MEASUREMENT TIPS
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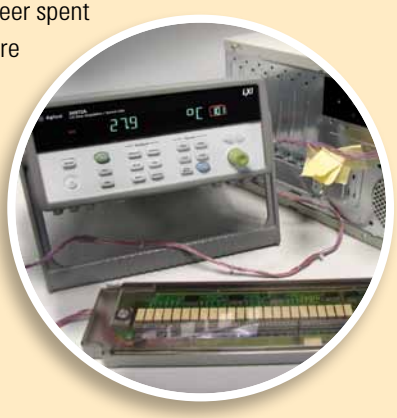
Simplify Data Acquisition with a Built-in LXI Web Server

There are many applications in which data acquisition plays a vital role. For example, R&D engineers use it during product characterization when they design new products. Production engineers use it for electronic functional test to ensure their production lines are running smoothly and producing quality products. Data acquisition systems typically have a variety of matrix, multiplexer (MUX), and relay switch modules, along with more general-purpose modules providing digital I/O, digital-to-analog conversion, and counters.

In data acquisition applications, you may want to simply open and close relays to route your signal to a measurement instrument. Or, you may want to scan many different measurement points or log data on just a few parameters making many measurements over a long period of time. In any of these cases, a data acquisition instrument with a fully featured built-in Web server can help you quickly begin acquiring data – you simply need a computer with a LAN port, a standard Web browser, and a LAN cable.

Snapshot: Make temperature measurements quickly and easily

While working on a new enclosure and internal layout design for a desktop computer, a design engineer working for a major computer company needed to evaluate the temperature profile of the new enclosure. The engineer used 24 strategically placed thermocouples located inside and outside the enclosure to measure temperature. He connected the thermocouples to the Agilent Technologies 34972A data acquisition/switch unit used as a data logger to capture thousands of temperature measurements. Once the thermocouples were placed and wired to his multiplexer (MUX) modules, using the instrument's built-in Web server, the engineer spent only minutes setting up a scan list to capture the desired temperature readings over a multiple-hour period. For each profile, he used only a portion of the built-in 50,000-reading memory. His analysis quickly led to an optimized layout and allowed him to select a less-expensive cooling fan.



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Many data acquisition instruments today have a LAN interface that you can use to set up the instrument via computer control and subsequently transfer measured data from it to your computer for analysis. The inevitable move to LAN as a method to control instrumentation has occurred recently because LAN is presently the primary vehicle for computer communication and data transfer, and it is virtually everywhere, making access easy.

An LXI (LAN eXtensions for Instrumentation) instrument has a LAN interface that goes beyond "just LAN" by adding the benefit of specified well-defined behavior for the instrument when it operates on a LAN. As part of the LXI specification, an LXI-compliant instrument must have a built-in Web server accessible from any standard Web browser. Premier instrument providers implement this built-in Web server in such a way as to simplify your interaction with the instrument, thereby making it easy for you to quickly set up and control the instrument and transfer data from it to your computer. You also can remotely operate or monitor the LXI instruments from virtually anywhere you have Web access, whether you are across the room, across the building, or across the world. And when you use the built-in Web server, you have all of this functionality at your fingertips without having to develop any software.

Control MUX relays

The simplest control you have when you use a well-designed Web server built into a data acquisition system is the ability to open and close relays in a MUX installed in the instrument. With the appropriate relay closed, your signal is routed to a digital multimeter (DMM), and you can make a measurement. **Figure 1** shows how Agilent has implemented the built-in Web server on the 34972A data acquisition/switch unit to simplify control. Just left-clicking with the mouse on the image of a relay will toggle the relay between opened and closed. Right-clicking on the relay allows you to configure the measurement made by the built-in DMM. The DMM has many functions from which you can choose. You can measure DC volts or amps, AC volts or amps, 2- or 4-wire ohms, frequency, period, and temperature using built-in thermocouple, thermistor, or RTD conversion algorithms. This wide variety of measurement capability allows you to use many types of available transducers that convert physical parameters such as temperature, flow, pressure, strain, position, weight, and speed into measureable electrical parameters.

