IEEE SW Test Workshop
Semiconductor Wafer Test Workshop

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San Diego, CA

Kevin Fredriksen /
MSO – Multi Site Optimizer
For IEEE SW Test Workshop

SPA
SOFTWARE FOR
PRODUCTION
AUTOMATION

Kevin Fredriksen, SPA GmbH
Germany
Customer support / Sales
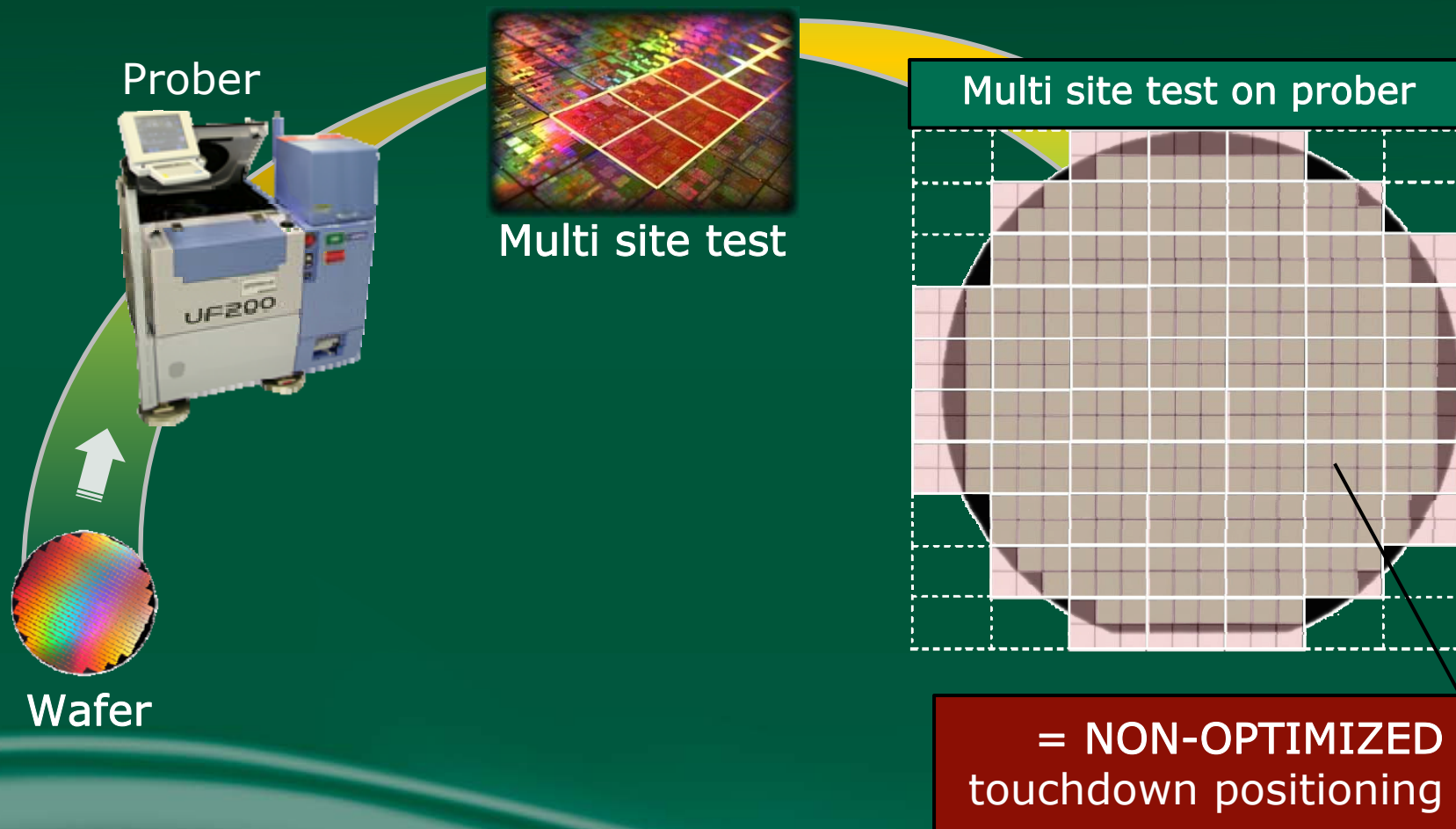
OVERVIEW

- MSO HISTORY
- MSO basics and facts
- Optimization example
- Multi site layouts & touchdown options
- Stepping path algorithms
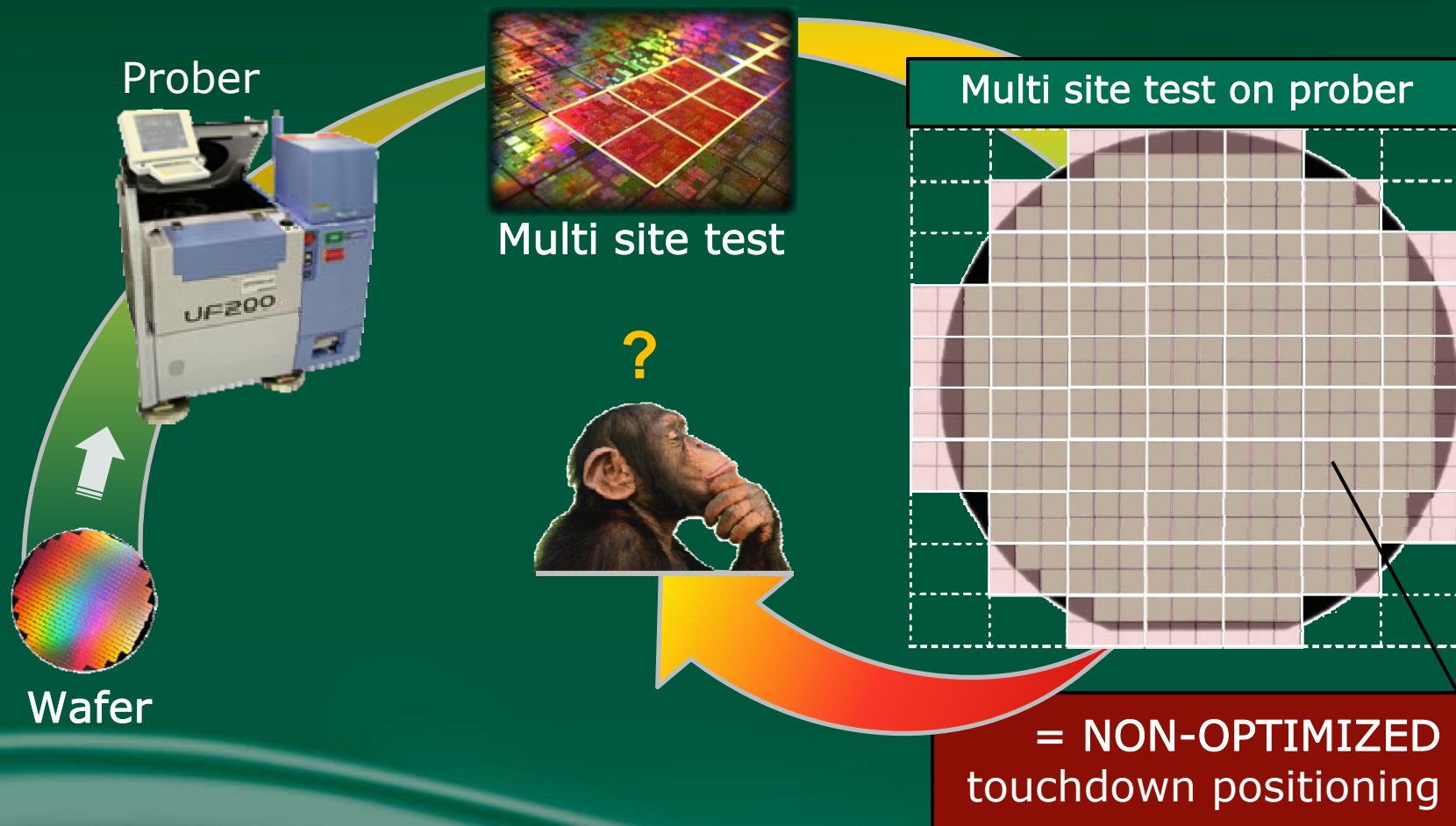- MEMS wafer test – a multi site quest!
- Summary

MSO HISTORY

Prober

Multi site test

Wafer

Multi site test on prober

= NON-OPTIMIZED
touchdown positioning

MSO HISTORY

Prober

Multi site test

Multi site test on prober

?

