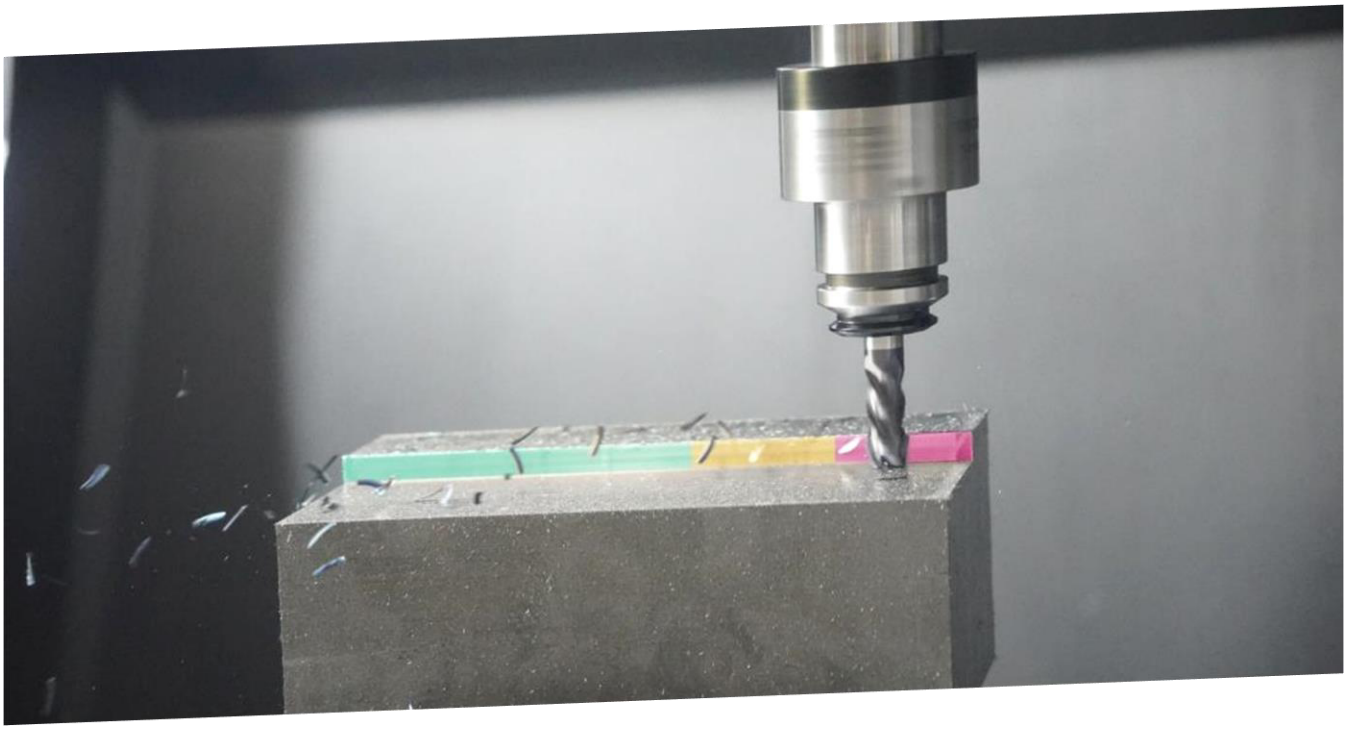
promicron
wireless solutions

OPERATION MANUAL

fusion

Software version 1.3.2791

Revision 1.0 – Issue date: February 2024



Imprint

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1 INTRODUCTION

General information

No liability is assumed for improper use or the resulting consequences.

All information and instructions in this manual refer to the development status at the time of publication.

The images used are symbolic photos. Due to possible typographical and printing errors, but also the need for ongoing technical changes, we ask for your understanding that we cannot accept any liability for the accuracy of the content.

Labelling

The spike® system (sensors and receiver) has a unique serial number for identification purposes, which is attached to the outside of the housing. The serial number is also programmed into the device.

scope of application

The system is used to measure the forces and moments acting on the tool holder during machining. The main areas of application are drilling, milling, turning, threading, grinding and reaming.

Bohren
Verlaufen / Versatz /
Verschleiß / Bruch

Drehen
Rattern / Aufmaßabweichung

Schleifen
Verschleiß / Schleifbrand

Reiben
Verschleiß /
Schneidenausbruch

1.0 SAFETY NOTICE

Compliance statement (part 15.19)

This device complies with part 15 of the FCC Rules and to RSS of Industry Canada. Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Warning (part 15.21)

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Information to the User (Part 15.105 (b))

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This Class B digital apparatus complies with Canadian ICES-003. Cet appareil numérique de Classe B est conforme à la norme Canadienne ICES-003.

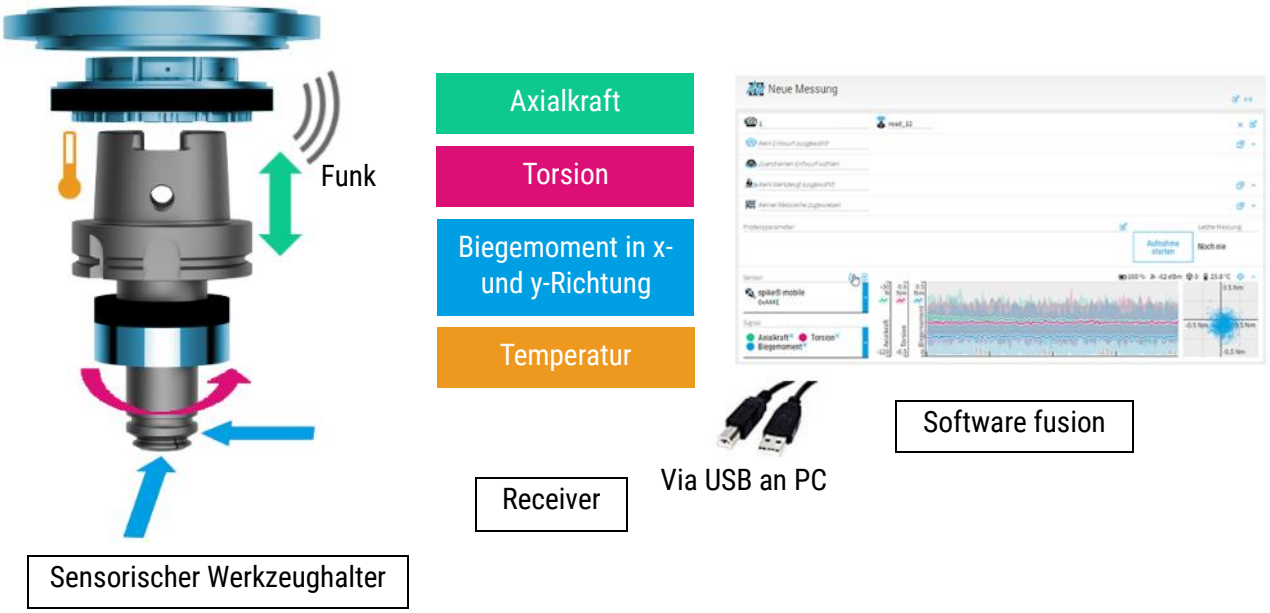
To comply with FCC and Industry Canada RF radiation exposure limits for general population, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 20 cm is maintained between the radiator (antenna) and all persons at all times and must not be co-located or operating in conjunction with any other antenna or transmitter.

1.1 OVERALL SYSTEM

1.2 PURPOSE OF THE SYSTEM

The spike® system consists of a sensory tool holder that communicates with a receiver. The fusion software accesses the receiver's data. The fusion software can be used to visualize the following physical variables that act on the tool holder:

- Torsion moment
- Bending moment
- Axial force
- Sensor recording temperature



This representation enables, among other things, the following aspects:

- Visualization of the process forces
- Limit monitoring
- Derivation of the tool status
- Creating reports

1.3 TARGET GROUP

This user manual is intended for trained specialist personnel. The content of these instructions must be made accessible to specialist personnel and implemented. The use of the spike® system is only permitted for trained personnel.

2 INSTALLATION

The software is installed on a PC/laptop or an industrial PC (IPC).

If the fusion software is installed on a PC/laptop, it can be used as a standalone program to manually control a connection to the receiving device. A PC/laptop allows direct access to the user interface of the fusion software . In addition, installation on a PC/laptop is recommended if the measurement data is recorded with a mobile system. This variant is chosen if automated, permanent process monitoring is not required.

fusion software on an IPC is used for permanent process monitoring within a machine .

2.1 SYSTEM REQUIREMENTS FOR PC AND IPC

The following minimum requirements apply for PC or IPC:

- Windows 10
- CPU: Intel Core i5 (10th generation)
- 8 GB of RAM
- 512GB SSD

Recommended:

- Windows 10
- CPU: Intel Core i7 (10th generation or higher)
- at least 16 GB of RAM
- 512GB SSD
- at least mid-range graphics card

If you have any questions about the system configuration for the fusion software, please contact promicron support.

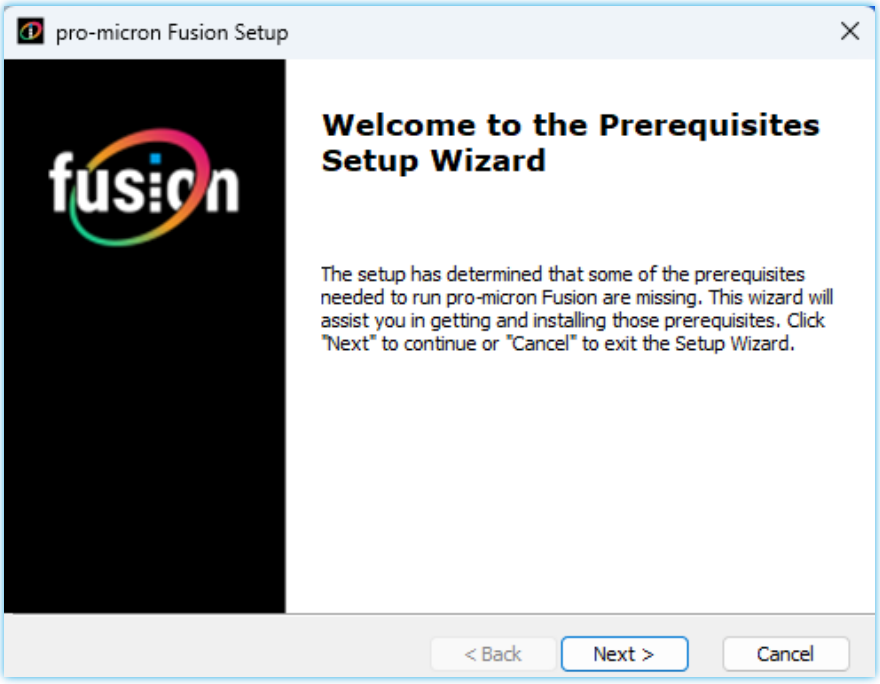
2.2 INSTALLATION PROCESS

fusion _[version number].exe" is located on the supplied data carrier . Admin rights are required to install the fusion software.

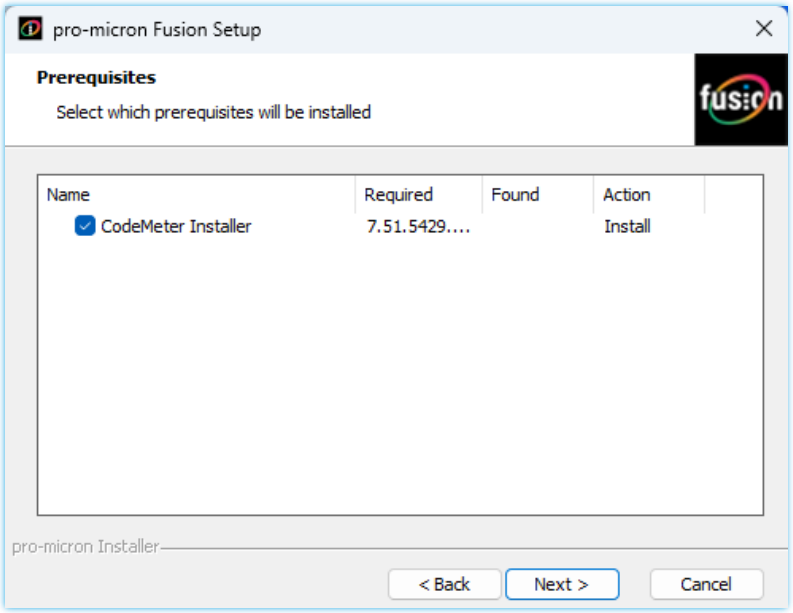
➔ Start " fusion setup.exe"

➔ Confirm Windows security warning with "Yes".

➔ Installation wizard opens

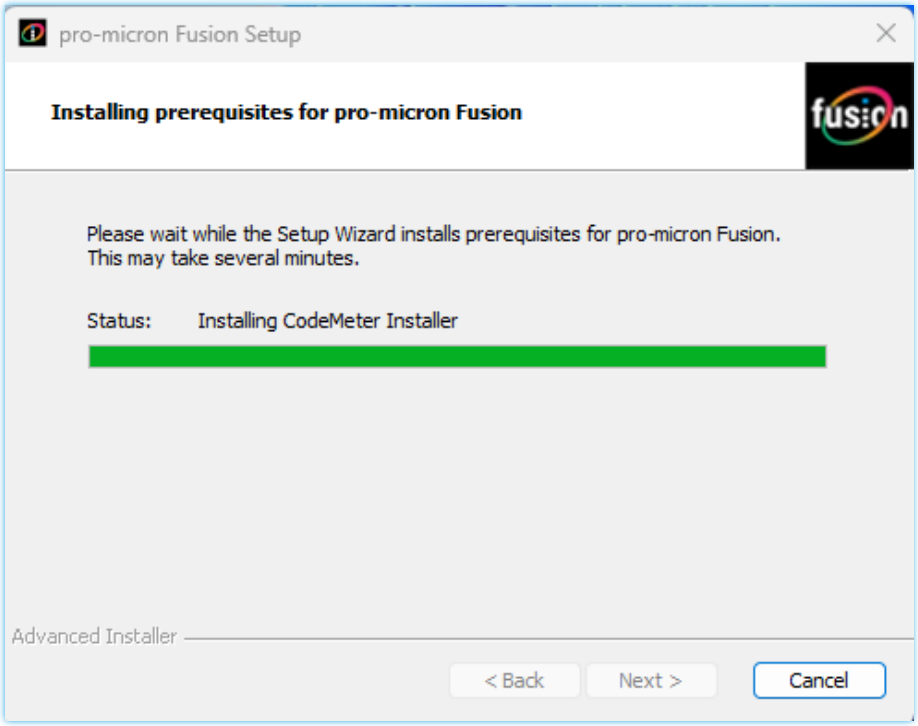


➔ Select "Next"



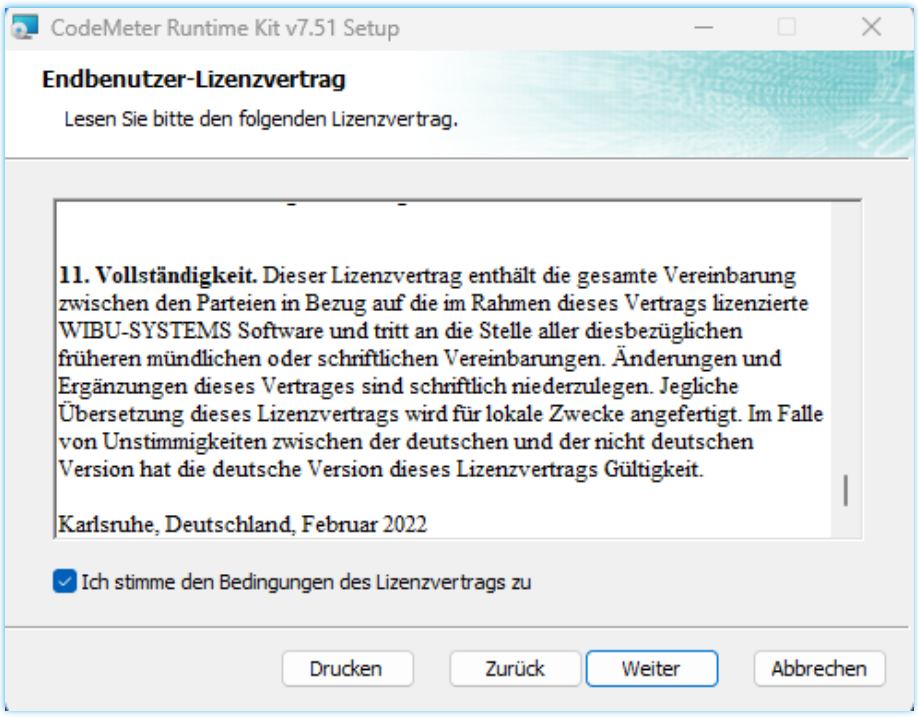
➔ Select "Next" to install CodeMeter (license checking software)

2.2.1 INSTALLING CODEMETER

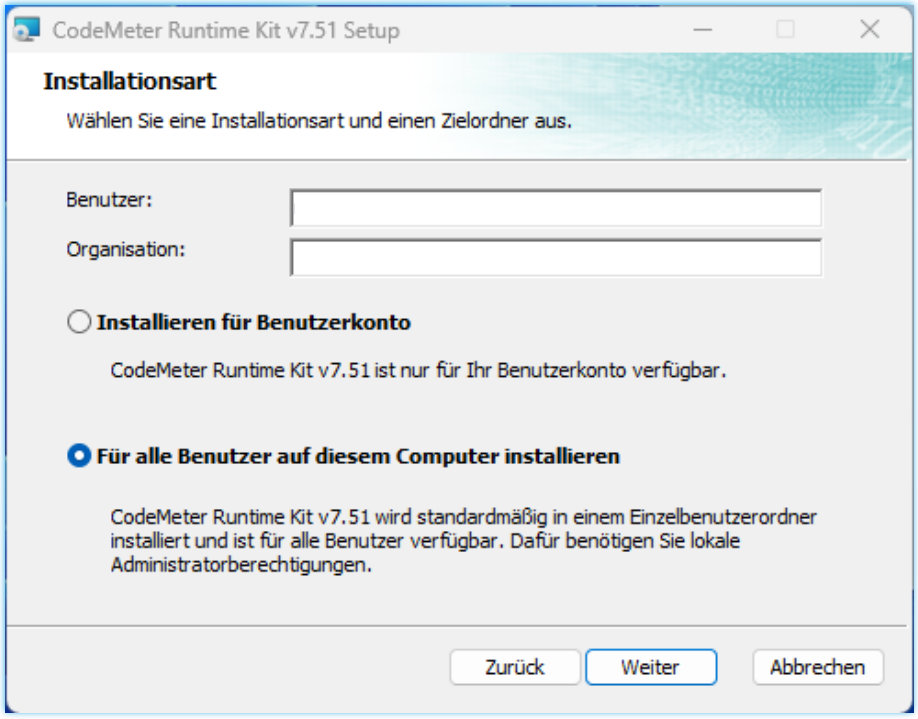


➔ Wait until the next request window appears

➔ Select “Next”



➔ Agree to license terms
➔ Select “Next”

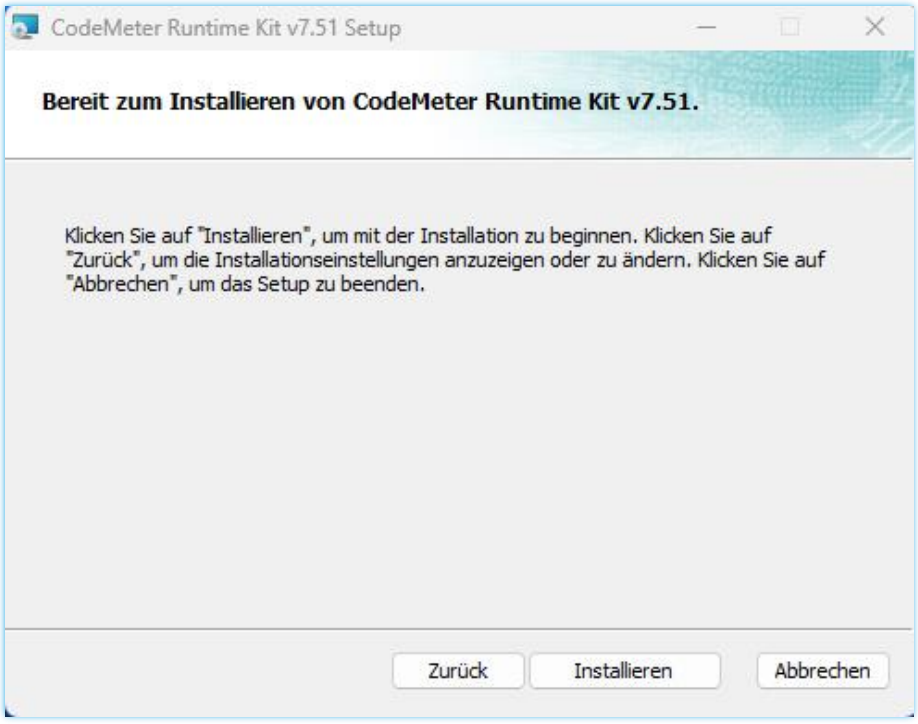


➔ Select “Next”

Features recommended for Custom Setup:

- WibuShellExtension
- User Help
- Automatic server search

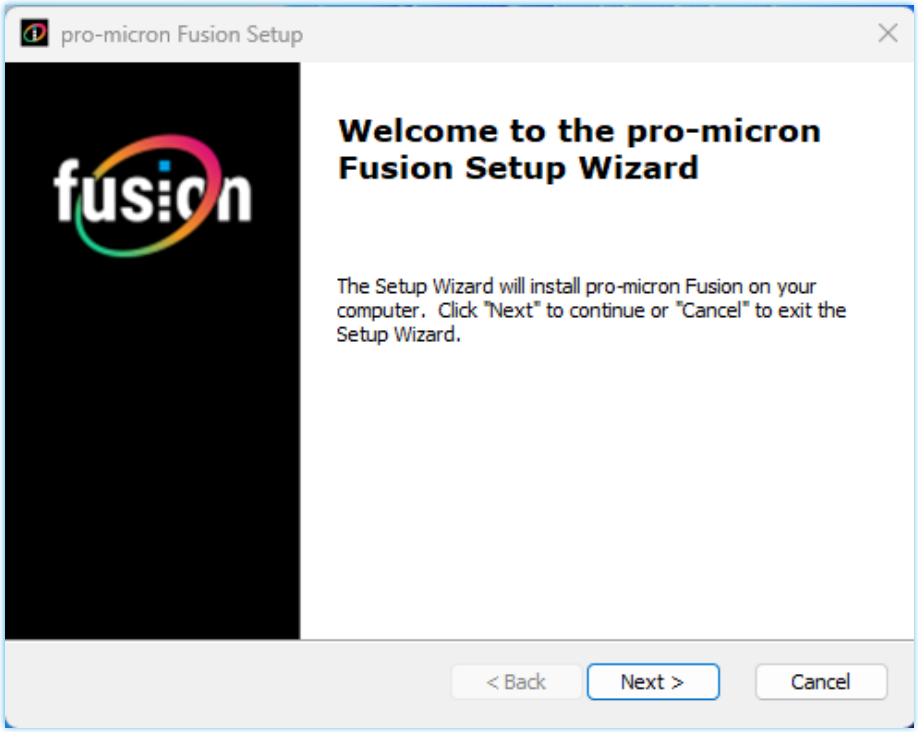
➔ Select “Next”



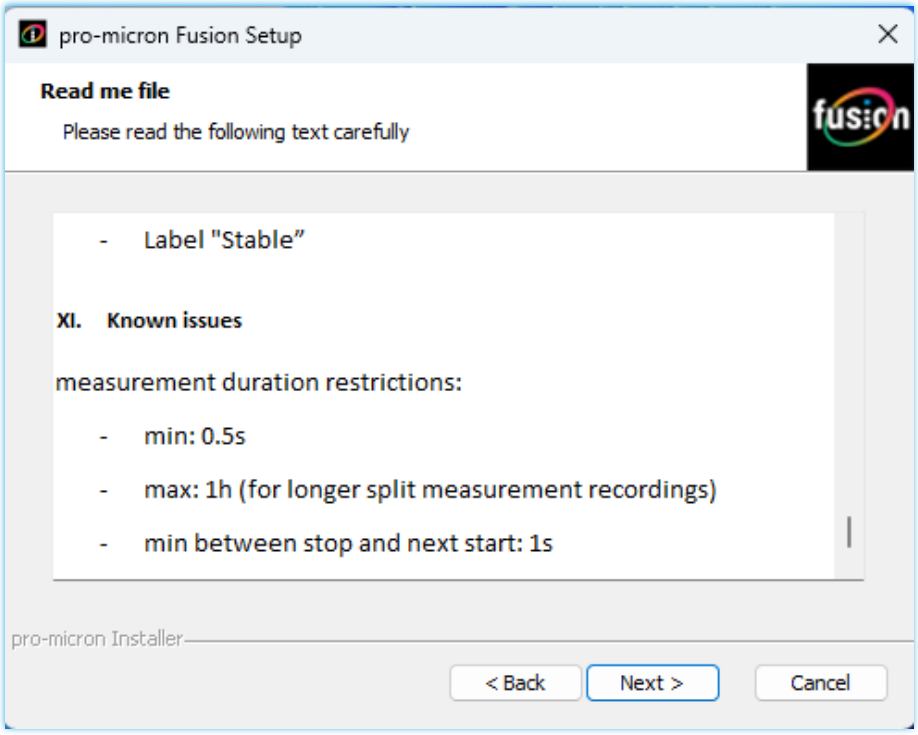
➔ Select “Install”