Note that the screenshots shown here in the figures are not from special software on a computer. The screenshots and all functionality

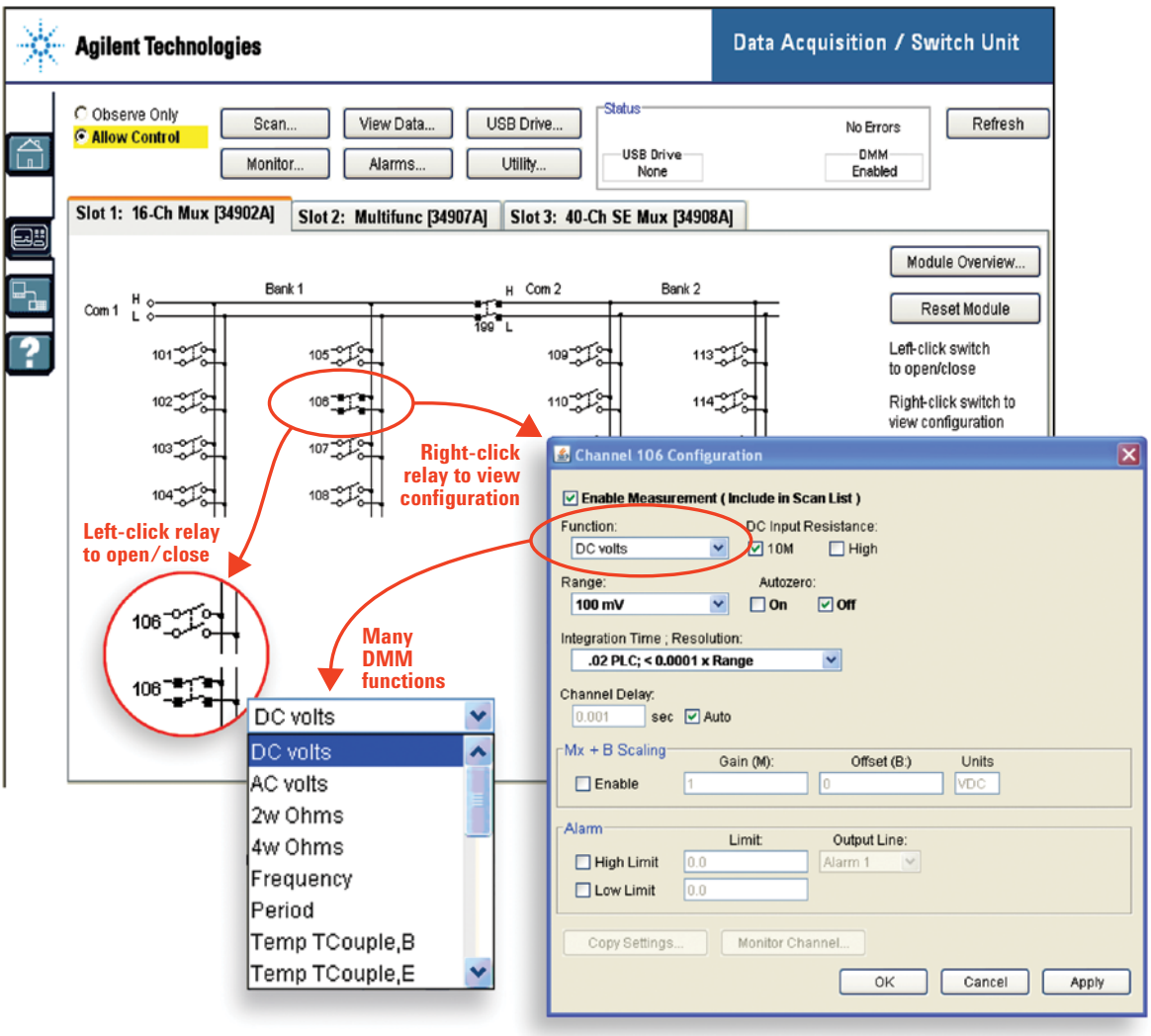

FIGURE 1: *Open and close relays or configure the built-in DMM measurement using the 34972A Web server*

discussed in this paper are accessible from a standard Web browser by using the browser to access the Web server built into the 34972A instrument. These screens are being produced by the instrument itself and the functionality resides in the instrument.

