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Manual

Laser Shaft Alignment Tool PCE-TU 3

Version 1.0
Date of creation: 09.09.2015
Date of last change: 01.03.2016

Contents

1 Introduction

Thank you for purchasing a Shaft alignment tool from PCE Instruments.
With the help of a Shaft alignment tool, you can perform shaft alignment on machines and motors quickly and easily. For this purpose, the Shaft alignment tool possesses two special laser sensors, which are fixed to the particular shaft. The Shaft alignment tool directly displays the corresponding correction values for every machine base after a short measurement time. In addition to special programs for the alignment of machines and motors, you can perform further geometrical measurements with the PCE-TU 3.

2 Safety notes

Please read this manual carefully and completely before you use the device for the first time. The device may only be used by qualified personnel and repaired by PCE Instruments personnel. There is no warranty of damages or injuries caused by non-observance of the manual.

This manual is published from PCE Instruments without any guarantee.

We expressly point to our general guarantee terms, they can be found in our general terms of business.

If you have any questions please contact PCE Instruments.

2.1 Precautions

The PCE-TU 3 is a class II laser system with a typical wavelength of 670 nm, < 1MW capacity and a maximal radiation energy of 0,1 mJ per impulse. The class II laser meets the requirements according to ANSI, BS 4803, IEC 825 and the US American FDA. Note the following safety notes to avoid injury and damages on the device.

Caution:

- **Do not ever directly look into the laser beam!**
- **Do not ever directly point the laser beam into anyone's eyes!**

Warning!
Make sure that the machines you measure are not started by accident, because injuries might occur. To avoid that risk, you should either block the power switch in the OFF position or remove the corresponding fuses. These security measures need to be maintained until the measuring system is removed from the machines.

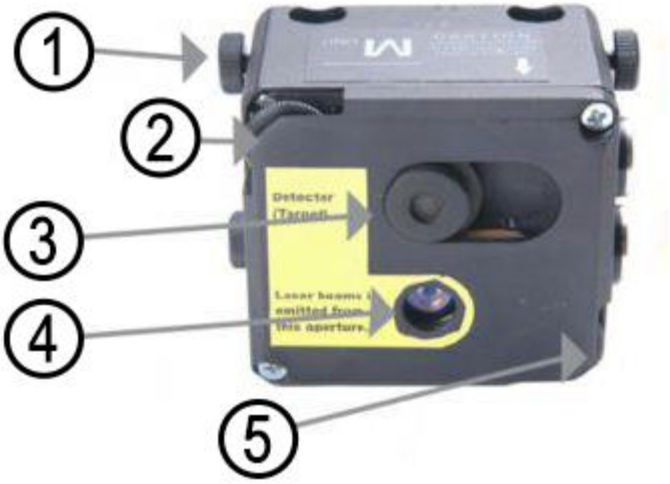
Disclaimer
Neither PCE Instruments, nor authorised salesmen can be blamed for damages on machines or working tools that might occur in the process of working with the PCE-TU 3 system. We check the manual carefully, to avoid possible errors. If you find an error in this manual, we would be very grateful, if you let us know.

3 Specifications

Sensor type	Position sensitive photodiodes
Laser type	Visual, red 635 ... 670 nm, < 1 MW
Max. Distance	10 m between the sensors
Measurement accuracy	± 1 % + 0,001
Resolution	0,001 mm
Display resolution	0,01 or 0,001 mm
Inclinometer	Resolution 0,1 °
Interface	USB, Bluetooth
Memory	2 GB
Functions	Horizontal alignment in every position from 60 to 360°
	Vertical alignment
	Auto sweep mode
	Adjustable tolerances
	Tilt measurement
	Thermal growth
	Spacer simulation
	PDF reports
Housing	With silicone protection Protection type: IP65
Power supply	NiMH-Battery (rechargeable)
Environmental conditions	-10 ... +55 °C
Weight	7,5 kg

4 System description

4.1 Technical description

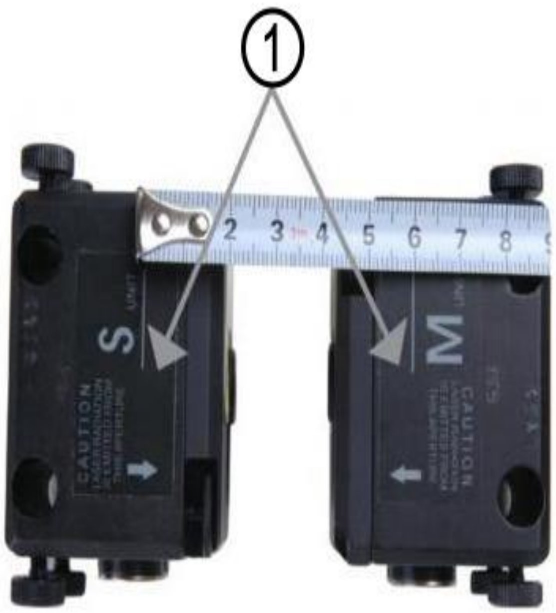


Front and top view of the measurement sensors

1	Lock button
2	Vertical alignment
3	Detector / target
4	Exit hole of the laser beam
5	Horizontal alignment

Measurement sensor side view

1	Reference point
2	Cable connector socket



Top view of the measurement sensors

1	Reference lines to measure the sensor distance

4.2 Application

The Shaft alignment tool PCE-TU 3 was designed to check and optimize the shaft alignment between machines. In order to do so, the relative position of two coupled machines (as for example a motor and a pump) need to be changed, in order to make sure, that the centre lines of the shaft need to be concentric during normal operation.

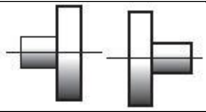
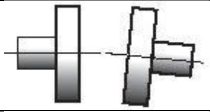
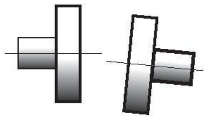
4.2.1 CE-Conformity

The Shaft alignment tool is conforming to the following CE requirements:
2006/95/EC, EN 61010-1:2001, EN 60825-1:2007, 2004/108/EC, EN 61326-1:2006, EN 61326-2-2:2006, EN 55011:2009+A1

4.3 Delivery content

1 x PCE-TU 3 display unit, 2 x probes, 2 x mounting sets for the probes, 1 x measurement tape ,
1 x battery charger, 1 x connection cable, 1 x software, 1 x USB-cable, 1 x manual, 1 x carrying case

4.4 Misalignment parameters

	Parallel misalignment
	Angular misalignment
	Parallel and angular misalignment (Offset + gap)

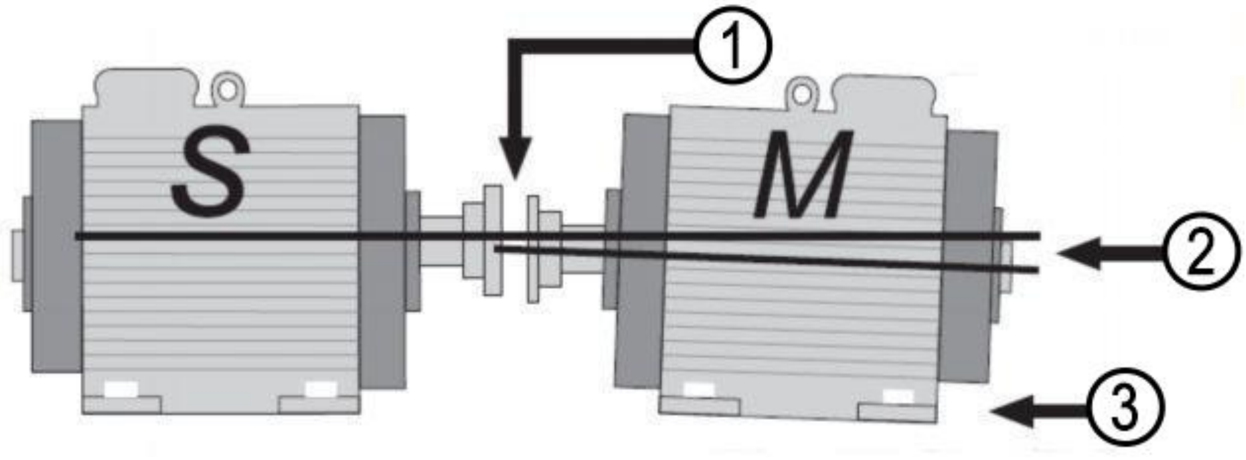
Parallel and angular misalignment can be determined in two rectangular planes. In order to eliminate parallel and angular misalignment, the position of the moveable machine (M) needs to be adjusted in both planes.

For horizontally mounted machines, the following needs to be applied:
The position of the moveable machine (M) needs to be aligned in the horizontal and vertical plane.

For vertically mounted machines, the following needs to be applied:
You need to discuss the use of the movement of a moveable machine under perspectives of operation and efficiency with the machine operator. After that, you need to determine the arrangement of correction planes.

Stationary machines (S):	The position of the machine is not changed in the course of measurement and elimination of parallel and angular misalignment
Moveable machines (M):	The position of the machine is adjusted, in order to eliminate parallel and angular misalignment

The measurement system determines the values for parallel and angular misalignment in the coupling (in two rectangular planes) and the corrective values which are necessary for the elimination of misalignments of the machine bases of the moveable machine (M). The following figure shows the misalignment and corrective values for the vertical plane.



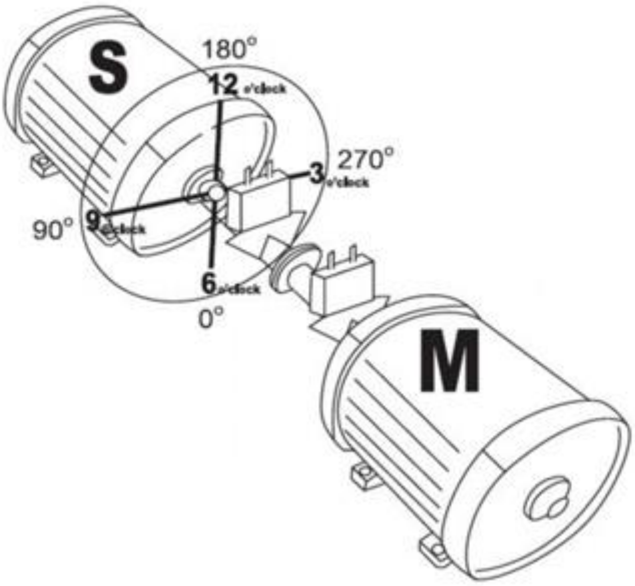
Misalignment (vertical plane)

1	Parallel misalignment (Offset)
2	Angular misalignment
3	Corrective value
S	Stationary machine
M	Moveable machine

5 Machine alignment

- Mount the measurement sensors to the shaft of both machines, (S) and (M)
- Select the corresponding measurement program
- Enter the distance between sensor (S) and sensor (M) and between the coupling and the machine base.
- Press ENTER START, in order to collect measurements on three different positions of the shaft
- Adjust the position of the machine bases of the moveable machine according to the determined measurement results.

Caution!
For the implementation of the measurement, it is important to conform to the rotation direction of the shafts and to the relative position of the sensors to the machines (S) and (M).



The figure above, shows machine (S) from the point of view of machine (M) from 12 o'clock position. The surfaces of the measurement sensors are marked as **S** and **M** and should be mounted to the corresponding shaft of the machine.

5.1 Determination of measurement data

The Shaft alignment tool PCE-TU 3 is based on the measurement of a moving laser beam in the target window of the receiving sensor while the shaft, the sensor is mounted to, is rotated.

In order to determinate the axis alignment, at least three measurements (on different positions during the rotation of the shaft) need to be carried out. A rotation of about 180 ° is sufficient here.

If a rotation of 180 ° should not be possible due to restricted spaces or an unfavourable arrangement of the machines, the PCE-TU 3 supports a mode for smaller rotation angles. Total rotations of 60 ° are sufficient in this mode.

5.2 System setup

Before working with the Shaft alignment tool, you need to control the battery status, and recharge the battery, if necessary.

The battery status is displayed as a small, coloured figure on the bottom of the main menu of the instrument, while the exact battery status is available in the menu item “Setup”.

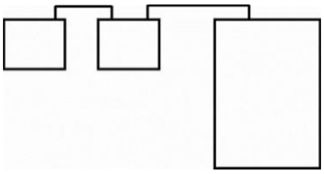
Check and clean the surface of the laser detector and the exit hole of the sensor, if necessary.

Use a cotton pad soaked in alcohol for the cleaning. Do not use solvents for the cleaning under any circumstances.

Check date and time of the system clock and adjust them, if necessary.

5.3 Connection of the measurement sensors

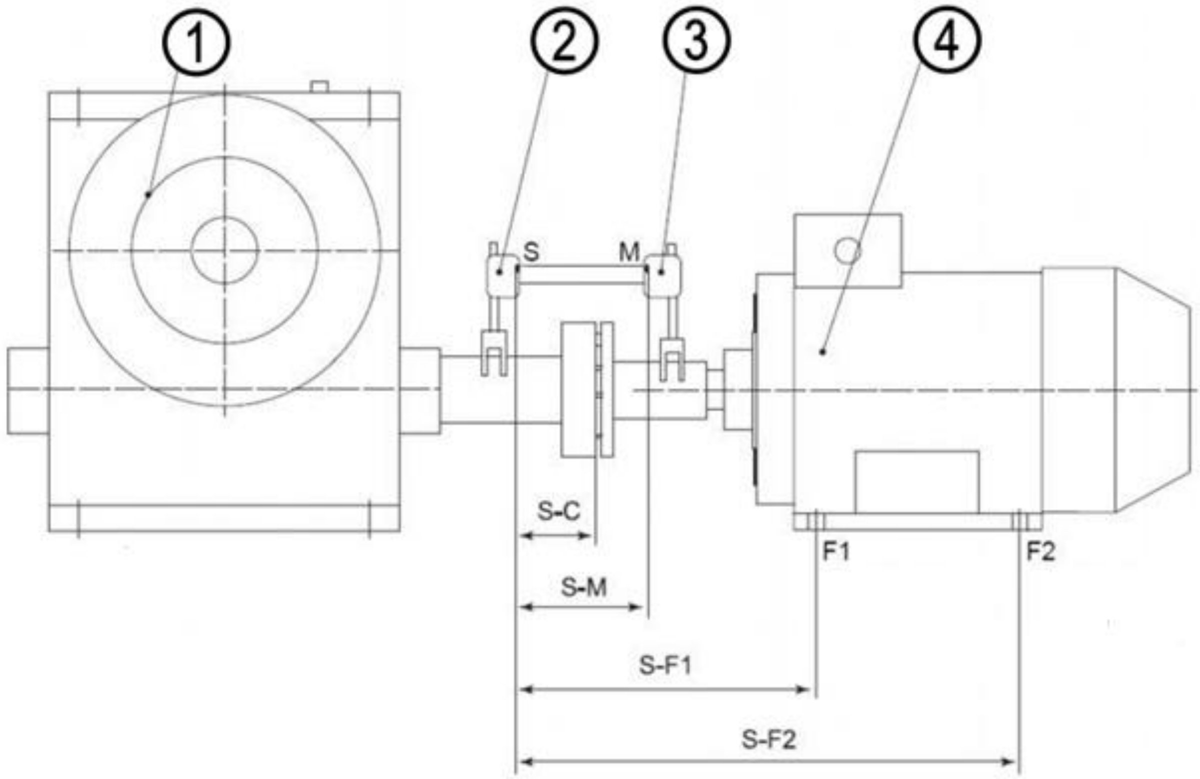
There are serial ports on the display unit, as well as on the measurement sensors. The sensors need to be connected in series to the display unit with the enclosed cables. Refer to the following figure



Serial connection of the sensors

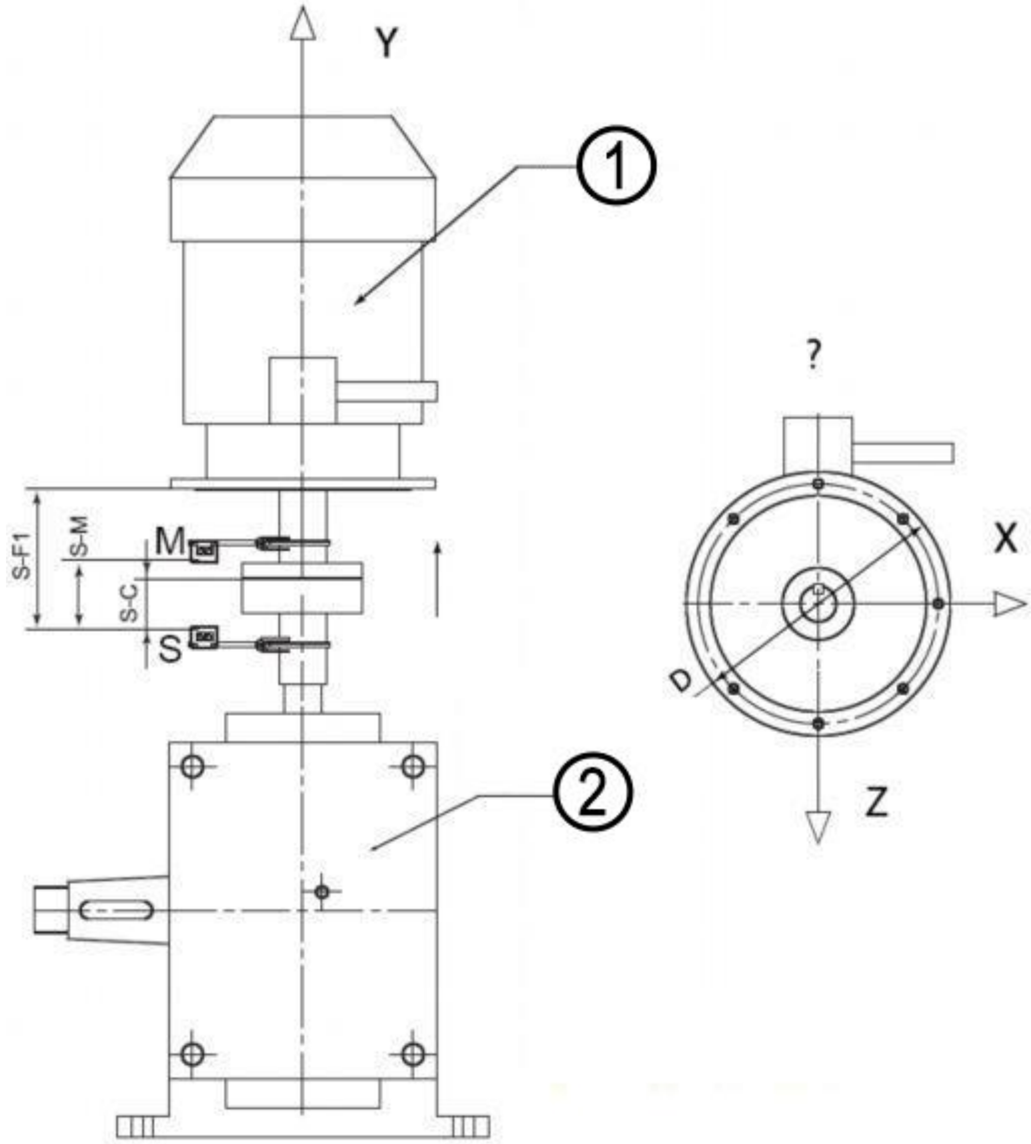
5.4 Entering of the dimensions

To achieve probable measurement results, you need to enter the distances between the sensors, the coupling and the machine bases first. The following figures show the required dimensions for both, horizontally and vertically mounted machines.



Horizontal alignment

1	Stationary machine
2	Sensor S
3	Sensor M
4	Moveable machine
F1	Front machine base
F2	Rear machine base
S-M	distance between the measurement sensors
S-C	distance between sensor S and the middle of the coupling
S-F1	distance between sensor S and the machine base F1
S-F2	distance between sensor S and the machine base F2 (needs to be larger than S-F1). If the machine has three pairs of machine bases, the value can be adjusted after the measurement. After a new measurement, you receive the corrective values for the third pair of machine base.



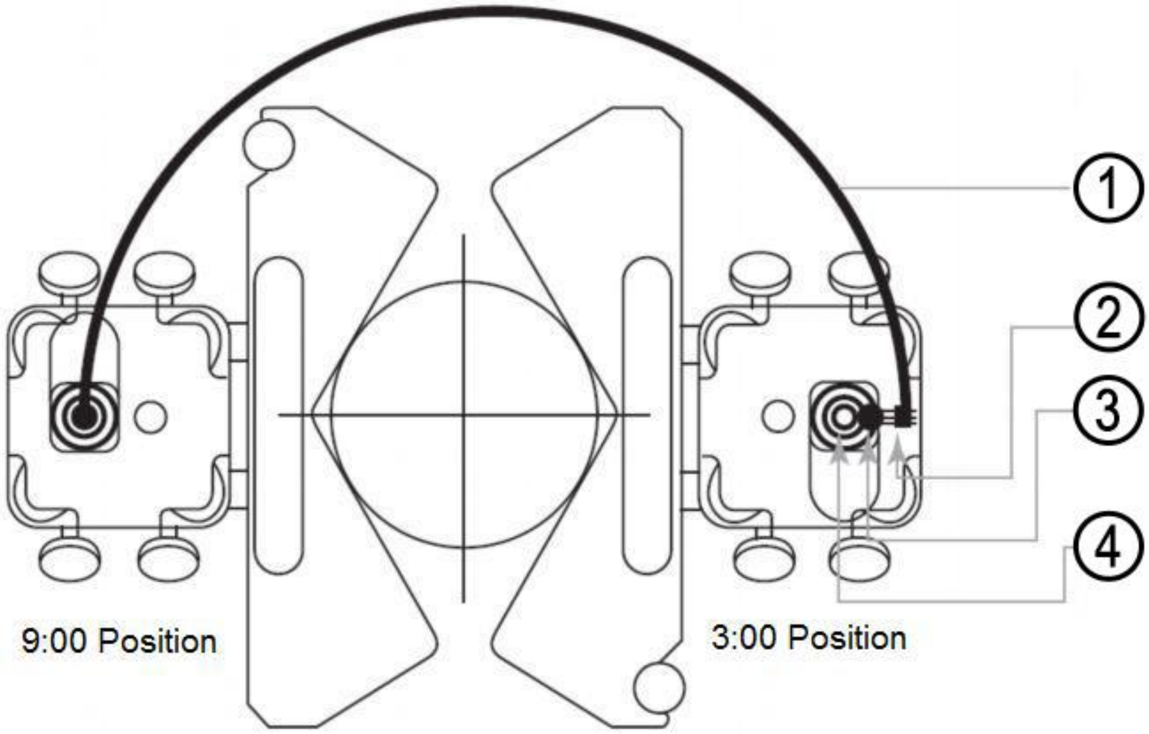
Vertical alignment

1	Moveable machine
2	Stationary machine
S-M	distance between the measurement sensors
S-C	distance between sensor S and the middle of the coupling
S-F1	distance between sensor S and the alignment plane F1

5.5 Rough alignment

Rough alignment should only be applied, if the axis alignment of the machines is in such a bad condition, that the laser beams do not meet the detector during the rotation of the shaft anymore.

5.5.1 Rough alignment (var. 1)



View from Sensor S

1	Route of the laser beam during the rotation of the shaft
2	Laser beam outside the detector area.
3	Fixing of the laser beam halfway of the route to middle of the detector
4	Alignment of the moveable machine (M), in order to make sure the laser beams meet (S) and (M) in the middle.

- Rotate the shaft with the measurement sensors to the 9:00 position. Aim the middle of the closed detector opening.
- Rotate the shaft with the measurement sensors to the 3 o'clock position.
- Check, where the laser beams meet and use the adjustment screws to fix the laser beam in the middle of the route, to the middle of the detector (figure **view from sensor**).
- Now align the moveable machine to the position, where the laser beam meets **S** and **M** from.
- Continue with your regular measurement procedure.

6 Commissioning

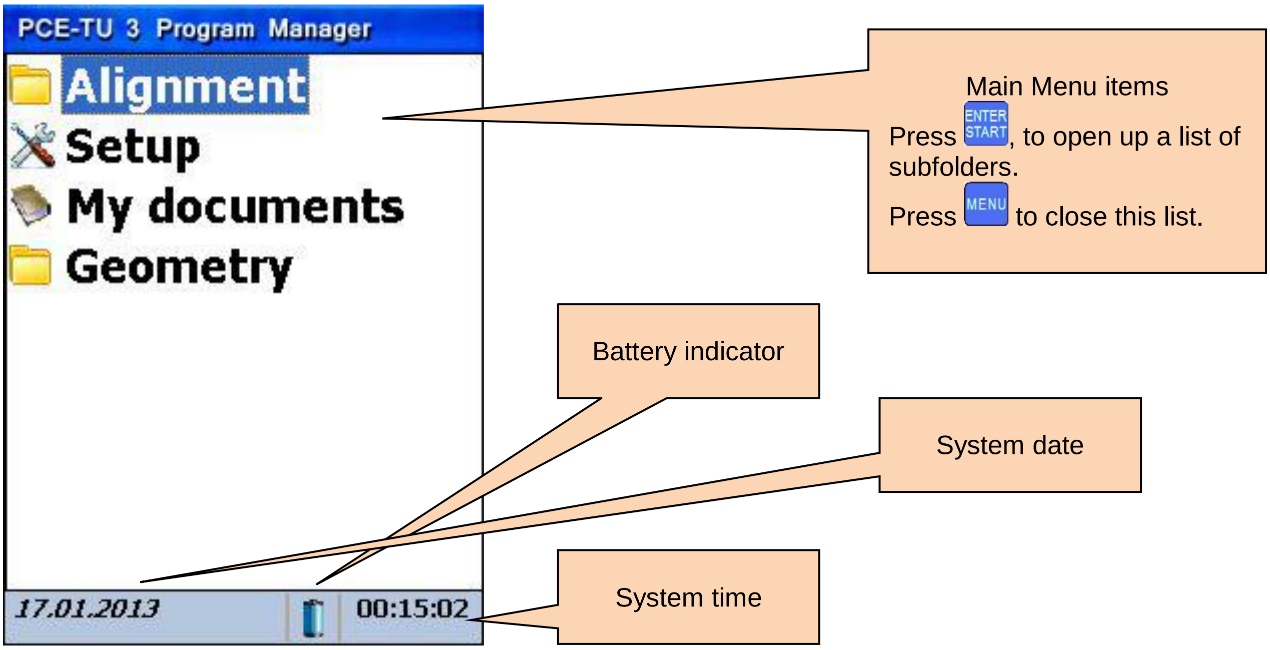
6.1 General control keys

To close all active windows – except for the main menu –without saving, you can push the MENU button (serves as ESC button).

The ENTER button serves to confirm or leave entering fields and active windows (except for windows with data entry, main screens of programs and some other).

6.2 Starting the PCE-TU 3

- Having completed the booting, the main menu appears on the display.



- To select a menu item, press ENTER

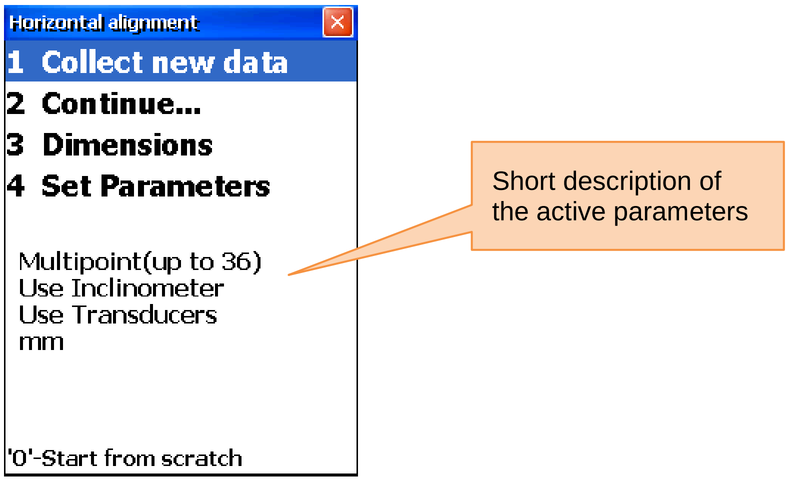
if the battery indication is flashing, you should immediately save all unsaved data and recharge the batteries. The symbol indicates that the instrument will turn off soon.

7 Machine alignment

7.1 Horizontal alignment

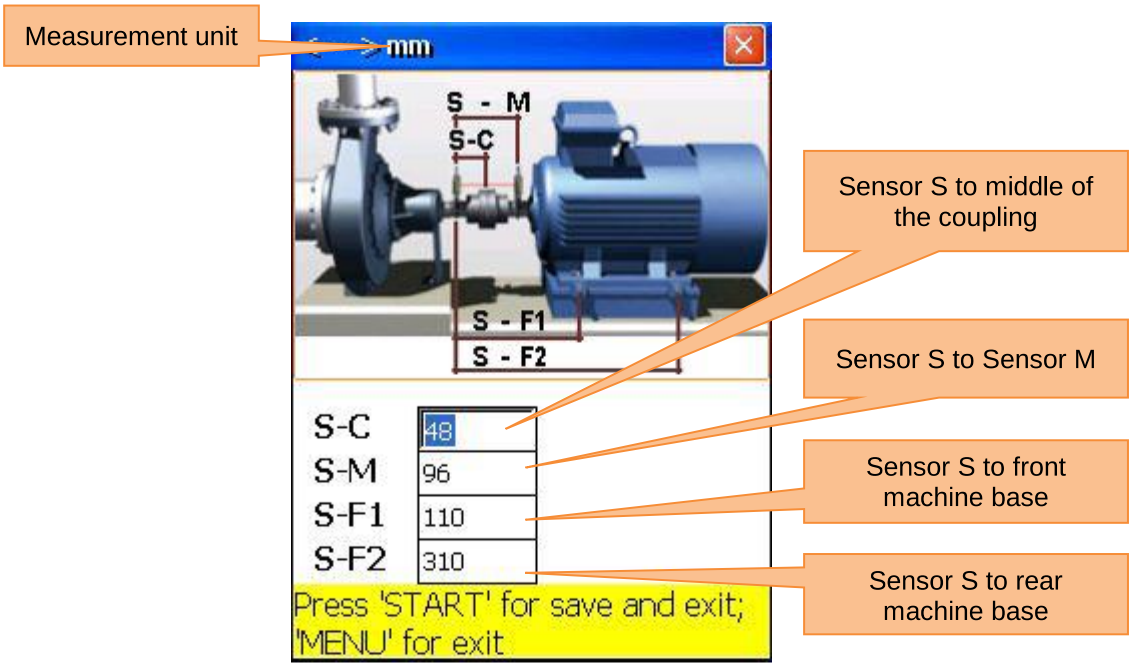
Mount the measurement sensor, **marked as S,** to the shaft of the stationary machine and the measurement sensor, **marked as M**, to the moveable machine. Connect the cable (**described in 3.3**) to the sensors and the main unit or configure the Bluetooth interface (only possible with the Bluetooth adaptor kit).

What should be noted in this window	Shortcuts in this window	
Firstly carry out the Soft Foot Measurement to avoid unexpected errors during the alignment check the result after alignment by measurement again	1	determination of new data
Functions in this window	2 ABC	Continue alignment
- Determine new data - Continue alignment - Change of parameters - Change machine dimensions and distances	3 DEF	Change machine dimensions and distances
	4 GHI	Change/add parameters



7.1.1 Enter dimensions

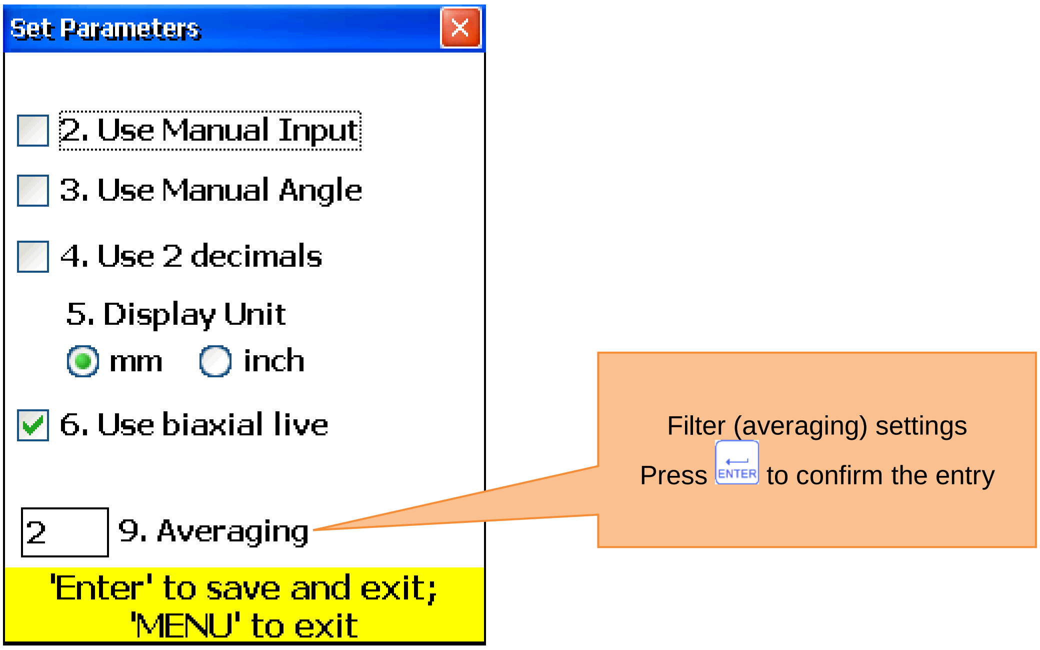
What should be noted in this window		Shortcuts in this window	
⚠	for correct measurement results, the following must be respected: S-C ≤ S-F1 < S-F2		Navigate up
Functions in this window			Navigate down
	- Enter distance sensor S – middle of the coupling - Enter distance sensor S – sensor M - Enter distance sensor S – middle of the coupling - Enter distance sensor S – front machine base - Enter distance sensor S – rear machine base	ENTER START	Save and leave and exit
		ENTER	Confirm entry



7.1.2 Change parameters

Press [4 GHI] to change the parameters.

