for Touch Probes

Workpiece Measurement

Quickstart
Programming instructions   English

Software	144334
Licence	144336
Version	V3A
Control	Brother

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focus on productivity

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We always supply the latest software version. If another version is requested, please contact our Service Department / Hotline.

Prior to the start up procedure it is mandatory to check if the parameters and the software range are already used by other programmes. If so, the cycles must be adapted because overwriting of used parameters and data can have unpredictable influence on the machine and could cause damage.

After finishing the installation, the used parameters and the performed changes to programme and machine must be documented.

Blum-Novotest GmbH is not liable for damages to the machine due to programming errors or faulty application of the measuring cycles. Installing the measuring cycles, the mentioned warranty exclusions are accepted.

We reserve the right for technical modifications which improve the product. All suggestions for improvement are gladly accepted.

Decisive for the technical contents is the language version of the manufacturer (DE/EN).

Original operating instructions

Please read the manual carefully first, then start up the measuring system and the measuring cycles!

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Content

1. General Information

Frequent workpiece measurements can be carried out by the software on hand in combination with a multi-directional Blum touch probe (e.g. TC50).

Possible measuring tasks:
- Single point touching
- Corner in 2 axes
- Corner in 3 axes
- Inside diameter
- Outside diameter
- Inside width
- Outside width
- Distance measurement
- Angle measurement

The following table includes the programmes overview of the software package.

1.1 Programme overview

O8700	MAIN	Main programme
O8701	TOUCH XYZ	Touching of single points and corners
O8702	XY CONTOUR	Touching of contours
O8703	PROTECTED MOVE	Protected traverse path
O8704	MEASURE	Measuring block
O8705	SET WCS	Zero point setting
O8706	SET TOOL	Tool correction
O8707	TOLERANCE	Tolerance control
O8708	PROBE ON/OFF LEVEL	Probe ON/OFF (level-controlled)
O8708	PROBE ON/OFF PULSE	Probe ON/OFF (pulse-controlled)
O8709	CALIBRATION SPHERE	Calibration on sphere
O8710	USERPARATAB	Input of user data
O8711	MESSAGES	Error messages
O8712	CALIB-PARAMETER	Conversion of calibration values
O8713	DM-3-POINTS MAIN	Calculation position diameter with 3 points
O8714	DM-3-POINTS CALCULATION	Calculation results diameter with 3 points
O8715	ANGLE-DISTANCE	Calculation of angles or distances
O8716	DPRNT	Data output via command DPRNT

1.2 Applications

The following measuring tasks can be carried out:

- Determination of the workpiece position in an active WCS
- Setting the WCS with options for predetermined set positions
- Temperature compensation of an axis
- Tolerance check
- Tool wear compensation
- Definition of distances and angles

With the programme MAIN all measuring tasks are carried out. The type of measuring task is defined by the call parameters only.

With the programme "PROTECTED MOVE" the probe can be displaced safely in the working area, i.e. if the stylus is deflected during displacement the machine will stop and the probe moves back into its start position. This ensures that collisions and damage to the touch probe can be avoided.

By the programmes PROBE ON/OFF, the probe is switched ON and OFF on requirement.
The parameters are defined with USERPARATAB.

The other programmes are auxiliary programmes that are implemented by the software automatically.

Before the first measurement is carried out, the following preparations must be made:

- Mechanical preparation of the probe, installation of the receiver and electrical connection.
- Installation and adaptation of the software (see installation instructions).
- Calibration of the probe (see chapter 11).

1.3 Notes concerning measurement

The measuring cycles can be regarded as examples for carrying out the measuring tasks and must be adapted to the respective machine type by the machine manufacturer or machine user. When commissioning the measuring cycles, the programme must be tested block-by-block while adopting all safety measures (block check before execution, single block, reduced feed).

For correct and safe measurement, the following must be observed:

- Approach the measuring position in a protected traverse path.
- Measurement and calibration must be carried out at the same speed.
- Take the machine's acceleration and brake ramps into account!
  Select the (safety) distance correspondingly.
- While probing, the machine may not be in an acceleration / braking ramp.
- The object to be measured must be mounted firmly.
- The measuring position must be selected so that the probed surface can only be reached with the stylus.
- In order to avoid errors due to the mm/µm adjustment on input, the parameters must be transferred with ".".

☞ **The measuring cycles can be started only in automatic mode.**
It is not possible to start the program from the MDI.

1.4 Legend of drawings

⇨	Measuring block of the probe
– – – – – –	Travel movement of the probe
▱	Workpiece
◕	Current workpiece zero point
———	Dimensioning line
←——→	Distance dimension (relative movement)
←———	Target position (absolute movement in active WCS)
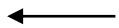
NOTICE

indicates measures to prevent material damage.

📖	Information on related literature
☞	Additional advice
WCS	Workpiece coordinate system
MCS	Machine coordinate system

2. Workpiece referencing

This section describes workpiece referencing on a workpiece.
Prepositioning of the probe is carried out by handwheel or by "Protected traverse path".
(see chapter 4).

Each measurement will be called with the programme O8700 MAIN. The parameter configuration determines the type of measuring point.

The software "Quickstart" enables workpiece referencing at the following measuring points:

- Single point touching
- Corner in 2 axes
- Corner in 3 axes
- Inside diameter
- Outside diameter
- Inside width
- Outside width

☞   A detailed description of the option parameters can be read in chapter 12.1.

2.1 Workpiece referencing: Single point

- Changing and positioning the probe in the proximity of the surface to be probed. The distance between the probe ball and the surface to be touched should be sufficient for the machine to accelerate to measuring speed.
- Programme call   X-axis: **G65 P8700 X... W...**
                                 Y-axis: **G65 P8700 Y... W...**
                                 Z-axis: **G65 P8700 Z... W...**

Parameter

- X/Y/Z   Touching axis and distance of probe ball to the workpiece
- W   Number of WCS which must be set

Results

In the WCS, defined with parameter **W**, a zero point is set in the corresponding axis.

Optional parameters

- I/J/K   If the edge of the workpiece in one axis in the WCS should not be set to zero, a set position can be transferred using the corresponding parameter **I, J, K** (X axis: **I**, Y axis: **J**, Z axis: **K**).

Examples:

Workpiece referencing single point X
G65 P8700 X10. W55.
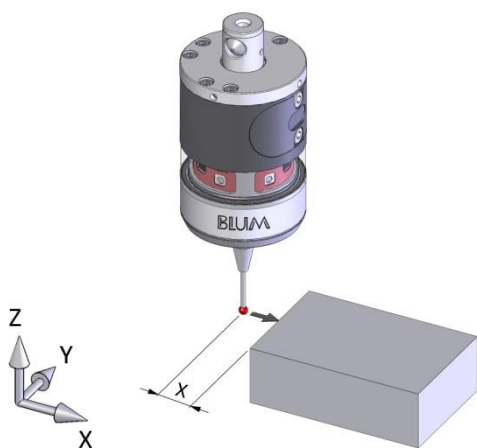
Workpiece referencing single point Y
G65 P8700 Y-20. W57.
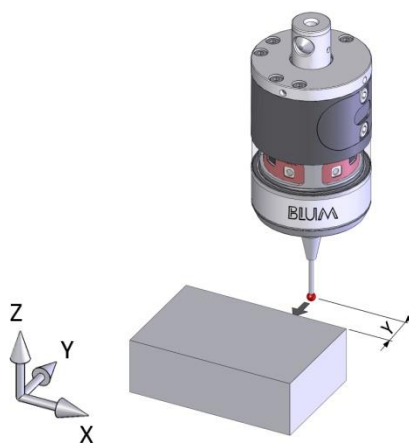
Workpiece referencing single point Z
G65 P8700 Z-15. W58.
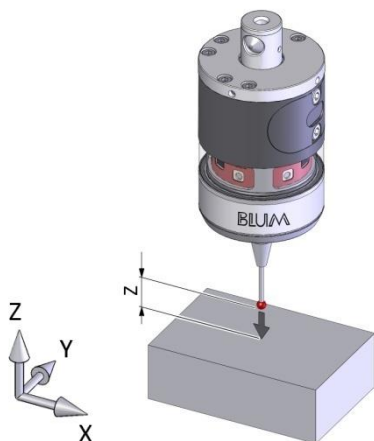
2.2 Workpiece referencing: Corner in 2 axes

- Changing and positioning of the probe outside the corner which must be touched.
  The traverse paths set with parameters *X, Y* or *Z* define the probing position.
- Programme call   XY-corner: **G65 P8700 X... Y... W...**
                    XZ-corner: **G65 P8700 X... Z... W...**
                    YZ-corner: **G65 P8700 Y... Z... W...**

Parameter

- X/Y/Z   Touching axes (2 of the 3 moving axes) and the distances of the probe ball to the workpiece in each axis.
- W   Number of WCS which must be set

Results

In the WCS, defined with parameter *W*, a zero point will be set in the corresponding axes.

Optional parameters

- I/J/K   If the edge of the workpiece in one or both axes in the WCS should not be set to zero, it is possible to give a set position with the corresponding parameter.
  At parameters *I, J, K* (X-axis: *I*, Y axis: *J*, Z axis: *K*) the sequence of the parameters in the programme call must be observed.

Examples:

Workpiece referencing XY-corner

G65 P8700 X10. Y10. W59.
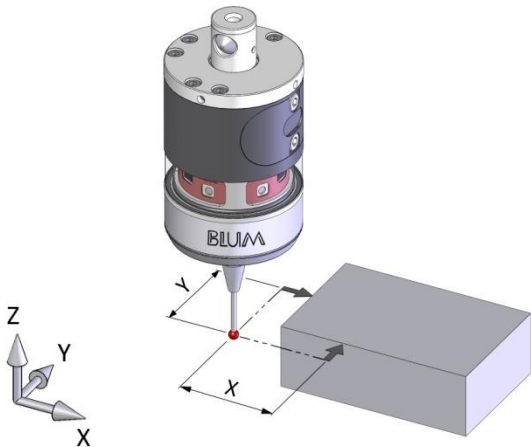
Workpiece referencing XZ-corner

G65 P8700 X-15. Z-10. W58
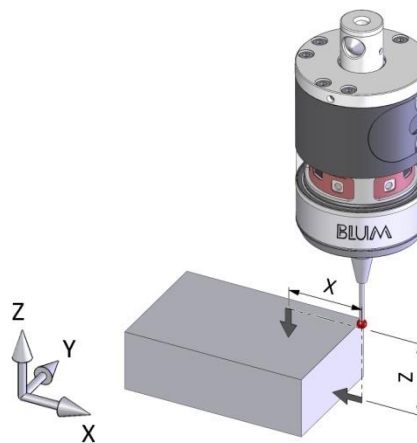
2.3 Workpiece referencing: Corner in 3 axes

- Changing and positioning of the probe outside the corner which must be touched.
  The traverse paths set with parameters *X, Y* or *Z* define the probing position.
- Programme call   XYZ-corner: **G65 P8700 X… Y… Z… W…**

Parameter

- X/Y/Z   Touching axes (all 3 moving axes) and the distances of the probe ball to the workpiece in each axis.
- W   Number of WCS which must be set

Results

In the WCS, defined with parameter **W**, a zero point will be set in the corresponding axes.

Optional parameters

- I/J/K   If the edge of the workpiece in one or several axes in the WCS should not be set to zero, it is possible
             to give a set position with the corresponding parameter.
             At parameters *I, J, K* (X-axis: *I*, Y axis: *J*, Z axis: *K*) the sequence of the parameters in the programme
             call must be observed.

**Example:**

Workpiece referencing XYZ-corner
G65 P8700 X10. Y10. Z-10. W59.

2.4 Workpiece referencing: Inside diameter

- Changing and positioning of the probe in the centre (by eye) in the inside diameter.
- Programme call: **G65 P8700 S... W...**

Parameter
- S   Diameter of the bore
- W   Number of WCS which must be set

Results

In the WCS, defined with parameter **W**, a zero point will be set in the axes X and Y. The position of the zero point refers to the centre of the inside diameter.
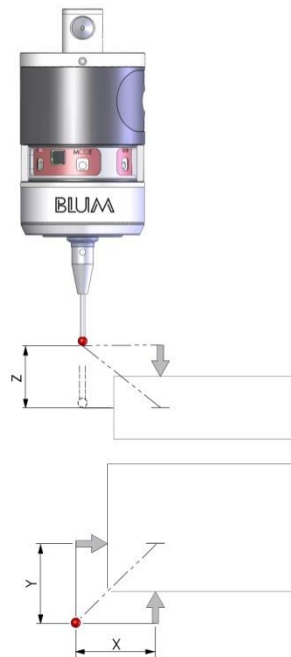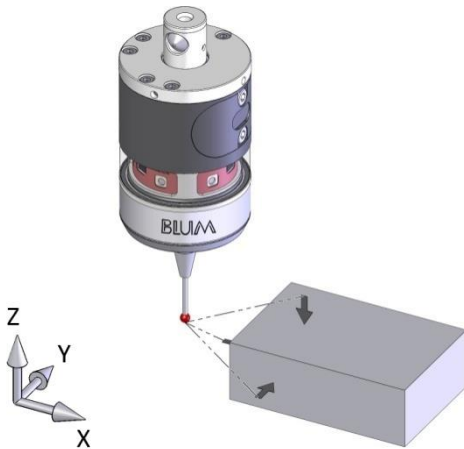
Optional parameters
- I/J   If the centre of the workpiece in one or both axes in the WCS should not be set to zero, it is possible to give a set position with the corresponding parameter.
  At parameters **I, J** (X-axis: **I**, Y axis: **J**) the sequence of the parameters in the programme call must be observed.

