The Machine Protection System for the R&D Energy Recovery Linac

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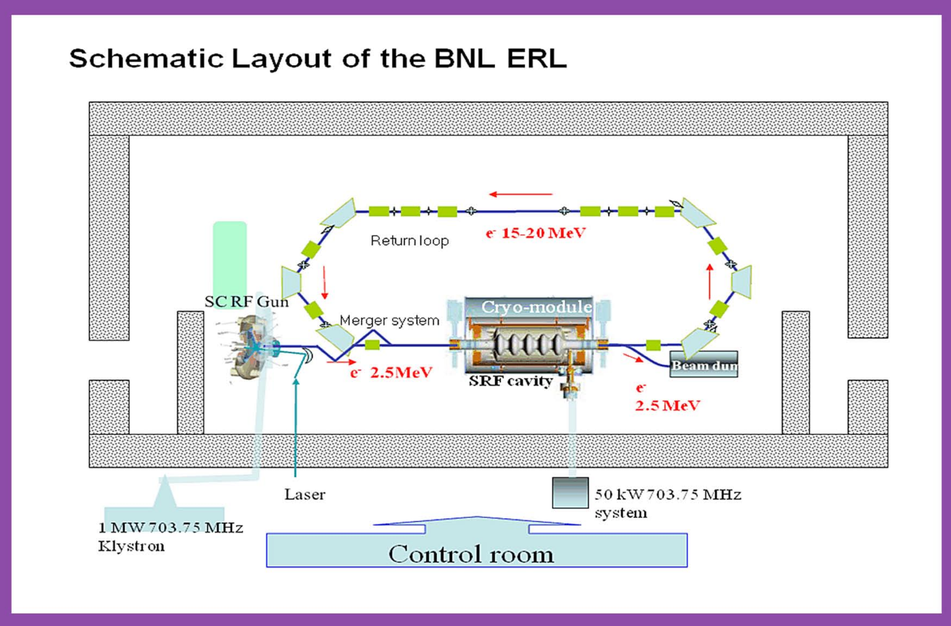
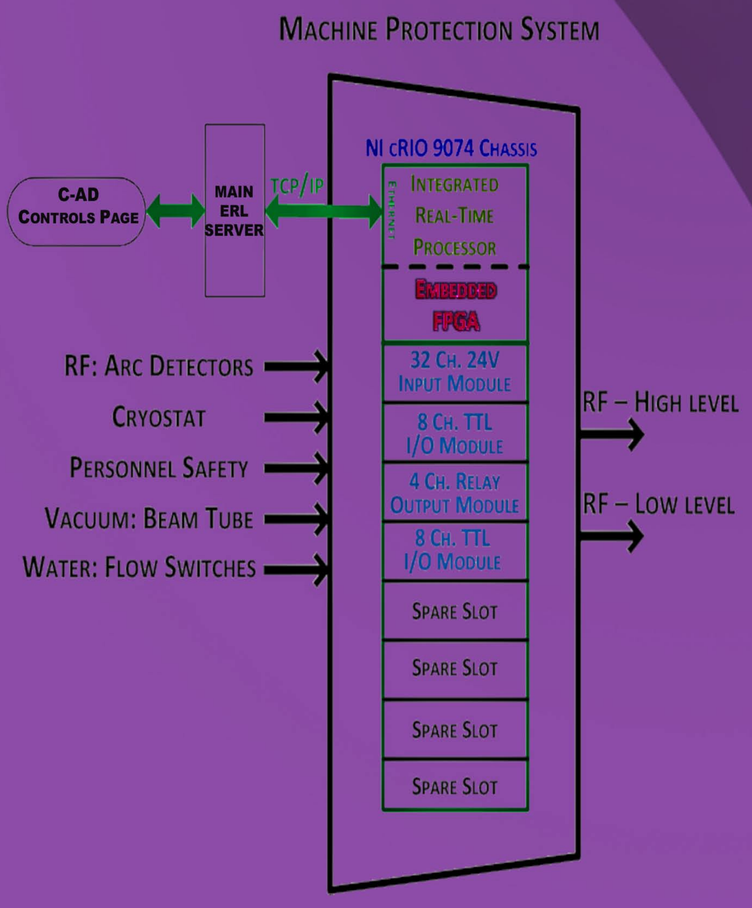


