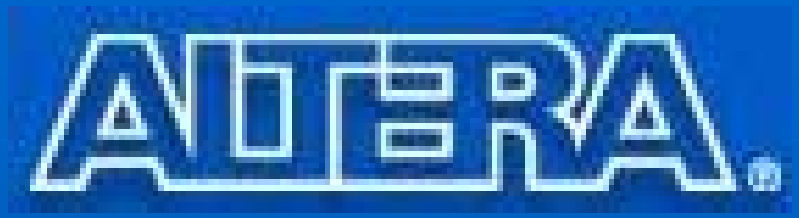

Implementing Inkless Wafer Sort

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Implementing Inkless Wafer Sort

- Introduction
- Benefits - Why implement inkless wafer sort?
- Inkless process flow example
- Implementation goals
- Requirements - key items for implementation
- Possible problems & solutions
- Summary

Introduction

- Altera is a fab-less FPGA / programmable logic company and does wafer sort in San Jose and at off-shore foundries
  - Started out with in-line inking
  - Progressed to off-line inking
  - Decided engineering time better spent on eliminating inking issues
- Process wafers from wafer sort to assembly without **INK!**
  - Electronic Wafer Maps identify passing and failing dice on each wafer
  - Visual Inspection rejects identified on wafer maps
  - It is NOT a quick fix to “push” count variance problems onto assembly. (And you don’t immediately say “good bye” to Xandex!)
  - It is part of an ongoing wafer sort improvement process

Benefits - Why Implement Inkless Wafer Sort?

- Increased Productivity
  - Reduced Cycle time.
    - Eliminates inking step
    - Eliminates ink cure time
  - Eliminate rework due to inking errors
  - Allows for good die recovery (no ink to remove)
  - More assembly flexibility
    - Speed binning die segregation
    - Qualifications of non-passing dice
    - Additional assembly “EPR” capabilities: binning, qualifications, sampling, etc.

Benefits - Why Implement Inkless Wafer Sort?

- Increased quality
  - No chance of inking incorrect dice or dripping ink on good dice.
  - Reduce chance for wafer breakage and bump damage
  - Solder-bumped wafers can be re-flowed if necessary
  - Reduces count discrepancies
  - Improves data systems

Inkless Process Flow Example

Wafer Sort - Includes Multiple Sort Steps

Sort Data

Wafer Flow

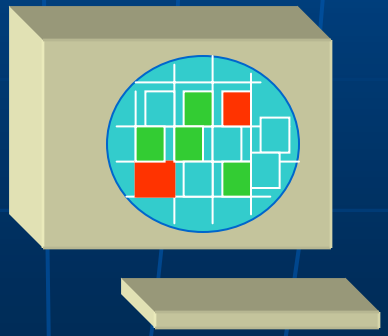
Network Server

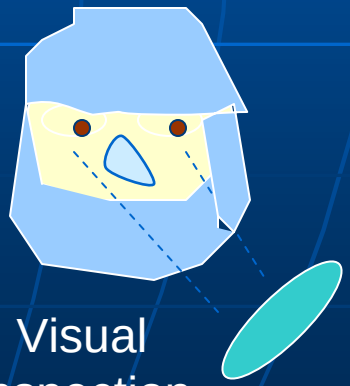
"Visual Inspector" computer – pulls Sort Data files and generates .vis data