Example:
Workpiece referencing inside diameter
G65 P8700 S40. W57.
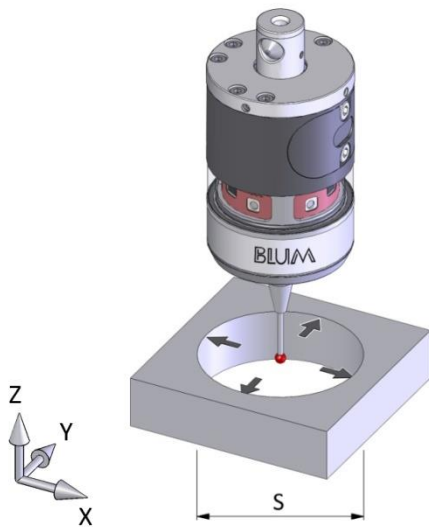
2.5 Workpiece referencing: Inside diameter with 3 measuring points

- Changing and positioning of the probe in the centre (as precise as possible) in the inside diameter.
- Programme call: **G65 P8700 S... W... H... U... V...**

Parameter

- S   Diameter of the bore
- W   Number of WCS which must be set
- H   First angle of probing in the WCS   (reference X(+)-axis)
- U   Second angle of probing in the WCS   (reference X(+)-axis)
- V   Third angle of probing in the WCS   (reference X(+)-axis)

☞
The three probing angles must be chosen so that they divide the full circle or the section in angle segments which are as big as possible (e.g.: three times 120 degrees). X-axis is the reference, example: 0° -> +X-axis, 90° —> +Y-axis.

Before cycle call, the probe should be positioned in the centre of the diameter as precise as possible. If necessary, the cycle can be carried out twice in a row to increase the accuracy.

Results

In the WCS, defined with parameter **W**, a zero point will be set in the axes X and Y. The position of the zero point refers to the centre of the inside diameter.

Optional parameters

- I/J   If the centre of the workpiece in one or both axes in the WCS should not be set to zero, it is possible to give a set position with the corresponding parameter.
          At parameters **I, J** (X-axis: **I**, Y axis: **J**) the sequence of the parameters in the programme call must be observed.

Example:
Workpiece referencing inside diameter 3 points
G65 P8700 S40. W57. H30. U150. V270.

2.6 Workpiece referencing: Outside diameter

- Changing and positioning of the probe in the centre (by eye) above the outside diameter.
- Programme call: **G65 P8700 S... Z... W...**

Parameter

- S   Diameter of the shaft
- W   Number of WCS which must be set
- Z   Traverse path of the probe in the Z-axis from the initial position to the measuring position

Results

In the WCS, defined with parameter **W**, a zero point will be set in the axes X and Y. The position of the zero point refers to the centre of the outside diameter.
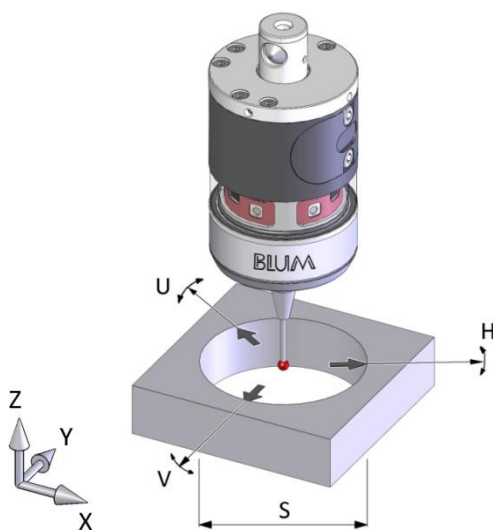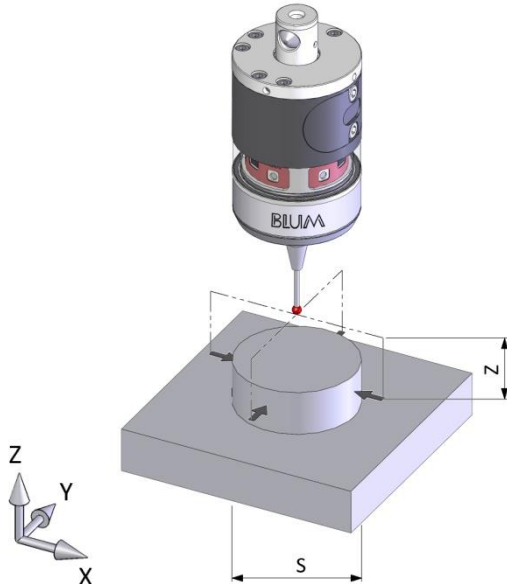
Optional parameters

- I/J   If the centre of the workpiece in one or both axes in the WCS should not be set to zero, it is possible to give a set position with the corresponding parameter.
            At parameters **I, J** (X-axis: **I**, Y axis: **J**) the sequence of the parameters in the programme call must be observed.
- R   Safety distance of the stylus to the workpiece for prepositioning in Z-direction.
            Standard: 10 mm. For outside diameter, **R** must be positive.

Examples:

Workpiece referencing outside diameter
G65 P8700 S30. Z-10. W54.

Workpiece referencing outside diameter
G65 P8700 S30. Z-10. R7. W54
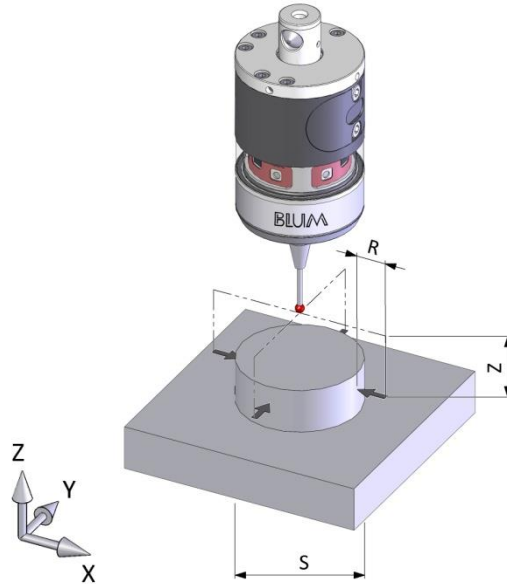
2.7 Workpiece referencing: Outside diameter with 3 measuring points

- Changing and positioning of the probe in the centre (as precise as possible) above the outside diameter.
- Programme call: **G65 P8700 S… W… Z… H… U… V…**

Parameter

- S   Diameter of the shaft
- W   Number of WCS which must be set
- Z   Traverse path of the probe in the Z-axis from the initial position to the measuring position
- H   First angle of probing in the WCS   (reference X(+)-axis)
- U   Second angle of probing in the WCS   (reference X(+)-axis)
- V   Third angle of probing in the WCS   (reference X(+)-axis)

☞ The three probing angles must be chosen so that they divide the full circle or the section in angle segments which are as big as possible (e.g.: three times 120 degrees). X-axis is the reference, example: 0° -> +X-axis, 90° —> +Y-axis.

Before cycle call the probe should be positioned above the centre of the diameter as precisely as possible. If necessary, the cycle can be carried out twice in a row to increase the accuracy.

Results

In the WCS, defined with parameter **W**, a zero point will be set in the axes X and Y. The position of the zero point refers to the centre of the outside diameter.
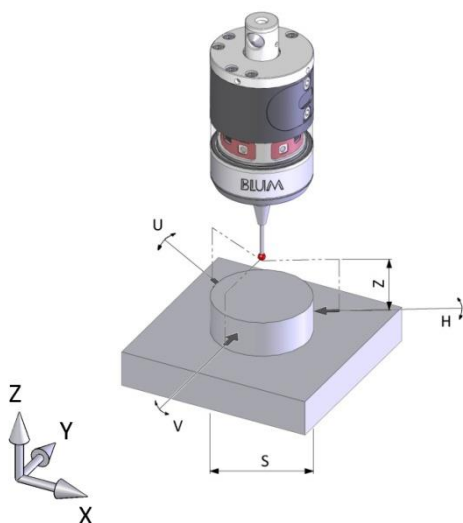
Optional parameters

- I/J   If the centre of the workpiece in one or both axes in the WCS should not be set to zero, it is possible to give a set position with the corresponding parameter.
  At parameters **I, J** (X-axis: **I**, Y axis: **J**) the sequence of the parameters in the programme call must be observed.
- R   Safety distance of the stylus to the workpiece for prepositioning in Z-direction. Standard: 10 mm. For outside diameter, **R** must be positive.

Examples:

Workpiece referencing outside diameter 3 points
G65 P8700 S40. W57. Z-10. H30. U150. V270.

Workpiece referencing outside diameter 3 points
G65 P8700 S40. W57. Z-10. H30. U150. V270. R7.
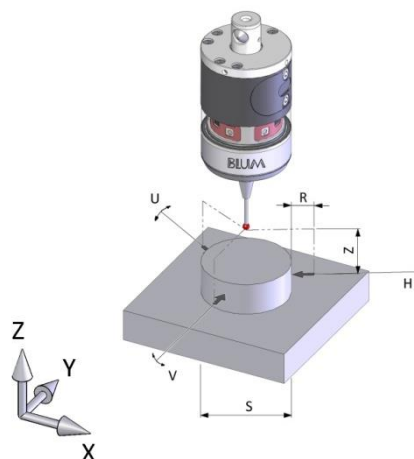
2.8 Workpiece referencing: Inside width

- Changing in and positioning of the probe in the centre (by eye) of the inside width.
- Programme call   measuring direction X: **G65 P8700 S... X1. W...**
                                            measuring direction Y: **G65 P8700 S... Y1. W...**

Parameter

- S   Set inside width
- X1./Y1.   Identification of the measuring direction (measurement in X- or Y-direction)
- W   Number of WCS which must be set

Results

In the WCS, defined with parameter **W**, a zero point is set in the corresponding axis. The position of the zero point refers to the centre of the inside width.

Optional parameters

- I/J   If the centre of the workpiece in one or both axes in the WCS should not be set to zero, it is possible to give a set position with the corresponding parameter.
  At parameters **I, J** (X-axis: **I**, Y axis: **J**) the sequence of the parameters in the programme call must be observed.

Examples:

Workpiece referencing inside width X
G65 P8700 S20. X1. W54.
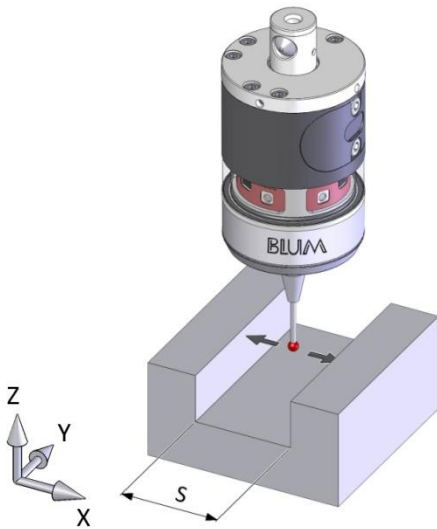
Workpiece referencing inside width Y
G65 P8700 S20. Y1. W54.
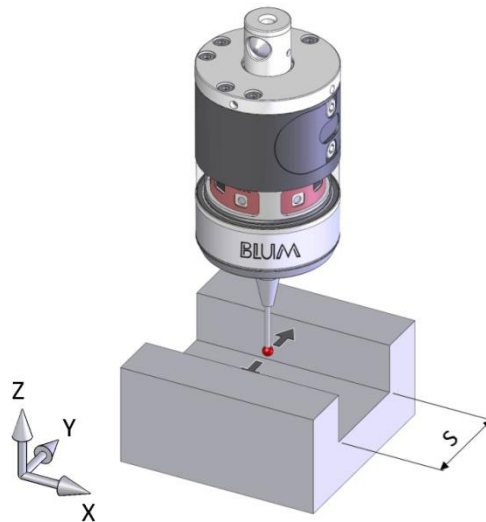
2.9 Workpiece referencing: Outside width

- Changing and positioning of the probe in the centre (by eye) above the outside width.
- Programme call   measuring direction X: **G65 P8700 S... X1. Z... W...**
                                      measuring direction Y: **G65 P8700 S... Y1. Z... W...**

Parameter

- S   Outside width
- X1./Y1. Identification of the measuring direction (measurement in X- or Y-direction)
- W   Number of WCS which must be set
- Z   Traverse path of the probe in the Z-axis from the initial position to the measuring position

Results

In the WCS, defined with parameter *W*, a zero point is set in the corresponding axis. The position of the zero point refers to the centre of the outside width.

Optional parameters

- I/J   If the centre of the workpiece in one or both axes in the WCS should not be set to zero, it is possible to give a set position with the corresponding parameter.
  At parameters *I, J* (X-axis: *I*, Y axis: *J*) the sequence of the parameters in the programme call must be observed.
- R   Safety distance of the stylus to the workpiece for prepositioning in Z-direction. Standard: 10 mm. For outside width, *R* must be positive.

