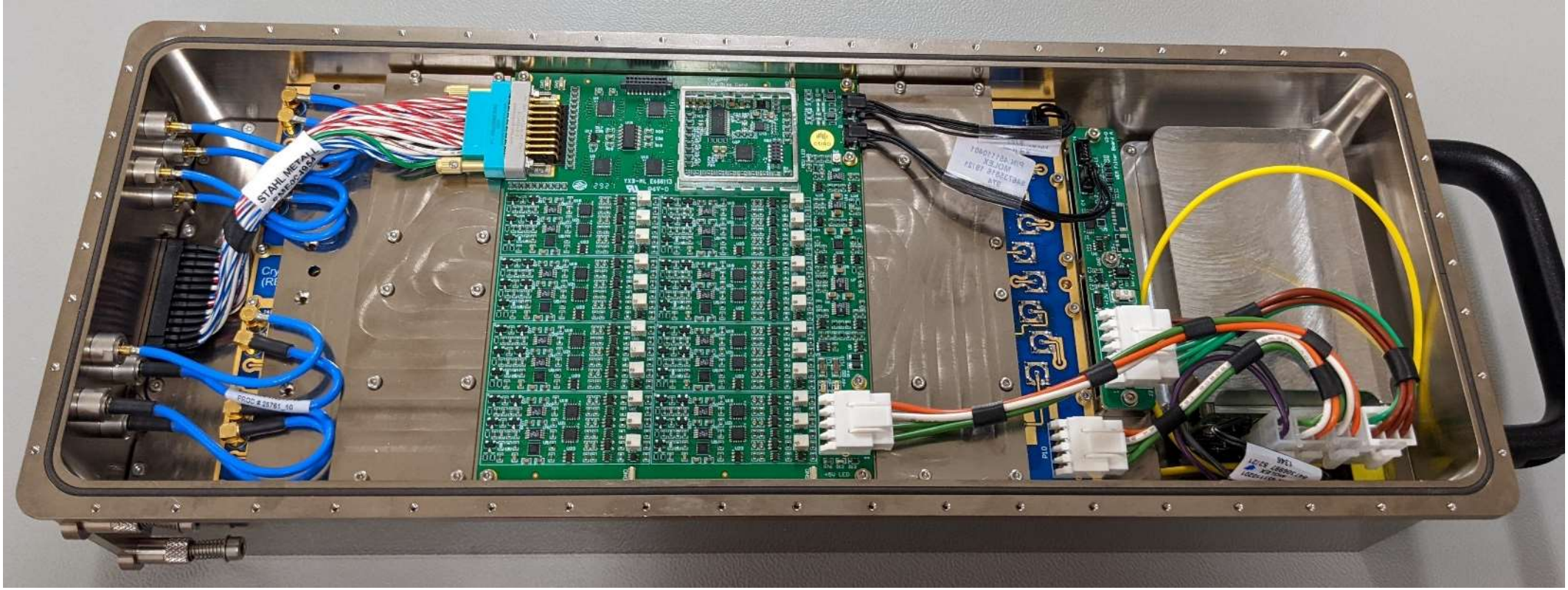
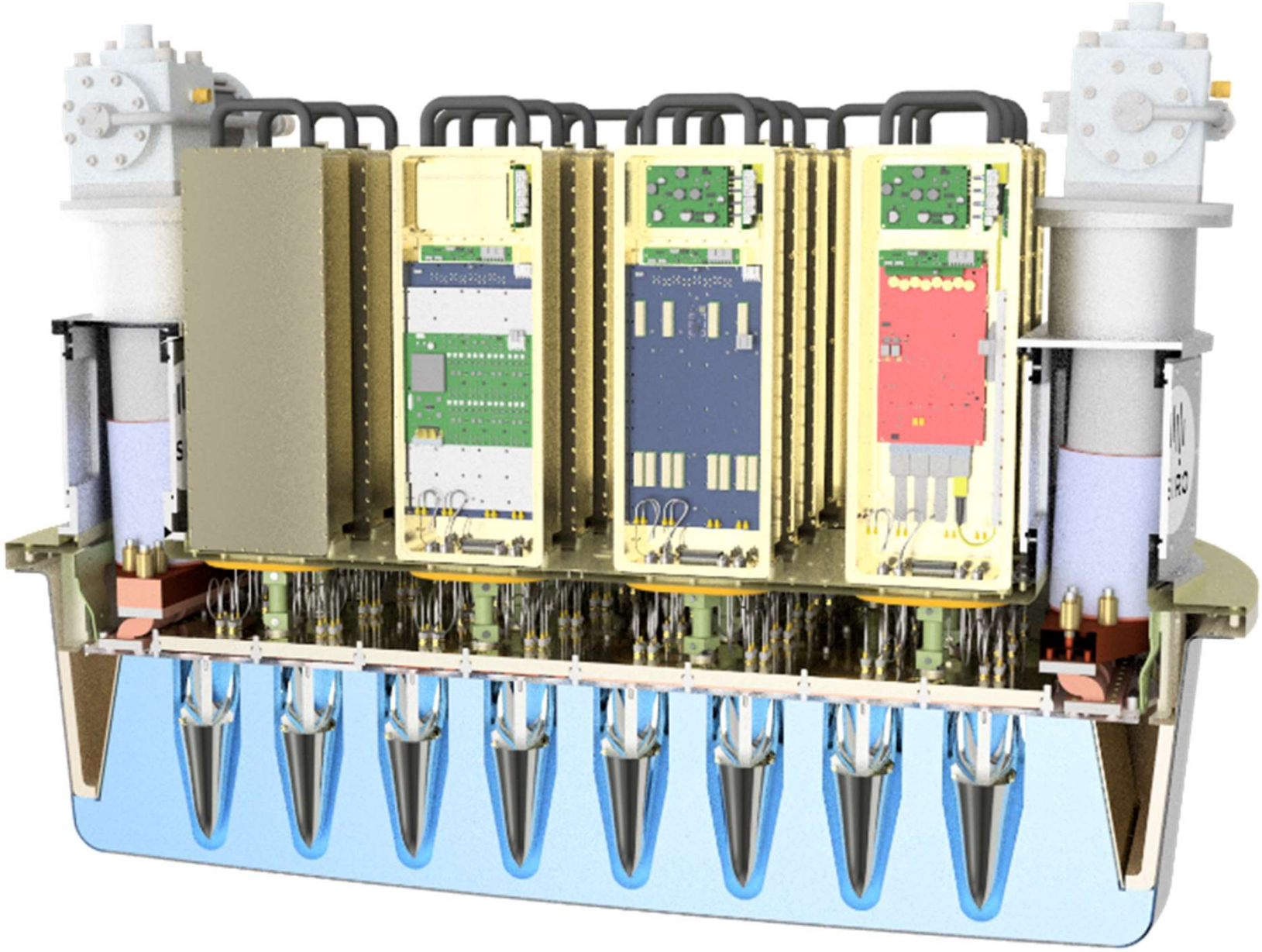


An EMI-shielded Module for the Parkes Cryo-PAF RFSoC Digitisers

Peter Roush, Ron Beresford, Paul Roberts, Sean Severs, Jeganathan Kanapathippillai



Why have digitisers at the focus?

