
EIGHTEENTH ANNUAL
BiTS
TM
Burn-in & Test Strategies Workshop
March 5 - 8, 2017
Hilton Phoenix / Mesa Hotel
Mesa, Arizona
Archive – Session 1
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Session 1

Marc Moessinger

Session Chair

BiTS Workshop 2017 Schedule

Performance Day

Monday March 6 - 10:30 am

Driving Performance

"Design for performance and advanced characterization of new contactors"

Markus Wagner – Cohu & Milen Cheshmedjiev – Melexis

"Investigation into Various Via Structures in High Speed Interconnect"

Carol McCuen - R&D Altanova

"Contactor and Package Design Effects on Crosstalk"

Noureen Sajid & Jeff Sherry - Johnstech International

"Contactor Based Final Test at 77 GHz on a Multi-Channel Radar Transceiver Chipset"

Brian Nakai & Jeffrey Finder - NXP Semiconductors

BiTS 2017 Burn-in & Test Strategies Workshop

Design for performance and advanced characterization of new contactors

Markus Wagner
Milen Cheshmedjiev

BiTS Burn-in & Test Strategies Workshop

BiTS Workshop
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Melexis INSPIRED ENGINEERING

Cohu

Contents

- Introduction
- Status before - History
  - Supplier side
  - Customer side
- First “golden setup delivered” – Results Melexis
- Qualification Process - COHU
- Introduction of new “golden setup + Denmark”
- Evaluation at Melexis
- Deployment – Industrialization and Results
  Conclusion + Outlook

Introduction

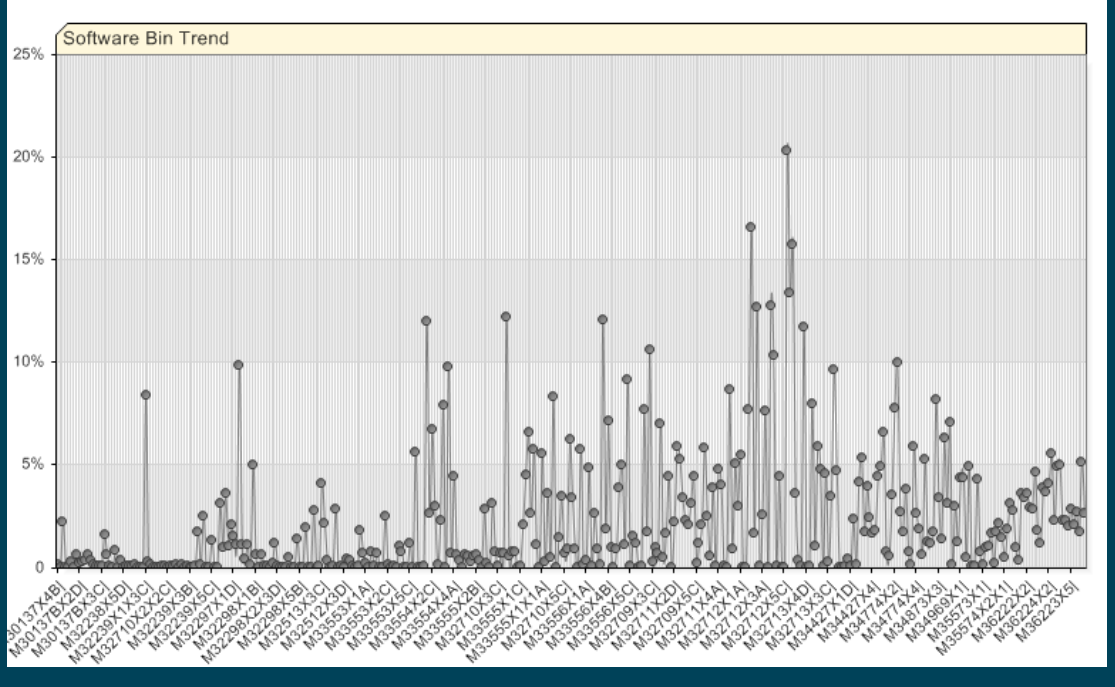
- Industry trend for all segments
  - higher requirements for Contactor specifications
  - shorter product life cycles
  - Faster Time-to-market
- Drivers:
  - Faster “Time-to-yield”
  - Proven contactor solutions
  - Detailed contactor specifications (mech./electrical)
  - System-integrated contactor solution
  - LED /MEMS… -> special Device geometry -> higher degree of integration

Status before - History

- Supplier side
  - Contact resistance
  - Force stroke simulation /measurement
  - Life span test
  - Temperature
- Customer side:
  - No performance qualifications
    - Contact resistance – not evaluated at buy off
    - Temperature performance - not checked
  - Real on floor performance
    - Each shift cleaning
    - Average re-test – 3.2%
    - 3% contact fail brings another few % other fail
    - Frequent stops for series of contact fails

Where did we start from?

- Contact fail 2012 @150°C
  Average value 3.2%



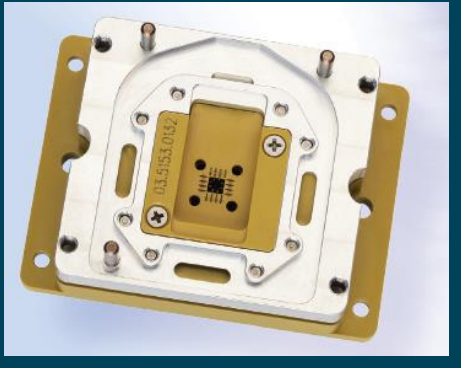
Design of experiment

- Contactor for SO1000
  - X4 parallelism
  - Kelvin
  - QFN4x4
  - Temperature range -40°C /35°C /150°C
  - 4 Sockets with different Spring types

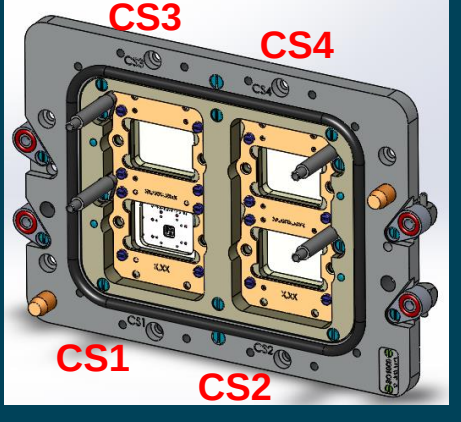
	IN	OUT
CS1	03.5100.1788 Old type springs	03.5100.2137 Increased force and relative travel
CS2	03.5100.1788 Old type springs	03.5100.2138 Longer
CS3	03.5100.2139 Decreased relative travel	03.5100.2138 Longer
CS4	03.5100.2139 Decreased relative travel	03.5100.2137 Increased force and relative travel

In = inner contact element of a Kelvin pair
Out = outer contact element of a Kelvin pair
CS = Contact site – (see picture)

