SW Test Workshop

Semiconductor Wafer Test Workshop

Probe Mark Inspection (PMI)

Present & Roadmap *(FastPMI)* process on Accretech TSK probers

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Overview

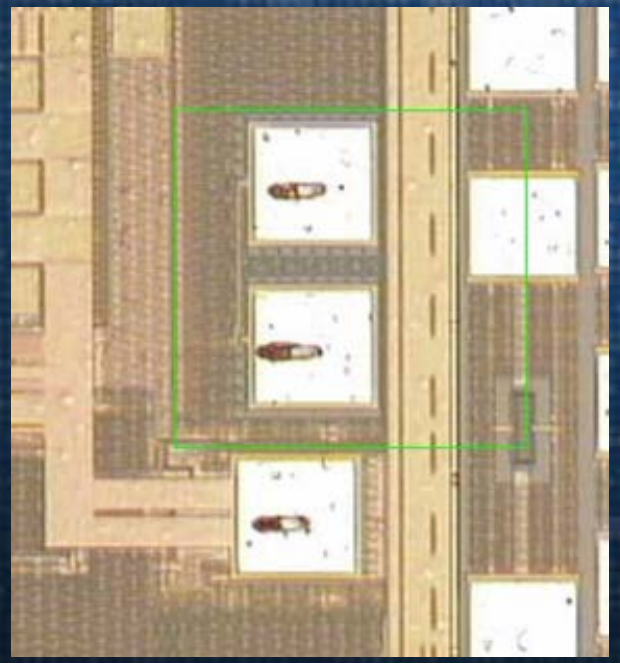
- Intro / Background
- Objectives
- Methods
- Results
- Summary
- Follow-On Work

Intro / Background

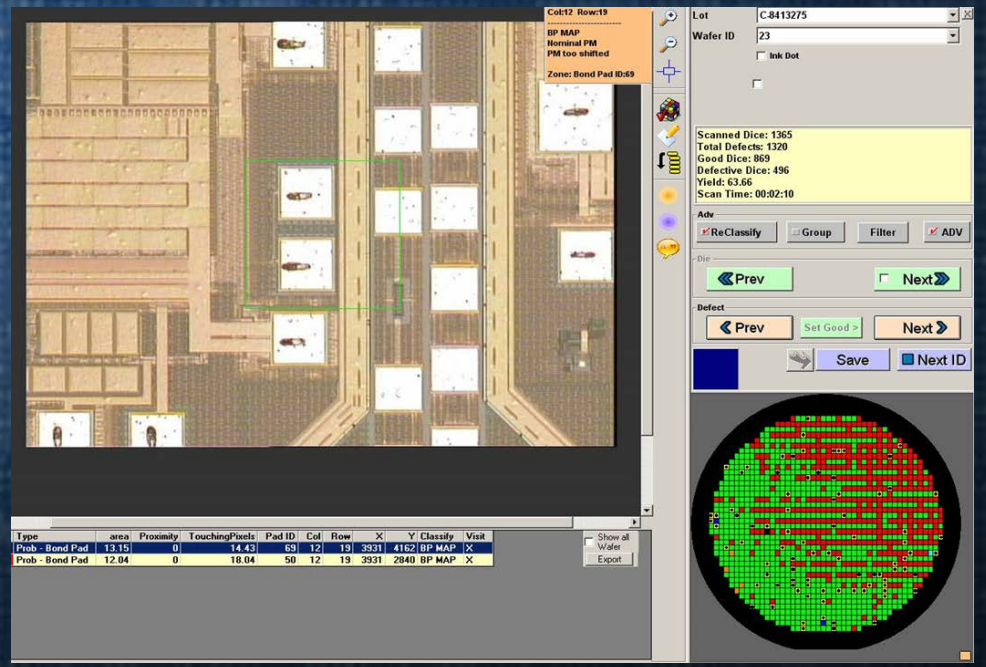
- **Probe Mark Inspection (PMI) has become increasingly important in the world of wafer probe. Allowing the probe scrubs to hit the edge of the bondpad and break the Protective Overcoat (PO) layer of the die can lead to quality issues. Therefore, damage caused by misaligned probe marks can result in die being scrapped and only found at out-going inspection, where they are the most expensive.**

- **The most challenging products for probe misalignment are those that:**
  - have multiple probe insertions
  - probe at higher temperatures.

