Introduction to Automated Test Fixtures

Testing of electronic assemblies involves three elements: the device under test, test equipment, and fixturing to make the connections between them. The challenge for a test engineer building a sophisticated test system is that instrumentation may need to measure thousands of test points through the mechanical interconnect.

Test Fixture Overview

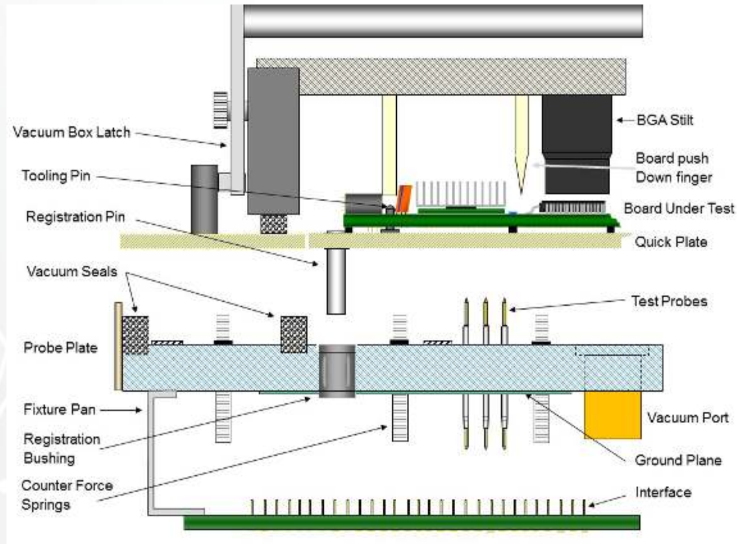
Below is a general representation of an automated test fixture. The vocabulary often used to define fixture based test systems include: Bare-board test - Printed circuit boards which are tested before any components are mounted. In-Circuit Test-Electrical test on an assembled board to check that all components are present, of the correct type and value, and connected together as expected with no shorts or opens. Functional Test - Testing a printed circuit board or product that is powered up and the circuit is exercised while operating.

Types of Test Fixtures

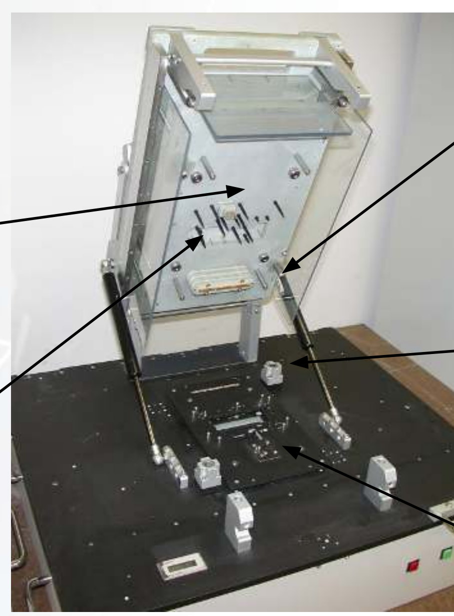
There are several common approaches to applying force to hold a product PCB against spring test probes, including mechanical arrangements, pneumatics and vacuum systems. In a mechanical system the probe plate and the product PCB are brought together by mechanical cams, levers and linkages. There are a wide variety of schemes in use, differing in complexity and cost. In more sophisticated test systems, most of the complexity is ensuring that the planes of the product and the probe plate remain parallel as the fixture operates. In simpler systems the pressure plate supporting the hold-down posts simply hinges down over the product. In a pneumatic system, the area between the probe plate and the product tested is pressed together by pneumatics that are placed on the top or bottom side of the fixture, sometimes both sides. Finally, in a vacuum system, the area between the probe plate and the product tested is a sealed cavity. A vacuum applied to this cavity pulls the two together.