What should be noted in this window		Shortcuts in this window	
⚠	Only use the “Biaxial Live” alignment function with stable shaft positions, because the smallest rotations can lead to errors	2 ABC	Activate/deactivate manual data entry
Functions in this window		3 DEF	Activate/deactivate manual angle entry
	- Manual entry or use of the sensor data - Manual angle entry or data from integrated inclinometer - Selection between 2 or 3 decimal digits - Selection between Inc and mm as measurement unit - Activate/deactivate “Biaxial Live” alignment function	4 GHI	Use 2 or 3 decimal digits
		5 JKL	Select between Inch and mm as measurement unit
		6 MNO	Activate/deactivate Biaxial Live alignment
		9 WXYZ	Entry for averaging
		ENTER	Save and exit

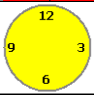
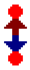


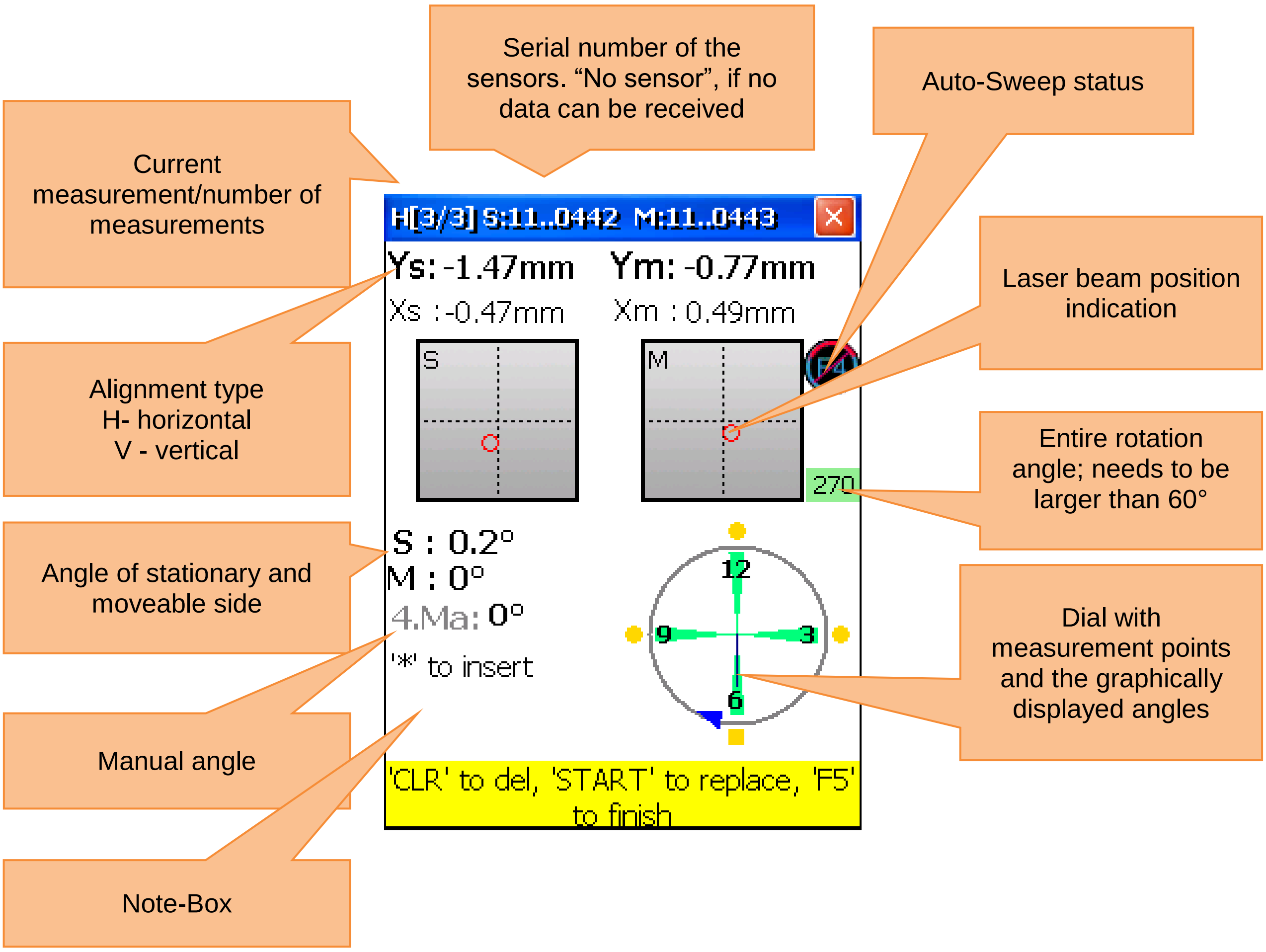
7.1.3 Data acquisition

Push 1 ⓘ to collect data.

What should be noted in this window		Shortcuts in this window	
	Before starting a new alignment process, you need to enter dimensions and parameters	0 DEL	Start again (deletes all values) Confirmation dialogue appears
	Do not change the position of measurement units when work is interrupted		
	Laser is now switched on		
Functions in this window		1 ⓘ	Enter Ys-values, if manual entry is activated
- Collect measured values (up to 36) - Select between auto sweep and manual mode - Manual entry of Ys- and Ym-values (if activated) - Manual angle entry (if activated) - Selection of measurement unit (mm/inch) - Navigate through collected data - Delete/add/replace measured values - Restart (all values are deleted) - Set Offset - Save collected data - Load collected data		2 ABC	Enter Ym-values, if manual entry is activated
		4 GHI	Enter angle, if manual entry is activated
		* *	If cursor is on the first place in the entry field, push this button twice to reverse sign
		6 MNO	Select the measurement unit (mm or inch)
		7 PQRS	Set parallel misalignment (Offset)
		8 TUV	Save all data in one file (see **chapter 10 „Handling of the Data Dialogue window“**)
		9 WXYZ	Load data from file (see **chapter 10 „Handling of the Data Dialogue window“**)
		CLR	Delete currently selected reading
		*	Enter new value. You have to switch to the last value saved, to make this option possible
		ENTER START	Save the current value or replace already saved values (confirmation dialogue appears)
		▲ ▼	Navigate through data
		F5	Continue to the result window. All necessary conditions need to be fulfilled
		F2	Open popup menu
		F4	Activate/deactivate auto-sweep. Auto-sweep can only be activated at the beginning of data acquisition or after restart. Manual entry of values and inclination need to be deactivated

Symbols and status in this window	
[C]	A blinking amber-coloured “C” in the display means that currently no data can be received from the sensors.
[R]	A blinking red “R” in the display means that you are already viewing a stored reading. This one can be deleted or replaced. If this sign is not displayed in the window, the current value has not been saved yet. Pressing ENTER START, you can store

	the value.
	The absence of the laser beam position indicator and a red blinking frame of the position indicator mean, that no laser beam meets arrives or no sensor data are recognized.
	An empty dial means that there is currently no angle established (or averaging is not completed) or that the rotation angle (to the next position) is too small (lower than 6°)
	A bright red indication means that the rotation angle does not meet the requirements of the single measurement points (at least 60°). A yellow indictaion means that the rotation angle is over 60°. A green indication means that the rotation angle is over the recommended area (over 90°).
	This symbol means that an expanded Y-value range is used.
	A crossed-out symbol means that the auto-sweep mode is deactivated.
	This symbol means that the auto-sweep mode is activated.



<table>
<tr><td colspan="2">Description of the dial
Saved measurement points are marked as green sectors on the dial and coloured points next to them. The coloured points are round by default. If a coloured dot is square, it means that you are currently viewing this saved measurement point. The colour of the dot informs about the standard deviation of the current alignment function.</td></tr>
<tr><td>●</td><td>A blue dot means that the data are not ready (less than 3 measurement points are saved).</td></tr>
<tr><td>●</td><td>A green dot means that the data are good.</td></tr>
<tr><td>●</td><td>A yellow dot means that the data are not good, but acceptable.</td></tr>
<tr><td>●</td><td>A red dot means that the data are bad. This measurement needs to be deleted or replaced. If you use a small amount of measurement points it might occur, that other points but this point are bad. For this case, you should use more measurement points to find out which one is bad.</td></tr>
</table>

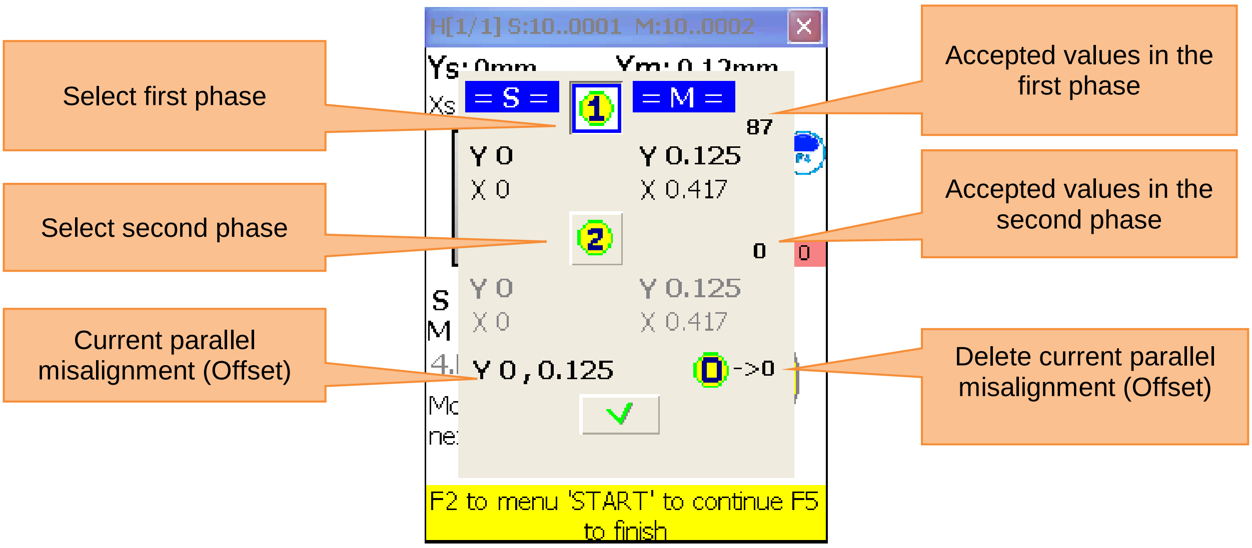
Use the adjustment screws on the measurement sensors to align the laser beams one after the other to the middle of the detector opening (figure **front and top view of the sensor/side view of the sensor**). If the laser beams aim both detectors, open the covers. The X- & Y-coordinates and the position von **S** and **M** are now displayed on the monitor. Rotate the shaft into the selected 1st measurement position. You can now switch to Auto-Sweep Mode or remain in the manual mode and save the active measurement point by pressing ENTER START. Save as many measurement points as possible (at least 3) and use a rotation angle as large as possible (at least 60°). If you have collected the necessary data, press F5 to start the alignment.

7.1.3.1 Set the parallel misalignment (offset)

Press 7 PQRS, for Offset settings.

<table>
<tr><th colspan="2">What should be noted in this window</th><th colspan="2">Shortcuts in this window</th></tr>
<tr><td>⚠</td><td>Do not rotate the shaft, especially not while adjusting the sensors.</td><td rowspan="2">1 ⓘ</td><td rowspan="2">Select the first setup phase</td></tr>
<tr><td>⚠</td><td>Do not delete the parallel misalignment (offset), after it was saved. Otherwise, you have to repeat the whole data acquisition process.</td></tr>
<tr><td colspan="2">Functions in this window</td><td>2 ▲ ABC</td><td>Select the second setup phase</td></tr>
<tr><td colspan="2" rowspan="2"></td><td>0 DEL</td><td>Delete the first Offset value and to return to the first setup phase.

Note: Do not perform this, if the settings are already complete.</td></tr>
<tr><td>ENTER</td><td>Save the set offset value.</td></tr>
</table>

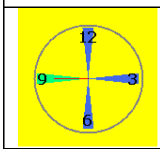


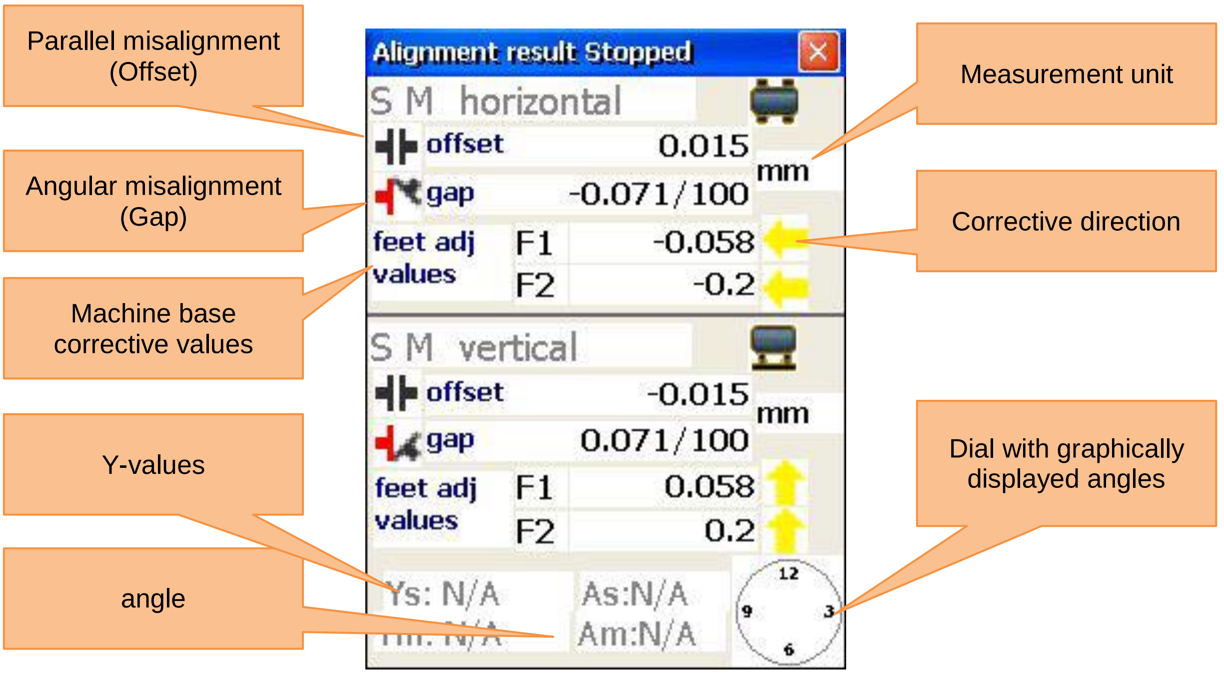
The Offset setup is a process consisting of two steps. Start with the first phase. Three digits need to be accepted here. Having accepted these values, hit 2 ABC to get to the second phase. Adjust the laser beam, until the value becomes 0 and wait for 5 seconds. Push ENTER to save the Offset value. After you have left the Offset menu, the symbol appears to display the Offset settings.

7.1.4 Result

To display the result of the measurement, push [F5], if you are located in the measurement screen or push [2 ABC], if you are located in the “horizontal alignment” option.

What should be noted in this window		Shortcuts in this window	
⚠	Do not rotate the shaft, while moving the machine.	[0 DEL]	Entry of misalignment tolerances
⚠	Do not change the position of the measurement unit, while Live Mode is activated		
Functions in this window		[1 i]	Spacer simulation
- View the calculated misalignment - Carry out Live Alignment - Pause/continue Live Mode - Manual entry of the angle (if activated) - Selection between 2 or 3 decimal digits - Selection of the measurement unit (mm/inch) - Entry of tolerances - Entry of thermal growth - Save the alignment results - Load the alignment results - Spacer simulation		[2 ABC]	For flange correction view (just vertically)
		[3 DEF]	Selection between 2 or 3 decimal digits
		[4 GHI]	Manual entry of the angles (if activated). In this case, you need to interrupt the Live mode and enter the angle afterwards.
		[*] [*]	If the cursor is in the first place of an entry field, push the button twice, to reverse sign
		[5 JKL]	Entry of thermal growth
		[6 MNO]	Selection of the measurement unit (mm/mils)
		[7 PQRS]	Interrupt/continue Live Alignment
		[8 TUV]	Save the alignment results to a file (see **chapter 10 „Handling of the Data Dialogue window“**)
		[9 WXYZ]	Load results from file (see **chapter 10 „Handling of the Data Dialogue window“**)

Symbols and status in this screen	
	A yellow dial in the alignment screen means that the angle of the measurement points is not accepted or that averaging is not completed. The Live Alignment mode is deactivated in this case.
	A red half of a coupling means that the current misalignment is out of the tolerance limits. If the misalignment is within these limits, the symbol is displayed in grey colour.
	A blinking checkbox in the headline of the particular plane means that Live Alignment can be used for this plane. Otherwise, this is not possible for the particular plane.
	This blinking error report means that the position of the shaft was changed unexpectedly. The Live Alignment mode will be deactivated. To activate it again, press [7 PQRS] to pause it and then [7 PQRS] again to continue.



The corrective values for the machine bases F1 and F2 of the moveable machine (M) on the horizontal plane show the horizontal displacement. Positive values tell you, that the bases need to be pushed, where negative values show that bases need to be pulled.

The corrective values for the machine bases F1 and F2 of the moveable machine (M) on the vertical plane show the vertical displacement. Positive values express, that the machine bases need to be lifted, where negative values tell you that they need to be lowered.

7.1.5 Live Alignment

7.1.5.1 Horizontal Live Alignment

To start the horizontal Live Alignment mode, the sensors should be in the 9 or 3 o'clock position. If you need to rotate the shaft, you have to pause the live mode by pressing 7 PQRS. Turn the shafts to the required position now and continue the live alignment by pressing 7 PQRS another time. Do not forget to enter the angle manually, if this option is activated. After a short message, Live Alignment should be enabled for the required plane (indicated by a blinking checkbox in the plane headline. Loosen the machine bases now and start the adjustment with the help of the calculated corrective values.

7.1.5.2 Vertical Live Alignment

To start the vertical Live Alignment mode, the sensors should be in the 6 o'clock or 12 o'clock position. If the shafts need to be rotated, you should proceed as described in the horizontal Live Alignment mode. Plane 6-12 should now be enabled for the Live Alignment. Loosen the machine bases and align them by means of the corrective values.

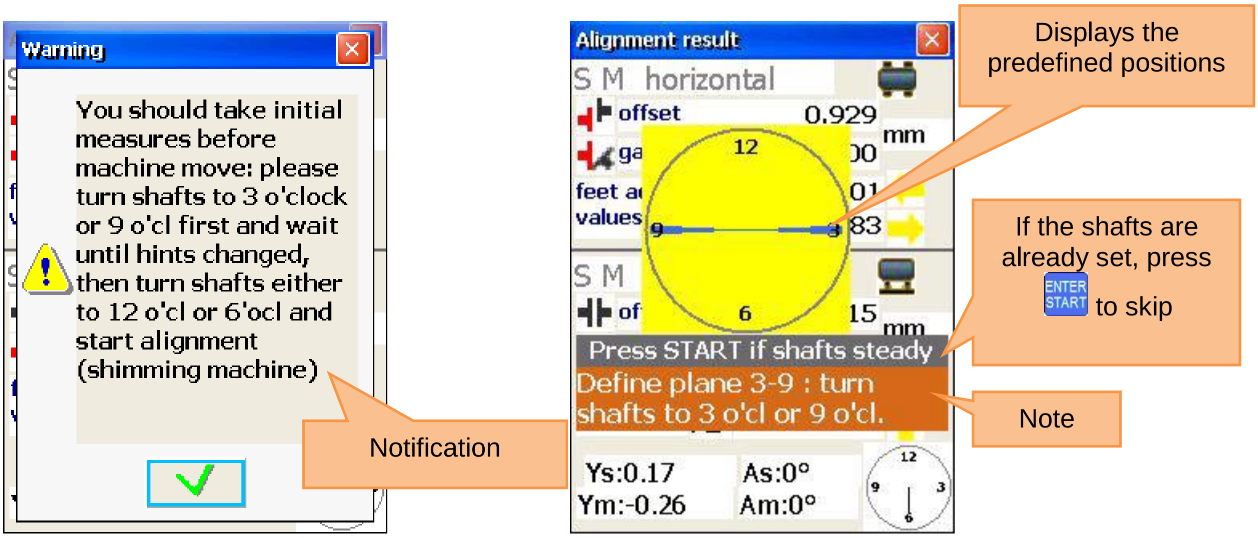
7.1.5.3 Biaxial (Y,X) Live Alignment

The biaxial Live Alignment process does almost take place as the horizontal or vertical alignment. The only difference is, that the sensors do not need to be in a predefined position. Nevertheless, it is recommended to place the sensors at an angle of about 45° (45°, 135°, 225°, 315°), to avoid measurement errors.

⚠ Movements of the shafts should be avoided in the course of biaxial alignment!

7.1.5.4 Carry on working after the position of the sensors has been changed

Before you continue with the alignment, after the position of the sensors has been changed, you need to place the sensors in two predefined positions (3/9 o'clock and 6/12 o'clock). A notification describing the procedure will appear. Do not forget to enter the angle manually, if this option is activated. If the sensors have been placed in a predefined position, the next step is automatically continued after a short setting time. If the shafts are already set, the setting time can be skipped by pressing ENTER START.

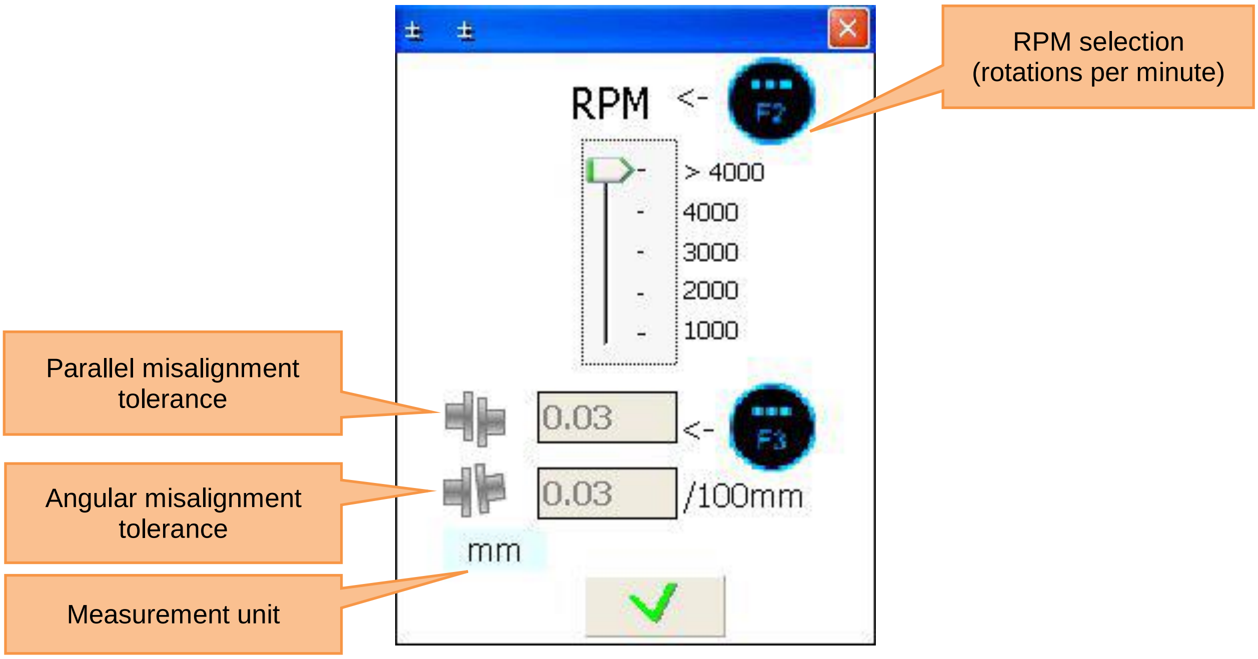


After the first step is finished (e.g. 3:00 /9:00 position), the position indication changes with the note for the second step (e.g. 6:00/12:00 position).
After the second step is finished as well, the note and the yellow dial vanish and the Live Alignment process starts.

7.1.5.5 Entry of tolerances

To enter tolerances, press 0 DEL

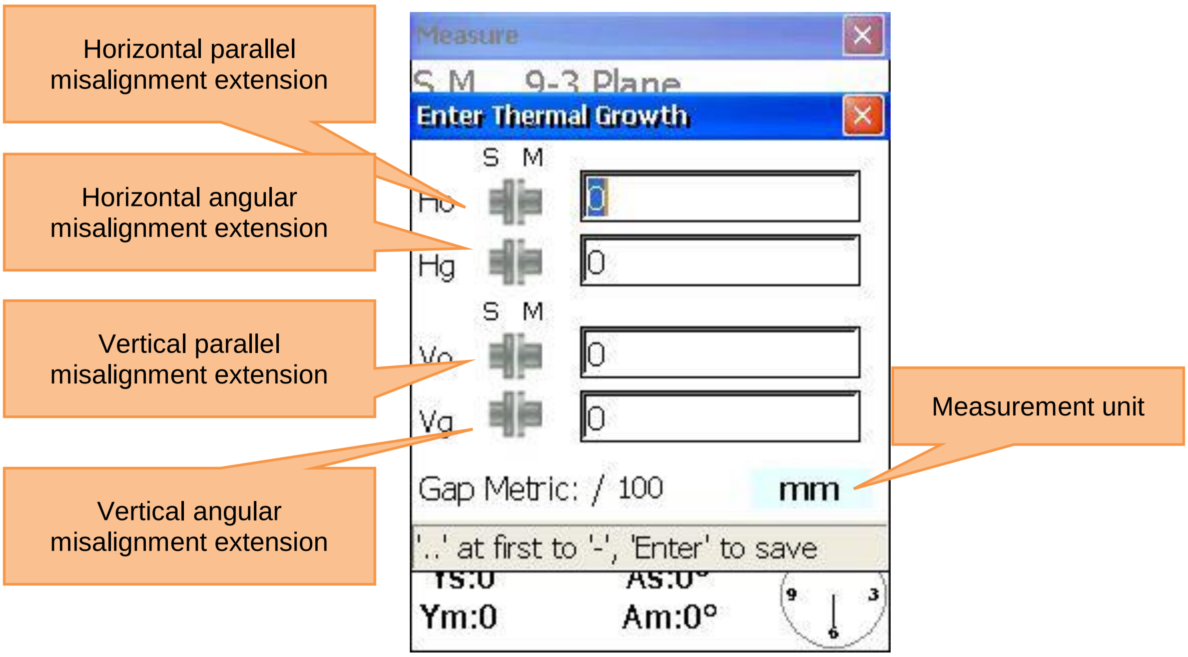
Functions in this window	Shortcuts in this window	
- Selection of industry standard tolerances via the RPM selection - Manual tolerance entry	F2	Adjust tolerances via RPM (rotations per minute)
	F3	Manual entry of tolerances
	▲	If the RPM selection is activated: Raise RPM by one step. If manual entry is activated: Select parallel misalignment
	▼	If RPM selection is activated: Reduce RPM by one step. If manual entry is activated: Select angular misalignment entry
	ENTER	Save and exit



7.1.5.6 Entry of thermal growth

To enter thermal growth, press 5 JKL.

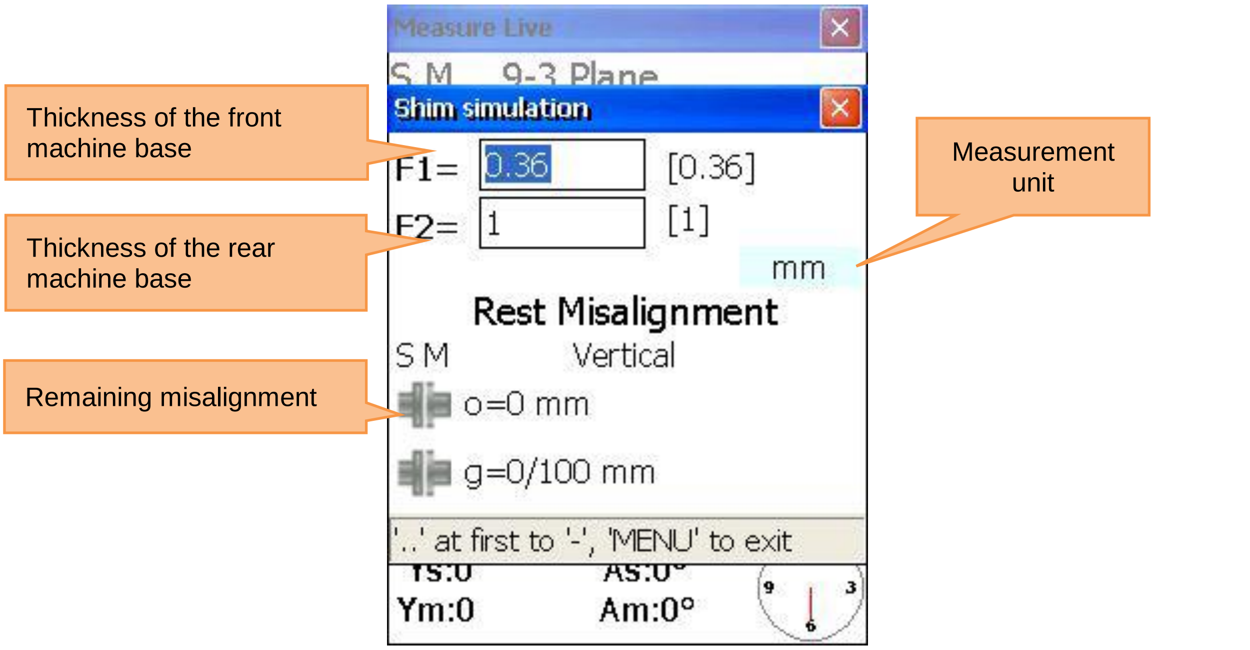
Functions in this window	Shortcuts in this window	
- Enter horizontal parallel misalignment extension - Enter horizontal angular misalignment extension - Enter vertical parallel misalignment extension - Enter vertical angular misalignment extension		Navigate up through the entry fields
		Navigate down through the entry fields
	* *	If the cursor is in the first place of an entry field, push the button twice, to reverse sign
	ENTER	Save and exit



7.1.5.7 Spacer simulation

To simulate spacers, push

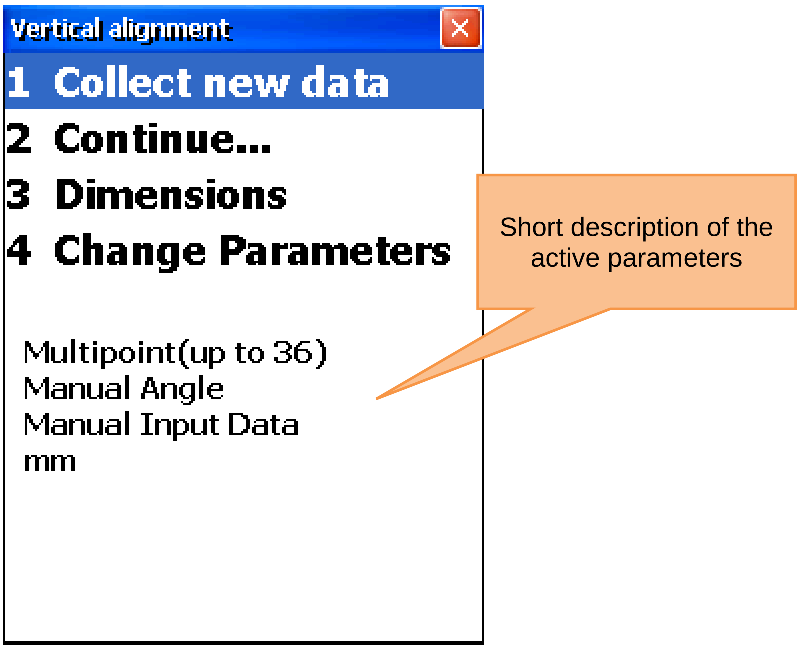
Functions in this window	Shortcuts in this window	
- Entry of the thickness of the front machine base (F1) - Entry of the thickness of the rear machine base (F2) - Remaining misalignment		Navigate up through the entry fields
		Navigate down through the entry fields
	ENTER	Save and exit



7.2 Vertical machine alignment

Mount the measurement sensor, marked as **S**, to the shaft of the stationary machine and the measurement sensor marked as **M** to the moveable machine.
Note: Mark the 3, 6, 9 and 12 o'clock position on the machine housing.
Connect the cable as described in chapter 5.3 **"Connection of the measurement sensors"** or configure the Bluetooth-interface (only with optional Bluetooth adaptor).

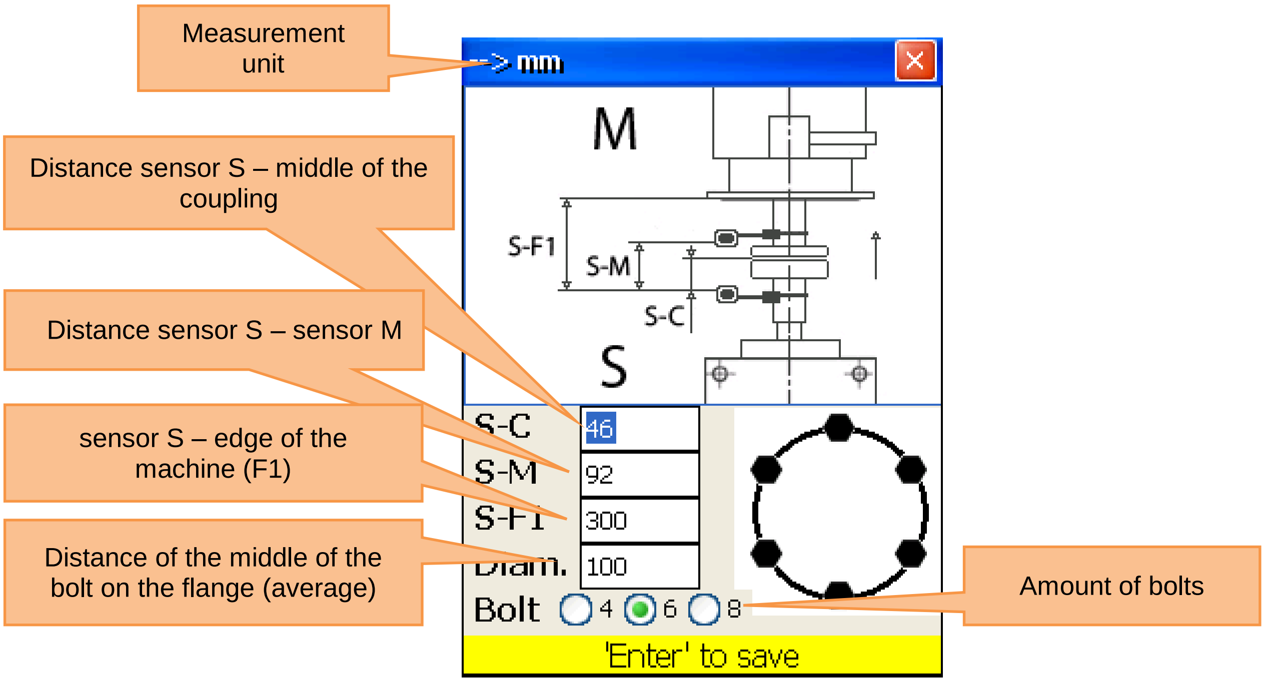
What should be noticed in this window		Shortcuts in this window	
⚠	Check the result after the alignment, by measurement again	1	Determine new data
Functions in this window		2 ABC	Continue alignment process
	- Determine new data and start the alignment - Continue the alignment - Change parameters - Change dimensions and distances - View/change	3 DEF	Change the machine dimensions and distances
		4 GHI	Add/change parameters



7.2.1 Entry of machine dimension

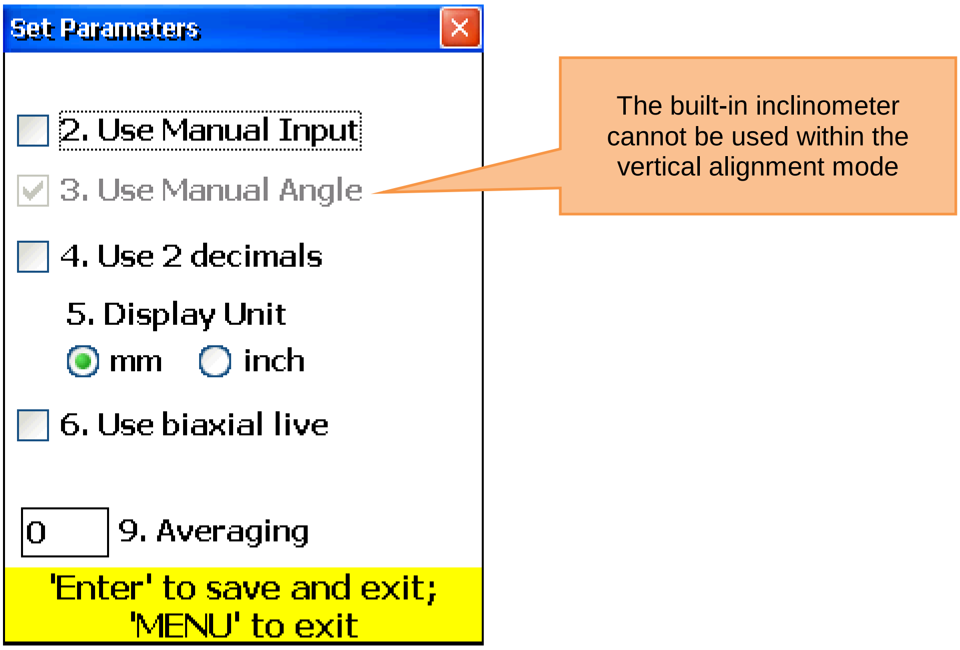
To enter the machine dimensions, press 3 DEF.