Example: Probe misalignment



Example: Outgoing automatic inspection (AVI) scrap



Intro / Background

- PMI, completed at routine intervals during probing, is a key manufacturing process to periodically verify that the probe marks are not close to the PO edge.

- This used to be done manually by the Operator, until the prober's current On-Demand PMI function became available. This function automatically inspects all sites/pads of the probe card array on the wafer, at the user's request, giving 100% coverage with pass/fail results.

- Operator has to then decide whether or not to adjust probe marks, or identify any probe card or tool issues for technician evaluation.

Intro / Background

- **The downside to this process is that test time overhead increases since the tool has to be stopped while performing PMI.**

- **Optimizing PMI to be as fast and efficient as possible is the path towards achieving true success for both quality and efficiency.**

Objectives

- **This paper will look at TI's evolution of PMI, utilizing the current On-Demand function, and looking ahead to the new FastPMI software/hardware upgrade for the Accretech TSK prober, which speeds the prober's PMI execution time while retaining every bit of accuracy.**
- **In this presentation, the advantages and requirements for these will be shown, as well as comparisons in speed for the different PMI functions.**

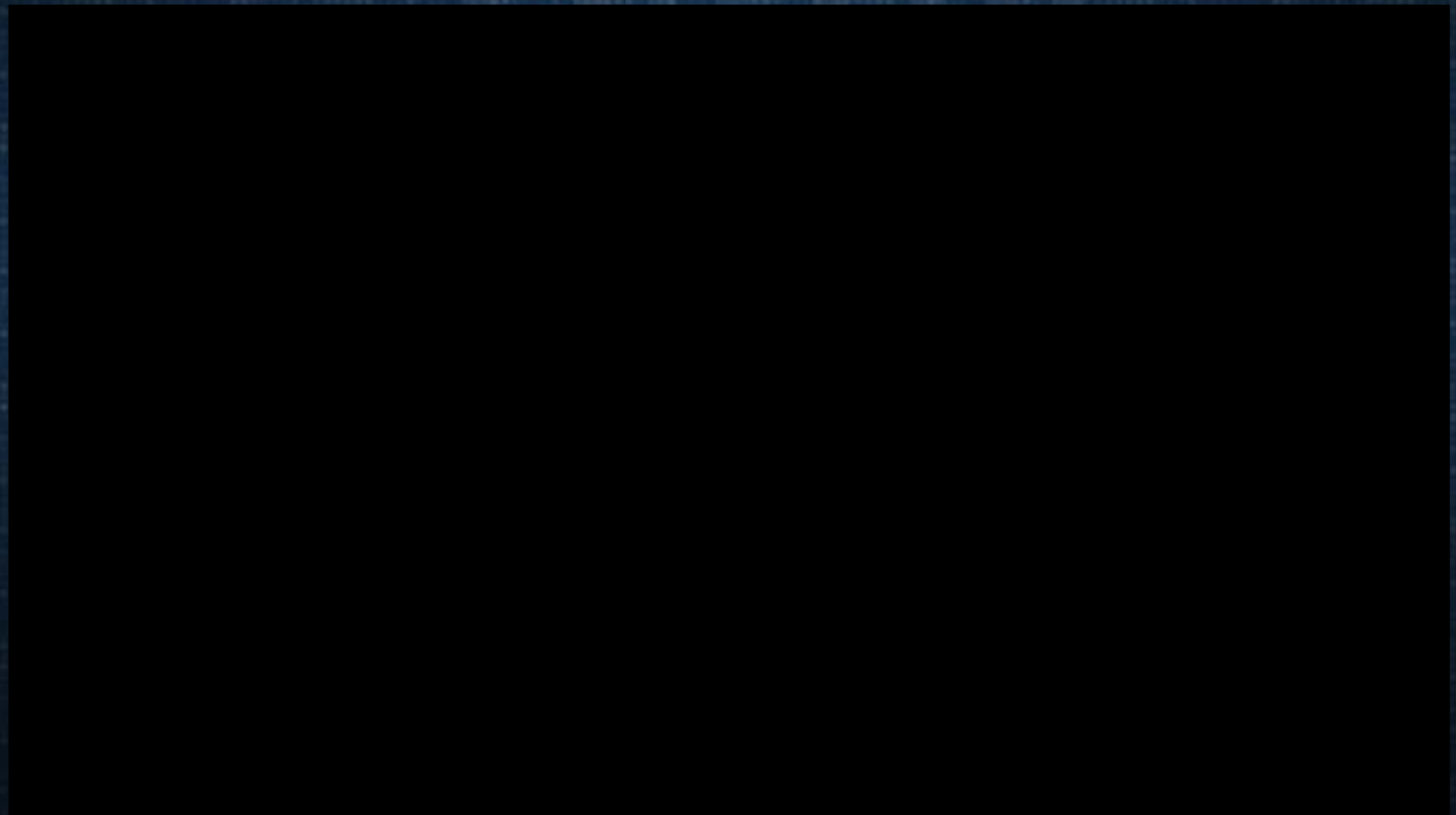
- **Key parameters to look at:**
  - Speed / execution time
  - Auto Visual Inspection (AVI) yield loss scrap improvement

