American Standard Circuits
Sunstone Circuits

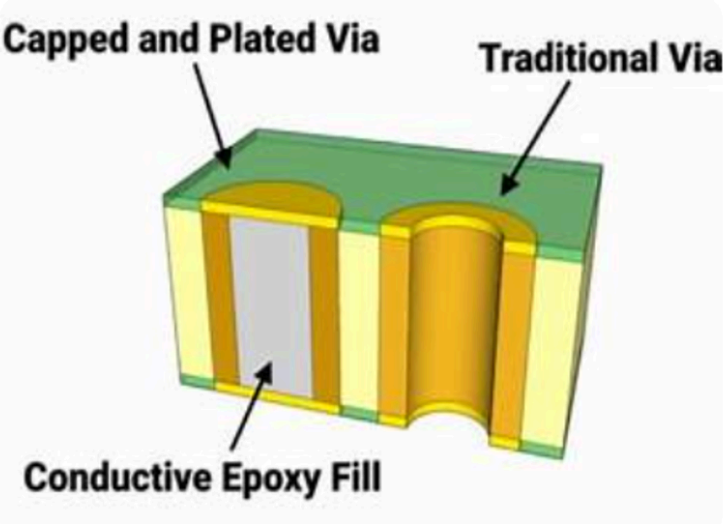
Ultra High Density Interconnects (UHDI)

Ultra HDI - Beyond The Traces - Copper Filling Of Vias

Ultra HDI and the VIA Challenge

Ultra High Density Interconnect (UHDI) design pushes PCB technology to its limits with sub-25 micron traces, ultra-thin dielectrics, and stacked microvias. To unlock these benefits, vias must be filled and plated in ways that keep pace with the density and reliability requirements.

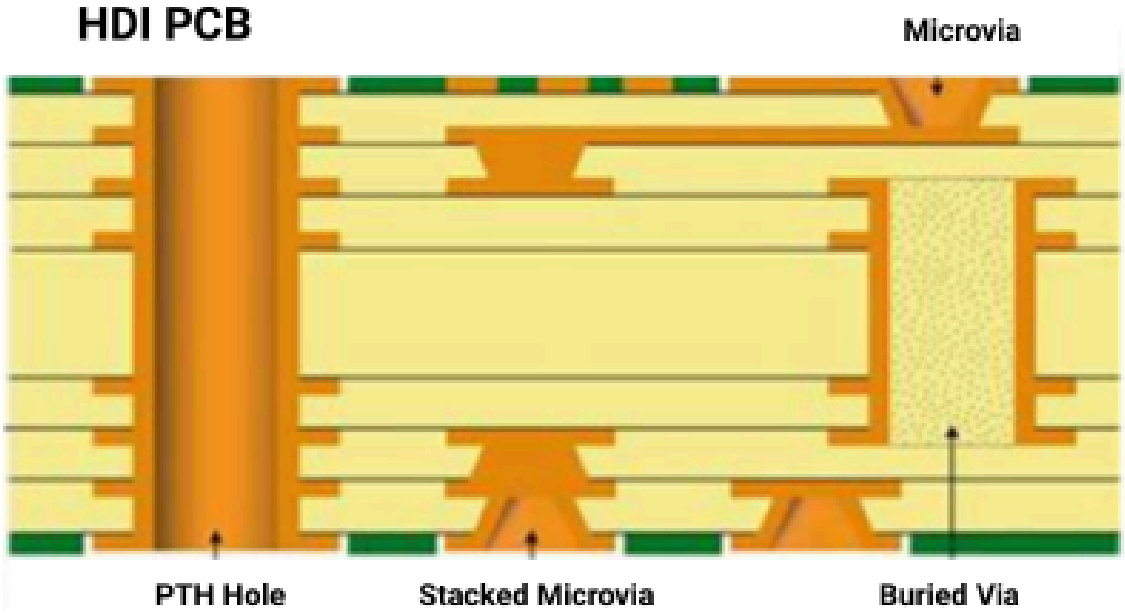
- **Traditional HDI:** Relied on resin fills and planarization, which introduced registration issues and reliability risks.
- **UHDI:** Uses copper-filled vias and innovative via fence strategies to achieve stable stacking, finer routing, and improved signal isolation.



American Standard Circuits
Sunstone Circuits

Ultra High Density Interconnects (UHDI)

Ultra HDI - Beyond The Traces - Via Structures



Why Copper Fill is Key to UHDI

Copper-filled vias support UHDI's drive toward smaller, denser, more reliable designs:

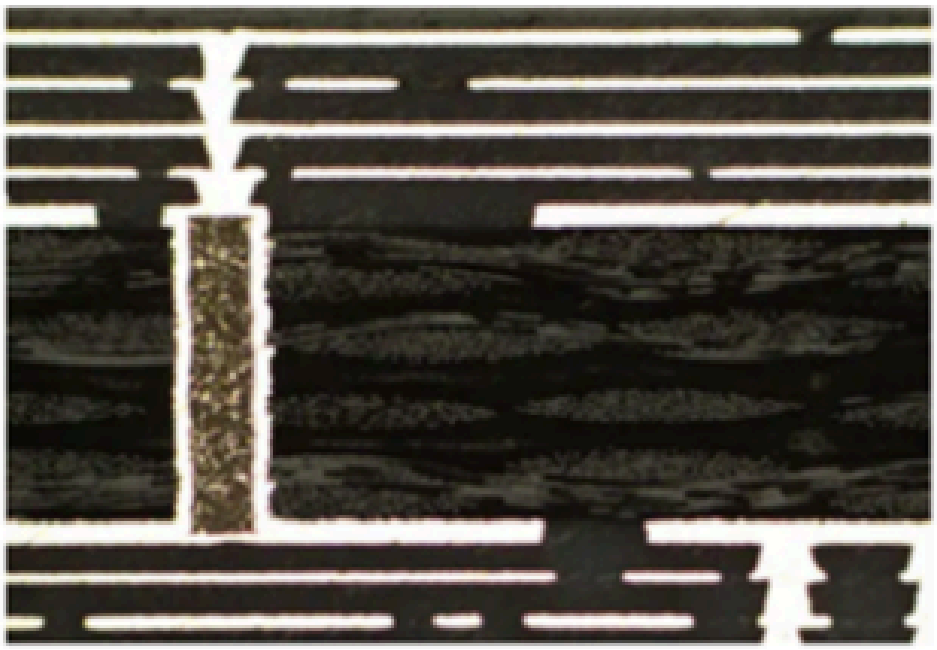
- **Stacking Reliability:** Copper provides a solid foundation for stacked microvias, eliminating concerns about drilling through weak resin caps.
- **Signal Integrity:** Landing on copper ensures consistent, low-resistance connections even at extreme geometries.
- **Registration Stability:** By avoiding aggressive planarization, UHDI designs maintain uniformity across the panel.

Design Note: UHDI fabricators typically require a 1:1 aspect ratio – a 50 µm via should not exceed a 50 µm dielectric. This balance between via size and dielectric thickness directly influences impedance and trace widths.

American Standard Circuits
Sunstone Circuits

Ultra High Density Interconnects (UHDI)

Ultra HDI - Beyond The Traces - Via Structures



Materials Make the Difference

UHDI leverages advanced substrate materials with low dielectric constants and high Tg values. These properties reduce Z-axis expansion, enabling via stacks of four or five layers with proven reflow reliability.

- **Earlier Limitations:** Stacks deeper than two layers risked cracks and opens.
- **Today's UHDI Materials:** Support deeper stacks and tighter integration, essential for aerospace, RF, and high-reliability applications.

American Standard Circuits
Sunstone Circuits

Ultra High Density Interconnects (UHDI)

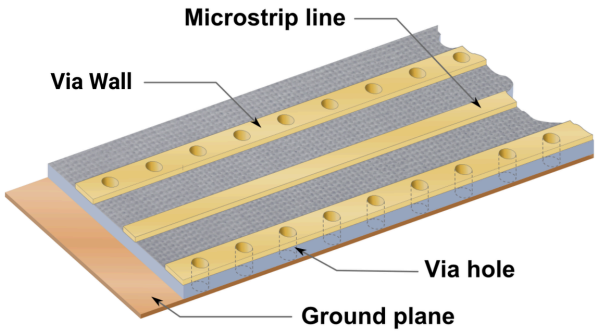
Ultra HDI - Beyond The Traces - Via Structures

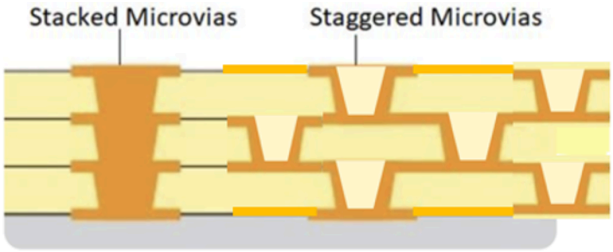
Via Wall Structures in UHDI

As line widths shrink and RF applications expand, via walls become a powerful design tool:

- **Signal Isolation:** Staggered or stacked vias form barriers that keep differential pairs tightly contained, like a waveguide.
- **Design Flexibility:** With UHDI's fine line capability, walls can be placed closer together, improving shielding without consuming routing space.
- **Reliability Advantage:** Staggered via fences reduce stress on the core and avoid zipper-like failures, enhancing mechanical robustness.

Think of it this way: copper-filled vias provide the vertical "posts," while UHDI design rules allow those posts to be arranged in precise wall patterns that block noise and secure clean signals.





American Standard Circuits
Sunstone Circuits

Ultra High Density Interconnects (UHDI)

Ultra HDI - Beyond The Traces - Via Structures

Practical UHDI Takeaways

- Copper fill is not optional in UHDI, it’s the backbone of reliable stacked via structures.
- Respect aspect ratios: Ultra-small vias demand ultra-thin dielectrics.
- Use new materials to extend stack depth without compromising reliability.
- Explore via fences for RF shielding and high-speed designs.
- Remember the real value of UHDI: reduced layers, improved SWaP, and higher performance through smarter interconnect strategies.

ASC experts work hand-in-hand with customers to identify the best method to achieve their desired results.

Contact Us Today!!

ADDITIONAL RESOURCES FOR YOU
OUR WEBSITE:
UHDI NEWSLETTER:
UHDI TECHNOLOGY, ADVANTAGES, DESIGN PARAMETERS AND FAQS IN A BROCHURE: