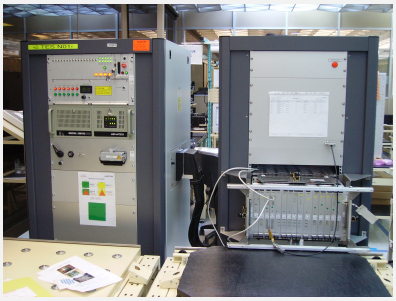
Alstom Transport Standardizes Electronic Test with PXI Instrumentation, LabVIEW, and NI TestStand



The test bench consists of a generic instrumentation rack as well as an interface rack that is specific to the product under test.

"“The high quality of NI software and hardware products as well as the support provided by the company’s staff enabled us at the test means department at Alstom to quickly and efficiently produce four fully-functional test systems under extremely stringent deadlines.” "

- Francois Charreire , Test Means Department, Alstom Transport

The Challenge:

Developing a flexible and scalable test bench that meets the manufacturing test needs of electronic products at the Alstom Transport site in Villeurbanne, France.

The Solution:

Relying on NI hardware standards with PC and PXI instrumentation as well as NI TestStand and LabVIEW software while integrating a hardware/software abstraction software layer to increase durability.

Author(s):
Francois Charreire - Test Means Department, Alstom Transport

The mission of Alstom Transport in Villeurbanne, which has a staff of more than 600 employees, is to design and manufacture embedded electronic systems in railway rolling stock, signals, and safety alerts. The test means department at Alstom develops most of the manufacturing test tools for these electronic systems. One of our biggest challenges is building a flexible and scalable standardized test bench architecture that is high-quality and reduces software porting costs. To overcome this challenge, Alstom test engineers developed a new generic test bench called Neptune. Unlike other test benches at Alstom, which were specific to a single product, Neptune has the capacity to test a wide range of products. We use Neptune to test the electronic boards manufactured at our Villeurbanne site. Alstom customers also use the test bench to troubleshoot system breakdowns.

Drawbacks of a Nongeneric Tester

The products under test are mainly plug-in units that consist of electronic boards in a 6 U form factor. Before integration, each board went through standard burn-in or dielectric test phases. After integration, we conducted a functional plug-in unit test in order to confirm that they functioned as we expected.

Building a Test Bench That Accommodates All of Our Needs

To develop a generic bench, we relied on the product under test that consisted of the most complex and demanding instruments, while assuming a 20 percent margin to ensure that the bench could test most of our current and future products. This increased our test bench instrumentation capabilities.

We used two racks to build the test bench: a generic instrumentation rack and another one dedicated to interfacing the products under test. The generic rack integrates an industrial PC, which can house a large number of PCI boards, linked to two NI PXI 18-slot chassis, a signal conditioning block for rail strain adaptation (24 V to 110 V), two programmable loads, an adjustable power supply, and a power supply control module. Both PXI chassis contain an NI PXI-4070 6½-digit multimeter, NI PXI-6602 counter, four NI PXI-5412 arbitrary waveform generators, NI PXI-6713 analog output module, NI PXI-2569 SPST relay module, four NI PXI-2568 SPST relay modules, and 13 NI PXI-2529 crosspoint matrix switches.

The hardware architecture, which integrates four independent buses, can accommodate up to 380 differential inputs and meet test needs for the most basic to complex products such as motor or safety control units.

Advantages of Using the PXI Platform for Our Test Bench

We decided to use the PXI platform because of its scalable and flexible architecture and high test throughput performance instead of VXI instrumentation as we did in testers from previous generations. However, it was the instrument reliability that attracted us to the PXI platform the most. We mainly worked on the software and chose the LabVIEW graphical development environment as well as the NI TestStand sequencing tool. The LabVIEW graphical language is well-adapted to engineers who are not computer specialists. Moreover, the LabVIEW code is easy to reuse. Our product validation engineers continue to use LabVIEW and we can consider reusing the code development for future test benches. We chose NI TestStand because of its openness, ease-of-use, and high customization level.

Software Architecture Based on LabVIEW and NI TestStand

We developed a modular, yet scalable software architecture in three layers: a low-level first layer that corresponds to the hardware drivers, an abstraction layer, and an application layer that relies on NI TestStand. For the abstraction layer, We worked with a contractor to create the abstraction layer and define the “job” LabVIEW objects based on interchangeable virtual instrument (IVI) drivers. Thus, we have instrument-independent objects that are easy to manipulate such as a current-voltage generator, programmable source, and more.

We developed the application layer in house, linking to our product experience and the tests they require. We created the HMI under LabVIEW and used the same principles as previous generation test benches as not to disturb operators. We took special care to localize the user interface so that test system users can switch from one language to another with a simple click on the user interface.

