

**MIDDLE EAST TECHNICAL UNIVERSITY**

**DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING**

**EE 464 - Static Power Conversion II - Term Project**

**Social Isolation Inc.**

**Development of a DC-DC Converter for Battery Charging**

**Berkay Uzun - 2263812**

**Ali BELLİ - 2231421**

**Ahmet Halis Sabırlı – 223xxxx**

Table of Contents

[1.Project Definition 3](#_Toc70436224)

[2. Topology Selection 3](#_Toc70436225)

[3. Controller Selection 4](#_Toc70436226)

[4. Transformer Design 6](#_Toc70436227)

[4.1. Magnetic Core Design 6](#_Toc70436228)

[4.2. Winding Selection 6](#_Toc70436229)

[4.3. Finite Element Analysis 6](#_Toc70436230)

[5. Component Selection 6](#_Toc70436231)

[6. LTspice Simulation Results 6](#_Toc70436232)

[6.1 Steady-State Full-Load Responses 6](#_Toc70436233)

[6.2 Load Regulation 6](#_Toc70436234)

[6.3 Line Regulation 6](#_Toc70436235)

[7. Conclusion 6](#_Toc70436236)

[8. References 6](#_Toc70436237)

# 1.Project Definition

In electrical cars, inside the vehicle, there are two different electrical systems which are low voltage and high voltage. The use of low voltage is to run the low power and low voltage components of the vehicle such as monitor, audio player or fans of the cooling system. To be able to charge the low voltage battery, there is a need of DC/DC converter between high voltage and low voltage system. The main motivation of the project is to construct an isolated 100W DC/DC converter which steps down the 220-400 V input to the 12 V output.

# 2. Topology Selection

For the topology selection, there is only one main consideration which is the output power level. The selected topology must satisfy the output power and should not be over designed on it. To do that, we have made some research and found the source to decide the topology. From the information given in Table 1, there are 5 options [1].

Table 1- Power ranges of some of isolated DC-DC converter topologies

|  |  |
| --- | --- |
| **TOPOLOGY** | **POWER RANGE HISTORICALLY USED** |
| **Flyback** | <100 W |
| **Forward** | 50W-200W |
| **Active Clamp Forward** | 50W-300W |
| **Push-Pull** | 100W-500W |
| **Half-Bridge** | 100W-500W |
| **Full-Bridge** | >500W |

When we look at the options, the Full-Bridge is not suitable. In addition, we can see that Push-Pull and Half-Bridge may be over design for our application because the lower limit of them is satisfying the maximum power requirement of our system. Therefore, they are not suitable for our application. After that point, there are staying 3 different topologies. Forward and Active Clamp Forward has more component compared to the Flyback converter and the Flyback converters maximum power limitation is satisfying our power level. Because of these reasons, we decided to use the Flyback topology to design the DC-DC converter. In addition to them, Flyback is a widely used topology and there are a lot of sources and controllers for this topology in power electronics field. Therefore, easy implementation of the topology has also made us to choose this topology.

# 3. Controller Selection

For the controller selection, we have only found two different controllers of the Analog Devices for our application. One of them is Forward and the other one is Flyback converter. The main limitation on the controllers is the maximum input voltage. Although, we have checked so many different producers’ controllers, we did not find suitable controllers other than the LT8316 and LT3752-1. The main typical applications of the controllers are given in Fig.-1 and Fig.-2.

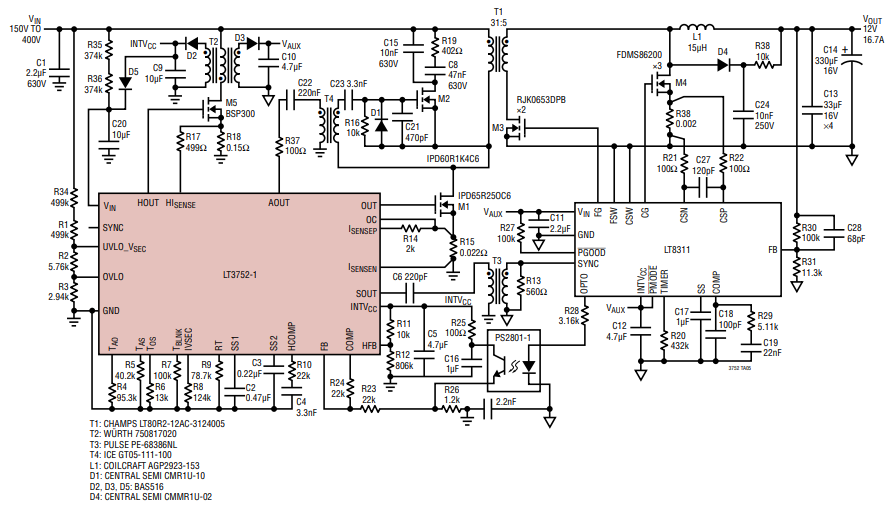


Figure-1 LT3752-1 Typical use

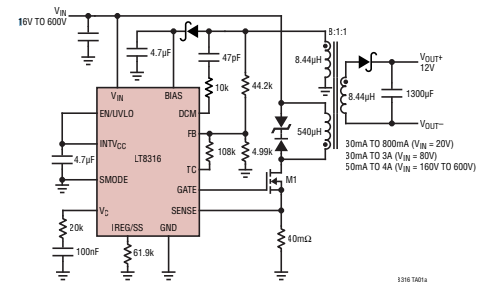


Figure-2 LT8316 Typical use

As the consideration given in the topology selection session, the Forward controller requires more component than the Flyback controller. Therefore, we have chosen the LT8316 DC-DC Flyback controller to develop the converter.

# 4. Transformer Design

## 4.1. Magnetic Core Design

## 4.2. Winding Selection

## 4.3. Finite Element Analysis

# 5. Component Selection

# 6. LTspice Simulation Results

## 6.1 Steady-State Full-Load Responses

## 6.2 Load Regulation

## 6.3 Line Regulation

# 7. Conclusion

# 8. References

1. Topology Key to Power Density in Isolated DC-DC Converters. (n.d.). Retrieved April 27, 2021, from <https://www.powerelectronics.com/technologies/dc-dc-converters/article/21854364/topology-key-to-power-density-in-isolated-dcdc-converters>