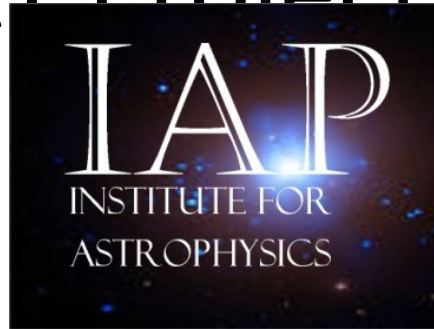


بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# IAP Space Program 2013-2015 (IAP SAT Project Report 1)



A member institute of AECENAR  
[www.aecenar.com/institutes/iap](http://www.aecenar.com/institutes/iap)



IAP space Program 2013 - 2015

# Program Overview

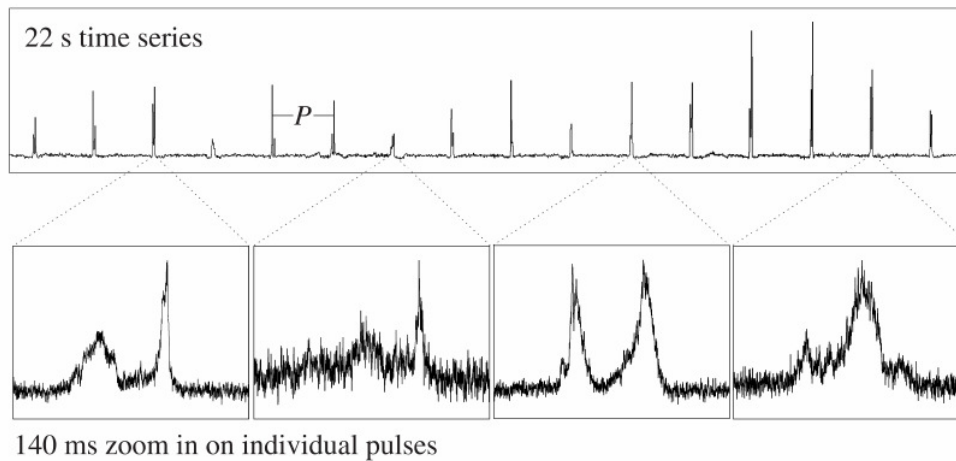
Scientific Program

Satellite Design and Construction

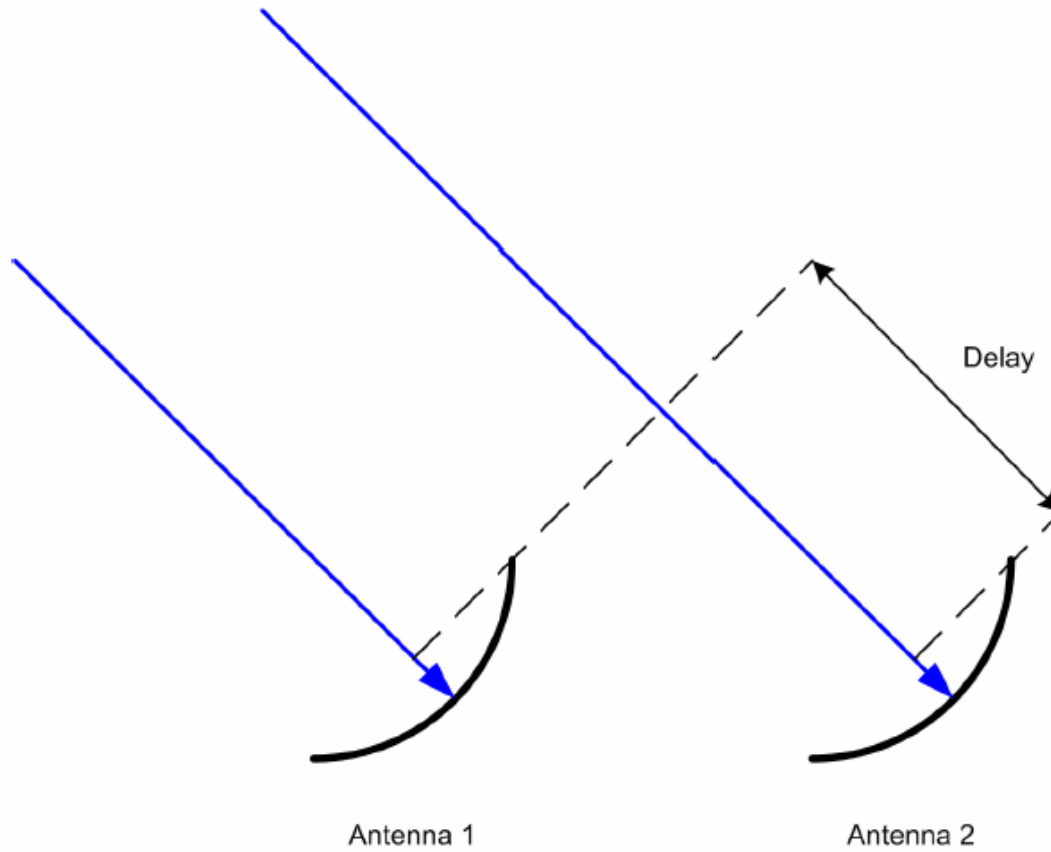
Design and Construction Shuttlesystem

# Scientific Program

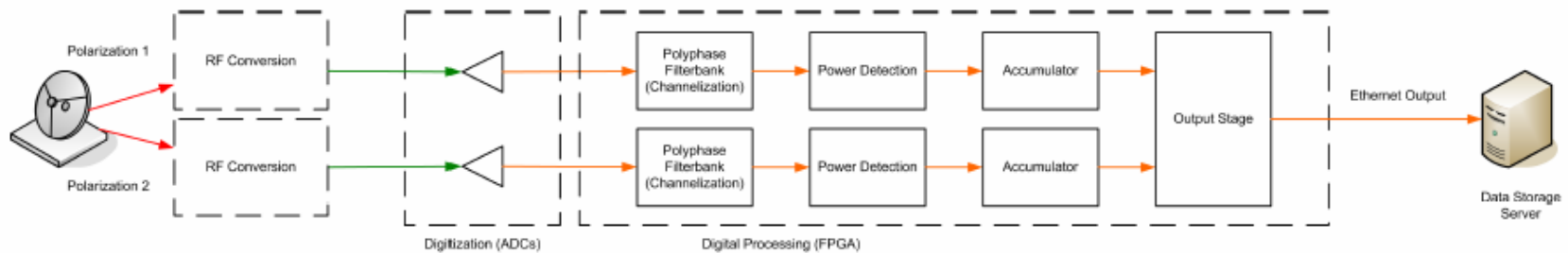
