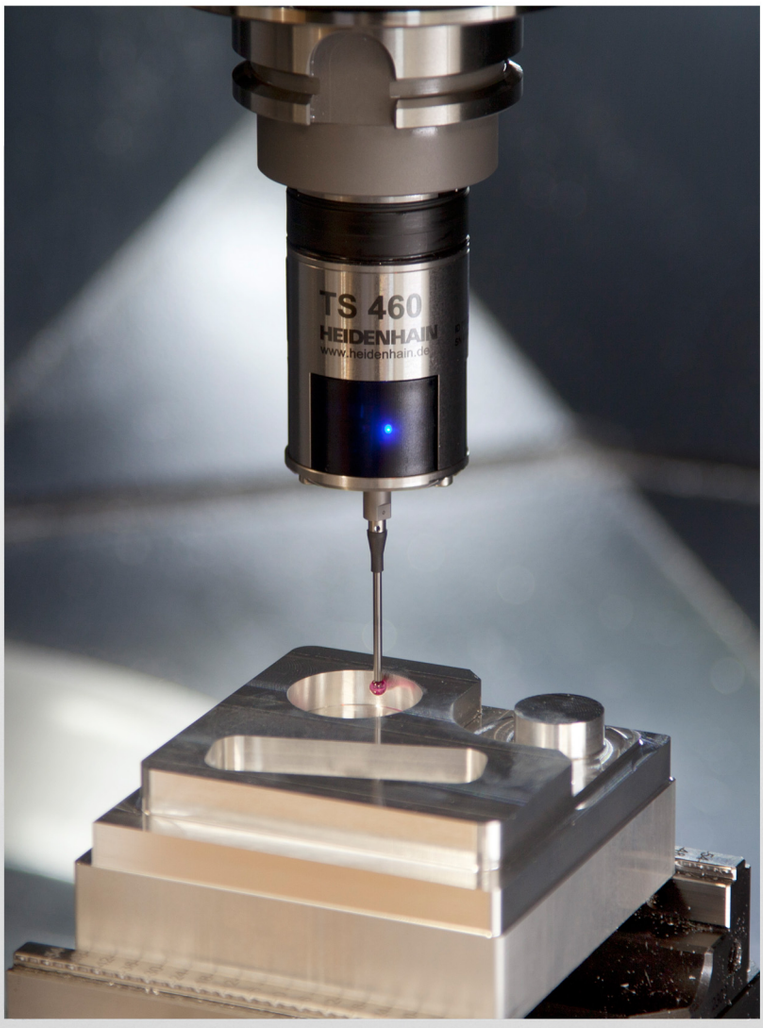
HEIDENHAIN



Fanuc

User's Manual
Touch Probe Cycles
for Workpiece Measurement

NC Software
0, 0i, 16, 18, 21, 30, 31, 32

English (en)
02/2014

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Fundamentals

1.1 Important notes

Please read the programming instructions carefully and then commission the touch probe and cycles.

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Violation obligates compensation for damages.

All data has been carefully tested. Nevertheless, no warranty can be assumed with respect to completeness and freedom from errors.

The measurement cycles should be interpreted as examples for solving measurement tasks and must be adapted by machine manufacturers or users to the specific type of machine. Before commissioning, determine whether the parameters used by the measurement cycles are already being used. If this is the case these cycles must be adapted, as the overwriting of used parameters may cause unforeseeable damage to the machine.

When commissioning the measurement cycles the program must be tested blockwise under observance of all safety measures (especially block testing prior to execution, single block and reduced feed rate). After completion of commissioning, parameters used and executed machine-specific program adaptations must be documented.

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We reserve the right to technical modifications for product improvements. Our General Sales Conditions apply.

1.2 About this manual

The symbols used in this manual are described below.

This symbol indicates that important information about the function described must be considered.

WARNING This symbol indicates a possibly dangerous situation that may cause light injuries if not avoided.

This symbol indicates that there is one or more of the following risks when using the described function:

- Danger to workpiece
- Danger to fixtures
- Danger to tool
- Danger to machine
- Danger to operator

This symbol indicates that the described function must be adapted by the machine tool builder. The function described may therefore vary depending on the machine.

This symbol indicates that you can find detailed information about a function in another manual.

1.3 Fundamental software information

Program overview

This software can be used to execute the most frequently required workpiece measurement tasks on a machine tool with a HEIDENHAIN TS touch probe.

The software contains the following programs:

Program		Content
O9700	MAIN	Main program
O9701	TOUCH XYZ	Probing single points and corners
O9702	XY CONTOUR	Probing contours
O9703	PROTECTED MOVE	Protected traversing block
O9704	MEASURE	Measurement block
O9705	SET WCS	Set datum
O9706	SET TOOL	Tool compensation
O9707	TOLERANCE	Tolerance monitoring
O9708	PROBE ON/OFF LEVEL	Switch on / off touch probe (level controlled)
O9708	PROBE ON/OFF TS444	Switch on / off touch probe (HEIDENHAIN TS444)
O9708	PROBE ON/OFF PULSE	Switch on / off touch probe (pulse controlled)
09709	CALIBRATION SPHERE	Calibration on a sphere
O9710	USERPARATAB	User data input
O9711	MESSAGES	Error messages
O9712	CALIB-PARAMETER	Conversion of calibration data
O9713	DM-3-POINTS MAIN	Calculation of position of diameter with 3 points
O9714	DM-3-POINTS CALCULATION	Calculation of results of diameter with 3 points
O9715	ANGLE-DISTANCE	Calculation of angles or distances
O9716	DPRNT	Data output via DPRNT command

All measurement tasks are executed with the MAIN program. The type of measurement task is determined by call parameters.

The touch probe is safely traversed in the machining space with the PROTECTED MOVE program. If the touch probe is deflected during a movement, the machine aborts the movement and the touch probe returns to its start position. This avoids collisions and damage to the touch probe.

The touch probe is switched on and off when required via the PROBE ON/OFF programs.

The software parameters are defined in the USERPARATAB program.

All further programs are support programs used internally by the software.

Installation information

Before working with the touch probe cycles you must carry out the following:

Requirement for installation

- See "Software installation", page 94

Mechanical installation

- see the installation instructions of the HEIDENHAIN touch probe used

Software installation

- Installing the software: page 94
- Set parameters in the 09710 USERPARATAB program: page 96
- Set parameters in the 09708 PROBE ON/OFF program: page 111

Calibrating the touch probe

- See "Calibrating a touch trigger probe", page 78

1.4 Fundamentals of touch probe cycles

Available touch probe cycles

Touch probe cycles are available for the following tasks:

Calibrating TS touch probes

- See page 78

Automatically measuring workpieces

- See page 24

Automatically measuring workpieces

- See page 38

Special cycles

- 5.1 "Program 09703 PROTECTED MOVE: Protected move", page 72
- 5.3 "Test component presence", page 75
- 5.2 "Function G68: Measuring in a Rotated Coordinate System", page 73

Possibilities of use for touch probe cycles

Possible measuring tasks

- Single probing in any axis (X/Y/Z)
- Corner in two axes
- Corner in three axes
- Slot
- Ridge
- Inside diameter
- Outside diameter
- Distance measurement
- Angle measurement

Possible measurement results

- Determine workpiece position in an active WCS
- Set datum
- Test tolerances
- Correct tool data
- Determine distances and angles

1.5 Fundamentals of Correct Measuring

Measurement cycles should be interpreted as examples for solving measurement tasks and must be adapted by machine manufacturers or users to the specific type of machine.

When commissioning the measurement cycles the program must be tested blockwise under observance of all safety measures (block testing prior to execution, single block and reduced feed rate).

For safe, correct measurements:

- Traverse the measurement position to a protected traversing block (See page 72).
- Use the same speed for measuring and calibrating.
- Observe the acceleration/brake ramp of the machine.
  Specify the (safety) clearance accordingly.
  The machine must not be in the acceleration/brake ramp during probing.
- Firmly clamp the measurement object.
- Specify the measurement position so that the probed face is only reached with the probe tip.
- Enter parameters with a point "." ("1." corresponds to 1mm, "1" corresponds to 1 µm).

2

Touch Probe Cycles: Automatically Measuring Workpieces

2.1 Fundamentals of automatic datum setting

This chapter specifies the functions for setting a datum on a newly clamped workpiece.

Pre-positioning the touch probe is carried out either with the handwheel or with the axis direction keys. You can alternatively pre-position the touch probe with a "protected traversing block" (See page 72).

Use the O9700 MAIN program to call all measurement functions. Configuration of the parameters determines the method of datum measurement.

The software supports the following processes:

Function	Page
Datum Setting in any axis	page 25
Datum Setting a corner in two axes	page 26
Datum Setting a corner in three axes	page 27
Setting datum in the center of a slot	page 34
Setting datum in the center of a ridge	page 35
Setting datum in the center of a bore hole (4 measured points)	page 28
Setting datum in the center of a bore hole (3 measured points)	page 29
Setting datum in the center of a stud (4 measured points)	page 31
Setting datum in the center of a stud (3 measured points)	page 32
Setting datum in the center of a bore hole or center of a slot, each with obstacle	page 36

- Observe that the function **G68** (coordinate rotation) is inactive during the execution of probing cycles.
- Detailed descriptions of optional parameters: See "Call parameters", page 86.

2.2 Datum Setting in any axis

This function sets the datum in a selectable axis.

Cycle run

Probe process:

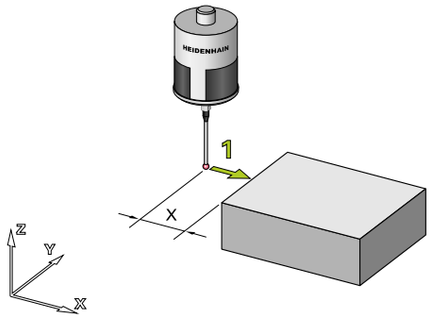
1 The touch probe traverses from the initial position **1** in the programmed probing direction to the workpiece and back

Result:

2 The software sets the measured datum in the defined **WCS** (workpiece coordinate system)

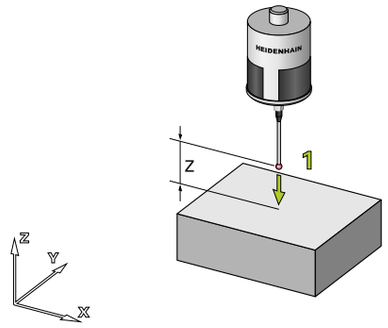
Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **X/Y/Z**: Enter the distance of the ball tip to the measuring surface. The measurement direction is defined with the algebraic sign
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **I/J/K** (optional): If the function should set the probed surface to any value, you must transfer the corresponding value via the parameters **I/J/K** (X axis: **I**, Y axis: **J**, Z axis: **K**)
- **Q** (optional): Enter override



Example: Measure datum in X

```
G65 P9700 X10. W55.
```



Example: Measure datum in Z

```
G65 P9700 Z-10. W57.
```

2.3 Datum Setting a corner in two axes

This function sets the datum at a corner in two selectable axes.

Cycle run

First probe process:

1 The touch probe traverses from the initial position **1** to the starting point **2**

2 From the starting point **2** the touch probe traverses in the programmed probing direction to the workpiece and back

3 From the starting point **2** the touch probe traverses back to the initial position **1**

Second probe process:

4 The touch probe traverses from the initial position **1** to the starting point **3**

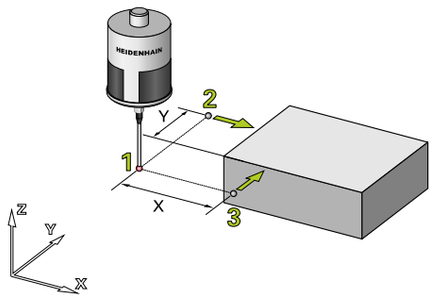
5 From the starting point **3** the touch probe traverses in the programmed probing direction to the workpiece and back

6 From the starting point **3** the touch probe traverses back to the initial position **1**

Result:

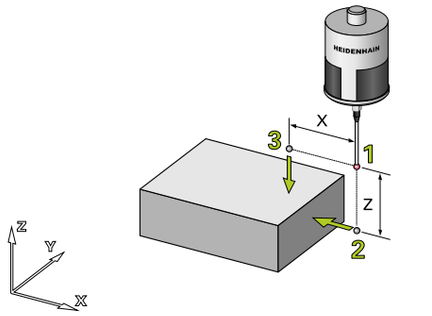
7 The software sets the measured datum in the defined **WCS** (workpiece coordinate system)

The cycle **does not calculate the corner** but only enters the **measured values** into the **WCS** you defined.



Example: Measure datum in X and Y

```
G65 P9700 X10. Y10. W59.
```



Example: Measure datum in X and Z

```
G65 P9700 X-15. Z-10. W58.
```

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **X/Y/Z**: Enter the distance of the ball tip to the measuring surface. The measurement direction is defined with the algebraic sign
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **I/J/K** (optional): If the function should set the probed surface to any value, you must transfer the corresponding value via the parameters **I/J/K** (X axis: **I**, Y axis: **J**, Z axis: **K**)
- **Q** (optional): Enter override

2.4 Datum Setting a corner in three axes

This function sets the datum at a corner in all three main axes.

Cycle run

First probe process:

1 The touch probe traverses from the initial position **1** to the starting point **2**

2 From the starting point **2** the touch probe traverses in the programmed probing direction to the workpiece and back

3 From the starting point **2** the touch probe traverses back to the initial position **1**

Second probe process:

4 The touch probe traverses from the initial position **1** to the starting point **3**

5 From the starting point **3** the touch probe traverses in the programmed probing direction to the workpiece and back

6 From the starting point **3** the touch probe traverses back to the initial position **1**

3. Probe process:

7 The touch probe traverses from the initial position **1** to the starting point **4**

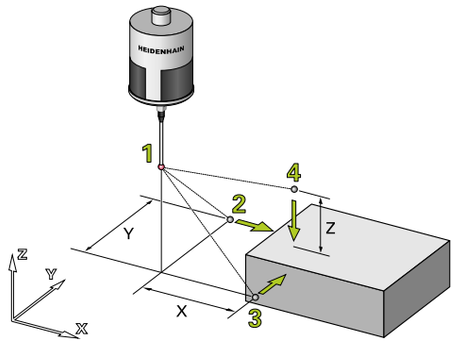
8 From the starting point **4** the touch probe traverses in the programmed probing direction to the workpiece and back

9 From the starting point **4** the touch probe traverses back to the initial position **1**

Result:

10 The software sets the measured datum in the defined **WCS** (workpiece coordinate system)

The cycle **does not calculate the corner** but only enters the **measured values** into the **WCS** you defined.



Example: Measure datum in X, Y and Z

```
G65 P9700 X10. Y10. Z-10. W59.
```

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **X**: Enter the distance of the ball tip to the first measuring surface. The measurement direction is defined with the algebraic sign
- **Y**: Enter the distance of the ball tip to the second measuring surface. The measurement direction is defined with the algebraic sign
- **Z**: Enter the distance of the ball tip to the third measuring surface. The measurement direction is defined with the algebraic sign
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **I/J/K** (optional): If the function should set the probed surface to any value, you must transfer the corresponding value via the parameters **I/J/K** (X axis: **I**, Y axis: **J**, Z axis: **K**)
- **Q** (optional): Enter override

2.5 Setting datum in the center of a bore hole (4 measured points)

This function sets the datum in the center of a bore hole with 4 measured points.

Cycle run

First probe process:

1 The touch probe traverses from the initial position **1** to the starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back

Second probe process:

3 From starting point **2** the touch probe traverses to starting point **3**

4 From starting point **3** the touch probe traverses to the workpiece and back

5 The software calculates the exact bore hole center in the **X direction** and positions the touch probe there

3. Probe process:

6 From the bore hole center (X direction) the touch probe traverses to starting point **4**

7 From starting point **4** the touch probe traverses to the workpiece and back

4. Probe process:

8 From starting point **4** the touch probe traverses to starting point **5**

9 From starting point **5** the touch probe traverses to the workpiece and back

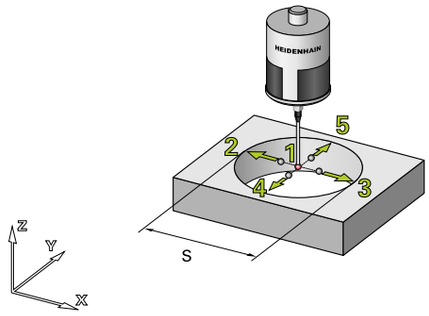
10 The software calculates the exact bore hole center in the **Y direction** and positions the touch probe there

Result:

11 The software sets the measured datum in the defined **WCS** (workpiece coordinate system)

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **S**: Input the bore hole diameter
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **I/J** (optional): If the function should set the bore hole center to any value, you must transfer the corresponding value via the parameters **I** (for X axis) or **J** (for Y axis)
- **R** (optional): Safety clearance of stylus from the workpiece edge from which the probe process starts. Always input **R** as a **negative** value; the default value is **R** = -10 mm
- **Q** (optional): Input override



Example: Measuring the datum of a bore hole center

```
G65 P9700 S40. W57.
```

2.6 Setting datum in the center of a bore hole (3 measured points)

This function sets the datum in the center of a bore hole with 3 measured points.

- Before calling the cycle, position the touch probe as precisely as possible in the center of the diameter (initial position **1**).
- Run the cycle twice if required to increase precision.

Cycle run

First probe process:

1 The touch probe traverses from initial position **1**, starting with the X axis (positive direction), with the predefined angle **H** to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back

Second probe process:

3 From starting point **2** the touch probe traverses with the predefined angle **U** to starting point **3**

4 From starting point **3** the touch probe traverses to the workpiece and back

3. Probe process:

5 From starting point **3** the touch probe traverses with the predefined angle **V** to starting point **4**

6 From starting point **4** the touch probe traverses to the workpiece and back

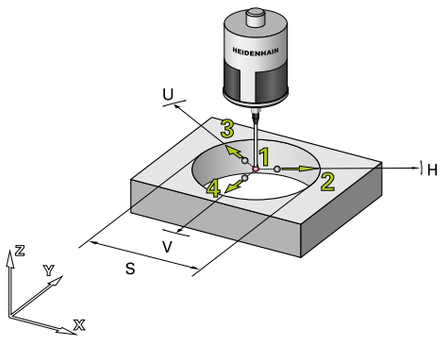
7 The software calculates the exact bore hole center and positions the touch probe there

Result:

8 The software sets the measured datum in the defined **WCS** (workpiece coordinate system). The position of the datum references the center of the inside diameter.

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **S**: Input the bore hole diameter
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **Z**: Input the traverse path of the length gauge in the Z axis from the initial position to the measurement position
- **H**: Input first probing angle in the **WCS** (reference X(+) axis)
- **U**: Input second probing angle in the **WCS** (reference X(+) axis)
- **V**: Input third probing angle in the **WCS** (reference X(+) axis)



Example: Measuring the datum of a bore hole center (3 measured points)

```
G65 P9700 S40. W57. H30. U150.
V270.
```

2.6 Setting datum in the center of a bore hole (3 measured points)

- Specify the three probing angles to divide the full circle or circle segment in angle segments that are as large as possible (e.g. 3 x 120°).
- Reference is the X axis:
  Example: 0° → + X axis, 90° → +Y axis.

- **I/J** (optional): If the function should set the bore hole center to any value, you must transfer the corresponding value via the parameters **I** (for X axis) or **J** (for Y axis)
- **R** (optional): Safety clearance of stylus from the workpiece edge from which the probe process starts. Always input **R** as a **negative** value; the nominal value is **R** = -10 mm
- **Q** (optional): Input override

2.7 Setting datum in the center of a stud (4 measured points)

This function sets the datum in the center of a stud with 4 measured points.