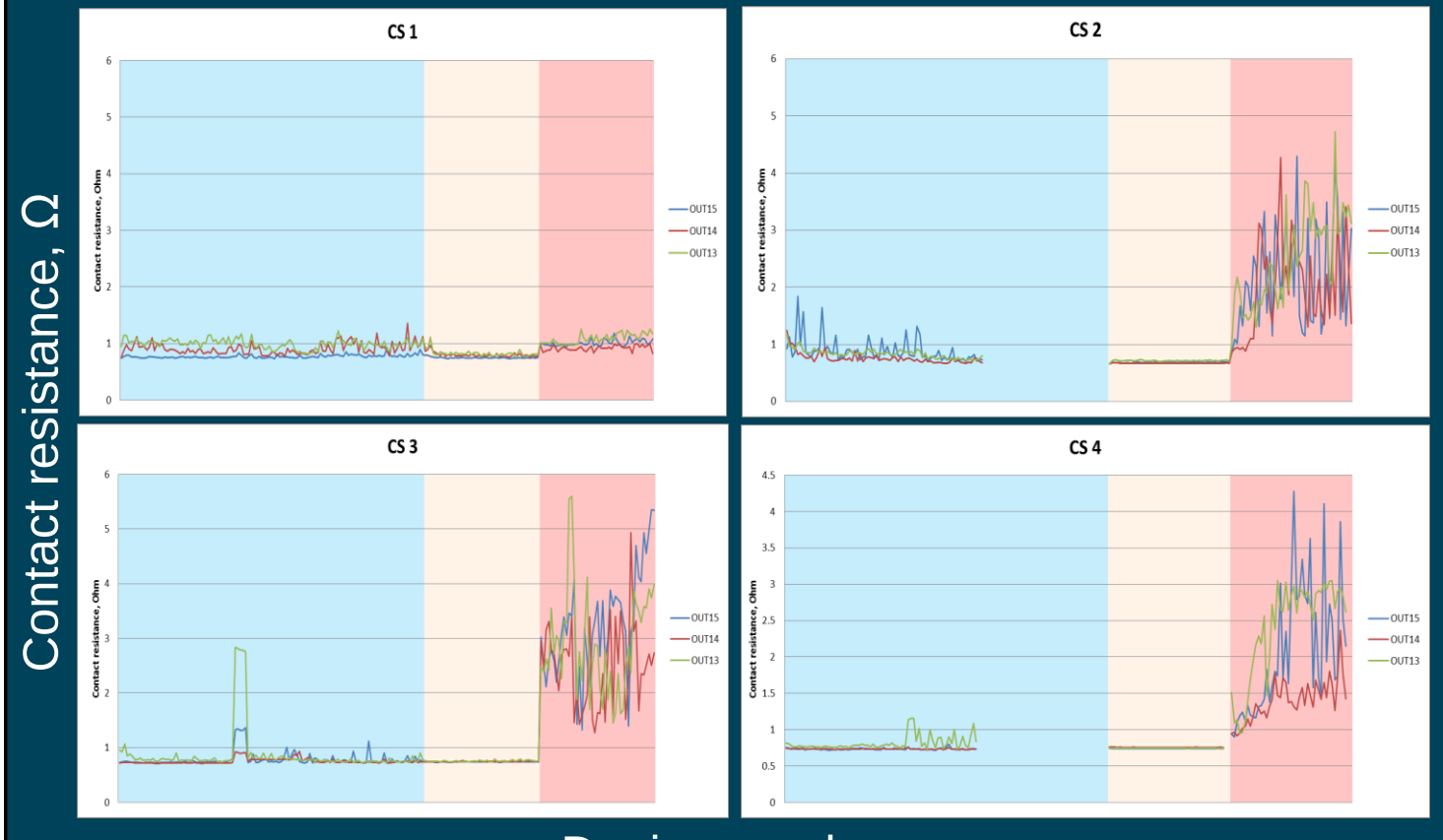
Contact socket



Contact holder x4



Results at Melexis

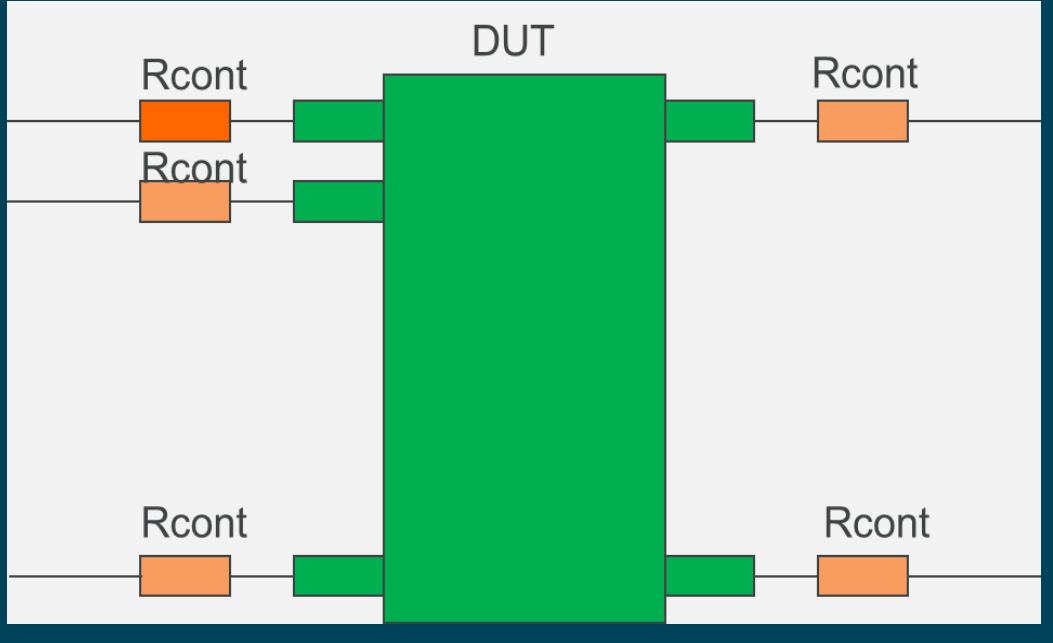


Evaluation criteria

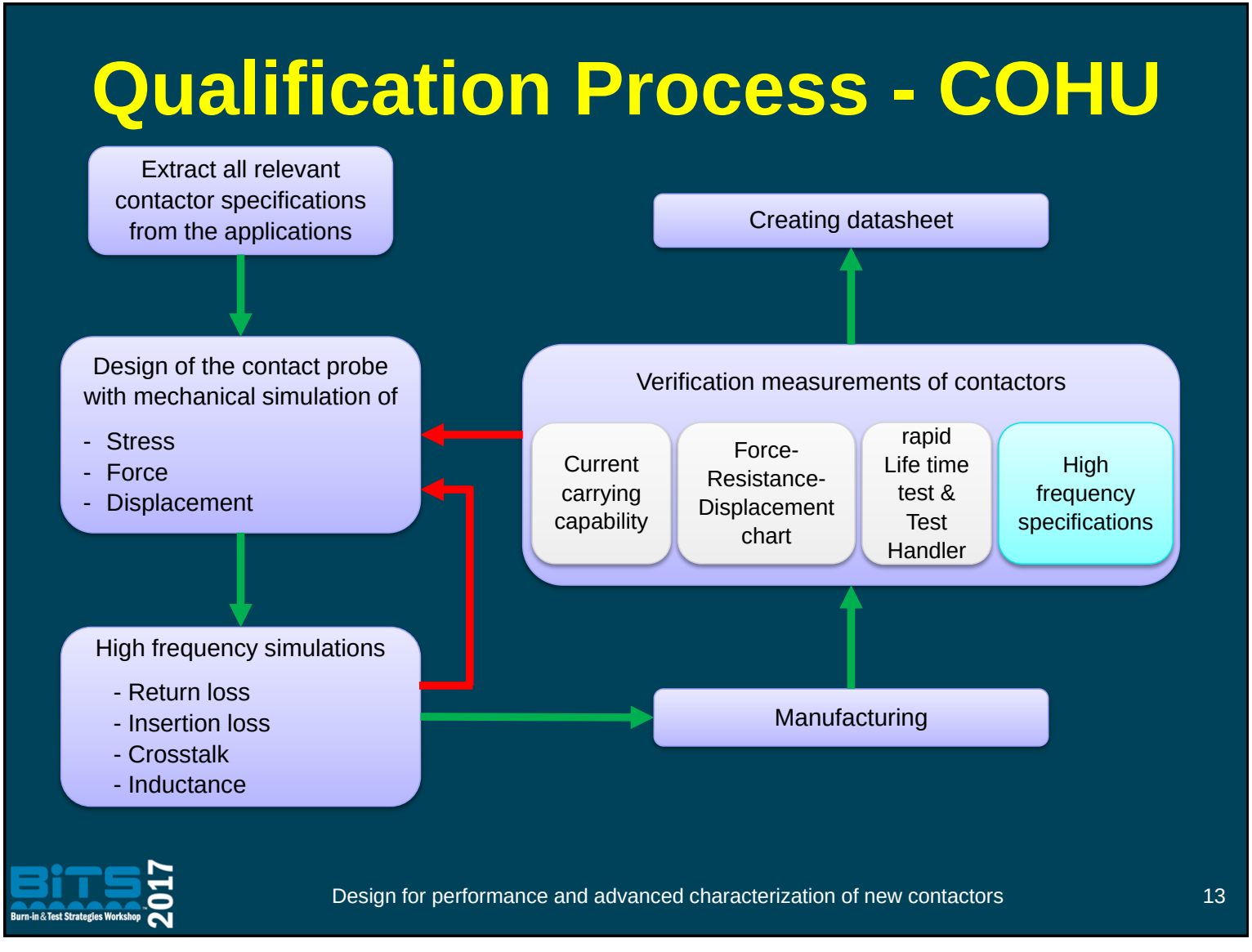
- Electrical contact – **the ultimate feature**
- Cres Requirements:
  - < 1 Ω
  - Small δ
- How it can be measured?
  - Contact measurement system
  - Contact fail data from regular production

Where does the value come from?

