves

$$Pg := Ki \cdot \frac{10^4 W}{(m^2 T^2) Hz} \cdot WindowWidth \cdot Ig \cdot Fsw \cdot \beta ac^2$$

McLyman - Transformer and Inductor design Handbook

$$Pg = 2.917 W$$

### ***Skin Depth and Wire Selection***

$$\rho := 1.7241 \cdot 10^{-6} \Omega \cdot cm$$

Nema M1000 pdf

$$\alpha := 0.0039$$

Temperature Compensation for Cu

$$TempW := 100$$

Degree C Operating Wire temperature

$$Tambient := 20$$

Ambient Wire Temperature the Cu constant was derived from

$$\rho e := \rho [1 + \alpha \cdot (TempW - Tambient)]$$

$$\rho e = 2.262 \times 10^{-6} \Omega \cdot cm$$

Adjusted electrical Resistivity

$$Kcu := \sqrt{\frac{\rho e}{\rho}}$$

$$\delta := \frac{6.62}{\sqrt{Fsw}} \cdot Kcu \cdot \sqrt{Hz} \cdot cm$$

$$\delta = 0.029 \cdot cm$$

Skin Depth in cm

$$MaxWireDia := 2 \cdot \delta$$

$$MaxWireDia = 0.573 \cdot mm$$

Maximum wire Diameter that uses 100% of the Cu area at the fundamental switching frequency

## **Primary Side Wire Selection**

$$I_{pRMS} := \sqrt{\frac{\text{DutyCycle} \cdot \left[ (I_{pk} - \Delta I)^2 + (I_{pk} - \Delta I) \cdot I_{pk} + I_{pk}^2 \right]}{3}} \quad \text{Primary Current}$$

$$\text{WireDiaPri} := 0.35 \text{ mm} \quad \text{Bare Cu wire Diameter for the Primary Winding}$$

$$\text{WireODPri} := 0.387 \text{ mm} \quad \text{Uses 2UEW (JIS Grade 2) See wire table}$$

Expand Table Below for wire gauges

$$\frac{\text{BobbinWidth} \cdot 2}{N_p} = 0.487 \cdot \text{mm} \quad \text{Max wire dia for } N_p/2 \text{ turns}$$

$$\text{MaxTurnsPri} := \text{floor} \left( \frac{\text{BobbinWidth}}{\text{WireODPri}} \right)$$

$$\text{MaxTurnsPri} = 40 \quad \text{This is the Maximum Number of turns for single layer construction. Check this value against } N_p$$

$$\text{Idensity} := 800 \frac{\text{A}}{\text{cm}^2} \quad \text{Suggested Wire current density. 300 is very conservative, 500 is normal (often used for continuous power), 800 is high but is often used as the peak power number}$$

$$\text{SuggestedNumbStrands} := \frac{I_{pRMS}}{\left( \frac{\text{WireDiaPri}}{2} \right)^2 \cdot \pi \cdot \text{Idensity}}$$

$$\text{SuggestedNumbStrands} = 3.47$$

$$\text{NumPriStrands} := 1 \quad \text{Number of parallel strands of wire to use in the primary winding}$$

$$A_{wbPri} := \pi \cdot \left( \frac{\text{WireDiaPri}}{2} \right)^2 \cdot \text{NumPriStrands} \quad \text{Cross Sectional area of the stranded wire}$$

$$A_{wbPri} = 0.096 \cdot \text{mm}^2$$

$$R_{cuPri} := \frac{\rho_e}{A_{wbPri}} \cdot \text{MLT} \cdot N_p \quad \text{DCR Of the Primary Winding}$$

$$R_{cuPri} = 0.727 \cdot \Omega$$

$$P_{cuPri} := I_{pRMS}^2 \cdot R_{cuPri} \quad \text{Power Dissipation of the primary winding}$$

$$P_{cuPri} = 5.185 \text{ W}$$

$$N_{s1} := \frac{(V_{o1} + V_{fd1}) \cdot (1 - \text{DutyCycle}) \cdot N_p}{\text{DutyCycle} \cdot V_{BulkMin} \cdot K_{coupling}} \quad \text{Need a schottky diode here. Kcoupling compensation for Coupling losses.}$$

$$N_{s1} = 24.436$$

Number of turns on the secondary side

$$N_{s1} := 24$$

$$I_{dcS1} := \frac{I_{o1} \cdot \left( 1 + \frac{V_{fd1}}{V_{o1}} \right)}{(1 - \text{DutyCycle})}$$

