

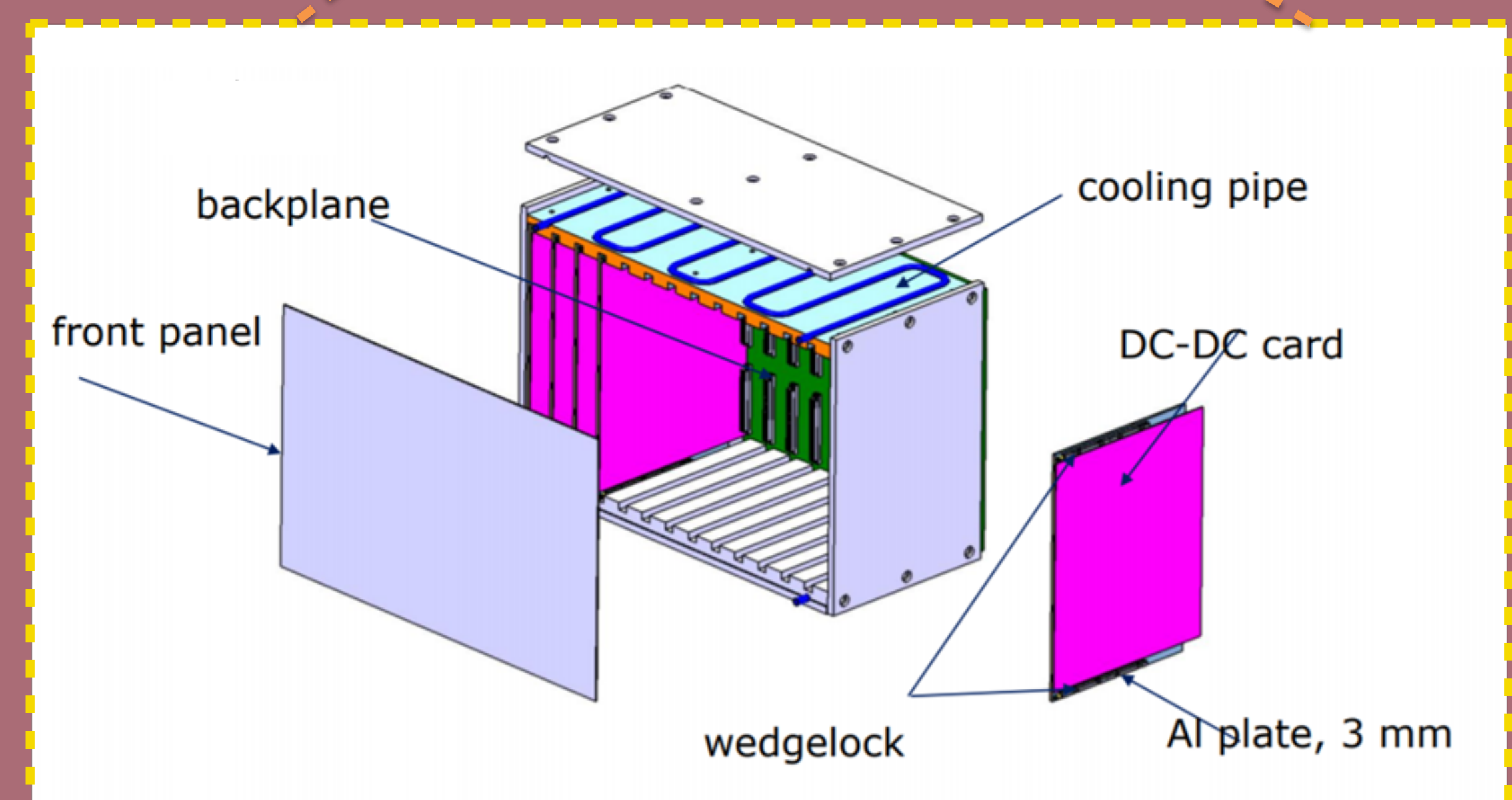
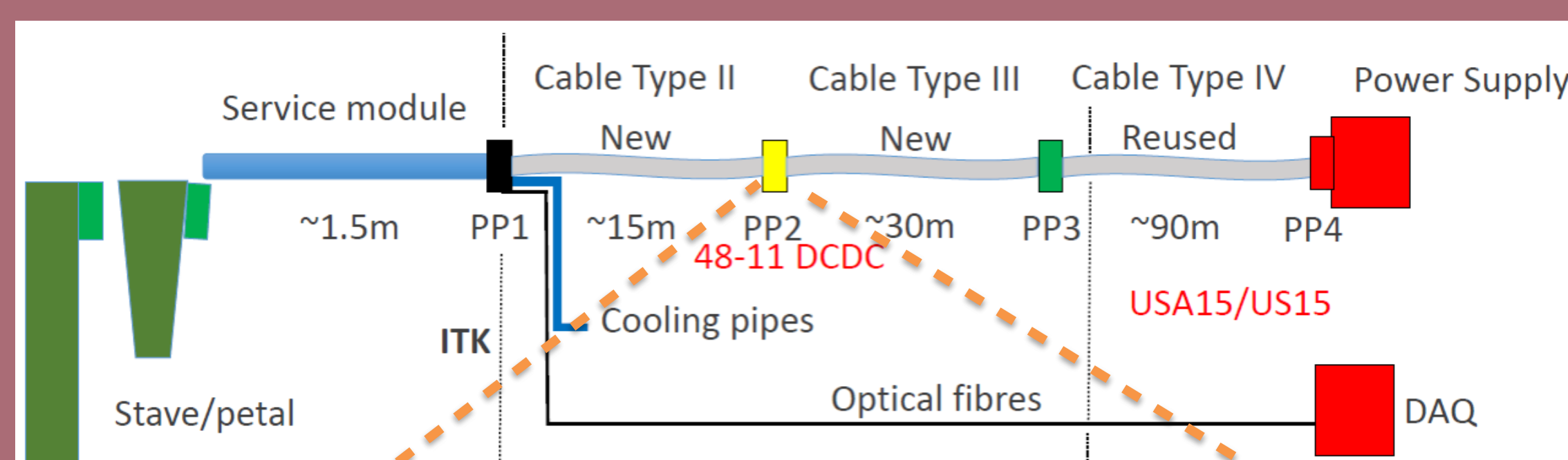
Introduction

