Abstract

The Central Timing System (CTS) is a specialized system intended to synchronize the operation of hundreds of devices distributed across the whole accelerator with great temporal accuracy. Cosylab's MRF-based timing system is an off-the-shelf product, adaptable to the needs of PT accelerators of varying type and size.

Key features

The main features of the Central Timing System are:

- Developed as a MADIE plug-in for seamless integration with other devices developed in the same framework. Supports standard interfaces including interfaces to medical systems and a variety of SCADA systems.
- Provides a central source of clock, triggers and time for synchronizing operation of devices and precise data timestamping.
- Distributed and scalable system capable of running a virtually limitless number of receivers and ensuring that all timing receivers are phase-locked to the timing generator with no phase drift.
- Real-time data distribution enabling fast energy switching. Data is transmitted in real time to the end devices, thus allowing fast reconfiguration of the devices.
- Real-time control using the NI FlexRIO modules, Cosylab provides an API for seamless integration to the customer’s real-time control system.
- Fast acknowledging mechanism ensures speed and reliability during medical treatments, where lowering energy switching time directly impacts the treatment time, increasing overall patient throughput.

Technical Specifications

- Minimal event resolution: 110 ns
- Event time-keeping accuracy: 10 ns
- Max number of receivers: unlimited
- Data transmission bound-rate: max 80 Mbit/s

Micro Research Finland equipment list for reference implementation of CTS:

- PXe-EVR-300I + IFB-300 + UNIV-HFBR-1414 allows for export of up to 16 optical triggers per single event receiver.

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>PXe-EVG-300</td>
<td>PXI Express Event Generator</td>
</tr>
<tr>
<td>PXe-EVR-300I</td>
<td>PXI Express Event Receiver with VHDCI for IFB-300</td>
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<tr>
<td>IFB-300</td>
<td>I/O Interface Box for PXIe-EVR-300I / PXe-EVG-300I</td>
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<tr>
<td>UNIV-HFBR-1414</td>
<td>Universal I/O Optical fiber receiver</td>
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<tr>
<td>IFB-1M-GCOR</td>
<td>1 m connection cable for IFB-1M Interface Box</td>
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<tr>
<td>UNIV-TTL</td>
<td>Universal I/O Module with two TTL level output</td>
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</tbody>
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Conclusion

- Highly configurable and easy to use.
- It comes off-the-shelf with dedicated features for PT devices.
- Developed according to industrial development processes (ISO 9001).
- Comes with detailed documentation and expert support.

Hardware Architecture

- Event, codes based system
- Deterministic real time data distribution
- Events sent out with event clock rate derived from external RF reference (GPS)
- Event granularity of up to 10 ns (100 MHz)
- All receiver’s clocks are phase-locked to the generator clock

Proven MRF Hardware

- Built on top of Micro Research Finland (MRF) hardware, ensuring extremely precise synchronization.
- The MRF hardware is powered by Cosylab firmware and software.
- Ensures the best balance between flexibility, usability, robustness and ease of integration with other devices.