Cycle run

First probe process:

1 The touch probe traverses from the initial position **1** in a negative X direction and then at measuring height to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back

3 The touch probe returns to the initial height and to starting point **3** on the opposite side of the stud

Second probe process:

4 From starting point **3** the touch probe traverses to the workpiece and back

5 The software calculates the exact stud center in the **X direction** and positions the touch probe there

Third probe process:

6 From the stud center (X direction) the touch probe traverses to starting point **4**

7 From starting point **4** the touch probe traverses to the workpiece and back

Fourth probe process:

8 From starting point **4** the touch probe traverses to starting point **5**

9 From starting point **5** the touch probe traverses to the workpiece and back

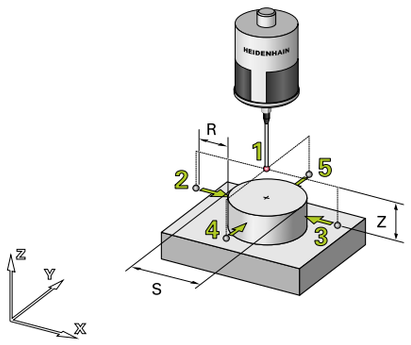
10 The software calculates the exact stud center in the **Y direction** and positions the touch probe there

Result:

11 The software sets the measured datum in the defined **WCS** (workpiece coordinate system)

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **S**: Input the bore hole diameter
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **I/J** (optional): If the function should set the bore hole center to any value, you must transfer the corresponding value via the parameters **I** (for X axis) or **J** (for Y axis)
- **R** (optional): Safety clearance of the probe tip to the workpiece with prepositioning in Z. The default value is **R** = 10 mm. Always input a **positive** value with an outer diameter **R**
- **Q** (optional): Input override



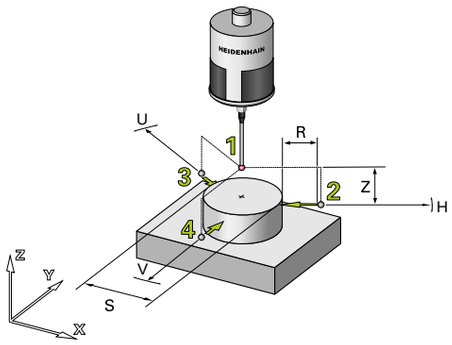
Example: Measuring the datum of a stud

```
G65 P9700 S30. Z-10. R7. W54.
```

2.8 Setting datum in the center of a stud (3 measured points)

This function sets the datum in the center of a stud with 3 measured points.

- Before calling the cycle, position the touch probe as precisely as possible in the center of the diameter (initial position **1**).
- Run the cycle twice if required to increase precision.



Example: Measuring the datum of a stud (3 measured points)

```
G65 P9700 S40. W57. Z-10. H30.
U150. V270. R7.
```

Cycle run

First probe process:

1 The touch probe traverses from initial position **1**, starting with the X axis (positive direction), with the predefined angle **H** at measuring height to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back

Second probe process:

3 From starting point **2** the touch probe traverses to initial height, and continues at the predefined angle **U** and at measuring height to starting point **3**

4 From starting point **3** the touch probe traverses to the workpiece and back

Third probe process:

5 From starting point **3** the touch probe traverses to initial height, and continues at the predefined angle **V** and at measuring height to starting point **4**

6 From starting point **4** the touch probe traverses to the workpiece and back

7 At the end the control positions the touch probe exactly in the center of the stud.

Result:

8 The software sets the measured datum in the defined **WCS** (workpiece coordinate system). The position of the datum references the center of the outside diameter.

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **S**: Input the stud diameter
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **Z**: Input the traverse path of the length gauge in the Z axis from the initial position to the measurement position
- **H**: Input first probing angle in the **WCS** (reference X(+) axis)
- **U**: Input second probing angle in the **WCS** (reference X(+) axis)
- **V**: Input third probing angle in the **WCS** (reference X(+) axis)

Setting datum in the center of a stud (3 measured points) 2.8

- Specify the three probing angles to divide the full circle or circle segment in angle segments that are as large as possible (e.g. 3 x 120°).
- Reference is the X axis:
  Example: 0° → + X axis, 90° → +Y axis.

- **I/J** (optional): If the function should set the bore hole center to any value, you must transfer the corresponding value via the parameters **I** (for X axis) or **J** (for Y axis)
- **R** (optional): Safety clearance of the probe tip to the workpiece with prepositioning in Z. The default value is **R** = 10 mm. Always input a **positive** value with an outer diameter **R**
- **Q** (optional): Input override

2.9 Setting datum in the center of a slot

This function sets the datum in the center of a slot. The slot axis can be either in the X or Y direction.

Cycle run

First probe process:

1 The touch probe traverses from initial position **1** in a negative direction to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back

Second probe process:

3 From starting point **2** the touch probe traverses to starting point **3**

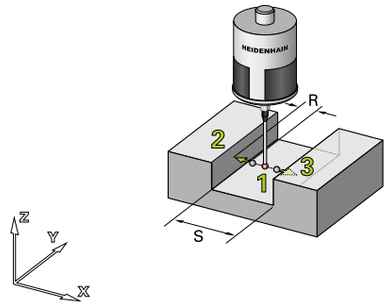
4 From starting point **3** the touch probe traverses to the workpiece and back to the calculated slot center

Result:

5 The software sets the measured datum in the defined **WCS** (workpiece coordinate system)

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **S**: Input the width of the slot
- **X1** or **Y1**: Define the measuring axis. If **X1** is entered the function calculates the datum in the X direction, and if **Y1** is entered the Y direction
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **I/J** (optional): If the function should set the slot center to any value, you must transfer the corresponding value via the parameters **I** (for X axis) or **J** (for Y axis)
- **R** (optional): Safety clearance of stylus from the workpiece edge from which the probe process starts. Always input **R** as a **negative** value; the default value is **R** = -10 mm
- **Q** (optional): Input override



Example: Datum in a slot (X direction)

```
G65 P9700 S20. X1. W54.
```

2.10 Setting datum in the center of a ridge

This function sets the datum in the center of a ridge. The ridge axis can be either in the X or Y direction.

Cycle run

First probe process:

1 The touch probe traverses from initial position **1** in a negative direction and at probing height to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back to initial position **1**

Second probe process:

3 From initial position **1** the touch probe traverses in a positive direction and at probing height to starting point **3**

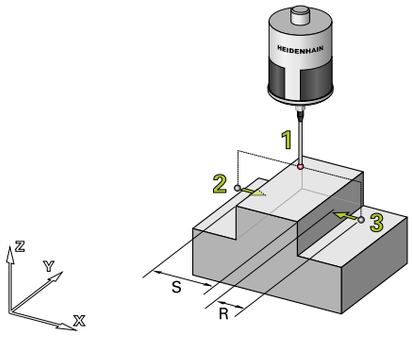
4 From starting point **3** the touch probe traverses to the workpiece and back to the calculated ridge center **1**

Result:

5 The software sets the measured datum in the defined **WCS** (workpiece coordinate system)

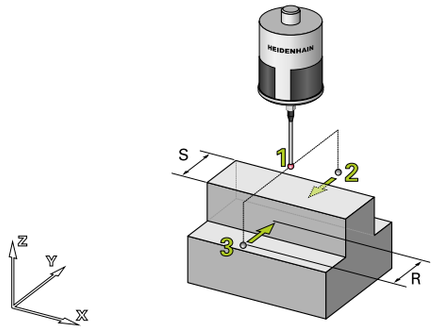
Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **S**: Input the width of the ridge
- **X1** or **Y1**: Define the measuring axis. If **X1** is entered the function calculates the datum in the X direction, and if **Y1** is entered, in the Y direction
- **Z**: Traverse path of the touch probe in the Z axis from the initial position to measuring height The direction of traverse is defined via the algebraic sign
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **I/J** (optional): If the function should set the ridge center to any value, you must transfer the corresponding value via the parameters **I** (for X axis) or **J** (for Y axis)
- **R** (optional): Safety clearance of the probe tip to the workpiece with prepositioning in Z. The default value is **R** = 10 mm. With a ridge, always input **R** as a **positive** value
- **Q** (optional): Input override



Example: Ridge datum (in X direction)

```
G65 P9700 S20. X1. Z-20. W54.
```



Example: Ridge datum (in Y direction)

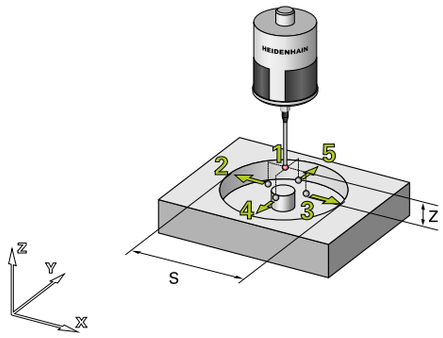
```
G65 P9700 S20. Y1. Z-10. R7. W54.
```

2.11 Setting datum in the center of a bore hole or center of a slot, each with obstacle

This function sets the datum in the center of a bore hole or the center of a slot, with the software traversing around an obstacle in the center of each.

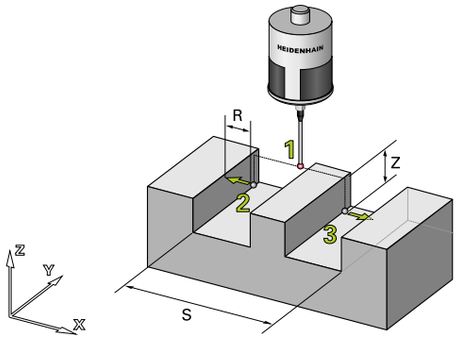
Cycle run

1 The control traverses the touch probe from the momentary position **1** in a negative X direction and then at measuring height to the starting position **2** of the first probe process
2 From this location the touch probe traverses in a negative X direction, and following successful probing returns to starting point **2**
3 The touch probe then traverses back to initial height and to the opposite side of the bore hole or slot
4 The control traverses the touch probe at measuring height to starting point **3** of the second probe process
5 The touch probe then traverses in the positive X direction, and following successful probing returns to starting point **3**
6 The touch probe finally returns to initial height and in the calculated center of the X axis
7 Slot measurement is then concluded. For measuring a bore hole, the control carries out the same measuring run **1** to **6** in the Y direction (starting point **4** and starting point **5**) and positions the touch probe in the calculated center of the Y axis
8 The software sets the measured datum in the defined **WCS** (workpiece coordinate system)



Example: Measuring the datum of a bore hole center with obstacle

```
G65 P9700 R-10. S30. Z-15. W56.
```



Example: Measuring the datum of a slot with obstacle

```
G65 P9700 R-5. S40. X1. Z-10. W55.
```

The cycle run is also analog for a slot measured in the Y direction.

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **R**: Safety clearance of the probe tip to the workpiece with prepositioning in Z. With inside diameters and slots always input **R** as a **negative** value
- **S**: Input the diameter of the bore hole or slot width
- **X1** or **Y1,** for measuring a slot: Define the measuring axis. If **X1** is entered the function calculates the datum in the X direction, and if **Y1** is entered, the datum in the Y direction
- **Z**: Traverse path of the touch probe in the Z axis from the initial position to measuring height The direction of traverse is defined via the algebraic sign
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **I/J** (optional): If the function should set the bore hole center or slot center to any value, you must transfer the corresponding value via the parameters **I** (for X axis) or **J** (for Y axis)
- **Q** (optional): Input override

3

Touch Probe Cycles: Automatically Measuring Workpieces

3.1 Fundamentals of automatic measuring

This chapter describes the functions for automatically measuring a clamped workpiece.

The difference between probe cycles for datum acquisition and for measuring:

For **datum acquisition** the dimensions in the program call are **relative to the workpiece**, meaning the distance from the probe tip to the workpiece is entered.

With the **measuring** function, dimensions in the program call are **absolute to the workpiece**, meaning the program is given absolute coordinates about the active WCS. This absolute dimensioning is identified with the additional parameter **A1.** when calling the program O9700 MAIN.

Pre-positioning the touch probe is implemented either with the handwheel or the axis direction keys. You can alternatively pre-position the touch probe with a "protected traversing block" (See page 72).

Use the O9700 MAIN program to call all measurement functions. The configuration of the parameters determines the type of measurement position.

The software supports the following processes for measuring:

Function	Page
Measuring a Single Point in any Axis	page 40
Measuring a Corner in Two Axes	page 41
Measuring a Corner in Three Axes	page 43
Measuring a Slot	page 53
Measuring a Ridge	page 55
Measuring a Bore Hole (4 Measured Points)	page 45
Measuring a Bore Hole (3 Measured Points)	page 47
Measuring a Stud (Outside Diameter, 4 Measured Points)	page 49
Measuring a Stud (Outside Diameter, 3 Measured Points)	page 51
Measuring Bore Hole or Slot, Each with Obstacle	page 57

- Detailed descriptions of optional parameters: See "Call parameters", page 86.

Advanced parameters for production process monitoring

Parameter	Function
T	The parameter **T** is used after workpiece production to test various dimensions for dimensional accuracy and tolerance. If the predefined tolerance has been exceeded, the program is interrupted and an error message is output.
W	With the parameter **W** the precise workpiece datum can be determined and corrected if required between two processing steps.
E	With the parameter **E** the wear of a workpiece can be determined for updating the values in the tool memory. With the distance-angle function, the parameter **D** can be used to calculate angles or distances.

3.2 Measuring a Single Point in any Axis

This function determines the coordinates of a position on the aligned workpiece in a selectable axis and calculates the deviation from the nominal position.

Cycle run

Measuring process:

1 The touch probe traverses from the initial position **1** in the programmed measuring direction to the workpiece and back

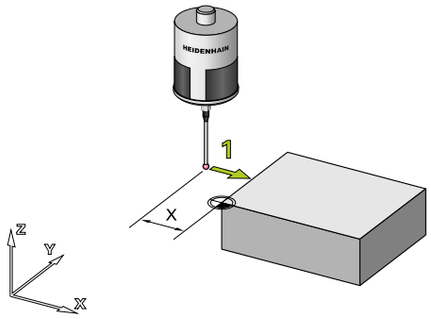
Result:

2 The software saves the actual position of the probed edge in the active **WCS** (workpiece coordinate system) and the calculated deviation from the nominal position in the following result parameters:

Measurement axis	Parameter	Meaning
X	#111+0	X position of the edge in the active WCS
X	#111+3	Deviation from the entered position or from the nominal position (parameter **I**) in X
Y	#111+1	Y position of the edge in the active WCS
Y	#111+4	Deviation from the entered position or from the nominal position (parameter **J**) in Y
Z	#111+2	Z position of the edge in the active WCS
Z	#111+5	Deviation from the entered position or from the nominal position (parameter **K**) in Z

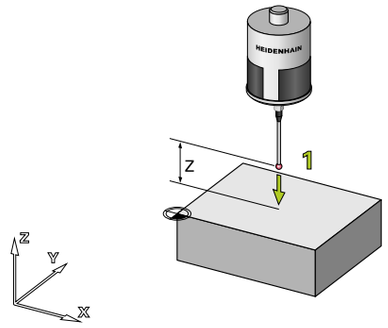
Cycle call and cycle parameters

- Activate WCS: **G...**
- Open a new program block and enter the cycle definition: **G65 P9700**
- **A1**: Use absolute dimensioning
- **X/Y/Z**: Input the measuring axis and nominal position of the edge to be measured
- **E** (optional): Input the workpiece number that the software should correct by the determined deviation
- **T** (optional): Input the permitted tolerance after which the software should output an error message
- **W** (optional): Input the number of the **WCS** that you wish to set or correct
- **I/J/K** (optional): Nominal position of the edge in a reset **WCS** if deviating from zero. With parameters **I, J, K** (X axis: **I**, Y axis: **J**, Z axis: **K**) the sequence of parameters in the program call must be observed.
- **Q** (optional): Enter override



Example: Measuring single point X

```
G54
G65 P9700 A1. X0.
```



Example: Measuring single point Z

```
G54
G65 P9700 A1. Z0.
```

3.3 Measuring a Corner in Two Axes

This function determines the coordinates of a position on the aligned workpiece in a selectable axis and calculates the deviation from the nominal position.

Cycle run

First measuring process:

1 The touch probe traverses from the initial position **1** to starting point **2**

2 From starting point **2** the touch probe traverses in the programmed measuring direction to the workpiece and back

3 From starting point **2** the touch probe traverses back to initial position **1**

Second measuring process:

4 The touch probe traverses from initial position **1** to starting point **3**

5 From starting point **3** the touch probe traverses in the programmed measuring direction to the workpiece and back

6 From starting point **3** the touch probe traverses back to initial position **1**

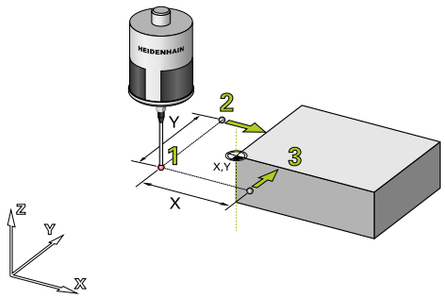
Result:

7 The software saves the actual position of the two probed edges in the active **WCS** (workpiece coordinate system) and the calculated deviation from the nominal position in the following result parameters:

Measurement axis	Parameter	Meaning
X	#111+0	X position of the edge in the active WCS
X	#111+3	Deviation from the entered position or from the nominal position (parameter **I**) in X
Y	#111+1	Y position of the edge in the active WCS
Y	#111+4	Deviation from the entered position or from the nominal position (parameter **J**) in Y
Z	#111+2	Z position of the edge in the active WCS
Z	#111+5	Deviation from the entered position or from the nominal position (parameter **K**) in Z

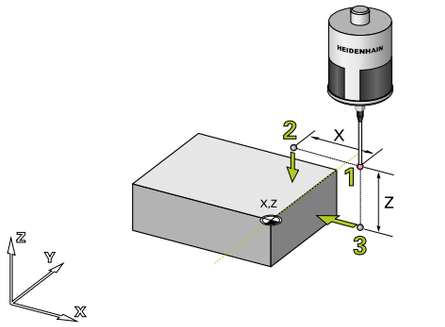
Cycle call and cycle parameters

- Activate WCS: **G...**
- Open a new program block and enter the cycle definition: **G65 P9700**
- **A1**: Use absolute dimensioning
- **X/Y/Z**: Input the measuring axis and nominal position of the edge to be measured
- **E** (optional): Input the workpiece number that the software should correct by the determined deviation
- **T** (optional): Input the permitted tolerance after which the software should output an error message



Example: Measuring an XY corner

```
G54
G65 P9700 A1. X10. Y10.
```



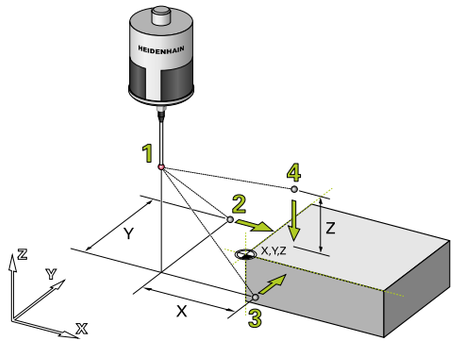
Example: Measuring an XZ corner

```
G54
G65 P9700 A1. X-10. Z-5.
```

- **W** (optional): Input the number of the **WCS** that you wish to set or correct
- **I/J/K** (optional): Nominal position of the edge in a newly set **WCS** if deviating from zero. With parameters **I, J, K** (X axis: **I**, Y axis: **J**, Z axis: **K**) the sequence of parameters in the program call must be observed.
- **Q** (optional): Enter override

3.4 Measuring a Corner in Three Axes

This function measures the coordinates of a corner on the aligned workpiece in three axes and calculates the deviations to the nominal values.