The goal is to develop DC/DC converter system to supply LV power for the ATLAS ITk Strip Detector segments. The system will be localized inside the ATLAS detector between muon chambers and calorimeter in the regions called Patch Panel 2 (PP2).

System requirements:

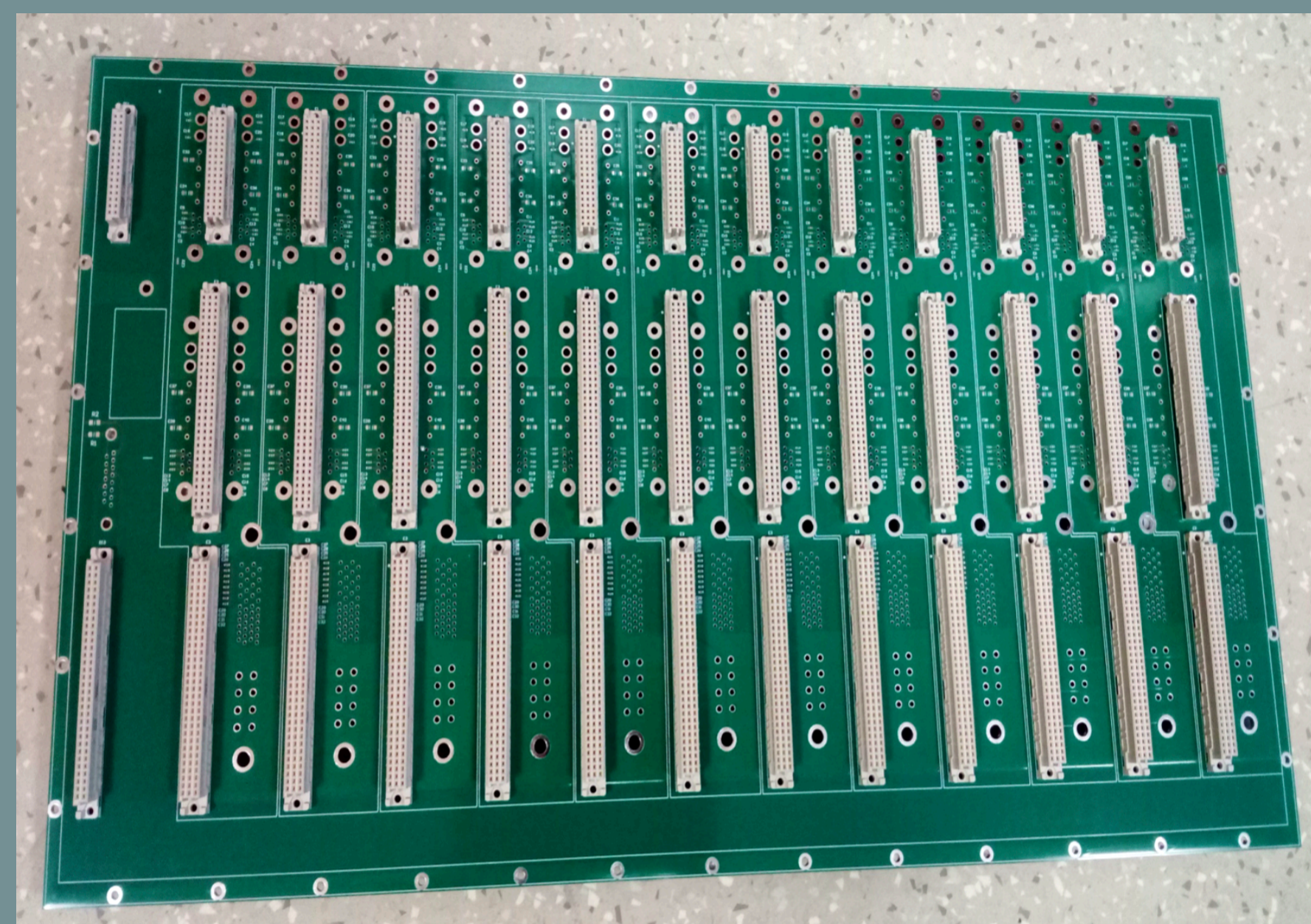
- 48V → 11V DC/DC conversion
- Output current up to 10A (HP) or up to 5A (LP)
- **Independent floating** channels per card: 2 (HP) or 4 (LP)
- Magnetic field tolerant
- Radiation-hardness (TID 20 Gy, 3x10¹¹ neq/cm²)
- Control and monitoring functionality (based on AMAC* chip)

