**Component Selection**

1. **Reasons Behind Selection**

**Bridge Rectifier**

We used KBPC3510 Bridge rectifier since it has a robust size and the limits it can withstand are high. Its operation boundary can reach around 35 A and 1000V which is adequate for our rectifier circuit since we rectified a voltage around 15 V-25V (line to line).

**MOSFET**

For power MOSFET we used **IRF540N** since it has a fast switching performance and wide operation range.

|  |  |  |  |
| --- | --- | --- | --- |
|  | VDS (Breakdown) | VGS | Rds(on) |
| IRF540N | 100 V | ± 20 V | 0.04 Ω |

**Buck Converter Diode**

For Buck Converter, we tried to choose it with high durability and suitable with step down voltage values. We used a schottky diode (MBR20100CT) in order not to handle with switching losses.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Forward Voltage | Max DC Blocking Voltage | Tj Max |
| MBR20100CT | 0.85 V | 100 V | 150 °C |

**PWM Controller IC**

For the design of analog controller we used TL494N IC since it can has an internal oscillator and error amplifiers to generate PWM signals and regulate them according to the feedback.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Supply Voltage | Temperature Range | Oscillator Frequency |
| TL494 N | 7V - 40V | -65 °C - 150 °C | 300 kHz |

**2. Used Components**

|  |  |
| --- | --- |
| COMPONENTS | PRICE |
| 35A 1000V Single Phase Bridge Rectifier \*2 | 35 TL\*2 =70TL |
| 1000uF 35V Aluminium Capacitor | 7 TL |
| TL494CN Integrerated Regulator Controller | 20 TL |
| 10 ohm 11W Stone Resistor | 12 TL |
| BD139 BJT (NPN) | 2.5 TL |
| BD140 BJT (PNP) | 2.5 TL |
| 470uF 50V Aluminium Capacitor | 5 TL |
| MBR10100G Schottky Diode | 27 TL |
| 0.1 ohm Sense Resistor(Stone) | 11 TL |
| 1nF Ceramic Capacitor | 1.30 TL |
| 2.5 uF Capacitor | 21TL |
| 13 Standard Resistors (1/4W) | 0.30 TL \* 13 = 3.90 TL |
| 50 mH Inductor | 80 TL |
| [647-10ABEP](https://www.digikey.co.uk/en/models/2580183) Heatsink \* 2 | 45TL \* 2 = 90 TL |
| TOTAL | 353.20 TL |

**Thermal Calculations**

When the load is connected, the components will heat up, which could lead to component damage. This necessitates the need for thermal calculations, which will determine the heatsink selection. The simulation was used to make this calculation. Calculation are made according to the upper boundary voltages, 10 A output current and switching frequency of 250 kHz.

# For Bridge Rectifier Diode (KBPC3510 35A 1000V Bridge Diode)

We used two of these diodes for the three-phase rectification. In one of them, we used 2 AC inputs and in the other one, 1 AC input is used so we looked at the thermal value for rectifier with two inputs in order to handle the safer situation.

### RthJA = 2.1 °C / W

𝑃rectifier = 15.57 W

𝑃rectifier \* Rja = 32.7 °C = Tloss

Ttotal = Tambient + Tloss = 25 °C + 32.7 °C = 57.7 °C

This temperature is suitable since the operation temperature of this rectifier is between -55 C° to + 150 C°.

**For MOSFET ( IRF540N)**

𝑃MOSFET = 12.06 W

RthJA = 62 °C / W

RthJC = 1.0 °C / W

𝑃MOSFET \* Rja = 747.72°C = Tloss

Ttotal = Tambient + Tloss = 25 °C + 747.72 °C = 772.72 °C

This is a very dangerous temperature for the MOSFET, so thermal paste and heat sink should be used.

RthCS = 0.50 °C / W

(RthCS+ RthJC)\* Tloss = 1.5 °C/ W \* 12.06 W = 18,09 C°

maden içeren bir resim

Açıklama otomatik olarak oluşturuldu

Figure a. BOARD LEVEL 647 SERIES HIGH-PERFORMANCE HEAT SINK

metin, çizgi, diyagram, öykü gelişim çizgisi; kumpas; grafiğini çıkarma içeren bir resim

Açıklama otomatik olarak oluşturuldu

For around 12 W Power dissipation, Heat sink temperature reaches to around 43 °C above the ambient temperature. Moverover we used a thermal paste with Rth,ch = 0. 8 ° C / W .

Rth,ch \* Ploss = 0. 8 ° C / W \* 12 W = 9.65 ° C

Toverall =25 ° C (Ambient) + 18.08 ° C + 43 ° C+ 9.65 ° C = 95.73 ° C

Our MOSFET has an operation temperature range between -55 °C to + 175 °C. So our cooling operation is succesfull without any forced convection.

**For Schottky Diode (MBR20100CT)**

RthJC = 2.5 °C / W

RthJA =60 °C / W

Ploss= 5.6 W

Ploss \* RthJA =336 °C = Tdissipated

Tambient + Tdissipated = 25 °C + 336 °C = 361 °C

This is a very dangerous temperature for our Schottky Diode, so again thermal paste and heat sink should be used.

RthJC = 2.5 °C / W

RthCS  = 0.5 °C / W

(RthJC + RthCS )\* Ploss = 3 °C / W \* 5.6 W = 16.8 °C

For the component selection simplicity we used the same heat sink and thermal paste.

Temperature difference fort he thermal paste can be calculated as belove:

Tpaste= Rth,ch \* Ploss = 0. 8 ° C / W \* 5.6 W = 4.48 °C

Since we used same Heat Sink (Board Level 647 Series High-Performance), temperature reaches 25 °C above the ambient temperature.

metin, çizgi, diyagram, öykü gelişim çizgisi; kumpas; grafiğini çıkarma içeren bir resim

Açıklama otomatik olarak oluşturuldu

Toverall =25 ° C (Ambient) + 16.8 ° C + 25 ° C+ 4.48 °C = 71.28° C

Our Schottky has an operation temperature range between -65 °C to + 150 °C. So again our cooling operation is succesfull without any forced convection.