Force-controlled device contacting

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esmo semicon

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- Influences on the contact level
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Introduction

Effects on contact level

- device tolerances
- setup deviations
- thermal influences

The contacting quality of IC devices is influenced by various factors with a static contacting level.

Overview of test setup / procedure

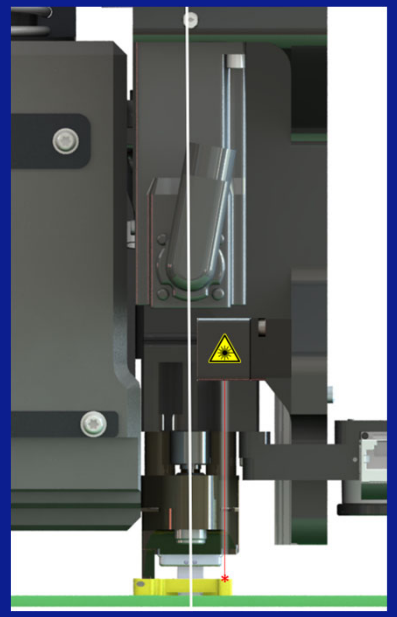
esmo talos – engineering handler

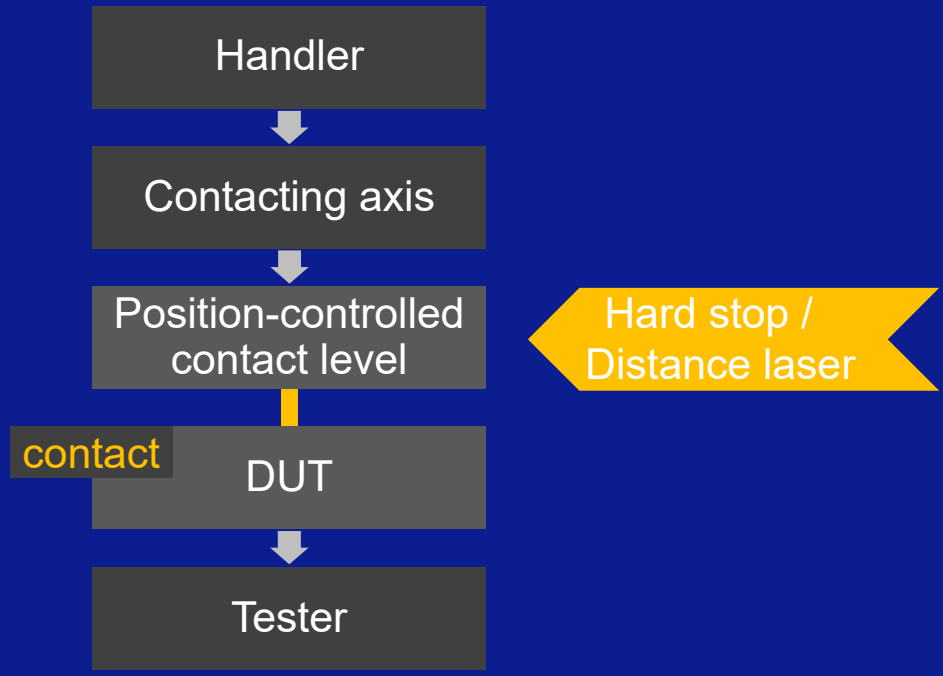
- Pick + place tri-temp handler
- Position-controlled contacting axis – in standard configuration
- Force-controlled contacting axis – as optional configuration

QFN 3x3 Microcontroller – tested device

- QTY: 500
- Different test temperatures

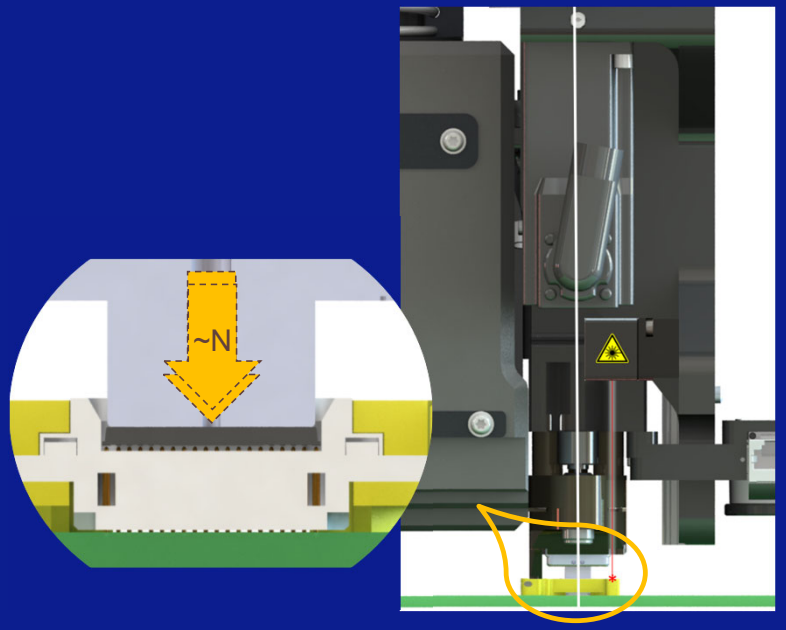
Schematic of position-controlled contacting axis





Position-controlled axis with hard stop or distance laser measurement.