- Put 2 Ω on each DUT pin and test it!



Qualification Process - COHU

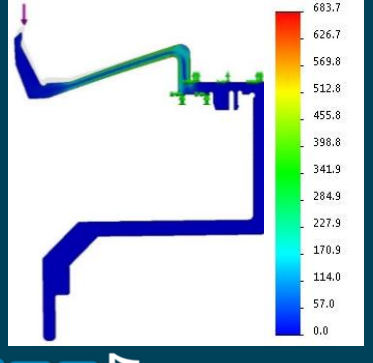


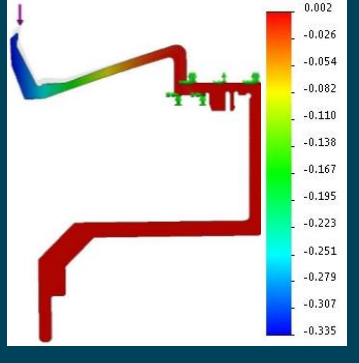
Design + Simulation

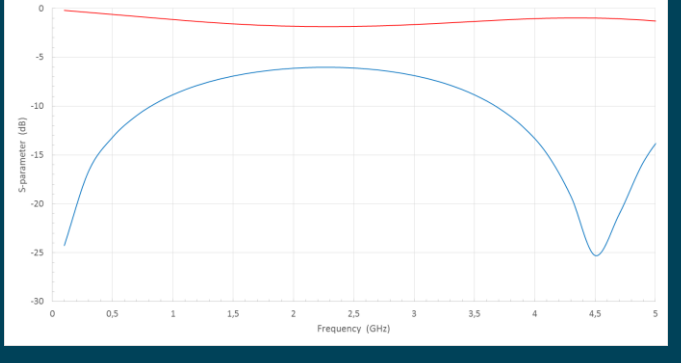
- Mechanical simulation
  - Material: Denmark* with gold plating
  - Thickness: 0.15 mm plus coat thickness
  - Stroke: 0.25 mm /Force /Scrub…)
- Electrical simulation (Ansys HFFS)
  - Relevant specifications for the probes are: (return loss /insertion loss /Crosstalk /Inductance …)

*Proprietary material

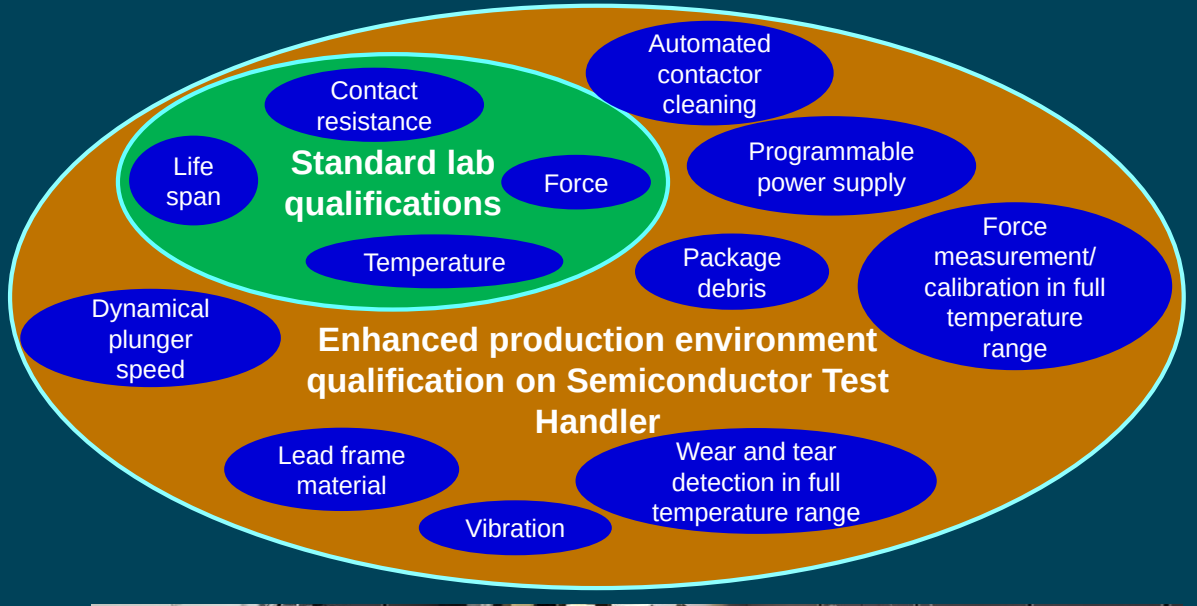
Stress (N/mm²) Displacement (mm) RF Parameters







Design Verification



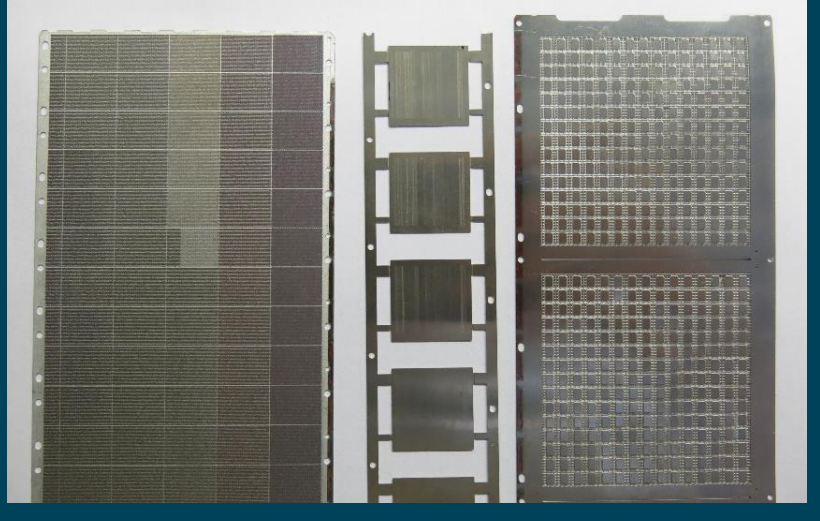
Design for performance and advanced characterization of new contactors

Design Verification

- Features of the test handler (COHU Jaguar – mod.)
  - Definition of the contact stroke:
    - very accurate contact start position detecting
      - perform an exact contact stroke
    - continuous check of the contact stroke
    - measurement of pin tip wear continuously
    - determine depth of contact probe imprints
  - For contact force measurements:
    - calibration procedure of the contact force measurement tool at each temperature
    - contact force measurement at each temperature continuously
  - Automated contactor cleaning

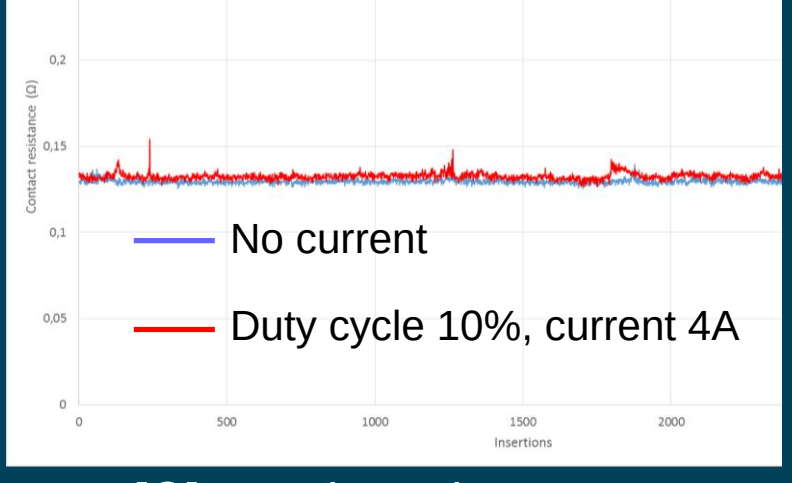
Design Verification – Lead material

- Contactor performance test on a Semiconductor Test Handler
  - Different lead frame shapes
  - Variance in Lead plating pure tin & NiPdAu
  - Scrub direction on lead material