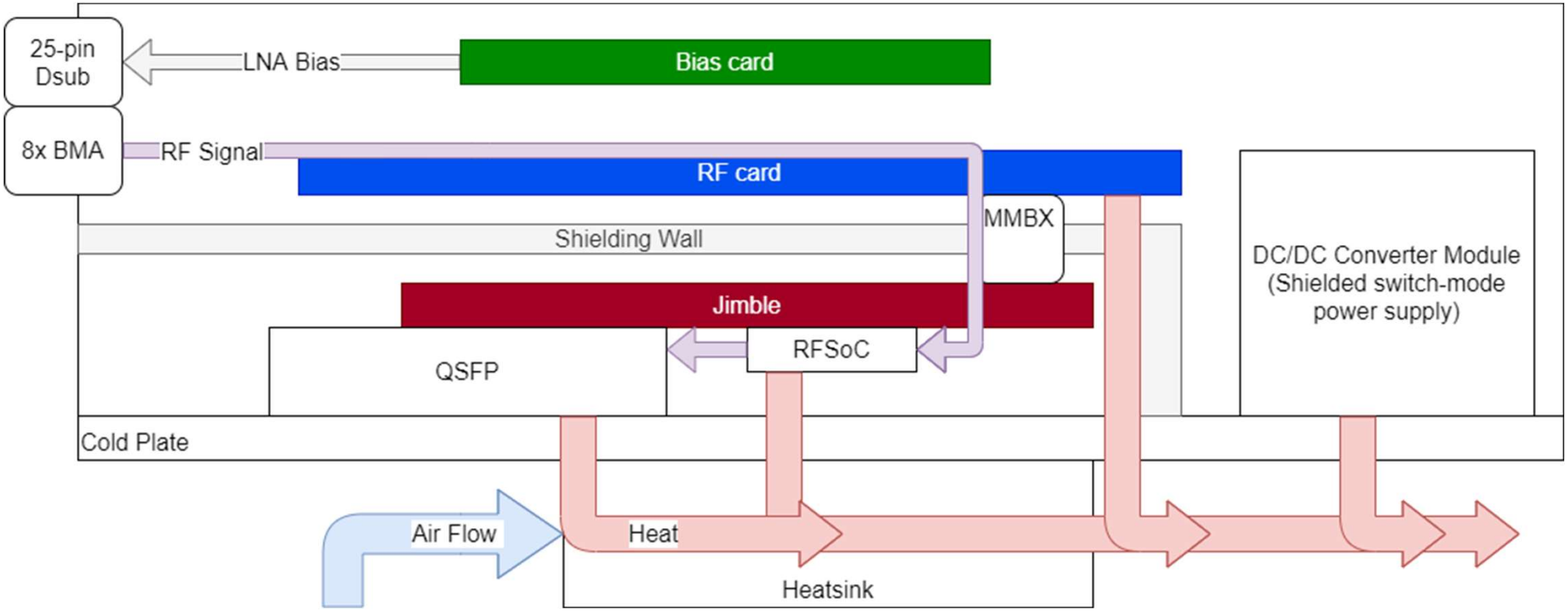
Pros:

- High dynamic range to cope with Parkes RFI environment
- 26 fibre ribbons instead of 196 coax cables
- Avoids issues with long coax cables:
  - Insertion loss slope
  - Spectrum ‘ripple’ due to reflections

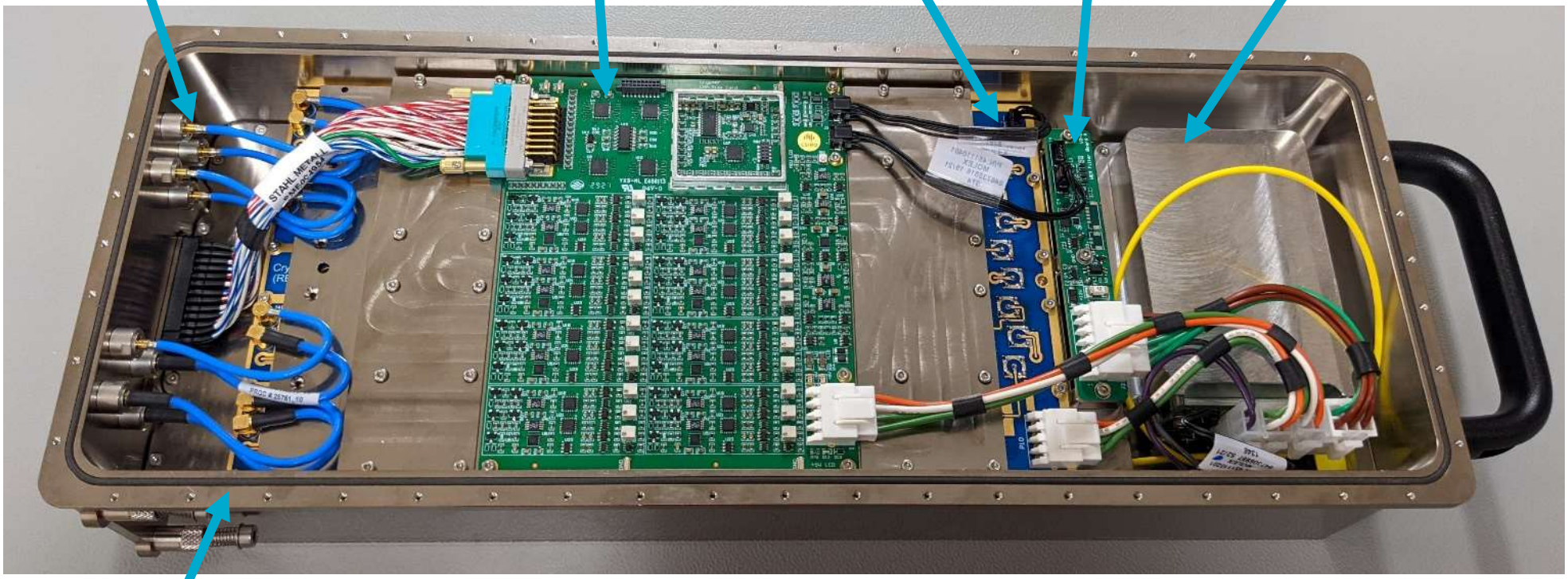
Cons:

- Digitisers produce broadband RFI which can impact receiver sensitivity.
- High power consumption: switched-mode power supplies and active cooling.

