Evaluation results of $\mu$TCA equipment

xTCA Interest Group, 6th meeting
09/04/2013

Collaboration (PH/ESE)
Vincent Bobillier, Matteo Di Cosmo, Stefan Haas, Markus Joos, Sylvain Mico, Francois Vasey and Paschalis Vichoudis
Outline

**Introduction**
- xTCA Evaluation Project
- ESE-BE xTCA Equipment

**Testing MicroTCA equipment**
- Test tools
- Test performed
- Labview Test GUI
- Polaris Tester
- IPMI Sniffer

**Test example: Power Module NAT DC780**
- Test setup
  - Load Sharing-Interoperability problems
- Results discussion
- Comparison with Vadatech UTC010

**Conclusions**
- Failures and reparations
- Observation
- Future work
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Introduction\xTCA Evaluation Project

- **MicroTCA evaluation project in PH-ESE group launched in 2011**
  - Technical evaluation of components for MicroTCA and MTCA.4 systems
  - Technical evaluation of AC/DC converters
  - Development of tools (H/W and S/W) for the testing of commercial components
  - Conduct market surveys
  - Report and share results

- **Recently expanded the evaluation project to also include ATCA**

- **Longer term goal**
  - Try to standardize MicroTCA and ATCA shelves and power supplies
    - Many options (backplanes, cooling, RTMs, power supply, ...)
  - Propose acceptance test procedures
  - Propose a selected set of equipment to the experiments
  - Provide centralized support for these items
MTCA Crates

Vadatech VT892 MTCA.0
(12 AMCs, 2 MCHs, 2PMs, 2CUs)

ELMA 043-012 MTCA.4
(12 AMCs, 12 RTMs, 2 MCHs, 4PMs, 2CUs)

Schroff MTCA.4 + AC/DC CM100
(6 AMCs, 6 RTMs, 1 MCHs)

PMs

4xNAT DC780
(792W)

Vadatech UTC010
(792W)

Wiener AC/DC
(Prototype, 800W)

MCHs

Vadatech

NAT MCH

Kontron AM4904

AMCs

ELMA Load Board

Kontron AM5030

ESD ADIO24

CCT AM31

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Introduction

ESE-BE xTCA equipment

**ATCA Crates**
- Schroff 14-slot 13U ATCA shelf with SHMM

**ATCA boards**
- Kontron AMC Carrier
- Comtel load boards (including RTM)

**AC/DC Power Supply**
- Emerson network power NetSure501
- PowerOne Aspiro
- PowerOne Guardian
- Lineage Power CPS

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AMC and RTM load modules developed in-house Based on switched resistive loads

- Used for power supply and cooling performance measurements
- Control via MMC
  - Based on design CPPM/Marseille
  - Based on code DESY

![AMC Load Board](image1)

![RTM Load Board](image2)

![MMC](image3)
Testing MicroTCA equipment

Test performed

• Electrical Evaluation of Power Modules
  ▪ Static Tests
    - Load Regulation
    - Line Regulation
  ▪ Dynamic Tests
    - Load transient Response
    - Ripple and noise
  ▪ Efficiency and Power Factor
  ▪ Overcurrent protection

Instruments

LeCroy 104Xi
LeCroy API015 Current probe
Agilent 34970A Data Logger
Agilent N3300A Electronic Load
> Testing MicroTCA equipment

Test performed

- Thermal Evaluation
  - Cooling performance

<table>
<thead>
<tr>
<th>ALB temp sensors position</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH6 CH5 CH4</td>
</tr>
<tr>
<td>CH3 CH2 CH1</td>
</tr>
</tbody>
</table>

Instruments

- Agilent 34970A Data Logger
- 34901A 20 Channel Multiplexer

ΔT1 ΔT2 ΔT3

Slot 1 Slot 2 Slot 3 Slot 4 Slot 5 Slot 6

AMC position

On board position

Temperature Delta (°C)

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Testing MicroTCA equipment

Labview GUI

Remote Linux Server (ipmitool)

IPMI over LAN

MCH

Target FRU

PM

CU

AMC

IPMI CMD LIST

Ipmitool -I lan -h mch -U admin

Ethernet Packets

IPMI Packet

FRU address

NetFN

CMD

DATA

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Testing MicroTCA equipment\Labview test GUI

