

Refrigerator Testing

using the DaqScan

Application Summary

Manufacturers that turn out superior products have especially vigilant quality control inspectors and test engineers who make certain no problems can get past them that will tarnish an outstanding company reputation. Supporting these people are aggressive quality control procedures and management who believe the team should have the best facilities and test equipment for carrying out their jobs. One such company is Sub-Zero® Freezer Co. Inc., Madison, Wisconsin, a manufacturer of luxury residential refrigerators. The company maintains thorough quality assurance procedures, processes, and practices and a group that



The data acquisition system is housed in a computer equipment rack. The IOtech DaqScan units are located in the bottom section, while the monitor resides in the top. Doors protect the system from factory floor hazards, but a glass window in the top door lets test engineers see the monitor during operation.

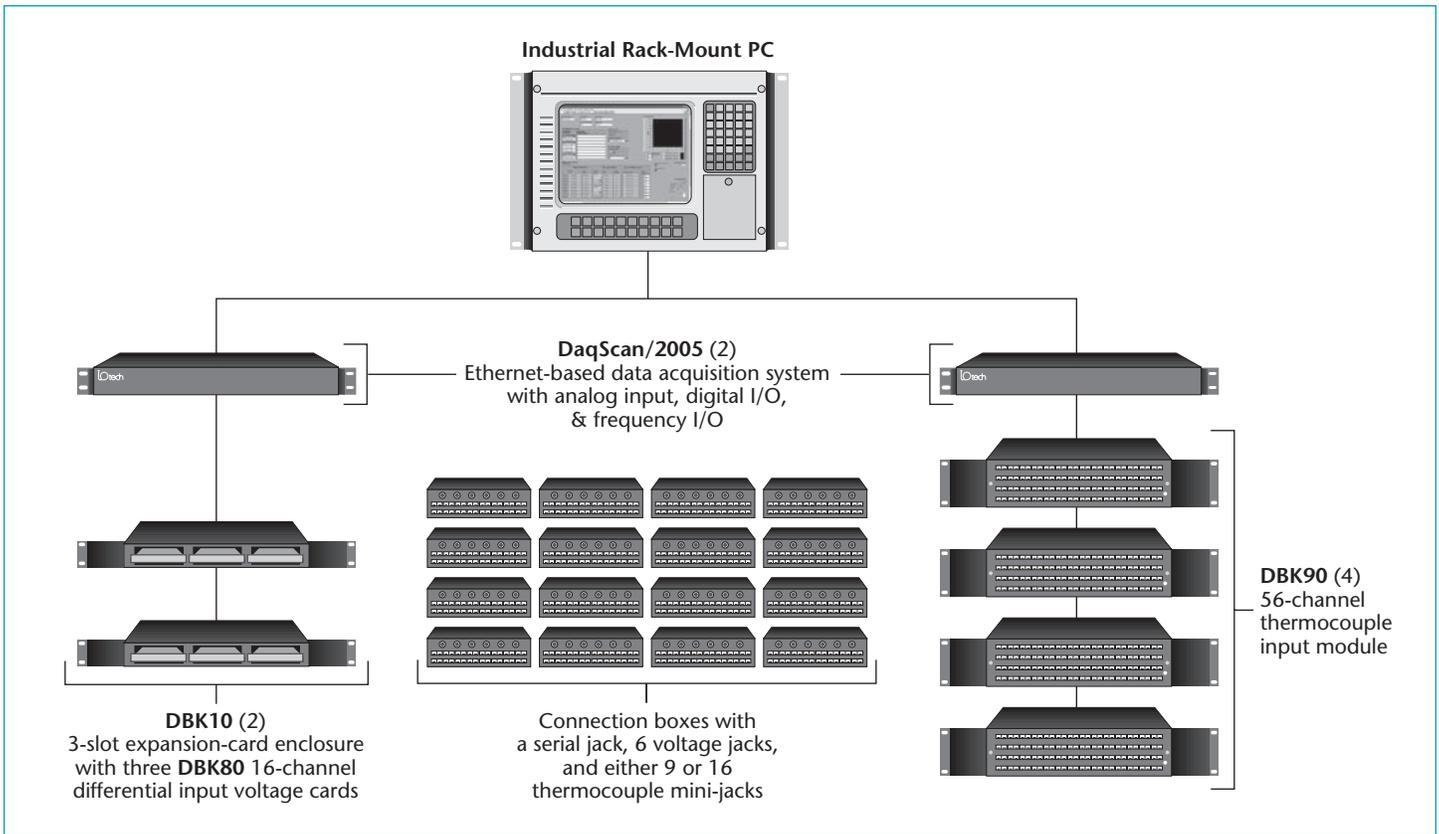
enforces them on the normal production line — as do many companies. But they go a giant step further as evidenced by their new research and test facility that focuses on quality control beyond the factory floor. The facility is located in a new factory that produces the “Built-In” product line, and is devoted to two functions: production testing, called Extended Functional Testing, and post-production quality assurance activities in the Customer Audit Lab.

