Moving-Probe Testing

Time is money. But how do you translate this rule when it comes to selecting the right testing approach?

Randy T. Allinson

The growth of contract manufacturing, among other factors, has increased the number of short production runs and required an accelerated time to market for many products. Traditional bare-board test fixturing is often uneconomical for short runs and can increase time to market. Fine-pitch patterns (10-mil-pitch and below) also make traditional fixturing difficult, adding even more time and expense to the production cycle.

Many manufacturers are turning to moving-probe testers (MPTs) when fixturing is not practical from an economic or technical standpoint. MPTs can shorten the test cycle and eliminate fixturing costs for short-run production. Rather than serve as a replacement for bed-of-nails testing, MPTs can complement fixtured testing.

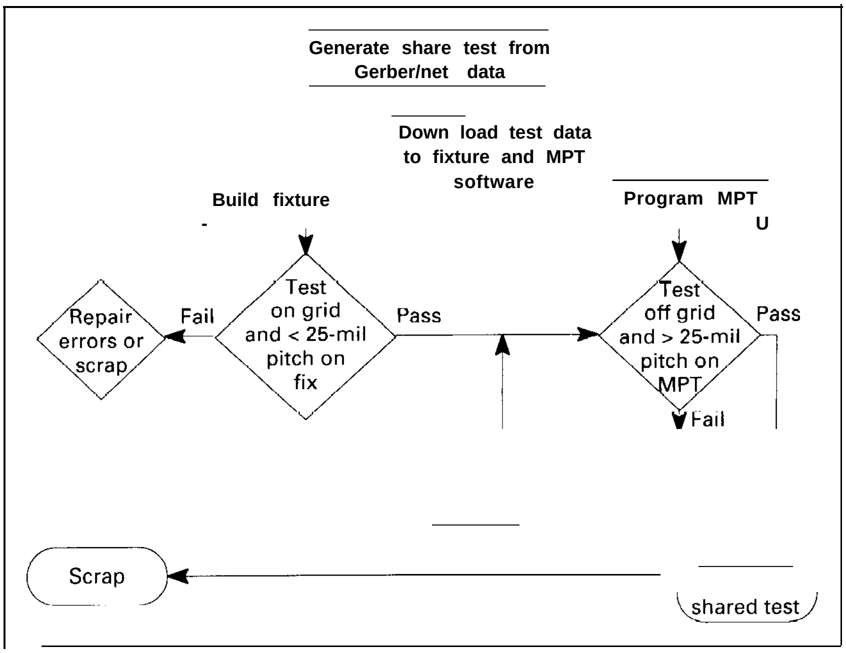


Figure 1. Shared testing.

How MPTs Work

The moving-probe tester is an electrormechanicaI device that can accurately and rapidly move measurement probes around a circuit board to critical test points. The probes make contact with the board, perform electrical measurements, and determine continuity and isolation. The basic elements of the system are test generation software, a motion system to move the test probes, a computer-based controller, measurement instrumentation, Lua!d-holding hardware, and a printer.

Applications

Moving-probe testers were originally intended to reduce the waiting time for a board to be tested. In the early 1980s, a fabricator might wait two to three weeks for a few prototype MLBs to be completed.

Today's MPTs come in a variety of configurations, including sys-

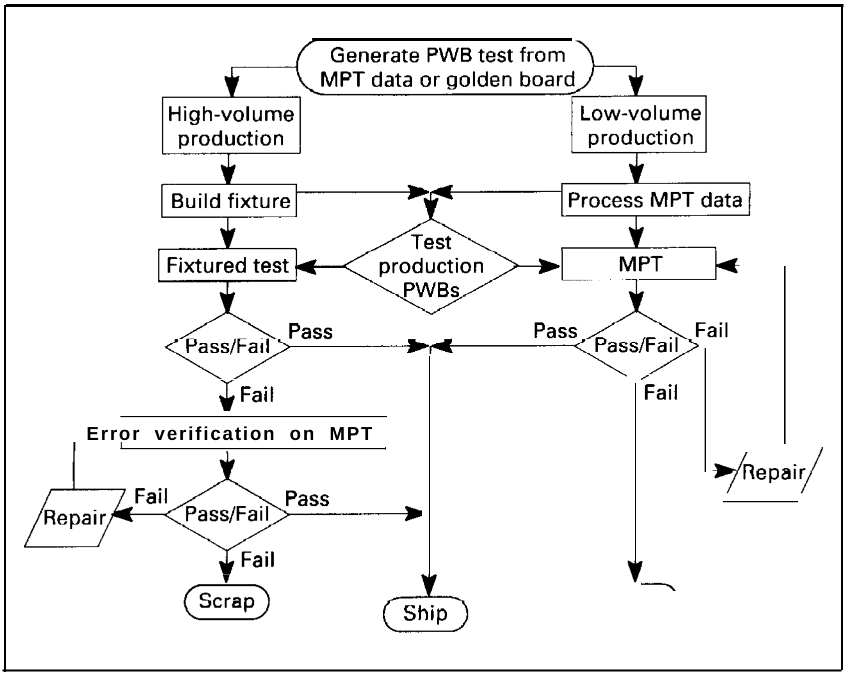


Figure 2. High-volume and error verification applications

In the early stages of product design or process development, testing must be completed as quickly **as** possible. Software allows the user to compare the finished PCB to the design. As schematics and layouts **are completed**, CAL) data is developed. Once good data is available, boards can be manufactured and passed to the MPT. Each design revision can be checked and tested in the same manner.

