

AMSAT GOLF-TEE

**Electronic Power
Subsystem
(EPS)**

AMSAT Symposium 2025

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Golf-Tee EPS Overview

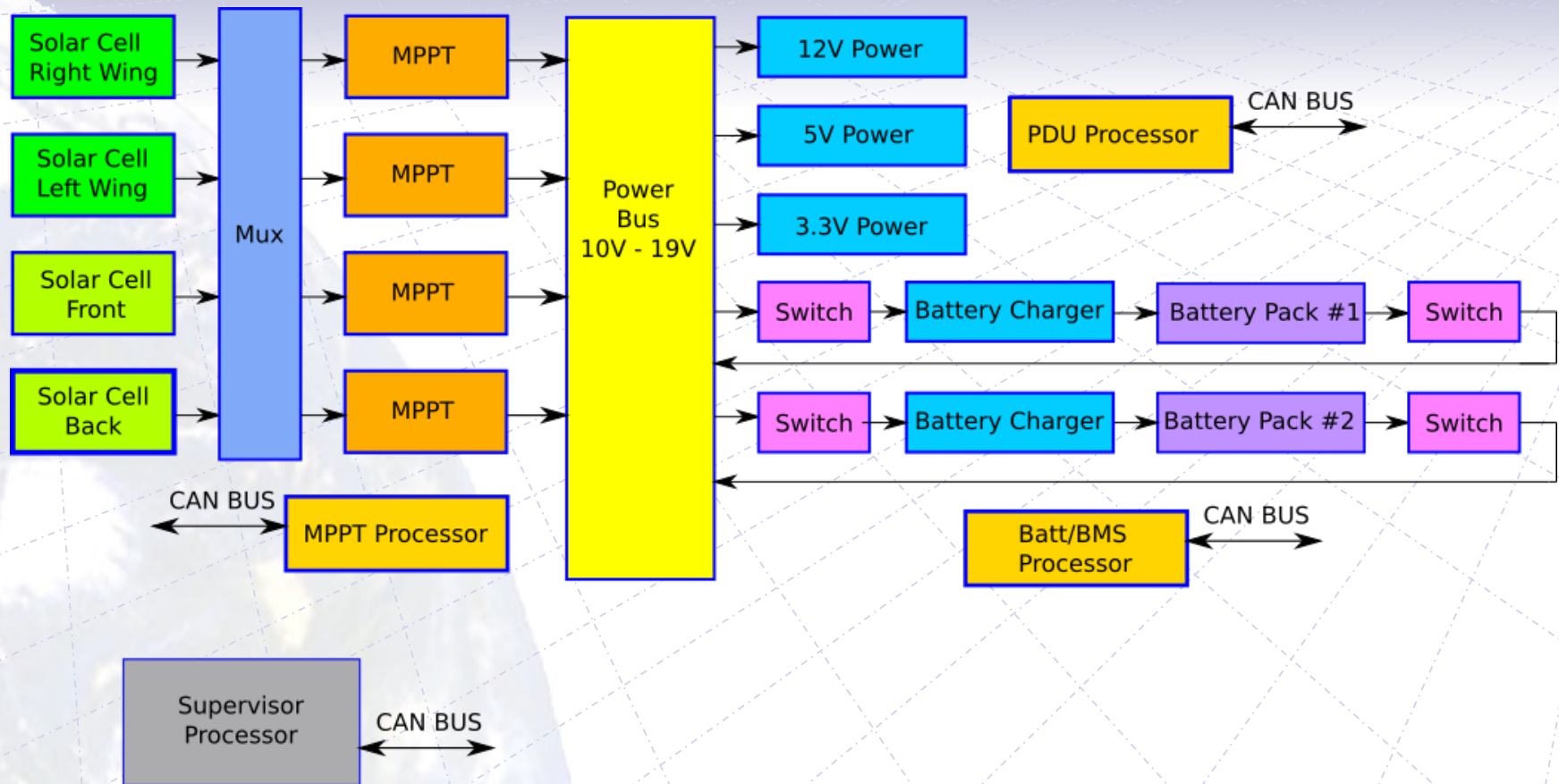
- EPS takes power from Solar Panels, and/or batteries, and provides 3.3V, 5.1V or 12V for all the systems on the satellite
- When we have light we charge batteries
- When is dark we use power from the batteries
- At 90 minutes for a charge/discharge cycle, we have about 29,000 cycles in 5 years



