Phase 2 Power Supply and Mechanics

V. González

i2N – ETSE - University of Valencia

Outline

- Phase 2 Power Supply Status
  - Design review
  - Noise measurement
  - Backplanes
- Phase 2 Mechanics Status
  - Design
  - AdvPhase1 problem
- System Test
- Production status

Phase 2 Power Supply

V2 PSU Design

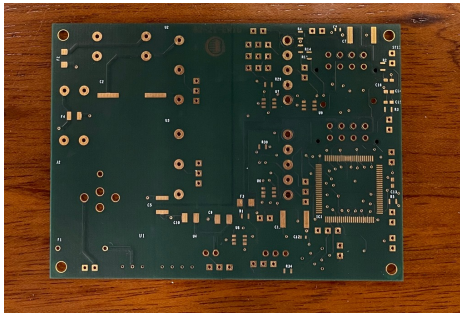
Features

Input
- **48V, Isolated GND**

Outputs with isolated GND from input
- **3.3V (20 A) for Digiopt12**
- **5 V (20 A) for PACE**
- **3.3V (0.7 A) for PACE Boot and SC FPGAs**
- **2 V (5A) for DigiOpt12**

4 Temperature sensors (T1..T4)

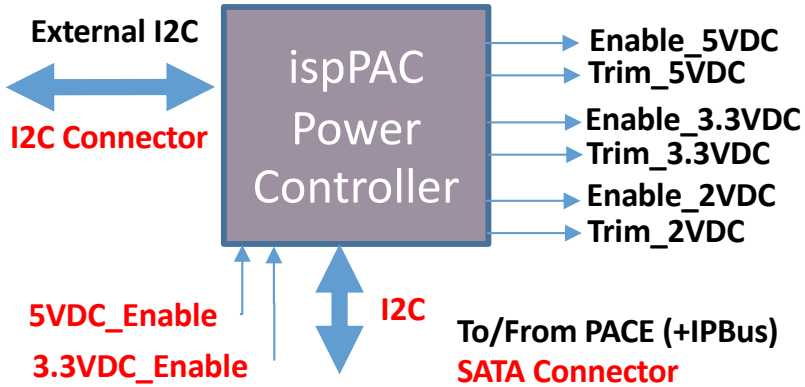
V2 PSU Dimensions



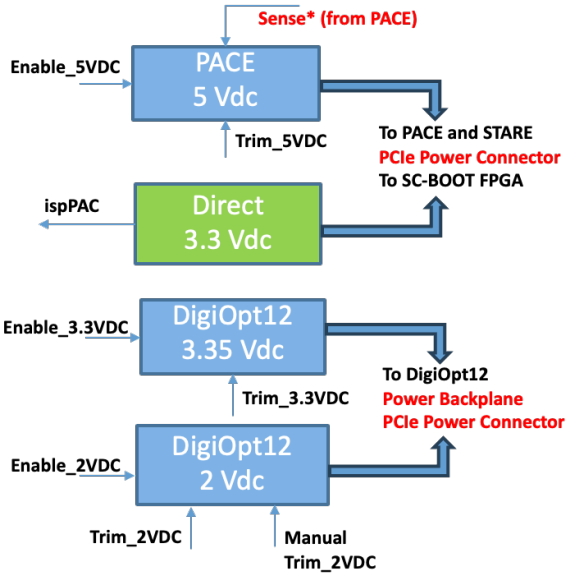
90 x 65 mm²

- 51% Area from Ph1 PSU

