KEITHLEY A GREATER MEASURE OF CONFIDENCE

The Test Bench Today

What designers and test engineers need from a test-bench instrument

Dale Cigoy, Keithley Instruments, Inc.

PHOTOS of a typical test bench usually show rows of boxes stacked several feet high with a maze of wires, cords, and test leads curling around the benchtop. A typical test-bench contains a number of instruments necessary to engineers designing, developing, and testing new product designs. As a result, to get all the necessary functionality, several different types of instruments may be needed, including voltmeters, current meters, ohmmeters, voltage and/or current sources, and frequency generators.

However, newer generations of instruments combine many, if not most, of the functions found in stand-alone instruments into one box. This article looks at the changing world of benchtop instrumentation.

New instruments

The biggest and most notable change in the design and manufacture of newer generations of benchtop instruments is increased integration. Traditionally, digital multimeters (DMMs) were multi-function devices that measured voltage, current, and resistance. Now, they can measure more parameters. Most DMMs can handle frequency and temperature, for instance, including parameters for specific diode and transistor tests.

Later generations of DMMs included scanner cards that let them switch from point to point in a circuit or to several devices under test (DUTs). Most DMMs now also include a storage buffer with the capability to store up to 450,000 readings. A scan and storage capability is a key option for test engineers. They can now use the full functionality of the DMM and the multipoint testing capability of the built-in scanner and store collected data, or it can be retrieved for a more real time update of data. The latest DMMs can be configured as full data acquisition systems to switch, read, and store data.

Another integrated feature is some type of source unit. In the past, test engineers had to link power supplies and/or signal generators together with a measuring instrument, such as a DMM. Now, there are single units available that both provide source signals and can measure and record results. Some of these instruments have two or more channels for even greater density and flexibility.

Along with increased integration comes the demand for more specialized instruments. For instance, some oscilloscopes feature specialized interfaces for testing newly emerging serial buses. On the other hand, some cutting-edge applications demand entirely new tools and features. The field of nanotechnology research and development demands instruments that can measure extremely small quantities in the range of nanovolts and below, accurately and repeatedly. Nanotechnology research also demands highly accurate and stable sources of arbitrary waveforms. Many instruments can now offer the precise and stable waveforms necessary for nanotechnology applications.

New interfaces

The growth of the Internet and the World Wide Web has also impacted test instruments. Web-enabled instruments are fairly common today. Most of these instruments contain an Ethernet connection that lets the instrument talk to a PC or connect to other

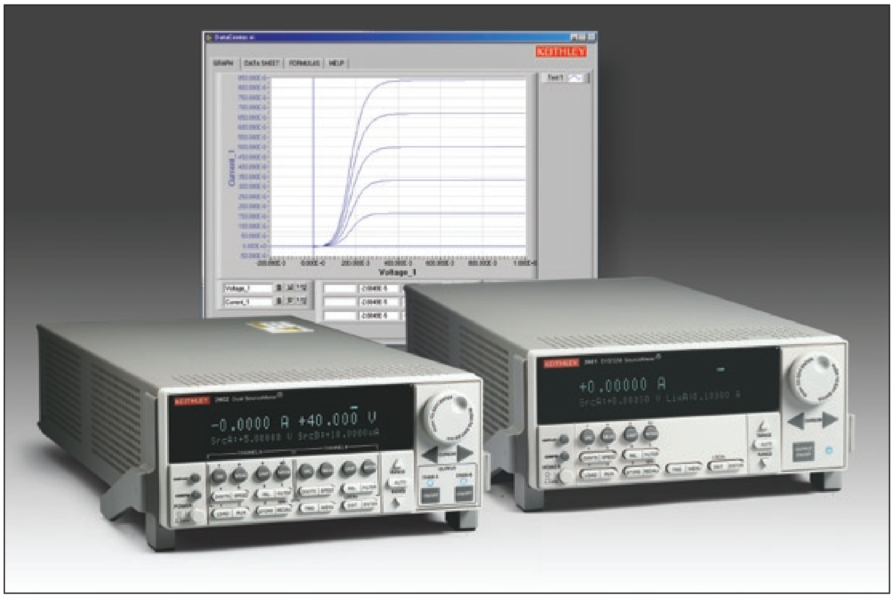

Figure 1. Series 2600 System SourceMeter(R) instruments offer electronic component and semiconductor device manufacturers a scalable, high throughput, highly cost-effective solution for precision DC, pulse, and low frequency AC sourcemeasure testing.

instruments to form a complete data-acquisition system. Most Web-enabled instruments contain a built-in Web page with a specific instrument URL. The Web page allows users to read and set network parameters, such as IP address, MAC address, and calibration dates, and to send commands to and query data from a unit.

