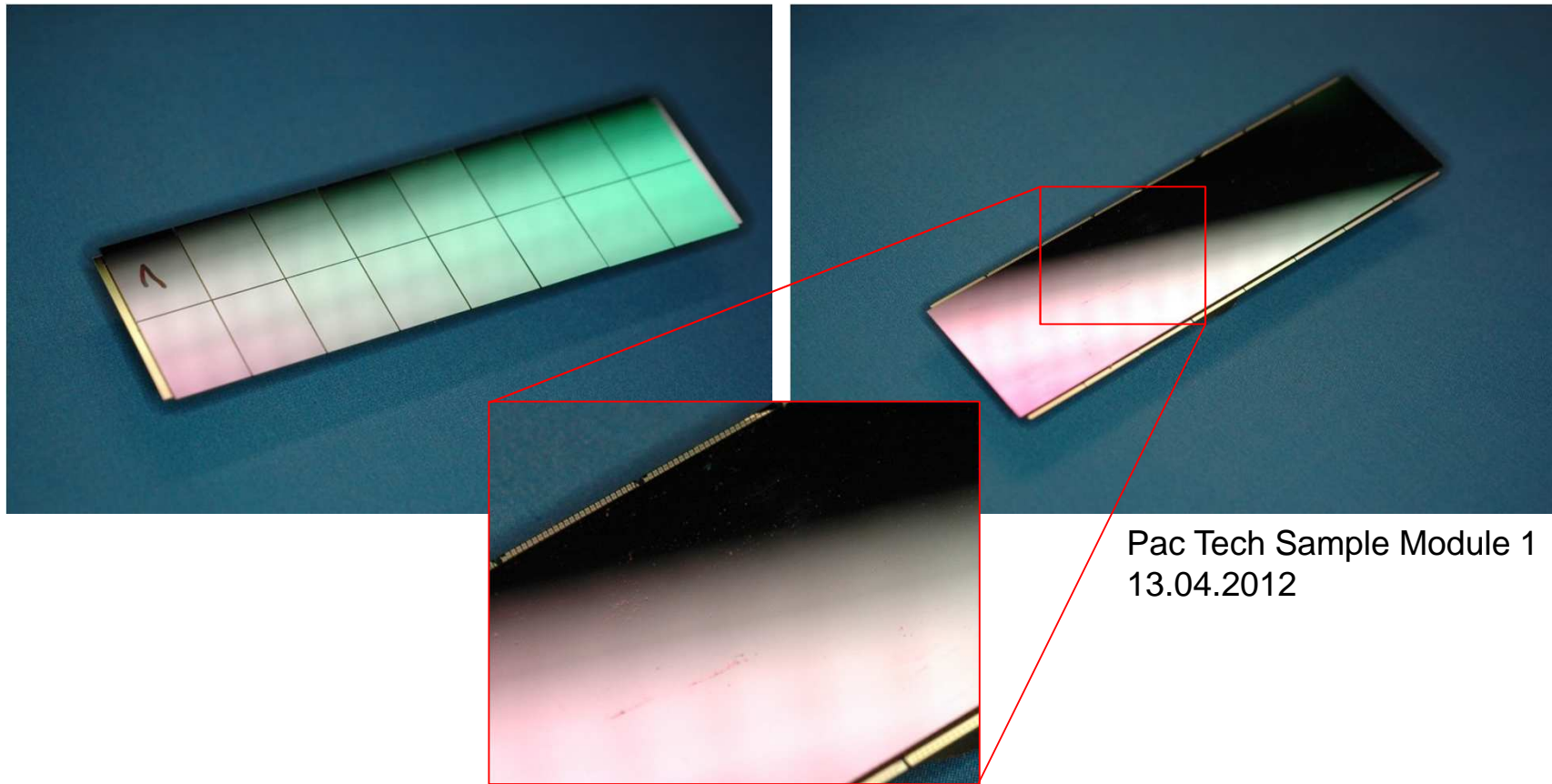


# Dummy modules successfully assembled with both machines Femto and LaPlace

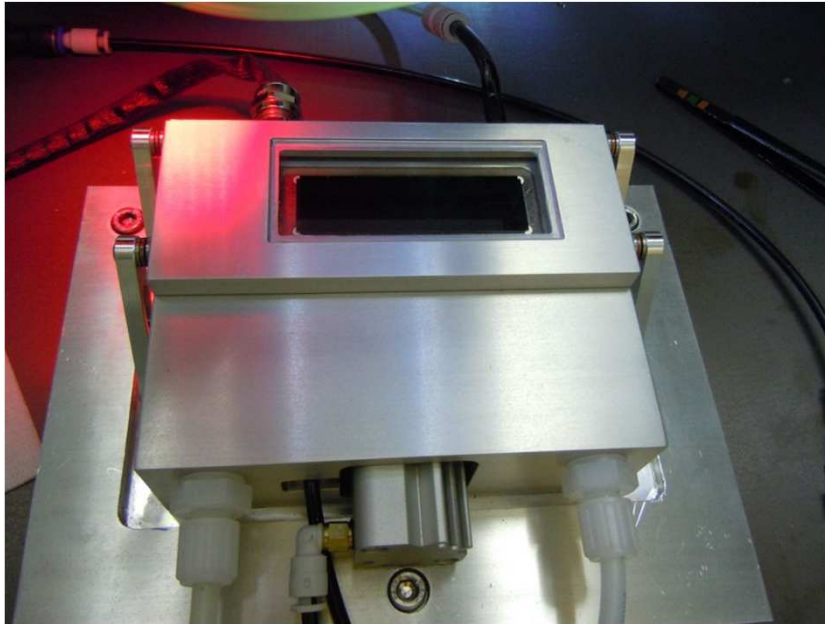
TOP AND BOTTOM SIDE PICTURES OF A DUMMY MODULE



