# Power calculation

Specifications of project are

Vin(min) =220 V,

Vin(max) =400V,

Pout =100W,

Vout=12V

We have to decide some values for calculation and to get smaller transformer and ripples we decide switch frequency as 100khz. Our system will operate in Discontinuous conduction mode and we decide dwell time as one over ten period time. Also, maximum duty ratio as taken 0.2. Our secondary side diode will operate at high current so we can’t just assume its on voltage as zero volt, before deciding diode we take diode on voltage as 1V. Transformer won’t operate at 100% efficiency and before designing that we assume efficiency as 90%. So decided values are as given.

fS = 100kHz

Ddwell = 0.1

Dmax= 0.2 at 220V and Dmin = 0.11 at 400V

Vdiode = 1 V

ɳtransformer = 0.9

Primary and Secondary powers

By using output power and output voltage, average output current calculated. Then diodes power dissipation added and secondary sides total power calculated. Transformer is not ideal and we choose efficiency as 90% percent and primary sides power calculated with including core loss.

Iout(avg)= Pout / Vout = 8.33 A

Pdiode = Vdiode x Iout(avg) = 8.33 W

Psecondary = Pdiode + Pout = 108.33 W

Pprimary = Psecondary / ɳtransformer = 120.37 W

Primary and secondary sides peak current:

Primary and secondary sides inductor current is triangular shape and its peak value calculated with the following equations.

For 220 volt source voltage:

Iin(avg) = Pprimary / Vin(min) = 0.55 A

Iin(peak) = 2 x ( Iin(avg) / Dmax) = 5.47 A

For 400 volt source voltage:

Iin(avg) = Pprimary / Vin(max) = 0.55 A = 0.30 A

Iin(peak) = 2 x ( Iin(avg) / Dmin) = 5.47 A

Isecondary(peak) = 2 x (Iout(avg) / (1 - Dmax - Ddwell)) = 23. 80 A

Ratings of Components

Transformer, Mosfet, Diode and Output Capacitor are important components for flyback converter, Transformers calculation showed in previous part and turn ratio taken as 6. Mosfet, Diode and Output Capacitors required ratings analytically calculated in following equations.

Nturn = 6

For Mosfet:

VDS(max) = Vin(max) + (Vout x Nturn) = 472 V

IDS(peak) = Iin(peak) = 5.47 A

For Diode:

VD(max) = Vout(max) + (Vin(max) / Nturn) = 78.67 V

ID(max) = Isecondary(peak) = 23.80 A

Output Capacitor:

∆Vout(max) = Vout x (3/100) = 0.36 V

IC(pp) =(Iout(avg) x (1+ ((Dmax + Ddwell) / (1 - Dmax - Ddwell))) = 11.90 A

∆VESR = ESR x IC(pp) = ESR x 11.90

∆QC = Iout(avg) x (Dmax + Ddwell) / (Cout x fS) = 2.5x10-5 C

∆VC  = ∆QC / Cout = 2.5x10-5 / Cout

∆Vout = ∆VESR + ∆VC  = ESR x 11.90 + 2.5x10-5 / Cout

When Cout is infinity ESR must be smaller than 30.25 mΩ

When ESR is zero Cout must be bigger than 69.44 uF