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## Standardization of automated industrial test equipment for mass production of control systems

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Power converters and their controls electronics are key elements for the operation of the CERN accelerator complex, having a direct impact on its availability. They must be designed to achieve a high Mean Time Between Failure (MTBF) and hardware reliability must be ensured by board level testing before hardware is assembled and installed. In this framework, the National Instrument PCI extension for Instrumentation (PXI) was chosen as standard platform for the development of testers. This paper reports on the design strategy and approach used focusing on the tester hardware, firmware and software development.

### Summary

The CERN accelerator complex consists of a series of accelerators that work together to accelerate particles to increasingly higher energies. Several different magnets are used to deflect, focus and defocus the particles during their trajectory. For powering these magnets different power converter topologies are used. The machine overall availability significantly relies on the converter electronics. A big challenge for the next LHC era is to increase the machine availability by ensuring higher Mean Time Between Failure (MTBF) by ensuring board level testing before controls hardware is assembled and installed. A key element to achieve this is the development of the industrial testers used in the board production phases. The roles of these testers are: to validate mass production during the manufacturing phase and to provide a means to repair failed modules brought back from operation during exploitation.

The Electrical Power Converter (EPC) group at CERN is in charge of the design, development, installation and maintenance of electrical power converters for all accelerators. In this framework, the Converter Controls Electronics (CCE) section provides the electronic infrastructure for controlling and monitoring those systems. Recently, the National Instrument PCI Extension for Instrumentation (PXI) was chosen as standard platform for the development of testers. PXI is a modular platform for measurement and automation systems offering a low cost and flexible solution providing the benefits of an open industry standard.

National Instruments provides many standard modules to choose from, each providing a different function. Third party vendors can also produce boards for the NI PXI system making the system extremely adaptable to any tester setup.

This allows the testers to share the same hardware and software structure resulting in significant resources sharing, a quick turnaround time, and a lower per-unit cost than a complete in-house design.

In addition to the PXI crate, the generic test setup consists of a specific Test Control Card (TCC) designed to interface the PXI Chassis with the Device Under Test (DUT), and a control sequence written in LabWindows, a c-based language providing an easily maintainable structure.

This paper reports on design strategy and approach used focusing on the hardware, firmware and software development.

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