Wafer

= NON-OPTIMIZED
touchdown positioning

MSO HISTORY

MULTI SITE TEST SITUATION

- Most probers do **not** supply any intelligent stepping algorithms

- Unnecessary **high amount** of touchdowns to process
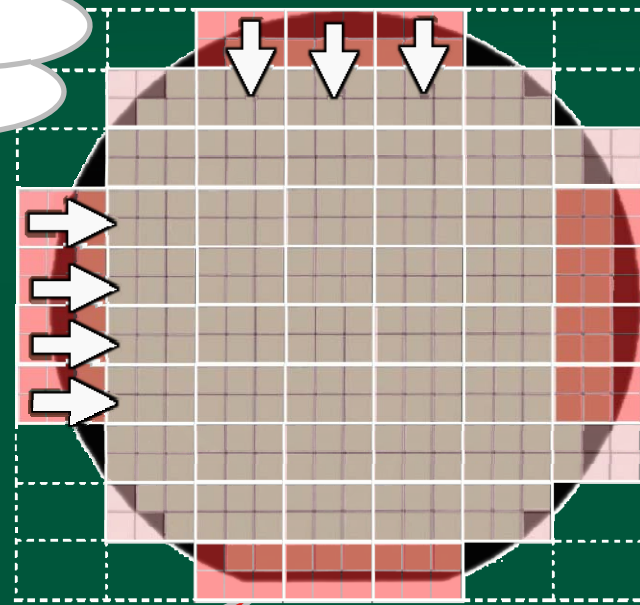
- As a result: **long process times**

Multi site test on prober

Highlighted fields signalize potential touchdown surplus !
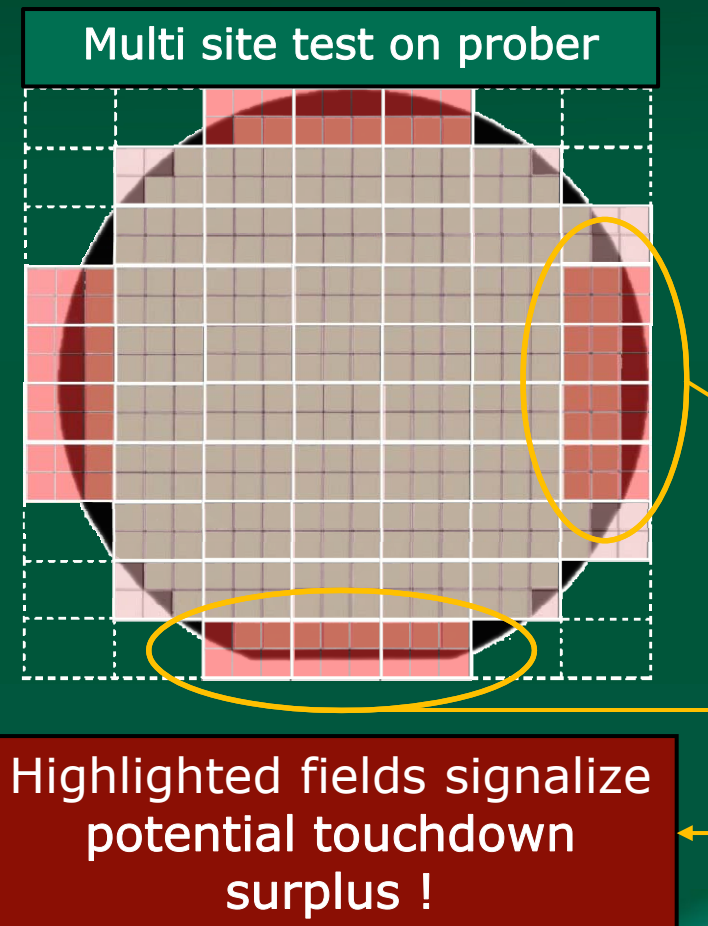
MSO HISTORY

Create a program that minimizes touchdowns by _automatic_ shifting of touchdown coordinates.

IS-TEST
GmbH

MSO HISTORY

Touchdown **column** shift

Optimized touchdown positioning

Touchdown **row** shift

Touchdown surplus/fall-out after column/row shift

6 out of 56 touchdowns saved!

MSO

Basics and facts

The benefits and usability of MSO

INTRODUCTION

The Multi Site Layout Optimizer (MSO) is an easy to use software for optimizing multisite layouts.
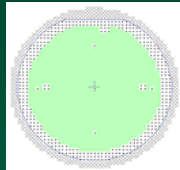
The benefits: ➔ *Less touchdowns*

➔ *Optimized probing path*

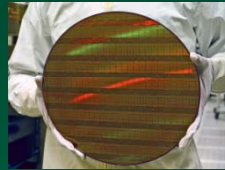➔ *Optimized hot probing*

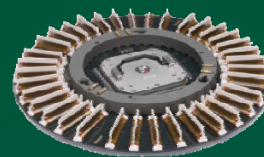➔ *Find ideal probecard layout*

MSO workflow A

Controlmap + Physical wafer + Multisite probecard

MSO
Multi Site Layout Optimizer

Optimized touchdowns   Optimized stepping
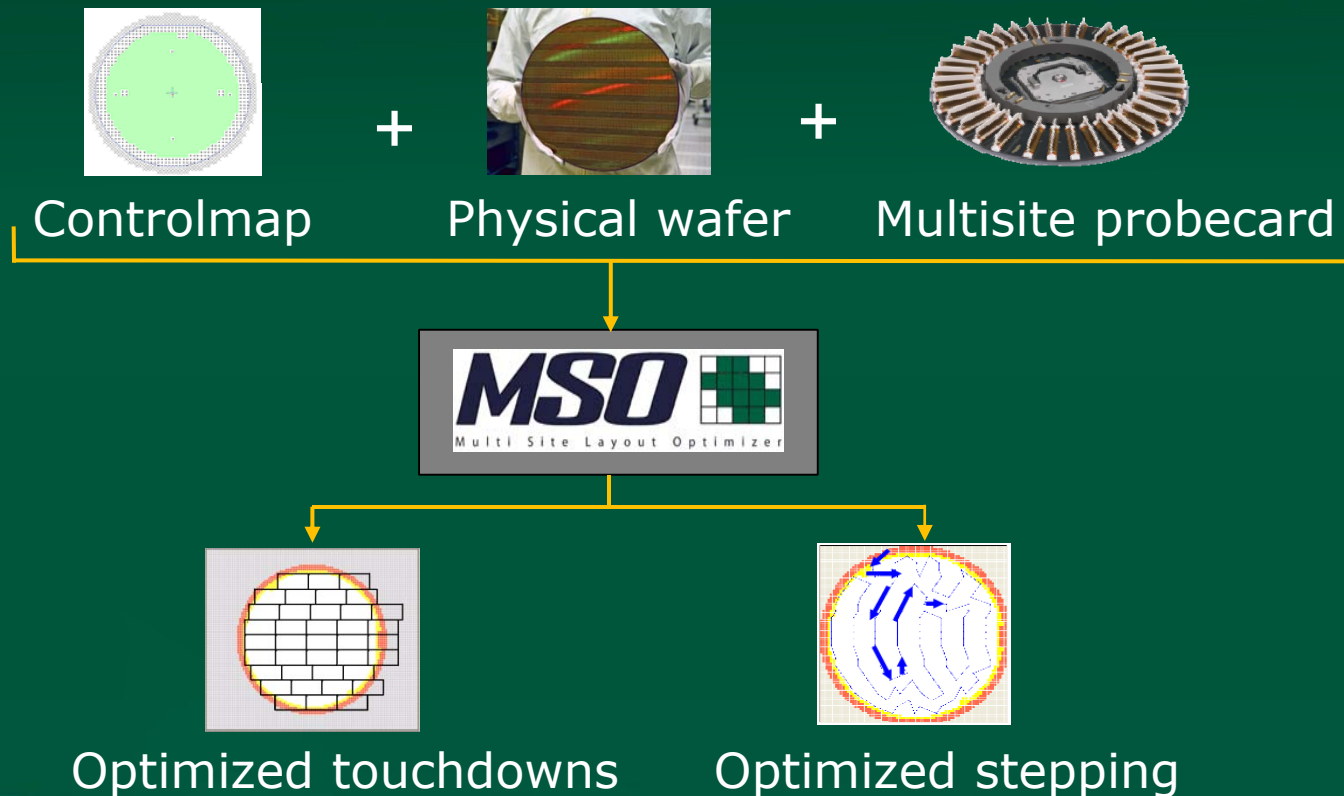
MSO workflow B

