Project presentation
PJAS – Polytechnic Institute of Leiria - CERN

Author:
Alexandre Mateus Correia

Supervisor:
Mr. Gregory Nicolas Pigny

Work under supervision of:
Mr. Nikolaos Chatzigeorgiou

Presentation

- **Name:** Alexandre Mateus Correia;
- **Home Institution:** Polytechnic Institute of Leiria;
- **Course:** Electrical and Computer Engineering;
- **Start Date:** February 2019;
- **At:**
  - **Department:** Technology (TE);
  - **Group:** Vacuum, Surfaces and Coatings (VSC);
  - **Section:** Interlock, Controls and Monitoring (ICM);

Importance of Vacuum

Vacuum in the LHC is crucial to:

- Minimize beam – gas interactions;
- Thermal insulation of cryostats & helium distribution lines;

More than 6000 vacuum instruments to be controlled and monitored:

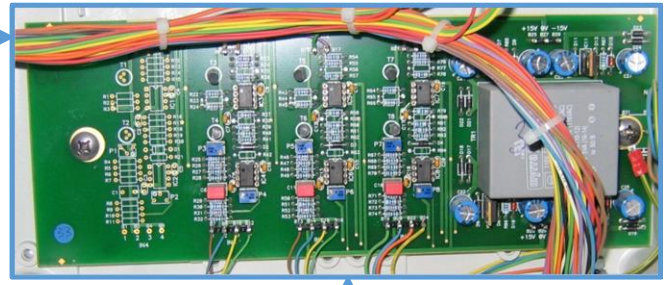
- Gauges: 3000 (pressure range from 1000 mbar down to 10^{-12} mbar)
- Pumping groups: 250
- Ion pumps: 2700
- Sector valves: 500
- PLC: 300
- SCADA (Supervisory Control And Data Acquisition): 7

Project context – Present situation in the LHC ARC/DS

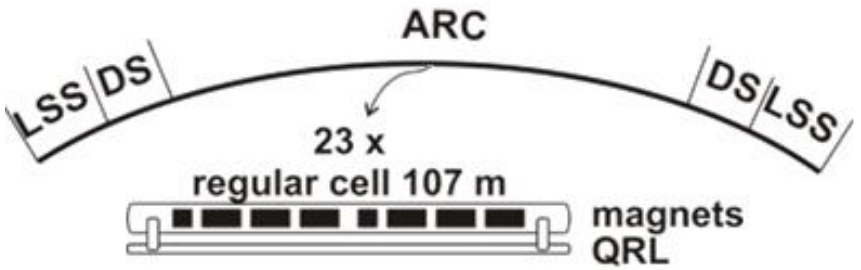
Pirani +Penning gauge

Signal (Penning)

Signal cable (Pirani)



ARC: 2 460 m
DS (Dispersion Suppressors): 170m
LSS (Long Straight Section): 540m



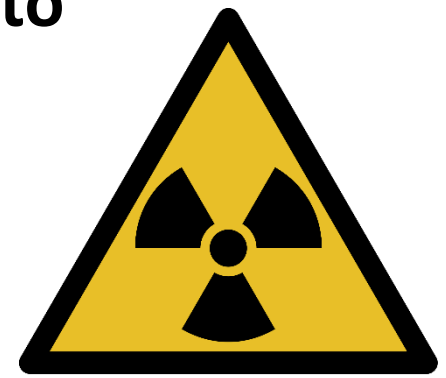
Signal cable (Piezo)

Piezo gauge

Project motivation – R2E (Radiation to electronics)

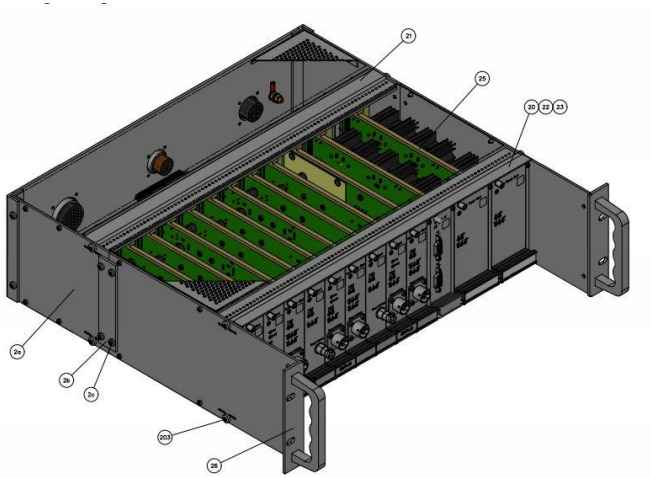
Radiation levels will greatly increase during HL-LHC era.