➔ "Finish" selection

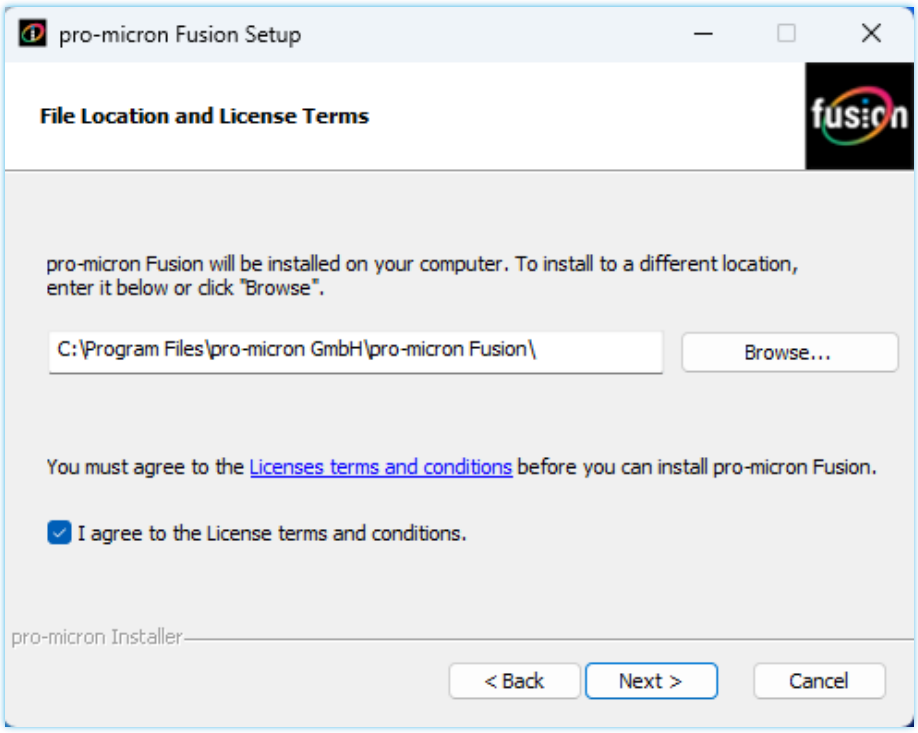
2.2.2 INSTALLATION OF FUSION



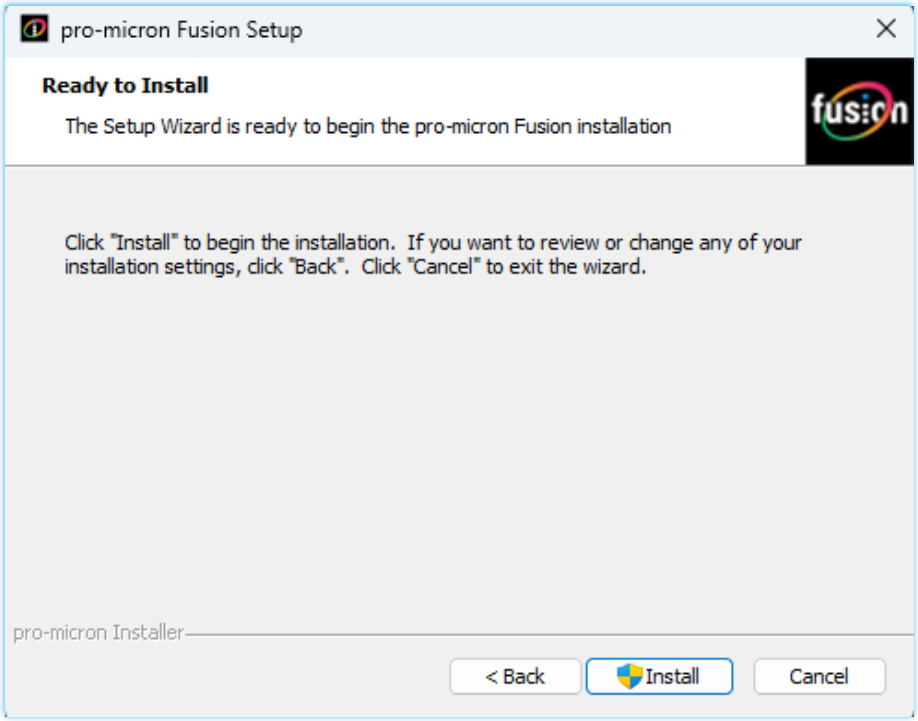
➔ Selection "Next"



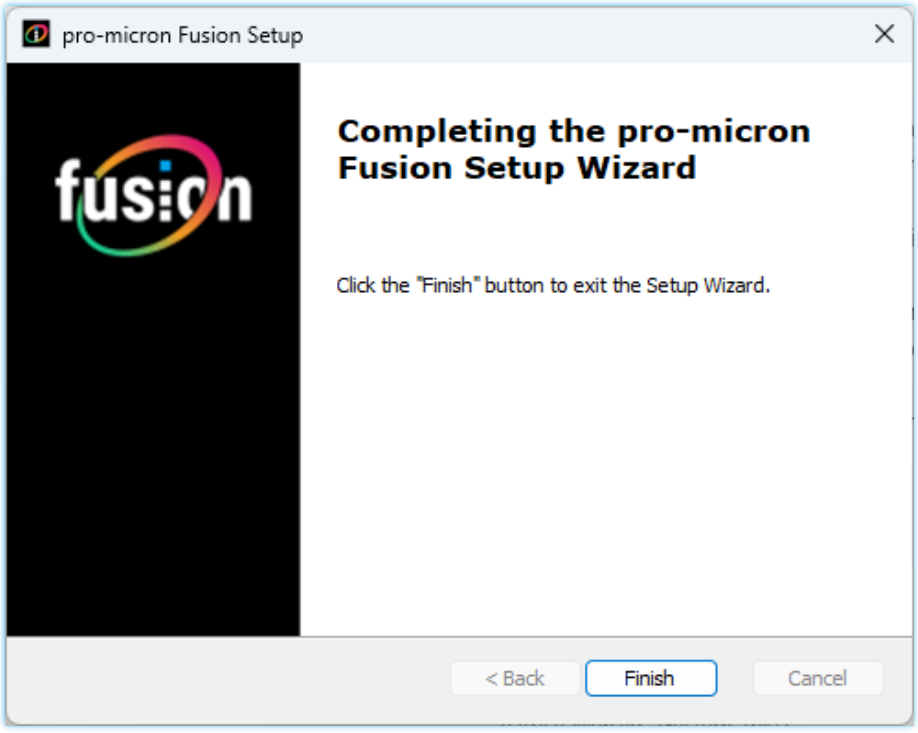
➔ Selection “Next”



➔ Select installation folder
➔ Agree to license terms
➔ Selection “Next”



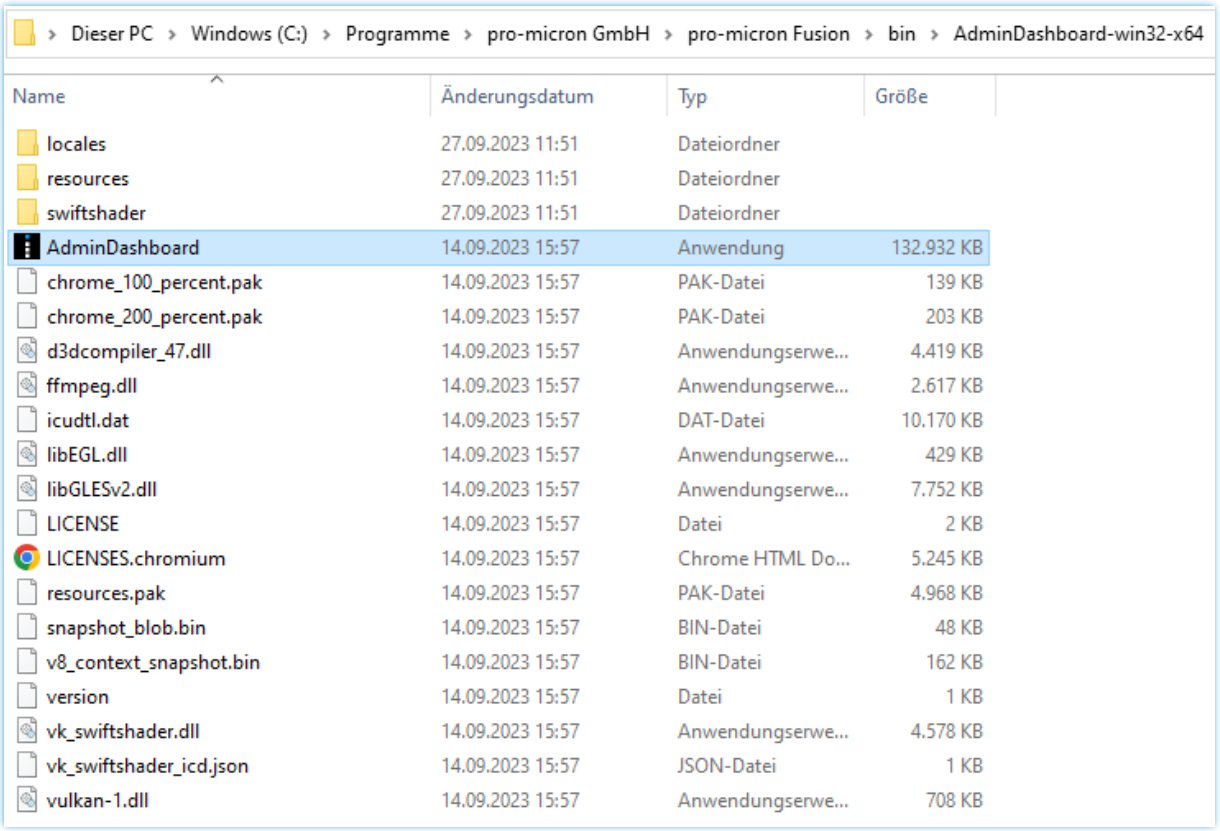
➔ Select “ Install ”



➔ “Finish” selection

There is now a shortcut to the admin dashboard on the desktop.

2.3 MAIN PROGRAM LOCATION



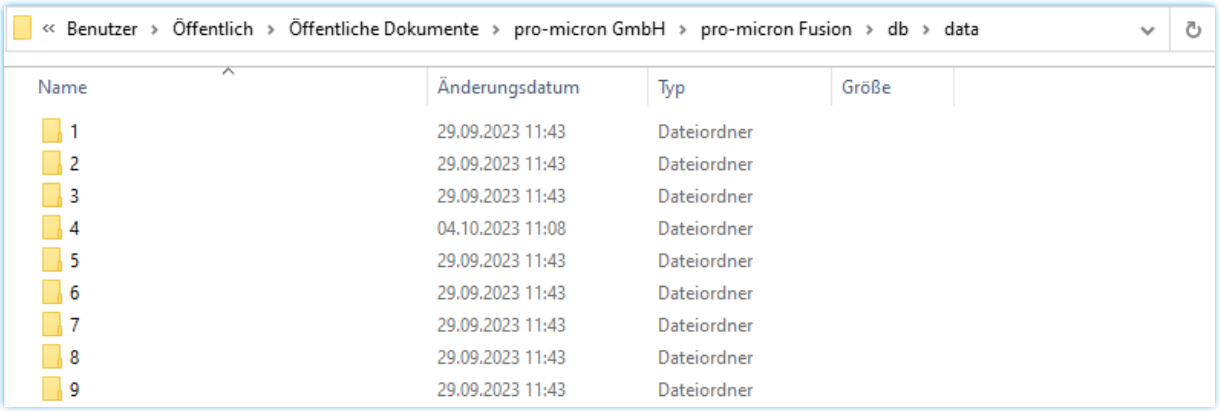
The main program “ AdminDashboard ” of the fusion software can be found by default at the following path:

C:\Program Files\pro- micron GmbH\pro- micron Fusion\bin\AdminDashboard-win32-x64

or

C:\Programs\pro-micron GmbH\pro- micron Fusion\bin\AdminDashboard-win32-x64

2.4 STORAGE LOCATION OF MEASUREMENT DATA



The folder for the saved measurement data can be found at the following path:

C:\Users\Public\Documents\pro-micron GmbH\pro- micron Fusion

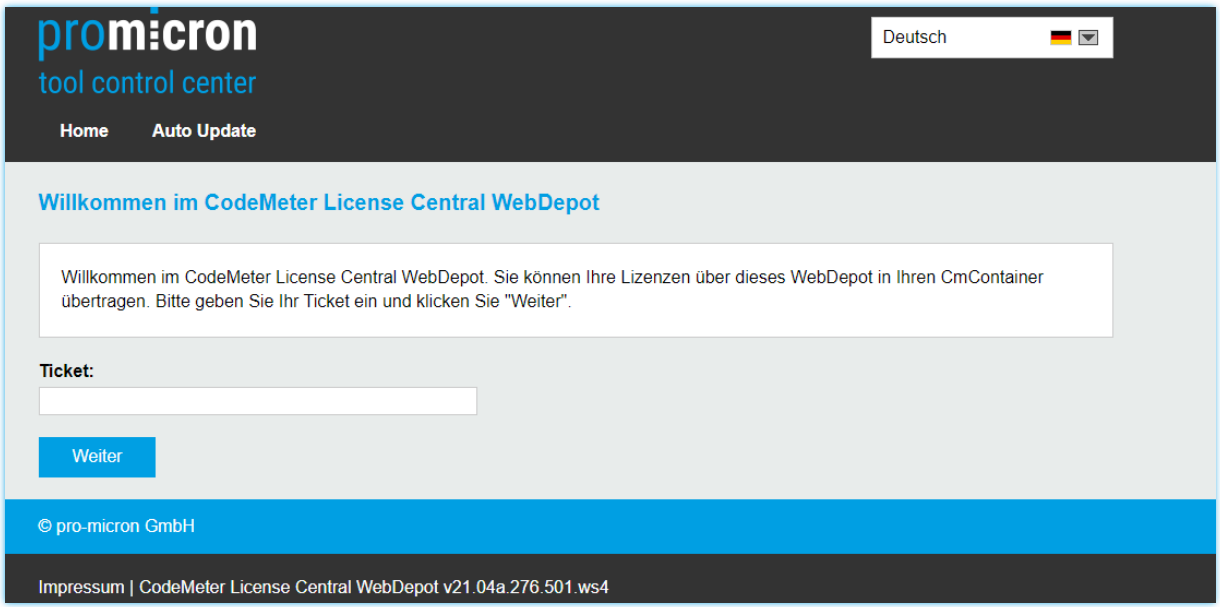
or

C:\Users\Public\Public Documents\pro- micron GmbH\pro- micron

2.5 LICENSING AND ACTIVATION

The license can be activated via the following website:

https://iot.pro-micron.de/index.php

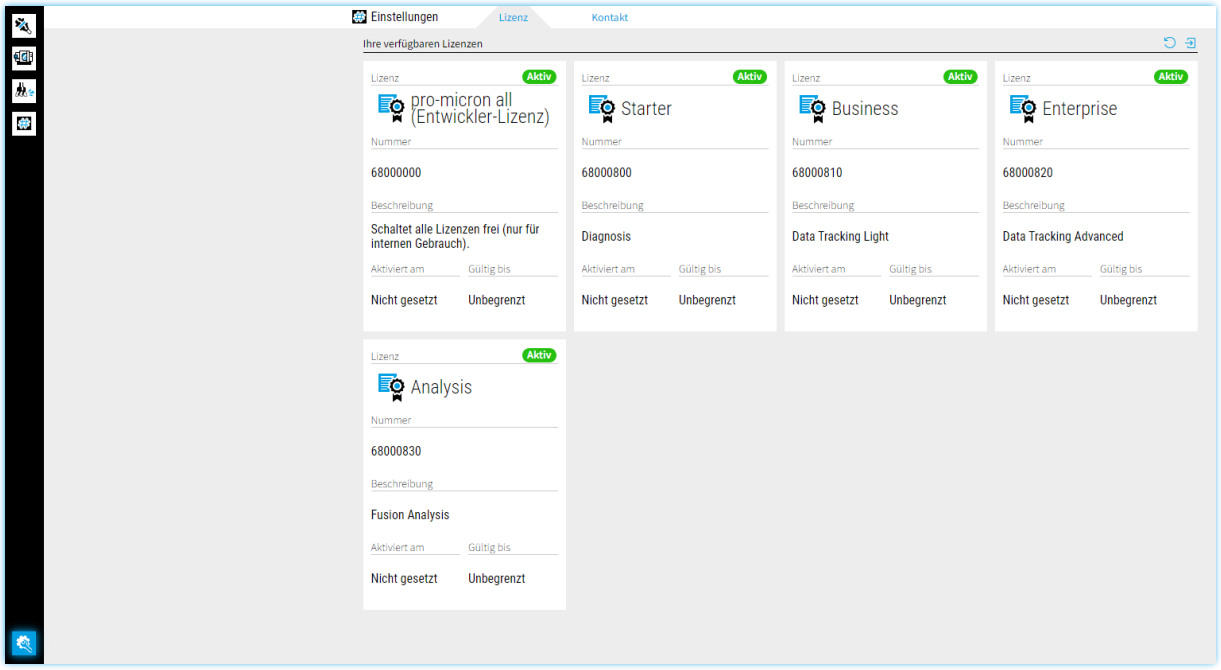


➔ Enter ticket number in the input field

➔ Select “Next”

➔ Select “Activate licenses”

The activated licenses or the status of the licenses can later be viewed in the “Settings” tab.



License overview:

- Starter **:** for easy measurement data recording and viewing of individual measurement files using tags and the database
- Business **:** with machine connection; Software access to machine data (e.g. axis data and tool data) via a machine interface (pm-connector)
- Enterprise **:** full functionality
- Analysis: for individual measurement data analysis and for overlaying multiple measurement data streams

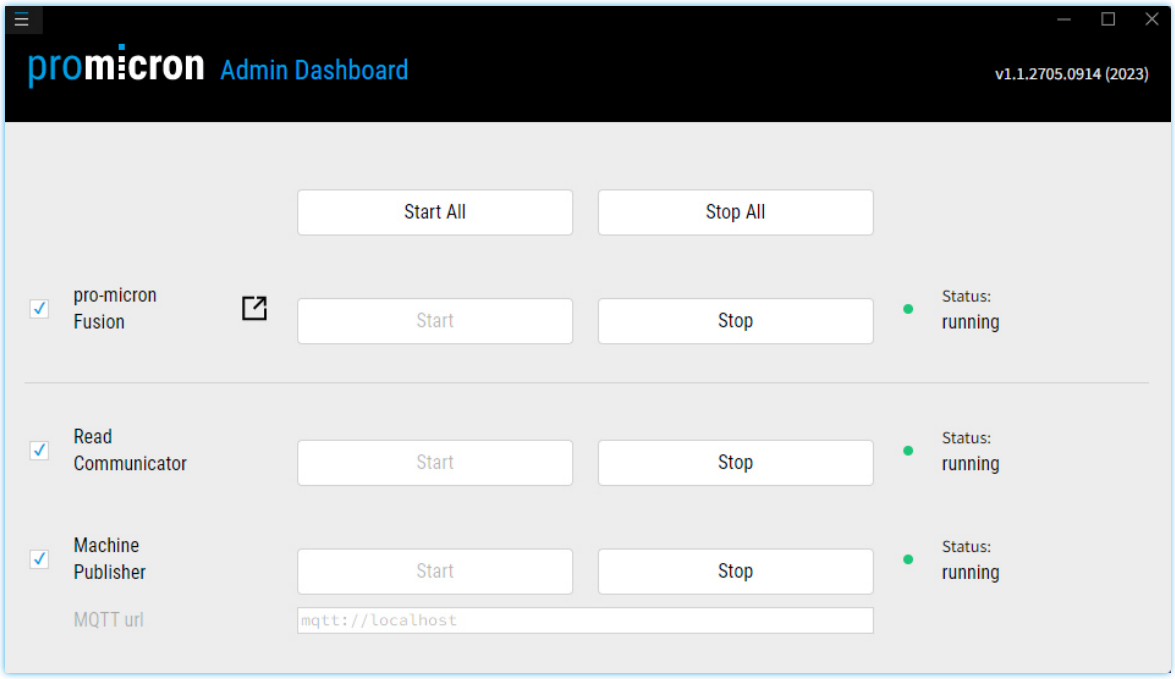
3 MAIN FUNCTIONS

3.1 ADMIN DASHBOARD

The admin dashboard is started by double-clicking the icon on the desktop.

Alternatively, it can be opened via Explorer if no shortcut to the admin dashboard has been created:

C:\Program Files\pro- micron GmbH\pro- micron Fusion\bin\AdminDashboard-win32-x64

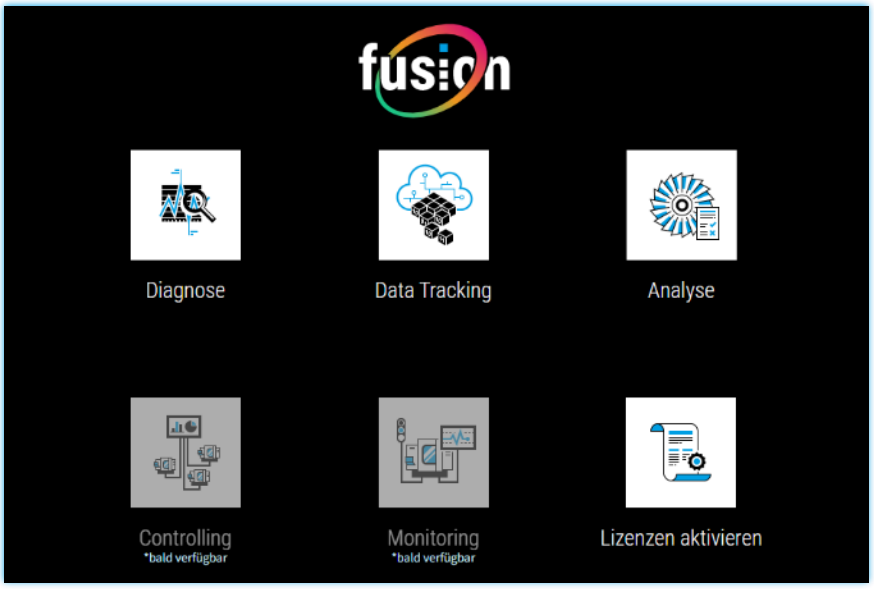


Three components are centrally controlled via the admin dashboard:

- **pro- micron Fusion:** the actual software, executed as an application
- **Read Communicator:** for communication between the PC/laptop/IPC and the receiving unit
- **Machine Publisher:** for communication between the PC/laptop/IPC and the machine via the pm-connector

It is recommended to select (tick) the components that correspond to the existing overall structure and then start the software including communication interfaces together via “Start All”. After the start, the status of the relevant components changes to “ running ”. The fusion software dashboard opens. Alternatively, the components can be started individually.

Clicking on this icon will directly  start the fusion software and open the fusion dashboard.

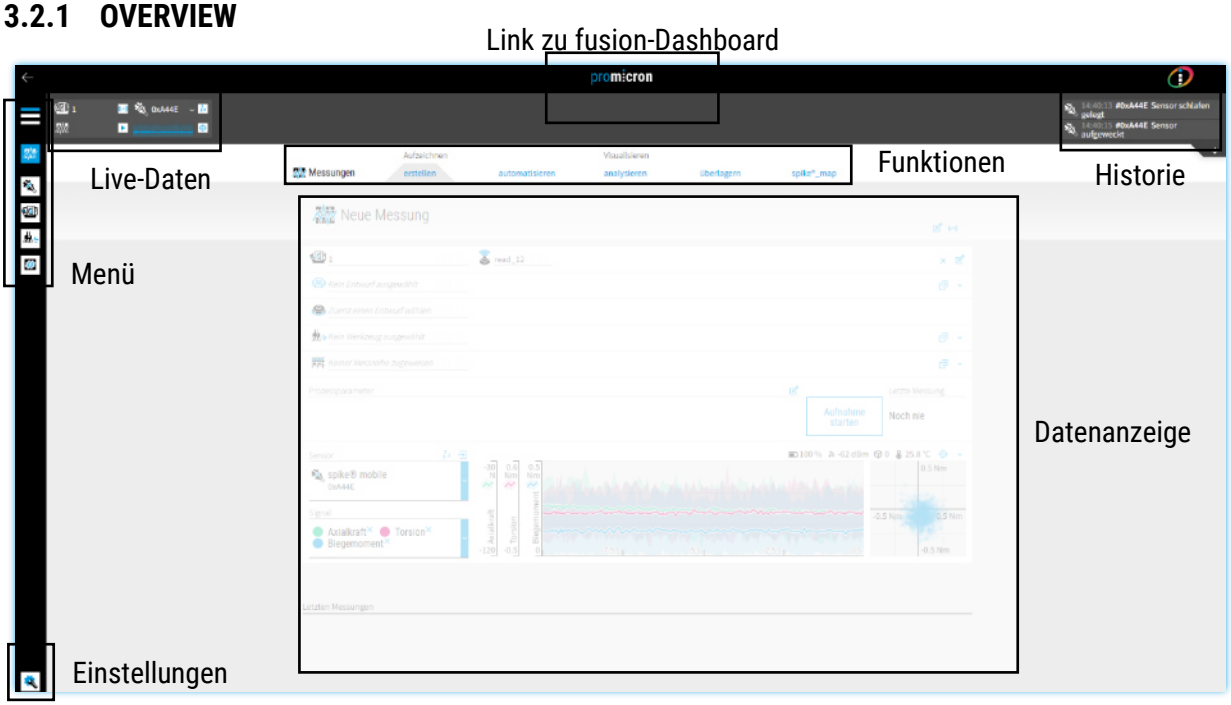


via the fusion dashboard, depending on the user's focus. The respective home screen opens by clicking on the corresponding icon.