## Pulsar radio astronomy



# Scientific Program



# Scientific Program



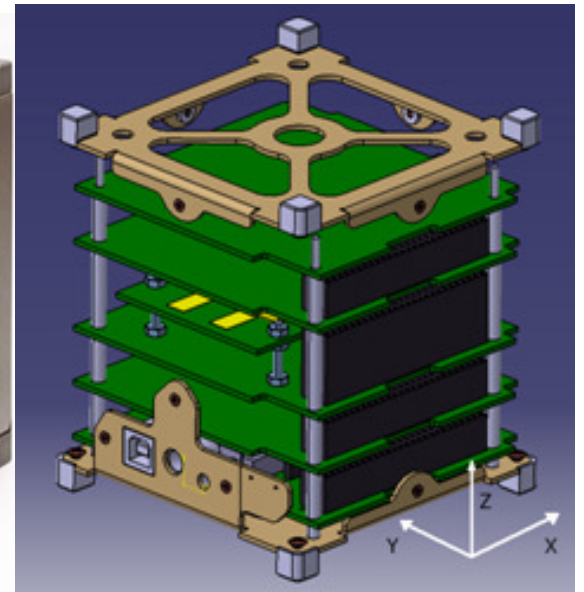
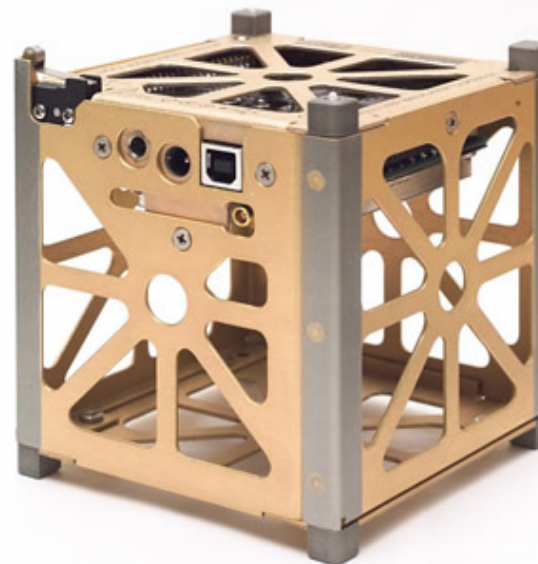
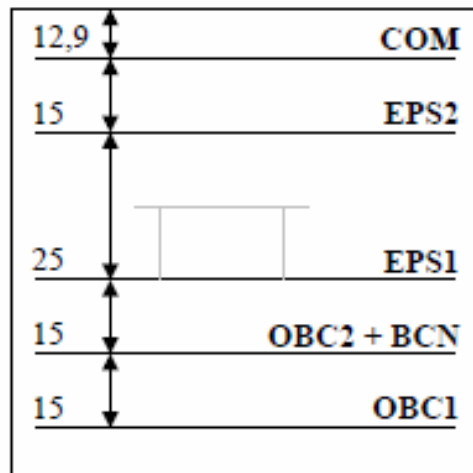
# Satellite Design and Construction

- [Die Architektur einer Satellitenmission](#)
- [Der Entwurf einer Satellitenmission](#)
- [Entwurf und Planung eines Satelliten](#)
- [Entwurf des Energieversorgungssystems](#)
- [Entwurf des Lageregelungssystems](#)
- Entwurf des Antriebssystems
- [Performance Evaluation of Propulsion Systems](#)
- [Excercise: Propulsion System Selection](#)