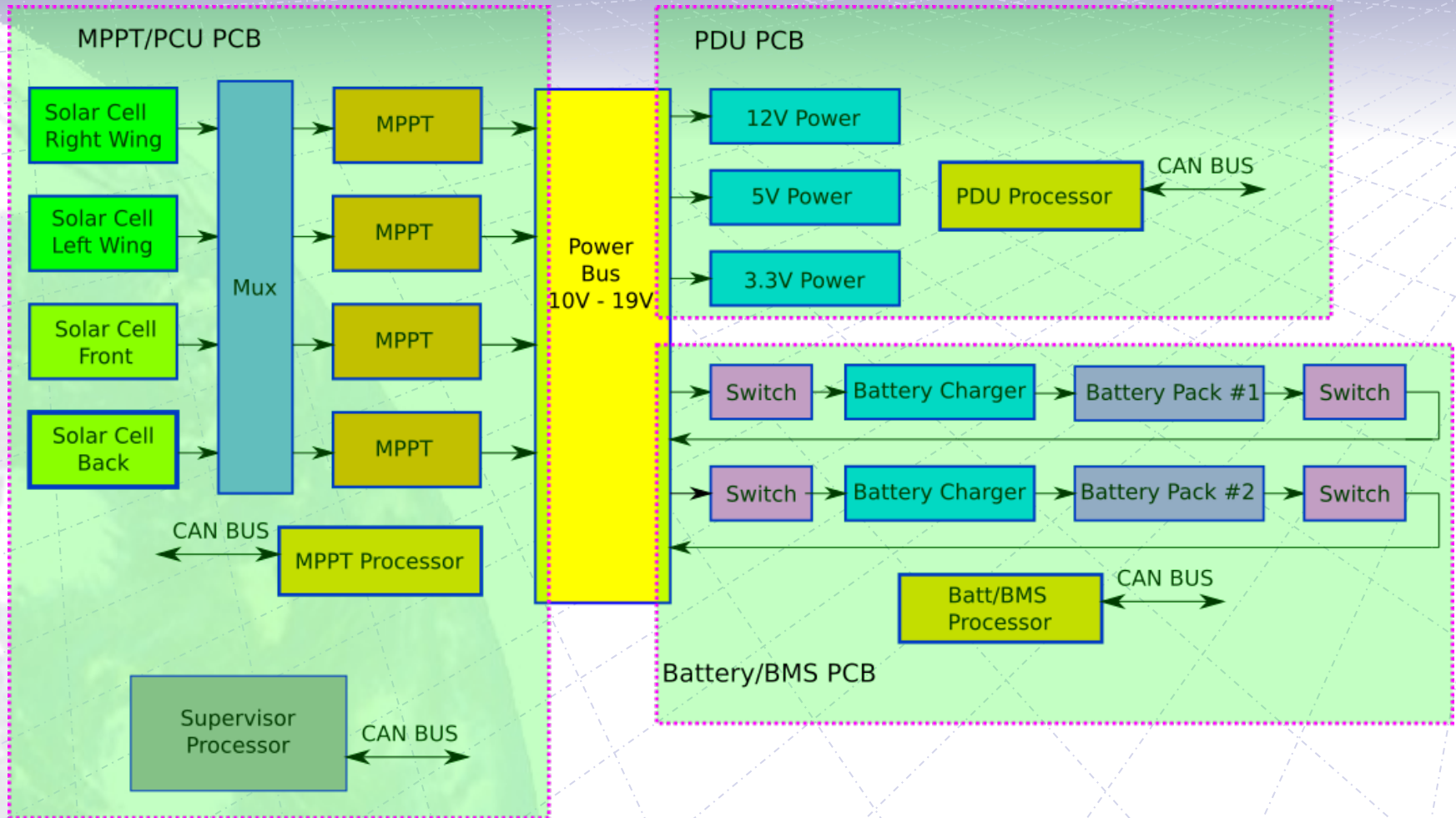
Golf-Tee EPS Specifications

- The most we can ever get from all the solar cells is about 35 Watts
- One estimate is that the electronics will use between 20 and 22 Watts Maximum
 - When we plug everything in we will know how close that is.
- The power supplies are over designed
 - 12V up to 1 Amp (12W)
 - 5.1V up to 6 Amps (30.6W)
 - 3.3V up to 6 Amps (19.8W)
 - To run cooler, last longer, handle unexpected design changes.

Simplified EPS Block Diagram



EPS Block Diagram -- PCB Split



- Three 92 x 92 mm PCBs make up the EPS
- MPPT/PCU (Power Conditioning Unit)
 - Converts Solar Power to 19V for use by the other systems.
 - Hosts the Supervisor that manages the whole EPS