Influences on the contact level



Position-controlled contact level

contact

device tolerances

setup properties

thermal influences

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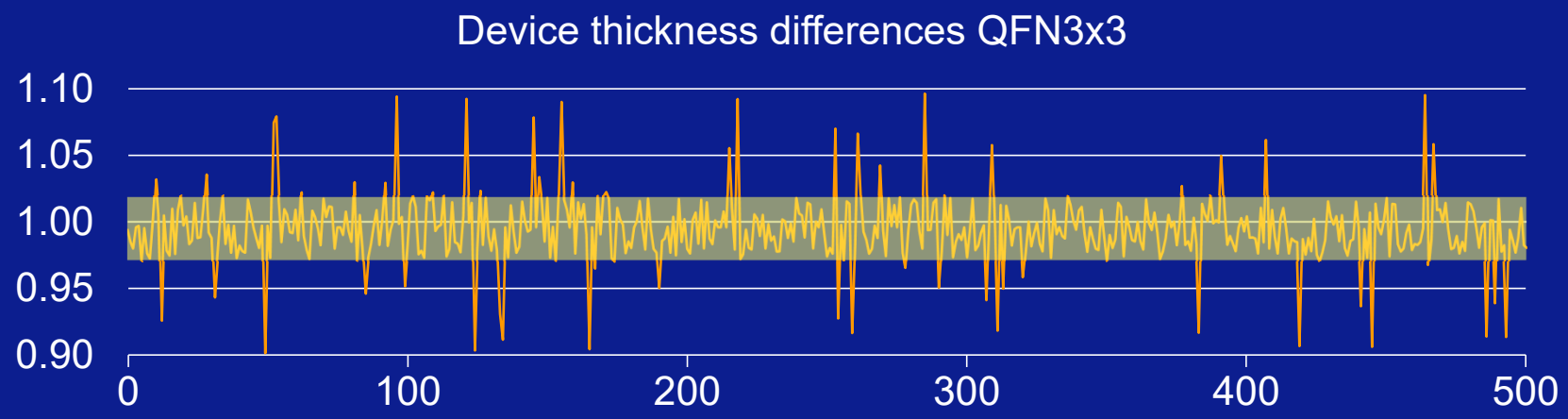
Varying contact level & force

The position-controlled axis has no influence on varying contact level.

Influence: Device tolerances



QFN3x3 device thickness measurement QYT: 500

Nominal 1 mm +/-0.1 mm

min. 0.908 – max. 1.085

~ 88% in range of 0.96 – 1.03

Influence: Device tolerances

Pin force with nominal stroke/ ideal situation:

16g ≙ 0.157 N

Pin count: 88x

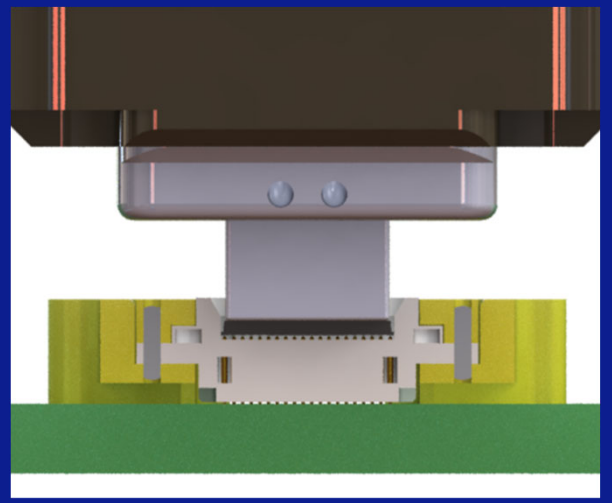
→ Fc: 13.816 N – nominal thickness

→ Fc: 18.252 N – max. thickness

→ Fc: 9.271 N – min. thickness

With +/-10% device thickness

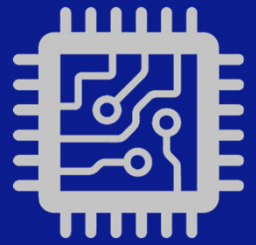
Contact force varies +/-30%



Influence: Setup properties

Setup-dependent challenging properties

- Special socket designs
- Sensitive test devices
- Adjustment of required contact height
- Durability and wear

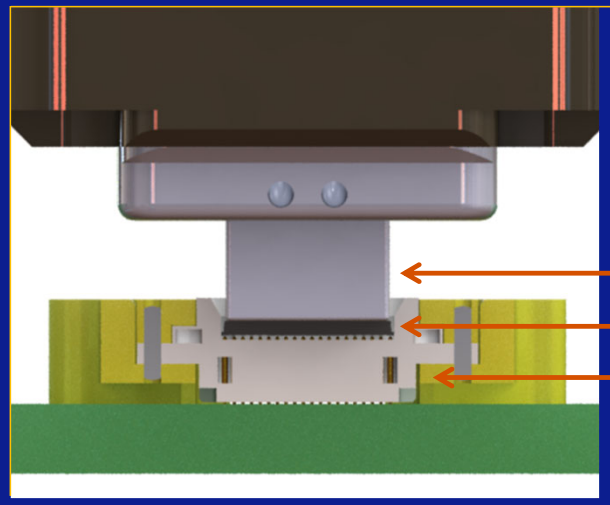


Influence: Thermal influences

Thermal volume changes during temperature tests on

- Contacting plunger
- Test device
- Socket / -periphery

→ Most critical
during extreme tri-temp test sequences w/o possibility to adjust the contact level