V2 PSU Slow Control



DC/DC Enabling
- **Manual (jumpers)**
- **External (I2C, PACE)**

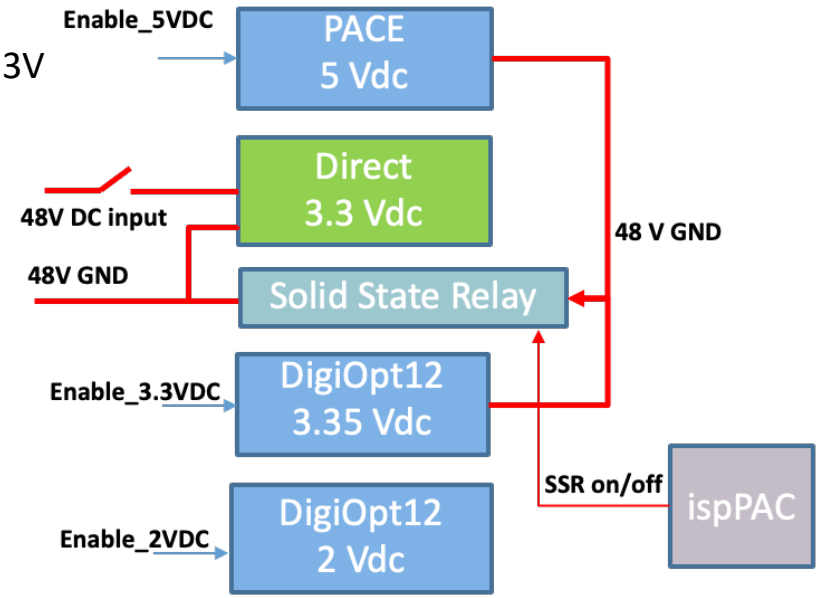


Phase 2 Power Supply

PSU V2 versions

Design modifications

- **V2.4 (prototype t11)**
- Include on/off switch
  - To handle 3.5 A max input current we need a big switch
  - Solution
    - Use a Solid State Relay to control GND connection of the DC/DC converters
    - Use a small switch to switch on/off the Direct 3.3V DC/DC.
- Modify PCIe power connector to use commercially available cables
- **V2.5**
- Modify de 2V trace to increase current capacity.
- Include jumper to bypass the Solid State Relay for manual operation.
- Fix DC/DC drill diameters to fit different models

