RapiTrim Solutions

Flying Probes Myths and Misconceptions

The concept of flying probe testers has been around for many years. Until recently however, there was no adequate implementation of flying probes for laser resistor trimming. PPI's RapiTrim fixtureless trim and test systems have changed the landscape and there are now many RapiTrim systems deployed in production environments.

Customers who have been using legacy probe card systems for decades are unfamiliar with modern flying probe technology and so have some concerns and reservations about the RapiTrim design and operation. Since PPI offers both modern flying probe and modern probe card versions of the RapiTrim system, we fully understand the merits of each probing technique. Here we address some of the prime myths and misconceptions that we have heard about flying probes.

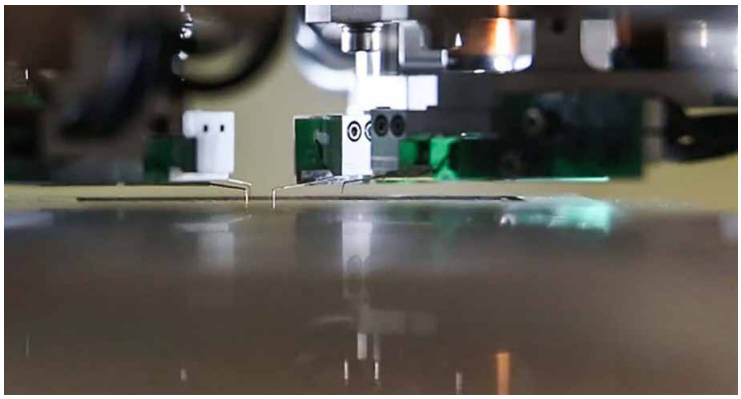
Myth #1. Flying probes are too slow compared to probe card operation.

There are two perceptions at play here. The first is that sequential access of test points by flying probes will be slower than parallel access of test points by probe cards. On the surface this is true to a larger or lesser degree depending on the situation. But look deeper at the many other time factors at play in the complete trim and test of many substrates with different layouts and it is clear that in many production scenarios that flying probes can actually trim more product per week than probe card versions. Customers have shared their real-world experiences that are presented in our Case Studies. These provide a very clear picture of the overall speed / efficiency advantage of flying probes, especially in high-mix situations.

The second part of this myth is the outdated perception that the flying probe movement itself is too slow. Previous flying probe designs did not have access to modern voice coil motors and high speed linear motion stages that PPI has incorporated into its design. With this technology the probe move times are similar to the measure / trim times. Also consider that PCB fabricators are very familiar with high speed flying probe testers that cover the whole area of the PCB, rather than just the laser scan field size in use with the RapiTrim. The small and light PPI flying probe mechanism makes the RapiTrim system throughput competitive with probe card systems for speed, and with many additional advantages.

Myth #2. Flying probes are too costly.

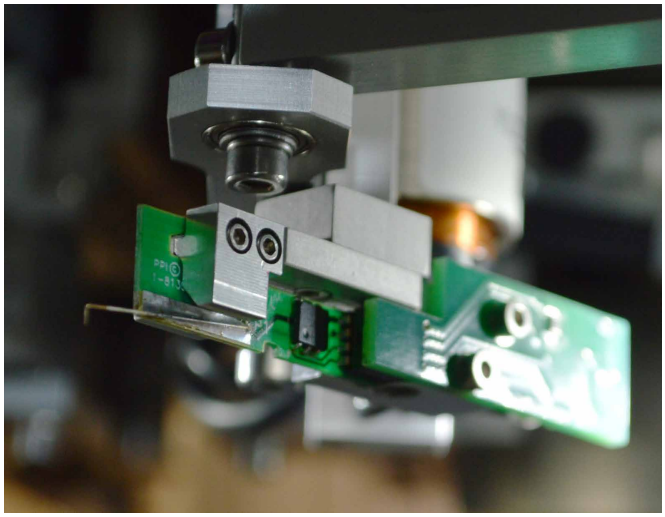
The probe tips in the RapiTrim system consist of a small PCB with the required needle type (e.g. 5 mil (125µm) BeCu) soldered to it. On this PCB there is a chip that is programmed with the needle type and also counts the touches or hits of that needle onto the test pads. Needles can be used for millions of hits, with the ultimate life dependent on the type of needle and the amount of overtravel that is requested in the job. Wear will eventually lead to failure, requiring the replacement of a tip. All four tips are usually replaced together (e.g. one customer (see Case Study #3) replaces tips proactively after 5 weeks of consistent operation). To promote consistent wear, the software programs tip assignments to use all four tips about the same amount. One set of probe tips are used on all jobs needing that type of needle until they need replacement. Operating cost can then be predictable for a given production load.



Probe card costs are initially high to build the probe card, but the usage factor per needle is lower depending on the number of needles on the card (e.g. with 24 needles the usage factor is 6X lower than the flying probe method). If there are not many substrates in a particular job lot, then the probe card is removed and put on the shelf, possibly for future use if that part is ordered again. If it is a one-time job then the residual value of the probe card is never used. The obvious conclusion here is that if production involves high volume of the same part with a relatively simple needle layout, then the probe cards have an advantage. If, however, production involves small job lots of many different (possibly unique one-time) part designs, then flying probe operation is going to be much lower cost. This simple analysis does not yet include the cost of storage of a large number of probe cards built up over a decade or two of operation, nor whether spare probe cards are made for most jobs, adding to both the up-front and storage costs.

Myth #3. Flying probes are at risk of collisions.

