RapiTrim Solutions

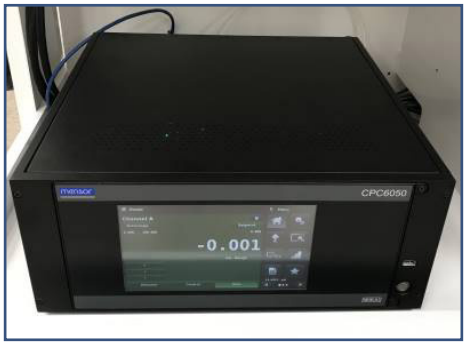
Pressure Sensors

The RapiTrim family of resistor trimming systems can be delivered in a variety of configurations suited to different applications. The flying probe version is ideally suited to high-mix, quick-turn production. The probe card version is more appropriate for high volume production of only a few part layouts. While both system configurations can be of use in the manufacture of pressure sensors, custom solutions also play a role.

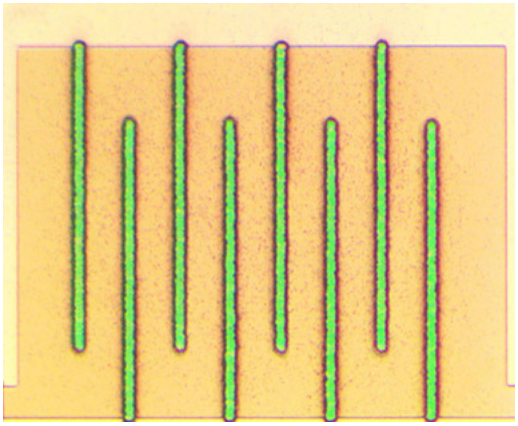
Pressure sensors are used in a wide variety of applications including automotive, process equipment, and industrial and medical equipment (e.g. for respirators for Covid-impaired patients). Pressure sensors can be fabricated with standard thick-film pastes on alumina or FR4 substrates, or thin films on alumina or silicon substrates, with the choice dependent on the application, the tolerance required and the acceptable price point among other factors.

Substrate Layout

Pressure sensors need trimming so that they are accurate over their operating range. This typically requires a multi-step process to adjust both the offset from a baseline and linearity over the operating range. To perform these tasks the sensors are presented as near-finished devices in their final packages, in an array of products (e.g. all on a board to be singulated after trimming and other steps, or already single devices mounted together in a carrier frame or in test sockets).



Mensor pressure controller installed in internal instrument bay.



Example of a serpentine trim in thin film on a silicon substrate with a 7.5µm kerf width.

Laser and Beam Delivery

The choice of laser wavelength and spot size will depend on the resistor material, desired kerf width, target tolerance and required depth of field to accommodate variations in height of the resistor locations. Thick film resistors are typically trimmed with the 1.06µm laser wavelength set to produce about a 25µm spot. Thin film materials are often trimmed with the same wavelength but a smaller spot (e.g. 10µm) to achieve tighter beam placement accuracy needed for the very fine circuit geometry and possibly improved trimmed resistor tolerance. Beam focus is critical when using small laser spots. Autofocus with TTL vision can be used, or the height of all trim regions on a substrate can be mapped in a separate step and the results used for automatic compensation during processing.

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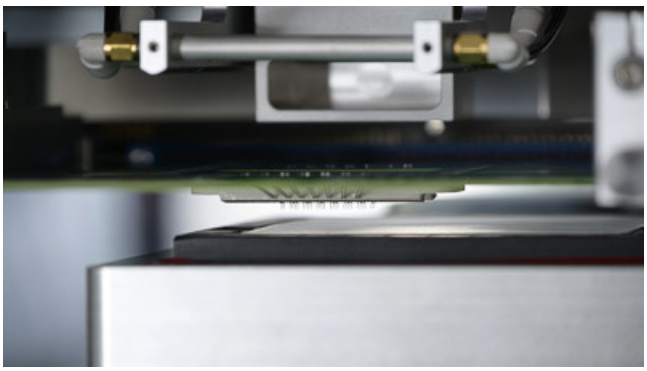
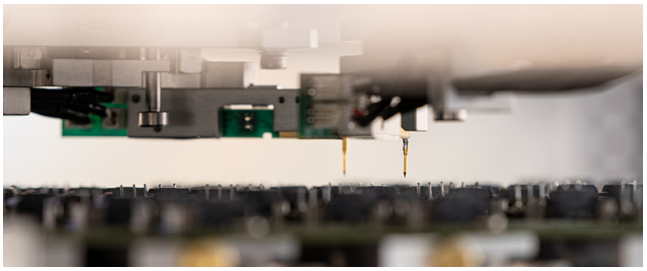
Part fixturing and pressure control.

