Flying Probe Testers in Production

In the electronics market, the ability to anticipate market trends and changes is essential. Manufacturers are faced with the challenge of designing innovative products to capture market share as quickly as possible, while at the same time being able to manufacture new products faster and cheaper than yesterday. Additionally, faster, smaller, and lower-power components are introduced on a daily basis, further compound the difficulty of test and production being able to keep up with prototype and production changes.

Technology revolutions are few and far between. Evolutions, on the other hand, are the norm. Electronic Manufacturers can quickly reposition an existing product to new markets, change its price points and profitability, or move it to new markets by altering existing PCB designs. But while the re-engineering of existing designs may seem logical and simplistic to a marketing manager, they can be a true nightmare for manufacturing.

The core of the evolution — the continual improvement of component technology — is what presents the greatest challenge to those tasked with building the products. New designs and Engineering Change Orders (ECOs) happen almost in real-time. In the past, the “luxury” of having weeks, sometimes months, to plan for ECOs was commonplace. Today, delays in ECO implementation can mean missed market opportunities and missed profits.

When flying probe test systems were introduced, it was to address the need for an in-circuit prototype test system. Prototype testing requires detection of shorts and opens, as well as the verification of the presence and value verification of all analog components. Previously, whenever electronics manufacturers wanted to test new revisions of a pre-launch design, they had to either modify an existing fixture or buy a new one — both of which are expensive and time-consuming options. Compounding the prototype fixture problem is the rapid pace of new product design, brought about by the accelerated introduction of faster, denser and more complex components and the consumer’s appetite for the latest technology.

Flying probe test systems are the platform of choice for prototype testing. The most obvious and appealing attribute of the flying probe tester is the fixtureless design, eliminating the expense and time lag of ICT fixture changes. Next, and perhaps an equally important attribute, is flexibility the flying probe tester gives the test engineer. With a flying probe tester, engineers can take CAD system data and quickly incorporate design changes to a test program, measuring the results instantaneously. This capability allows test engineers to keep pace with the ever-increasing stream of new products and product revisions. In the past, test programming typically required 3-4 days, but the link between design and test has eliminated this time lag.

Classical Flying Probe Testers

Initially, flying probe testers were effective, but very limited, in their capabilities. For example, test program preparation was a mostly manual process that required 3-6 days to complete one program. Poor test coverage made these original machines only suitable for prototype testing. Slow throughput made these testers unusable in a production environment, except for very small volumes.
New Generation of Flying Probe Testers

When flying probe testers were first introduced, many of them did not have a test program generator. Test program generation on the earlier models would take an average of 3-6 days to generate and debug a new program. Today, flying probe test systems have evolved into much more sophisticated systems.

The modern flying probe tester should be able to:

- Use the CAD data to generate circuit descriptions for the test program generator.
- Select the proper and ideal test locations according to user-given priorities and pad sizes.
- Allow the user to manipulate CAD data such as redefining the landing position on pads or via's.
- Automatically read the BOM files and enable the user to generate filters to read BOM files from different sources.
- Include a component library that will allow the user to define a component only once and reuse the information for other boards.
- Manage a component test library for various components to guarantee reasonable fault coverage without increasing the test preparation time.
- Support multiple test strategies (such as analog and digital ICT, Functional, support of fixed pins, power up test, flash programming, Boundary Scan test, vision test, etc.), and allow the user to define the optimal test strategy.
- Utilize a powerful test program generator.
- Offer tools to verify the selected test locations.
- Offer tools for easy and fast program debugging.
- Protect test programs against operator changes.
- Provide a complete and accurate test coverage report.

To be an effective tool for today’s electronics manufacturers, a flying probe tester should be capable of generating a complete test program for a 1000 net board in less than an hour and finish test program debugging in less than a day.

The best flying probe test systems have software that offers a variety of debugging tools, including validation of the test location, a graphical interface to change test locations, board layout and intelligent schematics tools, and menus that will show all the measurement parameters and the current measurement results. All of the board information, net information, component information and component data sheets should be available to the user.