Examples:

Workpiece referencing outside width X
G65 P8700 S10. X1. Z-20. W54.
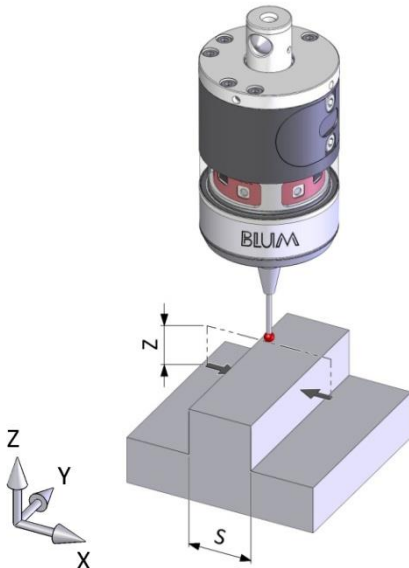
Workpiece referencing outside width Y
G65 P8700 S15. Y1. Z-10. R7. W55.
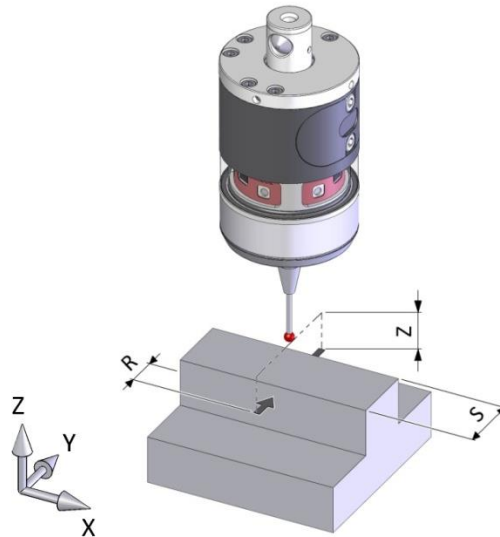
2.10 Workpiece referencing: Inside width or inside diameter with obstacle

- Changing and positioning of the probe in the centre (by eye) above the inside diameter or inside width.
- Programme call   inside diameter: **G65 P8700 R... S... Z... W...**
  inside width measuring direction X: **G65 P8700 R... S... X1. Z... W...**
  inside width measuring direction Y: **G65 P8700 R... S... Y1. Z... W...**

Additional parameters compared to inside width/inside diameter without obstacle:

- R   Safety distance of the stylus to the workpiece for prepositioning in Z-direction.
  Standard 10 mm. For inside diameter and inside width, **R** must be negative.
- Z   Traverse path of the probe in the Z-axis from the initial position to the measuring position
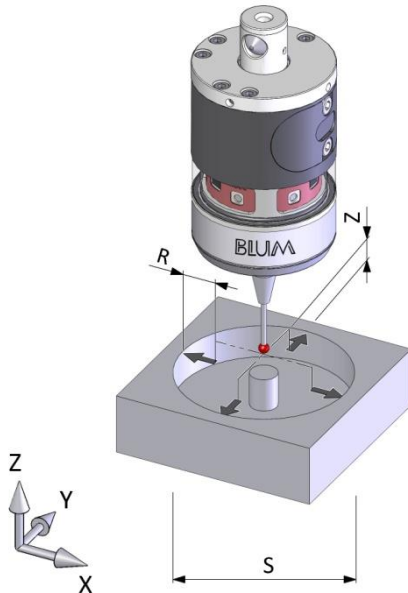
☞   The results and optional parameters are the same as for inside diameter (see chapter 2.4) or inside width (see chapter 2.8).
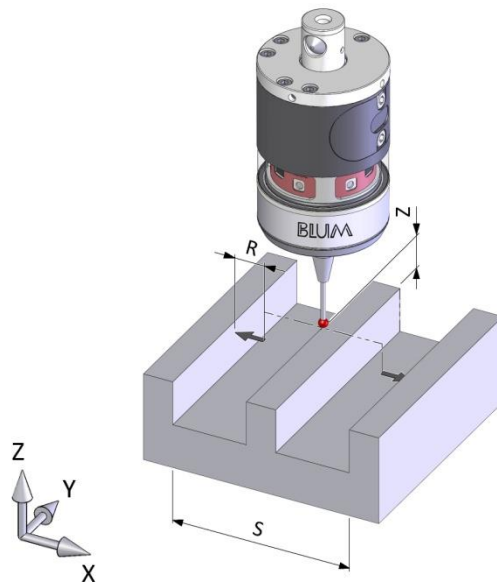
Examples:

Workpiece referencing inside diameter with obstacle
G65 P8700 R-10. S30. Z-15. W56.

Workpiece referencing inside width X with obstacle
G65 P8700 R-5. S40. X1. Z-10. W55.

3. Measurement in production process

The following chapter describes measuring tasks which can be carried out within a part programme. The prepositioning of the probe is usually made by manual data inputs in the part programme (see chapter 4).

Each measurement will be called with the programme "MAIN". The parameter configuration determines the type of measuring point.

The software "Quickstart" enables workpiece referencing on the following measuring points:

- Single point touching
- Corner in 2 axes
- Corner in 3 axes
- Inside diameter
- Outside diameter
- Inside width
- Outside width

The transfer of advanced parameters offer different possibilities to control the production process. The tolerances can be checked, the workpiece zero points can be corrected and the tool wear can be defined.

With parameter *T* it is possible to check different dimensions concerning tolerance after production of the workpiece. If the tolerance is exceeded, the measuring cycle is interrupted with an error message.

If the approx. workpiece zero point is already defined before the machining of a workpiece, e.g. by a defined setting of the workpiece, the zero point of the workpiece can exactly be determined with parameter *W*. Furthermore, it is possible to correct the workpiece zero point between two machining steps.

The parameter *E* can be used to determine the wear of a tool and to update the values in the tool memory. Due to the deviation to the rated dimension the wear of the tool can be calculated. Therefore, it is possible to measure the diameter e.g. after machining an inside diameter. If the machine diameter differs from the rated diameter the tool wear can be put into the tool table. During the next machining step with this tool, the wear of this tool is automatically considered.

With the function distance angle it is possible to define angles or distances with parameter *D*.

☞   A detailed description of the option parameters can be read in chapter 12.1.

☞   The only logical difference between referencing and measurement during the production process is the type of dimensioning. At referencing the dimensions in the programme call are in relation to the workpiece, i.e. the distance from stylus to workpiece is transferred. At the examples for measurement in the programme, the dimensions in the workpiece are absolute to the workpiece, i.e. absolute coordinates concerning the active WCS are transferred to the programme. This absolute dimensioning will be marked with the additional parameter *A1*. when calling the programme „MAIN". Apart from this difference, referencing and measurement in the programme are identical., i.e. all possibilities which are described in the following chapter are available for referencing.

3.1 Measuring: Single point

- Changing and positioning the probe in the proximity of the surface to be probed. The distance between the probe ball and the surface to be touched should be sufficient for the machine to accelerate to measuring speed.
- Activation of WCS: **G...**
- Programme call   X-axis: **G65 P8700 A1. X...**
      Y-axis: **G65 P8700 A1. Y...**
      Z-axis: **G65 P8700 A1. Z...**

Parameter

- A1.   Use absolute dimensioning
- X/Y/Z   Touching axis and set position of the edge which must be measured in the active WCS.

Results

Measurement in X:

#111+0	X-position of the edge in the active WCS
#111+3	Deviation from the transferred position or from the set value (parameter *I*) in X

Measurement in Y:

#111+1	Y-position of the edge in the active WCS
#111+4	Deviation from the transferred position or from the set value (parameter *J*) in Y

Measurement in Z:

|	
#111+2	Z-position of the edge in the active WCS
#111+5	Deviation from the transferred position or from the set value (parameter *K*) in Z

Optional parameters

- T   Position tolerance of the edge
- E   Tool number of the tool to be corrected
- W   Number of a WCS, which must be set optionally (see note in chapter 12.1)
- I/J/K   Set position of the edge in a new set WCS if it differs from zero.
  At parameters *I, J, K* (X-axis: *I*, Y axis: *J*, Z axis: *K*) the sequence of the parameters in the programme call must be observed.
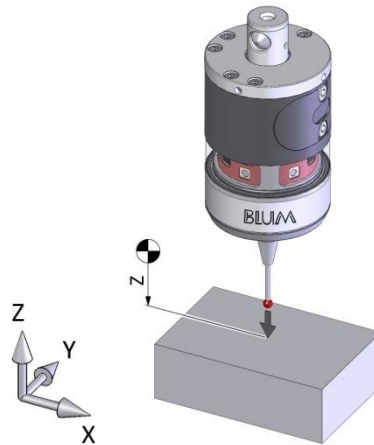
Examples:

Measurement single point X
G54
G65 P8700 A1. X0.
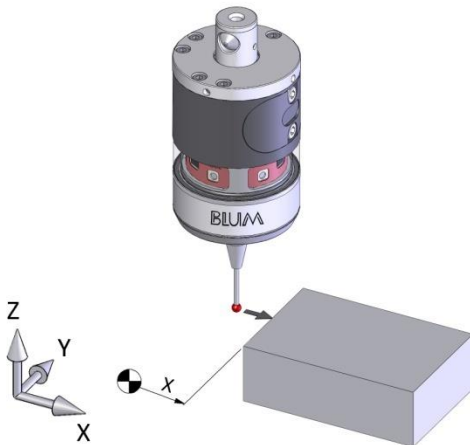
Measurement single point Z
G54
G65 P8700 A1. Z0.

3.2 Measuring: Corner in 2 axes

- Changing and positioning of the probe outside the corner which must be touched. The distance between the probe ball and the surface to be touched should be sufficient for the machine to accelerate to measuring speed.
- Activation of WCS: **G...**
- Programme call   XY-corner: **G65 P8700 A1. X... Y...**
                       XZ-corner: **G65 P8700 A1. X... Z...**
                       YZ-corner: **G65 P8700 A1. Y... Z...**

Parameter

- A1.   Use absolute dimensioning
- X/Y/Z   Touching axes (2 of the 3 displacement axes) and the set position of the point which must be touched in the actual WCS

  ☞   Reference point for positioning in Z is the probe ball centre.

Results

Depending on the measuring axes the results of two measuring directions are stored.

Measurement in X:
#111+0	X-position of the edge in the active WCS
#111+3	Deviation from the transferred position or from the set value (parameter *I*) in X

Measurement in Y:
#111+1	Y-position of the edge in the active WCS
#111+4	Deviation from the transferred position or from the set value (parameter *J*) in Y

Measurement in Z:
|	
#111+2	Z-position of the edge in the active WCS
#111+5	Deviation from the transferred position or from the set value (parameter *K*) in Z

Optional parameters

- T   Position tolerance of the corner
- W   Number of a WCS, which must be set optionally (see note in chapter 12.1)
- I/J/K   Set position of the corner in a new set WCS if it differs from zero.
  At parameters *I, J, K* (X-axis: *I*, Y axis: *J*, Z axis: *K*) the sequence of the parameters in the programme call must be observed.

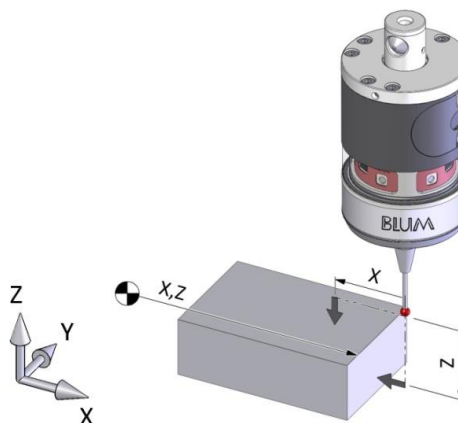**Examples:**

Measurement XY-corner
G54
G65 P8700 A1. X10. Y10.
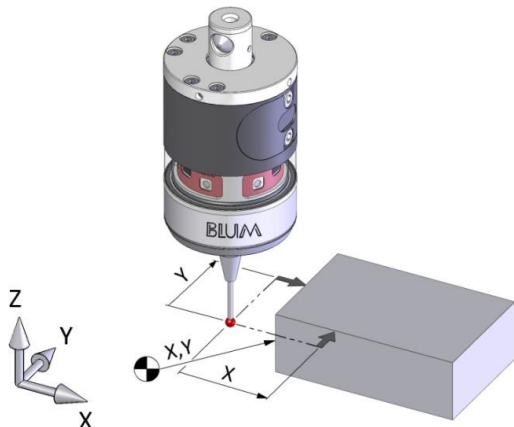
Measurement XZ-corner
G56
G65 P8700 A1. X-10. Z-5.

3.3 Measuring: Corner in 3 axes

- Changing and positioning of the probe outside the corner which must be touched. The distance between the probe ball and the surface to be touched should be sufficient for the machine to accelerate to measuring speed.
- Activation of WCS: **G...**
- Programme call: **G65 P8700 A1. X... Y... Z...**

Parameter

- A1.   Use absolute dimensioning
- X/Y/Z   Touching axes (3 displacement axes) and the set position of the point which must be touched in the actual WCS.

    ☞   Reference point for positioning in Z is the probe ball centre.