Parameter	Nominal value	Type
DC/DC input voltage	48V	Monitoring
DC/DC input current	1.5A (Low Power) 3A (High Power)	Monitoring
DC/DC output voltage	11V	Monitoring
DC/DC maximum output current	5A (Low Power) 10A (High Power)	Monitoring
End-of-Stage input voltage via sense wires	2 x NTC	Monitoring
4x HV switch enable	DIO	Monitoring/Control
DC/DC enable	DIO	Monitoring/Control



Simplified view of the ITk Strip system and the PP2 crate.

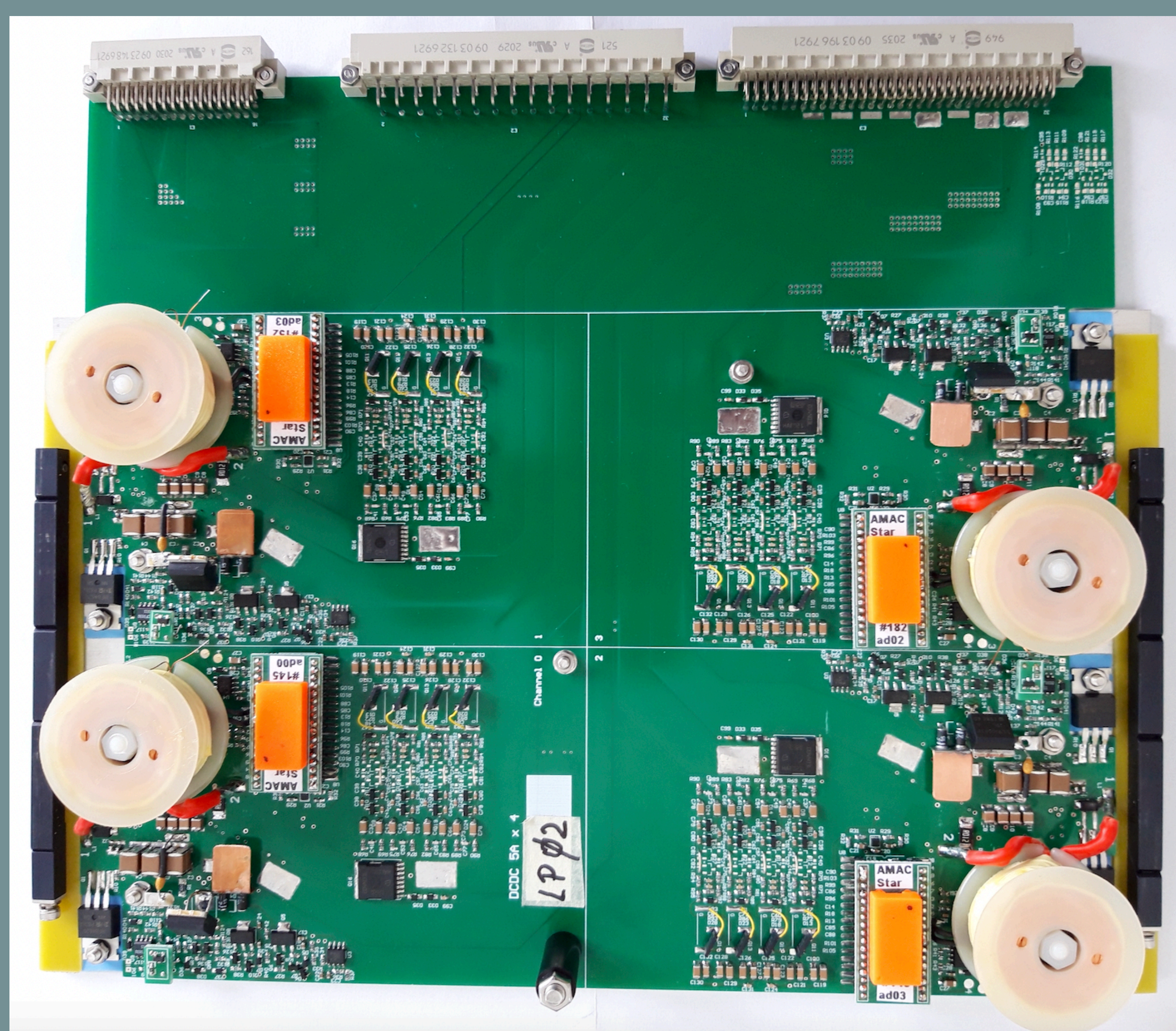