- Create diagnostic →measurements→create
- Data tracking→ Measurements → automate
- Analysis →Analyze measurements→ analyze
- Activate licenses →Settings →Licenses

3.2 SCREEN DISPLAY

3.2.1 OVERVIEW



3.2.2 LINK TO FUSION DASHBOARD

The fusion dashboard can be selected from any level of the software by -clicking on the pro micron logo.

3.2.3 MENU

Any other functionality can be achieved from any home screen.

Measurements

Sensors

machinery

Tools

tags

3.2.4 SETTINGS

menu	Description
License	Overview of available licenses
Contact	Contact details for pro- micron support

3.2.5 FEATURES

Different functionalities are assigned to the different menu objects.

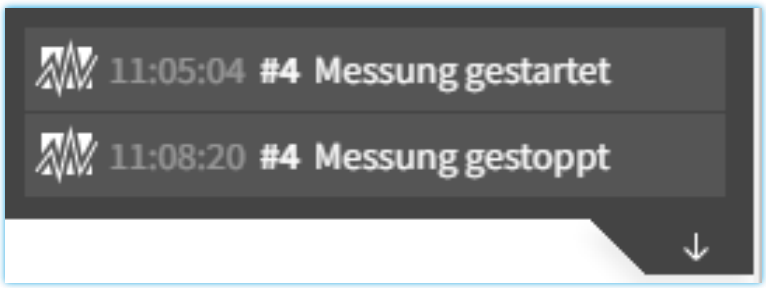
Function **menu→**	**Description**
Measurements	Visualization of measurements
Create measurements→	Create and stream measurements
Measurements→ automate	Creating automated measurements (e.g. fieldbus, NC trigger or M commands)
Analyze measurements→	Analyzing measurements that have already been created
Measurements→ overlay	Overlay multiple measurements for comparison
Measurements→ spike_map	Visualized representation of the process flow including the force - influences
Sensors	Configuration of the sensors
Sensors→ create	Representing the registered receiving unit and sensor
Sensors→ edit	Editing the parameter list
Test sensors→	Carrying out self-tests for the sensor and receiving unit
machinery	Configuration of the machine used
machinery→ create	Setting the machine parameters
machinery→ edit	Editing the machine's parameter list
Tools	Configuration of the tools used
Create tools→	Creating new tools
Tools→ edit	Editing already created tools
tags	Configuration of tags and labels
tags→ create	Creating new tags
tags→ edit	Editing already created tags
labels→ create	Creating new labels
labels→ edit	Editing already created labels

3.2.6 LIVE DATA

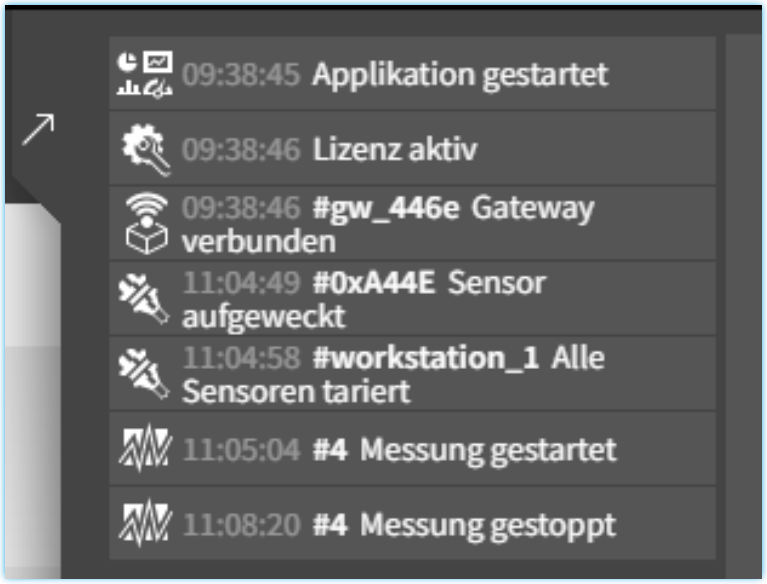
The live data provides an overview of the current status of the entire system.

3.2.7 HISTORY

The history lists information about activities, status messages and error messages.



The history display is expanded by clicking on the arrow on the right and collapsed again by clicking on the left arrow.



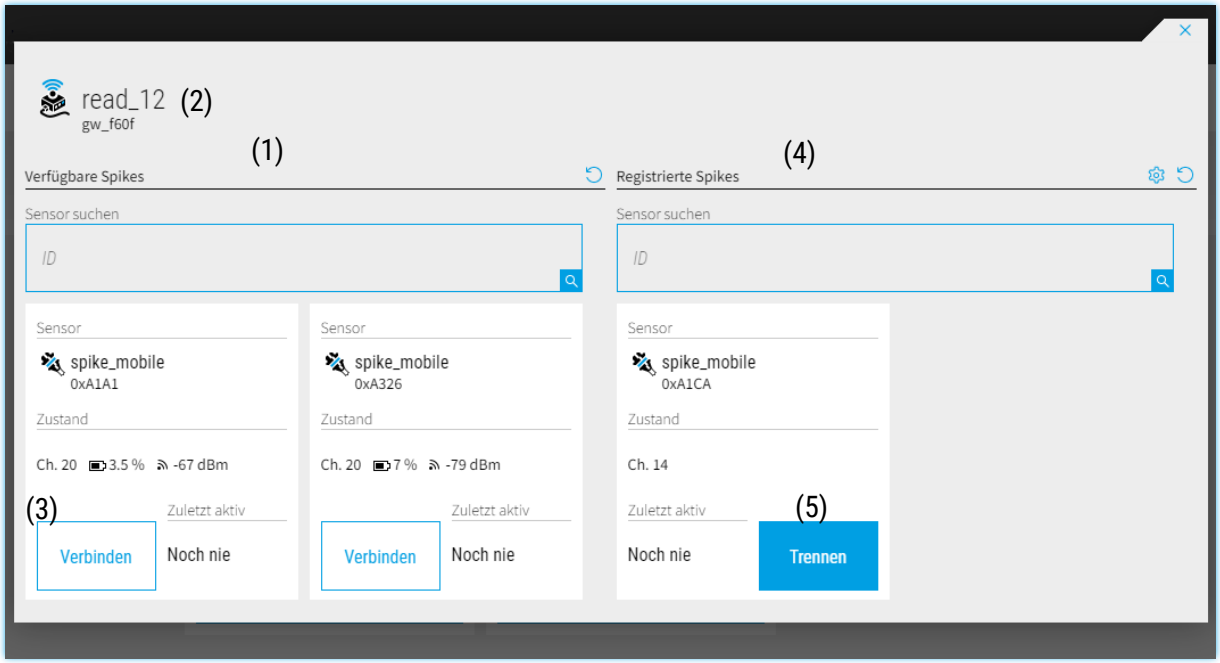
3.2.8 ADVERTISEMENT

The representations in the display depend on the selected function.

4 STEP-BY-STEP INSTRUCTIONS

4.1 CONNECT A SENSOR

In the Sensors > Create menu, the send icon must be clicked, then a list opens with all sensors that are in the area and recognized by the system. Alternatively, quick access is possible via the send icon in the live data area. This list updates automatically a few seconds after the window opens.



The available spikes area (1) lists the sensors that are recognized by the receiving system (2) and have not yet been registered. To register a sensor, “Connect” (3) must be selected. A connected sensor is listed under Registered Spikes (4). The receiving system can now exchange data with this sensor. A registered sensor can be selected in the main menu and in the submenus.

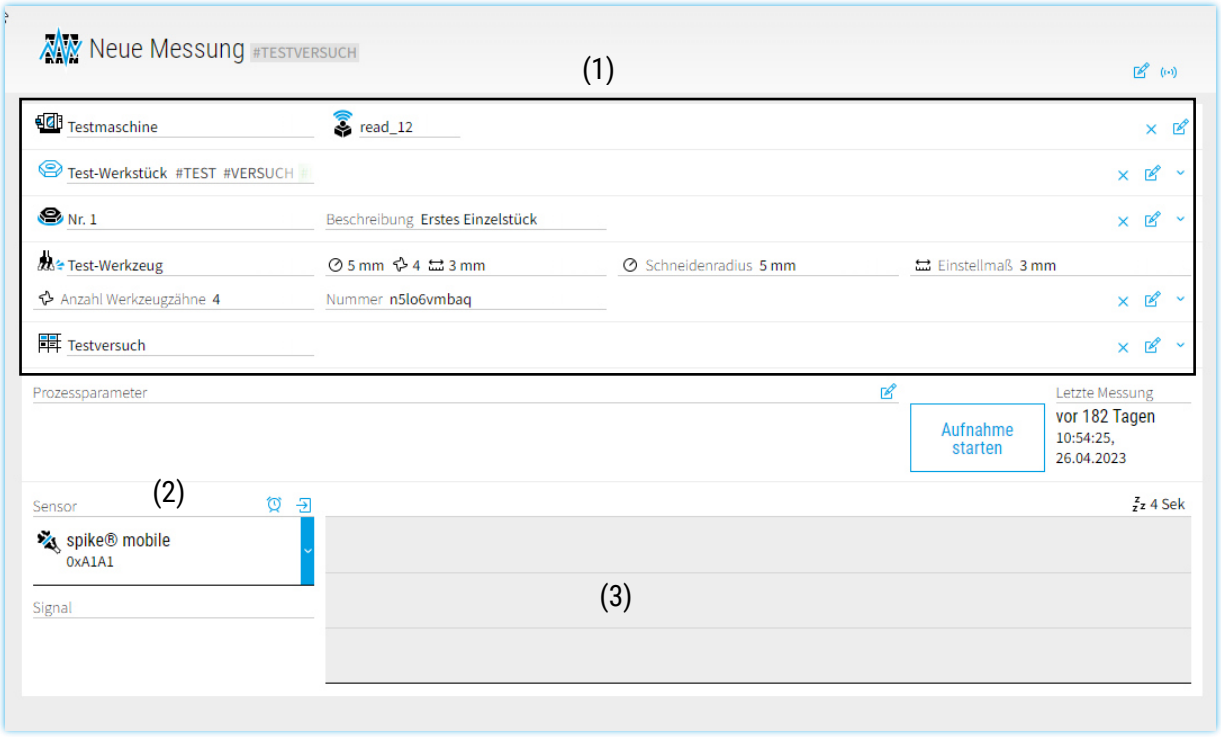
If a sensor is disconnected again (5), it no longer sends data to the receiving system and is listed again under Available Spikes. Available sensors cannot be selected in the main menu or in submenus.

If a sensor is in the area but is not listed under Available Spikes, the power supply is not sufficient to send a radio signal. The sensor must then be charged first.

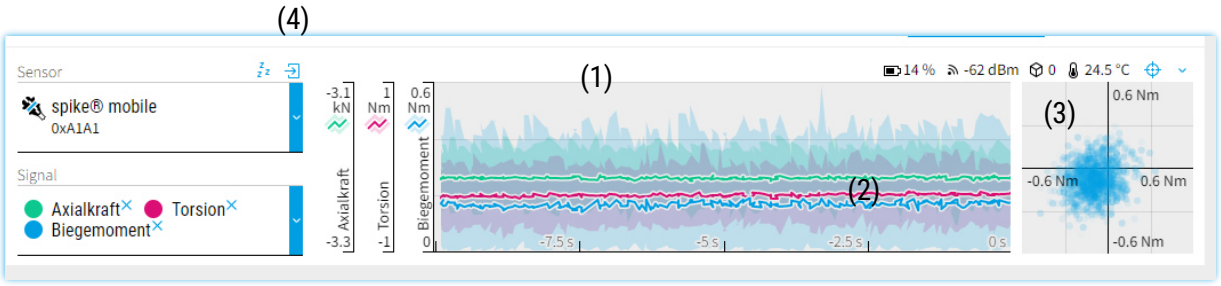
4.2 START A MEASUREMENT

4.2.1 START A MEASUREMENT WITH SPIKE®_MOBILE

If a sensor is registered, the software can capture and record its measured values. In the Measurements menu under the Create function, all essential information (1) is first recorded that facilitates the subsequent traceability of the measurements, for example the processing machine, the process parameters and the tool. Tags are also available; their use is explained in Section 0.



The registered spikes are available for selection in a list (2). The desired spike is selected and woken up from sleep mode by clicking on the alarm clock icon. This activates the data stream, the current measured values are displayed in the diagram (3). The alarm clock icon changes to the “sleep” icon. When not in use, the sensor can be put back into energy saving mode by clicking on the “sleep” symbol.



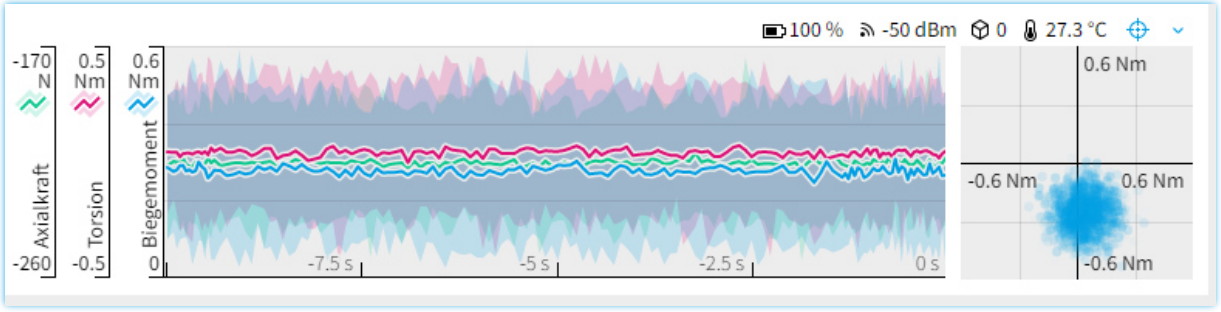
If the data stream is active, the data that the sensor measures and transmits is displayed. Depending on the sensor, the bending moment, torsion and axial force are shown in the diagram. For each of these variables, the values are continuously aggregated and displayed as lines (2). The representation of the spike_polar (3) represents the measured bending moment in the coordinate system.

The data stream transmits further information about the sensor, which is displayed:

- current battery status
- RSSI value (as a measure of the strength of the received signal in wireless communication - systems; a lower value indicates greater signal strength, while a higher value indicates lower signal strength)
- Packet error rate (number of incorrect or not transmitted data packets in relation to the total number of data packets sent)
- Sensor temperature.

If you want to check or adjust the settings of the selected registered sensor, you can access the parameter list of the selected sensor using the “Access” icon (4). Details on this follow in Section 5.

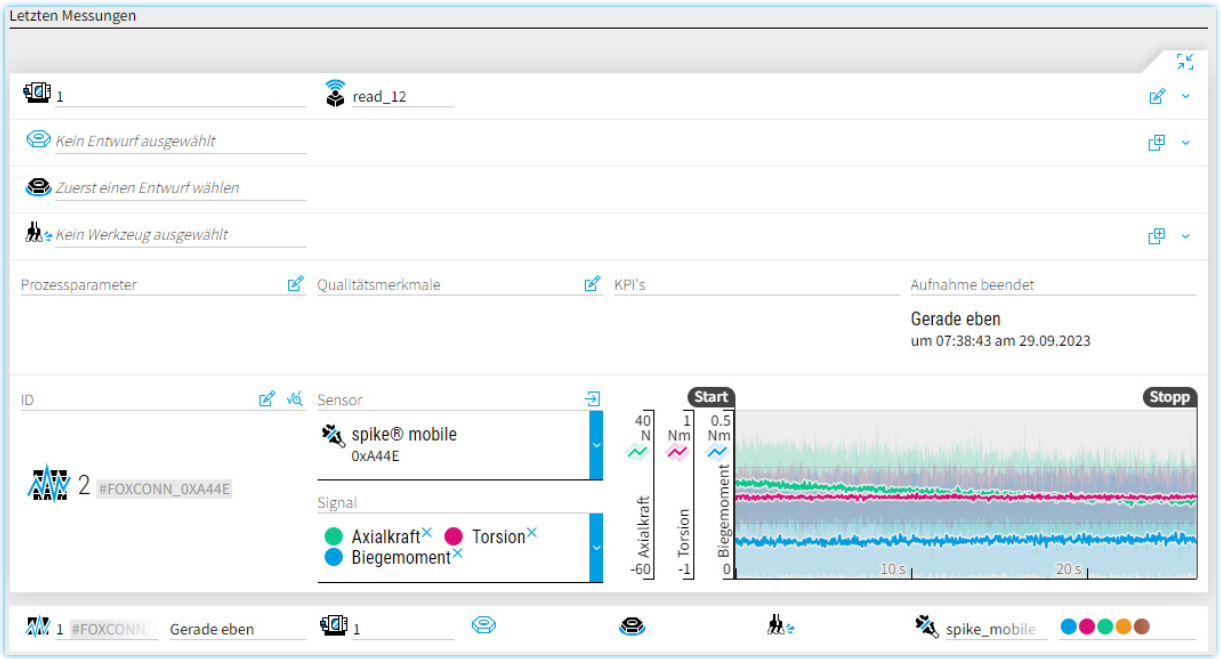
If the tool is not engaged, there are no forces acting; the measurement data shows the background noise of the sensor. This point cloud should lie at the origin of the coordinate system, but it can be shifted from the zero point due to physical effects. By digitally taring by clicking on the crosshair icon, the basic deviation of the bending moment in the x-direction and y-direction is corrected to zero .



In order to start a measurement, you must click on “Start recording” (1).

After a measurement has been started, measured values are recorded. Individual measurements can be assigned to measurement series.

The last saved measurements are shown below the display of the current sensor data. The details become visible after the line of the corresponding measurement is expanded by clicking. Further information about the measurement can be entered manually here.



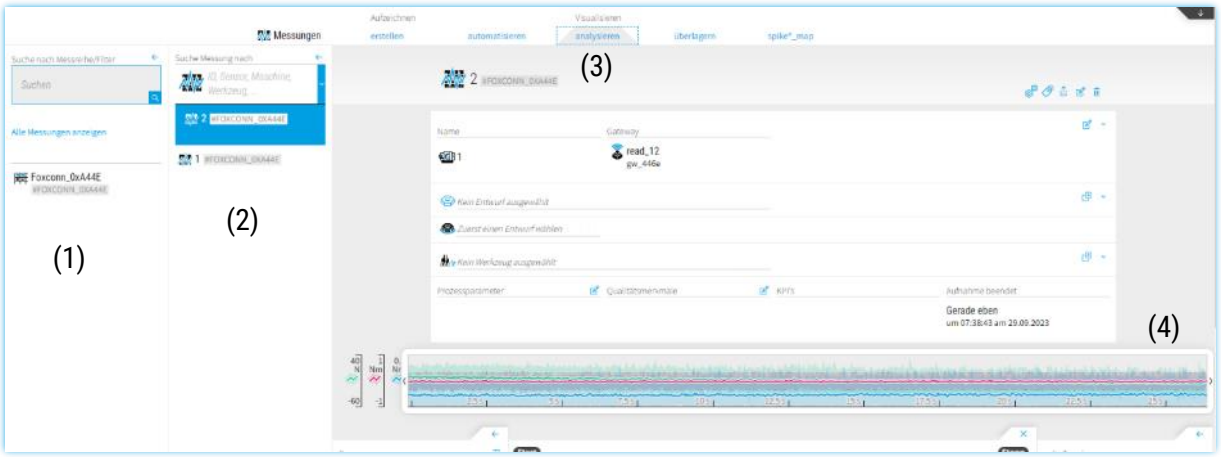
4.2.2 START A MEASUREMENT WITH SPIKE_INSPINDLE

With spike_InSpindle systems, a lot of machine information can be transferred to the software via a so-called pm_connector . Such process parameters are automatically linked to the respective measurements. This includes the current NC program, the tool and the maximum bending moment that is stored in the machine.

The measurement can be started by clicking on the play button above the point cloud, and the measurement can be stopped by clicking on the stop button.

4.3 ANALYZE A MEASUREMENT

Main view:

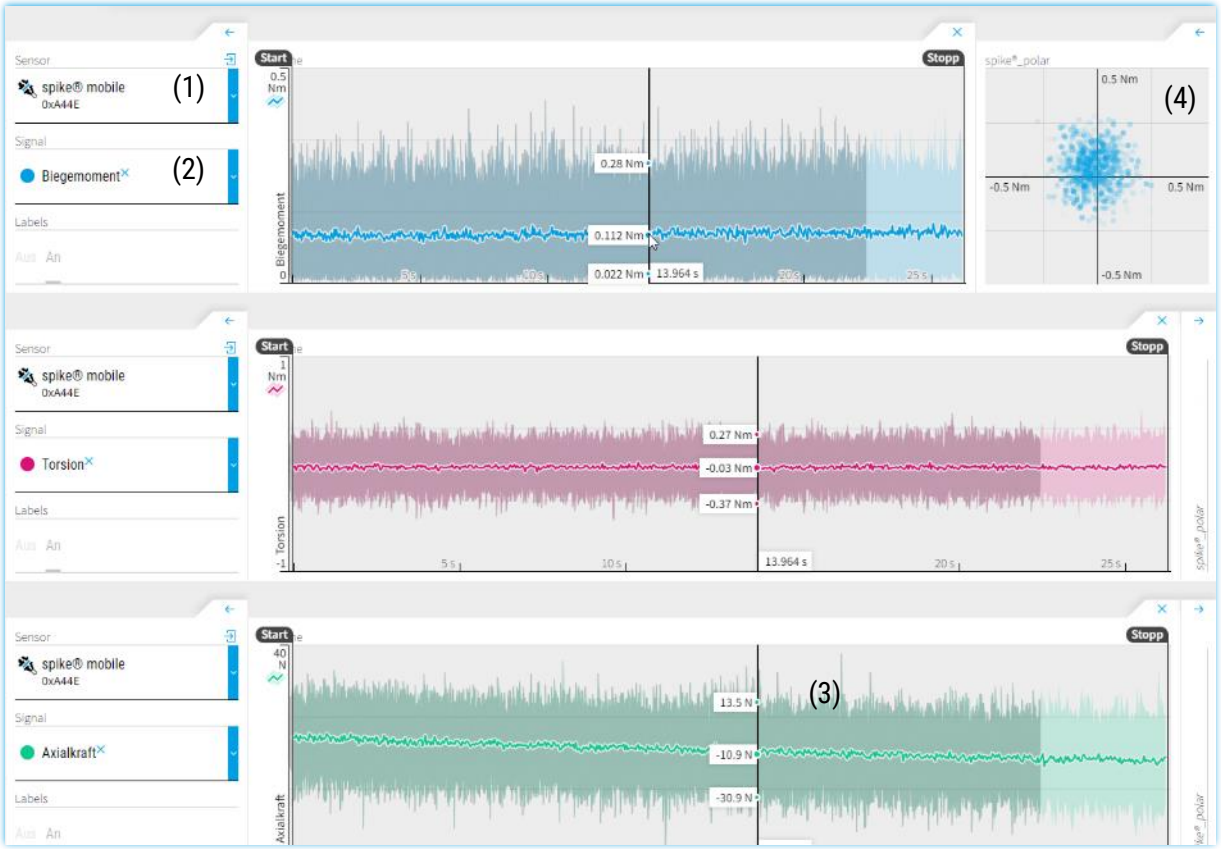


(1) The desired series of measurements is selected using a specific component or filter.

(2) Individual measurements are selected from this series of measurements.

(3) The tool and process parameters of the selected measurement are clearly displayed.

(4) The data stream is displayed clearly or in detail when scrolling further down.



(1) The different sensors with which the measurement was recorded are selected.

(2) The different signals can be displayed selected.

(3) The black line shows the measurement data at a specific point in time.

(4) By clicking on the arrow on the right, the spike®_polar for this selected time can be displayed.

4.4 AUTOMATE A MEASUREMENT

You can select from various recording strategies under Measurements > Automate.

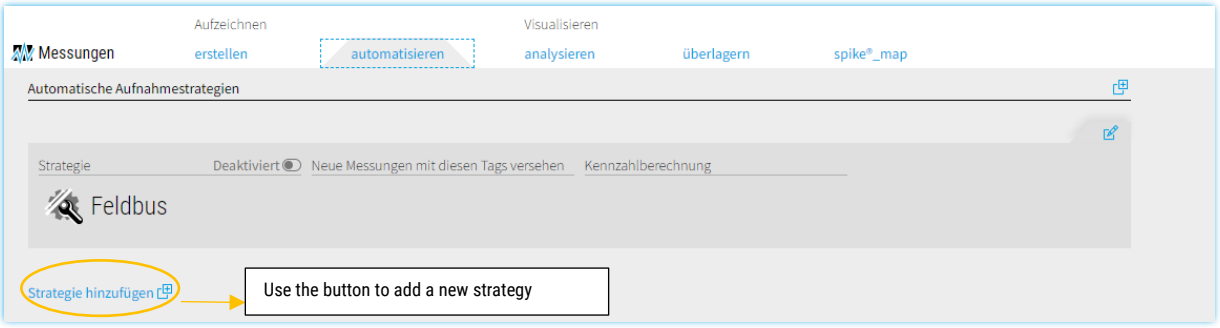
choose between force, NC, M command and fieldbus (M commands sent via Profibus). The parameterization of the respective strategy takes place in the relevant columns. Multiple strategies can be selected for different application areas using “Add strategy”. The settings are applied by saving.

