The FGClite Project

Status Update and Requirements

R2E Extended Project meeting

TE-EPC-CC R2E Team

Presentation

- Specification
- Components
- Hardware
- Firmware – VHDL
- Software
- Manufacturing
- Test Environment
- Conclusions

Specification

- The global specification seemed obvious, until ….
  - software is very well documented
  - hardware is missing a lot of specifications
  - FCGlite = reverse engineer the current FGC2

- Ongoing work to write specifications for FGClite (and FGC2)

Components

- First had to select suitable components…
  - nanoFip FPGA is one of the basic building blocks
  - needed to identify a suitable Analogue to Digital Converter
  - and also a Digital to Analog Converter
- Other components copied from FGC2, proven track record
- This resulted in list of 35 semiconductors, split into 3 classes…

Component Classification

- Class 0:

known to be resistant to radiation, or easily replaced if found to be weak. The basic design of the system is not influenced by these parts.

- Class 1:

potentially susceptible to radiation, in less-critical parts of the system. Substitution of parts or mitigation of issues is possible with a re-design.

- Class 2:

potentially susceptible to radiation, in more-critical parts of the system. The basic design is compromised if these parts do not perform well. Substitution of parts or mitigation of issues would be difficult

Semiconductor List

Class 0

Silicon Serial Number	DS2401Z
Silicon Serial Number/Thermometer	DS18B20
Small Signal Diode	BAV70
Small Signal Diode	BAV99
NPN Transistor	BC817-25
PNP Transistor	BC807-25
PNP Transistor	BCP53
PNP Transistor	FMMT591

N MOSFET	IRFL110
N MOSFET	IRF1004
Zener Diode	BZX85C3V9
Zener Diode	BZX85C6V2
Transient Voltage Suppressor	TVS15V
Operational Amplifier	OPA2227U
LED	HSMF-A203-A00J1

Class 1

ADC with Multiplexor	MAX11046
Optocoupler	TLP124BV
Oscillator	IQXO-70-4M
Oscillator	SPXO018042-40M
Bus Transceiver	SN74LVC2T45
Voltage Regulator	MIC3702
Multiplexor	MAX337CWI
Voltage Regulator	LM340MP-5.0

Schmitt Trigger Buffer	74LVC14APW
Voltage Reference	LT1236ACS8-10
Voltage Regulator	TPS73033
Analogue Switch	DG412DY
Memory	F/M/SRAM
Operational Amplifier	THS4130
RS485 Driver	MAX3491
Precision Temperature Sensor	LM45CIM3

Class 2

FPGA	A3P400-PQFP208
ADC	ADS1281

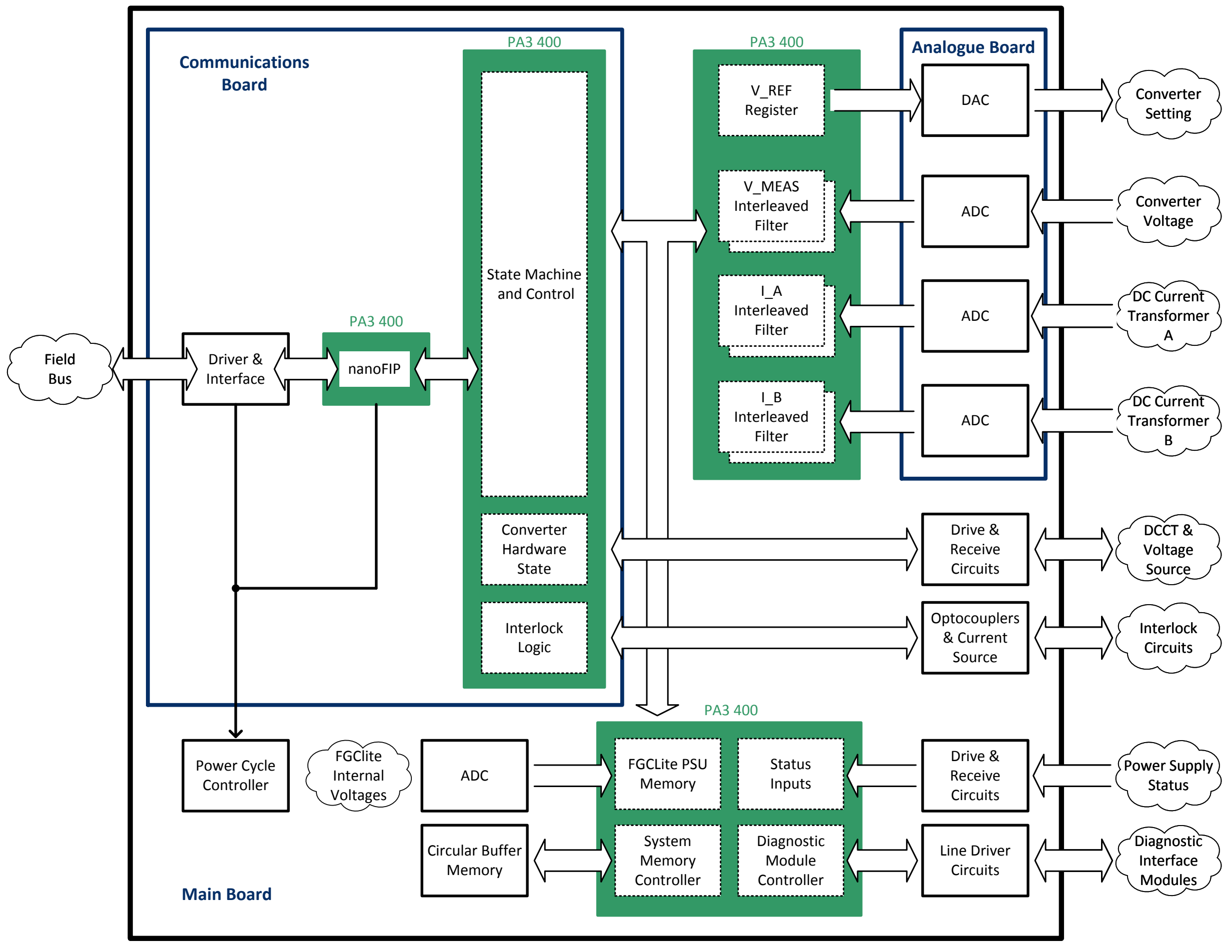
DAC	MAX5541CSA
Field-Bus Driver	FIELDRIVE