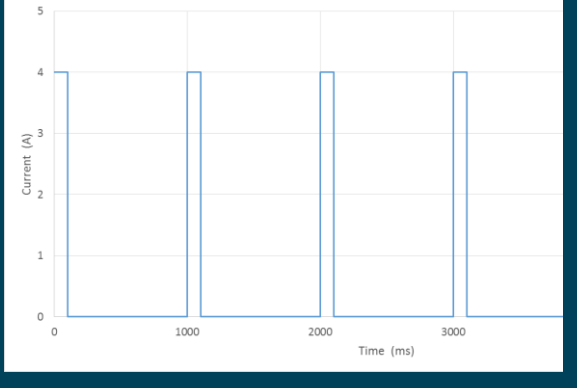


Design Verification - current

- Contactor performance test on a Semiconductor Test Handler
  - Effects of pulsed-current on contact resistance
  - Effects of polarity on contact resistance
  - Effects of continuous current



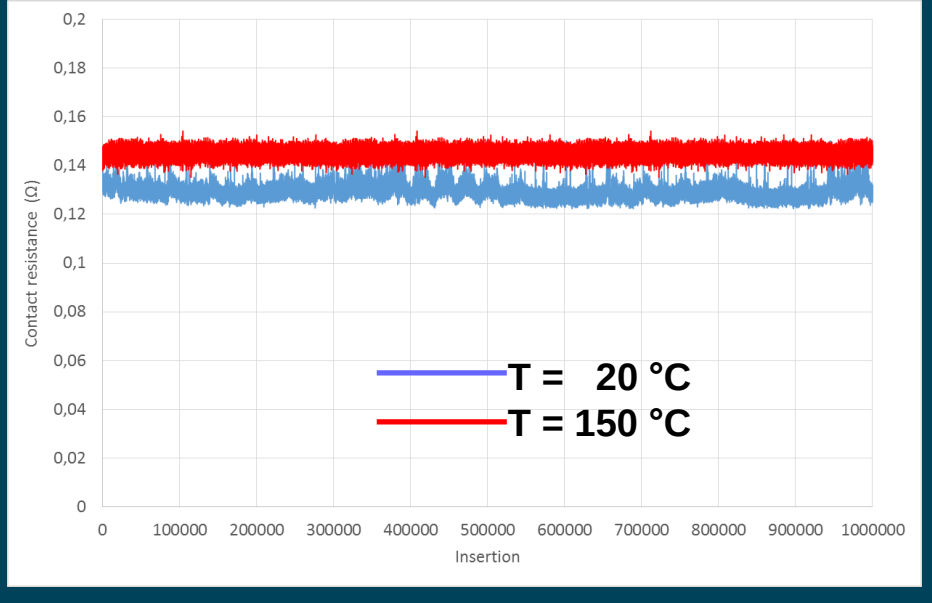
Cres [Ω] over insertion



Current [A] over time [ms]

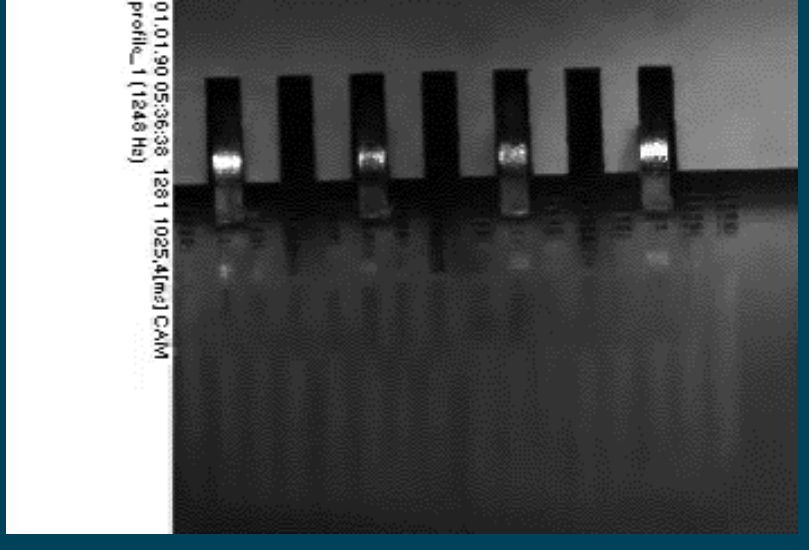
Design Verification - temperature

- Contactor performance test on a Semiconductor Test Handler
  - Contact resistance of probe at different temperatures
  - Temperature-dependent of probe specification – Lifetime/CCC/…



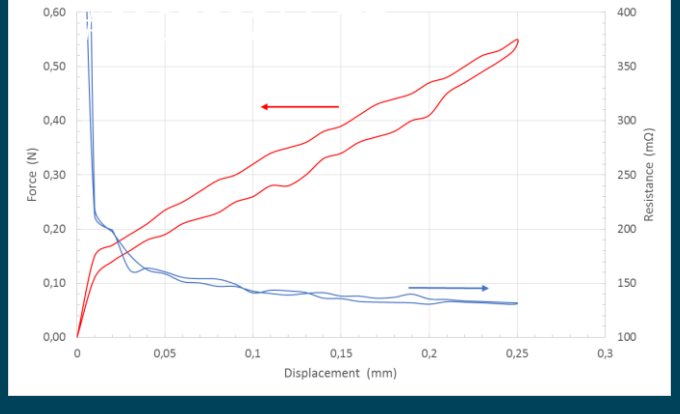
Design Verification System relevant

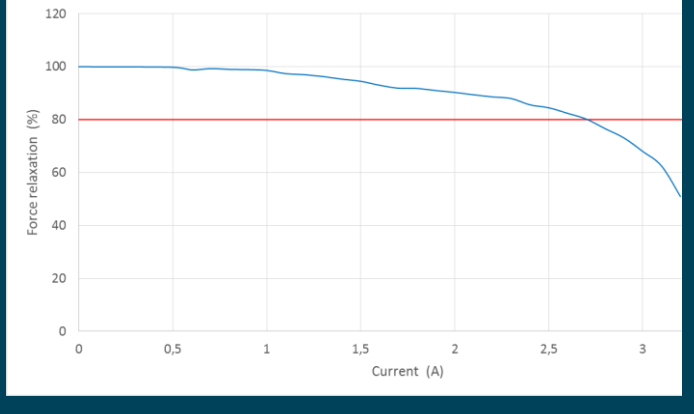
- Contactor performance test on a Semiconductor Test Handler
  - Parallel tests on several statistically relevant number of probes
    - Influence of external effects from the test handler, e. g. vibrations, dynamical plunger effects, temperature, debris
    - Integrated high-resolution camera for test socket check



Design Verification

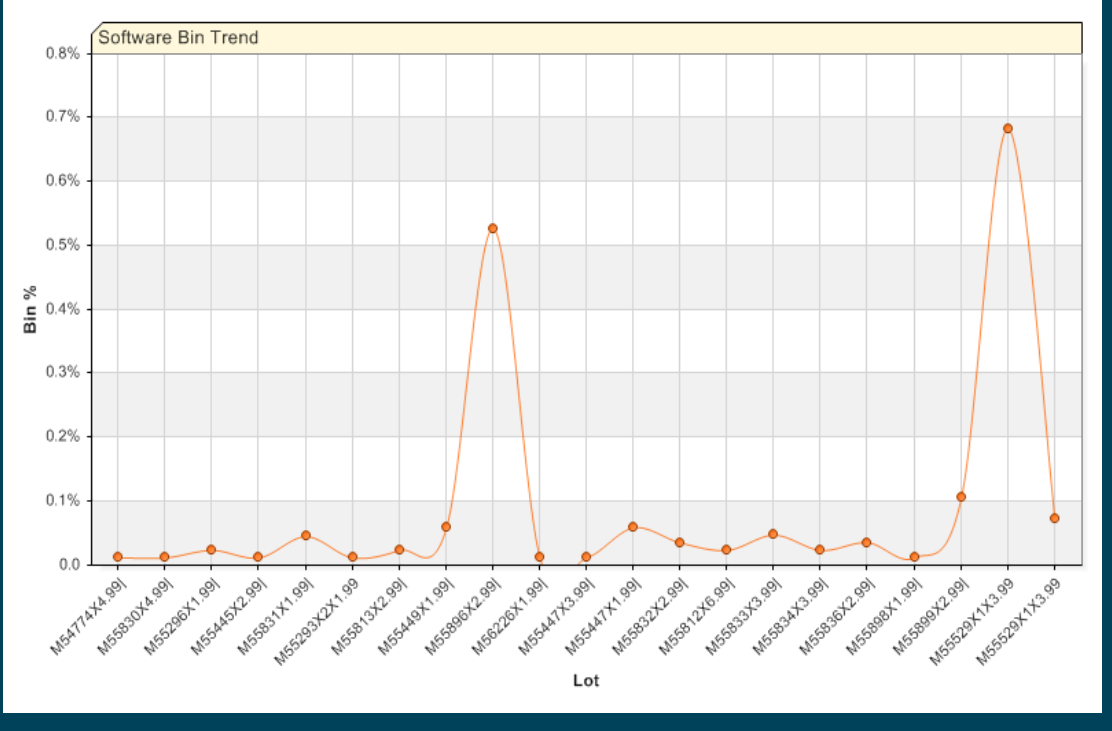
- Force-Resistance-Displacement (FRD) chart
  - Stroke of probe to a conductive plate is incrementally increased
  - Contact resistance (4-wire Sense Method) and force are measured simultaneously
- Current carrying capability (CCC)
  - Mainly conducted by measuring rise in temperature
  - Unreliable approach for miniaturized probes
  - Alternative approach: force relaxation measurement after ISMI