- [Table for Excercise Results](#)
- [Description of the Analysis Tool](#)
- [Entwurf der Funkverbindung](#)
- [Entwurf des Borddatenverarbeitungssystems](#)
- [Entwurf des Thermalkontrollsystems](#)
- [Entwurf der Struktur und Mechanismen](#)
- [Zuverlässigkeit und Produktsicherung](#)

# Satellite Design and Construction

## Entwurf und Planung eines Satelliten

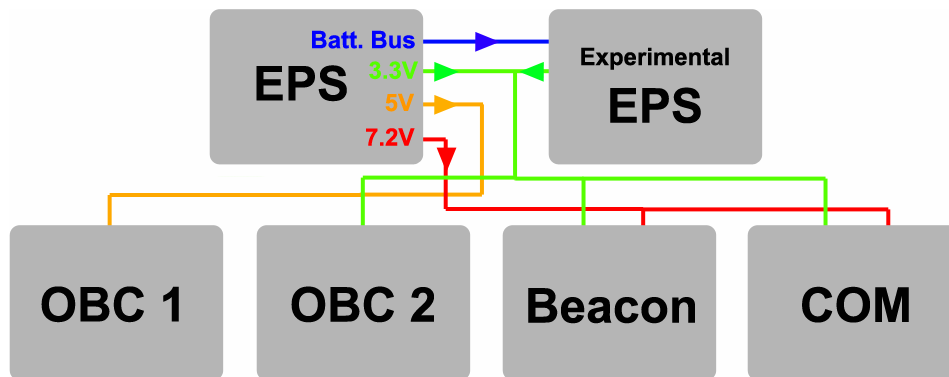
Base: **10 ccm Student Nanosatellite OUFTI-1 of University of Liège**  
(OUFTI-1 is designed for communications in D-STAR, an amateur-radio communication protocol)



