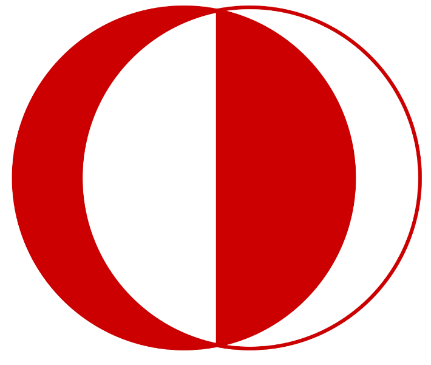
**EE 464**

**Hardware Project**

**Simulation Report**



**Team 5**

**Student 1 & ID: Alper Soysal & 2305324**

**Student 2 & ID: Hüsnü Oğuz Yorgancılar &**

**Student 3 & ID: Göktuğ Tonay &**

# **Introduction**

In this report, we will make a design decision and select a topology to produce an isolated DC-DC converter. Also, we will analyse this circuit in the simulations and obtain some results. Then, we will select some components according to simulation. Lastly, we will look at the preliminary results of transformer and inductor that we build.

# **Topology Selection**

There are many topologies to design an isolated DC-DC converter such as flyback, forward, push pull etc. Each of them has some advantages and disadvantages. So, we want to select the topology as different from the other hardware project. As a result, we decided to design a “Push Pull Converter”.

**Advantages**

* Good transformer core utilization
* Easier to base drive (low side switching)
* Small Filter and Transformer
* Interleaved Structure

**Disadvantages**

* Voltage stress on the FET’s is twice the input voltage
* Asymmetric switch signals cause a flux walking in the core
* Number of the semiconductors are larger than the other topologies

# **Transformer Design**

In order to determine the turn ratio of the transformer, we can look at the push pull converter voltage equation.

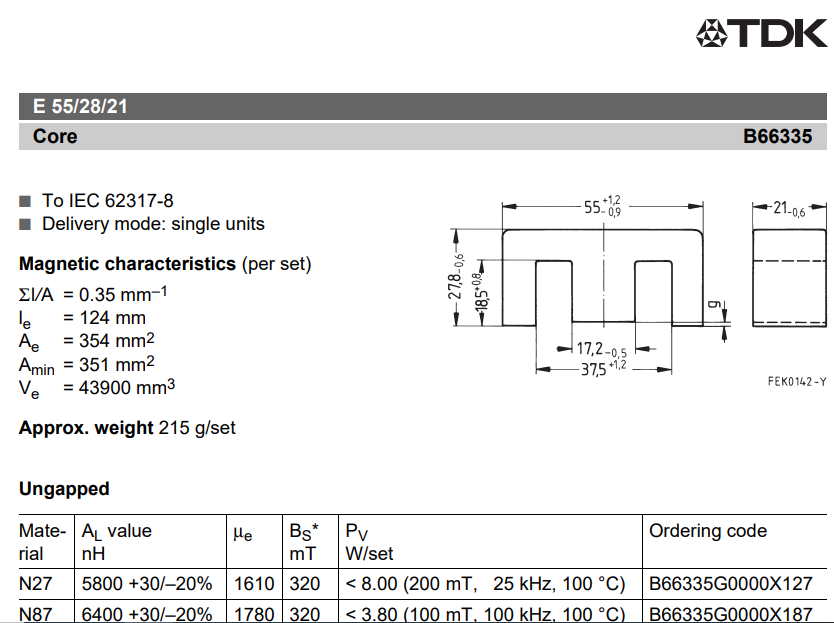
In the design requirements, we know that input voltage varies between the 24V and 48V. Also, push pull converter requires duty cycle which is smaller than the 0.5.

If we put a range for duty cycle such as 0.2 < D <0.4, we can find the necessary turn ratio

To make the number of turn as integer, we can select the

Minimum number of turns can be determined as the flux density in the core cannot reach the saturation. So, minimum number of turns can be calculated as following formula.

Then, we can use the effective area of the core. Our first core decision is the TDK Electronics B66335G0000X187 magnetic core. Its effective cross-sectional area is 354 mm2 .



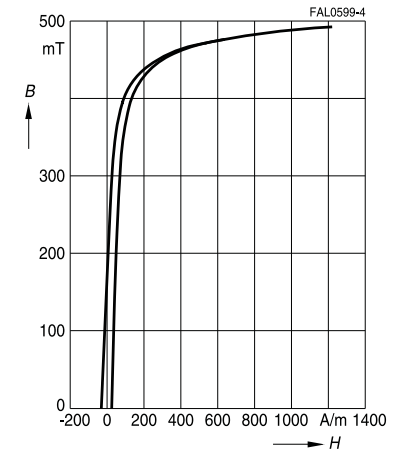


Figure-1: The properties of B66335G0000X187 magnetic core

Maximum flux density varies depends on the material of the core. For a safety, we can select as maximum 0.2 T.

So, number of turns 6 and 8 is sufficient.

In the simulation, maximum current is 2.2 A for input, 3.3 A for the output. Also, our core has more window area. So, we decided to use directly a litz cable which has 3 mm^2 area. Then, when we calculate the fill factor, we obtained the following calculation

# **Inductor Design**

# **Preliminary Results**

In order to verify our transformer and inductor design, we should measure the magnetizing inductance and leakage inductance of the transformer, and the inductance of the inductor. Also, primary and secondary resistances are obtained. These values are measured using LCR meter as seen in Figure-2&3. The magnetizing inductance seen from primary is 103.3µH, the leakage inductance is 3.83µH, and resistance is 1.02Ω. In addition, the inductance of the output inductor is measured as 43µH with an ESR of 245mΩ as seen in Figure-4.



Figure-2: Magnetizing inductance and primary resistance

metin, iç mekan içeren bir resim

Açıklama otomatik olarak oluşturuldu

Figure-3: Leakage inductance,

metin, iç mekan, elektronik eşyalar içeren bir resim

Açıklama otomatik olarak oluşturuldu

Figure-4: Inductance of output inductor

# **Simulation Results**

# **Component Selection**