Electrical Ground Support Equipment (EGSE)

EGSE - Wiring and Setup

The main objective of this section is to document and explain how to proceed with the wiring of the different parts of the EGSE to use it correctly. Additionally, it will explain the fundamentals for operating it properly.

The EGSE does not have all the SSVs interconnected by default, so we will need to create cable buses to interconnect the SSVs, we also need to prepare some special pieces to hold certain parts, such as the solar panels and the bottom board with the kill switches.

Next, we can see an render of the EGSE without connections and without any SSVs. Therefore, we will proceed with documenting the necessary interconnections for the EGSE and the properties it offers
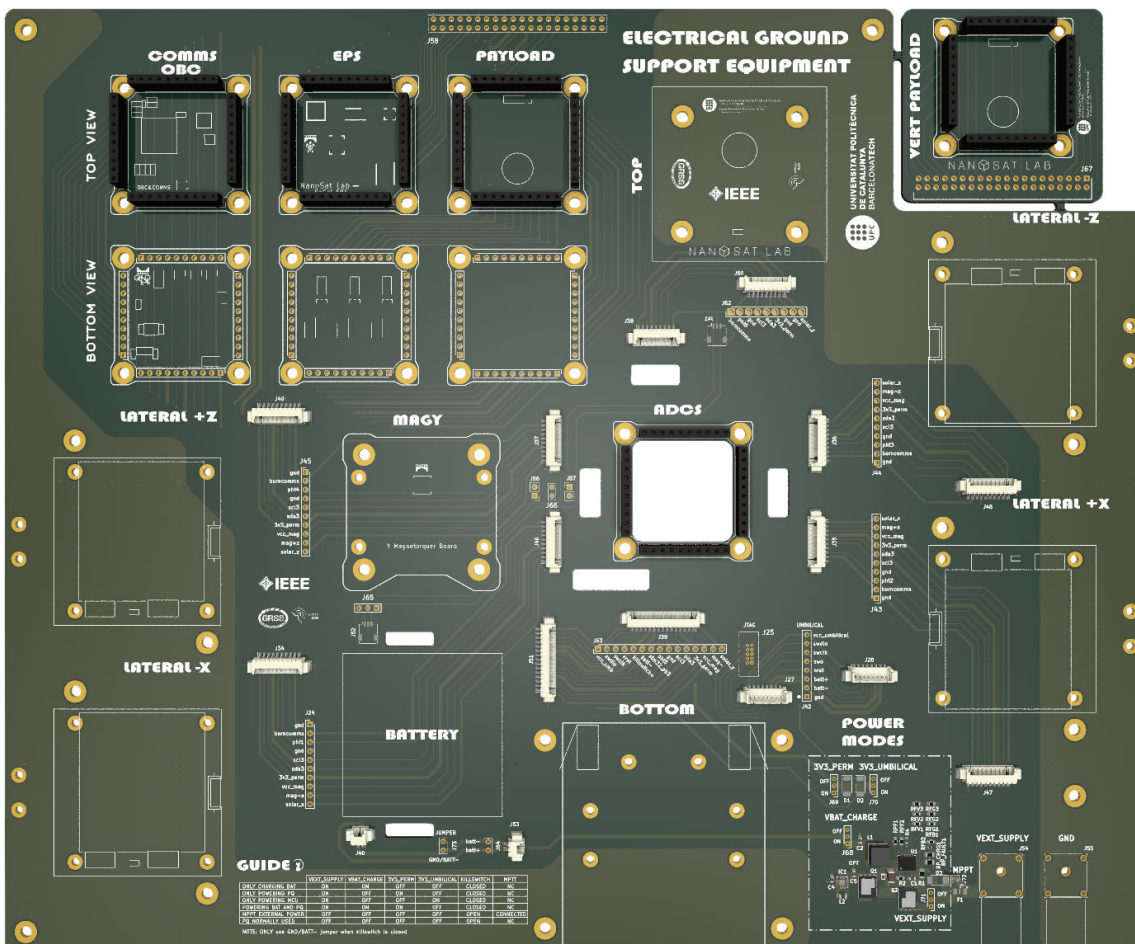
1. Cable bus

First, we need to prepare the interconnection buses, so we will start by creating these using mainly PicoBlade and PicoClasp connectors (Before making the cables, we will need to ensure they have the correct length)

