Compact LXI Data Acquisition System Saves Gas Turbine Manufacturer Time and Ensures Reliability

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Today's leading suppliers of power generation and energy delivery products require cutting edge technology and superior performance to meet the world's most demanding energy requirements. Gas turbine systems are primarily used in auxiliary electric power generation to manage peak loading conditions or for emergency power generation. Using gas turbines, power utility companies as well as various other industrial companies, can reduce their dependency on costly primary sources of power since these generators can be located anywhere and used as power needs fluctuate.

In simplistic terms, a gas turbine produces power by compressing air mixed with burning fuel that is expanded through spinning turbine blades to drive a generator and convert the spinning energy into electricity. Gas turbines range in size from very small units to larger combined cycle generators capable of generating up to 300 MW of power by utilizing advanced materials and technologies. In order to produce such high power levels, much higher turbine inlet temperatures and corresponding cooling systems are required. As a result, sophisticated data acquisition systems are needed in order to ensure the behavior of the turbine at such extreme temperatures.

Figure 1: Gas Turbine Assembly

Testing is a critical aspect of gas turbine manufacturing. Typical tests involve recording, measuring and analyzing the physical characteristics associated with gas turbines to ensure their reliability and efficiency. The most common measurements taken are temperature (inlet/outlet gas), pressures, loads, and torque. High-performance test instrumentation is required during research & development to improve the

efficiency of new designs as well as ensure the reduction of undesirable gas emissions and during production or startup testing at the time of installation to verify proper setup and ensure reliability.

Remote Health Monitoring

The ability to remotely monitor gas turbine testing provides several benefits. By continuously collecting and remotely monitoring test data, turbine manufacturers can reduce potential damage to the equipment being monitored and make timely changes to offset costly repairs. Successful gas turbine testing also involves the coordination of people from various departments, often separated by geographical distances and time zones. Remote monitoring enables real-time access to test data from anywhere in the world and at anytime.

Remote monitoring is also useful when the gas turbines are deployed, especially in emergency circumstances, when they are pushed to their limits and beyond their normal recommended service intervals to meet the high demands for supplemental power.

LXI is the Ideal Test Platform

LXI (LAN eXtensions for Instrumentation) is the standard for Ethernet control of instrumentation. By standardizing and extending the LAN to instrumentation support, LXI simplifies the use of Ethernet for gas turbine data acquisition test systems, providing a low-cost, cross-platform computer interface that can be controlled at any distance.

Since LXI instruments are based on Ethernet, test engineers are able to connect directly to the network using industry standard cables and connections, reducing equipment costs, to quickly verify communications and functionality of the turbine from a built-in Web interface. The LXI platform allows centralized monitoring of the system by factory personnel at remote locations worldwide.

In addition, the LXI standard, developed and maintained by the LXI Consortium, enables the synchronization of multiple, distributed test instruments over a single Ethernet cable through the IEEE 1588 Precision Time Protocol. This is particularly useful to provide detailed timing information in the event of an out-of-tolerance condition or failure, saving both time and money since problems can be resolved quickly.

An Example of an LXI Data Acquisition System

A gas turbine manufacturer needed to upgrade its data acquisition test system to a more portable, scalable one that maintains high accuracy (better than 1° C). A common hardware platform that can scale from 100 channels for on-site testing to thousands of channels for R&D testing was essential. Portability was also needed for on-site production testing.

The gas turbine manufacturer worked with VTI Instruments, an active member of the LXI Consortium, to identify an Ethernet-based LXI system as a possible replacement. To test performance, the manufacturer purchased six EX1048A thermocouple LXI instruments to run in parallel with the existing test system as well as other competitive data acquisition systems.

