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Semiconductor Wafer Test Workshop

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Ghosting – Touchdown Reduction Using Alternate Site Sharing

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Introduction

- High parallelism testing on small to medium densities (up to 3K DPW on 200mm wafers) requires multiple touchdown to complete wafer probing
- Testing parallelism is gated by tester resources available (which can be increased by channel sharing)
- Probe card array layout determines the probing efficiency per touchdown
  - Rectangular array – lower efficiency
  - FWA (full wafer array) – higher efficiency
- Decision to skip dies to reduce touchdown count is based on cost

Goal

- DPW, max parallelism, and probe card array layout determine touchdown count
- How can we reduce it even further and avoid skip dies?

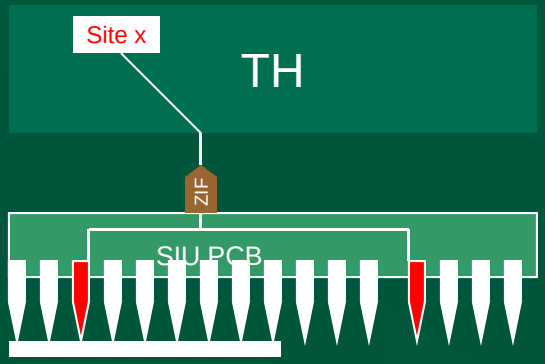
Ghosting!

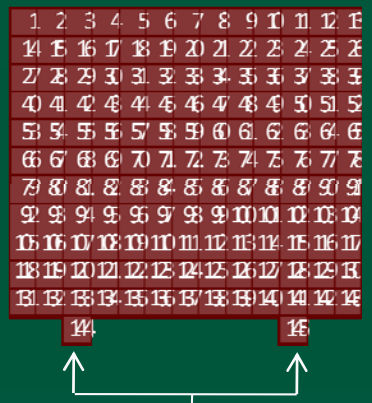
Ghosting Concept

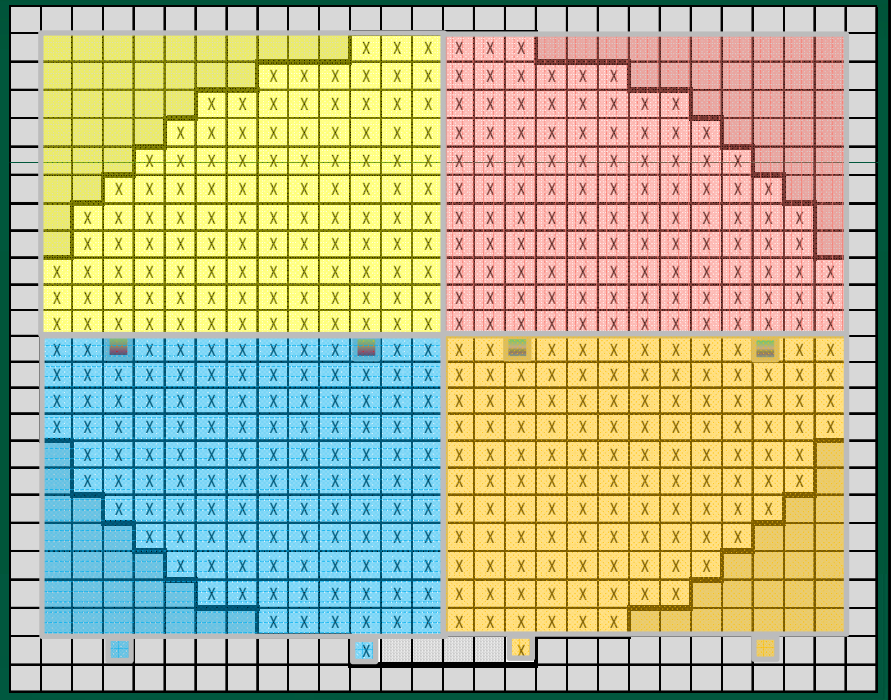
- Expend probe card array beyond available tester resources
  - For example: //144 tester sites with //154 probe card sites
- Based on the wafer layout, electrically split some tester sites into X2 probe card sites
  - In the above example, need to split 10 tester sites into 20 probe card sites; all channels of a single tester site are shorted between two probe card sites
- At each touchdown, need to ensure only one of the shorted probe card sites will touch the wafer
  - The other probe card site is off the wafer (“ghosted”)

