Appendix

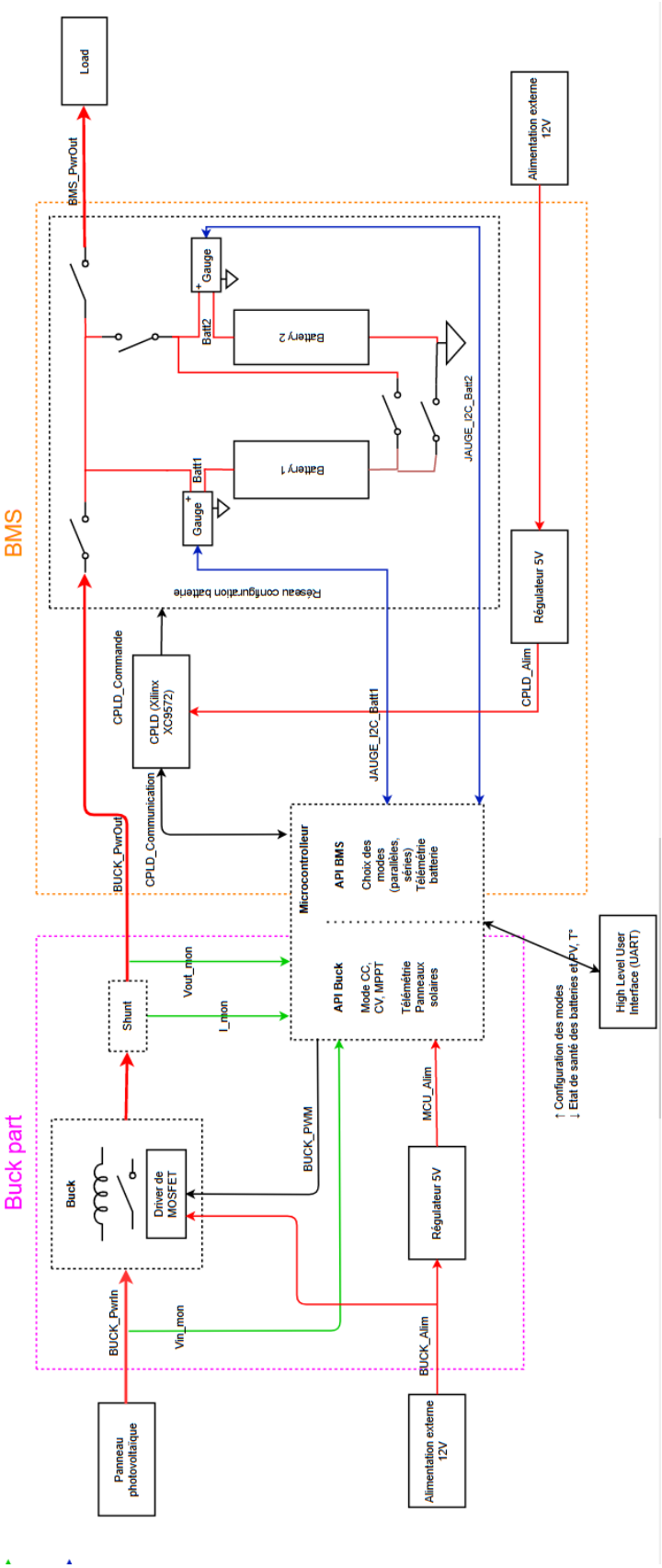

FIGURE 1 – Buck and BMS high level architecture

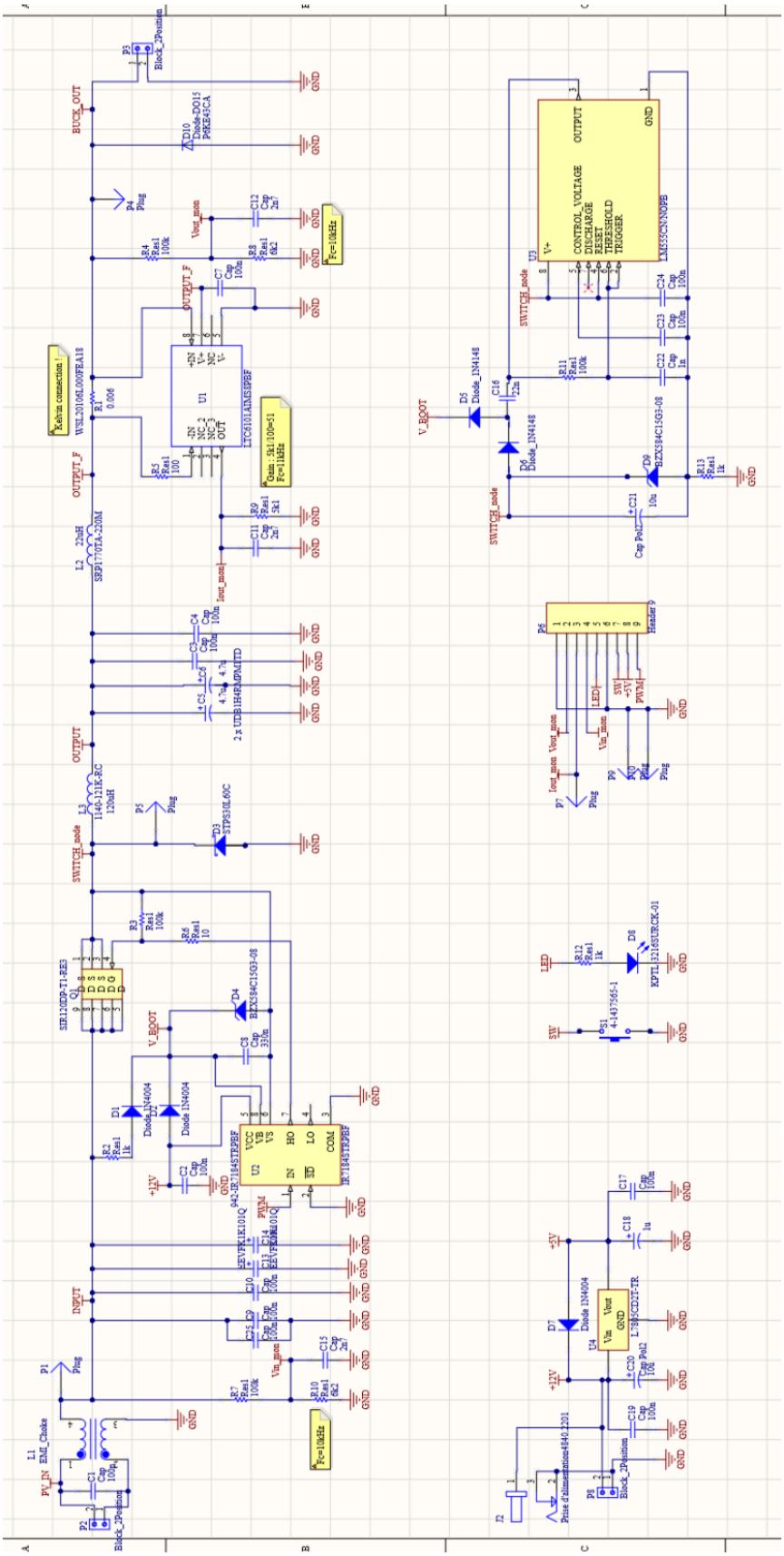

FIGURE 2 – Buck schematic

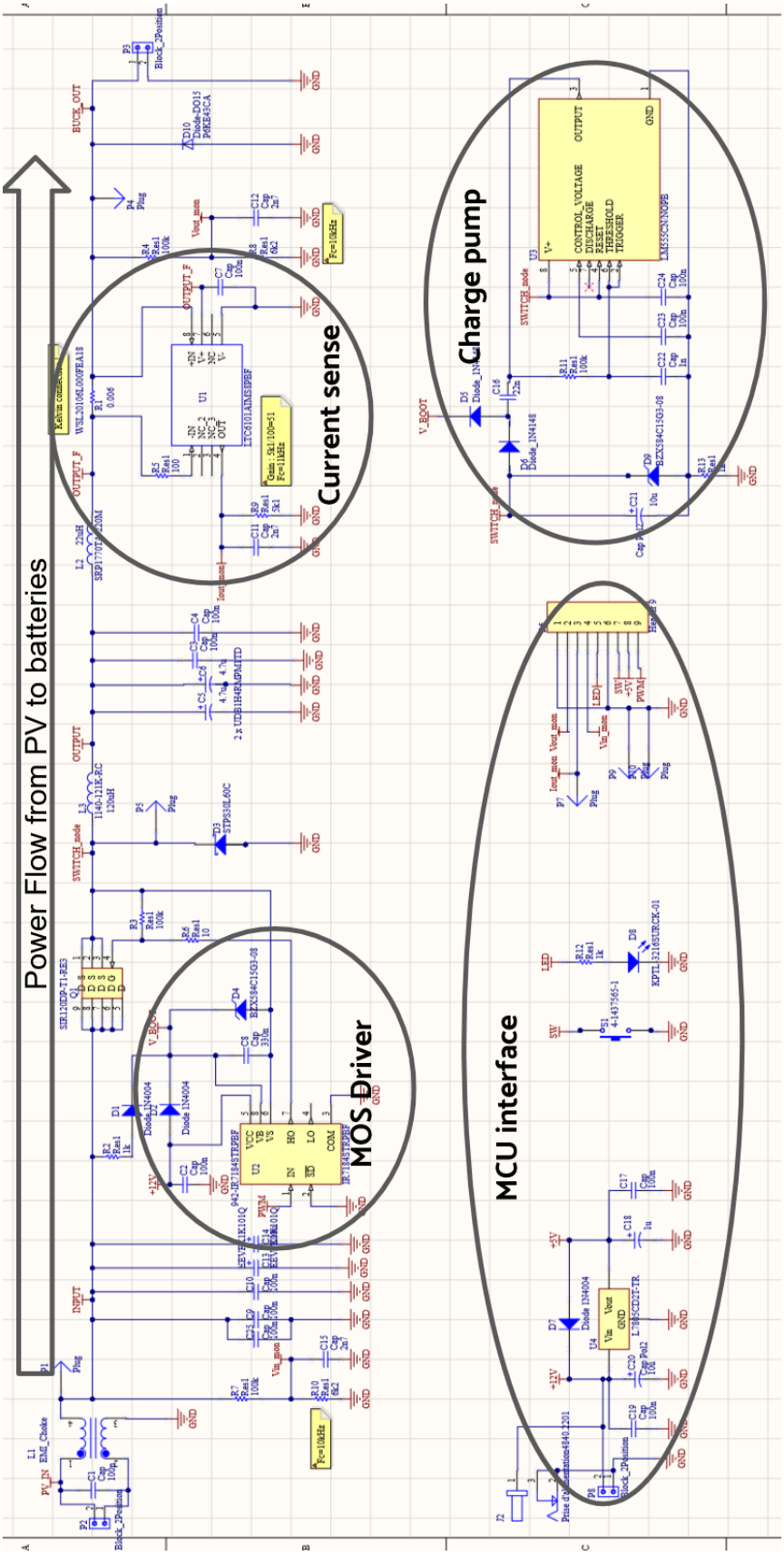

FIGURE 3 – Global buck schematic

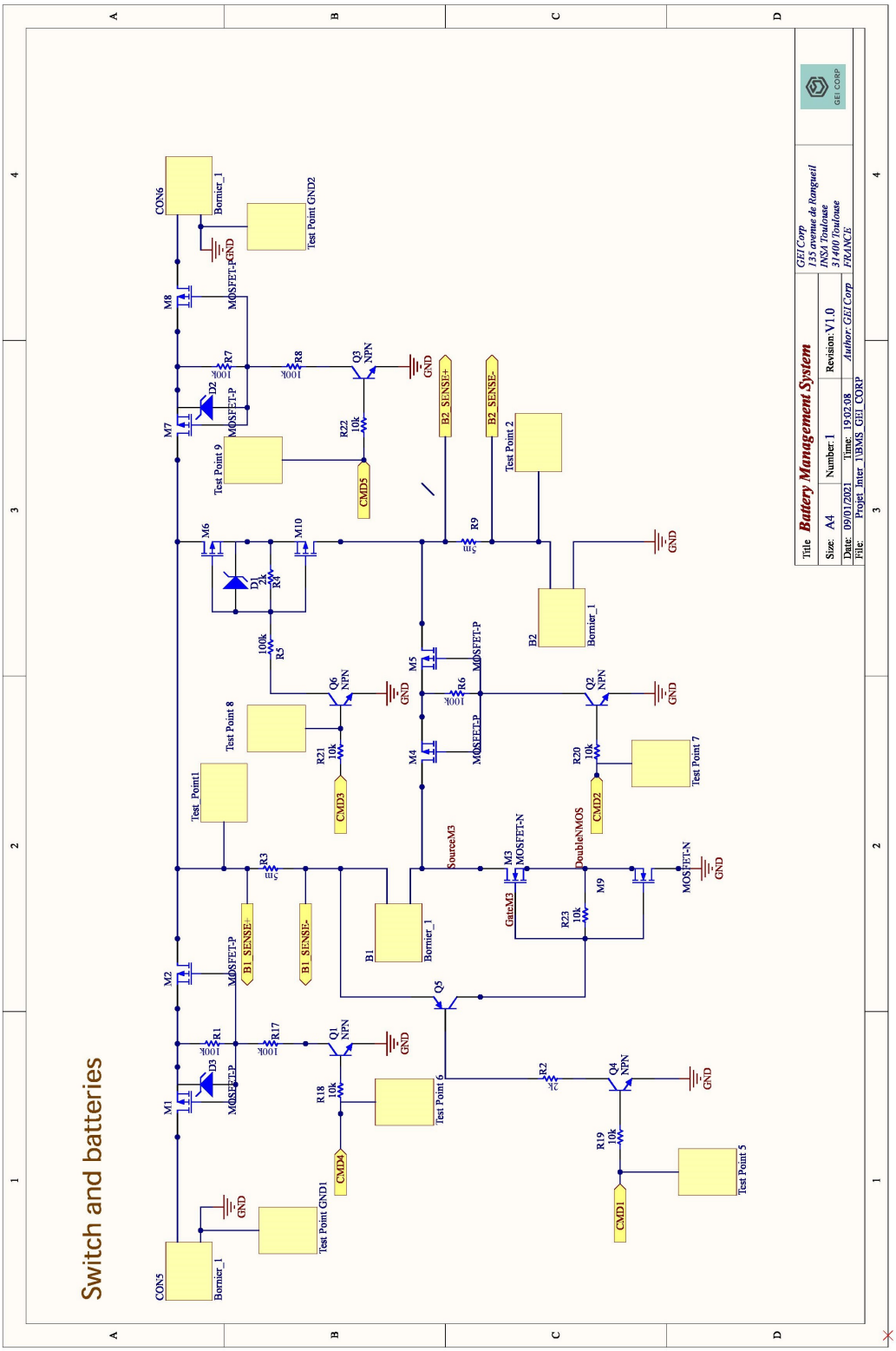

FIGURE 4 – Detailed buck schematic

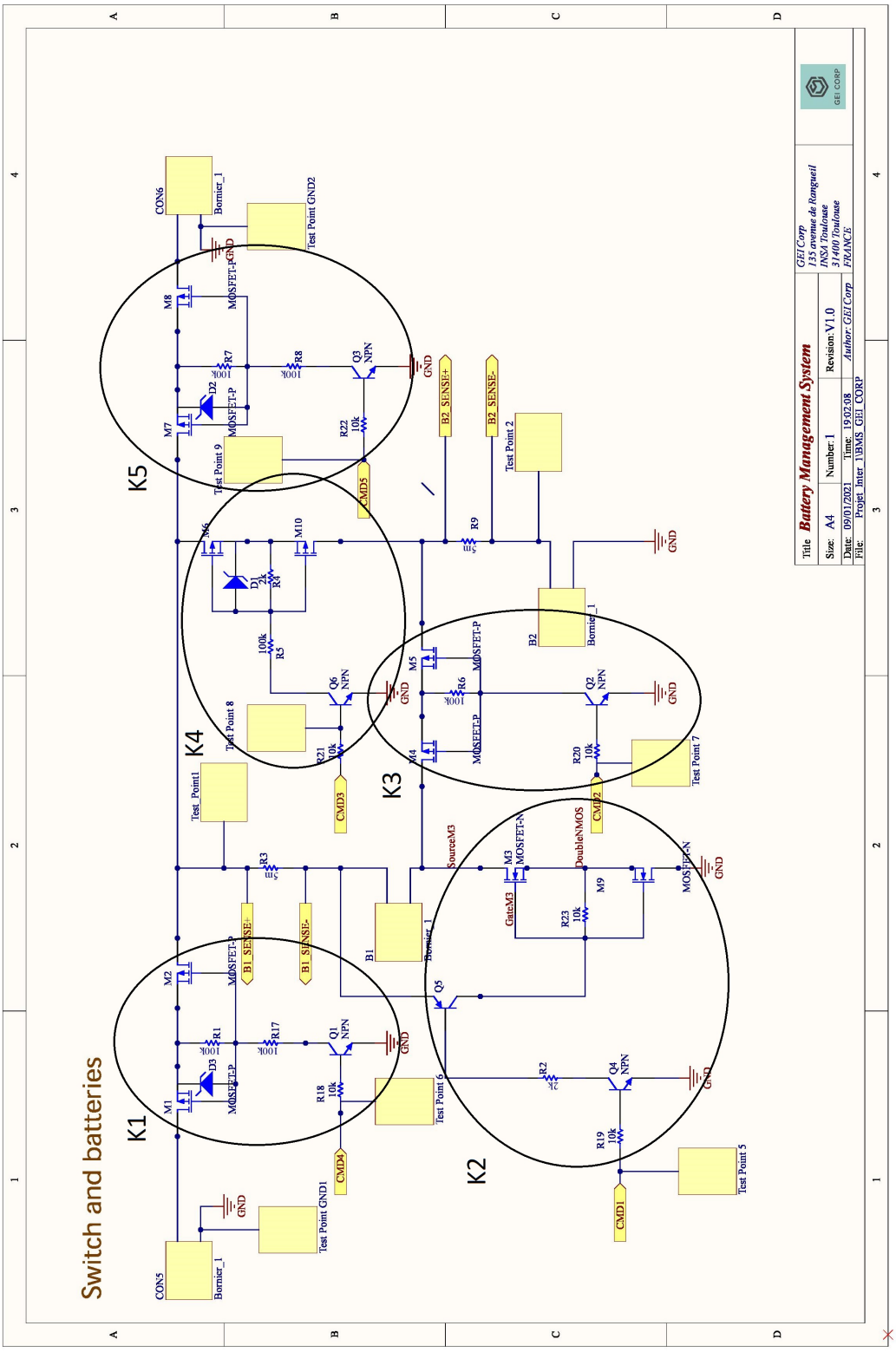

FIGURE 5 – Switch schematic

A Functionalities

F1 : The DC Section must supply an unregulated direct voltage. Must be able to operate in two separate modes, F1a and F1b.

- F1a : the DC section supplies energy (DC) by prioritizing the photovoltaic panel. In the event of excessive battery discharge, the system cuts off the power supply and recharges the batteries
  - F1a_1 : if the output power reaches the maximum authorized power, an LED or an audible beep indicates this at the end 10 seconds, the system cuts off the power,
  - F1a_2 : if the power reaches the maximum power + 10%, the system cuts the power immediately,
  - F1a_3 : in the event of a power cut, the system indicates via the LCD whether it is due to low batteries, or if it is a power overrun. In the latter case, the user can reset the system (once the overload has been removed). If it is a battery problem, there is nothing the user can do with the system. He can just navigate in the HMI to see the state of the system (Battery socket, charging mode, etc.)
  - F1a_4 : depending on the charge level of the batteries (to be defined), the system tries to take the maximum of possible power on the PV (Photovoltaic Panel). If the requested power is greater, the batteries fill the gap. Conversely, the batteries are recharged. If the demanded power is relatively low compared to the available solar power, the system reduces the demand for solar power and the PV is underutilized, that's okay.

