BWS-LIU Electronics/Firmware Status and Plans

29.01.2020
J. Emery
BWS-LIU Electronics/Firmware

- Firmware
- Hardware
- Tests and production
Firmware design (FPGA code)

- 3 FPGA + 1 CPLD to manage
- Two people working in parallel (David – Acq, Jonathan – Ctrl)
- Weekly meeting with SW team to work on the interface
- Starting to interface HW-SW in March to be one time for the IST
- One bachelor thesis starting next month on the data processing
Document to describe the interaction between SW and FW-HW

• Document started “CERN LIU Beam Wire Scanner behavioural interface between hardware-firmware-software”
• 18 pages at the moment
• Plan to be edited by HW and SW team

4.1 Scan sequence overview

Figure 3: Scan sequence cases and timings definition

<table>
<thead>
<tr>
<th>Name</th>
<th>min.</th>
<th>max.</th>
<th>unit</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_{\text{charge}}$</td>
<td>60</td>
<td>70</td>
<td>s</td>
<td>Charging time of the DC-BUS</td>
</tr>
<tr>
<td>$T_{\text{Align}}$</td>
<td>tbd</td>
<td>tbd</td>
<td>s</td>
<td>Align forks and recharge DC-BUS</td>
</tr>
<tr>
<td>$T_{\text{wait-trig}}$</td>
<td>-</td>
<td>60</td>
<td>s</td>
<td>Timeout waiting for trigger</td>
</tr>
<tr>
<td>$T_{\text{in-out}}$</td>
<td>0.1</td>
<td>1</td>
<td>s</td>
<td>Between IN trig to OUT trigger</td>
</tr>
<tr>
<td>$T_{\text{data-transf}}$</td>
<td>tbd</td>
<td>tbd</td>
<td>s</td>
<td>Move IOFS data to BWSASC</td>
</tr>
<tr>
<td>$T_{\text{recharge}}$</td>
<td>1</td>
<td>5</td>
<td>s</td>
<td>Recharge DC-BUS to 100%</td>
</tr>
<tr>
<td>$T_{\text{stop}}$</td>
<td>$T_{\text{data-transf}}$</td>
<td>$T_{\text{max-de-on}}$</td>
<td>s</td>
<td>Between end of scan and new request$^{1}$</td>
</tr>
<tr>
<td>$T_{\text{max-de-on}}$</td>
<td>-</td>
<td>5</td>
<td>minutes</td>
<td>wait for scan request, DC-BUS at 100%</td>
</tr>
<tr>
<td>$T_{\text{discharge}}$</td>
<td>-</td>
<td>&lt;10</td>
<td>minutes</td>
<td>Time to discharge the DC-BUS$^{1}$</td>
</tr>
</tbody>
</table>

$^{1}$ Scan request can be initiated during DC-BUS charge or discharge.
LIU Beam Wire Scanner (BWS) architecture

Particle beam

Position (Resolver)

Power

Position (Optical)

Losses

M-PMT

BWSIDC
(Intelligent drive crate)

Acquisition and Supervision crate

LIU BWS electronics status - J.Emery - 29.01.2020
Partial externalization design & production

- Crate BWSIDC (standard, assembled)
- Crate BWSMCU
  Designed with TE-MPE-EM
  Production Pentair/Schroff
- Crates internal mechanics
  Designed with TE-MPE-EM
  produced EN-MME-MA
- Cabling
  Design BE-BI-PM
  Production EN-EA-AS
- Electronics boards
  Design & components ordering BE-BI-PM
  CAD entry & Layout TE-MPE-EM
  Production coordination TE-MPE-EM
BWSCPC (Charger) - new revision V4

- Pre-serie received (10pcs)
- Design changes validated
- Final charging time 1 minutes (16mF – 380 V) to limit heat dissipation related issues
- Functional test completed (10pcs)
- Ready for integration into the BWSIDC
BWSMIB (Motor inverter) – V2

- Pre-serie (10pcs)
- Automated test bench completed (Jean & Guillaume)
- Analysis scripts ready
- 10 boards under test
- 7 done
- Many board issues under investigations
Test bench outputs (txt and tdms)

Short circuit tests plots for all tested boards
BWSAIF (Interface FMC) - new revision V4

• Pre-serie received (10pcs)
• Design changes validated on first card
• Test procedure document finalised (33 pages)
• Manual procedure including measures, assemblies and expert app manipulation (python)
• New circulators validated (cost effective version)
Motion Control Unit (MCU)
LHC potentiometer interface

