



Microelectronics

Probing the World of

PROBE TIPS #14

A Technical Bulletin for Probing Applications

Overtravel & Laser Trimming

The role of overtravel is often misunderstood and misused in today's high volume laser trim manufacturing operations. We hope the perspective developed through this application note will result in a more effective use of probe cards to improve productivity.

Cantilever beam fixed pattern probe cards are the fixturing of choice for most high production laser trim systems. Overtravel is a measure of distance from the first probe contact of the part to be trimmed to the position where the Z-axis motion (up & down) stops. This range of motion on the system probe module must exceed the mechanical tolerances of the probes and probe card assembly and the device (e.g. probe planarization & device flatness) in order to obtain reliable contact and measurements.

The market demand for high throughput, high-speed laser trim systems has resulted in system configurations that are tough on probe cards. With indexing speeds approaching those of high speed wafer sort probers but burdened by a need for much greater range of motion, the laser trim systems can be really exercise a card assembly to its limits. Most manufacturers calibrate the systems within 2 mils across the range of the X and Y travel; Z axis resolution and accuracy is generally better than 1 mil.

The Probe Card Holder

This mechanism can usually be calibrated to hold a card assembly flat and parallel to the part WITHIN 1 mil. Depending on the cardholder design, the working distance (planarization depth) specifications of the probe card assemblies must be adhered to closely. These cardholders must be calibrated flat and parallel to the part at the specified working distance of the card assembly. When there is a disparity between the cardholder and the and the card assembly, the resulting lack of parallelism to the trim part causes probes in one quadrant of the assembly to touch the device first and the other probes to touch later in time.

Significant amounts of additional overtravel are then required to cause all probes to make contact. Therefore, adjusting the Laser Z axis mechanism to insure all probes touch may seem like the right solution but in fact creates other problems. We have seen situations where the probes have even pushed the part out of position in the vacuum chuck. Excessive and uneven probe wear always occurs and results in uneven probe pressure with resulting uneven contact resistance.

The last element to consider is Part Camber. For this example, we will assume 3 mils camber in the parts to be trimmed. A typical thick film stack up of tolerances might look like the following.

Probe Card Assembly	2 mils
Probe Card Holder	1 mils
X-Y-Z Motion System	2 mils
Parts Camber	3 mils
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<u>Total accumulated tolerances</u>	8 mils
<u>Recommended additional overtravel</u>	7 mils
<u>Total Z Motion After Initial Contact</u>	15 mils

The above situation is typical in thick film laser trim operations where system planarization and probe card repair and maintenance are given appropriate attention. The additional 7 mils of overtravel will result in adequate scrub of the pads and probe contact pressure. With a probe point size to pad ratio of 1:2, probe wear will not be excessive.

More Overtravel is NOT the Solution to Most Contact Problems

In fact, excessive overtravel veils the original problem in a whole host of other problems:

1. Probe scrubs too far; goes off pad.
2. Probe goes too far; hits the resistor ink.
3. Overworking probe causes intermittent contact due to failed needle to body solder joint.
4. Overworked probe breaks at inflection point where tip is bent downward.
5. Probe tips wear out 2 to 3 times faster than properly used probes increasing repair and maintenance costs as well as causing machine down time reducing production capacity.
6. Probe tips deform, bending at the point of attachment to the body. The resulting angular change of the tip to the part causes scrub distance reduction and frequently the probe bottoms out in contact with adjacent parts, scratching or otherwise damaging them.

There's more if you think 6 isn't enough! Please don't think these things are only happening to Hybrid ops. The IC world has been battling planarity and contact problems like these for years.

Too Much Overtravel? How Come?

1. Excess overtravel is often used to compensate for poor system or poor probe card planarity. Remember the maxim: Overtravel must exceed the stack up of mechanical tolerances- otherwise no contact and no measurement.
 2. Excess overtravel solves (?) pad contamination problems. There are better ways to deal with contact failure due to ash on the pads than to over exercise the probes. Why not improve the parts vacuum? Two probe tips on a single probe body will double the chance of clean contact. Consider the trim yield improvement.
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Conclusion

There is really no need to use excess overtravel in order to "solve" problems downstream.

Real solutions are:

1. Planarize and maintain the laser trim system.
2. Calculate the mechanical tolerances and add some additional overtravel for good contact.
3. Troubleshoot the cause of intermittent measurement. It isn't always the probe card assembly - so why beat on it?
4. Keep a known good, spare probe card assembly in case it is the card. This will be the fastest way to eliminate the card as the culprit and get production flowing again.