

# Quench Detector and other upgrades

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# Recent Upgrades (in progress)

- FPGA based quench detector
- PXI real time system based quench detector
- Quench antenna assembly and its fast data logger
- Automated operation of gas recovery valve during quench
- Installation and calibration of new and redundant cernox temperature sensors
- Confirmation of strain gage connections.
- Interface for CLIQ control, power and diode string connections

# Quench Detector during Mirror test

- Mirror magnet test was done using only one real time PXI based hardware platform
- Q-detector had only seven digital out signals.
  - 3 QHPS, PS OFF, IGBT Off, trigger for fast logger for magnet and trigger for fast logger for IGBT switch.
- Q-detector had about 8 analog signals to monitor
- Q-detector loop time of 1ms was sufficient
- All analog inputs were read by one simultaneous sampling A to D card (PXI 6123)
- All digital outputs were issued by one 8 bit digital port.

# Quench Detector during last quad test

- Because of 12 QHPS and added quench antenna DAQ trigger, 20 synchronized digital output line are required
- Due to monitoring of many joints, lot more simultaneously sampled analog input channels are required.
- Same PXI system but added two more analog input card with two 8 bit digital output ports
- Processing of all these signals increased the loop time to around 2.5ms creating sluggish response
- Multiple cards and parallel processing of all these signals produced considerable delay between execution of digital command and actual change in state at the output port.

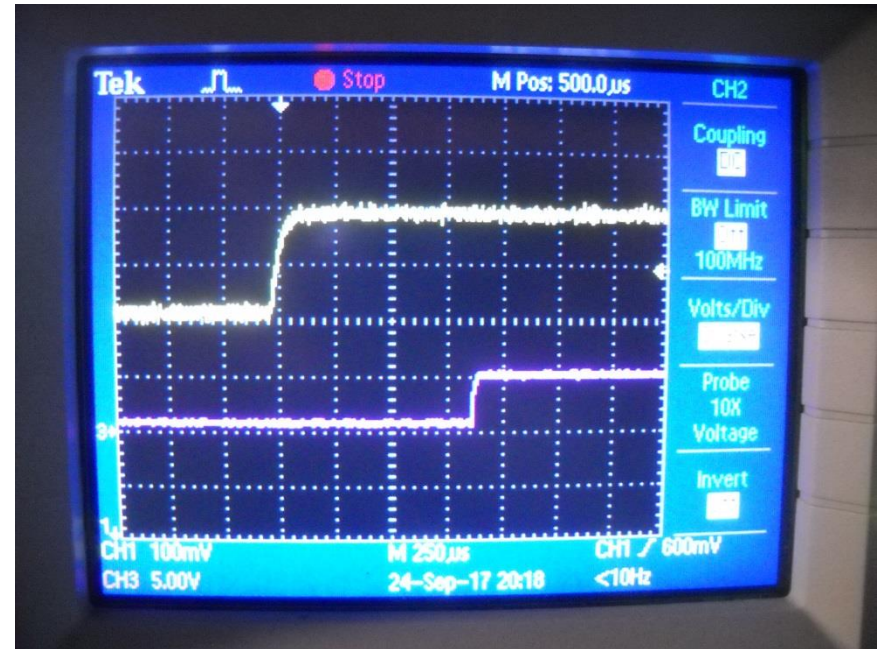
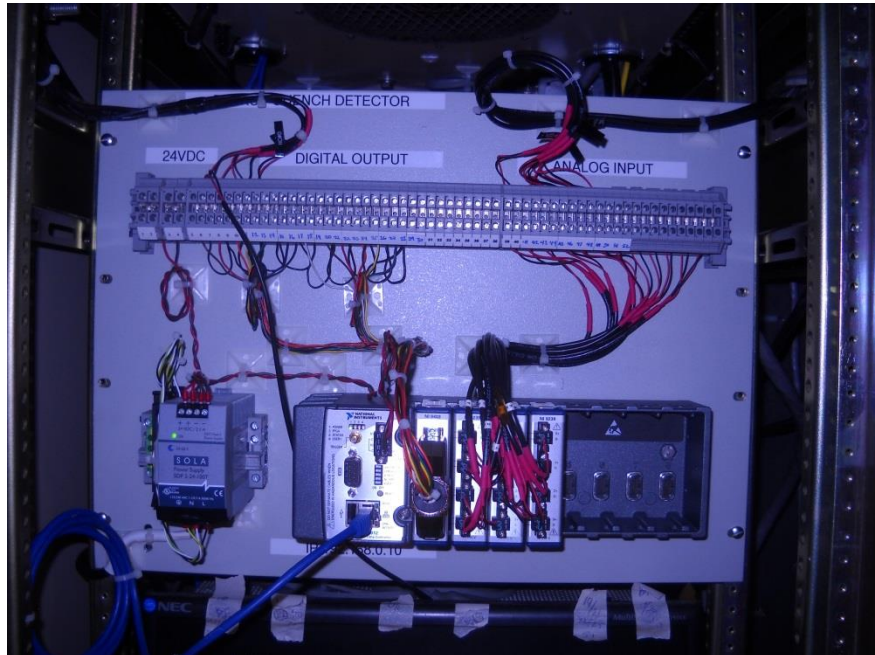
# New configuration of Q-detector system for quad test

