Types of Data Acquisition Architectures

Application Note 1387

Introduction

There are a number of test equipment choices in the data acquisition market, ranging from PC plug-in cards to stand-alone data acquisition units. To select the optimal equipment for your application, it is important for you to evaluate your measurement performance needs, including resolution, accuracy, functionality and throughput speeds. With so many choices available today, you will want to choose a flexible solution that can grow in tandem with your application, so you can protect your investment in the future.

To help you choose a system that meets your needs, this article explains the different types of data acquisition system architectures and explores some of their advantages and disadvantages. It also describes two applications using different data acquisition solutions.

PC Plug-In Cards

PC plug-in cards are typically positioned as a low-cost data acquisition solution. These cards are designed to communicate with a PC over its internal bus and have direct access to the PC's internal memory. Manufacturers currently offer PC plug-in cards with a wide range of capabilities, including signal conditioning, stepper motor control, analog input/output, and digital input/output.

Typically, the channel count is low with PC plug-in cards due to the physical space available inside the PC. Data acquisition systems that use PC plug-in cards are normally less accurate than stand-alone instruments due to the electrical noise generated by the PC. In addition, PC plug-in cards are generally not very robust and cannot typically handle voltages greater than 10 volts.

With PC plug-in data acquisition, you will need signal conditioning components to make ac voltage and temperature measurements. If an application requires signal conditioning, be aware that this will greatly affect the overall cost of the data acquisition system. In fact, the cost of the signal conditioning components could potentially equal the cost of the PC plug-in card.

It is also important to note that integrating a PC plug-in card into a PC may not be a straightforward task. Since the card is installed directly into the PC, it is crucial to select interrupt lines or memory addresses that are not reserved for other devices in the PC.

Switch Boxes

For many design verification and product testing applications, switches boxes are included as a type of data acquisition system. A switch box is typically used to route test signals between the device-under-test and other instrumentation such as oscilloscopes, counters, power supplies, and digital multimeters. Switch boxes are available that can switch signal levels from a few microvolts to several hundred volts, and from dc to several gigahertz.

In addition to basic switching, some switch boxes add simple control capabilities. For example, some manufacturers have added digital input/output capabilities, analog output control, and isolated actuators for controlling high-power devices.

Stand-Alone Data Loggers

Data loggers are used primarily to monitor signals over a period of time in order to identify irregularities that may require attention. Most data loggers also provide a way to graph and analyze the data, which is collected through a PC connection. Although used primarily in the up-front design-verification stage of product development, data loggers also are used in-house for environmental-chamber monitoring, component inspection, benchtop testing, and process trouble-shooting. Since they typically are used in single-instrument applications, data loggers also make great portable field-testing instruments.

Application Example: Switching in an Automated Test System

Customer Profile: Electronics Manufacturer, Production Test Department

Application Requirements: An entire rack of test instruments has been assembled to create a "generic" tester to be adapted to test a number of the company's products. A switch system is required to route the signals between various test points to the racked instruments, under program control.

Solution: Since only switching is required for this application (no actual measurements), a switch box will provide the needed functionality. The customer can use a matrix switch for the most flexible signal routing and an actuator switch for custom switching topologies and test interface control. For high-frequency signal routing, such as routing signals to an oscilloscope or spectrum analyzer, the customer should use a radio frequency (RF) multiplexer configuration.

Some data loggers have the ability to perform mathematical operations on the measured data, compare the measured data against user-defined limits, and output signals for control operations. For example, when measuring temperature, signal conditioning or linearization must be applied before the measured data is useful. If the data logger has these

Application Example: Environmental Test

Customer Profile: Electronics Manufacturer, Test Department

Application Requirements: The customer is looking for a data acquisition system to monitor the internal temperature and humidity of an environmental chamber, as well as the temperatures of the instruments inside the chamber.