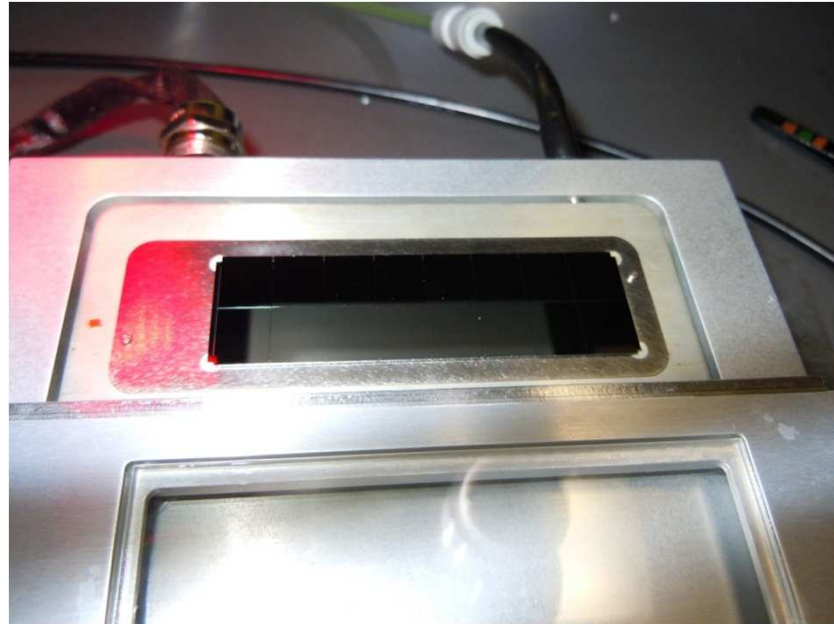
Pac Tech Sample Module 1  
13.04.2012

# LaPlace formic acid chamber is open during tacking

PICTURES OF A MODULE INSIDE THE FORMIC ACID CHAMBER



Closed during reflow

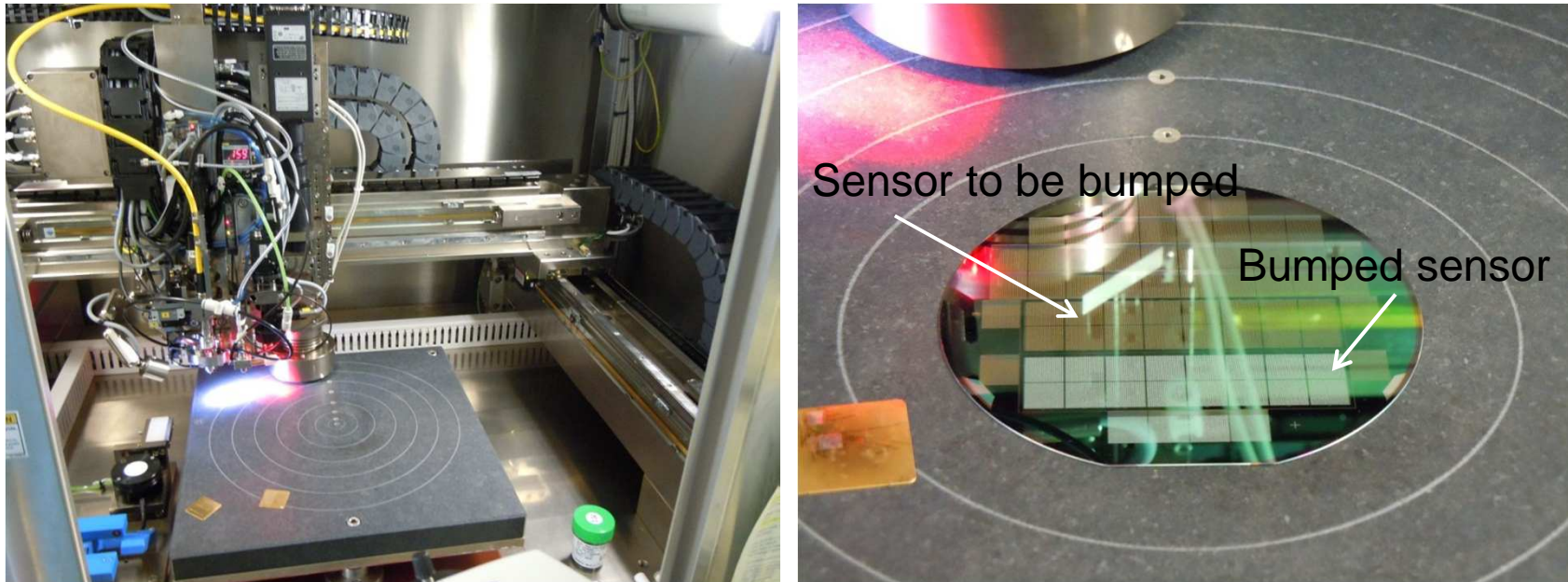


Open during tacking

- Base plate temperature constantly at 100°C
- 5 N tacking force (2 sec. applied)
- Reflow 10 sec / chip

# SB<sup>2</sup> jet process successfully modified to work at high speed also with CMS sensors

SB<sup>2</sup> WORKING AREA AND DUMMY WAFER DURING BUMBING



## Bumping time

5 bumps / sec (head cleaning procedure every ~1000 bumps)

15 min / ROC

240 min / sensor (excl. rework)