F2 : the system provides for a fine and complete charge of each battery individually. This mode intervenes systematically during the WE (thanks to the RTC). During the week, this mode intervenes when the batteries are excessively discharged during use.

- F2_1 : During this phase, the load is disconnected from the system. It operates in a vacuum,
- F2_2 : each battery can be fully charged in isolation (one after the other). PV is the one and only source of energy. By full charge is meant compliance with the manufacturer's charge cycle (GEL type battery), namely bulk phase, absorption phase, floating phase. The floating phase can be carried out with the two batteries in parallel,
- F2_3 : each battery has its own gauge making it possible to know its Soc, the voltage, the current at its terminals,

F4_2 : Information mode (default mode, you enter it after 10 seconds of not using the PBs). The LCD will be used by the system to give various messages : alerts and request for interaction with the user, relevant information on the current mode of the system ... to be refined with the customer.

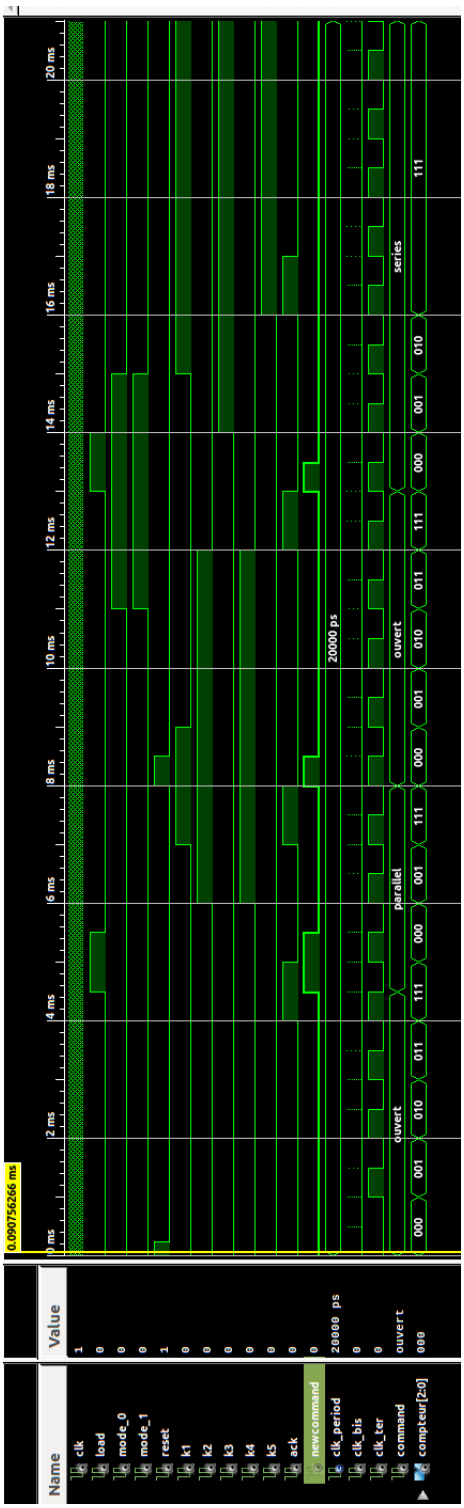

FIGURE 6 – Simulations on Xilinx ISE : Mode PARALLEL-RESET-SERIES

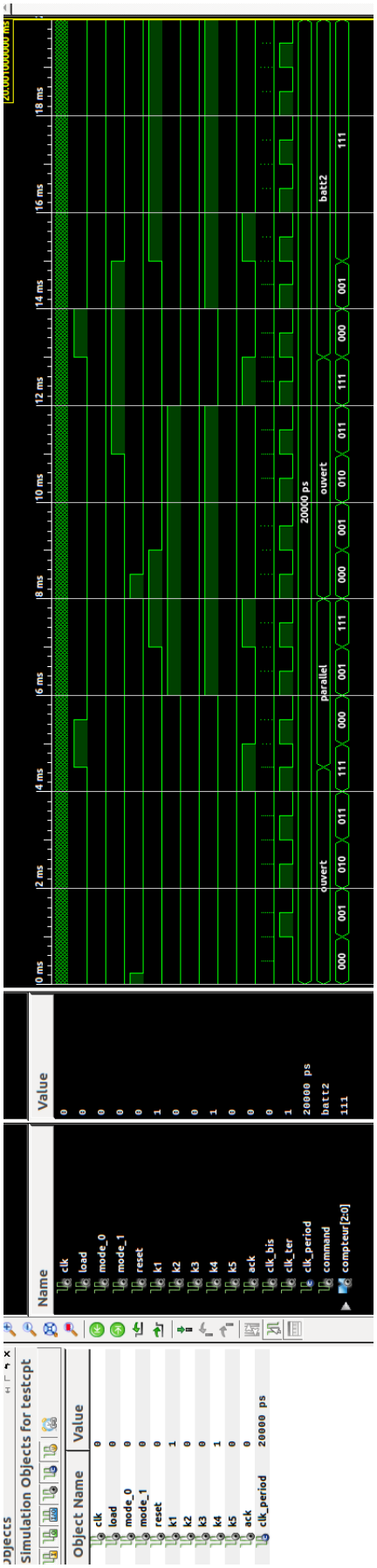

FIGURE 7 – Simulations on Xilinx ISE : Mode PARALLEL-RESET-BATT2

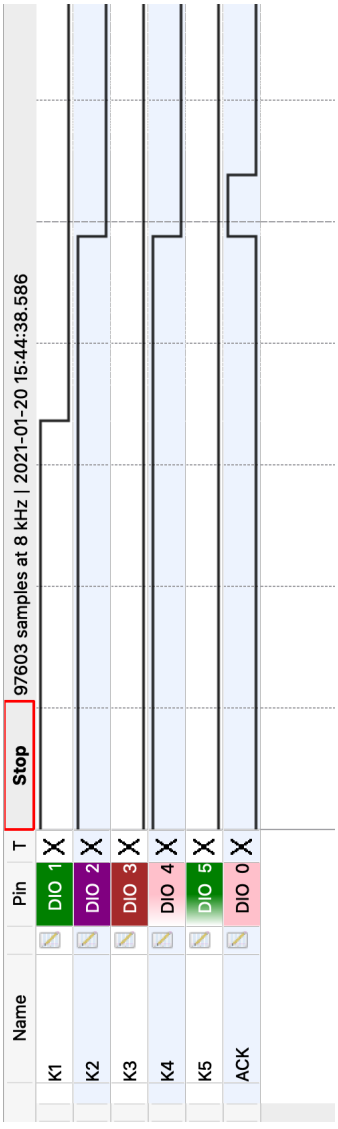

FIGURE 8 – Results with the logic analyzer : PARALLEL-RESET

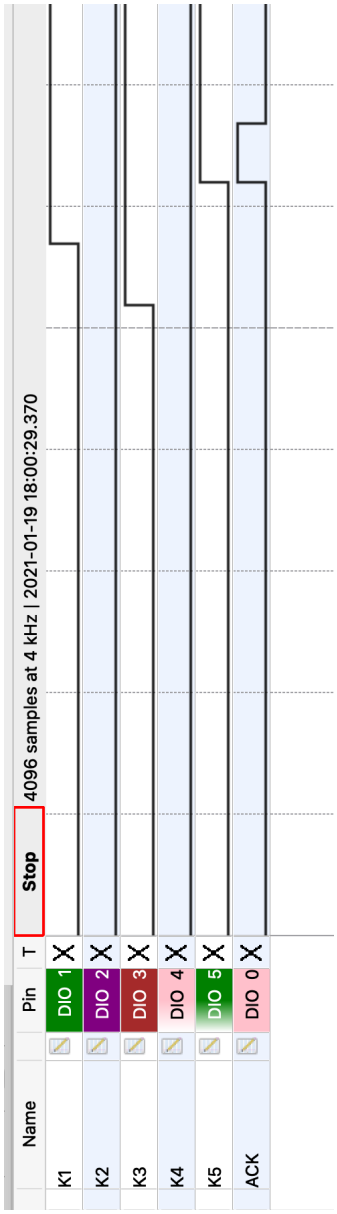

FIGURE 9 – Results with the logic analyzer : RESET-SERIES