In the LHC ARC/DS areas, the present system is not designed to withstand such doses.



Therefore, new radiation tolerant conditioning electronics for vacuum measurements are required to withstand such conditions, while improving accuracy reading and reliability.

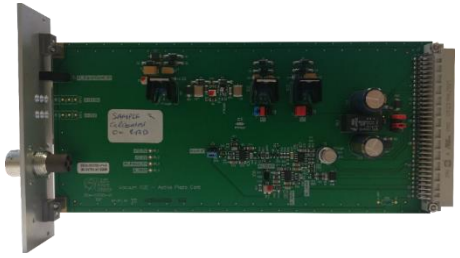
Project R2E – As a whole



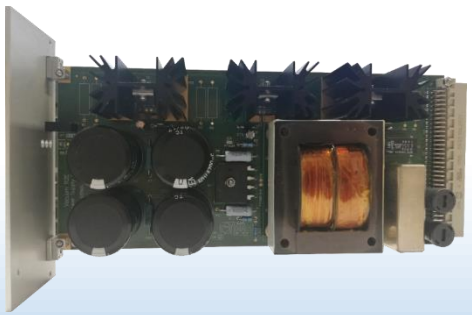
Penning

Pirani

Piezo



Power Supply



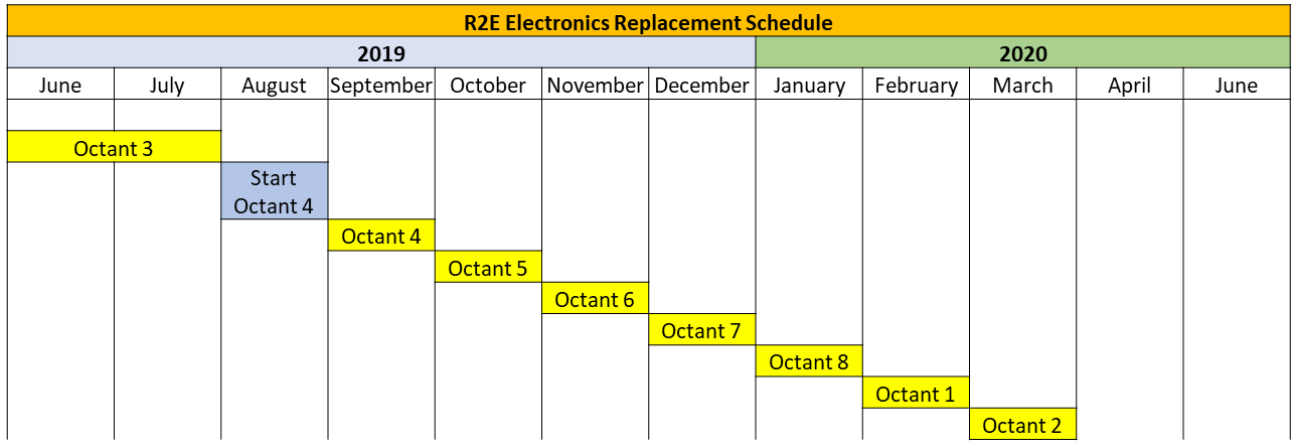
Auxiliary electronics

By-Pass valve local control

Profibus Active Termination

Contribution and status of the project

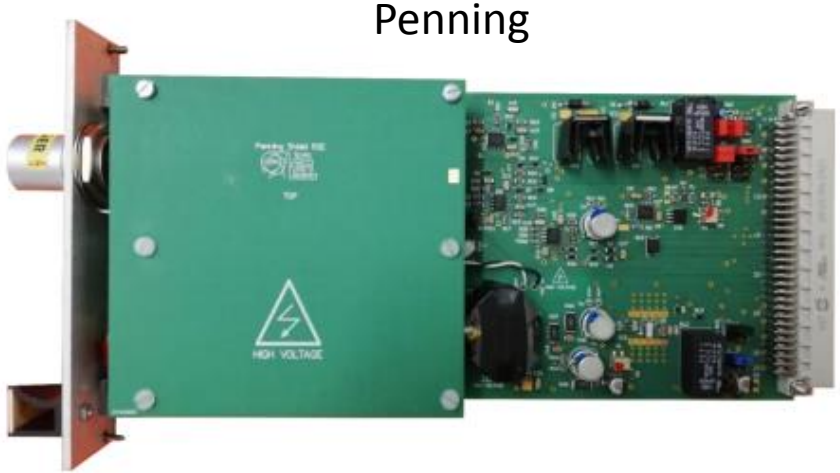
- ✓ • Electronic design modifications;
- ✓ • Prototype Testing – Vac Test bench;
- 🔄 • Series Assembly;
- 🔄 • Series Test & calibration;
- 🔄 • Tunnel Installation;
- 🔄 • Testing & Commissioning;