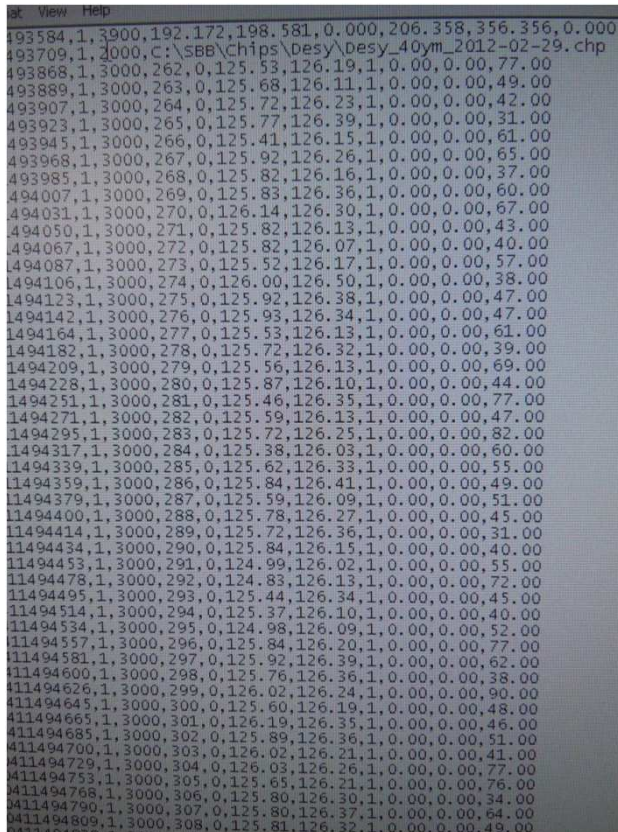
2 sensors / day

440 to 500 sensors / year



# Each bump position is documented and can be accessed directly for rework

## PICTURE OF A DUMMY SENSOR ON-SCREEN BUMPING PROCESS LOGFILE

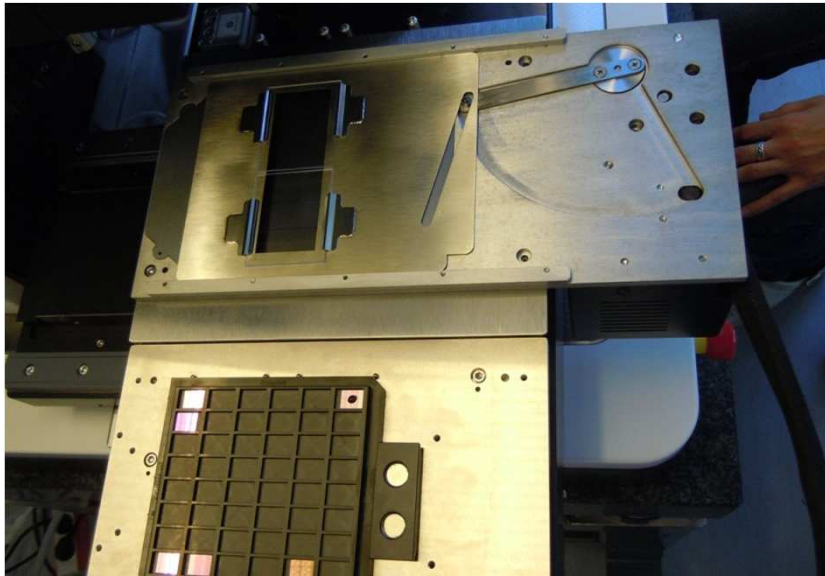


The image shows a screenshot of a logfile window titled 'Log View Help'. The window contains a list of data rows, each representing a bumping event. Each row contains 11 columns of data: a unique ID, a status (always 1), a time value (e.g., 3900), and eight coordinate values (e.g., 192.172, 198.581, 0.000, 206.358, 356.356, 0.000). The logfile is titled 'c:\sbb\chips\Desy\Desy\_40ym\_2012-02-29.chp'.

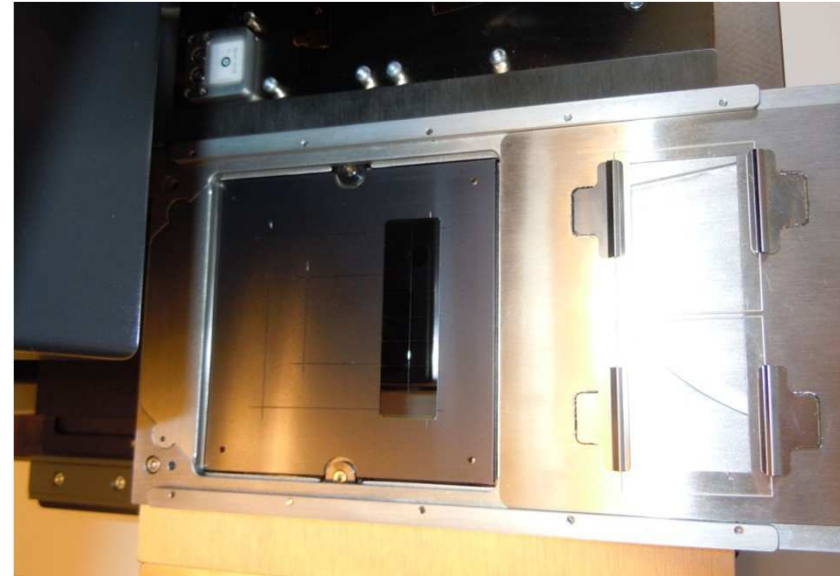
- Real time logging of position and time of each bump
- After sensor completion and inspection each position can be reworked separately