System design



Backplane prototype.



Crate controller system (lpGBT-based).



4-channel LP DC/DC card prototype.

Irradiation tests

Several irradiation campaigns performed at Proteus C-235 cyclotron, Krakow in 2021. Both individual components and full DC/DC channels are tested.

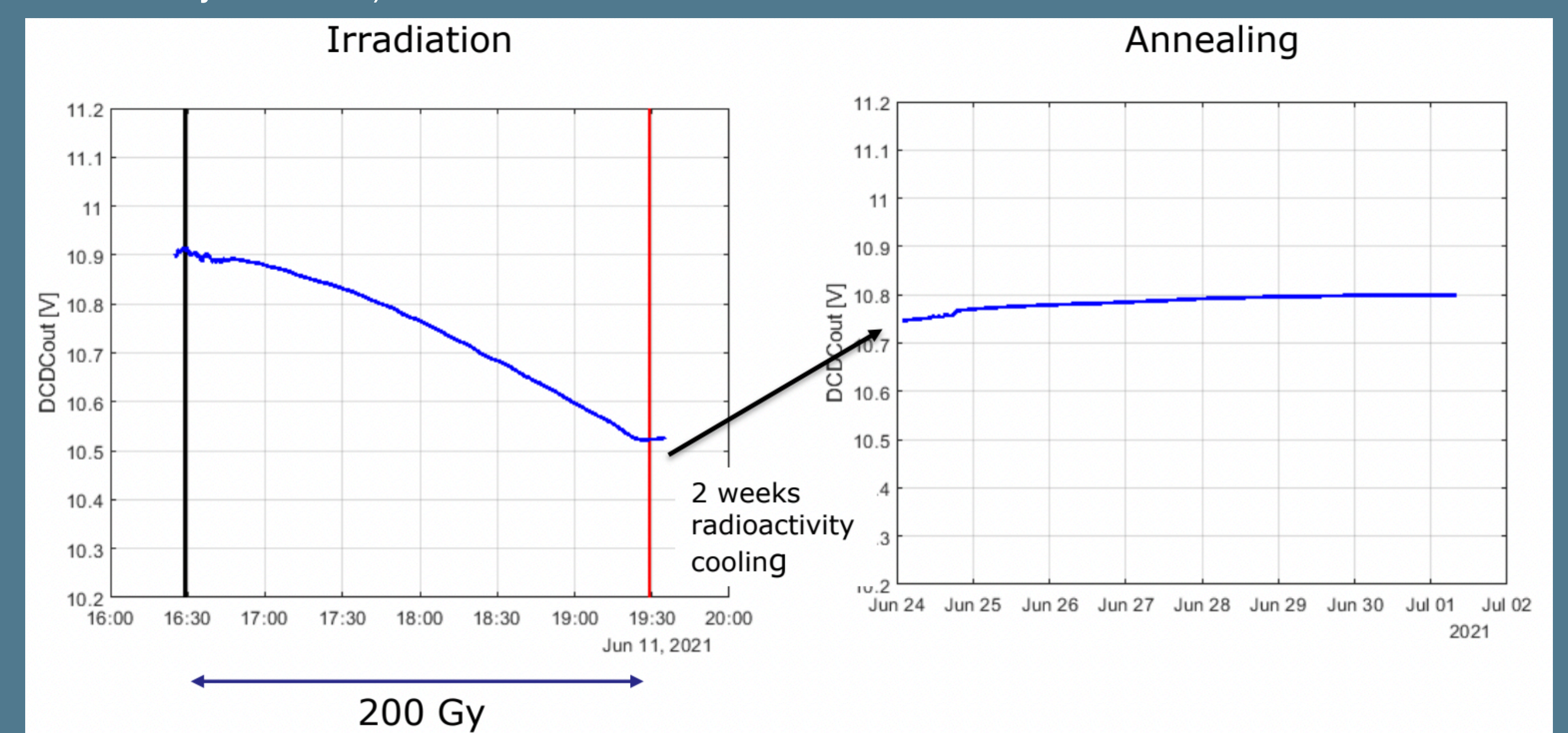
Parameter	Value	Safety factor
Beam energy	230 MeV	-
TID	200 Gy	10
Hadron fluence	3x10 ¹¹ /cm ²	10
1MeV neq	3x10 ¹¹ /cm ²	1

