



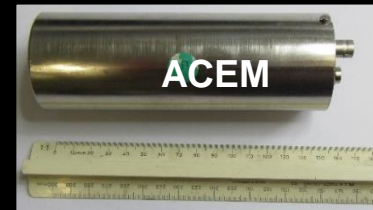
10 Orders of magnitude Current Measurement Digitiser for Beam Loss Systems

CERN,
26th October 2018

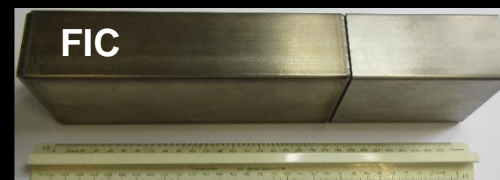
Beam Loss Monitor System



- The BLM system is a **measurement and protection system** where various detectors can be used.
- CERN **requirements** for BLMs are the **highest** in the world.
- The system has to be **fail-safe** to ensure the accelerators safety.
- The BLM electronics has to guarantee a **long life** and a **low failure probability** (about 5000 channels are connected to the interlock system).



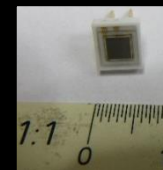
PEP II



Diamond



Silicon Diode



Cherenkov Detector



What can we find on the market?



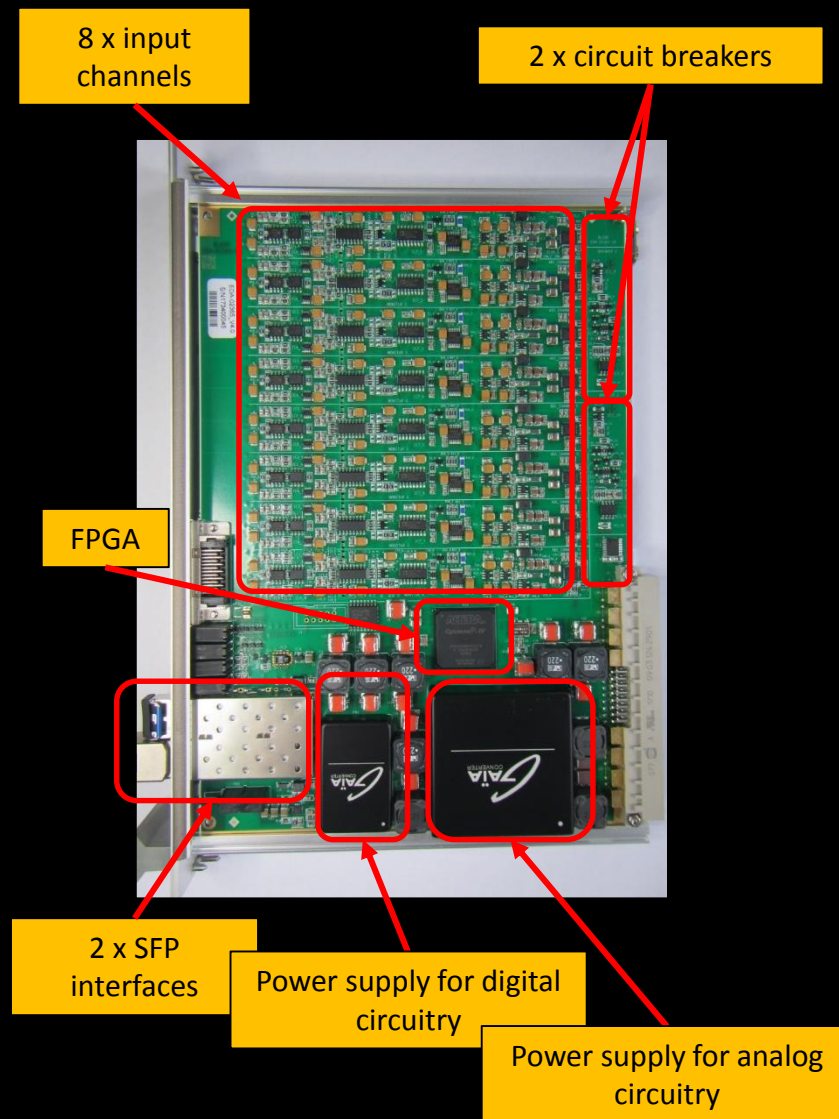
- Measurement cards with **limited range**, not designed for the specific purpose of the Beam Loss Monitor system.
- **Slower** sampling rate.
- **No fail-safe** topology.
- **Unable to diagnose system faults.**



The solution: CERN BLM Digitiser Board



- 10 orders of magnitude input current range: $\pm 10\text{pA}$ - $\pm 200\text{mA}$.
- Sampling rate: $2\mu\text{s}$ for a minimum resolution of 31nA .
- Fail-safe design architecture.
- 100% self diagnostics.
- Long life time.