Example: Measuring an XYZ corner

```
G54
G65 P9700 A1. X5. Y5. Z-5.
```

Cycle run

First measuring process:

1 The touch probe traverses from the initial position **1** to starting point **2**

2 From starting point **2** the touch probe traverses in the programmed measuring direction to the workpiece and back

3 From starting point **2** the touch probe traverses back to initial position **1**

Second measuring process:

4 The touch probe traverses from initial position **1** to starting point **3**

5 From starting point **3** the touch probe traverses in the programmed measuring direction to the workpiece and back

6 From starting point **3** the touch probe traverses back to initial position **1**

3. Measuring process:

7 The touch probe traverses from initial position **1** to starting point **4**

8 From starting point **4** the touch probe traverses in the programmed measuring direction to the workpiece and back

9 From starting point **4** the touch probe traverses back to initial position **1**

Result:

10 The software saves the actual position of the probed edges in the active **WCS** (workpiece coordinate system) and the calculated deviation from the nominal position in the following result parameters:

Measurement axis	Parameter	Meaning
X	#111+0	X position of the edge in the active WCS
X	#111+3	Deviation from the entered position or from the nominal position (parameter **I**) in X
Y	#111+1	Y position of the edge in the active WCS
Y	#111+4	Deviation from the entered position or from the nominal position (parameter **J**) in Y
Z	#111+2	Z position of the edge in the active WCS
Z	#111+5	Deviation from the entered position or from the nominal position (parameter **K**) in Z

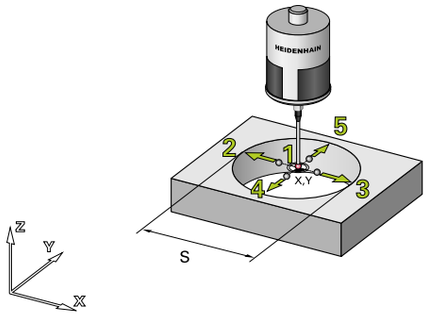
Cycle call and cycle parameters

- Activate WCS: **G...**
- Open a new program block and enter the cycle definition: **G65 P9700**
- **A1**: Use absolute dimensioning
- **X/Y/Z**: Input the measuring axis and nominal position of the edge to be measured

- **E** (optional): Input the workpiece number that the software should correct by the determined deviation
- **T** (optional): Input the permitted tolerance after which the software should output an error message
- **W** (optional): Input the number of the **WCS** that you wish to set or correct
- **I/J/K** (optional): Nominal position of the edge in a newly set **WCS** if deviating from zero. With parameters **I, J, K** (X axis: **I**, Y axis: **J**, Z axis: **K**) the sequence of parameters in the program call must be observed.
- **Q** (optional): Enter override

3.5 Measuring a Bore Hole (4 Measured Points)

This function measures the diameter and center of a bore hole with 4 measured points and calculates the deviations from the nominal values.



Example: Inside diameter

```
G55
G65 P9700 A1. S60.
```

Cycle run

First measuring process:

1 The touch probe traverses from initial position **1** to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back

Second measuring process:

3 From starting point **2** the touch probe traverses to starting point **3**

4 From starting point **3** the touch probe traverses to the workpiece and back

5 The software calculates the exact bore hole center in the **X direction** and positions the touch probe there

Third measuring process:

6 From the bore hole center (X direction) the touch probe traverses to starting point **4**

7 From starting point **4** the touch probe traverses to the workpiece and back

Fourth measuring process:

8 From starting point **4** the touch probe traverses to starting point **5**

9 From starting point **5** the touch probe traverses to the workpiece and back

10 The software calculates the exact bore hole center in the **Y direction** and positions the touch probe there

Result:

11 The software saves the actual position of the bore hole center in the active **WCS** (workpiece coordinate system). The calculated deviation from the nominal position and the diameter of the bore hole are saved in the following result parameters:

Parameter	Meaning
#111+6	Bore hole diameter
#111+7	Deviation from nominal diameter
#111+0	X position of the midpoint in the active WCS
#111+3	Deviation from the entered position or from the nominal position (parameter **I**) in X
#111+1	Y position of the midpoint in the active WCS
#111+4	Deviation from the entered position or from the nominal position (parameter **J**) in Y

Cycle call and cycle parameters

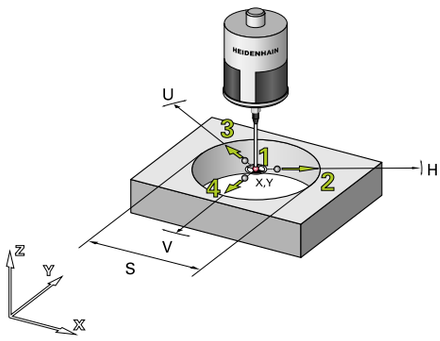
- Activate WCS: **G...**
- Open a new program block and enter the cycle definition: **G65 P9700**
- **A1**: Use absolute dimensioning
- **S**: Input the bore hole nominal diameter

- **E** (optional): Input the workpiece number that the software should correct by the determined deviation
- **T** (optional): Input the permitted tolerance after which the software should output an error message
- **W** (optional): Input the number of the **WCS** that you wish to set or correct
- **I/J** (optional): Nominal position of the edge in a newly set **WCS** if deviating from zero. With parameters **I, J** (X axis: **I**, Y axis: **J**) the sequence of parameters in the program call must be observed.
- **Q** (optional): Enter override

3.6 Measuring a Bore Hole (3 Measured Points)

This function measures the diameter and center of a bore hole with 3 measured points and calculates the deviations from the nominal values.

- Before calling the cycle, position the touch probe as precisely as possible in the center of the diameter (initial position **1**).
- Run the cycle twice if required to increase precision.



Example: Measuring inside diameter (3 measured points)

```
G55
G65 P9700 A1. S50. H30. U150. V270.
```

Cycle run

First measuring process:

1 The touch probe traverses from initial position **1**, starting with the X axis (positive direction), with the predefined angle **H** to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back

Second measuring process:

3 From starting point **2** the touch probe traverses with the predefined angle **U** to starting point **3**

4 From starting point **3** the touch probe traverses to the workpiece and back

Third measuring process:

5 From starting point **3** the touch probe traverses with the predefined angle **V** to starting point **4**

6 From starting point **4** the touch probe traverses to the workpiece and back

7 The software calculates the exact bore hole center and positions the touch probe there

Result:

8 The software saves the actual position of the bore hole center in the active **WCS** (workpiece coordinate system). The calculated deviation from the nominal position and the diameter of the bore hole are saved in the following result parameters:

Parameter	Meaning
#111+6	Bore hole diameter
#111+7	Deviation from nominal diameter
#111+0	X position of the midpoint in the active WCS
#111+3	Deviation from the entered position or from the nominal position (parameter **I**) in X
#111+1	Y position of the midpoint in the active WCS
#111+4	Deviation from the entered position or from the nominal position (parameter **J**) in Y

3.6 Measuring a Bore Hole (3 Measured Points)

Cycle call and cycle parameters

- Activate WCS: **G...**
- Open a new program block and enter the cycle definition: **G65 P9700**
- **A1.**: Use absolute dimensioning
- **S**: Input the bore hole nominal diameter
- **E** (optional): Input the workpiece number that the software should correct by the determined deviation
- **H**: Input first probing angle in the **WCS** (reference X(+) axis)
- **U**: Input second probing angle in the **WCS** (reference X(+) axis)
- **V**: Input third probing angle in the **WCS** (reference X(+) axis)

- Specify the three probing angles to divide the full circle or circle segment in angle segments that are as large as possible (e.g. 3 x 120°).
- Reference is the X axis:
  Example: 0° → + X axis, 90° → +Y axis.

- **T** (optional): Input the permitted tolerance after which the software should output an error message
- **W** (optional): Input the number of the **WCS** that you wish to set or correct
- **I/J** (optional): Nominal position of the edge in a newly set **WCS** if deviating from zero. With parameters **I, J** (X axis: **I**, Y axis: **J**) the sequence of parameters in the program call must be observed.
- **Q** (optional): Enter override

3.7 Measuring a Stud (Outside Diameter, 4 Measured Points)

This function measures the diameter and center of a stud and calculates the deviations from the nominal values.

Cycle run

First probe process:

1 The touch probe traverses from the initial position **1** in a negative X direction and then at measuring height to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back

Second probe process:

3 From starting point **1** the touch probe traverses to starting point **3**

4 From starting point **3** the touch probe traverses to the workpiece and back

5 The software calculates the exact stud center in the **X direction** and positions the touch probe there

Third probe process:

6 From the bore hole center, the touch probe traverses in the X direction to starting point **4**

7 From starting point **4** the touch probe traverses to the workpiece and back

Fourth probe process:

8 From starting point **4** the touch probe traverses to starting point **5**

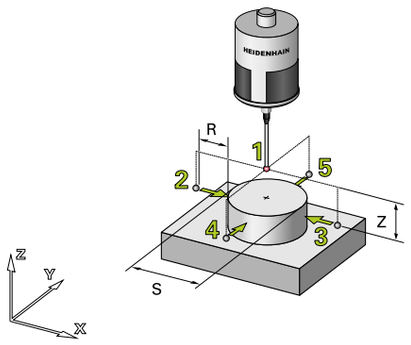
9 From starting point **5** the touch probe traverses to the workpiece and back

10 The software calculates the exact stud center in the **Y direction** and positions the touch probe there

Result:

11 The software saves the actual position of the stud center in the active **WCS** (workpiece coordinate system). The calculated deviation from the nominal position and the diameter of the stud are saved in the following result parameters:

Parameter	Meaning
#111+6	Actual diameter of the stud
#111+7	Deviation from nominal diameter
#111+0	X position of the midpoint in the active WCS
#111+3	Deviation from the entered position or from the nominal position (parameter **I**) in X
#111+1	Y position of the midpoint in the active WCS
#111+4	Deviation from the entered position or from the nominal position (parameter **J**) in Y



Example: Measuring outside diameter

```
G55
G65 P9700 A1. S50. R7. Z-5.
```

3.7 Measuring a Stud (Outside Diameter, 4 Measured Points)

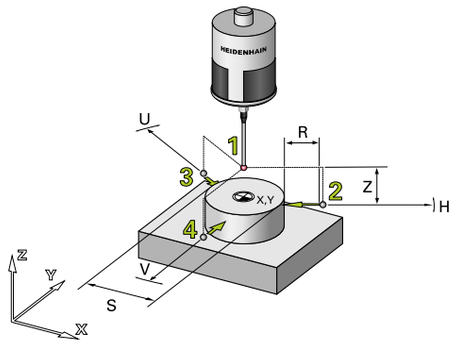
Cycle call and cycle parameters

- Activate WCS: **G...**
- Open a new program block and enter the cycle definition: **G65 P9700**
- **A1.**: Use absolute dimensioning
- **S**: Input the bore hole diameter
- **Z**: Measurement position in the Z axis in the active WCS. The datum for positioning in Z is the ball tip center
- **E**: Tool number of the tool to be corrected
- **T**: Position tolerance of the midpoint (**T** negative), or tolerance of the diameter (**T** positive)
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **I/J** (optional): If the function should set the bore hole center to any value, you must transfer the corresponding value via the parameters **I** (for X axis) or **J** (for Y axis)
- **R** (optional): Safety clearance of the probe tip to the workpiece with prepositioning in Z. The default value is **R** = 10 mm. Always input a **positive** value with an outer diameter **R**
- **Q** (optional): Input override

3.8 Measuring a Stud (Outside Diameter, 3 Measured Points)

This function measures the diameter and center of a stud and calculates the deviations from the nominal values with 3 measured points.

- Before calling the cycle, position the touch probe as precisely as possible in the center of the diameter (initial position **1**).
- Run the cycle twice if required to increase precision.



Example: Measuring a stud (3 measured points)

```
G55
G65 P9700 A1. S50. H30. U150. V270.
Z-3.
```

Cycle run

First measuring process:

1 The touch probe traverses from initial position **1**, starting with the X axis (positive direction), with the predefined angle **H** at measuring height to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back

Second measuring process:

3 From starting point **2** the touch probe traverses to initial height, and continues at the predefined angle **U** and at measuring height to starting point **3**

4 From starting point **3** the touch probe traverses to the workpiece and back

Third measuring process:

5 From starting point **3** the touch probe traverses to initial height, and continues at the predefined angle **V** and at measuring height to starting point **4**

6 From starting point **4** the touch probe traverses to the workpiece and back

7 At the end the control positions the touch probe exactly in the center of the stud.

Result:

8 The software saves the actual position of the stud center in the active **WCS** (workpiece coordinate system). The calculated deviation from the nominal position and the diameter of the stud are saved in the following result parameters:

Parameter	Meaning
#111+6	Diameter of outside diameter
#111+7	Deviation from nominal diameter
#111+0	X position of the midpoint in the active WCS
#111+3	Deviation from the entered position or from the nominal position (parameter **I**) in X
#111+1	Y position of the midpoint in the active WCS
#111+4	Deviation from the entered position or from the nominal position (parameter **J**) in Y

Cycle call and cycle parameters

3.8 Measuring a Stud (Outside Diameter, 3 Measured Points)

- Activate WCS: **G...**
- Open a new program block and enter the cycle definition: **G65 P9700**
- **A1.**: Use absolute dimensioning
- **S**: Input the stud diameter
- **Z**: Traverse path of the touch probe in the Z axis from the initial position to measuring height. The direction of traverse is defined via the algebraic sign. The datum for positioning in Z is the ball tip center
- **H**: Input first probing angle in the **WCS** (reference X(+) axis)
- **U**: Input second probing angle in the **WCS** (reference X(+) axis)
- **V**: Input third probing angle in the **WCS** (reference X(+) axis)

- Specify the three probing angles to divide the full circle or circle segment in angle segments that are as large as possible (e.g. 3 x 120°).
- Reference is the X axis:
  Example: 0° → + X axis, 90° → +Y axis.

- **E**: Tool number of the tool to be corrected
- **T**: Position tolerance of the midpoint (**T** negative), or tolerance of the diameter (**T** positive)
- **W**: Enter the number of the **WCS** in which the measured datum should be set
- **I/J** (optional): If the function should set the bore hole center to any value, you must transfer the corresponding value via the parameters **I** (for X axis) or **J** (for Y axis)
- **R** (optional): Safety clearance of the probe tip to the workpiece with prepositioning in Z. The default value is **R** = 10 mm. Always input a **positive** value with an outer diameter **R**
- **Q** (optional): Input override

3.9 Measuring a Slot

This function measures the width and center of a slot and calculates the deviations from the nominal values. The slot axis can be either in the X or Y direction.

Cycle run

First measuring process:

1 The touch probe traverses from initial position **1** in a negative direction to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back

Second measuring process:

3 From starting point **2** the touch probe traverses to starting point **3**

4 From starting point **3** the touch probe traverses to the workpiece and back to the calculated slot center

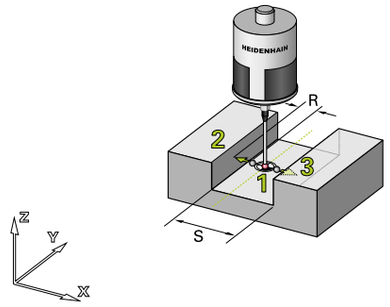
Result:

5 The software saves the actual position of the two probed edges in the active **WCS** (workpiece coordinate system) and the calculated deviation from the nominal position in the following result parameters:

Measurement axis	Parameter	Meaning
	#111+6	Slot width
	#111+7	Deviation to nominal width
X	#111+0	X position of the midpoint in the active WCS
X	#111+3	Deviation from the entered position or from the nominal position (parameter **I**) in X
Y	#111+1	Y position of the midpoint in the active WCS
Y	#111+4	Deviation from the entered position or from the nominal position (parameter **J**) in Y

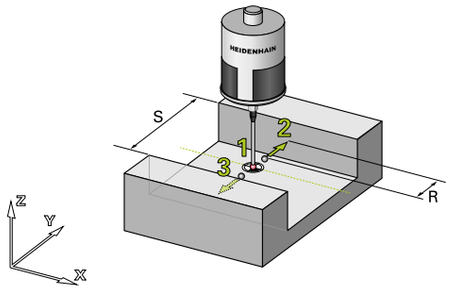
Cycle call and cycle parameters

- Activate WCS: **G...**
- Open a new program block and enter the cycle definition: **G65 P9700**
- **A1**: Use absolute dimensioning
- **S**: Input the nominal width of the slot
- **X1** or **Y1**: Define the measuring axis. If **X1** is entered the function calculates the slot width in the X direction, and if **Y1** is entered, in the Y direction
- **E** (optional): Input the workpiece number that the software should correct by the determined deviation
- **T** (optional): Input the permitted tolerance after which the software should output an error message
- **W** (optional): Input the number of the **WCS** that you wish to set or correct



Example: Measuring slot X

```
G54
G65 P9700 A1. S20. X1.
```



Example: Measuring slot Y

```
G54
G65 P9700 A1. S20. Y1.
```

- **I/J** (optional): Nominal position of the edge in a newly set **WCS** if deviating from zero. With parameters **I, J** (X axis: **I**, Y axis: **J**) the sequence of parameters in the program call must be observed.
- **R** (optional): Safety clearance of the stylus from the workpiece edge from which the probe process starts. Always input **R** as a **negative** value; the default value is **R** = -10mm
- **Q** (optional): Enter override

3.10 Measuring a Ridge

This function measures the width and center of a ridge and calculates the deviations from the nominal values. The ridge axis can be either in the X or Y direction.

Cycle run

First measuring process:

1 From starting point **1** the touch probe traverses to starting point **2**

2 From starting point **2** the touch probe traverses to the workpiece and back to initial position **1**

Second measuring process:

3 From starting point **1** the touch probe traverses to starting point **3**

4 From starting point **3** the touch probe traverses to the workpiece and back to the calculated ridge center

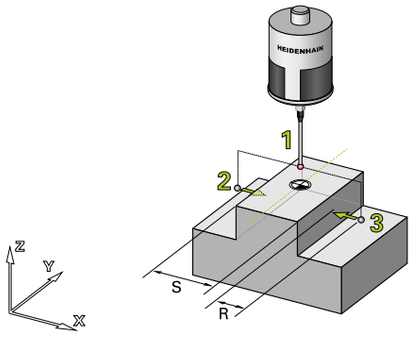
Result:

5 The software saves the actual position of the two probed edges in the active **WCS** (workpiece coordinate system) and the calculated deviation from the nominal position in the following result parameters:

Measurement axis	Parameter	Meaning
	#111+6	Ridge width
	#111+7	Deviation to nominal width
X	#111+0	X position of the midpoint in the active WCS
X	#111+3	Deviation from the entered position or from the nominal position (parameter **I**) in X
Y	#111+1	Y position of the midpoint in the active WCS
Y	#111+4	Deviation from the entered position or from the nominal position (parameter **J**) in Y

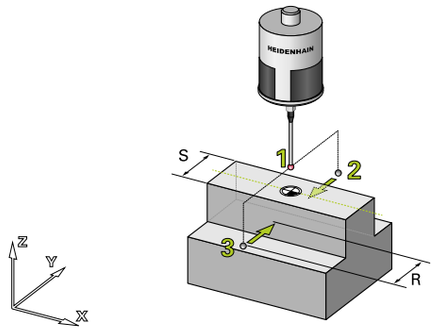
Cycle call and cycle parameters

- Activate WCS: **G...**
- Open a new program block and enter the cycle definition: **G65 P9700**
- **A1**: Use absolute dimensioning
- **S**: Input the nominal width of the ridge
- **X1** or **Y1**: Define the measuring axis. If **X1** is entered the function calculates the slot width in the X direction, and if **Y1** is entered, in the Y direction
- **Z**: Measurement position in the Z axis in the active WCS.
- **E** (optional): Input the workpiece number that the software should correct by the determined deviation
- **T** (optional): Input the permitted tolerance after which the software should output an error message
- **W** (optional): Input the number of the **WCS** that you wish to set or correct



Example: Measure ridge in X axis

```
G57
G65 P9700 A1. S20. X1. Z-4.
```



Example: Measure ridge in Y axis

```
G54
G65 P9700 A1. S35. Y1. Z-5. R7.
```

- **I/J** (optional): Nominal position of the edge in a newly set **WCS** if deviating from zero. With parameters **I, J** (X axis: **I**, Y axis: **J**) the sequence of parameters in the program call must be observed.
- **R** (optional): Safety clearance of the probe tip to the workpiece with prepositioning in Z. The default value is **R** = 10 mm. With a ridge, always input **R** as a **positive** value
- **Q** (optional): Enter override

3.11 Measuring Bore Hole or Slot, Each with Obstacle

This function measures:

- The diameter and the center of a bore hole or
- the width and center of a slot.

The software calculates the deviations to the nominal values, whereby an obstacle in the center is traversed around in each case.