Exceeding Expectations

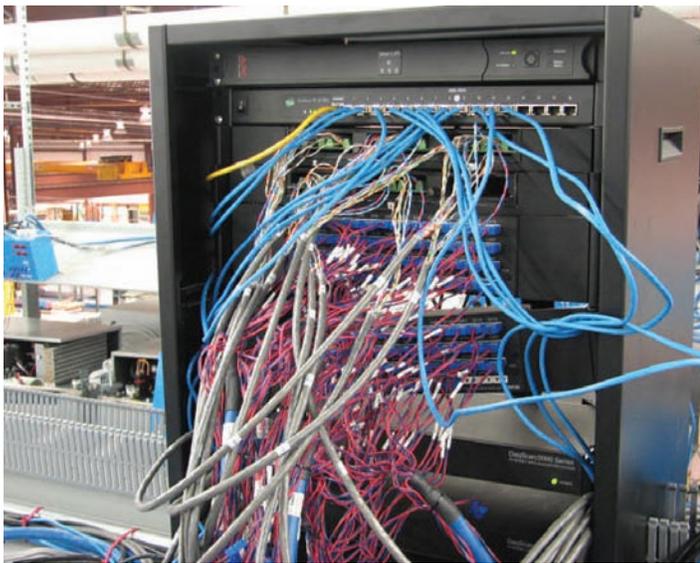
Sub-Zero recently built a new facility for testing refrigerators for the primary purpose of revealing extraordinary or sinister anomalies that might get past the day-to-day quality assurance procedures. Bart Cianciolo, Test Engineer, works in this new facility and focuses on recording and analyzing temperature profiles, among other tasks. He began making these measurements with a well-known brand data acquisition system. It comprised an SCXI-based main rack that housed individual plug-in thermocouple signal conditioning cards. The system maintained accuracy well enough, but it had a few drawbacks; the main deficiency was the inability to record several channels of temperature and timing data simultaneously and continuously. Cianciolo needed to accurately correlate data from several channels in real time to see the profile of internal temperature gradients and ultimately get a handle on the airflow. To solve his problem, Cianciolo was faced with the choice of purchasing additional units of the same brand, or look for a less expensive and easier-to-program data acquisition system.

The IOtech Solution

After a thorough search and an evaluation of sample units, Cianciolo selected LabVIEW® software and several IOtech DaqScan units with DBK90 thermocouple input modules and DBK80 differential voltage input cards, all housed in DBK10 expansion enclosures. One system uses 224 temperature channels to cover 16 test stations. Each station has 14 channels of type-T thermocouples located in the refrigerator, one thermocouple placed on the condenser, and one spare. Other instrumented channels record timing data as well as line supply voltage and current, which the software uses to compute input power. Says Cianciolo, “Input power measurements are required by the



The block-functional diagram shows Sub-Zero's Customer Assurance Lab. It contains a pair of 16-station rows. Each row has a pair of DaqScan/2005 units and a computer that controls the 16 stations. Units can be added to or removed from a single test at any time without disturbing the other tests. Each connection box has a serial jack to connect with the control board, 6 voltage jacks, and either 9 or 16 thermocouple mini-jacks (depending on the model to be tested). The thermocouples monitor the thermal gradients within the refrigerator under test.