ID	From	Num of cables	Connector	To	Num of cables	Connector	Lenght (mm)
1	Lat +Z	10	PicoBlade	PCB Connector	10	PicoBlade	
2	PCB Connector	10	PicoBlade	ADCS	10	PicoClasp	
3	Lat -Z	10	PicoBlade	PCB Connector	10	PicoBlade	
4	PCB Connector	10	PicoBlade	ADCS	10	PicoClasp	
5	Lat +X	10	PicoBlade	PCB Connector	10	PicoBlade	
6	PCB Connector	10	PicoBlade	ADCS	10	PicoClasp	
7	Lat -X	10	PicoBlade	PCB Connector	10	PicoBlade	
8	PCB Connector	10	PicoBlade	ADCS	10	PicoClasp	
9	Battery	2	PicoBlade	-	-	-	
10	PCB Connector	2	PicoBlade	Bottom Board	2	PicoBlade	
11	Battery Heater & NTC	3	PicoClasp	-	-	-	
12	PCB Connector	3	PicoClasp	ADCS	3	PicoClasp	
13	Umbilical	8	PicoBlade	PCB Connector	8	PicoBlade	
14	Bottom Board	15	PicoBlade	PCB Connector	15	PicoBlade	
15	PCB Connector	15	PicoBlade	ADCS	15	PicoClasp	
16	Top Board	9	PicoBlade	PCB Connector	9	PicoBlade	

| 17 | PCB Connector | 9 | PicoBlade | ADCS | 9 | PicoClasp | |

The +Y magnetometer with the ADCS has to be connected through a simple wire; there is no connector between these parts.

Each cable should be approximately the length specified in the table, which serves as a reference for the cable lengths used in the poCat-LEKTRON EGSE.

In this following diagram, we see the cables we just constructed indicated by black lines. These lines represent which parts of the EGSE will be wired. The colors indicate that they belong to the same part.

If we look closely, all the colored areas are not connected by default; we connect them using the cables we just made
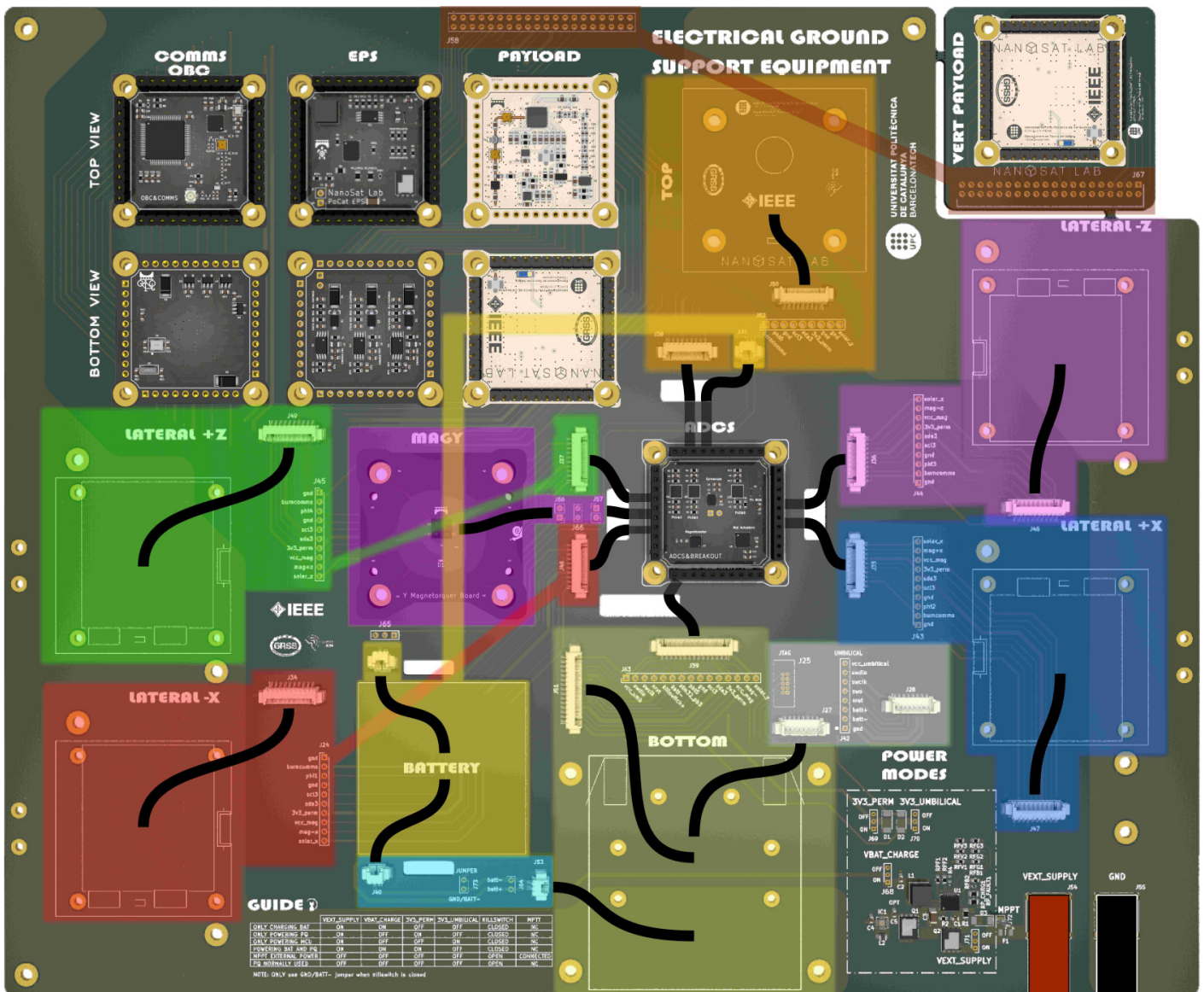
EGSE - Design Specifications