Results

Measurement in X:

#111+0	X-position of the edge in the active WCS
#111+3	Deviation from the transferred position or from the set value (parameter *I*) in X

Measurement in Y:

#111+1	Y-position of the edge in the active WCS
#111+4	Deviation from the transferred position or from the set value (parameter *J*) in Y

Measurement in Z:

#111+2	Z-position of the edge in the active WCS
#111+5	Deviation from the transferred position or from the set value (parameter *K*) in Z

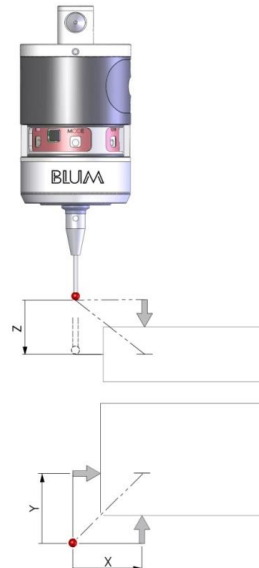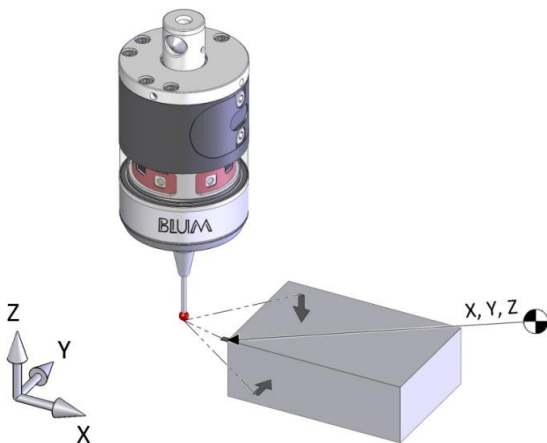**Optional parameters:**

- T   Position tolerance of the corner
- W   Number of a WCS, which must be set optionally (see note in chapter 12.1)
- I/J/K   Set position of the corner in a new set WCS if it differs from zero.
  At parameters *I, J, K* (X-axis: *I*, Y axis: *J*, Z axis: *K*) the sequence of the parameters in the programme call must be observed.

Example:

Measurement XYZ-corner

G54

G65 P8700 A1. X5. Y5. Z-5.

3.4 Measuring: Inside diameter

- Changing and positioning of the probe in the centre of the inside diameter.
- Activation of WCS: **G...**
- Programme call: **G65 P8700 A1. S...**

Parameter

- A1.   Use absolute dimensioning
- S   Set diameter of the bore

Results

#111+6   Diameter of the bore
#111+7   Deviation from the set diameter

#111+0   X-Position of the centre point in the active WCS
#111+3   Deviation from the transferred position or from the set position (parameter *I*) in X

#111+1   Y-Position of the centre point in the active WCS
#111+4   Deviation from the transferred position or from the set position (parameter *J*) in Y
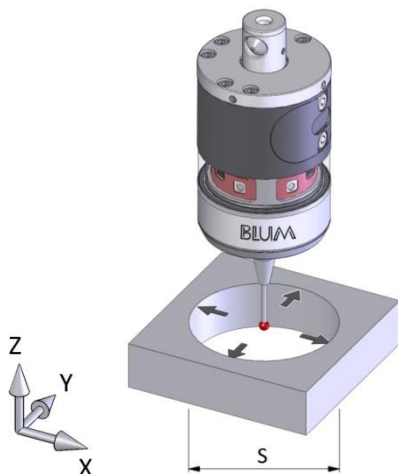
Optional parameters

- E   Tool number of the tool to be corrected
- T   Position tolerance of the centre point (*T* negative), or tolerance of the inside width (*T* positive)
- W   Number of a WCS, which must be set optionally (see note in chapter 12.1)
- I/J   Set position of the centre point in a new set WCS if it differs from zero.
           At parameters *I, J* (X-axis: *I*, Y axis: *J*) the sequence of the parameters in the programme call must be observed.

Example:
Measurement inside diameter
G55
G65 P8700 A1. S60.

3.5 Measuring: Inside diameter with 3 measuring points

- Changing and positioning of the probe in the centre of the inside diameter.
- Activation of WCS: **G...**
- Programme call: **G65 P8700 A1. S... H… U… V…**

Parameter

- A1.   Use absolute dimensioning
- S   Set diameter of the bore
- H   First angle of probing in the WCS   (reference X(+)-axis)
- U   Second angle of probing in the WCS   (reference X(+)-axis)
- V   Third angle of probing in the WCS   (reference X(+)-axis)

☞ The three probing angles must be chosen so that they divide the full circle or the section in angle segments which are as big as possible (e.g.: three times 120 degrees). X-axis is the reference, example: 0° -> +X-axis, 90° –> +Y-axis.

Before cycle call, the probe should be positioned in the centre of the diameter as precise as possible. If necessary, the cycle can be carried out twice in a row to increase the accuracy.

Results

#111+6   Diameter of the bore
#111+7   Deviation from the set diameter

#111+0   X-Position of the centre point in the active WCS
#111+3   Deviation from the transferred position or from the set position (parameter *I*) in X

#111+1   Y-Position of the centre point in the active WCS
#111+4   Deviation from the transferred position or from the set position (parameter *J*) in Y

Optional parameters
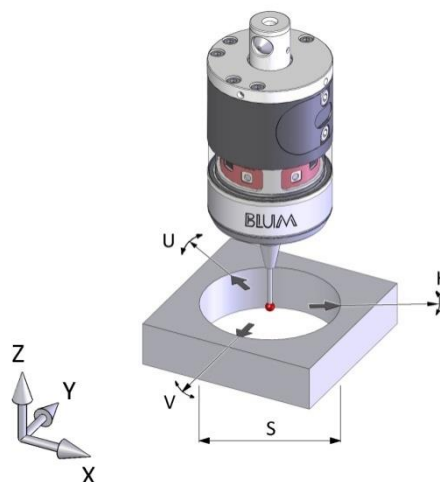
- E   Tool number of the tool to be corrected
- T   Position tolerance of the centre point (*T* negative), or tolerance of the diameter (*T* positive)
- W   Number of a WCS, which must be set optionally (see note in chapter 12.1)
- I/J   Set position of the centre point in a new set WCS if it differs from zero. At parameters *I, J* (X-axis: *I*, Y axis: *J*) the sequence of the parameters in the programme call must be observed.

Example:
Measurement inside diameter 3 points
G55
G65 P8700 A1. S50. H30. U150. V270.

3.6 Measuring: Outside diameter

- Changing and positioning of the probe in the centre above the outside diameter.
- Activation of WCS: **G...**
- Programme call: **G65 P8700 A1. S... Z...**

Parameter

- A1. Use absolute dimensioning
- S Set diameter of the outside diameter
- Z Measuring position in Z-axis in the active WCS

☞ Reference point for positioning in Z is the probe ball centre.

Results

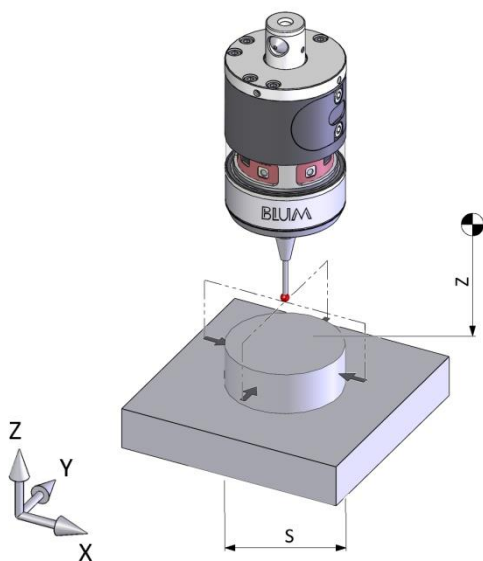|	
#111+6	Diameter of the outside diameter
#111+7	Deviation from the set diameter
#111+0	X-Position of the centre point in the active WCS
#111+3	Deviation from the transferred position or from the set position (parameter *I*) in X
#111+1	Y-Position of the centre point in the active WCS
#111+4	Deviation from the transferred position or from the set position (parameter *J*) in Y

Optional parameters

- E Tool number of the tool to be corrected
- T Position tolerance of the centre point (*T* negative), or tolerance of the diameter (*T* positive)
- W Number of a WCS, which must be set optionally (see note in chapter 12.1)
- I/J Set position of the centre point in a new set WCS if it differs from zero.
  At parameters *I, J* (X-axis: *I*, Y axis: *J*) the sequence of the parameters in the programme call must be observed.
- R Safety distance of the stylus to the workpiece for prepositioning in Z-direction. Standard: 10 mm. For outside diameter, *R* must be positive.
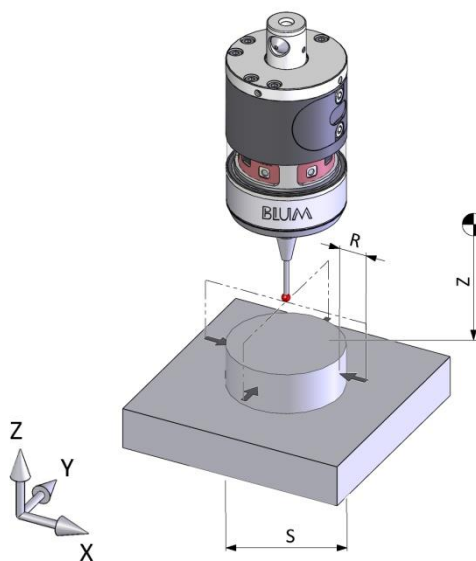
Examples:

Measurement outside diameter
G55
G65 P8700 A1. S50. Z-3.

Measurement outside diameter
G55
G65 P8700 A1. S50. R7. Z-5.

3.7 Measuring: Outside diameter with 3 measuring points

- Changing and positioning of the probe in the centre above the outside diameter.
- Activation of WCS: **G...**
- Programme call: **G65 P8700 A1. S... Z... H... U... V...**

Parameter

- A1.   Use absolute dimensioning
- S   Set diameter of the shaft
- Z   Measuring position in Z-axis in the active WCS

☞   Reference point for positioning in Z is the probe ball centre

- H   First angle of probing in the WCS   (reference X(+)-axis)
- U   Second angle of probing in the WCS   (reference X(+)-axis)
- V   Third angle of probing in the WCS   (reference X(+)-axis)

☞   The three probing angles must be chosen so that they divide the full circle or the section in angle segments which are as big as possible (e.g.: three times 120 degrees). X-axis is the reference, example: 0° -> +X-axis, 90° –> +Y-axis.

Before cycle call the probe should be positioned above the centre of the diameter as precisely as possible. If necessary, the cycle can be carried out twice in a row to increase the accuracy.
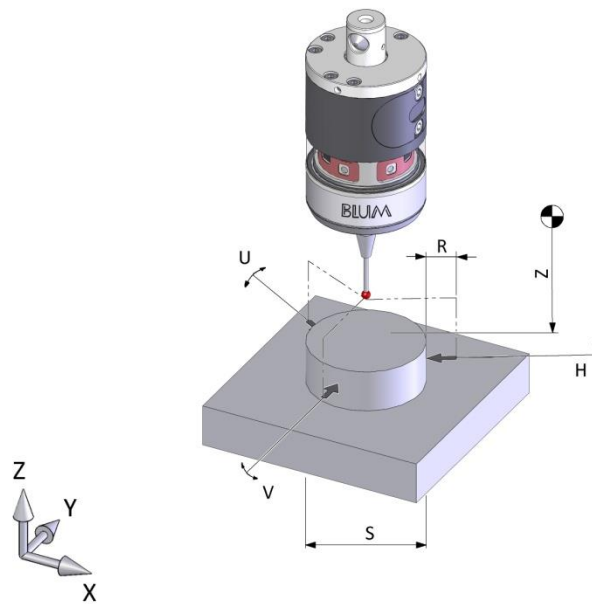
Results

#111+6   Diameter of the shaft
#111+7   Deviation from the set diameter

#111+0   X-Position of the centre point in the active WCS
#111+3   Deviation from the transferred position or from the set position (parameter *I*) in X

#111+1   Y-Position of the centre point in the active WCS
#111+4   Deviation from the transferred position or from the set position (parameter *J*) in Y

Optional parameters

- E   Tool number of the tool to be corrected
- T   Position tolerance of the centre point (*T* negative), or tolerance of the diameter (*T* positive)
- W   Number of a WCS, which must be set optionally (see note in chapter 12.1)
- I/J   Set position of the centre point in a new set WCS if it differs from zero.
  At parameters *I, J* (X-axis: *I*, Y axis: *J*) the sequence of the parameters in the programme call must be observed.
- R   Safety distance of the stylus to the workpiece for prepositioning in Z-direction.
  Standard: 10 mm. For outside diameter, *R* must be positive.

Example:
Measurement outside diameter 3 points
G55
G65 P8700 A1. S50. H30. U150. V270. Z-3.