Warm Electronics Module



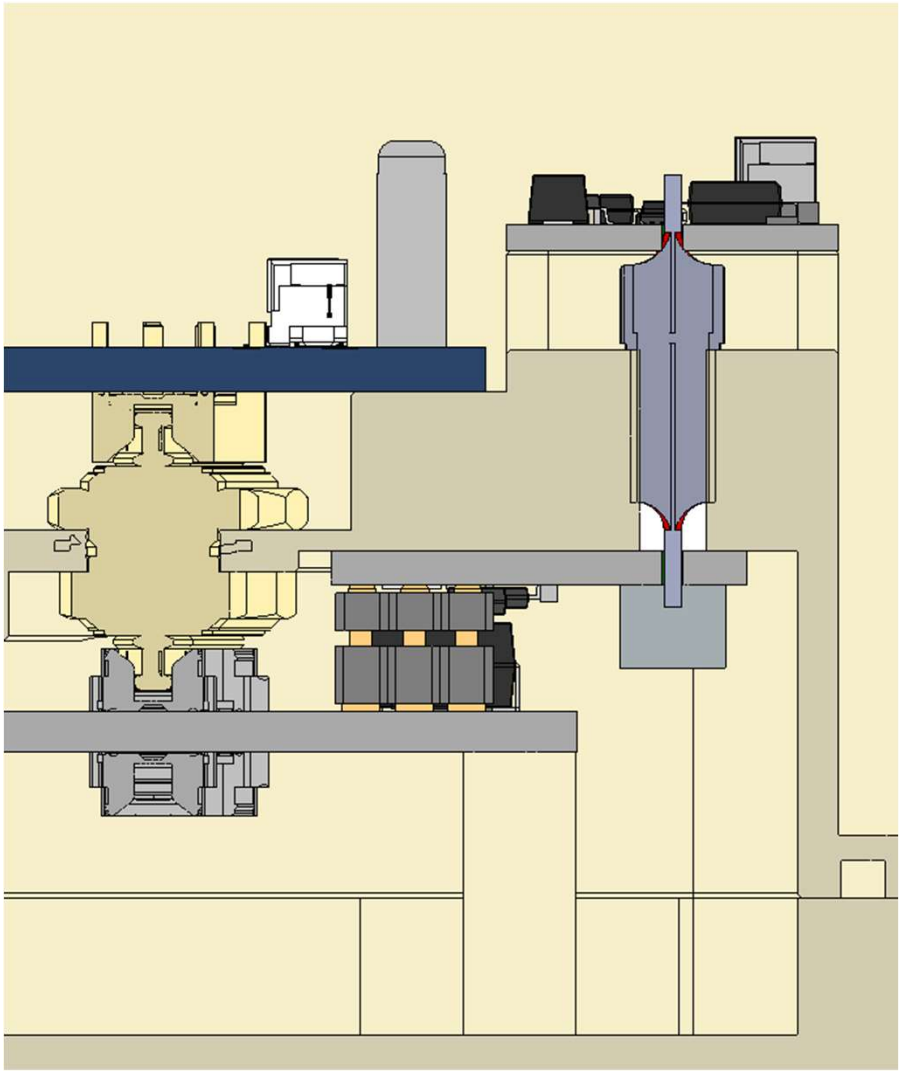
Warm Electronics Module



41 cm long
4.3 kg
130 W power dissipation

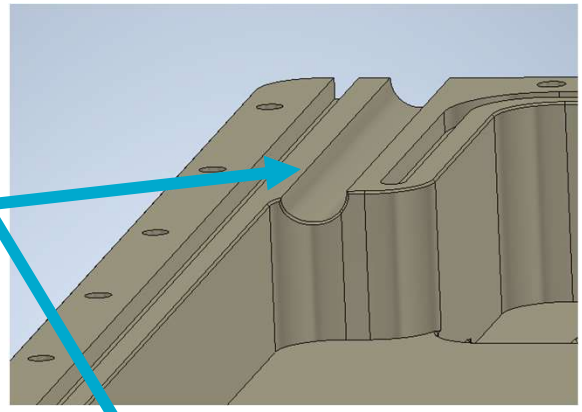
Shielding design

- Priorities:
  - In-band radiated emissions
  - EMI coupled into LNA supply
- Multiple layers of shielding and filtering
- Gaskets have 100 dB nominal shielding effectiveness
- Electrical penetrations are limited to power and low-speed internal communications.
- All electrical penetrations use low-pass Pi feedthrough filters (75dB in-band insertion loss)
- LNA regulators with high Power Supply Ripple Rejection (PSRR)