Scan multiple MUX channels

You can use a MUX module for sequentially scanning multiple parameters by closing one relay at a time and making a measurement each time. For example, let's say you have to monitor 12 thermocouples connected to your device, and you want to measure all 12 temperatures in less than 1 second and repeat these 12 measurements every 5 seconds for 2 hours (17,280 total measurements). You can easily set this up by using the Agilent 34972A built-in Web server with a 34902A 16-channel high-speed MUX module. The scan control screen from the Web server is shown in **Figure 2**. The Web server makes it simple for you to choose which channels you want to scan, what measurement you want to make on each channel, how long the measurement should take, and the length of time between measurement cycles.

MEASUREMENT TIP

Produce an alarm when limits are exceeded

When you make a measurement, you frequently want to compare the result to a set of limits to ensure the measurement falls between expected high and low values. If you want to be alerted when the result is outside these limits, the 34972A has a function to do this that is accessible from the built-in Web server. The settings for this feature are visible in Figure 2. Any scanned channel can be configured to generate an alarm when its measured value falls outside of the limits set for that particular channel (each channel's alarm values can be set independently). The alarm readings are stored in reading memory and are also logged in an alarm queue. When an alarm is activated, you can choose to generate a hardware trigger signal that you can connect to an external circuit or instrument to initiate another action.