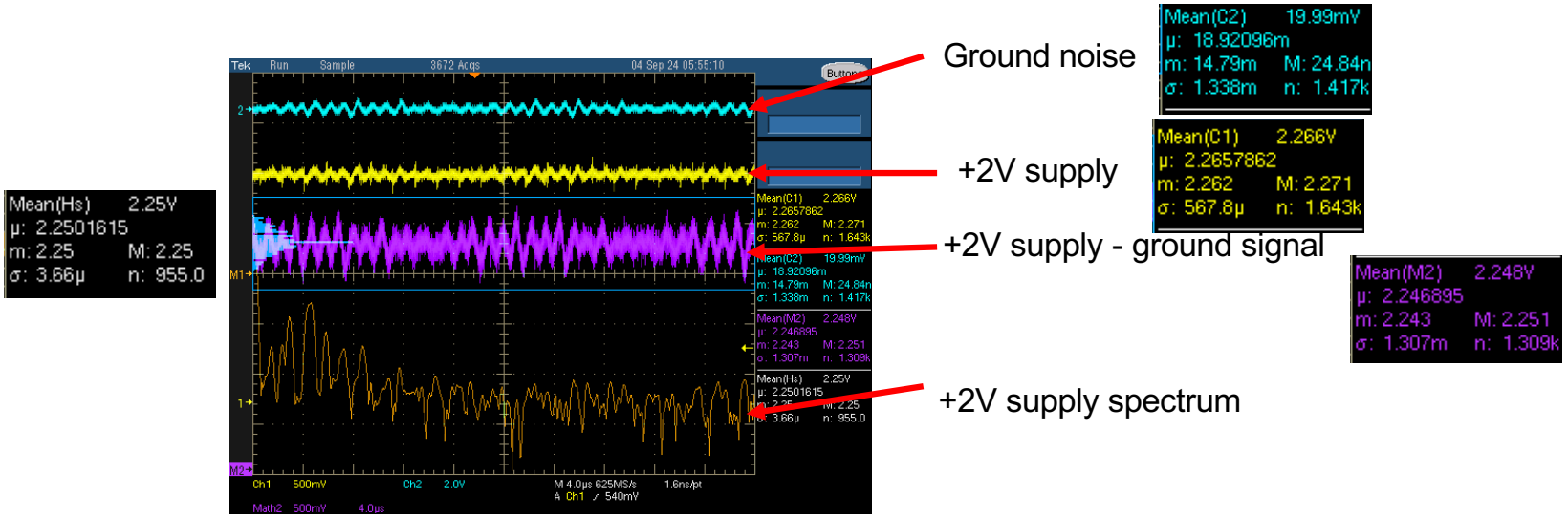


Phase 2 Power Supply

PSU +2V noise

PSU noise tests

- Present DigiOpt12 ADC chips consume more on the 3.3V supply.
- New DigiOpt12 ADC chips consume more on the 2 V. Some concern about noise in that voltage
- First preliminary results as PACE system was not operative until first week of August.

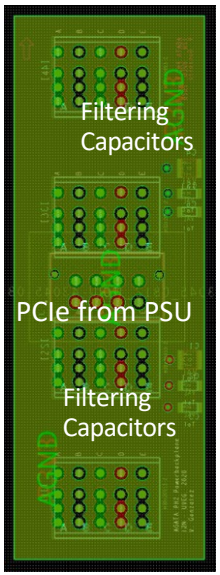


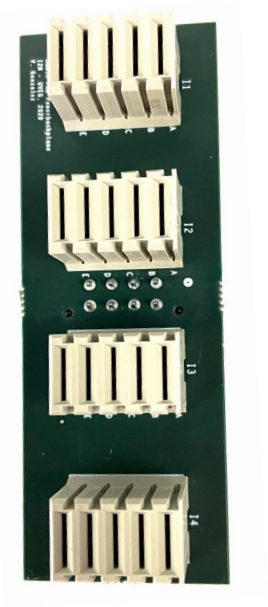
Phase 2 Power Supply

Backplanes

POWER BACKPLANE

- Distributes +3.3V and +2V to DigiOpt12
- Capacitors for additional filtering





SIGNAL BACKPLANE

- Distributes to CLKs, SynPat, SPI, I2C to DigiOpt12
- FireFly connection to PACE
- Additional local I2C Access
  - Through I2C bridge
- SIGNAL BACKPLANE redesigns

V2_t11

Missing Enable connection for i2C bridge

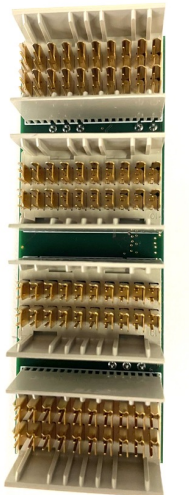
Improved SILKSCREEN information

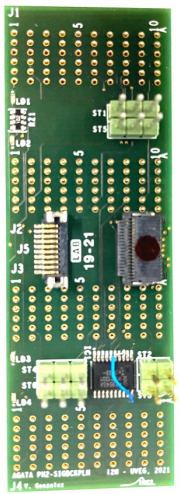
V2.4

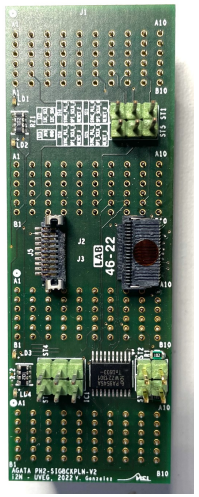
Firefly connector wrong pinout affects DigiOpt12 SYNC_PATTERN & CLOCK signals

