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TEST HANDLING OPTIONS

Towards a more efficient test paradigm

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There is a growing consensus that test and burn-in (TBI) requires a new approach. SEMI's CAST consortium is just the latest attempt to bring focus to an aspect of this looming problem.

TBI consumes an increasing portion of the manufacturing cost of semiconductor devices. The problem continues to worsen as test time grows with increasing device complexity.

And "no value-added" burn-in refuses to go away, as high-margin products push technology to limits that require screening for latent defects. Conversely, devices that do not need burn-in are typically low-value commodities.

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The response of the test community has been to move toward more parallel testing and intelligent burn-in schemes—improvements all within a standard, time-proven backend paradigm.

Parallel testing of DRAMs has been extended to full 300mm wafer test. Parallelism in test of logic is moving from 8-up toward 16-up testing. And test during burn-in (TDBI) extracts more value from necessary burn-in of high-complexity parts. While these improvements help, more is needed in the way of test efficiency.

MORE PARALLELISM NEEDED

The way forward appears to involve more parallelism and standardized automation. Automatic handling of large arrays of parts is a logical approach to facilitate the cost reduction of parallel testing and burn-in.

Strip testing or TnT permits automated handling of large arrays in a standard format.

Strip testing or Test-in-Tray (TnT) permit automated handling of large arrays in a standard format.

Pioneered a decade ago by Jack Kessler at Amkor, strip testing is still used in specialized cases where devices are fabricated in strip arrays.

TnT, a close cousin of strip test, is more broadly applicable across a large variety of package types from MEMS sensors to WLP and TSV devices.

As a platform for broad standardization, TnT promises to be a powerful facilitator for the massively parallel testing of large arrays of devices.

Surmounting a major obstacle to the adoption of strip test, TnT does not require a return from the test floor to package processing for the final steps of lead forming and singulation.

TnT'S BENEFITS

TnT users enjoy the same benefits promised by strip testing while potentially enabling adoption across major segments of the industry.

Parallel testing of large TnT arrays is independent of the method used for fabrication of the device. The size of the array is limited only by the number of test channels.

Similar to strip testing, TnT allows automatic handling of arrays throughout the testflow from burn-in to final test. Because each part remains in its array position in bar-coded trays, tracking of individual devices is relatively simple throughout the process.

And automation uses simple, standard transports for jam-free operation, with manual intervention at a minimum. All contribute to a dramatically increased throughput for the test operation.

THREE-FOLD THROUGHPUT INCREASE

Charles Schleich, manufacturing director at Atmel, San Jose, claims that "strip test provides a three-fold increase in throughput for a given test cell."

Schleich, an early advocate of TnT, first introduced the author to the advantages of testing devices in trays. The increased efficiences derive from the fast transport of large arrays through the test process.

The device remains in the array without the need for pick-and-place of devices at each step. As a practical matter, testing in strip format is accomplished first because certain classes of parts are packaged in strip format and the packaging paradigm can easily be extended to testing.

THE CONTACTOR SYSTEM IS KEY

The key technology in any parallel test scheme is the contactor system, including the connector or probe, the alignment mechanism and the interconnections.

Reliable, low-maintenance contactors are needed for the large arrays of high-performance devices, many of which operate at high current levels.

Fine-pitch contactor spacing is an additional challenge in these dense arrays. And unlike test sockets where periodic cleaning and maintenance allow reliable contact, contactors in arrays of upwards of 50,000 terminals must provide reliable contact without onerous and costly maintenance.

Present-day contactors used for test sockets do not scale well to these extreme demands for reliability. It appears that TnT will drive a next leg upward in contactor technology needed for massively parallel testing.

The added demands of operation at high temperature and power for tray burn-in are particularly difficult with current contactors, mandating substantial advances in technology.

Thermal management becomes an issue for parallel testing of high performance processors and high power devices. Cooling a dense array of 100W processors is a challenge—64 such devices dissipate 6.4 KW in a small area.

While thermal management is a challenge, it is not insurmountable considering the potential cost reduction involved. Standardization is an essential element needed for adoption and growth of the Test-in-Tray industry.

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TNT OFFERS BROAD APPLICATIONS

While TnT promises the benefits of strip testing, it allows the broad application and standardization across a broad spectrum of package types from MEMS sensors to high-performance processors. Importantly, TnT breaks the test format free from the format used in package production.

For example, an array of 32 devices may be packaged in a strip format, but the test can be most efficiently performed in a tray of 128 devices tested in parallel. Conversely, small devices may be packaged in a tightly spaced array of 256 devices, while testing can be performed best on 32 devices in an array of fixed centers.

While quite adaptable, standards must be set for tray size, marking, features and materials. The tray format can be standardized to a common format, allowing the same automation, transport and data tracking to be used for a very broad range of device types.

CHALLENGES NOT INSURMOUNTABLE

The technological challenges we face in implementing TnT are known and not insurmountable, particularly with the tremendous cost savings of fully automated parallel test enabled by TnT.

Questions about implementing TnT? Contact Tom at Centipede Systems, tom@centipedesystems.com.