- PDU (Power Distribution Unit)
 - Generates 12V, 5.1V and 3.3V for the other satellite systems
 - Generates power usage information for the CAN Bus
- Battery/BMS
 - Hosts two 4S 18650 Lithium battery packs
 - Charges, monitors, and levels the batteries for maximum life



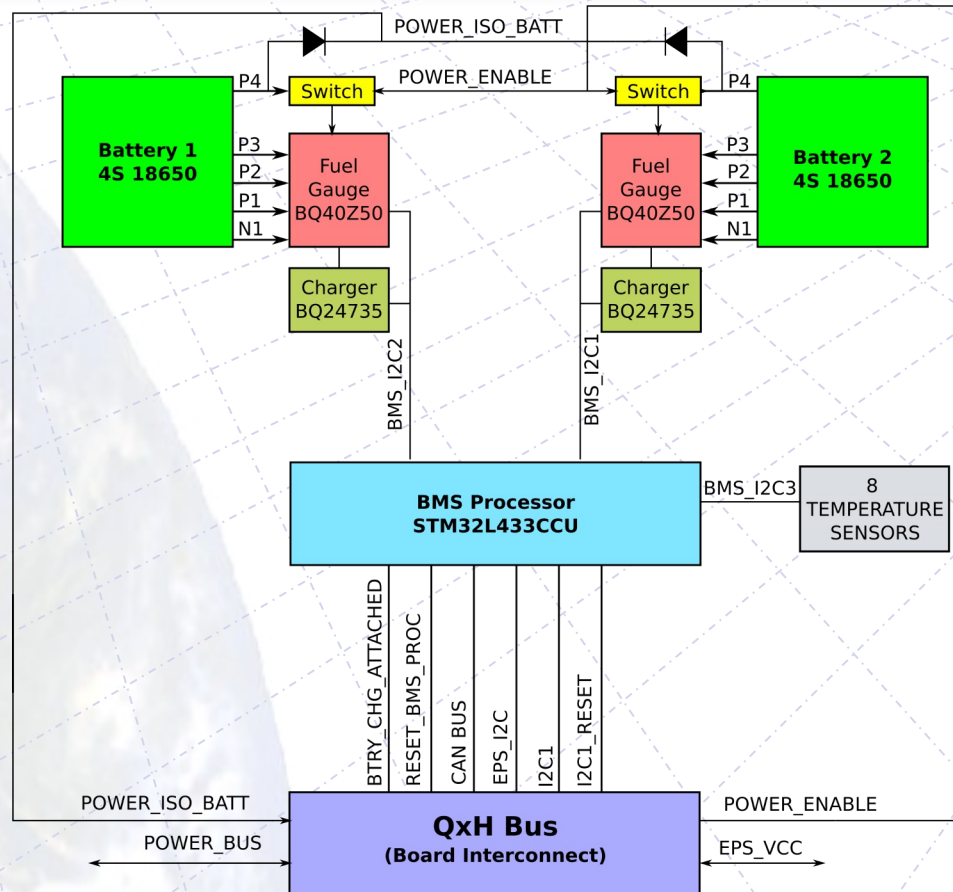
QxH Bus for PCB Interconnect

- Samtec QSH/QTH 60 pin connectors for interconnecting between PCBs
 - MPPT/PCU
 - PDU
 - Battery/BMS
 - CIU
- Each pin can handle up to 2A.
 - Power Bus 5 pins, 5.1V 4 pins, 12V 2 pins, 3.3V 2 Pins
 - Rest of pins less than 10 mA
- 8 unused pins for future expansion
- Available in different heights for different board spacing.