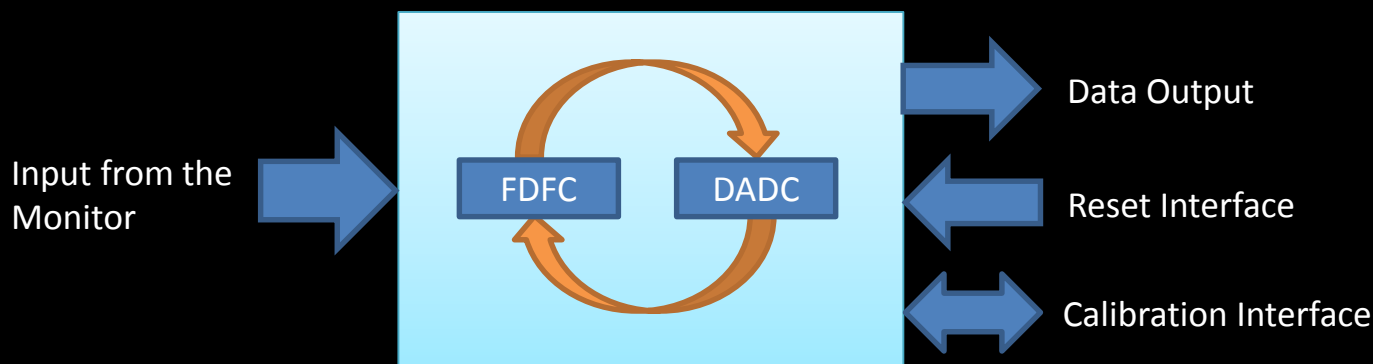


Obtaining the wide input range

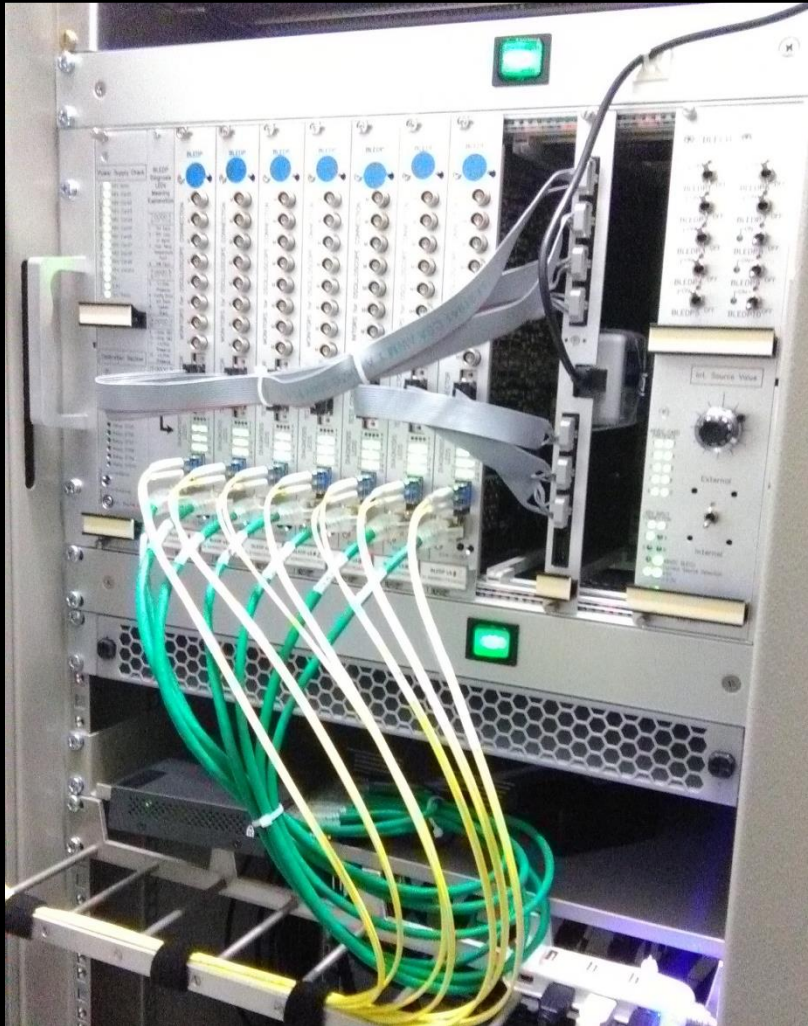


The large measurement range ($\pm 10\text{pA}$ - $\pm 200\text{mA}$) is obtained by using two methods of measurements:

- Fully Differential Frequency Converter (FDFC): $\pm 10\text{pA}$ - $\pm 10\text{mA}$.
- Direct Acquisition Direct Converter (DADC): $\pm 50\mu\text{A}$ - $\pm 200\text{mA}$.



Use of the BLM digitizer card



- The current digitiser card requires a custom crate designed by CERN which includes the possibility to use 8 current digitiser cards, and connects up to 64 channels.
- This BLM system is installed and operational in the LINAC4, PSB, PS and the BTY transfer lines.
- In the future it will also be installed in all the transfer lines up to the SPS injection.

Portable Beam Loss Monitor system



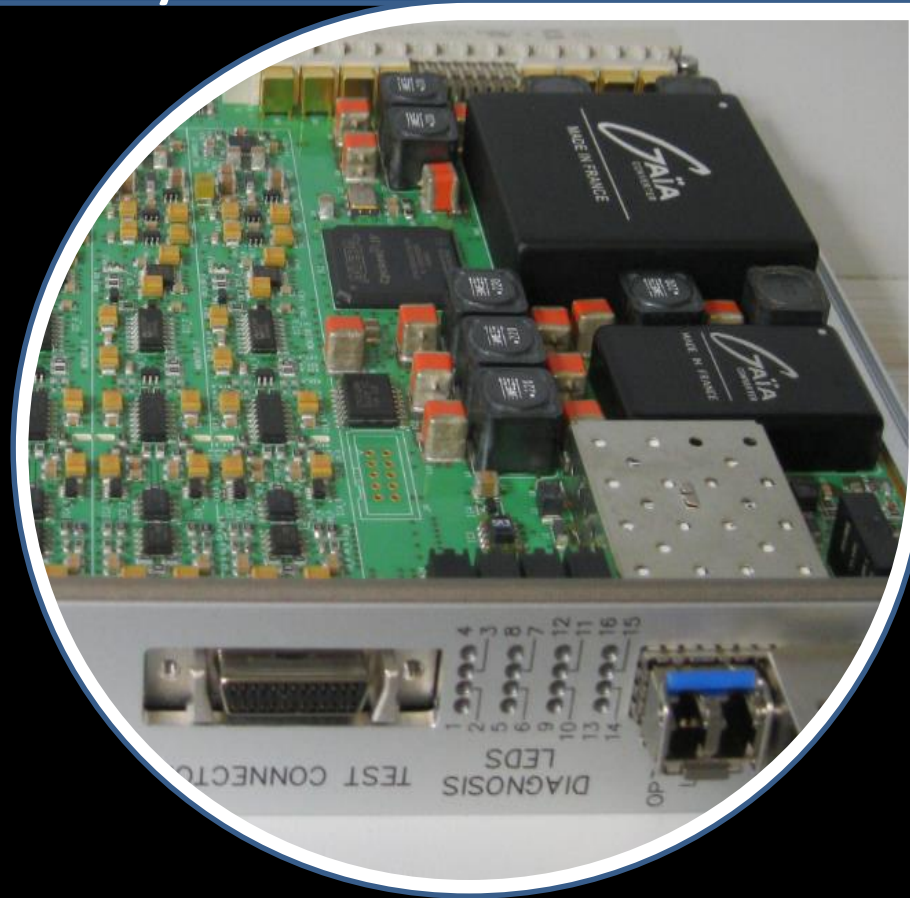
- The **BLM digitizer card** can be installed in a stand alone crate as a well as be used in a portable system.
- This solution has been given to the **European Spallation Source (ESS)** to develop their BLM system.
- A measurement campaign was done with this system at the **Institute of Modern Physics in Lanzhou (China)**.



Next steps to transfer the BLM digitizer card to the community



- The present Current Digitizer Board can be used in all particles accelerators since the performance is more than adequate for most systems and the design respects all necessary safety critical rules.
- Additional algorithms will need firmware development (The board is currently operational even if the firmware development is not completed).



Questions?

Additional slide

Acquisition channel - Block Diagram