.vis data

.vis data

Outgoing QA Inspection



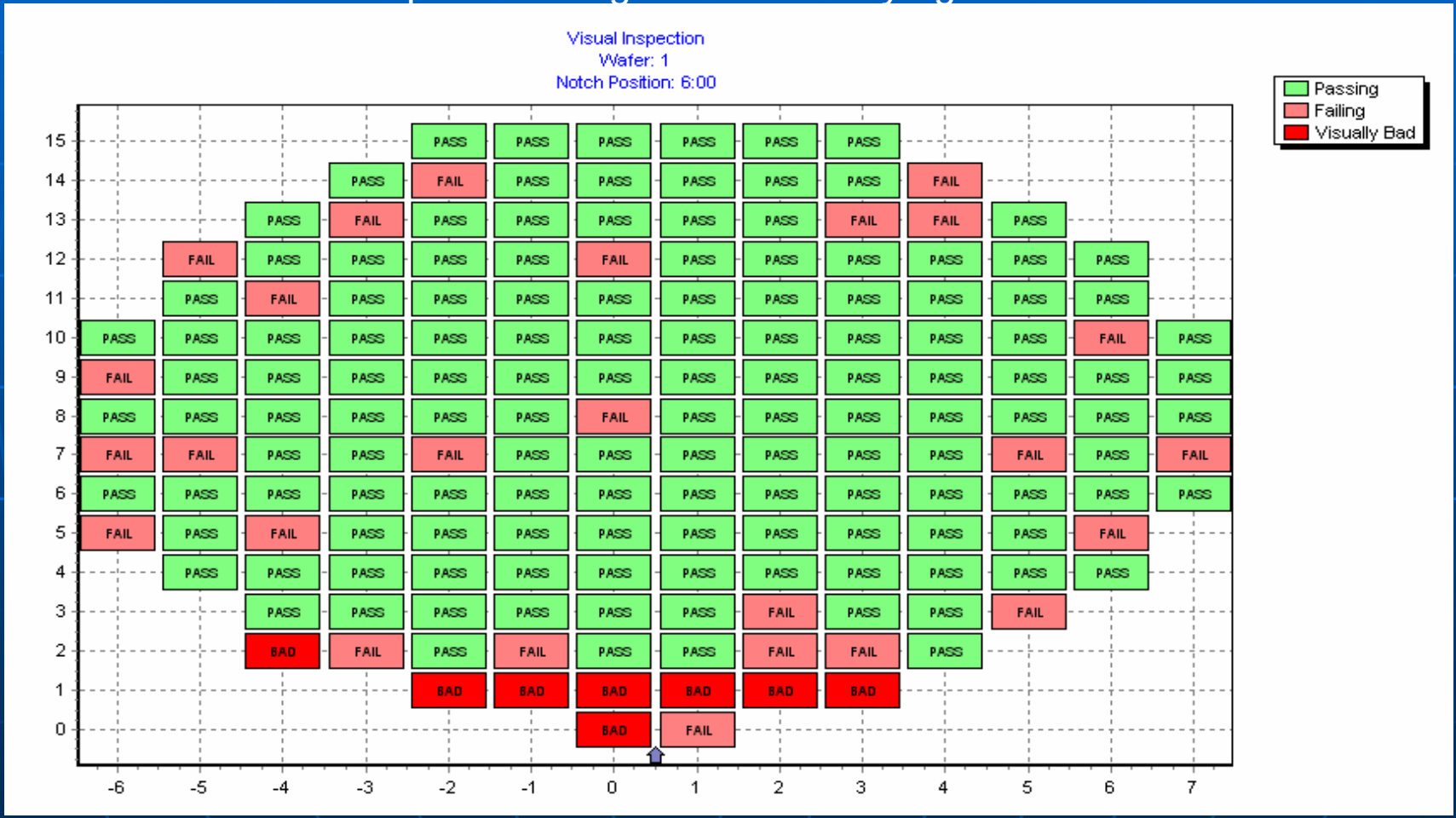


Inspection Data ".vis" file stays with lot data on server

Visual Inspection

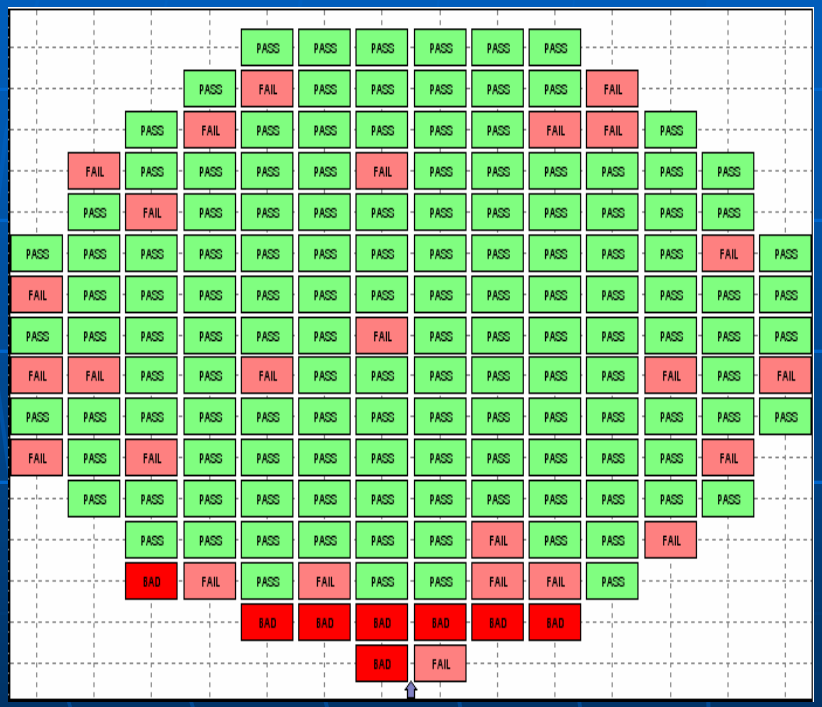
Inkless Process Flow Example

"Visual Inspector" Program for identifying visual defects



Inkless Process Flow Example

- Visual Inspection file (.VIS) over-laid onto Sort Data files.