Cycle run

First probe process for bore hole and slot:

1 The control traverses the touch probe from the momentary position **1** in a negative X direction and then at measuring height to the starting position **2** of the first probe process

2 From starting point **2** the touch probe traverses to the workpiece and back

3 The touch probe then traverses back to initial height and to the opposite side of the bore hole or slot

Second probe process for bore hole and slot:

4 The control traverses the touch probe at measuring height to starting point **3** of the second probe process

5 The touch probe then traverses in the positive X direction, and following successful probing returns to starting point **3**

6 The touch probe finally returns to initial height and in the calculated center of the X axis

7 Slot measurement is now concluded

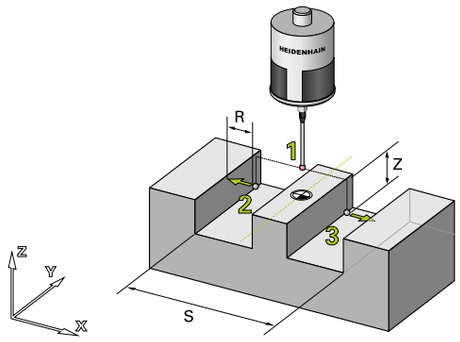
Further probe processes only for bore holes:

8 For measuring a bore hole, the control carries out the measuring run **1** to **6** in the Y direction again (starting point **4** and starting point **5**) and positions the touch probe in the calculated center of the X and Y axis

Result:

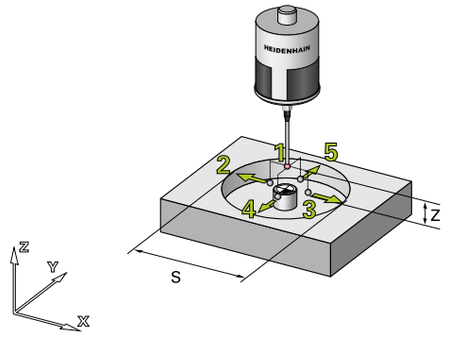
9 The software saves the measured actual position in the active **WCS** (workpiece coordinate system), and calculated deviations to the nominal values and slot width or circle diameter in the following result parameters:

Parameter	Meaning
#111+6	Bore hole diameter
#111+7	Deviation from nominal diameter
#111+0	X position of the midpoint in the active WCS
#111+3	Deviation from the entered position or from the nominal position (parameter **I**) in X
#111+1	Y position of the midpoint in the active WCS
#111+4	Deviation from the entered position or from the nominal position (parameter **J**) in Y



Example: Measuring slot X with obstacle

```
G58
G65 P9700 A1. R-5. S30. X1. Z-5.
```



Example: Measuring bore hole with obstacle

```
G59
G65 P9700 A1. R-10. S30. Z-5.
```

3.11 Measuring Bore Hole or Slot, Each with Obstacle

The cycle run is also analog for a slot measured in the Y direction.

Cycle call and cycle parameters

- Activate WCS: **G...**
- Open a new program block and enter the cycle definition: **G65 P9700**
- **A1**: Use absolute dimensioning
- **R**: Safety clearance of the probe tip to the workpiece with prepositioning in Z. With inside diameters and slots, always input **R** as a **negative** value
- **S**: Input the bore hole nominal diameter
- **X1** or **Y1,** if measuring a slot: Define the measuring axis. If **X1** is entered the function calculates the slot width in the X direction, and if **Y1** is entered, the slot width in the Y direction
- **Z**: Measuring height in the Z axis in the active **WCS**
- **E** (optional): Input the workpiece number that the software should correct by the determined deviation
- **T** (optional): Input the permitted tolerance after which the software should output an error message
- **W** (optional): Input the number of the **WCS** that you wish to set or correct
- **I/J** (optional): Nominal position of the edge in a newly set **WCS** if deviating from zero. With parameters **I, J** (X axis: **I**, Y axis: **J**) the sequence of parameters in the program call must be observed.
- **Q** (optional): Enter override

3.12 Measuring angle or distance

Activate the function with #137 in the program O9710 USERPARATAB: See page 96.

If you carry out two identical measurements consecutively then the software, depending on the measuring task implemented, can measure a distance or an angle.

Possible measuring tasks:

- Angle of a slot
- Angle of a ridge
- Angle of a surface
- Distance between two diameters
- Distance between two corners
- Height or width of a step

Avoiding measuring errors

- For correct results, the active WCS must not be modified between the first and second measurement, and no other WCS should be activated.
- Measurements must be carried out consecutively.
- For correct results the global parameters (#100 to #149/#199) between both measurements must not be deleted.
- The setting parameters #110 to #149 must not be used.
- The result parameters as defined in #111 must not be used.

Read the documentation

- of the control manufacturer and
- in these instructions the section: 8.2 "Program O9710 USERPARATAB: Setting parameters", page 96

Measuring distance

The parameter **D** activates the angle distance function **(D ≥ 0)**. When measuring the distance between two measurement positions, the parameter **D** is entered with values # 0. If only single points are measured, the value in parameter **D** corresponds to the nominal value.

Cycle call and cycle run

Measure the first measurement position:

1 Open a new program block and enter the cycle definition:
G65 P9700 A1. X0. ...

Measure the second measurement position:

2 Traverse the touch probe to the second measurement position with the handwheel or traversing block

3 Measure the second measurement position with the secondary parameter **D**

4 Open a new program block and enter the cycle definition:
G65 P9700 A1. X0. D ...

Result:

5 The following parameters are saved depending on the measuring axes:

Parameter	Meaning
#[#137+9]	Distance in the X direction
#[#137+10]	Distance in the Y direction
#[#137+11]	Distance in the Z direction
A comparison between the value transferred in parameter **D** and the measured distance (nominal value) can only be implemented with measurements in a single axis (single point).	
#[#137+12]	Deviation to the nominal value in the X direction
#[#137+13]	Deviation to the nominal value in the Y direction
#[#137+14]	Deviation to the nominal value in the Z direction

Detailed example:
See "Distances on sample components", page 68

Measuring angle

The parameter **D** activates the angle distance function **(D < 0 and D ≥ -360)**.

Angles are measured with **D** < 0.

When measuring the angle of two measurement positions, parameter **D** is transferred as the nominal value of the angle with a negative algebraic sign. The value of -360° corresponds to a nominal value of 0°.

Option bit 2 (See "Program O9710 USERPARATAB: Setting parameters", page 96 / #131.8) is used to set the output format of the angle.

Cycle call and cycle run

Measure the first measurement position:

1 Open a new program block and enter the cycle definition:
G65 P9700 A1. X0. ...

Measure the following measurement positions:

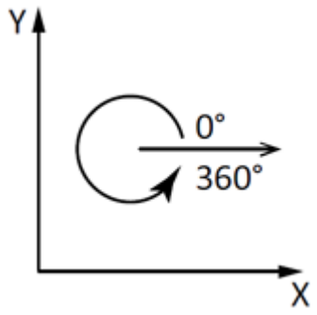
2 Traverse the touch probe to the second measurement position with the handwheel or traversing block

3 Measure the second measurement position with the secondary parameter **D**

4 Open a new program block and enter the cycle definition:
G65 P9700 A1. X0. D ...

5 Calculation of the angles is implemented according to the sketched angle specifications.

6 The probing sequence of the points corresponds to the measurement direction or arrow:



Result:

7 The calculated angle is saved in the following parameters:

Parameter	Meaning
#[#137+7]	Calculated angle
#[#137+8]	Deviation to transferred nominal angle
#[#111+9]	Additional saving of the deviation between the calculated angle and the nominal angle transferred with "D" for the internal program O9705 (SET WCS).

Output format

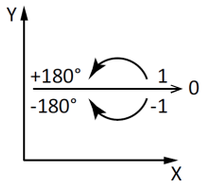
The output format of the result depends on the setting in #131.8.

The output format of the angle can be set in option bit 2.

Setting for result output

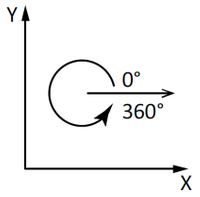
#131.8= 0

180° > 0 > -180°



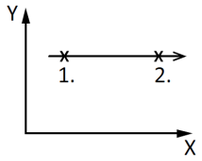
#131.8= 1

0° – 359°

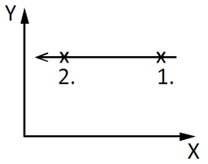


Algebraic sign of measuring result

Positive measuring result (Pos. 2 > Pos. 1):



Negative measuring result (Pos. 1 > Pos. 2):

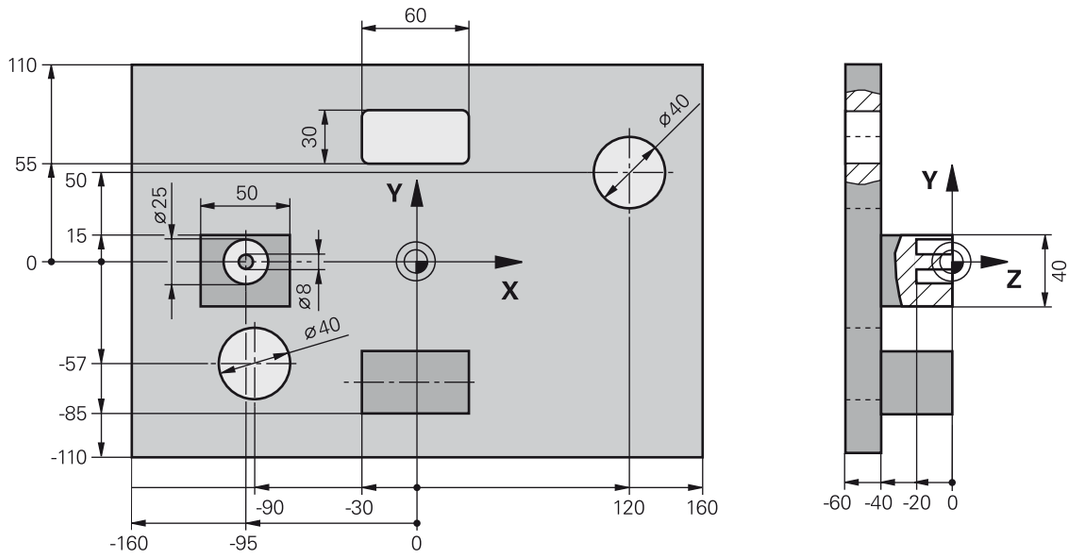


Detailed example:
See "Measuring angles on sample components", page 69

4

Programming examples

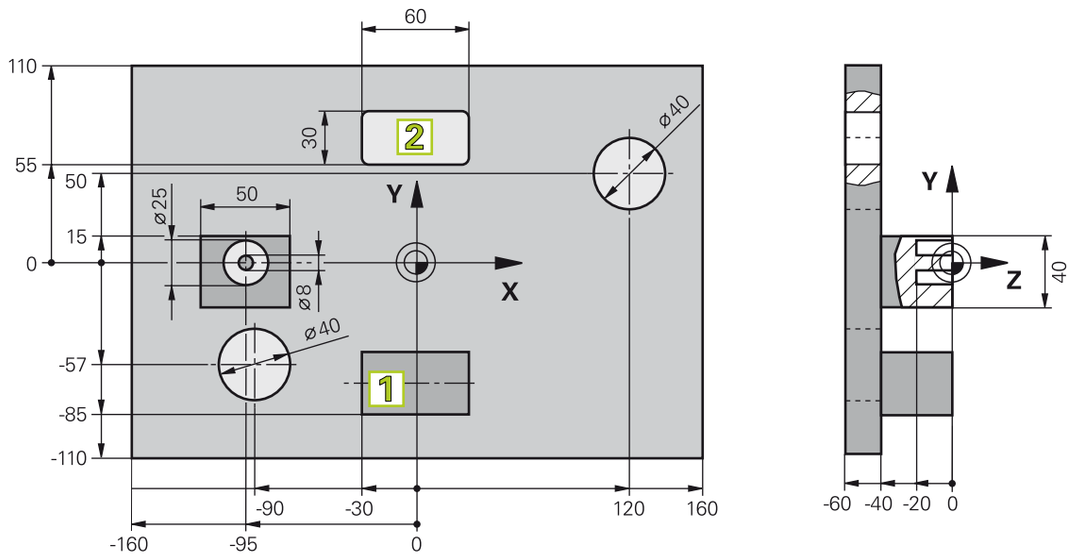
4.1 Measuring sample components



Parameter settings for the example program in program O9710 USERPARATAB:

- #111=100 (default)
- Results #100…#109
- #137=150
- Start address function "D" angle distance

Measuring a sample component (part 1)



Program start

(MEASURING BLOCK)	
G54	Activate workpiece coordinate system (WCS)

Probe corner "1" of the cuboid

G65 P9703 X-35. Y-90. Z5.	Protected positioning movement in X and Y direction
G65 P9703 Z5.	Protected positioning movement in Z direction
G65 P9700 X10. Y10. Z-10. W54. I-30. J-85 .Q15.	Probe corner "1" of the cuboid and set the datum in the X and Y direction on the workpiece center. Do not modify Z

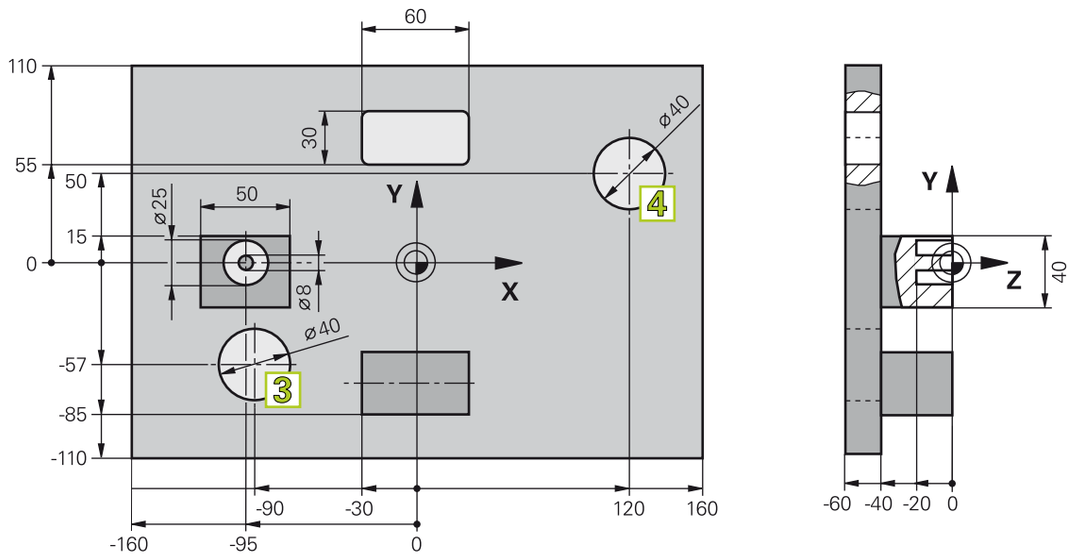
Measure slot "2" in the Y and X direction

G0 Z10.	Pre-position touch probe in Z
G65 P9703 X0.	Protected positioning movement in X direction
G65 P9703 Y70.	Protected positioning movement in Y direction
G65 P9703 Z-47.	Protected positioning movement in Z direction
G65 P9700 Y1. S30. A1. T-0.04	Measure slot "2" in the Y direction
#1=#101	Save the actual position of the slot center Y in parameter #1
#2=#104	Save the deviation to the nominal position Y in parameter #2
#3=#106	Save the actual width of the slot in Y direction in parameter #3
G65 P9700 X1. S60. A1. T-0.04	Measure slot "2" in the X direction
#4=#100	Save the actual position of the slot center X in parameter #4
#5=#103	Save the deviation to the nominal position X in parameter #5
#6=#106	Save the actual width of the slot in X direction in parameter #6

Programming examples

4.1 Measuring sample components

Measuring a sample component (part 2)



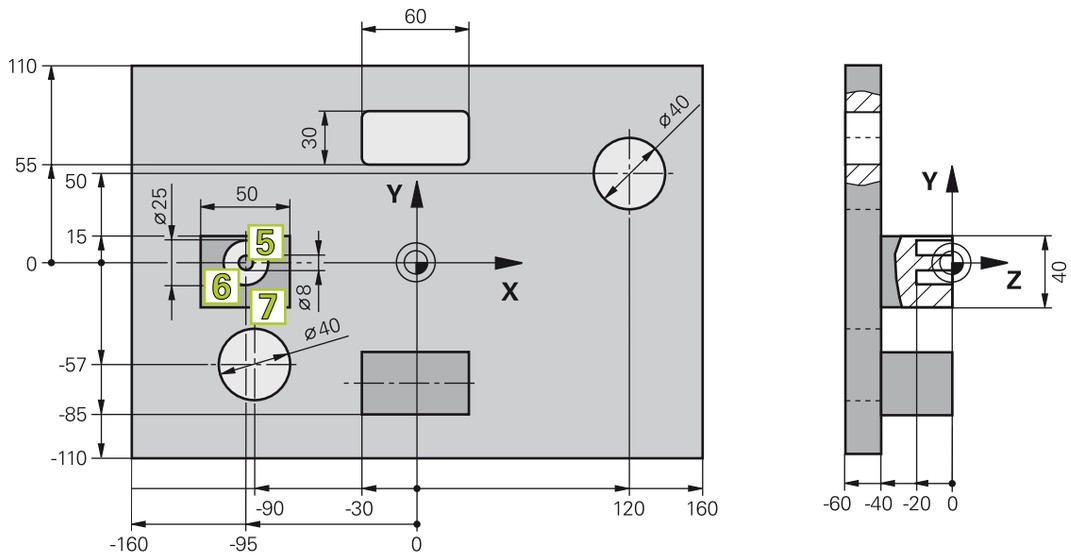
Measuring bore hole "3"

G0 Z10.	Pre-position touch probe in Z
G65 P9703 X-90. Y-57.	Protected positioning movement in X and Y direction
G65 P9703 Z10.	Protected positioning movement in Z direction
G65 P9700 A1. S40.	Measure bore hole "3"
#7=#100	Save the actual position of the circle center X in parameter #7
#8=#101	Save the actual position of the circle center Y in parameter #8
#9=#106	Save the actual diameter of the bore hole in parameter #9

Measure bore hole "4" and distance to bore hole "3"

G0 Z10.	Pre-position touch probe in Z
G65 P9703 X120. Y50.	Protected positioning movement in X and Y direction
G65 P9703 Z-47.	Protected positioning movement in Z direction
G65 P9700 A1. S40. D0.	Measure bore hole "4" and distance to bore hole "3"
#10=#100	Save the actual position of the circle center X in parameter #10
#11=#101	Save the actual position of the circle center Y in parameter #11
#12=#106	Save the actual diameter of the bore hole in parameter #12
#13=#159	Distance of bore holes in X direction in parameter #13
#14=#160	Distance of bore holes in Y direction in parameter #14

Measuring a sample component (part 3)



Measuring stud "5"

G0 Z10.	Pre-position touch probe in Z
G65 P9703 X-95. Y0.	Protected positioning movement in X and Y direction
G65 P9700 S8. Z-5. A1. R2. T0.05	Measure stud "5", diameter tolerance
#15=#100	Save the actual position of the stud center X in parameter #15
#16=#101	Save the actual position of the stud center Y in parameter #16
#17=#106	Save the actual diameter of the stud in parameter #17

Measuring bore hole "6" with a stud as obstacle

G65 P9700 S25. Z-10. A1. R-2. T0.1 E5.	Measure bore hole "6" with a stud as obstacle
#18=#100	Save the actual position of the circle center X in parameter #18
#19=#101	Save the actual position of the circle center Y in parameter #19
#20=#106	Save the actual diameter of the bore hole in parameter #20

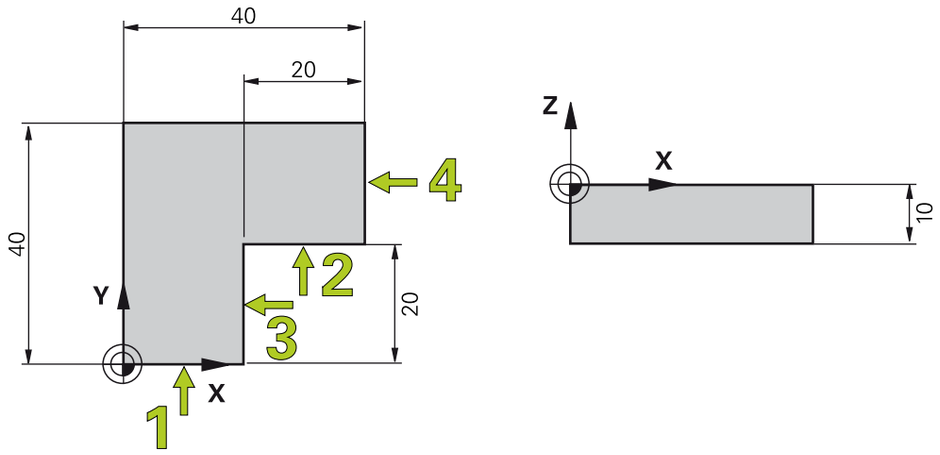
Measuring cuboid (ridge) "7" in the Y and X direction