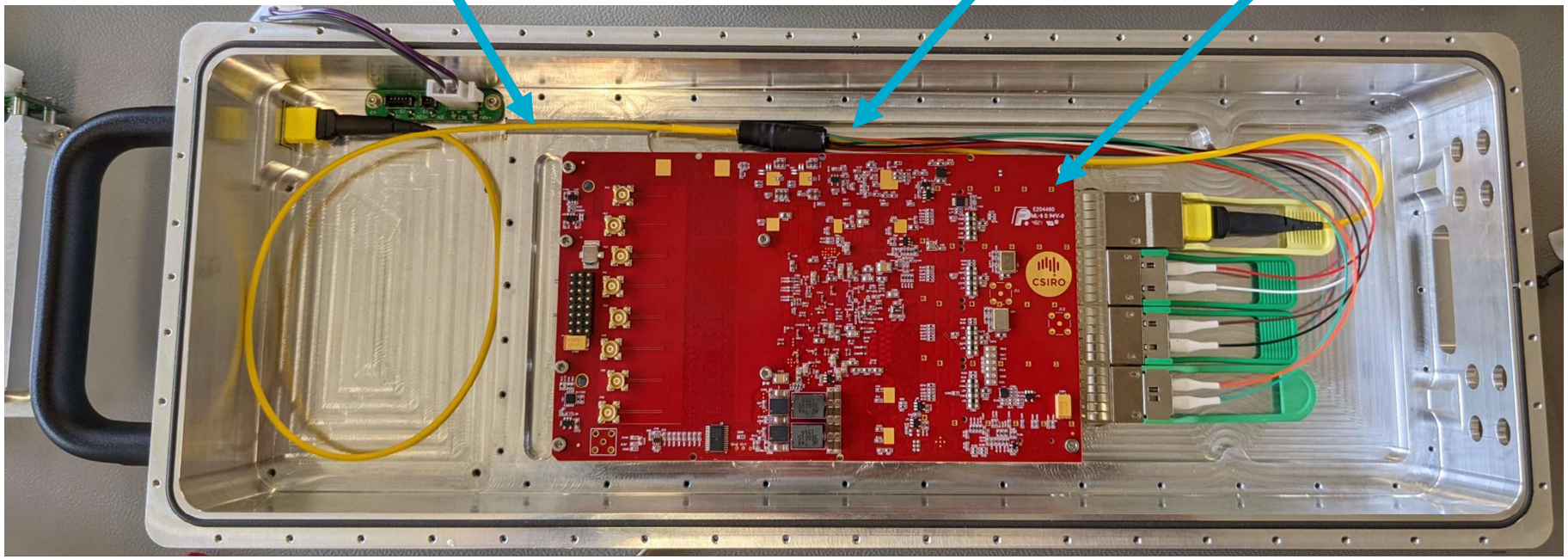
Fibre-Optics

Waveguide beyond cut-off acts as a high-pass filter with cut-off above 30 GHz

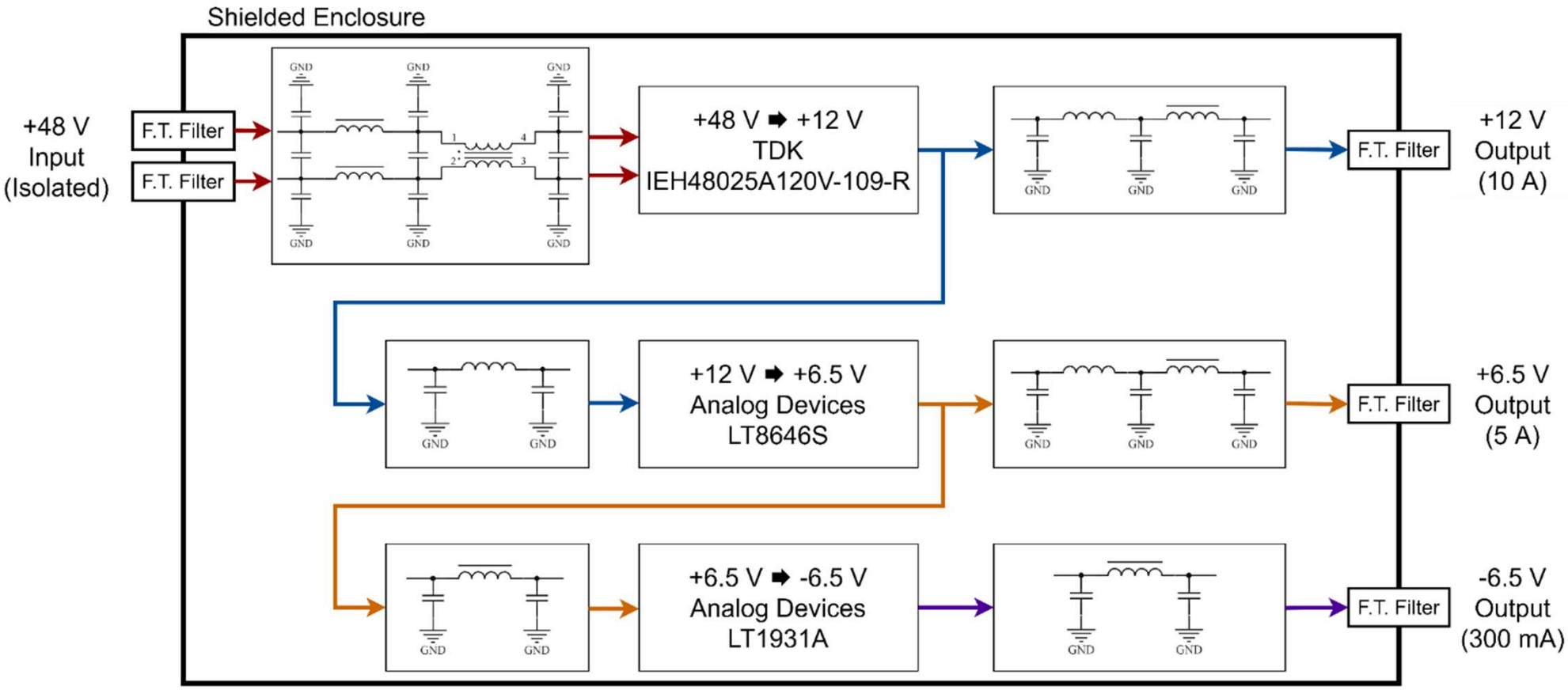