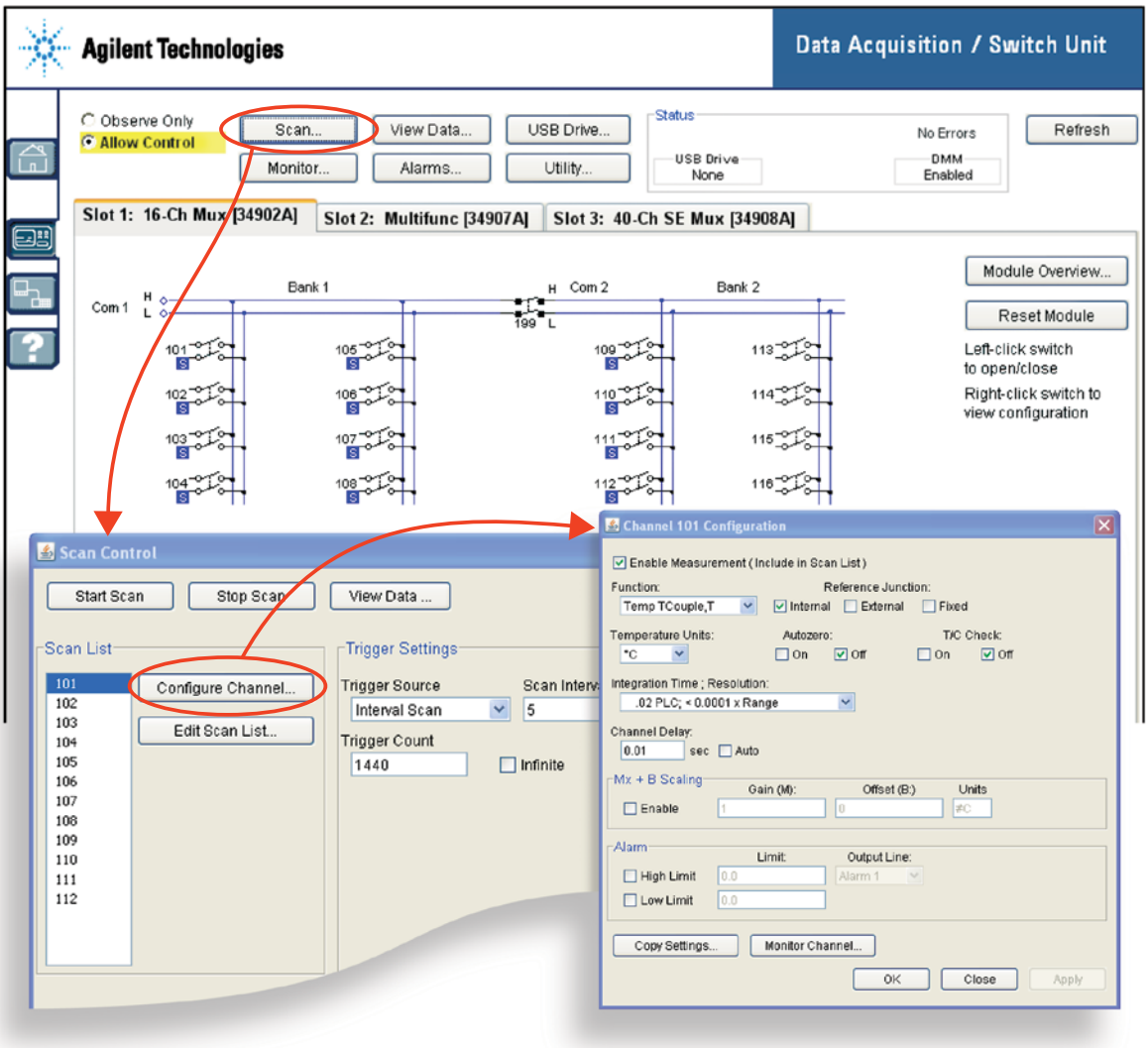

FIGURE 2: *Select channels to scan, measurements to make, time between scans, and alarm settings using the 34972A Web server*

Log data for seconds, minutes, hours, or days

Sometimes you will want to acquire large amounts of data on just a few measurement parameters, but over a long period of time. For example, you may be controlling an environmental test chamber and will have to log data on temperature, humidity, and atmospheric pressure surrounding the device being tested in the chamber over a multiple-day period. There are a variety of transducers available that are capable of converting the physical parameters into measureable electrical signals that can be logged using a Web server built into an instrument such as the 34972A. You can easily set up the 34972A to monitor temperature using, for example, a type-T thermocouple. Also, you can monitor humidity using a capacitive sensor that has signal conditioning circuitry converting the capacitance (varies with humidity) to a voltage and record atmospheric pressure with a pressure sensor that produces mV of voltage proportional to the pressure. You can capture data for days, store it in the 34972A, and finally transfer it to your computer. If the built-in 50,000 non-volatile reading memory is not enough, you can connect a USB flash drive to the built-in USB port and log data directly to the flash drive.

MEASUREMENT TIP

Capture SCPI commands to simplify programming

While a well-designed built-in Web server provides you with access to the extensive features of your data acquisition instrument, there still may be times when you want to write software to control this instrument as well as other instruments in your system. The 34972A built-in Web server has yet another feature that will greatly simplify this task: command monitor. You can use the Web server to sequentially perform the tasks you want your program to perform. While you are doing this, the SCPI commands associated with each of the actions you choose are being captured. Later, you can use the Web server to display all of the captured SCPI commands that were needed to complete the actions you selected. You can then simply copy and paste these SCPI commands into your program to accomplish the same tasks. You don't ever have to consult an operating manual or command reference to get the appropriate SCPI commands and syntax; the Web server shows you exactly what they are. Refer to **Figure 3** for an example.