G65 P9700 S40. Z-10. Y1. A1. R5.	Measure cuboid (ridge) "7" in the Y direction
#21=#101	Save the actual position of the ridge center Y in parameter #21
#22=#106	Save the actual width of the ridge in parameter #22
G65 P9700 S50. Z-10. X1. A1. R5.	Measure cuboid (ridge) "7" in the X direction
#23=#101	Save the actual position of the ridge center X in parameter #23
#24=#106	Save the actual width of the ridge in parameter #24

Program stop

#21=#101	Possible reworking; use measured values from #1 to #24
M[30]	End of program

4.2 Distances on sample components



Measuring task

- Measurement on a workpiece
- Position of the component in G54.
- Distances of the cutout in X and Y to outside contour

Program start

(MEASURING BLOCK DISTANCE)	
G54	Activate workpiece coordinate system (WCS)

Preposition touch probe

G65 P9703 X10. Y-10. M1.	Protected positioning movement in X and Y direction
G65 P9703 Z-5. M3.	Protected positioning movement in Z direction

Measure distance in Y / result: #[#137+10]

G65 P9700 A1. Y0. M3.	Measure workpiece in Y (1)
G65 P9703 X30. M3.	Protected positioning movement in X direction
G65 P9700 A1. Y20. D20. M3.	Measure workpiece in Y (2)

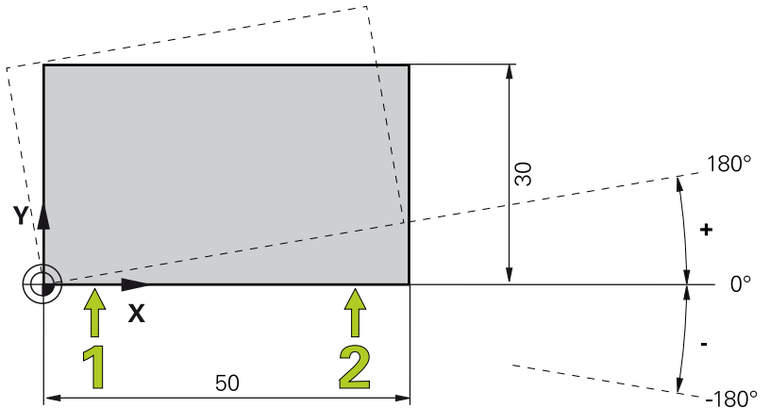
Measure distance in X / result: #[#137+9]

G65 P9703 Z5. M3.	Protected positioning movement in Z direction
G65 P9703 X50. Y10. M3.	Protected positioning movement in X and Y direction
G65 P9703 Z-5. M3.	Protected positioning movement in Z direction
G65 P9700 A1. X20. M3.	Measure workpiece in X (3)
G65 P9703 Y30. M3.	Protected positioning movement in Y direction
G65 P9700 A1. X40. D20. M3.	Measure workpiece in X (4)

Program stop

G65 P9703 Z5. M2.	Protected positioning movement in Z direction
M[99]	End of program

4.3 Measuring angles on sample components



Measuring task

- Measurement on a workpiece
- Position of the component in G54.
- Workpiece angle in XY plane

Program start

(MEASURING BLOCK ANGLE)	
G54	Activate workpiece coordinate system (WCS)

Preposition touch probe

G65 P9703 X10. Y-10. M1.	Protected positioning movement in X and Y direction
G65 P9703 Z-5. M3.	Protected positioning movement in Z direction

Result angle / result: #[#137+7]

G65 P9700 A1. Y0. M3.	Measure workpiece in Y (1)
G65P9703 X45. M3.	Protected positioning movement in X direction
G65 P9700 A1. Y0. D-360. M3.	Measure workpiece in Y (2)

Program stop

G65 P9703 Z5. M3.	Protected positioning movement in Z direction
M[30]	End of program

4.4 Testing tolerances

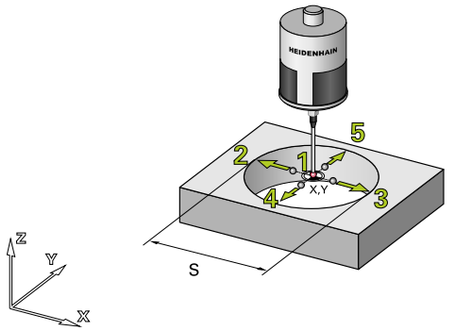
The tolerance of a measured point, a contour (S) or a position for example can be determined with the parameter **T** .

Transferred value for T:

T negative: Test surface, corner, slot, ridge or diameter

T positive: Test position or midpoint

The nominal value or position specifications **I, J** and **K** are considered. If the tolerance is exceeded the program stops with a "Tolerance exceeded" error message. Because the tolerance can only be controlled absolutely the nominal value must be positioned in the center of the tolerance field.



Example 1:

Inside diameter measurement = 60 mm; tolerance +0.2 mm

To test the diameter, the value input with **T** must be **positive**. The nominal value must be input as 60.1 mm.

```
G55
G65 P9700 A1. S60.1 T0.1
```

Example 2:

Inside diameter measurement = 60 mm; tolerance ± 0.2 mm

To test the diameter, the value input with **T** must be **positive**. The nominal value must be input as 60 mm.

```
G55
G65 P9700 A1. S60. T+0.2
```

Example 3:

Position of inside diameter measurement; tolerance ± 0.2 mm

The datum is in the center of the inside diameter. To test the position, the value input with **T** must be **negative**. Only one tolerance field can be tested.

```
G55
G65 P9700 A1. S60. T-0.2
```

Example 4:

Position of inside diameter measurement; tolerance + 0.3 mm

The center of the inside diameter is "50." in X and "50." in Y. To test the position, the value input with **T** must be **negative**. Only one tolerance field can be tested.

```
G55
G65 P9700 A1. S60. I50.15 J50.15
T-0.15
```

5

Special cycles

5.1 Program 09703 PROTECTED MOVE: Protected move

The program O9703 PROTECTED MOVE is available to enable the touch probe to be safely traversed in the machining space.

Cycle run

Protected positioning:

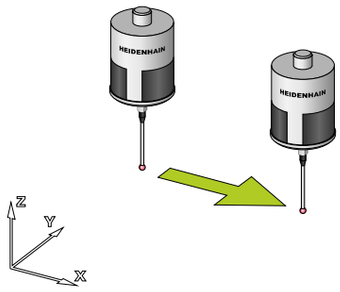
- The touch probe traverses from the momentary position to the given target position

Result:

- If the target position is reached without deflection of the touch probe, the measurement block is concluded without errors.
- If the probe tip is deflected during the move, the control stops the traverse and returns the touch probe to the initial position; it is then switched off and an error message is output.

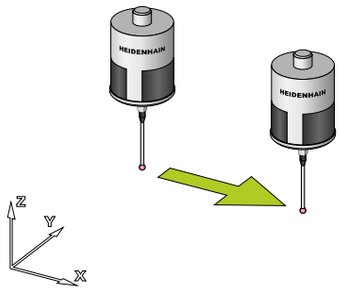
Cycle call and cycle parameters

- **G** (optional): Activate WCS
- Open a new program block and enter the cycle definition: **G65 P9703**
- **X/Y/Z**:
  Reference in **X,Y**: Center of selected probe ball (probe radius not considered)
  Reference in **Z**: Probe tip
- **A0.** (optional): Positioning is relative in the active WCS
  A=1. or **A=#0** Positioning is absolute in the active WCS



Example: Protected move (absolute)

```
G54
G65 P9703 X30.
INITIAL POSITION: G54 X10. Y0. Z0.
TARGET POSITION: G54 X30. Y0. Z0.
```



Example: Protected move (relative)

```
G54
G65 P9703 A0. X30.
INITIAL POSITION: G54 X10. Y0. Z0.
TARGET POSITION: G54 X40. Y0. Z0.
```

5.2 Function G68: Measuring in a Rotated Coordinate System

Read the documentation of the control manufacturer.

The "G68" function enables measuring in a rotated coordinate system, e.g. with small clamping errors of the workpiece in the XY plane.

The approaches are transferred to the rotated coordinate system.

Skip positions and results are calculated by the software back to the non-rotated plane.

Measurement precision

The G68 function of the software is intended for correcting small angles to 5°.

Malfunction

With the G68 command, rotation must be implemented around the active datum -> **G68 X0. Y0. R...**

If coordinate conversion is considered by the control (e.g. #5400.5 = 1 / LV3), the option bit "#131.1=0" has to be set.

If the G68 command is active the WCS data cannot be corrected.

Requirements for installation

- The coordinate system rotation function is only available for the following controls:
  FANUC: 0iD, 30i, 31i, 32i, 300i, 310i, 320i
- Parameter setting and installation in the program O9710 USERPARATAB

  To use the G68 coordinate system rotation function, the option bit #131.1 has to be set.

Parameter	Description	
#131.1	Option bit 2 BIT 1	(0): Function G68 not available (2): Function G68 available
#140	Angle coordinate rotation	

Malfunction

The angle of coordinate rotation must be known for the approaches and skip positions to be correctly calculated.

The value of the rotation angle must be entered into parameter #140 before calling the first measurement, and deleted following the last measurement.

Coordinate rotation must be implemented in the datum.

Results

The results are calculated back to an axially parallel system.

This means the results are only output in the given measuring axis.

The results are input into the result parameter #111+0 …#111+7.

Software calls with active G68 function

Measuring cycles can be run at random.

The following sequence for function calls must be observed:

- Calculate the basic rotation of the component
- Approach the datum for coordinate rotation
- Enter the rotation angle in #140
- Call the coordinate rotation function with G68, e.g. **G68 X0. Y0. R#140**
- Measure with the software
- Evaluate results and buffer if required
- Deactivate the coordinate rotation function with G69
- #140 = #0 delete

Example: Measuring a slot in X (datum and center of rotation is slot center)

O1	EXAMPLE G68
#1=1.0	Calculate the coordinate rotation angle
G54	Active datum
G65 P9703 X0. Y0. M1.	Approach rotation midpoint
#140=#1	Angle in #140
G68 X0 Y0 R#140	Coordinate rotation function
G65 P9700 S20. X1	Measure slot; slot widths are in the result parameters
G69	Coordinate rotation function "off"
#140=#0	Delete angle in #140

5.3 Test component presence

Component presence can be tested with the "Protected move" program.

Cycle run

Protected positioning:

1 The touch probe traverses from the momentary position to the given target position 1

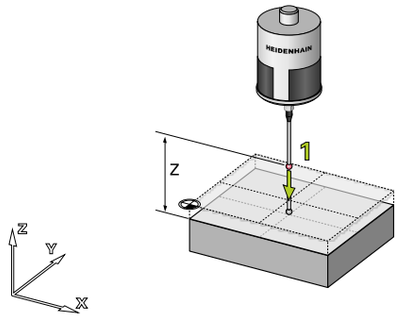
Result:

2 If the touch probe is deflected, the movement is stopped and the result "component available" is entered in **#111+8 "1"**.
If the touch probe reaches the target position, the result "component not available" is entered in **#111+8 "-1"**. The probe, depending on the algebraic sign of the parameter **T,** is traversed to the initial position or remains at the target position.

Cycle call and cycle parameters

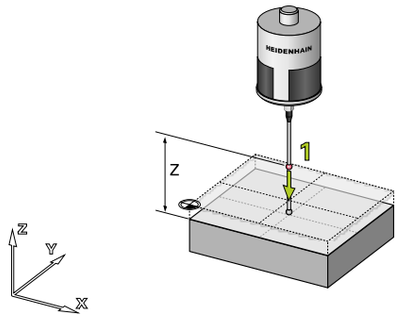
- **G** (optional): Activate WCS
- Open a new program block and enter the cycle definition: **G65 P9703**
- **X/Y/Z**: Target position (absolute A=1 or A=#0) of movement in the active WCS
  Relative movement (A=0) by the distance entered
  Reference in **X,Y**: Center of selected probe ball (probe radius not considered)
  Reference in **Z**: Probe tip
- **T1**: Activate component presence function. Retraction to initial position
  T-1: Activate component presence function. Stop at target position
- **A0.** (optional): Positioning is relative in the active WCS
  A=1. or **A=#0** Positioning is absolute in the active WCS
- **Q** (optional): Input override

Ensure that sufficient "override" is available at the given target position.



Example : Protected move - target: Absolute position

```
G54
G65 P9703 A1. Z0. T1.
```



Example : Protected move - target: Relative position

```
G54
G65 P9703 A0. Z-10. T1.
```

6

Calibrating a Touch Trigger Probe

6.1 Calibrating a touch trigger probe

Why calibrate?

The stylus of the touch probe approaches the workpiece during the probe process. As soon as the stylus is deflected by the workpiece, the machine stops the movement and saves the momentary spindle position in special control parameters. The saves spindle position however does not precisely correspond to the position of the measured workpiece edge.

Reasons for deviations:

- Time delay of the control
- Ball tip radius
- Center misalignment of ball tip

When to calibrate

Always calibrate the touch probe with:

- Commissioning
- Stylus breakage
- Stylus exchange
- Modification of parameters for measurement speed (#126, #127) in the program O9710 USERPARATAB
- Irregularities caused, for example, when the machine heats up
- Very precise measurements
- Changing the unit of measurement from metric to inch dimensions and vice versa

How to calibrate

To ensure that the control supplies precise measurement results, the actual trigger of a touch probe must be determined by calibration.

The control measures the following calibration values:

Function	Calibration values	Page
Measuring touch probe length with the ring gauge	Calibration value Z axis	page 80
Measuring touch probe radius and center misalignment with the ring gauge	Calibration value X axis / Y axis Center misalignment X axis / Y axis	page 81
Measuring touch probe radius and center misalignment with the calibration sphere	Calibration value X axis / Y axis Center misalignment X axis / Y axis	page 83

For **calibration in Z,** the software requires a surface in the XY plane precisely known in the Z position.

For **calibration in X and Y,** a ring gauge or calibration sphere is required with precisely defined diameter.

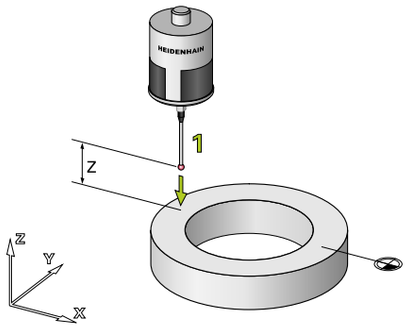
The calibration is called via the program **09700 MAIN** . Selecting calibration is implemented by transferring the corresponding parameters.

Calibrating the touch probe in the X and Y axes is carried out separately from calibration of the Z axis.

6.2 Measuring touch probe length with the ring gauge

This function measures the effective touch probe length with reference to the momentary datum in the Z axis, e.g. the upper edge of a ring gauge.

- Before starting the probe process, the datum in the spindle axis must be set so that Z=0 on the calibration surface.
- Position the touch probe over the ring gauge.
- The distance from the ball tip to the calibration surface is not relevant but should be at least 5 mm.



Example: Calibration in the Z axis

```
G54
G65 P9700 C1. Z-10.
```

Cycle run

Calibration process:

1 The touch probe traverses from the initial position **1** in a negative Z direction to the workpiece and back

Result:

2 The software calculates the difference between the actual effective length and the length specified in the tool memory. This value is saved as the calibration value. The location for saving is specified by parameter #110 in the program O9710 USERPARATAB:

Parameter	Meaning
#[#110+5]	Calibration value Z axis

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **C1**: Implement calibration
- **Z**: Input distance of touch probe to the calibration surface

6.3 Measuring touch probe radius and center misalignment with the ring gauge

This function measures the effective ball tip radius and ball tip center misalignment.

Ball tip center misalignment corresponds to the mechanical misalignment between the spindle axis and the touch probe axis.

Cycle run

Measure the effective ball tip radius:

1 The touch probe traverses from initial position **1** in a negative X direction **2** and back

2 The touch probe traverses from initial position **1** in a positive X direction **3** and back

3 The software calculates the exact ring center in the **X direction** and positions the touch probe there

4 From the ring center in X direction the touch probe traverses in a negative Y direction **4** and back

5 The touch probe traverses from initial position **1** in a positive Y direction **5** and back

6 The software calculates the exact ring center in the **Y direction** and positions the touch probe there

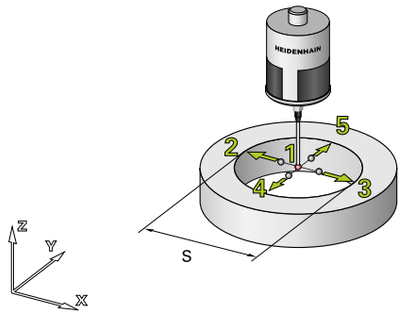
Measure the ball tip center misalignment:

7 **a) With spindle orientation**
The control rotates the **touch probe automatically through 180°.** The software starts the probe processes in a negative and positive X direction **2** and **3** and in a negative and positive Y direction **4** and **5** to determine center misalignment. Rotates the touch probe again to 0° initial position.
b) Without spindle orientation
Rotate the **touch probe manually by 180°** and press the **key NC Start**. The software starts the probe processes in a negative and positive X direction **2** and **3** and in a negative and positive Y direction **4** and **5** to determine the existing ball tip center misalignment.

Result:

8 The software saves the calibration values. The location for saving is specified by parameter #110 in the program O9710 USERPARATAB:

Parameter	Meaning
#[#110+0]	Calibration value, X axis
#[#110+1]	Calibration value, Y axis
#[#110+2]	Center misalignment, X axis
#[#110+3]	Center misalignment, Y axis



Example: Calibration in the X and Y axis

```
G65 P9700 C1. S50.002
```

Calibrating a Touch Trigger Probe

6.3 Measuring touch probe radius and center misalignment with the ring gauge

- During calibration the touch probe is oriented automatically or manually depending on the settings in option bit #130.
- Calibration can also be carried out on an outside diameter. The optional parameter **Z** is used for this.

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **C1**: Implement calibration
- **S**: Input the exact diameter of the ring gauge
- **Z** (optional): Input distance of touch probe to the calibration surface

6.4 Measuring touch probe radius and center misalignment with the calibration sphere

This function measures the effective ball tip radius and ball tip center misalignment.

Ball tip center misalignment corresponds to the mechanical misalignment between the spindle axis and the touch probe axis.

Cycle run

Prepositioning in Z:

1 The touch probe must be calibrated in **Z**

2 The touch probe traverses from initial position **1** to position **2** and back

Measure the effective ball tip radius:

3 The touch probe traverses from initial position **1** in a positive X direction and at the height of the calibration sphere equator, and probes in a negative X direction to the calibration sphere equator **3**

4 The touch probe traverses from initial position **1** in a negative X direction and at the height of the calibration sphere equator, and probes in a positive X direction to the calibration sphere equator **3**

5 The software calculates the exact calibration sphere center in the **X direction** and positions the touch probe at the corrected position **1**

6 Steps 3 and 4 are repeated in the Y direction

7 The software calculates the exact calibration sphere center in the **Y direction** and positions the touch probe at the correct position **1**

8 The touch probe traverses from the correct initial position **1** to position **2** and back to measure the precise calibration sphere center in the **Z direction**

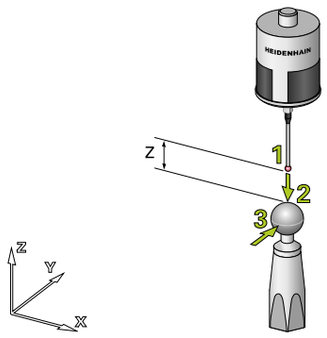
Measure the ball tip center misalignment:

9 **a) With spindle orientation** the control rotates the touch probe **automatically by 180°.**
b) Without spindle orientation the operator must rotate the touch probe **manually by 180°** and then press the **NC Start** key.

10 The control measures the sphere center. The touch probe runs the probe processes (steps 3-7) in negative and positive X and Y directions to determine the existing touch probe center misalignment

11 The ball tip runs the probe processes (steps 3-5) in negative and positive X direction to determine the effective touch probe radius

12 **a) With spindle orientation** the control rotates the touch probe **automatically to 0°** initial position.
b) Without spindle orientation the operator must rotate the touch probe **manually back to 0°**.



Information: The positions for **3** lie on the calibration sphere equator plane in the X or Y direction.