Where we are today?

- Contact fail results 2016
  - <0.1% @150°C
  - Life time >5 million touchdowns
  - No cleaning!



Datasheet

General information

• Part number	08.5100.0591
• Used in Socket	PTB ESX

Electrical Parameters

• Self inductance (nH)	10
• S11 (GHz)@-20dB	0.2
• S21 (GHz) @ -1dB	0.5
• Contact resistance on pure tin DUT surface (mΩ)	130
• CCC (A)	3
• Maximum peak current @10ms (A)	20

Mechanical Parameters

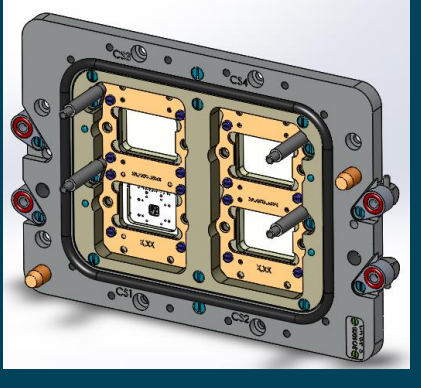
• Stroke (mm)	0.25
• Xrel movement (mm)	0,05
• Force	1
• Bending stress max. (N/mm²)	611

Thermal Specification

• Operating Temperature	-60°C to +160°C

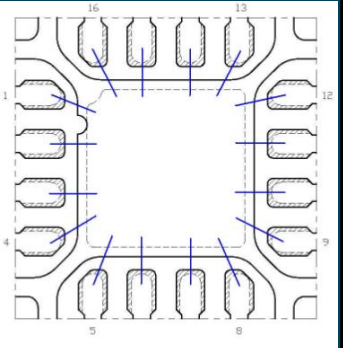
Golden Setup delivered

- Definition of golden Setup:
  - Delivered one contactor - 4 sites with the new Denmark material
  - COHU SO 1000 / QFN4x4 /Kelvin /…
- Definition of Test condition and initial check of Equipment (Handler /Board/ Cabling…)
  - Initial contact resistance measurement
  - Regular monitoring of spring condition and data collection
  - (No) Cleaning definition
  - Test on all Temperatures
  - Device position on plunger into socket
  - No maintenance (without notifying Rasco)
  - Training technician
  - 6 months usage on production floor

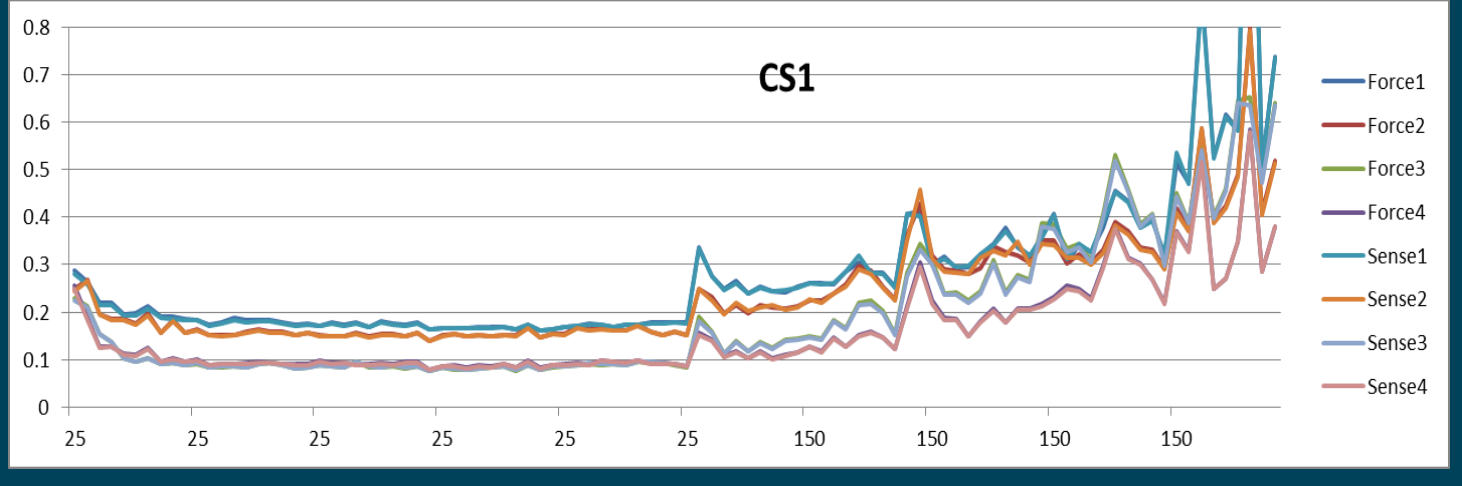


Contact measurement system

- Using shorted dummy devices
- Measure in normal production mode
- At all temperatures - -40, 160°C
- Large number of devices - >200
- Providing mean, δ and trend for each pin/blade

