Upgrade of the MDC-DAQ system

Jan Michel
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Each chamber is equipped with 16 “motherboards”, each carrying TDCs and “daughterboards” with amplifiers. Amplifies analog signals from sense wires. 64 or 96 channels. Time resolution 500 ps.
MDC DAQ – Front End Electronics: OEP

- FPGA configures, controls and read data from motherboards
- Sends data to PCs / storage (Eventbuilder)
- Motherboard and OEP need many voltages: 5V, 3.3V, 1.2V, 1V, +3V, -3V
- All voltages are monitored, 4 are regulated on-board
- 2 Flash ROMs to store different FPGA designs
- Temperature sensor
- 250 Mbit/s optical transceiver
- ... and all on a board measuring just 4 x 5 cm²!
MDC DAQ: Power distribution

- 5V TDCs
- 3.3V FPGA I/O
- 1.2V FPGA Core
- 1V TDC Reference
- ±3V Amplifier

- 8x 0.14mm² per FEE board

- 6x 4mm²

- 5 voltage regulators for each FEE board

low-voltage switchboard

power supplies

FanPW
MDC DAQ: Power distribution - Components

- Power supplies
- Low-voltage switchboard
- FanPW
MDC DAQ: Power distribution - Components

120 relais & fuses
800 A total current
5 voltages between -3 and 5V
MDC DAQ: Power distribution - Components

108 voltage regulators
35 A total current
MDC DAQ: Trigger Distribution

power supplies

low-voltage switchboard

CTS

1 twisted pair + 8x 0.14mm² per FEE board

FanPW

1 twisted pair

6 x 4mm²

- 5 voltage regulators for each FEE board
- distribution of trigger signal
MDC DAQ: Optical Network

- Slow Control
- Eventbuilder
- MDC optical AddOn
- Power supplies
- Low-voltage switchboard
- 32 opt. fibres
- 1 twisted pair
- 6 x 4mm²
- FanPW
MDC DAQ: Optical Network

preliminary
MDC DAQ: Optical Network

- Power supplies
- Low-voltage switchboard
- MDC optical AddOn
- Slow Control
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- 32 opt. fibres
- 1 twisted pair
- 6 x 4mm²
MDC DAQ: Optical Network - Components

- 5 voltage regulators for each FEE board
- distribution of trigger signal
MDC DAQ: Current Status

- Power Supplies: installed
- Low-voltage Switchbox: installed
- Cable from switchbox to chambers: installed
- Optical cables from AddOn mounting point to chambers: installed
- Optical Endpoints: mass production running, 40 ready
- MDC AddOns: 4 prototypes available, mass production: end of year
- Readout tests & noise measurement with one half chamber: successful
- All chambers equipped with new readout: ~ december
MDC DAQ: Software - libtrbnet

- C-Library to access all Boards inside DAQ optical network
- Allows to manually test all request types on TrbNet
- Main purpose: Slow Control / Debugging / Monitoring
- Split into TrbNet-library, FPGA-connection library & high-level software
  - Easy to implement in own code

Commands:
- `r <trbaddress> <register>` -> read register
- `w <trbaddress> <register> <data>` -> write register
- `rm <trbaddress> <register> <size> <mode>` -> read register-memory
- `wm <trbaddress> <register> <mode> <file>` -> write to register-memory from ASCII-file
- `i <trbaddress>` -> read unique ID
- `s <uid> <endpoint> <trbaddress>` -> set trb-address
- `T <input> <type> <random> <info> <number>` -> trigger by slowcontrol
- `I <type> <random> <info> <number>` -> read IPU data slowcontrol
- `f <channel>` -> flush FIFO of channel
- `R <register>` -> read register of the FPGA
- `W <register> <value>` -> write to register of the FPGA

> trbcmd i ffff
0xee000001e43c17c1 0x01
0x8e000001fc533228 0x01
MDC DAQ: Software - trbflash

- Programming flash ROMs (FPGA design) on all OEPs and RICH ADCM via trbnet
- Much faster than conventional programming via JTAG
- Can program all 400 boards at once
- Essential tool – some boards are not accessible after mounting

```
> trbflash program 0xfffd mdc_oepb_golden_alpha3.bit
Found 2 Endpoint(s) of type MDC
NAME: mdc_oepb_golden_alpha3.bit
USER:
Start programming ImageFile 'mdc_oepb_golden_alpha3.bit'
You decided to reprogram the FlashRom(s) #1 of MDC, are you sure [N,y]: y
Programming Endpoint(s) @ Address 0xfffd
Symbols:
  E: Erasing
  P: Programming
  V: Verifying
  X: Failed (see logfile 'trbflash.log' for details)
  @: Success
  .: Skipped

Block: 0 1 2 3 4 5 6 7 8 9 A B C D E F
0   . . . . . . . . . . . . . . . . . .
1   . . . . . . . . . . . . . . . . . .

Success
```

Also available: readout software, compatible to Eventbuilder standard
Under development: Direct readout via Ethernet to Eventbuilder