Example: Calibration in the X and Y axis

```
G65 P9700 C2. S25.003 Z-10.
```

6.4 Measuring touch probe radius and center misalignment with the calibration sphere

Result:

13 The software saves four calibration values for the X and Y axes. The location for saving depends on parameter #110 in the program O9710 USERPARATAB:

Parameter	Meaning
#[#110+0]	Calibration value, X axis
#[#110+1]	Calibration value, Y axis
#[#110+2]	Center misalignment, X axis
#[#110+3]	Center misalignment, Y axis

The calibration sphere center in the active WCS is measured.

Parameter	Meaning
#[#111+0]	Sphere center in the X axis in the active WCS
#[#111+1]	Sphere center in the Y axis in the active WCS
#[#111+2]	Sphere center in the Z axis in the active WCS

- Z calibration must be implemented first with sphere calibration.
- During calibration the touch probe is oriented automatically or manually depending on the settings in option bit #130.

Cycle call and cycle parameters

- Open a new program block and enter the cycle definition: **G65 P9700**
- **C2**: Implement calibration on the sphere
- **S**: Input the exact diameter of the calibration sphere
- **Z**: Input the distance of the touch probe to the calibration surface

7

Parameter tables

7.1 Call parameters

Parameter		Meaning
A	#1	The positions in the program call are interpreted as absolute coordinates in the active WCS (workpiece coordinate system) and not as distances of the ball tip to the workpiece or traverse path in Z. **A=1.** or **A=#0** (PROTECTED MOVE) Positions are interpreted as absolute coordinates **A=0.** Positions are interpreted as relative coordinates.
C	#3	Missing calibration data **C1.** Calibration in Z and XY on the calibration sphere **C2.** XY calibration on the sphere
D	#7	Parameter **D** on the second measurement position activates the distance-angle function. The distance of the measurement positions is determined with values entered >0. When measuring the angle of two measurement positions, parameter D is transferred as the nominal value of the angle with a negative algebraic sign. The value of -360. corresponds to a nominal value of 0°. The function must be activated.
E	#8	Following measurement, the tool data of the tool is corrected with which the measurement position was processed. The tool number is transferred with parameter **E**. This function can be used with all measurement positions except for measuring corners. According to the configurations of parameters in the SET TOOL program, either the geometry data or the wear data of the tool are corrected in the tool memory.
H	#11	Angle for 3-point probing with bore holes or studs. The value for the angle must be between 0° < **H** < 360° – minimum distance between the angles is 10°.
I	#4	X nominal position of a midpoint or surface during measuring or in the WCS to be set. If the measured point in the specific axis does not correspond to "0", the corresponding value can be defined with a suitable nominal value. Example: The nominal position in X is not "0" but "10". -> program call "I10."
J	#5	Y nominal position of a midpoint or surface during measuring or in the WCS to be set. If the measured point in the specific axis does not correspond to "0", the corresponding value can be defined with a suitable nominal value. Example: The nominal position in Y is not "0" but "10". -> program call "J10."
K	#6	Z nominal position of a surface during measuring or in the WCS to be set. If the measured point in the specific axis does not correspond to "0", the corresponding value can be defined with a suitable nominal value. Example: The nominal position in Z is not "0" but "10". -> program call "K10."
M	#13	As standard the touch probe is switched on before each measuring task and then switched off. If several measuring tasks are executed consecutively, it makes sense to switch on the touch probe only before the first measurement and to switch it off following the last measurement. For this purpose, parameter **M** must be entered with its correct value with each program call. Parameter **M** can be used both in the MAIN program as well as in PROTECTED MOVE. **M1.** only switch on **M2.** only switch off **M3.** neither switch on nor switch off Depending on the setting #131.9, user data are loaded depending on the M1. call. **This function is not available for the HEIDENHAIN TS444.**

Parameter		Meaning
Q	#17	The touch probe traverses by a predefined measuring path / distance with each measurement block. The touch probe moves beyond the position of the expected surface to prevent it from stopping when no trigger signal was triggered on this measuring path. The edge is "searched for". This distance corresponds by default to the double measuring path defined in the program O9710 USERPARATAB, in the parameter #114 (X,Y). If these values are unsuitable for a specific measuring task, the XY override can be entered with **Q**. A correction in Z is not possible.
R	#18	The safety clearance when measuring a slot, ridge, inside diameter or outside diameter is 10 mm by default. If required this can be modified with the parameter **R**. With a slot and inside diameter **R must be negative**, and for a ridge and outside diameter **R must be positive**.
S	#19	Size of a measurement position, i.e. width of a slot / ridge or diameter of a bore hole / outside diameter.
T	#20	The tolerance of a measured point, a contour (S) or a position for example can be determined with the parameter **T** . To test a surface, corner, slot, ridge or diameter for tolerance the value transferred with parameter **T** must be positive. The transferred value must be negative to test a position or the midpoint of a contour for tolerance. The nominal value or position specifications **I, J** and **K** are taken into account. If the tolerance is exceeded the program stops with a "Tolerance exceeded" error message. The parameter **T** activates component presence testing in the program O9703 PROTECTED MOVE.
U	#21	2. Angle for 3-point probing with bore holes or outside diameters. The value for the angle must be between 0° < U < 360°. The minimum distance between the angles must be 10°.
V	#22	3. Angle for 3-point probing with bore holes or outside diameters. The value for the angle must be between 0° < U < 360°. The minimum distance between the angles must be 10°.
W	#23	The number of the WCS (workpiece coordinate system) to be set is transferred with the parameter **W**. As standard, **W54.** to **W59.** can be entered. **W53.** sets external datum shifting. If several workpiece coordinate systems are optionally available, the number of an optional WCS (P1… P48 / P300) is entered with a negative algebraic sign. The WCS "G54.1 P40" is set with "W-40.". The optional WCS systems for clamping correction (G54.2 P1…P8 / 30 series) can be set with **W-1. ...W-8**. With simultaneous use of the parameters **A1.** and **W,** the nominal positions must be transferred with the parameters **I, J** and **K**.
X	#24	The distance of the surface to be probed in the X direction (without **A1.**), or X position of the touch point in the active WCS (with **A1.**).
Y	#25	The distance of the surface to be probed in the Y direction (without **A1.), or Y position of the touch point in the active WCS (with A1.**).
Z	#26	The distance of the surface to be probed in the Z direction (without **A1.), or Z position of the touch point in the active WCS (with A1.**).

7.2 Result parameters

Parameter	Meaning
#111+0	X result of the measurement in the momentary WCS (workpiece coordinate system)
#111+1	Y result of the measurement in the momentary WCS
#111+2	Z result of the measurement in the momentary WCS
#111+3	Deviation of the X measurement result to the nominal position in X. If no nominal position is transferred in X (parameter **I**) then this value corresponds to the X measurement result.
#111+4	Deviation of the Y measurement result to the nominal position in Y. If no nominal position is transferred in Y (parameter **J**) then this value corresponds to the Y measurement result.
#111+5	Deviation of the Z measurement result to the nominal position in Z. If no nominal position is transferred in Z (parameter **K**) then this value corresponds to the Z measurement result.
#111+6	Result of a contour measurement. (diameter of bore hole / width of a slot or ridge)
#111+7	Deviation of the measurement result to the nominal value transferred with parameter **S**
#111+8	Result of the component presence test #111+8= 1: Component present #111+8=-1: Component not present
#111+9	Result of angle measurement for control of an n-th axis. If #111+9 # 0, during writing of the WCS the entered value is written in the axis entered in the O9710 USERPARATAB program in #136.

7.3 Calculating and result parameters Function D

Parameter	Meaning
#137+0	Saves the type of the last measured measurement position (diameter, single point...)
#137+1	X result of first measurement
#137+2	Y result of first measurement
#137+3	Z result of first measurement
#137+4	X skip position of first measurement
#137+5	Y skip position of first measurement
#137+6	Z skip position of first measurement
#137+7	Angle result
#137+8	Deviation of actual angle to nominal value
#137+9	Distance result in X
#137+10	Distance result in Y
#137+11	Distance result in Z
#137+12	Deviation to nominal value with distance measurements in X (distance in one axis)
#137+13	Deviation to nominal value with distance measurements in Y (distance in one axis)
#137+14	Deviation to nominal value with distance measurements in Z (distance in one axis)

7.4 Calibrating parameters

Parameter	Meaning	
#110+0	Calibration value in X	(e.g. ball tip radius 3 mm – HSS: approx. 2.785)
#110+1	Calibration value in Y	(e.g. ball tip radius 3 mm – HSS: approx. 2.788)
#110+2	Probe center misalignment in X	(e.g. ball tip radius 3 mm – HSS: approx. 0.005)
#110+3	Probe center misalignment in Y	(e.g. ball tip radius 3 mm – HSS: approx. 0.010)
#110+4	Retraction path, second measurement block	
#110+5	Calibration value in Z	(e.g. ball tip radius 3 mm – HSS: approx. 0.206)

7.5 Internal parameters

Malfunction:
Parameters specified here must not be modified.
These are only for information and error diagnosis purposes.

Parameter	Meaning
#116	Not used
#117	Transfer parameter SET WCS 1 Transfer data in program SET WCS
#118	Transfer parameter SET WCS 2 Transfer data in program SET WCS
#119	Transfer parameter SET TOOL Transfer data in program SET TOOL
#120	Conversion factor mm/Inch Division factor for feed rates and measurement paths when switching from mm -> Inch
#121	Error marker Error number stored
#122	Tool length from memory Tool length of the active tool
#123	Measurement block result in X Skip position
#124	Measurement block result in Y Skip position
#125	Measurement block result in Z Skip position
#129	Confidence interval Internal: Do not modify.
#138	Not used
#139	Not used
#141	Calibration value in X Internal calibration value in the X axis, adapted to rotation (e.g. G68)
#142	Calibration value in Y Internal calibration value in the Y axis, adapted to rotation (e.g. G68)
#143	Probe center misalignment in X Internal probe center misalignment in the X axis, adapted to rotation (e.g. G68)
#144	Probe center misalignment in Y Internal probe center misalignment in the Y axis, adapted to rotation (e.g. G68)

8

Software installation

8.1 Software installation

Program overview

The following tables contain a program overview of the software package.

Program		Content	Page
O9700	MAIN	Main program	
O9701	TOUCH XYZ	Probing single points and corners	
O9702	XY CONTOUR	Probing contours	
O9703	PROTECTED MOVE	Protected traversing block	
O9704	MEASURE	Measurement block	
O9705	SET WCS	Set datum	page 103
O9706	SET TOOL	Tool compensation	page 105
O9707	TOLERANCE	Tolerance monitoring	
O9708	PROBE ON/OFF LEVEL	Switch on / off touch probe (level controlled)	page 108
O9708	PROBE ON/OFF TS444	Switch on / off touch probe (HEIDENHAIN TS 444)	
O9708	PROBE ON/OFF PULSE	Switch on / off touch probe (pulse controlled)	page 111
09709	CALIBRATION SPHERE	Calibration on a sphere	
O9710	USERPARATAB	User data input	page 96
O9711	MESSAGES	Error messages	page 112
O9712	CALIB-PARAMETER	Conversion of calibration data	
O9713	DM-3-POINTS MAIN	Calculation of position diameter with 3 points	
O9714	DM-3-POINTS CALCULATION	Calculation of results diameter with 3 points	
O9715	ANGLE-DISTANCE	Calculation of angles or distances	
O9716	DPRNT	Data output via DPRNT command	page 114

Requirements for installation

Malfunction:
The measurement software ID 627875-XX is not compatible with the momentary measurement software.

- Fanuc Custom MACRO B
- 16 free program names
- 35 KB of free NC memory
- #1 - #26, #110 - #149 freely available
- 10 global, consecutive variables for results output (default #100-#109)
  6 permanent, consecutive variables for saving calibration values
  Optional: 15 global, consecutive variables with use of function D (angle distances)
- 3 call levels
- The "Measuring with 2-dimensional coordinate conversion (G68)" function is available for the following controls: 0iD, 30i, 31i, 32i, 300i, 310i, 320i
- The measurement software cannot be used with G68.2 ("Tilted working plane" function).

Recommended:

- High speed skip
- 2 PLC inputs for error monitoring (readiness, battery warning)

Installing hardware

Read the installation instructions of the touch probe used.

Installing and testing software

- Transfer all programs in the installation package to the control

  FANUC measurement software:
  Package with programs that cannot be modified by the user:
  9700-9707, 9709, 9711-9716

  User programs:
  Programs that must be modified by the user:
  9708, 9710
- Modify program O9710 USERPARATAB (See page 96)
- Modify program O9708 PROBE ON/OFF (See page 111)
- **Enter the precise touch probe length into the tool table of the machine.**

Before commissioning

- Before commissioning, check whether the used parameters and software areas are already being used.
- If this is the case, cycles must be adapted, as the overwriting of parameters and data used may cause unforeseeable damage to the machine.
- After completion of commissioning, parameters used and executed machine-specific program modifications must be documented.

Testing measurement cycles

- Measurement cycles should be interpreted as examples for solving measurement tasks and must be modified by machine manufacturers or users to the specific type of machine.
- When commissioning the measurement cycles the program must be tested blockwise under observance of all safety measures (block testing prior to execution, single block and reduced feed rate).
- Write protection must be canceled to load and modify the measurement programs: Parameter 3202 bit 4 (NE9) = 0: Write protection for programs O9xxx inactive

8.2 Program O9710 USERPARATAB: Setting parameters

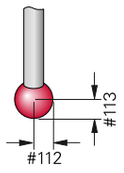
Program O9710 USERPARATAB: Setting parameters

The basic settings for parameters are input by the user in the USERPARATAB program.

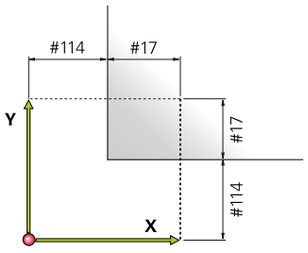
- Paths, diameters and feed rates must be entered with the unit [mm].
- The touch probe must be recalibrated if parameters are modified.

Parameter	Meaning
#1	**Start address of offset WCS** Description See "Program O9706 SET WCS: Parameters #1 to #4 ", page 103
#2	**Distance of WCS memories (X to Y to Z...)** Description See "Program O9706 SET WCS: Parameters #1 to #4 ", page 103
#3	**Distance of memory between the single axes (X1 to X2 ...)** Description See "Program O9706 SET WCS: Parameters #1 to #4 ", page 103
#4	**Start address of optional WCS** Description See "Program O9706 SET WCS: Parameters #1 to #4 ", page 103
#5	**Base address for tool length wear** Description See "Program O9706 SET TOOL: Parameters #5 to #8 ", page 105
#6	**Base address for tool radius wear** Description See "Program O9706 SET TOOL: Parameters #5 to #8 ", page 105
#7	**H number of the touch probe** The H number is normally the magazine location of the touch probe.
#8	**Base address for tool memory of tool length** Description See "Program O9706 SET TOOL: Parameters #5 to #8 ", page 105
#9	**Supplementary tool length offset** If the momentary tool length has to consider a further reference value, this can be implemented with the supplementary tool length offset.
#110	**Base address for permanent parameters (calibration values)** Calibration values are saved to six unused consecutive parameters by default. These must not be deleted when the machine is switched off. The initial value for these parameters is saved in #110. If values are to be saved in #500 to #505 for example, then #110 must be set to to 500. Parameters #100 to #199 must not be used. Default value: 500

Parameter	Meaning
#111	**Base address for results** The measurement results are saved in 10 parameters. The initial value for these parameters is saved in #111. If values are to be saved in #100 to #109 for example, then #111 must be set to to 100. The setting parameters #110 to #149 must not be used. The result parameters as defined in #137 must not be used. Default value: 100
#112	**Ball tip radius XY**
#113	**Ball tip radius Z**



#114	**Measurement path X,Y** The measurement path is the difference between the value from prepositioning and the expected trigger. The trigger is "searched for" on this path. The path is stored in #114 for probing in X and Y (#17 Override - see diagram). With contours, #114 is defined as override if #17 is not transferred. Default value (X/Y): 10 mm



#115	**Measurement path Z** The path is stored in #115 for probing in Z. Default value (Z): 5 mm
#126	**Measurement feed rate of the first measurement block in mm/min** A measurement feed rate, depending on measurement input, must always be defined for the first measurement block: HighSpeedSkip: The value can be between 1000 and 5000. Default value: 2000 mm/min X4.7 (Default skip): The value can be between 30 and 60. Default value: 50 mm/min. The value can be between 100 and 1000 if a second measurement block is used. See specification for #127. Default value: 500 mm/min
#127	**Measurement feed rate of the second measurement block in mm/min (standard X4.7)** If parameter #127 has been assigned a value not equal to 0, a second measurement block is executed with the transferred value. If parameter #127=0, no second measurement block is executed. X4.7 (Default skip): The value should be between 30 and 60. Default value: 50 mm/min.
#128	**Feed rate of protected move** Default value: 5000 mm/min

Parameter	Meaning
#130	**Option bit 1 (measurement basic settings)** In #130, relevant data for the software are saved in bit form. **Data input:** #130 = bit0: 1 + bit1: 2 + bit2: 4 + bit3: 8 + bit4: 16 + bit5: 32 Add the values of the required functions: Example: #130=2+4+32 - "legibility" of the set bits or: #130= 38 if bit 1, 2 and 5 should be set.

Bit No.	Value	Function
Bit 0	0:	Override feed rate possible When measuring, feed rate can be controlled with the override.
	1:	Lock override feed rate **Note**: When measuring, feed rate cannot be controlled.
Bit 1	0:	Protected Move - traverse movement with G0 The traverse movements in program O9703 PROTECTED MOVE are protected (feed rate from #128). **Note**: The program O9703 PROTECTED MOVE is used for prepositioning by the O9700 MAIN program, and can also be called directly by the user.
	2:	The traverse movements in program O9703 PROTECTED MOVE are executed with G0. **Note**: The movement is not stopped if the probe tip is deflected.
Bit 2	0:	The infrared receiver is NOT operated in continuous auto flash mode, i.e. 24 volts are NOT continuously applied to the TC MODE and FLASH/ START signals of the receiver.
	4:	The infrared receiver is operated in continuous auto flash mode, i.e. 24 volts are continuously applied to the TC MODE and FLASH/ START signals of the receiver.
Bit 3	0:	The validity of a trigger is NOT tested. **Note**: If infrared transmission is interrupted during a measurement block an invalid trigger is generated. If free inputs on the control are available, each trigger can be tested for validity.
	8:	The validity of a trigger is tested.
Bit 4	0:	The validity of the start condition is NOT tested. Start conditions (infrared transmission exists, probe tip not deflected) before a measurement block are NOT tested. **Note**: If free inputs on the control are available then start conditions before each measurement block can be tested.
	16:	The validity of the start condition is tested.
Bit 5	**Note**: The tool length must always be entered into the tool memory.	

Parameter	Meaning		
	Bit No.	**Value**	**Function**
		0:	De-selection of tool length offset
		32:	Selection of active tool length offset (default)
	Bit 6	0:	Machine parameter 5006.6 = 1 and 6006.4 = 0 (for series 30i, 31i, 32i: #6019.4 = 1)
		64:	Machine parameter 5006.6 = 1 and 6006.4 = 1 (for series 30i, 31i, 32i: #6019.4 = 0)
	Bit 7	0:	Not used
		128:	Not used
	Bit 8	0:	Tool active start condition (H- / T code) is tested.
		256:	Tool active start condition (H- / T code) is not tested.

Parameter	Meaning
#131	**Option bit 2** In #131, relevant data for the software are saved in bit form. **Data input:** #131 = bit0: 1 + bit1: 2 + bit2: 4 + bit3: 8 + bit4: 16 + bit5: 32 Add the values of the required functions Example: #131=2+4+32 "legibility" of set bits received or: #131= 38 if bit 1, 2 and 5 should be set.