# Final version of the Femto formic acid chamber will allow „closed“ chamber during tacking

PICTURES OF A MODULE INSIDE THE FORMIC ACID CHAMBER



Closed chamber during reflow



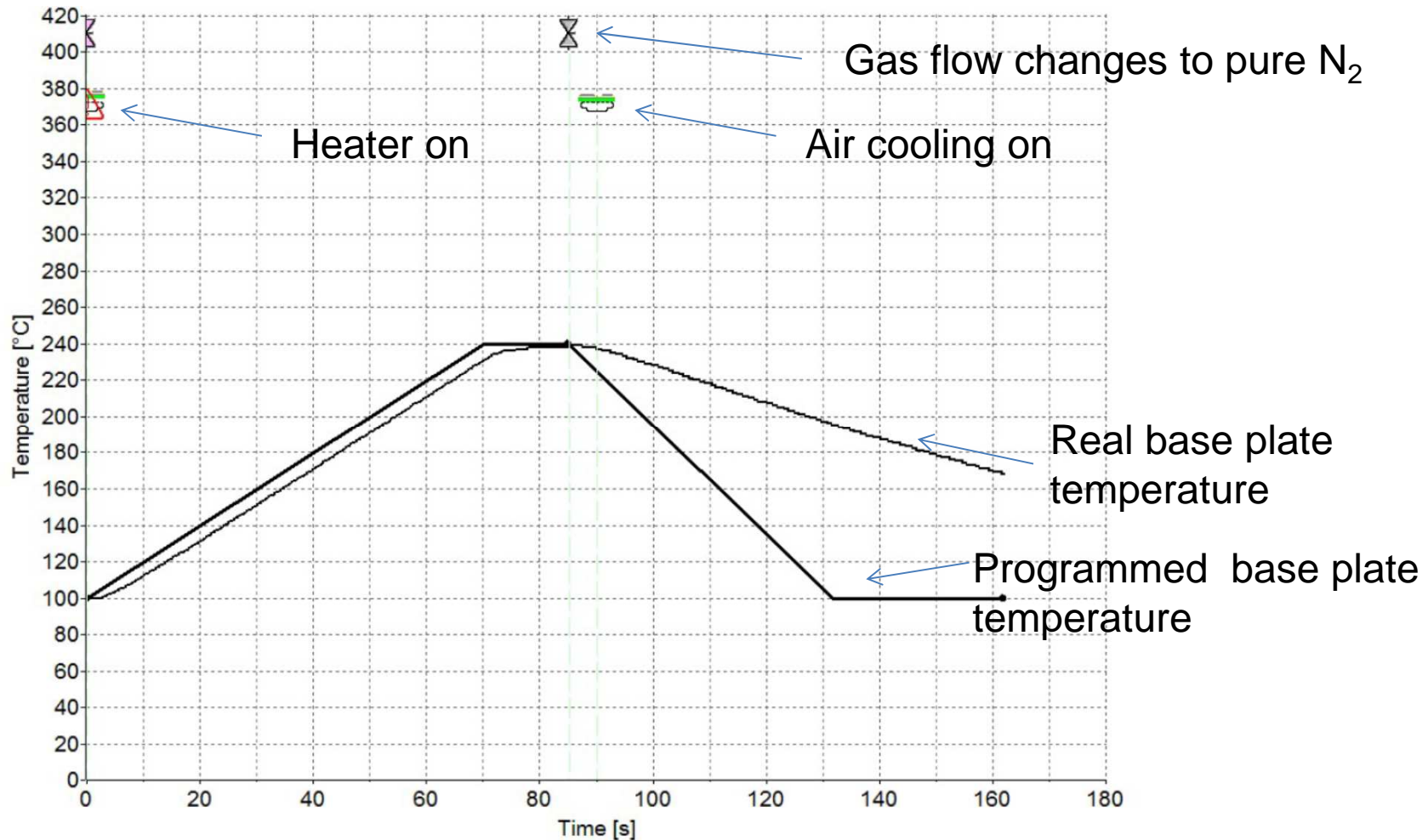
Open chamber

New chamber has an opening in the cover of the size of the bond head that follows the bond head to the next position

- Base plate temperature constantly at 100°C
- 5 N tacking force (12 sec. applied)
- Reflow ~170 sec. / sensor

