



Nordic Testforum

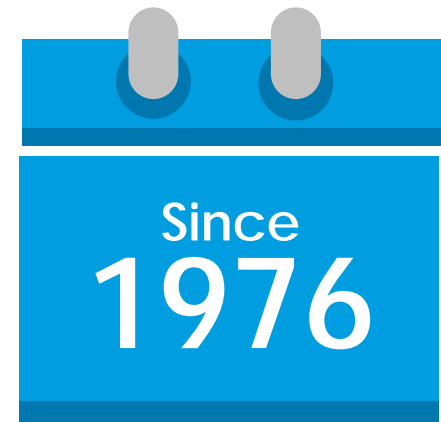
November 28th and 29th, 2017

Sokos Hotel Flamingo, Vantaa, Finland

**COULD THE FLYING PROBE TESTING BE A GOOD
ALTERNATIVE TO BOARD TESTERS?**

Lothar Diez

Who we are



A global leader in test equipment
for **Electronics, Semiconductor, MEMS and Sensor** industries

91 €Millions

2016 worldwide sales

25,500

Square meters of facilities

8,000+

Systems installed worldwide

Quality

9001:2008 Certification
14001:2004 Certification
17025:2005 Compliance

47%



Semiconductor Test Division

Test equipment for MEMS, Sensors, integrated circuits and power devices

53%



Board Test Division

Flying probe, bed-of-nails and functional testers for electronic boards and modules



4080 Flying Probe Tester

4080 replaces bed-of-nails testers



4080 can conveniently replace bed-of-nails systems
also for high production volumes



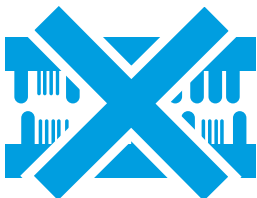
THROUGHPUT

- 80 boards/hour tested*
- Over 630,000 boards/year tested*
- Automatic inline board loading/unloading in 2.5s



MICRO-PAD CONTACTING

- 50µm minimum pad size
- 10µm probing accuracy
- Simultaneous probing at different heights



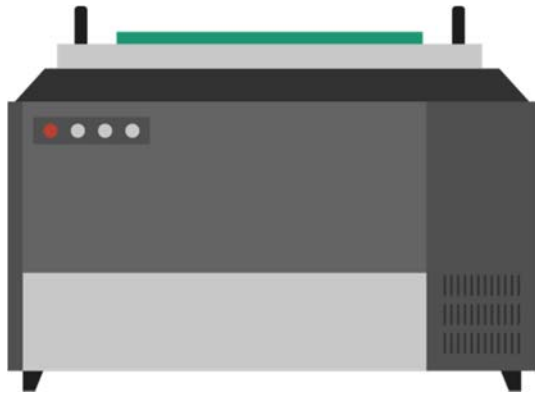
NO COST OF FIXTURING:

- Fixture development and manufacturing
- Bench testing during product development (4080 is immediately ready to test)
- Fixture duplicates in case of multiple production lines
- Fixture re-design at product layout changes
- Fixture maintenance and replacement at end-of-life

* Real data based on a panel of 4 boards, 950 nets, 700 components.

CASE STUDY • 4080 replaces Bed-of-nails Tester

Test Solutions



Existing test solution

Model	Bed of Nails with vacuum receiver
Coverage	99%
Test Program Cost	1.500 - 3.000 €
Fixture Cost (Including 288 Led Sensor)	25.000 €
Handling Time (IL–Manual)	3.5s - 11s
Test Time	46s

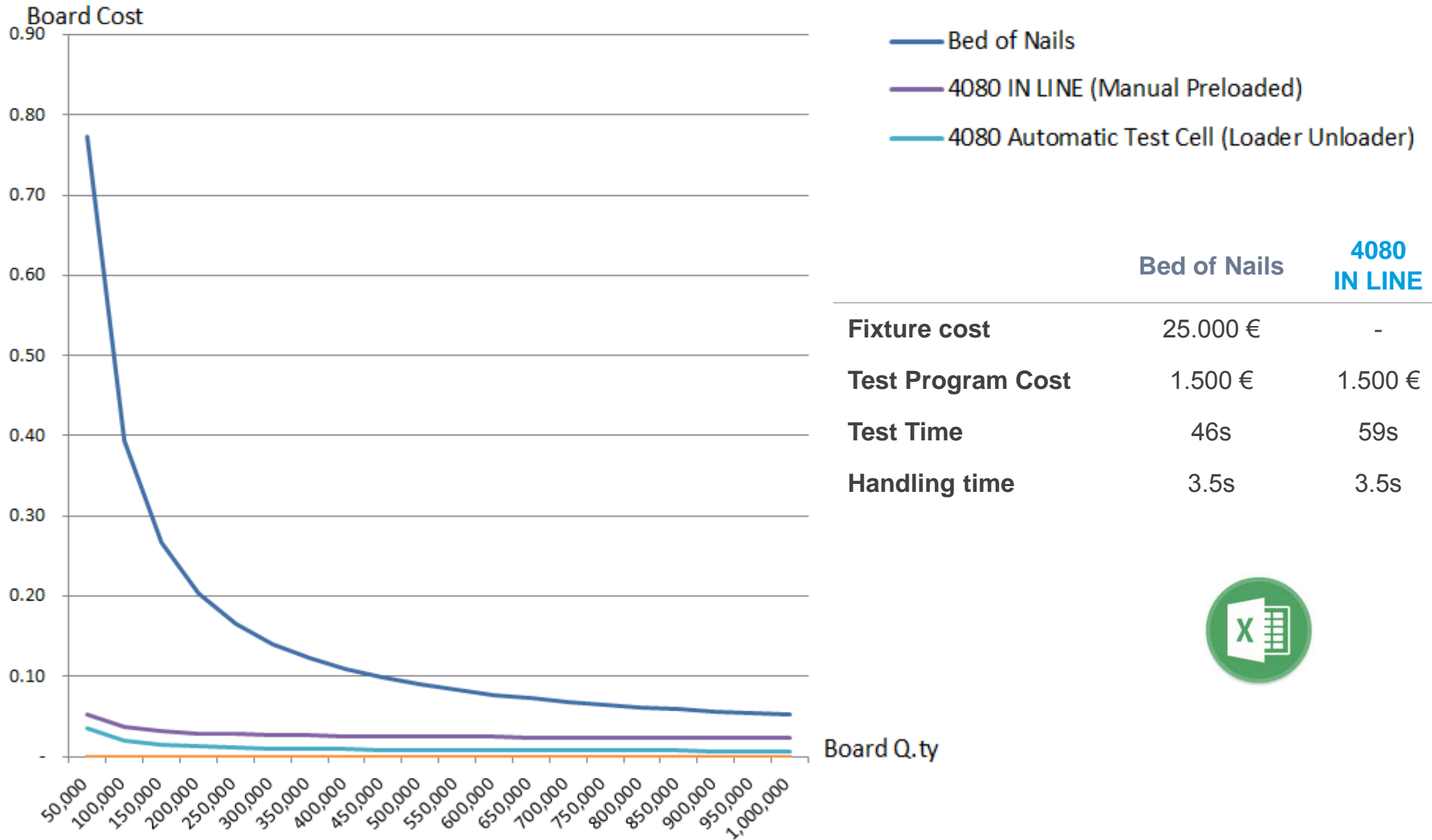


4080 IN LINE

Coverage	99%
Test Program Cost	1.500 €
Fixture Cost	-
Handling Time	3.5s
Test Time	59s