Controlmap   +   Physical wafer   +   Multisite params

Ideal multi site
probecard layout

MSO

Complete Optimization

Touchdowns and stepping path

MINIMIZE TOUCHDOWNS
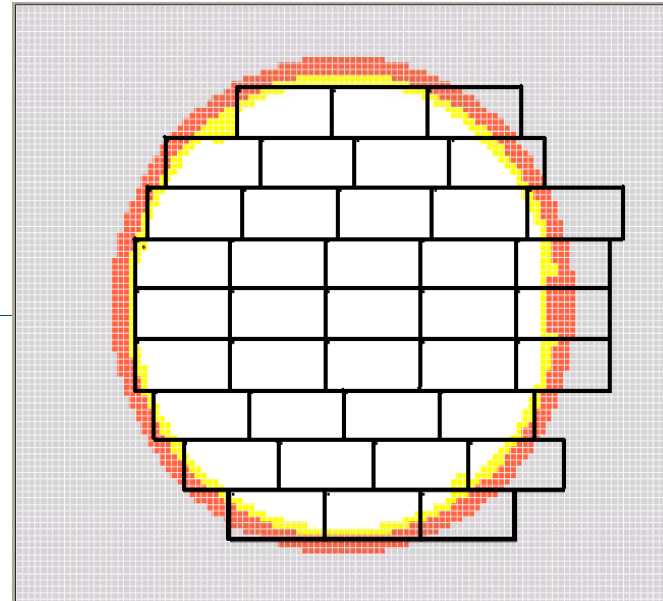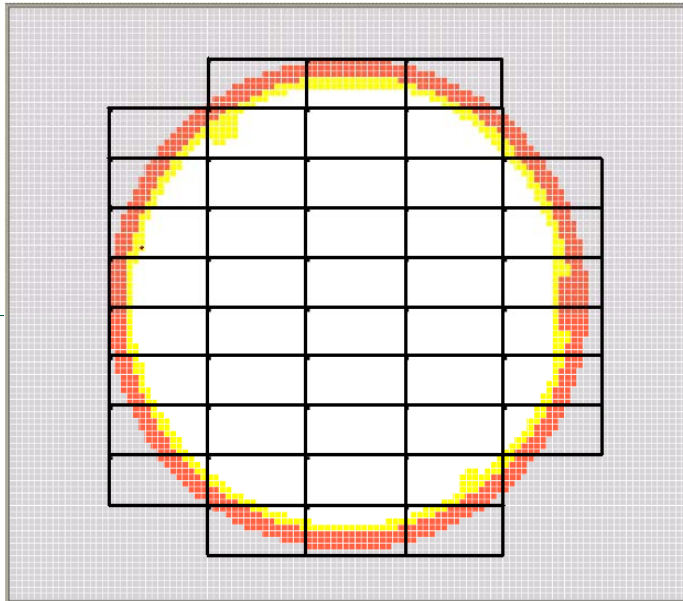
Prober: 44 Tochdowns ➡ MSO: 38 Touchdowns

Technology: automatic column / row shift

= 14,6 % TD reduction!

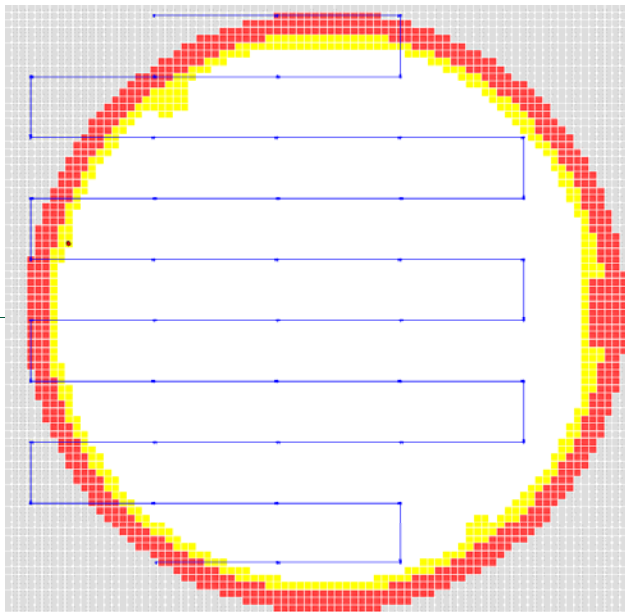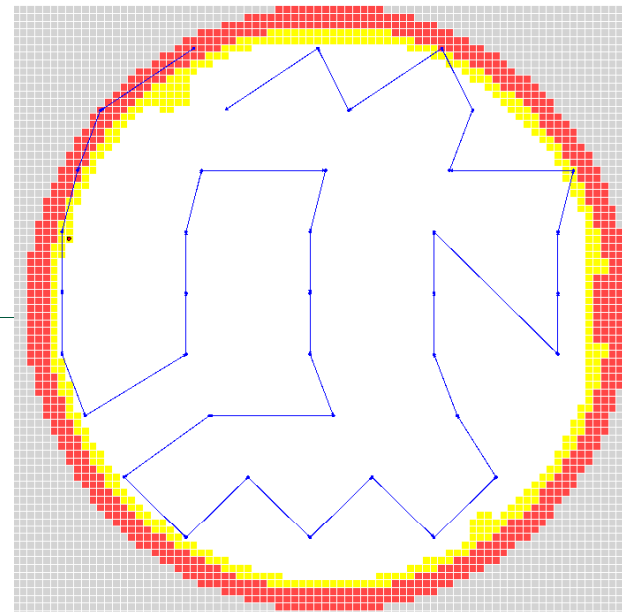# OPTIMIZE PROBING PATH

Prober stepping: 1680mm ➡ MSO stepping: 1056mm

Technology: shortest way

= ~37 % Stepping reduction!

TEST-COST REDUCTION

Wafertype/Prober parameters

Dies to test / Wafer = 3.823	Test Time / TD	= 5 sec.
Number of DUT = 128	X/Y Stepping / sec	= 100mm

	Non-optimized	MSO
Number of TD / Wafer	44 TD	38 TD
Test time / Wafer	220 sec.	190 sec.
X/Y Stepping / Wafer	1680 mm	1056 mm
Stepping Time / Wafer	17 sec.	11 sec.
Total Test Time / Wafer	**237 sec.**	**201 sec.**

Process time reduction /wafer = 36 sec.   = ~15%

TEST COST REDUCTION!