Full chronology:

- Boards biased and working at nominal configuration with a load of 5A during irradiation
- Output voltage and input current monitored continuously
- After irradiation boards were stored at room temp. for ~2 weeks (because of radioactivity)
- Then annealing for 1 week at 100 degC

Results:

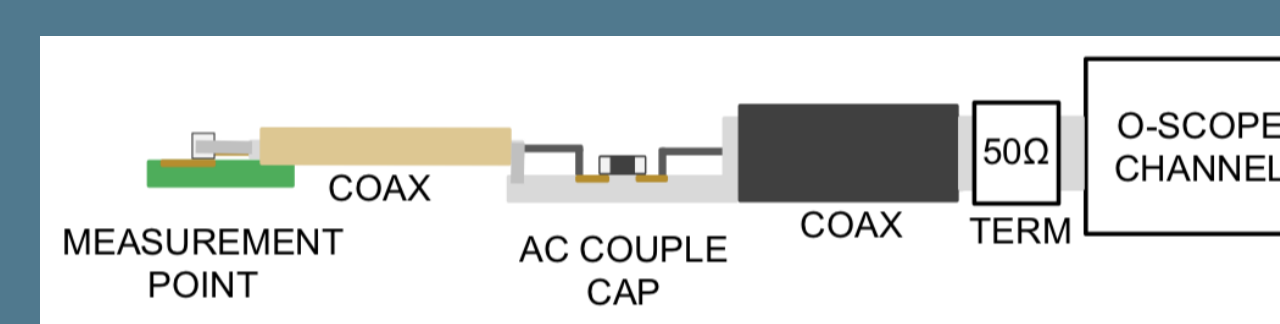
- All components used in the design have been qualified for radiation tolerance
- DC/DC channels operational during irradiation with only slight drift of the output voltage
- Minor increase of the input current observed during irradiation (related to transient effects caused by radiation)