→ Exemplary length expansion
Tri-Temp Test
-50 / 25 / 175 °C
-58 / 77 / 347 °F

Heat Sink ~ 0.124 mm
Test Device ~ 0.02 mm
Socket ~ 0.03 mm

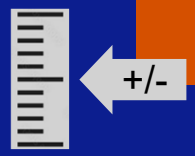
→ ∑ 0.13 mm

Conclusion – position-controlled contacting

Combination of various influencing factors

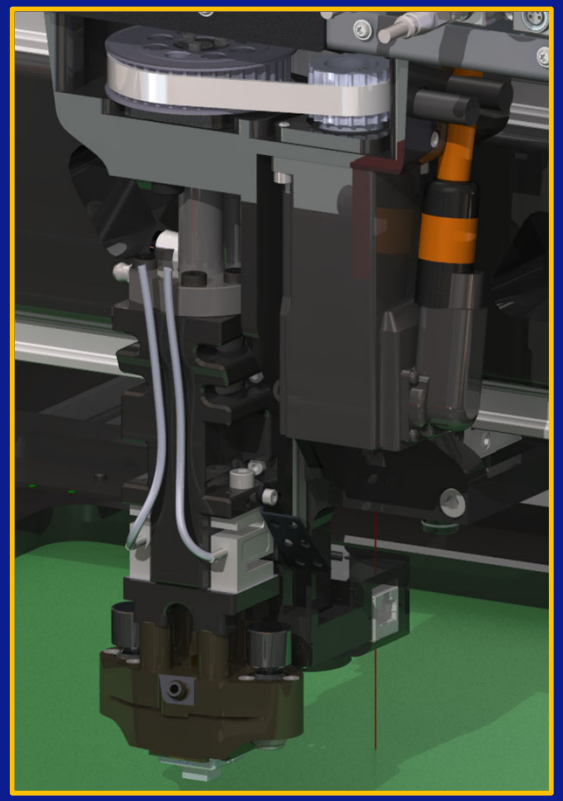
Position-controlled contacting axis

Difficult to **adjust**



No real time **compensation**

Force-controlled contacting axis



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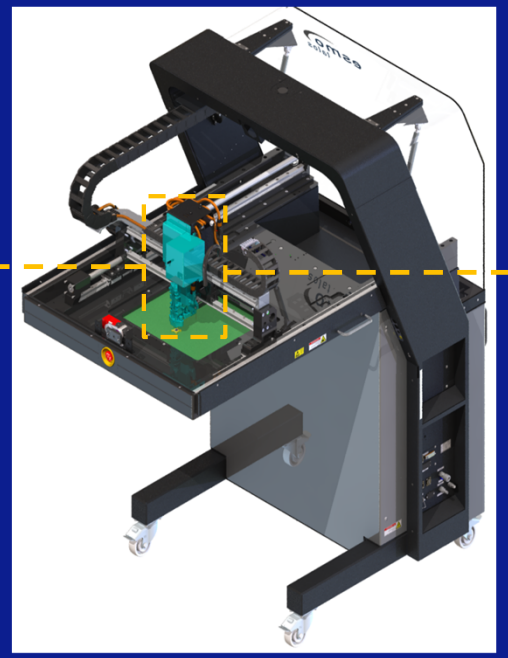
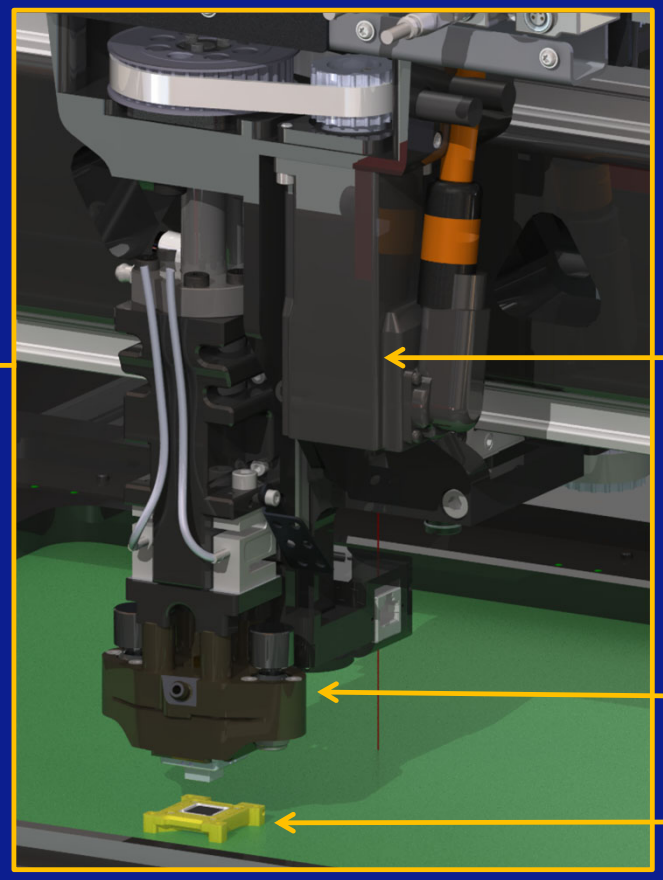
Force-controlled device contacting