Bit no.	Value	Function
Bit 0	0:	Machine has no spindle orientation.
	1:	Machine has spindle orientation.
Bit 1	0:	Function G68 is NOT available.
	2:	Function G68 is available.
Bit 2	0:	Error texts are called language-specifically. (see description for #132)
	4:	Error queries and error texts are output customer-specifically. Required modifications can be implemented in the program O9711 MESSAGES.
Bit 3	0:	Switch-on testing of the probe is implemented via the "readiness" input signal.
	8:	Switch-on testing of the probe is implemented via a "micromove".
Bit 4	0:	Input signal for "readiness" is tested (default).
	16:	Input signal for "INVERSE readiness" is tested.
Bit 5	0:	Input signal for "INVERSE trigger signal" is tested (default).
	32:	Input signal for "trigger signal" is tested inversely.
Bit 7	0:	Touch probe returns to initial position. If an error occurs during measuring the touch probe is traversed back to the initial position.
	128:	Touch probe returns to block position. If an error occurs during measuring the touch probe is traversed back to the initial position of the active measurement block or protected move.
Bit 8	0:	The results of the angle calculation are displayed from -180°<0<180°.
	256:	The results of the angle calculation are displayed from 0°…359°.
Bit 9	0:	The program O9710 USERPARATAB is executed with each O9700 MAIN / O9703 PROTECTED MOVE program call.
	512:	The program O9710 USERPARATAB is only executed with a O9700 MAIN / O9703 PROTECTED MOVE program call when the parameter M1. (activate touch probe) is entered.
Bit 10	0:	The touch probe is not oriented during measuring (default).
	1024:	The touch probe is oriented in the measurement direction during measuring (mono-directional). Alignment required in the measurement direction!
Bit 11	0:	The touch probe is oriented clockwise (precondition: #131.10=1).
	2048:	The touch probe is oriented anti-clockwise (precondition: #131.10=1).

Parameter	Meaning
#132	**Country identification, language output** Error texts are displayed in accordance with #132 : 0: English 1: German 2: French Default value: 1
#133	**Input for signal readiness** If the readiness signal is applied the input can be entered in #133. Example: Readiness signal on IN1010: #133 = 1010 No readiness signal existing: #133 = 0 Default value: 0
#134	**Input for trigger signal signal** If the trigger signal signal is applied the input can be entered in #135. Example: Trigger signal signal on IN1011: #134 = 1011 No trigger signal signal existing: #134 = 0 Default value: 0
#135	**Input for warning signal** If the warning signal is applied the input can be entered in #135. Example: Warning signal on IN1012: #135 = 1012 No warning signal existing: #135 = 0 Default value: 0
#136	**Number and direction of a fourth axis** Default values: A fourth axis is never set following angle measurements: 0 Rotational axis around X should be settable: +4 Rotational axis around Y should be settable: +5 Rotational axis around Z should be settable: +6 As standard, the algebraic sign is positive with normal direction of rotation of the axes. Default value: 0
#137	**Base address function "D" distance and angle (optional)** The results and calculation parameters of the function "D" angle and distance are saved in 15 parameters. The initial value for these parameters is saved in #137. If values are to be saved in #150 to #164 for example, then #137 must be set to to 150. The setting parameters #110 to #149 must not be used. The result parameters as defined in #111 must not be used.

Parameter	Meaning
#(#110+4)	**Retraction path of second measurement block in mm** The touch probe is retracted from the first skip via this path. Range of validity: 0.25 < #[#110+4] < 5 mm default: 2.5

Program O9706 SET WCS: Parameters #1 to #4

Parameters #1 to #4 are set centrally in the program USERPARATAB 09710.

Read the documentation of the control manufacturer.

Parameter	Meaning
#1	**Start address of offset WCS** The number of the parameter in which the first offset value of the WCS data (X value of the external offset) is saved.
#2	**Distance of WCS memories (X to Y to Z...)** The difference between the memory of a value in a WCS to the memory of the value of the next axis in this WCS (delta amount between the memories of adjacent axes).
#3	**Distance of memory between the single axes (X1 to X2 ...)** The difference between the memory of a value in a WCS to the memory of the value of the next WCS in this axis (delta amount between the memories of adjacent WCS).
#4	**Start address of optional WCS** The number of the parameter in which the first offset value of the optional WCS data (X value of the first optional offset) is saved. If no optional WCS exist the value is set to 0.

FANUC 16-MB (no optional WCS)

WCS	X axis	Y axis	Z axis
External offset	#2500	#2600	#2700
G54	#2501	#2601	#2701
...	...	...	...
G59	#2506	#2606	#2706

FANUC 16i (with optional WCS P1...P48 or P1...300)

BASIS WCS	X axis	Y axis	Z axis
External offset	#5201	#5202	#5203
G54	#5221	#5222	#5223
...	...	...	...
G59	#5321	#5322	#5323
OPTIONAL WCS P1... P48	**X axis**	**Y axis**	**Z axis**
G54.1 P1	#7001	#7002	#7003
...	...	...	...
G54.1 P48	#7941	#7942	#7943

Example: Parameter input with FANUC 16-MB

```
#1=2500
#2=100
#3=1
#4=0
```

Example: Parameter input with FANUC 16i

```
#1=5201
#2=1
#3=20
#4=7001 (P1...P48) OR #4=14001 (P1... P300)
```

OPTIONAL WCS P1… P300	X axis	Y axis	Z axis
G54.1 P1	#14001	#14002	#14003
…	…	…	…
G54.1 P300	#19981	#19982	#19983

Program O9706 SET TOOL: Parameters #5 to #8

- Parameters #1 to #4 are set centrally in the program USERPARATAB 09710.
- The maximum permissible correction value is monitored in the O9706 SET TOOL program. If required, this limit value can be modified in the program O9706 SET TOOL; parameter #3 (default value: 2 mm)
- The data for the base address of the wear correction values depend on the active tool correction memory. With the base addresses, the data of the first tool are saved in the corresponding parameters. The base addresses are the addresses before the addresses of the first tool in each case.

Read the documentation of the control manufacturer.

Parameter	Meaning
#5	**Base address for tool length wear** Base address of the tool memory for tool length wear
#6	**Base address for tool radius wear** Base address of the tool memory for tool radius wear
#7	**H number of the touch probe** The H number is normally the magazine location of the touch probe.
#8	**Base address for tool memory of tool length** Base address of the tool memory for the tool length. The "base address" references the address **before** the address of the first tool.

Execution examples

FANUC 15-B,150-B	Area	Base address
Tool length (#8)	#2001...#2200	2000
Tool length wear (#5)	#2201...#2400	2200
Tool radius wear (#6)	#2601...#2800	2600

FANUC 15-B,150-B (Memory C)	Area	Base address
Tool length (#8)	#11001...#11999	11000
Tool length wear (#5)	#10001...#10999	10000
Tool radius wear (#6)	#12001...#12999	12000

FANUC 16i,18i,21i,160i,180i,210i (Memory C)	Area	Base address
Tool length (#8)	#2201...#2400	2200
Tool length wear (#5)	#2001...#2200	2000
Tool radius wear (#6)	#2401...#2600	2400

FANUC 16i, 18i, 21i, 160i, 180i, 210i (Memory C, option)	Area	Base address
Tool length (#8)	#11001...#11999	11000

FANUC 16i, 18i, 21i, 160i, 180i, 210i (Memory C, option)	Area	Base address
Tool length wear (#5)	#10001...#10999	10000
Tool radius wear (#6)	#12001...#12999	12000
FANUC 30i, 31i, 32i, 300i, 310i, 320i (Memory C)	**Area V15=0 (#6000.3)**	**Base address**
Tool length (#8)	#11001...#11999	11000
Tool length wear (#5)	#10001...#10999	10000
Tool radius wear (#6)	#12001...#12999	12000
FANUC 30i, 31i, 32i, 300i, 310i, 320i (Memory C)	**Area V15=1 (#6000.3)**	**Base address**
Tool length (#8)	11000	10000
Tool length wear (#5)	10000	11000
Tool radius wear (#6)	12000	13000

Oriented spindle stop

- Set spindle orientation to the starting position in the **program USERPARATAB,** line N20.
- Set the command M19

```
N20 M19
```

From line N30, the command input for spindle orientation (option bit #131.0 = 1) is saved with calibration.

```
N30 IF[[#131AND1]NE1]GOTO35
M19S[180]
GOTO40
N35
M0(TURN PROBE 180 DEGREE)
N40
M[99]
```

Option: Machine without spindle orientation

The spindle cannot be oriented, i.e. rotation through 180° must be manually executed.

- Set the option bit #131.0 to 0 (no spindle orientation)
- The machine stops with an M0 command
- Manually rotate the touch probe by 180°

If this is not possible, because the local parameters are deleted following the M0 command for example, the touch probe must be manually set to have no radial runout error (<0.001 mm).

- Delete command M0 (TURN PROBE 180 DEGREE) from the program O9710 USERPARATAB

For calibration, the parameter "SAR - traverse without spindle speed" can be modified (See page 115).

Measuring error: Radial runout errors directly affect the measuring result.

Malfunction: Parameters modified for calibration must be reset to their initial condition following implemented calibration.

Option: Machine with spindle tracking

If the machine features the spindle tracking function:

- Activate the spindle tracking option (option bit 2 / bit 131.10)
- The touch probe is always oriented in the measurement direction.

If the orientation command is not executed with **M19S...**, then these commands must be modified in the programs O9703 PROTECTED MOVE and O9704 MEASURE.

8.3 Program O9708 PROBE ON/OFF: Switching the touch probe on/off

Switching the touch probe on and off

The switch-on or switch-off sequences for the touch probe are entered in the PROBE ON/OFF programs.

Activation is with via program call **G65 P9708 M1.**

Deactivation is via the program call **G65 P9708 M2.**

The corresponding program must be installed and modified according to the switching method of the touch probe via LEVEL (signal applied continuously during "probe ON"), TS444 (for HEIDENHAIN touch probe 444) or PULSE.

Program O9708 PROBE ON/OFF LEVEL

Direct outputs, M functions and other commands for switching on and off can be used in the program PROBE ON/OFF LEVEL.

Switching on the touch probe can be monitored optionally using the readiness signal or a " micromove" (See "Program O9710 USERPARATAB: Setting parameters", page 96 - BIT 131.3).

With the micromove the touch probe is transversed by a fixed value to a target position.

The touch probe is switched on when the target is reached.

PROBE OFF

N5 IF[#13EQ1.] GOTO10	PROBE OFF
#1116=0	FLASH/START
G04X0.05	
G53	
#1114=0	MODE TC
M[99]	

PROBE ON

N10	PROBE ON
#1114=1	MODE TC
#1116=1	FLASH/START
G53	

If activation of the touch probe should not be monitored, then a corresponding dwell time and an M[99] can be programmed after the G53.

N10	PROBE ON
#1114=1	MODE TC
#1116=1	FLASH/START
G53	
G04X0.5	Dwell time
M[99]	

Program O9708 PROBE ON/OFF TS444

In the program "PROBE ON/OFF TS444", direct outputs, M functions and other commands for switching on or off and activating the compressed air for supplying the turbines can be used.

Malfunction:

Connection of the battery and readiness signals is mandatory for using the TS444.

To charge the turbines the corresponding NC output or the compressed air "on" and "off" function must be entered in the program "PROBE ON/OFF TS444".

The switch on/off probe function using the "M" parameter is not available.

Parameter	Description
#1	**NC output for activating compressed air** Address of the NC output for activating compressed air supply for the TS444 charging process. Alternatively, the on/off switching commands can be replaced by other functions (e.g. M commands).
#2	**TS444 charging time** The charging time dependent on input pressure can be determined from the TS444 data sheet. The time is specified in seconds Default value: 4,000 milliseconds

With "..." designated program lines:
Enter the corresponding control-dependent commands here.

%	
O9708	PROBE ON/OFF TS444
#1=1	ADDRESS OUTPUT COMPRESSED AIR
#2=4000.	CHARGING TIME mS
IF[#13EQ#0] GOTO10	NO M -> M=1 / PROBE ON
IF[#13NE2.] GOTO10	
...	PROBE OFF
...	FLASH
...	MODE TC OFF
#140=#0	
M[99]	
N10	
...	PROBE ON
...	MODE TC ON
...	FLASH
IF[#[#133] EQ[1-[#131 AND 16/16]]] GOTO20	

#[#1]=1	OUTPUT COMPRESSED AIR ON→ **Compressed air "ON"**
#3=0	
WHILE[#3LE20.] DO1	
G04X[[#2/20.]+1.]	
G53	
IF[#[#135] EQ[1-[#131 AND 64/64]]] GOTO15	
#3=#3+1.	
END1	
#121=108.1	
N15 G04X[#2/10.]	
G53	
#[#1]=0	OUTPUT COMPRESSED AIR OFF →**Compressed air "OFF"**
M[99]	
N20	
IF[#[#135] NE[1-[#131 AND 64/64]]] GOTO30	
M[99]	
N30	
#[#1]=1	OUTPUT COMPRESSED AIR ON→**Compressed air "ON"**
#3=0	
WHILE[#3LE20.] DO1	
G04X[[#2/20.]+1.]	
G53	
IF[#[#135] EQ[1-[#131 AND 64/64]]] GOTO35	
#3=#3+1.	
END1	
#121=108.1	
N35 G04X[#2/10.]	
G53	
#[#1]=0	OUTPUT COMPRESSED AIR OFF →**Compressed air "OFF"**
N40	
M[99]	
%	

Program O9708 PROBE ON/OFF PULSE

The direct outputs (MODE TC, FLASH/START) must be entered in the "PROBE ON/OFF PULSE" program for activating and deactivating these.

The readiness signal must be entered in the program USERPARATAB (See page 96 - BIT 131.3).

O9708	PROBE ON/OFF PULSE
#1= 1114	MODE TC
#2= 1116	FLASH/START
#3=#133	
...	

Function clean measuring position

All wireless TS touch probes feature a function for cleaning the measuring surface. Here a compressed air blast is output from the probe. Input the cleaning command in the program O9704 MEASURE.

With "..." designated program lines:
Enter the corresponding control-dependent commands here.

%	
O9704	MEASURE
...	OPTIONAL: INTEGRATION FUNCTION CLEANING MEASURING POSITION
...	FUNCTION CLEANING ON → **Set output/function "clean/blast ON"**
G04X0.2	DELAY → **Delay time**
...	FUNCTION CLEANING OFF → **Reset output/function "clean/blast OFF"**
IF[[#130AND16] EQ0] GOTO15	

8.4 Program O9711 MESSAGES: Error output

The language-specific error texts are output in the program O9711 MESSAGES.

The output language is selected in the program O9710 USERPARATAB in **#132**:

0: English
1: German
2: French

With an error, the touch probe is deactivated and the corresponding text is output in the set language. From line N2100 the texts can be individually modified and further functions added if required. To activate this function, the "customer-specific error processing" bit must be set in #131.2 (See "Program O9710 USERPARATAB: Setting parameters", page 96).

ERRORMESSAGE ENGLISH

...	
N100	
N101#3000=101	INVALID CALL PARAMETERS
N102#3000=102	TOLERANCE EXCEEDED
N103#3000=103	UNEXPECTED OBSTACLE

ERRORMESSAGE DEUTSCH

...	
N200	
N201#3000=101	UNGUELTIGE AUFRUFPARAMETER
N202#3000=102	TOLERANZ UEBERSCHRITTEN
N203#3000=103	UNERWARTETES HINDERNIS

ERRORMESSAGE FRENCH

...	
N300	
N301#3000=101	PARAMETRES NON VALIDES
N302#3000=102	HORS TOLERANCE
N303#3000=103	OBSTACLE INATTENDU

ERRORMESSAGES USERDEFINED

...	
N2100	
N2101#3000=101(UD: INVALID CALL PARAMETERS)	Invalid call parameters
N2102#3000=102(UD: TOLERANCE EXCEEDED)	Tolerance exceeded
N2103#3000=103(UD: UNEXPECTED OBSTACLE)	Unexpected obstacle
N2104#3000=104(UD: MEASURING WITHOUT TRIGGER)	Measuring without trigger
N2105#3000=105(UD: ERROR TOOL COMPENSATION)	Erroneous tool length compensation
N2106#3000=106(UD: ERROR MEAS.STROKE/PRT.MOVE)	Erroneous measurement block/protective move
N2107#3000=107(UD: INVALID MEASURING POSITION)	Erroneous measuring position
N2108#3006=108(UD: BATTERY LOW)	Battery low
#121=0	

M[99]	
N2109#3000=109(UD: WRONG TOOL LENGTH)	Erroneous tool length
N2110#3000=110(UD: ERROR ON SWITCH-ON)	Error with probe on/off
N2111#3000=111(UD: WRONG TOOL)	Wrong tool selected
N2112#3000=112(UD: NO CALIBRATIONVALUE IN Z)	Not calibrated in Z
N2113#3000=113(UD: ERROR USERPARATAB)	Erroneous parameter entry in O9710 USERPARATAB
N2115#3006=115(UD: TURN SPINDLE 180 DEGREE)	Turn spindle through 180°
IF[#121NE0]GOTO2116	
#3006=116(PARAMETERSETTING)	Test parameter setting
N2116#121=0	
M[99]	
N9999	
...	

8.5 Program O9716 DPRNT: Data output

Results can be output directly via the RS-232 interface using parameter **V** and recorded in a text file.

For this purpose, parameter **V** is transferred with a negative algebraic sign.
Default: **V-1**.

If at the same time the function measuring with 3 points or the option 2…12 measured points is used, the nominal value for the measuring function is transferred with a negative algebraic sign.

Example: Output position of a single point

```
G65P9700 A1. X0. V-1.
```

Result:

Nominal position of the single point in X

The following parameters are passed to the RS232:

Parameter	Meaning
#[#111+0]	Position in X
#[#111+3]	Deviation to the nominal value in X

Example: Output position of a bore hole with 3 measured points

```
G65P9700 A1. S50. H0. U120. V-240.
```

Result:

Nominal position of the bore hole in X and Y

Diameter and deviation to the nominal value

The following parameters are passed to the RS232:

Parameter	Meaning
#[#111+0]	Position in X
#[#111+1]	Position in Y
#[#111+3]	Deviation to nominal value in X
#[#111+4]	Deviation to nominal value in Y
#[#111+6]	Diameter
#[#111+7]	Deviation to nominal value (diameter)

8.6 Modifying machine parameters

Malfunction

- Erroneously set machine parameters may cause collisions and malfunctions.
- System parameters should only be modified after agreement with the machine manufacturer or customer.

Read the documentation of the control manufacturer.

The following parameter settings must be tested and modified if required.

- If a high speed skip measuring input is used, the corresponding option bit must be set in the machine data. During measurement (G31), this high speed skip input is accessed. In special cases, Px (x=1..8) must be added in the program (in lines with G31).
- Cancel the write protection to load and test the measurement programs:
  Parameter 3202 bit 4 (NE9) = 0: Write protection for programs O9xxx inactive

FANUC 0

Machine parameter	Function	Meaning
0040.6=1	COMC	Global variables with RESET/M00 0: deleted 1: not deleted

FANUC 15-MB, 150MB

Machine parameter	Function	Meaning
2400.0=1		Parameter/data input implemented in 0: µm 1: mm
2401.6=0		Multibuffer mode 1: read ahead 15/60 blocks 0: standard 5 blocks Switching with G05.1 P1: multibuffer mode off G05.1: multibuffer mode on
7000.6=1	CLV	Global variables with RESET/M00 0: deleted 1: not deleted
7200.4=1	HSS	Skip uses high speed skip
7200.5=0	SFP	Feed rate skip function implemented

Machine parameter	Function	Meaning
7200.6=x	SRE	Signal skip 0: with rising edge 1: with falling edge
7201.x=1	1Sx	High speed skip input x used for G31
7300.7=1	SEB	Allowance and compensation of acceleration/delay and servo delay (type B)

FANUC 16-MB, 160-MB, 18-MB, 180-MB, 16i, 160i

Machine parameter	Function	Meaning
3708.0=0	SAR	Traverse without spindle speed
3708.1=1	SAT	"Spindle speed attained" query always checked
6001.6=1	CCV	Global variables with RESET/M00 0: deleted 1: not deleted
6201.1=1	SEB	Allowance and compensation of acceleration/delay and servo delay (type B)
6200.0=1	GSK	The signal "delete skip distance to go" is valid (simulation)
6200.1=x	SKO	Signal skip 0: with rising edge 1: with falling edge
6200.4=1	HSS	Skip uses high speed skip (HSS option required)
6200.6=x	SRE	Signal high speed skip 0: with rising edge 1: with falling edge
6200.7=1	SKF	Dryrun, override, automat. acc./dec. activated
6202.x=1*	1Sx	High Speed Skip Input x used for G31 / G31 P1
6203.x=1*	2Sx	High Speed Skip Input x used for G31 P2
6204.x=1*	3Sx	High Speed Skip Input x used for G31 P3
6205.x=1*	4Sx	High Speed Skip Input x used for G31 P4

* only if required

FANUC 30i-B, 31i-B5, 32i-B, 35i-B

Machine parameter	Function	Meaning
3008.2=x*	XSG	Signal skip X4.7 0: active 1: saved from setting in parameter 3012
13012=x*		Assignment address skip signal (e.g. 4=X4.7, 11=X11.7, 13=X13.7)
3708.0=0	SAR	Traverse without spindle speed
3708.1=1	SAT	"Spindle speed attained" query always checked
6001.6=1	CCV	Global variables with RESET/M00 0: deleted 1: not deleted
6200.0=1	GSK	The signal skip "delete distance to go" is valid (simulation)
6200.1=x	SKO	Signal skip X4.7 0: with rising edge 1: with falling edge
6200.4=1	HSS	Skip uses high speed skip (HSS option required)
6200.5=1	SLS	Optional: Multi step skip signal used 0: HSS not 1: HSS
6200.6=x	SRE	Signal high speed skip 0: with rising edge 1: with falling edge
6200.7=1	SKF	Dryrun, override, automat. acc./dec. activated
6201.1=1	SEB	Allowance and compensation of acceleration/delay and servo delay (type B)
6201.4=0	IGX	"Delete distance to go" signal released with skip
6201.7=0	SKPXE	Activation or deactivation of "delete distance to go" signals
6202.x=1	1Sx	High Speed Skip Input x used for G31
6207.3=1	SAF	Skip measurement with feed forward enabled
6207.4=1	SAI	Skip measurement improvement deceleration enabled
6207.6=1		ACC/DEC before interpolation enabled for skip function

* only with use of skip X4.7.
These parameters must only be modified by the **machine manufacturer**.