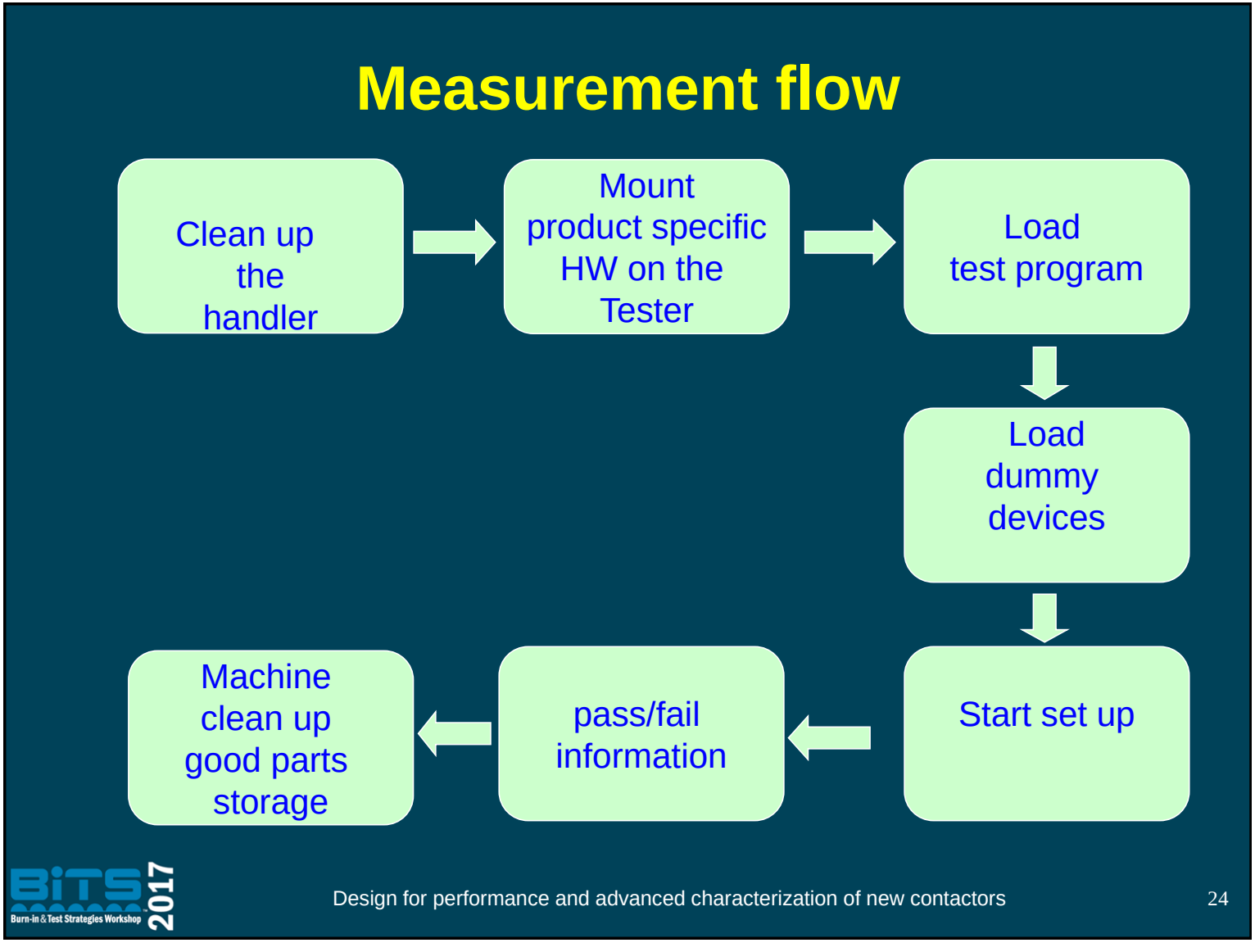


4X4 MLPQ-16L



Benefits from Contact measurement system

- Immediate machine performance is measured
- Useful for buy off and after maintenance check
- Direct independent contact evaluation
- Includes the full machine complexity


Measurement flow
Clean up the handler
Mount product specific HW on the Tester
Load test program
Load dummy devices
Start set up
pass/fail information
Machine clean up good parts storage
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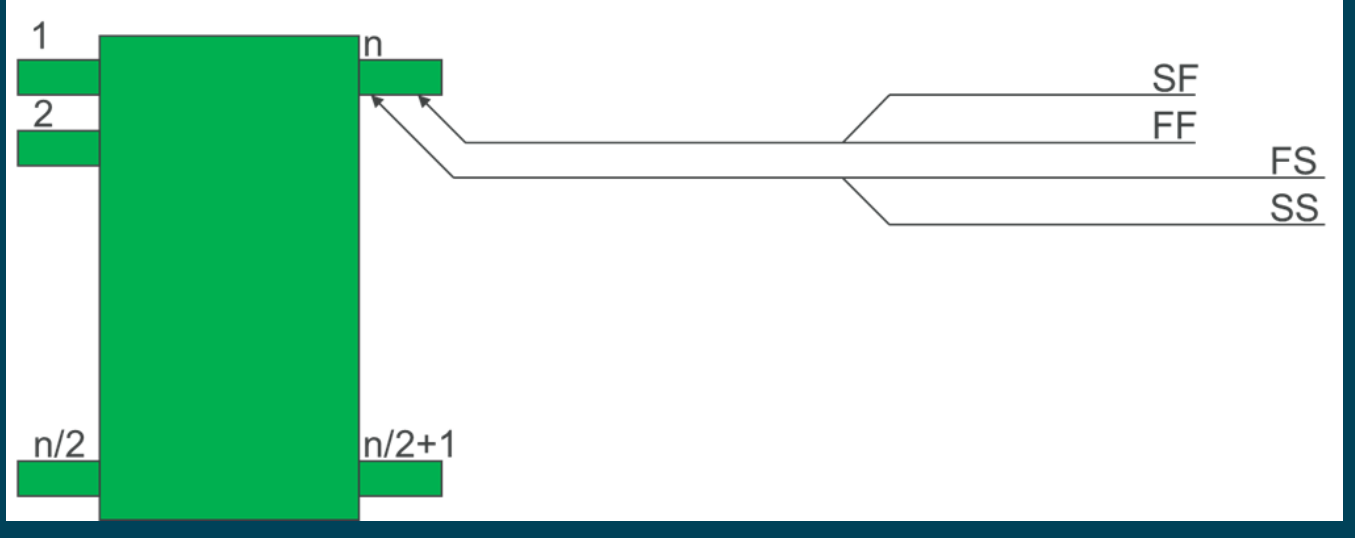
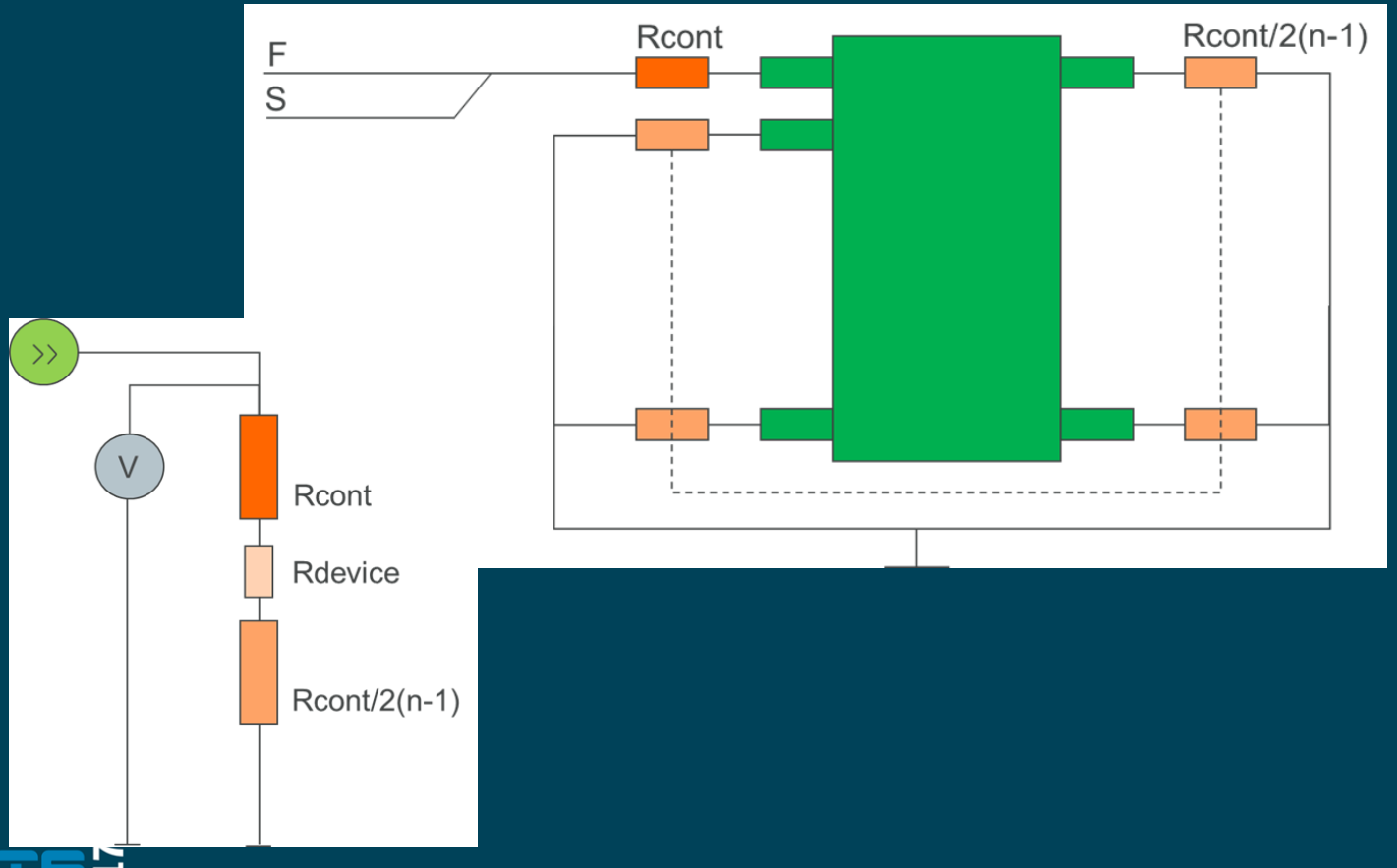
What does the system measure?

