Overview of n-XYTER Front-End Electronics boards for CBM

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n-XYTER: The DETNI Neutron Detector Readout ASIC

Front-End:

- 128 channels
- Ready for different popular input signals
- Charge sensitive pre-amp and peak detector
- Time stamping with 1ns LSB and 2ns resolution
- Peak detection and analogue storage (10 bit electronic storage)
- Purely data driven, autonomous hit detection (self triggered)
- Average per channel hit rate 160 kHz with 10% dead time
  (determined by pile up on slow channel)

Readout:

- Per channel analogue energy and digital timestamp FIFO (1ns res.)
- De-randomizing, specifying Token Ring readout at 32 MHz
N-XYTER - architecture

PreAmp → fast shaper → comparator → time walk comp. → digital FIFO

slow shaper → peak detect & hold → analog FIFO

token cell

32 MHz readout rate

time stamp counter

token manager

output drivers

outputs:
1 analog differential
8 digital LVDS (4*32 MHz)

peaking time
fast: 20 ns
slow: 140 ns

1 ns step
Motivation for FEBs

Requirement for new board dedicated to work with detectors:
- Silicon strip detectors (STS)
- Gas detectors (GEM-TPC)
- Other applications

Adapted to work with SysCore ReadOut Controller:
- Unificated connector standard
- Full operative
- Contain ADC

Last but not least:
- Thanks to this FEB we can employ full DAQ chain!
Motivation for FEBs

Hence, we decide to design three different boards:

- n-XYTER FEB – general purpose board, planned to be used in lab and for first tests of DAQ. At least, used in beamtime in September 2008 at GSI.

- n-XYTER FEB GEM-TPC – board designed for Panda experiment at GSI.

- n-XYTER Quattro – purposed to be used in beamtime in September 2008, will be used in CBM Beamtime in December 2008 at Potvino.
n-XYTER FEB (General purpose)

Equipment:
- One n-XYTER
- One 10/12-bit ADC
- Power supplies: 1.8V and 3.3V

Front-end connector:
- 2 x 68 pins – 128 input channels + 4 grounds

Back-end connector:
- 80 pins – ready for two n-XYTERs + ADC
- High speed signals via LVDS connections
- I2C and SPI via single lines
n-XYTER FEB – Revisions overview

- revision A – newer released
- revision B
  - Released in July 2008
  - Technical problems with surface – only half of channels bondable
  - Some design errors: missing ADCs discreet components, some shortcuts and missing connections – but all boards succesfull patched.
  - Three boards used in CBM Beamtime in September 2008
- revision C
  - Released in September 2008
  - Fixed some errors from rev. B
  - Populated, wait for chip bonding
- revision D
  - Planned to be designed
  - Changed fanout
N-XYTER FEB

- Dimensions: 91 x 95 mm
- 8 layers
n-XYTER FEB - Challenges

Cutting edge:
- 361 bondpads around the chip!
- 133 pads on input-side:
  How to bond them all?
- Chip-in-board is good solution
- But is also expensive!
- We still look for other ways
n-XYTER FEB

Input fanout

- Two rows of bondpads: 2 x 64 pads
- Bondpad dimensions: 50um x 300um
- Bondpads pitch: 101.4um
n-XYTER FEB

Input pads placed on inner layer, aspect ration of pad-gap is ~50/50

Input pads placed on top layer, aspect ration of pad-gap is ~22/78!

Bondpads on top layer are not bondable. We can use only half of channels
n-XYTER FEB – Bonding scheme

Data wires
Vdd wires
GND wires
N-XYTER FEB - connectors

Front-End Connectors
- ERNI Dual Row Right Angle Male Connectors
  - Partnumber: 114805
  - 68 pins (2 x 34)
  - Pitch: 1.27 mm (0.05 mils)

Back-End Connector
- Partnumber: 114806
- 80 pins (2 x 40)
- Rest like above

Power Connectors
- ERNI Right Angle Male & Vertical Male
  - Partnumbers: 214012 and 214017
  - 4 pins on each connector
  - Pitch: 1.27 mm (0.05 mils)
n-XYTER FEB GEM-TPC for PANDA

Equipment:
- Two n-XYTERs
- One 10(12)-bits ADC
- Voltage regulators: 1.8V and 3.3V

Front-end connector:
- 1 x 300 pins: 128 input channels, grounds, control lines

Back-end connector:
- 80 pins – ready for two n-XYTERs + ADC
- High speed signals via LVDS connections
- I2C and SPI via single lines
- Power supply: 4-5V/2A
n-XYTER FEB GEM-TPC for PANDA

- Dimensions: 265 x 103 mm
- 8 layers

Board status: in production

Rafal Lalik – 12th CBM Collaboration Meeting, JINR Dubna, October 15th 2008
n-XYTER FEB GEM-TPC for PANDA - techniques

- doubled connectors
- n-XYTER

flexible part

- metal board for cooling

Flex part allow to fold the board to move chips outside the beam. It is possible to cutout flex part.
n-XYTER FEB GEM-TPC for PANDA - connectors

**Front-End Connectors**
- SAMTEC Micro Board-to-Board Connector
- Partnumber: BSH-150-01-X-D-EM
- 300 pins (2 x 150)
- Pitch: 0.5 mm (0.0197 mils)

**Back-End Connector**
- Partnumber: 114806
- 80 pins (2 x 40)
- Rest like above

**Power Connectors**
- ERNI Right Angle Male & Vertical Male
- Partnumbers: 214012 and 214017
- 4 pins on each connector
- Pitch: 1.27 mm (0.05 mils)

Photos from http://www.erni.com
n-XYTER Quattro

**Equipment:**
- Four n-XYTERs
- One 10(12)-bits ADC
- Voltage regulators: 1.8V and 3.3V
- One CBM01B1 Detector

**No front-end connector**
- Chips are bonded directly to Baby Detector

**Back-end connectors:**
- 2 x 80 pins – ready for four n-XYTERs + ADC
- High speed signals via LVDS connections
- I2C and SPI via single lines
- Power supply: 4-5V/4A
n-XYTER Quattro

- 100 x 100 mm
- 8 layers

Status: In production!

Purposed to be used in Beamtime next Portvino, Dec 2008
n-XYTER Quattro – cooling system

Four n-XYTERs chips require to dissipate ~15W of power.

Problems apper on CBM01B1 detector which should be kept in as lowest as possible temerature. We need effective cooling system for the Quattro board.

Passive heat-sinks need to be big for effective cooling. Extra air-flow (fans, etc) does not resolve the problem.

Solution colud be heat-pipes – difficuldf for home-made. Prefabricated components does not match to our board.

Fluid cooling systems looks promissing. Prefabricated parts are to heavy and to big.

Life could be simpler... ;(-)
n-XYTER Quattro – cooling system

Whole cooling system need to be mounted on metal frame because of weight of all parts.

We need to develop our own components.
n-XYTER Quattro - connectors

Front-End Connectors
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Back-End Connector
- Partnumber: 114806
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- Rest like above

Power Connectors
- HV Connector for CBM01B1:
  - Limo connector
- LV Connector

Photos from http://www.erni.com
Summary

✔ We have three different designs of FEB boards

✔ First is already released and it works → beam time in September 2008.
This boards is still improved and newer revisions are produced.
Board works fine with GEM and SSD detectors.

✔ Next two are in production – we expect it in close future:
October – November 2008

✔ Future developments are:
  ✔ Cooling systems for Quattro boards.
  ✔ Boards improvements if necessary (hope not!)
The End

Than you for your attention

Question time...