12-Fibre Breakout

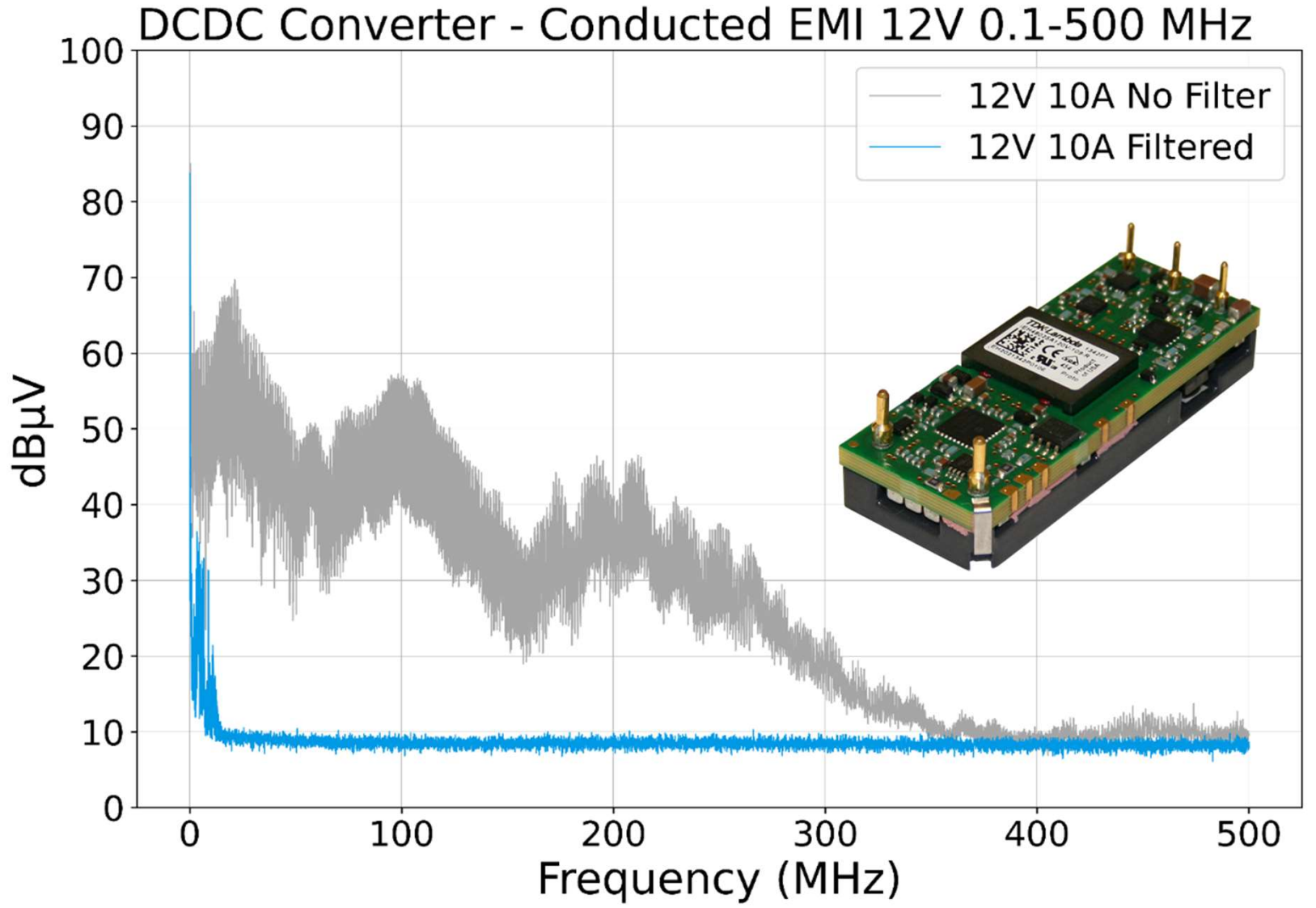
Jimble



Switched-mode Power Supply

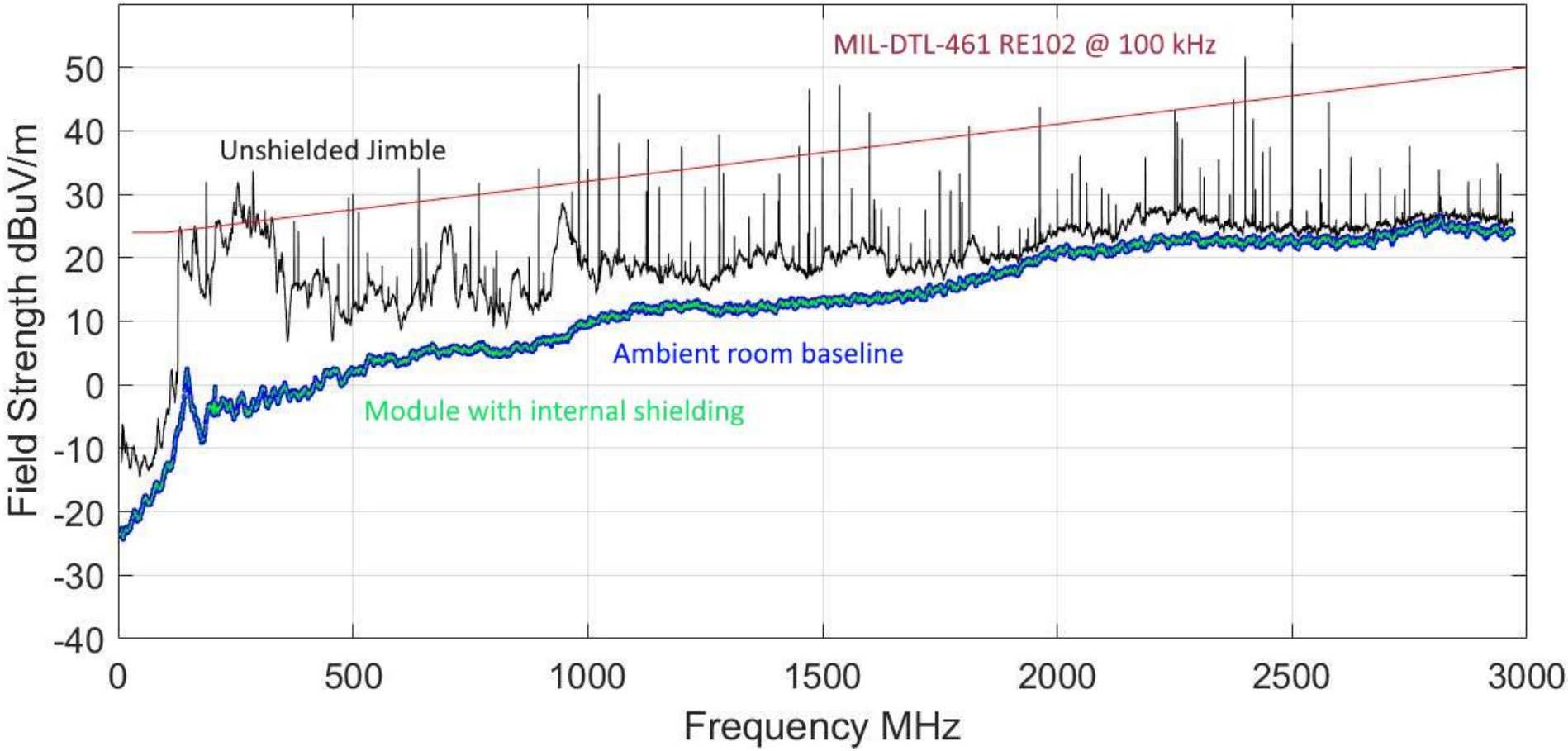


Switched-mode Power Supply

