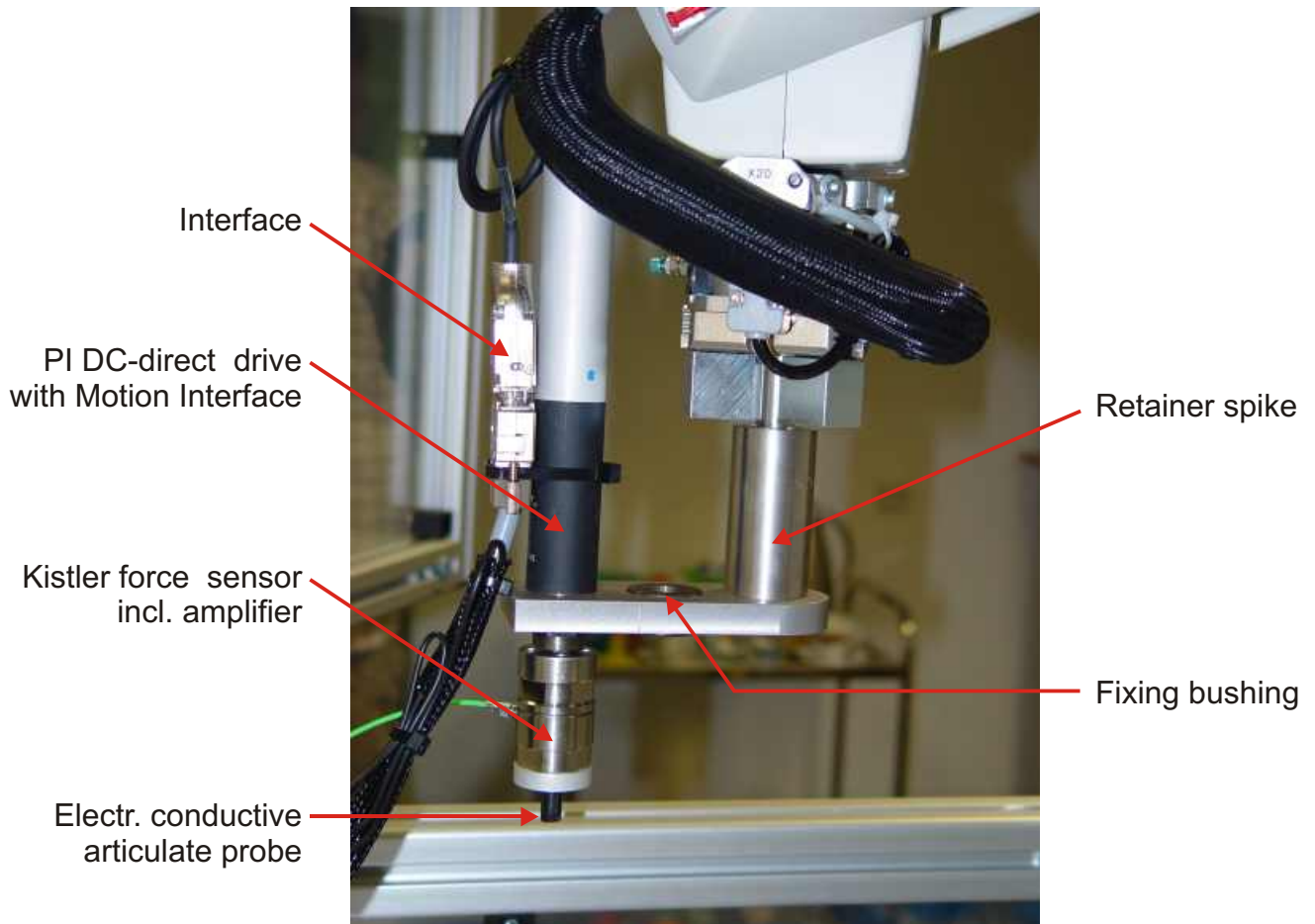


The test cell is developed as standing workstation essentially comprising the following components:

- Compact, welded tubular steel frame
- Protective coating
- Sliding table with fixture for the DUT
- Mitsubishi multiple-axis robot with pneumatic gripper
- Measuring head
- Electrical und pneumatic power supply unit
- Display and control elements
- Keyboard
- Measuring & control unit Fa. MCD



For the exact determination of the key actuation forces and for the creating of the force-deflection graph a ways-force-measurement with the following components is used:



The acquisition and analysis of the measuring data is processed by a measuring board of NI, the appropriate software and hardware was developed by MCD.

The complete system can be exactly positioned in a unit above a tapered fixing bushing.

