## **Analytical Calculations**

In this part, analytical calculations of the flyback converter are made for the ideal case. According to the research, the duty cycle of the flyback converter should be lower than 0.5 to diminish output ripple and the proper operation of the switch. Therefore, we have decided the turn ratio(N1/N2) as 1.43 from the calculation so that the duty cycle is changing between %23-%47.

The controller operates flyback in boundary and discontinuous conduction mode. All calculations are made assuming boundary mode operation. We have taken boundary mode results as the limit values for discontinuous conduction. Therefore, continuous current mode formulas are utilized for boundary condition calculations. When Vin=24V, it operates at boundary condition and when input voltage increases it passes to the discontinuous current mode that are observer from simulations.

* Using turn ratio assumption and continuos conduction at the boundary, duty cycle is calculated as:

when ,

The maximum required inductance can be calculated as follows [1],

[1] Texas Instruments, “LM34XX how to design flyback converter with LM3481 boost ... - ti.com.” [Online]. Available: https://www.ti.com/lit/an/snva761a/snva761a.pdf. [Accessed: 09-May-2022].

Setting the magnetizing inductor current as:

where,

• is the fraction chosen, we have chosen KL as 2 in order to set boundary operation.

* (ideal case, the efficienct is %100)

Then, maximum magnetizing inductance is determined when Vin=24V so that it operates discontinous mode when input voltage increases.

After determining Lm, we can calculate minimum duty cycle when it pass to the discontinuos mode,therefore the duty cycle calculation is revisited:

Minimum duty cycle is calculated when Vin=48V,

* Calculation of maximum voltages on diode and MOSFET,

Generally in applications, rated voltage of MOSFETs are chosen as 1.5 multiplication of maximum voltage while 1.2 multiple of maximum value in diodes,

This values are critical for selection of MOSFET and diode for the application.

* In order to find suitable filtering capacitance, the output ripple requirement should be used:

Then for the simulation the following values are chosen:

Also, in order to see parasitic effect of capacitance, the required ESR value can be calculated as follows: