For touch probes

Workpiece measurement

Programming instructions

Article number	260605
Version	V4A
Machine control	Brother

Translation of the original German document.

The language version of the manufacturer (DE) is relevant for the technical content.

Subject to technical change without notice.

Table of Contents

1. Introduction

Please read and observe these instructions and the other applicable documents!

1.1 Legend – Warnings, marks, symbols

⚠ CAUTION!

This information indicates a dangerous situation that, if not avoided, may result in mild to medium injury.

▶ ... and shows you how you can avoid it.

NOTICE

This information warns about an immediate threat of property damage.

▶ ... and shows you how you can avoid it.

✓ The check mark indicates the required preconditions.

▷ The white triangle prompts you to carry out an action.

⇨ The arrow indicates the consequences of your action.

(1) ... The number in brackets refers to a respective item in an illustration.

ⓘ Here you will find additional instructions and tips.

*; x This character in a file name or similar acts as a place holder for the version level, numbering, etc.

GN LED is lit.

GN LED flashes.

off LED switched off.

GN green RD red YE yellow BU blue VT violet WH white

TQ turquoise red-green-blue alternating

1.2 Abbreviations and technical terms

NC	Numerical control.	(Numerical Control)
PLC	Programmable logic controller.	(Programmable Logic Control)
N/A	Abbreviation in table – stands for *not available, not applicable, not relevant, not occupied, reserved ...*	(Not Available ...)

2. Safety

2.1 Intended use

The BLUM *Quickstart* software is exclusively developed and intended:

- for installation on the intended machine control.
- for measurement tasks on the workpiece.
- for use with one or more multidirectional BLUM probes for workpiece measurement.
- For use in combination with suitable BLUM technology cycles.
- for installation by trained specialists with comprehensive knowledge of sensitive areas (NC PLC, ...) of the corresponding machine control or by trained BLUM service employees.
- for programming by trained specialists with comprehensive knowledge of NC programming of the corresponding machine control system or by trained BLUM service employees.
- for operation by trained specialist personnel.

2.2 Further applicable documents

- Measuring system data sheets (for any measuring devices, receivers, interfaces, extension modules and accessory products involved).
- Measuring system operating instructions (as appropriate: measuring devices involved).
- Measuring system installation instructions (as appropriate: receivers, interfaces, extension modules involved).
- Wiring diagrams *Wiring*.
- Installation instructions *SETUP* (as appropriate: software, technology cycles involved).
- Programming instructions *APPL* (as appropriate: software, technology cycles involved).
- Operating instructions *APPL* (as appropriate: software involved).
- Documentation from the component manufacturer (any hardware involved – industrial PC, etc.).
- Documentation of the machine manufacturer.
- Documentation of the control manufacturer.

2.3 General safety instructions

NOTICE

Property damage caused by malfunction due to faulty data.

- ▶ Operate BLUM measuring systems exclusively with BLUM software.
- ▶ Only install BLUM software that has been programmed to match the machine control.
- ▶ Always limit the measurement set overtravel in the BLUM software.
- ▶ Only change the machine settings after consulting with the machine manufacturer or the customer.

NOTICE

Property damage caused by a collision due to faulty calculations.

- ▶ Always enter values within the BLUM parameter table in metric units (*mm*, *mm/min* …) – regardless of the machine control setting.
- ▶ Always enter values outside the BLUM parameter table (transfer parameters, tool table, ...) in metric units (*mm*, *mm/min* …) **or** in imperial units (in, in/min, ...) – as per the machine control setting.
- ▶ If necessary, turn the machine off and on again after changing the measurement unit.
- ▶ Always calibrate or adjust the measuring system after changing the measurement unit.

NOTICE

Property damage caused by collision due to faulty data.

- ▶ Always adapt programs and parameters of the BLUM software correctly to the machine (kinematics, deceleration ramp, etc.), measuring device (measuring set overtravel, etc.) and machine control.

NOTICE

Property damage from collision due to lacking or incorrectly executed function test.

- ▶ Always perform a function test before completing the commissioning.
- ▶ Always perform the function test in a single set.
- ▶ Always perform the function test at a reduced feed rate.

NOTICE

Damage caused by collision due to failure to switch the device back on properly after NC-STOP or NC-OFF.

- ▶ Under no circumstances should you use *NC-Start* to continue a stopped measuring cycle.
- ▶ Always call up and restart a measuring cycle that has been stopped.

NOTICE

Property damage due to measuring errors.

- ▶ Ensure that the machine is always at operating temperature during calibration and measurement.
- ▶ Always clamp the measuring object securely.
- ▶ Always calibrate and measure using the same constant feed rate.

NOTICE

Property damage caused by malfunction due to faulty program call.

- ▶ BLUM software may only be programmed by trained specialists with comprehensive knowledge of NC programming of the corresponding machine control system or by trained BLUM service employees.
- ▶ Always use correct, plausible program calls.

NOTICE

Property damage caused by malfunction due to faulty operation.

- ▶ The BLUM software may only be applied by trained specialists with basic knowledge of the corresponding control system.

NOTICE

Property damage caused by collision due to faulty tool data.

- ▶ Always enter appropriate and accurate tool data in the tool table.

NOTICE

Measuring error due to missing or incorrect calibration.

- ▶ Always calibrate before measuring.
- ▶ Ensure that the machine is always at operating temperature during calibration and measurement.
- ▶ Ensure that the determined calibration temperature is not overwritten under any circumstances.
- ▶ Always calibrate and measure using the same constant feed rate.

NOTICE

Property damage caused by collision due to the absence of a safety distance.

- ▶ Select the measuring position on a freely accessible surface.
- ▶ Maintain the safety distances.
- ▶ Approach the measuring position in a protected travel path.

3. General information

3.1 Setting the system of units

ⓘ The current system of units of the machine is read at the start of the measuring cycle. The basic settings of the variables in the program 8710 (USER GLOBAL) or 8717 (TC-USER) are calculated automatically. An adjustment of these variables is therefore not necessary.

ⓘ All programming examples are displayed in mm.

Set the unit of measurement – inch:

▷ Execute the *Calibration in Z* measuring cycle with values in inches: `G65 P8700 Z-0.394 C1.`

ⓘ Reference surface in workpiece coordinate system (WCS) is active.

▷ Execute the *Calibration in XY* measuring cycle with values in inches: `G65 P8700 S1.9685 C1.`

ⓘ Calibration ring: 50,002 mm

▷ Call up the desired measuring cycles with values in inches – e.g.:
`G65 P8700 X0.394 W55.` (zero point offset single point X)

⇨ The unit of measure has been set.

Set the unit of measure – mm:

▷ Execute the *Calibration in Z* measuring cycle with values in mm: `G65 P8700 Z-10 C1.`

ⓘ Reference surface in workpiece coordinate system (WCS) is active.

▷ Execute the *Calibration in XY* measuring cycle with values in mm: `G65 P8700 S50.002 C1.`

ⓘ Calibration ring: 50,002 mm

▷ Call up the desired measuring cycles with values in mm – e.g.:
`G65 P8700 X10. W55.` (zero point offset single point X)

⇨ The unit of measure has been set.

4. Operation

4.1 Calibrating the touch probe

ⓘ Calibration of the probe in X and Y is carried out independently of the calibration in Z.

ⓘ Before performing calibration on a sphere, the calibration in Z must be performed.

When probing a workpiece, the stylus of the probe is moved towards the workpiece. If the stylus is deflected by the workpiece, the machine stops the movement and the current spindle position is stored in the control in special variables. However, this stored spindle position does not match the position of the workpiece edge.

These are the main reasons for this:

- delay of the control.
- radius of the probe ball.
- centre offset of the probe ball.
- deviation of the probe.

The calibration values are determined and saved when a probe is calibrated; they include the delay of the control as well as the radius of the probe ball. These calibration values correspond to the theoretical radii of the probe ball. In addition, the centre offset of the probe ball is determined and stored in two additional values. These values are used for a later measurement. This results in an exact measuring result.

The following calibration values are determined and saved:

- Calibration value X axis.
- Calibration value Y-axis.
- Centre offset X-axis.
- Centre offset Y-axis.
- Calibration value Z axis.

A probe must be calibrated in the following cases:

- When the software is being set up.
- After the parameters for the measurement speed are changed in the program 8717 (TC-USER 1).
- When the stylus has been changed or the concentricity of the stylus has been readjusted.
- When very accurate measurements are required.
- After the unit of measurement has been changed from metric to inches or vice versa.
- After the basic address for the calibration parameters is changed in the program 8717 (TC-USER 1).

4.1.1 Calibrating the probe in Z

ⓘ The distance between the probe ball and the probed surface must be selected so that an acceleration to the measuring speed is possible.

✓ The calibration surface (e.g. upper side of the calibration ring) has been prepared in the machine's machining area in the XY plane.

✓ The Z-position of the calibration surface in the machine coordinate system has been determined to the nearest µ (e.g. with final dimension).

✓ The Z-position of the calibration surface has been entered into any WCS.

✓ The probe has been changed.

▷ Position the probe **over** calibration surface.

▷ Enable the WCS in which the position of the calibration surface was stored: `G...`

▷ Call the program.

⇨ The probe has been calibrated in Z.

Program call
`G65 P8700 C1. Z...`

Parameter	**Description**
C	Carry out calibration.
Z	Position the probe in Z (relative traverse path).

All determined results are stored in the following parameters:

Parameter	**Description**
#110+5	Calibration value of the Z axis.

Example

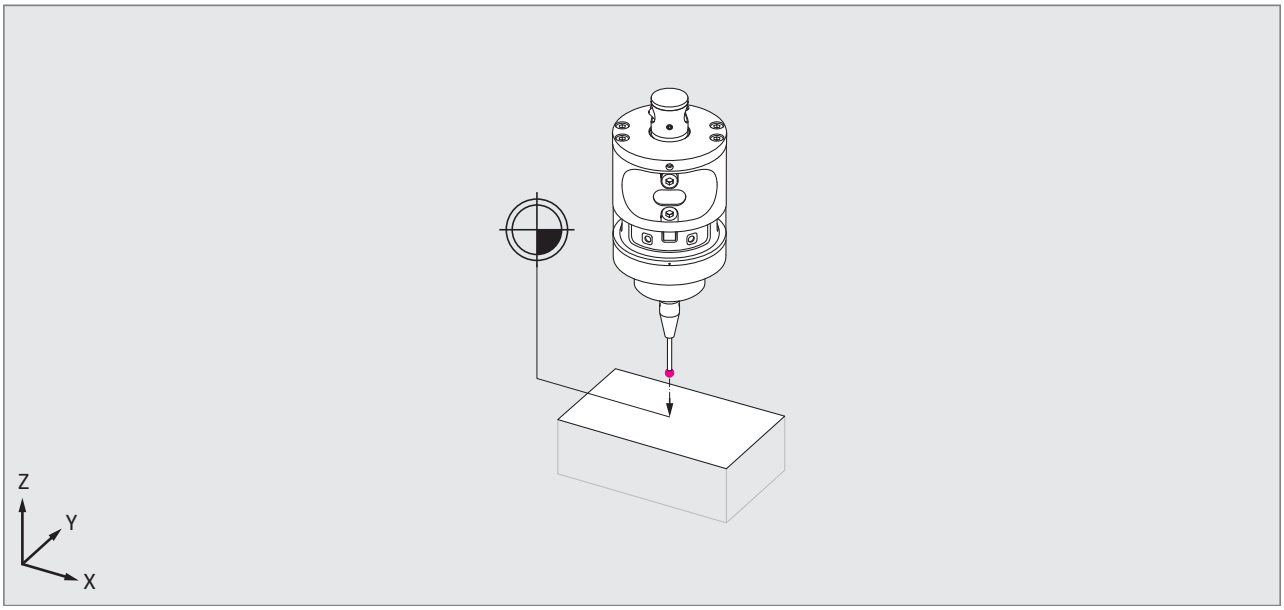


Fig. 4-1 Calibrating the probe in Z

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8700 C1. Z-10.`

⇨ The probe has been calibrated in Z.

4.1.2 Calibrating the probe in X and Y using the calibration ring

ⓘ During calibration, the probe is oriented automatically or manually, depending on the settings in option bit #128.

ⓘ The optional parameter Z can be used to perform the calibration on the outside diameter.

✓ The calibration ring has been installed in the machining area of the machine.

✓ The probe has been changed.

▷ Position the probe as **centrally** as possible inside the calibration ring.

▷ Call the program.

⇨ The probe has been calibrated in X and Y using the calibration ring.

Program call
`G65 P8700 C1. S...`

Parameter	Description
C	Carry out calibration.
S	Dimension of measuring point.

Parameter, optional	Description
Z	Position the probe in Z (relative traverse path).

All determined results are stored in the following parameters:

Parameter	Description
#110+0	Calibration value of the X axis.
#110+1	Calibration value of the Y-axis.
#110+2	Centre offset of the X-axis.
#110+3	Centre offset of the Y-axis.

Example

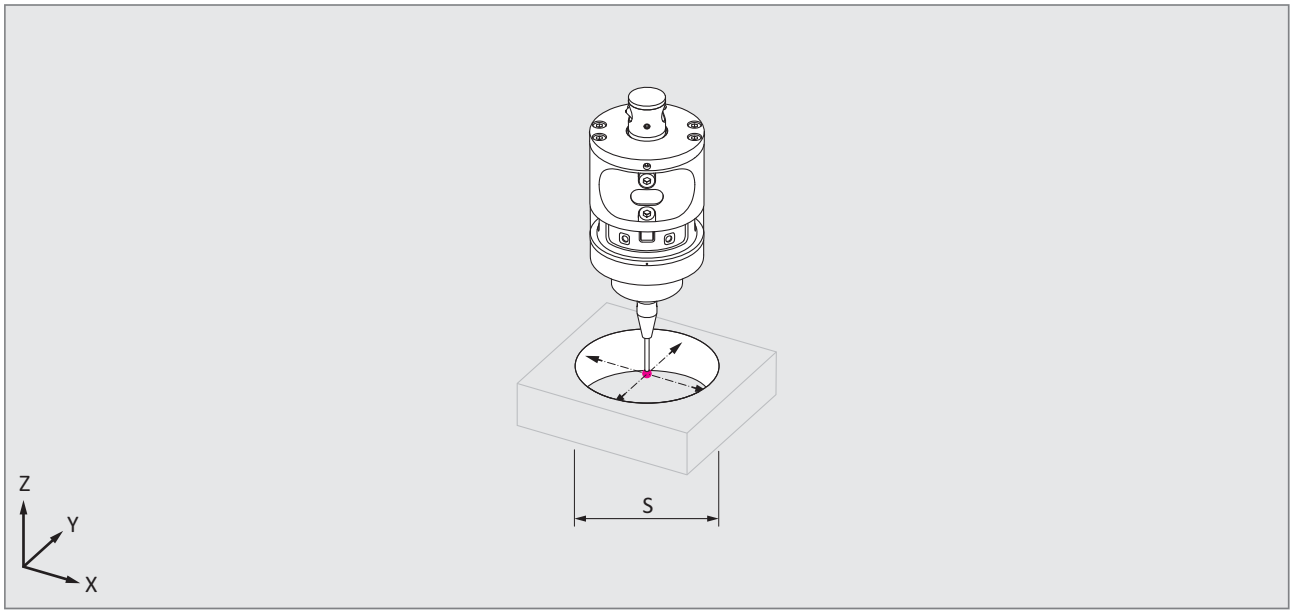


Fig. 4-2 Calibrating the probe in X and Y using the calibration ring

▷ Call the program: `G65 P8700 C1. S50.`

⇨ The probe has been calibrated in X and Y using the calibration ring.

4.1.3 Calibrating the probe in X and Y using the calibration sphere

ⓘ Before calibrating a sphere, the calibration in Z must be performed.

ⓘ During calibration, the probe is oriented automatically or manually, depending on the settings in option bit #128.

✓ The calibration sphere has been installed in the machining area of the machine.

✓ The probe has been changed.

▷ Position the probe as **centrally** as possible above the calibration sphere.

▷ Call the program.

⇨ The probe has been calibrated in X and Y using the calibration sphere.

Program call
`G65 P8700 C2. S... Z...`

Parameter	Description
C	Carry out calibration.
S	Dimension of measuring point.
Z	Position the probe in Z (relative traverse path).

All determined results are stored in the following parameters:

Parameter	Description
#110+0	Calibration value of the X axis.
#110+1	Calibration value of the Y-axis.
#110+2	Centre offset of the X-axis.
#110+3	Centre offset of the Y-axis.
#111+0	Sphere centre in the X-axis in the enabled WCS.
#111+1	Sphere centre in the Y-AXIS in the enabled WCS.
#111+2	Sphere centre in the Z-axis in the enabled WCS.

Example

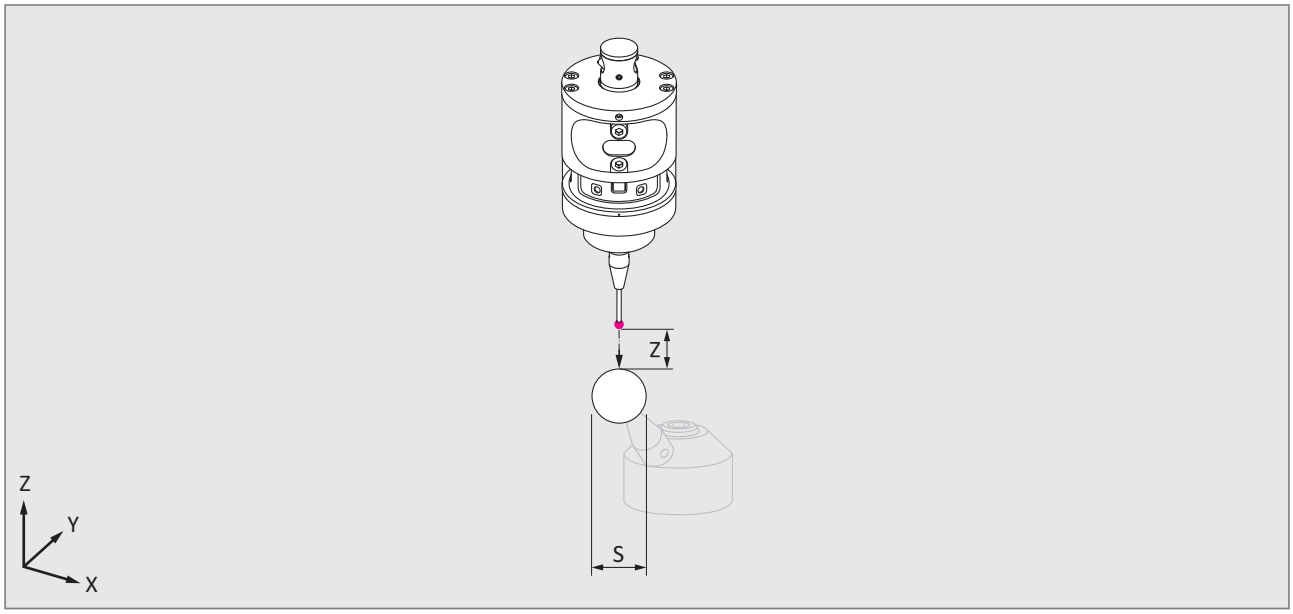


Fig. 4-3 Calibrating the probe in X and Y using the calibration sphere

▷ Call the program: `G65 P8700 C2. S25. Z-10.`

⇨ The probe has been calibrated in X and Y using the calibration sphere.

4.2 Using a protected travel block – PROTECTED MOVE

ⓘ If parameter A is undefined, the absolute dimensions are used for PROTECTED MOVE.

The protected travel block can be used to move the probe safely into a specific position.

The switched-on probe is moved from the start position to the transferred target position. If the stylus is deflected during this movement, the movement is stopped, the probe is returned to the start position and an error message is output.

✓ The probe has been changed.

▷ Enable the WCS (optional): `G...`

▷ Call the program.

⇨ The probe is moved to the transferred target position in the protected traverse path.

Program call
`G65 P8703 A... X... Y... Z...`

Parameter	**Description**
X	Position the probe in X.
Y	Position the probe in Y.
Z	Position the probe in Z.

Parameter, optional	**Description**	
A	Use absolute dimensioning/relative dimensioning.	
	#0./1.	Use absolute dimensioning
	0.	Use relative dimensioning

Example

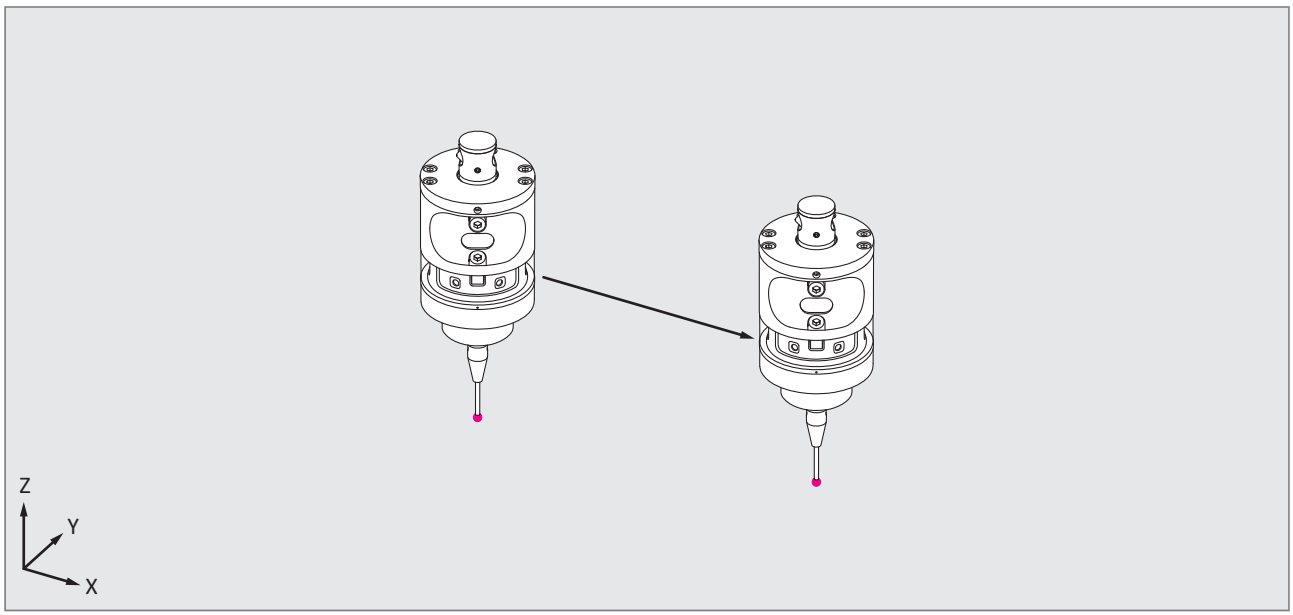


Fig. 4-4 Protected travel block

Protected travel block (absolute movement)

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8703 X30.`

⇨ The protected travel block is performed from the start position (`G54 X10. Y0. Z0.`) to the target position (`G54 X30. Y0. Z0.`).

Protected travel block (relative movement)

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8703 A0. X30.`

⇨ The protected travel block is performed from the start position (`G54 X10. Y0. Z0.`) to the target position (`G54 X40. Y0. Z0.`).

4.3 Checking for component presence

ⓘ The transferred target position must have a sufficient measuring distance so that the object can be reliably detected.

To check the component presence, the 8703 (PROTECTED MOVE) program is used.

The switched-on probe is moved from the start position to the transferred target position. If the stylus is deflected during this traverse movement, the movement is stopped and #111+8 = 1 (component present) is entered. When the probe reaches the target position, #111+8 = -1 (component not present) is entered.

Then the probe either moves back to the start position and an error message is output, or the probe remains in the target position, depending on the prefix of the parameter T. If a component is present, the probe is always moved back to the start position.

✓ The probe has been changed.

▷ Enable the WCS (optional): `G...`

▷ Call the program.

⇨ The component presence has been checked.

Program call
`G65 P8703 A... X... Y... Z... T...`

Parameter	**Description**	
X	Position the probe in X.	
Y	Position the probe in Y.	
Z	Position the probe in Z.	
T	Check the component presence.	
	1.	Component presence check and return to the start position
	-1.	Component presence check and remain in the target position

Parameter, optional	**Description**	
A	Use absolute dimensioning/relative dimensioning.	
	#0./1.	Use absolute dimensioning
	0.	Use relative dimensioning

All determined results are stored in the following parameters:

Parameter	**Description**
#111+8	Component presence.

Example

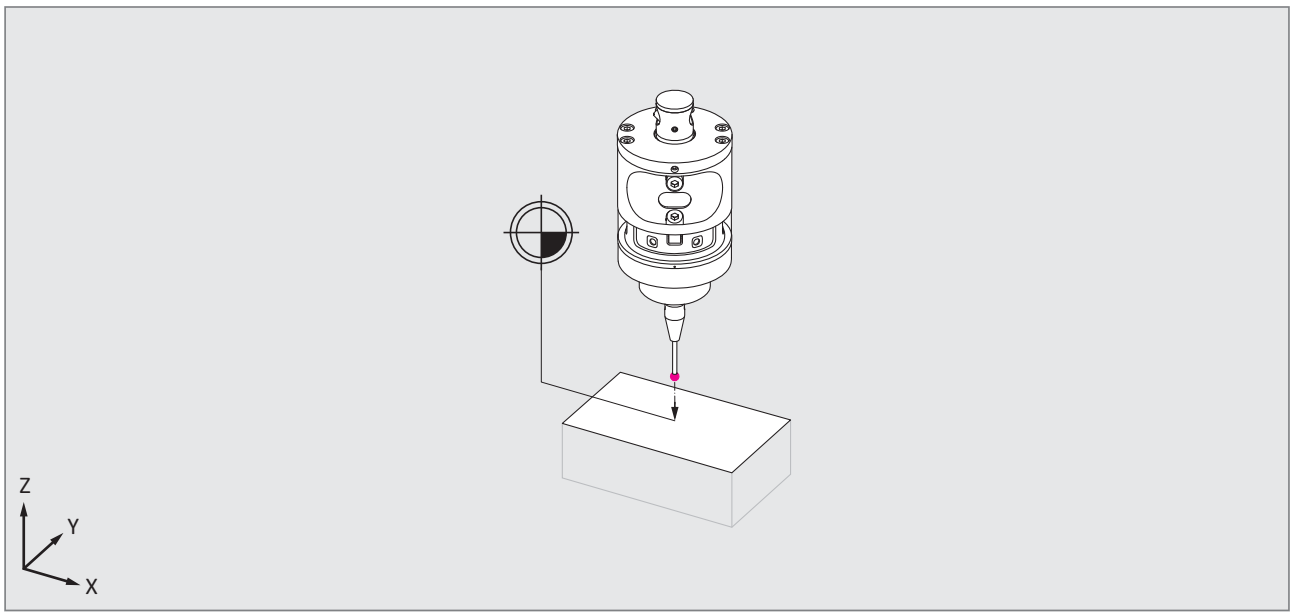


Fig. 4-5 Checking the component presence (absolute position)

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8703 A1. Z0. T1.`

⇨ The component presence has been checked.

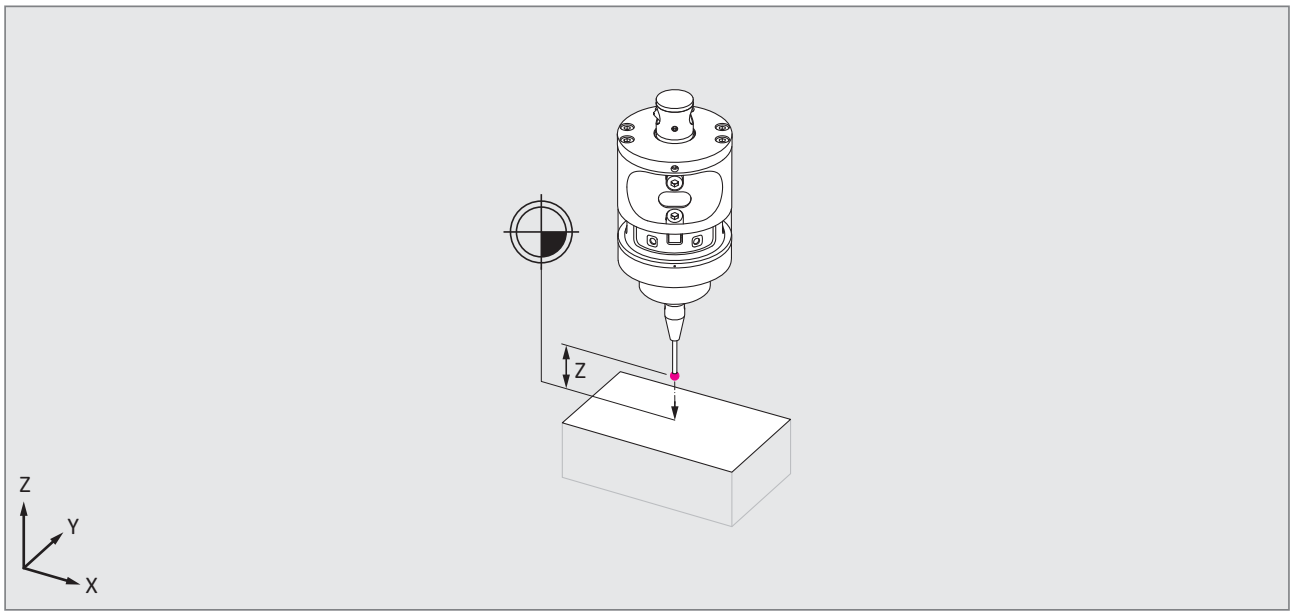


Fig. 4-6 Checking the component presence (absolute position)

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8703 A0. Z-10. T1.`

⇨ The component presence has been checked.

4.4 Determining the zero point

ⓘ The distance between the probe ball and the probed surface must be selected so that an acceleration to the measuring speed is possible.

ⓘ A measurement task is performed to determine the zero point. Dimensions are transferred relative to the workpiece.

4.4.1 Determining the zero point – individual point

✓ The probe has been changed.

▷ Position the probe **in front of** the surface being probed.

▷ Call the program.

⇨ The zero point is set in the selected WCS and the corresponding axis.

Program call
`G65 P8700 X... W...`
`G65 P8700 Y... W...`
`G65 P8700 Z... W...`

Parameter	Description
X	Position the probe in X (relative traverse path).
Y	Position the probe in Y (relative traverse path).
Z	Position the probe in Z (relative traverse path).
W	Select the workpiece coordinate system.

Parameter, optional	Description
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
K	Transfer the set position in Z. ⓘ Note the sequence of the parameters in the program call.

Example

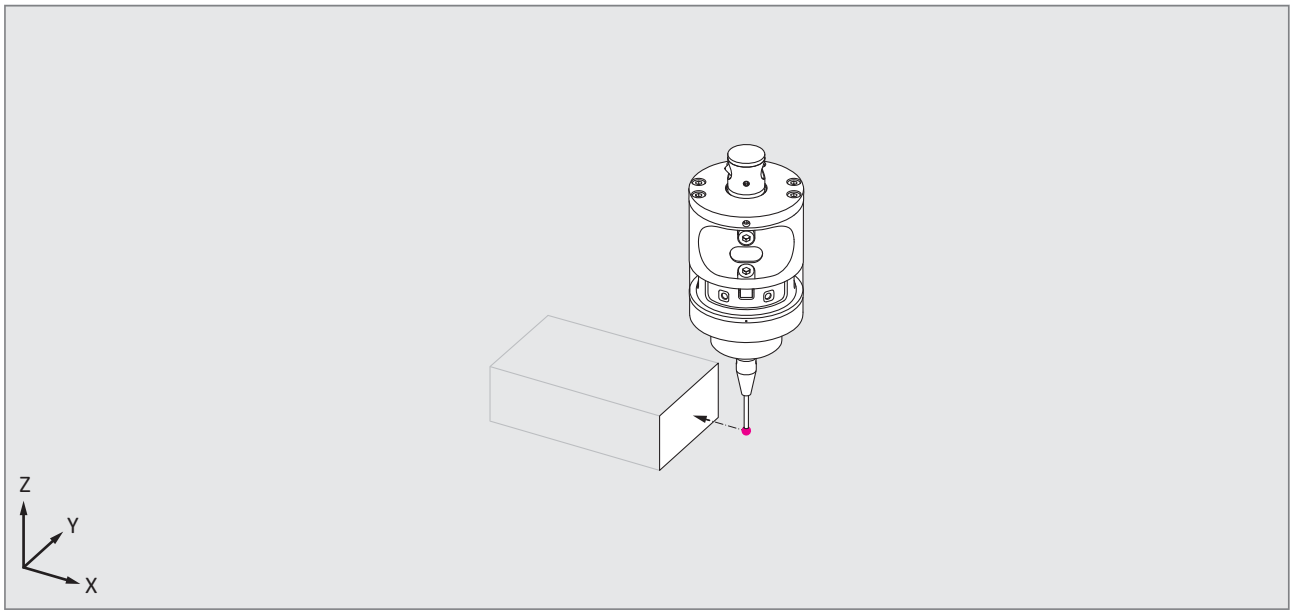


Fig. 4-7 Determining the zero point – individual point in X

▷ Call the program: `G65 P8700 X-10. W55.`

⇨ The zero point has been determined.

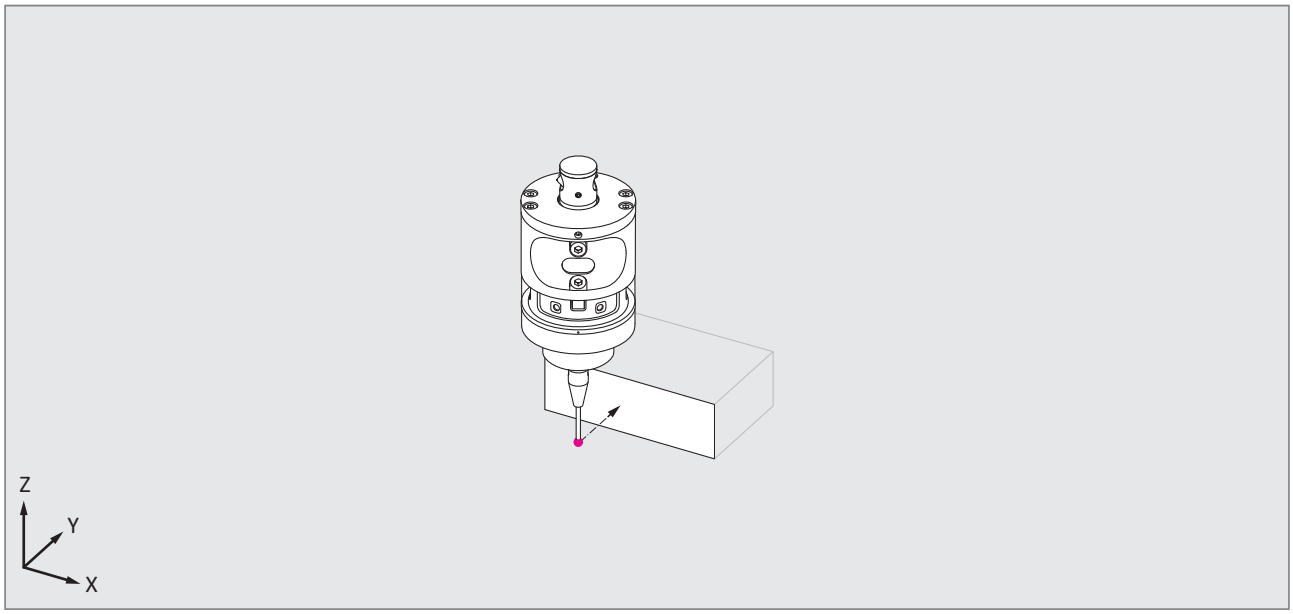


Fig. 4-8 Determining the zero point – individual point in Y

▷ Call the program: `G65 P8700 Y20. W57.`

⇨ The zero point has been determined.

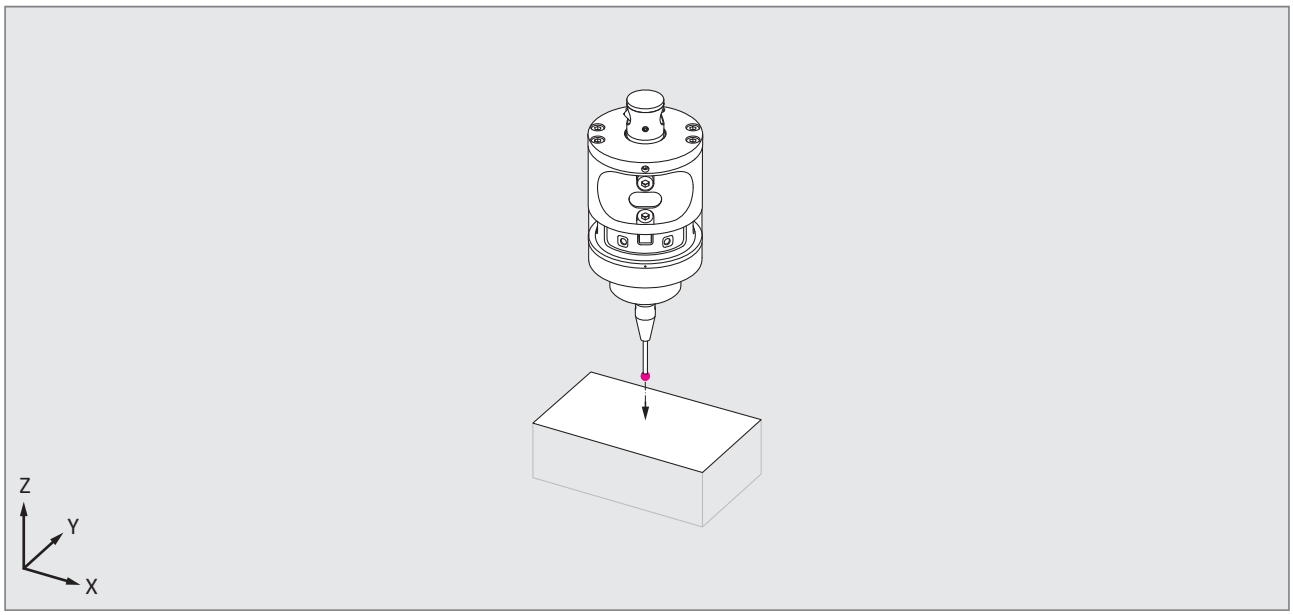


Fig. 4-9 Determining the zero point – individual point in Z

▷ Call the program: `G65 P8700 Z-15. W58.`

⇨ The zero point has been determined.

4.4.2 Determining the zero point – corner in 2 axes

✓ The probe has been changed.

▷ Position the probe **outside** of the corner being probed.

▷ Call the program.

⇨ The zero point is set in the selected WCS and the corresponding axes.

Program call
`G65 P8700 X... Y... W...`
`G65 P8700 X... Z... W...`
`G65 P8700 Y... Z... W...`

Parameter	**Description**
X	Position the probe in X (relative traverse path).
Y	Position the probe in Y (relative traverse path).
Z	Position the probe in Z (relative traverse path).
W	Select the workpiece coordinate system.

Parameter, optional	**Description**
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
K	Transfer the set position in Z. ⓘ Note the sequence of the parameters in the program call.

Example

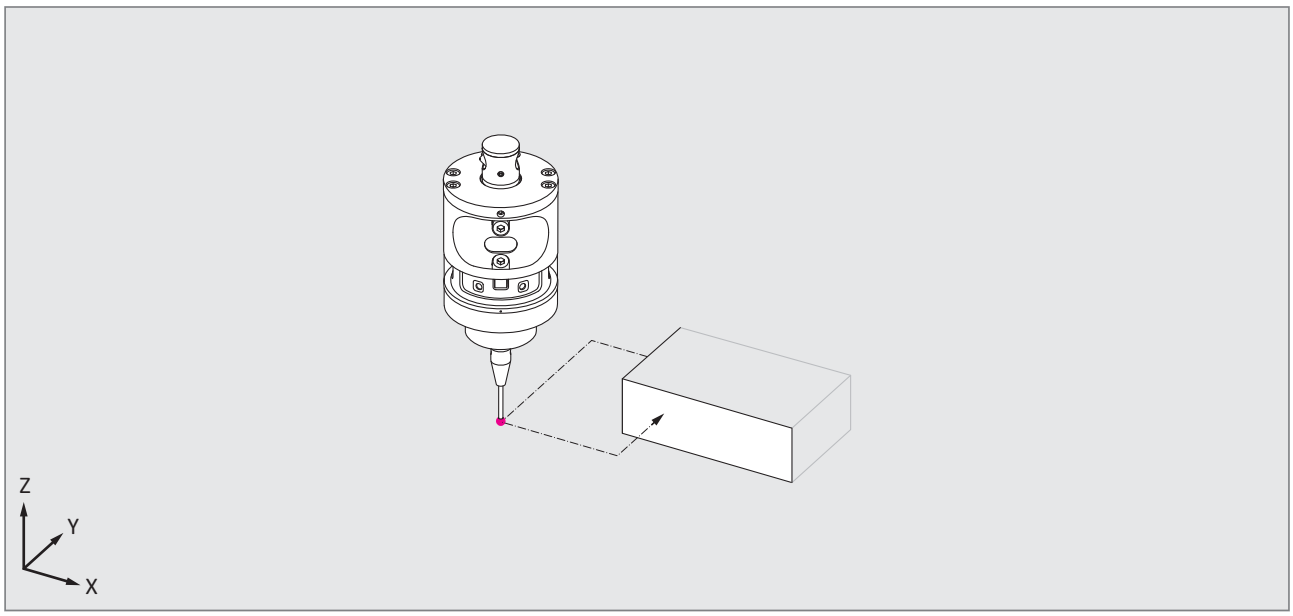


Fig. 4-10 Determining the zero point – corner in XY

▷ Call the program: `G65 P8700 X10. Y10. W59.`

⇨ The zero point has been determined.

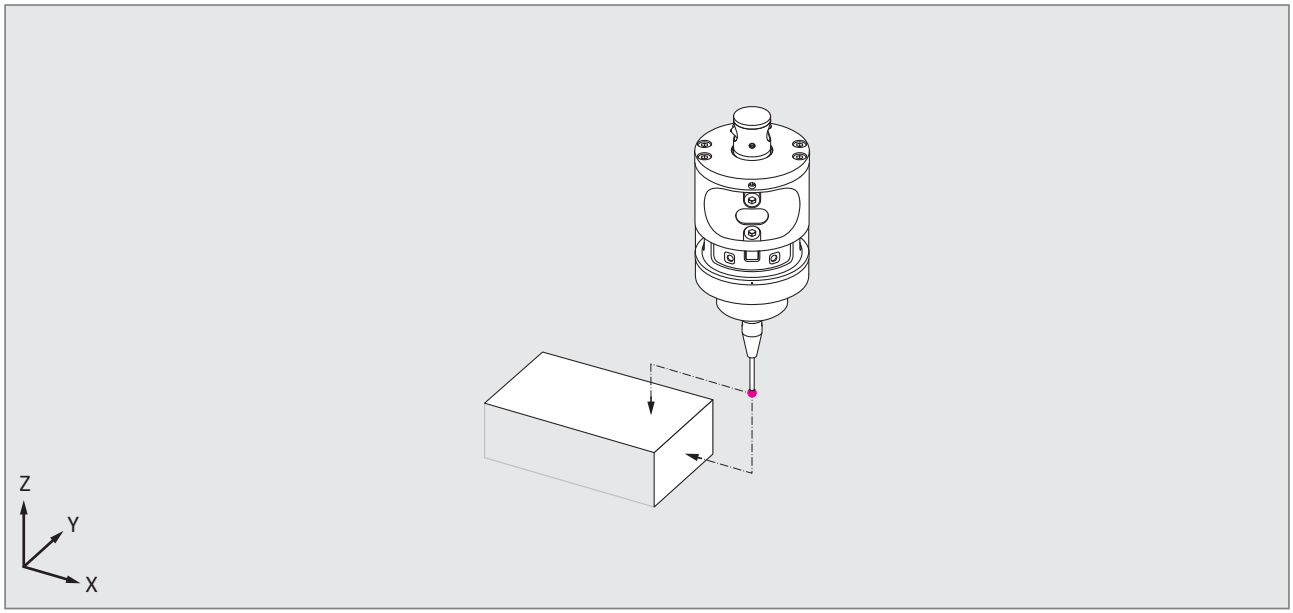


Fig. 4-11 Determining the zero point – corner in XZ

▷ Call the program: `G65 P8700 X-15. Z-10. W58.`

⇨ The zero point has been determined.

4.4.3 Determining the zero point – corner in 3 axes

✓ The probe has been changed.

▷ Position the probe **outside** of the corner being probed.

▷ Call the program.

⇨ The zero point is set in the selected WCS and the corresponding axes.

Program call
`G65 P8700 X... Y... Z... W...`

Parameter	Description
X	Position the probe in X (relative traverse path).
Y	Position the probe in Y (relative traverse path).
Z	Position the probe in Z (relative traverse path).
W	Select the workpiece coordinate system.

Parameter, optional	Description
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
K	Transfer the set position in Z. ⓘ Note the sequence of the parameters in the program call.

Example

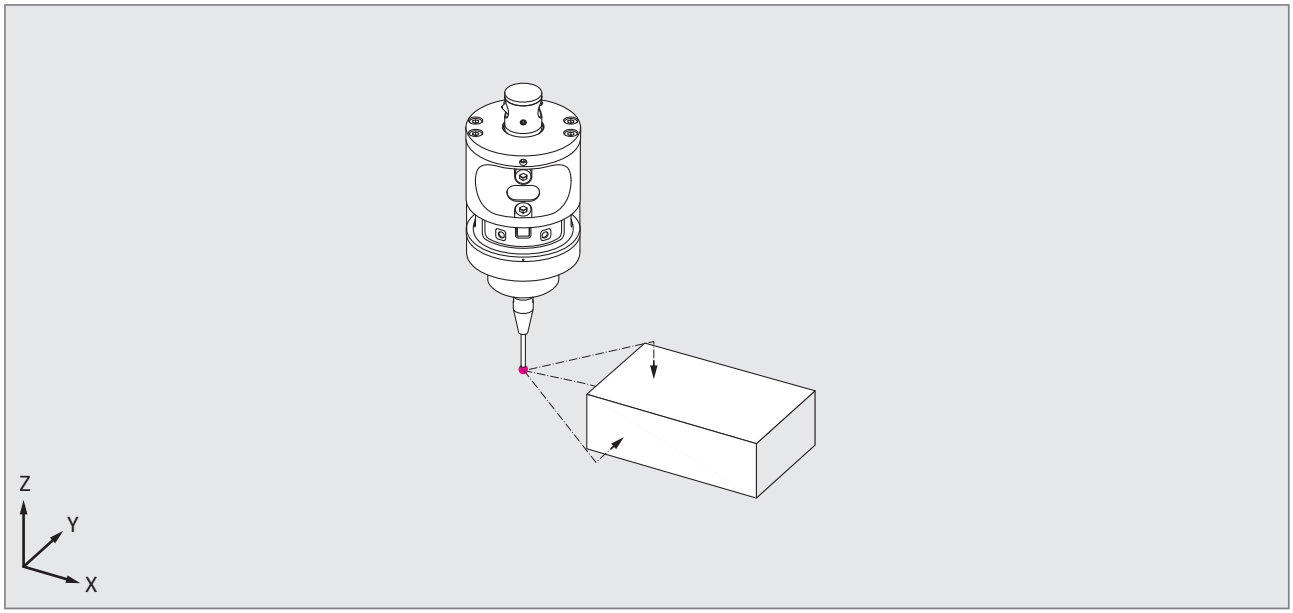


Fig. 4-12 Determining the zero point – corner in XYZ

▷ Call the program: `G65 P8700 X10. Y10. Z-10. W59.`

⇨ The zero point has been determined.

4.4.4 Determining the zero point – inside diameter

✓ The probe has been changed.

▷ Position the probe as **centrally** as possible within the inside diameter.

▷ Call the program.

⇨ The zero point is set in the selected WCS in X and Y. (The position of the zero point is in the centre of the inside diameter.)

Program call
`G65 P8700 S... W...`

Parameter	Description
S	Dimension of measuring point.
W	Select the workpiece coordinate system.

Parameter, optional	Description
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be negative.

Example

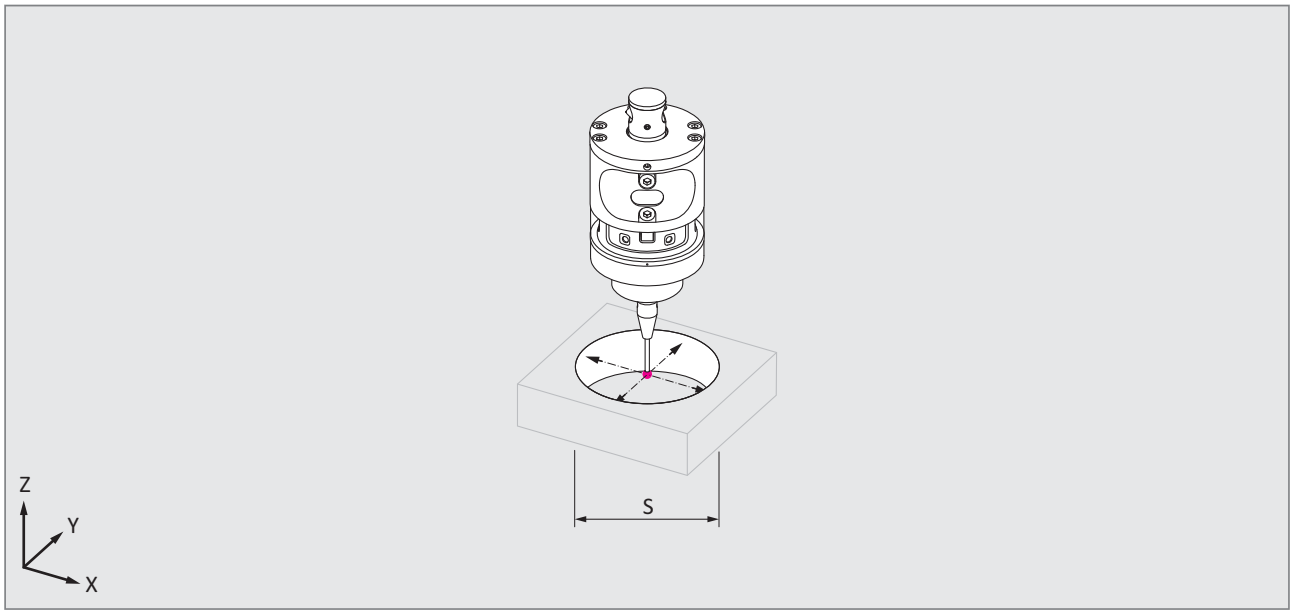


Fig. 4-13 Determining the zero point – inside diameter

▷ Call the program: `G65 P8700 S40. W57.`

⇨ The zero point has been determined.

4.4.5 Determining the zero point - inside diameter with 3 measuring points

ⓘ Before calling up the cycle, position the probe as centrally as possible within the inside diameter. If required, the cycle can be repeated to increase accuracy.

ⓘ The 3 probing angles must be chosen so that they divide the full circle or section in angle segments which are as wide as possible. X-axis is the reference.

✓ The probe has been changed.

▷ Position the probe as **centrally** as possible within the inside diameter.

▷ Call the program.

⇨ The zero point is set in the selected WCS in X and Y. (The position of the zero point is in the centre of the inside diameter.)

Program call
`G65 P8700 S... W... H... U... V...`

Parameter	**Description**
S	Dimension of measuring point.
W	Select the workpiece coordinate system.
H	Define the angle of the 1st probing in the WCS.
U	Define the angle of the 2nd probing in the WCS.
V	Define the angle of the 3rd probing in the WCS. ⓘ If the parameter is transferred with a negative sign, a report file is also output.

Parameter, optional	**Description**
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be negative.

Example

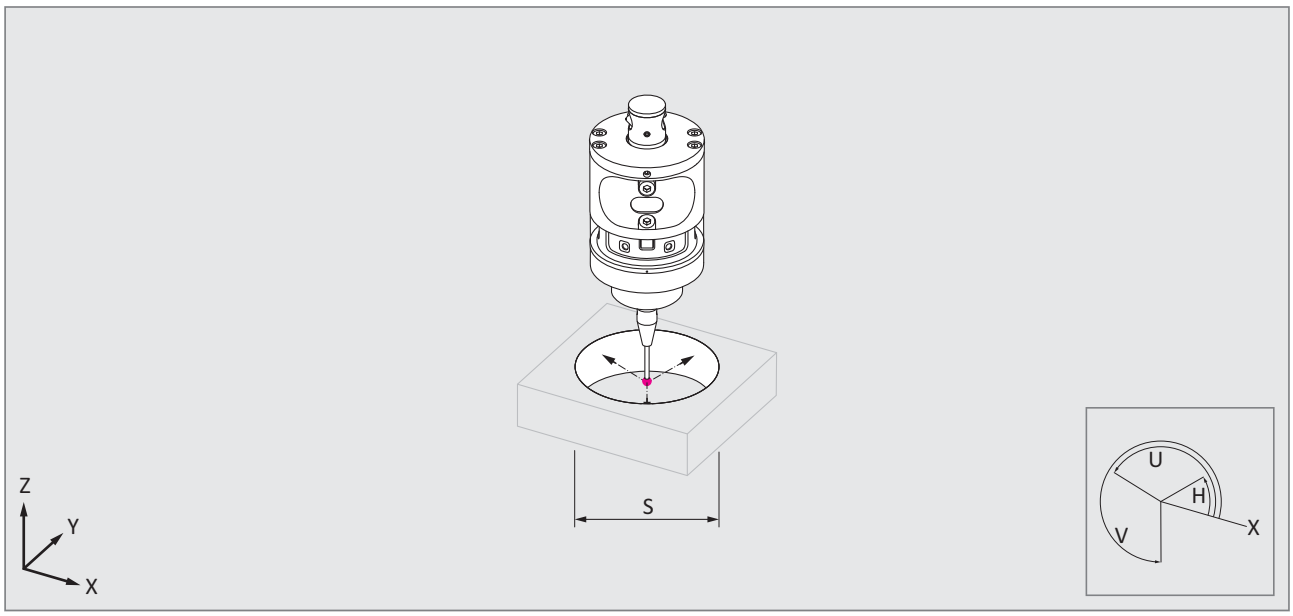


Fig. 4-14 Determining the zero point – inside diameter with 3 measuring points

▷ Call the program: `G65 P8700 S40. W57. H30. U150. V270.`

⇨ The zero point has been determined.

4.4.6 Determining the zero point – outside diameter

✓ The probe has been changed.

▷ Position as **centrally** as possible above the outside diameter.

▷ Call the program.

⇨ The zero point is set in the selected WCS in X and Y. (The position of the zero point is in the centre of the outside diameter.)

Program call
`G65 P8700 S... Z... W...`

Parameter	Description
S	Dimension of measuring point.
Z	Position the probe in Z.
W	Select the workpiece coordinate system.

Parameter, optional	Description
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be positive.

Example

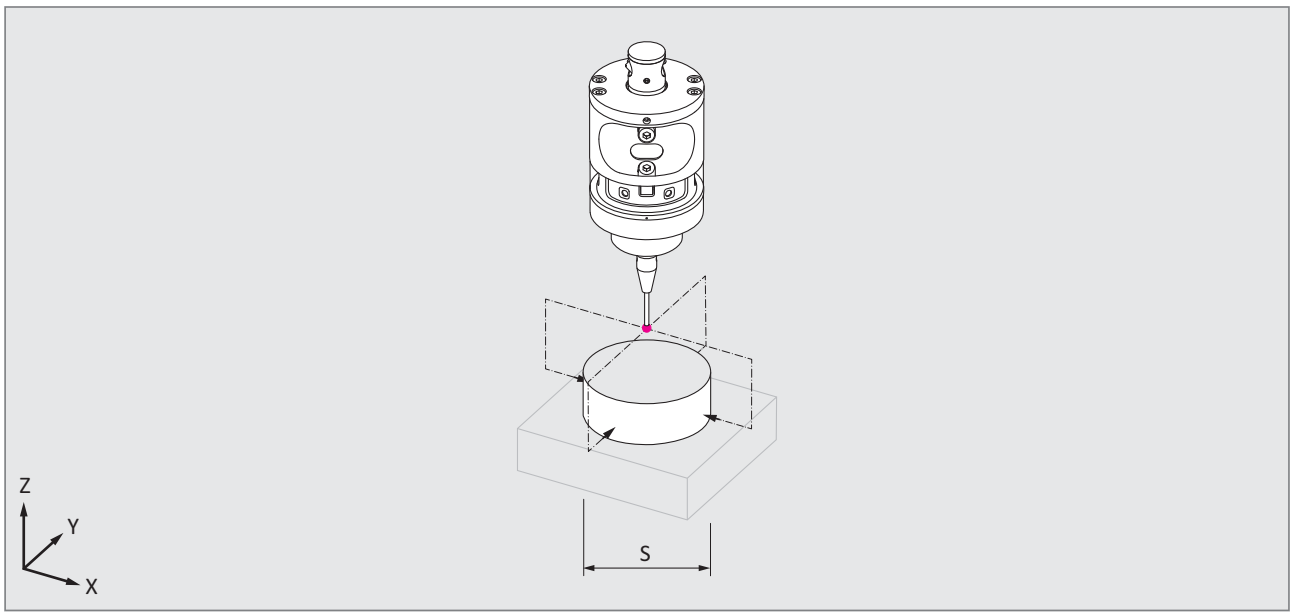


Fig. 4-15 Determining the zero point – outside diameter

▷ Call the program: `G65 P8700 S30. Z-10. W54.`

⇨ The zero point has been determined.

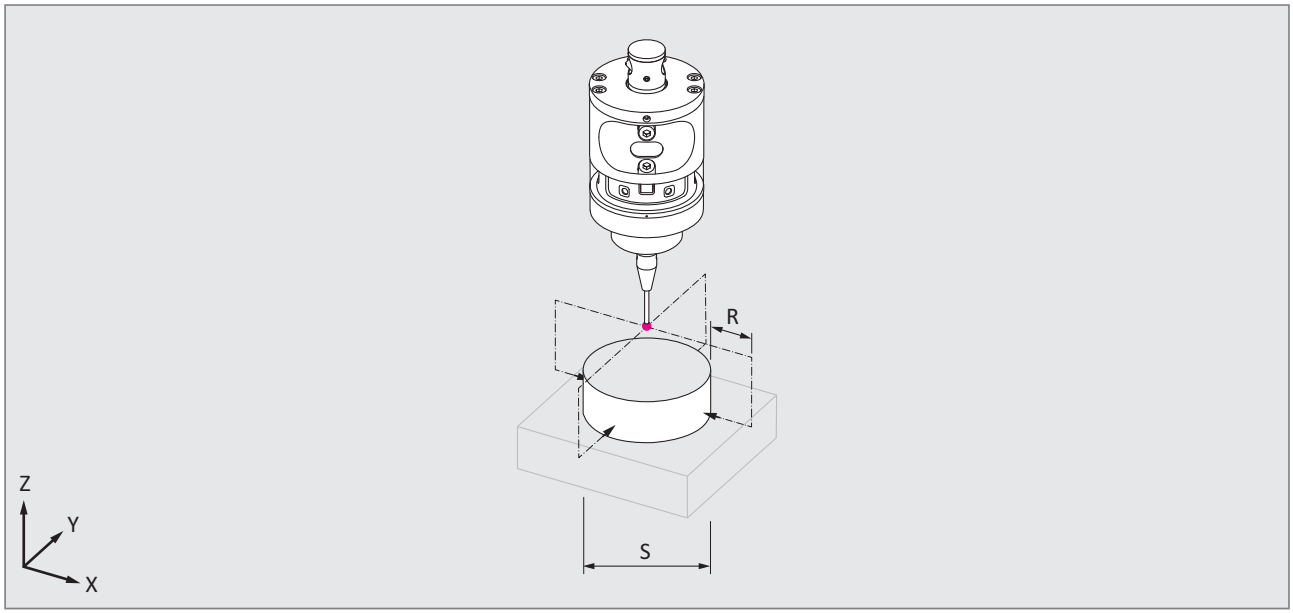


Fig. 4-16 Determining the zero point – outside diameter with safety distance

▷ Call the program: `G65 P8700 S30. Z-10. R7. W54.`

⇨ The zero point has been determined.

4.4.7 Determining the zero point – outside diameter with 3 measuring points

ⓘ Before calling up the cycle, position the probe as centrally as possible above the outside diameter. If required, the cycle can be repeated to increase accuracy.

ⓘ The 3 probing angles must be chosen so that they divide the full circle or section in angle segments which are as wide as possible. X-axis is the reference.

✓ The probe has been changed.

▷ Position as **centrally** as possible above the outside diameter.

▷ Call the program.

⇨ The zero point is set in the selected WCS in X and Y. (The position of the zero point is in the centre of the outside diameter.)

Program call
`G65 P8700 S... W... Z... H... U... V...`

Parameter	**Description**
S	Dimension of measuring point.
W	Select the workpiece coordinate system.
Z	Position the probe in Z.
H	Define the angle of the 1st probing in the WCS.
U	Define the angle of the 2nd probing in the WCS.
V	Define the angle of the 3rd probing in the WCS. ⓘ If the parameter is transferred with a negative sign, a report file is also output.

Parameter, optional	**Description**
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be negative.

Example

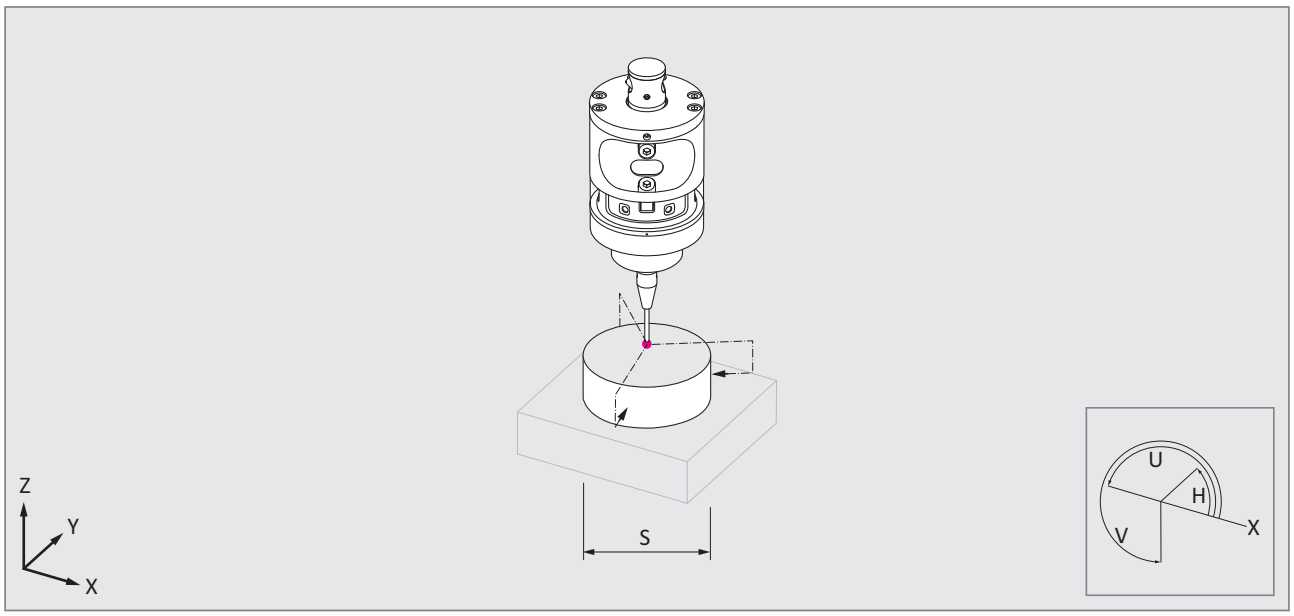


Fig. 4-17 Determining the zero point – outside diameter with 3 measuring points

▷ Call the program: `G65 P8700 S40. W57. Z-10. H20. U140. V260.`

⇨ The zero point has been determined.

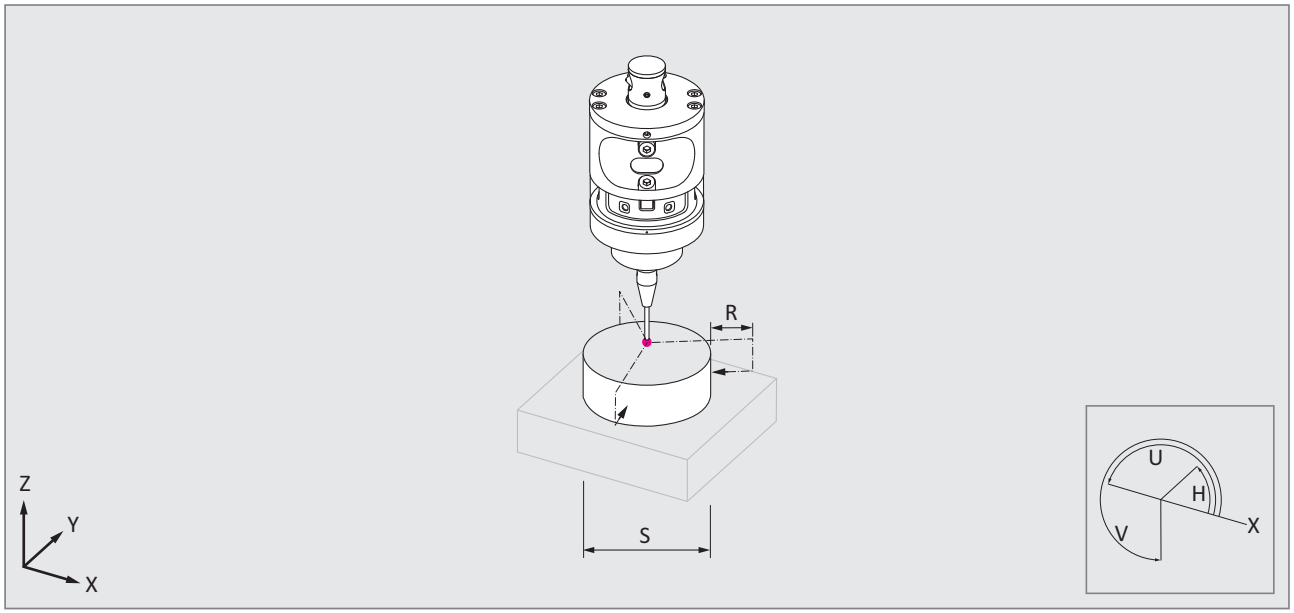


Fig. 4-18 Determining the zero point – outside diameter with 3 measuring points and safety distance

▷ Call the program: `G65 P8700 S40. W57. Z-10. H20. U140. V260. R7.`

⇨ The zero point has been determined.

4.4.8 Determining the zero point – inside width

✓ The probe has been changed.

▷ Position the probe as **centrally** as possible in the inside width.

▷ Call the program.

⇨ The zero point is set in the selected WCS in the corresponding axis. (The position of the zero point is in the centre of the inside width.)

Program call	
`G65 P8700 S... X1. W...`	(Measuring direction X)
`G65 P8700 S... Y1. W...`	(Measuring direction Y)

Parameter	**Description**
S	Dimension of measuring point.
X	Position the probe in X.
Y	Position the probe in Y.
W	Select the workpiece coordinate system.

Parameter, optional	**Description**
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be negative.

Example

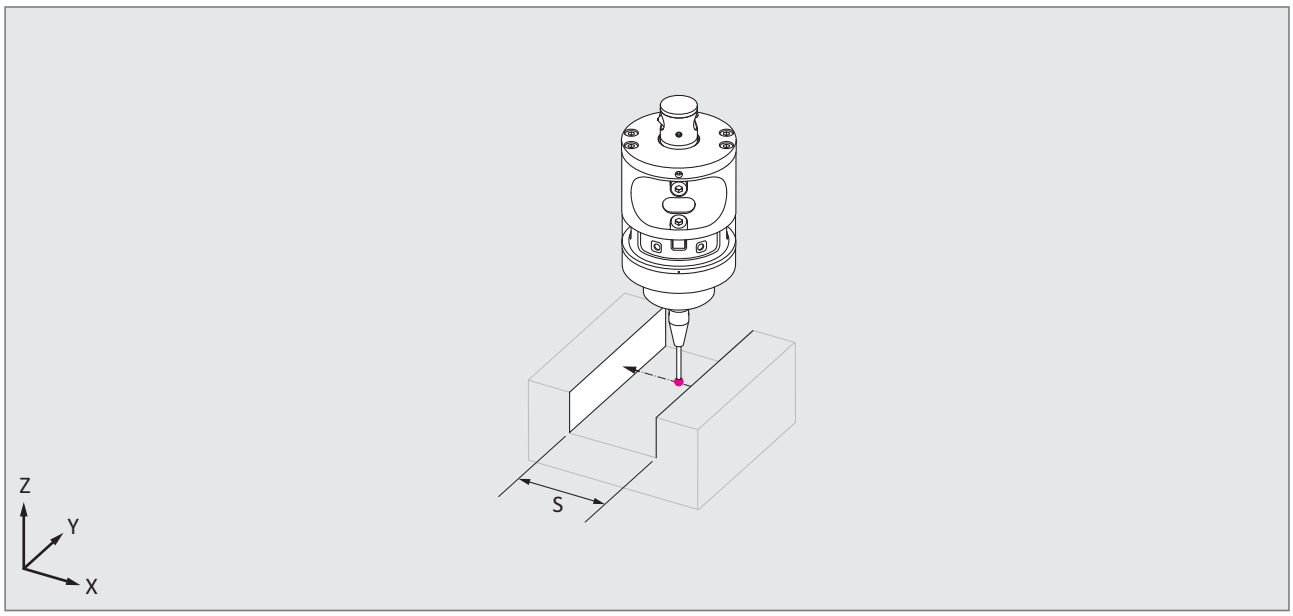


Fig. 4-19 Determining the zero point – inside width X

▷ Call the program: `G65 P8700 S20. X1. W54.`

⇨ The zero point has been determined.

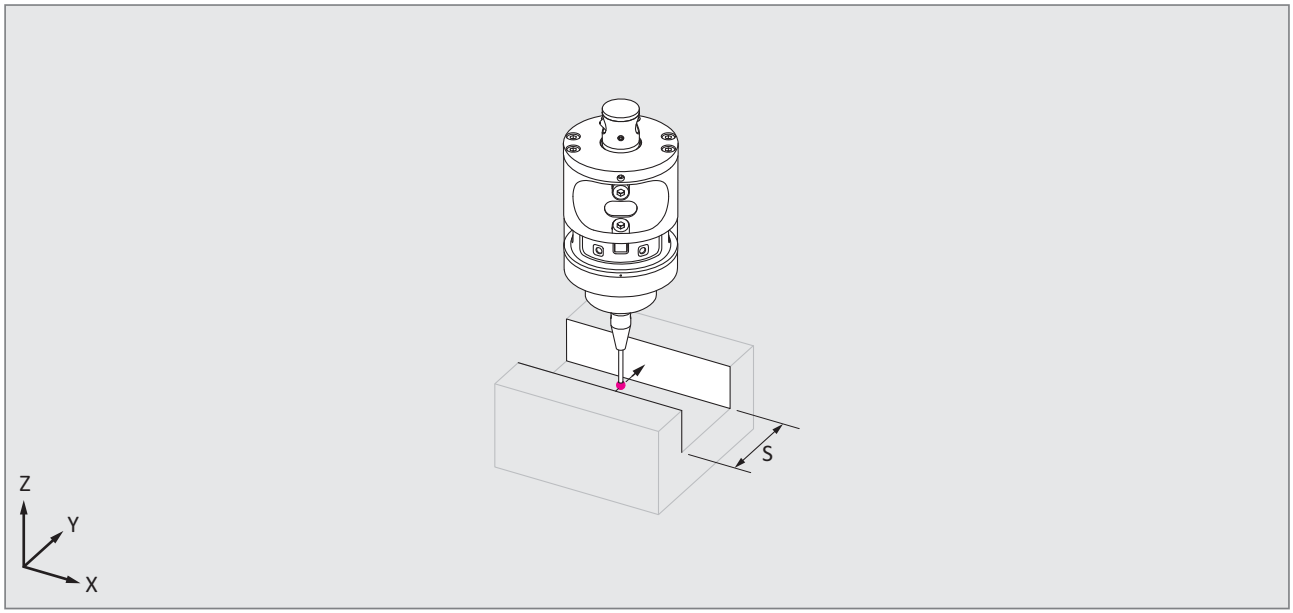


Fig. 4-20 Determining the zero point – inside width Y

▷ Call the program: `G65 P8700 S20. Y1. W54.`

⇨ The zero point has been determined.

4.4.9 Determining the zero point – outside width

✓ The probe has been changed.

▷ Position the probe as **centrally** as possible above the outside width.

▷ Call the program.

⇨ The zero point is set in the selected WCS in the corresponding axis. (The position of the zero point is in the centre of the outside width.)

Program call
`G65 P8700 S... X1. Z... W...`
`G65 P8700 S... Y1. Z... W...`

Parameter	Description
S	Dimension of measuring point.
X	Position the probe in X.
Y	Position the probe in Y.
Z	Position the probe in Z.
W	Select the workpiece coordinate system.

Parameter, optional	Description
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be positive.

Example

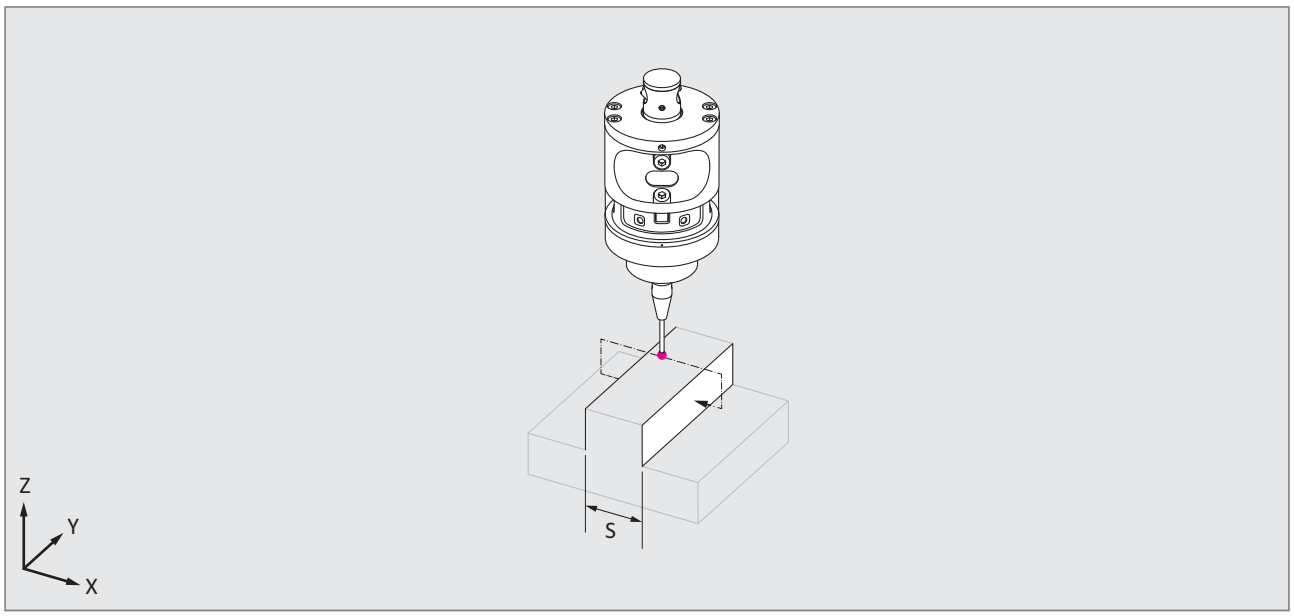


Fig. 4-21 Determining the zero point – outside width X

▷ Call the program: `G65 P8700 S10. X1. Z-20. W54.`

⇨ The zero point has been determined.

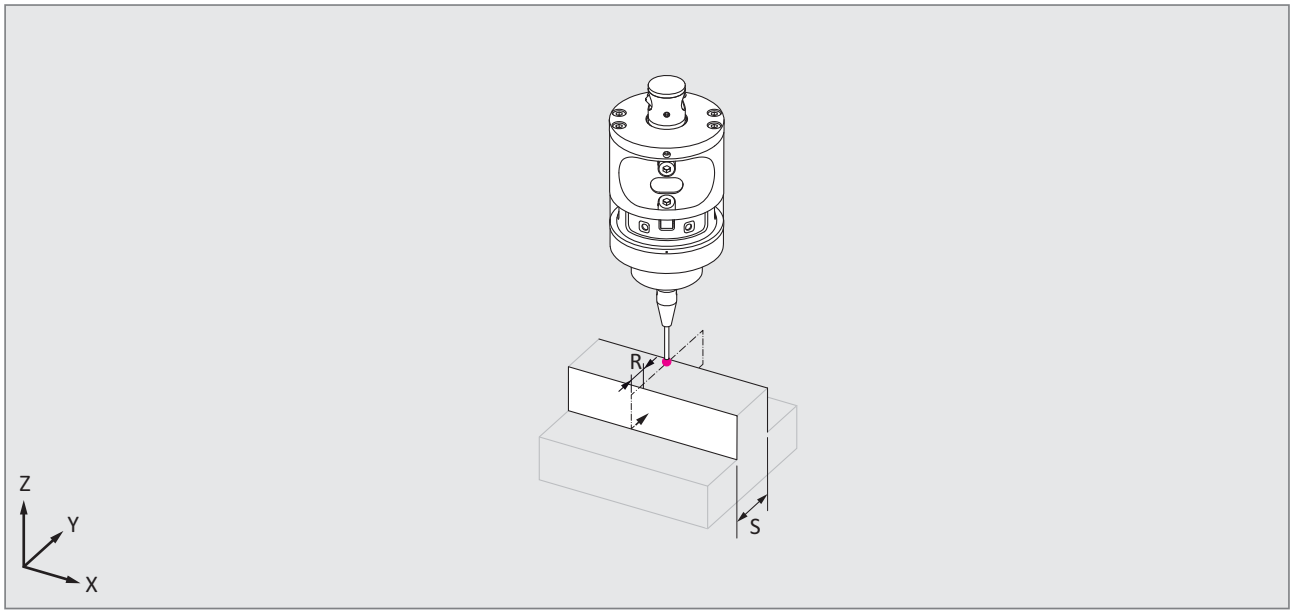


Fig. 4-22 Determining the zero point – outside width Y

▷ Call the program: `G65 P8700 S15. Y1. Z-10. R7. W55.`

⇨ The zero point has been determined.

4.4.10 Determining the zero point – inside width or inside diameter with obstacle

✓ The probe has been changed.

▷ Position the probe as **centrally** as possible above the inside diameter or over the inside width.

▷ Call the program.

⇨ The zero point is set in the selected WCS in X and Y or in the corresponding axis. (The position of the zero point is in the centre of the inside diameter or the inside width.)

Program call	
`G65 P8700 R... S... Z... W...`	(Inside diameter)
`G65 P8700 R... S... X1. Z... W...`	(Inside width, measuring direction X)
`G65 P8700 R... S... Y1. Z... W...`	(Inside width measuring direction Y)

Parameter	**Description**
R	Define the safety distance. ⓘ R must be negative.
S	Dimension of measuring point.
X	Position the probe in X.
Y	Position the probe in Y.
Z	Position the probe in Z.
W	Select the workpiece coordinate system.

Parameter, optional	**Description**
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.

Example

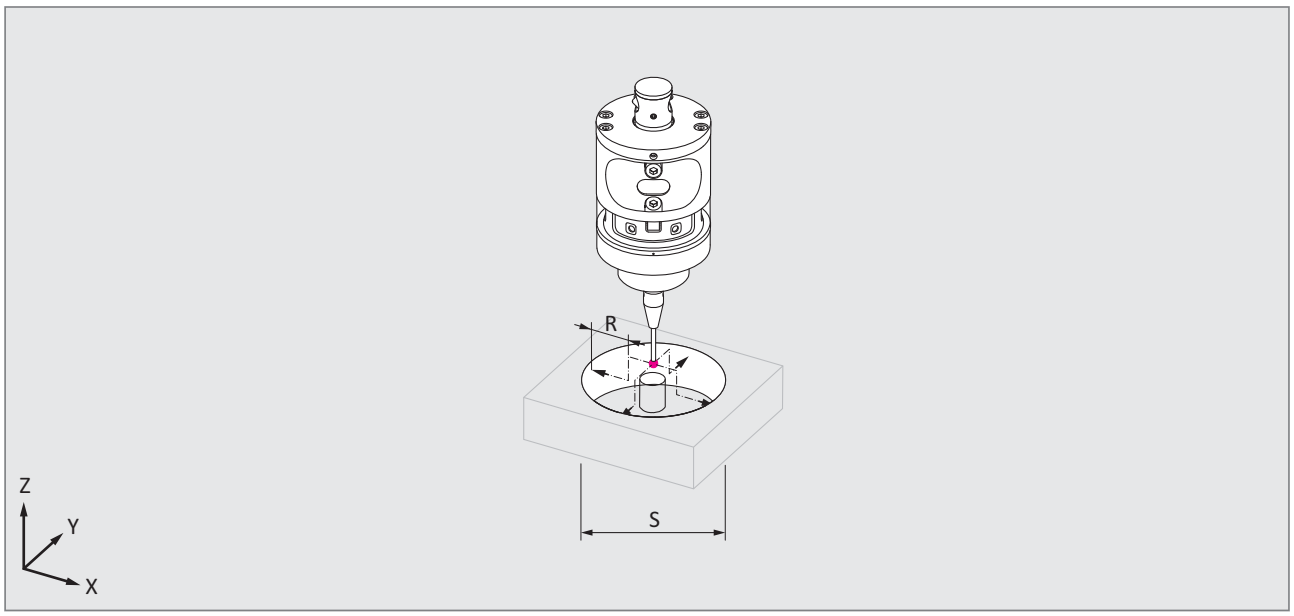


Fig. 4-23 Determining the zero point – inside diameter with obstacle

▷ Call the program: `G65 P8700 R-10. S30. Z-15. W56.`

⇨ The zero point has been determined.

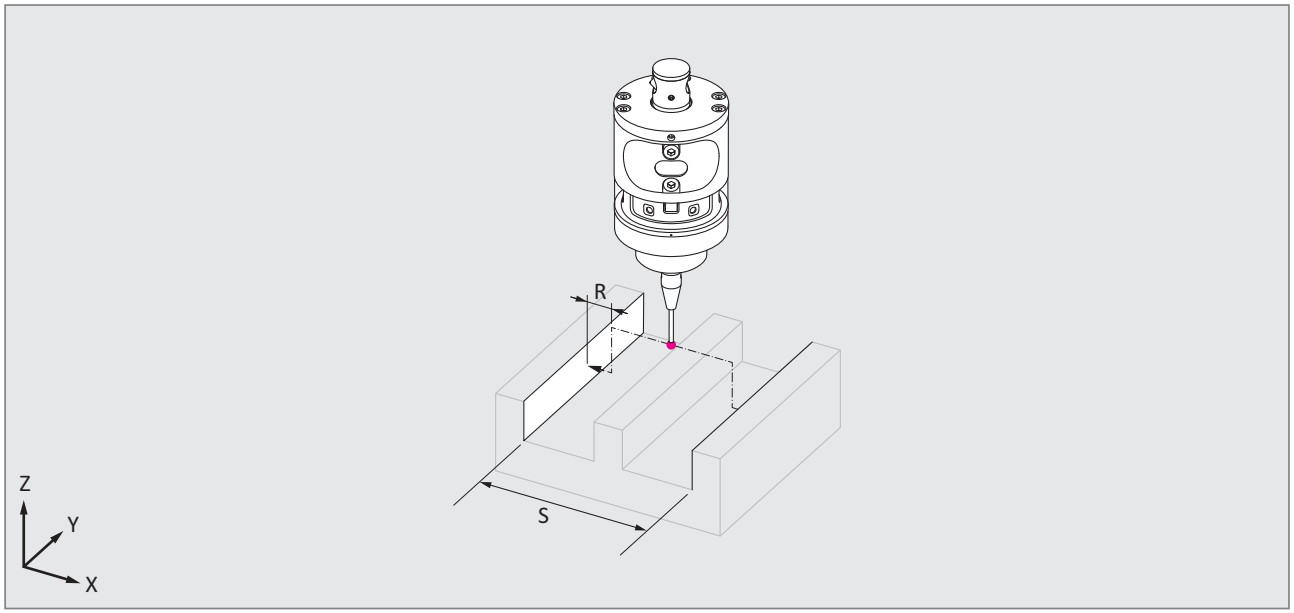


Fig. 4-24 Determining the zero point – inside width with obstacle

▷ Call the program: `G65 P8700 R-5. S40. X1. Z-10. W55.`

⇨ The zero point has been determined.

4.5 Correcting the zero point in rotation axis

NOTICE

Property damage due to malfunction.

- ▶ Do not correct the zero point during active rotation in the rotation axis.
- ▶ To avoid the summation of corrections, only call up the program once.

ⓘ The distance between the probe ball and the probed surface must be selected so that an acceleration to the measuring speed is possible.

ⓘ #111+9 must not be undefined (#0).

ⓘ Only 1 axis can be corrected.

Using the extended function in the program 8705 (SET WCS), the zero point can be corrected directly in a rotary axis. The axis is corrected by the value contained in the result parameter #111+9.

✓ The probe has been changed.

▷ Position the probe **in front of** the surface being probed.

▷ Determine the rotational angle using any measuring function.

ⓘ To determine the rotational angle, it is possible, for example, to use 2 single points and the program 8715.

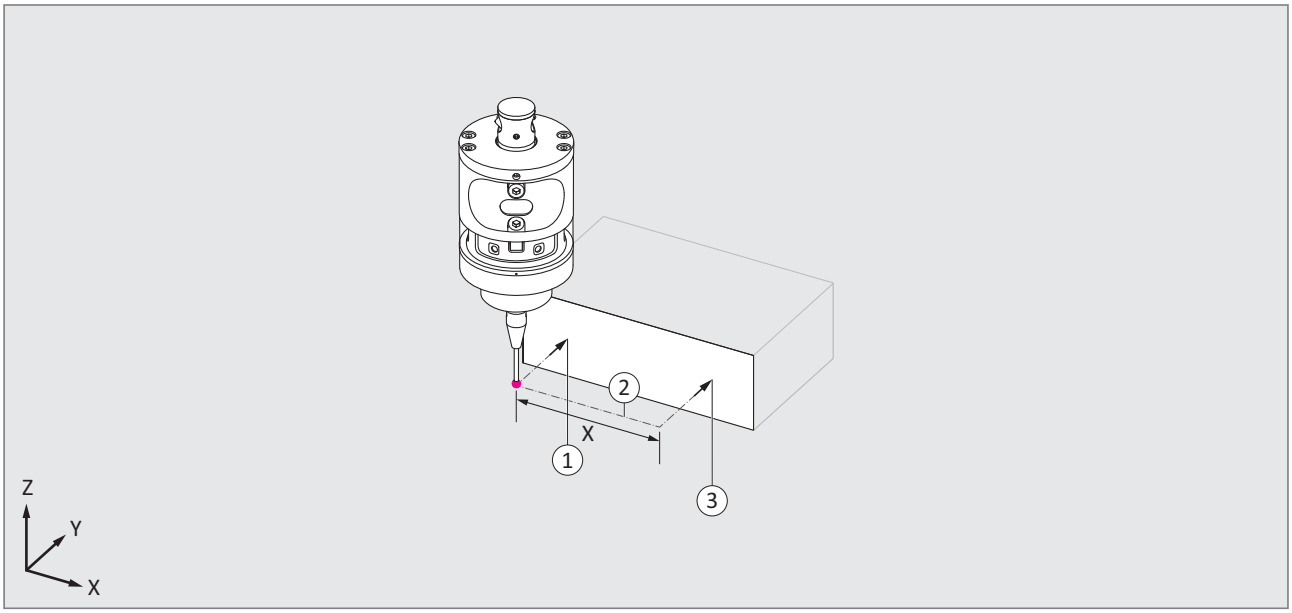
▷ Call the program.

⇨ The zero point has been corrected in the rotation axis.

Program call
`G65 P8705 W... A... B... C...`

Parameter	**Description**	
W	Select the workpiece coordinate system.	
A	The zero point in the A-axis is corrected with the result from #111+9.	
	1	Anticlockwise direction of rotation
	-1	Clockwise direction of rotation
B	The zero point in the B-axis is corrected with the result from #111+9.	
	1	Anticlockwise direction of rotation
	-1	Clockwise direction of rotation
C	The zero point in the C-axis is corrected with the result from #111+9.	
	1	Anticlockwise direction of rotation
	-1	Clockwise direction of rotation

Example



(1) Start position and 1st measuring position (2) Traverse movement	(3) 2nd measuring position

Fig. 4-25 Correcting the zero point in the rotation axis with the program 8715 (ANGLE-DISTANCE)

▷ Enable the WCS: `G54`

▷ Determine the rotation angle with the program 8715: `G65 P8715 X20`

⇨ The 1st measuring block is performed orthogonally to the transferred traverse movement.

⇨ Traverse movement to the 2nd measuring position.

⇨ The 2nd measuring block is performed orthogonally to the transferred traverse movement.

⇨ Retraction to start position.

⇨ Determine the rotation angle with the program 8715 (ANGLE-DISTANCE).

⇨ The deviation from the transferred position or from the set value is entered in #111+9 for zero point correction.

▷ Call the program: `G65 P8705 W54. C1.`

⇨ The zero point has been corrected in the rotation axis.

▷ Delete the entry in #111+9.

⇨ The zero point correction in the rotation axis has been performed.

4.6 Measuring during the production sequence

ⓘ The distance between the probe ball and the probed surface must be selected so that an acceleration to the measuring speed is possible.

ⓘ The probe is usually prepositioned by a protected travel block.

Each measurement task within a subroutine is called with the 8700 (MAIN) program. The parameter configuration defines the measurement task.

The measurement in the production process only differs from the determination of the zero point in terms of the type of dimensioning. During workpiece referencing, the dimensions **relative** to the workpiece are transferred, i.e. the distance between the stylus and workpiece is transferred. In the measurement tasks, the dimensions are **absolute** relative to the workpiece, i.e., the absolute coordinates with respect to the enabled WCS are transferred. This absolute dimensioning is marked with the additional parameter **A1.** when the 8700 MAIN program is called.

4.6.1 Measuring the single point

✓ The probe has been changed.

▷ Position the probe **in front of** the surface being probed.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The single point has been measured.

Program call
`G65 P8700 A1. X...`
`G65 P8700 A1. Y...`
`G65 P8700 A1. Z...`

Parameter	Description
A	Use absolute dimensioning.
X	Position the probe in X.
Y	Position the probe in Y.
Z	Position the probe in Z.

Parameter, optional	Description
T	Check the tolerance.
E	Select the tool for the tool correction.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
K	Transfer the set position in Z. ⓘ Note the sequence of the parameters in the program call.

All determined results are stored in the following parameters:

Parameter	Description
#111+0	X-position of the edge in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y-position of the edge in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.
#111+2	Z-position of the edge in the enabled WCS.
#111+5	Deviation from the transferred position or from the set position (parameter K) in Z.

Example

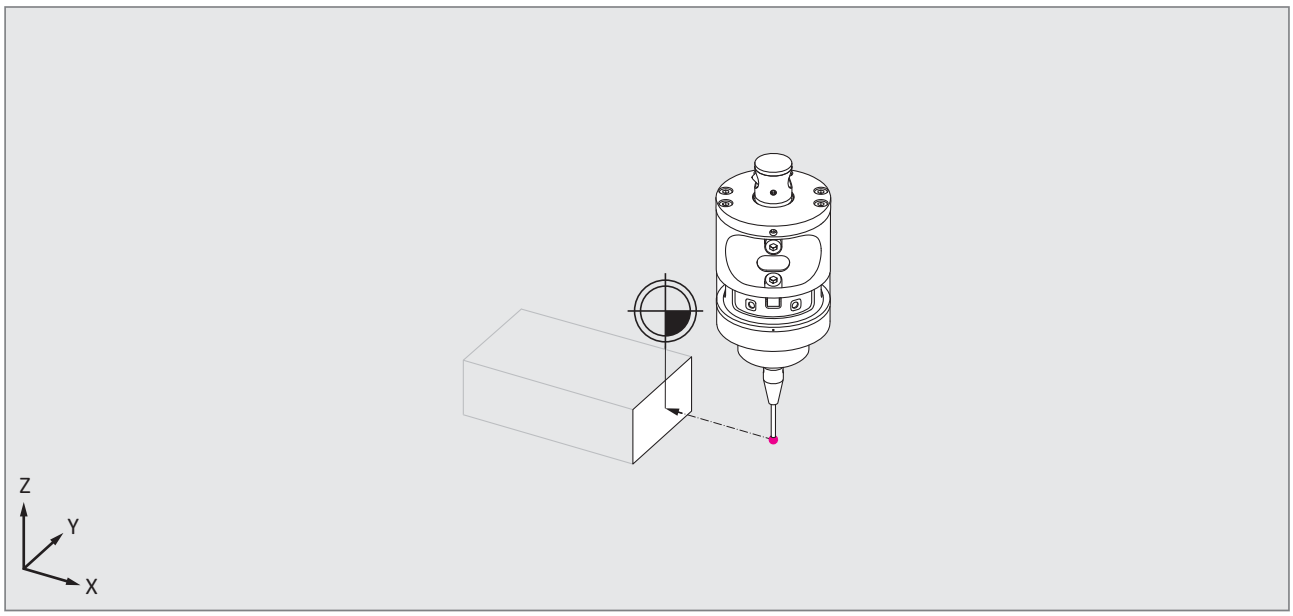


Fig. 4-26 Measuring single point in X

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8700 A1. X0.`

⇨ The single point has been measured.

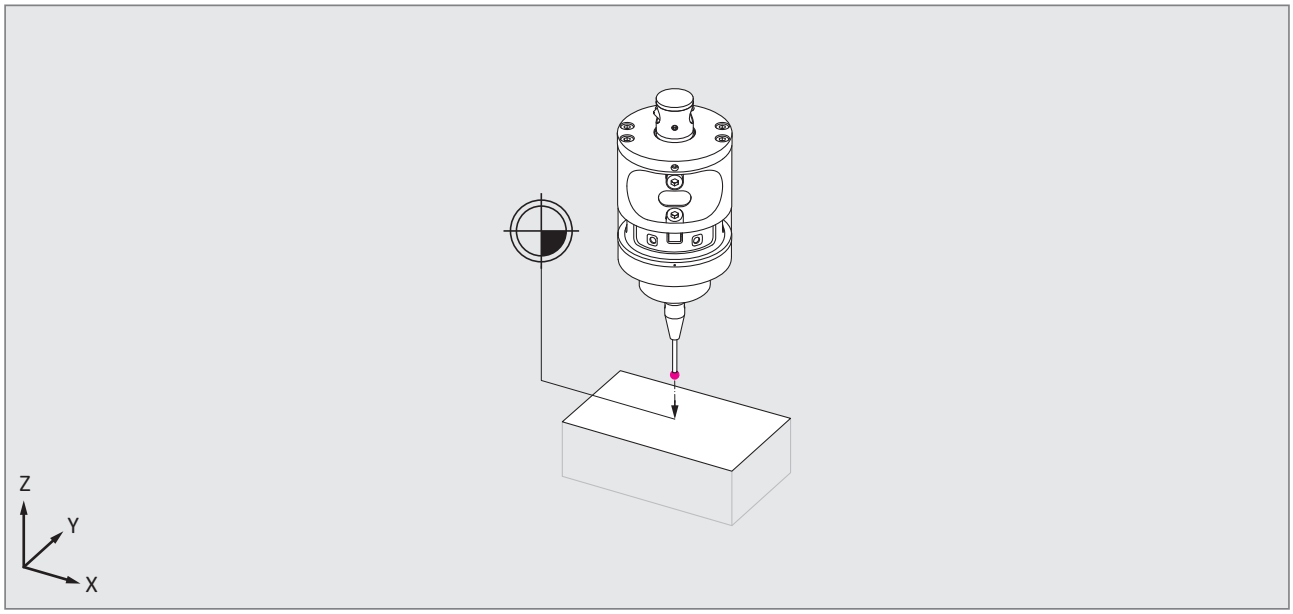


Fig. 4-27 Measuring single point in Z

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8700 A1. Z0.`

⇨ The single point has been measured.

4.6.2 Measuring the corner in 2 axes

✓ The probe has been changed.

▷ Position the probe **outside** of the corner being probed.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The corner has been measured in 2 axes.

Program call
`G65 P8700 A1. X... Y...`
`G65 P8700 A1. X... Z...`
`G65 P8700 A1. Y... Z...`

Parameter	Description
A	Use absolute dimensioning.
X	Position the probe in X.
Y	Position the probe in Y.
Z	Position the probe in Z.

Parameter, optional	Description
T	Check the tolerance.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
K	Transfer the set position in Z. ⓘ Note the sequence of the parameters in the program call.

All determined results are stored in the following parameters:

Parameter	Description
#111+0	X-position of the edge in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y-position of the edge in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.
#111+2	Z-position of the edge in the enabled WCS.
#111+5	Deviation from the transferred position or from the set position (parameter K) in Z.

Example

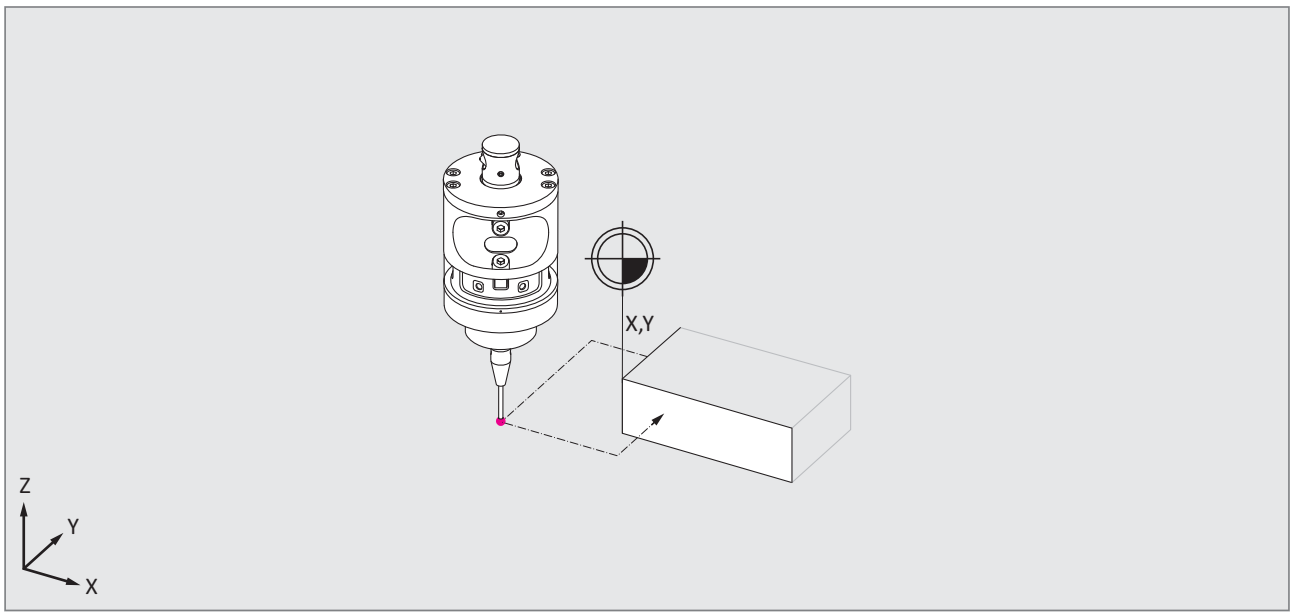


Fig. 4-28 Measuring the corner in XY

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8700 A1. X10. Y10.`

⇨ The corner has been measured.

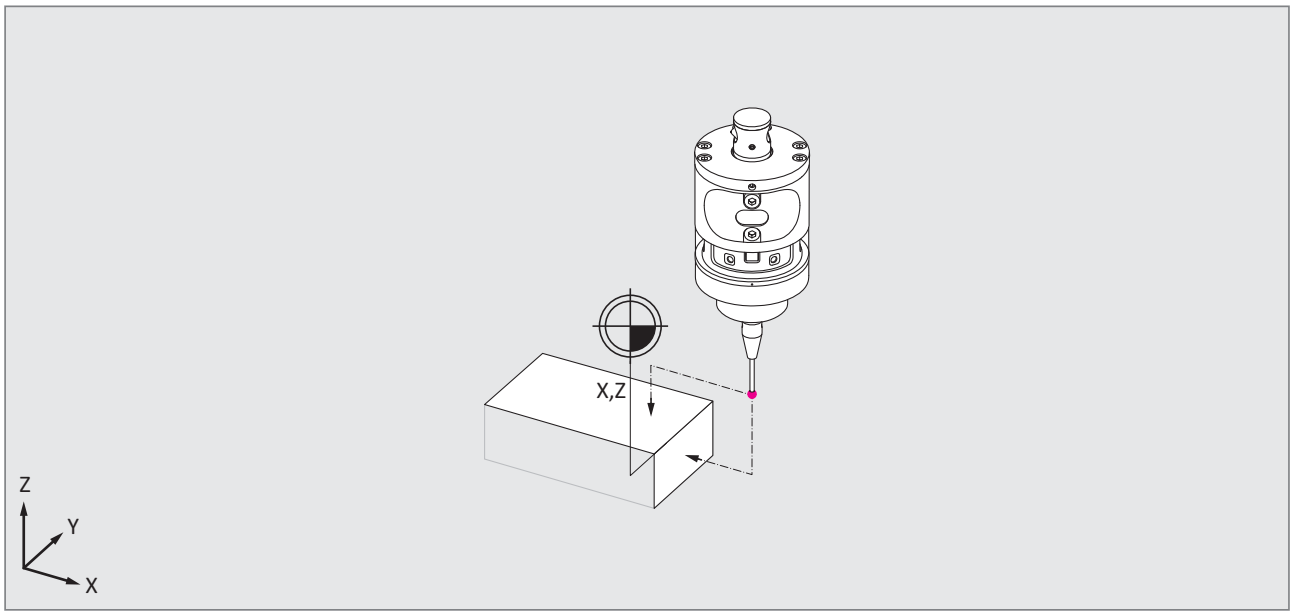


Fig. 4-29 Measuring the corner in XZ

▷ Enable the WCS: `G56`

▷ Call the program: `G65 P8700 A1. X-10. Z-5.`

⇨ The corner has been measured.

4.6.3 Measuring the corner in 3 axes

✓ The probe has been changed.

▷ Position the probe **outside** of the corner being probed.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The corner has been measured in 3 axes.

Program call
`G65 P8700 A1. X... Y... Z...`

Parameter	**Description**
A	Use absolute dimensioning.
X	Position the probe in X.
Y	Position the probe in Y.
Z	Position the probe in Z.

Parameter, optional	**Description**
T	Check the tolerance.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
K	Transfer the set position in Z. ⓘ Note the sequence of the parameters in the program call.

All determined results are stored in the following parameters:

Parameter	**Description**
#111+0	X-position of the edge in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y-position of the edge in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.
#111+2	Z-position of the edge in the enabled WCS.
#111+5	Deviation from the transferred position or from the set position (parameter K) in Z.

Example

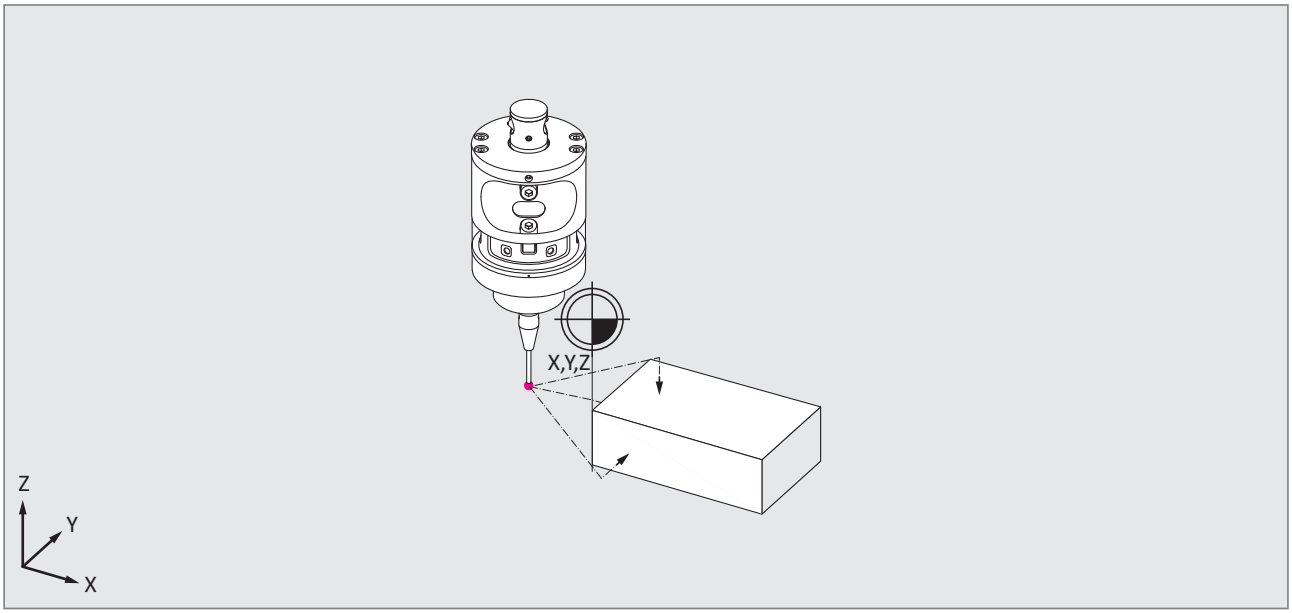


Fig. 4-30 Measuring the corner in XYZ

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8700 A1. X5. Y5. Z-5.`

⇨ The corner has been measured.

4.6.4 Measuring the internal diameter

✓ The probe has been changed.

▷ Position the probe as **centrally** as possible within the inside diameter.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The inside diameter has been measured.

Program call
`G65 P8700 A1. S...`

Parameter	**Description**
A	Use absolute dimensioning.
S	Dimension of measuring point.

Parameter, optional	**Description**
T	Check the tolerance.
E	Select the tool for the tool correction.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be negative.

All determined results are stored in the following parameters:

Parameter	**Description**
#111+6	Diameter of the bore.
#111+7	Deviation from the set diameter.
#111+0	X-position of the centre point in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y-position of the edge in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.

Example

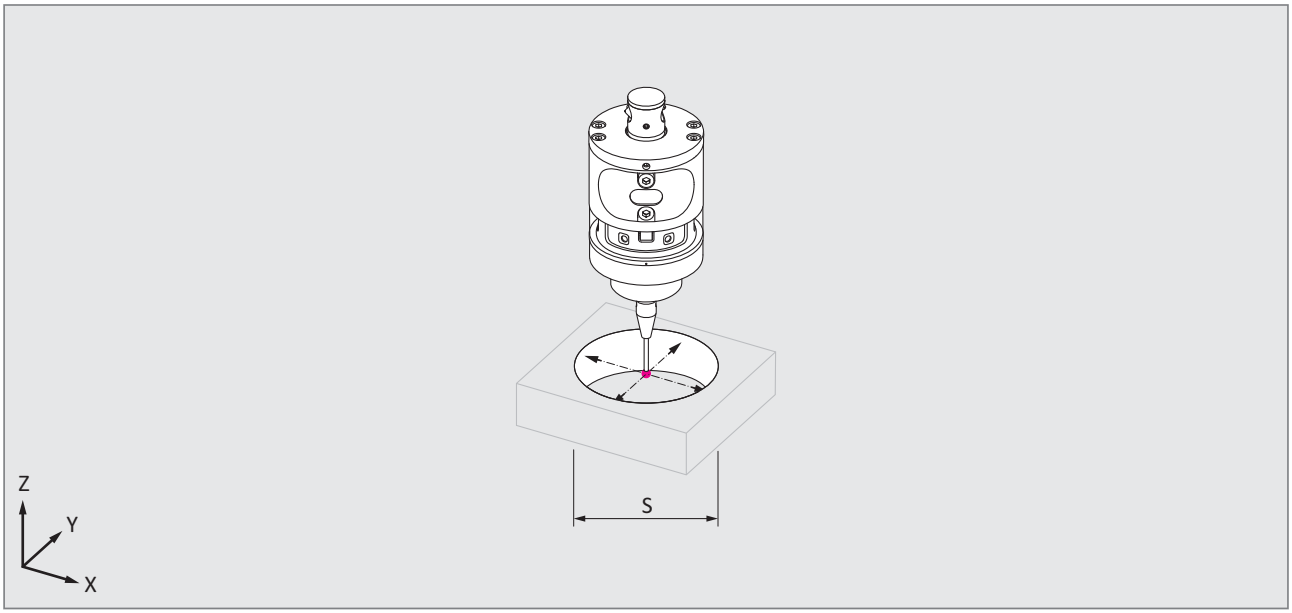


Fig. 4-31 Measuring the internal diameter

▷ Enable the WCS: `G55`

▷ Call the program: `G65 P8700 A1. S60.`

⇨ The inside diameter has been measured.

4.6.5 Measuring the inside diameter with 3 measuring points

ⓘ Before calling up the cycle, position the probe as centrally as possible within the inside diameter. If required, the cycle can be repeated to increase accuracy.

ⓘ The 3 probing angles must be chosen so that they divide the full circle or section in angle segments which are as wide as possible. X-axis is the reference.

✓ The probe has been changed.

▷ Position the probe as **centrally** as possible within the inside diameter.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The inside diameter with 3 measuring points has been measured.

Program call
`G65 P8700 A1. S... H... U... V...`

Parameter	**Description**
A	Use absolute dimensioning.
S	Dimension of measuring point.
H	Define the angle of the 1st probing in the WCS.
U	Define the angle of the 2nd probing in the WCS.
V	Define the angle of the 3rd probing in the WCS. ⓘ If the parameter is transferred with a negative sign, a report file is also output.

Parameter, optional	**Description**
T	Check the tolerance.
E	Select the tool for the tool correction.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be negative.

All determined results are stored in the following parameters:

Parameter	**Description**
#111+6	Diameter of the bore.
#111+7	Deviation from the set diameter.
#111+0	X-position of the centre point in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y-position of the edge in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.

Example

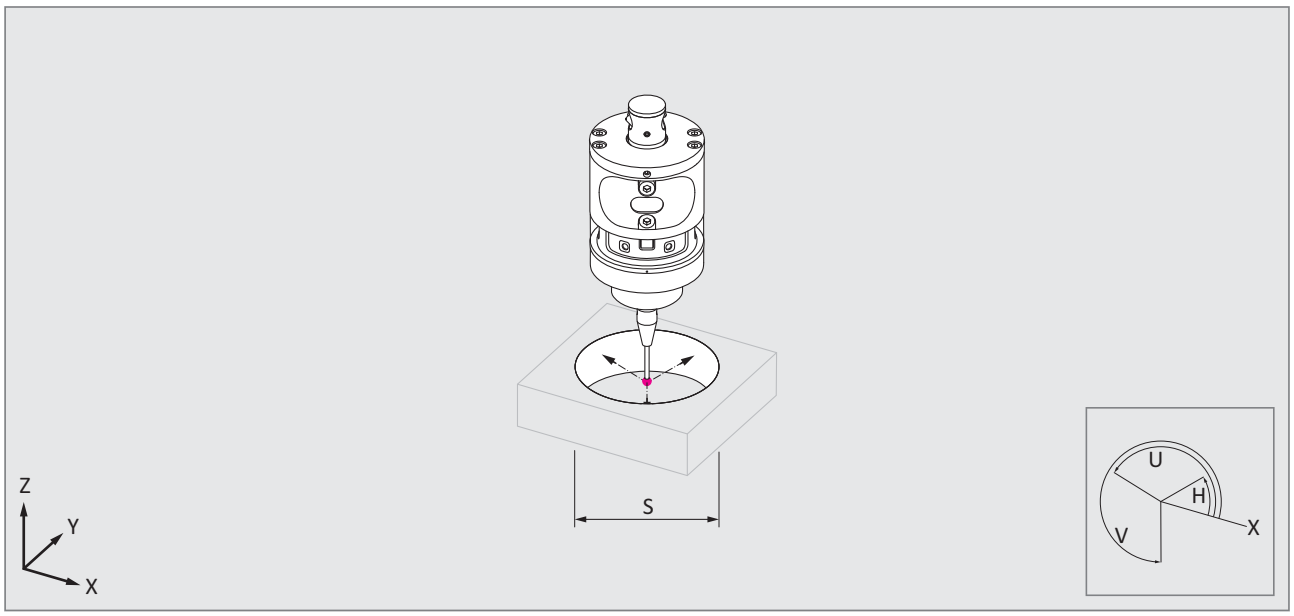


Fig. 4-32 Measuring the inside diameter with 3 measuring points

▷ Enable the WCS: `G55`

▷ Call the program: `G65 P8700 A1. S50. H30. U150. V270.`

⇨ The inside diameter has been measured with 3 measuring points.

4.6.6 Measuring the outside diameter

✓ The probe has been changed.

▷ Position as **centrally** as possible above the outside diameter.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The outside diameter has been measured.

Program call
`G65 P8700 A1. S... Z...`

Parameter	Description
A	Use absolute dimensioning.
S	Dimension of measuring point.
Z	Position the probe in Z.

Parameter, optional	Description
T	Check the tolerance.
E	Select the tool for the tool correction.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be positive.

All determined results are stored in the following parameters:

Parameter	Description
#111+6	Outside diameter or diameter of the shaft.
#111+7	Deviation from the set diameter.
#111+0	X-position of the centre point in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y-position of the edge in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.

Example

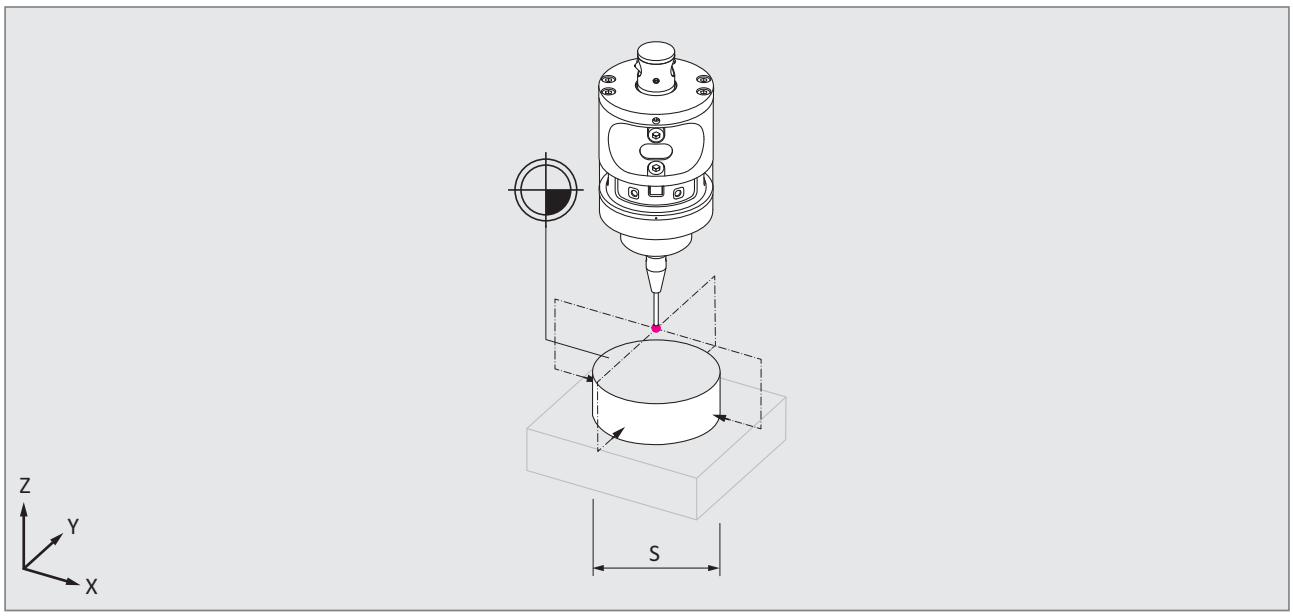


Fig. 4-33 Measuring the outside diameter

▷ Enable the WCS: `G55`

▷ Call the program: `G65 P8700 A1. S50. Z-3.`

⇨ The outside diameter has been measured.

4.6.7 Measuring the outside diameter with 3 measuring points

ⓘ Before calling up the cycle, position the probe as centrally as possible above the outside diameter. If required, the cycle can be repeated to increase accuracy.

ⓘ The 3 probing angles must be chosen so that they divide the full circle or section in angle segments which are as wide as possible. X-axis is the reference.

✓ The probe has been changed.

▷ Position as **centrally** as possible above the outside diameter.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The outside diameter with 3 measuring points has been measured.

Program call
`G65 P8700 A1. S... Z... H... U... V...`

Parameter	**Description**
A	Use absolute dimensioning.
S	Dimension of measuring point.
Z	Position the probe in Z.
H	Define the angle of the 1st probing in the WCS.
U	Define the angle of the 2nd probing in the WCS.
V	Define the angle of the 3rd probing in the WCS. ⓘ If the parameter is transferred with a negative sign, a report file is also output.

Parameter, optional	**Description**
T	Check the tolerance.
E	Select the tool for the tool correction.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be positive.

All determined results are stored in the following parameters:

Parameter	**Description**
#111+6	Outside diameter or diameter of the shaft.
#111+7	Deviation from the set diameter.
#111+0	X-position of the centre point in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y-position of the edge in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.

Example

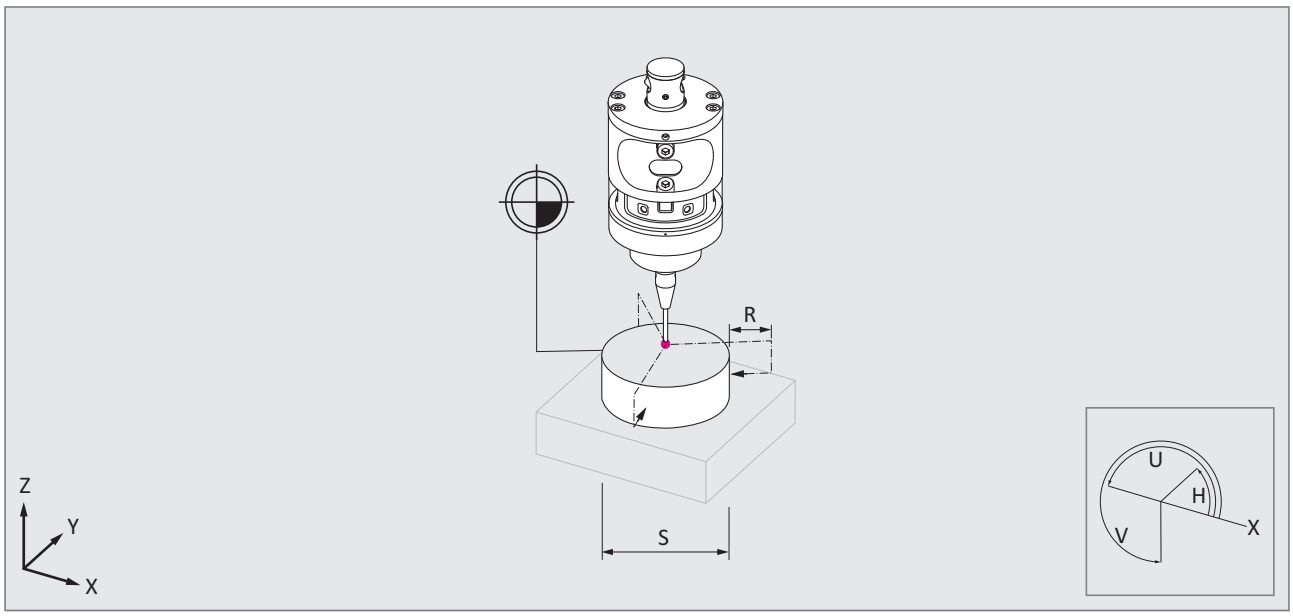


Fig. 4-34 Measuring the outside diameter with 3 measuring points

▷ Enable the WCS: `G55`

▷ Call the program: `G65 P8700 S40. W57. Z-10. H20. U140. V260. R5.`

⇨ The outside diameter has been measured with 3 measuring points.

4.6.8 Measuring the inside width

✓ The probe has been changed.

▷ Position the probe **centrally** in the inside width.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The inside width has been measured.

Program call
`G65 P8700 A1. S... X1.`
`G65 P8700 A1. S... Y1.`

Parameter	**Description**
A	Use absolute dimensioning.
S	Dimension of measuring point.
X	Position the probe in X.
Y	Position the probe in Y.

Parameter, optional	**Description**
T	Check the tolerance.
E	Select the tool for the tool correction.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be negative.

All determined results are stored in the following parameters:

Parameter	**Description**
#111+6	Width of inside width/outside width.
#111+7	Deviation from the set width.
#111+0	X-position of the centre point in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y-position of the edge in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.

Example

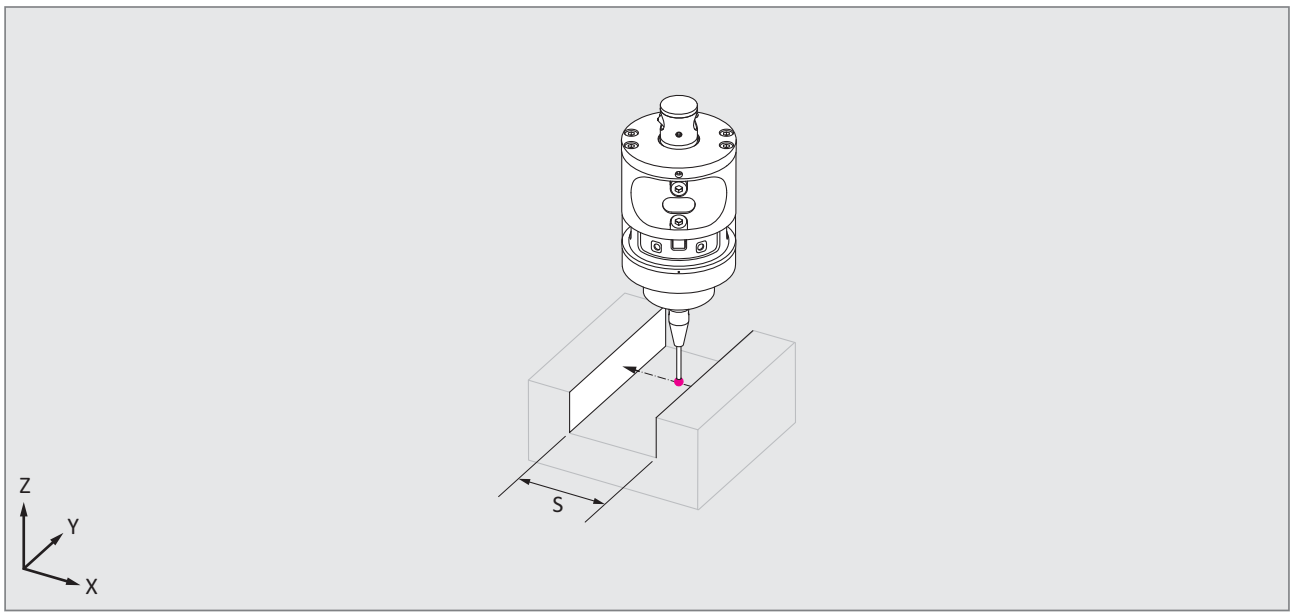


Fig. 4-35 Measuring the inside width in X

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8700 A1. S20. X1.`

⇨ The inside width has been measured.

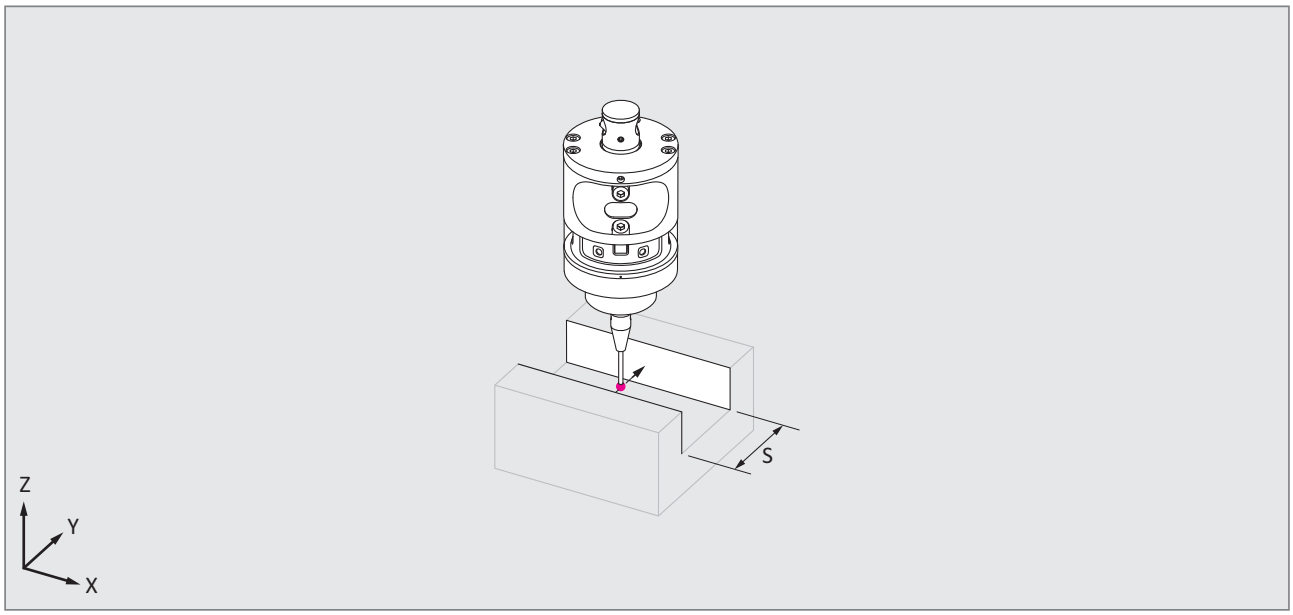


Fig. 4-36 Measuring the inside width in Y

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8700 A1. S20. Y1.`

⇨ The inside width has been measured.

4.6.9 Measuring the outside width

✓ The probe has been changed.

▷ Position the probe **centrally** above the outside width.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The outside width has been measured.

Program call
`G65 P8700 A1. S... X1. Z...`
`G65 P8700 A1. S... Y1. Z...`

Parameter	Description
A	Use absolute dimensioning.
S	Dimension of measuring point.
X	Position the probe in X.
Y	Position the probe in Y.
Z	Position the probe in Z.

Parameter, optional	Description
T	Check the tolerance.
E	Select the tool for the tool correction.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be positive.

All determined results are stored in the following parameters:

Parameter	Description
#111+6	Width of inside width/outside width.
#111+7	Deviation from the set width.
#111+0	X-position of the centre point in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y-position of the edge in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.

Example

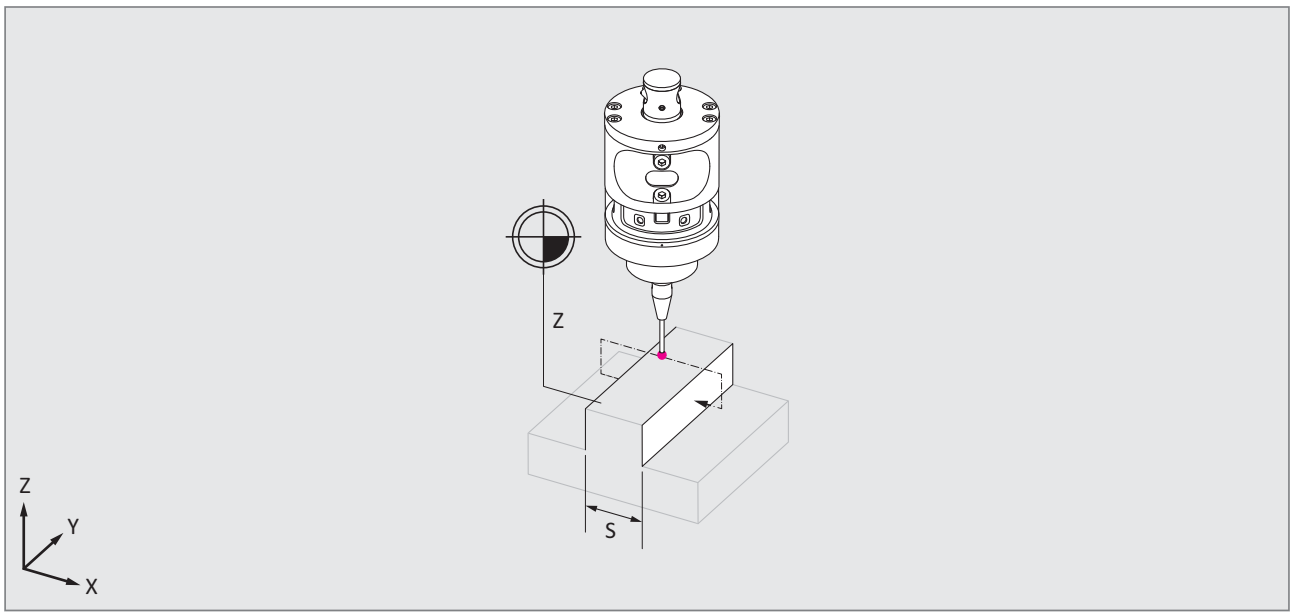


Fig. 4-37 Measuring the outside width in X

▷ Enable the WCS: `G57`

▷ Call the program: `G65 P8700 A1. S20. X1. Z-4.`

⇨ The outside width has been measured.

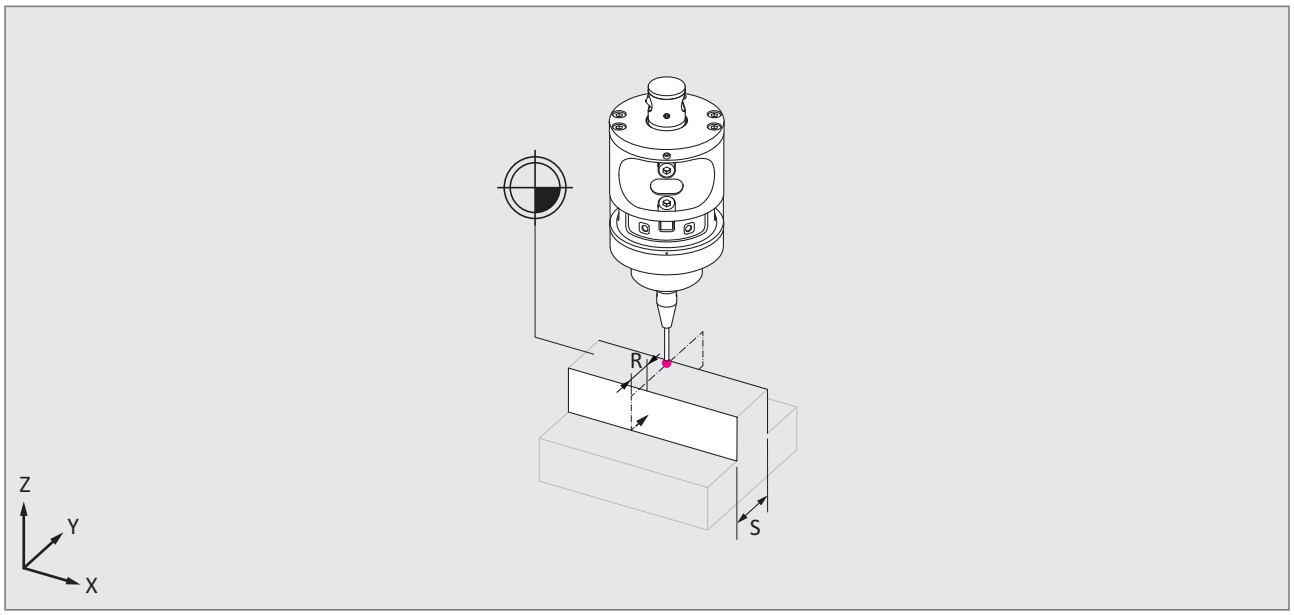


Fig. 4-38 Measuring the outside width in Y

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8700 A1. S35. Y1. Z-5. R7.`

⇨ The outside width has been measured.

4.6.10 Measuring the sphere diameter

ⓘ Before measuring the sphere diameter, the probe must be calibrated in Z.

ⓘ When the sphere diameter is measured, the spindle is indexed by 180°.

✓ The probe has been changed.

▷ Position the probe **centrally** above the sphere.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The sphere diameter has been measured.

Program call
`G65 P8700 S... Z... U-1.`

Parameter	**Description**
S	Dimension of measuring point.
Z	Position the probe in Z. ⓘ The relative dimensioning is used for positioning.
U	Measure the sphere diameter.

Parameter, optional	**Description**
T	Check the tolerance.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.
K	Transfer the set position in Z. ⓘ Note the sequence of the parameters in the program call.
R	Define the safety distance. ⓘ R must be positive.

All determined results are stored in the following parameters:

Parameter	**Description**
#111+0	Sphere centre in the X-axis in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Sphere centre in the Y-AXIS in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.
#111+2	Sphere centre in the Z-axis in the enabled WCS.
#111+5	Deviation from the transferred position or from the set position (parameter K) in Z.
#111+6	Diameter of the sphere.
#111+7	Deviation from the set diameter.

Example

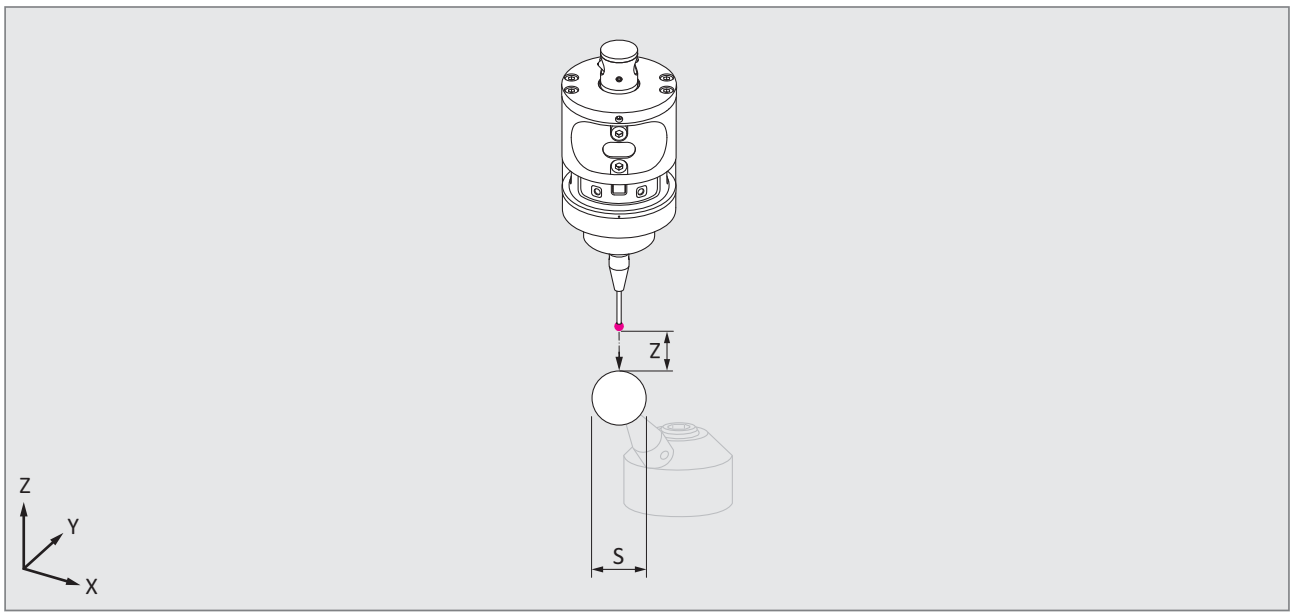


Fig. 4-39 Measuring the sphere diameter

▷ Call the program: `G65 P8700 S25.00 Z-10. U-1.`

⇨ The sphere diameter has been measured.

4.6.11 Measuring the inside width and inside diameter with an obstacle

✓ The probe has been changed.

▷ Position the probe **centrally** above the inside width or in the inside diameter.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ Inside width or inside diameter measured with obstacle.

Program call	
`G65 P8700 A1. R... S... Z...`	(Inside diameter)
`G65 P8700 A1. R... S... X1. Z...`	(Inside width, measuring direction X)
`G65 P8700 A1. R... S... Y1. Z...`	(Inside width measuring direction Y)

Parameter	**Description**
A	Use absolute dimensioning.
R	Define the safety distance. ⓘ R must be negative.
S	Dimension of measuring point.
X	Position the probe in X.
Y	Position the probe in Y.
Z	Position the probe in Z.

Parameter, optional	**Description**
T	Check the tolerance.
E	Select the tool for the tool correction.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.

All determined results are stored in the following parameters:

Parameter	**Description**
#111+6	Diameter of the bore or width of inside width.
#111+7	Deviation from set diameter or from set width.
#111+0	X-position of the centre point in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y-position of the edge in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.

Example

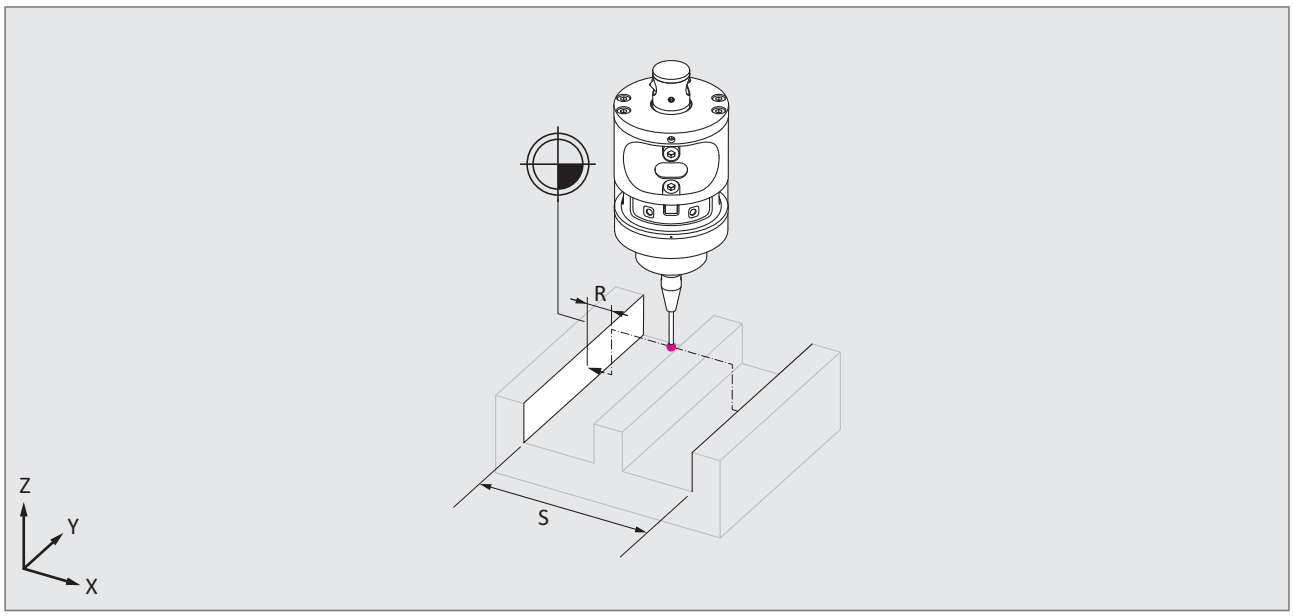


Fig. 4-40 Measuring the inside width with obstacle

▷ Enable the WCS: `G58`

▷ Call the program: `G65 P8700 A1. R-5. S30. X1. Z-5.`

⇨ The inside width has been measured.

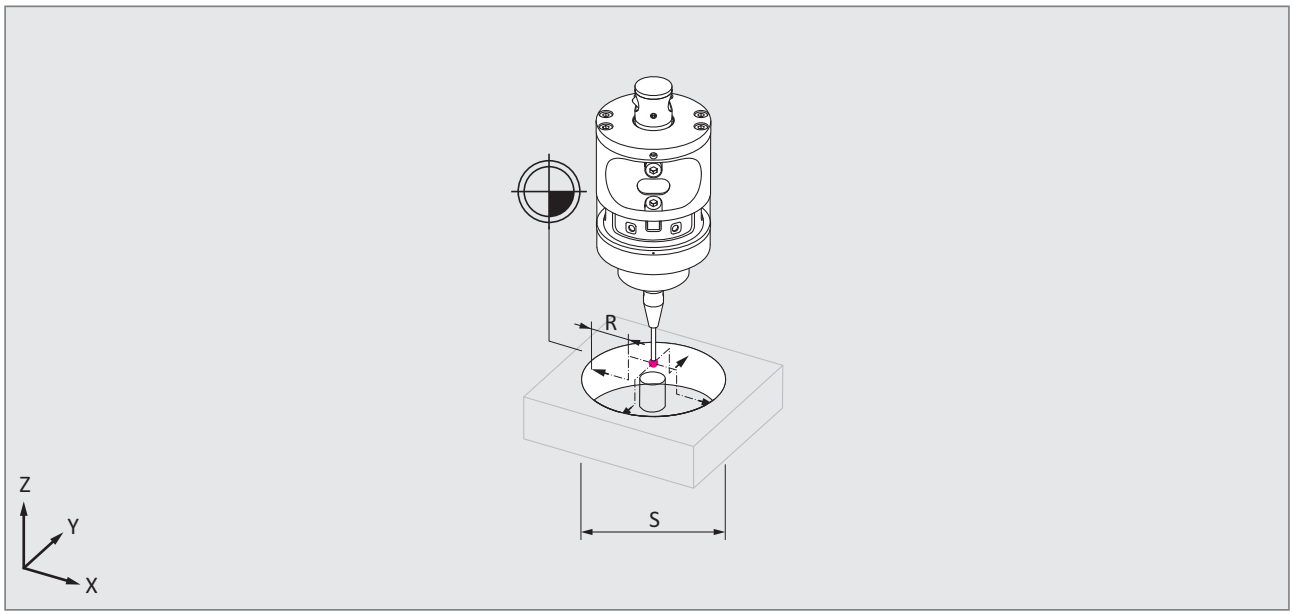


Fig. 4-41 Measuring the inside diameter with obstacle

▷ Enable the WCS: `G59`

▷ Call the program: `G65 P8700 A1. R-10. S30. Z-5.`

⇨ The inside diameter has been measured.

4.7 Measuring with coordinate system rotation – function G68

NOTICE

Measuring error when probing sloped surfaces due to coordinate rotation.

▶ Only use function *G68* in case of minor deviations (angle < 5°).

NOTICE

Malfunction due to wrong traverse movement.

▶ Save the angle of the coordinate system rotation in #110+4 before the 1st measurement is called and delete it again after the last measurement.

NOTICE

Malfunction due to faulty calculation of rotation.

▶ With function G68, execute the coordinate rotation around the active zero point.

ⓘ Function *G68* must be enabled by the machine manufacturer and fully set up.

ⓘ To calculate the start-up distances and skip positions correctly, the angle of the coordinate rotation must be known.

Function *G68* (measuring with coordinate system rotation) can be used to measure in a rotated coordinate system (in the XY plane). The movements are transferred to the rotated coordinate system. The skip positions and results are counted back to the not rotated level. The results can be output in the measurement direction.

▷ Determine the coordinate system rotation angle.
▷ Activate the zero point.
▷ Move to the rotation centre point.
▷ Transfer the coordinate system rotation angle in #110+4.
▷ Activate the *Coordinate system rotation* function with G68.
▷ Perform the measurement (1st measurement **M1.**, subsequent measurement **M3.**, last measurement **M2.**).
▷ Evaluate the results and save them temporarily if necessary.
▷ Deactivate the *Coordinate system rotation* function with G69.
▷ Delete the coordinate system rotation angle in #110+4.
⇨ Measurement is performed in the rotating coordinate system.
⇨ The results were calculated back to an axis-parallel system, i.e. output in the transferred measurement axis, and entered in the result parameters #111+0…#111+7.

Example: Measurement of inside width in X (zero point and rotation centre inside width)

```
O1(EXAMPLE G68)
#1=1.0
G54
G65 8703 X0. Y0. Z-3. M1.
#[#110+4]=#1
G68 X0 Y0 R#1
G65 8700 S20. X1. M3.
G65 8700 A1. Z-10. M2.
G69
#[#110+4]=#0
```

4.8 Measuring the angle/distance

4.8.1 Measuring the angle/distance with optional parameter D

NOTICE

Property damage caused by collision due to faulty measurements.

- ▶ Do not change the enabled WCS between the 1st and 2nd measurements.
- ▶ Execute the 1st and 2nd measurements consecutively.

NOTICE

Measurement error due to faulty evaluation on account of missing comparability.

- ▶ Compare the same measurements and evaluate them (single point with single point, diameter with diameter, etc.).
- ▶ Do not delete global parameters between the measurements.
- ▶ Do not use or change setting parameters and result parameters.

If two measuring points are measured consecutively, the distances or angles between these measuring points can be measured in the corresponding axes. Parameter D activates the distance-angle function.

The following data of a workpiece can be determined in this manner:

- Angle of inside width.
- Angle of outside width.
- Angle of surface.
- Distance between 2 diameters.
- Distance between 2 corners.
- Height or width of an outside width.

Measuring distance with optional parameter D

ⓘ Only the determined distance (set value) is transferred. The current value is not transferred.

ⓘ A comparison between the value transferred in parameter D and the defined distance (set value) can only be carried out with measurements in one axis (single point).

When defining the distance between 2 measuring points, parameter D is transferred with a value ≥ 0. If only single points will be measured, the value in parameter D corresponds to the set value.

▷ Call up the program and measure the 1st measuring point.

▷ Using the hand heel or travel block, move the probe to the 2nd measuring point.

▷ Call up the program and measure the 2nd measuring point with the additional parameter D.

⇨ Angle or distance measurement with the optional parameter D has been performed.

Program call	
`G65 P8700 A1. X0. ...`	(Measure the 1st measuring point)
`G65 P8703 Y50.`	(Travelling block)
`G65 P8700 A1. X0. D...`	(Measure the 2nd measuring point)

All determined results are stored in the following parameters:

Parameter	Description
#144	Deviation from set value in X-direction.
#145	Deviation from set value in Y-direction.
#146	Deviation from set value in Z-direction.

Measuring the with optional parameter D

When defining an angle between 2 measuring points, parameter D is transferred with a value < 0.

ⓘ A -360 set value corresponds to an angle of 0°.

▷ Call up the program and measure the 1st measuring point.

▷ Using the hand heel or travel block, move the probe to the 2nd measuring point.

▷ Call up the program and measure the 2nd measuring point with the additional parameter D.

⇨ Angle or distance measurement with the optional parameter D has been performed.

Program call	
`G65 P8700 A1. X0. ...`	(Measure the 1st measuring point)
`G65 P8703 Y50.`	(Travelling block)
`G65 P8700 A1. X0. D...`	(Measure the 2nd measuring point)

ⓘ Depending on the setting in option bit #128.9, the results of the angle calculation of -180°…180° or 0°…360° are displayed.

All determined results are stored in the following parameters:

Parameter	Description
#142	Calculated angle in the active workpiece coordinate system.
#143	Deviation from the passed set value.
#111+9	Deviation from the passed set value for the zero point offset – data are made available for the internal program 8705 (SET WCS).

4.8.2 Measuring the angle with the program *ANGLE-DISTANCE*

ⓘ The distance between the probe ball and the probed surface must be selected so that an acceleration to the measuring speed is possible.

ⓘ The measuring block is executed orthogonally to the transferred positioning movement.

ⓘ The measuring path (distance between pre-positioning – workpiece edge) is predefined at 10 mm.

ⓘ An angle or distance can only measured in X or Y.

The program 8715 ANGLE-DISTANCE can be used to determine the angle of an edge using 2 single measurements. In doing so, the probe moves along the transferred axis relative to the transferred dimensions.