Document scope

This document specifies the electronic and mechanical aspects necessary to understand and operate the Electronic Ground Support Equipment. Specification and objectives of the EGSE are defined, as well as the board components and power modes available.

Equipment description and objectives

The Electrical Ground Support Equipment (EGSE) in a nutshell is a PCB (Printed Circuit Board) to facilitate testing, debugging and maintenance of the PocketQube on the ground. EGSEs in general consist of hardware and/or software elements that perform satellite tests, simulating the missing (sub)system interfaces to ensure full compatibility once integrated into the overall platform.

To achieve it, should allow the placement of all the PCBs contained in the disassembled PocketQube, making all the PCBs accessible and giving access to all the signals of the PocketQube.

Design specifications

Specifications
Allows the placement and connection of the PQ completely disassembled, complying with PQ boards dimension.
Allows the placement of the PQ boards on top and bottom view to facilitate the testing.
Includes accessible test points for all PQ signals.

| |
|---|
| Added an external power supply with a protection circuit for overcurrent, overvoltage and reverse polarization. |
| The external power supply feeds the PQ itself and also charges the battery. For that reason, the EGSE includes the battery charger and EPS regulator of the design, to ensure similarity during the tests. |
| Includes a power management circuit with which, by means of jumpers, the type of supply to be used can be selected. Fig1 |
| Added a connector for programming the MCU, a standard connector such as JTAG. |
| Include lateral boards sliders printed parts to move them away from the EGSE and avoid overheat the EGSE when recharging the cells with a solar lamp. |
| Include bottom board slider printed part to activate and deactivate the kill switches. |
| Add some space and mounting holes for standoffs and the printed 3D parts. |
| Allows vertical positioning of the payload to facilitate antenna deployment, including a vertical connector and a little board adaptor. |
| The project must be carried out in KiCad as it is an open-source tool. |

