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Embedded Script Processors and Embedded Software Rank Among the Most Significant T&M Instrument Design Trends of the Last Decade

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Over the last decade, there has been increasing consumer demand for greater functionality in almost all the electronic products that consumers buy — from smartphones to tablet computers. This has made testing the components that go into these products more challenging for these manufacturers' suppliers and on their own production lines. Therefore, because these devices are changing more frequently than ever, they require new testing routines to characterize and/or confirm their performance. That often means that the test instruments used last year for characterizing the current-voltage (IV) characteristics of a device may lack the capabilities necessary for this year's test challenges. In response to this constant change, several trends have emerged as instrumentation vendors have worked to create new instruments that can adapt quickly to take on new test routines.

The first trend is the growing use of embedded microcontrollers/script processors, which allows the control of an instrument's operation locally, rather than running a control program on an external PC and communicating commands to the instrument via GPIB, USB, LXI or other interface. Another complementary trend is the use of embedded test software to speed and simplify the process of creating new test routines.

Test Advantages of Instruments with Embedded Microcontrollers

A test script is a collection of instrument control commands and/or program statements. These program statements control script execution and provide facilities such as variables, functions, branching, and loop control. Because scripts are programs, they are written using a programming language, often Lua, which allows users to create powerful, high-speed, multi-channel tests with significantly reduced development times. Test scripts can be downloaded into either volatile or nonvolatile memory of an instrument with an embedded script processor to allow the instrument to control itself, independent of the system host controller. This "local control" approach eliminates communications bus traffic delays that would otherwise slow the process of transferring commands from an external controller to the instrument. Controlling an instrument using an embedded script processor can free up the system controller to interface with other instruments in the rack more frequently, thereby increasing the overall system throughput.

For example, the TSP® (Test Script Processor) technology provided in Keithley's Series 2600B System SourceMeter® Source Measurement Unit (SMU) instruments and other test platforms goes far beyond traditional test command sequencers; it fully embeds complete test programs within the instrument itself and then executes them. This virtually eliminates all the time-consuming bus communications to and from the PC controller, dramatically improving overall test times. ***Figure 1*** illustrates the functionality of an instrument with an embedded microcontroller.

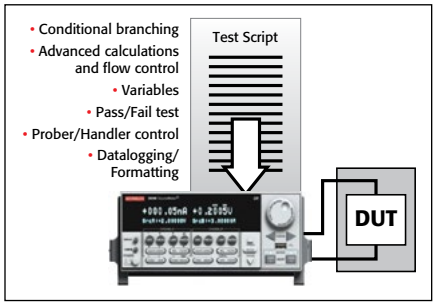

Figure 1: TSP technology executes complete test programs from non-volatile memory.

Some instruments with an embedded script processor can even control multiple instruments from a single master unit if they are connected via a high-speed trigger synchronization/inter-unit communication bus. TSP-Link® is a channel expansion bus that enables multiple Series 2600B SMUs to be inter-connected so they function as a single, tightly synchronized, multi-channel system. TSP-Link technology works together with TSP technology to enable high-speed, SMU-per-pin parallel testing. Unlike other high-speed solutions, these instruments support parallel testing without requiring

test system builders to take on the cost or burden of a mainframe. A test script runs on the embedded script processor on the master instrument and controls any slave unit(s): one script program controls both the master and any connected slaves. This type of master/slave operation is much faster than sending commands and trigger signals back and forth between the controller and the individual instruments in the test configuration over a traditional communications bus and helps reduce programming complexity. ***Figure 2*** illustrates how the combination of embedded script processors and a high speed intercommunication bus can speed and simplify parallel testing. Systems based on TSP-Link architecture also offer test engineers superior flexibility, allowing for quick and easy system re-configuration as test requirements change as new versions of devices are created.