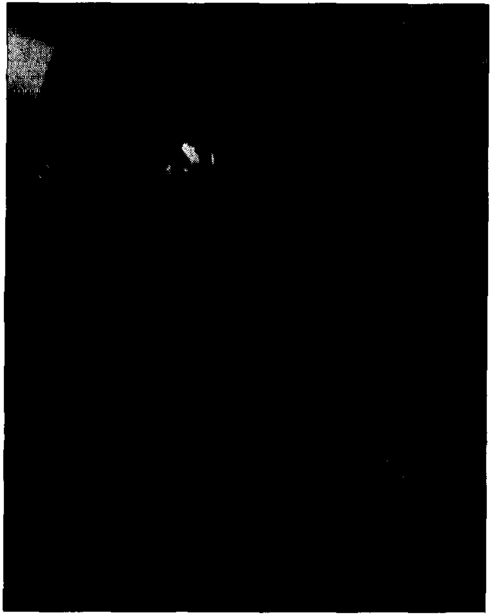
The major benefit of the MPT is reduced time to market. Because there is no fixture investment during the prototype stage, the recurring fixture cost is eliminated and fixture building time, labor costs, and turnaround time are saved. The production department is freed of the burden of engineering tests. MPTs can also increase the number of productive development hours and shorten development cycles.

Another use is in the process development area, where quick adjustments can be made. Fixtures don't have to be modified and rebuilt to accommodate changes, and no testing must be done on the production line. Fixtured test systems provide speed advantages not found in MPTs, but compatibility between the two types of systems can be achieved (Figure 1). The first step is to separate high-volume production runs from low-volume runs. The high-volume tester should constantly be "protected" from low-**volume rcquirements;** the latter work should be diverted to the moving-probe tester (Figure 2).

Next, the cost factors associated with board size and density must be analyzed. All but the finer-pitch test areas should be allocated to the fixture and the fine-pitch areas to the MPT. Software programs can be used to allocate tests to both types of systems, producing an effective test routine.

Cost Analysis

Several examples illustrate the factors that impact the cost of using a moving-probe test system. The first involves a supplier of engineering workstations who uses dedicated fixtures for most of his volume test needs. The company's captive shop was faced with a growing number of requests to supply product development groups with tested dense MLBs that have component lands on both sides.



High-accuracy placement of *a small number of probes frees the* MPT from pitch, grid, *and density [imitations,*

The board used in this example is a double-sided SMT board with 30,000 test points. All the test points are off grid, and some are on 25-mil spacing. Because immediate test results were required, outside test services applied a multiple of their standard rate, resulting in a charge of $40,000. A turnaround time of one week for 20 boards was specified. This is equivalent to $2,000/board.

The same boards were tested using an MPT, starting the day the printed circuit hoards were fabricated, at a rate of one every 2.5 hours. At $75/hour, this is a cost of $187.5/hour board, or a lot charge of $3,750. This translates to a savings of $36,250. Based on these figures, using this technique on one program per month could produce a return on investment in less than one year,

The second example involves a PCB shop with a prototype job consisting of a 10-piece run. Each board contains 2,000 test points, 20- and 25-mil-pitch devices, and standard through-hole test areas. The cost to set up the job in-house was calculated to be about $1,180, not including the cost of machine time on the bed-of-nails tester. By dividing the lot charge by 10, the per-piece test cost was estimated to be $6.25. In this case, an additional benefit was realized because the bed-of-nails system was free to test a high-volume job.

In a third example, a company was faced with the task of designing, prototyping, and producing a family of very large logic boards. Each board measured about 30” X 32”, with 50 layers and over 98,000 test points. Fixturing costs for such boards would run hundreds of thousands of dollars, and fixture changes could be equally expensive, so a scheme was needed to reduce the amount of refixturing that would occur during both prototype manufacturing and process development For this application, the cost of one moving-probe tester system was less than the cost of one fixture.

In another example, an engineer needed to quickly test 10 dense double-sided SMT boards. One option meant building a fixture and using the production tester. The cost of the fixture based on an estimate of $.85/point and $15/hour for, fixture and translator fabrication was combined with processing time and translator materials to yield a total cost of $4,500.

The other option was to test the boards on the MPT. This test involves approximately one hour for data processing at $15/hour, plus two hours’ testing time. The cost of ownership of the MPT is estimated at $75/hour. Based on these figures, savings achieved by using the MPT total more than $4,300 in a two-hour period.

Another hypothetical example further illustrates these concepts. Consider the case of a 24-layer 11” X 14” board with 20-mil-pitch SMT features on both sides, over 22,000 test points, and over 3,000 nets. The test time with a moving-probe system is under 12 minutes, and the cost is a few dollars per board. A clamshell fixture required for a grid tester would cost well over $10,OOO.

Conclusion

Today’s test techniques have nearly reached their limits. Keeping up with changes in PWB technology can be expensive. BY leveraging the speed and durability of bed-of-nails systems with the quick setup time and flexibility of the MPT, users can continue to confidently ship tested products without incurring higher testing costs. FAB

Randy T. Allinson is president of *Probot* Inc., Branford, CT.