What should be noticed in this window		Shortcuts in this window	
	for correct measurement results, the following must be respected: S-C ≤ S-F1 < S-F2		Navigate up through the entry fields
Functions in this window			Navigate down through the entry fields
-	Enter distance sensor S – middle of the coupling		Set the amount of bolts
-	Enter distance sensor S – sensor M	ENTER	Save and exit
-	Enter distance sensor S – edge of the machine		



7.2.2 Change/add parameters

<table>
<tr><td colspan="2">What should be noticed in this window</td><td colspan="2">Shortcuts in this window</td></tr>
<tr><td>⚠</td><td>Use the Biaxial Live function with stable shaft positions, because the smallest rotations can lead to errors</td><td>2 ABC</td><td>Activate/deactivate manual data entry</td></tr>
<tr><td colspan="2">Functions in this screen</td><td>4 GHI</td><td>Selection between 2 or 3 decimal digits</td></tr>
<tr><td colspan="2" rowspan="3">- Manual entry or use of the sensor data
- Selection between 2 or 3 decimal digits
- Selection of the measurement unit (mm/inch)
- Alignment to the X- and Y-coordinates simultaneously or just to the Y-coordinates (default)</td><td>5 JKL</td><td>Selection of the measurement unit (mm/inch)</td></tr>
<tr><td>6 MNO</td><td>Activate/deactivate Biaxial Live Alignment</td></tr>
<tr><td>ENTER</td><td>Save and exit</td></tr>
</table>

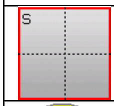
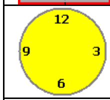


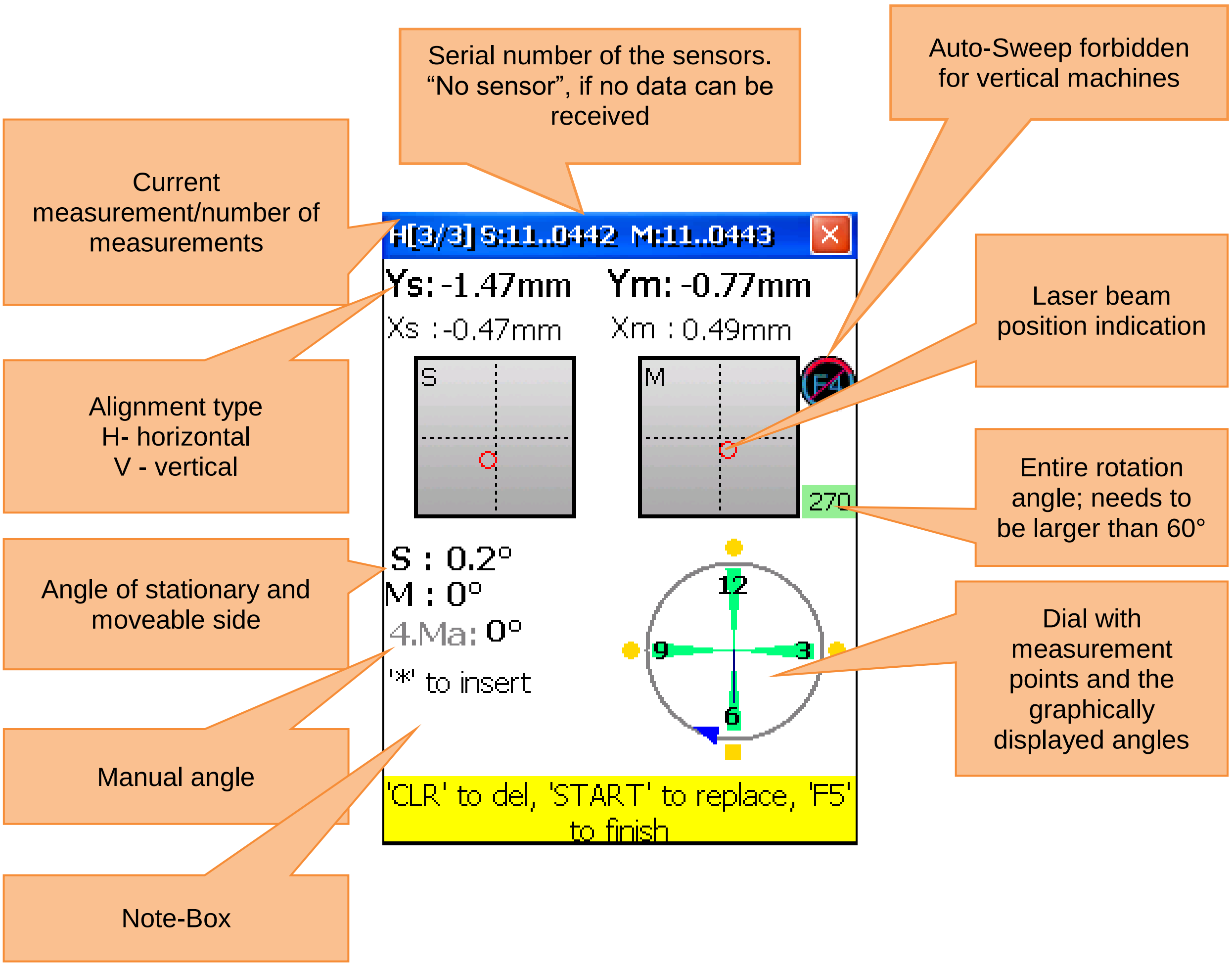
7.2.3 Data acquisition

To collect data, press 1 ⓘ.

What should be noted in this window		Shortcuts in this window	
⚠	Before starting a new alignment process, you need to enter dimensions and parameters	0 DEL	Start again (deletes all values) Confirmation dialogue appears
⚠	Do not change the position of measurement units when work is interrupted		
⚠	Laser is now switched on		
Functions in this window		1 ⓘ	Enter Ys-values, if manual entry is activated
-	Collect measured values (up to 36)	2 ABC	Enter Ym-values, if manual entry is activated
-	Select between auto sweep and manual mode	4 GHI	Enter angle/inclination, if manual entry is activated
-	Manual entry of Ys- and Ym-values (if activated)	*. *.	If cursor is on the first place in the entry field, push this button twice to reverse sign
-	Manual angle/inclination entry (if activated)	6 MNO	Select the measurement unit (mm or inch)
-	Selection of measurement unit (mm/inch)	7 PQRS	Set parallel misalignment (Offset)
-	Navigate through collected data	8 TUV	Save all data in one file (see **chapter 10 „Handling of the Data Dialogue window“**)
-	Delete/add/replace measured values	9 WXYZ	Load data from file (see **chapter 10 „Handling of the Data Dialogue window“**)
-	Restart (all values are deleted)	CLR	Delete currently selected reading
-	Set Offset	*.	Enter new value. You have to switch to the last value saved, to make this option

- Save collected data - Load collected data		possible
	ENTER START	Save the current value or replace already saved values (confirmation dialogue appears)
	▲ ▼	Navigate through data
	F5	Continue to the result window. All necessary conditions need to be fulfilled
	F2	Open popup menu
	F4	Activate/deactivate auto-sweep. Auto-sweep can only be activated at the beginning of data acquisition or after restart. Manual entry of values and inclination need to be deactivated

Symbols and status in this window	
[C]	A blinking amber-coloured “C” in the display means that currently no data can be received from the sensors.
[R]	A blinking red “R” in the display means that you are already viewing a stored reading. This one can be deleted or replaced. If this sign is not displayed in the window, the current value has not been saved yet. Pressing ENTER START, you can store the value.
	The absence of the laser beam position indicator and a red blinking frame of the position indicator mean, that no laser beam meets or no sensor data are recognized.
	An empty dial means that there is currently no angle established (or averaging is not completed) or that the rotation angle (to the next position) is too small (lower than 6°)
0	A bright red indication means that the rotation angle does not meet the requirements of the single measurement points (at least 60°). A yellow indictaion means that the rotation angle is over 60°. A green indication means that the rotation angle is over the recommended area (over 90°).
	This symbol means that an expanded Y-value range is used.
	A crossed-out symbol means that the auto-sweep mode is deactivated.


Serial number of the sensors.
“No sensor”, if no data can be received
Auto-Sweep forbidden for vertical machines
Current measurement/number of measurements
H[3/3] S:11..0442 M:11..0443
Ys: -1.47mm
Ym: -0.77mm
Xs : -0.47mm
Xm : 0.49mm
S
M
F4
Laser beam position indication
Alignment type
H- horizontal
V - vertical
270
Entire rotation angle; needs to be larger than 60°
S : 0.2°
M : 0°
4.Ma: 0°
'*' to insert
12
9
3
6
Angle of stationary and moveable side
Dial with measurement points and the graphically displayed angles
Manual angle
'CLR' to del, 'START' to replace, 'F5' to finish
Note-Box

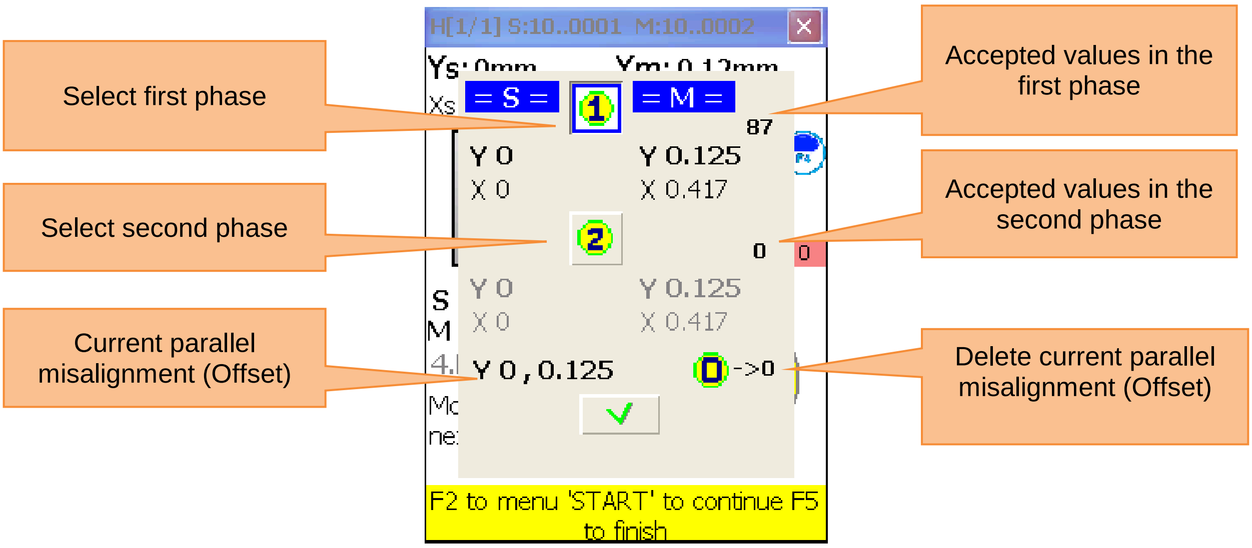
Description of the dial Saved measurement points are marked as green sectors on the dial and coloured points next to them. The coloured points are round by default. If a coloured dot is square, it means that you are currently viewing this saved measurement point. The colour of the dot informs about the standard deviation of the current alignment function.	
●	A blue dot means that the data are not ready (less than 3 measurement points are saved).
●	A green dot means that the data are good.
●	A yellow dot means that the data are not good, but acceptable.
●	A red dot means that the data are bad. This measurement needs to be deleted or replaced. If you use a small amount of measurement points it might occur, that other points but this point are bad. For this case, you should use more measurement points to find out which one is bad.

Use the adjustment screws on the measurement sensors to align the laser beams one after the other to the middle of the detector opening (figure **front and top view of the sensor/side view of the sensor**). If the laser beams aim both detectors, open the covers. The X- & Y-coordinates and the position von **S** and **M** are now displayed on the monitor. Rotate the shaft into the selected 1st measurement position. Save the active measurement point by pressing ENTER START. Save as many measurement points as possible (at least 3) and use a rotation angle as large as possible (at least 60°). If you have collected the necessary data, press F5 to start the alignment.

7.2.3.1 Set the parallel misalignment (offset)

Press 7 PQRS, for Offset settings.

What should be noted in this window		Shortcuts in this window	
⚠	Do not rotate the shaft; especially not while adjusting the sensors.	1 ⓘ	Select the first setup phase
⚠	Do not delete the parallel misalignment (offset), after it was saved. Otherwise, you have to repeat the whole data acquisition process.		
Functions in this window		2 ABC	Select the second setup phase
		0 DEL	Delete the first Offset value and to return to the first setup phase. Note: Do not perform this, if the settings are already complete.
		ENTER	Save the set offset value.

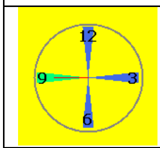


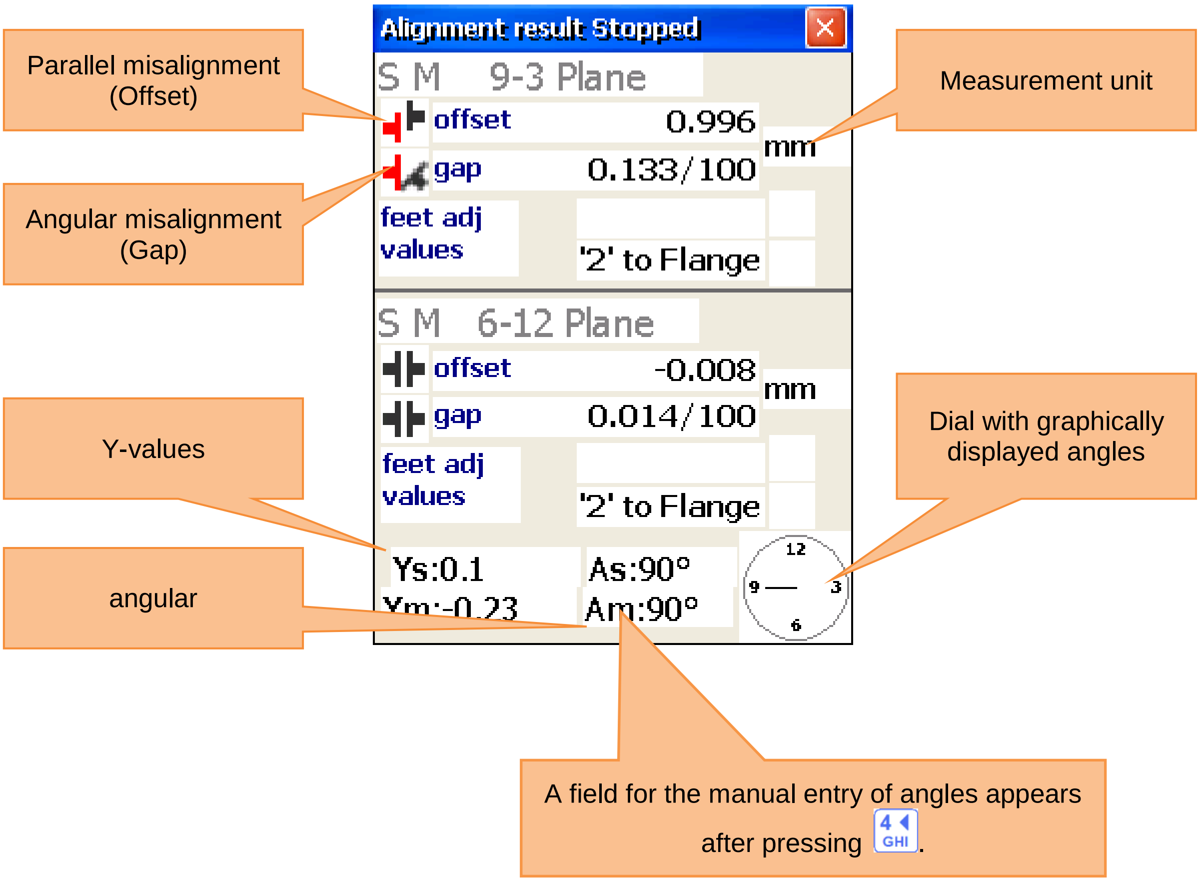
The Offset setup is a process consisting of two steps. Start with the first phase. Three digits need to be accepted here. Having accepted these values, push to get to the second phase. Adjust the laser beam, until the value gets 0 and wait for 5 seconds. Push to save the Offset value. After you have left the Offset menu, the symbol appears to display the Offset settings.

7.2.4 Result

To display the result of the measurement, push F5, if you are located in the measurement screen or push 2 ABC, if you are located in the “horizontal alignment” option.

What should be noted in this window		Shortcuts in this window	
⚠	Do not rotate the shaft, while moving the machine.	0 DEL	Entry of misalignment tolerances
⚠	Do not change the position of the measurement unit, while Live Mode is activated		
Functions in this window		1 ⓘ	Spacer simulation
- View the calculated misalignment - Carry out Live Alignment - Pause/continue Live Mode - Manual entry of the angle (if activated) - Selection between 2 or 3 decimal digits - Selection of the measurement unit (mm/inch) - Entry of tolerances - View Corrective values for the flanged bolt (with live update) - Save the alignment results - Load the alignment results		2 ABC	For flange correction view (just vertically)
		3 DEF	Selection between 2 or 3 decimal digits
		4 GHI	Manual entry of the angles (if activated). In this case, you need to pause the Live mode and enter the angle afterwards.
		* . * .	If the cursor is in the first place of an entry field, push the button twice, to reverse sign
		5 JKL	Entry of thermal growth
		6 MNO	Selection of the measurement unit (mm/mils)
		7 PQRS	Pause/continue Live Alignment
		8 TUV	Save the alignment results to a file (see **chapter 10 „Handling of the Data Dialogue window”**)
		9 WXYZ	Load results from file (see **chapter 10 „Handling of the Data Dialogue window“**)

Symbols and status in this screen	
	A yellow dial in the alignment screen means that the angle of the measurement points is not accepted or that averaging is not completed. The Live Alignment mode is deactivated in this case.
	A red half of a coupling means that the current misalignment is out of the tolerance limits. If the misalignment is within these limits, the symbol is displayed in grey colour.
☑	A blinking checkbox in the headline of the particular plane means that Live Alignment can be used for this plane. Otherwise, this is not possible for the particular plane.
Error - shafts turned! ✕	This blinking error report means that the position of the shaft was changed unexpectedly. The Live Alignment mode will be deactivated. To activate it again, press 7 PQRS to pause it and then 7 PQRS again to continue.



To eliminate angular misalignment, you need to correct the angle of the rotation axis of the moveable machine with the help of spacers with the values from the bolt corrective value window.

⚠ Do not change the lateral position of the moveable machine when adjusting the spacers.

9-3 plane Live Alignment

To start the 9-3 plane Live Alignment, the sensors should be located in the 9 or 3 o'clock position. If you need to rotate the shafts, pause the Live Alignment and continue it by pressing 7 PQRS. Do not forget to enter the angle manually. After a short notification, the Live Alignment should be enabled for the required plane. (indicated by a blinking checkbox in the headline of the plane). Loosen the machine bases and start the adjustment with the help of the calculated corrective values in the 9-3 plane.

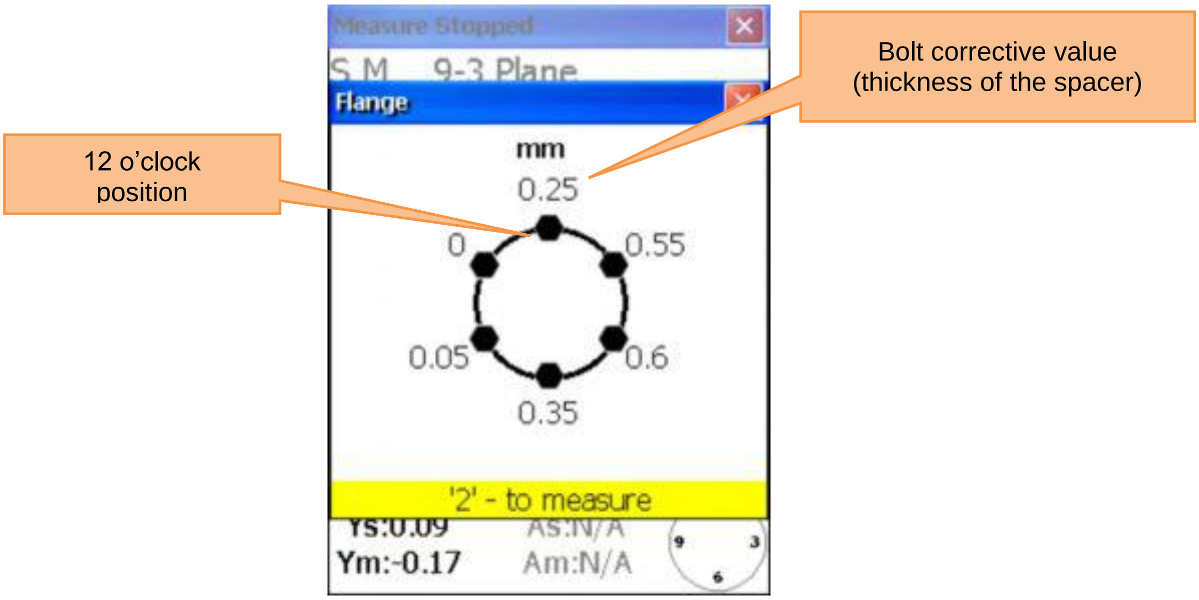
6-12 plane Live Alignment
To start the 6-12 plane Live Alignment, the sensors should be located in the 6 or 12 o'clock position
If you need to rotate the shafts, proceed as described in the "9-3 plane Live Alignment". The 6-12 plane should be enabled for the Live Alignment now. Loosen the machine bases now and align the moveable machine in the 6-12 plane.

Biaxial Live Alignment

The biaxial Live Alignment process does almost take place as the horizontal or vertical alignment. The only difference is that the sensors do not need to be in a predefined position. Nevertheless, it is recommended to place the sensors at an angle of about 45° (45°, 135°, 225°, 315°), to avoid measurement errors.

7.2.4.1 View bolt corrective values

To view the corrective values for each bolt, press 2 ABC to make the according window appear. To close the window, press 2 ABC .once again.



Before you continue working, after the position of the sensors was changed, you need to place the sensors in two predefined positions. Proceed as described in **7.1.5.4. (" Carry on working after the position of the sensors has been changed")**

7.2.4.2 Entry of tolerances

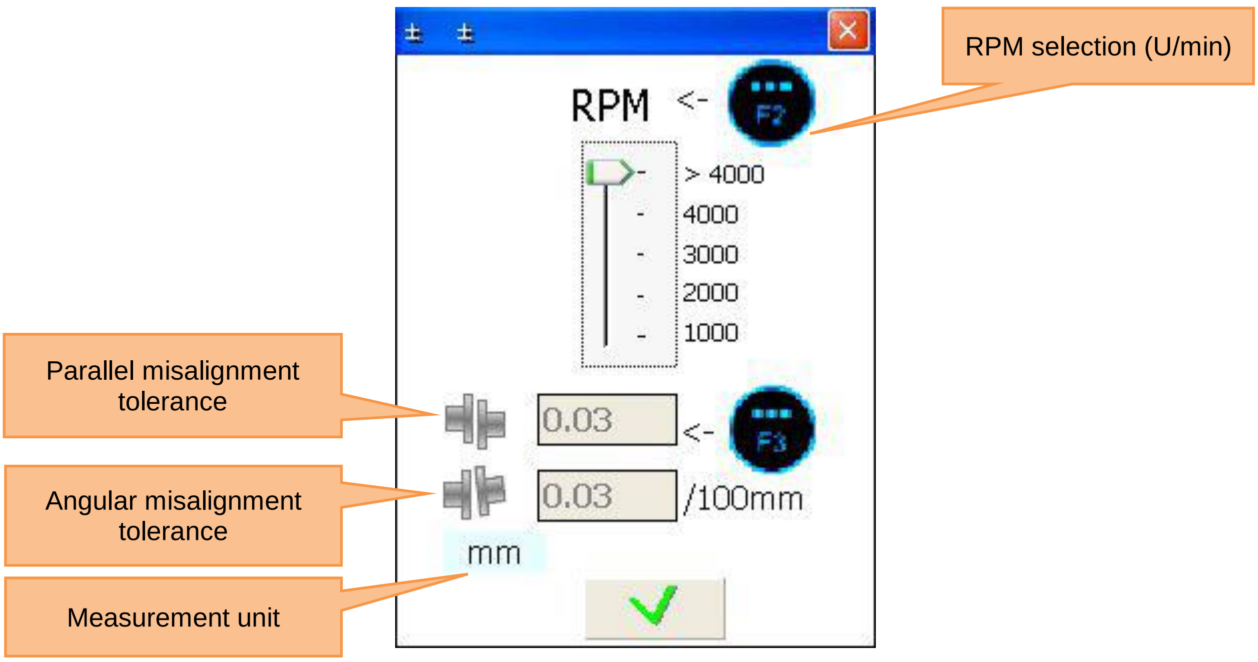
To enter tolerances, press 0 DEL

<table>
<tr><th>Functions in this window</th><th colspan="2">Shortcuts in this window</th></tr>
<tr><td rowspan="5">- Selection of industry standard tolerances via the RPM selection

- Manual tolerance entry</td><td>F2</td><td>Adjust tolerances via RPM (rotations per minute)</td></tr>
<tr><td>F3</td><td>Manual entry of tolerances</td></tr>
<tr><td></td><td>If the RPM selection is activated:
Raise RPM by one step.

If manual entry is activated:
Select parallel misalignment</td></tr>
<tr><td></td><td>If RPM selection is activated:
Reduce RPM by one step.

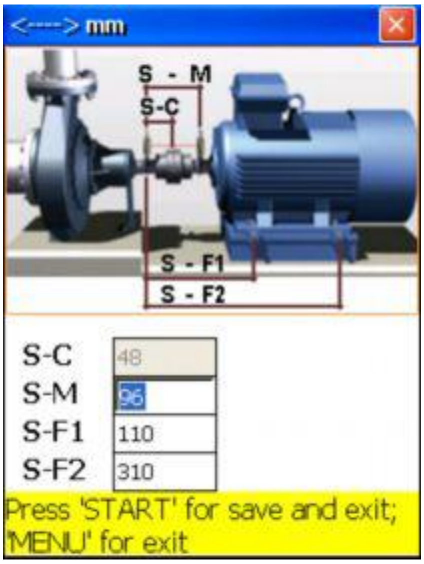
If manual entry is activated:
Select angular misalignment entry</td></tr>
<tr><td>ENTER</td><td>Save and exit</td></tr>
</table>

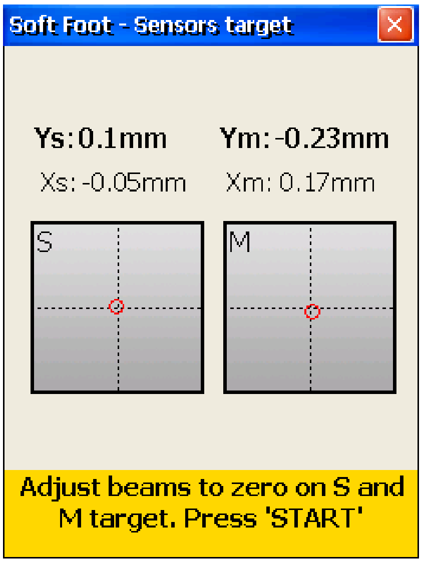


7.3 Soft Foot Measurement

What should be noted in this window		Shortcuts in this window	
⚠	The machine dimensions should be entered first (go to the according menu item)	ENTER START	Start the Soft Foot Measurement. Rotate the sensors to the 12 o'clock position and adjust the laser until it aims the target plate S and M in the middle.
Functions in this window		0 DEL	Restart the Soft Foot Measurement
-	Perform Soft Foot Measurements for all machine feet	8 TUV	Save results to a file (see **chapter 10 "Handling of the Data Dialogue window"**)

Firstly enter the machine dimensions (just as described with the horizontal alignment) or skip the process by pressing ENTER START and go to the sensor aiming screen.

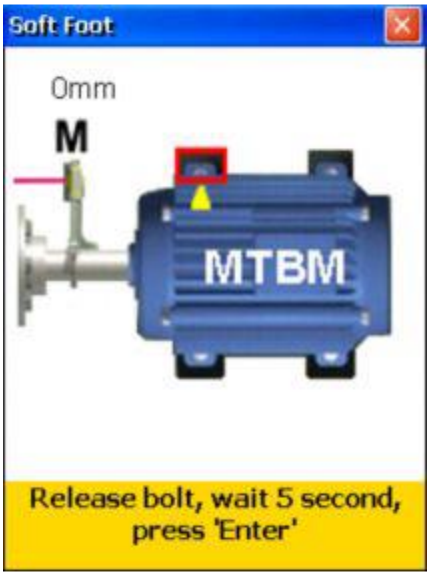


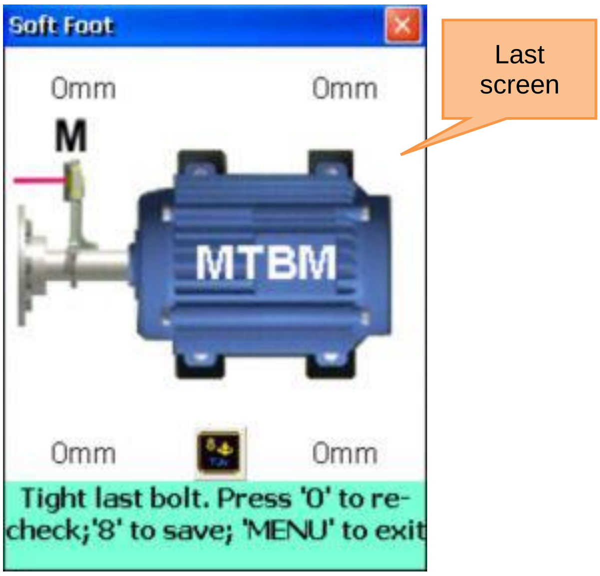


If the laser beams are aligned and you leave the sensor aiming screen, you get to the Soft Foot Measurement screen.

Now go through the following steps for every single machine base:

- Loosen the mounting (placed on the red square) of the required machine base, wait for 5 seconds and press ENTER to store the value. Having done that, you need to remount the machine base and press ENTER START, to continue with the next base.





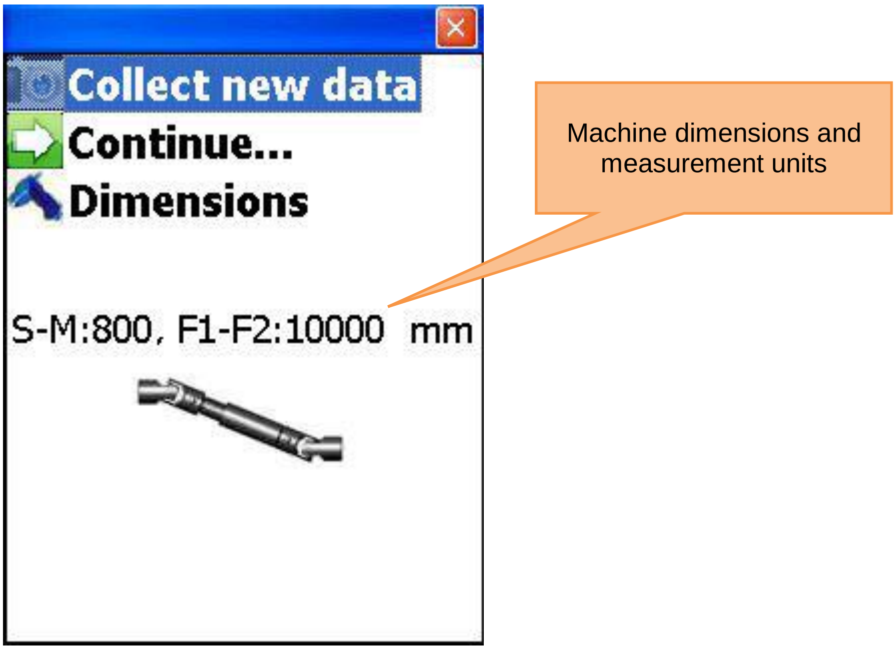
If all measurements are finished, a blinking 8 TUV symbol appears and you can save the measurement results by pressing this symbol. To restart the Soft Foot Measurement, press 0 DEL.