Handler hardware – overview



Device contacting axis



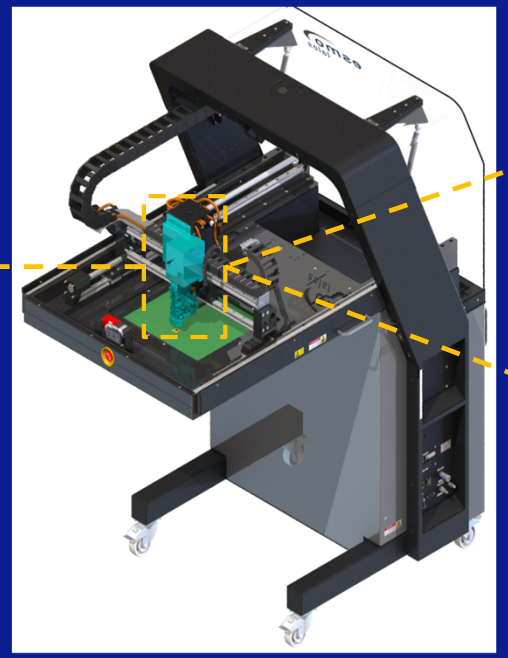
Spindle driven contact axis

Contact Thermal Plunger

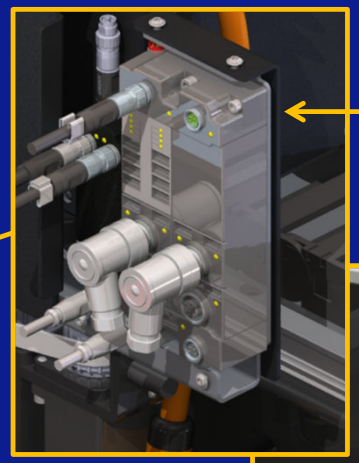
Socket

Force-controlled device contacting

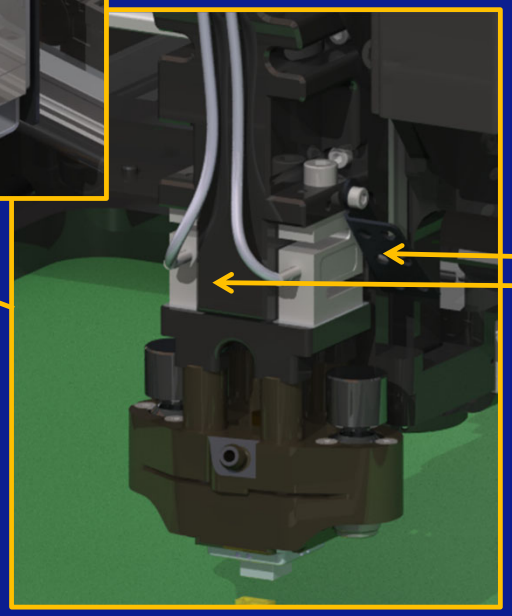
Force control hardware



Device contacting axis with force cells



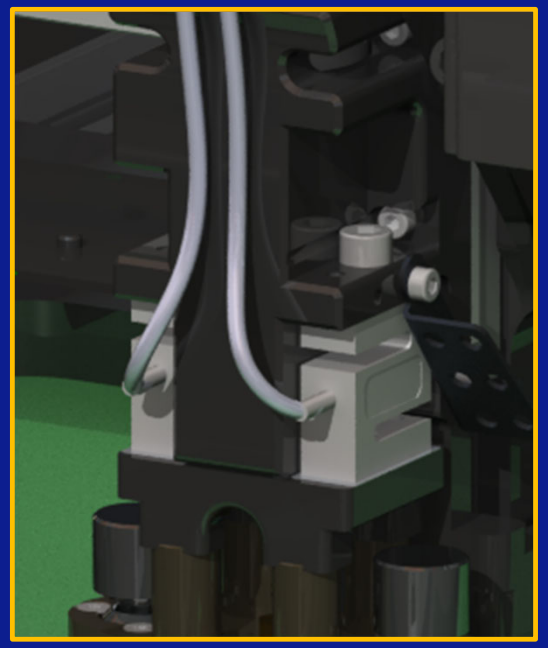
Force cell evaluation module with voltage transmitter