Another advance in interfaces comes later this year with the LAN extensions for instrumentation (LXI) through the work of the LXI Consortium. Basically, LXI is an Ethernet-based communications standard for small, modular instruments with or without front panel control or on board display. LXI instruments are designed to operate with Ethernet as the system communications backbone. The Consortium's goal is to define a common instrumentation standard to offer flexible packaging and tight integration advantages of proprietary modular instruments without the physical constraints and added cost of card-cage architectures. The plan is for the LXI standard to evolve and take advantage of current and future LAN developments that go beyond the basic connection capabilities of legacy test and measurement systems including web-style interfacing, local and wide area networking, and precision timing synchronization capabilities.

As for other communication interfaces, IEEE-488 or GPIB is still a dominant network, partly because it has been around for nearly three decades and, as such, is built into many, if not most, instruments on the market. It was one of the first networks specifically developed to connect together and control programmable instruments. Data speeds for this parallel interface are published as 1 Mb/s with a maximum data rate of up to 8Mb/sec in burst mode.

Another interface gaining popularity in test and measurement applications is USB. It is already widely used in computer peripherals such as printers, mice, and digital cameras as a quick and easy way to connect to a PC. Virtually all desktop and laptop PCs on the market come equipped with USB ports. These ports have full software support under common operating systems such as Windows 2000 and XP.

For test and measurement applications, USB offers some significant advantages. USB provides users with a simple means of developing test and measurement applications by offering advantages over PC plug-in boards. These include plug-and-play capability, better noise immunity, cost savings, and portability, among others.

USB offers full- and high-speed data transfer rates. Computers configured with USB 1.1 ports can transfer data at up to 12 Mbits/second. For high-performance applications, high-speed USB 2.0 ports boast speeds of up to 480 Mbits/second.

Software and programming

More and more instruments now come equipped with software so that users can develop application-specific test routines and execute them from either the instrument itself or from a PC. Only a few years ago, software to control rack and stack test systems was used mostly in production applications. Connecting a computer to an instrument to log data provides records of test data, which ISO and other standards are making necessary.

Some examples of software that ships with test instrumentation include Test Script Builder (TSB) and LabTracer™ software for Keithley's Series 2600 SourceMeter® instruments. LabTracer is a Windows-based application software that controls the instruments and allows simultaneous use of up to eight source-meter instruments for collecting, time stamping, and graphing voltage and/or current readings.

Other examples include Benchlink software, which ships with 34XXX series instruments from Agilent. Benchlink controls the instrument, allows for scanning of multiple channels, and logs and graphs data. Also, Jitter Analysis Software from Tektronix is used with its oscilloscopes to capture and analyze data and make accurate jitter measurements.

Along with increased use of software and programmability options, there are a host of standard communication interfaces available to ease transfer and collection of recorded data. One of these is VISA. This is a software layer that standardizes communication between test instruments and different buses such as GPIB, serial links, Ethernet, etc. It allows programmers and users to choose different buses for communication within the same program.

Another is IVI. This is a level of standardization for instruments of the same type, i.e., DMMs, sources, etc. It is another layer on top of VISA. For instance, this lets a DMM from Keithley respond to the same calls as a DMM from Agilent.

Adapting to a rapidly changing world of test

Today, test bench instruments need to be easily and quickly customizable for a number of different measurement tasks. Flexibility is a must, especially with shorter engineering cycles and tighter instrumentation budgets.

A basic instrument can be tailored to any number of specific measurement tasks with the help of embedded scripting. Basically this allows an instrument to execute a specified number of source and measure functions repeatedly. For instance, an individual instrument can be set up as a thermal impedance meter, LIV test system, or a small scale functional tester.

Conclusion

Today's testbench instruments offer engineers a lot more power, choice, and flexibility than ever. As test demands become increasingly complex, instrumentation will continue to keep pace, meeting the needs of tomorrow's test challenges.

Keithley Instruments, Inc. 28775 Aurora Road • Cleveland, Ohio 44139 • 440-248-0400 • Fax: 440-248-6168
1-888-KEITHLEY (534-8453) • www.keithley.com

No. 2649
1005