CIRCUITCHECK

INNOVATIVE TEST SOLUTIONS



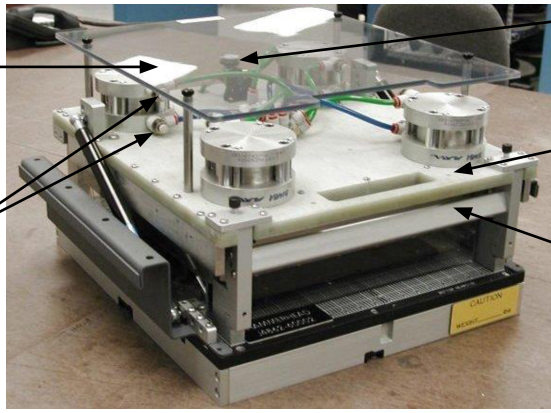
Manual Drive Fixtures



Pneumatic Drive Fixtures

Pneumatic Regulator

Pneumatic Air Cylinders



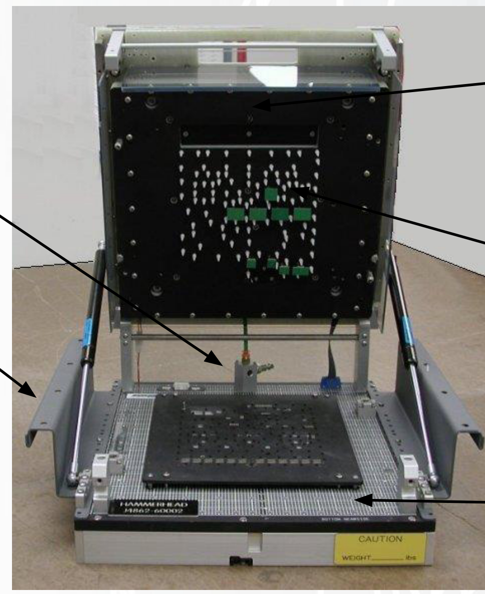
Pivot Plate

Flow Control

Latch Open Bar

Jumper Plate

Air Block



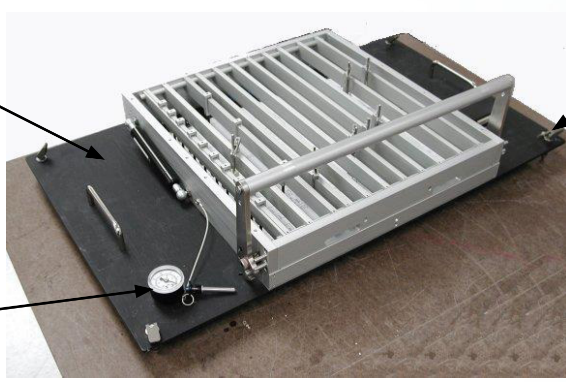
Top Side Probe Guide Plate

Fixture Lift Handles

Probe Plate

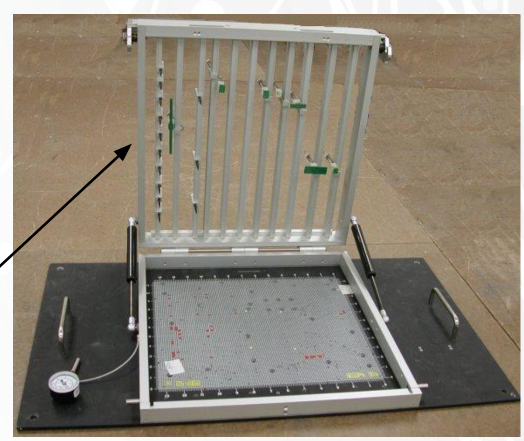
Heavy Duty Gate (HDG) - CAM Fixtures

Top Plate



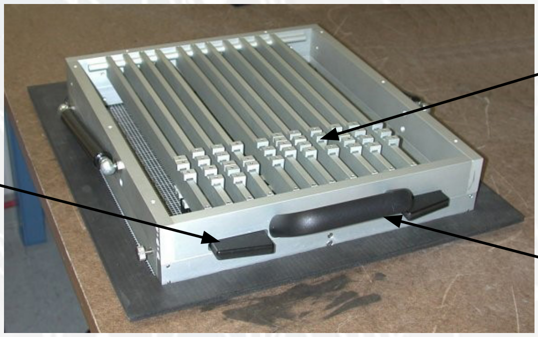
Locking Registration Pin

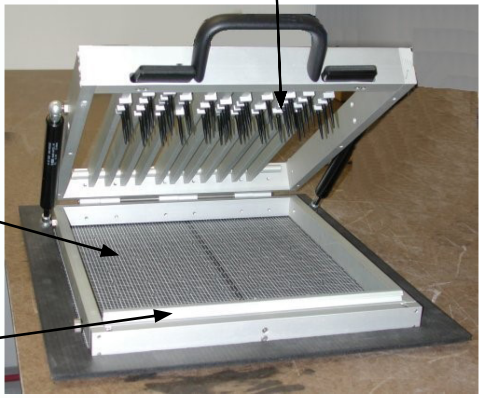
Vacuum Gauge (Optional)



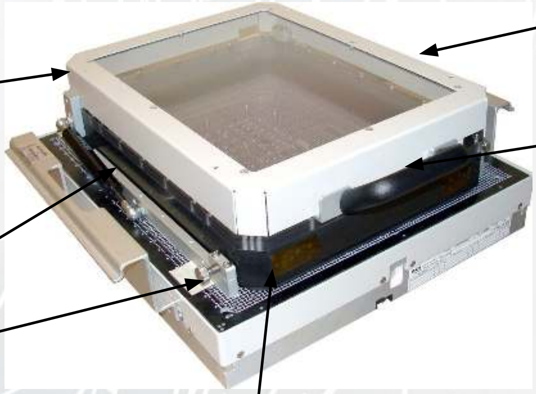
HDG Top

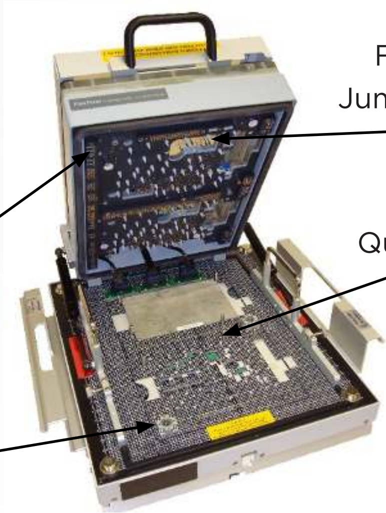
Heavy Duty Gate (HDG) - Thumb Latch Fixtures





Vacuum Actuation - Vacuum Box Fixtures





Test Fixture Wiring

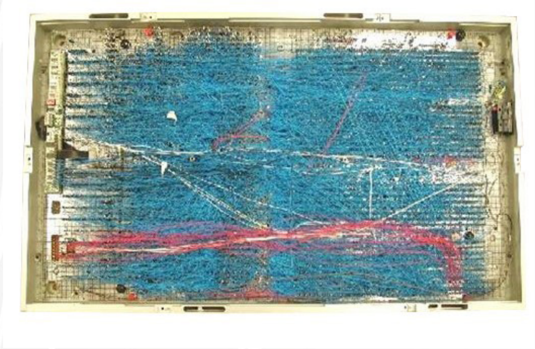
There are three major methods of establishing contact between the product printed circuit board being tested using a probe based test fixture, commonly called bead-of-nails fixture.   These methods include long-wire, short-wire, and wireless fixtures. Selecting the proper fixturing approach for a specific application is important to total system costs and tester longevity. In addition to fixture type, decisions often must be made as to allow for removable fixtures using some form of mass interconnect between the test instruments and the fixture. Examples include the following:

Long Wire Fixtures

On lower probe count product PCBs or prototypes where the design is subject to change, long-wire fixtures provide a very economical approach because they avoid nonrecurring costs.