Two force cells

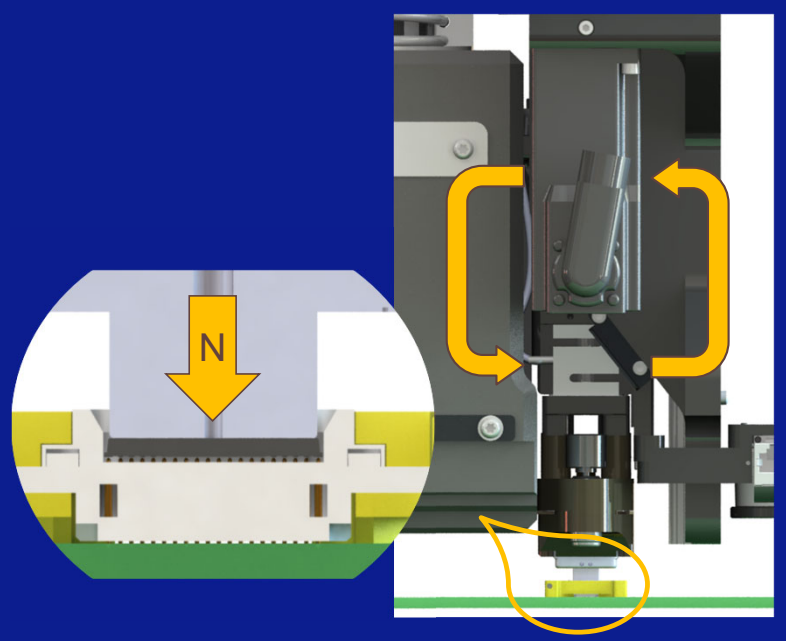
Force controlled device contacting

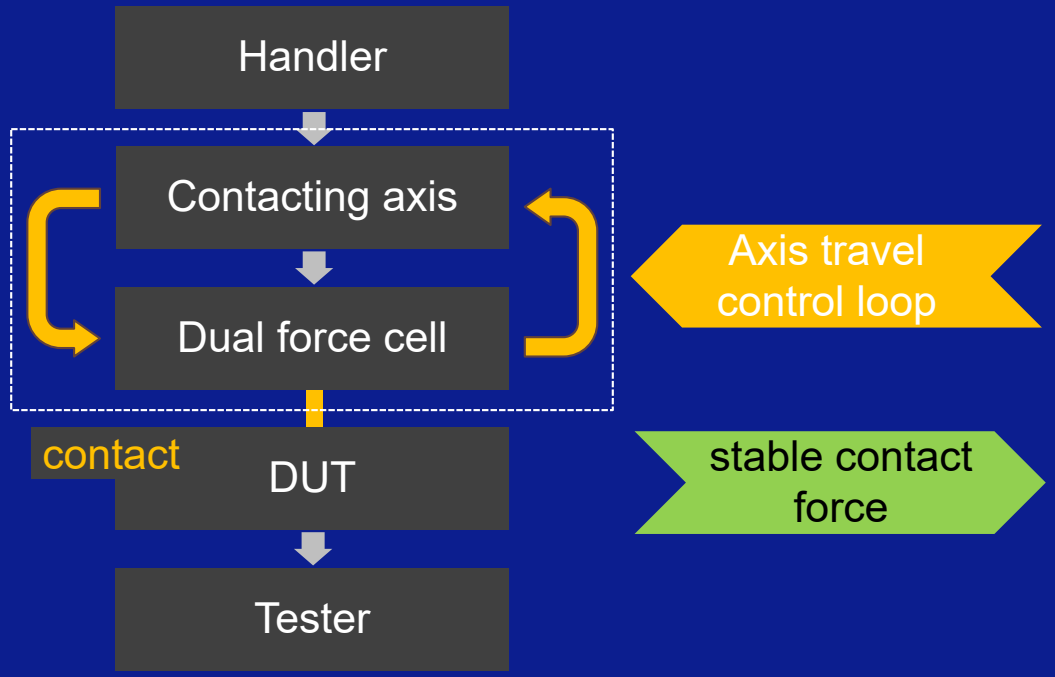
Force cell



- 4 wire multi-range sensor
  for tension & compression
- rated force: 500 N / pcs → ∑ 1000 N
- accuracy of 0.1% at output of 0.5 mV/V

Schematic of force-controlled contacting axis





Continuous constant contact force regardless of external influences on test setup

