Low Voltage Power Supply FST07e With DCM dc/dc converter

1 Introduction

In this report it's described the solution used to power supply the low power consumption circuit, in order to avoid the use of an extra battery, reduce the weight and reduce the conection complexity. In Figure 1 is shown how will be implemented the new power supply system without the use of an extra battery.

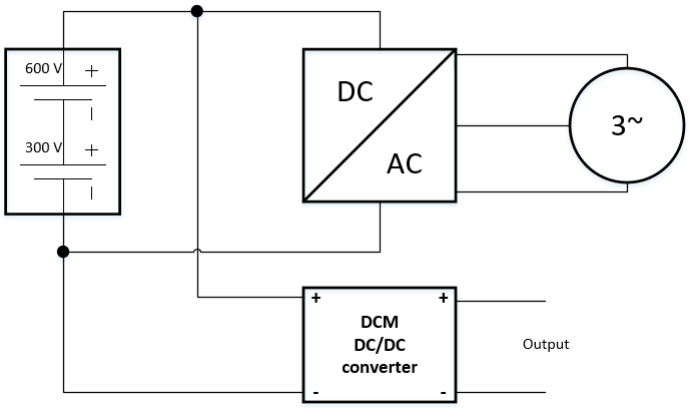


Figura 1: Low power supply system blockdiagram.

As shown in Figure 1, this system is connected in parallel to the battery. In Figure 2 is represented the schematic of the Low power system power supply.

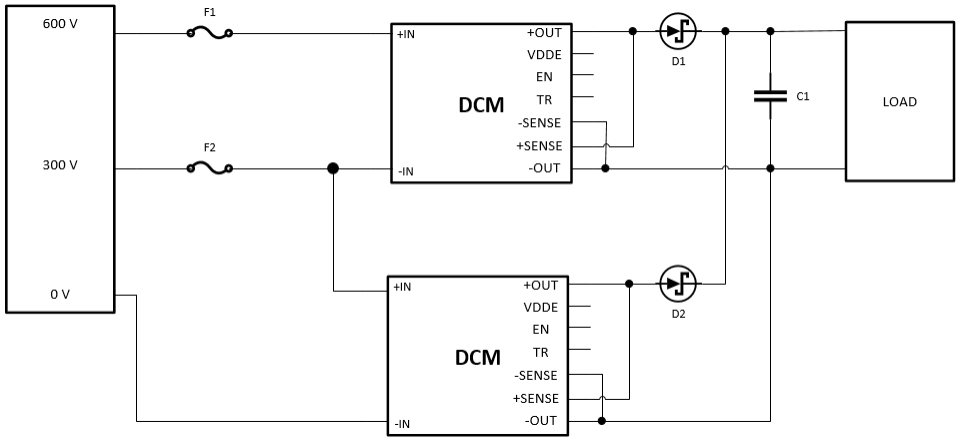


Figura 2: Low power supply system schematic.

2 Protection

The first think to do in this kind of system is to choose the right method to protect the circuit, in other words, choosing the right components to protect the devices. For the protection circuit were chosen fuses, as the protection circuit used in the battery and it was recommended by the manufacturer the use of fuses.

"Input line fusing is recommended at the system level, in order to provide thermal protection in case of catastrophic failure."

The fuses chosen were the, **BUSSMANN BY EATON FWH5-005A6F Cartridge Fuse, FWH Series, 5 A, 500 V, 6.3mm x 32mm, 1/4"x 1-1/4", 50 kA**, from the manufacturer **BUSSMANN BY EATON**, model: **FWH-005A6F**. This fuses have the follow specifications:

- **Maximum Current**: 5A;
- **Maximum DC Voltage**: 600V;
- **Maximum AC Voltage**: 500V;
- **Power Losses**: 2.1W;
- **Interrupting Rating**: 50kA DC;
- **Pre-arcing**: $15A^2s$.

This fuses have Low arc voltage and low energy let-through I^2t, have an excellent cycling capability and DC performance and as in the specifications, they have a low loses.

Another protection device used in this device is the **Schottky diode**. The schottky diode are in series with the output of each converter, in order to, prevent the inverse current to damage the DCM converters, as shown in Figure 2. The schottky diode used is the VBT3045BP-E3, from Vishay General Semiconductor. The schottky diode used has the follow specifications:

- IF(DC): 30 A;
- VRRM: 45 V;
- IFSM: 200 A;
- VF at IF = 40 A: 0.51 V;
- TOP max. (AC mode): 150 °C;
- TJ max. (DC forward current): 200 °C;
- Package: TO-263AB;
- Diode variation: Single die.

In Figure 3 is illustrated the Schottky diode VBT3045BP-E3 and pinout of the device.

(a) Schottky diode VBT3045BP-E3.

(b) Schottky diode pinout.

Figura 3: Schottky diode VBT3045BP-E3 and pinout of the device.

3 DC/DC converters specifications

The dc/dc converter used is the DCM Series 300V-24V VIA packaging, this converter was chosen, due to the efficiency, the input voltage range and output voltage, short-circuit protection, over voltage protection, under voltage protection, thermal protection and due to the reduced dimensions. In the Figure 4 is shown the packaging of the DC/DC converter.

Figura 4: DC/DC converter packaging.