# Satellite Design and Construction

## Entwurf des Energieversorgungssystems

- base: Pierre THIRION, Design and Implementation of On-board Electrical Power Supply of Student Nanosatellite OUFTI-1 of University of Liège (Master Thesis)

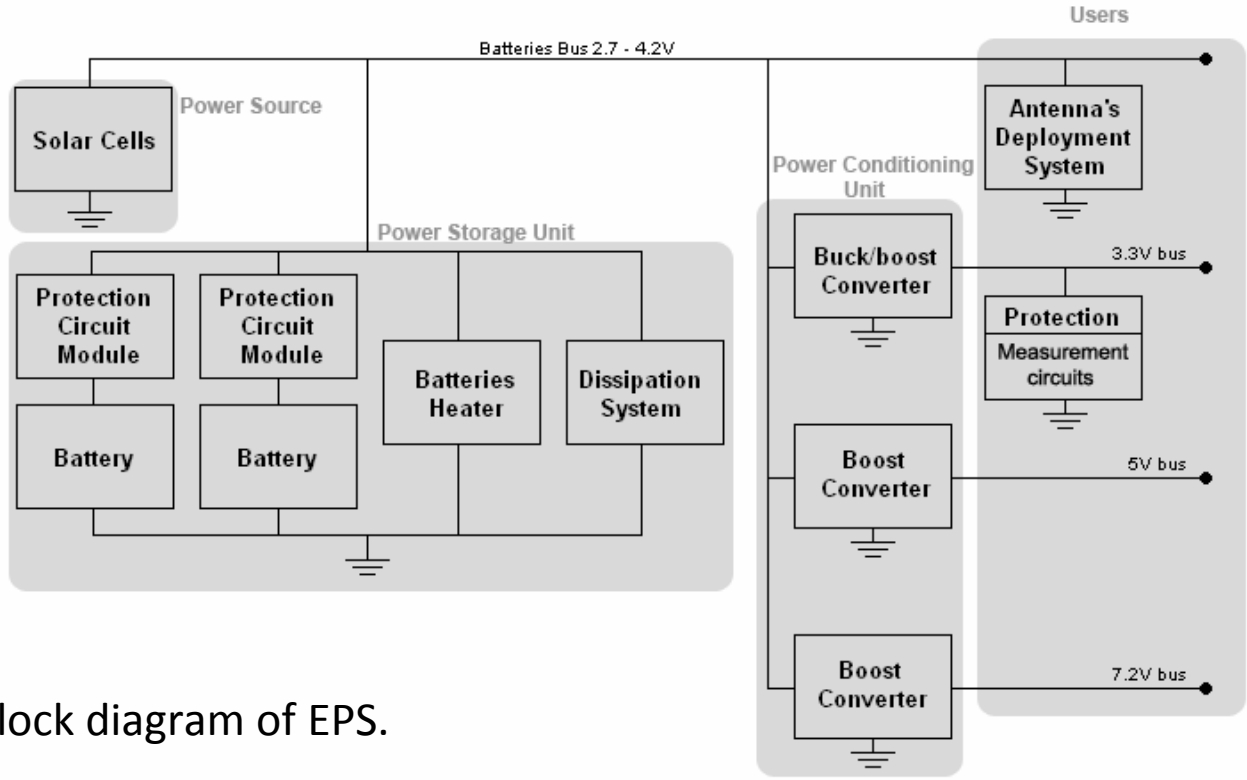


OUFTI-1 subsystems and power buses



# Satellite Design and Construction

## Entwurf des Energieversorgungssystems

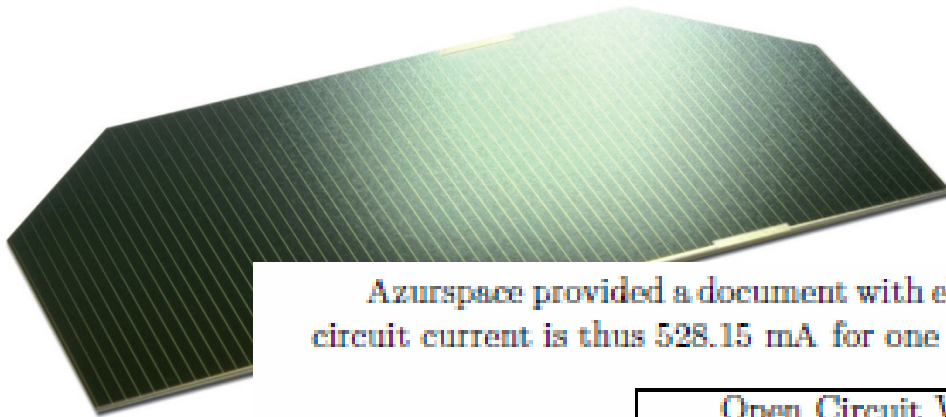


Block diagram of EPS.

# Satellite Design and Construction

## Entwurf des Energieversorgungssystems

3G - 28% solar cell from AzurSpace



The commercialized model, the “3G - 28%”, has an efficiency of 28% at Begin Of Life (BOL), the dimensions of the solar cells are 80mm x 40mm with cropped corners, for a total surface of  $30.18\text{cm}^2$ .