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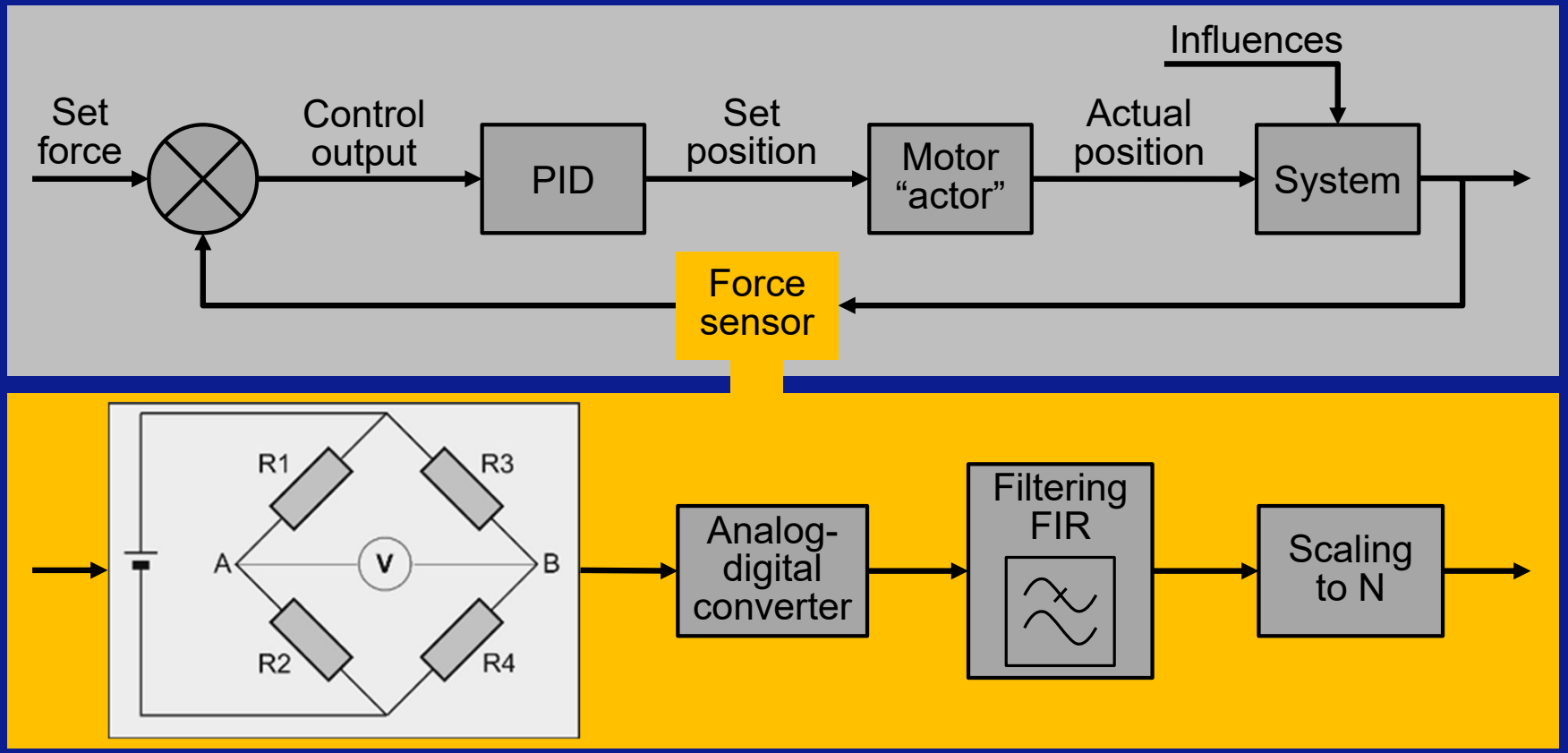
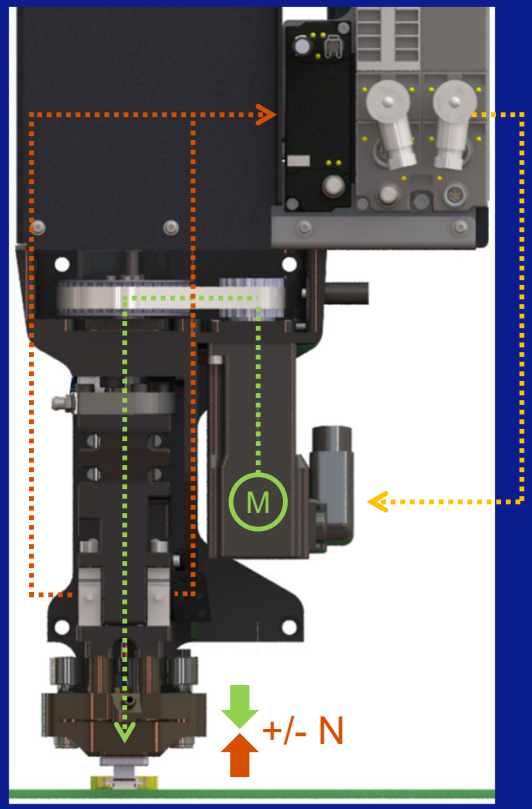
Block diagram of force-control system