PMI Method Evolution

- ***Before → Manual PMI (human)***
  - Time consuming
  - Inefficient
  - Prone to variance
- **<u>Current</u> → On-Demand PMI (prober auto inspection software)**
  - Faster
  - Efficient
  - More accurate
- **Future → FastPMI (faster version of On-Demand)**
  - Even faster

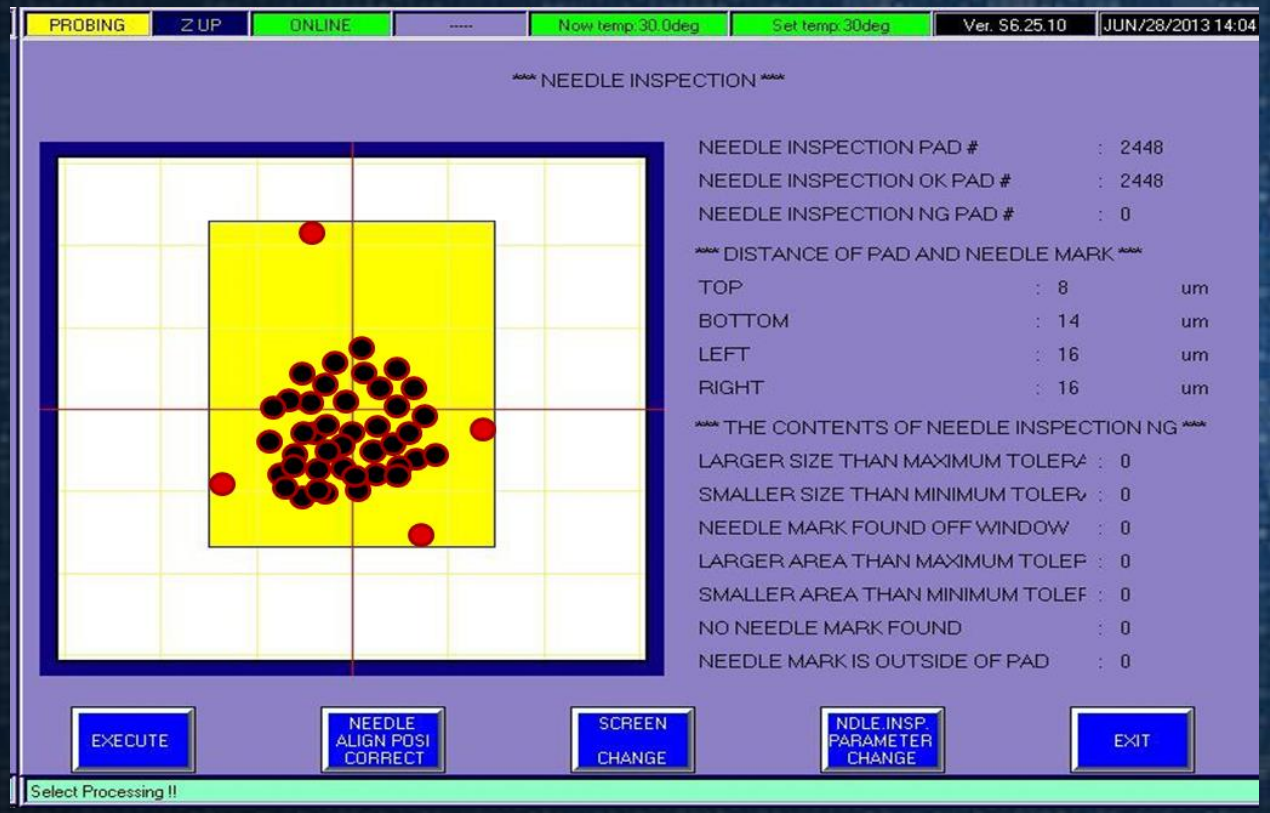
PMI comparison – Manual vs On-Demand

- This video will show the process difference between manual and On-Demand PMI.