Azurspace provided a document with electrical data for the 30% cells (table 3.1). The short circuit current is thus 528.15 mA for one cell, and the current at max. power is 513.06mA.

Open Circuit Voltage $V_{OC}[\text{mV}]$	2,716
Short Circuit Current $J_{SC}[\text{mA}/\text{cm}^2]$	17.5
Voltage at max. Power $V_{pmax}[\text{mV}]$	2,427
Current at max. Power $J_{pmax}[\text{mA}/\text{cm}^2]$	17.0
Maximum Power $P_{pmax}[\text{mW}/\text{cm}^2]$	41
Average Efficiency $\eta_{BOL}[\%]$	30.1

Table 3.1: Electrical characteristics of Azurspace 3G - 30% solar cells at  $28^\circ\text{C}$  and for the AM0 spectrum [23].

# Satellite Design and Construction

## Entwurf des Energieversorgungszsystems

### Electrical Design of EPS

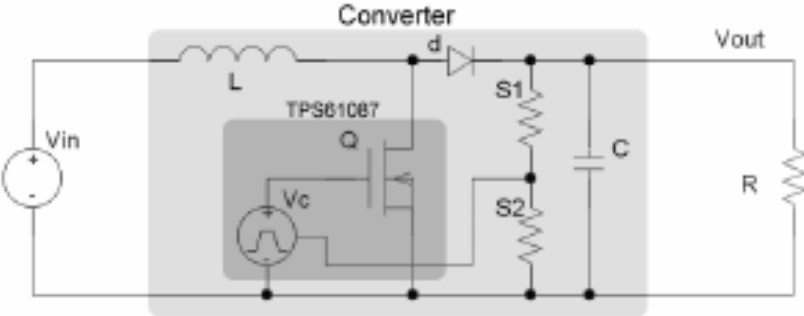


Figure 5.6: Simplified schematics of the 7.2V converter.

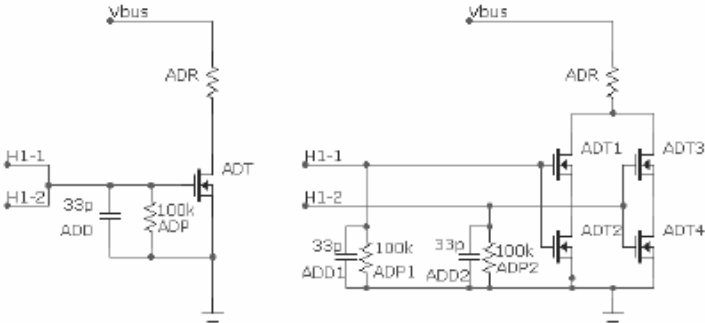


Figure 5.42: Propositions for the antennas deployment system.