MSO

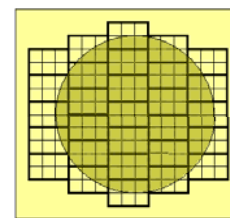## *Feature Overview*

Multi site layouts and touchdown options
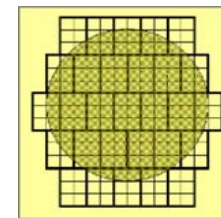
MSO TOUCHDOWN OPTIONS

- Multi site shape options:
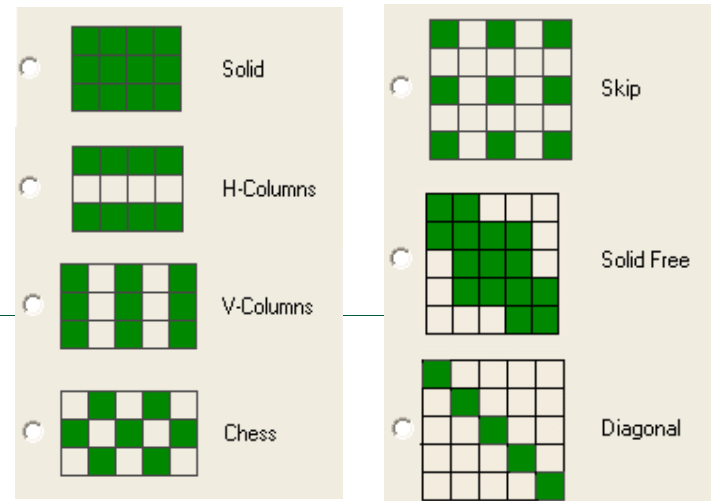
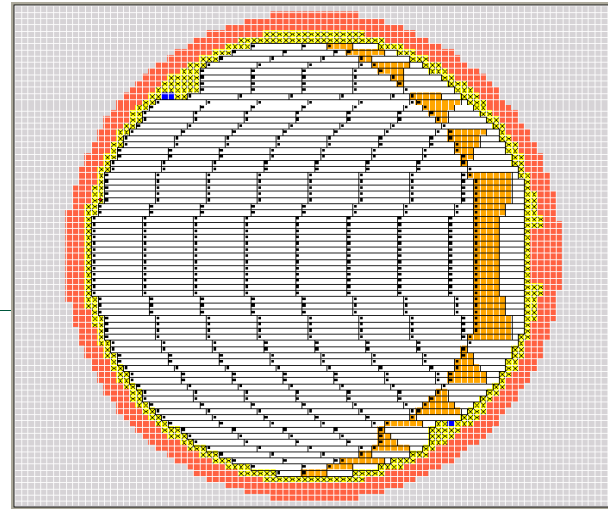
- Touchdown shifting algorithms:
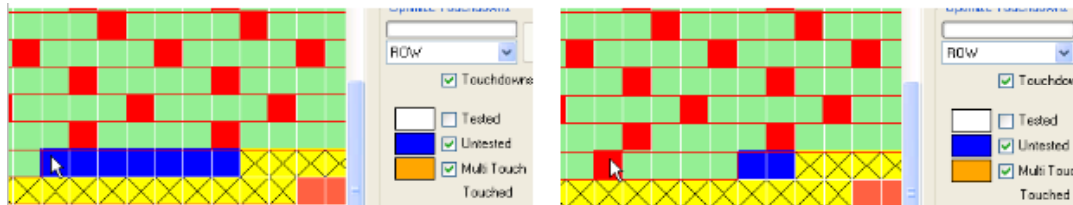

COL shift   ROW shift

MSO TOUCHDOWN OPTIONS

- Untouchable die zones

  (=> overlappings/untested)

- Manual touchdown edit

MSO RESULT DATA

Touchdown data

Optimize Touchdowns

ROW_ADV [Analyze]

☑ Touchdowns		38
	max.	40
☐ Tested		3.823
☐ Untested		0
☐ Multi Touch		0
Touched		4.864
Multi Site Factor		100,61
		79%

Stepping path data

Optimize Path

Step/Time [Analyze]

☑ ShowPath
☐ Show TD Numbers

Step Route	Total (mm)	1098
	X / Y	612 / 796
Step Time	Total (sec.)	10

MSO
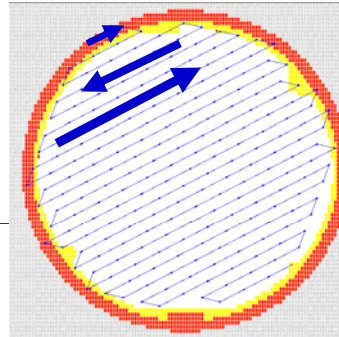
Feature Overview
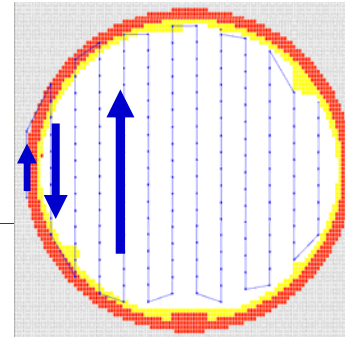
Stepping path algorithms

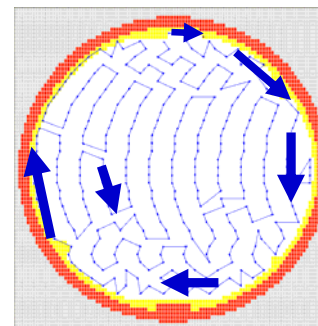# MSO STEPPING OPTIONS

- Meander stepping options
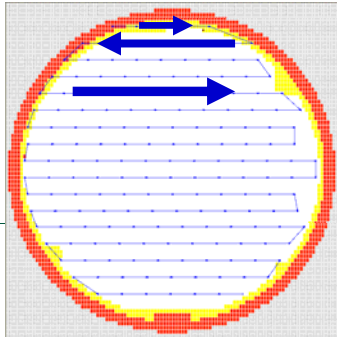
Meander

Meander_shift
(North-East shift)

Meander_shift
(Column shift)
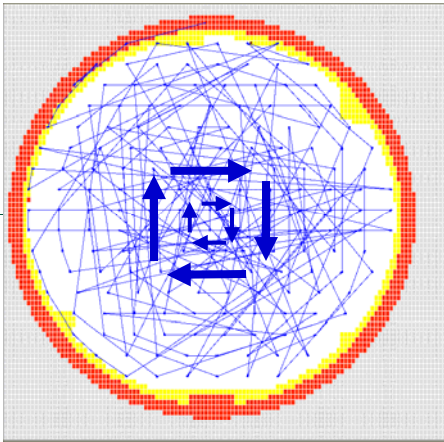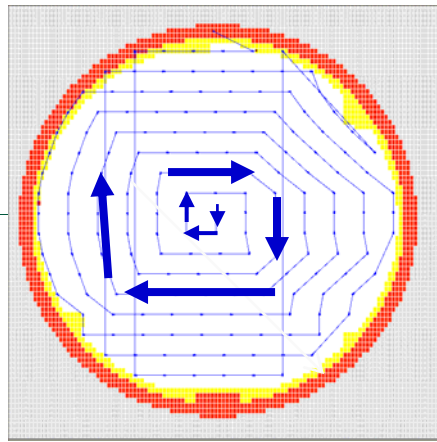
- Time optimized stepping
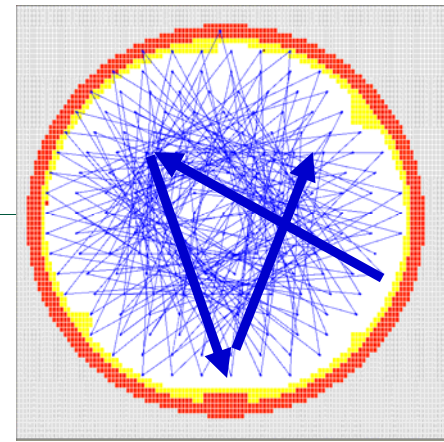
Shortest way

MSO STEPPING OPTIONS

- Hot probing optimizations *

Radial   Spiral   Longest way

Optimized stepping for more uniform heat expansion
of probe card, tester interface and prober head plate.

