Agilent
High Node Count Fixturing Solutions for Agilent Short-Wire Test Fixtures

Application Note

Agilent Technologies

High Node Count Fixturing Solutions for Agilent Short-Wire Test Fixtures

This paper discusses problems encountered in building large, high node count vacuum actuated test fixtures for the Agilent *Medalist* In-ciruit Test (ICT) family of board test systems. First is a discussion on the various problems that can occur in these applications followed by a description of two successful solutions that are recommended by Agilent. One of these solutions, the dual-plate method, is a new concept to many fixture builders and is described in some detail in this paper. The other solution, involving using a thicker probe plate, is straight-forward and requires little supporting explanation. In addition to the solutions discussed here, board test system users should also consider using mechanical fixturing solutions to deal with some of the problems discussed here. Mechanical fixturing will not eliminate probe plate bowing but it can be helpful in dealing with areas of dense probing. A variety of mechanical fixturing solutions for Agilent *Medalist* ICT fixturing applications are available from Agilent and from Agilent Channel Partners

Large, high node count test fixtures often present special challenges for the fixture finisher. A problem that has become more common as probing densities increase and boards get larger is related to the upward flexing of the fixture's probe plate. This flexing occurs when the fixture is pulled onto the system testhead and the system interface pins press upward against the bottom of the Personality Pins which are installed in the bottom of the probe plate. The probe plate "flexes" or "domes" in response to this upward force. The amount of flexing is affected by several factors. The flexing, if excessive, can cause problems in the operation of the fixture, including:

Sticking tooling pins. This is caused by the tooling pins not being absolutely parallel to each other as the plate flexes. Long, non-tapered, tightly fitting tooling pins are likely to bind against the sides of the DUT tooling pin holes and make it difficult to load or unload boards from the test fixture.

Vacuum sealing problems. When the plate domes, the seal between the DUT board and the fixture's vacuum seal may become difficult to maintain, making boards hard to pull down.

Intermittent probing. In the most severe cases, some probes may miss their targets, causing serious testing problems.

Problem Parameters Associated with Plate Flexing

Probe plate flexing occurs to some degree in all single-plate fixtures. Variables that govern how much the plate will flex or how much problem the flexing may cause include:

Number of nodes. As the node count increases, plate flexing increases. Higher node counts cause extra contact with the system interface pins and the total upward force on the plate increases. Also, higher node count means more drilling (and weakening) of the probe plate. A weaker plate flexes more. Fixtures with >2500 nodes are more likely to have problems caused by plate flexing.

Size of fixture. Large fixtures are more likely to have troublesome flexing than standard fixtures. Troublesome flexing is rare in standard size fixtures.

Probing pattern on DUT board. Boards with very dense probing along a line or narrow zone extending across the fixture are more likely to cause problems, because the plate drilling along this "line" weakens the fixture in a regular and troublesome pattern. Areas of dense probing near the center of the fixture tend to cause more flexing than areas near the edges.

Boards with small test targets. Although not actually affecting the amount of plate flexing, boards with test targets below about .035 inches are more likely to have problems due to the smaller probing error margins on these boards.

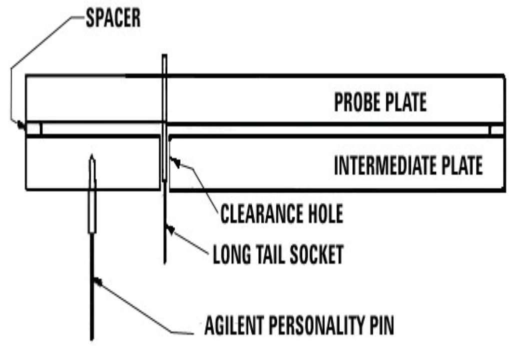
Fixtures with thin or weakened plates. Probe plates that are thinner than the standard 9/16 in. (.563 in.) or that have been weakened by machining away material for gasketing or hardware mounting are more likely to cause troublesome flexing.

Fixtures with excessive probe set-height. Excessive probe set height (> .58 in) increases probe pointing error and amplifies errors caused by probe plate flexing.

Avoiding plate flex problem

The best time to deal with probe plate flexing is before starting construction of the fixture. If your fixture will be >2500 nodes, you could be facing a flexing problem. The degree of flexing and the problems that will occur are hard to accurately quantify and can be largely a judgment call until you have thoroughly characterized your shop's materials and processes.