.VIS map

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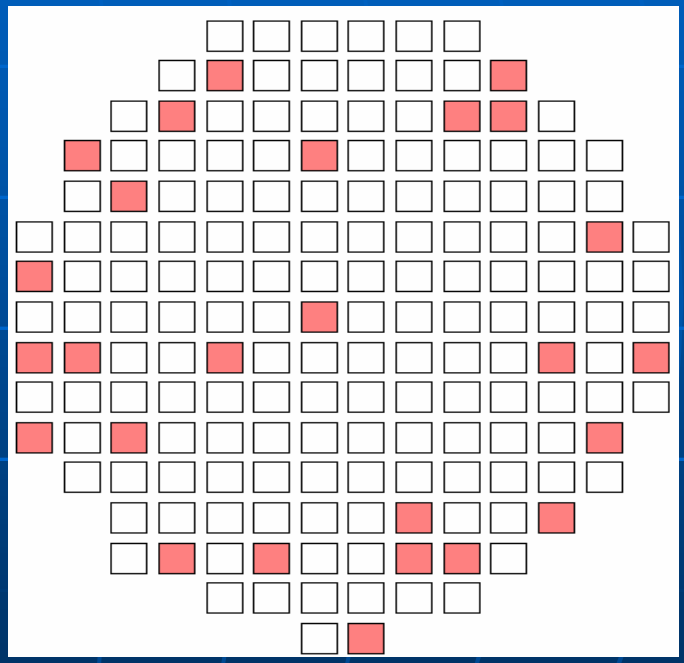

Sort Data map

Inkless Process Flow Example

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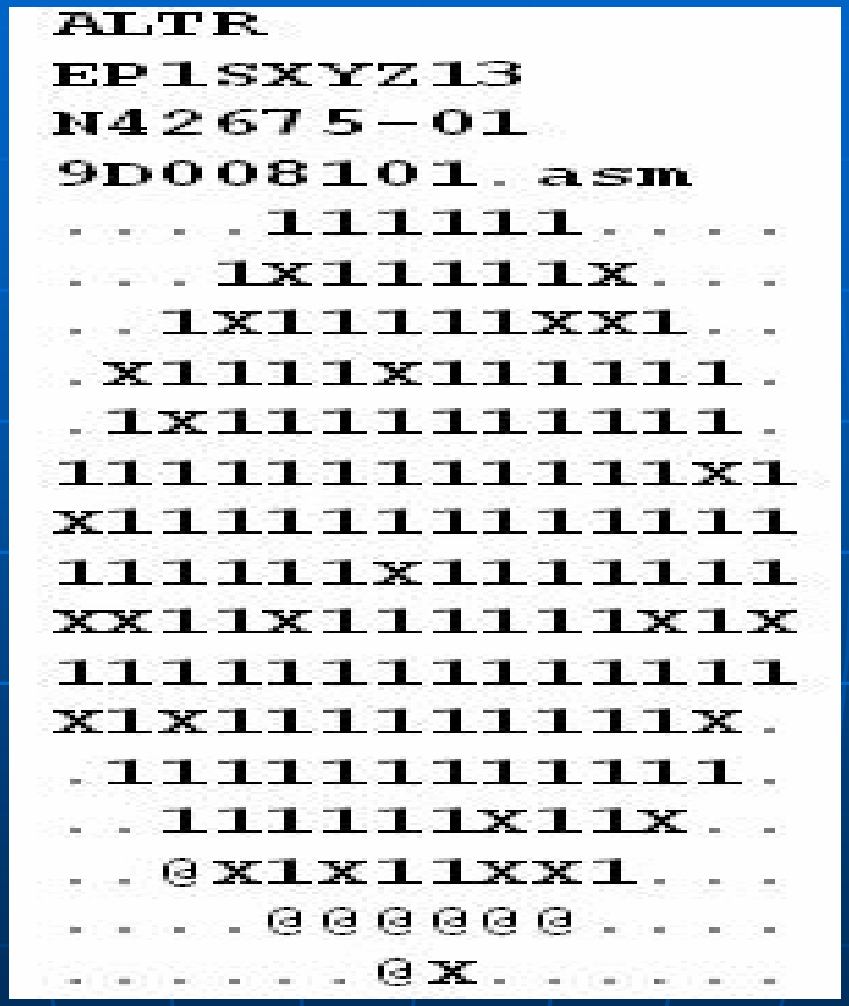
Wafer map used for assy



Inkless Process Flow Example

Planner issues assy instruction using Manufacturing Control System

Manufacturing Control System notifies **summary** server to generate wafer maps

Summary network server pulls .ldb and .vis files from specified product and lot # and runs *Mapgen* program to generate assy maps which are FTP'd to assy house