Thermocouple lead wires and multiple-conductor cables exit the rear of the data acquisition system. Despite the spaghetti-looking arrangement, proper shielding and grounding procedures are exercised, and the system records accurate, noise-free data.

Department of Energy (DOE) to comply with their regulations for energy efficiency. Without the IOtech equipment, I would have had to purchase additional wattage transducers for several hundred dollars, but since I was already gathering voltage and current waveform data, I could calculate the wattage with LabVIEW for free." Timing data are also collected and used to monitor the number of minutes that the compressor runs and the number of seconds that water supplies the icemaker in order to calculate the power and the amount of water used.

A typical test may take six hours, while others may require from 18 to 72 hours. The facility also lets Cianciolo run tests to acquire new data that may not have been initially required on the production line, but could be of value in the future. "Currently, the primary test purpose is to ensure that the data verify the effectiveness of the algorithms that were programmed into the refrigerators' controller, particularly the adaptive defroster heater and the vegetable crisper," says Cianciolo. "The DaqScan data acquisition system records the number of minutes the defroster runs with an accuracy within 0.01 to 0.10 seconds, and makes certain that the crisper operates 2° F cooler than the rest of the refrigerator."

DaqScan/2000 Series

All Sub-Zero refrigerators contain onboard diagnostics to assist service personnel. The top of the line unit has a built-in read-out display, and the others have an I/O connector, which allows a service person to attach a hand-held device to access the diagnostic data. "The information available covers numerous potential problems, some of which can cause the refrigerator to fail, or just reduce efficiency, such as a compressor fan failure," says Cianciolo. Many failures can be simulated while the DaqScan units record the outcome and provide the data to program the controllers' algorithms.

"A definite advantage of the DaqScan system over the others is that I can add more channels through an Ethernet device as I need them, more easily and for less cost," says Cianciolo. "Also, not only is LabVIEW software easy to use, it lets me write my own analysis routines."

Conclusion

Cianciolo replaced an existing data acquisition system with several IOtech DaqScan units so he could record multiple channels of simultaneous and continuous data that the old system could not accomplish. In addition, the DaqScan units and LabVIEW analysis software are easier to program, much less expensive, and can be expanded easily. The IOtech DaqScan system approach saves Cianciolo money in both time and equipment costs.

The DaqScan/2000 Series of Ethernet-based system components provide analog, digital, and frequency I/O capability for Ethernet-based test systems. The DaqScan Series builds on IOtech's IEEE 488-based predecessors. Two models in the DaqScan Series are available, and include the full-featured DaqScan/2001 which provides 16 analog inputs, 4 analog outputs, 40 digital I/O, 4 frequency inputs, and 2 timer outputs.

Features

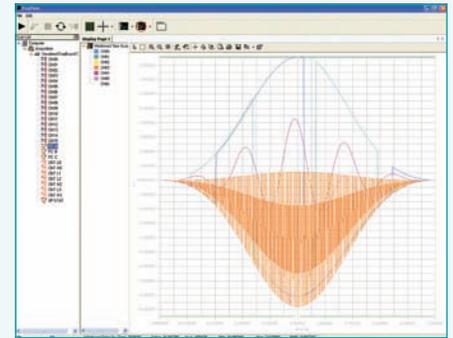
- Adds analog I/O, digital I/O, and frequency I/O to Ethernet-based test systems
- All I/O can be synchronous, enabling precise timing between various I/O functions
- 8 differential, or 16 single-ended inputs, expandable up to 256 voltage or 896 TC channels using signal conditioning and expansion options
- Up to 40 built-in TTL-level digital I/O, expandable up to 256 channels of isolated I/O using low-cost isolation modules
- Convenient 1U high 19" rack mount package minimizes rack space in test systems



The DaqScan/2000 Series provides compact data acquisition capability for Ethernet-based test systems

Software

- Includes DaqView *Out-of-the-Box* software application for effortless data logging and analysis
- Comprehensive drivers for DASyLab®, LabVIEW®, MATLAB®, Visual C++®, Visual C#®, Visual Basic®, and Visual Basic® .NET
- DaqCal software application for easy user calibration



DaqView Out-of-the-Box spreadsheet-style setup, data acquisition, and display software

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