

Can a Flying Probe system be more cost effective than a ICT system while providing increased fault coverage?

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With today's latest technology Flying Probe systems, such as Digitaltest's Condor platform, is it possible to switch from ICT to Flying Probe as your main test platform?

What are the challenges? Costs, Test Coverage, Cycle Times? Lets discuss the capabilities of each of these points.



Costs and Cycle Times

Costs and Cycle Times are two variables that are irrevocably linked, as the Cycle time affects cost, and faster hardware increases capital costs. So the two key factors driving the cost differences between ICT and Flying Probe are; 1, Fixturing Costs associated with ICT, and 2, Nets-Per-Second capability of the Flying Probe system.

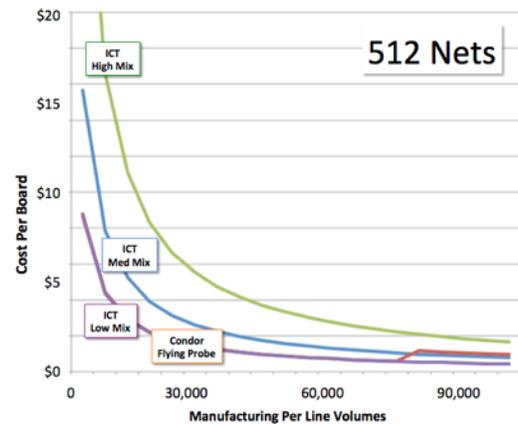
ICT systems vary in cost from the simple MDA platforms to fully-fledged combinational platforms. The cost will also vary by the maximum pin count (Number of nets on a board the system can test). Where the Flying Probe costs are pretty static, the costs of running an ICT system is more complex to calculate.

We have been modeling the cost per board against Digitaltest's Condor Flying Probe System with fully optimized programs using our pipelined test algorithms and SNAP (Significant Node Access Probe) techniques. To provide the highest throughput we pipeline tests allowing multiple tests to occur synchronously with each head movement. Typically 5-10 tests can be performed with a single head movement. The SNAP techniques used on the Condor systems allow you to constantly probe large nets, which in addition, can improve throughput by up to 30%.

For this discussion we have modeled 3 scenarios based across manufacturing volumes from 5,000 to 100,000 and products with net counts from 512-2048.

The three scenarios¹ are:

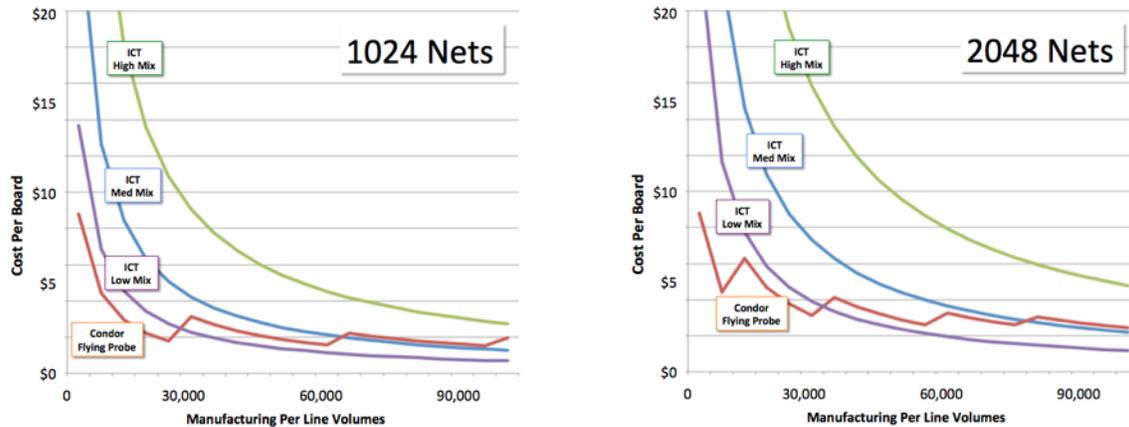
- Low Mix – 4 New Products per Year
- Medium Mix – 10 New Products per Year
- High Mix – 25 New Products per Year



Note: These scenarios are modeled against 3-stage, conveyerised systems. The model does not work with manually loaded or vertical systems with significant load/unload times.

Its clear, that although the Flying Prober is slower than an ICT system the flexibility of the product and the removal of the need for fixtures allows for cost advantages in the cases we modeled.

If you are manufacturing less than 30,000 boards per year in all cases the Flying Prober could be more cost effective than ICT. At any of the volumes we evaluated for a Medium to High Mix manufacturer the Flying Probe system can save money.



Fault Coverage.

What fault coverage can you expect from a Flying Probe System like Condor vs. an ICT, or a MDA system.

On most electronics assembly's fault coverage is determined by two factors;

- 1, The physical/electrical access the board.
- 2, The number of test techniques available to test the product.

Firstly physical and electrical access can be enhanced using a Flying Probe system like Digitaltest's Condor. This is to a point where Flying Probe solutions can provide access to nets where no access is available to fixtured ICT test systems. A high accuracy Flying Probe system like Condor can accurately probe pads that fixtures cannot access today. Digitaltest's Condor system can probe pads below 100um. This allows, smaller components, micro-electronic substrates, and pads to be probed where coverage would have previously been lost.