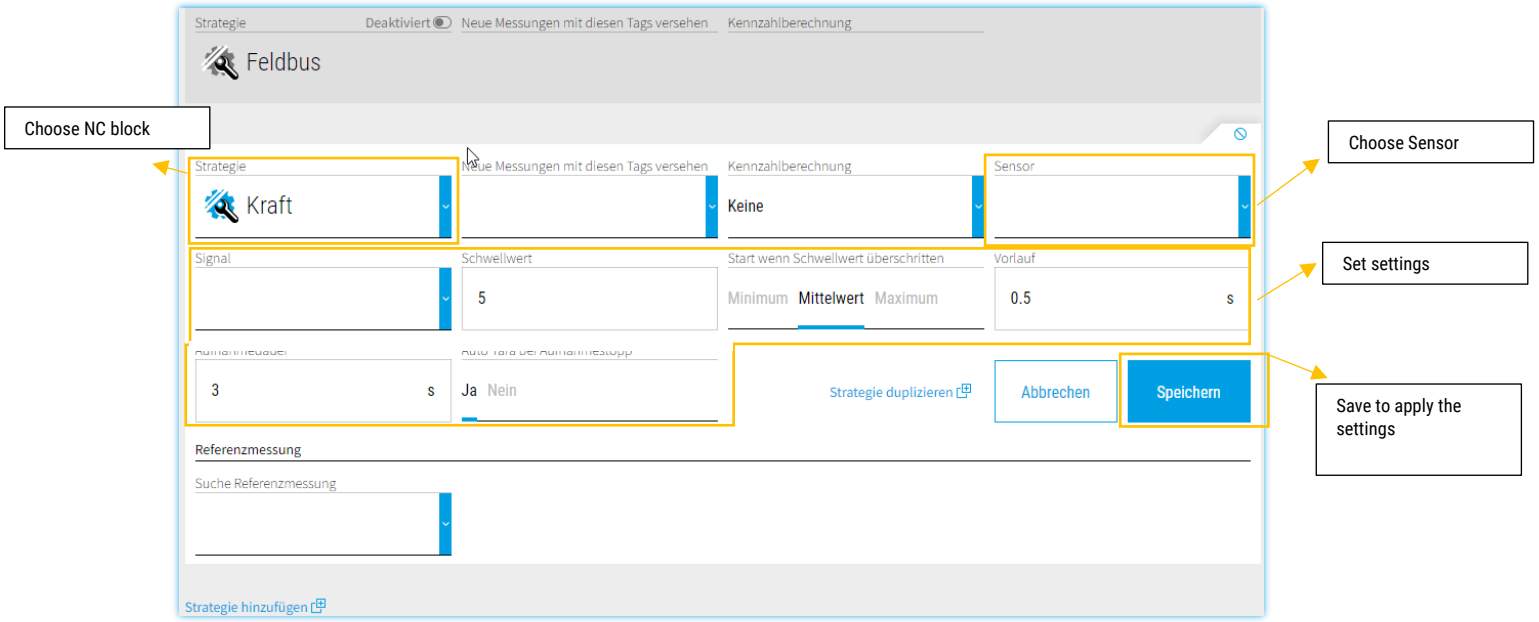
The first recording strategy is defaulted to fieldbus and cannot be changed. Fieldbus communication can be activated by clicking on the virtual switch.

If you want to use a different strategy, you must activate it via “Add strategy”. The fieldbus strategy should be deactivated in this case.

4.4.1 FORCE COMMAND TRIGGER

With a force trigger, a reaction is triggered when a limit value for a physical quantity or force is exceeded. This signal can then be used to start a measurement. The trigger is typically placed at a location where force is to be measured, such as a process step to be monitored. As soon as the predefined force is reached or exceeded, the signal is triggered and the appropriate measures are taken, for example a measurement is started.

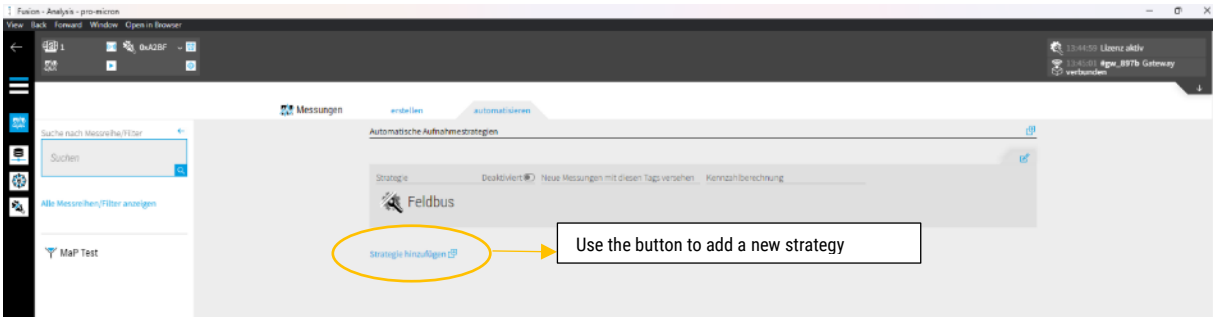


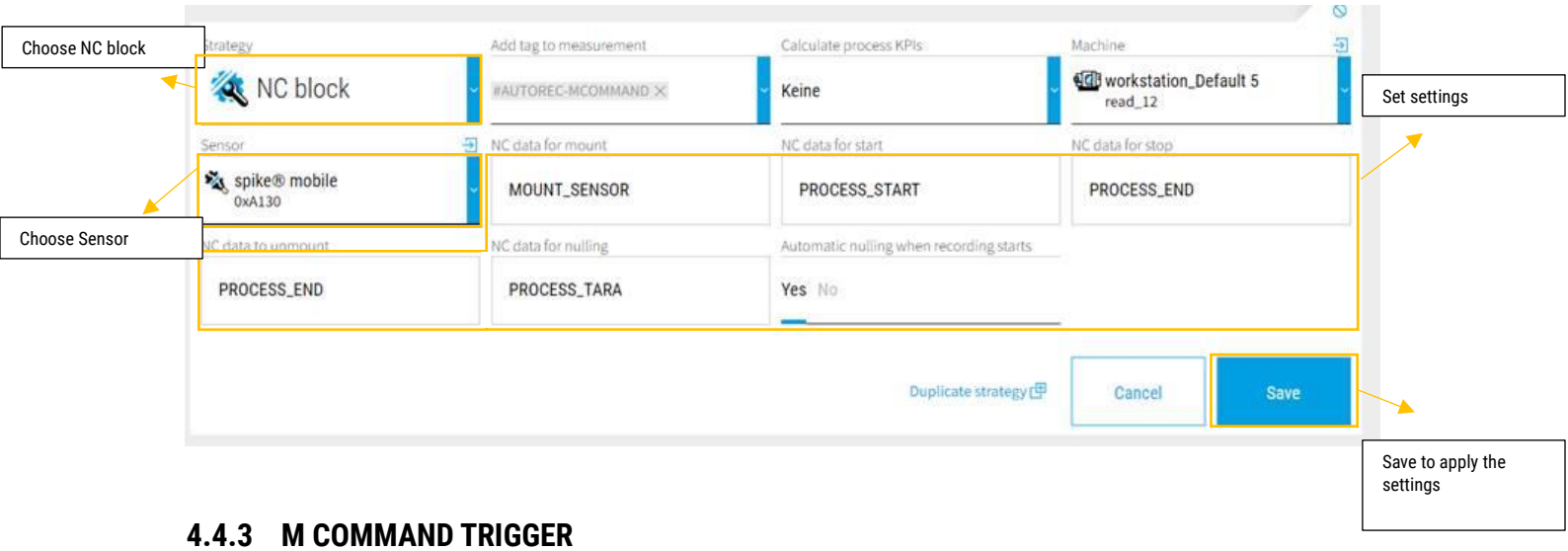


4.4.2 NC BLOCK TRIGGER

An NC set trigger is a mechanism that triggers a signal based on a specific set of numerical control commands (NC set). An NC block contains instructions for controlling the movements and actions of the machine, such as the positioning of the tool or the speed of machining. The trigger is used in the NC block to mark the start or end of a specific section. As soon as the predefined section has been processed, the signal is triggered and the machine carries out the corresponding actions (e.g. tare, wake up, put to sleep, start and stop measurement). In order to automate the system for NC blocks, the pm-connector is required as an interface between Fusion and the machine.

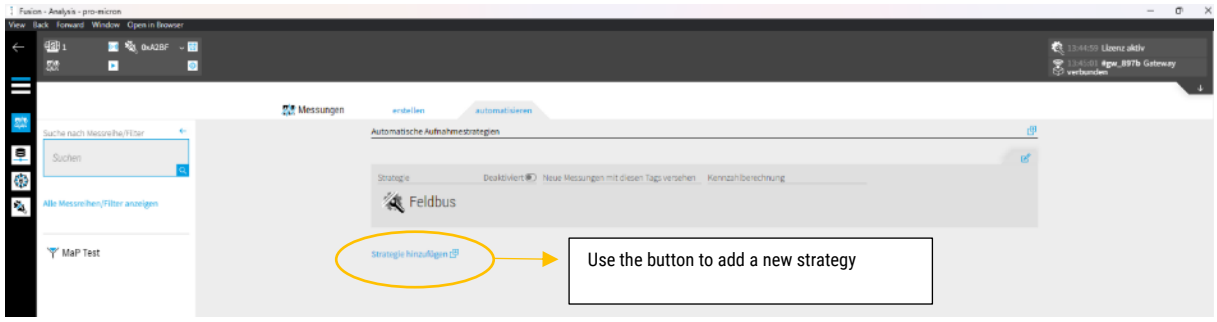
Setup example for Siemens:

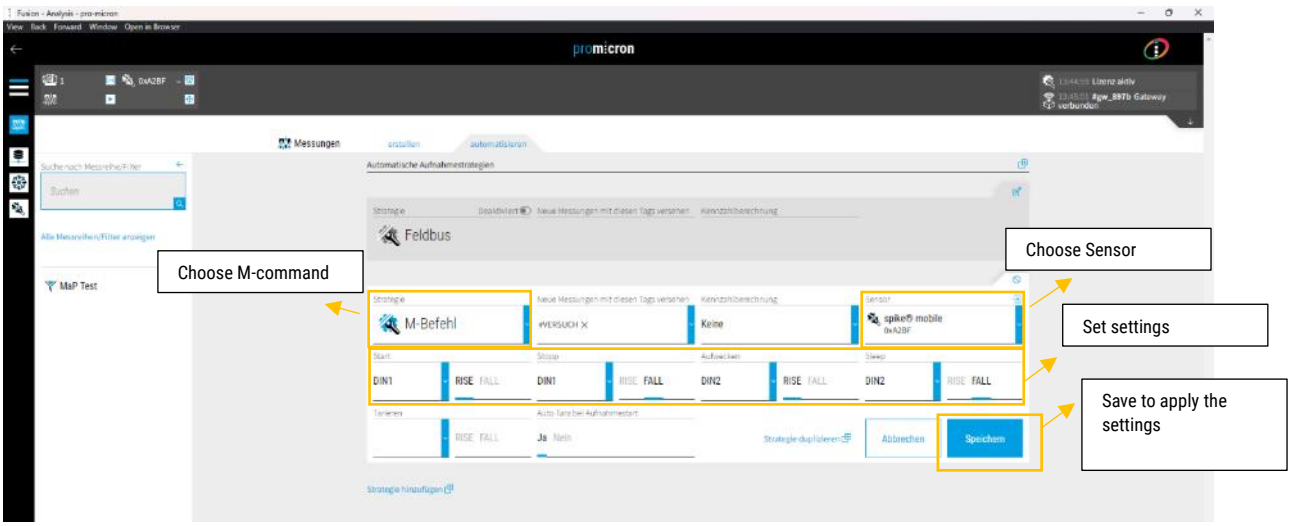




4.4.3 M COMMAND TRIGGER

An M-command trigger is a command used in CNC programming to trigger specific actions on a machine. The letter "M" stands for " Miscellaneous " and is followed by a number that indicates the specific command.



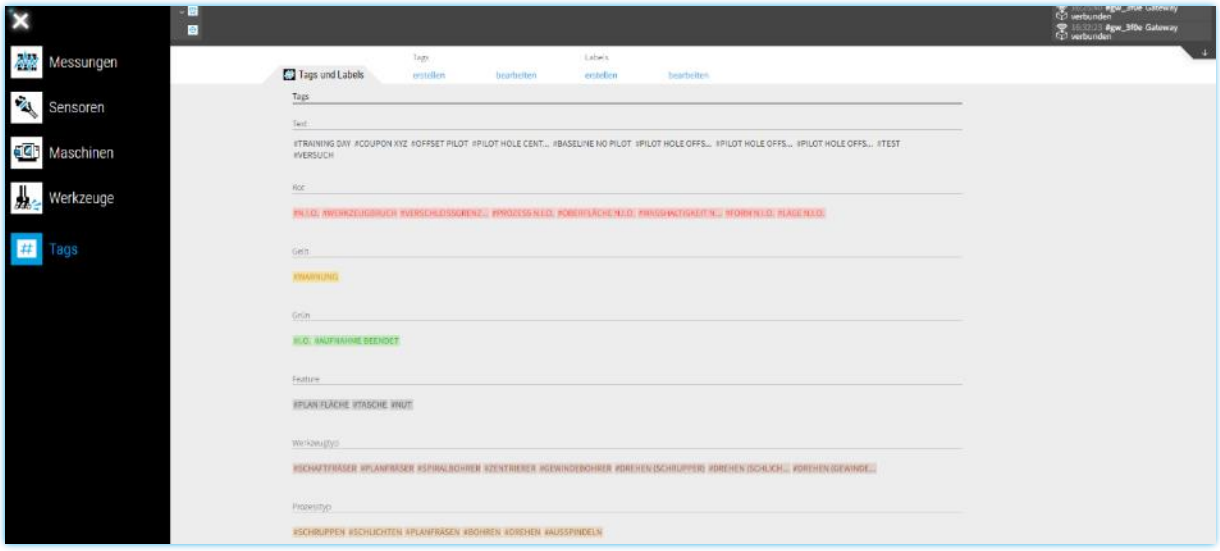


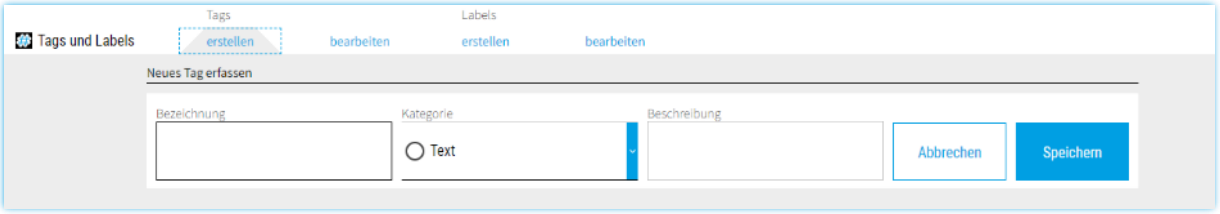
4.4.4 FIELDBUS TRIGGER

A fieldbus trigger is a function used in the control of a machine to trigger communication via a fieldbus. A fieldbus is an industrial data bus that makes it possible to connect various devices and components and exchange data. It is usually inserted into the control program and placed at specific locations where communication via the fieldbus is required.

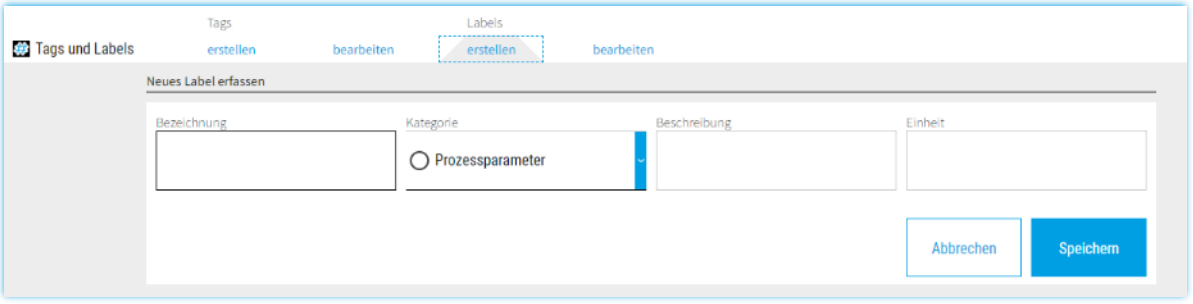
4.5 SET TAGS AND LABELS

Tags and labels simplify traceability and marking of special events in the process. They are suitable as filter parameters for later analyses. Tags are essentially used to add information about the process to the data, such as “test,” “tool break,” or “groove.” Labels provide information about process parameters such as feed speed and cutting depth, as well as downstream quality results (e.g. surface quality and tolerances).





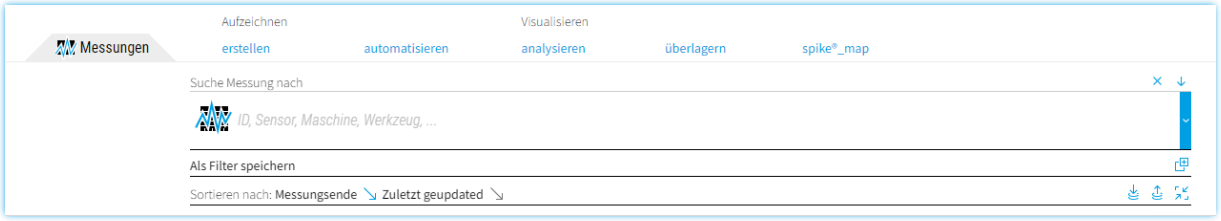
To create a new tag, select Tags > “create” in the bar at the top. Here the name, text color and description of the selected tag can be edited and added to the database by “Save”.



To create a new label, select “Create” in the Labels tab at the top. Now the name, description and category of the label to be created can be selected and the desired unit can be named or stored for the category.

4.6 IMPORT MEASUREMENT DATA

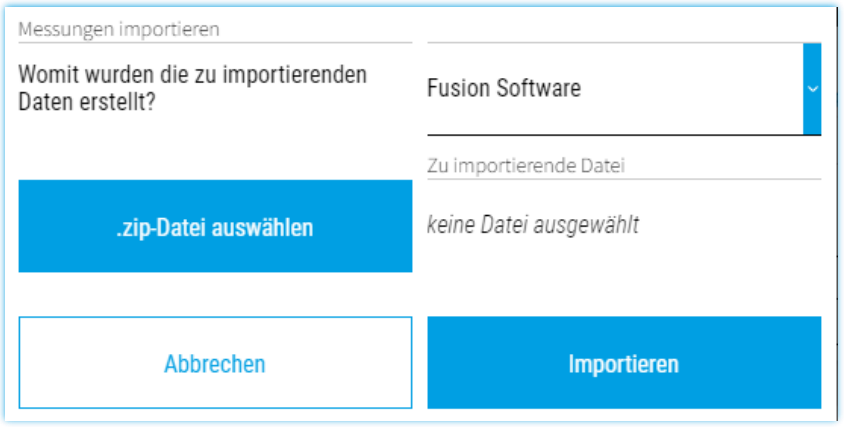
To import measurements, click on the “Measurements” tab:



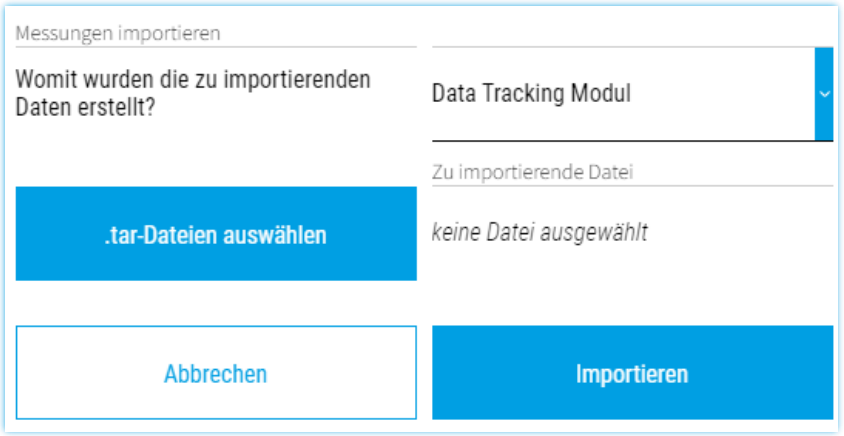
be imported using the database import icon

The following options are available for data transfer:

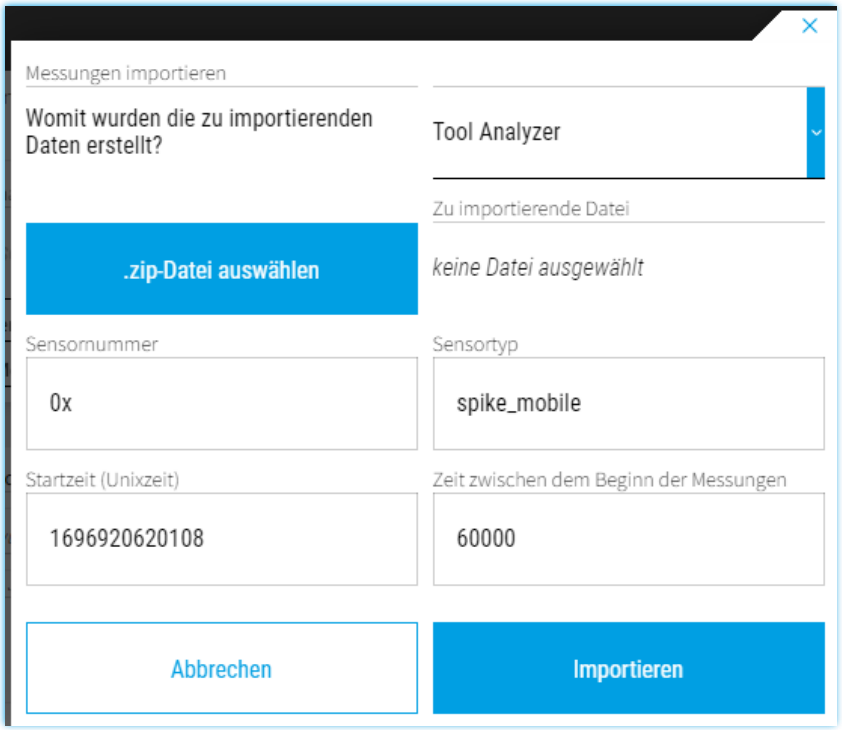
- Measurement data in . zip format recorded with the fusion V1.1 software:



- Measurement data in . tar format recorded with a data tracking module:



- Measurement data in . zip format, which were created with the Analyzer tool:

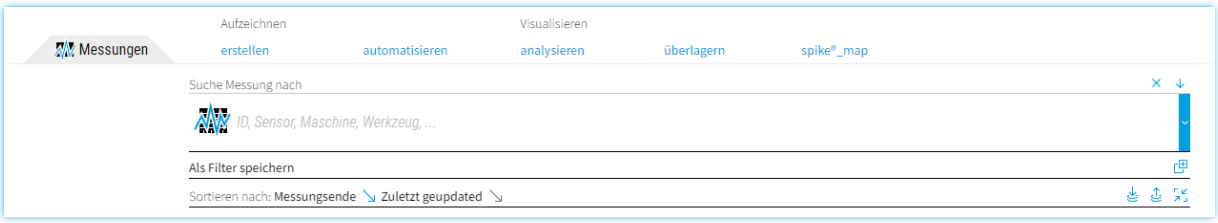


If the desired format is selected and the “Select file” button is clicked, the explorer opens and the desired measurements can be selected in the database. Clicking “Import” starts the import process.

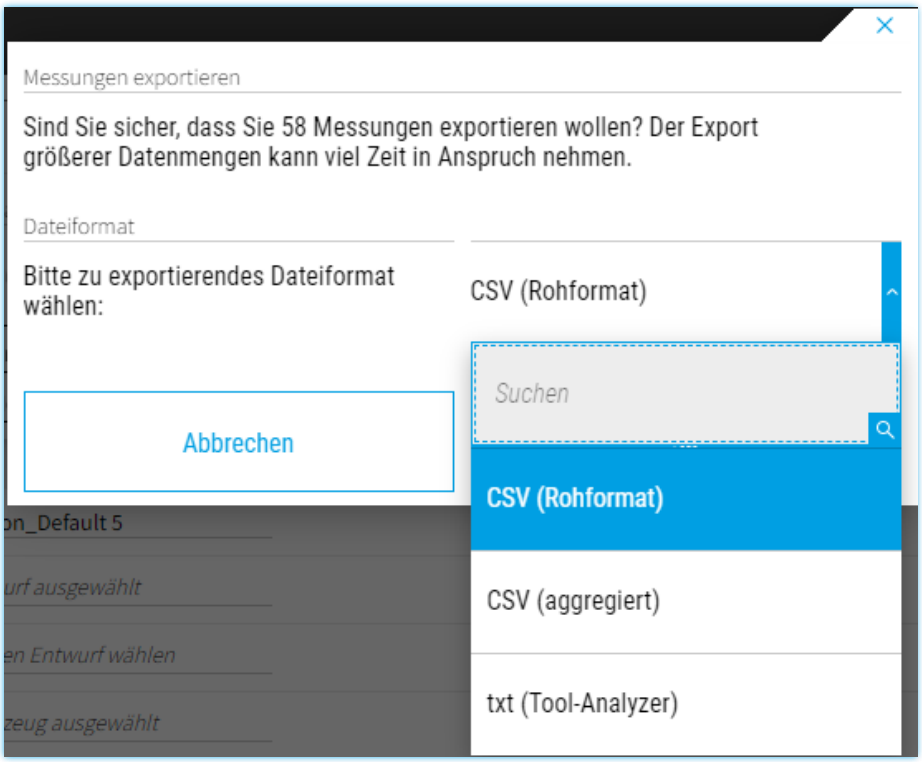
If data was recorded with an early version of fusion and is no longer compatible with the current version, please contact promicron support to convert the data.