CASE STUDY • 4080 replaces Bed-of-nails Tester

Economics - 1x New Product per Year

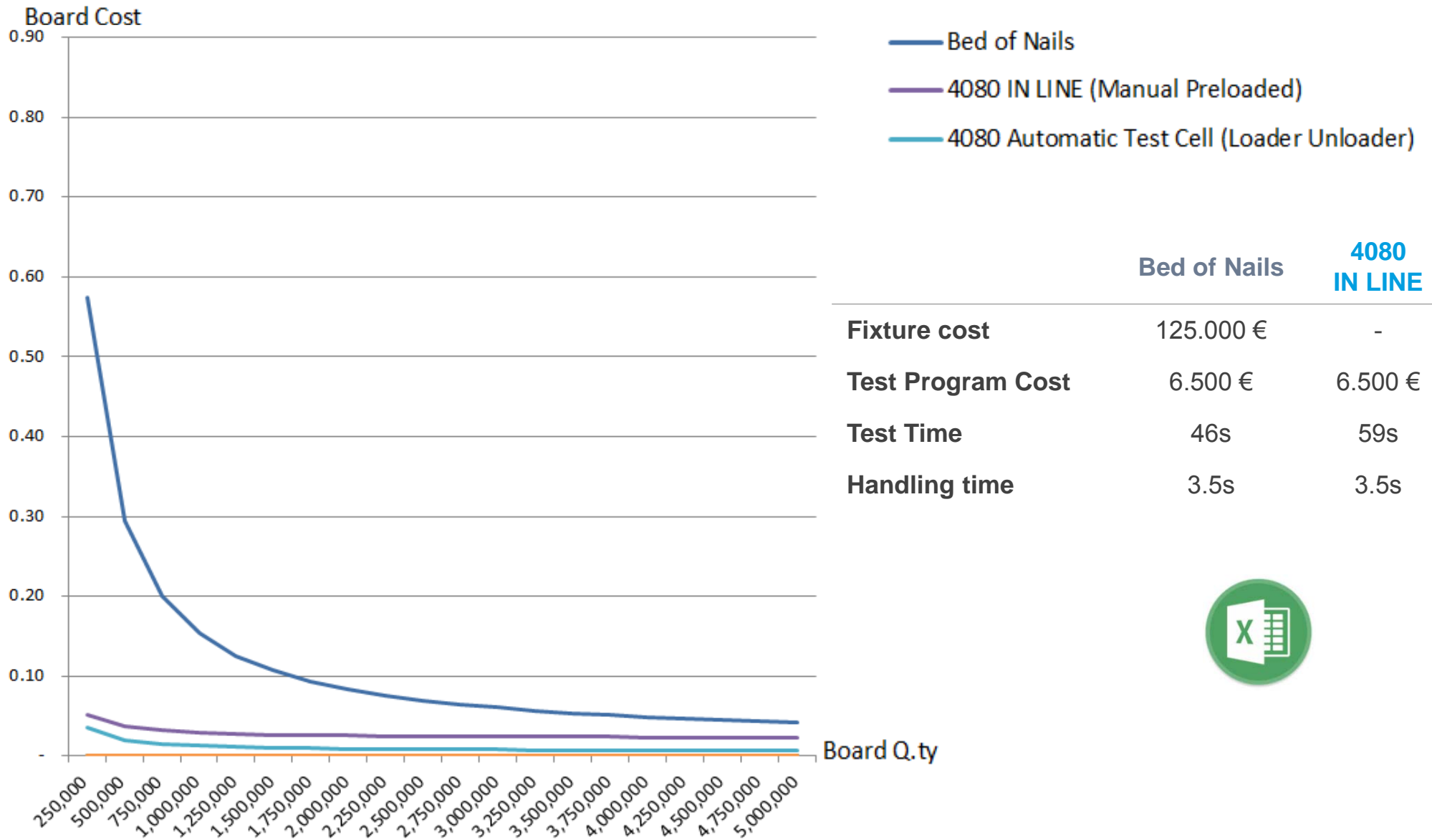


	Bed of Nails	4080 IN LINE
Fixture cost	25.000 €	-
Test Program Cost	1.500 €	1.500 €
Test Time	46s	59s
Handling time	3.5s	3.5s



CASE STUDY • 4080 replaces Bed-of-nails Tester

Economics - 5x New Products per Year



	Bed of Nails	4080 IN LINE
Fixture cost	125.000 €	-
Test Program Cost	6.500 €	6.500 €
Test Time	46s	59s
Handling time	3.5s	3.5s



4080 detects all possible defects

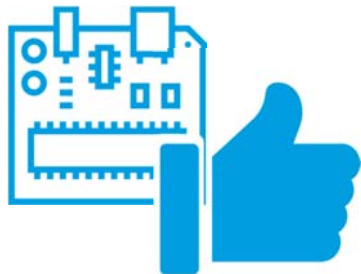


4080 provides a test coverage higher than any flying probe system



ZERO ERRORS AT FUNCTIONAL TEST

- Failure rate at the final functional test is close to zero
- Repair costs are greatly reduced by component-level diagnostics
- Early failure detection reduces costs of following steps
- Functional test equipment can be simplified, functional test time reduced



REDUCED FIELD RETURNS

- 4080 is able to measure, at in-circuit level, key parameters of critical components (e.g. power components, sensing components, actuators), in order to detect weak components (destined to early break down):
- Field returns are practically eliminated



No other Flying Probe tester can reach this speed and this accuracy.
How did SPEA get it?



- **Solid granite chassis**, with high vibration damping performance and thermal stability
- **Equilibrated** cross-centered horizontal axes architecture
- **Robust & light axes** mechanics
- Ultrafast **linear motors on X-Y-Z axis**
- High accuracy sub-micron **linear encoders on X-Y-Z axis**

up to 180
touches/sec

50 μ m
min. Pad size



Natural Granite Chassis

Natural granite chassis guarantees low vibration and thermal stability. This combination ensures unprecedented probing precision at ultra-fast test speed



CHARACTERISTICS

- Natural granite
- High thermal stability
- High stiffness
- High damping performances

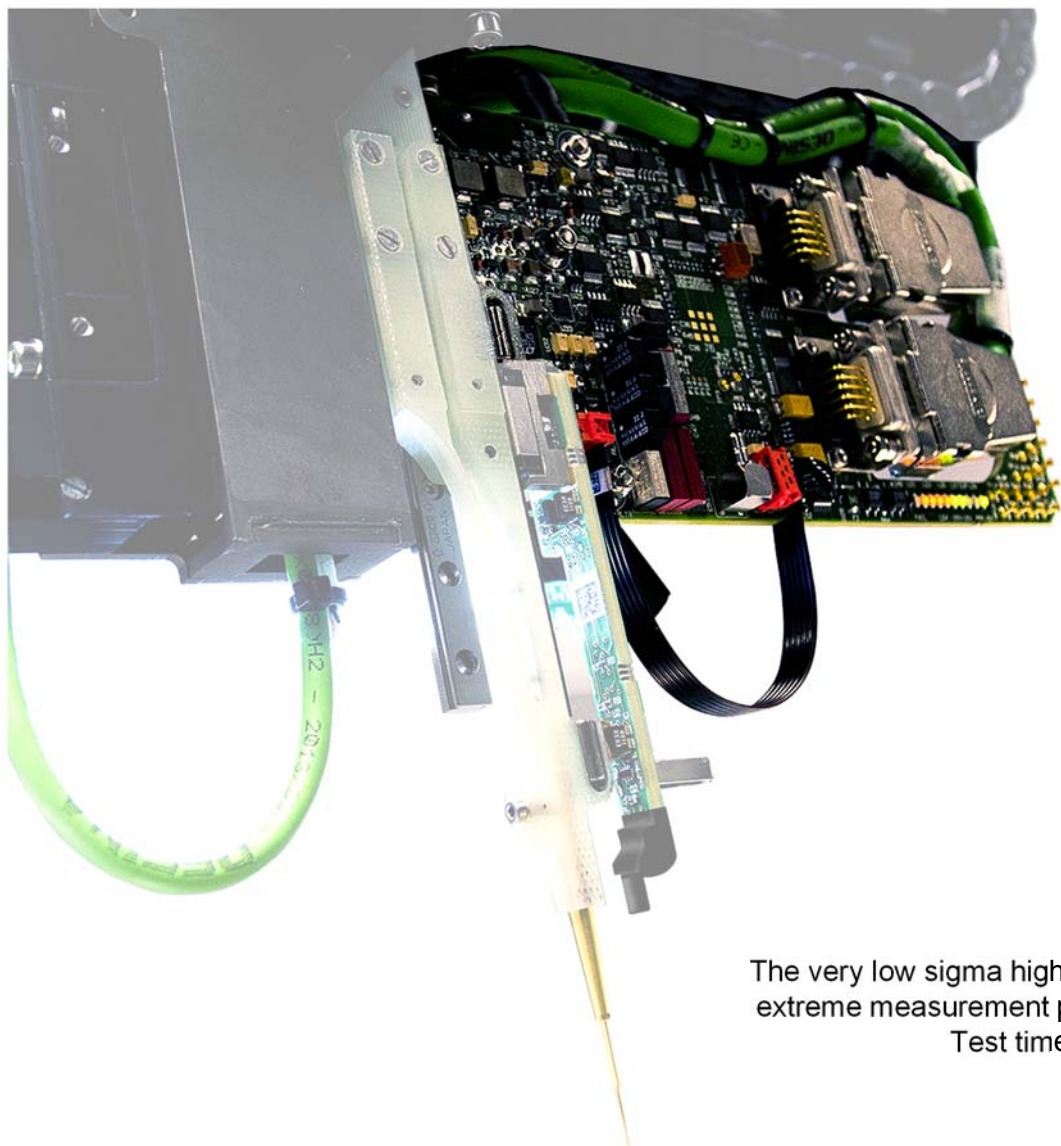
SPECIFICATIONS

Material	White Granite
Resonance frequency	>50 Hz
Max warpage @ full speed	<15 μm
Damping ratio	0.5 %

Flying Tester Concept



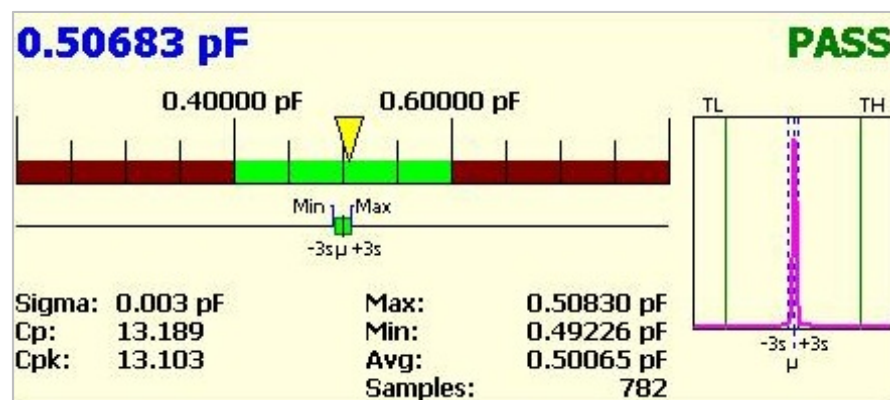
Disruptive innovation: **Force/Measure Instruments** mounted directly on each probe



The very low sigma highlights the extreme measurement precision.
Test time: 0.5 ms.