# Satellite Design and Construction

## Entwurf des Energieversorgungszsystems

### Matlab code for the I-V curves of solar panels

The first function gives the current in one solar cell as a function of the voltage (in V), the insolation G (with  $G_{nom} = 1350W/m^2$  as unity), and the temperature (in C).

```
function I = Cell_GaAs(V,G,TaC)
%Code produced by the team from the CubeSat SwissCube
%and modified by Philippe Ledent (OUFTI-1) (september 2008)
% Pierre Thirion (OUFTI-1) (april 2009)
%
%Model of 30% efficiency solar cell from Azurspace : I=f(V,T)
%Use of function : I = Cell_GaAs(V,G,TaC)
%V = Voltage on cell terminals [V]
%G = relative insolation [-] (G=1 => 1367 W/m^2)
%TaC = temperature of the cell in operation [Celsius]
%Boltzman constant
k = 1.38e-23;
%Electric charge
q = 1.60e-19;
.....
.....
```

# Satellite Design and Construction

## Entwurf des Energieversorgungszsystems

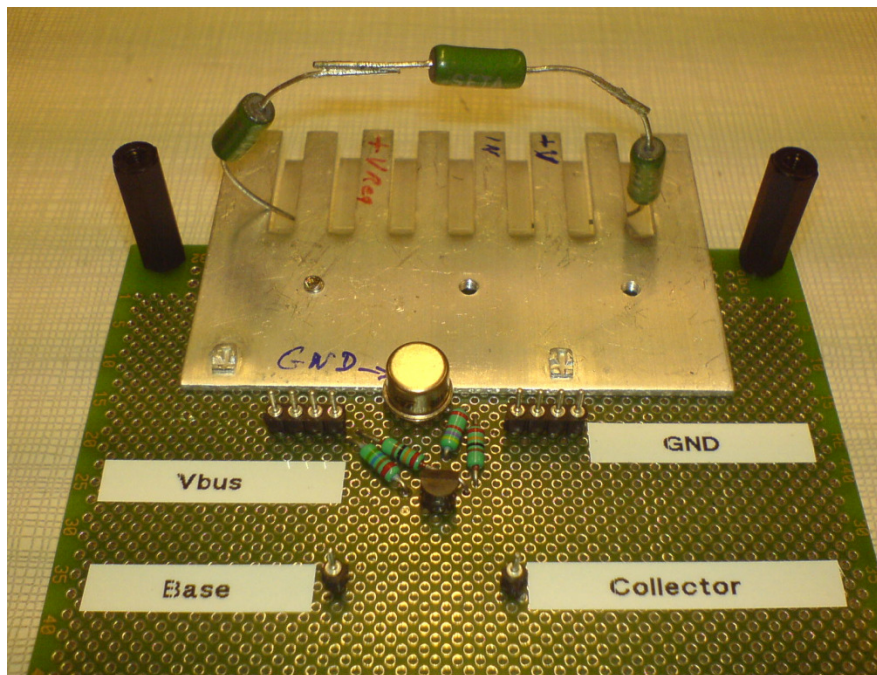


Figure C.1: Prototype of the shunt regulator.