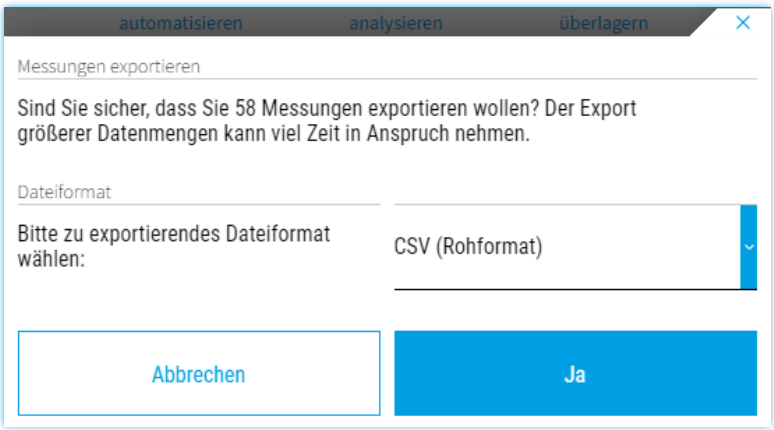
4.7 EXPORT MEASUREMENT DATA

To export measurement data, select the “Measurements” tab:



By clicking on the data export icon, a window opens in which you can select the file format with which the data should be exported. The data can be saved as . csv (raw format or aggregated) as well as . txt (for Tool Analyzer).





After selecting the file format, confirm the process with “Yes” and the export starts.

4.8 SPIKE®_MAP

To efficiently manage large amounts of raw data, tools for automatic storage, sorting, labeling, synchronization and validation are necessary.

fusion software, the data is prepared so that it can be efficiently interpreted and correlated without any further manual effort.

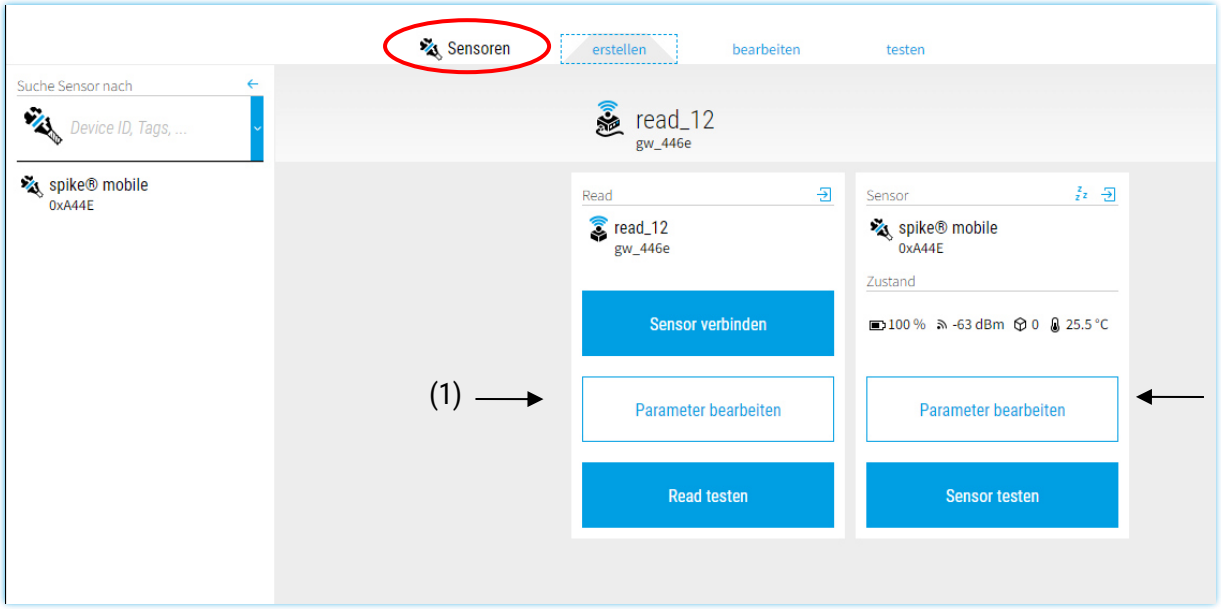
This process data is also suitable for creating a digital twin.

The machine data is transferred to the software via an interface and recorded there. A model of the workpiece can be generated from the position information and the individual forces can be displayed for each individual point. The NC code can be displayed for each of these points.

Further analysis functions include the “ fusion analysis” software, which is used to evaluate large amounts of data without a measuring system.

5 PARAMETERS AND SELF-TEST SEE

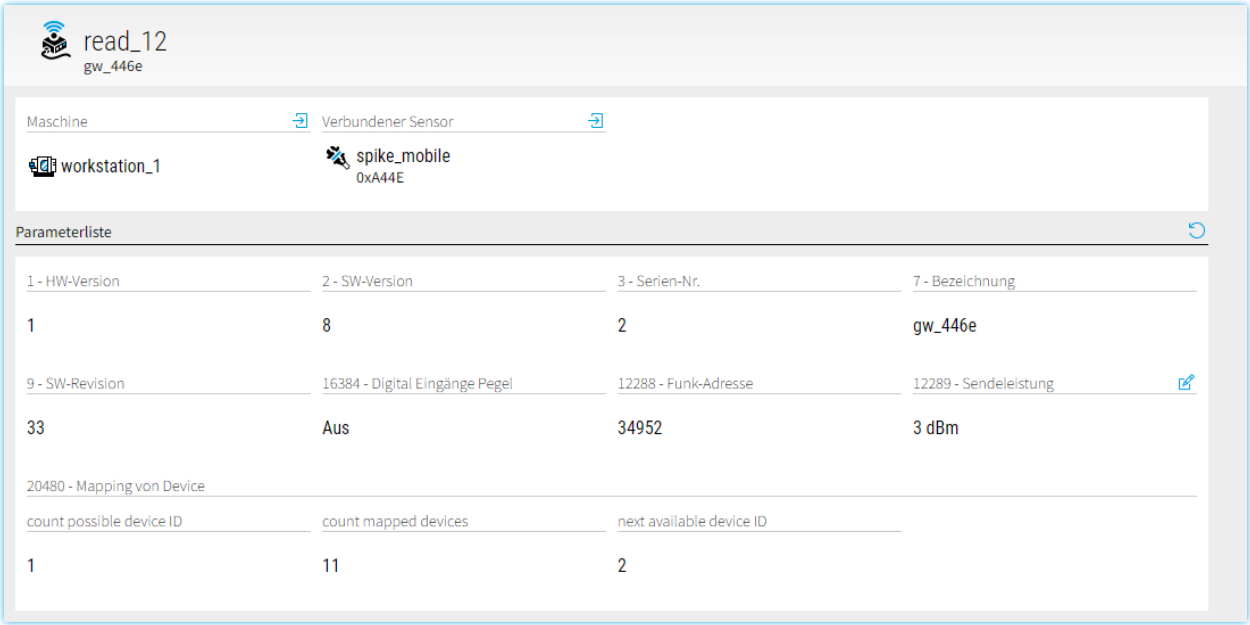
5.1 SETTING SPECIFIC PARAMETERS WITH SPIKE® MOBILE



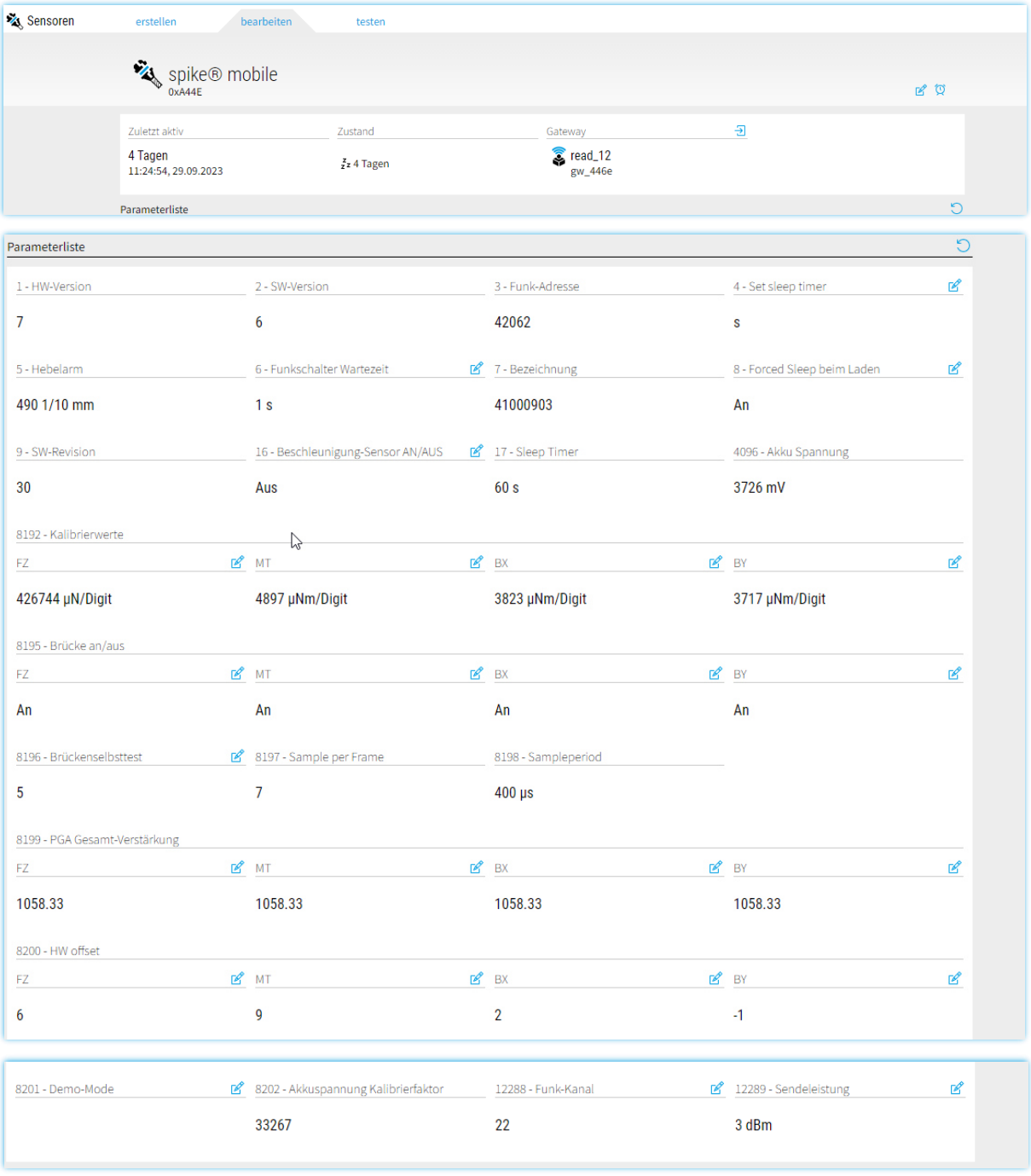
(1) To edit the recipient (Read), click Read > “Edit Parameters”.

(2) To edit the sensor, click Sensor > “Edit Parameters”.

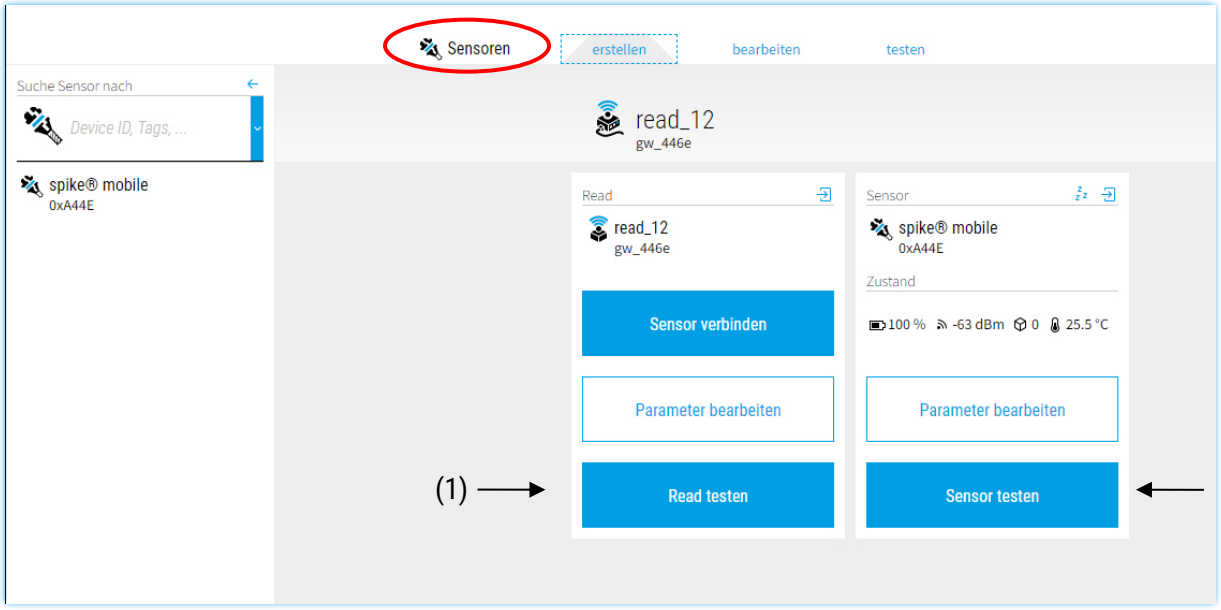
Parameter list for the read:



Parameter list for the spike®mobile :



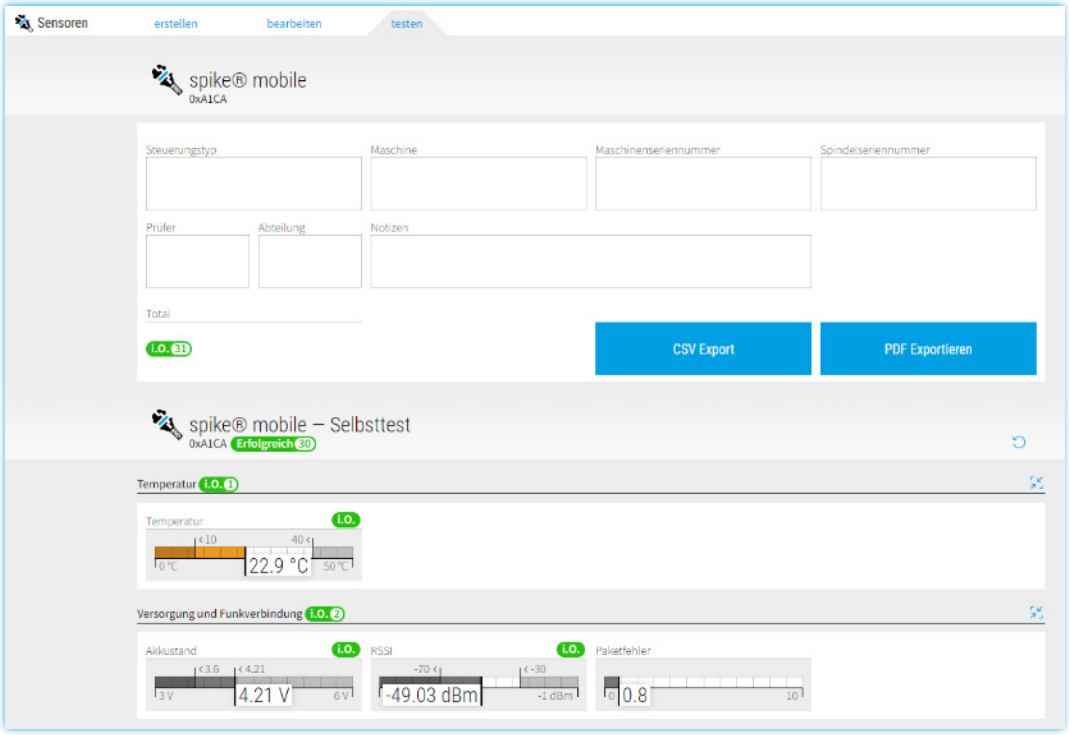
5.2 SELF-TEST WITH SPIKE® MOBILE

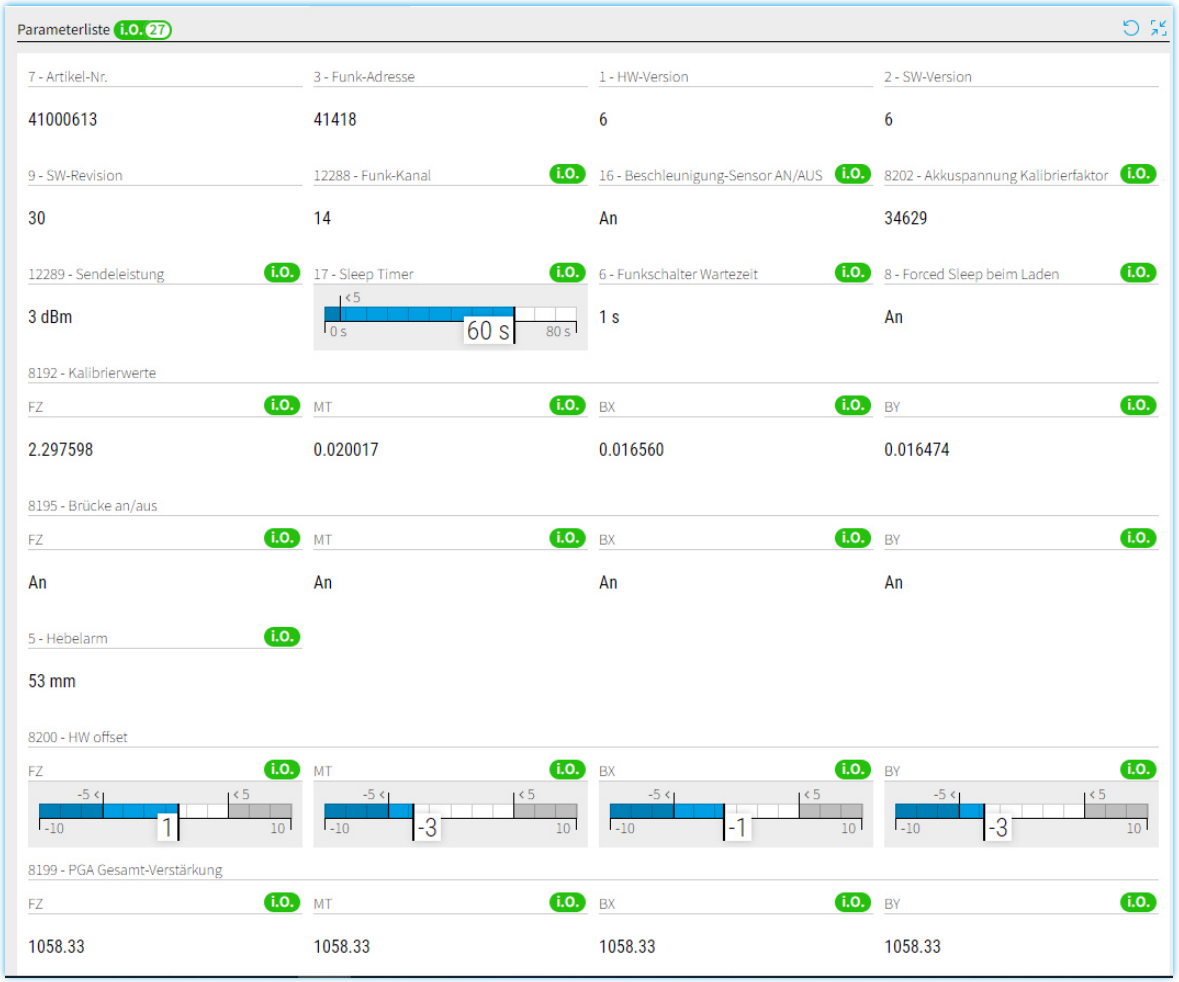


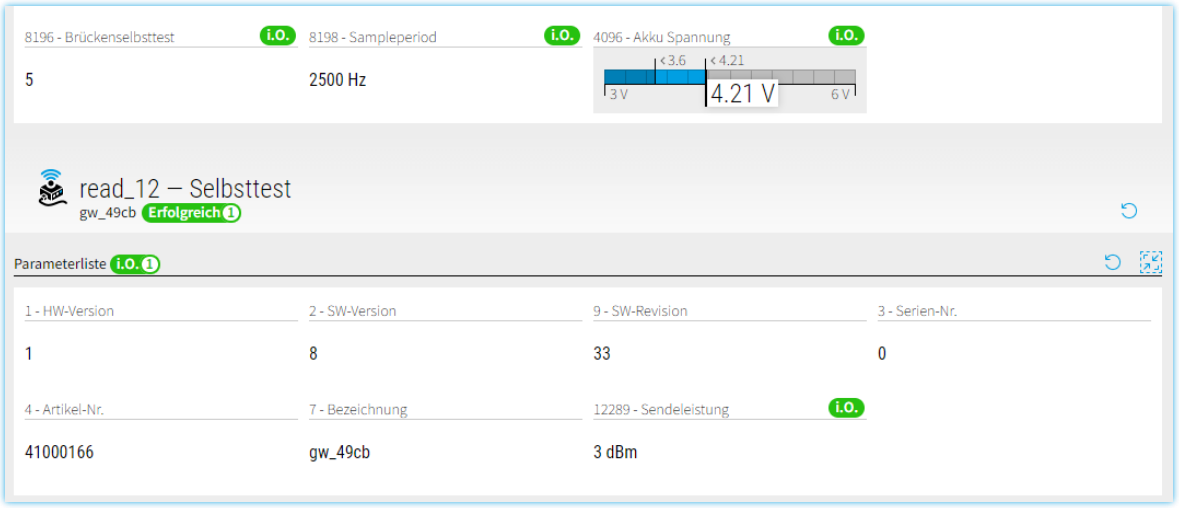
(1) To test the receiver, click on “Test Read” (self-test)

(2) To test the sensor, click on “Test Sensor” (self-test)

By clicking one of the two buttons, a self-test of the selected system is carried out and the result is displayed. It is recommended to add optional information about the entire system before saving. The result of the self-test can be saved in a file in . csv or . txt format (“ CSV Export ” or “PDF Export”) can be output and saved.

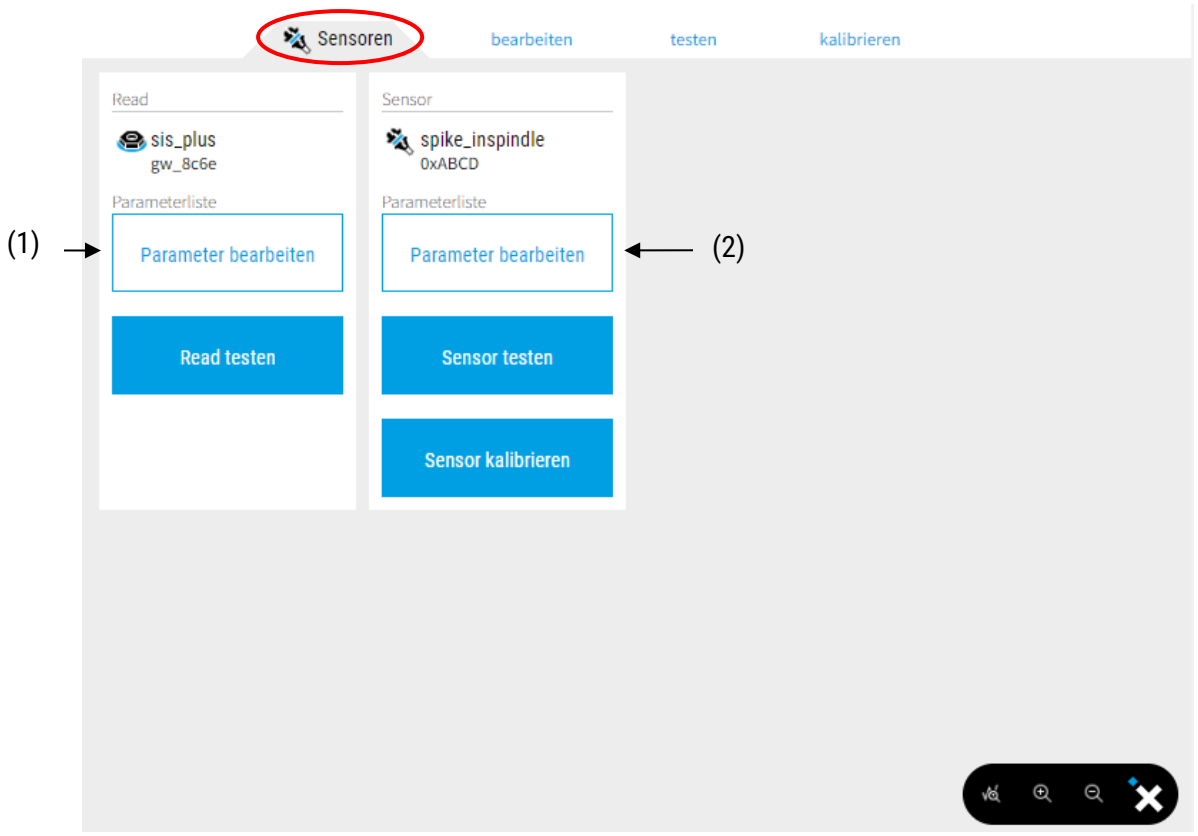






Since a sensor self-test always requires a receiving device, both the sensor and the receiving unit are checked during a sensor self-test.

5.3 SETTING SPECIFIC PARAMETERS WITH INSPINDLE



(1) To edit the recipient (Read), click on “Edit parameters”.