BENEFITS

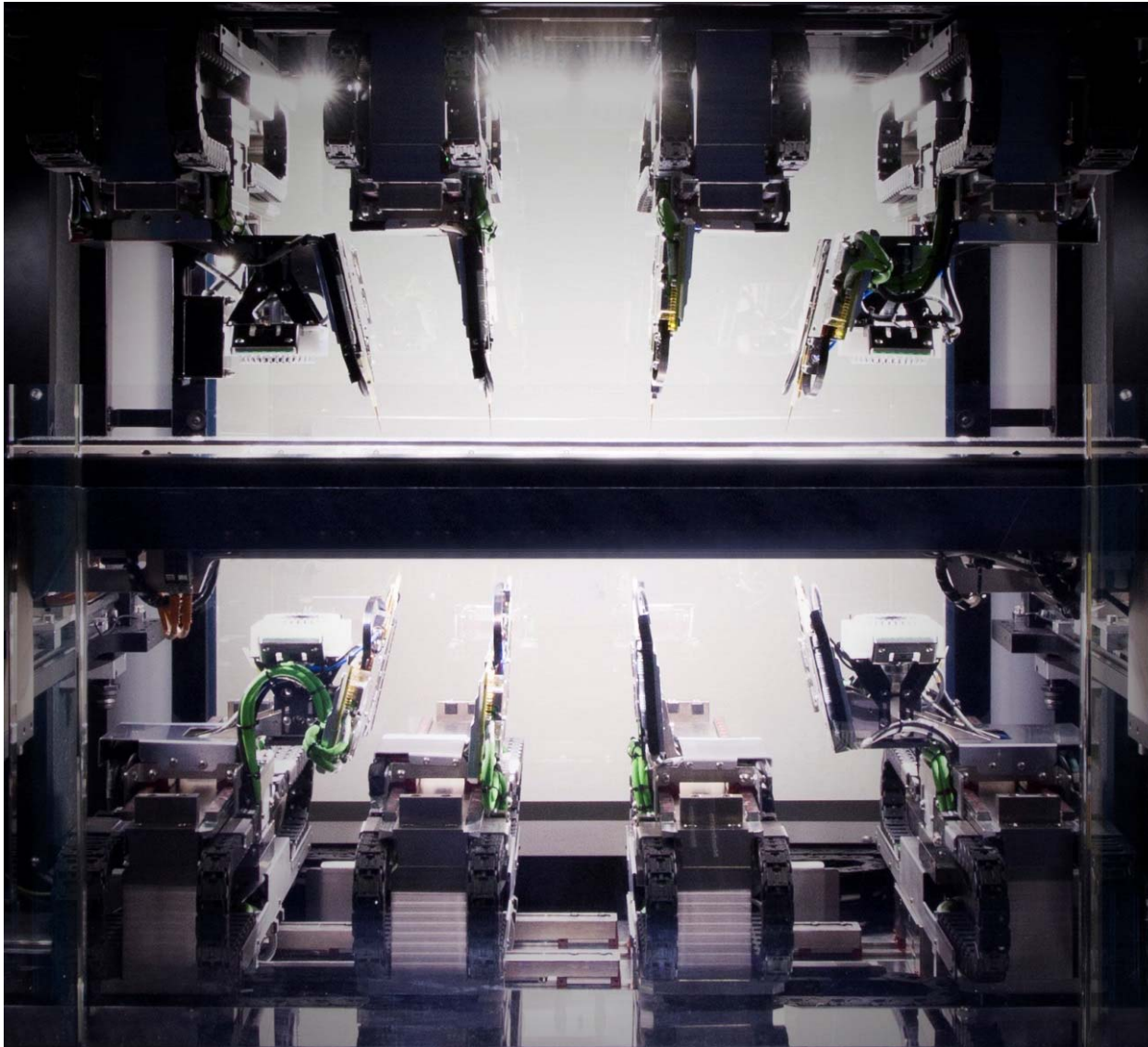
- ✓ Best available measurement performance and accuracy
- ✓ Shorter test time
- ✓ Signal Integrity
- ✓ No measurement degradation or interference due long cables



New X-Y-Z Top-Performance Linear Motors



State-of-the-Art **best motion technology**
Used by the best latest generation Pick & Place machines



BENEFITS

- ✓ Highest available speed of movement
- ✓ Shorter test time
- ✓ Longer life (no tear & wear)
- ✓ Mechanical stability through time

Giotto ATOS 4.0 – The Easy App-based Software



- Automatic test program generation **in minutes**
- Self-explanatory: no need for skilled technician
- Automatic test program generation **with or without CAD file**
- Full & quick automatic **Debug & Tuning**
- **Circuit & Testability analysis**
- **Test strategy optimization**
- Automatic **board repair software**
- Automatic **Pick & Place X-Y file import**
- **Built in Self Test (BIST) compliant**
- New user-friendly intuitive graphic interface

Confidential & Proprietary

Test Techniques



IN-CIRCUIT



ALL NETS
SHORT CIRCUIT



NODAL
IMPEDANCE



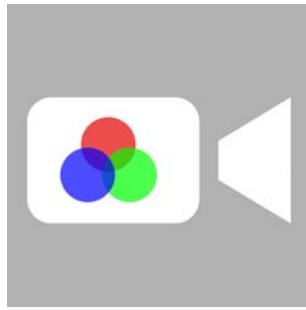
OPEN PIN SCAN



POWER ON



FUNCTIONAL



COLOR
OPTICAL TEST



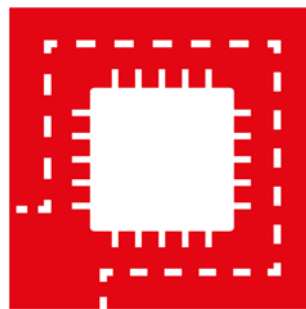
LED COLOR &
INTENSITY TEST



3D LASER TEST



ON-BOARD
PROGRAMMING



BOUNDARY
SCAN

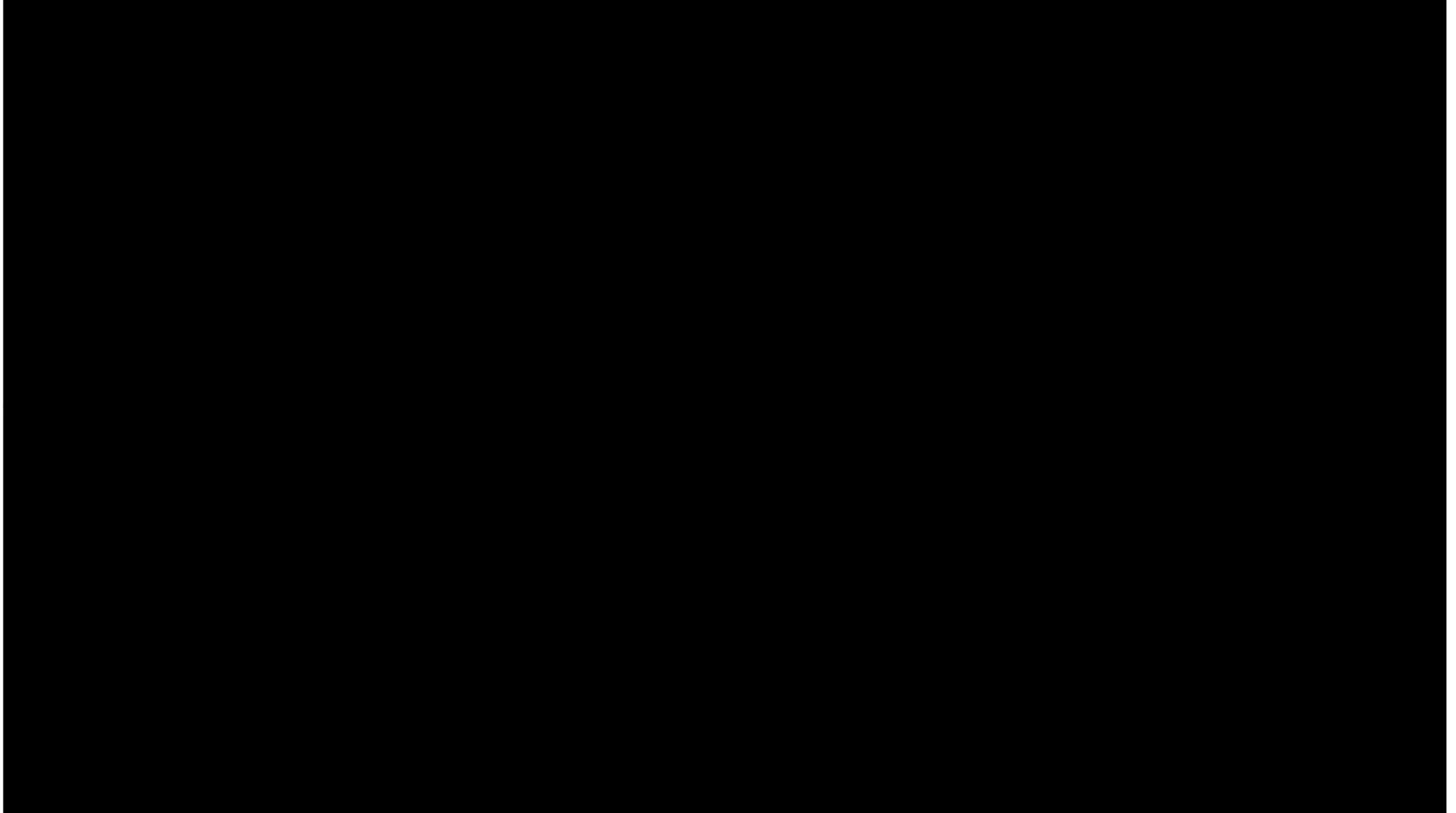


BUILT-IN
SELF-TEST



WAVEFORM
CAPTURE

The new 4080 Flying Probe Tester



Some of the companies relying on SPEA



THANK YOU!