Connection Settings

Host
beplus

Host protocol
SSH

Host Username
mdicosmo

Host Password

MCH Select
NAT MCH

MCH Username
admin

MCH Password

Send command

Terminal output

Static Measurements  Dynamic Measurements  Thermal Test  Miscellaneous

Input Binary File

Current Read [mA]
7809

Desired Current [mA]
7809

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> Testing MicroTCA equipment\Polaris tester

Functionality Test

- Polaris Tester
  - MicroTCA Tester
    - MCMC
    - MMC
    - EMMC
    - Carrier
  - AMC Tester
  - ATCA Tester
  - MTCA.4 Tester

Example test results:

- **Packet Sent**:
  - Packet Sent
  - Packet Received

- **Debug**:
  - Debug

- **User Prompt**:
  - User Prompt

- **Invalid**:
  - Invalid

- **Error**:
  - Error
Testing MicroTCA equipment

IPMI Sniffer

- Useful for test, debug and development purposes.
- Many I2C Analyzer available but no universal commercial IPMI real-time monitor
- The solution consists in using a Totalphase i2c Beagle Protocol Analyzer and Wireshark
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NAT DC780 PM

- Standard MicroTCA DC/DC PM
- 792 W, Minimum efficiency 95.5%
- Support for
  - 12 AMCs,
  - 2 CUs
  - 2 MCHs

Test Setup

- Host: Vadatech VT982 Crate
- External AC/DC Power Source (1.5kW)
- *Shared LOAD* configuration needed..
Load Sharing configuration

- Necessary to fully power the crate
- Useful for testing (current control and ripple)
- Load configuration defined in Backplane FRU Info
- More than one Primary PM
- Each PM powers a defined set of FRUs

Test example: PM NAT DC780

PM1 Under Test Primary

PM2 Auxiliary Primary

NatView FRU Editor

NatView FRU Editor

**AMCs slots** (Channels 5-16)

**MCH, CUs** (Channels 1-4)
Load Sharing configuration

- Seems not to be a trivial setup
- Various and serious interoperability problems encountered
- Different behaviors for different manufacturer modules
- NAT and Vadatech mainly concerned

NAT: Problems being solved in cooperation with the support. Full load sharing support will require PM firmware modification.

“... not all vendor PM and MCH modules are capable of handling this configuration well. You cannot mix PM modules from different vendors, that is not something you want to do. Two vendor PM may not synchronize and operate properly on a chassis.” Vadatech Support, 05 March 2013

NAT MCH + 1 NAT or Coredge PM as auxiliary PM
NAT DC780 PM

• Results discussion: Input Voltage/Line Regulation

DC780 Specs: -60V<Vin<-40V

According to the manufacturer:
• The input FET experienced much current causing the rupture of the PM.
• A modification of the existing specification will be required (min -48V)
NAT DC780 PM

- Results discussion: Efficiency

DC780 Specs: 95.5% (min)
NAT DC780 PM
• Results discussion and comparison with Vadatech UTC010

<table>
<thead>
<tr>
<th></th>
<th>Test Conditions</th>
<th>Measured</th>
<th>DC780 Specs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Power</td>
<td>Vi=-48V</td>
<td>730W</td>
<td>780W</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>-48V to -53V</td>
<td>-40V to -60V</td>
<td></td>
</tr>
<tr>
<td>Load Regulation</td>
<td>Full power</td>
<td>8.6%</td>
<td>10%</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>Full load, Vin: -40V to -53V</td>
<td>2mV (max) before failure</td>
<td>Not reported</td>
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<tr>
<td>Efficiency</td>
<td>Vi = -48V, 1-100% of full power</td>
<td>94% (max)</td>
<td>95.5% (min)</td>
</tr>
<tr>
<td>Ripple</td>
<td>Full power</td>
<td>20mV</td>
<td>Not reported</td>
</tr>
<tr>
<td>Voltage transient deviation</td>
<td>Load step from 25% to 75% of full load</td>
<td>±0.5V</td>
<td>Not reported</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>Test Conditions</th>
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<th>UTC010 Specs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Power</td>
<td>Vi=-48V</td>
<td>600W</td>
<td>780W</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>-38V to -53V</td>
<td>-36V to -75V</td>
<td></td>
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<tr>
<td>Load Regulation</td>
<td>Full power</td>
<td>1.2%</td>
<td>Not reported</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>Full load, Vin: -38V to -53V</td>
<td>1.93V</td>
<td>Not reported</td>
</tr>
<tr>
<td></td>
<td>Minimum load, Vin: -38V to -53V</td>
<td>1.22V</td>
<td>Not reported</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Vi = -48V, 1-100% of full power</td>
<td>93% (max at 300W)</td>
<td>95% (full load)</td>
</tr>
<tr>
<td>Ripple</td>
<td>Full power</td>
<td>73mV</td>
<td>Not reported</td>
</tr>
<tr>
<td></td>
<td>Minimum Power</td>
<td>700mV</td>
<td>Not reported</td>
</tr>
<tr>
<td>Voltage transient deviation</td>
<td>Load step from 25% to 75% of full load</td>
<td>±0.4V</td>
<td>Not reported</td>
</tr>
</tbody>
</table>