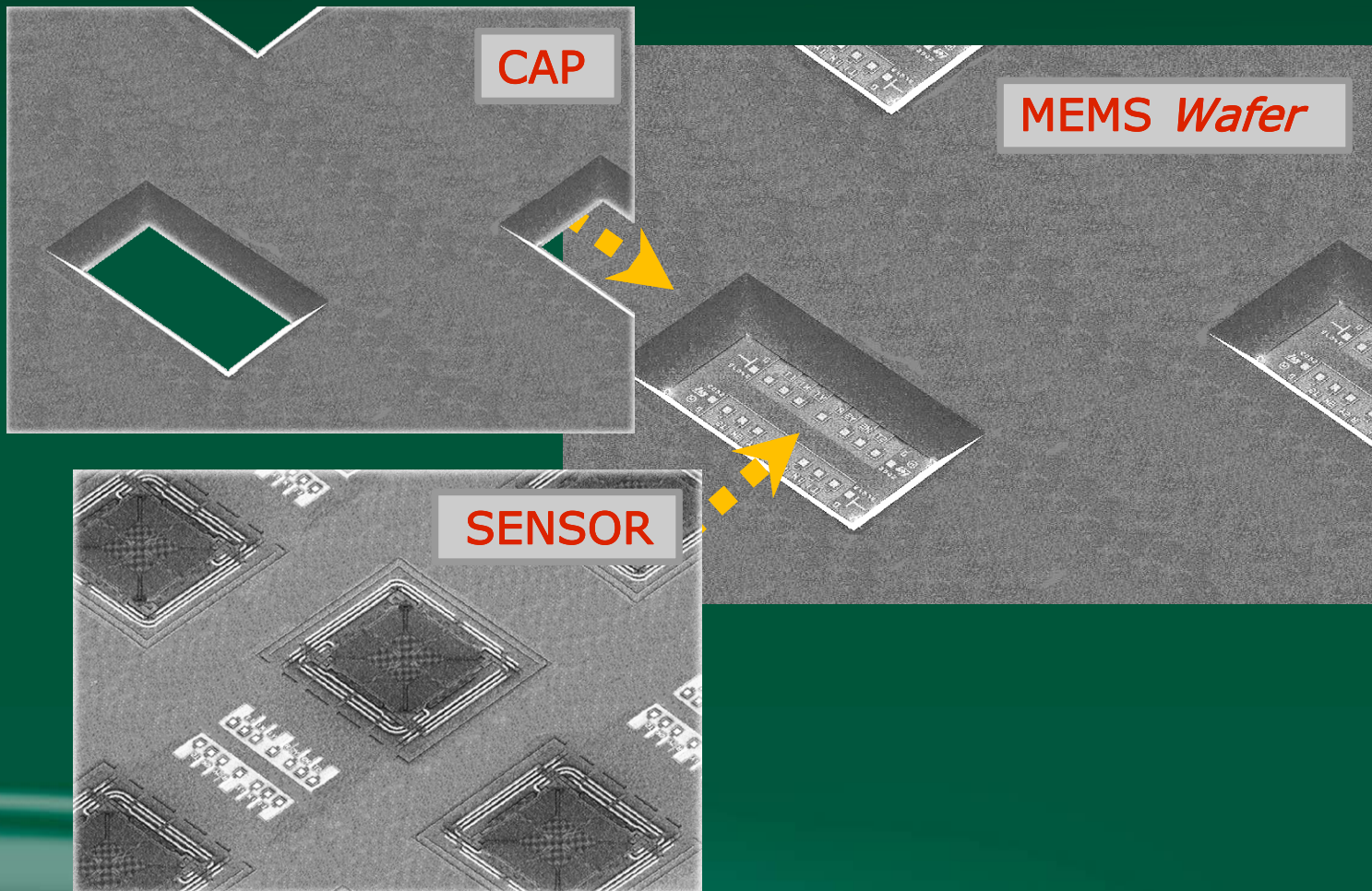* BLEYL, et al, SWTW 2011

MEMS wafer test

:: a multi site quest ::
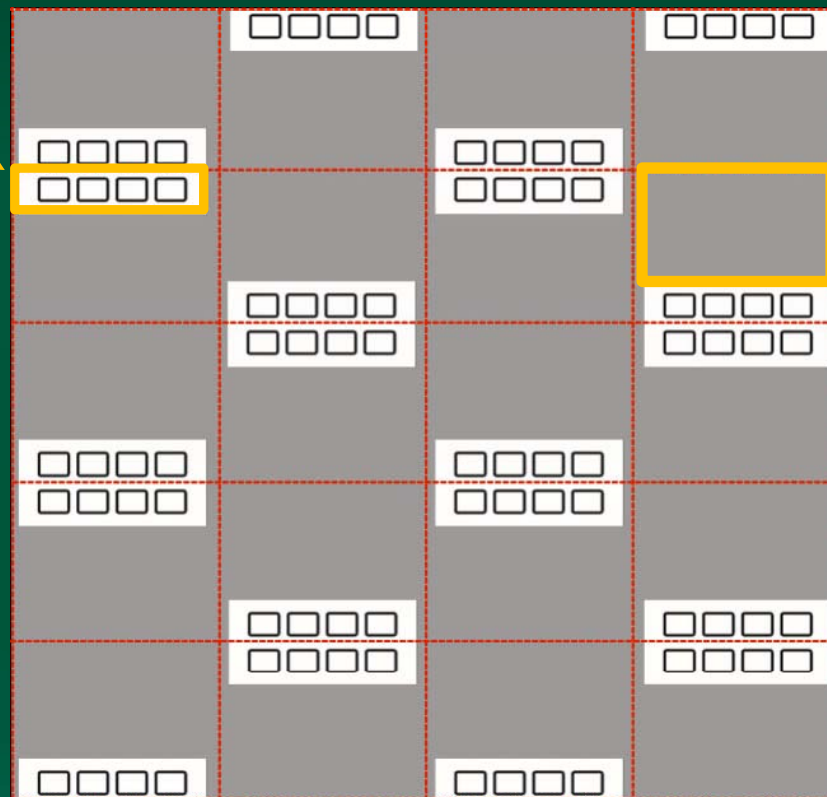
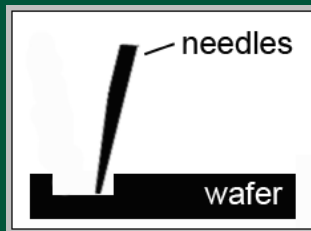# MEMS Waferprocess