7.4 Drive Shaft Alignment

This program serves to the alignment of those machines connected by a drive shaft or cardan shaft. With the optional mounting kit for cardan shafts, the sensors can be mounted. The cardan shaft alignment is mostly identical to the horizontal machine alignment. Therefore, please do refer to **chapters 7.1 ("Horizontal machine alignment")** **and 5.5** (**"Rough alignment"**). The differences to these chapters are described in the following

Drive Shaft main menu

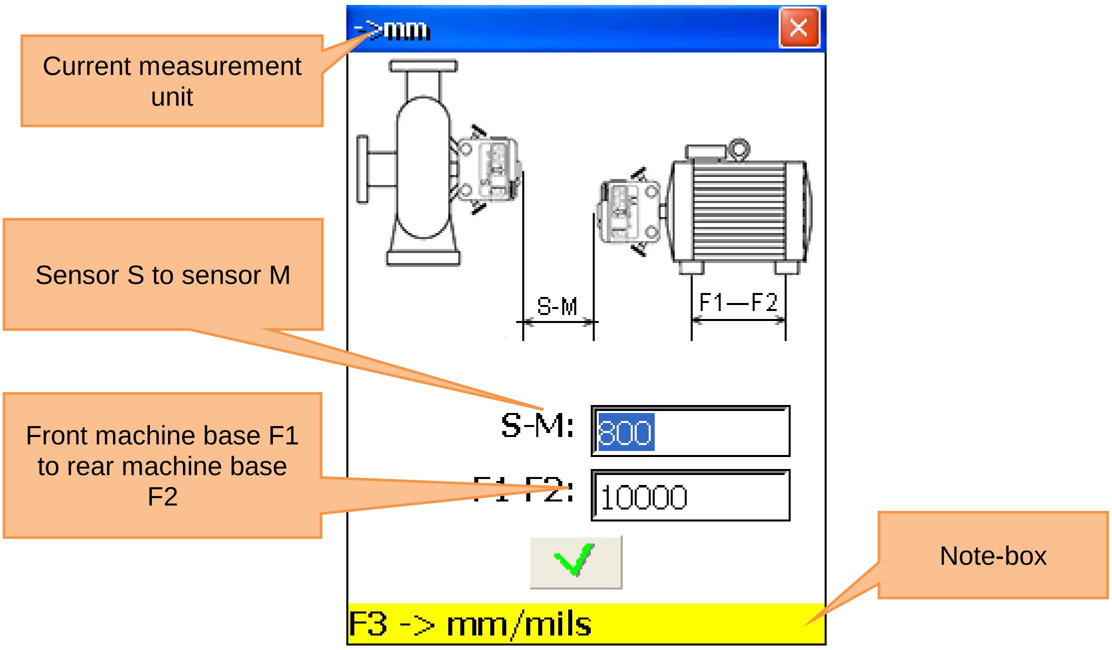
What should be noted in this window		Shortcuts in this window	
⚠	Before the measurement, a Soft Foot Measurement should be carried out to avoid unexpected measurement errors.	1	Acquire new data
⚠	Check the result after alignment by measurement again		
Functions in this window		2 ABC	Continue the alignment procedure
- Acquire new data and start alignment - Continue alignment - Change distances and dimensions - Change the parameters		3 DEF	Change the machine dimensions and distances
		4 GHI	Change the paramters



7.4.1 Set machine dimensions and measurement units

To set the machine dimensions and measurement units, press 3 DEF.

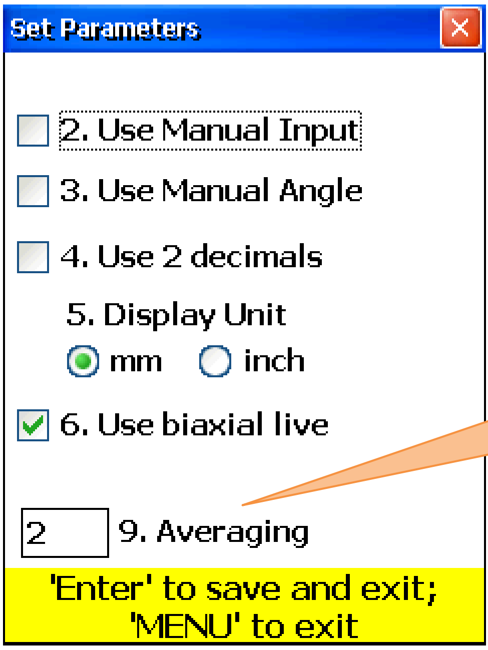
Functions in this window	Shortcuts in this window	
- Enter distance sensor S – sensor M - Enter distance front machine base –rear machine base	▲	Navigate up
	▼	Navigate down
	F3	Switch between measurement units (mm/mils)
	ENTER	Save and exit



7.4.2 Change parameters

Press 4 GHI, to change parameters.

What should be noted in this window		Shortcuts in this window	
⚠	Only use the Biaxial Live function with stable shaft positions, because even the smallest rotations can lead to measurement errors	2 ABC	Activate/deactivate manual data entry
Functions in this window		3 DEF	Activate/deactivate manual angle entry
- Manual entry or use of the sensor data - Manual angle entry - Selection between 2 or 3 decimal digits - Selection between inch and mm as measurement unit - Activate/deactivate Biaxial Live Alignment		4 GHI	Select 2 or 3 decimal digits
		5 JKL	Select mm or inch as measurement unit
		6 MNO	Activate/deactivate Biaxial Live Alignment
		9 WXYZ	Entry for averaging
		ENTER	Save and exit



Filter (averaging) settings
Push ENTER to confirm the entry.

7.4.3 Collect data and align

Proceed as in the horizontal machine alignment. Pay attention to the following differences:

- The minimal shaft rotation angle must not be smaller than 75°
- Corrective values for the parallel misalignment are irrelevant when it comes to cardan shafts and will not be displayed
- Standard tolerances cannot be used for cardan shafts. Please ignore them.
- Only corrective values for one machine base are needed, because parallel misalignment is not corrected with cardan shafts.

7.5 Alignment of machine trains

7.5.1 Short explanation

A machine train consists of three or more units with rotating shafts, which are connected with couplings, as for example driving unit – gear – driven unit. With a common alignment measurement, an alignment measurement for every single machine would be necessary. The PCE-TU 3 system performs all necessary measurements automatically and offers the possibility to define the stationary or reference machine. To use this function, you should be familiar to **chapter 7.1 ("Horizontal machine alignment")**.

7.5.2 Execution of a machine train alignment

To start the program, select "machine train" and press ENTER START. The main screen of the program will appear.

What should be noted in this window
Similar to the horizontal alignment, a Soft Foot Measurement should be carried out before. If needed, corrections should be made. Do not forget to enter the dimensions in the menu for the horizontal machine alignment.
All needed dimensions should be entered correctly.
The Sensor M must always be placed right to the coupling on the machine; also it is actually a stationary one.

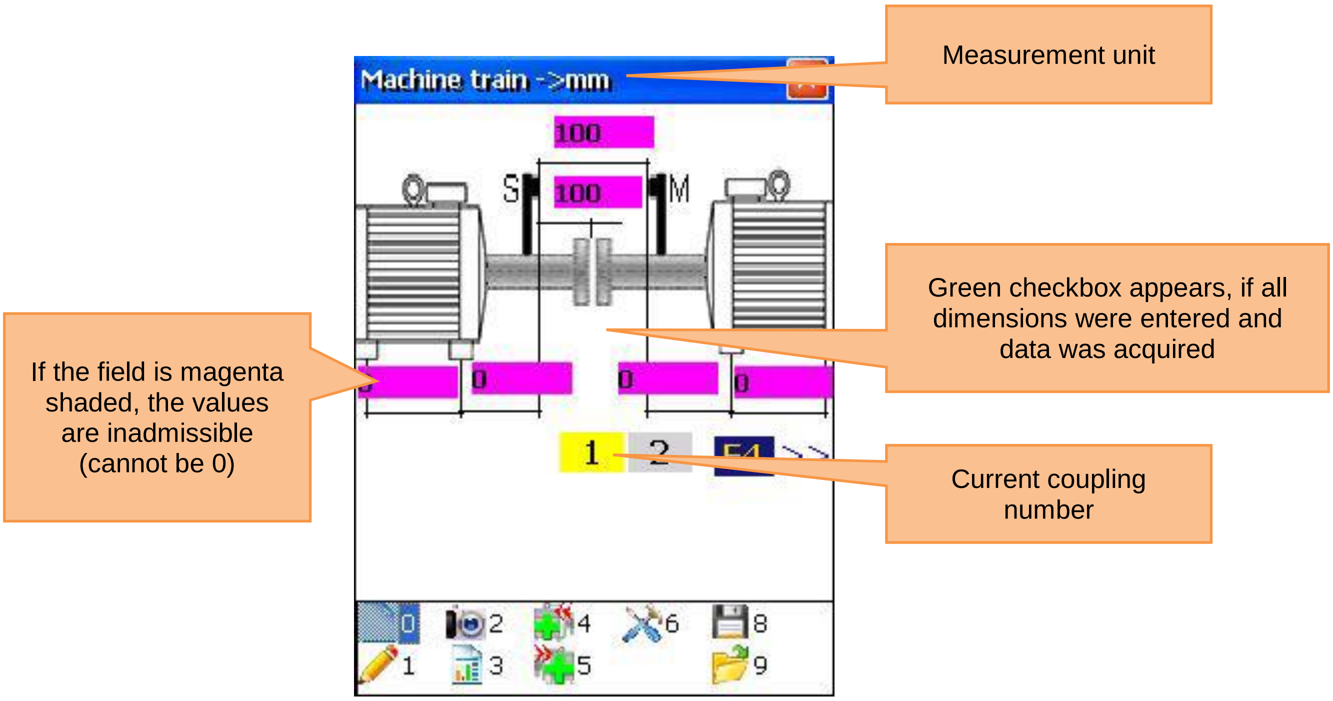
Functions in this window
- Create/modify/view a train - Determine parameters - Enter dimensions - Identify misalignment - View the measured data - Save the results - Load saved results

Shortcuts in this window	
0 DEL	Create a new train (initially 3 units in the train)
1 ⓘ	Dimensions of the machines and the selected coupling need to be entered first.
2 ABC	Collect data (refer to chapter 7.1 „Horizontal machine alignment") Use F5 in the measurement screen to finish the collection process and return to the main menu of the program
3 DEF	View alignment results
4 GHI	Add a machine on the left side of the train
5 JKL	Add a machine on the right side of the train
6 MNO	Set parameters
7 PQRS	reserved (no function)
8 TUV	Save results to a file (see **chapter 10 "Handling of the Data Dialogue window"**)
9 WXYZ	Load data from file (see **chapter 10 „Handling of the Data**

		Dialogue window")
	F2	Open pop-up menu
	F3	Scroll left
	F4	Scroll right
	MENU	Exit program
Symbols and status in this window		
✔	A green checkbox near the middle of the coupling means that the dimensions were entered correctly and that the data were detected correctly	

Press F3 or F4, to scroll through the complete train; press 1 ⓘ, to enter the dimensions for the machine of the current coupling. Press 6 MNO, to change the parameters (see chapter 7.1.2 **"Change parameters"**). press 2 ABC,
to determine misalignment for the current coupling. Every coupling is measured as described in **chapter 6.3 ("Soft Foot Measurement")**.

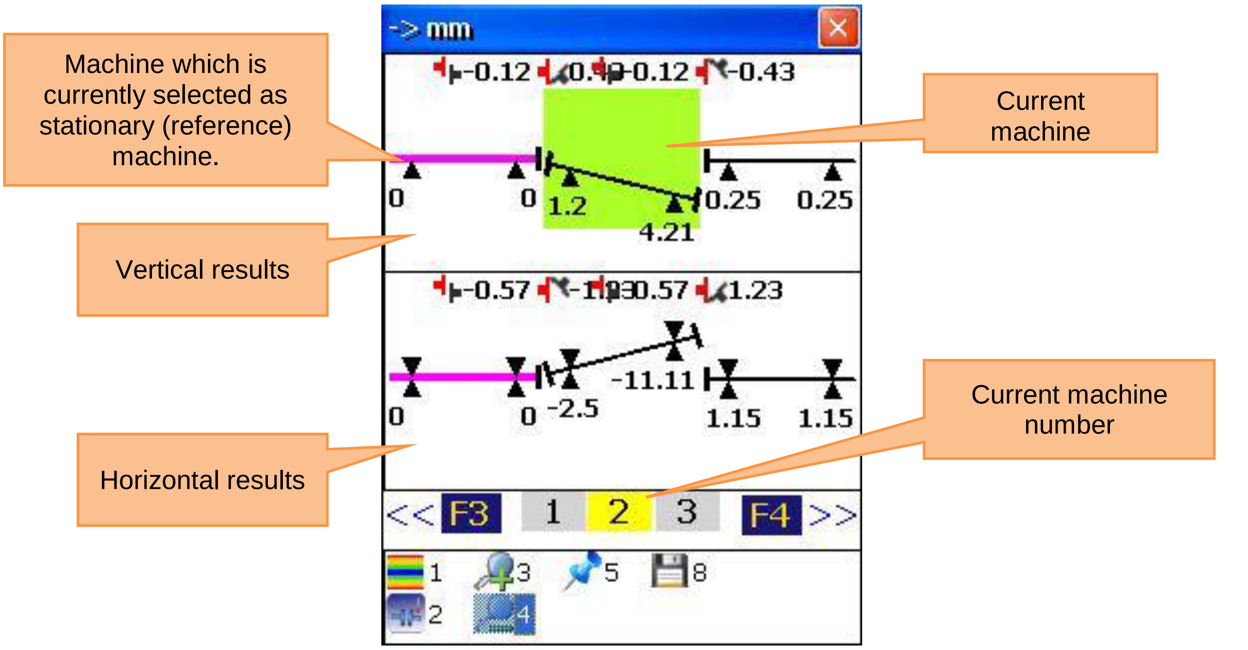
⚠ The minimal rotation angle of two adjacent measurement points is 18° and the minimal overall rotation angle is 75°. Press 3 DEF to view the measurement results.

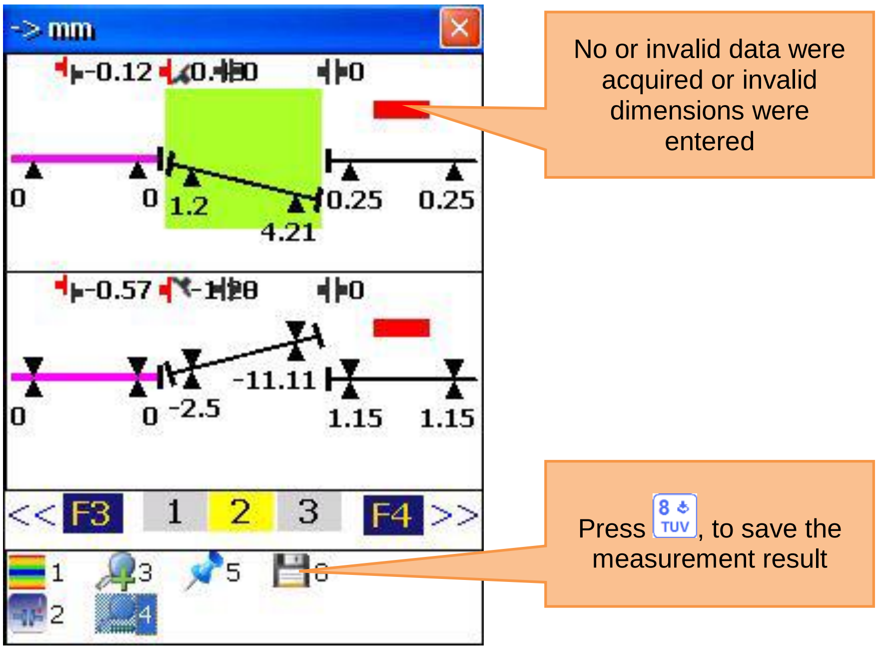


7.5.3 View measurement results

To view the measurement results, press 3 DEF in the main menu screen of the program.

<table>
<tr><th>Functions in this window</th><th colspan="2">Shortcuts in this window</th></tr>
<tr><td rowspan="10">- Overview of measurement results and Soft Foot Measurement corrective values
- Entry of shaft tolerances
- Entry of thermal growth
- Save the results</td><td>1 ⓘ</td><td>Set tolerances for the current coupling.
Note: The entered tolerances are always valid for the left shaft or machine.</td></tr>
<tr><td>2 ▲ ABC</td><td>Set thermal growth.
Note: The values for the thermal growth are always valid for the left shaft or machine.</td></tr>
<tr><td>3 DEF</td><td>Zoom-in</td></tr>
<tr><td>4 ◀ GHI</td><td>Zoom-out</td></tr>
<tr><td>5 ▼ JKL</td><td>Define the current machine as reference machine.</td></tr>
<tr><td>8 TUV</td><td>Save results to a file (see chapter 10 “Handling of the Data Dialogue window”)</td></tr>
<tr><td>F2</td><td>Open pop-up menu</td></tr>
<tr><td>F3</td><td>Scroll left</td></tr>
<tr><td>F4</td><td>Scroll right</td></tr>
<tr><td>MENU</td><td>Exit program</td></tr>
<tr><td colspan="3">Symbols and status in this window</td></tr>
<tr><td></td><td colspan="2">If a red square appears on the machine place, it means that the entered dimensions or the evaluated data are not valid (or no data were acquired):</td></tr>
<tr><td></td><td colspan="2">A magenta coloured shaft marks the stationary machine (reference machine).</td></tr>
</table>





7.6 Spindle Program

To align spindles (for example of lathes), mount the transmitter (Sensor S by default) to the chuck and the receiver to the tool slide.

To start the Spindle Program, select "Spindle" in the main menu and press ENTER. The main screen of the Spindle Program will appear.

7.6.1 Main screen of the Spindle Program

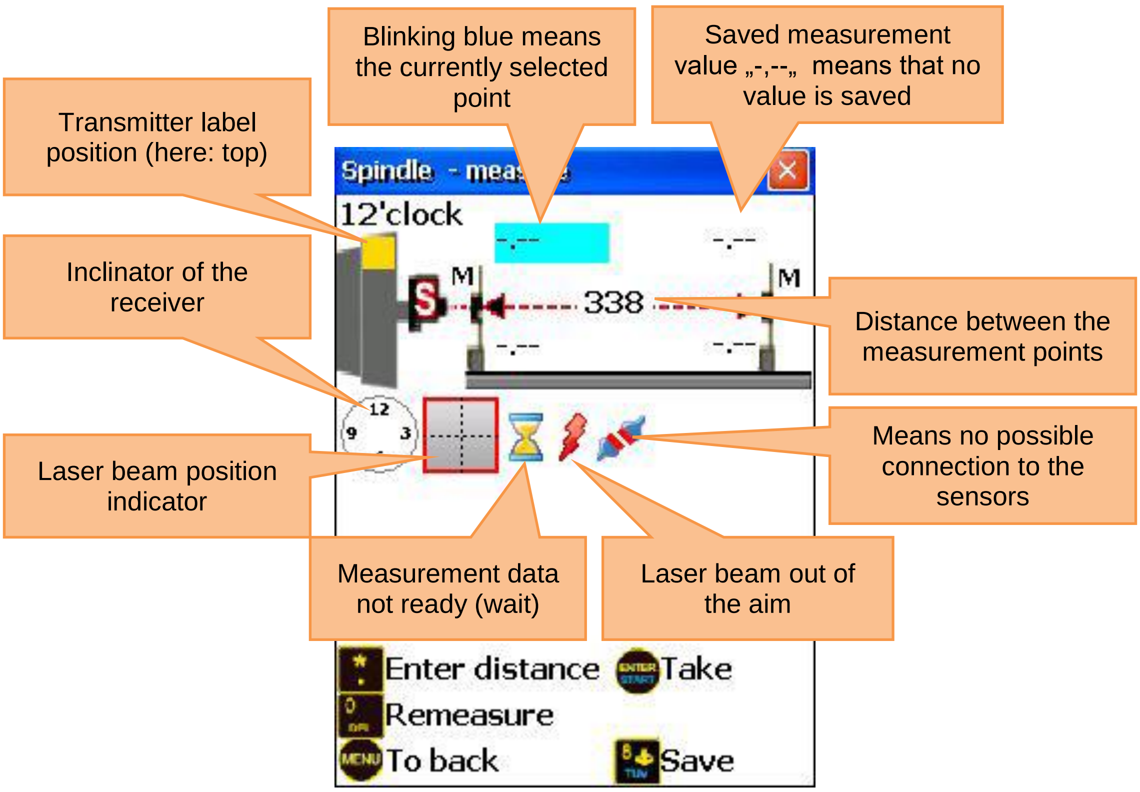
What should be noted in this window		Shortcuts in this window	
⚠	The needed dimensions should be entered correctly (can be changed later on, if recommended).	0 DEL	Start new measurement or restart measurement (all acquired data will be lost)
Functions in this window		1 ⓘ	Enter the amount of measurement points (positions)
- Enter dimensions - Start measurement - View measurement results (available, if all needed measurements are finished) - Save		*	Enter the distance between the measurement points (near and far)
		8 TUV	Save results to a file (see **chapter 10 "Handling of the Data Dialogue window"**)

7.6.2 Measurement process

Mark two points on the machine bed (near and far), where the receiver shall be placed on the tool slide for future measurement.
Enter the distance between the near and the far measurement point. Mount the transmitter to the spindle and the receiver to the tool slide. You can carry out a rough alignment, if needed. Press ENTER START, to get to the measurement screen.

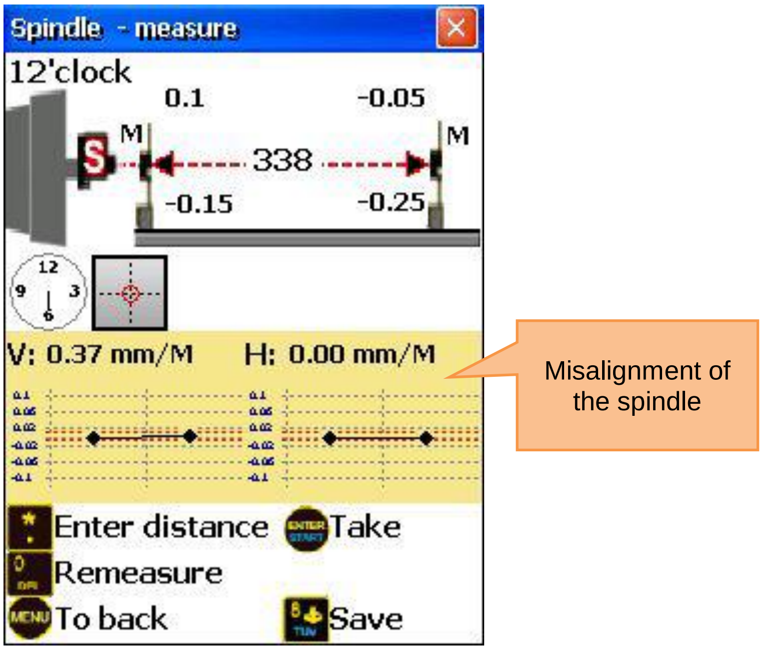
7.6.3 Carry out measurement

Press ENTER START, to carry out a measurement. Use ◀ and ▶, to switch between the measurement points.
Press MENU, to return to the former screen



7.6.4 View and save results

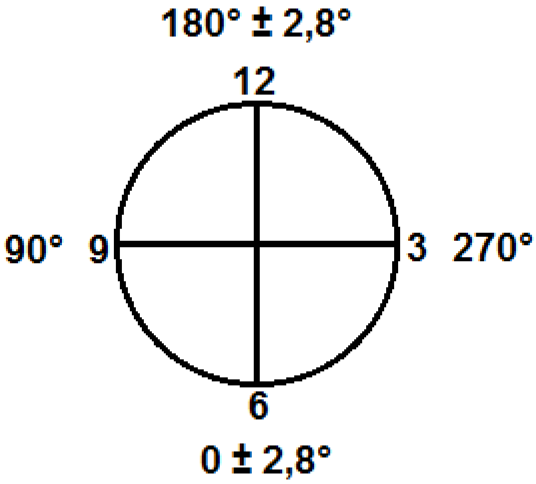
The results of the misalignment of a spindle are available; after all four measurements were carried out. To leave the current screen, press MENU. To leave the Spindle Program, press MENU again. To save the results, press 8 TUV, refer to **chapter 10 ("Handling of the Data Dialogue window")**



7.7 Plumbline Program

7.7.1 Short explanation

The Plumbline Program is used to carry out straightness measurements on shafts and to measure their central axis relative to the plumbline. This program provides a function for self-calibration of the lasers, if they are fixed to the 180° position. The laser transmitter is placed on four sides of the shaft in the 12 and 6 o'clock position.
To achieve results which are as accurate as possible, you should carry out alignment very carefully (due to planes).



Plan your measurement placing the transmitter in the first position (12 o'clock) and confirm the position by manually entering the angle (just numbers, no „°"). Mark the measurement points on the shaft. Save all measurement results for the transmitter position. Move the transmitter to the opposite site of the shaft (6 o'clock position) and switch to the opposite side by pressing F3. Confirm the new position by manually entering the angle (once per side) and save all readings for the new transmitter position.

7.7.2 Carry out Plumbline Measurement

To start the program, select „Plumbline“ in the main menu of the instrument and press ENTER START. The main screen of the program will appear.

7.7.3 Main screen of the program

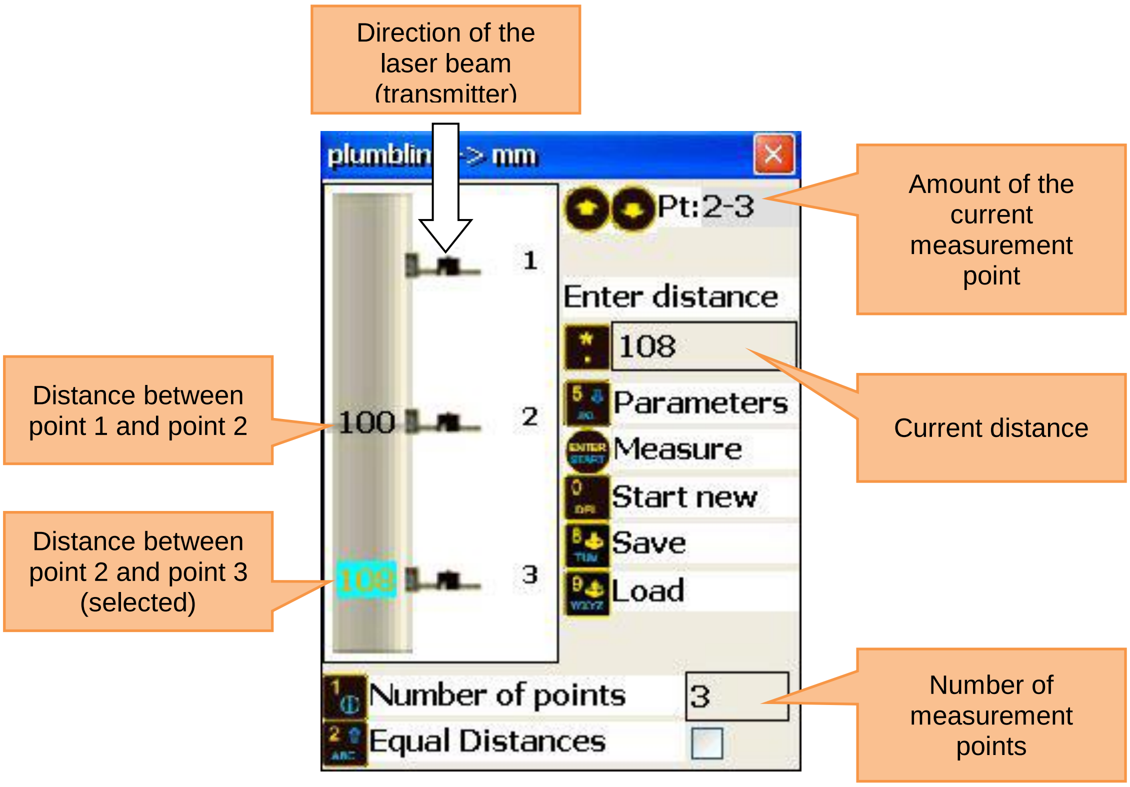
What should be noted in this window		Shortcuts in this window	
⚠	The required dimensions should be entered correctly (can be changed later on, if recommended).	0 DEL	Start a new measurement
⚠	The manual angle entry should always be used for vertical shafts		
Functions in this window		1 ⓘ	Enter amount of measurement points (positions)
- Create/modify/view points - Change parameters - Enter dimensions - Start measurement - View results (available, if all required measurements are finished) - Save - Load		2 ▲ ABC	Activate/deactivate to equate all distances
		* .	Enter current distance
		5 ▼ JKL	Change parameters Note: The inclinator cannot be used for vertical measurements
		7 PQRS	View results (available, if all required measurements are finished)
		8 TUV	Save results to a file (see **chapter 10 „Handling of the Data Dialogue window“**)
		9 WXYZ	Load saved results from a file (see **chapter 10 „Handling of the Data Dialogue window“**)
		▲ ▼	Select a point to enter the distance

7.7.4 Configuration process

Enter the amount of measurement points (positions) by pressing and then enter a value (between 2 and 300). If the measurement points are arranged in the same distance to one and another, press and make sure that the checkbox for "same distance" is activated. Press and enter the distance. If the points are arranged in different distances to each other, use and , to select the required point and press , to enter the distance to the next point. Repeat the process, until all distances are entered.

To change parameters, press . The parameter screen will appear.
To activate or deactivate the manual data entry, press .
To activate or deactivate the manual angle entry, press .
To switch between measurement units, press .
To perform averaging, press , enter the sample number and confirm by pressing .
To save and exit the parameter screen, press .

7.7.5 Screen overview



7.7.6 Carry out measurements

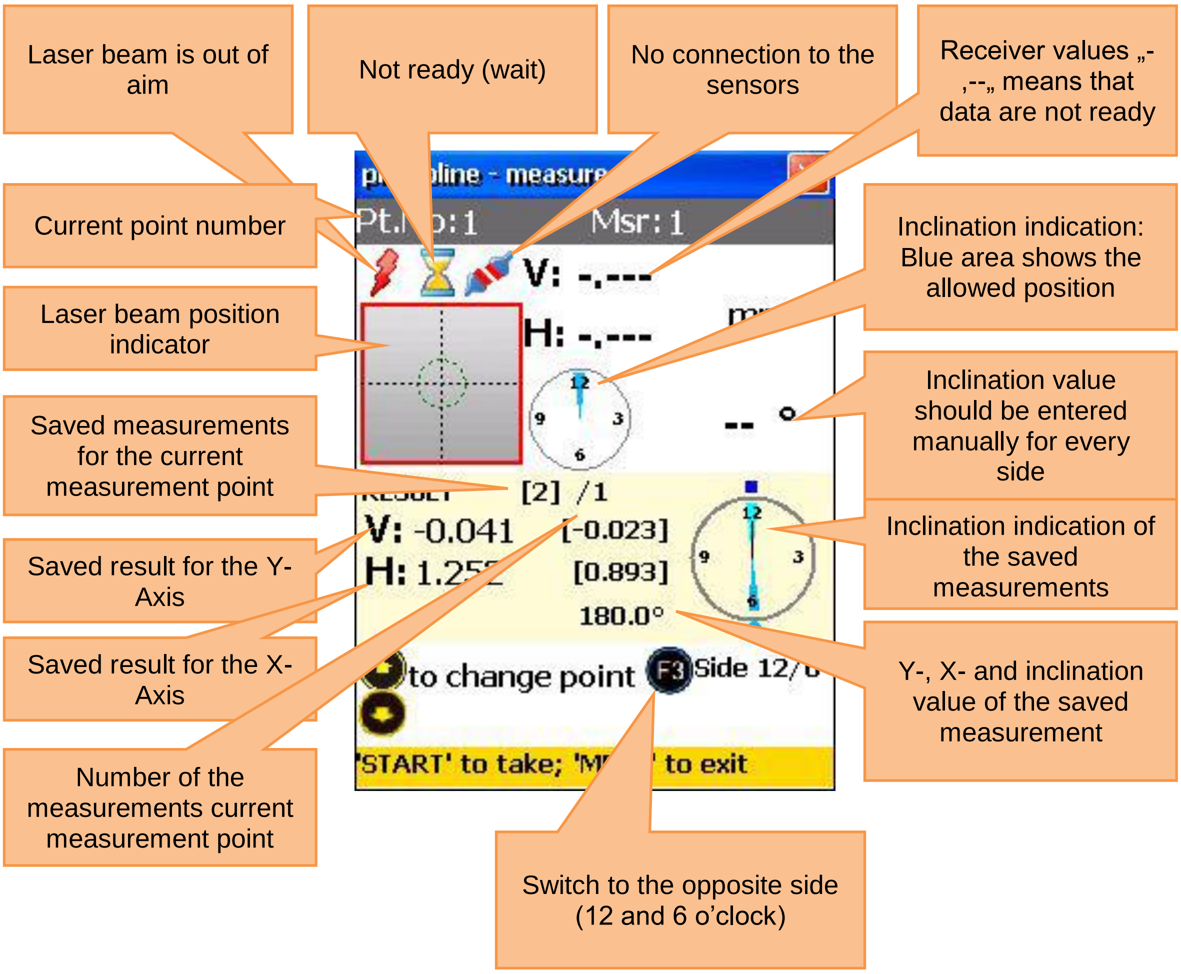
Press ENTER START in the main screen of the program, to make the measurement screen appear.

What should be noted in this window		Shortcuts in this window	
⚠	Align the transmitter very carefully with the help of a spirit plane, to receive a result as accurate as possible.	F3	Switch to the opposite site (12 or 6 o'clock position)
Functions in this window		1	Manually entering of the receiver value (V)
- Carry out measurement - Manually entering data (if activated)		2 ABC	Manually entering of the receiver value (H)
		4 GHI	Manually entering of the angle (necessary for the position confirmation)
		6 MNO	Switch between measurement units
		F2	Open context menu
		ENTER START	Carry out or replace measurement
		▲ ▼	Move through measurement points

7.7.7 Duration of the connection establishment

Depending on which interface is used to connect the sensors (Bluetooth or serial), the connection establishment can take between 2 and 30-40 seconds. It is recommended to wait about 10 seconds (cable connection) or about 50 seconds (wireless connection). If no connection is established after that time, check the sensors and the system settings of the PCE-TU 3.

7.7.8 Display overview



To carry out (and save) a measurement or to replace a measurement, press ENTER START. Use ▲ and ▼, to switch between the measurement points (positions). Always pay attention to the current selected side of the shaft and switch it (if recommended) by pressing F3.

7.7.9 View and save results

If the measurements for all measurement points are finished, press MENU,to display a result. There are two reference line models you can chose between by pressing 5 JKL.
Ref.point Mode: if one of the reference points is undefined, the result is the unchanged receiver value. If two reference points are defined, the result is the difference between the calculated reference line and the receiver value.