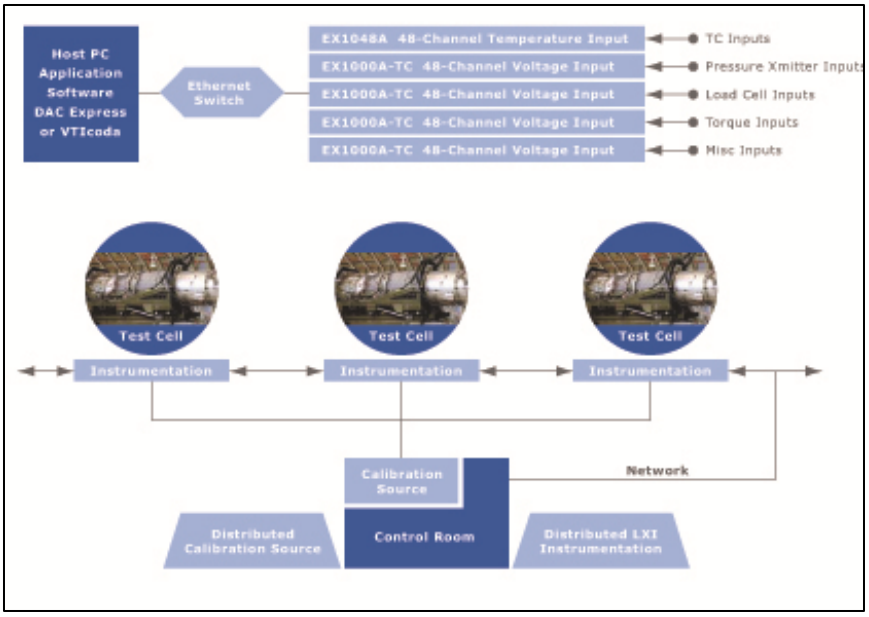

Figure 2: LXI Data Acquisition System for Gas Turbine Manufacturing Test

During the trial period, the EX1048A provided the highest accuracy (0.5° C) of any of the data acquisition systems tested and delivered the improved environmental and portability requirements that were needed. Setup time was reduced from 2.5 days to only 6 hours. The mini-TC connector used for the EX1048A allowed thermocouples to be directly connected to the instrument without using external reference junctions, patch panels, or terminal blocks. This simplified connectivity while reducing wiring errors. Test engineers had real-time access to measurement data for analysis via its built-in Web interface.

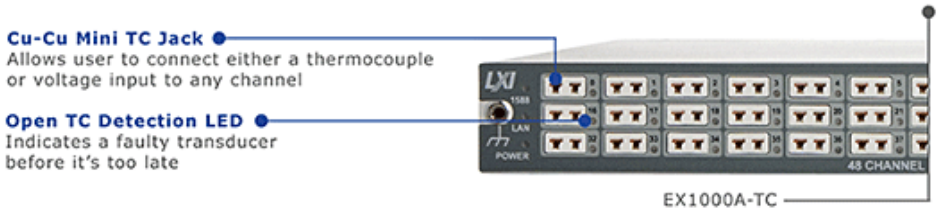

Figure 3: VTI's EX100A-TC LXI Instrument with Mini-TC Connectors

In addition to the EX1048A, VTI provided the EX1000A for voltage measurements (outputs from pressure and load transducers). The final solution involved combining the EX1048A and the EX1000A to create a single Ethernet-based LXI solution called the EX1000A-TC. This instrument can take both thermocouple and voltage measurements and provide unlimited expansion for high channel counts as well as the flexibility and portability that an Ethernet-based LXI test system enables.

Summary

Aside from its proven performance, the gas turbine manufacturer selected this LXI system because of its compact design, ease of use, and cost savings. Startup testing involves shipping a large amount of test equipment to the customer site for new turbine installation testing and verification. The high-density LXI components weigh just 500 lbs – significantly less than the 4,000 lb weight of the previous system. This enables the company to save over $11,000 in shipping costs alone when instrumentation is transported for startup testing.

In general, an LXI-based data acquisition system for gas turbine testing provides the following advantages:

- Web based remote monitoring
- Reduces testing times
- Increases data integrity
- Reduces setup time
- Lowers hardware, support, and operating costs
- Maximizes uptime

Due to the successful implementation of the LXI data acquisition system for gas turbine testing, the manufacturer is planning to leverage these instruments for future test and measurement applications in its wind turbine business. The LXI platform will allow them to host the instruments remotely in each wind turbine for real-time health monitoring in multiple locations from a single control room, providing improved reliability and reduced operating costs.

Author on behalf of the LXI Consortium

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