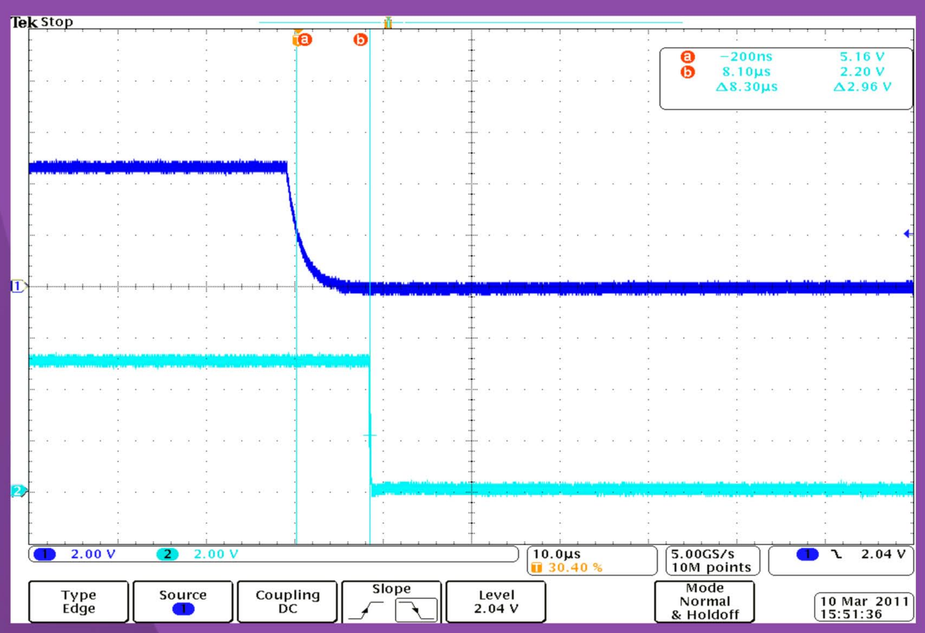


The Overall System Diagram for the Current Setup

Hardware

The National Instruments CompactRIO Platform:

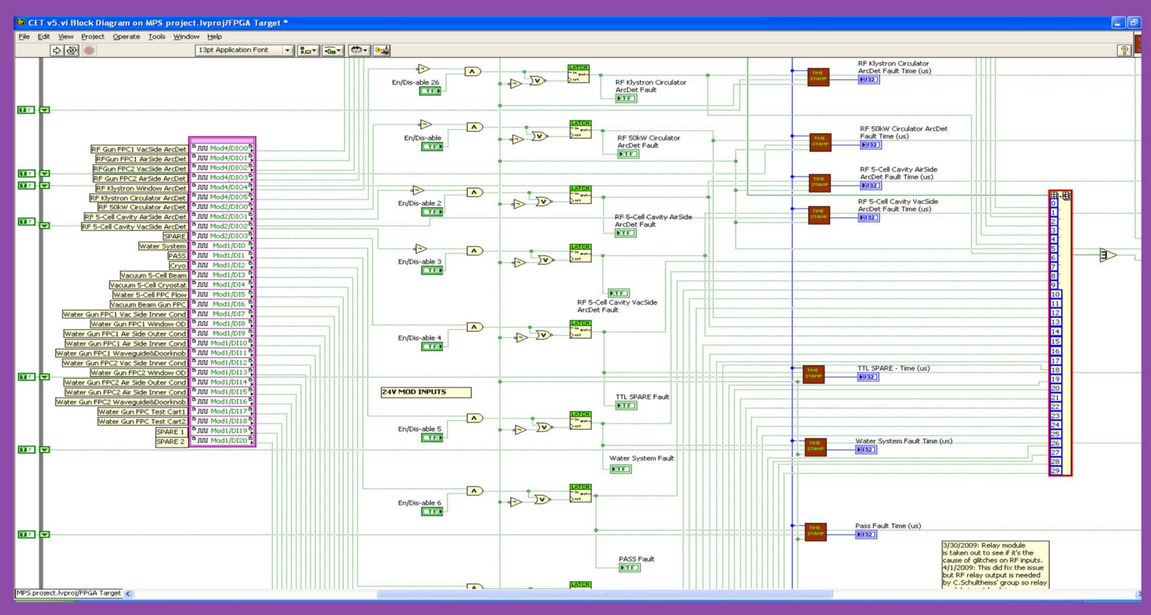
- cRIO 9074
  - 8-slot chassis
  - Integrated 400MHz Freescale MPC5200 processor with WindRiver VxWorks Real-Time OS
  - Xilinx Spartan 3 with 2M gates and 720KB RAM
  - 256MB non-volatile memory
- NI 9401
  - 8-channel bidirectional digital I/O module
  - 5V/TTL high-speed
  - Hot -swappable
- NI 9425
  - 32-channel digital input module
  - 24V capable
  - Hot -swappable
- NI 9215
  - 4-channel SPST relay output module
  - 30VDC (2A)
  - Hot -swappable



A scope image of the MPS response time (8.3µs)

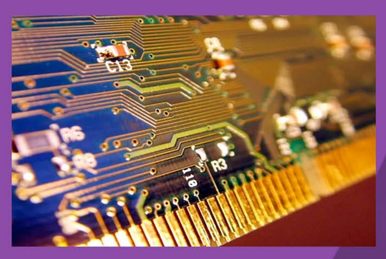
Software

- LabVIEW 8.6
- LabVIEW FPGA Software Module
- LabVIEW Real-Time Software Module



Properties

- High level input = Fault
- Latched faults
- Recorded Time of fault (time-stamp)
- Maskeable Inputs
- Software (user) reset to clear Faults
- Remote web access to monitor & control



ABSTRACT

The Machine Protection System (MPS) is a device-safety system that is designed to prevent damage to hardware by generating interlocks, based upon the state of input signals generated by selected sub-systems. It protects all the key machinery in the R&D Project called the Energy Recovery LINAC (ERL) against the high beam current. The MPS is capable of responding to a fault with an interlock signal within several microseconds. The ERL MPS is based on a National Instruments CompactRIO platform, and is programmed by utilizing National Instruments' development environment for a visual programming language. The system also transfers data (interlock status, time of fault, etc.) to the main server. Transferred data is integrated into the pre-existing software architecture which is accessible by the operators. This paper will provide an overview of the hardware used, its configuration and operation, as well as the software written both on the device and the server side.

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