SPEA

YOUR BEST WAY TO TEST

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ADDITIONAL INFO

Test Techniques

- Component In-Circuit Test
- All Nets Short Circuit Test
- Nodal Impedance Test
- Open Pin Scan
- Power On and Functional Test
- Color Optical Test
- Light Test
- 3D Laser Test
- Parallel On Board Programming
- Boundary Scan
- Waveform Capture



Component In-Circuit Test



ICT

4080 provides 6 types of ICT Power Off test

- Standard ICT Power Off: V/I maximum values used are 100mA and 10V
- Safe ICT Power Off: To be used to test circuits using IC technology that do not allow V/I application higher than 5mA and 0.3V
- Hi-Accuracy ICT Power Off: Measurements made using instrumentation with accuracy of 0.1%
- Hi-V ICT Power Off: 4-Quadrant V/I force and measure up to 100V and 100mA
- Stress ICT Power Off: 4-Quadrant V/I force and measure up to 1A. Used to detect defects of power devices such as MOS and Power ICs
- Dynamic V/I ICT Power Off: Force and measure synchronized V/I signals with timing of 1us step. Used to test dynamically transformers, relays, power devices

UNIQUE

UNIQUE

UNIQUE

UNIQUE

UNIQUE

Performance:

2000 tests performed in 30 seconds

All Nets Short Circuit Test



4080 applies a short test techniques based on high-accuracy impedance measurement, able to detect any short of each net in respect to all other nets.



Unique accuracy guaranteed by Flying Tester Architecture

BENEFITS

- ✓ Test time reduction (1 touch per net)
- ✓ 100% shorts coverage
- ✓ Impedance value of each net is measured
- ✓ Resolution 0.1pF: also shorts between single point nets are detected (e.g. connected connector pins)
- ✓ No need for golden board



Short circuits, if left undetected, can cause **breakages and damage** when the board gets powered up for the first time (e.g. during Functional test). These faults can cause a damage/degradation that results in a shorter life of the component.



NZT technique detects IC failures with no need to power up the board.

The **Nodal Impedance Test significantly increases the test coverage** of the Flying Prober.

Resistance, capacitance, junction of each net is measured to identify several types of defects that would not be detectable by the In Circuit test:

- Open Pins
- Damaged I/O stages of ICs
- Bus line impedance out of specs
- Tracks leakage



NZT is a **power-off test technique**:

it is not required to power on the board, so there is no risk of stressing and damaging the UUT

BENEFITS



Test coverage increase

Prevent “infant mortality” of the PCBA

No stress/damage of the UUT



Damages to the I/O stages of ICs (they are often caused by ESD)

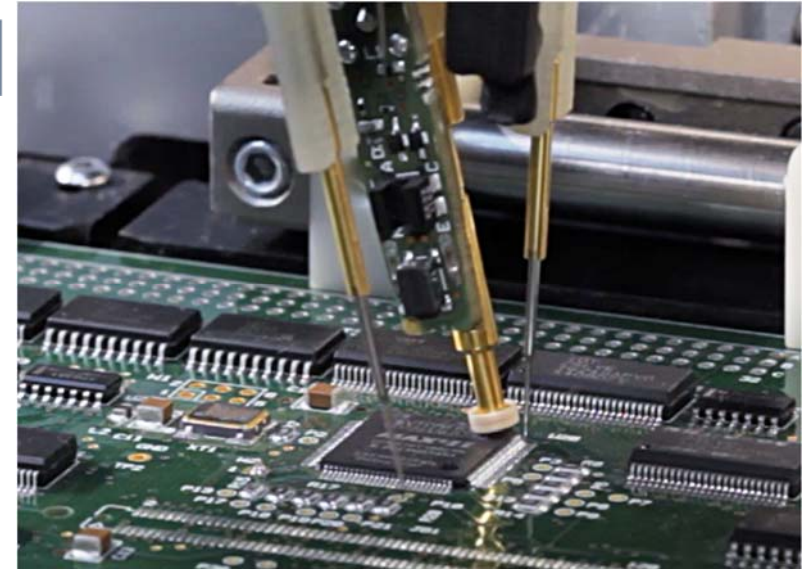
Open Pin Scan



2 vectorless test techniques detect open pins and other process defects easily and quickly, without powering the board. Test is automatically generated starting from board data description

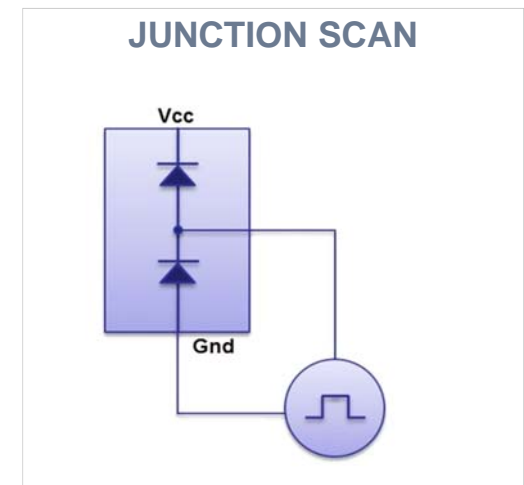
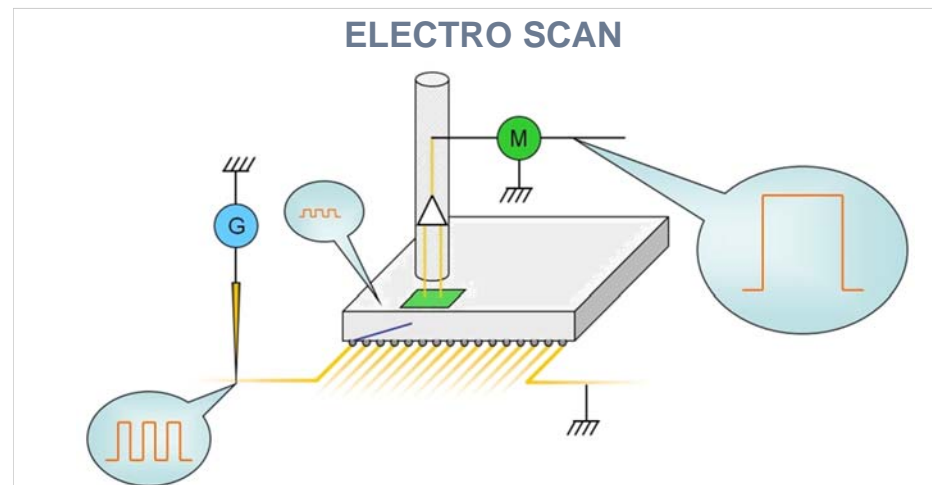
TEST CAPABILITIES

- ✓ Open pins
- ✓ IC orientation
- ✓ Electrolytic capacitor polarity
- ✓ Presence of connector pins
- ✓ Stray capacitor presence
- ✓ Parallel pins testable
- ✓ Metallic case component testable

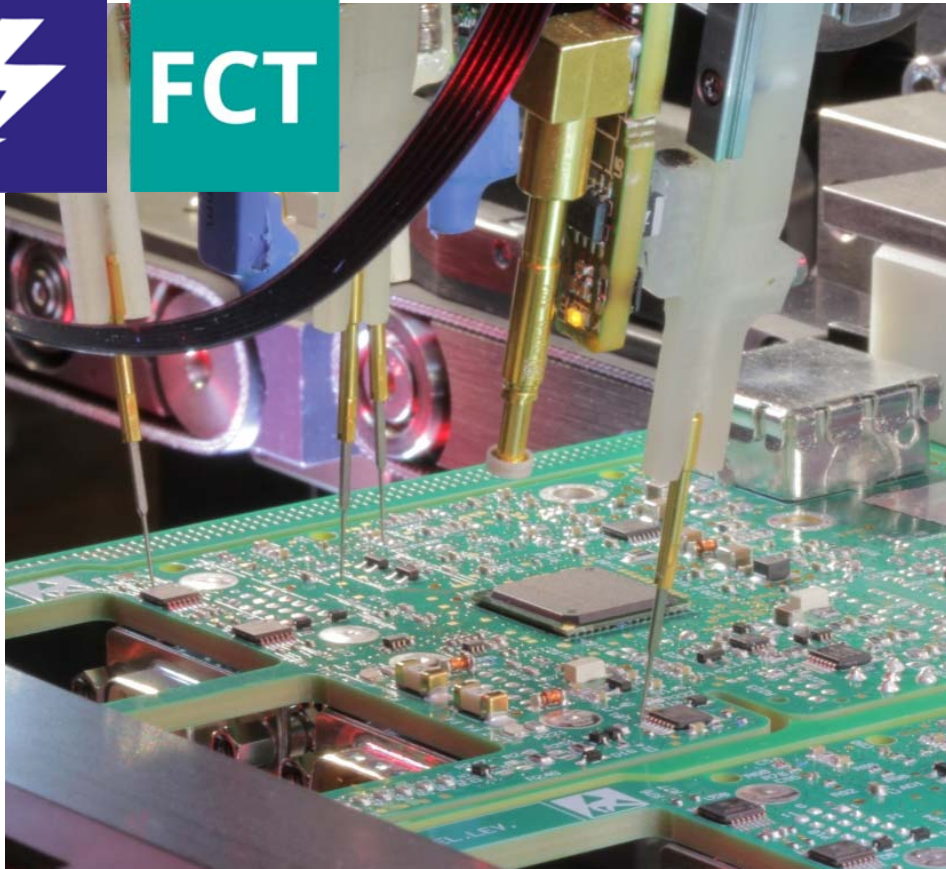
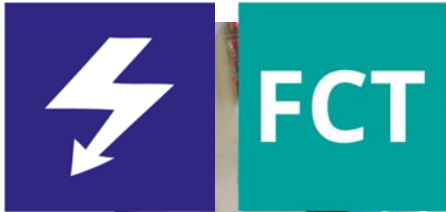