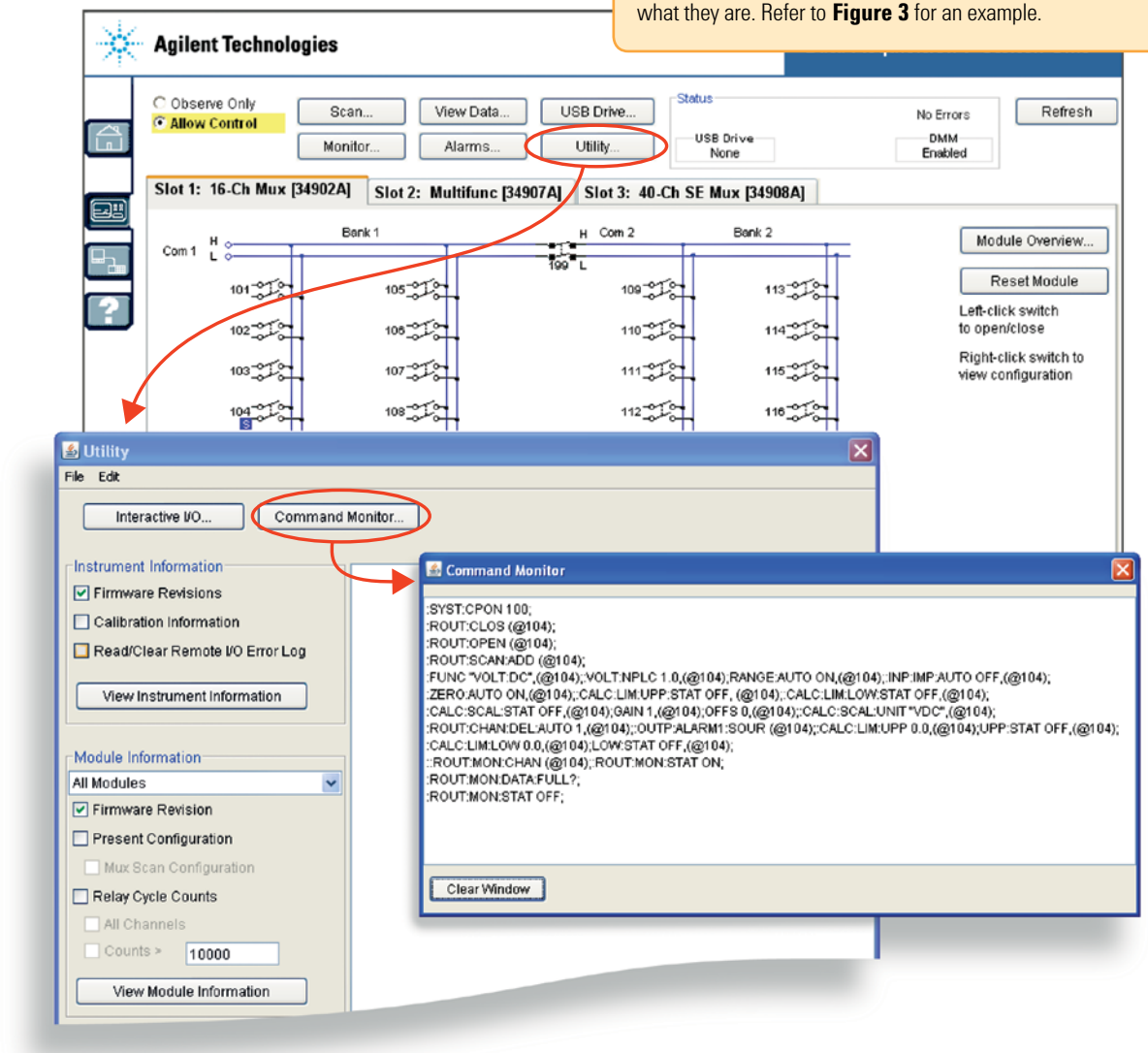

FIGURE 3: *View, copy, and paste SCPI commands associated with each Web server action to simplify writing a program*

Transfer data to your computer

Of course, once your data acquisition system has acquired the desired data, you will want to transfer the data to your computer for analysis and store it for documentation purposes. A well-designed Web server will make this task simple. For example, using the 34972A, you can use the Web server to view the stored data and then either copy and paste it into a spreadsheet or simply store it directly in CSV (comma-separated values) format. An example is shown in **Figure 4**. Since the built-in 50,000 reading memory is non-volatile, you can use the instrument in one location to collect data, unplug it, move it to a new location closer to another PC, plug it in again and access your stored data. Or, you can use the built-in USB port to store data directly on a USB flash drive and then move the data to a PC by moving the flash drive.

Conclusion

You can control available data acquisition instruments with a variety of methods. Only some of these instruments have LAN control. Of the ones with LAN control, only some of these conform to the LXI standard. All of the LXI-compliant instruments have a built-in Web server, but only some of these provide an extensive easy-to-use interface to simplify your setup, control, and data transfer from the instrument. The Agilent 34972A data acquisition/switch unit is such an instrument. This LXI class C compliant product, with its fully featured and easy-to-use built-in Web server, will help you to quickly and easily acquire the data you need without having to develop any software.

