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Choosing a strategy for component test automation

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Component testing can be done sequentially, in parallel, or in a combination. Here's how to choose the arrangement that works best for your situation.

TESTING and characterization of devices on the factory floor or wafer fab can be done sequentially, multiplexed, in parallel, or concurrently, for a wide range of sophistication and complexity. This article will examine each of these strategies, explain how it works, and show where it's best applied.

In all automatic test strategies, communications between component handler, robot, or wafer prober and the test equipment is critical. A long delay between placing a DUT in the test fixture and signaling the test equipment to start wastes time, while starting the test before the DUT is connected gives bad data. Keeping the chain of command as short as possible reduces the likelihood of mis-communicating the start test and end of test events.

Sequential and multiplex test

The sequential test strategy is simple. The component handler puts a component in the test fixture and signals the test equipment to begin the test sequence (***Figure 1***). Once the sequence is complete, the test equipment sends the test result to the component handler, which bins the part and places another in the fixture. Sequential test is appropriate when the component handler costs less than the test equipment.

In the multiplex test method (***Figure 2***) the component handler puts multiple components in the test fixture at once, and the test equipment includes a multiplexer to switch between devices. This increases throughput—especially if the component handler can move all components simultaneously, as with tape-and-reel systems or wafer prober systems with a multi-site probe card. This method is appropriate when the test sequence is short compared to the time required to index to the next set of test sites on the wafer or position the next set of DUTs in the fixture.

Parallel and concurrent

Adding multiple test sets allows parallel test, with all components tested at the same time (***Figure 3***). This is good when throughput is vital and the test sequence execution time is significant compared to the component handler or wafer prober index time—and especially when the test equipment costs significantly less than the component handler or wafer prober.

To accomplish more than about a 2× improvement in throughput over sequential and multiplex test, the test equipment must oper-

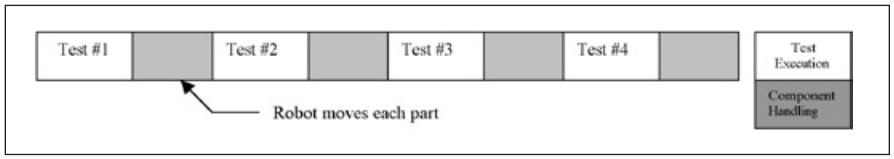

Figure 1: Sequential Test Method.

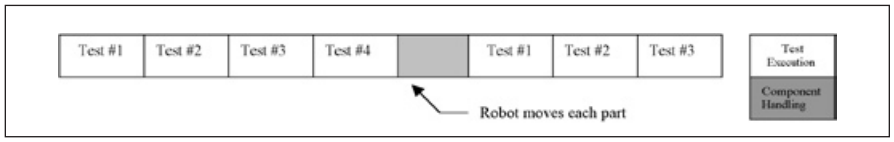

Figure 2: Multiplex test can double throughput when the multiplexer operation is much faster than the component handler operation.

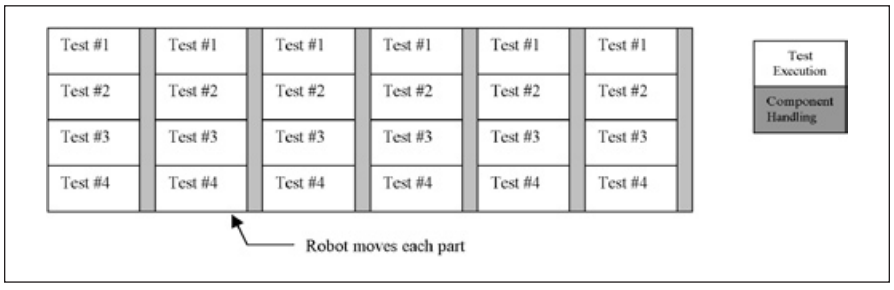

Figure 3: Parallel test with RT Controllers triples throughput.