NEW

Electroscan enabling mechanism
Just **80ms** to enable/disable the electroscan probe during test



Power ON and Functional Test



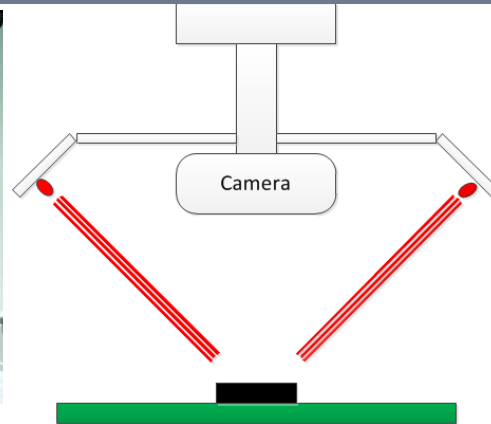
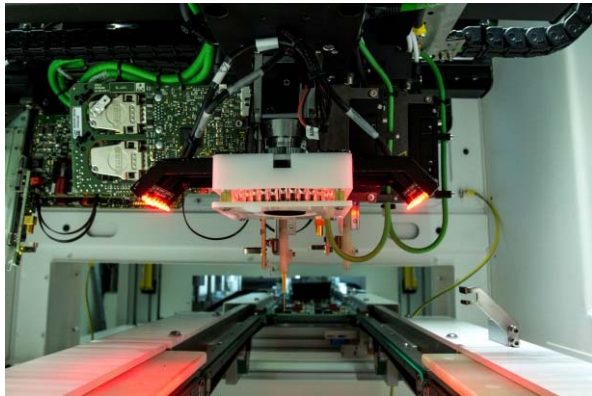
Type	Measured parameter
Supplies	Input voltage verification Output voltage verification Absorption current value
Current regulators	Output voltage Load regulation Line regulation
DC/DC converters	Output voltages Load regulation Line regulation
Comparators	Presence and orientation Positive saturation Negative saturation Short circuit current Source current Sink current
Operational amplifiers	Presence and orientation Positive saturation Negative saturation Short circuit current Source current Sink current Positive slew rate Negative slew rate Voltage follower
Logic gates	Truth table
Watch Dog	Voltage Timing
PWM	Output voltage Switching frequency
Quartz oscillators	Nominal frequency

Color Optical Test



Up to 4 color cameras with **tangential red lights** provide fast & reliable optical test of components and characters

TANGENTIAL RED LIGHT

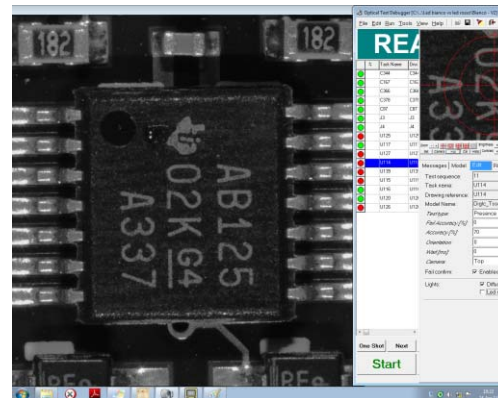
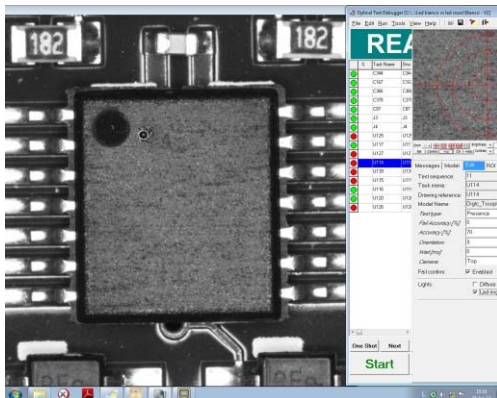


TEST CAPABILITIES

- ✓ **Presence or absence of components** that cannot be tested electrically
- ✓ **Components recognition**
- ✓ **Correct orientation of components:** electrolytic capacitors, connectors, ICs
- ✓ **Character and symbol recognition (OCV),** such as 2D barcode and IC device names
- ✓ **Laser mark reading**

Standard lighting

Tangential red lighting

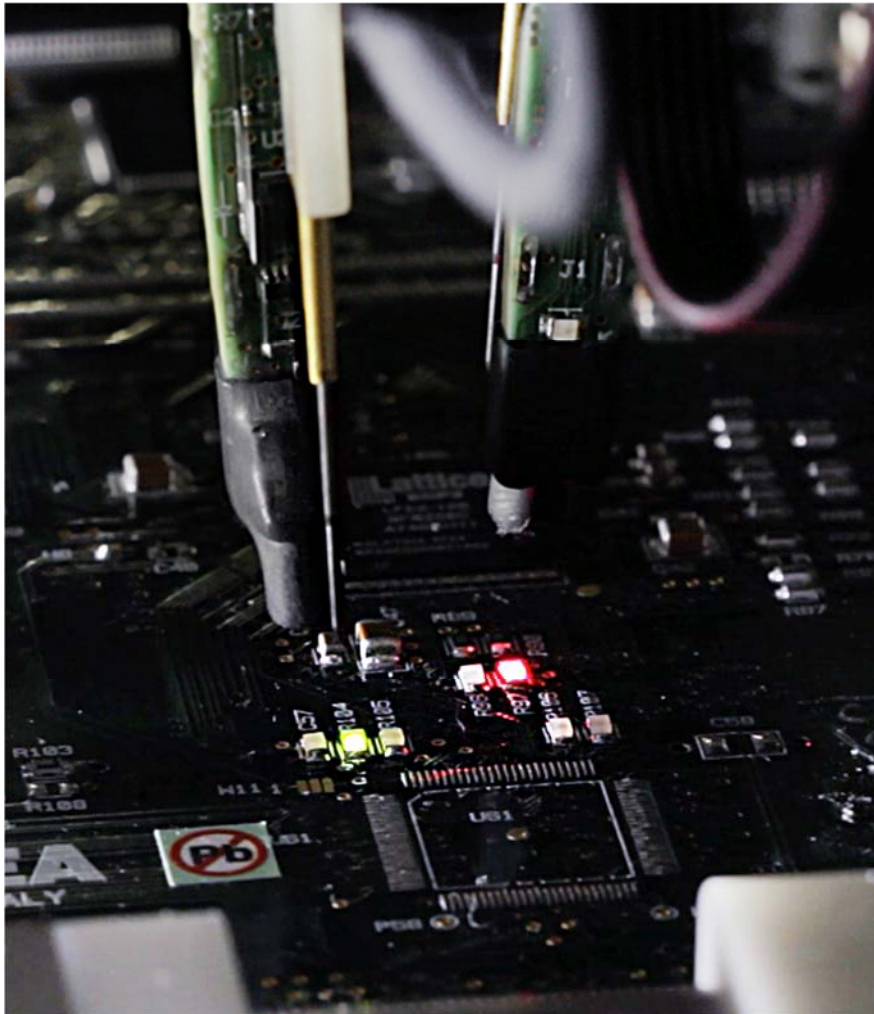


NEW

**Autofocus
Liquid Lens Technology**



Automatic & Reliable measurement of Color, Intensity and Chromaticity of the light emitted by LEDs or other light sources



COMPLETE

Light color test:

- HSL color space
- RGB color scale
- X-Y Chromaticity diagram (CIE 1931)
- Correlated Color Temperature (CCT)
- Dominant Wavelength
- Candela (mcd)

Light intensity test:

- 0-60.000 Lux

FAST

- **Parallel test of up to 4 different-type LEDs**
- **Ultra-fast LED Test (10 LED/sec @ 5mm distance)**
- Test time **independent** from light intensity & PC