V2.5 production

Firefly cable crosses signal pins. Corrected

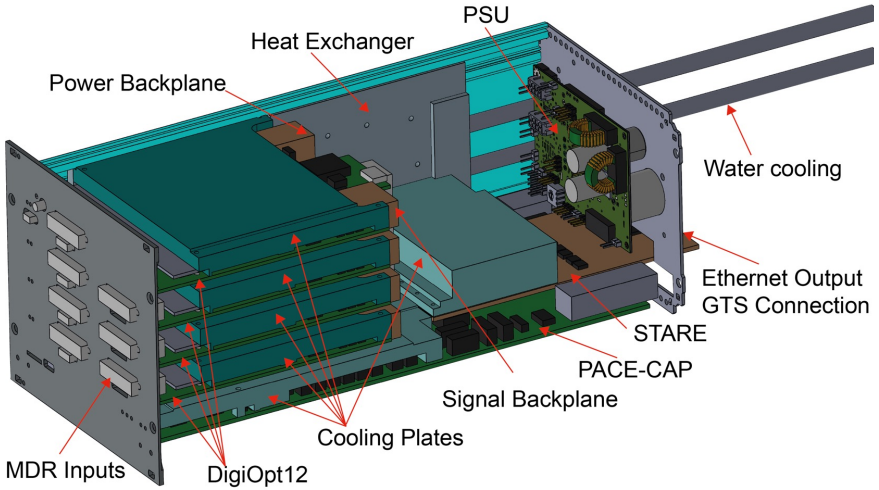






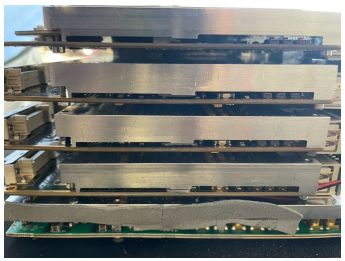
Phase 2 Mechanics

Design



- Cut out to place USB programmer

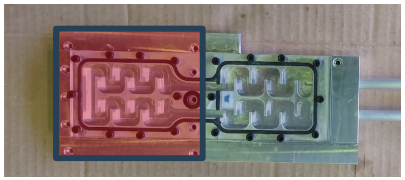
- Increase heat dissipation using side plates



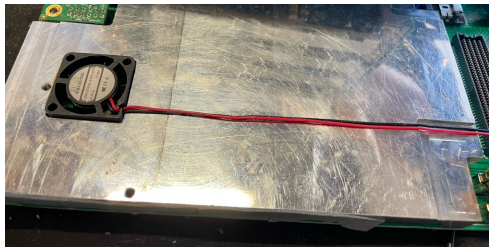
- Thermal Pads on top and bottom layers. Use bottom plate as heat spreader

Modifications to control temperature

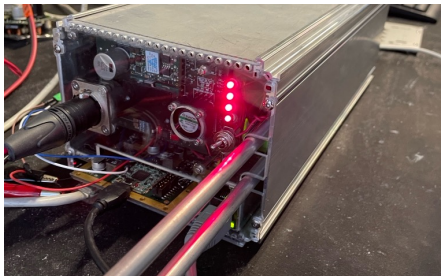
- New Heat Exchanger for better cooling



- Fan in PACE cooling block to lower temperature around DC/DC converters. 70,000 hours lifetime.