The reality is that the probe needles can not touch each other. Collisions are avoided because the probe positions are calibrated to within 25µm and the part of the software that governs probe movement takes this into consideration when commanding their trajectories. The risk of probe collisions has been eliminated.



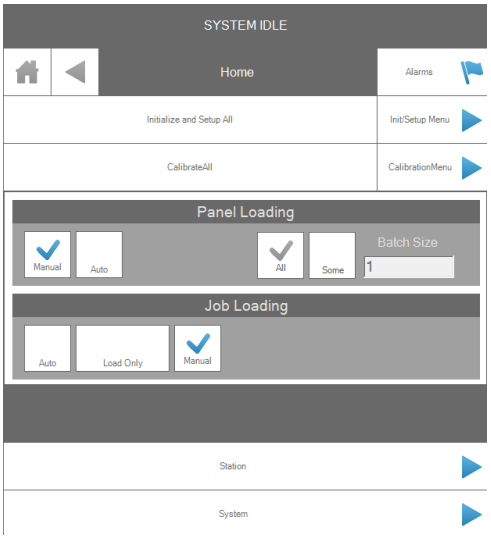
Myth #4. Flying probes are too complicated, requiring too much operator or engineering intervention.

The RapiTrim systems are full of advanced technology. Fortunately this comes with a sophisticated software package and well-designed graphical user interface (GUI) that controls the machine operation and automates the processes that require it (e.g. assignment of probes to probe pads).

From the Operator perspective, the screens are limited to what is necessary, primarily loading jobs and parts, and pressing the Run button. The use of the machine is simpler; there is no requirement to insert and calibrate probe cards for each job.

For the Engineers there is complete access to job setup functions including trim types and laser process tools for all the trim steps in the job. Depending on the amount of information in a DXF, creation of the job itself can be partly or fully automated. Modifications can be done directly in the GUI, no programming is required unless that is desired for a specific task. Totally manual job creation is also possible if no DXF is available (e.g. legacy products).

Calibrations are performed automatically at requested intervals and do not require any operator intervention. These calibrations include coarse and fine alignment cameras, laser power, laser spot position around the process field, and probe positions around the process field.



Myth #5. Flying probe systems are not flexible enough to allow engineers the full programmable control they had with old probe card systems.

Almost the opposite of Myth #4, this is potentially a concern of the process engineer thinking that the programming that was not only available but necessary with old probe card systems is being removed, possibly limiting system performance. Such is not the case. While the goal of the RapiTrim design has been to automate all routine functions for greater user convenience, manual programming is still possible. When there are custom sequences required in the trim operation (conditional processing (if-then-else…), looping, control of internal or external voltage and current sources and measuring instruments, local alignment of separate circuits, as well as interactive operator messages and instructions) these can be programmed to act at the appropriate point in an otherwise standard job.

The engineer maintains full control over how a job is created and executed: fully automated through DXF ingestion, fully manually programmed, or a hybrid approach that includes manual programming for unique features of a circuit.

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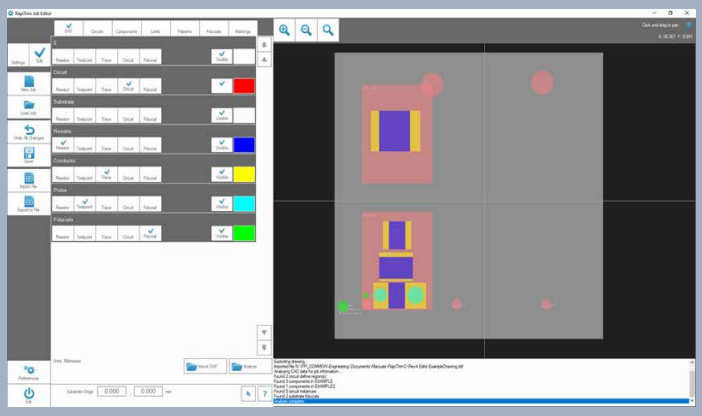
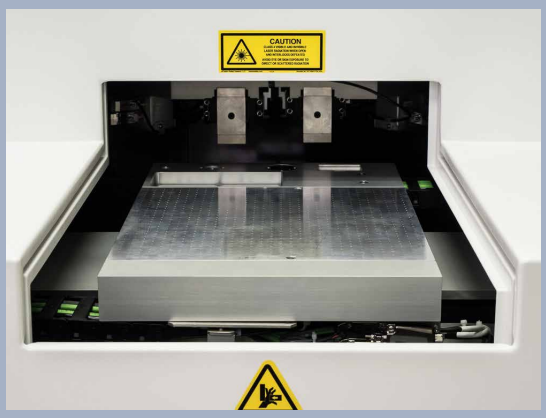
Pickup head for the optional stack loader.



Streamlined job editing with the DXF auto-import function.



Standard flat vacuum chuck on the left and a custom fixture on the right for a 3x3 array of substrates.

Flying Probe Myths ~ Busted

RapiTrim is *The Future of Resistor Trimming™*.

Summary

Don't be misled by myths about flying probes that you might have heard. For the real facts, come to the experts that have both flying probes and probe card solutions for your production needs. PPI staff are available to help you make the choice.

A complete family of RapiTrim products is available with different wavelengths and automation options (stack loader, magazines, or custom solutions). Other options include custom fixturing and external instrument support.

PPI can provide turnkey solutions for all trimming needs, from standard component and circuit trim to complex active-trim scenarios with custom fixturing.