Battery/BMS PCB Block Diagram

BATT/BMS PCB

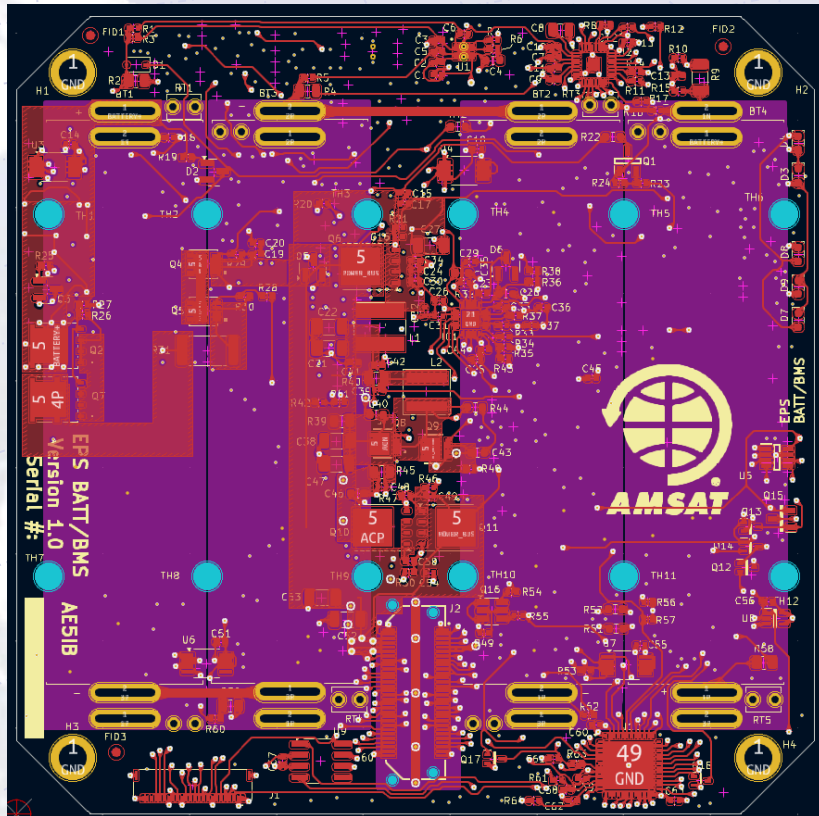
Version 2, 6/28/25



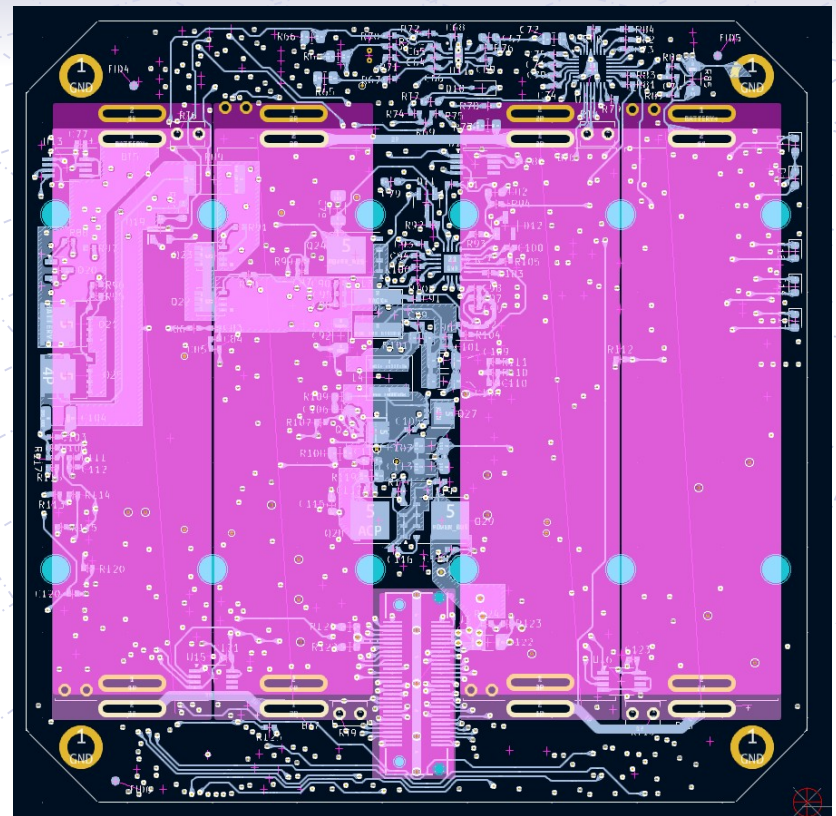
- A lithium battery is advertised to last 500-700 charging cycles
 - That is from full charge to full discharge.
- 90 minutes for an orbit, means about 29000 charging cycles in 5 year satellite life span