At the end of the test program debugging the user can compile his test program in a .exe file and protect it against change. After test program compilation the programmer can release the test program for use by the operator.

Production Test – a New Home for Flying Probe Testers

The global marketplace is changing. As was mentioned previously, consumer-buying patterns have evolved to a near-insatiable desire to always have the latest technology in all things electronic. Yesterday’s products, with yesterday’s features, are old news. From PCs to PDAs to cell phones, this consumer-buying pattern has forced manufacturers to bring new products to market on an almost daily basis. As marketing tries to keep pace with consumers and their
competition, those on the test and production side struggle to maintain the flow of new products to the market.

As test and manufacturing engineers looked for ways to efficiently and cost-effectively build new products, they discovered that the flying probe tester can play a significant role in a production environment. Whether an OEM or Contract Manufacturer, the cost pressures are the same and the need to employ the best test strategy is essential. Just as fixture costs have made the flying probe tester a logical choice in prototype testing, so too is the case on the production floor. Significant throughput improvements have made flying probe testers fast enough to be an integral part of a successful test strategy.

There are many fixture-related reasons why a flying probe tester is a more logical choice than a bed of nails ICT tester. First, the space needed for test locations for a bed of nails tester have become smaller and smaller, leading to test fixtures that are more expensive and less reliable. Flying probe testers can contact pads as small as 6mils, vs. 25mils for a fixture. More importantly, the available locations for test points on a fixture are diminishing, forcing the use of either an expensive double-sided fixture or a compromise in test coverage. The loss of test coverage is of critical concern and is a key motivator behind the use of flying probe test systems in production. Therefore, to ensure that test coverage is not compromised, many manufacturers are employing a combination of flying probe and bed of nails testing to be sure that optimal test coverage is achieved.

Modern testers however should allow simple fixtures to be able to power up the boards. Fixed pins connected to nets with high pin count can be extremely useful to reduce test time while increasing fault coverage. Boundary Scan and on board programming can only be performed if simple fixtures can be used.

In the early stages, flying probe testers provided only simple MDA capabilities testing for shorts and opens on passive components such as diodes and transistor junctions. Now, equipped with an array of new features such as on-board memory module programming and Boundary Scan testing, they provide the performance of an in-circuit tester. For example, programmable power supplies allow users to power up the PCBA and perform more than simple MDA-type tests. Powering up the board is possible through fixed pins that can be used though magnetic probes or through a simple fixture.

In addition to the ICT-test capabilities, Digitaltest has incorporated a wide range of functional test modules such as voltage and current source and measurement, time and frequency measurement, Waveform analyzer, resistor decade, open Collector and user relays, IEEE and VXI interface into its flying probe test system. Graphical tools and menu-driven programming tools simplify the development and debugging of functional test programs.

**Technical Advancements of Flying Probe Testers**

The advancements made in flying probe test systems have been significant in the last few years, changing their utilization from a prototype only system to an integral part of an effective test strategy. Despite all of the advancements, flying probe testers cannot operate as a single solution that satisfies all of the test requirements. The major factor of why flying probe testers cannot be used in production is the lengthy test time. Test time is often longer than the cycle time of the product. The test time of a flying probe tester is determined by the mechanical speed of the
test heads. But more important is the number of tests. A major part of the test program is the shorts test. The number of shorts tests used is a major determinant of the test time needed. The usage of fixed pins can reduce the test time dramatically by eliminating many head movements. Also the concept of test program translation protects the test program from change and at the same time uses the pipelining concept to increase test speed and increase tester throughput.

**Flying Probe Testers – a Multi-use Tool**

Today’s flying probe test systems have quickly evolved into an essential tool that can perform multiple tasks in prototype and production environments. In the prototype area alone, the incorporation of advanced programming tools has significantly reduced programming times while improving the user’s capabilities. In its new role of production test system, the flying probe tester is an essential part of a test strategy on complex designs, and can serve as a stand-alone system for testing small lots or less-complex PCBA. Inclusion of functional test capabilities further advances the flexibility and value of a flying probe tester. Overall, a full-featured flying probe test system has quickly become a tool that manufacturers of all types can’t live without.