MTCA.4 based BPMs at DESY

BUTTON AND STRIP-LINE BPM ELECTRONICS

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Thanks for Material, Discussions and Inspiration

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M. Bruno, O. Tavares, LNLS

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MTCA.4 based BPMs at DESY

What is a BPM? = Beam Position Monitor

18FL2EXTR

\[ y = m \frac{A-B}{A+B} \]

(Quelle: Dirk Lipka MDI, internal talk 2019)
BPMs at DESY

BPM

Linac
- single bunch resolution,
- large bunchspacing

Button type
- Buttons
- Stripline

RFFE
Peak Detekor
Delay line

Cavity
Ref cavity

EBPMs
Button array

Ring
- Turn by turn
- long time stability

Ring for Multibunch FB
- Single Bunch
- High resolution

Button type
RFFE

pre accelerator
- long->short bunchlength
- ramp up

RFFE
Peakdetektor with delayline
for linacs with large bunchspacing

Button or stripline BPM

Delay = 100ns
RF cable ½” ~26m

Combiner type: broadband

RTM low charge
Peak detector electronics

- Delay line
- Combiner
- Patch panel + connectors
- Analog frontend
- Digitization / Readout Engine and Processing
- RX
- ADC + FPGA
- CPU, DOOCS Server

Combiner type:
- Broadband
- RTM low charge
- Peak detector electronics
Peakdetektor

4 Channel Input RTM

Struck SIS8300L2

Crate with electronic 6 Struck ADCs for 12 BPMs possible 12 AMC for 24 BPMs

Delayline = 100ns RF cable ½” ~26m

(Quelle: B Lorbeer, Desy Operatortraining 2019)
EBPMS for Energie measurement

Beam position measurement with 500mm range

- Mtca crate installed in tunnel near to Bunchcompressor
- Radiation Problems at BC2
- SSD and FPGA latchup problems
- need SSD replace (typ. 2 time/year)
- reboot FPGA (typ. 2 time/year)

Figure 1: European XFEL Section Overview with bunch compressors.

Figure 2: Sketch of XFEL BC chicane layout.

(Quelle: B. Lorbeer et al., IPAC2018)
Ideas for new Petra BPM

Motivation:
- Looking for replacement for outdated libera BPM
- new requirement for Petra 4
- mtca.4 at PETRA

Libera Spark
Compact beam position monitor electronics for electron & hadron linear machines

Libera Brilliance+
High performance beam position monitor electronics for electron circular machines

Sirius mTCA based BPMs
(Quelle: RF BPM ELECTRONICS  M. Bruno, O. Tavares, LNLS, Campinas, SP, Brazi)
Detector with Pilot and Switching

RTM Testsetup
RTM BPM Development

Prototype

- 8 Channel for 2 BPMs
- SIS8325 250MSPS ADC
- Pilot ton
- 2 Channel Switching
- PLL
- temperature stabilized
- Mtca.4 RTM
- Based on SIRIUS open Hardware design
RTM BPM Development

Promising first results
Thank you for your attention!
Peakdetektor Calibrating

(Quelle: B. Lorbeer, 2017)
Lock-in-filter for pilot-tone separation

appendix

preliminary, under labor conditions

![Signal and Pilot-ton](image-url)

![signal](image-url)
Drifts: signal and pilot-tone

appendix
generic server for mtca.4 BPMs

appendix

MSK Firmware Internal Interface (VHDL code) → .map file → Doocs server generated property's from .map file → automatic generated Doocs calls for all Internal Interface registers

PCle Bus

Default settings on demand for Internal Interface Registers
Resolution of BPMs at Flash

appendix

(Quelle: N.Baboi,B.Lorbeer  Flash Messsicht 2017-19)
PSI type BPMs at XFEL and FLASH

appendix

E-XFEL BPMs

Undulator Cavity BPM RFFE

- 2nd version (2011): Active temperature stabilization, solid shielding, ADC clock synthesis, more gain ranges, ...
- Beam tests: 1-2μm RMS noise @ FLASH without adjusting gain, delays, LO, ... (1 shift, lack of time ...) → expect < 1μm if adjusted.
- Lab & beam test with properly adjusted/calibrated RFFE ongoing.

mtca.4 crate
optical link
external BPM elektronik