- Two hardware platforms
  - Very fast FPGA based Q detector to protect the magnet only
  - PXI based Q detector (original) as a back up to FPGA with added function of monitoring many joints and gas cooled leads

# FPGA based Q-detectors

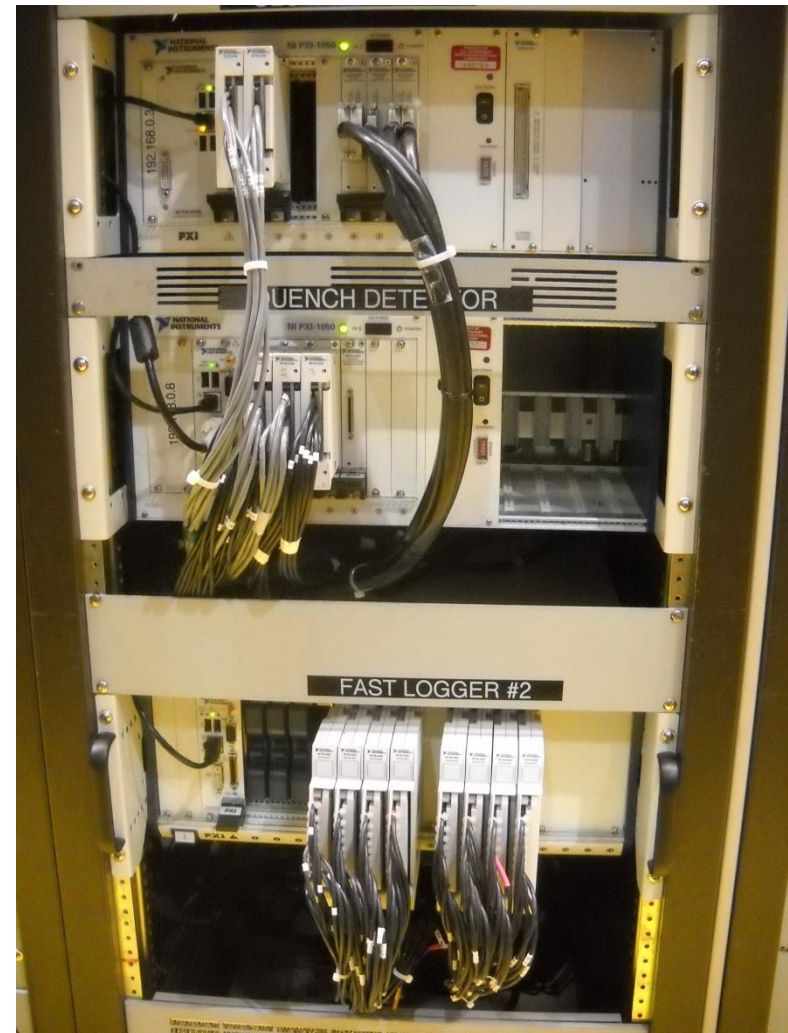
- Monitors half coil voltage for comparison with a threshold
- Monitors whole coil voltage, computes  $L di/dt$  voltage and compare the difference to a threshold
- Triggers all 12 heater power supplies (QHPS) with prescribed delays.
- Trigger Energy Extraction and PS turn OFF
- Trigger CLIQ
- Trigger fast data loggers
- Digital output response time of less than a millisecond (850us)

# FPGA Q-Detector



# PXI based Q-detector

- Performs all the function of FPGA Q-detector
- Initiates slow discharge in case of problem with GCL or joint voltage
- Loop time and digital response time slower than FPGA. (1ms v/s 25ms)





# Block diagram

## FPGA BASED QUENCH DETECTOR