Test Advantages of Instruments with Embedded Software

Embedding test software in the instrument itself allows users to start making measurements far sooner than they could if they had to write and debug a test program to run on a PC or even a test script. For example, Keithley's embedded Java-based test software for Series 2600B instruments allows users to begin characterizing new devices almost immediately, with no need for software installation or programming, enabling true "plug-and-play" I-V characterization through any browser, on any computer, from anywhere in the world. Test engineers can connect these instruments to the internet via a LAN cable, open a browser, type in the instrument's I.P. address, and begin testing. The resulting data can be downloaded to a spreadsheet program such as Excel for further analysis and formatting, or for inclusion in other documents or presentations. This unique capability boosts productivity across a wide range of applications, such as R&D, education, QA/FA and more.

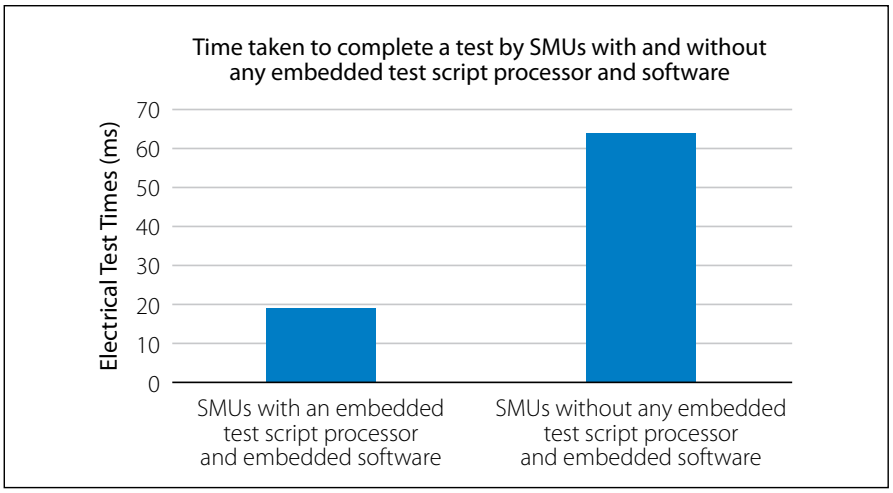

Figure 3: Results from a typical LED test sequence demonstrate the impact of an embedded microcontroller and embedded software on SMU throughput.

Impact of Embedded Microcontrollers and Software on Test Throughput

Instruments that combine the use of an embedded microcontroller with embedded software afford test engineers significantly greater throughput advantages that either capability can provide separately. For example, taking strictly electrical test times into account, Keithley's Series 2600B SMUs are 200 percent faster than competitive SMUs (***Figure 3***).

Conclusion

The combination of embedded script processors and embedded software in a single test instrument offers test system builders and users important advantages, particularly higher throughput and easier system integration, that can help them keep up with fast-changing device test challenges. ■

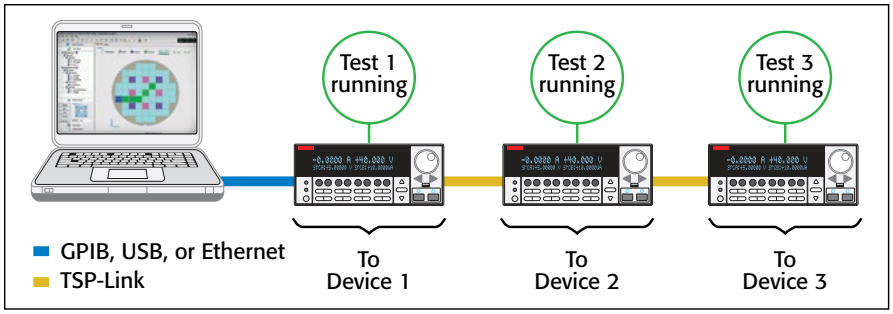

Figure 2: SMU-per-pin parallel testing using TSP and TSP-Link improves test throughput and lowers the cost of test.

About the Author

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