

TECH NOTES – Analyzing Shift

REGISTRATION **SHIFT** ERROR IN PCBs Progression of Analysis

1. **Front-to-back error - Occurs during dry-film exposure**

A) If it is random, it may be caused by *tooling variables*, such as:

- * worn pins
- * loose hinges
- * damaged holes
- * irregular/uneven vacuum pull-down
- * loose micrometer adjusters

B) If the error is repetitive, it is caused by artwork *set-up error*, such as:

- * incorrect or defective punch targets
- * operator error
- * mechanical non-repeatability of punch
- * plotter out-of-square
- * mechanical alignment problems in exposure frame

When the core leaves the dry-film exposure process, front-to-back registration is permanently set.

2. **Core-to-core error - Occurs during lamination**

A) If it is random, it may be caused by:

- * too much force used during stack-up
- * loose or worn tooling pins or holes
- * variation in post-etch-punch

B) If it is repetitive, it is caused by set-up error, such as:

- * incorrect post-etch punch target (CAM or plotting)
- * inaccurate datum or reference calibration on post-etch punch

When the stack leaves lamination, core-to-core registration is permanently set.

3. **Panel-to-panel error - Occurs during drill**

A) If it is random from panel to panel, it is caused by:

- * loose tooling at the drill table

- * worn “soft” tooling or pins
 - * variation/non-repeatability of the pinning function
 - * inability of drill to repeat “zero” address
- B) If it is repetitive/consistent from panel to panel, it is caused by:
- * incorrect set-up of pins at pinning function
 - * incorrect “zero” reference calibration of drill

4. Other variables that may affect or corrupt the above data-driven process:

- * environmental effects on artwork
- * variability in press cycles
- * variability in materials
- * scaling the drill to match outer layers

Registration error is almost always caused by a *combination* of the factors described above. To isolate the *causes*, it is necessary to use the PerfectTest data to separate the variable *results/symptoms* as described above. It is then possible and *realistic* to make the appropriate process improvements.



Processes and systems described here have become the primary tools for controlling material scaling and registration with fabricators worldwide, ranging from the very largest to some of the smallest. These processes and systems are protected by patents worldwide.

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