Lot, Wafer numbers, and selective assy decisions input by planner into Manufacturing Control System

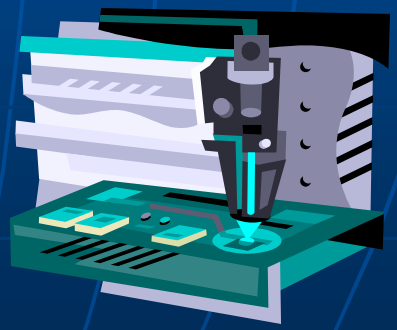
Maps generated with .ldb and .vis files merged together

Inkless Process Flow Example

Map Data & Assy Report FTP'd to Assy House

Wafers are shipped to Assy House

Map Data and wafers combined during pick and place. OCR fab lot # and Wafer # matched with data to prevent errors. "X, @, and ." dice discarded. Bin -1 dice assembled.



Implementation Goals

- Two Goals:
  - 1) Satisfy Wafer Sort Area Customer –
    - Prove data management system works
      - Off-line inking (1st)
      - Visual Inspection System (2nd)
  - 2) Satisfy Assembly House Customers – including Planners
    - Don't trade ink problems for inkless problems:
      - Die count discrepancies between Inventory Control Database and Wafer Sort Summary Database
      - Wafer map quality and transfer problems

Requirements - Key Items for Implementation

- Wafer Sort Area Customer
  - Understand Sort Process Test Flow
    - How many sort steps are there?
    - Are there re-test steps?
    - Which sort steps affect yield?
    - How / where / when do lot WIP data get stored?
  - Use OCR scribed or bar coded wafers
    - Test data should cross reference OCR lot number
  - Establish robust Off-line inking process
    - Prove data system works – verify inking quality – correct dice inked, no count discrepancies
  - Develop electronic wafer map inspection system
    - No Ink! Must “Mark” Visual Inspection Rejects and record data
  - Start with one product and focus on making it work

Requirements - Key Items for Implementation

- Assembly House Customers:
  - Understand Sort Process Data Flow
    - Where do Sort Data Originate?
    - Are there multiple Sort Sites?
    - Whose Sort Data?
      - Sort Vendor's?
      - Your company's testers?
    - Where / how does WIP system data get distributed to planners and assembly house?
    - Where are Sort Data Stored?
      - Sort Vendor / Fab / Your HQ (fabless model)?
    - Who maintains Sort Data?
    - How do you adjust for Count Discrepancies between WIP Control System and Sort Data Base?

Requirements - Key Items for Implementation

- Wafer Map Standard
  - Use existing specifications
    - Wafer Fab / Sort Facility
    - Assembly house
- Assy Vendors must have procedures and equipment for inkless assy
  - Verify these:
    - Map standards
    - FTP capabilities
    - OCR capabilities
  - Avoid: “Sure we do inkless – Blind Builds, Anyone?!”
- Initial management buy-in

Requirements - Key Items for Implementation

- Develop a Team – Manufacturing Engineering, Materials Planning, Test Engineering, MIS, Wafer Sort and Assembly Vendors
  - Ongoing communication
  - Team leader
- Servers and Software
  - Wafer Sort Data file system
  - Map generation software system
  - Material Automation Software to execute map generation with die release order
- Develop manual map generation back-up system
- Run Sample Inkless Lot
  - Inspect wafer skeletons, compare with maps
  - Make appropriate adjustments, run another sample lot

Requirements - Key Items for Implementation

- Develop monitoring system for quality improvement
  - Track number of inkless lots processed
  - Track number of issues
  - Feedback results to team members
- Seek upper management buy-in
- Introduce more products as more success and knowledge evolve

Possible Problems and Solutions

- Problem - Incorrect map / incorrect map data
- **Solution** - Same data system used for off-line ink used for map generation. History of off-line inking success. Wafers are identified by Fab lot # and wafer #. Map data contain Product type, Fab Lot #s, sort lot #s, and Wafer #.

- Problem - Map data fails to transfer to assy vendor
- **Solution** - Data are stored on local server. TE and ME can regenerate and FTP or email maps as required. No assy will occur unless maps are FTP'd.

- Problem – Edge dice on wafer aren't on wafer map
- **Solution** – Develop map "padding" for unprobed edge dice

Summary

- Inkless processing reduces cycle time and improves quality
- The goal is to satisfy two customers
  - Wafer sort area
  - Assembly house
- There are several key items for implementation
  - Sort data knowledge
  - Teamwork
  - Hardware
  - Software
  - Management approval
- Implementing inkless processing is a continuous improvement process