**Applications**

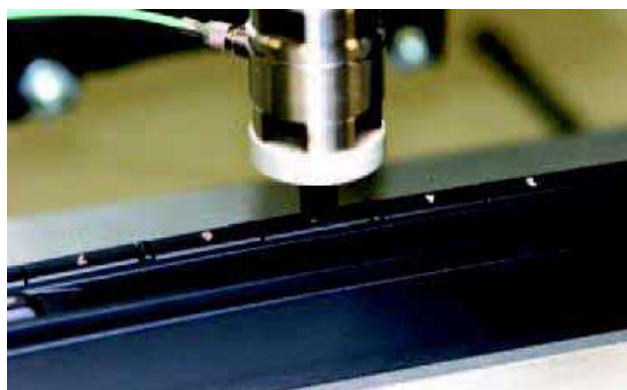
- Force-displacement measuring for
  - Test of keyboards and control elements
  - measurement of mechanical elements
- Test of switch positions

**Design**

- Servo drive
- Force sensor with amplifier
- Mechanical mounting
- Positioning of the measuring system optionally by a robot

**Function**

- Positioning of the test prod
- Soft-land for accurate putting on to the keys
- Recording of the force-displacement curve in different directions of motion with synchronization between force and displacement
- End switch by force and displacement
- Immediate or delayed analysis of the measured values and the curve progression by
  - envelope
  - window area
  - minimum / maximum
  - et al.
- Integration of the control- and analysis-software in a wide variety of Windows programs via COM interface (COM-Server)
- Parameterisable filtering of measured curves



## Measurement range

The measurement respectively valuation ranges are very project-specific and dependent on the drive and force sensor specifically used.

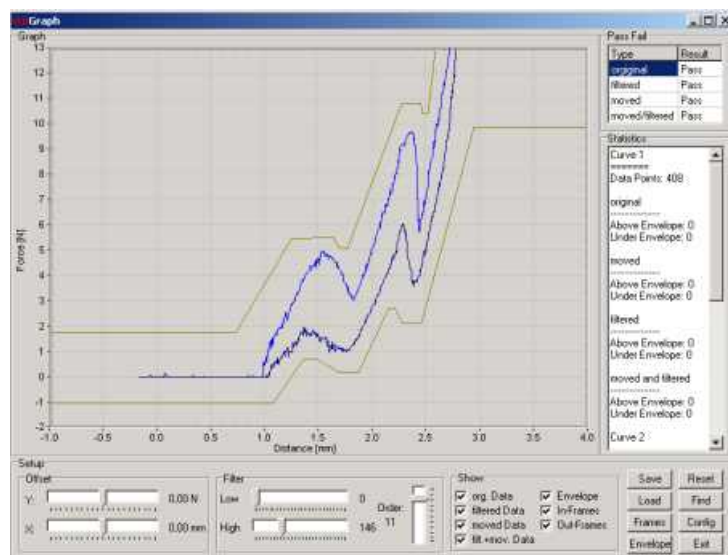
The following table shows the valuation of a reference project as an example.

indicated value	item	valuation range	resolution [bit]	resolution according to item	accuracy
force	N	0 N to 20 N	12 bit / 20 N	0,005 N	?
way	mm	± 10 mm	11 bit / mm	0,5 µm	?
velocity measuring system	mm/s	0 mm/s 10 mm/s	11 bit / mm/s	0,5 µm/s	?
velocity moving unit (robot)					
number of measured values	-	max. 1000/ moving direction	-	300 / s	

The recording of the force-displacement curve takes place via a synchronous scanning of the force and way measurand during key actuation. Both ways are seized forwards and backwards. The number of measuring points depends on the measuring speed and the keyboard stroke. In one second 300 procedures can be noted and evaluated in the example above.

With a key drop of e.g. 3 mm and a speed of 2 mm/s for each direction of motion 450 measured values can be seized.

Optionally other engines and/or force sensors for larger forces, ways or accuracies can be used.



## Control software

The control software for the hardware as well as for the evaluation of the measured values is provided in two independent Windows applications.

One part of the software is responsible for the controlling of the robot optionally available for the positioning of the measuring system. The second part of the software is intended exclusively to be used for the control of the measuring drive and acquisition of measuring data.

Both applications are independent programs. They can be controlled directly or by external programs via COM interface.

The configuration of the movements, measurements and evaluations can be accomplished in different ways.

The following possibilities are available:

- Direct input of the individual parameters via configuration dialogues in the program
- Configuration instructions via COM interface for parameterizing by other programs
- Configuration via parameter files

The analysis of the measured values can be directly realized by FDM software.

In addition, the measuring points can be exported and evaluated by other programs.

If the evaluation takes place via the FDM software, the following mechanisms are available:

- Monitoring of the force-way curve in case given envelopes
- Check that user-defined window areas are enclosed by the curve progression or will pass it
- Check that user-defined window areas are not contacted by the curve progression
- Fixing of the curve minimum and maximum in a given interval, in order to determine the switching point

In order to adjust different environmental influences, the software additionally offers the possibility of filtering the measured values (e.g. in order to remove interference peaks) or balancing the indicated values concerning force-displacement with constant correction offsets. These offsets can also be determined by the program.

Following a measurement also individual measured values or evaluations (Pass/Fail) can be retrieved via COM interface.