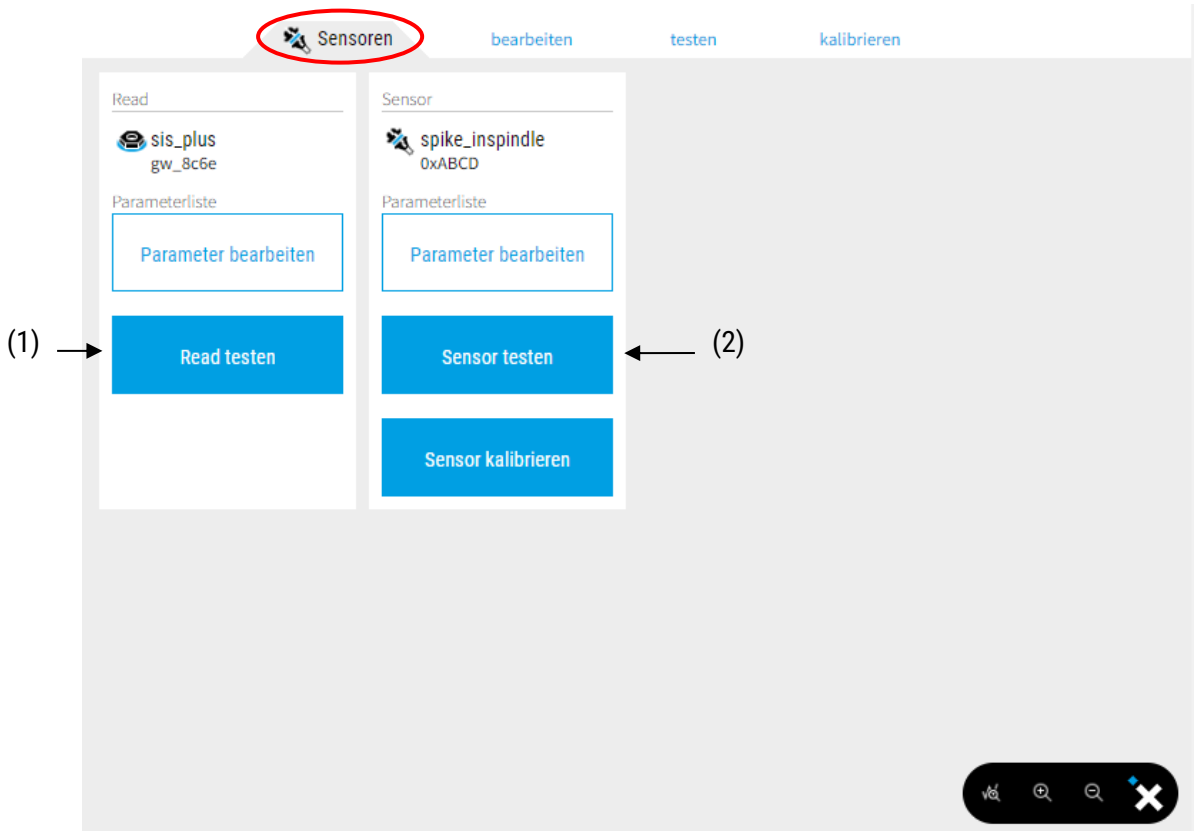
(2) To edit the sensor, click on “Edit parameters”.

5.4 SELF-TEST WITH INSPINDLE

It is recommended that verification and calibration of an InSpindle system be performed sequentially .

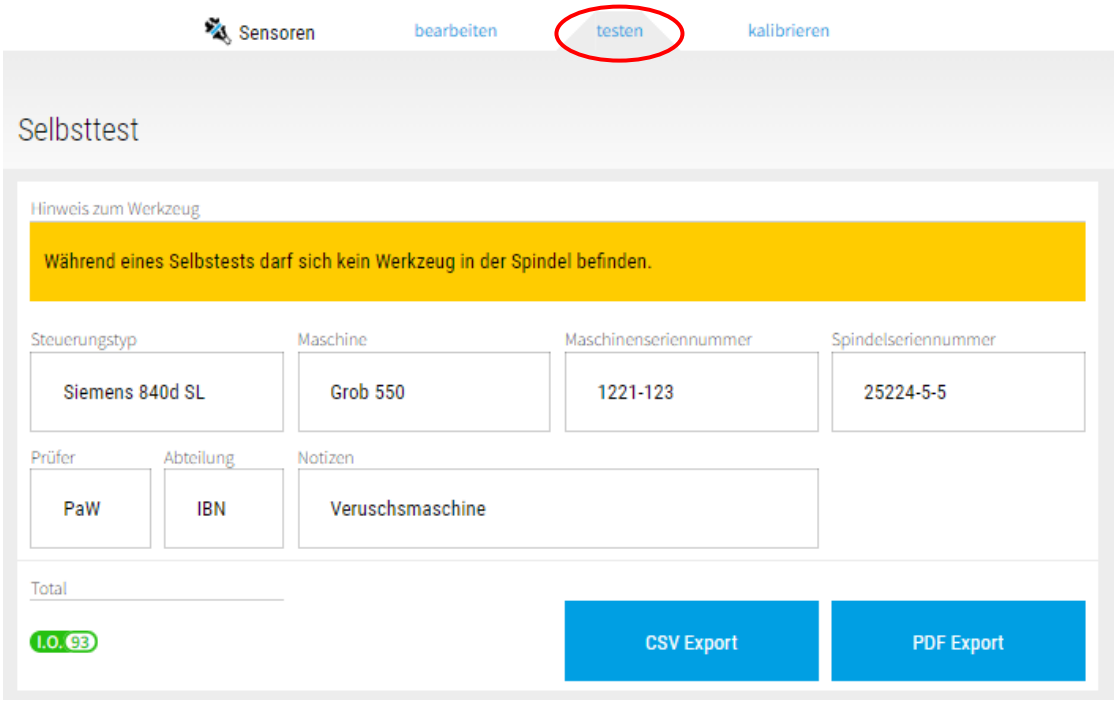
- Self-test **:** for basic checking of the system and its parameters
- Chip in spindle: for teaching in a defined error chip using error tools
- Pull-in force: for calibrating the pull-in force using an external tool
- Process force and overload: for calibrating the process force
- Temperature compensation: for calculating system-specific coefficients for temperature compensation

5.4.1 CARRY OUT SELF-TEST



(1) To test the read, click “Test Read”.

(2) To test the sensor, click “Test Sensor”.

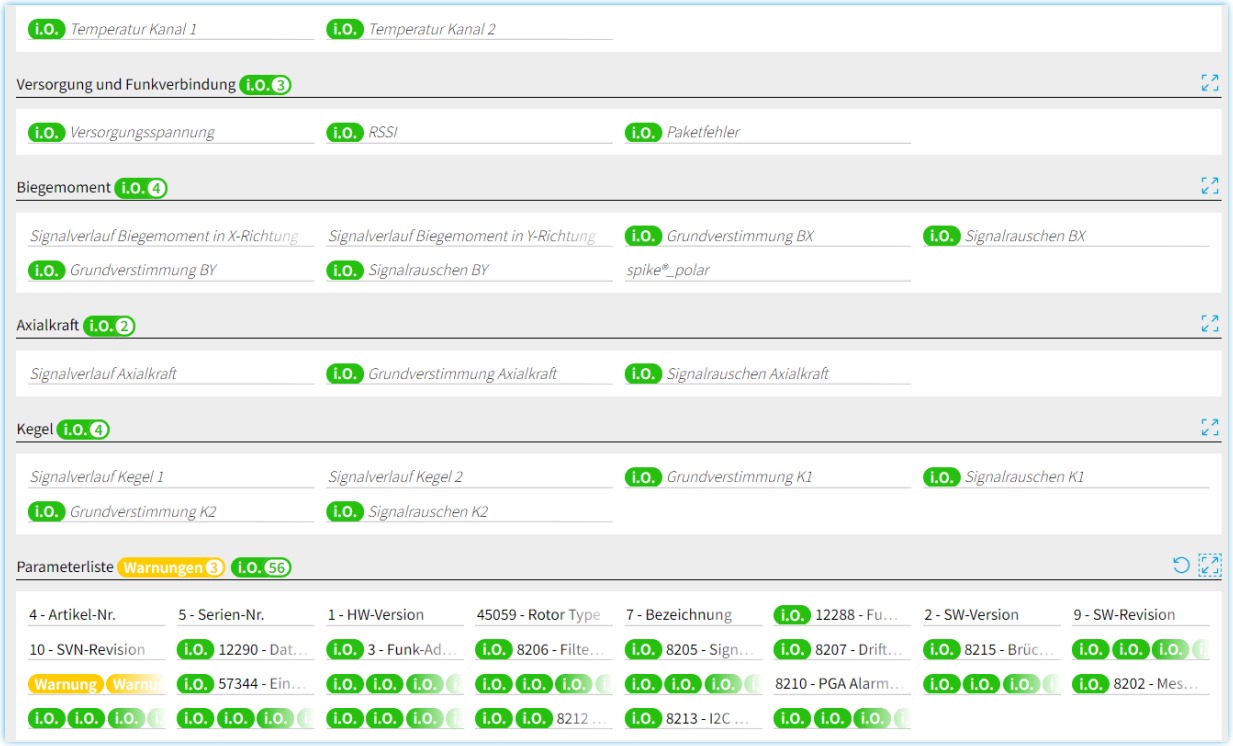


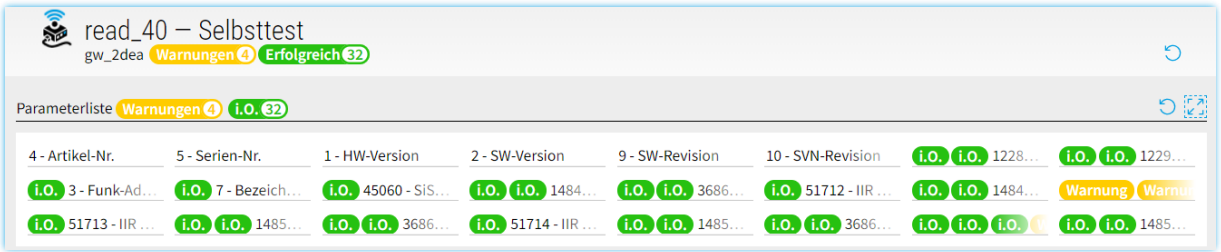
To carry out the self-test correctly and to avoid damage, there must be no tools in the spindle. It is again recommended to add optional information about the entire system before saving.

The self-test can be done either in . csv format or in . saved in PDF format .

“Total” shows how many values are OK (IO up to 93); when scrolling, the self-test is listed.

A warning Warnung is given if a value deviates from the default value. If a value or parameter is rated as “ not OK , ” n.i.O. a calibration must be carried out.

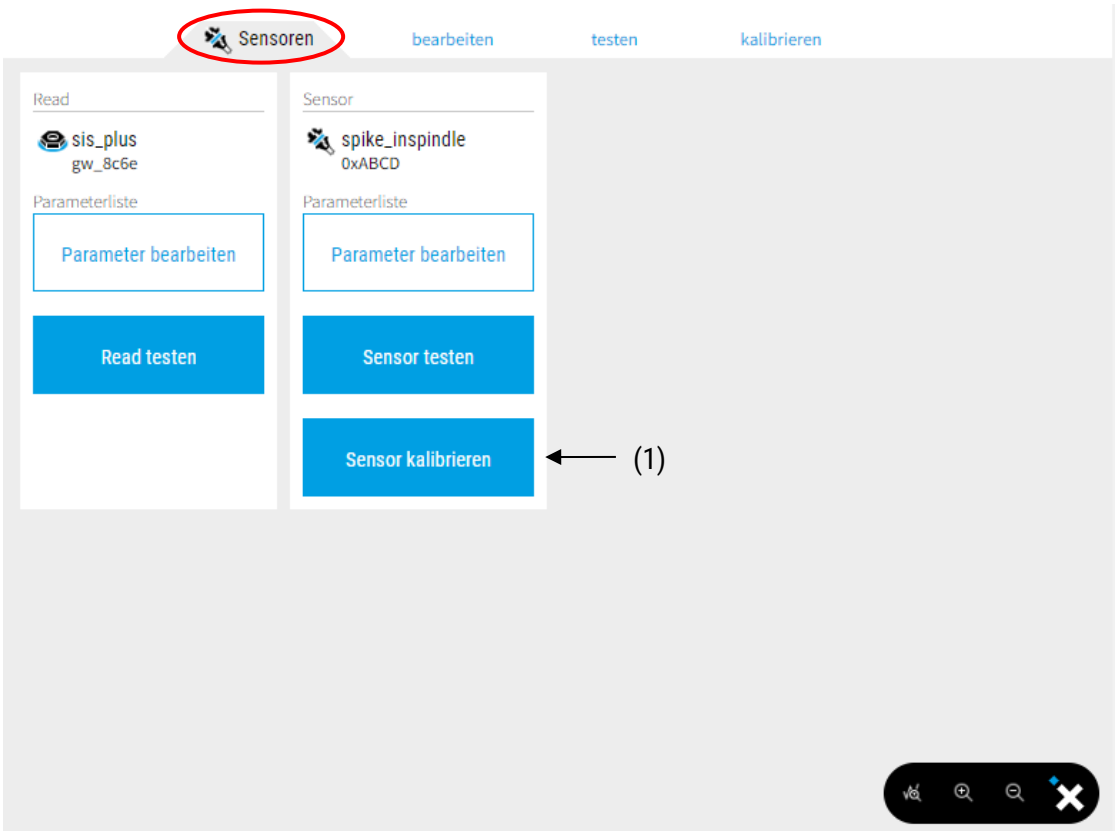




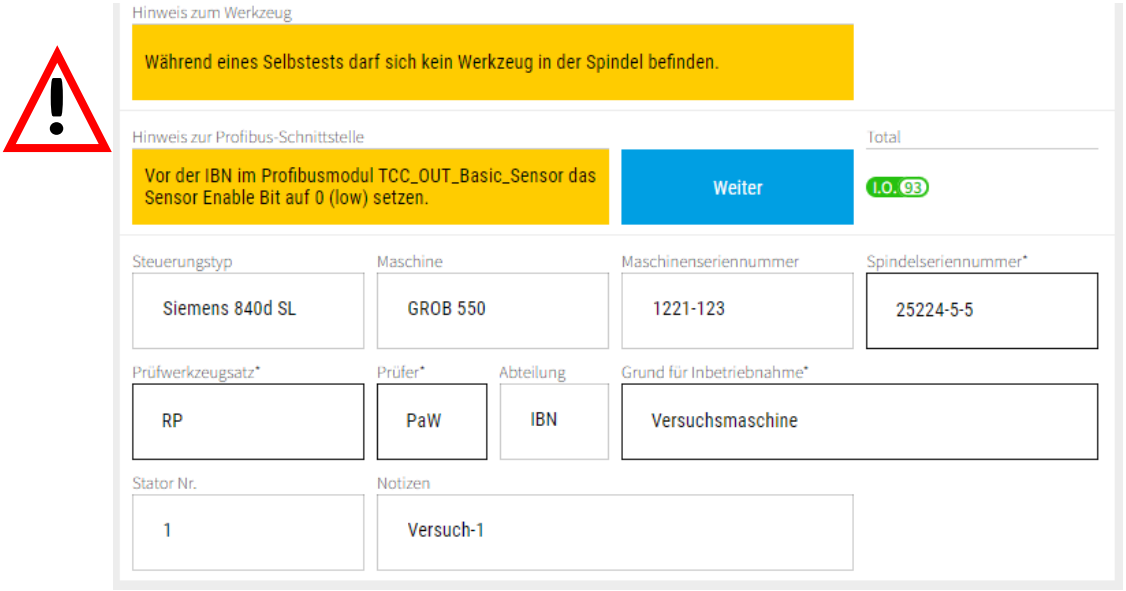
By expanding the individual columns, the individual test steps can be viewed in more detail.

The detailed consideration of the bending moment provides, for example, information on the signal curve of the bending moment, the basic detuning and the signal noise, each differentiated according to the x and y axes. The recommended value range is visible.

5.4.2 CALIBRATING THE INSPINDLE



(1) To calibrate the sensor, click on “Calibrate Sensor” or select Sensors > “Calibrate” from the menu



The “calibrate” tab is password protected and only accessible to authorized personnel.

As part of the calibration, a self-test is carried out again. The message therefore appears repeatedly that no tool may be clamped in the spindle. In addition, a parameter for the calibration period must be changed via the Profibus interface.

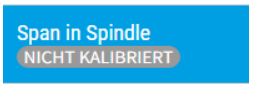
“Total” shows how many variables and parameters were classified as correct or suitable during the self-test.

For sustainable documentation, we recommend manually inserting additional information (example illustration). The fields marked with a * are mandatory and must be filled out.

The result of the self-test is listed below the input mask.

After completing the self-test, you can click on “Next”. The green “IO” symbol will then appear in the menu on the left.

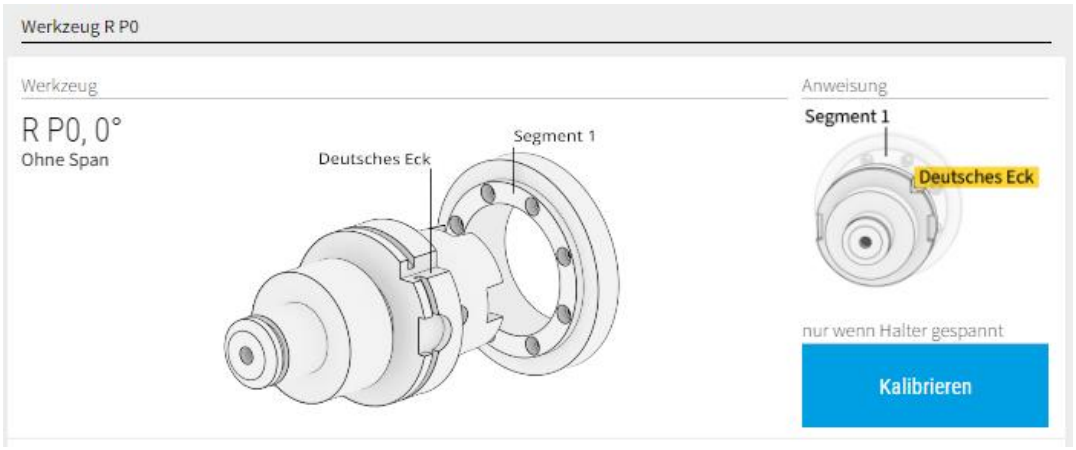
5.4.3 CHIP IN LOCKERS L



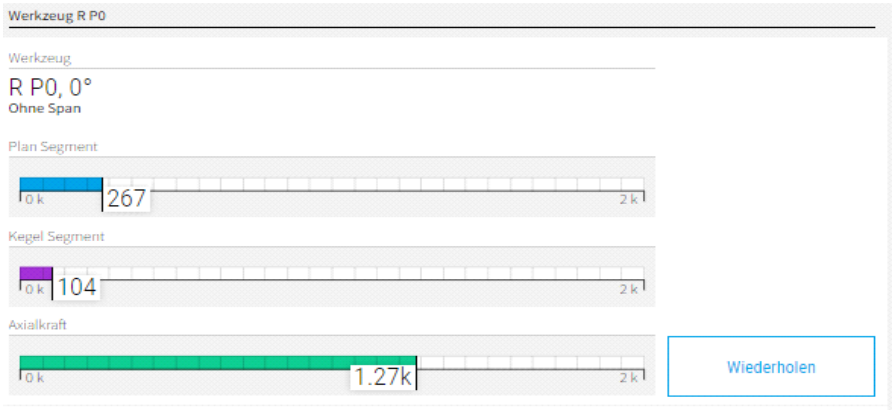
After calibrating the spike_InSpindle, the Span in Spindle function is calibrated. The button must be selected for this.

To calibrate the chip in spindle functionality, the error chip calibration tool set with the reference tool **RP0** and the error chip calibration tools **P S0 10** , **P S1 10** , **R S0 30** and **R S2 30 is** required.

The holder must be loosened and secured from falling. Then click on “Tare”.



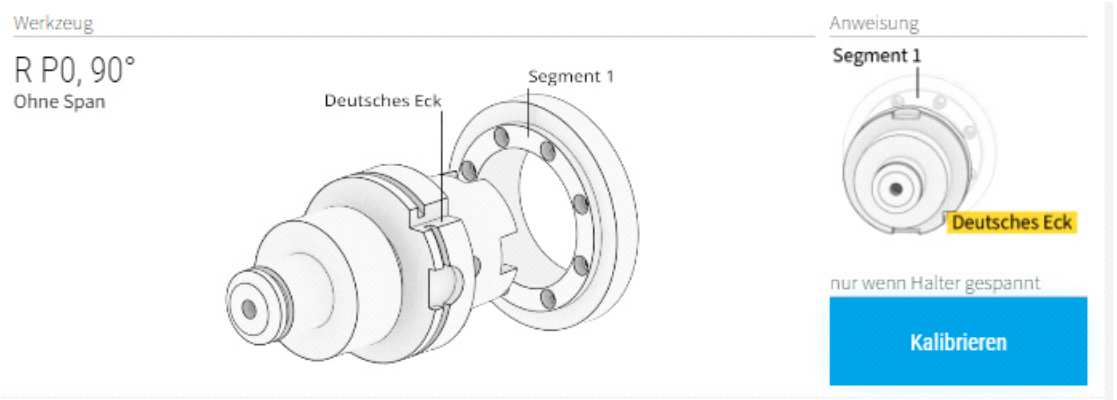
After the holder has been loosened, the **RP0** tool is used. The **RP0** tool is inserted manually into the motor spindle as shown. Please note that the "German corner" (notch in the tool) is to the right of segment 1, corresponding to **position 0°** . The tool is clamped by the machine, then click on "Calibrate".



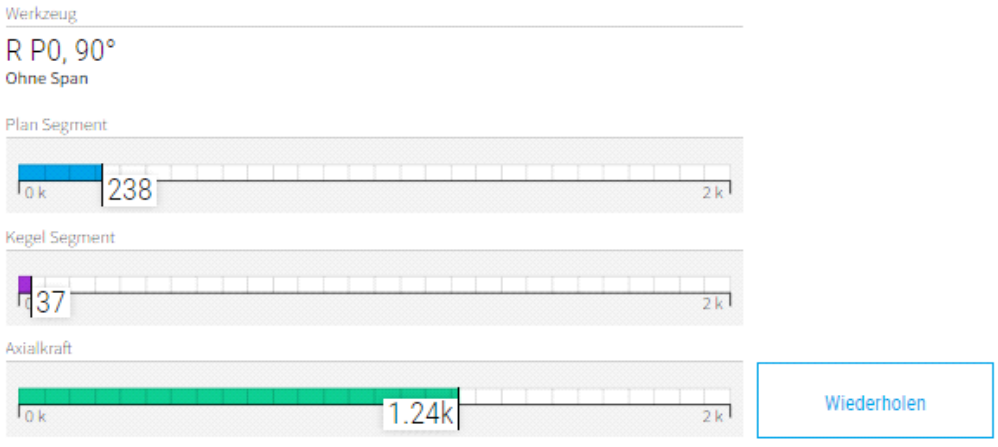
The following values should be displayed at all positions with the **RP0 tool:**

Plan segments: < 0.4k
Cone segments: < 0.2k
Axial force: > 0.9k

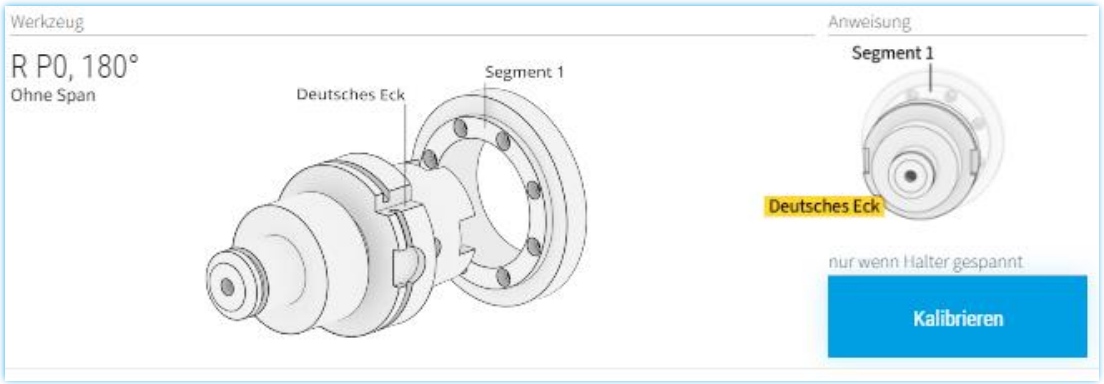
If one of these values or several values are outside the recommended range, the tool must be removed and cleaned manually. The calibration must then be repeated.



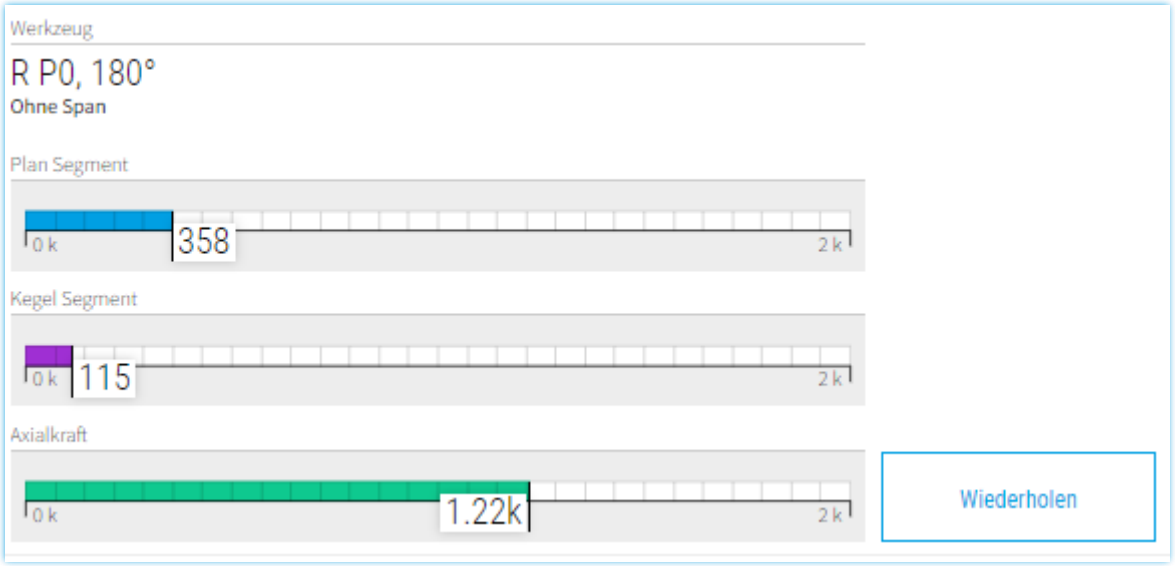
After calibrating to position 0°, the tool is rotated clockwise to **position 90° as instructed** . Once the tool has been rotated 90° as shown on the right, it can be inserted and clamped again. Then click on “Calibrate”.