NEW

Light Test Probe enabling mechanism

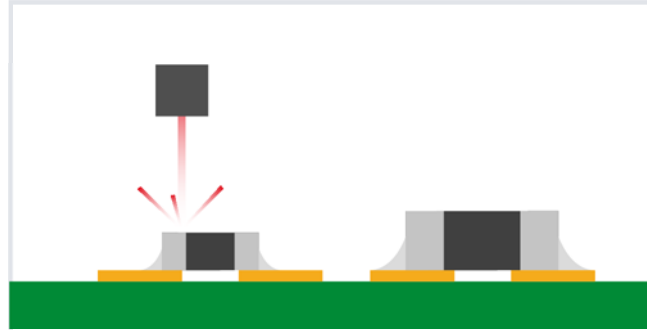
Just **80ms** to enable/disable the light test probe during test



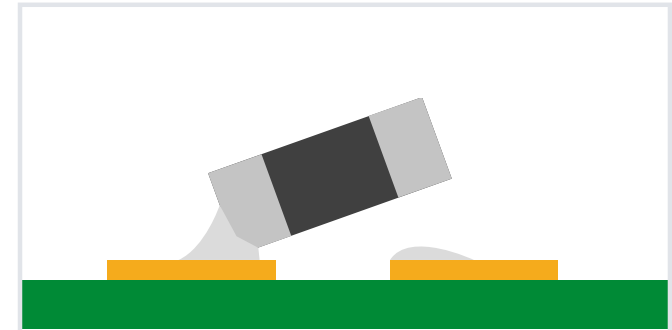
Laser Test verifies the **presence** and **correct placement** of components



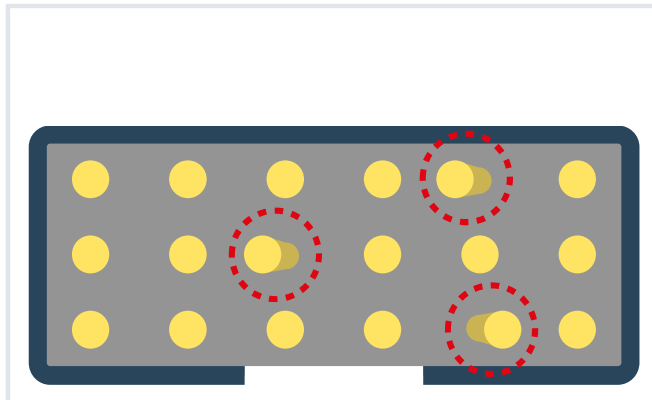
COMPONENT PLANARITY



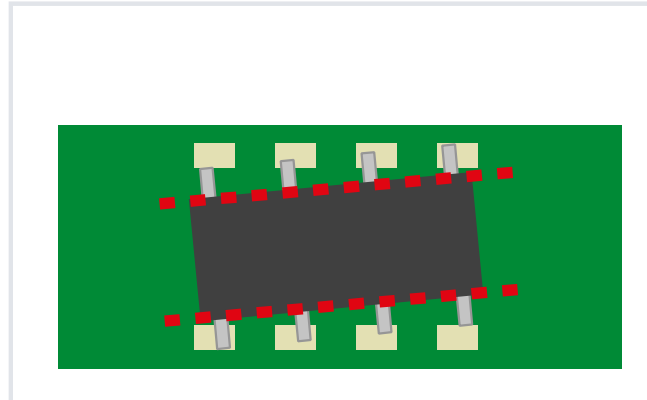
COMPONENT DIMENSIONS



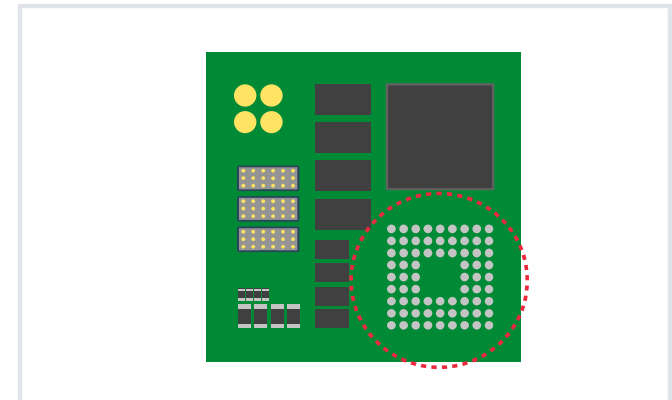
TOMBSTONE



BENT CONNECTOR PINS



COMPONENT ROTATION



COMPONENT PRESENCE



Parallel On-Board Programming

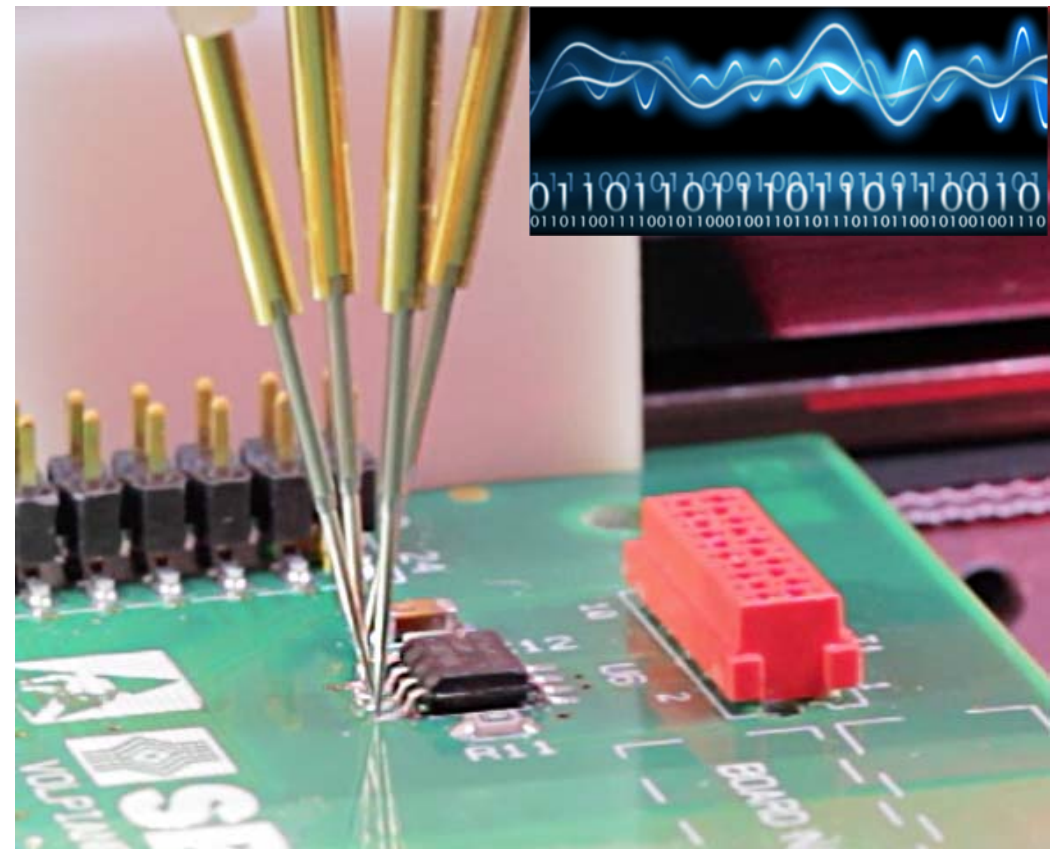


SPEA On Board Programming directly performs component **programming on board**, during, before or after the test execution

HIGHLIGHTS

- On-board programming via flying probes or system interface
- **Parallel programming of different-type components**
- Up to **64 direct 1:1** digital driver/sensors
- Easy to use with **Smart OBP** software
- **Large library** with hundreds of devices and drivers

On-axis measurement module allows accurate digital signal transmission via flying probe

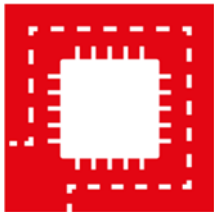


INTERFACES & PROTOCOLS

- | | |
|----------------------------------|-------------------------------------|
| • JTAG-interface | • UART interface |
| • BDM interface | • Microwire |
| • PIC family | • Single Wire |
| • I ² C-Bus-interface | • Parallel Flash Memory |
| • SPI-interface | • Microcontroller |
| • LIN interface | • Serial E ² prom memory |

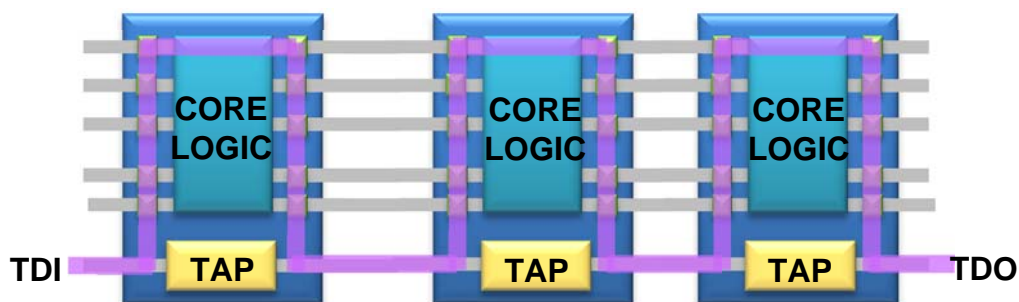


Boundary Scan



4080 **combines** the most complete in-circuit test with the best **boundary scan test**, through the cooperation with leader technology partners