Solution: Using the Agilent 34970A data acquisition/ switch unit and a 20-channel multiplexer plug-in module, the customer can make all of the measurements required for this application. The customer can use thermocouples or RTDs connected to the plug-in module for the temperature measurements. To measure the humidity inside the chamber, the customer can use a humidity sensor that outputs a 4 to 20 mA signal.
The 34970A's Mx+B scaling feature can then be used to convert the current reading to relative humidity. The 20-channel multiplexer module also has two fused current input channels for measuring current directly (no shunts) if needed. Alarm limits can be set and a TTL alarm output bit can be wired to the control system to indicate if the temperature inside the chamber exceeds a maximum value. A PC is connected to the 34970A to monitor and record the necessary data.

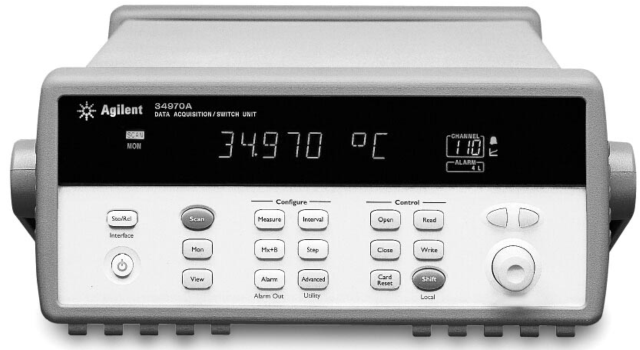

Figure 1. Agilent 34970A Data Acquisition/Switch Unit

built-in capabilities, a computer may not be at all necessary.

Most data loggers also have a communications interface (GPIB or RS-232) to allow measurement data to be down-loaded to a PC in real-time or after a specific test is completed. If the application requires real-time downloading of the measurement data, the PC must continuously monitor the data logger, resulting in the loss of the data logger's stand-alone benefits. If the data logger has its own internal data storage capability, or access to an external storage device such as a disk drive, then you can download the measurements for analysis at a later time.

Note that a low-cost data logger with fewer than 20 channels and a relatively low scan rate is adequate for many data logging applications. For greater flexibility and functionality, select a data logger that can operate as a stand-alone instrument, can be easily upgraded, and can be connected to a PC. A data logger should also have plug-in slots and the ability to measure different types of input signals without external signal conditioning.

Agilent Technologies' 34970A Data Acquisition/Switch Unit is an example of a stand-alone instrument that can be used for a multitude of data logging and monitoring applications. Its flexible, modular design makes it scalable from 20 channels to 120 channels. It is also possible to add an actuator, digital input/output and analog output channels for simple control applications. For automated testing applications, GPIB and RS-232 interfaces are included standard with the 34970A.

by David Heintz
Agilent Technologies,
Multi-Industry Business Unit

Biographical Information

David Heintz has been a technical writer at Agilent Technologies since 1984. He has written customer documentation for numerous test and measurement instruments, and his work has been recognized by the Society for Technical Communication.

Agilent Technologies' Test and Measurement Support, Services, and Assistance
Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

Our Promise
Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

Your Advantage
Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

By internet, phone, or fax, get assistance with all your test & measurement needs
Online assistance: www.agilent.com/find/assist

Phone or Fax
United States:
(tel) 1 800 452 4844

Canada:
(tel) 1 877 894 4414
(fax) (905) 282 6495

China:
(tel) 800 810 0189
(fax) 1 0800 650 0121

Europe:
(tel) (31 20) 547 2323
(fax) (31 20) 547 2390

Japan:
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Korea:
(tel) (82 2) 2004 5004
(fax) (82 2) 2004 5115

Latin America:
(tel) (305) 269 7500
(fax) (305) 269 7599

Taiwan:
(tel) 080 004 7866
(fax) (886 2) 2545 6723

Other Asia Pacific Countries:
(tel) (65) 375 8100
(fax) (65) 836 0252
(e-mail) tm_asia@agilent.com

Printed in the USA January 11, 2002
5988-5387EN

Agilent Technologies