

## Calibration and setup of part probe

### Fundamentals

To measure workpiece dimensions, an electronic touch-trigger probe is required that provides a signal change (edge) when deflected with the required repeat accuracy. The probe must operate virtually bounce-free. Measuring cycles are general subroutines designed to solve specific measurement tasks. They can be adapted to specific problems via parameter settings.

When taking general measurements, a distinction is made between

- Workpiece measurement
- Tool measurement

Measuring can be performed in:

- JOG mode with use of semi-automated measuring functions for general workpiece setup and tool measuring by the machine operator
- AUTO mode for in-process measuring with use of automated cycles in a part program

Workpiece measuring is used to determine workpiece tolerances during manufacturing processes.

Depending upon the measuring cycle used, you can select the following options as result of the workpiece measurement:

- Only measurement without offsets (actual value is measured)
- Work offset correction (setpoint — actual value deviation)
- Tool data offset (setpoint — actual value deviation)



### NOTE

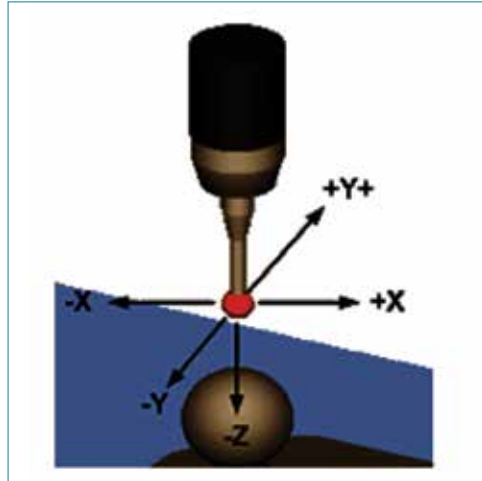
Please observe the information provided by the manufacturers of electronic probes and /or the machine tool builder's instructions on the following points:

- Electrical connection
- Mechanical calibration of the probe
- If a workpiece probe is used, both the direction of deflection and transmission of switching signal to the machine column (radio, infrared light or cable) must be taken into account. In some versions, transmission is only possible in particular spindle positions or in particular ranges.

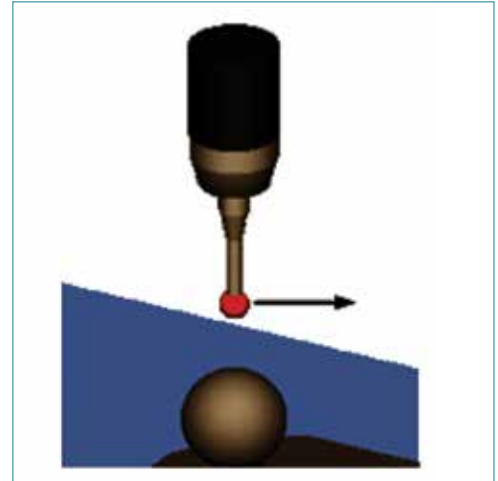
Probes are distinguished according to the number of measuring directions:

- Multi-directional (multi-probe)
- Mono-directional (mono-probe)

**Figure 1 (left)**  
Multi-directional 3D probe



**Figure 2 (right)**  
Mono-directional probe



The probes also differ in the form of the stylus tip.

The measuring cycles support pin, L and star probes as autonomous tool types.

The use of the probe types is referenced in the individual measuring cycles.






The multi-probe is universally applicable.

The use of probes requires a spindle that can be positioned. For mono-probes, the switching direction is tracked for each measurement by orienting the spindle.

All probes must be mechanically correctly adjusted before use. The switching directions must be calibrated before the probe is used in the measuring cycles for the first time.

This also applies when changing the stylus tip of the probe (check probe type).

**Figure 3**  
Tool data probes

<b>710</b>	<b>3D milling probe</b>	
<b>711</b>	<b>Edge finder</b>	
<b>712</b>	<b>Mono probe</b>	
<b>713</b>	<b>L probe</b>	
<b>714</b>	<b>Star probe</b>	

The probes differ as a result of the tool type and the switching directions in tool parameter \$TC\_DP25[ ] bit16 to bit 25.