0.1. Board overview
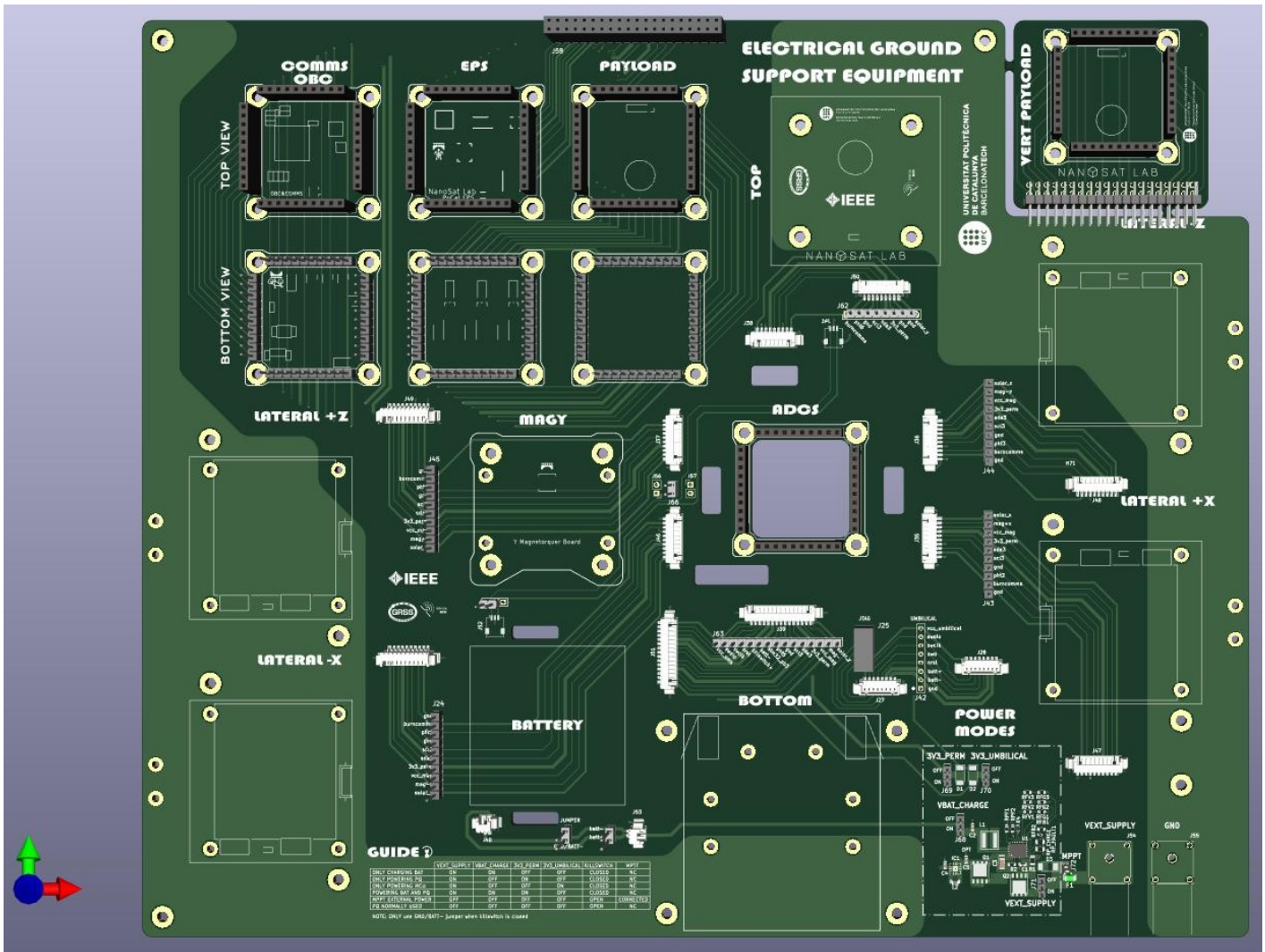
Fig1. EGSE 3D view
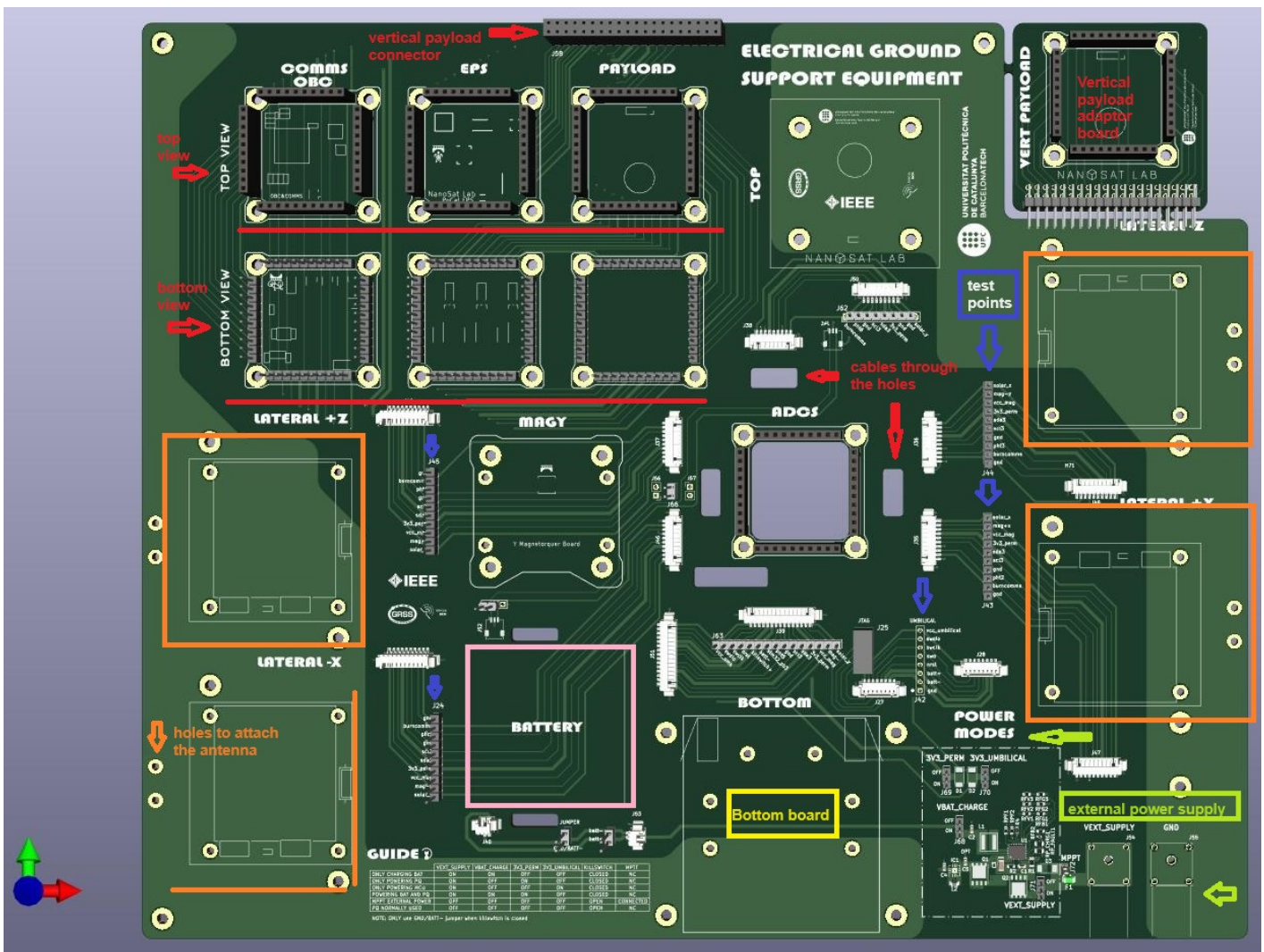
Fig2. EGSE 3D view annotations