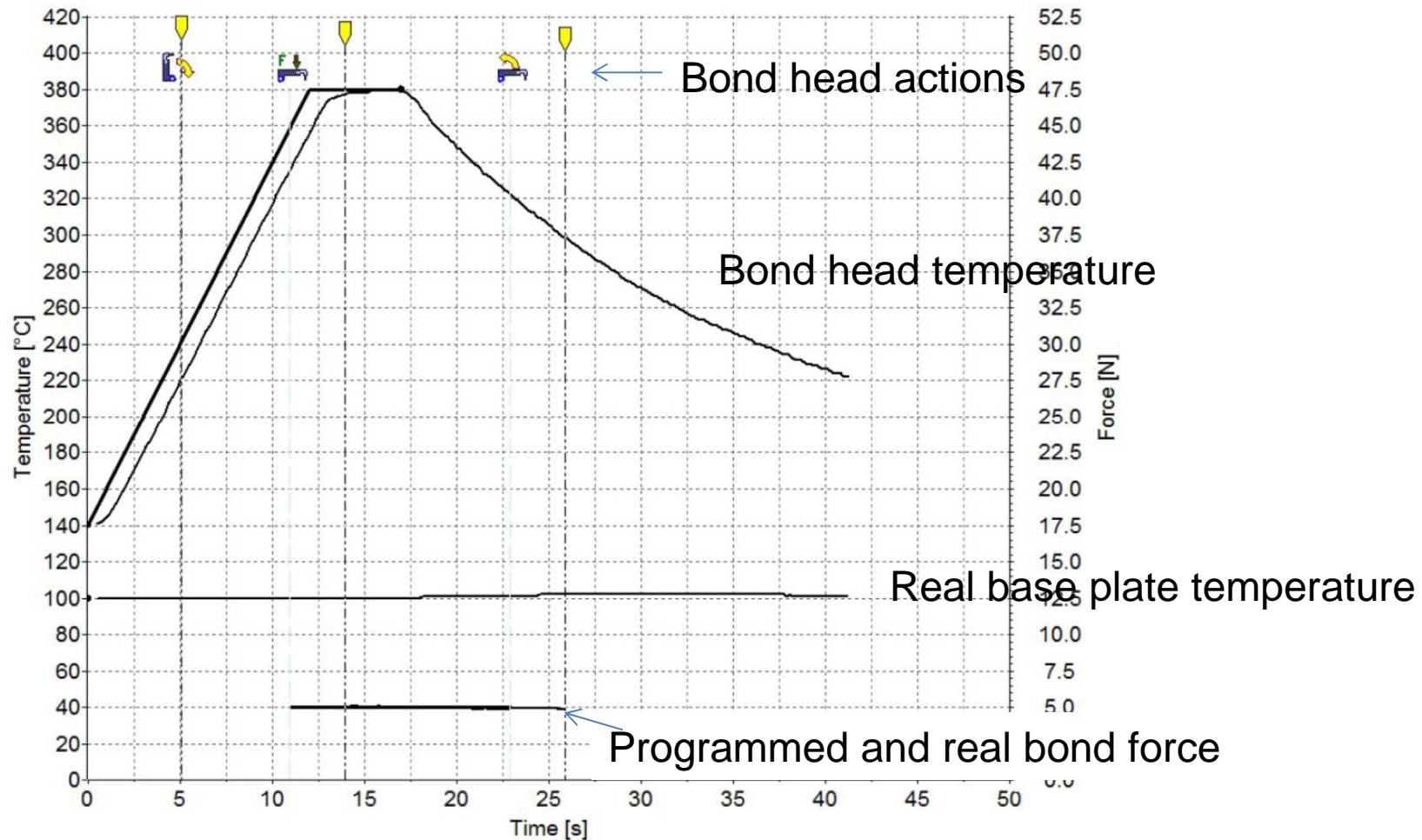
# Femto allows complete and easy monitoring of all important parameters