Allows for the output power and power dissipation of the output rectifier

$$I_{dcS1} = 7.814 \text{ A}$$

$$\Delta I_{S1} := \Delta I\% \cdot I_{dcS1}$$

$$I_{pkS1} := I_{dcS1} + \frac{\Delta I_{S1}}{2}$$

$$I_{pkS1} = 9.494 \text{ A}$$

$$I_{s1RMS} := \sqrt{\frac{(1 - \text{DutyCycle}) \cdot \left[ (I_{pkS1} - \Delta I_{S1})^2 + (I_{pkS1} - \Delta I_{S1}) \cdot I_{pkS1} + I_{pkS1}^2 \right]}{3}}$$

$$I_{s1RMS} = 4.658 \text{ A}$$

$$\text{NumS1Strands} := 1$$

Number of parallel strans on one layer

$$\text{NumS1Layers} := 1$$

Number of layers of parallel windings

$$\text{WireDiaS1} := 0.5\text{mm}$$

Bare Cu wire Diameter for the Primary Winding

$$\text{WireODS1} := 0.725\text{mm}$$

Uses 0.5mm TEX-E Wire

$$\text{MaxTurnsS1} := \text{floor} \left( \frac{\text{BobbinWidth}}{\text{WireODS1} \cdot \text{NumS1Strands}} \right)$$

$$\text{MaxTurnsS1} = 21$$

This is the Maximum Number of turns for single layer construction. Check this value against NS1

$$A_{wbs1} := \pi \cdot \left( \frac{\text{WireDiaS1}}{2} \right)^2 \cdot \text{NumS1Strands} \cdot \text{NumS1Layers}$$

$$A_{wbs1} = 1.963 \times 10^{-3} \cdot \text{cm}^2$$

$$R_{cus1} := \frac{\rho_e}{A_{wbs1}}$$

Wire resistance ohms/cm

$$R_{cus1} = 1.152 \times 10^{-3} \cdot \frac{\Omega}{\text{cm}}$$

$$R_{s1} := R_{cus1} \cdot \text{MPL} \cdot N_{s1}$$

S1 Wire Resistance

$$R_{s1} = 0.16 \Omega$$

$$P_{cus1} := I_{s1RMS}^2 \cdot R_{s1}$$

Power Loss to the Cu in the S1 winding

$$P_{cus1} = 3.468 \text{ W}$$



$$N_{s2} := \frac{(V_{o2} + V_{fd2}) \cdot (1 - \text{DutyCycle}) \cdot N_p}{\text{DutyCycle} \cdot V_{\text{BulkMin}} \cdot K_{\text{coupling}}}$$

Need a schottky diode here. Kcoupling compensation for Coupling losses.

$$N_{s2} = 9.789$$

Number of turns on the secondary side

$$N_{s2} := 5$$

$$I_{dcS2} := \frac{I_{o2} \cdot \left(1 + \frac{V_{fd2}}{V_{o2}}\right)}{(1 - \text{DutyCycle})}$$

Allows for the output power and power dissipation of the output rectifier

$$I_{dcS2} = 0.126 \text{ A}$$

$$\Delta I_{S2} := \Delta I\% \cdot I_{dcS2}$$

$$\Delta I_{S2} = 0.054 \text{ A}$$

$$I_{pkS2} := I_{dcS2} + \frac{\Delta I_{S2}}{2}$$

$$I_{pkS2} = 0.153 \text{ A}$$

$$I_{s2RMS} := \sqrt{\frac{(1 - \text{DutyCycle}) \cdot \left[ (I_{pkS2} - \Delta I_{S2})^2 + (I_{pkS2} - \Delta I_{S2}) \cdot I_{pkS2} + I_{pkS2}^2 \right]}{3}}$$

$$I_{s2RMS} = 0.075 \text{ A}$$

$$\text{NumS2Strands} := 1$$

Number of parallel strans on one layer

$$\text{NumS2Layers} := 1$$

Number of layers of parallel windings

$$\text{WireDiaS2} := 0.21 \text{ mm}$$

Bare Cu wire Diameter for the Primary Winding

$$\text{WireODS2} := 0.241 \text{ mm}$$

Uses 0.21 mm 2UEW Wire

$$\text{MaxTurnsS2} := \text{floor} \left( \frac{\text{BobbinWidth}}{\text{WireODS2} \cdot \text{NumS2Strands}} \right)$$

