Fast Orbit Feedback Hardware for the Sirius Light Source





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Brazilian Synchrotron Light Laboratory

Slide 1

Architecture

- The Sirius storage ring is divided in 20 sectors;
- Each sector has one MicroTCA crate populated with BPM digitizers, one FOFB Controller and one Fast Corrector Power Supply;
- The FOFB controller board aggregates data from local BPMs and BPMs from other segments;
- The Fast Corrector Power Supply (RTM-LAMP) is connected directly to the FOFB controller board.





Crate configuration





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FOFB Controller

- Receives BPM position data from local BPM digitizers via backplane P2P links;
- Receives and forwards data via SFP links between different crates;
- Compute the currents for 8 fast correctors and controls the power supply (RTM-LAMP).



BPM Data Distribution

- Dedicated low latency network for BPM data distribution (13.44 μs for 80 BPMs);
- Diamond Communication Controller (DCC) with customizations.



Crate Backplane







AMC FMC Carrier v4

- Fixed various hardware bugs;
- Automatic JTAG chain configuration;
- Simpler clock cross-bar configuration;
- MMC microcontroller upgraded (LPC1764 \rightarrow LPC1768).







AMC FMC Carrier v4

- Xilinx Artix 7 XC7A200T-3FFG1156C FPGA;
- 2 GiB DDR3 memory;
- 2x general purpose FMC slots;
- 1x Rear Transition Module (RTM) slot;
- Low jitter clock oscilators;
- Flexible clock configuration via the IDT-8V54816 clock switch (soon obsolete?);
- White Rabbit capable.







FOFB power supply (RTM-LAMP)

- RTM Linear Amplifier;
- 12 channels, ± 1 A each @ 3.7V max;
- Small signal (± 10 mA) bandwidth of 10 kHz;
- Designed to drive inductive loads of 3.5 mH to 6.2 mH;
- μRTM form factor, zone 3 pin assignment class D1.3;







FOFB Performance (early results)







Next steps

- Increase BPM FOFB data rate from 25 ksamples/s to 50 ksamples/s;
- Improve diagnostic tools to measure system performance and check FOFB network integrity;
- Improve controller design by including a FIR block before the integrator;
- Tune parameters to better suit the beam lines requirements.





Thank you!

- RTM-LAMP Hardware design: https://github.com/Inls-dig/rtm-lamp-hw
- AMC FMC Carrier Hardware design (version 4): https://ohwr.org/project/afc/tree/cti_afc4
- OpenMMC: https://github.com/Inls-dig/openMMC
- LNLS Accelerator Controls GitHub organization: https://github.com/Inls-dig
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Backup Slides





FOFB Performance (Top-up)





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FOFB Performance (PSD)









Fast Corrector Magnet







BPM Rack Front View

RFFE Modules

Ethernet switch

RFFE Modules

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BPM Rack Rear view



RF Cables from RFFEs



Slide 17



Sirius Light Source



Booster and Storage Ring Tunnel



