New-Generation Multi-function IC Handlers
Combine Hot-Testing Chamber with Inspection, Marking and Packaging

Written for EP&P Europe
By
Remy Degan
Corporate Marketing Manager
Ismeca, S.A.

Over the past decade, great strides have been made in the efficient automation of most front-end IC fabrication processes as well as many of the initial back-end IC packaging operations. However, significant challenges have still remained when it comes to fully automating the "end-of-the line" back-end IC processes, such as electrical testing through laser marking, inspection and finally packaging the components into tubes, trays or tape. Although a variety of automated handling capabilities have evolved to deal with each of these various steps, too often the real-world result has been a series of separate standalone single-function machines, taking up valuable floor space and requiring constant tinkering to balance their throughput. In the aggregate, these isolated "islands of automation" have helped improve efficient at specific points in the production flow but have inherently fallen short of the overall optimization of all critical end-of-the-line back-end processes.

To address this need for integrated automation of these back-end operations, a new generation of IC handling equipment has now emerged, with high-speed capabilities to simultaneously deliver multiple devices for IC test, as well as carrying out subsequent laser marking, inspection and packing operations, all in the same machine. In addition some advanced versions of these multi-function machines even include built-in oven capabilities for conducting the entire electrical test handling process within an elevated temperature-controlled environment.

One prime example of this emerging new generation of integrated back-end handlers is the M232AT system from Ismeca, S.A. By combining the speed, flexibility and robustness of the M232 platform's proven rotary turret handling mechanism with a new high-throughput technique for parallel electrical testing under controlled temperatures, the system automates the entire back-end from test to packing within a single, small footprint transportable system.

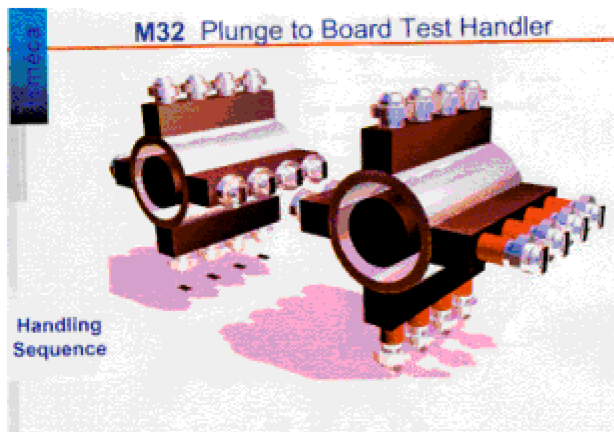
Such integrated handling systems are basically an outgrowth of the specialized systems first developed for placing finished components into final packaging such as tape and reel. Because virtually all components ultimately had to be packaged, standardized methods for automation evolved quickly for addressing this process. In addition, it quickly became apparent to companies like Ismeca that the investment in automation at the final step could be efficiently migrated upstream to compass other related processes such as inspection, marking, and electrical testing.

Parallel, Multi-Device Plunge-to-Test Capabilities

Early test handlers simply extended the flexibility of the rotating turret concept to integrate test sockets at one or more of the turret's 32 stations. By placing the handler close to the test equipment, the cable length could be minimized between the test head and the test station, thereby allowing relatively tight integration of discrete testing into the handling system. However, when it came to electrical testing of high-volumes of relatively small devices with short test times, such as Small Outline ICs (SOICs), the "one device at a time" nature of such testing methods could not provide sufficient throughput to keep up with overall requirements. Because maintaining high utilization of expensive test equipment is critical to production line effectiveness, a new consistently fast and reliable test handling method was required.

The newest innovation to address this need for higher throughput consists of a rotating barrel-shaped module that can simultaneously present a linear array of up to four components to the test head in each pass. (See Figure 1) By combining the rotary motion and multi-station flexibility of the proven turret system with the speed of parallel electrical testing the new system provides a robust foundation for effectively integrating all of the final back-end handling operations.

Figure 1



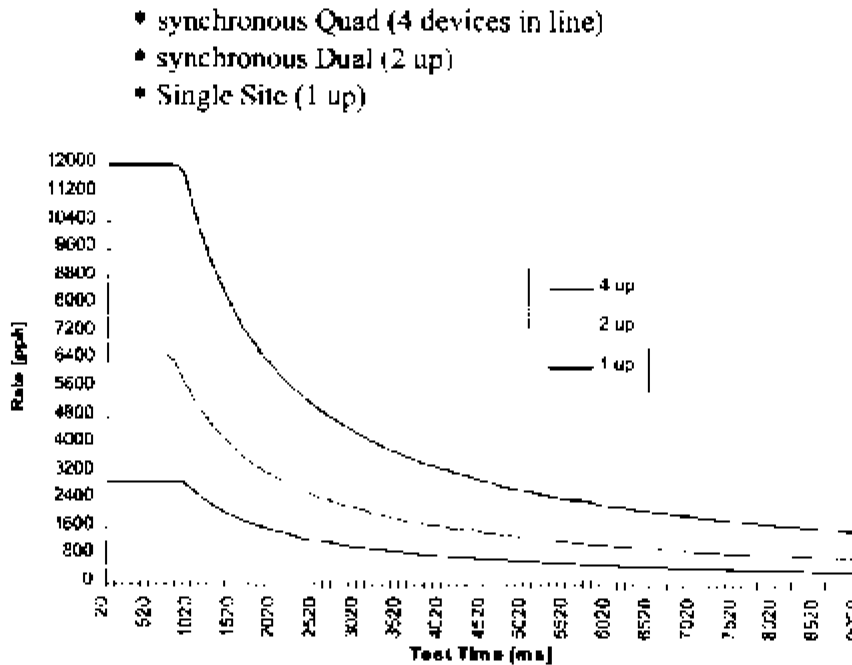
The use of the following four distinct positions in each complete rotation of the plunge-to-test barrel provide for continuous throughput, while maintaining perfect synchronization with the rest of the handling system:

- First position – simultaneous pick-up of four components
- Second position – re-centering of components using reference leads for proper alignment
- Third position – reserved for tooling changes
- Fourth position – insertion of all four components into test sockets

Parallel testing of multiple devices can be particularly beneficial when test times are relatively short as is typical with SOICs, such as MSOP, TSSOP, SSOP, SOT devices.

As can be seen in Figure 2, when test times are less than about 1000 milliseconds, the use of a dual or quad plunge-to-test fixture can double or nearly quadruple the sustained throughput rate in parts per hour over the rates achievable with a single-device test method. Although all three methods show a significant drop-off and then flattening out of throughput rates as test times increase the quad and dual fixtures demonstrate significant advantages even with longer test times.

Figure 2



Hot-Test Controlled Temperatures Throughout the Test Process

One of the most important factors in electrical testing for many semiconductor components is the capability to bring the devices up to a specified temperature prior to and during the test process. The use of elevated temperatures can significantly accelerate the stress on the devices and more accurately simulate the extremes that will be encountered under actual operating conditions.

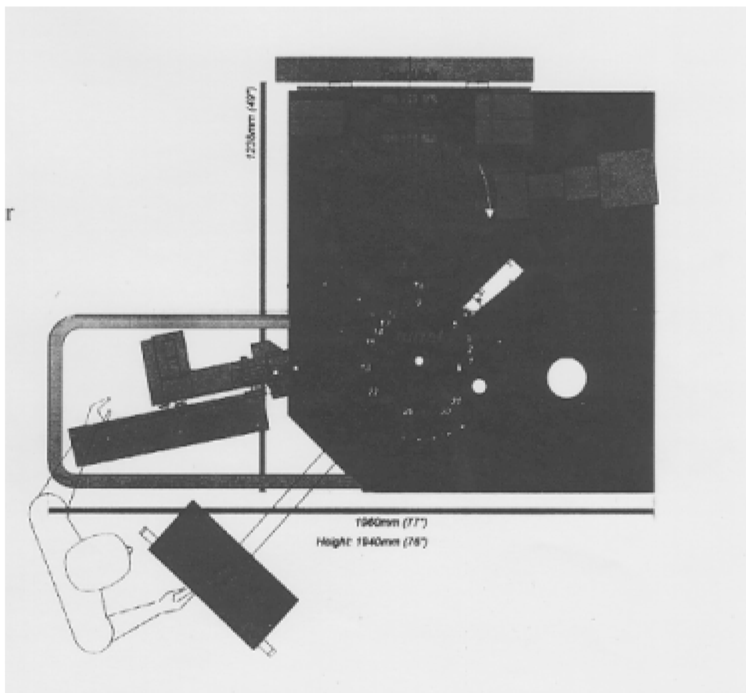
In order to accomplish this more rigorous testing in the most efficient fashion, the M232AT Hot Test Handler configuration adds an integrated oven to the system that encloses the entire process from the point where the components are initially loaded into transit boats through completion of the plunge-to-test step. Under flexible software programmable control, the integrated oven can achieve and precisely maintain any temperature level between +25?C and +155?C. In addition, closed-loop feedback controls maintain highly consistent temperatures at each test socket. Accuracy of 1?C is

maintained for each test site across the entire temperature range with a maximum deviation of 0.2?C during any 10-minute period. Fast temperature transition time of only 30 minutes to go from 25?C to 155?C enables the system to be quickly adjusted to different specified testing temperatures for various devices.

Small Footprint and Flexible Production Integration

Integration of the environmental chamber and hot testing functions with other related back-end functions ultimately provides a unique opportunity for manufacturers to combine maximum functionality into minimum floor space. Building upon the inherent flexibility of the rotating turret concept, the system is able to follow up the electrical test step with options for in-system laser marking, mark inspection, true 3D lead inspection and finally packaging to a variety of output formats. In essence the IC manufacturer is able to replace up to five previously separate machines with a single multi-function unified system.

Figure 3



As can be seen in Figure 3, the entire system, including the integrated temperature controlled chamber measures only 1300mm (51 inches) deep by 1900mm (75 inches) wide, thereby providing full automation of the test-through-packing back-end operations, all within a highly efficient single-machine footprint. In addition, by placing the entire system on rollers and optimizing for quick tooling changeover times, the design allows the M232AT to be easily moved around the production floor for interfacing to a variety of dedicated electrical test systems.

For the IC manufacturer, the end result is a greatly increased level of automation, integration and efficiency for all of the end-of-the-line back-end production processes. The tight integration of elevated temperature control over the electrical testing process ensures more rigorous and reliable product quality while the integration with other functions provides significant savings in equipment expenditure, production set-up requirements and floor space utilization. Finally, the increased throughput achievable with the four-up, parallel plunge-to-test methodology enables the entire integrated back-end handling system to run at sustained throughput rates as high as 10,000 parts per hour.

System Photo