$$\text{MaxTurnsS2} = 65$$

This is the Maximum Number of turns for single layer construction. Check this value against NS1

$$A_{wbs2} := \pi \cdot \left( \frac{\text{WireDiaS2}}{2} \right)^2 \cdot \text{NumS1Strands} \cdot \text{NumS1Layers}$$

$$A_{wbs2} = 3.464 \times 10^{-4} \cdot \text{cm}^2$$

$$R_{cus2} := \frac{\rho_e}{A_{wbs2}}$$

Wire resistance ohms/cm

$$R_{cus2} = 6.531 \times 10^{-3} \cdot \frac{\Omega}{\text{cm}}$$

$$R_{s2} := R_{cus2} \cdot MPL \cdot N_{s2}$$

S1 Wire Resistance

$$R_{s2} = 0.189 \, \Omega$$

$$P_{cus2} := I_{s2RMS}^2 \cdot R_{s2}$$

Power Loss to the Cu in the S1 winding

$$P_{cus2} = 1.06 \times 10^{-3} \, W$$

$$P_{xfmrLoss} := P_g + P_{cuPri} + P_{cus1} + P_{cus2}$$

$$P_{xfmrLoss} = 11.571 \, W$$

$$\Delta T := \left[ \frac{\frac{P_{xfmrLoss}}{W} \cdot 10^3}{\left( \frac{A_t}{cm^2} \right)} \right]^{.833} \, ^\circ C$$

Estimated Temperature  
Rise over Ambient

$$\Delta T = 201.712 \, ^\circ C$$

## STP12NK60 MOSFET Analysis

$$n := \frac{N_p}{N_{s1}}$$

Primary/Secondary Turns Ratio

$$K_{pl} := \sqrt{1 - \frac{L_k}{L_p}}$$

Coupling Factor

$$K_{pl} = 0.994$$

$$V_d := 0.9V$$

Bridge Diode Forward Voltage Drop the worst case  
scenario is when the  $V_d$  is low giving a max  $V_{bus}$