**Calibration and setup procedure:**

1. Define probe in tool list
2. Set reference point for calibration (WO)
3. Mechanical concentricity check and setup of workpiece probe
4. Workpiece probe length calibration
5. Workpiece probe ball radius/diameter calibration

**Step 1: Define probe in tool list**

Define probe as tool type 710 and assign an approximate length (+/- 5mm) and Ø to the workpiece probe in the tool list.

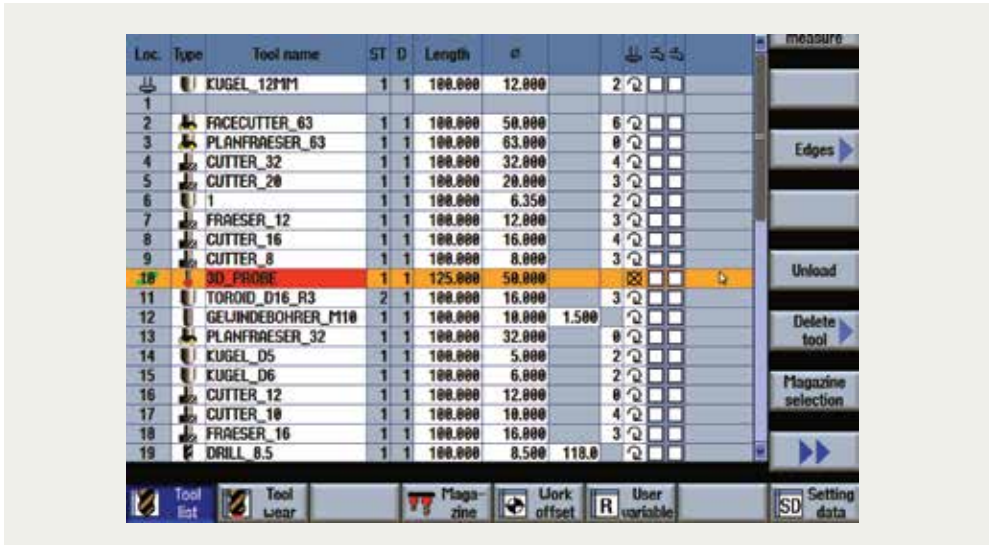


Figure 4

Disable spindle rotation in tool list for workpiece probe with the "SELECT" key.

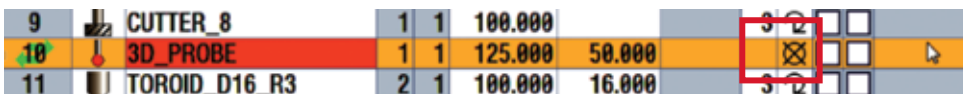
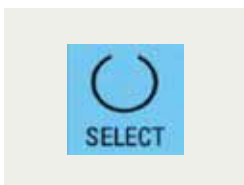


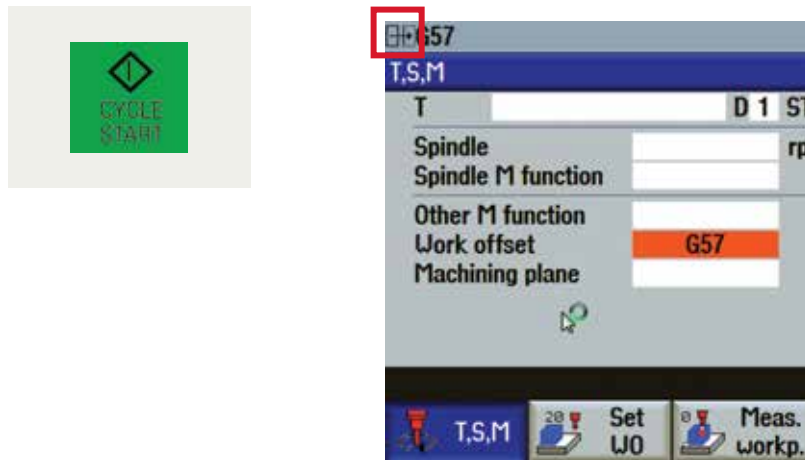
Figure 5

This protects the probe from being accidentally damaged through a spindle start (M3/M4). Spindle positioning with SPOS is still working

### Step 2: Set reference point for calibration (WO)

Activate any work offset (G57) with "Cycle Start".

Figure 6



Traverse the machine spindle head to set "Z" reference.

For measuring, you require a gage block—for example 150mm.