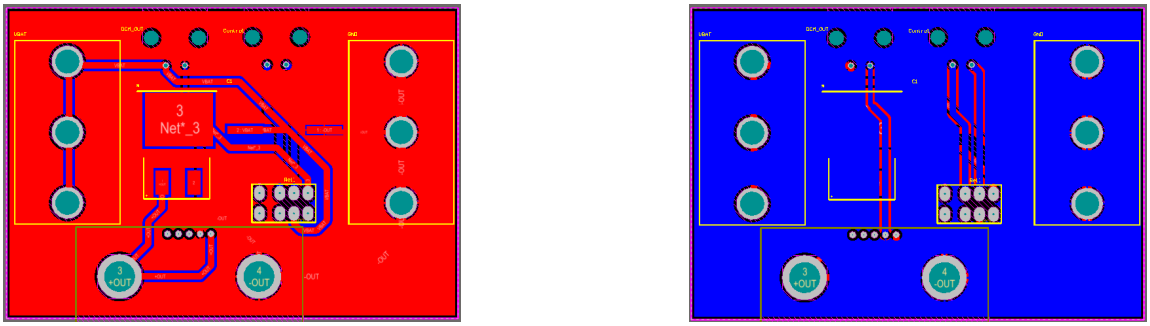
In Table 1 is shown the characteristics of the DCM converters.

Tabela 1: DCM characteristics.

Manufacturer	Vicor Power
Model	DC/DC Converter DCM Series 300V-24V VIA packaging
Part number	DCM3714VD2H26F0C01
Nominal Power	600 W
Output current	25 A
Power density	309 W/in3
Protection	Safety Extra Low Voltage (SELV) Short circuit and thermal protection
Input voltage range	200-420 V DC
Output voltage	24 V DC
Dimension	3.750” x 1.400” x 0.370” (95.13 mm x 35.5 mm x 9.30 mm)

4 Schematics and Layouts

This system is divided in two PCBs, one of the PCBs is called the Main DCM wich as the capacitor and is the PCB that has the headers to provide power supply to the low voltage system. The other PCB is called the DCM 2, and has one connector to connect to the Main DCM. This situation is illustrated in the the following Figures.



(a) Top Layer.

(b) Bottom Layer.

Figura 5: Layout of the DCM main PCB.

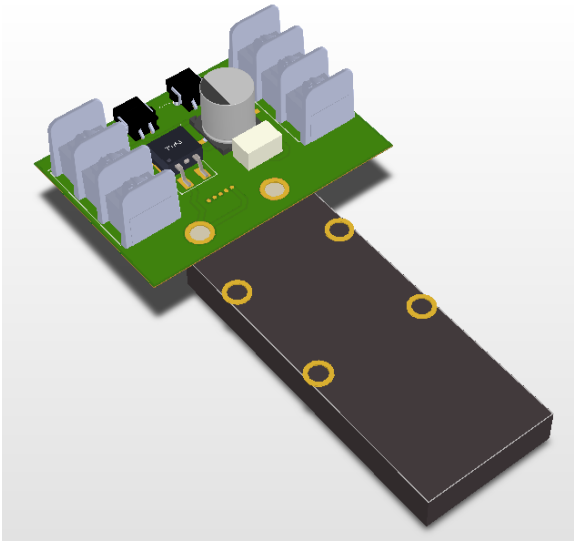


Figura 6: 3D view of DCM main PCB.

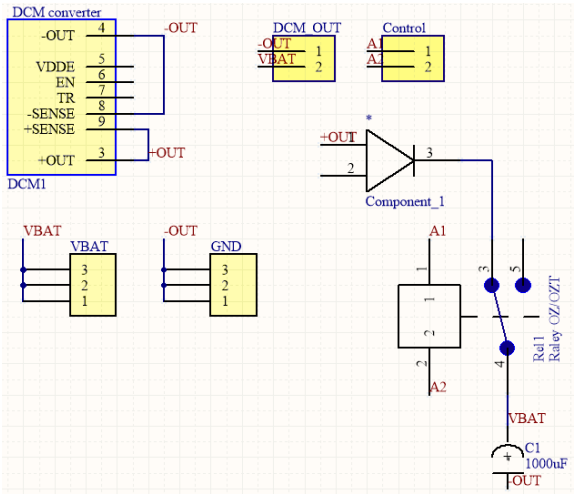
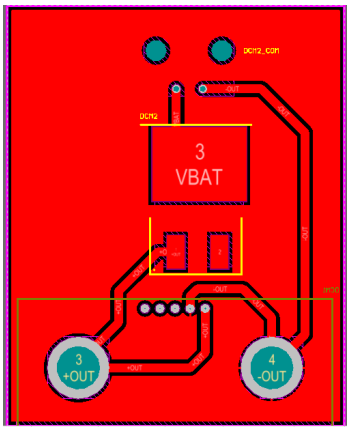
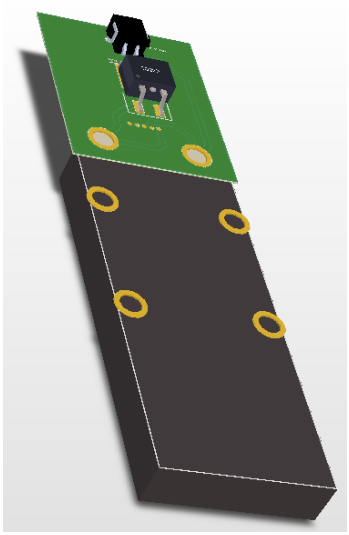


Figura 7: Schematic of the DCM Main PCB.

DCM 2 PCB



(a) Top Layer.



(b) 3D view of DCM 2 PCB.

Figura 8: Layout of the DCM 2 PCB.

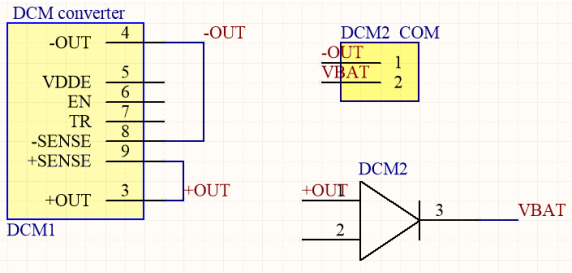


Figura 9: Schematic of the DCM 2 PCB.