Linear LHC pot

Noise std ~3 [bit] => ENOB 14bits => 133mm stroke => 8um resolution before processing

Pot displacement by hand
BWSAIF (Interface FMC) - new revision V4
• Production & Test lab ready for the series
• Assembly well undergo thanks to Christiane, Guillaume, Georges and Thasos (BL Greek team).
• All parts for 10pcs ready
• All supply chain for the rest of the production under control.
Hardware tests and production

- Production and tests running at the same time.
- 5 people involved in procurement & production
- 4 people involved for validation and tests of the electronics
- Partial crate production ahead, Waiting for electronic boards
- Tech student stating in February for reliability tests & LHC adaptation.
# BWS Hardware design and production status

<table>
<thead>
<tr>
<th>EDA</th>
<th>Designation</th>
<th>Description</th>
<th>Current rev.</th>
<th>Part Numbers</th>
<th>Status</th>
<th>Status</th>
<th>Pre-Serie 10pcs</th>
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<tbody>
<tr>
<td>EDA-03656</td>
<td>BWSAIF</td>
<td>BWS – Analog Interface FMC</td>
<td>V4</td>
<td>95</td>
<td>100%</td>
<td>Produced and under testing</td>
<td>tests then integration BWSIDC</td>
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<tr>
<td>EDA-03622</td>
<td>BWSFCPC</td>
<td>BWS – Capacitor Power Charger</td>
<td>V4</td>
<td>40</td>
<td>100%</td>
<td>Produced and tested</td>
<td>Integration BWSIDC</td>
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<tr>
<td>EDA-03519</td>
<td>BWSMIB</td>
<td>BWS – Motor Inverter Board</td>
<td>V2</td>
<td>64</td>
<td>100%</td>
<td>Produced and under testing</td>
<td>tests then integration BWSIDC</td>
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<tr>
<td>EDA-03624</td>
<td>BWSFHE</td>
<td>BWS – FMC Height Extender</td>
<td>V3</td>
<td>2</td>
<td>100%</td>
<td>Entire production done</td>
<td>Integration BWSIDC</td>
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<tr>
<td>EDA-03668</td>
<td>BWSVPDA</td>
<td>BWS – VME Power Adapter</td>
<td>V1</td>
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<td>Entire production done</td>
<td>Integration BWSIDC</td>
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<tr>
<td>EDA-03634</td>
<td>BWSIDC</td>
<td>BWS – Intelligent Drive Crate</td>
<td>V3</td>
<td>105</td>
<td>100%</td>
<td>in production</td>
<td>Production</td>
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<td></td>
<td></td>
<td>crate</td>
<td></td>
<td>1</td>
<td></td>
<td>Produced (whole serie)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>custom mechanics</td>
<td></td>
<td>11</td>
<td>100%</td>
<td>Produced (whole serie)</td>
<td></td>
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<tr>
<td></td>
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<td>Cables harness</td>
<td></td>
<td>30</td>
<td>100%</td>
<td>Produced (10pcs)</td>
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<tr>
<td>EDA-03697</td>
<td>BWSMCU</td>
<td>BWS – Motion Control Unit</td>
<td>V2-1</td>
<td>57</td>
<td>100%</td>
<td>in production</td>
<td>Production</td>
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<tr>
<td></td>
<td></td>
<td>crate</td>
<td></td>
<td>1</td>
<td></td>
<td>Produced (whole serie)</td>
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</tr>
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<td></td>
<td>custom mechanics</td>
<td></td>
<td>4</td>
<td>100%</td>
<td>Produced (whole serie)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Cables harness</td>
<td></td>
<td>9</td>
<td>100%</td>
<td>Produced (whole serie)</td>
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<tr>
<td>EDA-03764</td>
<td>BWSPSA</td>
<td>BWS – Particle Shower Acquisition</td>
<td>V1</td>
<td>16</td>
<td>100%</td>
<td>Entire production done</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>- BOCQDAF Quad ADC on FMC</td>
<td></td>
<td>IAM ELECTRONIC</td>
<td>1</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- BWSPSP BWS - Particle Shower Protection</td>
<td></td>
<td>BLUEWAVE</td>
<td>1</td>
<td>0%</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>total</td>
<td></td>
<td>439</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Summary

• Designs complete, waiting for an intensive test campaign (Feb.)
• Pre-serie (10 units) is in production
• Series components procurement done waiting for last comp. reception
• Boards test benches and procedures done
• Next design steps firmware and hardware tests & SW integration