CAP

MEMS *Wafer*
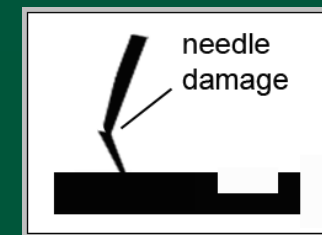
SENSOR

MEMS chip structure

SENSOR test pads
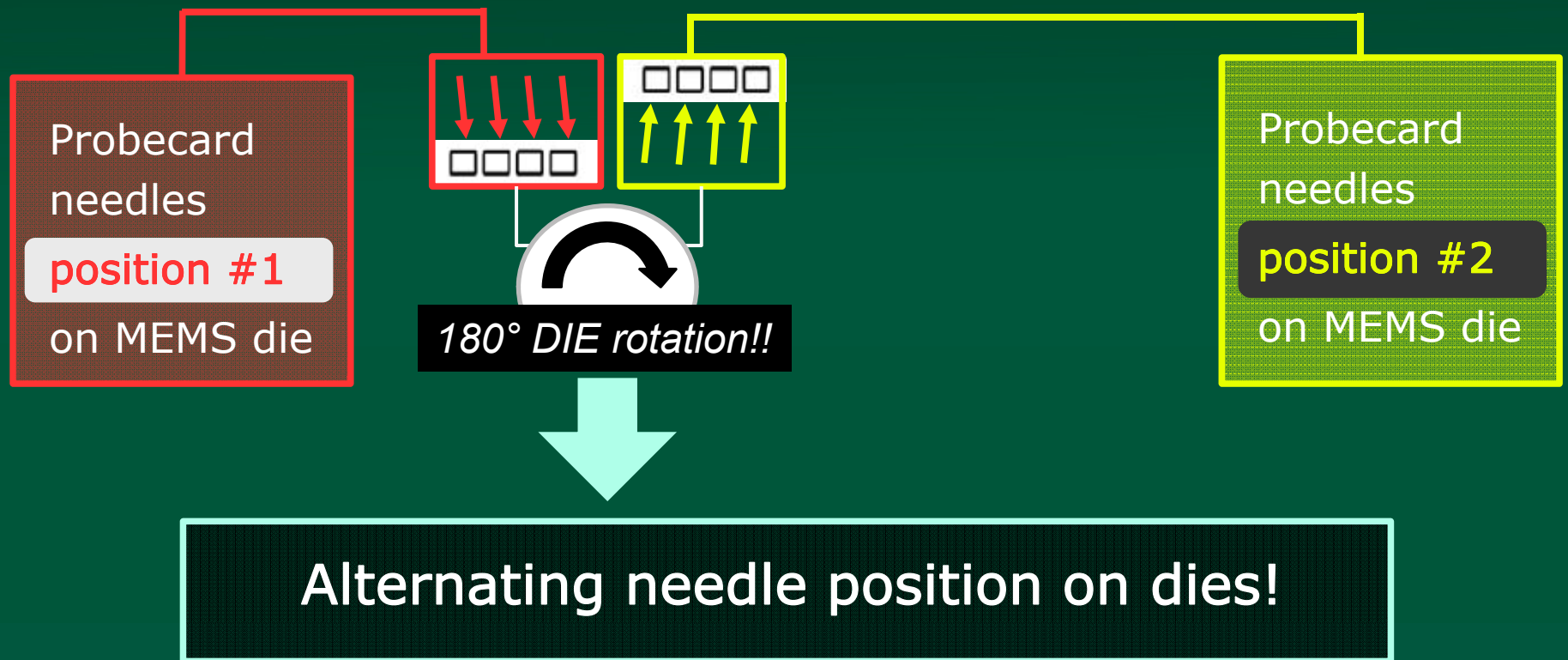
- electrical testing
- probecard needles contact area

CAP wafer surface

- NO-contact area for probecard needles

MEMS test pads

Probecard needles
position #1
on MEMS die

180° DIE rotation!!

Probecard needles
position #2
on MEMS die

Alternating needle position on dies!

MEMS wafer test

Single Site probing
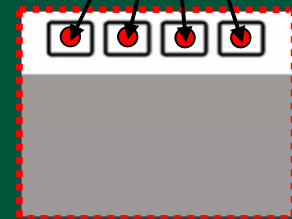
Example

MEMS single site test
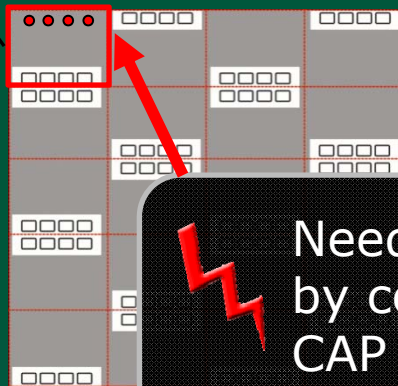
Needles contacting
<u>upper</u> sensor pads

Probecard layout

MEMS die

Chip type a
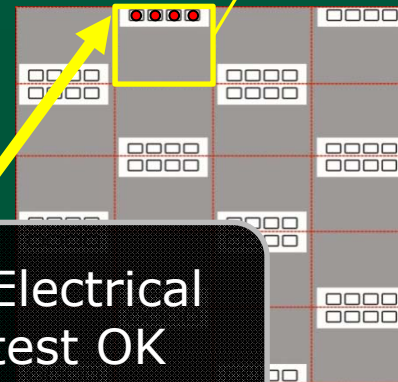
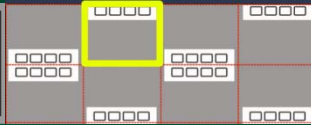Chip type b