Systems like the Condor system can also provide multiple test channels for full digital or functional testing through the use of multiple test probes on the bottom side of the product. So a Flying Probe system like Condor can provide greater test access than a traditional ICT and fixture system.

For fault coverage, a full-featured Flying Probe solution such as Condor can provide increased test coverage over ICT. While having the capability to provide the same electrical test tools, full featured Flying Probe systems also add optical inspection capabilities for devices that can't be tested using ICT.

	Flying Probe (Condor)	ICT (General)
Test Capability - Analog		
Shorts/Opens	●	●
Presence/Absence	●	●
Values	●	●
Low Value Components	●	●
Parallel Component Values	●	●
Presence/Absence of Parallel Components	●	●
Polarity	●	●
Semiconductors	●	●
Character Recognition	●	●
Test Capability - Digital		
Powered Digital Test	●	●
Boundary Scan	●	●
Functional Tests	●	●
Capacitive Opens	●	●
Diode Check	●	●
Memory Test/Prog	●	●
Functional Test	●	●
Other Features		
Full Physical Test access	●	●
Can Access Nets Without Test Access	●	●
Fast Program Development	●	●

Figure 4 shows the differences between a full featured Flying Probe system and ICT platform with full digital capability.

Flying Probe solutions like Condor take advantage of active head technology, which allows measurements to be made without the losses normally found in the cables between the nails and the measurement system. Allowing low value components to be accurately measured. Typically capacitances down to 1pf can be tested.

Parallel components are normally tested as a group using electrical test methods on an ICT or a Flying Probe system. Here the Flying Probe system can provide an advantage, where it can deploy AOI techniques to determine the components presence and value.

Polarity can be checked on electrolytic capacitors on both ICT and Flying Probe systems with “Opens Check” techniques. But for devices such as tantalum capacitors, this technique does not work. Flying Probe with AOI can inspect the polarity markings using OCV techniques.

In cases where loss-of-access is a problem, a high accuracy Flying Probe system can provide access, when using a fixture this would be lost. The systems probing need to be repeatable and accurate to reduce false fails. Be careful on specs for probing accuracy, they can be very ambiguous, as some manufactures quote the resolution of the linear encoders (used for motor feedback) vs. probing accuracy and the pad size they can probe. Be sure to understand the exact repeatability and accuracy the probing system can provide. The build up of tolerances from the head position, to the probe angle, warpage compensation and nail rigidity all needs to be considered when judging accuracy and repeatability. To probe a 5mil pad, you do need a system with sub 25um repeatability and accurate optical fiducial alignment to ensure consistent, accurate probing.

As always with a Flying Probe system, time to market is a fraction of the time of ICT. As there is no lead time for fixture development this can be a big advantage for NPI environments.

In these observations, it is clear that not all Flying Probe and ICT systems are the same, some are simple MDA platforms. Some Flying Probe systems use double sided probing which can limit the speed and overall capabilities of the system.

Single sided Flying Probe systems can test and inspect all components on a board as well as being able to probe significant nodes, probe multiple nodes and apply power. For a double-sided system boundary scan and powered tests can be limited, because of the limitations of providing constant power to the UUT, through low current signal pins. Providing power to a board is an even more complex issue to resolve with vertical systems. It should also be considered that if you are looking at products that need board supports, this could also be an issue with double-sided platforms.

Flying Probe System Type	Both Sides of Board Can be Tested	Powered Tests	Full Digital tests	Supports for Large/Warped Boards	Price
Single Sided + SNAP Pins	Green	Green	Green	Green	\$\$
Double Sided	Green	Yellow	Red	Yellow	\$\$\$\$

In Conclusion.

It is clear that a full featured Flying Probe system can provide the full test coverage that todays products need, including Analog, Digital, Functional, Programming and Optical Inspection capabilities (Examples Shown in Figure 6). Most systems are configurable so you can choose the features you require.

Analog	Digital	Functional	Inspection	Programming
Shorts	Vector Testing	Analog	Presence	i ² C
Opens	Boundary Scan	Digital	Absence	Flash
Values	Memory	Hybrid	Position	CAN Bus
Polarity	BIST		Part Markings	All Propriatry
	Nand-Tree		Polarity	
	OpensCheck		Billboard	

For throughput the ICT platforms are clearly faster than a Flying Probe system. But the faster Flying Probe platforms can keep up with lower volume production volumes. In the model we used if you are below <35,000 boards a year, a Flying Probe system like Digitaltest’s Condor can meet all your requirements. On lower node count boards, even with the slower test times, you can get to 80,000 boards per year, in a single shift.

When you add fixturing costs to the equation, the system can provide improved fault coverage and reduced costs in many Low, Medium and High Mix environments.

As always you need to clearly understand your own manufacturing environment, volumes and test requirements to correctly model your costs. This study shows there are many scenarios where Flying Probe systems like the condor can credibly meet your cost, test, inspection and, volume requirements

1, Modeled at 512, 1024 and 2048 nets. An average cost of \$10 per node was used for Fixturing. A cost of \$100 per net for an ICT pin with full digital capability. With a \$50,000 base price. Digitaltest’s Condor standard pricing was used. In the calculations all systems were depreciated over 5 years.

If you would like more information on the model used or would like more information on the Condor Flying Probe system please contact:

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