On-Demand PMI

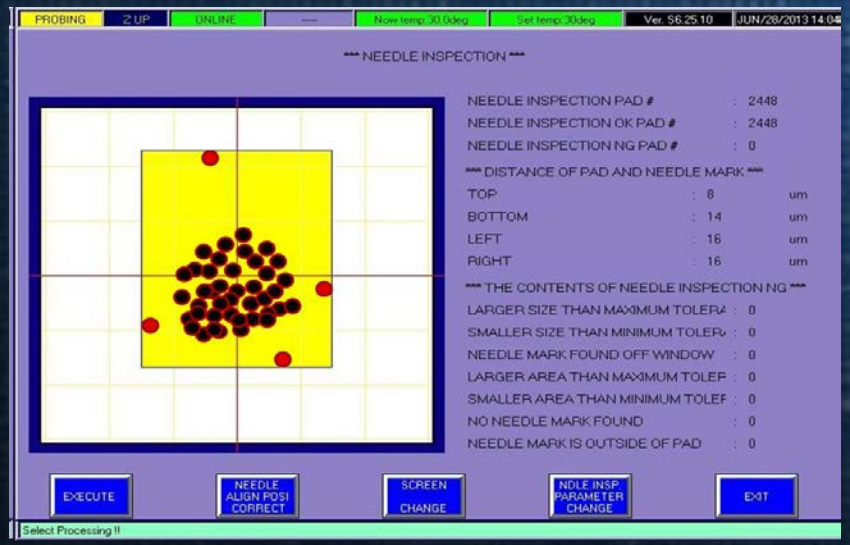
On-Demand PMI result screen

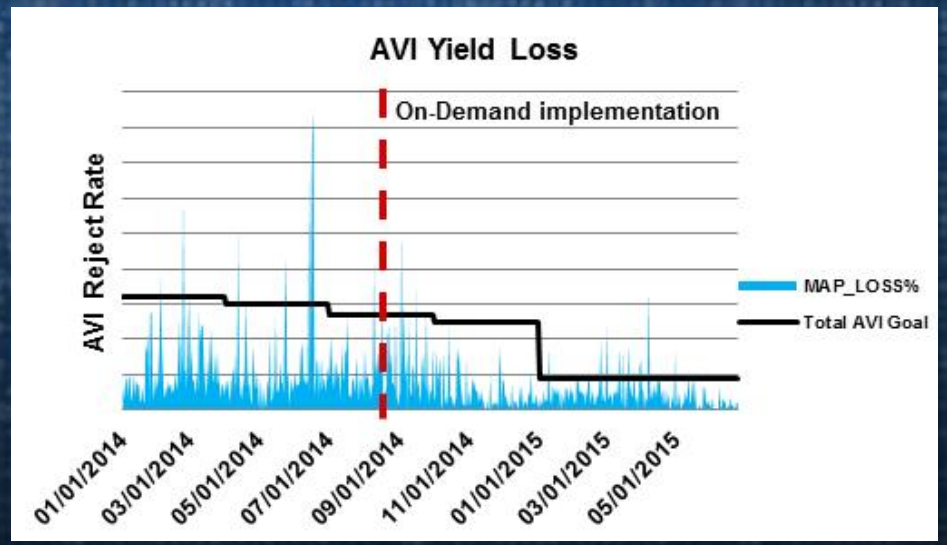


- Developed with TI's request for desired features and functionality to support critical PMI needs, especially for Automotive products
- Available for UF200/300/3000 (software upgrade)
- Requires updating all prober product files and registering every bond pad on the die
  - very time consuming initially

Results: On-Demand PMI

- **100% inspection, Standardization → Reduce AVI yield loss from misalignment probe**
- **Faster inspection time vs. the average manual inspection (especially for larger array cards)**
  - 30% faster for a 16-site card
- **Pin-point accuracy**
  - Single bent/missing pins can be identified quickly
- **Any aluminum-pad card technology can be inspected (even VPC)**





- **Impact benefits**
  - 40% reduction in probe misalignment loss
  - Efficiency / throughput gain, 28% reduction in PMI execution time
  - Cost/time savings per year
  - Enables mfg to attend to other duties while On-Demand is running