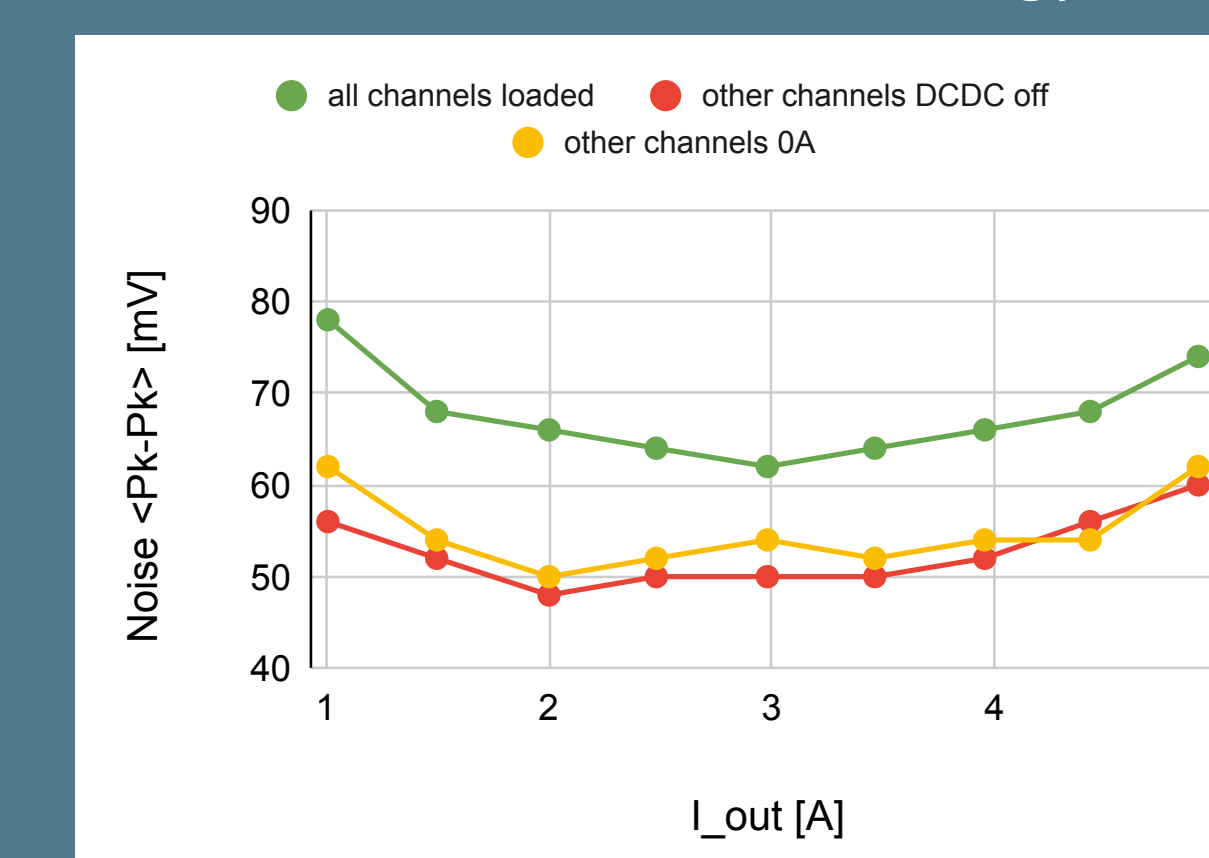
Output voltage behaviour during and after the irradiation.

Output noise and other measurements

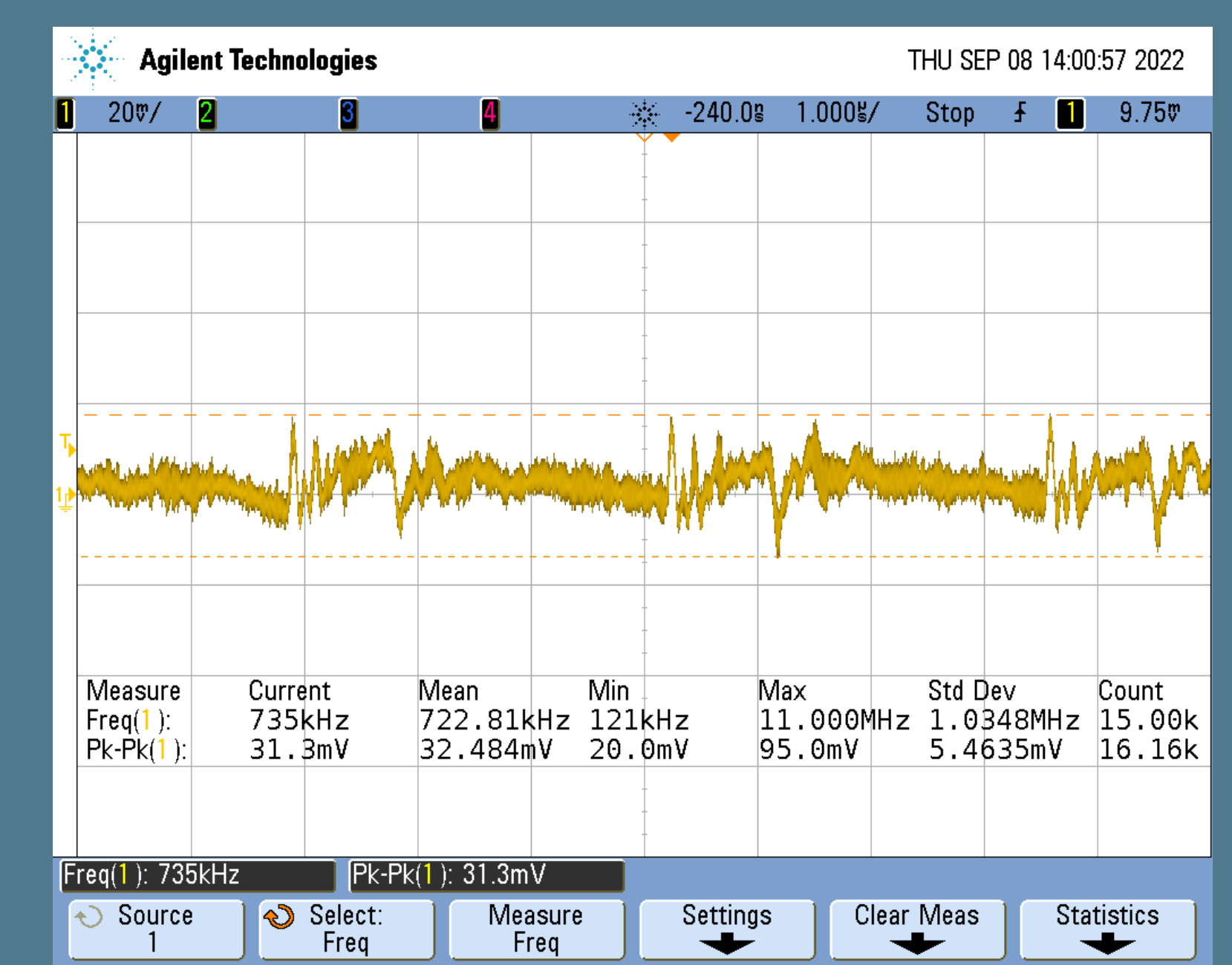
Noise and ripple measurements via custom 0.5x probe. Probing is done at the end of the 15m Glenair Type-II cable, connected between DC/DC card out and the load. The measured noise amplitude does not exceed 50-100 mV <Pk-Pk> in the full load range.