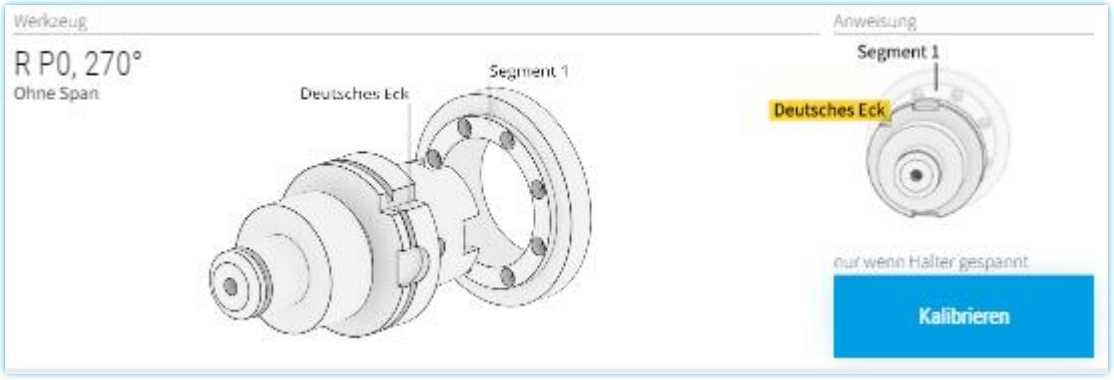
When calibration is completed at position 90°, the tool can be rotated another 90° to **position 180°** .



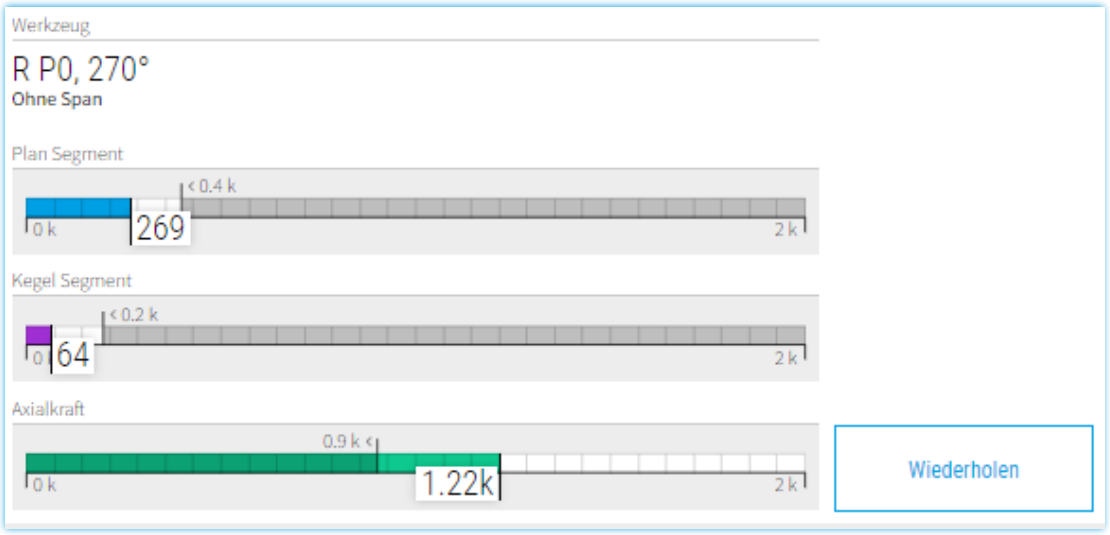
The “Deutsches Eck” is now opposite Segment 1, as shown in the instructions on the right. After the tool is plugged in and clamped, click “Calibrate”.



The last step is to rotate the tool again 90° clockwise to **position 270°** .



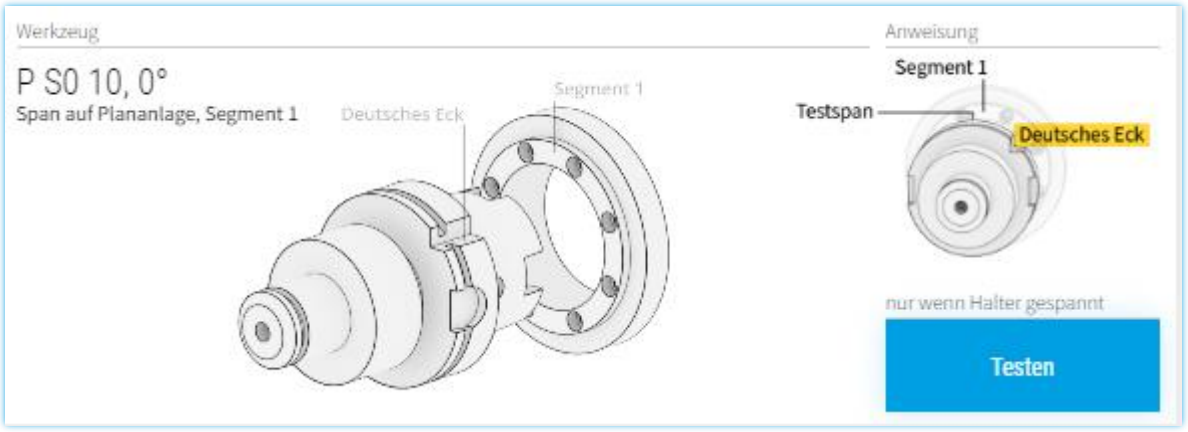
The “German Corner” is now to the left of Segment 1, see instructions on the right. After the tool is clamped, “Calibrate” is selected.



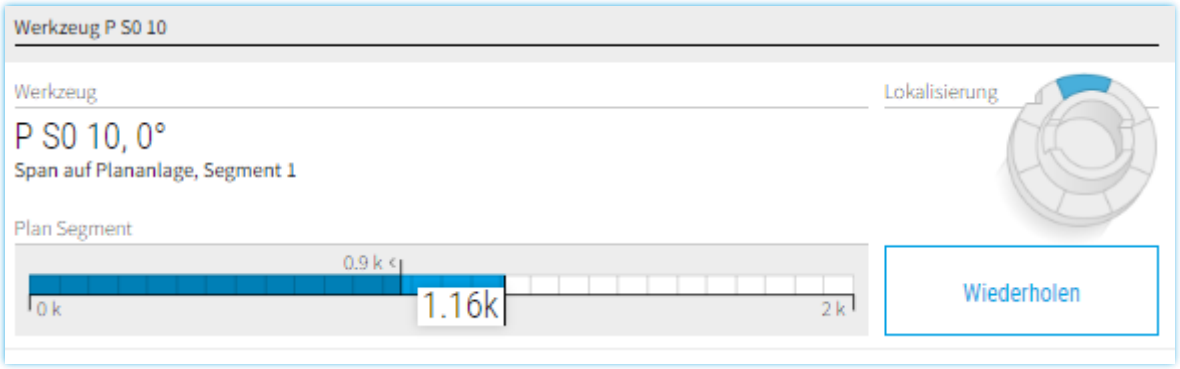
The measurements with the **RP0** tool form the reference value for the following steps.

The error chip tools are then used to check whether the spike_InSpindle reliably detects the error chip.
With the tools **P S0 10** and **P S1 10,** a defined 10 µ error chip is specified on the planar system. The position of the error chip in the two tools differs by 45° in relation to the four driving grooves.
With the tools **R S0 30** and **R S1 30,** a defined 30 µ error chip is specified on the conical surface. The position of the error chip in the two tools differs by 45° in relation to the four driving grooves.

P S0 10
The process is analogous to calibrating with the **RP0** tool. The tool must be inserted according to the instructions and then clamped, whereby the positioning of segment 1 and the test chip (alternatively "German corner") must be strictly observed. Then click on "Test".



The software shows at which position a chip was detected. If the position and size of the measured value match, the test is successful.



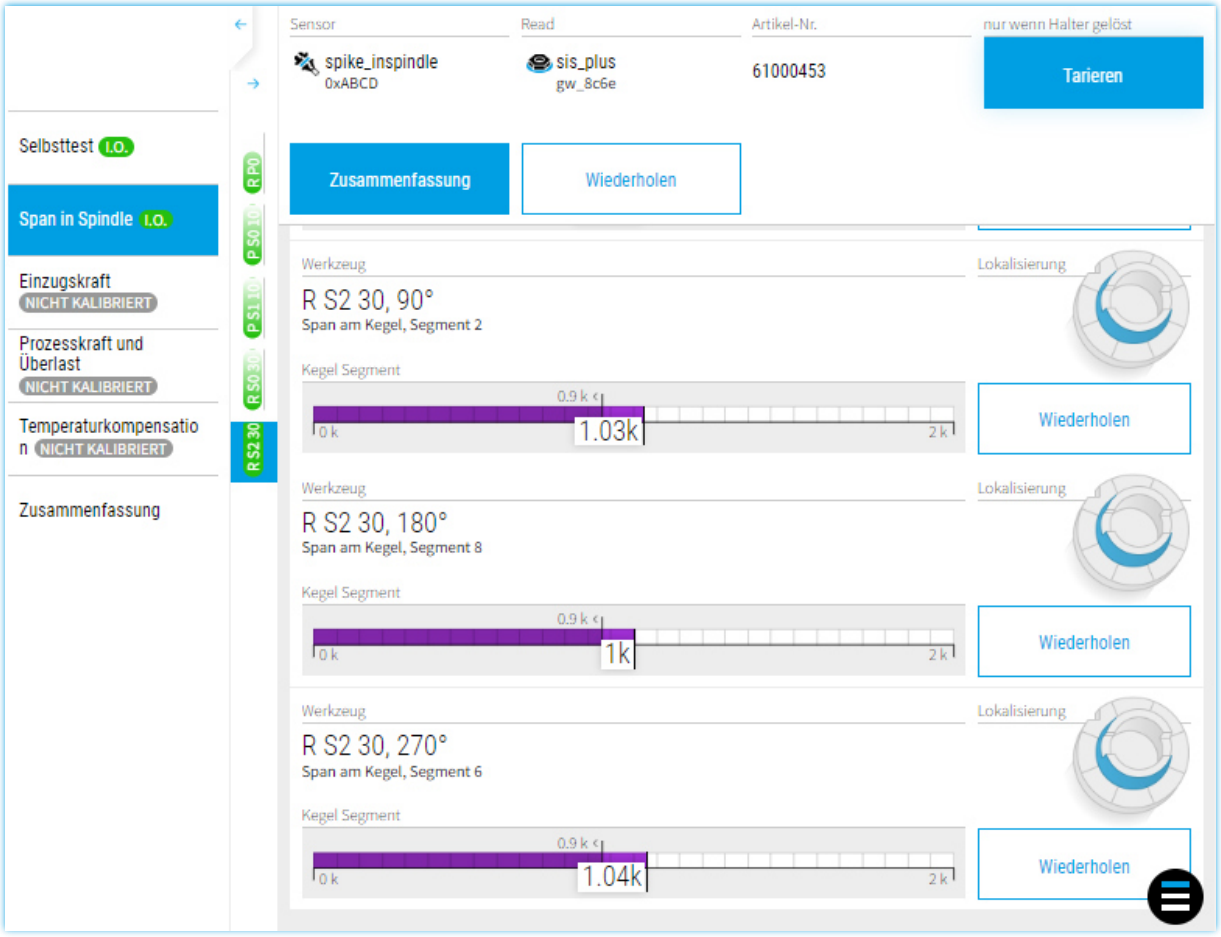
A chip on the plan system must have a value greater than 0.9k for the test chip to be recognized. If the value is less than 0.9k, the tool must be removed and the test repeated.

This process must be carried out equally for the positions 90°, 180° and 270°.

P S1 10, R S0 30, R S2 30
The steps of **P S0 10** are repeated identically with the tools **P S1 10** , **R S0 30** and **R S2 30** .

(1) →

(2) →

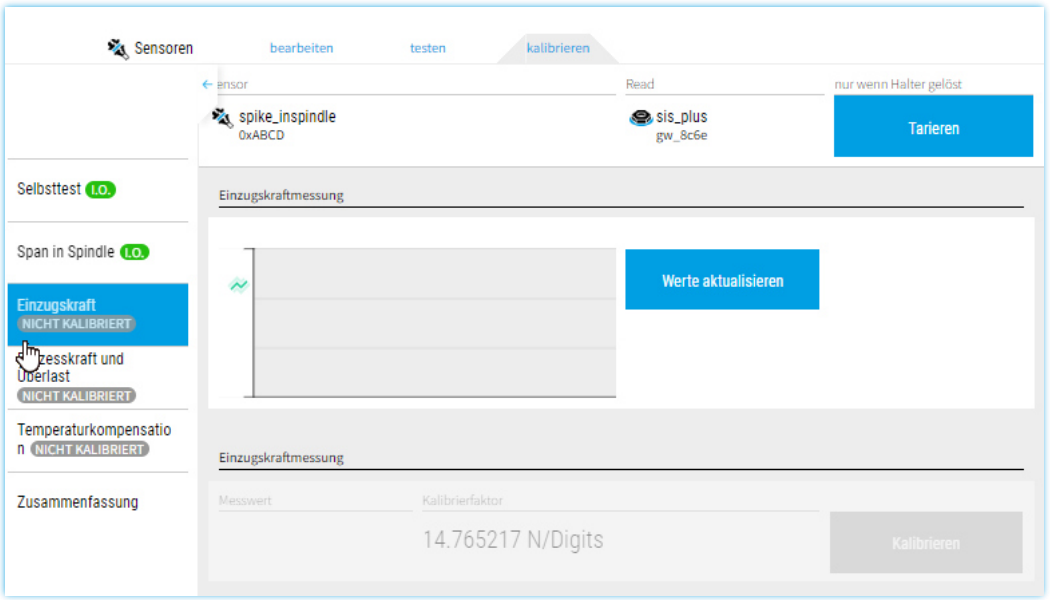


(1) After calibration with the RP0 tool and the test with the four error chipping tools, a green “IO” symbol appears in the “Chip in Spindle” tab.

(2) The pull-in force measurement is then calibrated. To do this, click on “Pull-in force”.

5.4.4 PULL-IN FORCE

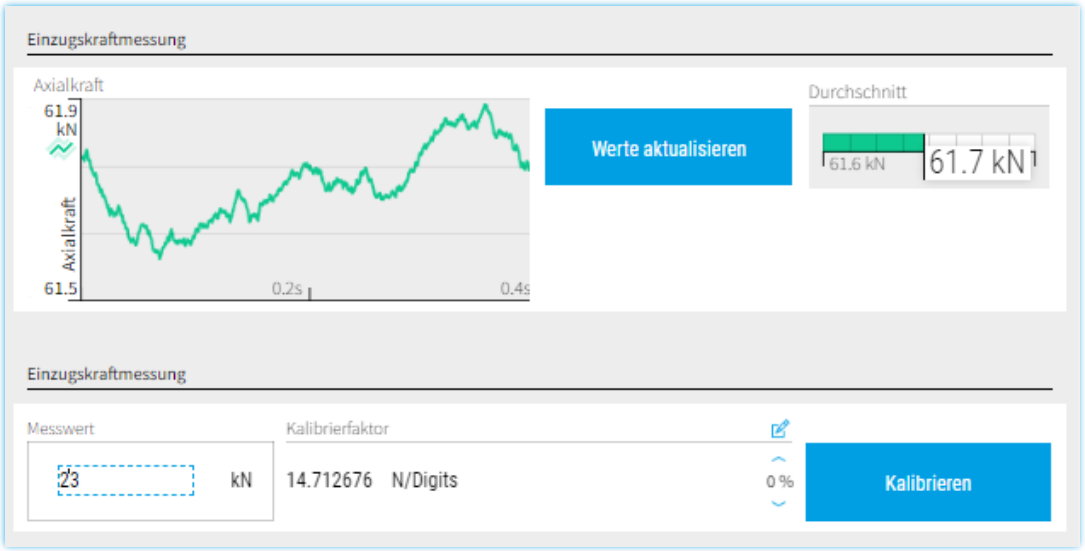
An external measuring device is required to measure and calibrate the pull-in force.



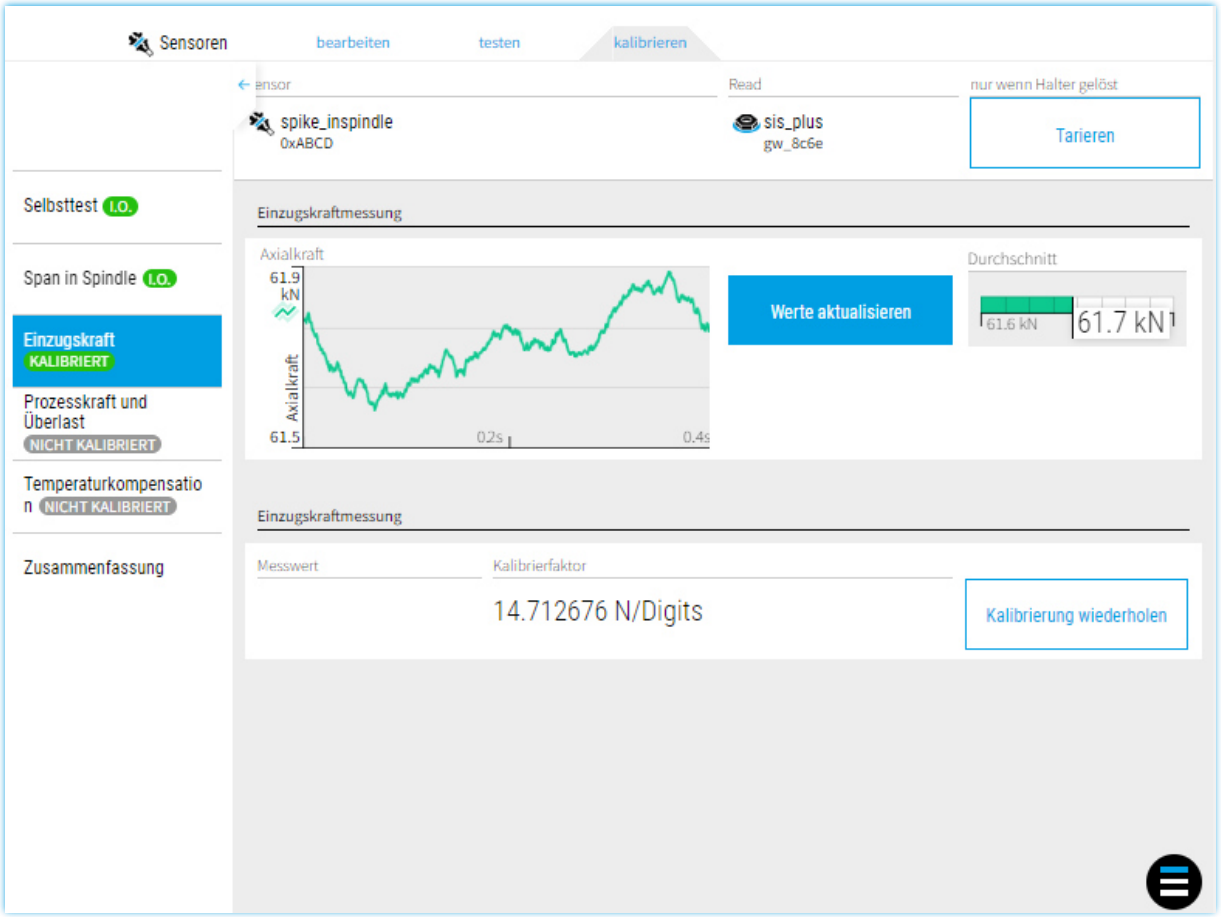
➔ Before starting the pull-in force measurement, click on “Tare” to zero the measurement.

➔ Press “on” on the external pull-in force measuring device, then “Clear off” to zero it too.

➔ The measuring device is then replaced and clamped. The external measuring device determines the pull-in force and displays the measured value in [kN]. This displayed value [kN] must be entered in the software input mask. Then click on “Calibrate”. (The values and graphs in the example are for illustrative purposes only).



➔ “Update values” can be selected to continuously display the measured values from the Spike _inspindle.

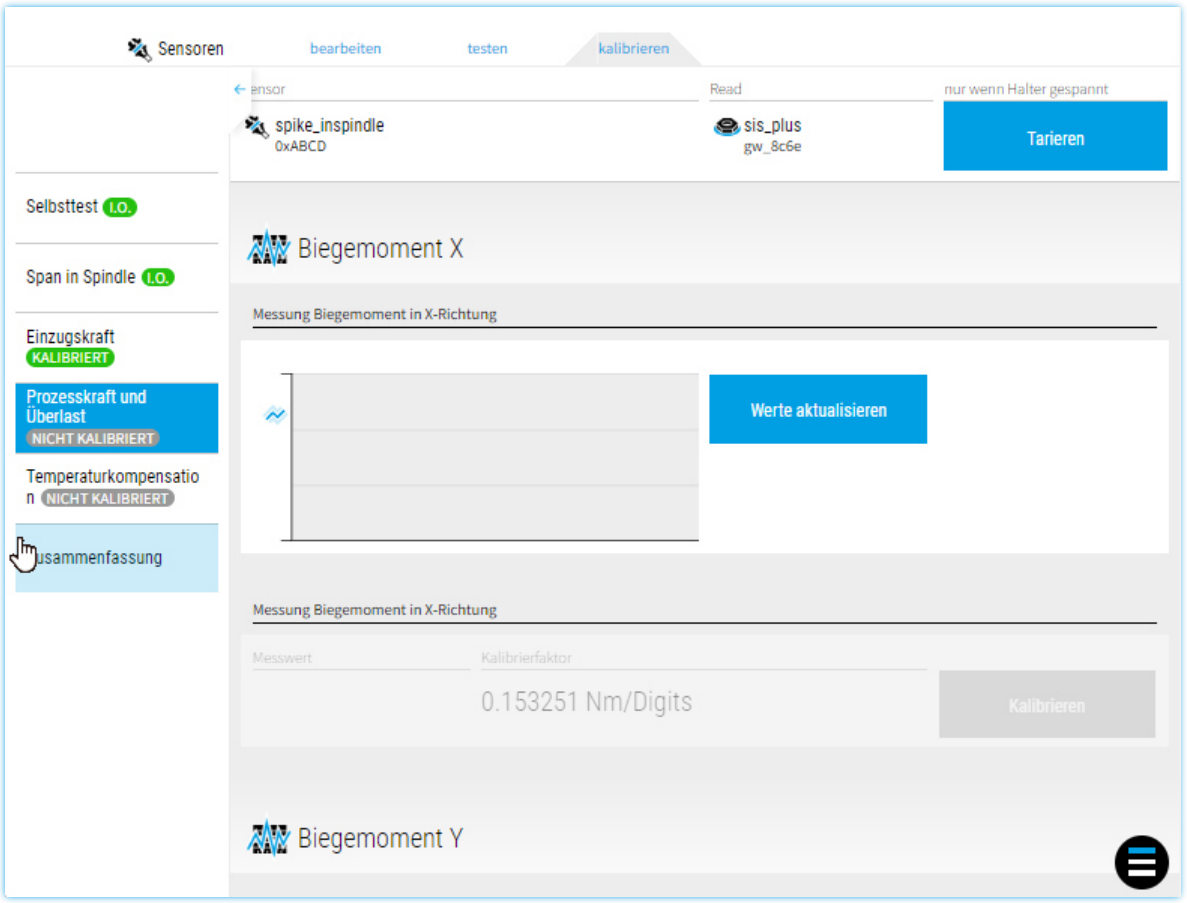


(1) After calibration with the external measuring device, a green “CALIBRATED” symbol appears in the “Pull-in force” tab.

(2) “Process force and overload” is then set.