Immediate Functionality

We spent more than one year developing the test bench and asked four or five people to assist us with the project. The project was ambitious because we did not know which hardware and software elements we would be working with. We found it remarkable that despite these obstacles we turned, what was supposed to be a prototype, into an immediately functional preseries unit. We expected these results when we chose the “100 percent NI” solution, because the hardware is high-quality, and we did not experience any hardware/software integration issues. The only problem we faced was related to the signal-conditioning section, which delayed the CE certification. NI products were delivered within expected deadlines and we developed the rest of the test bench elements quickly and smoothly.

Our goal is to produce an additional five or six test benches in order to meet our internal manufacturing test needs, as well as those of our clients and Alstom maintenance sites. The Neptune project follows the standard Alstom product cycle, like the electronic products that we provide our customers. The test bench is a standard product available in our catalog and shipped ready to use. Because most of our customers purchase several Alstom products at the same time, now they can invest in a single generic rack completed with the interface racks that are specific to the products under test.

We designed the interface racks to reduce total test configuration times. A single wear connector covers the link between both racks, which tremendously reduces the wiring handles. We have the option to add a board in the industrial PC and the process takes only 5 minutes and we can reconfigure the test bench in less than 2 hours if we change the product under test.

Successes and Next Steps

We achieved our goals for the Neptune project and developed a generic tester, which can meet most of our current and future testing needs, by replacing the rack that interfaces to the product under test. The instrument rack interchangeability makes maintenance easier and the tester available, allowing for manufacturing optimization throughput according to our needs. As far as customers are concerned, this generic rack is a substantial way for our customers to save money and increase product life.

The new test bench also presents a time-to-market advantage because now we can quickly test any new product and speed up its time to market.

We are considering the integration of manufacturing follow-up tools with database implementation in order to proceed to statistical analysis and improve tester quality. We are also looking at opportunities to narrow the gap between the product, design, and manufacturing test through code reuse.

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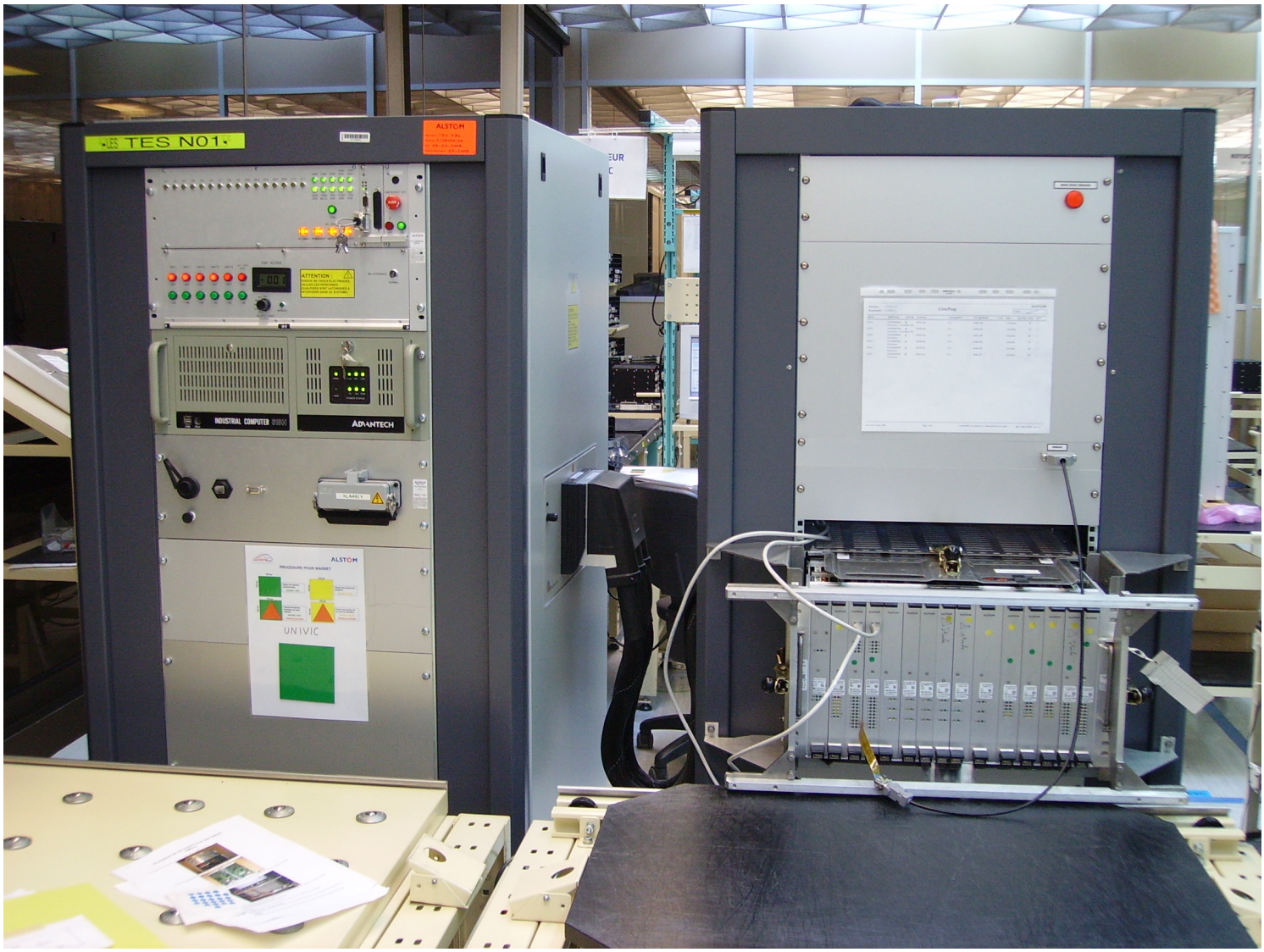

