Registration Accuracy

5 mils | 10 mils | 5 mils

perfect registration

accurate registration

inaccurate registration

±0 mils

±1-5 mils

+5 mils

20 mils

✅ Accurate Registration
±1-5 mil tolerance

cross section

copper
substrate
copper

top view

1 mil

10 mils
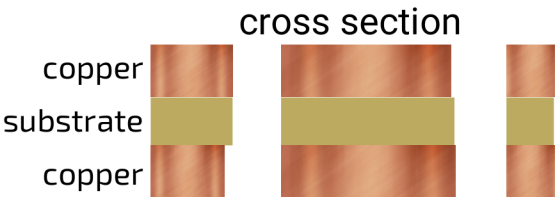
👎 Inaccurate Registration
+5 mil tolerance

cross section

top view

1 mil

10 mils
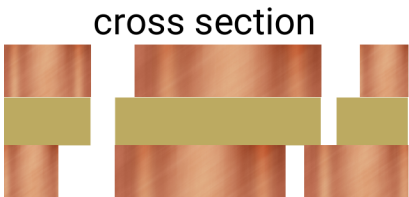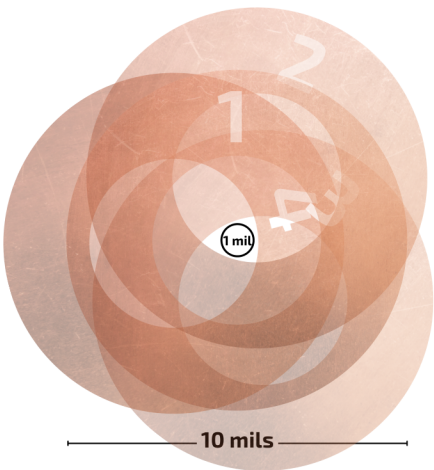
LDI — LASER Direct Imaging

- Front-to-back registration can be as tight as 10µm leaving very little error within a single core—providing excellent layer to layer registration.
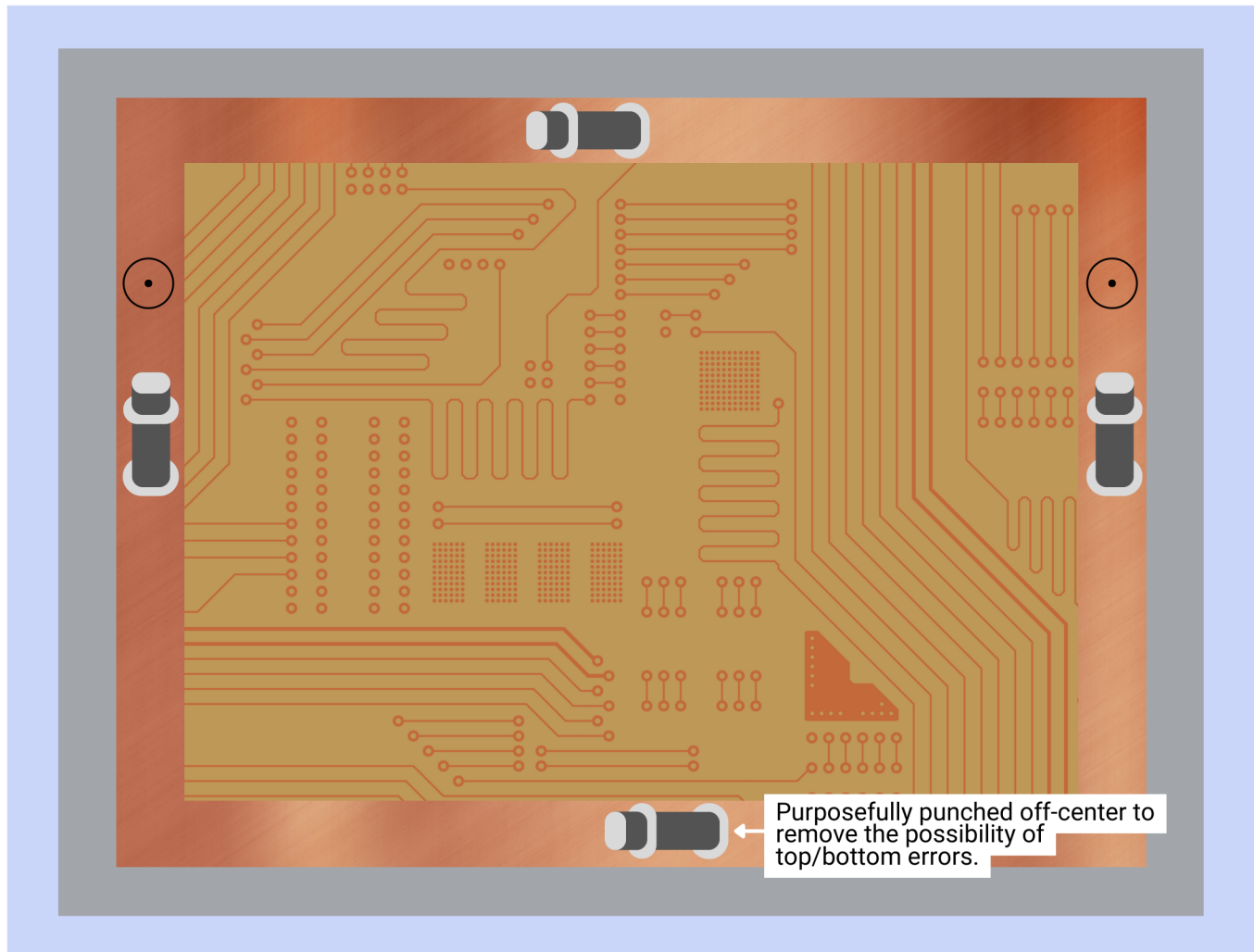
Registration Multi-Core — Core-to-Core

