**Picking components using simulation results:**

A lazy way to do the component selection would be to use the simulation results and just add some safety margin. For example, if the simulation says the RMS of the output capacitor is 10A, then just pick a capacitor rated for 15A.

Adding a safety margin is needed because it is hard to determine the exact losses in the system. Even if I assume a certain efficiency, it is difficult to obtain the results without going through an intense mathematical derivation or reading reference books to find out the analytical solutions. It is much easier to just simulate and add some safety margin.

**Controlling the dead time in the DCM**

I’ve observed that the % inductance from the critical conduction mode seems to be roughly linearly controlling the deadtime. For example, the deadtime will be 0.8Ts if the primary inductance is 80% of the critical conduction mode inductance.

**Current concerns:**

1.)The instantaneous power goes up to 2.4kW I am not sure if this can be safely provided by the house’s wiring. It seems that this could even get higher as input voltage increases even more, because currently I am simulating with minimum input DC voltage.

Update: This can be mitigated by limiting the maximum current at the primary coil. Can easily be implemented using peak current mode control IC.

2.) I should simulate with the rectifier next and start thinking about the input capacitors.

Update(14 May 21): Input capacitor can be determined by the hold-up time considerations.

3.) The current limit is getting triggered first before the voltage limit. This needs to be looked at.

**Issue: Picking the primary inductance to keep flyback at DCM**

Picked 220uH for the primary inductance for now. The simulation model simulates with minimum Vin of 260VDC. The turns ratio is also set to 7 based on the output voltage of 24V and a maximum MOSFET voltage of 700V with 80% derating.

Both the max load and 10x of the max load regulates at 24V and the model is stable. However, at higher load, the model takes longer to settle at 24V.

Right now, the main concern that the secondary peak currents are too high (about 35A) when the current limit is set to 5A. However, it seems that the current limit can be set to 4A and the model will still regulate at 24V. In either case, I need to determine if such high currents are practical and can be built.

Update on current limit (May 5th 21): High currents up to 35A is possible if the trace widths are made wider, longer and thicker. Also for the diode on the secondary, the diodes can usually handle high current, but are need to be double check in the datasheet.

Another observation is that the peak current limit gives the system some output voltage overshoots as high as 35V @ 10x max load. This seems to be affected by the output capacitance and the peak current limit. A lower output capacitance gives lower overshoots.

With the current simulation model, the efficiency is about 88% @ maximum load. And the maximum primary current goes up to 3.92A. And the max input power go as high as 1kW @ maximum load.

With 10x of max load, the max input power goes up to 1.3kW.

**Issue: Picking the bulk input capacitor**

So far there seems to be some sort of rule of thumb like 2uF/W to estimate the capacitance needed for the input capacitor.

Update (May 5th 21): This rule of thumb depends on the voltage across the capacitor. Usually, this is so that the hold up time considerations are met.

The input capacitance cannot be made too big otherwise the RMS currents through it will increase.

The tolerance + end of life of a capacitor should also be considered to select the value of the input capacitor. For example, capacitance tolerance of 20% and end of life capacitance decrease of 20% this means that the capacitance should be at least 156.25% higher than the initial design. This is done so to make sure the designed input voltage drop don’t go too low and increase the duty cycle which could potentially saturate the inductors.

**5/11/22 – 2:40PM**

**Change from DCM to CCM flyback**

I decided to implement a CCM flyback instead of DCM. This is because I wanted to use a smaller core for the coupled inductor. With DCM, the core needed to be quite big to prevent saturation due the high peak current inherent with DCM. With CCM, the primary side inductor current isn’t as high thus, allowing me to use smaller core.

**6/11/22 – 4:54PM**

**Verified the inductance of the coupled inductor using MAXWELL**

I used MAXWELL to verify the inductance. The simulation outputs the “AL”, so given this information and knowing the turns I initially designed for I was able to calculate the inductance on the primary of the coupled inductor. The simulation output was 277.65nH/N^2 so this gives a total inductance of 966uH, which is higher than what is designed for which is 900uH. However, is alright since CCM operation is still ensured.