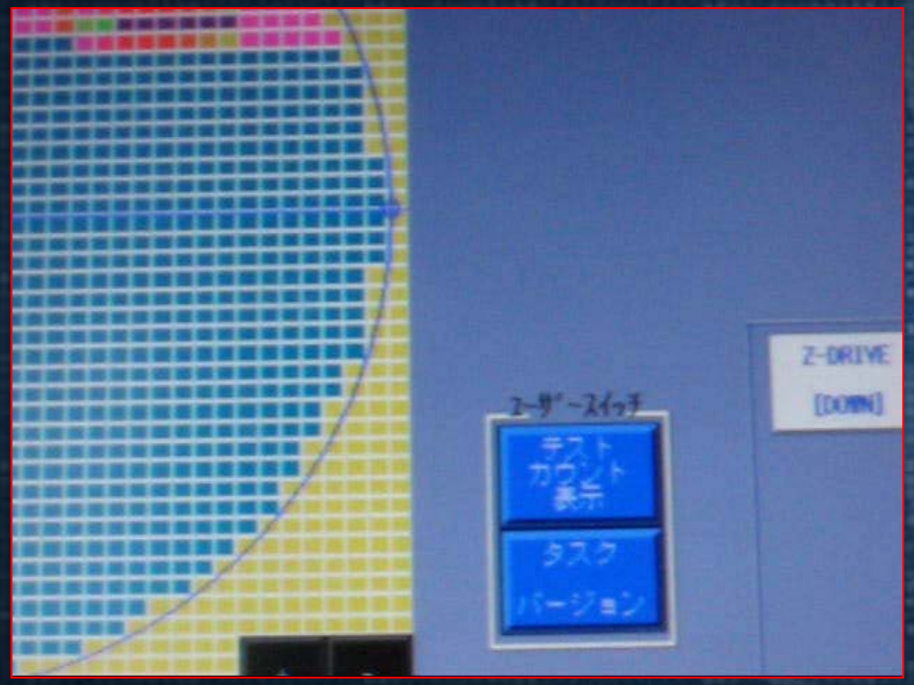
Going forward: FastPMI - Methods / Requirements

- **The FastPMI function can only be utilized on newer Accretech prober models:**
  - UF3000 (requires prober CPU hardware/software upgrade)
  - UF3000EX/EX-e (requires software only)

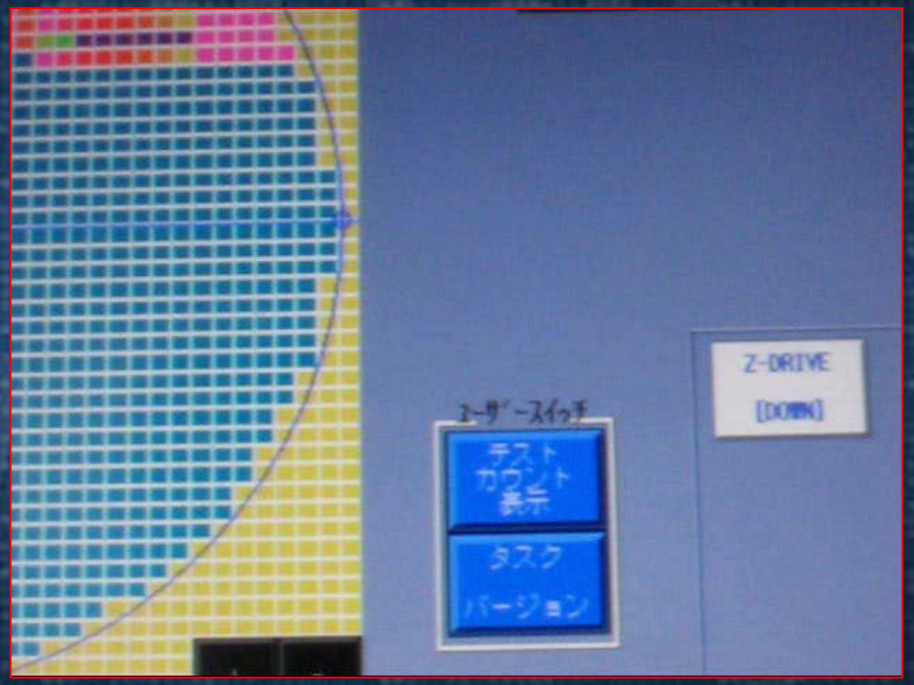
- **The FastPMI evaluation was done on a few TI UF3000 probers on production devices, and compared to the standard On-Demand PMI function (regular speed)**

Results – On-Demand vs FastPMI

- **Speed comparison (video)**



On-Demand PMI (standard)