PEP — Post-Etch-Punch — ±3-5 mils accuracy
- Also known as hard-pinning
- This process uses imaged & etched targets (fiducials) and up to 8 camera systems to calculate center of the targets. Aligning the image to center and "punches" 4 slotted tooling holes into each core to place hard-pins into.
- This type of tooling is featured in most board shops, both foreign and domestic.
- **Most Flexible** — offers high accuracy at a lower cost than most registration types.

Purposefully punched off-center to remove the possibility of top/bottom errors.

Registration Pins — flat on two sides to decrease mis-alignment

⊙ PEP Target - Post-Etch-Punch

American Standard Circuits
Sunstone Circuits

Registration Multi-Core — Core-to-Core

Optical/Welded — alternate pin-less method — ±1-3 mils accuracy
- **In use since 1999** — slowly on the rise worldwide but mostly used in Asia, where PCB fabrication is newer.
- **Most Accurate** — though HDI and/or high-layer count boards are often done using hard-pin registration, pin-less optical/welded registration offers significant benefits for accurate alignment with tight spaces, traces and hole density.
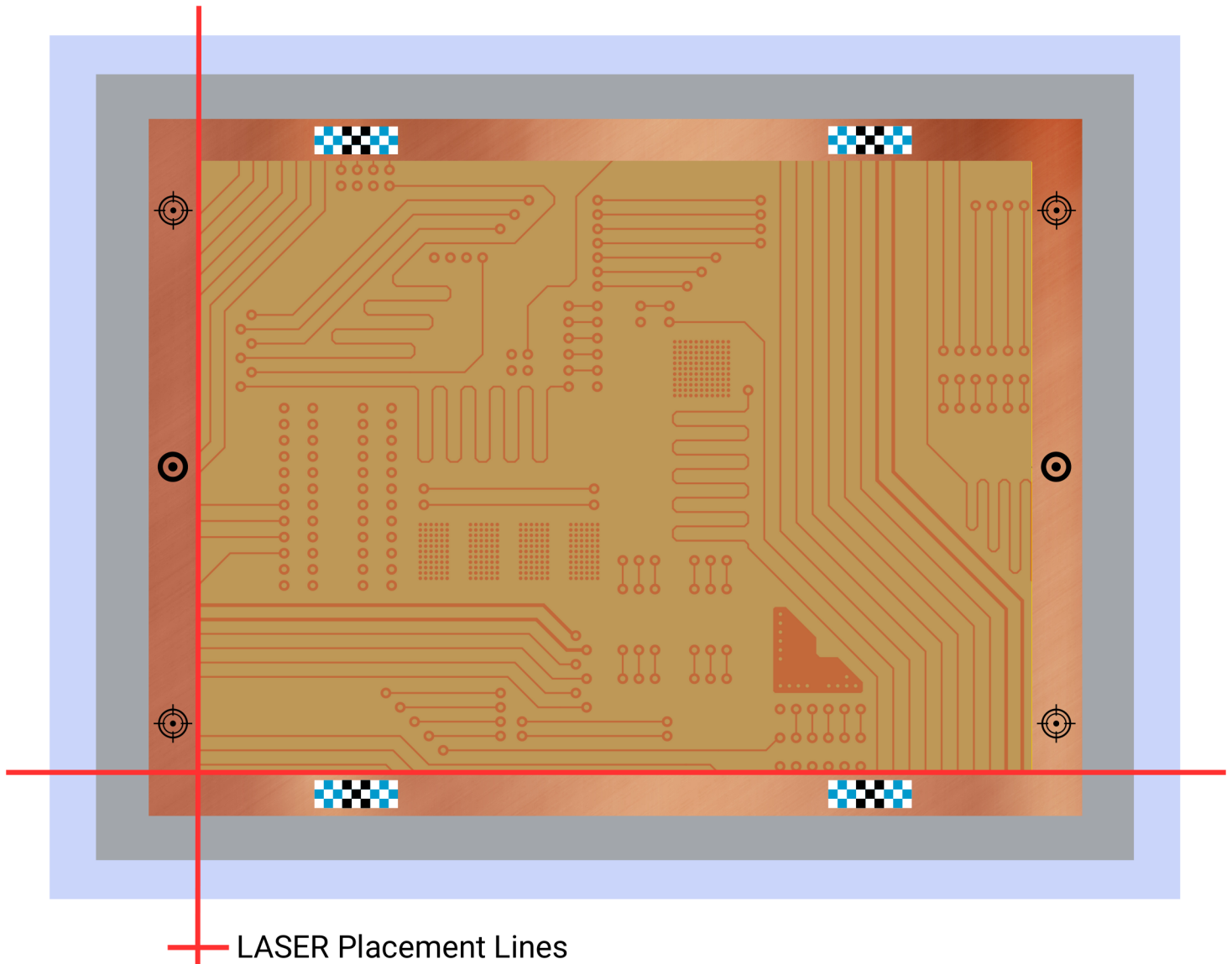
──┼── LASER Placement Lines