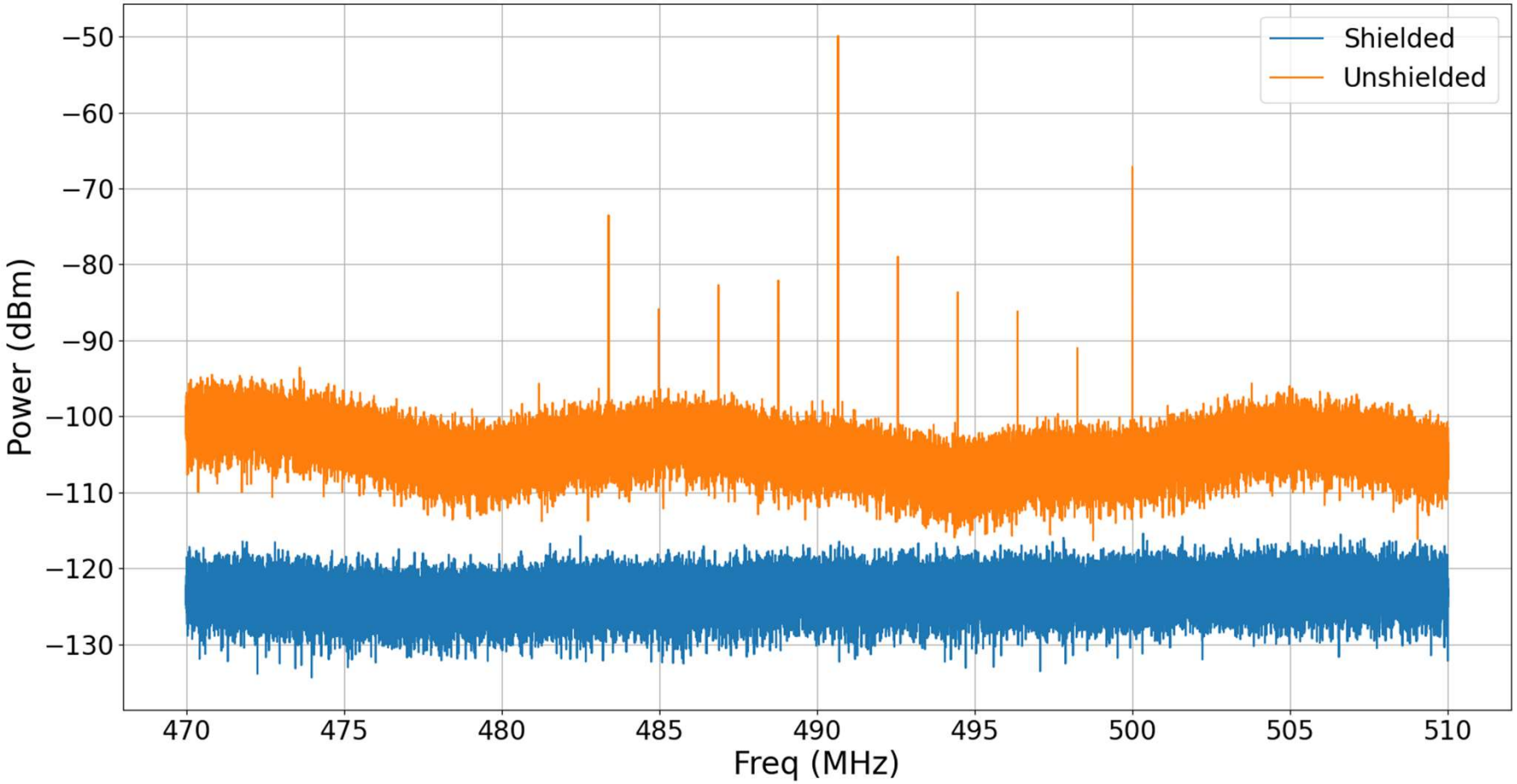


Radiated EMI measurement

Radiated EMI measurement

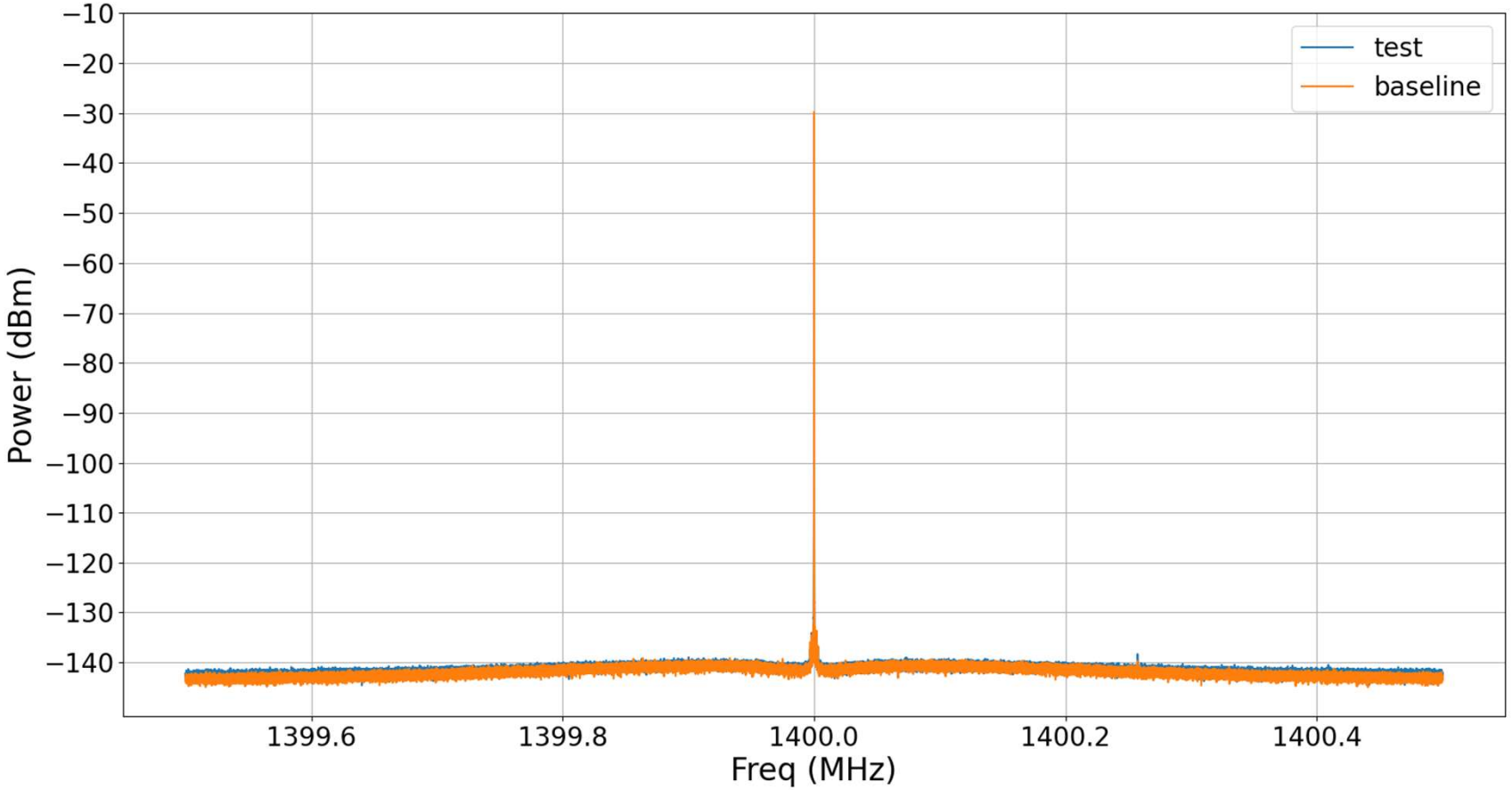


Radiated EMI measurement (490 MHz)



