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Overview of MicroTCA.4 Applications for Accelerators based on CAEN ELS Picoammeters

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Overview of Picoammeters Installations







Overview of Future Projects





Picoammeters Overview

- □ 4-channel Bipolar current-input stage (transimpedance readout)
- **Two standard measuring ranges** ($\pm 1 \text{ mA and } \pm 1 \mu \text{A}$)
- CUSTOMIZATION of ranges upon request:
 - Full scale limits (up to 10 mA, down to 1 μ A)
 - Bandwidth (up to 300 kHz bandwidth)
- 20-bit resolution @ 1 MSPS
- □ Input channels floating up to ±300 V
- Extremely low unbalance between channels (by analog design)
- Standard FMC Vita 57.1
- I²C EEPROM
 - in-factory calibration of gain and offset
 - user offset additional compensation (i.e. for dark currents)



FMC-Pico-1M4

Equivalent Input Noise								
Sampling Frequency	RNG0: ±1 mA	RNG1: ±1 μΑ						
1 kHz	1 ppm/FS -120 dB	2.5 ppm/FS -112 dB						
1 MHz	8 ppm/FS -102 dB	15 ppm/FS -96 dB						





Based on the DAMC-FMC25 carrier designed by DESY

- □ 1 MSPS 20-bit simultaneous sampling (8-channels)
- □ Inputs floating up to 300 V
- BSP and Linux driver
- **GUI with Oscilloscope functionality**







License Agreement LV75 between DESY and CAEN ELS





Overview of Picoammeters Installations



Overview of Future Projects



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MPS requirements:

Response time of 5 μsec (35 kHz bandwidth)

□ Sampling time 1 MS/sec

□ Large dynamic range (from < 1 nA to 1mA)

Custom firmware:

FRIB

- to incorporate accurate timestamp from a global timing system (GTS)
- improved signal processing,
- digital filters, background noise subtraction, advanced threshold triggering, etc.

Table 1: Acute and Chronic Beam Loss Detection

Beam Loss	Diagnostic Response Time			
100% (2 J)	15 usec			
10% (0.2 J)	150 usec			
Slow (0.1 W/m)	seconds			

Table 2: FRIB Diagnostic Devices

Device	Total #
Beam Position Monitor *	149
Beam Current Monitor (ACCT) *	12
BLM - Halo Monitor Ring *	66
BLM - Ion Chamber *	47
BLM - Neutron Detector *	24
BLM – Fast Thermometry System *	240
Profile Monitor (Lg., Sm. Flapper)	41
Bunch Shape Monitor	1
Allison Emittance Scanner (2 axis)	2
Pepper pot emittance meter	1
Wire Slit Emittance Scanner (2 axis)	1
Faraday Cup	7
Fast Faraday Cup	2
Viewer Plate	5
Selecting Slits System - 300 W	5
Collimating Apertures - 100 W	2
Intensity Reducing Screen System	2













Gear For Science

DLS: Photon Beam Stabilization



C. Bloomer *et al.*, "Fast Feedback using electron beam steering to maintain the x-ray beam position at a monochromatic x-ray diagnostic at Diamond Light Source", *Proceedings of IBIC2019*



IBS: Machine Protection System



Up to 5 AMC-PICO8 boards per crate 40 channels per MicroTCA Crate (a total of 320 channels)

tor Basic Sciences

MPS requirements:

Response time of 1 µs (300 kHz bandwidth)
 Large dynamic range (from 10 nA to 10mA)
 Custom firmware:

- 3 configurable thresholds
- 2 circular buffers of 1000 samples (1 µs and 1 ms resolution)
- Post-mortem
- Continuous or Trigger mode acquisitions



Overview of Future Projects





DAMC-FMC2ZUP



- Xilinx Ultrascale+ MPSoC XCZU11EG
 - PL: 635k Logic Cells, ~3k DSP slices, PCIe Gen 4 x8, 100G Eth
 - PS: Quad-Core ARM Cortex-A53 1.5GHz, MALI-400 GPU
 - Transceivers: 16 GTY, 32 GTH, 4 GTR

IFMC+ slot (16 GTY + 6 GTH, all LA and HA connected)

- ☐ 1 FMC standard HPC socket
- USB Type-C connector (Display Port and USB 3.0)
- 64-bit 4GB DDR4 connected to PS
- 16-bit 1GB DDR4 connected to PL
- SD-Card (front panel) connected to PS
- Gigabit Eth interface over SFP+ (front panel)
 - Clock input and two trigger in/out signals
 - White Rabbit support (input front panel, output backplane M-LVDS and TCLKs)
- Flexible clocking (MTCA backplane TCLKs, 3 PLLs for clocking PS/Zone3/FMCs)
- 8 GB eMMC connected to PS
- □ JTAG support with FPGAs, FMCs and RTM as targets
- Full HPM update functionality
- Firmware development with Vivado, HLS

Conclusions and Future Projects

Picoammeter

Machine Protection System functionalities

Beam Stabilization System functionalities

Conclusions and Future Projects

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Beam Stabilization System functionalities

Linux Embedded

Conclusions and Future Projects

Picoammeter

Machine Protection System functionalities

Beam Stabilization System functionalities

Linux Embedded

EPICS IOC

Gear For Science

Conclusions and Future Projects

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된.	GAENEIS Gear For Science	CAENELS ABOUT US YOUTUBE PRODUCTS	GITHUB UPDATES			0.2020 , made with $\pmb{\Psi}$ by CAENris for a better power supply.		
							Web server (JS) GUI, Oscilloscope	JS

THANK YOU FOR YOUR ATTENTION!