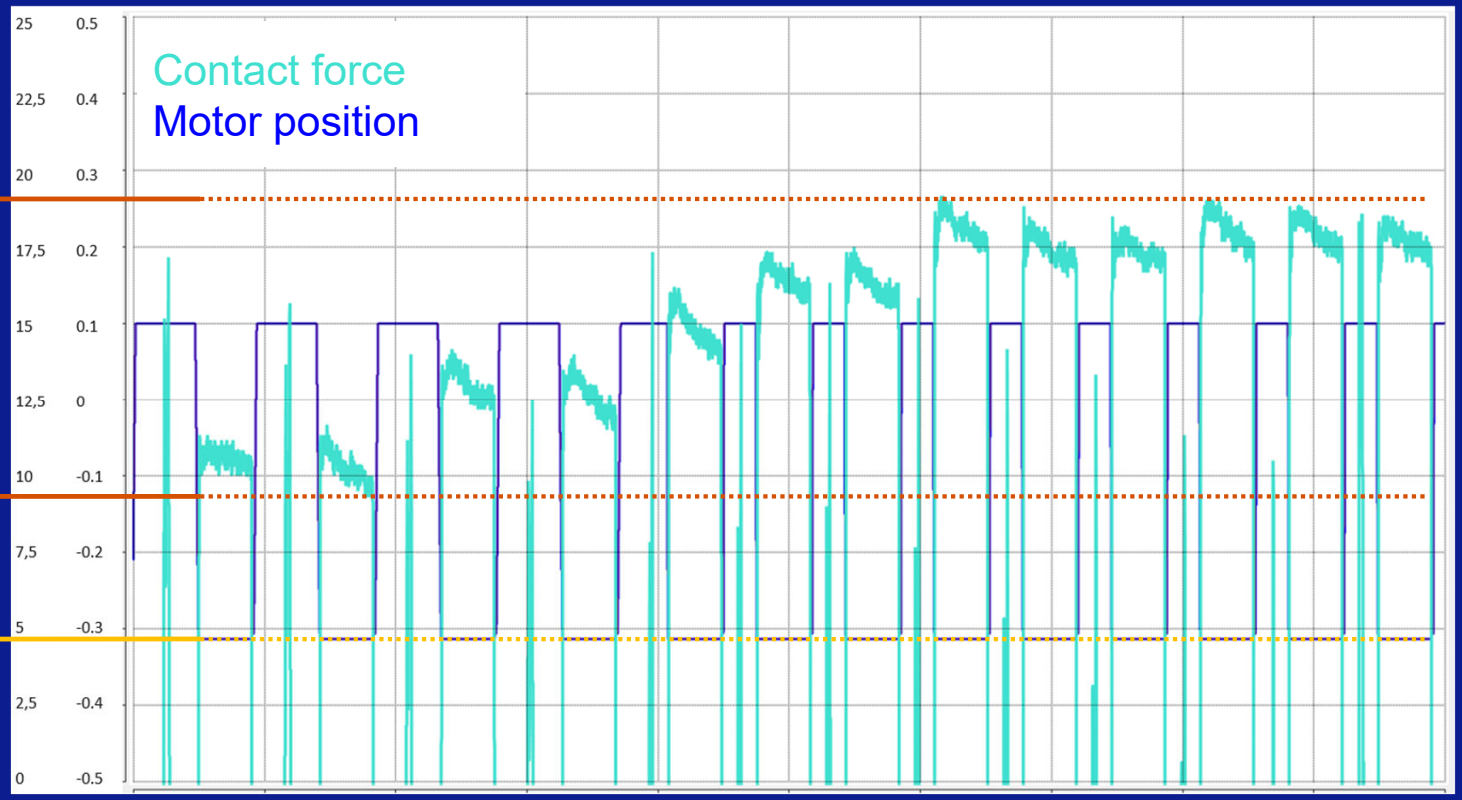


Contacting sequence with force-controlled axis

1. Top level of device detected by Laser
2. Travel of contact axis to 0.2 mm before device top level – position controlled
3. Further travel with force control activated
4. Axis travel until defined contact force is reached
5. Continuous detection of contact force by active controlling of motor position



Scope recording – position controlled



Range of actual contact force
9.3 N … 18.9 N

Constant level of contact height
pin stroke -0,32

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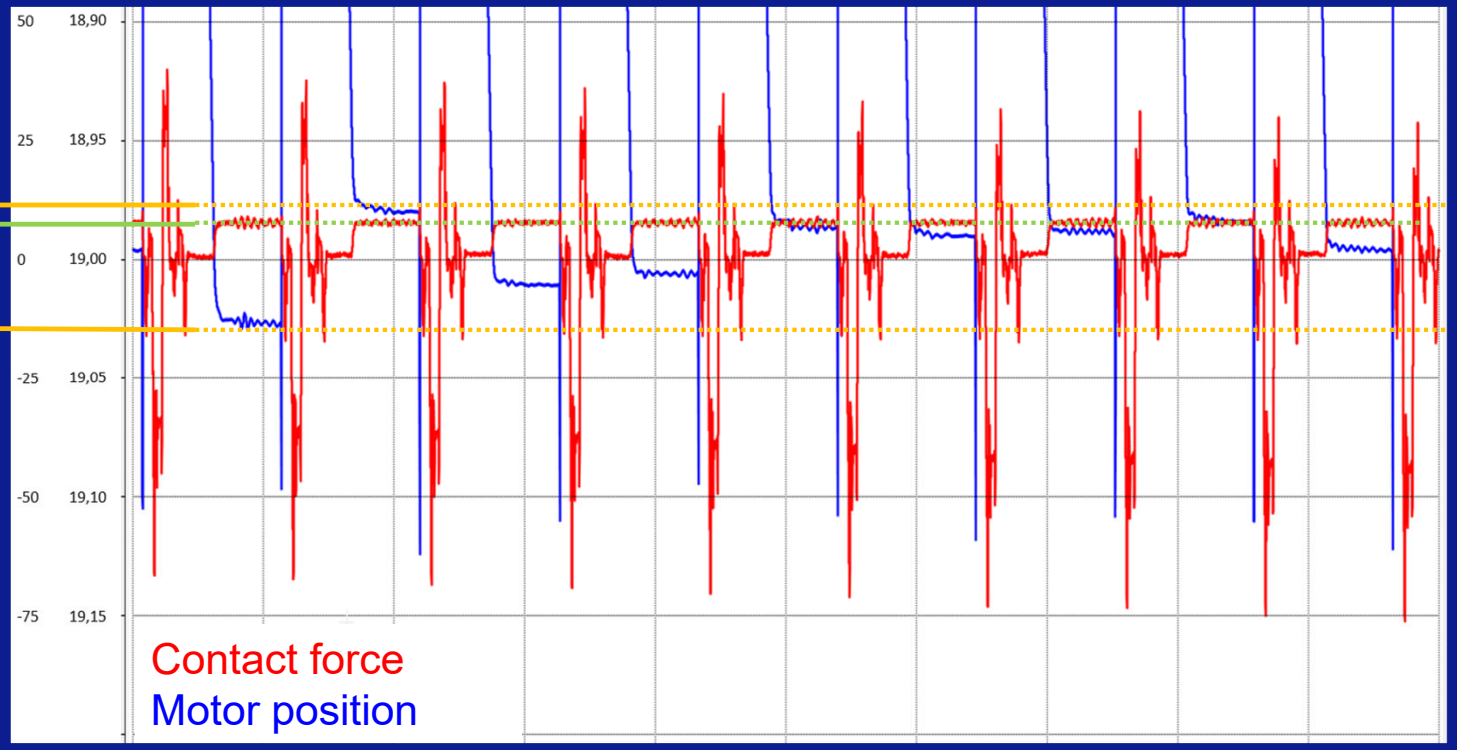
Scope recording – force controlled