## FINAL REFLOW DOCUMENTATION



# Femto allows complete and easy monitoring of all important parameters

## TACKING PROCEDURE DOCUMENTATION



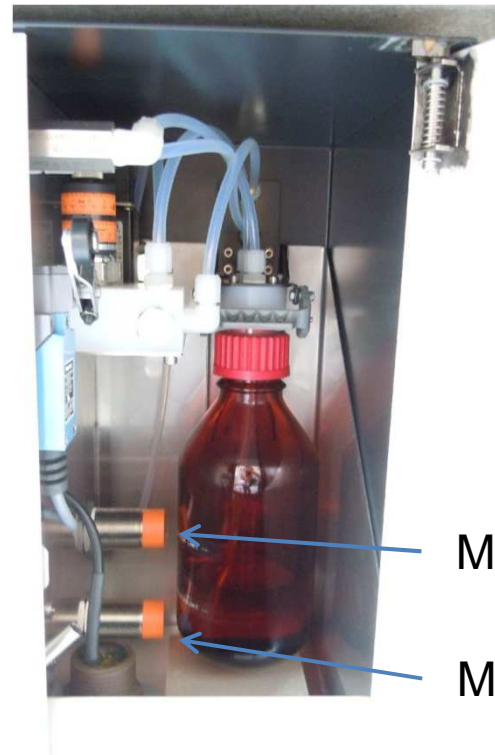


# Finetech also delivers a decent and controllable formic acid module

## PICTURES OF THE FORMIC ACID MODULE



Front view

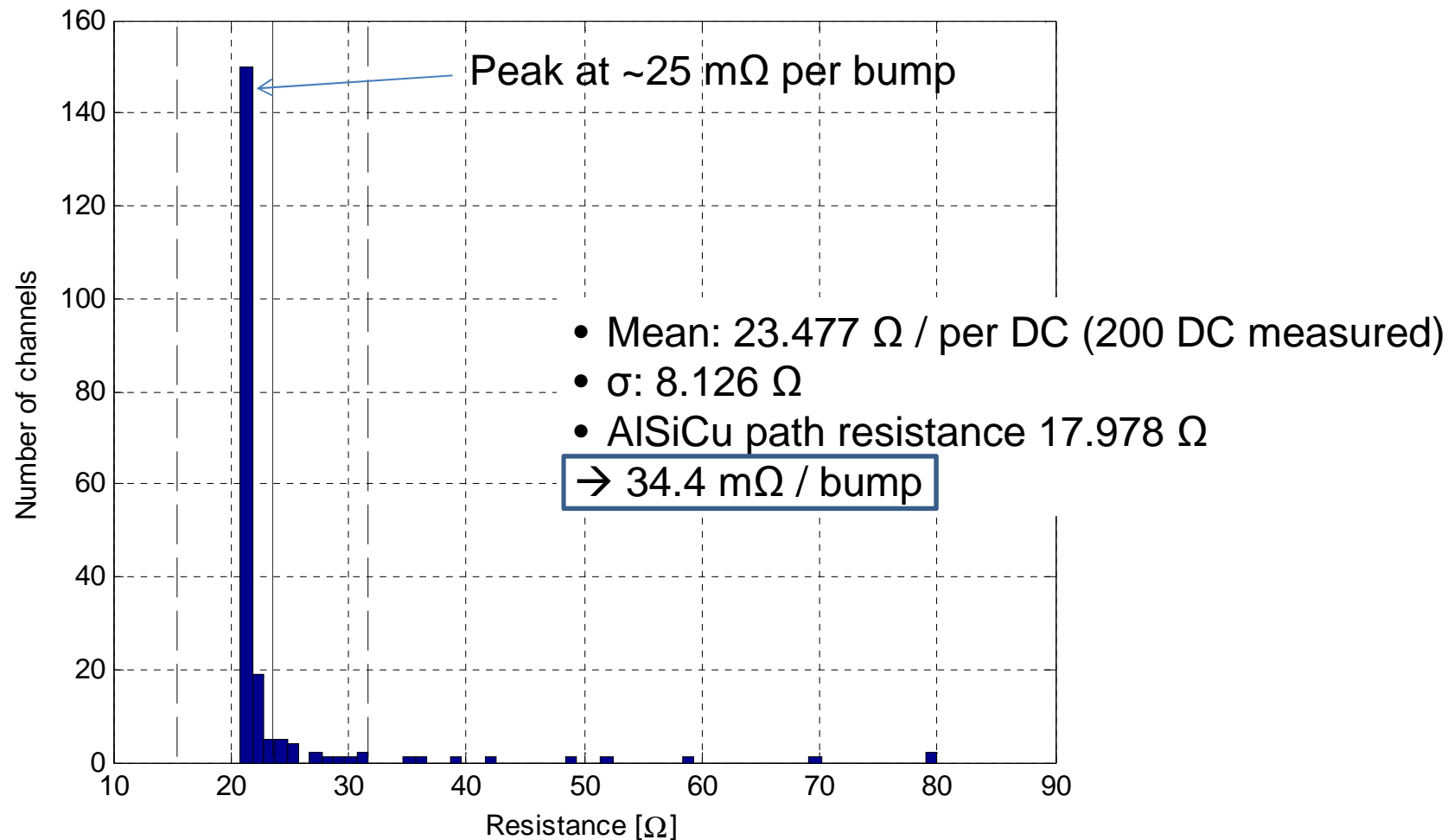


Inside module



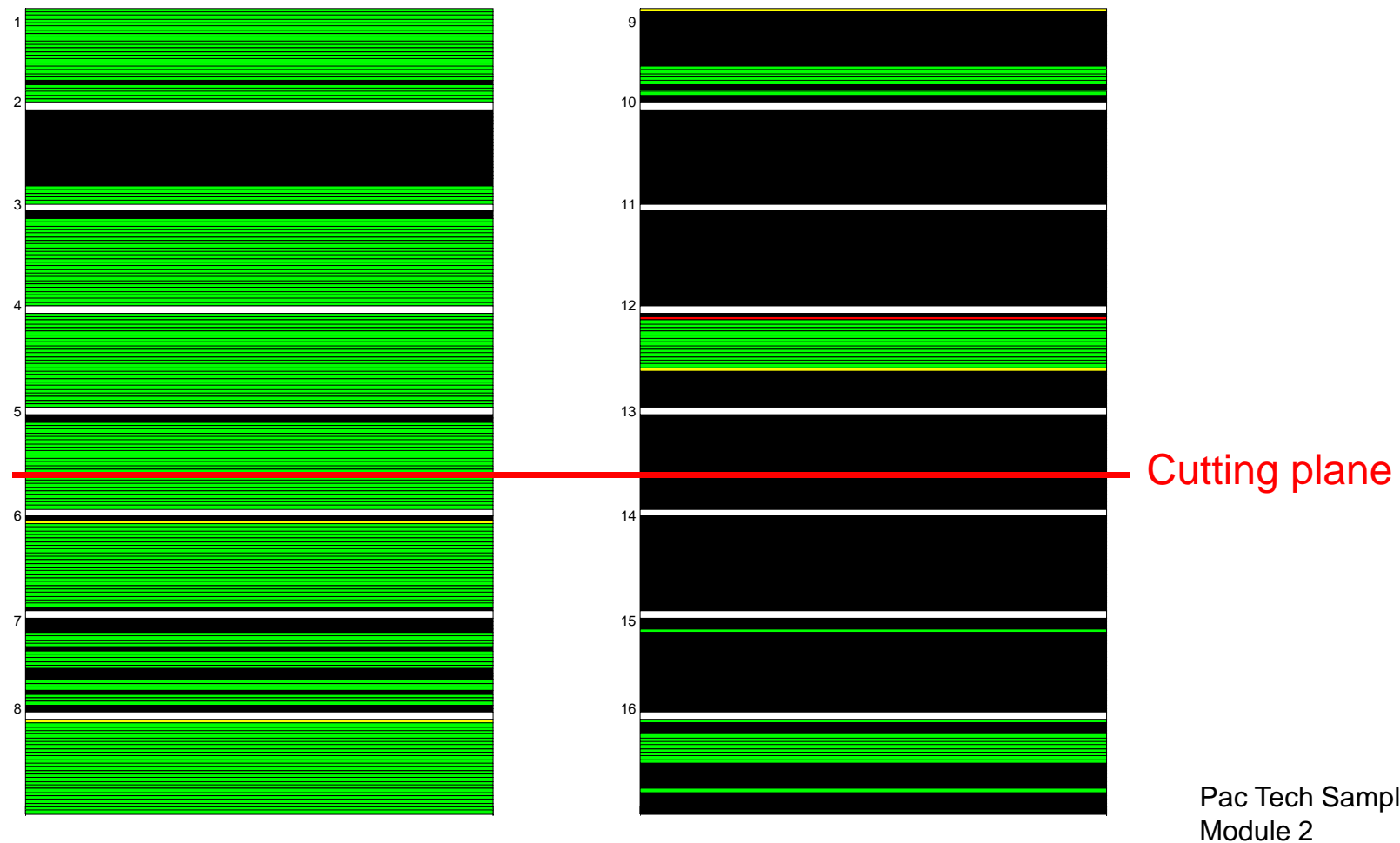
# Large variation in resistance measurements found