Figure 7  
Height gage blocks



Make sure that there is no tool in the spindle, no tool offset active and that the axis positions are displayed in Work coordinate system. Traverse the Z axis in "JOG" mode with help of the handwheel and the incremental JOG steps, until the gage block (150mm) fits snug between the spindle reference surface (gage line) and table surface.

Set work offset in Z-axis for G57.

Input the height of the gage block as work offset (G57).

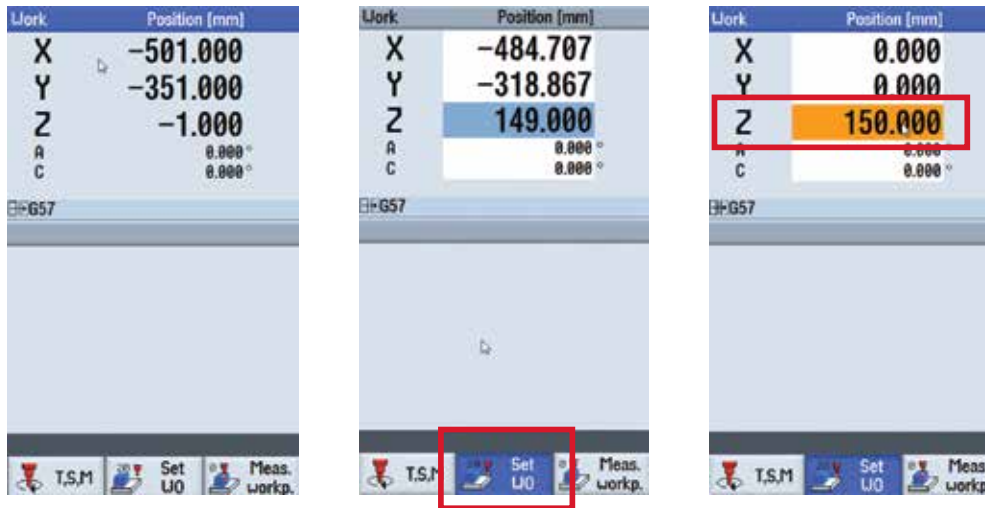
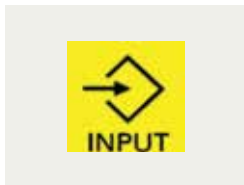


Figure 8

Enter this height into work offset table with Input key.



Machine act value			-484.707	-318.867	149.000	0.000	0.000
G57			-484.707	-318.867	-1.000	0.000	0.000
Total UO			-484.707	-318.867	-1.000	0.000	0.000
Tool:			0.000	0.000	0.000	0.000	0.000

Figure 9

**Step 3: Mechanical setup/check of probe sphere concentricity**

Check concentricity (run out error) of probe sphere with dial indicator (resolution 0.002mm). Recommended run out error not to exceed  $\pm 0.005\mu\text{m}$ .

Figure 10



In case run out error lies outside tolerance, then a mechanical adjustment of probe sphere concentricity is necessary.

**Note**

Refer in this case to the probe manufacturer's instructions.

**Step 4: Workpiece probe length calibration**

Required measuring equipment: Height Gages

Change workpiece probe into spindle.

Figure 11



Traverse workpiece probe in "JOG" mode in Z approximately 10mm above gage block in order to calibrate against "0".



Figure 12

Open "Calibrate probe" screen by pressing "Meas. Workp." — "Calibrate probe" — and then "Length" in order to calibrate probe length.



The input screen form of the "probe calibration" cycle is being opened.