Here are some simple things you can do to reduce plate flexing:
• Do not use a thin or weakened probe plate. Avoid excessive machining of material away from the probe plate.
• Reduce probe set height to .58 in. or less.
• Take steps to improve probing accuracy such as using quality drilling methods, correct spindle speeds, etc., to improve the straightness of the probe receptacle holes. This will reduce probe pointing error.
• Use probes and receptacles with known low pointing error. Selecting probes and receptacles that have the best pointing accuracy can be difficult because these parameters are not specified in a consistent way on many of these products, but you can determine experimentally which devices work best in your process.
• Do not use tight-fitting or non-tapered tooling pins. They are more likely to stick. Consider using Agilent Variable Diameter Tooling Pins.
• Use two tooling pins to locate the board on the fixture. If three pins must be used to prevent board orientation problems, the third pin should be undersized to reduce pin sticking.



If you are expecting moderate or severe flexing problems (more likely to occur if you have two or three of the problem parameters), consider using one of the two following methods:

1. Use a thicker probe plate (available from various vendors & fixturing houses). This may be the preferred method if your fixture builder can drill the thicker material, and may also be the least expensive solution. A variation of this approach is to thicken a standard-thickness probe plate by adding an additional layer of probe plate material, sometimes called a “beef plate”.

2. Consider using the dual-plate modification. This method can greatly reduce upward probe plate flexing in most applications and does not require drilling thick probe plates. The method does require performing a number of extra construction steps and adding some special materials, so it could be more expensive.

Dual-Plate -- the concept

Instead of using the single fixture probe plate (the thick plate with probe receptacles on the top side and Personality Pins on the bottom side), the Agilent dual-plate uses two plates that are separated by a small distance--approximately .050 inch. The plates are attached around their perimeter, but no spacers or standoffs are used in the entire central area of the fixture. Long tail probe receptacles are installed in the probe plate; Personality Pins are installed in the intermediate plate. Upward plate bowing, which is caused by the force of the Personality Pins pressing against the spring-loaded pins on the Agilent 3070 pin cards, will still occur, but primarily in the intermediate plate where it will not affect the board-under-test. Probe plate bowing, due to the force of the P-Pins, will be close to zero until the two plates touch. At that point, a small amount of remaining upward force will be transferred to the probe plate as the final part of the force is absorbed, but *probe plate bowing* (which causes fixture contact problems) will be low because the *intermediate plate* has already counteracted most of the force.

How to implement the dual plate solution

(a) Use the standard probe plate (Agilent or other) for the Intermediate Plate.
(b) Select a ⅜ to 9/16 in. thick plate to use for the Probe Plate. A standard 9/16 in. Agilent probe plate can be used for this part, requires no modifications, and will be very strong. A thinner plate can be used, will weigh less, and not be as strong, but should be adequate for many applications. Consider any hardware that you intend to mount to the probe plate (top hats, gates, etc.) when deciding on the probe plate to use.
(c) Manufacture the perimeter spacer using .050 in. G10 material or something similar. Provide passage holes for fixture vacuum between the two plates (unless fixture does not use vacuum).
(d) Drill the plates. Personality Pin holes do not need to be drilled in the Probe Plate. Receptacle holes need to be drilled oversize in the Intermediate Plate to provide clearance for the receptacle tails.
(e) Assemble the plates and perimeter spacer. Use RTV or a similar adhesive to glue the plates and spacer assembly together.
(f) Install long-tail receptacles. Install Agilent Personality Pins.
(g) Wire the fixture plate assembly and finish assembling the fixture using your normal processes. Use long screws in place of the standard screws to attach the fixture plate assembly to the fixture walls.

Special fixure kits?

Agilent does not offer fixture kits based on either the dual-plate or thicker probe plate design. Because both of these modifications are fairly simple from a materials standpoint, we believe it is more efficient (requiring less inventory) to have fixture building companies add the additional materials in their shop on an as-needed basis. The added materials are readily available from several sources. The added plate for the dual-plate method can be either a normal Agilent probe plate, or can be fabricated from other materials. Long-tailed receptacles are available from probe and receptacle vendors. Thicker probe plates can be fabricated by some fixture finishing companies and are an effective solution if the finishing shop has the equipment and processes for properly drilling the thicker material.

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