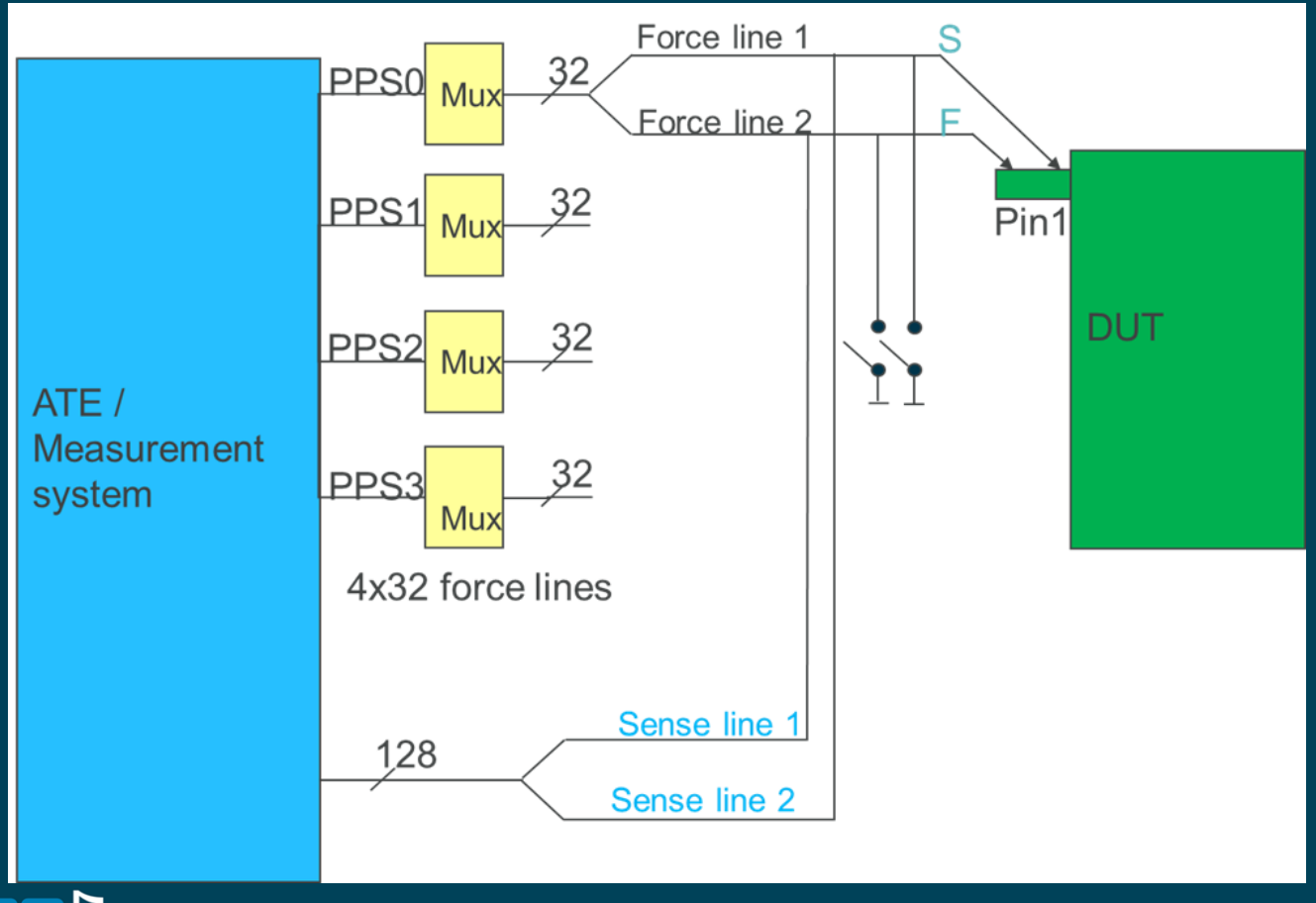
- Measured both force and sense terminals
- Each with Kelvin connection
- Measured each pin



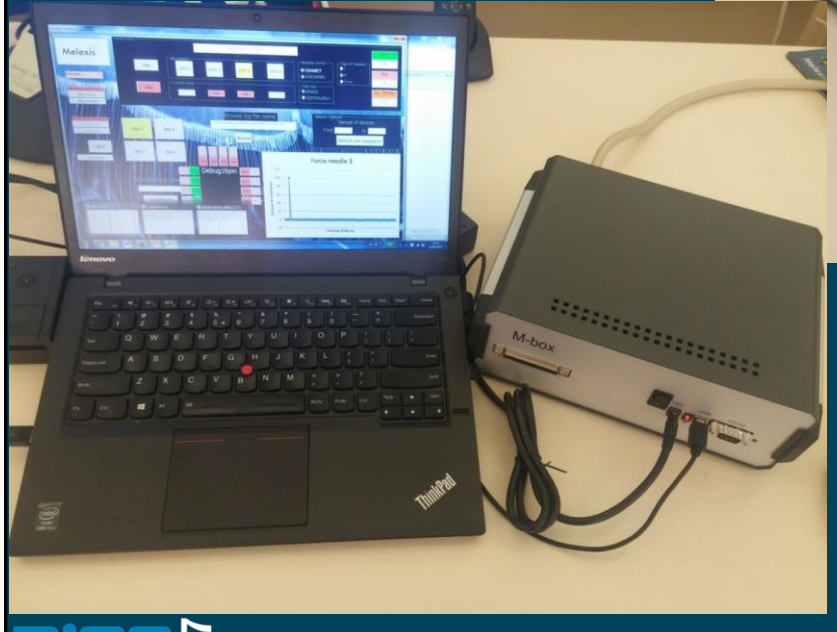
Measured Cres on one pin - all the rest to Gnd