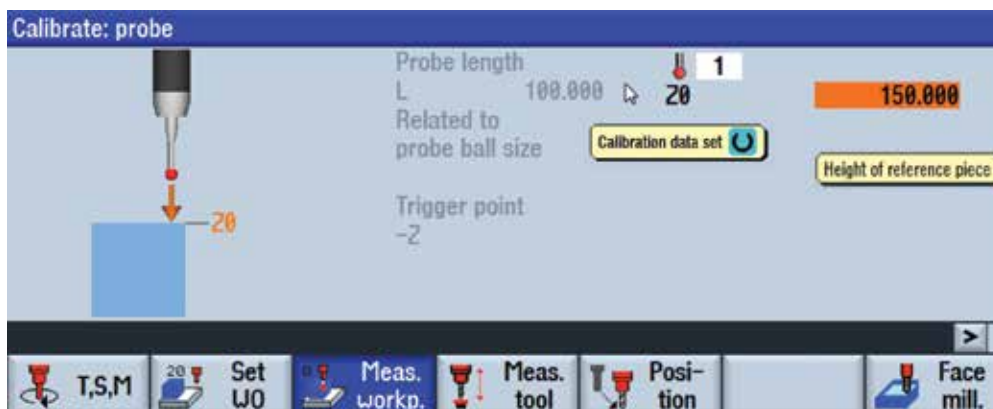


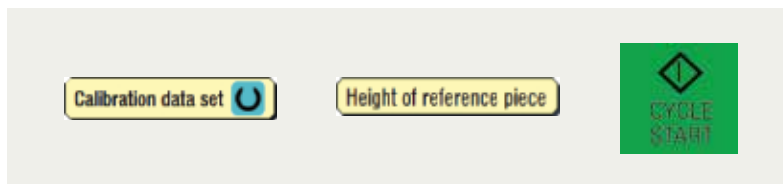
Figure 13



Under “Calibration data set”, enter the data set number with help of the “SELECT” key for which the calibration data of the active probe is supposed to be saved to (this parameter field can be enabled with Bit3 in the general setting data SD54780 \$SCS\_MEA\_FUNCTION\_MASK\_PIECE).

For probe length calibration, under Z0, input the “height of reference piece” relative to the active work offset (e.g. Workpiece height or table surface). In this example, we enter the gage block height of 150mm.

Start the calibration cycle with the “CYCLE START” button.



The length calibration is now in process, and the trigger point (switching point) of the workpiece probe in measuring direction of the active working plane is being determined. The length offset is transferred into the tool list.

Figure 14



#### Notes

User-specific pre-setting “Height of reference piece”

For the Input field “Height of reference piece” (height of reference surface), it is possible to pre-set separate fixed values for every probe number with parameter MD51772[0] - [12] (calibration data record).

If these parameters are set, then the values are being displayed in the in-put field “Height of reference piece” in the cycle. Further changes of the values in the cycle are then no longer possible.



Workpiece probe length is now calibrated and transferred into tool list.





5		CUTTER_20	1	1	100.000	20.000	3		<input type="checkbox"/>	<input type="checkbox"/>
6		3D_PROBE	1	1	190.001	5.180			<input type="checkbox"/>	<input type="checkbox"/>

Figure 15

### Step 5: Calibration of workpiece probe diameter

Required measuring equipment: Ring Gages



Figure 16

Traverse workpiece probe in "JOG" mode into the approximate center of calibration ring.



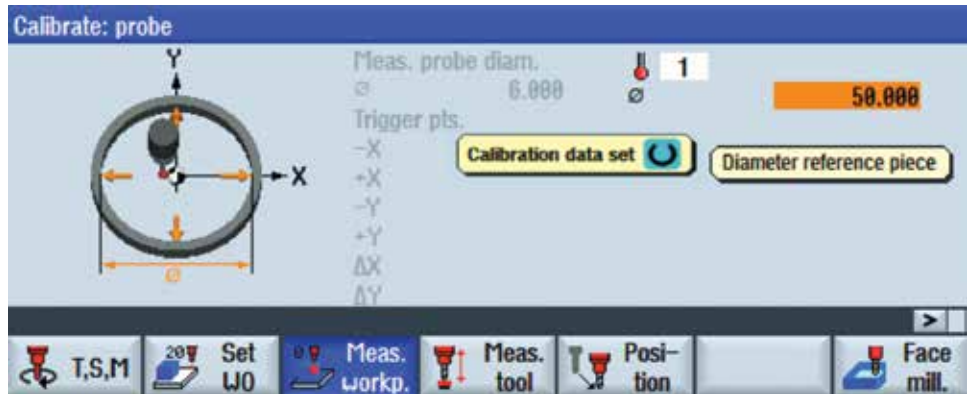
Figure 17

Open "Calibrate probe" screen by pressing "Meas. Workp." — "Calibrate probe" — and then "Diameter" in order to calibrate probe ball diameter.



The input screen form of the “probe calibration” cycle is being opened.