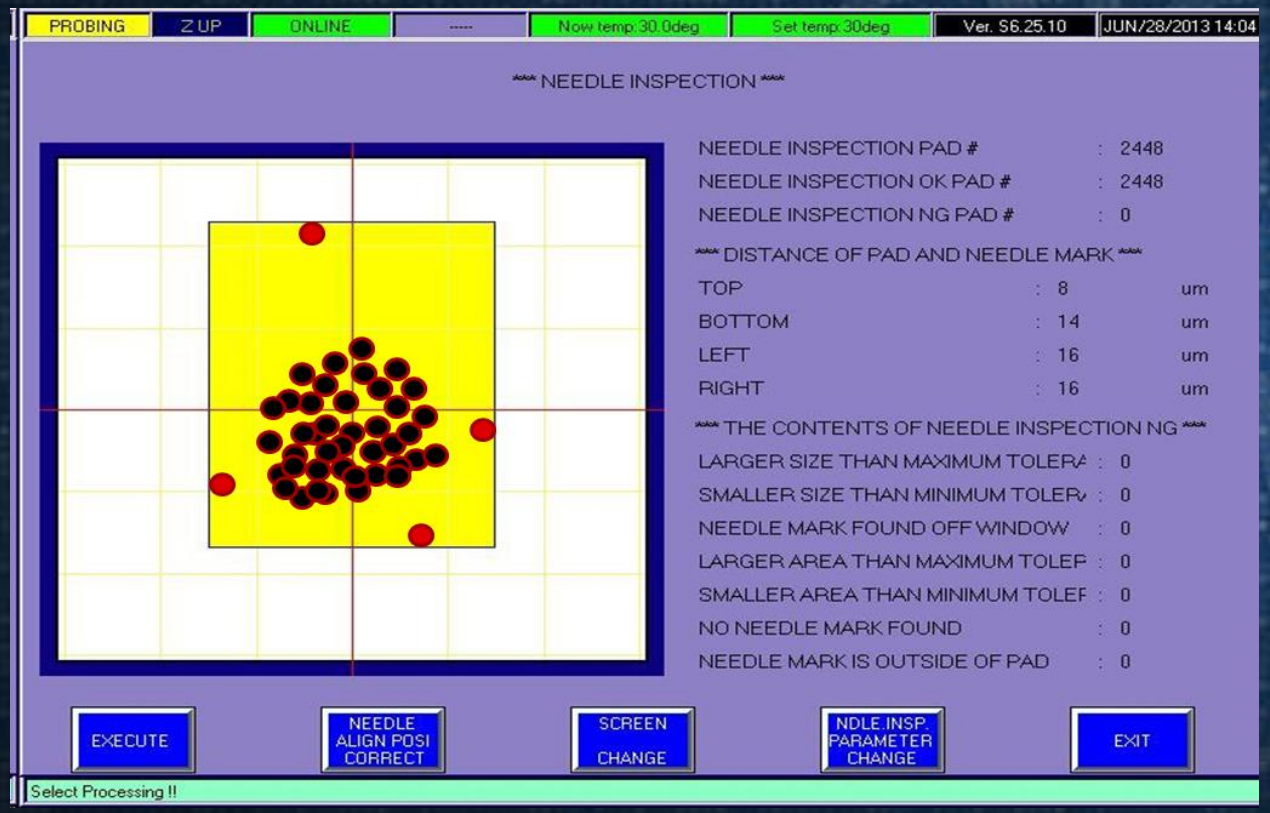


Fast PMI

- **Conditions**
  - 2448 pads, x16 multi site
- **Results**
  - **~75% faster execution time**
  - Same accuracy is maintained

Results

- **PMI result screen after execution**



- Consistent 100% inspection of all probe marks
- Standardizes/automates the PMI process, removing the human element, reduced variability
- Single bent pin excursion detection/prevention

Summary

- **FastPMI speeds up the execution time up to 75% on average, increasing**
  - Throughput
  - Efficiency
  - Decreases operational costs
- **Retains full accuracy, consistency of inspection**
- **Increased benefit on large array (x32, x64, x128, etc) platforms and devices**
- **Relative high upgrade cost per prober**

Future Work

- TI has a few probers upgraded with the FastPMI option. Currently working on cost justification to upgrade the rest of the prober fleet.

- Also entertaining possibility of “ScanPMI” option from Accretech.

Acknowledgements

- Mark Gillette – Texas Instruments, EE
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Questions