Synchronously Driven Power Converter Controller Solution for MedAustron

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MedAustron

MedAustron - ion beam cancer therapy and research centre in Wiener Neustadt, Austria.
- Clinical and non-clinical research
- Medical treatment of cancer
- Synchrotron based accelerator
- Protons and carbon ions

Cosylab and MedAustron work closely together on MedAustron Control System (MACS).

Power Converter Controller (PCC) Solution

- PCC controls 260 power converters (power supplies) in MedAustron’s accelerator
- Power converters deliver power to magnets, in order to steer, focus and extract the beam
- PCC applies output values to power converters and acquires measurements in precise points in time
- Integrated with the timing system for synchronous operation
- Controls power converters with an accuracy of 1 microsecond or better

Generic Design and Simplified Integration

- Front End Device hardware is generic and modular
  - Easy support for new types of power converter interfaces (only design a new baseboard)
  - FED board is generic and always stays the same
- Software support for power converters
  - New power converter type requires implementation of a new driver
  - API is fixed around the driver, implementation requires minimal effort
- API developed within the control system framework

Conclusion

- PCC allows control of arbitrary number of power converters
- Synchronous control with an accuracy of 1 us or better
- Simplified integration of new types of power converters

Technology Behind the Power Converter Controller

- Distributed system based on PXie crates and custom developed front end devices
- COTS PXie crates and controllers from National Instruments
  - PCC control system software is implemented in LabVIEW
  - Each crate can control up to 90 power converters
- Time-critical tasks handled by FPGA-based FlexRIO Module cards
  - Transmission of (output values) voltage levels to power converters
  - Acquisition and buffering of measurements
- Custom developed FlexRIO Adapter Module with generic optical interfaces
  - FlexRIO Adapter plugs into the FlexRIO Module
  - Provides 6 generic optical connectors to interface front-end devices
  - Custom designed real-time fibre link @ 100 Mbit/s

Front End Device (FED):

- Custom developed FPGA-based board which connects directly to the power converter
  - Optical interface, serial interface (RS-422), parallel UHPI, GPIOs
  - FED can be located a few hundred meters away from PXie crate
- Baseboard, DSP board
  - FED plugs onto a baseboard or DSP board
  - Baseboard provides additional connectors
  - In-house designed DSP board implements regulation logic