- **Red**: COMMS/OBC, EPS and PAYLOAD placements. There are two sockets that allow top or bottom view,
  the position can be set following the printed footprint on the board. On top right there is a small board adaptor that
  can be split off the EGSE and used to place the payload in vertical position pointing outwards to deploy any antenna
  if needed. The vertical payload connector is on top center of the EGSE. There are also some holes on the board that
  permit to pass through the cables on the ADCS, the position of the ADCS should be attached under the EGSE with
  the picoblades connectors facing downwards so that the ADCS components can be seen from above.
- **Blue**: Available test points, on the top left boards the pins of the top or bottom position can be used as a test point
  when not used.
- **Orange**: LATERAL board placement, it has extra holes to attach the slider printed part. Also, two extra holes on
  the edge to attach the cable of the antenna and test the deployment.

- **Pink**: Battery location, it has two extra holes to be able to attach it to the EGSE with zip tie or others.
- **Yellow**: BOTTOM board location, it has extra holes to attach the slider printed part.
- **Green**: External power supply, it has bananas and the jumpers to select the power mode.

0.2. Power section

Description of the power management options of the EGSE.

The EGSE allows using the PQ with its own battery and solar cells but also permits to use an external power with several configurations. The EGSE interfaces the external power supply with some protections (overcurrent, overvoltage and reverse polarization) and uses the battery charger or backup and the EPS voltage regulator to mirror the power management of the PQ. The available modes are described in Table 1.

Power Mode	Description
ONLY CHARGING BAT	If it's only necessary to charge the battery on the same conditions of the PQ and the power on the PQ it's not needed
ONLY POWERING PQ	Use of the PQ with the external power source, but without charging the battery.
ONLY POWERING MCU	Mode to program the MCU without charging the battery or using the other subsystems.
POWERING BAT AND PQ	Nominal mode of the PQ, but using an external power source.
MPPT EXTERNAL POWER	Mode that allows to simulate the power of the solar cells with the external power source. Connect the MPTT EGSE pin to the pin on the EPS board directly with a long cable.
PQ NORMALLY USED	Without using an external power source, mode nominal of the PQ using the battery and solar cells, the external power is isolated of the PQ.