Flying probes, used as boundary scan channels, raise diagnostic capabilities by integrating control points in the boundary scan chain

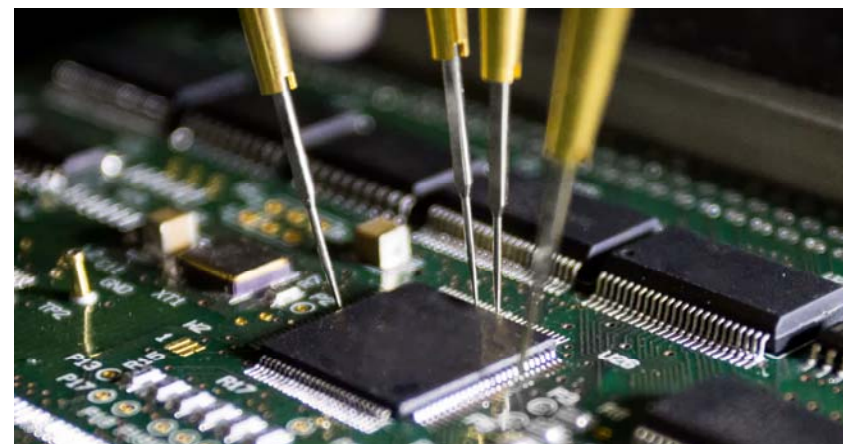


AVAILABLE TESTS

- Boundary Scan IC
- Stand-alone IC
- Single IC through component chains
- TAP port integrity
- Verification of device mounted by "id Code"
- Short circuit to Gnd and supply
- Short circuit between non-contactable IC pins
- Verification of non contactable device pin soldering
- Net interconnection

HIGHLIGHTS

- **Unique integrated software interface**
- **Increased fault coverage with ICT + Boundary Scan** combined test program generation
- **No redundant tests**
- Optimized number of probe movements



Waveform Capture

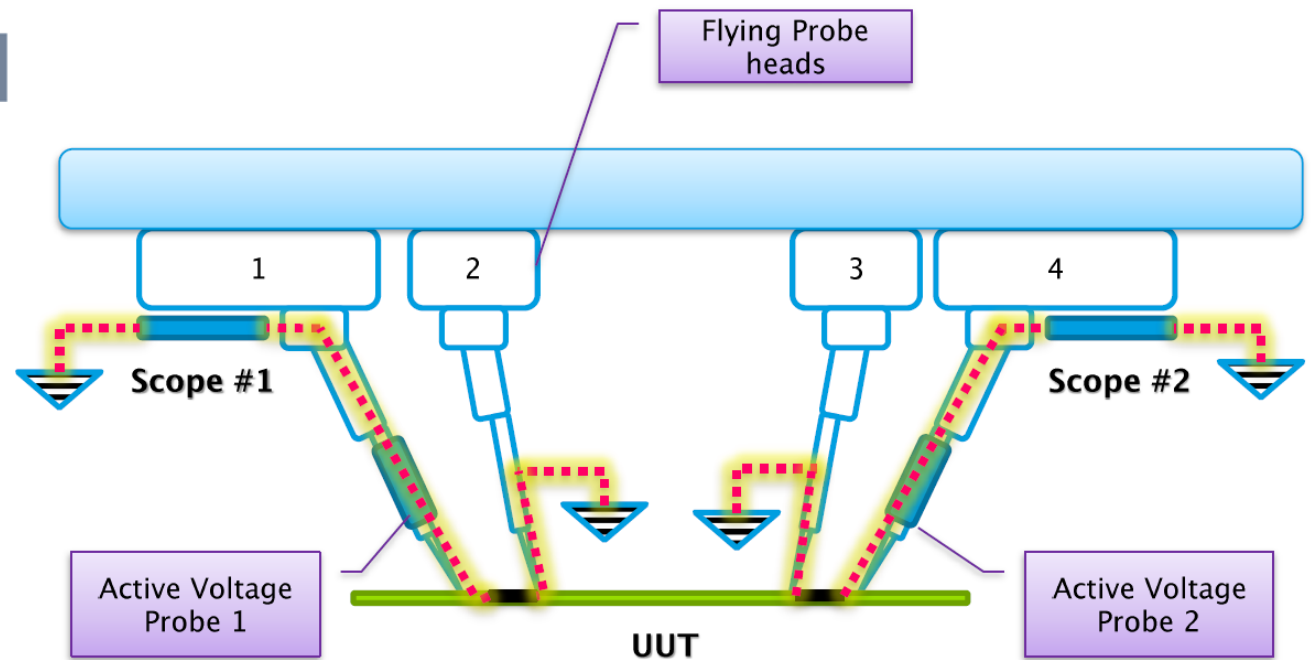


Equipped with the Flying Scope tool, the flying prober can **acquire the waveform** of nets and components of a board.

Measurement is accurate and reliable: the measurement is acquired by **active voltage flying probes**, which **avoid signal crosstalk and distortions** due to cable connections between probe and oscilloscope. Oscilloscope is mounted directly on the axis, so to minimize cable length.

HIGHLIGHTS

- Oscilloscope mounted on axis
- Active Voltage Probe
- Bandwidth: 500 MHz
- Sampling rate: 5GS/s
- Each captured value can be stored and exported to Excel report.



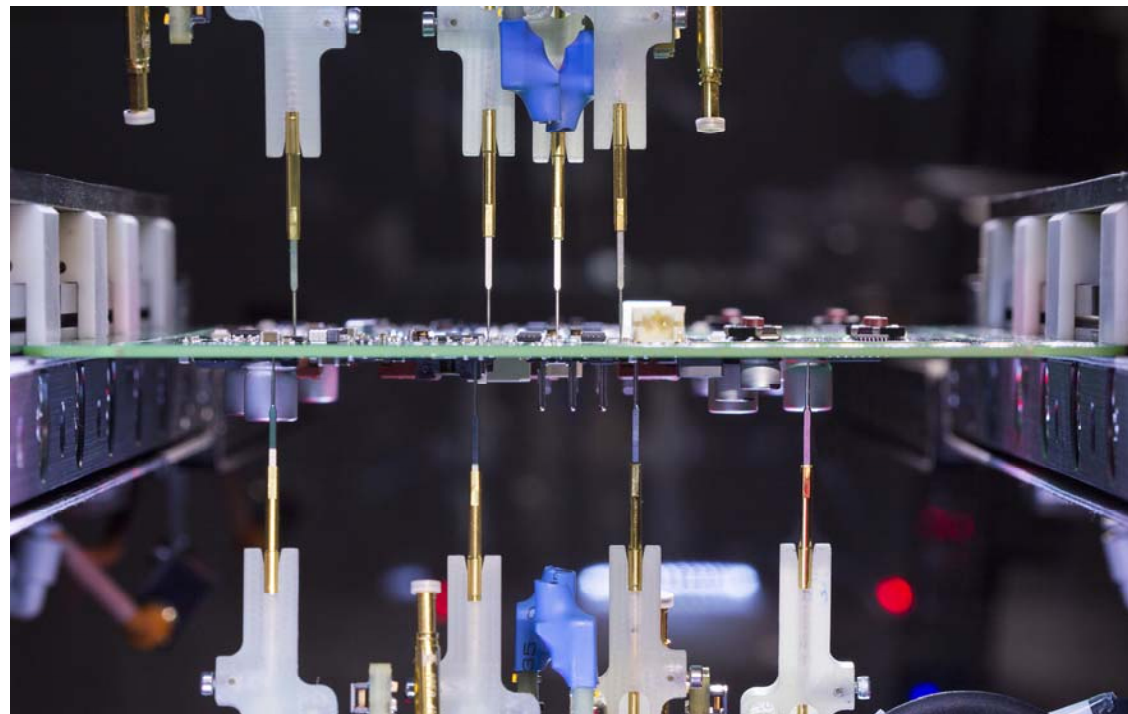
Utility Probes



Electrical Probe + Utility Probe on each axis
8 axes => 16-probe machine

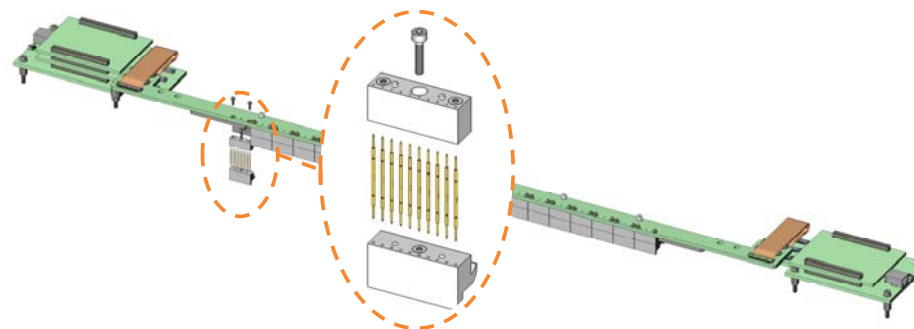
Each 4080 axis can install two probes:

- One **Electrical Probe** for all electrical tests
- One Multifunction **Utility Probe** for different functions:
 - Electric field test (ElectroScan)
 - 3D laser test
 - Light test (color and intensity)
 - Multi-probe
 - Dynamic support rods
 - Thermal test
 - Marker



ADDITIONAL POINTS ON THE LOADING LINE

4080 integrates fixed contacting points in the board loading line. They can be used, for example, for grounding or power supply.