To define reference points, press * and enter reference point number 1 and reference point number 2. Press ENTER to confirm. In order to delete a reference point, enter * as the value.

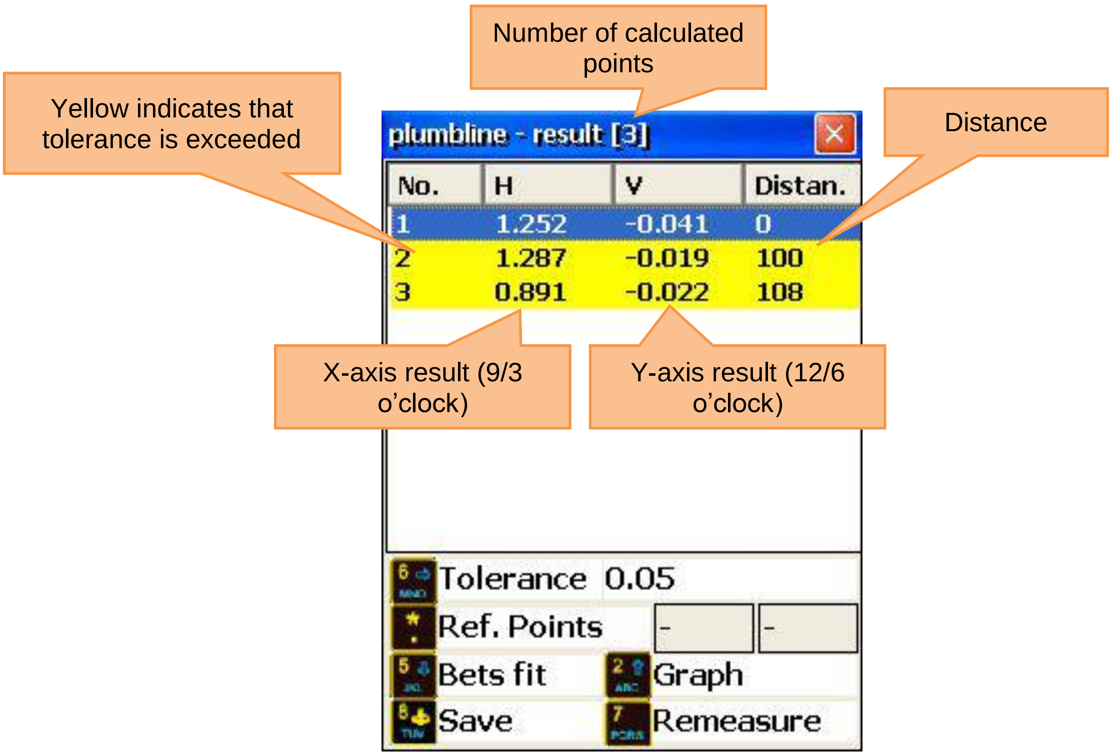
Best- Fit Mode: in this mode, the result is the difference between the calculated best fit reference line and the receiver value.

The result can be displayed as a table or a graph. Due to 2 ABC, you can switch between these illustrations.

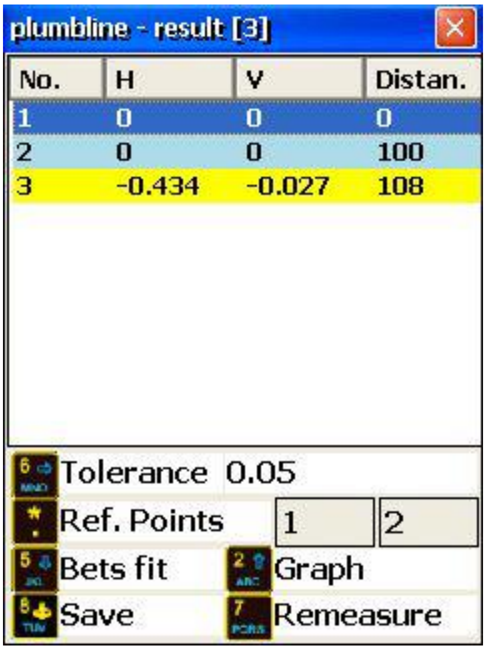
To save the result, press 8 TUV, (refer to **chapter 10 „Handling of the Data Dialogue window“**)

To return to the main menu of the program, press MENU.

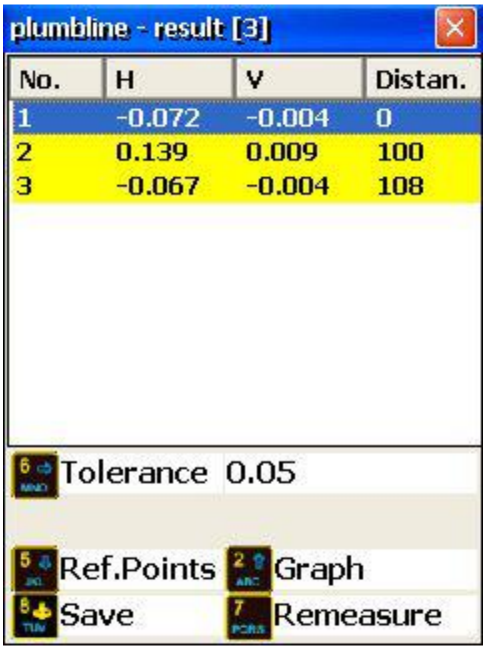
Functions in this window	Shortcuts in this window	
- Carry out measurement - Manual data entry (if activated)	2 ABC	Switch between table and graph illustration
	*	Define reference point (use ENTER, to confirm your entry
	5 JKL	Switch reference point mode
	8 TUV	Save
	7 PQRS	Repeat measurement (all current data will be deleted)
	ENTER START	Return to measurement screen

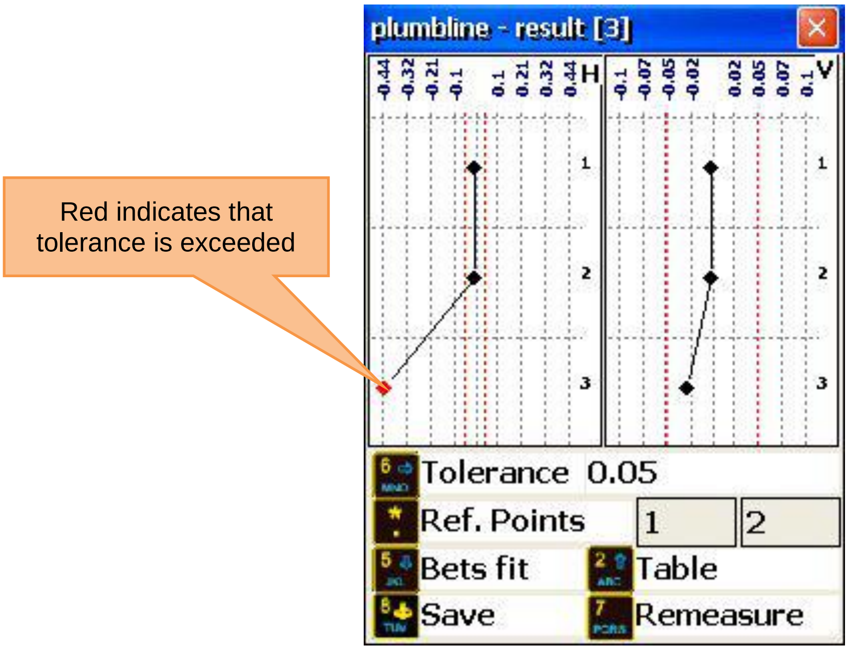


Ref. Point Mode



Best-Fit Mode





8 Extended alignment tools

8.1 Flatness Program

8.1.1 Short explanation

The Flatness Program is applied to measure the flatness of different planes compared to a reference surface, which is formed by the laser beam. The measurement points of the plane can be arranged circular or rectangular with constant or variable bars. The plane can also include milling groves. Up to 1600 measurement points can be used as absolute values or calculated to a best-fit plane. Moreover, 3 points can be assembled to a reference plane.

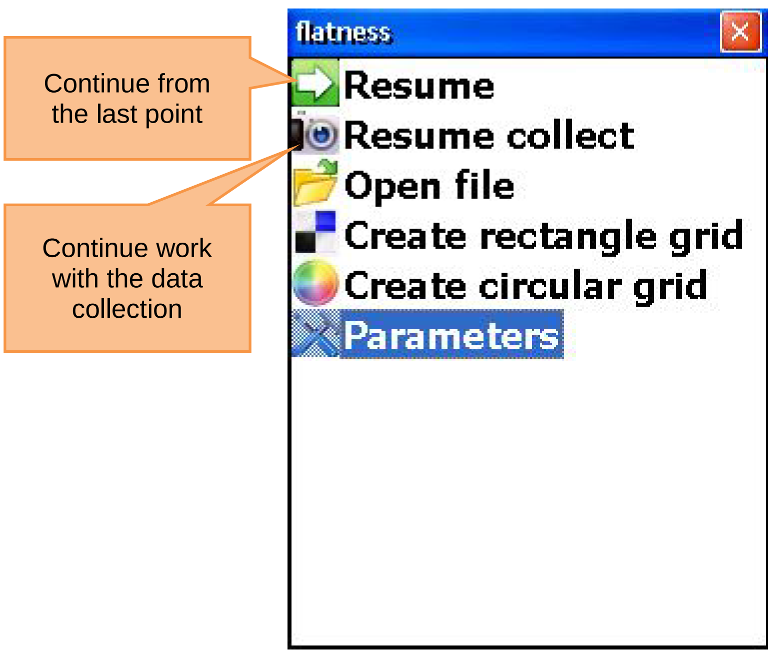
Procedure: Plan the measurement and mark the points where the receiver shall be placed. Align the laser towards X- and Y- direction within 0,5 mm and start the Flatness Program. Use the S or M sensor as a receiver.

⚠ The receiver should be placed with its label facing upwards.

To start the Flatness Program, select “Flatness” which is a sub item of “Geometry” in the main menu and press ENTER START. The main screen of the program will appear. Main screen of the program

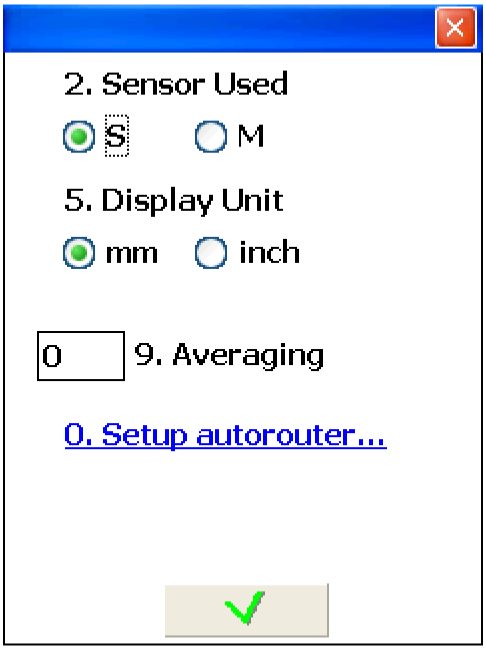
8.1.2 Main screen of the program

Functions in this window	Shortcuts in this window	
- Create a new grid (circular or triangular) - Change parameters - Continue work - Load saved data	1	Continue work
	2 ABC	Continue measurement
	3 DEF	Open file
	4 GHI	Create rectangular grid
	5 JKL	Create circular grid
	6 MNO	Change parameters
	▲ ▼	Select menu item



8.1.3 Change parameters

To change the parameters, press 6 MNO or select the corresponding menu item and press ENTER START.
To define, which sensor shall be applied as the receiver, press 2 ABC.
To select the measurement unit, press 5 JKL.
To set a filter, press 9 WXYZ, enter a value for averaging and confirm with ENTER.
To get to the Auto-Router settings, press 0 DEL.
Press ENTER START to save and leave the screen.

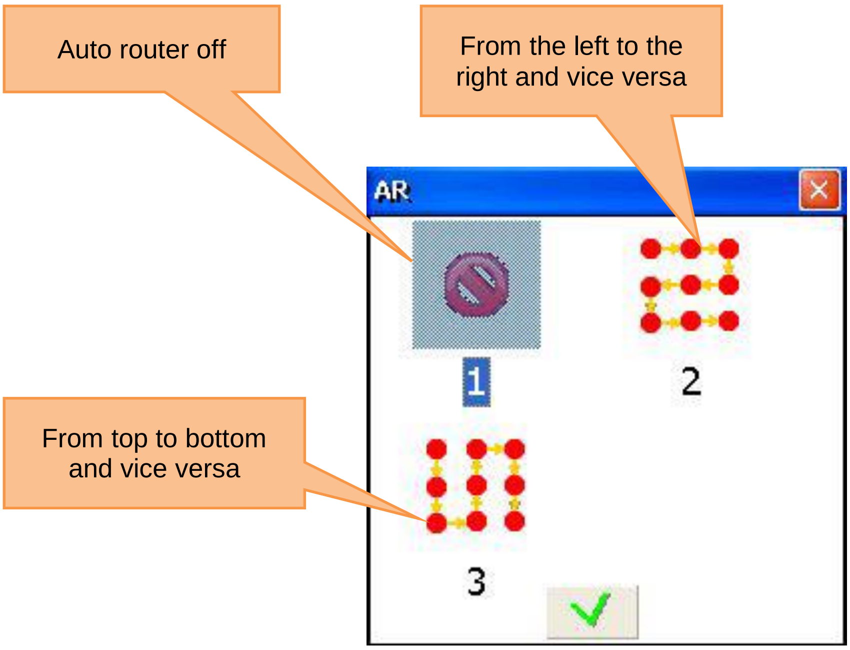


8.1.3.1 Auto-Router

The Auto-Router can be deactivated or configured in the two following modes:

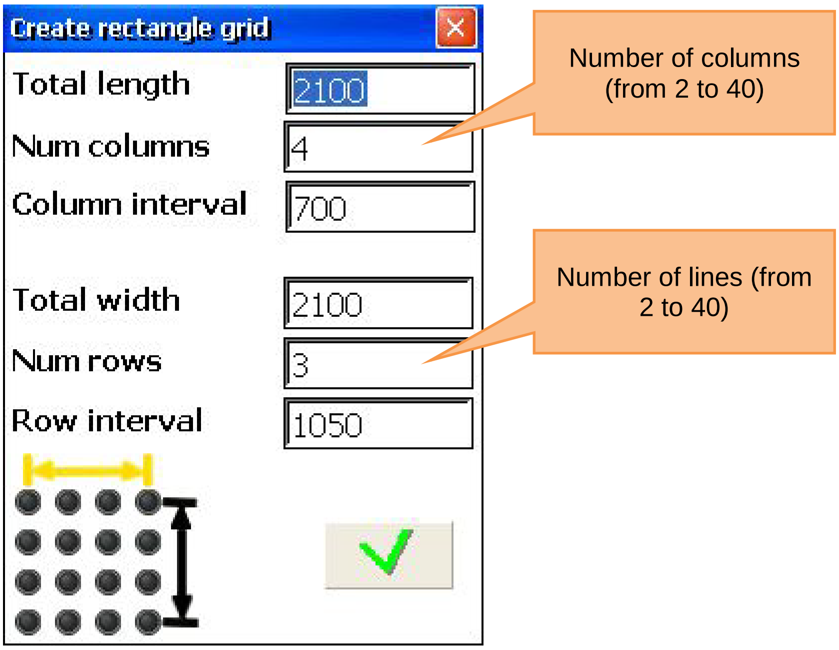
- From the left to the right (and vice versa)
- From the top to the bottom (and vice versa)

Press 1 ⓘ to turn it off.
To select the mode “left to right”, press 2 ABC.
To select the mode “top to bottom”, press 3 DEF.
Press ENTER START, to confirm the selection and leave the screen.



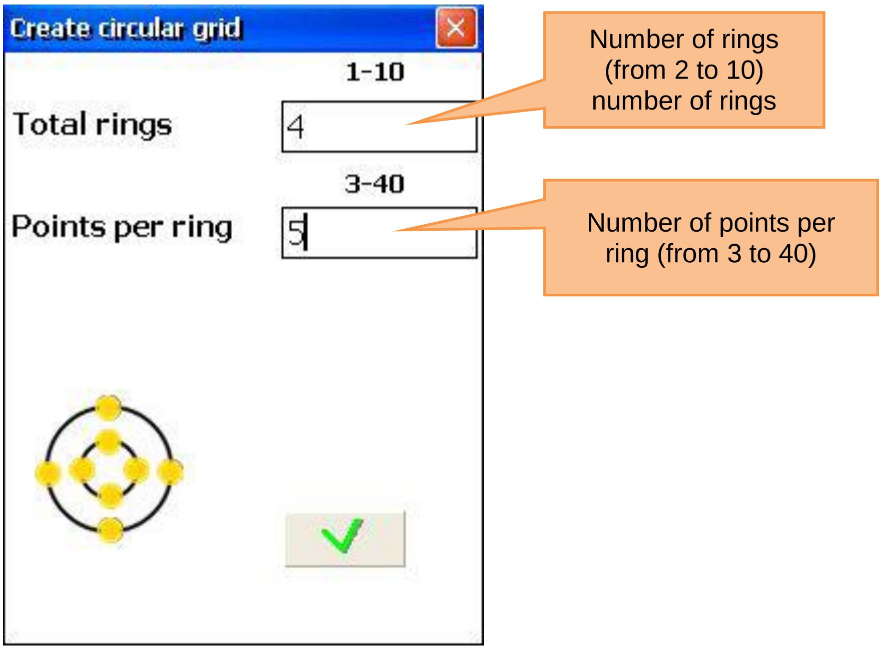
8.1.4 Create or edit a rectangular grid

To create a new rectangular grid, press 4 GHI or select the according menu item and press ENTER START. Use ▲ and ▼, to move between the entering fields. To define the grid, you need to enter the amount of columns (from 2 to 40) and the amount of lines (from 2 to 40) in the beginning. Furthermore, you need to enter a value for the total width/length or line/column spacing. Every time, you change the total width/length, the values for the line/column spacing are recalculated (and vice versa). The grid is defined with constant line/column spacing. Single spacings can later on be changed independently from another. Press ENTER START, to save and to get to the screen where you can edit the grid.



8.1.5 Create circular grid

To create a new circular grid, press 5 JKL or the corresponding menu item and press ENTER START. Use and , to navigate through the entering fields. Enter the amount of rings (from 2 to 10) and the amount of points per ring (from 3 to 40). Press ENTER START, so save and to get to the screen where you can edit the grid.

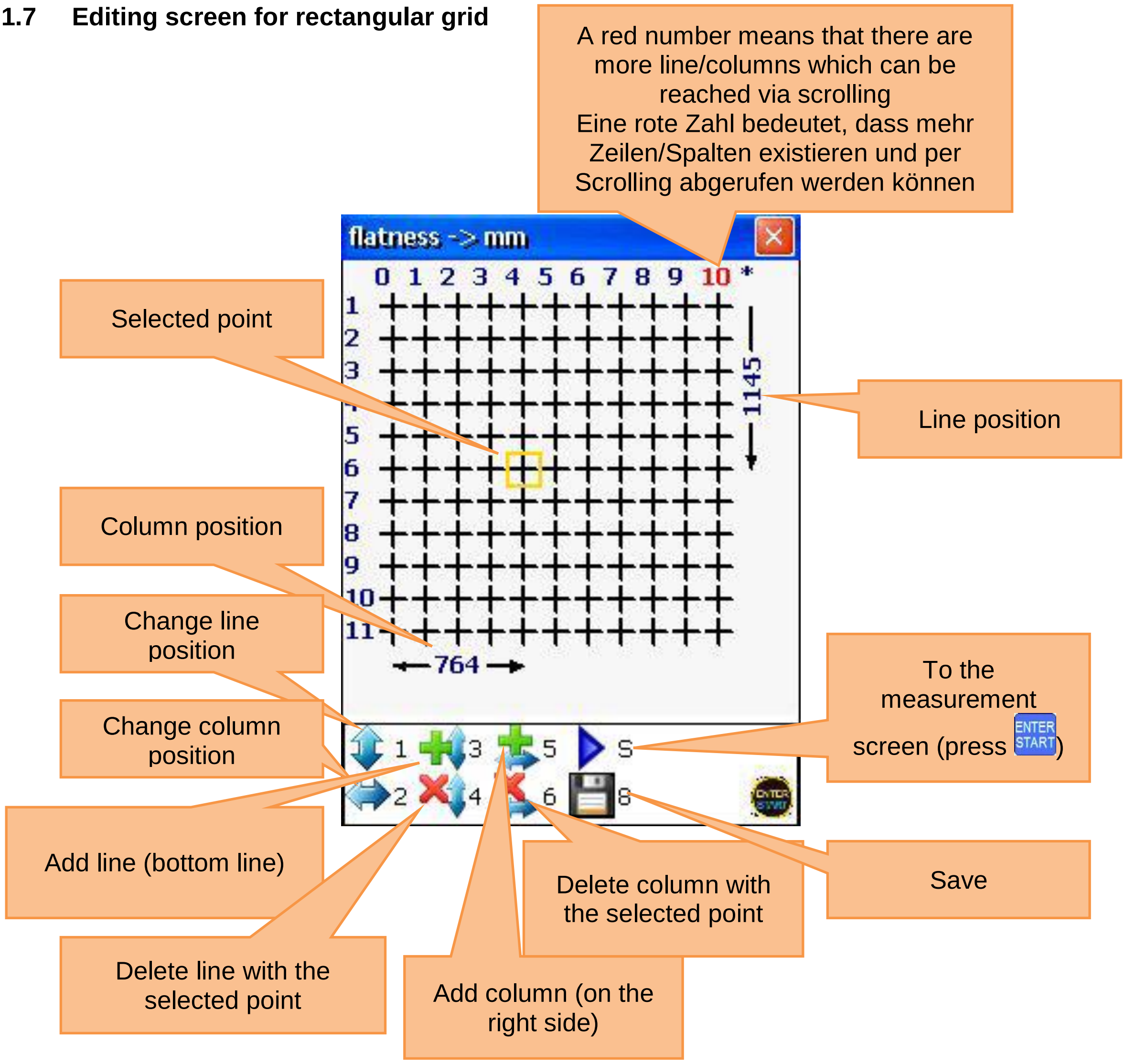


8.1.6 Edit the grid

Use the arrow keys, to navigate through the grid.

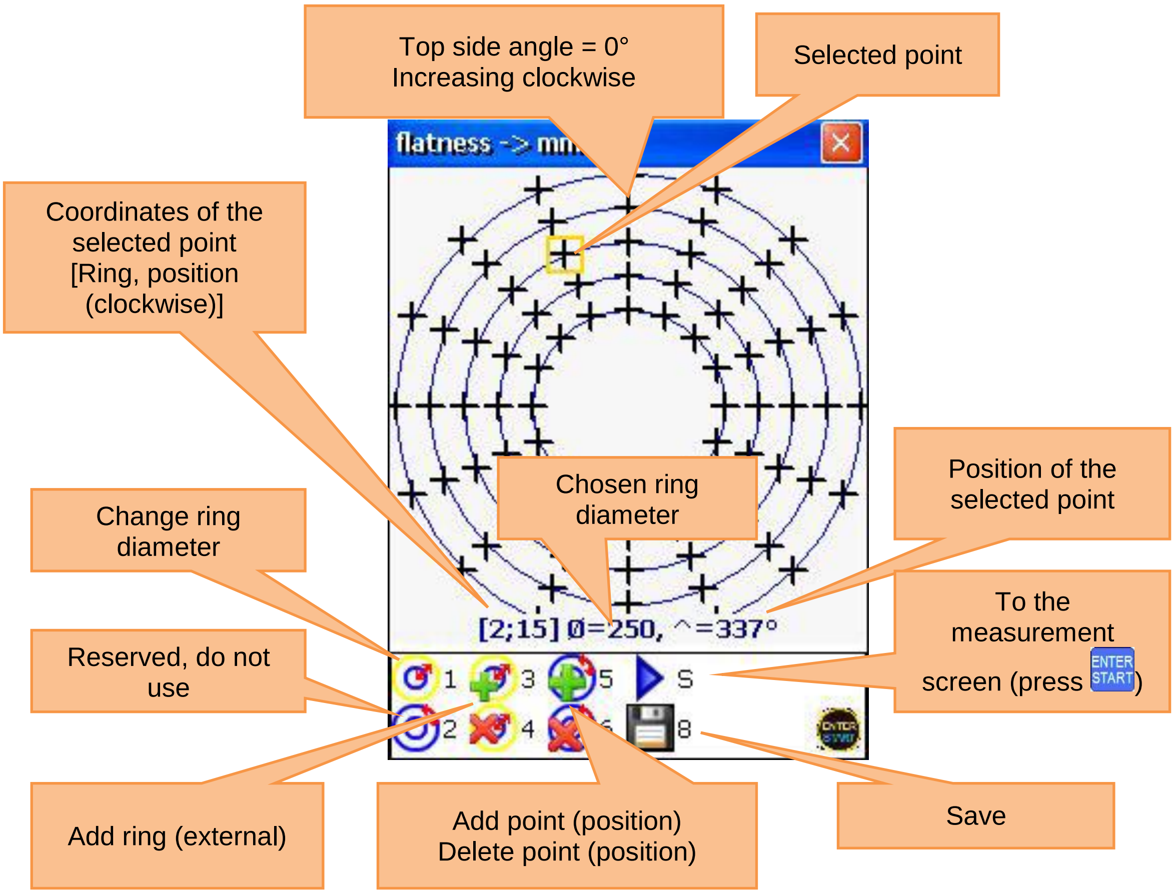
What should be noted in this window		Shortcuts in this window	
⚠	All required dimensions need to be entered	1	Change the line/ring position of the line/ring, which the selected point belongs to
Functions in this window		2 ABC	Change the position of the column, which the selected point belongs to
- Change line position / radius of the ring - Change column position - Add/delete line/ring - Add/delete column/point		3 DEF	Add line/ring. Line is added on the bottom; ring is added as an outer ring
		4 GHI	Delete line/ring, which the selected point belongs to
		5 JKL	Add column/point. Column is added on the right side; point clockwise
		6 MNO	Delete column, which the selected point belongs to
		8 TUV	Save
		ENTER START	Go to measurement screen

8.1.7 Editing screen for rectangular grid



8.1.8 Editing screen for circular grid

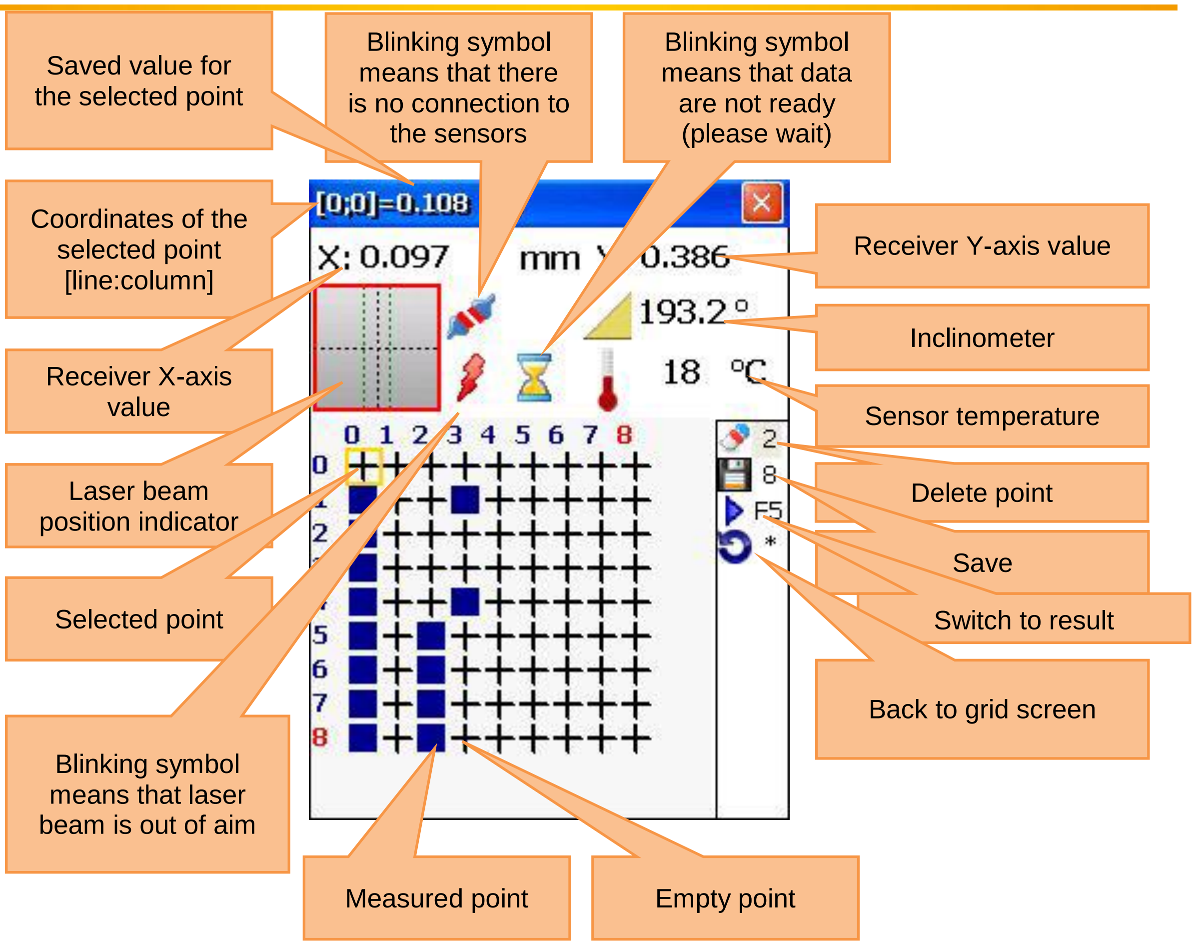
Use and to select the ring and and to select the position.

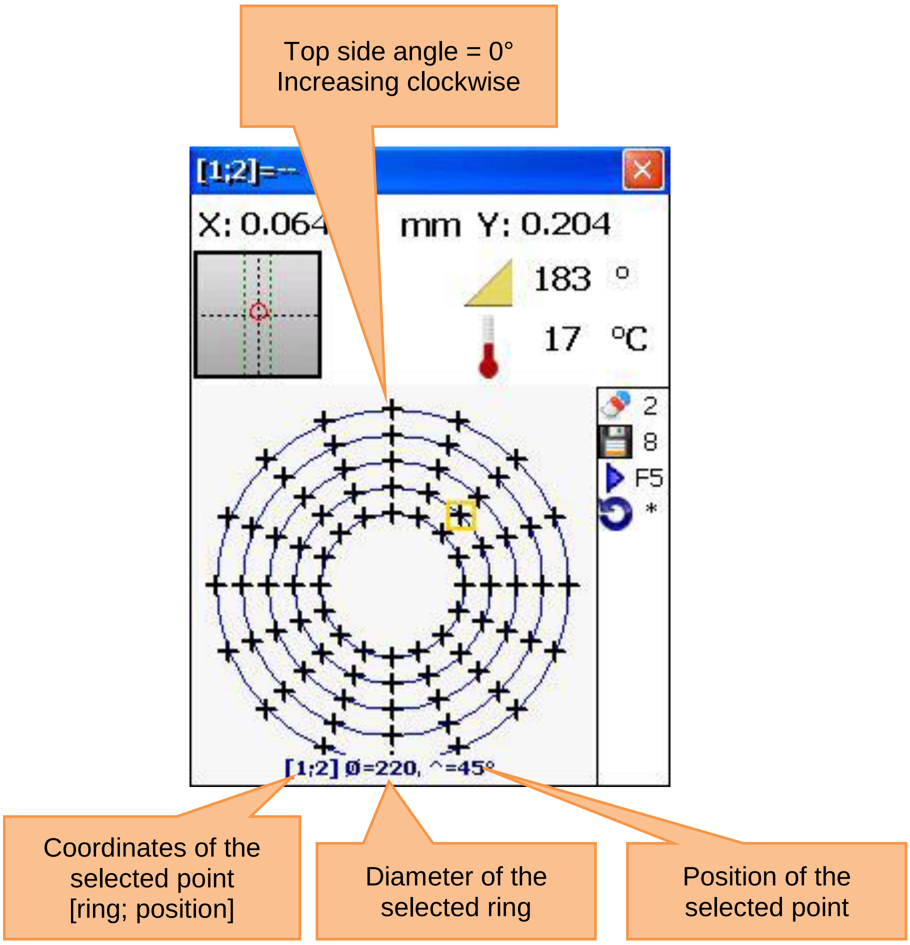


8.1.9 Carry out measurement

Press ENTER START in the grid screen, to get into the measurement screen. Use the arrow keys to select points. You can skip those points, where no values are necessary or where no measurements can be carried out.

