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Making the most of boundary scan

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Since its adoption as an IEEE standard in 1990, boundary scan has offered engineers an important tool for testing complex circuit boards. Harry Bleeker of JTAG Technologies, who initiated the work on the original concepts in 1985, discusses the potential of this technology in meeting quality-assurance challenges.

Q: What role is boundary-scan technology playing in controlling the costs of circuit board test?

A: Boundary scan has a beneficial effect on all aspects of circuit board testing. Test preparation time is reduced. Since scan-based tests are highly automated, they can be prepared quickly and evaluated for test effectiveness prior to board layout. You also reduce fixture costs, since boundary scan achieves test access without a large number of physical test points. So, you simplify board layout and minimize or eliminate fixtures. The technology also results in better quality and reproducibility of testing, which again yields lower test times. In addition, boundary scan leads to more precise diagnostics—another time saver. And in terms of capital investment, the cost of boundary-scan equipment can be an order of magnitude less than conventional in-circuit test (ICT).

Q: Why were IC manufacturers initially reluctant to make their devices compatible with boundary-scan specifications?

A: Initially, there was a perception that the cost of the added silicon, particularly with smaller ICs, would not be justified. For all intents and purposes, vendors have overcome their hesitation to include scan logic in ICs because they realize that their customers need devices supporting board and system-level testing. Most of the more complex digital devices today comply with the IEEE 1149.1 specification. Considering the increasing complexity of electronic assemblies, it's been clear from the beginning that boundary scan was the logical next step.

Q: What industries are leading the way in use of boundary-scan technology?

A: Any industry that is moving to higher-density circuit assemblies, such as ball-grid

arrays, is now solidly in the camp of satisfied users. We have many users of boundary scan in avionics, aerospace, defense, telecom, medical electronics, and so on. The user population also includes many contract manufacturers as well as OEMs.

Q: At what stage of product development are you seeing the most innovative use of boundary scan?

A: At all stages, the benefits are significant. Remember that with the older methods, test engineering for the same design was done three times: first for prototype testing, then for production testing, and finally for field repair. Now, engineers can use boundary-scan as a unified test method throughout the whole product life cycle. The system designer will now have a mighty method to debug and program flash and PLD prototypes.

Q: What about manufacturers who need to have their boundary-scan-compatible devices upgraded or reconfigured in the field?

A: Manufacturers want to have flexibility to customize or upgrade their products in their factory or in the field to meet local requirements or customer needs. This can be done in software, but also by programming the hardware. Boundary scan offers this flexibility by supporting in-system programming of logic devices and flash memories. All that's needed is to prepare the design for scan access.

Q: How do you see boundary-scan technology changing?

A: Soon, we will see a new scan-based test method for high-speed communication channels (1149.6). Also, we anticipate a gradual migration to boundary scan for certain analog tests, which will have a major impact on minimizing the cost of test in the future.

In 1993, Drs. Bleeker co-founded JTAG Technologies, a company specializing in boundary-scan products. He received his degree in physics from the University of Amsterdam in 1968, and for many years was responsible for testing and factory automation at various divisions of Philips Electronics. From 1985 until 1990, Bleeker was the chairman of the Joint Test Action Group (JTAG), which developed the boundary-scan testing standards that resulted in IEEE Standard 1149.1.

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