Ghosting Concept

1st example – POC product (2009)







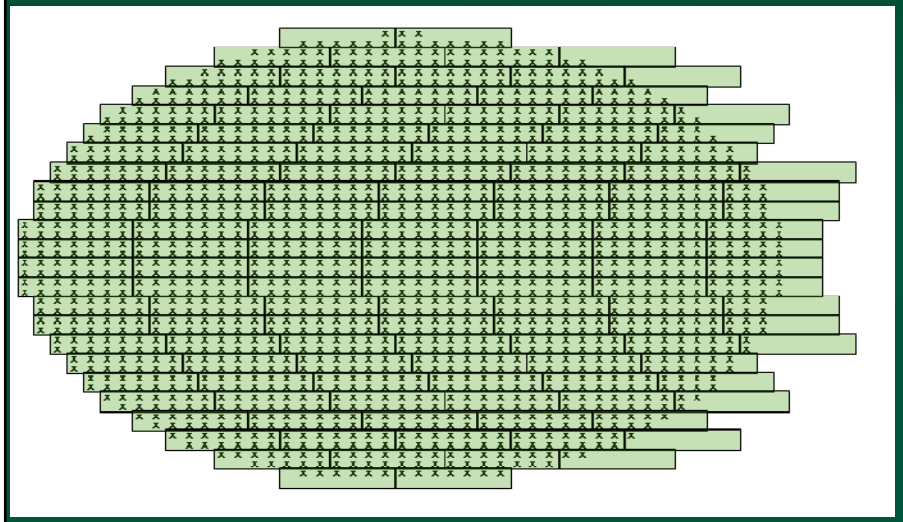
PC array

Off
Off

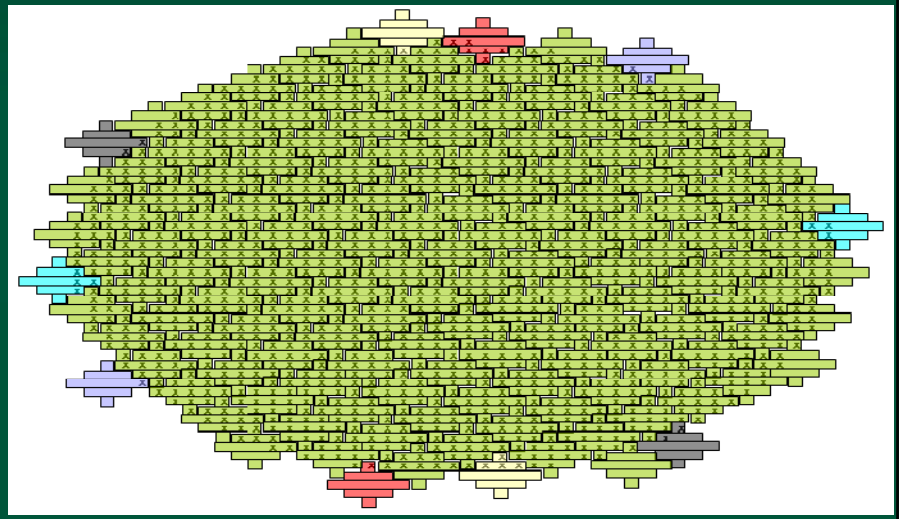
Wafer coverage

Ghosting Concept

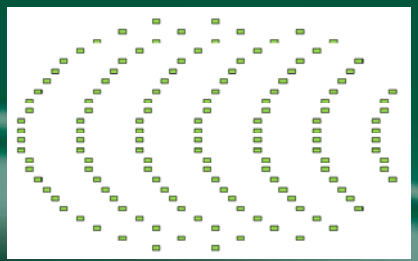
2nd example – 8% TD reduction (2010)
Ghosting layout is based on known partial dies