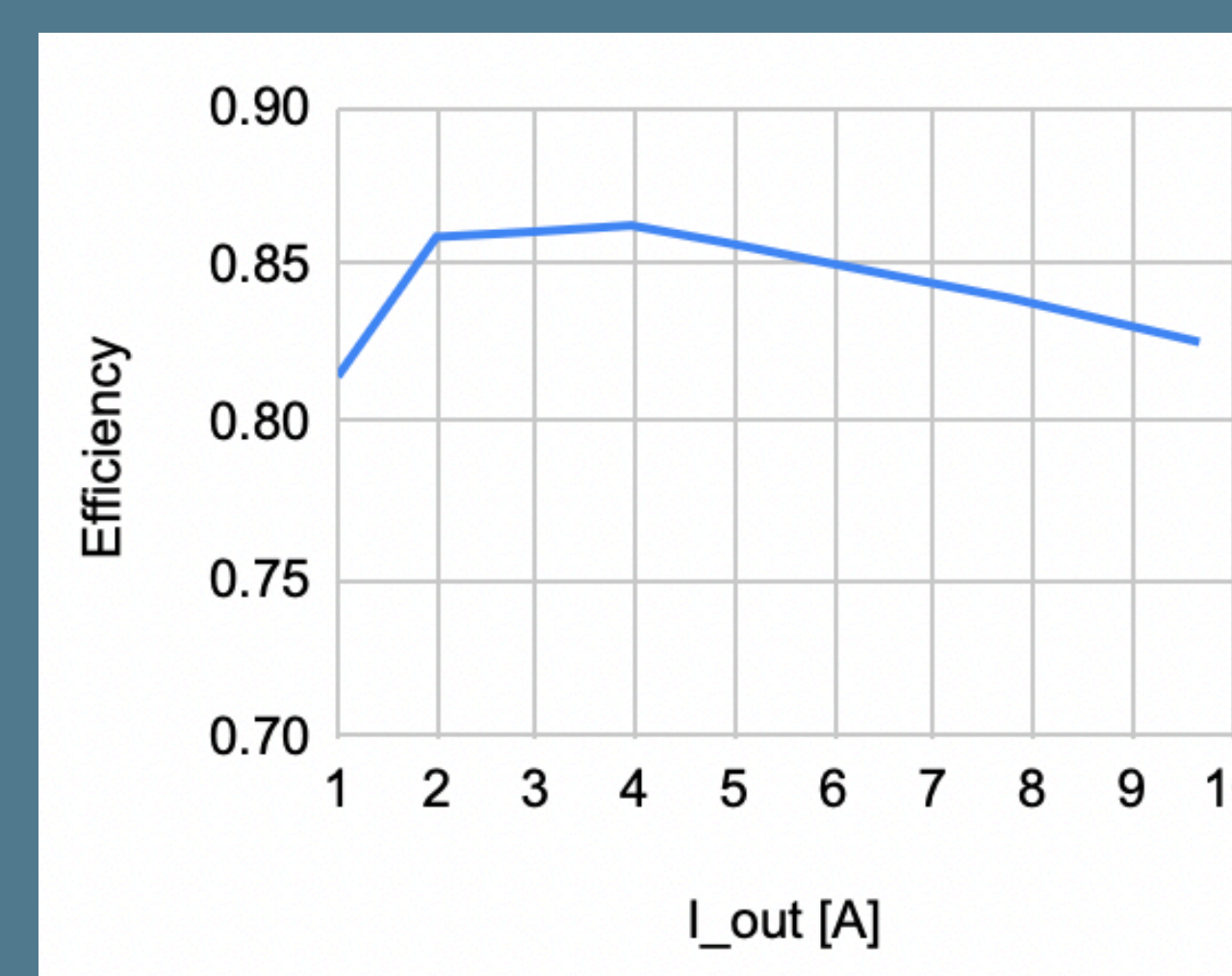
Noise measurement methodology.