Each sensor can have a unique identifier providing its location on the substrate or within a block of fixtured parts, along with a code for that substrate or batch. If needed PPI works with customers to configure the part fixturing to accommodate pneumatic connections to the pressure port(s) of the sensors. In some cases this may be a simple O-ring seal on a nozzle.

Equally critical is a well-designed clamping mechanism to ensure flatness of the parts for beam focus considerations, especially if using small laser spots.



Probe card with mutiple needle sets for contacting several DUTs simultaneously, optimizing test / process time.



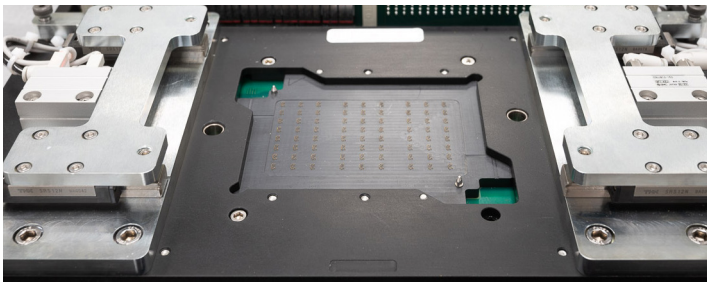
Tall pogo pin tips may allow flying probes to be used despite the height of the pressure sensor packages.

Probing and measurement options.

Both flying probes and probe cards can be used in this application. PPI can help the customer assess which of these techniques is the better fit for their requirements. If high accuracy is required, Kelvin probing is available.

As with fixturing, a whole variety of probing solutions can be considered. Standard probe needles (on probe cards or with flying probes) can be used if the surface features of the array of parts don't protrude much above the substrate. Often this is not the case and alternative methods need to be employed. When parts have high features, flying probes with tall pogo pins have proven quite successful.

In some cases the complexity of the relief on the top surface of the substrate prevents any top-side probing from either probe cards or flying probes. However, with backside contacts available there is another option. A fixture with an array of pogo pins can be used along with a pneumatic clamping mechanism to ensure contact with all contact points (over 1000 in the example below) on the substrate. Signals from each DUT are automatically routed by the switch matrix to any of the four independent source-measure units, each Kelvin-capable. With this in place the laser has full access to anywhere within the process field, with no time lost for repositioning of probe cards or flying probes, leading to very high throughput.



Part fixture with over 1000 pogo pins for backside contact with an array of sensors.

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Automation options.

Two main options are used. Single test boards with sensors in arrays of individual sockets are mounted in frames. These can be larger than the size of the process area (300x300mm) as long as the devices to be trimmed fall within this area. These frames are loaded manually and clamped in place.

Smaller substrates, again holding arrays of sensors, can be transported in magazines, and operation of standard magazine loader / unloader units can be integrated with the RapiTrim using the SMEMA interface. Substrates are moved from the magazine to a fixed pickup location using a short conveyor. A robot then picks up the substrate and places it on the fixture on the XY stage. If surface features preclude pickup by vacuum cups the robotic load head would use corner grippers to pick up the substrate.

An array of pressure sensors on an alumina substrate is presented to the RapiTrim's internal belt from either a magazine loader or directly by an external conveyor. A robot uses pneumatic corner grippers for pickup and transfer to the process chuck.

Job creation.

A DXF is still useful for importing all the geometry related to the sensor. However, it is likely that trimming will be more involved than simply making a simple DC measurement. There is typically a multi-step procedure required, and a script is written to handle this aspect of the trim and test process. The script can involve conditional processing (if-then-else...), looping, and control of additional measurement instruments, among other tasks. Execution of any of these processes is performed seamlessly within the RapiTrim job without the need for operator intervention.

PPI has your solution for pressure sensors.

RapiTrim

The Future of Resistor Trimming™