Status of the new SEM-Grid Readout Electronic

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DAQ for HEBT Profile Grid (Preparation Meeting)
March 19th, 2013
Agenda

- Short overview “old” PG Proto”1” system
- PG Proto2 system overview
- New hardware overview
- Status of setting-up operation
- Next steeps
PG Proto“1“ Readout Unit
PG Proto“1“ Logic Unit
### Checked so fare with PG Proto“1”

<table>
<thead>
<tr>
<th>Year</th>
<th>Go4 Version</th>
<th>Dates</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Go4 ver. 1</td>
<td>5.11., 6.11., 7.11.</td>
<td>first beam test</td>
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<tr>
<td></td>
<td>Go4 ver. 2</td>
<td>9.11., 10.11.</td>
<td>10 time slices (TS)</td>
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<tr>
<td></td>
<td>Go4 ver. 3</td>
<td>22.11., 24.11.</td>
<td>high current (offset)</td>
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<tr>
<td>2011</td>
<td>Go4 ver. 4</td>
<td>4.2.</td>
<td>cable length</td>
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<tr>
<td></td>
<td>Go4 ver. 5</td>
<td>3.4., 5.4., 10.4.</td>
<td>64ch. MWPC, 100 TS resolution test</td>
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<tr>
<td></td>
<td></td>
<td>5.10.</td>
<td>TASCA SEM-Grid</td>
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<tr>
<td>2012</td>
<td>Go4 ver. 6</td>
<td>29.3., 3.4.</td>
<td>additional tests</td>
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<td>11.9., 12.9., 13.9., 14.9.</td>
<td>e⁻-stripping</td>
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<tr>
<td></td>
<td></td>
<td>6.11., 27.11.</td>
<td>e⁻-stripping</td>
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<tr>
<td>2013</td>
<td>Go4 ver. 6.2</td>
<td>21.2.</td>
<td>ion sources</td>
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</table>
Test with PG Proto“1“ and before

- Test with different detector types (SEM, MWPC, Faraday Cup, Ionization Chambers, Multiple Faraday Cup Arrays)
- High-Current / Low-Current beam test
- Readout performance as a function of cable length (up to ~20m)
- “Fragmentation” of measured profiles (up to 100 time slices)

- QFW temperature dependency
- Total ionizing dose (TID) tests of QFW (tested up to 11 kGy)
PG Proto”1” Typical Measurements
Now new PG Proto2 System
From CSEE Electronics department the following colleagues are more or less involved or had helped to get the PG Proto2 system running:

Layout: - Peter Skott
Sourcing of material: - Maria Wiegand, Bernd Zumbach
Assembly: - Gabi Zeitträger, Susanne Zweig, Michael Traxler
Die bonding: - Helga Schindler
ASIC bonding: - Harald Deppe, Carmen Simons (RBDL)
Software (Linux): - Jörn Adamczewski-Musch
Software (MBS): - Nikolaus Kurz
Software (FPGA): - Jochen Frühauf, Shizu Minami, Ivan Rusanov
White Rabbit (PCB): - Jan Hoffmann

and almost everywhere else: Jochen Frühauf
PG Proto2 – EE-Lab configuration

**PC**
- Remote Desktop
- e.g. Ethernet

**MBS (FESA READY)**
- Analyse with GO4

**PEXOR**

**TRIXOR**
- Triggermodul

**LEVCON**
- (Trigger / DT) Converter
- 2x CFC
- 2x CFC
- 2x CFC
- 2x CFC

**QFW Logic Unit (QFW_LU1)**
- 8x MLVDS
- In/Out
- NIM/TTL
- 2x In
- 2x Out
- 32 channel

**Profile Grid**

**White Rabbit**

**FIBER OPTIC CABLE**

**White Rabbit**

**USB for Service**

**DATA / INSTRUCTIONS**

**Remote Desktop**
- e.g. Ethernet

**Analyse with GO4**

**PC**
- Remote Desktop

**Start Trigger**

**End of Measurement**

**White Rabbit**

**Remote Desktop**
- e.g. Ethernet

**Analyse with GO4**

**PC**
- Remote Desktop
- e.g. Ethernet

**Start Trigger**

**End of Measurement**
PG Proto2 – FESA configuration (1)

Triggered option

Accelerator “Beam On“ signal

FIBER OPTIC CABLE

PC

TRIXOR Triggermodul

LEVCON (Trigger / DT) Converter

Readout Start Trigger

End of Measurement

PEXOR

FESA

2x In 2x Out

8x MLVDS In/Out

NIM/TTL

32 channel

DATA / INSTRUCTIONS

QFW Logic Unit (QFW_LU1)

USB for Service

FESA configuration (1)

Triggered option

PG Proto2 – FESA configuration (1)
PG Proto2 – FESA configuration (2)

Direct trigger option

Accelerator “Beam On“ signal

PC

FESA

KINPEX

In/Out

DATA / INSTRUCTIONS

FIBER OPTIC CABLE

2x CFC

2x CFC

2x CFC

2x CFC

USB for Service

FESA configuration (2)