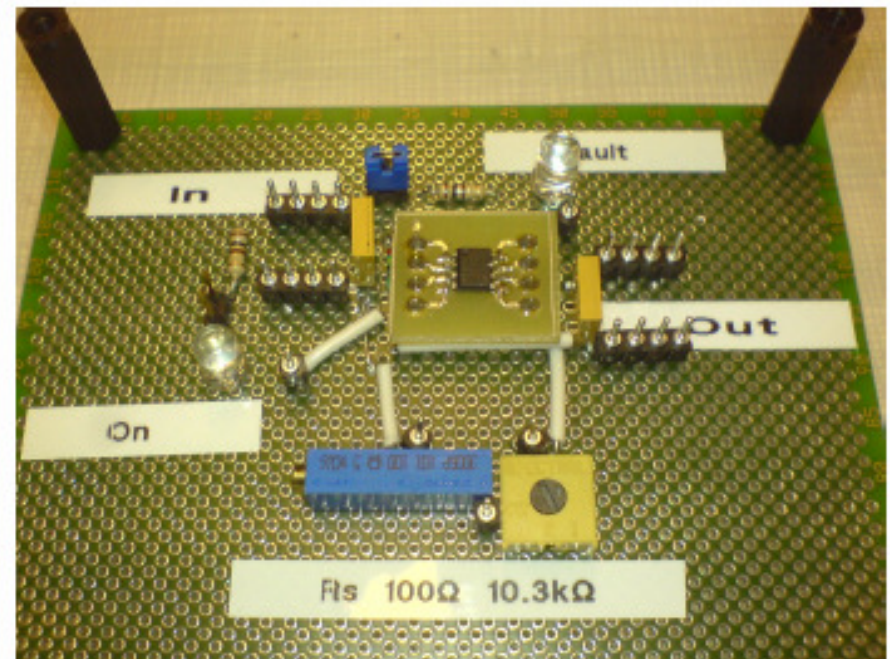


Figure C.2: Prototype of the protection circuit.

# Satellite Design and Construction

## Entwurf des Energieversorgungszsystems

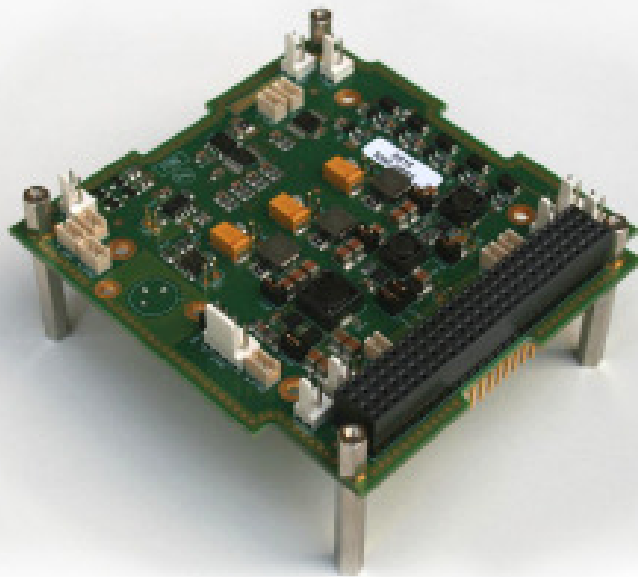
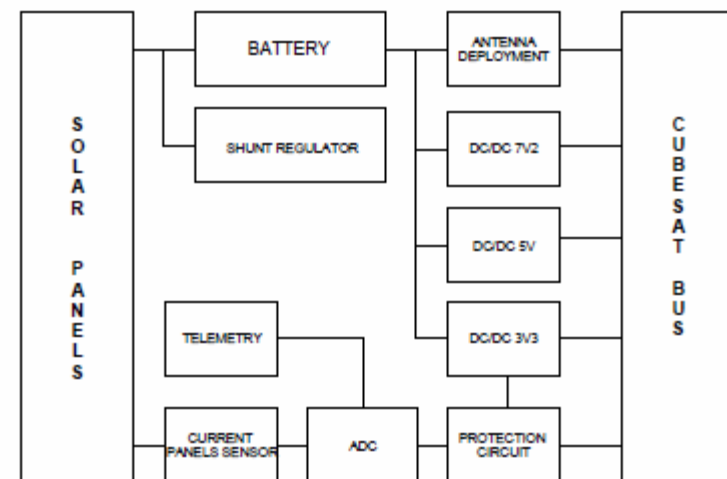


Figure C.3: Engineering model of the EPS card.

DESIGN TOP LEVEL :



# Satellite Design and Construction

## Entwurf des Lageregelungssystems