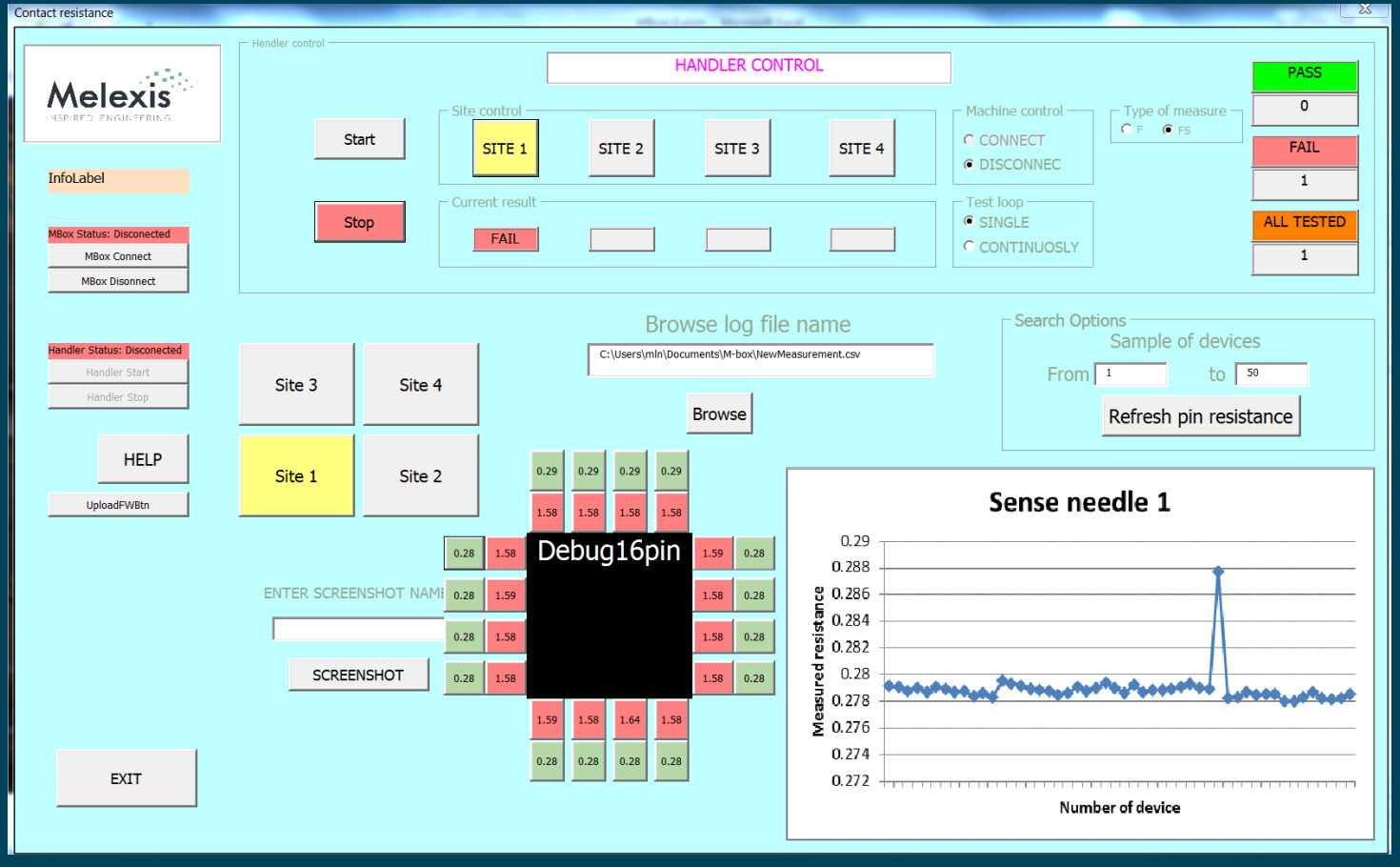
Measurement system



M-box

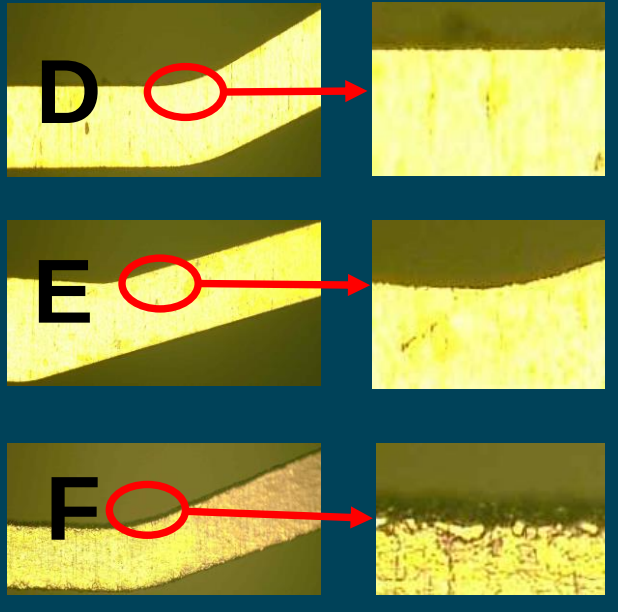


M-box SW


Contact resistance
Melexis
Hendler control
HANDLER CONTROL
Start
Stop
Site control
SITE 1
SITE 2
SITE 3
SITE 4
Machine control
CONNECT
DISCONNEC
Type of measure
Current result
FAIL
Test loop
SINGLE
CONTINUOSLY
PASS
0
FAIL
1
ALL TESTED
1
InfoLabel
MBox Status: Disconected
MBox Connect
MBox Disonnect
Handler Status: Disconected
Handler Start
Handler Stop
HELP
UploadFWBtn
Browse log file name
C:\Users\mln\Documents\M-box\NewMeasurement.csv
Browse
Search Options
Sample of devices
From 1
to 50
Refresh pin resistance
Site 3
Site 4
Site 1
Site 2
Debug16pin
ENTER SCREENSHOT NAME
SCREENSHOT
EXIT
Sense needle 1
Measured resistance
Number of device
0.29
0.288
0.286
0.284
0.282
0.28
0.278
0.276
0.274
0.272

Deployment + Industrialization

- After successful evaluation and test at Melexis first Volume orders came
  - Different materials
    - Properties
    - Hardening process
    - Availability...
  - Different cutting process
    - Burr formation
    - Dimension control
  - Different coating process
    - Control of thickness
    - Control of composition
    - New definition of pretreatment



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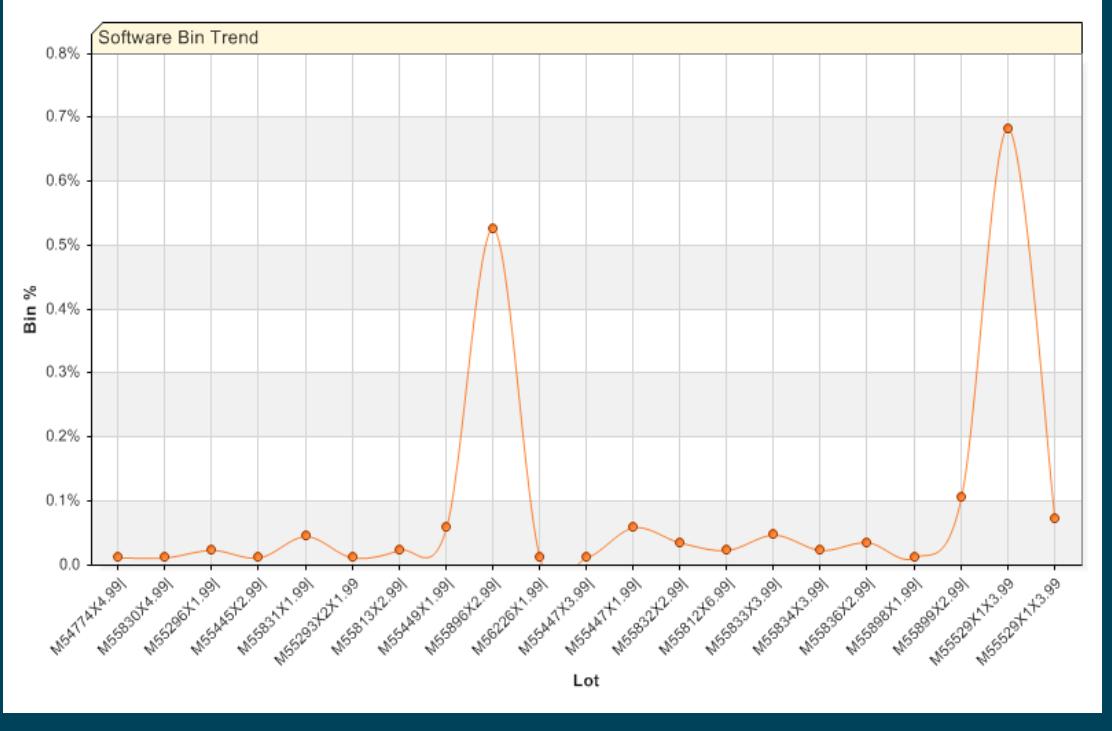
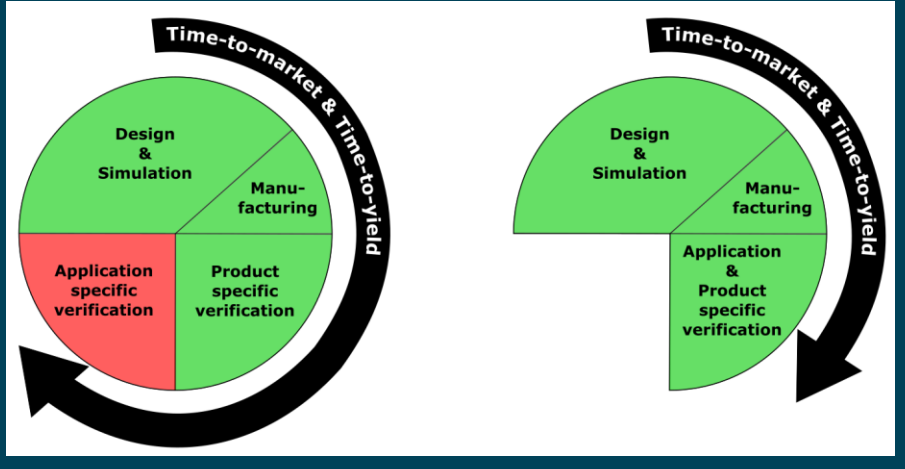


Gain

- 0.8% yield gain at one condition
- 13k Euro/month
- Better throughput

Conclusion + outlook



- Outlook - Contactor improvement:
  - Electrical path length: 22mm (RASCO ESX:30mm)
  - Current capability: >3Amp
  - Inductance: <7nH
  - Insertion Loss S21 @ -1dB: >5GHz