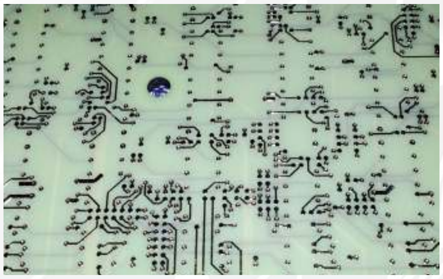
Short Wire Fixtures

Short-wire fixtures provide better signal fidelity than long-wire fixtures. Changes to a short-wire fixtures are often more difficult to perform than long-wire fixtures due to the wire densities associated with their compact design.

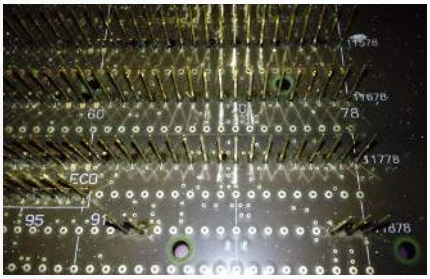


Wireless Fixtures

Advantages of a wireless fixture include decreased debug time, greater signal fidelity, increased capabilities to test low voltage and multi-logic modules, and reduced signal crosstalk. Wireless fixtures generally perform much more reliably than wired fixtures because PCB designers can control exactly how each trace is routed on the bottom side of the T-board, making it possible to isolate troublesome signals.



Double-Ended probes contact the Gold pads on the topside of the T-Board.



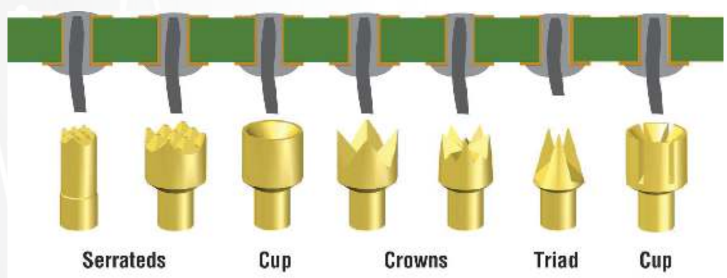
Stake Pins are soldered into the T-Board to make contact the tester's interface

Test Fixture Probe Tips

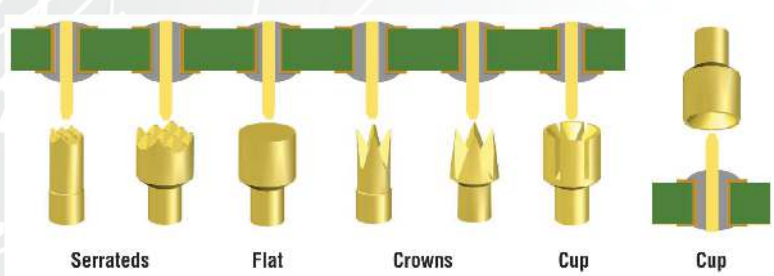
Spring loaded test probes are available in a variety of tip styles, plating, spring forces and travel to accommodate any test target. The test targets can be plated through hole (PTH) leads, plated vias, solder pads, bare vias etc. The internal spring that exerts force on the probe tip is usually selected depending on the surface finish of the test target, higher spring force is required to break through contaminants like oxides, fluxes and other surface preservatives. High concentration of excessive probe forces can be detrimental around sensitive components which often require Finite Element Analysis (FEA) to determine the correct and safe spring forces and Strain Gage testing for verification of strain levels.

