

EPS System Specifications

EPS

ID	Requirements
	The production budget shall compute the losses of the regulators of the PCC.
	The EPS shall weigh between 20-30% of the total weight of the CubeSat.

BAT

In these system requirements, two batteries will be considered. A primary battery, which will be named the battery and secondary battery which will be named the cell.

ID	Requirements
RQ01-BAT-1	The BAT pack shall contains two batteries: a primary battery and a cell.
RQ01-BAT-2	Battery shall have a heater control to maintain its temperature over 0°C.
RQ01-BAT-3	The temperature of the battery shall be maintained at least at 0°C to avoid the depth of discharge.
RQ01-BAT-4	The heater shall be activated when the temperature of battery is below 0°C and deactivated when the temperature is above 5°C.
RQ01-BAT-5	Battery shall be able to charge between 0°C and 45°C.
RQ02-BAT-1	Battery shall take in account a margin on the number of cycles. The number of cycle needed with a mission of 30 days and an altitude of 573 Km, so an orbital period of 136 min is 461 cycles.
RQ02-BAT-2	Battery shall deliver power to supply all the modules in their functioning time during the eclipse phase.
RQ02-BAT-3	The heater shall consume less battery than if it is not used.

RQ03-BAT-1	During the eclipse, battery shall comply with the needs of energy required by the modules. Provided that the level of charge remains between 25% and 90% of a battery capacity.
RQ04-BAT-1	Battery shall be protected against too low and too high voltage by the PCC.
RQ05-BAT-1	Battery shall be oversized of 30%.
RQ06-BAT-1	Battery shall have different modes: very critical states (15%), critical states (15-20%), medium state (25-90%), full (100%). These states will define the state of the of charge of the battery.
RQ06-BAT-2	Battery charge shall not be under 20% of the global capacity. It will cause irreversible damage.
RQ07-BAT-1	Cell shall have to supply at least an energy of 1 Wh in order to supply the ADCS during the detumbling mode.
RQ07-BAT-2	Battery capacity shall considers margin of no less than 5% on available power for the launch phase.
RQ08-BAT-1	The charging time shall not be longer than the time that the CubeSat is illuminated by the Sun.

PV

ID	Requirements
RQ01-PV-1	MPPT shall be wired between the PV modules and the BAT modules.
RQ01-PV-2	Each MPPT has to be connected with two opposite PV modules of the CubeSat.
RQ01-PV-3	PV modules have to provide energy to the battery and to the other modules.
RQ01-PV-4	The technology of PV cells shall be Triple Junction (TJ).
RQ01-PV-5	The size of the PV cells shall not cover the entire side of the CubeSat to enable the wiring of solar cells, the connection of the solar sensors and the fixation of the magnetorquers.
RQ02-PV-1	PV modules shall be covered by a protected cover glass to prevent certain wavelength which could damage the cells.

RQ02-PV-2	The thermal control system of the satellite shall be able to evacuate the excess heat.
RQ03-PV-1	PV cells of each panel shall be connected in series with a bypass-diode.
RQ03-PV-2	Each solar panel of the cubesat shall be connected in parallel.
RQ04-PV	A cover glass protection shall be placed on each PV modules to protect them against particles.
RQ05-PV	At launch, the satellite shall have a 5% margin on the available power and energy considering EOL design and one string failed.
RQ06-PV	The design of PV modules shall includes the weight of the magnetorquers.
RQ07-PV-1	The sizing of PV modules shall be computed at EOL.
RQ07-PV-2	PV modules have to be oversized to take into account the decrease of the efficiency of PV module at its EOL.

PCC

ID	Requirements
RQ01-PCC-1	The regulator choice shall be made to maximize their efficiency in order to minimize the conversion losses.
RQ02-PCC-1	An electronic switch shall link the modules to the energy supply.
RQ02-PCC-2	A microcontroller shall be able to switch on or off any modules.
RQ02-PCC-3	A microcontroller shall control the electronic switch (open and close) to turn on or off any modules.
RQ02-PCC-4	Each module shall have its own wire connected to the electrical supplier.
RQ02-PCC-5	Each module shall be connected to an adapted regulator (3.3 V or 5 V depending on the need of the concerned module)
RQ02-PCC-6	Modules shall be both connected to the MPPT through the regulators, and the battery, differentiating sunshine and eclipse phasis.
RQ03-PCC-1	Microcontroller shall communicate with OBC using an UART bus.

RQ03-PCC-2	Microcontroller shall act on the electronic switch following OBC orders.
RQ04-PCC-1	Microcontroller shall convert the battery voltage data in a charge level (Wh or %C depending on OBC expectations on the form of data).
RQ04-PCC-2	Microcontroller shall send to the OBC the battery charge rate.
	The MPPT shall be connected to the 3.7 V battery charge controller.
RQ05-PCC-1	The Battery module shall be protected against reverse current using a diode.
RQ05-PCC-2	The switch shall integrate a protection for the modules against overload and overcurrent.
RQ05-PCC-3	A regulator of 3.7 V shall regulate the MPPT output voltage to the BAT input requirement.
RQ05-PCC-4	The 3.7 V regulator shall be made using a standard 3.3 V adjustable regulator and a voltage divider.
RQ05-PCC-5	The voltage dividing bridge shall have two resistors with a R2/R1 ratio of 0.12.
RQ05-PCC-6	The adjustable input pin of the 3.7 V regulator shall be connected to the voltage divider in order to regulate the output at 3.7 V.
RQ05-PCC-7	The MPPT shall be suited to the maximum of power the PV can produce and receive it as a minimum. Whether not it could damage the controller permanently.
RQ06-PCC-1	Microcontroller shall measure the voltage output of the battery through an ADC component.
RQ02-PCC	Microcontroller shall include six analog/digital outputs wired to the switches of the modules.
RQ02-PCC	Microcontroller shall have an SPI BUS wired to the ADC in order to obtain the level of charge of the battery.
RQ02-PCC	The input voltage range of the microcontroller may be 2-3.6V.