

Comprehensive Test at minimal Cost

At Max-Planck-Institute in Garching/Germany, a low cost Boundary Scan System handles all Test Tasks

The Max-Planck-Institute has a worldwide reputation for excellence in basic research for various areas in physics. In Garching near Munich/Germany the CODAC (Control and Data ACquisition) Electronics Development division is developing and maintaining several hardware and software systems for experiments in nuclear fusion. Core components are data acquisition system frontends used in the execution of experiments. The variety of PCB assembly designs is very large because the diagnostics associated with each experiment have specific physical principles, which require special acquisition systems. The PCB's life time is 20 years and longer.

In addition to many kinds of experiments, the CODAC technicians must deal with electrical maintenance work and repairs in the case of system failures. Many times, special solutions for various control and regulation tasks are required, which are not commercially available due to the unique requirements and characteristics of each experiment's operation.

A major part of the assemblies being developed contain digital (sub) systems based on programmable logic devices such as CPLDs and FPGAs, because the operation of CODAC's experiments require a high level of flexibility. The opportunity for in-system programming enables short-term changes in the development process, and therefore fast prototyping with reasonable effort. This flexibility provides an ideal price-performance ratio, in particular for small series between 1 and 150.

The developed prototypes and boards are produced and equipped in-house, including multi-layer boards. For larger quantities external manufacturing partners are used.



Image1: Selection of different assemblies

Quality Assurance is a Must

There are very high quality requirements for the printed circuit boards (PCBs), because if any measurement channel fails during the data acquisition in a running experiment, these measurement data are irretrievably lost. It must be clear that each experiment cycle during plasma ignition is unique and expensive! Horst Eixenberger, Head of Electronics in the CODAC Division knows: "If data get lost due to electronic failures or the entire discharge does not work, it's both pricy and annoying". That's why PCB quality has to be assured, particularly as a multitude of electronic systems must be functioning together to ensure a smooth total system process. Small mistakes often have big impacts.



Image2: Horst Eixenberger at test station

For quite a time, manual inspection and functional tests were used. But especially the latter proved less effective, in particular because of the increasing complexity and density of the boards. Additionally, test times increased unacceptably due to utilization of BGA technology. Electronics designer Gerald Sellmair summarizes: "Manual functional tests are limited as high test coverage can neither be guaranteed nor achieved".



Image 3: Gerald Sellmair tests with Boundary Scan

Consequently, an automated test solution was mandatory to the designers' requirements. Horst Eixenberger had considered purchasing a JTAG/Boundary Scan system for quite a few years, but a lack of manpower and constant work pressure did not allow it.

Due to the massive utilization of FPGA/CPLD components, – innately including the necessary IC architecture –, the board design “more and more developed towards Boundary Scan”, says Horst Eixenberger, and the importance of subsequent testability constantly increased.

Cost-efficient Solutions from an experienced Vendor

CODAC decided for the hardware/software package *ScanBooster/USB DesignerStudio*, which enables JTAG/Boundary Scan operations within the shortest time. For necessary basic tests “the system is fairly sufficient and also interesting for the wallet” says Horst Eixenberger.

He had been pursuing the Boundary Scan market for quite some time, oftentimes being confronted with GOEPEL electronic. “We had simply a very good impression of the company”, he adds. In particular, the continuous further developments, product support and the company’s positive image as well as the “fair and professional purchase advice” were key arguments.

GOEPEL electronic engineers and some CODAC team members worked on a characteristic reference design and created the first infrastructure and interconnection tests. These basic tests were implemented in less than 30 minutes – with a convincing result. In addition, GOEPEL electronic’s Boundary Scan systems provide interfaces for various layout programs, which was particularly important for the research field as many other systems are only available as stand-alone solutions.



Image4: Test set-up with a small board and two Boundary Scan paths

CODAC consciously decided for a ‘small solution’ that can be upgraded at any time. Horst Eixenberger rates *ScanBooster/USB Designer Studio* as having a “very good price-performance-ratio”. The system works trouble-free, and if there are problems GOEPEL electronic’s application engineers are available within the shortest time. Horst Eixenberger commends the logical Boundary Scan system structure as an intuitive solution. All automated tests and test runs are “press button solutions that make the work much easier”, complements Gerald Sellmair.

On the one hand, *ScanBooster/USB DesignerStudio* guarantees required flexibility, on the other hand the integrated programming language CASLAN enables customer-specific tests that can also be executed easily by operators through the use of interactive dialogues.

CODAC technicians increased test coverage through customer-programmed cluster tests and detected faults undetectable before. A sustainable cost reduction is expected incl. quality improvement and customer satisfaction. According to Gerald Sellmair, the CODAC engineers have a "very good feeling" in shipping tested systems. He rates the Boundary Scan system as a powerful tool for analysis of faulty assemblies.

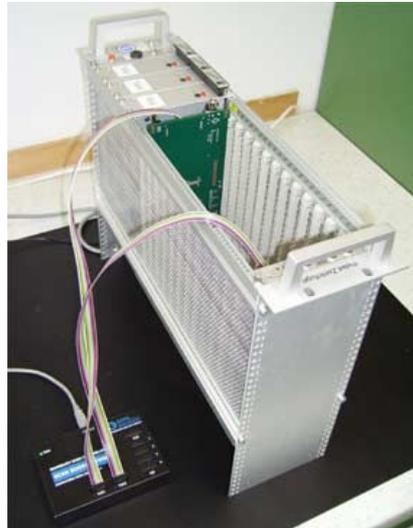


Image 5: Overall system test with ScanBooster/USB DesignerStudio

Summa Summarum, the engineers with CODAC Electronics Development in the Max-Planck-Institute in Garching/Germany don't regret having backed the right horse, namely Boundary Scan from GOEPEL electronic. Quite the contrary, they recognise how much costs and time could have been saved if the solution would have been available much earlier ...

Authors:

Stefan Meissner, GOEPEL electronic GmbH, in cooperation with Gerald Sellmair and Horst Eixenberger, Max-Planck-Institute, CODAC (CONTROL and Data ACquisition) Electronics Development