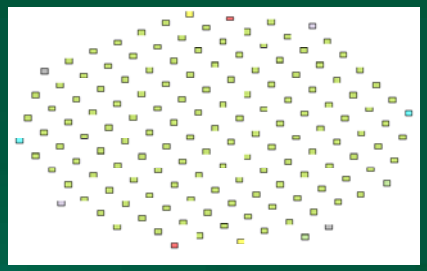
14TD FWA solution



13TD FWA/ghosting solution



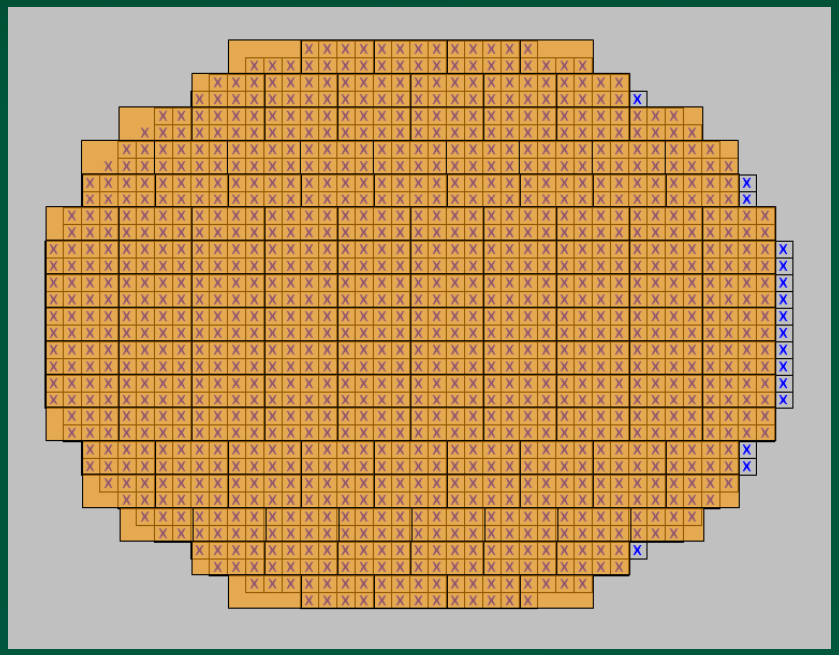
PC layout

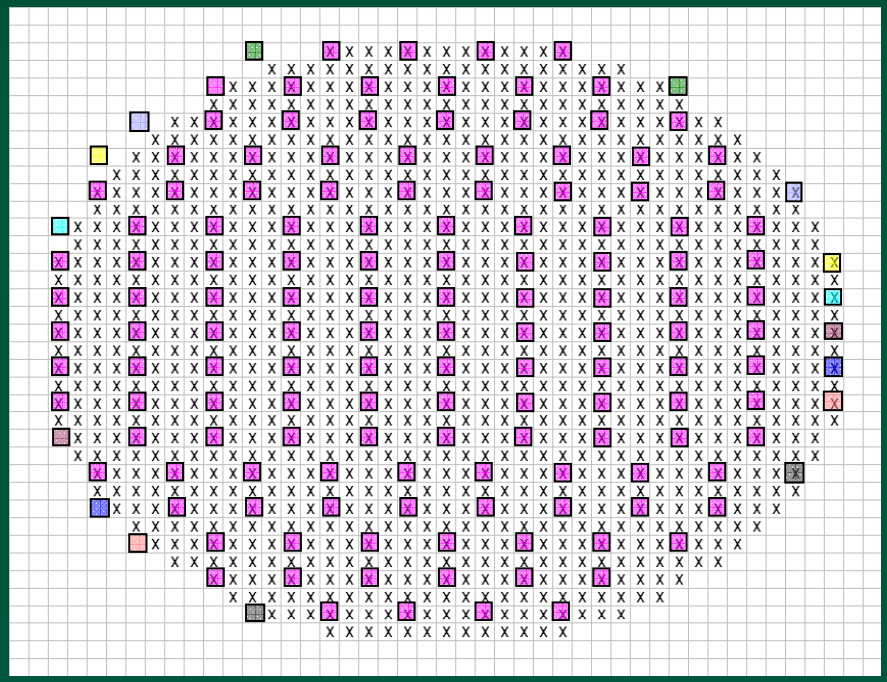


PC layout

Ghosting with Relays

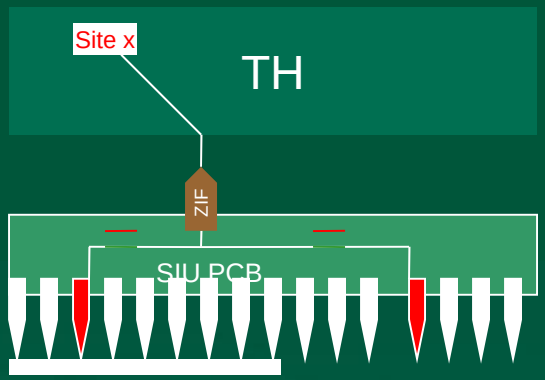
3rd example – 12% TD reduction (TBD)
Ghosting method using relays (to avoid short with partial dies)





