

The Evolution of a System

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The Challenge: Creating a data acquisition system to measure the performance of high-current electrical connectors that can grow with the needs of the test laboratory. We required a system that is fault tolerant and provides easy access to data during multi-month-long tests.

The Solution: Using National Instruments LabVIEW and data acquisition hardware, we created a flexible software distributed system. The current version of the system is comprised of three software applications and one centrally located data acquisition system controlling three independent tests.

Introduction

Tyco Electronics is a manufacturer of high-current electrical connectors used in the utility industry. We subject these connectors to a series of stringent ANSI tests. One of these tests is the current cycling test for compliance

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to industry standards. This test consists of subjecting the connectors to high AC current for a period of 30 min to 2 hrs then shutting off the current for the same time period. Currents can range from a few hundred amperes to a few thousand amperes. A single test may have up to 500 cycles. We take temperature measurements at the end of the current on-period and resistance measurements at the end of the current off-period. We also take resistance measurements by passing up to 12 amperes DC through the test chain and measuring the voltage. We test up to 20 connectors at once. Each connector has at least one temperature measurement and three voltage measurements. Prior to automation, an operator using a multimeter and a clipboard performed these tests.

Automating the Test System

We decided to automate the current cycling test system (CCTS), and we chose National Instruments data acquisition hardware as the hardware platform and LabVIEW software as the development platform. Hardware consisted of an AT-MIO-16X data acquisition card connected to three AMUX-64T cards. A DIO-24 card

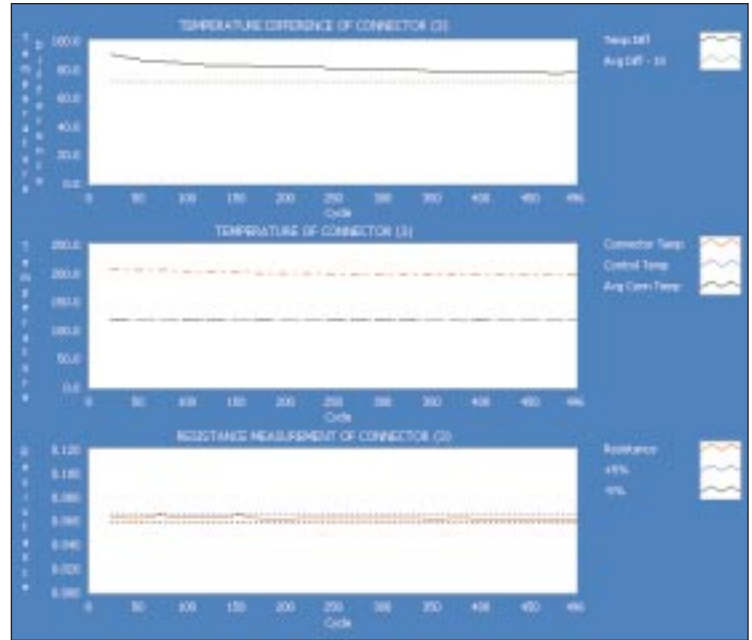
connected to SC-2060, and SC-2062 cards for digital input and output respectively. We then used digital lines to control the power supply which injected the current into the connectors. The initial system implemented the ANSI standard test rigidly. We operated the entire system from one computer. We performed all data acquisition, control, data visualization, and reporting from this single computer.

Because the tests were so long, up to several months, the chances of a power outage or the network going down were high. Because powering a 24 KVA power supply from an uninterruptible power supply was impractical, we developed a scheme to resume a test after a catastrophic fault.

As a safety feature, the system monitors all thermocouple channels constantly, and if any thermocouple exceeds a predetermined maximum value, the test automatically shuts down.

Flexibility for Changing Needs

In an effort to increase quality and meet customer needs, Tyco personnel realized that



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the system was useful for more than just the standard ANSI testing. Although the ANSI test requirements remain an integral part of the system, we added features for monitoring and logging of the temperatures and resistances during cycles. We also added custom tests for testing beyond the ANSI criteria. Designers now have the flexibility to stress products during development, so that qualification testing is a mere formality.

Reusing Code with LabVIEW

The current system hardware consists of the original AT-MIO-16X data acquisition card connected to an SCXI-1001 chassis containing nine SCXI-1100 modules, one SCXI-1162HV module, one SCXI-1163R module, and one SCXI-1124 module.

Because of the modular nature of LabVIEW, we easily reused code during the upgrade process. The ANSI standard had not changed substantially, so most of the basic functions of the test remained unchanged. The required changes were to make the system work with three independent test bays running three independent tests. With LabVIEW, the addition of these test bays was easy. We also divided the software into three separate modules.

The first module resides in the control room and runs the tests. The current version retains all fault-recovery and safety features of the original system. We saved data locally in the control computer and on a network drive. In case of a network problem, the control computer suspends data saving on the network and resynchronizes the data when the network connection is re-established.

The second software module resides on the operator's desktop in a report generator, where the operator can view data and generate printed reports in a standard format.

The third software module publishes data live on the Internet. This saves the operator from having to generate interim reports for the month-long tests and gives the operator the ability to monitor the test from anywhere there is an Internet connection.

Conclusion

Using National Instruments hardware and software, this system moved through a variety of software, hardware, development environment, and operating system upgrades with minimal compatibility issues. Thus,

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