3.8 Measuring: Inside width

- Changing in and positioning of the probe in the centre of the inside width.
- Activation of WCS: **G...**
- Programme call   measuring direction X: **G65 P8700 A1. S... X1.**
                          measuring direction Y: **G65 P8700 A1. S... Y1.**

Parameter

A1.   Use absolute dimensioning
S   Set inside width
X1./Y1.   Identification of the measuring direction

Results

#111+6   Inside width
#111+7   Deviation from set width

Measuring direction X:
#111+0   X-Position of the centre point in the active WCS
#111+3   Deviation from the transferred position or from the set position (parameter *I*) in X

measuring direction Y:
#111+1   Y-Position of the centre point in the active WCS
#111+4   Deviation from the transferred position or from the set position (parameter *J*) in Y
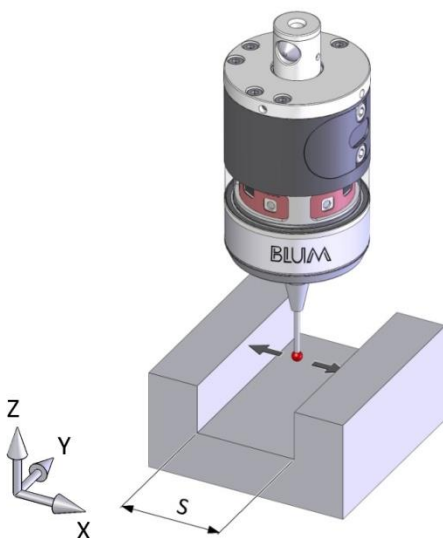
Optional parameters

- E   Tool number of the tool to be corrected
- T   Position tolerance of the centre point (*T* negative), or tolerance of the inside width (*T* positive)
- W   Number of a WCS, which must be set optionally (see note in chapter 12.1)
- I/J   Set position of the centre point in a new set WCS if it differs from zero.
           At parameters *I, J* (X-axis: *I*, Y axis: *J*) the sequence of the parameters in the programme call must be observed.
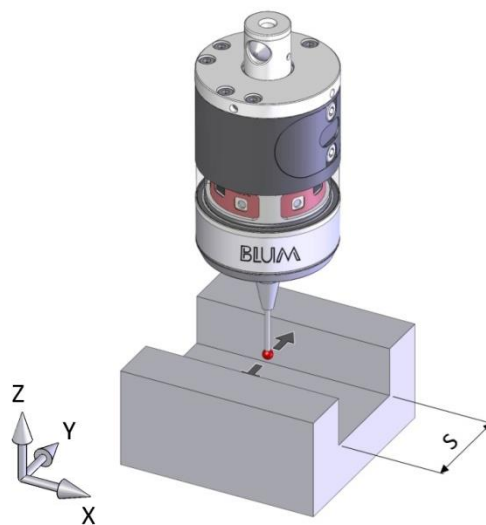
Examples:

Measurement inside width X   Measurement inside width Y
G54   **G54**
G65 P8700 A1. S20. X1.   **G65 P8700 A1. S20. Y1.**

3.9 Measuring: Outside width

- Changing in and positioning of the probe in the centre above the outside width.
- Activation of WCS: **G...**
- Programme call   measuring direction X: **G65 P8700 A1. S... X1. Z...**

  measuring direction Y: **G65 P8700 A1. S... Y1. Z...**

Parameter

- A1.   Use absolute dimensioning
- S   Set outside width
- X1./Y1.   Identification of the measuring direction
- Z   Measuring position in Z-axis in the active WCS

☞   Reference point for positioning in Z is the probe ball centre.

Results

#111+6	Outside width
#111+7	Deviation from set width

Measuring direction X:

#111+0	X-Position of the centre point in the active WCS
#111+3	Deviation from the transferred position or from the set position (parameter *I*) in X

measuring direction Y:

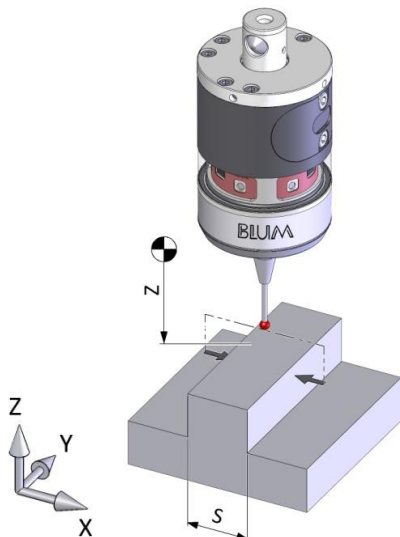|	
#111+1	Y-Position of the centre point in the active WCS
#111+4	Deviation from the transferred position or from the set position (parameter *J*) in Y

Optional parameters

- E   Tool number of the tool to be corrected
- T   Position tolerance of the centre point (*T* negative), or tolerance of the outside width (*T* positive)
- W   Number of a WCS, which must be set optionally (see note in chapter 12.1)
- I/J   Set position of the centre point in a new set WCS if it differs from zero.
  At parameters *I, J* (X-axis: *I*, Y axis: *J*) the sequence of the parameters in the programme call must be observed.
- R   Safety distance of the stylus to the workpiece for prepositioning in Z-direction. Standard: 10 mm. For outside width, *R* must be positive.

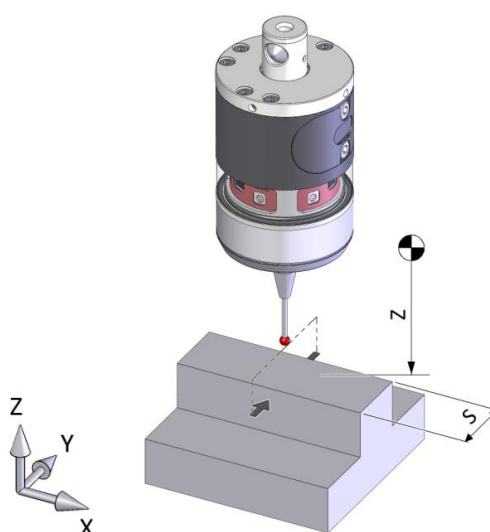**Examples:**

Measurement outside width X	Measurement outside width Y
G57	**G54**
G65 P8700 A1. S20. X1. Z-4.	**G65 P8700 A1. S35. Y1. Z-5. R7.**

3.10 Measuring: Inside width or inside diameter with obstacle

- Changing and positioning of the probe in the centre above the inside diameter or inside width.
- Activation of WCS: **G...**
- Programme call   inside diameter: **G65 P8700 A1. R... S... Z...**
                         inside width measuring direction X: **G65 P8700 A1. R... S... X1. Z...**
                         inside width measuring direction Y: **G65 P8700 A1. R... S... Y1. Z...**

Additional parameters compared to inside width/inside diameter without obstacle:

- R   Safety distance of the stylus to the workpiece for positioning in Z. For inside diameter and inside width, *R* must be negative.
- Z   Measuring position in Z-axis in the active WCS.

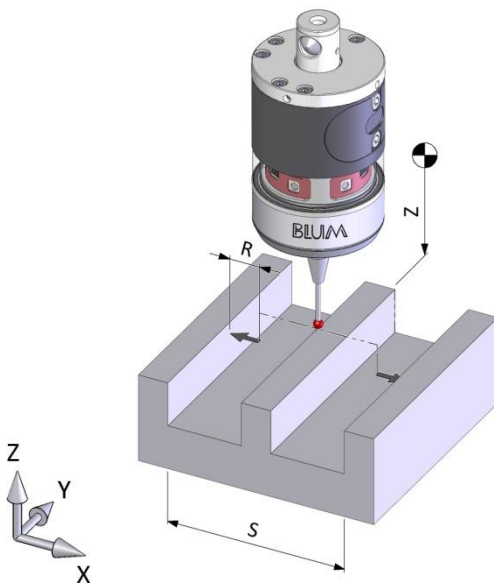☞   Reference point for positioning in Z is the probe ball centre.

☞   The results and optional parameters are the same as for inside diameter (see chapter 3.4) or inside width (see chapter 3.8).
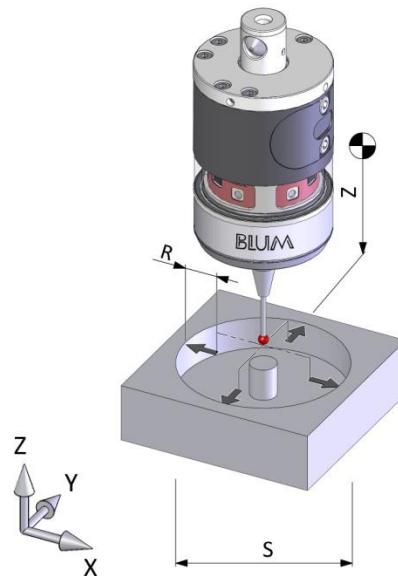
Examples:

Measurement inside width X with obstacle   Measurement inside diameter with obstacle
G58   **G59**
G65 P8700 A1. R-5. S30. X1. Z-5.   **G65 P8700 A1. R-10. S30. Z-5.**

4. Protected traverse path (PROTECTED MOVE)

The "Protected move" programme can be used for protected movement of the probe to a defined position. The switched on probe is moved from the start position to the target position that has been transferred. If the stylus is deflected during this travel movement, the movement is stopped and the probe is returned to the start position.

- Optional: Activation of WCS: **G...**
- Programme call: **G65 P8703 A... X... Y... Z...**

Parameter

- X/Y/Z   Target position (absolute A=1 or A=#0) of the movement in the active WCS
  Relative travel movement (A=0) by the entered distance
  Reference in X,Y: Centre of the selected probe ball (no consideration of the radius of the stylus)

☞   The probe tip is the reference point for positioning in Z.

Result

If the target position is reached without deflection of the probe, the measuring block is completed without error. If the probe meets an obstacle during positioning, it is moved back to the start position, switched off and an error message is issued.
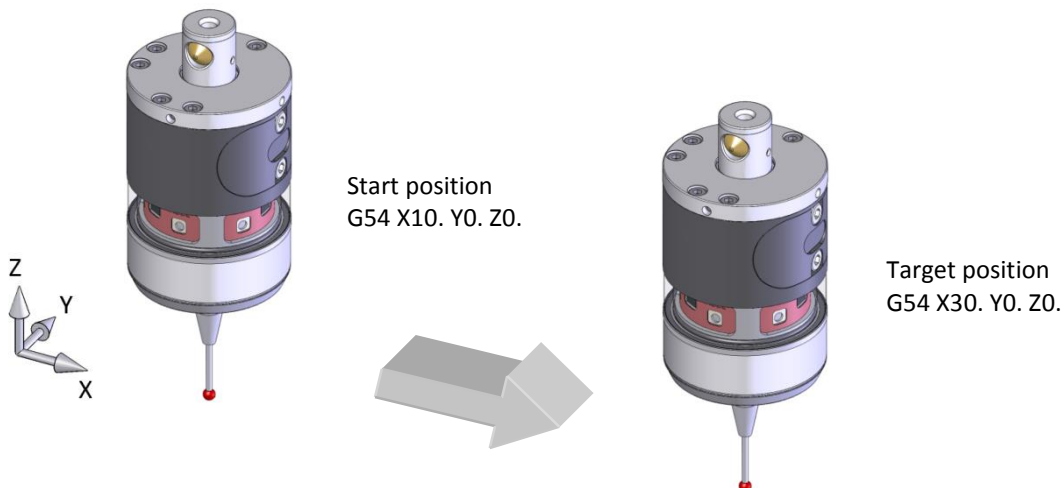
Optional parameters

- A   Positioning is carried out
  0.:   Relative
  1. / #0:   Absolutely in the active WCS

Example 1:
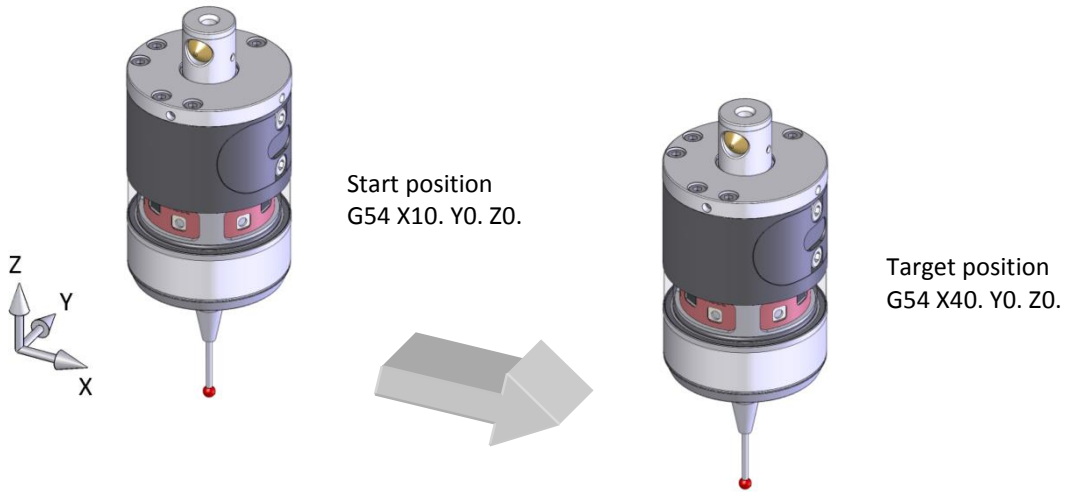Protected travel movement (absolute)

G54
G65 P8703 X30.

Start position
G54 X10. Y0. Z0.

Target position
G54 X30. Y0. Z0.

Example 2:
Protected travel movement (relative)

G54
G65 P8703 A0. X30.

Start position
G54 X10. Y0. Z0.

Target position
G54 X40. Y0. Z0.

5. Check for characteristic

In order to check the availability of a component, the programme "protected move" is used.
For that purpose, the probe will be traversed to a target position.
If the stylus is deflected during this travel movement, the movement is stopped and entered in #111+8 "1" as result "component available". If the probe reaches the target position, it is entered in 111+8 "-1" as result "component not available". Then, the probe will traverse back to the start position or remains on the target position, depending on the prefix of the parameter *T*.
If a component is available, the probe is always moved back to the start position.

- Optional: Activation of WCS: **G...**
- Programme call: **G65 P8703 A... X... Y... Z... T...**

☞   Please observe that sufficient overtravel is available at the transferred target position.

Parameter

- X/Y/Z   Target position (absolute A=1 or A=#0) of the movement in the active WCS
  Relative travel movement (A=0) by the entered distance
  Reference in X,Y: Centre of the selected probe ball (no consideration of the radius of the stylus)
  Reference in Z: Probe tip
- T   1:   Activation of the function component availability. Retraction to start position
          -1:   Activation of the function component availability. Stop on target position

Result

Component available: #111+8=1
Component not available: #111+8=-1

Optional parameters

- A   Positioning is carried out
  0.:   Relative
  1. / #0:   Absolutely in the active WCS

Examples:

Protected travel movement target absolute position   Protected travel movement target relative movement

G54
G65 P8703 A1. Z0. T1.

G65 P8703 A0. Z-10. T1.

6. 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 permanently mounted workpiece is necessary, e.g. a building block or calibration master in the machining area. Workpiece referencing in three axes is made on this master (reference measurement). After the machine is heated-up, the position of the workpiece is measured again (comparison measurement). Due to the heat changes of the machine, the workpiece in the WCS will now be on a position deviating from zero. This deviation will be transferred into the external point zero offset of the control. In this way, heat changes of the machine are compensated. After a reference measurement any number of comparison measurements can be made, i.e. before production start of any new part to keep the set deviations on the workpiece due to temperature drift as low as possible.

In general, a temperature compensation can be made with each measurement (single point). It is appropriate to carry out temperature compensation in all three axes. 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 programme O8705 (SET WCS).

Carrying out a reference measurement

- Changing and positioning the probe for initial workpiece referencing.
  Important: Positioning should be made by manual data input so that there are exactly the same conditions for reference and comparison measurement.

- Workpiece referencing on the workpiece by using any WCS.
  Programme call: **G65 P8700 ... W...**

Carrying out a reference measurement

- Changing and positioning the probe for comparison measurement.
  Important: Positioning should be made with the same manual data input as used for reference measurement.
- Activation of the WCS in which the zero point of the workpiece is stored:
  G...
- Measurement on the workpiece with the same parameters as used for reference measurement and with the additional parameter *W53*.
  Programme call: **G65 P8700 ... W53.**

Result

By comparative measurement with the parameter *W53.* the determined deviation will be registered in the external zero point offset of the control.

7. Angle or distance measurements

📖   This function must be activated via #137 in programme O8710 USERPARATAB.
Read Installation Instructions.

If two measuring points are measured consecutively, the distances or angles between these points can be measured in the corresponding axes. So, it is possible to define e.g. the following data of a workpiece:

- Angle of inside width
- Angle of outside width
- Angle of surface
- Distance of two diameters
- Distance of two corners
- Height or width of a step

NOTICE

Malfunction
▶ To get a correct result, it is not allowed to change the active WCS between the first and second measurement or to activate another WCS.
▶ The measurements must be carried out directly one after the other.
▶ Only equal measurements can be compared: Single point with single point, diameter with diameter.
▶ To get correct results, it is not allowed to delete the global parameters (#100 up to #149/#199) between the two measurements.
▶ Using the setting parameters #110 to #149 is not allowed.
▶ Using the result parameters defined in #111, is not allowed.

📖   Read the documentation of the control manufacturer.
📖   Read Installation Instructions.

Function parameter D of the second measuring point

Parameter **D** will activate the angle-distance function.
If a value ≥ 0 is given for D, distances will be measured. Angles will be measured at D < 0.
A -360 set value corresponds to an angle of 0°.

Sequence of angle or distance measurement (see example programmes chapter 9)

- Measure first measuring point.
  Programme call: **G65 P8700 A1. X0. ...**
- Traverse probe to the second measuring point by handwheel or by traverse path.
- Measure second measuring point with the additional parameter **D**.
  Programme call: **G65 P8700 A1. X0. D...**

7.1 Distance (D ≥ 0)

If the distance between two measuring points must be defined, parameter **D** is transferred with values ≥ 0. If single points will be measured only, the value in parameter **D** corresponds to the set value.

Results

Depending on the machine axes the following parameters are stored.

- #[#137+9]   Distance in X-direction
- #[#137+10]   Distance in Y-direction
- #[#137+11]   Distance in Z-direction

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

- #[#137+12]   Deviation to set value in X-direction
- #[#137+13]   Deviation to set value in Y-direction
- #[#137+14]   Deviation to set value in Z-direction

7.2 Angle (D < 0 and D ≥ -360.)

At the definition of an angle of two measuring points, the parameter **D** is transferred as set value of the angle with negative prefix. The value -360. corresponds to a set value of 0°. With option bit 2 (Installation Instructions / #131.8) the output format of the angle can be defined.

Presentation and calculation of the angles
The calculation of the angles is carried out according to drafted angle specifications.
The probing sequence of the points corresponds to the measuring direction or the arrow.
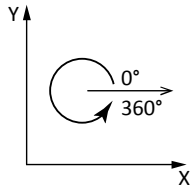
Results
The calculated angle is stored in the following parameters:
- #[#137+7]   Calculated angle
- #[#137+8]   Deviation to the transferred set angle

Providing the data for the internal programme O8705 (SET WCS), the deviation between the calculated angle and the set angle transferred with "D", is additionally stored in parameter #[#111+9].

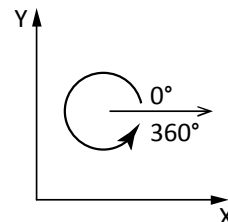☞   The output format of the result depends on the setting in #131.8.

Output format
       With option bit 2 the output format of the angle can be defined.
- #131.8   Adjustment of the result output in
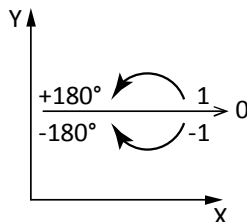
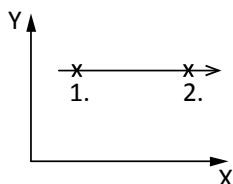   #131.8=0   #131.8=1
   180° > 0 > -180°   0° − 359°
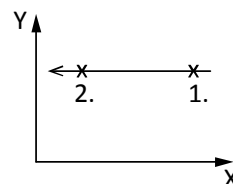
- Sign measuring result

   Measuring result positive (Pos. 2 > Pos. 1):   Measuring result negative (Pos. 1 > Pos. 2):

8. Tolerance check

Parameter *T* can be used to set the tolerance of a measuring point, of a contour (S) or of a position, for instance. To check a surface, corner, inside width, outside width or diameter for tolerance, the transferred value with parameter *T* must be positive. To check a position or centre point of a contour for tolerance, the transferred value must be negative.

The specifications of set value or position *I, J* and *K* are considered. If the tolerance is exceeded, the programme stops and the error message "Tolerance exceeded" is issued. As the tolerance can only be checked absolutely, the set value must be in the centre of the tolerance field.

Example 1:
Measurement inside diameter 60 mm with tolerance +0.2 mm.
To check the diameter, the value transferred with *T* must be positive.
The set value must be transferred with 60.1 mm.

Measurement inside diameter 60 mm
Dimension tolerance: +0.2 mm
G55
G65 P8700 A1. S60.1 T0.1

Example 2:
Measurement inside diameter 60 mm with tolerance ±0.2 mm
To check the diameter, the value transferred with *T* must be positive.
The set value must be transferred with 60 mm.

Measurement inside diameter 60 mm
Dimension tolerance: ± 0.2 mm
G55
G65 P8700 A1. S60. T+0.2

Example 3:
Measurement of the position of the inside diameter with tolerance ±0.2 mm
The zero point is in the centre of the inside diameter.
To check the position, the value transferred with *T* must be negative.
It is only possible to check a tolerance field.

Measurement inside diameter 60 mm
Position tolerance: ± 0.2 mm
G55
G65 P8700 A1. S60. T-0.2

Example 4:
Measurement of the position of the inside diameter with tolerance +0.3 mm
The centre of the inside diameter is in X "50." and in Y "50.".
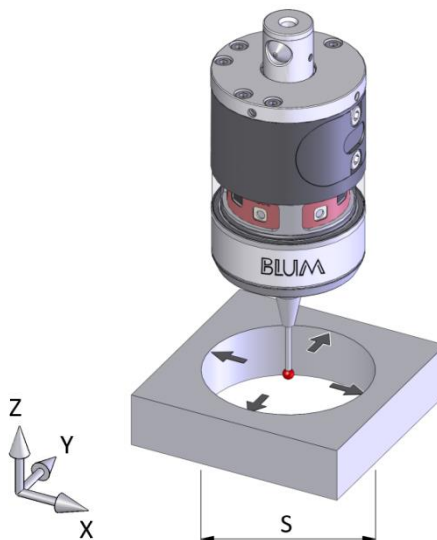To check the position, the value transferred with *T* must be negative.
It is only possible to check a tolerance field.

Measurement inside diameter 60 mm
Position tolerance: + 0.3 mm
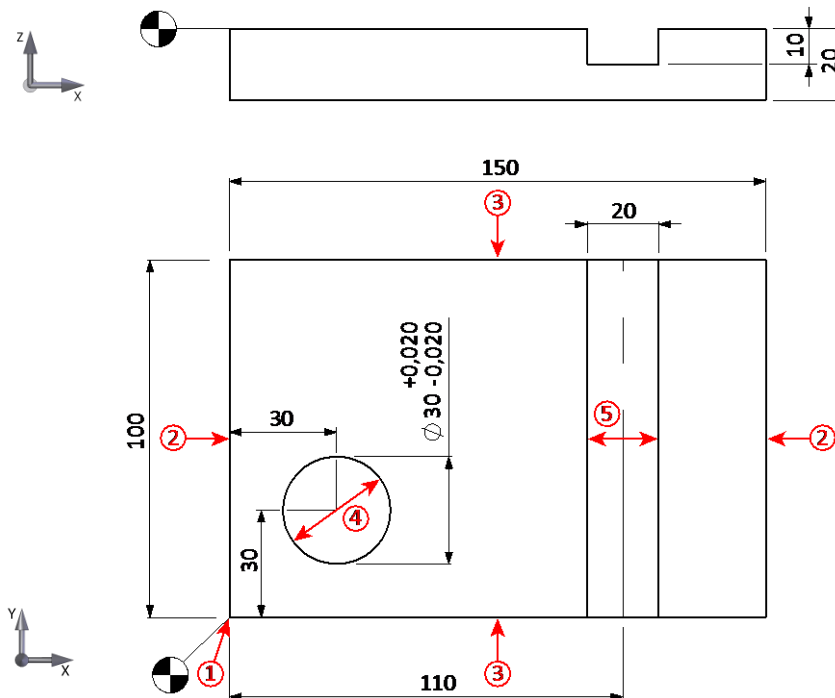**G55**
G65 P8700 A1. S60. I50.15 J50.15 T-0.15

9. Examples for measuring programmes and evaluations

9.1 Measurements on sample part

Measurement on a workpiece, position roughly defined by a vice.
Measuring task: Length and width of workpiece, diameter (tolerance) and inside width.

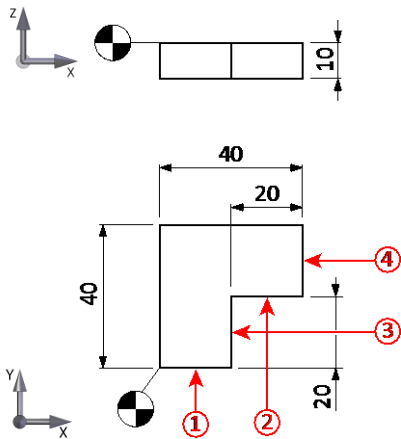| O1(EXAMPLE 1)	
G54	Activation of zero point
G65P8703 X-5. Y-5. M1.	Positioning of probe
G65P8703 Z5. M3.	Positioning of probe
G65P8700 X10. Y10. Z-10. W54. M3.	Correction of zero point in XYZ (1)
G65P8703 X75. Y50. M3.	Positioning of probe
G65P8700 A1. S150. X1. Z-5. M3.	Workpiece measurement in X (2)
→ #150=#[#111+6]	Result in #150
G65P8700 A1. S100. Y1. Z-5. M3.	Workpiece measurement in Y (3)
→ #151=#[#111+6]	Result in #151
G65P8703 X30. Y30. M3.	Positioning of probe
G65P8703 Z-5. M3.	Positioning of probe
G65P8700 A1. S30. M3.	Measurement of bore diameter 30 (4)
→ #152=#[#111+6]	Result in #152
G65P8703 Z5. M3.	Positioning of probe
G65P8703 X110. Y50. M3.	Positioning of probe
G65P8703 Z-5. M3.	Positioning of probe
G65P8700 A1. S20. X1. M3.	Inside width measurement in X (5)
→ #153=#[#111+6]	Result in #153
G65P8703 Z5. M2.	Positioning of probe
M[30]	Programme end

9.2 Distance measurement

Measurement on a workpiece, position of the component in G54.
Measuring task: Recess distances in X, Y to the outside contour

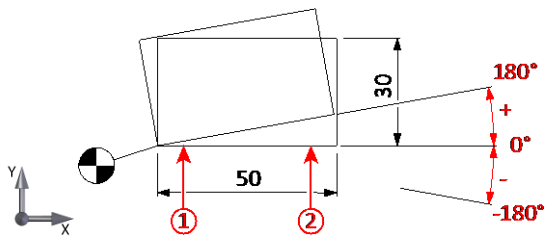|	
O2(EXAMPLE 2)	
G54	Activation of zero point
G65P8703 X10. Y-10. M1.	Positioning of probe
G65P8703 Z-5. M3.	Positioning of probe
G65P8700 A1. Y0. M3.	Workpiece measurement in Y (1)
G65P8703 X30. M3.	Positioning of probe
G65P8700 A1. Y20. D20. M3.	Workpiece measurement in Y (2)
→ #[#137+10]	Result distance in Y
G65P8703 Z5. M3.	Positioning of probe
G65P8703 X50. Y10. M3.	Positioning of probe
G65P8703 Z-5. M3.	Positioning of probe
G65P8700 A1. X20. M3.	Workpiece measurement in X (3)
G65P8703 Y30. M3.	Positioning of probe
G65P8700 A1. X40. D20. M3.	Workpiece measurement in X (4)
→ #[#137+9]	Result distance in X
G65P8703 Z5. M2.	Positioning of probe
M[99]	Programme end

9.3 Angle measurement

Measurement on a workpiece, position of the component in G54.
Measuring task: Angle of the workpiece in XY-plane

O3(EXAMPLE 3)	
G54	Activation of zero point
G65P8703 X5. Y-10. M1.	Positioning of probe
G65P8703 Z-5. M3.	Positioning of probe
G65P8700 A1. Y0. M3.	Workpiece measurement in Y (1)
G65P8703 X45. M3.	Positioning of probe
G65P8700 A1. Y0. D-360. M3.	Workpiece measurement in Y (2)
#[#137+7]	Result angle
G65P8703 Z5. M2.	Positioning of probe
M[30]	

40

10. Data output with DPRNT O8716 (DPRNT)

By parameter *V* results can be given and recorded directly with the RS-232-interface (text file).
For that purpose the parameter *V* will be transferred by a negative prefix.
Default: *V-1.*
If the function measuring with 3 points is used, the set value for the measuring function will be transferred with a negative prefix.

Examples:

- **Output position of a single point**

    G65P8700 A1. X0. V-1.

    Result:
    Set position of a single point in X
    Following parameters will be provided at RS232:

Position in X:	#[#111+0]
Deviation of set value in X:	#[#111+3]

- **Output position of a bore with 3 measuring points**

    G65P8700 A1. S50. H0. U120. V-240.

    Result:
    Set position of the bore in X and Y
    Diameter and deviation of set value

    Following parameters will be provided at RS232:

Position in X:	#[#111+0]
Position in Y:	#[#111+1]
Deviation of set value in X:	#[#111+3]
Deviation to set value in Y:	#[#111+4]
Diameter:	#[#111+6]
Deviation to set value (DM):	#[#111+7]

11. Calibration

Why calibrate?

When a workpiece is probed, the stylus of the touch probe is moved towards the workpiece. If the stylus is deflected by the workpiece the machine stops the movement and the current position of the spindle is stored in the control in special variables. However, this stored spindle position does not match the position of the workpiece edge. There are three main reasons for this:

- Delay of the control
- Radius of the probe ball
- Eccentricity of the probe ball

When calibrating, values are measured and stored, which 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. Also, the eccentricity of the probe ball is determined and stored in two additional variables. These values are used for subsequent measurements to obtain an exact measuring result. The following five calibration values are determined and stored:

- Calibration value X-axis
- Calibration value Y-axis
- Eccentricity X-axis
- Eccentricity Y-axis
- Calibration value Z axis

When to calibrate?

The probe must be calibrated, if...
- ...this software is commissioned.
- ...the parameters for measuring speed (#126/#127) have been changed in USERPARATAB
     (see Installation Instructions).
- ... the stylus has been changed or the concentricity of the stylus has been re-adjusted.
- ...should be measured very accurately.
- ... the measurement unit has been changed from metric to inch or vice versa.
- ... the basic address (#110) for the calibration parameter was changed in the programme USERPARATAB.

How to calibrate?

For calibration of the probe in Z, a surface in XY plane, which must be known exactly in its Z-position, is required. For calibration of the probe in X and Y, a calibration ring or a calibration sphere with exactly defined diameter is required. Calibration is called via the programme MAIN. Selection of the calibration method is determined by calling relevant parameters.

☞   Calibration of the probe in the X and Y axes is carried out independently of the calibration in the Z axis.

       When calibrating on a sphere, at first the Z-calibration must be carried out.

11.1 Calibration in Z-axis

- Preparation of a calibration surface (i.e. the upper side of the calibration ring) in the machining area of the machine in XY-level.
- µ-precise definition of the Z-position of the calibration surface in the machine coordinates system (e.g. with gauge block).
- Input of Z-position of the calibration surface into any WCS.
- Changing and positioning the probe above the calibration surface. The exact distance of the probe ball to the calibration surface is not important, but it should not be less than 5 mm.
- Activation of the WCS where the position of the calibration surface is stored: **G ...**
- Programme call: **G65 P8700 C1. Z ...**

Parameter

- C1.   Calibration is carried out
- Z   Distance of probe ball to calibration surface

Results

The calibration value of the Z-axis is stored.
The storage location is depending on parameter #110 in the programme USERPARATAB.

- #[#110+5]   Calibration value Z-axis

Example:
Calibration Z-axis
G54
G65 P8700 C1. Z-10.
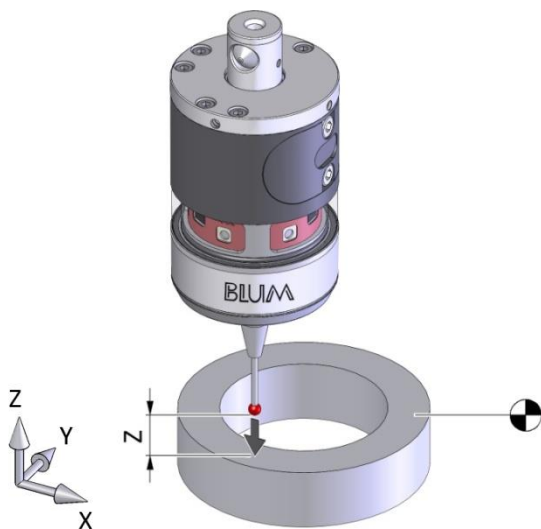
11.2 Calibration in the axes X and Y with calibration ring

- Installation of the calibration ring in the machining area of the machine.
- Insert the probe and position it (by eye) centred inside within the calibration ring.
- Programme call: **G65 P8700 C1. S ...**

Parameter

- C1.   Calibration is carried out on the ring
- S   µ-precise diameter of the calibration ring

Results

Four calibration values for the X- and Y-axes are stored.
The storage location is depending on parameter #110 in the programme O8710 (USERPARATAB).

- #[#110+0]   Calibration value X-axis
- #[#110+1]   Calibration value Y-axis
- #[#110+2]   Eccentricity X-axis
- #[#110+3]   Eccentricity Y-axis

☞   During calibration, the probe is oriented automatically or manually depending on the adjustments in option bit #130 (see Installation Instructions).

☞   The calibration can also be carried out on an outside diameter. In this case the optional parameter *Z* is used.

Optional parameters

- Z   Traverse path of the probe in the Z-axis from the initial position to the measuring position

Example:
Calibration of the X- and Y-axes
G65 P8700 C1. S50.002
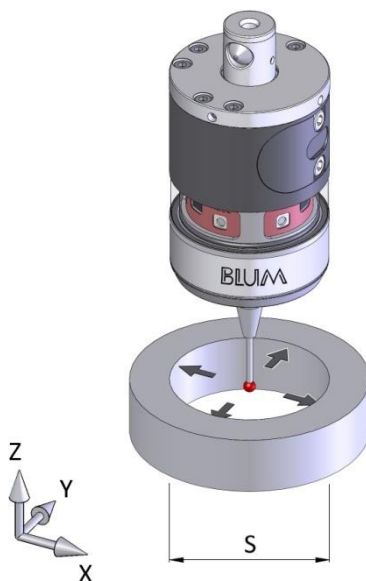
11.3 Calibration in axes X and Y with calibration sphere

- Installation of the calibration sphere in the machining area of the machine.
- Changing and positioning of the probe in the centre (by eye) above the calibration sphere.
- Programme call: **G65 P8700 C2. S... Z...**

Parameter

- C2.   Calibration is carried out on the sphere.
- S   µ-precise diameter of the calibration sphere
- Z   Approximate distance between calibration sphere and probe

Results

Four calibration values for the X- and Y-axes are stored.
The storage location is depending on parameter #110 in the programme O8710 (USERPARATAB).

- #[#110+0]   Calibration value X-axis
- #[#110+1]   Calibration value Y-axis
- #[#110+2]   Eccentricity X-axis
- #[#110+3]   Eccentricity Y-axis

The calibration sphere centre in the active WCS is defined.

- #[#111+0]   Sphere centre in the X-axis in the active WCS
- #[#111+1]   Sphere centre in the Y-axis in the active WCS
- #[#111+2]   Sphere centre in the Z-axis in the active WCS

    When calibrating on a sphere, at first the Z-calibration must be carried out.

☞   During calibration the probe is oriented automatically or manually depending on the adjustments in option bit #130.
(Read Installation Instructions).

Example:
Calibration of the X- and Y-axes
G65 P8700 C2. S25.003 Z-10.
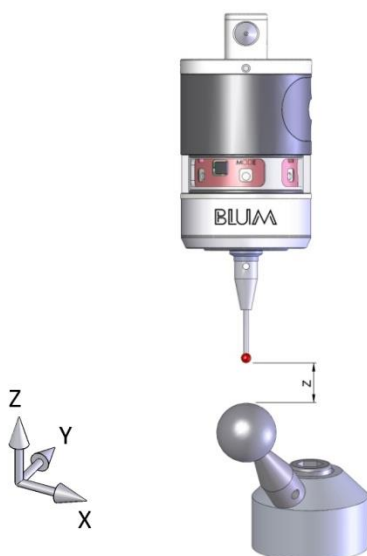
12. Parameter tables

For further information, read installation instructions.

12.1 Call parameter

Call parameter		Meaning
A	**#1**	The positions in the programme call are interpreted in the active WCS as absolute coordinates and not as distances of the probe ball to the workpiece or traverse path in Z.
		With A=1. or A=#0 (PROTECTED MOVE), the positions are interpreted as absolute coordinates, with A=0. as relative coordinates.
C	**#3**	Carrying out a calibration
		C1.: Calibration in Z and XY on the calibration ring
		C2.: XY-calibration on sphere
D	**#7**	With parameter **D** the function "distance-angle" is activated on the second measuring point.
		With the transferred values >0, the distance of the measuring points will be defined. At the definition of an angle of two measuring points, the parameter **D** is transferred as set value of the angle with negative prefix. The value -360. corresponds to a set value of 0°.
		The function must be activated - see Installation Instructions.
E	**#8**	After measurement, the data of the tool with which the measuring point was machined, are corrected. The tool number is transferred with parameter **E**. This function can be used for all measuring points except of the measurement of a corner.
		Depending on the configuration of the parameters in programme „SET TOOL" either the geometric or the wear data of the tool in the tool memory are corrected.
H	**#11**	Angle for 3-point probing at bores or pins.
		The value of the angle must be between 0° < H < 360° − minimum distance between the angles 10°.
I	**#4**	X set position of a centre point or a surface during measurement or in the WCS to be set.
		If the measured point of the respective axis does not correspond to "0", the appropriate value can be defined with a suitable set value.
		Example: Set position in X ≠ "0", but "10." instead -> programme call "I10."
J	**#5**	Y set position of a centre point or a surface during measurement or in the WCS to be set.
		If the measured point of the respective axis does not correspond to "0", the appropriate value can be defined with a suitable set value.
		Example: Set position in Y ≠ "0",but "10." instead -> programme call "J10."
K	**#6**	Z set position of a surface during measurement or in the WCS to be set.
		If the measured point of the respective axis does not correspond to "0", the appropriate value can be defined with a suitable set value.
		Example: Set position in Z ≠ "0", but "10." instead -> programme call "K10."
M	**#13**	As standard, the probe is switched on before each measuring task and switched off afterwards. If several measuring tasks are carried out one after the other, it is expedient to switch on the probe before the initial measurement and switch it off after the last one. In addition, the parameter **M** with the correct value must be transferred to each programme call. Parameter **M** can be used for programme "MAIN" as well as for "PROTECTED MOVE".
		M1. switch on only
		M3. neither switch on nor off
		M2. switch off only
		Depending on setting of #131.9, the user data are loaded depending on call **M1.** For further information, read Installation Instructions