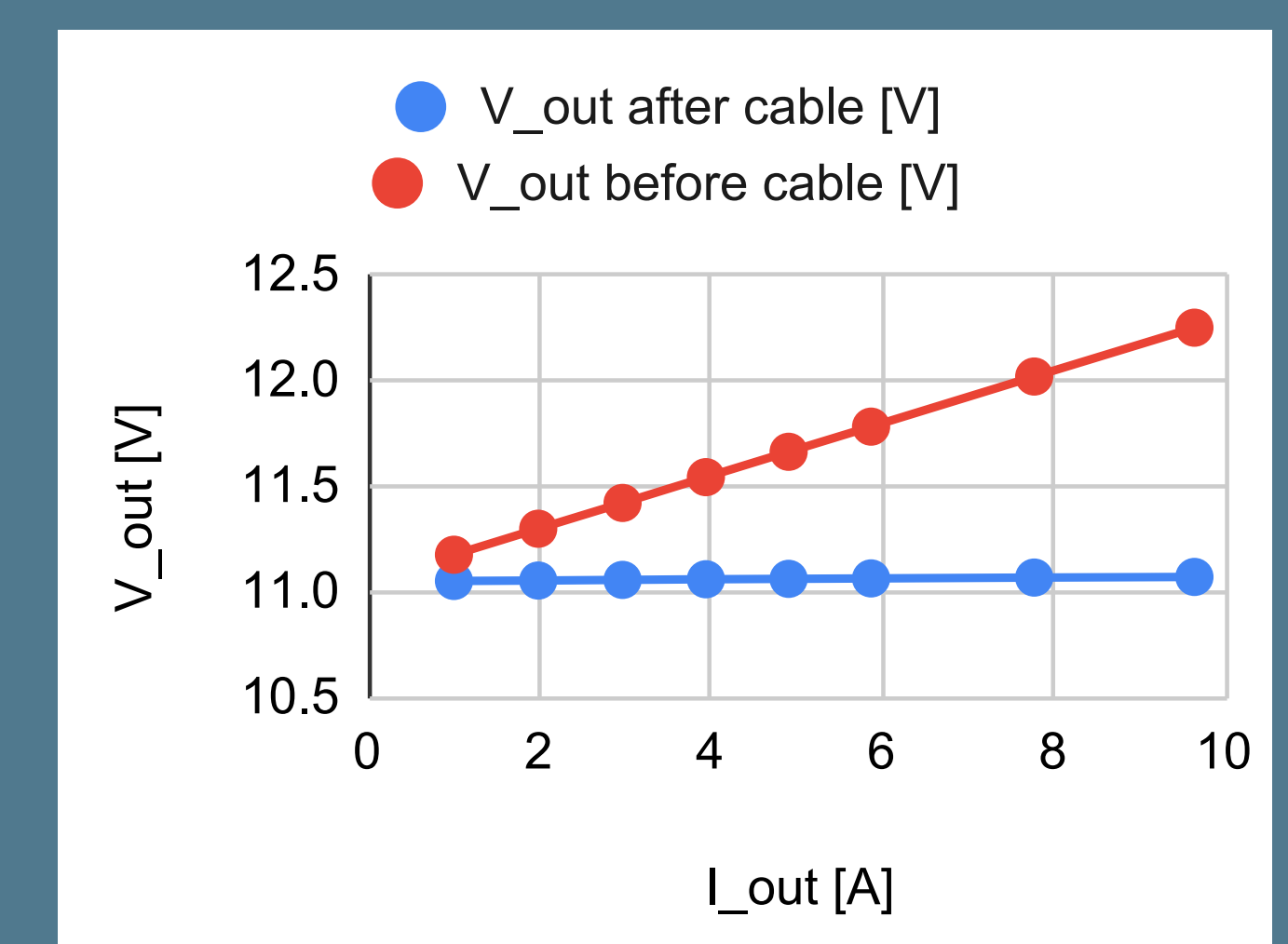
Noise amplitude vs load.



Typical output voltage waveform @cable end.



Efficiency measurement.



Voltage correction system performance.

Acknowledgements

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