Board Test on the Spectrum 8800-Series at Siemens

Implementng boundary-scan and built-in-self-test

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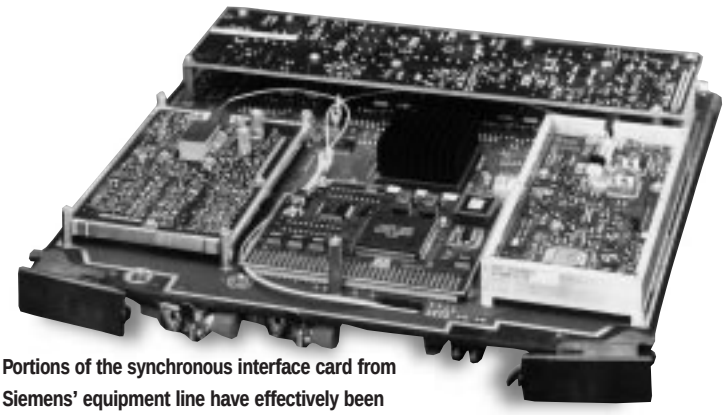
The Siemens Public Communications Networks in Berlin-Siemensstadt, Germany, recently set up three new production lines for a new generation of telecommunications circuit boards. The boards produced were relatively large, ranging from approximately 24x27cm to 56x30cm, with a mixture of analog and digital components. These new board design layouts used state-of-the-art components, which in turn caused a redefinition of the production test strategy.

"When setting up these new production lines," says Bernd Schumacher, test engineer at Siemens, "we looked beyond the current in-circuit test requirement and defined a strategy for managing process test with limited board access. With this in mind, boundary scan and built-in-self-test (BIST) were high on the shopping list of requirements for our new test system."

In-line process manufacturing test systems were evaluated, and Teradyne's Spectrum™ 8800-Series was specified. The system is an open-architecture VXI-based manufacturing test platform that performs manufacturing process test to find structural or assembly defects. Functional test capabilities, once performed on custom rack-and-stack configurations or "hot mock-ups," can also be performed on the Spectrum 8800 as well. For this project, however, Siemens utilized primarily the in-circuit capabilities of the Spectrum.

Key to Siemens' purchase decision was the Spectrum 8800's non-multiplexed architecture and in turn the fixturing programming time and cost savings. Explains Schumacher, "With the Spectrum 8800, we could start fixturing as soon as the board layout was in a concrete form, compressing the time-to-market cycle by almost a week. The fixture is also much easier to design — I have turned around new layouts in a day and a half. Our fixturing costs are now approximately 20% lower. Whereas, with a multiplexed fixture, you need to wait until all the digital libraries are available before fixture design starts in earnest."

"This is ideal for boundary-scan tests as in most cases it does not require reloading the test vectors. Also, because of the non-multiplexed architecture, we have the flexibilty to add boundary-scan tests later. Tools like VICTORY's VIT (Virtual Interconnect Test) or VCCT (Virtual Component Cluster Test) and BSID (Boundary Scan Intelligent Diagnostics), which combine real tester channels with boundary-scan patterns, allow us to test boards with limited access without losing fault coverage," says Schumacher.



Portions of the synchronous interface card from Siemens' equipment line have effectively been tested on Teradyne's Spectrum 8800.

Advanced test techniques

As new boards are equipped with more complex devices like FPGAs and EPLDs, vectorless test and boundary-scan techniques were easier to implement with the non-multiplexed architecture of the Spectrum 8800.

The Spectrum 8800 can perform boundary-scan tests, which require additional test points, without directly accessing an IC pin. The Spectrum 8800 hardware design uses a central memory for storing test patterns.

For vectorless test applications, Siemens uses Teradyne's DeltaScan™ vectorless test tool. The DeltaScan technique performs simple DC current measurements on unique pin pairs of the device under test, using the ESD protection (or parasitic) diodes present on virtually every digital device pin and most mixed-signal device pins. DeltaScan requires no additional fixture hardware such as overclamps or sensors; it is implemented on fixture wires for standard in-circuit test with the addition of two (typically) reference wires.

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"The final argument that swung us towards the Spectrum was the ability of DeltaScan to detect opens without a sensor. In common with most surface mount processes, we find that opens dominate our fault spectrum," says Schumacher.

Test process

Today's test operation software makes debugging test programs easier than ever before. Unlike some older test systems, the Spectrum 8800 does not require tests to be compiled before execution. This feature makes debugging a program particularly straightforward. There is no need to amend ASCII files by hand. The engineer has full access to the high-level instructions at all times. A test can be started at any point, simply by highlighting the appropriate graphical symbol and clicking start.

"Having provided such easy-to-use system software, it seems to me that there is clearly potential for Teradyne to develop this software further. Debugging could be made even easier," comments Schumacher.

In programming and debugging analog boards, Schumacher found the Spectrum 8800's Validate function particularly helpful. For example, Validate, which tries to find a working configuration for a given device, ensures that the correct measurement range is selected by working against a known good board.

"Care is needed," explains Schumacher, "because widening the tolerance band on a device can sometimes 'trip' a measurement into a new range."

Validate also takes care of guarding requirements. With typically 300-400 analog measurements to be taken per board, this feature reduced Siemens' test programming time by as much as 2-3 days off each program design cycle.

As mentioned, the functional test capabilities of the Spectrum 8800 were not fully utilized for the majority of these new test programs.

Schumacher explains, "Functional test is becoming more and more complex and is completely impossible to implement in the time constraints of a real-time, high-volume production environment. For most of our boards it is necessary to perform a functional test. We have tried to implement functional testing on in-circuit testers in the past and found it difficult to program and unstable in practice. Because the Spectrum 8800 offers the possibility to integrate VXI instruments to the tester itself, we hope to make implementation of functional test easier. As a result, our test strategy evolved into performing digital functional test only if it was easy to implement. Otherwise, we use vectorless test to uncover process faults and assume the device is good."

Additionally, Siemens' quality management procedures have increasingly put the onus on device suppliers to deliver "known good products," making functional test less critical to Siemens' product reliability.

All this being said, Siemens does perform select functional tests on boards that require it, such as high-frequency boards. They plan to use the Spectrum's VXI interface to implement these tests while the board is inline. "This eliminates a handling stage and removes some duplication of process," explains Schumacher.

Looking forward

"This is a new tester both to Teradyne and to Siemens," says Schumacher, "and we have yet to fully exercise its capabilities. We are confident, however, that the Spectrum 8800 will serve Siemens Public Communications Networks well into the future." ■

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Teradyne, Inc.
321 Harrison Avenue
Boston, MA 02118
617-482-2700

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