⊕ Corner Targets — 4x Top & Bottom — for layer measurement

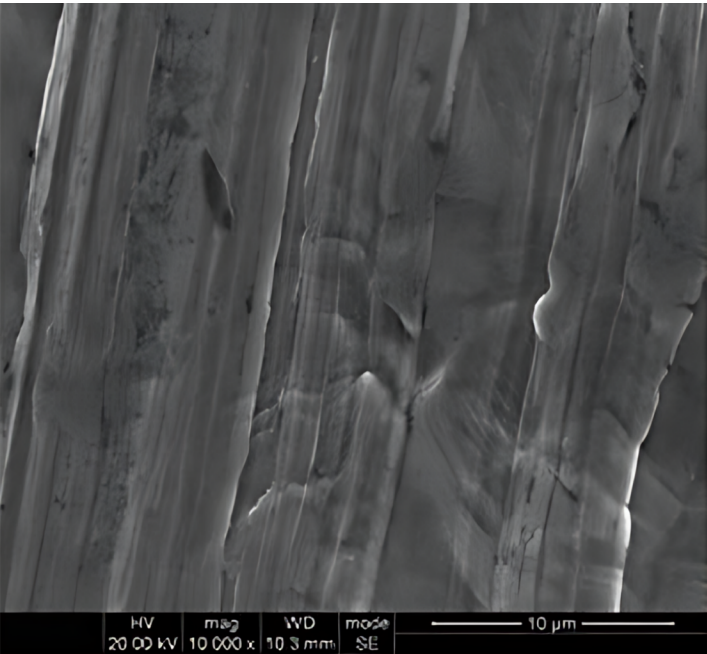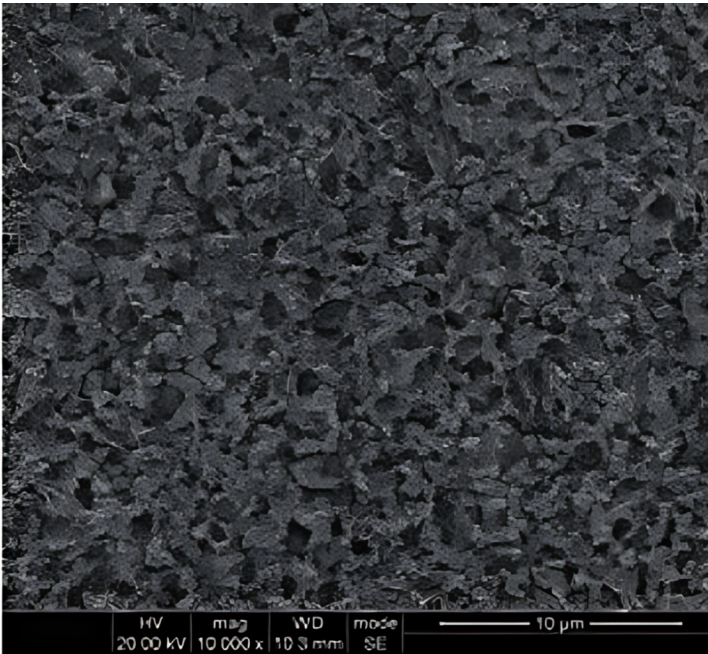◉ Alignment Targets — 2x Top & Bottom

▦ Weld Coupons — 4x

American Standard Circuits
Sunstone Circuits

Oxide SEM—Before & After

Scanning Electron Microscopy photos of a board before and after oxide process.

before
Smooth Copper

after
Oxided (roughened) Copper