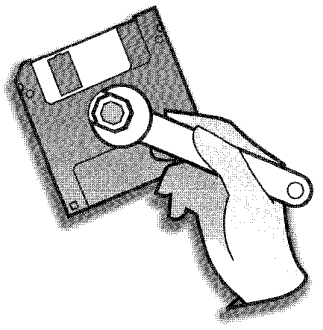

# Built-In Self-Test: Assuring System Integrity

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**Today's complex electronic products are harder to test using traditional external methods. BIST can frequently be used without significantly increasing a product's size, cost, and production time.**

Microelectronics products and their components are tested many times during their life cycles. Integrated circuits begin their life on a wafer and are tested even before the wafer is diced into chips. The chips subsequently are packaged and used in higher level electronics. Each manufacturing step can introduce new defects that require new testing.

Each stage of the assembly process poses a different challenge for accessing, testing, and verifying chips and other product elements.

Accessing deeply embedded complex functions in higher level products to perform system-level tests can be very difficult. System-level integration turns each chip into a hierarchical assembly containing an ever-growing number of embedded core functions, such as memories, processors, and multimedia.

Determining the effects of the manufacturing process and environmental conditions on a product's ac and dc characteristics, debugging, and verification present additional problems. After all, it is not easy to probe submicron signal lines on buried wiring layers in the middle of a chip with a logic analyzer or an oscilloscope.

Also, limitations on bandwidth and on the performance of both the test equipment and the interface between the equipment and the product being tested make access difficult. Low-cost interfaces, like the ones used for system-level test access, tend to be serial and thus too slow for large amounts of test data. On the other hand, it is very difficult for automatic test equipment to access chips on a wafer through complicated high-performance interfaces.

Moreover, testing for calibration, stability, and noise is becoming more difficult to tackle as chip technologies begin to operate in the gigahertz operating frequency range. It is difficult to maintain clean waveforms across the interface between the tester and chips operating at such high frequencies.

Finally, regenerating and managing huge amounts of chip test data for each new assembly level, hardware revision, and system configuration quickly become a major burden on engineering resources and product development time.

In many cases, built-in self-test (BIST) alleviates these problems. And the addition of BIST features to electronics hardware frequently does not significantly increase a product's size, cost, and production time, as was the case in the past. This makes BIST practical in many cases.

## ADVANTAGES OF BIST

In the 1980s, a number of system houses developed BIST solutions for distributing and embedding critical test functions into product components, in part because of data volume and access issues. The system houses did this because BIST avoids the complexities of external testing and access mechanisms by moving critical test and measurement functions inside products.

Embedded test and measurement utilities match the chip's technology capabilities and open up new possibilities for high-speed access to internal functions. In addition, BIST reduces the need for complex and expen-

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