8.7 Switching Units of Measurement (metric / inch)

Read the documentation of the control manufacturer.

Measuring error: Recalibrate the system after switching the unit of measurement from mm to inches or vice versa.

Malfunction: The machine must be switched off and then on again to activate the set parameters.

8.8 Checking validity of the trigger

Validity of Checking the trigger

If the signal level at the measuring input falls, a trigger signal is released by the control. The control differentiates between a valid trigger or malfunction, e.g. a transmission error.

The validity of a trigger must be tested to increase measuring certainty. For this purpose the "trigger signal" (measuring start) and "readiness" signals must be checked. The signals of the receiver must be connected to the control and linked to parameters in the PLC. Input is in the program O9710 USERPARATAB (96).

Parameter	Description
#133	Input signal readiness Example: Readiness signal on IN1010: #133 = 1010
#134	Input trigger signal INVERSE Example: Trigger signal INVERSE on IN1011: #134 = 1011

Autostart modefor touch probes with infrared transmission

Measuring error: If the validity of a trigger is not tested the control is unable to identify an invalid trigger Erroneous measurement is possible.

If only the measuring input is available on the control, the IR receiver can be operated in autostart mode.

Interface installation and assembly

See the installation instructions of the user interface, section Activating Autostart /Timeout Off

In this case trigger validity and the start condition before measuring cannot be tested. The option bits (#130), bit3 and bit4 have no meaning in this case.

8.9 Addresses of available inputs and outputs

Read the documentation of the control manufacturer.

To activate and deactivate the touch probe and for evaluating the readiness, trigger and warning error signals the corresponding address of the applied input or output must be entered in the software.

FANUC 16-MB, 16-MA, 160-MB, 18-MB, 18-MA, 180-MB, 20-FA, 21-MB16i, 18i, 21i, 160i, 180i, 210i (RB5-PMC)

Input signals:	#1000...#1015
Output signals:	#1100...#1115

FANUC 15-B, 150-B16i, 18i, 21i, 160i, 180i, 210i (RB6-PMC), 30i, 31i, 32i, 300i, 310i, 320i

Input signals:	#1000...#1031
Output signals:	#1100...#1131

9

Fanuc GUI Installation

9.1 Fanuc GUI installation

Fundamentals

The graphical user interface (**GUI**: **G**raphical **U**ser **I**nterface) is a software component that supports the user with input masks, images and texts when creating the cycle programs.

The Fanuc GUI supports the following encoders:

- all HEIDENHAIN TS systems
- all HEIDENHAIN TT systems

The existing software package contains the graphical user interface for all specified encoders.

The individual interfaces are activated during installation with the system parameter 8801.

Read and observe the documentation of the control manufacturer before installing the software package.

The graphical user interface (GUI) has been designed for the FANUC control with "Manual Guide i".

Requirements for installation

Malfunction possible via modifications to system parameters and files

- Installation should only be carried out by authorized personnel
- The files "CEX2DATU" and "CEX3DATU" from other manufacturers must not be installed
- The system parameter 8801 must not be assigned

Requirements

- GE FANUC control with "Manual Guide i"
- Memory requirements: 700 KB
- The HEIDENHAIN encoder used must be installed and be completely operational

Data backup

Malfunction possible due to data loss

- Backup existing data before installing the new data.

- Activate the CF card with the key "OFFSET/SETTING"
- Press the "SETTINGS" soft key
- Select parameter "4" in the "I/O channel" screen display line

- Switch off the control
- Insert the CF card
- Simultaneously press both right soft keys in the boot monitor

- Switch on the control and wait until "SYSTEM MONITOR MAIN MENU" is displayed

- The following soft keys are used for operating the "SYSTEM MONITOR MAIN MENU":

Soft key	Meaning
[SELECT]	Selection
[YES]	Yes
[NO]	No
[UP]	Up
[DOWN]	Down
Arrow key	Change overview

- Select "SYSTEM DATA SAVE" in the menu

Fanuc GUI Installation

9.1 Fanuc GUI installation

- Backup the files "CEX2DATU" and "CEX3DATU" as follows:
  a) Select the file "CEX2DATU" in the overview

  b) Confirm the selection with the "SELECT" soft key
  c) Confirm the screen message "SAVE OK" with the "YES" soft key: The data is saved to the CF card
  d) Return to the selection menu with the "SELECT" soft key
  e) Repeat processes a) to d) for the "CEX3DATU" file
- Exit the "SYSTEM DATA SAVE" menu via the "END" menu item

- Exit the "SYSTEM MONITOR MAIN MENU" menu via the "END" menu item

- The control is rebooted
- Remove the CF card and archive the saved files "CEX2DATU.000" and "CEX3DATU.000".

Installing data on the control

Malfunction possible due to data loss

- Backup existing data before installing the new data.

- Copy the "CEX2DATU" and "CEX3DATU" files to the CF card
- Activate the CF card with the key "OFFSET/SETTING"
- Press the "SETTINGS" soft key
- Select parameter "4" in the "I/O channel" screen display line
- Switch off the control
- Insert the CF card
- Simultaneously press both right soft keys in the boot monitor

- Switch on the control and wait until "SYSTEM MONITOR MAIN MENU" is displayed

- Select "SYSTEM DATA LOADING" in the menu

Fanuc GUI Installation

9.1 Fanuc GUI installation

- Load the files "CEX2DATU" and "CEX3DATU" as follows:

  a) Select the file "CEX2DATU" in the overview

  b) Confirm the selection with the "SELECT" soft key

  c) Confirm the screen message "LOADING OK" with the "YES" soft key. The data is transferred to the control

  d) Return to the selection menu with the "SELECT" soft key

  e) Repeat processes a) to d) for the "CEX3DATU MEM" file

- Exit the "SYSTEM DATA LOADING" menu and the "SYSTEM MONITOR MAIN MENU" via the "END" menu item

- Exit the "SYSTEM MONITOR MAIN MENU" menu via the "END" menu item

- The control is rebooted
- Remove the CF card and modify the system parameters

Modifying system parameters

Deactivating the Fanuc measurement cycles

Malfunction possible due to modifications to system parameters and files.
- The system parameter 8801 must not be assigned
- Contact the machine manufacturer if required

▶ Enter the following system parameters to deactivate the Fanuc measurement cycles:

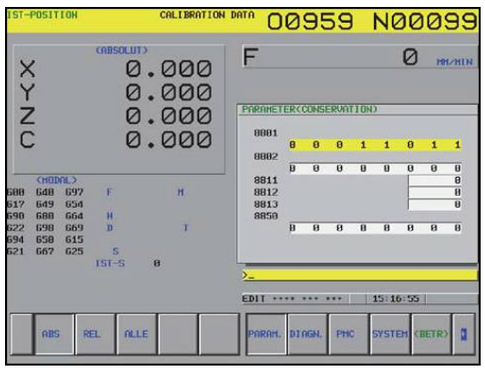
System parameter	Description
#27221.0=1	TLZ: The graphical user interface of the Fanuc measurement cycles is not visible
#27221.1=1	TLX: The graphical user interface of the Fanuc measurement cycles is not visible
#27221.2=1	WRZ: The graphical user interface of the Fanuc measurement cycles is not visible
#27221.3=1	WRX: The graphical user interface of the Fanuc measurement cycles is not visible
#27221.4=1	CAX: The graphical user interface of the Fanuc measurement cycles is not visible
#27221.7=1	TLN: The graphical user interface of the Fanuc measurement cycles is not visible

Activating the specific user interface(s)

The graphical user interface for the installed measurement cycles differs according to the encoder installed.

▶ Enter the following system parameters to activate the specific user interface(s):

System parameter	Description
#8801 0=7	The graphical user interface for the HEIDENHAIN-TS is visible
#8801 0=3	The graphical user interface for the HEIDENHAIN-TT is visible

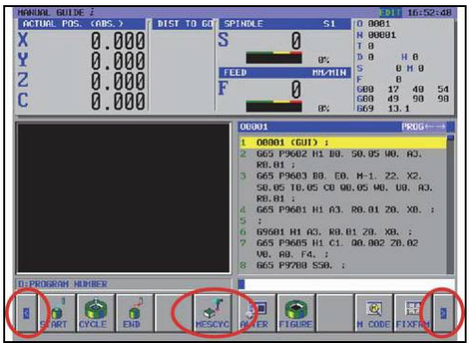


Overview of system parameter 8801

9.2 Operating the graphical user interface

Selecting measurement cycles

- Press the "EDIT" key on the control
- Position the cursor in the program editor on the required line or an empty line
- Activate the "Manual Guide i" function with the "GRAPH" key
- Navigate in the menu until the "MESCYC" soft key is displayed and select this



- An overview of the installed graphical user interface / activated products is displayed:

- With the cursor keys, select the required function ("UP" and "DOWN" keys) or the required tab ("RIGHT" and "LEFT" keys)

- Call the required function with the "SELECT" soft key

Entering parameters for measurement cycles

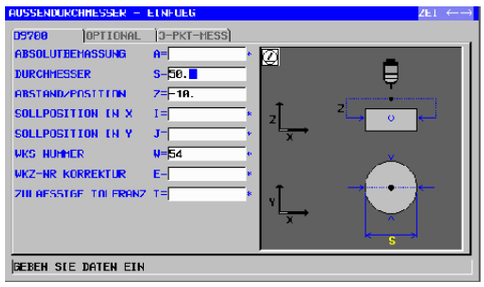
The graphical user interface supports users when generating the measurement cycles.

The cycle mask is displayed following selection of the corresponding product/tab. Several fields are assigned default values. All input fields in the mask can be assigned with values. The default values can be overwritten.

Use the cursor keys to navigate ("UP" and "DOWN" keys) Each call parameter has an explanation, appearing when the corresponding input field is marked.

For measurement cycles with more than 10 call parameters, further registers with input fields are used. To change the current register, use the cursor keys ("RIGHT" and "LEFT"). Optional input fields are designated with an asterisk.

If all mandatory input fields have been given permissible values, the call line of this cycle can be entered in the editor window with the "ENTER" soft key.



View of input mask

- Because measurement cycles are called with the "Macro Call G65" function, the "old" function is not available. A warning is displayed if the "alter" function is used.
- The programming instructions of the specific encoder contain more detailed explanations of measurement functions, parameters and error messages.

10

Error messages

10.1 Error messages

Error message

In cases of error, the error number is set and an error message is displayed on the screen.

- Abort the program with the RESET key.
- Eliminate the cause of error.
- Restart the program.

Advanced error diagnosis

See "Advanced error diagnosis", page 136

Number	Message	Cause of error and corrective action
3101	INVALID CALL PARAMETER	Check the program call. Only enter valid values for the program call.
3102	TOLERANCE EXCEEDED	The maximum tolerance entered via parameter **T** has been exceeded. Control the measurement results.
3103	UNEXPECTED OBSTACLE	Protected move has not reached the target position. Check if an obstacle/the workpiece was approached. Enter a reachable target position.
3104	MEASURING WITHOUT TRIGGER	No trigger was detected during a probe process. Program a reachable target position or modify the position of the touch probe before the measurement call.
3105	ERROR TOOL CORRECTION	Tool data cannot be updated following the measurement of a corner. (1) Check the program call. Program a valid program call. (2) Check the parameter settings entered for the tool memory. Correct the parameter settings entered for the tool memory.
3106	ERROR MEASUREMENT BLOCK/ PROT. MOVE	A valid measuring block could not be executed. (1) Was the touch probe switched on before measuring? Check whether the touch probe was switched on. Check the transfer parameter **M**. (2) Check the ERROR signal. Eliminate the transfer fault. (3) Check the start condition (IR transfer, touch probe already deflected). Position on a valid or possible start position.
3108	BATTERY LOW	The "check battery signal" option is set and the "Warning" error signal is active. (1) Check the batteries (touch probe flashes green/blue). Replace the batteries. (2) Check for correct querying of the batteries. Enter the address parameter (#135) correctly.
3109	WRONG PROBE LENGTH	The tool length entered is "0". Check the parameters entered for tool length (#7, #8). Only enter valid values for the probe length.

Number	Message	Cause of error and corrective action
3110	ERROR UPON SWITCH-ON	The touch probe could not be switched on in the prescribed time. Check the function O9708 PROBE ON/OFF (See "Program O9708 PROBE ON/OFF PULSE", page 111) Enter valid functions in the program O9708 PROBE ON/OFF.
3111	WRONG TOOL	The H number of the touch probe defined in the program O9710 USERPARATAB is inactive. Check whether the correct "tool" was loaded or whether the correct tool number was activated. Activate the correct "tool".
3112	NO CALIBRATION VALUE IN Z	The parameter or content for the Z calibration value has not been defined. (1) Check whether the touch probe was calibrated. Calibrate the touch probe in Z. (2) Check whether the start address for the calibration values (#110) is correct. Modify the start address for the calibration values (#110).
3113	ERROR PROG. USERPARATAB	The parameters entered in the program O9710 USERPARATAB are invalid or erroneous. Check the parameters. Only enter valid values for the required parameters.
3115	ROTATE SPINDLE BY 180 DEGREES	Message: The touch probe must be rotated by 180° during calibration. For this purpose the machine stops with an "M0" and the touch probe can be rotated manually by 180 degrees, if the machine has no automatic spindle orientation.
3116	PARAMETER SETTINGS	Parameters #100 to #149 are deleted with an "M0". The machine cannot be stopped with "M0" during measuring/ calibration. Check the parameter settings (See "Oriented spindle stop", page 107). Align the touch probe mechanically if necessary.

10.2 Advanced error diagnosis

Description of error messages
See "Error messages", page 134

Advanced error diagnosis

With messages (e.g. E115), execution of the program is interrupted with "M0".

- Continue the cycle with "Cycle Start".
- The advanced diagnosis overview enables precise error analysis by reading out the internal parameter #121 (error marker).

Error message: 3101 - INVALID CALL PARAMETER

Error marker: #121=101.**XX**

No. (XX)	Program	Meaning
1	9700	Call #W and #E simultaneously
2	9701	Neither #S nor #X,#Y, #Z defined as call parameters
3	9701	Call #X and #C simultaneously
4	9701	Call #Y and #C simultaneously
5	9705	Enter machine setting µm: #W without "."
6	9705	#W > 59
7	9705	#W with invalid range (53…59 / 1…+8 / -1…-48 / -1…-300)
8	9705	#W < 53
9	9702	Call contour "S": X and Y simultaneously
10	9702	-
11	9702	Call X or Y with calibration call (#C)
12	9706	#119 in USERPARATAB undefined transfer values for SET TOOL
13	9711	No value in error transfer (#E) transferred for error number -> internal error
14	9713	Distances for angle too small (minimum distance 10°) or transfer value is not between 0° and 360°
15	9713	Path for measurement block/protected move < 0
16	9709	No value for "Z" or "S" transferred for calibration on sphere
17	9708	No address entered for the readiness signal in the program 9710 USERPARATAB
18	9715	The type of measurement positions with angle or distance measurements is not identical. Two different measurements were implemented.
19	9704	Measurement block: Transferred target position=start position / parameter A1.
20	9714	Error with regression calculation – internal transfer values
21	9713	Call parameters for 2…12, check measured points: "H", "U", "V"

Error message: 3102 - TOLERANCE EXCEEDED

Error marker: #121=102.**XX**

No. (XX)	Program	Meaning
1	9707	Tolerance exceeded for single point distance/position
2	9707	Tolerance exceeded for WCS setting
3	9707	Tolerance exceeded for contour distance
4	9707	Tolerance exceeded for contour position

Error message: 3103 - UNEXPECTED OBSTACLE

Error marker: #121=103.**XX**

No. (XX)	Program	Meaning
1	9703	Unexpected obstacle or probe off

Error message: 3104 - MEASUREMENT BLOCK WITHOUT TRIGGER

Error marker: #121=104.**XX**

No. (XX)	Program	Meaning
1	9704	Measurement block without trigger (first measurement block)
2	9704	Measurement block without trigger (second measurement block)

Error message: 3105 - MEASUREMENT BLOCK WITHOUT TRIGGER

Error message: #121=105.**XX**

No. (XX)	Program	Meaning
1	9706	Tool correction error Check #5 and #6 in the O9710 USERPARATAB program
2	9706	Permissible maximum correction value exceeded The limit value (#3) specified in the O9706 SET TOOL program was exceeded.

Error message: 3106 - ERROR MEASUREMENT BLOCK/PROT. MOVE

Error marker: #121=106.**XX**

No. (XX)	Program	Meaning
1	9703	"Trigger" signal is missing
2	9703	"Readiness" signal is missing
3	9704	"Trigger" signal is missing
4	9704	"Readiness" signal is missing
5	9704	2. Probing with error (readiness) terminated
6	9704	Start position = skip position in first measurement block
7	9704	Start position = skip position in second measurement block

Error message: 3108 - BATTERY LOW

Error marker: #121=108.**XX**

No. (XX)	Program	Meaning
1	9708	Low battery, feedback IF 59 -> NC battery signal pending

Error message: 3109 - WRONG PROBE LENGTH

Error marker: #121=109.**XX**

No. (XX)	Program	Meaning
1	9710	Probe length = 0, no correct values entered for tool length or zero tool. With zero tool: bit 131.8 set?

Error message: 3110 - ERROR WITH SWITCH-ON

Error marker: #121=110.**XX**

No. (XX)	Program	Meaning
1	9708	Error when switching on the touch probe Check transfer Check battery Check the programming of the touch probe Probe already deflected?

Error message: 3111 - WRONG TOOL

Error marker: #121=111.**XX**

No. (XX)	Program	Meaning
1	9710	The H number defined in #7 does not correspond with the currently active H number in #4120. Tool activated?

Error message: 3112 - NO CALIBRATION VALUE IN Z

Error message: #121=112.**XX**

No. (XX)	Program	Meaning
1	9700	Calibration value Z = #0 Measuring without calibration / implement calibration in Z
2	9710	Calibrate sphere without Z For calibration on the sphere, the touch probe must be calibrated in Z.

Error message: 3113 - ERROR PROG. USERPARATAB

Error message: #121=113.**XX**

No. (XX)	Program	Meaning
1	9710	Error with parameter checking in USERPARATAB Check the following parameters: (#1, #2, #3, #110, #111, #112, #113, #126, #128)

Error message: 3116 - PARAMETER SETTINGS

Error message: #121=116.**XX**

No. (XX)	Program	Meaning
1	9710	Parameter setting. With "M0", content of the parameters is deleted. Modification to the machine settings is required (See "Modifying machine parameters", page 115).

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