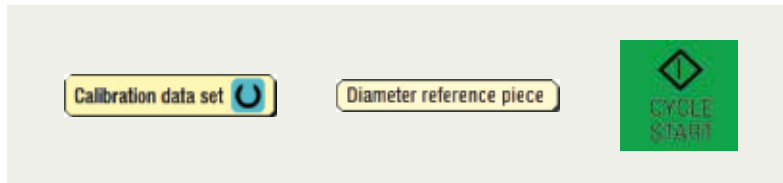
Figure 18



Under “Calibration data set”, enter the data set number with help of the “SELECT” key for which the calibration data of the active probe is supposed to be saved to (this parameter field can be enabled with Bit3 in the general setting data SD54780 \$SCS\_MEA\_FUNCTION\_MASK\_PIECE).

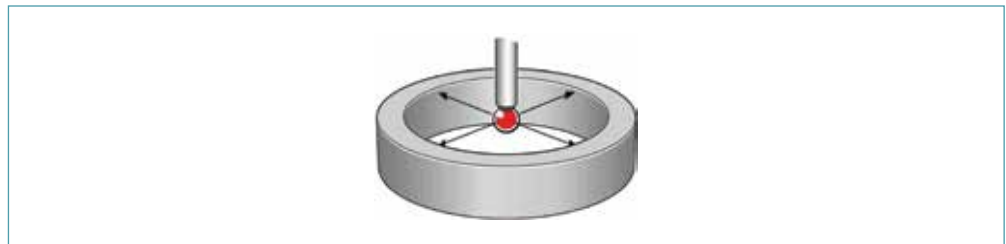
For probe ball diameter calibration, input the reference diameter of the calibration ring under ∅. In our example, 50.003mm.

Start the calibration cycle with the “CYCLE START” button.



The probe diameter calibration is now in process. First, the exact ring center is determined, the four trigger points are determined by traversing the probe in each quadrant against the inner-wall of the calibration ring. This process is being repeated with a 180° probe ball reversal, to measure the positional probe deviation (skew) for each measure axes.

Figure 19



Measured calibration values for the first calibration data set

The determined probe ball diameter is stored in the following general setting data:

```
54600[0] $SNS_MEA_WP_BALL_DIAM          5.000 mm
```

Figure 20

The trigger points (switching points) of each measuring axis in positive and negative direction are being stored in following general setting data:

```
54601[0] $SNS_MEA_WP_TRIG_MINUS_DIR_AX1  3.001 mm
54602[0] $SNS_MEA_WP_TRIG_PLUS_DIR_AX1   -3.001 mm
54603[0] $SNS_MEA_WP_TRIG_MINUS_DIR_AX2  3.001 mm
54604[0] $SNS_MEA_WP_TRIG_PLUS_DIR_AX2   -3.001 mm
```

Figure 21

The positional deviation (skew) of the probe ball (sphere) are being stored in the following general setting data (for G17 X,Y):

```
54607[0] $SNS_MEA_WP_POS_DEV_AX1        0.000 mm
54608[0] $SNS_MEA_WP_POS_DEV_AX2        0.000 mm
```

Figure 22

#### Calibration data record for a workpiece measuring probe:

```
54600[0] $SNS_MEA_WP_BALL_DIAM =          ;Diameter of the probe sphere
54601[0] $SNS_MEA_WP_TRIG_MINUS_DIR_AX1 = ;Trigger point -X
54602[0] $SNS_MEA_WP_TRIG_PLUS_DIR_AX1 =  ;Trigger point +X
54603[0] $SNS_MEA_WP_TRIG_MINUS_DIR_AX2 = ;Trigger point -Y
54604[0] $SNS_MEA_WP_TRIG_PLUS_DIR_AX2 =  ;Trigger point +Y
54605[0] $SNS_MEA_WP_TRIG_MINUS_DIR_AX3 = ;Trigger point -Z
54606[0] $SNS_MEA_WP_TRIG_PLUS_DIR_AX3 = 0
54607[0] $SNS_MEA_WP_POS_DEV_AX1 =        ;Position deviation in X
54608[0] $SNS_MEA_WP_POS_DEV_AX2 =        ;Position deviation in Y
54609[0] $SNS_MEA_WP_STATUS_RT =          ;Calibr. act value of the geo axes
                                           XYZ and the spindle
54610[0] $SNS_MEA_WP_STATUS_GEN =         ;Status value after calibration
54611[0] $SNS_MEA_WP_FEED[0] =            ;Calibration and measurement feed
```

Figure 23

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