TTR = Time To Reply

PP Voltage within the MTCA Specification (10V-14V)
Evaluation Report of a NAT DC780 MTCA Power Module

Abstract:
The purpose of this document is to show the results of the electrical performance evaluation and function test.

Evaluation Report of a Schroff uTCA.4 Crate

Abstract:
The purpose of this document is to show the results of the evaluation performed on the Schroff uTCA.4 Crate (ref. 11500-016). This includes the efficiency of the cooling unit.

Evaluation Report of a Vadatech UTC010 MTCA Power Module

Abstract:
The purpose of this document is to show the results of the evaluation performed on a Vadatech UTC010. This includes electrical performance evaluation and functionality tests.
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NAT PM DC780. Input stage compromised after line regulation tests
  ➢ Being repaired under warranty

Schroff for Physics Crate. Management Power not available for MCH and first AMC slot. Same problem encountered two years ago on two AMC slots.
  ➢ Repaired under warranty

NAT MCH. i2c ports failing.
  ➢ Sent twice for repair under warranty, still waiting for a report
  ➢ Up to now one i2c port not working again

AMC Backplane connector mating cycles, equipment involved:
  ➢ Schroff for Physics Crate. Sent for repair last Christmas. (Backplane replacement)
  ➢ NAT AMC Extender (Connector replaced manually in the LAB)
  ➢ First six AMC slots on Vadatech VT982 will give up soon...
  ➢ Time wasting and serious problem for test

• The MicroTCA specification defines 200 minimum mating cycles for this connector. The main connectors distributors comply with this number. (Harting, CONEC,..)

• Precautions must be taken:
  ➢ Use AMC Extender when/where possible
  ➢ Save insertions cycles avoiding to reprogram the MMC to change the FRU info.
    ➢ FRU Current Requirement Editor developed in Labview
    ➢ Write FRU using IPMI commands
Lesson learned and results obtained

- List of written evaluation reports
- System architecture knowledge
- Cooperation with manufacturers
- Detailed test procedure defined
- Test setup available
  - Load modules
  - LabView GUI
  - IPMI monitor
- Full IPMI test suite (Polaris Tester)

But also

- Several interoperability problems faced during test
  - Must be solved in collaboration with the manufactures
- Interoperability not always assured (standards lacks...)
- Complete technical specification not always verified or provided by manufacturers
- Importance of Support
Conclude MicroTCA Equipment evaluation (hopefully end April)
  - Finish the evaluation of a Vadatech VT892 and ELMA MTCA.4 Crate
  - Polaris tester (IPMI test of MCHs) and MTCA.4 Beta Tester
- **Start AdvancedTCA Evaluation**
  - Schroff Crate and ATCA components evaluation
  - Annecy IPMC + Test Carrier
  - ASIS ATCA crate (Vertical airflow)
- **AC/DC Converters** (first results available)
Useful links

- AMC Short Form Specification [http://www.picmg.org/pdf/AMC.0_R2.0_Short_Form.pdf](http://www.picmg.org/pdf/AMC.0_R2.0_Short_Form.pdf)
- ATCA Short Form Specification [http://www.picmg.org/pdf/PICMG_3_0_Shortform.pdf](http://www.picmg.org/pdf/PICMG_3_0_Shortform.pdf)
- Polaris Tester [http://www.polarisnetworks.net/atca-test-tool.html](http://www.polarisnetworks.net/atca-test-tool.html)
- Vadatech Website [http://www.vadatech.com/](http://www.vadatech.com/)
THANK YOU