- Do you see a problem?
- It appears that during the dark part of the orbit we would use about 20% of the battery charge
- Do not charge the battery to capacity it will last longer
 - Charge to 80% or to 60% not 100%

Battery/BMS PCB Layout

Front



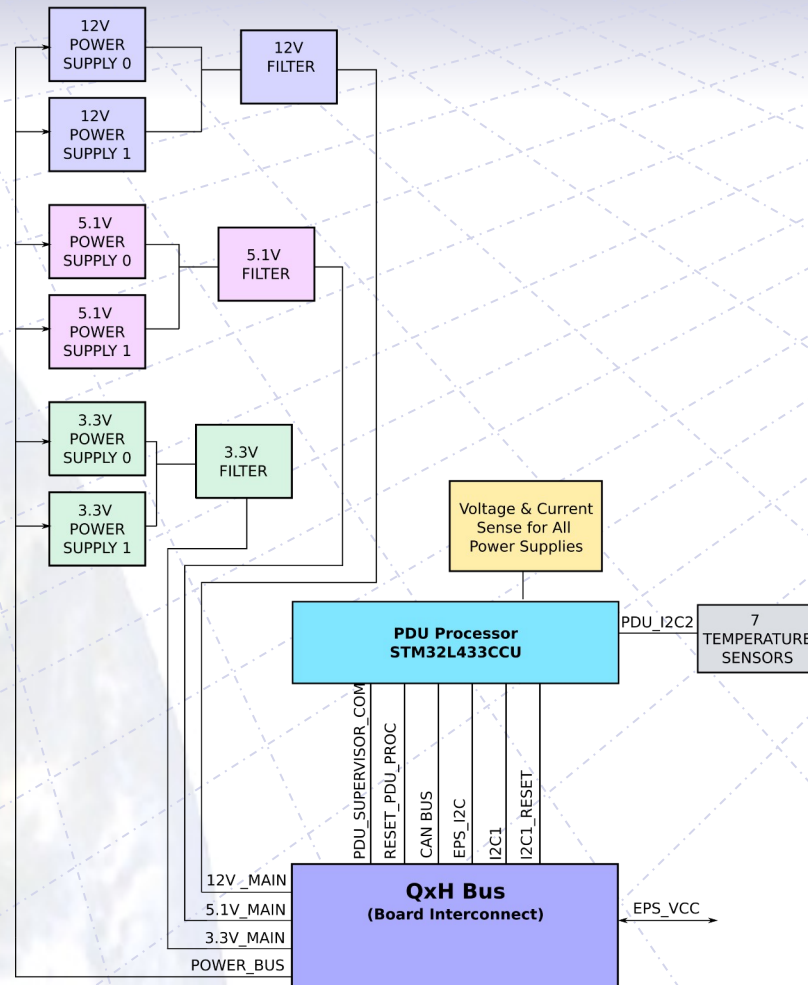
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PDU PCB Block Diagram