Needle damage
by collision with
CAP surface

Electrical
test OK

MEMS single site test
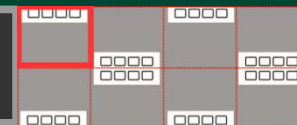
1. Test

2. Test
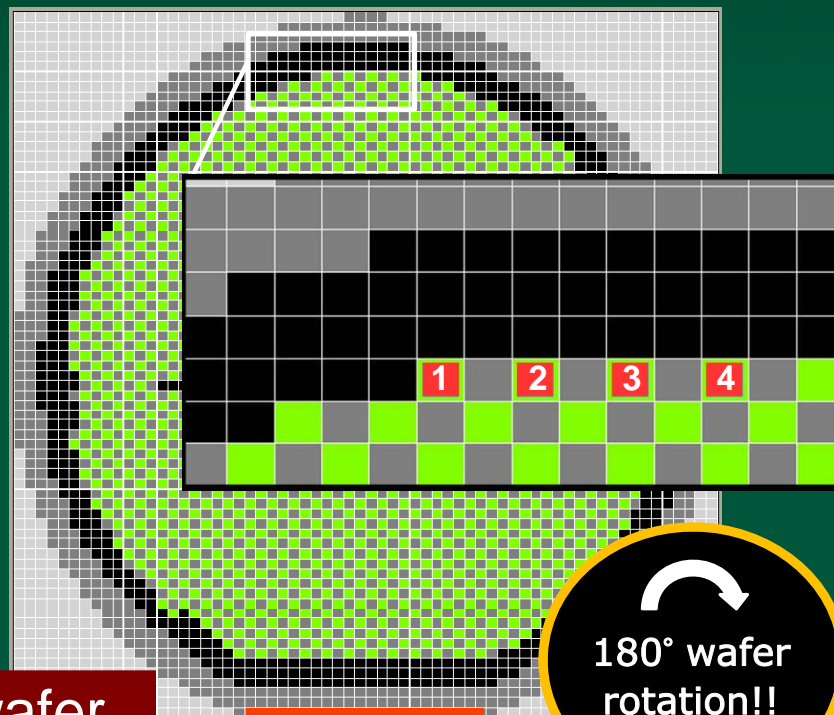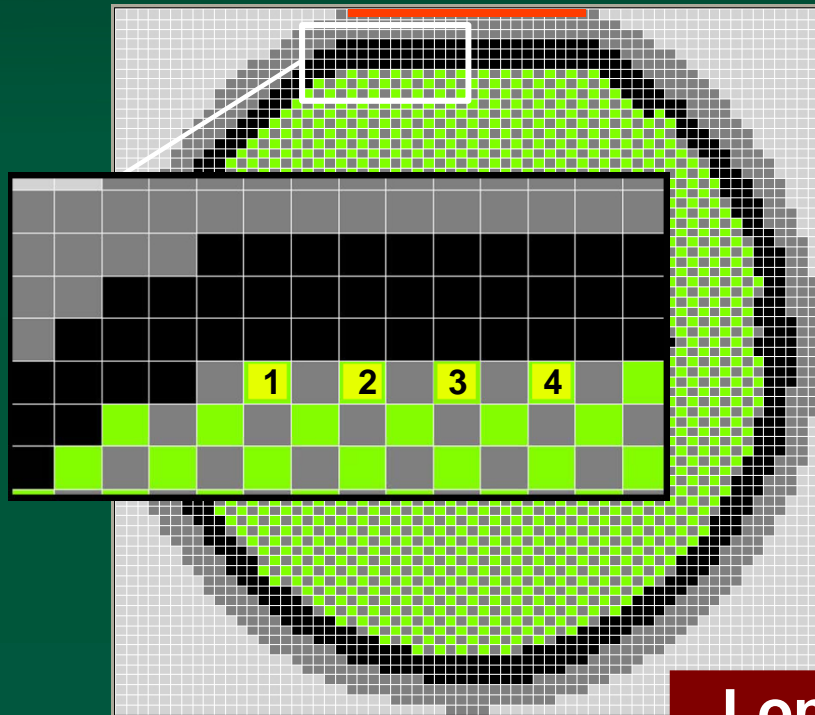
Long wafer process **time !**

180° wafer rotation!!

MEMS Wafertest

Why not process

MEMS wafer within

<u>ONE</u>

test cycle ?

MEMS Wafertest

Multi Site Probing !!!

MEMS multi site test

What are the potential **blocking points**

for multi site testing
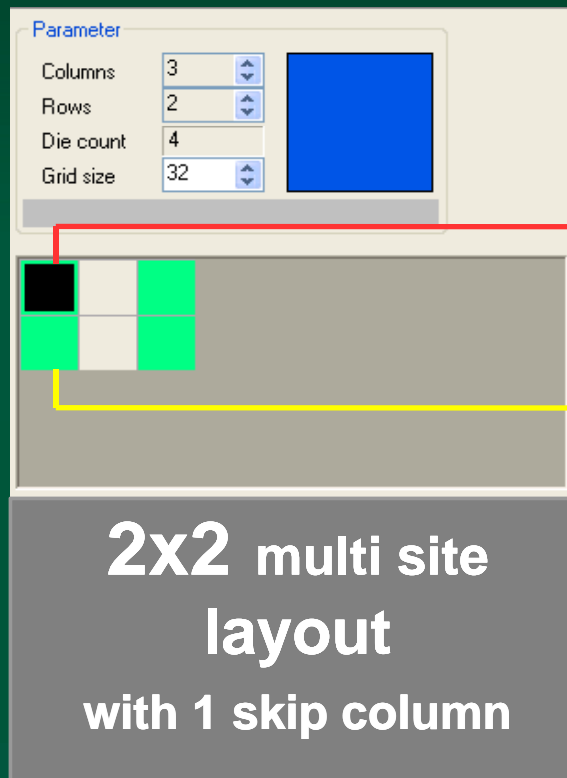
MEMS devices?

MEMS multi site test

Blocking points?

- **Probecard site needles touching the CAP Wafer surface (causing damage)**

  → **Needles touching <u>CAP</u> area of die**

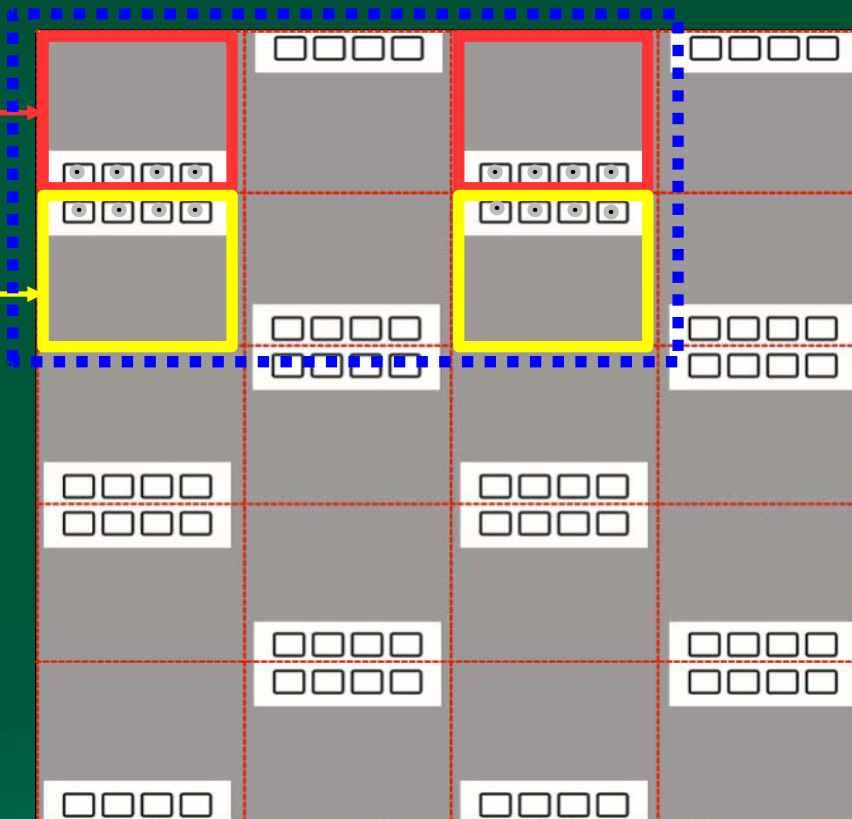 → **Needles touching wafer <u>EDGE</u> area**
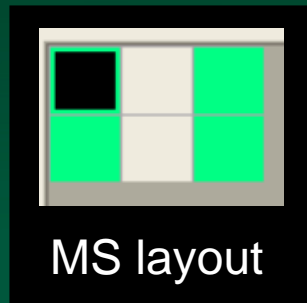
MEMS multi site test

One touchdown

Parameter
Columns 3
Rows 2
Die count 4
Grid size 32
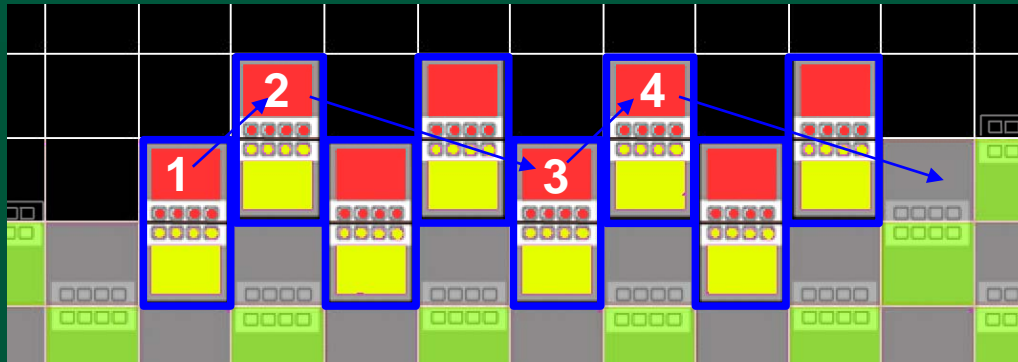
2x2 multi site layout

with 1 skip column

MEMS multi site test

MS layout

First touchdown

Special stepping algorithm for MEMS to avoid CAP contact

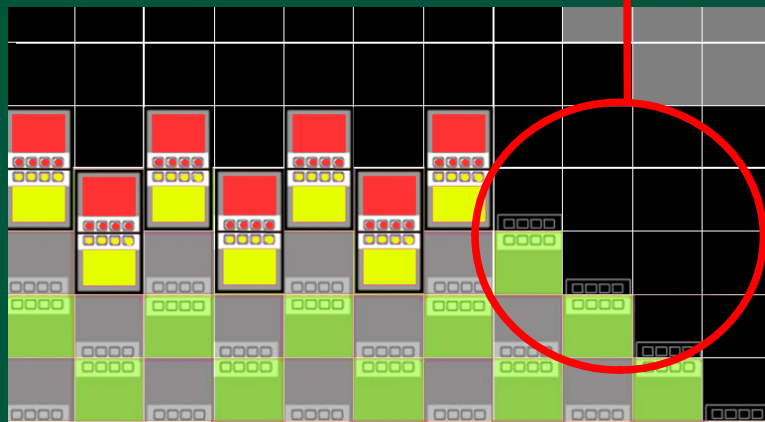**MEMS device can be tested in <u>ONE</u> probing cycle!**

