Design and Status of the MicroTCA.4 Based LLRF System for TARLA.


6’th MicroTCA Workshop for Research and Industry

Turkish Accelerator and Radiation Laboratory in Ankara
The Turkish Accelerator and Radiation Laboratory in Ankara (TARLA) is an Infrared Free Electron Laser (IR-FEL) and Bremsstrahlung facility located at Ankara – Turkey.

- 3-250μm FEL, usage of Bremsstrahlung radiation and fixed target experiments
- Collaboration with DESY:
  - Installation and commissioning of the Low-Level Radio Frequency (LLRF) Control system.
Facility Information

- Similar design with ELBE Accelerator in HZDR (Dresden/Germany)
- Continuous-Wave RF Operation
- Expected Beam Energy ~40MeV
- Bunch repetition rate of 52 MHz (max) 13 MHz nominal

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Base Value</th>
<th>Upgrade Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam Energy</td>
<td>MeV</td>
<td>0 - 40</td>
<td>0 - 40</td>
</tr>
<tr>
<td>Max Bunch Charge (at 13 MHz)</td>
<td>pC</td>
<td>77</td>
<td>115</td>
</tr>
<tr>
<td>Max Average Beam Current</td>
<td>mA</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>Horizontal Emittance</td>
<td>mm mrad</td>
<td>&lt;15</td>
<td>&lt;15</td>
</tr>
<tr>
<td>Vertical Emittance</td>
<td>mm mrad</td>
<td>&lt;12</td>
<td>&lt;12</td>
</tr>
<tr>
<td>Longitudinal Emittance</td>
<td>keV ps</td>
<td>&lt;85</td>
<td>&lt;85</td>
</tr>
<tr>
<td>Bunch Length</td>
<td>ps</td>
<td>0.4 - 6</td>
<td>0.3 - 6</td>
</tr>
<tr>
<td>Bunch Repetition</td>
<td>MHz</td>
<td>13</td>
<td>0.001-104</td>
</tr>
<tr>
<td>Macro pulse Duration</td>
<td>μs</td>
<td>10 - CW</td>
<td>10 - CW</td>
</tr>
<tr>
<td>Macro pulse Repetition</td>
<td>Hz</td>
<td>1 - CW</td>
<td>1 - CW</td>
</tr>
</tbody>
</table>
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Latest Update from Site[1]

- Commissioning of gun is almost complete
- Injector commissioning on going, will be ready by Q1 of 2018.
- Helium plant commissioning is almost done and will be ready by Q1 of 2018
- First cryomodule tests without beam after finishing He plant tests
- Expected LLRF System shipment is around Q4 of 2018
- First beam is expected by Q1 of 2019

LLRF Control System Overview

- AMC
- RTM
- MTCA Backplane
- PCIe BUS
- PZT4
- MD22
- FMC25
- XTlinear
- UP
- CH

Sub-Harmonic Buncher Cavity
Buncher Cavity

9 Cell Tesla Cavity
Cryomodule - 1

9 Cell Tesla Cavity
Cryomodule - 2

Beam Direction
LLRF Control System Overview

Future upgrades?

Beam Loading Compensation
Optical Connection to external PC?
GPUs?
Rack and Crate Layout

Main Crate

Spare Crate
• Initial tests with DOOCS using ChimeraTK
  • Tutorial from Martin Killenberg (DESY)
• Switching to EPICS(3+4) Interface
• Successful integration to OPC-UA Adapter at HZDR
  • Talk from Reinhard Steinbrück (HZDR)
Putting things together at DESY

- Individual component tests using ADC & RTM Test Stand (Performance + Functionality)
- Firmware & Software Development (Parallel with HZDR)
- Complete System Integration + Inner Rack Cabling + Documentation
- Shipment
- Training of TARLA staff
  - MicroTCA Training
  - Server Structure
  - Hardware Experience
Thank you for your attention!