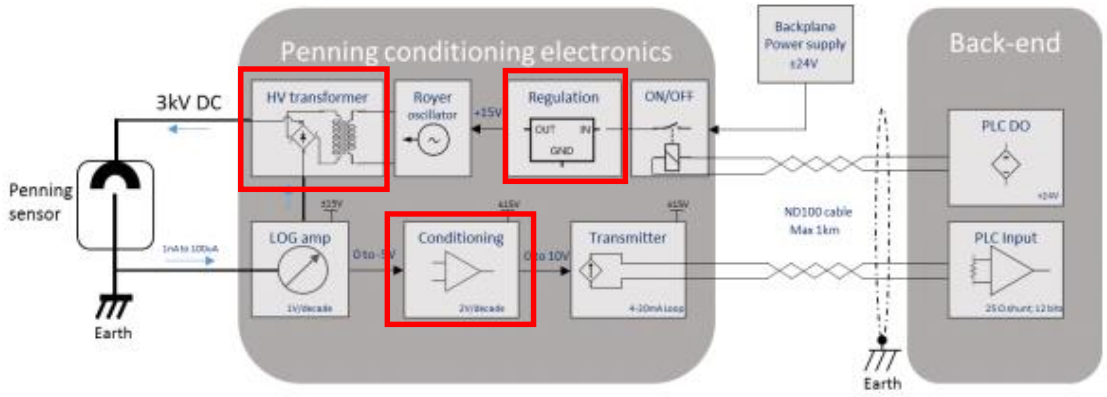


- Several weeks;
- Several days;
- Few days;

Project R2E – Design modification

Penning





HV module:

- Tested several components to match the desired transfer function;
- HV output characterization;

Regulation:

- Over current protection modification;

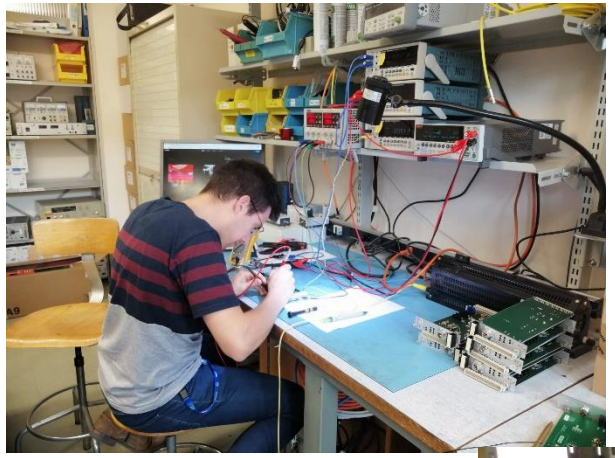
Conditioning electronics:

- Transfer function matching – trough different slopes overlapping;
- Measurement characterization;

Test Penning Card strongly modified

Penning Card prototype (without cover)

Contribution to the project



Testing and Pre calibration.

Mechanical crates assembly.

Gauge reading PLC's & controls installation.

Minirack placed under the magnet with **new** electronics.

This work will continue!

Contribution to the project

Cabling Minirack – Boxes containing old electronics.

Communication check.