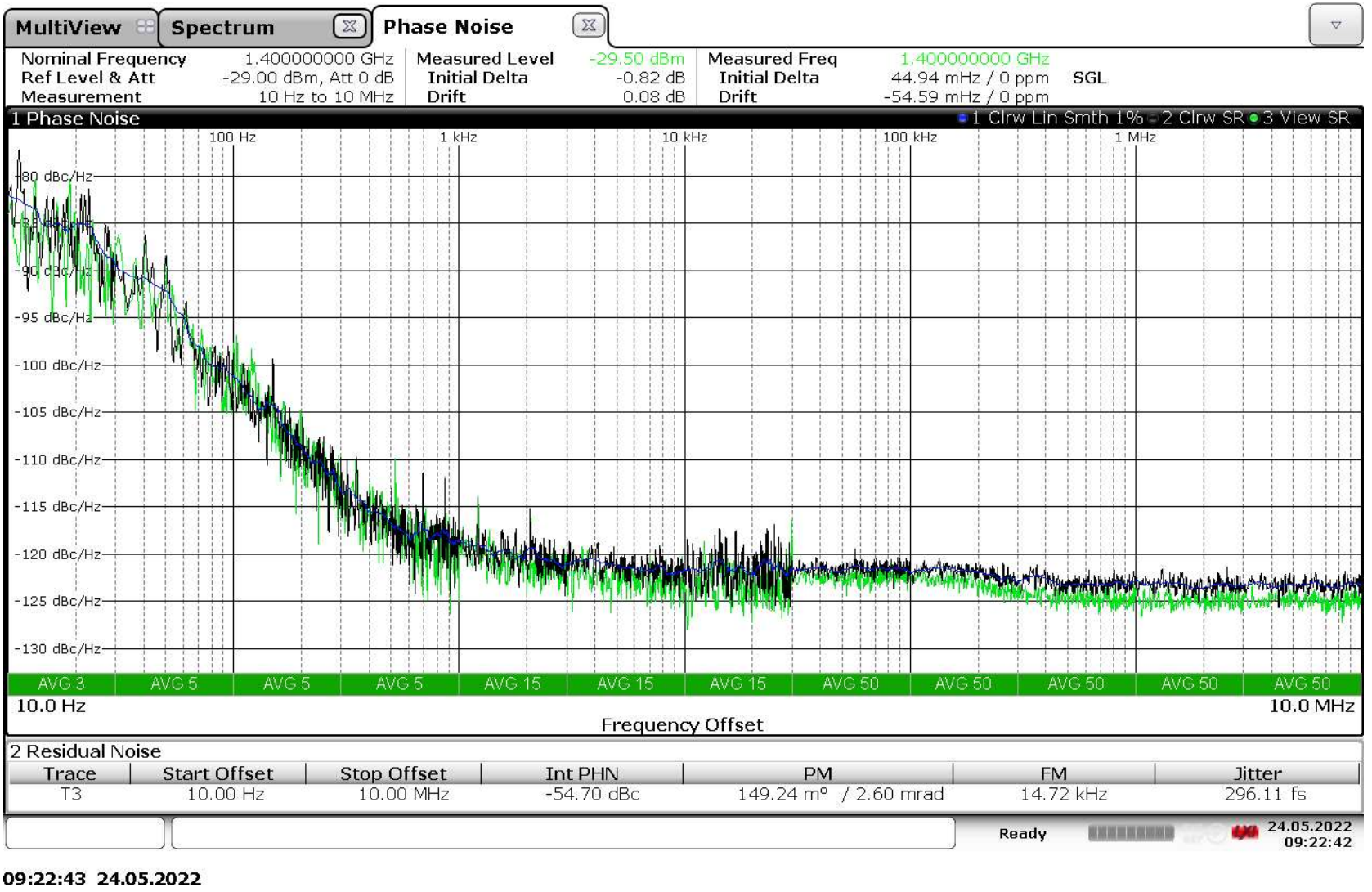
Unshielded: Narrow spike at 490.6 MHz is ~70 dB above noise floor
Shielded: no detectable emissions

Injected Tone measurement



No modulation spurs visible in the LNA output when a tone is injected into the LNA input.

Injected tone measurement (Phase noise)



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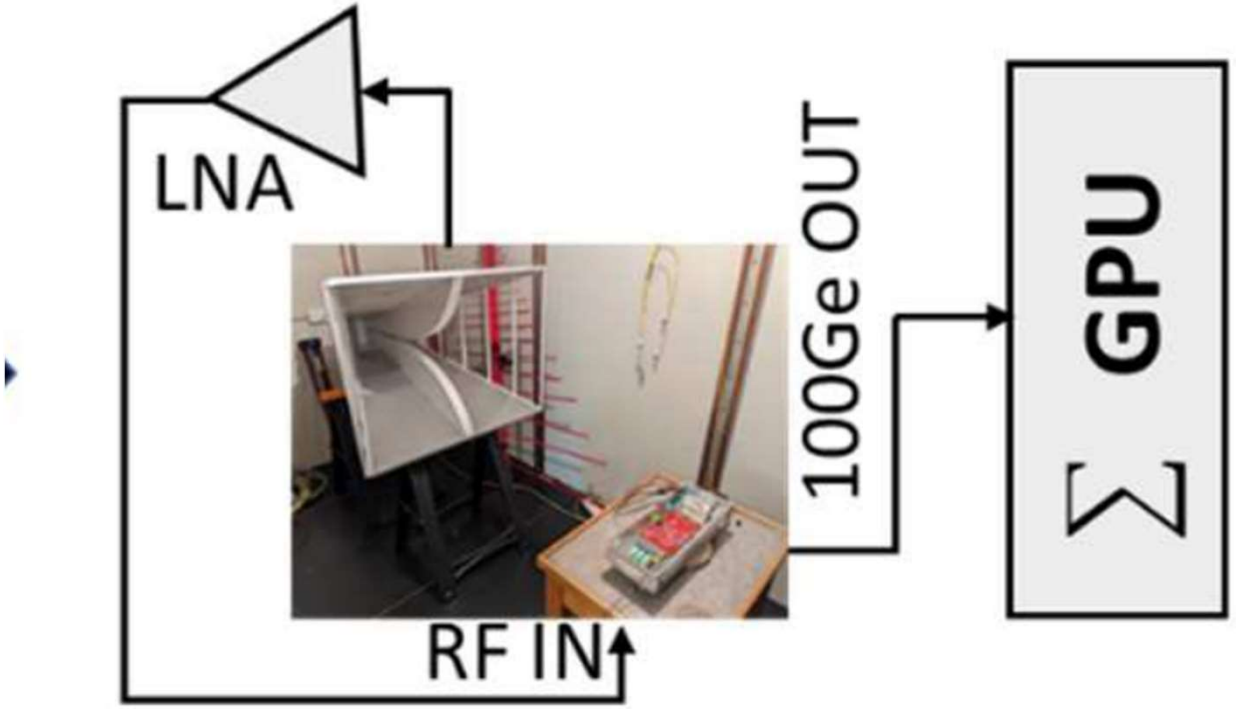
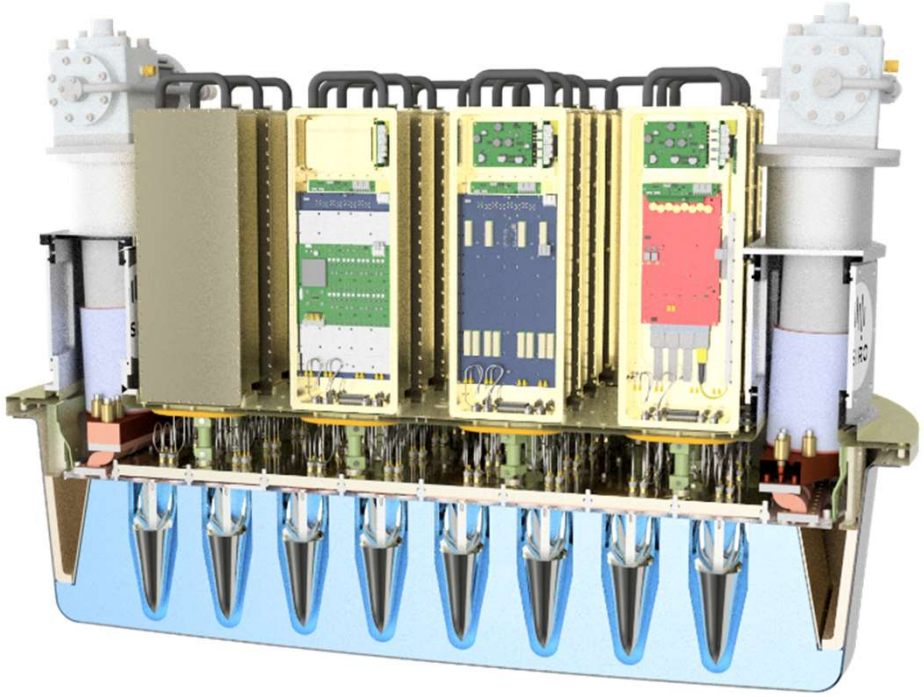
Future measurements