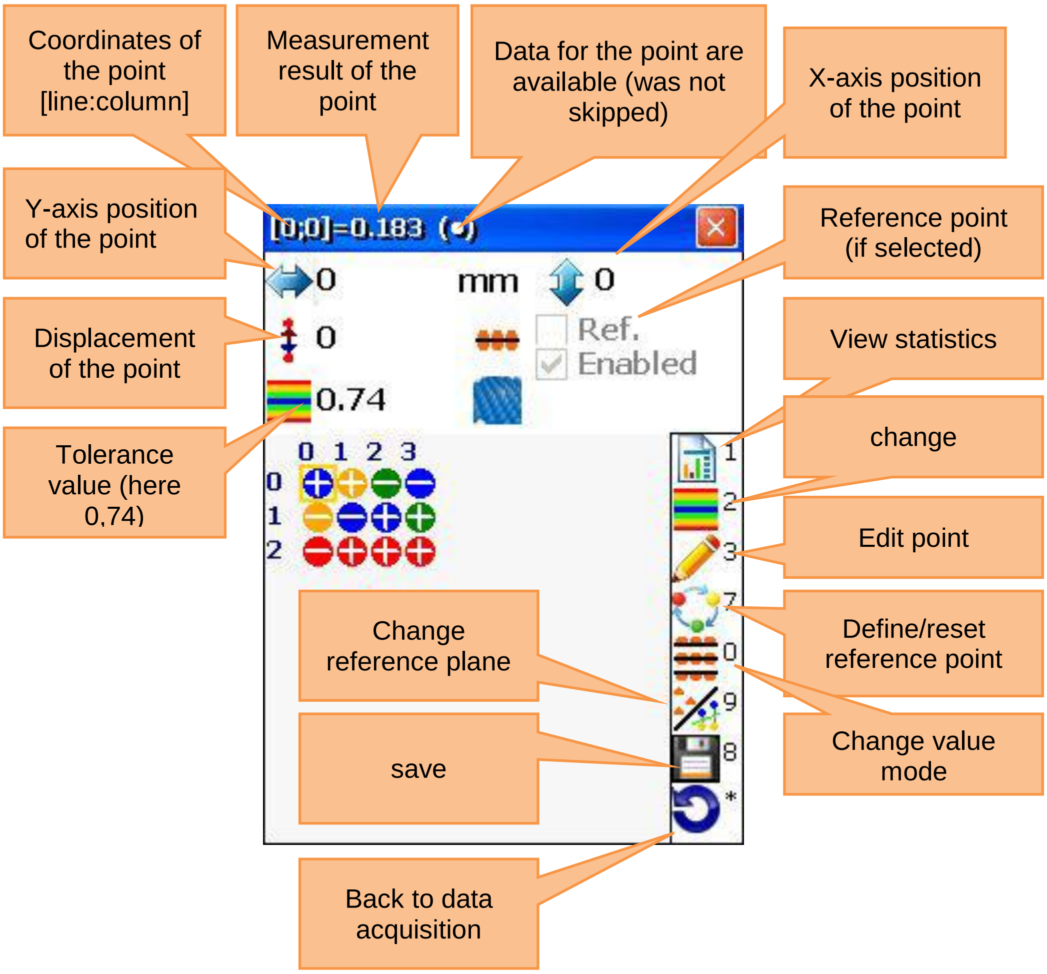
What should be noted in this window		Shortcuts in this window	
⚠	Wait until the data are ready before carrying out another measurement (sandglass symbol must not be blinking)	2 ABC	Delete selected point
Functions in this window		F5	View result
-	Carry out measurement at the selected point	8 TUV	Save
-	Delete the selected point	*	Back to the grid screen
-	Replace measurement data at the selected point	ENTER START	Carry out measurement


Saved value for the selected point
Blinking symbol means that there is no connection to the sensors
Blinking symbol means that data are not ready (please wait)
Coordinates of the selected point [line:column]
Receiver Y-axis value
Inclinometer
Receiver X-axis value
Sensor temperature
Laser beam position indicator
Delete point
Save
Selected point
Switch to result
Back to grid screen
Blinking symbol means that laser beam is out of aim
Measured point
Empty point
[0;0]=0.108
X: 0.097
mm Y: 0.386
193.2 °
18 °C


Top side angle = 0°
Increasing clockwise
[1;2]=--
X: 0.064
mm Y: 0.204
183 °
17 °C
[1;2] Ø=220, ^=45°
Coordinates of the selected point [ring; position]
Diameter of the selected ring
Position of the selected point

8.1.10 View and save results

For a better understanding, the measurement results are displayed as a grid, where the relative position of the individual items is graphically displayed. Each point is displayed as a coloured circle or as a colouered triangle (triangle = reference point) and is equipped with „+“, „-„ or 0.
„+“ indicates above and „-„ indicates beneath the reference plane.
The **blue colour** indicates “excellent”(tolerance <25%)
The **green colour** indicates ”good” (tolerance < 50%)
The **yellow colour** indicates ”warning” (tolerance <100%)
The **red colour** indicates “bad” (tolerance < 50%)
The headline of the screen shows the coordinates and the measurement value of the selected point. The value depends on the selected mode.



8.1.11 Reference modes

There are three reference modes, you can select between by pressing .

8.1.11.1 No reference plane

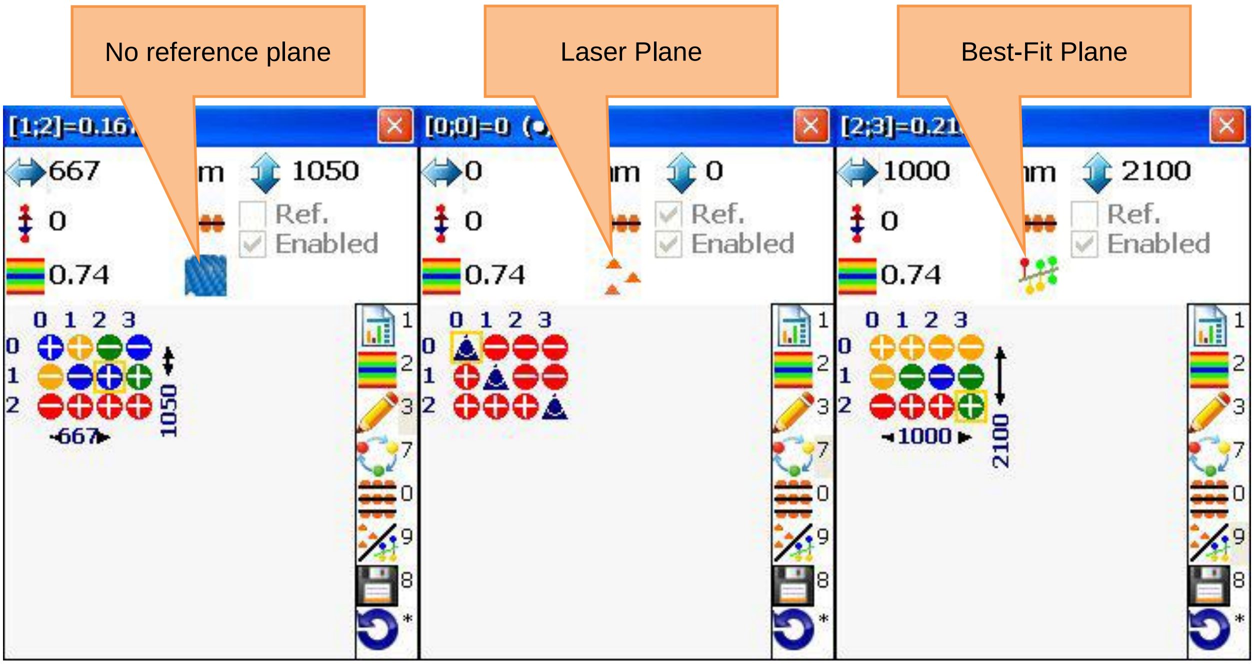
The result is an unchanged receiver value

8.1.11.2 Laser Plane

If no reference points are defined, the result is an unchanged receiver value, if three reference points are defined, the result is the difference between the calculated three-point-reference plane and the receiver value.

8.1.11.3 Best-Fit Plane

The result is the difference between the calculated Best-Fit-Plane and the receiver value.



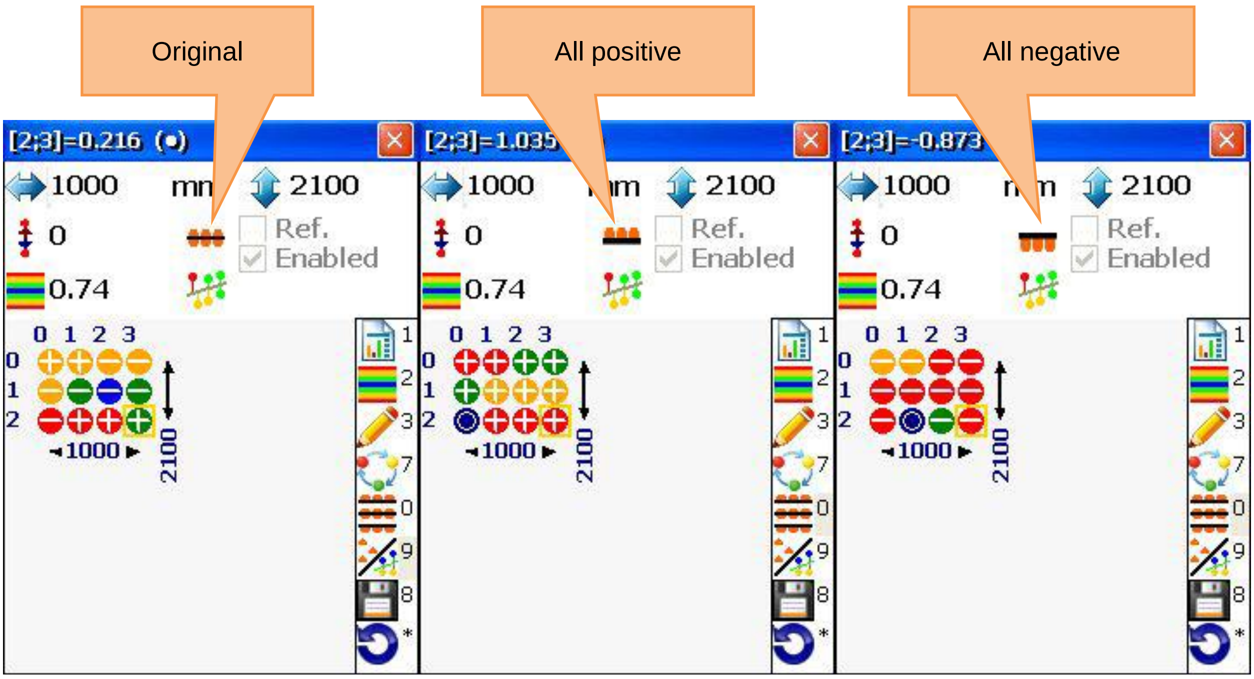
8.1.12 Define reference points

To define or delete reference points, use the arrow key. With the help of those, you can select a position and confirm with . You can only define or delete reference points in the Laser Plane mode.

8.1.13 Result modes

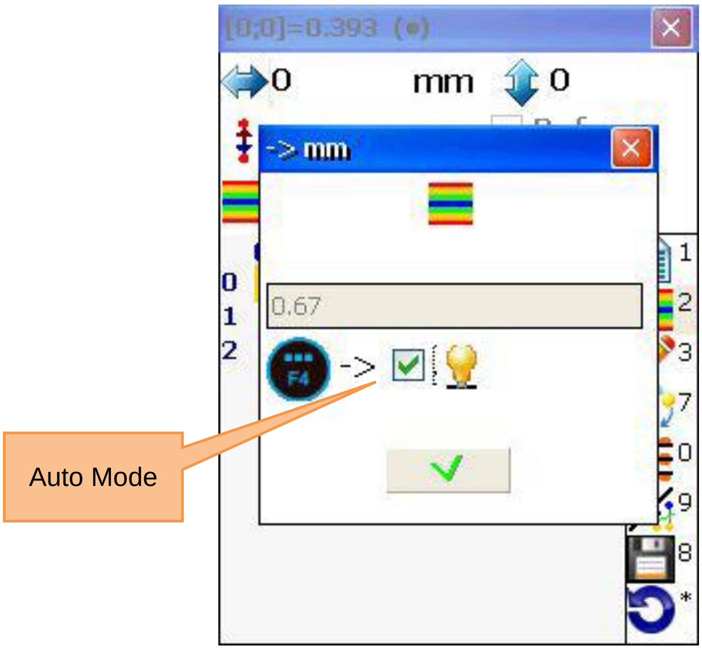
There are three different modes to view the results.

Original: Values are shown as positive and negative values
All positive: Values are shown relative to the lowest value; values cannot be negative.
All negative: Values are shown relative to the highest value; values cannot be positive.



8.1.14 Enter tolerances

Press , to enter tolerances. Enter the required value to the entering field and confirm by pressing or press F4, to switch to the Auto Mode. If the Auto Mode is activated, the tolerances are defined as 35 % peak-to-peak.



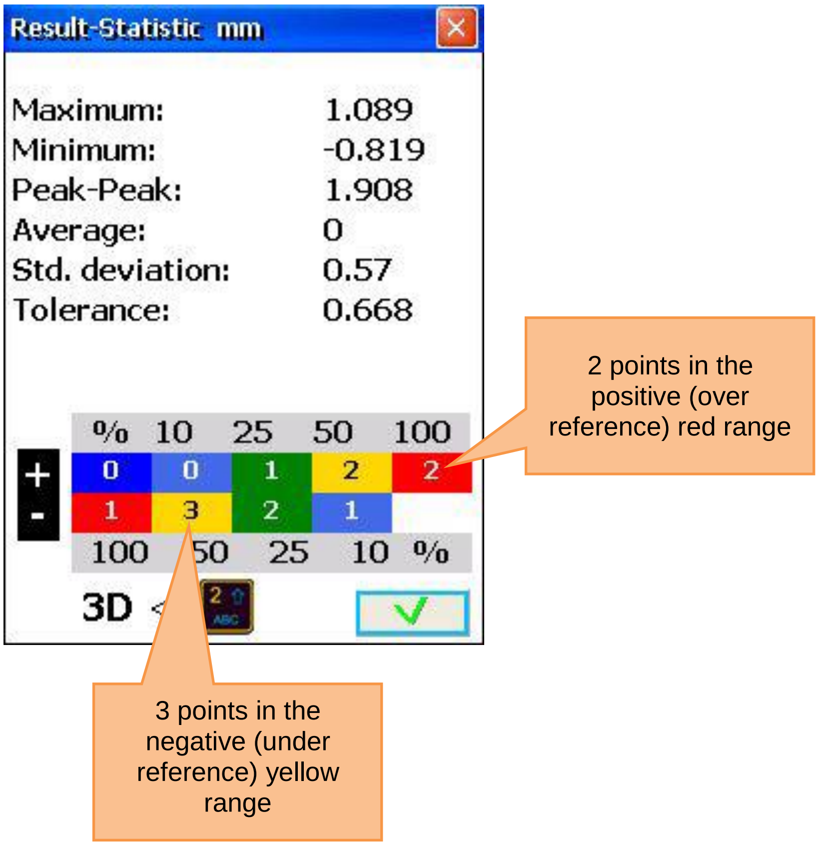
8.1.15 View statistics

To view the statistics, press .

Maximum: maximum value
Minimum: minimum value
Peak-Peak: peak-to-peak value
Average: average value
Std.deviation: standard deviation value
Tolerance: tolerance value

The coloured bar on the bottom of the screen shows error percentages and the amount of points in this error ranges. The coloured bar is defined as described in the following:

blue : value is ≤ 10% of the tolerance
light blue: value is between 10% and < 20% of the tolerance
green : value is between 25% and < 0% of the tolerance
yellow: value is between 50% and < 100% of the tolerance
red : value is 100 % of the tolerance and more


Result-Statistic mm
Maximum: 1.089
Minimum: -0.819
Peak-Peak: 1.908
Average: 0
Std. deviation: 0.57
Tolerance: 0.668
% 10 25 50 100
+ 0 0 1 2 2
- 1 3 2 1
100 50 25 10 %
3D
2 points in the positive (over reference) red range
3 points in the negative (under reference) yellow range

8.2 Bores and centre line programme

8.2.1 Short explanation

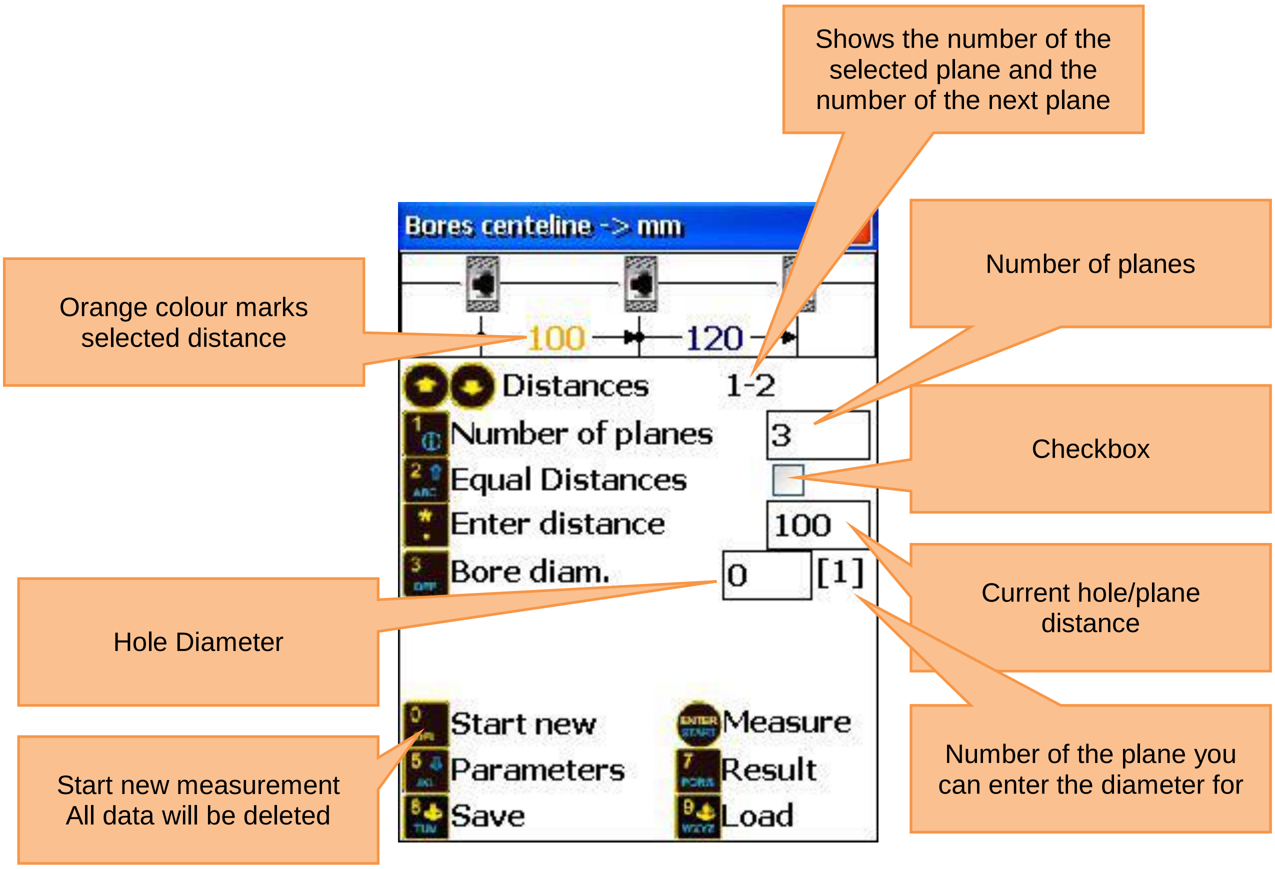
This program is applied to measure the straightness of holes and drillings. For example, inner rings of ball bearings (also those with changing diameters) or stators of machines can be measured. Due to the multipoint function, measurements on up to 36 points in every angle for every bore are possible. Vertical objects can also be measured (manual angle entry must be activated). In the following, objects with bores to be measured are termed as plane.

Carry out bores centre line function

To start the program, select –„bores centre line“ in the main menu under the sub item „Geometry“ and press ENTER START. The main screen of the program will appear.

8.2.2 Main screen of the program (configuration of planes and changing of parameters)

What should be noted in this window		Shortcuts in this window	
⚠	The required dimensions should be entered correctly (can be changed later on, if recommended, measurement data will not be influenced).	0 DEL	Start a new measurement
Functions in this window		1 ⓘ	Enter amount of planes (holes)
- Create/change/view row of holes - Set parameters - Enter dimensions - Start measurement - View misalignment results (available when all required measurements are finished) - Save - Load		2 ABC	Set or delete all distances equally
		*	Set current distance
		3 DEF	Enter hole diameter (optional). If only 3 measurement points are used, the entry of the hole diameter increases the accuracy of the measurement result
		5 JKL	Change parameters (manual data entry or of the sensor; manual angle entry or of the inclinometer; filter settings, …)
		7 PQRS	View results (available, if all required measurements are finished)
		8 TUV	Save results to a file (see **chapter 10 “Handling of the Data Dialogue window“**)
		9 WXYZ	Load saved results from a file (see **chapter 10 “Handling of the Data Dialogue window“**)
		▲ ▼	Select hole, to enter the distance (to the next hole) and hole diameter.



8.2.3 Configuration process

Enter the amount of planes (holes) by pressing and entering the value to the entering field (value should be between 3 and 300). If the planes to be measured are arranged with the same distance one to the other, activate the "Equal Distances" function by pressing and hooking the checkbox. Press and enter the distance. If the distances between the planes are not equal, they you can select single planes with the help of and and enter the particular distances with . If you only want to use three measurement points for the plane (not recommended), it makes sense to enter the hole diameter for the particular plane. To do that, press and enter the particular value for the current plane. If you want to change parameters, press , to get to the parameter screen. Here, you can activate/deactivate the manual data entry by pressing or the manual angle entry by pressing . By pressing , you can switch between the measurement units mm and inch. Press , to use sensor S as your aim and , if you want to use an external laser. For averaging, press , enter your sample number and confirm pressing . In order to save and leave the parameter menu, press

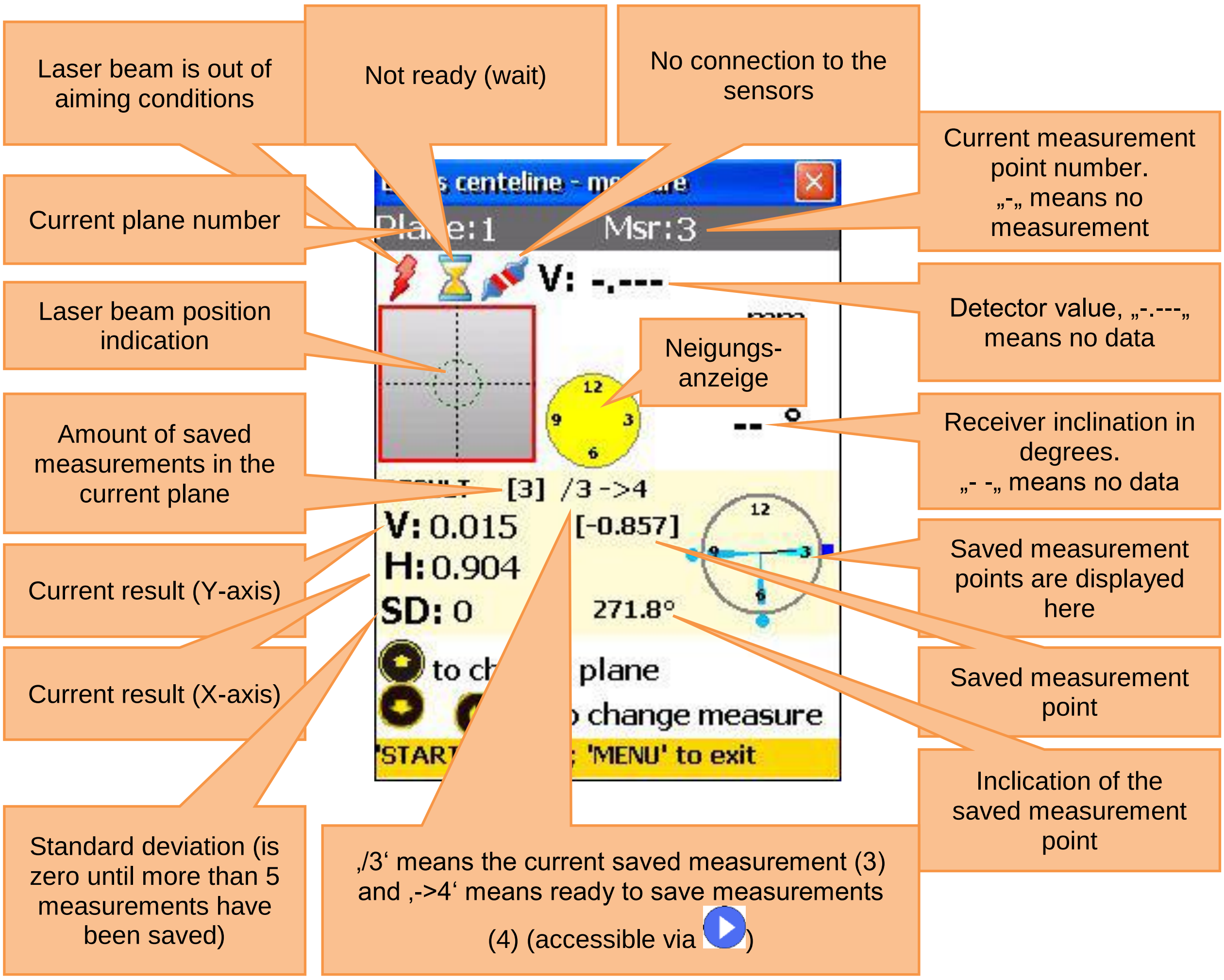
8.2.4 Carry out measurement

Press ENTER START in the main screen of the program and the measurement screen will appear.

What should be noted in this window		Shortcuts in this window	
⚠	Carry out a rough alignment of the laser, if you want to start a new measurement.	0 DEL	Delete the measurement points of the current plane (all saved values will be lost)
Functions in this window		1 ⓘ	Manual entry of the detector value
- Carry out measurement - Manual data entry (if activated) - Manual angle entry (if activated)		4 GHI	Manual angle entry
		6 MNO	Switch measurement unit
		F2	Open context menu
		▲ ▼	Navigate forwards/backwards through the planes
		◀ ▶	Navigate through measurement

8.2.5 Duration of the connection establishment

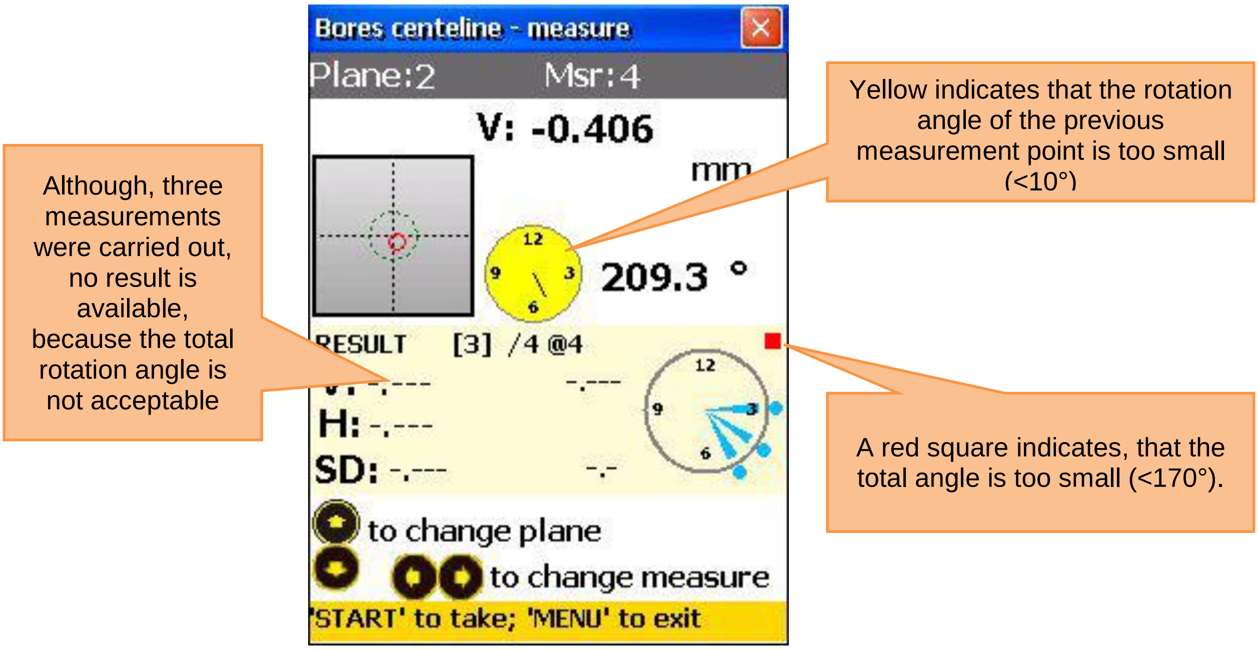
Depending on which interface is used to connect the sensors (Bluetooth or serial), the connection establishment can take between 2 and 30-40 seconds. It is recommended to wait about 10 seconds (cable connection) or about 50 seconds (wireless connection). If no connection is established after that time, check the sensors and the system settings of the PCE-TU 3.



Rough alignment of the laser beam
Refer to **chapter 5.5 („Rough alignment“)**.

8.2.6 Carry out, view and replace measurements

To carry out a measurement, press .
The saved measurement is now displayed in the measurement point screen. Please consider the following:
If the inclination indicator is yellow, the current inclination is not acceptable (the minimum rotation of about 10° could be fallen short of. If the manual angle entry is activated, a yellow inclination indicator means that the angle was not entered (in this case there is no pointer).
At least three measurements should be carried out to calculate the result. Save as many measurements as possible (max. 36) in order to receive a result as accurate as possible. The minimum rotation angle (amount of the particular rotations between the particular measurement points) cannot be under 170°. A red square on the top right of the measurement point indicator means, that the total angle is too low.



To view the saved measurements, use and . To replace a measurement, select the according measurement and press . A confirmation dialog will appear. Select “YES”.

8.2.7 View and save results

If measurements have been carried out for all planes, press MENU for the result.

There are two reference models, you can switch between by pressing 5 JKL

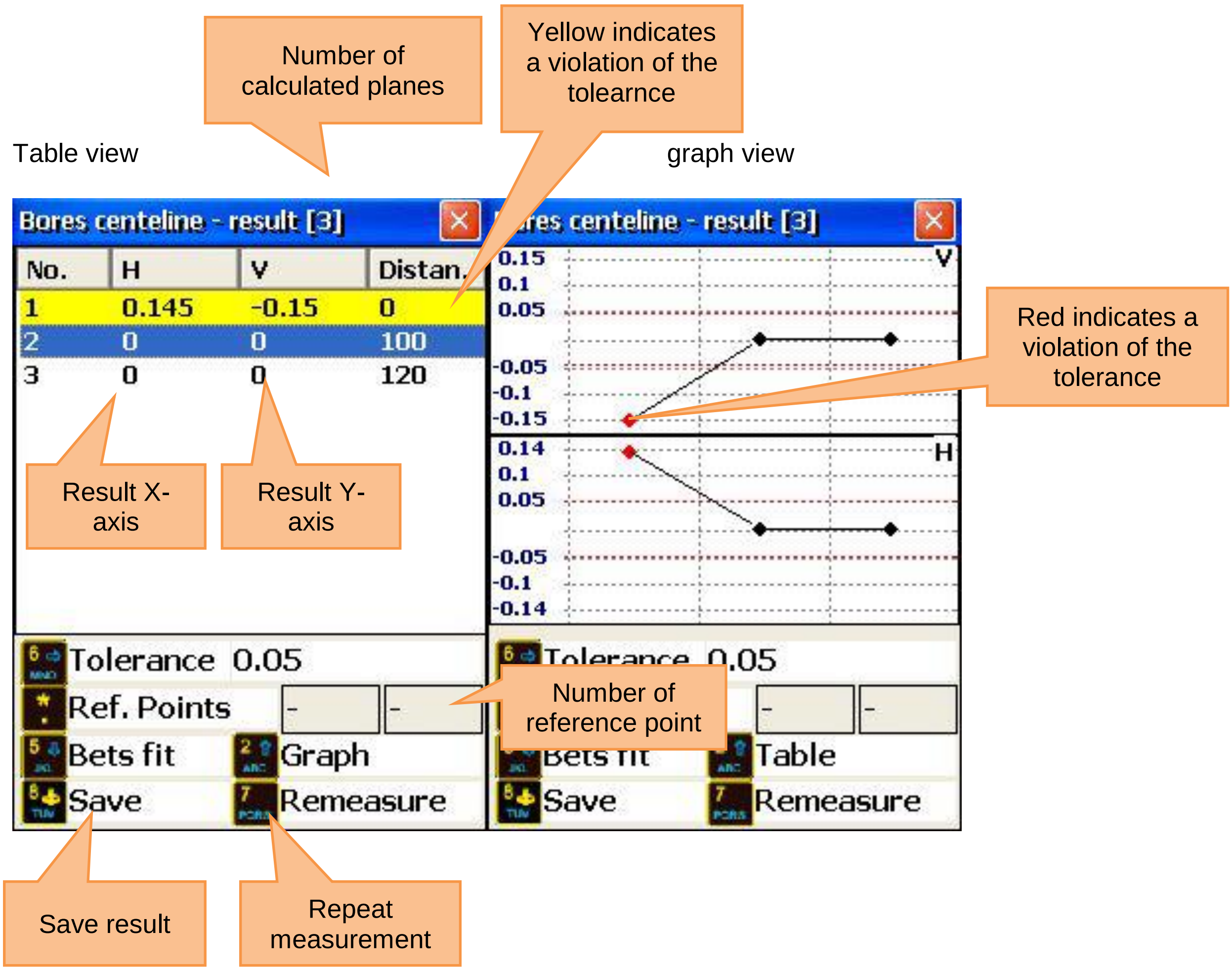
Ref Points Mode: If one of the reference points is undefined, the result is the unchanged detector value. If two reference points are defined, the result is the difference between the calculated reference line and the detector value.

To define reference points, press * and enter reference point number 1 and reference point number 2. Press ENTER to save. In order to delete the reference points, enter the value *.

Best Fit Mode: In this mode, the result is the difference between the calculated best fit reference line and the detector value.

The result can be displayed as a graph or as a table. By pressing 2 ABC, you can switch between these illustrations.

To save the results, press 8 TUV. Refer to chapter 10 “**Handling of the Data Dialogue window”** to do that.



Press MENU, to return to the main screen of the program or press ENTER START, to start the Live Mode.

8.2.8 Live Mode

To carry out live alignment for the selected plane, place the detector in the centre of the bore. The clamping device should be fixed to the bottom side of the bore, inclined at 180°.

Switch from the reference line mode to the result mode and the table illustration. Select the required plane due to ▲ and ▼ and press ENTER START to receive the measurement screen, where the Live Mode can be activated.

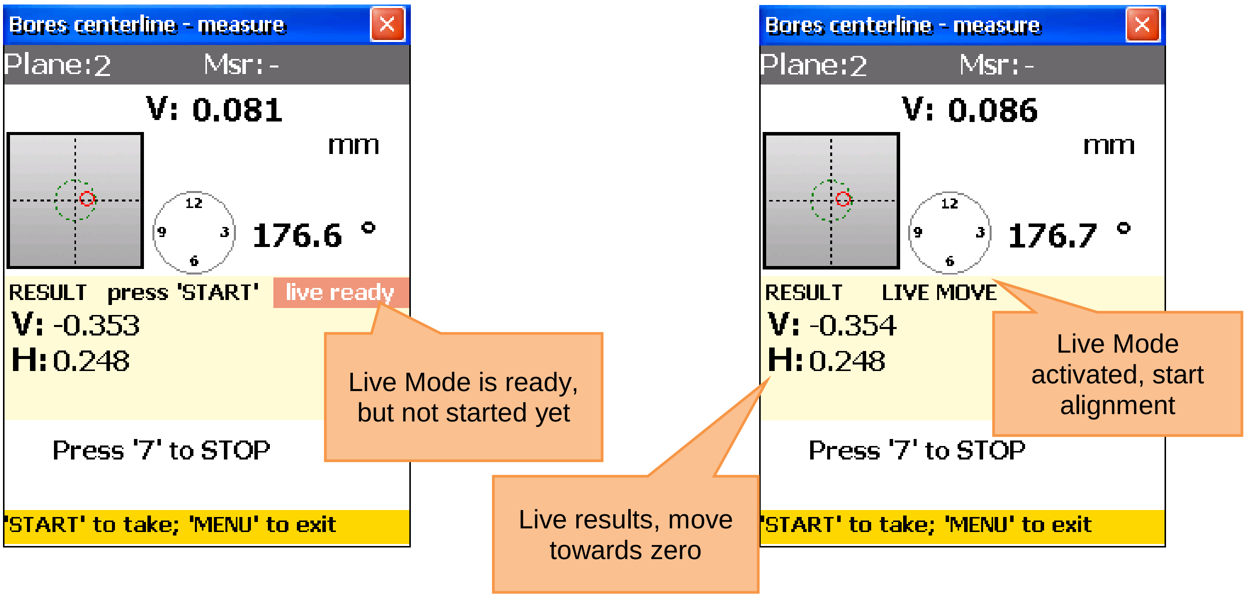
⚠ If the manual angle entry is activated, enter the corresponding value.