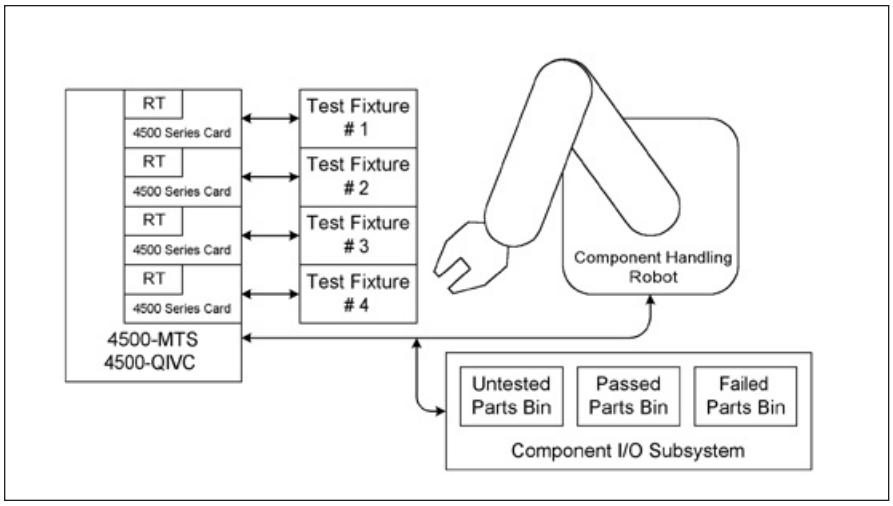

Figure 4: In this example of synchronous concurrent testing a robot component handler tends a four-site test system. The robot loads modules in each test head in turn, triggering test equipment as it does so.

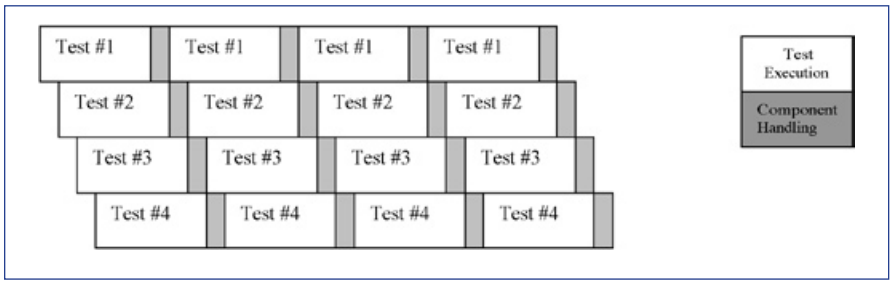

Figure 5: Synchronous concurrent test sequencing nearly quadruples throughput compared to serial test.

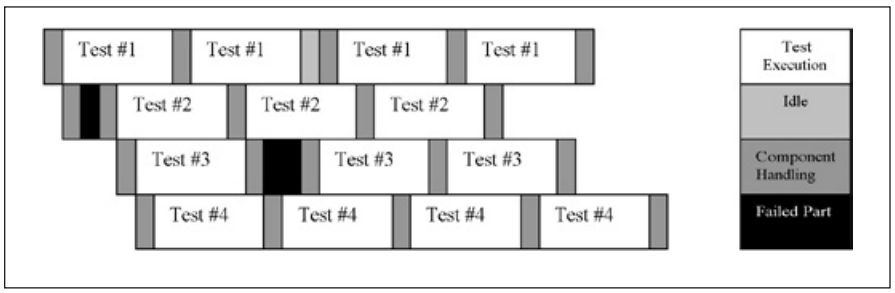

Figure 6: Asynchronous concurrent reject priority provides the highest possible throughput.

ate autonomously during execution, preferably using embedded real-time controllers.

Robotic component handling at the module level requires more sophisticated test strategies. ***Figure 4*** shows a robot component handler tending a four-site test system. The robot loads a module in each test head and signals the test equipment to begin testing on that head, then goes on to the next. Each set of test equipment executes concurrently on different modules. As the robot finishes loading the module on the last test head, the first test head is reporting results so that the robot can put the module in the pass or fail bins. This strategy is called synchronous concurrent (***Figure 5***).

Most module testing requires a number of components to be tested. If a component in the module fails, it's best to stop the test and reject the module rather than to continue testing it. This calls for an asynchronous concurrent test strategy (***Figure 6***).

Conclusion

The choice of which test strategy is appropriate for a particular situation depends upon the relative speeds and costs of the test equipment and the component handler, robot, or wafer prober. But make sure when choosing that the equipment has all the capabilities required and also provides an upgrade path as test throughput needs change. KEITHLEY

About the Author

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