MEMS multi site test

WAFER EDGE ZONE !!!
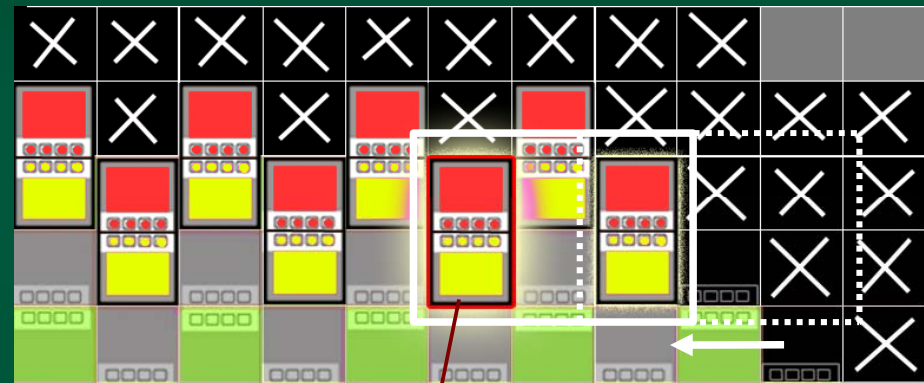
Needle damage!

SOLUTION → *see next page*

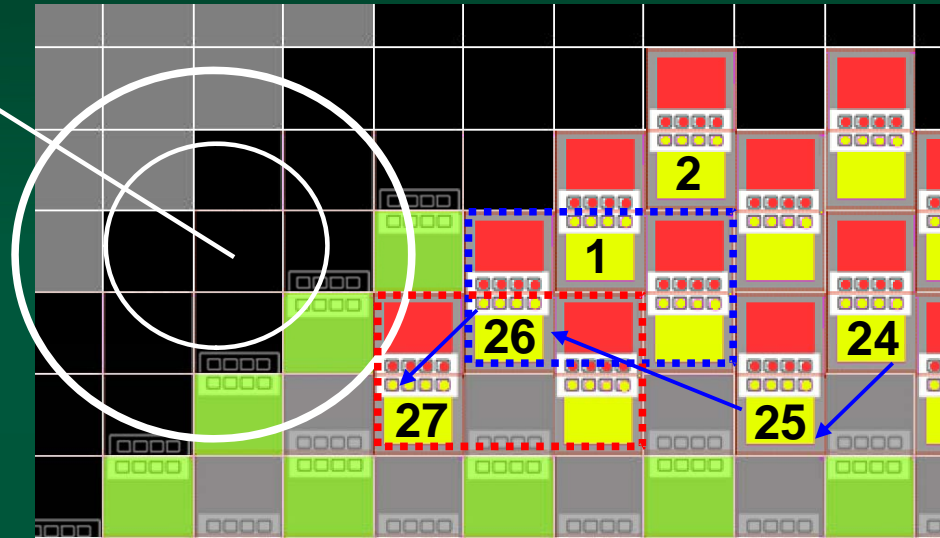# MEMS multi site test

UNTOUCHABLE DIES
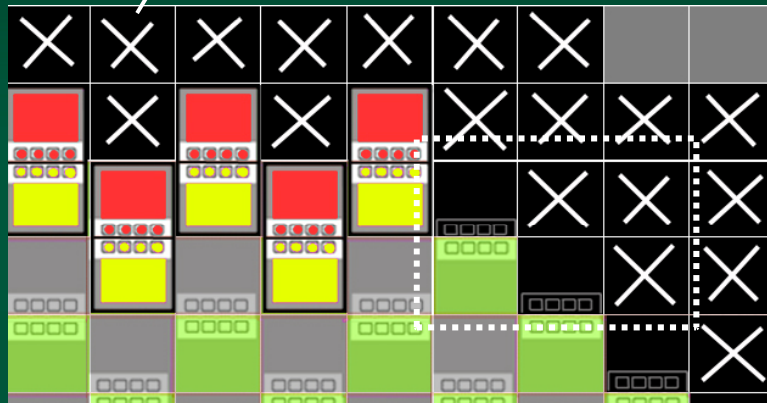
Automatic touchdown repositioning
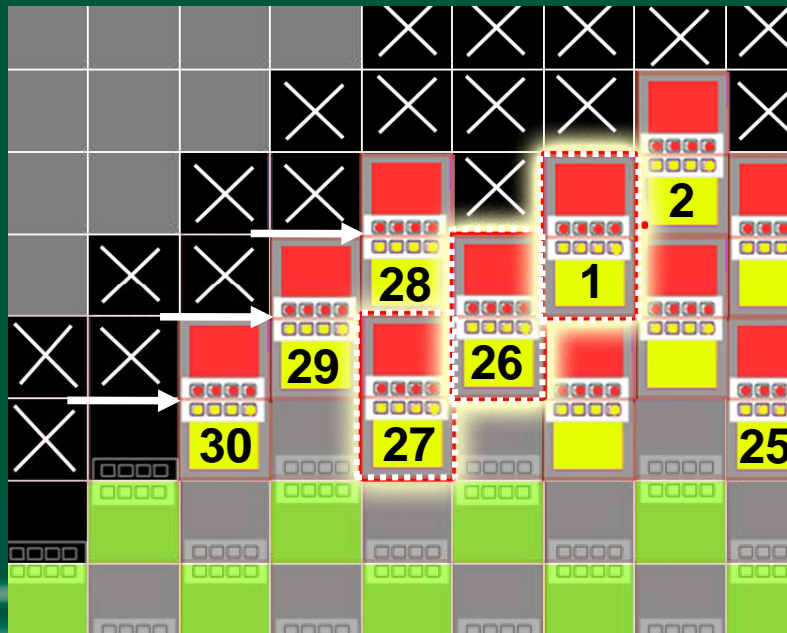→ creating 2 double touched dies!

=> Safe needle contacting via <u>untouchable die</u> zones !

MEMS multi site test

WAFER EDGE ZONE !!!

Automatic touchdown
repositioning → creating 6
double touched dies here !

MEMS multi site test

Blocking points?

- Contact of probecard and CAP/EDGE wafer **can** be avoided by intelligent touchdown positioning**!**

SUMMARY

- MSO optimized touchdown positioning increases prober test efficiency and saves process time!

- MSO is able to provide special stepping path algorithms, which are useful to:

  - compensate probing-related problems such as needle expansions during HOT PROBING (already used by customer NXP)

  - handle wafer-specific features and optimize the test process (e.g. MEMS / future prospect)

ACKNOWLEDGEMENTS

- Jan Martens (NXP Germany)

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- Roland Fredriksen (TRF GmbH)

THANK YOU
VERY MUCH FOR YOUR ATTENTION!

Questions?

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