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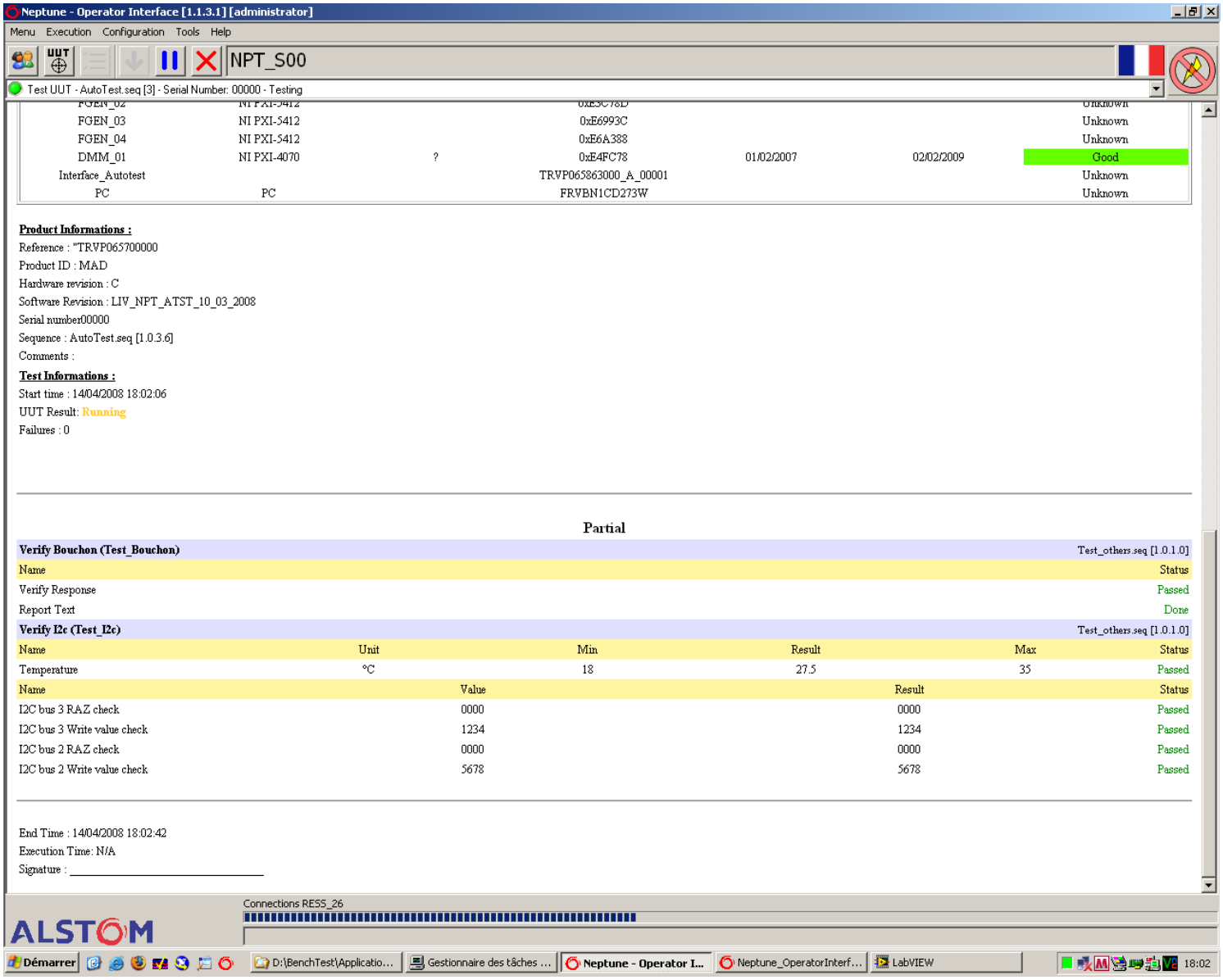

The test bench human machine interface (HMI), which was written in LabVIEW, is multilingual in order to meet the needs of Alstom's global customers.