Ghosting with Relays

- Every channel of a shared site is shorted with its ghosted site channel
- At every touchdown, all channel relays of the probing site are closed, and the channel relays of the ghosted site are open
- Requires available channel for relay control

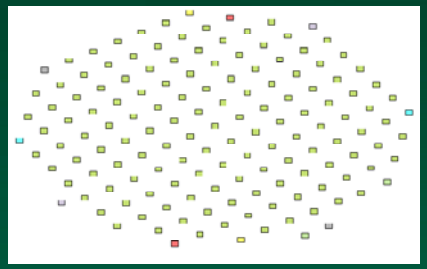


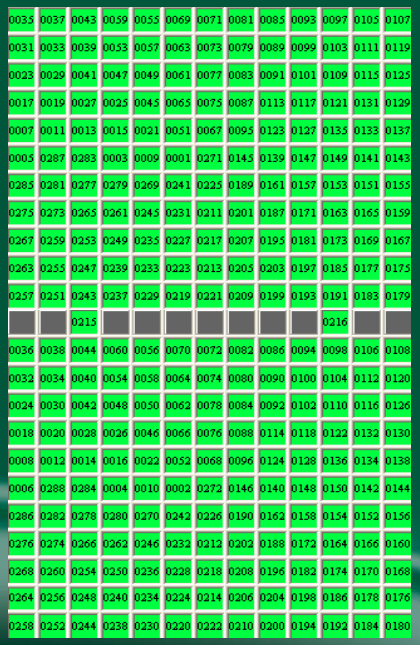
Ghosting Implementation

- Ghosting requires some manipulation in the probing environment to handle site activation at each touchdown
- Switching between ghosted sites at each touchdown requires multi-DUT capability
- Dummy multi-DUT probe card array is created to control site activation at each touchdown
  - For example, if tester resource is //144 and using //160 probe card sites, it requires to create //288 dummy array

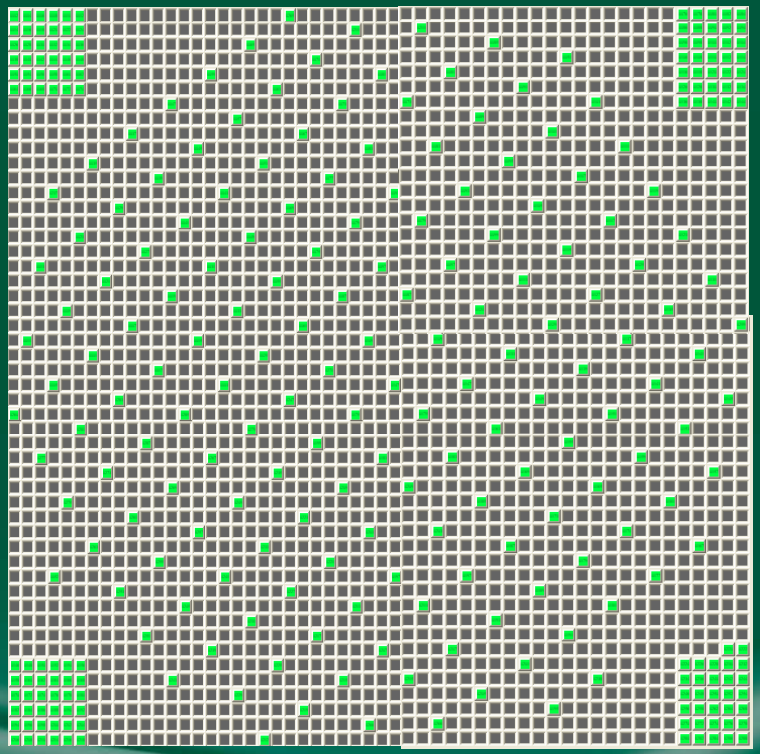
Ghosting Implementation

Probe card array //144 + ghosted sites





Probing map //288



Next Steps

- Develop the ghosting with relays solution
  - Find component that can switch all channels of a site using one control channel
  - Explore ghosting method on designs that already embed site sharing (X2/X4 power supply and driver sharing)
- Continue to implement ghosting on new designs to ensure lowest touchdown count possible