✓ The probe has been changed.

▷ Position the probe **in front of** the surface being probed.

▷ Enable the WCS: `G . . .`

▷ Call the program.

⇨ The 1st measuring block is performed orthogonally to the transferred traverse movement.

⇨ Traverse movement to the 2nd measuring position.

⇨ The 2nd measuring block is performed orthogonally to the transferred traverse movement.

⇨ Retraction to start position.

⇨ The angle measurement has been performed.

Program call
`G65 P8715 X...`
`G65 P8715 Y...`

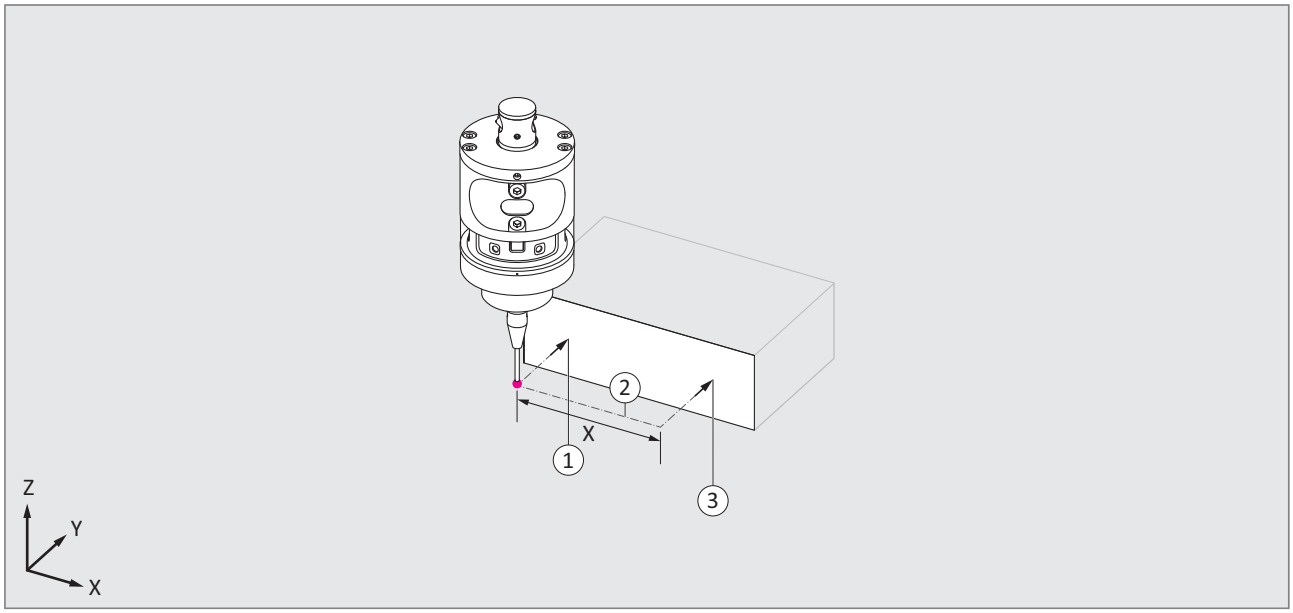
Parameter	**Description**
X	Position the probe in X (relative traverse path).
Y	Position the probe in Y (relative traverse path).

Parameter, optional	**Description**
U	Measuring direction.
D	Set angle (position of edge).
Z	Target position in Z for the measurement with obstacle (dependent on A).
A	Movement to target position in Z.
W	Number of the workpiece coordinate system that is to be set.

All determined results are stored in the following parameters:

Parameter	**Description**
#142	Calculated angle in the active workpiece coordinate system.
#143	Deviation from the passed set value.
#111+9	Deviation from the passed set value for the zero point offset – data are made available for the internal program 8705 (SET WCS).

Example

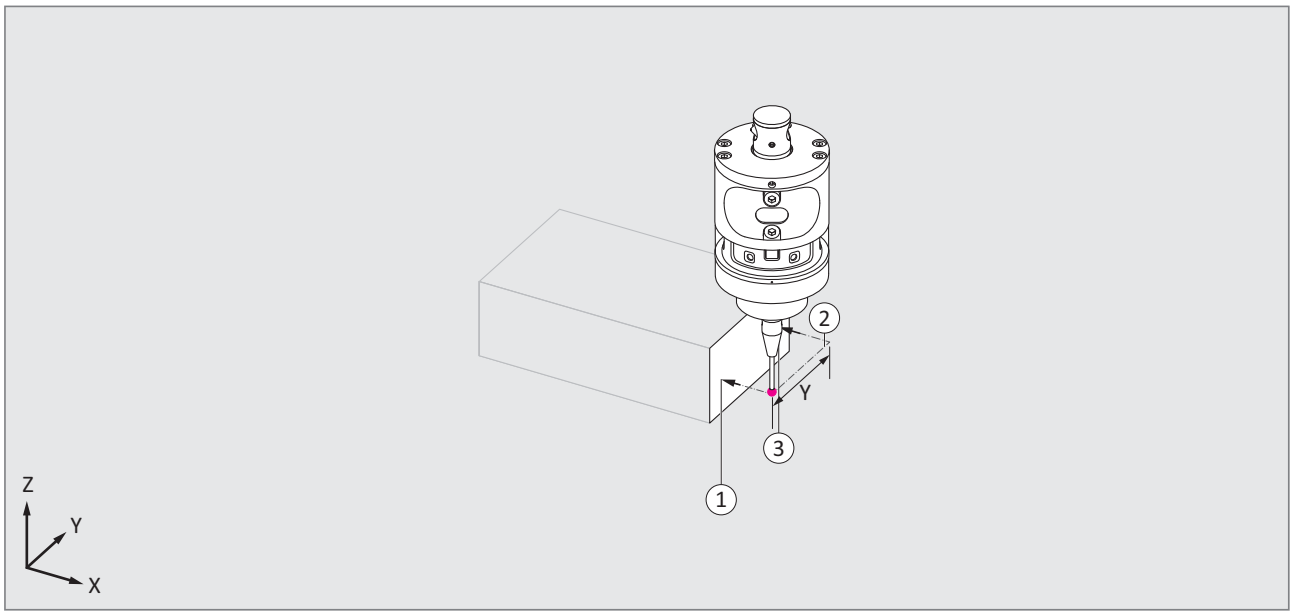


(1) Start position and 1st measuring position (2) Traverse movement	(3) 2nd measuring position

Fig. 4-42 Measuring the angle with the program ANGLE-DISTANCE along the X axis

▷ Call the program: `G65 P8715 X20.`

⇨ The angle has been measured.



(1) Start position and 1st measuring position (2) Traverse movement	(3) 2nd measuring position

Fig. 4-43 Measuring the angle with the program ANGLE-DISTANCE along the Y axis

▷ Call the program: `G65 P8715 Y20. U-1.`

⇨ The angle has been measured.

4.9 Performing the temperature compensation

A temperature compensation is important to compensate the thermal drift of the machine. In spite of the thermal drift of the axes, it is possible to produce constantly unchanged parts. To carry out the temperature compensation, a fixed mounted workpiece, e.g. a building block or calibration master, is required in the machining area. The zero point is determined on this workpiece in 3 axes (reference measurement). After the machine is heated-up, the position of the workpiece is measured again (comparative measurement). Because of the heat changes in the machine, the measured zero point now varies from the previously measured value. This deviation is entered in the external zero point offset of the control. In this way, heat changes of the machine are compensated. After a reference measurement, any number of comparative measurements can be performed.

In general, a temperature compensation can be made with each measurement (single point). It is advisable to carry out a temperature compensation in all 3 axes. Either the individual axes must be compensated one after the other, or the results must be stored and directly written into the external zero point offset with program 8705 (SET WCS).

Carrying out a reference measurement

✓ The probe has been changed.

▷ Position the probe.

ⓘ The probe must be positioned using a protected travel block so that there are exactly the same conditions for reference and comparative measurements.

▷ Enable any WCS: `G...`

▷ Call the program.

⇨ The reference measurement has been performed.

Program call
`G65 P8700 ... W...`

Carrying out a comparative measurement

✓ The probe has been changed.

▷ Position the probe.

ⓘ The probe must be positioned using a protected travel block so that there are exactly the same conditions for reference and comparative measurements.

▷ Enable the workshop coordinate system in which the zero point of the workpiece was saved: `G...`

▷ Call the program: Use the same parameters as for the reference measurement and the additional parameter W53..

⇨ Comparative measurement has been performed and the determined deviation has been entered in the external zero point offset of the control.

Program call
`G65 P8700 ... W53.`

4.10 Defining the corner point using 3 or 4 measuring points

ⓘ The distance between the probe ball and the probed surface must be selected so that an acceleration to the measuring speed is possible.

ⓘ The measuring path (distance between pre-positioning – workpiece edge) is predefined at 10 mm.

ⓘ The travel movements are executed under consideration of the indicated angles (K, D).

ⓘ At least 3 traverse paths must be transferred. Parameter U and parameter V are optional.

ⓘ When 3 travel paths are transferred, the straight lines are defined vertically next to each other.

ⓘ When the measurement contains 3 points, no angles for the component and position (K, D) can be defined.

✓ The probe has been changed.

▷ Position the probe **in front of** the surface being probed.

▷ Enable the WCS: `G...`

▷ Call the program.

⇨ The corner mark has been determined.

Program call
`G65 P8712 R... X... U... Y... V...`

Parameter	**Description**
R	Define the position of the angle or initial position for the following traverse paths.
X	Relative traverse path from the initial position to the 1st measuring position (page 1).
U	Relative traverse path from the initial position to the 2nd measuring position (side 1).
Y	Relative traverse path from the initial position to the 1st measuring position (page 2).
V	Relative traverse path from the initial position to the 2nd measuring position (side 2). ⓘ If the parameter is transferred with a negative sign, a report file is also output.

Parameter, optional	**Description**
D	Angle position of the corner. ⓘ Note the sequence of the parameters in the program call.
K	Set angle of the corner. ⓘ Note the sequence of the parameters in the program call.
A	Movement to target position in Z.
Z	Define the measuring position when measuring from the safety plane.
T	Check the tolerance.
W	Select the workpiece coordinate system.
I	Transfer the set position in X. ⓘ Note the sequence of the parameters in the program call.
J	Transfer the set position in Y. ⓘ Note the sequence of the parameters in the program call.

All determined results are stored in the following parameters:

Parameter	**Description**
#111+0	X position of the corner in the enabled WCS.
#111+3	Deviation from the transferred position or from the set position (parameter I) in X.
#111+1	Y position of the corner in the enabled WCS.
#111+4	Deviation from the transferred position or from the set position (parameter J) in Y.
#111+7	Calculated position of the corner (D).
#111+8	Calculated angle of the corner (K).

Description of the call parameters for determining a corner mark with 3 or 4 measuring points

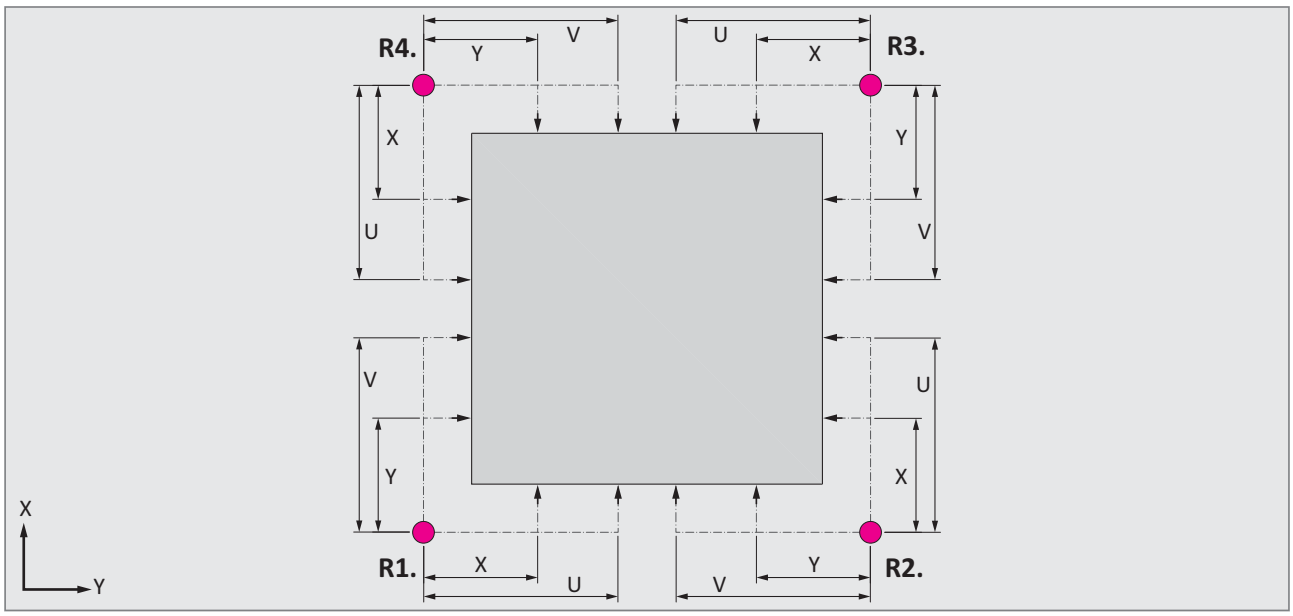


Fig. 4-44 Move to the outside angle to determine a corner point with 3 or 4 measuring points – definition of parameters R, X, U, Y, V

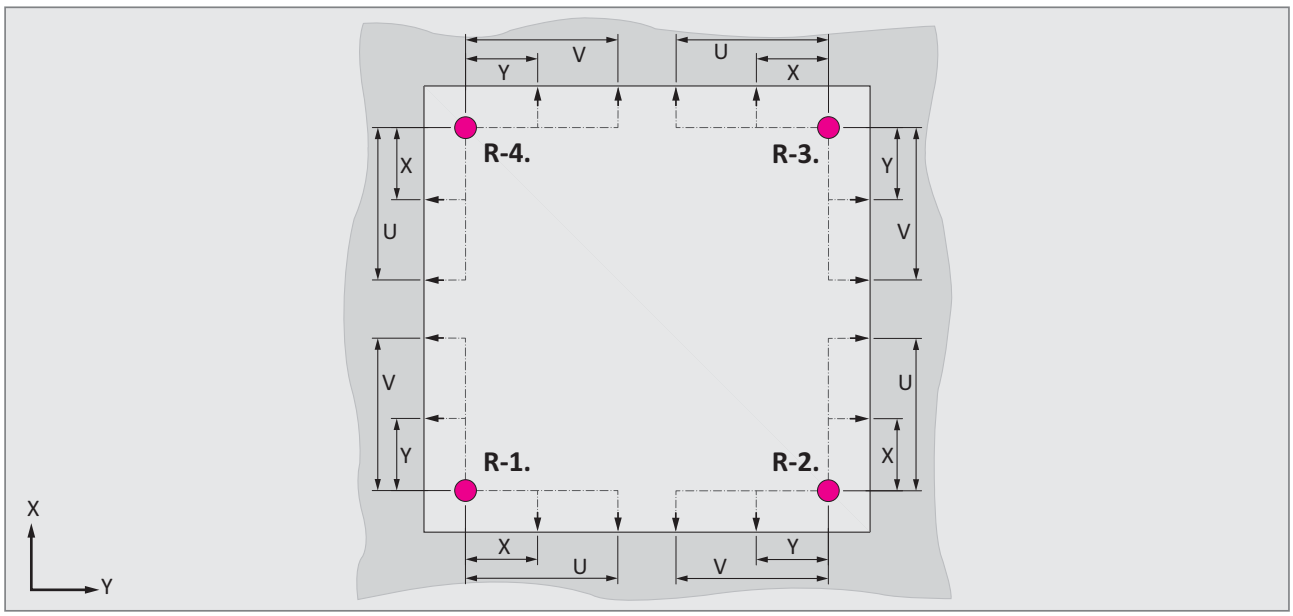


Fig. 4-45 Move to the inside angle to determine a corner point with 3 or 4 measuring points – definition of parameters R, X, U, Y, V

Example

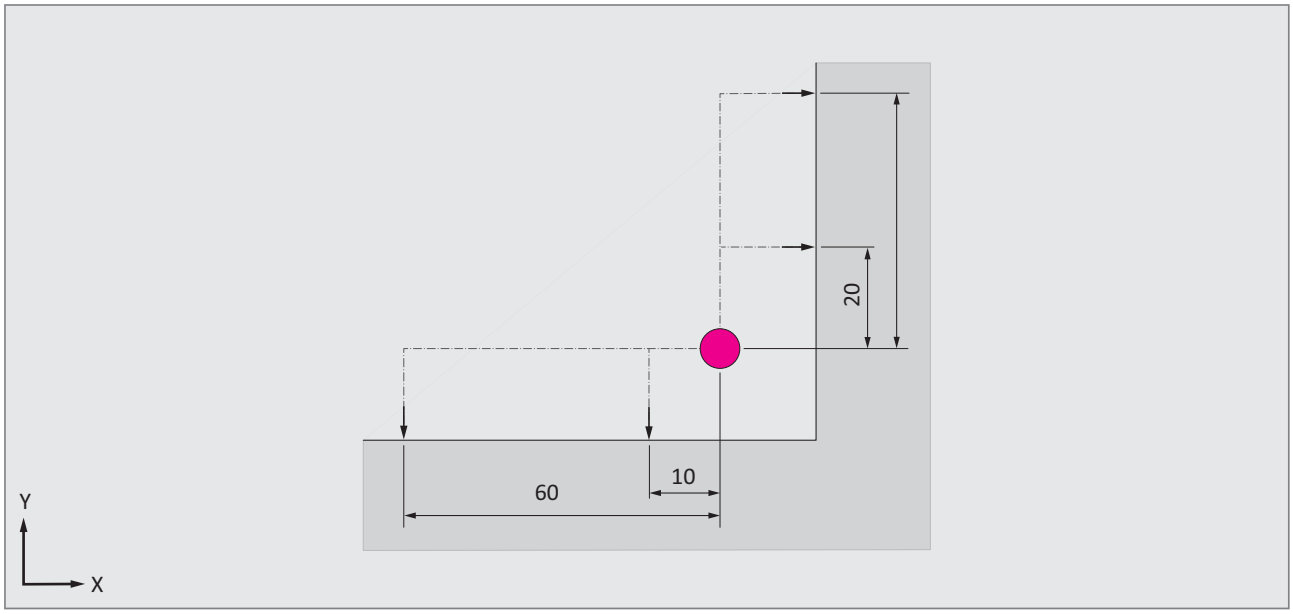


Fig. 4-46 Determining the corner point – inside corner

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8712 R-2. X20. U50. Y10. V60.`

⇨ The corner mark has been determined.

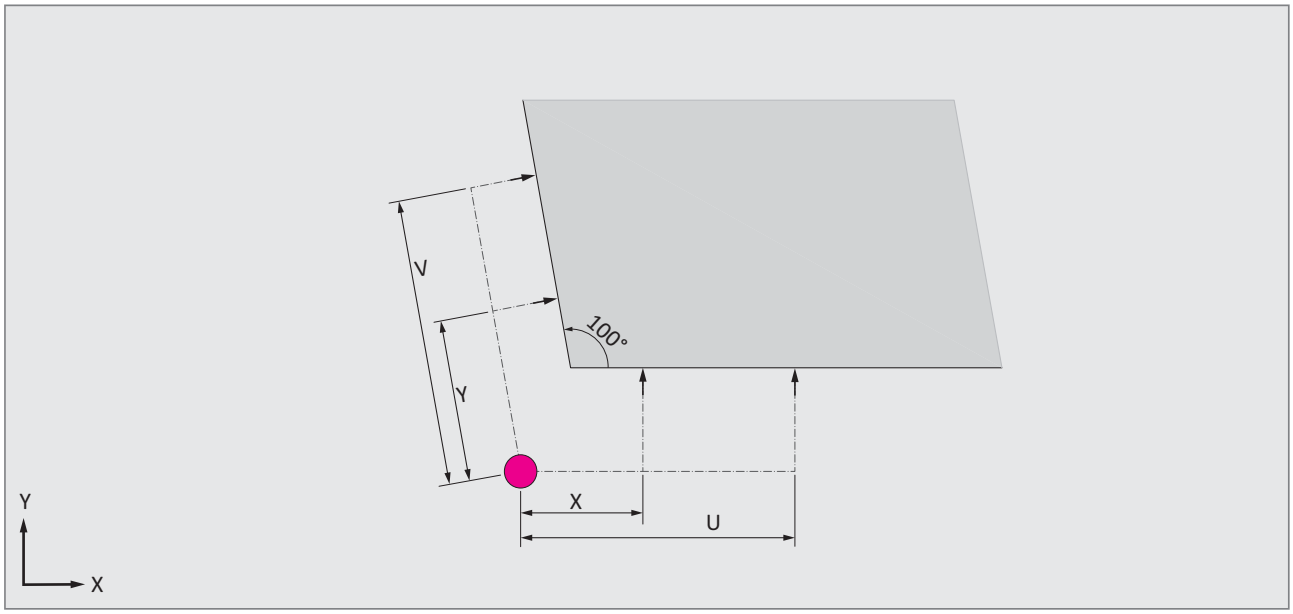


Fig. 4-47 Determining the corner point – outside corner

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8712 R1. X20. U50. Y20. V60. K100.`

⇨ The corner mark has been determined.

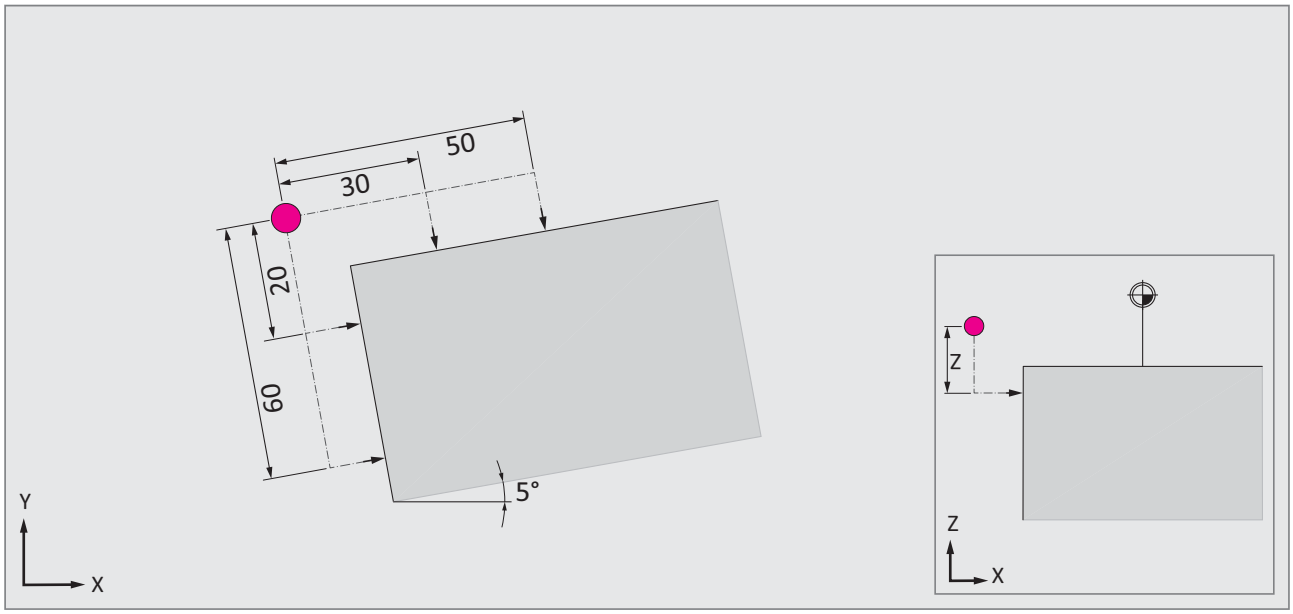


Fig. 4-48 Determining the corner point – outside corner with pre-positioning in Z

▷ Enable the WCS: `G54`

▷ Call the program: `G65 P8712 R4. X20. U60. Y30. V50. D5. Z-15.`

⇨ The corner mark has been determined.

4.11 Correcting the tool and adapting the process

NOTICE

Malfunction due to incorrect tool data.

- ▶ Execute the program only once.
- ▶ Open the program directly after a measurement.

ⓘ The distance between the probe ball and the probed surface must be selected so that an acceleration to the measuring speed is possible.

ⓘ The measuring result must be stored in the corresponding result parameters.

The program 8706 (SET TOOL) can be used to correct the wear value of a tool.

In addition to the tool correction, the optional parameters can be used to adapt the process.

✓ The probe has been changed.

▷ Position the probe **in front of** the surface being probed.

▷ Measure single point, corner or contour.

▷ Call the program.

⇨ The tool has been corrected.

⇨ The process has been adjusted, if necessary.

Program call
`G65 P8706 E...`

Parameter	**Description**
E	Select the tool for the tool correction.

Parameter, optional	**Description**
T	Upper tolerance for the tool correction (reference: set value).
U	Lower tolerance for the tool correction (reference: set value).
I	Non-intervention limit.
J	Fixer offset.
K	Correction factor.

4.12 Checking the tolerance

4.12.1 Checking the tolerance with call parameter T

Parameter T can be used to determine the tolerance of a measuring point, a contour or a position.

To check the position of a surface or corner or a contour for tolerance, the value transferred must be positive.

To check a position or a centre point of a contour for tolerance, the value transferred must be negative.

The specifications of set value or position I, J and K are considered. If the tolerance is exceeded, the program stops with the error message *Tolerance exceeded*.

As the tolerance can only be checked absolutely, the set value must be in the centre of the tolerance field.

Example

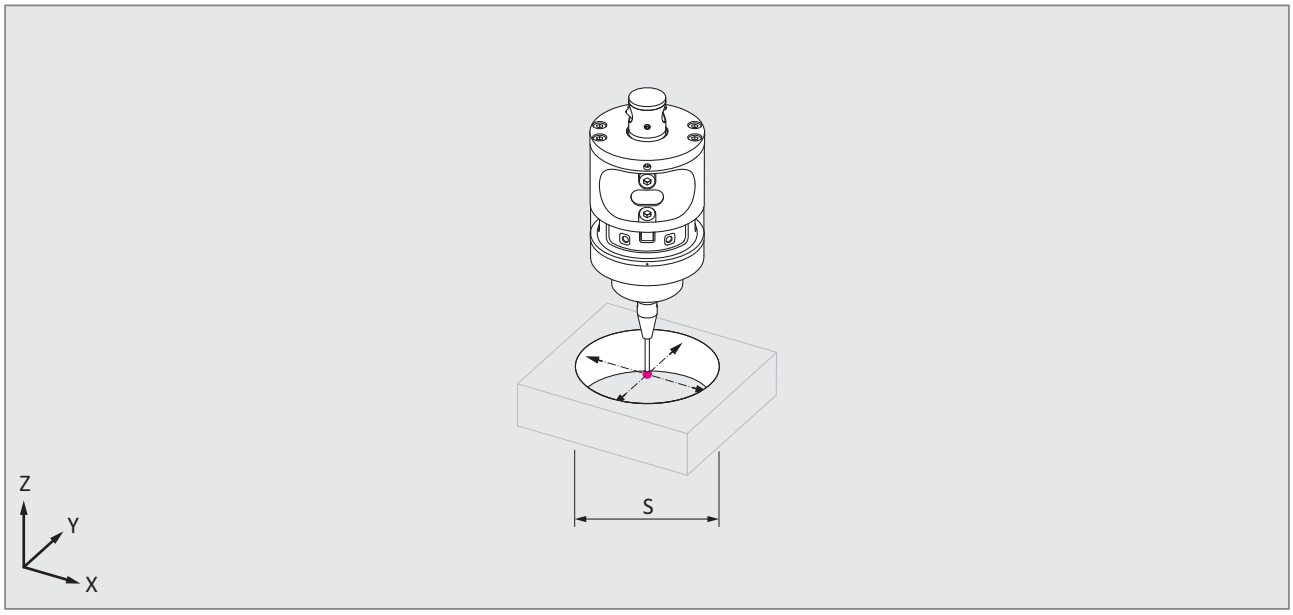


Fig. 4-49 Checking the tolerance of a contour or position with the call parameter T

Check the tolerance of a contour – with a dimensional tolerance of ±0.2 mm:

▷ Enable the WCS: `G55`

▷ Measure the internal diameter and check the tolerance of the contour: `G65 P8700 A1. S60. T+0.2`

⇨ The tolerance of the contour has been checked.

Check the tolerance of a contour – with a dimensional tolerance of +0.2 mm:

▷ Enable the WCS: `G55`

▷ Measure the internal diameter and check the tolerance of the contour: `G65 P8700 A1. S60.1 T0.1`

⇨ The tolerance of the contour has been checked.

Check the tolerance of a position – with a position tolerance of ±0.2 mm:

▷ Enable the WCS: `G55`

▷ Measure the internal diameter and check the tolerance of the position: `G65 P8700 A1. S60. T-0.2`

⇨ The tolerance of the position has been checked.

Check the tolerance of a position – with a position tolerance of +0.3 mm:

▷ Enable the WCS: `G55`

▷ Measure the internal diameter and check the tolerance of the position: `G65 P8700 A1. S60. I50.15 J50.15 T-0.15`

⇨ The tolerance of the position has been checked.

4.12.2 Checking the tolerance with the *TOLERANCE* program

ⓘ The distance between the probe ball and the probed surface must be selected so that an acceleration to the measuring speed is possible.

ⓘ The measuring result must be stored in the corresponding result parameters.

ⓘ The tolerance check is always in terms of the measuring result.

ⓘ At least one parameter must be transferred.

The program 8707 (TOLERANCE) can be used to check the tolerance of the measuring position and the tolerance of the contour.

✓ The probe has been changed.

▷ Position the probe **in front of** the surface being probed.