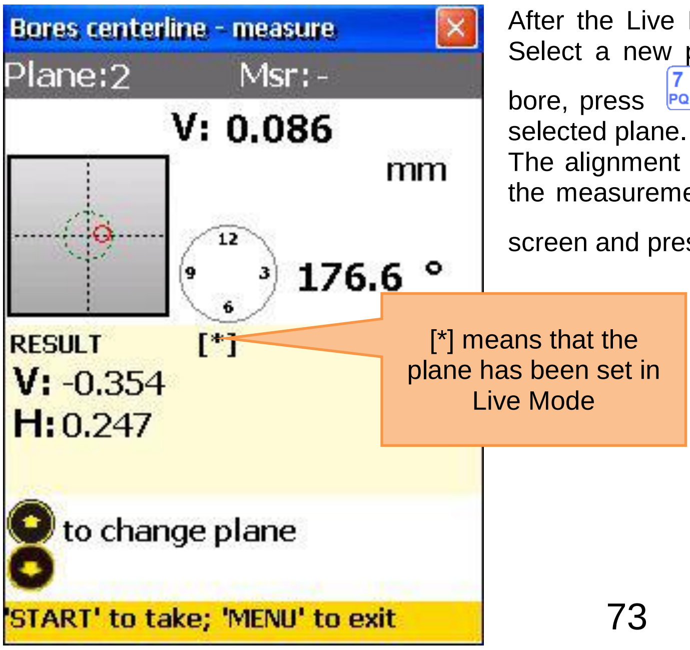
Press ENTER START again, to start the Live Mode.

⚠ Do not move any components until “LIVE MODE” appears on the screen.

Move the component towards zero with the help of the measurement values on the screen. To stop the Live Mode and to receive the result after the movement, press 7 PQRS.

⚠ Do not stop the Live Mode, if the measurement values are not ready (laser beam is out of aim, sand glass symbol or connection problems)





After the Live Mode was stopped, a plane can be selected. Select a new plane, place the detector in the centre of the bore, press 7 PQRS and then ENTER START, to start the Live Mode for the selected plane.
The alignment of a plane can influence other planes. Repeat the measurement after using the Live Mode (go to the result screen and press 7 PQRS to repeat the measurement).

8.3 Straightness Program

8.3.1 Short explanation

The Straightness Program is applied to determine the straightness of objects. Very long objects can be measured in parts (Splices). The measurement of vertical objects is possible as well.

8.3.2 Carry out a straightness measurement

To start the program, select “Straightness” in the main menu under the sub item “Geometry” and press ENTER START. The main screen will appear.

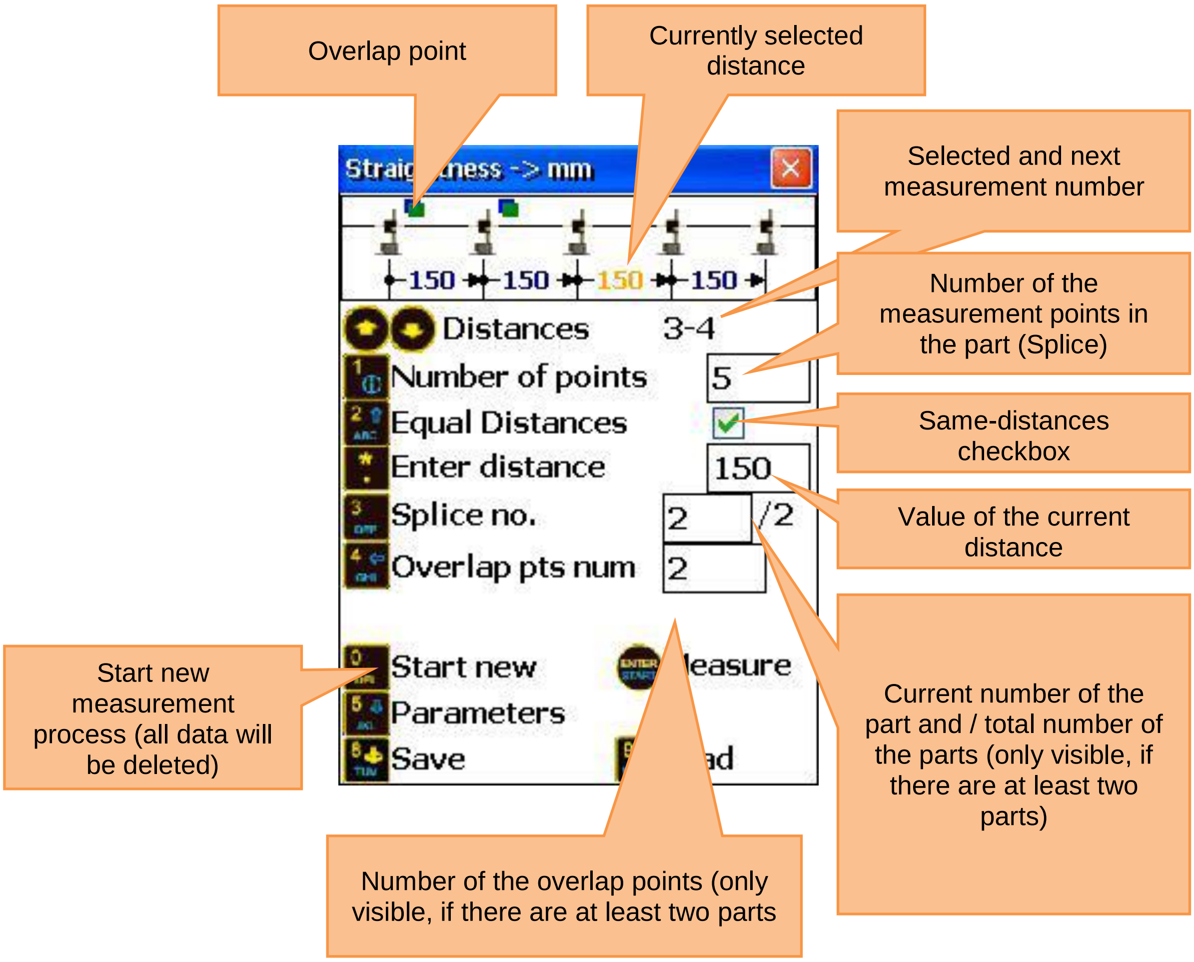
8.3.3 Main screen of the program (configure positions and change parameters)

What should be noted in this window	
⚠	The required dimensions should be entered correctly (can be changed later on, if recommended, measurement data will not be influenced).

Functions in this screen
- Create/modify/view point - Create/modify/view Part (Splice) - Change parameter - Enter dimensions - Start measurement - View misalignment results (available, after all required measurements have been carried out - Save - Load

Shortcuts in this window	
0 DEL	Start a new measurement
1 ⓘ	Enter number of measurement points (positions)
2 ▲ ABC	Equal or delete all distances
* .	Enter current distance
3 DEF	Enter number of the parts (splices) – (optional). When using splices, this button adds a new part.
5 ▼ JKL	Change parameters (manual data entry or for the sensor; manual angle entry or for the inclinator ; filter settings.
7 PQRS	View results (available, if all required measurements have been carried out)
8 TUV	Save results to a file (see **chapter 10 “Handling of the Data Dialogue window“**)
9 WXYZ	Load saved results from a file (see **chapter 10 “Handling of the Data Dialogue window“**)
▲ ▼	Select point to enter distance

8.3.4 Screen overview



8.3.5 Splice explanation

If a measured object is longer than the effective length of the laser system (10 m between the sensors), it can be divided into parts (splices) and measured that way. A part can consist of 3 up to 300 single measurement points where parts overlap in 2 up to 8 points (end of the previous part with the beginning of the current part). These overlaps are necessary to carry out a straightness measurement of the whole object correctly. If the effective length of the laser is longer than the measured object, there is no need to use parts (splices).

8.3.6 Configuration process

To enter the number of points, press 1 and enter the desired value (3 up to 300 points are possible). Confirm the entry by pressing ENTER. Make sure, that all points are placed on the current part (splice). If the field “Splice no.” displays “-“, there is only one part.

If the distances between all points (in all splices) are the same, press 2 ABC and activate the “Equal Distances” checkbox. Press * now, to reach the field of distance entry, enter a value and confirm by pressing ENTER. The entered value is used for all distances, if the checkbox “Equal Distances” is activated. If the distances between the points are not equal, use ▲ and ▼, to select a point and press *, to enter the distance to the next point. Repeat the process for all points (except for the last one).

Note: If you use more splices, check the splice number displayed at “Splice no.”, to check in which part you are currently situated. The distance between two overlap points cannot be edited.

To add a new splice, press 3 DEF and add “1” to the current “Splice no.” (if the current value is “-“, enter “2”). Configure the new splice after that.

If you want to change parameters, press 5 JKL, to reach the parameter screen. Here you can activate/deactivate the manual data entry by pressing 2 ABC or the manual angle entry by pressing 3 DEF. Pressing 5 JKL makes it possible to switch between the measurement units mm and inch. Press 6 MNO, to use the sensor S as your aim and press 7 PQRS, if you want to use an external laser. For averaging, press 9 WXYZ, enter a probe number and confirm by pressing ENTER.. Press ENTER START to save and exit the parameter menu.

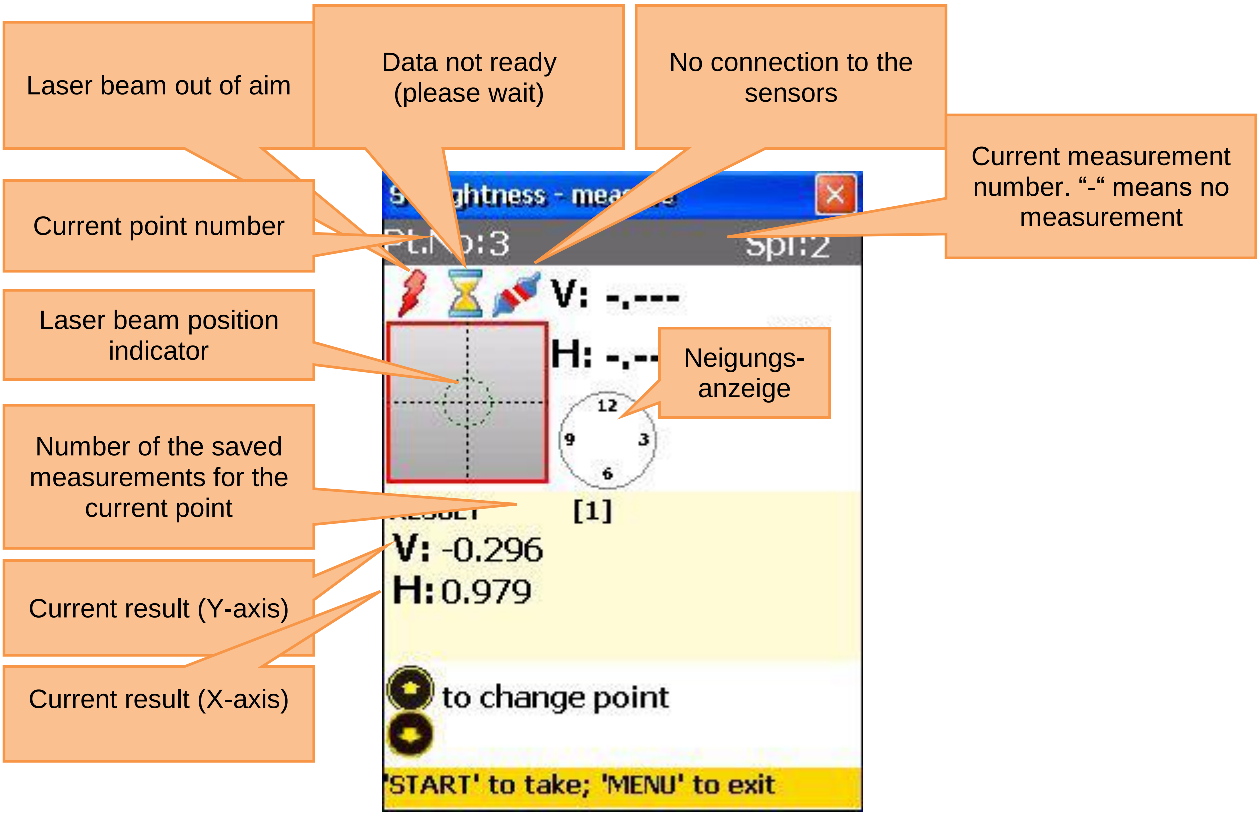
8.3.7 Carry out measurements

Press ENTER START in the main screen of the program, to get to the measurement screen.

What should be noted in this window		Shortcuts in this window	
⚠	Carry out rough alignment of the laser, when you start a new measurement	0 DEL	Delete measurement point
Functions in this window		1	Manual entry of detector value (V)
- Carry out measurement - Enter data manually (if activated)		2 ABC	Manual entry of detector value (H)
		6 MNO	Change measurement units
		F2	Open context menu
		▲ ▼	Navigate forward/backward through the points

8.3.8 Duration of the connection establishment

Depending on which interface is used to connect the sensors (Bluetooth or serial), the connection establishment can take between 2 and 30-40 seconds. It is recommended to wait about 10 seconds (cable connection) or about 50 seconds (wireless connection). If no connection is established after that time, check the sensors and the system settings of the PCE-TU 3.



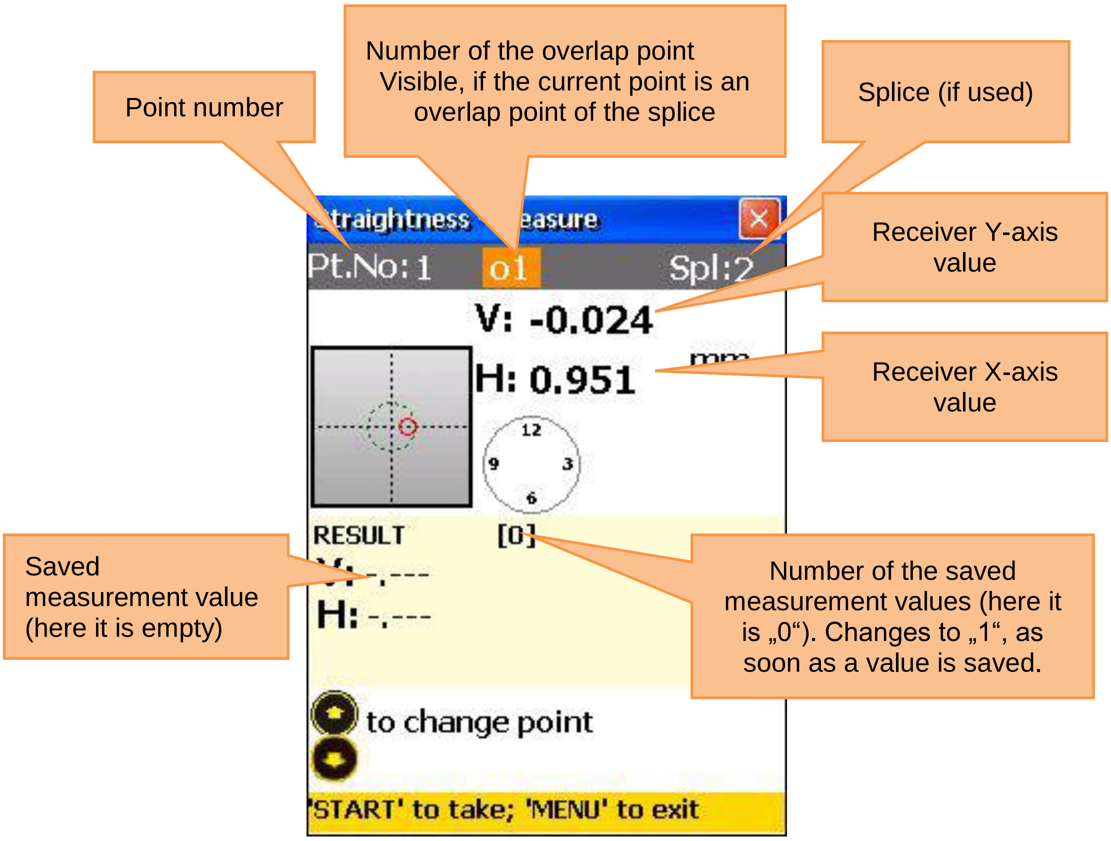
8.3.9 Rough alignment of the laser beam

Position the laser transmitter (sensor S is set by default) as close as possible at the beginning of the object (or at the first overlap point of the splice you want to measure, if more splices are used). Position the receiver (sensor M is set by default) as close as possible to the transmitter. Adjust the position of the transmitter, so that the laser beam maims the middle of the receiver. The laser position indicator on the display shows the exact position. Move the receiver as far as possible (but only on the particular splice) from the transmitter.
Adjust the position of the laser beam to the receiver with the help of the adjustment screws on the transmitter once again. The laser beam should aim the middle of the receiver again. Move the receiver to the first measurement point. Be sure that the right measurement point and the right splice (if used) are selected.
If the laser beam is out of the aim on the receiver, repeat the adjustment process. Rough alignment should be carried out once for each measurement object or each splice (if used).

⚠ Do not touch the transmitter or adjust the receiver in the course of the measurement.

8.3.10 Carry out, access and replace measurement

To carry out a measurement, press ENTER START. Saved values are displayed as a result.



To navigate through the saved values, use and . To replace the selected measurement value, press ENTER START and conform by pressing „Yes“ in the following dialogue window.

8.3.11 View and save results

If the measurements for all planes are finished, press MENU, to view the result. There are two reference line models, you can switch between pressing 5 JKL.

Ref.point Mode: if one of the reference points is undefined, the result is the unchanged receiver value. If two reference points are defined, the result is the difference between the calculated reference line and the receiver value.

To define reference points, press * . and enter reference point number 1 and reference point number 2. Press ENTER to confirm. In order to delete a reference point, enter * . as the value.

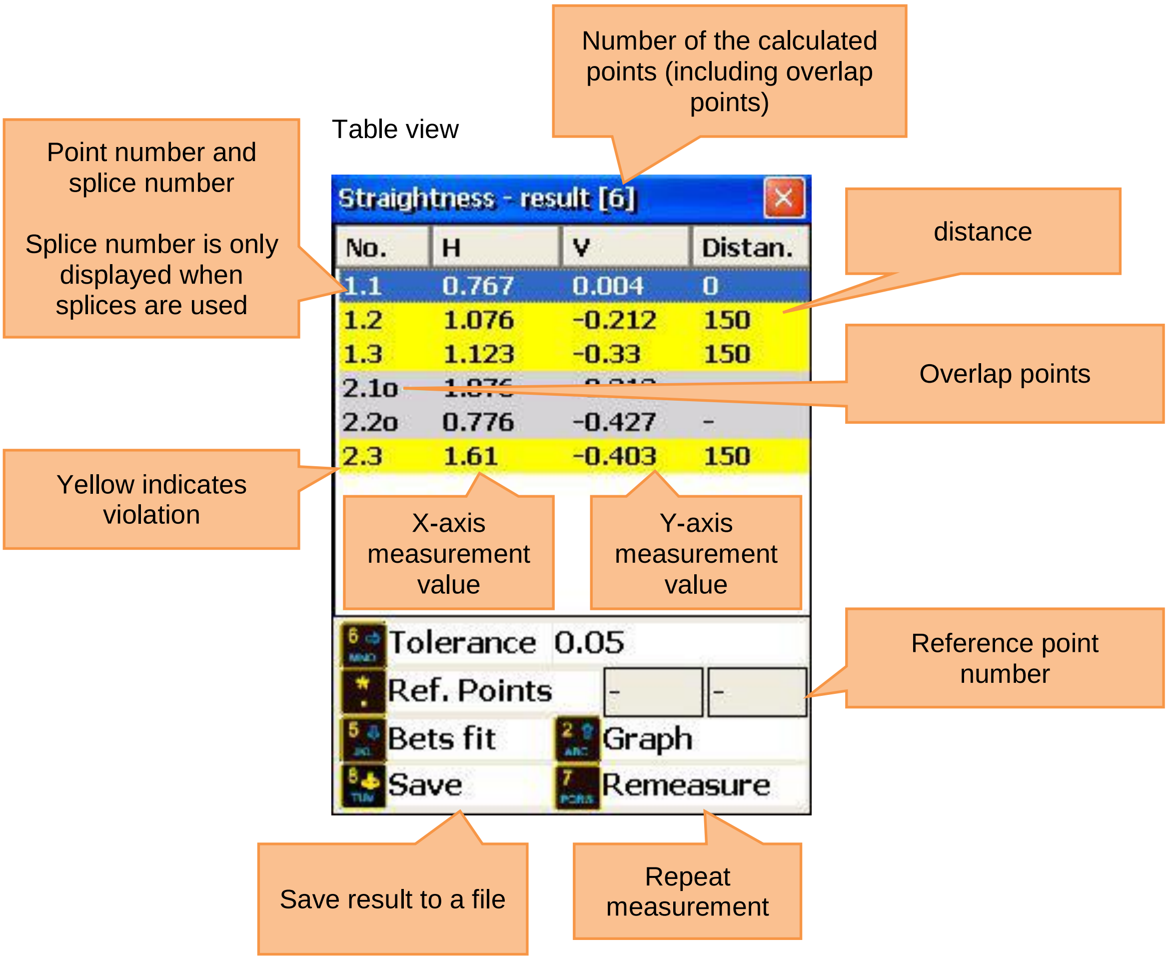
Best- Fit Mode: in this mode, the result is the difference between the calculated best fit reference line and the receiver value.

The result can be displayed as a table or a graph. Due to 2 ABC, you can switch between these illustrations.

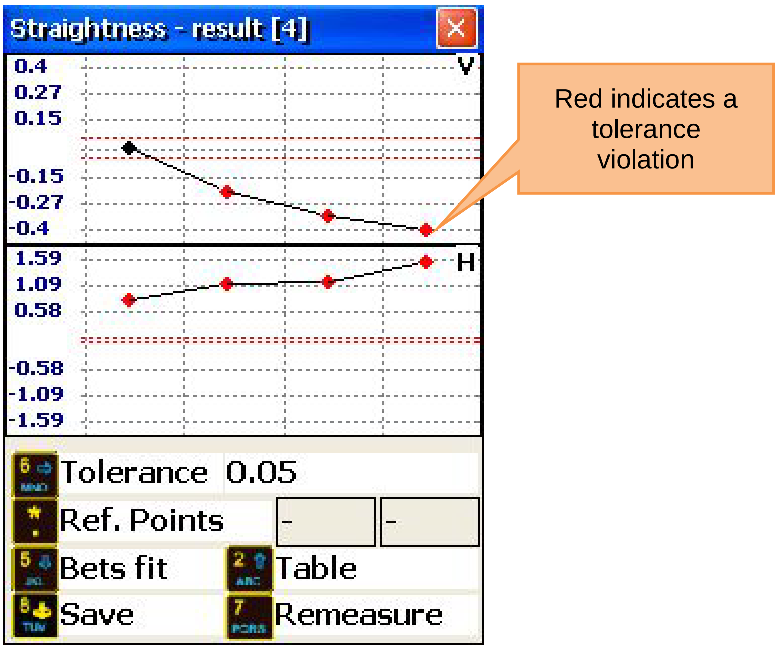
To save the result, press 8 TUV, (refer to **chapter 10„Handling of the Data Dialogue window“**)

To return to the main menu of the program, press MENU

Table view



Graph view
(keep in mind that the overlap points are not displayed in the graph. Therefore, the amount of measurement points is only 4 and not 6)



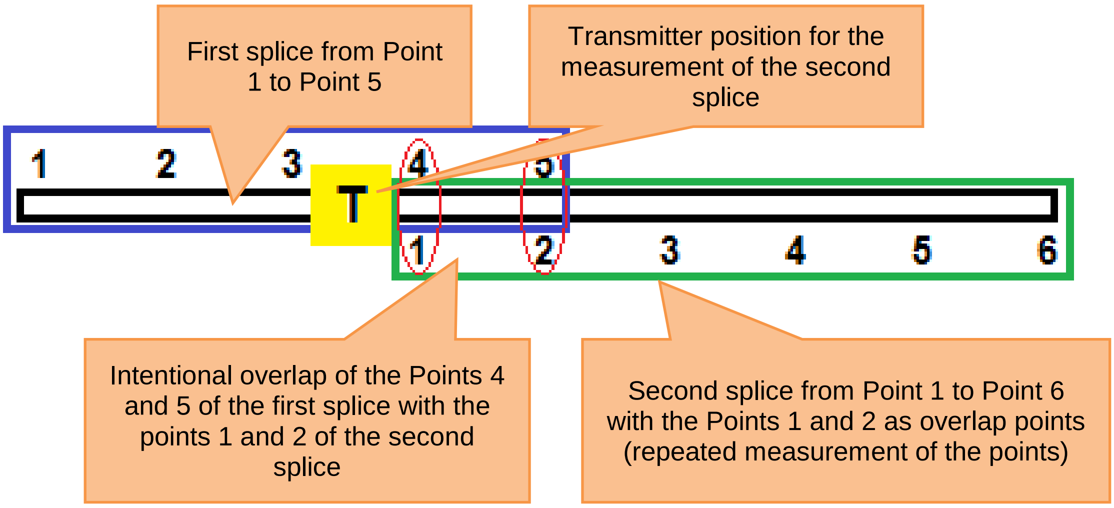
Press MENU, to return to the main screen.

8.3.12 Tutorial for the use of splices

If you want to measure an object which is longer than the effective length of the laser measurement system, you need to divide it (only on paper) into individual sections (splices), which do not exceed the effective length (refer to the following picture).Keep in mind, that the minimal amount of measurement points should not be less than 3 and at least one more than the amount of overlap points (minimal amount of overlap points is 2). At the beginning, you need to carry out rough laser alignment for the first splice. If the measurements for the current splice are finished, move the transmitter as close to the overlap point as possible. Carry out rough laser alignment for the next splice and start the measurement. Place the receiver on the first overlap point. Check the display for the correct numbers of the point and the splice. The correlation of point number, splice and overlap point is shown in the following picture as well.

In this example, we divide the object into two splices. The first splice possesses 5 measurement points (positions) and the second splice possesses 6 measurement points including the overlap points. In the beginning, you need to collect the receiver values of the first slice (from Point 1 to Point 5). Move the transmitter to its next position (Yellow Square). Carry out rough laser alignment for the second splice.

Note:
Point 1 on the second splice has the same physical position on the object as Point 4 in the first splice.
Point 2 on the second splice has the same physical position on the object as Point 5 in the first splice.
The distance between Point 2 and Point 3 on the second splice is the distance between Point 5 on the first splice and Point 3 on the second splice so that this distance after the first splice contributes to the total length in the following.

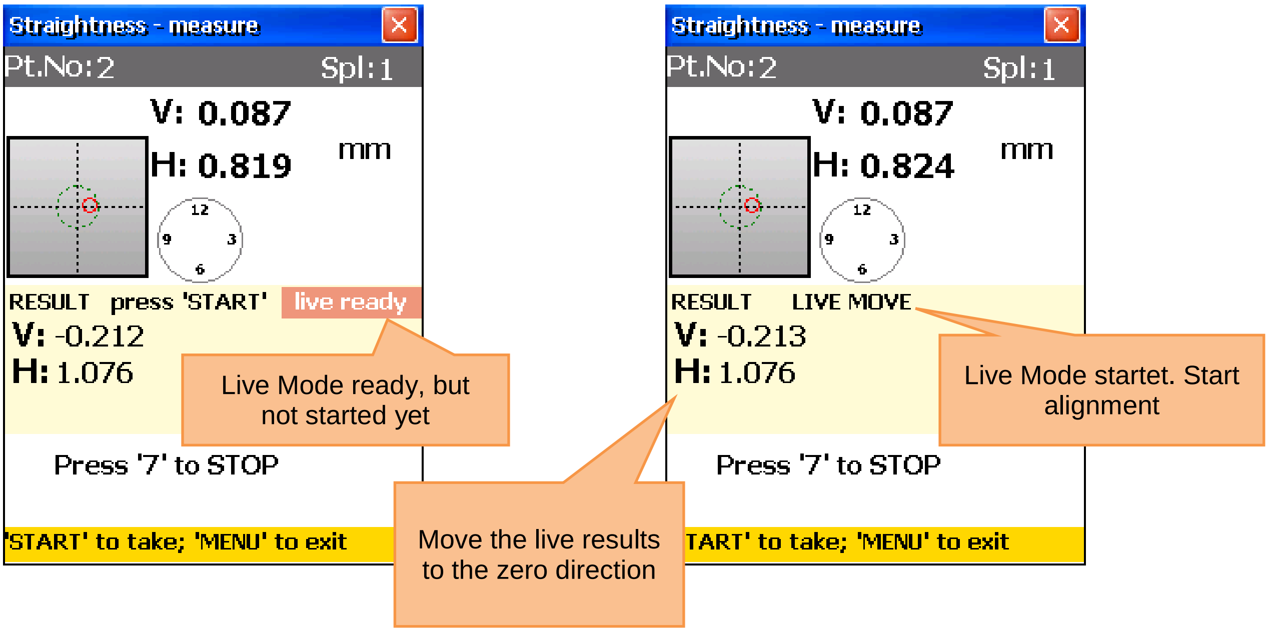


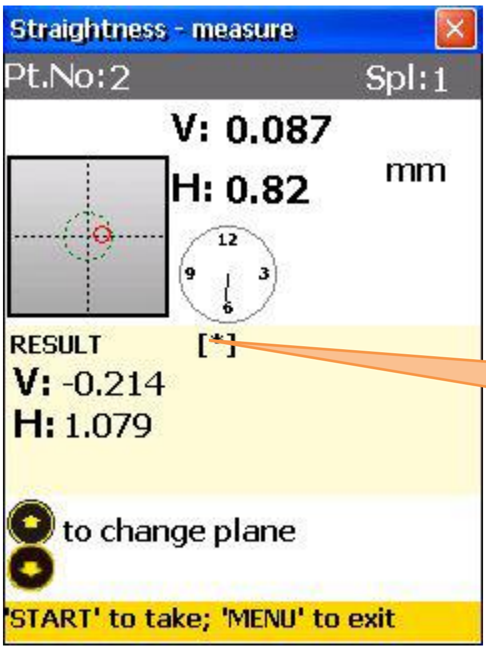
8.3.13 Live Mode

Place the receiver on this position to carry out a live measurement on the selected position. Turn the result screen into the reference line mode and in the table view now. Select the required plane with ▲ and ▼ and press ENTER START, to get to the measurement screen, where you can activate the live mode. Press ENTER START another time, to start the live mode.

⚠ Do not move any objects, until a blinking „LIVE MODE“ appears!
Move the object to the zero direction with the help of the measurement values on the screen. To stop the live mode and receive the result, press 7 PQRS.

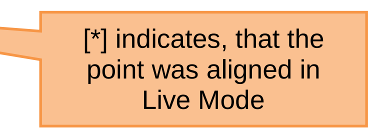
Do not stop the Live Mode, while the measurement data are not ready (laser beam out of aim, sand glass symbol or connection problems)





After the Live Mode was stopped, another point can be selected. Select a new point, place the receive on the selected position, press 7 PQRS and after that ENTER START, to start the Live Mode for the next selected plane.

The alignment of a point can influence other points. Repeat the measurements after using the Live Mode (return to the result screen and press 7 PQRS to repeat the measurement)

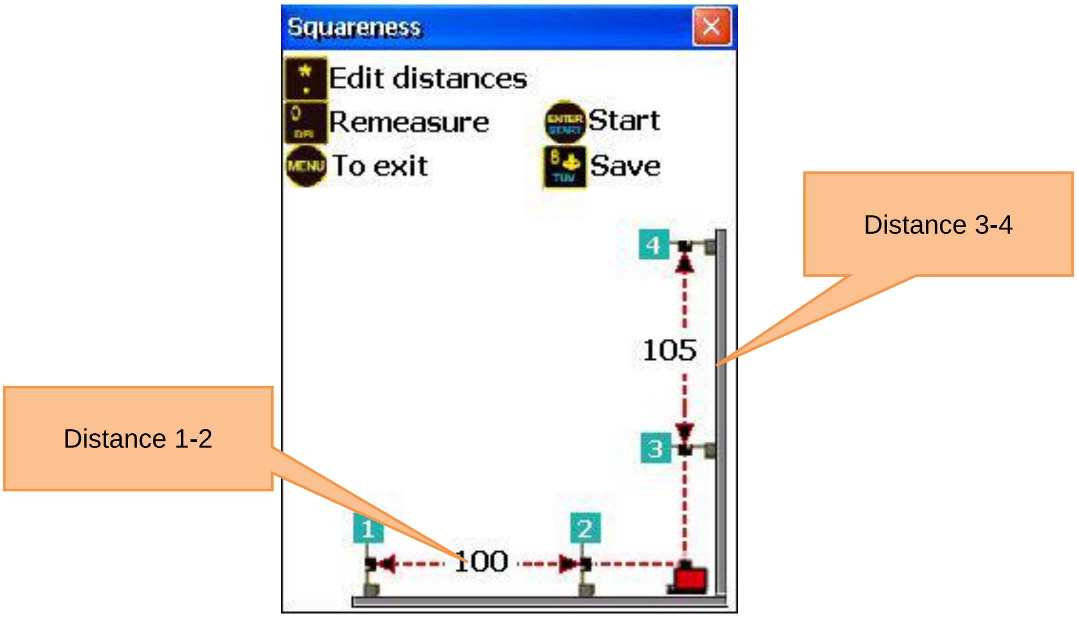


8.4 Rectangularity program („Squareness programm“)

This program is used to determine the rectangularity of two planes to each other. The rotatable laser transmitter RI-20 can emit laser beams in an exact angle of 90° with the help of its integrated Pentaprism. The two rectangular laser beams are used as a reference. Four measurements shall be carried out – two measurements on one plane and – after the direction of the laser beam was changed – two measurements on the other plane. Place the rotatable laser transmitter in the corner between both planes. Now you place the receiver (sensor M set by default) on the first position. Carry out rough alignment, if necessary.