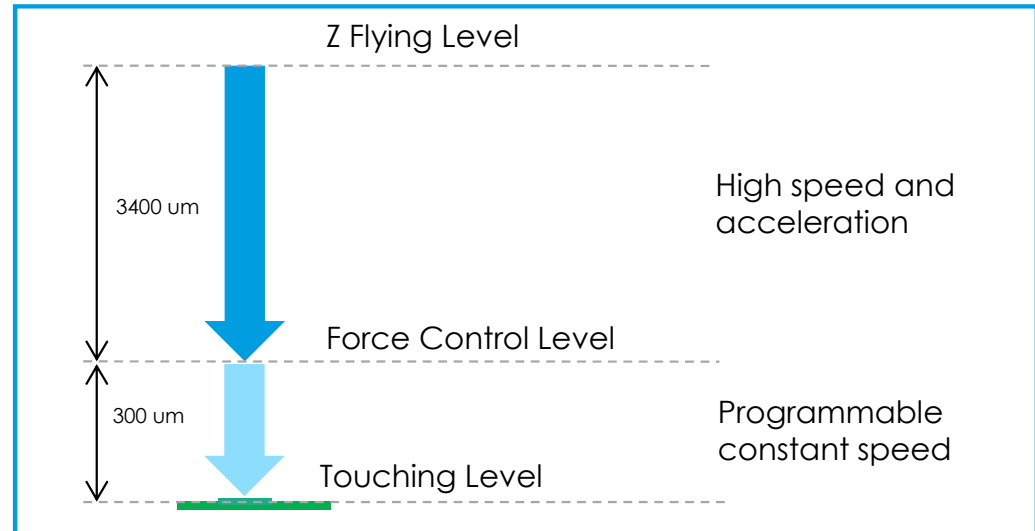


Programmable Probing Force

Test point contacting at near-zero energy

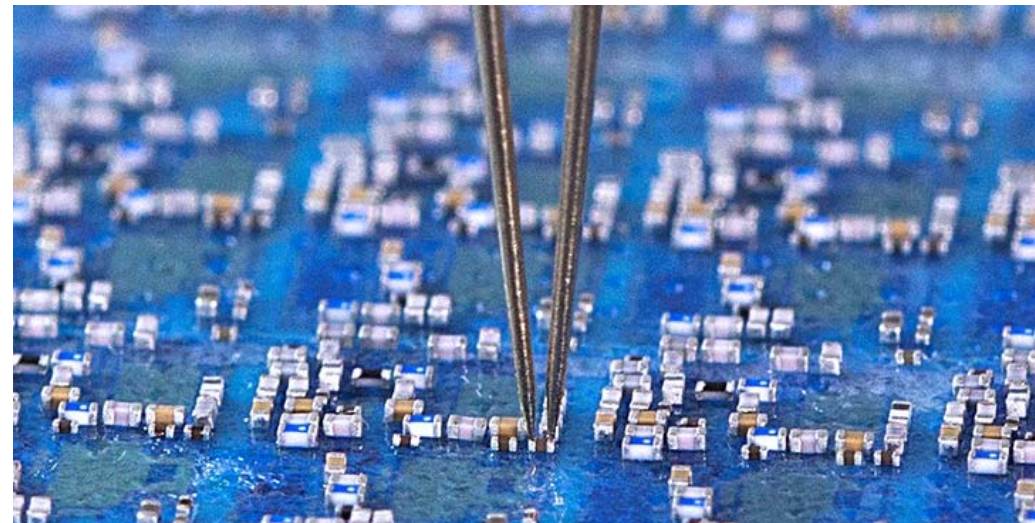
BENEFITS

- ✓ Programmable probing force (10 – 400g)
- ✓ No test point damage
- ✓ Safe ultra-small test point contacting
- ✓ No board vibration



APPLICATIONS

- Fragile surfaces (wire-bond pads, gold pads, ...)
- Sticky boards
- Flex circuits
- Ultra-fine pitch pads
- Wafer
- Aerospace & medical electronics



4080 contacting 01005 SMD on sticky board



Warpage compensation

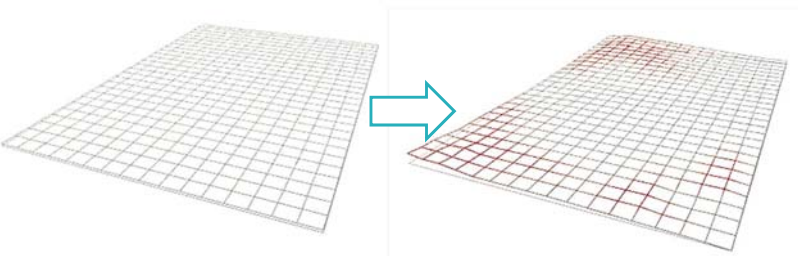


Especially useful for Multiplexed boards, ultra-thin boards

1 Laser sensor measures the height values of the board (1µm resolution)



2 The software recalculates the coordinates

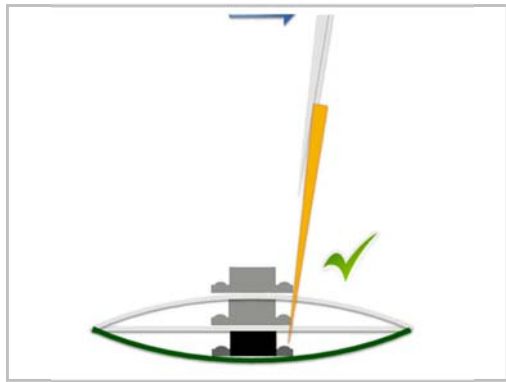
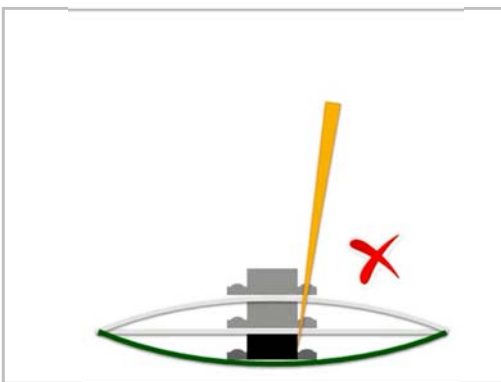
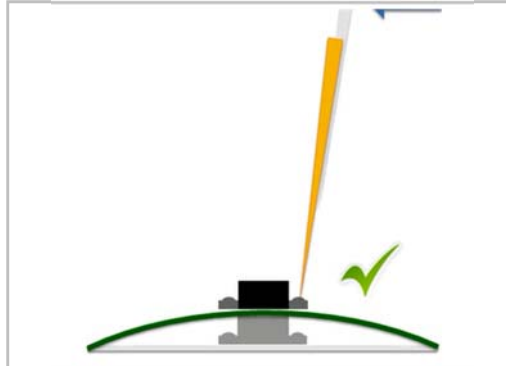
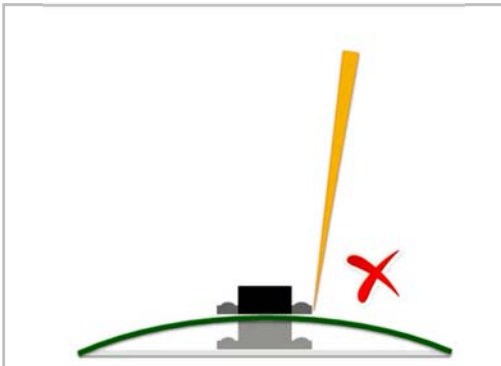
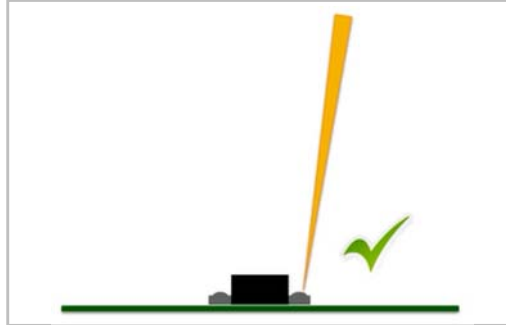
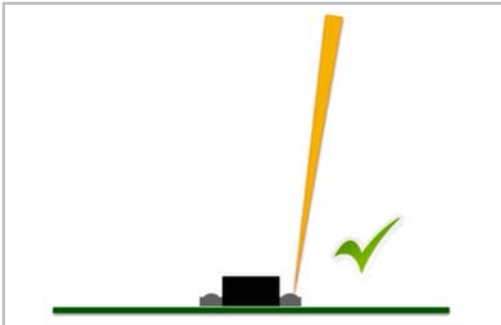


3 Axis positioning changes according to the UUT warpage (max warpage compensation: 2mm)

WARPAGE COMPENSATION

OFF

ON



Specifications



Main	Touches/sec	180
	Max test area	510x460mm [20x18"]
	Max board size	1500x460 [59x18"]
	X, Y, Z linear motors with linear encoders	Standard
	Max component height (mm)	110
Probes	Top Flying Heads	4
	Bottom Flying Heads	4
	Board planarity support	Dynamic
	Multi-probe unit option	Top/Bottom
	Programmable probing force and level	Standard
Board loading	Manual	Standard
	In-line	Optional
	Combined	Standard
Dimensions	Footprint	1700x1300mm [67x51"]