Call parameter		Meaning
Q	#17	At each measuring block, the probe is traversed for a pre-defined measuring path/distance. To avoid stopping the probe if there is no trigger signal on this measuring distance, the probe is displaced over the expected surface. So to speak the edge is "searched". This distance usually corresponds to the double measuring distance defined in programme O8710(USERPARATAB), in parameter #114 (X,Y).
		If these values are not suited for a special measuring task the overtravel XY can be transferred with Q. Correction in Z is not possible.
R	#18	The safety distance while measuring inside width, inside/outside diameter is 10mm as standard and it can be changed by parameter *R* if required. For inside width, inside diameter *R* must be negative, for outside width, outside diameter *R* must be positive.
S	#19	Size of a measuring point, i.e. width of an inside / outside width or diameter of a bore / outside diameter.
T	#20	Parameter *T* can be used to set the tolerance of a measuring point, of a contour (S) or of a position, for instance.
		To check a surface, corner, inside width, outside width or diameter for tolerance, the transferred value with parameter *T* must be positive. To check a position or centre point of a contour for tolerance, the transferred value must be negative.
		The set values or position settings *I, J* and *K* are taken into account.
		If the tolerance is exceeded, the programme stops and the error message "Tolerance exceeded" is issued.
		In programme O8703 (PROTECTED MOVE) parameter *T* activates the check of component availability.
U	#21	2nd angle for 3-point probing at bores or outside diameter.
		The value for the angle must be between 0° < U < 360° – minimum distance between the angles 10°.
V	#22	3rd angle for 3-point probing at bores or outside diameter.
		The value for the angle must be between 0° < U < 360° – minimum distance between the angles 10°.
W	#23	The number of the WCS which must be set is transferred with parameter *W*.
		Usually it is possible to pass *W54.* to *W59.*
		The external zero point offset is set with *W53.*
		If there are more WCS available by option, the number of an optional WCS with (G54... P1 / P48) with negative prefix is transferred. WCS "G54.1 P40" is set with "W-40.".
		The optional WCS for the clamping tool correction (G54.2 P1…P8) can be described with *W1.* … *W8.*. For further information, see Installation Instructions.
		At simultaneous usage of *A1.* and *W*, the set positions must be transferred with parameters *I, J* and *K*.
X	#24	Distance of surface which must be touched in X-direction (without *A1.*), or X-position of the point which must be touched in the active WCS (with *A1.*).
Y	#25	Distance of surface which must be touched in Y-direction (without *A1.*), or Y-position of the point which must be touched in the active WCS (with *A1.*).
Z	#26	Distance of surface which must be touched in Z-direction (without *A1.*), or Z-position of the point which must be touched in the active WCS (with *A1.*).

12.2 Result parameter

Parameter	Meaning
#111+0	X result of the measurement in the current WCS.
#111+1	Y Result of the measurement in the actual WCS.
#111+2	Z result of the measurement in the current WCS.
#111+3	Deviation from measuring result X to set position in X.
	If no set position is transferred in X (parameter *I*), this value corresponds to the X-measuring result.
#111+4	Deviation of the Y measuring result from the set position in Y
	If no set position is transferred in Y (parameter *J*), this value corresponds to the Y measuring result.
#111+5	Deviation from measuring result Z to set position in Z.
	If no set position is transferred in Z (parameter *K*), this value corresponds to the Z-measuring result.
#111+6	Result of contour measurement.
	(Diameter bore, inside width or outside width)
#111+7	Deviation from the measuring result to the set value transferred with parameter *S*.
#111+8	Result of check of component availability
	#111+8=1: Component available
	#111+8=-1: Component **not** available
#111+9	Result of the angle measurement to activate a nth axis.
	If #111+9 ≠ 0, when writing the WCS the entered value is written into the axis which is entered in programme O8710(USERPARATAB) under #136.

12.3 Calibration parameter

Parameter	Meaning	
#110+0	Calibration value in X	(e.g. probe ball radius 3 mm - HSS approx. 2.785)
#110+1	Calibration value in Y	(e.g. probe ball radius 3 mm - HSS: approx. 2.788)
#110+2	Probe centre offset in X	(e.g. probe ball radius 3 mm - HSS: approx. 0.005)
#110+3	Probe centre offset in Y	(e.g. probe ball radius 3 mm - HSS approx. 0.010)
#110+4	Retraction path 2nd measuring block (see Installation Instructions)	
#110+5	Calibration value in Z	(e.g. probe ball radius 3 mm - HSS approx. 0.206)

12.4 Calculation and result parameter function D

Parameter	Meaning
#137+0	Storage of the type of the measuring point measured at least (diameter, single point,...)
#137+1	X result of 1st measurement
#137+2	Y result of 1st measurement.
#137+3	Z result of 1st measurement.
#137+4	X-skip position of 1st measurement.
#137+5	Y-skip position of 1st measurement.
#137+6	Z-skip position of 1st measurement.
#137+7	Result angle
#137+8	Deviation angle set to actual value
#137+9	Result distance in X
#137+10	Result distance in Y
#137+11	Result distance in Z
#137+12	Deviation from set value at distance measurement in X (distance in one axis)
#137+13	Deviation from set value at distance measurement in Y (distance in one axis)
#137+14	Deviation from set value at distance measurement in Z (distance in one axis)

12.5 Parameter USERPARATAB O8710

Parameter	Description
#1	Start address offset WCS
#2	Distance memory locations between the single axes
#3	Distance of WCS memory locations
#4	Start address optional WCS
#5	Basic address tool length wear
#6	Basic address tool radius wear
#7	H-number of the probe
#8	Basic address tool memory tool length
#9	Additional tool length offset
#110	Basic address permanent parameters (calibration values)
#111	Basic address results
#112	Probe ball radius XY
#113	Probe ball radius Z
#114	Measuring distance X,Y
#115	Measuring distance Z
#116	Axis constellation for "Rotary fixture offset – G54.2"
#126	Measuring feed of the 1st measuring block in mm/min
#127	Measuring feed of the 2nd measuring block in mm/min (default X4.7)
#128	Feed protected move
#129	Confidence interval
#130	Option bit 1 (basic settings for measurement)

	Bit 0:	0: Override feed possible	1: Disable override feed rate
	Bit 1:	0: Protected Move	1: Travel movement with G0
	Bit 2:	0: Operating mode default	1: Auto-flash
	Bit 3:	0: Validity of trigger point not checked	1: ... will be checked
	Bit 4:	0: Validity of start conditions not checked	1: ... will be checked
	Bit 5:	0: No active tool length compensation	1: **Default:** Active tool length compensation
	Bit 6:	reserved	
	Bit 7:	reserved	
	Bit 8:	0: Data tool length will be checked	1: ... not checked

Parameter	Description		
#131	Option bit 2		
	Bit 0:	0: Spindle indexing: "No"	1: …"Yes"
	Bit 1:	0: Reserved	1:
	Bit 2:	0: Standard error texts	1: Error texts user-defined
	Bit 3:	0: Switch on check "Error"	1: … "Micromove"
	Bit 4:	0: Signal ERROR	1: Signal ERROR INVERS
	Bit 5:	0: Signal STATUS INVERS	1: Signal STATUS
	Bit 6:	0: Signal BATTERY	1: Signal BATTERY INVERS
	Bit 7:	0: Retraction to start position	1: Stop after error
	Bit 8:	0: Output format angle -180°<0<180°	1: Output format angle 0°…359°
	Bit 9:	0: Always charge USERPARATB1	1: …only at programme call with M1.
	Bit 10:	0: Probe multidirectional	1: … Mono-directional, orientation in measuring direction
	Bit 11:	Rotation direction orientation - condition Bit10=1	
		0: Clockwise orientation	1: Counter-clockwise orientation
#132	Country code language tags		
#133	ERROR input signal		
#134	STATUS input signal		
#135	BATTERY input signal		
#136	Number and direction of a fourth axis.		
#137	Basic address function D		
#138	G-Code for measuring block		
#[#110+4]	Retraction path 2nd measuring block		

13. Entering the call parameter (mm/inch)

The current machine measuring system (mm/inch) is read in at the beginning of the cycle. The basic settings of the variables in the auxiliary programme O8710 (USERPARATAB) are calculated automatically. Therefore, these variables need not be modified.

NOTICE

Damage of the measuring system and the workpiece by different dimensions is possible

▶ The call parameter has to be entered in accordance with the measuring system of the machine (values given in mm or inches).

▶ All programming examples are shown in mm.

Procedure after measuring system is changed from mm to inches:

- Executing of programme calibration in XY and Z - calibration ring 50.002 mm with values in inch:
  Calibration in Z - reference surface active in WCS: **G65 P8700 Z-0.394 C1.**

  Calibration in XY - calibration ring 50.002 mm   **G65 P8700 S1.9685 C1.**

- Call of the requested cycles – workpiece referencing single point X with values in inches:
  G65 P8700 X0.394 W55.

Procedure after measuring system is changed from inches to mm:

- Executing of programme calibration in XY and Z - calibration ring 50.002 mm with values in mm:
  Calibration in Z - reference surface active in WCS: **G65 P8700 Z-10. C1.**

  Calibration in XY - calibration ring 50.002 mm   **G65 P8700 S50.002 C1.**

- Call of the requested cycles – workpiece referencing single point X with values in mm:
 **G65 P8700 X10. W55.**

14. Error messages

In case of error, the error number is set and an error message is displayed on the screen. The programme must be aborted by means of the RESET key, the cause of error must be eliminated and the programme must be restarted.
At messages (e.g. 3 115), the processing of the programme is interrupted by "M0". The cycle can be continued with "Cycle Start".

Legend:

3...	= Error message
	= Error description
	= Check the following points
	= Remedy

3 101	INVALID CALL PARAMETERS
	The call parameters are invalid or faulty.
	Check the programme call.
	Enter valid values for the programme call.

3 102	TOLERANCE EXCEEDED
	The tolerance transferred in the call was exceeded.
	Check of the measuring result

3 103	UNEXPECTED OBSTACLE
	The protected traverse path has not reached the target position.
	Was an obstacle/the workpiece encountered?
	Enter a possible / reachable target position.

3 104	MEASURING BLOCK WITHOUT TRIGGER POINT
	The probe did not deflect on the transferred measuring distance.
	Was a reachable position programmed in the cycle call?
	Programme a reachable target position or adapt the position of the probe before the measuring call.

3 105	ERROR TOOL COMPENSATION
i	No tool data could be written following measurement.
🔍	(1) Check the programme call. (2) Check the parameter settings for the tool memory.
🔧	(1) Programme a valid programme call. (2) Correct the parameter settings for the tool memory.

3 106	ERROR MEASURING BLOCK/PROT. MOVE
i	No valid measuring block could be carried out.
🔍	(1) Was the probe switched on before measurement? (2) Check the ERROR signal. (3) Check the start conditions (IR / radio transmission, probe already deflected).
🔧	(1) Check if the probe is switched on. Check the transfer parameter *M*. (2) Eliminate the transmission fault. (3) Position to a valid / possible start position.

3 108	BATTERY LOW
i	The "Check battery signal" option is set and the BATTERY error signal is active.
🔍	(1) Check the batteries (probe flashes green - blue) (2) Check that the batteries query is correct.
🔧	(1) Change the batteries. (2) Enter address parameter (#135) correctly.

3 109	WRONG PROBE LENGTH
i	The entered tool length is "0".
🔍	Check the entered parameters for the tool length (#7, #8).
🔧	Input valid values for the probe length. For further information, e.g. zero tool, read Installation Instructions.

3 110	ERROR ON SWITCH-ON
i	The probe could not be switched on within the permitted time interval.
🔍	Check function O8708 (PROBE ON/OFF). See installation instructions.
🔧	Enter valid functions in programme O8708 (PROBE ON/OFF).

3 111	TOOL WRONG
	The H-number of the probe defined in programme USERPARATB is not active.
	Check if the correct "tool" was changed in or if the correct tool number was activated.
	Activate the correct "tool".

3 112	NO CALIBRATION VALUE IN Z
	The parameter or content for calibration value Z is undefined.
	(1) Check, if the probe is calibrated. (2) Check, if the start address for the calibration values (#110) is correct.
	(1) Calibrate the probe in Z. (2) Adapt the start address for the calibration values (#110).

3 113	ERROR PROG. USERPARATAB
	The parameters entered in programme USERPARATAB are invalid or faulty.
	Check the parameters.
	Enter valid values for the required parameters.

3 116	PARAMETER SETTINGS
	The parameters #100-#149 are deleted at "M0"! The machine cannot be stopped during measurement/calibration with "M0" (see Installation Instructions).
	Check the parameter setting (see Installation Instructions).
	Adapt the parameter settings. If required: Mechanical alignment of the probe!

Messages

3 115	TURN SPINDLE BY 180°
	Message: During calibration the probe must be turned by 180°. To this end, the machine stops with "M0" and the probe can be rotated manually by 180° if the machine does not have automatic spindle indexing. For further information, read installation instructions.

15. Service

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