QFW Logic Unit (QFW_LU1)

32 channel

8x MLVDS

In/Out

NIM/TTL

FIBER OPTIC CABLE

End of Measurement

Readout Start Trigger

PG Proto2 PG Proto2 –– FESA configuration (2)
PG Proto2 – FESA configuration (3)

Polling option

PC

FESA

PEXOR

Accelerator “Beam On” signal

QFW Logic Unit (QFW_LU1)

2x CFC

2x CFC

2x CFC

2x CFC

8x MLVDS In/Out

NIM/TTL

32 channel

USB for Service

FIBER OPTIC CABLE

DATA / INSTRUCTIONS

PG Proto2 – FESA configuration (3)
PG Proto2 – String Together

PC

FESA

PEXOR

QFW Logic Unit

2x CFC
2x CFC
2x CFC
2x CFC

Data (Kapton or Optical Cable)

Trigger Bus (copper)

White Rabbit

OR

Accelerator
“Beam On“ signal

to next unit
PG Proto2 – EE-Lab configuration

PC Remote Desktop

Start Trigger

Profile Grid

FIBER OPTIC CABLE

USB for Service

In/Out NIM/TTL

MLVDS

End of Measurement

PC

MBS (FESA READY)

Analysse with GO4

Remote Desktop

e.g. Ethernet

MBS

NIM/TTL

32 channel

FIBER OPTIC CABLE

QA Logic Unit (QFW_LU1)

In/Out USB for Service

QFW Logic Unit (QFW_LU1)

8x MLVDS

2x CFC

2x CFC

2x CFC

2x CFC

2x In 2x Out

PEXOR

Converter

LEVCON (Trigger / DT)

READ OUT

With

Go4

DATA / INSTRUCTIONS

Readout Start Trigger

March 19th, 2013

DAQ for HEBT Profile Grid (Preparation Meeting)
PG Proto2 – Motherboard

• Motherboard of PG Proto2
  Name: PG_QFW_MB1
• Carrier board of:
  – Logic Unit
  – Equipped with up to 4 QFW piggy-ups (4 x 8 channel)
  – Input protection diodes
• Status: 4 boards assembled
  – 1 with a bad soldered power regulator (already reworked)
PG Proto2 – Logic Unit

• Logic Unit of PG Proto2
  Name: PG_QFW_LU1
• Central Readout Logic Unit:
  – 1 FPGA
  – 2 SPI Flashes: for official released firmware and a (possible) later firmware update (via optical fibers)
  – 3 SFPs (optical or Kapton)
  – 2 Input / 2 Output Lemo connectors (NIM or TTL)
  – 1 Trigger connector
• Status: 4 boards assembled
  – all working, problems with NIM to TTL level switching
PG Proto2 – QFW Piggy-Up

- Current to Frequency Input Boards of PG Proto2 system
  Name: PG_QFW_PIGGY1
- QFW Piggy-Up:
  - 2 QFW ASICs (2 x 4 channels)
  - SPI DACs for external offset calibration (and “test pattern” injection)
- Status: 2 boards fully assembled
  - all working
- 4 more boards already die bonded (ASICs are glued to PCB), but not bonded
- 20 more boards will be ready soon
PG Proto2 – Protection Diodes

- Protection Diodes Adapter Board of PG Proto2 system
  Name: PG_QFW_DIODE1

- Status: 32 boards fully assembled
  - electrically tested
PG Proto2 – Complete System

So far tested:

- Programming of CPLD and FPGA
- JTAG
- Programming of flashes
- IOs / LED
- Programming of DACs (offset and calibration of QFWs)
- Monitoring of QFW output pulses with an internal logic analyzer
PG Proto2 – Complete System

Know “features”:

- NIM/TTL level switching ➔ for now fix to 1 level
- main Clock input: FPGA assigned pin cannot host clock signals ➔ use clock of White Rabbit adapter board as internal system clock

➔ No show-stopper right now!
Things to do in the next weeks:

- Shizu Minami will implement the optical transport protocol (GOSIP) into FPGA code (around 2 to 4 weeks)
  - Access via PC → PEXOR → PG Proto2 possible
- In parallel, define memory addresses of data location
- Afterwards FESA access can be implemented
- Adapt Go4 online MBS analysis for new system
- Test of glob top chip protection (to provide mechanical support and exclude contaminants e.g. a damage of the QFW bond wires)
Test of PG Proto2 system with a detector
- e.g. multiple faraday cups of the ion sources group
- other possibilities?

- lab characterization of PG Proto2 system
  - offset temperature drift
  - software (FPGA) tests of slow control

- irradiation test with protons at the CBM beam test end of June 2013 at COSY (Jülich) with 2 GeV protons
  - test of QFW in beam (performance)
  - test of Logic Unit (defined restart possible)
  - test of device components - e.g. power regulators, line drivers