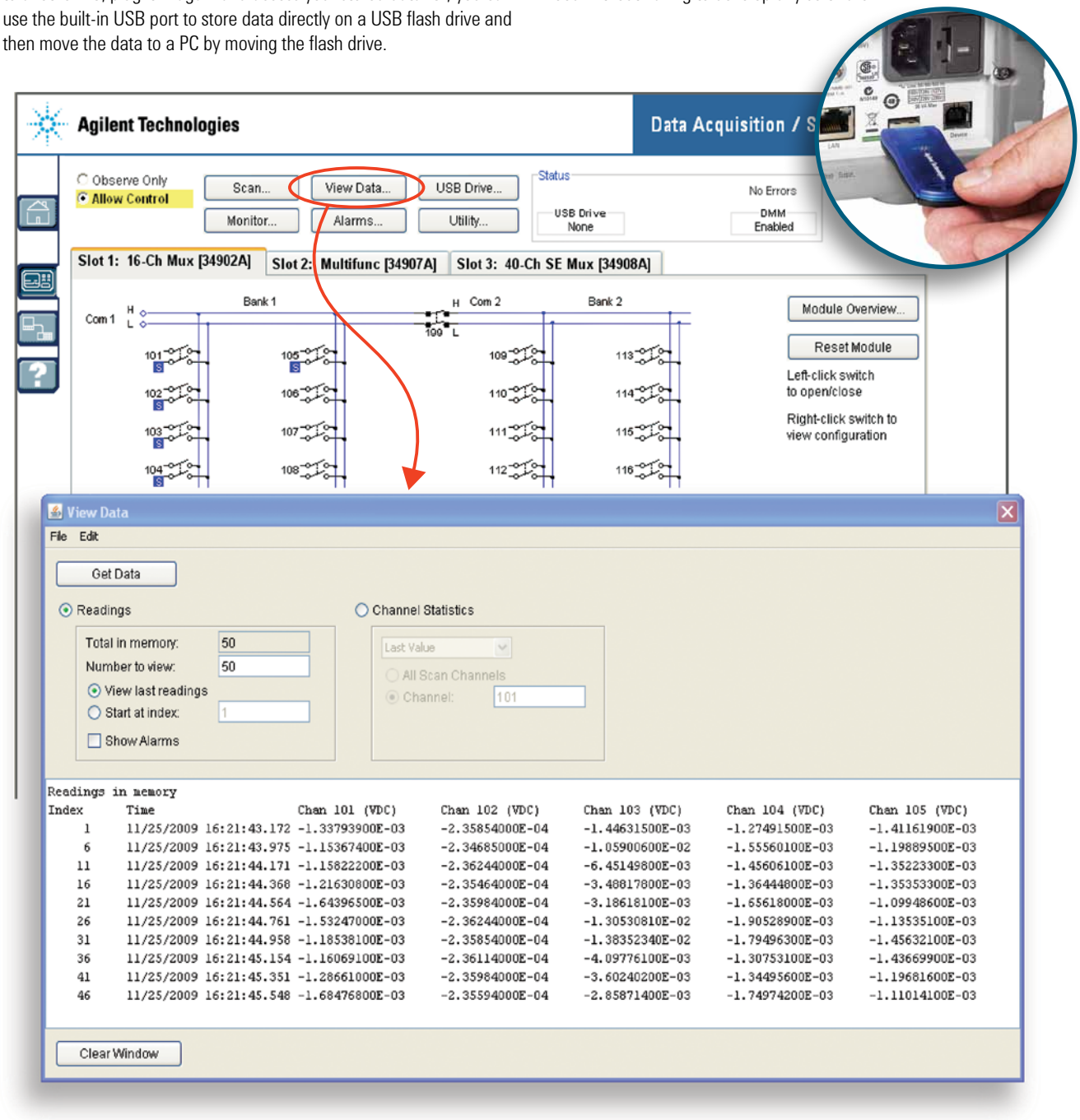

FIGURE 4: *View, copy, and paste measured data or store it directly in CSV format*

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