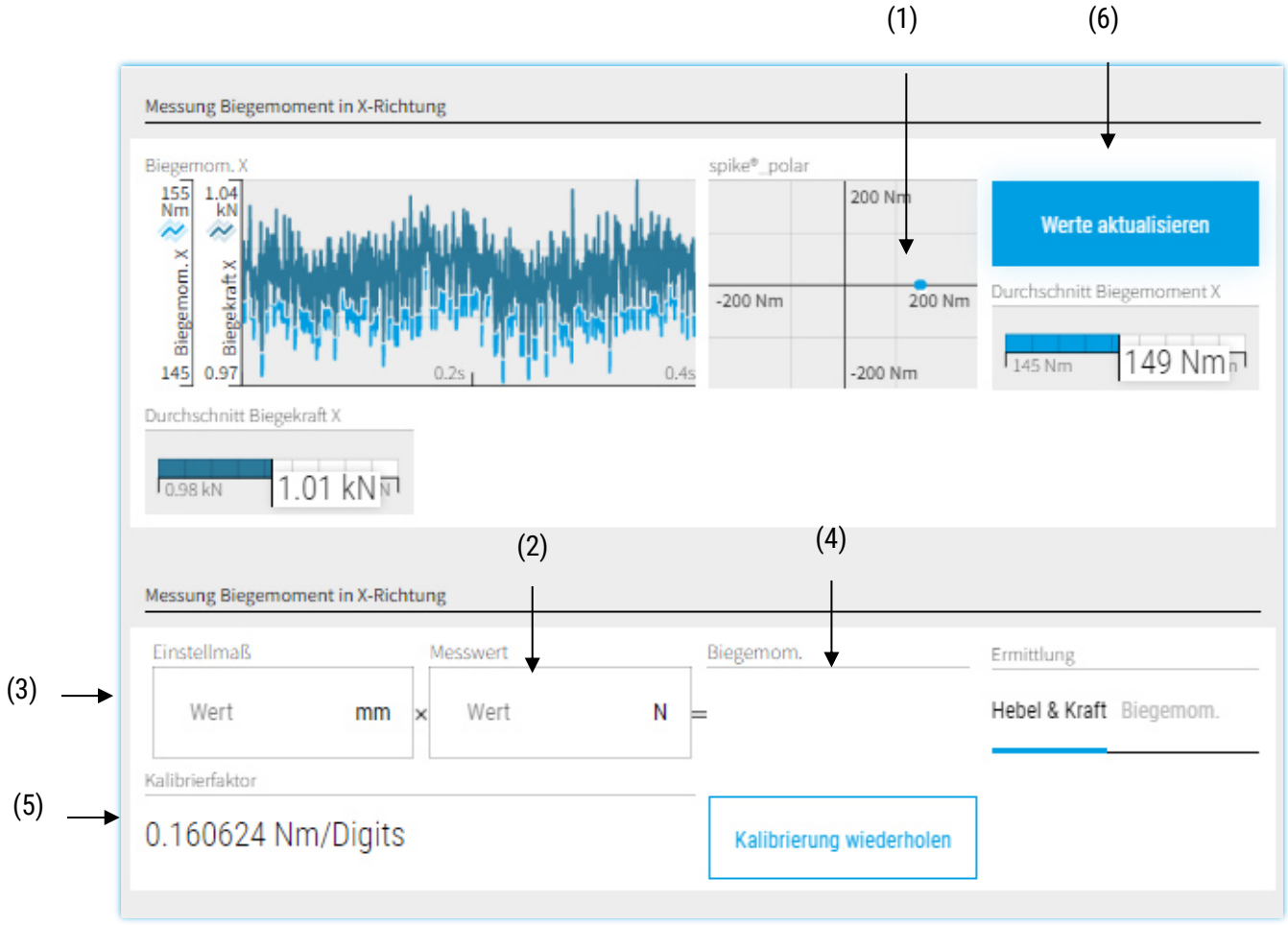
5.4.5 PROCESS FORCE AND OVERLOAD

To calibrate the process force, a specific ball tool clamped in a tool holder and a load cell are required. The setting dimension of the ball tool must be known.



➔ First, the holder is clamped with the calibration tool (ball).

➔ Then click on “Tare”.



First, the bending moment is calibrated in the x direction.

(1) The motor spindle with the ball tool and the load cell must be positioned in such a way that when the ball tool comes into contact with the load cell, the force is applied exclusively in the x direction of the sensor. The force input in the y-direction should be minimal. The Spike_polar shows the actual force distribution . Ideally, these measured values lie exclusively on the x-axis.

(2) The load cell shows the amount of force with which the ball acts on the load cell (thumb value approximately 1000N). This measured value must be entered under “Measured value”.

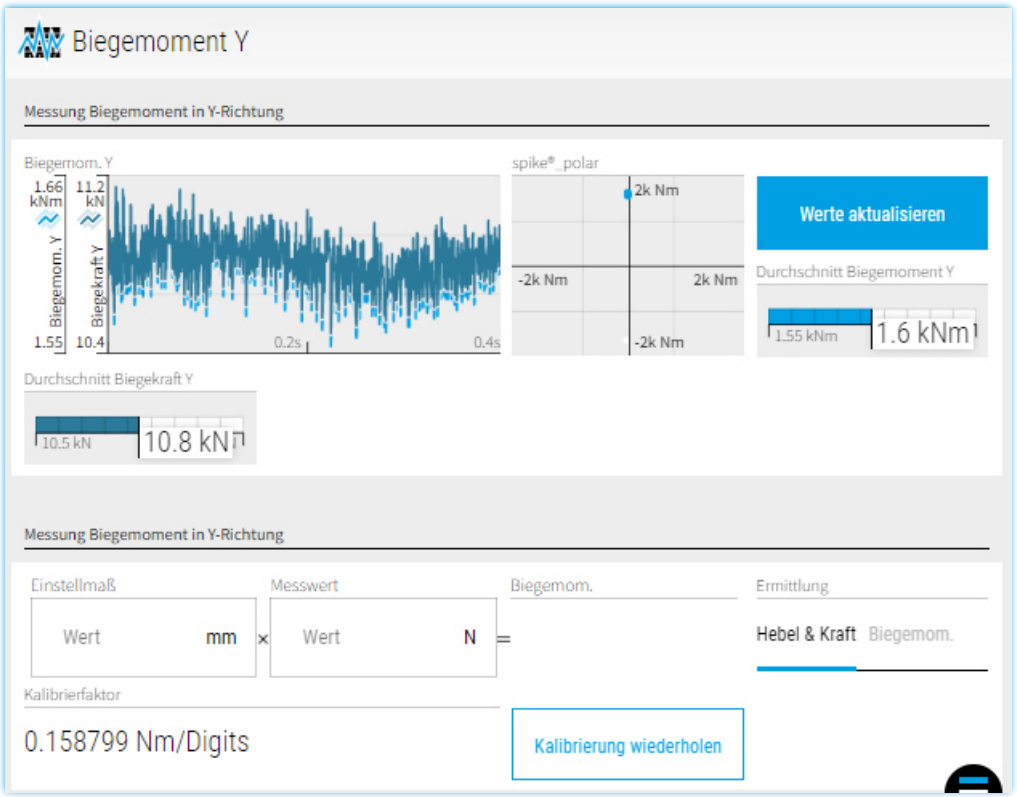
(3) The setting dimension of the ball tool must be entered in the “Setting dimension” field.

(4) The bending moment is calculated from the setting dimension and the measured value (via the product of the lever arm and force).

(5) The correct calibration factor is displayed.

(6) By “Update values” the calibration factor is adopted and the display of the measurement data in the history graph and in spike_polar is updated.

The procedure for calibrating the bending moment in the y-direction must be carried out in the same way. To do this, the motor spindle must be rotated by 90° (clockwise or counterclockwise).



To determine whether an overload is acting on the motor spindle bearing, the axial force must be calibrated. To do this, the load cell is aligned so that the calibration tool presses frontally onto the load cell.

(1) The load cell indicates the amount of force with which the ball acts on the load cell (set to approximately 1000N). This value must be entered under “Measured value”.

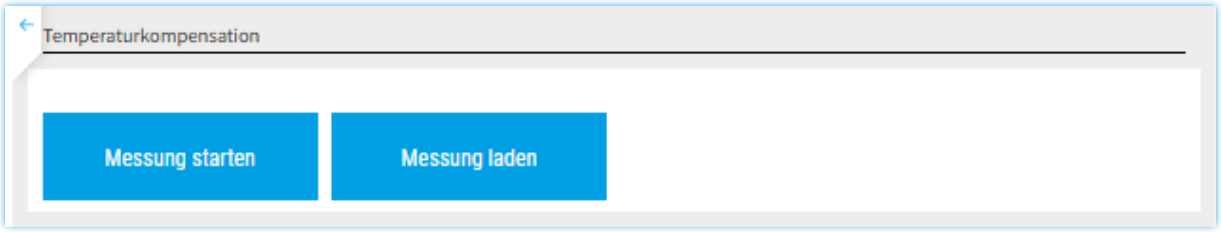
(2) The correct calibration factor is displayed.

(3) With “Update values” the calibration factor is adopted and the display of the measurement data in the history graph is updated.

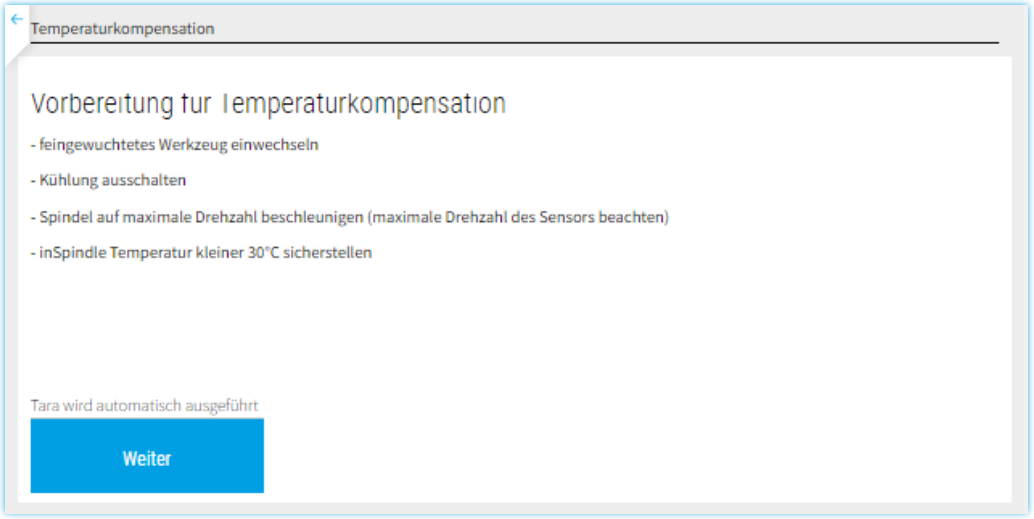
After calibrating the process force and the axial force, a green “CALIBRATED” symbol appears in the “Process force and overload” tab. This is followed by “temperature compensation”.

5.4.6 TEMPERATURE COMPENSATION

To correct the thermal influences to which the spike_InSpindle measuring system is subject, the measurement data is subjected to temperature compensation. During commissioning, the correction factors must be calculated and saved in the system. This is usually done by heating the motor spindle. Alternatively, an existing data set can be loaded.

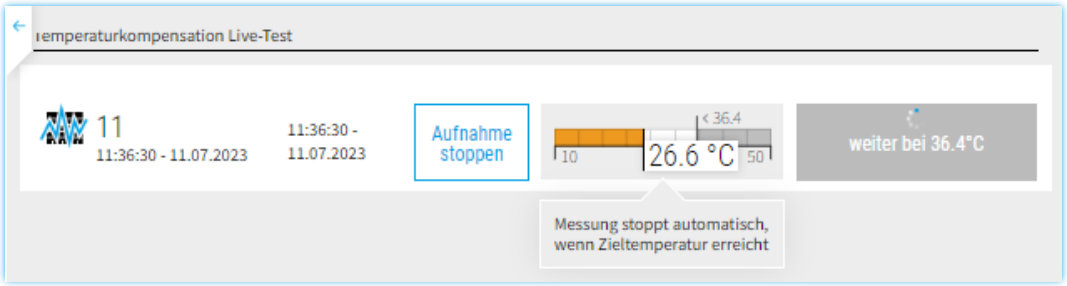


➔ If a new data record for temperature compensation is to be created, select “Start measurement”.

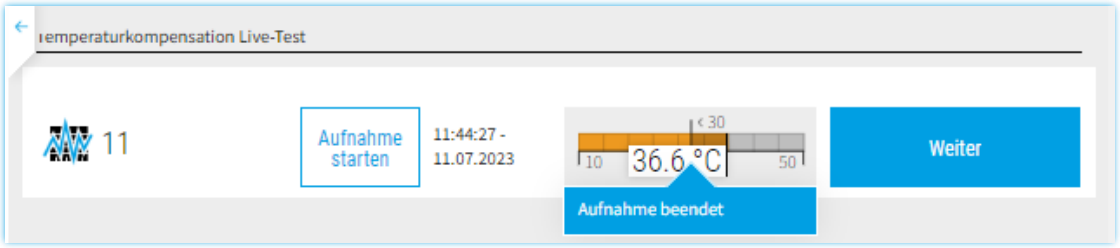


➔ To carry out temperature compensation, the following points must be observed:
- There is a finely balanced tool in the motor spindle.
- The cooling of the motor spindle must be deactivated.
- At the start of the measurement, the temperature measured by the InSpindle is less than 30°C.
- The motor spindle is accelerated to the maximum speed of the entire system (motor spindle, sensor, tool).

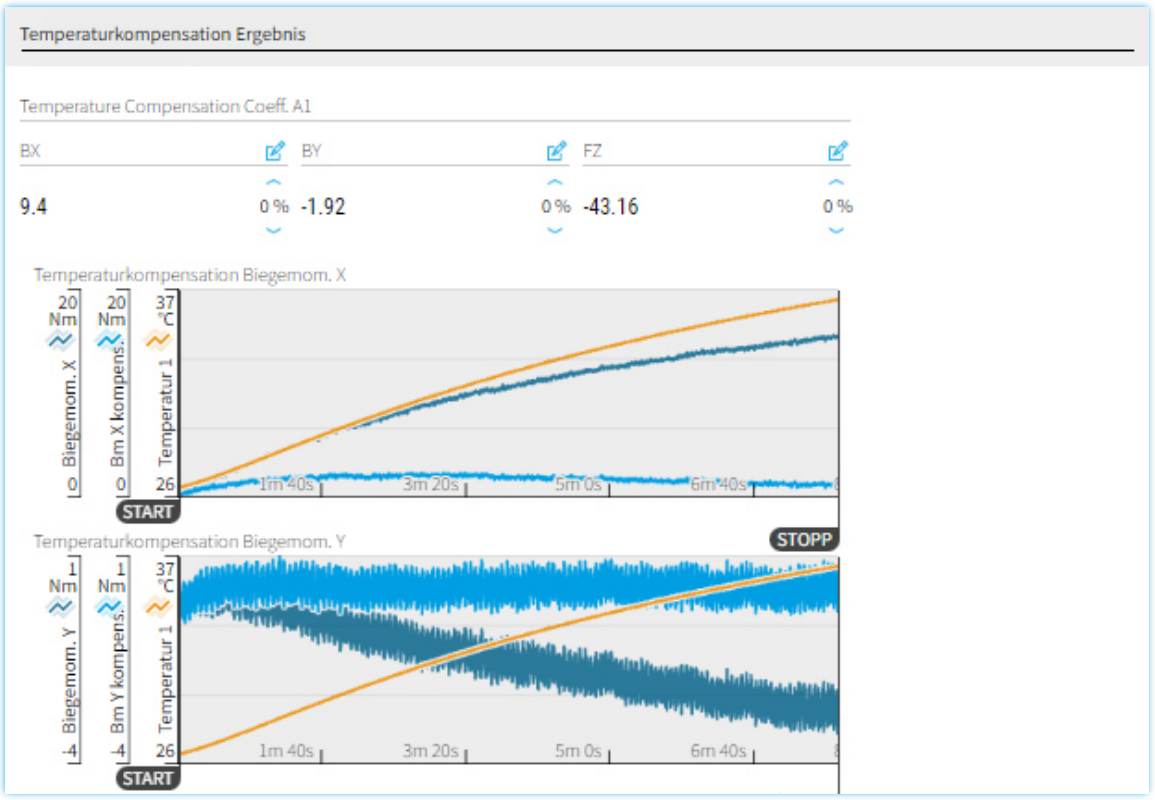
➔ Once the specifications have been made, click on “Next”.

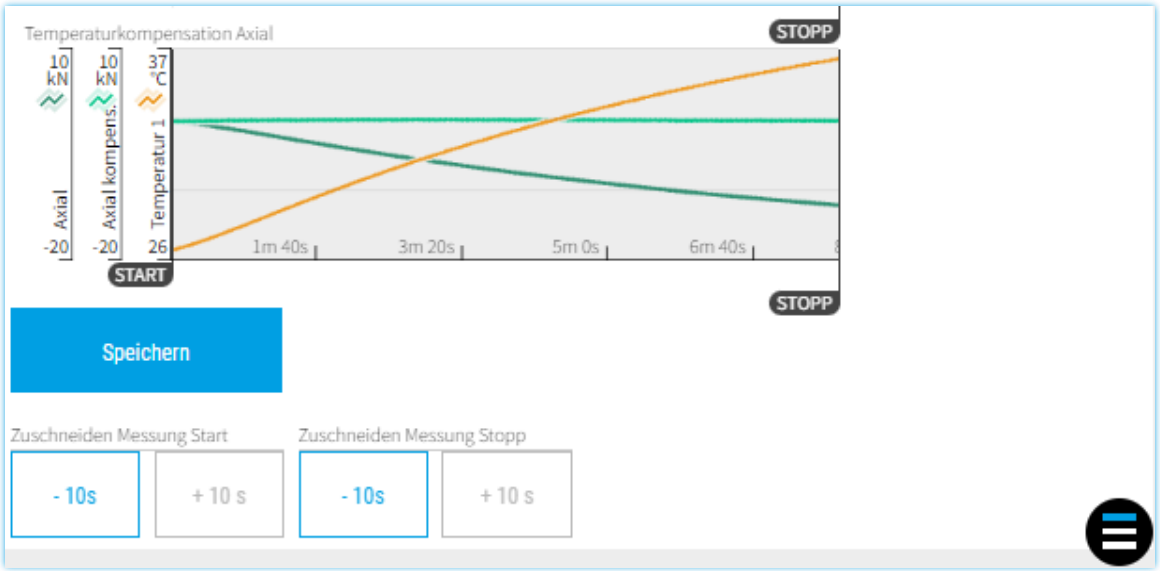


➔ Data recording must be activated via “Start recording”. Data recording ends automatically as soon as a temperature difference of 10°C is reached compared to the initial temperature.



➔ Once the recording is finished, the motor spindle can be stopped.
➔ Clicking “Next” displays the result of the measurement.
➔





The graphs for the bending moment in the x and y directions as well as for the axial force are displayed and compared with the measured temperature (yellow).

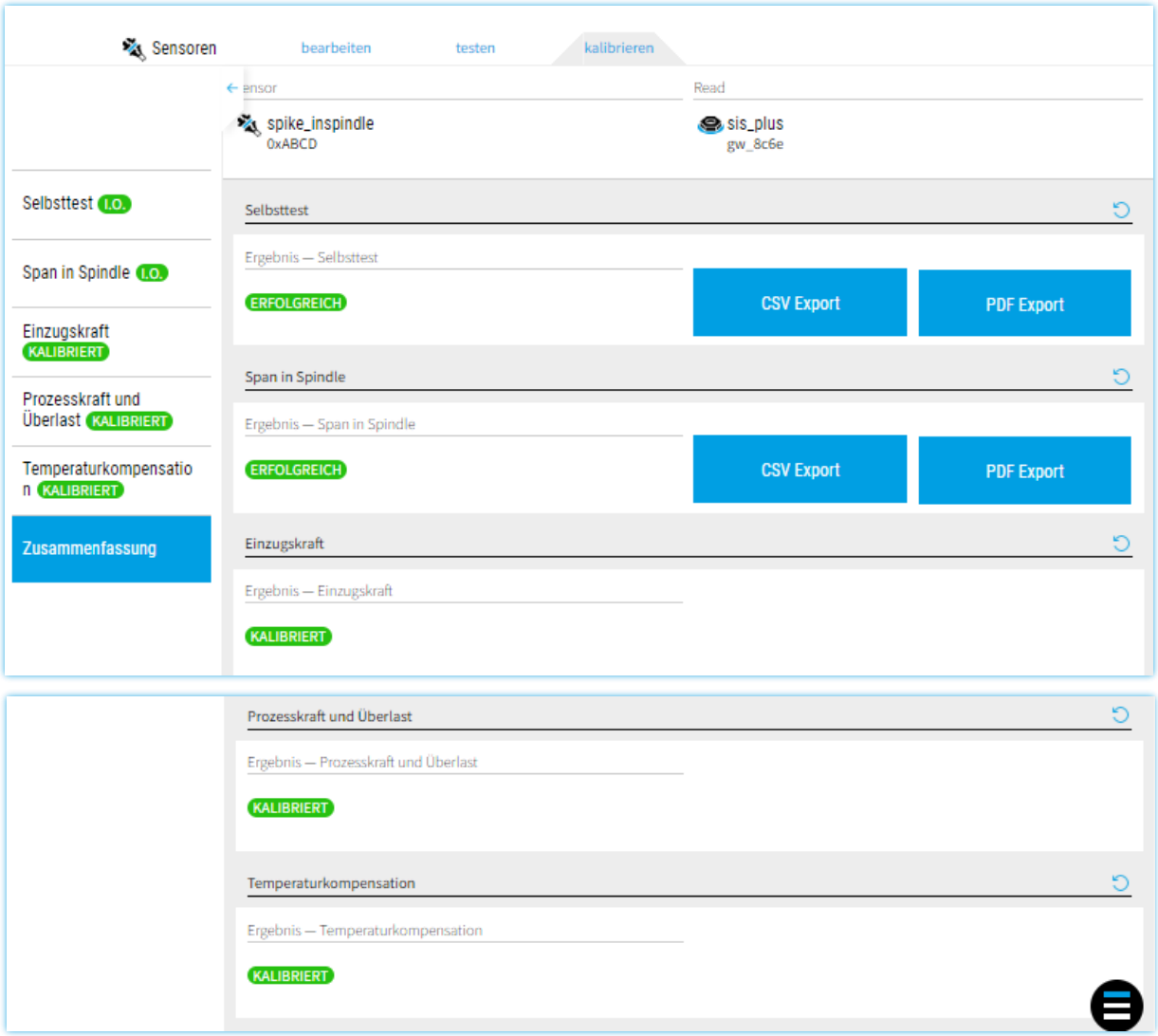
The entire measuring range shown in the graph is used to calculate the correction parameters. If the measurement was started too early and the temperature does not yet show a clear change, the range can be adjusted using the “Crop measurement start” option. The same applies to “Crop Measurement Stop” if the measurement was ended too late. By default, the step size is set to 10 seconds.

After calculating the parameters for the temperature compensation, a green “CALIBRATED” symbol appears in the “Temperature compensation” tab.

This is followed by “temperature compensation”. The calibration of the spike_inspindle is finished.

5.4.7 SUMMARY

An overview of the calibration results can be found in the “Summary” tab.



The results can be exported as a csv file or as a pdf file. System documentation is recommended. It also forms the basis for service requests.

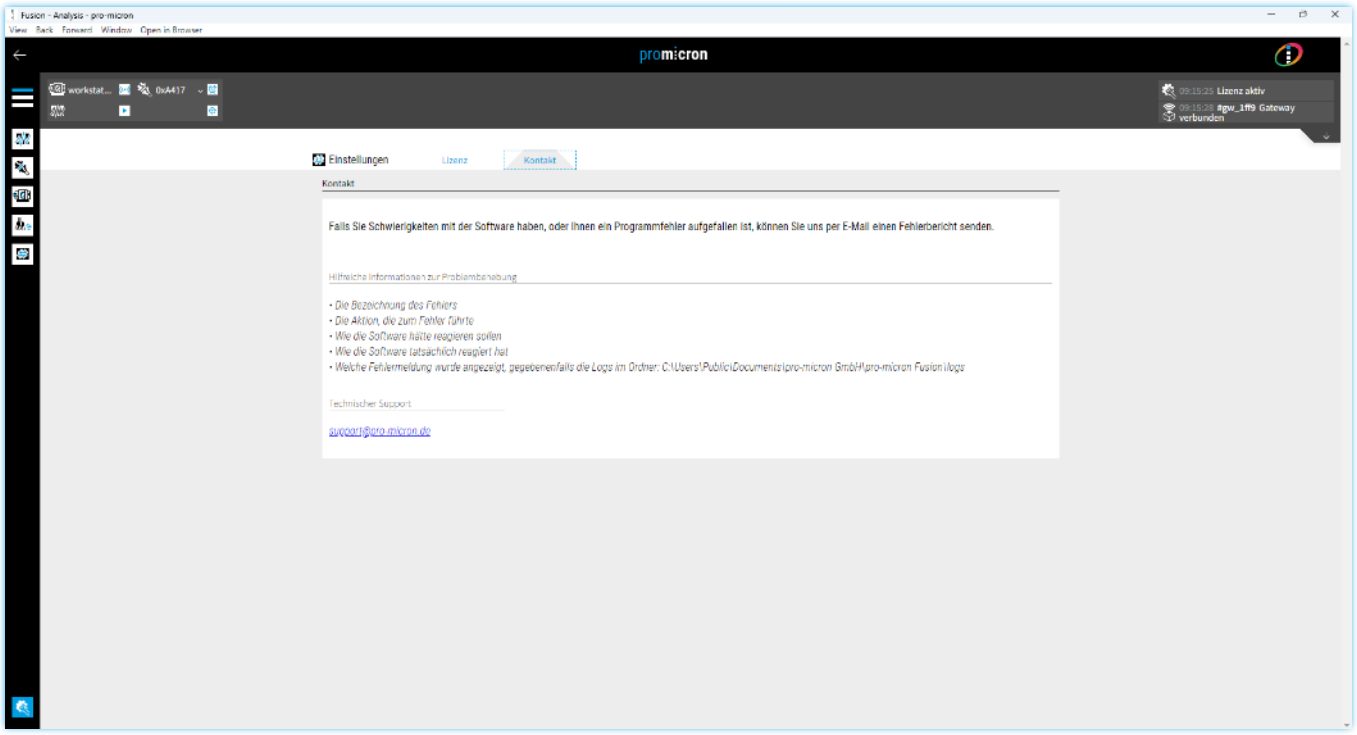
6 TROUBLESHOOTING

6.1 CONTACT SUPPORT

promicron support can be found under Settings > Contact . The following information is relevant for a comprehensive analysis:

- Self-test of the entire system
- Error label
- Brief description of the entire system (machine type, control, receiving device, software licenses)

This information can be sent by email to support@pro-micron.de or must be kept ready for telephone inquiries.



7 GLOSSARY

Expression	Description
spike®	Measuring system with which the forces and moments acting on the tool during machining can be directly measured. Using the measurement data, the machining process can be diagnosed offline and monitored online.
spike®_connect	The promicron base station for receiving sensor data, commonly referred to as “Read”.
IPC	Industrial PC (IPC) used for tasks in the industrial sector.
IBN	Installation
USB	Serial bus system for connecting a computer to external devices .