$$Q1V_{dss} := 650V$$

$$C_{oss} := 40pF$$

Equivalent output capacitance 0-480V

$$Q1R_{dson} := 0.53 \, \Omega$$

Typical  $R_{DSon}$

$$Q1SpecAvalanchEnergy := 260 \times 10^{-3} \, J$$

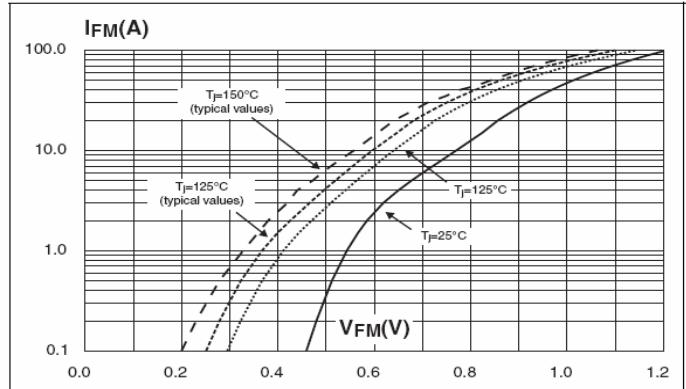
$$t_r := 18.5ns$$

$$t_f := 31.5ns$$

$$Q_{gate} := 59nC$$

$$V_{gate} := V_{o2}$$

**Figure 11. Forward voltage drop versus forward current (maximum values, per diode)**



$$V_{\text{flyback}} := (V_{o1} + V_{fd1}) \cdot \frac{n}{K_{pl}}$$

Flyback votage seen on the primary side

$$V_{\text{flyback}} = 88.983 \text{ V}$$

$$V_{\text{bus}} := V_{\text{pkmax}} - 2 \cdot V_d$$

Input Bus Voltage - the bridge diode drops

$$V_{\text{bus}} = 369.752 \text{ V}$$

$$V_{ds} := V_{\text{bus}} + V_{\text{flyback}}$$

Plateau Drain Source Voltage at the FET

$$V_{ds} = 458.736 \text{ V}$$

$$Q1V_{ds}\text{Derating} := \frac{V_{ds}}{Q1V_{dss}}$$

$$Q1V_{ds}\text{Derating} = 0.706$$

This meets the 80% derating requirement

Assuming DCM operation at 264Vac the  $I_{pk}$  calculation is as follows

$$\text{DiodeStressV} := \frac{V_{\text{bus}}}{n} + (V_{o1} + V_{fd1})$$

Vrr stress on the rectifier

$$DCHighLine := \frac{(V_{o1} + V_{fd1}) \cdot n}{V_{ds}}$$

High LIne Duty Cycle

$$I_{dchl} := \frac{P_{in}}{V_{\text{bus}} \cdot DCHighLine}$$

DCCurrent at High line

$$I_{dchl} = 1.41 \text{ A}$$

$$tonhl := \frac{1DCHighLine}{Fsw}$$

On time for the main FET

$$tonhl = 2.754 \cdot \mu s$$

$$Ipkhl := tonhl \cdot \frac{Vbus}{Lp}$$

Peak Current through the primary winding

$$Ipkhl = 3.294 \text{ A}$$

$$Cclamp := 1500pF$$

Output capacitance of Q1 measured @1MHz  
0-480V from Spec Sheet  
Cap on the RCD clamp

$$Cxfmr := 100pF$$

worst case transformer inter-winding capacitance  
(measured using the Lm and SRF of the  
transformer)

$$Vpk := Ipk \cdot \sqrt{\frac{Lk}{Cxfmr + Coss + Cclamp}} + Vbus + Vflyback$$

$$Vpk = 648.697 \text{ V}$$

Worst case Leakage Inductanc spike

$$Ek := \frac{1}{2} \cdot (Lk) \cdot Ipk^2$$

Available energy in the inductance spike

$$Ek = 2.959 \times 10^{-5} \cdot J$$

As you can see this result is Pass

$$Pgate := Qgate \cdot Vgate \cdot Fsw$$

Watts Power Loss to the Gate

$$Pgate = 0.05 \text{ W}$$

$$Pcoss := \frac{Coss}{2} \cdot (VBulkMin)^2 \cdot Fsw$$

Watts Power Loss to FEToutput capacitance

$$Pcoss = 3.101 \times 10^{-3} \text{ W}$$

$$Iqrms := IpRMS$$

$$Pcond := Q1Rdson \cdot Iqrms^2$$

Watts conducted Power Loss from Rdson

$$Pfettr := \frac{VBulkMin}{2} \cdot Iqrms \cdot 0.9 \cdot (tr + tf) \cdot Fsw$$

Watts Power Loss during transition

$$Pfettr = 0.198 \text{ W}$$

$$PQ1 := Pgate + Pcoss + Pcond + Pfettr$$

$$PQ1 = 4.031 \text{ W}$$

## Output Rectifier

$P_d := I_{o1} \cdot V_{fd1}$  Output rectifier power dissipation approximation

$P_d = 2.523 \text{ W}$

DiodeStressV = 170.696 V Choose a 100V schottky diode

## Bridge Diode Power Calculation KBP206G D3

$I_{BDpk} := 60$  Peak inrush current from spec. this will be used later

$I_{acrms} := \frac{P_{in}}{V_{acmin} \cdot 1 \text{ V}}$  AC RMS Current

$I_{acrms} = 1.117 \text{ A}$

$R_{load} := \left( \frac{P_{in}}{I_{acrms}^2} \right)$  Load Resistance

$R_{load} = 80.553 \Omega$

$I_m := I_{acrms} \cdot \sqrt{2}$  Use 0.5 instead of 1.414 for a half bridge

$I_m = 1.58 \text{ A}$  Peak Current in the Bridge

$I_{av} := \frac{1}{\pi} \cdot \int_0^{\pi} I_m \cdot \sin(\omega) d\omega$  use  $1/2 \cdot \pi$  for half bridge

$I_{av} = 1.006 \text{ A}$

$P_{rect} := V_{brfd} \cdot I_{av} \cdot 2$  2 diodes are conducting at a time

$P_{rect} = 1.811 \cdot \text{W}$  Average Power Dissipation of Bridge

$P_{totLoss} := P_{xfmrLoss} + P_{rect} + P_d + P_{Q1}$

$P_{totLoss} = 19.936 \text{ W}$

$P_{xfmrLoss} = 11.571 \text{ W}$

$\text{Efficiency} := 1 - \frac{P_{totLoss}}{P_o}$

$P_{rect} = 1.811 \text{ W}$

$P_d = 2.523 \text{ W}$

$\text{Efficiency} = 76.676\%$

$P_{Q1} = 4.031 \text{ W}$