- Fan at rear panel to lower PSU temp

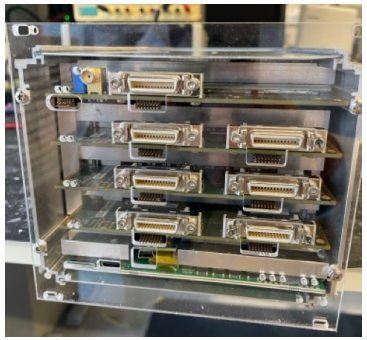


Phase 2 Mechanics

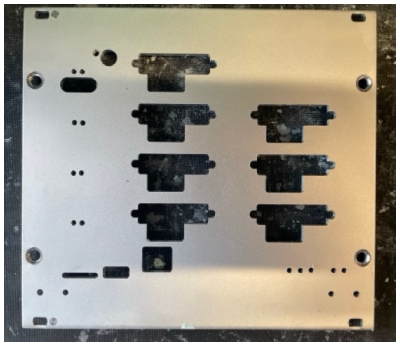
Design

Front and rear panels

- Front panel

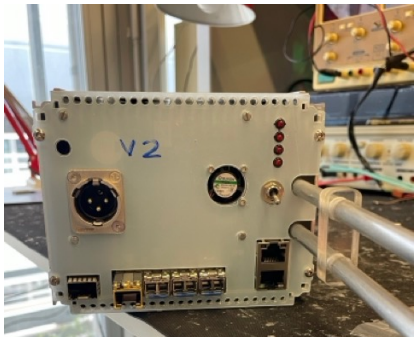


Plastic prototype

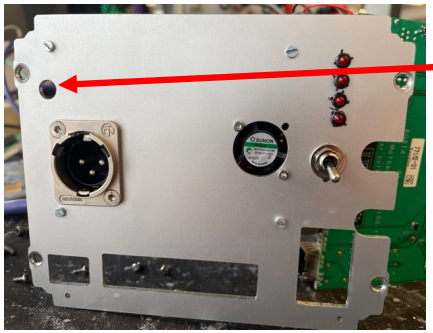


Aluminium prototype

- Rear panel



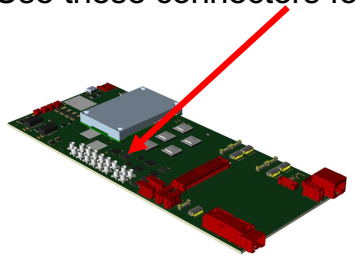
Plastic prototype

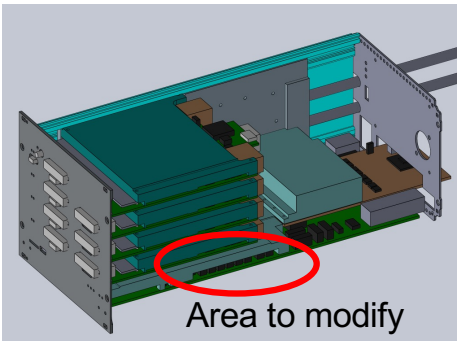


Aluminium prototype

Possible rework in the PACE cooling block to allow for a connection to an external trigger input.

Use these connectors for the trigger input





Hole for trigger connector

EGG.00.302.CLL

No panel mount available

AdvPhase 1 Mechanics

Corrosion problem

Recent failure in AdvPh1 electronics showed a corrosion problem in the heat exchangers

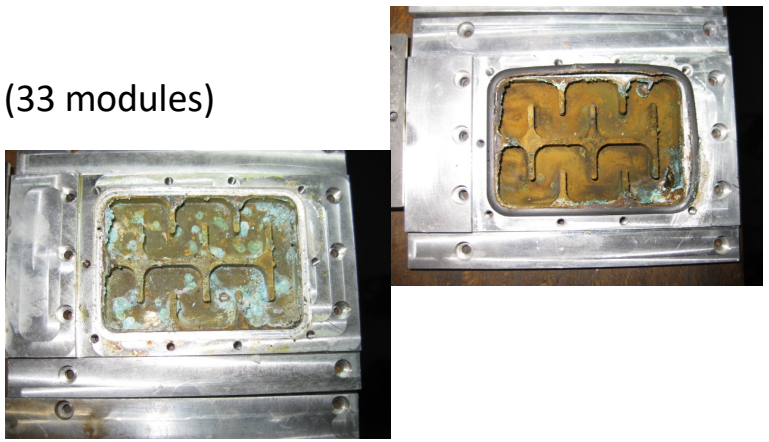
- Produces water leakage through holes in the exchangers
- Water analysed

pH	Conductivity (µS/cm)	Alkalinity ($mgCaCO_3/L$)	Anions (ppm)									Cations (ppm)					
			Clorhides	Nitrites	$N\text{-}NO_2$	Nitrates	$N\text{-}NO_3$	Phosphate	$P\text{-}PO_4$	Sulphate	$S\text{-}SO_4$	Sodium	Ammonium	$N\text{-}NH_4$	Potassium	Magnesium	Calcium
5.69	420	8.01	6.69	0.90	0.27	155.32	35.07	3.94	1.28	7.37	2.46	6.83	16.35	12.72	54.62	4.28	5.33