▷ Measure single point, corner or contour.

▷ Call the program.

⇨ The tolerance has been checked.

Program call
`G65 P8707 T... U... I... J...`

Parameter	**Description**
T	Upper tolerance for the contour control.
U	Lower tolerance for the contour control.
I	Upper tolerance for the position of the measuring point/contour.
J	Lower tolerance for the position of the measuring point/contour.

Example

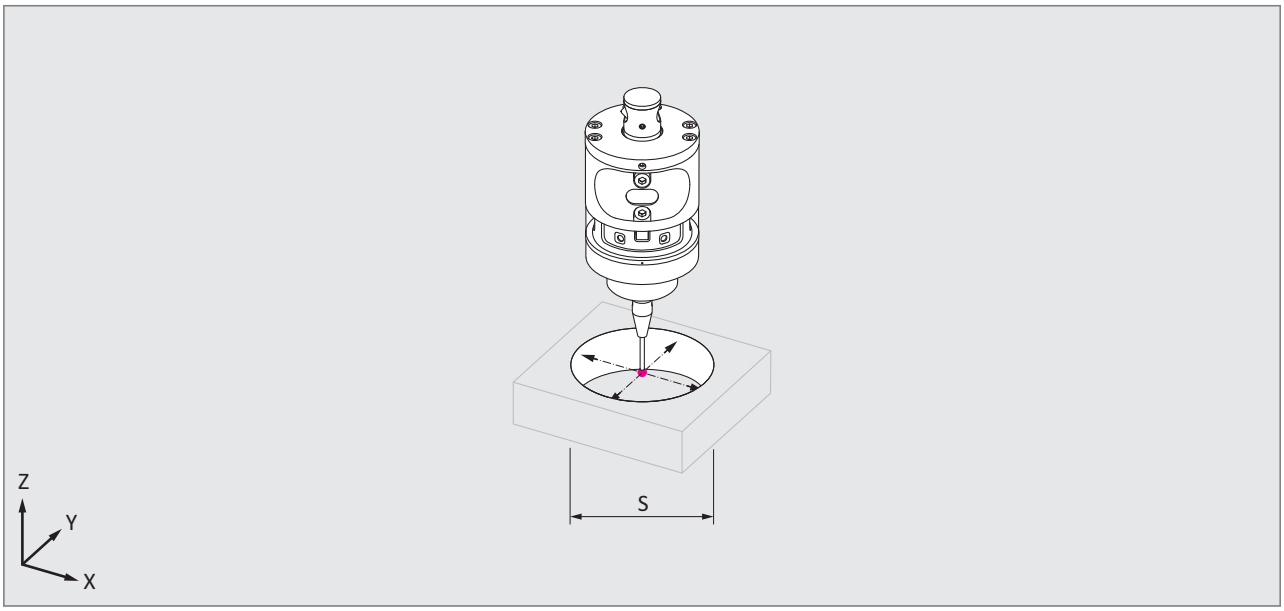


Fig. 4-50 Checking the tolerance of a contour or position with the TOLERANCE program

Check the tolerance of a contour:

▷ Enable the WCS: `G55`

▷ Measure the internal diameter: `G65 P8700 S60.`

▷ Check the contour with a dimensional tolerance of +0.2 mm…-0.3 mm: `G65 P8707 T+0.2 U-0.3`

⇨ The tolerance of the contour has been checked.

Check the tolerance of a contour and tolerance of a position:

▷ Enable the WCS: `G55`

▷ Measure the internal diameter: `G65 P8700 S60.`

▷ Check the contour and position with a dimensional tolerance of +0.2 mm…-0.3 mm and a position tolerance of +0.1 mm…-0.1 mm: `G65 P8707 T+0.2 U-0.3 I+0.1 J-0.1`

⇨ Tolerance of the contour and tolerance of the position have been checked.

Check the tolerance of a position:

▷ Enable the WCS: `G55`

▷ Measure the internal diameter: `G65 P8700 S60.`

▷ Check the position with a position tolerance of +0.1 mm…-0.1 mm: `G65 P8707 I0.1 J-0.1`

⇨ The tolerance of the position has been checked.

4.13 Outputting the data via DPRNT

ⓘ When the data output via DPRNT is customised, the data output takes place according to the corresponding settings.

ⓘ The data output depends on the machine settings.

ⓘ If parameter V is used for the data output of a measurement with 3 measuring points, the value for the 3rd probing angle is also transferred with a negative prefix.

Parameter V can be used to output and log results directly via DPRNT (standard function or customer-specific). For this purpose, parameter V is transferred with a negative prefix by default.

Example

	No entry.
10.0	Measurement 1, position in X.
0.02	Measurement 1, deviation from set value in X.
	No entry.
9.998	Measurement 2, position in X.
-0.002	Measurement 2, deviation from set value in X.
…	

Tab. 4-1 Data output without comment when measuring a single point

▷ Call the program: `G65 P8700 A1. X0. V-1.`

⇨ A single point is measured and all determined results are stored in the following parameters: #111+0, #111+3

⇨ The data have been output.

	No entry.
0.002	Measurement 1, position in X.
-0.001	Measurement 1, position in Y.
0.002	Measurement 1, deviation from set value in X.
-0.001	Measurement 1, deviation from set value in Y.
50.04	Measurement 1, diameter.
0.04	Measurement 1, deviation from set value (diameter).
	No entry.
-0.001	Measurement 2, position in X.
0.003	Measurement 2, position in Y.
-0.001	Measurement 2, deviation from set value in X.
0.003	Measurement 2, deviation from set value in Y.
49.97	Measurement 2, diameter.
-0.03	Measurement 2, deviation from set value (diameter).
…	

Tab. 4-2 Data output without comment for measurement of a bore with 3 measuring points

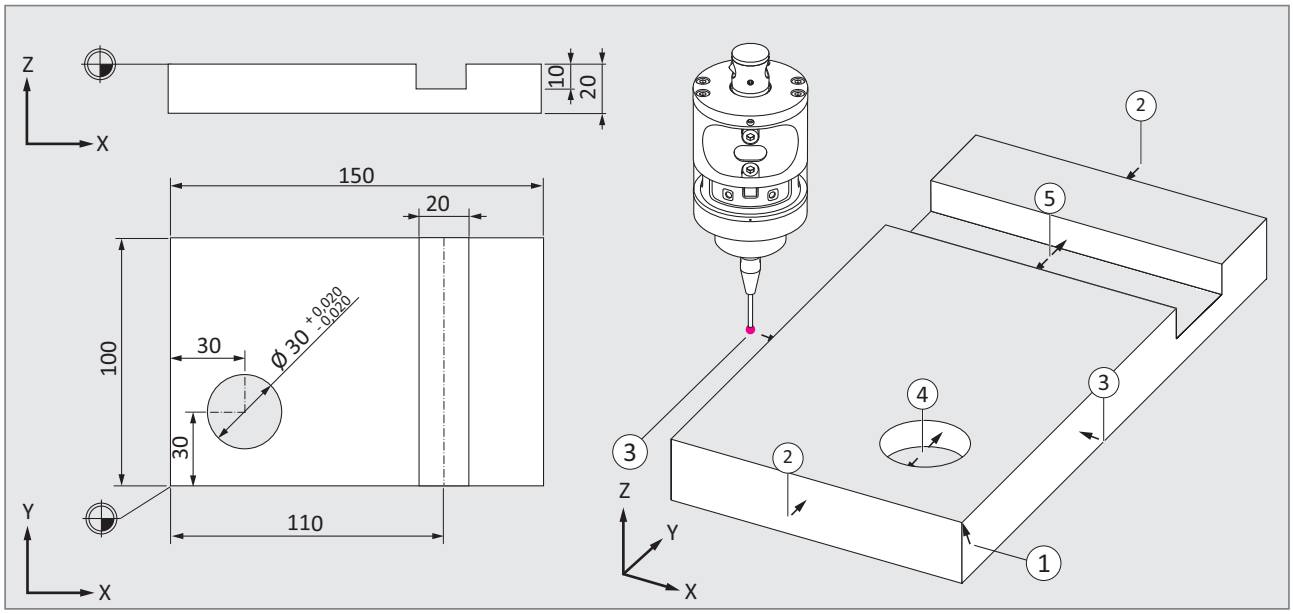
▷ Call the program: `G65 P8700 A1. S50. H0. U120. V-240.`

⇨ A bore with 3 measuring points is measured and all determined results are stored in the following parameters: #111+0, #111+1, #111+3, #111+4, #111+6, #111+7

⇨ The data have been output.

4.14 Examples

4.14.1 Measurements on sample part

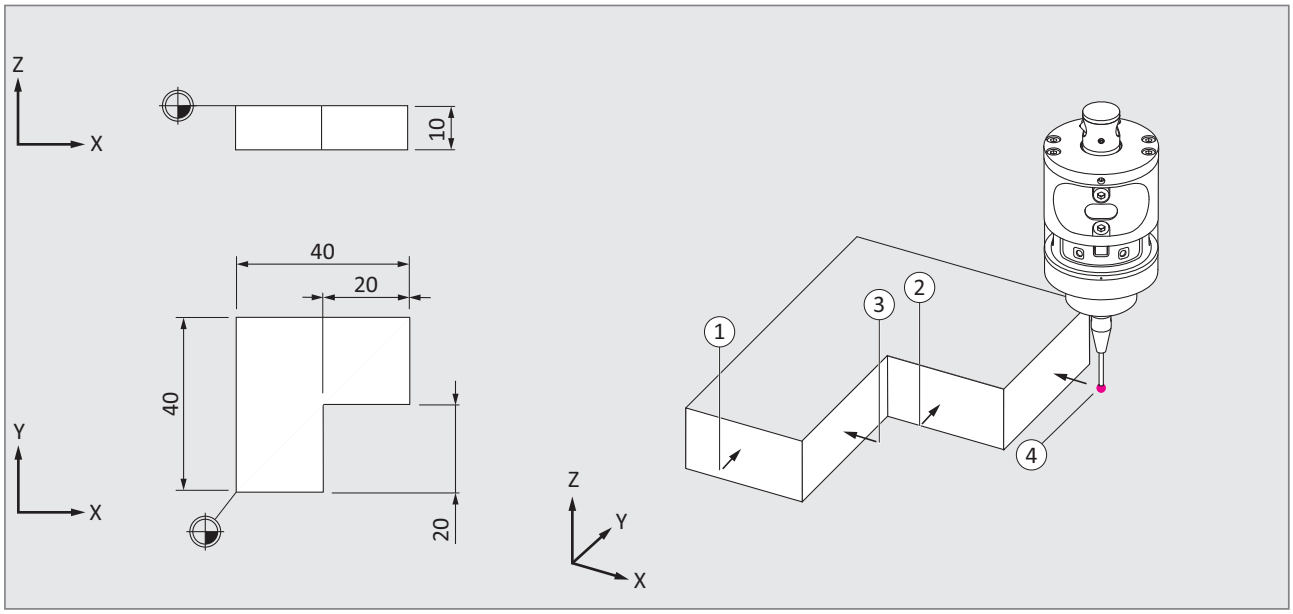


(1) Correct zero point in XYZ	(4) Measure the bore
(2) Measure workpiece in X	(5) Measure inside width in X
(3) Measure workpiece in Y	

Fig. 4-51 Measuring the length and width of a workpiece, diameter (tolerance) and inside width

```
O1(EXAMPLE 1)
G54                                  Activate the zero point.
G65 P8703 X-5. Y-5. M1.              Position the probe.
G65 P8703 Z5. M3.                    Position the probe.
G65 P8700 X10. Y10. Z-10. W54. M3.   Correct zero point in XYZ.
G65 P8703 X75. Y50. M3.              Position the probe.
G65 P8700 A1. S150. X1. Z-5. M3.     Measure workpiece in X.
#150=#[#111+6]                       Save result in #150.
G65 P8700 A1. S100. Y1. Z-5. M3.     Measure workpiece in Y.
#151=#[#111+6]                       Save result in #151.
G65 P8703 X30. Y30. M3.              Position the probe.
G65 P8703 Z-5. M3.                   Position the probe.
G65 P8700 A1. S30. T0.02 M3.         Measure the bore.
#152=#[#111+6]                       Save result in #152.
G65 P8703 Z5. M3.                    Position the probe.
G65 P8703 X110. Y50. M3.             Position the probe.
G65 P8703 Z-5. M3.                   Position the probe.
G65 P8700 A1. S20. X1. M3.           Measure inside width in X.
#153=#[#111+6]                       Save result in #153.
G65 P8703 Z5. M2.                    Position the probe.
M[30]                                Program end.
```

4.14.2 Distance measurement

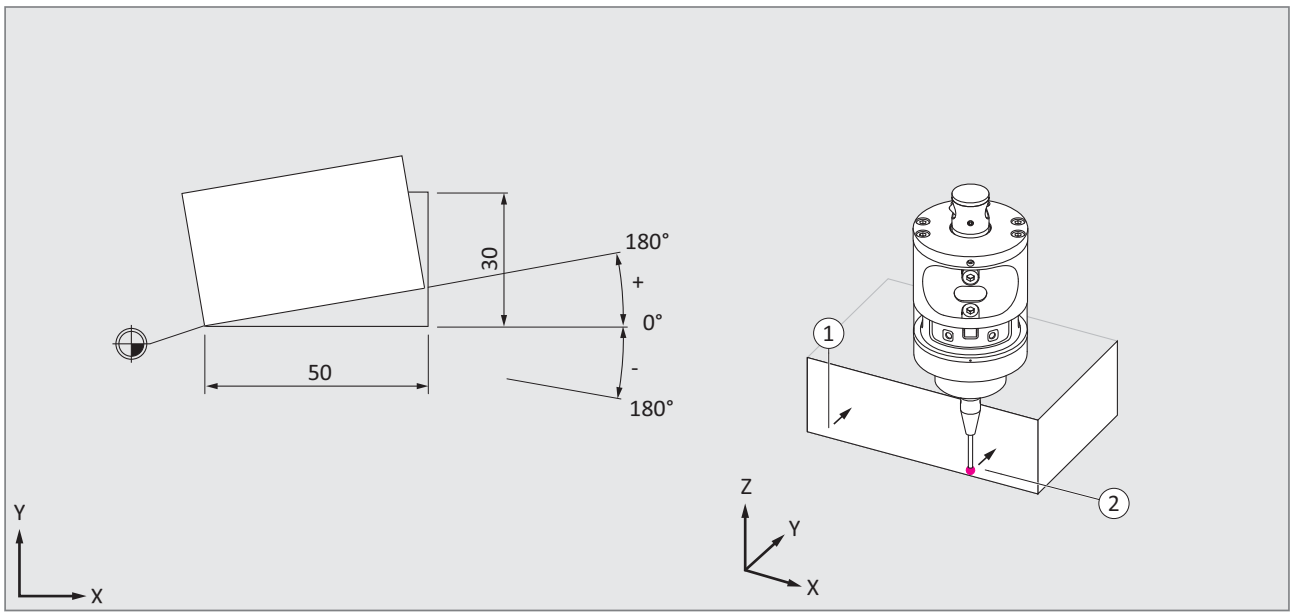


(1) Measure workpiece in Y	(3) Measure workpiece in X
(2) Measure workpiece in Y	(4) Measure workpiece in X

Fig. 4-52 Measuring the distances of the recess in X and Y to the outside contour

O2(EXAMPLE 2)	
G54	Activate the zero point.
G65 P8703 X10. Y-10. M1.	Position the probe.
G65 P8703 Z-5. M3.	Position the probe.
G65 P8700 A1. Y0. M3.	Measure workpiece in Y.
G65 P87033 X30. M3.	Position the probe.
G65 P8700 A1. Y20. D20. M3.	Measure workpiece in Y.
#150=#145	Save the result: Distance in Y.
G65 P8703 Z5. M3.	Position the probe.
G65 P8703 X50. Y10. M3.	Position the probe.
G65 P8703 Z-5. M3.	Position the probe.
G65 P8700 A1. X20. M3.	Measure workpiece in X.
G65 P8703 Y30. M3.	Position the probe.
G65 P8700 A1. X40. D20. M3.	Measure workpiece in X.
#151=#144	Save the result: Distance in X.
G65 P8703 Z5. M2.	Position the probe.
M[99]	Program end.

4.14.3 Angle measurement



(1) Measure workpiece in Y	(2) Measure workpiece in Y

Fig. 4-53 Measuring the angle of the workpiece in the XY-plane

O3(EXAMPLE 3)	
G54	Activate the zero point.
G65 P8703 X5. Y-10. M1.	Position the probe.
G65 P8703 Z-5. M3.	Position the probe.
G65 P8700 A1. Y0. M3.	Measure workpiece in Y.
G65 P8703 X45. M3.	Position the probe.
G65 P8700 A1. Y0. D-360. M3.	Measure workpiece in Y.
#150=#143	Save the result in #150.
G65 P8703 Z5. M2.	Position the probe.
M[30]	Program end.

5. Messages

5.1 Error messages

✓ The error number has been set.

✓ The error message is displayed on the screen.

▷ Note the error number.

▷ Follow the instructions, if any.

▷ Press *RESET* button.

▷ Eliminate the cause of the error.

ⓘ Precise error analysis by reading out the error marker in #121.

⇨ The cause of error is eliminated.

Error 3...	Marker	Title	Possible cause ▷ Remedy
101		Invalid call parameters	One or more call parameter are set with a critical or invalid value. ▷ Pre-set call parameters with valid values.
	.01		8700: #W, #E called simultaneously. ▷ Call #W or #E.
	.02		8701: #S, #X, #Y, #Z are not defined as call parameters. ▷ Define #S, #X, #Y, #Z as call parameters.
	.03		8701: #X, #C called simultaneously. ▷ Call #X or #C.
	.04		8701: #Y, #C called simultaneously. ▷ Call #Y or #C.
	.05		8705: #W called without a full stop (.) for the machine setting µm. ▷ Call #W with a full stop.
	.06		8705: Impermissible value entered in #W. ▷ Enter value ≤ 59.
	.07		8705: Impermissible value entered in #W. ▷ Enter value ≤ -48.
	.08		8705: Impermissible value entered in #W. ▷ Enter value 8...52.
	.09		8705: Axis cannot be corrected. ▷ Transfer selected axis with correct address (≠ 0).
	.11		8705: The primary axis is not entered in 8710. Axis cannot be corrected. ▷ Enter the primary axis.
	.12		8705: No zero point offset allowed with active G68/G68.2. ▷ Do not call parameter W.
	.13		8710: Unexpected error occurred. ▷ Check the settings. ▷ Contact service if necessary.
	.14		8702: #X and #Y called when measuring the inside or outside width. ▷ Call #X or #Y.

Error 3...	Marker	Title	Possible cause ▷ Remedy
	.15		8702: #X and #Y called during calibration. ▷ Call #X or #Y.
	.16		8709: When calibrating with the calibration sphere, no value entered in #Z or #S. ▷ Enter the value.
	.17		8715: When measuring an angle/distance, two different measurements were performed (type of measuring point was not identical). ▷ Perform comparable measurements.
	.18		8715: Measurement direction was not transferred. ▷ Transfer the measurement direction.
	.19		8715: An angle < 45° was transferred. ▷ Transfer a permissible angle.
	.21		8711: Angle transferred with a distance that is too small (minimum distance 10°) or transfer value is not between 0° and 360°. ▷ Transfer a permissible angle.
	.23		8704: Transferred start position and target position are identical. ▷ Transfer the correct target/start position.
	.24		8707: No tolerance limits transferred. ▷ Transfer tolerance limits.
	.26		8712: #X not transferred. ▷ Transfer #X.
	.27		8712: #Y not transferred. ▷ Transfer #Y.
	.28		8712: #U or #V not transferred (at least 3 points must be transferred). ▷ Transfer #U or #V.
	.29		8712: Impermissible angles were transferred. ▷ Transfer permissible angles.
	.31		8712: Permissible angles for component position were exceeded. ▷ Transfer permissible angles.
	.32		8712: Only 3 points were transferred for entry of the angle for the intersection. ▷ Transfer correct values.
	.33		8712: Parameter R for selecting the corner is outside of the permissible range (1…4). ▷ Transfer correct values.
	.34		8714: The calculated points to not represent in an intersection. ▷ Calculate the points again.
	.35		8722: The regression calculation is not correct. ▷ The calculated points must form a circle.

Error 3...	Marker	Title	Possible cause ▷ Remedy
	.36		8720: Distance of probing points/transfer value is not correct. ▷ Ensure distance of probing points >10°. ▷ Ensure correct transfer value (0°...360°).
	.37		8720: Call parameter H, U, V are not correct. ▷ Transfer correct values.
	.38		8720: Probe ball radius > contour diameter. ▷ Ensure that the probe ball radius < contour diameter.
	.39		8723: Parameter setting not correct. ▷ Ensure correct value ranges of macro variables.
	.41		8720: Call parameter for calibration in Z is not correct. ▷ Transfer permissible call parameters (C1.,Z).
	.42		8720: Setting of zero point with 2 measuring points not permitted. ▷ Call measurement with at least 3 measuring points.
102		Out of tolerance	The permissible tolerance limit has been exceeded. ▷ Check measurement result.
	.01		8707: General error – called as stand-alone program and no call parameter transferred. ▷ Transfer call parameter.
	.02		8707: Tolerance exceeded – position. ▷ Adhere to tolerance limit.
	.03		8707: Tolerance exceeded – contour. ▷ Adhere to tolerance limit.
	.04		8712: Corner: Tolerance exceeded – contour. ▷ Adhere to tolerance limit.
103		Unexpected obstacle	The probe has not reached the target position. ▷ Enter a reachable target position.
	.01		8703: Unexpected obstacle or probe off. ▷ Enter a reachable target position. ▷ Switch on the probe.
104		Measuring block without trigger point	Probe did not deflect on the transferred measuring path. ▷ Enter a reachable target position. ▷ Adapt the position of the probe before the measurement call.
	.01		8704: 1st measuring block without trigger. ▷ Enter a reachable target position. ▷ Adapt the position of the probe before the measurement call.
	.02		8704: 2nd measuring block without trigger. ▷ Enter a reachable target position. ▷ Adapt the position of the probe before the measurement call.

Error 3...	Marker	Title	Possible cause ▷ **Remedy**
105		Error tool correction	No tool data could be written after measurement. ▷ Program a valid program call. ▷ Correct the entered parameter settings for the tool memory.
	.01		8706: Multiple correction axes defined. ▷ Define one correction axis.
	.02		8706: Limit value exceeded (#3). ▷ Correct the parameter settings.
	.03		8706: Tolerance exceeded. ▷ Correct the parameter settings.
	.04		8706: The value for FIX CORR exceeds the max. permissible limit value (#3). ▷ Transfer a permissible value.
	.05		8706: Max. permissible correction factor (#7) was exceeded. ▷ Correct the parameter settings.
106		Error in measuring block/prot. move	No valid measuring block could be executed. ▷ Check transfer parameter M. ▷ Eliminate transmission fault is necessary. ▷ Position at a valid or possible start position.
	.01		8703: No STATUS signal. ▷ Check transfer parameter M.
	.02		8703: No ERROR signal. ▷ Eliminate transmission fault is necessary.
	.03		8704: No STATUS signal. ▷ Check transfer parameter M.
	.04		8704: No ERROR signal. ▷ Eliminate transmission fault is necessary.
	.05		8704: 2nd probing ended with ERROR (1st measuring block). ▷ Eliminate transmission fault is necessary.
	.06		8704: Start position and skip position are identical (1st measuring block). ▷ Position at a valid or possible start position.
	.07		8704: Start position and skip position are identical (2nd measuring block). ▷ Position at a valid or possible start position.
	.08		8703: 2nd move to target position ended with ERROR (2nd measuring block). ▷ Position at a valid or possible start position.

Error 3...	Marker	Title	Possible cause ▷ **Remedy**
108		Battery low	The *Check battery signal* option is set and the BATTERY error signal is active. ▷ Change the batteries. ▷ Enter the correct address parameter.
	.01		8708: Active BATTERY error signal from interface. ▷ Change the batteries. ▷ Enter the correct address parameter.
	.02		8708: Active BATTERY error signal from interface (pulses). ▷ Change the batteries. ▷ Enter the correct address parameter.
109		Wrong probe length	Entered probe length = 0. ▷ Enter valid values.
	.01		8717: No correct values entered for tool length or zero tool. ▷ Enter valid values.
110		Error when switching on or off	The probe could not be switched on or off within the specified time. ▷ Enter valid values.
	.01		8708: Error when switching on: ERROR signal missing. ▷ Enter valid values.
	.02		8708: Error when switching on: No micro move possible/ probe already deflected or OFF. ▷ Enter valid values.
	.03		8708: Error when switching on: ERROR signal not defined (pulses). ▷ Enter valid values.
	.04		8708: Error when switching on: ERROR signal missing (pulses). ▷ Enter valid values.
	.05		8708: Error when switching off: ERROR is active – probe ON (pulses). ▷ Enter valid values.
111		Wrong tool	The tool correction number (H number) of the probe defined in program USERPARATAB is not active. ▷ Activate the correct tool.
	.01		8717: The tool correction number (H number) defined in #1 does not match the tool correction number stored in #4111/ #4120. ▷ Activate the correct tool.
112		No calibration value in Z	The parameter or content for the calibration value in Z is undefined. ▷ Calibrate probe in Z. ▷ Adapt start address for the calibration values.
	.01		8700: Calibration value in Z is undefined. ▷ Calibrate probe in Z. ▷ Measure without calibration.
	.02		8709: Calibrate sphere without Z. ▷ Calibrate probe in Z.

Error 3...	Marker	Title	Possible cause ▷ **Remedy**
113		Error prog. USERPARATAB	The parameters entered are invalid or faulty. ▷ Enter valid values.
	.01		8717: The tool correction number (H number) or value for the tool length are missing. ▷ Enter valid values.
	.02		8717: Value for the start address of the calibration data is outside of the permissible range (500…999). ▷ Enter a valid value.
	.03		8717: Probe ball radius XY. ▷ Enter valid values.
	.04		8717: Probe ball radius Z. ▷ Enter valid values.
	.05		8717: Distance XY. ▷ Enter valid values.
	.06		8717: Distance Z. ▷ Enter valid values.
	.07		8717: Feed 1st measuring block = 0. ▷ Enter valid values.
	.09		8717: Feed Protected Move. ▷ Enter valid values.
	.11		8710: Start address of results invalid or faulty. ▷ Enter valid values.
	.12		8710: Axis numbers (X, Y, Z) invalid or faulty. ▷ Enter valid values.
114		Communication	timeout or error when communicating with counterpart. ▷ Adapt the parameter settings. ▷ Establish the connection.
	.01		8716: The machine control is waiting for QUIT from the counterpart. ▷ Adapt the parameter settings. ▷ Establish the connection.
116		PARAMETER SETTINGS	For M0, the parameters #110…#149 are deleted: During measurement/calibration, do not stop the machine with M0. ▷ Adapt the parameter settings. ▷ Mechanically align the probe if necessary.
	.01		8710: Parameter setting deleted for M0. ▷ Adapt the machine setting.

5.2 Messages relating to programmed stop

✓ The program was interrupted by M0.

✓ The message is displayed on the screen.

▷ Carry out the instruction.

▷ Press the *NC Start* button.

⇨ The cycle is continued.

Error 3...	Marker	Title	Possible cause ▷ **Remedy**
115		Turn spindle by 180°.	During calibration the probe must be turned by 180°. ▷ Perform an automatic spindle indexing. ▷ If necessary, turn the probe manually by 180°.

6. Annex

6.1 Program overview

Program	Description
8700	MAIN Main program
8701	TOUCH XYZ Touching of single points and corners
8702	XY CONTOUR Touching of contours
8703	PROTECTED MOVE Protected travel block
8704	MEASURE Measuring block
8705	SET WCS Set zero point
8706	SET TOOL Tool correction
8707	TOLERANCE Tolerance control
8708	PROBE ONOFF STATUS Switch the probe on/off (level-controlled)
8709	CALIB-MEAS SPHERE Calibration on sphere
8710	USER GLOBAL Input of user data
8711	3-POINTS CONTOUR Probing of contours with 3 points
8712	CORNER MAIN Calculation of a corner/contour location
8713	CORNER MOVE Position calculation CORNER MAIN program
8714	CORNER CALCULATION Result calculation CORNER MAIN program
8715	ANGLE-DISTANCE Calculation of angles or distances
8716	DPRNT Data output via command DPRNT
8717	TC-USER 1 Settings for the 1st probe
8718	TC-USER 2 Optional: Settings for a 2nd probe
8719	TC-USER 3 Optional: Settings for a 3rd probe

6.2 Call parameter

6.2.1 MAIN program

Parameter		Description
A	#1	**Using absolute dimensioning/relative dimensioning** The positions in the program call – depending on the program call – are interpreted in the enabled WCS either as absolute coordinates or as relative coordinates and not as a distance between the probe ball and workpiece or traverse path in Z. #0./0. Use relative dimensioning 1. Use absolute dimensioning
B	#2	**Selecting the probe** Select and activate the probe. #0./1. Select probe 1 2. Select probe 2 3. Select probe 3
C	#3	**Performing a calibration** 1. Perform calibration in Z and XY on the calibration ring 2. Perform the calibration in XY on the calibration sphere
D	#7	**Activating the distance-angle function** ⓘ If a value ≥0 is transferred for D, distances are measured. ⓘ If a value <0 is transferred for D, angles are measured. ⓘ A -360 set value corresponds to an angle of 0°.
E	#8	**Selecting the tool for the tool correction** After each measurement, the data of the selected tool used to machine the measuring point is corrected. Depending on the configuration of the parameters in program "SET TOOL" either the geometric or the wear data of the tool in the tool memory are corrected. ⓘ This function cannot be used in the *Measuring a corner* function.
H	#11	**Defining the angle of the 1st probing in the WCS** Define the angle between the X axis and 1st probed point. Value range: 0°…360°
I	#4	**Transferring the set position in X**
J	#5	**Transferring the set position in Y**
K	#6	**Transferring the set position in Z**
M	#13	**Switching the probe on and off** As standard procedure, a touch probe is switched on before each measuring task and switched off afterwards. If several measuring tasks are to be carried out one after the other, the touch probe can be switched on before the 1st measurement and switched off again after the last one. In addition, the parameter M with the correct value must be transferred to each programme call. 1. Switch on probe 3. Switch the probe neither on nor off 2. Only switch the probe off ⓘ Depending on the setting in option bit #131.9, the USER data are either loaded with M1. or are always loaded.
Q	#17	**Transferring the overtravel in XY** For each measuring block, the probe is moved by a predefined measuring path/distance. To prevent the probe from stopping if there is no trigger signal on this measuring path, the probe is moved beyond the position of the expected surface. This distance usually corresponds to double the measuring distance defined in 8710 in #114 (X,Y). If these values are unsuitable for a special measuring task, the over travel in XY can be transferred with Q. ⓘ Correction in Z is not possible.