Summary

- Ghosting is a low-cost solution to ensure lowest touchdown count will be achieved without skipping dies
  - Invest effort in probe card array layout vs. die layout
- Ghosting is beneficial for designs with multiple touchdown count
- Ghosting requires some manipulation of probing environment to handle the alternate site sharing
  - Depends on Multi DUT configuration

Thank you for listening

Questions?

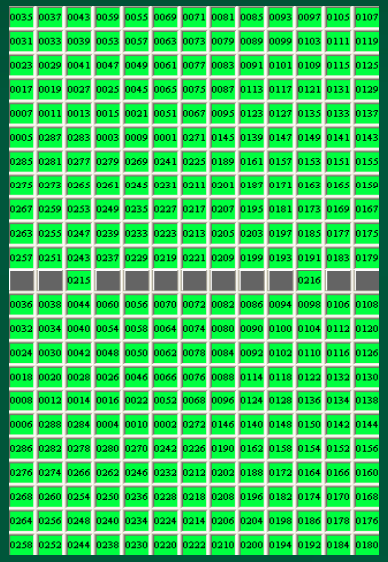
Backup

Yield comparison
Ghosted vs. Non-Ghosted

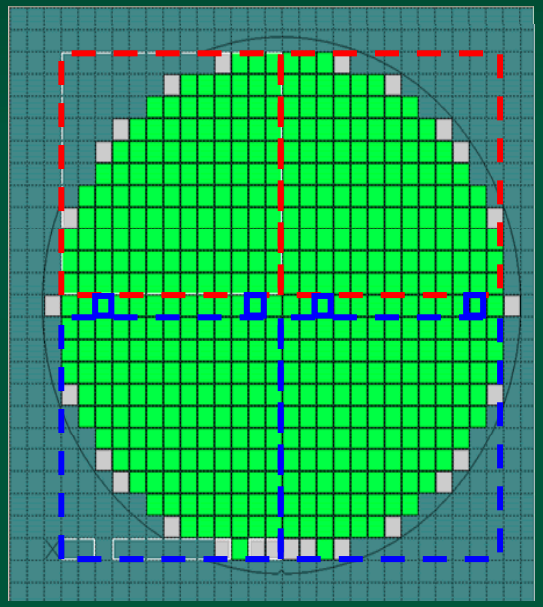
No impact using Ghosting

Ghosting Implementation

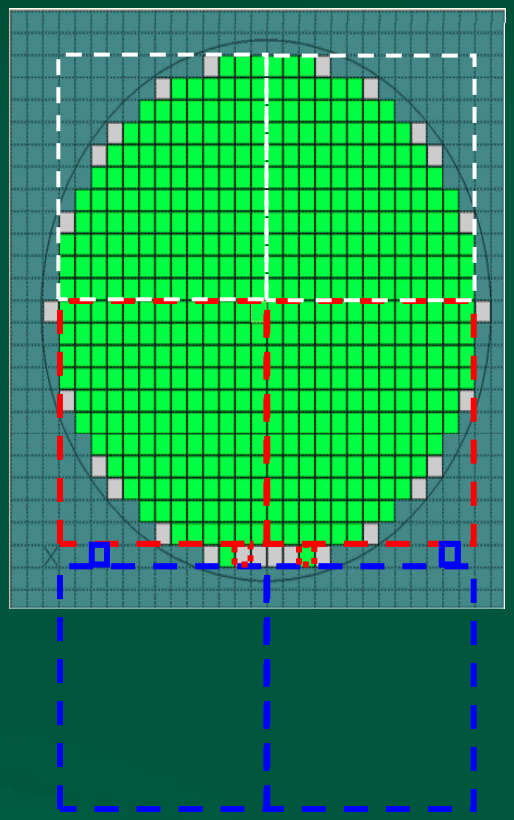
Prober map



TD# 1, 2



TD# 3,4



Active sites

Non active sites

Ghosting Concept