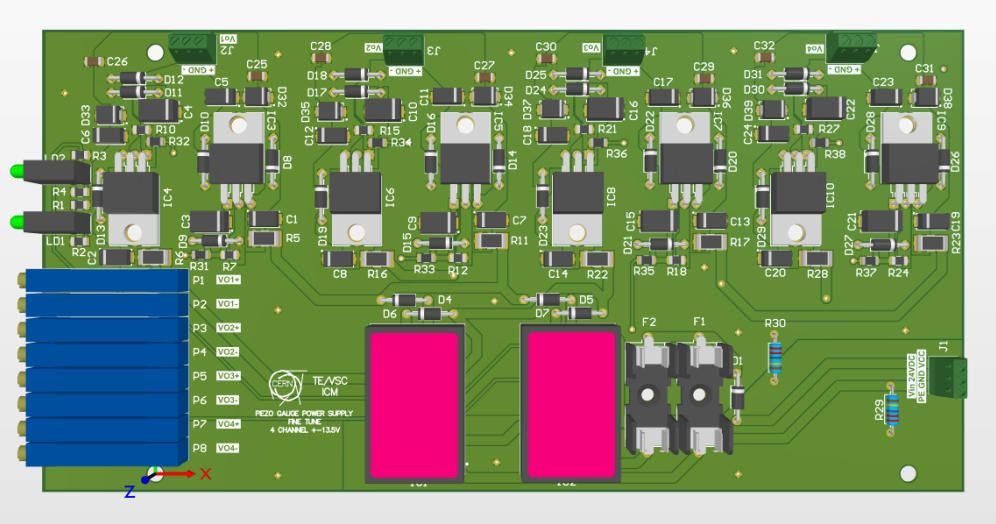
Gauge reading PLC's & controls installation.

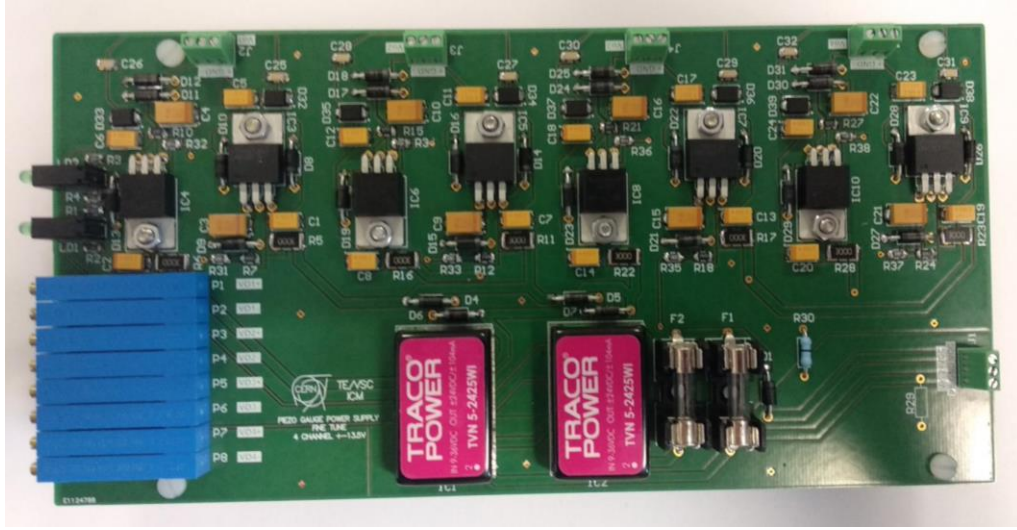
Gauge reading check.

This work will continue!

Other task – Side project

With the knowledge acquired from R2E Piezo Cards, a 4 channel fine tune piezo redundant power supply was designed.





- Electronic Design;
- Electronic Production;
- Mechanical Design;
- Mechanical Assembly;

Conclusion – Personal experience

- Strong increase of technical knowledge:
  - Advanced printed circuit board (PCB) design software course (Altium);
  - Good practices in PCB design;
  - Linear and non-linear analog electronics, signal conditioning circuits, very low level signals (pA, nA);
  - On field intervention, installation and tests;
  - Transmission of knowledge from more experienced people;

- Very good resources available to carry out work and tasks:
  - Development tools (e.g. Altium, OrCAD);
  - Measurement and simulation equipment (e.g. scope, high precision SMU, bench multimeters);

Conclusion – Personal experience

- Privilege of working with people with capabilities to assist you;
- Good work environment with respectful people;
- New ways of thinking – Different approaches to solve setback/issues;
- Challenges & Difficulties:
  - Specific analog electronics with very low level signals;
  - A lot of changes in a small time frame: new “home”, new people to deal with, new work place, new culture, new language, new city …;

Future

- Finish the R2E Project (HL-LHC):
  - Series Assembly, Test & calibration;
  - Tunnel Installation;
  - Testing & Commissioning;
- Development, implementation and test of new Interlock and valve controllers for HL-LHC;

Thank you for your attention. Questions?