Parameter		Description
R	#18	**Changing the safety distance** The safety distance while measuring the inside width, outside width, inside or outside diameter can be changed if required. For inside width, inside diameter R must be negative, for outside width, outside diameter R must be positive.
S	#19	**Size of the measuring point** Width of an inside width or outside width, diameter of a bore or outside diameter.
T	#20	**Checking the tolerance** Determine the tolerance of a measuring point, a contour (S) or a position. To check a surface, corner, inside width, outside width or diameter for tolerance, the value transferred with parameter **T** must be positive. To check a position or a centre point of a contour for tolerance, the value transferred with parameter **T** must be negative. The specifications of set value or position I, J and K are considered. If the tolerance is exceeded, the program stops with the error message *Tolerance exceeded*.
U	#21	**Defining the angle of the 2nd probing in the WCS or measuring the sphere** Define the angle between the X axis and 2nd probed point. The angle between the 1st probed point and the 2nd probed point is at least 10°. In addition, parameter U can be used to define that a sphere diameter is measured. For this purpose, the parameter with the value -1 must be transferred. Value range: 0…360 or -1
V	#22	**Defining the angle of the 3rd probing in the WCS** Define the angle between the X axis and 3rd probed point. The angle between the 2nd probed point and the 3rd probed point is at least 10°. ⓘ If the parameter is transferred with a negative sign, a report file is also output. Value range: 0…360 or -1…-360 Example: 10 (angle is 10°) -10 (angle is 10°/log file is output) -1 (no angle transferred/log file is output)
W	#23	**Selecting the workpiece coordinate system** As a standard feature, the workpiece coordinate systems G54…G59 are available. If more WCSs are available as an option, the number of an optional WCS (G54 P1…P48) is transferred with a negative prefix. The optional WCSs for the fixture offset (G54.2 P1…P8) can be described with W1…W8. ⓘ When parameters A1. and W are applied simultaneously, the set positions must be transferred with parameters I, J and K. ⓘ The external zero offset is set via W53.. Example: -40 (the workpiece coordinate system G54.1 P40 is set)
X	#24	**Positioning the probe in X** Distance from the probed surface in the X-direction (without **A1**.) or X-position of the probed point in the enabled WCS (with **A1.**).
Y	#25	**Positioning the probe in Y** Distance of the probed surface in the Y-direction (without **A1.**) or Y-position of the probed point in the enabled WCS (with **A1.**).
Z	#26	**Positioning the probe in Z** Distance of the probed surface in the Z-direction (without **A1.**), or Z-position of the probed point in the enabled WCS (with **A1.**).

6.2.2 PROTECTED MOVE program

Parameter		Description
A	#1	**Using absolute dimensioning/relative dimensioning** The positions in the program call – depending on the program call – are interpreted in the enabled WCS either as absolute coordinates or as relative coordinates and not as a distance between the probe ball and workpiece or traverse path in Z. 0. Use relative dimensioning #0./A1. Use absolute dimensioning
B	#2	**Selecting the probe** Select and activate the probe. #0./1. Select probe 1 2. Select probe 2 3. Select probe 3
F	#9	**Transferring the feed** The feed speed can be adapted In the pre-positioning.
M	#13	**Switching the probe on and off** As standard, the touch probe is switched on before each measuring task and switched off afterwards. If several measuring tasks are to be carried out one after the other, the touch probe can be switched on before the 1st measurement and switched off again after the last one. In addition, the parameter M with the correct value must be transferred to each programme call. 1. Switch on probe 3. Switch the probe neither on nor off 2. Only switch the probe off ⓘ Depending on the setting in option bit #131.9, the USER data are either loaded with M1. or are always loaded.
T	#20	**Checking the component presence** 1. Component presence check and return to the start position -1. Component presence check and remain in the target position
X	#24	**Positioning the probe in X** The reference point for the positioning is the centre of the selected probe ball. The probe ball radius is not considered. ⓘ Depending on the settings in parameter *A*, either a target position of the movement in the active WCS is selected or a relative traverse movement is selected over the entered distance (A0).
Y	#25	**Positioning the probe in Y** The reference point for the positioning is the centre of the selected probe ball. The probe ball radius is not considered. ⓘ Depending on the settings in parameter *A*, either a target position of the movement in the active WCS is selected or a relative traverse movement is selected over the entered distance (A0).
Z	#26	**Positioning the probe in Z** The stylus tip is the reference point for positioning. ⓘ Depending on the settings in parameter *A*, either a target position of the movement in the active WCS is selected (A#0./A1.) or a relative traverse movement is selected over the entered distance (A0).

6.2.3 SET WCS program

Parameter		Description
A	#1	**Correcting the zero point in A** The zero point in the A-axis is set with the result from #111+9. 1. Anticlockwise direction of rotation -1. Clockwise direction of rotation
B	#2	**Correcting the zero point in B** The zero point in the B-axis is set with the result from #111+9. 1. Anticlockwise direction of rotation -1. Clockwise direction of rotation
C	#3	**Correcting the zero point in C** The zero point in the C-axis is set with the result from #111+9. 1. Anticlockwise direction of rotation -1. Clockwise direction of rotation
W	#23	**Select the workpiece coordinate system.** As a standard feature, the workpiece coordinate systems G54…G59 are available. If more WCSs are available as an option, the number of an optional WCS (G54 P1…P48) is transferred with a negative prefix. The optional WCSs for the fixture offset (G54.2 P1…P8) can be described with W1…W8. ⓘ When parameters A1. and W are applied simultaneously, the set positions must be transferred with parameters I, J and K. ⓘ The external zero offset is set via W53.. Example: -40 (the workpiece coordinate system G54.1 P40 is set)

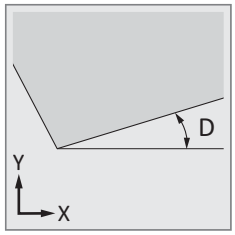
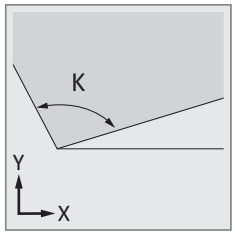
6.2.4 SET TOOL program

Parameter		Description		
E	#8	**Selecting the tool for the tool correction** After each measurement, the data of the selected tool used to machine the measuring point is corrected. Depending on the configuration of the parameters in program "SET TOOL" either the geometric or the wear data of the tool in the tool memory are corrected. ⓘ This function cannot be used in the *Measuring a corner* function.		
I	#4	**Non-intervention limit** Value of the non-intervention limit is absolute: Below this limit, the tool is not corrected.		
		Example:	0.05	(Measuring result +0.1 mm: tool is corrected by -0.1 mm)
			0.15	(Measuring result +0.1 mm: tool is not corrected)
J	#5	**Fixer offset** A fixer value (empirical value) can be added to the correction value. This empirical value is only added when a correction is carried out. If the measuring result is less than the non-intervention limit, the fixed offset is not taken into account.		
K	#6	**Correction factor** To prevent levelling off around a correction value, it can be corrected by a factor.		
		Example:	0.7	(Measuring result +0.1 mm: tool is corrected by -0.07 mm)
			1.3	(Measuring result +0.1 mm: tool is corrected by -0.13 mm)
T	#20	**Upper tolerance for the tool correction (reference: set value)**		
U	#21	**Lower tolerance for the tool correction (reference: set value)**		

6.2.5 TOLERANCE program

Parameter		Description
I	#4	**Upper tolerance for the position of the measuring point/contour**
J	#5	**Lower tolerance for the position of the measuring point/contour**
T	#20	**Upper tolerance for the contour dimension**
U	#21	**Upper tolerance for the contour dimension**

6.2.6 CORNER MAIN program

Parameter		Description
A	#1	**Selecting the movement to the target position in Z** #0./A0. Movement is relative 1. Movement is absolute
D	#7	**Defining the angle position of the corner** The first side (X/U) is always the reference. ⓘ If no value is transferred, 0° will be taken as angle position. Value range: ± 45/325…45 
I	#4	**Transferring the set position in X**
J	#5	**Transferring the set position in Y**
K	#6	**Defining the angle of the corner** ⓘ If no value is transferred, 90° will be taken as set angle. ⓘ When transferring 3 measuring points, the set angle is always 90°. Default value: 90 
R	#18	**Defining the position of the angle or initial position for the following traverse paths** Select the type and position of the corner. Inside angle are determined by negative values. Outside angle are determined by positive values.
T	#20	**Checking the tolerance** Determine the tolerance of a measuring point, a contour (S) or a position. To check a surface, corner, inside width, outside width or diameter for tolerance, the value transferred with parameter **T** must be positive. To check a position or a centre point of a contour for tolerance, the value transferred with parameter **T** must be negative. The specifications of set value or position I, J and K are considered. If the tolerance is exceeded, the program stops with the error message *Tolerance exceeded*.
U	#21	**Selecting the relative traverse path from the initial position to the 2nd measuring position (side 1)** This is not an axial traverse path. Starting from the initial position, the measuring points are moved to in an anticlockwise order.
V	#22	**Selecting the relative traverse path from the initial position to the 2nd measuring position (side 2)** This is not an axial traverse path. Starting from the initial position, the measuring points are moved to in a clockwise order. ⓘ If the parameter is transferred with a negative sign, a report file is also output.
W	#23	**Selecting the workpiece coordinate system** Select the workpiece coordinate system. As a standard feature, the workpiece coordinate systems G54…G59 are available. If more WCSs are available as an option, the number of an optional WCS (G54 P1…P48) is transferred with a negative prefix. The optional WCSs for the fixture offset (G54.2 P1…P8) can be described with W1…W8. ⓘ When parameters A1. and W are applied simultaneously, the set positions must be transferred with parameters I, J and K. ⓘ The external zero offset is set via W53.. Example: -40 (the workpiece coordinate system G54.1 P40 is set)

Parameter		Description
X	#24	**Selecting the relative traverse path from the initial position to the 1st measuring position (side 1)** This is not an axial traverse path. Starting from the initial position, the measuring points are moved to in an anticlockwise order.
Y	#25	**Selecting the relative traverse path from the initial position to the 1st measuring position (side 2)** This is not an axial traverse path. Starting from the initial position, the measuring points are moved to in a clockwise order.
Z	#26	**Defining the measuring position when measuring from the safety plane** The probe can be moved without danger in the safety plane. The reference point for positioning in Z is the probe ball centre.

6.2.7 ANGLE-DISTANCE program

Parameter		Description
A	#1	**Selecting the movement to the target position in Z** #0./A0. Movement is relative 1. Movement is absolute
D	#7	**Selecting the set angle (position of edge)**
U	#21	**Selecting the measuring direction** 1. Measuring direction in the positive axial direction -1. Measuring direction in the negative axial direction
W	#23	**Selecting the workpiece coordinate system** As a standard feature, the workpiece coordinate systems G54…G59 are available. If more WCSs are available as an option, the number of an optional WCS (G54 P1…P48) is transferred with a negative prefix. The optional WCSs for the fixture offset (G54.2 P1…P8) can be described with W1…W8. ⓘ When parameters A1. and W are applied simultaneously, the set positions must be transferred with parameters I, J and K. ⓘ The external zero offset is set via W53.. Example: -40 (the workpiece coordinate system G54.1 P40 is set)
X	#24	**Positioning the probe in X** Distance from the probed surface in the X-direction (without A1.), or X-position of the probed point in the enabled WCS (with A1.).
Y	#25	**Positioning the probe in Y** Distance of the probed surface in the Y-direction (without A1.) or Y-position of the probed point in the active WCS (with A1.).
Z	#26	**Selecting the target position in Z for the measurement with obstacle** ⓘ Depending on the settings in parameter A, the movement to the target position is absolute or relative.

6.3 Calibration parameter

Parameter	Description	
#110	**Basic address of calibration values**	
	Start address of 6 consecutive calibration values.	
#110+0	**Calibration value in X**	
	Example:	2.785 (probe ball radius 3 mm, High-Speed-Skip)
#110+1	**Calibration value in Y**	
	Example:	2.788 (probe ball radius 3 mm, High-Speed-Skip)
#110+2	**Probe centre offset in X**	
	Example:	0.005 (probe ball radius 3 mm, High-Speed-Skip)
#110+3	**Probe centre offset in Y**	
	Example:	0.010 (probe ball radius 3 mm, High-Speed-Skip)
#110+4	**Saving of basic rotation for G68**	
#110+5	**Calibration value Z**	
	Example:	0.206 (probe ball radius 3 mm, High-Speed-Skip)

6.4 Result parameter

Parameter	Description
#111	**Basic address results** Start address of 10 consecutive result parameters.
#111+0	**Result of the measurement in X in the current WCS**
#111+1	**Result of the measurement in Y in the current WCS**
#111+2	**Result of the measurement in Z in the current WCS**
#111+3	**Deviation between the measuring result in X and the set position in X** If no set position is transferred in X (parameter *I*), this value corresponds to the X measurement result.
#111+4	**Deviation between the measuring result in Y and the set position in Y** If no set position is transferred in Y (parameter *J*), this value corresponds to the Y measurement result.
#111+5	**Deviation between the measuring result in Z and the set position in Z** If no set position is transferred in Z (parameter *K*), this value corresponds to the Z measurement result.
#111+6	**Result of contour measurement** Diameter bore, inside width or outside width.
#111+7	**Deviation of the measurement result from the set value transferred with parameter S**
#111+8	**Result of check for component presence** 1 Component available -1 Component not available
#111+9	**Result of the angle measurement to activate an nth axis** If #111+9 ≠0, the entered value, when writing the WCS, is written into the axis which is entered in program 8710 (USERPARATAB) under #7.
#142	**Angle-distance function: Result of angle measurement**
#143	**Angle-distance function: Deviation between result and**
#144	**Angle-distance function: Result of distance measurement in X (set value)**
#145	**Angle-distance function: Result of distance measurement in Y (set value)**
#146	**Angle-distance function: Result of distance measurement in Z (set value)**

6.5 Diagnosis parameters

Parameter	Description
#112	**Tool correction number (H-code)** Before point: Internal storage of the probe number of the selected item (transferred with parameter B and stored here) After point: Tool correction number (H number) of the probe
#113	**Probe ball radii XY, Z** Before point: Probe ball radius XY After point: Probe ball radius Z
#114	**Measuring distance XY, Z** Before point: Measuring path in X and Y After point: Measuring path in Z
#115	**Feed 1st measuring block, 2nd measuring block** Before point: Feed 1st measuring block After point: Feed 2nd measuring block
#116	**Feed protected move, feed G00/G01** Before point: Feed protected move After point: Feed G00/G01
#120	**Axis assignment of main axes** Storage of the axis numbers for the main axes X, Y, Z.
#121	**Error marker** Storage of error number.
#122	**Tool length from memory** Tool length of the active tool.
#123	**Measuring result in X** Skip position.
#124	**Measuring result in Y** Skip position.
#125	**Measuring result in Z** Skip position.
#129	**Tool length offset** Offset of the tool length and skip position.
#130	**Axis assignment of rotation axes** Storage of the axis numbers for the rotation axes A, B, C.
#131	**Calibration value in X** Internal calibration value in X, adapted to rotation (e.g. G68).
#132	**Calibration value in Y** Internal calibration value in Y, adapted to rotation (e.g. G68).
#133	**Probe centre offset in X** Internal probe centre offset in X, adapted to rotation (e.g. G68).
#134	**Probe centre offset in Y** Internal probe centre offset in Y, adapted to rotation (e.g. G68).
#135	**Task** Type of measuring point.
#136	**Angle-distance function: Measuring result in X of the 1st measurement**
#137	**Angle-distance function: Measuring result in Y of the 1st measurement**
#138	**Angle-distance function: Measuring result in Z of the 1st measurement**
#139	**Angle-distance function: Measuring result in Y of the 2nd measurement**
#140	**Angle-distance function: Measuring result in Y of the 2nd measurement**

Parameter	Description
#141	**Angle-distance function: Measuring result in Y of the 2nd measurement**
#147	**Measuring point marker** Adapted marker for tool corrections.
#148	**TC pulse addresses** Storage of addresses for the control in pulse mode. Before point: TC start address After point: TC mode address
#149	**Skip data start address** Start addresses of the skip data in *Angled surface machining* mode.

6.6 Macro variables

6.6.1 SET WCS program

Variable	Description
#1	**Start address offset WCS** Number of the parameter in which the 1st offset value of the WCS data (X value of the external offset) – see .
#2	**Distance of the WCS-memory locations (X to Y to Z...)** Difference between the number of the storage location of a value and the number of the storage location of the value of the next axis in this WCS (delta amount between storage locations of adjacent axes).
#3	**Distance of memory location between the single axes (X1 to X2 ...)** Difference between the number of the storage location of a value of an axis in a WCS and the number of the storage location of the value of the axis in the next WCS (delta amount between storage locations of adjacent WCSs).
#4	**Start address of an optional WCS G54 P1...P48** Number of the parameter in which the 1st offset value of the optional WCS data (X value of the 1st optional offset) is stored. ⓘ If no optional WCSs are available, the value can be set to zero.
#5	**Start address of optional WCS fixture offset** Number of the parameter in which the 1st offset value of the optional WCS data for the fixture offset (X value of the 1st optional offset) is stored. ⓘ If no optional WCSs are available, the value can be set to zero.

6.6.2 SET TOOL program

Variable	Description
#1	**Basic address tool length wear** Basic address of the tool correction memory for tool length wear.
#2	**Basic address tool radius wear** Basic address of the tool correction memory for tool radius wear.
#3	**Maximum tolerance** Maximum permissible correction value.
#7	**Maximum permissible correction factor**

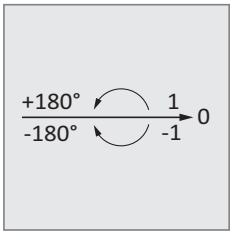
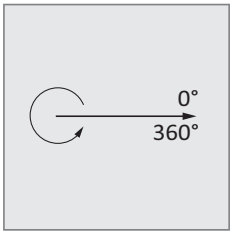
6.6.3 USER GLOBAL program

Variable	Description	
#2	**Country code language tags**	
	The error texts are displayed, depending on #2:	
	0	English
	1	German
	2	French
	99	User-defined
	Texts for the error messages can be adapted.	
	Default value:	1
#111	**Basic address results**	
	Start address of 10 consecutive result parameters.	
	ⓘ Using the setting parameters #110 to #149 is not allowed.	
	Default value:	100
	Example:	100 (the measuring results are stored in #100…#109)
#117	**ERROR input signal**	
	If the measuring input signal level falls off, the control issues a trigger signal. The control cannot distinguish between a valid trigger point or an error condition, e.g. a transmission error.	
	To increase the measurement reliability, the validity of a trigger point must be checked. The ERROR signal must be checked for this purpose.	
	ⓘ The receiver signals must be connected to the control and linked to the PLC with the corresponding parameters .	
	1010	ERROR signal on IN1010 (falling signal flank)
	0	No ERROR-signal available
	-1010	ERROR signal on IN1010 (rising signal flank)
	Default value:	0
#118	**$\overline{\text{STATUS}}$ input signal**	
	It is checked whether the probe has already been deflected before a measurement.	
	ⓘ The receiver signals must be connected to the control and linked to the PLC with the corresponding parameters .	
	1011	$\overline{\text{STATUS}}$ signal on IN1011 (falling signal flank)
	0	No $\overline{\text{STATUS}}$ signal available
	-1011	$\overline{\text{STATUS}}$ signal on IN1011 (rising signal flank)
	Default value:	0
#119	**BATTERY input signal**	
	If the BATTERY signal is applied, the input can be entered in #119.	
	ⓘ The receiver signals must be connected to the control and linked to the PLC with the corresponding parameters .	
	1012	ERROR signal on IN1012 (falling signal flank)
	0	No BATTERY signal available
	-1012	ERROR signal on IN1012 (rising signal flank)
	Default value:	0

Variable	Description		
#128	**Option bit 1 (basic adjustments measurement)** Some data relevant to the software are stored in bits. Enter and add desirable options.		
	Example:		2+4+32 or 38 (BIT1, BIT2, BIT5 set)
	BIT0	0	Feed override is enabled. When measuring, the speed of the feed can be controlled with the override.
		1	Feed override is disabled. When measuring, the speed of the feed cannot be controlled.
	BIT1	0	The traverse movements in program 8703 (PROTECTED MOVE) are protected. ⓘ The program 8703 (PROTECTED MOVE) is used from program 8700 (MAIN) for prepositioning and can also be called directly by the user. ⓘ In the program 8717 (TC-USER), the feed for the protective traverse movement in #9 can be defined.
		2	*NOTICE* Property damage due to collision caused by failure to delete remaining distance when the stylus is deflected. ▶ Always ensure that the traverse path is free. The traverse movements in program 8703 (PROTECTED MOVE) are carried out with G0.
	BIT2	0	The machine has spindle indexing.
		4	The machine has no spindle indexing.
	BIT3	0	The data output via DPRNT takes place without a comment. The data are not formatted.
		8	The data output via DPRNT takes place with a comment. The results are assigned.
	BIT4	0	N/A
		16	N/A
	BIT5	0	Format for calculating ATAN: ATAN [#i / #j]
		32	Format for calculating ATAN: ATAN [#i]/ [#j]
	BIT6	0	Data for determining the angle or distance is written in the background.
		64	The *Distance/angle* function is not used → time savings.

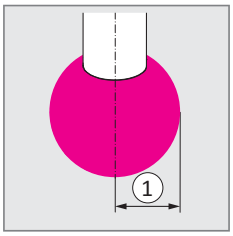
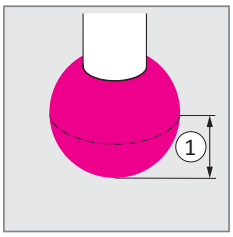
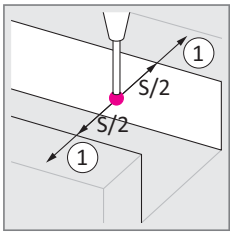
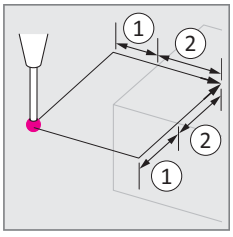
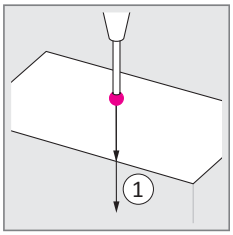
Variable	Description		
	BIT7	0	When calling 8700 (MAIN) or 8703 (PROTECTED MOVE), 8710 (USERPARATAB) is executed.

		128	*NOTICE* Property damage from collision due to incorrect application of the *Switching on the probe* function (parameter M1.).
			▶ Only use the function for consecutive quickstart calls.
			▶ Ensure that there are no G-code calls between the quickstart calls.
			When calling 8700 (MAIN) or 8703 (PROTECTED MOVE), 8710 (USERPARATAB) is only executed if *M1.* (switch on probe) is transferred.
			OK:
			`G65P8703 X… Y… Z… M1.`
			`G65P8703 X… Y… Z… M3.`
			`G65P8700 S… M3.`
			`G65P8703 X… Y… Z… M3.`
			`G65P8700 Z… M2.`
			NOK:
			`G65P8700 Z… M1.`
			`G65P8703 X… Y… Z… M3.`
			`G0G90 X… Y… Z…`
			`G65P8700 X… M2.`

	BIT8	0	Retraction of probe to start position. If an error occurs during measurement, the probe is retracted to the start position of the active measuring block.
		256	Retraction of probe to block position. If an error occurs during measurement, the probe is retracted to the start position of the active measuring block or of the protected move.
	BIT9	0	The results of the angle calculation are shown from -180° < 0° < 180°. 
		512	The results of the angle calculation will be shown from 0° ...359°. 
	BIT10	0	The probe is not oriented during measurement (default).
		1024	The probe is oriented in the measuring direction during measurement (mono-directional). ⓘ Alignment towards measuring direction is necessary. ⓘ Prerequisite: #128 BIT 2 = 0 (machine has spindle orientation)

Variable	Description
#3	**Axis configuration/axis number XYZ** The control-internal parameters from which the current position of the WCS can be read out are defined. The 3 decimal places correspond to the axes X, Y, Z: X-axis: Hundreds digit Y-axis: Tens digit Z-axis: Unit digit Default value: 123 Example: 123 The current position of the WCS in X is read from #504**1**. The current position of the WCS in Y is read from #504**2**. The current position of the WCS in Z is read from #504**3**. The current position of the WCS in A is read from #504**4**. The current position of the WCS in B is read from #504**5**. The current position of the WCS in C is read from #504**6**.
#4	**Axis number A-axis** In case of a clockwise direction of rotation (DIN), the axis number is entered with a positive sign; in case of an anticlockwise direction of rotation, a negative sign is entered. Default value: 0 Example: 4 (clockwise direction of rotation) -4 (anticlockwise direction of rotation)
#5	**Axis number B-axis** In case of a clockwise direction of rotation (DIN), the axis number is entered with a positive sign; in case of an anticlockwise direction of rotation, a negative sign is entered. Default value: 0 Example: 5 (clockwise direction of rotation) -5 (anticlockwise direction of rotation)
#6	**Axis number C-axis** In case of a clockwise direction of rotation (DIN), the axis number is entered with a positive sign; in case of an anticlockwise direction of rotation, a negative sign is entered. Default value: 0 Example: 6 (clockwise direction of rotation) -6 (anticlockwise direction of rotation)
#7	**Main rotation axis for angle correction function** Selection of the main rotation axis that is to be corrected when using angle measurement. This axis is corrected in case of an angle measurement with transfer parameter *D*. 1 A-axis 2 B-axis 3 C-axis Default value: 0

6.6.4 TC-USER 1 program

Variable	Description
#1	**Tool correction number (H number or T number) of the probe** Normally, the tool correction number (H number) corresponds to the magazine slot of the probe. If the active tool correction number is to be used, #4111 can be used for the active H number or #4120 for the active T number. *NOTICE* Property damage caused by collision due to the faulty activation of a tool. ▶ Activate the correct tool. Example: #4111 Active H number 20 TC with active H number 20
#2	**Basic address permanent parameters (calibration values)** Start address for 6 free, consecutive calibration parameters. ⓘ The value from #2 is copied to #110. #2 is an intermediate memory. ⓘ The calibration parameters must not be deleted when the machine is switched off. ⓘ Parameters #100...# 199 are not permitted to be used. Default value: 500 Example: 500 (calibration values are stored in #500...#505)
#3	**Probe ball radius XY** The probe ball radius XY (1) is entered in #3. ⓘ If the probe ball radius is entered with #3 = 0, the radius is read from the tool table and copied in #3 and #4 (Z). For this function, only a ball is permitted as a stylus. 
#4	**Probe ball radius Z** The probe ball radius Z (1) is entered in #4. ⓘ If the probe ball radius is entered with #3 = 0, the radius is read from the tool table and copied in #3 and #4 (Z). For this function, only a ball is permitted as a stylus. 
#5	**Overtravel/measuring distance X, Y** #5 is the overtravel (1) at single points and contours (diameter, inside width, outside width, etc.) if *Q* is not transferred.  **Special case: corner** At corners in 2 or 3 axes, the measuring distance is the difference between the position (prepositioning) before the measuring block and the expected trigger point. The default value of the measuring distance (1) for probing in X and Y is defined with #5. #5 is also defined as overtravel (2) if *Q* is not transferred. Default value: 5 
#6	**Overtravel/measuring distance Z** For probing in Z, the overtravel (1) is stored in #6. Default value: 3 

Variable	Description		
#7	**Measuring feed of the 1st measuring block**		
	For the first measuring block, a measuring feed depending on the measuring input must always be defined.		
	Value range:	1000 mm/min…5000 mm/min	
	Default value:	2000 mm/min	
#8	**Measuring feed of the 2nd measuring block**		
	If a value ≠ 0 is assigned to the parameter #8, a 2nd measuring block is executed with the value that has been transferred. If #8=0, no 2nd measuring block is executed.		
	Value range:	100 mm/min…1000 mm/min	
	Default value:	500 mm/min	
#9	**Feed of protected travel block**		
	Default value:	5000 mm/min	
#10	**Retraction speed**		
	#10 can be used to define whether the probe is moved to the start position during measurement with a specified speed (G00 = 0) or a defined speed (G01 ≠ 0).		
	Default value:	0	
	Example:	0	G00
		20000	G01 F20000
#16	**Basic address tool length**		
	Basic address of the tool memory for the tool length.		
	Default value:	10000	
#17	**Basic address tool radius**		
	Basic address of the tool memory for the tool radius.		
	Default value:	12000	
#20	**Address of the output signal MODE TC for pulse control of the probe**		
	Address of the NC output to set the MODE TC at the interface for switching on the probe.		
	Default value:	0	
	Example:	1100	
#21	**Address of the output signal START TC for pulse control of the probe**		
	Address of the NC output to set the START TC at the interface for switching on the probe.		
	Default value:	0	
	Example:	1101	

7. Service

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