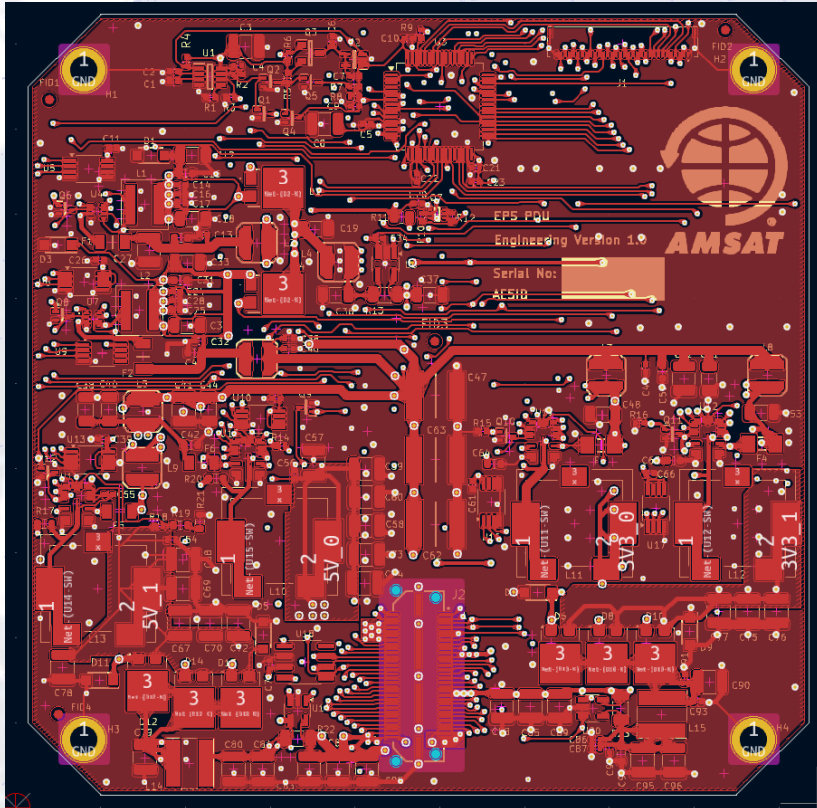
PDU PCB

Version 2, 10/12/25

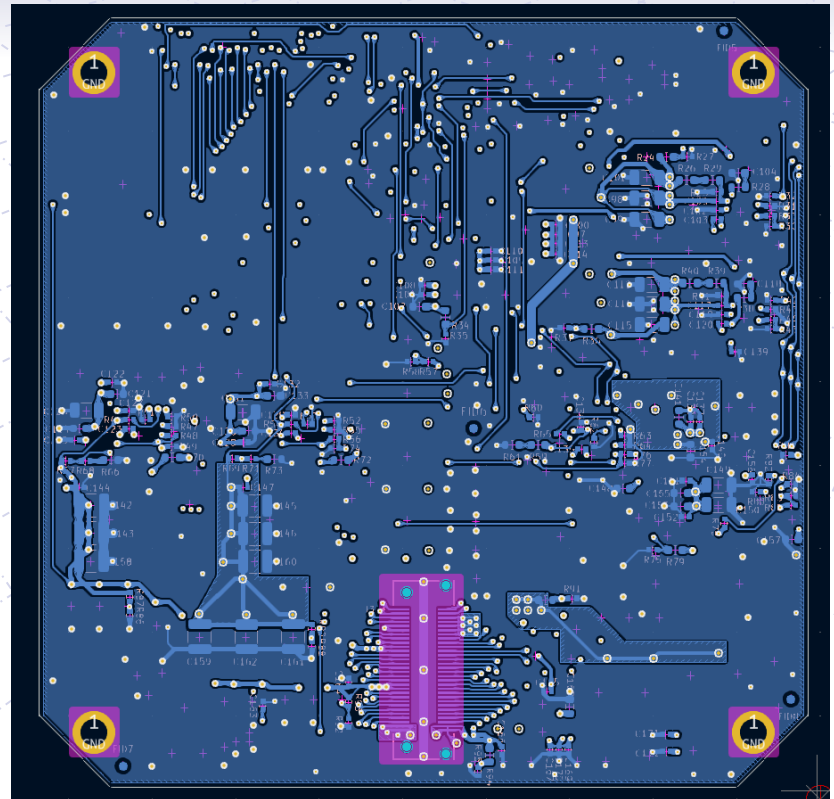


PDU PCB Layout

Front



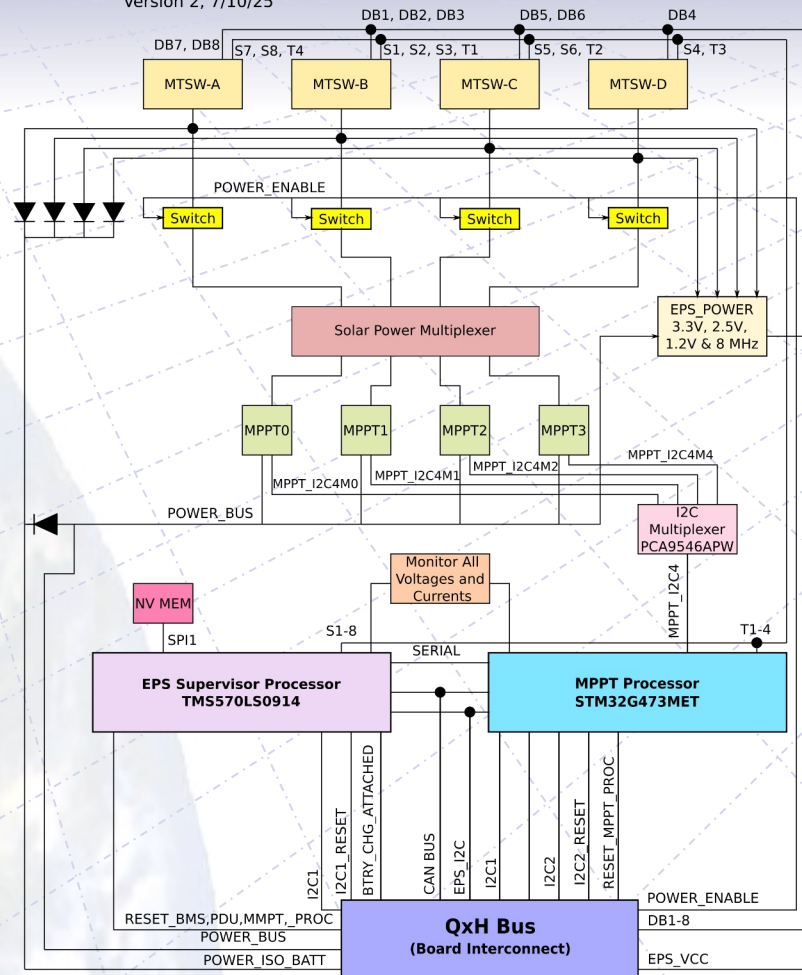
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MPPT/PCU PCB Block Diagram

MPPT/PCU PCB

Version 2, 7/10/25





Golf-Tee EPS PCB Status

- The Battery/BMS and PCU
 - Released for production for 6 PCBs and 3 populated
 - Getting quotes for build, not sure if build started yet
 - Batteries ordered and delivered
- MPPT/PCU
 - Still needs ground copper pours in layout
 - Checking BOM to make sure it is 100% correct
 - Double checking schematic for missed connections
- Test Boards
 - Simple boards to expand signals from test connectors for each PCB – Not started



Golf-Tee EPS Help Needed

- Up to now it has been mostly just me
 - With valuable help from Carl Wick, Eric Skoog and others
- Software help needed
 - I think I have lost my TMS370LS0914 programmer
 - We are not using an operating system like RT IHU
 - Need help with STM32 programming.
 - Lowest level code for the peripherals is working
 - Need help with the rest
 - Works like a big state machine

- Thank you for the opportunity to present at the 2025 AMSAT Symposium

Questions?