Probe tip selection by surface:

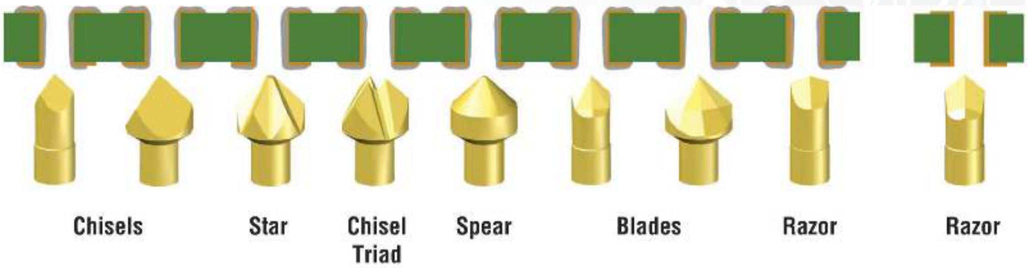
Leads: Choose the point style which will be most stable on the lead in order to minimize side loading the probe and to extend probe life. SERRATEDs are generally the most stable on long leads. CUPs can be used on extremely long leads but are likely to require more maintenance. Standard CROWNs (valleys cut straight across the point) are more stable than self-cleaning styles (valleys sloping down and out). Point styles with fewer tips or sharper internal geometry such as TRIADs are best used on short contaminated leads. Smaller leads will require tip styles with closely spaced cutting edges to trap the leads.

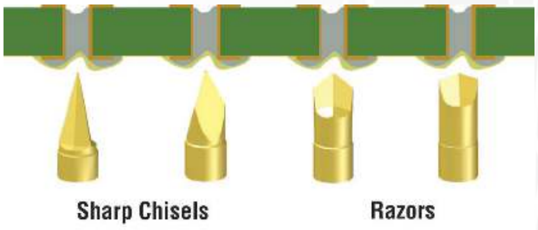


Terminals and Posts: SERRATEDs or FLATs are stable on this type of contact, but have little ability to penetrate contamination. Use FLATs in clean conditions and with higher spring forces. Self-cleaning CROWNs will require less maintenance than CUPs if used in an upward-pointing orientation, but are more likely than a CUP to glance off the post. Slotted CUPs are best when used upwards, since traditional CUPs can easily collect dust and contamination from the unit under test, they are best used in a horizontal or downward pointing orientation.



Pads: When contacting gold plated pads, CHISELs and SPHERICALs are recommended so that marking is minimized. Reduced CROWNs or TRIADs are good choices for contacting clean flat solder pads, as they distribute the force over a greater area (reducing the likelihood of marking the pad) but require more frequent maintenance. Use a SPEAR, SHARP CHISEL, SHARP NEEDLE or RAZOR to increase tip contact pressure for reliable testing of heavily oxidized or flux-coated solder pads.





Holes or Vias: Use a CHISEL or STAR to contact open holes. CHISELS have fewer contact edges than STARs and therefore higher contact pressure. The CHISEL TRIAD is a good choice for contacting open holes where flux is present. The SPEAR is used when the rim of the hole must remain free of marks. Contact is made on a circle rather than on sharp edges. The BLADEs and RAZORs will provide the highest penetrating pressure since contact is made on just two sharp cutting edges.

Solder Beads / Bumps / Domes: FLAT tip styles are the least aggressive and are used where minimal witness marks are desired. The MICRO-SERRATED are more durable and are recommended on points that have light flux residues. The FLAT STAR is self-cleaning and used when a board will see high cycle counts. The CENTER POINT STAR is the most aggressive, making them ideal for no-clean flux processes where sharper cutting edges are needed.

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Conclusion

To design and build a high performance test system, an engineer must understand how the measurement signals will travel from the instrument to the pins that touch the product under test. Testing of electronic assemblies involves three elements: the device under test, test equipment, and the fixturing to make the connections between them. Please contact Circuit Check Inc. to learn more about product test fixturing. Our experience and resources put us in a unique position to anticipate your needs and meet the challenges of complex test criteria and aggressive timetables.

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