Conclusion

- High likelihood of promoting algae growth, due to the elevated levels of phosphates, nitrates, and ammonium.
- The ammonium ions can react with aluminium forming aluminium complexes that could potentially accelerate the corrosion rate.
- Algae can contribute forming more acidic biofilms on the surface of aluminium that can lead to pitting corrosion.
- The presence of copper salts produce galvanic corrosion promoting dissolution of the aluminium also leading to pitting corrosion.

- **Solution**
  - Apply an Alodine treatment to the heat exchanger serpentine (33 modules)
  - Use particular cooling system for electronics.
- **Prevention:** don't leave water inside exchangers if it's not flowing.

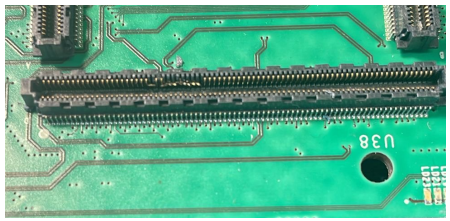


System test

Thermal tests

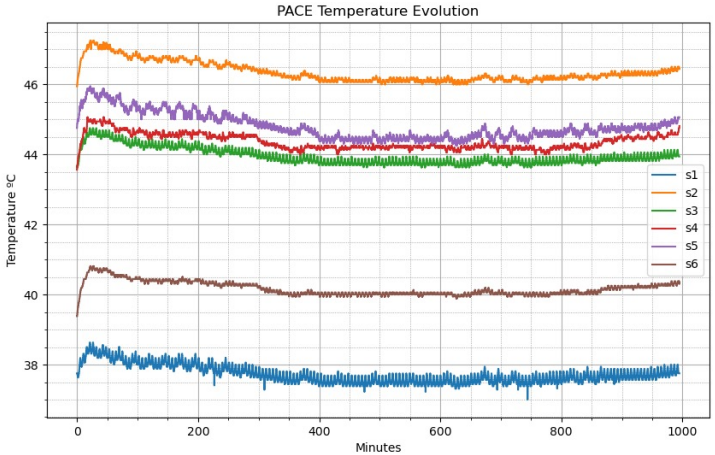
Tests with box closed

- Faced several issues with PACE operation
  - SOM PLL stopped
  - SOM connector replacement
  - SD card reader not working



- Finally, PACE system up and sending data to server through optical fiber (only one link) with the help of Javier during August.
- Temp sensors monitoring in PACE through ipBus.
- Vcc =48 V, Icc = 1.833A

Run test for ~16 hours



Yesterday at 11pm after running for 4 days

```
 |PACE|  PACE_SC_temp
48: 39.44 °C (S1)
49: 48.06 °C (S2)
4A: 45.44 °C (S3)
4C: 48.13 °C (S4)
4D: 46.81 °C (S5)
4E: 42.63 °C (S6)
```

Production status

For 50 units

PCB
- Power backplane: 52 units
- Signal backplane: 60 units
- PSU: final design ready. Waiting in case noise results imply design modification

Component procurement
- Power backplane: ok
- Signal backplane: ok
- PSU: ok

Mechanics
- Boxes: for 51 units
- Crates: for 51 units
- Cooling plates + heat exchangers:
  - 12 PACE cooling blocks
  - 66 STARE cooling blocks
  - 204 Digitopt12 cooling blocks
  - 59 Heat exchanger + 9 with older design to modify
  - 2 Frontal panels
  - 1 Rear panel

Cables
- Firefly: ok
- PCIe: commercial, to be procured
- SATA: commercial, to be procured

Thank you for your attention