Use an integrating GPU spectrometer to reduce the noise floor of the radiated EMI measurement.



Summary

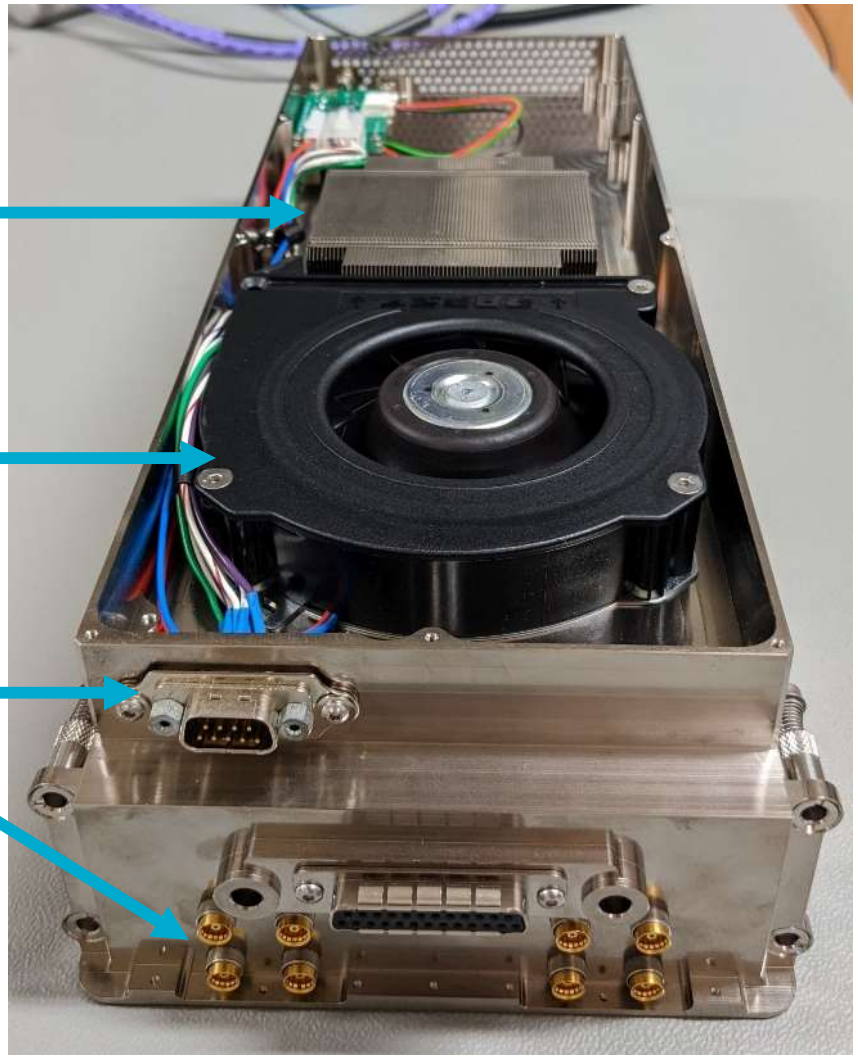
- The ‘Jimble’ RFSoC digitiser offers major advantages for PAF designs but requires careful shielding.
- This integrated module successfully shields and cools the Jimble and other electronics.
- Future plans to increase test sensitivity.
- Compact size and 4.3kg weight is ideal for PAF designs.



Unused slides below

Thermal design

Cools up to 150 W of internal power dissipation



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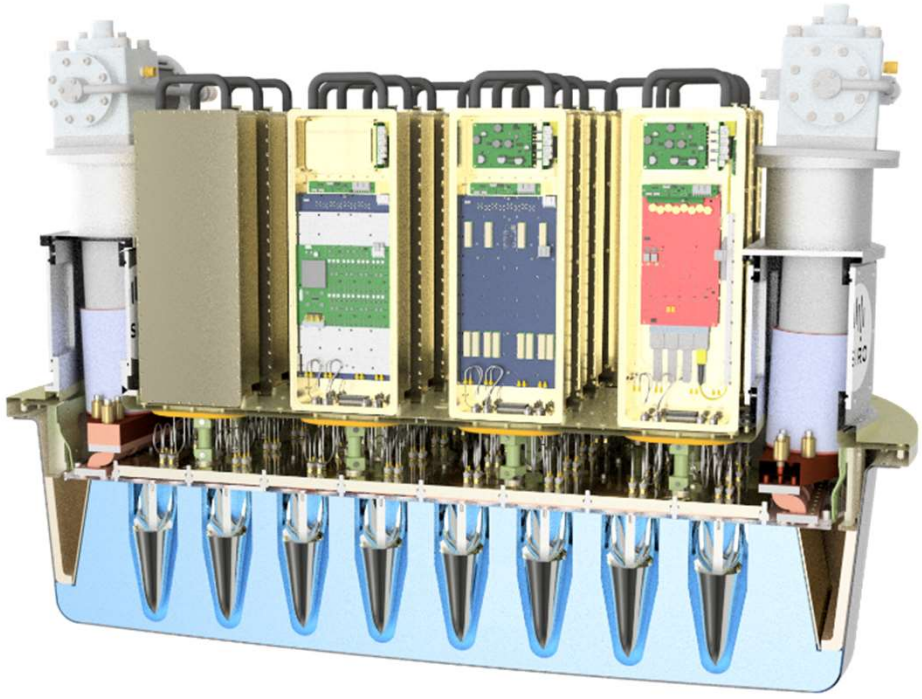
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