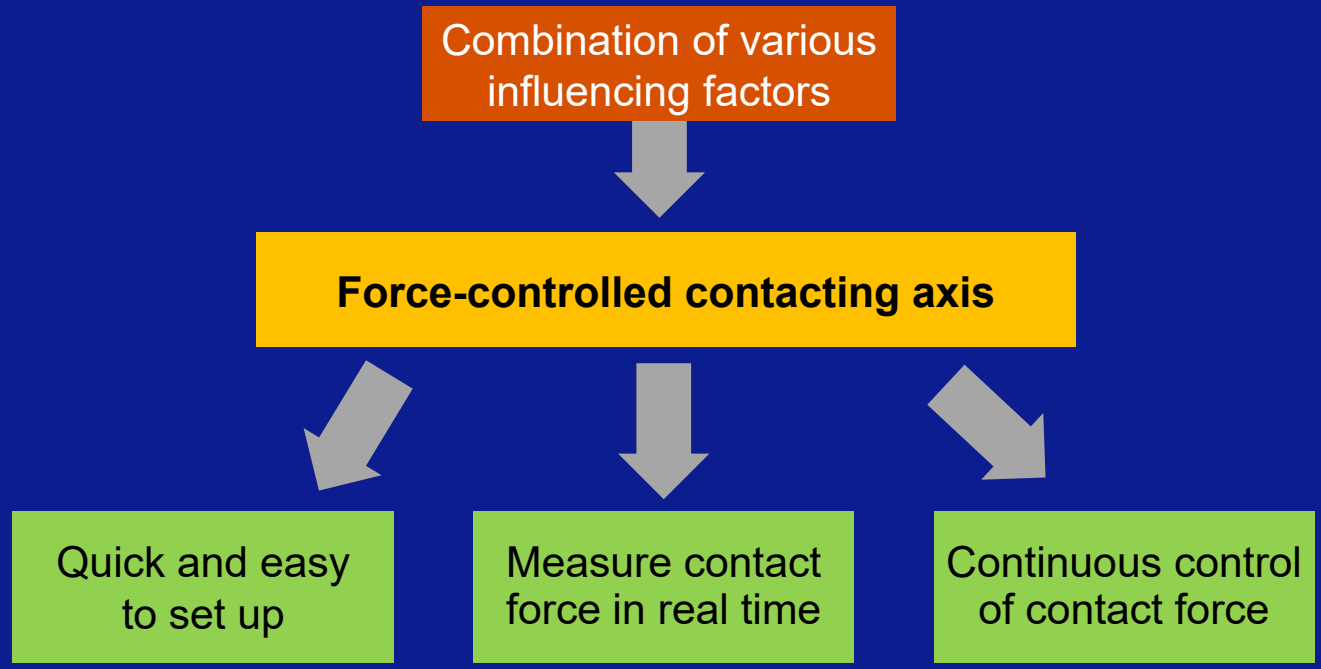
Constant level of contact force 13.8 N set value

Range of actual contact height 0.05 mm



Force-controlled device contacting

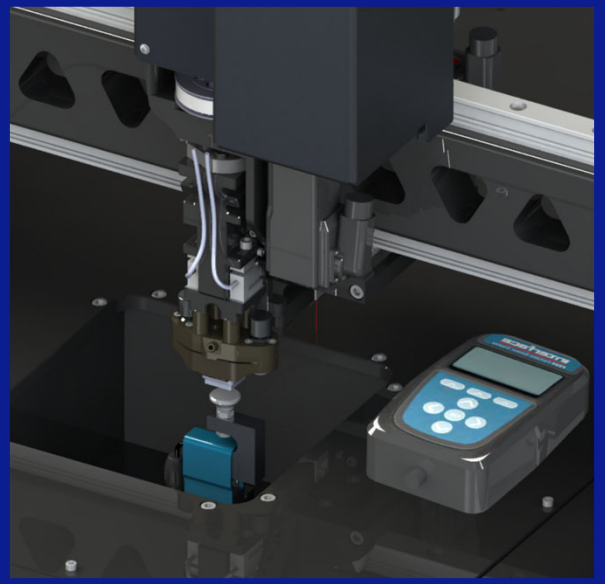
Conclusion – force-controlled contacting



Continued developments

Roadmap items for force-controlled axis development

- Fully automatic calibration of force-controlled axis
- Smooth autotune for PID control parameters for various setups



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