## HISTOGRAMM OF PAC TECH MODUL 2 ELECTRICAL MEASUREMENTS



# Pac Tech's test bonds have not been reproducible over the module

OPEN PATH DOUBLE COLUMNS IN BLACK



Pac Tech Sample  
Module 2

# Very compressed bumps can be found for the Pac Tech tacking

## CROSS SECTIONS OF PAC TECH MODUL 2 CHIP 5 (CLOSED PATH)



Sensor center



~Sensor center

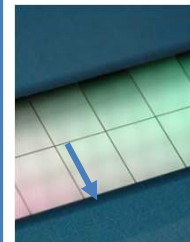


~ROC center



Sensor edge

- Pressed too closely
  - Bump squeezed out
  - Liquid bumps during tacking?
- Different pad sizes on top and bottom of a bump
  - rotational misalignment
  - Manual alignment



Going along a column from sensor center outwards.

Different cutting planes presented



# Laser energy transfer was higher towards chip center

## CROSS SECTIONS OF PAC TECH MODUL 2 CHIP 5 AT TWO DIFFERENT CUTTING PLANES



Close to ROC boundary



Further grinded towards ROC center (~1.5 mm)

IMC growth strongly increased towards chip center

→ Temperature gradient present

→ Input energy distribution is inhomogeneous

# Misalignment in theta, level and position lead to open electrical path

## CROSS SECTIONS OF PAC TECH MODUL 2 CHIP 13 (OPEN PATH)



Sensor center



~ROC center

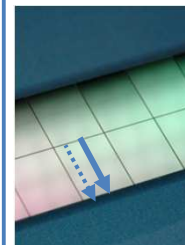


Sensor edge



Sensor edge

- Different pad sizes on top and bottom of a bump
  - Strong rotational misalignment
- Different bump heights
  - Leveling problem

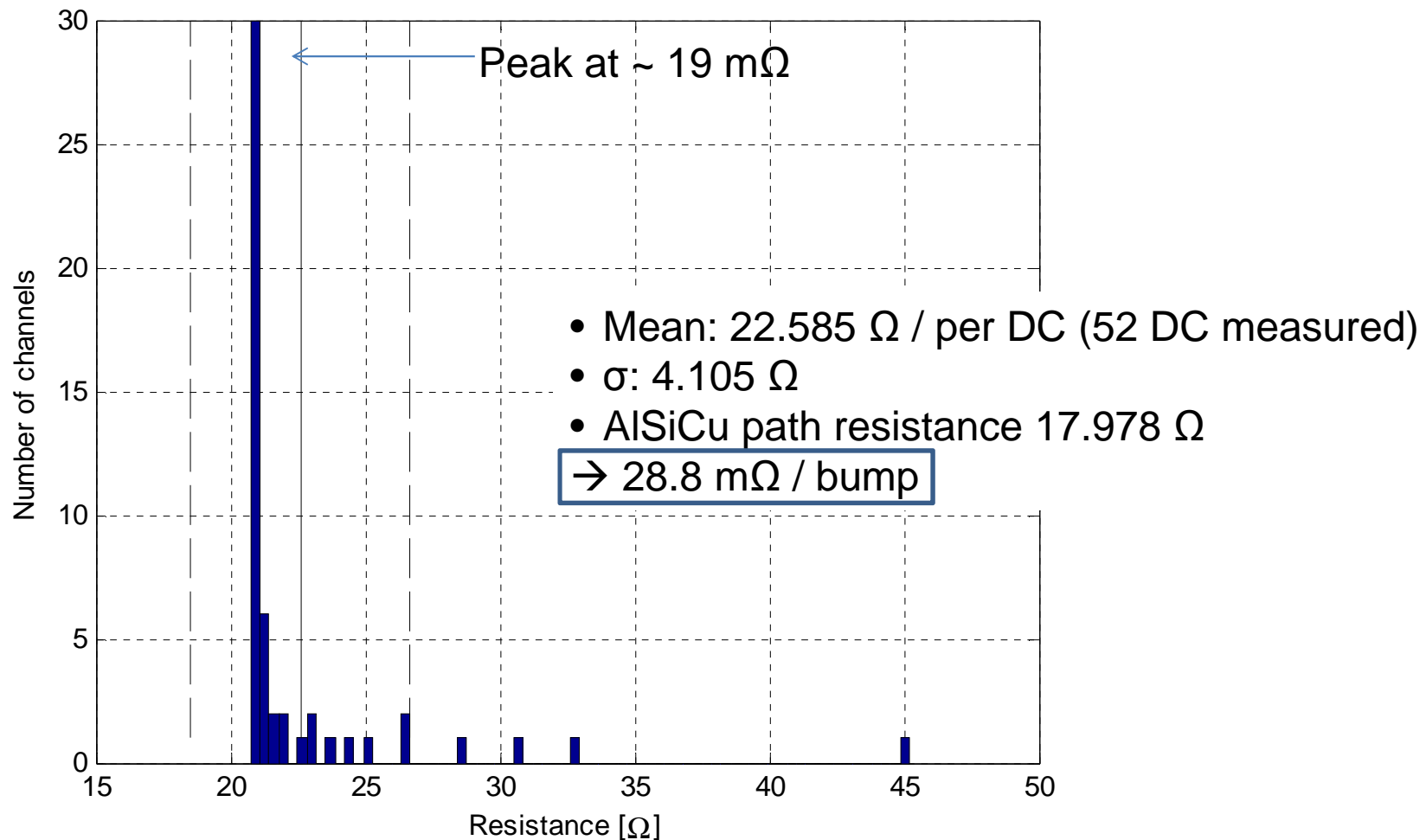


Going along a column from sensor center outwards.