Component Type & Batch Testing

- Type-testing of components
  - EN / STI
  - TE/EPC
    - UCL
    - PSI
    - H4IRRAD
- Batch-testing of components
  - BE / CO = nanoFIP and FPGA
  - TE/EPC
    - UCL
    - PSI
    - PS East Area – mid 2014 (critical path for project)

Hardware

- Specification translated into block diagram:



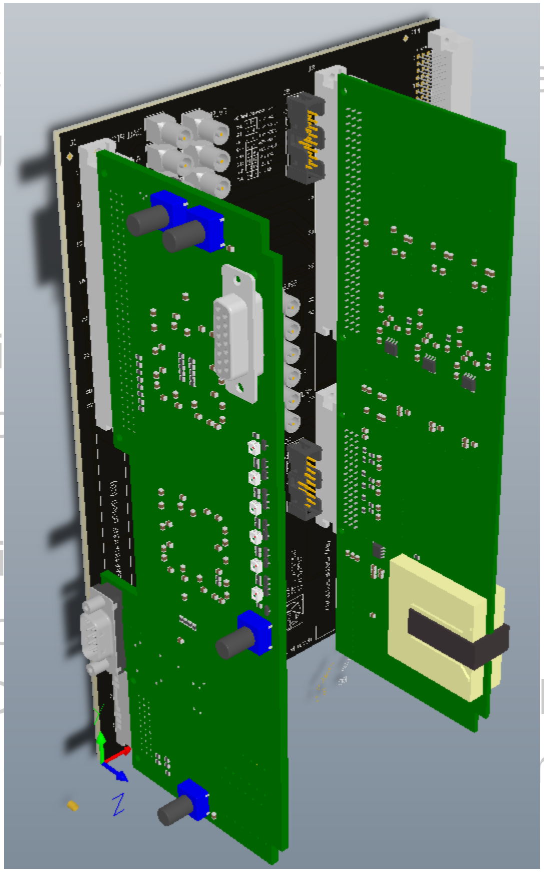
Boards

- Analogue Board
  - 3 ADCs, 1 DAC, latch-up detectors, Voltage reference & multiplexors
  - no digital processing on-board

- Communications Board
  - nanoFip FPGA & Critical FPGA
  - reset buttons, diagnostics connector & LEDs

- Main Board (μ-lite version)
  - no analogue FPGA or auxiliary FPGA yet
  - no I/O hardware or Diagnostic Interface Module yet
  - just wiring, test connectors & voltage regulators
  - will allow VHDL and software development
  - validate analogue board and closed loop regulation principles

Boards



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Firmware - VHDL

- “Microsemi Libero” – challenging
  - bugs, bugs, bugs…

- Small working group of 4 people – working with PA3 evaluation kits
  - IP Core Development – Dallas 1-wire Bus
  - radiation test platforms (no Xilinx…)
  - ADC filter software processing converted to circuits in VHDL
  - memory implementation

- Get an idea what capacity of FPGA is needed
- No triple-mode-redundancy yet
- Code verification (as from Feb 2013)

Software

- New variant of FGCD needed in the gateway to provide
  - Gateway Class 6
  - FGClite Class 92

- Development of an FGC-µ-lite Gateway
  - generate V-ref with DAC
  - read-back measurements from 3 ADCs
  - store results and analyse

Manufacturing

- Component sourcing for about 100 FGClites
- Prudence by using ‘old stock’ components from FGC2… (availability)
- Negotiations with industry
  - TI for ADCs
  - ST about memory
- Prototypes
  - bare PCBs from 3 vendors – check vendor skills
  - manual assembly @ CERN
- Invitation to Tender

Test Environment

- Evaluation started of National Instrument – PXI based chassis
  - off-the-shelf hardware
  - tester control cards (TCCs)
  - LabWindows CVI
  - development PXI board for ADC demodulators

Conclusion

- promised at the beginning of this year a prototype in Autumn: FGC-**μ**-lite
  - Arni Dinius – Project Leader
  - Benjamin Todd – Hardware Engineer
  - Slawosz Uznanski – Research Fellow Radiation Expert
  - Karol Motala – Technician
  - Gilles Ramseier – Analogue Engineer
  - David Millar – until end 2012 – Technical Student – Dallas 1-wire
  - Andrea Vilar Villanueva – Research Fellow VHDL Engineer
  - Stephen Page – Software Engineer
  - Technical Student – from start 2013 – Testers (request approved)
  - Research Fellow 2013-2014 – VHDL Verification (request approved)

The rapid development of FGC-μ-lite has only been possible due to an enormous team effort!