8.4.1 Main screen of the program

What should be noted in this window		Shortcuts in this window	
	All required dimensions should be entered correctly (can be changed later on, if recommended)		Start new measurement or repeat measurement (all collected data will be lost)
Functions in this window			Enter dimensions
- Enter dimensions - Start measurement - View results (available, if all required measurements are finished) - Save			Save all data in one file (see **chapter 10 „Handling of the Data Dialogue window“**)

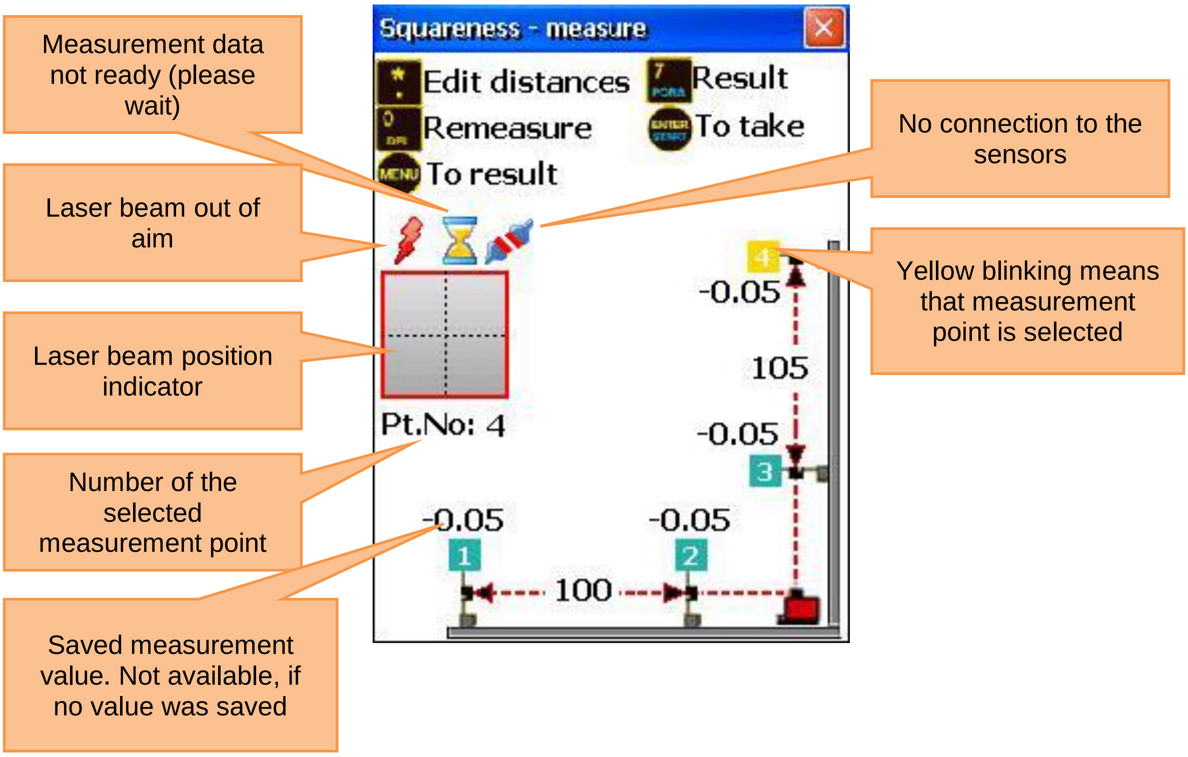


8.4.2 Measurement process

Mark two points (near and far) on the first plane and repeat this action for the second plane. Press and enter the distance between Point 1 and Point 2. Confirm pressing and enter the distance between Point 3 and Point 4. Confirm again by pressing . Place the rotatable laser transmitter in the corner between both planes and place the receiver on the first measurement point (far). Press now, to get to the measurement screen.

8.4.3 Carry out measurement

Press ENTER START to carry out a measurement. Use ◀ and ▶, to select the required measurement point. Press MENU to leave this screen again.



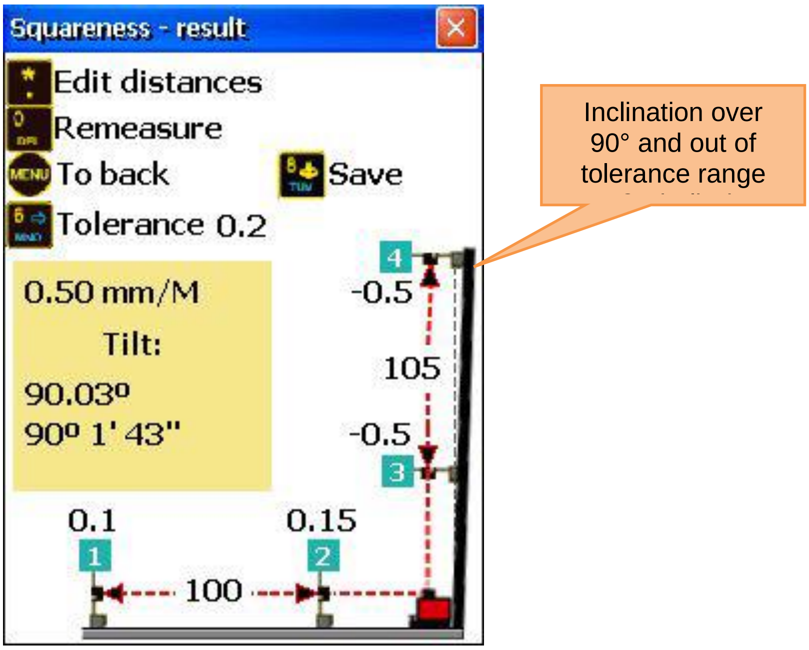
Having carried out the measurement for Point 1, move the receiver to Point 2 and carry out a measurement. Turn the rotatable laser transmitter 90° to the direction of the second plane afterwards. Carry out measurements for Point 3 and Point 4 now.

⚠ The RL-20 laser transmitter must not be moved after the beginning of the measurement. Be careful when you turn the laser beam.

The order of measurement data acquisition is not important for the measurement.

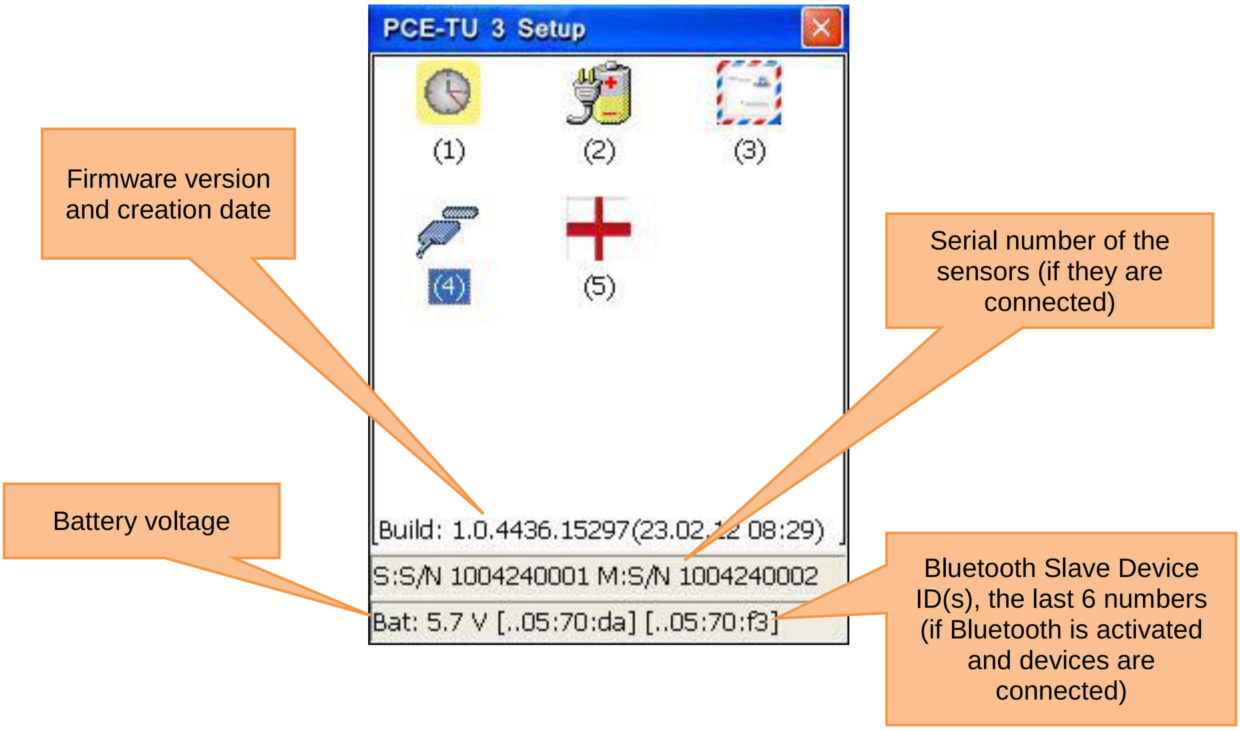
8.4.4 View and save results

To view the measurement results, press 7 PQRS. To save the results, press 8 TUV. To return to the main screen of the program, press MENU. If you want to enter tolerances, press 6 MNO. If the calculated results are out of your tolerance range, the vertical plane is illustrated inclined and dark.



9 System settings

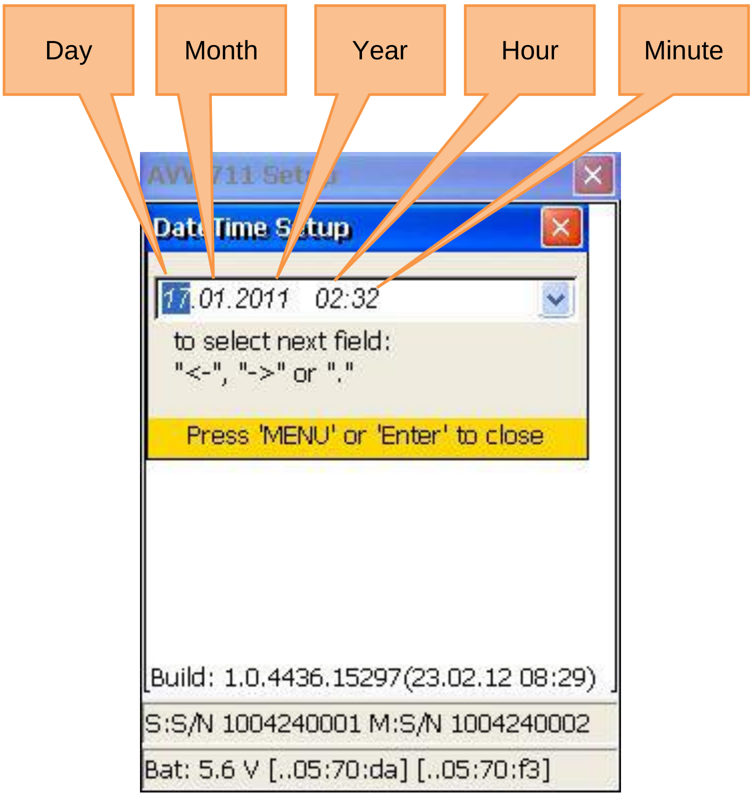
Functions in this window	Shortcuts in this window	
- Set date and time	1 ⓘ	Set date and time
- Configure automatic turn-off	2 ▲ ABC	Configure automatic turn-off
- View/set up program licences	3 DEF	View/set up program licences
- Set data transfer to the sensors (Bluetooth or serial)	4 ◄ GHI	Set data transfer to the sensor
- Retrieve firmware version and status information	5 ▼ JKL	Set user language
- Set language	6 ► MNO	Set USB-mode
- Set USB-mode		



9.1 Set date and time

To set date and time, press [1 ⓘ]

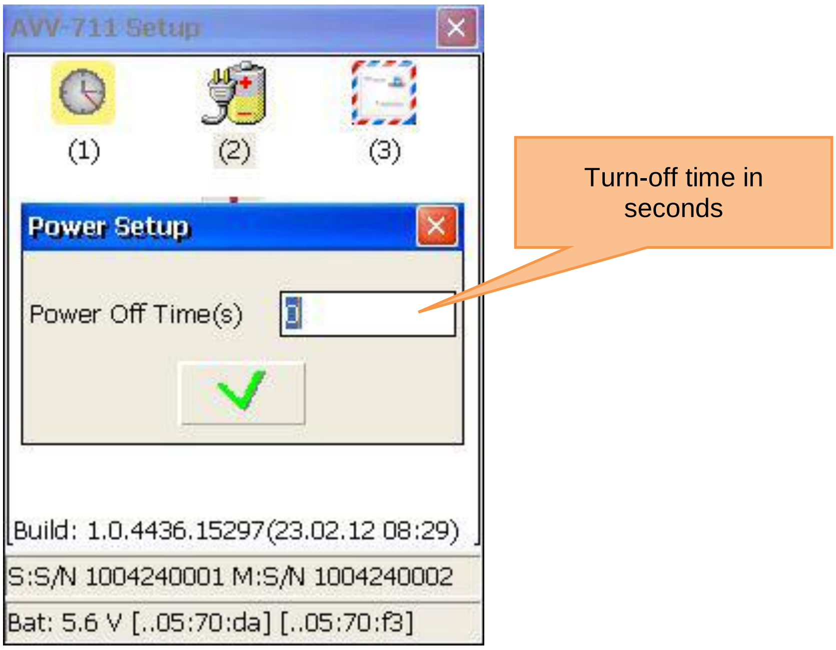
Functions in this window		Shortcuts in this window	
			Navigate left between the fields
			Navigate right between the fields
			Increase the current value
			Decrease the current value
		* .	Move between the fields (cyclically)
		MENU / ENTER	Leave date and time settings (close window)



9.2 Configure automatic turn-off

To configure automatic turn-off, press 2 ABC.

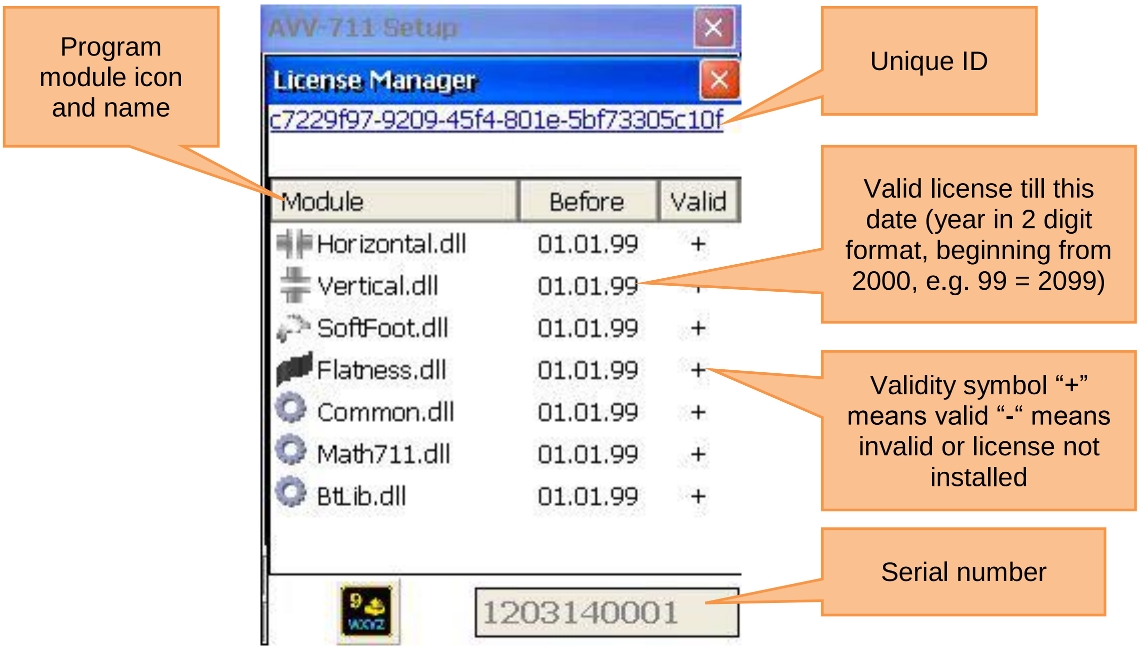
Functions in this window		Shortcuts in this window	
⚠	Setting of the turn-off time in seconds ***Note 1:*** To deactivate auto turn-off, set the time to zero or leave the box blank. ***Note 2:*** If the values below 30 seconds are entered, the box is highlighted in yellow in order to indicate a turn-off time which is to short.	MENU	Leave without saving
		ENTER	Confirm the new value



9.3 View/set up program licences

To view/set up program licences, press 3 DEF

Functions in this window	Shortcuts in this window	
- View licence status - Add/update license by loading a license file („.lic") from the folder "My documents" or from an SD card ("Storage Card" folder) - View serial number of the device - View unique ID of the device	9 WXYZ	Load license file (add/update license)
	MENU	Exit



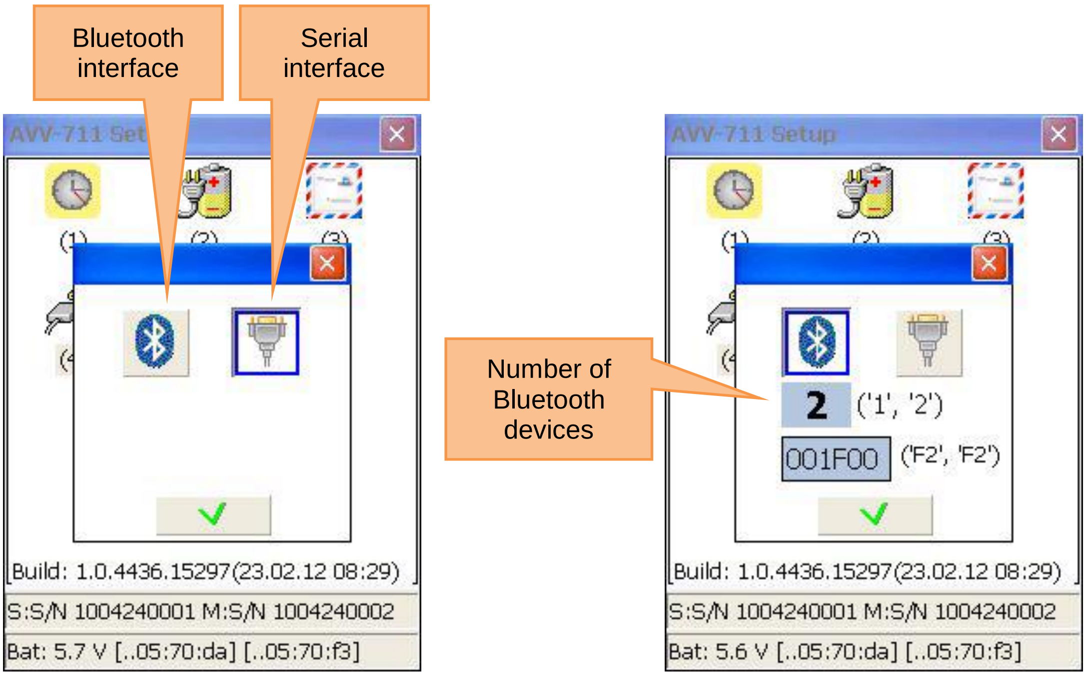
In order to get a license, send the serial number of the instrument to the salesman. If he sends you the license file, copy it to the "My documents" folder on your instrument or to the SD card and insert it.

To load this file, press 9 WXYZ and a loading dialog appears. Use the arrow keys to select the correct license file and press ENTER to load it. If you need to select another medium, press F2 to get to the selection field. Use ▲ and ▼ for the selection of the medium, the license file is located and press F2 again, to get back to your file selection

9.4 Set data transfer of the sensor

To set the data transfer of the sensor, press 4 GHI

Functions in this window	Shortcuts in this window	
- Select between Bluetooth and serial interface - Configure Bluetooth interface (Slave-Device-Number)		Select Bluetooth interface
		Select serial interface
	If Bluetooth is activated	
	1	Use a sensor via Bluetooth
	2 ABC	Use both sensors via Bluetooth
	F2	(Not) Change the Bluetooth Slave Device – COD (does not change it)



9.5 Set the user language

To set the user language, press 5 JKL

Functions in this window	Shortcuts in this window	
Change user language	(Up / Down)	Navigate through available languages
	ENTER	Save and exit
	MENU	Exit without saving

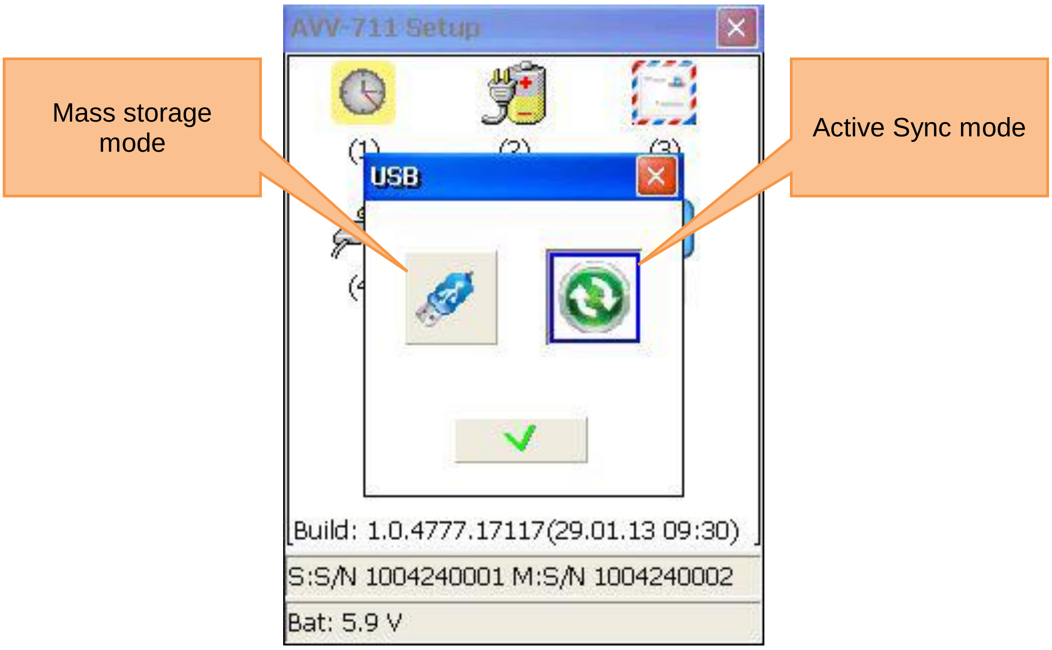
9.6 Set USB-mode

To set the USB-mode, press . To select the mass storage mode, press .
If you select the mass storage mode, the device can be used as a normal USB stick. If you select the Active Sync mode, you need the Microsoft Mobile Device Centre or Microsoft Active Sync 4.5 to get access to the device.

Do not start any loading or saving processes on the device, while the device is used via USB in mass storage mode.

Functions in this window	Shortcuts in this window	
- Change the USB mode between Active Sync and mass storage mode	◀	Select mass storage mode
	▶	Select Active Sync Mode
	ENTER	Save and exit
	MENU	Exit without saving

Changes only become operative after restarting the device.

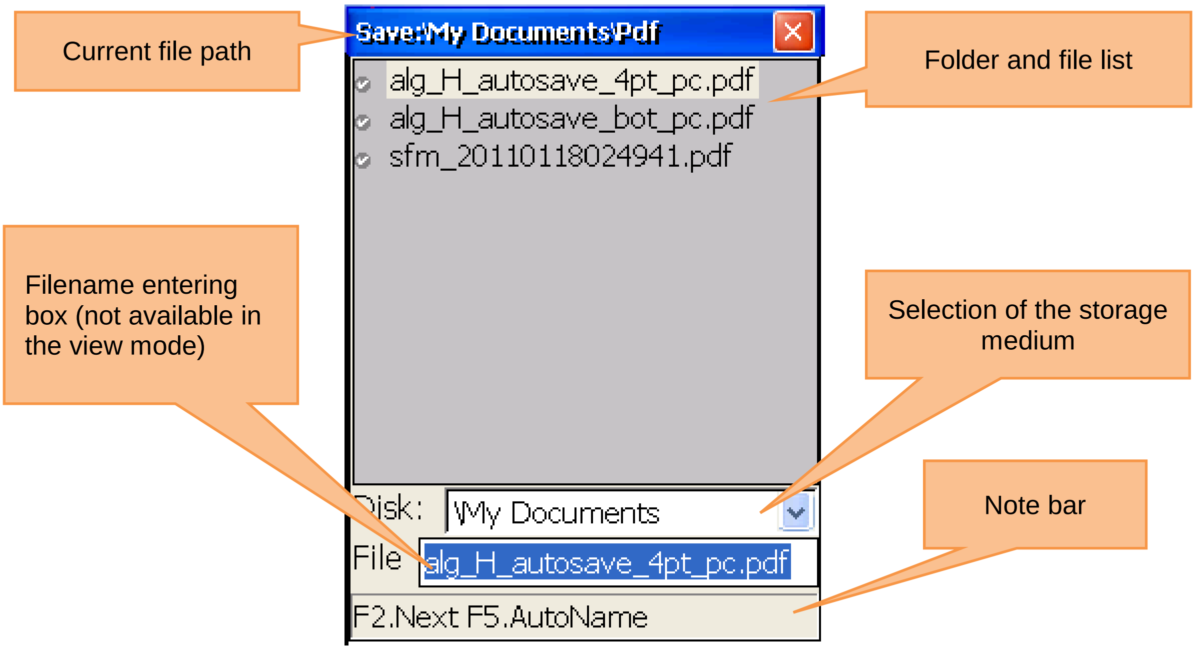


10 Handling of the Data Dialogue window

Explanation of the “Disk” selection field
There are two different saving options

- The “My documents” folder (internal, always available)
- The “Storage Card” folder (external SD card, only available, if an SD card is inserted)

General structure of the Data Dialogue window



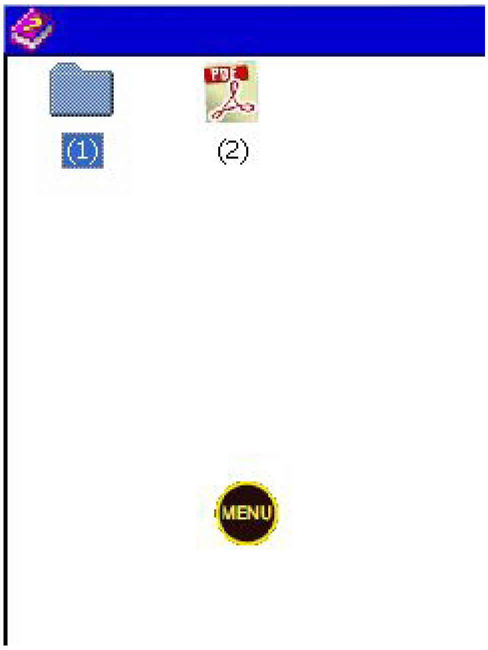
<table>
<tr><th>Functions in this window</th><th colspan="2">Shortcuts in this window</th></tr>
<tr><td rowspan="8">- Select storage medium
- View files and folders
- Navigate through folder hierarchy
- Create new folder
- Delete selected folder or file
- Enter/edit filename
- Generate filename automatically (current date + time)</td><td>▲
▼</td><td>If folder and file list is selected: Navigate through the list

If the storage medium selection field is selected: Select between internal storage (“My documents”) and SD card (“Storage Card”)</td></tr>
<tr><td>CLR ⇤</td><td>If folder and file list is selected and you are at a subfolder: Navigate a step up in the folder hierarchy</td></tr>
<tr><td>0 DEL</td><td>If folder and file list is selected: Delete the selected folder/file (Caution)</td></tr>
<tr><td>7 PQRS</td><td>If folder and file list is selected: Create a new folder</td></tr>
<tr><td>F2
F3</td><td>Switch between folder and file list, storage medium selection field and the filename entering field</td></tr>
<tr><td>F4</td><td>If the storage medium selection field is selected: Open/hide dropdown menu</td></tr>
<tr><td>F5</td><td>Generate filename automatically (current date + time). The name appears automatically in the corresponding entering field</td></tr>
<tr><td>↵ ENTER</td><td>If a folder is selected: Open folder / navigate down one step in the folder hierarchy

If a file is selected: Save file (overwrites the selected file) or load data</td></tr>
</table>

11 „My Documents“ option

Functions in this window	Shortcuts in this window	
- Find/organize files and folders - Save reports as a .pdf-file	1 ⓘ	Find/organize folders and files, create new folders, delete folders and files
	2 ▲ ABC	Save the report as .pdf-file

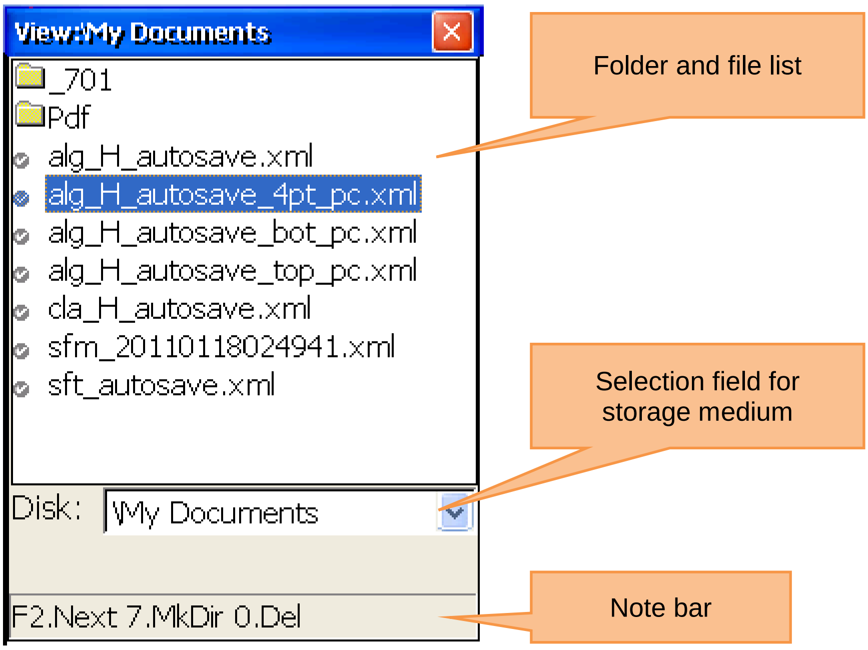


11.1 Find/organize folders and files

To find/organize folders and files, press 1 ⓘ.

Functions in this window	Shortcuts in this window	
- Find folders and files - Switch between internal storage and SD card - Delete folders - Delete files - Create a new folder	▲ ▼	If the folder and file list is selected: Navigate through the list If the storage medium selection field is selected: Selection between SD card and internal storage (“My documents”)
	CLR	Navigate a step up in the folder hierarchy
	0 DEL	If the folder and file list is selected: Delete folders or files
	7 PQRS	If the folder and file list is selected: Create a new folder
	F2 F3	Switch between folder and file list and the storage medium selection field

	F4	If the storage medium selection field is selected: Open/close dropdown menu
	ENTER	If the folder is selected: Navigate a step down in the folder hierarchy (Open folder)

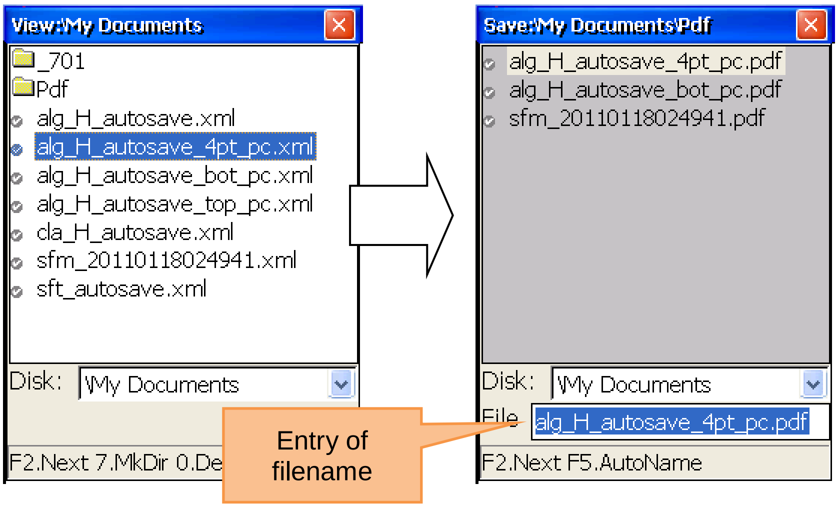


11.2 Save a report as PDF file

To save a report as .pdf-file, press 2 ABC.

Functions in this window	Shortcuts in this window	
- Select report, which shall be save as .pdf-file. - Select storage medium/folder/file, which shall be saved as a pdf.-file	▲ ▼	If the folder and file list is selected: Navigate through the list If the storage medium is selected: Selection between SD card ("Storage Card") and internal storage ("My documents")
	CLR	Move up a step within the folder hierarchy
	0 DEL	If the folder or file list is selected: Delete file or folder
	7 PQRS	If the folder or file list is selected: Create new folder
	F2 F3	Switch between the folder and file list, the storage medium and the entry field for the file name
	F4	If the storage medium is selected: Open/close the dropdown menu
	F5	Generate the file name automatically (current date + time) Not recommended, use the original name instead.
	ENTER	If the folder or file list is selected: Move a step down in the folder

		hierarchy (open folder) Otherwise select a report in the view dialog and save the report in the save dialog.



If you do not wish/need to change the storage medium, there is an easy one-click method to save reports as a PDF:

Press first; the save-dialog will appear. Press again, to save the report as a PDF-file. A PDF subfolder is automatically created and the report with the same filename and .pdf-ending is stored inside.

12 Appendix

Standard tolerances for shaft alignment

In the following, you see the standard tolerances for the alignment of industrial machines with flexible coupling. Only use these tolerances, if there are no in-house guidelines or guidelines provided by the shaft manufacturer. Do not exceed these tolerances.

RPM	Good		Acceptable	
	Parallel misalignment	Angular misalignment	Parallel misalignment	Angular misalignment
Up to 1000	0,08	0,07	0,12	0,10
Up to 2000	0,06	0,05	0,10	0,08
Up to 3000	0,04	0,04	0,07	0,07
Up to 4000	0,03	0,03	0,05	0,05
More than 4000	0,02	0,02	0,04	0,04

13 Disposal

For the disposal of batteries, the 2006/66/EC directive of the European Parliament applies. Due to the contained pollutants, batteries must not be disposed of as household waste. They must be given to collection points designed for that purpose.

In order to comply with the EU directive 2012/19/EU we take our devices back. We either re-use them or give them to a recycling company which disposes of the devices in line with law.

If you have any questions, please contact PCE Instruments.

www.pce-instruments.com

14 Contact

If you have any questions about our range of products or measurement instruments please contact PCE Instruments.

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