Project plan:

Battery to Low Voltage Bus Power Converter

# Introduction

This document introduces the constraints and requirements for the design for the Battery to Low Voltage Bus Power Converter.

It is not a requirement that a single power converter delivers the entirety of the power to the low voltage bus.   
There are as of right now no real constraints on the number of low voltage converters.  
The argumentation for having multiple or even dedicated ones for particularly critical systems is not out of the question but that is needed to be investigated.  
isolating the low voltage bus may also be advantageous as the DC bus would otherwise become very long, potentially causing EMI problems.

Additionally, if several poorly filtered components are attached to the 12V supply they might cause EMC problems by sending noise back on the line.

# Voltage supply and delivery constraints

We assume the battery voltage won’t exceed 144V as that is the voltage rating for the motor which is powered from this, via a controller and driver.

We also expect that the battery will be designed such that its maximum voltage is below 120V as that is the maximum rating for the current motor driver that is to be used. The KLS96601-8080IPS with the ME1616 IP67 motor

The output voltage of the low voltage power supply should be 12V.

Because of these constraints from the motor driver, the voltage of the battery CAM72FI will vary between:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Cells | Maximum voltage single cell | Minimum voltage single cell | Total maximum voltage | Total minimum voltage |
| 32 | 3,65V | 2,5V | 116,8V | 80V |

To futureproof the design the converter should be designed such that it can handle a significantly higher input voltage than 144V in case a higher voltage battery or motor driver is found.

Additionally, it would be convenient if the converter, if combined with a filtered rectifying bridge, could be connected to European Mains 230Vrms but 160V(144V+10%) may be an upper limit if 230Vrms is beyond the scope of this project.

Safety bounds for the minimum voltage are unknown for now (please add them when known) but the converter should at least be able to handle 70Vm(80V-10%)

# Expected power consumption of low voltage bus:

The powerdraw from the peripherals listed below is found to be:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| System | Lights | | | | | Cooling | | Audio System | Total |
| Subsystem | Head | Tail | Fog | Blink | Controller | Pump Motor | Pump Battery |
| Power [W] | 30.6 | 7 | 31 | 2.5 | 5 | 25 | 25 | 25-50 | **151,1-176,1** |

## Lights:

### Head lights

Philips LED Headlights consume 23W.

LEDriving HL H4 Gen2 consume 14W nominally and at most 15.4W and are high beam LED’s (fjernlys LED’er)

We will need 2 of these for a total of:

30.8W

### Rear lights

The power consumption is probably lower for the rear lights

* Example:
* STL8RB
  + <https://www.etrailer.com/p-STL8RB.html>
  + Specs:
    - Rear lights run at 12V
    - Configuration: passenger's side
      * Driver's side: STL9RB (sold separately)
    - Dimensions: 5-1/16" wide x 4-9/16" tall x 2-5/8" deep
      * Light face: 4-9/16" wide x 4-9/16" tall
    - Distance between mounting studs (center on center): 2"
    - Diodes: 14
    - Power draw at 12.8V:
      * Stop light: 0.259 amps
      * Side marker light: 0.062 amps (Normal Rear Light)
      * Resulting in:
        + 3,3152W Stop light
        + 0,7936W Side marker light (Normal Rear Light)
    - Lifetime warranty on LEDS
* Two rear lights will be used to my knowledge

This, for the time being results in:

7W

### Fog lights

Unresearched

## Philips X-tremeUltinon gen2 LED Fog Lights H8/H11/H16 (Twin) https://www.powerbulbs.com/eu/product/x-tremeultinon-gen2-led-fog-lights-h8-h11-h16-twin

Er 15.5W stykket som så er:

31W i de hele.

### Blink/hazard lights

Unresearched but probably similar to rear light when on normally. Therefore, in total probably 2.38W if all 6 are on, blinking in half periods.

### Light Drivers

Unresearched, but Texas Instruments has some LED drivers and DTU Roadrunners have a light driver board that should be looked into to see if we can use it or borrow large parts of it for the future. The LED Drivers hopefully don’t draw more than 5W in total for all the peripheral lights.

5W

## Cooling Systems

### Pumps for motor and motor driver cooling:

Based on the assumption that we will need a pump that can deliver 1200L/h of fluid at a reasonable pressure, two or more 0 392 023 232\* must be used from the bosh Electric motor catalogue.

They each, at most draw 1A@12V à 12W. Therefore, the total power consumption from the pumps, including their controller, probably drawing less than 1W, at most:

25W

### Pumps for battery cooling

Reading “Investigation of the Internal Resistance in LiFePO4 Cells for Battery Energy Storage System” it says from a quick read that the cells can have a resistance of 13 to 15 or so mOhm. With the maximum current draw being 576A for 30 seconds as we plan on having two cells in parallel, the power draw will be:

The expected power loss in the motor is similarly at most 3kW

### Air Cooling of Batteries

Therefore, the expected energy required to cool the batteries is:

25W

## Audio System

We don’t expect to implement an audio system in the initial car but if the power budget allows for it, we will probably spend 25 or at most 50W on an audio system.

25-50W