Table 1. Power modes description

GND/BATT−	VEXT_SUPPLY	VBAT_CHARGE	3V3_PERM	3V3_UMBILICAL	KILLSWITCH	MPTT
ONLY CHARGING BAT	ON	ON	OFF	OFF	CLOSED	NC
ONLY POWERING PQ	ON	OFF	ON	OFF	CLOSED	NC
ONLY POWERING MCU	ON	OFF	OFF	ON	CLOSED	NC
POWERING BAT AND PQ	ON	ON	ON	OFF	CLOSED	NC
MPPT EXTERNAL POWER	OFF	OFF	OFF	OFF	OPEN	CONNECTED
PQ NORMALLY USED	OFF	OFF	OFF	OFF	OPEN	NC

NOTE: ONLY use GND/BATT− jumper when killswitch is closed
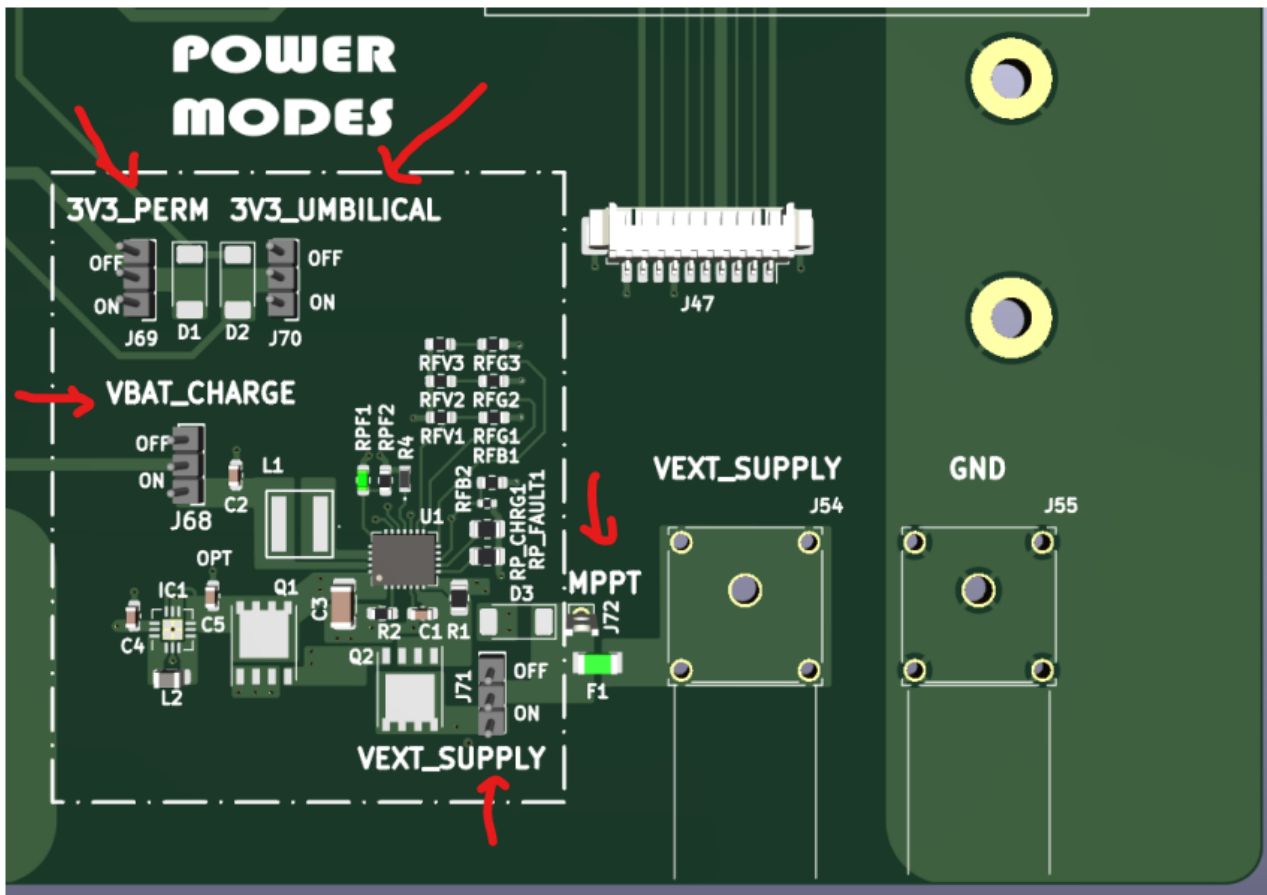
Fig3. Jumper position power modes EGSE

Fig 4. Physical position of the jumpers on the EGSE