Different cutting planes presented

# Finetech bonding sample has lower variations in double column resistance

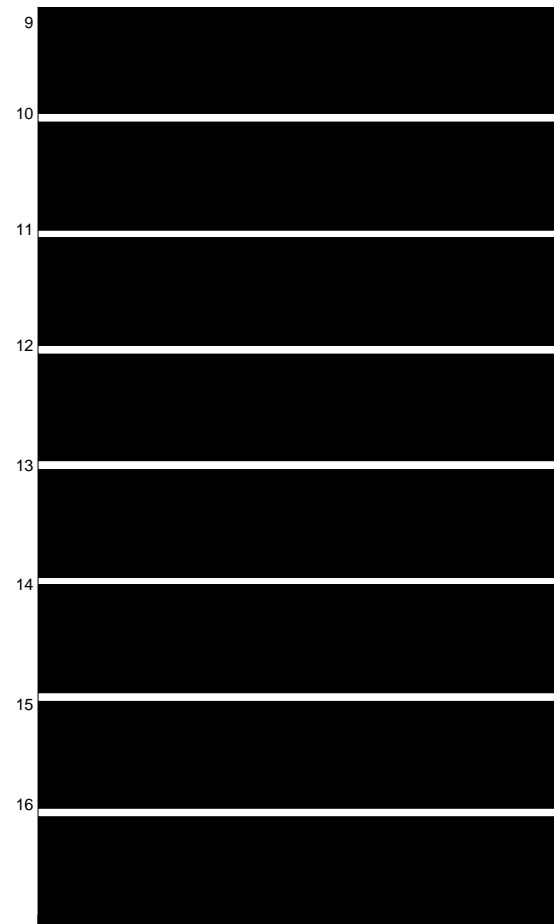
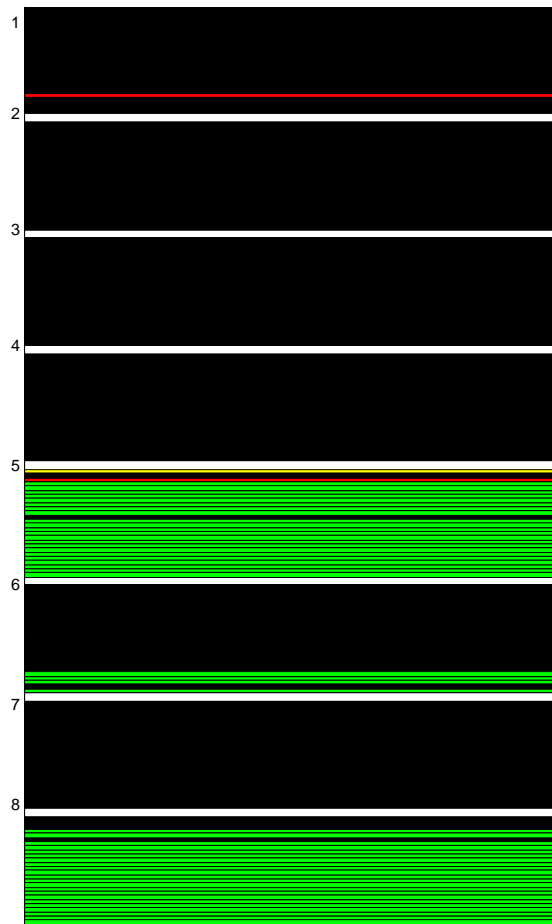
## HISTOGRAMM OF FINETECH MODUL 1 ELECTRICAL MEASUREMENTS





# Finetech's test bonds have not been reproducible over the module

OPEN PATH DOUBLE COLUMNS IN BLACK (MODULE 1)

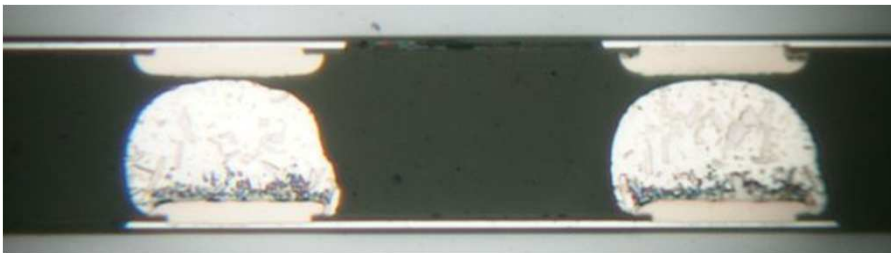


# Poor leveling of the bonding tool can be found for the Finetech bond

CROSS SECTIONS OF FINETECH MODUL 2 CHIP 12 (1.5 mm FURTHER GRINDED TO ROC CENTER)



Sensor center

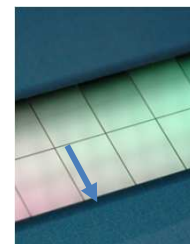


~ROC center



Sensor edge

- Very good alignment
- Tool was accidentally produced nonflat
- Leveling problem
- Clear IMC growth



Going along a column from sensor center outwards.

---

# An output of about 2 bare modules a working day seems realistic

## PROCESS TIMES

### Bumping time

5 bumps / sec (head cleaning procedure every ~1000 bumps)

15 min / ROC

240 min / sensor (excl. rework)

2 sensors / day

440 to 500 sensors / year

← Limiting time for module production

### Bonding time

< 1.5 min / ROC (excl. KGD testing)

< 25 min / Bare Module

### Testing time

bumping time – bonding time = enough